

# A Report on the Town of Purcellville's Existing and Possible Urban Tree Canopy

## Summary

An analysis of Purcellville's urban tree canopy (UTC) based on high resolution satellite imagery found that 337 acres of the town is covered by tree canopy (termed Existing UTC). This corresponds to 20% of Purcellville's land area (land area refers to all areas not occupied by water). An additional 64% (1057 acres) of the town could theoretically be improved to support urban tree canopy (termed Possible UTC), although the amount of land where it is desirable to plant trees is less.

The majority of Purcellville's Existing UTC (61% of all tree canopy, 189 acres) is located in areas of residential land use. Residential land also contains most of the Possible UTC (62% of all the Possible, 606 acres).

UTC enhancement in Purcellville will most efficiently be realized by maximizing protection and maintenance in combination with new plantings and natural regeneration. The town should consider setting a UTC goal and focus on reallocating public agency resources (funds, staff, etc.) to enhance UTC. UTC increases will be easiest to make on institutional lands (schools, parks, etc.). On private lands, a combination of education and outreach, landowner and redevelopment incentives, and refocusing of regulatory mechanisms to specifically achieve the objectives of the UTC goal will likely be required.

## Project Background

The analysis of Purcellville's urban tree canopy (UTC) was carried out at the request of the Town of Purcellville. 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 Town of Purcellville. The UTC assessment protocols make use of high resolution geospatial datasets (satellite imagery, property boundaries), enabling UTC metrics to be computed at the parcel level. UTC metrics provide detailed information on a community's urban forest, and form the basis for UTC goal setting.

This project sought to leverage existing investments in geospatial data made by the town, enabling the analysis to be completed at a reasonable cost.

## High Resolution Land Cover

Readily available land cover datasets lack both the detail and accuracy to effectively map tree canopy in urban areas. The National Land Cover Dataset's (NLCD) tree canopy layer is very valuable for regional analysis but with a relatively coarse resolution (30 meters) it fails to capture all of the tree canopy in Purcellville's urban forest (Figure 1). NLCD 2001 estimates put the town's tree canopy at 12%. The 20% estimate presented in this report was derived using high resolution (60 centimeter) imagery acquired by the Quickbird satellite in October 2007. State of the art image processing routines were used to automated the development of a high resolution land cover dataset (Figure 1).

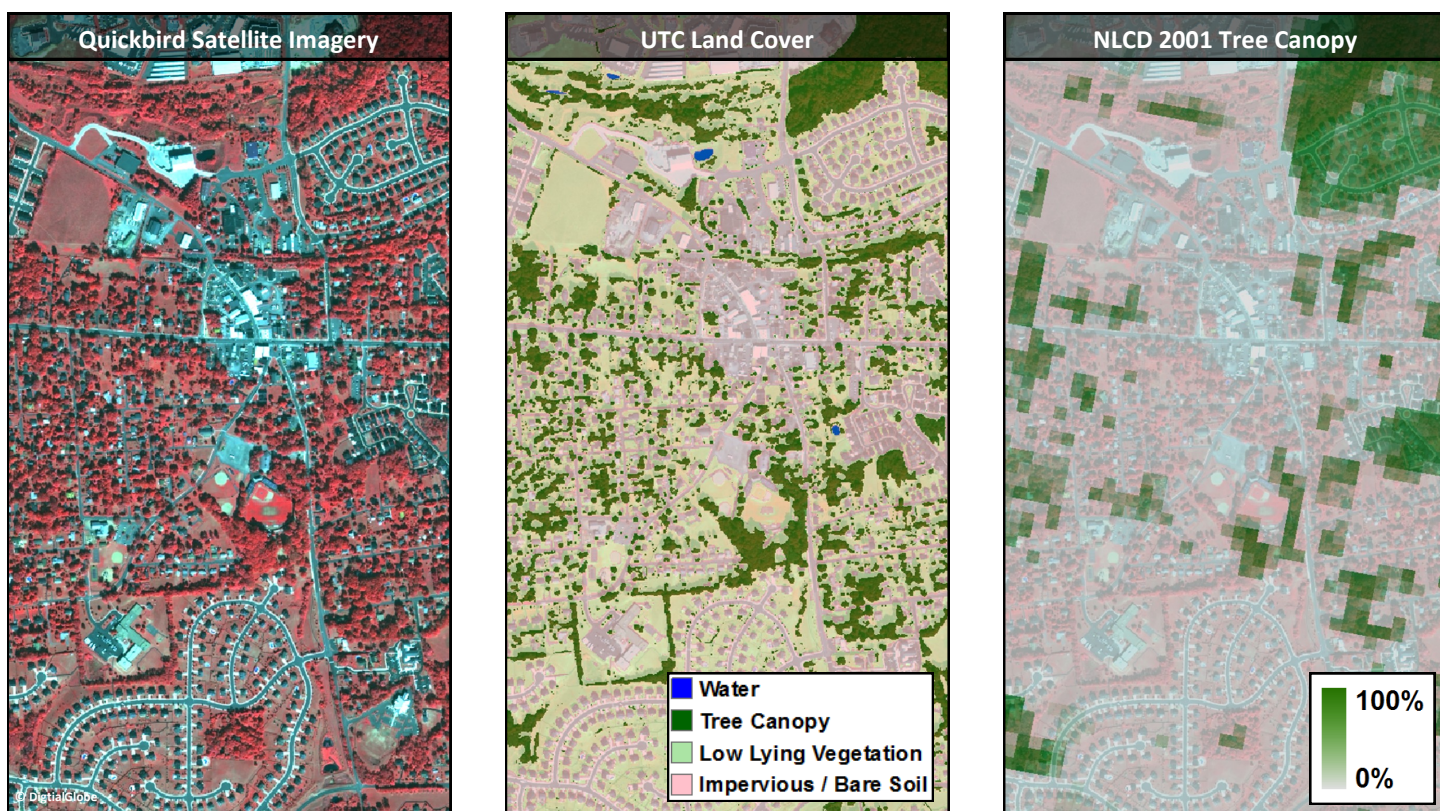
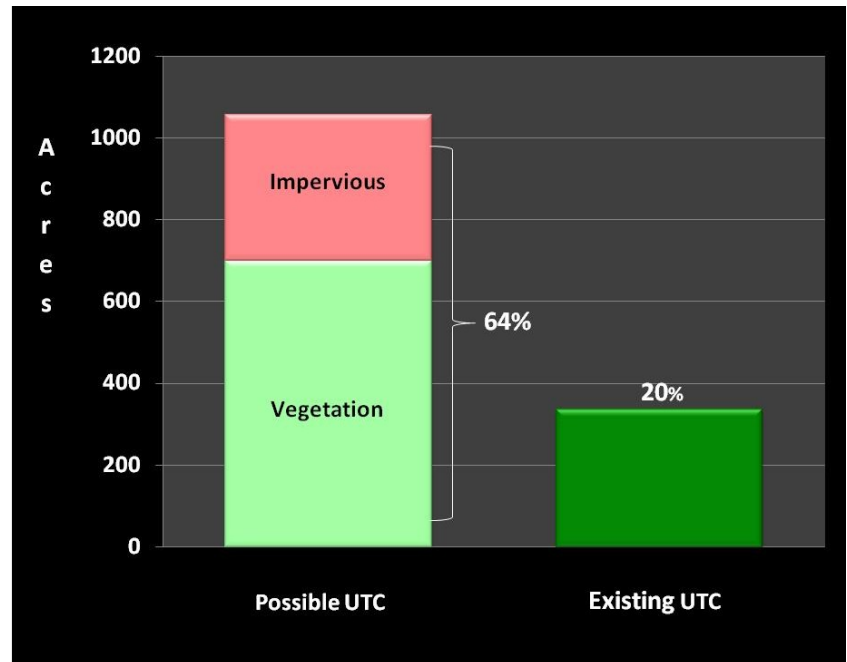


Figure 1: Comparison of the high resolution UTC land cover dataset developed as part of this project to NLCD.

## Town UTC Metrics

Based on October 2007 Quickbird satellite imagery Purcellville is estimated to have 20% of its land area covered by tree canopy (Existing UTC). It would be biophysically feasible to establish tree canopy on another 64% of the town's land (Possible UTC). Possible UTC excludes structures, roads, and water; it is divided into two subcategories: impervious and vegetation. Possible UTC is further broken down into Impervious Possible UTC and Vegetated Possible UTC. Impervious Possible UTC consists primarily of parking lots and driveways, areas where only small improvements in tree canopy could be made. Establishing tree canopy on the Vegetated Possible UTC, which consists of grass and shrubby areas will be much easier.

Figure 2: UTC town-wide metrics. Percentages are in relation to the total of the town's land area.



## Existing and Possible UTC

UTC metrics for the Town of Purcellville were computed using the UTC assessment protocols developed by the USDA Forest Service. The UTC protocols integrate the land cover layer with existing GIS data layers from the town's GIS database.

Existing UTC was computed by simply summarizing all features identified as "tree canopy." Two types of Possible UTC were computed: Vegetated Possible UTC and Impervious Possible UTC. Vegetated Possible UTC was computed by finding all areas in the land cover dataset identified as "low lying vegetation." Impervious Possible UTC was computed by summarizing all land cover in the "impervious/bare soil" category, excluding roadways and buildings. Those areas that did not fall into either the Existing UTC or Possible UTC categories were classified as "not suitable." Not suitable areas consist of buildings, roads, and water.

## Parcel & Land Use Summary

Following the computation of the Existing and Possible UTC the UTC metrics were summarized for each property in the town's parcel database (Figure 3). 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 county's parcel database in combination with the 2007 Quickbird satellite imagery. This land use layer was the basis for summarizing UTC by land use category (Figure 4). Table 1 presents a more detailed summary of the UTC land use metrics. For each land use category UTC metrics were computed as a percent of all land in the town (% Land), as a percent of land area by zoning land use category (% Category) and as a percent of the area for the UTC type (% UTC Type). For example, residential areas have the most Vegetated Possible UTC in raw acreage (13%, % Land), but institutional lands have the greatest percentage of their land (72%, % Category) as Vegetated Possible UTC (Table 1).

Figure 3: Parcel-based UTC metrics. UTC metrics are generated at the parcel level, allowing each property to be evaluated with respect to its Existing UTC and Possible UTC.



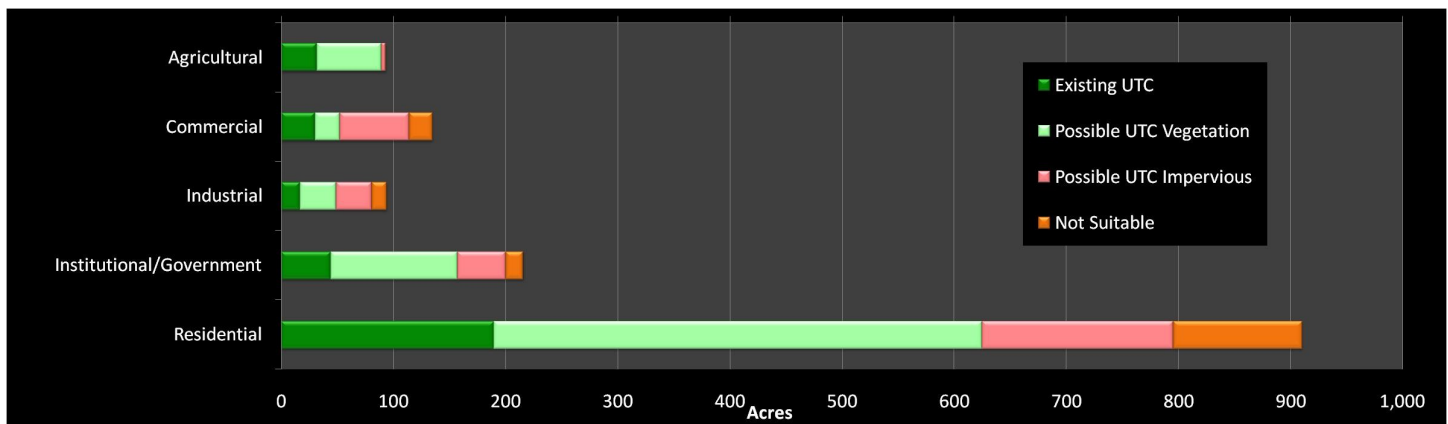


Figure 4: UTC metrics summarized by land use. Land use was determined for existing property parcels based on 2007 satellite imagery.

| Land Use                 | Existing UTC |            |            | Possible UTC Vegetation |            |            | Possible UTC Impervious |            |            |
|--------------------------|--------------|------------|------------|-------------------------|------------|------------|-------------------------|------------|------------|
|                          | % Land       | % Category | % UTC Type | % Land                  | % Category | % UTC Type | % Land                  | % Category | % UTC Type |
| Agricultural             | 2%           | 34%        | 10%        | 4%                      | 61%        | 9%         | 0%                      | 4%         | 1%         |
| Commercial               | 2%           | 22%        | 10%        | 2%                      | 17%        | 3%         | 4%                      | 46%        | 9%         |
| Industrial               | 1%           | 18%        | 5%         | 2%                      | 34%        | 5%         | 2%                      | 34%        | 5%         |
| Institutional/Government | 3%           | 20%        | 14%        | 8%                      | 52%        | 17%        | 3%                      | 20%        | 7%         |
| Residential              | 13%          | 21%        | 61%        | 30%                     | 48%        | 66%        | 12%                     | 19%        | 26%        |

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

The % Land value of 13% indicates that 13% of Purcellville's land area is tree canopy in areas zoned for residential land use.

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

The % Category value of 21% indicates that 21% of land in the residential land use category 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 61% indicates that 61% of all Existing UTC lies in areas zoned for residential land use.

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

## Decision Support

The parcel-based UTC metrics were integrated into the town's existing GIS database. Decision makers can use GIS to find out 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.

| Field                           | Value   |
|---------------------------------|---------|
| PLAT NUM                        | N/A     |
| Subdivision                     | Town    |
| Legal Square Footage            | 216,057 |
| Existing UTC Area               | 23,920  |
| Existing UTC Percent            | 11.6    |
| Possible UTC Area               | 169,950 |
| Possible UTC Percent            | 82.4    |
| Possible UTC Vegetation Percent | 37.8    |
| Possible UTC Impervious Percent | 44.6    |



Figure 5: GIS-based analysis of the 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.

## Results

- 20% of Purcellville's land area is covered by tree canopy (Existing UTC), a total of 337 acres.
- It is biophysically feasible to establish tree canopy (Possible UTC) on 64% (1057 acres) of Purcellville's land. However, It would neither be socially desirable or economically feasible to plant trees on all of this land. Of the Possible UTC the majority (67%) consists of grassy areas where it would be relatively easy to plant trees.
- The greater part of the town's land (63%, 910 acres) in residential land use. In pure acreage, residential land has the majority of Existing UTC in the town at 61% (189 acres). 67% (606 acres) of residential land is available for the establishment of new tree canopy.
- Land zoned for agricultural use is the most densely stocked with tree canopy. 34% (32 acres) of agricultural land consists of Existing UTC.
- Industrial land is the least densely stocked with tree canopy. Only 18% (17 acres) of industrial land is comprised of Existing UTC.
- Institutional land has the highest percentage of its land available for the establishment of tree canopy. 72% (156 acres) on institutional land consists of Possible UTC.

## Conclusions

- Purcellville's urban tree canopy is a vital town asset; reducing stormwater runoff, improving air quality, reducing the town's carbon footprint, enhancing quality of life, and serving as habitat for wildlife.
- The town's Existing UTC percentage is lower than cities that are more established such as Annapolis, MD and Burlington, VT, and its neighbor, Leesburg, but higher than comparable communities such as Frederick, MD (Figure 6). The amount of Possible UTC indicates that there is the requisite land area to support a sizable increase in tree canopy in the town.
- Purcellville's residents control the vast majority of the town's tree canopy. Programs that educate residents on tree stewardship and incentives provided to residents that plant trees are crucial if Purcellville is going to improve its overall UTC percentage.
- Increases in UTC will be most easily achieved on institutional lands, where there is the highest relative amount of Possible UTC and where the government can most readily implement policy.
- Development pressures will make it imperative that the town preserve its existing trees and seek out new planting opportunities.
- Tree plantings in Purcellville's rights-of-way (street trees), should be continued due to the numerous benefits they afford, but street tree plantings alone will not be able to substantially increase UTC in the town.
- With Existing UTC and Possible UTC summarized at the parcel level and integrated with the Town's GIS database, individual parcels and subdivisions can be examined and targeted for UTC improvement.

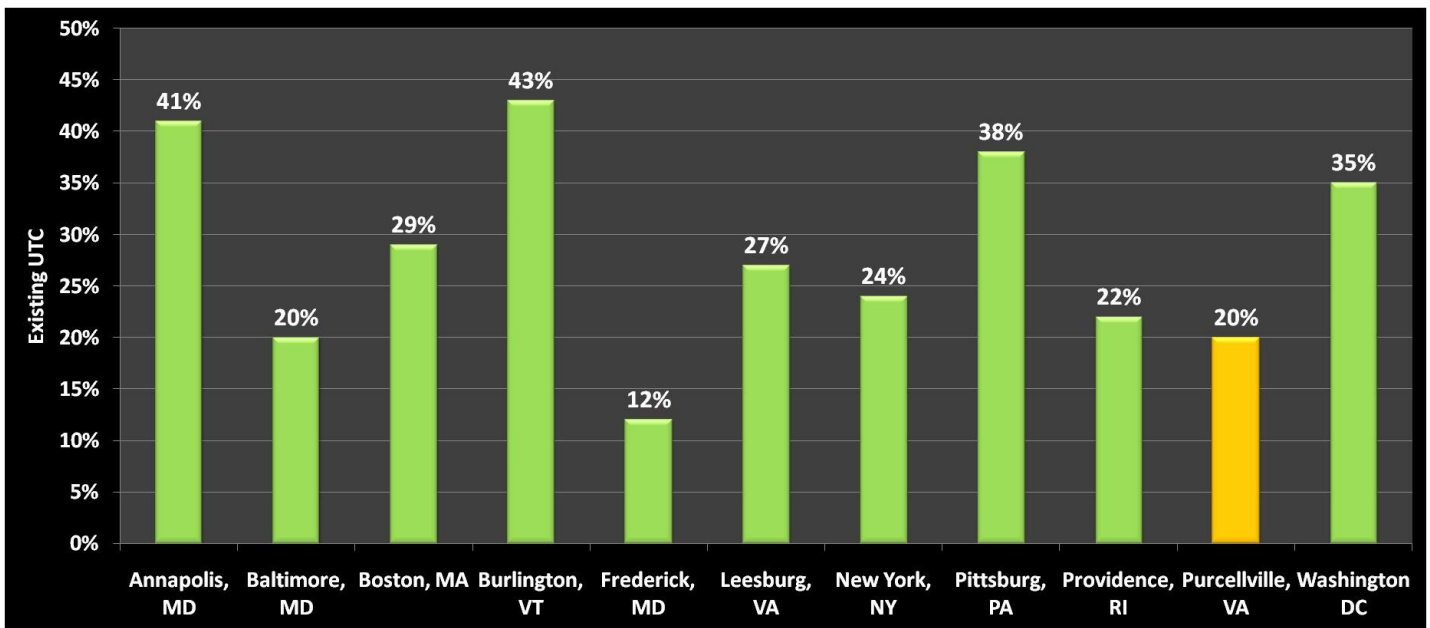


Figure 6: Comparison of Existing UTC among cities that have completed UTC assessments.

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