PLANNER'S FOREST TOOLKIT

A Guide for South Carolina's Towns, Cities and Counties

A publication of
the South Carolina
Forestry Commission,
Urban and Community
Forestry Program

JUNE 2021

Green Infrastructure Center

Written by the Green Infrastructure Center Inc.

Planner's Forest Toolkit: A Guide for South Carolina's Towns, Cities and Counties

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About the SC Urban and Community Forestry Program

The SC Urban and Community Forestry (SCU&CF) program's goal is to help foster, support and enhance long-term, sustainable, urban and community forestry programs within communities. SCU&CF staff provide technical, educational and financial assistance, primarily to cities, towns, non-profit organizations and state and county governments. Secondary assistance is offered to educational institutions, businesses and private landowners. For more about the program, see: https://www.state.sc.us/forest/urban.htm

To learn more about the nonprofit Green Infrastructure Center Inc. visit www.gicinc.org

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I. Making the Case for Healthy Forests

Introduction

This toolkit was created to place all urban forestry program and policy answers for South Carolina in one place. It is intended as a reference guide to address the needs of planners, urban foresters and policy makers, from beginner to advanced expert. It is intended as a reference guide, rather than a book to be read from cover-to-cover.

The South Carolina Forestry Commission receives many requests for information about those policies, codes and practices that lead to a healthy urban forest – Questions such as ,"Why do we need an urban tree ordinance?"; "Why do we keep having to replace the trees in our downtown every 10 years?"; and "How can we get more trees planted, or reduce the rate of loss?" Many of these concerns should not necessarily be answered by planting more trees. Often, it is not the lack of new trees that is causing the greatest decline – it is the lack of strong policies to protect treed landscapes from excessive clearing. In some cases, cities and towns are planting plenty of trees, but lack the necessary standards or care plans to maintain their health, causing tree cover to decline over time.

In addition, a local organization may know all about how to keep trees healthy and thriving, but is unable to convince its local elected officials and government staff to spend the required resources (time and money) to maintain or expand the community's urban and rural forests. Often, if a community can show that other communities have invested the necessary resources to manage their trees well, their experiences can convince local governments to adopt new ideas or practices. That's why this toolkit references examples and policies that are underway in South Carolina (plus a few that are not yet, but should be – if you want to be a first adopter!). Since seeing is believing, we invite you to check out the projects and policies of your colleagues, referenced throughout this toolkit, and then modify or adopt them for use in your community.

The need to 'manage the urban forest' may not be on the radar of your local government, or they may think that their policies only need to apply to public trees in parks, in front of city hall and around other municipal buildings. Yet, people are increasingly aware that cities, towns and counties are suffering from rising temperatures (urban heat islands), lower air quality (airborne particulates, ozone, volatile organics), urban flooding and standing water, storm damage, and loss of aesthetics as older trees decline and are not replaced. To address these urban challenges, cities, towns and counties need policies that will affect their entire forest, not just trees in rights of way or at parks and schools. Rural forests also need attention and we address them as well.

How to Use This Toolkit

This toolkit is not intended to provide information found easily in other reference manuals – its aim is to establish and share best practices and policies for community forests and examples for implementation across South Carolina. It is not a technical manual for tree care. It does not describe how to plant or prune a tree, as there are many excellent references already available in that field. Rather, this toolkit is concerned with the policies and practices that should be put in place for a successful urban or community forestry program.

This toolkit is concerned with the policies and practices that should be put in place for a successful urban or community forestry program

Section I, Introduction

We lay out the **essential elements for an urban forestry** program, from basic to advanced, so you can determine where your community fits within the continuum of forest care and management, and what else may be needed to foster robust and resilient forests.

If you are already aware of such policies, perhaps you just need help convincing local officials to adopt them. So, this toolkit also provides key arguments to make for different stakeholders, along with the latest and most convincing statistics and facts tailored to the unique concerns of each entity (e.g. elected officials, planners, park managers, chambers of commerce, etc.). There are many avenues for making the case for funding and managing the urban and community forests.

Section II, Managing Rural and Urban Forests

We explain the key economic and ecological considerations for **managing a healthy urban forest**, including how to connect (or reconnect) the landscape. Even a certified arborist or forestry professional may find some new information in this chapter, when considered from the viewpoint of green infrastructure planning.

Section III, Including Trees and Forests in Planning

We detail **best practices and policies** by type and intent so that readers can choose the methods or approaches they wish to implement for their city, town or urbanizing county. We also cover the data needed for such decision making and point out that this may require some research on your part to determine which practices and policies are already in place in your community.

Links are provided throughout the toolkit to allow the reader to quickly jump to relevant sections or visit a website to view source material. **Text boxes** also provide helpful tips and background to use as you create, build or improve your community forestry program.

Section IV, Creating Tree Ordinances

Provides the key elements for different **ordinance types and sample language**, along with case examples for how communities have implemented these policies.

Section V, Implementation of Urban and Rural Forestry Programs

Covers the **implementation**, including the on-going care, funding and engagement needed to sustain a healthy forest.

Appendix

Includes **citations** for facts and statistics, sample **bidding forms** for hiring consultants, a **glossary** of terms commonly used in ordinances and a partial **list of trees** that can best withstand adverse conditions.

This toolkit provides the best practice standards and references for key codes, ordinances and policies to emulate or adapt in your locality.

Toolkit Audience

This toolkit includes the arguments you need to make to fellow policy makers, as well as the key legislative priorities and programs you should include in your city or town.

Planners

Planners play a key role in determining policies for growth and development through comprehensive plans, zoning, landscaping ordinances, transportation plans, capital improvement plans, open space plans and many other plans that affect where development occurs, whether land is cleared or whether landscapes are broken up into smaller areas through parcelization. Local government policies and rules affect the intactness, extent and health of the urban forest.

Foresters/Horticulturalists/ Landscape Architects

Tree care and landscape professionals all play a vital role in planning for and planting the urban forest. Yet the developed environment is a tough one for a tree – a vegetation that is designed to live in a forest or forest edge, rather than such harsh places as sidewalks, plazas and roadsides, where heat, wind, storms and pests can wreak far more damages on an exposed tree than it would normally experience. In addition, urban trees face such constraints as undersized planting areas, underground and overhead utilities, poor or inappropriate stock for the site, and lack of funding for adequate care and maintenance. While forest and landscape professionals usually know what is needed to keep trees healthy and thriving, they are seldom able to dictate the urban planting conditions needed for success.

Photo credit: South Carolina Forestry Commission

South Carolina Forestry Commission staff show how to evaluate urban tree health.

Elected and Appointed Officials:

Policy makers in a community have a key role in setting strategic directions – Will the community's forests be sustainable, resilient and thriving? They also establish priorities for spending that affect whether the urban forest is healthy and expanding or dying and shrinking. A lack of policies for tree conservation or replacement is a key driver for why urban trees are on the decline nationwide.

You may be a policy maker, but you might need more arguments to convince others that new rules, policies or practices are necessary to save your community trees and forests. Also, local decision-makers need to know that, while tree care costs money, trees pay back far more revenue from improved real estate values, lower vacancy rates, increased sales and restaurant tax revenues, lower utility bills, and savings on costs for stormwater systems and public health as communities become more walkable!

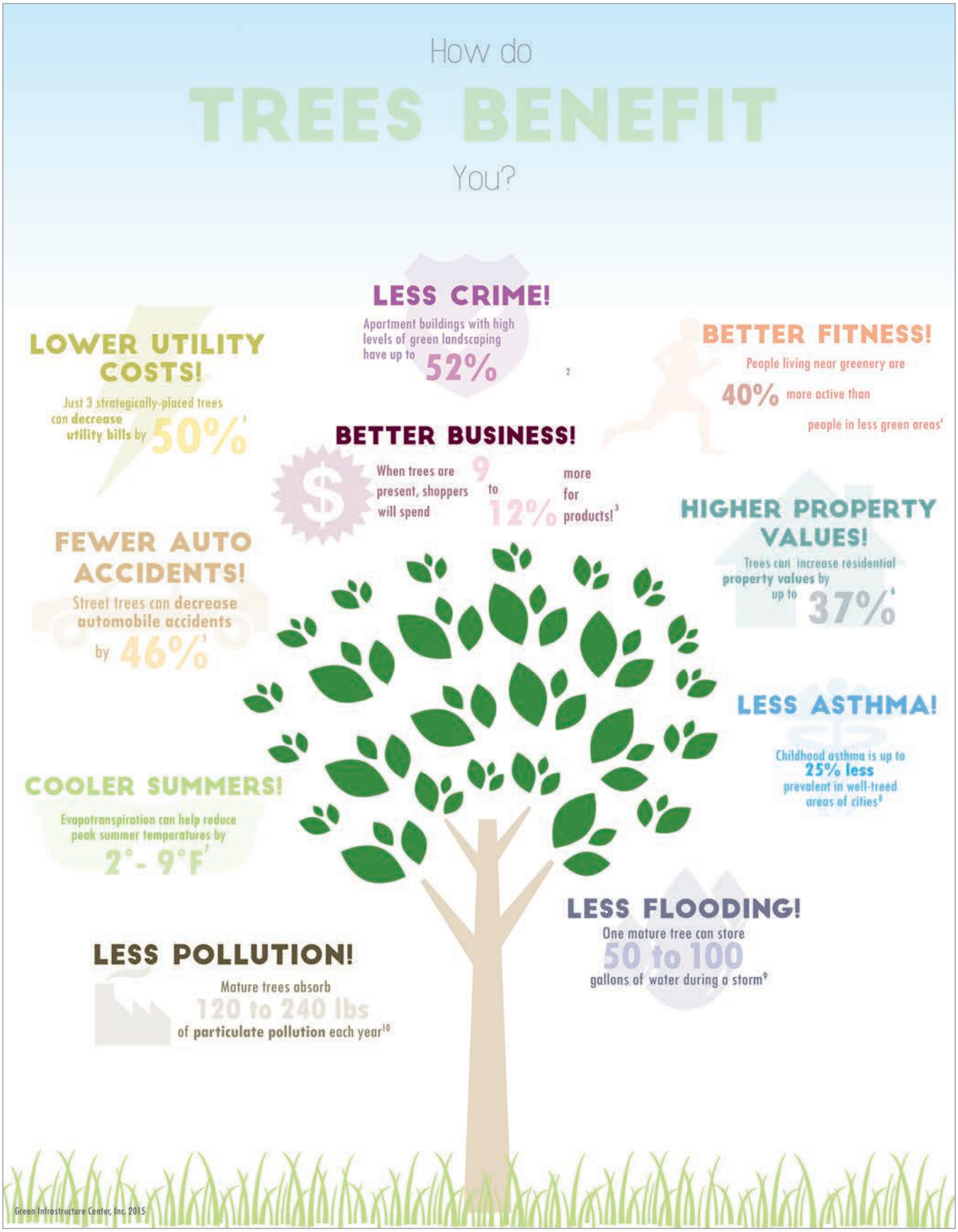
Conservation and Tree Care Groups

Many times, nonprofit and community advocates play the key role in galvanizing their towns and communities to care for their urban forest. This toolkit provides the advocacy framework for speaking to elected bodies, appointed boards or the media about why urban forests need a strong set of policies and practices in place to help them thrive. Community and nonprofit groups may be working hard to plant hundreds of thousands of trees annually, but, if their city lacks policies to prevent excessive land clearing or tree removals, tree planting efforts to maintain forest cover may not be effective.

This toolkit can be used to convince elected and appointed officials, tree boards and others of the importance of having the most effective policies in place to prevent tree loss over time.

South Carolina Forestry Commission staff survey a damaged tree.

Photo credit: South Carolina Forestry Commission



Trees provide many benefits! (see Bibliography in Appendix for references)

Essential Elements for Urban Tree Care Programs

Cities and towns vary according to which forest policy and practice elements are contained in their urban forestry programs – or they may not have a program at all. The following chart includes a list of key policies, programs and groups that should be in place for a successful urban tree care and management program. Many communities are aware of the Arbor Day Foundation's Tree City USA Program, which establishes a basic benchmark for urban forestry in cities and towns. However, some communities are not ready to meet that standard (e.g. they don't yet spend enough on urban forestry), while some have long ago achieved the status of "Tree City USA" and perhaps even won a "growth award" for program expansion...but even these cities can often do much more to ensure a well-funded and functioning program.

We have created the following four tiers: The "**tree**" being the most robust and desired outcome for a program. While, a small town may remain at the "**roots**" or "**sapling**" stage because of resource constraints, it could go all the way to the "tree" level by investing in its urban forest and establishing partnerships to make the canopy plan work. For examples of variations in programs, see the case studies in this chapter.

Become a "Tree City USA"

Tree City USA is an annual recognition program for cities and towns striving for excellence in the fundamentals of urban forest management. Administered by the Arbor Day Foundation, the program requires participating cities to:

- ✔ **Have a tree care ordinance.**
- ✔ **Have a tree board, department or individual in charge of trees, or a combination of all three.**
- ✔ **Spend $2 per capita on tree care annually.**
- ✔ **Host an annual Arbor Day celebration.**

Cities going beyond the basic requirements can apply for Growth Awards. Tree City USA status also makes cities eligible for tree planting grants and other state grant programs.

TREE CITY USA®

URBAN TREE CARE PROGRAM ELEMENTS & TIERS	Seeds	Roots*	Sapling	Tree
DATA NEEDED TO TRACK AND MANAGE TREES				
Map of public places where trees planted/managed	■	■	■	■
City/town tree maintenance records/expense reports		■	■	■
Tree Canopy (mapped for city/town)/ Tree Canopy estimated by i-Tree canopy)		■	■	■
Spatially-based Tree Canopy Data and Map (includes both existing canopy and open space locations for planting)				■
Tree Inventory (citywide, downtown, parks or other planning geography)				■
STAFFING -DESIGNATE CITY/TOWN DEPARTMENT OR CONSULTANT RESPONSIBLE FOR TREE WORK				
Named staff member/contractor tree care	■	■	■	■
Identify process/parties to remove hazard trees	■	■	■	■
Staff landscape architect, horticulturalist, forester, arborist*		■	■	■
City Arborist (certified by ISA)			■	■
Continuing education credits/staff attending trainings			■	■
Tree Risk Assessment Certified (TRAC) Staff				■
CODES GOVERNING TREE CARE, PLANTING OR REMOVAL				
Code designates responsible party for tree care/planting	■	■	■	■
Tree care ordinance (for removal or care of public trees)		■	■	■
Protect trees during/after construction (fencing, signage, retention, after care for newly planted trees)		■	■	■
Urban planting and landscaping standards			■	■
Tree removal permit for private property			■	■
Standards for street and RoW plantings, parking lots and plazas (including application of ANSI Standards for tree installation and maintenance)				■
Incentives for structural support such as Silva Cells™				■
Including trees as green infrastructure for stormwater, drinking water protection				■

*Meets TreeCityUSA requirement

URBAN TREE CARE PROGRAM ELEMENTS & TIERS	Seeds	Roots*	Sapling	Tree
PLANS				
Trees' importance mentioned in Comprehensive Plans	■	■	■	■
Urban forest maintenance and planting plan			■	■
Urban Forest Management Plan				■
Emergency Management Plan				■
Tree Recycling and Re-use Plan (Urban Wood Utilization Plan)				■
ENGAGEMENT				
Information on city website or town newsletter about city tree benefits and city contacts regarding tree care/planting.	■	■	■	■
Annual public education event for tree care/planting	■	■	■	■
Website about city trees, who to contact, basic benefits		■	■	■
Regular engagement events/education for new residents		■	■	■
Arbor Day Celebration		■	■	■
Advisory Group/Tree Board		■	■	■
Community Tree Planting Program/Volunteers/Partnership			■	■
Tree-focused Advocacy Group				■
FUNDING				
Funded program for tree care and maintenance	■	■	■	■
Spend at least $2 per capital on urban forestry/landscaping		■	■	■
Tree donation program				■

*Meets TreeCityUSA requirement

Camden, SC

Despite being a small city with only a population of just 7,220 people the City of Camden, SC, is recognized as a Tree City USA with over 31 years committed to its urban trees. Tree City USA is a national recognition program under the Arbor Day Foundation and the National Association of State Foresters. In order to qualify for Tree City USA status, a community must meet four core standards for managing its urban forests (see Tree City USA text box). Camden goes beyond these standards by exceeding the $2 per capita budget for tree care and maintenance; in fact, it spends around $60 per capita. While this may seem like a large investment for a small community, it is returned in the form of a healthy forest and knowledgeable city staff who can provide additional services to the community.

One such service allows residents to request the examination of a public or private tree. City staff provide a site visit free of charge, which helps avoid unnecessary tree removals and conflicts with utility companies, and can identify pests and diseases before they become a large problem.

The city created brochures for pruning, watering, fertilizing, and planting, along with other recommendations to educate residents about best management practices (BMPs) for trees. The city's urban forestry website also maintains a list of those tree species best suited for various local site conditions.

All of these tree information and services that Camden offers to the community support the long-term health, maintenance, and growth of its urban tree canopy. Tackling some of these key elements takes time, but Camden is an example of how a small community can develop the programs, policies and resources to make a big impact.

McClellanville, SC

In the village of McClellanville, SC, (pop. 542) stands a massive oak tree, the Deerhead Oak. It is the most photographed spot in the village with thousands of tourists coming to view this majestic tree and take a photo of it. Estimated to be more than 1,000 years old, this massive live oak has a large branch that resembles a deer's head, giving it its name. This historic and well-treasured tree is considered a member of the McClellanville community and the village is working with the Charleston County Greenbelt Program and the East Cooper Land Trust to secure the acre-sized parcel upon which the tree is located in order to protect it for the public in perpetuity.

The village's dedication to tree protection is demonstrated in their 2025 Comprehensive Plan which states "McClellanville's rich natural resources: clean air, water resources, scenic wildlife habitats, and abundant trees have been identified as some of the most significant assets of the community. These resources play an integral role in the town's economic basis and quality of life."

Coupled with the village's volunteer Tree Board and its Memorial Tree Fund, this small community is making strides to protect its natural resource assets, not only for its human residents, but also for the Deerhead Oak and its residents – birds, insects and mammals.

Photo credit: Linda Brown

The 1,000-year old Deerhead Oak is McClellanville's most famous tree.

Rock Hill, SC

The City of Rock Hill, (pop. 75,048) has a successful community forestry program that covers city tree canopy care, a tree protection ordinance, a memorial tree fund, tree commission board members and the annual Arbor Day celebration. Each of these elements is deemed critical to the long-term health and maintenance of the City's urban forest.

One key program element is the mandating that all City contractors use the American National Standards Institute's (ANSI) A-300 standards in caring for and maintaining public trees around utilities. Requirements for proper pruning help ensure the long-term health of the urban forest while reducing potential conflicts with overhead utility wires.

Most communities already invest in their urban forests, but communities looking for a way to start small with a big impact should focus on educating the public about the importance of trees and the benefits they provide to the community's quality of life. Rock Hill's website includes a section on tree species, tree biology, and how trees clean the air and soak up excessive stormwater. Having a central resource for people to find and access information about community trees is a valuable tool for any community. Websites can provide forums for sharing planting projects, current codes and policies, and opportunities to plant trees on public and private properties.

A successful community forestry program such as Rock Hill's takes time and resources to build; however, any community can take small first steps to move forward, whether it is recognizing the importance of trees in the next update of the comprehensive plan or planting trees at local public schools for Arbor Day. Visit Rock Hill's website for inspiration or ideas to include in educating the community at: https://www.cityofrockhill.com/departments/utilities/more/utilities/community-forestry.

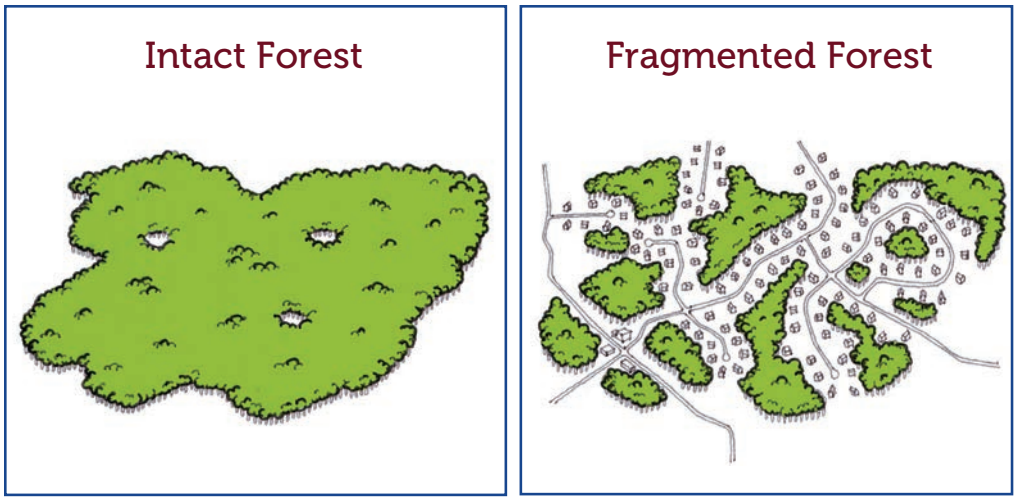
South Carolina's Forests At Risk

Forests have long been an integral part of the South Carolina landscape, from the mountainous Piedmont region in the west to the coastal plains and forested marshes in the southeastern low country. As a southern state facing rapid growth, South Carolina's forested land cover remains impressive, accounting for 66 percent, or 12.9 million acres, of the land area (USFS, 2019). However, forested landscapes are not distributed equally statewide and some areas are at risk of losing forests to land conversion – changing them permanently from rural forest land to developed landscapes.

South Carolina's forested land cover remains impressive, accounting for 66 percent, or 12.9 million acres, of the land area

As South Carolina's forests age, biomass in the forests is increasing. However, although forest biomass is greater now than any time in recent memory, the extent of forest cover has declined in the state for both rural landscapes and urban areas. To keep the strong forest economy going and ensure vibrant cities, towns and suburbs, tree cover should be maintained. While trees harvested can be regrown, land conversions from forests and tree cover to other uses mean a lasting loss of many of the services – economic, ecological, social – that trees provide.

In addition, while total acreage is important, the quality and intactness of forests is of even greater significance. Indeed, forest fragmentation remains the greatest threat to southern forests. Even though South Carolina's forest cover has been relatively stable overall in recent years, land conversions from forest to development are accelerating.



Development can cause the breaking up of forests into smaller isolated patches that are too small to support wildlife or other forest values.

Forestry in South Carolina makes a $21.2 billion dollar contribution to South Carolina's economy in sales and forest-based recreation and supports 98,306 jobs.

The more edge area is present, the greater the likelihood that outside influences may harm the forest. Increases to forest edges are often caused by roads cutting through a forest. Those roads also serve as vectors for invasive pests or invasive plants. For example, invasive insects, such as the emerald ash borer (Agrilus planipennis), have been known to hitchhike on vehicles and drop off along the way, thus infesting forests far from initial outbreak sites (Buck and Marshall 2009). Roads can be designed and routed to limit the amount of new forest edge created by avoiding bisecting large forests. Large intact forest, especially forest cores of at least 100 acres that are home to interior, forest-dependent species, should be avoided whenever possible when planning new roads for development or transportation projects. This is because many native species require large intact forests in which to live, rather than smaller, disconnected forest patches.

Emerald Ash Borers are one of many invasive pests that harm South Carolina's trees.

The U.S. loses about 36 million trees annually to development, storms, old age and removals.

Cities and towns are also losing their forest cover. Nationally, the rate of urban forest loss is on the increase. Recent national data show urban and suburban tree canopy cover is trending downwards at a rate of about 175,000 acres per year – approximately 36 million trees annually. As these trees are lost, so are the benefits they provide – an economic loss of $96 million per year (Nowak and Greenfield 2018). Some of the causes for this decline include land conversion for development, storm damage, hurricanes and lack of tree replacement as older trees die. Clearly, we need to stem the loss of urban and community forests. Having a robust urban forestry program at the municipal level is one way to achieve that for developed landscapes.

Urban trees suffer many challenges. This tree may have grown too large for its inadequate planting bed.

Although logging is often blamed as a source of rural forest losses, harvested landscapes managed for forestry are usually regrown and represent a stable land cover of forest over time. But when land is cleared for development, that forest is lost forever. Like many Southern states, South Carolina's urban areas have been continuously increasing in recent decades. Over the last 50 years, the developed landscape in South Carolina has expanded three-fold (from 1 million to 3 million acres approximately). Over the past decade, the loss in rural areas has occurred at an average rate of 24,000 acres per year (Brandeis et al. 2017).

Growth in South Carolina's Developed Landscape

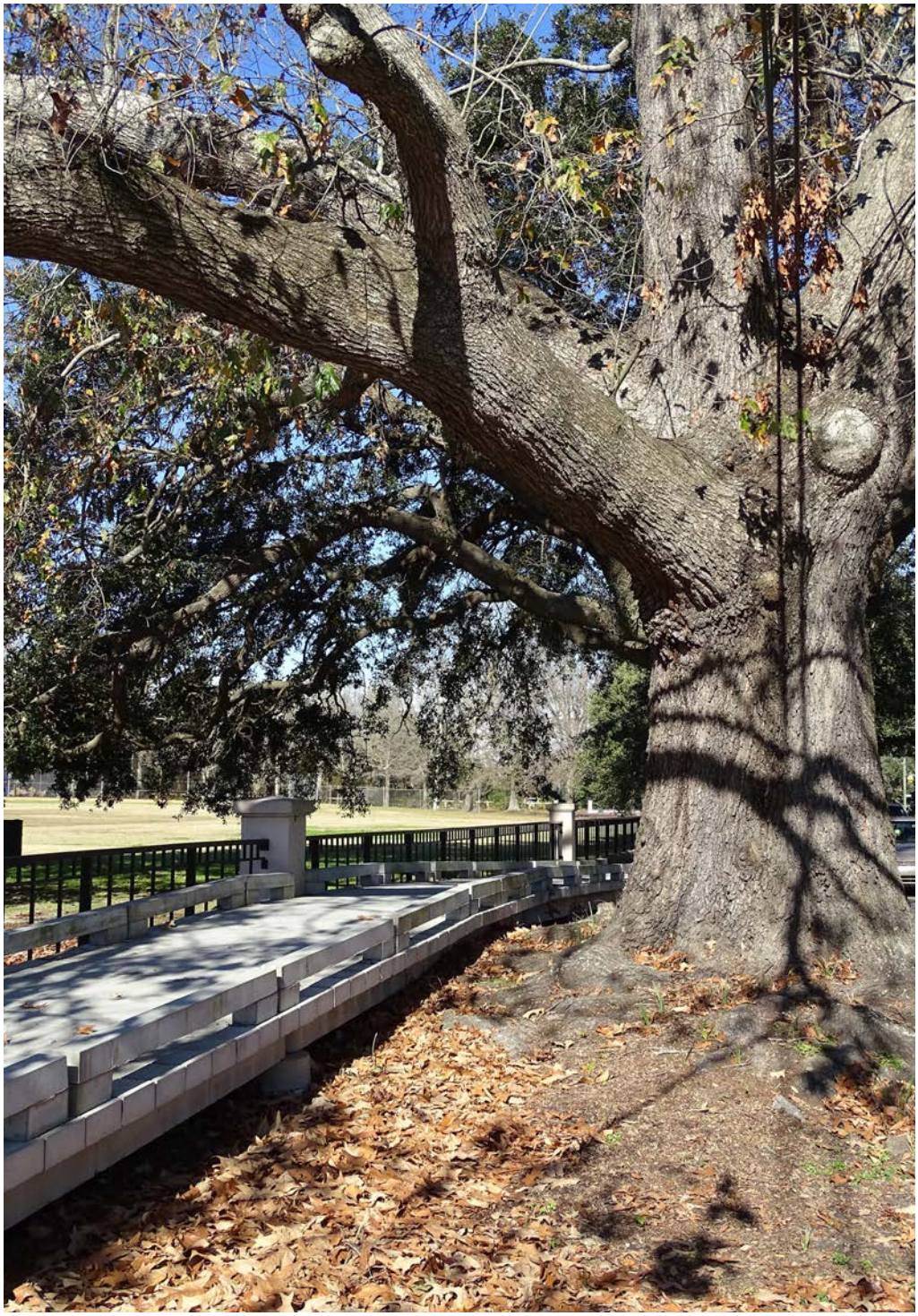
Over the last 50 years, the developed landscape in South Carolina has expanded three-fold from 1 million to 3 million acres.

Although large trees have been fenced for protection during construction, the forest has been deconstructed through the loss of most trees.

Development impacts the forest in myriad ways; not just the physical transformation of forests to turf grass, roads and rooftops, but in more subtle ways, such as increasing edge effects or escalating risks of fire. At the forest's edge, invasive pests gain access, so the increase in edge area simply adds more opportunities for incursions to occur. Since the majority of forest fires are caused by people, more development close to forests adds to the likelihood that a carelessly thrown cigarette or unattended burn pile will lead to a new wildland fire.

Small parcel size is another factor that makes it difficult to effectively manage a forest. According to the Southern Forest Research Station, the number one threat to forests in the Southern Region is breaking them up into smaller and smaller parcels. As forested land is subdivided, those smaller parcels are more likely to be developed. Small, developed lots impede wildlife movement, impair surface waters as more roads are required for access, increase fire risks, hinder groundwater recharge and are too small to manage for forestry or wildlife uses. Even individual houses built at the edges of cities – in areas referred to as the 'wildland-urban interface' – can also cause impacts to forests. These developments within rural areas add to forest fragmentation. There are ways to conserve forest area by designing new developments as conservation subdivisions. For more on that see Chapter Four on Ordinances and also visit: http://www.gicinc.org/PDFs/DesignGuide_final.pdf .

Within cities and towns, forests are usually smaller (several acres or less) and the focus turns to street trees, trees in parks and at public facilities, and trees planted in sensitive areas, such as along streams or in forested wetlands. However, there are many ways to ensure forests and individual trees in cities and towns remain healthy and to stem the decline of urban forest coverage.

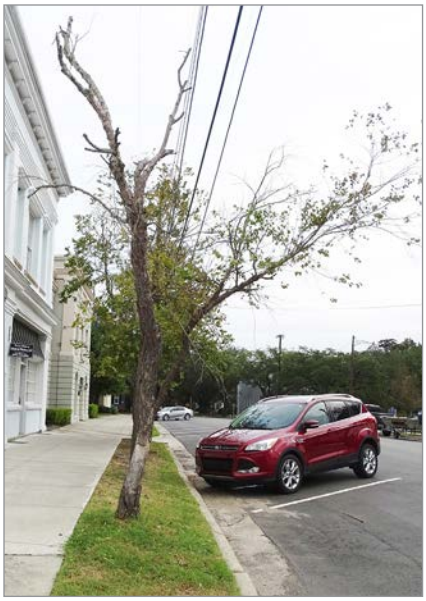


This live oak along a Charleston park has been accommodated by raising the sidewalk, rather than removing the tree.

Another challenge for cities and towns is the aging of our urban canopy. Just as we are all aging, so is the urban forest. Oftentimes, leafy, shaded neighborhoods are overlooked when considering where more trees are needed. And yet, these areas of a city, town or suburb are precisely where new trees are needed. Just as our society continues through children and grandchildren, so do our street and yard trees. Without 'children,' a.k.a. next generation trees, neighborhood canopy coverage will begin to decline.

Even well canopied neighborhoods need to have the next generation of trees planted.

Communities are often shocked when many large oaks, hickories or beech trees begin to decline or come down at around the same time. That happens because, often, the trees were planted in the same year, if not the same month, just after the houses were built, and were often planted one in each front yard. Once those trees are more than 100 years old, they are well into their senior status and may start to decline. And while it's true that a well-cared-for live oak or beech tree can live hundreds of years, we put many unusual stresses on urban trees that can limit their life span – from pruning roots to avoid sidewalk uplift to cutting back limbs for power lines.



This tree is suffering from a multitude of urban ills and will soon be dead. Urban trees need both good planting conditions along with care to allow them to live a long time.

This tree is retrenching, dropping its limbs as part of a process of aging. If this tree were along a sidewalk it may need to be removed as it could pose a danger to people.

Photo credit: South Carolina Forestry Commission

The Asian longhorned beetle is a threat to the state's maple, elm, ash, sycamore, poplar and willow trees.

Similarly, old trees will often go through retrenchment: dropping limbs such that their crown spread begins to shrink inward, while adding girth to the trunk. Retrenchment is a natural process whereby an old tree dies back to a smaller, lower crown. However, retrenched trees can 'look funny' – think of how some of us look after we pass age 75 – but it is a natural process that adds stability to older trees.

Threats to both rural and urban forests from pests are also increasing. The emerald ash borer has been present in South Carolina since August 2017, when it was first detected in Greenville, Oconee and Spartanburg counties. Some cities and towns are just beginning to realize that their community's downtown has a lot of ash trees that need to be treated or removed before they find themselves with a treeless business district. The Asian long horned beetle (*Anoplophora glabripennis*), also known as ALB, is another serious threat. It is a wood-boring beetle that threatens a wide variety of hardwood trees, including maple, elm, ash, sycamore, poplar and willow. In June 2020, a 58.6 square mile quarantine area for the ALB was established around Charleston after confirmation of its presence in trees in and around Hollywood in Charleston County. Other newly arrived pests, such as the spotted lanternfly, or SLF, (*Lycorma delicatula*) have not yet reached South Carolina, but it may be only a matter of time.

This toolkit lists the many ways urban forests can be better cared for, planted and protected. Following are some primary causes of urban forest decline and examples of solutions (covered in greater detail in Sections Three and Four).

Primary Causes of Urban Forest Decline and Solutions

TREE LOSS PROBLEM	RESULT	SOLUTION
Street trees dying within 10 years of planting; or lack of street trees.	Streets devoid of trees, hot neighborhoods, replacement costs.	• Ensure adequate soil volume. • Choose hardy species. • Monitor for pests/disease. • Care program (water, mulch, prune – especially in first 2 years after planting).
Excessive clearing of trees from sites.	• Loss of canopy with new development. • Increased stormwater runoff. • Loss of habitat for people, birds and pollinators. • Urban heat island effect.	• Prevent lot-line to lot-line clearing before land development permits approved. • Require urban forest surveys for large trees before development. • Create minimum canopy standards by zoning class. • Increase development tree protection standards.
Trees coming down in storms.	• Property damages or loss of life. • Loss of mature canopy and ecosystem services. • Loss of assessed property value.	• Tree risk assessments to find and address hazards ahead of time. • Replanting programs. • Hazard mitigation plan for the urban forest.

Pests and Climate Change

Southern pine beetle (*Dendroctonus frontalis*) has been a native pest to South Carolina pines for as long as there have been tree inventories. They often are most successful when attacking a stressed tree, such as one suffering from extended drought.

Historically, cooler months at the end and beginning of the year have tempered this pest. However, according to researchers, recent years in in South Carolinas have lacked the normal cool period and Southern pine beetle outbreaks are happening as early as February. Warming climate trends may also result in more reproductive cycles per year, leading to more pests – and more damage.

Image credit: South Carolina Forestry Commission

These egg galleries show tree damage from the southern pine beetle.

Threats to South Carolina Forests

- southern pine beetle
- asian longhorned beetle
- ambrosia beetle
- emeral ash borer
- laurel wilt disease
- cogongrass
- salt
- climate change

In addition to pests, forests suffer from other diseases or blights, such as the vascular disease commonly known as **laurel wilt disease**, which is killing red bay trees. Red bay is also known as the 'evergreen of the coast' and is common to low country barrier islands. It is caused by the fungus *Raffaelea lauricola* and is transmitted by the invasive **red bay ambrosia beetle** (*Xyleborus glabratus*).

Even plants can be invasive to forests. **Cogongrass** (*Imperata cylindrica*), which originated from Southeast Asia, is one of the most invasive plants on the planet and is now found on every continent. It tolerates the low-light conditions of healthy forests, exploding in population as more light is let in (e.g. after trees are felled by a storm). It is also fire adapted. Since cogongrass increases fuel loads, forest fires or prescribed burns in infested stands can get hotter than the trees can tolerate, resulting in unintended harm from managed burns. When cogongrass gets a foothold, it can effectively convert a forest to grassland (SC Forestry Commission).

Climate change is another factor that can add stress to both urban and rural forests. Fluctuations in climate, such as longer wet or dry periods, can stress trees, making them more susceptible to pests and diseases. *(See text box on pine beetles above.)*

Cogongrass can overtake native forests, converting them to grasslands and increasing fire risk.

Salt Damage to Trees

Salt-damaged trees that are stressed may be more susceptible to other risk factors, such as drought or pests. Airborne salt from coastal storms or salt from winter road treatments can kill both root systems and dormant buds by penetrating leaf scars. Salt can accumulate in the soil, where it breaks down into sodium and chlorine, both of which affect vegetation. In extreme cases, chlorine ions in the soil are taken up by the tree in early spring, where they enter the sap and concentrate in shoots, preventing bud openings. Eventually, the chlorine is transported to actively growing leaf margins where it causes leaf scorch, curling and death.

Sodium ions in the soil follow the same route as the tree's nutrients, blocking magnesium and potassium, both of which are necessary for the production of chlorophyll. In extreme cases, this can result in a potassium deficiency that may inhibit the tree's resistance to drought and disease.

The Hobcaw Barony Forest in South Carolina has been studying the salt impact of Hurricane Hugo for more than a decade. Researchers continue to find high salt concentrations in the soil, even ten years after the hurricane.

When disasters strike, communities often have plans for debris removal, but not for tree replacement. And, if recent intense storms and highly active hurricane seasons are any indication, warming oceans may mean more tropical storms making landfall in South Carolina, with associated wind damage and flooding that harms property, utilities and infrastructure and puts lives at risk – while also harming our forests through tree damage – broken limbs, uprooting and failure. Even trees that seem to survive storms – at first glance – may be weaker from repeating wind and flooding impacts to their roots and stresses to their canopy branches. Repeated exposure to salt in winds can also cause serious long-term damage. (See the text box, page 21, for how salt harms trees).

Convincing Others That Trees Matter

If you are a local government official, planning commissioner, city or town planner, a tree care group or the city arborist, you have a key role to play when making the case for tree conservation, care and planting in your community. However, for an argument to be effective, it should appeal to the key interests of the message recipient. If your city or town has a resiliency or sustainability officer, or a livability or health plan, these staff will likely be very interested in statistics about health. An economic development director will also be interested in these statistics, along with the values trees provide for lowered vacancy rates, improved commercial area revenues and for marketing the attractiveness of the area to new businesses and future residents. Statistics, examples and case studies are often effective tools in making the case that the issue is important and there are real-world, implementable solutions to solve it.

Additionally, tree advocacy groups or city arborists can use these same statistics to argue for the value of urban trees and request improved funding levels. Following are these arguments broken down by stakeholder types so you can target your key messages to the right people, and convince them to do more for trees.

Key statistics you can cite as evidence for these claims are found throughout this toolkit and the Bibliography lists sources and available links to download articles and studies with the supporting data. There are also examples of cities that have adopted ordinances or funding projects that you can use to show that "they did it and so can our community."

Trees in the business district of Georgetown, SC, improve revenues from sales taxes. These trees invite us to linger – and spend more.

Elected and Appointed Officials

(City, Town and County Councilors & Planning Commissioners)

Trees increase property values, revenues for shopping districts, improve community health and make communities more resilient to climate change and attract new businesses and entrepreneurs. Trees will pay their way through increased economic activity and better tax revenues from property values. Large natural forest areas have a greater positive impact on nearby property prices than small urban parks or developed parks, such as playgrounds, skate parks and golf courses.

Homes located within 1,500 feet of natural forest areas enjoy statistically significant property premiums, on average $10,648, compared to $1,214 for urban parks, $5,657 for specialty parks and $8,849 for golf courses (in 1990 dollars). The existence of a park within 1,500 feet of a home increased its sale price between $845 and $2,262 (in 2000 dollars). (Shoup, and Ewing 2010). This means that, while all parks support a healthy tax base for local government, forested areas are especially significant, and can also help meet goals for community health and livability, since they provide opportunities to exercise and get close to nature.

Homes located within 1,500 feet of natural forest areas enjoy statistically significant premiums in property value, on average $10,648.

In rural communities, forestry is key part of the economy, and even more so when there are value-added industries, such as paper mills or furniture manufacturers, in the area. As we have already mentioned, timber sales and forest-based recreation support 98,306 jobs in South Carolina. And forests also support economic values from such tourist activities as hunting, fishing, birding, hiking and photography, all of which enhance the local economy.

See more economic values of forests at: https://www.state.sc.us/forest/sctpo13.pdf .

Photo credit: South Carolina Forestry Commission

Arguments by Stakeholder Type

City Public Works & Engineering

Trees have been shown to take up stormwater, reduce standing water, lower surface temperatures and extend pavement life. They also improve air quality for particulates, ozone, volatile organic compounds and sequester carbon to mitigate climate change and, if your area is coastal, then forests also buffer against ocean storms. Trees also clean the air and water and reduce flooding at a cost far cheaper than engineered solutions. According to American Forests, an average healthy mature tree can absorb 10 pounds of air pollutants while providing 260 pounds of oxygen annually. GIC has calculated that trees in the City of Charleston, SC capture an additional 2.272 million additional gallons of rain water over 24 hours in a 10-year storm, thus reducing standing water and urban flooding.[1] Trees can be used as Best Management Practices too and added to stormwater features, such as bioswales, to increase stormwater uptake. Also, while trees are often seen as causing problems by interfering with utilities, they can be planted in areas away from buried cables and pipes and there are methods such as physical and chemical barriers to discourage roots from encroaching on utilities and sidewalks.

Trees clean the air and water and reduce flooding at a cost far cheaper than engineered solutions.

[1] A 10 year storm refers to the volume of rainfall statistically likely for a storm with a 10% chance of occurring. This calculation comes from GIC's Trees and Stormwater Calculator tool.

These newly planted trees in a bioswale will also help to break down pollutants and evaporate stormwater.

City Health Officials & Hospitals

Patients heal up to 30% faster when they can see or access green spaces.

Well-treed communities have better respiratory health and fewer hospital visits from chronic conditions, such as asthma. Trees encourage people to walk and bike more and farther, thus encouraging heart and lung health and reduced Type II diabetes. Patients heal up to 30% faster when they can see or access green spaces (Kuo 2015). Children who suffer from Attention Deficit Hyperactivity Disorder (ADHD) benefit from living near forests and other natural areas and children who moved closer to green areas have better and improved cognitive function after the move. (Taylor and Sullivan 2011) (Bratman, Hamilton and Daily 2012).

Trees also reduce heat-related illnesses. More than 9,000 Americans have died from such causes since 1979, according to death certificates (U.S. EPA). Also, 75% of the 244 US cities analyzed were experiencing longer heat streaks than 50 years ago. Charleston, SC, will be 3.5°F hotter in the summer by 2050.[2] Trees reduce *urban heat islands*, which are caused when excessively paved areas become much hotter than surrounding landscapes. Furthermore, trees allow people to enjoy the outside more safely by avoiding heat stresses on trees, as well as on themselves.

[2] https://www.vox.com/a/weather-climate-change-us-cities-global-warming

Trees encourage people to walk and bike more and farther.

Arguments by Stakeholder Type

City Parks and Recreation Managers

Parks with good tree canopy are more inviting and healthier for users (*see health reasons at left*). Trees provide more options for diverse uses in parks, such as shaded picnic tables and barbecue pits, cooler, shaded enjoyment of nature and both walking and bike trails that get more use. Larger natural parks increase the value of nearby parcels more than skate parks or other developed parks, such as golf courses.

The National Association of Home Builders report, *Preferences of the Boomer Generation: How They Compare to Other Home Buyers*, found that, across boomers, genXers and millennials, every age group chose as their two top, most-wanted amenities within a neighborhood: to be close to a park area; and to have access to walking and jogging trails. Access to nature improves both mental and physical health too – which can tie into community health goals. So supporting nature in cities creates healthier and more desirable communities.

Larger natural parks increase the value of nearby parcels more than skate parks or other developed parks, such as golf courses.

Nearby trails with trees, such as this forested walk in downtown Charleston, is one of the top most desired amenities for homebuyers.

Arguments by Stakeholder Type

Local Business Owners

Skilled professionals (also called the Creative Class) seek out communities that are greener and have plans for tree and open space protection. So a green community helps to recruit skilled workers, so perceptions of businesses as being green provide them with a competitive advantage.[3] Businesses also often own plantable landscape areas, especially around corporate headquarters or commercial areas, which could provide much needed habitat and healthier spaces for workers to walk, eat lunch, or just enjoy a better view from their work spaces. Workers will exercise more if they can access nature close to their offices, which means a healthier and more invested workforce with less absenteeism.

[3] https://www.forbes.com/sites/forbesnycouncil/2018/11/21/do-customers-really-care-about-your-environmental-impact/#418a9fc8240d

Residents & Neighborhood Associations and HOAs

Less crime occurs in well-treed neighborhoods. Trees have been shown to improve metabolic rates and moods. They also increase walkability – and more people walking equates to safer communities. Property values are 18% higher for well-treed lots and trees save about 20% of summer energy bills. In addition, residents can be encouraged to plant trees in their own back and front yards. Common spaces managed by HOAs can support healthy urban trees in spaces large enough to provide room for them to grow.

Conservation, Nature & Garden Clubs

Trees support beneficial insects and pollinators – which we need for a healthy food supply. They also clean the air and water of pollution and support healthy soil formation. Although trees in forests are usually wind-pollinated, understory plants and some broadleaf forest trees rely on insect pollination services and provide forage for native pollinators. A mature oak tree supports up to 534 species of insects and more moths and butterflies – key pollinators – than any other native tree species.[4] Trees also reduce heat stress on fish and amphibians.

[4] https://edgeofthewoodsnursery.com/nine-reasons-plant-oak#:~:text=Oaks%20support%20hundreds%20of%20butterfly,our%20ecosystem%20to%20function%20properly

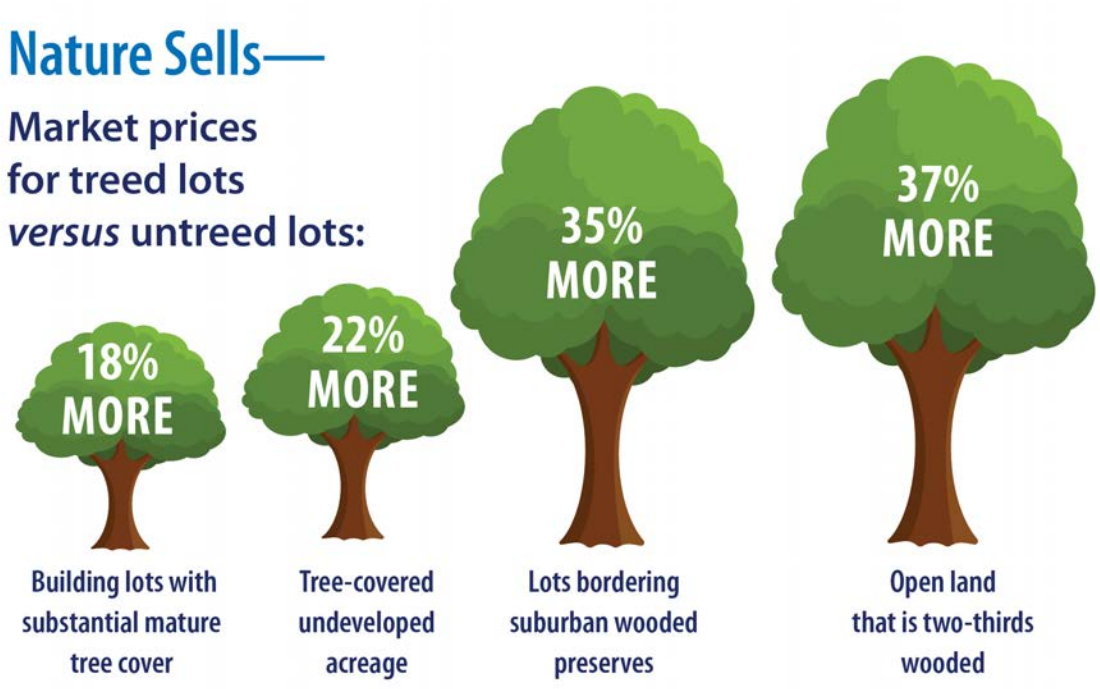
Arguments by Stakeholder Type

Real Estate & Land Developers

Trees help sell development, and while there may be some costs to conserving trees (one study found development costs were just 5.5% greater for lots where trees were conserved), researcher Kathleen Wolf notes that builders have reported that they were able to recover the extra costs of preserving trees in a higher sales price for a house and faster rates of sales for homes on wooded lots (Wolf 2007). Maintaining trees on lots is, in fact, quite lucrative, as they add value to the lots through sales prices and retained value.

Large Landholders

A privately owned forest provides many public benefits and may also serve as a critical connector to other habitats. Forests provide habitat for pollinators, sequester and clean greenhouse gases and air pollutants, and support native wildlife and songbirds, while also filtering pollutants from water and recharging aquifers. They also provide buffers against noise and road impacts. A map of your forested area and conducting surveys to look for pests, invasive species or other diseases can help flag problems that need to be addressed to ensure a healthy forest long into the future. If well managed over time, a forested property provides a lasting legacy to pass on to the next generation.



Source: Kathleen Wolf, 2007, *City Trees and Property Values*.

Frances Waite, SCFC Urban and Community Forestry Coordinator provides advice to a landowner on forest management.

Once you have convinced people to care about their trees, or made the case that the trees need more attention, it may be time to gain a better understanding of the extent and health of your canopy cover. While many people and communities care about their trees, they often lack data about their extent and health of the canopy, the types of trees there are, or detailed strategies to conserve or restore them (e.g. for tree conservation or replacement during or after development). For more on the measures of forest extent and quality see *Section II Forest Care and Management.*

Section Summary

In this section of the Toolkit, we covered the format and audience and some examples for how South Carolina's cities and towns are rising to the challenge of conserving their urban forests, as well as arguments for why we need better forest policies and practices. In the next section, we cover the basics of forest care and management – setting the stage so that planners, arborists and foresters can advocate and plan for a robust forest cover. We also highlight the fact that forests need to be managed because of the risks our forests are facing, impacts from our past actions and the rewards to be reaped by better forest care, management, and expansion. These include mitigating against large scale (catastrophic) forest fires. In Section II, we cover key components of a healthy forest and why management is needed for both urban and rural forests.

II. Managing Rural and Urban Forests

In Section II, we explain the key economic and ecological considerations for managing a healthy forest, including connecting (or reconnecting) the landscape. Even a certified arborist or forestry professional may find some new information in this chapter, such as approaches to minimizing tree losses before sites are developed.

Why Forests Need Management – Healing Impacted landscapes

It might seem strange to discuss the need for forest management in a guide designed to be used by forest advocates, planners and arborists. But we hope this guide will also be used by local government staff or elected officials who are not forestry professionals, and who may find it useful to have some ready arguments from this guide (or to refer it to others).

This guide is informed by hundreds of public meetings conducted by the authors, many of which focused on forest management plans for both urban and rural forests. Attendees at these meetings often questioned the notion that forests need management at all.

In cities and towns, the fact that someone (for example, a city arborist or contractor) is caring for their street trees is not commonly known by the public. In rural forests, many community members think that 'mother nature' is taking care of the forest. For these reasons, we briefly articulate the main reasons why forests need to be managed.

1) Overcoming damage

In rural areas, forests may be damaged and need to be restored to health. If damaged forests are left alone, they may take decades or generations to regenerate to a healthful state, or may allow invasives and pests to gain a foothold in the forest. Forest managers can assist with restoration by removing invasive species, and implementing prescribed burns to remove buildup of fuel from years of fire suppression that may have caused excess woody debris to accumulate. Prescribed burns can also release fire-dependent seed stock, which is the case with several species of pine. Forests may also need new tree plantings to help areas damaged by high intensity wildfires or after a logging project to recover.

This tree has lost limbs due to storms and is now dead and requires removal to protect public safety.

In urban areas, forests and trees face different types of challenges than large, natural forests. The built environment is not optimally designed for trees to have room to grow and thrive. Trees may be planted in the wrong place, be surrounded by too much impervious surface, which will result in heat stress, be cut back because of utility lines, have their roots impacted by road or sidewalks' construction, face environmental stressors, such as pollution and drought, or impacts from individuals, such as vandalism or accidents.

Storm damage may also be more severe for urban trees because they are not sheltered within a forest, so wind, hail or ice can more readily affect them. Forests may need to be managed after a natural disaster or severe storm event to reduce hazards to the public, pick-up debris or salvage timber. An important part of storm mitigation is assessing the urban forest and managing its long-term health, in order to reduce risks to life and property. For more on storm mitigation see Section V of this toolkit.

2) Mis-use/Mis-management

Many forests are already being managed – but not with forest health in mind. For example, there might be impacts from off-road vehicles, which can cause a lot of damage when trails are not maintained or are over-used. Furthermore, some forests are being impacted by mining operations, over-harvesting of plants such as ginseng, quarries, trash dumps, overhunting, previous land uses, such as over-grazing, and other detrimental land uses that may not be readily obvious to the casual viewer. Restoration work can include replanting, removal of toxic materials from land dumps, removing invasive species, closing or re-rerouting ATV trails, and other work. To learn more about threats to forest health see: Threats to Forest Health https://www.state.sc.us/forest/sfra-threat.pdf .

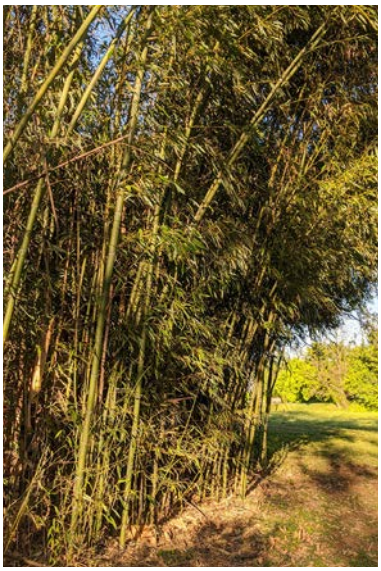
Restoration work can include replanting, removal of toxic materials from land dumps and mine tailings, removing invasive species, closing or re-rerouting ATV trails, and other work.

This tree is too large for its planting space and is now causing safety concerns for pedestrians.

3) Lack of seed stock

Forests may have regrown on prior farmlands and those forests may lack the seed stock of a native forest. Excessive plowing or erosion may have removed some of that seed stock over decades of farming. If they were arable fields, the dominant species will often be those cattle didn't like to eat – such as eastern redcedar (*Juniperus Virginiana*). Trees that are growing in a former field may be stunted by poor soils because of intensive farming or grazing, or they can overrun by invasive or opportunistic species, such as *Ailanthus* ('tree of heaven'), that take advantage of disturbed sites.

4) Invasive species



Once invasive species get a foothold, often following a disturbance, it may take a great deal of effort to remove them. Even some native species can be a problem when they over-proliferate. An example would be a native rhododendron such as *Rhododendron maximum*. Although it is considered a naturalized plant by some and there are "native species in South Carolina[5]," in disturbed forests, these evergreens can kill off native plants and prevent natural regeneration; in particular, they eliminate the ground flora, change the soil profile and exclude associated wildlife.

In urban forests, a common invasive species is Callery or Bradford pear, *Pyrus calleryana*, which was first introduced to the U.S. in 1909. It's pretty white flowers made it a common choice for both streets and yards. However, its poor branching structure makes it susceptible to wind damage and loss of limbs. Urban foresters recommend cutting it down and replacing it with stable, native species, such as serviceberry, fringe trees or dogwoods, among others. Similarly, bamboo, a popular evergreen ornamental (grass family *Poaceae*) was planted in the 1920s and '30s, but has taken over some urban areas where trees once grew. Bamboos such as the *Phyllostachys* species are invasive and illegal to sell or propagate in some areas of the U.S. They are particularly invasive because they spread by rhizomes underground, making eradication very difficult. This bamboo should be removed since, if unchecked, it will continue to expand.

5 https://www.postandcourier.com/features/native-azaleas-flourished-in-s-c-long-before-asian-varieties-filled-plantations-and-yards/article_d0bc5d2c-26d3-11e8-a0fd-43e34f8f01c8.html

5) Low diversity

The diversity of tree species within a forest may be low for several reasons. A forest that is aging, with larger canopy trees may have less sunlight reaching the ground, thus reducing the prevalence of understory species. This is often referred to as a late successional or 'climax forest.'

Biodiversity is not, by itself, a perfect indicator of forest health, since a relatively stable older forest may be less diverse than a new forest that is in the process of regrowth (early to mid-successional) or as diverse as a forest that has had some disturbance, in which events such as blowdowns from a storm or a fire event, have allowed the release of seeds or new species to spring up.

Indeed, it is not just forest age that can lower diversity, a forest could have grown up all at once, e.g. after farmland has been abandoned, resulting in stands of relatively even-aged trees with little diversity in age classes. Over time, this can lead to closed canopy forests that lack some of the species that would be found in a more natural forest. The Landfire Model[6] provides results of studies and models showing the expected forest types and structure based on multiple factors that affect forest composition and distribution. For more see the modeling tools at https://landfire.gov/lf_applications.php. Some managers use these data to determine which species should be restored within the forest.

6 The Landfire Model is a tool of the Landfire Program which is shared by the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior's wildland fire management bureaus under the direction of the Wildland Fire Leadership Council (WFLC).

6) Fire suppression

Decades of fire suppression – putting out fires to reduce health and safety risks – may have prevented the release of fire-dependent seed stock, such as shortleaf pine (Pinus echinata, also sometimes called southern yellow pine or shortstraw pine) which regenerate by re-sprouting after a fire. An extensive root system and dormant buds protected underground allow these pines to utilize nutrients stored in the root system for quick sprouting after a fire. Table Mountain pine (*Pinus pungens*, also called hickory pine, prickly pine or mountain pine) grows in dry, rocky sites in the Appalachian Mountains and requires fire to open cones up to re-sprout. For more about the pines of South Carolina, see: http://herbarium.biol.sc.edu/pines.html. Introduced, or prescribed, fire can be implemented by trained forestry professionals to help the forest regain its equilibrium, following years of fire suppression.

Prescribed burns, as well as smoke management plans and forest conservation overlays, are some of the tools that may be needed to implement a better fire management regime and reduce the fuel loads in forests where fire has been suppressed.

Public safety is another reason why a forest may need to have a prescribed fire. Years of fire suppression may have allowed the buildup of fuel material on the forest floor, making it more susceptible to a destructive (hotter) or more widespread fire, since materials that build up can become “ladder fuels” that help ground fires reach the upper canopy, where real damage can occur. Once fires reach the tops of trees, a hotter, a more destructive crown fire can ensue. Prescribed burns, as well as smoke management plans and forest conservation overlays, are some of the tools that may be needed to implement a better fire management regime and reduce the fuel loads in forests where fire has been suppressed.

Management plans can be prepared to help the landowner manage the forest for wildlife, recreational access or other human uses.

7) On-going silvicultural operations:

A forest that is actively being logged should also have a forest management plan (FMP) to ensure that best management practices (BMPs) are in place to reduce any impacts from active logging operations. Such a plan can be prepared to guide decision making and project what species to regenerate, how and when. This is true for both urban and rural forests. A landowner who plans to harvest his or her forest should prepare a management plan to ensure the landscape remains in good condition.

Even if there are no plans to utilize the forest for silviculture, management plans can be prepared to help the landowner manage the forest for wildlife, recreational access or other human uses, in order to reduce the disturbance caused and implement those management activities that will mitigate any harm and foster regeneration. For example, access roads should be well designed to limit erosion and invasive species may need to be removed.

To learn more about technical assistance for forest management planning or other tools, such as forest stewardship plans and prescribed burns, visit: https://www.state.sc.us/forest/mstew.htm

Pine Trees Have Value

Pine trees are often maligned by the public, city and town planners, and commercial real estate developers and public works officials because they are perceived as risky trees that fall down in storms and don't have much value. So let's start with the perception of pines as prone to failure. Why do they seem to fall down more often (not that they do, just the perception)? One reason pines can be weaker is because the setting in which they grew up has changed. Often, pine forests are cut down to make way for development. Sometimes, a thin border or buffer of pine trees is left standing after the majority of the forest has been removed. A pine forest that was thousands of feet wide is now just 20 feet wide. This allows wind to easily get into that small grove of trees. Trees that grew up in a protected forest often do not have the ability to withstand strong winds when they are isolated, making them more susceptible to damage and failure.

In addition to wind damage, development may cause more runoff to be directed into the forest, saturating soils and weakening the hold of tree roots within the ground. It is not uncommon to see one tree left on a site that was once within a forest. That remaining tree will often be more susceptible to damage without its neighboring trees acting as a buffer. Does that mean you should cut down all the pines on your lot? No. Have a professional arborist or other certified expert inspect the trees to see if they are damaged or their roots have been compromised (e.g. by digging trenches for new utilities or paving the ground around them).

The pine trees in this forest are growing in sheltered conditions protected from wind damages by the surrounding forest.

Pine trees provide a lot of different values. Here are just some of them:

- Pine trees support habitat for rare species. For example, red-cockaded woodpeckers, federally listed as endangered, prefer longleaf pine forests and depend on them for essential habitat, returning to the same tree cavity year after year.

The endangered Red Cockaded Woodpecker is endangered due to habitat loss. They depend on mature forests to thrive.

- Pine trees soak up a tremendous amount of stormwater, in part because they have a high Leaf Area Index (LAI). Leaf area index refers to the amount of leaf surface area available to catch rainfall. Pine trees produce long, narrow needles. For example, longleaf pine trees (*Pinus palustris*) grow needles 8-12 inches long. Although pine needles are skinny, there are more than a hundred thousand needles on a mature pine tree, so a large pine could capture more water than an oak.

- Furthermore, as evergreens, pine trees capture stormwater all year round, diverting thousands of gallons of stormwater through their branches, trunk and roots, and eventually evapotranspiring much of that water back into the atmosphere. This means that streams and streets are less likely to flood when pine trees are present.

  In addition, the pine needles that fall below, sometimes called pine straw, can soften the impact of raindrops, building a mat of needles that reduce erosion and the sediment pollution of nearby streams.

- All trees provide shade that can reduce energy bills – Trees properly placed around your home can reduce your air conditioning needs by up to 56 percent, saving on annual air-conditioning costs. Evergreens that block winter winds can save an additional three percent on heating costs https://www.fs.usda.gov/learn/trees.

- Like all trees, pines reduce air pollutants and sequester carbon that mitigate increases in climate change-causing greenhouse gases. There have been various articles on irritants from pine trees (pollen and volatile organic gases), but on the whole, the benefits from pine trees for air quality outweigh any potential impacts. For more about this see: https://agrilifetoday.tamu.edu/2003/08/14/ozone-from-pine-trees-urban-myth-says-forestry-specialist/ and also https://blogs.nicholas.duke.edu/citizenscientist/trees-and-air-pollution/.

- Pine trees in rural areas form the basis for much of the agricultural and forestry economy.

- Some communities do not include pine trees in required tree inventories for site plans and some do not require permits to cut down pine trees, even though permits are required for hardwood trees. Pine trees should be treated the same as any other tree and not excluded from site surveys or removal permits. To learn more about pine tree form and function see: https://homeguides.sfgate.com/pine-trees-39374.html.

Duff Layer –
The sponge of the forest

Mature, older forests have a thick layer of organic matter (the 'duff layer') under them, which builds up over time as leaves, bark and other detritus collect on the forest floor. This layer plays a key role in the biogeochemical process of the forest, transferring nutrients as materials decay, keeping soils moist and absorbing the impact of rainfall.

The duff layer acts like a sponge, holding water and filtering it so that there is less runoff, less erosion and cleaner water for both wildlife and people. It provides exceptional habitat for invertebrates and fungi. It also provides food and habitat for small mammals, reptiles and amphibians, which in turn are a food source for larger predators.

The duff layer also supports a rich variety of microbes that play a key role in the forest ecosystem. In new forests, this layer is very thin or even non-existent as it takes many decades to build up.

Value of a Mature Forest

Often, when forests are removed for development, any newly planted trees replace only a fraction of those lost. Therefore, it's important to protect as much forested land in developments as possible and to reduce tree removals. A new forest, or a new tree, does not immediately replace the value of a mature one. It will take decades for newly planted trees to even come close to providing the ecological and social benefits of an established forest.

An established, mature forest with larger trees and a thick duff layer can support a greater diversity of species, absorb more rainfall and provide richer, better developed organic soils than a new forest springing up in an old field. Although young forests provide other values (more open areas for quail or ruffed grouse, for example), they cannot provide the same degree of environmental benefits or support the interior forest species that a mature forest can.

In this mature forest, the thick duff layer on the forest floor acts like a sponge, holding water and nutrients.

Similarly, forested wetlands — swamps and treed islets within marshes — provide unique habitats for amphibians, reptiles, plants and insects, such as the common red spotted newt (*Notophthalmus viridescens*) and the frosted flatwoods salamander (*Ambystoma cingulatum*), and for migratory birds, such as the swallow-tailed kite (Elanoides forficatus). For example, the Savannah, Combahee, Ashepoo, Edisto, Cooper, Santee, Congaree, Wateree, Pee Dee, and Waccamaw rivers support highly significant wildlife habitats. Extensive palustrine forested bottomland hardwoods and swamps adjacent to those rivers provide abundant wildlife habitat, accounting for up to of 3.7 million acres of such forested wetlands, primarily in the coastal plain. The location of these forested wetlands — along the fastest growing coastline in the eastern U.S. — puts them at serious risk.

Forests provide unique habitats for an extensive variety of species, such as the bobcat, black bear, pileated woodpecker and alligator. Protecting South Carolina's ecosystems allows both animals and humans to thrive.

Connectivity of forests is another key management need that is often overlooked. This is especially true in the southern United States, where most of the forest land is under private ownership. This leads to a patchwork quilt of ownership and many different decisions about how to manage or not manage the forest. One owner could be managing it for wildlife, while an adjacent owner is putting up a large fence to discourage wildlife movement or for privacy which will impair the functioning of the forest. Another developer might clear all the trees along a stream to increase views of a water feature (even though it degrades water quality) or segment the forest into patches of open space that destroys the connectivity of the forest. (See illustrations of two possibilities on below.) Careful planning for future growth and development are critical to ensure that South Carolina's landscape, quality of life and economy are not just sustained, but enhanced.

Development can maintain forest connection

The developments on the left panel each conserved some open space, but it does not connect to facilitate wildlife movement.
The developments on the right conserve connected open space and accommodate the same amount of housing.

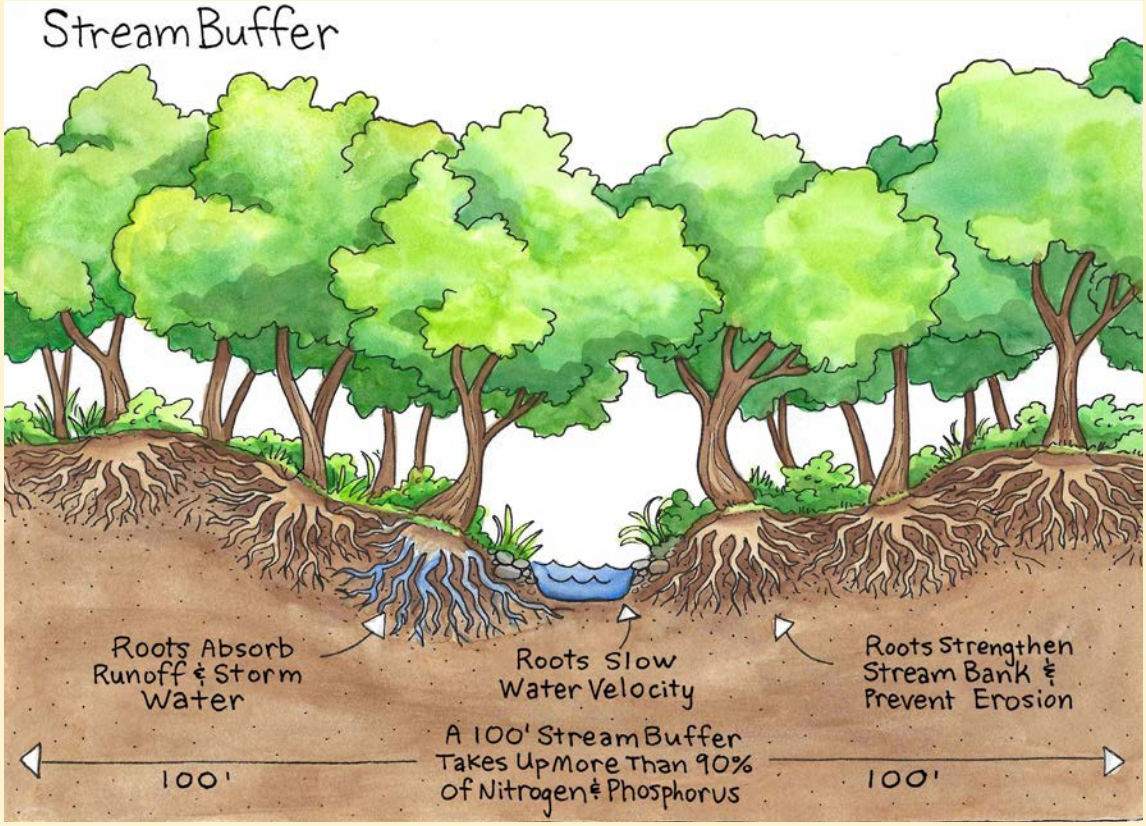
How forested buffers help rivers, lakes and bays

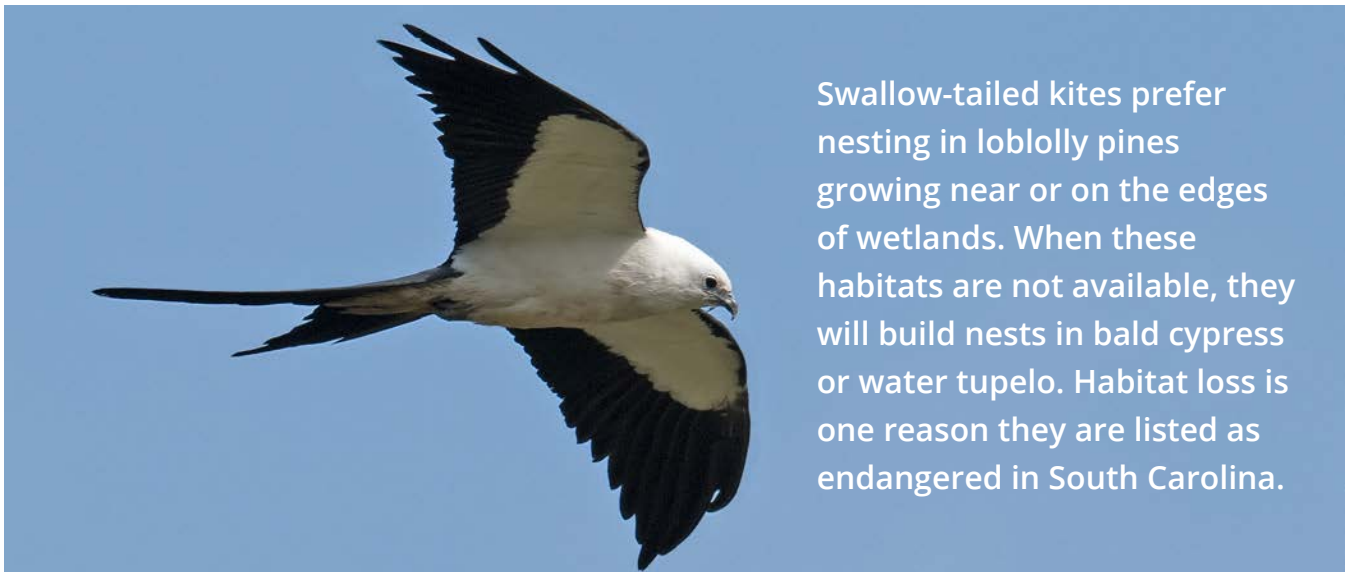
Streamside forests support wildlife, songbirds, and other species that depend on access to water such as salamanders. Shade provided by trees also cools the water, which helps maintain oxygen levels needed by fish and other aquatic invertebrates. Birds such as kingfishers, osprey, eagles and herons also nest and forage along streams and need trees for habitat. To support a wildlife corridor, wider buffers such as 600 feet are desired; although a thinner buffer still provides many benefits. Wide buffers also provide opportunities for greenway trails and other recreational uses.

Leaves dropped by trees also provide food for macroinvertebrates that begin their lifecycles in the stream. Trees along waterways also hold banks in place, reducing soil erosion and changes in stream depth.

A forested buffer of at least 100 feet wide can remove more than 90% of the nitrogen, phosphorus and sediment from overland runoff. However, if stormwater pipes bypass the buffer underneath and discharge to the stream directly, then much of the buffer's benefits for mitigating polluted runoff are lost. The type of land cover — pervious or impervious — also matters. As a general rule of thumb, impacts to aquatic life tend to be seen even at impervious levels just above 10%.

Forests along waterways and bays also provide buffering from off-shore winds and storm surges by absorbing some of the impacts. The thicker (wider) the buffer, the better the protection. When these trees are lost due to storms or rising water levels, they should be replanted to sustain the buffering effect and to provide the many other benefits noted above.





Swallow-tailed kites prefer nesting in loblolly pines growing near or on the edges of wetlands. When these habitats are not available, they will build nests in bald cypress or water tupelo. Habitat loss is one reason they are listed as endangered in South Carolina.

Forestry Practices

There are many ways that forestry is practiced. Selective harvesting is one approach and is used to remove only certain trees because of their size, tree type or form. In the past, this had been hailed as a more environmentally sensitive method to avoid unnecessarily removing trees with little or no commercial value or trees that are too small to be used in a milling operation. However, this method has also been called "high grading" in which the best stock is removed from a forest, leaving inferior genetic stock and causing a decline in forest value over time (there is debate as to the effects of high grading on forest stock, since seed stock from the parent tree is likely to be present and may sprout in the future).

Another method of tree removal is known as a "clearcut;" a term that refers to clearing a forested area entirely by cutting and removing all the trees. Clearcuts range in size and may be done all at once, or section by section, over a large area. They may be limited by ownership, which means clearcutting just one parcel, or they may comprise several parcels across a forested landscape. They are often maligned by the public because:

1) They look ugly and untidy just after harvest

2) There may be serious erosion if the timber firm did not follow best management practices, and if trees were harvested too close to streams, or if forestry access roads were poorly designed.

Clearcuts may not only be to harvest timber. They can be used by forest managers to restart a forest in order to encourage the growth of native species or to foster biodiversity. A clearcut can allow a damaged forest to regenerate into a healthy one. For more on this, see the article by Tony Quadro in the text box. For more information on land management options, see: A Landowner's Guide to Forestry in South Carolina at: https://www.state.sc.us/forest/sfilg.pdf.

Clearcutting: Good or Bad?

By **Anthony P. Quadro**, Forester, Westmoreland Conservation District, Greensburg, PA

(reprinted with permission)

There has been a lot of negative press lately regarding the practice of clearcutting. It can be a very emotional issue because of perceptions about environmental damage. But many of these perceptions are not accurate.

The principal objective of clearcutting is to regenerate the forest with healthier trees, not to harvest timber. Timber harvesting is a secondary objective. In a true clearcut, all of the trees greater than 2 inches in diameter are cut, as opposed to a commercial clearcut where only marketable trees are removed. Clearcutting is especially useful in regenerating species of trees whose seedlings cannot thrive in the shade of a forest understory. Shade-intolerant species such as black cherry need full sunlight for optimum development. Clearcutting actually mimics openings created naturally from tornadoes and fires.

Clearcutting does not cause soil erosion. Soil erosion is caused by poorly laid out road systems, whether or not the forest is clearcut or only partially cut. Clearcutting can be done without significant erosion or sedimentation if roads are pre-planned and built correctly by using accepted Best Management Practices to protect streams.

Logging companies do not clearcut just because it is the most economical way to harvest timber. In fact, many loggers dislike clearcutting because it forces them to spend time and money cutting trees they have no use for. Trees smaller than 10 inches in diameter are often stunted, poorly formed trees just as old as the larger trees. They are also likely to be genetically inferior specimens that have no chance of ever growing to a large size. It is obviously best not to leave them behind as residual trees taking up space in the next generation of the forest.

Clearcutting is ugly—at first. Yes, that's true, especially to the untrained eye. Diameter-limit cutting, which is removing all trees over a selected diameter such as 14 inches (often called "select cutting"), leaves a lot of trees in the woods, and can look better than a clearcut, but it degrades the long term health of the forest because it does nothing to clear away the small, elderly, slow-growing "junk" trees.

Clearcuts can be beneficial to wildlife. New openings grow very quickly into small trees and berry- and seed-producing shrubs, which provide both food and shelter for wildlife. Clearcutting increases the biological diversity of the forest, which enhances the habitat for a variety of wildlife. Some species of wildlife actually thrive better in brushy thickets of seedlings and small saplings.

Clearcutting is not deforestation. Most of the time clearcuts regenerate initially into dense thickets with thousands of tree seedlings per acre, then gradually thin themselves out as the stronger trees show dominance and crowd out the weaker trees. Many hillsides that are densely forested today originated as clearcuts in the early part of the last century.

This former clearcut site is naturally regenerating to a forested state.

Is clearcutting always the best way to regenerate a forest? No, but it is often the best approach in certain situations, especially if advanced regeneration (seedlings) is present. It then allows the forest to start over, usually with the healthiest, genetically superior trees outcompeting their slower-growing neighbors. Clearcutting is not the only way to regenerate a forest. Other traditional silvicultural techniques include the shelterwood, seed-tree, and selection methods. All four are important and viable tools to regenerate a forest. As long as a clearcut has been carefully planned using sound forestry principles, and is carried out using proper erosion-control practices, it is consistent with sustainable forest management.

This article was first printed here:
https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/b/3829/files/2014/05/Unit1_Activity4_Reading_Clearcutting-26agqkf.pdf .

Forest Conflicts in Developing Landscapes

Foresters often term the zone where new developments move into rural areas as the "wildland-urban interface." The US Forest Service defines the wildland-urban interface (WUI) as a place where "humans and their development meet or intermix with wildland fuel."[7] Although the origin of the term wildland urban interface was coined to reference areas at risk of wildland fires due to increasing development, it also now refers to the area where the risk of conflict between development and nature is greatest — for example, bears foraging in garbage bins or accidents with deer and other wildlife crossing busy roads.

Wildfire is an issue for South Carolina. The South Carolina Forestry Commission (SCFC) fights an average of 1,418 wildfires each year, which burn more than 10,000 acres annually. Although wildfires occur in every county in South Carolina, the Coastal Plain and Sandhills portion of the state have the highest incidence of fire (SC Forest Action Plan 2020). However, the ability to control fires varies across South Carolina. Wildfires that occur in the foothills of the Piedmont and higher elevations in the northwestern portion of the state can be more difficult to control as steep terrain makes it more difficult for firefighters and heavy equipment to reach fires. Also, since fires move more quickly up slopes, steeper terrain can contribute to higher rates of spread. This makes it more challenging to ensure the safety of people living in WUI areas in these localities. The opposite problems occur in the Lowcountry, where access is hindered, not by slopes, but by wet soils and marshes that are also difficult to move fire-fighting equipment across.

7 https://www.fs.fed.us/openspace/fote/reports/GTR-299.pdf

Storms can often cause blowdowns in these coastal forests, adding more debris that can create obstacles for firefighters and become fuel for ignition sources.

As mentioned earlier, some wildfires arise from natural causes and are part of the process by which fire-adapted species thrive. Nutrients are released back into the soil, and new openings are created for wildlife to forage and move. However, the presence of people in these areas can put both residents and firefighters at risk. Most wildland fires (98%) are caused by people through unintentional actions, such as backyard debris burns that escape, careless tossing of a lit cigarette or a campfire not properly extinguished. Unfortunately, some fires are also set intentionally by arsonists. The prevalence of human-caused fires is why population increases in WUI areas also accelerate the occurrence of fire, putting both forests and communities at greater risk.

As explained at the beginning of this chapter, prescribed fire is one way to reduce the risks and extent of future fires. Many areas in South Carolina's Coastal Plain rely on prescribed fire to manage such risk. However, as more people move into these areas, they are often less tolerant or are fearful of prescribed fires because of smoky conditions or concerns that a fire may spread and damage property or harm wildlife. For more on public attitudes about prescribed fire, see the text box. People may not be aware that prescribed fires can have benefits for reducing wildfire risk, improving biodiversity or helping fire-adapted species.

There are many other issues that occur when adding more intensive human uses to previously rural areas. There may be greater issues with invasive species – those planted by homeowners, such as bamboo, or invasive pests, such as emerald ash borer, that hitch rides on piles of firewood. According to Annie Hermansen-Báez with the USFS, the WUI will continue to grow as the South's population increases and people continue to migrate to less populated areas. The South's WUI zone was predicted to increase by 24% over the past 20 years. To learn more about WUI challenges, see: https://www.srs.fs.usda.gov/compass/issue7/issue7.pdf.

Prescribed burning

Just after the burn

Six months later the forest floor is revegetated

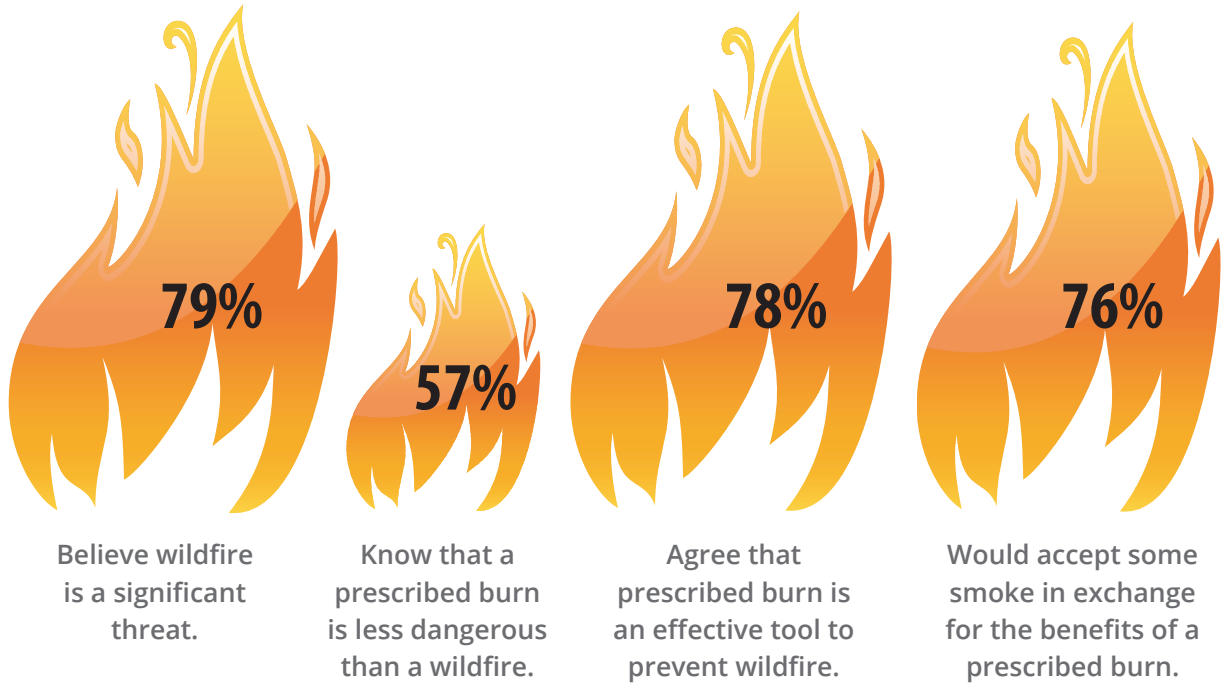
Public Perception of Prescribed Fire

In 2007, the SCFC funded a study to assess the knowledge, perceptions and opinions South Carolina residents hold concerning prescribed fire and wildfire, in terms of the risk to public safety and the necessity of fire for the health and function of forests in the state. The vast majority of residents (85%) had heard or seen the term "controlled burning," whereas only 34% had heard the term "prescribed burning." However, the majority of residents (83%) had heard little-to-nothing about controlled burning or prescribed fire in the last 12 months. This indicates that fire management operations are not releasing information widely or effectively to the public.

57% know that prescribed fire is less dangerous than wildfire
78% of South Carolinians agree prescribed fire is an effective forest management tool

The public is aware of the ecological benefits of prescribed fire, understands the risks, and is willing to accept some smoke impacts, as long as it is managed in the interest of public health and safety. Policy and program recommendations should be centered around education, messaging and outreach to the public, particularly in wildland-urban interface areas, where the public is more likely to encounter prescribed fire operations more frequently. For more, see the study South Carolina Residents' Knowledge of, Perceptions of, and Opinions on Wildfires and Controlled Burning at: https://www.state.sc.us/forest/scpresfiresurvey.pdf.

South Carolinians Opinions About Wildfire and Prescribed Burns



Education about risks in **wildland-urban interface** areas can help ensure homes and subdivisions are designed to minimize wildfire risks to people and structures.

Reducing conflicts in WUI areas, which make up a large percentage of South Carolina's landscape, requires a combination of education and better planning to avoid building developments in fire-prone areas in the first place. Better planning may require changes to zoning or adding a zoning overlay, such as Horry County's Limited Agricultural Forestry District, which ensures forestry activities can continue, while placing limits on incompatible development. Not all South Carolina counties have zoning, and some have zoned only that portion of their county that is within a designated growth area. This makes it difficult to avoid developments in fire-prone areas, or at sites with limited access to firefighting services.

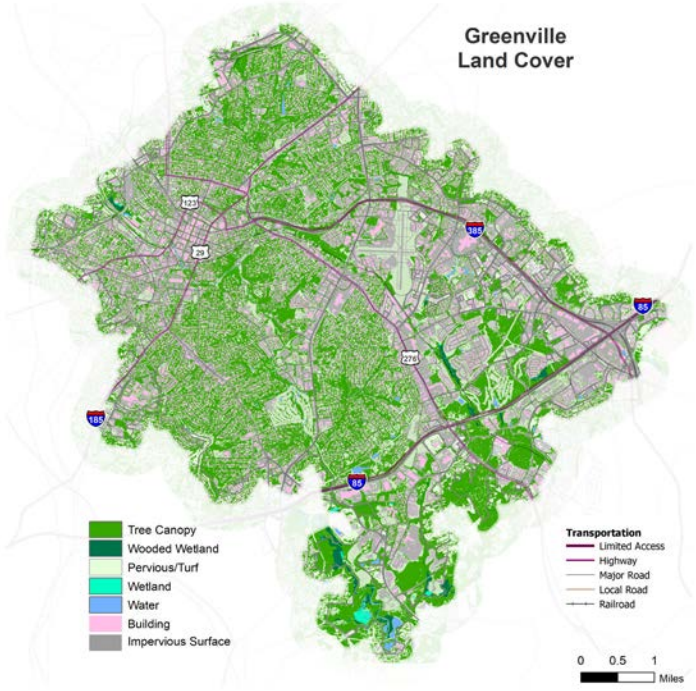
Education about risks in WUI areas can help ensure homes and subdivisions are designed to minimize wildfire risks to people and structures. The SCFC uses the Firewise USA™ Program to educate communities and homeowners in high-risk areas on how to protect homes from wildfire damage or destruction. To learn more about creating Firewise developments, see: http://www.state.sc.us/forest/firewise.htm.

Assessing Urban and Rural Forests

Whether managing a rural or urban forest, conducting assessments of their extent and condition is essential to informing management decisions, plans for urban growth or zoning, or land conservation strategies. It's also important to establish goals for the desired forest condition and to set in place the process or steps needed for that end result. There are very different tools to inventory an urban versus a rural forest and great differences in the desired condition. While some cities and towns still contain intact natural forests, trees in cities tend to be spread across an urban land cover and are characterized more by ownership and placement, e.g. street trees, park trees, yard trees, forest buffers of waterways, landscaping buffers and natural areas. Rural forests, on the other hand, may need goals for overall forest health or decisions about whether, where and when to harvest or replant trees.

Forest data should inform decisions about conservation, planning and development. For example knowing the location of high-value forest habitats can inform site plans for subdivisions or for planning conservation subdivisions in which 50 percent or more of the land is reserved for conservation purposes (Firehock 2019). Similarly, knowing the extent and location of the city's canopy cover can make it much easier to establish canopy standards for different zoning classes, such as residential or commercial.

Maps of forest canopy can also show the need for strategies that protect canopy cover by highlighting areas of a town or city where the percentage of canopy is lower and needs to be improved. Tree inventories can also be used to plan for where and when trees need to be replaced (e.g. now, because of disease; or later, because of old age).



Greenville Land Cover

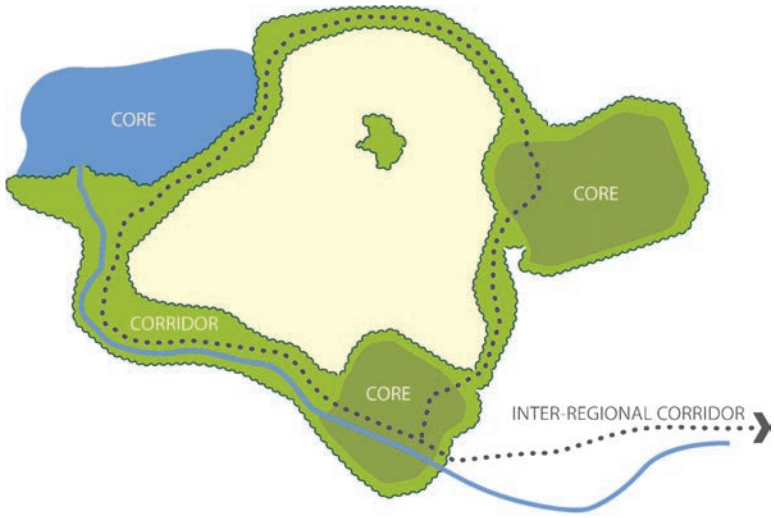
Knowing the extent and location of the city's canopy cover can make it much easier to establish canopy standards for different zoning classes, such as residential or commercial.

Common measurements to indicate forest health			
FOREST TYPE	DATA TYPE	PURPOSE	SOURCE
URBAN	Canopy Cover	Ensure adequate cover to provide ecosystem services, such as shade, pollution removal, stormwater uptake, aesthetics and habitat.	Imagery analysis to convert aerial photos to tree cover locations.
	Tree Inventory	Determine health and needs of individual trees. Calculate tree diversity (and need for improvement). Identify trees for removal or care.	Inventories conducted by staff (e.g. arborists) or trained volunteers.
	Tree Risk Assessment	Prepare for and reduce the prevalence of risk-prone trees. Flag trees or limbs for removal or further monitoring.	Surveys conducted by TRAQ certified arborists.
RURAL	Forest Inventory and Analysis (FIA)	Randomly sampled data characterizing large areas, as to species diversity, age, health and incidence of pests.	FIA plots from USFS (random spots).
	Forest Type	Characterize forest type, which can then be used to discern management needs and recommendations.	Forest Plots input into Landfire Model.
	Forest Surveys	Timber cruising or forest surveys provide faster assessments to determine density per acre or basal area for silviculture, flag trees for removal or thinning, survey for pests and diseases, etc.	Forester field surveys.

NOTES: TRAQ = tree risk assessment qualification; USFS = US Forest Service.

Rural Forest Habitats and Connectivity: Cores, Corridors and Buffers

When evaluating a landscape, whether it is in a rural or urban area, many animals require substantial habitat acreage to forage, breed and thrive. These large intact habitats are called habitat cores, and consist of an inner area that is undisturbed and an outer edge that is usually about 300 feet wide, where the impacts of disturbances from human activity, wind or invasive edge species can negatively impact forest habitat. The interior area, away from the edge, should be at least 100 acres in size, to support interior forest birds and other wildlife.



Forest Cores

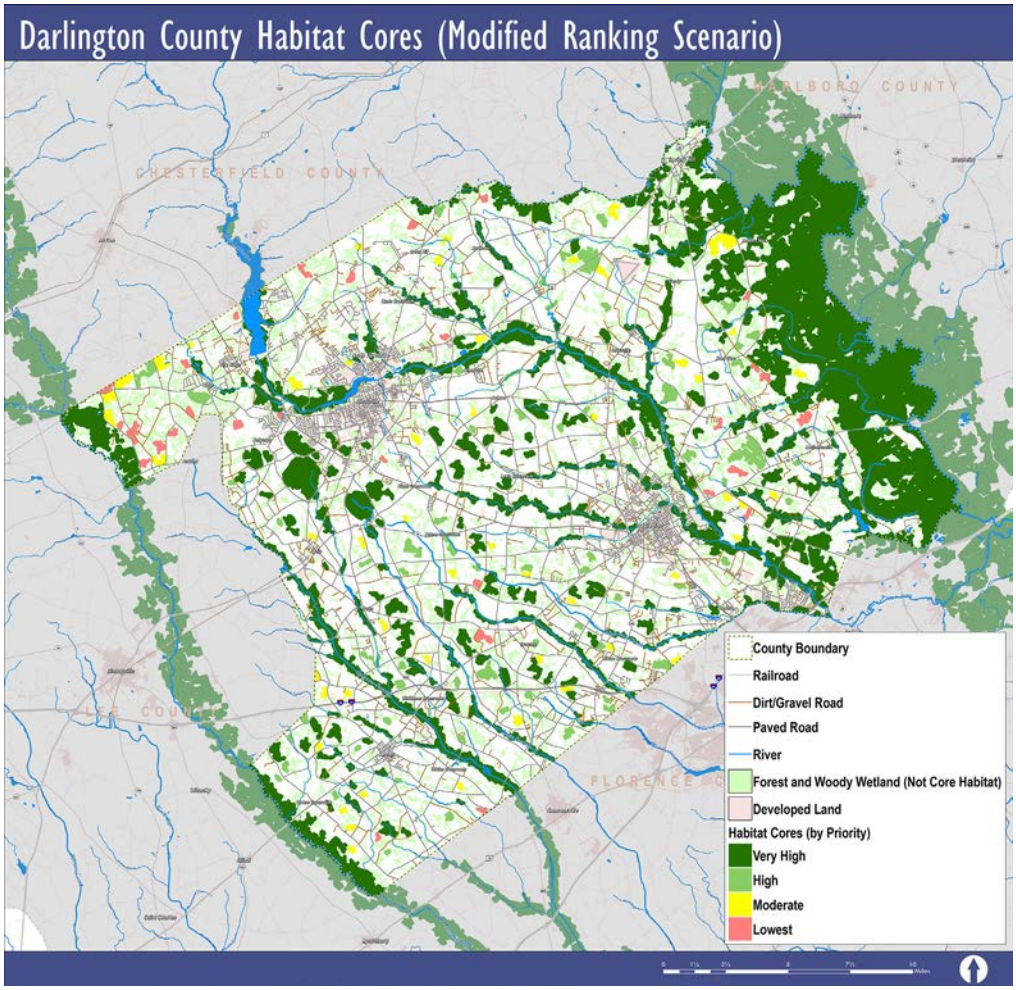
Intact forest habitats of at least 100 acres are known as forest cores and are essential to support birds, wildlife, amphibians and people. Connecting forested corridors facilitates biodiversity by allowing species to move between cores.

Wildlife, pollinators and plants move between these cores, along corridors, which can either be continuous, such as a riparian corridor along a river or stream, or in patches that together form a step-wise corridor between larger cores. When these corridors are along streams and rivers they are referred to as riparian buffers. To support movement of larger mammals, a 600-foot wide buffer is recommended on each side of the waterway.

Corridors support biodiversity as they allow species to intermingle and also to repopulate areas following disturbances, such as wildfires or hurricanes. The more connected the landscape, the higher the biodiversity can be and the more resilient the landscape. More pathways increase ability to forage for food, find new habitats or breeding partners, and for seed dispersal.

Maps showing the location of high value forest cores can inform transportation plans, resiliency plans, park and open space planning and other planning efforts. Instructions for mapping these cores are found in the guide *Evaluating and Preserving Green Infrastructure Across the Landscape: A Practitioner's Guide, SC Edition*. This guide can be accessed at: http://www.state.sc.us/forest/gic-sc15.pdf. South Carolina has mapped its largest forest cores and an updated map of South Carolina's highest value forest cores is underway. Check with the SCFC's Urban and Community Forestry Program for more information.

Cores are intact habitats that are large enough to support a diversity of species and provide other values, such as filtering and storing water, cleaning the air and opportunities for recreation. Cores can be forests, wetlands, dunes or other native landscapes. The SCFC funded the GIC to help Darlington County assess and rank their habitat cores based on environmental and cultural values.



Intact Forests Support Our:

HEALTH — air quality recreation, food, drinking water

ECONOMY — forestry, hunting, tourism

In cities and suburbs, however, there are few large tracts of undisturbed habitat, which means that species have to rely upon smaller areas such as parks and streams to move around. But even in cities, corridors can be provided along streams and through back yards, for smaller mammals, birds and pollinators.

Taken together, this network of intact forest, wetland or riparian habitats serve as 'green infrastructure' because it supports our health (air quality, recreation, food) and our economy (drinking water, forestry, hunting, tourism) etc. Just as we plan for grey infrastructure, we also need to plan for 'green infrastructure.' (Firehock 2015) For more, *Evaluating and Preserving Green Infrastructure Across the Landscape: A Practitioner's Guide, SC Edition*. This guide can be accessed at: http://www.state.sc.us/forest/gic-sc15.pdf.

Urban Forest Measurements: Tree canopy cover and inventories

Following are a few key data types – canopy maps, inventories and risk assessments – to consider when managing, conserving or expanding the urban forest. If your community lacks the in-house capacity to create high-resolution tree canopy maps or tree inventories, consider hiring a consultant or firm to assist with that work. There is also an Appendix that provides a sample Request for Proposals for obtaining tree canopy assessments, tree inventories or urban forest management plans. In Section III of the toolkit we discuss those polices needed to best protect or expand forests.

Tree Canopy Mapping and Canopy Goal Setting

A tree canopy map shows the percentage of tree cover and the locations of the tree canopy. It can determine those areas that are well treed and those that need more trees. It can be analyzed by function and type of uses, such as determining tree cover for commercial areas or public spaces, such as parks and schools. Data can be created from canopy maps to show such benefits as air quality, cooling, stormwater uptake, and wildlife and pollinator pathways. The best use of the data is for setting goals for your forest, such as 'no net loss' or 'to expand the canopy to realize even more goals for air and water quality.

Some cities have established tree canopy goals or set "no net loss" goals for maintaining a certain percentage of urban forest cover (e.g. 40%). A goal should be established based on canopy present now and the desired future condition. For example, if the town's tree canopy is found to be relatively low — say 25% coverage — you may want to initiate a planting campaign to expand your canopy cover to 30% or more. If your community has high canopy coverage, say 45%, but you are experiencing a high rate of growth, you may need to enact policies to maintain that canopy coverage. Usually, canopy is lacking in certain areas of the city, such as the downtown or in low-income areas, which will need targeted assistance to plant and care for trees.

If the city or town has actual forests (clusters of trees at least an acre in size and in a natural state — not mowed under) then the city should also focus on maintaining as much intact forest landscape as possible and not just on the canopy total as an benchmark. As noted earlier, individual trees spread across the landscape do not provide the same benefits for water capture and infiltration, wildlife habitat or wind and storm buffering as an actual forest.

Although tree canopy is best mapped by location using aerial imagery, if there are budget constraints, free software such as i-Tree canopy can be used to determine an estimated canopy. I-Tree canopy uses randomly sampled points to estimate canopy percentages for an entire city or town. However, planning for canopy planting and setting realistic canopy goals requires a spatially-derived canopy map that is based on canopy location. Canopy must be tied to a specific location in order to plan for its protection or expansion. This is usually determined by classifying aerial imagery to map tree cover to see where canopy is located and to map open spaces available for planting. However, as a first step, i-Tree canopy can generate knowledge about tree cover percentage and provide tools to estimate how the community's trees are benefiting society— also known as its ecosystem services. i-Tree Canopy and i-Tree Eco provide options to calculate ecosystem benefits, such as carbon sequestration,

Questions a community might want to have answered from a canopy mapping exercise are:

Canopy Percentage:
How much canopy do we have now – what percent of our city or town is tree covered?

Ecosystem Services:
What are the ecosystem services (e.g. air quality, urban cooling or stormwater filtering and uptake) performed by the city's canopy?

Canopy Distribution:
How evenly are trees distributed: by neighborhood, by downtown or other business districts; by race; or by income?

Canopy Change:
What is the rate of change for our city – is the canopy declining? Increasing? Where is canopy changing the most (public versus private lands; older neighborhoods versus new subdivisions)?

or reductions in air pollutants, such as volatile organic compounds.

Determining a community's goal for tree canopy cover is usually most successful when it is a collective undertaking. Multiple agencies within a city – planning, public works, parks and recreation, and economic development will have an interest in plans to reforest or conserve community trees as will local advocacy groups such as garden clubs, tree care groups, or civic associations. Consider bringing multiple parties together to establish tree canopy goals. Use a canopy map and analysis to answer the community's concerns that can inform where canopy is deficient or needed to meet a variety of goals.

Engage the community in canopy goal setting.

Tree Inventory/Survey

A tree inventory maps the location, type and conditions of trees. Since an inventory is expensive and time consuming for each tree evaluated, it should be conducted only to meet specific needs, such as to determine the condition of trees in public parks or school properties; examine the needs for more planting or better tree care; and to monitor species diversity to ensure a healthy ecosystem, or to ensure that existing species are resistant to invasive pests. For example, if a city finds that it has an abundance of ash trees in the downtown, then the area may be more susceptible to tree losses from the emerald ash borer. A tree survey might be conducted in a targeted area of interest, such as a downtown park, commercial area or enterprise zone, where economic investment is desired.

Staff from the SC Forestry Commission inspect street trees in Georgetown

A **Tree Risk Assessment Qualified (TRAQ) survey** is a more advanced tree inventory conducted to measure whether trees are a potential risk to people or property. It is conducted in areas where public safety is a concern, such as schools, pathways or parks, or areas used for public assembly and as playgrounds. Some trees on private property may also pose a risk to public areas if they could fall into public spaces. For more information on preparing to address tree risks see: https://www.isa-arbor.com/Credentials/ISA-Tree-Risk-Assessment-Qualification.

Once the case is made to decision makers that trees are important, there are many tools for ensuring that the canopy is maintained, as well as expanded.

Once the case is made to decision makers that trees are important, there are many tools for ensuring that the canopy is maintained, as well as expanded. This toolkit covers those policies throughout. But a first step for a community is to determine the extent of their forested landscape. For a complete guide to mapping and planning for tree canopy expansion, see GIC's Tree Campaign Guide at www.gicinc.org

Cross-Agency Coordination for Better Decision Making

A planner may approve a landscaping plan for a development and find out later that public works does not agree that the species is appropriate for the chosen location.

The challenge of managing our forests, whether urban or rural, is the same challenge faced by decision makers for multiple natural resources. One agency is often designated to be "in charge" of that resource or landscape type, even though the natural resource is affected by many agencies. In cities, the entity that manages public trees is often the Department of Public Works because trees are in street rights-of-way (RoW) and need to be trimmed or removed to avoid street or utility conflicts. It may also be the case that trees fall under the city or towns' Park Agency, which may be independent, or part of the Public Works Department. Yet other departments also deal with trees such as Planning and Zoning or Emergency Management, and they may or may not consult with the city agencies in charge of tree health. A planner may approve a landscaping plan

Ideal Tree Ordinances Include the Following:

1) A list of tree species appropriate for:

a. streets and rights of way
b. parking lots
c. parks and other public spaces
d. yards and common lands within developments

2) Standards for tree planting area—
sizing for tree wells, spacing, avoidance of utility conflicts, limits on tree damages and standards for diagonal trenching or root protection during construction (of adjacent sidewalks, streets, utilities).

3) Bonding of trees required as part of site plans—
requiring full replacement for up to 2-3 years.

To find examples of these ordinances, see Section III and IV of this Toolkit.

for a development and find out later that public works does not agree that the species is appropriate for the chosen location. Some communities also have resiliency and sustainability officers and they are often located in the mayor's office and disconnected from daily planning decisions. But these specialist staff should be engaged in local planning because they are often working on flooding and resiliency plans, tree campaigns and climate plans — all of which are affected by planning decisions.

Also, the SC Department of Transportation (SCDOT) is the entity responsible for trees on state routes and RoWs for smaller communities that do not manage and maintain their own road networks. Communities may run into conflicts with SCDOT over new tree planting or removals in RoWs and along higher traffic-volume streets.

In summary, interagency coordination is often difficult across departments. Why does this matter? Let's discuss three examples. And please note that these examples are all taken from real-life cases.

Real-life cases

SCENARIO 1

A developer proposed to add trees to new parking lot islands. Her choice was the red maple (*Acer rubrum*). Local planners signed off on the plan, but two years later, the trees were all dead. This is a very common scenario. But, why did they die? Do they need to be replaced? Should they be? And with what species of tree?

Red maples do very poorly in parking lots and along streets because they are sensitive to radiant heat from paved surfaces. The community may also lack adequate standards for planting bed sizes that can support mature shade trees. There may also have been no maintenance plan (e.g. watering weekly, until establishment) and pruning (after years 1 and 2). An arborist could have helped with these issues, but the locality may not have a staff arborist or lack ordinances to protect such trees.

SCENARIO 2

A builder proposed to develop a large area of land in the rural section of a growing city. Previously, the city had annexed large tracts of forested wetlands and some land near the interstate that seemed prime for development and added that land to the official growth area. The proposed site comprised forested wetlands with many large, older trees, but lacked roads and other infrastructure. Although the developer knew that wetlands were important for water storage and habitat, he still wanted to maximize the number of units built on the site. However, the county had an ordinance in place that required all large trees of 20" dbh be preserved on-site.

The “preserved trees” ended up in a fenced sunken pit. Within 6 years, all these “protected trees” will be dead.

In order to develop the site, the developer first had the site surveyed and tagged all the trees they had to preserve. He then put a perimeter fence around the large trees 20 feet from their trunks. But, in order to develop this forested wetland site, the developer obtained a permit to fill in the wetlands to create a dry land base on which to develop. So he filled the site around the trees to a depth of 4-5 feet.

To further complicate matters, many of these now-sunken trees were in an area designated for a parking lot, so the perimeter of the lot had to be considerably extended, in order to make up for those parking spaces lost to trees preservation. The expansion of the parking lot pushed the buildings further out, requiring the removal of more forested area. Meanwhile, an arborist or forester could have told the city that those sunken trees would not survive being in holes with their surface roots 4-5 feet underground. As a result, within six years, all the sunken trees will be dead. The forested buffer around the development, now too thin, has experienced wind damage and tree loss.

When dealing with such a scenario, a locality may lack any of the following:

1) A process to consult with the city arborist on plans for saving identified specimen trees to ensure methods will work.

2) A variance to allow for some loss of specimen trees in exchange for saving large areas of intact forest at the edge or throughout the development.

3) A cluster ordinance to allow the developer to creatively re-arrange lot sizes and set-backs to avoid building in sensitive environmental areas.

4) A prohibition against building in environmentally sensitive areas (steep slopes, wetlands, etc.).

5) A standard for wooded perimeter buffers that is wide enough to withstand wind damage.

6) A requirement that natural resources staff — arborists and foresters — be consulted for all forested site development plans.

In this example, an initial consultation should have been held with staff (before the site plans were developed) to discuss the site and options to maximize:

1) forest cover
2) connectivity in and out of the site
3) reduction of impacts to adjacent or nearby sensitive environmental and cultural features.

Planning staff could also be trained on what to look out for and when to bring in expert consultation.

Finally, it is important to note that draining and filling forested wetlands usually results in more flooding downstream, as both forests and water storage are diminished.

Forestland losses from development often result in more downstream flooding.

SCENARIO 3

A land investor wanted to attract development, but knew there would be community opposition. Since land development costs are high and developers are looking for sites that are easy to access and buildable without much public opposition, the landowner cut down the entire forested area, ground up and removed the stumps and built several large commercial grade "driveways" into the site. Next, he placed a For Sale sign on the land that also stated that it was "Ready to develop" and "Build to Suit." The community did not object initially since they thought it was to be a forestry operation (which it was, for a time).

So what was the problem? Well, the land was purchased and a subdivision built that lacked both shade and attractiveness because it was devoid of trees. It was also loud because it was near a major roadway with nothing to buffer the sound. New residents complained that their neighborhood was hot, had a standing water problem, was not attractive and did not hold its real estate value as well as nearby communities with parks and shade trees.

GIC's landscape design team works on a conservation subdivision plan that will maximize forest connectivity and health.

When dealing with this scenario, the locality may lack the following:

1) A prohibition against applying for rezoning immediately after land has converted from forest cover to open space (e.g. a waiting period to prevent land clearing without an approved development plan in place).

2) A requirement to plant trees in new neighborhoods (e.g. at minimum one tree per house, not including required trees in rights-of-way).

3) If desired to keep land in forest or forestry uses, an overlay for forest or agricultural uses (and corresponding prohibitions against dense development).

4) A conservation subdivision requirement or cluster ordinance if in an area is designated for rurally compatible development.

Given the above scenarios, it is clear that having effective ordinances, policies and practices in place makes a difference as to how land is developed and whether, when and how forests are conserved. In the next section of this toolkit, we examine the types of interests, needs and goals involved in forestry management and link them to the tools available to achieve them.

Section Summary

As Section II has demonstrated, the public does not always understand the need or the methods for forest management. Education is key to ensuring that existing and future residents and businesses understand the role that local and state agencies play in managing both rural and urban forests. We also need to understand the larger landscape context for trees and forests and avoid fragmenting forests or overly stressing remaining trees. Finally, we should examine county, city and town codes to avoid unintended consequences, such as protecting large trees in ways that limit their survivability. In Section III, we discuss the many ways that trees and forests can and should be included in public policies and plans.

III. Including Trees and Forests in Planning

In this toolkit, we have covered the importance of tree conservation and management. This section delves into the local government policies that should include considerations for trees and forests. Having the right policy tools in place is key to ensuring a healthful community forest. You may know the outcome you want to achieve, but be uncertain about the practice or policy needed to achieve it. This section links the outcomes desired (e.g. healthier communities) and the types of forest or tree policies (e.g. planting standards) needed to achieve them. For example, if a developer is required to plant street trees, but there are no standards for how they are planted and maintained, they may die within a few years due to improper planting. Similarly, if the locality's code focuses only on requiring new yard trees, while allowing the mature forests or large trees to be removed, an opportunity to maximize the greater benefits mature trees provide is missed.

In the following sections, we describe the essential elements – both why they are essential and what they are intended to achieve. The chart on the following page shows the link between the intended outcome and the code or practice that needs to be in place, along with examples of where they are currently being applied.

Utilizing Trees and Forests to Meet Community Needs

Trees meet myriad social, economic, health, nature and aesthetic needs. The following chart provides a rationale for how tree conservation and forestry can be applied to meet general societal needs found in comprehensive plans, sustainability plans, resiliency plans, capital improvement plans (CIP), and other county and municipal plans.

Linking Tree Objectives to Community Needs

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Ensuring long-lived street and public trees (more than 7-9 years)		Shaded streets for walkability	Adequate soil volume required (500 ft^3 – 1000 ft^3)	Street tree standards Subdivisions Regulations: Codes of Development Arborist review of site plans
		Vibrant shopping districts	Two year care plan for new trees	
		Traffic calming	Plant street trees in medians, bump outs, traffic circles	
		Aesthetics/beauty	Prune and care for trees/form	Tree inventories and tree maintenance plans

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Conserve trees in private development		Developments of lasting quality	Avoid harming remaining trees during construction	Standards to protect tree roots, trunks and soils during development process
			Ensure minimum canopy met	Adopt canopy percentages required by zoning class (residential, commercial etc.)

Goals Coded as follows:

- Aesthetics/ intrinsic values
- Economics
- Flooding/ stormwater
- Health/ air quality
- Recreation
- Water quality
- Safety/ Risk Reduction
- Sustainability
- Shade/ urban heat island
- Wildlife/ nature

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Ensure healthy trees for future		Maintain visual quality in new developments	Require damaged or dead trees are replaced	Bonding of trees planted for subdivision site plans Tree care plan for development

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Buffer reservoirs and water intakes with trees		Reduce drinking water treatment costs	Protect and plant forests around reservoirs, drinking water recharge areas and upstream of river water intake pipes	Stream buffer ordinances Require 200-1000ft buffers around reservoirs Require high canopy cover

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Protect coastal areas from storms		Reduce and prevent storm damages	Require forested buffers (100+ feet) along streams to protect water quality	Tree buffer ordinance for streams and bays
			Assess potential risks to the urban forest	Adopt Forest Storm Mitigation Plan Conduct a tree risk assessment by a Tree Risk Assessment Qualified (TRAQ) arborist

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Identify significant and heritage trees		Protect and foster historic character	Inventory large trees before development occurs Identify and map historic trees that contribute to local character	Adopt heritage tree ordinance Adopt specimen or large tree preservation Adopt a champion tree program

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Prevent canopy loss and forest land conversion to development		Reduce heat-related illness	Tree Canopy Goal (increase or no net loss)	Map tree canopy and plantable open space – set a goal
		Decrease fine airborne particulates, and O_3 for air quality		
		Reduce flooding	Prevent excessive land clearing for development	Required waiting period (e.g. 2-3 years) after harvest, before rezoning Require site plans before land clearing
		Sequester carbon and reduce greenhouse gases to decrease climate change	Conservation development ordinance requiring at least 50 percent of forests intact	Rural zoning districts and conservation cluster ordinances
		Improve water quality for fisheries, drinking, recreation	Avoid excessive pavement and allow for more open space	Reducing parking spaces required Establish parking maximum Allow variable space sizing Parking reduction credits if public transportation present/nearby
		Support pollinators	Strict rural zoning that disallows most urban uses and larger lot sizes appropriate for farms or forestry	Conservation or rural zoning with lots in subdivisions limited to 50 acres or more
		Protect songbirds, amphibians and wildlife	Reduce costs of holding agricultural lands	Use Value Taxation: use value taxation to tax lands used for forestry at a lower tax rate
		Recharge water supplies	Reduce conflicts with new residents and keep mills open	Designated forestry districts (overlay zones) Rural zoning for larger lots
		Provide recreation opportunities in new neighborhoods	Require provision of forested open space in new development	Adopt standards for forested parks in subdivision requirements

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Prevent power line conflicts		Reliable power supply	Plant right (small stature) trees under and near power lines	Right tree right place program Underground power lines and avoid root conflicts

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Utilize wood from trees removed for development or downed by storms		Locally made wood products	Foster local wood utilization for furniture, crafts	Create an urban wood utilization program to harvest and quickly distribute urban wood felled by storms or left over from land clearing

OBJECTIVE	GOAL / NEED		PRACTICE	POLICY METHOD
Ensure viability of timber industry		Reliable timber supply	Reduce conflicts with residential development	Adopt timber overlay districts Adopt rural area zoning to protect working lands

As these charts indicate, trees meet many social, economic, health and safety needs. But in order for trees to be able to meet these values, we also need to apply the right tools to codify their protection, care, conservation, replanting or replacement. We next discuss comprehensive plans, zoning and the many other plans and strategies for which forests should be included.

Comprehensive Plans

Communities should have the right strategic visions and policies in place to establish the rationale for why forest and tree codes and policies are necessary. In American planning, the comprehensive plan establishes the future growth and direction for communities. Since the comprehensive plan provides the basis for future zoning as well as spending and development decisions, including trees and forests is essential. Forests may be discussed within the natural resources section of the comprehensive plan; however, it is important to consider the impact of forestry/forests on all of the plan's elements. Forests and trees can be used to meet comprehensive plan goals for clean air, sustained and clean drinking water, protection from storms, recreation, such as hiking, birding, hunting and fishing, revitalizing downtowns or low-income areas, restoring and expanding park lands, and economic goals, such as sustainable rural economic development. To learn more about how and where to incorporate forests in comprehensive plans see GIC's guide *Forests and the Comprehensive Plan: A planners guide* (2017). For more on the role of comprehensive plans see sidebar Comprehensive Planning in South Carolina.

Comprehensive Planning in South Carolina

Comprehensive planning has a long history in South Carolina. In 1967, the Comprehensive Planning Act authorized county governments to create local planning commissions, as well as joint city-county planning commissions. Counties were authorized to undertake planning, zoning, and subdivision regulation within their boundaries. The county planning commission is authorized to prepare, maintain and implement a local comprehensive plan. Planning controls, such as zoning, were to be used to guide growth and promote planned, orderly land development. For the enabling ordinance text see: http://www.scstatehouse.gov/code/t06c029.php.

Required comprehensive plan elements in South Carolina include: population, economy, natural resources, culture, community facilities, housing, land use, transportation, and priority investments. The "natural resources element" is where the locality should include data and plans for agricultural soils, forests, key habitats, parks and other open spaces, scenic areas, watersheds and their rivers and streams, lakes, wetlands, beaches and dune areas, flood plains and floodways, or locations of mineral resources.

Although, by statute, comprehensive plans should be reviewed at least every five years to determine if changes are needed, this timeframe is not always met. This means that information in the plan may be out of date and the plan may not reflect current priorities. It may not include data on forest economics, goals for urban tree canopy, or maps for where forest assets are located and so the plan should be updated to include these elements.

Zoning

Zoning that is adopted should generally be "in accordance with the comprehensive plan," so it is important that the comprehensive plan indicate support for forest values in order to justify new legal tools or to expend resources (time, personnel and equipment) on urban or rural forests. While not all communities in South Carolina have zoning in place, it is recommended that zones are established to designate allowed uses, in order to protect both public values and private property investments. Zoning is a tool that reduces conflicts. It ensures that rural forestry can continue while new subdivisions are located in areas close to existing infrastructure, such as transportation and schools. For more see the text box below, "Zoning, Why Does It Matter?"

Zoning, Why Does It Matter?

Zoning is an important tool for local governments to regulate land use within their jurisdiction. Zoning, by design, keeps compatible land uses in proximity to each other and reduces conflicts by separating incompatible uses. For example, residential land uses are often separated from heavy industrial uses to reduce the impact on homeowners from loud noises, heavy truck traffic and pollution. Zoning also creates standards for the layout, spacing and look of developments in the community. It ensures typical "public goods," such as adequate light, air and open space, are available and accessible, both now and into the future, as communities grow. It reduces the impact on existing infrastructure and plans for future needs for schools, streets, sewers, water, police and fire.

Zoning should reflect how and where a community plans to grow and should be informed by the Comprehensive Plan. Zoning is split into two components: first, the zoning ordinance, which lays out how land can be used, where buildings should be located on a lot, how many parking spaces should be permitted, etc.; second, a zonal boundary map that shows the boundaries of the different zoning classes and what is permitted where on the landscape. The zoning ordinance and map are not static, but are periodically reviewed and updated by a community as it develops.

Not all South Carolina localities use zoning to manage and plan for development and growth. The residents of rural counties that lack zoning often cite the desire to manage or develop their property as they see fit and not have their rights "infringed" upon by the local government. However, this leaves residents vulnerable to undesirable land uses abutting their properties – for example a landfill. This can lead to conflict and tensions between landowners and to a decline in property value. Zoning is a land use tool intended to reduce these tensions by developing a set of rules and standards guided by the community for growth and development. For more about the authority to plan and zone, see the state's Planning Enabling Act: https://www.scstatehouse.gov/code/t06c029.php

The zoning ordinance specifies the types of appropriate land uses by location and also sets standards for what is required for different zoning classes. Percentages of tree canopies by zoning classes (e.g. residential, commercial), street tree and parking lot standards, should be included in the zoning ordinance. It also can specify conservation or forestry overlays to protect forested land or foster silvicultural uses (as discussed earlier in this toolkit). Riparian buffers and protection of floodways can also be addressed here.

Zoning alone will not ensure that forests are protected or expanded; additional regulations may be needed to govern how trees are planted in new developments or where forest buffers are required. And there are many codes that affect the likelihood that those forests can remain or expand. Indeed, planners can ensure many aspects of the health of forests – the following list of policies are some suggestions for where forests should be included. For a complete guide to what to look for in codes and forest health in cities and towns, see the Tree Policy Audit Tool: https://www.state.sc.us/forest/urban.htm.

Subdivision ordinance

Subdivisions are often covered under a separate ordinance than the general zoning ordinance. If this is the case, then trees should also be mentioned in the subdivision ordinance. Street trees may be required by blocks or based on the housing units (e.g. one street tree per lot). If this is difficult to require, encourage developers to do this (remind them that treed lots sell faster and for higher prices).

Tree standards should include requirements for:

- spacing
- planting standards and diversity for street trees
- parking lots
- yard trees
- parks, open spaces, and plaza
- open space management
- list of desired trees and disallowed trees

Including Forests in Environmental and Open Space Plans

There are many additional plans that communities produce — and they can and may include trees and forests. Following are some of the many ways that trees should be included.

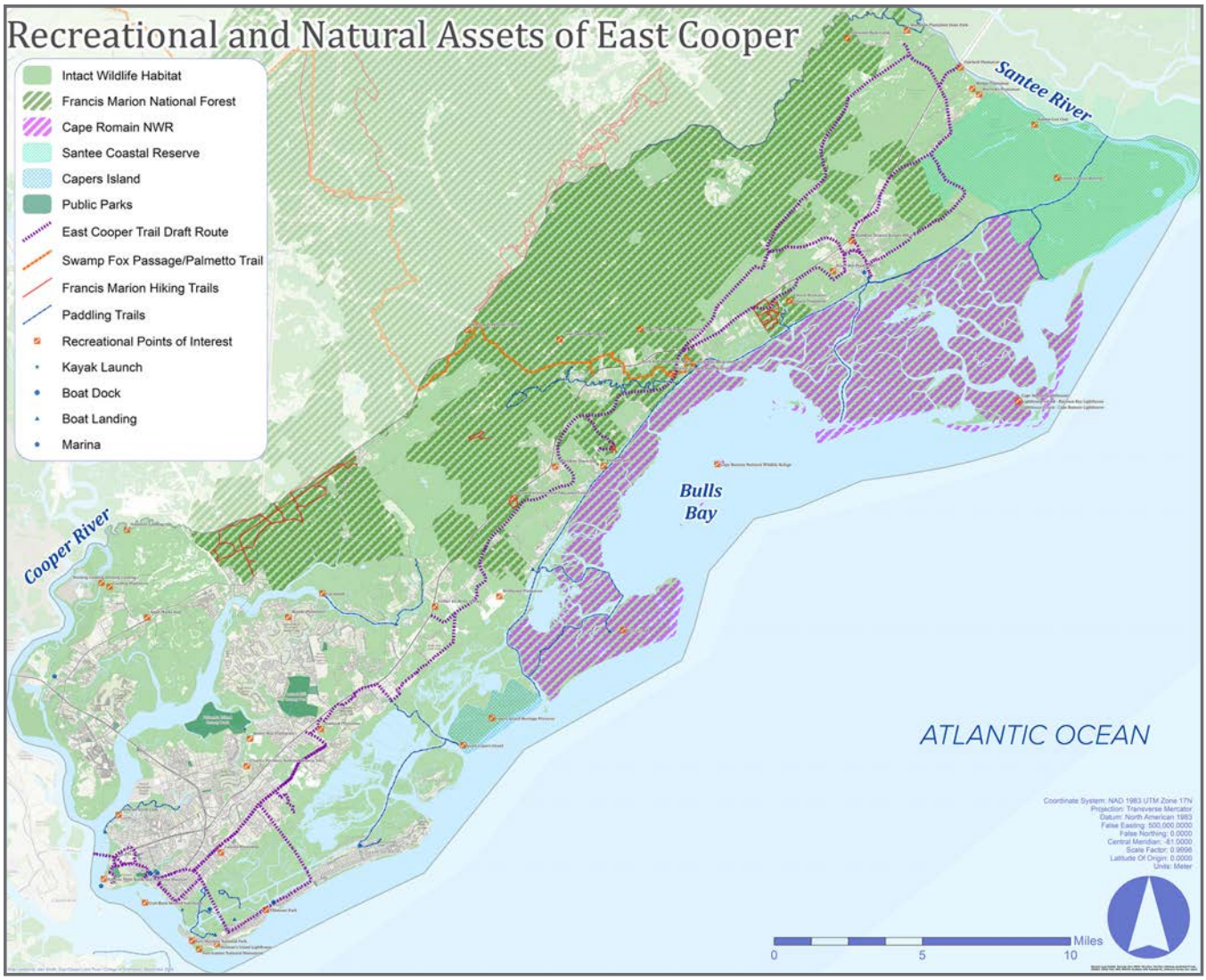
Resiliency or Sustainability Plans

While these plans often focus on mitigating storms or saving energy, they should include the roles played by trees and forest in achieving plan goals. Trees and forests help buffer communities from storms, take up stormwater to reduce flooding, provide habitat for pollinators to meet food security goals, retain and create healthy soils, provide places for outdoor recreation, keep developed areas cooler thus reducing urban heat island and sequestering carbon and reducing greenhouse gas formation to mitigate climate change.

Greenway Plans and Open Space Plans

These plans usually provide linear trails and other opportunities for outdoor recreation. Large intact forests or riparian areas provide key elements to support these plans and locations for trails or recreation. Acquisition of new park lands can also support conservation of high-value forests.

Protecting this coastal forest along the marsh within the City of Charleston buffers the city from storms.



Credit: East Cooper Land Trust

Watershed Plans

Many communities create strategies to improve the health of streams, rivers, wetlands and bays. Land cover is one the greatest determinants of water quality and forests are key to absorbing and cleaning water as well as holding streambanks in place. A land cover map showing the location of forests can inform how well forested the uplands are, the adequacy of forested buffers around waterways and areas for improvement through reforestation.

Forested wetlands provide key habitats for birds, such as this juvenile white ibis.

Water Supply Plans

Trees are key to helping recharge groundwater as they capture and release water to the aquifer. They also protect water quality by holding soils in place. Forests around water supply reservoirs can lower the costs of treating drinking water by 'pretreating rainfall runoff' before it reaches the reservoir. Well-forested riparian (stream-side) areas also protect drinking water intakes for cities and towns located along rivers. One city (Fredericksburg, VA) purchased riparian land for many miles upstream of their drinking water intake and they continue to work on acquiring protected easements to safeguard the water supply.[8]

Forests to Faucets

The USDA Forest Service's National "Forests to Faucets 2.0 Assessment" uses Geographic Information Systems (GIS) to determine the relative importance of small watersheds to surface drinking water supplies. Imbedded in the data is the vital role forests play in protecting source water. For more see: https://www.fs.fed.us/ecosystemservices/FS_Efforts/forests2faucets.shtml.

Green Infrastructure Plans

Considering trees as part of infrastructure is one way to both meet government needs and to draw attention to the importance of rural and urban trees. Many communities develop green infrastructure plans to conserve large patches of forest habitats (cores) and connect them through links (corridors) to ensure that they have a healthy functioning landscape to meet multiple needs, such as bird and pollinator habitat, wildlife conservation, outdoor recreation, healthy watersheds and scenic vistas and cultural values. Forested landscapes are a key component of green infrastructure plans.

Having a green infrastructure plan in place can also qualify a community to reduce its community rating system (CRS) by earning credits under the National Flood Insurance Program managed by the Federal Emergency Management Agency (FEMA). The CRS assigns credits to communities for flood risk reduction practices and programs, which then lower insurance rates for residents and businesses in the community. For more about the National Flood Insurance Program and the CRS, see: https://www.fema.gov/flood-insurance/rules-legislation/community-rating-system.

Stormwater Management Plans

Trees play a key role in mitigating stormwater runoff. As noted earlier, a large, mature canopy tree can intercept thousands of gallons of stormwater annually. Tree cover can be mapped and included in goals for stormwater reduction and cleansing. For more, see the GIC's tools.

8 https://fredericksburg.com/news/local/easement-will-help-protect-rappahannock-river-local-water-supply/article_7f8de5d4-f95c-5ae9-b778-2082baaf03be.html

Codes and Policies Governing Tree Care, Planting and Removal

Standards for ensuring trees and forests are conserved, cared for and replaced are essential. Otherwise, a community's trees are likely to decline over time. Ensuring that trees are conserved requires foresight and strong links between a community's aspirational policies (comprehensive plans, strategic plans, open space plans and master plans) and the codes and policies intended to realize those plans. For example, if your community allows all land on a site to be cleared without an approved site plan in place, there is no opportunity to discuss whether and where trees should be conserved. While it is easier to sell cleared land or design projects on land that has already been cleared and graded, that is not the way to conserve South Carolina's forests. Restrictions should be in place to prevent clearing land before development plans have been approved.

If your community allows all land on a site to be cleared without an approved site plan in place, there is no opportunity to discuss whether and where trees should be conserved.

Development waiting period on land cleared for forestry

(§. 5.11.100.D.6: Beaufort Clearcut Mitigation code)

Beaufort County's ordinance requires that "If trees are cut down prior to a development receiving all necessary permits from the County, the County shall not issue a permit to allow the development to occur within two years of the tree removal, unless the property owner provides mitigation for the trees removed. Mitigation shall involve the replanting of trees a minimum of 2.5 caliper inches with a total caliper equal to 1.25 times that of the DBH of the trees removed."

This code discourages permanent forest loss from opportunistic development by penalizing the applicant with a two year delay or by penalizing them with high upfront mitigation costs in the form of requiring greater mitigation than the original forest cover lost and by requiring large caliper planting stock. These requirements are intended to preserve active forest land while disincentivizing clearing forests for development without first having an approved site plan in place.

In the rural landscape, a similar problem can occur where long-term silvicultural operations run into conflicts with new developments that make it difficult to continue cycles of planting and harvesting. As development sprawls into traditional forestry landscapes, conflicts with suburban landowners increase and land conversions from forests to housing estates reduce harvestable land, resulting in the closure of mills as lumber supplies dwindle.

Requiring forest buffers along coastal marshes and preventing the development of floodplains can avoid loss of forested wetlands and later problems caused by storm damage and flooding.

Appropriate zoning for rural land uses (e.g. agricultural or conservation zones), or overlays designating working landscapes, can reduce these conflicts and resultant forestland loss. Similarly, requiring forest buffers along coastal marshes and preventing the development of floodplains can avoid loss of forested wetlands and later problems caused by storm damage and flooding.

As noted in Section II of this Toolkit, forests that support the timber industry can be protected by limiting new land subdivisions to ensure forestry uses can continue. Larger parcels are more conducive to forestry operations and may benefit from additional zoning considerations, such as rural zoning that limits smaller parcel sizes. For example, agricultural or rural zoned districts can limit minimum lot sizes, which will prevent the subdivision of larger properties into smaller lots. In order for forestry operations to be economically viable for continual management as a forestry operation, there needs to be adequate acreage (e.g. 30 acres or more), otherwise it may not be cost effective for the harvester, unless the smaller forested tracts are in close proximity to each other.

When new housing subdivisions are placed next to active forestry sites and residents object to forestry uses that have been in operation for many decades, conflicts can arise. It is possible to establish agricultural zones that can keep the number of permitted dwellings per acre low (e.g. 1 dwelling unit per 20 acres). By maintaining lower housing densities in agricultural landscapes and directing new development into designated urban growth areas, it is possible to reduce conflicts between active forestry sites and residential areas.

Now part of a Georgetown County Park, these pines once formed the International Paper seed orchard, which provided the high quality genetic stock used for planting.

Effective Programs for Forest Conservation

Whether you are concerned with urban or rural forests, it's important to have a solid strategy in place to maintain forest cover in your locality. An effective forest conservation program or strategy is one that engages, at every stage of the process, key decision makers who can affect the health or extent of the urban forest. While it is important to have the right regulations in place, staff need to oversee and enforce those regulations for them to be effective. In one community studied by this guide's authors, the staff were not aware of a regulation to ensure that large mature trees are indicated on site plans and their protection status noted. In that case, it was assumed that the regulation, long forgotten or unknown to new staff, was not being enforced.

A robust urban forestry program should be accompanied by an education process – for both the staff and the public – as well as a way to ensure that regulations are enforced (or that they are enforceable). Let's take a few examples to illustrate the point. Some communities are able to engage an urban forester to review large site plans to ensure the approaches to conserving trees are sound. This review allows the staff to ask if the most important trees are to be left in place or to ask that this be done. Are buffers sufficiently wide to resist wind damage? Are forests connected across parcel boundaries, instead of isolated in the middle of the development? To allow such questions (and solutions) some communities suggest or require a pre-meeting with the locality's urban foresters and development applicants before site designs are completed.

Other questions that should be asked include "Are standards in place to support survival for large trees? Are trees to be planted at the right time of year?" One city's engineering department, while well meaning, delayed a streamside planting project for a community park project while waiting for a footbridge to be installed, thus pushing the tree planting along the streambank into July. The trees did not survive, since they should have been planted in the dormant season (and especially not during the hottest month of the year). Had the city consulted their own urban foresters (of which there were three) they would have easily flagged this problem and avoided the trees' mortality.

Similarly, education is often needed to ensure the public understands why ordinances are in place. While the city or town may be protecting riparian forest buffers, it's important that the public understand why trees along streams and bays are protected. In one example, landowners who wanted trees removed so they could see the creek more easily, changed their minds when they learned the trees were cleaning urban runoff, holding the banks in place and keeping the water cool for fish. Similarly, homeowners were dissuaded from cutting down large shade trees when they learned their worth in terms of increased property values and reduced summer cooling costs.

Section Summary

In this section, we covered the areas of rural and urban community planning that should include forests and trees. We also highlighted the many goals that can be met by having a robust forestry program and values such as clean water, community safety, economic development and aesthetic values (to name just a few. In Section IV, we highlight the details for effective forest policies and provide South Carolina examples.

IV. Creating Tree Ordinances

Having the right policy tools in place is key to ensuring a healthy community forest. In Sections I-III , we introduced the reasons for conserving urban trees and forests, guidance on levels of urban forest programs, the need to manage urban and rural forests, and the goals that can be met through having robust urban and community forestry programs.

In Section IV, we cover the details and key elements for the policies mentioned in Section III. We provide specific examples for these policy or code elements that have been implemented in South Carolina so that new codes or policies do not have to be invented wholesale. We can adapt those codes that have been implemented elsewhere and update them to be used in our communities. In some cases, we have included examples from other states. Even if no other South Carolina communities have yet adopted the tool or strategy, consider whether your community could be the first to do so.

When considering whether to replicate an ordinance in your community, you should also evaluate whether it has been successful in achieving its intended outcomes in other communities. For example, in cases where the ordinance requires a permit to take an adverse action such as removing a tree, ask the municipal or county staff such questions as, “In what percent of development cases was a variance granted?” If the answer to these of questions is “100% of the time,” then it’s clear the permit is not meeting its intent, which is to require professional review and discretion in the granting of such permits, in order to reduce the number of trees removed.

Similarly, if an ordinance offers incentives to encourage its use (e.g. density bonuses in exchange for retaining canopy), ask how often these incentives have been utilized. Often, well-intentioned incentives are not applied because they don’t go far enough (they lack enough benefits) or they are too difficult to implement. This issue can usually be avoided by holding focus groups to ask developers before the incentives are finalized, to determine if they would ever utilize the intended incentives.

Overarching Tree Ordinance

Like many natural resources, trees are often managed in a piecemeal fashion. There is a great deal of variability in where and how local governments enact tree policies and codes.

Ordinances and policies affecting trees can be found in:

- The comprehensive plan
- Subdivision ordinances, cluster or conservation subdivisions (open spaces and common areas, yard trees and tree spacing and species)
- Parking lot standards (e.g. trees per number of spaces)
- Landscape buffers (vegetation between different uses such as residential and commercial or entry corridors)
- Street trees (types of, utility placement and conflicts, tree well design)
- Park and open space plans (land cover, playground design, natural areas versus mowed and manicured areas, greenways)
- Regulations governing tree protection during development (fencing to protect roots, placement of or access for utilities, erosion and sediment controls and more)
- Standards for tree canopy by zoning classes (e.g. residential and commercial)
- Regulations for local authority buildings – such as government centers and schools
- Entrance corridor regulations (tree placement)
- Stormwater regulations (water volume credits for maintaining or adding trees)

Rather than addressing trees separately in each code, consider an overarching ordinance that specifies standards for urban trees (e.g. types of street trees and planting standards, stream buffers, landscaping, etc.) in one ordinance. This can help avoid confusion, duplications or even conflicts between ordinances. These conflicts are found often in water ordinances or open space rules, and can also be a problem for rules governing trees. For example, one city code mandates only native or non-invasive species for landscaping, while another does not. An example of an overarching tree ordinance, developed to compliment this toolkit, can found on the SCFC website at: https://www.state.sc.us/forest/urban.htm.

Forestry Best Management Practices (BMPs)

BMPs help ensure that logging operations do not cause offsite harm, such as erosion, while maintaining safety. Although most are voluntary, South Carolina's forestry BMPs should be implemented to comply with other regulations, such as the Clean Water Act, the Endangered Species Act, SCDOT requirements for ingress/egress safety, avoiding streamside management zones and other regulations. To see the full suite of required or voluntary BMPs, please review the state's manual at: https://www.state.sc.us/forest/refbmp.htm#contents.

Note that rural counties may lack standards for street tree plantings or other urban-type codes. This is due to a lack of local authority to manage some standards. For example, the SCDOT controls most or all of the roads outside of incorporated cities and towns and they have strict rules that govern planting along state roads. For more see their manual at: https://www.scdot.org/business/pdf/accessMgt/trafficEngineering/ARMS_2008.pdf#page=100.

Road building, especially for major transportation corridors, affects both tree additions and tree losses (although there may be off-site mitigation to account for lost trees). Communication and power utility corridors (especially high voltage transmission lines) are another impact to rural forests, as they often bisect forest habitats.

Other drivers of forest loss include growth pressures, such as bedroom communities that spring up close to metropolitan areas. Zoning for rural areas is a tool that can be used to manage forest cover loss or conservation because it affects where land is developed and in what way. In recent years, large-scale (also called utility-scale) solar farms have become a concern for forestland conversions for forests located within a mile of a substation or transmission line (69 kV or higher). See the text box on the South Carolina Solar Habitat Act for guidance on solar "farms" and forest conservation.

South Carolina Solar Habitat Act

Image: South Carolina Department of Natural Resources

The South Carolina Department of Natural Resources (SCDNR) and Clemson University developed guidelines and standards for certification of wildlife-friendly solar farms. Proper site assessment and design can reduce the impact of solar projects on existing forest cover. Making sure valuable agricultural and forested land is not cleared and lost to renewable energy projects is key to maintaining healthy ecosystems on a landscape for animals, people and the economy.

This voluntary program encourages solar farm developers to plan for wildlife and pollinators on site by utilizing low-growing herbaceous wildflowers and grasses underneath solar panels, establishing pollinator-friendly buffer zones along fence lines and preserving sensitive habitat features, such as wetlands, tree snags and forests.

Visit the SCDNR's website to learn more about how solar projects can be more ecologically friendly: https://www.dnr.sc.gov/solar/training.html

As the tools and approaches for rural versus urban areas are very different, we describe best practices (codes/ordinances or policies), first, for rural areas and, second, for urban and suburban areas. Also included are examples of useful codes and policies. Advice and examples in this toolkit are all derived from real scenarios.

Not all South Carolina counties have zoning in place. Zoning helps protect existing land uses and landowner investments.

Rural and Large Landscape Tools

Zoning is the most effective tool to direct growth to areas where it is desired (e.g. closer to towns) and away from areas where is isn't desired (e.g. along drinking water reservoirs). There are also other incentive tools such as decisions about whether and where to provide access to public water and sewer.

Not all South Carolina counties have zoning in place, and some counties that do have zoning limit its use to designated growth areas. Rural zoning often sets minimum lot sizes. For example, Rural Area (RA) zones could establish a minimum lot size for new subdivisions of 20 or more acres per lot while a rural

Scuffletown Rural Conservation District (RCD)

In July 2016, Greenville County in South Carolina created the Scuffletown Rural Conservation District (RCD). This zoning meets many principles for conservation subdivisions, such as requiring that "designated open space shall be contiguous with open space areas on adjacent parcels to provide uninterrupted expanses of open space where possible."

The RCD also requires that 50 percent of the land remains in open space conservation to "maintain interconnected networks of open space lands," which shall also have access from internal subdivision roads. It also mandates 50-foot buffers for perennial streams draining 50 or more acres, and 150-foot buffers for rural scenic roads. See the Landscape Planning Tools Chart on page 87 for examples of zoning types.

The Scuffletown RCD establishes minimum lot sizes of 6,000 square feet (0.14 acre). It also requires 35 percent open space for neighborhood centers, 25 percent for community centers, 30 percent for "suburban transitional residential" and 50 percent for "rural residential and rural preservation" zones. These zones also establish standards for public access and usability.

The plan also includes standards for trees in the developed areas. For example, it requires street trees to be planted at 30-foot intervals along every public street, and that at least two species of trees must be planted on each parcel in the neighborhood and community center zones. For more see: https://www.greenvillecounty.org/apps/LongRangePlanning/uploads/ScuffyAreaPlanReviewBrochure.pdf

conservation zone would usually be more restrictive, for example, a 50-acre minimum. They can also designate RC zones for uses to those associated with a rural landscape, such as forestry, farming, parks, fish hatcheries, and small-scale retail needs supplied by general stores. This can avoid incompatible land uses and reduce conflicts between neighboring landowners. You can also enable important forest management tools such as allowing "by right" activities in some of the larger zoning districts, such as prescribed fire, which would not be tolerated in more densely settled areas.

In addition to RA and RC zones, there are a number of specific tools to ensure trees and forests are better protected and connected:

Clustering

Clustering is a type of subdivision that allows for smaller or variable lots in order to avoid sensitive, historic or highly valued site features. As areas become more developed, it may be harder to find suitable development sites. Features such as steep slopes or wetlands, or historic elements, such as old cemeteries, Native American mounds or iconic views, make it challenging to build at desired densities without impacting those features. An enabling ordinance that allows clustering can make it easier to have the same number of houses without impacting sensitive sites. Cluster ordinances usually allow reductions in yard setbacks and height variances, and establish more lenient criteria for parking and other features, such as allowing private roads which can be narrower than those managed by SCDOT.

Clustering can be enabled through a zoning overlay specifying areas where it is allowed or preferred, or it can be implemented as part of a Planned Unit Development (PUD; sometimes called a Planned Development or PD). See the Scuffletown Rural Conservation District textbox for an example. PUDs/PDs allow clustering to avoid sensitive site features, but also stipulate that at least 15% of the site will be protected as open space.

Conservation subdivisions

A conservation subdivision is a type of clustering that requires that at least 50 percent of a site is designated as open space. Such developments are intended to provide habitats for both people and wildlife. Leaving more land in forests and other habitats provides for cleaner air, absorbs rainfall and cools temperatures. Furthermore, property values are improved dramatically and residents have many more options for recreation, such as birding, hiking, fishing and mountain biking. These types of developments also sell faster and their properties tend to improve their value over time.

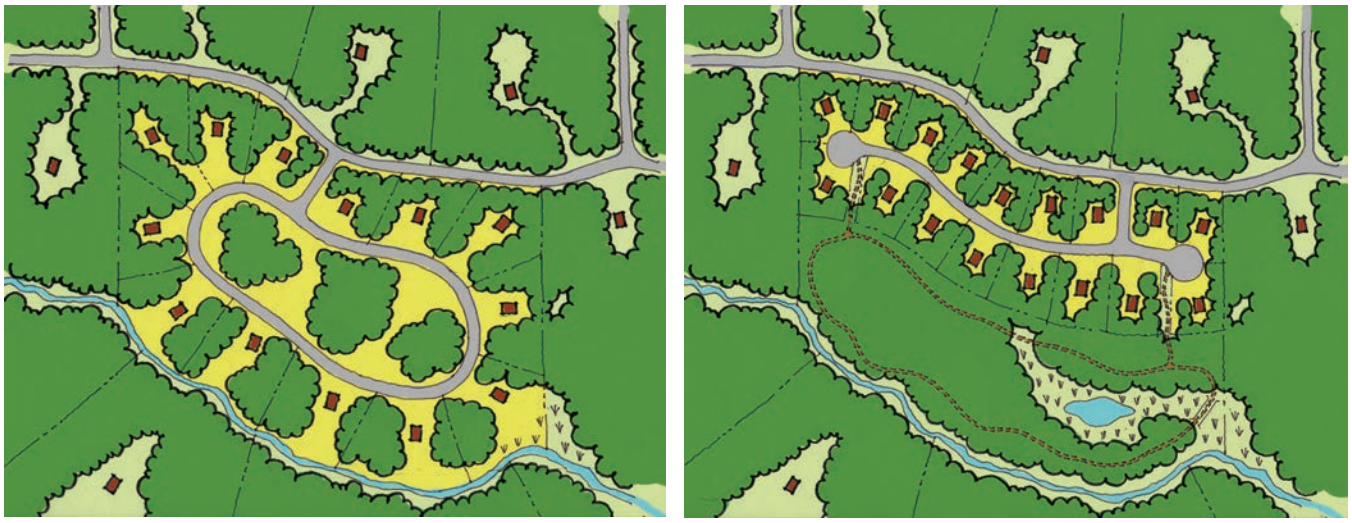
Leaving more land in forests and other habitats provides for cleaner air, absorbs rainfall and cools temperatures. Furthermore, property values are improved dramatically and residents have many more options for recreation.

Conservation Subdivisions Standards and Principles

GIC and the SCFC developed the following Standards and Principles for Conservation Subdivisions:

- **Preserve at least 50 percent of the site as undeveloped land.**
- **Protect and restore native habitats within that open space.**
- **Respect and maintain natural hydrology by limiting stream crossings, stream piping or wetland filling.**
- **Avoid disrupting or severing natural wildlife corridors and restore them where needed.**
- **Consider the context of the surrounding landscape, with sensitivity to adjacent land uses and regional connectivity.**
- **Avoid development in remote rural areas and plan for growth near already developed areas.**
- **Avoid steep slopes and unstable or wet soils, in order to prevent erosion.**

To learn more about the benefits, design considerations and implementation guidance for conservation subdivisions, see the Forest Connectivity in the Developing Landscaping: A Design Guide for Conservation Developments available at: https://www.state.sc.us/forest/urbconnectguide.pdf



The development on the left provides green space, but it is disconnected and the development takes up all of the landscape. The development on the right, redesigned for the same parcel, utilizes smaller lots, avoiding impacts to the wetlands and river while providing recreational trails and open space areas for all to enjoy. It will also cost less to treat stormwater due to the smaller amount of impervious surfaces (less road miles).

Conservation easements

Conservation easements protect a site from significant land use changes that affect the character of the site. Easements restrict development rights. In other words, existing development parcels may not be built upon if the development changes the easement's allowed uses.

Conservation easements protect a site from significant land use changes that affect the character of the site.

Conservation Easements are voluntary and can allow a landowner to:

- **Ensure the land continues in present uses forever (legacy establishment).**
- **Reduce property taxes by allowing them to be based on actual use, rather than the zoning (also known as use-value taxation). This is helpful if the easement changes a use for which the land is zoned to one that is more restrictive (e.g. land is zoned for residential development but used for forestry or agriculture), thereby saving the landowner from paying the higher tax rate of the more intensive use.**
- **Ensure that protections for landscape functions, such as wildlife corridors, groundwater recharge or scenic views remain in place.**
- **Allow for existing uses, such as farming or forestry, to continue; usually, they also allow on-farm sales of products and the construction of new agricultural buildings.**

Purchase of Development Rights (PDR)

Some local governments sponsor their own easement programs to buy development rights for places that they want to conserve. They may want to preserve a site because its distance from existing infrastructure or schools makes it difficult to support, or due to its location within a sensitive area, such as a floodplain or wetland. In these cases, the government authority can offer to purchase the development rights and place an easement on the property to remove development rights. The landowner is still in control of their property but they will no longer be able to realize the prior development allowances.

Transfer of Development Rights (TDR)

Another tool similar to conservation easements and PDRs is a transfer of development rights (TDR). TDRs remove the development potential in certain "sending areas" — typically, rural areas where growth is undesirable, such as near military installations, power stations, paper mills or other sensitive or conflicting land uses. These rights are transferred to "receiving areas" where development and growth are more desirable.

This tool allows a property owner to realize the development potential of her land by selling or transferring those rights to another location where more dense development is allowed, while preserving natural landscape qualities at the sending site, such as habitat or rural usage.

As these arrangements — easements, PDRs and TDRs — are voluntary, they are rarely controversial.

It is worth noting that the presence of large easements can actually attract nearby growth, since people have built new homes next to conservation easements, knowing that the views or uses are guaranteed to remain forever. The following chart — Landscape Planning Tools — provides examples for these policies.

LANDSCAPE PLANNING TOOLS

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Transfer of development rights (TDR). Move rights from sending zone (rural) to receiving zone (urban/growth area). **Purchase of development rights (PDR).** Purchase rights to allow uses to continue but restricts new development.	Protect high quality natural landscapes from fragmentation by over-development. Protect rural landscapes and land uses. Reduce costs of providing services to far-away communities.	Establishment of sending and receiving zones. # of development rights transferred away from rural areas. Acres of high value rural land protected. New developments closer to existing infrastructure and urban areas.	**TDR**: **Beaufort County** **Town of Bluffton** **Greenville County** *Ord. 1064 Sec. 2* **Example**: ... provides for greater development potential through increased density to parcels of land which may or may not be contiguous or under the same ownership. Only those zoning classifications as designated... shall contain transfer of development rights. Once a parcel of land has transferred its development right, it is permanently reserved from specified development uses; except in the case of where a single parcel has been developed to less than its maximum yield, then such land may receive development rights transferred to it from other eligible property in the particular zoning classification. **PDR**: **Beaufort County** *Rural and Critical Lands Preservation Program Ordinance Sec. 26-27* **Example**: It is the purpose of this article to: (1) Provide a means by which rural and critical lands may be protected and enhanced as economic and environmental resources of major importance. (2) Encourage landowners to make a voluntary long-term commitment to rural and critical land protection by offering landowners financial incentives and security of land use.
Open Space Planning	Provide opportunities for recreation and access to nature.	Make available a list of standards that are nationally or regionally recognized based on population size. For example, 1 acre of greenspace for every 1000 people; 10 miles of greenway for every 5000 residents, etc.;	**Beaufort** **York County** **Edisto Beach** **Example**: The objective of establishing a Recreational Master Plan is to update, prioritize and align the Town's strategy for addressing park and recreational land planning and activity in the Town.

This chart was first published in *Forests and the Comprehensive Plan: A Planner's Guide*. See bibliography.

LANDSCAPE PLANNING TOOLS *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Conservation easements	Protect land use in perpetuity for scenic, agricultural, forestall, wildlife or other values. Create a network of protected lands.	Acreage of highest valued lands protected (suggest basing this on maps of habitat cores and high value ag soils).	**Charleston County** **Richland County** **Example**: In order to preserve farms, forests and open space, established a Conservation Commission to process and review potential voluntary easements from landowners to protect resources permanently.
Establish a conservation fund	Generate revenue source to purchase and protect high valued lands for conservation and/or recreation.	Number of acres of high-quality land acquired.	**Charleston County** *Sec. 7.5-127.* **Example**: shall establish... the Charleston County Greenbelt Bank Fund and may receive revenues annually from the proceeds of the half-cent sales tax as approved by voters. Revenues are restricted solely for financing the cost of greenbelts.
Resource Protection Plan	Identify important resources and develop strategies to implement for their preservation or conservation.	Maps and inventories documenting high-valued environmental, cultural and historical resources. A strategic and financing plan document.	**Mt. Pleasant** **Dorchester County** *Sec. 2-399.* **Example**: The commission... with the assistance of the county staff, shall prepare and submit annually... a plan for the protection of significant resources in the county. Such plan shall include a list of significant natural, cultural, or historical resources in the county, which are recommended to the county council for acquisition, lease or development. A financing strategy shall accompany each recommendation... minimizing the utilization of public monies and maximizing the utilization of other sources, such as grants, public donations, etc.

LANDSCAPE PLANNING TOOLS *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Urban Growth Boundaries	Channel growth to areas with services and protect sensitive or productive rural lands.	Maintenance of growth boundary (minimal expansions/ exceptions). Majority of new growth within the boundary	**City of Charleston** Century V Plan Update: The City of Charleston Comprehensive Plan, Land Use Chapter **Example**: Designation of an Urban Growth Boundary (UGB) protecting rural areas surrounding the City of Charleston and other urban areas of Charleston County. Lands outside the boundary are designated for preservation and/or limited development.
Conservation Districts	Provide additional restrictions on land uses to protect sensitive, natural or scenic areas. Protect safety by preventing development in flood prone/ hazard areas. Protect historic resources. Provide open space access/ recreation.	Number of acres protected or restricted. Lack of frequent variances. Inclusion of key natural resources within the districts (use of maps to inform district boundaries).	**Abbeville County** **Berkeley County** **City of Charleston** **Greenwood County** **Oconee County** **Orangeburg County** **Sumter City/County** **Horry County** *Sec. 736.* **Example:** Intended to be used for low impact activities associated with the growing, care, harvesting, and production of trees and timber such as located in forestry management areas and to provide for the conservation of natural areas such as preserves and reserves. Development upon property within this district is restricted to that of a single residence per twenty (20) acres... The preservation of pristine areas in, on, or around rivers, flood prone areas, floodways, marshes, wetlands, green belts, greenways, etc. is encouraged in this district.
Planned Unit Developments	Requires 15-25% open space.	Percent of high value natural resources within open space.	**Beaufort City** **Charleston County** **Conway** **Edisto** **Jasper County** **Loris** **Mt. Pleasant** **Columbia** *Sec. 17-303.4* **Example**: A minimum of 25 percent of the property or land area shall be left in common open space. Any buffer strips or areas less than ten feet wide shall not be included in the open space calculation.

LANDSCAPE PLANNING TOOLS *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Riparian buffers	Protect open water from adjacent runoff and improve water quality.	Number of miles of shoreline protected. Lack of infractions. Improved water quality. Wildlife abundance and healthy fisheries.	**Beaufort City** **Greenville** **Lexington County** **Richland County** **Summerville** **York County** *Sec. 155.324.* **Example**: Any existing, undeveloped, or new lot... adjacent to the project boundary of Lake Wylie shall incorporate a 50-foot natural buffer along the entire length... and shall incorporate a 100-foot natural buffer along the entire length of the boundary adjacent to the Catawba River. Additionally... any portion... adjacent to any perennial stream that drains directly into Lake Wylie or the Catawba River shall incorporate a 50-foot natural buffer along the entire length of the stream's banks...
Land Acquisition	Provide opportunities for recreation and access to nature. Protect land use in perpetuity for scenic, agricultural, forestall, wildlife or other values. Create a network of protected lands.	Number of priority acres acquired. How well inter-connected natural areas are in the network.	**Beaufort City** **Charleston County** **Conway** **Edisto** **Jasper County** **Loris** **Mt. Pleasant** **Columbia** *Sec. 17-303.4* **Example**: A minimum of 25 percent of the property or land area shall be left in common open space. Any buffer strips or areas less than ten feet wide shall not be included in the open space calculation.
Minimum Large Lot Sizes for Agricultural/ Forestall Districts	Preserve agricultural and forestall lands from being subdivided.	Number of acres in agricultural or forestall production.	**Horry County** **York County** **Skagit County, WA** *Sec. 14.16.420* **Example**: The SF-NRL zone provides a zoning district where smaller scale timber and other resource management activities can occur while providing protection from encroachment of residential activity that may encumber standard forest practices. Minimum lot size of 20 acres.

LANDSCAPE PLANNING TOOLS *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Conservation or Cluster Developments	Protect high quality natural landscapes from fragmentation by over-development. Provide opportunities for recreation and access to nature.	Number of developments that apply through a cluster or conservation permit application.	**City of Charleston** **Greenville County** **Walterboro** **Oconee County** *Sec. 38-5.6.b; Sec. 38-5.6.c; Sec. 38-5.6.g* **Example**: A minimum of 50 percent of the gross area shall be preserved as green space. Lot size may be reduced to 10,000 square feet provided that a nontraditional septic system is approved by the South Carolina Department of Health and Environmental Control (DHEC). An increase in green space by at least 15 percent shall permit the developer to decrease the minimum lot size by 20 percent (to 8,000 square feet). All conservation lands shall be contiguous to provide for integrated open space throughout the subdivision, excluding thoroughfares. Long thin strips of conservation land (less than 150 feet in width) shall be prohibited.
Agricultural (Forestall) Land-use Value for property taxes	Provide opportunities for recreation and access to nature.	Make available a list of standards that are nationally or regionally recognized based on population size. For example, 1 acre of greenspace for every 1000 people; 10 miles of greenway for every 5000 residents, etc.;	**Spartanburg County** **York County** *South Carolina Code 12-43-220 (d)(1)* **Richland County** *Sec. 12-43-232.1.a* **Example**: If the tract is used to grow timber, the tract must be five acres or more. Tracts of timberland of less than five acres which are contiguous to or are under the same management system... are treated as part of the qualifying tract. Tracts of timberland of less than five acres are eligible to be agricultural real property when they are owned in combination with other tracts of nontimber land agricultural real property that qualify as agricultural real property. For the purposes of this item, tracts of timberland must be devoted actively to growing trees for commercial use.

LANDSCAPE PLANNING TOOLS *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Environmental Overlays	Protect sensitive environmental resources from degradation or development.	Number of acres protected from certain types of development or degradation. Measurable improvement or maintenance of the specific resource.	**Lancaster County** *4.2.2 Carolina Heelsplitter Overlay District* **Example**: This overlay district is created to help protect the natural habitat of the Carolina Heelsplitter and, therefore, maintain the existing populations... in Lancaster County.
Watershed Protection Districts	Protect open water from adjacent runoff and improve water quality.	Improved total maximum daily loads (TMDLs). Delisting of impaired water bodies. Reduced costs for treating drinking water supplies. Miles of streams or acres of land protected from more intense forms of development.	**Oconee County** **Kershaw County** *3:7.4 Lake Wateree Overlay District* **Example**: "The goal of Lake Wateree land use policies is to allow for a high quality of life for residential uses, provide for commercial establishments serving the residential and tourist/recreational communities while preserving water quality and protecting the ecology of the Lake and its watershed."
Minimum Large Lot Sizes for Agricultural/ Forestall Districts	Increase amount of tree canopy required. Limit areas of disturbance. Increase landscaping standards. Adopt tree protection ordinance. Provide for infill development	Percent canopy required to be retained. Areas of open space/green space maintained. Number of trees saved from removal. Reduction in runoff. Credits for building within development area.	**City of Charleston** **Beaufort County** **Columbia** *The Comprehensive Plan for Columbia, South Carolina: 2008-2018.* **Example**: The Impervious Surface Tax has allowed for an increased rate of repair and updating to the existing storm water system. This has helped fund major improvements totaling over $50 Million.

Urban Forest Standards

There are many rules that can be adopted to ensure that communities retain or add trees as they grow, develop or redevelop. The following sections cover those policies and ordinances that are essential in protecting or expanding the urban forest.

Tree Canopy

Tree canopy standards can be specified by zoning classes to ensure that new neighborhoods, commercial districts, or even industrial areas, maintain a minimum number of trees. Tree canopy provides the benefits described earlier, but trees are also a tool to stabilize and increase property values.

Tree canopy is usually established as a "minimum" and can be as low as 20% residential, 15% planned development, and 10% commercial or industrial. However, for a well-shaded, green neighborhood, canopies approaching 40% - 50% or greater are desirable, especially as they create cooler neighborhoods during South Carolina's hot summers.

Tree canopy standards can be specified by zoning classes to ensure that new neighborhoods, commercial districts, or even industrial areas, maintain a minimum number of trees.

Tree Removal Protection

Trees may need to be removed for a variety of reasons; they can become safety hazards because of storm-caused damage, pest infestation, disease, old age or improper planting, all of which put a tree at high risk of failure. While many scenarios justify the removal of a tree, in some situations an alternative solution can be proposed to save it. Preventing unnecessary urban tree removals requires both education of the community about the benefits trees provide and a regulatory system to prevent removals without a permit. A tree removal permit regulates where (public or private property, or both) trees are allowed to be removed and for what reasons. A tree removal permit system allows for additional review prior to a tree's removal to assess whether it is necessary for health or safety reasons.

Permit review should be conducted by an arborist or other trained and certified tree care professional. In some localities, this task is performed by a local tree advisory board or commission, particularly for champion or heritage trees. Some tree removal permits regulate the removal of trees along streams or in riparian buffers. Trees in these zones are critical for supporting clean water, watershed

Professional review is needed to determine whether trees need to be removed or not. The City of Georgetown SC inspects damaged trees to help residents determine whether they can be saved or should be removed for public safety reasons.

health and wildlife habitat. Some communities also regulate the removal of "significant," "grand," or "heritage," trees that, due to their size, location or history, are designated for protection. These trees are designated as such by statute.

While a tree removal permit system may add an extra layer of bureaucracy, the process can be streamlined by clearly identifying scenarios in which tree permits are likely to approved (e.g. a tree that is clearly dead and poses a safety hazard to someone's home). In addition, establishing a pre-approved list of invasive tree species for which removal permits are not required, is also helpful. Specific criteria should be provided to stipulate what types of trees and situations may necessitate a removal, versus those situations in which a tree is being taken down due to fear, misinformation or as a matter of personal preference. Although there is a cost in staff time to administer a tree removal permit system, comparing that cost to the benefits lost for shade, stormwater uptake and property values makes this time well worth the effort. A robust program of education and outreach about tree health and benefits can reduce the number of removal permits requested as people learn about the values their trees provide.

Heritage Trees

Protection of heritage and witness trees adds a cultural and aesthetic component to urban forestry while also protecting more trees. Heritage and witness trees can commemorate historical events that hold great significance to a community. Some communities equate heritage trees with large trees and simply designate all trees above a minimum dbh as "heritage," but their value to the community should be the main criterion for a heritage designation.

Some communities, such as Charleston, protect "Allee" trees – rows of trees that used to line a road to a plantation or other historic site. "Champion trees" are those that are of a certain species and diameter and are considered exceptionally important, and may also be associated with a specific historical event; these are often designated as "witness trees." In order for such designations to have their intended effect, they should ensure permanent protection for the tree against damage or removal. The fine for removal needs to be hefty enough to serve as a deterrent. Trees SC provides awards for those communities that recognize and protect heritage trees. For a list of trees awarded such status, visit: http://www.treessc.org/awards/

Trees SC provides awards for those communities that recognize and protect heritage trees.

The tree lined routes to current or former plantations – known as "allees" – are protected in Charleston.

The Angel Oak, named after the family's land where it stands, is a classic example of a very old live oak and is a tourist attraction, visited by more than 40,000 people each year.

Perhaps the best-known heritage tree in South Carolina is the Angel Oak in Charleston, named after the family's land where it stands. The oak is estimated to be hundreds of years old. It is 66 feet tall and 28 feet in circumference, producing canopy shade of around 17,200 square feet. From tip to tip, its longest branch is 187 feet long. More than 40,000 people visit the tree annually, making it a great tourist attraction. For more large tree facts, see the tree registry maintained by Clemson University at: https://www.clemson.edu/public/champtree/

URBAN FOREST STANDARDS GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Minimum forest cover standards	Preserve existing forest cover. Maintain property values and livability. All goals for air, water, wildlife, birds, shade etc.	Acres of forest cover preserved. Percent canopy cover preserved or conserved.	**Beaufort County** *Sec. 5.11.90* **Example**: Existing forest types listed below shall be protected in accordance with Table 5.11.90.A
Create a network of connected forest across the landscapes.	Preserve landscape connectivity for movement of wildlife and the exchange of ecosystem services. Protect biodiversity and forest resiliency.	Miles of contiguous forest cover. Corridors that connect to high-quality and intact forest cores.	**Beaufort County** *Sec. 5.11.90.F* **Example**: Protected forest resources shall, to the maximum extent practicable, be located to adjoin, extend, and enlarge any protected forest or other open space areas that exist adjacent to the development. Preservation of small, fragmented remnants of forest shall be avoided where possible.
Arborist reviews and approves tree removal permits for trees greater than 8 inches (DBH).	Reduce unnecessary tree loss. Increase community education about the value of trees.	Number of avoided tree removals/number of trees saved.	**Summerville** *Sec. 8.3.1.C* **Example**: Removal prohibited except as approved by Town Staff and in accordance with the mitigation standards.

URBAN FOREST STANDARDS GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Minimum tree cover standards (by percent)	Preserve or maintain tree canopy cover. Reduce stormwater runoff and flooding. Reduce water pollution loads to local waterways. Reduce urban heat island. Increase property values.	Reduce percent tree canopy loss. Capture or infiltrate runoff. Reduce pollution loads. Reduce energy use and costs for cooling. Lower surface temperatures. Increased home sale prices.	**Columbia** *Sec. 17-5.4(d)(1):* **Example**: Any development or other activity subject to this Section shall retain a percentage of existing tree canopy on the site in accordance with Table 17-5.4(d)(1). Trees retained on site shall be credited toward the site tree density requirements in Sec. 17-5.3(h).
Minimum tree cover standards (by basal area per acre)	Same as above plus: Potentially larger and older trees are saved in the landscape.	See above. Greater diversity in age classes of trees.	**Hilton Head** *Sec.16-6-104.G.1.a* **Example**: All new development except for the construction of any public street, pathway, drainage project, single family subdivision, athletic field, airport runway, golf course or minor utility and the redevelopment or alteration of existing development... shall include at least 900 adjusted caliper inches (ACI) of trees per acre of pervious surface area.
Penalty for heritage tree removal	Reduce unnecessary tree loss. Save historic or culturally important trees in the landscape and protect cultural values.	Number of avoided tree removals. Number of historic trees saved.	**Conway** **Jasper County** *Sec. 13.6.* **Example**: If a landmark tree is removed without permission from the zoning administrator, the county may seek retribution for the appraised value of the tree. Appraisal should be conducted by a certified arborist following the guidelines set forth in the Guide for Plant Appraisal 9th Edition.

URBAN FOREST STANDARDS GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Tree Board reviews and approves tree removal permits for trees greater than 16 inches (DBH).	Reduce unnecessary tree loss. Maintain greater ecosystem service benefits.	Number of avoided tree removals. Increase in the basal area of trees per acre.	*Summerville* *Sec. 8.3.1.C* **Example**: Removal prohibited except as approved by the Tree Protection Board and in accordance with the mitigation standards.
Tree removal permit for public property	Reduce unnecessary tree loss. Track tree removals. Maintain property values and assessments.	Number of avoided tree removals. Replace trees removed in a timely manner.	**Walterboro** *Sec. 11.6.2* **Example**: List of criteria for the acceptable removal of trees from public property without the consultation of the Tree Board. Example criteria include, tree(s) are dead, trees pose a safety hazard, tree(s) are located in a building footprint with no alternative site placement, etc.
Tree removal permit for private property	Reduce unnecessary tree loss. Educate homeowners on the potential tree hazards.	Number of avoided tree removals. Number of homeowners educated.	**Tega Cay** *Sec. 22-91.* **Example**: Tree removal permit is required to cut down any tree or shrub greater than 4 inches in diameter measured one foot above the ground.
Protect trees from being cut or removed in riparian buffer zones.	Reduce unnecessary tree loss. Enhance water quality. Provide important habitat.	Number of avoided tree removals. Number of stream miles forested or with tree canopy cover.	**North Charleston** *Sec. 5-8.d.2* **Example**: No tree shall be cut or removed from within one hundred (100) feet of the edge of the Ashley River and adjacent lowlands as defined in section 5-8(b)(2).

URBAN FOREST STANDARDS GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Allow for removal of invasive tree species (of a certain size) without a permit.	Remove invasive tree species from the landscape. Prevent the cost of having to remove invasive that spread to other properties.	Decrease the prevalence of invasive tree species.	**Beaufort County** *Sec. 5.11.100.G* **Example**: All invasive species less than 12 inches DBH may be removed without a tree removal permit. Removal of an invasive species 12 inches DBH or greater requires a tree removal permit... except when located on a single-family developed lot outside of a required buffer.
Require replacement of three times or greater the DBH of any unlawfully removed trees.	Preserve or maintain tree canopy cover. Reduce unnecessary tree loss.	Number of inches of DBH replaced. Reduced number of enforcement actions.	**Orangeburg County** *Sec. 4.5.6.* **Example**: Where significant trees have been removed... in violation of this section: Combined DBH of replacement trees is equal to or greater than three (3) times the DBH of the tree removed. **City of Charleston** *Sec. 54-331.a.2* **Example**: For trees removed unlawfully from all other properties (not single-family), the Board is authorized to require up to ten (10) times the total D.B.H. of the tree(s) removed.
Establish a tree mitigation bank for sites that cannot accommodate new tree plantings.	Preserve or maintain tree jurisdiction-wide canopy cover. Provide flexibility for site design. Create an alternative to onsite planting.	Number of trees planted for offsite mitigation. No net loss of percent tree canopy.	**North Myrtle Beach** *Sec. 23-70.2* **Example**: The tree mitigation bank is established as an alternative to planting required replacement trees when it is not feasible to plant said trees. The purpose of the bank is to obtain funds in lieu of planting the trees on private property. The funds will be used for the sole purpose of planting trees on public grounds and rights-of-way... Replacement value shall be one hundred dollars ($100.00) for each one (1) caliper inch required.

URBAN FOREST STANDARDS GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Create a spatially-based tree canopy map and data (this includes both existing canopy and open space locations for planting).	Ensure tree canopy is distributed equitably. Calculate ecosystem services. Identify planting spots.	Number of trees planted in low canopied neighborhoods. Quantify the benefits trees provide to the community.	**Summerville** **Example**: The Town of Summerville partnered with the Green Infrastructure Center to spatially map tree canopy and possible planting areas. The town is using data to maintain existing tree canopy and build capacity for a community centered tree planting campaign.
Mention the importance of trees and forests in comprehensive plans and create actionable goals.	Develop action steps to protect and conserve green infrastructure. Educate the public on the importance of trees, forests, and other green infrastructure assets are to well-being and quality of life.	Number of action goals related to green infrastructure. Number of residents who advocate for green infrastructure.	**Fairfield County** *Ord. 582 Fairfield County Comprehensive Plan 2021* **Example**: The value of the county's forest and forest products cannot be overstated. In the county's urban environs, canopy trees serve to protect and enhance property values, control erosion, moderate climate extremes, provide screens and buffers, promote traffic safety and contribute to community ambience and beautification. In urban and urbanizing areas, regulating and monitoring the care and cutting of trees on public rights-of-way as well as private property are recommended as means of protecting and enhancing the environment. In rural areas of the county, forests are essential to clean air, water, wildlife, many natural cycles, and outdoor recreation, among other things. And forest products contribute substantially to the local economy. Goal: NR-1: Conserve, responsibly utilize and integrate into an evolving environment the county's natural resources.

Protecting Trees Before Development Begins

The development process can be very risky for tree survival, even in cases where trees are identified for protection. In this section, we focus on the policies and practices that can protect trees before, during and after development. There are many ways that trees can be damaged when protection measures are lacking. For example, even if a community has a strong ordinance that requires leaving large specimen trees in place, heavy equipment can damage or kill them during or shortly after construction ends. The following is a description of these challenges and solutions, followed by a chart of example ordinances.

Retention of large trees during development continues the ecosystem services they provide, such as stormwater management, shade and community character, as well as increased real estate values.

Development Review for Tree Conservation

Development and land conversion are perhaps the greatest threat to forests. When forested land is developed, some trees need to be removed to make way for roads, utilities, parking and structures. The concern is with excessive tree removal; for example, clearing all trees from a site or removing more trees than necessary to accommodate a new development. Establishing minimum canopy cover standards for new developments is key to avoiding treeless and barren communities. Also, retention of large trees onsite continues the ecosystem services they provide, such as stormwater management, shade and community character, as well as increased real estate values. However, if the site is cleared entirely before site plan review, there is no allowance for a conversation about how best to conserve forests and large trees.

Some developers may avoid negotiations about which trees or forests to protect by first clearing a site for “forestry” and then, after the site is cleared, applying for a subdivision plat. In that case, the already-cleared land condition prevents the locality from asking for minimum canopy retention, requiring heritage or specimen tree conservation, or applying other local requirements, such as forested stream buffers. Some communities have prevented this situation by enacting a moratorium on land development following a forestry operation for a period of two-to-three years. While the site can still be developed if permitted, it makes it less likely that someone will undertake a land clearing activity for future development under the guise of “forestry” when the clearing was done primarily for a future development. A developer who intends to develop a site certainly has the right to realize the benefits of harvesting trees on his land and usually has up to five years to begin construction for a permitted development. The key consideration is, if the site is intended to be developed rather than used for continued silviculture, the landowner should have a pre-approved development plan.

Qualified forestry staff (arborists, horticulturalists, foresters, landscape architects with training in urban forestry) should be engaged in review of site plans (hopefully at the conceptual stage before plans are completely engineered). The following is a simple recommended checklist for a trained forestry professional’s review of site plans for new or redevelopment. Their analysis should be conducted with and informed by planning and engineering staff who can also provide advice or details, such as whether entrances can be moved to save trees, requirements for lot line setbacks, building locations, or opportunities for relocating utilities.

Qualified forestry staff (arborists, horticulturalists, foresters, landscape architects with training in urban forestry) should be engaged in review of site plans.

Development Plan Review Checklist for Conserving Trees on Sites Proposed for Development

- ☐ What is the site's current and potential future canopy (by percent, by location)?
- ☐ Are there incentives for retaining trees on site that could be realized (e.g. faster permit processes, conservation or cluster subdivisions to allow more creative arrangement of the built environment to save and connect treed landscapes)?
- ☐ Are existing clusters of trees and forests indicated on the site/ conceptual plan? What percent of tree cover currently exists and where are trees indicated for removal? If a percentage of tree cover is codified by zoning class, does the final plan's coverage meet minimum standards?
- ☐ If healthy, mature trees are recommended for removal, are there options to avoid their removal (e.g. can a driveway be shifted, could a proposed building be moved, could a one story building become two stories to reduce the development footprint, or could on-site parking be reduced)?
- ☐ Are the forests well connected on and across the site? Are forests 'trapped' as clusters in the middle or are they connected across and off of the site providing opportunities for pollinator and bird movement or future trails? Suggest opportunities or locations to better connect the landscape (see illustrations on page 85).
- ☐ Are buffers of trees required (at the edges or between land uses)? If so, are buffers of adequate width to withstand damages from wind (especially important for coastal or higher elevation sites)? If buffers are too thin and are created from remnant forests, trees may not be able to withstand wind damages and will be at risk of falling. Thinner buffers are also more susceptible to invasive species colonizing and taking over.
- ☐ Are street trees included in the site plan? If so, are planting standards indicated, e.g. where to plant, correct soil volume and planting standards (if a site plan, refer to notes details)?
- ☐ Are the names of trees (species/ cultivars) specified for any planted trees? Do they meet existing standards for diversity? Are the street tree species indicated appropriate for streets and native or adapted to the region?
- ☐ Where are utilities (above and below ground) to be located? Are there potential conflicts with tree canopy or roots and (if so) how are they dealt with?
- ☐ Although not part of site plan review, staff may ask about the maintenance plan or codicils governing community open space to ensure it remains intact and is well managed, as well as ensuring they are indicated for permanent protection. For example, are open space areas to be deeded as "permanent open space" or "parkland" not to be developed?

Once the general concepts of development layout are agreed to, the protection of trees during development is also equally important. The final site plan should include details for how trees will be protected during construction. While areas to be protected or disturbed should be adequately defined, additional requirements may be needed to ensure protection of large or historic trees. For example, if a large beech tree is designated for protection, but is located near areas of disturbance, then more robust fencing may be needed (e.g. metal fencing instead or plastic fencing) to protect the tree's roots or, root matting or a thick layer of wood chips spread out in highly trafficked areas to prevent soil compaction.

A tree survey needs to be performed before site design, in case there are specimen trees that require protection and that would alter a site's layout.

Tree survey

Tree protection begins with a tree survey. This will provide information about the type, age and caliper of existing trees on a site. If a locality has a requirement for protecting specimen trees (often at least 20" in diameter), then a survey needs to be performed before site design, in case there are trees that require protection and that alter a site's layout. This can be daunting for a large, forested site, but many developers with valuable timber on their property have already cruised the site to locate large trees with commercial value.

Some localities allow the use of aerial photos to document the extent of the forest for proposed developments of large forested tracts. In the Town of Saluda "groups of trees in close proximity may be designated as a clump of trees with the predominant species, estimated number and average diameter indicated." The Town adds that, for developments that exceed 10 acres, "an aerial photograph may be substituted for a tree survey, with the approval of the zoning administrator." But that is only if the photograph "would provide the

Avoid planting species that are highly susceptible to damage

There are four species of ash (*Fraxinus*) found in South Carolina – green ash (*Fraxinus Pennsylvanica*), white ash (*Fraxinus Americana*), pumpkin or swamp ash (*Fraxinus profunda*), and Carolina ash (*Fraxinus Caroliniana*); they are all susceptible to the emerald ash borer.

A large dying white ash tree infected with the Emerald Ash Borer.

same information as the tree survey." Hopefully, if the site has large intact woodlands, there is a plan to protect some of those woods and ensure connectivity of forest patches to adjacent sites. This is not only advantageous to wildlife, but can also provide recreation opportunities, such as birding or hiking. To learn more about this, see: *Forest Connectivity in the Developing Landscape* in the Resources section of this report.

Some cities that have a requirement to catalog specimen trees exclude pine trees, under the mistaken belief that they are not important and subject to falling more often than other trees. However, as mentioned earlier, pine trees provide tremendous benefits and should be included in specimen tree standards. See the text box on pine trees on page 38 for more details.

Tree diversity and tree lists

Species selection for new trees is also critical. Some tree species are especially tolerant to disturbance or drought (such as willow oak, *Quercus phellos*) or poor drainage (bald cypress, *Taxodium distichum*), and some trees thrive despite poor quality soils and tough planting conditions (crepe myrtle, *Lagerstroemia*) while others require good soils to grow well (southern magnolia, *Magnolia grandiflora*). See the SC Urban and Community Forestry website for a list of urban tree types and needed conditions at: https://www.state.sc.us/forest/refsel.htm.

A community can adopt a list of desired or required street and public space trees, as well as a list of trees to avoid based on susceptibility to known pests. For example, ash trees (*Fraxinus*) used to be considered good street trees, but they are no longer recommended because of their susceptibility to the emerald ash borer.

As noted earlier in this Toolkit, selecting a diversity of street trees is one way to ensure that trees will be more resilient. If a new pest emerges, it may not affect all the trees at a site or along a street if there are a variety of tree species present. For example, a subdivision ordinance could require the planting of street trees and also specify that at least four distinct species of shade trees be grown. A general rule of thumb to follow for urban forest species diversity is the 30:20:10 rule. This means that your community's tree species population should not comprise more than 30% of species from the same taxonomic family (e.g., the Fagaceae family is made up of oaks and beeches); no more than 20% from the same genus (e.g. Quercus = oaks); and no more than 10% of the same species (e.g.: Quercus coccinea, scarlet oak).

30:20:10 rule

Your community's tree species population should not comprise more than 30% of species from the same taxonomic family; no more than 20% from the same genus; and no more than 10% of the same species.

Consult with local urban foresters or the city arborist to create an appropriate tree list. Some communities eschew tree lists as too limiting, while others find that developers usually pick the top three trees from the list (consider randomly resorting the list every so often to avoid this). The tree list should be divided by condition and location. A simple chart with check boxes can help (e.g. Good street tree; Open space tree; Drought tolerant; Wet tolerant, etc.), This makes it easier for developers to include the right trees on their plans.

Street Tree Standards

Many specifications and practices affect whether urban trees survive. As noted in Section I of this Toolkit, only half of the nation's street trees survive more than nine years. This is because of poor species choices for the site or climate, inadequate planting conditions, improper installation and lack of follow up. "Right tree, right place" is the mantra of the urban forester.

These street trees have adequate soil volume and canopy space in which to grow and spread out.

Columbia, SC, Tree size requirements

Trees. See section 17-55, Definitions, for tree classifications.

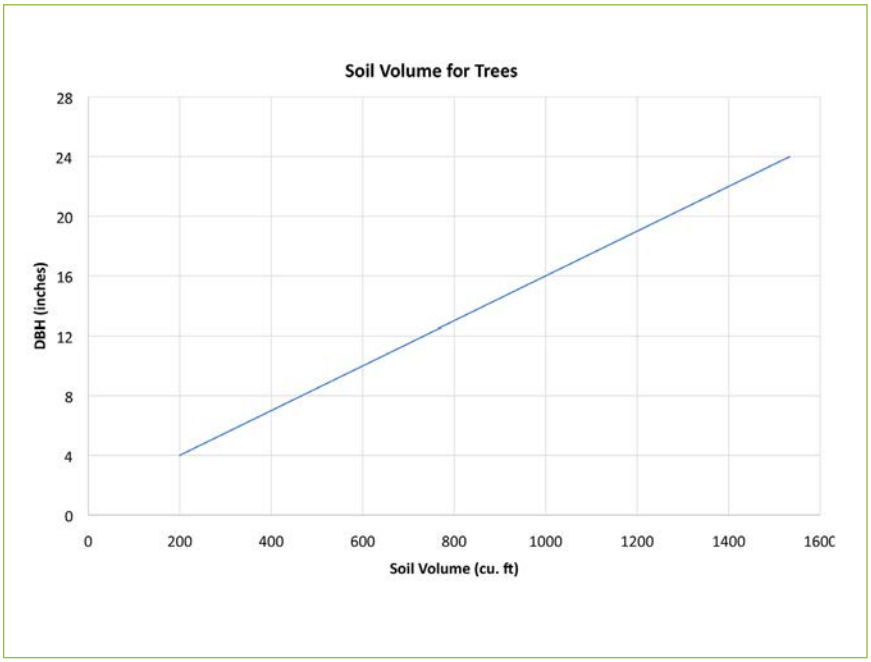
(1) Size. All shade trees planted in accordance with the requirements of this section shall be a minimum of 10' in height, and small-maturing trees a minimum of 8' in height, when planted. Both shade trees and small-maturing trees must be 2" caliper (measured one-half foot above ground level) when planted. Any new trees of above 4" caliper size shall be measured 12" above the ground.

(2) Spread relationship. The height-to-trunk caliper ratio, root ball sizes, or spread relationship for any tree to be planted shall meet the current "American Standards for Nursery Stock" as set forth by the American Association of Nurserymen.

(3) Multi-trunk trees. All multi-trunk trees must be "tree form" with a maximum of three to five stems or trunks and a minimum height of eight 8' at planting.

Tree pit size and soil volume

There are many charts available that depict the necessary soil volume urban trees require. A tree pit is the underground planting area required for a mature tree, sized to contain the grown tree's roots. The pit should be large enough to provide the tree with adequate soil volume, both to allow structural support by the tree's roots and to allow for nutrients to reach the tree.



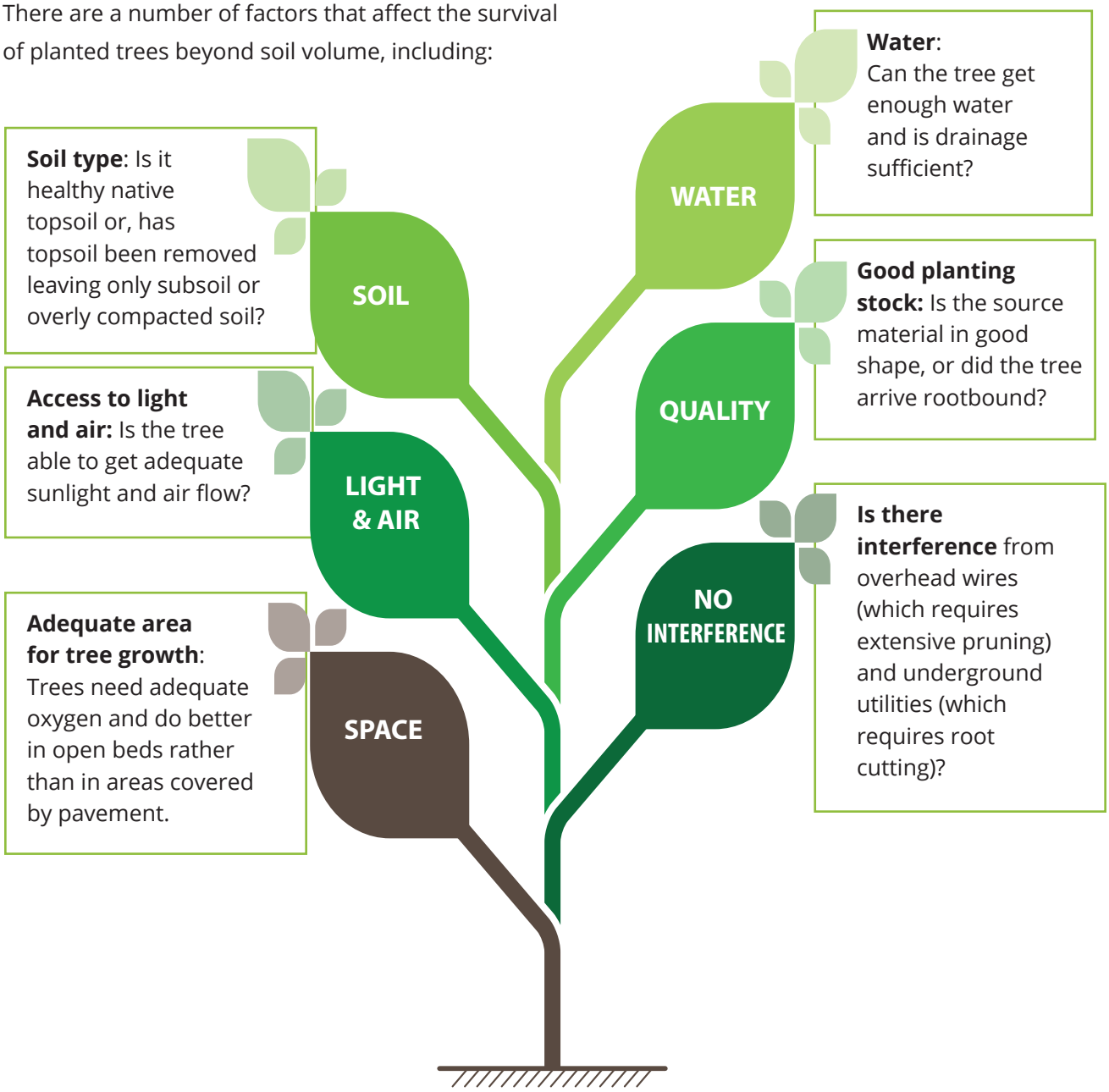
Trees need adequate soil volume to survive and thrive.

Localities may also specify minimum sizes for planted trees (see text box on Columbia SC Tree Size Requirements) as well as the volumes of soil and open area needed to support a healthy tree. Many charts are available that show a mature large tree needs to have 1000 cubic feet of soil volume in order to grow to full size. The Town of Bluffton, SC provides details for soil volume needed by tree size as follows:

Tree Size	Planting Strip Width (minimum)	Open Soil Surface (minimum)	Total Soil Area based on 3' depth (minimum)
Small	4 ft.	16 ft.^{2}	400 ft.^{3}
Medium	6 ft.	25 ft.^{2}	800 ft.^{3}
Large	8 ft	25 ft.^{2}	1,000 ft.^{3}

Factors affecting tree survival

There are a number of factors that affect the survival of planted trees beyond soil volume, including:



Not all of the above issues can be dealt with in local codes, but some can. Tree pit size can be regulated. Localities commonly require no more than 200 sq. feet of soil volume for tree pits – which is fine if the "tree" is a crepe myrtle, but is insufficient to support large shade trees, such as Chestnut Oaks. When installing utility projects, some communities use the opportunity to expand planting areas or add underground supports for trees.

Many trees and shrubs arrive root bound after being in a pot. The roots can be pulled out to help the plant grow, but if the problem is severe, return the tree to the nursery.

Image credit: GreenBlue Urban

Underground structures can direct roots, and provide space for utilities, allowing large trees and underground utilities to co-exist.

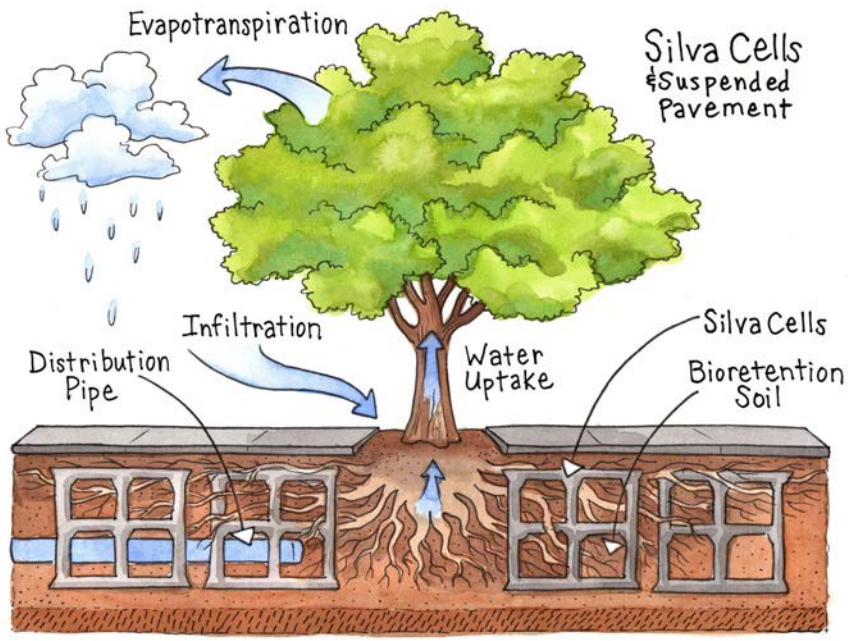
Some communities also specify the ratios and size for their street trees. Columbia, SC, for example, provides detailed specification for the tree's size and references the American Standards for Nursery Stock to ensure that trees purchased for planting are of good quality. (See text box on prior page.)

Soil loss and compaction

Soils can be especially challenging at urban sites. Many construction projects conduct extensive site grading, often removing the first foot of topsoil, where most of the organic matter and critical soil nutrients are found. A recent "best practice" is to store the removed soil and then re-spread it on the site after all development is completed. However, once soil has been disturbed, the structural integrity and health of the soil is not necessarily maintained.

A more significant issue, especially for urban sites, is soil compaction. Urban sites often have compacted soils which result in lowered oxygen and water supply or drainage issues. Some localities specify the soil compaction and soil types to support buildings, but these compacted conditions do not facilitate healthy tree roots. So, soil standards for tree planting areas should also be included. Some localities encourage the use of 'native soils' (soils from the site), but permitters should make sure in-situ soils are good-quality before requiring this. Words to the effect of "Re-use of on-site native soils is preferred, as long as those soils are of adequate quality to support healthy vegetation" are recommended.

Structural Supports (Silva Cells)



The Silva Cell is a modular suspended pavement system that expands soil volumes to support large tree growth and provide powerful on-site stormwater management through absorption, evapotranspiration and interception.

Parking lot islands

Trees in parking lots suffer from many issues. Chief among them are undersized planting wells (discussed above). These can be ameliorated by providing adequate surface areas and soils, along with proper watering, pruning and other care. Structural methods such as soil cells can be used to support large trees, even in parking areas, along streets and in plazas. (See diagram bottom left.)

Treed parking lots are attractive and provide highly desirable shade. Shaded pavement also lasts longer, so maintenance costs associated with roadways and sidewalks are less (McPherson and Muchnick 2005). Adding and expanding the size of tree wells in parking lots is usually possible because parking lots are often overbuilt for peak shopping days and sit half vacant the rest of the year. Having a parking maximum (cap) is one way to prevent this problem, as well as flexible standards for businesses with short-term visits (e.g. a pet day care center that mainly deals with pickups and drop offs, or gyms that people visit for less than an hour) as well as reductions in spaces required when the site is near public transportation.

Trees in parking lots can be combined with stormwater management features, such as bioswales. Instead of mounded planting beds, a developer can create recessed planting beds and use biofilter soils to capture and treat stormwater. To provide even more water to tree roots, permeable paving can be used in parking spots instead of impermeable pavement.

These parking lot "islands" in the City of Charleston are recessed and engineered as bioswales planted with trees to aid in filtering and evaporating stormwater. They also added permeable parking spaces too.

Parking lot ordinances can require trees by specifying the number of tree wells for every X number of spaces (e.g. 1 tree well for every 10 spaces). For example, the Town of Ridgeland requires a treed planting bed for every six parking spaces.

Another way to encourage treed parking lots is through incentives. The City of Walterboro, SC, provides an equal percent decrease in the amount of parking spaces for every 10% increase in canopy coverage (pavement is expensive, so this incentive is worthwhile to a builder). Since some trees can be messy (e.g., the American sweetgum, Liquidambar) or have poor tolerance of heat radiating from pavement (e.g. the red maple, Acer rubrum), providing a list of desired shade trees for parking lots and streets is recommended.

Some businesses may complain that street trees and parking lot trees block their views. This is an easy problem to address. Species that have a V-shaped form and grow limbs higher (see example image) are better at not interfering with or obscuring signage since they do not branch out laterally and interfere with cars and visibility. Another option is to perform regular maintenance to remove lower limbs that may block signage. It is also worth pointing out that tree-lined shopping districts are more attractive to patrons, who tend to shop longer and spend more (Wolf 2007). So, rather than reducing visitation by obscuring views, treed shopping plazas and parking lots attract more shoppers. For examples, see the chart on page 114. Underground supports for tree soil volumes and roots can help trees grow well, even in shopping plazas. See images at right.

These trees have been “limbed up” to allow the business to be seen. The trees add beauty to the business façade thereby attracting shoppers too.

Image credit: GreenBlue Urban

Trees in shopping areas that are heavily trafficed can still be healthy by adding in underground structural supports.

Image credit: GreenBlue Urban

An experiment to test the importance of adequate structural supports shows the poor growth of small open planter areas (left) with the healthy trees supported by underground structural support.

SITE PLANNING AND DESIGN GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Create an approved list of street tree species to be planted.	Avoid unwanted or undesirable trees planted in rights-of-ways. Expand diversity of planted trees.	A list of approved species Reduced number of trees removed or lost due to improper planting location Increased diversity of street and public trees	**Rock Hill** **Example**: Maintains two lists for approved street trees developed by the Tree Commission. One, is a list of canopy tree species, the second is a list of smaller ornamental tree species.
Create an approved list of vegetation for development sites.	Give clear guidance to the public and developers for where, what and how to plant.	A list of approved species Reduced number of trees removed or lost due to improper planting location	**Horry County** **Example**: Horry County developed a landscape book that contains a list of approved vegetation species for any potential site development, giving developers and contractors clear guidance on appropriate plant materials.
Create (or link to) a prohibited list of tree species to be planted.	Give clear guidance to the public and developers. Avoid planting invasive species. Improve urban habitat for wildlife and insects.	Reduce the prevalence of invasive species Reduced number of trees removed or lost due to improper planting location Increase in wildlife and insect populations	**Greenville** *Administrative Manual Appendix E Table F* **Example**: Species that are listed within the following documents are prohibited from use: 1. "Invasive Plant Pest Species of South Carolina." Clemson Extension. 2. "Roadside Plants to Avoid." SCDOT. 3. "South Carolina EPPC List." 4. "Prohibited Plant List for the South Carolina Upstate Region"
Require a minimum number of different species to be replanted.	Increase urban forest resiliency to pests and diseases. Improve urban habitat for wildlife and insects.	Increase species biodiversity Increase in wildlife and insect populations	**Greenwood County** *Sec. 6-3-147.h.3; Sec. 6-3-147.i.5* **Example**: 1-5 Trees = 1 species 6-10 Trees = 2 species 11-20 Trees = 3 species 21-50 Trees= 4 species 51 or more Trees = 5 species

SITE PLANNING AND DESIGN GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Planting trees in the rights-of-ways of new subdivision developments	Reduce tree cover loss. Reduce urban heat island effects. Increase property values. Improve aesthetics of the community.	Reduced surface temperatures Increased home sale prices	**Lexington** *Sec. 156.11.02* **Example**: All "Street Trees" planted in the Right of Way shall meet at least one of the following criteria: 1. Be planted no closer than five feet (5') to a public sidewalk; or 2. Be an approved understory tree; or 3. Be planted with an approved and inspected root control system in place.
Street trees in new subdivision developments shall be maintained by the developer and/or homeowners association to be eligible for density bonuses.	Ensure proper care and maintenance of street trees. Increase housing density.	Reduced cost for care by the local government Increase the lifespan of street trees	**Berkeley County** *Sec. 13.6.D.v.d* **Example**: *Sec.v.* If street trees are provided... throughout the entire development/subdivision... a bonus density of seven and one-half-percent can be applied: *Sec. d.* Trees shall be maintained by the developer and/or homeowners association. Trees that die... shall be replanted by the developer and/or homeowners association or similar entity. Maintenance responsibilities shall be clearly defined in all encroachment permits and covenants and restrictions.
Increase percent of trees for an equal reduction in percent of parking spaces.	Reduce urban heat island effects. Reduce stormwater runoff. Reduce the amount of imperviousness.	Reduced surface temperatures Reduced volume in runoff Reduced installation and maintenance costs Increased retail spending and tax revenue	**Walterboro** *Sec. 8.3.G* **Example**: An increase of up to 10 percent in required parking lot trees may allow a development to reduce the number of required parking spaces by an equal percent.

SITE PLANNING AND DESIGN GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Increase the number of parking islands relative to parking spaces.	Reduce urban heat island effects. Reduce stormwater runoff. Reduce the amount of imperviousness. Attract shoppers to commercial and business districts. Increase lifespan of pavement.	Reduced surface temperatures Reduced volume in runoff Reduced installation and maintenance costs Increased retail spending and tax revenue	**Ridgeland** *Sec. 5.11.2.B* **Example**: In lieu of landscape strips, landscape islands can be provided. No more than 6 consecutive parking stalls are permitted without a landscape island of at least 6 feet in width and extending the entire length of the parking stall. A minimum of one tree shall be planted in each landscape island.
Require shade trees to be planted in parking lots.	Reduce urban heat island effects.	Reduced surface temperatures	**City of Greenville** *Sec. 19-6.2.2.d* **Example**: Disallow non-shade columnar species in parking lots.
Incorporate trees and forest cover into stormwater basin designs.	Reduce stormwater runoff (evapo-transpiration). Improve urban habitat for wildlife and insects. Improve performance for water quality function.	Reduce runoff volumes Increase in wildlife and insect populations Increase property values Utilize site as amenity	**Edgefield County** *Sec. 24-29.d.4.I.4.* **Example**: A detention pond in a highway overlay district may be counted as open landscaped area unless it is unable to support healthy trees...

SITE PLANNING AND DESIGN GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Establish minimum soil volume standards for trees by size.	Provide adequate room for root growth and tree stability.	Increase the life and health of trees. Potentially reduce hazard risk of urban trees.	**Decatur, GA** *Tree Canopy Conservation Ordinance Administrative Standards* **Example**: Minimum Soil Volume **Large**: 1,200 cubic feet **Medium**: 675 cubic feet **Small**: 300 cubic feet **Very Small**: 108 cubic feet
Establish minimum soil surface area standards for trees by size.	Provide adequate air and water infiltration for healthy tree growth. Increase groundwater recharge and reduce runoff.	Increase the life and health of trees.	**Fountain Inn** *Sec. 20-27.f* **Example**: Open soil surface area. Trees shall have a minimum of 25 square feet of open soil surface area when planted in tree wells or concrete cutouts. Otherwise, trees shall have the minimum open soil surface areas listed below. **(1) Small trees.** Suitable for spaces no less than 16 square feet and up to 100 square feet of total planting area; in a planting strip at least four feet wide; or planted at least 2.5 feet from pavement or wall. **(2) Medium trees.** Suitable for spaces no less than 64 square feet and up to 200 square feet of total planting area; in a planting strip at least six feet wide; or planted at least four feet from pavement or wall. **(3) Large trees**. Suitable for spaces with no less than 200 square feet of total planting area; in a planting strip at least eight feet wide; or planted at least six feet from pavement or wall.
Within a cluster or conservation subdivision, avoid designating only unbuildable or sensitive lands as open space.	Increase the amount of useable open space for the public.	Number of acres of useable open space available	**Greenville County** *Sec. 8-9.3-5.6* **Example**: No more than 50% of designated open space may be wetlands and/or floodplain.

SITE PLANNING AND DESIGN GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Increase widths to buffer yards between conflicting land uses.	Reduce visual nuisances. Reduce noise. Improve urban habitat for wildlife and insects.	Increased aesthetics Increase in wildlife and insect populations	**Berkeley County** *Sec. 17.7.3.* **Example**: The following standard will be used in establishing bufferyard requirements: Buffer Type A B C D E 15′ 25′ 50′ 100′ 15′ Minimum buffer depth (feet from property line)
Prohibit new development from occurring in the 100-year floodplain.	Protect public safety by preventing development in flood prone/hazard areas. Protect property from repetitive loss claims.	Reduced costs for emergency operations Discounts or incentives for the National Flood Insurance Program Community Rating System	**Albemarle County, VA** *Sec. 30.3.3* **Example**: On and after April 2, 2014, no land shall be developed and no structure shall be located, relocated, constructed, reconstructed, enlarged, or structurally altered except in full compliance with the terms and provisions of section 30.3, this chapter, and any other applicable ordinances and regulations which apply to uses within the county.
Prohibit development in non-tidal wetlands (with few exceptions).	Protect safety by preventing development in flood prone/hazard areas. Improve urban habitat for wildlife and insects. Protect rare, threatened or endangered species. Reduce flooding by protecting flood storage functions of natural wetlands.	Discounts or incentives for the National Flood Insurance Program Community Rating System Increase in wildlife and insect populations	**Beaufort County, SC** *Sec. 5.11.40* **Example**: Development in non-tidal wetlands is prohibited, except in the following instances: **A. Structures.** Where structures are necessary to a permitted use and cannot be located outside the wetland, as determined by the Director, the structure shall be located on piles. Where needed, access shall be provided on structures such as boardwalks. All structures located in wetlands shall be approved by USACE/ OCRM.

Protecting Trees During Construction

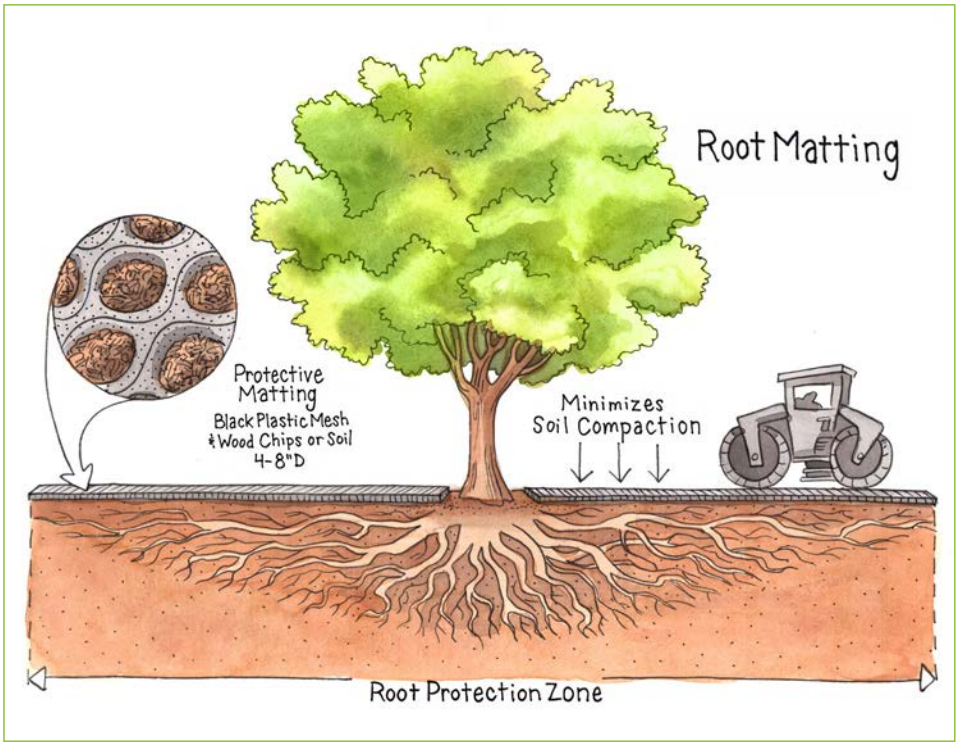
Tree protection mechanisms

Tree damage sustained during construction poses a significant threat to a locality's tree canopy. The tree protection method required by some communities is a simple orange plastic fence with a few wooden stakes, which is generally ineffective. This type of fencing can be easily removed, run over by a bulldozer or trampled down. Trees inadequately protected in this way may suffer such development impacts as root compaction and trunk damage. Instead, localities should use sturdy metal chain-link fencing in high risk areas (such as near heavy construction equipment and active site grading) and only use orange plastic fencing in lower risk areas (such as along woodlands at the edge of a development property).

Localities should use sturdy metal chain-link fencing in high risk areas and only use orange plastic protective fencing in lower risk areas.

Root matting

Trees are sometimes located in high-trafficked areas and need additional measures to protect their roots. An ordinance would not require specific materials, such as root mats, but might list it as a recommended measure to be included on site plan detail under "tree protection measures."



Root matting is used when the root protection zone must be breached because of site constraints. These are either plastic root mats or wood chips. A 6"-12" layer of wood chips is placed over the root protection zone, which minimizes compaction of the soil below. However, if using wood chips, it is important to spread them out after heavy construction is completed so that no more than 4" remain over the root zone. Thick layers of wood chips or mulch can suffocate tree roots, undoing compaction mitigation. Developers and builders may not be familiar with these methods, so consider providing education about tree protection methods to ensure proper installation and usage.

Tree protection fencing location

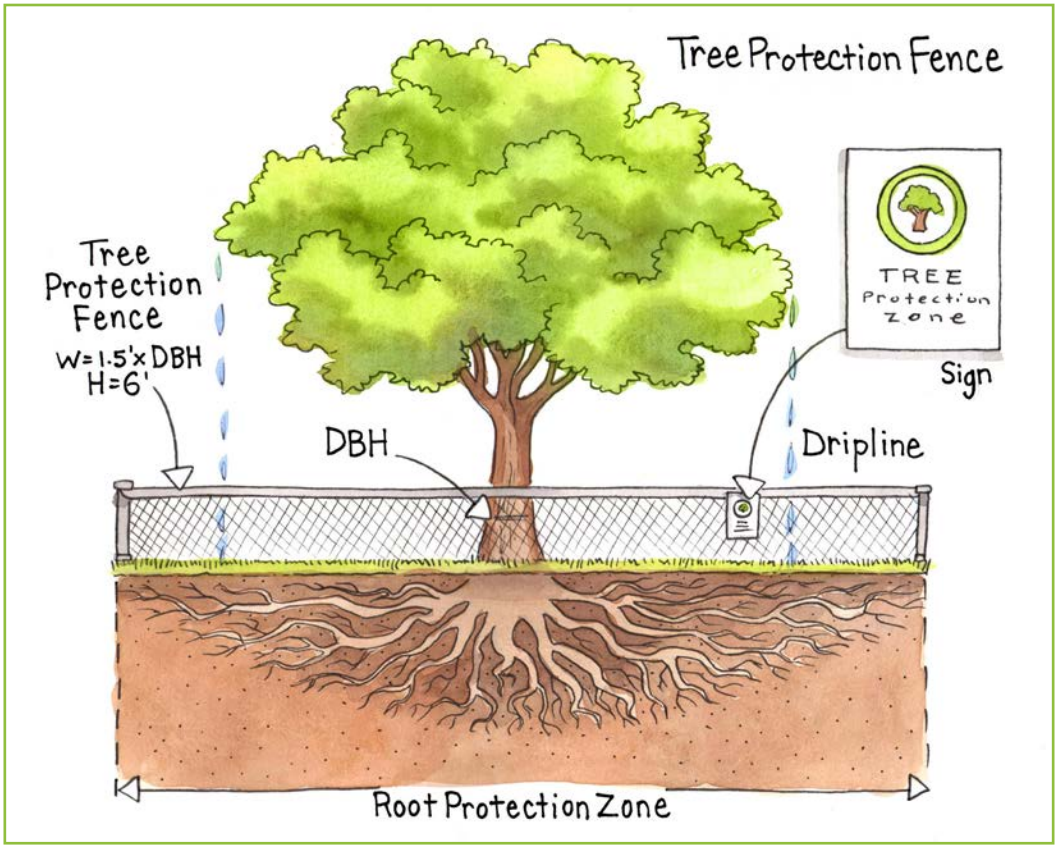
Small roots at the radial extent of the tree root area uptake water and absorb nutrients. Protection of the small fibrous roots is critical for optimal tree health. Localities that have fencing requirements usually demand that the fencing only protect the tree's dripline, omitting protection for those tree roots most involved in stormwater uptake. For the optimal protection of roots, tree protection fencing should be placed at a distance of 1.5' from the tree trunk per inch of diameter at breast height (DBH) of the tree. For example, a 20-inch diameter tree would need to have a 30' radius protection zone from the base of the tree.

For the optimal protection of roots, tree protection fencing should be placed at a distance of 1.5' from the tree trunk per inch of diameter at breast height (DBH) of the tree.

A good qualifier some localities use is the greater area of either the tree dripline or the diameter-distance. One concern about using the "dripline" is if an individual "pruned" the tree and made the dripline much smaller. The diameter is going to remain the same, whereas the dripline could be easier to manipulate.

Some trees, such as American beech (*fagus grandifolia*), have extensive surface roots and may especially need this level of extended root protection to avoid permanent damages. For all tree protection of significant trees, such as designated heritage trees, a sturdier fence than orange plastic is recommended. A wire fence that is taller is advised for trees that need to have the strongest possible protection. In addition, patches and groves of trees in areas that have been fenced off should also be closely monitored to ensure heavy equipment avoids those areas. If the barrier isn't something permanent/sturdy/substantial, then it probably will not be effective.

The lack of fencing and the track imprints near this tree show that this tree's roots are being compromised.



Tree protection signage

Tree protection signage communicates how work crews should understand and follow tree protection requirements. It also informs them about the consequences of violating county or city codes. Construction crew members may not understand that building materials may not be placed in tree protection zones and that moving the protective fencing around the tree is never permitted. Localities should design a standard tree protection sign that summarizes the rules of working near and around tree protection zones and require that the signage is installed at various points along the tree protection fence.

Finally, sites with extensive forest patches or many heritage or specimen trees designated for protection may need additional inspections to ensure that the site is developed according to local code. Many things can go wrong during construction, which can result in permanent damage or the eventual death of trees intended for protection. Something to keep in mind is that a tree impacted by construction can take months, or even years, to die from development impacts, long after construction has been completed. The authors of this toolkit have witnessed construction sites with soil piled 15 feet up tree trunks, backhoe tracks across forested wetlands, grading in preservation areas, tree protection fences removed, trees damaged and the death of newly planted trees. Penn State extension has a particularly well thought-out guide for protecting trees before and during construction: https://extension.psu.edu/a-guide-to-preserving-trees-in-development-projects

TREE PROTECTION GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Exempt commercial timberland from regulations for land clearing for development.	Prevent conflicts with legitimate timber harvesting operations and forested lands.	Number of notifications to the local planning authority.	**Lexington County** *Sec. 3.1.7* **Example**: Forest management activities, including timber harvesting, as defined under SC State Law 48-23-205, are exempt from the Landscape and Open Space Ordinance.
Require notification of timber harvest.	Reduce confusion between timber harvesting and clearing for development.	Number of notifications to the local planning authority.	**Columbia** *Sec. 17-794.a* **Example**: The property owner shall notify the zoning administrator prior to beginning any timber harvesting or land clearing conducted as a commercial timber operation.
Penalty for improper use of commercial forestry to clear land for development.	Prevent the preemptive clearing of forestland to circumvent land clearing regulations.	Reduce the number of acres of illegally cleared forestland.	**Lexington County** *Sec. 3.1.7* **Example**: Development permits may be denied for a period of three years following a timber harvest if there was a willful intent... to circumvent any provision of the Landscape and Open Space Ordinance.
Prevent rezoning of single family to multi-family or commercial for 2 years if significant or grand trees removed without prior approval.	Prevent the removal of large trees for in-fill redevelopment.	Reduce the number of large trees removed for in-fill projects.	**Aiken County** *Sec. 24-2.12.13.b* **Example**: If significant or grand trees are removed on land zoned to permit single-family residential, no application for rezoning to a commercial or multifamily residential zoning classification will be considered for two (2) years...

TREE PROTECTION GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Prior to any development approval, require a survey of trees on site.	Prevent the removal of large trees prior to permitting. Ensure forest cover or tree cover standards are met.	Number of trees saved on site. Number of acres of forest saved or conserved on site.	**Beaufort County** *Sec. 5.11.100.C* **Example**: Prior to any development approval, a tree survey of the areas in which building, clearing or construction activities are planned in accordance with the following: • The tree survey shall include all trees 8 inches DBH and larger, and all dogwoods (Cornus spp.), redbuds (Cercis canadensis), and magnolias (Magnolia spp.) four inches DBH and larger. • The tree survey shall indicate species type and size (DBH). • The tree survey shall be conducted by a certified arborist, professional urban forester, registered landscape architect, or registered land surveyor. All tree surveys shall be certified by a registered land surveyor. • A tree survey shall be less than five years old beginning from the application submission date for which the survey pertains.
Maintain physical barriers around trees during construction.	Reduce compaction or damage from heavy machinery or related activities on site.	Reduce the number of trees killed or damaged/increase tree survival.	**Town of Lexington** *Sec. 156.07.02.A* **Example**: Maintain a physical barrier around a tree a minimum distance of 1.5 feet for every one inch of diameter at breast height (measured 4.5 feet above the ground) or the dripline, whichever is greater.
Irrigate trees during dry weather or drought.	Reduce tree stress and mortality from heat and lack of water.	Reduce the number of trees killed or damaged/increased tree survival.	**Town of Lexington** *Sec. 156.07.03.I* **Example**: Irrigate protected trees during periods of drought or dry weather.

TREE PROTECTION GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Display signage to "keep out" of protected zones.	Educate construction workers and the public on regulations to protect trees.	Educate the number of workers on rules and regulations. Reduce the number of trees killed or damaged.	**Town of Lexington** *Sec. 156.07.03.D* **Example**: The placement of tree protection or keep out signage shall be attached to the physical barrier and maintained until all construction activities are completed. The placement and quantity of signage shall be on all sides and convey the intent of the tree protection zone and barriers.
Mitigate poor drainage or ponding around root zone.	Reduce ponding of water in root protection zones.	Divert drainage away from protected trees.	**Town of Lexington** *Sec. 156.07.02.B* **Example**: Mitigate drainage around protected trees if regrading the site causes poor drainage or ponding in root zone.
If unavoidable, mitigate compaction by applying mulch to root zones.	Reduce compaction from unavoidable construction impacts in the root zone.	Number of trees spared from impacts.	**Hilton Head** *Sec.16-6-104.J.4.b* **Example**: Where compaction might occur due to construction traffic or materials delivery through a tree protection zone the area must first be mulched with a minimum four-inch layer of wood chips.
If trees adjacent to protected trees are to be removed, trench and cut roots prior to clearing to avoid damage.	Reduce impacts from removals to protected trees.	Reduce the number of trees killed or damaged/increase tree survival.	**Hilton Head** *Sec.16-6-104.J.4.f* **Example**: The removal of trees adjacent to tree protection zones can cause inadvertent damage to the protected trees. Prior to clearing activities, trenches with a minimum width of one-and-one-half inches and a minimum depth of 12 inches shall be cut along the limits of land disturbance, so as to cut, rather than tear tree roots.

Avoiding Utility Conflicts

Trees that grow up under power lines often end up being pruned in this V-shape which is bad for the tree's health and stability.

For new development sites, as well as for redevelopment or the new installation of utilities, there are many considerations for protecting existing trees. Utilities should be co-located and allow for access points for when lines need repair or replacement. Although open cut, or trenching, is the most common way to install and connect utilities, its use is most appropriate for when the ground above the utilities can be disturbed and there are no buildings, trees or other obstructions in the way. When trees are present, it is difficult to install ground utilities in an open trench. Tunneling is an approach that avoids trenching. It may be referred to as boring, moling or trenchless technology. Directional boring can be used to reduce disturbance to existing trees. Directional boring can be used where open-cut excavation is planned, as well as to go under roads, sidewalks and even tree roots, in order to avoid removing those obstacles. To learn more, see: https://www.arborday.org/trees/bulletins/documents/035-summary.pdf.

A site plan or an ordinance can require the use of directional boring to protect tree roots during the construction process, but this can also be required for utility work in and around existing street tree wells and trees in public spaces. Underground utilities also can be run through other tree support structures, such as Silva Cells. For more, see: https://www.deeproot.com/silvapdfs/resources/supporting/2014-Silva-Cells-and-Utilities.pdf

"Root damage leads to the slow, insidious decline of otherwise healthy trees."

— National Arbor Day Foundation

When trees have grown up into overhead power lines, the power company may conduct V-shaped pruning that is not ideal for the tree. A better approach is to ban the planting of large canopy trees under power lines. Smaller trees, such as crab apples (*Malus*) or crepe myrtles (*Lagerstroemia*), can be planted and not interfere with overhead wires. The International Society of Arboriculture has guidance for avoiding utility conflicts, at: https://www.treesaregood.org/portals/0/docs/treecare/Avoiding_Conflicts.pdf.

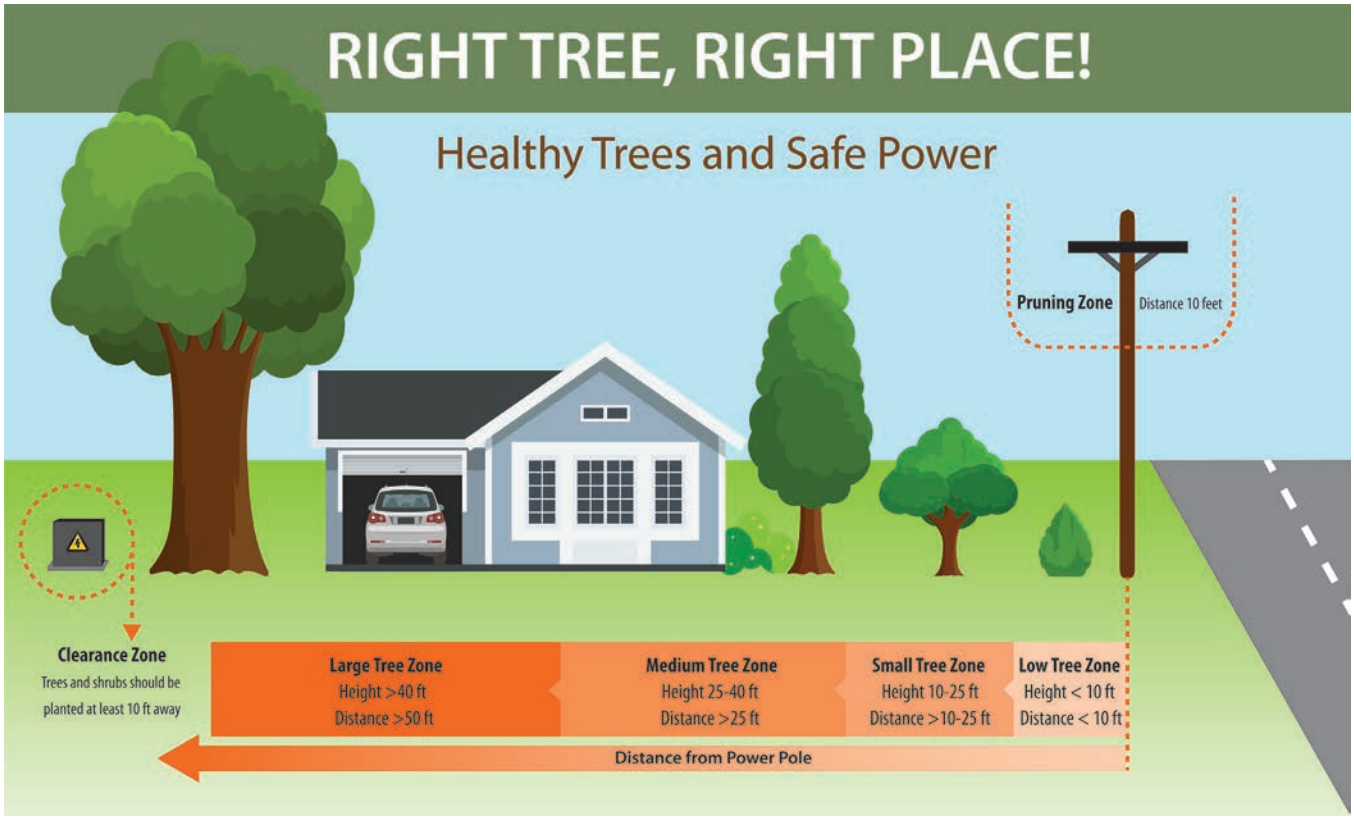
Some utilities recommend selecting trees less than 15 feet tall, while others, such as Dominion Energy SC, recommend trees be no more than 10 feet tall. For more, see: https://www.sceg.com/docs/librariesprovider5/pdfs/electricrightofway.pdf.

Selecting trees with roots that spread less and are less sensitive to disturbance is one approach to reducing conflicts with utilities.

In addition to the tree height, root spread is also an important factor for street trees. Selecting trees with roots that spread less and are less sensitive to disturbance is one approach. There are also chemical and physical barriers that can be used to keep roots in check. Selecting trees with roots that spread less and are less sensitive to disturbance is one approach to reducing conflicts with utilities.

Also see: https://uretek-gulfcoast.com/tree-root-barriers-how-do-they-work/ for cautions about how and when to use these barriers. The SCFC has a list of trees and recommendations for where they are appropriate. The Utility Arborist Association also publishes guidance, at: https://www.gotouaa.org/project/faq/ and see SC requirements at: https://ors-test.sc.gov/sites/default/files/Documents/Consumers/Electric/treetrimming.pdf.

For any underground digging, call 811 or visit https://sc811.com/. Consider publishing an infographic to educate the public, such as the one below:



This diagram provides guidance on standards for avoiding power utility conflicts.

TREES AND UTILITIES GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Avoid creating a hazard or interfering with overhead or undergrwound utilities.	Prevent improper tree planting. Increase public safety.	Prevent poor tree care management or removals.	**Rock Hill, SC** *Sec. 28-61.* **Example**: It shall be the duty of any person planting or growing a public tree to: Place no tree so as to be, in the opinion of the forester, a traffic hazard or an interference with overhead or underground public utilities. Prune trees so as not to cause a hazard and so that the minimum clearance of any overhanging portion is eight feet above any sidewalk and 14 feet above any street.
Re-route utilities around tree protection zones or if unavoidable, tunnel utilities.	Avoid damage to tree roots.	Prevent the number of trees killed or damaged due to construction impacts.	**Lexington, SC** *Sec. 156.07.03.E* **Example**: Underground utilities shall be routed around tree protection zones. Necessary installation through protection zones shall be accomplished through tunneling rather than cutting open trenches. This applies to any irrigation systems, drainage, electric, gas, telephone, cable TV, etc.
Develop a cooperative agreement for tree maintenance between utility providers and locality.	Increase communication and operations between utilities and public agencies. Reduce conflicts and complaints from the public.	A cooperative agreement with clear guidelines and expectations.	**Anderson County, SC** *Sec. 2-600.* **Example**: Utility companies shall be exempt from these standards, provided the utility companies provide the county administrator with tree pruning and removal policies in conformance with ANSI A300 standards for tree care operations and a mutually acceptable written policy is executed by and between the county and the utility company.
Submit annual line clearing plans for review.	Increase communication and operations between utilities and public agencies.	Annual clearing plans submitted.	**Beaufort County, SC** *Sec. 5.11.100.F.4.e* **Example**: Provides for submittal of annual line clearing plans for review.
Create an approved list of tree species for planting under overhead powerlines and utilities.	Avoid unwanted or undesirable trees planted in rights-of-ways. Avoid conflicts from wrong tree, wrong place.	A list of approved species. Reduced number of trees removed or lost due to improper planting location.	**Rock, Hill, SC** **Example**: The City maintains a list of approved species to be planted under overhead powerlines and utilities.

Example care plan

- New street trees to be installed with watering bags (or similar functional system), and watered weekly from March – October.
- Trees to be mulched following ANSI standards twice per year in spring and fall for the first two years.
- Trees to be pruned twice in their early stages (once in the dormant season at the end of year one; and once at end of year two) by a licensed arborist.
- Trees to be inspected by tree care professional (ISA certified) after 1.5 years to note their condition and if any trees need replacement or treatment. Damaged trees to be replaced.
- The bond to be released after 1.5 years following inspection by the city arborist.

Urban Tree Care and Maintenance

Tree care

Trees in public spaces need to be cared for throughout their life. A tree care plan for newly planted trees is essential to their survival. Ordinances should specify that trees required or offered as part of a legal subdivision plan, rezoning application, planned development or other zoning class, have a care plan. A care plan entails scheduled watering, pruning or mulching in the first two years, as well as regular inspections by an arborist. To ensure that new trees survive, some communities include the trees in the performance bonds for a development. This may seem strange, but it's the same procedure that is followed when issuing bonds for stormwater features, interior roads and other development elements that are required as part of the site design. The City of Abbeville, SC, requires that a maintenance agreement for plant material is included in the property covenant and bonded for one year. Other communities, such as Beaufort County, require a two-year bond be established prior to issuing the certificate of occupancy. The bond is not released until the city arborist visits the site and finds that the trees are in good condition.

A site plan can also specify details for how trees will be planted. This may seem rather elementary, but the authors of this report have witnessed many trees planted incorrectly and then not mulched, or piled with mulch 20 inches up the trunk (volcano mulching — which can create a whole host of problems for the health and survival of a tree).

It is also worth enquiring about the seasonal timing of any tree planting (e.g. Will trees be planted in the dormant season when survival rates are better?) and is the maintenance plan aligned with this timing? These standards can make the difference between a mall or neighborhood full of dead trees or a thriving community that holds its real estate values and attracts residents and customers.

Some communities also have bans on poor tree care, such as prohibitions on tree topping (which often causes trees to die).

Site placement and future use

One tip to ensure new homeowners don't remove trees is to plant them carefully so as not obstruct a key view or get in the way of pathways to the front door. In one community studied in Georgia, the residents cut down trees because they were planted in the middle of their front yards, making it difficult to play there, throw a ball, etc. By simply positioning trees to the side, more of the yard is useable for play.

Planting trees to offer solar protection (and explaining this to new homeowners) is another way to ensure they will remain. Species selected should also be those that are not messy (e.g. with heavy leaf fall or prickly seed pods), which may inspire landowners to remove them.

This tree was planted or cared for improperly and is now dying. Trees should be monitored several years after planting and dead or diseased trees should be replaced.

Trees create vibrant downtowns where people want to gather.

URBAN TREE CARE AND MAINTENANCE GUIDE

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Establish local government authority to maintain, protect, and remove trees located on public property or rights-of-ways.	Establish authority over the care of trees in rights-of-ways and on public property. Facilitate the removal of trees established as hazardous.	Posted rules and regulations made publicly accessible.	**Myrtle Beach** *Sec. 19-62.* **Example**: The city shall have the right and responsibility to establish, maintain, protect, and remove trees located on public property and rights-of-way. Public tree maintenance standards shall... following professional standards from the American National Standards Institute.
Require hired contractors and tree care businesses to sign an affidavit they read the city's tree protection ordinance and 2001 ANSI A300 Standards.	Ensure that local businesses and contractors are aware of the codes and regulations governing tree care.	Reduce the number of trees mutilated or killed due to improper care.	**Conway** *Sec. 3-4-7* **Example**: It shall be unlawful for any person who is being paid a fee for the business of planting, cutting, trimming, pruning, removing, or otherwise modifying trees within the city limits... to conduct such business without first signing an affidavit stating... received and read the City of Conway tree protection ordinance and 2001 ANSI A300 Standards... Such affidavit shall be completed and submitted when making application for, or renewing, a City of Conway business license.
Require the owner of the property to maintain in good health all landscaping in perpetuity. (Suitable to include in site plans or trees indicated for permanent protection etc.)	Ensure proper care and maintenance of trees. Replace dead or dying trees on the property.	Increase the lifespan of urban trees. Maintain tree canopy cover percentages.	**Greenwood County** *Sec. 6-3-147.f* **Example**: The owner of the property of record is responsible for maintaining all required plant materials and planting areas in good health and appearance into perpetuity. All dead, unhealthy or missing plants shall be replaced within 180 days of notification. **Lexington** *Sec. 156.10.02.E* **Example**: ...within 45 days of notification.

URBAN TREE CARE AND MAINTENANCE GUIDE

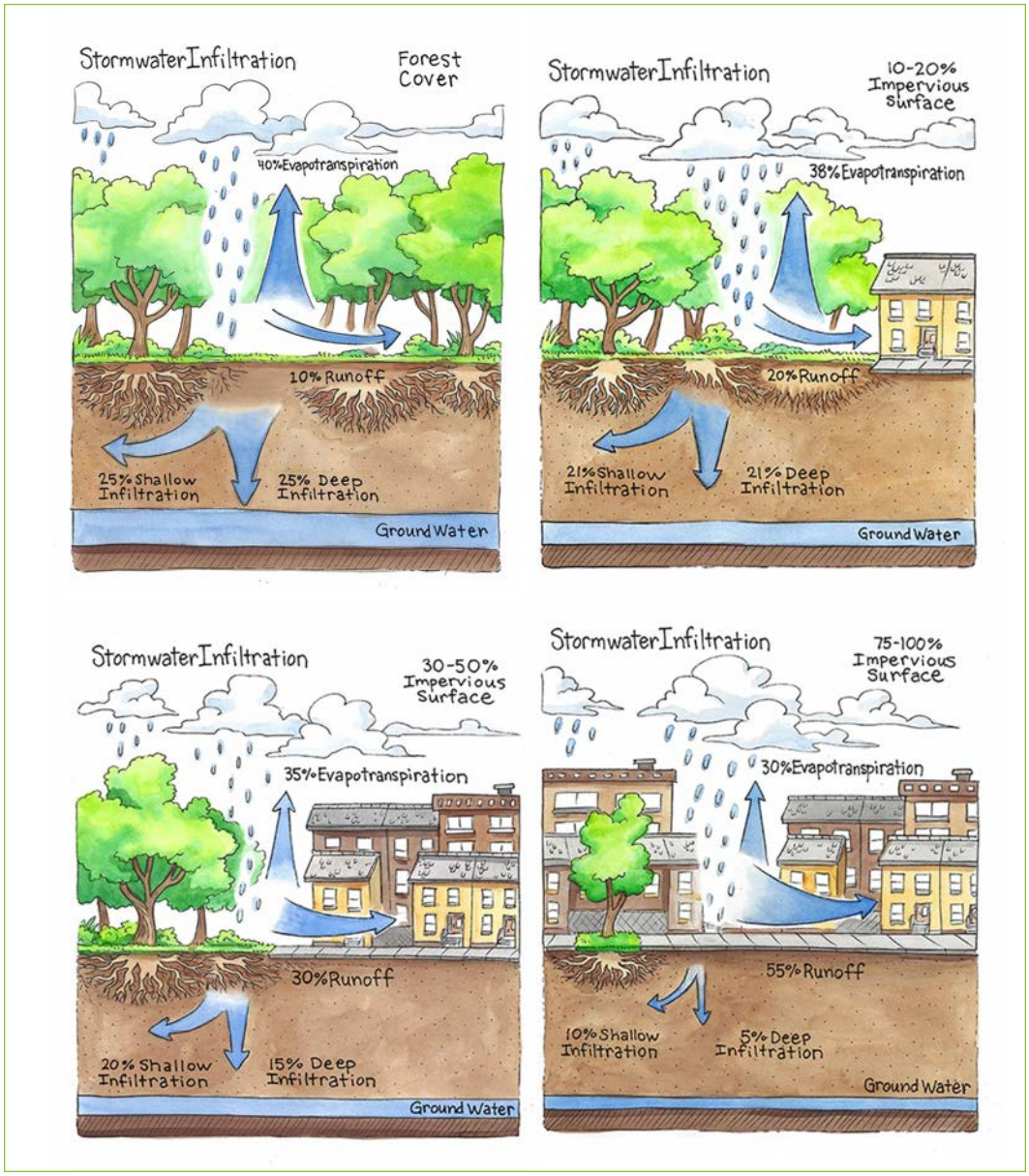
TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Prevent tree topping by city contractors working on street, park or other public trees.	Prevent the improper care or maintenance of trees. Prevent the creation of hazards. Ensure long-lived trees.	Reduce the number of trees mutilated or killed due to improper care. Reduce the likelihood of hazards.	**Spartanburg** *Sec. 21-59.* **Example**: It shall be unlawful as a normal practice for any person to top any street trees, park trees or other tree on public property. Topping is defined as the severe cutting back of limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree.
Establish a minimum two-year survival bond for landscaping.	Maintain canopy requirements on site.	Number of trees replaced/retained.	**Beaufort County** *Sec. 5.8.110.B.4* **Example**: Establishes a two-year survival bond for landscaping.
Conduct a public tree inventory.	Determine the species composition of trees in the urban forest. Assess tree risk on public property and in rights-of-way. Prepare the urban forest for potential storms and natural disasters.	Percentage of trees belonging to specific taxonomic classes (Family, Genus, or species). Reduce the potential for tree hazards. Creation of a forest storm mitigation plan.	**North Myrtle Beach** *Sec. 19-60.* **Example**: The city shall maintain a current inventory of all public trees. The inventory data gathered and recorded for each tree shall include, at a minimum, the following information. • Location (address or geographic coordinates) • Tree species • Caliper measurement and/or DBH • Condition • Maintenance needs
Create an Urban Forest Management Plan.	Holistic and data informed management of the urban forest. Include stakeholder and public involvement in the care management of the urban forest.	Urban Forest Management Plan Number of stakeholder and members of the public involved in its creation.	**Charlotte, NC** **Decatur, GA** **Example**: The suburban community of Decatur, just outside the Atlanta Metropolitan Area, developed a community forest plan in 2012. Highlights of the plan include: a canopy increase of 5% over the next 25 years, hiring a full-time city arborist; and the establishment of a tree utility fee.

URBAN TREE CARE AND MAINTENANCE GUIDE *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Have on staff a landscape architect, horticulturalist, forester, or arborist (ideally ISA certified).	Expertise on staff that can inform BMP design and installation.	Professionally trained staff positions that support an Urban Forest program.	**City of Greenville** **Sullivan's Island** **Example**: The City of Greenville has on staff an arborist and a landscape architect. **Example**: Sullivan's Island's planner became a certified arborist to better staff the tree board and oversee tree related plans and decisions.
Document your locality's tree maintenance records and expense reports.	Create an efficient system for tracking tree care and costs.	Recordkeeping that tracks work orders on specific trees. Accurate budget tracking and expenditures on the urban forest.	**City of Charleston** **Example**: Urban Forestry maintains all trees on city owned property, including the street trees within the city limits. The division keeps an accurate computer inventory of all city trees, including species, condition, and maintenance records. Urban Forestry routinely performs maintenance and responds to citizen requests for tree work on public property.
Spend at least $2 per capita on urban forestry and landscaping.	Meet minimum standards to qualify for Tree City USA. Consider spending more for a robust program and canopy replacement/ rentention.	Spending for urban forestry maintained or expanded.	**Camden** **Example**: Despite having a relatively small population (~7200 people in 2018), the City of Camden spends on average $60 per capita on its urban forestry program.

Trees as Stormwater BMPs

Most forestry professionals and many others understand that trees capture rain. Anyone who has ever stood under a tree for shelter during a rainstorm knows that trees intercept water. But very few communities use trees as part of their regulatory structure. However, trees should be considered as part of any plan for reducing storm runoff and improving water quality. The SCFC funded GIC to study how trees soak up rainwater and to develop an audit tool for communities to evaluate whether their policies were causing more pavement to be laid (e.g. high number of parking spaces) or whether they had policies in place to prevent tree losses (e.g. specimen tree standards or, more importantly, requirements to conserve clusters of mature trees or forest).



As landcover becomes more urban, more water runs off and less water reaches the aquifer. Trees play a critical role in capturing, storing and evaporating water.

Trees filter stormwater and reduce overall runoff volume. So, planting and managing trees is a natural way to mitigate stormwater. Estimates from a study in Dayton, Ohio, found a seven percent reduction in stormwater runoff as a result of existing tree canopy coverage and a potential increase to 12 percent runoff reduction as a result of a modest increase in tree canopy coverage (Dwyer et al 1992). Conserving forested landscapes, urban forests and individual trees allows localities to spend less money treating water through their municipal storm systems and also reduces flooding.

Each tree plays an important role in stormwater management. For example, based on GIC's review of multiple studies of canopy rainfall interception, a typical street tree's crown can intercept 760 – 3,000 gallons per tree per year, depending on the tree species and age (size). If a community were to plant an additional 500 such trees, annual stormwater runoff could be reduced by a million gallons. This means less flooded neighborhoods, reduced stress on storm drainage pipes and decreased runoff into creeks, with less erosion.

According to the U.S. Environmental Protection Agency (EPA), excessive stormwater runoff accounts for more than half of the pollution in the nation's surface waters and causes increased flooding and property damage, as well as public safety hazards from standing water. The EPA recommends a number of ways to use trees to manage stormwater in the book *Stormwater to Street Trees*. (See the Bibliography.)

To model stormwater interception by trees, GIC developed a methodology to account for uptake of stormwater based on a community's forest cover and changes in stormwater runoff if trees were added or lost. GIC's "Trees and Stormwater Calculator Tool" allows planners, urban foresters, stormwater engineers and forest advocates to model the impact of stormwater runoff caused by adding or losing trees during a particular storm event, as well as associated reductions or additions of water pollutants, such as nitrogen, phosphorus and sediment.

Examples of counting trees for stormwater management.

The City of Portland in Oregon provides a 'tree credit' that can be used to offset 10 percent of a site's impervious surface as stormwater management. It also uses trees extensively in bioswales and other green infrastructure practices. For more, see: https://www.portlandoregon.gov/bes/article/582102.

Pine Lake, GA, provides 10 gallons of credit per inch of diameter at breast height (DBH) for preserving trees that are under 12" DBH, and 20 gallons of credit per inch of DBH for preserving trees over 12" DBH.

Washington D.C. provides a water volume credit of 20 cubic feet for each preserved tree, and 10 cubic feet for each planted tree. Trees planted as part of a BMP, such as bioretention, also receive 10 cubic feet of stormwater credit. Many recent articles have reviewed the use of credits in relation to trees and stormwater management. For more, see: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6134866/

Charleston, South Carolina, USA* **Urban Tree Canopy Stormwater Model** **version July 2, 2019**

The Green Infrastructure Urban Tree Canopy Stormwater Model estimates stormwater runoff yields for current and potential land cover. The methodology is based upon the NRCS TR-55 method for small urban watersheds. It is used to provide better estimates using GIC's high-resolution land cover and modeling of potential canopy area.

			million gallons										
TOTALS	58.0%	13.8%	2,272.3	323.3	2,134.4	60.9%							
Statistics by Drainage Basin (current settings)							Variable						
Area	Current Tree Cover	Current Impervious Cover	Tree H_2O Capture	Increased H_2O w/xx% tree loss	Added H2O Capture w/xx% PPA	Tree Cover Goal	Pick an Event	Pick a loss scenario		Converted Land			Canopy Added
	%		million gallons			%	Event	% UTC loss	% FOS Loss	% Imperv	PCA	PPA	% of Land
1 030502010708-Atlantic Oce	50.0%	16.7%	(0.0)	(0.00)	0.00	25%	10 yr / 24 hour	10%	10%	40%	0.0%	-50.0%	-25.0%
2 Bohicket Creek	65.4%	15.3%	7.1	3.60	0.32	69%	10 yr / 24 hour	10%	10%	40%	71.7%	6.4%	3.2%
3 Folly Creek	42.3%	31.2%	0.4	0.29	0.02	44%	10 yr / 24 hour	10%	10%	40%	45.4%	3.2%	1.6%
4 French Quarter Creek	77.6%	1.7%	0.9	0.99	0.00	77%	10 yr / 24 hour	10%	10%	40%	77.2%	-0.4%	-0.2%
5 Goose Creek	40.1%	27.4%	0.5	0.26	0.04	49%	10 yr / 24 hour	10%	10%	40%	57.1%	17.0%	8.5%
6 Guerin Creek	97.1%	0.6%	12.2	9.42	0.00	97%	10 yr / 24 hour	10%	10%	40%	97.2%	0.1%	0.0%
7 Lower Ashley River	48.9%	31.8%	69.0	44.61	2.42	51%	10 yr / 24 hour	10%	10%	40%	52.3%	3.3%	1.7%
8 Lower Cooper River	41.0%	30.9%	45.7	31.61	6.37	47%	10 yr / 24 hour	10%	10%	40%	53.5%	12.5%	6.2%
9 Lower Wando River	72.3%	9.2%	47.3	27.79	1.21	74%	10 yr / 24 hour	10%	10%	40%	76.3%	4.0%	2.0%
10 Middle Ashley River	59.5%	9.1%	2.4	1.66	0.04	60%	10 yr / 24 hour	10%	10%	40%	61.3%	1.8%	0.9%
11 Rantowles Creek	76.1%	6.5%	89.85	8.69	90.85	78%	10 yr / 24 hour	10%	10%	40%	79.5%	3.5%	1.7%
12 Stono River	48.7%	9.6%	70.56	6.86	71.55	50%	10 yr / 24 hour	10%	10%	40%	50.9%	2.2%	1.1%
13 Stono River-Atlantic Intracoa	68.0%	14.0%	1,419.17	137.90	1,445.45	70%	10 yr / 24 hour	10%	10%	40%	72.0%	4.0%	2.0%
14 Upper Cooper River	82.6%	3.6%	497.54	48.68	506.48	84%	10 yr / 24 hour	10%	10%	40%	86.1%	3.4%	1.7%
15 Wadmalaw River-Atlantic In	81.9%	6.2%	9.49	0.92	9.61	83%	10 yr / 24 hour	10%	10%	40%	84.7%	2.8%	1.4%

The trees and stormwater calculator tools uses the local landcover and plantable areas to calculate how much water existing or future trees will soak up.

Creating the land cover maps and data to run the Stormwater Calculator Tool requires computer skills in GIS. Cities usually have a GIS staff person, but not all GIS staff are skilled in using remotely-sensed data to create canopy maps. If the community already has a canopy map, further work using GIS is needed to add roads and sidewalks to account for canopy overhanging paved surfaces and to calculate plantable open spaces. The spreadsheet tool can then be populated with the canopy and plantable area data, to create a custom stormwater calculator tool. Technical instructions for how to customize a canopy map to be used with the Trees and Stormwater Calculator Tool are on GIC's website at: http://www.gicinc.org/trees_stormwater.htm

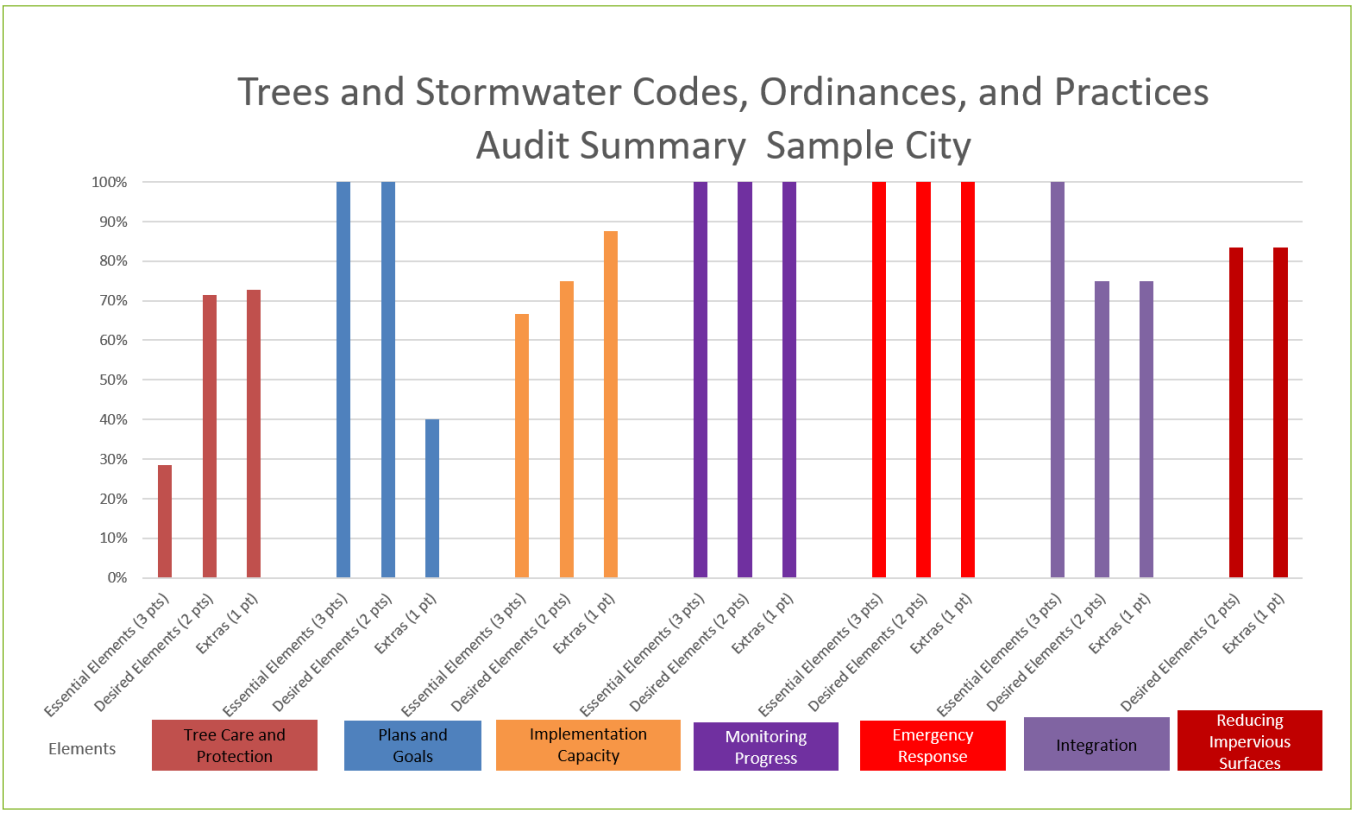
The Center for Watershed Protection also has suite of tools for crediting stormwater uptake by trees. For more, see: https://www.cwp.org/making-urban-trees-count/

In addition to providing stormwater credits for tree conservation or planting, local governments should review their codes and policies to determine if municipal codes and policies are causing a loss of open space or protecting the urban forest. GIC provides a tool for cities and urbanizing counties called the Codes, Ordinances and Forest Practices Audit Tool (COFPAT) to evaluate whether local codes and policies make communities more impervious or more

According to the U.S. Environmental Protection Agency (EPA), excessive stormwater runoff accounts for more than half of the pollution in the nation's surface waters and causes increased flooding and property damage, as well as public safety hazards from standing water.

tree covered. Based on field testing with 15 communities, the COFPAT is a simple Excel spreadsheet with a series of queries concerning those aspects of a city or town's codes, practices, plans and programs that make the community more or less likely to expand impervious surfaces and the best practices for urban forest management. The tool's purpose is to help communities recognize ways to reduce excess impervious areas, maximize forest cover and provide good urban forest management.

Each practice or code receives points based on its importance. The tool provides results for where a city has done well and shows areas for improvement. It requires some familiarity with planning and forestry regulations, but it can also be filled out by a novice or intern with some additional research. The Excel spreadsheet and instructions for using the audit tool can be downloaded at: http://www.gicinc.org/trees_stormwater.htm



The Codes, Ordinances and Forest Practices Audit Tool (COFPAT) can be used to evaluate whether codes and policies make communities more impervious or more tree covered and they get a chart showing them where to improve.

The Liberty suspension bridge in Greenville SC allows residents to walk amongst the downtown's treetops. Interacting with nature improves both mental and physical health.

Section Summary

In this section, we have covered the basic codes that cities, towns and counties should consider to better protect or expand their forests and foster healthy trees. Charts provided the specific examples for where ordinances can be obtained and then adapted to meet your own community's needs. In Section V, we consider on-going forest care and management and funding, along with case studies of urban and community forestry programs at various stages of development.

V. Implementation of Urban and Rural Forestry Programs

In Section V, we focus on the key ingredients for successful urban and community forestry programs within local governments and the importance of partnerships and funding to achieve community aims. Case studies throughout the chapter provide examples of these ideas in action.

Establishing Long-Term Goals and Management Plans

The need for management of both urban and rural forests was discussed in Section Two. In Section Five we emphasize the importance of on-going monitoring under an "adaptive management" framework. Forest management ensures there is a methodology applied to the managing of rural and urban forests and a budget to meet management needs. For a rural forest, management may include plans for timber harvesting, wildlife conservation, the protection of surface waters and the mitigation of invasive species. Such plans can be completed for both public lands, such as state forests, and privately owned land.

Adaptive management

When working on specific natural resource goals, adaptive management can be a very useful approach. This treats natural resources management as an on-going process that emphasizes the need to continually evaluate whether goals are being met, and if not, to make changes to the plan. Indeed, the goals themselves may also be changed.

Some goals may only be partially met because they were unachievable in practice, implementation was lacking, or because of unanticipated events. For example, a forest restoration goal might not be met because newly planted trees were destroyed by a hurricane. Or a plan for a prescribed fire comes up against local community objections. You may also find that local ordinances or easements prohibit some action you hoped to take.

Adaptive management means that you adapt your plan to meet these challenges by periodically updating it. For example, you might decide to change your planting schedule, or increase your tree planting for the next year, in order to reach your established goal. Or you might decide to adjust your goals downwards, or extend a five-year plan out to seven years, if time or funds for new trees are insufficient to meet the new need.

As noted previously, when establishing goals for your future tree canopy, data should be gathered to determine current tree cover and available planting space. A good example is the community with a tree planting goal that exceeded all the available open

space and would have required razing buildings to achieve it. That mistake could have been avoided by using data to establish a realistic goal. When determining plantable areas, calculations should subtract areas where it is undesirable or impracticable to plant, such as sports fields or areas with overhead or underground utility conflicts. A goal to plant no more than half the available open space is usually realistic because this will leave room for other outdoor activities, such as vegetable gardens, flying kites and field sports.

For more on adaptive management, see: https://www.fs.fed.us/rm/pubs_series/rmrs/gtr/rmrs_gtr389/rmrs_gtr389_02.pdf

Also see: https://cpr-assets.s3.amazonaws.com/documents/Adaptive_Management_1104.pdf

Adaptive management treats natural resources management as an on-going process that emphasizes the need to continually evaluate whether goals are being met, and if not, to make changes to the plan.

Whether managing a rural or urban forest, one thing is certain: unexpected changes will occur, many of which will be outside the control of whoever crafted the management plan. Imagine if a major industry moves to town and suddenly there is the need to house 20,000 more people. The demand to convert open space for development may be overwhelming. This will require a nimble local government to plan for more density; new growth areas to avoid massive deforestation or the adoption of new rules to ensure that minimum canopy is achieved in newly established neighborhoods.

In rural areas, a new pest could cause the forest to decline or a hurricane could cause extensive salt and wind damage that results in severe long-term issues and dramatically slows down its recovery to a healthy forest state. Depending on the source of the change, you might decide on a management action that treats the pest, or to divert resources from a new tree planting area into restoring trees in older neighborhoods. You might find a way to accommodate rising (or falling) population levels and forest activities into a plan that allows for multiple uses, or that opens up new opportunities.

If the forest area is lost permanently, perhaps as a result of land conversion or sea level rise, the solution may be to protect other forested areas or replant open spaces to avoid a net loss of forest cover.

An adaptive management framework requires monitoring and constant feed-back. So, for an urban or a rural area, establishing a baseline measurement of forest cover can tell you whether forest extent is increasing or decreasing. For urban areas, a tree cover map is essential and there are software tools to help GIS users create such maps. Usually those maps focus on a fine-grained scale of analysis (e.g. 1 meter resolution). However, maps for rural areas are usually at a much larger scale (e.g. 30 meter resolution). This is more appropriate for areas where there are few small-scale changes such as new light poles, utility lines, sidewalks or driveways to account for.

In rural areas, a forest stewardship plan can help the landowner recognize the values the forest provides to a community and set management goals and best practices to achieve desired outcomes. These values can include safe

The Benefits of a Healthy Forest

- **safe drinking water**
- **increased wildlife**
- **beautiful viewshed**
- **local recreation**
- **noise barrier**
- **cleaner air**
- **health benefits**

drinking water, increased wildlife, a beautiful viewshed, local recreation opportunities, noise and smell barriers, health benefits, and so on. A community should establish what these values are and even rank them in terms of priorities, and any goals of the management plans should be oriented towards achieving those priorities.

For more on family farm ownership, tools and other certification programs, such as The South Carolina Tree Farm Program and the Sustainable Forestry Initiative, see: A Landowner's Guide to Forestry in South Carolina at: https://www.state.sc.us/forest/sfilg.pdf

Urban forest programs: gap analysis

For urban and suburban areas, there should be standards and policies in place to ensure that trees in public places are planted properly, that they are not excessively cleared for development, and that reviews for proposed developments consider all the key factors that can affect the urban forest. A gap analysis is one way to determine if forest policies are lacking. Gap Analysis is the comparison of actual performance with potential or desired performance; that is, the current state and the desired future state.

Refer to the chart in Chapter One for a list of essential elements for an urban forestry program. Consider whether there are key ordinances missing in your community:

- Do you require tree removal permits?
- Do you have a tree protection ordinance, landscaping standards or canopy requirements for new developments?
- Do you allow for conservation subdivisions, or do you offer incentives for tree conservation, such as density bonuses?
- Do you engage your urban forester in review of site plans or concept plans for sites with extensive forest cover or sensitive features, such as wooded wetlands?

As noted previously, GIC's COFPAT tool allows communities to determine if they have all the right codes and practices in place for managing their urban forests and for reducing paved surfaces that contribute to stormwater runoff. That tool is available at: http://www.gicinc.org/PDFs/TSW_Codes_Ordinances_Review_Template_Final.xlsx

Keys to Urban Forest Management Plan (UFMP)

A good urban forest management plan is far more than a cataloging of urban forestry operations — it should also anticipate and identify future needs. The plan should detail key management actions, which may include:

- **plans for tree inventories**
- **maintenance and tree care schedules**
- **risk assessment activities**
- **allocation of personnel**
- **budgeting and both short- and long-term goals**

Urban Forest Management Planning

An urban forest management plan (UFMP) is a long-term strategic document that provides recommendations and action items to assist tree care professionals to manage an urban forest. A UFMP is defined by the area of interest (geographic or political boundaries); the timeframe for the plan; the population being served; and the type of resources being managed (public, private or both).

An Urban Forest Management Plan should also anticipate and identify future needs.

Urban forest management plans (UFMP) are usually developed for city or town agencies to cover canopy goals, tree inventory and care, and budgeting for tree protection and risk management. A key application of UFMP's is to establish the city or town's best practices when it comes to managing their urban forest.

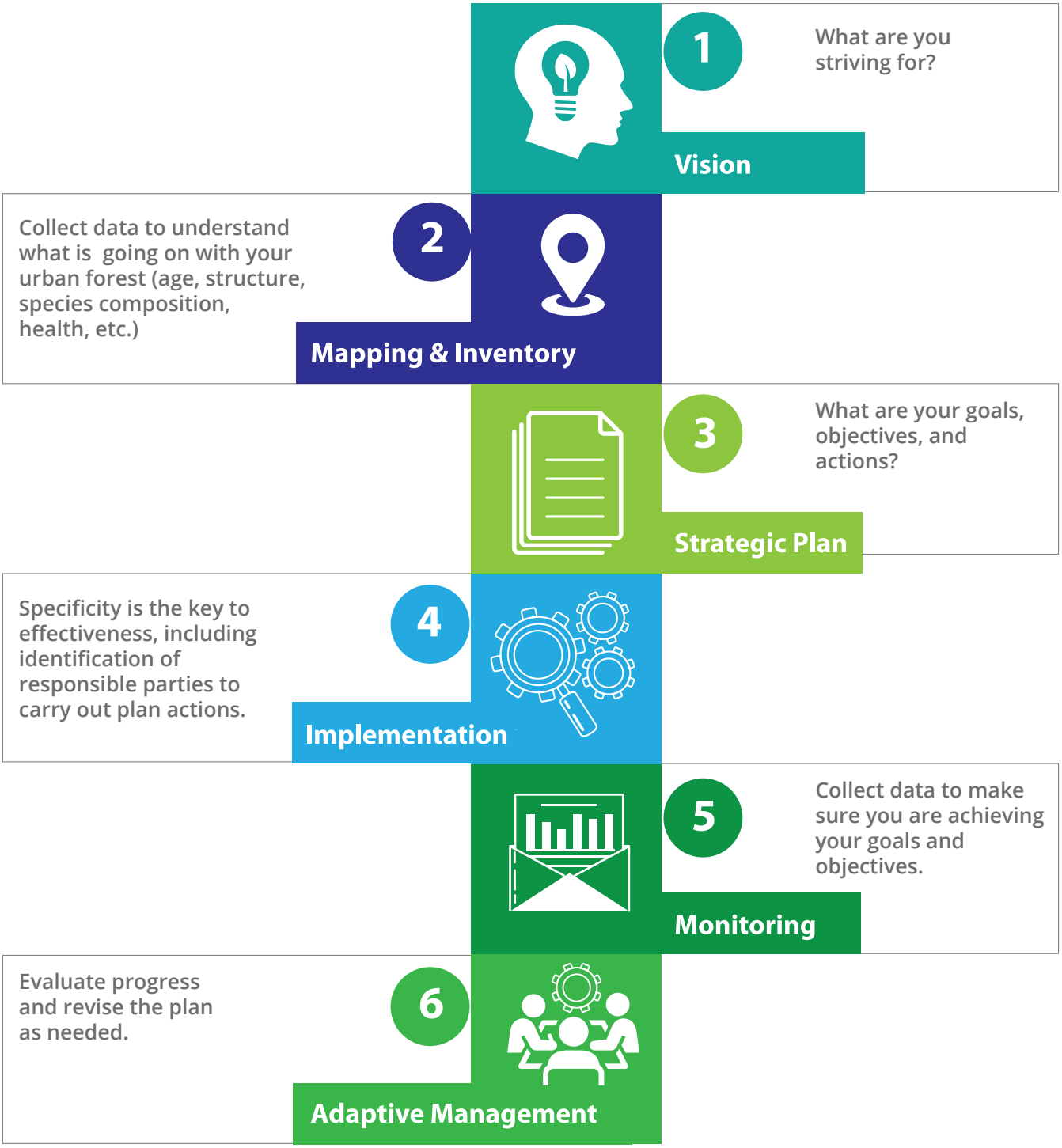
A UFMP should be far more than a catalog of urban forestry operations. It should also anticipate and identify future needs. For example, if the town is located on South Carolina's coast, the plan could highlight the need to utilize more salt-tolerant tree species, since coastal storms may increase in the future. It could also implement a plan for urban waste wood and an improved method to salvage storm-damaged trees for such uses as specialty carpentry, lumber and fuel.

Since private lands make up close to 80% of most jurisdictions' land covers, it is important that the process is collaborative. Creating partnerships with local stakeholders and engaging with the public early and often can make all the difference.

Questions to consider before getting started

- What area of interest does the plan encompass?
- What is our baseline data on forest extent, health, tree types, pest infestation, soil types, future threats, current laws, codes and public access, etc.?
- Who will gather this data?
- Who are the stakeholders we need to involve in our development stage?
- Who will benefit?
- What local government agencies will need to be involved?
- How should we involve all these groups in our decision-making process?
- What benefits, or values, does the forest hold for these stakeholders?
- How would we prioritize those benefits and values?
- What are our goals, arising from those priorities?
- What is the timeframe for the plan?
- Can that timeframe be broken down into specific time periods, such as two years, five years, and ten years?
- What resources are available to develop the plan? These include financial, professional and volunteer.
- How should we allocate resources to specific goals?
- How should we monitor the plan? What feed-back do we need to gather, by whom, and at what intervals?
- What are the possible obstacles to meeting our goals? Do we need a contingency plan?

Basic Framework for an Urban Forest Management Plan



In general, the plan creates a shared community vision for the forest, collects tree inventory and other data, analyzes and evaluates data, develops goals and priorities, sets specific action items and benchmarks, guides implementation, creates a system for monitoring progress and evaluates progress to revise the plan accordingly. If your community lacks the time or expertise to create a plan, there are many consulting foresters and organizations that help with forest management planning, mapping or inventories. The SC Forestry Commission provides guidance on what to look for when hiring a tree care professional, at: https://www.state.sc.us/forest/urbanpr.htm, and Appendix B provides a sample request for proposal templates for hiring outside consultants to provide tree inventories, canopy mapping and management plans. Other elements typically included in the plan are: annual budgets and expenditures, local codes, ordinances and policies related to trees, and best management practices.

Urban forest management plans can either be developed in-house by city planning staff and municipal arborists or contracted out to professional tree consulting firms.

Urban forest management plans can either be developed in-house by city planning staff and municipal arborists or contracted out to professional tree consulting firms. Several online resources exist such as the U.S. Forest Service's Urban Forestry South, which has an urban forest management planning tool and library to get you started. Another online resource is the Urban Forest Management Planning Toolkit hosted through the U.S. Climate Resilience Toolkit, an interagency initiative under the U.S. Global Change Research Program. It outlines the framework for an effective UFMP and navigates the user through the steps to create a management plan. The site includes template tables for developing goals, objectives, timelines, a monitoring plan, implementation plan and more.

Follow these two links to access tools to help you prepare for or develop your own urban forest management plan:

> U.S. Forest Service Urban Forestry South — Urban Forest Management Tool, at: https://urbanforestrysouth.org/products/management-plan-tool
>
> U.S. Global Change Research Program's Climate Resilience Toolkit — Urban Forest Management Toolkit, at: https://ufmptoolkit.net/

Other avenues for urban forest management include resiliency planning or green infrastructure plans at the landscape scale. The U.S. Forest Service has established standards for what they hope to see in UFMPs: https://apps.fs.usda.gov/nicportal/cars/help/hs/cars_help.htm#t=Glossary.htm%23management_plans

An urban forest management plan can be useful for any jurisdiction regardless of size or population, or even level of programming. However, some elements are necessary prior to developing a plan. For example, if your community does not have data about your urban forest, such as an urban tree canopy map or a tree inventory, then those data need to be developed before diving into the planning process.

To give you an idea of what other communities of various sizes and populations have done with their management plans, check out these examples of southern urban forest management plans:

Charlotte, NC (297 sq. miles, pop. 857,000)

The city of Charlotte, NC, developed an urban forest management plan in 2016 that was launched in 2017. The city maintains a website that outlines the UFMP's process, action items and progress-to-date, as well as its partners and how to get involved. The web site provides a centralized source of information update the public and partners on progress. This also maintains accountability in terms of achieving goals and action steps.

Review Charlotte's Urban Forest Management Plan and website here: http://charlottetreeplan.weebly.com/

Decatur, GA (4.5 sq. miles, pop. 24,000)

The suburban community of Decatur, just outside the Atlanta Metropolitan Area, developed a community forest plan in 2012. Highlights of the steps it is taking to improve its urban forest include: a canopy increase of 5% over the next 25 years; hiring a full-time city arborist; a strong focus on community engagement and education to increase tree literacy; and the establishment of a tree utility fee to provide consistent funding and support for its urban forest. These action steps are just one element in the plan, but they define both community priorities and steps for implementation. Learn more about Decatur's tree canopy and community forest management plan at: https://www.decaturga.com/sites/default/files/fileattachments/planning_and_zoning/page/7192/decaturcommunityforestmana.pdf

As these examples illustrate, even small communities can develop programs and plans to manage urban forests. For more, see the case studies see the small South Carolina towns of Sullivan's Island and James Island featured in this section.

CASE STUDY

Sullivan's Island, SC

3.5
square miles

1,900
2019 population (est.)

The Town of Sullivan's Island is located in South Carolina's Lowcountry, not far from Charleston. Although the town is small, it does a lot to protect its trees. Indeed, it has been a Tree City USA for at least five years (as of 2021) and annually celebrates Arbor Day under the guidance of the Town's Tree Commission. When planner Joe Henderson took over as the Director of Planning and Zoning several years ago, he realized he would be staffing the Tree Commission, in addition to the other planning and zoning boards and commissions. To prepare for this, he studied for and was awarded certification as an arborist by the International Society of Arboriculture (ISA).

Photo credit: Town of Sullivan's Island

The town celebrates Arbor Day annually.

Being a certified arborist has proven to be very important, not only to staff the Tree Commission, but also to administer the city's tree ordinance. The town limits removal of Category 1 trees (16" DBH or greater), unless approved by the Tree Commission, and such removal can only be allowed under a prescribed set of criteria articulated in the Commission's by-laws. Even if trees are deemed to be hazardous, as the result of a certified tree risk assessment, Category 1 trees can only be removed with the approval of the Planning Director.

When a tree's removal is requested, Henderson usually conducts a site visit to verify the findings of the certified arborist's report and will often talk with the landowner about why they wish to remove the tree. According to Henderson, "One of the most gratifying things I do in my job is talk to people about tree care and maintenance." The result is that local tree care companies know the town will not approve a tree removal unless it is adequately mitigated or supported by a legitimate tree risk assessment.

One key reason that the town supports its trees is its awareness that trees soak up a tremendous amount of stormwater. According to Henderson, "Islanders understand that trees mitigate our severe drainage issues. Every tree you cut down means more sheet flow of rain water across your driveways and streets."

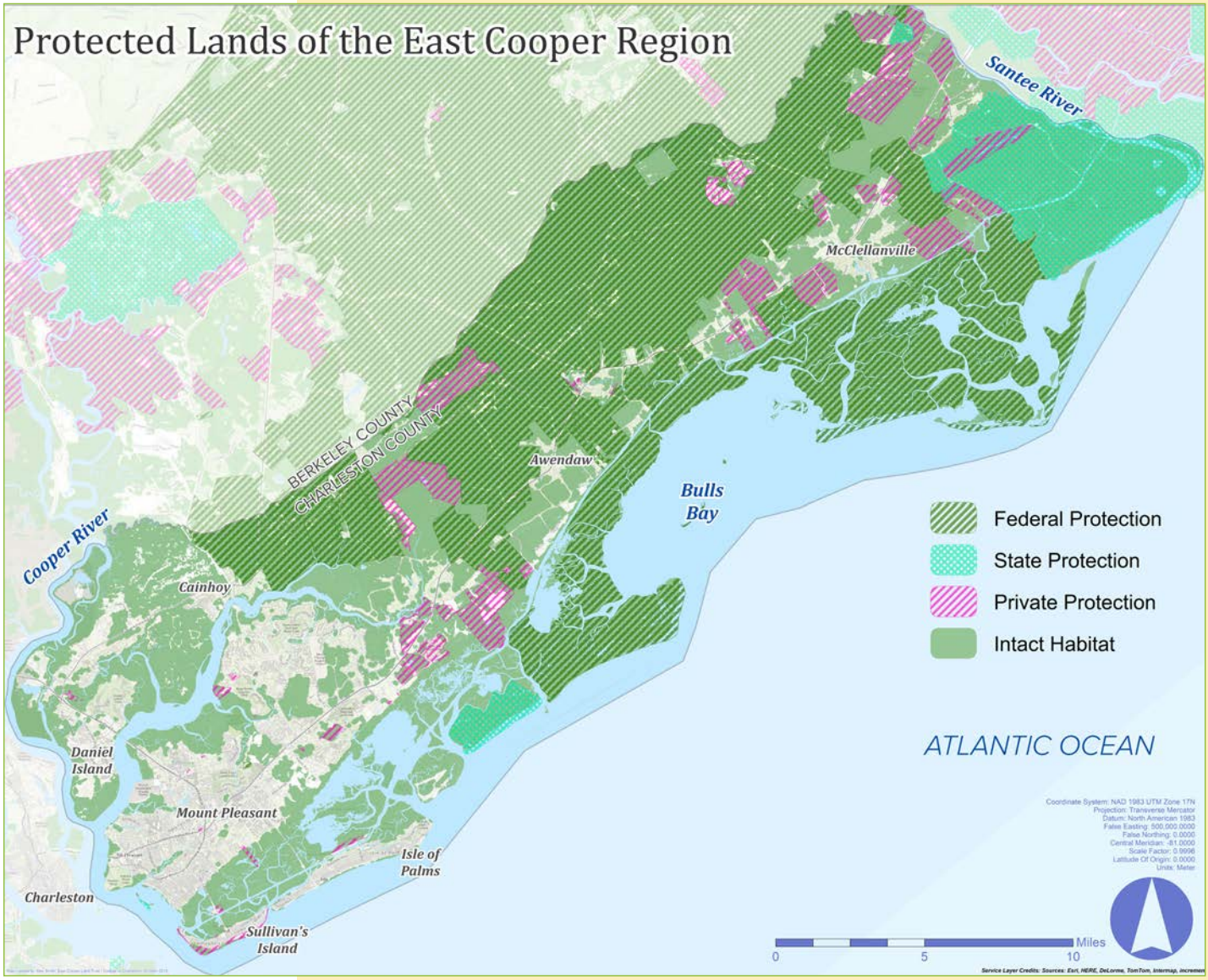
CONTINUED

CASE STUDY
Sullivan's Island, SC

The town is also familiar with the notion of trees as "green infrastructure." They previously participated in a green infrastructure study with the East Cooper Land Trust to work on connectivity of their green landscape throughout the town and beyond. Furthermore, Sullivan's Island is part of the regional greenway that reaches south to Mt. Pleasant and north to the Santee River.

A copy of the town's green infrastructure plan can be found at: https://www.scseagrant.org/wp-content/uploads/2017-East-Cooper-Connected-Land-Conservation-Plan.pdf. The town manages over 200 acres of deed-restricted protected land, which includes trees and dunes that protect the town from ocean storm surge.

Sullivan's Island is part of the regional Green Infrastructure Plan.



Credit: East Cooper Land Trust

The town's comprehensive plan was recently updated and guides continued work to ensure its trees remain healthy long into the future. The importance of these resources is recognized in the town's current comprehensive plan, which has as one of its overarching goals: "Natural Resources Policy 4:

> ***Encourage the use of native vegetation and protection of existing trees on public and private property."***

In October, 2015, the Planning Commission developed a Zoning Ordinance regulation that proactively incentivizes shoreline retreat from beachfront development by encouraging the removal of single-family homes from buildable island properties, while encouraging conservation easements, in recognition of the fact that "all properties on Sullivan's Island are part of a dynamic and everchanging barrier island environment, which are predisposed to erosion, loss of critical dune vegetation and potential structural damage." ■

CASE STUDY
Sullivan's Island, SC

The trees are part of the town's heritage as well. Perhaps the most famous tree is "The Goldbug Tree," originally thought to be the inspiration for Edgar Allen Poe's short story The Goldbug. Poe was stationed as a young naval officer at Sullivan's Island in 1840 and was inspired to include the tree in his dramatic story of pirate treasure.

Credit Town of Sullivan's Island

CASE STUDY

James Island, SC

4.77
square miles

12,100
2019 population (est.)

The Town of James Island has long cared for the health of its trees. Since the fall of 2014, the town of has celebrated South Carolina Arbor Day on the first Friday of December with James Island Pride (the town's environment and beautification committee). In December 2020, the town formalized its commitment to tree protection by becoming a designated Tree City USA with the National Arbor Day Foundation, as well as instituting a Tree Council. One impetus for formalizing the town's commitment to its trees was citizen concern over the loss of trees in the surrounding area. Like many coastal communities in South Carolina's Lowcountry, the region is experiencing high growth pressure.

Credit: Town of James Island

One challenge, according to the town's planning director Kristen Cane, is the sometimes confusing and complicated jurisdictional boundaries separating the town, the City of Charleston and unincorporated areas of Charleston County. Attendees to tree events are sometimes unsure if they are allowed to participate. However, the town strives to be inclusive and welcomes everyone to engage in tree events or giveaways.

Garrett Milliken, Chairman of the Town's Trees Council and also a Town Councilman, acknowledges the importance of town trees, stating that, "We are pleased to have planted dozens of trees, including live oaks, red cedars, red buds, tulip trees and many others. We have enjoyed working with middle school and high school students, Boy Scouts and Junior ROTC members to plant trees on our sea island. Our goal is to continue to replenish, and also to protect and care for, our island's urban tree canopy. SC Arbor Day, and now our Trees Council, is a great way to bring our community together to do that."

The town protects its "grand trees" by ordinance, which defines them as "Any species of tree measuring 24" or greater diameter at breast height (DBH), except pine and sweet gum." All grand trees are prohibited from removal unless a grand tree removal permit is issued. The ordinance allows that, "Any invasive tree species, as referred by Clemson Extension and the South Carolina Exotic Pest Plant Council, shall be exempt" from removal prohibitions. Staff require that removals are allowed only for damaged trees that pose a significant risk. If there is no obvious damage, a certified arborist must sign off on the removal application.

New programs underway for the Town's Tree Council include awards for "canopy of distinction" to recognize residents and businesses with exceptionally good tree cover, who are expanding educational opportunities and working to get more street trees planted. The Tree Council also recently decided to take up acorns from their heritage "Pinckney Tree." Each tree committee member will strive to grow 50 seedlings in time to give out to children to plant at the town's 2022 Arbor Day celebration. Cataloging and surveying the island's urban tree canopy with mapping software is another major project that the Tree Council will embark on in 2021, with the help of several interns, staff and an arborist. ■

CASE STUDY
James Island, SC

The Pickney Tree pictured is a live oak located within Pickney Park. It is named after former slave Simeon Pinckney, who joined the Union Army at age 16, enlisting in the 3rd South Carolina Infantry and the 21st U.S. Colored Infantry. After the war he bought the land where this tree stands for $350.00, where he farmed, raised his family and invited others to join him. Many generations later, the family sold the land to become Pickney Park, where this protected heritage tree resides today.

Emergency Management, Assessment, and Planning

Climate change is already having significant impact on events such as hurricanes, tornados and wildfires, making them more intense and more frequent than before. And with these natural disasters it is becoming clearer that communities need to prepare for the worst when they plan for and safeguard their infrastructure, including green infrastructure and urban forests. As with any asset that needs to be managed, trees should be maintained and assessed for risk of failure. By creating and implementing a forest storm mitigation plan, a community can achieve greater resilience in its urban forest before, during and after a disaster.

These storm mitigation plans are in addition to, and should be informed by, a community's urban forest management plan (UFMP). Much of the same data, such as canopy maps and tree inventories, are used to evaluate and develop priorities and targets for the UFMP, which can be utilized to evaluate a community's preparedness for severe weather phenomena and disasters.

Having a strategic plan in place before disaster strikes is critical to the efficiency of tree debris cleanup. Working together with emergency managers, fire, public safety, utilities, and community liaisons to develop an agreed upon strategy will make the difference in how and where cleanup occurs and can be the difference between accessing federal dollars to reimburse a locality's cleanup costs or shouldering the cost burden alone.

Storm preparation

Storm preparation is the advanced work required to get a community ready in the event of when, not if, a disaster occurs. Storm preparation requires pulling together a mitigation team, reviewing data, highlighting critical facilities and infrastructure, determining areas for staging and debris management, creating advanced readiness contracts and cooperative agreements, mitigating tree risk, and developing a communication's strategy and plan to share information internally and with the public. This work is the most critical in a preparation plan. The more of this work a community has done in advance of a disaster, the more able it is to respond and recover in its aftermath.

Storm response

Storm response takes place in the immediate aftermath of the event and can last for several months or longer, depending on the severity of the storm and the extent of the damage. Storm response is about mobilizing resources, diverting and managing debris clean-up efforts, assessing damage to the urban forest, sharing information with the public and detailed record keeping. This is the hard, grinding and resource-intensive work needed to get a community back up and running after a major disaster. Often, depending on how well prepared a community is, there can be uncertainty and chaos as to what to do. Advanced planning and decision-making in times of calm can provide the guidance needed to address issues on the ground during the response phase.

Depending on how well prepared a community is, there can be uncertainty and chaos as to what to do after a major disaster. Advanced planning and decision-making in times of calm can provide the guidance needed to address issues on the ground during the response phase.

Storm recovery

Storm recovery occurs after both the storm event and the storm response phase, though the last two may well overlap. It comprises post-storm analysis, inventory, ongoing tree mitigation, tree planting, recordkeeping, and continued outreach to, and education of, the public. This includes work to replace lost trees, evaluate new risks from the event and continue ongoing maintenance and mitigation to prevent or reduce future risk. To learn more about forest storm mitigation planning, see the Storm Mitigation Planning Manual at: http://gicinc.org/storm_mit.htm.

Sustainable Funding

There are multiple ways local governments can fund activities related to urban and rural forestry. Following is an overview of the various options.

It is a good idea to dedicate funding to programs that protect rural forests. Charleston County, SC, established a bank account separate and distinct from all other city funds.

Capital Improvement Plans (CIP)

While the CIP is viewed as the budgeting tool for capital and construction projects, the CIP can also support the acquisition of forests for new parks and trails, planting trees to protect reservoirs or drinking water intakes, the creation/beautification of entrance corridors, trees for traffic calming projects and downtown revitalization, or fortifying storm buffers along rivers, wetlands and bays.

Taxes and bonds

Voter-approved ballot measures can allow for the generation of revenue through a variety of fiscal instruments, such as taxes or bonds. According to The Trust for Public Land's LandVote database, the three most common public financing options used by communities over the last 30 years were general obligation bonds (41%), property taxes (41%) and the sales tax (8%) (McDonald et al 2017).

Types of tax that can be used to fund urban forestry

General Obligation Bonds | Property Tax | Sales Tax (goods, lodging, food and beverage) | Fuel Tax | Real Estate Tax | Utility Tax

Urban forestry programs are often budgeted for under the General Fund, though they may also be found within the budget of the Departments of Public Work or Parks and Recreation. One risk to having urban forestry programs under the General Fund is that, during times of fiscal austerity, it will have to compete with other critical services, such as public safety or infrastructure repairs. Dedicating a revenue source for the urban forest through a special tax reduces conflict. St. Louis, Missouri, uses a combination of sales and property tax to fund its urban forest program. Since research shows that trees increase property values and that people shop longer and spend more in well-treed districts (Wolf 2007), it seems only fair the urban forest receives a share of the greater tax revenue it generates for the community.

It is also a good idea to dedicate funding to programs that protect rural forests. Charleston County, SC, established an account separate and distinct from all other city funds called the Charleston County Greenbelt Bank Fund, which can receive revenues annually from the proceeds of the half-cent sales tax, as approved by voters. Revenues are restricted solely to financing the cost of greenbelts. This tax was approved by voters in 2004 and led to the protection of 21,000 acres of land, with over 9,300 acres purchased for public parks and greenspaces. In 2016, voters approved a second round of funding of a halfpenny sales tax over the next 25 years. It is estimated this tax will bring in $210 million in additional funds for the Greenbelt Program (Charleston County Greenbelt Program, 2021). Dedicated funding streams are one way to ensure that necessary environmental programs receive consistent funding.

Charleston County Green Belt Program

21,000

acres of land protected

9,300

acres of land purchased for public parks and greenspaces

Sustainable Funding Sources for Urban and Rural Forestry Programs

- Capital Improvement Plans (CIP)
- Taxes and bonds
- Impact fees
- Incentives
- Penalties and Fines
- Stormwater Utility Fees
- Waste wood utilization
- Mitigation Funds
- Tax Increment Financing (TIF)
- Business Improvement District (BID)
- Grant Opportunities
- Public-Private Partnerships

Impact fees

Impact fees offset the impact of a new development or infrastructure project through a one-time fee. An example would be the creation of new park or expanded utility service to offset the impact of a new subdivision. Most local governments in South Carolina do not have impact fees and those that do tend to be in high urban growth areas, such as Charleston, Myrtle Beach and Hilton Head. South Carolina state law requires a locality to conduct a detailed study for calculating the fees, and those fees must be updated every five years. Required fees can vary depending on the type of development and the extent of the impact.

Impact fees are normally applied near the site of the original impact; however, they can provide funding for parks and recreation in the form of open space, stormwater infrastructure or flood control measures, all of which can translate into new greenspaces, tree plantings or upgrading green infrastructure. For example, the Town of Fort Mill, SC, has a development impact fee to fund parks and recreation needs generated by new residential construction.

Incentives

Incentives are a way to encourage desirable practices or preferred development patterns. They can take many different forms and do not have to be monetary in nature. For example, an incentive could be reduced parking requirements in exchange for increasing the number of trees on a site, or fast-tracking or "green lighting" the permit process for a project with a low-impact footprint or ecological design. Other incentives include density bonuses, increases in floor area ratios and stormwater credits for utilizing BMPs, such as increasing the number of trees on a site. In Walterboro, SC, an increase of up to 10 percent in required parking lot trees allows a development to reduce the number of required parking spaces by an equal amount. This benefits the developer by reducing pavement costs, while the locality reduces impervious surfaces that contribute to stormwater runoff.

Penalties and Fines

Penalties or fines disincentivize and punish bad behavior or practices. One common example found in local codes are penalties for removing trees without a permit. A penalty could be payment for the replacement cost, set at $100 per inch of diameter at breast height (DBH) for any tree removed without prior approval. Another example would be to fine motorists involved in accidents that damage trees.

Penalties may not always be monetary. For example, Lexington County, SC, disincentivizes timber harvesting that is conducted to circumvent tree preservation ordinances by having a three-year waiting period after a forestry operation before applying for a development permit.

Waste wood utilization

Instead of chipping, composting or recycling wood waste, a community can sell woody products downed by storms or road construction to a biomass plant or lumber mill. Selling the wood reduces overall energy use and waste, repurposes waste wood into a value-added product and can defray the costs of transportation and landfill tipping fees. Wood waste and its utilization vary depending on its origins, quality and the amount of waste generated. The City of Harrisonburg, Virginia, installed bioreactors to support water quality improvements by removing nitrogen in the Black Run tributary. The wood chips used in the bioreactors originated from ash trees killed by the emerald ash borer at one of its parks. The woodchips safely dispose of wood waste generated by an invasive species outbreak, while also supporting the function of the bioreactor, which removed nitrogen from surface runoff into a stream.

Source: Ridgetoreefs.org

Layered wood chips, filter fabric, and dirt in the bioreactor promote the growth of beneficial microbes and provide physical filtration and water retention. Structuring these materials supports maximum efficiency of the natural nitrogen removal process.

Stormwater Utility Fees

Stormwater utility fees charge property owners for the stormwater generated by their impervious surfaces. Fees are usually tied to the amount of impervious land cover on a site. The greater amount of impervious cover, the higher the rate paid. This incentivizes property owners to reduce their impervious cover by installing infiltration practices, such as rain gardens, bioswales, green roofs and cisterns. The City of Rock Hill, SC, gives stormwater credits for properties that install and maintain stormwater runoff control facilities and institute BMPs for stormwater and other water-quality controls. Arlington County, Virginia, uses a

portion of its stormwater utility fee to plant trees on public lands and directly connects the role trees play to meeting its MS4 (multiple separate storm sewer) permit requirements. “As of 2018, Arlington County allots a little over $250,000 per year to its tree planting fund” (Environmental Finance Center, 2019).

Mitigation Funds

A mitigation fund generates revenue through fines or other penalties applied to specific activities, such as development, to replace lost tree benefits. In some localities, this fund can be used for general urban forestry operations; however, its intent is to mitigate lost canopy cover by planting new trees. North Myrtle Beach, SC, established a tree mitigation bank in lieu of tree plantings for development sites that are unable to accommodate new trees, as required by the tree replacement code. The code states that this fund is to be used solely for planting trees on public grounds or in rights-of-way.

Tax Increment Financing (TIF)

Tax increment financing creates special districts where bonds are issued to subsidize development or redevelopment to support infrastructure improvements or create public amenities, such as parks or greenspaces. The bonds’ value is based on future taxes generated from the development. Some states require that TIF funds can only be used in neighborhoods designated as “blighted,” “distressed” or in “economic development areas.” Urban forestry and tree planting are both justifiable uses of TIF funding, since studies show that trees and public greenspaces increase the value of property and provide public infrastructure benefits. An example of successful TIF funding for greenspaces is Legacy Park in Norman, Oklahoma. This 10-acre site was a result of a combination of TIF funding and a private donation for a mixed-use development.

Business Improvement District (BID)

Business improvement districts (BIDs) provide services to the area above and beyond those a city currently provides through a levy or other self-imposed tax. BID funding to support landscaping and tree care is based on the idea that well-kept and green shopping districts attract a customer base, thereby increasing business revenues. Research into the spending habits of consumers indicates

shoppers spend more money and shop longer in well-treed business districts than those with lower tree cover (Wolf 2007).

A BID can make a co-beneficial investment by providing greater public goods that a locality may not be able to provide, while increasing revenue for the businesses that contributes to the funding. In 2011, Columbia, SC's City Center Business Improvement District instituted an annual assessment equal to $0.001844 per dollar of the fair market value of each parcel (based on Richland County Assessor data) for funding a variety of services, which included landscaping services, such as weeding, tree grate maintenance, beautification plantings and other special landscaping projects.

Grant Opportunities

Urban and rural forest grant opportunities are available to localities through public and private sources. Many public grants require matching funds, depending on the agency and source of funds. Most federal grants require a match rate of 1:1, while state and local match requirements vary depending on their policies. Localities can leverage their funds by applying for grants and bringing in private investment for projects. One public grant funding example is the Community Forestry Grants Program administered by the SCFC: https://www.state.sc.us/forest/urbangr.htm

Private foundations, such as the Arbor Day Foundation, provide funds and corporate sponsorships to localities for tree plantings or tree giveaways. Other private foundations fund a variety of program interests, such as education, healthcare, food access or the environment. Private foundations will often change their funding priorities, so it is a good idea to research the current or recent projects they have funded.

Private foundations, such as the Arbor Day Foundation, provide funds and corporate sponsorships to localities for tree plantings or tree giveaways.

Public-Private Partnerships

Finally, public-private partnerships can play a critical role by supporting or financing urban forestry programs and budgets. These partnerships are becoming more common in cities across the country and the next section details how private entities, such as corporations, private foundations, nonprofits, community groups and individuals, are playing a role. For more, see the case study on the Savannah River Clean Water Fund Initiative.

CASE STUDY

2.79 Million total acres
Lower Savannah River Basin

1.5 million people
in two states rely on the basin for their drinking water

78%
of the basin is forested

14,165 acres protected
of forestland (2 conservation easements) in the basin.

4,200 acres additional
received from donated easements

973 acres protected
by closing on a fee simple purchase

60% forested, 210,000 acres highest priority forests
goal over the next 20 years

Savannah River Clean Water Fund Initiative

The Savannah River Clean Water Fund was formed in 2014 by the South Lowcountry Task Force — a group of land conservation partners, land trusts and private landowners — to provide more resources for forest conservation through land protection, improved forest management and support for science and research. The fund's mission is to protect the water supplied by the lower Savannah River to serve communities and businesses in Georgia and South Carolina. The fund is a unique, bi-state, basin-wide approach to coordinate partners in the basin who are interested in drinking water and forest conservation. Partners comprise five different public water utilities in Georgia and South Carolina that withdraw river water, as well as conservation organizations from both states.

The partnership was broadened in 2017 when The Longleaf Alliance launched the Savannah River Clean Water Fund Initiative to provide outreach concerning forest management and land conservation opportunities to forest landowners. The coalition leveraged funds from the U.S. Endowment for Forestry and Communities and the USFS Forest Landscape-Scale Restoration fund to support an expanded role for The Longleaf Alliance as the coordinator and administrator for the Initiative. It also received funding from the National Fish and Wildlife Foundation and from the SoLoACE* Longleaf Partnership to support longleaf pine establishment and restoration, along with landowner outreach to ensure easement compliance.

Photos credit Lisa Lord, The Longleaf Alliance

Tools and policies used so far to achieve objectives:

- conservation easements
- fee simple acquisitions
- landowner outreach
- ongleaf forest restoration

Key takeaway

The project entails non-traditional partnerships and coalitions to protect forests and drinking water. A key lesson is to understand other group's perspectives, challenge preconceived notions, reach out to non-traditional partners and seek common ground.

The fund leveraged the utilities' contributions for conservation easements 5:1.

Partners:

- 5 drinking water utility partners
- South Carolina Forestry Commission
- Georgia Forestry Commission
- The Longleaf Alliance
- U.S. Endowment for Forestry and Communities
- Southeastern Partnership for Forests and Water
- International Paper
- Land Trusts
- Other conservation and forestry partners

Lessons learned and next steps

Working with the budgeting cycle for water utilities has proved challenging since fiscal cycles and needs for closing on transactions for land protections are not always synchronized. In addition, the utility's geographic service areas don't necessarily align with areas of concern for the land trust at the large landscape scale.

The next steps for the coalition are to assess and update the 2014 Watershed Management Priority Index (WMPI), including GIS maps hosted online. The assessment will focus on two approaches: long-term conservation through land protection; and immediate needs for restoring impaired waterways.

The coalition also plans to determine the largest water users within the basin and the status of existing discharges into the river. It hopes to work with these users, such as International Paper, to help them meet regulatory standards for clean water.

Another outreach effort is to local governments, in order to determine how local policies and codes affect forest conservation. The cities of Savannah and Augusta both have drinking water utilities that are art of the partnership, but there is a need to bring local and county government into the dialogue. The group continues its work to broaden coalition membership and funding sources.

*Southern Lowcountry and Ashepoo, Combahee, and Edisto Basin.

Community Engagement: Partnerships, Tree Boards and Planting Campaigns

Community engagement is key for any successful tree or forest program and there are many reasons to engage the community in both rural or urban areas. For example, it is not uncommon for newcomers to a rural area to complain about forestry operations. They may not think of forests as a renewable resource or understand that the view of the forest across the street may be someone's livelihood. Educating residents about the importance of timber to the rural economy is key. Residents who think they have moved to an "old growth" forest area may not realize the forest they are looking at has already been clear cut over four times already – and that sustainable forestry has allowed the landowner to keep that land forested, as opposed to becoming a subdivision or shopping mall.

Consider partnering with the SCFC to host workshops, seminars or public service announcements on the benefits that trees provide for capturing, cleaning and replenishing groundwater, supporting songbirds and other wildlife, and providing other public benefits.

Enlist the community as "partners" in tree care and management. Provide partners with options/encouragement/subsidies or credits to plant trees on their properties, engage them in tree surveys, encourage forest planning for managed open spaces, ask them to support tree purchases and giveaways and more. Engaging with a broader audience will build support for funding forestry programs.

It's important to recognize the role of forests in comprehensive plans and consider a webpage about the county's agricultural products and values, including trees. Highlight how many jobs are provided by forests and the many species found at different stages of a forest's lifespan.

Rural residents also have a role to play in caring for and maintaining trees on their property. Consider partnering with the SCFC to host workshops, seminars or public service announcements on the benefits that trees provide for capturing, cleaning and replenishing groundwater, supporting songbirds and other wildlife, and providing other public benefits. The Extension Service specializes in landowner education and property care. Invite them to host a workshop on tree care or to meet with local landowners.

Urban residents should be engaged, both as people who have a role to play in caring for their own trees, and also to ensure there is public support for the town's urban forest program and budget priorities. As noted, since 20 percent of urban and suburban land is under government ownership or control, the remaining 80 percent is under private ownership, so meeting goals for planting

must engage and incentivize both the public and private sectors. Keep in mind that, although publicly-owned lands may be limited, it's important for local governments to demonstrate good stewardship of the urban forest by "doing their part" to grow the canopy. Most successful urban forestry programs emphasize the importance of community engagement.

Most successful urban forestry programs emphasize the importance of community engagement.

Tree boards

Most cities and towns that have a tree ordinance also have a tree board, and a tree board is also required as part of Tree City USA. However, some of these boards meet infrequently, while others meet often and conduct community outreach for city tree programs and plantings. Tree boards can be a tremendous asset, regardless of the size of a town. For instance, the small town of Irmo, SC, (land area about 6.8 mi2 and population around 12,483) has an active tree board that supports planting projects and has raised more than $100,000 for community supported plantings. The town's Public Works Director relies on the tree board to help with events, plantings and setting goals.

If the board has knowledgeable experts, such as arborists or foresters, they can be consulted to review larger development projects. It can also host community events, such as prepping for and running tree giveaways and broadening participation in town initiatives. For instance, Irmo's tree board is made up of people who know just about everybody, so when the word needs to get out about a tree-related initiative, they connect with the community. Also, if social media support is not well staffed in a community, consider adding an intern or younger person to the tree board who can make social media posts – and ensure continuity for the tree board itself.

The tree board should also be engaged in helping to develop forest visions and goals for the comprehensive plan. They could engage other stakeholders in this effort by chairing a subcommittee that discusses updates to the comprehensive plan. As noted in the case examples in this Toolkit, tree boards can also play a role in regulatory decisions such as large tree removal permits or variances.

Some urban forestry programs stop at a tree board. But engagement should go far beyond just the tree board. Other types of groups to engage in goal setting, education and planting projects are shown in the chart below. Note that these may be some new partners for your city, town or county, and that it is a list of private sector groups only. Also, form partnerships with your regional SCFC staff at: https://www.state.sc.us/forest/scurban.htm. There, you will receive advice on other partnerships, tree planning and planting and potential funding opportunities.

ENGAGING COMMUNITY GROUPS

ENTITY/PERSON	ROLES	ADDITIONAL NOTES
Garden Clubs/Civic Groups	Tree planting, public support	May be utilized to plant trees, support work
Tree Conservation Group	Implement tree planting, public support	May be lead for a planting project if not city-led
Neighborhoods/HOAs	Tree care in common areas, street trees	May need tree care standards
Chambers of Commerce	Fundraise and support public trees and beautification projects	Build support for trees in commercial areas
Hospitals/City Health Officials	Plant arboretums/wellness gardens	May link to existing healthy community plans
Universities and Other Institutions	Manage large treed landscapes	May want data on their own tree cover
Large landholders	May control large acreage of canopy	Land conservancies, private nature preserves
Power Company	Interest in reducing utility conflicts	May fund planting of smaller trees/shade trees
Forest Landowners Associations	Support or participate in planning for rural forestry	Forestry Association of SC has county chapters
Land Trusts	Interest in large forest landscape conservation planning	May also have interest in forest restoration projects

City of Conway, SC

CASE STUDY

24.5
square miles

25,956
2019 population (est)

The City of Conway, SC, has been a Tree City USA for 35 years now, but its tree stewardship is much older. The story of tree protection began in 1886 with the threatened destruction of the Wade Hampton Oak to widen the street for a new railroad. Mary Beaty stood in front of the now famous oak with shotgun in hand and threatened any person who might try to use an ax or saw on the tree. Today, this oak is also known as the "Mary Beaty Tree" and many in Conway attribute this early tree protector to the contemporary city's love for its trees.

According to City Arborist/Landscape Designer, Wanda Lilly, Conway continues to recognize and protect its heritage Landmark trees and regularly receives "growth awards" from the Arbor Day Foundation for efforts to expand tree plantings, protection and awareness.

Photo Credit: Wanda Lilly

The Wade Hampton Oak known as the "Mary Beaty Tree".

When Hurricane Florence pushed the Waccamaw River to flood Conway in the fall of 2018 cresting at 21.2 feet, it caused extreme damage to much of the community, especially since the water receded slowly. As would be expected, in addition to property damages, trees were uprooted or broken, and some also died as a result of prolonged inundation. The city responded by giving away 1,000 new seedlings to city residents to restore what had been lost.

The city also acquired lots that were deemed to have "repetitive loss" from multiple floods and are planting those lots with trees and shrubs to help the properties act as sponges for future floods, as well buffer the community from storms. One mature oak can soak up thousands of gallons of water per year, thus reducing standing water and localized flooding. Park plantings are a key focus for the city, especially parkland along the river damaged by Florence. They are also redoing a parking lot on the Waccamaw River to reduce pavement and expand tree cover.

The city's tree ordinance ensures that trees are protected before, during and after construction. It sets strict policies to prevent tree removals, unless the tree is severely damaged, or its location makes a lot completely unbuildable.

CONTINUED

CASE STUDY
City of Conway, SC

While many communities have tree ordinances, the City of Conway does a particularly good job of helping people understand the rules. As a coastal community, a lot of people have moved to Conway from other places. City Arborist Lilly meets in person with people to look at their trees and explain the rules. The city's website is also very helpful in showing where, when and how to obtain a permit. This is important since many cities don't post their tree ordinance information where the public can find it easily. Applications to remove a significant tree – a "Landmark tree" – must be heard by the Community Appearance Board, which serves as the tree board. They also have detailed rules for avoiding damages during construction (see Section 4 of this toolkit).

"Here in Conway, trees have the right of way—our roads go around our trees because the people here really care about them."

The city regularly surveys its trees and they use a drone to get a good look at the canopy of their larger trees. They also protect smaller trees, such as dogwoods, crepe myrtles and redbuds that are at least 4" DBH, as well as larger trees, such as oaks, magnolias, red maples, bald cypresses, river birches and sycamore that are at least 8" DBH. According to Lilly, the community shares great enthusiasm and pride in its trees: "Here in Conway, trees have the right of way – our roads go around our trees because the people here really care about them."

Photo Credit: Wanda Lilly

Planting Campaigns

Since about 80 percent of available planting space in urban areas is on private lands, fulfilling an ambitious canopy coverage goal requires planting trees on private lands. And, communities likely do not have enough funding to plant all needed spots located on private sites. A tree planting campaign can be used to fund and incentivize participation by the private sector. So, the first step in any tree planting campaign is to get significant public support and engagement. The following steps are abbreviated from a more detailed tree campaign guide published by GIC and the USFS.

01 Step One: Getting Organized:

Decide on who should be involved, and on the organizational structure you wish to create. Can an existing government body take responsibility, or should it be a voluntary organization? Does one already exist, or should a new committee with this one specific task be set up, with limited goals and a limited timeframe? What sort of budget should it have, and who should be invited to attend?

A planting campaign should be on-going throughout the year to build awareness with tree plantings planned for the dormant season when likelihood for tree survival is highest.

01

Getting Organized: Some of the decisions the planting campaign will have to make include the following:

- What will be the name of the campaign?
- Who will lead the campaign? (city, tree planting group, consortium of groups?)
- Who else will needs to be involved?
- Which city departments need to be engaged/informed?
- Does the campaign need partners/ sponsors? What about other voluntary or community groups?
- How will planting locations be chosen?
- What types of trees should be planted? How old? From where will they be obtained?
- How will planted tree locations be recorded?
- How will trees be ordered and paid for?
- Who will do the plantings?
- Who will do continued maintenance and monitoring of the plantings?
- What is the timeframe for the campaign? Just a week? A year? Ongoing, without a specified time period?

02

Step Two: Choose planting areas

(e.g. neighborhoods, river buffers) or planting locations (e.g. parks).

Examples of places to prioritize for planting include:

- business districts, to improve aesthetics, reduce vacancies and increase sales and rental revenues.
- neighborhoods with low canopy, to improve public health, provide access to woodlands for walking, increase property values and improve aesthetics.
- schools and parks, to provide shade, increase use and enjoyment, and provide educational opportunities.
- along waterways and lakes, to increase water quality and provide both wildlife habitat and leisure opportunities, such as hiking and fishing.
- on and near cultural sites, to beautify scenic roads, protect historic settings and provide shade for visitors, picnickers, nature trails, etc.
- at locations affected by climate change, to mitigate urban heating, or places where sea level rise could require new upland plantings to offset lowland losses.

03

Step Three: Obtain free trees, or budget for trees to plant.

Determine if trees can be supplied by the government or a non-profit. If trees are supplied by the government, their planting locations should be tracked to determine progress in meeting the campaign's goals (see below). Some governments use development violation fines or established tree funds to support planting campaigns or simply tap the general fund for the community's landscaping. Due to the public source of these funds, their use may be limited to planting on public lands. Others seek donations from the private sector (which can also be used to overcome limitations to planting on government-owned land).

04

Step Four: Record planting locations.

Create a system to track where trees are planted to determine where and how planting goals are met. If the campaign is a tree give-away, record each recipient's planting location. Use the data to determine equitable distribution based on the campaign's goals and its effectiveness. Many cities offer a planting program that allows residents to request a street tree for their neighborhood. A map of tree planting locations helps communicate to the public a campaign's success. Google maps offers a quick way to pinpoint the latitude/longitude of a planting location and some municipalities such as Summerville SC have developed their own in-house apps to mark planting locations with a smart phone and bring them into the town's GIS.

The next generation plants the next generation of trees as part of the tree planting campaign in Irmo, SC

05

Step Five: Keep the campaign funded and prevent tree losses through year-round education.

The campaign should establish a system to accept and track donations (either through the city or an established nonprofit with a reliable accounting system). Have a system in place to take on-line donations and recognize contributions. Plan public events, such as tree care talks, Earth Day and Arbor Day festivals, tips on growing fruit trees and tree care to continue engagement throughout the year. Devote technical resources such as brochures, consultations or field visits to support landowners who have planted trees, but have questions and concerns. See the Tree Campaign Guide for funding and event ideas for your planting campaign at www.gicinc.org.

Remember that a tree purchased by a homeowner and planted in their yard is the cheapest option as the tree has a greater chance for success away from utilities and impacts from vehicles or crowds.

Partnerships, professional marketing

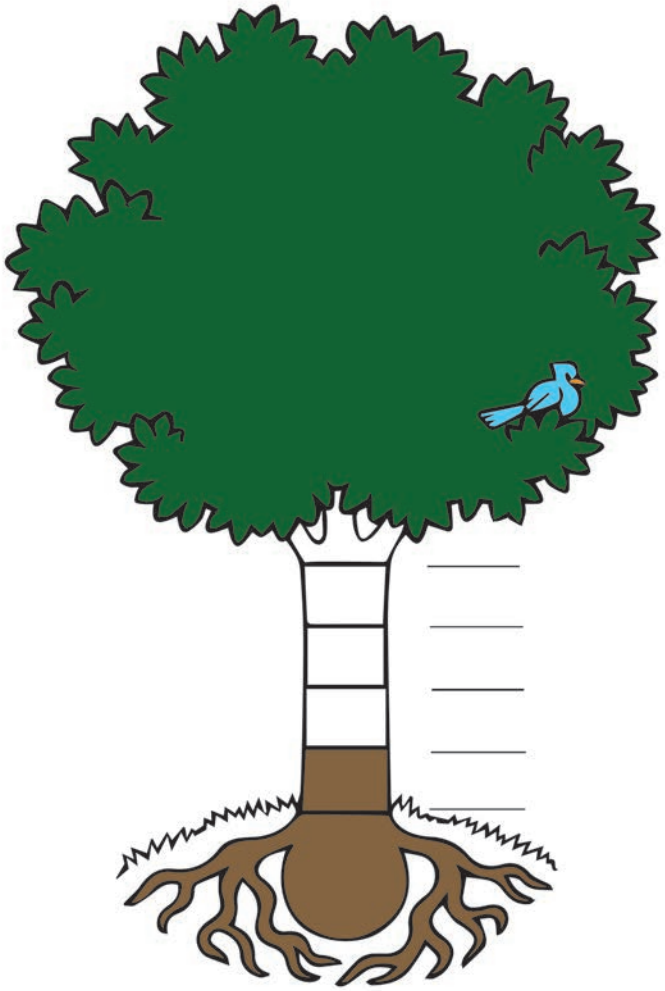
If running a public campaign to plant and care for trees, consider enlisting your city or county's press and marketing staff. They likely already manage social media sites, such as Facebook, Instagram, Twitter and others, and can craft messages that are more likely to resonate with the public or specific target groups. The SCFC worked with the City of Greenville to encourage it to adopt a city-sponsored planting campaign. As a result, it timed the start of its campaign "Rooted in Greenville" to coincide with its new tree ordinance. This showed the community that, while the city was instituting new rules to protect trees, it was also launching a planting campaign to put public dollars into new trees in the ground. The city also gave away trees to citizens to plant in their yards. Trees Upstate was a key partner too, which led efforts with the private sector.

Both the city and Trees Upstate then joined together to adopt a tree canopy coverage goal of 40% and branded their joint campaign as Plant GVL (Greenville). GIC served as the partnership coordinator and contributed technical skills, including mapping tree cover and plantable areas and calculated ecosystem services provide by the city's trees for clean air, stormwater and carbon uptake to show the benefits the city's trees provide. GIC's work was funded by a grant from SCFC, the USDA FS Southern Region and the other partners contributed trees, staffing, campaign media support and logo development.

This example shows the importance of partnerships, as no one group can achieve the work on its own. For more, see the case example of Greenville, South Carolina, on page 175.

Developing professional looking logos is easy with today's clip art and free on-line software. At right is an example of a project logo and on-line media created by GIC for public use.

Key messages should be developed to meet the interests of the intended audience and may be different, depending on demographics and whether the desired outcome is to inform, inspire action or both. An effective marketing campaign is worthwhile to build support for rural or urban forestry programs. GIC inspired Greenville to adopt the theme of "plant the next generation of trees" by showcasing saplings and seeds as the children and grandchildren of the urban forest. They then linked tree images with generational photos of local families to get the point across. To learn more about marketing and messaging, see the Tree Campaign Guide on GIC's website: www.gicinc.org. See ideas for establishing and tracking community goals in the following chart and the Greenville case study.



Create a tree thermometer to record progress toward campaign goals by adding a total and dollar values or numbers of trees to each level.

TOOLS FOR MEETING COMMUNITY TREE PROGRAM GOALS

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Expand canopy cover by XX percent.	Create a tree donation program.	Set a goal for funding/# of trees raised per year or season.	**City of Greenville** **Example**: The Greenville Tree Foundation was established in 1980 to enhance and plant more trees in the community. Over 8,000 trees have been planted since the fund began.
Expand peer support and recognition.	Apply to become a Tree City USA member. Application: https://www.arborday.org/programs/treecityusa/	Maintain Tree City USA status and seek annual Growth Award for Tree City USA.	**Cheraw** **Example**: This small community of approximately 5,500 people has been a Tree City USA member for over 40 years.
Increase awareness of forests and programs. Expand community participation.	Post information on city website or town newsletter about the benefits of trees and contact information regarding tree care and planting.	Set a goal for numbers of unique 'hits' or visitors. Use "Google Analytics" to measure time spent and links clicked.	**Rock Hill** **Example**: Rock Hill maintains a dedicated webpage to its community forestry program, providing a "go to" resource for the public to find information ranging from tree removal permits, species selection lists, to local tree codes. https://www.cityofrockhill.com/departments/utilities/more/utilities/community-forestry
Increase awareness about tree planting and care.	Host an annual public education event for tree care or planting.	Track who participated by location and whether they planted a tree at home.	**Conway** **Example**: One year after Hurricane Florence, the City of Conway planted and gave away $35,000 worth of trees in some of the hardest hit flooded areas. Tree giveaways are tied to the Conway Strong Festival and tree events include opportunities to speak with the city arborist about proper planting and care.

TOOLS FOR MEETING COMMUNITY TREE PROGRAM GOALS

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Expand community participation.	Host an Arbor Day Celebration.	# of media mentions, # of attendees, new trees planted etc.	**Irmo** **Example**: The Town of Irmo holds an annual Arbor Day Celebration to add trees back into community spaces. See some of the most recent celebrations by the community: http://thenewirmonews.com/arbor-day-planting-in-irmo/
Increase engagement and support for tree policies. Increase expertise for the community.	Establish a Tree Commission.	# of meetings and outcomes (consider making a work plan for the year)	**Columbia** *Sec. 17-814.* **Example**: Established; powers and duties of the Columbia Tree and Appearance Commission. The Commission shall have the following powers and duties: **(1)** To review and recommend policies and ordinances affecting the planting, removal and preservation of trees on public and private property. **(2)** To provide advice on the allocation of resources and policies for the planting, care, and removal of trees in the City of Columbia. **(3)** To serve as an advisory body to the city forestry and beautification superintendent in the administration of this article. **(4)** To review and make recommendations related to the city forestry and beautification division's annual work plan and any comprehensive urban forestry or reforestation plans. **(5)** To provide public education and advocacy on tree value, preservation and care. **(6)** To make recommendations to council on disbursements of the Columbia Landscape and Tree Fund. **(7)** To oversee the development and implementation of a master plan for the beautification of the city. **(8)** To advise the city and its boards or commissions regarding landscaping, tree planting, protection and removal.

TOOLS FOR MEETING COMMUNITY TREE PROGRAM GOALS *(CONTINUED)*

TOOLS	GOALS	METRICS INDICATORS	SOUTH CAROLINA EXAMPLE*
Increase engagement and support for tree policies. Increase expertise for the community. *(continued)*	Establish a community tree planting program.	Engagement with government. Number of events and new partnerships # of trees planted	**Irmo** **Example**: The Irmo Arbor Day Committee, a local nonprofit, works in partnership with the Town of Irmo staff to select sites and plant trees in the community, recruit volunteers, and create new greenspaces for residents to enjoy.
	Create or partner with a tree-focused advocacy group.	Engagement with government. Number of events and new partnerships # of trees planted	**City of Greenville & Piedmont Region** **Example**: Trees Upstate partners with Greenville City and County and other localities in the Piedmont Region of South Carolina to advocate and plant trees in the community. Website: https://www.treesupstate.org/

City of Greenville, SC

CASE STUDY
City of Greenville, SC

29.9
square miles

70,635
2019 population (est)

The City of Greenville has long taken pride in the health of its trees and is well known for its amazing Liberty Bridge, which spans the falls of the Reedy River. This suspension bridge and the beautiful park below it resulted from a long-term effort by citizens, the city and the garden club. Like many post-industrial southern cities, Greenville was a textile town that suffered job losses and a resultant economic downturn that led to derelict and vacant buildings in the downtown.

The Carolina Foothills Garden Club wanted to see a beautiful park in the downtown and worked for decades to realize that dream, with the park and bridge finally dedicated in 2004. A key element of the park's establishment was removing the automobile bridge over the falls of the Reedy River, which hid the dramatic beauty below. The Garden Club knew that affording a view of the dramatic cascading falls just below the bridge was key to the park's revitalization. It took a five-year campaign, led by the Garden Club's landscape architect Andrea Mains and Mayor White, to overcome resistance to removing the auto bridge. They both shared a vision for what the parkland could become. Once the old bridge was removed and replaced with the new suspended pedestrian bridge in 2004, the dream to see the beautiful falls and park below was realized.

Liberty Bridge

Reedy River Falls

Tree Along Swamp Rabbit Trail

Today, the park and associated Swamp Rabbit Trail, which traverses an old railroad path, contain impressive trees. This park and the many trees planted and conserved have become a draw for residents, tourists and businesses, leading to a dramatic revitalization of the West End neighborhood and the city's downtown. However, the work did not end with the bridge and park. The city also invested in care of the large

CASE STUDY
City of Greenville, SC

The majestic oaks downtown have been a great investment for revitalization.

Cutaway for Trunk Expansion

Photo credit: TreesUpstate

TreesUpstate leads many planting projects.

oaks downtown along Main Street. These investments led to recognition by *Livability* magazine which ranked Greenville's downtown one of the Top 10 Best Downtowns in the country, and the *New York Times* called Greenville "a national model for a pedestrian-friendly city center."

Another important development in the community's support for trees was TreesUpstate – a nonprofit founded in 2005. TreesUpstate formed to "Plant, Promote and Protect" trees in response to sprawl patterned development spreading through Greenville County. While growth will happen, Greenville County residents thought it could be done better – without losing so many trees - and realized they also needed to replant trees being lost to development. TreesUpstate's board, comprised of many long-standing Greenville families, began by focusing, each year, on planting trees in one gateway (interstate) and one school. In 2008, TreesUpstate expanded this focus to include community tree plantings. It planted 325 15-gallon trees in parks, schools and neighborhoods throughout Greenville County. Its 2010 strategic plan focused on:

1) Legacy Trees – large canopy trees intended to last a lifetime.
2) Neighborwoods – focus on planting trees in neighborhoods.

Realizing that trees are also a social equity issue, and that lower income communities lacked the means to plant their neighborhoods, TreesUpstate created partnerships to make this happen, including the Greenville County Redevelopment Authority (GCRA). This partnership proved to be a tremendously effective way to reach community members and get trees planted in yards.

TreesUpstate's 2010 strategic plan also included a shift from "we plant" to "you plant." Tree giveaways and public tree planting campaigns were one approach to maximize the number of trees planted. Their original campaign was to plant 10,000 trees in 10 years but they managed to plant 11,000 trees within 5 years — so they reset their 10-year goal to the ambitious target of 25,000 trees.

CASE STUDY
City of Greenville, SC

In 2019, TreesUpstate, the City of Greenville, the Green Infrastructure Center (GIC) and the South Carolina Forestry Commission partnered to create a canopy map and goal for a long-term planting campaign for the city. This coincided with the city's work to create a new tree protection ordinance and an associated campaign "Rooted in Greenville," which helped promote passage of an updated tree ordinance in January, 2021. The city showed their commitment to restoring the canopy by linking new rules to reduce tree losses with new tree plantings.

Photo credit: Trees Upstate

The updated tree ordinance improves standards of tree care, protection for heritage trees and for the replacement of total tree diameter for removed trees. The city was very intentional in merging the idea of replanting the city with the new ordinance to better protect city trees. According to the city's landscape architect Edward Kinney, "We've lost over 33 million square feet of canopy since we started taking recorded photos in 2001…and there was really no reason for us to assume that the decline wouldn't continue the way that it had for the past ten or 20 years, unless we did something to substantially halt its decline."[9]

The mission of Trees Upstate is to "Plant, Promote and Protect" trees.

The tree canopy, as mapped by GIC, was shown to cover only 36% of the city. The city and TreesUpstate have now formed a partnership to increase that to 40% canopy cover by 2040, or: "40 by 40."

The city has committed to planting 1,000 new trees per year, while TreesUpstate plans to continue planting and to give away over 3,000 trees annually. With a tree campaign goal of "40 by 40", a joint slogan "Plant GVL" and joint fundraising by the city and TreesUpstate, and with both social media and education efforts begun, the campaign is well on its way to achieving a long-term increase in canopy coverage and a healthy urban forest for the future. ■

Using social media platforms and key messages helps to engage the public. This campaign is part of GIC's Tree Campaign Cities Project with the City of Greenville.

Photo credit City of Greenville

9 "Keeping Greenville green: City Council passes first reading of tree ordinance aimed at replenishing canopy" Anne Maxwell, Jan. 13, 2021, Channel 7 news, https://www.wspa.com/news/top-stories/keeping-greenville-green-city-council-passes-first-reading-of-tree-ordinance-aimed-at-replenishing-canopy/

Outcomes For Your Community

A good urban or rural forestry program will always be evolving. But – if the work has been done to educate the community about the importance of trees; to include tree conservation and expansion in policy documents, such as the Comprehensive Plan, watershed improvement or water supply protection plans; and to require trees as part of development planning – then there should be on-going support for funding the program. A robust effort by local and regional governments, conservation groups, tree advocacy groups and private forest landowners should result in the following, along with specific benchmarks for success:

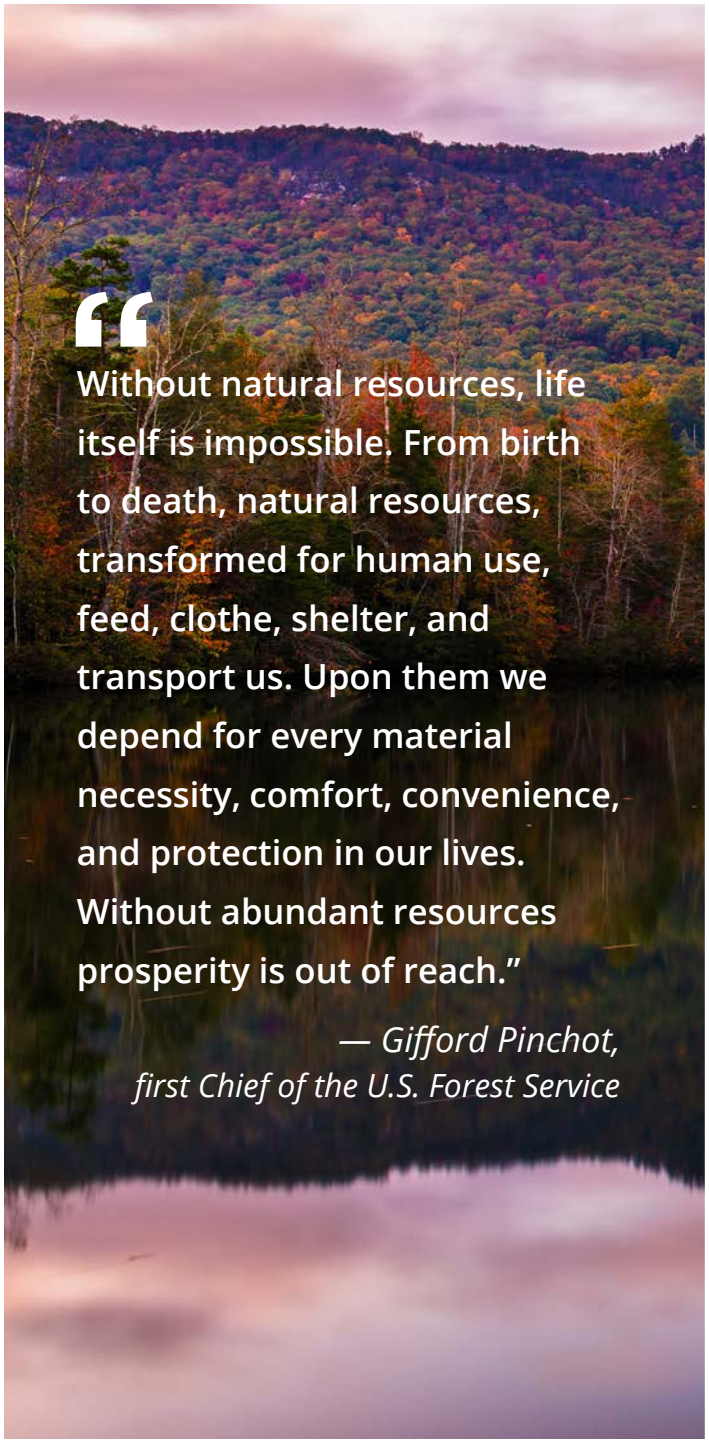
- Support for continued funding of tree planting, conservation and education efforts – dedicated in the budget by the county or city.
- Robust engagement by the public and voluntary planting of trees on private property.
- A canopy goal that is continually being evaluated through new canopy mapping and evaluation of benchmarks for achieving canopy goals, such as trees planted per year and net trees retained (planted trees minus trees lost or removed).
- A decline in complaints – unless there are more complaints due to increased awareness.
- An increase in requests for consultations, such as what trees to plant, which are salt tolerant, how to evaluate tree damage, how to create a forest management plan, etc.
- Development plans that include tree conservation areas, retention of significant trees, new plantings included on site plans, and increased survival of planted trees.
- Increased tree literacy, which can be measured by surveys, types of public inquiries, etc.
- Applications to serve on the local tree board; consider a tree advocacy or boosters group to allow more ways to be engaged beyond the limited seats on a tree board.
- Numbers of trees requested and given away.
- Numbers of new forest stewardship plans requested and implemented.
- Multitude of ways that trees are included in policy-making for such issues as: stormwater management, reducing urban heating, climate change planning, energy conservation, storm preparation, community health and wellness, etc.

Implementing a robust tree focus for a city, town, county or region takes both time and dedication. Urban tree programs often suffer funding cuts during economic downturns. However, compared to many other government programs, tree programs cost relatively little and pay big dividends in return by protecting, and even increasing, property values and health, reducing energy costs, supporting the rural economy and jobs, reducing flooding and runoff, beautifying our landscapes, preserving our drinking water, and much, much more. By calculating social and ecological values (using programs such as i-Tree), mapping (to document tree cover extent and where trees are needed) and publishing and promoting those values, trees can be seen as integral to the success of any community. And just as we fund community health and wellness, so should we fund our trees and forests. Documenting and promoting these values will ensure that tree programs are not cut, but instead are seen as vital to community health and wealth, and as a legacy for future generations.

Oak Avenue, Charleston, South Carolina

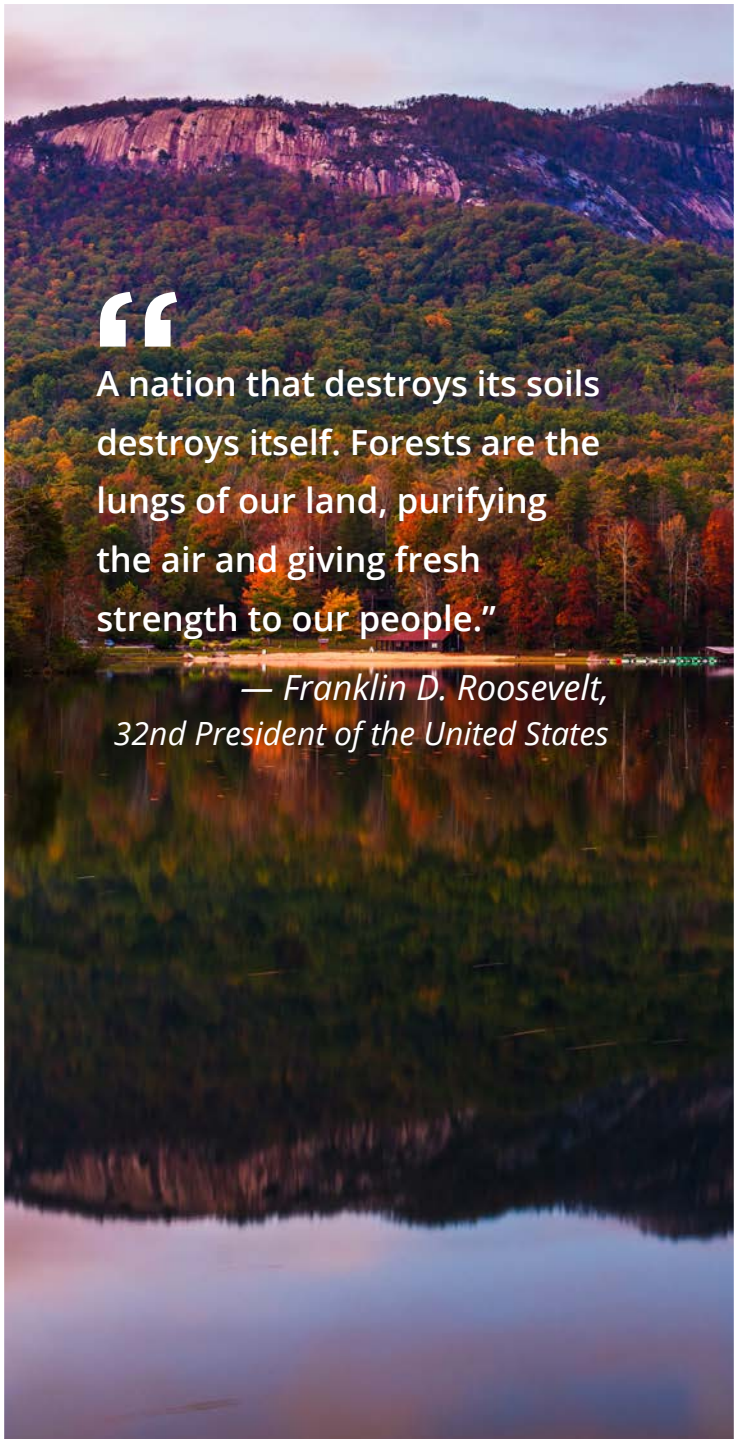
Finally...

We hope this toolkit has been useful. Please continue to use it as a reference as you grow and develop your programs to expand and nurture your forests from wildlands to downtowns. We leave you with some final quotes to inspire your journey...



"Without natural resources, life itself is impossible. From birth to death, natural resources, transformed for human use, feed, clothe, shelter, and transport us. Upon them we depend for every material necessity, comfort, convenience, and protection in our lives. Without abundant resources prosperity is out of reach."

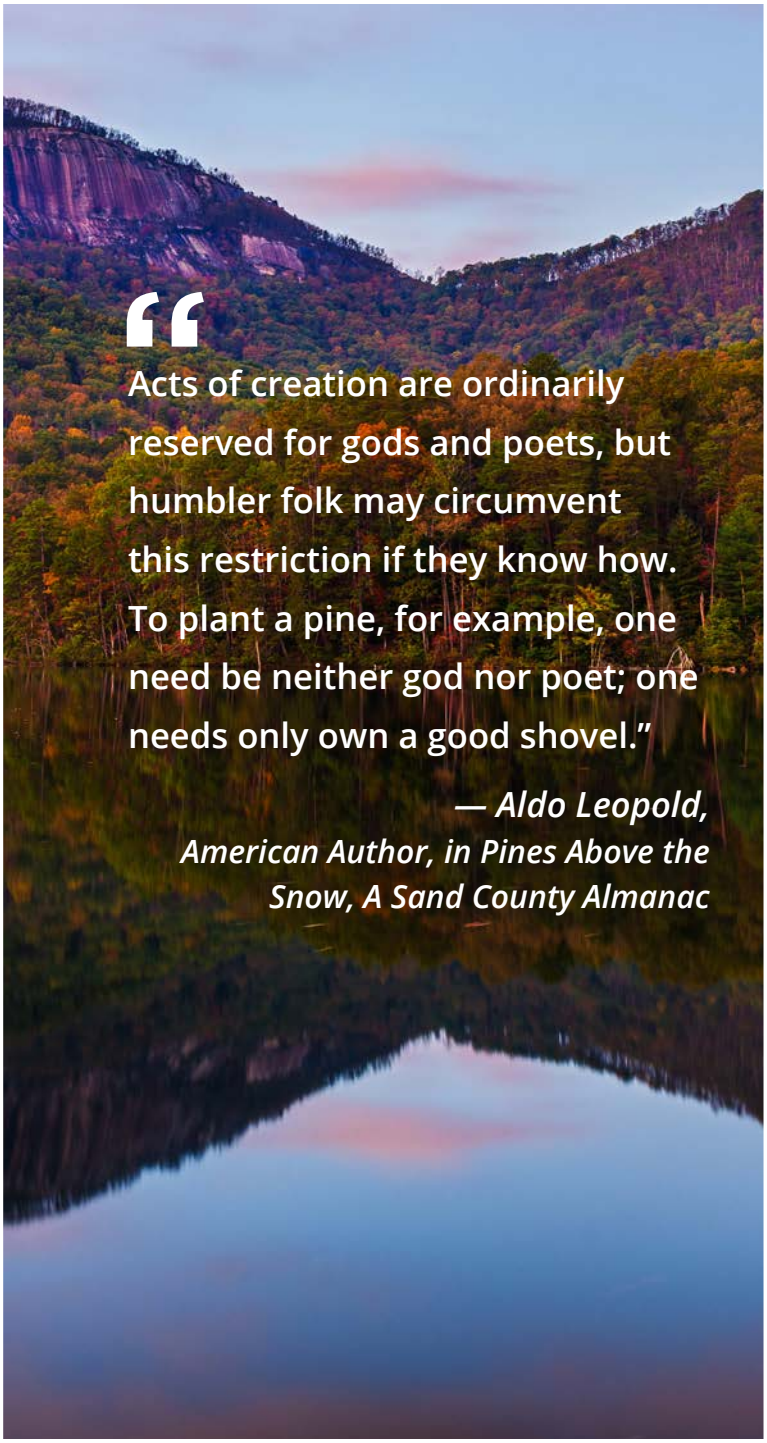
— Gifford Pinchot, first Chief of the U.S. Forest Service



"A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people."

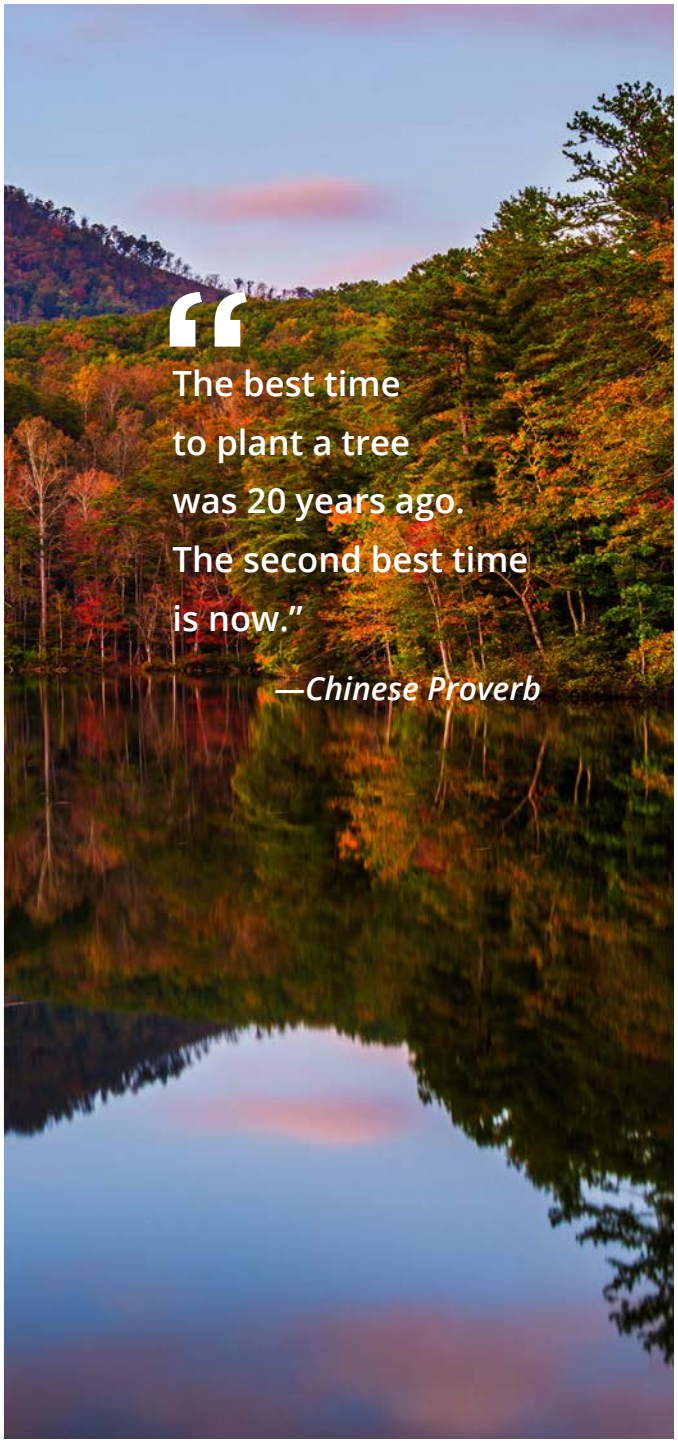
— Franklin D. Roosevelt, 32nd President of the United States

Table Rock Mountain,
Pickens, South Carolina



"Acts of creation are ordinarily reserved for gods and poets, but humbler folk may circumvent this restriction if they know how. To plant a pine, for example, one need be neither god nor poet; one needs only own a good shovel."

— Aldo Leopold,
American Author, in Pines Above the Snow, A Sand County Almanac



"The best time to plant a tree was 20 years ago. The second best time is now."

—Chinese Proverb

VI. Appendixes

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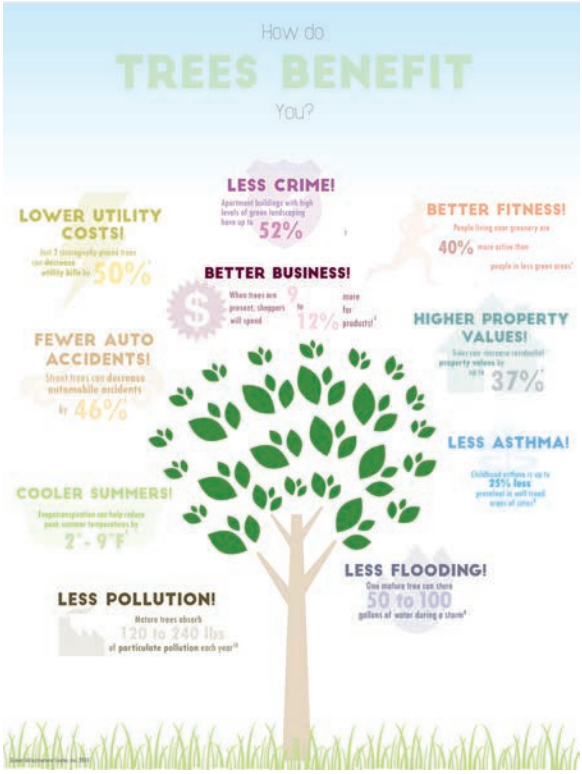

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B. SAMPLE REQUESTS FOR PROPOSALS

TEMPLATE

Tree Inventory, Canopy Mapping, Management Plan

[Date] *[For a Word file of this form contact SCFC Urban and Community Forestry Program]*

Request for Proposals (RFP) for any or all of the following:

(insert RFP Topics 1, 2, 3 as appropriate)

I) Tree Inventory (GIS Data and Report) II) Urban Tree Canopy Map and Report III) Management Plan

Requested by: [Department], [City]
Issuing Agency: [City Address, City, SC ZIP]
All Inquiries: [Person, Email Address, Phone number]
Submittal Deadline: [Date]
Attention: [Person Department]
[Address, City, SC ZIP]

SCOPE OF SERVICES REQUESTED

Project Description

The [City/Town of_____] is seeking proposals from qualified companies with experience in urban forest assessment and management to procure and prepare a [pick one or more of the following]:

I. Tree Inventory [GIS Data and Report]
II. Urban Tree Canopy Map and Report
III. Urban Forest Management Plan

Project Background

[Add a paragraph here: Describe the need for the project (e.g. requested by City Council, needed for Open Space Plan), has this work been done previously (e.g. tree inventory was last done in 1990), community size, character. How will the results of this work be utilized by the community? (describe)]

Deadline

All work is to be completed by [Date].
[Add any interim deliverables or draft products required before final submission.]

Ownership

All data created for this project becomes the property of [City/Town], and must be turned over at the project's completion. This includes all processed data, images, maps and analyses produced in final format. The firm may utilize these products to showcase their performance or in portfolios but they do not retain the rights to reproduce or share these data without prior permission from [City/Town].

Discontinuance of Work

The [Town/City Staff] shall have the authority to suspend the work, wholly or in part by written order for such period as the [Town/City Staff] may deem necessary due to unsuitable weather, or due to failure on the part of the Contractor to carry out the work to an acceptable level of quality or to comply with any provisions of the contract documents. Any practice obviously hazardous, as determined by the [Town/City Staff] or his/her representative, shall be immediately discontinued by the Contractor upon receipt of either written or oral notice to discontinue such practice.

B. SAMPLE REQUESTS FOR PROPOSALS *(CONTINUED)*

I. Tree Inventory [GIS Data and Report]:

Scope of Work

Conduct a street tree inventory in selected street rights-of-way, street tree easements, parks, public facilities grounds, and other public property for approximately [XXXX] trees [Or by increments of each 1000 trees]. Include cost per tree in bid and for additional increments of 1000. Contractor may use a GPS-based data collection system and must provide the data output to the [City/Town] in Microsoft Excel, Access, or ESRI shapefile formats. Locations to be inventoried include:

[Specify exact locations for inventory, e.g. street rights of way, parks, schools and estimated # of trees]

Data Collection*:

Tree inventory data fields must include, but are not limited to:

- Location – street address, GPS coordinates to decimeter precision (4 inches), assign record # to tree (e.g. 1, 2, 3)
- Image of Tree (photo)
- Tree Common Name
- Tree Latin Name (Genus, species) unless unknown (e.g. crabapple)
- Trunk Diameter at Breast Height (DBH at 4.5' above grade)
- Tree Height (Estimated in feet)
- Trunk Spread (Visual estimated in feet)
- Stems – number of stems below DBH

Tree Health Condition (Overall) – good, fair, poor, dead as follows:

Good- normal for the species including shoot growth, wound wood development, foliar color and density, and absence of dieback or damaging pests

Fair- deficiency in one category such as below normal shoot growth, wound wood development, foliar color and density, or presence of dieback or a damaging pests or disease

Poor- below normal or deficiency in two or more categories such as shoot growth, wound wood development, foliar color and density, or presence of dieback or damaging pests

Very Poor- major deficiency in two or more categories such as shoot growth, wound wood development, foliar color and density, or presence of dieback or damaging pests

Dead- no living tissues

Tree Structure: Condition of mechanical or structural portions of the tree, expressed as:

Good- absence of any significant mechanical defects although minor defects such as low amounts of decay that are unlikely to fail under normal weather conditions may be present

Fair- minor structural defect(s) is present that may fail under storm conditions, or several minor mechanical defects can be found

Poor- one or more significant structural defect is present that may fail under normal weather conditions

Very Poor-several significant structural defects are present that may fail under normal weather conditions. Most significant defect present and severity; Roots, Root Crown, Trunk, Trunk/Scaffold Union, Scaffolds, Branches

* If interested in performing a Tree Risk Assessment: Require GPS location of each inventoried tree, performance of work by ISA Tree Risk Assessment Qualified (TRAQ) Professional and collection and recording of tree risk data as specified by ISA in their Tree Risk Assessment Manual and Form. For more see https://www.isa-arbor.com/education/onlineresources/basictreeriskassessmentform

Observations – general observations warranting recognition

Primary Maintenance Needed

- Overhead utilities- presence of primary or secondary electrical distribution wires or telephone or street lighting
- Site Type –Planting Area – Most limiting dimension of planting area in feet
- Other – for trees requires further inspection;
    - Risk- for trees that need a full Tree Risk Assessment note need
    - Check ROW- determine if the tree is in the Right of Way
    - Limited access

Growing Space Type: type of location the tree is growing in such as lawn area, natural area, border tree, tree lawn, or tree pit

Quality Control -- All data, as itemized below, to be reviewed digitally for errors and errors corrected. Contractor will report the findings and corrections at the completion of each step.

- Field quality review of 2% of all data points collected in the first week of data collection with particular emphasis on trees identified for removal
- Field quality review of 1% of all data points collected each week after the first week of data collection with particular emphasis on trees identified for removal
- Cross data collector review (other reviewer than the original data collector) for all data collection personnel.
- Office review of 100% of data for data mismatch errors, for example, appropriate tree health or structural condition rating for "Removal" maintenance classification; appropriate street for side street versus on street classification, appropriate diameter size for "Train" maintenance classification, and all other similar data reviews that can be completed in the office.
- Field resolution of data errors identified.
- 100% correct species identification; no unknowns in data set.
- Visually review and correct mapped tree data for correct locations.

Deliverables— DATA and REPORT:

The consultant will provide a map and database of all collected tree data.

The consultant shall provide an inventory report summarizing the methodologies, urban forest management statistics outlined as follows.

1. Inventory Methodologies
2. Quality Control Summary (methods and results)
3. Management Statistics
    a. Species Distribution
    b. Diameter Distribution
    c. Health Distribution
    d. Work Need
    e. Tree Species Exceeding 10% of the Total Population
        i. Diameter Distribution
        ii. Health Distribution
        iii. Trees Flagged for Additional Risk Assessment
        iv. Work Needs/Recommendations

II. Urban Tree Canopy Map and Report

Scope of Work

The consultant will conduct the classification of citywide land cover using the most recent aerial imagery from the National Aerial Imagery Project (NAIP) (4-bands) available for [City/Town]. Specifically, imagery will be classified into all classes including tree canopy, other vegetation (turf, shrubs), impervious surfaces, bare soil/sand, building and non-building impervious surfaces, and water. Consultant to obtain the most recent LiDAR data to differentiate smaller shrubs from trees (e.g. under and over 10 feet). The city will provide the consultant with base GIS data to aid in the analysis (any existing data for roads, streets and rights of way, parcels, publicly owned properties such as parks and schools, and utilities).

Land cover classes will be calculated by percent and also by specific requested areas of analysis for urban tree canopy (up to 5 geographies, e.g. trees citywide, in parks, historic districts, census blocks/tracts, downtown).

Misidentification of shrubs versus trees is a common error in classification of vegetation in the south and application of LiDAR and other object recognition tools should be used to help to prevent this mistake.

The consultant will also prepare a QA/QC report for derived data to achieve at least 90% overall mapping accuracy. Consultant to report on how accuracy was determined (e.g. confusion matrix, field verification etc.).

The consultant will provide at minimum the following information based on the data collection in the form of data, maps and narrative:

1. Calculation of acres and percent of land area in covered by tree canopy citywide and at least three other geographies (e.g. land use, neighborhood, right of way, census block groups, parks).
2. Identification and mapping of areas that are suitable for tree planting = Potential Planting Areas (PPA). Consultant should detail how unsuitable areas (sports fields, utility conflicts) will be accounted for and removed from the PPA. Areas suitable for planting may also be categorized in terms of priority areas related to benefits of trees such as urban heat island, stormwater flooding, or other benefits.
3. Quantification of ecosystem services of the city's tree canopy, which may include but are not limited to, stormwater management, air quality, carbon sequestration, and urban heat island mitigation. At the completion of this task, the consultant will present results to government staff. Tools in the i-Tree suite https://www.itreetools.org/ can be used for some of these calculations.
4. Recommendations for a percentage tree canopy goal based on the current tree canopy percentage and the PPA determined.
5. The consultant will present a draft of the canopy data and maps to [City/Town] staff to review and staff comments will be addressed before the final maps and report are complete.

Deliverables— DATA and REPORT:

1) Tree canopy assessment report [XX pages] including findings and methods to also include maps of tree canopy, potential planting areas, identified priority areas by canopy cover (e.g. parks), and documentation of ecosystem services' calculations. The report will be formatted for printing and an ADA compliant version digital version will be provided for the City website. [Optional: Specify X # printed copies to be provided by consultant].

2) PPTX presentation of results in slide deck to be used for community education [15-20 slides] including maps and canopy assessment results.

3) A GIS file and geodatabase of the tree canopy and land cover to incorporate into the city's GIS system. GIS files must include tree canopy data in both raw raster and vector formats, as well as pre-made map documents from (1) above that include all relevant files created for the project.

4) *Optional*: [Add community education event, workshop or survey on tree values to engage the community in understanding canopy assessment and supporting canopy protection or expansion.]

III. Urban Forest Management Plan

3) Urban Forest Management Plan: The contractor will support the [City/Town] in developing a comprehensive urban forest management plan. The plan shall be based on inventory data and discuss major trends, such as species composition and tree conditions, as identified in the inventory. Tree characteristics that affect management, such as species diversity, condition, and maintenance requirements, should also be discussed. Provide a multi-year budget and management recommendations. Additional content may include, but are not limited to:

- Trends – species diversity, size distribution, condition, primary maintenance needs, etc.
- Ecosystem Benefits – using the digital tree inventory data, i-Tree, or generating report through i-Tree Eco
- Current Canopy Cover (by percentage if known)
- 5 and 10 year strategies for maintenance schedules
- Annual, 5-year and 10-year budgets for maintenance activities
- Assessment of current personnel, equipment and capacities to meet management needs
- Potential pest and disease management
- General recommendations including relevant goals for forest cover
- Applicable charts and graphs
- Appendices

PROJECT PRICING

I. GIS Based Tree Inventory

Data Collection Cost per tree ..... **$** _____

Cost per each increment of 1,000 ..... **$** _____

Total Data Collection Cost for [# trees, e.g. 2,000] ..... **$** _____

Total Cost for Tree Inventory..... **$** _____

II. Tree Canopy Cover Data, Maps and Report

Total Cost for Tree Canopy Assessment ..... **$** _____

III. Urban Forest Management Plan Development

Total Cost for Urban Forest Management Plan..... **$** _____

B. SAMPLE REQUESTS FOR PROPOSALS *(CONTINUED)*

Clauses below are provided as examples only. Check with the town/city/county procurement office for a complete list of what to include. Some clauses, such as e-verify, are required when using federal funds.

1. References and Qualifications

Provide at least three (3) references with contact information and detail the firm's relevant prior work. References should relate to similar work performed and demonstrate the firm's qualifications to perform the Scope of Services. If available, provide links to digital work samples.

Relevant qualifications for all staff to be included in the project along with roles must be specified. For example, if the principal is for a certified arborist, the qualifications should specify their role in the project (project manager, field data collection etc.).

For tree inventory work add: [Bidder shall be able to recognize the native trees of SC as well as a wide variety of ornamental trees. *Bidder shall be an ISA Certified Arborist for at least 3 years and Tree Risk Assessment Qualified for at least 1 year. *Bidder shall be proficient in using tree inventory software. Must provide Documentation of ISA Certified Arborist Number and TRAQ Certification]

2. Terms of Contract

Once awarded, the term of this contract shall be for the period of _____ [years/months] and may be extended for up to ____ [years/months] upon written agreement between the [City/Town of] and the contractor.

3. Insurance

Contractor shall file with the [City/Town of] evidence of Workman's Compensation, Commercial General Liability, and Business Auto Liability for owned or non-owned automobiles. Limits of insurance shall be as follows: Minimum amounts of $1,000,000 in employer liability, statutory required amounts in Workman's Compensation, $1,000,000 Commercial General Liability, and $500,000 in Auto Liability. A certificate of insurance shall be filed with [City Staff, Title, City/Town of] prior to award of contract. The [City/Town of] shall be listed as an additional insured under General Liability and also listed as a certificate holder. Such insurance shall be maintained throughout the term of this contract.

4. Indemnification

The contractor agrees to hold harmless and indemnify the [City/Town of] against any and all claims, suits, damages, costs, or legal expense as a result of bodily injury or property damage resulting from the negligence of the contractor. All policies of insurance carried by the contractor shall be written as primary policies, not contributing with and not in excess of insurance coverage which the [City/Town of] may carry.

5. Governing Law and Venue

Contracts shall be governed by the laws of the State of South Carolina.

6. E-Verify

Contractor shall utilize e-verify to confirm the status of each employee or contractor utilized to complete the work under this RFP. https://www.e-verify.gov/employers

7. Iran Divestment Act

The contractor shall submit a form stating that their company is not on the SC Final Divestment List, in accordance with the Iran Divestment Act, before being awarded a contract. The [City/Town] is prohibited to contract with any company that is on the SC State Treasurer's Final Divestment List. For more information see: *SC Code § 11-57-330 (2014)*

PROPOSAL EVALUATION AND CONSULTANT SELECTION

The [City/Town of] Board of Commissioners/City Council has established procedures to be followed in selecting professional services. Procedures, as established, are for the purpose of ensuring the contractor is selected in a fair and uniform manner, that those selected for work are qualified and experienced. Applicants shall demonstrate their qualifications to satisfy the Scope of Services. The firm's submittal shall address all aspects of the RFP and clearly express the applicant's understanding of the [City/Town]'s specific requirements, indicating the company's personnel qualifications to conduct these services in a thorough and efficient manner.

[City/Town of] will select from offering firms presenting complete submittals by [time am/pm on date].

Selection will be based on:

- Company qualifications
- Relevant experience of company
- Relevant certifications and qualifications,
- Demonstration of understanding of the project description, scope of services and work to be performed
- Schedule and cost estimated for identical tasks in the scope of services
- Other relevant experience
- Current or prior work in [City/Town of].

B. SAMPLE REQUESTS FOR PROPOSALS *(CONTINUED)*

ADMINISTRATIVE INFORMATION

A. Standard Terms and Conditions of Request for Proposals

1. All submittals must be valid for a minimum period of ninety (90) days after the date of the submission.
2. The [City/Town of] makes no guarantees to any offering company until such time the [City/Town of] approves the contract.
3. The [City/Town of]reserves the right to reject any or all proposals and to make the award as deemed in the best interest of the [City/Town of].

B. Project Contact

The [City/Town of]'s contact for this project is [City Staff]. Prospective applicants may make inquiries concerning the Request for Proposals to obtain clarification of the requirements. Direct all inquiries to:

[City Staff Title,
Address, City, SC, ZIP
Phone number or by email at Email address]

C. Purpose

This RFP provides perspective companies with sufficient information to prepare and submit quotations for consideration by the [City/Town of]. To be considered, each offering must demonstrate the ability to complete the scope of services outlined in the RFP.

D. Submittal

The offering shall be submitted to the attention of [City Staff] at the [Department] by [time am/pm] on [date]. Electronic copies may be submitted to [email address]. The [Department] is located at [Address]. Late submissions will not be accepted. It is the responsibility of each firm submitting a proposal to ensure that the documents arrive at the [Department] by the submittal deadline. The submission must be on the vendor's letterhead. Applicants are encouraged to submit a digital copy of all or part of the proposal for ease of distribution.

E. Response Material Ownership

All materials submitted regarding the RFP become the property of the [City/Town of] and will only be returned at the [City/Town]'s option. Responses may be viewed by any person after the final selection has been made. The [City/Town] has the right to use any or all of the material outlined in the Proprietary Information above.

F. Incurring Costs

The [City/Town] is not liable for any costs incurred by those who have submitted proposals prior to issuance of a signed contract.

G. Acceptance of Scope of Services

The Scope of Services will become contractual obligations if a subsequent agreement is reached. Failure of the selected firm to accept these obligations may result in cancellation of the award.

H. Acceptance Time

The [City/Town of] intends to make a selection by [Date].

I. Payment for Services

The Vendor agrees to bill the [City/Town of] at an interval of [monthly, quarterly] with the invoice to include reporting on completed tasks, percent completion and any reasons for anticipated delays in deliverables. Vendor to allow 30 days for payment to be received from date of receipt by agency.

C. GLOSSARY

Glossary of Terms Commonly Used In Tree and Forest Related Ordinances

Agricultural practices: These practices include normal farming, silviculture and ranching activities such as gardening, plowing, seeding, cultivating, harvesting for the production of food, fiber, forest products, nursery stock and livestock; maintenance of agricultural drain tiles, irrigation and drainage ditches; maintenance of farm roads and other access areas for farm vehicles and equipment use.

Alteration: The removal of any part or portion of any tree, shrub or other woody plant, including, but not limited to, any stem, trunk, limb, branch, twig, leaf, bark or root.

ANSI A300 Standards: The voluntary industry consensus standards for managing trees, shrubs and woody plants. ANSI (American National Standards Institute) A300 Standards are divided into multiple parts (Part 1, Part 2, etc.) each focusing on a specific aspect of woody plant management (pruning, fertilization, etc.). ANSI requires that approved standards be developed according to accepted principles, and that they be reviewed and, if necessary, revised every five years.

Appraised tree value: The appraised value of a tree shall be calculated by a certified arborist based on the current edition of the Guide for Plant Appraisal developed by the Council of Tree and Landscape Appraisers and published by the International Society of Arboriculture.

Authority horticultural landscape: Any individual or source, licensed, registered, degreed or otherwise acknowledged as capable of providing expert information and reference in horticultural science and/or landscape design and maintenance.

Berm: Any hill or slope which represents a change of elevation of at least two feet (2') at a slope of between twenty-five percent (25%) and fifty percent (50%) and which is covered with an appropriate stabilizing vegetation.

Best Management Practices: The design, construction, and maintenance practices and criteria for natural resources management that minimize the impact of stormwater runoff rates and volumes, prevent erosion and capture pollutants.

Biodiversity: Diverse use of living landscape material so that on parcels of zero to one acre there are no more than forty percent (40%) of any one species of living landscape materials excluding turf grass and ground cover is used over the entire property. On parcels greater than one acre but less than five (5) acres, no more than twenty-five percent (25%) of any one species of living landscape material excluding turf grass and ground cover is used over the entire property. On parcels greater than or equal to five (5) acres, no more than ten percent (10%) of any one species of living landscape material excluding turf grass and ground cover is used over the entire property.

Buffer: An area of predominantly vegetated land to be left open, adjacent to drainageways, wetlands, lakes, ponds or other surface waters for the purpose of eliminating or minimizing adverse impacts to such areas.

Buffer, Perimeter: An area of land along the perimeter of a development site that contains any combination of vegetative materials, berms, fences, and walls, and provides separation and screening to minimize potential adverse impacts between the development and dissimilar development on abutting property.

C. GLOSSARY *(CONTINUED)*

Buffer, River: An area of land along tidal waters or tidal wetlands extending inland 50 feet from the OCRM critical line. See also Critical Line.

Caliper: The standard for trunk diameter measurements of nursery stock. Caliper of the trunk is measured six inches above the ground for four-inch or smaller caliper trees and 12 inches above the ground for larger sizes.

Cambium: The layer of formative cells between the wood and bark in woody plants.

Canopy Tree: A tree that has an expected height at maturity greater than 30 feet and produces significant shade because it has a crown that is oval, round, vase-shaped, or umbrella-shaped.

Certified arborist: An individual who has passed the International Society of Arboriculture's Certified Arborist examination, is designated as a certified arborist by said organization, and maintains such designation through attending at least thirty (30) hours of qualifying continuing education within each three-year period certification period.

Clearcutting: The removal of all trees from a property, whether by cutting or other means, excluding stream buffer requirements.

Cluster subdivision: A form of residential subdivision that permits housing units to be grouped on sites or lots with dimensions, frontages, and setbacks reduced from conventional sizes, provided the density of the tract as a whole shall not exceed the density allowed by the district under existing regulations and the remaining land area is devoted to common open space.

Commercial arboricultural operation: The practice of planting, raising, harvesting and replanting of urban trees for profit.

Commercial timber operations: Activities occurring on tracts of land five acres or more in size devoted to the production of marketable forest products through generally accepted silvicultural practices including, but not limited to, harvesting, site preparation, and regeneration.

Common open space: Land and/or water within or related to a cluster residential development, not individually owned, which is designed and intended for the common use or enjoyment of the residents of the development or the public which may contain such accessory structures and improvements as are necessary and appropriate for recreational purposes and utilities. A condition of the cluster residential development approval shall be that common open space may not be further subdivided.

Community forest management plan: A written plan, developed and maintained by the forester and the tree commission, which prescribes a program of systematic management for the city's public trees.

Community forestry program: All of those city resources, time and efforts directed toward the development and maintenance of a safe, healthy, aesthetically pleasing and fully stocked population of public trees.

Critical root zone: The area of tree roots within the crown dripline. This zone is generally defined as a circle with a radius extending from the tree trunk to a point no less than the farthest crown dripline. Disturbances within this zone will directly affect a tree's chance for survival.

C. GLOSSARY *(CONTINUED)*

Critical Root Zone, Structural (SCRZ): Similar to a Critical Root Zone, but with a smaller radius. Significant risk of catastrophic tree failure exists if roots within this area are damaged or destroyed.

Crown: The upper portion of a tree that contains the large scaffold limbs, branches, twigs, and leaves.

D.B.H.: Diameter at breast height, the standard for trunk diameter measurements of trees existing on a site. D.B.H. is measured in inches at a height of 4½ feet above the ground. If a tree splits into multiple trunks below 4½ feet, the trunk is measured at the narrowest point beneath the split.

Deciduous: Not evergreen; shedding leaves annually.

Density factor for the site (DFS): A unit of measure used to prescribe and calculate required tree coverage on a site. Unit measurements are based on tree size.

Diseased Trees: Those trees that may constitute a hazard to life and property or harbor insects or disease which represent a potential threat to other trees as determined by a Certified Arborist.

Dripline: A vertical line extending from the outermost edge of the crown of a tree straight down to the surface of the ground beneath the tree.

Edge: Trees growing on the periphery of a stand where it transitions to being tree less. Trees on the edge are under conditions of light and exposure different from those prevailing in the interior of the stand.

Ecosystem Services: The benefits people obtain from nature through use, consumption, enjoyment, and/or simply knowing these resources exist (non-use).

Endangered Species: A species in danger of extinction throughout all or a significant portion of its range.

Establishment: The selection, placement, planting, and maintenance of new trees in the landscape. The minimum period of time required for establishing trees is generally considered to be three (3) years.

Evergreen: A tree, shrub, or other plant whose leaves remain green throughout all seasons; opposed to "deciduous".

Flood: A temporary rise of water level in lakes, streams, natural drainage courses, artificial drainage courses or other waterways that results in inundation of areas not ordinarily covered by water.

Flood frequency: The average length of time between flood occurrence, statistically determined, for which it is expected that a specific flood level will be equaled or exceeded.

Flood, regulatory: A flood which is representative of large floods known to have occurred generally in the area or reasonably characteristic of floods which may be expected to occur, having a specified flood frequency, and which may reasonably be expected to cause damage or hazard of damage sufficient to justify protection therefrom.

Floodplain: Those areas subject to periodic inundation by large floods which occur with calculable flood frequency and subject to flooding which may reasonably be expected to cause damage or hazard of damage sufficient to justify protection therefrom. For purposes of this article, the floodplain is considered to be that area designated by the notation "-FP" appended to a basic district classification. The boundaries of such areas are generally lateral to the boundaries of floodway areas or to the drainage course along which they are located.

Floodway: The cross-sectional area of the floodplain which is necessary for hydraulic conveyance and discharge of the regulatory flood and within which hydraulic velocities are such that significant hazard to structures or other properties exists.

Forest: Land supporting a stand or potential stand of trees valuable for timber products, watershed or wildlife protection, recreational uses or for other purposes.

Forest Activity: Includes, but is not limited to, timber harvest, site preparations, control burning, tree planting, applications of fertilizers, herbicides, pesticides, weed control, animal damage control, fire control, insect and disease control, forest road construction, and animal other general accepted forestry practices.

Forest buffer: In forestry, trees and shrubs and other plants that grow adjacent to creeks, streams and rivers that are important in reducing erosion potential through soil stabilization, improvement of water quality by filtering pollutant runoff and protection of wildlife habitat. Also called “buffer,” “riparian buffer,” and “streamside management zone.”

Forester: The individual, or his/her agent, appointed to administer the provisions of this chapter. A professional in charge of caring for, assessing, planting and managing trees in forests. Management can involve a range of activities including restoration, conservation, timber harvest and protection and management of forested/wooded areas.

Forest Management Plan: A document or documents prepared or approved by a forester registered in the state that defines a landowner’s forest management objectives and describes specific measures to be taken to achieve those objectives. A management plan shall include silvicultural practices, objectives, and measures to achieve them, that relate to a stand or a potential stand of trees that may be utilized for timber products, watershed or wildlife protection, recreational uses, or for other purposes.

Forest stand: In forestry, a contiguous community of trees sufficiently uniform in composition, structure, age, size class, distribution, spatial arrangement, site quality, condition, or location to distinguish it from adjacent communities.

Grand tree: Any tree in fair or better condition that equals or exceeds a specific diameter size (typically a very large diameter). A lesser-sized tree can be considered a grand tree if it is a rare or unusual species, of exceptional quality, or of historical significance.

Grand tree stand: A contiguous grouping of trees that has been determined to be of value by the zoning administrator. Determination is based on any of the following criteria: maturity (even-aged); purity of species composition; rare or unusual nature of the species; historical significance; or exceptional aesthetic quality.

Ground cover: Low-growing plants that grow in a spreading fashion to form a more or less solid mat of vegetation, generally planted to provide decorative landscaping or permeable cover for bare earth that prevents soil erosion.

Habitat: Contains food, water, cover or space that a species depends upon to carry out one or more of its life processes.

Hardwood tree: A broad-leaved tree, so called because its wood is harder and more compact than that of a softwood, or needle-bearing conifer.

C. GLOSSARY *(CONTINUED)*

Hazard tree: A tree that is at risk for failure, or damage/blow over from high winds, either whole or in part, with some part large enough to cause damage, and there exists within the falling distance of the tree or tree part a target, such as people, buildings, vehicles, or hardscape. A hazard tree shall be considered a public nuisance.

Heritage tree: All trees growing on publicly owned property or rights-of-way within the city limits that meet one (1) or more of the following criteria shall be designated as heritage trees.

a. Has a caliper measurement greater than twenty-four (24) inches, also known as an historic tree.

b. Is of a landmark character, associated with a place, individual, or event important to the city or neighborhood or its history, or located such that it is a widely known and appreciated tree within the city.

c. Is a rare or unusual species, or an unusually large size for the species.

Impervious Surface: A surface that has been compacted or covered with a layer of material so that it is highly resistant to infiltration by water. It includes, but is not limited to, surfaces such as compacted clay, as well as most conventionally surfaced streets, roofs, sidewalks, parking lots, patios, swimming pool decks, and other similar structures.

Invasive Species: An introduced species (also called “non-indigenous” or “non-native”) that adversely affects the natural habitat it invades by dominating and choking out indigenous species.

Land-disturbing activity: Any activity involving the clearing, cutting, excavating, filling, or grading of land or any other activity that alters land topography or vegetative cover

Large canopy tree: Any single-stem tree of a species which normally reaches a height of forty feet (40') of more and a crown spread of twenty feet (20') or more at maturity.

Like kind: Trees of similar species or type (deciduous, evergreen or semi-evergreen) to be used in replacement. The tree planting master plan will be used as a guide for determining like kind replacements.

Low impact development (LID): A stormwater management strategy concerned with maintaining or restoring the natural hydrologic functions of a site to achieve natural resource protection objectives and fulfill environmental regulatory requirements.

Maintenance: Routine, periodic, or occasional activities directed at maintaining or improving a tree’s health and condition. Maintenance activities include but are not limited to mulching, pruning, irrigation, fertilization, pest control, cabling and bracing, and lightning protection system installation.

Mitigation: Measures taken to eliminate or minimize damage from development activities, such as construction in wetlands or regulatory floodplain filling, by replacement of the resource

Mulch: A protective covering, such as pine straw, shredded bark, or other materials, spread evenly around trees, shrubs and ground covers to reduce evaporation, maintain even root temperatures, prevent erosion, and control weeds.

Open Space: Land not covered by lots, buildings, accessory structures, driveways, parking areas, or impervious surfaces.

C. GLOSSARY *(CONTINUED)*

Planting Strip: Areas intended for the placement of vegetation within the interior of parking lot areas or along street right-of-way edges, typically between the back of the curb and the inside edge of the side

Property owner: The record owner or contract purchaser of any parcel of land.

Protection: The active or passive protection of a tree's roots, trunk, and crown for the purpose of avoiding damage to these living structures and maintaining tree health and structural integrity.

Protected tree: Any broad-leaved tree located with the street frontage, perimeter or required landscape zones having a minimum D.B.H. or greater (depending on the ordinance). Also includes the definition of specimen tree.

Protective tree barriers: Barricades made of wood, wire or chain link fencing, and shall be constructed around trees to establish a tree protection zone. Tree protection or keep out signs shall be attached to the barrier.

Protected zone: Portions of a property required by permit to remain in open space; areas required by permit to be landscaped areas and buffers.

Pruning: The deliberate removal of tree branches for a specific purpose, i.e. young tree training, deadwood removal, utility line, traffic, or pedestrian clearance, or correcting structural defects.

Public tree: Any street tree, or any tree originating on city-owned property.

Regulatory flood protection elevation: The elevation of the regulatory flood at any point, which may vary from place to place depending on topography, anticipated hydraulic conveyance capacity, encroachment into areas subject to flooding, and other factors.

Removal: The cutting of a tree at ground line to remove the tree's trunk and crown. The tree stump and roots may or may not be removed along with the trunk and crown.

Riparian buffer: In forestry, trees and shrubs and other plants that grow adjacent to creeks, streams and rivers that are important in reducing erosion potential through soil stabilization, improvement of water quality by filtering pollutant runoff and protection of wildlife habitat. Also called "buffer," "forest buffer," and "streamside management zone."

Roots: The below ground portion of a tree that includes large, woody support roots and small, non-woody, fibrous "feeder" roots. Roots are generally located within the top eighteen (18) inches of soil and extend out from the trunk two (2) to three (3) times the width of the crown.

Shade tree: An evergreen or deciduous tree of a species with an expected mature height of over 40 feet and an expected crown spread of over 30 feet.

Shrub: A woody plant, smaller than a tree, consisting of several small stems emerging from the ground, or small branches near the ground. Shrubs may be deciduous or evergreen

Small-maturing tree: An evergreen or deciduous tree with a mature height of over 15 feet but no greater than 25 feet.

C. GLOSSARY *(CONTINUED)*

Softwood tree: A coniferous (cone-bearing) tree such as pine, cedar and bald cypress.

Specimen tree: Any broad-leaved large canopy tree with a D.B.H. of twelve inches (12") or greater or any understory tree with a D.B.H. of six inches (6") or greater.

Streamside Management Zone: In forestry, trees and shrubs and other plants that grow adjacent to creeks, streams and rivers that are important in reducing erosion potential through soil stabilization, improvement of water quality by filtering pollutant runoff and protection of wildlife habitat. Also called "buffer," "forest buffer" and "riparian buffer."

Stem: The main trunk of a tree or woody plant.

Street tree: Any tree, shrub or other woody plant growing within the city limits and originating within the current right-of-way of a public roadway.

Street protective yard: A landscaped area planted with trees and other vegetation that is parallel *and adjacent to the recorded or proposed public street right-of-way*.

Suggested plant list: The list of trees, shrubs, and ground covers approved for use in the city for compliance with this chapter as reflected in the design and specification manual.

Thinning: The selective cutting or removal of trees.

Threatened species: A plant or animal species likely to become endangered within all or much of its range within the foreseeable future.

Timber harvesting: The felling of trees and removal of logs for timber products. This term may include both clear-cutting and the thinning of timber.

Topping: The improper removal of tree limbs with cuts made between nodes; also known as "tipping," "heading," and "shearing."

Treatment: The application, introduction or installation of any substance or material to any tree, shrub or other woody plant, either by direct application to the tree or by application to the soil or roots, including, but not limited to, fertilizers, other elemental nutrients, pesticides, growth-inhibiting agents, soaps, oils, chemicals, cabled or threaded bolt or other type of support systems, lightning protection systems or cavity fillers.

Tree: A self-supporting woody perennial plant with a trunk diameter of at least two inches measured at six inches above ground level, with a mature height of at least 12 feet, and usually having one main stem or trunk and many branches.

Tree circumference: The trunk circumference is measured at four and one-half feet (4½') above grade in order to obtain diameter at breast height (DBH).

Tree form: Plants that have been grown and maintained as trees, not shrubs, usually with three to five stems, trunks, or canes, and free of limbs from the ground up to three or four feet.

Tree fund: A fund established by the locality to receive deposits. The amount contributed is based on an equivalent value of what normal and customary landscaping costs would be to replace lost vegetation.

C. GLOSSARY *(CONTINUED)*

Tree inventory: A tally of the number, species, approximate size and approximate location of existing trees on a site, obtained through photos, including aerials. To be verified by on-site viewing of city staff authorized to perform the verification.

Tree planting master plan: A document, approved by the city or county that serves as a guide for the selection of appropriate species and for tree planting within the city or county.

Tree Risk Assessment: The systematic process to identify, analyze, and evaluate tree risk.

Tree Risk Assessment Qualification (TRAQ): A professional certification offered through the International Society of Arboriculture (ISA) as a standardized, systematic process for assessing tree risk and providing information to tree owners and risk managers for making informed decisions that will promote the safety of people and property and enhance tree benefits, health, and longevity.

Tree survey: A survey completed by a registered land surveyor, arborist or forester, usually as part of a site plan, of the location, size (as DBH) and species of the existing trees on a site. (For purposes of this ordinance, this survey shall include grand trees, trees of 12 inches or greater D.B.H. in any areas to be disturbed, and any other trees identified to meet the required density factor for the site.) To be verified by on-site viewing of city staff authorized to perform the verification.

Trophy tree: A large canopy tree with a diameter breast height of twenty-four inches (24") or greater, or an understory tree of twelve inches (12") or greater.

Trunk: The main woody stem of a tree that supports the crown and functions in the transport of water, nutrients, and carbohydrates from the crown to the roots and the roots to the crown.

Understory Tree: A tree that has an expected height at maturity of no greater than 30 feet.

D. Trees Suitable for Adverse Climate Conditions

Trees suited for near Rights-of-way (ROW)

Very Small Canopy Trees (up to 15' height)

- Serviceberry, *Amelanchier arborea*
- American Beautyberry, *Calicarpa Americana*
- Swamp titi, *Cyrilla racemiflora*
- Common Witch Hazel, *Hammamelis virginiana*
- Star Magnolia, a magnolia hybrid, *Magnolia stellata*
- Southern wax myrtle, *Morella cerifera*
- Yaupon holly, *Ilex vomitoria*
- Chickasaw plum, *Prunus angustifolia*
- Rusty blackhaw (Southern blackhaw), *Viburnum rufidulum*

Small Canopy Trees (15-30' height)

- Red Buckeye, *Aesculus pavia*
- Alternate leaf dogwood/Pagoda dogwood, *Cornus alternifolia*
- Flowering dogwood, *Cornus florida*
- Kousa Dogwood, *Cornus kousa*
- Common Chinquapin/Dwarf chestnut, *Castanea pumila*
- Eastern redbud, *Cercis canadensis*
- Mayhaw Hawthorn, *Crataegus aestivalis*
- 'Prairefire' Flowering Crabapple (Malus sp. 'Prairiefire).
- Choke Cherry, *Prunus virginiana*

Drought Tolerant Shade Trees

- Bur oak, *Quercus macrocarpa*
- Chinkapin oak, *Quercus muehlenbergii*
- Eastern redcedar, *Juniperus virginiana*
- Hackberry, *Celtis occidentalis*
- Kentucky coffeetree, *Gymnocladus dioicus*
- Live oak, *Quercus virginiana*
- London planetree, *Platanus x acerifolia*
- Northern catalpa, *Catalpa speciosa*
- Northern red oak, *Quercus rubra*
- Shumard oak, *Quercus shumardii*

Source: https://arbordayblog.org/treeplanting/10-drought-tolerant-trees-that-will-throw-shade/

Wind Resilient Trees

- Bald cypress, *Taxodium distichum*
- American beech, *Fagus grandifolia* var. *Caroliniana*
- Cabbage palmetto, *Sabal palmetto*
- Crape myrtle, *Lagerstroemia spp*.
- Live oak, *Quercus virginiana*
- Southern magnolia, *Magnolia grandiflora*
- Sweet bay, *Magnolia virginiana*
- Tulip tree, *Liriodendron tulipifera*

Source: https://www.gardeningchannel.com/best-wind-resilient-trees-and-shrubs-list/

D. Trees Suitable for Adverse Climate Conditions

Salt Tolerant Trees

- American holly, *Ilex opaca*
- Cabbage palm, *Sabal palmetto*
- Live oak, *Quercus virginiana*
- Loquat, *Eriobotrya japonica*
- Southern magnolia, *Magnolia grandiflora*
- Southern redcedar, *Juniperus virginiana var. silicicola*
- Yaupon holly, *Ilex vomitoria*

Source: https://hgic.clemson.edu/factsheet/salt-tolerant-plants-for-the-south-carolina-coast/

Flood Tolerant Trees

- Bald cypress, *Taxodium distichum*
- Black gum, *Nyssa sylvatica*
- Hackberry, *Celtis occidentalis*
- Honey locust, *Gleditsia triacanthos*
- Ironwood, *Carpinus caroliniana*
- Laurel oak, *Quercus laurifolia*
- Loblolly bay, *Gordonia lasianthus*
- Loblolly pine, *Pinus taeda*
- Pecan, *Carya illinoinensis*
- Persimmon, *Diospyros virginiana*
- Pond cypress, *Taxodium ascendens*
- Red maple, *Acer rubrum*
- River birch, *Betula nigra*
- Slash pine, *Pinus elliotti*
- Swamp white oak, *Quercus bicolor*
- Sweet bay, Magnolia virginiana
- Sweet gum, *Liquidambar styraciflua*
- Sycamore, *Platanus occidentalis*
- Water tupelo, *Nyssa aquatica*
- White cedar, *Chamaecyparis thyoides*
- Willow oak, *Quercus phellos*

Source: https://hgic.clemson.edu/factsheet/plants-for-damp-or-wet-areas/