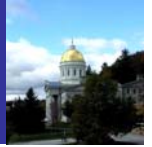


A Report on the City of Montpelier's Existing and Possible Tree Canopy



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. 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 city as well as the amount of tree canopy that could theoretically be established.

Project Background

The goal of the project was to apply the USDA Forest Service's TC assessment protocols to the City of Montpelier. The analysis was conducted based on year 2009 data. This analysis of Montpelier's tree canopy (TC) was made possible by funding from the USDA Forest Service and was conducted in collaboration with the City of Montpelier, the Central Vermont Regional Planning Commission, and the US Forest Service's Northern Research Station. The Spatial Analysis Laboratory (SAL) at the University of Vermont's Rubenstein School of the Environment and Natural Resources carried out the assessment.

How Much Tree Canopy Does Montpelier Have?

An analysis of Montpelier's tree canopy based on land cover data derived from high-resolution aerial imagery (Figure 1) found that 4,021 acres of the city were covered by tree canopy (termed Existing TC), representing 62% of all land in the city. An additional 31% (2,026 acres) of the city could theoretically be modified (termed Possible TC) to accommodate tree canopy (Figure 2). In the Possible TC category, 3% (191 acres) of the city was classified as Impervious Possible TC and another 28% was Vegetated Possible TC (1,835 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 the City of Montpelier.

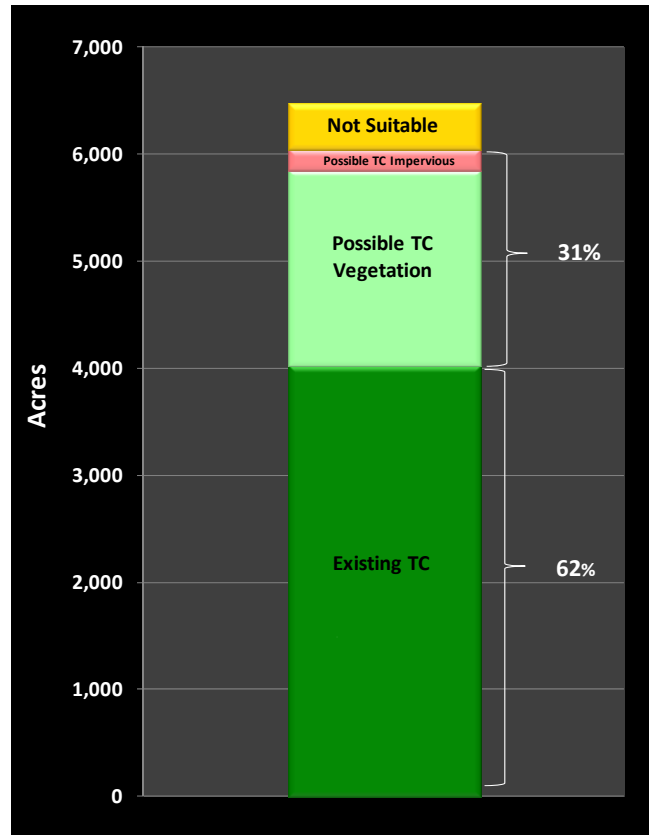


Figure 2: TC metrics for Montpelier based on % of land area covered by each TC type.

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 or shrub area that is theoretically available for the establishment of tree canopy.

Mapping Montpelier's Trees

Prior to this study, the only comprehensive remotely-sensed estimates of tree canopy for Montpelier 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 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 the percent tree canopy to be 52% as opposed to the more accurate 61% estimate obtained by this study.



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

Parcel Summary

After land cover was mapped city-wide, Tree Canopy (TC) metrics were summarized for each property in the city'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 area ÷ land area of the parcel).

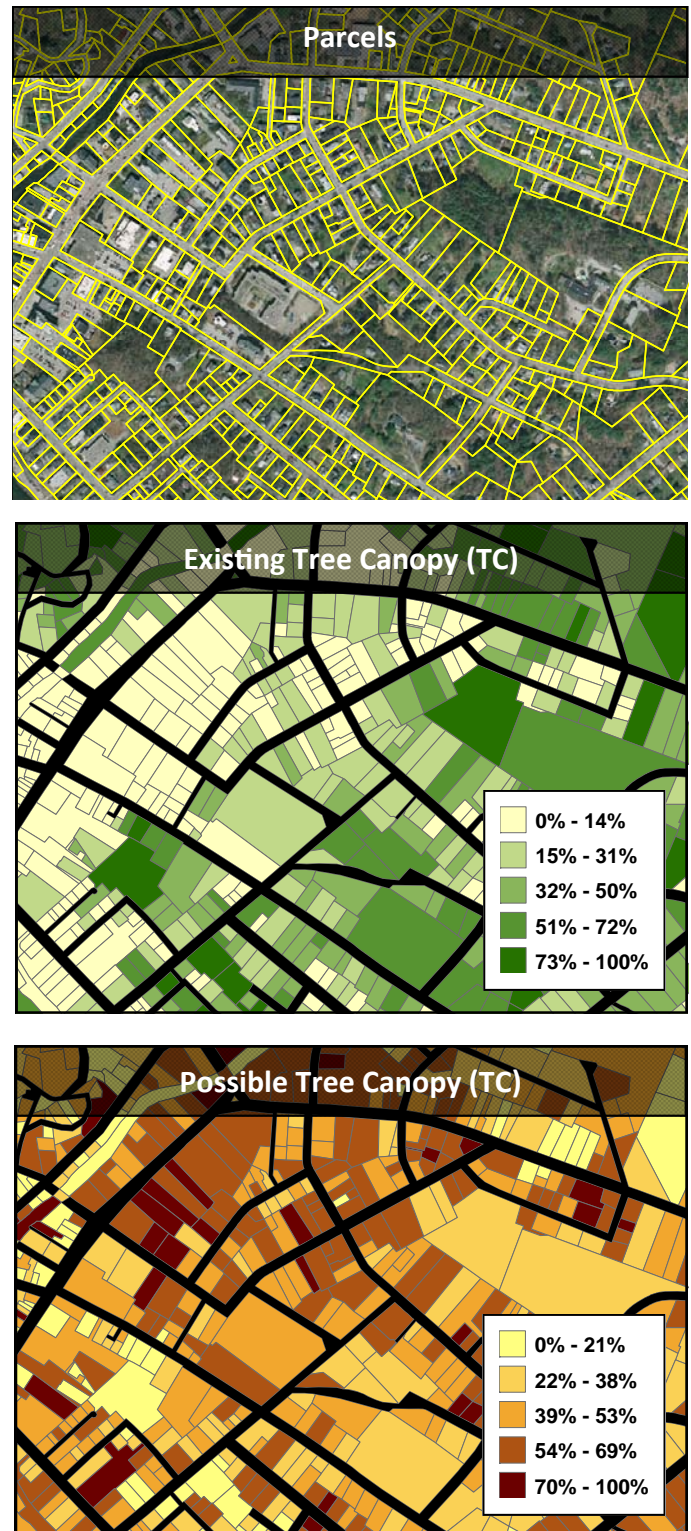


Figure 4a, 4b, 4c: Parcel-based TC metrics. TC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing TC and Possible TC.

Zoning

An analysis of Existing and Possible tree canopy by zoning category was conducted using the city's current zoning layer (Figure 5, Table 1). For each zoning class, Tree Canopy (TC) metrics were calculated as a percentage of all land in the city (% Land), as a percentage of land area in the specified zoning category (% Category), and as a percentage of the area for TC type (% TC Type). Areas zoned as "Low Density Residential" have the largest amount of tree canopy of any category with 56% of all tree canopy in the city. The "Recreation" class, with a much smaller total land area, has the highest amount of TC by category at 90%. The residential classes have the greatest proportion of land available to support tree plantings, with 14% (Low Density) and 9% (Medium Density) of all land in the city being Vegetated Possible TC in these classes.

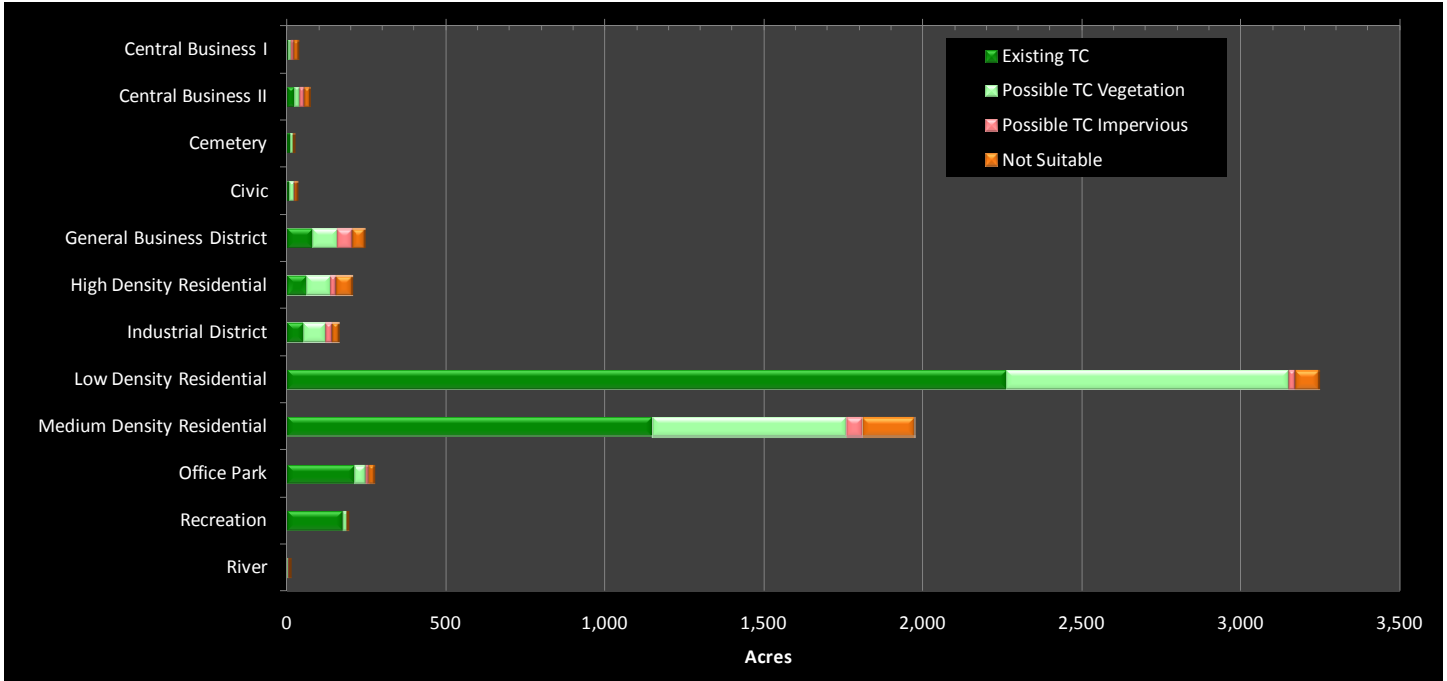


Figure 5: Tree Canopy (TC) metrics summarized by zoning class.

Zoning District	Existing TC			Possible TC Vegetation			Possible TC Impervious		
	% Land	% Category	% TC Type	% Land	% Category	% TC Type	% Land	% Category	% TC Type
Central Business I	0%	6%	0%	0%	26%	1%	0%	24%	5%
Central Business II	0%	31%	1%	0%	24%	1%	0%	17%	7%
Cemetery	0%	38%	0%	0%	52%	1%	0%	0%	0%
Civic	0%	19%	0%	0%	49%	1%	0%	7%	1%
General Business District	1%	32%	2%	1%	32%	4%	1%	19%	24%
High Density Residential	1%	29%	1%	1%	36%	4%	0%	10%	10%
Industrial District	1%	32%	1%	1%	43%	4%	0%	11%	10%
Low Density Residential	35%	70%	56%	14%	27%	48%	0%	1%	10%
Medium Density Residential	18%	58%	29%	9%	31%	33%	1%	3%	27%
Office Park	3%	76%	5%	1%	15%	2%	0%	3%	4%
Recreation	3%	90%	4%	0%	8%	1%	0%	0%	0%
River	0%	8%	0%	0%	27%	0%	0%	29%	2%

$$\% \text{ Land} = \frac{\text{Area of TC type for zoning district}}{\text{Area of all land}}$$

The % Land Area value of 35% indicates that 35% of Montpelier's land area is covered by tree canopy in the Low Density Residential zoning class.

$$\% \text{ Category} = \frac{\text{Area of TC type for zoning district}}{\text{Area of all land for specified land use}}$$

The % Category value of 70% indicates that 70% of land in the Low Density Residential zoning class is covered by tree canopy.

$$\% \text{ TC Type} = \frac{\text{Area of TC type for zoning district}}{\text{Area of all TC type}}$$

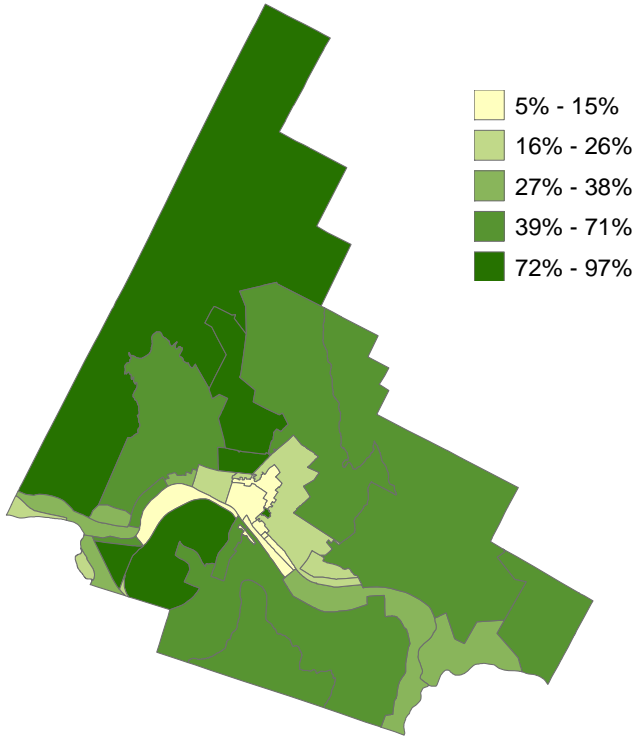
The % TC Type value of 56% indicates that 56% of all tree canopy is in land zoned as Low Density Residential.

Table 1: Tree Canopy (TC) metrics were summarized by zoning category. For each zoning class, TC metrics were computed as a percentage of all land in the city (% Land), as a percentage of land in the specified zoning district (% Category), and as a percentage of the area for TC type (% TC Type).

Zoning Analysis

Assessment of Tree Canopy (TC) by Zoning class reveals an expected pattern of lower Existing TC at the City core where commercial, civic, and high density residential land uses are dominant, and higher Existing TC in the low and medium density residential areas on the periphery of town. While 34% of all aggregated land zoned as “Medium Density Residential” is Possible TC (Table 1), closer examination shows that this number varies greatly from one district to another. Over 65% of the “Medium Density Residential” district on the eastern edge of the City core (TC_ID 30) is available for tree planting, while just 23% of the district to the west of the City core (TC_ID 2) is available. (Figure 6).

Existing Tree Canopy



Possible Tree Canopy

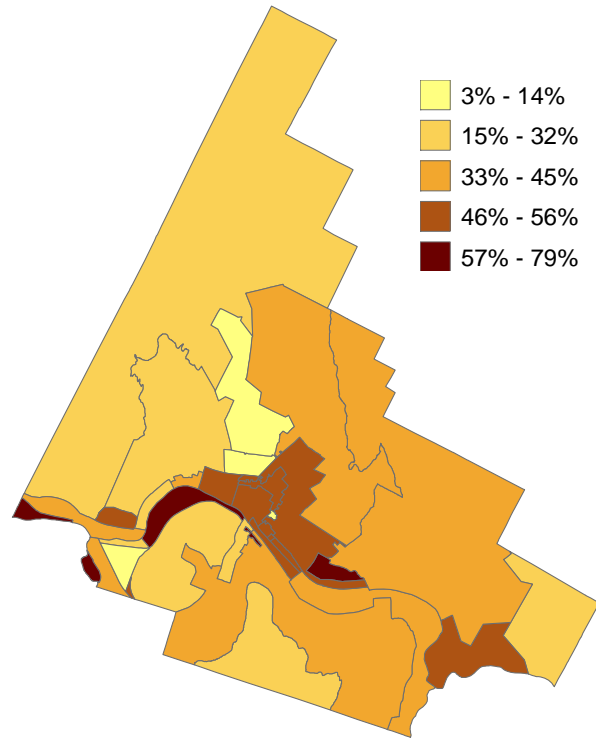
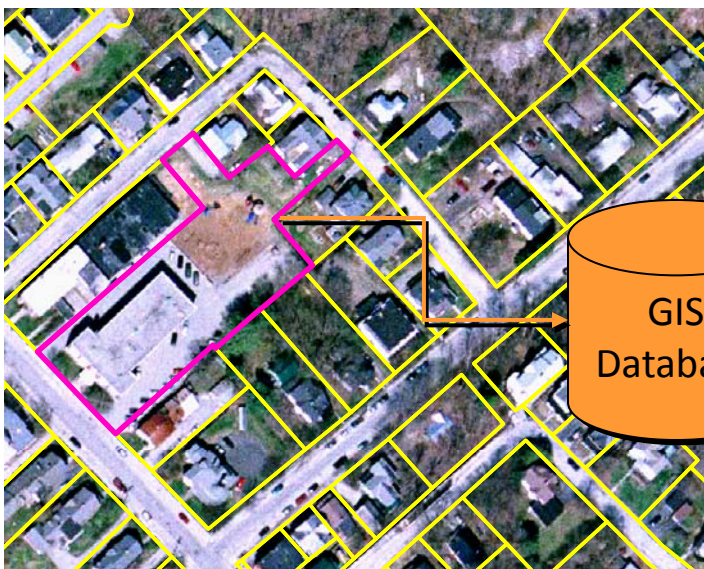


Figure 6 Existing TC (left) and Possible TC (right) as a percentage of land area by park.

Decision Support



Parcel-based Tree Canopy (TC) metrics were integrated into the city's existing GIS database (Figure 7). Decision makers can use GIS to query specific TC and land cover metrics for a parcel or set of parcels. For example, this information can be used to estimate the amount of tree loss in a planned development or set TC improvement goals for an individual property.

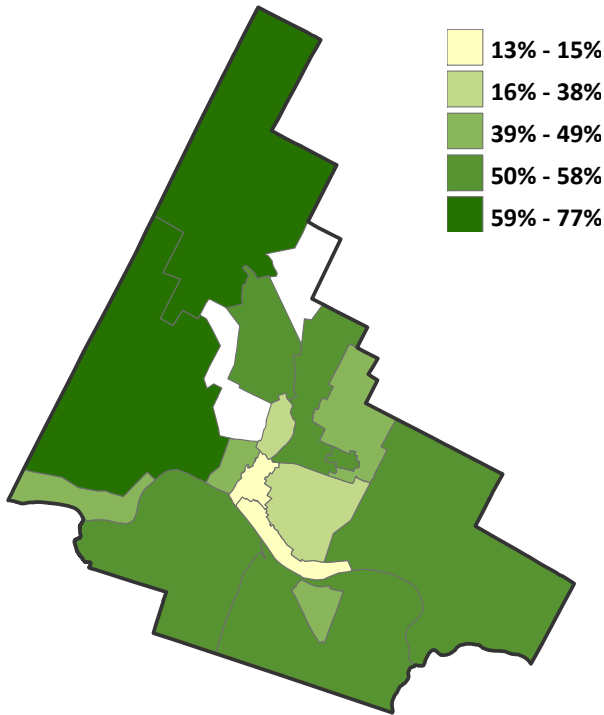
Attribute	Value
Parcel Type	Senior Center
Owner Type	City
Address	52 Barre Street
Existing TC	7%
Possible TC	72%
Possible TC—Vegetation	36%
Possible TC—Impervious	36%

Figure 7: GIS-based analysis of parcel-based TC metrics for decision support. In this example, GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based TC and land cover metrics, are displayed in tabular form providing instant access to relevant information.

Neighborhoods Analysis

The downtown and adjacent neighborhoods in the north-central part of town have the lowest Existing Tree Canopy (TC) and highest Possible TC. These values are the result of the more developed nature of the Downtown Core, The Meadow, and College Hill neighborhoods and the presence of agricultural fields in the Murray Hill neighborhood. The Park West and Upper Elm Street Neighborhoods on the western edge of town have the highest Existing TC.

Existing Tree Canopy



Possible Tree Canopy

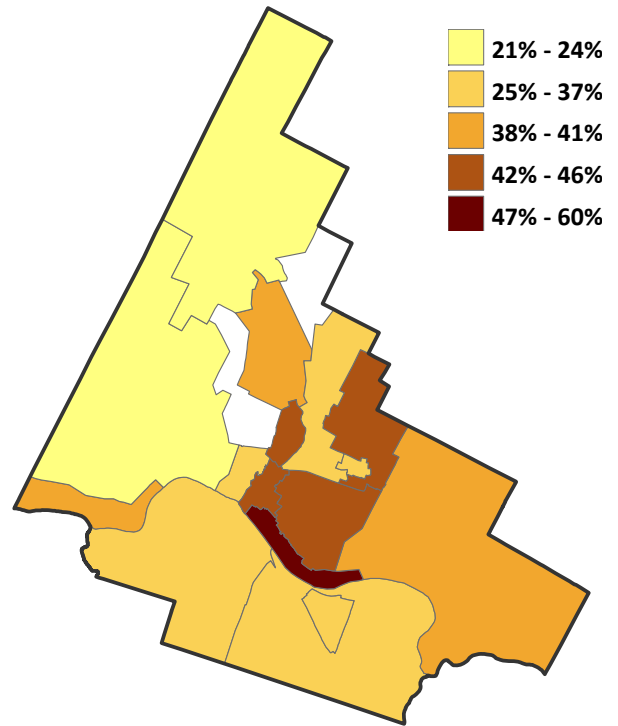


Figure 8: Existing TC (left) and Possible TC (right) as a percentage by neighborhood.

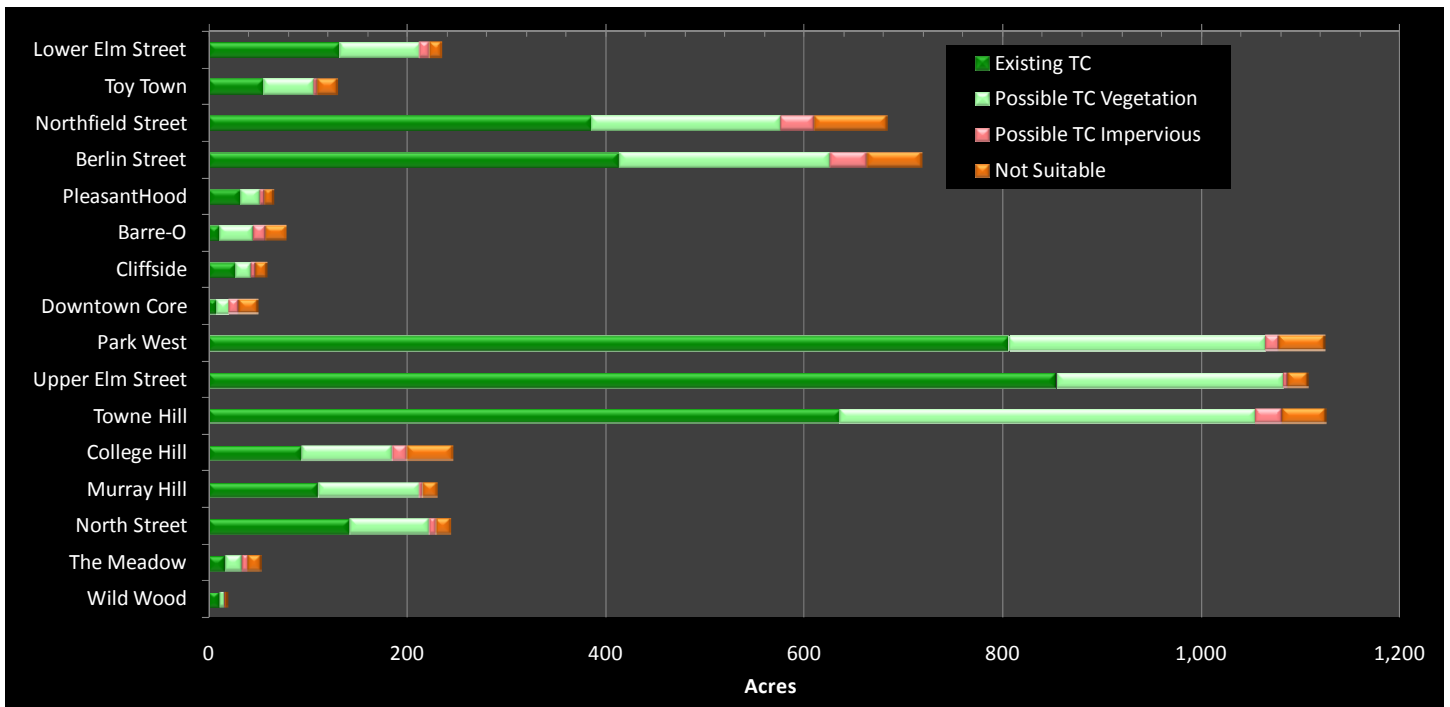
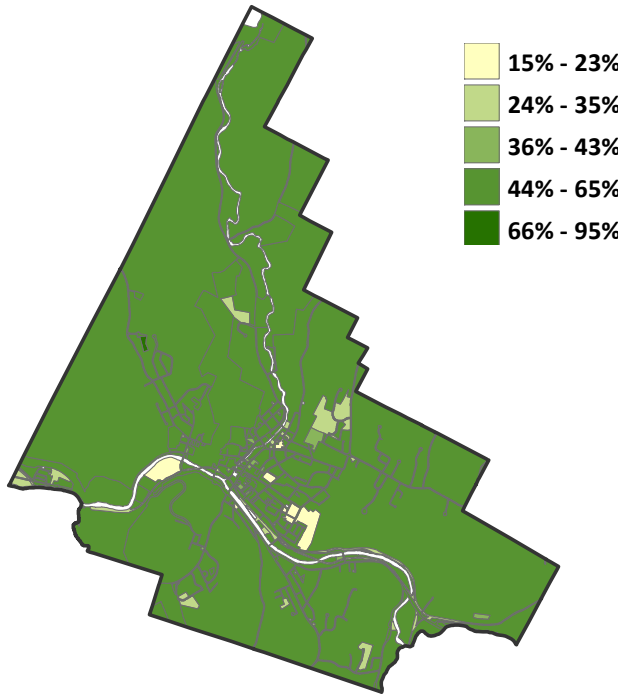


Figure 9: TC metrics summarized by neighborhood.

Parcel Ownership Analysis

Analysis of tree canopy by type of parcel ownership results in a distinct contrast between privately owned parcels and those that are publicly owned or are multiple-unit residences (Figure 10). Parcels for which ownership is classified as Education (66%), Condo (54%), Land Trust (53%), and Commercial (53%) have the highest proportions of Possible TC by category. However, Possible TC as a percentage of all land in the city is greatest on privately owned parcels (25% or 1625 acres), which constitute the bulk of the land on the periphery of town.

Existing Tree Canopy



Possible Tree Canopy

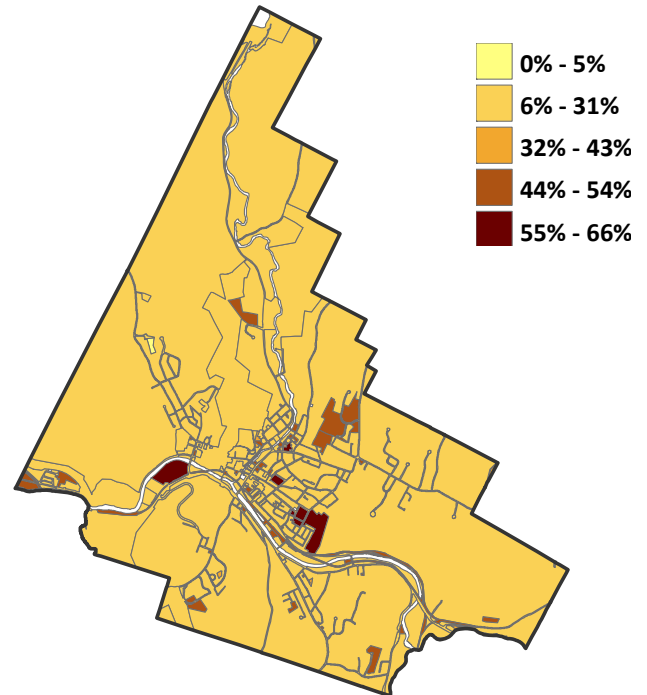


Figure 10. Existing TC (left) and Possible TC (right) as a percentage by parcel owner type.

Water Features and ROW Analysis

Tree Canopy (TC) metrics were computed for a 35ft buffer surrounding all lakes, ponds, streams and rivers and for right-of-ways. Within the water buffer zone 49% of the land area is tree canopy and 44% of the land is available for the establishment of tree canopy. Within the ROW those values are 9% and 36% respectively.

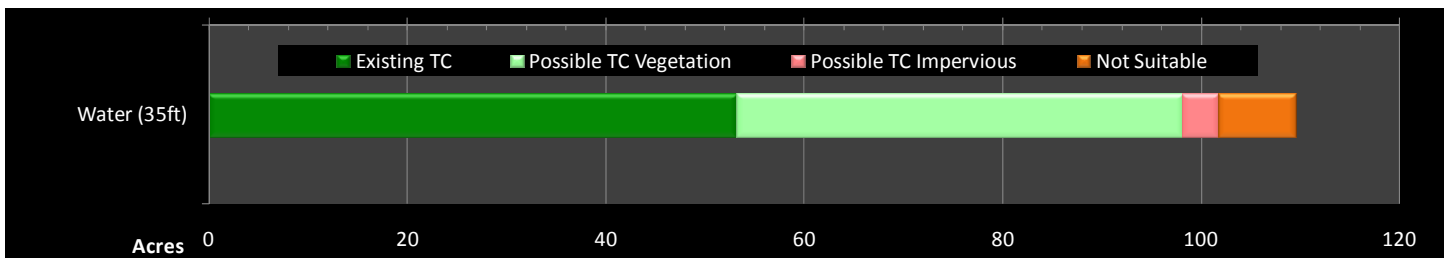


Figure 11: Tree Canopy metrics summarized for a 35ft buffer surrounding all water features.

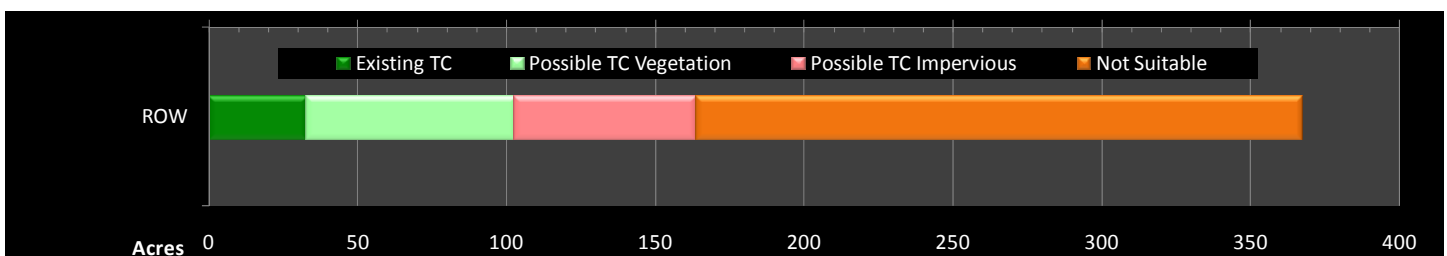


Figure 12: Tree Canopy metrics summarized for right-of-ways.

Conclusions

- Montpelier’s urban tree canopy is a vital city asset that reduces stormwater runoff, improves air quality, reduces the city’s carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as habitat for wildlife.
- Although this assessment indicates that nearly one-third of the land in Montpelier could theoretically support tree canopy, planting new trees on much of this land may not be social desirable (e.g. recreation fields) 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 TC summarized at the parcel level and integrated into the city’s GIS database, individual parcels and subdivisions can be examined and targeted for TC improvement. Of particular focus for TC improvement should be parcels in the city 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.
- Montpelier’s residents control the majority of the City’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 Montpelier is going to sustain its tree canopy in the long term.
- Neighborhood and Parcel Ownership summaries can be used to examine the relationship between socio-economic conditions and the extent and distribution of tree canopy. These summaries can also be used to target tree planting and preservation efforts in different parts of the city.
- The city’s rights-of-way (ROW) contain 9% Existing TC and 36% Possible TC, suggesting that opportunities exist for increasing the number of street trees.
- Although just 1% of Montpelier’s land base consists of areas within 35 feet of water features, tree plantings on the 49 acres of Possible TC (44%) here could help to improve water quality.
- Tree plantings in the city core, particularly commercial lands in the river district and institutional and public lands in the downtown area, would help to provide a more consistent distribution of canopy in Montpelier.

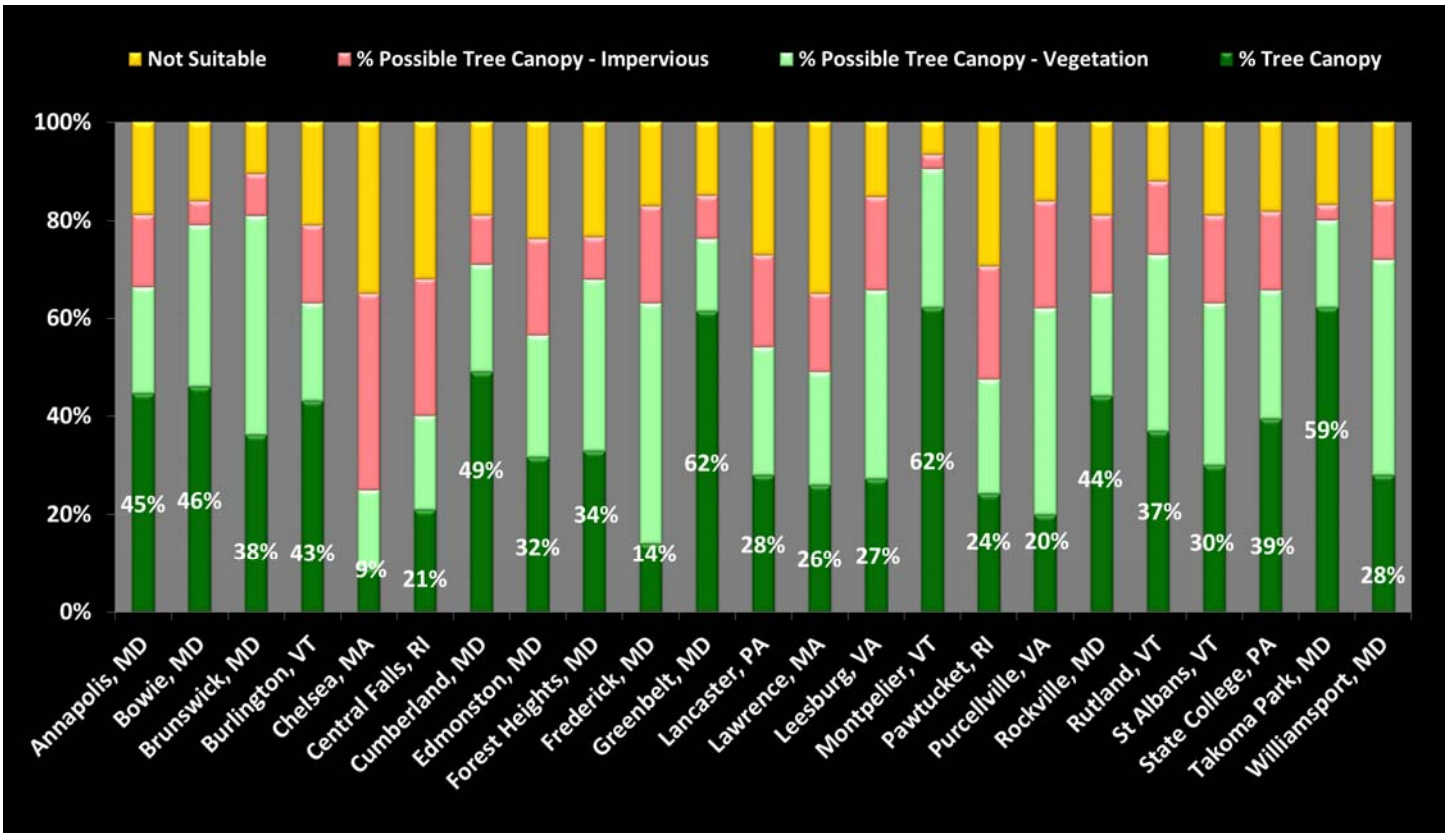


Figure 13: Comparison of Existing and Possible Tree Canopy with other selected cities that have completed Tree Canopy Assessments.

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Additional Information

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



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