

The Green Legacy Project

Mapping and Evaluating the Benefits of West Chester University's Campus Trees

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Urban trees, including those found on many college campuses, contribute to sequestering and storing carbon, mitigating urban heat island effects, ameliorating air pollution, reducing stormwater runoff, improving water quality, providing habitat for native species, and enhancing aesthetics. In order to better understand and thus maximize the benefits provided by our campus trees, a collaborative group of faculty, staff, and students at West Chester University initiated the Green Legacy Project.

History of the Green Legacy Project

Our campus trees are praised for their historical value and beauty. However, data were lacking on the value and condition of this "treasure of trees." A faculty, staff and student partnership developed with the purpose of creating a GIS (geographic information systems) management database to document and illustrate the value of our trees for pollution reduction, carbon sequestration and storage, storm water management, and heating and cooling cost reduction. The primary research objective of the Green Legacy Project was to evaluate the benefits and management issues of our campus forest. The resulting geodatabase provides a tool for long-term management of our tree resource and for authentic classroom learning.

Beginning in the summer of 2009, West Chester University students conducted a complete inventory and assessment of north campus tree resources, and developed a management GIS database. Students collected information on every single campus tree greater than 5 centimeters in diameter at breast height (DBH), which included:

- ✓ species
- ✓ diameter
- ✓ height (total, live stem, canopy base)
- ✓ crown (width, exposure, and percent missing)
- ✓ site (percent impervious, grass, shrub)
- ✓ condition (insect feeding, decay, exposed roots, wounds,
- ✓ dead branches, dieback)
- ✓ distance and direction to nearby buildings
- ✓ location (latitude, longitude coordinates)

The data was mapped in *ArcGIS 9.3* and entered into a tree benefits analysis program, *i-Tree*, a free software suite provided by the U.S. Forest Service (www.itreetools.org). Campus land cover (tree canopy, impervious surfaces, and mowed lawn) was also mapped and analyzed using recent aerial photographs and CITYgreen, an American Forests *ArcGIS 9.3* extension.

Findings

Our analysis found the benefits of campus trees exceeds \$250k annually with a total estimated value of \$3.2 million in reduction of stormwater runoff, storage of carbon, removal of air pollutants, and lowered building energy costs, in addition to the provision of habitat and enhanced aesthetics.

Benefit or Ecosystem Service	quantity	value
Air Pollutants	625kg	\$3,492
Carbon Storage	672 tons	\$15,250*
Carbon Sequestration	16.65 tons/year	
Energy avoided	7 Mwhts	\$700**
Asian Long-Horned Beetle threat	>35% of all campus trees	\$1.5 million damage

*Calculated at \$25 per pound
 **Calculated at 10 cents per kilowatt-hour

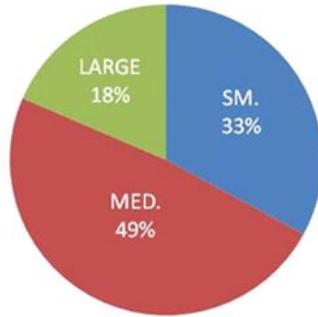
The diameter size class distribution is weighted heavily in the medium range which means that the campus forest trees were planted years ago, and not enough new trees have been added to the forest. Ideally there would be equal numbers of small, medium and large if maintenance of the campus forest was consistent.

With most trees in the good condition category, that represents a large population that is need of some maintenance. Ideally the majority of the trees would be in great condition, with a small percentage in the annual maintenance rotation which would include the 'good' or 'fair' condition categories.

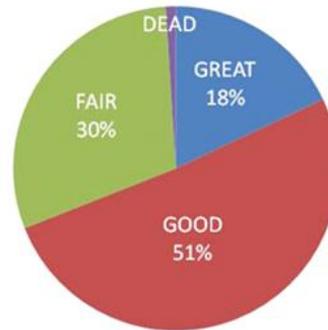
North Campus tree population

>1,900 Living Trees

**DIAMETER
SIZE-CLASS**



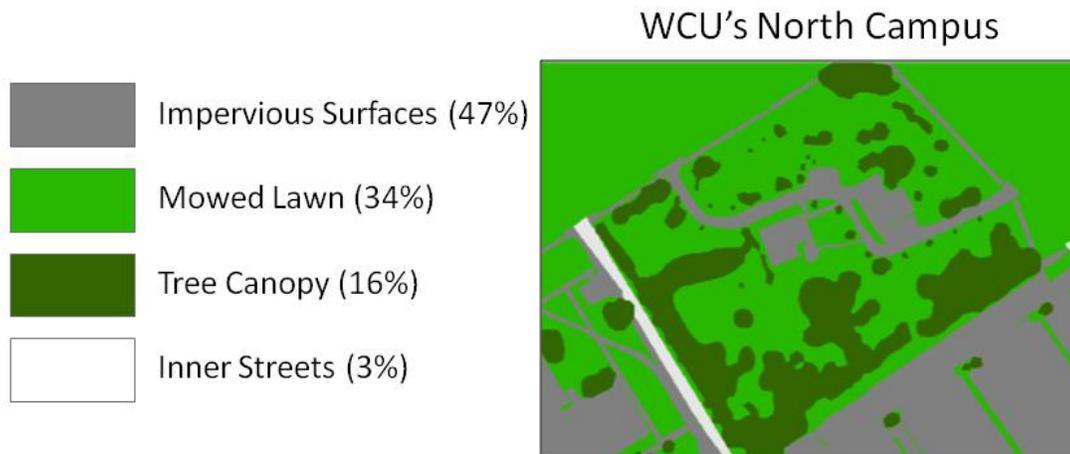
TREE HEALTH



The campus forest should include more native than introduced tree species and species diversity should be high. At this point, there are a number of tree species that are vulnerable to pest infestations and so a tree management plan that recognizes that importance of focusing on native species and increasing the diversity of the population would be essential for protecting and expanding the urban forest benefits.

Most Common Trees:	arborvitae, zelkova, hemlock, Norway spruce
-sm. diameter:	-arborvitae, maple, oak, hemlock
-med. diameter:	-arborvitae, spruce, pear, & zelkova
-lg. diameter :	-London planetree, maple, oak, honey locust
Rarest Native Trees:	Elm, cucumber magnolia, American beech, red spruce, boxelder, witchhazel, gray birch
Most Vulnerable Trees:	143 non-Norway maples, 24 ash, 21 American beech, 16 elms, 13 black cherry, 7 mulberries
Most Invasive Trees:	56 Norway maple
Biggest Trees	24 >=100 cm. diam., including: white & green ash, sycamore, silver maple, swamp white & willow oak, basswood, white mulberry, cottonwood

From previous studies, the average canopy cover of the Borough of West Chester is about 25%, and in the northeastern part of the United States, it is closer to 40% (Nowak et al. 2002). Canopy cover is around 16% on campus and so there is a significant need to increase that number. Given the benefits that trees provide, the long-term goal should be set for 40%.



Conclusions

Some key areas of concern that were identified in this study include significant vulnerability of the campus tree population non-native pests, (Asian long-horned beetle; Emerald ash borer; hemlock woolly adelgid), and the low ratio of tree canopy to impervious surface. We recommend increased efforts to protect and manage existing trees, and to both increase and diversify campus tree cover. While this study estimated benefits that can be calculated, numerous intangible benefits of our campus tree population should also be considered in any tree management plans, such as the aesthetic and psychological benefits of trees, provision of habitat especially for native species, and the ability to serve as refugia for stressed species in a changing climate.

Acknowledgements

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