A Report on the City of New Haven's Existing and Possible Urban Tree Canopy

Why is Tree Canopy Important?

Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Urban tree canopy provides many benefits to communities, including 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 UTC goal is crucial for those communities seeking to improve their green infrastructure. A UTC assessment that estimates the amount of tree canopy currently present (Existing UTC), along with the amount of tree canopy that could theoretically be established (Possible UTC), is the first step in the UTC goal-setting process.

How Much Tree Canopy Does New Haven Have?

An analysis of New Haven's urban tree canopy based on land cover derived from high-resolution aerial imagery (Figure 1) found that more than 4,468 acres of the city were covered by tree canopy (termed Existing UTC) representing 38% of all land in the city. An additional 41% (4,824 acres) of the city could theoretically be improved (Possible UTC) to support tree canopy (Figure 2). In the Possible UTC category, 21% (2,480 acres) of the city were Impervious Possible UTC and another 20% were Vegetated Possible UTC (2,344 acres). Vegetated Possible UTC, or grass and shrubs, is more conducive to establishing new tree canopy, but establishing tree canopy on Impervious Possible UTC will have a greater impact on water quality.

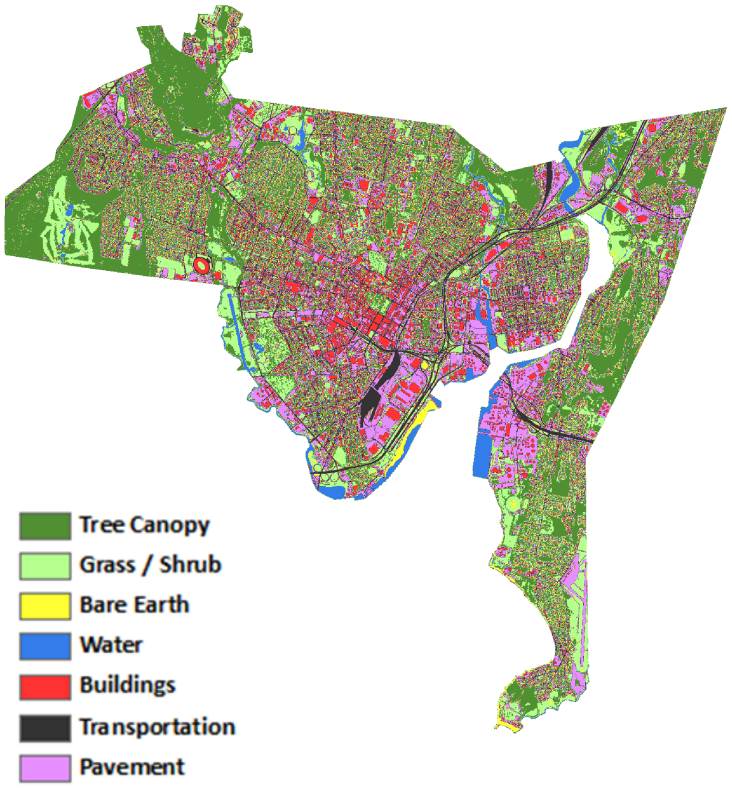


Figure 1: Land cover derived from high-resolution aerial imagery for the City of New Haven.

Project Background

The analysis of New Haven's urban tree canopy (UTC) was carried out in collaboration with the City of New Haven, the Urban Resources Initiative at the Yale School of Forestry & Environmental Studies, The University of Connecticut's Center for Land Use Education & Research, and the State of Connecticut Department of Environmental Protection. The analysis was performed by the Spatial Analysis Laboratory (SAL) of the University of Vermont's Rubenstein School of the Environment and Natural Resources, in consultation with the USDA Forest Service's Northern Research Station.

The goal of the project was to apply the USDA Forest Service's UTC assessment protocols to the City of New Haven. This analysis was conducted based on year 2008 data.

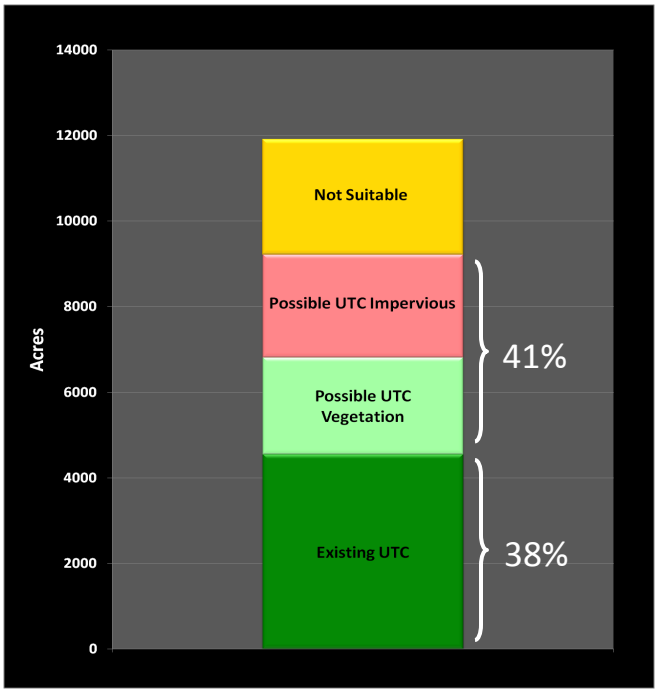


Figure 2: UTC metrics for New Haven based on % of land area covered by each UTC type.

Key Terms

UTC: Urban tree canopy (UTC) 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 UTC: The amount of urban tree canopy present when viewed from above using aerial or satellite imagery.
Impervious Possible UTC: Asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy.
Vegetated Possible UTC: Grass or shrub area that is theoretically available for the establishment of tree canopy.

Mapping New Haven's Trees

Prior to this study, the only available estimates of tree canopy for New Haven were from the 2001 National Land Cover Dataset (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 (1 meter) aerial imagery acquired in the summer of 2008 (Figure 3b), in combination with advanced automated processing techniques, land cover for the city was mapped with such detail that single trees were detected (Figure 3c). NLCD 2001 estimated the city to have only 28% tree canopy, compared to the more precise estimate of 38%.

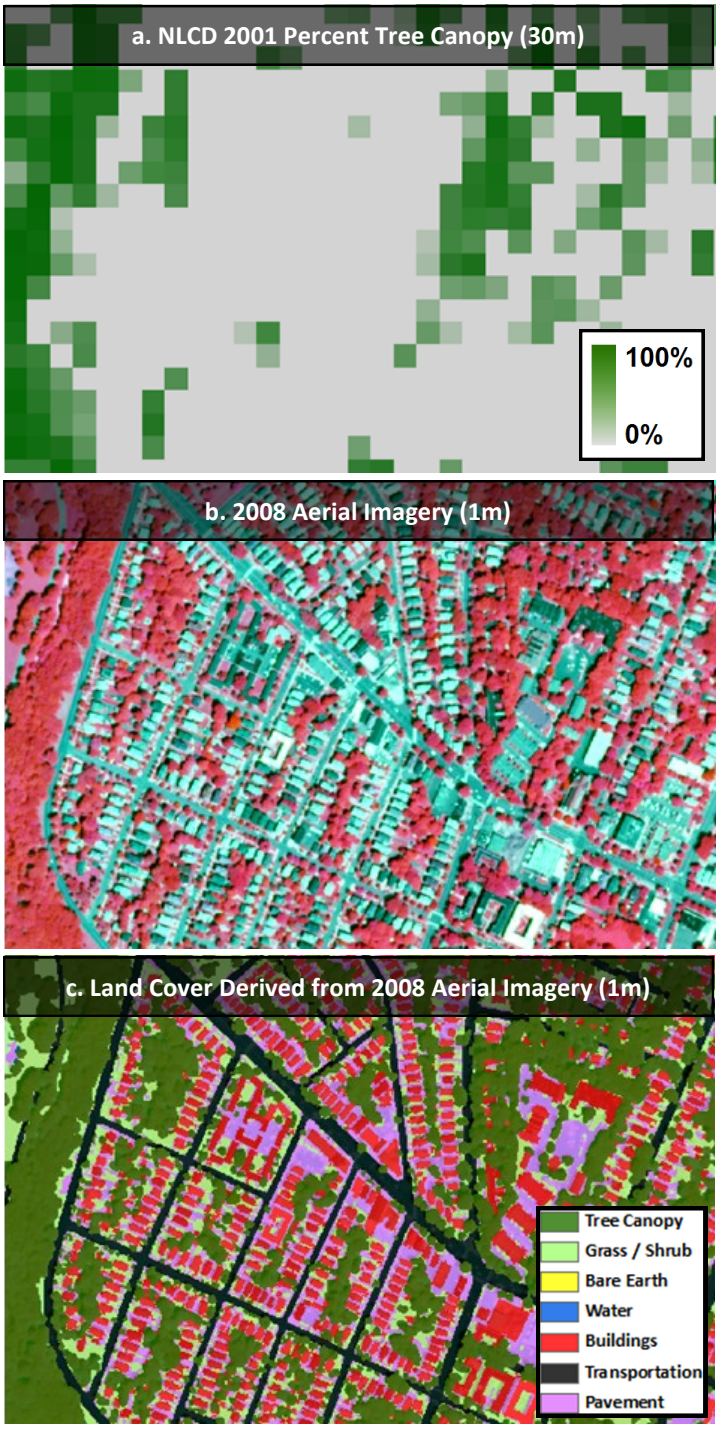


Figure 3a, 3b, 3c: Comparison of NLCD 2001 to high-resolution land cover.

Parcel & Land Use Summary

Following computation of Existing and Possible UTC, the UTC metrics were summarized for each property in the city's parcel database (Figure 4). For each parcel, the absolute area of Existing and Possible UTC was computed along with the percent of Existing UTC and Possible UTC (UTC area/area of the parcel).

An updated land-use layer was generated using the city's parcel layer in combination with the 2008 aerial imagery. This layer was used to summarize UTC by land-use category (Figure 4). For each land-use category, UTC metrics were computed as a percentage of all land in the city (% Land), as a percent of land area by land-use category (% Category), and as a percent of the area for UTC type (% UTC Type). For example, land designated as "Residential" has the most Existing UTC in raw acreage (13% by % Land), but by the percentage of land-use type occupied by possible UTC vegetation, land designated as "Exempt" (28% by % Category) has the most (Table 1).

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

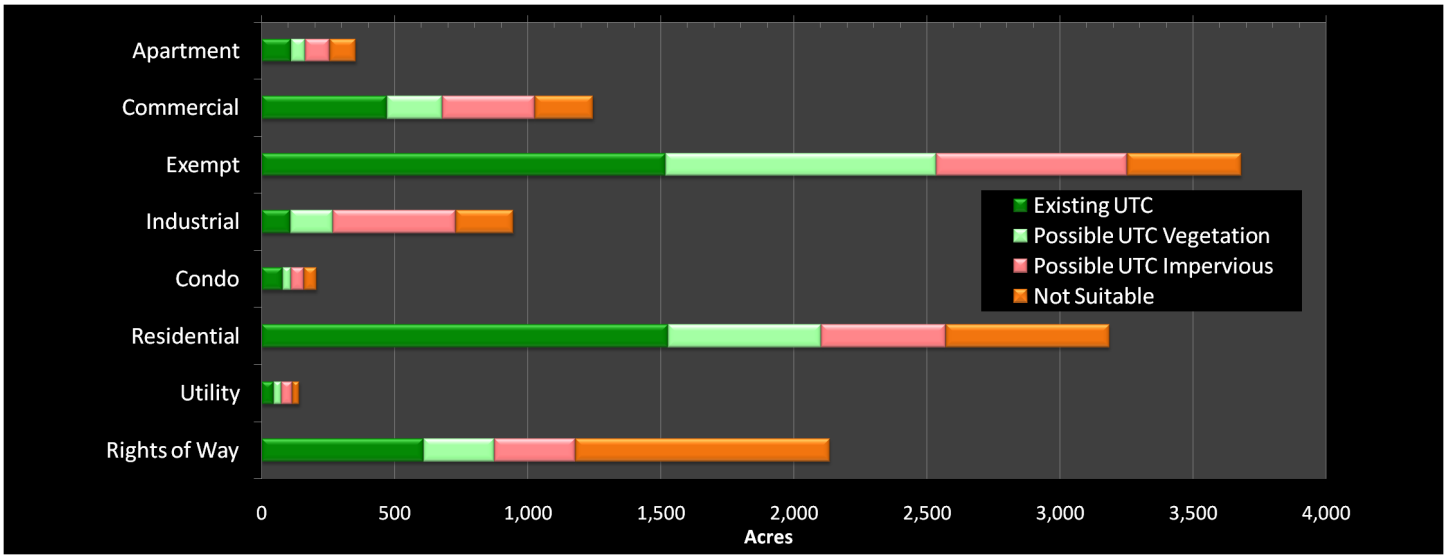


Figure 5: UTC metrics summarized by parcel land use.

Land Use	Existing UTC			Possible UTC Vegetation			Possible UTC Impervious		
	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type
Apartment	1%	32%	3%	0%	14%	2%	1%	27%	4%
Commercial	4%	38%	11%	2%	17%	9%	3%	28%	15%
Exempt	13%	41%	34%	9%	28%	43%	6%	20%	31%
Industrial	1%	11%	2%	1%	17%	7%	4%	49%	20%
Condo	1%	38%	2%	0%	16%	1%	0%	23%	2%
Residential	13%	48%	34%	5%	18%	25%	4%	15%	20%
Utility	0%	32%	1%	0%	21%	1%	0%	28%	2%
Rights of Way	5%	29%	14%	2%	12%	11%	3%	14%	13%

$$\text{\% Land} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land}}$$

The % Land Area value of 13% indicates that 13% of New Haven's land area is tree canopy in areas where the land use is "Residential."

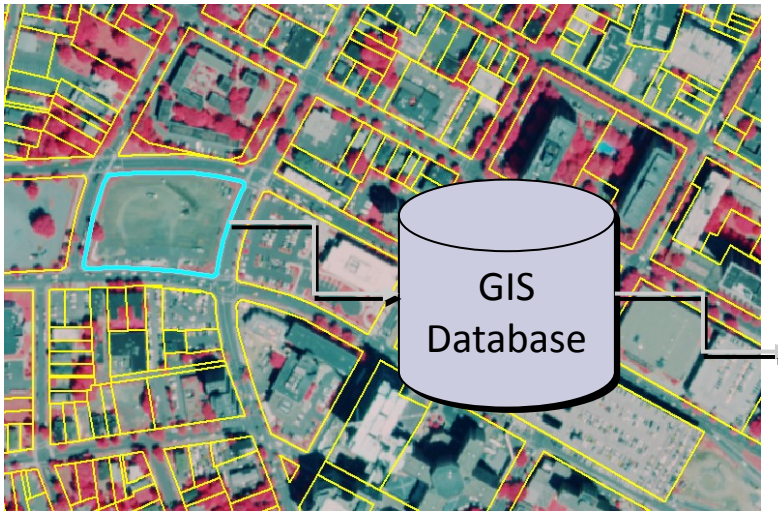
$$\text{\% Category} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land for specified land use}}$$

The % Land Use value of 48% indicates that 48% of "Residential" land is covered by tree canopy.

$$\text{\% UTC Type} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all UTC type}}$$

The % UTC Type value of 34% indicates that 34% of all Existing UTC lies in areas of "Residential" land use.

Table 1: UTC metrics were summarized by land use. For each land-use category, UTC metrics were computed as a percent of all land in the city (% Land), as a percent of land area by land-use category (% Category), and as a percent of the area for UTC type (% UTC Type).



Decision Support

Parcel-based UTC metrics were integrated into the city's existing GIS database. Decision makers can use GIS to identify specific UTC metrics for a parcel or set of parcels. This information can be used to estimate the amount of tree loss in a planned development or set UTC improvement goals for an individual property.

Attribute	Value
Parcel ID	298-0176-00700
Land Use	Exempt
Legal Square Footage	110592.06
Existing UTC Area	1548.29
Existing UTC	1%
Possible UTC Area	108380.22
Possible UTC	98%
Possible UTC - Vegetation	87%
Possible UTC - Impervious	11%

Figure 6: GIS-based analysis of parcel-based UTC metrics for decision support. In this example, GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based UTC metrics, are displayed in tabular form providing instant access to relevant information.

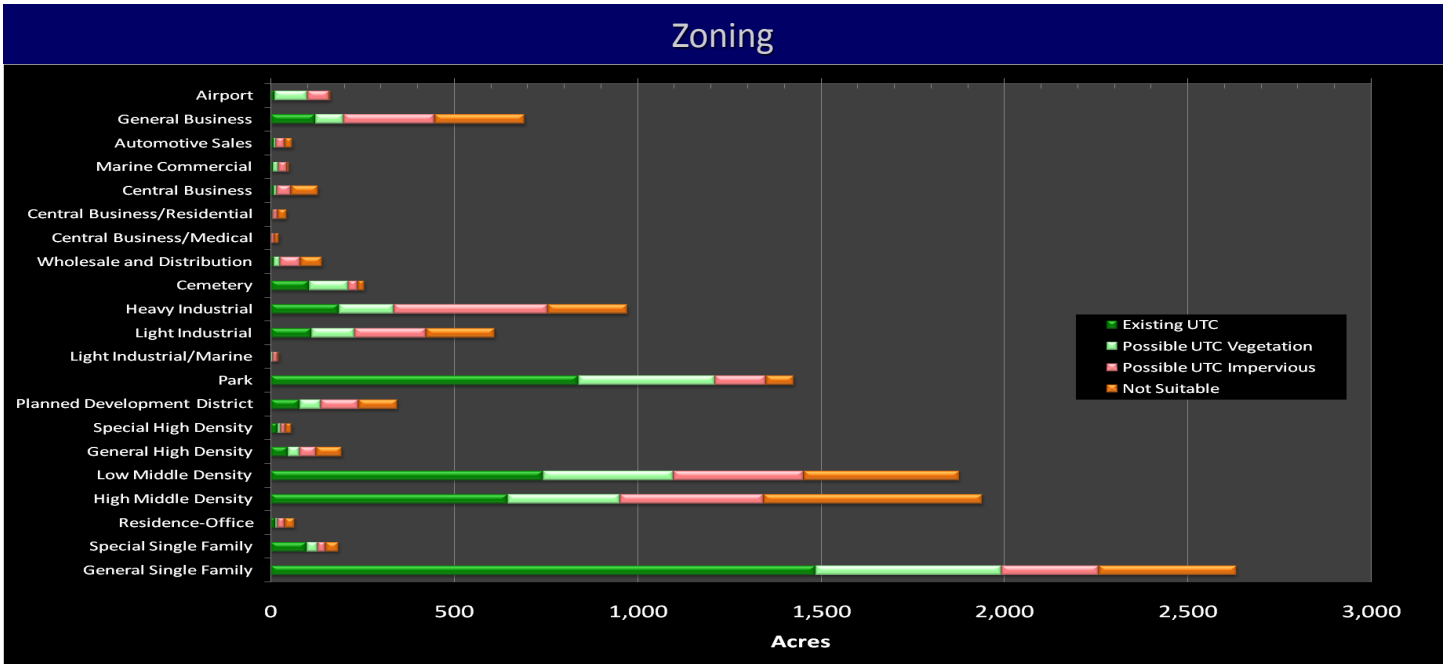


Figure 7. UTC metrics summarized by zoning category.

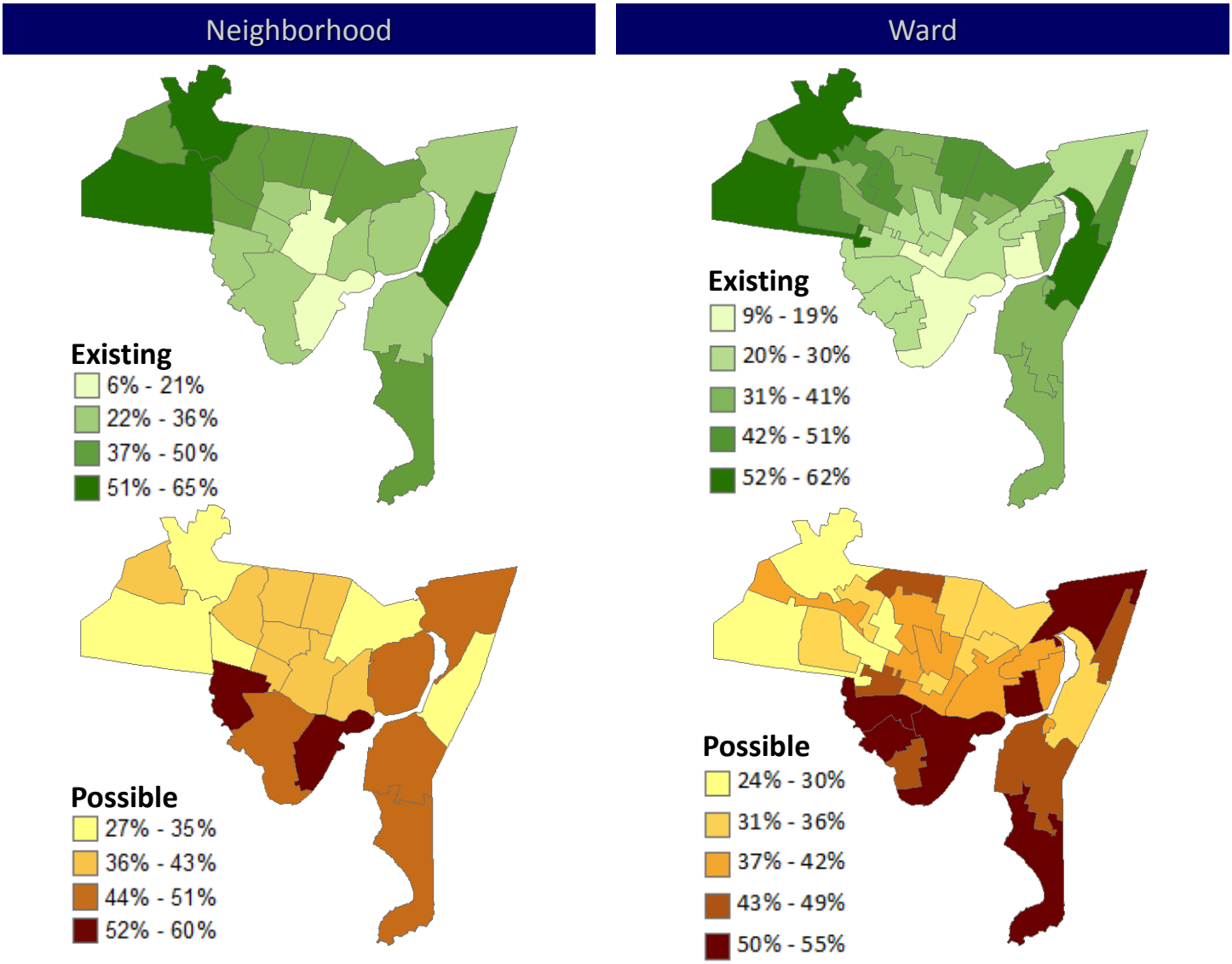


Figure 8. Existing and Possible UTC as a percentage of land area by neighborhood and ward.

Conclusions

- New Haven'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.
- With 38% of its land area occupied by tree canopy, New Haven has above average UTC compared to cities of similar size in other states.
- New Haven should consider establishing a UTC goal. Such a goal should not be limited to increasing the city's overall tree canopy; it should also focus on increasing tree canopy in those parcels or blocks that have the least Existing UTC and highest Possible UTC. This targeted effort can be performed using the UTC parcel database that was produced as part of this assessment.
- With Existing UTC and Possible UTC summarized at the parcel level and integrated with the city's GIS database, individual parcels and subdivisions can be examined and targeted for UTC improvement.
- Of particular focus for UTC improvement should be parcels within 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.
- By ownership type, it is New Haven's residents that control the largest percentage of the city's tree canopy. Programs that educate residents on tree stewardship and provide incentives for tree planting are crucial if New Haven is going to sustain its tree canopy in the long term.
- Increases in UTC will be most easily achieved on governmental land and in transportation rights of way. These land uses have a relatively high percentage of Possible UTC and encompass areas where the city can most readily implement policy.
- Parcels encompassing "commercial" land uses have a disproportionately low amount of tree canopy (1%). Incentives or regulatory measures should be employed to encourage retailers to increase tree canopy on their properties. This will improve water quality, and according to one study, improve business.
- Zoning-, neighborhood-, and ward-level summaries could be used for targeting tree planting and preservation efforts within different regions of the City.
- Existing tree canopy is relatively low in transportation rights-of-way (5%). Accordingly, a "street trees" initiative should be employed to increase tree canopy in these areas.

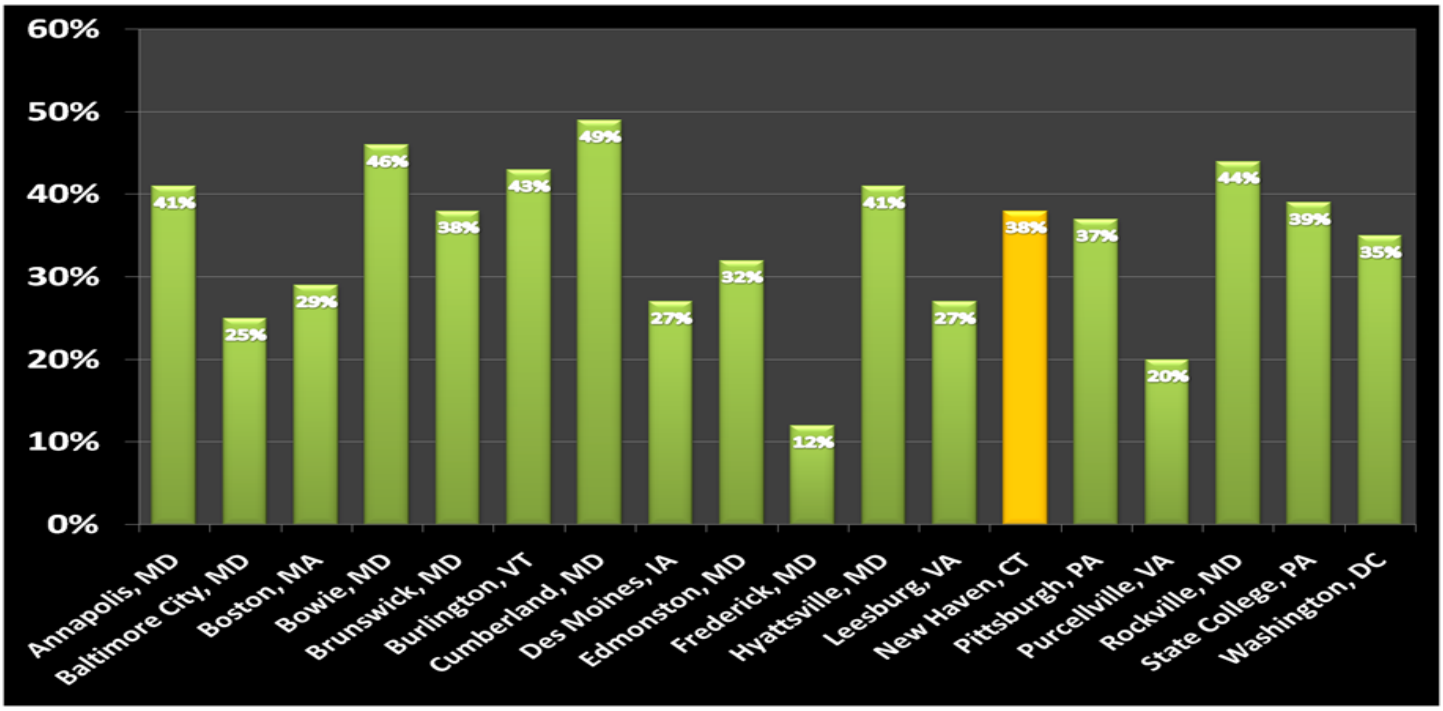


Figure 9: Comparison of Existing UTC with other selected cities that have completed UTC assessments.

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Additional Information

Funding for the project was provided by the USDA Forest Service under award 09-CA-41420004-026. More information on the UTC assessment project can be found at the following web site:

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