i-Tree Overview

Assessing the value of urban trees
Today’s Session

- Introduction
- Urban Forests in Context
- What is i-Tree: An Overview
- i-Tree Components & Tools
- Choosing the Correct i-Tree Tool
- Demo of i-Tree Software
i-Tree Overview

Assessing the value of urban trees

www.unri.org/research-documents
Urban Forests & Tree Canopy
Urban Forests & Tree Canopy

Annapolis, MD
Urban Forests & Tree Canopy

Boston, MA
Urban Forests & Tree Canopy

Hartford, CT
Urban Forests & Tree Canopy

New York
Urban Forests & Tree Canopy

New York
Urban Forests & Tree Canopy

Long Island, NY
Urban Forests & Tree Canopy
Urban Forests & Tree Canopy
What is i-Tree?

A suite of software tools to assess urban vegetation and their ecosystem services and values

Initial Release Components
Public-Private Partnership

- USDA Forest Service
- Davey Tree Expert Co.
- National Arbor Day Foundation
- Society of Municipal Arborists
- International Society of Arboriculture
- Casey Trees
Goals

- Simple and low-cost tools and methods to aid in urban forest planning and management

- Complete process – start to finish
Assessing Tree Populations

i-Tree assesses:

- Structure
- Function
  - Energy use
  - Air pollution
  - Carbon
  - VOC emissions
- Value
- Management needs
  - Pest risk
  - Tree health
  - Exotic/invasive spp.
The Foundation: Local Data

Local Sample or Inventory

Local information:
- Weather
- Pollution
- Environmental variables

Hourly simulations
Benefit-Based Approach

i-Tree Tools

Comprehensive Value

Environmental Services

Structure

Strategic Management & Advocacy
Conserving Energy

Image courtesy of the Center for Urban Forest Research
Improving Air Quality

Image courtesy of the Center for Urban Forest Research
Reducing Atmospheric Carbon Dioxide

Image courtesy of the Center for Urban Forest Research
Reducing Stormwater Runoff

Image courtesy of the Center for Urban Forest Research
i-Tree is...

Development, Dissemination, Support, & Refinement

• Credible, USDA FS peer-reviewed tools

• Public Domain Software

• Accessible

• Technical Support

“Putting USFS Urban Forest science into the hands of users”
What’s being used?
i-Tree Use

Program distribution increasing about 25% per year

Distributed to over 90 countries
NFL favors proven strategies for a green Super Bowl

Tampa Bay Business Journal - by Alexis Muellner Editor

Real carbon impacts

To that end, for the first time at a Super Bowl, the U.S. Forest Service is implementing in Tampa a public domain software monitoring system called i-Tree that it developed in collaboration with Kent, Ohio-based Davey Tree Expert Co. The software, its proponents say, is expected to do a far more accurate job of monitoring the carbon impacts of tree-planting efforts than current systems offer.
Maybe Only God Can Make a Tree, but Only People Can Put a Price on It

- Climate change
- Storm water mgt.
- Pollution mitigation
- Energy conservation
- Carbon strategies
- Economic development
- Green job creation
- Public health issues
"Instead of spending money planting trees on a causeway, we should fix the bridge on the causeway,"...

--Senator Tom Coburn (R-OK)
Using technology to tell your story?
i-Tree: Demonstrating That Trees Pay Us Back!

Street Tree Benefits in Minneapolis:

- $6.8 million in energy savings
- $9.1 million in reduced storm water runoff
- $7.1 million increase in property value
- $1 million improvements to air quality
Park Lane trees get report cards, some question program

The City of Kirkland has given each tree along Park Lane a report card and some of them are not doing so well. The report cards state that the city is "working to restore, enhance..."
How do we communicate the value of community trees?

“Shame on you City of Kirkland! Government has too much money if we can afford to grade trees!”
Pittsburgh’s Urban Forest
City of Pittsburgh, Pennsylvania Municipal Forest Resource Analysis

April, 2008

$2.94 in benefits for every $1 spent

**Benefit Summary for Pittsburgh’s Street Trees**

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Total ($)</th>
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<tbody>
<tr>
<td>Energy</td>
<td>$1,205,133</td>
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<tr>
<td>CO2</td>
<td>$35,424</td>
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<tr>
<td>Air Quality</td>
<td>$252,935</td>
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<tr>
<td>Stormwater</td>
<td>$334,601</td>
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<tr>
<td>Aesthetic/Other</td>
<td>$572,882</td>
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<tr>
<td><strong>Total Benefits</strong></td>
<td><strong>$2,400,975</strong></td>
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</tbody>
</table>
Chestertown, MD: linking technology with policy

Chestertown Goes Green

- Energy: $31,280
- Carbon: $7,760
- Air quality: $8,287
- Stormwater: $83,413
- Property: $103,020

Total annual benefits: $223,750
Milwaukee i-Tree Eco Assessment

EAB Structural Impacts:

17.4% Canopy Loss
$221 Million structural damage
(citywide)

EAB Functional Impacts:

- $243,785 less pollutant removal
- $138,000 less energy savings (cooling costs)
- $2.6 million reduction in storm water benefits (1996 study)
Milwaukee Ecosystem Assessment

Milwaukee’s Trees
A $900,000 Cooling Benefit
Think about it...

Milwaukee’s Trees
Help Us Breathe Easier
Think about it...
GOAL: Reduce global warming pollution levels to 7 percent below 1990 levels by 2012.

U.S. Conference of Mayors, Climate Protection Agreement
### Table 13. Net Atmospheric CO₂ Reduction by Chattanooga’s Street Trees—City-Managed Population Only

<table>
<thead>
<tr>
<th>Species</th>
<th>Sequestered (lb)</th>
<th>Soquested ($</th>
<th>Net Total (lb)</th>
<th>Total ($)</th>
<th>SE</th>
<th>% of Total Tree Numbers</th>
<th>% of Total $</th>
<th>Avg. $/tree</th>
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<tbody>
<tr>
<td>hackberry</td>
<td>3219030</td>
<td>41</td>
<td>4041645</td>
<td>30,312.34</td>
<td>(±5,126)</td>
<td>10.8%</td>
<td>12.1%</td>
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<td>798960</td>
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<td>(±1,285)</td>
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<td>black cherry</td>
<td>1132151</td>
<td>8</td>
<td>1398996</td>
<td>10,492.47</td>
<td>(±2,031)</td>
<td>4.5%</td>
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<td>mimosa</td>
<td>2562225</td>
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<td>322339</td>
<td>2,417.54</td>
<td>(±592)</td>
<td>3.9%</td>
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<td>311476</td>
<td>2,336.07</td>
<td>(±712)</td>
<td>3.6%</td>
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<td>Yoshino flowering</td>
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<td>chestnut oak</td>
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<td>Chinese elm</td>
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<td>southern red oak</td>
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<td>black tupelo</td>
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<td>Other street trees</td>
<td>6645139</td>
<td>49</td>
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<tr>
<td>Citywide Total</td>
<td>27020224</td>
<td>$207,151.70</td>
<td>$1110142</td>
<td>$180999</td>
<td>$8,404.06</td>
<td>$52,273.95</td>
<td>$334,1542</td>
<td>$250,961.59</td>
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</tbody>
</table>

- Average CO₂ reduction = 200 lbs
- Average tree maintenance costs = $3.46
- Cost of CO₂ reduction = $35 per ton
- 25% of Carbon emissions offset by municipal trees
Springfield Massachusetts
June 1, 2011 Tornado
Springfield Massachusetts
June 1, 2011 Tornado
Tornado Damage Quick Facts
Impacts on Springfield’s Street Trees

On June 1, 2011, a series of three tornadoes ripped through Western Massachusetts, including the second strongest tornado ever recorded in Massachusetts, with wind speeds estimated at 136 to 165 mph, according to the National Weather Service. The most severe tornado was the EF-4, on the Enhanced Fujita Damage Classification Scale, that carved a half-mile-wide path for 10 miles from Westfield to Charlton, killing three people and injuring 750. In Springfield, the tornado impacted city’s South End, the Corners, East Forest Park and sixteen acres neighborhoods.

In the neighborhoods of Springfield affected by the storms, damage to the street trees was extensive, destroying or severely damaging many of the public trees growing in these areas. A team of US Forest Service and City of Springfield personnel conducted a preliminary review of the streets in these neighborhoods, and an initial summary of the storm impacts was developed.

A preliminary review of the storm damage to Springfield public street trees follows here:

- 87 miles of the 246 total miles of city streets were impacted by the storm;
- 16.1% of Springfield’s streets showed some damage to the public trees growing on them;
- Approximately 1,440 of the 8,810 streets trees, growing in the impacted areas, were destroyed or severely damaged, necessitating removal;
- Immediate impacts include the reduction of rainwater interception by 2,444,412 gallons;
- Reduced storage of 7,220,861 pounds of carbon;
- Approximately 53,312 pounds of sequestered CO₂ has been lost.

For more information please contact:

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Alexander R. Sherman
City of Springfield
Assistant City Forester
arsherman@eco.mass.edu
# Annual Loss in Benefits of Springfield’s Street Trees

## Annual Benefits of Impact Zone Street Trees

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Quantity</th>
<th>Impact Zone Value</th>
<th>Loss Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Saved</td>
<td></td>
<td></td>
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<tr>
<td>Electricity (MWh)</td>
<td>360.6</td>
<td>$18,393</td>
<td>$4,598</td>
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<tr>
<td>Natural Gas (therms)</td>
<td>129,018.6</td>
<td>$85,439</td>
<td>$29,903</td>
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<tr>
<td>Total (S)</td>
<td></td>
<td>$103,832</td>
<td>$34,501</td>
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<tr>
<td>Carbon Dioxide</td>
<td></td>
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<tr>
<td>CO₂ Sequestered (lbs)</td>
<td>946,377</td>
<td>$3,123</td>
<td>$1,093</td>
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<tr>
<td>CO₂ Released (lbs)</td>
<td>-244,714</td>
<td>-$808</td>
<td>-$283</td>
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<tr>
<td>CO₂ Avoided (lbs)</td>
<td>1,086,259</td>
<td>$3,585</td>
<td>$1,255</td>
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<tr>
<td>Total (lbs, $)</td>
<td>1,787,922</td>
<td>$5,900</td>
<td>$2,065</td>
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<tr>
<td>Air Quality</td>
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<tr>
<td>Avoided pollutants* (lbs)</td>
<td>4954</td>
<td>$21,451</td>
<td>$7,508</td>
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<td>Deposited pollutants** (lbs)</td>
<td>4264</td>
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<td>BVOC emitted (lbs, $)</td>
<td>-1,140</td>
<td>-$2,634</td>
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<td>Total (lbs, $)</td>
<td>8,078</td>
<td>$41,775</td>
<td>$14,621</td>
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<td>Storm Water</td>
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<tr>
<td>Rainfall intercepted (gal)</td>
<td>6,983,576</td>
<td>$55,872</td>
<td>$19,555</td>
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<td>Aesthetic/Other</td>
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<tr>
<td>Added Property Value</td>
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<td>$140,569</td>
<td>$49,199</td>
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<td><strong>TOTAL VALUE</strong></td>
<td></td>
<td>$347,948</td>
<td>$121,782</td>
</tr>
</tbody>
</table>

*NO₂, SO₂, VOC, PM10  **O₃, NO₂, PM10, SO₂
Tornado Damage Quick Facts
Impacts on Springfield's Urban Forest

On June 1, 2011, a series of three tornadoes ripped through Western Massachusetts, and included the second strongest tornado ever recorded in Massachusetts, with wind speeds estimated at 138 to 155 mph, according to the National Weather Service. The most severe tornado was the EF-3, on the Enhanced Fujita Damage Classification Scale, that carved a half-mile-wide path for 30 miles from Westfield to Charlton, killing three people and injuring 200. In Springfield, the tornadoes impacted city’s South End, Six Comers, East Forest Park and Sixteen Acres neighborhoods.

In the neighborhoods of Springfield affected by the storms, damage to the urban forest canopy was extensive, destroying or severely damaging many of the trees growing in these areas. A team of US Forest Service and City of Springfield personnel conducted a preliminary review of the streets in the impacted neighborhoods, and utilized i-Tree modeling software to analyze the impacts of the storms on the urban forest, and an initial summary of the damage was developed.

A preliminary review of the storm damage to Springfield’s urban tree canopy follows here:

- Based on initial estimates, over 13,000 trees were destroyed or severely damaged;
- Immediate impacts include the reduction of rainwater interception by over 7.5 million gallons per year;
- Reduced storage of over 30 million pounds of carbon annually;
- Approximately 1.4 million pounds of sequestered CO₂ has been lost.

For more information please contact:

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Assistant City Forester

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asherman@co.springfieldma.gov
i-Tree Canopy Analysis of Springfield Tornado Zone

- Over 13,000 trees were destroyed or severely damaged;
- Immediate impacts include the reduction of rainwater interception by over 7.5 million gallons per year;
- Reduced storage of over 30 million pounds of carbon annually;
- Approximately 1.4 million pounds of sequestered CO2 has been lost.
i-Tree Version 2014

5 New or Enhanced Tools
This 21 inch Northern pin oak provides overall benefits of $160 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

If this tree is cared for and grows to 26 inches, it will provide $195 in annual benefits.
Vue – Estimates Ecosystem Services from National Cover Maps and Google Maps
Remote Sensing Canopy Assessment Tools

- **Satellite Based**
  - i-Tree Vue

- **Statistical Estimation via photo-interpretation**
  - i-Tree Canopy

- Hyperspectral classification, GIS analysis, and photo-interpretation
  - UTC
i-Tree Canopy

Get started in three easy steps!

One
Browse to your project area boundary GIS file. The file must be in ESRI Shapefile format and in lat/long coordinates.
- Load ESRI Shapefile
- Or
- Load Sample Project

Two
Configure the cover classes for your survey.
- Configure Survey

Three
Begin i-Tree Canopy Survey

Been here before?
Already started an i-Tree Canopy survey? Load it here and resume your work.
- Load Previous i-Tree Canopy Survey

More Information!
- Technical Notes

With i-Tree Canopy, you can load a polygon boundary in ESRI Shapefile format on the map above and conduct a cover assessment for a project area.
- Collect data on your own cover classes of interest.
- 500-1000 survey points are suggested, the more points you complete, the better your...
Classify random points
Remember, the more points you survey, the lower your Standard Error, and the more precise your sampling will be. More points surveyed provide for a better estimation of Land Cover across your study area.

Save Your Data

Save Data

Save Early. Save Often. Don't lose your project data!
About i-Tree Canopy

The source and prototype of this program were developed by David J. Novak, Jeffery T. Watson, and Eric J. Greenfield (USDA Forest Service). The current version of this program was developed and adapted to i-Tree by David Ellingsworth, Mike Binkley, and Scott Maco (Davey Tree Expert Company).

Limitations of i-Tree Canopy

The accuracy of the analysis depends on the ability of the user to properly classify each point into one of several classes. If the number of points for a cover type is too low, the precision of the estimate will increase as the classification of the remaining points becomes more certain.
Pest detection Protocol

- Component of Streets in i-Tree v.4.0
- Collect Pest & Disease
  - Signs
  - Symptoms
- Reports
  - Associated pest & diseases
  - Trends/patterns
**i-Tree-Hydro**

- Separate GIS program
- Calibrates against stream flow data
Rock Creek Watershed Area (m²) 161,653,500
Percent Impervious cover 15.8
Percent Tree Cover 27
Percent of Tree Cover over Impervious Area 10
Percent Water Cover 0.3
Average Tree Leaf Area Index (LAI) 3.5
Percent Shrub Cover 7.8
Percent Grass Cover 33.8
Percent Evergreen Trees 4.2
Percent Evergreen Shrubs 21
Shrub LAI 3.9
Leaf on Day 80
Leaf off Day 294
Hydro Reporting

Current vs. Management Scenario

- Current Total Flow (m³/hr)
- Management Total Flow (m³/hr)
- Current Base Flow (m³/hr)
- Management Base Flow (m³/hr)
- Current Overland Flow (m³/hr)
- Management Overland Flow (m³/hr)
- Current Impervious Flow (m³/hr)
- Management Impervious Flow (m³/hr)
- Rainfall (mm/hr)
i-Tree 5.0 Tools for Urban Forest Assessment