A Report on The Abingtons’ 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, 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 TC goal is crucial for those communities seeking to improve their green infrastructure. A TC assessment that estimates the amount of tree canopy currently present (Existing TC), along with the amount of tree canopy that could theoretically be established (Possible TC), is the first step in the TC goal-setting process.

How Much Tree Canopy Does The Abingtons Have?

An analysis of the Abingtons’ tree canopy based on land cover derived from high-resolution aerial imagery (Figure 1) found that more than 4,964 acres of is covered by tree canopy (termed Existing TC), representing 51% of all land area. An additional 40% (3,907 acres) of the Abingtons could theoretically be improved (Possible TC) to support tree canopy (Figure 2). In the Possible TC category, 5.7% (553 acres) of the city were Impervious Possible TC and another 34.4% were Vegetated Possible TC (3,354 acres). Vegetated Possible TC, or grass and shrubs, is more conducive to establishing new tree canopy, but establishing tree canopy on Impervious Possible TC will have a greater impact on water quality.

Project Background

The analysis of the Abingtons’ tree canopy was carried out with funding from the Pennsylvania Department of Conservation and Natural Resources. 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 Tree Canopy Assessment Protocols to the Abingtons. This analysis was conducted based on year 2008 data.

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 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.

Figure 1: Land cover derived from high-resolution aerial imagery for The Abingtons and the corresponding land cover metrics.

Figure 2: TC metrics for the Abingtons based on % of land area covered by each TC type.
Mapping The Abingtons’ Trees

Prior to this study, the only available estimates of tree canopy for the Abingtons 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). Such data is not well-suited for examining tree canopy at the local level. Using high-resolution (1 foot) aerial imagery and LiDAR, in combination with advanced automated processing techniques, land cover for the city was mapped with such detail that single trees were detected (Figure 3c). In addition this land cover dataset includes the most comprehensive inventory of impervious surfaces for the area.

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

Figure 4: 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.
Parcel-based TC metrics were integrated into the Abingtons’ existing GIS database. Decision makers can use GIS to identify specific TC 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 to set TC improvement goals for an individual property.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
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<tbody>
<tr>
<td>Land Use</td>
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<tr>
<td>Owner</td>
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<td>Address</td>
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<tr>
<td>Existing TC</td>
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<tr>
<td>Possible TC</td>
<td>75%</td>
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<tr>
<td>Possible TC—Vegetation</td>
<td>58%</td>
</tr>
<tr>
<td>Possible TC—Impervious</td>
<td>17%</td>
</tr>
</tbody>
</table>

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

Table 1: TC metrics summarized by land-use category. For each category, TC metrics were computed as a percentage of all land in the Abingtons (% Land), as a percentage of land area by land-use category (% Category), and as a percentage of the area for the TC type (% TC Type). Note that land-use classes with less than 1% of the county’s land area are not shown.

Figure 5: TC metrics summarized by dwelling type (land use).
There are four municipalities within the Abingtons’ boundary covering a total area of 9,897 acres. Figure 6 summarizes two TC categories—Existing TC % (left) and Possible TC % (right) for the municipalities. South Abington has the highest acreage of tree canopy, but Abington has a higher percentage of its land area covered by tree canopy. Interestingly it is the two most urbanized municipalities, Clark’s Summit and Clark’s Green, that have the highest Possible TC as a percentage of land area. Not surprisingly, the amount of Possible TC that is impervious is considerably higher in these two municipalities than both Abington and Sought Abington.

Figure 6. Existing TC (left) and Possible TC (right) as a percentage of land area within the Abingtons’ municipality boundaries.

Figure 7. TC metrics summarized by The Abingtons’ municipality boundaries.
To assess how “green” the streets in the Abingtons are roads were buffered by 25 feet. Within the road buffer tree canopy accounts for 25% (359 acres) of the land.

**Figure 8:** TC metrics summarized for 25-foot buffer of all roads in The Abingtons.

Tree canopy currently exists on 58% (195 acres) of the land area within a 35 foot buffer of all streams in the Abingtons (Figure 9). Riparian buffer initiatives could be targeted on the 36% of the riparian area that is covered by grass and shrubs.

**Figure 9:** TC metrics summarized for the 35-foot buffer of all streams in The Abingtons.

Tree canopy currently exists on 28% (286 acres) of the land area within the Abingtons’ right of ways (ROW) (Figure 10). Much of the land (roads) is not suitable for tree plantings but there is still room for increasing tree canopy by planting street trees.

**Figure 10:** TC metrics summarized for the ROW in the Abingtons.

Figure 11. Aerial image overlay showing the hydrology (blue), right of way (black outline), and roads (salmon) layers.

Legend
- Hydrology 35ft buffer
- Roads 25ft buffer
- ROW
In addition to simple descriptive statistics, more sophisticated techniques can help identify areas of the Abingtons where tree-planting and stewardship programs would be most effective. One approach would be to focus on spatial clusters of Existing and Possible TC. For example, when a 250-foot grid network is superimposed on the Abingtons’ land-cover map (Figure 12a), it is possible to map regions of the municipalities where high values of Existing TC are tightly clustered (Figure 12b). A similar map can be constructed for Possible TC (Figure 12c). It is even more informative, however, to create a single index by subtracting the percentage of Existing TC per grid cell from Possible TC, which produces a range of values from $-1$ to $1$. When clustered, this tree canopy opportunity (TCO) index highlights areas with high Possible TC and low Existing TC (Figure 12d); these areas theoretically contain the best opportunities for expanding the municipalities’ tree canopy and increasing its many attendant benefits.

Figure 12: (a) Grid network (250-foot cells) superimposed on land-cover map for the Abingtons and then used in spatial cluster analyses; (b) Spatial clustering of Existing TC in the Abingtons; dark green areas are highly clustered and have high Existing TC values; (c) Spatial clustering of Possible TC in the Abingtons; dark red areas are highly clustered and have high Possible TC values; and (d) Spatial clustering of a combined index of Existing and Possible TC; red areas theoretically provide the best opportunities for expanding tree canopy.
Conclusions

- Tree canopy in the Abingtons is a vital asset for the four municipalities. It reduces stormwater runoff, improves air quality, reduces the carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as habitat for wildlife.
- The municipalities should consider establishing a TC goal. Such a goal should not be limited to increasing the overall tree canopy; they should also focus on increasing tree canopy in those parcels or blocks that have the least Existing TC and highest Possible TC.
- Given the different land cover composition of each one of the four municipalities it is likely that site specific approaches will be required for maintaining and increasing tree canopy.
- With Existing TC and Possible TC summarized at the parcel level and integrated with the Abingtons’ GIS database, individual parcels and subdivisions can be examined and targeted for TC improvement.
- Of particular focus for TC improvement should be parcels within the Abingtons 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.
- Tree canopy can be used to improve water quality by focusing on establishing riparian buffers in the less developed sections, such as agricultural parcels. In the urbanized areas an even distribution of tree canopy will have a greater impact.
- There exists room for additional tree plantings within the rights-of-way. Such an initiative would help reduce stormwater runoff, reduce noise, and improve property values.
- By ownership type, it is the residents of the Abingtons who 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 the Abingtons are going to sustain its tree canopy in the long term.

Figure 13: Comparison of Existing TC with other selected cities that have completed TC assessments.