

CHARLOTTESVILLE URBAN FOREST ASSESSMENT REPORT

JUNE 2026



Prepared For
CITY OF CHARLOTTESVILLE

Prepared By
EOCENE ENVIRONMENTAL GROUP

Table of Contents

EXECUTIVE SUMMARY	i
TREE CANOPY ANALYSIS	1
SUMMARY	1
METHODS	2
Assessment Levels	3
Quality Control	3
Limitations	3
Ecosystem Benefits	4
Potential Planting Area	4
Urban Heat	4
FINDINGS	5
Current Citywide Land Cover	5
Citywide Tree Canopy & Land Cover Change	6
Tree Canopy Cover & Change by Planning Neighborhood	8
Tree Canopy Cover & Change by Land Ownership	10
Tree Canopy Cover & Change by Parcel	11
Potential Planting Area	12
Urban Heat	13
ECOSYSTEM BENEFITS	14
COMPARISON OF CURRENT & PREVIOUS STUDIES	15
CONCLUSIONS	17
STREET TREE STUDY	19
SUMMARY	20
METHODS	21
FINDINGS	21
Stocking	22
Species Composition & Diversity	22
Invasive Tree Species	23
Tree Size & Age	23
Tree Condition	24
Maintenance	24
Maintenance Priority	25
Small Tree Species vs. Large Tree Species	25
Planting Sites	26
ECOSYSTEM BENEFITS	27
CONCLUSIONS	27
VEGETATION ASSESSMENT	29
SUMMARY	30
METHODS	31

FINDINGS	32
Tree Species Composition	33
Tree Age & Size	33
Tree Condition	34
Invasive Plants	34
Ground Conditions	35
Forest Regeneration	36
Tree Planting Space	36
CONCLUSIONS	37
REFERENCES	38

Appendices

APPENDIX A – DATA COLLECTION ATTRIBUTES	40
APPENDIX B – USER & PRODUCER ACCURACY ASSESSMENT	41
APPENDIX C – POTENTIAL PLANTING AREA GUIDELINES	43
APPENDIX D – LAND COVER CLASSIFICATIONS	44

Acknowledgements

EOCENE ENVIRONMENTAL GROUP

RICHARD HAUER, PH.D. | SUBJECT MATTER EXPERT
LIZ LINGO | PROJECT MANAGER
SARAH LILLEY | CONSULTING URBAN FORESTER
PAOLA NANSEL | ASSISTANT CONSULTANT
MATT JOHNS | CANOPY ANALYST
LUKE WOHLTMANN | LEAD INVENTORY ARBORIST
ILIA DONNER | INVENTORY ARBORIST



CITY OF CHARLOTTESVILLE PROJECT CORE TEAM

STEVEN GAINES | URBAN FORESTER
KRISTEL RIDDERVOLD | DIRECTOR, OFFICE OF SUSTAINABILITY
ROB MATHES | LANDSCAPE MANAGER
DAN FRISBEE | WATER RESOURCES SPECIALIST
TORI KANELLOPOULOS | LONG RANGE PLANNER



Partial funding was provided by the USDA Forest Service through the Inflation Reduction Act. The contents do not necessarily reflect the views or policies of the USDA Forest Service.

All photographs courtesy of the City of Charlottesville and Eocene Environmental Group.

Inventory data collected by Eocene Environmental Group is based on visual observations recorded at the time of inspection. Observations were made from the ground, without specialized equipment, and during standard weather. Eocene is not responsible for conditions that were not visually observable at the time of inspection. Inventory data may not remain accurate after inspection due to tree growth, decline, and damage caused by environmental and anthropogenic factors. The provided maintenance recommendations are the client's responsibility to act upon.

EXECUTIVE SUMMARY

The City of Charlottesville undertook a comprehensive urban forestry assessment in 2025 to evaluate current tree canopy, street trees, and vegetation across private and public lands. This study aimed to inform policy, prioritize planting, and guide management by integrating three components: a high-resolution tree canopy analysis using historical and current data, a street tree survey, and a citywide vegetation assessment.

Tree Canopy Coverage and Change

Charlottesville's tree canopy analysis reveals a decline in tree canopy over the past two decades. Current citywide tree canopy coverage stands at 46.5% in 2025. This represents a statistically significant decrease from 51.8% in 2006, a net loss of 5.3 percentage points over 19 years. The greatest loss occurred between 2006 and 2014, coinciding with 11% population growth and likely influenced by development pressures and invasive pests.

There are notable variations among neighborhoods, with canopy coverage ranging from 21% in 10th & Page to 67% in Barracks/Rugby. These disparities are directly linked with urban heat patterns, as neighborhoods with the lowest canopy coverage experience the highest average temperatures.

Street Tree Survey

Charlottesville's street tree population reveals both strengths and opportunities for improvement. With an estimated 7,634 street trees, the city averages 45.2 trees per street mile, less than two-thirds of the national average of 76.1 trees per mile. However, Charlottesville maintains a 66% street tree stocking rate, which exceeds the national average of 60% but falls short of a minimum recommended 75-80% stocking goal.

The street tree population exhibits good overall health, with 84% of trees rated in Good or Excellent condition and an average condition rating of 73%. Species diversity in the street tree population is moderate; however, flowering dogwood and red maple each comprise 10.8% of the population, exceeding recommendations. The relatively high maintenance requirement is primarily related to clearance pruning rather than tree health issues, reflecting a younger tree population with infrastructure conflicts that may be outgrown in time. A total of 4% of the street tree population consisted of invasive species, such as the tree of heaven or Norway maple. A majority of available planting spaces (almost 63%) were only suitable for small trees, a consequence of limited space and design constraints. Nonetheless, data indicates that the City has prioritized planting in sites that support large trees, which offer more public benefits. However, small and medium trees still vitally contribute to overall public tree benefits.

Vegetation Assessment

To complement the street tree inventory, a broader vegetation analysis was conducted on 302 parcels spanning 61.3 acres (1.1% of total land area) randomly stratified across the City's various zoning designations. Results estimate 221,982 trees on parcels citywide, with an average density of 40.6 trees per acre. Tree diversity is high, with 131 species recorded and no single dominant species, suggesting a more resilient forest structure. A concern emerged regarding invasive species, which were estimated to be present across 83.4% of acres citywide. Tree of heaven was the most frequently noted invasive tree species and is estimated to comprise almost 3% of the tree population. Invasive vines, such as English ivy, were also prevalent. Tree health was generally good (average condition rating of 65.0%), though lower than the City street tree rating. The ground-based impervious surface estimate (43.1%) exceeds the aerial canopy analysis figure (32.9%) because field observers recorded surfaces beneath tree canopy that aerial imagery classified as tree cover.

Planting Potential and Opportunities

Despite constraints, opportunities exist for expanding the urban forest. Approximately 13.4% of the city's land area is suitable for tree planting, representing an opportunity to restore lost tree canopy cover. When combined with the existing canopy, Charlottesville has the potential to achieve 59.9% tree canopy coverage. Private property offers the greatest potential for large tree plantings, which provide more long-term benefits.

City street tree planting faces limitations: only 7% of available sites are suitable for large trees and 63% are restricted to small trees. This constraint calls for creative solutions such as street bump-outs, medians, and partnerships with private property owners.

Economic and Environmental Benefits

The urban forest provides substantial economic value through ecosystem services, as estimated by i-Tree Eco and Canopy. Street trees have a total replacement value of almost \$18 million and provide over \$93,000 in combined environmental benefits annually. The entire city's tree canopy generates over \$2.55 million in annual benefits, including carbon sequestration (\$1.83 million), air pollutant removal (\$0.44 million), and avoided water runoff (\$0.29 million). The total carbon storage value exceeds \$45 million. Combining the values of tree canopy on City-owned parcels with those of City street trees reveals that City trees comprise approximately 18% of the overall tree canopy within the city. It is also important to recognize that i-Tree estimates exclude several significant benefits of tree canopy, including those associated with public health, social well-being, recreational opportunities, and aesthetic appeal.

Recommendations

Ensuring the sustained health, adaptability, and community benefits of the urban forest requires a multifaceted approach. Charlottesville can stabilize and potentially increase canopy cover through strategic action, collaborative partnerships, and data-driven decisions, improving urban forest health and structure to realize the full benefits of a

thriving tree canopy. The following are preliminary actions based on the initial analysis and will serve as a basis for the City's future Urban Forest Management Plan (UFMP).

Immediate Actions:

- Increase street tree stocking to 75-80% by strategic planting in largest sites
- Prioritize tree planting in heat-vulnerable neighborhoods with low canopy coverage
- Implement aggressive invasive species management, particularly targeting tree of heaven and invasive vines
- Develop routine inspection and maintenance programs to address street trees requiring maintenance

Strategic Initiatives:

- Establish realistic neighborhood-specific canopy goals based on planting potential
- Engage major landowners (University of Virginia, Charlottesville Redevelopment & Housing Authority) to increase canopy on their properties
- Expand street tree planting efforts beyond ROWs through partnerships with adjacent property owners and alternative spaces like medians and bump-outs
- Build upon existing programs and explore additional incentives and educational resources to help private property owners replace lawns and impervious surfaces with native trees
- Preserve mature and specimen trees on private property through education, outreach, and funding assistance for maintenance
- Integrate urban forestry considerations into public and private sector citywide design and planning

Long-Term Sustainability:

- Diversify species composition, particularly among street trees, to reduce over-reliance on flowering dogwood and red maple
- Focus on climate-appropriate, native species selection suited to the planting site
- Update canopy assessment every 2-4 years to track progress and adapt strategies
- Enhance non-profit and educational organization partnerships to expand program reach, particularly related to tree planting and invasive species management

Conclusion

Charlottesville's urban forest assessment reveals a community asset under pressure but with significant potential for enhancement. While the urban forest faces challenges from decreasing canopy coverage, invasive species, infrastructure constraints, and development trends, the analysis identifies clear pathways for improvement.

A critical finding is that the vast majority of tree planting potential lies on private property, making property owner engagement critical to canopy retention and growth. Limited space for large trees, particularly street trees, further underscores the need to preserve existing mature canopy – trees lost to development cannot easily be replaced due to planting constraints. Success will require coordinated efforts across public and private sectors, data-driven decision-making, interdepartmental collaboration, and sustained commitment to urban forest stewardship. The City's leadership on public property, combined with partnerships and community engagement, can help reverse current trends to build a more resilient urban forest that enhances public health and well-being.

TREE CANOPY ANALYSIS

Charlottesville



PART 1

Summary

In general, a tree canopy assessment (TCA) provides a perspective of how much land within a geographic area of interest is covered by tree canopy. Unlike a public tree inventory, a TCA considers the contributions of private property trees to the overall canopy cover. However, it does not provide data on the species, condition, or size of the trees. The vegetation assessment and street tree sampling components of the project provide that information. Using consistent and replicable methods, a tree canopy cover (TCC) estimate was developed using both current 2025 and historical data. This will assist the City in continuing to track changes in tree canopy and neighborhood trends over time.

Key Insights

Canopy Cover:

- Charlottesville's tree canopy declined from 51.8% in 2006 to 46.5% in 2025
- Neighborhood canopy coverage varies from approximately 21% (10th & Page) to 67% (Barracks/Rugby)
- Tree canopy cover is directly linked to urban heat in neighborhoods, with the lowest canopy cover in neighborhoods experiencing the hottest temperatures

Ecosystem Benefits:

- Estimated citywide tree canopy benefits are over \$2.55 million annually
- Trees on City-owned parcels and City street trees contribute about 17% of that value

Planting Potential:

- An estimated 13.4% of land in the city is plantable
- Planting space availability varies from 2-22% of the total land area in the neighborhoods

Recommendations

To expand tree canopy across the city and maximize public benefits, the following recommendations are proposed:

- Prioritize tree planting in heat vulnerable neighborhoods
- Use data-driven tools and community input to guide planting strategies and distribution
- Engage landowners such as University of Virginia, Charlottesville Redevelopment & Housing Authority, and the Charlottesville City School Board to increase canopy on their properties
- Establish canopy goals with a focus on neighborhood boundaries and community desires
- Continue to assess canopy cover and change approximately every 2 to 4 years

Methods

The City of Charlottesville's current and historical land cover was estimated through a sample point assessment (Figure 1). The sample point methodology is based on a 95% confidence interval and provides a high level of accuracy, within 1-2% of the actual value. The sample point system is considered the standard for comparison with machine-learning systems (Clymire-Stern, 2022). In this method, geospatial points are randomly generated and subsequently classified by a reviewer. Points were classified as Tree Canopy, Grass & Herbaceous Plants, Impervious Surface, Water, or Bare Soil (Figure 2).



Figure 1. Distribution of sample points in Charlottesville.

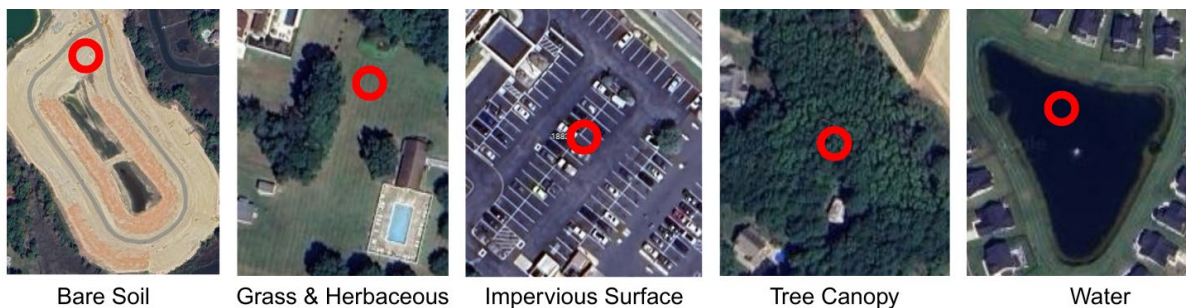


Figure 2. Land covers assessed for this project, with red circles representing classified points.

To perform the current 2025 land cover analysis, 6,000 points were classified using commercial imagery with 30-centimeter resolution. The 2025 imagery had approximately 3% cloud cover, which affected the classification of 95 points (1.5%); these points were excluded from the assessment. Historical coverage was assessed for 2006, 2014, and 2021 using high-resolution imagery (60-centimeter to 1-meter) from the National Agriculture Imagery Program (NAIP). The historical imagery was classified using 3,000 sample points.

The consistent application of sample point methodology across all four time periods enables a more accurate assessment of tree cover changes over time compared to an analysis employing various approaches. This consistency reduces potential variance from different analytical approaches, ensuring that observed changes reflect actual land cover change rather than methodological differences.

Assessment Levels

In addition to estimating citywide land cover percentages, tree canopy analysis was disaggregated into various geographical boundaries to explore patterns, trends, and change on different scales. The boundaries included:

- Citywide: the area of interest in which sample points were randomly distributed.
- Right-of-Way (ROW): sample points not falling within the boundary of a parcel. Some ROW may not be managed by the City, such as State, private, or the railroad. ROW also includes tree canopy overhanging roads where the tree is located on private property.
- Planning Neighborhoods: the City's 19 Planning Neighborhoods plus the University of Virginia (UVA). It is important to note that although portions of UVA fall within the City limits, the City does not manage trees in those areas.
- Land Ownership: summarizes tree canopy and change by ownership, such as Charlottesville City School Board, City-owned, Charlottesville Redevelopment & Housing Authority (CRHA), UVA, and private ownership. A parcel jointly owned by the City and County was included in the City's ownership calculation. Schools located on parcels owned by the City of Charlottesville were included as part of Charlottesville School System.
- Parcels: for the City's 13,792 parcels, supervised classification was used to develop current canopy and change estimates due to the small unit size analyzed.

Quality Control

Prior to initiating the sample point assessment, evaluators conducted a calibration using 50 sample points. The calibration intends to identify potential issues with the imagery and review features that may be unique to the project area. After calibration, the primary evaluator classified each point for each time period. For further quality control, the secondary evaluator independently classified a 10% sample of each time period's points (1,500 points in total). Analyzing the classification of land covers by both evaluators allows for an assessment of the primary evaluator's accuracy. For this project, the primary evaluator achieved tree canopy accuracy rates of 98.1% in 2006, 95.9% in 2014, 97.5% in 2021, and 94.9% in 2025 (Appendix B).

Limitations

The sample point method does have limitations, especially without the inclusion of Light Detection and Ranging (LiDAR) or other three-dimensional data. It provides only a two-dimensional view, so the vertical forest structure and differences between tall trees and shrubs are difficult to distinguish. Accuracy depends heavily on imagery resolution and clarity, which can vary throughout the years available through NAIP. Boundaries between tree canopy and non-canopy can be hard to interpret, such as where trees overhang impervious surfaces. Sample point assessment does not provide information on tree size, height, or condition. While it provides a statistically valid estimate of tree cover, it is less effective for more fine scale tasks such as parcel-level analysis.

Despite limitations, the sample point system offers the most balanced approach to canopy assessment, delivering accurate, cost-effective, and statistically valid results. It provides reliable city and neighborhood-scale estimates for goal-setting, planting prioritization, and progress tracking. This methodology has been used successfully in over 400 communities and allows for consistent monitoring and benchmarking.

Ecosystem Benefits

To measure the benefits of Charlottesville's tree canopy, i-Tree Canopy (canopy.itreetools.org) was used. Carbon storage value and annual values of avoided water runoff, carbon sequestration, and air pollutant removal were estimated based on the city's 2025 tree canopy cover of 46.5%. The standard error (SE) and a 95% confidence interval (CI) were calculated for each value. For example, water runoff was estimated at 32.61 (± 0.89) million gallons annually, with that estimate having a 95% chance of being within the range of 31.72 to 32.50 million gallons per year. To estimate the contribution of all City trees, including street trees and those on City-owned property, values from i-Tree Canopy and i-Tree Eco were used.

Potential Planting Area

To develop an estimate of how much land area is potentially plantable, sample points classified as Impervious Surface, Tree Canopy, and Water were considered unsuitable for planting a tree. Additional layers available through Charlottesville's Open Data website, such as buildings, were further incorporated into the plantable assessment. Points originally classified as Bare Soil and Grass and Herbaceous were assessed for their suitability for tree planting. Points in these classifications may not support a new tree due to their current use, such as a sports field or proximity to infrastructure. The methods to determine plantability are located in Appendix C.

Urban Heat

To explore the relationship between urban heat and tree canopy cover, average neighborhood temperatures were calculated using data from the City's 2021 Urban Heat Island Mapping Campaign (Figure 3). Almost 12,000 temperature readings collected along a traverse were aggregated by planning neighborhood to determine localized heat patterns.

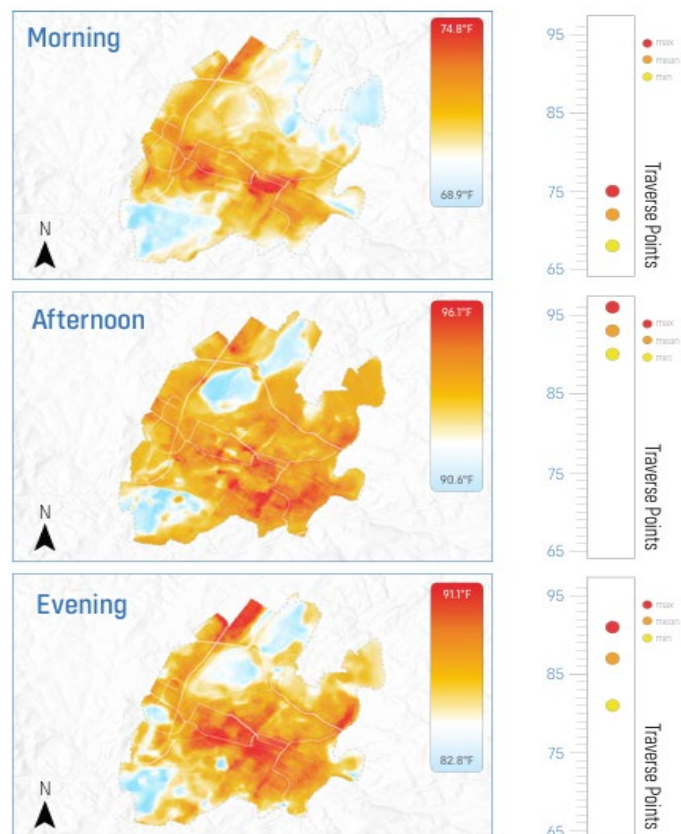


Figure 3. Charlottesville Heat Mapping Results
Source: City of Charlottesville, 2021 Heat Watch Report

Findings

Tree canopy assessments capture the extent of tree cover across the landscape at a specific point in time. As a key metric in urban forestry, they offer valuable insights into future planning and tracking changes over time. The following section outlines how Charlottesville's tree canopy has evolved, including a breakdown by planning neighborhoods.

Current Citywide Land Cover

In 2025, Tree Canopy was the most common land cover in Charlottesville, accounting for 46.5% (Figure 4). Other land covers included Impervious Surface (32.9%), Grass and Herbaceous Plants (19.2%), Bare Soil (1.2%), and Water (0.3%). A visual representation of the city's current land cover is shown in Figure 5. In contrast to the vegetation assessment's ground-based estimation of coverage, Impervious Surfaces and Grass are both lower in the TCA. This observed variation can be attributed to tree canopy cover extending over roadways, built structures, and lawns. Further study may be required to differentiate specific land covers (e.g., vines vs. grass or herbaceous plants).

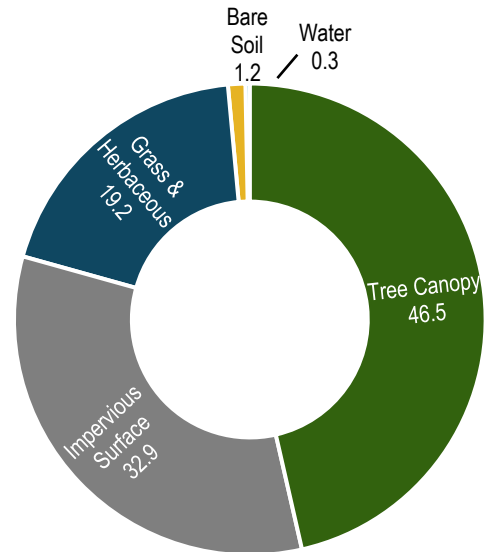


Figure 4. Land cover distribution in Charlottesville.

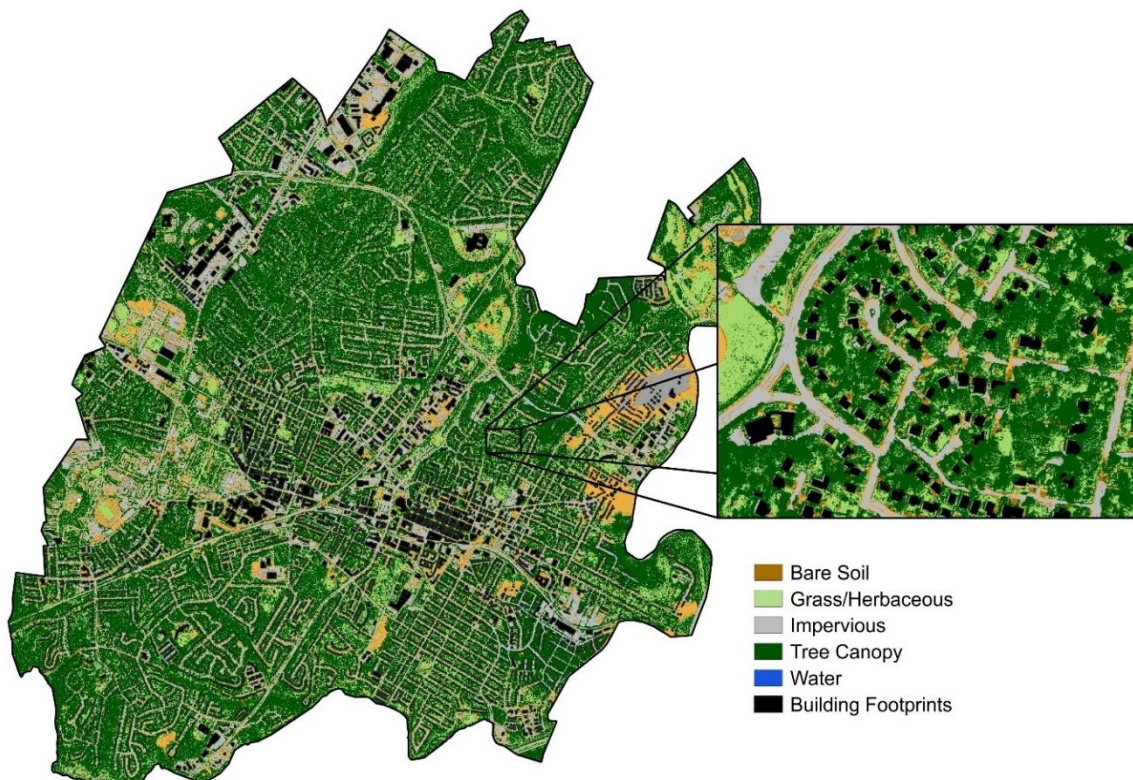


Figure 5. Current land cover map developed using supervised classification.

Citywide Tree Canopy & Land Cover Change

Between 2006 and 2025, the land cover categories of Bare Soil, Impervious Surface, and Water showed no statistically significant change. The two land covers with a statistically significant change were Grass and Herbaceous Plants and Tree Canopy (Figures 6 and 7). From 2006 to 2014, Grass and Herbaceous Plants increased by almost 5 percentage points, from 12.6% to 17.4%. In the same time period, Tree Canopy decreased by similarly, from 51.8% to 47.6%. The Grass and Herbaceous cover continued to slightly increase, although not statistically significantly, from 2014 to 2025. A corresponding slight decrease in Tree Canopy occurred concurrently, from 47.6% in 2014 to 46.5% in 2025 (Figure 6). In total, the tree canopy decreased by 5.3 percentage points from 2006 to 2025. The detailed land cover classifications for each assessed year are located in Appendix D.

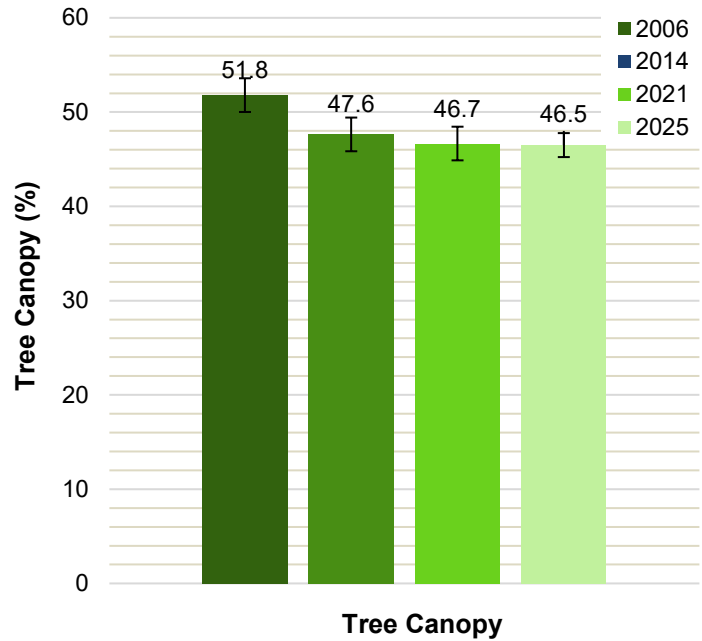


Figure 6. Tree canopy comparison from 2006-2025.

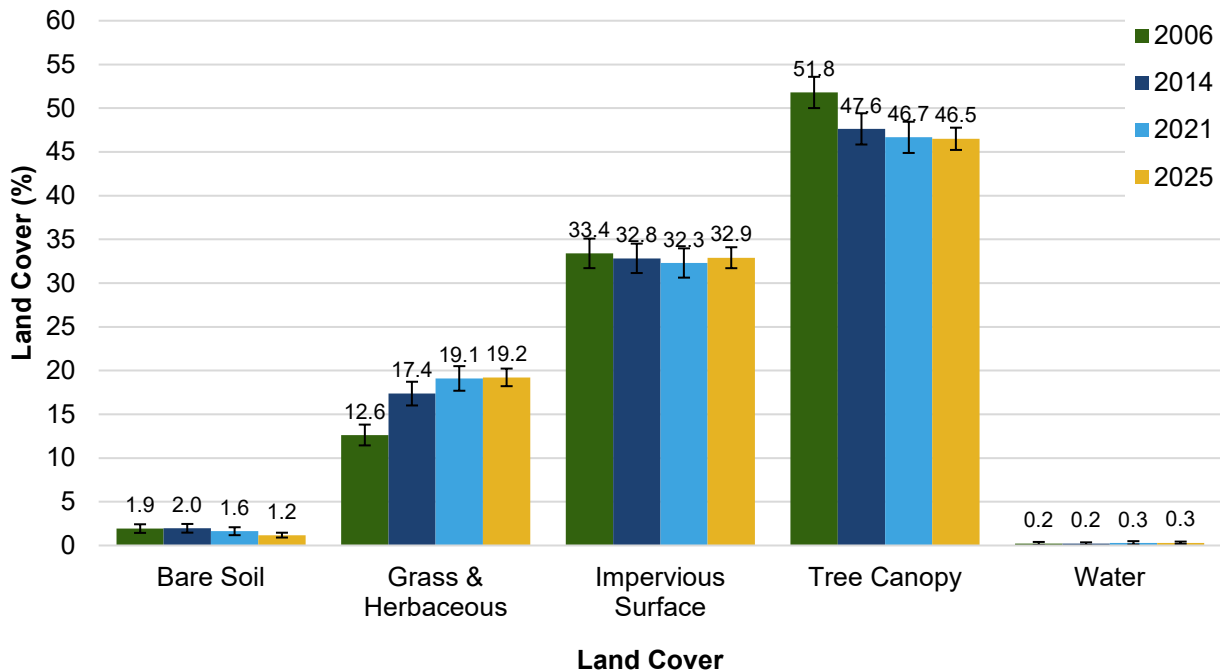


Figure 7. Land cover distribution in Charlottesville from 2006-2025.

As shown in Figure 8, Charlottesville's tree canopy change map shows areas of consistent tree canopy alongside canopy loss and gain. Tree canopy expansion generally results from new plantings, natural regeneration, and the maturation of existing trees. In contrast, canopy loss is primarily attributed to development, but storms, pests, and disease can also play significant roles.

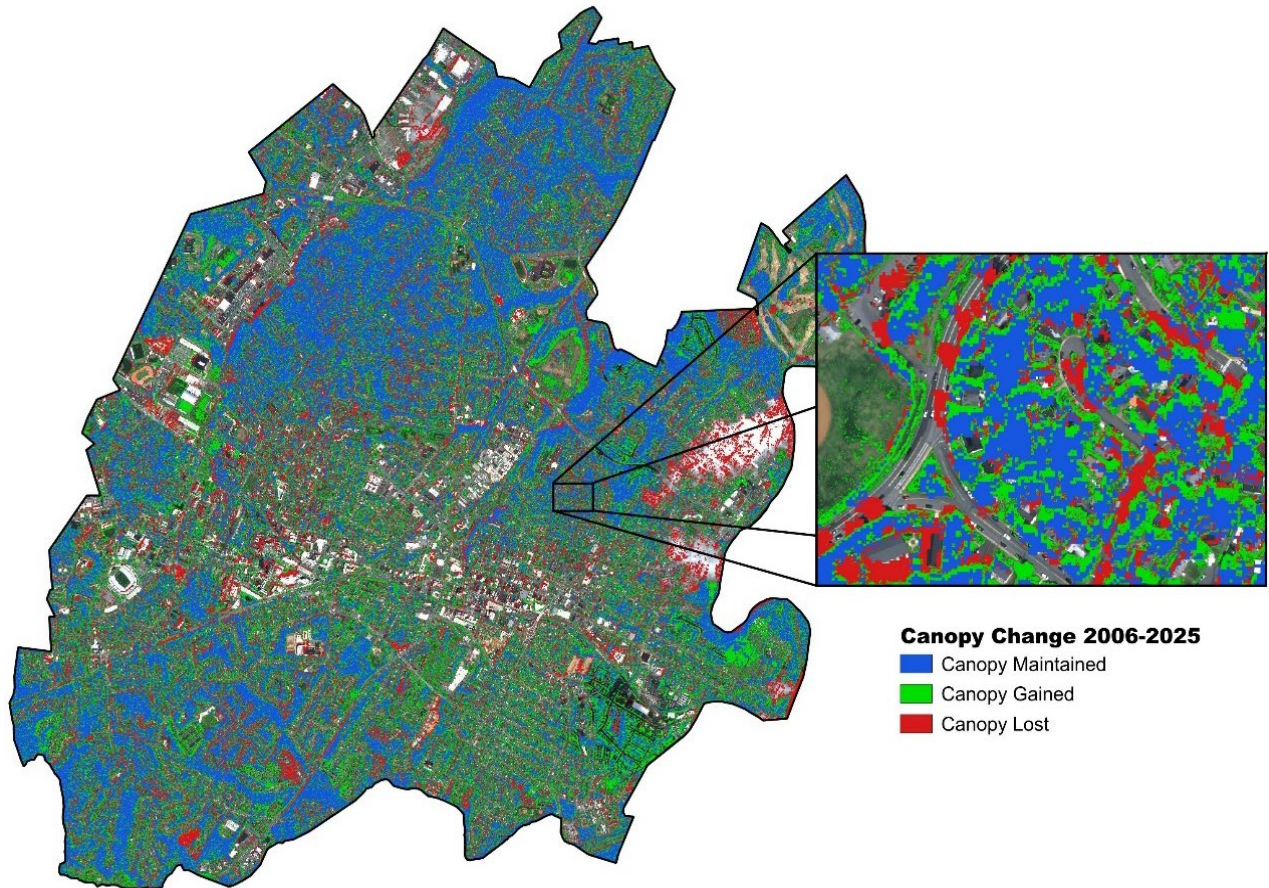


Figure 8. Citywide tree canopy change from 2006-2025.

The sharp decline in tree canopy between 2006 and 2014 likely resulted from several factors. Development pressure from the 2006-2008 building boom contributed to the canopy loss, with the clearing of trees for development and infrastructure. The derecho in June 2012, which caused devastating tree loss across the state, likely accounts for a significant portion of the decline. The recession in 2008 may also have reduced public and private tree planting and maintenance due to budgetary constraints. Population growth also appears tied to the canopy loss, as Charlottesville's population increased by 11% from 2006 to 2014 (Cooper Center, 2024).

The land cover data provides important context for understanding why Tree Canopy declined between 2006 and 2014, while Grass and Herbaceous vegetation increased and Impervious Surface remained stable. This pattern suggests that tree loss was not driven primarily by widespread paving or major construction projects, but rather by projects that converted treed areas to maintained lawns. This likely included homeowners expanding

yard space, institutional properties creating active recreation areas, and storm damaged areas being converted to lawns and gardens.

Although tree canopy trends downwards through 2025, the only statistically significant change occurs from 2006 to 2014. Tree canopy remained essentially stable between 2014 and 2025, declining only 1.1 percentage points (within normal statistical variation) despite a population gain of 9% (Cooper Center, 2024). This stabilization suggests that tree planting, growth of existing trees, infill development, and redevelopment of previously cleared sites (such as parking lots) have helped to preserve the canopy despite population gains. The coinciding stability in impervious surface coverage further indicates that new development occurred on already developed land rather than converting treed areas.

Tree Canopy & Change by Planning Neighborhood

For the City of Charlottesville's planning neighborhoods, including UVA, estimates for tree canopy cover and canopy change were developed based on sample point analysis (Table 1, Figure 9). In 2025, the Barracks/Rugby neighborhood had the highest tree canopy coverage at approximately 67%. The neighborhood of 10th & Page had the lowest TCC at 21%. The remaining neighborhoods ranged from 25% (Starr Hill) to 60% (Fry's Spring).

Table 1. Neighborhood TCC in 2006, 2014, 2021, 2025 color-coded by absolute change from 2006-2025.

Planning Neighborhood	2006 (%)	2014 (%)	2021 (%)	2025 (%)	Change 2006-2025 (%)
Starr Hill	9.1	22.7	18.2	25.5	16.4
Fifeville	40.1	43.0	39.4	46.3	6.2
Rose Hill	29.5	36.4	38.6	31.1	1.6
Barracks Road	31.8	29.4	28.2	32.5	0.7
North Downtown	33.0	35.9	31.6	33.5	0.5
UVA	41.0	38.2	38.2	39.4	-1.6
Woolen Mills	49.6	46.2	45.4	46.2	-3.4
Belmont	37.4	37.4	34.5	33.8	-3.6
Martha Jefferson	44.8	37.5	38.5	40.9	-3.9
10th & Page	27.1	20.8	29.2	21.3	-5.7
Jefferson Park Avenue	38.9	34.4	33.3	33.0	-5.9
The Meadows	38.7	32.0	34.7	32.1	-6.6
Barracks/Rugby	74.0	64.1	66.4	67.1	-6.9
Johnson Village	66.7	66.7	52.0	59.3	-7.3
Venable	54.9	46.3	48.2	47.4	-7.4
Greenbrier	67.1	59.8	65.7	58.6	-8.5
Locust Grove	55.6	53.7	47.2	47.1	-8.5
Ridge Street	52.9	42.8	39.1	39.1	-13.8
Fry's Spring	73.8	67.3	65.4	60.0	-13.9
Lewis Mountain	61.8	49.1	47.3	47.1	-14.8

Lewis Mountain, Fry's Spring, Ridge Street, and Locust Grove all experienced a tree canopy coverage decrease of 10 percentage points or greater between 2006 and 2025. The Starr Hill and Fifeville neighborhoods experienced an increase in canopy cover greater than 5 percentage points between 2006 and 2025. A majority of neighborhoods (75%) had an overall decline in tree canopy between 2006 and 2025.

In the neighborhoods, a significant portion of canopy loss occurred between 2006 and 2014, mirroring the citywide canopy assessment data. However, over half of the planning neighborhoods experienced canopy loss from 2014 to 2025 as well. This is particularly concerning because while citywide canopy has slightly declined since 2014, some individual neighborhoods are experiencing larger downward trends. In total, only 7 of the 20 neighborhoods are above the citywide TCC of 46.5%. These neighborhoods include Lewis Mountain (47.1%), Locust Grove (47.1%), Venable (47.4%), Greenbrier (58.6%), Johnson Village (59.3%), Fry's Spring (60.0%), and Barracks/Rugby (67.1%). Additionally, all of these neighborhoods experienced a loss in canopy between 2006 and 2025.

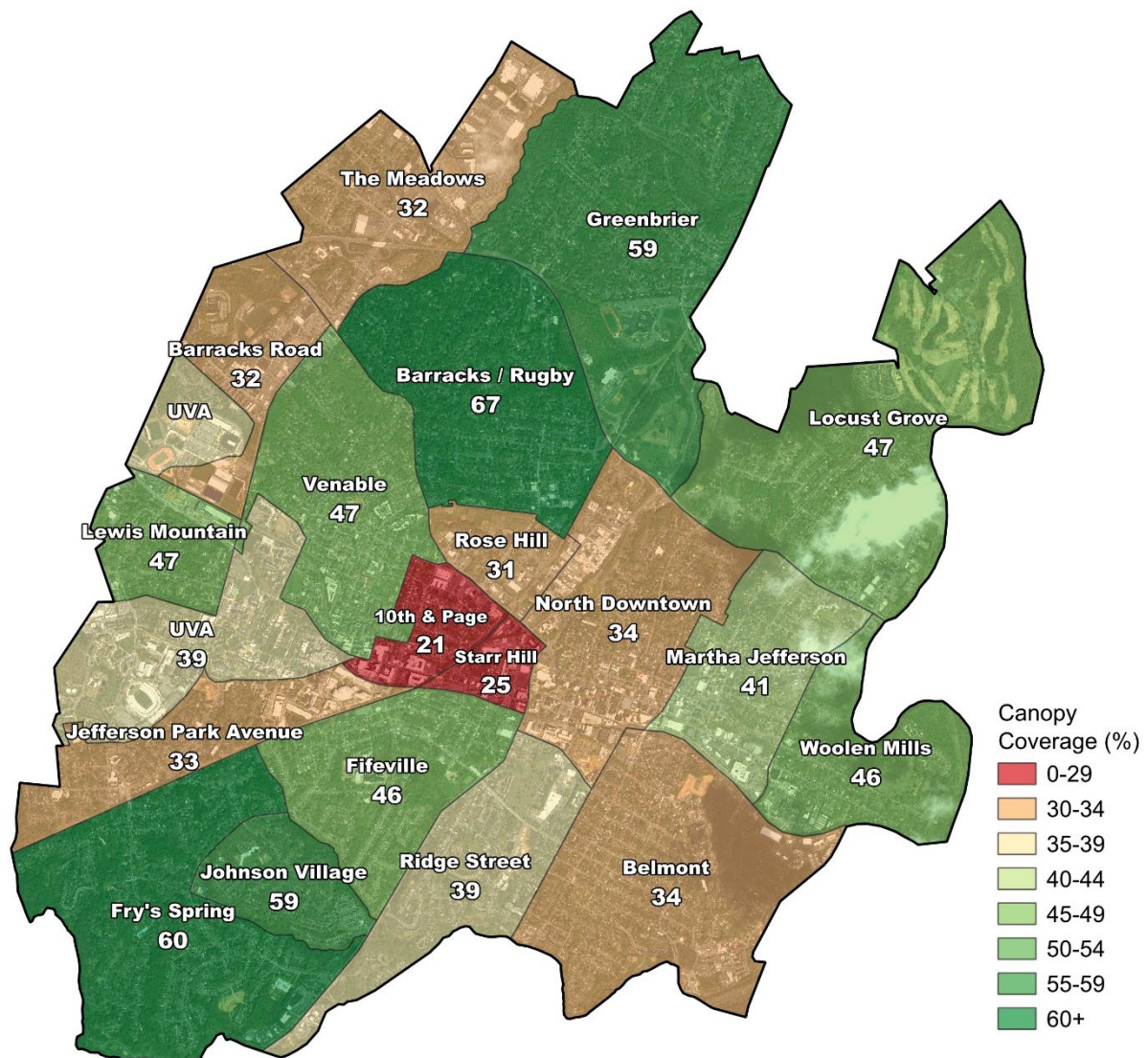


Figure 9. Current tree canopy cover by planning neighborhood.

Tree Canopy & Change By Land Ownership

As part of the City's investigation into existing canopy cover and canopy change over time, the assessment was divided into land ownership (Figure 10). CRHA had the lowest current canopy cover at 35%, while land owned by the City of Charlottesville had the highest tree canopy cover at 60%. As much of the City-owned land is parkland, it follows that there would be higher tree density and canopy cover. Both the City and Private land ownership canopy covers were higher than the citywide TCC of 46.5%. However, CRHA, the Charlottesville City School System, and UVA all fell below the average. Although a majority of UVA is not within the official city limits, it has been included in past and most recent Charlottesville canopy assessments. For the land area considered ROW, which is not part of any parcel, the current tree canopy coverage was 30.2%. Except for parcels owned by the City of Charlottesville, the other land ownership categories all experienced a decline in tree canopy from 2006 to 2025.

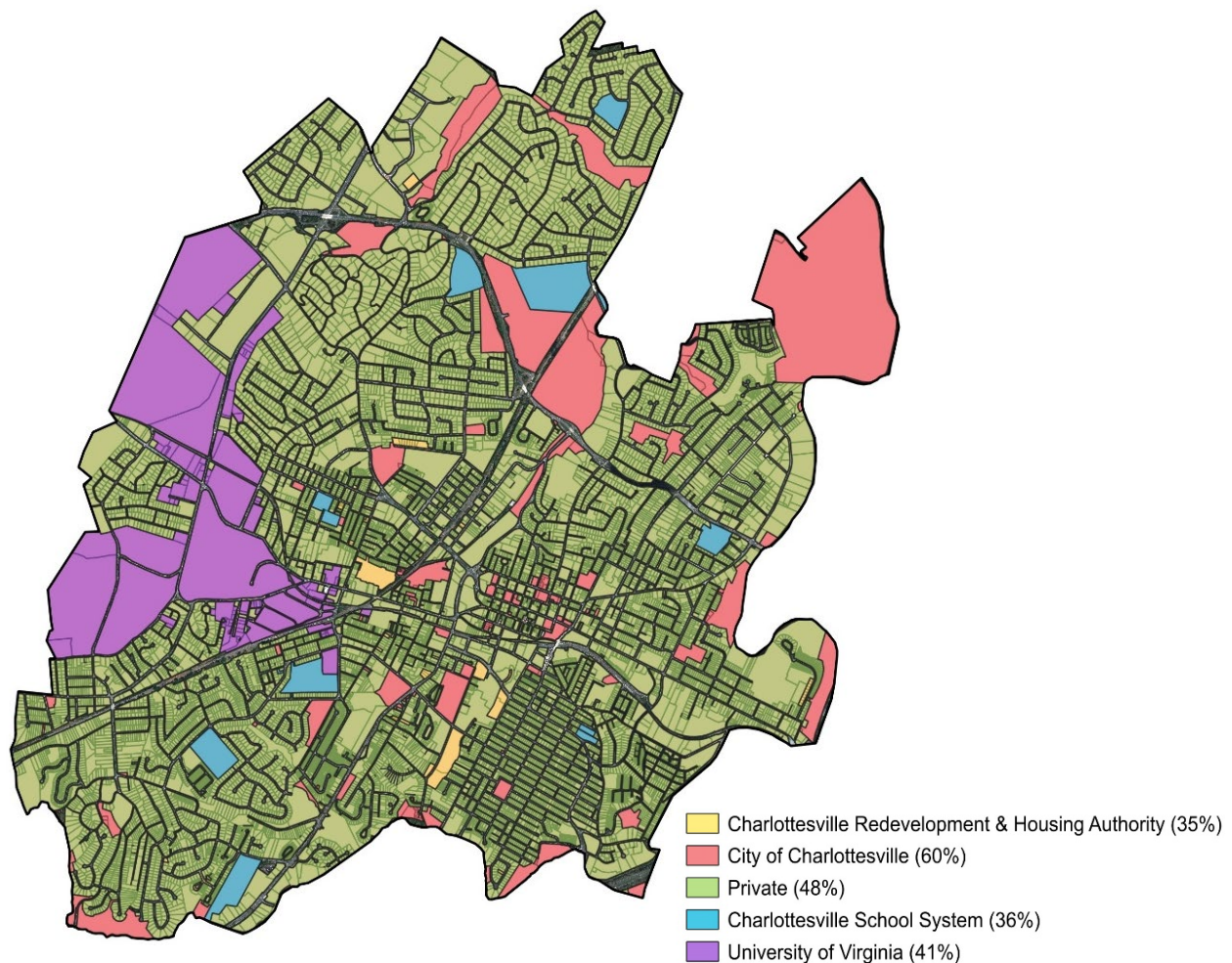


Figure 10. Current tree canopy cover by land ownership.

Tree Canopy & Change by Parcel

Although granular, monitoring canopy change by individual parcel can help pinpoint hotspots of canopy increase and decrease. In particular, larger parcels such as those owned by the City, UVA, and the Charlottesville City School Board can be examined in more detail. For example, the increase in tree canopy on City-owned parcels is evident, as seen in the Pen Park and McIntire Park locations (Figure 11). However, it should be noted that examining such small parcels does present challenges. The removal of a single tree can significantly affect a parcel's relative change. Such localized changes may appear dramatic, but they are not necessarily indicative of broader neighborhood or citywide trends.

In the 13,792 parcels tree canopy change ranged from a loss of 0.1 to 100% and a gain of 0.1 to 90%. Only 27 parcels (0.1%) showed no measurable change. On average, parcels experienced a canopy decrease of 7.2 percentage points, which is greater than the citywide decrease of 5.3 percentage points. This difference could stem from the exclusion of the ROW canopy in the parcel-level analysis. Additionally, it could suggest that smaller parcels are losing more canopy, thus influencing the average regardless of parcel size.

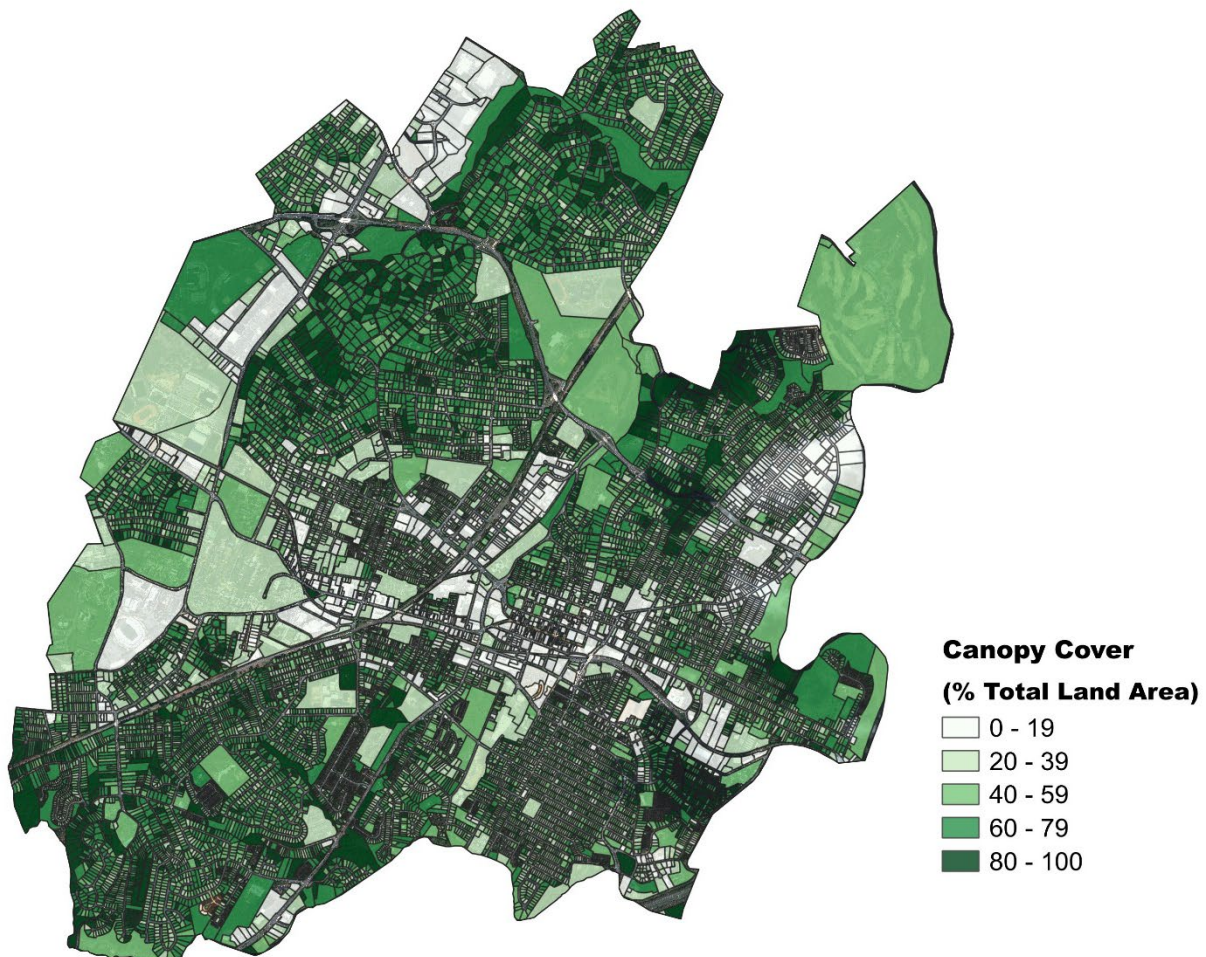


Figure 11. Current tree canopy cover by parcel in Charlottesville.

Potential Planting Area

While cities often set planting or canopy cover goals, these numbers can sometimes be unattainable. Limiting factors, such as ROW width and infrastructure conflicts, can reduce the percentage of land available for trees. By determining the current canopy cover and the potential canopy cover, the City can develop realistic and achievable canopy goals.

From the initial classification, potentially 20.4% of the city's total land area was plantable. This represents the combined total of the percentage of land classified as Bare Soil and Grass and Herbaceous Plants. Upon further examination and application of tree planting criteria (Appendix C) to the potentially plantable locations, approximately 13.4% of the total land area was deemed suitable for planting new trees. When added to the 46.5% existing TCC, Charlottesville has a current maximum potential of 59.9% tree canopy.

The assessment of planting area can be further broken down into the City's planning neighborhoods. The Ridge Street neighborhood has the most extensive available land area for tree planting, at 22%. Ridge Street also had one of the greatest canopy cover decreases from 2006 to 2025 (13.8%, Figure 12). The UVA1 area, although outside of the City's tree planting jurisdiction, had the next greatest availability of planting space (21%). Starr Hill had the least available planting space at 2%. Barracks Road also had limited planting space availability, with only 5% of the land available for new trees.

It is important to note that while planting criteria were applied and areas such as sports fields were not considered plantable, the analysis does not account for open green spaces needed for casual recreation, play, and community gathering. Cities need these open areas for activities like flying kites, playing frisbee, picnicking, and other uses that may be incompatible with tree canopy.

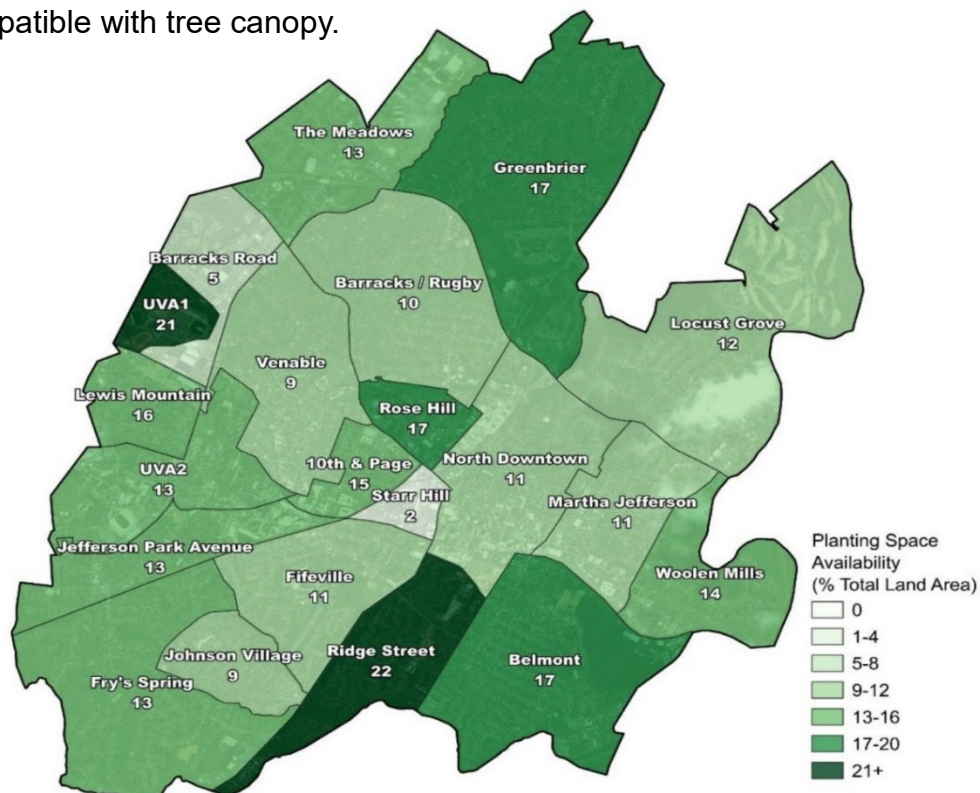


Figure 12. Current planting space availability by planning neighborhood.

Urban Heat

Examining urban heat patterns in relation to neighborhood tree canopy cover is crucial due to their interconnected impacts on public health and environmental quality. The urban heat island effect causes urban areas to be warmer than surrounding rural areas. Tree canopies provide shade and cool the surrounding air through transpiration. Neighborhoods with higher tree canopy cover can be cooler than those with little or no canopy. High urban temperatures are associated with increased mortality and health issues (World Health Organization, 2024), and trees can help mitigate these risks by cooling neighborhoods.

Comparing Charlottesville's heat map to the existing canopy cover map, the connection between low canopy cover and heat is evident. The two neighborhoods with the least tree canopy, 10th & Page and Starr Hill, also have the highest average temperatures (Figure 13). Neighborhoods with higher tree canopy cover tend to have lower average temperatures, such as in Fry's Spring. While the City's heat, existing canopy covers, and planting availability maps can be used to focus tree planting, other demographic and socio-economic factors should be considered as part of the strategy. Established methods are available, such as the Tree Equity Score (treeequityscore.org), or the City can create a priority-weighted system based on industry recommendations and community desires.

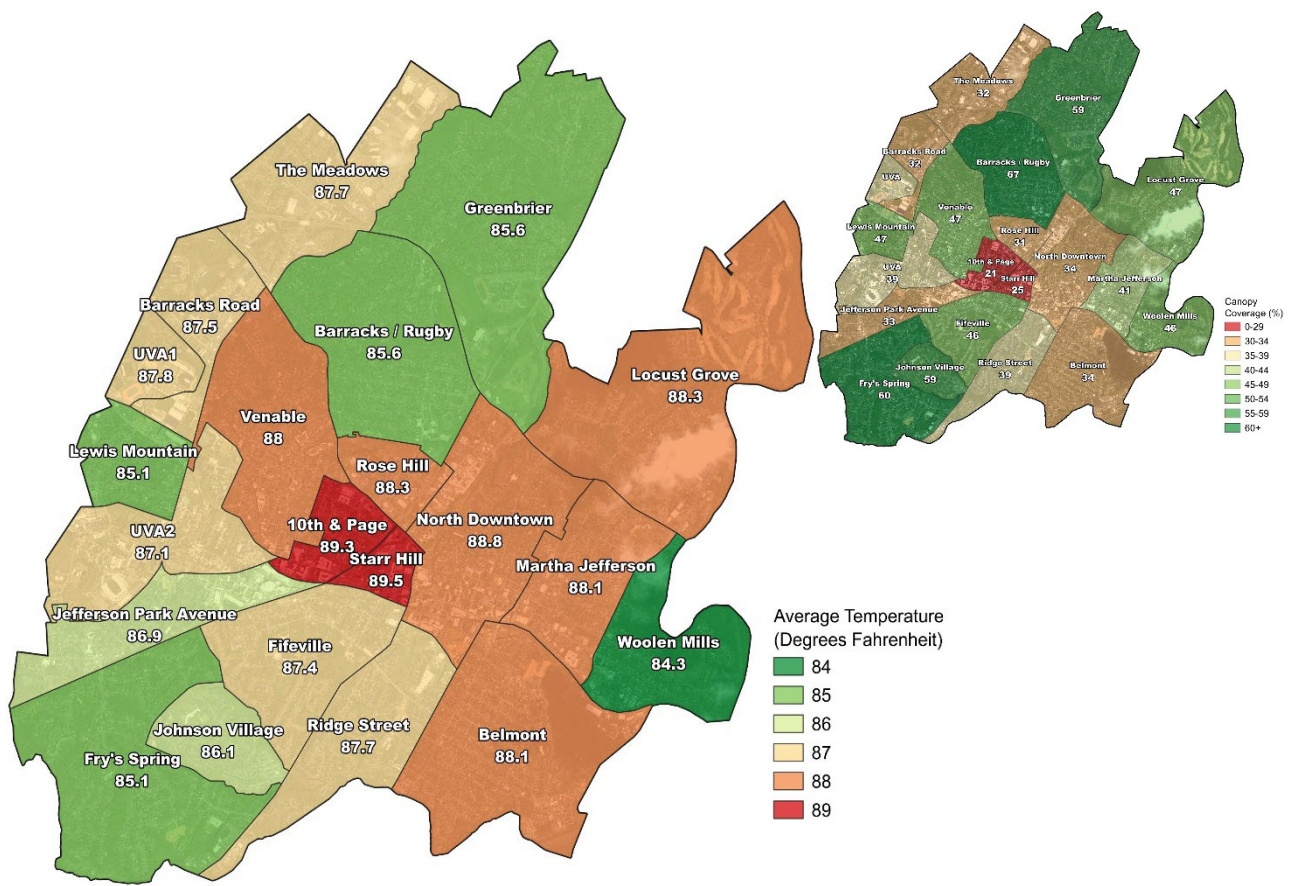


Figure 13. Average temperature map by neighborhood based on evening traverse (2021) with inset current neighborhood tree canopy cover map.

Ecosystem Benefits

Charlottesville's current tree canopy coverage was used to calculate the value its trees provide in terms of carbon sequestration and storage, water runoff, and air quality improvement. The current tree canopy in the city has over \$2.55 million in annual benefits (Table 2). Additionally, the estimated carbon storage of the trees has a value of over \$45.33 million (existing, not annual). Annual carbon sequestration values were the largest contributor to the annual benefit estimate, with a yearly value of almost \$1.83 million. Avoided water runoff contributed approximately \$0.29 million annually, while air pollutant removal (carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, and particulate matter 2.5 and 10) was valued at almost \$0.44 million per year.

Table 2. Ecosystem value of trees within the City of Charlottesville, calculated by i-Tree Canopy.

Annual Removal or Runoff Rates	Amount ¹	Standard Error (±)	95% Confidence Interval (±)	Value (\$)	Standard Error (±)	95% Confidence Interval (±)
Carbon Monoxide	1.63	0.02	0.04	2,171	30.30	59
Nitrogen Dioxide	7.65	0.11	0.21	3,991	55.70	109
Ozone	69.39	0.97	1.90	129,336	1,805.21	3,538
Sulfur Dioxide	2.78	0.04	0.08	279	3.89	8
Particulate Matter 2.5	2.83	0.04	0.08	207,350	2,894.08	5,672
Particulate Matter 10	15.01	0.21	0.41	94,123	1,313.72	2,575
Water Runoff	32.61	0.46	0.89	291,385	4,067.00	7,971
Carbon Sequestration	4.22	0.06	0.12	1,828,603	25,522.65	50,024
Annual Total				\$2,557,238		
Carbon Stored in Trees (not annual)	104.76	1.46	2.87	45,330,518	632,698.95	1,240,090

¹ Units in tons except water runoff in millions of gallons and Carbon in kilotons.

To examine the annual canopy benefits of City-owned properties, the City's ownership of 821.4 acres was compared to the total study area of 7,003.2 acres. The City owns approximately 11.7% of the calculated area with an average TCC of 59%, compared to an average citywide 46.5% TCC. In total, the tree canopy on City-owned property accounts for almost 15% of the total tree canopy in Charlottesville (Figure 14). If ecosystem benefits from the estimated street tree population are combined with those of City-owned parcels, the City's contribution rises to approximately 18% of the tree canopy and related benefits (Figure 14).

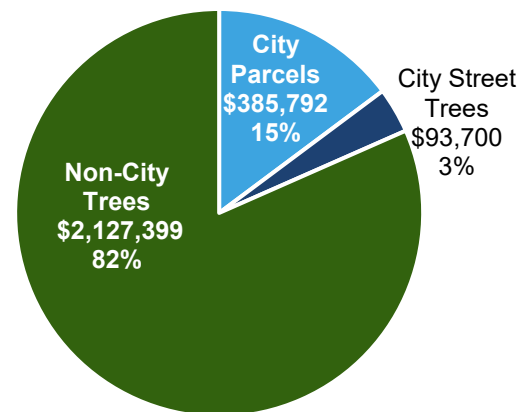


Figure 14. City tree values as part of citywide canopy values.

Although i-Tree is a standard tool to easily capture and display economic values through ecosystem services of tree canopy, it has limitations. The models assume uniform, relatively healthy trees with average species characteristics, which reduces accuracy when applied to Charlottesville's urban forest, which has varying tree health, sizes, and site conditions. Additionally, i-Tree does not capture less tangible values such as:



Photograph 1. Tree canopy supporting outdoor recreation in Charlottesville.

- **Aesthetic Values:** the visual appeal of trees can increase property values (Virginia Department of Forestry, n.d.)
- **Social Cohesion:** tree-lined streets and quality green spaces encourage social interaction, leading to bonding and a greater sense of community (Jennings & Bamkole, 2019)
- **Human Mental Health and Wellbeing:** tree canopy can lower anxiety and depression (Dhal et al., 2025) and decrease crime (Lin, Wang, & Huang, 2021).
- **Increased Recreation:** tree canopy helps increase outdoor activity (Locosselli & Buckeridge, 2023)

Comparison of Current & Previous Studies

As part of its ongoing commitment to the urban forest, the City of Charlottesville has conducted multiple assessments of its tree canopy cover. This latest analysis provides a 2025 canopy estimate and seeks to validate findings from previous studies. Unlike previous studies, which did not include statistical bounds or confidence intervals, this study provides standard error and 95% confidence interval values for current and historical canopy cover.

In comparing the previous and current assessments, they align in the estimated canopy covers for 2005/2006 and 2014 (Figure 15, Table 3). Although both studies employed the same sample point methodology, the current study used more points to enhance change analysis.

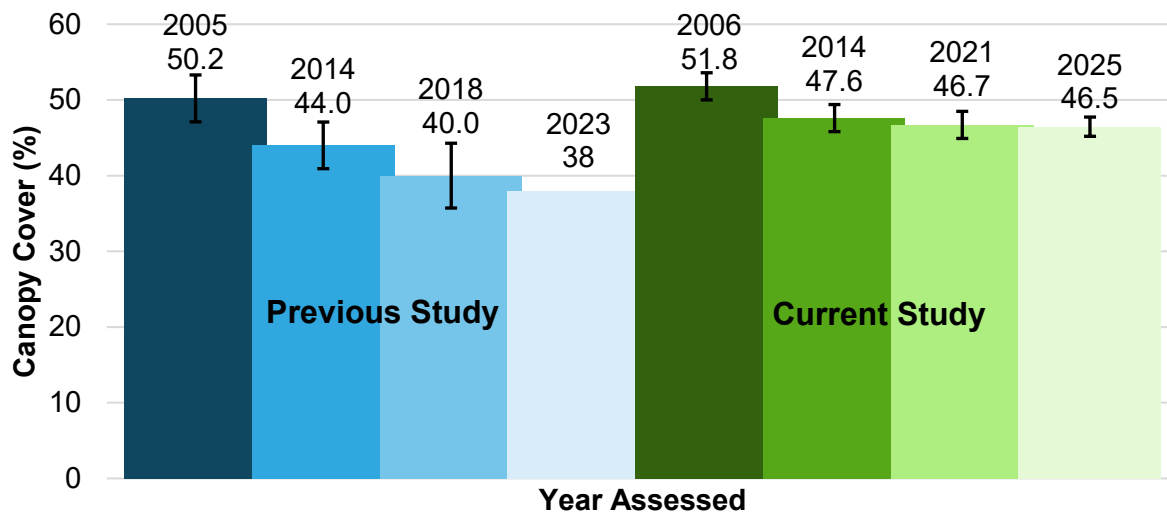


Figure 15. Comparison of estimated TCC from 2005-2025 from current and previous studies.

However, the next time frame (2018/2021) shows a notable difference in the studies' findings and methods (Table 3). Both showed a slight canopy decrease, but the previous study employed a different methodology, transitioning from sample points to supervised classification or machine learning. This shift in the previous study's methodology introduced potential variability that may have affected the change detection accuracy. The previous study also provided a 2023 canopy estimate, but it lacked a stated methodology, sampling frequency, and imagery source, so no confidence interval could be calculated.

Table 3. Comparison of current and previous canopy assessment studies.

Year	Tree Canopy Cover (%)	Confidence Interval (95%)			Study	Method and Source
		±	Lower	Upper		
2005	50.2	3.1	47.1	53.3	Previous	Sample point; 1000 points; Google Earth
2006	51.8	1.8	50.0	53.6	Current	Sample point; 3000 points; NAIP
2014	44.0	3.1	41.0	47.2	Previous	Sample point; 1000 points; NAIP
2014	47.6	1.8	45.9	49.4	Current	Sample point; 3000 points; NAIP
2018	40.0	4.3	35.1	43.7	Previous	Supervised classification; 500 pixels; NAIP
2021	46.7	1.8	44.9	48.9	Current	Sample point; 3000 points; NAIP
2023	38.0	-	-	-	Previous	Estimated, No Methodology Stated
2025	46.5	1.3	45.1	47.7	Current	Sample point; 6000 points; Commercial Imagery

In contrast, the current study applies a consistent sample point methodology across all four time periods, eliminating methodological variability and producing a more reliable change analysis. This consistency ensures that observed changes in canopy coverage reflect actual change rather than shifts in the analytical approach. While both the previous and current studies showed an overall decrease in tree canopy, the current study's consistent methodology and statistical analysis confirm that the canopy decrease between 2006 and 2025 is statistically significant. This means that the observed decrease in tree canopy is unlikely due to random chance or data variability, or methodological differences.

Conclusions

Charlottesville's comprehensive tree canopy analysis depicts nuanced urban forest dynamics over the last two decades. While the city maintains an overall canopy cover of 46.5% in 2025, the overall trend is decreasing canopy cover. The decline is statistically significant between 2006 and 2014 and continues to trend down from 2014 to 2025. The initial loss between 2006 and 2014 was likely driven by population growth and development pressures, although invasive pests may have also contributed to the decline.

The assessment highlights disparities in canopy cover across neighborhoods and land ownership types. Although the city's overall tree canopy has declined, the tree canopy located on City-owned parcels has increased. Neighborhoods such as 10th & Page and Starr Hill not only have the lowest canopy cover, but they are also subject to the highest urban heat levels. This underscores the relationship between environmental quality and tree canopy. Conversely, areas with higher tree canopy cover tend to be cooler. By connecting heat data and canopy cover with planting availability by neighborhood, the City can identify future TCC potential and make data-driven decisions on planting priorities. For example, Starr Hill has only approximately 2% of its land area available for new tree planting, limiting potential canopy gains, while 10th & Page has a greater tree planting availability of 15%.

Perhaps most importantly, the study identifies the potential to increase the tree canopy by up to 13.4%. This potential, combined with targeted engagement, outreach, and management strategies, can help Charlottesville enhance resilience and improve public health, thereby increasing benefits for the entire community.

Recommendations

The following are recommended for the City to explore in its future UFMP:

- Protect and maintain existing canopy through proactive maintenance, preservation policies, and incentives
- Collaborate with landowners, such as UVA, CRHA, and the Charlottesville City Schools, to increase canopy on those properties
- Set realistic canopy goals based on neighborhood and potential canopy cover
- Prioritize planting in neighborhoods with the lowest canopy and highest heat
- Consider incorporating existing tools or developing a custom tree planting prioritization model based on community input and socio-economic and demographic factors
- Perform canopy cover assessment regularly (approximately every 2-4 years), ensuring consistent and replicable methods

STREET TREE STUDY



PART 2

Summary

To enhance understanding and management of its urban forest, the City of Charlottesville conducted a street tree survey along 200 randomly selected segments. The inventory collected information on existing street trees, planting sites, and stumps, including species, size, condition, and recommended maintenance. The assessment covered one side of approximately 13.55 centerline miles of the City's 169 miles of maintained roads. This sample was extrapolated to develop citywide estimates for the total number of trees, planting spaces, and stumps present in the right-of-way. Charlottesville's sample street tree inventory reveals a relatively healthy street tree population, but it also highlights several constraints and opportunities for improvement.

Key Insights

Tree Density:

- Average of 45.2 street trees per centerline mile, below the national average of 76.1
- Approximately 7,634 total estimated number of street trees citywide

Species Composition:

- 68 species, 43 genera, and 27 families inventoried
- Flowering dogwood and red maple were most common, each making up 10.8% of the population
- Invasive trees accounted for 4% of the population

Tree Condition & Maintenance:

- Average condition rating of Good (~73%)
- High level of recommended maintenance (~60%), with Clearance Pruning most common

Planting Potential:

- Streets were approximately 66% stocked with trees
- Only about 7% of planting sites could support larger trees

Recommendations

To increase the long-term health, resilience, and community benefits of Charlottesville's street trees, the following actions are advised and will be explored in the City's future UFMP:

- Increase street tree stocking to 75-80% to align with best practices
- Focus planting efforts on sites that can support large or medium trees, prioritizing areas with lower canopy cover
- Look beyond available street tree planting space for alternatives such as street bump outs, medians, islands, and partnerships with adjacent private property
- Limit planting of over-represented species to increase resilience
- Introduce underused species appropriate for the site to increase diversity (e.g., American smoketree, American linden)

Methods

An inventory of randomly selected public street segments throughout the City of Charlottesville was conducted to identify tree and site conditions. A tree and planting site inventory provides information on the city's urban forest resource, such as the number and distribution of trees and available space for potential new trees. It also provides Charlottesville with maintenance recommendations to help efficiently allocate staff and budgetary resources.

For the City of Charlottesville, 200 street segments of varying lengths were randomly selected for inventory on one side of the street. The inventory included planting spaces, existing and dead trees, and stumps along public streets, totaling 463 sites. Data collected included tree species, size, location, condition, maintenance, and priority. Planting site selection followed guidance from the City of Charlottesville and industry standards from the University of Florida (Gilman, 2015). A complete list of attributes is provided in Appendix A. Data was collected by International Society of Arboriculture (ISA) Certified Arborists with Tree Risk Assessment Qualification during April and May 2025. An ISA Board Certified Master Arborist conducted onsite training, remote data checks, and quality control.

Findings

In total, 306 individual trees, 151 planting sites, and 6 stumps were inventoried along the randomly selected street segments (Figure 16). Of Charlottesville's 169 miles of maintained roads, approximately one side of 13.55 miles of streets were surveyed. Based on this sample, Charlottesville averaged about 45.2 trees, 22.3 planting sites, and 0.9 stumps throughout its 169 centerline miles. This is significantly below the national average of 76.1 street trees per mile and the Northeast regional average of approximately 116 trees per mile, but close to the average of 58 trees per mile for similarly sized communities (Hauer & Peterson, 2016). Expanding from this sample data, it can be estimated that Charlottesville has approximately 7,634 street trees, 3,767 planting sites, and 150 stumps along its streets.

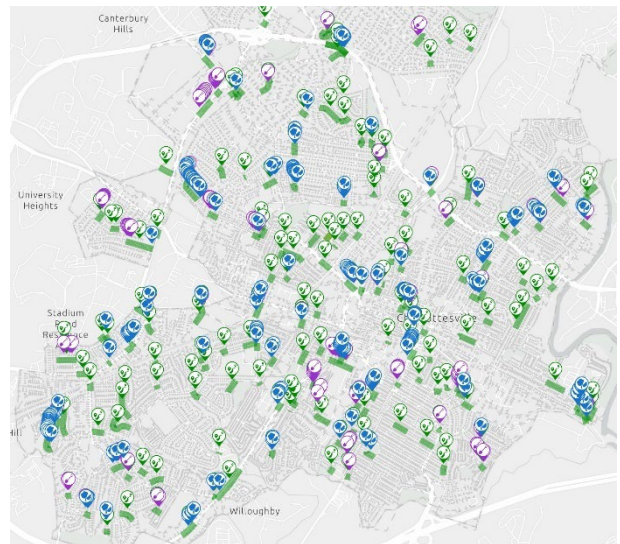


Figure 16. Geographical distribution of inventoried street segments, trees, planting sites, and stumps.

Stocking

The stocking of street trees in a city is the proportion of available planting spaces along streets that are planted with trees, typically expressed as a percentage. Measuring and understanding stocking levels enables planners to identify areas that need additional tree planting. It also assists in developing street tree planting plans and budgeting.

Of the 463 sites inventoried along the 200 street segments, 66.1% contained trees. Charlottesville exceeds the national average of 60%. However, urban forestry guidelines suggest that 75-80% street stocking is an ideal goal (Bassuk, 2018).

Species Composition & Diversity

A total of 68 unique species, 43 genera, and 27 families were inventoried along the street segments. The two most common trees found along the streets were flowering dogwood (10.8%) and red maple (10.8%, Figure 17). Other frequently observed species were eastern redbud (5.6%), willow oak (4.6%), Japanese flowering cherry (4.2%), London planetree (4.2%), sugar maple (4.2%), and Japanese tree lilac (3.3%).

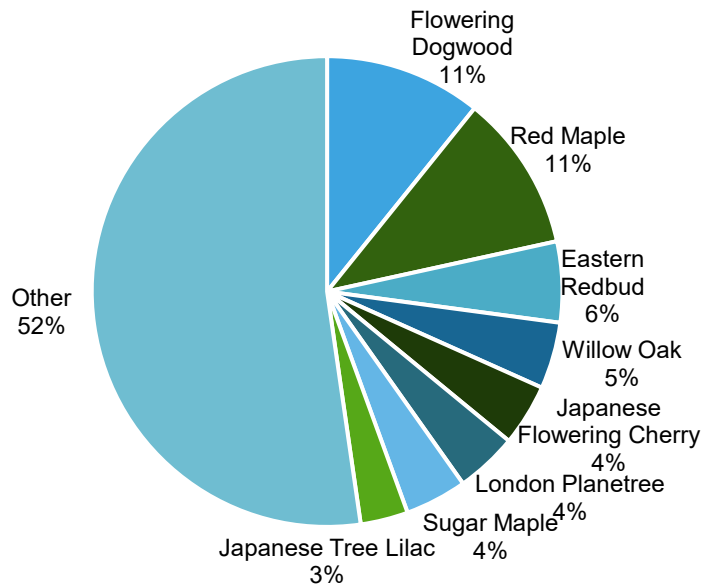


Figure 17. Tree species frequency in street tree study.

In the urban forest, tree species diversity is one metric cities can use to determine the resiliency of their street tree population. The greater variety of species, genera, and families found decreases susceptibility to significant canopy loss from disease, storms, and insects. While several established guidelines exist for species diversity, the most recent and strictest recommendation is the 5-10-15 guideline (Watson, 2017). It states that a population should not exceed 5% of a single species, 10% of a genus, or 15% of any family. While experts recognize that 5-10-15 may not be feasible in all urban areas, it provides valuable information for planning, particularly for tree planting and species selection.

Charlottesville's inventory showed three species, three genera, and one family exceeding the 5-10-15 diversity guidelines (Figure 18). Together, the three species exceeding the threshold comprised over 27% of the population.

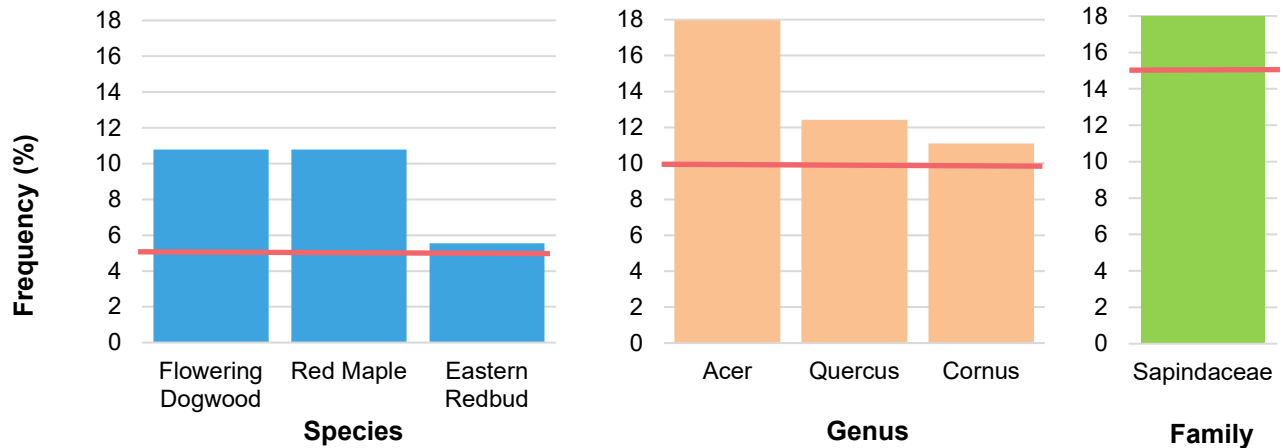


Figure 18. Species, genera, and family exceeding 5-10-15% diversity guidelines depicted by a bar at the threshold.

Invasive Tree Species

Of the inventoried trees, 4% were species considered invasive as determined by the Virginia Department of Conservation and Recreation (*Virginia Invasive Plant Species List*, 2023). These species included: Callery pear (1%), Norway maple (1%), tree of heaven (1%), and white mulberry (1%).

Tree Size & Age

Tree size, measured as the trunk diameter in inches, can be used to gauge the age of a tree population. Like species diversity, unequal age distribution is a desired attribute of a city's urban forest. Ideally, there would be a mixture of young to old trees to sustain canopy cover as older trees die and are removed (Clark et al., 1997). Charlottesville's size distribution graph (Figure 19) displays a mix of ages and an average tree diameter of 10.5 inches. However, there are some drops in the graph, illustrating years of higher and lower tree planting. Specifically, there are many small trees (under 4 inches in diameter), suggesting a recent planting effort. The highs and lows could be due to a variety of factors, such as inconsistent funding for new trees, fluctuations in staffing or volunteer numbers, construction, or policy changes.

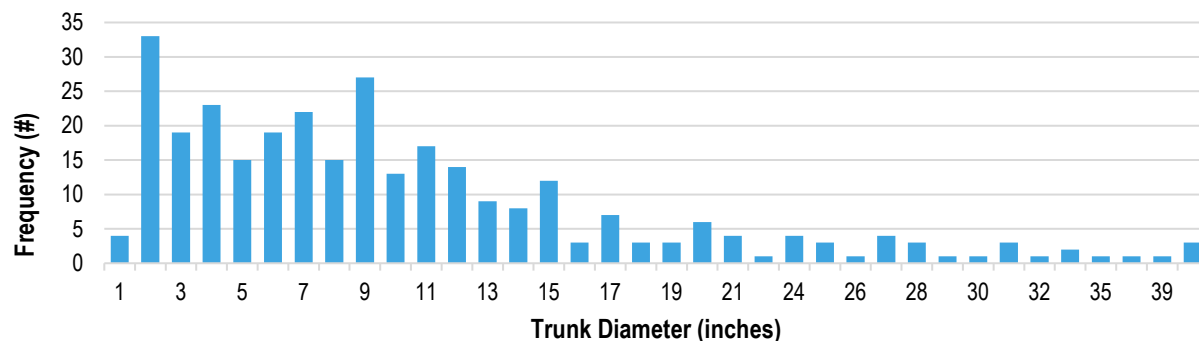


Figure 19. Street tree size by frequency.

Tree Condition

To evaluate the condition of a tree, the health and structure of the roots, trunk, branches, twigs, foliage, and buds are systematically examined. This results in a percentage rating, with 100% being a perfect tree and 0% being a dead tree. In Charlottesville, the majority (84%) of trees were in Good or Excellent condition, with an average condition rating of 73.2% (Figure 20). By removing the dead trees, Charlottesville's condition rating will increase to slightly over 75%. Preferably, the average tree condition would be 75% or higher, which is indicative of a well maintained street tree population.

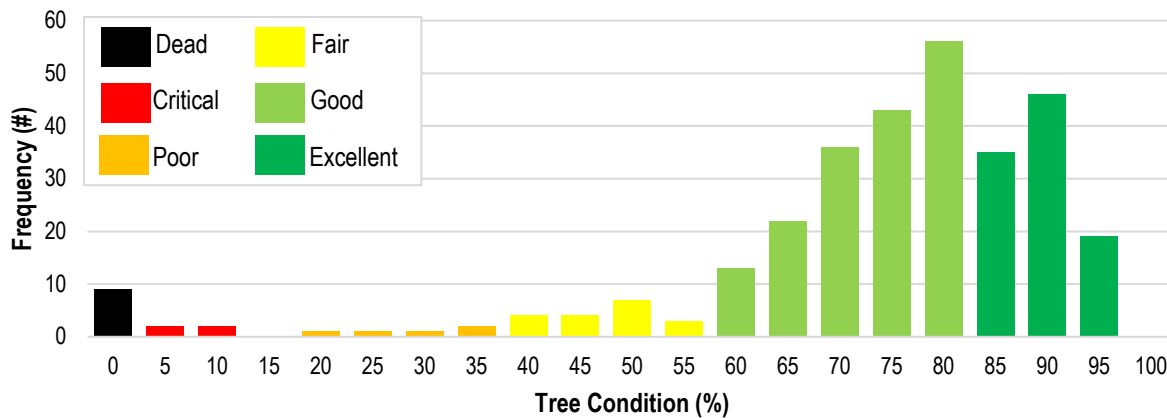


Figure 20. Tree condition based on Council of Tree and Landscape Appraisers (CTLA) system.

Maintenance

When developing maintenance recommendations for street trees, various factors, including tree size (height and diameter), location, and condition, are considered. Some recommendations, such as pruning dead wood, might be undertaken to improve tree health and reduce risk to the public. Other actions, such as removal or clearance pruning, may be based solely on reducing public risk.

While almost 40% of Charlottesville's trees had either no maintenance or visual monitoring recommended, over 60% had pruning, removal, or treatment recommended (Figure 21). Clearance Pruning, such as removing low branches over sidewalks or branches that obscure stop signs, was the most frequently recommended maintenance activity (30.1%). With many small, young trees inventoried, this is a common maintenance recommendation. Pruning dead, dying, and damaged tree branches or limbs was also commonly recommended (14.7%).

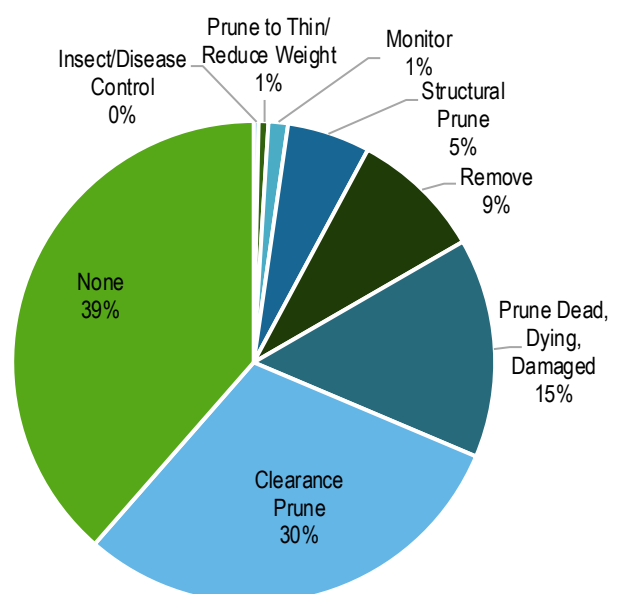


Figure 21. Recommended street tree maintenance.

Maintenance Priority

As part of developing a maintenance recommendation, inventory arborists categorized the action's priority as Priority 1, 2, or 3 (Figure 22). Priority 1 was the most urgent work, such as removing a large, dead tree limb over a children's playground. Although Charlottesville has a relatively high proportion of trees with maintenance recommendations, only 3.2% of those trees were classified as Priority 1. Priority 2 work accounted for 42% of the maintenance, while the lowest level of Priority 3 made up 54.8% of the recommendations.

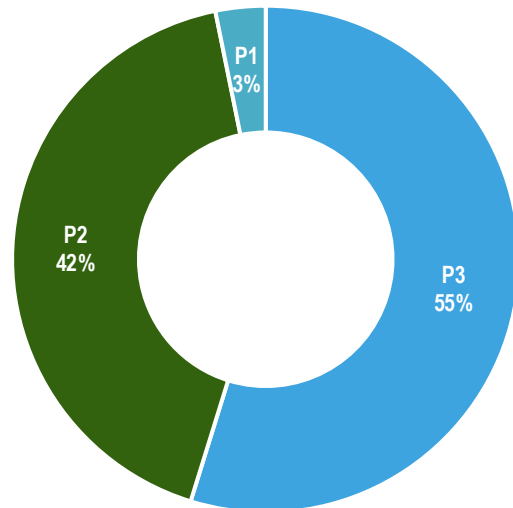


Figure 22. Priority of recommended tree maintenance.

Small Tree Species vs. Large Tree Species

Large-stature trees are widely recognized for delivering the most significant social, economic, and environmental benefits (Geiger, 2004). However, despite this understanding and a commitment to expanding urban tree canopy, many cities encounter physical and design limitations to planting large-stature trees. Constraints such as narrow rights-of-way, overhead and underground utilities, and competing priorities during street design often lead to the planting of smaller, ornamental tree species when trees are not considered earlier in the planning process. By analyzing the proportion of small to large street trees in Charlottesville, the City can better plan for consistent tree canopy while balancing infrastructure needs and environmental goals.

Overall, 37.6% of Charlottesville's inventoried street trees were small stature trees, or trees commonly growing less than 30 feet in height at maturity. While large tree species generally provide greater benefits, tree quality and health significantly affect the actual benefits delivered. Large trees that are invasive species, dead or dying, or have narrow or severely pruned canopies may provide fewer benefits than small trees that are healthy and appropriately matched to site conditions.

The ratio of small to large street trees in Charlottesville demonstrates the ongoing balance between maximizing environmental benefits and accommodating infrastructure constraints. Many of the City's street trees, which have been heavily pruned to clear overhead utility lines, will eventually require removal. If those trees are replaced, it is often with smaller-stature species due to site limitations, gradually moving the population toward smaller trees. This cycle reflects the challenge many cities face in sustaining an adequate large tree population while meeting infrastructure needs, highlighting the importance of appropriate species selection and coordination with utilities in urban forest planning.

Planting Sites

Along the 13.55 miles of streets surveyed, the availability of space to plant new trees was assessed. To determine viable planting sites, several logistical factors must be considered, including distance to street corners, size of the planting space, utilities, adjacent driveways, and signage. In Charlottesville, sites meeting those conditions were then assessed for the largest size tree they could support. Tree sizes were based on industry standard planting guidelines (Gilman, 2015), where a small tree is under 30 feet tall at maturity, a medium tree is less than 50 feet tall, and a large tree is taller than 50 feet. Such guidelines rely on soil volume, distance between sidewalk and curbing, and distance from pavement or walls to recommend a maximum tree size at maturity. Additional assessments were conducted for planting sites with minor restrictions, such as existing landscape plants or pavers, to evaluate their suitability for planting.

In total, 151 sites along the 13.55 miles of streets surveyed met planting requirements. Planting spots were further classified as Plantable 1 if they were shovel-ready, meaning they consisted of existing turf grass or bare soil and lacked restrictive site factors. Locations that required minor modification were labeled Plantable 2. Of the inventoried sites, an overwhelming majority were Plantable 1 (92%) (Figure 23). A small portion, approximately 8%, of the sites were Plantable 2 and required minor modifications to support a new tree.

Of all the planting sites identified, the majority (62.9%) could support only a small tree species. Almost 30% of the sites had enough space for a medium sized tree; slightly more than 7% of the planting spots could accommodate a large species tree. Regardless of the Plantable category, small tree planting sites consistently dominated across size classifications (Figure 24).

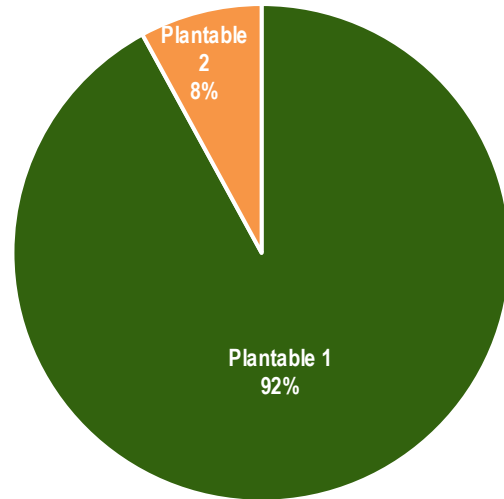


Figure 23. Proportion of planting site type along City streets.

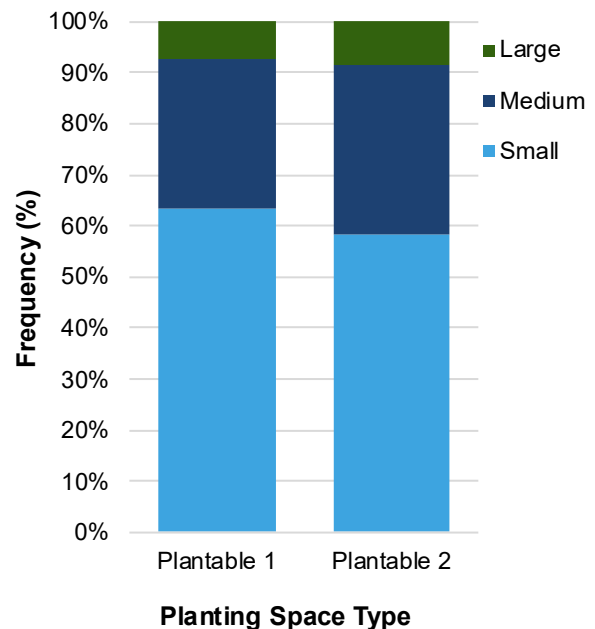


Figure 24. Comparison of planting site size between site types.

Ecosystem Benefits

Through i-Tree Eco, the sample of Charlottesville's street tree inventory can be used to estimate environmental values for the street tree population. I-Tree Eco accounts for the species, size, and condition of inventoried trees to estimate annual amounts of carbon sequestered, water runoff avoided, pollution removed from the atmosphere, and oxygen produced. Except for oxygen production, those amounts are translated into annual dollar amounts. i-Tree Eco also uses standardized values for calculations, combined with local weather station data. Additionally, it provides values for carbon storage and replacement that are not annual.

Using the estimate of 7,634 City street trees, i-Tree calculated a total replacement value of almost \$18 million and a carbon storage value of over \$1.3 million. Annual values were calculated to be slightly over \$93,000 combined (Table 4).

Table 4. Ecosystem benefits and monetary value of estimated street trees within the City of Charlottesville, calculated by i-Tree Eco.

Annual Removal or Runoff Rates	Amount ¹	Value (\$)
Gross Carbon Sequestration	74	31,813
Avoided Runoff	876,645	7,834
Pollution Removal	2	54,053
Oxygen Production	196	N/A
Annual Total		\$93,700
Carbon Storage (not annual)	3,145	1,361,164
Replacement Value (not annual)		17,872,498

¹ Units in tons except water runoff in gallons

Conclusions

Charlottesville's street tree study tells a story of limited opportunities. While the City's stocking rate of over 66% is higher than the national average of 60%, its density of 45.2 trees per centerline mile is less than the national average of 76.1. Even if 100% stocked with street trees, the City would remain below that average. This reflects Charlottesville's limited street tree planting opportunities: the City stocks available sites more effectively than other cities but has fewer planting sites per mile due to infrastructure constraints and narrow rights-of-way. This limitation means streets may be less tree-lined than in other cities, and achieving tree canopy goals will require significant contributions from private property and parks rather than relying primarily on street trees.

The City's trees are relatively healthy, but they require maintenance to remain functional and coexist with urban infrastructure needs. Most trees do not require removal; rather, they need routine maintenance to remain compatible with urban infrastructure. This

pattern is more evident with younger trees that, after planting, initially interfere with pedestrian and vehicle clearance but can be managed through pruning as they mature and develop appropriate canopy proportions. Thus, the maintenance needs are functional rather than health-related, focused on ensuring trees can coexist with infrastructure. While the high amount of recommended clearance pruning could indicate urban design challenges such as improper species selection or inadequate growing space, Charlottesville's tree size and condition data suggest that maintaining clearance for establishing young trees is the more pressing maintenance factor.

In terms of species diversity, the overutilization of flowering dogwood and red maple, which together account for almost 22% of inventoried trees, is concerning. While both are popular native species with a variety of benefits, dogwoods, in particular, have several pest and disease issues that can ultimately lead to their death. Since Charlottesville is located in an ideal climate for tree growth, it should be able to sustain a more diverse street tree population than was inventoried. However, a majority (62.9%) of the available planting spaces can only accommodate small stature trees, limiting the species selection for planting. While diversity is important for increasing the resilience of a tree population, planting trees matched to site conditions is equally or more crucial.

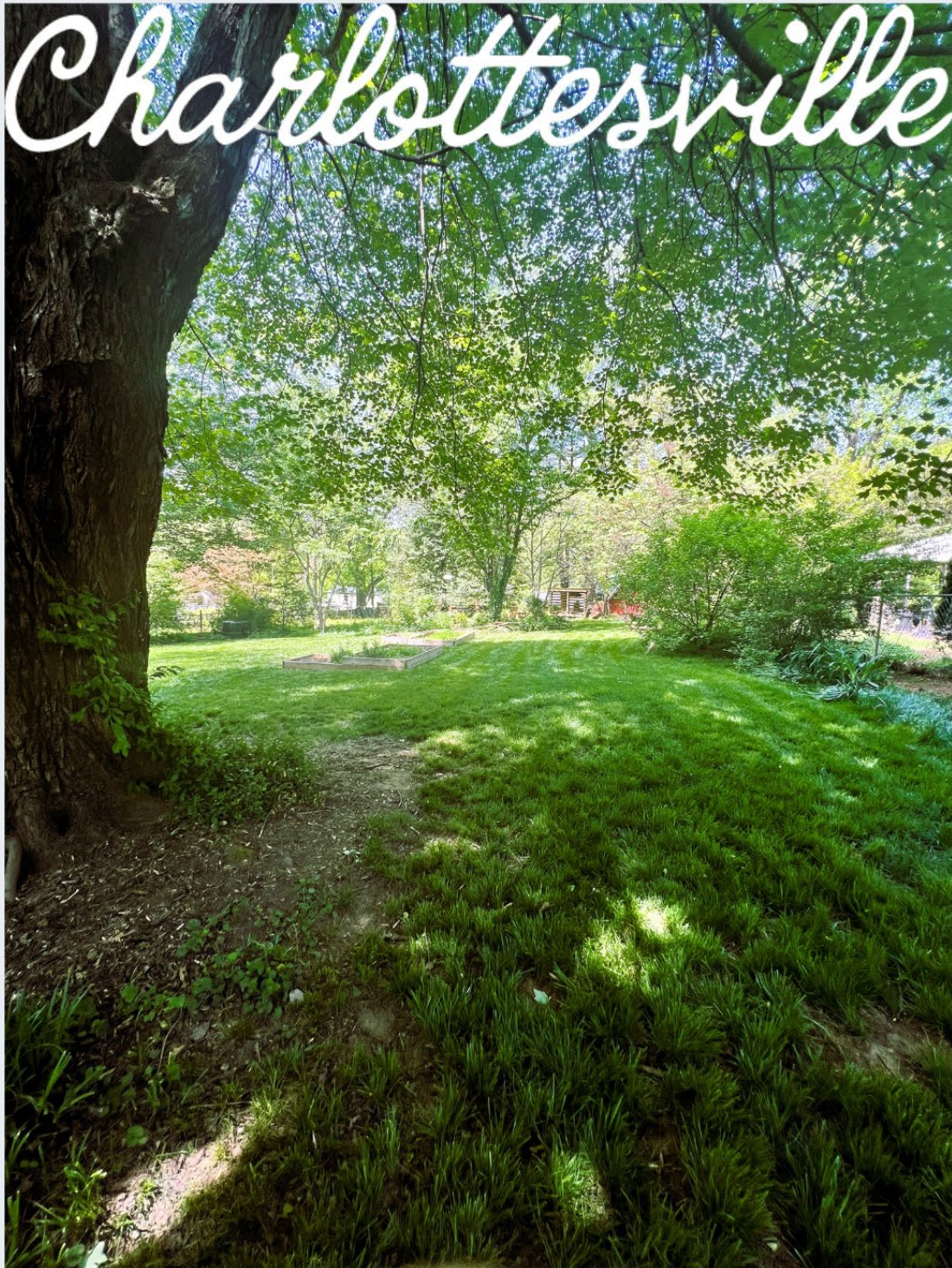
Of all the inventoried planting sites, a majority (almost 63%) were suitable for small stature trees. However, most trees inventoried (approximately 62%) were medium or large stature trees, likely because the City has prioritized planting sites that support larger trees first, leaving more smaller spaces open for future plantings. While large trees provide greater benefits related to canopy cover and ecosystem services, smaller stature trees remain valuable contributors to the urban forest, particularly for providing shade on a pedestrian level. Setting aside socio-economic and geographic variables, targeting the largest sites is most effective, as large trees deliver the greatest value and impact.

Recommendations

The following are preliminary recommendations to be further developed as part of the City's future UFMP:

- Increase street tree stocking to 75-80% to align with best practices
- Focus planting efforts on the largest sites in areas with lower canopy cover
- Look beyond available street tree planting space for alternatives such as street bump outs, medians, islands, and partnerships with adjacent private property
- Limit planting of over-represented species to increase resilience
- Introduce underused species appropriate for the site to increase species diversity
- Develop a routine inspection and maintenance plan to ensure trees are receiving the work needed to enhance and sustain public benefits
- Integrate urban forestry with citywide design and planning to ensure proper site design for trees, minimize future conflicts, and preserve mature trees

VEGETATION ASSESSMENT



PART 3

Summary

Traditional municipal tree inventories capture only City-owned trees, such as those in parks and along streets. However, a city's urban forest, by definition, is composed of all public and private trees within its boundaries. To develop a clear, representative picture of Charlottesville's urban forest, a vegetation analysis was conducted on randomly selected public and private parcels throughout the city. The data collected included tree and plant species, condition, ground cover, and the level of non-native species invasion.

The sampling design used a random stratified approach across six zoning categories, ensuring representation of various land uses. In total, 302 plots covering approximately 61.3 acres were assessed. Using the sampling ratios, estimates of tree density, planting space availability, and the total number of trees were developed.

Key Insights

Tree Density & Distribution:

- Average tree density of 40.6 trees per acre
- Highest density in Special and Residential zoning; lowest density in Industrial Flex
- 221,982 total estimated number of trees on parcels in the city

Species Composition & Condition:

- 131 species, 65 genera, and 36 families were inventoried
- Tulip tree and red maple were most common species
- High diversity, no species exceeding 10% of the population
- Average tree condition rating of Good (65.0%)
- Invasive trees accounted for 6% of the tree population
- Tree of heaven and vines were the invasive plants of most concern

Planting Potential:

- 79% stocking rate on parcels citywide vs. 66% stocking rate for City street trees
- Greater large tree planting potential on parcels compared to street rights-of-way

Recommendations

The following recommendations are intended for the City to explore in its future UFMP:

- Lead by prioritizing planting of trees and managing invasive species on City property
- Provide education, incentives, and support in planting new trees, removing dead trees, and controlling invasive species
- Encourage replacement of lawns and impervious surfaces with native trees
- Understand barriers to tree planting on private property and work to remove obstacles
- Continue to build relationships with nonprofit and educational organizations

Methods

The vegetation analysis employed a random stratified sampling approach to obtain a representative sample of the entire city. The six base zoning districts, including residential, residential mixed use, corridor mixed use, node mixed use, industrial flex, and special, were used for stratification. These districts were established in the City's Development Code (City of Charlottesville, 2023). Stratification was chosen for this study because it offers several advantages over simple random sampling, such as ensuring all key land uses are represented in the sample. Without stratification, some categories may be undersampled or even missed. Stratification enables more accurate, representative results for the city's vegetation with fewer plots than non-stratified sampling.

Both the total number of parcels and total parcel acreage were used to allocate the number of plots for assessment in each zoning category. For an anticipated 300 plots, 600 parcels were selected to request permission to access the property. The selected parcel owners were mailed letters requesting permission to conduct the vegetation study. In total, 302 parcels throughout the city were accessed (Figure 25).

For this study, the parcel was intended to serve as the plot, with a desired plot size of $\frac{1}{5}$ acre. If the parcel was larger than $\frac{1}{2}$ acre, arborists used a $\frac{1}{5}$ acre fixed radius plot. If the parcel was $\frac{1}{2}$ acre or smaller, arborists collected data on the entire parcel. Information collected for each plot included location, size, tree and plant species, invasive species, ground layer attributes, and tree size and health. In wooded or non-maintained settings, the minimum tree size inventoried was 4 inches in diameter; in maintained and landscaped settings, the minimum size inventoried tree was 1 inch in diameter and larger. The complete list of attributes is located in Appendix A.

Data was collected by Certified Arborists through the International Society of Arboriculture (ISA) with Tree Risk Assessment Qualification during April and May 2025. An ISA Board Certified Master Arborist conducted on-site training, remote data checks, and quality control.

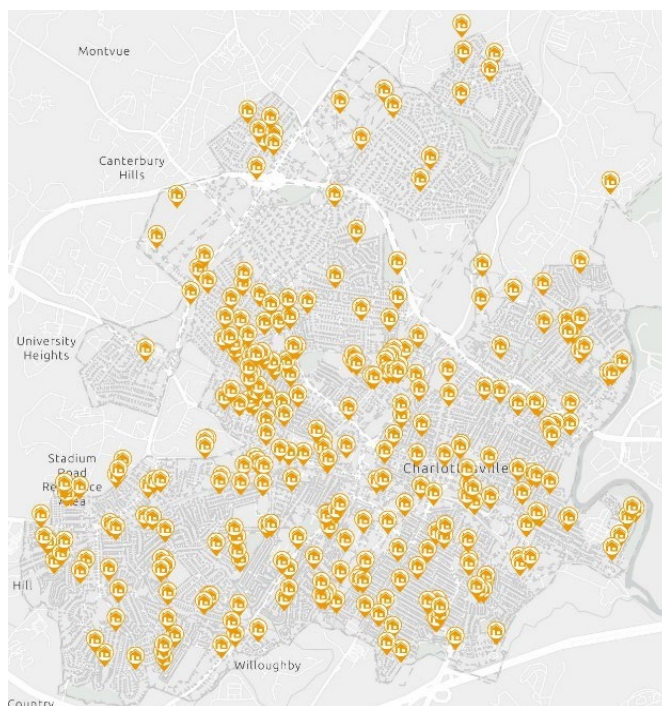


Figure 25. Distribution of plots throughout the City.

Findings

In total, 302 parcels were inventoried, covering approximately 61.3 acres of assessed land. The parcel selection was stratified by zoning categories, with the majority of parcels (53.0%) zoned Residential (Figure 26). The average plot size was approximately 0.2 acres.

To estimate the total number of trees, a tree-to-acreage ratio was calculated for each zoning category. Special

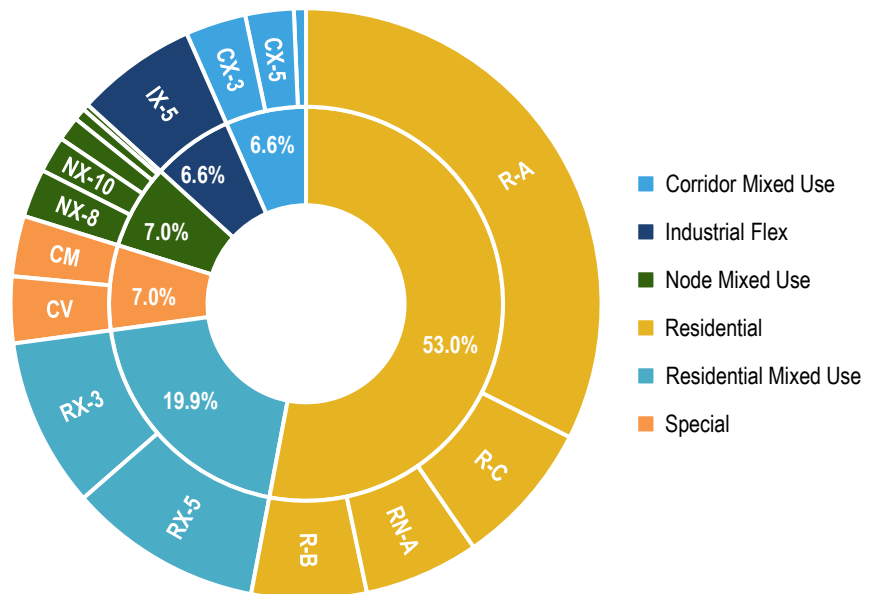


Figure 26. Distribution of plots by zoning category and sub-category.
Note: Percentages may not equal 100% due to rounding.

zoning had the highest number of trees per acre at almost 68 (Table 5). Residential and Residential Mixed Use were the next highest at approximately 40 and 26 trees per acre, respectively. Corridor Mixed Use averaged almost 18 trees per acre, while Node Mixed Use averaged about 8 trees per acre. Industrial Flex had the lowest average of under 3 trees per acre. Industrial Flex is also the smallest zoning category in the city by area, comprising only 1.3% of the total land area. Overall, the city is estimated to have an average tree density of 40.6 trees per acre and approximately 221,982 trees on parcels. This estimate excludes trees in the right-of-way, such as street trees.

Table 5. Estimate of total number of trees citywide by zoning category.

Zoning Category	Total Acres	Trees per Acre	Estimated # of Trees
Corridor Mixed Use	365.4	17.5	6,398
Industrial Flex	73.2	2.4	172
Node Mixed Use	524.9	8.2	4,313
Residential	2946.5	39.7	116,873
Residential Mixed Use	270.1	25.8	6,959
Special	1286.5	67.8	87,267
TOTAL			221,982

Tree Species Composition

Of the 1,984 inventoried trees, there were 131 unique species, 65 genera, and 36 families. This variety is what might be expected in an area like Charlottesville, where conditions encourage high diversity. The most dominant species was tulip tree (11.5%), followed by red maple (7.3%) and flowering dogwood (4.7%) (Figure 27). Silver maple, crapemyrtle, black locust, and black cherry were also prevalent in the parcel tree inventory. Compared to the street tree inventory, tulip tree was infrequently found, while red maple accounted for 11% of the street and parcel inventoried trees.

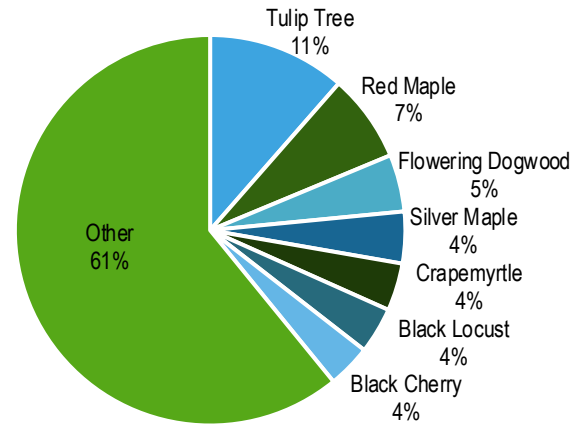


Figure 27. Tree species frequency in Charlottesville.

Invasive tree species comprised approximately 6% of the tree population (Table 6). This is notably higher than the street tree inventory, which found 4% of the trees were invasive. The tree of heaven is the most dominant invasive tree in the inventory, comprising almost 3% of the tree population.

Table 6. Invasive tree species across Charlottesville.

Species	% of All Trees
Tree of Heaven	2.7
Callery Pear	1.1
Mimosa	1.0
Norway Maple	0.5
White Mulberry	0.4
TOTAL	5.7

Tree Size & Age

An estimate of tree age can be developed by studying the size of trees within a population. An unequal age distribution, with a higher proportion of small, young trees, is considered desirable in an urban forest. The vegetation assessment indicated that Charlottesville has an uneven-aged tree population, with 11.4% of trees having a diameter of 25 inches or more (Figure 28). However, since seedlings, saplings, and most trees under 4 inches in diameter were not inventoried, the actual percentage is likely lower. There was also a large number of younger trees, 4 to 6 inches in diameter, indicating planting and regeneration.

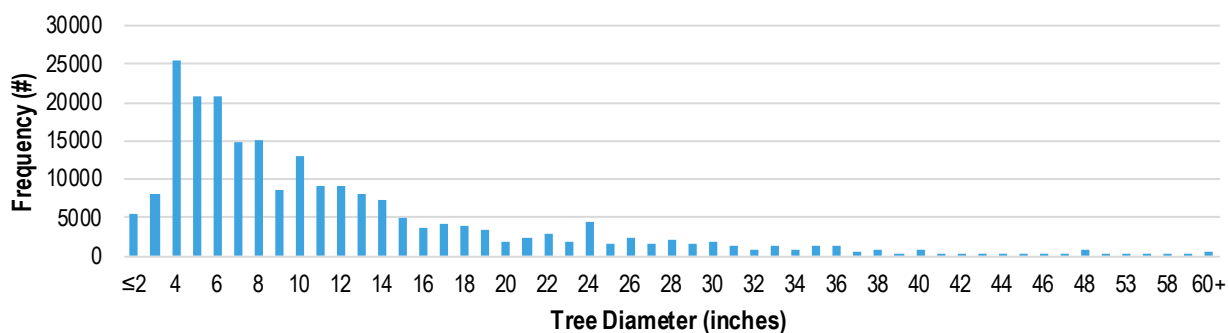


Figure 28. Frequency of tree diameters.

Tree Condition

Overall, the cataloged trees had an average condition rating of 65% (Figure 29). In general, a condition of 75% is associated with a well-managed and cared for tree population in maintained landscapes. While the citywide tree condition rating is lower than Charlottesville's street tree sample rating, it is still categorized as being in Good condition. If the inventoried dead trees were removed, the average would increase to almost 68%.

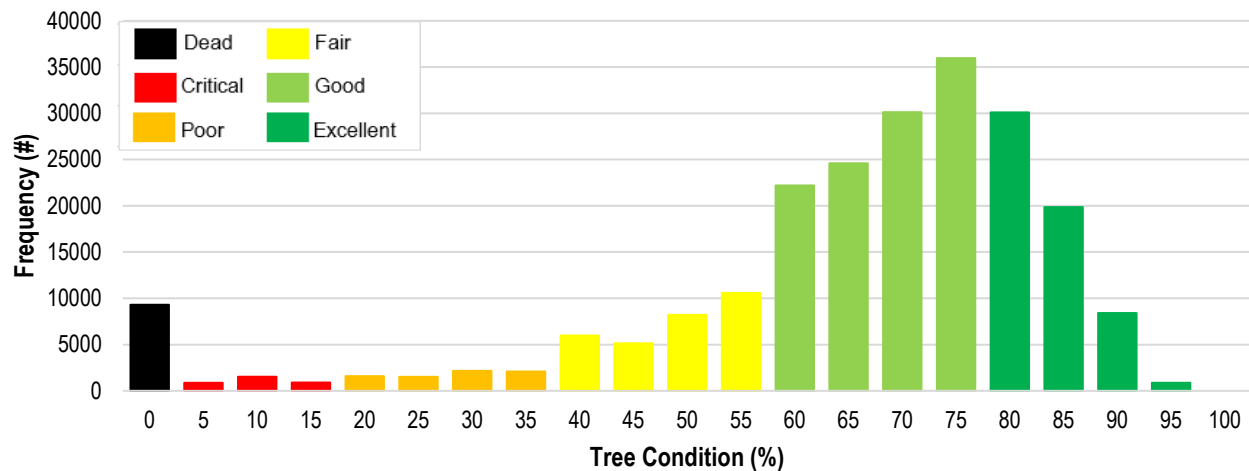


Figure 29. Tree condition based on Council of Tree and Landscaper Appraisers (CTLA) system.

Invasive Plants

Invasive species are one of the most significant threats to native plants. They can displace or drive out native plants, alter wildlife habitat, and reduce plant abundance and biodiversity. In Charlottesville, invasive plants (trees, shrubs, vines, and ground covers) were estimated to be present on 83.4% of citywide acres. Vines were the most widespread category, with English ivy alone estimated to be found in 3,969 acres or 72.6% of the city's acres (Figure 30). Tree of heaven was the most frequently invasive tree, estimated across almost 1,000 acres or 18.1% of citywide acreage. It is also the primary host of the spotted lanternfly, an invasive pest that feeds on and harms grape vines and fruit trees. Given the economic importance of nearby vineyards and orchards, tree of heaven management is necessary to help control this potentially damaging pest.

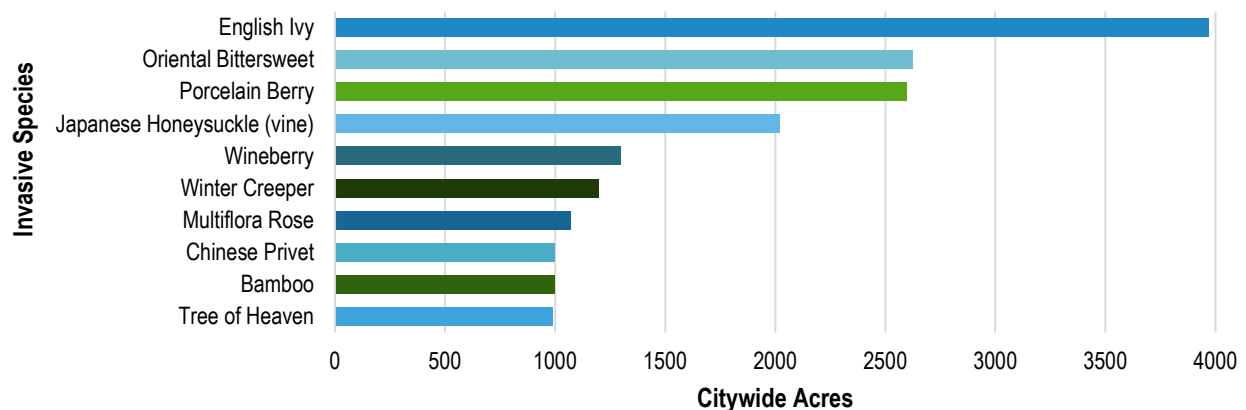


Figure 30. Estimated citywide distribution of the ten most prevalent invasive species across Charlottesville by acreage.

As part of the assessment, each plot was assigned an invasive species rating on a scale of One through Five. A plot with a One rating has few to no invasive plants, whereas a Five rating consists mainly of invasive species. The majority (59%) of plots citywide were rated Two for invasive rating, and 77% were rated One or Two (Figure 31). It is important to realize that all plots, including those entirely composed of impervious coverage, were included in these calculations. For example, a paved parking lot may receive a One rating if no invasive species are present.

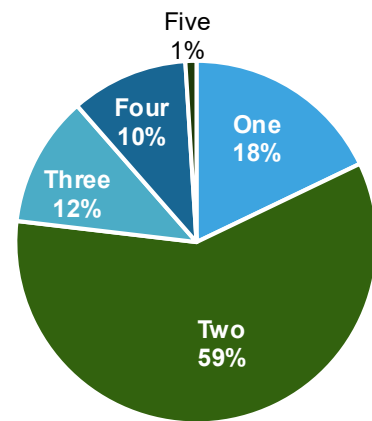


Figure 31. Intensity of invasive species in Charlottesville.

Although invasive species were commonly observed in plots, the overall invasion intensity in each plot remained relatively low. This pattern likely reflects the prevalence of lawns and impervious surfaces in sampled areas, which limit opportunities for invasive plants to establish. The dominance of invasive vines (e.g., English ivy, porcelain berry, Japanese vine honeysuckle) presents an ecological threat, as they tend to overtake the ground layer and suffocate young trees and plants. Once vines climb into the tree canopy, they can add weight to branches, increasing the risk of branch failure. Additionally, they may girdle limbs and kill foliage, further compromising tree health.



Photograph 2. Dense vine cover on a sampled parcel in Charlottesville, illustrating the presence of invasive species across the city.

Native Forest Regeneration

Forest regeneration, or the natural return of native trees and plants in wooded areas, was assessed separately from invasive species as an indicator of the ecological health and long-term resilience of Charlottesville's forested areas. The top native ground covers, shrubs, and trees in forested plots were identified. The top native ground covers were poison ivy and Virginia creeper. Others included ferns, grasses, greenbrier, mayapple, and goldenrod. In the shrub layer, the top plants were American holly and spicebush. Blackberry, flowering dogwood, and viburnums were also observed.

Various native trees were observed, with oaks as the most dominant, estimated to be found in over 1,500 acres citywide (Figure 32). Other frequently noted regenerating trees were maples (1,283 acres), hickories (1,145 acres), black cherry (876 acres), hackberry (800 acres), and eastern redbud (545 acres).

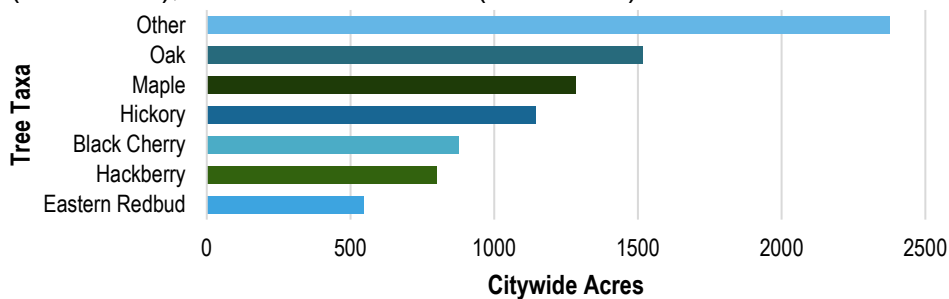


Figure 32. Estimated citywide distribution of native tree taxa regeneration by acreage.

Tree Planting Space

In addition to recording site conditions and vegetation, plots were assessed for planting suitability. Potential planting spots could not be under existing tree canopy and had to be “shovel-ready”, with existing ground conditions of mulch, turf grass, or bare soil. In accordance with industry standards (Gilman, 2015), small trees are under 30 feet tall at maturity, medium trees under 50 feet, and large trees over 50 feet. Guidelines rely on soil volume, distance from existing trees, and distance from pavement or walls to recommend a maximum tree size at maturity. In assessing planting site availability, larger trees were preferred where possible. While the assessment considered visible conditions, other unmarked conditions, such as private utilities, were not accounted for.

In total, an estimated 57,394 planting sites exist across Charlottesville, with an average of over 10 planting spots per acre. Of those sites, 89.7% are estimated to be located on land not owned by the City of Charlottesville. Parcels are approximately 79% stocked with trees, compared to 66% along City streets. This indicates that while planting opportunities exist, much of the available space already supports trees. Compared to streets, parcels also offer more opportunities for larger trees. Street tree planting availability was 7% for Large tree locations, while parcels had 42% suitable for Large trees (Figure 33).

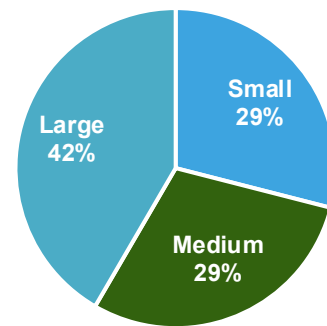


Figure 33. Planting size distribution.

Conclusions

The vegetation inventory across Charlottesville's sampled parcels reveals a landscape with a presence of invasive species, particularly vines and tree of heaven, that threaten tree health and public safety. Encouragingly, desirable native tree species are regenerating in forested areas, and species diversity was higher than in the street tree sampling. However, over-reliance on tulip tree and red maple remains a threat to the forest's resilience. Most assessed trees were healthy but would benefit from proper management, including dead tree removal. Invasive species control is also needed to protect native regeneration and long-term forest health.

The ground-based land cover analysis revealed significant grass lawn coverage and a higher percentage of impervious surfaces than the aerial assessment. While lawns offer potential planting areas, impervious surfaces make it challenging to identify spots with adequate space for root and canopy development. Despite limitations, parcels across Charlottesville offer greater potential for planting larger trees than City streets. Parcels are 79% stocked compared to 66% along streets, and 71% of parcel planting sites are suitable for medium or large trees compared to just 37% along streets.

The vegetation assessment highlights that private property is essential to canopy growth in Charlottesville. An estimated 90% of planting spaces lie on land not owned by the City, making private property engagement essential to any canopy growth strategy. Long-term success depends on strong partnerships, public engagement, effective programs, and a comprehensive regulatory framework to support tree preservation and canopy growth. Existing initiatives and partnerships should be strengthened and evaluated to ensure they support urban forest growth and sustainability.

Recommendations

The suggestions below will be developed further as part of the City's future UFMP:

- City to lead by example in prioritizing trees in public projects, tackling invasive species issues on City property, and increasing tree planting on public property
- Continue to develop and promote programs that provide free trees to residents
- Enhance and expand partnerships with non-profit and educational organizations
- Offer incentives for native tree replacement of turf grass and impervious surfaces
- Discourage use of overpopulated species through nursery programs and recommended species lists
- Provide education and technical assistance for invasive species management
- Support removal of dead trees through grants or cost-assistance programs
- Identify tree planting barriers through community engagement
- Strengthen existing ordinances to better protect existing trees through incentives, flexible regulations, and clear accountability mechanisms
- Map remaining forested areas to inform preservation priorities

References

- Bassuk, N. (2018). *Community Forestry, Conducting a Street Tree Inventory*. Cornell University. <http://www.hort.cornell.edu/commfor/inventory/utilizing.html>.
- City of Charlottesville, Virginia, Development Code § 34-1 (2023).
- Clark, J., Matheny, N., Cross, G., & Wake, V. (1997). A Model of Urban Forest Sustainability. *Arboriculture & Urban Forestry*, 23(1), 17–30. <https://doi.org/10.48044/jauf.1997.003>.
- Clymire-Stern, E. F., Hauer, R. J., Hilbert, D. R., Koeser, A. K., Buckler, D., Buntrock, L., Larsen, E., Timilsina, N., & Werner, L. P. (2022). Comparison between Artificial and Human Estimates in Urban Tree Canopy Assessments. *Land*, 11(12), 2325. <https://doi.org/10.3390/land11122325>.
- Dhal, L., Gordon, J., Young, A., Subedi, M. R., Jennings, K., Lepine, L., Brandeis, T., & Dwivedi, P. (2025). Examining the impacts of urban tree structure and condition on adult depression in the United States. *Trees Forests and People*, 100734. <https://doi.org/10.1016/j.tfp.2024.100734>.
- Geiger, J. (2004). The Large Tree Argument: The Case for Large Trees vs. Small Trees. *Western Arborist*, 30(1), 14–15. https://www.fs.usda.gov/psw/topics/urban_forestry/products/cufr476_large_tree_argument.pdf.
- Gilman, Edward F. (2015). *Special planting situations - Urban design - Landscape plants*. University of Florida IFAS. <https://hort.ifas.ufl.edu/woody/planting-guidelines.shtml>.
- Hauer, R. J., & Peterson, W. D. (2016). *Municipal Tree Care and Management in the United States: A 2014 Urban & Community Forestry Census of Tree Activities*. University of Wisconsin – Stevens Point.
- Hauer, R. J., & Peterson, W. D. (2017). Effects of emerald ash borer on municipal forestry budgets. *Landscape and Urban Planning*, 157, 98–105. <https://doi.org/10.1016/j.landurbplan.2016.05.023>.
- i-Tree Canopy. i-Tree Software Suite v6.1.51. (n.d.). <https://canopy.itreetools.org/>
- Jennings, V. & Bamkole, Omoshalewa. (2019). The Relationship between Social Cohesion and Urban Green Space: An Avenue for Health Promotion. *International Journal of Environmental Research and Public Health*. 16. 452. <https://www.mdpi.com/1660-4601/16/3/452>.
- Locosselli, G. M., & Buckeridge, M. S. (2023). The science of urban trees to promote well-being. *Trees*, 37(1), 1–7. <https://doi.org/10.1007/s00468-023-02389-2>.

Lin, J., Wang, Q., & Huang, B. (2021). Street trees and crime: What characteristics of trees and streetscapes matter. *Urban Forestry & Urban Greening*, 65, 127366. <https://doi.org/10.1016/j.ufug.2021.127366>.

Ning, Z. H., Nowak, D. J., & Watson, G. W. (2017). *Urban Forest Sustainability*. International Society of Arboriculture.

United States Department of Agriculture (2023). National Agriculture Imagery Program (NAIP). NAIP GeoHub. <https://naip-usdaonline.hub.arcgis.com/>.

Virginia Department of Forestry. (2019). *Planting Trees*. <https://dof.virginia.gov/urban-community-forestry/urban-forestry-homeowner-assistance/planting-trees/>.

Virginia Invasive Plant Species List. (2023). Virginia Department of Conservation and Recreation, Division of Natural Heritage. <https://www.dcr.virginia.gov/natural-heritage/document/nh-invasive-plant-list-2023.pdf>.

Virginia Population Estimates | Cooper Center. (2024). <https://www.coopercenter.org>. <https://www.coopercenter.org/virginia-population-estimates>

World Health Organization. (2024, May 28). *Heat and health*. World Health Organization; World Health Organization. <https://www.who.int/news-room/fact-sheets/detail/climate-change-heat-and-health>.

Appendix A– Data Collection Attributes

Table A-1. Data collection attributes and description for sample street tree inventory and plot vegetation assessment.

Street Tree Data Collection Attributes	
Data Attribute	Description
Address	Adjacent street address
Block Side	North, South, East, or West side of inventoried street segment
Street Seg Length	Length of street segment
Common Name	Common name of species
Botanical Name	Species and genus
DBH	Diameter measure in inches at 4.5 feet above ground level
Multistem	Yes/No
Condition	Percent health rating of tree (CTLA)
Recommended Maintenance	None, remove, monitor, clearance prune, structural prune, prune to thin/reduce weight, prune dead/dying/damaged, insect disease control
Maintenance Priority	P1 (highest priority), P2 (medium priority), P3 (lowest priority)
GPS Coordinates	Latitude and Longitude
Created By	Inventory arborist name
Date Created	Inventory date and time
ID	Unique tree ID number
Plot Vegetation Assessment Data Collection Attributes	
Address	Property Address
Parcel Number	From City GIS files
Parcel Size (Acres)	Total parcel size
Plot Size (Acres)	Size of study plot
Zoning	From City GIS files
GPS Coordinates	Latitude and Longitude of plot center
Invasive Species	Invasive species found in plot
Invasive Species Rating	Intensity of invasive species on a scale of One to Five
Planting Sites	Number of small, medium, and large planting sites available
Ground Conditions	Estimated percent coverage of gravel, bare soil, forest, impervious, turf grass, plants/mulch/landscaping, and other
Regeneration	Top native plants regenerating in forested areas for the ground layer, shrub layer, and trees
Plot ID	Unique plot ID number
Tree Species	Collected for each tree in the plot
Tree Condition	Percent health rating of tree; collected for each tree in the plot
Tree ID	Unique tree ID number
Created By	Inventory arborist name
Date Created	Inventory date and time

Appendix B– User & Producer Accuracy Outcome

Table B-1. 2006 user and producer quality control outcome by land cover.

Charlottesville 2006 Entire Area User and Producer Outcome: Quality Control Outcome							
Producer	User						Producer Accuracy
	Land Cover Type	Bare Soil	Grass & Herbaceous	Impervious Surface	Tree Canopy	Water	
	Bare Soil	2					100.0
	Grass & Herbaceous		40	1			97.6
	Impervious Surface		1	96	4		95.0
	Tree Canopy		3		152		98.1
	Water					1	100.0
Grand Total		2	44	97	156	1	300
User Accuracy		100.0	90.9	99.0	97.4	100.0	

Table B-2. 2014 user and producer quality control outcome by land cover.

Charlottesville 2014 Entire Area User and Producer Outcome: Quality Control Outcome							
Producer	User						Producer Accuracy
	Land Cover Type	Bare Soil	Grass & Herbaceous	Impervious Surface	Tree Canopy	Water	
	Bare Soil	2	2	2			33.3
	Grass & Herbaceous		49		1		98.0
	Impervious Surface		2	93	1		96.9
	Tree Canopy		5	1	141		95.9
	Water					1	100.0
Grand Total		2	58	96	143	1	300
User Accuracy		100.0	84.5	96.9	98.6	100.0	

Table B-3. 2021 user and producer quality control outcome by land cover.

Charlottesville 2021 Entire Area User and Producer Outcome: Quality Control Outcome							
Producer	User						Producer Accuracy
	Land Cover Type	Bare Soil	Grass & Herbaceous	Impervious Surface	Tree Canopy	Water	Grand Total
	Bare Soil	1		3			4
	Grass & Herbaceous		49	2	1		52
	Impervious Surface			86			86
	Tree Canopy		1	3	153		157
	Water					1	1
Grand Total		1	50	94	154	1	300
User Accuracy		100.0	98.0	91.5	99.4	100.0	

Table B-4. 2025 user and producer quality control outcome by land cover.

Charlottesville 2025 Entire Area User and Producer Outcome: Quality Control Outcome								
Producer	User							Producer Accuracy
	Land Cover Type	Bare Soil	Grass & Herbaceous	Impervious Surface	Tree Canopy	Water	Cloud	Grand Total
	Bare Soil	4						4
	Grass & Herbaceous	1	98	1				100
	Impervious Surface	1	3	189				193
	Tree Canopy	1	7	7	280			295
	Water					1		1
	Cloud						7	7
Grand Total		7	108	197	280	1	7	600
User Accuracy		57.1	90.7	95.9	100.0	100.0	100.0	

Appendix C- Potential Planting Area Guidelines

The plantability of the site was based on multiple criteria, including limiting factors such as soil volume, distance to infrastructure, and traffic control devices. In Charlottesville, the possibility of planting a tree was based on a small tree, defined as any tree less than 30 feet tall at maturity. In the planting assessment, no distinction was made between the suitability of small, medium, or large stature trees. The criteria below are based on industry standards (Gilman, 2015) and in consultation with the City of Charlottesville.

Table C-1. Minimum clearance for tree planting suitability.

Consideration	Minimum Clearance
Overhead wires	Acceptable
Minimum horizontal distance from wires	None
Distance between sidewalk and curb	3 ft
Total planting area	50 ft ²
Minimum distance from infrastructure	6 ft
Water meter &/or utility box	5-10 ft
Residential driveway	5 ft
Property line	5 ft
Non-traffic conducting signage	5 ft
Utility pole or light	5 ft
Fire hydrant	10 ft
Unregulated intersections	20 ft
Stop signs	30 ft
Commercial driveway or alley	30 ft
Intersection with traffic lights	40 ft

Appendix D- Land Cover Classifications

Table D-1. 2006 land cover classification for the City of Charlottesville.

Charlottesville 2006 Total Area Land Classification						
Land Cover Type	Point Count	Land Cover (%)	Standard Error (%)	Confidence Interval (95%)		
				±	Lower	Upper
Bare Soil	58	1.9	0.25	0.49	1.44	2.43
Grass & Herbaceous	379	12.6	0.61	1.19	11.44	13.82
Impervious Surface	1,002	33.4	0.86	1.69	31.71	35.09
Tree Canopy	1,554	51.8	0.91	1.79	50.01	53.59
Water	7	0.2	0.09	0.17	0.06	0.41
Totals	3,000	100.0	N/A	N/A	N/A	N/A

Table D-2. 2014 land cover classification for the City of Charlottesville.

Charlottesville 2014 Total Area Land Classification						
Land Cover Type	Point Count	Land Cover (%)	Standard Error (%)	Confidence Interval (95%)		
				±	Lower	Upper
Bare Soil	59	2.0	0.25	0.50	1.47	2.46
Grass & Herbaceous	521	17.4	0.69	1.36	16.01	18.72
Impervious Surface	985	32.8	0.86	1.68	31.15	34.51
Tree Canopy	1,429	47.6	0.91	1.79	45.85	49.42
Water	6	0.2	0.08	0.16	0.04	0.36
Totals	3,000	100.0	N/A	N/A	N/A	N/A

Table D-3. 2021 land cover classification for the City of Charlottesville.

Charlottesville 2021 Total Area Land Classification						
Land Cover Type	Point Count	Land Cover (%)	Standard Error (%)	Confidence Interval (95%)		
				±	Lower	Upper
Bare Soil	49	1.6	0.23	0.45	1.18	2.09
Grass & Herbaceous	573	19.1	0.72	1.41	17.69	20.51
Impervious Surface	969	32.3	0.85	1.67	30.63	33.97
Tree Canopy	1400	46.7	0.91	1.79	44.88	48.45
Water	9	0.3	0.10	0.20	0.10	0.50
Totals	3,000	100.0	N/A	N/A	N/A	N/A

Table D-4. 2025 land cover classification for the City of Charlottesville.

Charlottesville 2025 Total Area Land Classification						
Land Cover Type	Point Count	Land Cover (%)	Standard Error (%)	Confidence Interval (95%)		
				±	Lower	Upper
Bare Soil	70	1.2	0.1	0.3	0.9	1.5
Grass & Herbaceous	1135	19.2	0.5	1.0	18.2	20.2
Impervious Surface	1,943	32.9	0.6	1.2	31.7	34.1
Tree Canopy	2748	46.5	0.6	1.3	45.2	47.7
Water	18	0.3	0.1	0.1	0.2	0.4
Totals	5,905	100.0	N/A	N/A	N/A	N/A

*Totals may not add to 100% due to rounding

