Takoma Park Tree Canopy Assessment

Why is Tree Canopy Important?

Trees provide many benefits to communities, such as improving water quality, reducing stormwater runoff, lowering summer temperatures, reducing energy use in buildings, removing air pollution, enhancing property values, improving human health, providing wildlife habitat, and aesthetic benefits[1]. Many of the benefits that trees provide are correlated with the size and structure of the tree canopy which is the layer of branches, stems, and leaves of trees that cover the ground when viewed from above. Therefore, understanding tree canopy is an important step in urban forest planning. A tree canopy assessment provides an estimate of the amount of tree canopy currently present as well as the amount of tree canopy that could theoretically be established. The tree canopy assessment can be used by a broad range of stakeholders to help communities plan a greener future.

[1]National Research Council. *Urban Forestry: Toward an Ecosystem Services Research Agenda: A Workshop Summary*. Washington, DC: The National Academies Press, 2013.

How Much Tree Canopy Does Takoma Park Have?

An analysis of the City of Takoma Park based on land cover data (Figure 1) derived from circa 2018 data found that 772 acres of the city is covered by tree canopy (termed Existing Tree Canopy). This represents 58% of all of the land within the City (Figure 2). An additional 25% (338 acres) of the city's land area could theoretically be modified to accommodate tree canopy (termed Possible Tree Canopy). Within the Possible category, 15% (201 acres) of total land area was classified as Vegetated Possible and another 10% (138 acres) as Impervious Possible. Establishing tree canopy on areas classified as Impervious Possible will have a greater impact on water quality and summer temperatures while planting on Vegetated Possible (grass/shrub), will generally be easier. 17% (210 acres) of the city is generally not suitable for establishing new tree canopy (buildings and roads).

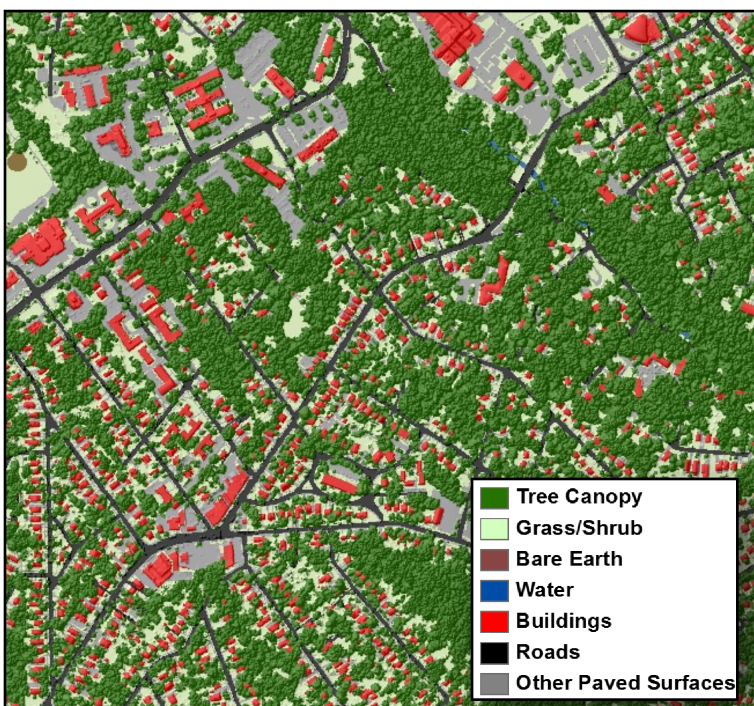


Figure 1: Study area and example of the land cover derived from high-resolution imagery for this project.

About the Project

This project applied the USDA Forest Service's Tree Canopy Assessment protocols to the City of Takoma Park. The analysis was conducted using imagery and LiDAR acquired in 2017 and 2018, respectively.

The Spatial Analysis Laboratory (SAL) at the University of Vermont's Rubenstein School of the Environment and Natural Resources carried out the assessment in collaboration with the City of Takoma Park.

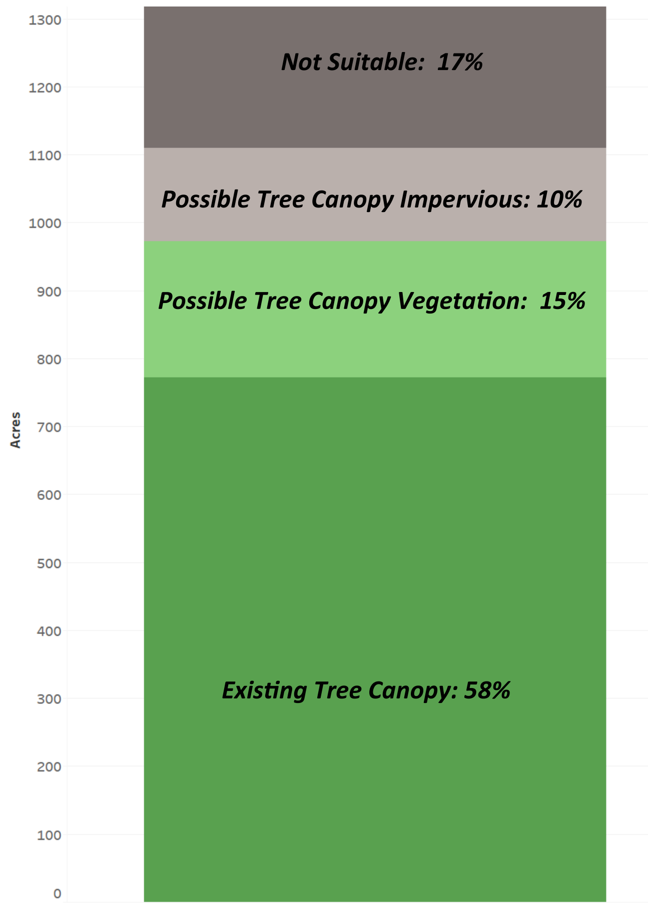


Figure 2: Tree Canopy metrics showing the total acres of land area covered by each category.

Key Terms

Tree Canopy: Tree canopy is the layer of branches, stems, and leaves of trees that cover the ground when viewed from above.

Land Cover: Physical features on the earth mapped from aerial or satellite imagery, such as trees, grass, water, and impervious surfaces.

Existing Tree Canopy: The amount of urban tree canopy present when viewed from above using aerial or satellite imagery.

Impervious Possible Tree Canopy: Asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy if improvements were made.

Vegetated Possible Tree Canopy: Grass or shrub area that is theoretically available for the establishment of tree canopy.

Not Suitable: Areas where it is highly unlikely that new tree canopy could be established (primarily buildings and roads).

Land Cover

Takoma Park is a predominately "green" city, with nearly three-quarters of the city covered by vegetation (Figure 3). Impervious surfaces make up a little of a quarter of the city's land cover. There is very little bare soil and water within the city. A robust tree canopy, such as that of Takoma Park's is valuable as it provides opportunity for natural growth and regeneration. The land cover of the areas not covered by tree canopy impacts the ability to plant new trees. New tree canopy is unlikely to be established on roads or buildings, although some overhang is possible. Plantings on other paved surfaces can be done, but requires modification to the surface material. The grass/shrub areas are those areas where it will be easiest to plant trees, but it will only be socially desirable to do so on a small percentage of this land as grassy open spaces are valued for their aesthetics and recreational purposes. These grass/shrub areas are referred to as Possible-Vegetation in the tree canopy assessment.

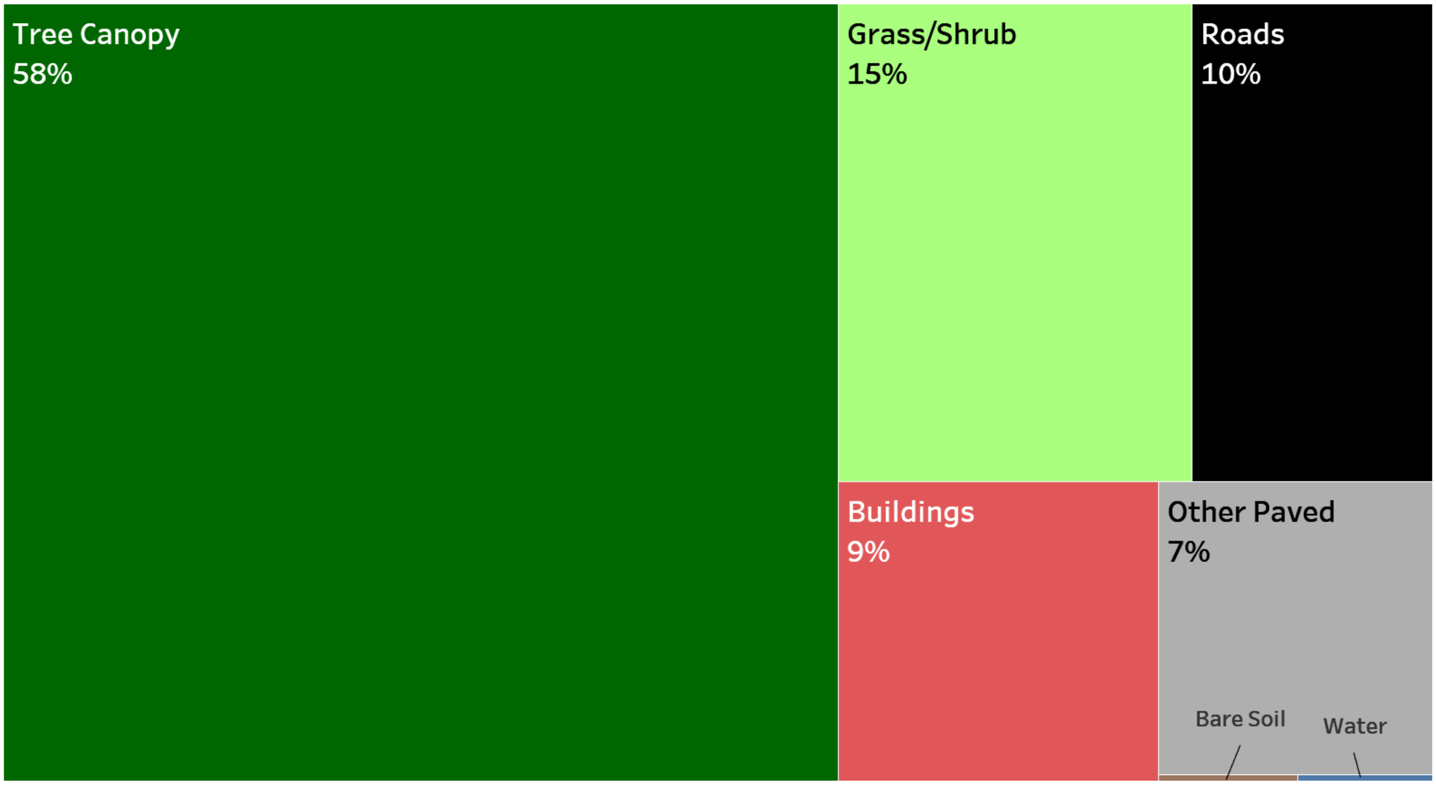
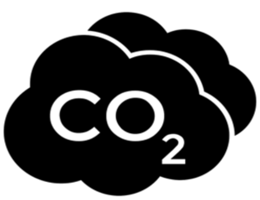


Figure 3: Proportion of the city in each of the seven land cover categories. The size of the box corresponds to the relative area of land cover.

Ecosystem Services

The USDA Forest Service's iTree tools were used to compute the value of the ecosystem services provided by the city's urban forest using industry-standard methods. These ecosystem services represent a tremendous value to the city. Replicating some of these services through traditional "gray" infrastructure would be extremely costly or impossible.



Carbon Storage: $4,278,690

Air Pollution Removal: $234,072

Avoided Runoff: $76,473

Tree Canopy Height

Knowing the height of the tree canopy can be of value for a variety of uses, ranging from locating large trees for preservation to estimating the age of a forest stand. The tree canopy dataset was divided into polygons approximating individual trees by using a combination of high-resolution imagery and LiDAR. Each one of these polygons was then assigned average and maximum height information from the 3D LiDAR data that were collected in 2018 (Figure 4). The resulting tree polygon database can be used to visualize the tree canopy in three dimensions or to carry out various analyses, such as estimating biomass, finding the tallest trees, or computing the number of trees over 100 feet. The vast majority of trees in the city range from 50 to 70 feet in height (Figure 5).

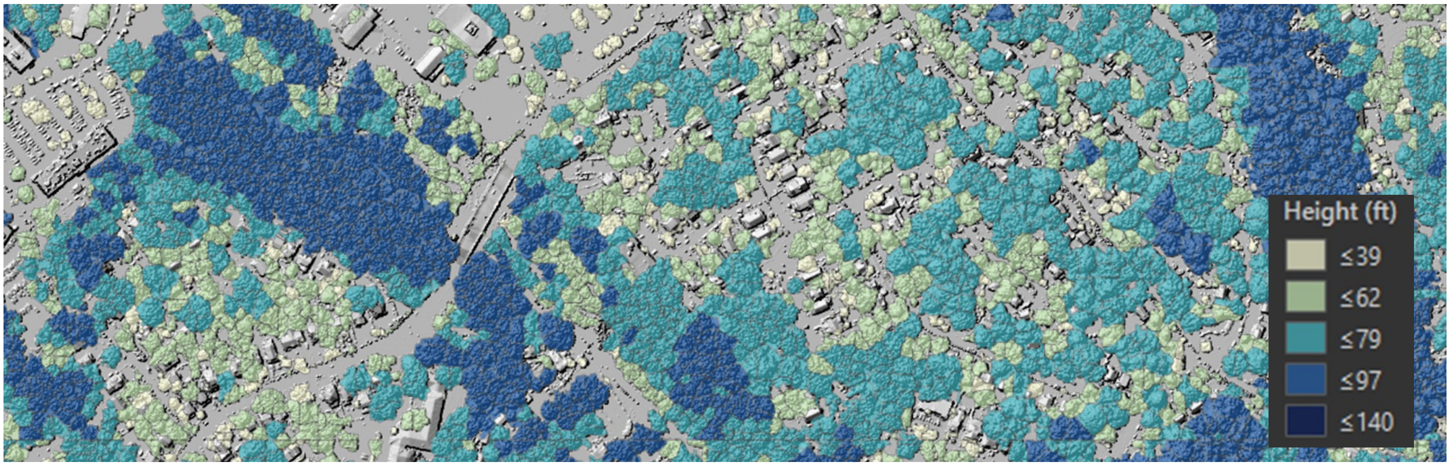


Figure 4: Maximum canopy height for individual trees.

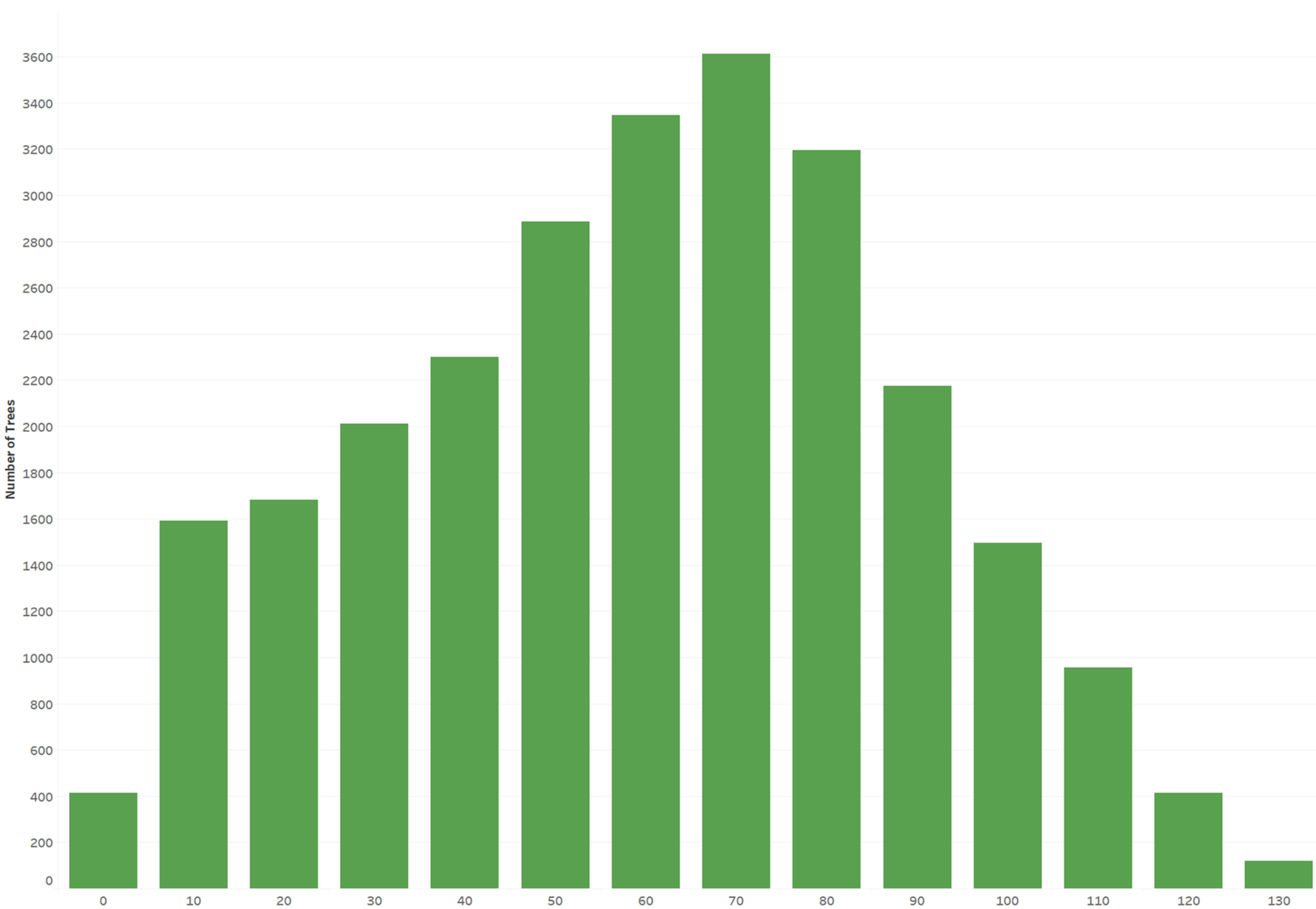


Figure 5: Count of tree canopy segments by max height class. The height of the bar reflects the number of tree canopy segments in each one of the 10 ft height classes.

Forest Patch Analysis

Not all tree canopy provides the same ecosystem services. Larger forested patches are associated with improved wildlife habitat and watershed health, among other positive attributes. This forest patch analysis partitioned the tree canopy into three classes based on their size, shape, and density: 1) small 2) medium, and 3) large. In general, small patches represent individual trees or small rows of trees, medium patches represent clumps of trees, large patches contains few edges and more core tree canopy (Figure 6). The majority of the City's tree canopy is in the medium patch class (Figure 7).

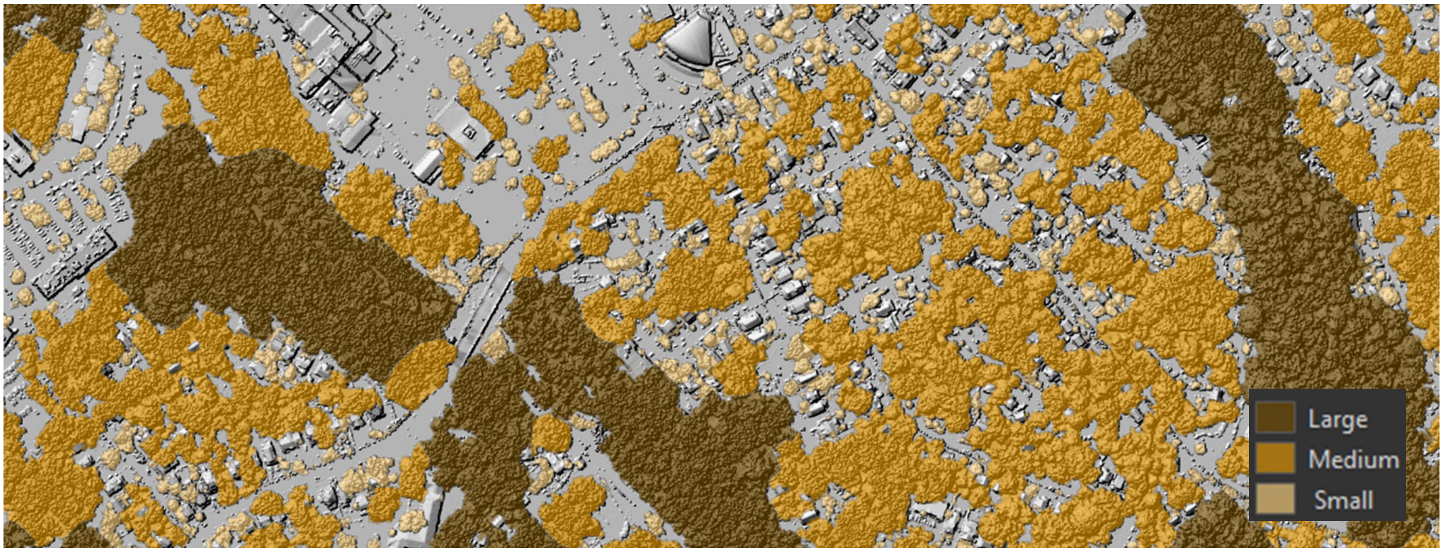


Figure 6: Forest patch classes, in which the tree canopy is subdivided into one of three categories.

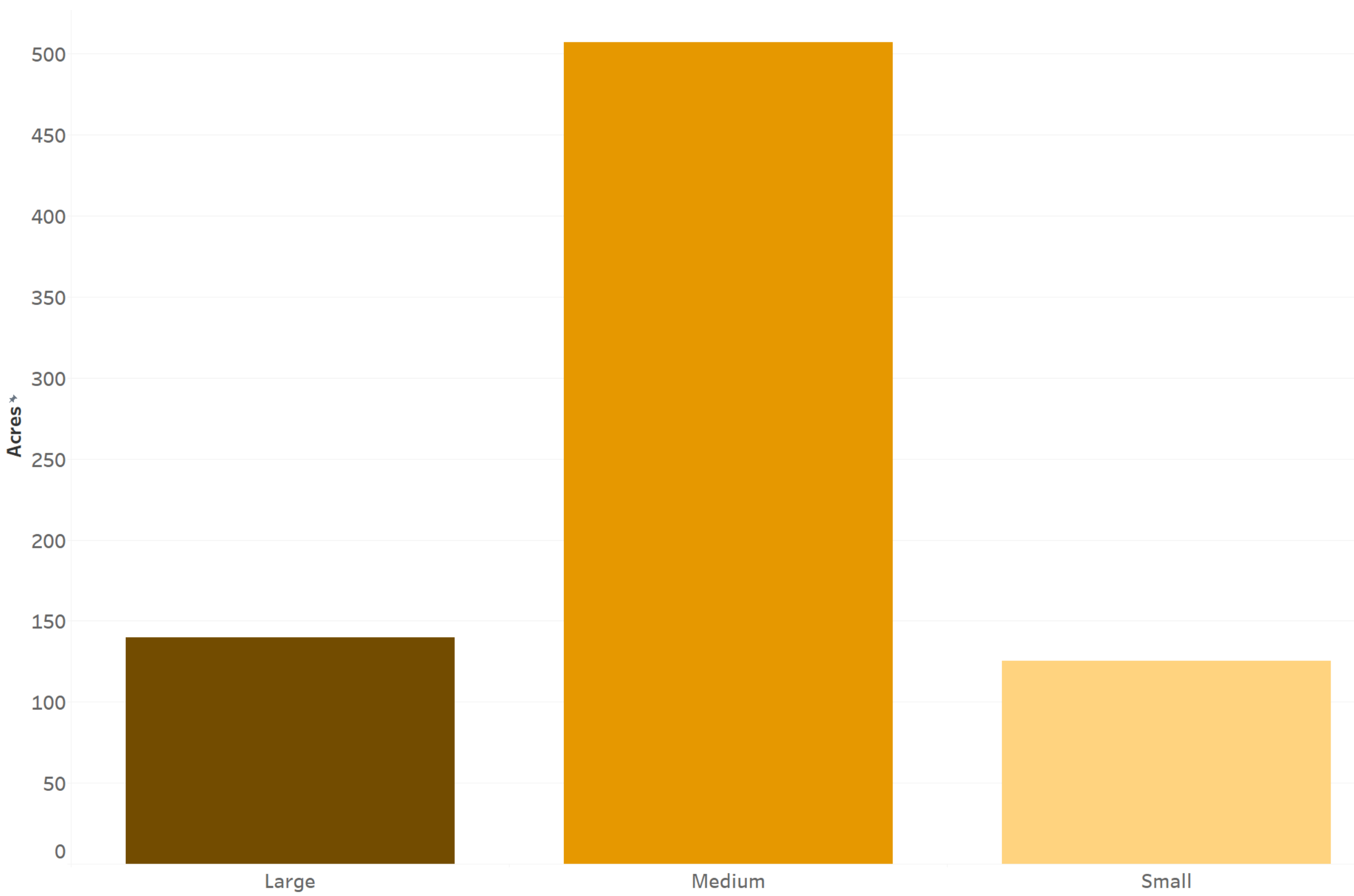


Figure 7: Number of acres in each forest patch class.

Land Use Metrics

Understanding the relationship between land use and tree canopy can provide insights into how development patterns influence the existing tree canopy as well as informing strategies for preserving tree canopy and establishing new tree canopy. Takoma Park is comprised of seven general land use types (Figure 8). The vast majority of existing tree canopy in the city falls within the medium-density residential land use, which is also the dominant land use type in the city (Figure 9). The most room to plant new trees also resides within the medium-density residential land use class. Deciduous forested land use has the highest percentage of its land area covered by tree canopy but contains very little room for establishing new tree canopy. Industrial land has the highest percentage of its land area available for establishing new tree canopy, but because industrial land constitutes such a small amount of the city's land base, even aggressive tree plantings on industrial lands will not result in significant increases to the city's overall tree canopy percentage. Open urban and institutional land uses also have relatively high percentages of their land area available for establishing new tree canopy, but these areas, which often consist of recreational fields, may not be socially desirable locations for large expansions of tree canopy. With most of the city's existing and possible tree canopy falling on residential lands, it is clear that residential areas are crucial when it comes to preserving and increasing Takoma Park's tree canopy.

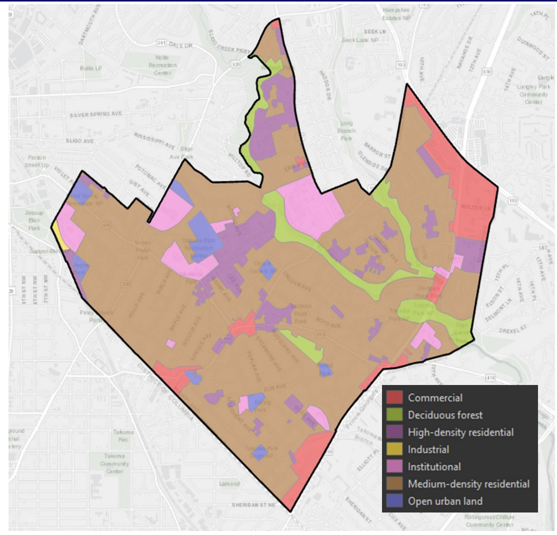


Figure 8: Land use in the City of Takoma Park.

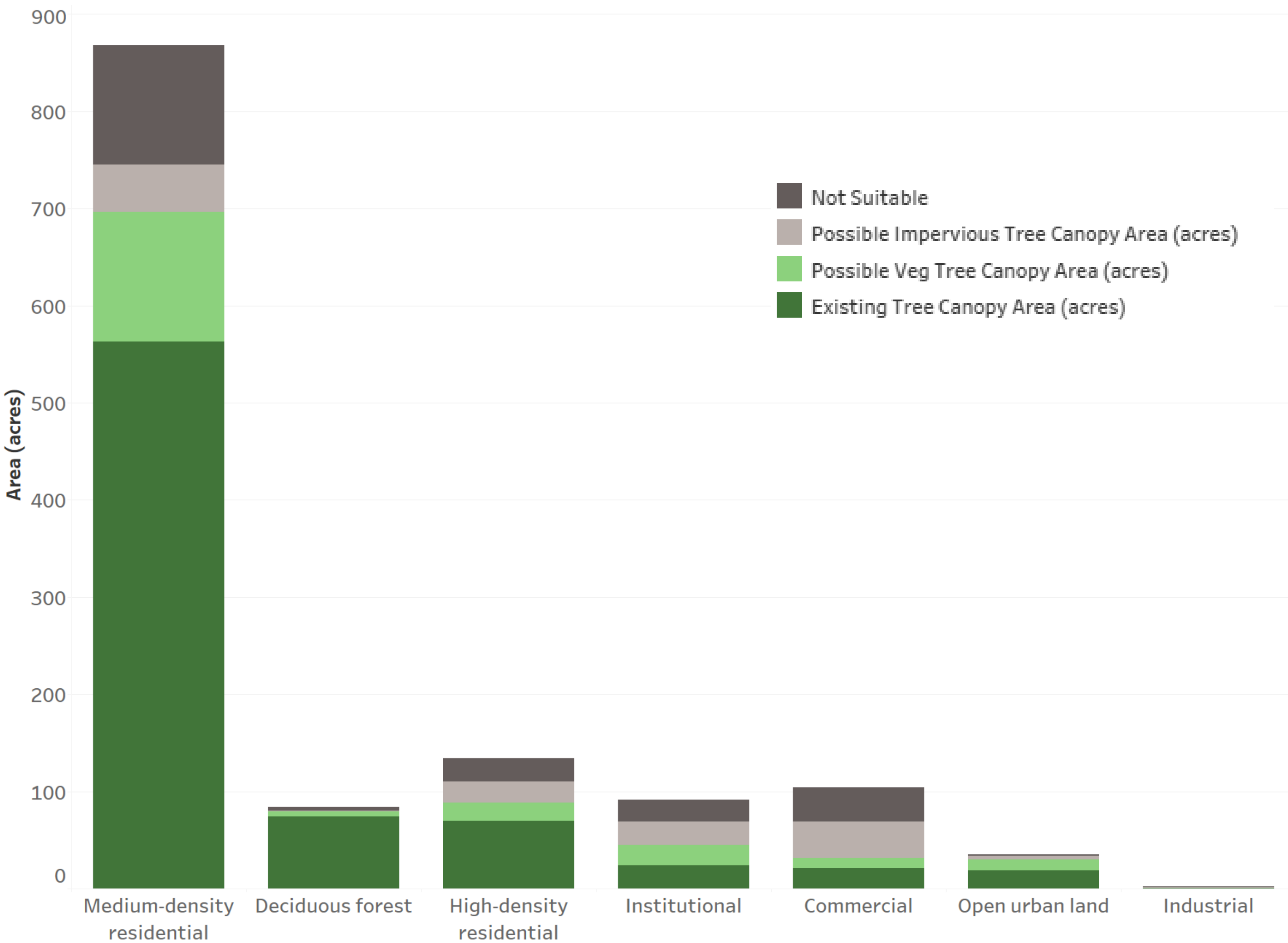


Figure 9: Tree canopy metrics summarized by land use.

Land Use Metrics

Figures 10 and 11 display the relative percentage of land for existing tree canopy and possible-vegetation respectively. This provides additional insights into the current and possible conditions for each land use type that can be obscured by looking at the total area estimates (Figure 8)

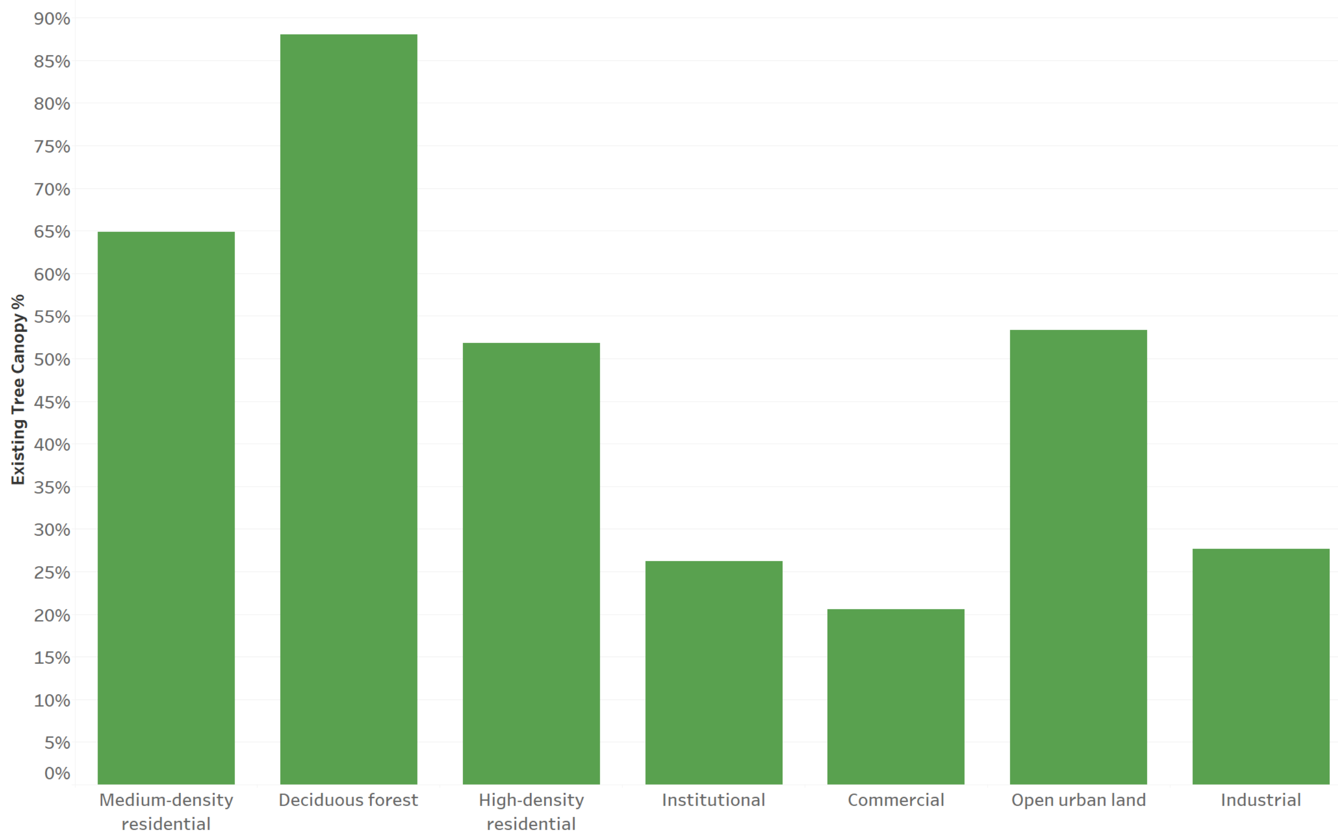


Figure 10: Existing tree canopy relative area metrics summarized by land use.

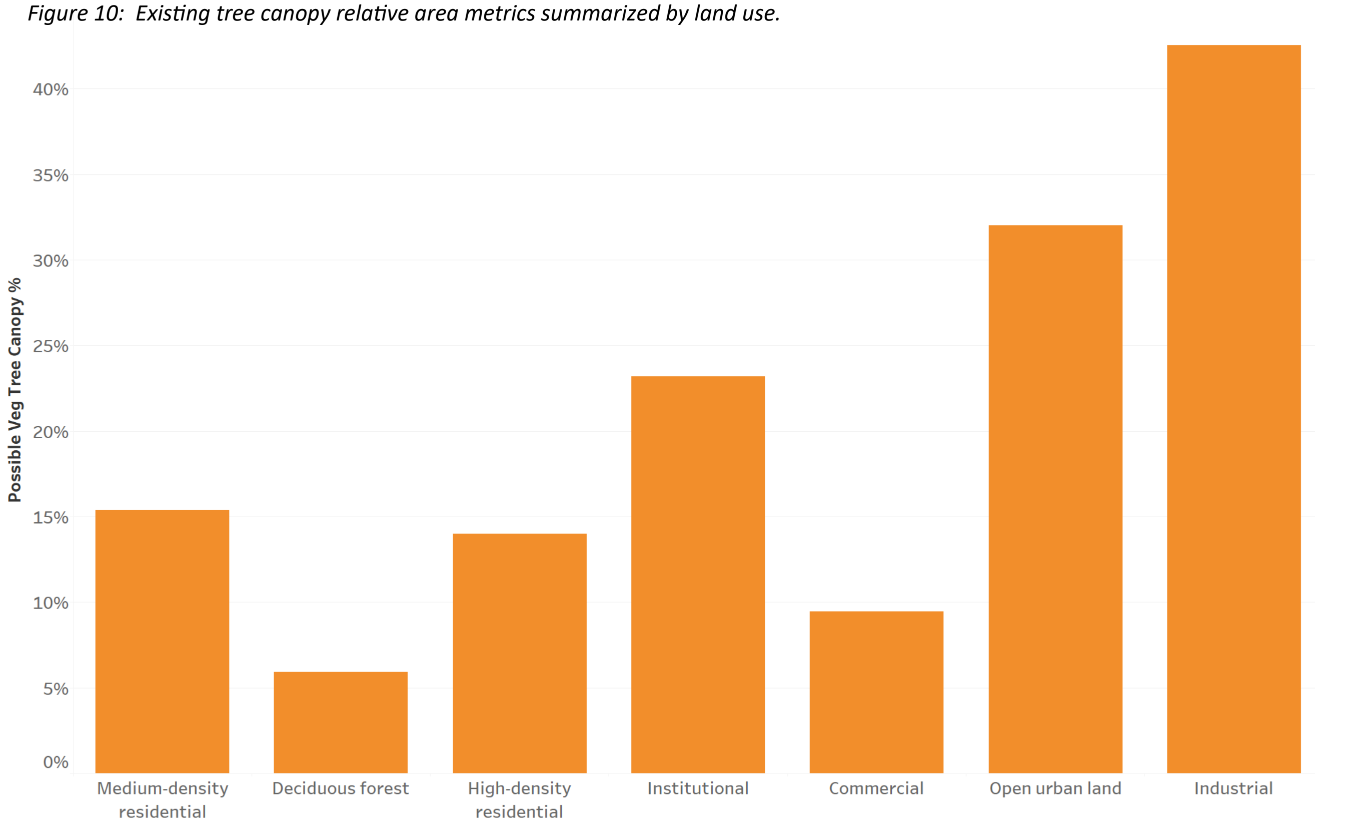


Figure 11: Possible vegetation tree canopy relative area metrics summarized by land use.

Ownership Metrics

There are seven general ownership types in the city (Figure 12). Ownership describes who controls the tree canopy. While related to land use, ownership does not provide the information needed to understand the areas in which the city has control over the tree canopy. The vast majority of the city is under private ownership, and although the city ordinances do provide some jurisdiction over these areas for activities such as tree removal, the city has considerably less influence when it comes to tree care and plantings. Most of the existing and possible tree canopy in the city is under private ownership. 74% of all the city's existing tree canopy is under the control of private entities (Figure 13). The rights-of-way (ROW) are the second most dominant ownership type for both existing and possible tree canopy. 13% of the city's tree canopy is within the ROW. Although the city does not exert control over all of the ROWs, it is clear that street trees are an essential contributor to the city's overall canopy and that there is room to establish more tree canopy along Takoma Park's roadways. The city has even less influence over other types of ownership, particularly the county and MNCPPC lands. MNCPPC lands, which include many of the key contiguous forested areas in the city, have a high percentage of existing tree canopy. Property under control of the Board of Education has the lowest percentage of existing tree canopy and the highest percentage of possible tree canopy. This stems from the vast expanses of playing fields, which although could theoretically support new tree canopy, are not socially desirable.

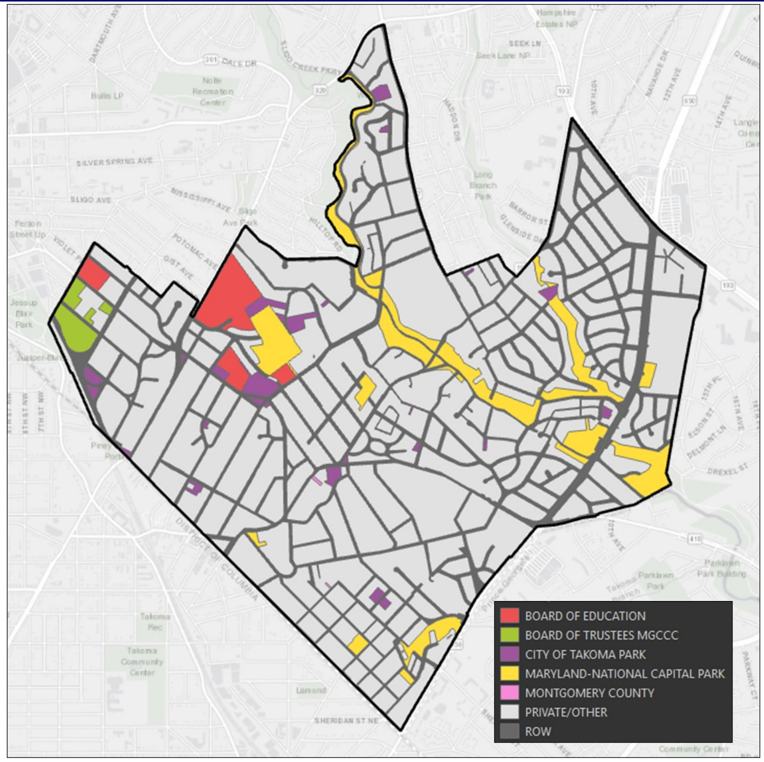


Figure 12: Ownership within the City of Takoma Park.

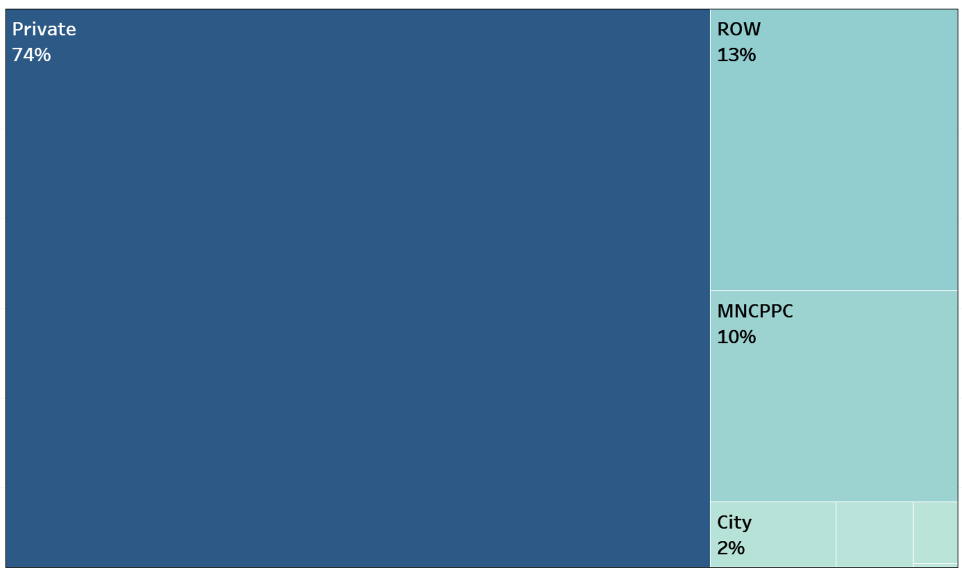


Figure 13: Relative proportion of existing tree canopy by ownership type.

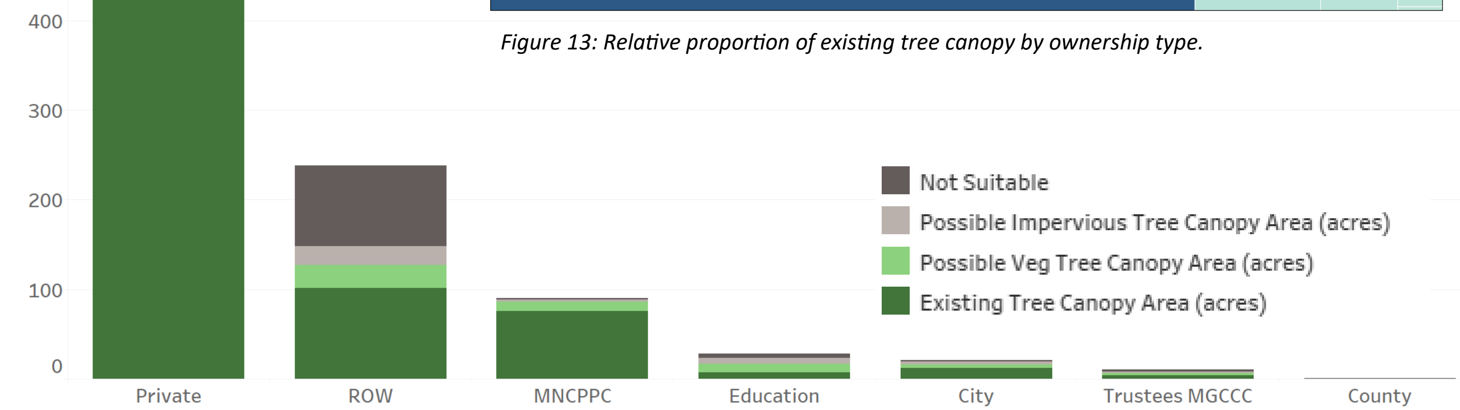


Figure 14: Tree canopy metrics summarized by ownership type.

Ownership Metrics

Tree canopy varies by ward, Ward 6 has the lowest percent of its land covered by tree canopy (44%) and Ward 2 has the highest percent of its land covered by tree canopy (68%). These relative percentages are influenced by land use, with Ward 6 having proportionally higher amounts of commercial and industrial land uses, which tend to have lower amounts of tree canopy. Ward 2 has the greatest amount of forested land use, which helps to explain its high existing tree canopy. Interestingly, Ward 1 has the second highest amount of land covered by tree canopy even though it contains no forested land use. This relatively high percentage of tree canopy is almost entirely due to the tree canopy within the residential areas. There exists the opportunity to expand tree canopy across all wards through natural grown/regeneration and new plantings. Most of the room to plant new trees lies in residential areas, but for Ward 4 land managed by the Board of Education has nearly as much room for new tree canopy as the residential areas. Of course planting on much of the educational land is not feasible as these areas are important for recreational activities.

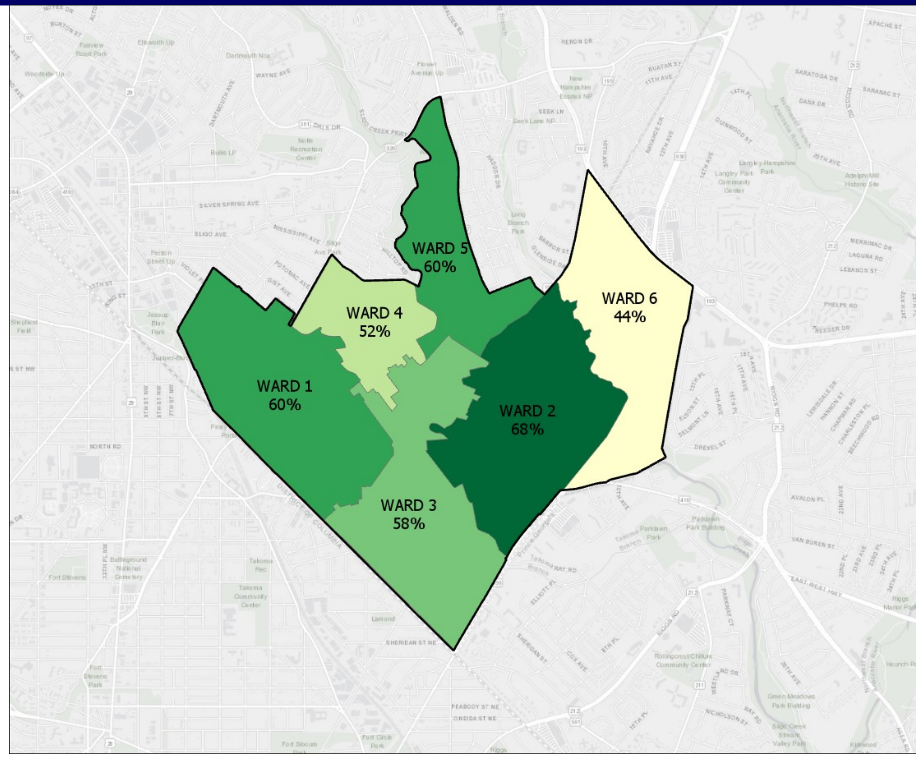


Figure 14: Existing tree canopy by ward.

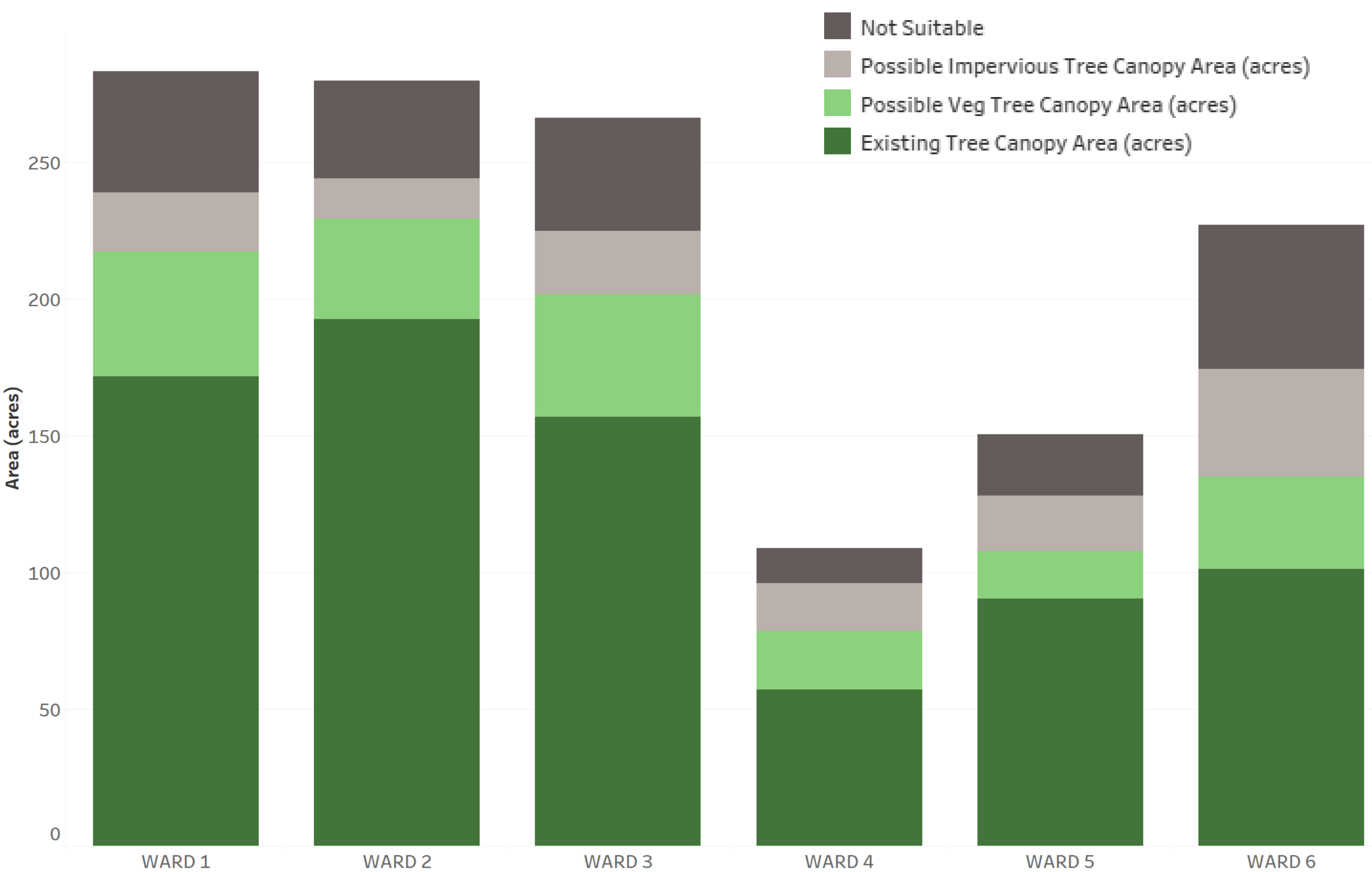


Figure 15: Tree canopy metrics summarized by ward.

Tree Canopy Change

This study represents the third time period in which tree canopy has been mapped for the City of Takoma Park. Since the first study was carried out in 2009, the percent of the city's land area covered by tree canopy has remained mostly stable. In 2009 the tree canopy was 59%, in 2014 the tree canopy was 62%, and in 2018 the tree canopy stands at 58%. Urban forests are dynamic ecosystems, and changes due to both natural and anthropogenic factors play a role in the change in tree canopy. Studies, like this one, that are carried out over relatively short time periods relative to a tree's lifespan tend to emphasize loss, which happens more quickly and is easier to detect. Growth occurs at such a fine scale that it can be difficult to detect over relatively short time periods. The source data used to map tree canopy also play a roll in the ability to track change. The 2014 LiDAR better represented tree canopy due to the timing of acquisition than the data from either 2009 or 2018, and although attempts were made to account for this variation in the data, it is likely that this made it easier to detect new growth in 2014.

Tree canopy change is not distributed uniformly throughout the city. As is shown in Figure 16 there are areas of concentrated tree canopy loss, particularly in the residential areas that warrant future investigation. Factors such as storms, pests, and lack of maintenance could all play a role.

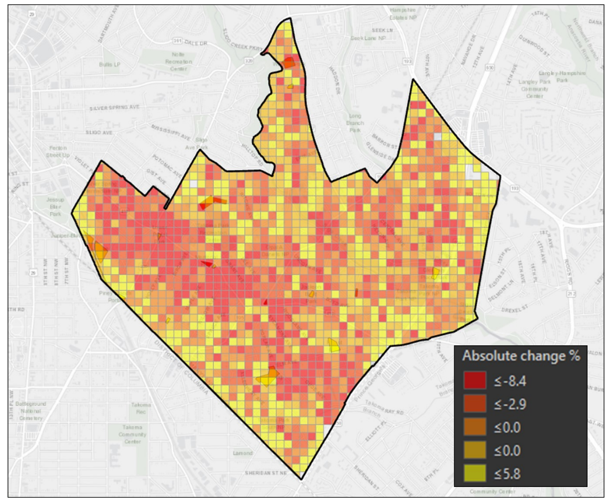


Figure 16: % absolute tree canopy change between 2014-2018.

Tree canopy was mapped at the scale of individual canopies to provide the most thorough and accurate estimates of tree canopy change in Takoma Park. Figure 17 and 18 show examples of the mapping that was done for the 2014-2018 time period. Canopy was classified into three categories: no change, loss, and gain. No change indicates that the tree canopy remained unchanged from 2014-2018. Gain indicates an increase over the four years. Loss refers to the removal of tree canopy during this time period. In Figure 17 the three tree canopy change classes are overlaid on the 2014 LiDAR. The rough texture appearance within the loss areas is indicative of tree canopy being present in 2014. In Figure 18 the same loss areas appear smooth or have clear evidence of the presence of non-tree canopy features (e.g., buildings). Gains in tree canopy are much harder to detect and are mainly observable when there are newly planted trees. Even though natural growth on the edges of existing trees undoubtedly happened over this period, the data do not support detecting this level of change.

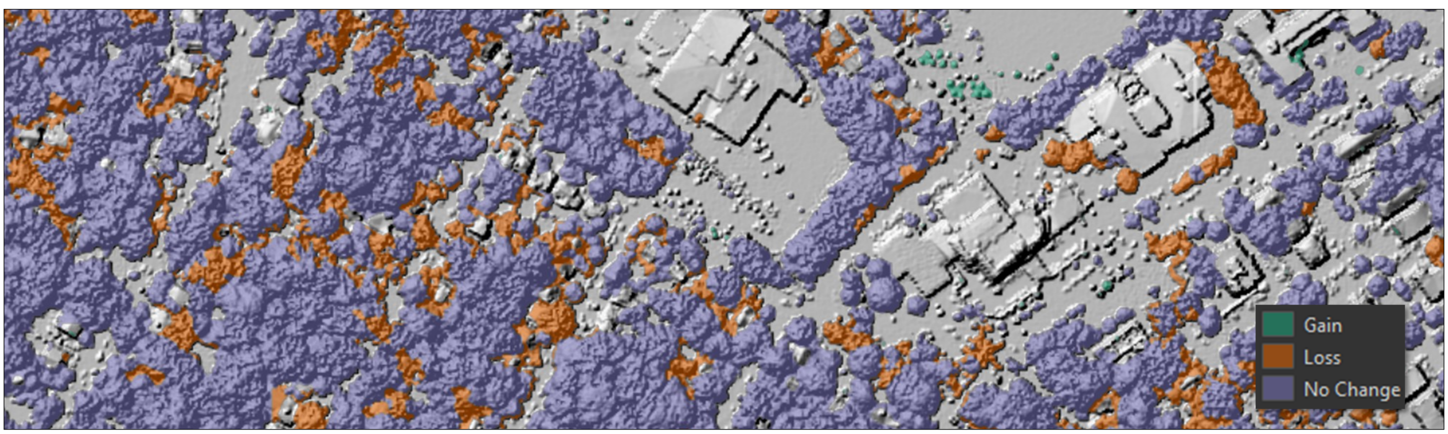


Figure 17: Tree canopy change for the 2014-2018 time period overlaid on 2014 LiDAR.

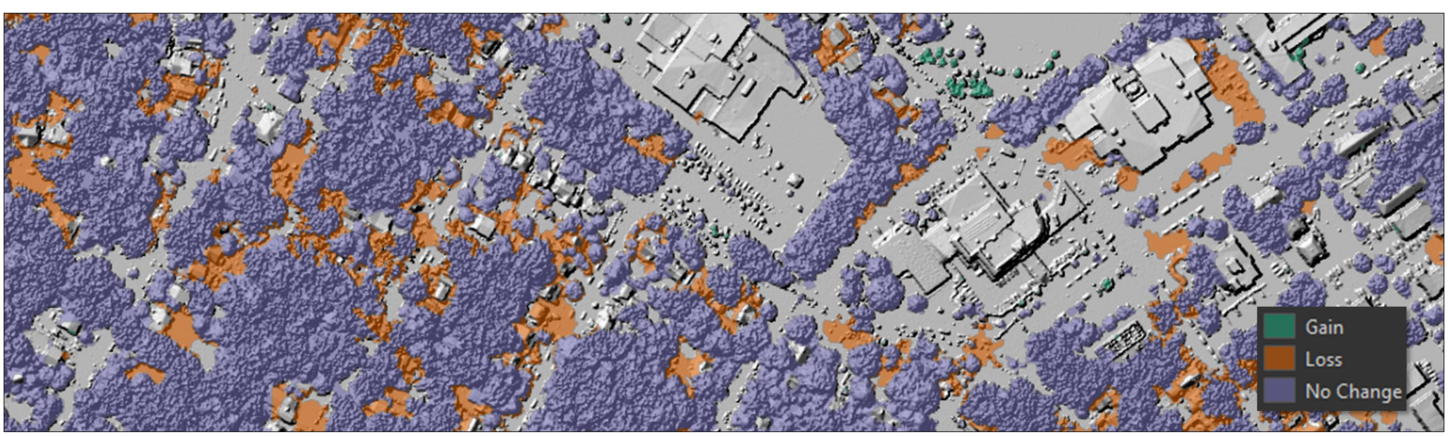


Figure 18: Tree canopy change for the 2014-2018 time period overlaid on 2018 LiDAR.

Tree Canopy Change — Ownership and Land Use

Tree canopy change varies by ownership and land use. Figure 19 shows the percent relative change by land use for the 2014-2018 timeframe. Percent relative change is calculated using the following formula.

$$\frac{\textit{2018 Tree Canopy - 2014 Tree Canopy}}{\textit{2014 Tree Canopy}}$$

This approach to calculating the change provides insight into the magnitude of change by land use class. The only land use class that showed an increase in tree canopy was industrial, but referring back to Figure 9 we see that industrial has hardly any tree canopy. This increase likely reflects natural growth of the little tree canopy that exists on industrial land rather than a concerted effort to improve the tree canopy within the city's industrial areas. Institutional land lost the highest percent of its tree canopy over the four-year timeframe.

The absolute acreage loss estimates displayed in Figure 20 that integrate land use and ownership show that the vast majority of the loss was on private land. Within the private ownership type, the greatest aggregate loss was within the medium-density residential land use.

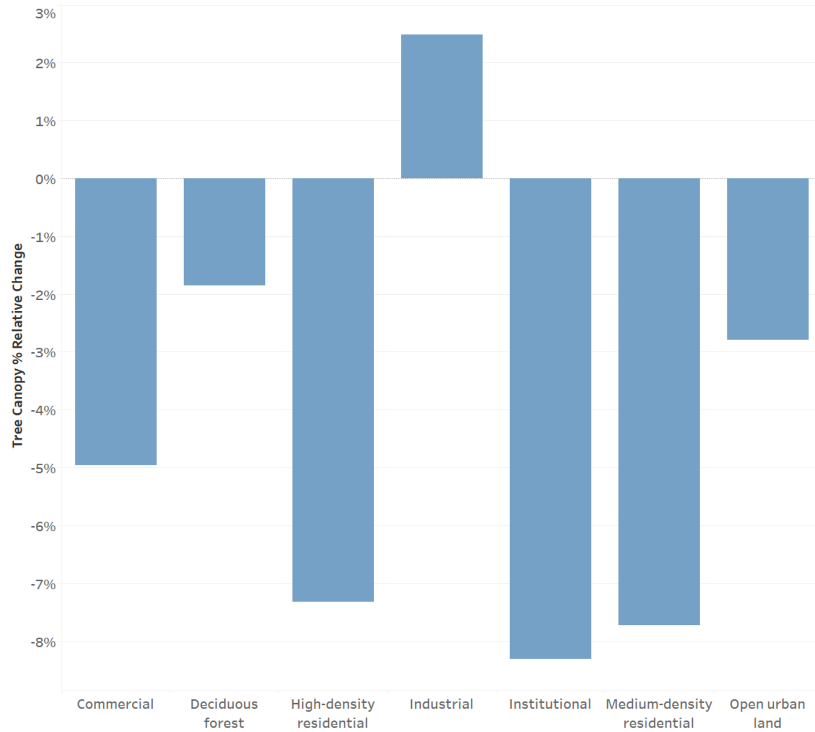


Figure 19: Tree canopy % relative change by ownership for the 2014-2018 timeframe.

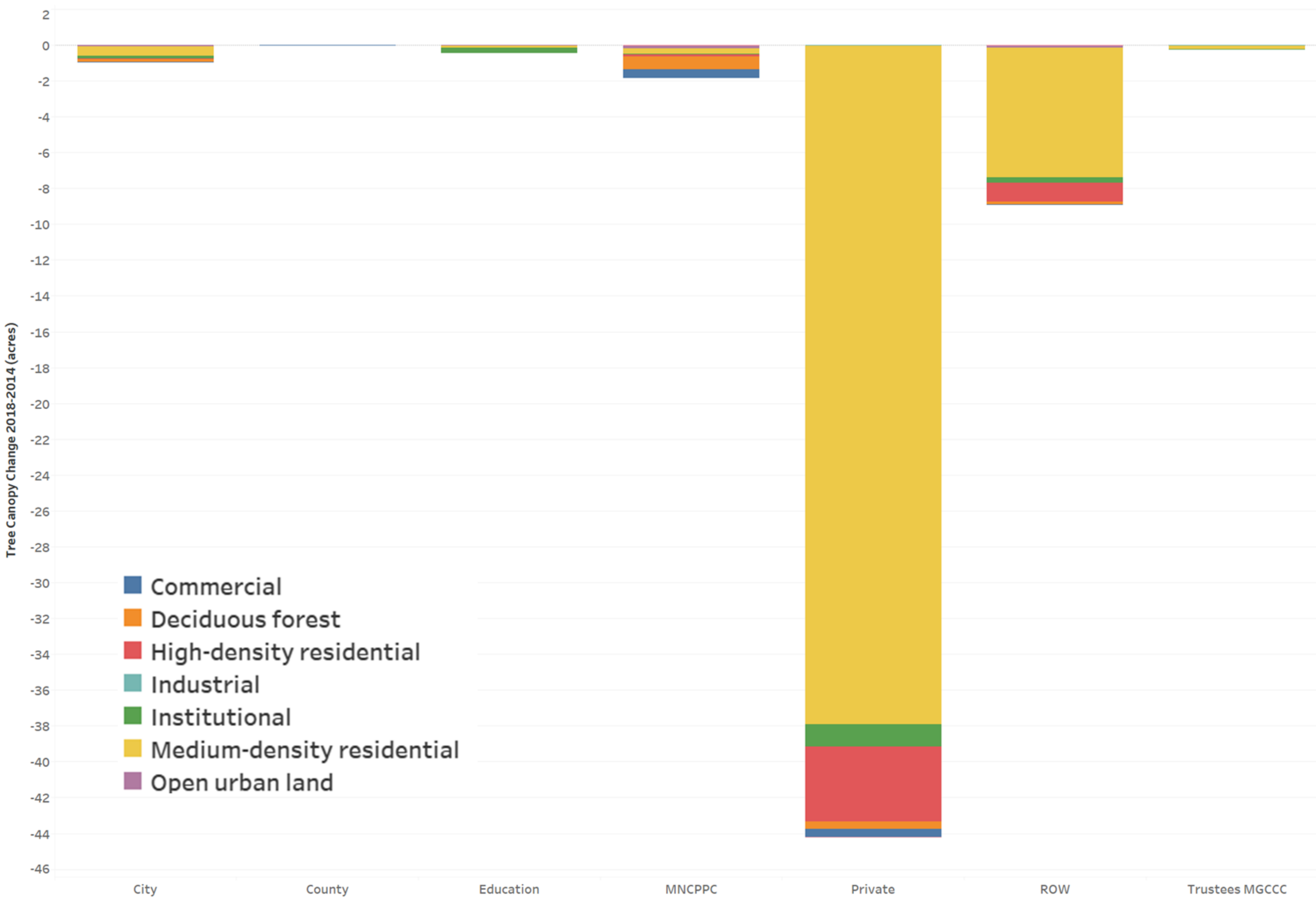


Figure 20: Total tree canopy change by ownership type and land use for the 2014-2018 timeframe.

Conclusions

Takoma Park has a robust urban forest. With tree canopy covering around 60% of the city's land area for the past decade, the city has tree canopy that would be the envy of many communities. Many other cities in Maryland, such as Annapolis, Bowie, and Hyattsville have around 40% of their area covered by tree canopy. Only Greenbelt has canopy that is on par with Takoma Park.

Preserving existing tree canopy is critical. The most efficient and effective way to sustain and increase tree canopy is to preserve the city's existing tree canopy. Recent losses of tree canopy, particularly on private land, highlight some of the threats to the city's overall tree canopy. While ordinances can help to prevent tree removal, it is difficult to legislate tree care and tree planning on private land, necessitating other approaches.

Residents hold the key. A clear majority of the city's tree canopy is on residential land or on rights-of-way in residential areas. The majority of tree canopy loss over the past decade has occurred on residential land. How residents value the trees in and around their property may very well be the determining factor in how Takoma Park's tree canopy changes over the coming decade. If residents fail to care for their trees and plant new ones to replace those that have been lost Takoma Park's urban tree canopy will continue to decline.

Continue mapping, monitoring, and inventorying. This project was able to provide insights into changes to Takoma Park's tree canopy over the past decade thanks to the investments made in imagery and LiDAR from MNCPPC. Without these data, this assessment would not have been possible. The city should continue to carry out tree canopy assessments every 2-6 years. The "top-down" approach used in this study is not a replacement for field work. Ground-based inventories are essential for assessing factors such as species, size, and health, which cannot be done effectively from above.

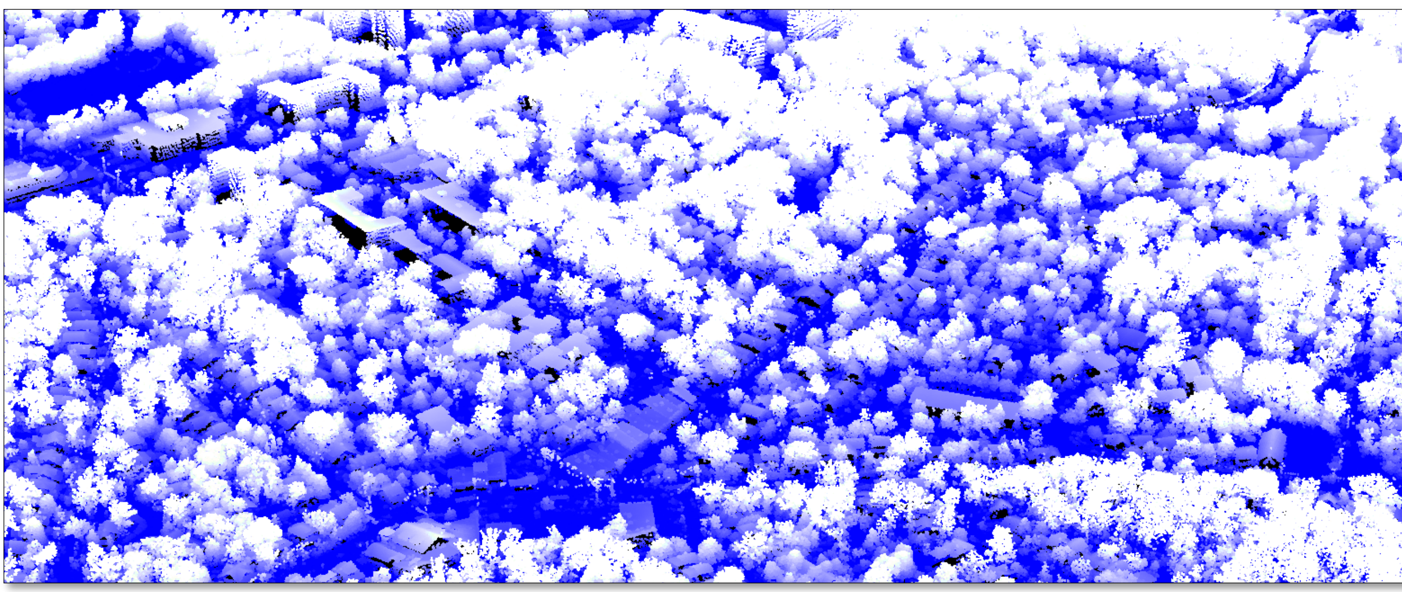


Figure 21: 3D visualization of the LiDAR collected in 2018. Without these data this assessment would not have been possible.

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Additional Information

For more info on the Urban Tree Canopy Assessment please visit **http://nrs.fs.fed.us/urban/UTC/**

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