A Report on the City of Baltimore'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 Baltimore Have?

An analysis of Baltimore's urban tree canopy based on land cover derived from high-resolution aerial imagery (Figure 1) found that more than 14,130 acres of the city were covered by tree canopy (termed Existing UTC) representing approximately 27.4% of all land in the city. An additional 43.5% (22,507 acres) of the city could theoretically be improved (Possible UTC) to support tree canopy (Figure 2). In the Possible UTC category, 22% (11,396 acres) of the city were Impervious Possible UTC and another 21.5% were Vegetated Possible UTC (11,112 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 Baltimore.

Project Background

The analysis of Baltimore's urban tree canopy (UTC) was conducted in collaboration with the City of Baltimore, the Maryland Department of Natural Resources, the USDA Forest Service, the Parks and People Foundation, and the Baltimore Ecosystem Study (BES). 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 Baltimore. This analysis was conducted based on year 2007 data.

Funding for this project was provided by the Baltimore Ecosystem Study under grant DEB-0423476 from the National Science Foundation.

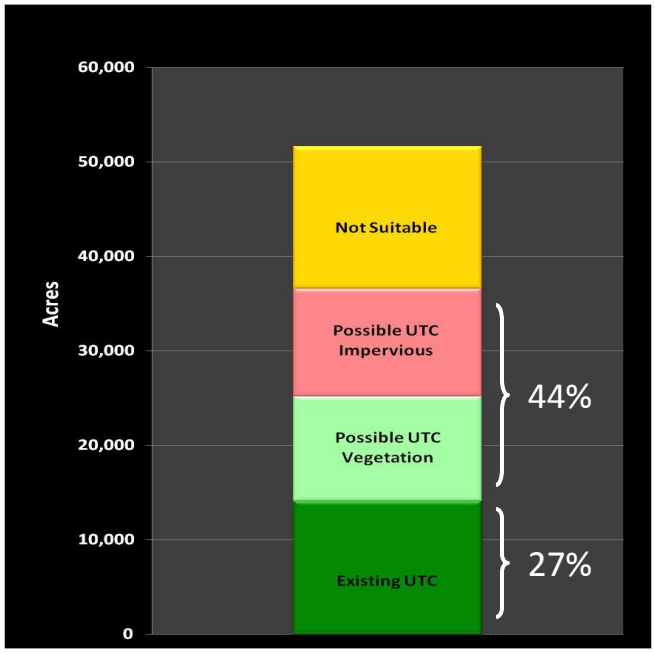

Figure 2: UTC metrics for Baltimore based on % of land area covered by each UTC type.

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: UTC metric indicating the amount of urban tree canopy present when viewed from above using aerial or satellite imagery.
Impervious Possible UTC: UTC metric indicating the asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy.
Vegetated Possible UTC: UTC metric indicating the grass or shrub area that is theoretically available for the establishment of tree canopy.

Mapping Baltimore's Trees

The Spatial Analysis Lab conducted its first UTC assessment for Baltimore City in 2001. The land cover data used to determine existing tree canopy coverage of 20% came from the Strategic Urban Forest Assessment (SUFA) dataset. SUFA relied on less accurate method to map land cover information from 2001 IKONOS satellite imagery. The current study employed better data, an improved methodology, and a rigorous quality assurance/quality control plan. As evident in Figure 3, the 2007 land cover dataset improved the detection of individual trees and smaller forest patches, resulting in a higher canopy estimate of 27%.

Figure 3a, 3b, 3c: Comparison of 2001 SUFA and 2007 UTC Assessment land cover datasets.

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 2007 MD PropertyView dataset. This layer was used to summarize UTC by land-use category (Figure 5). 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 (10% of all land and 37% of all Existing UTC), but Exempt parcels have the highest percentage tree canopy per unit area of all land use types (54%).

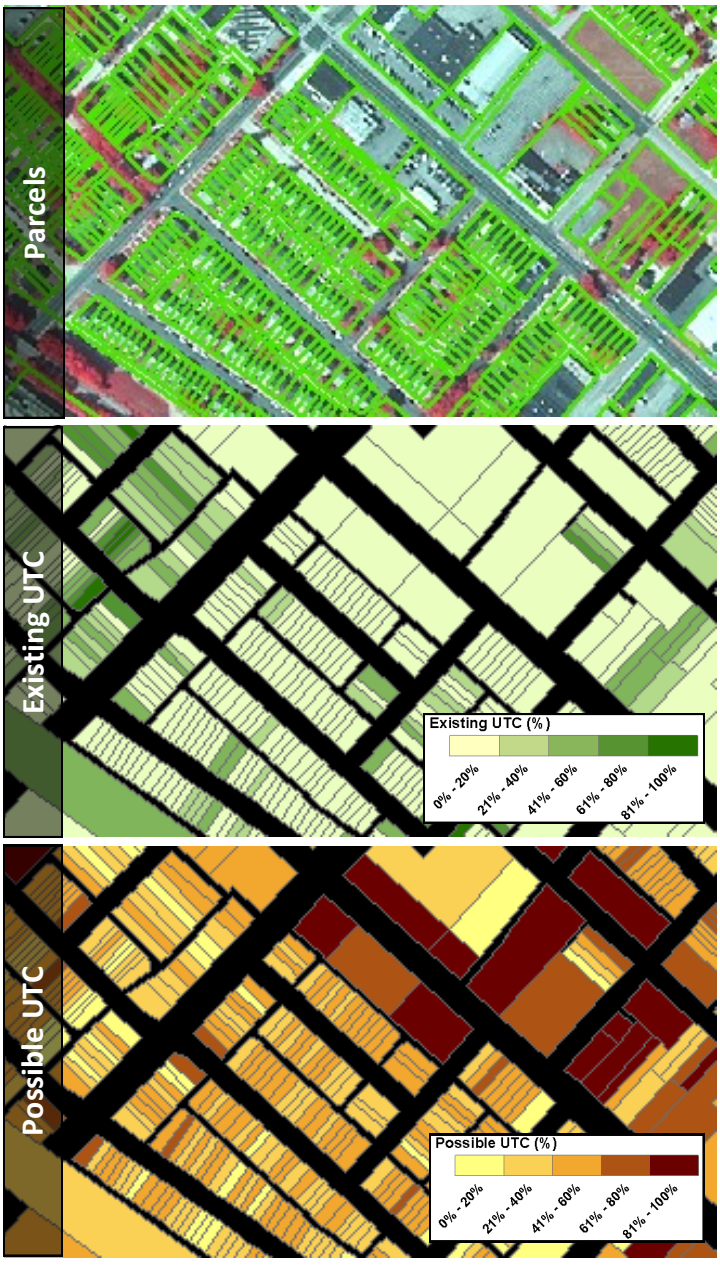

Figure 4: Parcel-based UTC metrics. UTC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing UTC and Possible UTC.

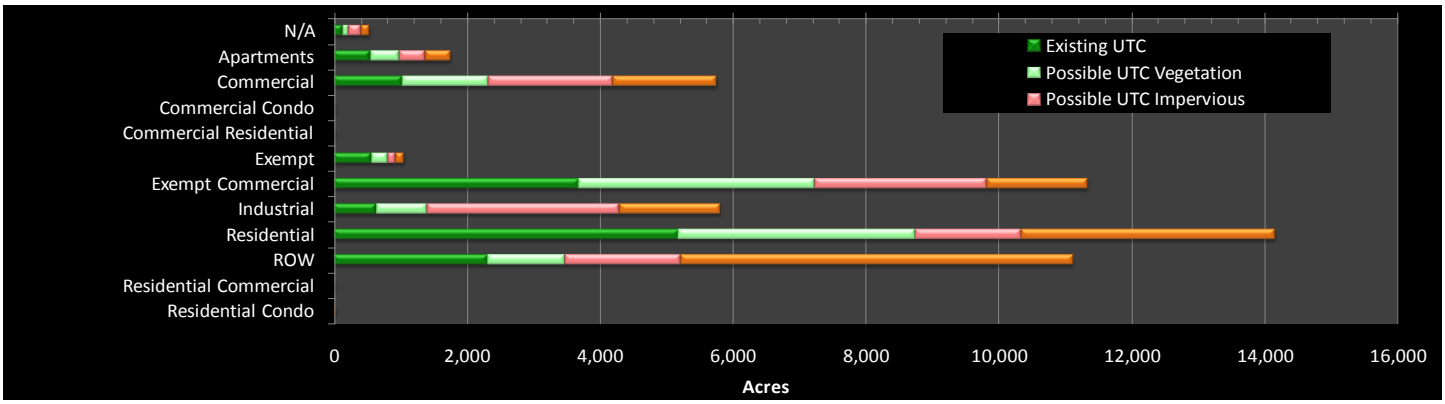

Figure 5: UTC metrics summarized by parcel land use.

Land Use	Existing UTC			Possible UTC Vegetation			Possible UTC Impervious		
	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type	% Land	% Category	% UTC Type
N/A	0%	27%	1%	0%	15%	1%	0%	34%	2%
Apartments	1%	31%	4%	1%	25%	4%	1%	22%	4%
Commercial	2%	18%	7%	2%	22%	12%	4%	32%	17%
Commercial Condo	0%	7%	0%	0%	8%	0%	0%	42%	0%
Commercial Residential	0%	2%	0%	0%	15%	0%	0%	17%	0%
Exempt	1%	54%	4%	0%	23%	2%	0%	10%	1%
Exempt Commercial	7%	32%	26%	7%	31%	32%	5%	23%	23%
Industrial	1%	11%	5%	1%	13%	7%	6%	50%	26%
Residential	10%	37%	37%	7%	25%	32%	3%	11%	14%
ROW	4%	21%	16%	2%	10%	10%	3%	16%	16%
Residential Commercial	0%	6%	0%	0%	6%	0%	0%	17%	0%
Residential Condo	0%	28%	0%	0%	9%	0%	0%	12%	0%

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

The % Land Area value of 10% indicates that 10% of Baltimore's land area is tree canopy in areas where the land use

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

The % Land Use value of 37% indicates that 37% 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 37% indicates that 37% 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
Land Use	Apartments
Owner	Housing Authority
Address	3800 W Belvedere Ave
Existing UTC	23%
Possible UTC	56%
Possible UTC—Vegetation	8%
Possible UTC—Impervious	48%

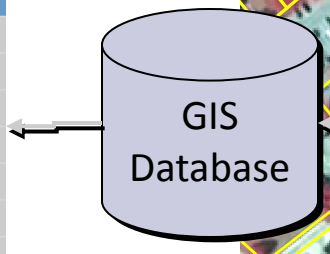

Figure 6: GIS-based analysis of parcel-based UTC metrics for decision support. In this example, GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based UTC metrics, are displayed in tabular form providing instant access to relevant information.

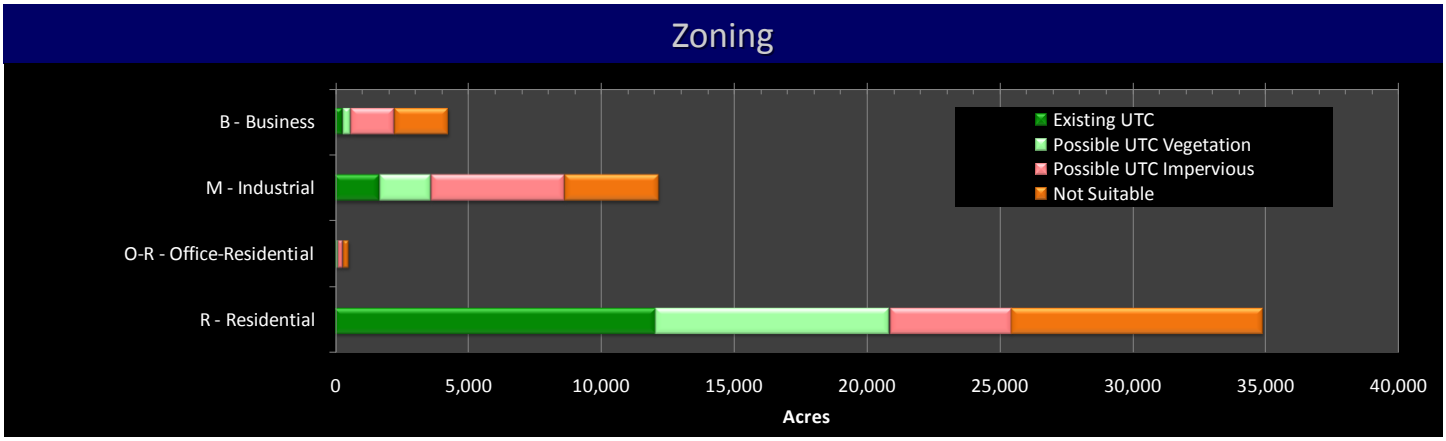

Figure 7. UTC metrics summarized by zoning category.

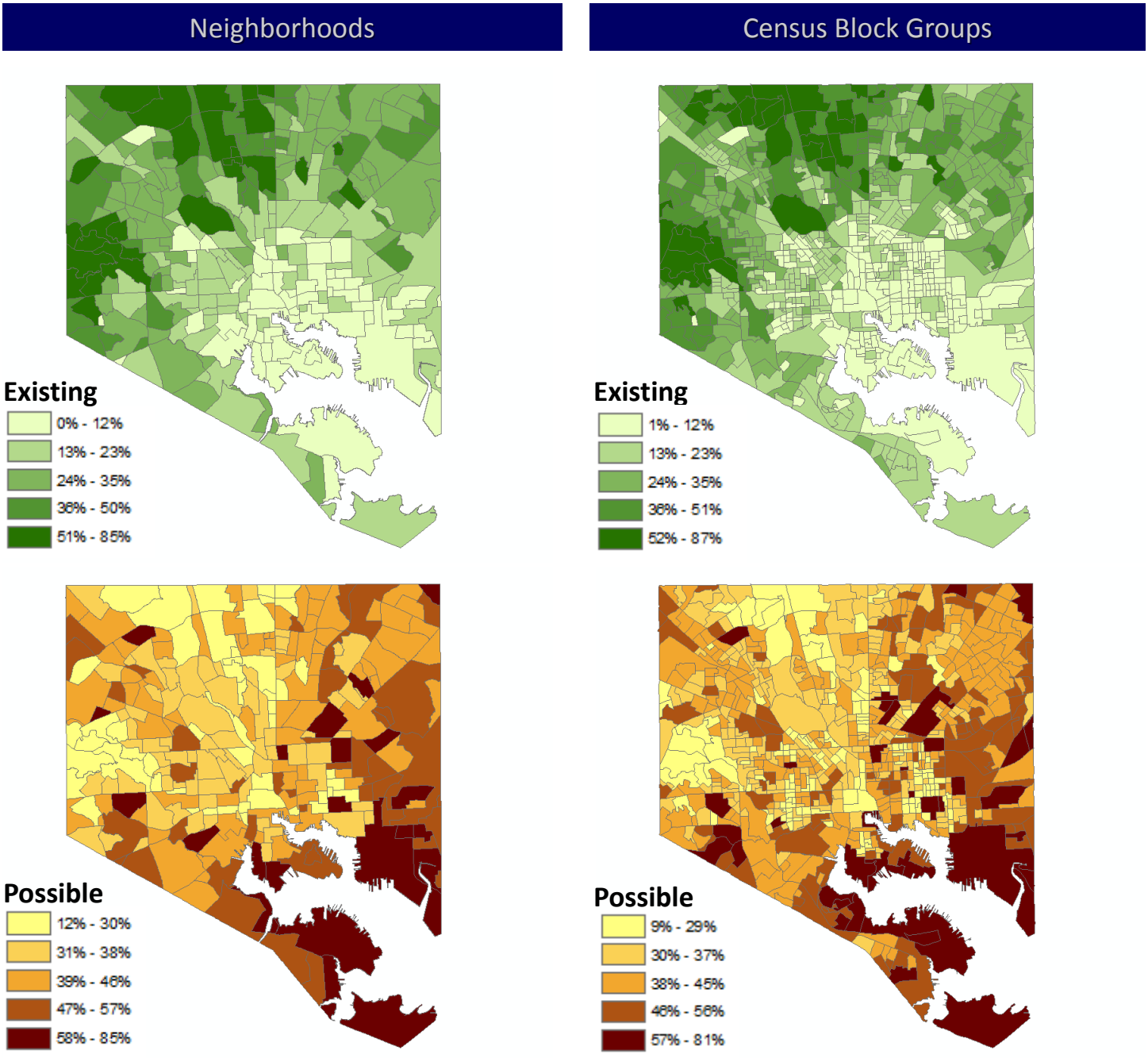

Figure 8. Existing and Possible UTC as a percentage of land area by neighborhood and ward.

Conclusions

- There is enough available land to support Baltimore City's tree canopy goal of 40%.
- The 27% estimate presented in this report reflects the improved detection of individual trees and small forest patches. It does not indicate that Baltimore City's tree canopy has increased 7% over the 20% estimate that arose from the 2001 analysis. Future mapping efforts of tree canopy in Baltimore City should note that the detection of individual trees and small forest patches are important for determining an accurate estimate of overall tree canopy
- Baltimore'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 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 Baltimore'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 Baltimore is going to sustain its tree canopy in the long term.
- After residential areas, commercial properties have the greatest potential for increasing tree canopy, with a total of over 9,000 acres (or greater than 18% of all land area in the city) of Possible UTC in commercial and exempt commercial land uses. Tree canopy can increase property values and in one study it was found to increase retail sales.
- A particularly large portion (32%) of commercial land in the city is impervious area that has potential for the establishment of tree canopy.
- Although Apartments comprise only a small part of the total land area in the city, a relatively high proportion of the category (47%) has been identified as having potential for the establishment of UTC.
- Census and neighborhood metrics are useful in examining the relationship between socio-economic conditions and the presence of tree canopy.
- Zoning-, neighborhood-, and census block group summaries could be used for targeting tree planting and preservation ef-

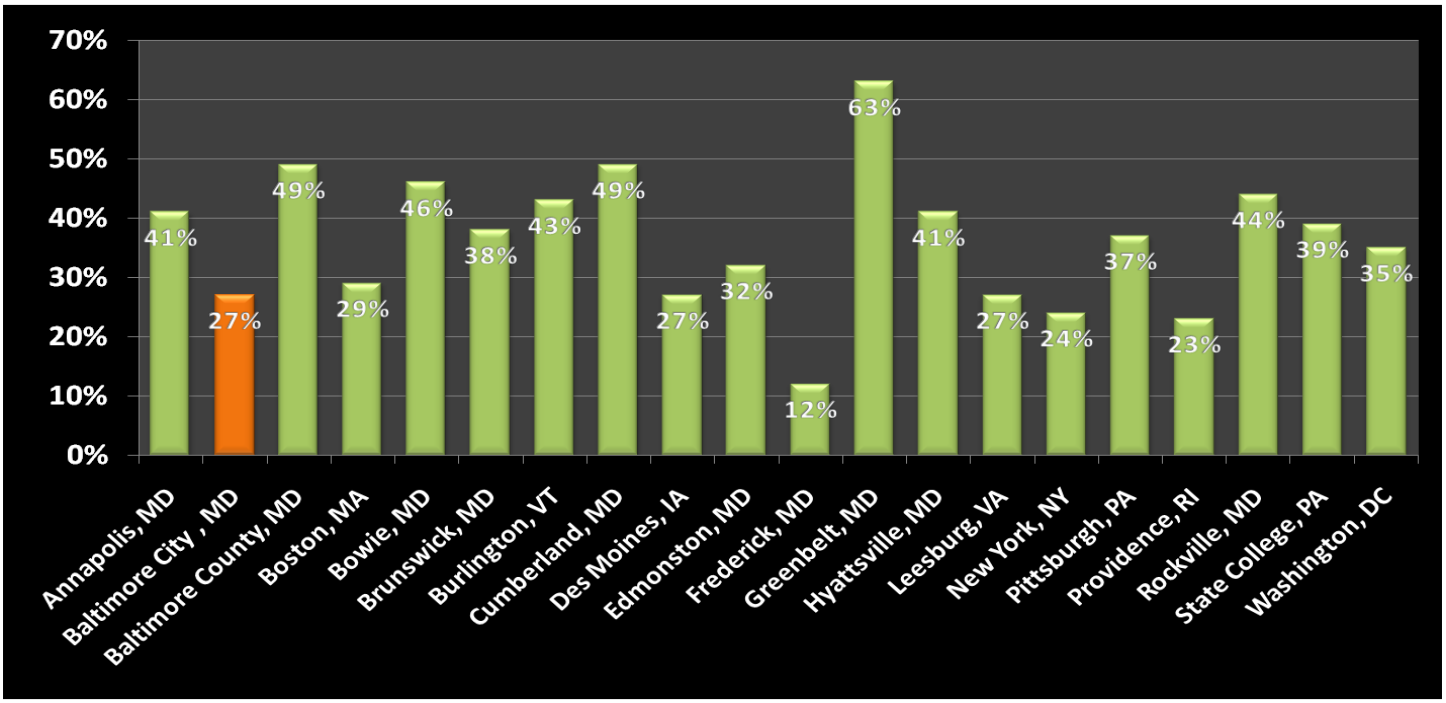

Figure 9: Comparison of Existing UTC with other selected cities that have completed UTC assessments.

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Additional Information

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More information on the UTC assessment project can be found at the following web site:

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