Sustaining and Improving Pennsylvania's Forest Land through Comprehensive Plans:

The Vital Role of Counties and Municipalities

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About the Authors

The authors, Paul J. Solomon and Jeanne M. Riley, prepared this document as a resource for county and municipal policymakers and planning professionals to raise awareness of the importance of Pennsylvania's forests as natural resources and as sources of economic, environmental, health, and recreational benefits to communities.

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Every effort has been made to ensure the accuracy of the content contained in this document. The views and recommendations contained herein, as well as any errors, are the responsibility of the authors.

Prologue

The **History of Cumberland and Adams Counties, Pennsylvania**, published in 1886, describes the impact of poorly planned and implemented forest management and harvesting decisions as observed by early settlers:

> *The fact has been pretty well established that the … clearing of land, which [has] been going on rapidly in the county during the last fifty years or more, [has] affected the rainfall and climate unfavorably. ... That the size of most if not all the streams in the county has greatly diminished within that length of time admits of no doubt. There are people now living who remember when the average volume of water in them was twice what it is now. … To the patriotic the lesson is obvious. All efforts to stay the needless destruction of timber, and which have for their object the restoration, either by natural or artificial means, of the forest growth of lands thus enuted should receive due encouragement.*

Sheely, Aaron, ed. *History of Adams County*,
in **History of Cumberland and Adams Counties, Pennsylvania**.
Warner Beers and Company, 1886.

This historical reference reveals that settlers in the 1800s recognized too late the adverse impacts associated with widespread clearing of land in their counties, with some even advocating for forest conservation as a patriotic duty. Today, Pennsylvanians are fortunate that the state's forests have regenerated, so that forests now comprise 58% of land cover. Advances in sustainable forest management and harvesting also make it possible for citizens, consumers, and landowners to enjoy the benefits and products forests provide, while enhancing the health and vitality of forests for the future. Nevertheless, as counties and municipalities contemplate the current state and future of Pennsylvania's forests in their own communities, this history serves as a reminder of the need to undertake the planning necessary for the conservation and responsible use of Pennsylvania's forest lands.

From the last decades of the 1800s into the 20th century, Pennsylvania was at the center of the industrial revolution, driven by the expansion of mining, railroads, petroleum, iron and steel (and hence charcoal) production, and manufacturing. By the beginning of the 1900s Pennsylvania's forest cover had dwindled from a 17th century pre-settlement high of 95% to 32%. Restoration efforts gained momentum and funding during the 1900s, and today, forests comprise 58% of the state's land cover.

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Executive Summary

When developing county and municipal comprehensive plans, explicit consideration to the state of the forest is essential for the conservation, protection, and restoration of this vital natural resource.

This document has been prepared primarily for county and municipal policymakers and planning professionals. It aims to raise awareness of the importance of Pennsylvania's forests as a natural resource and source of economic, environmental, health, and recreational benefits to communities and to ensure that forests are integrated into comprehensive planning activities. Pennsylvania's forests, woodlands, woodlots, hedgerows, or any other areas containing trees, collectively represent the most dominant land use and natural resource in the state. When developing county and municipal comprehensive plans, explicit consideration to the state of the forest is essential for the conservation, protection, and restoration of this vital natural resource. In fact, the Municipalities Planning Code (MPC) requires counties and municipalities to include provisions for protection of natural resources in their plans. Many such plans have, heretofore, not given sufficient consideration to the importance of forests as a natural resource or to ways of protecting them.

This document provides a detailed description of forest land, its benefits, and its importance as an economic, environmental, health-enhancing, and recreational resource for residents and visitors alike. As an example of the economic benefits, the Pennsylvania forest industry contributes an estimated $19 billion dollars annually to the state's economy and employs over 66,000 residents. The Pennsylvania tourism and outdoor recreation industry contributes $21.5 billion dollars annually in spending in Pennsylvania, 219,000 jobs, and $1.6 billion annually in state and local tax revenue. Forests also play a role in green infrastructure, contributing services, quite naturally, to pollution mitigation and natural resource protection, including watershed protection, air quality, climate stability, and aesthetic values (collectively, ecosystem services). Public officials are in the best position to assess how forests benefit their communities and to develop land use strategies that include forests.

This document also contains an in-depth description and analysis of the serious threats our forests are facing. These include deforestation, forest parcelization/fragmentation into smaller tracts, forest pests and diseases, failure to implement sustainable forest and harvesting management practices, inappropriate human activities, and climate change. Over 70% of Pennsylvania's forests are in private hands; leadership from policymakers and planners is vital in shaping how communities and landowners view, value, and care for forests so all can enjoy and benefit from them in the years to come.

Additionally, this document describes various tools for maintaining, protecting, and restoring forests. The majority of these tools involve land use-related requirements or enactments. Taxing policies, subsidies/incentives, and other measures also are discussed. The goal is to provide planners and policymakers with an array of possible solutions to the problems that their particular communities may be facing in encouraging retention and sustainable use of forest land.

The intent of this publication is to provide essential information about forests to aid county and local municipal officials and others in appreciating the value forests provide, as well as the need for action to maintain and enhance them. All communities should be concerned about the health and vitality of Pennsylvania's forests. By cataloguing the many benefits forests provide, by adopting regulations and practices that conserve forests, by allowing sustainable harvesting, and by educating residents about the value of forests, planners and policymakers can play a key role in ensuring the conservation and responsible use of Pennsylvania's precious forest lands.

Background and Purpose

A forest is broadly defined as a biological community dominated by trees and other woody plants.[1] In Pennsylvania, forests once comprised 95% of the landscape; today, they occupy 58%, or nearly 17 million of Pennsylvania's 28 million acres.[2] Forests are present in nearly every county and municipality across Pennsylvania and remain one of its major natural resources. Over 70% of Pennsylvania's forests are in private hands.

Forests occupy nearly 17 million of Pennsylvania's 28 million acres. Over 70% of the acreage is privately owned.

In our communities, forests exist in a variety of configurations or manifestations. While we all recognize large or extensive tracts predominated by trees as forests, other wooded parcels, such as farm woodlots, wooded open space within residential developments, and forested buffers along streams, also are key components of our forested landscapes.

Forests may originate spontaneously from tree seeds and sprouts or may be planted. The nature or characteristics of a forest are affected by the local climate (primarily precipitation and temperature), underlying geology, topography, soil characteristics, and past land use history.

Tracts of forest land of all types and sizes are important to our communities. Forested landscapes, whether publicly or privately owned, provide many essential economic, environmental, health, and recreational benefits for residents and visitors alike. The report of the Pennsylvania Twenty-First Century Environment Commission, published in 1998, highlighted the value of forests as an asset of the Commonwealth and advocated for forests as one of the preferred open space uses of the land.[3] Conserving wooded tracts of land, including forest remnants remaining in developed areas, enables us to retain these many benefits for our communities, residents, and visitors.

Planning and subsequent forest conservation efforts are essential to community well-being because forests are under increasing threat from a variety of natural and man-made forces. Communities, eager for growth, often overlook the importance of forests by implementing policies that reduce the size and impair the health and resiliency of our forests. Some landowners, lacking the skills, resources, interest, and/or knowledge to tend their forested lands properly, may neglect their forests or harvest trees in ways that are detrimental to forest health and sustainability. These actions of individuals and communities increase the vulnerability of our forests to ever-present threats from diseases, pests, and invasive plants. As a result, our forests may lose the ability to supply the many economic, environmental, health, and recreational benefits that are vital to communities.

Forested landscapes, both publicly and privately owned, provide many essential economic, environmental, health, and recreational benefits for residents and visitors alike.

1 Penn State University, College of Agricultural Sciences, Agricultural Research and Cooperative Extension. **Forest Stewardship Terminology** (UH074).
2 Widman, R.H. USDA, Forest Service. **Forests of Pennsylvania 2015**, Resource Update FS-92.
3 Seif, J.M., Glotfelty, C.E., et al. **Report of the Pennsylvania 21st Century Environment Commission**, September 1998.

The significance of the many benefits our forests provide, as well as the increasing natural and man-made threats they face, make it essential to consider steps we can take to conserve our forests. County and municipality planning processes are an effective vehicle for ensuring that Pennsylvania's privately-owned forest land is conserved and used responsibly. Well-considered county and municipal planning efforts will enable our communities to retain and enhance the benefits of this important resource in the years to come.

This document provides the background information necessary to enable county and local government planning agencies, as well as other entities, to include forests as a prominent subject in comprehensive plans and related documents. It details the many benefits forested landscapes provide to our communities and identifies the underlying threats to forests. Further, this document recommends tools to assist local communities in reducing forest loss and improving forest health and vitality.

The background information and recommendations contained in this document focus on land use planning relating to privately-owned forests or wooded parcels. Information on other natural resource improvement projects, such as community tree programs, can be found in the publications listed in Appendix II.

County and municipality planning processes are effective tools to ensure responsible forest conservation and use.

Benefits and Importance of Pennsylvania's Forests

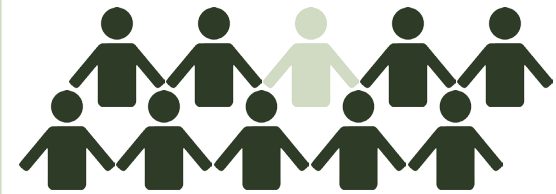
Pennsylvania's forest industry contributes more than $19 billion annually to the state's economy and accounts for over 66,000 jobs.

Pennsylvania's forests include some of the most intact and bountiful hardwood forests in the temperate world. Pennsylvania's forests were foundational to the growth of the Commonwealth and the United States. They continue to support a significant part of the state's economy and enrich the lives of its residents.

Pennsylvania is the nation's number one producer of hardwood lumber, accounting for approximately 10% of total hardwood lumber output in the US.[4] In Pennsylvania, the annual economic impact of the forest, paper, and wood products industries exceeds $19 billion a year.[5] Over 2,100 businesses, distributed in every county of the Commonwealth, are involved in the forest products industry.[6] The industry provides more than 66,000 jobs, accounting for approximately one of every nine manufacturing jobs, with an annual payroll exceeding $2.2 billion. This industry is so vital to the economic health of Pennsylvania that, in November 2015, Governor Tom Wolf convened the **Green Ribbon Task Force on Forest Products, Conservation, and Jobs** to explore how the Commonwealth could grow attractive jobs in the forest industry while conserving and improving forests as the foundation for this important industry. Efforts are also underway to enhance the market for wood and wood products, emphasizing their advantages as local, natural, versatile, and renewable products with a broad range of applications, such as buildings, furniture, flooring, cabinetry, and more.

Tourism and outdoor activities, including hunting and fishing, also provide forest-based economic benefits. The Outdoor Industry Association estimates that outdoor recreation accounts for $21.5 billion in consumer spending in Pennsylvania, 219,000 direct Pennsylvania jobs, $7.2 billion in wages and salaries, and $1.6 billion in state and local tax revenue each year.[7] In a separate survey by the Pennsylvania Department of Conservation and Natural Resources (PA DCNR), 91% of citizens surveyed indicated that outdoor recreation played a major role in their family's vacation and free time. Approximately 59% had high or very high interest in opportunities for hunting and fishing.[8] Private forested lands are an essential component of this tourism infrastructure. Forests provide the settings for recreational activities as well as the unique habitat necessary for wildlife to exist and thrive.

FOR 9 OUT OF 10 PA CITIZENS



outdoor recreation plays a major role in vacation plans and free time

4 Pennsylvania Forest Products Association website, **paforestproducts.org**.
5 Pennsylvania Ag Sciences News, May 18, 2017.
6 Pennsylvania Department of Agriculture. Hardwoods Development Council.
7 Leslie, G. et al. **Natural Connections: Pennsylvania's Statewide Comprehensive Outdoor Recreation Plan, 2014-2019**.
8 Pennsylvania Department of Conservation and Natural Resources. **Pennsylvania Outdoor Recreation Online Surveys**, 2014.

Pennsylvania's forests also provide a broad range of benefits along with infrastructure services to communities. These include:

- ***Clean Air***. One hundred mature trees can remove 53 tons of carbon dioxide (CO_2) annually and 430 pounds of other air pollutants each year.[9] Two mature trees provide enough oxygen for one person to breathe for one year.[10] Trees reduce dust and other windblown pollutants and modify or reduce winds. In neighborhoods with predominant tree canopy cover, air quality improves by up to 15%.[11]
- ***Clean and Plentiful Water***. More than half of US drinking water originates in forests. Forests intercept rainfall, allowing it to better replenish the groundwater system.
- ***Stormwater Mitigation***. Trees help control stormwater runoff in a variety of ways. They draw large quantities of water from the soil to enable photosynthesis. One large tree can capture and filter up to 36,500 gallons of water annually.[12] The leaves, branches, and trunk surfaces of trees intercept and absorb and subsequently evaporate up to 40% of the water they capture. Trees also take up harmful chemicals such as metals or solvents, transforming them into less harmful substances.[13] Enhanced infiltration of stormwater eliminates or greatly reduces overland runoff and pollution, while increasing groundwater levels, thereby improving year-round base flows in water courses.
- ***Erosion Control***. Forest lands are virtually erosion-free due to reduced runoff as described above. In addition, a leaf littered and porous forest floor also reduces erosion. Tree canopies reduce the velocity of rain, which reduces erosion.
- ***Soil Formation/Retention***. Forests, as natural systems, create, enrich, and retain soil, which is essential for water filtration and storage, water quality, and plant growth.[14]
- ***Temperature Regulation***. Trees properly placed around buildings can reduce air conditioning and heating needs. The evaporation from a single tree can produce a cooling effect equivalent to 10 room-size air conditioners.[15] Research in Pennsylvania has found that up to 15% in heat energy savings are possible in homes downwind from windbreaks.[16]
- ***Health/Physical and Spiritual Renewal***. Trees and parks deliver a variety of health and social benefits to individuals and communities. Physiological signs of stress were improved in studies comparing people who walked in forests versus those who walked in urban environments. Changes in brain activity also were documented. Other studies have revealed improvements in creativity, problem-solving, attention span, productivity, and memory after exposure to nature. Beautiful natural scenes inspired people to demonstrate increased generosity, trust, and helpfulness. Feelings of anger and aggression were reduced.[17] There is a recognized correlation between

Author Richard Louv coined the term nature deficit disorder *to describe the behavioral problems that can result when people, especially children, spend less time outdoors.*

9 US Forest Service, USDA website, Benefits of Trees, **www.fs.fed.us/learn/trees**.
10 **www.americanforestfoundation.org**.
11 **www.americanforestfoundation.org**.
12 **www.americanforestfoundation.org**.
13 Environmental Protection Agency. **Stormwater to Street Trees** (EPA 841 B 13 001).
14 Lehigh Valley Planning Commission. **Lehigh Valley Return on Environment Study**, 2014.
15 North Carolina State University, A&T State University Cooperative Extension. **Trees of Strength** website.
16 Swistock, B.R., DeWalle, D.R., Farrand, E.P. **Windbreaks and Shade Trees**. College of Agricultural Sciences Cooperative Extension, Penn State University, 2005.
17 Suttie, J. *How Nature Can Make You Kinder, Happier, and More Creative*. **Greater Good**, March 2, 2016.

green space and reduced crime.[18] Hospitalized patients benefit from having views of nature while recovering from surgery. Children with attention deficit hyperactivity disorder (ADHD) similarly benefit from access to nature.[19] In his 2005 book, **Last Child in the Woods**, author Richard Louv coined the term *nature deficit disorder* to describe the behavioral problems that can result when people, especially children, spend less time outdoors.[20]

- ***Higher Property Values***. Well-designed, landscaped, and maintained communities can raise property values by an average of 15%.[21] As an example, in the Lehigh Valley, the average real estate premium for a $185,100 home in a city or borough located within one-quarter mile of protected open space is approximately $28,200; the premium for one located in a rural township is $2,600.[22] These higher property values favorably impact property tax revenues for the county or municipality. The open spaces leading to these premiums can be created through conservation of trees and forests.

> **Well-designed, landscaped, and maintained communities can raise property values by an average of 15%.**

- ***Local Economy***. Commercial areas with trees tend to attract more customers, who shop longer and purchase up to 12% more in goods and services.[23]
- ***Opportunities for Recreation***. In a PA DCNR study conducted in 2014, 91% of residents surveyed described outdoor recreation as extremely important/important in their daily lives. Additionally, 89% of residents surveyed indicated that trails, natural areas, and waterways best reflected what they valued about their communities.[24]
- ***Scenic Relief***. Forested areas provide residents with attractive views and a variety of activities.
- ***Wildlife Habitat***. Two hundred fifty acres of forest can house more than 1,000 species of wildlife.[25] Trees and other plants also serve local pollinator populations, which are becoming increasingly crucial with the advent of colony collapse disorder and other problems impacting bee colonies.

> **Pennsylvania's publicly- and privately-owned forests provide a broad range of benefits and ecosystem services to communities.**

Overall, Pennsylvanians enjoy numerous economic, environmental, health, and recreational benefits from forests. This list includes, most importantly, the basic necessities of life: air and water. Counties and municipalities engaged in comprehensive planning should convey the many benefits of forests to their citizens and should develop strategies to promote retention and sustainable management of forests, including harvesting. When managed and used sustainably, forests can readily supply the raw materials necessary for the forest products industry to thrive, while simultaneously providing residents and visitors alike with a broad array of benefits. Counties and municipalities can use the comprehensive planning process to educate residents, landowners, and developers about how forests contribute to the health, well-being, and economic prosperity of their communities, and develop strategies to promote these values.

18 Spector, J. *Another Reason to Love Urban Green Space: It Fights Crime*. **Citylab**, April 13, 2016.
19 Penn State University, College of Agricultural Sciences, Agricultural Research and Cooperative Extension. **Managing Natural Resources: A Guide for Municipal Commissions**.
20 **www.wikipedia.org**.
21 **www.treepeople.org**.
22 Lehigh Valley Planning Commission. **Lehigh Valley Return on Environment Study**, 2014.
23 Wilson, R. *People and Trees: An Intimate Connection*. **American Forests**, Fall 2013.
24 Pennsylvania Department of Conservation and Natural Resources. **Pennsylvania Outdoor Recreation Online Surveys**, 2014.
25 **www.americanforestfoundation.org**.

Pennsylvania's Forests as a Key Component of Green Infrastructure

Gray infrastructure is quite costly to communities. In contrast, green infrastructure can provide the least costly, most reliable, and most versatile solution to many infrastructure needs.

Forests, whether privately or publicly owned, along with other open spaces such as wetlands, form the *green infrastructure* that provides many essential benefits and cost savings to our communities. The term *green infrastructure* describes the natural features contained in a landscape and how they function collectively to provide valuable environmental services to communities. In 1997, Costanza et al. identified the ecosystem services that green infrastructure provides to society.[26] A number of counties in Pennsylvania have undertaken *return on environment* studies (see Appendix II) to understand, and raise public awareness of, the benefits natural resources bring to our communities.

Green infrastructure is increasingly contrasted with the *gray, or built, infrastructure* used to support new development. Gray infrastructure is quite costly to communities. In 98 communities across 21 states, a study found that for every $1 received from residential development revenues, an average of $1.16, in turn, was spent on providing services to the new community.[27] In contrast, green infrastructure provides economic benefits to communities because natural areas do not require infrastructure such as roads and utilities, and because the green infrastructure naturally performs many necessary infrastructure functions. Green infrastructure can provide the least costly, most reliable, and most versatile solution to many of our infrastructure needs, particularly stormwater management or controls.

The Chesapeake Bay watershed, a critical natural system within the Mid-Atlantic region, is estimated to provide approximately $107.2 billion dollars annually (2013 dollars) in ecosystem services to the region, $32.4 billion of which involve water regulation and supply. Forests, including those conserved in riparian buffers, provide the majority of this value because the region contains considerable forest acreage, and because forests "…are particularly good at producing high-value services, like filtering drinking water, reducing flooding, providing aesthetic benefits and being excellent places for hunting, hiking, and other types of recreation."[28] If this green infrastructure were lost, local governments may need to replace it with gray (man-made) infrastructure.

Forests form a key component of green infrastructure that ensures water supply, water flow regulation, and waste treatment; mitigates air pollution; enhances climate stability; and provides aesthetic benefits associated with natural spaces, scenic views, and waterways.

26 Costanza, R., et al. *The Value of the World's Ecosystem Services and Natural Capital*. **Nature** 387, 1997.
27 Crompton, John. *The Impact of Parks and Open Spaces on Property Taxes*, Constance T.F. de Brun, Editor. **The Economic Benefits of Land Conservation**, The Trust for Public Land, 2007.
28 Phillips, S. and McGee, B. *Ecosystem Service Benefits of a Cleaner Chesapeake Bay*. **Coastal Management**, May 2016.

For planners, it is essential to recognize that forests, followed by wetlands, provide the greatest contributions to a green infrastructure. Trees intercept falling rain and store a portion of it on leaves and bark; some precipitation will evaporate and some will be released gradually into the soil.[29] Woodlands, with their leaf litter and porous soils, are infiltration "machines." They thereby reduce overland runoff and pollution, while increasing groundwater levels and improving year-round flow or base flow in water courses. Trees, when combined with other natural landscaping, reduce up to 65% of stormwater runoff in residential developments.[30]

Effective comprehensive planning takes into account the benefits forests provide and the dollar value associated with these benefits, as loss of forest land could have very real economic consequences for counties and municipalities. An effective comprehensive planning process also includes mechanisms for educating the public and forest landowners about the benefits forests and other natural resources provide to communities. Planners and policymakers should note that timber harvesting, when carried out in accordance with acceptable silvicultural practices, is entirely compatible with, and can actually contribute to, sustainable forest management. Well-planned and implemented timber harvesting will not adversely affect the ability of forests to provide these ecosystem services.

Forests, followed by wetlands, provide the greatest contributions to green infrastructure.

29 Fazio, J.R., ed. **Tree City USA Bulletin: How Trees Can Retain Stormwater Runoff**. Arbor Day Foundation, Number 55.
30 Fazio, J.R., ed. **Tree City USA Bulletin: How Trees Can Retain Stormwater Runoff**. Arbor Day Foundation, Number 55.

Threats to Pennsylvania's Forests

Having an understanding of the many benefits Pennsylvania forests provide to communities is critical because their health, overall size, and value are threatened by a number of conditions.

Pennsylvania's forests are under threat from both natural and man-made forces:

- **Forest loss**
- **Forest parcelization/ fragmentation**
- **Forest pests/diseases**
- **Improper forest management/ harvesting practices**
- **Inappropriate human activities**
- **Climate change**

Forest Loss

Conversion of forests to development, including residential, industrial/commercial, and institutional uses, destroys the continuous land cover necessary for the forest to perform its services for the community ecosystem. Industrial uses requiring such conversion include industrial/commercial building sites; energy, including electric transmission lines; fossil fuel extraction sites, including fracking locations and strip mines; and wind energy turbine sites. In addition, an unknown amount of forest land is cleared annually for crop or pastureland.

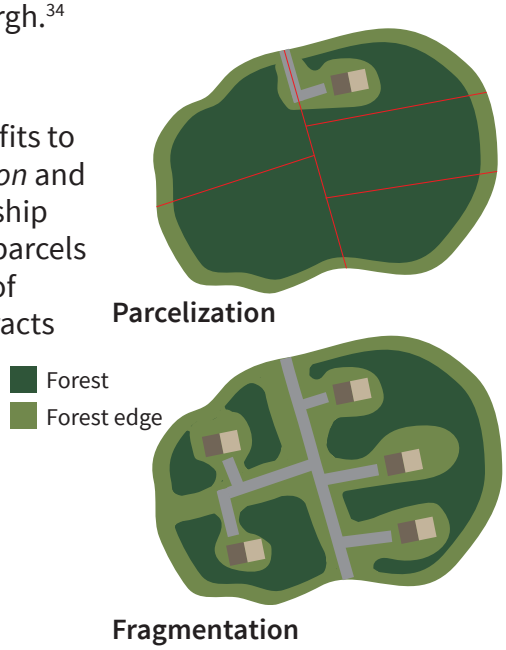
According to a report by the Brookings Institution, Pennsylvania historically has had the second-highest ratio of land consumption to population among the 50 states.[31] Inefficient land use unnecessarily destroys forests and other natural resources, and it diminishes the ability of the remaining forests to provide services on which we depend.[32]

Despite low population growth of 0.24% annually[33] (42nd in the nation among states), predictions for 2030 indicate that the threat of forest loss remains. As reported by Western Pennsylvania Conservancy, an estimated 6%, or 761,000 acres, of all privately-owned forest will succumb to residential development—an area equivalent to 20 cities the size of Pittsburgh.[34]

Forest Parcelization/Fragmentation

The contiguous forest land cover that delivers so many benefits to our communities is at imminent risk because of both *parcelization* and *fragmentation*. Forest parcelization describes changes in ownership patterns, in which large forested tracts are divided into smaller parcels owned by multiple parties. Forest fragmentation is the process of dividing large tracts of contiguous forest into smaller, isolated tracts surrounded by human modified environments[35].

Threats to the health, function, and value of forest land continue to grow as more large forested tracts become subdivided into smaller and smaller parcels, and as once-contiguous forests become more and more fragmented by roads, utility corridors, subdivisions, and other human development.



Parcelization

Fragmentation

31 Brookings Institution, **Back to Prosperity: A Competitive Agenda for Renewing Pennsylvania**. Philadelphia Forum, December 8, 2003.
32 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 9.
33 **www.worldpopulationreview.com**.
34 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 10.
35 Society of American Foresters.

Forest land parcelization and fragmentation are currently increasing across Pennsylvania. With 70% of forest land in private ownership, and an aging landowner population (average age of 59 years), significant generational land transfer is already taking place.[36] Surveyed in 2004, Pennsylvania forest land owners indicated they intended to sell or subdivide over 11%, or more than 1 million acres, of private forest holdings over the next five years. They also intended to pass to their heirs another 12% to 13%, or 1.1 million acres.[37] Nearly one-half of forest landowners surveyed intended to leave their land to more than one child[38], further increasing the likelihood that lands will be sold and put to different uses or managed independently by a larger number of owners. Thus, the 738,000 landowners[39] who own the majority of Pennsylvania's forested land will play a key role in determining the future of the forests whose presence enriches our communities.

County and municipal planners are tasked with balancing development needs with the benefits of open space in their communities.

Forest parcelization and fragmentation are spurred by a number of factors, including rising land values, sale of company forest lands, and subdivision of large residential or estate lots between 3 and 25 acres, for example. Sometimes a self-reinforcing cycle emerges. As development brings new roads, sewers, and other infrastructure into forested areas, the surrounding forests become more accessible for development. As land values rise, forest owners consider subdivision and sales.[40] In the more heavily populated regions of the state, privately-owned forest parcels are smaller and more numerous and therefore, are more parcelized or fragmented.

Land sales and transfers can pose obstacles to forest health, forest stewardship, and the community, even if the land remains mostly forested:

- Smaller tracts of land can be more difficult to manage as economic units or as wildlife habitat. Economies of scale are compromised in both forest management and harvesting operations.
- Owners of smaller tracts generally have less invested in their land and so may be less deliberate in their decision-making and management. While there are important exceptions, the size of a forest holding is an important factor in determining whether the owner feels connected enough to his or her land to keep it in good condition and resist pressures to sell it.
- Increases in forest fragmentation can lead to increases in the number of exotic or non-native species. Understandably, as parcel size decreases, the forest edge increases. This subjects adjacent forested areas to invasions by forest pests, insects, and diseases.
- In studies conducted in the Midwest, parcelization and development had negative impacts on recreation, aesthetics, forest health, forest productivity, community quality of life, and local infrastructure.[41]

36 Metcalf, A.L., Finley, J.C., Luloff, A.E., Muth, A.B. **Pennsylvania's Private Forests: 2010 Private Forest Landowner Survey Summary**, October 2012.
37 Butler, B.J. and Leatherberry, E.C. **Preliminary Data on the Woodland Owners of Pennsylvania, 2004**. USDA Forest Service, National Woodland Owner Survey, 2006.
38 Metcalf, A.L., Finley, J.C., Luloff, A.E., Muth, A.B. **Pennsylvania's Private Forests: 2010 Private Forest Landowner Survey Summary**, October 2012.
39 Metcalf, A.L., Finley, J.C., Luloff, A.E., Muth, A.B. **Pennsylvania's Private Forests: 2010 Private Forest Landowner Survey Summary**, October 2012.
40 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 8.
41 Gobster, P.H. and Rickenbach, M.G. US Forest Service. *Private forestland parcelization and development in Wisconsin's Northwoods: perceptions of resource-oriented stakeholders*. **Landscape and Urban Planning**, 2003.

Planners should examine local ordinances carefully to make sure that they do not discourage or make it impractical for landowners to retain their land as forest.

Those engaged in county and municipal planning efforts should carefully evaluate trends in forest loss, parcelization, and fragmentation, to understand their potential adverse impacts. The risk of parcelization and fragmentation should be taken into account in developing zoning and subdivision and land development ordinances. It is also worthwhile to examine existing and planned local ordinances carefully to ensure that they do not discourage landowners from retaining their land as forest or make it impractical for them to do so. In particular, landowners who earn revenue from sustainably harvesting their woodlots are more likely to retain their land as forest and invest in it for the future. Efforts continue within the Commonwealth to ensure strong markets for wood and wood products to provide these economic opportunities for forest landowners.

Forest Pests and Diseases

Pennsylvania forests are threatened and diminished by a variety of native and invasive plants, animals (particularly deer), and diseases.

Insects

A number of insects are changing Pennsylvania's forests. These native and invasive insect threats to forest health include:

Native	Invasive
Forest tent caterpillar	Asian long-horned beetle
Periodical cicada	Emerald ash borer
Redheaded pine sawfly	Gypsy moth
Elm spanworm	Hemlock woolly adelgid
	Spotted lanternfly
	Walnut twig beetle

Many landowners are already familiar with the invasive emerald ash borer, a green beetle that girdles or tunnels through the bark of trees, which has resulted in the loss of over 5% of Pennsylvania's forest resources due to mortality of white ash. Other threats include the Asian long-horned beetle, which feeds on many hardwood species such as maple, birch, poplar, and sycamore,[42] and the spotted lanternfly, newly discovered in southeastern Pennsylvania in 2014 and the subject of considerable concern.

The small hemlock woolly adelgid continues to ravage the remaining eastern hemlock in Pennsylvania, and is moving across the land at an average rate of 15 miles a year. Once found in 20% of the forest, the woolly adelgid, along with lumbering and land use change, have reduced hemlocks to little more than 5% of the forest.

42 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 13.

White-Tailed Deer

In the not too distant past, white-tailed deer were driven to near-extinction, primarily by overhunting. Deer have made a dramatic recovery during the second half of the 20th century due to land use changes and changing regulatory regimes as well as reductions in both the number of hunters and land available for hunting.

Deer density in many wooded areas now exceeds the capacity of the land to host them. When present in excess, deer cause severe damage to Pennsylvania's forest land by overbrowsing many native plants and, in particular, the naturally regenerating tree seedlings emerging from the forest floor. Across the state, only 49% of sampled stands have adequate regeneration to develop into high canopy forests.[43] Deer are a major cause of this loss.

Dr. Susan Stout, a research silviculturalist and a now-retired Project Leader and Research Forester with the USDA Forest Service, wrote in 2004, that:

> *…the forests of the Northeast have been under assault…from the ever-increasing herd of deer. In Pennsylvania…deer overabundance has changed our forests so much and for so long that we truly don't know how our forest would look without too many deer.*

Dr. Stout highlighted that the current density of deer is causing devastating and long-term damage to forests. Foraging deer consume seedlings of highly preferred species, reducing plant diversity. The damage sustained by forests from deer overbrowsing may take decades or even hundreds of years to repair.[44]

Deer are threatening forest regeneration and promoting less desirable and invasive trees, shrubs, and herbaceous plants to occupy our forests. Declines in both the number of hunters and loss of forest land to development have contributed to this problem. Also contributing to the problem are an absence of predators and lands where hunting is prohibited.

Fewer than 50% of sampled forest stands in Pennsylvania have adequate regeneration.

Invasive Plants

There are dozens of invasive trees, shrubs, vines, and grasses in Pennsylvania. As an example, tree of heaven (*Ailanthus altisima*) is well-established in Pennsylvania and grows rapidly in a variety of conditions, forming dense stands that displace native trees. It actually produces chemicals that kill other plants or prevent them from growing nearby. Japanese stiltgrass, a shade tolerant invasive, now blankets the ground in many forest clearings. Dense tangles of oriental bittersweet block out light, girdle plants, and topple trees with their immense weight.[45] Multiflora rose and bush honeysuckle are two particularly widespread invasive shrubs that thrive in full sun, but also compete well in shade as understory plants in a forested setting.

Invasive plants, such as multiflora rose, shown above, and bush honeysuckle, often take over forest edges and openings.

Invasive plant species alter nutrient recycling, hydrology, fire regimes, light penetration levels, regeneration of native species, and physical habitat

43 Nicholas, S. and Macky, N. **Woods That Work: Pennsylvania Green Ribbon Task Force Report**, October 25, 2016, page 14.
44 Stout, Susan. *The forest nobody knows*, **Forest Science Review**, 2004.
45 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 13.

structure throughout once healthy ecosystems.[46] Infestations by invasive plants are more likely to occur along edges and in forest openings.

Diseases

Most of the diseases impacting Pennsylvania's trees are caused by fungi or a fungal relationship with a particular insect. The American chestnut was at one time a dominant tree in Pennsylvania's forests. The chestnut blight fungus was first discovered in 1904 and quickly spread throughout the chestnuts' native range. Today the chestnuts represent less than 1% of the trees in the state's forest composition.

Other diseases include (but are not limited to):

- Beech bark disease
- Fabrella needle blight of hemlock
- Sudden oak death
- Thousand cankers disease
- Dutch elm disease
- Oak wilt

Most pathogens affect single tree species only. A disease can take months to years to kill the infected trees; thus its significance as a threat can be difficult to assess.

Improper Forest Management and Harvesting Practices

Forest management and harvesting are critical aspects of forest stewardship. Implemented appropriately, they enable landowners to enhance their forested properties while earning income from timbering and supplying essential raw materials for a variety of forest industries. Across Pennsylvania, there are many knowledgeable forest landowners who educate themselves in the complex discipline of forestry, who seek advice from consulting foresters and PA DCNR service foresters, and who are successful in managing and harvesting their forests sustainably. However, there are also landowners (and citizens) who suffer from a variety of misconceptions about forestry practices. They mistakenly believe that forests, left to themselves, will thrive without the benefit of any intervention. In fact, the opposite is true! Still others are unaware that some timber harvesting practices can enhance a woodlot, while other practices can significantly damage the woods and impair its future value.

Selective cutting techniques, notably high-grading, adversely affect forest diversity, quality, and resiliency.

As an example, some landowners employ a tree or forest harvesting practice called selective cutting, in which trees are harvested for specific characteristics, e.g., species or size. The most common application of selective cutting is a particularly destructive practice called high-grading or diameter-limit harvests, which remove the most commercially valuable, largest, or dominant trees; they "take the best and leave the rest." Harvests using these practices adversely affect tree species diversity, quality, resiliency, and the overall health and vitality of the forest. The publication referenced in Appendix II, *Forest Management and Timber Harvesting in Pennsylvania*, provides a useful overview of the various timber harvesting methods.

46 Nicholas, S. and Macky N. **Woods That Work: Pennsylvania Green Ribbon Task Force Report**, October 25, 2016, page 13.

Sustainable timber harvesting focuses on two components of the forest: 1) the residual conditions after the harvest, and 2) the potential of the forest for regeneration. Following a harvest, the residual trees represent the future species diversity of the forest, the potential future quality, and the ability to establish natural regeneration. If all the best trees based on quality and size are taken, the future forest will be less productive. In the same way, if the harvest does not consider forest regeneration, the future forest may be less diverse, have trees less suited to the site, produce poorer quality habitat, and create conditions where invasive and competitive plants dominate. Selective cutting or diameter cutting approaches cause long-term damage to the forest and are dominant factors behind the decline of the quality of our forests.

Incompatible Recreational Activities

The use of motorized vehicles in forests that do not contain roads and trails specifically designed for them, cause damage to the land. They damage the structure of forest soils, cause erosion and sedimentation, impact ground-covering vegetation, and disrupt wildlife.

Some state forest lands and local parks may contain trails designed for this type of recreational activity so as to minimize damage to forested areas; however, use of motorized vehicles on private forest lands ill-suited for this use is quite common.

Using trails designed for recreational use of motorized vehicles will minimize damage to forested ground cover.

Climate Change

Climate change is increasingly affecting forests, although the exact rate of change and effects of some impacts are not fully understood at this time. However, it is clear that higher temperatures and altered precipitation patterns will change forest composition and function, thereby potentially reducing the benefits forests provide to Pennsylvania residents.[47]

Emissions from human activities, such as the use of fossil fuels and deforestation, are raising concentrations of carbon dioxide (CO_2), methane (CH_4), and other compounds of concern, leading to an increase in long-term atmospheric temperatures, changes in precipitation intensity and patterns, and other weather-related events such as hurricanes, tornadoes, or ice storms. Elevated levels of these compounds in the atmosphere and a changing climate will undoubtedly alter forests in Pennsylvania.

Of the many threats described above, high-grading, deer overpopulation, and invasive species (plants, insects, and diseases) are perhaps the most significant immediate threats to regeneration in Pennsylvania's forests, while parcelization, fragmentation, and conversion to other uses could substantially decrease forest land acreage itself. Thoughtful land use planning and promotion of forest stewardship practices are essential for communities hoping to retain the benefits derived from forest land in the years to come.

47 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 14.

Using Comprehensive Plans to Address Forest Loss and Degradation

Under the Municipalities Planning Code (MPC), Article III, Sections 301.4 and 302(d), each county is required to develop a comprehensive plan and to update it every 10 years. Local municipalities are encouraged to develop comprehensive plans; if they do so, the plan must be generally consistent with the county's comprehensive plan. MPC Article III, Section 301 describes required plan elements or chapters. The municipality comprehensive plan must be reviewed every 10 years.[48] In fast-growing places, it is common practice to review certain plan components such as recreation or protection of natural resources every two or three years.

Given the essential benefits forests provide and the imminent threat of forest degradation, it is important to incorporate specific strategies for protecting forests into comprehensive plans.

As required by the MPC in Article III, Section 301 (a)(6), both county and municipal comprehensive plans must include provisions for the protection of natural and historic resources, including: "wetlands and aquifer recharge zones, woodlands, steep slopes, prime agricultural land, flood plains, unique natural resources, and historic sites."[49] Given the essential benefits our forests provide and the imminent threats of forest loss, fragmentation, and deterioration, it is important to incorporate specific strategies for protecting forests into comprehensive plans.

The conditions and uses of forests located within counties and municipalities should be addressed in the three main components of the comprehensive plan, goals and objectives, background studies, and functional or operational plans, as described below.[50]

Setting Community Development Goals and Objectives

Promoting the retention, health, and sustainable use of local forests or woodlands should be included as a primary goal. For example:

> To conserve, protect, restore, enhance, and expand forest land while managing for green infrastructure, wood products, watershed protection, wildlife habitat, non-motorized recreation, and scenic values.

Note that in Article VI, Section 603(f), the MPC prohibits counties and municipalities from unreasonably restricting forestry activities through zoning.[51]

Conducting Background Studies

Counties and municipalities are advised to consider a number of factors when performing background studies and assessments for comprehensive planning, including the history and current conditions of forests, the role they play in the economy and social fabric, the extent to which forests are a dominant land feature and resource, and the degree to which forested land is being managed under any current ordinances and regulations. It also is essential to determine what threats forests may face

48 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article III, Sections 301.4, 302(d), October 2015.

49 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article III, Section 301, October 2015.

50 Governor's Center for Local Government Services. **The Comprehensive Plan in Pennsylvania**, 7th Edition.

51 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article VI, Section 603(f), October 2015.

in the county or municipality, especially the extent to which parcelization and/or fragmentation are occurring. Well-prepared background studies should assess and convey the importance of forest land to the county or municipality so policies can be developed accordingly.

Under the general heading of background studies, publicly- and privately-owned forests should be discussed in several sections, including:

- ✓ ***Natural Resources***. The history, description, benefits, and scale of the forest resource should be assessed, along with any evidence of decline or other problems.
- ✓ ***The Local Economy***. The economic contributions of the wood products industry, as well as forest-related recreation and tourism, should be considered. The presence of forests also typically has a favorable impact on property values; these should be assessed.
- ✓ ***Recreation***. The economic and other benefits enjoyed by the community from recreation associated with forests should be evaluated.
- ✓ ***Green Infrastructure***. Economic and other benefits to the community from green infrastructure based on forest land should be assessed.
- ✓ ***Interrelationships of Different Categories of Land Use***. The role forests play vis-à-vis other land uses, such as, but not limited to, watersheds, riparian and other buffers, agricultural lands, and open space, should be assessed.

Note that in Article III, Section 301(b), both county and municipal comprehensive plans must include specific plans for a reliable supply of water. Section 301(a)(7) of the MPC contains additional requirements for county comprehensive plans, including the identification of "land uses as they relate to important natural resources and appropriate utilization of existing minerals."[52] As discussed earlier, forests are particularly effective at collecting and filtering water and in mitigating stormwater runoff and erosion. The background studies should include consideration of the manner in which existing forests are contributing to a reliable supply of water to ensure that these forests are managed and harvested sustainably.

> **When developing or revising a county or municipal comprehensive plan, it is important to carefully consider the plan's impact on forest land. Do new and existing ordinances encourage retention of land as forest and use of sustainable forest management and harvesting practices?**

Counties and municipalities might also consider the extent to which their forest land may impact adjacent counties and municipalities. The impact of a comprehensive plan on contiguous municipalities must be considered before the comprehensive plan is adopted. In Article XI, Intergovernmental Cooperative Planning, the MPC also provides for development of multi-municipal plans coordinated among multiple municipalities, which are contiguous or located within the same school district. Municipalities are required to develop multi-municipal comprehensive plans if they enact joint zoning with another municipality or if they take certain actions described in MPC Article V-A, Municipal Capital Improvements.[53]

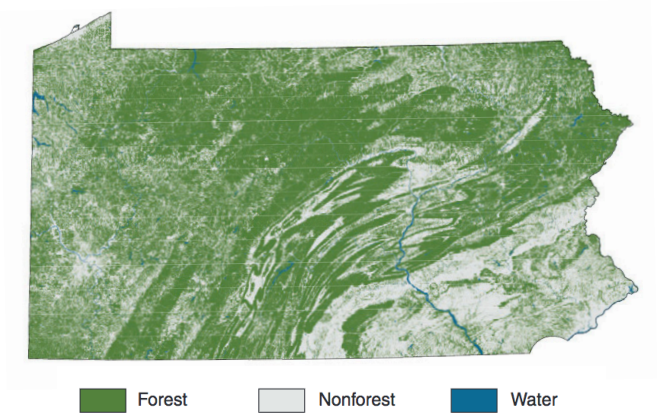
The collection of background information for inclusion in the comprehensive plan also represents an opportunity for counties and municipalities to review existing ordinances to ensure that they **encourage**, rather than **discourage**, retention of land as forest and use of sustainable forest management and harvesting practices.

52 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article III, Section 301(a)(7), 301(b), October 2015.

53 Pennsylvania Land Trust Association. **Planning & Land Use Ordinance Basics**. **conservationtools.org**.

The publications listed in Appendix II provide insights into cataloguing and measuring the benefits forests and other natural resources contribute to their localities as well as ways in which forests can be managed and harvested sustainably.

Preparing Current and Future Land Use Maps



*Map showing the distribution of forest land in Pennsylvania in 2001 (*National Land Cover Dataset, Homer, 2007*).*

Current and future land use maps are essential planning tools for envisioning future land use patterns. These maps form the basis for identifying and prioritizing the needed implementation tools, most notably, zoning ordinances and accompanying maps. A future land use map should be accompanied by descriptive data and analysis for each land use shown, including forests, which describes and supports the land uses as designated.

Local governments should consider identifying forested areas as a permanent feature of their communities. While some forest loss can be expected to occur within areas zoned for residential or other development, governments can make use of land use-related tools described below to reduce loss of forests or woodlands in developing areas. Retention of woodlands within a developing community will greatly enhance quality of life, property values, and environmental quality and protection.

Tools for Comprehensive Planning

Five basic categories of tools are available to assist counties and local governments in implementing their planning efforts. Land-use regulations, purchases of development rights, subsidies/incentives, and taxing policies, are the tools likely most familiar to planners. However, public, professional, developer, and landowner engagement and education also should be considered.

Land Use Regulations, Including Subdivision, Zoning, and Other Development Regulations

To achieve conservation of their forests and their related benefits, counties and municipalities should capitalize on the benefits that enlightened planning efforts afford. Importantly, under the MPC, "zoning ordinances shall provide for protection of natural and historic features and resources."[54] The MPC offers considerable flexibility to counties and municipalities in their efforts to develop tools that reflect the unique values and priorities of their communities. As a vital community resource, forest conservation measures should be considered for inclusion within zoning, subdivision and land development, and stormwater management ordinances as well as in other local government enactments. These measures could potentially include:

- Establishing a growth boundary or urban versus rural demarcation line. Prohibit development infrastructure, such as extension of existing public utilities or proposed new utilities, outside of this line as well as any zoning for development, other than limited allocation of low density/intensity development compatible with resource protection. The Pennsylvania Land Trust Association publication, **Urban Growth Boundary** (see Appendix II), provides more information about this tool as well as a case study on its implementation.
- Enacting innovative land use controls, primarily through subdivision and land development ordinances and zoning, as provided for in the MPC, Article V, Subdivision and Land Development,

54 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article VI, Zoning, Section 603(g)(2), October 2015.

and Article VI, Zoning. In particular, establish a forest zoning classification or district designed to promote forestry, by maintaining a forested land base of a size suitable to be self-insulating from conflicting land uses within any broad or dominant forested region limit. Within such a zone, conflicting uses and/or development would be excluded or limited, subject to legal limitations under the MPC. Such a zoning district could be part of, or an overlay district of, a broader agricultural zoning classification. Conservation/protection of forested land in these zones is preferably accomplished by establishing large minimum lot sizes wherever forested lots can be of sufficient size to make it practical and economically feasible to adopt best management practices. In some areas of the state where the landscape is more fragmented, or dominated by smaller parcels, large minimum lot sizes are not as feasible. In these situations, it may be effective to limit density to discourage further fragmentation.

- Refraining from over-zoning for development. In particular, understand that resource-related zoning classifications, such as forestry or agricultural zones, are fully "developed" or utilized for their stated or intended land use or purposes. Land zoned for these purposes should **not** be viewed as land held in reserve for future development. This same consideration applies when considering whether to support variances or initiate rezoning that adversely impacts forested land.
- Requiring clustering of development density (i.e., "smart development" or "conservation subdivision") on a relatively small portion of a parcel. Doing so requires implementation of specific regulatory amendments to provide flexibility in lot or parcel design, e.g., flexible setback requirements or lot size, while maintaining the integrity of the overall plan. Clustering enables a significant portion of a parcel to remain as open space or undeveloped. In addition, consider establishing a **maximum** lot size for the subdivision of land for development; for example, one acre or less for residential lots to be served by on-lot systems. In general, a proposed building lot should be no larger than physically necessary to facilitate on-lot septic systems and wells and other necessary improvements and amenities.
- Enacting lot averaging, a technique for designing and clustering development density in subdivisions. With lot averaging, some lot sizes may be reduced below the standard minimum, provided that other lot sizes are increased to maintain the overall average lot size for the zoned area. Lot designs then can reduce impacts on important natural resource areas such as forests.
- Favoring community on-site systems, rather than on-lot systems, since they permit smaller lots or tighter clustering.
- Utilizing a **net versus gross density** calculation within zoning classifications in which the number of lots is based on units/acre. That is, eliminate road, utility, and other rights-of-way from density calculations along with all development-limiting natural features, including, but not limited to steep slopes, floodplains, bodies of water, unfavorable soil conditions, wetlands, and riparian areas.
- Permitting transfer of development rights to designated growth areas zoned for increased density in municipalities having parcels with development rights located in areas designated for resource protection. Landowners are allowed to sever the development rights from their land and sell them for use elsewhere in the municipality. Under the MPC, the use of Transfer of Development Rights tools as described in Article VI, Zoning, Section 619.1, must be voluntary.[55] Incentives and appropriate market conditions are necessary for this tool to be effective. For example, the purchaser of a development right is often provided a bonus right by the municipality as an incentive to purchase a development right. That is, the purchaser acquires one right and receives an additional one for a total of two. The landowner or seller is able to sell the right at

55 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article VII, Section 702.1, and Article VII-A, Section 703-A, October 2015.

a premium because the purchaser will receive a bonus development right for each one purchased. This tool is quite flexible and can be attractive for both residential and non-residential development. Further information on this tool as well as examples of its application are available in the Pennsylvania Land Trust Association publication, **Transfer of Development Rights** (See Appendix II).

- Encouraging the sale and transfer of development rights from resource districts to pockets of existing rural subdivisions, within which areas of undeveloped land exist. Within these existing rural subdivisions, there frequently exists undeveloped land, including forest land, immediately adjacent to, or intermingled in tight proximity to, developed lots. Open space land within these small rural subdivisions is compromised or has greatly reduced value as functioning forest land or farmland. Yet, often there are no existing development rights remaining to complete an infill development. Permitting transfer of development rights from resource areas such as forest land, to pockets of rural subdivisions, aids in achieving or intensifying clustering.

Maryland, which enacted a Forest Conservation Act (FCA) in 1991, offers an example of what can be accomplished with state-level regulation.

In Frederick County, all subdivisions with lots greater than 40,000 square feet (0.92 acre) are subject to the FCA.

Reforestation occurs utilizing three formulae, which range from 15% to 50% reforestation, depending on the development site's zoning.

An afforestation goal has also been set, which, in Frederick County, requires a uniform 20% afforestation rate. Even if the development site has no trees, up to 20% of the site must be afforested, or planted in trees.

- Developing an Official Map and adopting it by ordinance, as provided for in the MPC, Article IV, Official Map.[56] Typically, municipalities develop maps of areas within the municipality which anticipate future public uses such as parks, greenways, road alignments, or township buildings. These maps facilitate planning for, and purchase of, open space in the context of the community's future infrastructure needs.
- Enacting zoning ordinances that protect trees and woodlots, including tree preservation, riparian buffer, and steep slope ordinances.
  - ✓ Tree preservation ordinances can require replacement of trees and shrubs on development sites if they have been removed. They can also require building envelopes on wooded lots, outside of which the existing forest must be conserved, resulting in a constantly maintained canopy of trees. (Such building envelopes should be of limited size, for example, less than 16,000 square feet.)
  - ✓ Wooded riparian buffers can be required along streams, springs, seeps, wetlands, and stormwater management facilities. Riparian buffers provide for setback zones along waterways where grading and development are either not permitted (resource protection) or are restricted (resource restriction).
  - ✓ Steep slope ordinances can prohibit or restrict use of sloped areas. These ordinances could either prohibit grading and development (e.g., slopes >25%), or restrict grading and development (e.g., slopes 15% to 25%).

56 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article IV, Sections 401 and 402, October 2015.

- Establishing landscape conservation standards as part of subdivision and land development ordinances. Such standards could include any number of meaningful provisions, such as planting of native street trees, maintaining wooded buffers, constructing bioretention areas, establishing rain gardens, and implementing other stormwater management tools along existing public roads and adjacent development.
- Implementing concepts such as Planned Residential Development or Traditional Neighborhood Development to ensure that natural features of the landscape, including forests, are protected and included in designing communities. Further information on these tools can be found in the Pennsylvania Land Trust Association publications, **Planning & Land Use Ordinance Basics and Traditional Neighborhood Development** (see Appendix II).
- Exploring the utility of the Growing Greener: Conservation by Design program to guide development of a particular area within the municipality. This program, a collaborative program of the PA DCNR, the Governor's Center for Local Government Services, and the Natural Lands trust, is a tool that helps municipalities ensure that high standards for the quality and quantity of open space are incorporated into development of a parcel from the outset. Resources are available to assist municipalities in implementing this tool. An overview of the program is provided in the Pennsylvania Land Trust Association publication, **Growing Greener: Conservation by Design** (see Appendix II).
- Engaging in multi-municipality zoning based on a multi-municipal comprehensive plan, where beneficial to achieve scale and enhance landscape connectivity.
- Requiring reforestation, on-site, to compensate for forest loss due to land clearing for development. Reforestation can be required at a development site under tree preservation ordinances. In doing so, the municipality should consider the scale and quality of the forest being cleared and require that the developer undertake reforestation, or afforestation if necessary, on-site to compensate for the scale and value of the trees that will be lost. Some municipalities have successfully negotiated with developers to plant a larger number of acres of trees to offset loss of mature trees.
- Enacting timber harvesting ordinances if timber harvesting practices in the community are of concern, are not addressed by existing state regulations, and continue despite education and other interventions. In considering the need for such ordinances, municipalities must balance a complex set of considerations, including the many benefits forests provide to the community, the desire to encourage landowners to retain their land as forest, and concerns about harvesting practices that may impair the forest or may impact the community. Obtaining appropriate expert legal and forestry advice in developing any such ordinances is essential in ensuring that they meet the municipality's objectives while not "unreasonably restrict[ing] forestry activities" as is prohibited by the MPC. On the one hand, forest landowners who are able to achieve acceptable economic gains from harvesting their woodlots typically retain their land as forest, allowing both the landowner and his/her community to enjoy the many benefits of forests described earlier. On the other hand, landowners' familiarity with best practices for management of forests varies widely. Given the serious long-term damage to forests that can occur when practices such as timbering are not done according to accepted silvicultural principles, having appropriate local ordinances in place can be a valuable tool. Local ordinances can be enacted to ensure that forests are managed in accordance with accepted silvicultural principles, provided the ordinances are consistent with Pennsylvania's Agriculture, Communities, and Rural Environment (ACRE) law, which governs local ordinances relating to normal agricultural operations, including forestry.

Municipalities considering enactment of local ordinances should thoroughly familiarize themselves with existing state regulations concerning important aspects of harvesting, which encompass:

- ✓ Site-specific erosion and sedimentation control
- ✓ Stream and wetland crossing
- ✓ Alteration or disturbance of streams, fish habitat, or watershed that may damage or destroy fish habitat and introduce substances harmful to fish life into Pennsylvania's waters
- ✓ Road maintenance and prevention/mitigation of local road damage

See state regulations 25 PA Code, Chapter 102 (Erosion and Sediment Control), Chapter 105 (Dam Safety and Waterway Management), the Fish and Boat Code, Chapter 25, (30 PA C.S.A. §§2051-2506), and Title 75 PCS, Chapter 49, Size, Weight, and Load, for further information.[57] State permits are required for some of the above activities. These state regulations are primarily related to protection of the environment and infrastructure, rather than silvicultural practices associated with harvesting. The MPC, Section 603(b), contains a list of other regulations that may be relevant in developing ordinances. Local ordinances, if prepared with appropriate input from forestry professionals and legal counsel, may also have a role to play in protecting forests and encouraging retention of forest land. The publication referenced in Appendix II, *Dealing with Local Timber Harvesting Ordinances*, contains a useful model timber harvesting ordinance that should serve the needs of municipalities that find it necessary to regulate timber harvesting.

Counties and municipalities should be particularly cautious about adopting timber harvesting ordinances that are highly prescriptive, requiring or prohibiting specific practices. While well-meaning, some such ordinances can inadvertently prevent landowners and their foresters from taking actions to restore forest health. Furthermore, timber ordinances that make it too difficult and/or costly for landowners to manage their forests for timber may cause them to sell their land for development.

Experience of Shrewsbury Township with Environmentally-Minded Policies and Regulations

Shrewsbury Township, in south central York County, PA, has incorporated an unusual number of "green" policies and regulations. This municipality has adopted or enacted most of the tools listed in this section. In 2008, this community was honored as the recipient of the coveted Pennsylvania Land Trust Association (PALTA) award for Government Leadership in Land Conservation.

Shrewsbury Township's most far-reaching enactment is its Agricultural Zoning Classification, which encompasses an estimated 15,395 acres, or 83%, of its total land area of 18,688 acres. Under this zoning, the number of lots permitted per farm is extremely limited; agricultural or forest land subdivisions cannot be under 50 acres in size; development lots are limited to a maximum lot size of 50,000 square feet, or about 1.15 acres, and proposed development lots generally cannot occur on prime or productive soils or otherwise conflict with farming activity or best management practices (e.g., farming on established contours).

57 Jacobson, M. Penn State University, Cooperative Extension. **Timber Harvesting in Pennsylvania: Information for Citizens and Local Government Officials**, October 2004.

The use of one or more of these tools will help reduce or eliminate the adverse impacts from fragmentation, parcelization, and poor harvesting practices, as well as overall forest loss. Establishing a well-conceived, extensive zoning district which includes a minimum parcel or lot size, would virtually eliminate additional undersized or difficult-to-manage parcels.

Public, Professional, Developer, and Landowner Education

Public, professional, and landowner education is also an important tool for preventing the adverse effects of fragmentation/parcelization and inappropriate logging or harvesting practices (see Threats).

Initiatives to consider include:

- Collaborating with recognized forestry organizations to educate private forest landowners (e.g., The Center for Private Forests at Penn State and College of Agricultural Sciences Extension, the PA DCNR Bureau of Forestry, the PA Forestry Association, Natural Resource Conservation Service, Conservation Districts).
- Encouraging engagement of trained consulting or service foresters to guide private forest owners in managing their properties in accordance with best management practices as well as wildlife habitat and aesthetic considerations. Most particularly, encouraging the involvement of trained consulting foresters in marking or selecting trees for harvest; determining the value thereof; overseeing a bidding process; and monitoring the harvesting operation itself.
- Encouraging state government, including elected representatives, to expand the service and education roles of state service foresters.
- Advocating for logger training through the Sustainable Forestry Initiative (SFI).
- Where local ordinances are necessary, ensuring that foresters and other natural resource professionals are involved to assure that environmental, forestry, water, and wildlife considerations are addressed appropriately. These considerations must be balanced against the county's or municipality's obligation to not unreasonably restrict forestry activities as required by the MPC.[58]
- Educating developers on the benefits of including reforestation or afforestation in their plans. As was described earlier, communities and neighborhoods containing forests offer many unique benefits that make them quite attractive to buyers. Properties in these communities may command a market premium.

Purchases of Development Rights

- Purchasing land to retain as open space through referendum and bond issues. (See information on Montgomery County, PA open space program at **www.montcopa.org/638/Open-Space-Program** for example.)
- Purchasing development rights as a municipality that have already been allocated. Once purchased, the municipality can then expunge, retain, or bank development rights for future assignment, or reassign and sell them to a landowner or developer within a growth boundary area.

Subsidies/Incentives

- Offering forest landowners additional incentives for tree planting for future harvesting or ecological/green infrastructure values.

58 Governor's Center for Local Government Services. **Pennsylvania Municipalities Planning Code**, 23rd Edition, Article VI, Section 603(f), October 2015.

- Developing financially viable options for sale/transfer of forest land to enable elderly landowners to extract value from their land while retaining it as forest.
- Encouraging development of a forest conservation easement program similar to, but separate from, existing farmland preservation programs.

Taxing Policies

- Educating state legislators on the important role forests play in communities to encourage development of policies that may increase forest stewardship among landowners in **Clean and Green** and/or other programs.
- Advocating for a tax credit inducement for the adoption of sustainable forest management practices. Establish a forest reforestation or afforestation revolving loan fund.

Importance of Coordinated Planning

Collaboration with other municipalities in multi-municipality plans is essential in promoting consistent forest stewardship practices across large tracts of forest land. This collaboration, which is provided for in the MPC, promotes the retention and connectivity of forest land which are essential to retaining the benefits from forests.

Conclusion

Forests, which provide innumerable economic, environmental, health, and recreational benefits to our communities, contribute substantially to the character and quality of Pennsylvania's community life. County and municipal planners are encouraged to ensure the responsible conservation and use of forests in their communities and to promote forest stewardship among private landowners. This publication provides the rationale and tools necessary to give forests due consideration in comprehensive plans and to consider amending existing plans as necessary to ensure that the communities' forests are conserved.

Appendix I — Definition of a Forest

Definition

A forest is broadly defined as a biological community dominated by trees and other woody plants.[59] Forests consist of, or can aptly be described as, biological communities containing their own unique ecosystems. Factors or determinants of the nature or characteristics of a forest include the local climate, primarily precipitation and temperature, as well as the underlying geology, topography, and soil characteristics. These factors, at play for thousands of years, shaped Pennsylvania's 17 million acres of forests as they exist today.

Forested tracts of land are important components of our landscapes, communities, and green infrastructure.

While we all recognize multi-hundred-acre public and privately-owned tracts predominated by trees as forests, other wooded parcels, such as 10-acre wooded backyards in residential areas, or forested areas along streams, also are key components of our forested landscapes.

Forests may originate spontaneously from tree seeds or sprouts, or may be planted, containing both native and foreign, or exotic, species. Today's hardwood forests primarily regenerate naturally from tree seeds and stump or root sprouts but may be planted in some areas. The nature or characteristics of a forest are affected by the local climate (primarily precipitation and temperature) and the underlying geology, topography, and soil characteristics.

Forested tracts of land, whether we describe them as backyards, woods, or forests, and whatever their size, are important components of our landscapes, communities, and green infrastructure.

Forest Structure

As described in the Pinchot Institute publication, **Pennsylvania's Forests**, the structure of the forest is quite complex:

> *The forest canopy, or uppermost layer, provides protection and shade for plants and animals, while also intercepting and slowing rain. Below this leafy roof is the understory—a layer of smaller trees and shrubs. Here, young trees begin to grow and eventually replace older ones as they die.*
>
> *The next layer, the forest floor, includes the grasses, herbs, vines, mosses, and other plants that live close to the soil. Plants, microorganisms, worms, insects, fungi, bacteria, and other living things populate the rich layer of decaying leaves and wood that forms the forest floor. This layer is rich in organic material and is a storehouse of nutrients. The litter on the forest floor also protects the underlying soil. Healthy forests often contain more living biomass in the soil below ground than what is found above it.*[60]

59 Penn State University, College of Agricultural Sciences, Agricultural Research and Cooperative Extension. **Forest Stewardship Terminology** (UH074).

60 Price, W. and Sprague, E. Pinchot Institute for Conservation. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, January 2012, page 3.

Forest Health

This publication, **Pennsylvania's Forests**, also defines what constitutes a healthy forest:

> *A healthy forest is a complex dynamic community of plants, animals, and soil. Healthy forests contain multiple layers of vegetation—each providing important functions. It is this complexity of interdependent parts and diversity of structure that makes forest land capable of providing clean water and diverse habitats.*
>
> *Healthy forests also contain a diversity of plant species, ages, and sizes that allow the ecosystem to bounce back from disturbances and provide a variety of habitats. A rich diversity of species provides insurance in case disease, drought, or other* conditions *severely deplete any one species. Healthy forests are also dynamic, constantly adapting to disturbances like wildfires, storms, and pests. A host of interacting factors including land management history, development pressure, pests, and diseases drive this variation.*[61]

To ensure that this dynamic community evolves in ways that are beneficial for woodland owners and citizens as well as for wildlife, forests require tending and management (e.g., management of invasive plants, insects, and diseases and thoughtful harvesting decisions).

Sustainable Forest Management

Forests in Pennsylvania are typically managed as working forests. Responsible landowners undertake practices that conserve forest health and capacity for self-renewal, while enabling the forest to provide wood products, non-wood forest products, and cultural and ecosystem services for the benefit of the landowners themselves and for the community. These management practices are wide-ranging and encompass techniques for promoting regeneration, managing invasives, establishing wildlife habitat, and harvesting timber using a variety of methods.

Like any professional discipline, forestry is a complex field. Those who are unfamiliar with the management of forest land may not be aware that timber harvesting, if done thoughtfully and with the guidance of a professional forester, is entirely compatible with sustainable forest management and can, in fact, improve the health of a woodlot. Harvesting also provides landowners with income that can be reinvested in their properties. If performed poorly, however, timber harvesting can cause a deterioration in the diversity and quality of tree species, potentially jeopardizing the future health and vitality of the forest.

Both landowners themselves and the planners, policymakers, and citizens who are concerned about the state of forests in their communities would be wise to seek out the advice of professional foresters in making decisions or policies that impact forests or their landowners.

61 Price, W. and Sprague, E. **Pennsylvania's Forests: How They Are Changing and Why We Should Care**, Pinchot Institute for Conservation, January 2012, page 3.

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