Mapping Baltimore County's Tree Canopy
Supporting the Forest Sustainability Program

Why is Tree Canopy Important?

Tree Canopy is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Tree canopy provides numerous benefits to the residents of Baltimore County including improving water quality, saving energy, lowering the temperature in urban areas, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits.

About this Project

This document presents the initial results of an analysis of Baltimore County's tree canopy. Funding for this study was provided by the USDA Forest Service, State & Private Forestry and the Maryland Department of Natural Resources. This project is ongoing, and is a collaborative effort between the USDA Forest Service, Baltimore County, the Maryland Department of Natural Resources (MD DNR), the Baltimore Ecosystem Study (BES), and the University of Vermont (UVM).

Estimating Tree Canopy

Over the years various estimates of tree canopy have been put forth. Some of these estimates are for the entirety of Baltimore County, others for only the land falling within the Urban-Rural Demarcation Line (URDL). Previous estimates have been generated using tree canopy data derived using three techniques: manually interpretation of aerial photographs, ground-based sampling, and moderate resolution satellite imagery. While these estimates have yielded valuable information, they have limitations with respect to accuracy, scale, and completeness. In order for tree canopy data to be suitable for policy and planning, the data must accurately estimate tree canopy within 1-2 percentage points, acquired at a scale detailed enough to allow for the information to be summarized at the parcel level, and offer complete coverage.

Manual interpretation of aerial photographs is extraordinarily time consuming. As a result, only larger forest patches are present in the existing dataset. Sample-based estimates, using plots randomly located then visited by field crews can provide reasonable estimates at the county or URDL level, but are not acquired in a manner that permits the information to be summarized at the parcel level. Tree canopy estimates from moderate resolution datasets, such as the 30m National Land Cover Dataset (NLCD), consistently underestimate tree canopy and are too coarse to permit parcel-based summaries to be made.

This study represents the first census* of tree canopy is Baltimore County. Leveraging investments made by the USDA, MD DNR, and Baltimore County, cutting-edge object-based image analysis (OBIA) techniques were used to extract detailed land cover information from high-resolution remotely sensed information (Figure 1) such as color infrared (CIR) imagery and light detection and ranging (LiDAR) datasets. Based on this study, 49% of Baltimore County is estimated to be covered by tree canopy. Within the URDL this amount drops to 38%

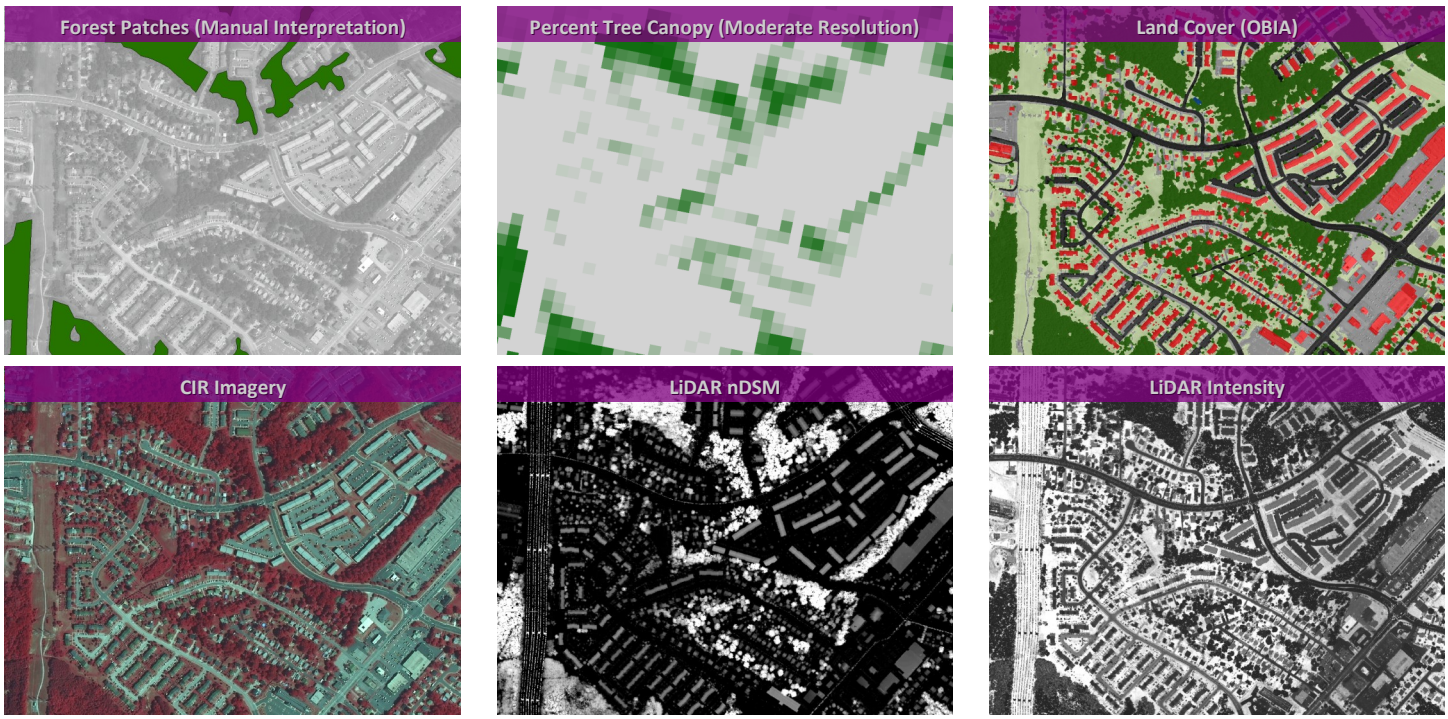

Figure 1a,b,c,d,e,f: Examples of the various land cover products and sources of remotely sensed data for Baltimore County. Forest Patches derived by manual interpretation (upper left), per-pixel percent tree canopy from NLCD 2001 (upper center), land cover generated as part of this project (upper right), CIR aerial imagery (lower right), LiDAR normalized Digital Surface Model (nDSM) (lower middle), and LiDAR intensity image (lower right)

**Imagery was not available for a small portion of the eastern part of the county.*

Land Use Analysis

Summarizing tree canopy by land use allows one to determine who effectively owns the tree canopy. Ownership is important, as strategies for increasing tree canopy of government land would likely involve programmatic decisions. Similar initiatives on residential land would require more of an incentive driven model. The land cover dataset generated using the OBIA methods was summarized by parcel land use for over 325,000 properties in the county (Figure 2). Baltimore County's residential areas have more tree canopy and more room to establish tree canopy than any other land use type, both in the entire county (Figure 2a) and within the URDL (Figure 2b). Figure 3 shows the distribution of percent tree canopy by parcel. It is relatively consistent in the rural areas (outside the URDL), and skewed in the urbanized (within the URDL).

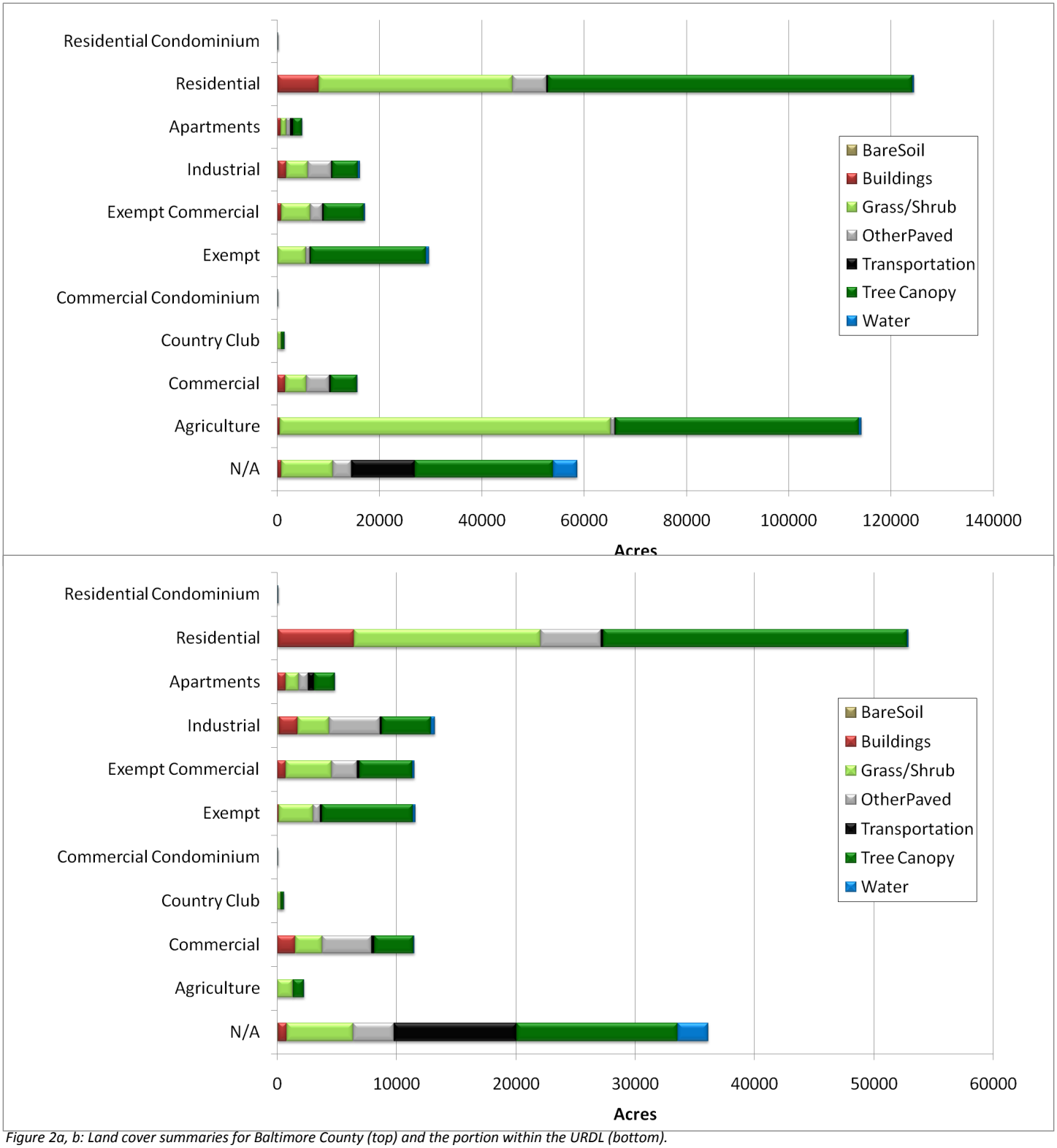

Figure 2a, b: Land cover summaries for Baltimore County (top) and the portion within the URDL (bottom).

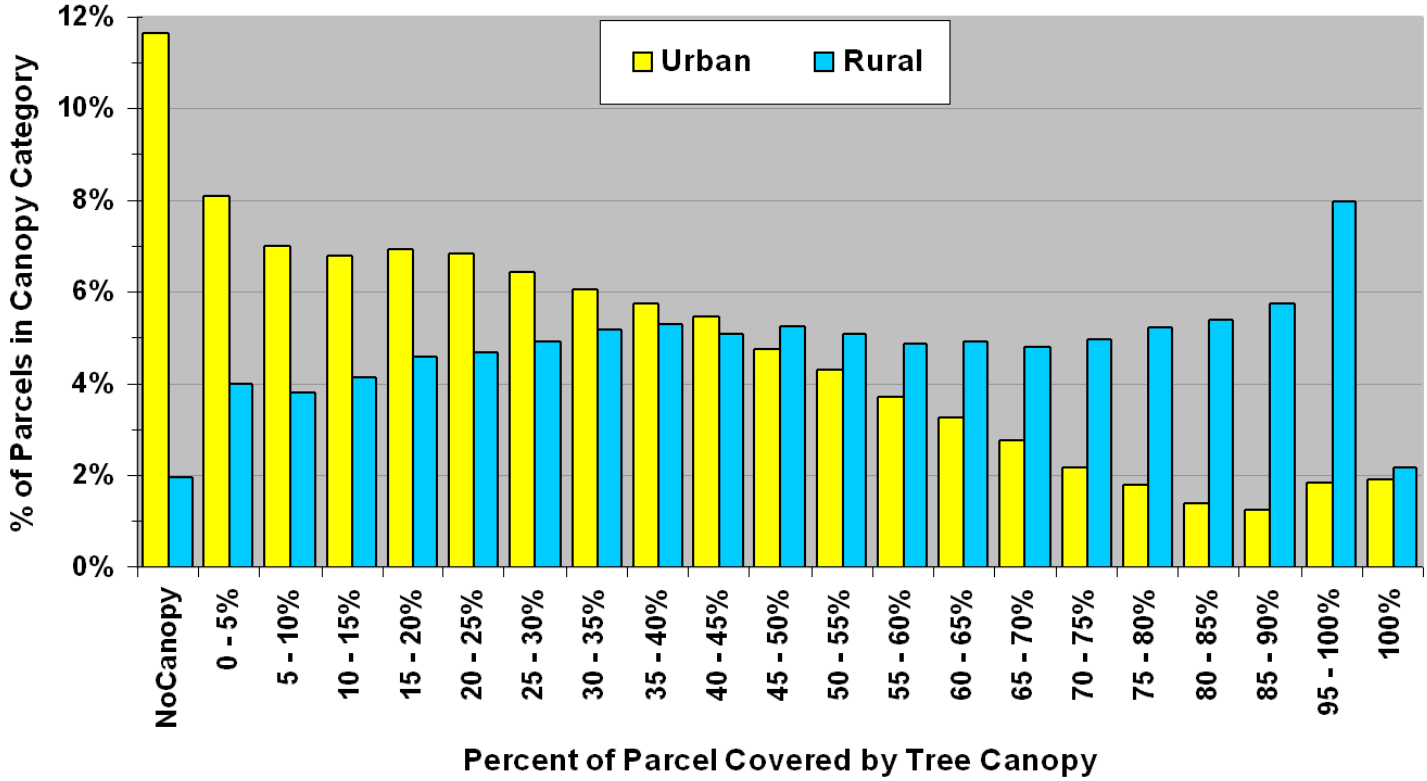

Figure 3: Parcel-based tree canopy summaries for the county as a whole and the URDL.

Census Places Analysis

As Baltimore County has no designated cities, summarizing by US Census Places allows the data to be presented in a manner that is meaningful to residents (Figure 4). The target of 40% tree canopy (Figure 4b) is considered to be a reasonable tree canopy goal for improving water quality. The most deficient US Census Places in terms of tree canopy are: Lansdowne, Parkville, Dundalk, and Edgemere.

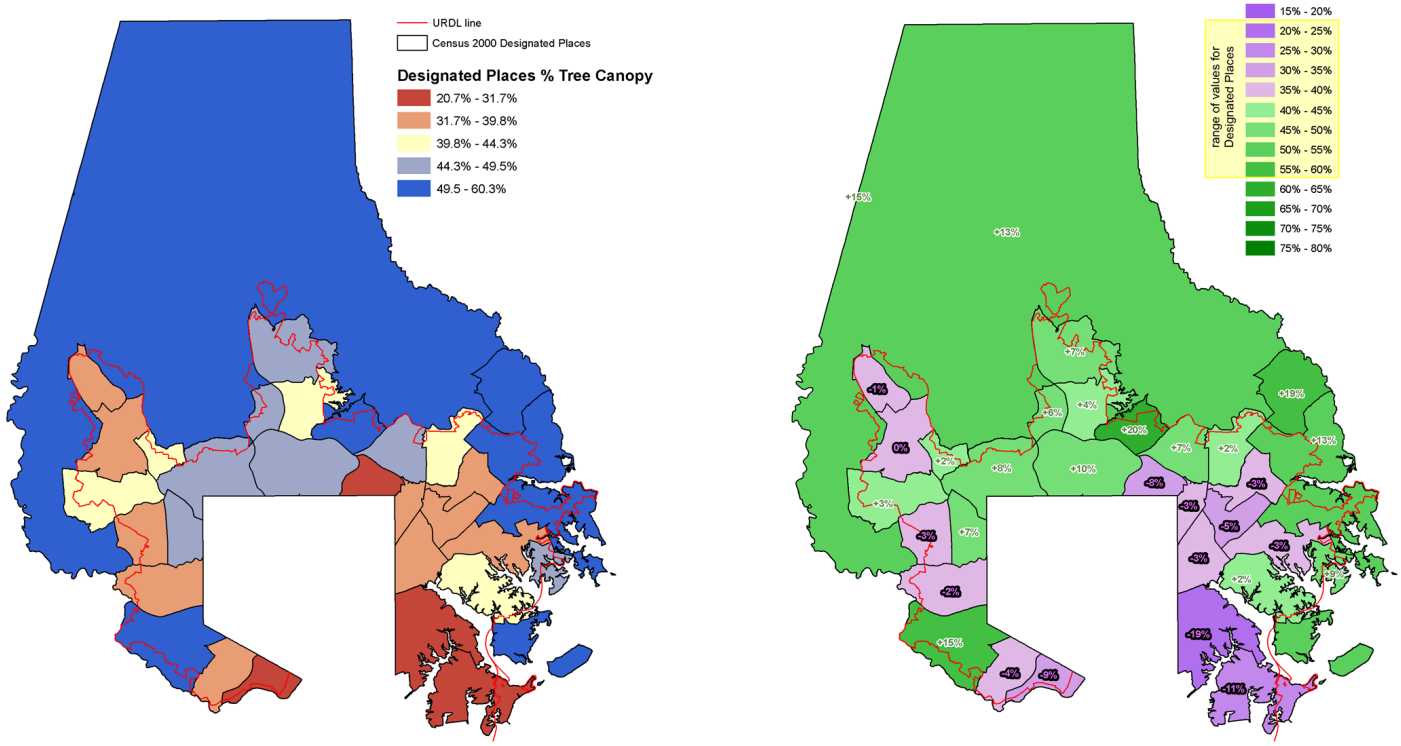

Figure 4a,b: Tree canopy summarized by US Census Places (left) and compared to a 40% goal (right).

Watershed Analysis

The Chesapeake Bay is an important natural resource threatened by nonpoint source pollution. Tree canopy is known to improve water quality. With detailed knowledge of the distribution of tree canopy at the HUC 8 (Figure 5a) and DEPRM (Figure 5b) scale, individual watersheds can be targeted for tree planting initiatives.

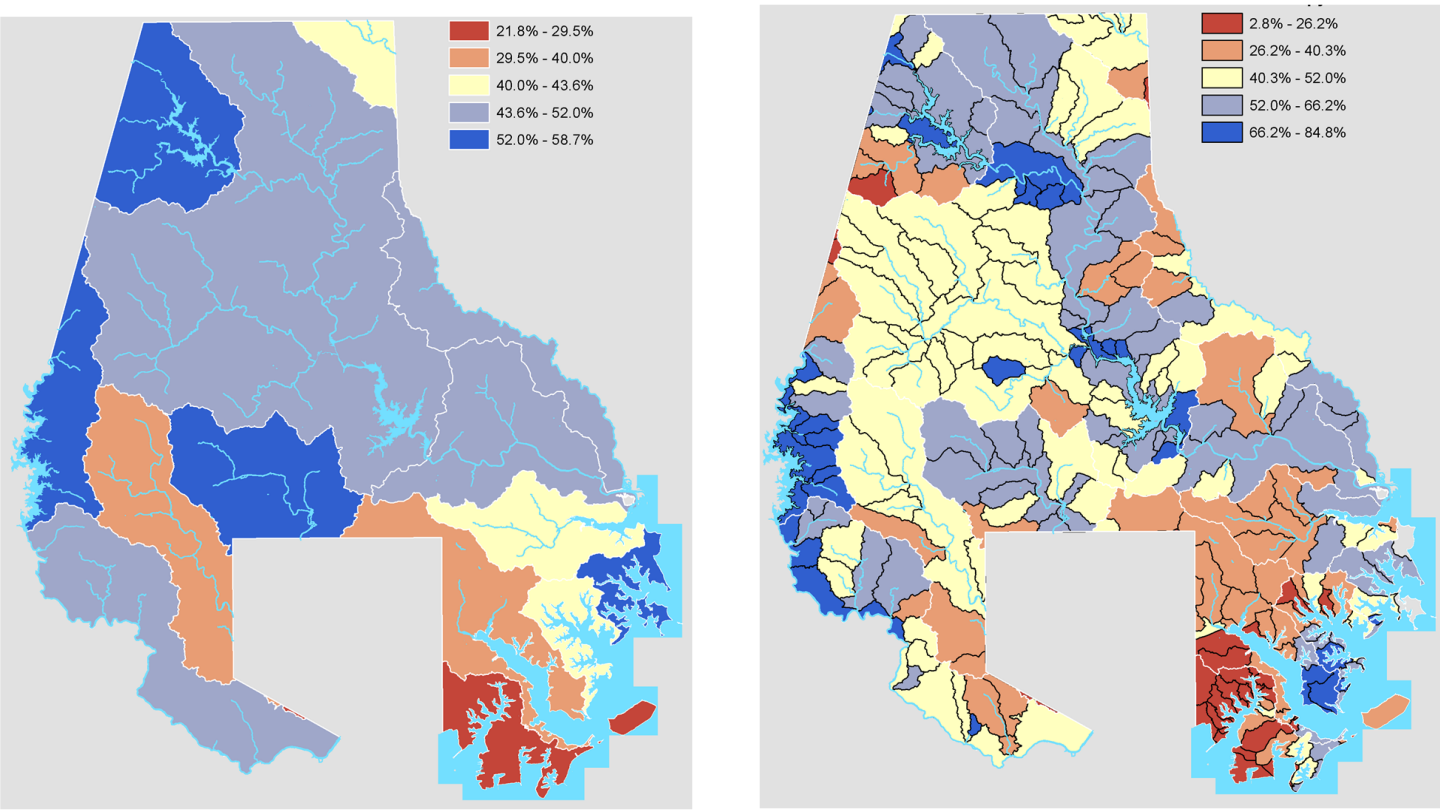

Figure 5a,b: Percent tree canopy summarized by USGS HUC 8 watersheds (left) and DEPRM subwatersheds (right).

Tree Canopy Height

LiDAR data allows detailed tree canopy height measurements to be made with sub-foot accuracy (Figure 6).

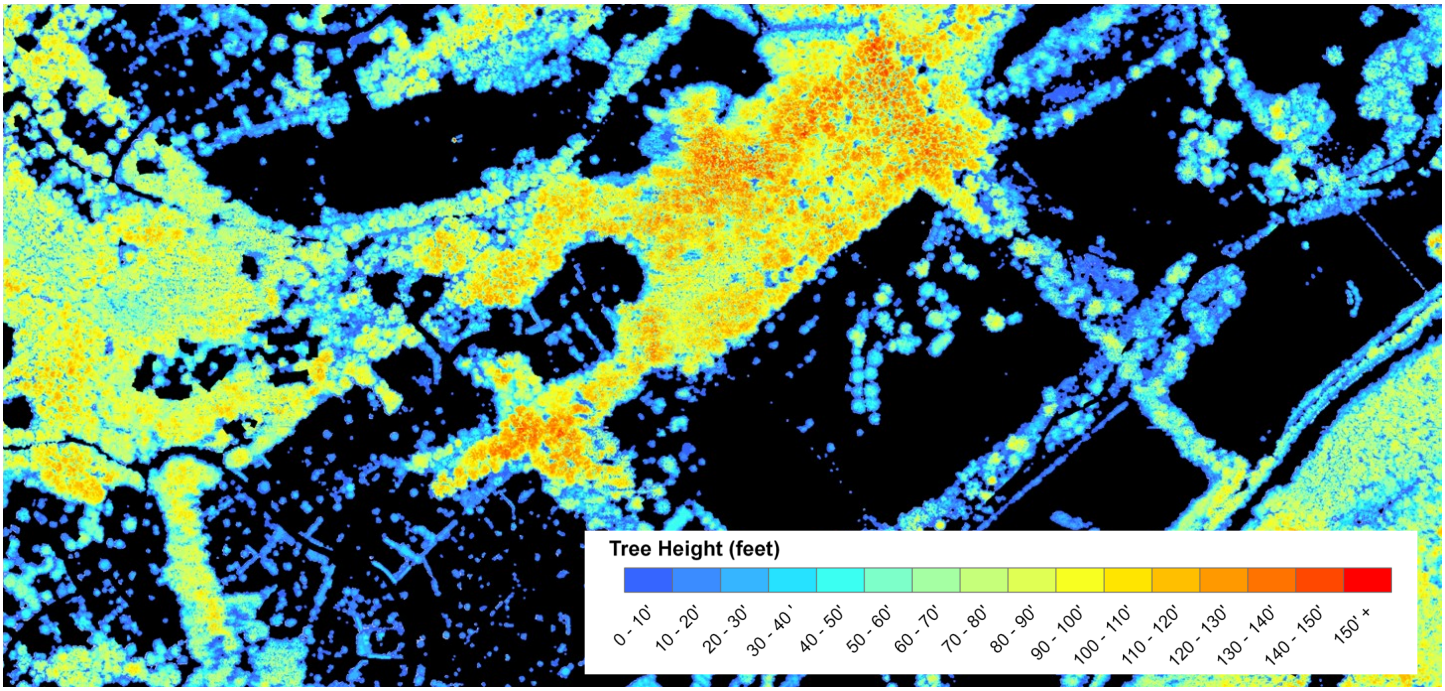

Figure 6: Tree canopy height measurement from LiDAR.

Preserving & Increasing Tree Canopy

Baltimore County now has access to the detailed information that will enable them to locate areas where tree canopy should be persevered or improved in both urban (Figure 7) and rural regions (Figure 8).

Figure 7a,b,c: Land cover (top), per-parcel percent tree canopy (middle), and tall trees identified based on LiDAR (bottom) in an urban area.

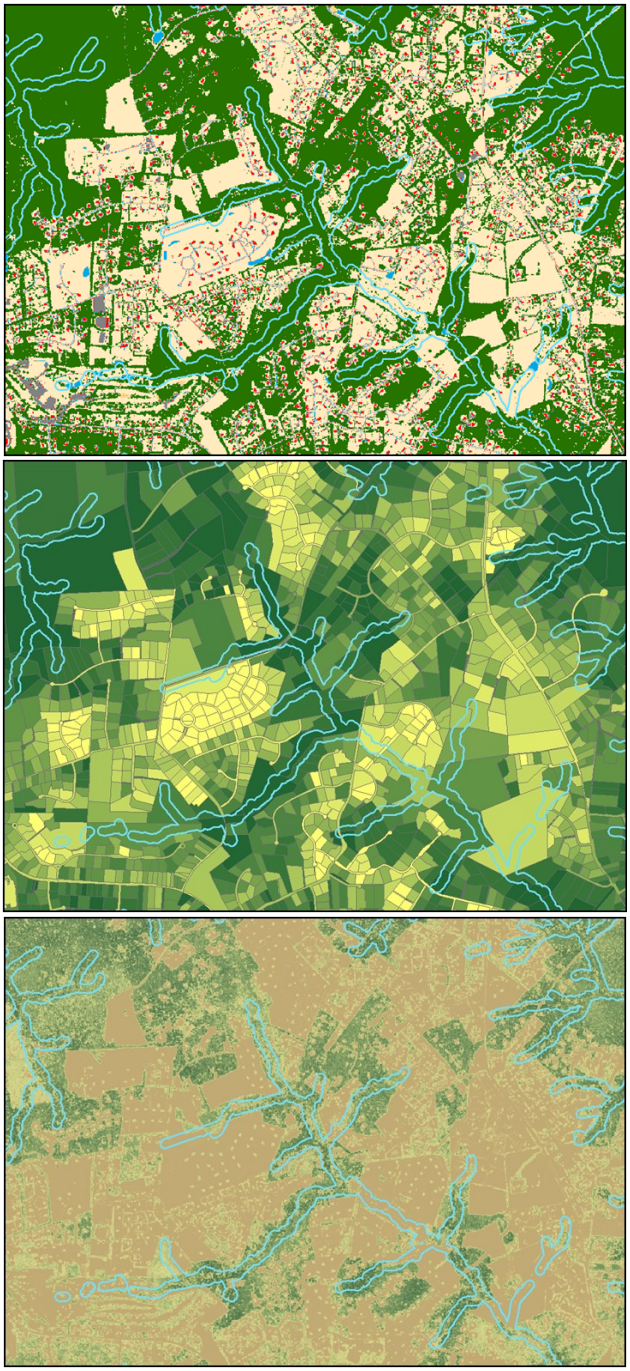

Figure 7a,b,c: Stream buffer overlaid on Land cover (top), per-parcel percent tree canopy (middle), and tall trees identified based on LiDAR (bottom) in a rural area.

Prepared by:

Jarlath O'Neil-Dunne
Geospatial Analyst
Spatial Analysis Laboratory
Rubenstein School of the Environment & Natural Resources
University of Vermont
joneildu@uvm.edu

This report contains some preliminary analyses that may be subject to change.