URBAN FOREST MANAGEMENT MASTER PLAN

CITY OF HARRISONBURG, VIRGINIA

September 2021

urbancanopy works, LLC

Acknowledgements

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Executive Summary

The City of Harrisonburg has a vision that its urban forest is safe, efficient to maintain, complements its development goals, delivers equitable benefits, and enhances the character and livability of the city. To accomplish goals to realize this vision, a comprehensive urban forest management plan is required. This plan was developed to assist Harrisonburg to better understanding its urban forest's composition, structure, and tree maintenance needs as well as plan for both short-term and long-term resource allocation and develop risk management strategies.

The plan was accomplished by completing these tasks:

- Analyzing tree inventory data
- Incorporating citywide canopy cover information
- Obtaining public and stakeholder input
- Making data-driven, sustainable urban forest management recommendations
- Presenting a multi-year budget

A brief summary of the data acquired, stakeholder input, and list of recommendations follows.

City of Harrisonburg's Tree Inventory

The tree inventory is an important planning tool that should help the City of Harrisonburg establish a systematic program for tree care and determine budget, staff, and equipment needs. Implementation of the maintenance recommendations will improve public safety and help guide future management decisions. When properly maintained, trees return economic, environmental, and social value to the community. These benefits greatly outweigh the time and money invested in planting, pruning, protection, and removal. City staff conducted a public tree inventory in 2020 and 2021. Trees located on streets, in parks, on school grounds were inventoried. The inventory was 100% completed on streets, 90% for schools and 50% for parks. The following brief statistical summary of the public tree population reflects genus and species composition, condition, and primary maintenance recommendations:

- Of the 2,131 sites collected, 382 (18%) were collected along the street right-of-way, 1,084 (51%) in parks, 464 (22%) were collected on school grounds, and the remaining 201 (9%) on other public properties.
- There are a total of 48 genera and 78 species represented within Harrisonburg's public tree population. The data indicate that Harrisonburg's urban forest very successfully meets the recommended standard for genera diversity. Maple *(Acer*) is the most frequently inventoried genus, yet only accounts for 13% of the population and is well below the 20% threshold. Of the species inventoried in Harrisonburg, eastern white pine (*Pinus strobus)*, red maple (*Acer rubrum*), and eastern redcedar (*Juniperus virginiana*) are the most frequently found and approach, but are below, the 10% threshold.
- Of the inventoried trees, 87% were recorded to be in Good or better condition. Conditions include: Excellent trees (7.2%); Very Good trees (21.6%); Good trees (58.3%); Fair trees (8.6%); Poor trees (3.0%); and Very Poor (1.4%).
- Since the majority of public trees are in Good or better condition, required maintenance is primarily considered routine. Recommended primary maintenance needs assigned were

either Prune, Remove, Water, Mulch, or Maintenance Completed. Pruning was recommended for the vast majority (42%) of the trees, and Removal was recommended for 75 (3.5%) public trees.

Harrisonburg's 2017 Urban Tree Canopy Analysis

The extent of urban tree canopy (UTC) is determined by classifying the land cover within the entire city boundaries; this include both public and private properties. The City benefitted from an urban tree canopy project titled *"Trees to Offset Stormwater, Case Study 08"* performed by the Green Infrastructure Center (GIC) in 2018.

It was determined that Harrisonburg estimated UTC is 26.6%. While this UTC percentage is lower than other Virginia cities and the national average, Harrisonburg has a relatively high impervious surface percentage (33.6) and having an agricultural land use history both contributes to limitations for expanding the tree canopy significantly.

Of the total canopy cover, 90% is on private land and 10% is on public land such as streets, school grounds, and parks.

However, looking at potential planting areas (pervious surfaces not used for cemeteries, athletic fields, and agriculture), there is the opportunity to set a goal for 34% UTC should the community decide that is compatible with other growth and environmental protection strategies.

Comparisons of Urban Tree Canopy in Virginia Cities

City	Canopy % of Area	City	Canopy % of Area
Roanoke	48%	Falls Church	35%
Waynesboro	43%	Charlottesville	27%
Richmond	42%	National average	27%
Front Royal	41%	**HARRISONBURG**	**26%**
Salem	40%	Abingdon	23%
Vinton	38%	Winchester	21%

Citizen and Stakeholder Input

From a public survey, municipal staff interviews, and Public Tree Advisory Board and other external stakeholder interviews, it was revealed that the citizens of Harrisonburg care about their trees and value the benefits provided by them. Input and opinions on the city's urban forest management program were also obtained.

There were six predominant themes that emerged from the public and staff input effort:

- More trees should be planted

- There should be greater diversity in the urban forest
- Greater access to urban forest education is needed
- The public wants to be engaged
- Regulations should be considered for protecting and/or replacing trees during land development and other construction projects.
- The City's urban forest management program and staff are valued.

Survey Results of Citizen Priorities for Public Urban Forest Management Actions

Rank	Urban Forest Management Action Item
1st	Plant more street trees
2nd	Plant more park trees
3rd	Provide tree planting and maintenance advice to property owners
4th	Increase City arborist staff to care for public trees
5th	Perform more maintenance (pruning, removal, stump grinding)

Urban Forest Management Program Sustainability Analysis Results

As part of developing this Urban Forest Management Plan, an adaptive management process was used to determine the sustainability of Harrisonburg's urban forest management program. It makes this determination by asking questions like "What do we have?" "What do we want?" and "How can we get there?".

There are three primary components of Harrisonburg's urban forest and the management program that are indicators of a sustainable community forest and program. Those components are and their current ratings are:

- ***The Trees:*** includes indicators related to the status of the tree resource itself, including knowledge of that resource. **Rating:** Moderate/Good
- ***The Players:*** evaluates the productive involvement and collaboration of stakeholders at all levels in the urban forest. **Rating:** Low
- ***The Management Approach:*** evaluates availability and use of different tools and/or management actions to improve and sustain the urban forest resource. **Rating**: Low/Moderate

Urban Forest Management Recommendations

Based on the analysis of the inventory and UTC data, with stakeholder and city staff input, and applying arboricultural industry standards and best management practices, the Harrisonburg Urban Forest Management Plan presents recommendations in major action steps and outlines programs and procedures for achieving success for small and large tasks in both the short and long terms.

Prioritized Compilation of Recommendations to Improve Urban Forestry Management and Service Delivery for the City of Harrisonburg

Action Step	Priority Rank	Recommendation	Timeframe
Action Step 1: Perform Priority and Proactive Maintenance	1	#1. Establish a five to ten-year MTP Cycle in which the trees in a defined management unit will be pruned each year.	Short term (1–5 years)
	1	#2: Implement a three-year YTP Cycle.	Short term (1–5 years)
	1	#3: Update inventory on a regular basis.	Short term (annually)
Action Step 2: Plant More Trees and Practice Purposeful Planting	2	#4: Create a Master Tree Planting Plan for City rights-of-way, parks, schools and other properties. a. Incorporate "Right Tree, Right Place" principles in the planting plan. b. Select tree species to increase diversity and maximize environmental benefits. c. Select Tree Species to prepare for climate change. d. Strive to include tree planting with capital projects	Mid-term (3-6 years)
	3	#5: Set a goal of achieving as least a 90% "stocking level" for street trees. a. Prioritize street tree planting. b. Consider alternative planting stock types and sizes to maximize the planting budget.	Long term (10+ years)
	3	#6. Promote tree planting on private property. a. Explore opportunities to provide citizens and businesses reduced/wholesale prices for tree planting. b. Promote the Harrisonburg Electric Commission's tree replacement program. c. Promote the Harrisonburg Conservation Assistance Program. d. Create and sustain a public education campaign about the need for and benefits of planting and caring for trees.	Long term (10+ years)
Action Step 3: Set a UTC Goal	3	#7: Set an urban tree canopy goal that balances tree benefits with the city's economic development goals and plans and accommodates other municipal infrastructure.	Long term (10+ years)
Action Step 4: Improve Ordinances and Policies	3	#8: Update Chapter 6 Public Tree Ordinance and consider adding new language and sections.	Long term (10+ years)
	3	#9: Continue to incorporate urban tree canopy and public tree management issues into the Comprehensive Plan during regularly scheduled Plan evaluations and updates.	Long term (10+ years)
	1	#10: Include current arboricultural industry standards in future revisions and updates to the Design and Construction Standards Manual.	Short-term (1-5 years)

	2	#11: Explore including tree protection and tree replacement planting requirements on private property in the land development regulations of the Zoning and Subdivision Ordinance as allowed by Commonwealth law.	Mid-term (5–10 years)
	2	#12: Expand the Public Tree Policy document with more policies that also have the support of other city departments.	Mid-term (5–10 years)
Action Step 5: Ensure Stable Funding and Identity New or Supplemental Funding Sources	1	#13: Ensure that the city's tree maintenance budget is no less than $104,000 annually.	Short term (1–5 years)
	1	#14: Consider supplemental funding options.	Short term (1–5 years)
Action Step 6: Perform Public Engagement and Build Partnerships	1	#15: Develop messaging that resonates.	Short term (1–5 years)
	2	#16: Develop an outreach plan.	Mid-term (3–6 years)
	2	#17: Create strong partnerships.	Mid-term (5–10 years)
	3	#18: Consider reinstituting a "Tree Stewards" Program.	Long term (10+ years)
Action Step 7: Continue the Urban Wood Reuse Program	2	#19: Continue and expand the urban wood reuse program.	Mid-term (3–6 years)
Action Step 8: Increase Urban Forest Management Program Staff and Provide Professional Training	2	#20: Create a City Forester position.	Mid-term (5–10 years)
	1	#21: Add a field arborist position.	Short term (1–5 years)
	1	#22: Provide training to staff and encourage professional certifications.	Short term (1–5 years)
Action Step 9: Regularly Update the Plan, UTC, and Inventory and Monitor the Plan's Success	3	#23: Update urban forest data and planning documents.	Long term (10+ years)
	1	#24: Monitor the Plan's implementation and success.	Short term (annually)

INTRODUCTION

Statement of Purpose

The trees in Harrisonburg are important components of the livability, sustainability, and ambiance of the city. The city's urban forest provides numerous benefits that are both tangible and intangible. Harrisonburg is seeking solutions to maintaining the historic character of the city while simultaneously dealing with modern and costly urban challenges like stormwater management, urban heat island effects, public health issues, and economic development. Harrisonburg recognizes that trees help define the character of the city and can be low-cost, high-impact infrastructure that provides solutions to many urban challenges. However, Harrisonburg does not currently have a community-wide tree management plan in place to sustain this important infrastructure.

Given the value of the urban forest, the City of Harrisonburg has taken the proactive step of creating a comprehensive, long-term Urban Forestry Management Plan. The Urban Forestry Management Plan is intended to provide strategies, goals, policies, standards, and actions to protect, enhance, expand, and preserve public trees and the tree canopy for the benefit of the community. The Plan intends to help coordinate and improve the city's tree management in an equitable, economic, and sustainable manner. Moreover, the Plan will be a valuable strategic planning tool that can support other municipal plans and projects.

This Plan was systematically developed by a comprehensive review of existing city ordinances, specifications and standards, other urban forest plans and information, through interviews with key city staff and leaders, using public participation input, analyzing inventory data and field observations, and by applying national arboricultural standards and best management practices. This is a holistic, customized Urban Forestry Management Plan for the City of Harrisonburg based on local conditions, resources, and priorities.

Vision

The Urban Forestry Management Plan takes its vision from the city's desire to maintain a high quality of life by focusing on actions to increase the benefits and values of trees, reduce risk, and improve the responsible, proactive management of Harrisonburg's urban forest. The Plan envisions these conditions for the future of the city's urban forest:

The City of Harrisonburg will have a safe, healthy, and diverse tree canopy by promoting public tree protection and planting within the city.

With the use of professional urban forestry leadership and staff, proper maintenance and planting techniques, more efficient management of city resources, and public education and support, the city's future urban forest will be viewed as an important community asset.

The urban forest will uniquely define the city's character and be a major factor in the continued growth and livability of Harrisonburg.

This plan is organized in sections that describe the characteristics of the urban forest, outline the valuable services provided by trees in Harrisonburg, assess the sustainability of the city's existing urban forest and management program, and put forth 24 recommendations for action on how to achieve this vision.

The Process

This plan is the result of a series of interviews, research, and data analysis tasks centered around the following questions and topics:

What do we have now?

- The number of public trees and quantity of tree canopy cover in Harrisonburg,
- The current condition of the urban forest,
- The strengths of our current urban forest and urban forest management program, and
- The challenges the City faces in the coming years.

What do we want in the future?

- The vision for the future urban forest, and
- The capacity to support a proactive urban forest management program.

How do we get there?

- The actions that will allow the City to reach its future goals,
- The resources will be needed, and
- Where to start; setting priorities.

How will we measure success?

- The benchmarks that should be used to measure success over the coming years, and
- The frequency of monitoring to assess the progress made and re-evaluate action steps.

Data Sources

To help answer these questions, understand the resource, and support the recommendations, urban forest data was analyzed, and many sources of information were used and referenced, including:

- Urban tree canopy (UTC) data and mapping assessment from 2018;
- Examination of the current street tree inventory data;
- Interviews with city staff and external stakeholders to examine the city's approach to management of the public trees and discuss future goals;
- Review of previous urban forest data and reports, existing plans and documents, and the city's code of ordinances;
- Informal public opinion survey; and
- Best practices sources such as American Public Works Association's Guidance Statement on Quality Management of the Urban Forest and current arboricultural industry standards and best management practices.

The following plan sections present the findings of the analyses and recommend the next steps in creating a sustainable urban forest for the current and future citizens of Harrisonburg.

Strengths and Challenges

As part of the answer to the question "What do we have now?", Harrisonburg's urban forest management program and the tree resource itself have many strengths, but also a number of challenges that either affect the safety and quality of the urban forest or the staff's ability to manage the program proactively and efficiently.

Strengths

The Current Urban Tree Canopy and Public Tree Population Provide Significant Benefits. Based on the 2018 *Trees to Offset Stormwater* study performed by the Center for Green Infrastructure, over 26% of Harrisonburg is covered with trees (on both private and public lands). Harrisonburg's street, park, and other public property tree population contains over 2,100 inventoried trees, and 87% are in Good or Very Good condition. Annually, the urban forest as a whole provides a variety of ecological, economic, and social benefits and greatly enhances the livability of the city.

Urban Forest Data, Interdepartmental Coordination, and Regulations Provide a Firm Foundation for Sustainability. The City has recent statistical and GIS-based mapping data for citywide tree cover and the public tree population. These resources allow for data-driven, rational decision-making about urban forest management activities. The existence of a tree ordinance and tree policy are mechanisms for the City to protect and better manage the tree resource. And, other City departments and staff understand the value of trees in the City and are supportive of the urban forestry program.

The Public Forest is Managed by Professional Staff. The City has highly experienced, knowledgeable, and dedicated management and field staff to perform important urban forest management tasks such as park and street tree removals and pruning, storm damage clean-up and correction, tree planting, and innovative special projects. Harrisonburg's urban forest management staff are engaged in professional organizations and have been recognized locally and at the state level for their leadership and special programs. The relatively recent reorganization and centralization of urban forest management into the Public Works Department will result in a more consistent and proactive approach. The expertise of city staff and the support of the Public Tree Advisory Board have resulted in Harrisonburg being recognized as a Tree City, USA for over fifteen years.

Challenges

Insect and Disease Threats are Increasing. Many non-native, invasive insects and diseases, such as gypsy moth, emerald ash borer, and white pine blister rust, pose serious threats to a large percentage of Harrisonburg's public and private urban forest. Emerging threats, such as Asian longhorn beetle and oak bot canker, while not confirmed in Harrisonburg, hold the possibility for spread and establishment of these and other known and unknown invasive forest pests. A more comprehensive approach to species diversity planning and integrated pest management is needed.

Climate Change. The effects of climate change are already being experienced in the Shenandoah Valley region. The increase in the frequency and severity of storm events can cause significant tree damage and canopy loss. However, preventive maintenance of public trees and purposeful

planting can significantly reduce the types and amounts of storm damage. Therefore, Harrisonburg needs to establish a citywide preventive, cyclical maintenance program and plant storm-resilient tree species. Additionally, beyond contributing to severe weather events and flooding, climate change may cause shifts in average temperatures and moisture levels. Trees adapted to Harrisonburg's historic climate may soon become stressed and more prone to insects and disease infestations as the climate changes over time.

Most Trees Are Privately Owned. In Harrisonburg, the vast majority of the tree canopy is located on private lands. For this reason, success in improving or maintaining tree canopy must include a citizenry that understands: 1) the value of trees and tree canopy to the community; and 2) how to plant and care for trees. Without this awareness and information, mature trees can be improperly pruned or removed at any time without a thought of the loss of benefits to the property owner, or overall impact on the community. And, replacement trees might not be planted; or if they are, they may be poorly placed and selected.

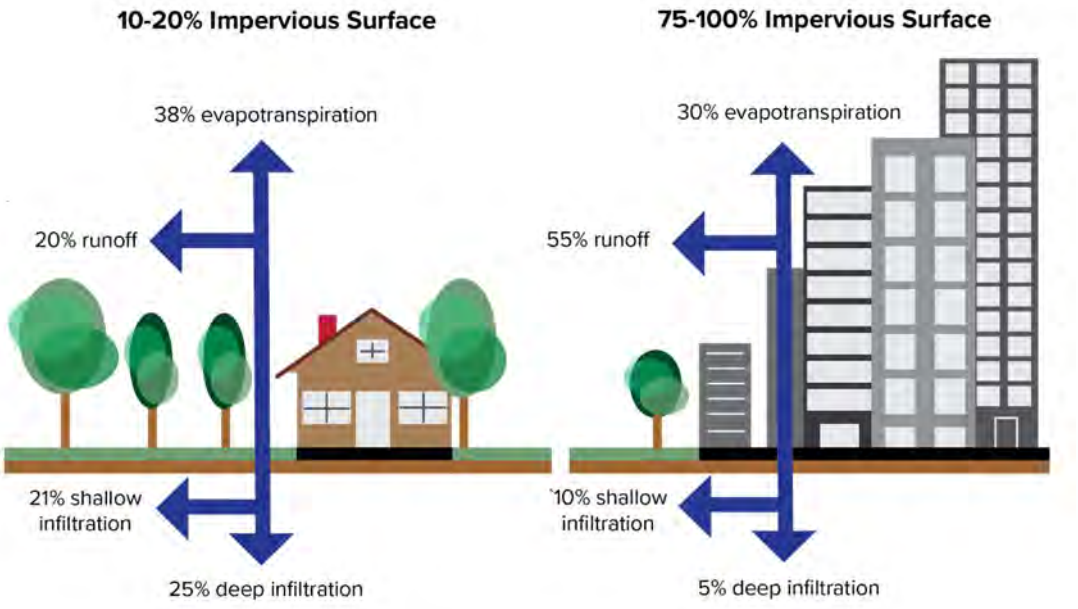
Land Use History and Future Land Use. The primary reason Harrisonburg's tree canopy may be lower than other cities in Virginia is the long history of agricultural land use. Trees have been cleared and removed on a consistent basis to accommodate field crops and grazing. Now that additional economic opportunities are offered in Harrisonburg, the city is growing and land development is removing any remnant forested tracts and mature landscape trees.

Benefits of Harrisonburg Trees

Trees provide numerous benefits to Harrisonburg. Trees conserve energy, reduce carbon dioxide levels, improve air quality, and mitigate stormwater runoff. In addition, trees provide many economic, psychological, and social benefits that are less quantifiable. When properly maintained, trees provide communities abundant environmental, economic, and social benefits that far exceed the time and money invested in planting, pruning, protection, and removal.

Urban Trees Reduce Water Pollution and Flooding. As cities grow, the amount of land that naturally absorbs rainwater (i.e., lawns, parks, fields, woods) tends to shrink, while hard surfaces that cause rain to runoff (i.e., roads, buildings, parking lots) tend to increase. After flowing over roads, parking lots, and lawns, rainwater accumulates pollutants (fertilizers, oil, chemicals, grass clippings, litter, pet waste, etc.). This contaminated stormwater flows into overloaded engineered sewers, ultimately reaching the local lakes and streams. Polluted water is a major cause of human health issues and degrades the local ecology. With more hard surfaces in an urbanized area, stormwater runoff also causes flooding. Rising incidences of flash floods in cities is a grave public health and safety concern that cities now need to address.

One mature deciduous tree can intercept over 500 gallons of rainwater a year. One mature coniferous tree can intercept up to 4,000 gallons of rainwater a year. (Seitz and Escobedo 2008)



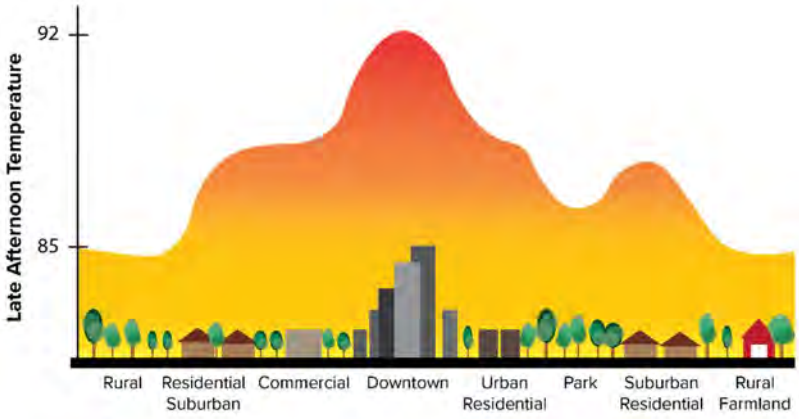
Infographic 1. Effect of pervious and impervious surfaces on water infiltration.

Urban Trees Clean the Air and Improve Health. Trees reduce or can completely remove many components of street-level air pollution, including carbon dioxide, ozone, nitrogen dioxide, sulfur dioxide (a component of smog), and small particulate matter (i.e., dust, ash, dirt, pollen, and smoke). This is an important service since air pollution creates significant public health issues. Ozone and particulates can especially aggravate existing respiratory conditions (like asthma) and create long-term chronic health problems (American Lung Association 2015).

In the first broad-scale estimate of air pollution removal by trees nationwide, U.S. Forest Service scientists and collaborators calculated that trees are saving more than 850 human lives a year and preventing 670,000 incidents of acute respiratory symptoms.

Urban Trees Alleviate Heat Stress and Improve Health. Due to the urban heat island effect, urban areas without trees often experience temperatures 15° to 25°F hotter than nearby, less developed areas. Heat stress has been proven to cause significant public health problems and even mortality. In fact, each year, more Americans die from extreme heat than all other natural disasters combined (i.e., hurricanes, floods, tornadoes, lightning). Those over 65 or under age 5 are especially vulnerable to heat-related health problems.

Urban trees are widely accepted as one of the most effective long-term solutions to reducing the effects of urban heat islands. Properly placed tree canopy can lower overall ambient temperatures by 20° to 45°F (EPA 2015).



Infographic 2. Effect of tree canopy and surface cover on temperatures.

Urban Trees Create More Successful Business Districts. It has been proven that tree-covered commercial shopping districts are more successful than those without canopy, as they create inviting business environments and give each area a unique character that becomes a draw as a destination.

In multiple studies, consumers showed a willingness to pay 11% more for goods and shopped for a longer period of time in shaded and landscaped business districts (Wolf 1998b, 1999, and 2003).

Urban Trees Make Streets Safer and More Walkable. In an age where walkability and pedestrian-friendly areas tend to draw the most people, tree cover is a powerful tool to revitalize business districts and neighborhoods.

According to the Federal Highway Administration, urban tree canopy along streets have been shown to slow traffic, helping ensure safe, walkable streets in communities (U.S. Department of Transportation 2015).

Urban Trees Remove Carbon Dioxide from the Air. Most of the carbon dioxide (CO2) in the atmosphere comes from human activities that involve the burning of fossil fuels. High levels of CO2 have resulted in climate issues, which has in turn caused more frequent and severe storms, droughts, and other natural stresses across the world in recent decades. Trees are constantly removing and storing carbon dioxide from the atmosphere.

One large tree is able to absorb as much as 48 pounds of carbon dioxide (CO2) per year, while one acre of trees stores the same amount of CO2 released by driving an average car for 26,000 miles (Megalos 2015).

Urban Trees Reduce Energy Usage and Costs. Both demands and costs for energy are rising. Heating and cooling account for approximately half of residential energy bills today (Department of Energy 2015). Trees provide energy savings by reducing cooling and heating costs, both through their shade as well as the release of moisture through transpiration. Beyond monetary saving, the cooling effect provided by trees is an important benefit for any resident, but can be a life-or-death issue for those prone to heat related illnesses and/or those in lower income areas, as described in the benefit on heat stress described earlier.

The cooling effect of one healthy tree is equivalent to 10 room-sized air conditioners operating 20 hours a day (North Carolina State University 2012).

Urban Trees Build Stronger, More Vibrant Communities. Tree-lined streets can create stronger communities and attract new residents. While less quantifiable, the tree benefits related to community building are no less important than other services.

Residents of apartment buildings surrounded by trees reported knowing their neighbors better, socializing with them more often, having a stronger community, and feeling safer and better adjusted than did residents of more barren, but otherwise identical areas (Kuo and Sullivan 2001).

Urban Trees Can Contribute to a Decrease in Crime. Recent studies have shown that tree-lined streets have been linked to lower crime, and tend to suffer from less graffiti, vandalism, and littering than their treeless neighbors (PHS 2015).

In New Haven, CT, a 10% increase in tree canopy was associated with a 15% decrease in violent crime, and a 14% decrease in property crime. (Gilstad- Hayden 2015)

Urban Trees Provide Buffers for Noise and Pollution. Pollution and noise from busy roadways and rail lines can create unhealthy and undesirable conditions for those living nearby, but buffers of trees can significantly reduce both noise and pollution.

A 100-foot-wide, 45-foot-high densely-planted tree buffer can reduce highway noise by 50% (NC State 2012).

Urban Trees Boost Property Values. This is beneficial to both the property owner and the city budget's bottom lines. As property values increase, city revenue from taxes also increases. Additionally, properties can sell faster since communities with trees are generally considered more desirable places to live.

Trees have been shown to increase residential property and commercial rental values by an average of 7% (Wolf 2007).

Urban Trees Provide Essential Wildlife Habitat. Trees are an essential component to habitat and conservation in urban areas. They intercept and clean large quantities of polluted stormwater, preventing further degradation to vital aquatic and terrestrial habitats. A healthy wildlife population also indicates a healthy place for people to live.

As smaller forests are connected through planned or informal urban greenways, trees provide essential habitat to a range of birds, pollinators, and other wildlife that feed on insects (Dolan 2015).

WHAT DO WE HAVE?
THE STATE OF HARRISONBURG'S URBAN FOREST

As part of the answer to the question "What do we have now," the existing public trees in Harrisonburg were assessed. The characteristics of the public urban forest are important to know for developing proactive management policies that protect and enhance the safety and sustainability of this important natural resource.

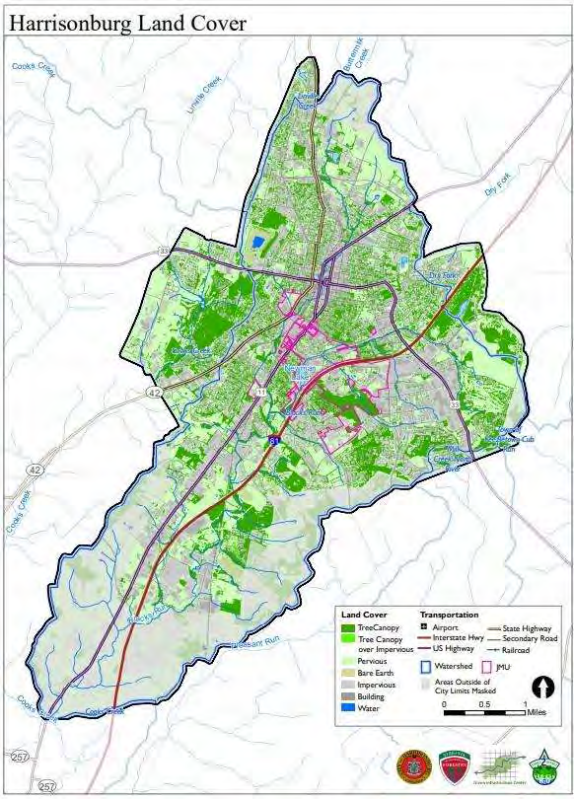
The urban forest within a city can be considered in two different ways. First, it can be defined as the entire population of trees (whether they are naturally occurring forests or human-planted landscape trees) growing on both public and private property within municipal boundaries. They are considered a community resource because they provide many benefits to everyone regardless of location or ownership. Collectively, trees on public and private property are generally referred to as the community's urban tree canopy (UTC).

Secondly, trees that are on public property (such as on streets, in parks, and near schools and public facilities) and managed by the city are a subset of the urban tree canopy and collectively are referred to as the public urban forest.

Assessment of the Urban Tree Canopy

The amount and distribution of the urban tree canopy (UTC) determine the urban forest's capacity for providing environmental and social benefits to the community. A community's UTC is expressed as a percentage of all land and is composed of all public and private trees within a community's urban forest, as viewed from above the trees.

Recognizing the importance of UTC, the City of Harrisonburg benefitted from an urban tree canopy project titled *"Trees to Offset Stormwater, Case Study 08"* performed by the Green Infrastructure Center (GIC) in 2018.



Citywide Tree Canopy Cover

The GIC analysis revealed that the estimated overall tree canopy coverage of Harrisonburg is 26.6%. The land cover results of the 2018 UTC analysis are provided in Table 1.

Table 1: Land Cover Results for Harrisonburg

Land Cover Classification	Percent of City
Impervious Surfaces	38.5%
Pervious Surfaces	33.6%
Tree Canopy	26.6%
Bare Soils	1.3%

The data from the GIC study reveal that impervious surfaces comprise the majority of land use cover in the City compared to the other three classes. Impervious surfaces are hard areas, such as all types of pavements and buildings, that do not allow water to seep into the ground. Instead, the water runs off an impervious surface, contributing to increased flooding and pollutants

entering storm drains and nearby bodies of water. Impervious surfaces also contribute significantly to "heat island effect" raising temperatures in urbanized, highly developed areas.

The GIS-based UTC and land use mapping and statistics are valuable tools the City can use to understand the location and quantity of tree canopy and to measure the success of its urban forest management program. Performing the analysis every 5 to 10 years, and then performing a comparative analysis, will allow the City to see both where and why positive and negative changes in tree canopy and impervious surfaces have occurred.

Table 2: Comparisons of Urban Tree Canopy in Virginia Cities

City	Canopy % of Area	City	Canopy % of Area
Roanoke	48%	Falls Church	35%
Waynesboro	43%	Charlottesville	27%
Richmond	42%	National average	27%
Front Royal	41%	**HARRISONBURG**	**26%**
Salem	40%	Abingdon	23%
Vinton	38%	Winchester	21%

Public Tree Canopy Cover

In Harrisonburg, the estimated public tree canopy cover (street, park, and school trees) collectively is 11.6% of the total land area within city limits. Table 3 . shows the distribution of the publicly managed tree canopy by the three primary types of public property.

Table 3: Percent of UTC on Publicly Managed Properties

Property Type	% of Citywide Canopy
Street/Right-of-way	1%
Parks	45%
Schools	10%

The urban forest occurs on both private and public land, and typically there are more privately controlled trees than publicly managed trees in a city. And clearly, the data reveals that almost 90% of the tree canopy in Harrisonburg is owned and controlled by private property owners. However, public trees, particularly in parks and on school grounds, tend to be larger. Street trees, for example, may only account for 10% of the total tree population, but can contribute 25% of the total leaf area in the urban forest. Therefore, Harrisonburg's public trees are an important natural resource that the City has direct control over and should proactively manage.

How Much Total Tree Canopy is Possible?

If Harrisonburg decides to set a goal to increase its tree canopy, then potentially every acre of land that is not paved (pervious) could support trees. This "Potential Planting Area" (PPA as defined by the 2018 GIC study) then is the sum of all land cover that is open, pervious ground (i.e., tree canopy, grass and low vegetation, and bare soil). In Harrisonburg, the PPA is 16% of the total land area within city limits.

However, open ground within municipal boundaries is also used for athletic fields, cemeteries, new houses and businesses, and other land uses important to a livable city. Therefore, it is not practical to consider the gross PPA as a goal; the GIC suggests using half of the calculated PPA as a reasonable estimate. Using this approach, and aiming to increase canopy by another 8%, Harrisonburg potentially could achieve a citywide UTC of approximately 34%.

What Canopy Percent Should We Be Aiming For?

The general UTC standard or goal used by cities in the last decades came from American Forests when they recommended that cities set an overall canopy goal of 40%, a 15% canopy in central business districts, 25% canopy in urban neighborhoods, and 50% canopy in suburban neighborhoods. They have since stated that tree canopy goals should be set by the city after careful data analysis and public input.

However, those general goals are still accepted by many municipal urban forestry programs as a reasonable and defensible "starting point." In fact, and applicable to Harrisonburg, according to a national analysis by U.S. Forest Service researchers, a 40-60% urban tree canopy is attainable under ideal conditions in forested states.

However, every community is unique, and these goals are only to be considered general guidelines. Determining tree canopy goals for Harrisonburg will involve a multi-step process of using these ideal canopy rates in combination with what is realistic and acceptable in Harrisonburg when balanced with other economic and social goals of the community.

Setting Realistic Urban Tree Canopy Goals

The amount of tree canopy drives the amount of ecosystem and human benefits that trees provide a city. Once the UTC percentage and benefits are determined, every city must decide whether they want to maintain the existing canopy level, increase it, or even set a minimum threshold for its citywide tree canopy. Setting UTC goals can help define future tree planting programs and direct tree preservation efforts. Establishing realistic and achievable tree canopy goals will help capitalize on the economic, environmental, and social benefits trees provide to the community.

Assessing a "realistic PPA," where planting is more practical, is based on an approach of identifying reasonable areas to plant trees. Harrisonburg should identify, assess, and prioritize these areas based on maximizing ecological services, providing equal access to trees and natural resources, and protecting public health and safety benefits.

Realistic planting areas could include the pervious surfaces within state corridors, highways, streets, parks, public properties, and private property within Harrisonburg. Land uses, such as agricultural land, cemeteries, golf courses, utility rights-of-way, and recreational fields, would be excluded from the analysis. Knowing where and how much is "realistic PPA" in Harrisonburg will make canopy goal setting more practical and achievable. How to set a goal will be discussed further in the *Action Steps* section of this plan.

Assessment of Public Trees

In the winter of 2020 through the spring of 2021, the City of Harrisonburg's arborists assessed and inventoried trees along the street rights-of-way, public parks, and schools. A total of 2,131 sites were collected during the inventory. It is estimated that 100% of the street trees are inventoried, 90% of schools, and 50% of public parks.

Of the 2,131 sites collected, 382 (18%) were collected along the street right-of-way, 1,084 (51%) in parks, 464 (22%) were collected on school grounds, and the remaining 201 (9%) on other public properties. Figures 2 and 3. display the locations of the inventoried trees, which are also included in Appendix A.

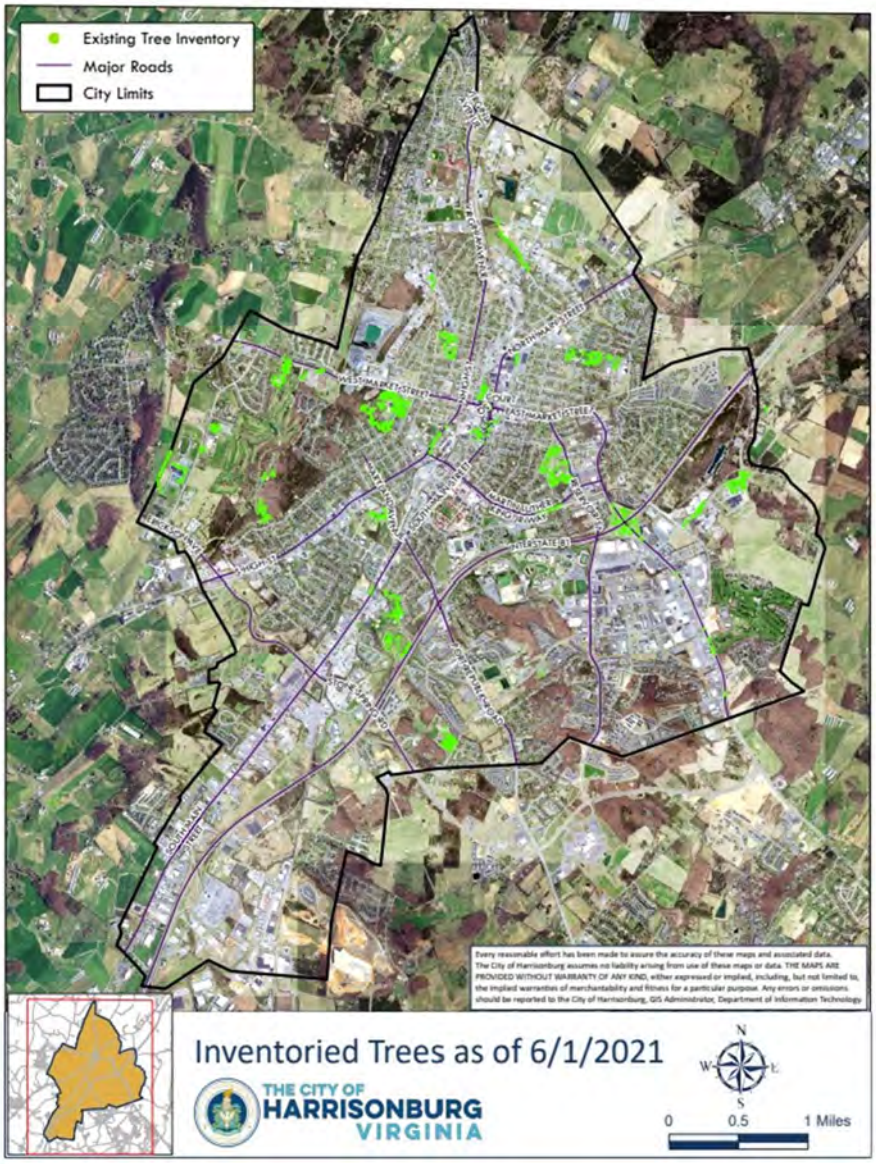
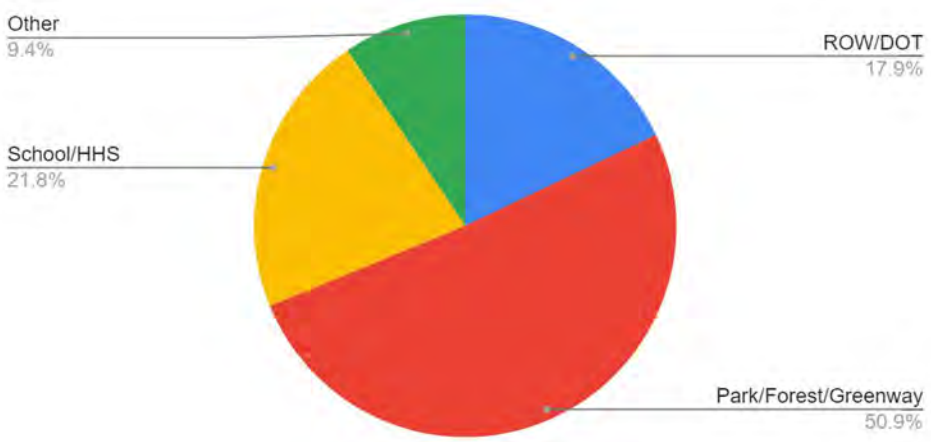


Figure 2: Location of public trees collected during the 2020-2021 inventory.

Figure 3: Percent of inventoried trees by location/property type.



Using the inventory data, the City can now see trends in the data that can help guide short-term and long-term management planning. For this plan, the following criteria and indicators of the inventoried tree population were assessed:

- **Species Diversity.** The variety of species in a specific population, affects the population's ability to withstand threats from invasive pests and diseases. Species diversity also impacts tree maintenance needs and costs, tree planting goals, and canopy continuity.
- **Diameter Size Class.** The statistical distribution of a given tree population's trunk-size class is used to indicate the relative age of a tree population. The diameter size class distribution affects the valuation of tree-related benefits as well as the projection of maintenance needs and costs, planting goals, and canopy continuity.
- **Condition**. The general health of a tree population indicates how well trees are performing given their site-specific conditions. General health affects both short-term and long-term maintenance needs and costs as well as canopy continuity.
- **Maintenance Need.** This provides insight into current and future maintenance needed to keep public trees in a safe and healthy condition.

Species Diversity

There are a total of 48 genera and 78 species represented within Harrisonburg's public tree population.

Species diversity affects maintenance costs, planting goals, canopy continuity, and the forestry program's ability to respond to threats from invasive pests or diseases. Low species diversity (large number of trees of the same species) can lead to severe losses in the event of species-specific epidemics, such as emerald ash borer's effect on ash trees. High diversity has proven to increase urban forest resiliency to storms and insect and disease issues, and thereby reduce maintenance costs.

The recommended composition of a municipal tree population should at least follow the "10-20-30 Rule" for species diversity: a single species should represent no more than 10% of the urban forest, a single genus no more than 20%, and a single family no more than 30%.

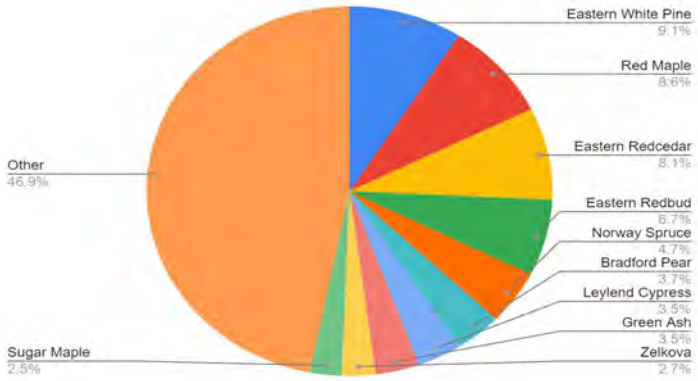
Table 4 displays the quantity of the top five genera in the inventoried population. The data indicate that Harrisonburg's urban forest very successfully meets the recommended standard for genera diversity. Maple *(Acer*) is the most frequently inventoried genus, yet only accounts for 13% of the population and is well below the 20% threshold.

Table 4: Top Five Genera

Genus	Quantity	% of Population
Acer	281	13.19%
Pinus	207	9.71 %
Quercus	181	8.49%
Juniperus	175	8.21%
Cercis	145	6.80%

Figure 4 shows the composition of the most populous species compared to all inventoried species. Of the species inventoried in Harrisonburg, eastern white pine (*Pinus strobus)*, red maple (*Acer rubrum*), and eastern redcedar (*Juniperus virginiana*) are the most frequently found and approach, but are below, the 10% threshold.

Figure 4: Overall tree species distribution and composition in Harrisonburg, Virginia (2021)



Continued diversity of tree species is an important objective that will ensure Harrisonburg's urban forest is sustainable and resilient to future invasive pest infestations.

Distribution of Tree Sizes/Ages

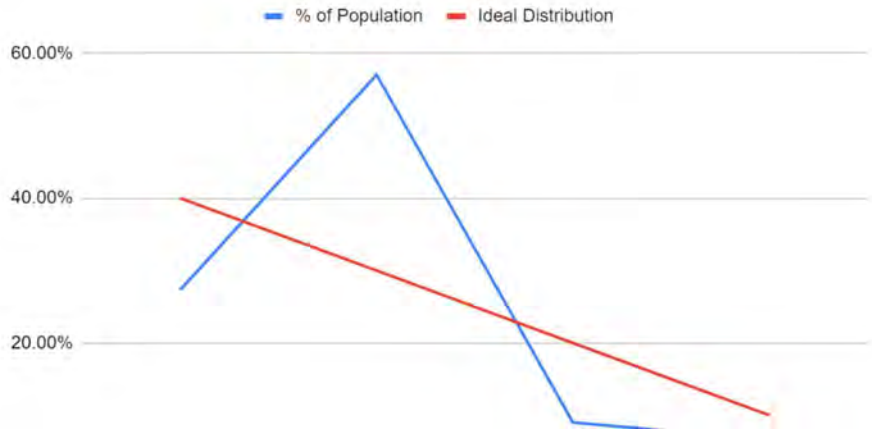
Analyzing the diameter size class distribution provides an estimate of the relative age of a tree population and offers insight into maintenance practices and needs.

The inventoried trees were categorized into the following diameter size classes: young trees (0–8 inches DBH), established (9–17 inches DBH), maturing (18–24 inches DBH), and mature trees (greater than 24 inches DBH). These categories were chosen so that the population could be analyzed according to an industry standard for ideal diameter size class distributions for street trees.

The accepted standard related to ideal distribution suggests that the largest fraction of trees (approximately 40% of the population) should be young (less than 8 inches DBH), while a smaller fraction (approximately 10%) should be in the large-diameter size class (greater than 24 inches DBH). A tree population with an ideal distribution would have an abundance of newly planted and young trees, and lower numbers of established, maturing, and mature trees.

Overall, the size distribution of all inventoried trees is presented in Figure 5, and the statistics indicate that Harrisonburg's urban forest has a nearly ideal distribution which bodes well for its future sustainability.

Figure 5: Size (diameter) distribution and ideal distribution of inventoried trees.

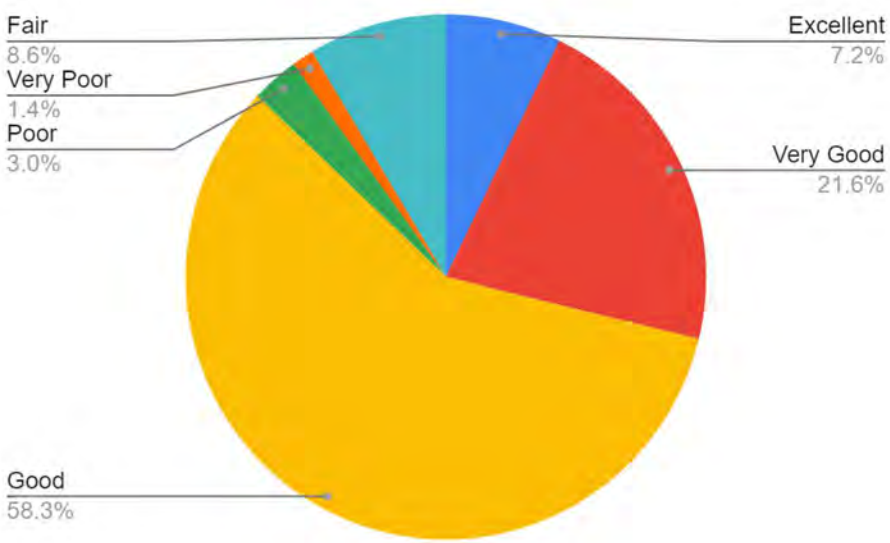


Planting trees is necessary to increase canopy cover and replace trees lost to natural mortality (expected to be 1%–3% per year) and other threats (for example, invasive pests or impacts from weather events such as storms, wind, ice, snow, flooding, and drought). Planning for the replacement of existing trees and identifying the best places to create new canopy is critical.

Condition of Public Trees

The City's Certified Arborists assessed the condition of individual trees based on methods defined by the International Society of Arboriculture (ISA) and professional judgement. The condition of each inventoried tree was rated Excellent, Very Good, Good, Fair, Poor, or Very Poor. Of the inventoried trees, 87% were recorded to be in Good or better condition. Figure 6. illustrates the general condition of all trees.

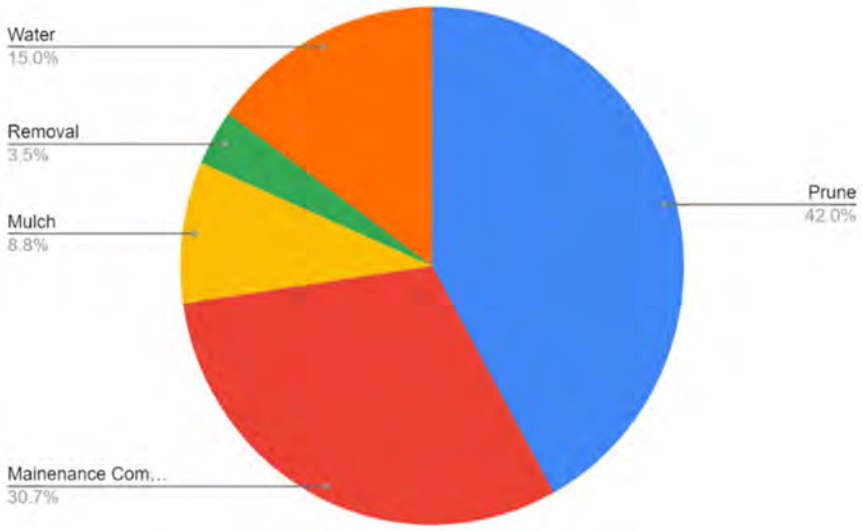
Figure 6: Tree condition of the inventoried trees.



Maintenance Needs

Each tree inventoried was assigned a primary maintenance recommendation. Those recommendations were either Prune, Remove, Water, Mulch, or Maintenance Completed. Pruning was recommended for the vast majority (42%) of the trees, and Removal was recommended for 75 (3.5%) public trees. Figure 7 displays the distribution of tree maintenance recommendations.

Figure 7: Maintenance Needs of Existing Trees



Potential Threats from Pests

Insects and diseases pose serious threats to tree health. Awareness and early diagnosis are essential to ensuring the health and continuity of street and park trees.

Many pests target a single species or an entire genus, but others have multiple hosts. The inventory data were analyzed to provide a general estimate of the percentage of trees susceptible to some of the known and/or potential pest threats in Virginia (see Table 5). It is important to note that the table only presents data collected from the inventory. Many more trees throughout Harrisonburg, including those on public and private property, may be susceptible to these invasive pests. Appendix B provides information about some of the current potential threats to Harrisonburg's trees.

Spotted lanternfly and Asian long-horned beetle are serious potential threats to a large percentage of the inventoried trees in the City. These pests have not been detected in Harrisonburg, but if they were detected Harrisonburg could see severe losses in its tree population.

Table 5: Potential impact of insect and disease threats in Harrisonburg.

Threats to Trees	Primary Host(s)	Percent of Inventoried Trees at Risk
Spotted lanternfly	ash, basswood, dogwood, maple, red oak, white pine	38.5%
Asian long-horned beetle	maple, elm, sycamore, birch	18.0%
White pine blister rust	Eastern white pine	10.0%
Gypsy moth	oak	8.5%
Sudden oak death	oaks	8.5%
Emerald ash borer	ash	3.6%

Harrisonburg should be aware of the signs and symptoms of potential infestations and should be prepared to act if a significant threat is observed in its tree population or a nearby community. An integrated pest management plan should be established. The plan should focus on identifying and monitoring threats, understanding the economic threshold, selecting the correct treatment, properly timing management strategies, recordkeeping, and evaluating results.

What do we have? Harrisonburg's Urban Forest Management Program

Public trees and the urban tree canopy are infrastructure assets, and as such should be managed efficiently and effectively to extend their service lives, maximize their benefits, and streamline operations. The key principles for successful operations management are to recognize the economic, environmental, and social values of the asset, optimize the funding invested in that asset over its life cycle, ensure it is professionally managed and cared for, and collaborate as an organization to ensure these public assets are functional and safe.

Key components of Harrisonburg's management program for the valuable public asset that is the urban forest are discussed in the following sections.

Planning and Policy

The City has many plans, policies and regulations that affect the urban forest, either directly or indirectly, and either positively or negatively. The planning and policy documents reviewed for the urban forest management plan include: 2018 Comprehensive Plan Chapter 6; Environmental Action Plan 2020; Downtown Streetscape Plan 2008, Chapter 6. Public Tree Ordinance; Zoning and Subdivision Ordinance (for land development regulations); Trees to Offset Stormwater Study 2018; the 2020 Public Tree Policy, and the current Design and Construction Standards Manual (DCSM).

Overall, the existing plans and regulations recognize the value of the urban forest and provide a solid foundation for professional management. The long-term goals and recommendations of the Comprehensive Plan, and particularly of the Environmental Action Plan, should be catalysts for strengthening the City's urban forestry program in the future.

However, the DCSM and the Tree Ordinance, which both guide and/or regulate current and short-term actions of the program, and those of external actors (such as developers, utility companies, and citizens) should be reviewed and evaluated so that new language and additional sections can be included to increase the effectiveness of the program and the sustainability of the public urban forest. Concepts for future improvements to these and other documents are discussed in the Recommendations section.

Organization & Staffing

Recently, the positions of Greenspace Manager and Landscape Supervisor were transferred to the Public Works Department from the Parks and Recreation Department. Along with these positions came the access to and management responsibility of the Trustees crew which performs minor tree planting and maintenance and mowing tasks. The Parks and Recreation Department retained staff and equipment for tree maintenance.

While it is not uncommon that execution of a variety of municipal tree management activities occurs within separate departments, most commonly the City Urban Forester/Municipal Arborist position is designated as having the primary responsibility for managing all public trees. This leadership designation ensures that the staff member with the most arboriculture and urban ecology expertise and experience is guiding the overall management of the urban forest and is collaborating across departmental lines. The City Forester can ensure that more proactive management strategies are applied to all public spaces, and that the public is educated and engaged about managing their own trees to benefit the community at large. This position,

however, needs the support of adequate field and office staff, and access to contractual services, to be most effective.

The placement of urban forest management in the Public Works Department is an effective organizational structure. The Public Works Department interfaces with most of the actors and activities that affect the urban forest on a daily basis in the City, such as road and public space construction projects, stormwater management, utility installation and repair, and storm response.

Budget

Adequate funding is needed for any city to implement an effective urban forest management program that provides short-term and long-term public benefits, ensures that priority maintenance is performed expediently, establishes proactive maintenance cycles, and plants trees to preserve and enhance the public canopy cover.

The urban forest management program in Public Works has a budget of approximately $200,000 that is roughly divided equally between operational costs (plant materials, supplies, and contract services) and administrative expenditures (staff salary and benefits, and office equipment). The urban forestry budget also supports the City's expanding pollinator program by purchasing plants and materials for it, and dedicating a significant amount of staff time to the program's implementation and management.

In addition to the Public Works Department, there are three other City agencies that allocate some funds related to urban forest activities. Parks allocates limited funds for park tree care and planting. The Harrisonburg Electric Cooperative performs tree pruning in the form of line clearance, and has a cost-share tree planting program. And the Stormwater Management program of Public Works supports tree planting when it is directly applicable to a green infrastructure project.

The current operation budget of approximately $100,000 is proportioned as follows: 20% tree planting and care; 30% routine and emergency mature tree maintenance; and 50% tree removal (primarily because of ash removal due to the EAB threat).

Completing the inventory, and then keeping the dataset up-to-date is crucial for making informed management decisions and projecting more accurate maintenance budgets.

Photograph 1: Tree removal operations in Harrisonburg.

Community Engagement

The City's urban forestry program has a robust community outreach and communication program. Citizens, civic groups, students, and non-profits are frequently targeted for messaging and announcements using the City's website, press releases, television interviews, and social media. For most of this messaging, the City is also diligent in offering translation services to reach non-English speaking residents.

Given the limited outreach resources the urban forest management program has, it has maximized them by offering a variety of hands-on learning and volunteer programs throughout the year (e.g. Arbor Day celebrations and tree planting, watershed clean-up and restoration projects, recycled and repurposed public wood product sales, EAB Cost-Share Program).

However, as evidenced by the community survey, citizens felt like they did not receive sufficient notice of events, and they want more targeted information on perennial topics such as proper tree maintenance and planting, and on current issues such as using trees to mitigate heat island and stormwater issues. Since the citizens also identified the City's arborists as a trusted source, this should indicate that looking for innovative and proven means to expand the urban forest management program's public outreach resources should be prioritized.

Beyond public education, the City could engage with the community more to create public-private partnerships to accomplish annual goals and large projects. Examples include reforesting large tracts of private land, protecting historic or large-diameter trees during development, managing a volunteer tree stewards program, supporting a professional educational campaign, and receiving funds and in-kind services for special projects to preserve and expand the City's urban tree canopy.

Urban Forest Management Operations Benchmarks

Table 6 displays various statistics from peer cities related to overall urban forest management program benchmarks and compares them to Harrisonburg's current program. The average and peer city statistics are provided for informational purposes only.

Table 6: Benchmark Table of Select Operational Categories

Urban Forest & Management Program Benchmarks*	Harrisonburg**	Cities with Pop. 50,000-99,999	Charlottesville	Blacksburg
Funding				
Municipal tree care and program budget	$200,000 ($435,000 with HEC budget)	$646,501	$323,053	$360, 265
Annual budget per capita	$3.30 ($8.16 with HEC budget)	$9.40	$6.71	8.14
Tree care and management program budget percent of total municipal operating budget	0.07%	0.53%	0.56%	0.54%
Program Staff and Ordinance				
Staffing complement (Full time equivalent)	3	6.3	NA	NA
Staffing complement (Total staff)	7 (inc. 4 trustee crew members)	9.1	NA	NA
Tree Preservation Ordinance	No	60% (yes)	Yes	Yes
Regular tree risk management	No	61% (yes)	NA	NA
Maintenance and Planting				
Perform cyclical/preventive maintenance	No	60% (yes)	NA	NA
Number of trees pruned annually	72	1734	186	60
Number of trees removed annually	401***	434	154	12
Number of trees planted annually	321	353	160	124
Number of trees treated for insects and disease annually	35	292	NA	NA

Desired cyclical maintenance cycle	5 – 10 years (TBD)	5 years	NA	NA

* Mean statistics from Hauer R. J. and Peterson W. D. 2016. Municipal Tree Care and Management in the United States: A 2014 Urban & Community Forestry Census of Tree Activities. Special Publication 16-1, College of Natural Resources, University of Wisconsin - Stevens Point. 71 pp.
** Harrisonburg statistics from 2020 Tree City, USA reports; Adopted FY20 Operating Budget = $259,650, 835
***372 ash removals

WHAT DO WE WANT?
DEVELOPING A UNIFIED VISION

To ensure that the work on this plan and resulting recommendations were comprehensive and representative of the community's needs and priorities, efforts were undertaken to gain information and insights from a variety of stakeholders in Harrisonburg. Primarily, these efforts included:

Public Survey. A survey to gauge the level of support for and knowledge of the urban forest and the City's urban forest management program was created and distributed through various means by the city. A total of 259 respondents answered 13 survey questions which asked questions about the city's urban forest management program, community values about trees, and priority action items related to trees.

Municipal Staff Interviews on Urban Forest Management Practices/Budgets. City staff provided a significant amount of data and input on current practices and challenges. The interviews were conducted remotely with participation from many departments including: Public Works, Community Development Services, City Manager's Office, and Parks.

Public Tree Advisory Board and Other External Stakeholder Interviews. Members of the Advisory Board and staff of James Madison University were also interviewed to get external perspectives of the urban forest and management program.

Citizen Input on Harrisonburg's Urban Forest and Management Program

Since nearly 90% of Harrisonburg's overall urban tree canopy is actually in private ownership, and even since "public trees" belong to the citizens, exploring the results of the public survey provides interesting insights into the management of the current and future forest in Harrisonburg.

The survey was made broadly available to citizens and had very good participation, but it was not a formal survey and the number of respondents represent a very low percentage of the city's total population. However, general observations can be made to gauge community sentiment about Harrisonburg's tree canopy, the city's urban forest management program, and new projects and initiatives. General survey results and representative comments are presented below.

Survey Themes and Results

The 2021 Urban Forestry Management Community Survey Results summary report, prepared by the City, presents data and interpretations of each of the 13 questions, and can be found in its entirety in Appendix C. However, based on the survey statistics and the many independent comments received, five clear themes emerged that most respondents made comments about. Briefly, they are:

More Trees Should be Planted. Respondents expressed their belief that trees help define the character of Harrisonburg, provide many ecological benefits, and generally improve the quality of life. Because of this, they said more trees should be planted on both public and private properties, but particularly in the downtown area, on residential streets, and on school grounds. If a discount or incentivized program existed for tree planting on private property, many property owners indicated they would participate.

- "We need a lot more trees in all areas of the City."
- "Downtown is particularly bleak in terms of its lack of trees comparable to other cities"
- "I wish there was some sort of incentive program to plant trees on private property.

There Should be Greater Diversity in the Urban Forest. Citizens cited that more species diversity (in terms of using native trees, creating "food forests" consisting of fruit and nut bearing species), and purposeful planting of more trees that provide seasonal interest should be planted in the future.

- "Encourage and incentivize residential planting of native trees."
- "I want to see greater species variety and having trees with utility to humans and wildlife alike."
- "Please plant fruit trees accessible to all!"

Greater Access to Urban Forest Education is Needed. Respondents requested that greater educational opportunities for tree care and planting be provided. The subjects of proper pruning, planting, and general tree care were of particular interest; and they would like this information to come from a trusted source such as the City and/or a Certified Arborist in an online or in-person workshop or special event format.

- "Greater effort could be placed on communicating the ecological and economic value of urban trees. Local landowners regularly fail to understand the benefits provided to them by planting and maintaining trees on their properties"
- "Please make an effort to educate people about what size tree to plant and proper pruning techniques. We need much more education, public service announcements, and newspaper articles about caring for trees."
- "It would be great to have a number to call to get advice about trees."

The Public Wants to be More Engaged. There appears to be a growing number of citizens that would be willing to participate in activities to enhance the urban forest. Having a "tree stewards" program was suggested multiple times. If asked and provided instructions, many abutting owners are willing to provide care for newly planted trees. People are willing to participate in volunteer events.

- "I would like to suggest re-establishing the Tree Stewards Program."

- "I would happily volunteer to help plant and maintain trees downtown."
- "Please let me know how I can help plant more trees in the City and help take care of the ones we have."

Regulations Should be Considered for Protecting and/or Replacing Trees During Land Development and Other Construction Projects. Some respondents said they would support creating regulations that protected large canopy trees and prohibited clear-cutting during development on private property. In the absence of those, many respondents suggested that at least there should be greater replacement tree planting required of developers to mitigate trees lost due to construction.

- "We could have better guidance or even rules that would help preserve existing trees during land development."
- "I would love to see the City incentivize developers to reclaim rarely used parking areas and plant trees."
- "Developers don't include greenspace in their designs."

The City's Urban Forest Management Program and Staff are Valued. Respondents reported that their interactions with and opinion of the urban forestry staff is very positive. They appreciate the knowledge and hard work of the City's arborists.

- "The fact that I've never noticed any trees being a problem in my 8+ years of living here means ya'll must be doing something right!"
- "The City is lucky to have such nice and professional employees who are very knowledgeable and very polite."
- "This is a beautiful effort, thank you for all your work!"

Citizens Want Action

The survey asked respondents to prioritize five action items that individually, or as a whole, would elevate Harrisonburg's urban forest management program to a more progressive and proactive program, and one that is also responsive to their needs and priorities. The results are presented in Table 7.

Table 7: Survey Results of Citizen Priorities for Public Urban Forest Management Actions

Rank	Urban Forest Management Action Item
1	Plant more street trees
2	Plant more park trees
3	Provide tree planting and maintenance advice to property owners
4	Increase City arborist staff to care for public trees

5	Perform more maintenance (pruning, removal, stump grinding)

Concluding Thoughts on the Survey Results

There is great support from the public for trees. Citizens appear to be willing champions for the urban forest management program. The bottom line is that Harrisonburg's citizens love the trees in their city. In the survey, they repeatedly indicated that the trees help define the city, make it a more inviting place to live and work, provide many health benefits to residents, and are important for the City's future.

More marketing/communications is needed to inform more people. The survey indicated that better tree care, more tree planting, and support for public trees would increase if there was more outreach and easy access to information about trees and urban forestry issues. City staff and stakeholders should strive to use information from the inventory and the management plan to create educational and marketing campaigns that can be used on websites, email listservs, social media outlets, and at special events. And, to maximize exposure, the City should leverage neighborhood and civic group outlets, business', and non-profit organizations' communication systems and networks to reach out to the public with important messages.

Evaluating the Sustainability of Harrisonburg's Urban Forest and Management Program

As part of developing this Urban Forest Management Plan, three primary components of Harrisonburg's urban forest and the management program that are indicators of a sustainable community forest and program have been rated. Those components are:

- ***The Trees*** category includes indicators related to the status of the tree resource itself, including knowledge of that resource.
- ***The Players*** category evaluates the necessary involvement and collaboration of stakeholders at all levels.
- ***The Management Approach*** category evaluates availability and use of different tools and/or actions to improve and sustain the urban forest resource.

The rating system used in the evaluation is a combination of James Clark's *Model of Urban Forest Sustainability*, and Andy Kenney's *Criteria and Indicators for Strategic Urban Forest Planning and Management*. The individual ratings presented in Table 8. were informed by analyzing the recent inventory and UTC data, reviewing the existing plans, guidelines and regulations, interpreting the public survey results, using local knowledge and experiences, and applying arboricultural industry standards.

Table 8: Urban Forest Resource and Management Program Sustainability Ratings

Indicators of a Sustainable Community Forest		Ideal Condition/Goal	Assessed Conditions or Performance		
			Low	Moderate	Good
The Trees	**Urban Tree Canopy Level (All Trees)**	Achieve the desired tree canopy cover according to goals set for the entire city and neighborhoods.			
	Canopy Location/Distribution (All Trees)	Ensure that the benefits of tree canopy are available to all, especially for those most affected by these benefits.			
	Condition (Public Trees)	Possess a detailed understanding of tree condition for all publicly-owned trees.			
	Size/Age Distribution (Public Trees)	Establish a diverse-aged population of public trees across the entire city and for each neighborhood. Ideal standard:40% young trees, 50% maturing trees, and 10% mature trees/			
	Species Diversity (Public Trees)	Establish a genetically diverse population of publicly-owned trees across the entire city and for each neighborhood. Tree populations should be comprised of no more than 30% of any family, 20% of any genus, or 10% of any species			
	Species Suitability (Public Trees)	Establish a tree population suited to the urban environment and adapted to the overall region. Suitable species are gaged by exposure to imminent threats, considering the "Right Tree for the Right Place" concept and invasive species.			
The Players	**Public Awareness**	The general public understands the benefits of trees and advocates for the role and importance of the urban forest.			
	City Department/Agency Cooperation	All city departments and agencies cooperate to advance citywide urban forestry goals and objectives			
	Large Private Landholder Involvement	Large, private, and institutional landholders embrace citywide goals and objectives through targeted resource management plans.			

	Utility Engagement	All utilities are aware of and vested in the urban forest and cooperates to advance citywide urban forest goals and objectives			
	Green Industry Involvement	The green industry works together to advance citywide urban forest goals and objectives. The city and its partners capitalize on local green industry expertise and innovation.			
	Regional Collaboration	Neighboring communities and regional groups are actively cooperating and interacting to advance the region's stake in the city's urban forest.			
The Management Approach	**Tree Inventory Data**	Comprehensive, GIS-based, current inventory of all intensively-managed public trees to guide management, with mechanisms in place to keep data current and available for use			
	Overall Canopy Data	Accurate, high-resolution, and recent assessment of existing and potential city-wide tree canopy cover that is regularly updated and available for use across various departments, agencies, and/or disciplines.			
	Existing Urban Forest Plans	Existence and buy-in for a variety of urban forest management plans to achieve city-wide goals. Re-evaluation is conducted every 5 to 10 years.			
	Risk Management Program	All publicly-owned trees are managed for maximum public safety by way of maintaining a city-wide inventory, conducting proactive annual inspections, and eliminating hazards within a set timeframe based on risk level. A Risk Management Plan exists.			
	Public Tree Maintenance Program	All publicly-owned trees are well maintained for optimal health and condition in order to extend longevity and maximize benefits. A reasonable cyclical pruning program is in place,			
	Public Tree Planting Program	Comprehensive and effective tree planting and establishment program is driven by canopy cover goals, equity considerations, and other priorities according to the plan.			
	Tree Protection Policy	Comprehensive and regularly updated tree protection ordinance with enforcement ability is based on community goals. The benefits derived from trees on public and private property are ensured by the enforcement of existing policies.			
	City Staffing & Equipment	Adequate staff and access to the equipment and vehicles to implement the management plan. A high-level urban forester or planning professional,			

		strong operations staff, and certified arborist technicians are on staff.			
	Funding	Appropriate funding in place to fully implement both proactive and reactive needs based on a comprehensive urban forest management plan.			
Totals			7	8	6

Discussion of the Ratings

THE TREES: Moderate/Good Overall Performance Rating

Harrisonburg's 26.6% tree canopy is currently lower than the national average and other Virginia communities. However, given the highly agricultural land use history of the region, this amount of canopy cover is understandable. The UTC is relatively dispersed throughout the city, but there are areas with little to no canopy. The public street, park, and school trees are generally in good condition, species diversity is high, and the age distribution is nearly ideal. Continuing to maintain a high-quality public tree population, and increasing the quantity of UTC to ensure that all citizens have access to the benefits of trees are the improvements recommended to move all sustainability indicators in this category to the Good rating.

THE PLAYERS: Low Overall Performance Rating

The criteria receiving the highest ratings in this category are Agency Cooperation and Public Awareness. City staff from various departments acknowledge the value of the urban forest and are supportive of the management program's goals and projects. The Public Tree Advisory Board is performing the duties prescribed in the tree ordinance, but its actions are fairly limited to hearing appeals. Despite the success of the seasonal volunteer clean-up and planting events, very few organized groups in the community are consistently and actively involved in urban forestry activities, and most urban forestry efforts and projects are initiated and funded by the City. Other than from area universities and local wood reuse vendors, there is little involvement in the urban forest management program from large landholders, community groups, schools, potential new funders, or regional partners. Partnerships are currently an untapped opportunity for Harrisonburg. As most of the indicators in this category received a Low performance rating, improvements in this category are strongly recommended. Recommendations include increasing public education; leveraging community and corporate involvement and support; increasing partnerships with schools; and partnering with other civic groups.

THE MANAGEMENT APPROACH: Low/Moderate Overall Performance Rating

The City is poised and prepared for effective and efficient management given the availability of an urban tree canopy study, an updated public tree inventory, and this Urban Forest Management Plan. Because these technical resources exist, they can be used to make defensible, data-driven management decisions. The City also employs highly skilled, professional arborists who have the

knowledge and experience to properly manage the forestry program. However, no tree risk or emergency response and recovery plans are in place; there is no policy or regulations for protecting trees on private property or during City projects; there is a need for more full-time staff; and funding is inadequate to begin and sustain a proactive urban forestry program. Implementation of this management plan would help the City make great strides towards achieving an improved performance rating in this category.

Using this Urban Forest Management Program Sustainability Assessment. By performing the assessment and looking at the results in context of the city's goals, improvements needed to achieve a more sustainable urban forest begin to emerge. These assessment results, when combined with a vision for Harrisonburg's future urban forest, will help clarify the strategies for action going forward, and are the basis for the recommendations that are presented in the next section. The various indicators of the assessment should also be used as benchmarks for measuring progress when the urban forest and this plan are reassessed in five to ten years.

HOW DO WE GET THERE? NEXT STEPS AND RECOMMENDATIONS

The City of Harrisonburg now has more comprehensive data regarding its public trees and citywide tree canopy coupled with thoughtful input and insight from its citizens, staff, and local leaders. All stakeholders expressed a desire for the urban forest to be expanded, protected, and promoted in an efficient manner, and for its benefits to be maximized for the enjoyment of all citizens. The city has direct control over public trees and has indirect influence on private trees. Using the guidance from the data, existing municipal plans, and stakeholder input, the following action steps with specific recommendations are provided for the city to formalize a proactive urban forest management program and reach its urban forest management goals. Each recommendation has also been ranked on a scale of 1 to 3, with 1 being a high priority and 3 being a lower priority.

The Objective of Urban Forest Management: To optimize the leaf area of the entire urban forest by establishing and maintaining a canopy of genetically appropriate (adapted & diverse) trees and shrubs with minimum risk to the public and in a cost-effective manner.
- Dr. W. A. Kenney, University of Toronto

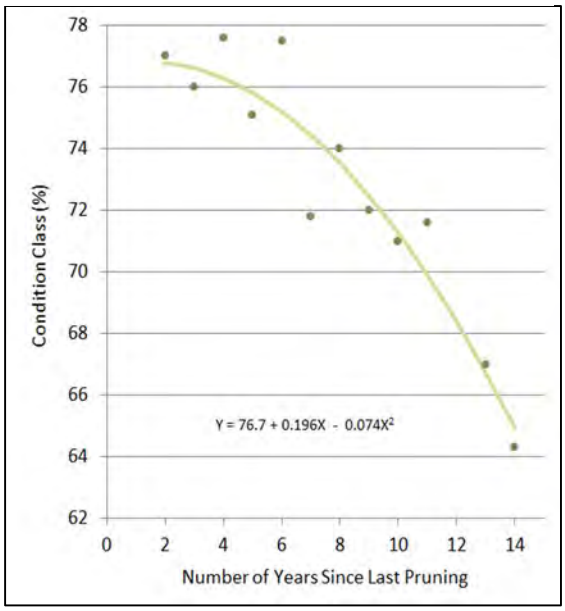
Since forestry operations and management are an integral part of the City's Public Works Department, it is important to note that the American Public Works Association (APWA) also recognizes the importance of public trees and the value of this green infrastructure component in cities. APWA maintains guidance position statements recommending that public works professionals follow certain practices, methods, and activities, and has issued one for "Quality Management of the Urban Forest" (see Appendix D). Implementing the action steps of this plan will also accomplish many of the APWA's recommendations.

Photo 3: Ash removals at the Court Square Bank building.

Action Step 1: Perform Proactive Tree Maintenance

Tree Pruning Discussion. Pruning generally requires cleaning the canopy of trees to remove defects such as codominant leaders, diseased limbs, and dead and/or broken branches that may be present even when the rest of the tree is sound. In most cases, pruning the branch or branches can correct the problem and reduce risk associated with the tree. Figure 8 clearly shows that regular, proactive pruning improves tree condition over time.

Figure 8: Relationship between average tree condition class and the number of years since the most recent pruning (adapted from Miller and Sylvester 1981).



Pruning Cycles. The goals of establishing pruning cycles are to visit, assess, and prune trees on a regular schedule to improve tree health and reduce risk. Proactive pruning has proven benefits for both mature and young trees. Due to the many benefits of a cyclical pruning program, the preferred cycle for Harrisonburg should be implemented as soon as possible. To ensure that all trees receive the type of pruning they need to mature with better structure and lower associated risk, two pruning cycles are recommended: the young tree pruning cycle (YTP Cycle) and the mature tree pruning cycle (MTP Cycle). The cycles differ in the type of pruning, the general age of the target tree, and length, but both are proactive, preventive maintenance actions the City should take.

Why Prune Trees on a Cycle? Miller and Sylvester (1981) examined the frequency of pruning for 40,000 street and boulevard trees in Milwaukee, Wisconsin. They documented a decline in tree health as the length of the pruning cycle increased. When pruning was not completed for more than 10 years, the average tree condition was rated 10% lower than when trees had been pruned within the last several years. Miller and Sylvester suggested that a pruning cycle of five years is optimal for urban trees.

The recommended number of trees in the pruning cycles will need to be modified to reflect changes in the tree population as trees are planted, age, and die. Newly planted trees will enter the YTP Cycle once they become established. As young trees reach maturity, they will be shifted from the YTP Cycle into the MTP Cycle. When a tree reaches the end of its useful life, it should be removed and eliminated from the MTP Cycle.

Mature Tree Pruning Cycle. For many communities, an on-demand response to pruning and removal needs of the mature trees in the urban forest is the norm; and a proactive tree management program is considered infeasible due to available funding, staffing, and/or equipment limitations. However, research has shown that a proactive program that includes a routine pruning cycle will improve the overall health of a tree population and reduce liability and maintenance costs in the long run.

Proactive mature tree maintenance has many advantages over on-demand maintenance; the most significant of which is reduced risk. In a proactive program, trees are regularly assessed and pruned, which helps detect and eliminate most defects before they escalate to a hazardous situation with an unacceptable level of risk.

Other advantages of a proactive program include: increased environmental and economic benefits from trees, more predictable budgets and projectable workloads, and reduced long-term tree maintenance costs.

Any pruning performed on mature trees should be completed in accordance with *ANSI A300 (Part 9)* (2011) standards. Proper and thorough tree pruning will remove dead, broken, diseased, and structurally unsound limbs. Additionally, tree canopy should not interfere with vehicular or pedestrian traffic, nor should it rest on buildings or block signs, signals, or lights.

Pruning to avoid clearance issues and raise tree crowns should follow local requirements or industry guidelines for clearance distance guidelines which are:

- 14 feet over streets;
- 8 feet over sidewalks; and
- 5 feet from buildings, signs, signals, or lights.

PROACTIVE CARE: CINCINNATI CASE STUDY

The City of Cincinnati's urban forest management program officially began in 1982. Prior to that, tree maintenance was performed only on a reactive basis. There were thousands of trees in need of maintenance and the backlog for resolving service requests was over two years.

While still responding to priority tree maintenance, resolving storm damage, and planting trees, the city began to perform inventory and preventive maintenance tasks each year on a limited basis in six management units as the budget would allow.

It took approximately 15 years to complete one cycle of preventive maintenance in the six units. But today, the City is benefitting from the long, but steady process of proactive maintenance. City trees are healthier and safer, and maintenance costs have decreased. The City documented a 40% decrease in tree maintenance costs after storms in each unit that had received the comprehensive and proactive maintenance.

Recommendation 1: Establish a five to ten-year MTP Cycle in which the trees in a defined management unit will be pruned each year. (Priority Rank 1)

The 2020-2021 tree inventory identified approximately 1,157 mature trees that should be proactively pruned. Using a goal of a 5-year pruning cycle, an average of 231 trees would be pruned each year. A variety of tree sizes will require pruning; however, the vast majority of trees that require routine pruning are smaller than 24 inches DBH.

These are the steps to take to create a 5-year maintenance rotation:

1. Identify five management units in the city (typically, these are based on existing areas such as police/fire districts, neighborhood groupings, planning areas, public works maintenance districts, etc.)
2. Use the GIS-based inventory data combined with field confirmation to create the work orders and/or contracts to perform the needed work on each tree in the first management unit.
3. Update the inventory database with information on the work performed, costs, and any related issue or topic.
4. Prepare for preventive maintenance work in the second unit the following year.

If a more conservative approach to establishing a proactive maintenance program is preferred or necessary, and a 10-year maintenance rotation is more feasible, then simply subdivide each of the five management units to create ten subunits.

Young Tree Pruning Cycle. Trees included in the YTP Cycle are generally less than 8 inches DBH. These younger trees sometimes have poor branch structures that can lead to potential problems as the tree ages. Potential structural problems include codominant leaders, multiple limbs attaching at the same point on the trunk, or crossing/interfering limbs. If these problems are not corrected, they may worsen as the tree grows, increasing risk and creating potential liability.

YTP pruning is performed to improve tree form or structure; the recommended length of a YTP Cycle is three years because young trees tend to grow at faster rates (on average) than more mature trees. However, this program can be phased as well, in a period of 6 year for example, if staff and funding resources are limited.

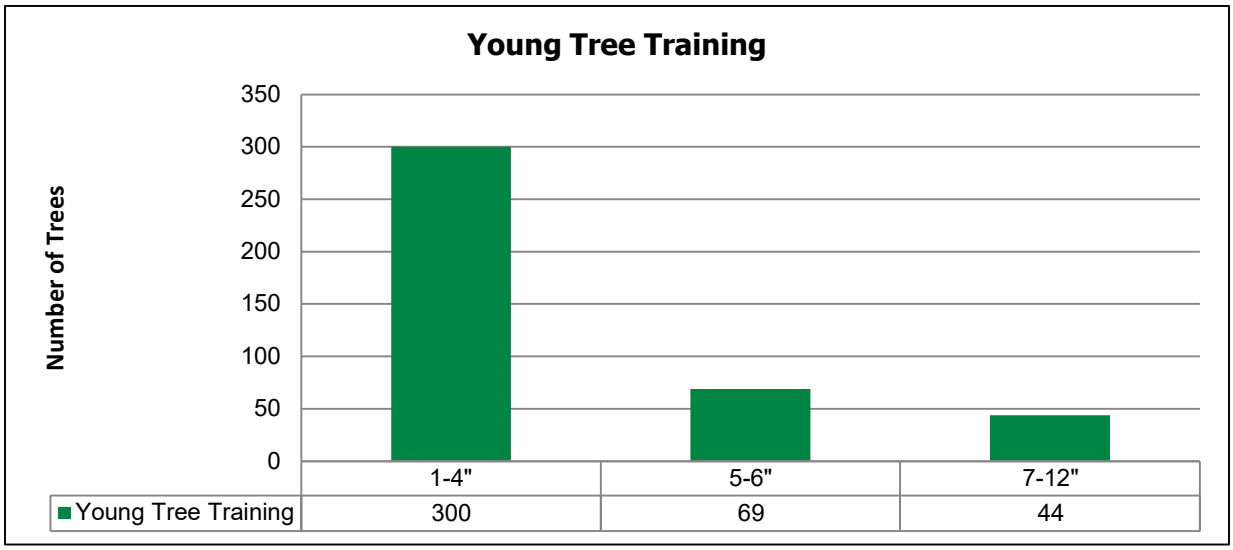
The YTP Cycle differs from the MTP Cycle in that these trees generally can be pruned from the ground with a pole pruner or pruning shears. The objective is to increase structural integrity by pruning for one dominant leader. YTP Pruning is species-specific, since many trees such as serviceberry or redbud may naturally have more than one leader. For such trees, YTP pruning is performed to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree.

Recommendation 2: Implement a three-year YTP Cycle (Priority Rank 1)

The YTP Cycle will include existing young trees. During the inventory, 754 trees smaller than 7 inches DBH were inventoried and are recommended for young tree training. Depending on the species, trees between 7 and 12 inches DBH (44 trees) can still be included in this maintenance program. Since the benefit of beginning the YTT Cycle is substantial, it is recommended that an

average of 250 trees be structurally pruned each year over 3 years, beginning in Year One of the management program. As trees are planted, they will enter the YTP Cycle after establishment, typically a few years after planting. Harrisonburg should strive to prune approximately one-third of its young trees each year.

Figure 9: Trees recommended for the YTP Cycle by diameter size class.



Maintenance Schedule. Utilizing data from the 2021 Harrisonburg tree inventory, an annual maintenance schedule was developed that details the number and type of tasks recommended for completion each year. Budget projections have been made using industry knowledge and regional tree maintenance costs for a commercial company to perform the work. Actual costs for in-house or locally contracted services can be entered into the table at any time in the future. The table of estimated costs for Harrisonburg's five-year tree management program is presented in Table 9. The schedule provides a framework for completing the inventory maintenance recommendations over the next five years. Following this schedule can shift tree care activities from an on-demand system to a more proactive tree care program.

Proactive tree maintenance has many advantages over reactive maintenance, the most significant of which is reduced risk to the public. Proactive systems ultimately reduce crisis situations in the urban forest because every public tree is visited, assessed, and maintained on a regular basis. Other benefits include more predictable budgets and projectable workloads,

reduced long-term tree maintenance costs, more equitable service delivery, and increased environmental and economic benefits from trees as more reach maturity.

Table 9: Estimated Estimated Budget for Harrisonburg Public Tree Maintenance and Planting

Estimated Costs for Each Activity			**YEAR 1**		**YEAR 2**		**YEAR 3**		**YEAR 4**		**YEAR 5**		Total Cost
Activity	Diameter Class	Cost / Tree ($)	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	# of Trees	Total Cost	
Current Removals	1-6"	$50	1	$50	1	$50	1	$50					$150
	7-12"	$220	6	$1,320	6	$1,320	6	$1,320					$3,960
	13-18"	$350	3	$1,050	2	$700	2	$700					$2,450
	19-24"	$850	1	$850	0		0						$850
	25-30"	$1,000	1	$1,000	0		0						$1,000
Activity Total(s)			**12**	**$4,270**	**9**	**$2,070**	**9**	**$2,070**					**$8,410**
Ash Removals 3-Year Cycle	1-6"	$50											$0
	7-12"	$220	2	$440	2	$440	1	$220					$1,100
	13-18"	$350	6	$2,100	5	$1,750	5	$1,750					$5,600
	19-24"	$850	5	$4,250	4	$3,400	4	$3,400					$11,050
	25-30"	$1,000	3	$3,000	3	$3,000	2	$2,000					$8,000
	31-36"	$1,500	1	$1,500	0	$0	0	$0					$1,500
	37-42"	$2,000	1	$2,000	0	$0	0	$0					$2,000
Activity Total(s)			**18**	**$13,290**	**14**	**$8,590**	**12**	**$7,370**					**$29,250**
1% Projected Removals	(diameters variable;	$600	21	$12,600	21	$12,600	21	$12,600	21	$12,600	21	$12,600	$63,000

Natural Mortality/Storms	average cost estimated)												
Activity Total(s)				$12,600		$12,600		$12,600		$12,600		$12,600	$63,000
Stumps	(averaged cost)	$120	36	$4,320	36	$4,320	36	$4,320	36	$4,320	36	$4,320	$21,600
Activity Total(s)				$4,320		$4,320		$4,320		$4,320		$4,320	$21,600
Routine Pruning Cycle	7-12"	$75	143	$10,725	143	$10,725	142	$10,650	142	$10,650	142	$10,650	$53,400
	13-18"	$120	73	$8,760	73	$8,760	72	$8,640	72	$8,640	72	$8,640	$43,440
	19-24"	$200	23	$4,600	23	$4,600	22	$4,400	22	$4,400	22	$4,400	$22,400
	25-30"	$350	11	$3,850	11	$3,850	11	$3,850	11	$3,850	10	$3,500	$18,900
	31-36"	$500	5	$2,500	5	$2,500	5	$2,500	4	$2,000	4	$2,000	$11,500
	37-42"	$650	2	$1,300	2	$1,300	2	$1,300	2	$1,300	2	$1,300	$6,500
	43"+	$850	2	$1,700	2	$1,700	2	$1,700	1	$850	1	$0	$5,950
Activity Total(s)			**259**	**$33,435**	**259**	**$33,435**	**256**	**$33,040**	**254**	**$31,690**	**253**	**$30,490**	**$162,090**
Young Tree Training 3-Year Cycle	1-3"	$20	131	$2,620	131	$2,620	131	$2,620	231	$4,620	231	$4,620	$17,100
	4-6"	$30	119	$3,570	119	$3,570	119	$3,570	219	$6,570	219	$6,570	$23,850
Activity Total(s)			**250**	**$6,190**	**250**	**$6,190**	**250**	**$6,190**	**450**	**$11,190**	**450**	**$11,190**	**$40,950**
Tree Planting (2" B&B)	Purchasing	$170	100	$17,000	100	$17,000	100	$17,000	100	$17,000	100	$17,000	$85,000
	Planting	$130	100	$13,000	100	$13,000	100	$13,000	100	$13,000	100	$13,000	$65,000
Activity Total(s)				**$30,000**		**$30,000**		**$30,000**		**$30,000**		**$30,000**	**$150,000**
Projected Budget for current inventory (approx. 75% complete)				$104,105		$97,205		$95,590		$89,800		$88,600	$475,300
Projected Budget for 100% complete inventory				$130,131		$121,506		$119,488		$112,250		$110,750	**$594,125**

Comments and considerations on Table 9 above.

- The public tree inventory is not 100% complete, therefore the work quantities are likely under-estimated.
- The cost per activity is based on estimated fees for contracted purchasing and labor; the cost for work performed by in-house/City crews may be different.
- Tree planting costs are averages for B&B stock; costs may decrease if containerized or bareroot trees are planted.
- The cost of maintenance activities (pruning/removal) do not include storm damage mitigation.
- The maintenance and planting budget does not reflect expenditures for staffing, equipment, and other urban forest management program activities such as PHC, IPM, and public outreach.

Recommendation 3: Update inventory on a regular basis. (Priority Ranking 1)

The tree inventory database should be updated regularly. This could be monthly for citizen service requests, storm damage mitigation, and tree planting; and annually before the cyclical maintenance project begins. Updating data can streamline workload management and lend insight into setting accurate budgets and staffing levels. Inventory updates should be made electronically and can be implemented using the City's preferred data collection and management software, or commercially available tree inventory data management computer software program.

When updating the public tree inventory, it is suggested that additional data fields and tree and site attributes be considered. These are: potential planting sites (address, type, dimensions), hardscape damage (type, amount of disturbance), and some prioritization method for tree pruning and removals to clarify the timeliness of the work needed (e.g. Removal 1 = high priority; Removal 2 = moderate; Removal 3 = low, etc.).

Action Step 2: Plant More Trees and Practice Purposeful Planting

While the inventory did not collect the locations and characteristics of vacant planting sites on public streets, there are many opportunities for tree planting on public lands, particularly on school grounds and in parks. The UTC study revealed that, by percentage, schools had the highest Potential Planting Area of all public ownership types.

When planning tree planting projects, the guiding principles for tree species and site selection should be "right tree in the right place," species diversity, and maximizing the ecosystem services provided by trees in Harrisonburg.

Recommendation 4: Create a Master Tree Planting Plan for City Rights-of-Way, Parks, Schools, and Other Properties. (*Priority Ranking 2)*

As the stakeholders clearly expressed, a priority for Harrisonburg is to plant more trees. The city now has access to a great deal of GIS mapping and other geospatial data to create a practical planting plan. Using tree inventory data, the City's heat study information, and the GIC's urban tree canopy cover and potential plantable areas mapping, the city should identify all realistic planting areas on public lands.

Supplementing the tree inventory with vacant planting sites would be an excellent project to engage the public and students. Collecting and recording the location, types, and dimensions of vacant planting sites is well-suited to volunteers. A master tree planting plan will make public tree

canopy expansion "shovel-ready" when grants, mitigation funds, fund-raising projects, and partnership agreements are available.

4a. Incorporate "Right Tree, Right Place" principles in the planting plan. When near overhead utilities, plant only small-growing trees within 20 feet of aerial lines overhead utilities, medium-size trees within 20–40 feet, and large-growing trees outside 40 feet. This will help improve future tree conditions, minimize future utility line conflicts, and reduce the costs of maintaining trees under utility lines.

When planting near underground utilities, it is advised to plant at least 5 feet away from access boxes, 5 feet on either side of lateral or service lines, and no closer that 15 feet to stormwater inlets or collection devices.

When planting around hardscapes, it is important to give the tree enough growing room above and below ground. Guidelines for planting trees among hardscape features, such as planting between the street and sidewalk, are as follows: give small-growing trees 4–5 feet; medium-growing trees 6–7 feet; and large-growing trees 8 feet or more between hardscape features. In most cases, this will allow for the spread of a tree's trunk taper, root collar, and immediate larger-diameter structural roots. Strive to provide 800 to 1,000 cubic feet of soil for trees planted in tree wells.

4b. Select tree species to increase diversity and maximize environmental benefits. The inventory data reveal that Harrisonburg's public urban forest is highly diverse. However, in the mid-term, the city should avoid planting many additional white pine, red maple, and Eastern redcedar since these three species already make up over 25% of the public urban forest. Instead, other species can be planted to improve diversity and provide specific desired benefits to the city.

To increase the benefits the urban forest provides, the City should prioritize planting large-crown, large-statured tree species that have been proven to manage the most stormwater, absorb the most CO2, remove the most air pollutants, and provide the most shade and energy conservation. Specifically for the significant stormwater benefits trees provide, the 2018 GIC study recommended and provided the City with GIS data analysis and mapping of areas where the purposeful planting of trees for stormwater should be focused.

As trees are removed and additional planting sites are identified, the following list of large-statured tree species and their primary benefit/services, generated using the U.S. Forest Service's i-Tree Species model, is recommended for the city to consider when ample growing space is available. These species will maximize important environmental benefits and contribute to the city's overall sustainability, and should also be promoted to land developers and private property owners where there is adequate space to grow these trees to maturity.

Pollutant Removal

- Tsuga canadensis (Eastern hemlock)
- *Ulmus americana* (American elm)
- Liriodendron tulipifera (tuliptree)
- Betula alleghaniensis (yellow birch)
- *Tilia americana* (American linden)

Carbon Storage

- Quercus shumardii (shumard oak)
- Nyssa sylvatica (black gum)
- Platanus occidentalis (American sycamore)
- Zelkova serrata(zelkova)
- *Ulmus americana* (American elm)

Stormwater Reduction

- Liriodendron tulipifera (tuliptree)
- *Ulmus americana* (American elm)
- *Tilia americana* (American linden/basswood)
- Betula alleghaniensis (yellow birch)
- Magnolia grandiflora (southern magnolia)

Air Temperature Reduction

- Liriodendron tulipifera (tuliptree)
- *Ulmus americana* (American elm)
- Populus deltoides (cottonwood)
- *Tilia platyptera* (big leaf linden)
- Picea spp. (spruce)

Energy Reduction

- Liriodendron tulipifera (tuliptree)
- *Ulmus americana* (American elm)
- *Tilia americana* (American linden/basswood)
- Platanus occidentalis (American sycamore)
- Populus deltoides (cottonwood)

4c. Select Tree Species to Prepare for Climate Change. Harrisonburg's *Environmental Action Plan* calls for action to mitigate the impacts of the changing climate to protect the community's health, economy, and well-being. Planting trees in anticipation of changing climate is a forward-thinking action to achieve that goal. The trees planted today should be adaptable to foreseeable future increases in temperatures and pollution concentrations.

Harrisonburg's species composition was compared against the U.S. Forest Service's Climate Atlas database, which projects changes in species adaptability to the predicted changes in climate over the next 100 years. The projections are based on varying degrees of temperature changes and carbon pollution, and can indicate if a species can either migrate or adapt to those conditions, or decline because of them in a given geographic area. For Virginia, Table 10 presents a selection of those tree species that can adapt in the future, and those that likely will not.

Table 10: Tree Species Adaptability to Predicted Climate Change in Harrisonburg

Tolerant of Predicted Change/Potential Increase in Future Population	Intolerant of Predicted Change/Potential Decrease in Future Population
Sweetgum	Yellow poplar
Eastern redcedar	Bur oak
Southern red oak	Swamp white oak
Shortleaf pine	American mountain ash
Willow oak	White pine
Post oak	Red maple
Laurel oak	Yellow birch

The results show that white pine and red maple, two of the City's most prevalent species, are at risk in the future. The City can prepare for the corresponding loss of tree canopy from these species by selecting trees that are more tolerant and adaptable to future climate conditions. Appendix E presents the full list of species and the degree of tolerance. The City should review the list and select tree species for future planting based on the scientific findings of the Climate Atlas. By doing so, not only will citywide species diversity increase, but the resiliency of the urban forest should as well.

4d. Strive to Include Tree Planting with Capital Projects. When a planting plan is complete, and when appropriate, capital projects in the City should be designed to include tree planting. Plans should be reviewed by the urban forestry staff to approve species selection and siting; and to inspect and monitor the trees after the project is complete.

Another consideration for capital projects is to use them as an opportunity to "make room for large canopy trees. Larger growing areas improve the survival rate of planted and developing trees, and increasing planting space can reduce the amount of tree related infrastructure conflicts. Restricted growing areas for medium to large canopy trees is currently a limitation to expanding tree canopy in the city, especially in areas with a high percentage of impervious surfaces.

Harrisonburg should look at options for creative partnerships and for innovative ways of creating larger growing sites for trees in the downtown and highly developed commercial areas, as well as on street rights-of-way. The City's Downtown Streetscape Plan recommends techniques to ensure tree planting success, and these should be applied to all commercial areas of the city.

There are many ways to make room for trees, and the City should consider these solutions:

- Plant larger canopied trees in medians.
- Plant on the right-of-way edge if it is adjacent to open lawn, and/or if there is at least two feet of right-way beyond the edge of a sidewalk, with the consent of the property owner.
- Consult with legal staff about planting trees on private property using a temporary construction easement.
- Explore offering private property owners wholesale or reduced prices for purchasing and/or planting large canopy trees on private land. Many respondents to the public survey made this suggestion indicating a way to increase tree canopy on private property.
- Identify suitable areas and plant more shade trees in parks and city-owned parking lots.
- A landscape bump-out, or curb extension, is a vegetative area that protrudes into the parking lane of a street to provide a larger growing space for trees. Spaces like this are effective in beautifying a streetscape, and provide greater storm water retention, along with the added benefit of slowing car speeds at the bump out location.
- Suspended pavement over non-compacted soil, or the implementation of structural cells, can greatly reduce the conflict between tree roots and infrastructure, as well as provide an ideal urban growing environment for the tree. The development of these types of planting sites can be costly and are typically taken on during larger capital improvement projects, due to their construction intensive nature. Engineering solutions such as these should be made part of the City's Design & Construction Manual.

Photo 5: The planters on Water Street Alley, made with reused wood from Rocktown Urban Wood, are an example of innovative tree planting solutions in developed areas.

Recommendation 5. Set a Goal of Achieving at Least a 90% "Stocking Level" for Street Trees. (Priority Ranking 3)

A common task of urban forest management is to examine how much of the available planting space has been utilized. This can be measured using "stocking levels." Stocking level is the ratio of street right-of-way (ROW) spaces occupied by trees to the total street ROW spaces suitable for trees. For example, a street ROW tree inventory of 1,000 total sites with 750 existing trees and

250 planting sites would have a stocking level of 75%. Park and other non-street public trees are excluded from this measurement.

Fully stocking the street ROW with trees is an excellent goal, and one that was also recommended by the 2018 Green Infrastructure Center project. Inadequate tree planting and maintenance budgets, along with tree mortality, will result in lower stocking levels. Nevertheless, working to attain a fully stocked street ROW is important to promote canopy continuity and environmental sustainability. For Harrisonburg, it is recommended that the street ROW stocking level be at least 90% so that no more than 10% of the potential planting sites along the street ROW are vacant at any given time.

5a. Prioritize street tree planting. As resources allow, focus on planting trees along residential streets. The City may want to consider a policy that for every street tree removed, at least one is replaced (if the site is appropriate for a tree). A better goal would be to strive for a 2:1 replacement/removal ratio. Residential streets lacking tree canopy, and in underserved areas should be prioritized over the next 5 years.

5b. Consider alternative planting stock types and sizes to maximize the planting budget. While 2-inch caliper B&B plant material is the norm for public tree planting, other tree stock types and sizes are available. Trees grown in containers have 100% of their root systems and are readily available in a variety of diameters. Bareroot trees can now be obtained in 2 to 3-inch calipers, and are significantly less expensive than B&B and container-grown trees. While bareroot stock does require special handling, storage, and staking, at least twice as many trees can be planted with the same budget for B&B and container trees. Bareroot trees are also lighter and may be more suited for volunteer projects. The City should explore the logistics and success of planting bareroot trees by planting them first in a public park or a school grounds.

Recommendation 6. Promote Tree Planting on Private Property (Priority Ranking 3)

Only an estimated 11% of Harrisonburg's urban tree canopy is publicly managed, so the amount and quality of the city's UTC is extremely dependent on the existence and longevity of trees on private properties. When the citizens were asked, they said effective ways to increase tree cover

on private property are through cost-share programs and public education campaigns to encourage property owners to properly plant and maintain trees.

6a. Explore opportunities to provide citizens and businesses reduced/wholesale prices for tree planting. As mentioned previously, many respondents to the public survey said they would take advantage of a wholesale pricing program if the City made such an arrangement with its nursery and landscape suppliers. In such a program, no public funds would be used; simply the citizens are able to show proof of residency or have a promotional voucher/coupon that enables them to pay less than retail. Nurseries and garden centers could even specify the special pricing is only for certain tree species or sizes in their inventory. The vouchers could be distributed at special events and educational programs.

UTC Supports the EAP

Currently the Environmental Action Plan (EAP) has identified focus areas and set broad goals that support this Action Step. For example, in Focus Area 2, there are three Goals that relate to the urban tree canopy:

- Goal 1: Modernize and establish enduring land use and development patterns.

6b. Promote the Harrisonburg Electric Commission's tree replacement program. If a tree has been or is in conflict with HEC's overhead electric distribution or transmission lines, the HEC offers all qualifying customers tree and stump removal services and a $50 certificate to a local nursery; all at no additional cost to the property owner. The replacement tree can be planted anywhere on the property as long as its mature size conforms with HEC guidelines on planting locations. This program should be promoted more by the City and local non-profit organizations as a means to increase tree canopy as well as ensure safe, uninterrupted delivery of energy.

6c. Promote the Harrisonburg Conservation Assistance Program (HCAP). One environmental initiative of the City to better manage stormwater is the HCAP program. The program, through the Shenandoah Valley Soil and Water Conservation District, awards funds to approved applicants throughout the year (contingent on available funding) for tree planting. Planting native trees to establish a riparian buffer along a water feature, addressing an erosion problem, or to convert an area from turf is supported by this cost-share program. The HCAP program is particularly well-suited for promotion to large landowners and businesses.

6d. Create and sustain a public education campaign about the need for and benefits of planting and caring for trees. The City already provides professional advice and general tree related education to the public through the website, social media posts, and at special events. In the near future, the City should focus on developing messaging about the benefits and need for tree planting on private property and use more and different outlets to relay those messages. More detail about public outreach is discussed in Action Step 6.

We cannot separate sustainable urban forests from the people who live in and around them. Sustainable urban forests are not born, they are made. They do not arise at random, but result from a community-wide commitment to their creation and management. Obtaining the commitment of a broad community, of numerous constituencies, cannot be dictated or legislated. It must arise out of compromise and respect." - Clark, et. Al., A Model of Urban Forest Sustainability Journal of Arboriculture, 1997

Action Step 3: Set a Urban Tree Canopy (UTC) Goal

Setting a tree canopy goal is an important step in the planning process, as goals provide metrics by which performance can be measured throughout the coming years. The process of setting a goal with the input of multiple stakeholders is also helpful to ensure that goals are realistic.

Currently, Harrisonburg has approximately 26% tree canopy cover. The general assessment performed by GIC also determined that a 34% to 40% tree canopy cover is possible.

Recommendation 7: Set an urban tree canopy goal that balances tree benefits with the city's economic development goals and plans and accommodates other municipal infrastructure. (*Priority Ranking 3)*

There are a number of ways canopy goals can be set:

- **Comparisons to an Industry or Regional Standard.** American Forests, a recognized leader in conservation and community forestry, had established standards and goals for canopy cover in metropolitan areas: an overall canopy of 40%, with 15% in the central business district, 25% in urban neighborhoods, and 50% in suburban neighborhoods. Harrisonburg can also compare its UTC percentage and goal with other cities in Virginia with a similar climate, size, etc.
- **Comparison to What is Possible.** "Relative canopy" is a measure of how much canopy has been achieved compared to what is possible. This metric is useful for setting realistic goals for very different areas. Harrisonburg has a potential canopy cover of up to 40%. The current UTC is 26%, making relative canopy 58% (26% divided by 40%). Setting a relative tree canopy goal, such as 70-75%, is a logical metric to measure until an actual canopy goal is set.
- **Outcome-Based Goals.** Choosing a canopy goal based on the desired benefits outcome, e.g., reduction in heat stress, stormwater intercepted, etc., is also a possibility using i-Tree analyses and projections from other tools and models.
- **Neighborhood Goals**. Canopy goals can also be set beyond simply citywide numbers. Neighborhoods in need of more canopy (and associated benefits) can help focus preservation and planting activities to areas in need in coming years. These local goals help distribute canopy benefits equally among all residents, no matter where they live.

It is not uncommon to use a combination of the above methods. A phased goal approach is also common, for example achieving no-net-loss within five years, then approximately 30% canopy by 2035. Some cities establish target dates; others have ongoing goals. Some establish target percentages; others aim for an increase of any kind. This is a topic that should be explored and discussed with other City staff, the Public Tree Advisory Board, and community leadership.

Action Step 4: Improve Ordinances and Policies

For a municipality to legitimately claim to have a comprehensive urban forestry program, a strong tree ordinance should be in place. A tree ordinance establishes standards and sets guidelines for the management of trees by the municipality and the treatment of trees by private entities. It is the legal framework within which local tree management activities are conducted for the general welfare. Tree ordinances can enhance the community-wide urban forest and ensure that it is protected to provide public health and safety as well as many other important benefits.

Harrisonburg recognizes trees as community assets. The City's 2018 Comprehensive Plan acknowledges the importance of tree canopy in Chapter 10 *Environmental Stewardship and Sustainability,* and Chapter 6 Public Tree Ordinance 2020 details regulations regarding protections of public trees. However, other City ordinances, guidelines, and manuals could be improved to have a greater focus on trees and tree canopy, and reflect current industry standards. Improvements to both planning documents and codes will aid the City to properly manage, protect, and grow the urban tree canopy, and will better reflect the community's future goals.

The following general recommendations are made for Harrisonburg to consider for strengthening its existing planning documents, code of ordinances, and policies:

Recommendation 8: Update Chapter 6 Public Tree Ordinance and consider adding new language and sections. (Priority Ranking: 3)

Overall, the City's tree ordinance is well written and addresses the basics of public tree management and protection. The next time this ordinance is updated, these recommendations are made:

- Cite arboricultural and horticultural industry standards, such as all Parts of ANSI A300 Tree, Shrub, and other Woody Plant Management – Standard Practices, ANSI Z133.1 American National Standards for Arboricultural Operations – Safety Requirements, and ANSI Z60.1 – American Standard for Nursery Stock.
- Make official reference to the Public Tree Policy document in the ordinance. A related administrative duty would be to promote the Public Tree Policy as a way to communicate proper tree care and protection in the city.
- Review and update/clarify or add new definitions as needed.
- The ordinance should state that it is the City's policy that no public tree shall be removed by any entity unless the tree is dead, diseased, or dying. If a healthy public tree is removed with or without a permit, then appropriate compensation and penalties should be levied.

- Improve and/or strengthen penalties for violations of the tree ordinance. The compensation for the removal or poor pruning of a public tree should be increased to demonstrate the City's commitment to protecting its public trees. The city should consider adding a compensatory payment requirement in the ordinance so that it has the authority to collect compensatory payments for unauthorized tree removal or damage. Sample language might be:
    - *No person shall remove any public tree without replacing such tree with a tree of equivalent dollar value in the vicinity of the removed tree. The value of a tree shall be determined by the city considering the species, location, size, and condition of the tree. If no suitable location exists in the vicinity of the tree removed or if the replacement tree is of lesser value, the person causing the tree to be removed shall make a compensatory payment to the City of Harrisonburg equal to the difference in value between the tree removed and any replacement tree. Compensatory payment shall also be made if a tree is damaged with the amount equal to the cost of mitigation plus reasonable administrative costs for performing the repair. Compensatory permits shall be paid into a fund established for that purpose and restricted to use for urban forestry programs. Compensatory payments may be in addition to other penalties."* Harrisonburg may want to refer to and investigate the manner in which other cities in the region define tree damage and penalize violators.
- The ordinance should state that tree protection and compensation should apply to City departments and activities.
- In the future, it may be advisable to revise the current tree ordinance to include language specifically relating to utility pruning and maintenance activities. The Ordinance could state that, "W*hen maintaining public trees for aerial line clearance, a private or public utility shall observe good arboricultural practices, as specified by the International Society of Arboriculture and the American National Standards Institute (ANSI) A300 Standards*." Or, it might state that "*An annual permit may be issued for routine utility pruning if pruning methods comply with International Society of Arboriculture and ANSI standards. The city's arborist shall periodically examine utility work to assure compliance.*" These statements, or others like them, placed in the tree ordinance would officially declare the city's acknowledgement of utility companies' important responsibilities, and also the need for following professional standards during such work. With a section that addresses tree and utility conflicts in the ordinance, if utility companies do not comply with permit conditions or national standards and damage public trees, then the city would have recourse to collect damages from or have appropriate mitigation performed by the utility company.
- Consider expanding the representation on and duties of the Public Tree Advisory Board. Currently, the PTAB primarily hears appeals. As an officially recognized citizen leadership group, the PTAB can do more if authorized or charged by the ordinance; such as: plan and coordinate volunteer tree plantings, organize training and educational programs; coordinate fundraising; interact with elected officials, and engage with the public to identify amended or new policies and ordinance provisions. The current composition of the PTAB is fairly limited in number and stakeholder representation. The City should consider expanding the

PTAB to include additional advisors from academics, arboricultural and horticultural industries, Extension agents, business leaders, and nonprofit organizations.

Tree Board Training Opportunity. The National Arbor Day Foundation offers a unique and valuable training course for tree boards in Tree City, USA cities. It's called "Tree Board University," and it is a free, self-paced online training course that helps board members learn more about trees, people, and serving in a citizen advisory role. Upon completion of the eight courses, graduates are able to join an online social networking community, where questions can be posted and interaction with other like-minded Tree Board members from across the USA can occur.

Recommendation 9: Continue to incorporate urban tree canopy and public tree management issues into the Comprehensive Plan during regularly scheduled Plan evaluations and updates. (Priority Ranking 3)

An overall goal stated in the Comprehensive Plan is to "preserve and enhance the City's natural environment for future generations through education and policies that encourage development that is compatible with nature and builds community resiliency and social responsibility within the community."

Specifically, *Objective 11.5* provides strategies to protect and increase tree canopy cover in the City. In the future, at a minimum, the Urban Forest Management Plan and mapping and data from UTC analyses should be referenced in the Plan; as well as goals and action steps related to proactive tree population management citywide.

Recommendation 10: Include current arboricultural industry standards in future revisions and updates to the Design and Construction Standards Manual. (*Priority Ranking 1)*

During the next DCSM update, or as a companion document, include sections, specifications, diagrams, standards and other information specifically for public tree planting, maintenance, protection, and removal. Additionally, it would be helpful to provide the same or similar information related to tree protection on private property during land development. If a companion document is viewed as an alternative to updating the DCSM, then it could be written in a user-friendly format and could include details about topics such as approved species, invasive species, street and sidewalk clearance standards, tree protection measures, and other best practices that can be updated more quickly and easily than the DCSM. This document could also include helpful information such as guidelines on where trees can be planted on private property (or where not to plant) based on utilities, spacing, and energy use. It could clearly and simply explain the permit process and provide contact information for key city staff.

Tacoma, Washington (https://www.cityoftacoma.org/cms/one.aspx?pageId=64782) and Raleigh, North Carolina (https://cityofraleigh0drupal.blob.core.usgovcloudapi.net/drupal-prod/COR24/UrbanForestryCityTreeManual.pdf) have excellent examples of these types of guidance manuals.

Recommendation 11: Explore including tree protection and tree replacement planting requirements on private property in the land development regulations of the Zoning and Subdivision Ordinance as allowed by Commonwealth law. (*Priority Ranking 2)*

Based on interest from citizens and staff, and urban forest management best practices, the City should consider adding requirements for tree protection and mitigation tree planting during private land development projects. Examples of actions to consider are:

- At the least, during the plan review process and before clearing or grading activities, developers should be required to provide the City information on the size, species, and condition of the trees on-site, and indicate whether the tree(s) will be removed or remain.
- Require and/or incentivize the protection of large, healthy shade trees (over 24" dbh) during development.
- Require street trees be planted on the public right-of-way of any new residential or commercial project.
- Determine a mitigation plan/formula for healthy trees that are removed on private property during land development. Mitigation can be in the form of in-lieu fees and/or replacement trees on and off-site.
- Create incentives for overall tree protection and tree planting on private property during development.

Additionally, the City should be aware of and follow the progress of House Bill 2042 introduced in the General Assembly of Virginia in January 2021. House Bill 2042 is a bill to amend and reenact §§ 15.2-961 and 15.2-961.1 of the Code of Virginia, relating to replacement and conservation of trees during development. The bill authorizes minimum tree canopy coverage and replacement tree numbers based on land use and development size.

Recommendation 12: Expand the Public Tree Policy document with more policies that also have the support of other city departments. (*Priority Ranking 2)*

Currently, City departments are supportive of each other's missions and priorities; and are genuinely dedicated to the success of each other's projects and initiatives. However, for clarity and better effectiveness, policies and procedures for tree management tasks and activities should be created by the Public Works Department to share with other departments, elected officials, and the general public. For example, to increase public safety and decrease municipal liability, a Standard Operating Procedure (SOP) or other administrative directive is needed that requires notifying Public Work if tree roots are cut during emergency repairs and/or for sidewalk and utility construction.

Examples of other urban forest management issues that Harrisonburg should consider having written policies for are (but not limited to):

- Community tree canopy cover goal
    - no net loss/short term goal
    - a target percentage/long term goal
- Tree planting
    - establishing a removal to replacement planting ratio
    - "right tree, right place" standards
    - preference for large stature shade trees
    - native vs. non-native species
    - young tree care
- Tree risk reduction
- Tree protection during construction and land development
- Invasive trees and other plant management/control
- Utility pruning
- A "Complete Streets" policy

With policies and guidance statements in place, the City can lead by example, and inspire citizens to also practice good tree management, and better communicate with business, utilities, and land developers about the expectations for their activities in the City that affect public trees and the tree canopy.

POLICY STATEMENT STRUCTURE

A typical policy statement is usually a single page document, organized by and containing information on the following items:

• Title/number

• Introduction - Why it is important; city goals and priorities the policy supports.

• Policy statement - The words that convey to residents and businesses and outside entities what a city is going to do, and what it is not going to do, and what it can achieve for the community as a whole.

• References - City code, national standards, city and county plans, etc.

Policy Statement Example:

Tacoma, WA has good examples of general urban forest management policies. Refer to Section II of their "Urban Forest Policy Element" document here: https://cms.cityoftacoma.org/enviro/urbanforestry/urban%20forest%20policy.pdf

Action Step 5: Ensure Stable Funding and Identify New or Supplemental Funding Sources

Unsurprisingly, many cities cite their biggest impediment to implementing and sustaining a proactive tree care and planting plan is funding. There is no national standard for the best or most effective urban forest budget amount or allocation. The allocation between activities may always be in flux depending on the condition of the trees, the planting needs, the incidences of severe weather, the presence and types of insect and disease threats, and the desires of the citizens and community leaders at the time the budget is developed.

Harrisonburg reports that the annual urban forest management expenses (not including the HEC's vegetation management expenditures) are approximately $200,000; with about 60% allocated for operations and 40% for staff salaries and benefits.

Recommendation 13: Ensure that the city's tree maintenance budget is no less than $104,000 annually. (*Priority Ranking 1)*

To implement the proactive maintenance schedule, the Harrisonburg's tree maintenance budget should be no less than $104,000 and up to $130,000 annually as shown in Table 8. This level of funding is needed to ensure that tree risks are remediated promptly, cyclical mature tree pruning and young tree care can begin, and proactive tree planting continues. With proper professional tree care, the safety, health, and beauty of the urban forest will improve.

The current maintenance budget is reported to be $60,200 with the

HOW TO INCREASE TREE BENEFITS AND REDUCE COSTS

Communities and homeowners can increase the benefits of the urban forest and decrease the costs by following guidelines for proper management and care.

- Determine and prioritize long-term objectives and a desired future for your urban forest.
- The less maintenance a tree requires, the lower its financial costs (use low maintenance, drought-resistant, urban-tolerant trees)
- Trees in harsh urban sites will incur greater financial and environmental costs than established trees in parks and natural areas.
- Longer-lived, large canopy trees will reduce costs and delay removal expenses.
- Established forests and trees need less maintenance, so preserving them should take precedence over planting new trees.
- Understand the community's attitudes and perceptions toward the urban forest.
- Seek public input during the development of management goals and objectives.
- Plant the right tree in the right place.

(Excerpted from "The Costs of Managing an

majority spent on tree removal. It appears that with an even with a modest increase in budget Harrisonburg could begin the important transition from a reactive public tree management program to a proactive one. Compared with cities of similar populations, and with peers in Virginia, Harrisonburg is not dedicating sufficient funds to its urban forest management.

However, other important urban forest management tasks and recommendations in the plan also require sufficient funding. The program's total budget needs to support equipment purchases, rentals, or other capital expenditures, additional full- or part-time staffing, plant health care, storm response, risk management, invasive pest management, staff training and development, volunteer programming and coordination, additional urban forest management analyses, and expanded public outreach.

Recommendation 14: Consider supplemental funding options. (*Priority Ranking 1)*

Through information obtained from stakeholder engagement, staff interviews, and innovative funding techniques used by other cities across the country, options for funding new urban forestry initiatives and expanding the existing program are offered for the Harrisonburg's consideration:

- **Seek grants from non-traditional sources.** The State's Division of Forestry has offered urban forest grants for decades. However, there are other granting agencies and private foundations that may provide funding for Harrisonburg to support historic tree preservation, native habitat conservation, community involvement, tree planting, and other projects. Consider applying for grants focused on the benefits trees provide, not just forestry-related grants (i.e., grants with an air quality focus, urban heat island, stormwater management, public health, and watershed-based funding). Grants and philanthropic funding should be carefully coordinated with city funding, and should follow policies and procedures already in place. It is critical that private funding supplement the city's public funding rather than replace it. The city could also partner with a nonprofit so that its status and influence as a 501(c)3 organization can be leveraged to apply for, secure, and hold grants and donations that benefit the City.

- **Use interlocal agreements for urban forest management.** Tree benefits are not provided or confined by jurisdictional boundaries; tree benefits extend beyond city limits to the region. Therefore, it could be financially beneficial for Harrisonburg to enter into an interlocal agreement with the County and/or regional communities for more efficient, cost-effective tree maintenance and planting projects. Virginia cooperative procurement law (VA. CODE.ANN § 2.2-4304, et seq) provides that any public body may participate in, sponsor, conduct, or administer a cooperative procurement agreement on behalf of or in conjunction with one or more other public bodies, or public agencies or institutions or localities of the several states, of the United States or its territories, the District of Columbia, or the U.S. General Services Administration, for the purpose of combining requirements to increase efficiency or reduce administrative expenses in any acquisition of goods and services. Pooling urban forest resources and funding with other jurisdictions could result in more competitive annual tree maintenance and planting contract prices, better pricing for coordinated wholesale tree purchases for property owners, and being more efficient and

timelier in treating insect pests and disease issues and removing invasive trees and plants, and sharing specialty equipment and assisting each other during and after severe weather events.

- **Authorize the sale of wood and wood products from public trees be earmarked for the urban forestry program.** Harrisonburg can boast of an urban wood utilization program that has gained attention and accolades regionally and nationwide. From providing fuel for the Purcell Park Bioreactor to lumber for tables in city offices, the Urban Wood Program has ensured that some of Harrisonburg's urban trees are being repurposed when they have to be removed. Currently, any revenue from wood products is returned to the general fund. The City should review its purchasing policies and procedures to more easily allow the sale of public wood and products and the return of revenue to the program. Funds from sales could be used to plant replacement trees and/or expand the wood reutilization program.

The Urban Wood Program

The Urban Wood Program was established in 2018 in response to the arrival of emerald ash borer. The program has continued to expand since city managers suggested using an online auction site (Public Surplus) to get the wood back into the community. The auction site allows the public to purchase logs and firewood keeping the woody debris out of the landfill. Sales from the auctions are projected to exceed $7,000 in 2021. This equates to 24,000 pounds/10 cords of firewood, and 130,000 pounds of logs that were diverted from the landfill.

- **Authorize an urban forestry assessment fee.** The Virginia Code (Article 2 § 15.2-2404). give cities the authority to impose taxes or assessments for local improvements; purposes. The City should explore the legal requirements to see if this funding mechanism is an option for supporting the urban forest management program. The justification and use of a tree assessment fee would be much like the city's stormwater assessment fee. All properties benefit from the city's tree canopy and public trees, and an assessment would ensure that every property contributed equitably to sustaining the urban forest. The assessment can be a set amount per front foot of right-of-way frontage or a percent of property value. A public education campaign about the benefits of this assessment would be required.

- **Perform an i-Tree benefits calculation, and then investigate the possible use of a portion of a future stormwater fee increase to fund the urban forestry program.** Trees play a significant role mitigating the city's stormwater issues. Using the recent inventory data, the City can use the U.S. Forest Service's i-Tree suite of tools to determine the level of benefits public trees are providing to the city. I-Tree calculates the quantity and value of stormwater absorbed and avoided, and the results are usually significant.

Once the magnitude of the contribution trees make to stormwater management in the city is understood, then Harrisonburg could consider using a small portion of stormwater fees to support tree planting and urban canopy maintenance. Milwaukee, as well as other cities, funds the majority of its premiere urban forestry program through its stormwater fees.

With sufficient financial resources to secure professional services, equipment, and management, the city can accomplish its goals, better respond to changes and challenges in the urban forest, and best serve the citizens of Harrisonburg.

Action Step 6: Perform Public Engagement and Build Partnerships

The urban forest influences and benefits everyone in the community. Reaching out and engaging the community is about not only informing them of the importance and benefits of trees, but also communicating the role urban forests play in ensuring Harrisonburg's livability and sustainability.

The City and other advocates of the urban forest in Harrisonburg should identify key groups and develop customized ways to reach them, such as the general public (adults and children), neighborhood groups, developers, staff/city departments, universities, health care providers, city leadership, etc.

Recommendations for educating the citizens and diverse stakeholders include:

- **General Public.** Create messages about the importance of trees and the difference they will directly have where they live (better air quality, summer cooling, reduced energy bills). Deliver these messages in a variety of media, on a regular basis, and in venues where large numbers of people are (festivals, concerts, sporting events, etc.). Additionally, a shorter, graphic-rich public version of this plan will be well-received by the general public and will also be appropriate to give to elected officials and department heads and their staff.
- **Developers.** Attend their industry events and meetings and give them information on the value of trees for business districts, property values, etc.; initially reach out to a few key developers and ask them to get involved.
- **K- 12 Schools.** Use existing messaging, curricula, and activities geared for younger students to educate them about the benefits of trees and how to plant and care for them.
- **Universities.** Get students to help spread the word and volunteer for neighborhood planting projects. Develop a canopy goal on university properties and provide tree preservation information to facility managers.
- **Large companies.** Heads of companies often respond better with peer-to-peer approaches. Determine which leaders are tree advocates, provide them with tree benefit information, and ask them to reach out to their peers with the 'ask.'
- **Urban Agriculture Proponents.** The suggestion to create "food forests" to offer nut and fruit trees in the city was suggested by participants in the survey and the interviews. Fruit tree planting is problematic on the right-of-way and even in parks for many reasons (fruit litter, liability during harvesting, application of pesticides, etc.) but is perfectly suited for

privately owned properties. Urban agriculturalists and even food bank volunteers can spearhead initiatives to encourage fruit and nut tree planting.

- **For All Private Landowners.** Frame tree plantings and tree preservation projects in terms of tree benefits specific to the type of landowner to influence large and small landholders. For example, health care facilities might be encouraged to start their own planting programs on the basis that trees reduce the rates of cardiovascular disease and childhood asthma. Landlords may be enticed to plant their trees because trees improve tenant retention and business profitability.

Performing public outreach and building partnerships is essential to maintaining a quality urban forest and long-term increases in tree canopy. City actions alone have limitations to improving and increasing the urban tree canopy because public land accounts for only a small percentage of land ownership in most cities. Fortunately, Harrisonburg's residents and other stakeholders have expressed the desire to get more involved. Positive public sentiment and a collective sense of priority for tree canopy can also result in more support/funding for public tree care budgets; and outreach efforts often reveal new partners and funding sources that otherwise can go untapped.

An education and outreach campaign will:

1. Foster an understanding of the connection between trees and the services they provide to the community, which contributes greatly to a high quality of life.
2. Prompt residents and businesses to take action in tree preservation and planting (or other needed actions) on private and public lands.
3. Cultivate support for public tree funding and management.
4. Convey the city's prioritization of trees as essential city infrastructure (leadership by example).

Recommendation 15: Develop messaging that resonates. (Priority Ranking 1)

Today's society is characterized by sound-bites and short attention spans. Combine this with the fact that the human brain does not retain a lot of information all at once, and the need for limited and concise messages about the urban forest becomes evident. The City should craft messages in terms of what people want for themselves and their neighborhoods, and what the public needs to know about the city's urban forestry program or trees in general. This means making the connection between trees and solutions to urban problems. Messages can also address some of the more emotionally-based tree perception issues. The most common of which is fear (i.e., trees, houses, and severe storms), but also the perception that trees are nuisances and extra work (messy, dirty, leaf clean-up). See Table 11 for examples of customizing messaging.

Table 11: Examples of Translating Public Desires to Effective Tree Messaging Topics

If the public wants…	Potential related tree messages or topics could then be centered on…
…safe and inviting streets for residents, workers, and visitors	Trees can help slow traffic, create safe, interesting, and vibrant neighborhoods, and are a key piece to a walkable and bike-friendly city by slowing traffic and providing safe buffers for pedestrians
…successful business districts	Tree-lined business districts encourage shoppers to pay more and stay longer
…to engage youth and young families and become a more connected and vibrant community.	Imagine signs that say "Join your neighbors in the next tree planting project. Come get your hands dirty. All ages welcome!"
… inclusion of all cultures, bridge perceived differences.	Neighborhood-wide tree planting projects or tree events that include all people.
…an attractive city people want to live and work in, and improved investments.	Cities with greater tree canopy have property values 7–15% higher than cities with less tree canopy.

Tips in Message Creation: There are two important considerations when developing messaging for an engagement or education campaign - limit the number of messages and talk to real people.

- **Limit the Messages.** There is a "Rule of Seven" concept in marketing that has been around for decades. The idea is that an audience needs to hear or see a marketing message at least seven times before they buy from you or get on board or take action. Since the rule was written years ago, today is likely 10 times that. And to count towards that 7, it needs to be the same message and images seen and heard repeatedly. This means the number of messages should be limited.
- **Talk to Real People.** Craft messages with words that appeal to real people about the issues they care about. Many citizens are not generally concerned with trees; they are more focused on getting their kids to school, putting food on the table, and keeping their families healthy and prosperous. Messaging about trees should therefore speak about the important difference they make in the lives of citizens.

Recommendation 16: Develop an outreach plan. (Priority Ranking 2)

Outreach and implementation are where the messages are put to work. It involves defining audiences, partnerships, and reaching out to the public, with the goal of getting the audience to support and participate in the care of the city's urban forest. There are distinct groups and individuals that actively impact the urban forest, such as homeowners, businesses, non-profits, schools, green industry professionals, and other civic groups. All can provide valuable assistance and support for urban forestry initiatives.

However, each group or segment views the urban forest differently and each has different priorities or goals. Typically, a blanket, one-message-fits-all approach is not effective. Therefore, each segment should be approached with the message that will most resonate with them. Each constituent group should be approached in a targeted way and informed of the vision, mission, and strategies of the urban forestry program and how it can get involved. Urban Forestry staff should work with the department's communication specialist and the PTAB to develop this plan.

Recommendation 17: Create strong partnerships. (Priority Ranking 2)

Sustainable outreach requires partnerships for long-term results. Each audience has the potential to produce partnerships and new community leaders can emerge throughout this process. Strong partnerships can occur where entity missions match up; meaning identify and connect with groups that prioritize the *services* trees provide (not trees themselves).

For example, neighborhood associations, public health organizations, community revitalization, and watershed groups may produce effective partnerships for the City given the mutually valued stormwater, health, and social benefits of trees. Large landholders (often businesses) can have a significant impact on increasing tree canopy simply due to large amounts of land available for trees. Large businesses also tend to have an interest in making their community a nicer place to live and work to retain good employees, and therefore be a source of funding and volunteers.

Harrisonburg should strengthen existing relationships, or begin to cultivate new partnerships, with local institutions and businesses such as James Madison University, Eastern Mennonite University, Sentara RMH Medical Center, Frazier Quarry, Rocco Enterprises. Rockingham Cooperative, among others. The Public Tree Advisory Board could create an ad hoc committee to identify, prioritize, and make connections with potential partners for funding, volunteer labor, materials and supplies, and public education.

Recommendation 18: Consider Reinstituting a "Tree Stewards" Program. (Priority Ranking 3)

As suggested several times in the community survey, the City should consider implementing an urban forestry support program composed of volunteers, often called "tree stewards," to assist with tree planting, invasive removal, public education, and new tree care such as watering, mulching, and pruning. This type of program was begun in 2014, but was discontinued due to competing priorities of city staff.

A tree stewards program provides yet another engagement opportunity and encourages partnership opportunities with youth groups (scout troops, church affiliated groups, high school community service programs), youth job corps programs, and/or garden clubs to accomplish many public tree care tasks. Tree Stewards could even be used to help plant trees on private property when the owners are unable to do it themselves.

Such a program does involve initial and continuing training, frequent mentoring, and overall coordination of the process and volunteers. While staff time and supplies are needed to sustain such a program, it may be a worthwhile investment for the City. The City could also explore partnering with AmeriCorps, the VISTA program, and the Student Conservation Association to secure the support needed to start and sustain this program.

Action Step 7: Continue and Expand the Urban Wood Reuse Program

Photo 6: Harrisonburg Urban Wood Program

Photo 7: Heritage Oaks Counter

Harrisonburg has an established and successful urban wood re-use/up-cycling program. Primarily initiated in response to the significant loss of ash trees due to the emerald ash borer, the program has since grown in size and type of products produced.

This award-winning program has given Harrisonburg well-deserved recognition at the state, regional, and national levels. Harrisonburg's program places the city in the ranks of Baltimore, Milwaukee, and Cincinnati in terms of having an innovative and viable urban wood reuse program.

Recommendation 19. Suport and expand the Urban Wood Program (Priority Ranking 2)

The City should continue the wood reuse program to gain these diverse and important benefits:

- Re-using urban wood reduces wood disposal costs and expenditures for finished wood products.
- Public relations is improved as the City demonstrates that it prioritizes responsible and sustainable management of it natural resources.
- Area wood industries and artisans are supported since they have access to a new sustainable source for raw materials. This can help businesses develop new products, create jobs, and keep revenue in the local economy.
- Capturing the highest and best use of removed urban timber puts less strain on the city's natural habitats and forests to supply usable wood products and building materials.

Action Step 8: Increase Urban Forest Management Program Staff and Provide Professional Training

Proactive and professional municipal urban forest management requires that experienced and well-trained managers and arborists are readily available to perform a wide variety of tasks that are

critical to the success of implementing Harrisonburg's urban forest management plan and creating a sustainable urban forest. Harrisonburg also has a growing pollinator and wood reuse program that current forestry staff manage; additional staff is needed so that these natural resource management programs can continue to serve the citizens and improve Harrisonburg's environment.

Recommendation 20: Create a City Forester position. (Priority Ranking 2)

To effectively and efficiently implement the recommendations of this plan, and the recommendations from and requirements of other City plans and regulations, Harrisonburg's urban forest management program would benefit by having a designated "City Urban Forester" position, and at least one additional full-time staff member. The need for dedicated staff is clear given the extensive nature of the urban forestry program's responsibilities. Beyond managing tree pruning, planting, and removal tasks, staff also currently, or in the future, must respond to and inspect requests from citizens and other departments, perform contract inspections and administration, assess tree risk, assist with storm damage mitigation, address overhead and underground utility work in the rights-of-way, review site plans, issue permits, develop and manage wood reuse systems, appraise tree damage, coordinate the work of nonprofits and program partners, attend community meetings, support special events, manage fleet and personnel, and perform other administrative duties.

Currently, the staff compliment is over-tasked. The creation of a "City Forester" position would benefit the City, citizens, and the urban forest in many ways; examples include:

- Elevating the management program from a reactive to a proactive approach, which decreases public safety risks and increases tree benefits.
- More easily and consistently ensures that the public tree asset is considered and incorporated in community planning, capital projects, and other municipal programs.
- Ability and authority to implement the Urban Forest Management Plan recommendations, as well as the goals of the Environmental Action Plan.
- Allows for strengthening inter-departmental coordination, and developing external relationships that can lead to more funding and other support for the program.

Once a City Forester position is created, a proactive urban forest management program has been established, and adequate funding and other resources are secured, a long-term goal the City should consider is creating a "natural resource or greenspace management" Division within the department. The urban forestry and horticulture programs could be separate sections, and be under the leadership of the City Forester.

Recommendation 21: Add a field arborist position (Priority Ranking 1)

Current city staff managing public trees are admirably executing their duties and interacting with the public, but will have limited time to take on the additional work and efforts required to implement many recommendations of this plan. Additionally, the City's pollinator program requires 50% of an arborist's time which further restricts the City's ability to properly manage its trees and provide excellent customer service.

Therefore, an additional field arborist is recommended; this position could conduct annual risk and post-storm event inspections on mature trees, conduct the annual cyclical maintenance inspections, manage inventory updates; perform ongoing minor tree work such as new and small tree care, tree planting, and plan and conduct public education events. This role, if made full-time, could also assume and assist with coordinating and managing a Tree Stewards program and other community volunteers.

Recommendation 22: Provide training to staff, encourage professional certifications (Priority Ranking 1)

The work involved in urban forest management has to be performed by trained, knowledgeable persons. The City of Harrisonburg should have a comprehensive, ongoing, and consistent training program for staff performing program management tasks and/or tree maintenance or planting operations. A quality training program is integral to keeping workers on the grounds safe, efficient in their work, and motivated about learning new skills. Training does more than just educate. Training supports professional development and job advancement, provides clear direction and expected performance outcomes, and positively influences the engagement levels, productivity, and attitudes and behaviors of staff. Recommendations for urban forestry training are:

- Staff should receive regular and updated training sessions for first-aid and CPR, chainsaw use, tree risk assessment, and minimum approach distances for energized electric lines to ensure that people are working safely and effectively.
- Create a training program for the city's park maintenance staff and Trustees crew that focuses on new and young tree care, proper pruning, fertilization, and mowing techniques to prevent injury to trees.
- Request local tree service companies, landscapers, University of Virginia Extension, and other local and regional professional organizations to provide free training for staff on appropriate topics.
- Provide current or future urban forest management program staff the opportunity to become International Society of Arboriculture Certified Tree Workers, Certified Arborists, Municipal Specialists, and/or obtain the Tree Risk Assessment Qualification.

Action Step 9: Regularly Update the Plan, UTC, and Inventory and Monitor the Plan's Success

The best approach to sustaining an urban forest and a proactive tree management program is to have up-to-date, accurate data available from a public tree inventory, urban tree canopy assessment, benefit calculations, and a municipal tree management plan.

Recommendation 23: Update urban forest data and planning documents. (Priority Ranking 3)

The City cannot make data-driven decisions without accurate and up-to-date data and plans. Best management practices for the frequency of updating urban forest management information are:

- Update the tree inventory database on a weekly, monthly, or semi-annual basis using the city's asset management program or a tree data management software program to record when maintenance or planting work is performed, track work history, and evaluate productivity to plan work and project budgets.
- Every year, re-inventory 20% of the street and park tree population by conducting a Level 2 assessment, and conduct a Level 1 assessment on the remaining 80% of the street and park tree populations. If this cannot occur, re-inventory the entire public tree population every ten years.
- Provide urban forest management staff training, access to customized mobile field applications, and all necessary equipment to be more productive.
- Update the tree canopy assessment at least every 10 years. At the time of the update, perform a change analysis to determine the amount and locations of gains and losses in tree canopy.
- Review and update the municipal tree management plan at least every five years. Updating may also occur in any given year that major shifts in funding, personnel, and the conditions of the urban forest occur.

Recommendation 24: Monitor the Plan's implementation and success. (Priority Ranking 1)

Monitoring is the periodic and systematic measurement of processes and metrics to gauge success. The City should institute three forms of monitoring in association with the urban forest management plan: implementation, effectiveness, and validation.

- **Implementation Monitoring.** Determines if the plan is being implemented as designed within resource and funding constraints. It asks, "Did we do what we set out to do?"
- **Effectiveness Monitoring.** Determines if the action achieved stated goals and objectives. It asks, "Did it work?"
- **Validation Monitoring.** Determines if assumptions, data, and models being used to make decisions are valid and appropriate.

Every year, a staff and PTAB meeting should be held to review the accomplishments and measure the effectiveness of the urban forest program, plan next steps, and make adjustments to goals and action steps as needed.

Every 5 years, an evaluation/ progress review meeting should be held that includes stakeholders and community representatives where there will be a more in-depth discussion and evaluation of the Plan's progress and level of success.

Benchmarks to measure this success can be custom developed by Harrisonburg based on specific program goals; and/or using the Urban Forest Sustainability Matrix. Table 12 below as an example of how to translate local goals into benchmarks; and the Sustainability Matrix template is found in Appendix F.

Table 12: Examples of Translating Goals into Benchmarks to Measure Future Progress

If the City's goal is:	Potential benchmark supported by data could be:
All public trees are in good condition and well maintained.	70% of all trees are in Good or Excellent condition and are maintained to maximize current and future benefits.
Historic and/or mature trees are preserved.	60% of historic or trees over 28" DBH are in Fair to Good condition.
The city's urban forest population is diverse.	No species represents no more than 10–15% of the citywide tree population.
Invasive trees are controlled on public property.	No more than 5% of inventoried trees are considered invasive species.
The public urban forest is safe.	All high risk removals and prunings are complete, and all publicly managed trees are free of recognized hazards.
The city's urban forest and tree canopy is appreciated and valued by the public.	Quantified public engagement numbers – number of volunteer project participants, educational programs/outreach efforts, and partnerships in place.

IMPLEMENTATION OF RECOMMENDATIONS

An important goal of the city will be to implement this Urban Forest Management Plan to create a safe, sustainable, and attractive urban forest. and incrementally expand tree planting and public outreach. To that end, the recommendations made in this plan for improving administrative, financial, and operational efficiencies and effectiveness and making better, more meaningful connections with the public have been summarized in Table 13. These recommendations have also been prioritized, and estimated costs have been provided where applicable and known.

Table 13: Prioritized Compilation of Recommendations to Improve Urban Forestry Management and Service Delivery

Action Step	Priority Rank	Recommendation	Timeframe
Action Step 1: Perform Priority and Proactive Maintenance	1	#1. Establish a five to ten-year MTP Cycle in which the trees in a defined management unit will be pruned each year.	Short term (1–5 years)
	1	#2: Implement a three-year YTP Cycle.	Short term (1–5 years)
	1	#3: Update inventory on a regular basis.	Short term (annually)
Action Step 2: Plant More Trees and Practice Purposeful Planting	2	#4: Create a Master Tree Planting Plan for City rights-of-way, parks, schools and other properties. a. Incorporate "Right Tree, Right Place" principles in the planting plan. b. Select tree species to increase diversity and maximize environmental benefits. c. Select Tree Species to prepare for climate change. d. Strive to include tree planting with capital projects	Mid-term (3-6 years)
	3	#5: Set a goal of achieving as least a 90% "stocking level" for street trees. a. Prioritize street tree planting. b. Consider alternative planting stock types and sizes to maximize the planting budget.	Long term (10+ years)
	3	#6. Promote tree planting on private property. a. Explore opportunities to provide citizens and businesses reduced/wholesale prices for tree planting. b. Promote the Harrisonburg Electric Commission's tree replacement program. c. Promote the Harrisonburg Conservation Assistance Program. d. Create and sustain a public education campaign about the need for and benefits of planting and caring for trees.	Long term (10+ years)
Action Step 3: Set a UTC Goal	3	#7: Set an urban tree canopy goal that balances tree benefits with the city's economic development goals and plans and accommodates other municipal infrastructure.	Long term (10+ years)
	3	#8: Update Chapter 6 Public Tree Ordinance and consider adding new language and sections.	Long term (10+ years)

Action Step 4: Improve Ordinances and Policies	3	#9: Continue to incorporate urban tree canopy and public tree management issues into the Comprehensive Plan during regularly scheduled Plan evaluations and updates.	Long term (10+ years)
	1	#10: Include current arboricultural industry standards in future revisions and updates to the Design and Construction Standards Manual.	Short-term (1-5 years)
	2	#11: Explore including tree protection and tree replacement planting requirements on private property in the land development regulations of the Zoning and Subdivision Ordinance as allowed by Commonwealth law.	Mid-term (5–10 years)
	2	#12: Expand the Public Tree Policy document with more policies that also have the support of other city departments.	Mid-term (5–10 years)
Action Step 5: Ensure Stable Funding and Identity New or Supplemental Funding Sources	1	#13: Ensure that the city's tree maintenance budget is no less than $104,000 annually.	Short term (1–5 years)
	1	#14: Consider supplemental funding options.	Short term (1–5 years)
Action Step 6: Perform Public Engagement and Build Partnerships	1	#15: Develop messaging that resonates.	Short term (1–5 years)
	2	#16: Develop an outreach plan.	Mid-term (3–6 years)
	2	#17: Create strong partnerships.	Mid-term (5–10 years)
	3	#18: Consider reinstituting a "Tree Stewards" Program.	Long term (10+ years)
Action Step 7: Continue the Urban Wood Reuse Program	2	#19: Continue and expand the urban wood reuse program.	Mid-term (3–6 years)
Action Step 8: Increase Urban Forest Management Program Staff and Provide Professional Training	2	#20: Create a City Forester position.	Mid-term (5–10 years)
	1	#21: Add a field arborist position.	Short term (1–5 years)
	1	#22: Provide training to staff and encourage professional certifications.	Short term (1–5 years)
Action Step 9: Regularly Update the Plan, UTC, and Inventory and Monitor the Plan's Success	3	#23: Update urban forest data and planning documents.	Long term (10+ years)
	1	#24: Monitor the Plan's implementation and success.	Short term (annually)

CONCLUSION

The recommendations made in this Plan are intended to be considered and implemented over a period of five to ten years. The results of this Plan's implementation, in relation to achieving the goals, objectives, and final measurable results of a proactive forest management program and maintaining or expanding the urban tree canopy cover, may take more time.

Trees are long-lived organisms, and by planting trees today the city is actually planting them to provide their benefits for future generations of citizens. However, by having systematic tree planting and maintenance programs in place, and by having adequate funding, staffing, regulations, and public education resources today, the current and future public tree population and overall urban forest will be expanded and sustainable.

Harrisonburg's urban forest is a municipal asset and amenity that appreciates over time because it is alive and growing. The trees provide tangible and intangible benefits to the city and its citizens. Because of their significance to the environmental, social, and economic well-being of the city, trees and the urban forest should be professionally managed and protected to preserve them now for all citizens and to expand them for future citizens.

Photo 8: Harrisonburg's tree canopy is key to the livability of the city for current and future generations

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GLOSSARY

American National Standards Institute (ANSI): ANSI is a private, nonprofit organization that facilitates the standardization work of its members in the United States. ANSI's goals are to promote and facilitate voluntary consensus standards and conformity assessment systems, and to maintain their integrity.

ANSI A300: Tree care performance parameters established by ANSI that can be used to develop specifications for tree maintenance.

arboriculture: The art, science, technology, and business of commercial, public, and utility tree care.

canopy: Branches and foliage that make up a tree's crown.

canopy cover: As seen from above, it is the area of land surface that is covered by tree canopy.

cycle: Planned length of time between vegetation maintenance activities.

defect: See structural defect.

Diameter at breast height (DBH): See tree size.

failure: In terms of tree management, failure is the breakage of stem or branches, or loss of mechanical support of the tree's root system

genus: A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature, the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.

geographic information system (GIS): A technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework. GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to provide a better understanding of how it all interrelates.

monoculture: A population dominated by one single species or very few species.

overhead utilities: The presence of overhead utility lines above a tree or planting site.

right-of-way (ROW): See street right-of-way.

risk: Combination of the probability of an event occurring and its consequence.

species: Fundamental category of taxonomic classification, ranking below a genus or subgenus, and consisting of related organisms capable of interbreeding.

street right-of-way (ROW): A strip of land generally owned by a public entity over which facilities, such as highways, railroads, or power lines, are built.

street tree: A street tree is defined as a tree within the right-of-way.

structural defect: A feature, condition, or deformity of a tree or tree part that indicates weak structure and contributes to the likelihood of failure.

tree: A tree is defined as a perennial woody plant that may grow more than 20 feet tall. Characteristically, it has one main stem, although many species may grow as multi-stemmed forms.

tree benefit: An economic, environmental, or social improvement that benefits the community and results mainly from the presence of a tree. The benefit received has real or intrinsic value associated with it.

tree inventory: Comprehensive database containing information or records about individual trees typically collected by an arborist.

tree ordinance: Tree ordinances are policy tools used by communities striving to attain a healthy, vigorous, and well-managed urban forest. Tree ordinances simply provide the authorization and standards for management activities.

tree size: A tree's diameter measured to the nearest inch in 1-inch size classes at 4.5 feet above ground, also known as diameter at breast height (DBH) or diameter.

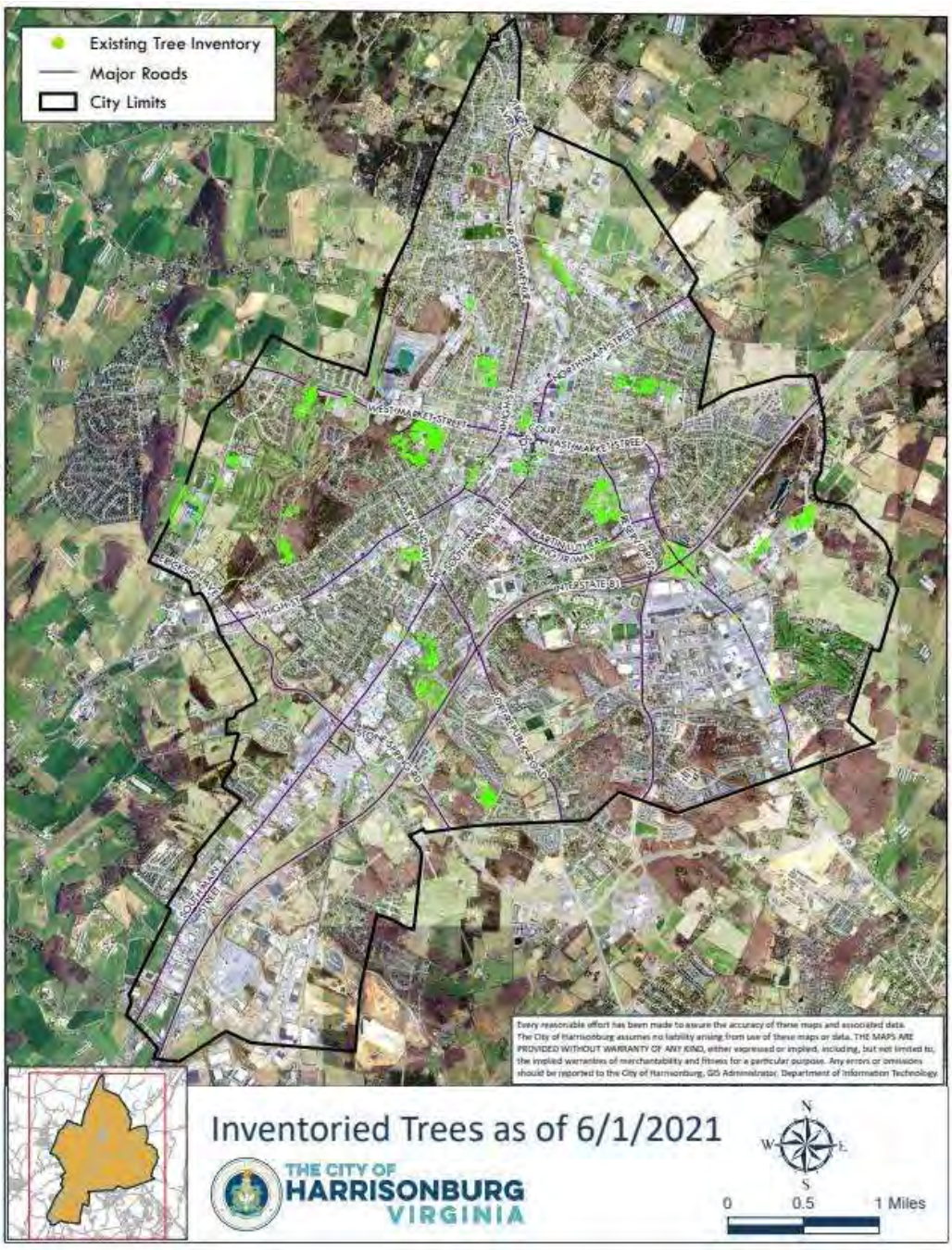
urban forest: All of the trees within a municipality or a community. This can include the trees along streets or rights-of-way, in parks and green spaces, in forests, and on private property.

urban tree canopy (UTC) assessment: A study performed of land cover classes to gain an understanding of the tree canopy coverage, particularly as it relates to the amount of tree canopy that currently exists and the amount of tree canopy that could exist. Typically performed using aerial photographs, GIS data, or Lidar.

young tree train: Data field based on ANSI A300 standards, this maintenance activity is characterized by pruning of young trees to correct or eliminate weak, interfering, or objectionable branches to improve structure. These trees can be up to 20 feet tall and can be worked with a pole pruner by a person standing

APPENDICES

Appendix A – Public Tree Inventory Map



Appendix B – Pest Threat Information

PEST ALERT

State of New Hampshire
Department of Resources and Economic Development
Division of Forests and Lands
Forest Protection Bureau–Forest Health Section

White Pine Blister Rust
Cronartium ribicola

Hosts: Five-needle pines including White Pine *(Pinus strobus)* in the northeast and Currants & Gooseberries (*Ribes spp.*)

Distribution: Throughout all the states along the Atlantic seacoast inland to Tennessee and up through the upper Midwest. Also along the Pacific Seacoast inland to South Dakota and down to New Mexico.

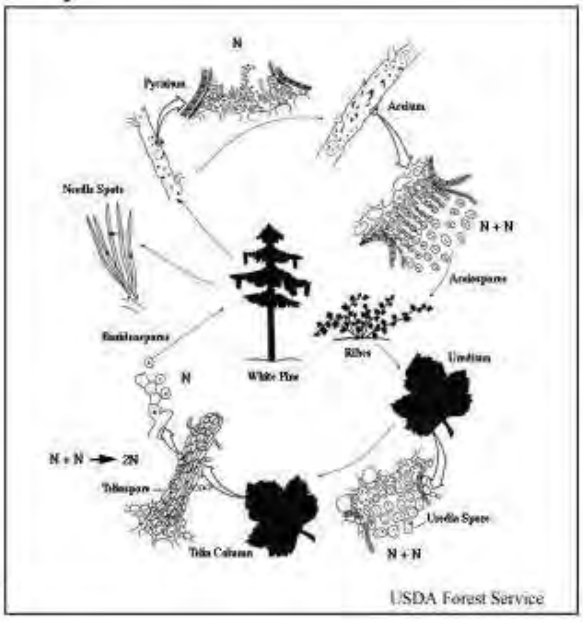
History: Introduced to North America from Europe in the 1890s, thousands of foresters and laborers spent millions of hours destroying gooseberries and currant plants throughout NH from 1917 to 1986 . This monumental effort was designed to break the disease cycle and by the mid 1990s the occurrence of blister rust damage in the northeast was relatively rare. Much research had gone into developing immune *Ribes* cultivars. By 2000 a short list of 19 gooseberries and currants were available to legally plant in NH if you provided the State with information on what species and cultivar you purchased off the list and where it was being planted. In 2011 scientists in Connecticut documented the occurrence of *Cronartium* infected *Ribes nigrum* cv. *Titania*, one of the immune cultivars. Subsequent research proved a breakdown of immunity in this cultivar and led to the removal of immune black currants from the varieties approved for planting in NH.

Symptomatic *Ribes*

Symptomatic Pines

Identifying Symptoms: Signs of the disease are visible on *Ribes* species in the summer and fall when rust colored uredia and telia are present on the undersides of leaves. On pine symptoms first appear as the disease infects the needles in the fall. The infection is most apparent by recently killed branch flagging and stem cankers early summer when orange aecia rupture the bark.

Life Cycle:



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USDA is an equal opportunity employer and provider

ASIAN LONGHORNED BEETLE

A significant threat to deciduous forests.

What is it?

The Asian longhorned beetle *(Anoplophora glapripennis)* or ALHB is an invasive wood-boring beetle native to China and Korea. It infests and kills numerous hardwood species, including maple trees.

Trees at risk

ALHB prefers maples *(Acer spp.)* over all other genera. It also attacks birch *(Betula spp.)*, poplar *(Populus spp.)*, willow *(Salix spp.)*, and other hardwoods to a lesser extent. It is a threat to Canada's maple syrup industry urban and natural forests.

Impacts

- Larvae bore large-diameter (9-14 mm) feeding galleries in trunks and branches, causing breakage and eventual death of affected trees.
- Has the potential to cause catastrophic damage to the maple syrup industry, and to disrupt and degrade natural and urban forest ecosystems.
- Early detection is key. If uncontrolled, ALHB can have catastrophic financial, cultural and ecological consequences.

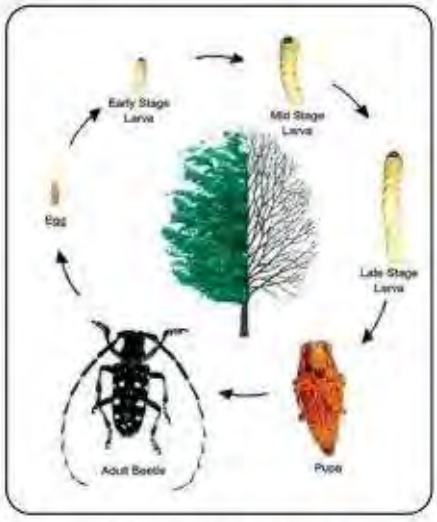
Life cycle

Adults: Adults are active from early summer to early fall. They feed on the bark of twigs periodically throughout the mating and egg-laying period. On sunny days, the adult beetles are most active from mid-morning to early afternoon. They usually rest in the canopy on cloudy days.

Eggs: In preparation for egg-laying, females chew oval pits in the bark in which they lay one egg about 5-7 mm in length. Sap stains are often associated with fresh egg-laying wounds. On average, each female will live approximately 40 days and during that period will lay about 25-40 eggs. The wounds may occur anywhere on the tree, including branches, trunk, and exposed roots. Eggs will hatch in one to two weeks.

Larvae: Young larvae begin feeding in the phloem tissue. As they mature, they migrate into the wood creating tunnels as they feed. These galleries cause tree stress and dieback, and in high densities lead to tree death.

Pupae: Larvae mature into pupae in the galleries before turning into adults in summer. The new adults exit the tree by creating large round exit holes about 10-15 mm in diameter.



Header: Melody Keena, USDA Forest Service, Bugwood.org
Life cycle: ALHB Life Cycle, North Dakota State University, Michael Bohnen, USDA, https://www.nsinvasives.org/copy_of_asian_longhorn_beetle/asian-longhornd-beetle-life-cycle

What to look for:

ALHB adults are distinctive. Watch for large (28-35 mm long), noticeably glossy black beetles with scattered white spots and long, black-and-white banded antennae. The ALHB can be confused with the native white spotted sawyer beetle, but the sawyer beetle can be differentiated by the characteristic white spot below the neck.

Top: Invasive Asian longhorned beetle
Bottom: Native white spotted sawyer beetle

Look for shallow pits or depressions chewed in the bark. Females deposit singly in these pits, laying about 90 eggs over the course of a season.

Be alert for large, round exit holes (15-20 mm in diameter) made by emerging adult ALHB.

Larvae go through 13 instar phases as they tunnel through wood, maturing at 50 mm long. Larvae and pupae will only be seen when cutting into a tree.

Look for unusually coarse frass (wood shavings mixed with feces) produced by larvae. Frass may be found in branch and truck unions, on the trunk, or at the base of a tree.

ALHB emerge throughout the season, and adults can be active from May through November. Homeowners should be aware that adult beetles can be caught in swimming pool filters, which can serve as a means of monitoring for ALHB.

Buy and burn your firewood locally, ALHB can be introduced to new areas through the movement of infested firewood. It is your duty to report sightings of ALHB under the Authority of the Plant Protection Act.

Report sightings of ALHB to:

- Canadian Food Inspection Agency www.inspection.gc.ca/pests
- Invading Species Awareness Hotline at 1-800-563-7711
- Early Detection and Distribution Mapping System, eddmaps.org

For more information visit www.invasivespeciescentre.ca

Eastern Ontario Model Forest

Invasive Species Centre

Ontario Trillium Foundation / Fondation Trillium de l'Ontario

IMG 1: Asian longhorned beetle, Kenneth R. Law, USDA APHIS PPQ, Bugwood.org IMG2: White spotted sawyer beetle, Kenneth R. Law, USDA APHIS PPQ, Bugwood.org IMG3: B.D. Gill, CFIA, IMG 4: USDA APHIS, aphis.usda.gov IMG 5: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

Virginia Cooperative Extension
Virginia Tech • Virginia State University
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Best Management Practices for Spotted Lanternfly in Yards and Landscapes

Authored by, Eric Day, Extension Entomologist, Department of Entomology, Virginia Tech; Mark Sutphin, Virginia Cooperative Extension; and Theresa Dellinger, Insect Identification Lab, Department of Entomology, Virginia Tech

Introduction

Spotted lanternfly (SLF) can be successfully controlled in yards, landscapes, and other public areas with Best Management Practices. The key for success depends on the proper timing of applications and the use of effective chemicals or biological controls. Since SLF is highly mobile and can easily move from tree to tree, or from ground level to up into trees, it is important to monitor SLF populations on a repeated basis during the year. Do not move any infested materials to limit the spread of this pest. Be aware that SLF will likely move from unsprayed areas into treated areas after treatments dissipate. Table 1 will help you look for the appropriate life stage at the proper time of the year. Table 2 specifies which treatment recommendations are appropriate for the time of year.

Table 1. Time of year and expected life stage of SLF.

November – April Look for SLF egg masses on branches and trunks of plants. Even pencil-sized branches may hold egg masses.	
May - June Early immature or nymph stages of SLF are black with white spots.	
Late June to early July The fourth and final stage of the SLF nymph has red coloration in addition to black with white spots.	
Mid-July – October Adults are present from mid-July until a hard frost in late fall. Adults start laying eggs in mid-September.	

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Table 2. Time of year and appropriate treatments.

Activity	January – April	May – October	November - December
Scrape eggs			
Apply dormant oil to egg masses			
Use sticky band traps on trunks			
Use contact insecticides as spot sprays			
Use soil drench of systemic insecticides			
Use organic sprays or biological control			
Do not move any infested materials			

Pesticides, Method of Application, and Timing for Best Control

Systemic insecticides, regardless of the application method, should be used after the tree or shrub has finished flowering. Soil drenches should not be used if flowering plants are planted at the base of the tree or shrub. These practices protect pollinators. Systemic sprays are not effective against egg masses.

Table 3. Systemic insecticides, methods, and timing for control of spotted lanternfly

Systemic Insecticides Active Ingredient	Method of Application	Timing for Best Control
Dinotefuran	Soil drench or trunk spray	July to September
Imidacloprid	Soil drench	After flowering to July
Imidacloprid	Trunk injection	July to September

Contact insecticides should be used as a spot spray for clusters of SLF adults or nymphs found on vegetation. The products listed below are effective, but SLF is highly mobile and will likely to move from untreated areas into treated areas after the insecticide wears off. Contact insecticides are not recommended for egg masses.

Table 4. Contact insecticides, methods, and timing for control of spotted lanternfly

Contact Insecticides Active Ingredient	Method of Application	Timing for Best Control
Bifenthrin	Trunk, branch, and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary
Carbaryl	Trunk, branch, and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary
Zeta-cypermethrin	Trunk, branch, and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary
Malathion	Trunk, branch, and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary
Tau-fluvalinate + tebuconazole	Trunk, branch, and foliage sprays	May – early July Spot sprays as needed. Repeat in Fall if necessary

Organic Control: Neem oil and natural pyrethrin's can be used when SLFs are found on plants, but repeated applications of these materials may be necessary as SLF is very mobile and more will move in after the pesticide wears off.

Dormant oil can be used as a spot spray on egg masses, but should only be used in late winter and before bud break in the spring. Some horticultural oils and paraffinic oils can be used as a spot spray on egg masses on trees in the growing season, but these materials should be tested on a few branches first to make sure it will not harm the tree. Wait 2 weeks and retreat entire tree if no damage is observed to the tree. Do not use oil sprays as a preventative application to a tree against egg-laying by SLF; this is not effective.

Table 5. Organic insecticides, methods, and timing for control of spotted lanternfly

Organic Controls	Method of Application	Timing for Best Control
Neem oil	Trunk, branch and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary.
Natural pyrethrin's	Trunk, branch and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary.
Insecticidal soap	Trunk, branch and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary.
Horticultural oil and paraffinic oil	Trunk, branch and foliage sprays	May – early July Spot sprays as needed. Repeat in fall if necessary. May damage some plants; treat a small area and wait 2 weeks to make sure it will not harm plants.
Dormant oil	Trunk and branches with egg masses. Do not apply to foliage.	Directly on egg masses. Treat from mid-February to late April, beginning when overnight temperatures do not go below freezing the first night after application.

Biological Control: Fungal preparations can be applied from early May to early June. Fungal preparations are limited by environmental conditions such as moisture levels and temperature. They are slow-acting and control may not be apparent for several weeks. Also, SLF is highly mobile and will likely to move from untreated areas into a treated area over time.

Table 6. Biological controls, methods, and timing for control of spotted lanternfly

Biological Controls	Method of Application	Timing for Best Control
Burkholderia spp. strain A396 (Venerate XC)	Trunk, branch and foliage sprays	May – early July Spot sprays as needed.
Beauveria bassiana (Botanigard, etc.)	Trunk, branch and foliage sprays	May – early July Spot sprays as needed.

References

Leach, Heather, E. Swackhamer, and A. Korman. 2019. "Spotted Lanternfly Management for Landscape Professionals." *https://extension.psu.edu/spotted-lanternfly-management-for-landscape-professionals*

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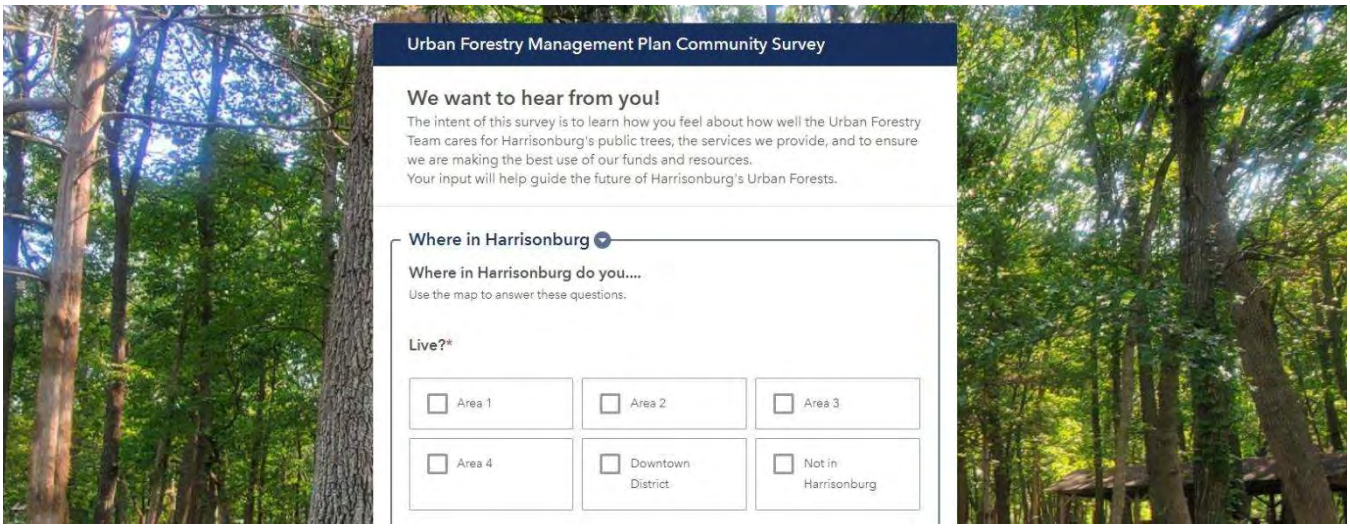
Appendix C – Public Survey Summary Report

Survey Summary:

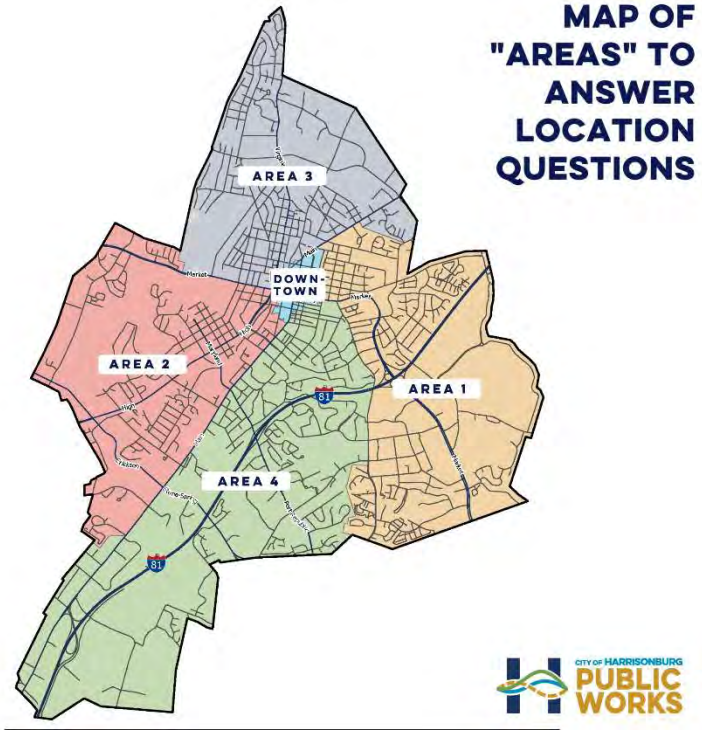
On March 5, 2021 the Urban Forestry Management Plan Community Survey went live. The survey was created using ArcGIS's Survey123. The survey was promoted via Facebook posts and several email newsletters. The survey was open for responses through March 31, 2021.



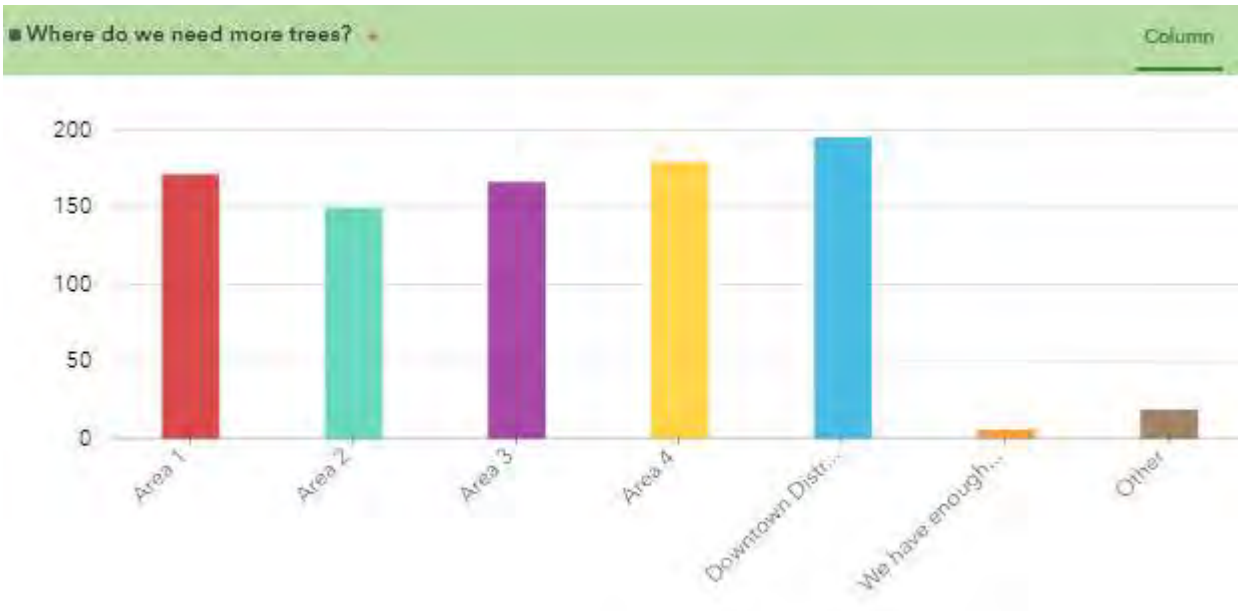
There were 259 respondents to the survey.

Of these respondents:

LIVE in	Area 1	36
	Area 2	78
	Area 3	51
	Area 4	37
	Downtown District	16
	Not in Harrisonburg	41
WORK in	Area 1	23
	Area 2	53
	Area 3	36
	Area 4	62
	Downtown District	67
	Not in Harrisonburg	58
PLAY in	Area 1	117
	Area 2	188
	Area 3	133
	Area 4	155
	Downtown District	185
	Not in Harrisonburg	83

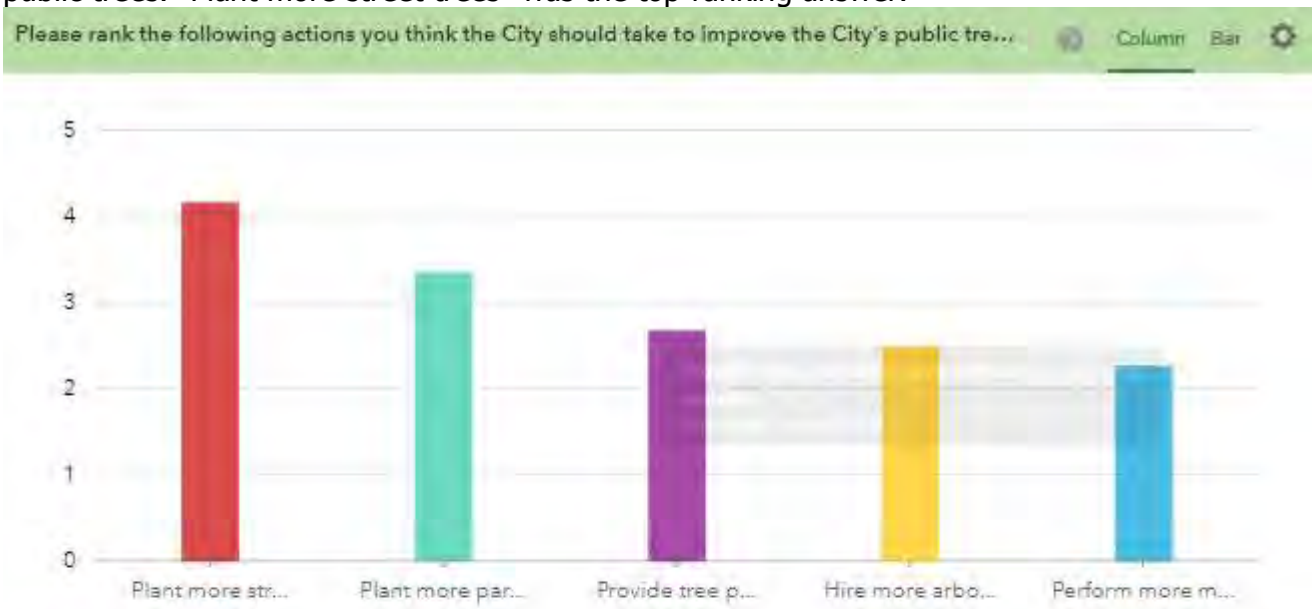


When asked "Where do we need more trees?" respondents could choose multiple areas based on the map above. The most respondents, 196, said the Downtown District needs more trees. Closely followed by Area 4 with 180 respondents and Area 1 with 172. Overall, it seems the respondents feel we need more trees throughout the city, with only 2.3% feeling Harrisonburg has enough trees.



The majority of respondents, 154, feel the City trees are maintained "Well" or "Very Well" with 86 respondents having a neutral opinion. Only 7.3% felt that a poor job was being done. Comments from the respondents who indicated "poor" to this question are notated by a * next to the comment in the comments section of this report.

The survey asked respondents to rank actions they feel the City should take to improve the City's public trees. "Plant more street trees" was the top-ranking answer.



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Show/hide choices

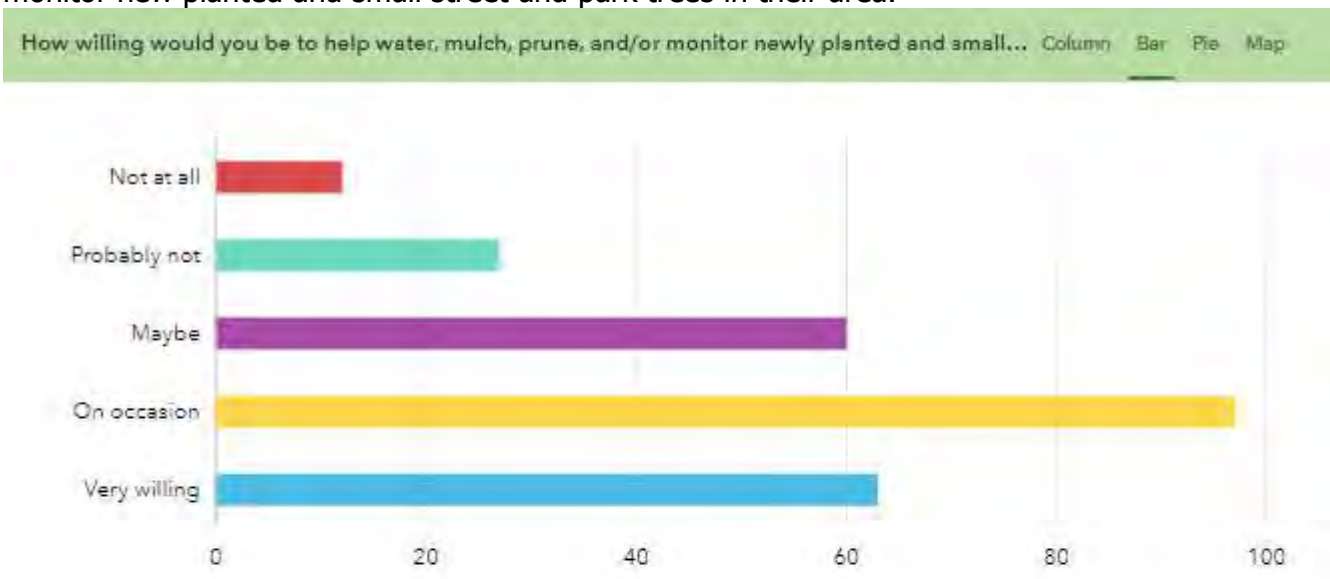
Sort

Rank	Answers	1	2	3	4	5	Average score
1	Plant more street trees	57.75% 149	18.22% 47	11.63% 30	8.53% 22	3.88% 10	4.17
2	Plant more park trees	17.05% 44	37.6% 97	20.16% 52	14.73% 38	10.47% 27	3.36
3	Provide tree planting care advice to property owners	13.18% 34	17.44% 45	20.16% 52	23.26% 60	25.97% 67	2.69
4	Hire more arborists to care of the trees	6.59% 17	13.18% 34	31.78% 82	20.54% 53	27.91% 72	2.50
5	Perform more maintenance (tree pruning, removal, stump grinding)	5.43% 14	13.57% 35	16.28% 42	32.95% 85	31.78% 82	2.28

Answered: 258 Skipped: 1

We were surprised to learn that 66.6% of respondents were not aware that the City offers volunteer tree planting events in the Spring and Fall. This emphasizes the need to find new ways to communicate with our community. Having widespread reach within the community is an ongoing effort, and challenge, not only for the Public Works Department, but Harrisonburg City as a whole.

Respondents to the survey shared that they would be willing "to help water, mulch, prune, and/or monitor new planted and small street and park trees in their area."



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Empty categories | Sort

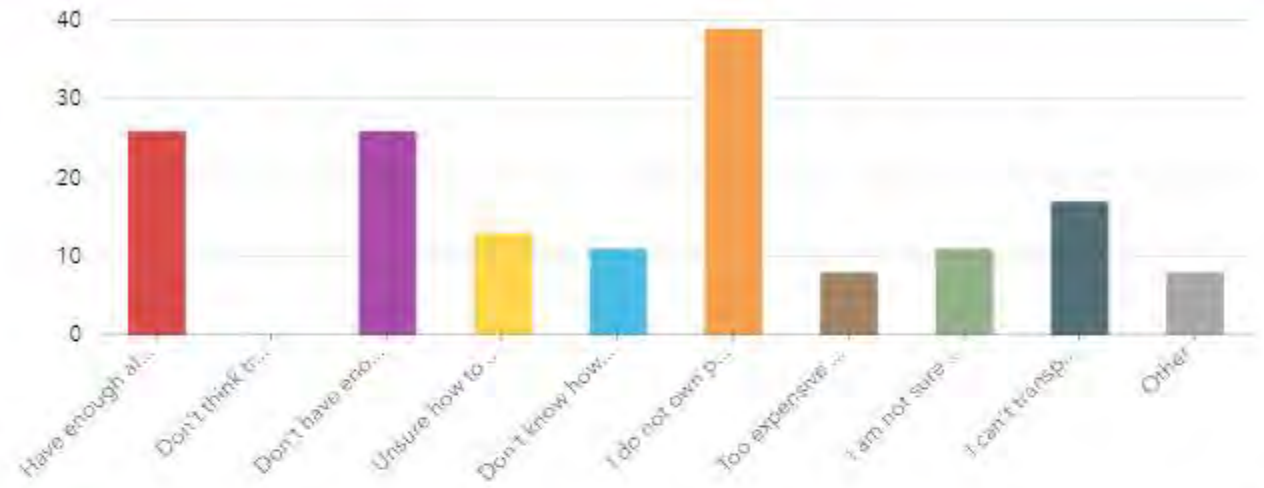
Answers	Count	Percentage
Not at all	12	4.63%
Probably not	27	10.42%
Maybe	60	23.17%
On occasion	97	37.45%
Very willing	63	24.32%

Answered: 259 Skipped: 0

Sixty-three percent of the respondents indicated they have planted a tree in the last 5 years. Of the 94 respondents who said they have not planted a tree in the last five years, the number one reason for not planting a tree was because they do not own property.

Why didn't you want to plant a tree?

Column Bar



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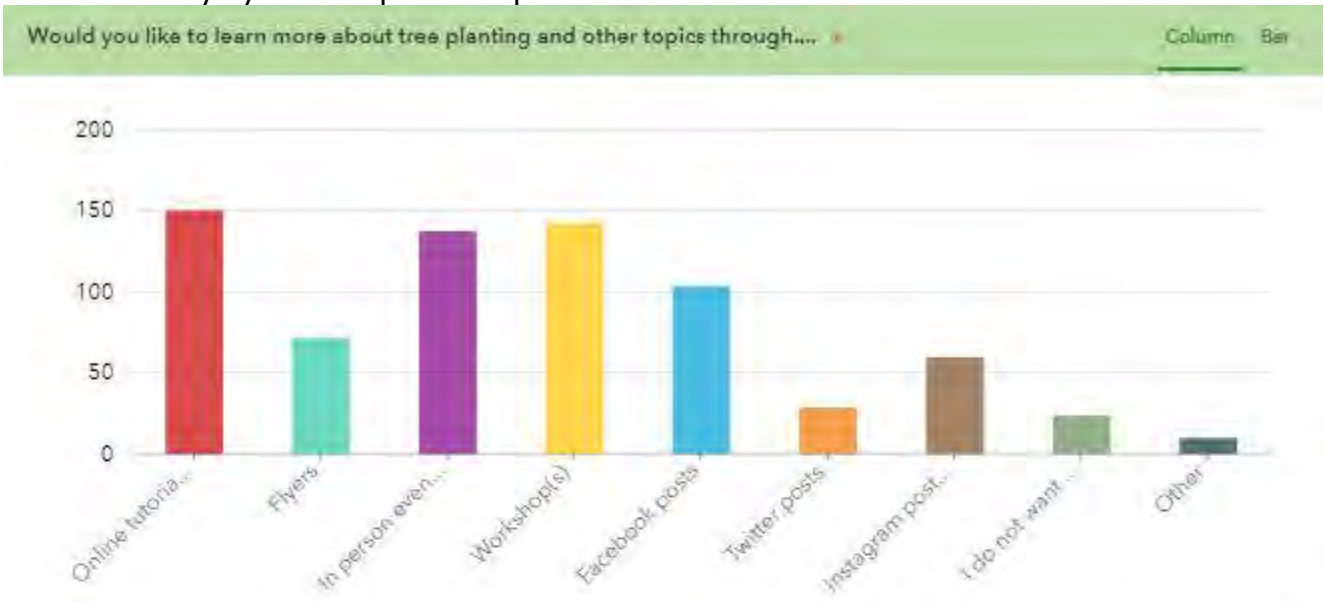
Other response Empty categories Sort

Answers	Count	Percentage
Have enough already	26	10.04%
Don't think trees are important	0	0%
Don't have enough space for a tree	26	10.04%
Unsure how to care for	13	5.02%
Don't know how to plant a tree	11	4.25%
I do not own property	39	15.06%
Too expensive to buy and maintain	8	3.09%
I am not sure where to get a tree	11	4.25%
I can't transport a tree home in my vechile	17	6.56%
Other	8	3.09%

Answered: 94 Skipped: 165

Of the 165 respondents who answered, 124 said they would be interested in participating in a program that promotes tree planting on their property. Several methods of delivering the information were offered for respondents to indicate their preference(s) and online tutorial followed closely by workshops and in person events.



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Other response Empty categories Sort

Answers	Count	Percentage
Online tutorials	151	58.3%
Flyers	72	27.8%
In person event(s)	138	53.28%
Workshop(s)	143	55.21%
Facebook posts	104	40.15%
Twitter posts	29	11.2%
Instagram posts	60	23.17%
I do not want any tree information	24	9.27%
Other	10	3.86%

Answered: 259 Skipped: 0

Survey Comments:

- Encourage and incentivize residential planting of native trees.
- We walk in Hillandale several times a week and our absolute favorite thing about the park is the amount of forest that has the feeling of being untouched while simultaneously being perfectly maintained. It's just enough to make it perfect and an absolute joy to spend time in in the city. It is SUCH a treat. Thank you!! We live nearby and also enjoy the variety of birds and other wildlife we get to see because they have their homes in the forested area of Hillandale nearby. Please always keep this amazing resource.
- There are so many old strip malls in Harrisonburg and acres of unused or rarely used parking leftover from when those areas used to be busy. I would love to see the city incentivize developers to reclaim some of those parking areas and plant trees instead.
- All medians should have trees planted in them, especially on 33 east in the city.1. I would love for citizens to know what we can do to get more trees. If we see a place that is clearly public property (park, school), what is the process and what options do we have to initiate more trees there? 2. Trees make better neighborhoods. I would love to see a tree promotion campaign for residents to plant their own trees! It would be great to have additional info for common obstacles to tree planting for city homeowners and a basic DIY ($, labor, what type of tree, how close to my house, do I need to call miss utility, what about power lines, road visibility, can I plant another tree next to this tree, what if it is close to my neighbors' yard...).
- All the trees are great. We should plant maples in parks, not near power lines and along streets, as so many currently are. Certainly there are species better suited for downtown and neighborhoods.
- As you probably have researched, one thing the city did about 20 years ago was blacks run restoration. Necessary for the water, but also in line with trees. I think that's moving well, at least in areas it can. Looks like it was planted and left, which I'm sure it's part of the process. Maybe clean up she educate again those that don't know what's going on. I've heard from old timers there used to be trout in blacks run back in early 1970s. Keep up with trying to see that in the future again!!!
- No need to add trees around streets, especially downtown unless the opportunity strikes itself with a new building etc.
- Try and focus on old ones you have that can be gathering areas. Be nice to identify the oldest tree in one of the parks or jmu or city or all three. Utilize free young backs at JMU!! Go dukes
- Urban forestry is different, so you're not going to have great big oaks. In the downtown people don't know what can grow or where it can.
- Maybe a small hemp farm 👌
- Best of luck in planting as many trees as you can and in educating the next generation. Lots of space for trees on school grounds.
- Can we try to stop people from simply chopping the tops off (the "flat top" haircuts)?
- Clean up those trees in the Rocktown trails
- Could we start planting more female trees? I know they tend to have more things dropping from them but data is showing an increase in pollen allergies Nationwide and planting more female trees can help those who suffer from hay fever or worse reactions as a result of tree pollen.
- Discounted trees to residents
- Downtown is particularly bleak in terms of its lack of trees comparable to other cities. Also, it would be wonderful to plant areas of each of the public parks with specific natural and local varieties of trees that have a diversity of fall colors adjacent to each other to create nice color clusters that would bring a lot of fall beauty. I've noticed in the main city parks there are very few brightly colored trees in the fall and if they are they are sporadic and not near any other variety that has a different color.
- Edible landscaping!!
- Native walnuts hickories honey locust persimmons

- Find a way not to prune trees to look ridiculous around utility lines.
- Great job 👏
- Greater efforts could be placed on communicating the ecologic and economic value of urban trees. In conversation with local landholders, they regularly fail to understand the ecosystem services provided to them by maintaining and planting trees on their respective properties (e.g., heating/cooling costs, hydrology, property value). There is a wealth of literature, as well as expertise in this community, that could be used to do so. Further, more substantial efforts need to be made to communicate the city's efforts in this area to promote community awareness.
- Also, on a more personal note, I would encourage the city to plant trees near the Park View Water tower to offset the hydrologic changes made to this site over the past years - to which, some of the "downhill" residents are facing flooding issues in their homes since construction and an increased runoff into their properties.
- *Harrisonburg origin as agricultural land is part of the reason relax trees above ground powerlines that are cheap hinder tree growth and make the city more ugly than it needed to be. Below ground untilities are more resilient to thunderstorms and ice and allow for treeplanting
- Highly in favor of more trees and prioritizing tree care around our beautiful city! Thank you for working on this.
- I am one of several people from Trinity Presbyterian involved in projects to make our rather large property more ecologically friendly and welcoming to our neighbors. Recently we had a large diseased ash cut down and have already replaced it with eight new trees, local varieties of serviceberry as well as different oaks and a tulip poplar. We would be very happy to reflect the city's efforts in our own.
- I also live near Purcell and visit the park at least five times a week. I am very happy to see how the park is being endowed with new and more resilient tree species. Thank you for your work!
- I feel strongly that we need more trees - areas like Harrisonburg Crossing are miserable because the developers didn't include green space in their design. If you go to charlottesville they have ton of green space with trees and it makes for a much more enjoyable experience outdoors.
- I fully understand the difficulty the city has had with ash borer. I think they have done a great job managing a risk threat and the new plantings downtown and at Westover Park will pay dividends in the long term. It's a shame to have to remove trees that were perfectly healthy 5 years ago and to completely change certain landscapes but you all have handled it well. Thanks
- *I have always enjoyed the beauty of our trees and appreciate the opportunity to provide feedbackI have noticed that it looks like the ash trees in Hillandale Park have been hit by the emerald ash borer (the wood peckers have started stripping bark off). I know this is a big problem all over and there isn't much to do, I just thought I would mention it.
- I have several trees in my backyard and honestly feel very lucky to have the space we have with trees and the nature we have around us.
- I live in the Woodland neighborhood by the corner of Reservoir Street and Lucy Drive/Woodland Drive. The "stream" that we have there provides a great opportunity to foster more trees. Please come check it out. The neighborhood would help.
- I live near EMU, and walk regularly in the small forest on campus (between EMS and VMRC). I have been distressed to see so many trees cut down this past year, which I assume were diseased. Trees make an enormous difference in the natural beauty of our city, and are a valuable asset to be cultivated.
- I look forward to the day when Bradford pear trees are but a dismal memory.
- I love Hillandale Park because of all the beautiful trees and forested areas. I wish the rest of our town emulated that environment!!!
- I love the beautiful variety of trees in my Sunset Heights neighborhood. Would love for others in my community and city to experience the same. I'll always vote for beautifying the city via trees and parks and gardens... btw the ranking question above did not work for me it auto selected the order.

- I met Jeremy & Mike out checking on trees at the park one day the city is lucky to have such nice and professional employees they were very knowledgeable and very polite
- *I moved to area in 1996. I remember the prevailing City and Co govt attitude that trees get in the way of flood water; and thus should be removed. Despite the scientific communities input. And I remember the name Rodney Eagle and fiasco golfcourse.
- I really appreciate tree lined streets and I think that would be a really great improvement in our City.
- I see so many residents "topping" trees on their property at the wrong time of year. It ends seriously damaging the tree, or sometimes even killing it. I feel like we have a culture in Harrisonburg that just reflexively cuts down trees if they become a problem, people don't even try to nurse a tree back to good health. Many of my neighbors have recently cut down trees or large bushes on their property, and as far as I can tell not replaced them with anything. In the long run, this will drive up my energy bills because of the loss of shade in the summer. I really wish there was more effort to educate property owners about the benefits of having trees, and maybe even have some sort of incentive program to plant trees on private properties.
- I think it would be cool if there was an invasive switch-out program of sorts for property owners. We have two HUGE Bradford Pear trees in our yard that we'd love to switch out but don't even know where to start - what kind of tree should we plant that will provide the same sort of aesthetic benefit...in our lifetime, etc.
- *I think that the downtown needs far more trees than it has. Trees will make the downtown more pleasant for pedestrians, as there is little shade from the hot summer sun on many of the sidewalks. We are often walking at a slow pace with our young child, and one block of treeless sidewalk can seem very long in the hot sun!
- I would happily volunteer to help plant and maintain trees in the downtown. We live in Urban Exchange and would gladly see more trees every time we look out our window and every time we walk around.
- Please prioritize trees in the downtown!
- I want to see greater species variety and having trees with utility to humans and wildlife alike. Maybe urban food forestry? Also invasive species control would be good and less lawn. Just use more ground covers.
- *I would like to suggest re-establishing the Tree Stewards Program.
- I wish trees were a code requirement for certain neighborhood areas. I live in Sunset Heights and I imagine nearly every property could have at least one tree planted. The requirement could read you need to have X trees per area, and here's a list of trees that are best suited for Harrisonburg. As funds allow, you may purchase city-subsidized trees and receive assistance with delivery and planting from the city or volunteers, or if you'd like a different tree, you will meet the code requirement but not receive funding assistance.
- I wonder whether it may be time to replant Chestnut trees throughout our area. Now that the Chestnut has been adapted to withstand that particular blight, and potential exists for a market in chestnut products (wood, nuts, flour, bakery items), the return of chestnuts to this region of Virginia could spur new products and employment. I would like a lot of nice fruit trees in public spaces for people. I'm sure there's some terrible downside to that, but it's what I want. Also I would really appreciate tree care and maintenance resources, because I own a lot of trees and I'm not sure what I'm supposed to be doing with them.
- I would live to help plant trees! Especially along 42 or 33 or other state or city land that borders the highways. I used to live in Area 3 on the north end near Harmony Square for 10 years. We had only a few trees in the whole neighborhood. Most trees were ornamental, which is not the same as a group of standing native hardwood or conifers together. We had very few birds and no other wildlife even though we were at the edge if the city limits. It makes it difficult since all the land is private up there, there is no common green space. I wish there were more corridors of green space that were common areas

throughout the city. Please let me know how I can help plant more trees and help take care of the ones we have.

- *I would love more trees in Harrisonburg. Not only that, better maintained trees and info to property owners about the horrible practice of topping trees. I don't think I have ever seen more topped trees than I have here. I don't know why everyone seems to do that horrible injustice to their trees!
- *I would love to see home owners plant more trees and take care of the trees they already have. Too many trees are topped for no good reason, and many trees are simply cut down because they're "messy." Education matters.
- I would love to see less grass in the parks and more natural land below the trees - (similar to some areas of Hillandale Park or the JMU Aboretum).
- I'm glad Harrisonburg cares about this issue. I have planted trees at the arboretum and other volunteer projects.
- I'm guessing the abundance of trees in Westover Park contributes to this, but the ground there is simply a slog to walk through after rain/snow/etc. Is there anything that can be done to improve this as well as the walking trail on the south side which has always been in terrible condition? I DO appreciate all the amenities of this park but it sure would be nice to have a better walking surface for the disc golfers and dog walkers and casual walkers like myself.
- I'd like a more clearly defined process for citizens to give input or suggestions to the city for where to plant more trees.
- I'd like to know more on where trees can be planted and which trees thrive in this area, how long things take to grow, etc.
- I'd like to see more fruit trees.
- I'd love to have a bonsai scene in harrisonburg
- In my area of the City there are many older homes (circa 1950-1970). Many of these homes are losing their private tree canopies due to age. I see many yards where trees have been taken down-- likely due to age-- but none replanted. I think an it may be worthwhile to create an educational campaign in partnership with local tree removal companies to teach residents about why replanting trees after cutting one down is so important for our environment and watershed. Or maybe a cut down a tree, receive a discounted sapling program? Although I know you are focused on the public tree canopy, the reality is that there is only so much room on public land to plant trees and expanding our canopy needs to be a private and public effort.
- It makes me so sad to see people "top" trees in their own yards, and prune them so improperly. You can see this throughout the city and the county. Often this is done even when there are no power lines around. Please make an effort to educate people about what size trees to plant, and a list of arborists or tree trimmers/pruners who can appropriately prune a tree if it's size is too large for the space, and proper pruning techniques if people must prune themselves. Trees that have been pruned improperly are so unsightly and also put the tree's health at risk and make it more likely that limbs will fall in the future as they grow back fast and weak. We need much more education, public service announcements on TV, in newspapers about this the proper way to prune trees.
- It'd be great to have a number to call to get advice about trees. Arborist are expensive
- It's important that trees do not interfere with utility lines and cause power outages. Charlottesville has a utility friendly trees arboretum.
- I've heard about the repurposing of dead trees in Harrisonburg. I hope this continues to happen along with planting of native trees across the city.
- I've heard food forests are becoming a thing. Figuring out a way to incorporate that into the City's tree planting plan would be interesting.
- Like the shade they provide. Wish some of the residential streets were lined with trees so that one could walk in shade.

- make topping trees against the law
- Maybe consider revising the Tree Stewards program to have a trained group of volunteer tree ambassadors.
- Maybe some signage on park trees as to what kind they are and their role in the ecosystem. It would be great if a dead tree or two could be mindfully left in less used parts of parks with maybe signage as to the importance of dead trees in the ecosystem. Also the occasional brush pile:) We need an attitude shift on what we perceive as landscape beauty.
- Thanks for all you're doing to promote our trees and pollinators!
- More stump grinding is needed on the numerous trees recently cut down at Heritage Oaks golf course.
- My yard is crammed full of trees which i planted 30 years ago. Would like to see some way to stop companies from "topping" trees, which just ensures a slow death. And to encourage people who buy homes with trees to not cut them all down. It happens too often.
- Native trees are preferred !
- Not enough trees and greenspace in the more high use areas. some of the parks the trees need to be cut to encourage health and vigor for the rest of the trees. the blacks run area of town is full of invasives and not enough good buffer vegetation.
- Not living in Harrisonburg means it is hard to be involved in Tree Planting, but I do work with New Community Project and other groups to plant trees.
- As a professor at JMU I am working on a food forest project and we are planning to plant a number of trees soon. Student volunteers for tree planting are quite possible to arrange.
- Planting trees that also provide food, medicine, fertility, and ecological restoration!
- Please continue to add and replace (when necessary) street trees, also adding them in medians and other public spaces to help create shade, fresh air and add to the beauty of our City. Often, when trees are removed due to damage or age and they are not replaced, they are sorely missed. They add function and a welcome “feel” to the landscape. Thank you for all you’ve been doing. I’ve noticed a considerable uptick in the care of our City’s trees in the past few years and think it is wonderful!
- Please plant fruit trees, accessible to all!! Public edibles please! Would love to see a public food forest.
- Please plant ONLY native trees! And keep up the good work with replacing grass in medians with other perennial plantings. Not just pollinator plants but native HOST plants. Also, need more small "parks" or just mini green areas around all the new construction.
- Please replace trees in Westover. I know they were diseased, but I hope they will be replaced.
- So sad to lose the ash trees. I understand we've been doing what we can to salvage them, or at least use the lumber. Now would be a good time to find a hardy species to replace the ash.
- some of the trees that ARE here are really beautiful!! but i wish i didn’t feel like i have to go all the way to Shenandoah to get a dose of nature
- Thanks for all the great work you're doing! I suggest planting more native trees and fruit and nut trees that feed wildlife (and people).
- The city accepting input on types of plantings would be nice. Our street was an early traffic calming site. Our suggestions for tree types were ignored. Now the trees selected by the city grow into the street and suffer hack job pruning when they grow in their normal manner.
- The city needs to cut spending. I love trees but our business and property taxes have us looking to move away from the city.
- The city owned property on 33 West is a treasure with a lot of potential for increased use without negative impacts on the health of the forest.
- The fact that I've never noticed any trees being a problem in my 8+ years of living here means y'all must be doing something right!
- The Jan 2020 EAP included an action item for a Greenhouse Gas Inventory. Presumably that inventory has been, or will soon be, completed. Whatever the sources of our current GHG production, trees can

help offset it. They can help clean up our air and our water. We need as many as we can possibly get! Keep up the work you're already doing and thanks for thinking, and asking others, what else can be done.

- I don't live in the city but I do own property (in Rham Co). If you provide info about the types of trees to plant in our area, I'll will use it. In the 26+ years I've owned my property, I have planted ~35-45 trees. But there's always room for more.
- The lights downtown during the winter on trees is delightful. The more trees in and around downtown the better.
- There needs to be more of them.
- The maple trees in private and public places seem to be suffering from disease but I have not heard any info about this. It has been noticeable to me over the past five years or so. The tree looks a little wilted one year then has dark black or patchy spots on its branches the next year. Fewer leaves the third year and then it seems to die in subsequent years. We hear a lot about the emerald ash bore beetle but I have heard nothing about maple tree diseases.
- The new trees in Westover Park were improperly mulched, with mulch piled high touching the trunk -- typical "mulch volcano". Workers should have been given basic instructions, you can't assume people know anything about planting stuff anymore, not even the basics. If this was a contract, it should have been spelled out in the contract.
- There are many poorly planted and/or maintained trees throughout the city. I would like to see efforts to encourage planting native trees, and information to help reduce the "butchering" that I see (especially tree-topping.) Also would like there to be more effort to connect homeowner's landscape choices to tax breaks or reduction of the stormwater fee. Basing that fee just on square feet of impervious surface doesn't address how the entire lot functions to reduce runoff. It especially bothers me to see developers clearcutting their land before building new structures. In most cases, this is not necessary We could have better guidance or even rules that would help to preserve existing trees.
- Note: your survey needs to have a "retired" or "not working" option for the question about where do you work!!!
- *There should be more attention and effort paid by the city to it's tree pruning and maintenance in regard to the natural beauty and appeal of what is being pruned or maintained (i.e.- trees being pruned due to telephone and electric lines should not end up looking like a wedge was cut out using a pie cutter, etc...).
- They need to be planted back away from street corners and pruned up so that large commercial vehicles (semi trucks) can see around them safely.
- This is such a beautiful effort, thank you all for this work! It would be amazing to see this overlap with food sovereignty efforts by encouraging both public and private spaces to grow trees that produce good food for people and other creatures! Indigenous people have taught us so much about tree care paired with provision of food, and would love to see Harrisonburg embodying these complementary practices!
- This seems like a great initiative!
- Trees are so good for the health of our region and the earth. We need more shade and more benefits from the trees. Parking lots need to be built with trees in mind. This can help with some flooding threats especially as we have more development in the area. Honestly, the more trees the better. Look at how many we've had to cut down as the city grows!
- Try to preserve them as best as possible and plant more. Urbanization is spreading, work to preserve as much of the natural world as possible please.
- *We have seen many trees cut down at city parks (Purcell, Westover) and none planted to replace them. It is very hot to play with no shade! Please plant more trees, a nice blend of softwoods that will grow fast and create shade cover and some hardwoods to provide longer-lasting shade and homes for critters.

- We have seen so many big trees cut down the past two years - some by public works / utility along the road, some at the parks & others by homeowners. I wish we could work with / prune older trees, rather than have them cut down. Several large trees were cut down on 2nd street between Chicago & Virginia, as well as in Morrison Park at the corner of Chicago & 2nd.
- I also wish homeowners understood the ecological harm they are doing by topping & cutting down trees. I understand disease is an issue, but some of the trees taken down are healthy. I know the city has efforts to plant native plants and I hope that is the case with trees. They are such an essential cornerstone species for birds, insects and the health of us & the ecosystem. Plant more!
- We live right on the outskirts of Harrisonburg, technically in the county but more so tied to Harrisonburg (Belmont Estates). Ever since we moved into the region we have been struck by the lack of trees in town. More lots are cleared for additional housing, stores, and so on while other areas remain abandoned. For instance, when Aldi came to town a whole corner near the mall was cleared, and now it just sits there - apart from a small corner used by Aldi. To me, it is unfathomable that the town does not mandate and regulate the planting of trees. Businesses need to be told to plant more trees - otherwise, the town soon looks like the parking lot of Lowes, Home Depot/ Walmart, the mall, or even downtown, where large structures or the space for the farmers market are just clear of any foliage. This is not just an aesthetic and environmental piece, it also makes sense for stormwater run-off and recreation. I hope this will be addressed.
- We need a lot more trees in all areas of the city.
- *We need many more street trees -- they help the aesthetics, environmental health, and human health of our city. Harrisonburg seems "under-treed" compared to other places.
- We need more beauty throughout the town. Encourage property owners to plant thees near their shops. Flowers are nice, too.
- We should have community food forests.
- We want more healthy trees in Harrisonburg!
- We would love more trees on the Franklin Street verge (I think it was historically ELM) and will get volunteers together if we can get a cost share program for the trees!
- Westover park and part of Hillandale near the entrance have terrible erosion problems. Westover becomes a swamp after rains. The cedars (I believe?) are nice, but not sufficient, and some sort of swale to channel the rain through shrubbery and trees would be a good solution, as well as more hardwoods. Hillandale could use a rain garden where the rain is channeled down the big down into the pit.
- We've seen a lot in the news about poor and minority areas of cities having less tree canopy (example, Richmond, VA. Heat related deaths and cooling bills are higher, there, among other concerns, compared to more affluent neighborhoods. Harrisonburg has somehow developed areas where there are highter concentrations of minority and poorer citizens living. QUESTION: is there a tree canopy disparity in those neighborhoods? If so, we should concentrate tree planting education, funding and other re-forestation assistance there.
- When considering the planting of additional trees, an urban streetscape plan and overall tree planting strategy should demonstrate intentionality and communicate (through plant selection) a thoughtfulness about time/place/intent.
- When I first moved here about 12 years ago, I was astounded at the amount of pavement and lack of tree canopy downtown. I still am. Whatever the city could do to incentivize businesses to set aside space to restore a downtown canopy would be a good idea in my opinion (maybe grants? subsidies?). And whatever the city could do to *dis*-incentivize cutting down mature trees (that are not sick or dangerous) would be helpful too.
- Trees improve quality of life in so many ways, from aesthetic to environmental; we need to change the downtown business culture that led us to the asphalt nightmare some areas have become.

- When the the Chestnut blight hit the US, we mistakenly harvested most of the chestnut as they were viewed as a lost cause. The action meant that any tree that could have survived the infection, wasn't given the chance to evolve the species. Please don't make the same mistake with the Ash.
- Would it be a crazy idea to plant fruit trees and other edible landscaping in our parks?
- Would like to see more collaboration with HEC and other utilities to preserve sides of streets that have no utility poles, so we can get tree canopies over the streets to cool the city in the summer. Disappointed to see large trees removed last year on the corner of Chicago and 2nd.
- Also, certain areas should be designated to allow dead trees to stand in the city to provide habitat for birds.

Appendix D – APWA Guidance Statement

American Public Works Association
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Washington DC 20005
202-408-9541/Fax202-408-9542

Guidance Position Statement

QUALITY MANAGEMENT OF THE URBAN FOREST

Statement of Purpose
The American Public Works Association (APWA), recognizing that the urban forest constitutes a vital public works infrastructure element, recommends that state, provincial, and local governments initiate programs that will enhance the quality of publicly maintained trees and related vegetation by adopting approved urban forest management standards.

Statement of Position
The APWA encourages public works agencies to maximize the environmental and quality of life benefits that the urban forest provides by:

- Utilizing the most current standards for planting, pruning, managing and preserving the urban forest.
- Incorporating tree canopy goals into community design standards.
- Identifying and meeting optimum mixed age and species distribution goals.
- Establishing reforestation practices that strategically address tree removals prior to the trees' decline.
- Coordinating the management of the urban forest with other agencies to minimize infrastructure conflicts.
- Preserving the integrity of remnant native forests.
- Recycling all green waste generated by urban forest management efforts.
- Maintaining active inventories of all urban forest assets.
- Obtaining political and stakeholder support that will ensure adequate funding for the long term care of the urban forest.

Background and Rationale
The urban forest is a significant and highly visual infrastructure system which provides a multitude of benefits to residents of urban, suburban and rural communities. Properly planned and managed, urban and community forests enrich our quality of life and environment by improving air and water quality, increasing property values, promoting

psychological and physical well-being, creating aesthetically pleasing neighborhoods, restoring wildlife habitat and building communities where people want to live.

The quality of life improvements and environmental benefits that urban and community forests provide to municipalities are fully realized when planning, design and management of the green infrastructure are integrated into the overall urban design and infrastructure management goals and strategies. Public and private agencies that impact the urban and community forest will maximize the benefits that trees bring to communities by adopting common goals and objectives.

Sponsor
Facilities and Grounds Committee

Appendix E – Climate Atlas Results Report

Virginia

States

Climate Change Atlas Tree Species

Current and Potential Future Habitat, Capability, and Migration

Landscape Change Research Group
Iverson, Peters, Prasad, Matthews
USFS Northern Research Station
Delaware, OH

Common Name	Scientific Name	Range	MR	%Cell	FIAsum	FIAiv	ChngCl45	ChngCl85	Adap	Abund	Capabil45	Capabil85	SHIFT45	SHIFT85	SSO	N
loblolly pine	Pinus taeda	WDH	High	42.6	1351.28	28.93	Sm. inc.	Sm. inc.	Medium	Abundant	Very Good	Very Good			1	1
yellow-poplar	Liriodendron tulipifera	WDH	High	79.1	1038.06	11.59	Lg. dec.	Lg. dec.	High	Abundant	Good	Good			1	2
red maple	Acer rubrum	WDH	High	88.4	875.91	8.56	No change	Sm. dec.	High	Abundant	Very Good	Good			1	3
chestnut oak	Quercus prinus	NDH	High	46.2	728.62	13.77	Sm. dec.	Sm. dec.	High	Abundant	Good	Good			1	4
white oak	Quercus alba	WDH	Medium	74.1	643.17	7.84	No change	No change	High	Abundant	Very Good	Very Good			1	5
Virginia pine	Pinus virginiana	NDH	High	51.8	500.56	8.91	Sm. dec.	Lg. dec.	Medium	Abundant	Fair	Fair			0	6
sweetgum	Liquidambar styraciflua	WDH	High	38.8	393.76	9.22	Lg. inc.	Lg. inc.	Medium	Common	Very Good	Very Good			1	7
northern red oak	Quercus rubra	WDH	Medium	56	296.44	4.51	Sm. inc.	Sm. inc.	High	Common	Very Good	Very Good			1	8
scarlet oak	Quercus coccinea	WDL	Medium	49.9	257.8	4.53	Sm. dec.	Sm. dec.	Medium	Common	Poor	Poor			0	9
eastern white pine	Pinus strobus	WDH	High	22.6	238.59	9.24	Sm. dec.	Sm. dec.	Low	Common	Poor	Poor	Infill +	Infill +	0	10
blackgum	Nyssa sylvatica	WDL	Medium	71	228.87	2.88	Sm. inc.	Sm. inc.	High	Common	Very Good	Very Good			1	11
black oak	Quercus velutina	WDH	High	56.5	228.49	3.68	Sm. inc.	Sm. inc.	Medium	Common	Good	Good			1	12
black locust	Robinia pseudoacacia	NDH	Low	39.9	227.44	4.81	Sm. dec.	Sm. dec.	Medium	Common	Poor	Poor			0	13
mockernut hickory	Carya alba	WDL	Medium	54.5	198.36	3.22	Sm. inc.	Sm. inc.	High	Common	Very Good	Very Good			1	14
eastern redcedar	Juniperus virginiana	WDH	Medium	37.5	196.68	4.88	Lg. inc.	Lg. inc.	Medium	Common	Very Good	Very Good			1	15
pignut hickory	Carya glabra	WDL	Medium	55.7	186.03	2.88	No change	No change	Medium	Common	Fair	Fair			1	16
American beech	Fagus grandifolia	WDH	High	36.8	178.64	3.88	No change	No change	Medium	Common	Fair	Fair			1	17
black cherry	Prunus serotina	WDL	Medium	47.9	168.8	3.19	Sm. inc.	Sm. inc.	Low	Common	Fair	Fair			1	18
sourwood	Oxydendrum arboreum	NDL	High	36.9	141.76	3.32	No change	Sm. dec.	High	Common	Good	Fair			1	19
southern red oak	Quercus falcata	WDL	Medium	33.5	132.46	3.63	Lg. inc.	Lg. inc.	High	Common	Very Good	Very Good			1	20
sugar maple	Acer saccharum	WDH	High	17.7	120.39	4.82	Sm. inc.	No change	High	Common	Very Good	Good	Infill ++	Infill ++	1	21
white ash	Fraxinus americana	WDL	Medium	32.2	114.71	3.27	Sm. inc.	Sm. inc.	Low	Common	Fair	Fair			1	22
sweet birch	Betula lenta	NDH	High	22.6	103.49	3.79	Sm. dec.	Sm. dec.	Low	Common	Poor	Poor	Infill +	Infill +	0	23
American holly	Ilex opaca	NSL	Medium	24.6	99.48	3.39	Sm. dec.	No change	Medium	Common	Poor	Fair	Infill +	Infill +	1	24
sassafras	Sassafras albidum	WSL	Low	27.6	79.16	2.36	No change	No change	Medium	Common	Fair	Fair			1	25
green ash	Fraxinus pennsylvanica	WSH	Low	20.8	70.54	3.33	Lg. inc.	Lg. inc.	Medium	Common	Very Good	Very Good			1	26
black walnut	Juglans nigra	WDH	Low	18.7	69.98	3.39	No change	Sm. inc.	Medium	Common	Fair	Good			1	27
ailanthus	Ailanthus altissima	NSL	FIA	15.6	67.6	4.11	Unknown	Unknown	NA	Common	NNIS	NNIS			0	28
shortleaf pine	Pinus echinata	WDH	High	16.3	66.84	3.81	Lg. inc.	Lg. inc.	Medium	Common	Very Good	Very Good	Infill ++	Infill ++	1	29
sycamore	Platanus occidentalis	NSL	Low	15.4	64.13	3.5	Sm. inc.	Lg. inc.	Medium	Common	Good	Very Good			1	30
eastern hemlock	Tsuga canadensis	NSH	High	12	61.84	3.74	Sm. inc.	Sm. inc.	Low	Common	Fair	Fair	Infill +	Infill +	1	31
American hornbeam; muscle	Carpinus caroliniana	WSL	Low	27.3	60.95	2.13	Sm. inc.	Lg. inc.	Medium	Common	Good	Very Good			1	32
flowering dogwood	Cornus florida	WDL	Medium	42	60.33	1.26	Sm. inc.	Sm. inc.	Medium	Common	Good	Good			1	33
pitch pine	Pinus rigida	NSH	High	15.9	59.95	3.65	No change	No change	Medium	Common	Fair	Fair			1	34
American elm	Ulmus americana	WDH	Medium	21.3	45.64	1.93	Sm. inc.	Lg. inc.	Medium	Rare	Fair	Good			1	35
willow oak	Quercus phellos	NSL	Low	14.8	44.71	2.68	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	1	36
swamp tupelo	Nyssa biflora	NDH	Medium	6.6	42.7	4.91	No change	No change	Low	Rare	Very Poor	Very Poor			2	37
American basswood	Tilia americana	WSL	Medium	10	42.59	3	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	1	38
shagbark hickory	Carya ovata	WSL	Medium	13.7	37.21	2.11	Sm. inc.	Sm. inc.	Medium	Rare	Fair	Fair	Infill +	Infill +	1	39
river birch	Betula nigra	NSL	Low	9.7	35.57	3.37	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	1	40
eastern redbud	Cercis canadensis	NSL	Low	18.2	35.37	1.79	No change	Sm. inc.	Medium	Rare	Poor	Fair			0	41
post oak	Quercus stellata	WDH	High	15.3	30.76	1.84	Lg. inc.	Lg. inc.	High	Rare	Good	Good	Infill ++	Infill ++	1	42
bitternut hickory	Carya cordiformis	WSL	Low	12.6	30.45	2.39	Sm. inc.	Lg. inc.	High	Rare	Good	Good	Infill ++	Infill ++	1	43
Table Mountain pine	Pinus pungens	NSL	Low	6.4	29.97	4.29	Sm. dec.	Sm. dec.	High	Rare	Poor	Poor	Infill +	Infill +	1	44
cucumbertree	Magnolia acuminata	NSL	Low	12.1	29.48	1.92	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	45
winged elm	Ulmus alata	WDL	Medium	11	23.22	1.91	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	1	46
boxelder	Acer negundo	WSH	Low	5.3	23.2	3.85	Sm. dec.	No change	High	Rare	Poor	Fair	Infill +	Infill +	1	47
slippery elm	Ulmus rubra	WSL	Low	9.9	22.94	1.96	No change	No change	Medium	Rare	Poor	Poor			1	48
common persimmon	Diospyros virginiana	NSL	Low	9.7	21.19	1.97	No change	Sm. inc.	High	Rare	Fair	Good			1	49
water oak	Quercus nigra	WDH	High	8.1	21.16	2.32	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good	Infill ++	Infill ++	2	50
yellow buckeye	Aesculus flava	NSL	Low	4.4	21.13	3.35	Sm. dec.	Sm. dec.	Low	Rare	Very Poor	Very Poor			2	51
serviceberry	Amelanchier spp.	NSL	Low	14.9	18.68	0.94	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	52
hackberry	Celtis occidentalis	WDH	Medium	7.2	17.74	2.32	No change	No change	High	Rare	Fair	Fair	Infill +	Infill +	1	53

www.fs.fed.us/nrs/atlas

Feb 2020

Virginia

States

Climate Change Atlas Tree Species

Current and Potential Future Habitat, Capability, and Migration

Landscape Change Research Group
Iverson, Peters, Prasad, Matthews
USFS Northern Research Station
Delaware, OH

Common Name	Scientific Name	Range	MR	%Cell	FIAsum	FIAiv	ChngCl45	ChngCl85	Adap	Abund	Capabil45	Capabil85	SHIFT45	SHIFT85	SSO	N
mountain or Fraser magnolia	Magnolia fraseri	NSL	Low	4.1	15.11	2.64	No change	No change	NA	Rare	Unknown	Unknown			0	54
pin oak	Quercus palustris	NSH	Low	2.9	14.85	5.33	Sm. dec.	Sm. dec.	Low	Rare	Very Poor	Very Poor			2	55
swamp chestnut oak	Quercus michauxii	NSL	Low	3.4	14.57	3.4	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	2	56
yellow birch	Betula alleghaniensis	NDL	High	3.3	11.93	2.79	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			2	57
eastern hophornbeam; ironw	Ostrya virginiana	WSL	Low	7.4	11.64	1.32	Sm. inc.	Sm. inc.	High	Rare	Good	Good	Infill ++	Infill ++	1	58
chinkapin oak	Quercus muehlenbergii	NSL	Medium	2.5	9.45	3.62	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	2	59
paulownia	Paulownia tomentosa	NSL	FIA	3.3	9.27	2.22	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	60
pin cherry	Prunus pensylvanica	NSL	Low	2.7	7.66	2.54	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	61
bald cypress	Taxodium distichum	NSH	Medium	1.4	7.49	4.55	Sm. inc.	Lg. inc.	Medium	Rare	Fair	Good	Infill +		2	62
water tupelo	Nyssa aquatica	NSH	Medium	0.8	7.41	9.59	No change	No change	Low	Rare	Very Poor	Very Poor			2	63
red spruce	Picea rubens	NDH	High	0.5	7.29	9.1	Sm. dec.	Sm. dec.	Low	Rare	Very Poor	Very Poor			0	64
bigtooth aspen	Populus grandidentata	NSL	Medium	3	7.21	2.41	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	65
cherrybark oak; swamp red o	Quercus pagoda	NSL	Medium	2.6	7.13	2.29	Sm. inc.	Lg. inc.	Medium	Rare	Fair	Good	Infill +		2	66
black willow	Salix nigra	NSH	Low	1.6	6.48	3.62	No change	Lg. inc.	Low	Rare	Very Poor	Fair		Infill +	2	67
pawpaw	Asimina triloba	NSL	Low	4	6.28	1.21	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	68
sweetbay	Magnolia virginiana	NSL	Medium	3.9	5.14	1.22	Sm. inc.	Lg. inc.	Medium	Rare	Fair	Good	Infill +	Infill ++	2	69
American chestnut	Castanea dentata	NSLX	FIA	5.2	4.93	0.87	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	70
red mulberry	Morus rubra	NSL	Low	3	4.52	1.85	No change	No change	Medium	Rare	Poor	Poor	Infill +	Infill +	2	71
pond pine	Pinus serotina	NSH	Medium	0.6	4.39	4.49	No change	No change	Low	Rare	Very Poor	Very Poor			2	72
redbay	Persea borbonia	NSL	Low	1.3	4.01	2.3	No change	Sm. inc.	High	Rare	Fair	Good	Infill +		2	73
Atlantic white-cedar	Chamaecyparis thyoides	NSH	Low	0.3	3.58	7.5	Sm. dec.	Sm. dec.	Low	Rare	Very Poor	Very Poor			0	74
florida maple	Acer barbatum	NSL	Low	2.3	3.07	1.29	Lg. inc.	Lg. inc.	High	Rare	Good	Good			2	75
silver maple	Acer saccharinum	NSH	Low	0.1	2.77	6.27	Sm. dec.	No change	High	Rare	Poor	Fair		Infill +	2	76
butternut	Juglans cinerea	NSLX	FIA	1.6	2.62	1.83	Unknown	Unknown	Low	Rare	FIA Only	FIA Only			0	77
Osage-orange	Maclura pomifera	NDH	Medium	0.5	2.3	4.76	Sm. dec.	No change	High	Rare	Poor	Fair	Infill +	Infill +	2	78
bear oak; scrub oak	Quercus ilicifolia	NSLX	FIA	0.9	2.1	1.6	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	79
chokecherry	Prunus virginiana	NSLX	FIA	0.2	1.43	7.4	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	80
honeylocust	Gleditsia triacanthos	NSH	Low	1.2	1.42	1.11	Sm. dec.	Lg. inc.	High	Rare	Poor	Good			2	81
laurel oak	Quercus laurifolia	NDH	Medium	0.9	1.39	1.26	Lg. inc.	Lg. inc.	Medium	Rare	Good	Good			2	82
blackjack oak	Quercus marilandica	NSL	Medium	1.1	1.09	1.03	Lg. inc.	Lg. inc.	High	Rare	Good	Good			2	83
white mulberry	Morus alba	NSL	FIA	0.7	1.07	1.58	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	84
pecan	Carya illinoinensis	NSH	Low	0.5	1.05	3.96	Sm. inc.	Lg. inc.	Low	Rare	Poor	Fair		Infill +	2	85
overcup oak	Quercus lyrata	NSL	Medium	0.5	0.94	1.95	Lg. inc.	Lg. inc.	Low	Rare	Fair	Fair	Infill +	Infill +	2	86
shingle oak	Quercus imbricaria	NDH	Medium	0.6	0.86	1.49	Sm. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	87
bigleaf magnolia	Magnolia macrophylla	NSL	Low	0.6	0.82	0.65	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	88
black maple	Acer nigrum	NSH	Low	0	0.74	2.07	Sm. dec.	Sm. dec.	High	Rare	Poor	Poor			0	89
eastern cottonwood	Populus deltoides	NSH	Low	0.2	0.72	3.61	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	90
Siberian elm	Ulmus pumila	NDH	FIA	0.1	0.66	6.8	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	91
blue ash	Fraxinus quadrangulata	NSL	Low	0.2	0.59	1.41	Sm. dec.	Sm. dec.	Low	Rare	Very Poor	Very Poor			0	92
northern catalpa	Catalpa speciosa	NSHX	FIA	0.2	0.55	2.87	Unknown	Unknown	Medium	Rare	FIA Only	FIA Only			0	93
pumpkin ash	Fraxinus profunda	NSH	FIA	0.1	0.51	4.54	Unknown	Unknown	NA	Rare	FIA Only	FIA Only			0	94
Shumard oak	Quercus shumardii	NSL	Low	0.2	0.28	0.45	Sm. inc.	Lg. inc.	High	Rare	Good	Good			2	95
rock elm	Ulmus thomasii	NSLX	FIA	0.2	0.26	1.33	Unknown	Unknown	Low	Rare	FIA Only	FIA Only			0	96
Scotch pine	Pinus sylvestris	NSH	FIA	0	0.21	0.94	Unknown	Unknown	NA	Rare	NNIS	NNIS			0	97
southern magnolia	Magnolia grandiflora	NSL	Low	0.5	0.21	0.41	No change	Lg. inc.	Medium	Rare	Poor	Good			2	98
shellbark hickory	Carya laciniosa	NSL	Low	0.2	0.16	0.82	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	99
Carolina ash	Fraxinus caroliniana	NSL	FIA	0.1	0.16	1.2	Unknown	Unknown	NA	Rare	FIA Only	FIA Only			0	100
striped maple	Acer pensylvanicum	NSL	Medium	7.1	0.11	4.38	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	101
sand hickory	Carya pallida	NSL	FIA	0	0.11	0.22	Unknown	Unknown	NA	Rare	FIA Only	FIA Only			0	102
bur oak	Quercus macrocarpa	NDH	Medium	0.2	0.11	0.56	Lg. dec.	Lg. dec.	High	Rare	Poor	Poor			0	103
northern white-cedar	Thuja occidentalis	WSH	High	0.1	0.07	0.7	No change	No change	Medium	Rare	Poor	Poor			0	104
swamp white oak	Quercus bicolor	NSL	Low	0.1	0.07	0.75	Lg. dec.	Lg. dec.	Medium	Rare	Very Poor	Very Poor			0	105
turkey oak	Quercus laevis	NSH	Medium	0.1	0.06	0.78	No change	No change	High	Rare	Fair	Fair			0	106

Virginia

States

Climate Change Atlas Tree Species

Current and Potential Future Habitat, Capability, and Migration

Landscape Change Research Group
Iverson, Peters, Prasad, Matthews
USFS Northern Research Station
Delaware, OH

Common Name	Scientific Name	Range	MR	%Cell	FIAsum	FIAiv	ChngCl45	ChngCl85	Adap	Abund	Capabil45	Capabil85	SHIFT45	SHIFT85	SSO	N
gray birch	Betula populifolia	NSL	Low	0.1	0.05	0.54	Sm. dec.	Sm. dec.	Medium	Rare	Very Poor	Very Poor			0	107
American mountain-ash	Sorbus americana	NSL	Low	0.1	0.05	0.5	Lg. dec.	Lg. dec.	Low	Rare	Very Poor	Very Poor			0	108
mountain maple	Acer spicatum	NSL	Low	0.1	0.03	0.3	No change	No change	High	Rare	Fair	Fair			0	109
black ash	Fraxinus nigra	WSH	Medium	0.1	0.03	0.27	No change	Lg. inc.	Low	Rare	Very Poor	Fair			0	110
sand pine	Pinus clausa	NDH	High	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat			3	111
slash pine	Pinus elliottii	NDH	High	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate ++	Migrate ++	3	112
longleaf pine	Pinus palustris	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate ++	Migrate ++	3	113
pond cypress	Taxodium ascendens	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Likely +	Likely +	3	114
Ohio buckeye	Aesculus glabra	NSL	Low	0	0	0	Unknown	Unknown	Medium	Absent	Unknown	Unknown			0	115
cittamwood/gum bumelia	Sideroxylon lanuginosum ssp	NSL	Low	0	0	0	New Habitat	New Habitat	High	Absent	New Habitat	New Habitat			3	116
water hickory	Carya aquatica	NSL	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat		Migrate +	3	117
black hickory	Carya texana	NDL	High	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	118
sugarberry	Celtis laevigata	NDH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Likely +	Likely +	3	119
loblolly-bay	Gordonia lasianthus	NSH	Medium	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Migrate +	Migrate +	3	120
silverbell	Halesia spp.	NSL	Low	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat	Likely +	Likely +	3	121
water elm	Planera aquatica	NSL	Low	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	122
quaking aspen	Populus tremuloides	WDH	High	0	0	0	Unknown	Unknown	Medium	Absent	Unknown	Unknown			0	123
live oak	Quercus virginiana	NDH	High	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat			3	124
bluejack oak	Quercus incana	NSL	Low	0	0	0	New Habitat	New Habitat	Medium	Absent	New Habitat	New Habitat		Migrate +	3	125
cedar elm	Ulmus crassifolia	NDH	Medium	0	0	0	New Habitat	New Habitat	Low	Absent	New Habitat	New Habitat			0	126

Appendix F – Urban Forest Sustainability Matrix

Indicators of a Sustainable Community Forest		Ideal Condition/Goal	Assessed Conditions or Performance		
			Low	Moderate	Good
The Trees	Urban Tree Canopy Level (All Trees)	Achieve the desired tree canopy cover according to goals set for the entire city and neighborhoods.		■	
	Canopy Location/Distribution (All Trees)	Ensure that the benefits of tree canopy are available to all, especially for those most affected by these benefits.		■	
	Condition (Public Trees)	Possess a detailed understanding of tree condition for all publicly-owned trees.			■
	Size/Age Distribution (Public Trees)	Establish a diverse-aged population of public trees across the entire city and for each neighborhood. Ideal standard:40% young trees, 50% maturing trees, and 10% mature trees/			■
	Species Diversity (Public Trees)	Establish a genetically diverse population of publicly-owned trees across the entire city and for each neighborhood. Tree populations should be comprised of no more than 30% of any family, 20% of any genus, or 10% of any species			■
	Species Suitability (Public Trees)	Establish a tree population suited to the urban environment and adapted to the overall region. Suitable species are gaged by exposure to imminent threats, considering the "Right Tree for the Right Place" concept and invasive species.			■
The Players	Public Awareness	The general public understands the benefits of trees and advocates for the role and importance of the urban forest.		■	
	City Department/Agency Cooperation	All city departments and agencies cooperate to advance citywide urban forestry goals and objectives			■
	Large Private Landholder Involvement	Large, private, and institutional landholders embrace citywide goals and objectives through targeted resource management plans.	■		

	Utility Engagement	All utilities are aware of and vested in the urban forest and cooperates to advance citywide urban forest goals and objectives			
	Green Industry Involvement	The green industry works together to advance citywide urban forest goals and objectives. The city and its partners capitalize on local green industry expertise and innovation.			
	Regional Collaboration	Neighboring communities and regional groups are actively cooperating and interacting to advance the region's stake in the city's urban forest.			
The Management Approach	**Tree Inventory Data**	Comprehensive, GIS-based, current inventory of all intensively-managed public trees to guide management, with mechanisms in place to keep data current and available for use			
	Overall Canopy Data	Accurate, high-resolution, and recent assessment of existing and potential city-wide tree canopy cover that is regularly updated and available for use across various departments, agencies, and/or disciplines.			
	Existing Urban Forest Plans	Existence and buy-in for a variety of urban forest management plans to achieve city-wide goals. Re-evaluation is conducted every 5 to 10 years.			
	Risk Management Program	All publicly-owned trees are managed for maximum public safety by way of maintaining a city-wide inventory, conducting proactive annual inspections, and eliminating hazards within a set timeframe based on risk level. A Risk Management Plan exists.			
	Public Tree Maintenance Program	All publicly-owned trees are well maintained for optimal health and condition in order to extend longevity and maximize benefits. A reasonable cyclical pruning program is in place,			
	Public Tree Planting Program	Comprehensive and effective tree planting and establishment program is driven by canopy cover goals, equity considerations, and other priorities according to the plan.			
	Tree Protection Policy	Comprehensive and regularly updated tree protection ordinance with enforcement			

		ability is based on community goals. The benefits derived from trees on public and private property are ensured by the enforcement of existing policies.			
	City Staffing & Equipment	Adequate staff and access to the equipment and vehicles to implement the management plan. A high-level urban forester or planning professional, strong operations staff, and certified arborist technicians are on staff.			
	Funding	Appropriate funding in place to fully implement both proactive and reactive needs based on a comprehensive urban forest management plan.			
Totals			7	8	6