TREE CANOPY ASSESSMENT

Prince George's County, MD

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EXECUTIVE SUMMARY

Prince George's tree canopy is considered a valued natural capital asset whereby changes to individual tree and forested areas are assessed through a Tree Canopy Assessment project. In 2025 a detailed study was conducted using the current tree canopy from airborne lidar data, identifying the pattern of change from 2020 - 2024 for the County as a whole, and to community areas of interest, deriving environmental and socioeconomic stress to identify strategic areas that could benefit from preservation efforts and possible tree planting. The findings are as follows:

- 2024 tree canopy coverage in the County was 52% meeting The Maryland Forest Act of 2013 state-wide goal of maintaining 40% percent forest and tree canopy with "no net loss of forest" in Maryland (Ch.384 5-101 pg5) and meeting the Plan Prince George's 2035 recommendation to sustain forest and tree canopy coverage at 52%.

- A net loss in tree canopy (-1.5%) (2,736 acres / 4.3 sq miles) and individual trees (-1.2%) from 2020 – 2024 was observed and are predominately in areas of development near the Washington DC boundary, indicating that the county has experienced a slight loss of both forest and individual trees during this time.

- Average tree height was 74 ft and 84% of tree heights were between 42 and 106 feet. Common tree species such as Red Maple (40'-60'), White Oak (80'-100'), Red Oak (60'-80') and American Sycamore (80'-130') mature at the tree height range. This suggests that the majority of trees in the County have reached a mature height and there will be less vertical growth in tree canopy.

- The largest proportion of relative change in loss of tree canopy occurs in Council Districts 2 and 3, including residential and industrial land use changes resulting in a reduction of -10% to –5% in the subwatersheds near the Washington DC boundary. The tree canopy loss occurred within high development areas in the County.

- Tree canopy growth was measured from lateral growth of existing tree crowns and vertical growth associated with younger forested areas with the largest area of single new tree growth of 5.25 acres.

- The data shows census tracts with more than 10% of household income <$25,000 have a median tree cover of 34% while tracts with less than 10% of household income <$25,000 have a median tree cover of 42% indicating an opportunity and a benefit to increasing additional tree canopy in the county's disadvantaged neighborhoods.

- Overlaying the Federal Highway Administration's AADT (Annual Average Daily Traffic) data with the 2024 tree canopy cover data indicates that many neighborhoods with the highest exposure to traffic have moderate tree cover (25-40%+). Increasing the tree canopy can improve air quality and provide acoustic barrier.

- Based on percentage of relative tree canopy change, tree counts, urban cooling, high traffic index, tree interception, and addressing environmental inequity, strategic tree planting would be beneficial along the western part of the County. The positive impacts to the community would be to reduce heat exposure, mitigate stormwater runoff, and address inequities. Furthermore, enhancing the tree canopy along riparian zones and transportation corridors would improve water and air quality. The analysis does not preclude that there are other locations with the County that could also benefit from tree planting.

THE VALUE OF TREES IN COMMUNITY DEVELOPMENT

Trees are vital assets to any community, delivering significant social, economic, and environmental benefits that enhance quality of life and promote resilience.

SOCIAL BENEFITS

Trees contribute to healthier, more connected and vibrant communities. A US Forest Service study shows that the presence of trees reduces stress, anxiety, and depression by up to 30%, while encouraging outdoor activity with greater opportunities for social connections. Green spaces foster interaction, improve mental well-being, and enhance public safety by creating more inviting and cared-for environments.

ECONOMIC BENEFITS

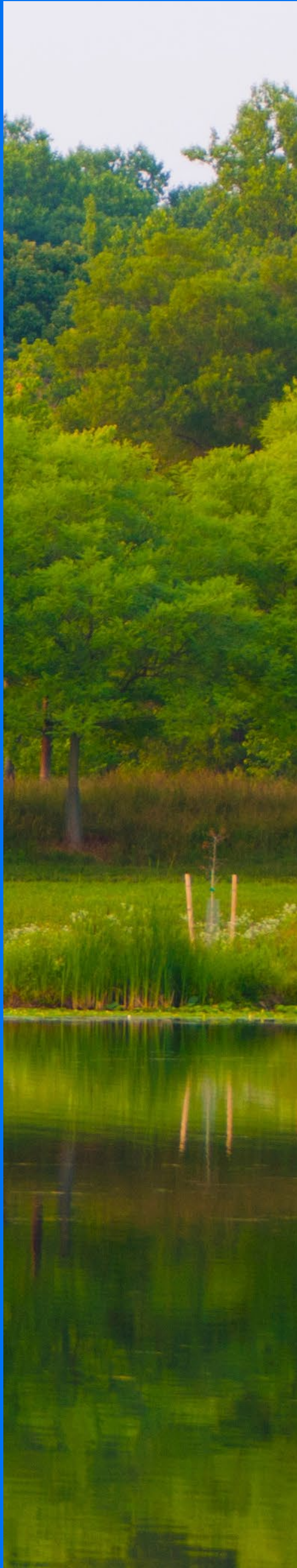
Trees offer substantial financial returns over their lifetime. Strategic investment in urban forestry increases property values and lowers energy costs. Trees provide shade in summer and act as windbreaks in winter thereby reducing heating and cooling expenses. They also mitigate stormwater runoff, easing pressure on municipal infrastructure and saving millions in public spending. Additionally, green spaces attract businesses, tourism, and support job creation in urban forestry.

ENVIRONMENTAL BENEFITS

Trees are crucial for a healthy, livable community. They play a critical role in flood mitigation and reducing erosion by intercepting rainfall, increasing soil absorption, and slowing water runoff. As a key component against the urban heat island effect, trees provide vital shade and cool the air through evapotranspiration. Natural cooling is essential in combating rising temperatures and improving thermal comfort. Trees improve air quality by filtering pollutants and absorbing carbon dioxide, making our air cleaner, healthier to breathe and helping combat climate change. They also support biodiversity by providing essential habitat for urban wildlife.

POLICY ALIGNMENT

Prince George's County has long recognized the greater importance of green infrastructure and its fundamental role in contributing to a thriving, sustainable community. Plan Prince George's 2035 is a comprehensive plan to guide future development within the county including the recognition of the natural capital of the environment. The plan sets aside natural environment goals that recognize forest and tree canopy within a legislative framework. Policy 5 in Plan 2035 outlines objectives and strategies to achieve the goal of preserving and enhancing forest and tree canopy coverage levels to maintain ecological functions, improve water quality and habitat, and support sustainable development.



URBAN TREE CANOPY ASSESSMENT

The Urban Tree Canopy (UTC) Assessment, a methodology originated by the USDA Forest Service, has evolved to become a cornerstone for communities across the United States and Canada seeking to understand, manage, and expand their urban forests. This assessment moves beyond traditional tree inventories to provide a comprehensive, top-down view of tree cover, often leveraging advanced geospatial technologies. This data-driven approach provides a baseline for evaluating current canopy coverage and identifying opportunities for expansion, preservation, and revealing where tree cover is lacking. It quantifies the existing tree canopy with social, economic and environmental factors to identify areas with potential for targeted new tree planting.

Communities across North America widely utilize UTC assessments for strategic urban planning and policy development. The data provides a baseline to set ambitious, evidence-based tree canopy goals, allowing for measuring and monitoring change over time.

Prince George's County Planning Department has been actively monitoring the evolution of tree canopy coverage. The data obtained enables policies and legislation to maintain and enhance tree canopy. Initiatives include the *2017 Green Infrastructure Plan: A Countywide Functional Master Plan*, the *Forest Preservation Act of 2013* and *Plan Prince George's 2035 Approved General Plan*, which specifically recommend sustaining forest and tree canopy coverage at 52%. The Planning Department has contracted Sanborn Geospatial to acquire LiDAR data to provide evidence-based information by quantifying the tree canopy changes every 2 to 3 years to continuously support informed decision making with the next anticipated collect in 2026-2027.

MAPPING TREE CANOPY FROM ABOVE

In continuity with the previous tree canopy assessment conducted in 2023, a similar analytical process was conducted during this tree canopy assessment. LiDAR data was applied to extract the tree canopy coverage, canopy change, support the land cover map and create metrics for important community values such as watersheds, council area and the impact on urban cooling. The process involved detailed mapping of the tree canopy and subsequent estimation of tree counts. This assessment relied on the Fall 2024 leaf off acquisition of airborne LiDAR data throughout Prince George's County boundary. The data was acquired at USGS Quality Level 1 (QL1), with a nominal pulse density of 8 points per square meter, ensuring high precision mapping. Prior to analysis, the LiDAR data underwent standardized processing steps known to achieve high-quality and accuracy, including rigorous calibration and classification. To maintain consistency with the previous study, only points classified as vegetation in the LiDAR data exceeding 8 feet in height were utilized for the tree assessment with all points classified as vegetation below this threshold excluded. Leaf-on NAIP imagery was used to support the refinements to the forest area gaps, mapping the vegetation classes in land cover and tree interception modeling.

A Digital Elevation Model (DEM) was generated from this dataset of ground-classified LiDAR points. This DEM was used for adjusting the height of the vegetation LiDAR points and converting them to above-ground level heights. The vegetation points were then rasterized to create a 50 cm (approximately 1.6 ft) resolution Canopy Height Model (CHM). The CHM represents the distribution of tree canopy in height above the ground and served as the foundational data layer for applying tree analytic algorithms which were used to segment both the tree canopy areas and individual trees. A conversion process transformed the CHM from a raster cell format into vector polygons. This was followed by a post-processing phase designed to minimize gaps within forested areas and smooth the polygons representing the tree canopy. A comprehensive Quality Control (QC) review was conducted to refine and adjust the tree canopy polygon boundaries to ensure accuracy and precision.

To quantify the change in tree canopy, a GIS-based change detection process was performed using the 2020 and 2024 tree canopy polygons. This geometric analysis identified and categorized tree areas as exhibiting tree gain, loss, or no change consistent with the 2023 study. Area and percentage metrics were then calculated to provide a clear quantification of these tree canopy changes.

Consistent with the prior study, individual tree analysis was conducted to create 'Tree Objects', a representation of the specific shape of each tree. Tree Crowns were visualized as circles proportional to the area of these tree shapes, and a Tree Centroid was established to represent the approximate position of each tree within its crown. The combination of the Tree Objects covers the geographic extent of the entire Tree Canopy Area throughout Prince George's County. The information derived for individual trees is approximate, as achieving absolute precision of segmented tree crowns within dense, intermixed forest is challenging to verify.

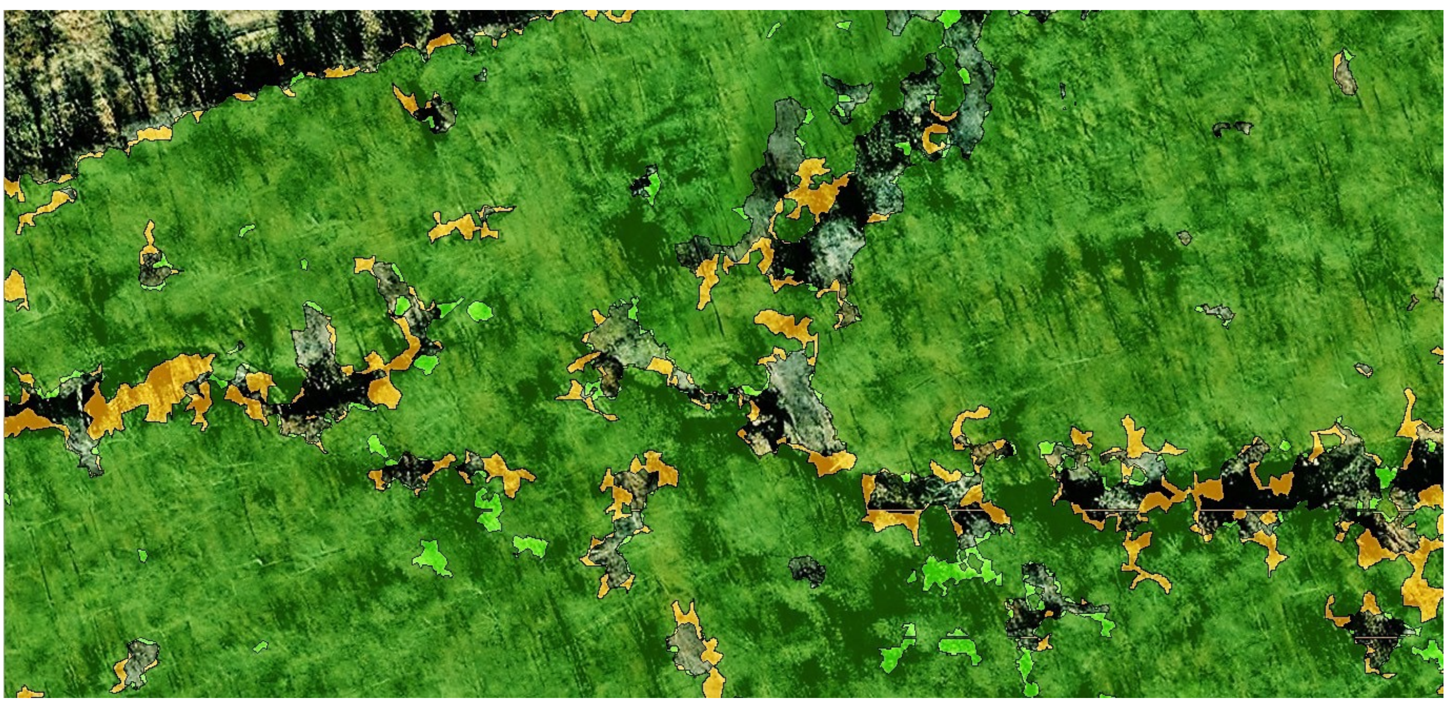
To complete the assessment, an updated, seven-class land cover map was created for the County. The land cover map description is provided on page 11. Tree canopy metrics and change distribution are used to visualize the concentration of trees across the county. Change analysis was conducted to identify patterns within boundaries of interests including council districts, zoning, planning, and watershed/sub-watershed. Further analyses focused on aspects of environmental equity and community resilience.

THE EVOLUTION OF TREE CANOPY COVERAGE

Tree Canopy Coverage Through Time

YEAR	ACRES	% TREE COVERAGE	ESTIMATED INDIVIDUAL TREES (TREE COUNTS)	% TREE COVERAGE CHANGE
2009	148,914	48.2	N/A	N/A
2018	158,860	51.4	N/A	+3.2
2020	164,121	53.4	6,393,800	+2.0
2024	160,792	51.9	6,314,660	-1.5

It is important to note that portions of the tree canopy loss in this study can be attributed to the complexity and uncertainty in mapping forest areas in leaf off conditions which can increase the presence of tree gaps complicated by variation in imagery such as sun angles and shadows. Although a QC process was applied to minimize the impacts of the gaps, their presence can lead to an overestimate of the tree canopy loss area when compared to 2020 data due to differences in addressing forest gaps. The 2020 LiDAR data was also collected under leaf off conditions, during a similar time period and density at QL1. Below is an example of loss gap area (orange) and gain (bright green) in a complex forest area between 2020 – 2024 tree canopy area.



Tree canopy loss (orange) and gain (light green) in a complex forest area.

TREE TALK

KEY TERMS

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

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

Possible Tree Canopy - Impervious: Asphalt, concrete or bare soil surfaces, excluding roads and buildings, that are 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).

MEASURING CHANGE

Area Change: The change in the area of tree canopy between the two time periods.

Relative % Change: The magnitude of change in tree canopy based on the amount of tree canopy in 2020.

Absolute % Change: The percentage point change between the two time periods.

OTHER TERMS

DNR: Maryland Department of Natural Resources

GEOBIA: Geographic Object Base Image Analysis are sets of algorithms in softwares like eCoginition to conduct image classification process based recognizing objects and regions in an image scene

NDVI: Normalized Difference Vegetation Index is remote sensing mathematic index that conducts a ratio between the red and Near Infrared spectral bands to identify the presence of vegetation

NAIP: National Airborne Image Program conducted by USDA in support of agricultural monitoring is collected across the US at 30cm to 60cm resolution to support a range of land cover applications

FEMA: Federal Emergency Management Agency support the identification of flood plains

Tree Counts: Represents an estimate of individual trees using LiDAR data to determine the tree crown, position and height

TREE COUNT

Estimating tree counts involves applying an automated analytical process to the LiDAR data to segment the individual tree canopy above 8 feet and determine the tree top location as shown in the image below. The tree count for Prince George's County from the 2024 LiDAR data is estimated at 6,314,660 individual trees. In 2020, the tree count was estimated to be 6,393,800. The change in estimated tree count from 2020 to 2024 is a slight decrease of 1.2%. The decrease is mainly occurring in areas where there are landscape changes due to industrial activities, residential expansion, and vegetation management along utilities lines. Other probable factors that can affect the tree count include windstorms and removal of unhealthy trees\branches. The two images below provide visual examples of a tree canopy area. The first for an industrial area with tree crown circles and tree centroids and the second for tree canopy within a residential area.

Estimate of individual trees (greater than 8ft)

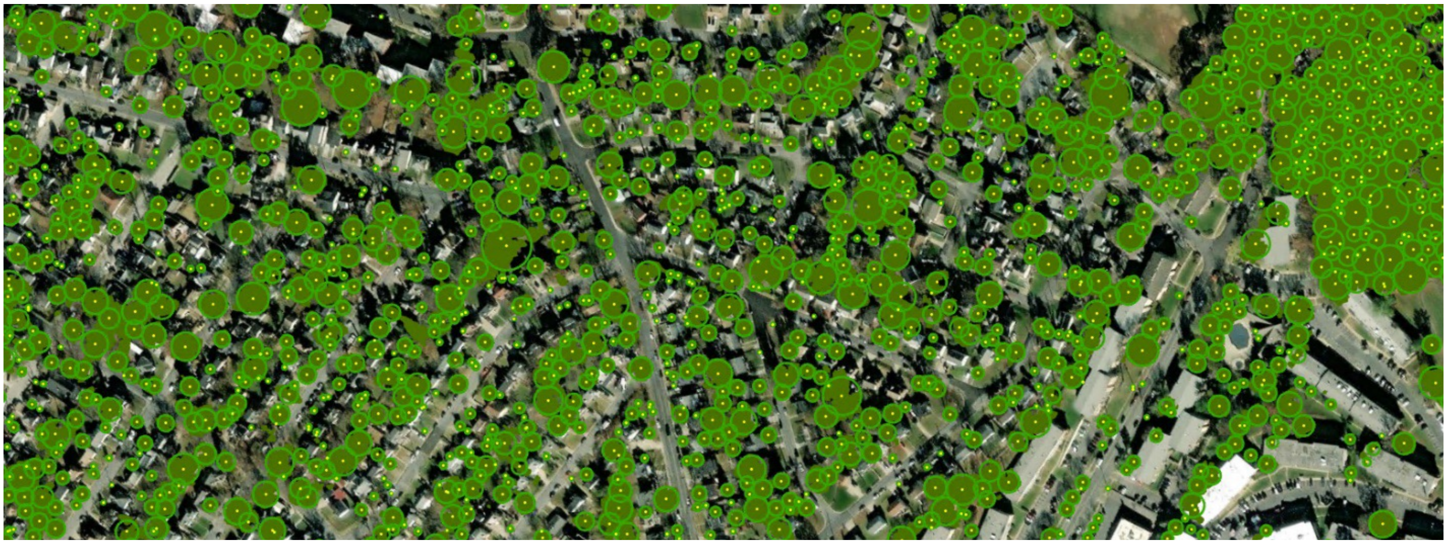
2020: 6,393,800

2024: 6,314,660

% Tree count change since 2020

-1.2%

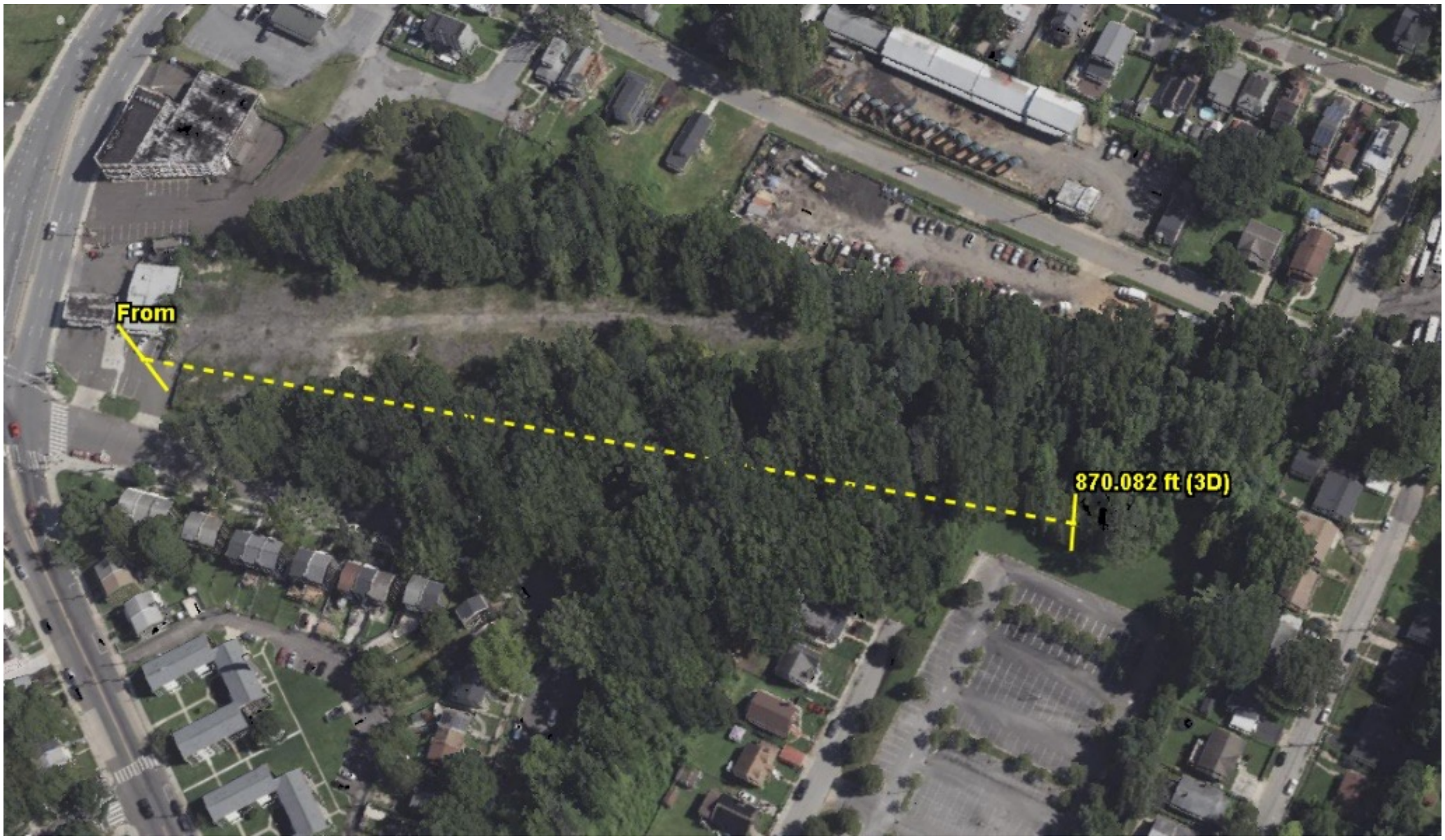
Tree Canopy area, Tree Crown Circles and Tree Centroid for industrial area



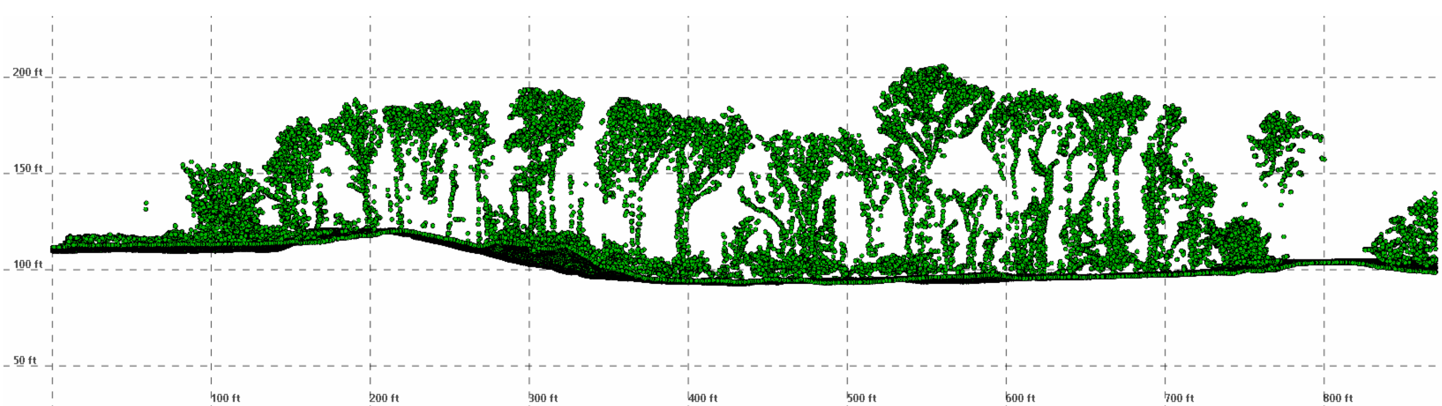
Tree Canopy area, Tree Crown Circles and Tree Centroid for a residential area

TREE HEIGHT

One strength of LiDAR data is that it can provide an insight into the height distribution based on the tree count. Tree height information provides insights for indicators of biomass and carbon sequestration, proxy information on shading to improve cooling, and tree interception for reducing flooding within the community. The below transect of a tree area from the LiDAR data illustrates the details of tree structures with respect to the tree height and crown area.

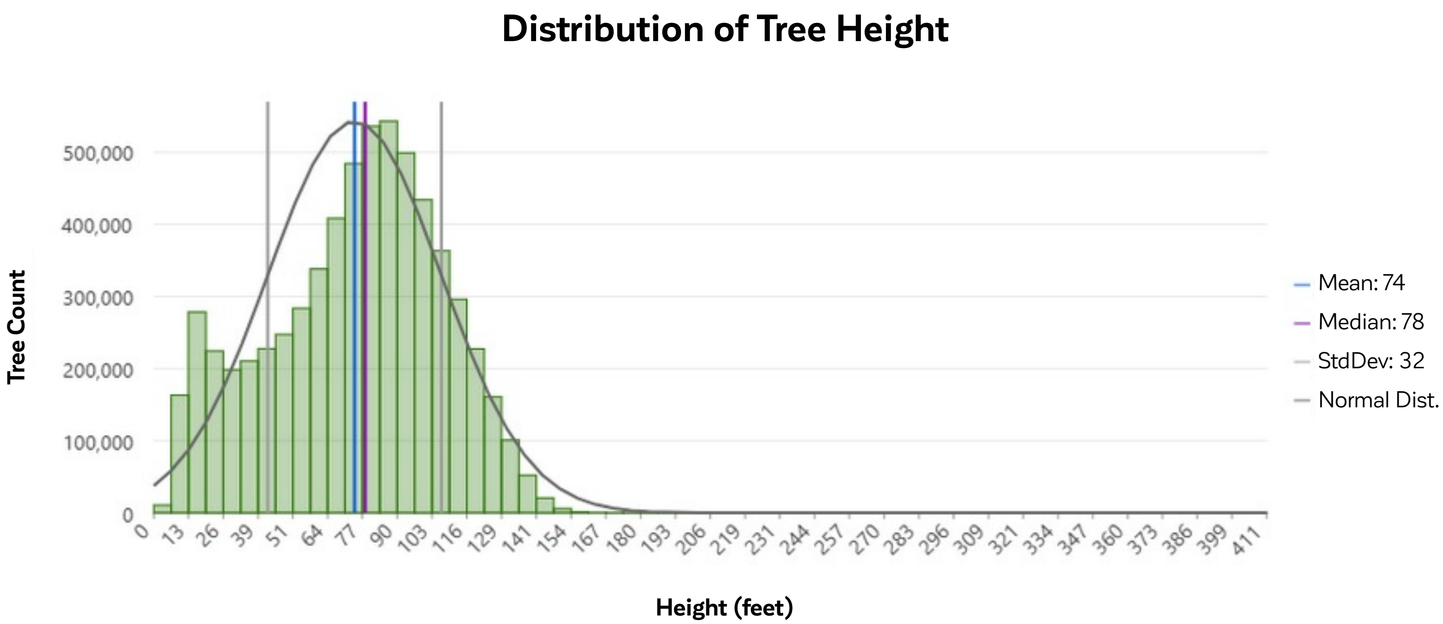


Transect of tree area



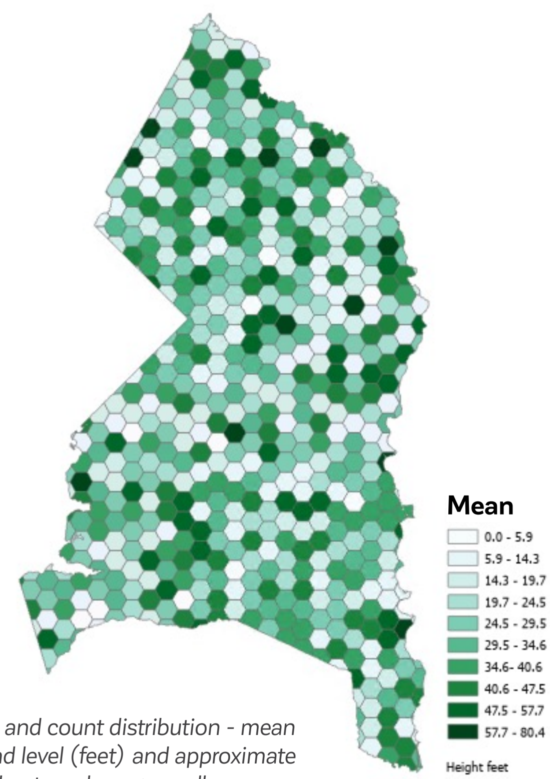
Tree canopy profile from the transect

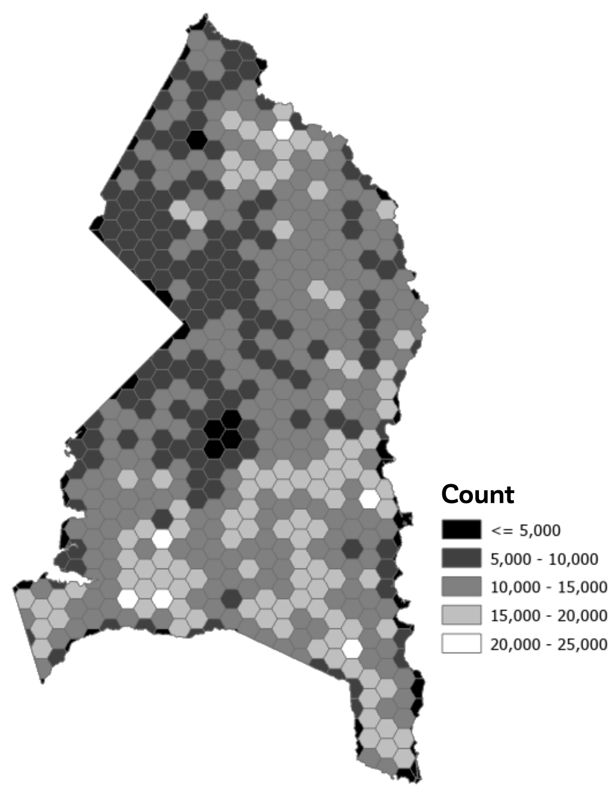
The following graph presents the height distribution of the trees across Prince George's County visualized through a histogram chart. The histogram graph reveals the average height of trees is 74 feet. Based on the Standard Deviation shown by the two vertical bars in the histogram graph, 84% of the trees are within a height range of 42 to 106 feet.



Tree Height Histogram Distribution

The spatial distribution of tree height was calculated for 250-hectare hexagon cells using the 50cm Canopy Height Model dataset. In the image below, the darker the cell, the greater the mean height for that cell. The below maps indicate the distribution of tree height and approximate density of trees by 250-hectare hexagon cell.

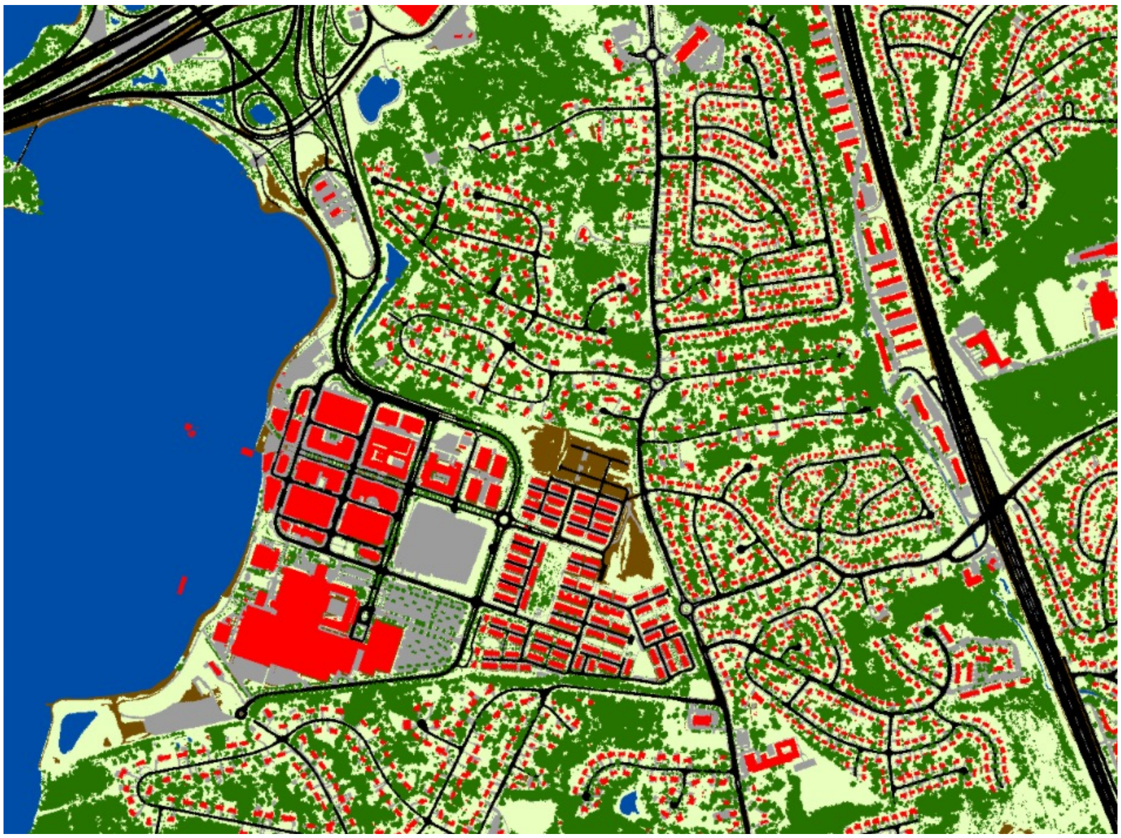




Tree canopy height and count distribution - mean height above ground level (feet) and approximate tree count for 250 hectares hexagon cell areas.

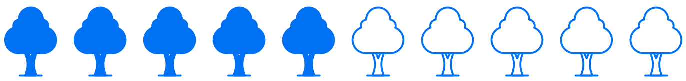
LANDCOVER MAPPING

The new 2024 high resolution land cover map consisting of 7 classes for Prince George's County is consistent with the 2023 study and was developed using 2024 LiDAR data and 2023 NAIP imagery. This was done by applying an object-based image analysis process utilizing eCoginition. The creation of the land cover map supports the tree canopy assessment in terms of its relationship with the surrounding environment including assessment of tree planting potential, urban cooling effects and traffic-related air pollution. The detail of this additional analysis are outlined in the proceeding sections of this report.



TREE CANOPY METRICS

TREE CANOPY COVERAGE



52% **of Prince George's County's land is covered by tree canopy**

An examination of the tree canopy coverage data yields 874,684 tree areas ranging from individual trees to large swaths of dense forested area representing a cumulative geographic area of approximately 251.24 sq miles within the County. The tree canopy coverage is equivalent to 51.9% of the county's 483 sq miles of land area. This is a reduction of approximately 1.5% from the 2020 tree canopy coverage of 53.4%. This change does not consider any statistical confidence or include estimates of uncertainty.

The tree canopy extraction resulted in 90% mapping accuracy.

Existing Tree Canopy %

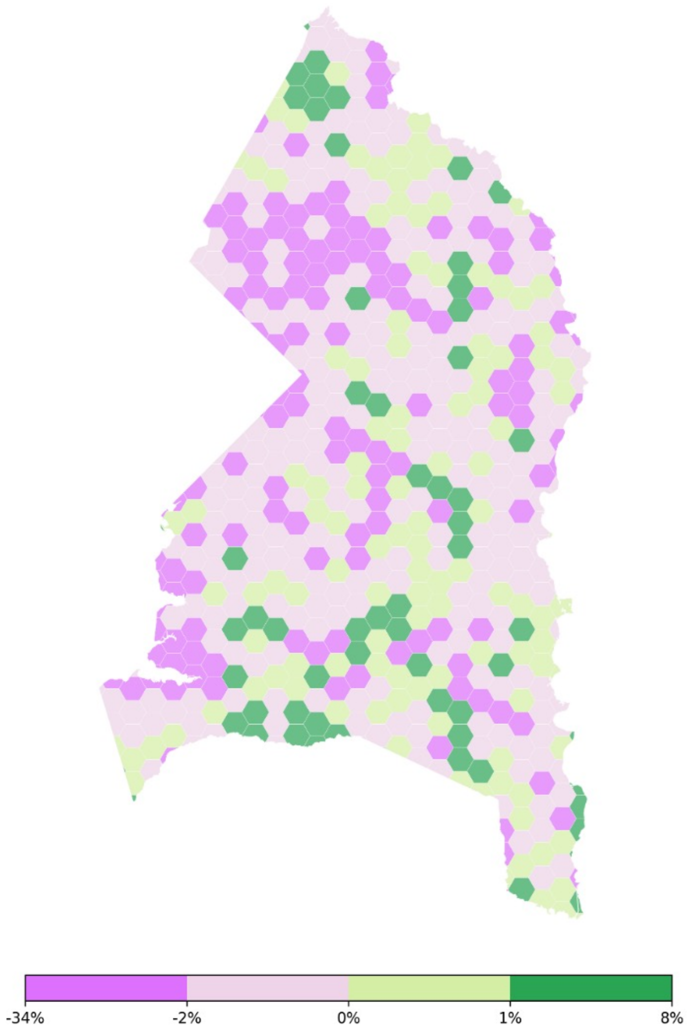
Tree canopy coverage across Prince George's County from 2024 LiDAR data

CANOPY CHANGE DISTRIBUTION

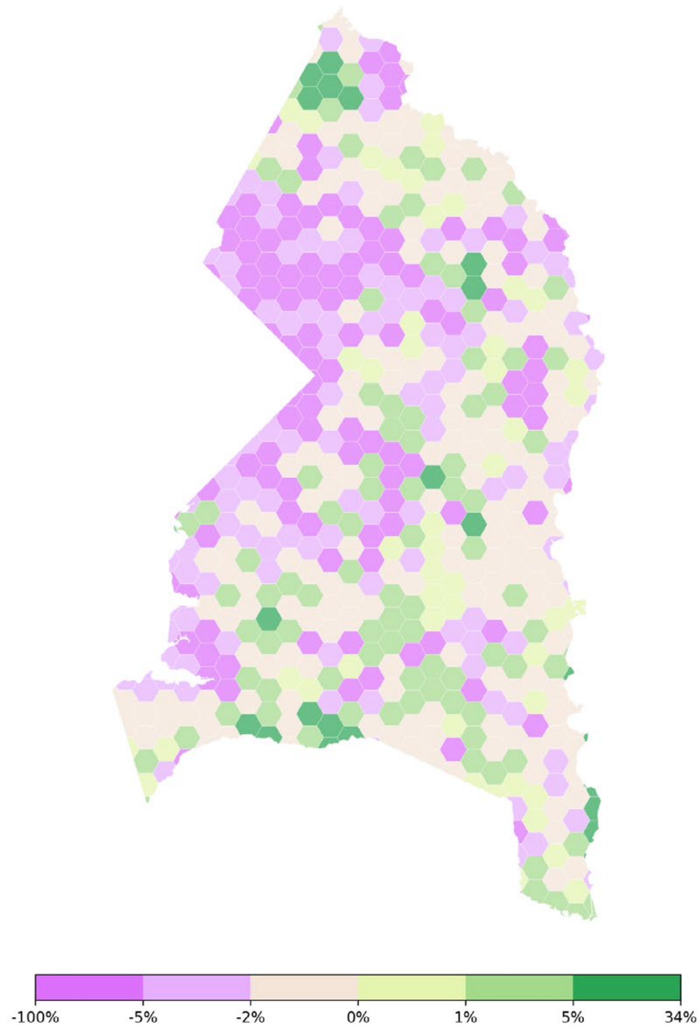
A 250-hectares hexagon grid was used to identify areas of absolute and relative change in the 2024 Tree Canopy assessment. Absolute change is comparing the direct differences between the 2020 and 2024 datasets with respect to the percentage of tree canopy coverage. Relative tree canopy change is calculated by subtracting the tree canopy area in 2020 from the tree canopy area in 2024, then dividing this number by the area of tree canopy in 2020. The relative change provides a perspective from a reference point. It compares the amount of change to the amount of tree canopy the area started with in 2020. As ratio it highlights the magnitude of change.

The maps illustrate the temporal evolution of tree canopy change influence by anthropogenic activities, impacts from storm events and ecological changes including canopy growth and tree succession.

% Absolute Change



% Relative Change



TREE CANOPY CHANGE

Over the past four years, human and natural landscape activities ranging from industrial expansion, new roads, storms, tree planting, and forest growth have altered the tree canopy resulting in changes.

Loss, Gain, and No Change over Time

CHANGE MAP YEARS	LOSS	GAIN	NO CHANGE
2009-2018	17,359.6	22,599.5	143,678.0
2018-2020	3,514.6	8,181.8	155,345.3
2020-2024	10,161.4	7,425.6	153,366.3

The tree canopy change was categorized as loss, gain, and no change for the County. From 2020 to 2024, the macro changes in tree canopy coverage are as follows:

89.7%
remains unchanged
(153,366.3 acres/239.6 sq miles)

5.9%
is loss
(10,161.4 acres/16.0 sq miles)

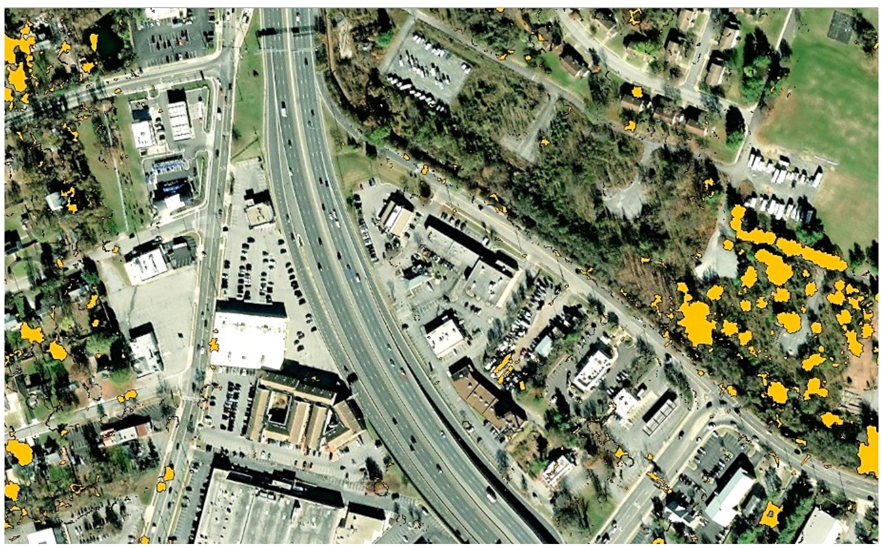
4.3%
is gain
(7,425.6 acres/11.6 sq miles)

Overall, there was approximately 1.5% loss of tree canopy coverage during this period, equivalent to 2,736 acres/ 4.3 sq miles.

The change detection results are used to examine the macro gains and loss across the county and to acquire an understanding of the factors influencing changes such as growth of tree planting, impacts from severe windstorms, and loss due to new land development. The following images are examples of gain, loss, and no change in tree canopy.

Tree Canopy Change Map, 2020-2024

Gain



Loss

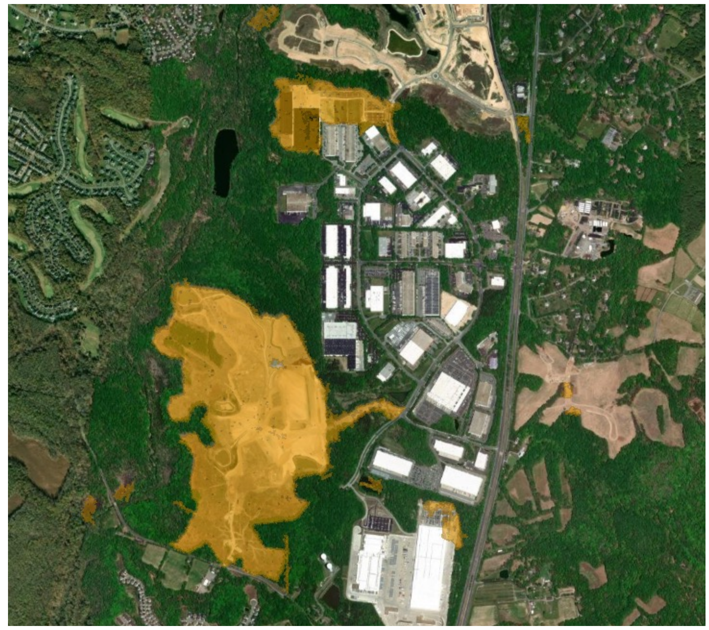
No change

PATTERNS OF CHANGE

THE DISAPPEARANCE OF TREES

Sanborn examined tree canopy areas with a loss greater than 0.5 acre. A total of 521 tree areas, consisting of a total of 1,838 acres were identified as loss. This reduction can be attributed to activities related to industrial expansion, potential agriculture development, corridor clearing, new roads and residential development.

The largest removal of trees in this comparison was 283 acres related to a development area.



Tree Canopy Removal Related to Development Area

Another example of a large area is the removal of trees for the expansion of a road corridor for mixed-use development.

Road Corridor Expansion for a Mixed-Use Development

DEVELOPMENT

Tree removal for residential developments attribute to tree loss in the example shown.

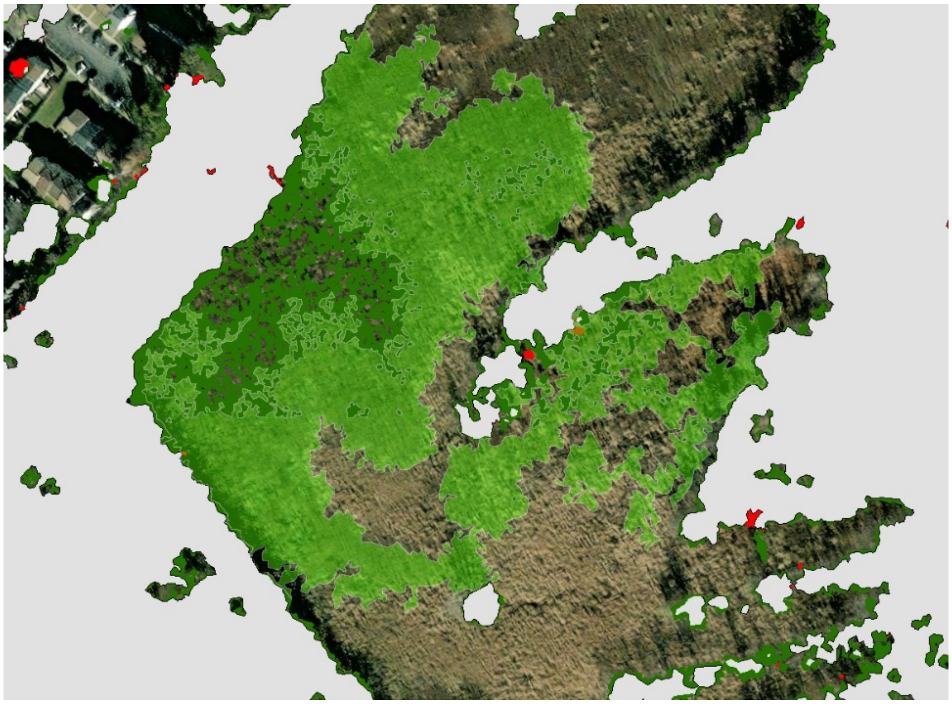
Tree Removal for Residential Development

TREE GROWTH

Many trees in both urban and forested areas were shorter than 8 feet. They have grown taller and now exceed the 8-foot height threshold. This change was detected and recorded using the LiDAR data. The mapping revealed that there were 2,434,822 tree areas that gained canopy coverage. Most of the tree growth (99%) was less than 1,000 sf (2,413,138 tree gain polygons). The data indicates that these polygons represent small growth around treed areas and can be attributed to the expansion of the individual tree crowns.

Example of Tree Canopy Growth Areas

There was also the presence of gain areas that were greater than 1 acre. A total of 50 areas were identified in this category totaling 95 acres. These represent new tree growth areas associated with sparse to dense forest areas. In the example, the largest gain area at 228,688 square feet (5.25 acres) is shown as light green. The 2018 to 2020 change detection is also shown in the image with gain as dark green, red as loss, and no change as white. The initial interpretation of the large gain is likely due to tree growth over the past 4 years exceeding the 8-foot tree height threshold which was used to screen vegetation.



Example of tree gain areas from 2020 to 2024 of 5.25 acres in light green. Also displayed is the 2018 to 2020 change as red for loss, white no change and dark green for gain.

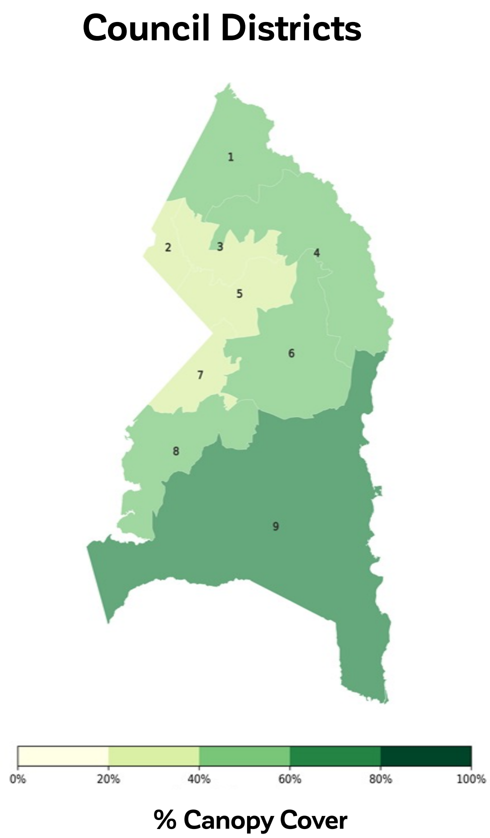
New Tree Growth in Forest Area

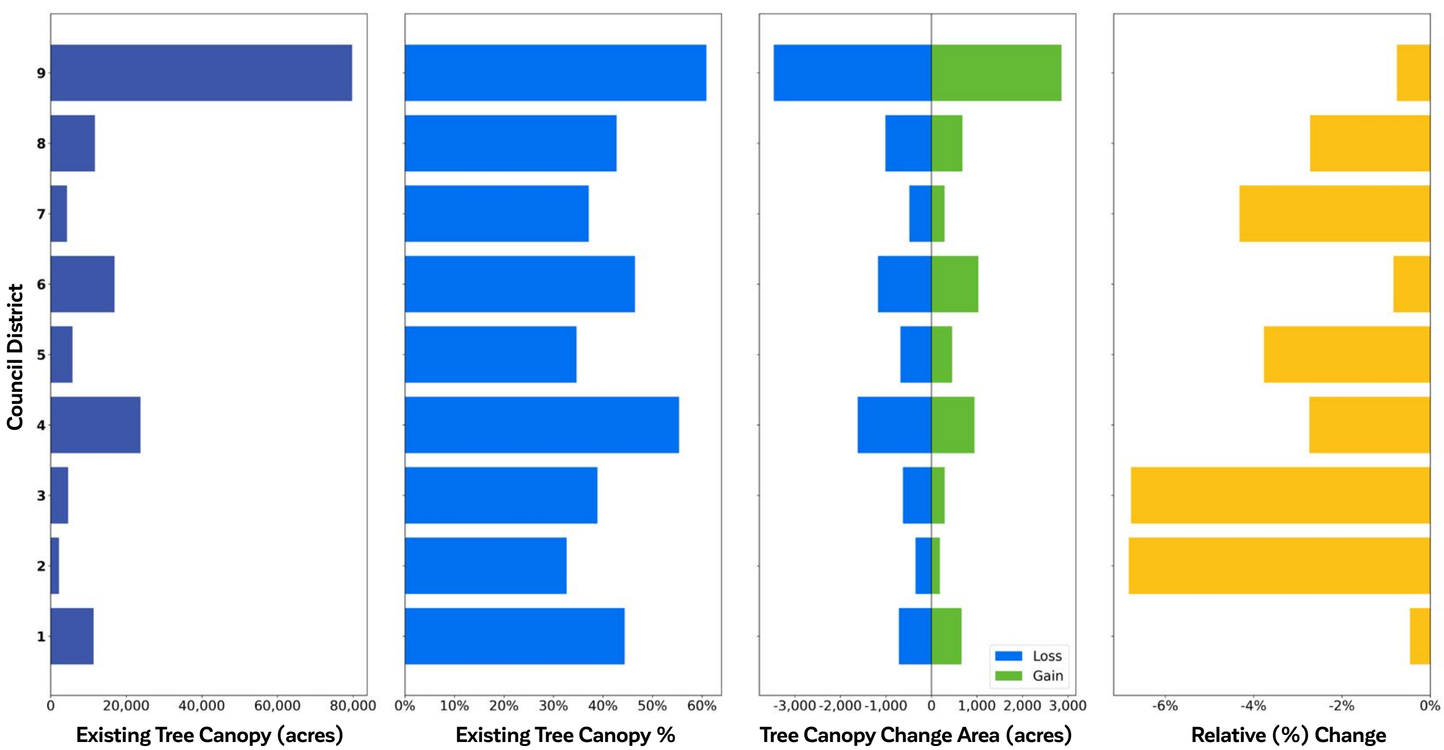
Forest Patch Growth

COUNCIL DISTRICTS

The highest percentage of canopy cover is found in Council District 9. This is expected as this area is characterized by rural and agricultural development.

All of Prince George's council districts experienced both gain and loss of tree canopy within their boundaries. Gains in Districts 1, 4, 6 and 9 followed similar patterns of gains and losses from the previous evaluation period (2009-2020) with gains nearly keeping steady with losses. The severity of losses was buffered by gains through replanting efforts and natural succession. Areas with large parks and open space tend to have more canopy, while neighborhoods that are denser with commercial or industrial use tend to have less tree canopy. Council District 9 contains the largest share of the county's 2024 tree canopy at about 79,731 acres. District 9 also saw the largest net tree canopy gains in terms of total area (2,857 acres). Districts 2 and 3 on the other hand, saw the largest tree canopy losses in terms of relative percentage change with 2.3% and 2.8% respectively.

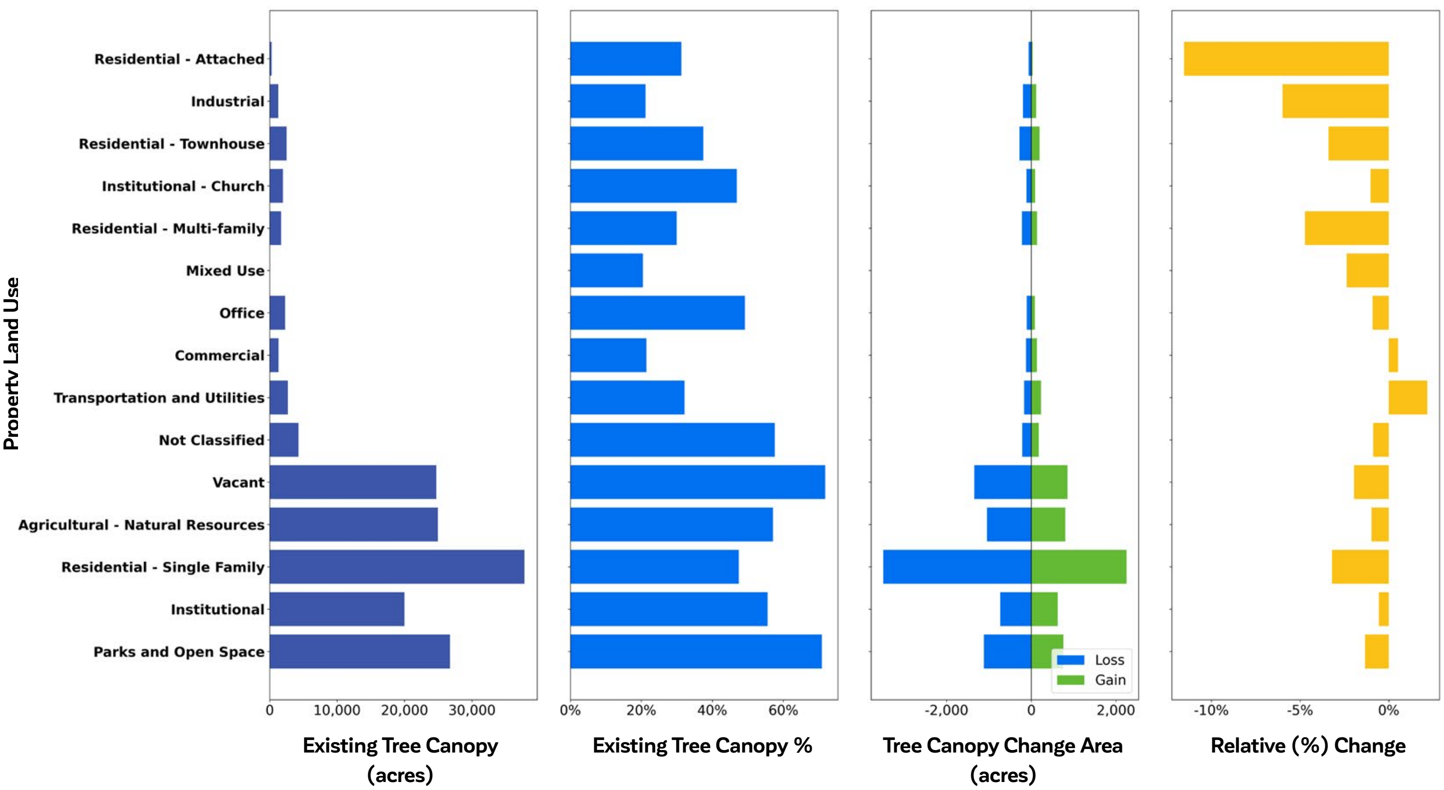




LAND USE

Land use is how humans make use of the land including the economic and cultural activities practiced there. Land use is not to be mistaken with land cover which refers to landscape features, such as trees, buildings, water and other classes mapped as part of this study. Land use can significantly influence the amount of tree canopy and the room available to establish new tree canopy.

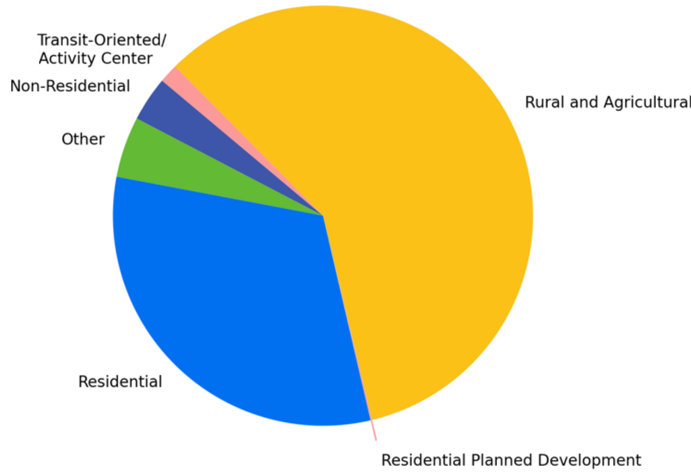
Tree canopy cover was calculated in terms of the percent of land area within each land use type to understand the proportion of each unit with canopy coverage. In addition, the land use was calculated as a percentage county-wide to determine contribution to the county's overall tree canopy. Nearly 33% of Prince George's tree canopy falls within one of the residential land use types (Single Family, Multifamily, Townhouse, and Attached). Single Family residential on its own contains 37,763 acres of tree canopy, contributing 28% of the county's total tree canopy. Single Family Residential also saw the most gains in any land use category, seeing 2,248 acres of gain; a total of 6% of the canopy in that category classified as new canopy. However, losses in canopy were also highest in this category, reflecting new development. Parks and Open Space remained relatively stable in gains and losses. Transportation & Utilities saw the highest relative gain of canopy at about 2%, reflecting a commitment to creating canopy in urban areas.



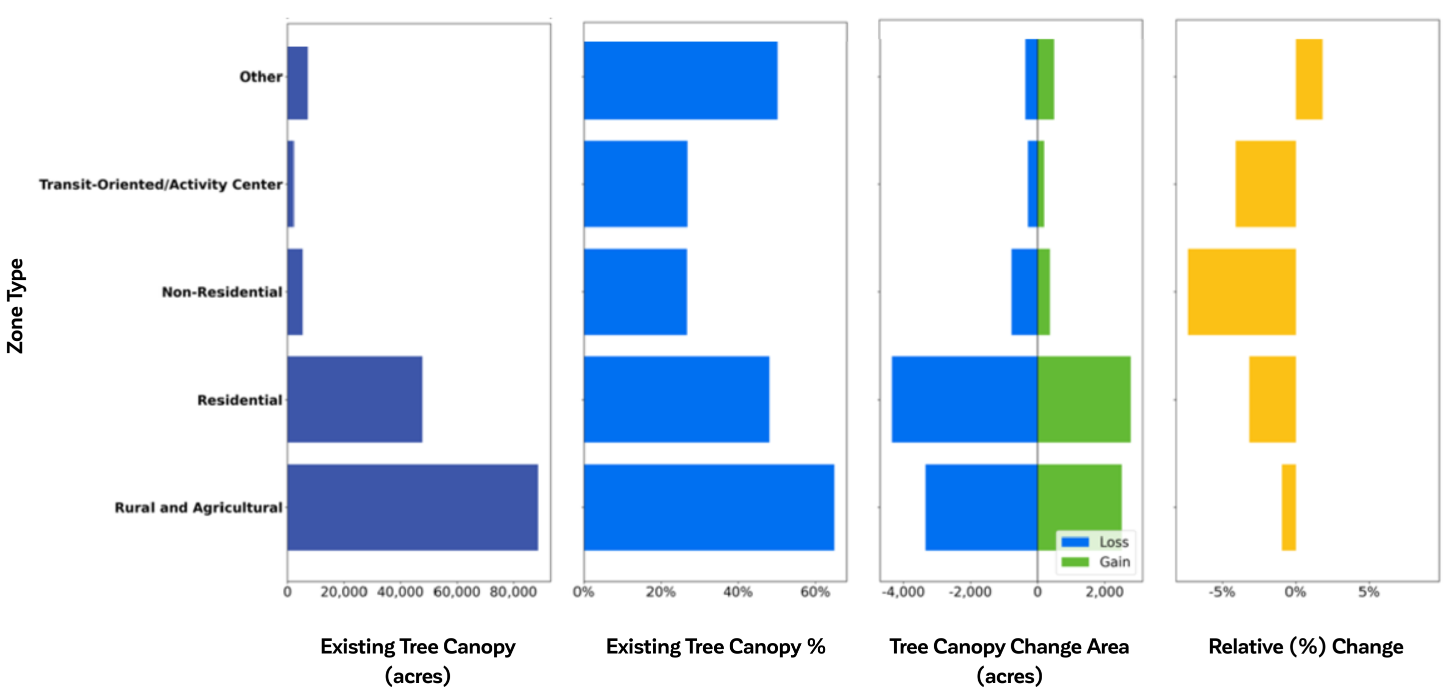
ZONING

Rural, agricultural, and residential areas are the majority contributors of tree canopy in Prince George's County.

Tree Canopy Distribution by Zone Type

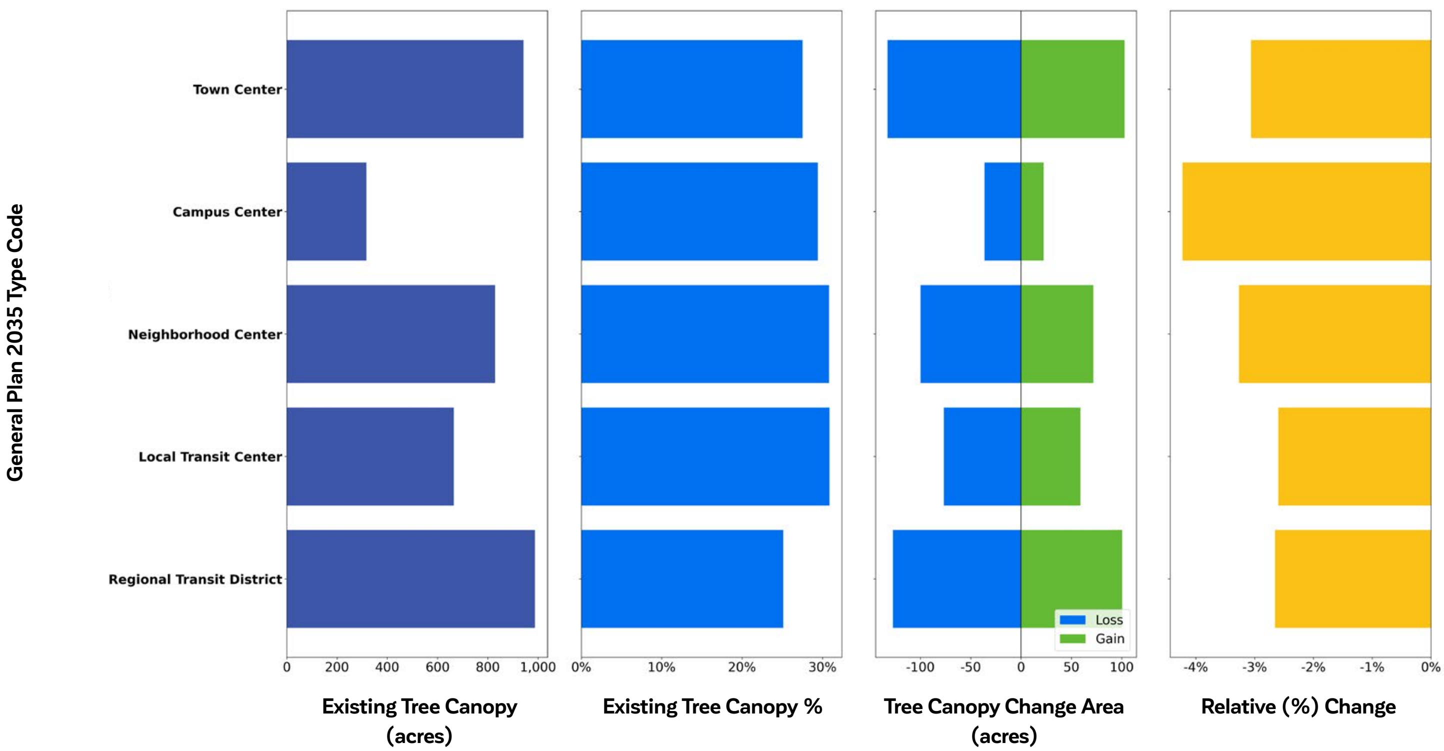


Understanding the location and land-use types that tree canopy falls into is important for coordination and planning purposes. Land zoned for Rural and Agricultural contained a majority of Prince George's existing tree canopy (49%) in 2024. Rural and Agricultural had the highest existing tree canopy percent with 66% of land covered by tree canopy. Between 2020 and 2024, land zoned for Rural and Agricultural saw a net gain of 2,513 acres of tree canopy amounting to a total 2024 area of 88,758 acres. The key role that Prince George's Rural and Agricultural areas play in the county's tree canopy underscores the need for thoughtful development as the county continues to grow. Residential zones were the next biggest contributors to Prince George's tree canopy, representing almost one third (32%) of the county's tree canopy. Both gains and losses in residential zones slightly outpaced Rural and Agricultural areas, signifying both increases in development coinciding with maintained growth in urban canopy.

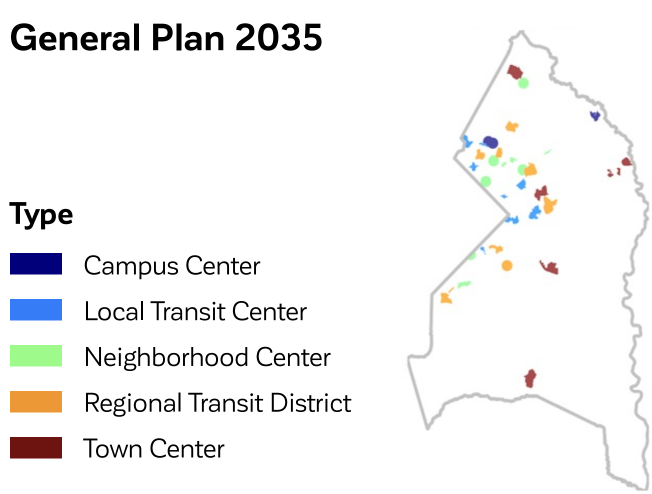


PRINCE GEORGE'S PLAN 2035

Prince George's 2035 General Plan provides recommended goals, policies, and strategies for future development within the county. This guidance, with a focus on sustainability and managing tree canopy as key green infrastructure, will be an important tool in reaching goals and achieving positive social, economic, and environmental impacts. Of the areas designated in the General Plan, each group had a relatively consistent canopy coverage ranging from 25% existing tree canopy percent (Regional Transit Districts) to 31% (Neighborhood Centers). In terms of change in tree canopy from 2020 to 2024, Local Transit Centers and Regional Transit Districts have a mix of gains and losses. Significant losses came primarily from several large new development projects including a large housing development to the south of Northwestern High and to the west of Ager Rd & US-500. Town Centers saw a relative decrease of 3% with some cleared lots with development potential but also saw regrowth in some previously cleared or vacant lots. Campus Center had the largest relative change, a loss of 4%, with the construction of new buildings and a transit corridor on the University of Maryland Campus and new buildings on the Bowie State University campus.



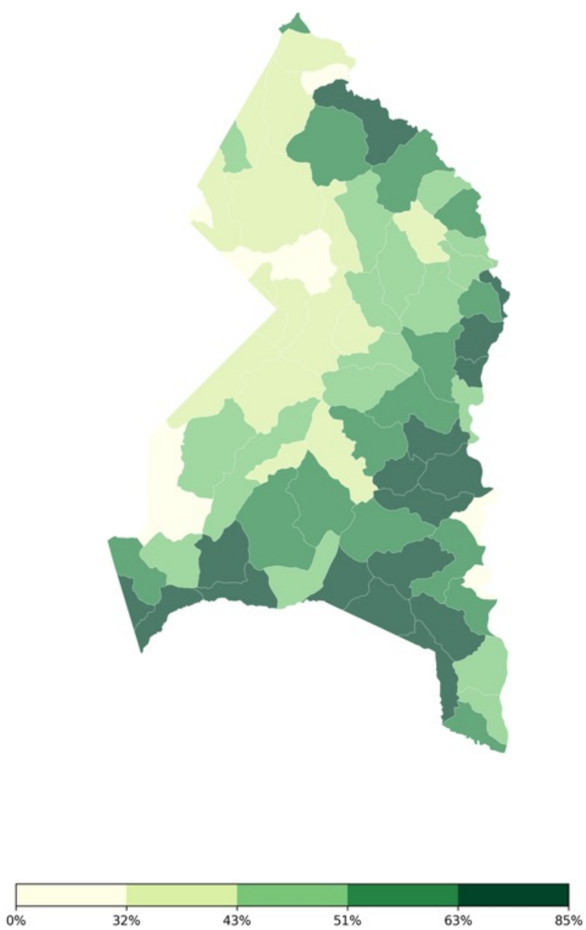
This map displays Prince George's General Plan type distribution of designated areas.



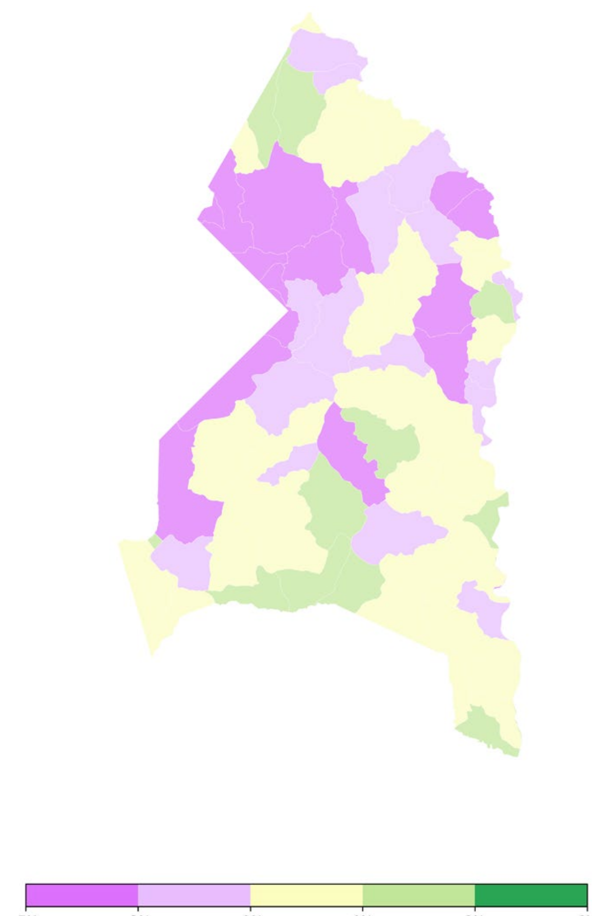
SUB WATERSHED DNR

Watersheds represent areas in which water moves and drains to reach streams, lakes, and other waterbodies. An increase in impervious surfaces, commonly due to increased development, impacts the water flow through a watershed. Water tends to flow faster and collect pollutants over impervious leading to higher risks of flooding, contamination of waterways, and loss of fish habitat. Trees can reduce stormwater runoff by acting as a sponge, absorbing approximately 18 inches of rainfall and then gradually releasing it into the watershed (Cotrone, 2025). The stormwater runoff of one acre of impervious surface generates the equivalent amount of annual runoff as 36 acres of forested land (Cotrone, 2025). Maintaining tree canopy, especially in riparian areas, is an important tool for managing the health of watershed ecosystems. Watersheds closer to Washington, DC had the least amount of existing tree canopy as of 2024 and experienced the largest decrease in relative tree canopy change over a 4-year period. Watersheds in the north and south of the county experienced modest canopy growth, while watersheds in the developed west of the county saw canopy decline. Sub watersheds near the DC area saw the greatest relative declines of up to 7%.

% Canopy by Sub watershed



% Relative Change by Sub watershed

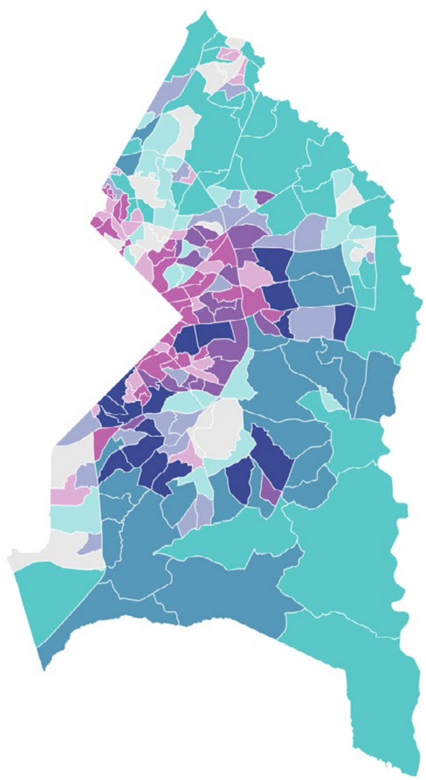


ENVIRONMENTAL EQUITY AND URBAN RESILIENCE

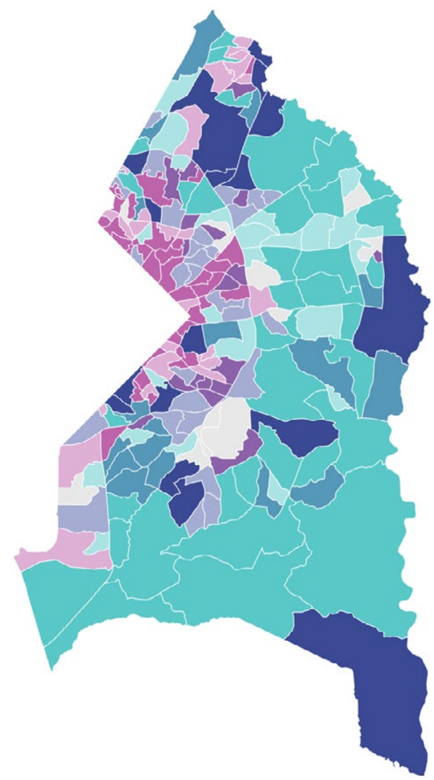
Ongoing urban development within Prince George's County is impacting tree canopy coverage, which affects neighborhoods differently. Identifying the exposure level of marginalized populations to the benefits of trees specifically for mental health and heat mitigation is important for improving environmental equity. Using 2023 ACS census data estimates, the relationship between 2024 tree canopy coverage and the percentage of non-white population and percentage of household income < $25,000 was investigated. These two variables were aggregated to discover the bivariate relationship against the tree canopy cover by 2020 census tract.

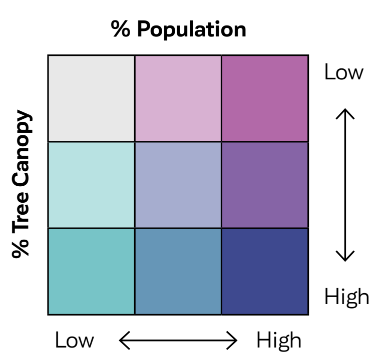
Several census tracts (980000, 805908, 805601, 805602, 803525) in the northwest regions of Prince George's County closest to Washington, DC have disparities in household income and tree cover compared to other neighborhoods in the county.

%Non-White (2023 ACS)



%Households with Income < $25,000

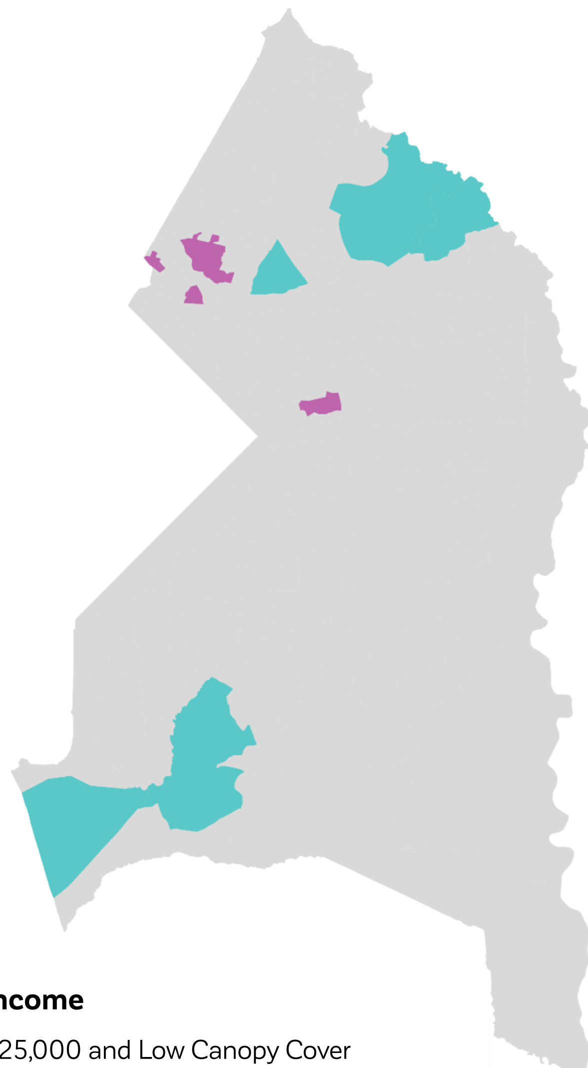




There is a clear relationship between lack of canopy and household income.

It was observed in the data that census tracts with more than 10% of household income < $25,000 have a median tree cover of 34% while census tracts with less than 10% of household income < $25,000 have a median tree cover of 42%. The median tree cover was calculated from the mean tree coverage value for all tracts with 10% of household income above or below the $25,000 threshold.

Census Tracts with Most and Least Tree Canopy Cover Equity by Percent of Households with Income < $25,000



Canopy Inequity: Household Income

- High % Household Income < $25,000 and Low Canopy Cover
- Low % Household Income < $25,000 and Low Canopy Cover
- Other

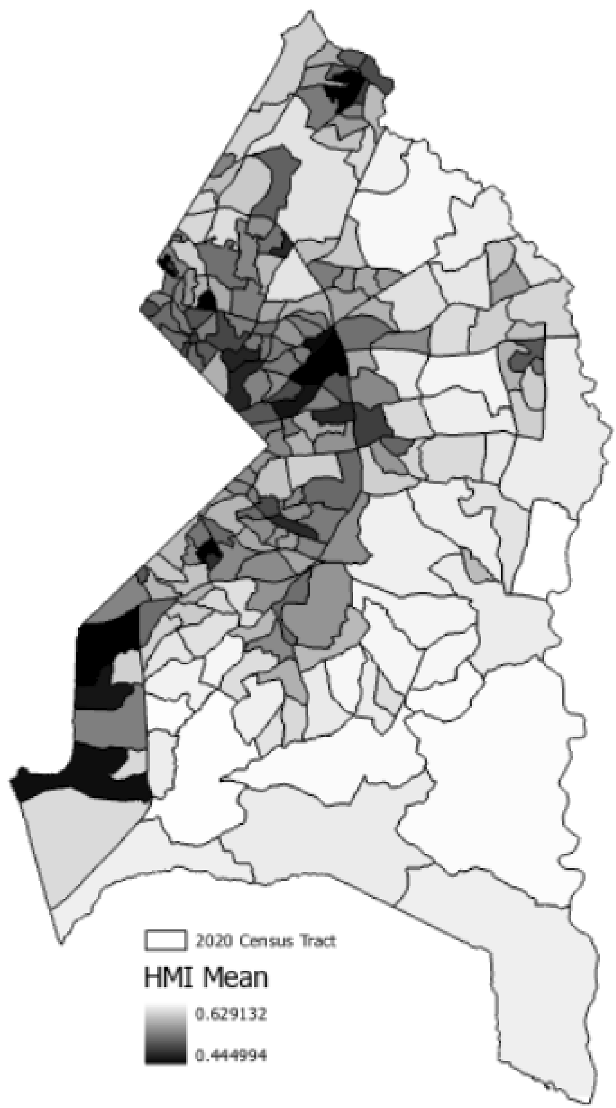
Highlighted are the top and bottom ranked tracts for canopy disparity.

ENVIRONMENTAL STRESSORS AND MITIGATION CAPACITY BY TREES

URBAN COOLING

Tree canopies offer communities significant cooling benefits by mitigating summer heat through the shading of buildings and paved surfaces. Evaporation by the trees and other vegetation absorbs surrounding heat causing a cooling effect. The extent of this cooling influence can be estimated using the Stanford University Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) Urban Cooling model. This model calculates a Heat Mitigation Index (HMI) based on three key factors: canopy shading, evapotranspiration, and albedo. It also considers the proximity of location to other cooling features, such as park areas. The scale is from 0 to 1, however the resulting HMI typically ranges from 0.25 (least mitigation) to 0.75 (most mitigation).

The model requires a Land Use/Land Cover (LULC) map which characterizes both green spaces and urban features which can then be related to thermal properties (absorption and emission of heat). LULC data was created using 2024 LiDAR, the extracted tree canopy, and supported with ancillary imagery and planimetric data. Evapotranspiration data is another important input into the model. The evapotranspiration process undertaken by trees and vegetation provides a cooling effect as liquid water molecules emitted from the leaves absorb surrounding heat causing a cooling effect. Instance Evapotranspiration data used in the model was acquired from NASA ECOSTRESS sensors aboard the International Space Station. In addition, air temperatures were obtained from available local stations within the County and rural reference stations from the NOAA National Centers for Environmental Information. A HMI map was generated for a model simulation run on August 2, 2024. Using the 2020 Census tract boundary, a statistical spatial zonal analysis was conducted to derive mean value and the standard deviation. The maximum and minimum HMI values across the County are 0.247 and 0.84. The mean value ranged from 0.445 to 0.63 while the standard deviation, which represents 66% of the distribution or spread around the mean value, was 0.0178 (small variability) to 0.1631 (larger variability). The model results are shown in the image to the right. Census tract areas that are darker in color are locations where tree planting mitigation measures would be beneficial.

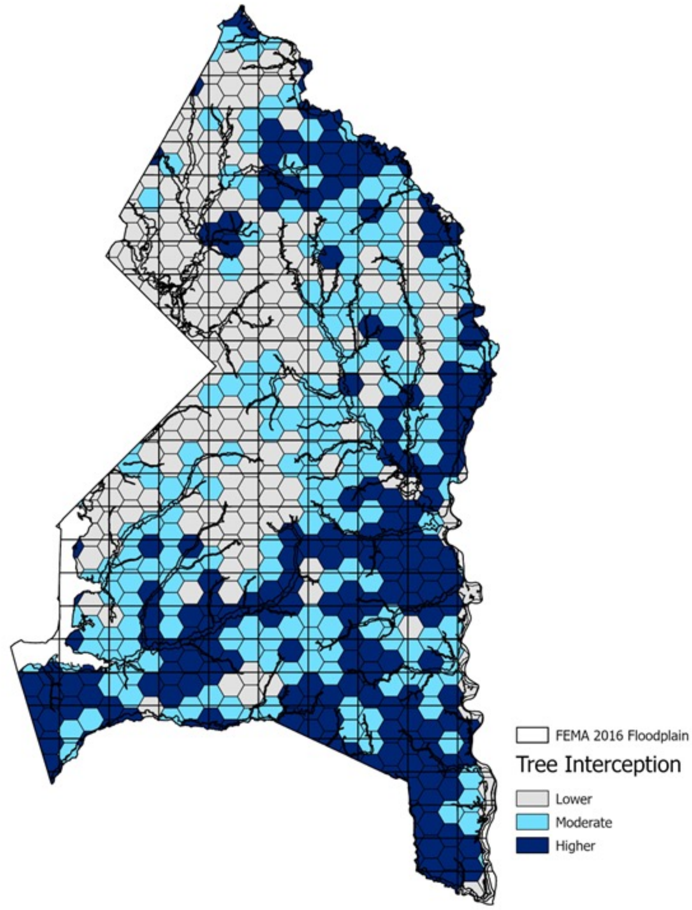


Heat Mitigation Index Mean for 2020 Census Tract Boundaries

WATER RETENTION

Tree interception can be referred to as a temporary storage of rainfall on the surfaces of leaves, branches, and stems preventing its direct contact with the ground. Water retained by the tree structure subsequently returns to the atmosphere through evaporation. Furthermore, trees delay direct precipitation from landing on the ground by acting as a buffer, reducing the volume of surface runoff and delaying the onset of peak flows in a flood event. The delaying of the precipitation by the trees improves ground water percolation which increases the inflow into groundwater aquifers.

As a dynamic process, interception depends on several factors such as tree species, canopy density, leaf density, branch structure, phenological stage (leaf on/leaf-off) as well as rainfall intensity, duration and frequency. Forest canopy interception has been studied in both laboratory and field experiments (Rutter et al. 1971; Aston 1979; Gash et al. 1995). In rural forests, Zinke (1967) found that 15% to 40% of annual gross precipitation can be lost by interception in conifer-dominated forests and 10% to 20% in hardwood-dominated forests. Interception may exceed 59% for old growth forest trees (Baldwin 1938). However, information on interception by open-grown urban trees is lacking (Xiao et al. 1998).



To provide a relative approximation of the tree interception across the County, a simple mathematical model was developed that leverages the general properties that increase interception using the available study data. The model incorporated the presence of tree canopy area to represent extent of crown projection area, the tree count to represent tree density, tree heights, and the NDVI values from the latest NAIP imagery to represent leaf density. Each parameter value was normalized to scale of 0 to 1. A statistical zonal analysis was conducted using hexagon cells of 250 hectares. For each cell, half the median value was applied for NDVI (this factor was applied because of the influence of grass), the mean value was used for tree height, the majority percentage was applied to binary tree canopy area, and tree density was derived from tree counts per zonal area. The cumulative values of the four layers was scaled by 100 and calculated as a relative indicator of tree interception. The results were separated by Quartiles into three ranges (Lower, Middle and Higher).

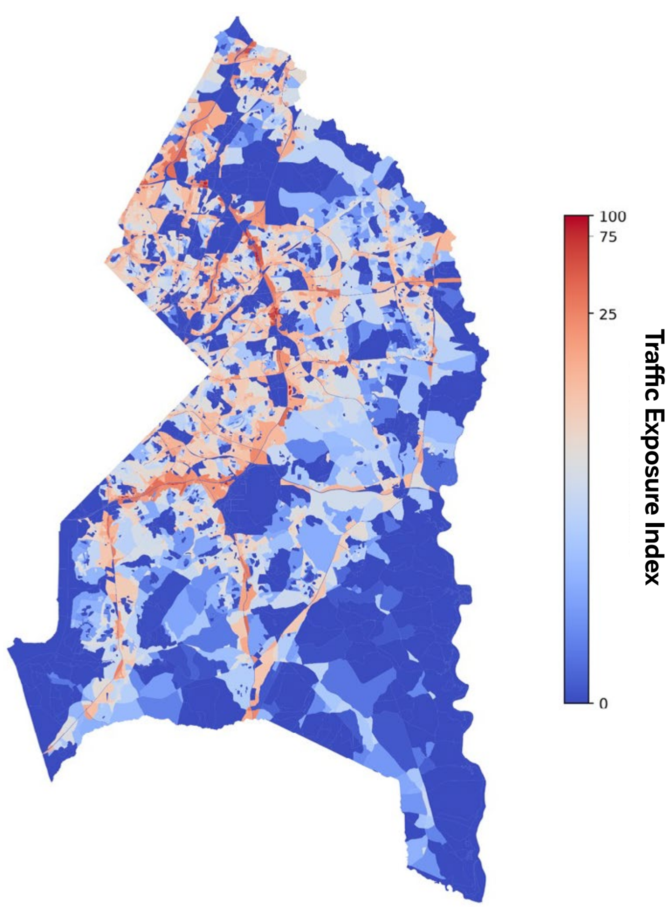
The use of the tree interception layer is to provide a guide for identifying areas for further investigation for the benefit trees can provide from a water resources perspective and to support future mitigation strategies for community resilience. The general goal of this model was to indicate areas consisting of lower, moderate, and higher interception values. The image above represents the tree interception map ranging from lower (white cells) to higher (dark blue cells) with FEMA 2016 flood plain layer in black.

REDUCING EXPOSURE TO TRAPs

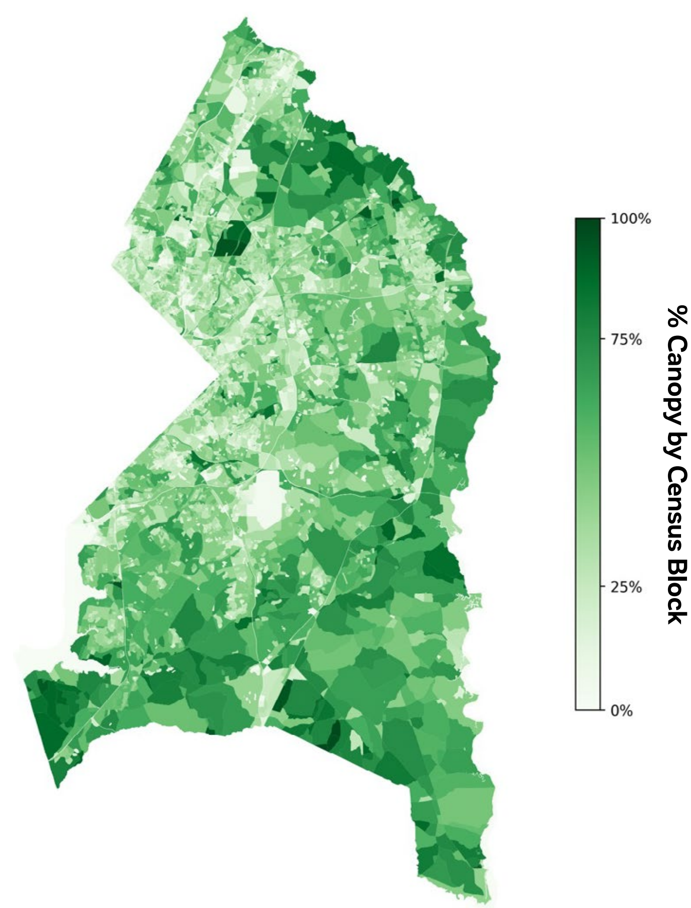
Transportation networks are an integral and essential part of a community's social and economic value from commuting to movement of goods and services. The downside is the creation of Traffic-Related Air Pollution (TRAP) and its contribution to overall air pollution from vehicle exhaust, tire and break wear, and road dust. Vehicles contribute by the release of particulate matter, gases emission (CO, NOx), Volatile Organic Components (VOC) and Black Carbon (Soot). Strategically planted trees can reduce TRAP and improve air quality through absorption and filtration while also providing a sound barrier reducing community noise pollution. A TRAP exposure assessment was calculated for each census block using the Federal Highway Administration's AADT (Annual Average Daily Traffic) data and Prince George's County Address data from 2023. An index was created utilizing the normalized traffic exposure by land area per block and dwellings within 300m of exposure to identify census blocks with the potential to be most adversely affected by TRAP.

Many neighborhoods with the highest exposure to traffic have moderate tree cover (25-40%+). Maintaining and increasing the canopy where possible in these areas is critical to maintaining canopy equity as traffic steadily increases each year.

Traffic Exposure Index (0-100)
2022 Annual Average Daily Traffic



Canopy Cover
by Census Block

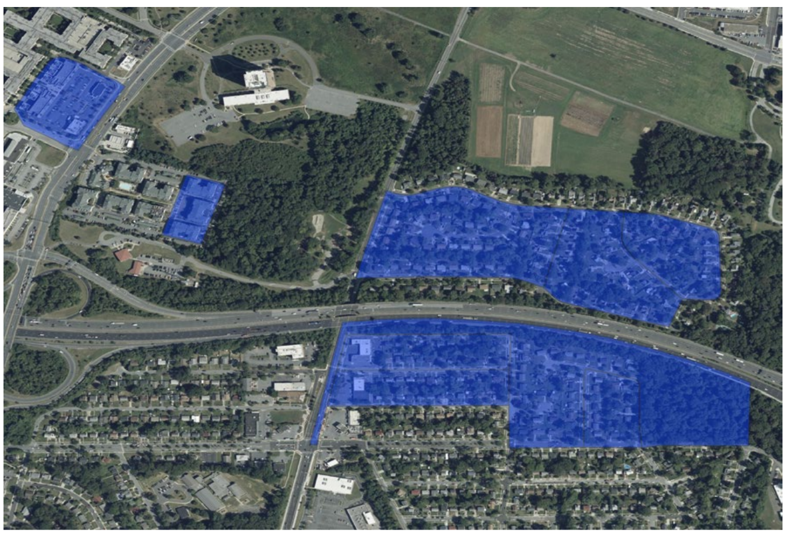


Several neighborhoods have been identified with moderate to high TRAP exposure and little canopy. Below, the top 3 census blocks with a high Traffic Exposure Index in combination with lower canopy cover have been identified. Also shown are neighboring blocks in the top 5% of traffic exposure in blue, with the neighborhood's mean Traffic Exposure Index and tree canopy cover displayed.

GLENARDEN PARKWAY & CAPITAL BELTWAY

25%
Average Tree Cover

47/100
Traffic Exposure Index



CAPITAL BELTWAY & RHODE ISLAND AVENUE

27%
Average Tree Cover

55/100
Traffic Exposure Index

HIGHWAY 50 & MAIDEN DR

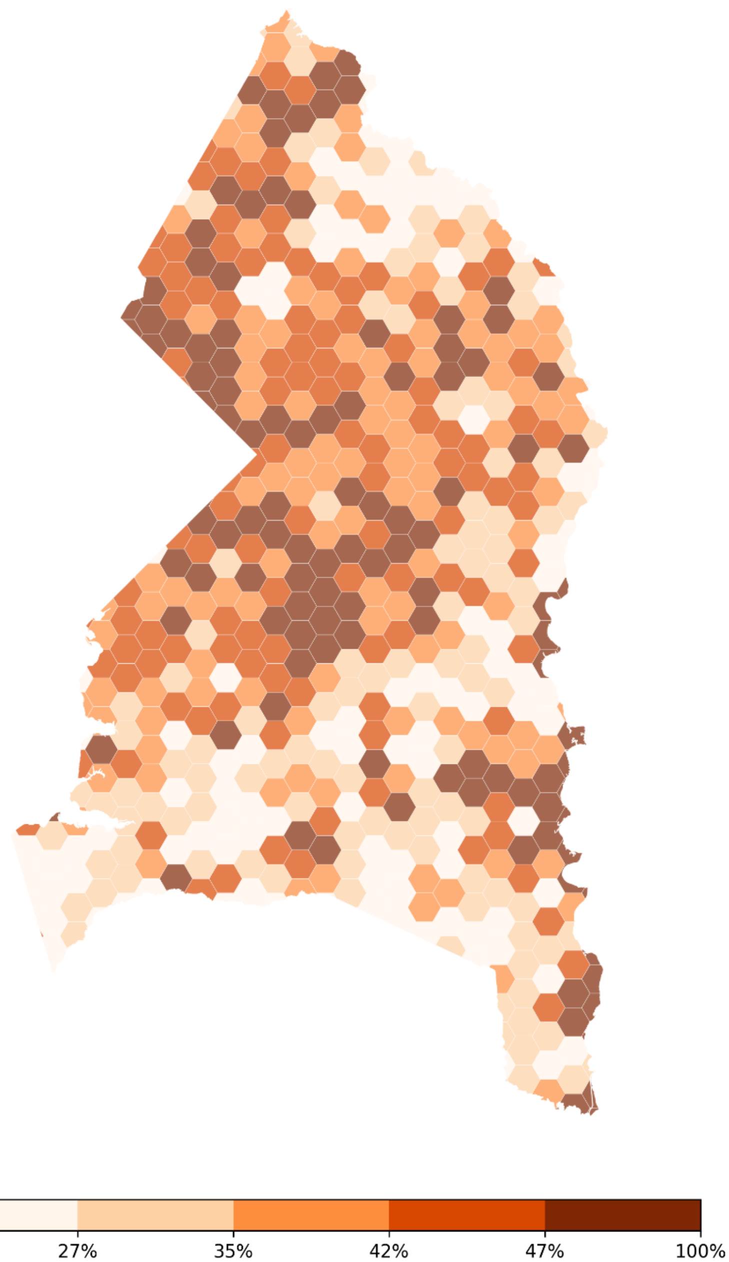
10%
Average Tree Cover

34/100
Traffic Exposure Index

TREE PLANTING POTENTIAL

Utilizing the land cover information and tree canopy coverage, possible planting areas can be identified. In this assessment, areas with no trees, roads or areas surrounding water bodies represent theoretical areas of tree canopy expansion as planting areas. A 250-hectares hexagon grid was used to categorize potential planting areas (land classified as grass/shrub, bare soil, other paved) by percentage of area based on 2024 tree canopy coverage. Darker cells are areas that have a higher potential for tree planting.

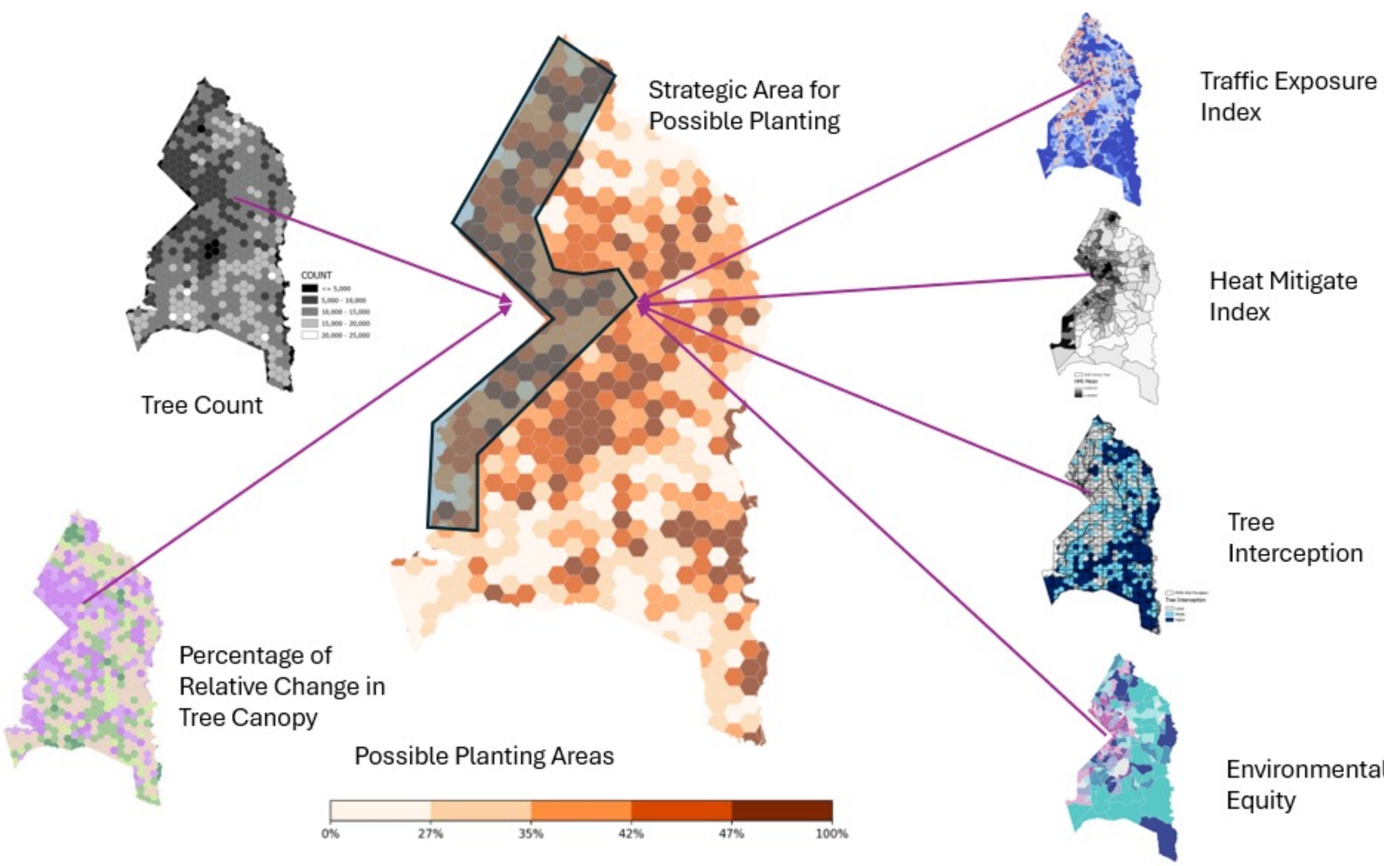
Possible Planting Area



Next, a visual analysis of environmental and socio-economic stressors modeled in this study was conducted as a strategic guide to refine possible tree planting areas. These stressors included urban cooling modeling to mitigate heat, tree interception to reduce surface water runoff, identification of traffic related air pollutants exposure, and areas of environmental inequity. In addition, tree canopy characteristics include the percentage of relative change and tree count as spatial indicators of tree canopy impact areas. The following criteria were applied to the selected stressors to support a macro scale visual analysis:

- Census tract areas with high heat mitigation index
- Locations with lower tree interception
- Corridors with high traffic pollution index
- Census tract areas with low household income and high percentage of non-whites.
- Areas with percentage of relative tree loss
- Locations with low tree count

The results identified a region along the western portion of the County as a strategic area for possible tree planting.



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CONTACT INFORMATION

The Sanborn Mapping Company Inc. was contracted by Prince George's County Planning Department to acquire LIDAR data and evaluate tree canopy cover change in the county from 2020 to 2024. The methods and analytics used to produce this report used in-house advance data analytics consistent with University of Vermont Spatial Analysis Lab process which was developed as part of collaboration with USDA Forestry.

Tree Canopy in Prince George's visualized in 3D using LiDAR and imagery

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