

A Report on the Montgomery County's Existing and Possible Tree Canopy



Why is Tree Canopy Important?

Tree canopy (TC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Tree canopy provides many benefits to communities, improving water quality, saving energy, lowering city temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits. Establishing a tree canopy goal is crucial for communities seeking to improve their green infrastructure and livability. A tree canopy assessment is the first step in this goal-setting process, providing estimates for the amount of tree canopy currently present in a county as well as the amount of tree canopy that could theoretically be established.

How Much Tree Canopy?

An analysis of Montgomery County's tree canopy based on land cover data derived from high-resolution aerial imagery and LiDAR (Figure 1) found that 157,219 acres of the county were covered by tree canopy (termed Existing TC), representing 50% of all land in the county. An additional 43% (136,888 acres) of the county could theoretically be modified (termed Possible TC) to accommodate tree canopy (Figure 2). In the Possible TC category, 5% (15,066 acres) of the county was classified as Impervious Possible TC and another 38% was Vegetated Possible TC (121,822 acres). Vegetated Possible TC, or grass and shrubs, is more conducive to establishing new tree canopy, but establishing tree canopy on areas classified as Impervious Possible TC will have a greater impact on water quality and summer temperatures.

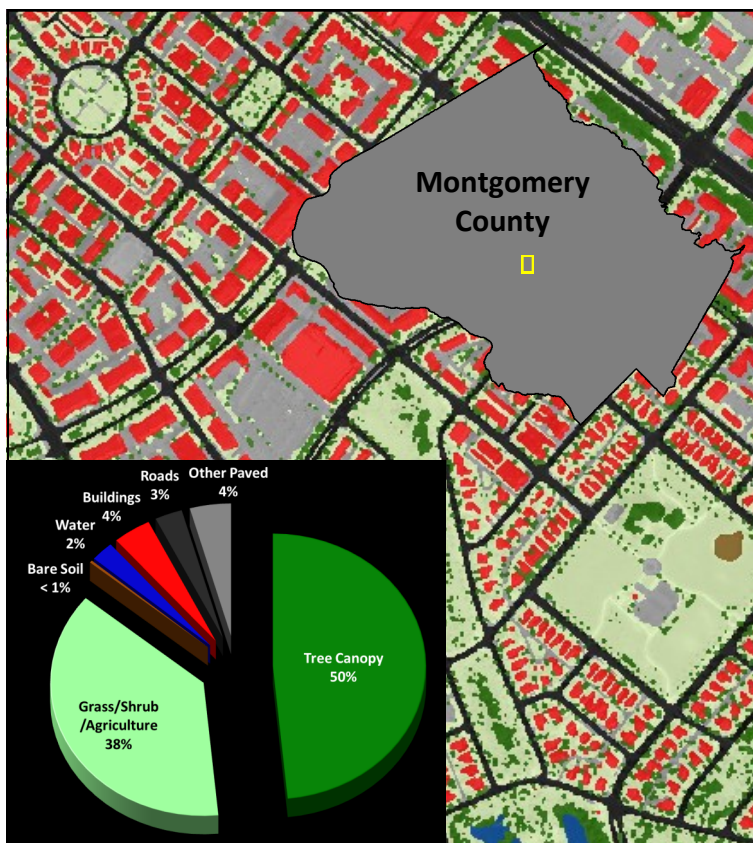


Figure 1: Land cover derived from high-resolution aerial imagery for Montgomery County.

Project Background

The goal of the project was to apply the USDA Forest Service's TC assessment protocols to Montgomery County. The analysis was conducted based on year 2009 data. This project was made possible through funding from the Maryland-National Capital Park and Planning Commission (M-NCPPC), Sandia National Laboratories, and the USDA Forest Service. The University of Vermont Spatial Analysis Laboratory (SAL) performed the assessment in collaboration with M-NCPPC and the USDA Forest Service's Northern Research Station.

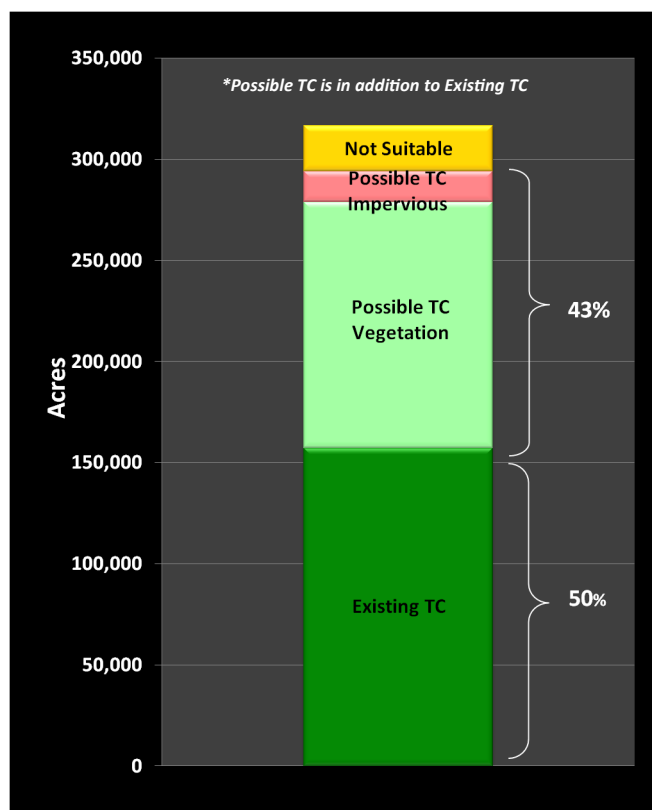


Figure 2: TC metrics for Montgomery County based on % of land area covered by each TC type.

Key Terms

TC: Tree canopy (TC) is the layer of leaves, branches, and stems 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 TC: The amount of urban tree canopy present when viewed from above using aerial or satellite imagery.

Impervious Possible TC: Asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy.

Vegetated Possible TC: Grass, shrub, or agricultural area that is theoretically available for the establishment of tree canopy.

Mapping Montgomery County's Trees

Prior to this study, the only comprehensive remotely-sensed estimates of tree canopy for Montgomery County was from the 2001 National Land Cover Database (NLCD 2001). While NLCD 2001 is valuable for analyzing land cover at the regional level, it is derived from relatively coarse, 30-meter resolution satellite imagery (Figure 3a). Using high-resolution aerial imagery and LiDAR acquired in 2009 (Figure 3b), in combination with advanced automated processing techniques, land cover for the city was mapped with such detail that trees as short as 6ft tall were detected (Figure 3c). NLCD 2001 estimated a mean percent tree canopy of 29% for Montgomery County largely because it failed to capture many isolated trees.

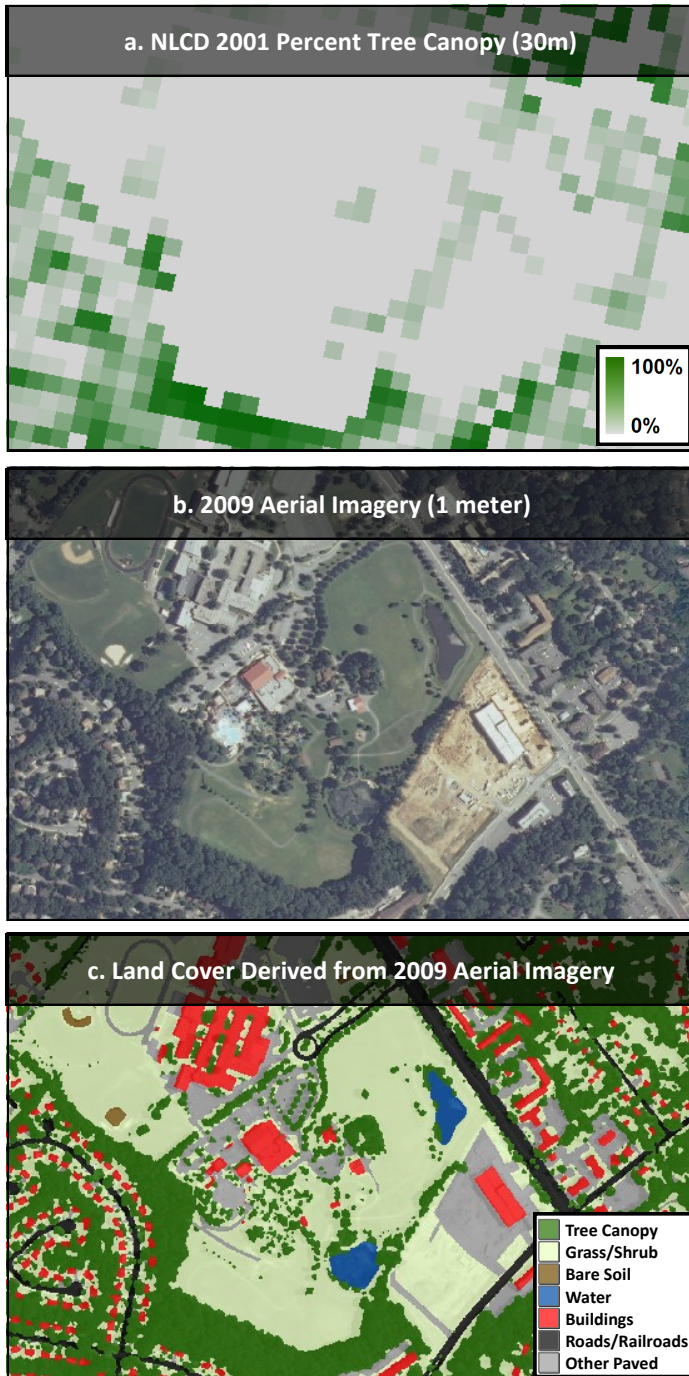


Figure 3a, 3b, 3c: Comparison of NLCD 2001 to high-resolution land cover.

Parcel Summary

After land cover was mapped county-wide, Tree Canopy (TC) metrics were summarized for each property in the county's parcel database (Figure 4). Existing TC and Possible TC metrics were calculated for each parcel, both in terms of total area and as a percentage of the land area within each parcel ($TC \text{ area} \div \text{land area of the parcel}$).

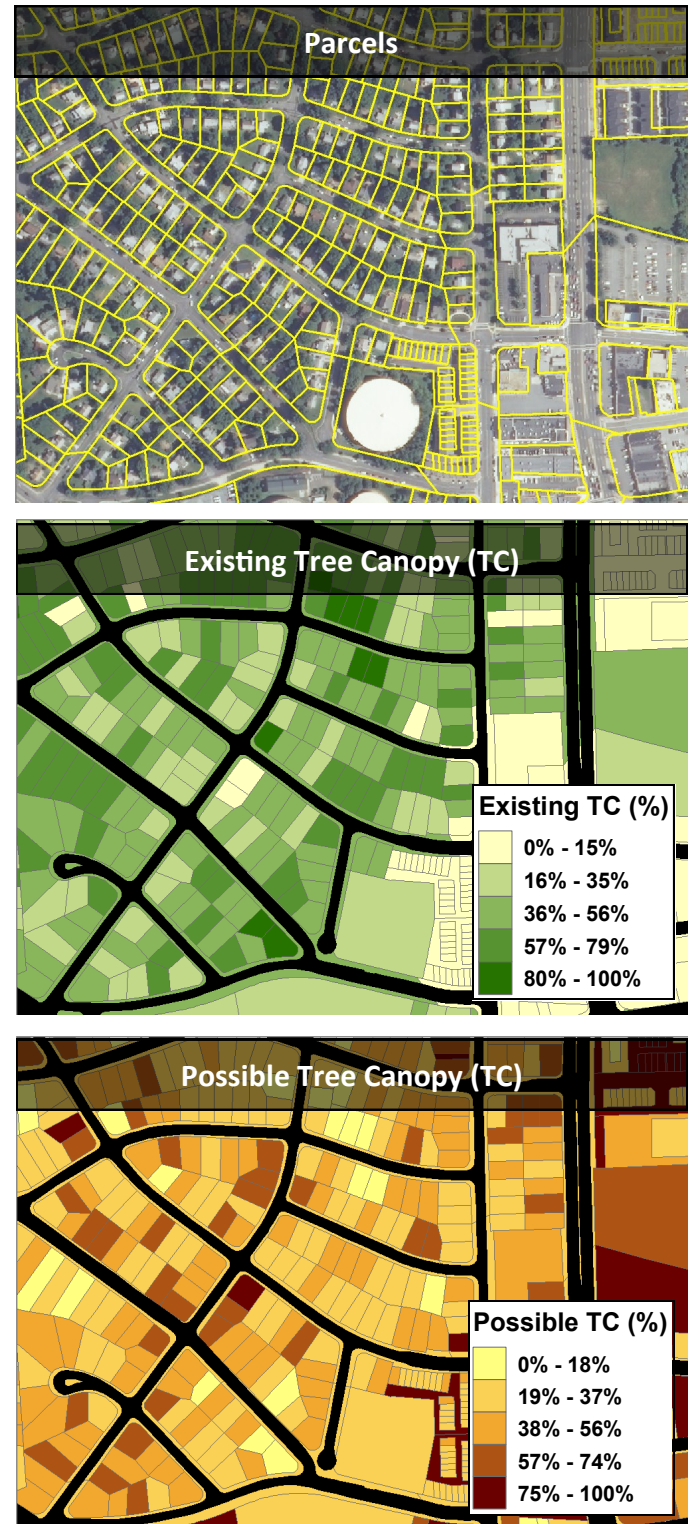


Figure 4a, 4b, 4c: Parcel-based TC metrics. TC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing TC and Possible TC.

Planning Team Region Analysis

Existing and possible tree canopy (TC) metrics were conducted for Montgomery County's three Planning Team Regions. Interestingly, Area 1, a very urbanized section of the county that borders the District of Columbia, has the highest percentage of tree canopy (59%). A three-dimensional analysis of the tree canopy in Area 1 indicated that this area contains an abundance of taller, more mature trees. Area 2 and Area 3 have virtually identical amounts of Existing Tree Canopy (49%), but differ greatly in the amount of Possible Tree Canopy. Although Area 3 has a highest percentage of Possible Tree Canopy of all the three Planning Team Regions, much of this land is in agricultural use, which makes it not suitable for widespread conversion to forest due to agriculture's important social and economic value to the region.

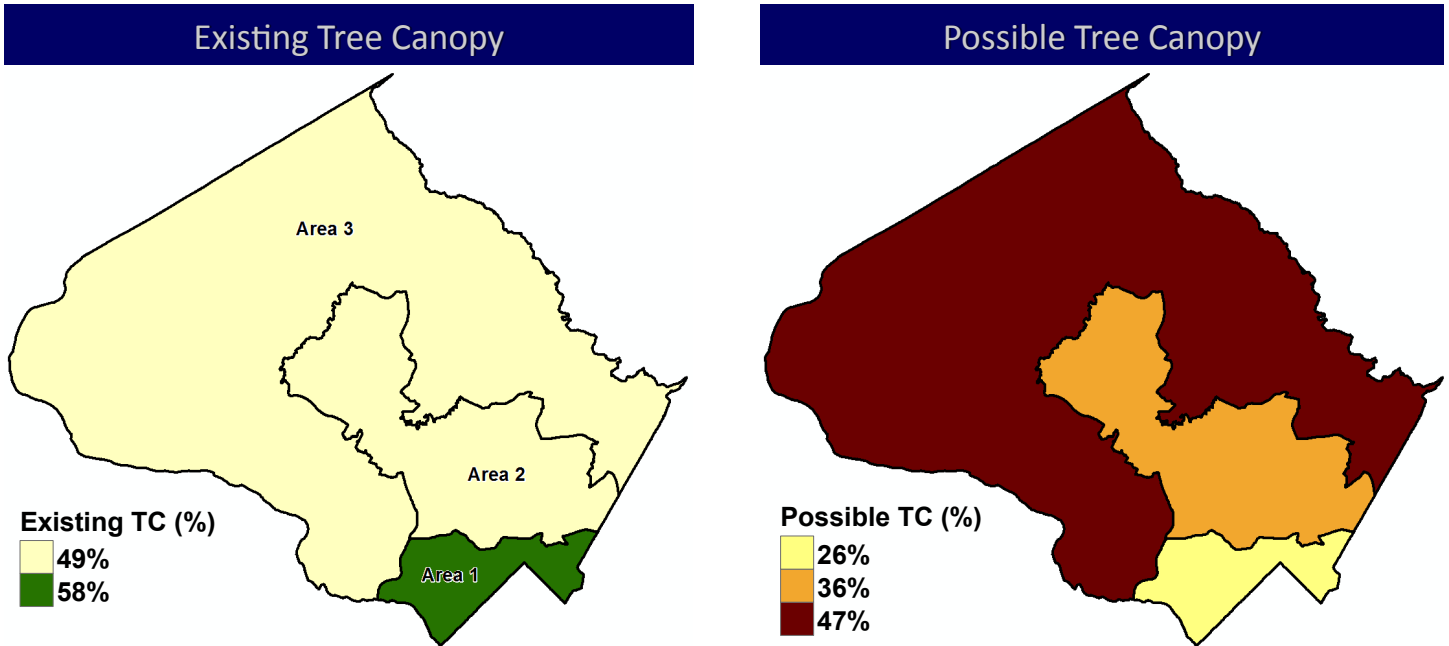


Figure 5: Existing TC (left) and Possible TC (right) as a percentage of area for each Planning Team Regions.

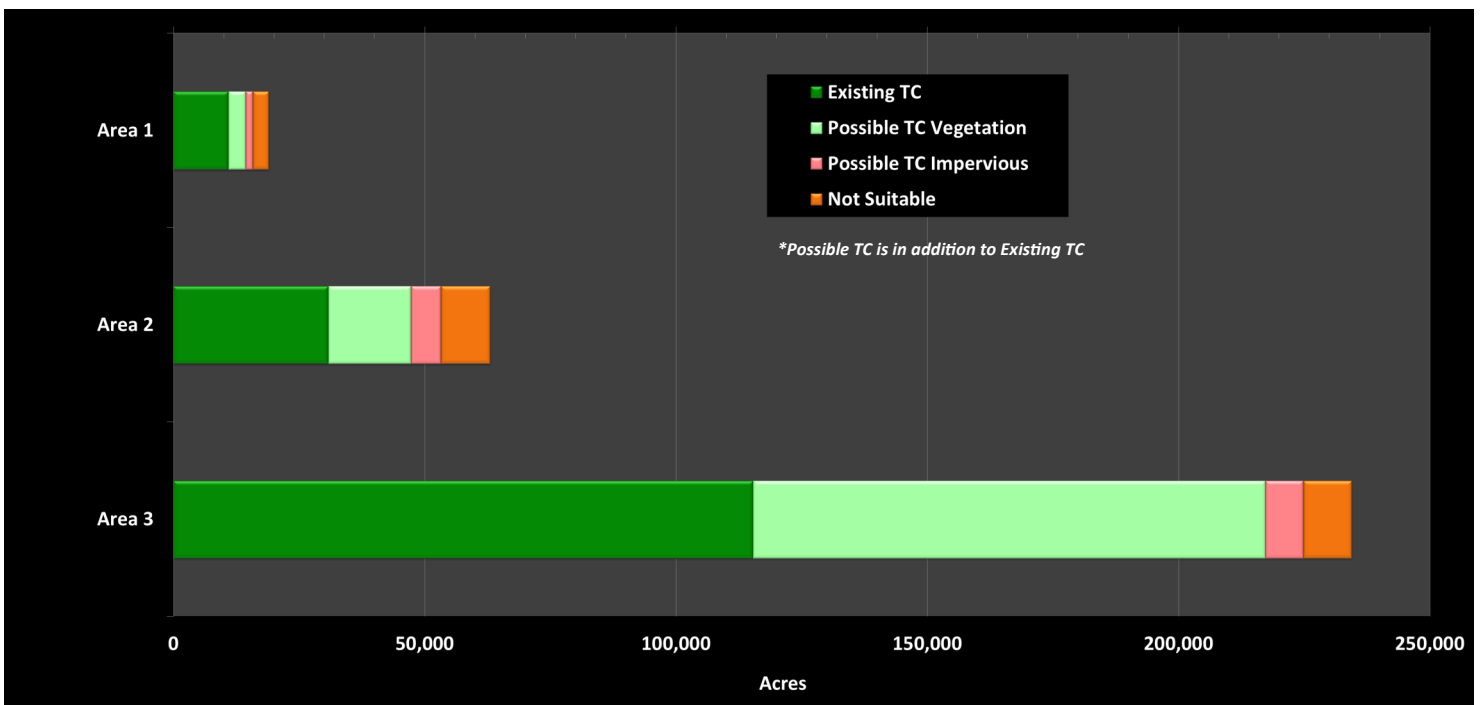


Figure 6. Graphical representation of the tree canopy acreage for the three Planning Team Regions.

Planning Areas Analysis

Existing and Possible Tree Canopy Metrics were generated for Montgomery County's 28 unique Planning Areas. The Potomac planning area has the highest percent of land covered by Existing Tree Canopy, at 63%. Gaithersburg City and Dickerson have the lowest Existing Tree Canopy values, at 39% and 41% respectively. Dickerson represents a unique area with one of the lowest Existing Tree Canopy values and the highest Possible Tree Canopy value of 57%. In general, the planning areas with the most available land for Possible Tree Canopy are concentrated in the western portion of the county which is largely devoted to agriculture. Bethesda/Chevy Chase has the lowest Possible Tree Canopy value of 24%. This assessment shows that Planning Areas with the lowest values of possible tree canopy, as a percent of their land area, are located in the southern portion of the county, largely because this area is fully developed with little undeveloped or agricultural land.

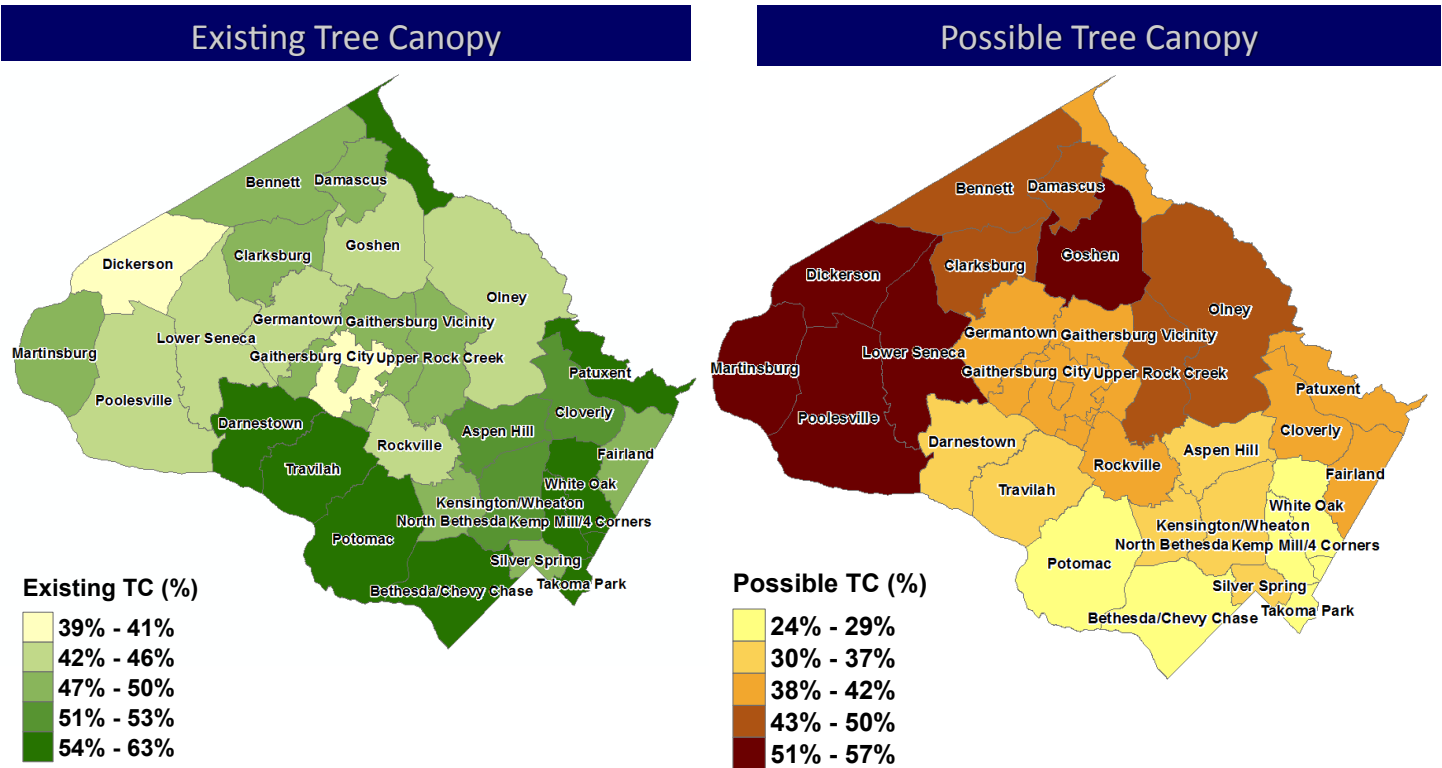


Figure 7: Existing TC (left) and Possible TC (right) as a percentage of area for each Planning Area.

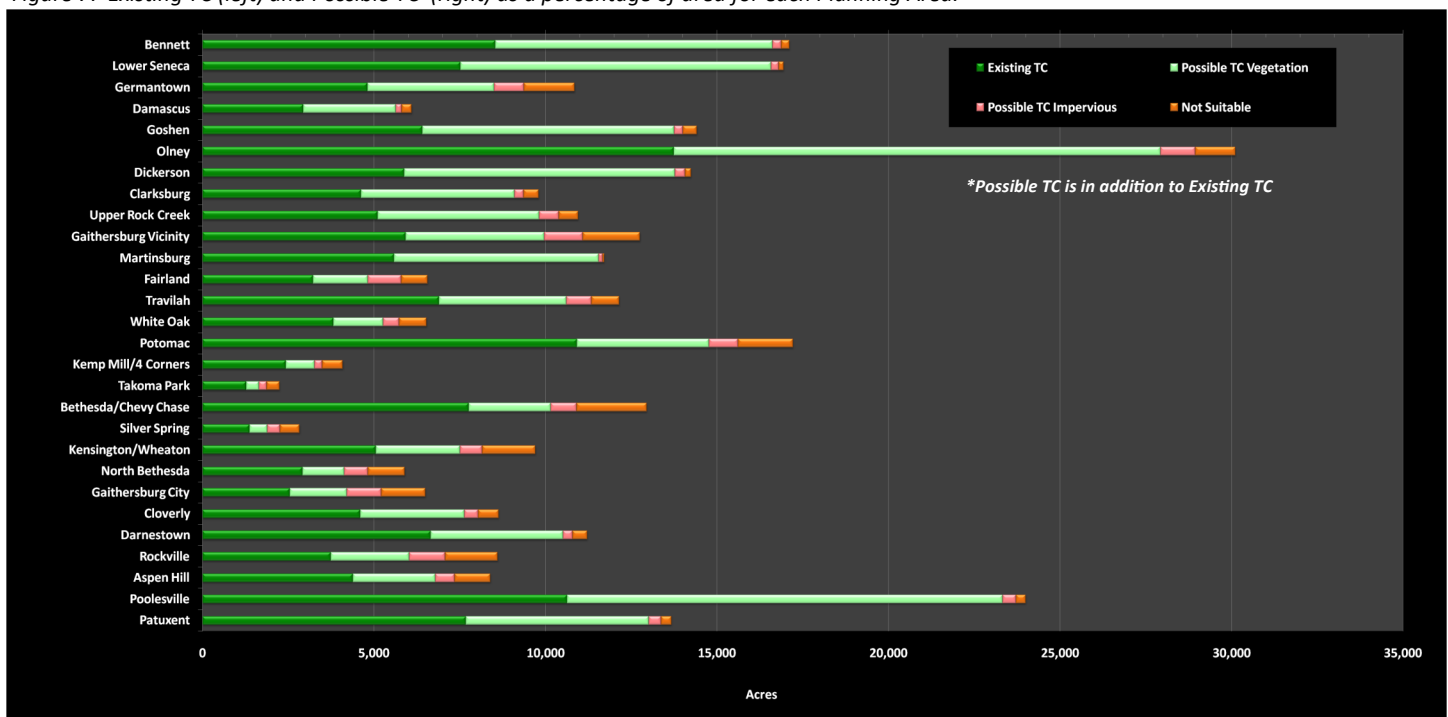


Figure 8. Graphical representation of the tree canopy acreage for the 28 unique planning areas of Montgomery County.

Master and Sector Plan Analysis

The Master and Sector Plan category is composed of 51 individual planning areas designated from 1978 through the present. Tree Canopy Metrics were calculated for each of these 51 areas. The highest percentage of Existing Tree Canopy (TC) is found in the Washington Grove area (83%). The Silver Spring CBD contains the lowest Existing TC at 14%. It should be noted that these high and low values are found in disproportionately small Sector Plan areas. The Laytonsville area has the highest Possible TC at 68%, while Washington Grove has the lowest at 13%. In terms of the relationship between Existing and Possible TC, areas with high Existing TC tend to have low Possible TC. There are however some notable exceptions to this relationship. The White Flint Sector and Twinbrook areas both have Existing TC percentages that are less than 20%, and Possible TC areas that are higher than 50%. These low Existing TC and high Possible TC percentages merit further investigation. As one might expect from such a large and diverse analysis area, there is high variation in these relationships between the 51 different Master and Sector Plan areas. The master plans currently underway are Chevy Chase Lake, the East County Science Center and the Long Branch Sector. The Existing and Possible Tree Canopy assessment of the master plans underway show the Chevy Chase Lake area's Existing TC at 44%, and the East County Science Center area has an Existing TC of 24%. The Long Branch Sector area has an Existing TC at 63%. The Possible TC percentage differs little between the three sites, ranging between 1% (Long Branch Sector area) to 30% (East County Science Center area). Despite the difference in land use history of the three areas, the Existing TC and Possible percentage of the areas are similar.

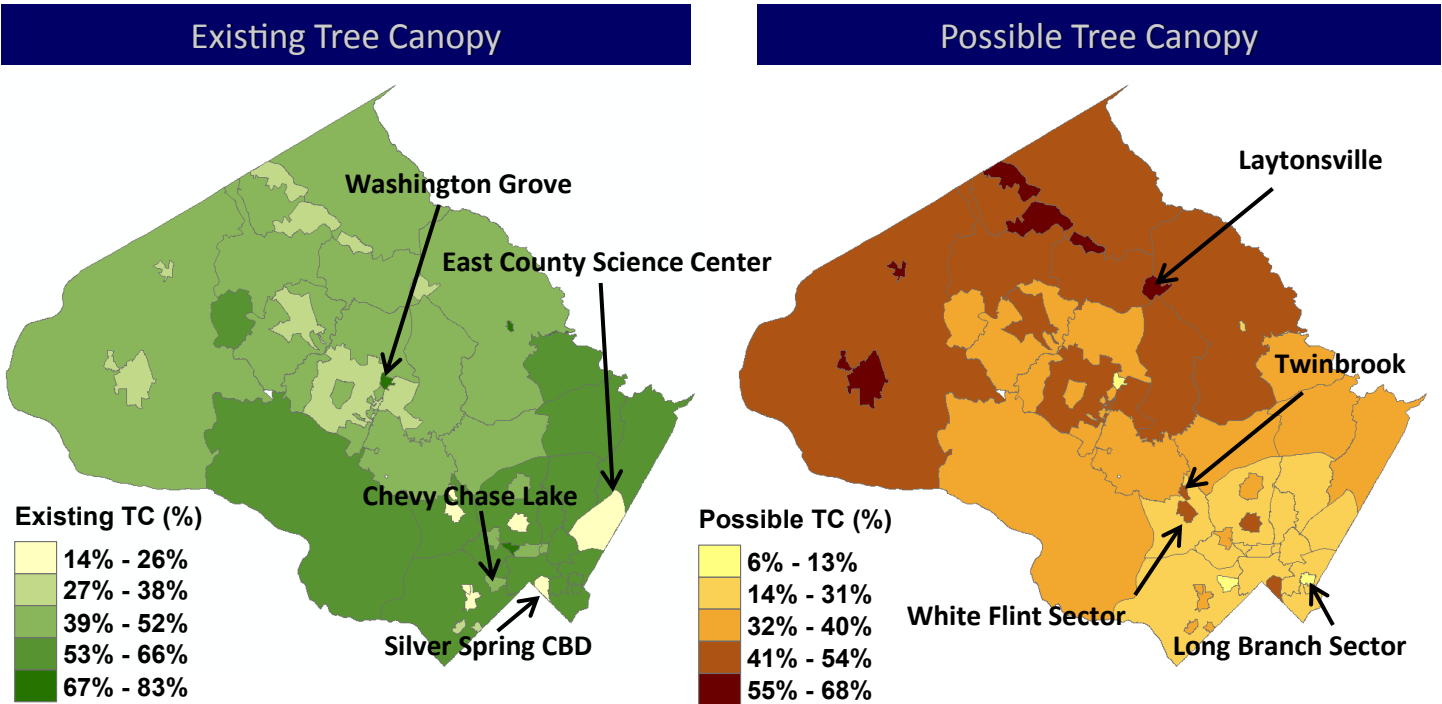


Figure 9: Existing TC (left) and Possible TC (right) as a percentage of area for each master and sector plan area.

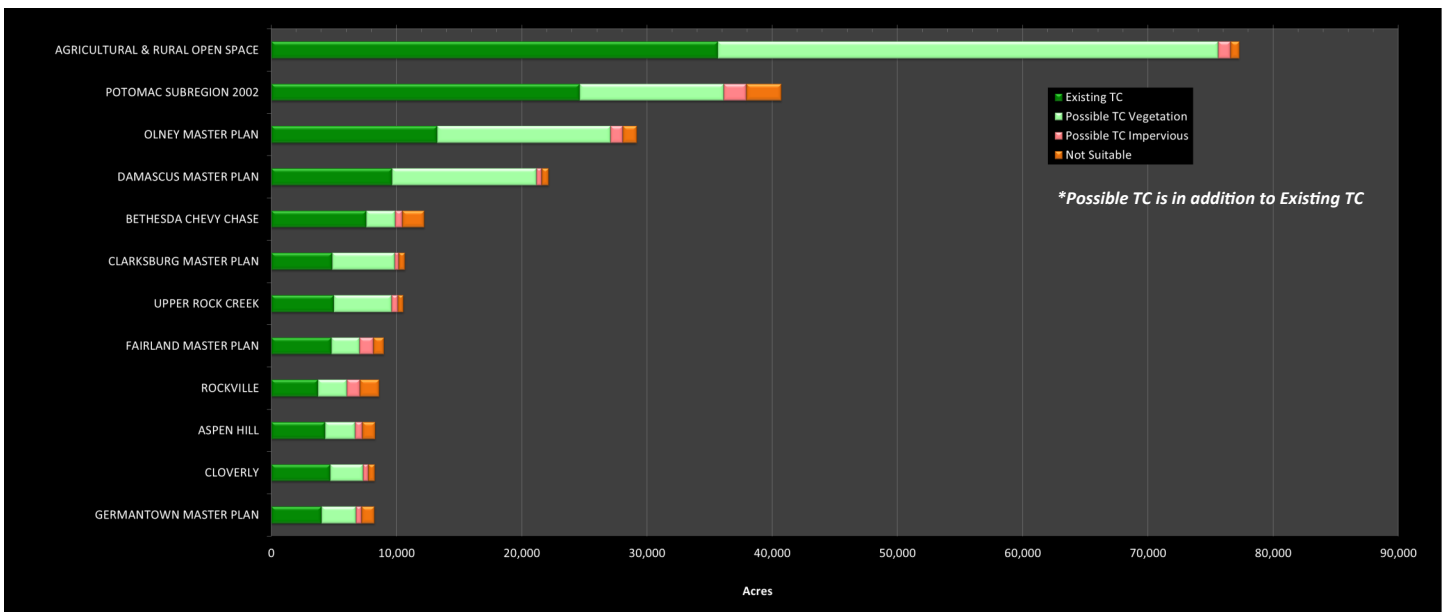
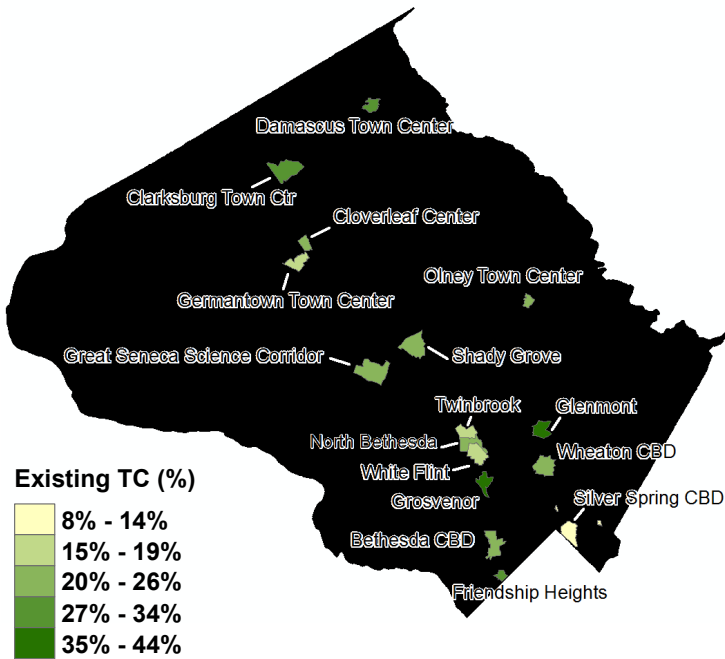


Figure 10. Graphical representation of the tree canopy acreage for the 15 largest master and sector plan areas by land area.

Urban Areas

Tree canopy (TC) metrics were generated for eighteen urban areas (as defined by the Road Code) located in the Montgomery County. Most of the urban area's range from 20-34% existing TC while only two, Grosvenor and Glenmont, fall within the highest Existing TC percentile (35-40%) and three (Montgomery Hills Parking Lot District, Flower Branch, Silver Spring CBD) within the lowest Existing TC percentile (8-14%). Spatially, all three urban areas with low Existing TC percentages fall in the Southeast corner of the county. In Possible TC percentages, many of the urban areas fall within the middle percentiles, ranging from 40-55% with only three urban areas (Great Seneca Science Corridor, Cloverleaf Center, Germantown Town Center) in the highest Possible TC percentile (56-59%) and two urban areas (Bethesda CBD, Grosvenor, Friendship Heights) in the lowest Possible TC percentile. The urban areas with higher Possible TC percentages are in the mid to northern section of the county while the southern urban areas have much lower possible TC percentages. This assessment highlights that urban areas located in the northern part of Montgomery County have more land available for the establishment of tree canopy.

Existing Tree Canopy



Possible Tree Canopy

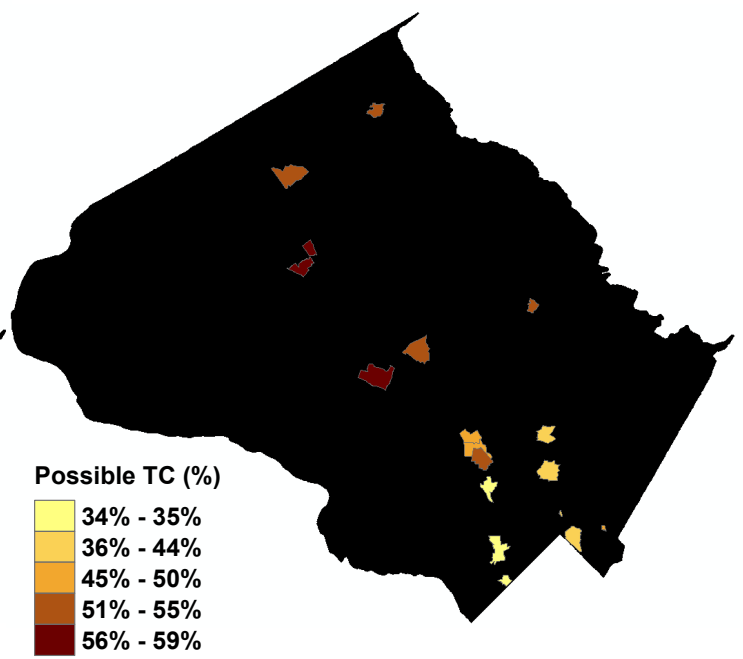


Figure 11: Existing TC (left) and Possible TC (right) as a percentage of area for each central business district and town center.

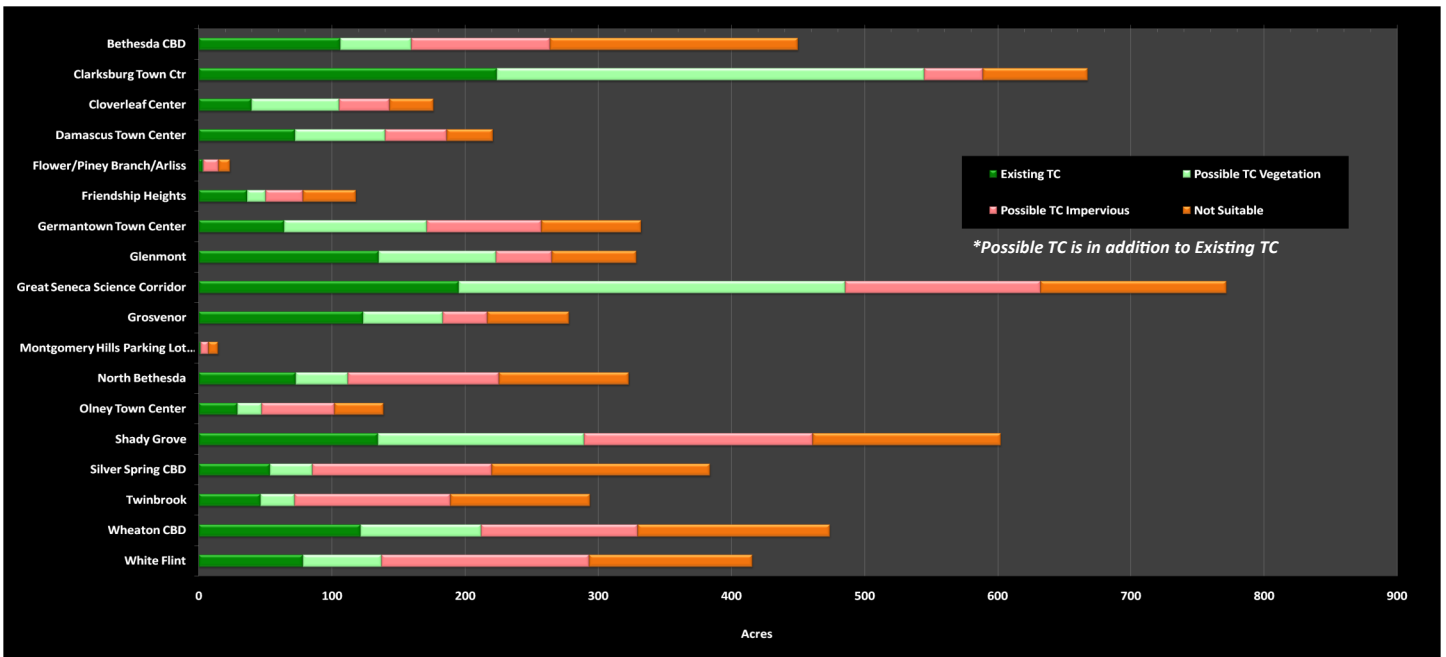


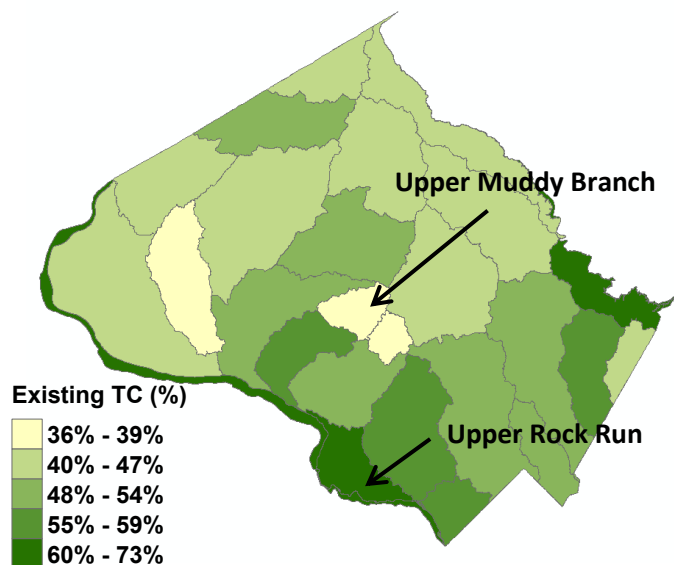
Figure 12: Graphical representation of the tree canopy metrics for the 18 central business districts and town centers in Montgomery County.

Watershed Analysis

Montgomery County contains portions of 25 watersheds (excluding the watershed named "Direct"—which are small tributaries that discharge directly to the main stem of the Potomac River). Tree Canopy (TC) metrics were run for these watersheds, revealing that the watershed with the highest Existing Tree Canopy percentage is Upper Rock Run (70%), while that with the lowest is Upper Muddy Branch (36%). Dry Seneca Creek has the highest percentage of Possible Tree Canopy (63%) while Upper Rock Run had the lowest (23%). Percentages of TC cover are highest towards the south and along the edges of the county where there is the most residential development and lowest where there is more agriculture and industrial development. Conversely, Possible Tree Canopy is highest in the northern and western areas of the county where there is the most agriculture. Of the 465 subwatersheds within these larger watersheds, 288 (62%) had Existing Tree Canopy values greater than 45%, which Goetz et al. identifies as usually indicative of "good" stream health.

Goetz, S. J., R. K. Wright, A. J. Smith, E. Zinecker, and E. Schaub. 2003. IKONOS imagery for resource management: Tree cover, impervious surfaces, and riparian buffer analyses in the mid-Atlantic region. *Remote Sensing of Environment* 88, no. 1: 195-208.

Existing Tree Canopy



Possible Tree Canopy

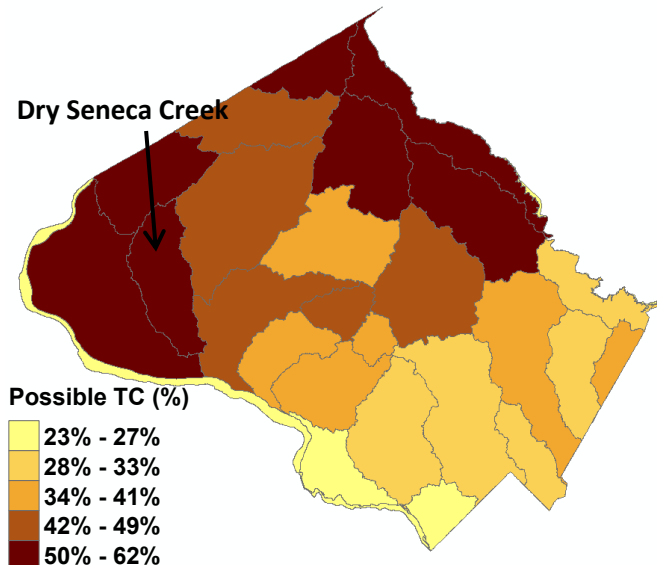


Figure 13: Existing TC (left) and Possible TC (right) as a percentage of area for each watershed.

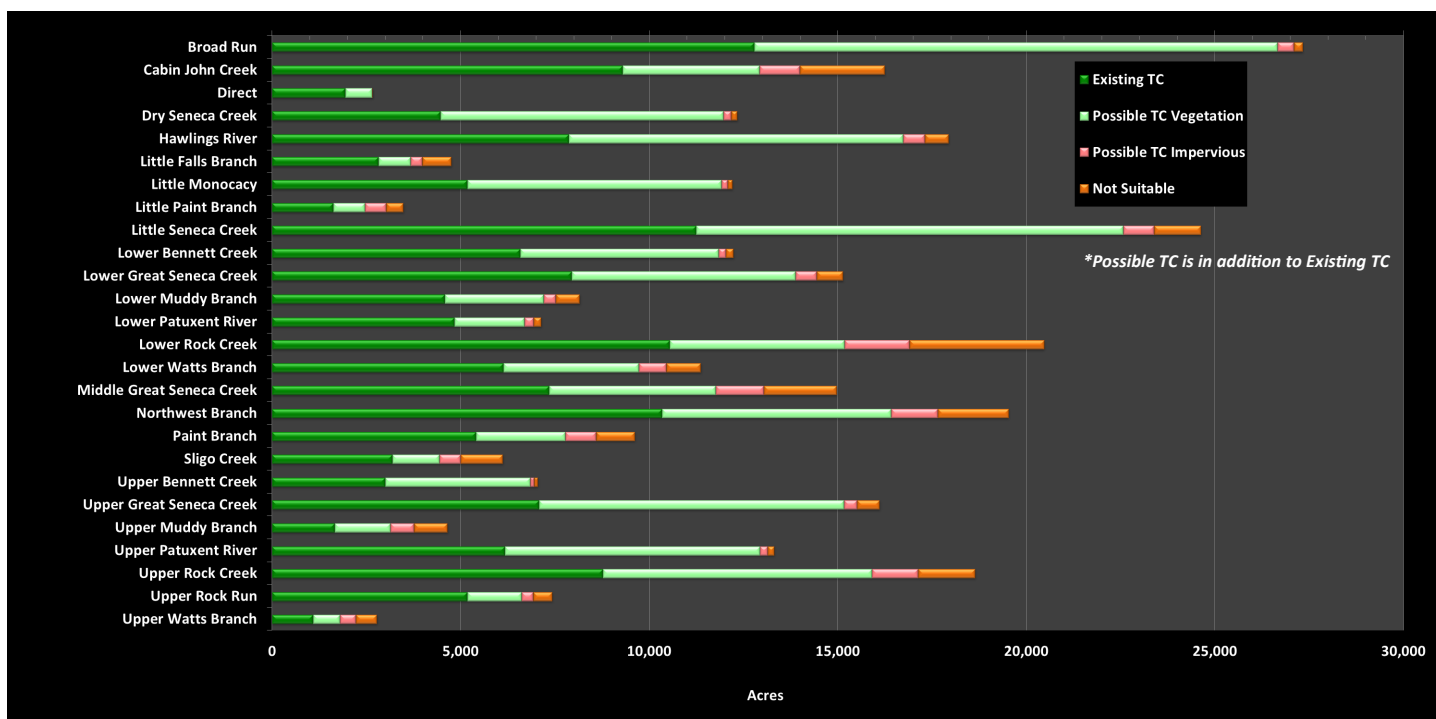


Figure 14. Graphical representation of the tree canopy acreages for the watersheds that intersect Montgomery County.

Stream Buffer Analysis

Stream buffers in Montgomery County were divided by watershed and Existing and Possible Tree Canopy were calculated for each stream buffer area. 11 of the 25 stream buffer areas have 80% or greater Existing Tree Canopy. The four stream buffer areas with the least amount of tree canopy all have less than 70% Existing Tree Canopy and consist of the Upper Watts Branch, the Upper Muddy Branch, the Lower Watts Branch, and the Hawlings River. Aside from the Hawlings River, all can be described as being in urbanized areas where stream buffers are less effective in reducing nonpoint source pollution than in agricultural areas. The Lower Patuxent River buffer area was found to have the highest Existing Tree Canopy, with 90% of land in the buffer region covered by tree canopy. The buffer area with the lowest Existing TC was in Upper Watts Branch, at 54%. In terms of Possible Tree Canopy in stream buffer areas, Upper Watts Branch was found to have the highest (36%) and Lower Patuxent River the lowest (9%).

Existing Tree Canopy

Possible Tree Canopy

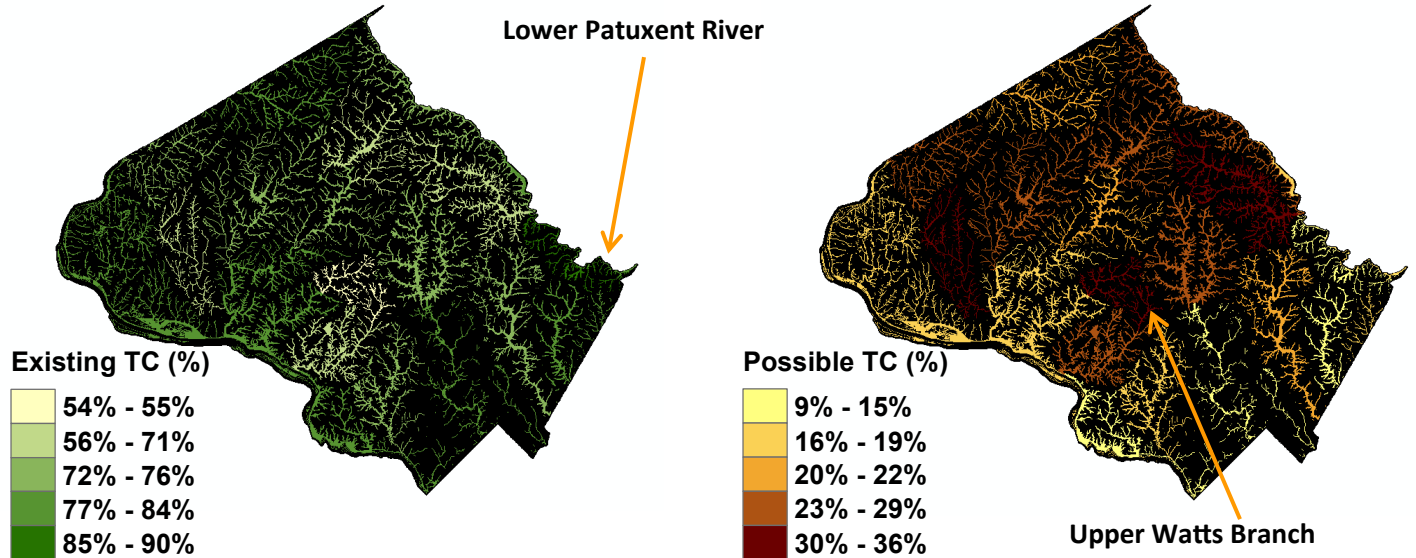


Figure 15: Existing TC (left) and Possible TC (right) as a percentage of area for each stream buffer.

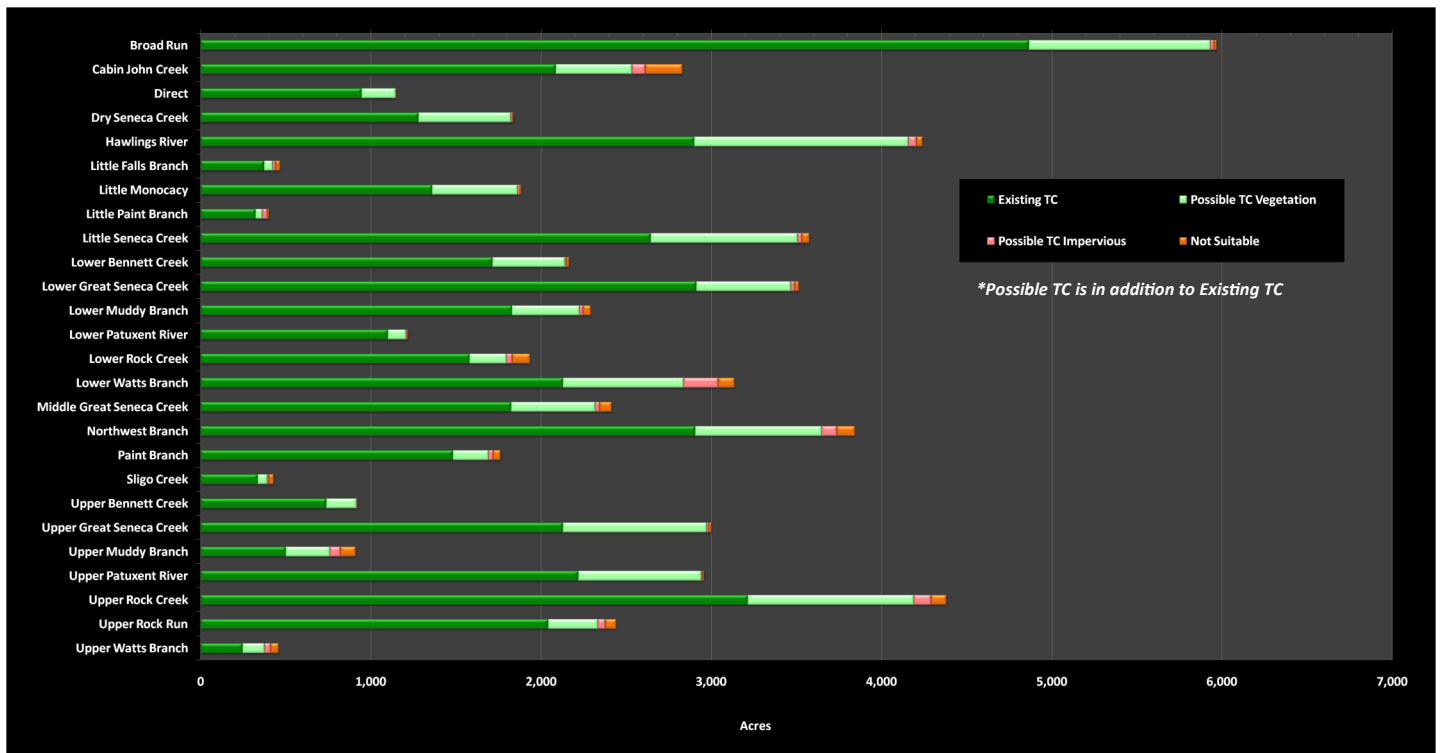


Figure 16. Graphical representation of the tree canopy acreage for the stream buffers of Montgomery County.

Parks Analysis

Existing and Possible Tree Canopy (TC) was analyzed for all existing and proposed park lands (Figure 20) and summarized by park type (Figure 21). As expected, these lands have relatively high Existing Tree Canopy, with parks such as Rachael Carson Conservation Park having over 92% of its land area covered by tree canopy. The assessment does reveal potential opportunities to increase coverage. For example, Ten Mile Creek Conservation Park has 80% of its land available for tree planting. While maintaining open spaces for recreation is an important social consideration, there still exists room for establishing new tree canopy.

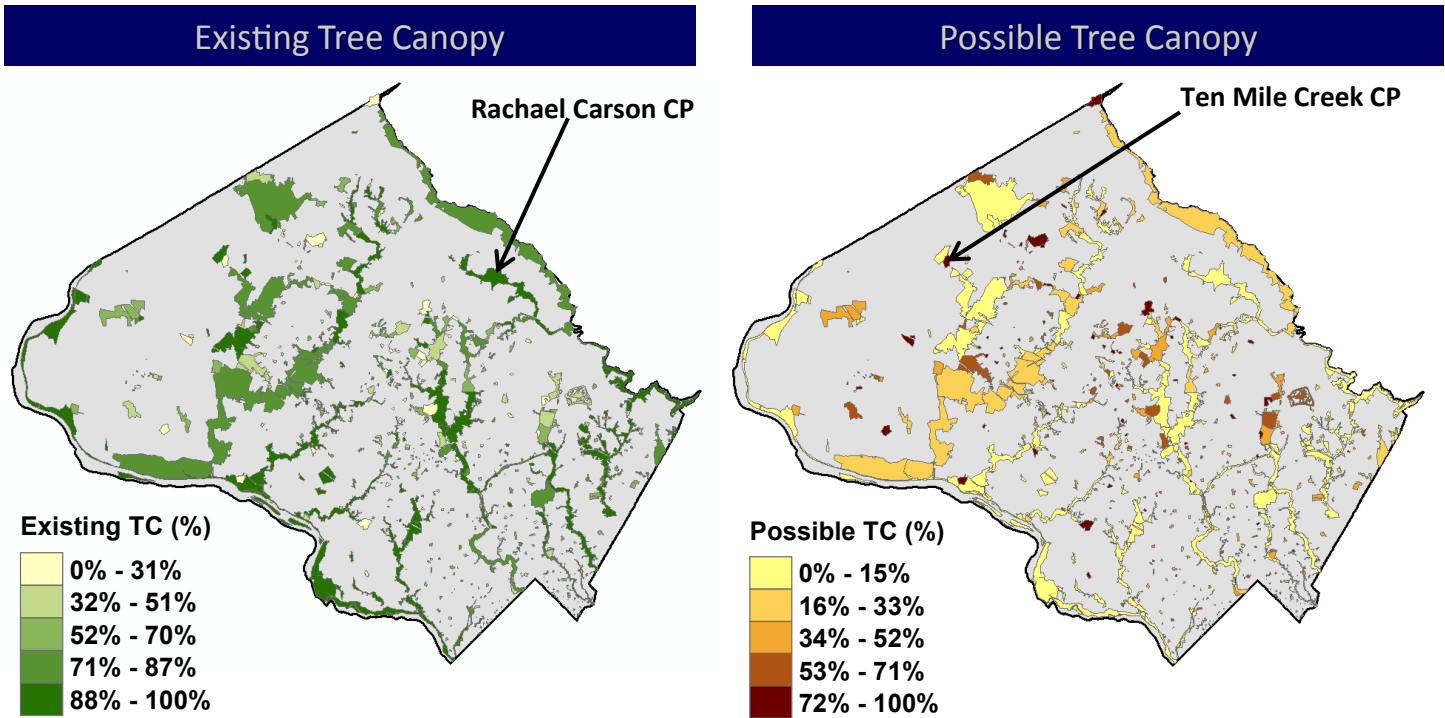


Figure 17. Existing TC (left) and Possible TC (right) as a percentage of land area by park.

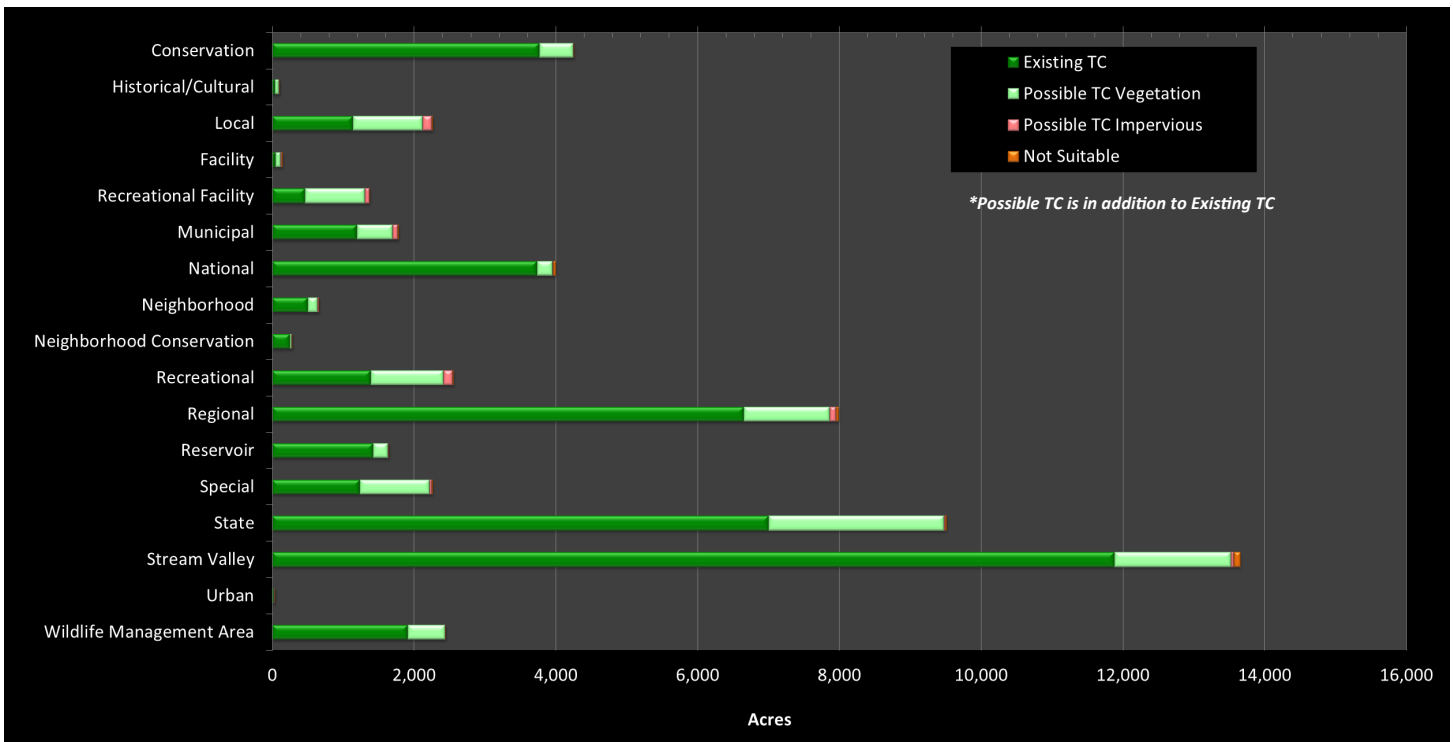


Figure 18. Existing TC (left) and Possible TC (right) as a percentage of land area by park type.

Conclusions

- Montgomery County's tree canopy is a vital asset that reduces stormwater runoff, improves air quality, reduces the county's carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as habitat for wildlife.
- Although this assessment indicates that 43% of the land in Montgomery County could theoretically support tree canopy, planting new trees on much of this land may not be socially desirable (e.g. recreation fields or agriculture) or financially feasible (e.g. parking lots). Setting a realistic goal requires a detailed feasibility assessment using the geospatial datasets generated as part of this assessment.
- With Existing and Possible Tree Canopy summarized at the parcel level and integrated into the county's GIS database, individual parcels and subdivisions can be examined and targeted for TC improvement. Of particular focus for tree canopy improvement should be parcels in the county that have large, contiguous impervious surfaces. These parcels contribute high amounts of runoff, which degrades water quality. The establishment of tree canopy on these parcels will help reduce runoff during periods of peak overland flow.
- Montgomery County's residents control the majority of the county's tree canopy and have most of the land to plant trees. Programs that educate residents on tree stewardship and provide incentives for tree planting are crucial if Montgomery County is going to increase and sustain its tree canopy in the long term.
- With tree canopy metrics summarized at the stream and watershed level, individual watersheds or stream buffers can be examined and targeted for TC improvement. For example, research by Goetz et al. (2003) indicates that watersheds with 37% tree canopy can be categorized as "fair" in a stream health rating; watersheds with 45% tree canopy can be categorized as "good."

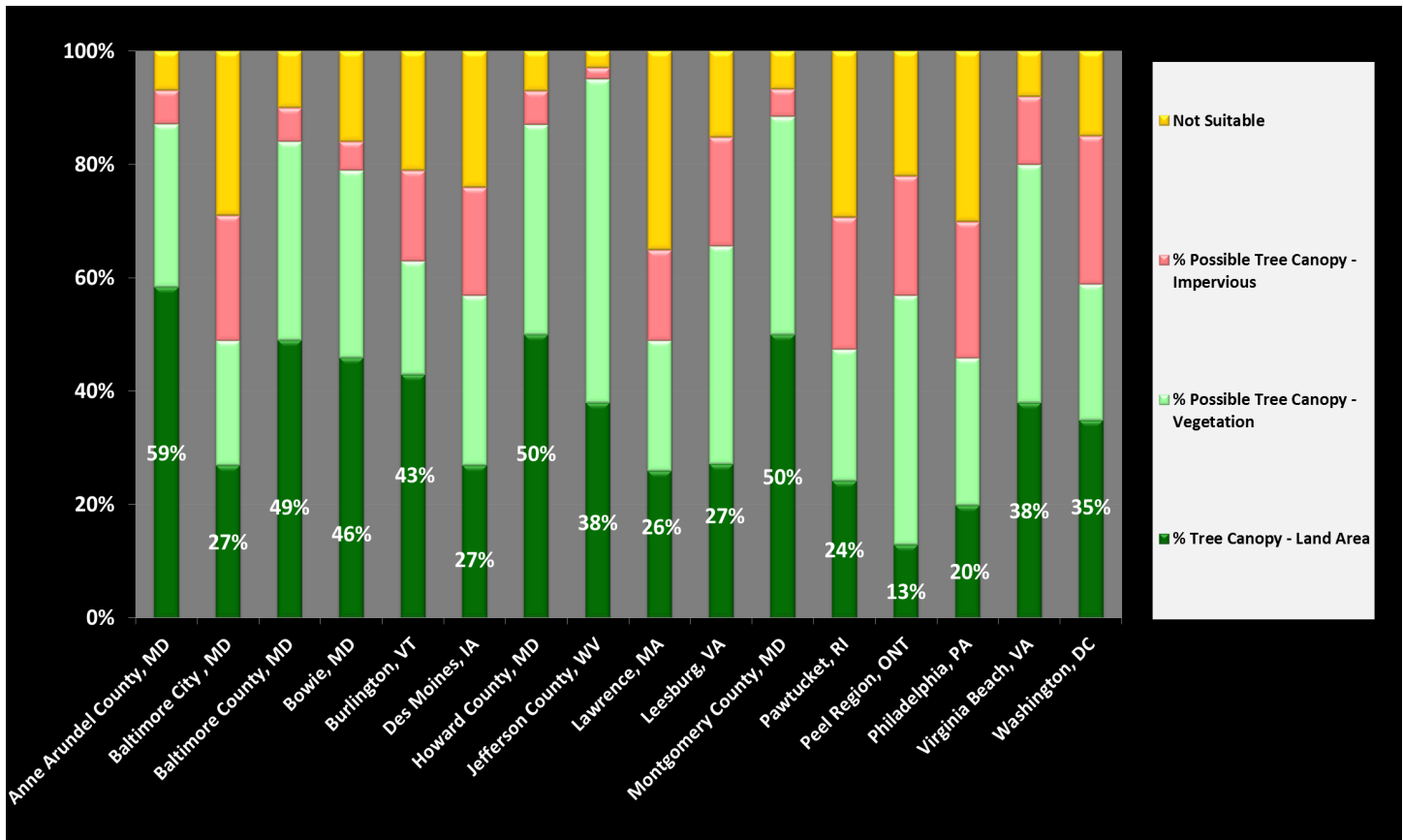


Figure 19: Comparison of Existing and Possible Tree Canopy with other selected areas that have completed Tree Canopy Assessments.

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Additional Information

Funding for the project was provided by M-NCPPC, Sandia National Laboratories and the USDA Forest Service. More information on the TC assessment project can be found at the following web site:

<http://nrs.fs.fed.us/urban/utc/>



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