Urban Tree Canopy Expansion and Urban Forest Planting BMPs

Chesapeake Water Environment Association
December 14, 2016

Neely L. Law, PhD
Center for Watershed Protection

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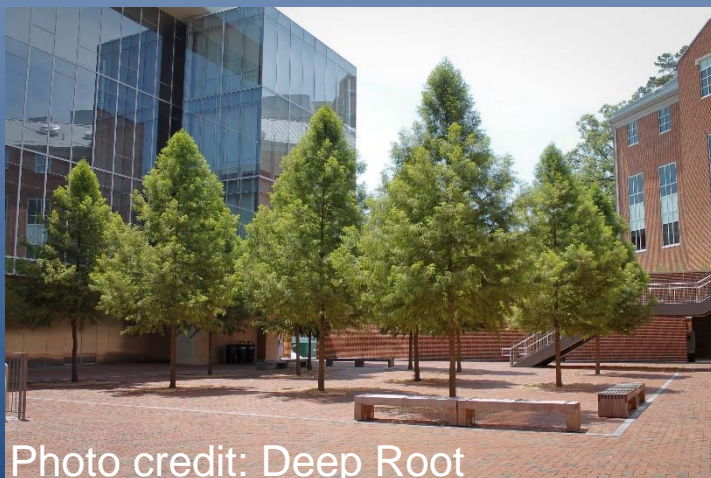# Urban Trees – We find them in many different places

Photo credit: Deep Root

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Outline

A. Panel membership & process
B. Key Definitions & Performance Measures
C. State of the science
D. Credit Overview
   – Method
   – Verification
   – Accountability
E. Future Management & Research Needs
F. Fact Sheet

Urban Tree Canopy Expert Panel

- The Chesapeake Bay Program Forestry Work Group convened an Expert Panel

- March 2015 – June 2016

- Determine pollution reduction estimates for expanded urban tree canopy BMP

- Approved September 2016

→ Phase 6 Chesapeake Bay Watershed Model to be released in 2017

Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion

Karen Cappiella, Sally Claggett, Keith Cline, Susan Day, Michael Galvin, Peter MacDonagh, Jessica Sanders, Thomas Whitlow, Qingfu Xiao

Accepted conditionally by Forestry Work Group, June 23, 2016
Approved by Watershed Technical Work Group, September 1, 2016
Final Approval by Water Quality Goal Implementation Team, September 12, 2016

Prepared by
Neely L. Law, PhD, Center for Watershed Protection, Expert Panel Chair
Jeremy Hanson, Virginia Tech, Expert Panel Coordinator

Photo credits:
http://www.saveitlancaster.com/resources/all-about-trees/street-trees/
http://www.saveitlancaster.com/resources/all-about-trees/street-trees/
https://www.google.com/earth/

Slide 4

HJ2   I replaced with new screenshot of report cover

Hanson, Jeremy, 11/9/2016

Rationale for New Credit

- **Improve definition and supporting documentation for credit**

- **"Every tree counts" perspective**
  - Enable to report and track all trees planted

- **New CBWM Phase 6 land uses**
  - Tree Canopy over Turfgrass
  - Tree Canopy over Impervious

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A. Panel Membership

Name	Affiliation
Panel Members	
Karen Cappiella	Center for Watershed Protection
Sally Claggett	US Forest Service, CBPO
Keith Cline	Fairfax County (VA)
Susan Day*	Virginia Tech
Michael Galvin	SavATree
Peter MacDonagh	Kestrel Design Group
Jessica Sanders	Casey Trees
Thomas Whitlow	Cornell University
Qingfu Xiao	University of California–Davis
Panel Support	
Neely Law (Chair)	Center for Watershed Protection
Jeremy Hanson (Coordinator)	Virginia Tech, CBPO
Brian Benham	Virginia Tech (Project Director)
Marcia Fox	DE DNREC (WTWG rep)
Ken Hendrickson	EPA Region 3 (Regulatory Support)
David Wood	CRC, CBPO (CBP modeling team rep)

During the Panel Process…

- New land use loading rates for Phase 6 model were approved March 14, 2016
- New Phase 6 land uses relevant to the Expert Panel include:
  - *Tree Canopy Over Impervious*
  - *Tree Canopy Over Turfgrass*

An important distinction
- Land uses represent "existing tree canopy"
- The BMP(s) is "new tree canopy"

Key Definitions

- **Two new BMPs**
  - Urban Tree Canopy Expansion
  - Urban Forest Planting
- **The Phase 5.3.2 Urban Tree Planting BMP *will not* be available for Phase 6**

Urban Tree Canopy Expansion BMP

- Tree plantings on developed land (impervious or turfgrass) that result in an increase in tree canopy but are not intended to result in forest-like conditions.
  - Not part of a riparian forest buffer, structural BMP
  - Does not conform to the definition of the Urban Forest Planting BMP.

- Credit is based on the number of individual trees planted

- Does not require trees to be planted in a contiguous area.

Urban Forest Planting BMP

- Tree planting projects in urban or suburban areas.
- Intent of establishing forest or similar ecosystem processes and function.
  - Not part of a riparian buffer planting, structural BMP (bioretention, tree planter)
  - Does not conform to Urban Tree Canopy Expansion BMP.

- Trees are planted in a contiguous area.

- This requires that urban forest plantings be documented in a planting and maintenance plan that meets State or DC planting density and associated standards for establishing forest conditions, including no fertilization and minimal mowing as needed to aid tree and understory establishment.

# Literature Review & Synthesis

Key Findings

*See Section 4 & Appendix C of Report
Also recent article in *Stormwater Magazine*
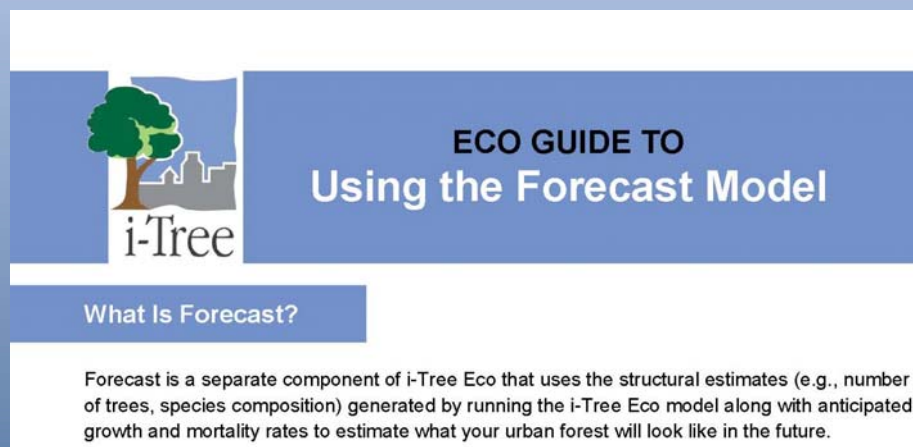
Literature Review & Synthesis

1. What is the effectiveness of urban tree canopy on reducing runoff, nutrient and sediment loads?

2. How does the effectiveness vary by species, over time, with differences in planting sites and with different maintenance strategies?

# Urban Tree Impacts on Hydrology and Water Quality
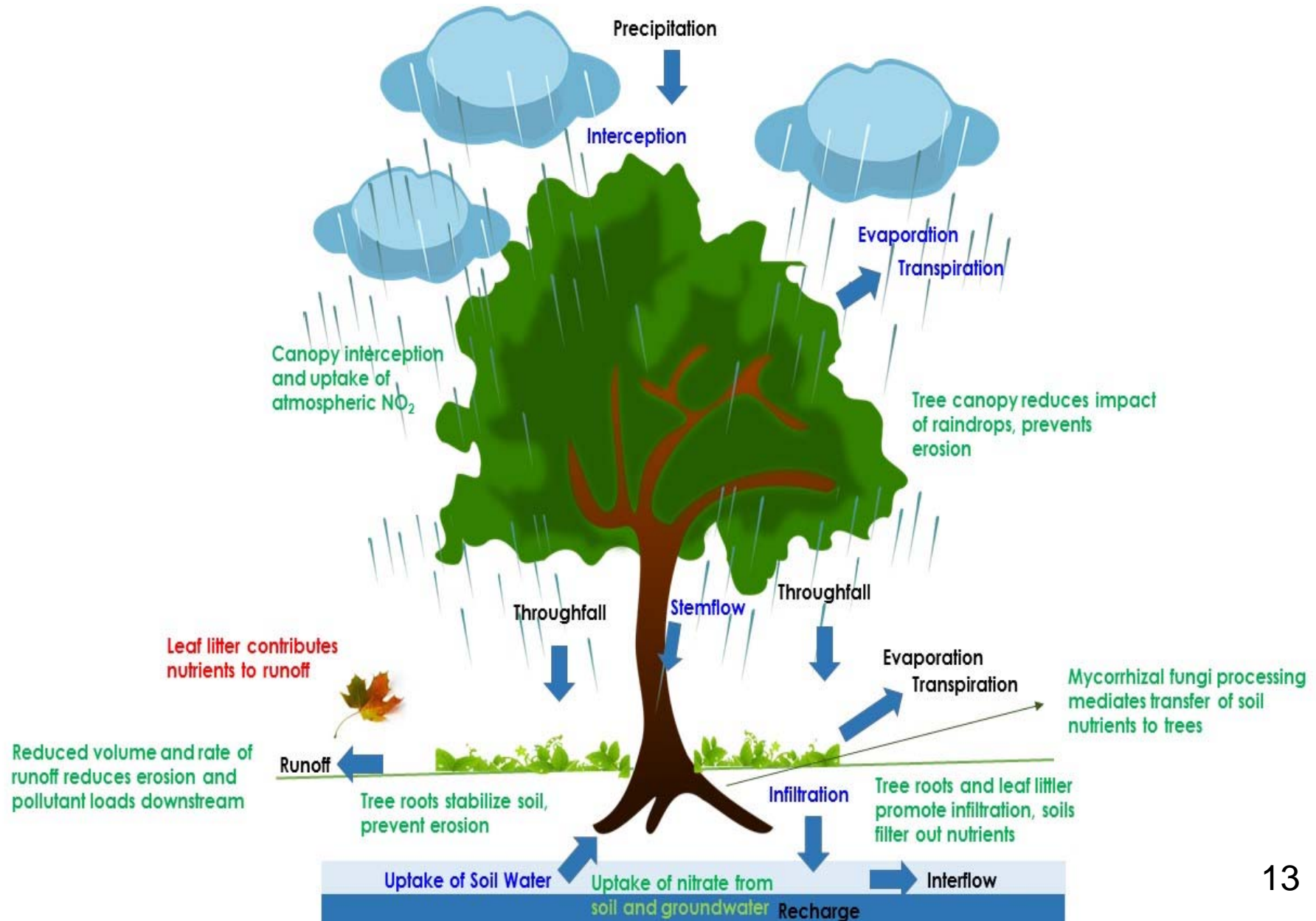
Modeling approach used by Expert Panel

- Derive area of tree canopy for trees planted
- Use of i-Tree Forecast to estimate average annual canopy area and growth

ECO GUIDE TO
Using the Forecast Model

i-Tree

What Is Forecast?

Forecast is a separate component of i-Tree Eco that uses the structural estimates (e.g., number of trees, species composition) generated by running the i-Tree Eco model along with anticipated growth and mortality rates to estimate what your urban forest will look like in the future.
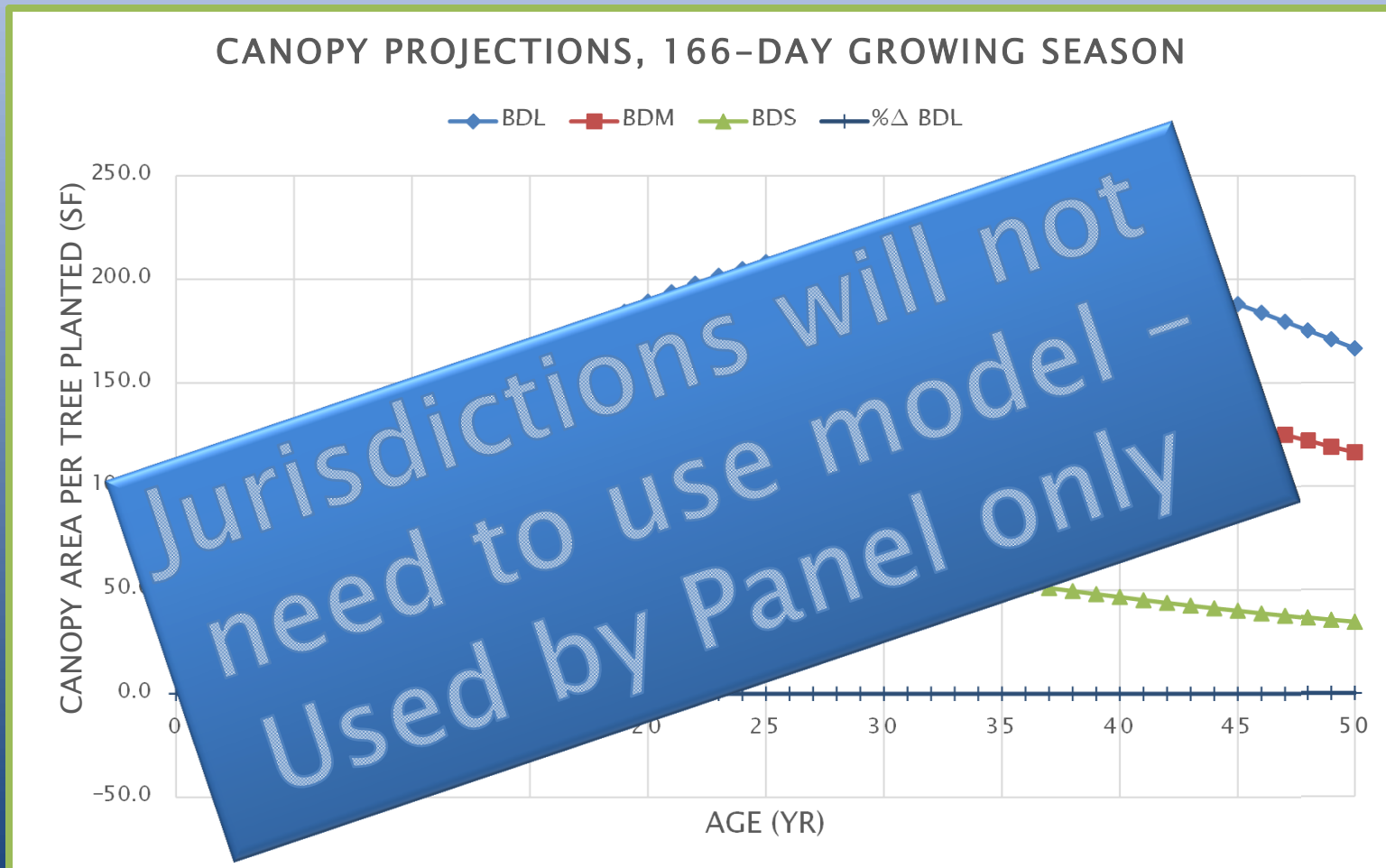
- Canopy cover predicted based on tree species (growth rate, height at maturity), DBH, light exposure and dieback
- Annual mortality rate, varies based on tree growth (DBH)

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Example Output from i-Tree Forecast for Broadleaf Tree Species

CANOPY PROJECTIONS, 166-DAY GROWING SEASON

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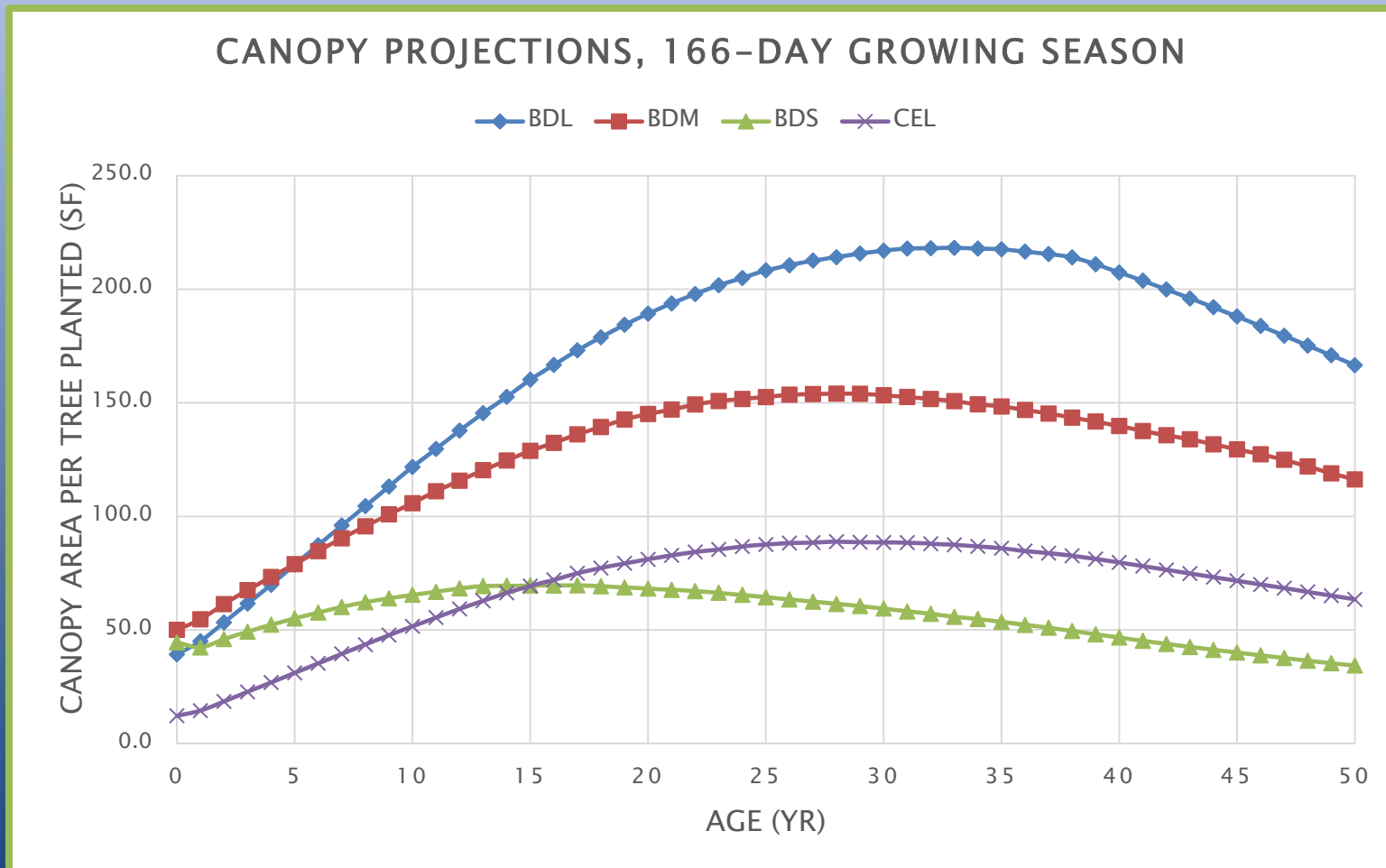
Example Output from i-Tree Forecast for Broadleaf Tree Species

What's the credit?

- Urban Forest Planting BMP
- Urban Tree Canopy Expansion BMP

http://www.liketotally80s.com/2009/09/80s-commercials-wendys/

BMP Performance Measures

Urban Tree Canopy Expansion

- Land use change
    - Impervious or Turfgrass to "Tree Canopy Over Impervious" or "Tree Canopy over Turfgrass"
- Relative (%) reduction to underlying land use
- Stackable; other BMPs may be applied to same acres treated
- Cumulative credit

BMP Performance Measures

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Urban Forest Planting

- Land Use Change
  - Turfgrass to Forest

- Credit is difference in land use loading rate
- No other BMPs may be applied

- Cumulative

Let's Calculate Credits But First A Caveat…

- For illustrative purposes only, example applies Phase 5.3.2 land use loading rates as a placeholder of Phase 6 land use loading rates for "turfgrass" and "impervious cover"

- Modeling tools such as CAST will calculate the actual reductions; this is a simplified example of how the calculation works

URBAN FOREST PLANTING BMP EXAMPLE

Urban Forest Planting BMP Example

- A jurisdiction reports 1,000 trees planted in 2017 at an under-utilized open space at a nearby park.

- Jurisdiction consulted State Forest Agency and determined that eligibility for the Urban Forest Planting Credit in the State, a minimum planting area of ¼ acre is needed for each project with a planting density of 200 trees per acre using 1" caliper trees. A planting plan with a maintenance agreement to not mow or apply fertilizers was also needed

- Results in 5 acres for the 1,000 trees planted given the jurisdiction satisfied the eligibility requirements

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- *1,000 trees planted*
- *Assume planting density of 200 trees/acre*
- *5 acres of creditable area assuming a 1:1 acre land use conversion credit*

Land Use	TN (lb/ac)	TP (lb/ac)	TSS (lbs/ac)
Turfgrass	12.4	0.55	180
Forest	3.92	0.11	78
	TN (lbs)	TP (lbs)	TSS (lbs)
Turfgrass	62	2.75	900
Forest	19.6	0.55	390
Load Reduction	42.4	2.2	510

Existing land use loading →

Converted land use loading →

URBAN TREE CANOPY EXPANSION BMP EXAMPLE

1. Nitrogen, Phosphorus and Sediment Reduction

- Relative Reductions in Non-Point Source Pollution Loads by Urban Trees (land use loading rate)
- Work completed by J. Hynicka and M. Divers
- Water balance modeling approach

Table 8. Tree canopy relative land use loading rates based on the underlying land use land cover (Source: Hynicka and Driver 2016)

Land Use	Total Nitrogen Reduction (%)	Total Phosphorus Reduction (%)	Total Sediment Reduction (%)
Canopy over Turfgrass	23.8	23.8	5.8
Canopy over Impervious	8.5	11.0	7.0

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2. Area of tree canopy associated with trees planted

- **Area per tree planted**: 144 ft^2

This translates to ~300 trees per acre (THIS IS NOT A PLANTING DENSITY)

- **All tree species planted will receive the same credit.**

- **Credit Duration**: 10 years

Example –
Urban Tree Canopy Expansion BMP

A jurisdiction reports 1,000 trees planted in 2017, 800 trees are planted on turfgrass and 200 trees are planted adjacent to sidewalks or impervious right-of-ways. The effectiveness value applied to the BMP is based on the underlying land use.

- Credit is 144 ft^2 <u>per</u> tree planted or 300 trees per acre
- Apply N, P and S reduction credits (see Table below)

Table 8. Tree canopy relative land use loading rates based on the underlying land use land cover (Source: Hynicka and Divers 2016)			
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Canopy over Turfgrass	23.8	23.8	5.8
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Estimated Lbs reduced/yr = Tree Canopy Acreage from Number of Trees Planted (ac) x Tree Canopy Land Use Loading Rate (%) x Based Tree Canopy Land Use Loading Rate (lb/ac/yr)

Convert # of trees to area: 800 trees / 300 trees per acre = 2.67
200 trees / 300 trees per acre = 0.67

Numbers Of trees Planted	Dominant underlying Land Use Land Cover (Phase 6)	Equivalent tree canopy (acres)	TN (lbs/ac)	TP (lbs/ac)	TSS (ton/ac)
800	Turfgrass	2.67	7.87	0.35	27.84
200	Impervious	0.67	0.88	0.14	60.67

What should jurisdictions submit to the Bay Program to receive credit for Urban Tree Canopy Expansion BMP for the Phase 6 Model?

For urban tree plantings, jurisdictions should report the following information to NEIEN:

- **BMP Name**: Urban Tree Canopy Expansion
- **Measurement Name**: Number of Trees Planted
- **Geographic Unit**: Qualifying NEIEN geographies including: Latitude/Longitude; or County; or Hydrologic Unit Code (HUC12, HUC10, HUC8, HUC6, HUC4); or State
- **Date of Implementation**: Year the trees were planted
- **Land Uses***: Turfgrass, Roads, Buildings and Other

* Phase 6 land uses

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Qualifying Conditions
(Urban Tree Canopy Expansion)

- Report the number of trees planted.

- Jurisdictions may also report the dominant land cover on which the tree is planted (pervious or impervious). If this information is not provided, the CBP will make assumptions based on the current distribution of land uses in the Phase 6 model.

BMP Verification

- Verification is an important process to ensure BMPs implemented continue to function to receive credit

- The Forestry Workgroup's BMP verification guidance for these two tree planting BMPs will be updated by June 2017 and posted on the Chesapeake Tree Canopy Network website.

Image source: https://environment.arlingtonva.us/trees/plant-trees/recommended-trees/

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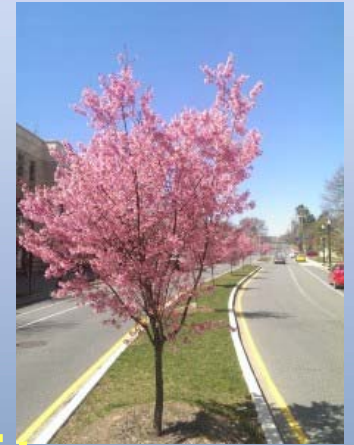
Future Research & Management Needs

RESEARCH

Recommendations address need to generate information about trees in urban areas, specifically: water quality, leaf litter and soils

MANAGEMENT

1) Jurisdictions review and adopt guidance for tree planting and post-planting care

2) Jurisdictions use tools to evaluate the net loss/gain of tree canopy beyond the Chesapeake Bay land use update.

3) Develop BMPs that address the conservation and maintenance of existing tree canopy.

FACT SHEET
To be released 2017

- PRACTICE AT A GLANCE

- PRACTICE DESCRIPTION

- WHERE TO FIND THE BEST OPPORTUNITIES IN YOUR COMMUNITY

- GENERAL COST INFORMATION

- TIPS FOR GETTING STARTED IN YOUR COMMUNITY

- WHAT DEGREE OF TECHNICAL SUPPORT IS NEEDED?

- COMPUTING THE POLLUTANT REMOVAL CREDIT

- EXAMPLES

- RESOURCES

Urban Tree Canopy Expansion and Urban Forestry Planting BMPs

PRACTICE AT A GLANCE

Tree planting is a critical activity for communities in the Chesapeake Bay watershed to undertake in the long-term to offset the loss of trees from development. While natural regeneration and conservation of existing forests will also contribute to increasing the tree canopy within developed areas of the watershed, there are two new tree planting BMPs for nutrient and sediment reductions available with the release of the Phase 6 Chesapeake Bay Watershed Model. The BMPs represent different types of tree planting projects that increase tree canopy found in developed areas – from single trees planted to contiguous planting areas. The two new BMPs provide opportunity for communities in the Bay watershed to count every tree planted. Only one type of credit may be applied for each tree planting project. Tree planting projects that are part of a riparian buffer, agricultural tree planting, or structural BMP do not apply to these BMPs, because they are tracked through other BMP credits.

PRACTICE DESCRIPTION

Two new BMPs are available for credit to Bay communities in the Phase 6 Chesapeake Bay Watershed Model for upland (non-riparian) tree plantings on developed land.

The **Urban Tree Canopy Expansion BMP** applies to tree plantings on developed land (impervious or turfgrass) that result in an increase in tree canopy but are not intended to result in forest-like conditions. This BMP does not require trees to be planted in a contiguous area. The credit is based on number of trees planted and an efficiency, or percent reduction relative to the underlying land use.

The **Urban Forest Planting BMP** applies to tree planting projects in urban or suburban areas with the intent of establishing forest ecosystem processes and function. Trees are planted in a contiguous area according to a planting and maintenance plan that meets State or District of Columbia definitions for planting density and associated standards for establishing forest conditions, including no fertilization and minimal mowing as needed to aid tree and understory establishment. The credit for this BMP is based on a land use conversion from developed turfgrass to forest.

WHERE TO FIND THE BEST OPPORTUNITIES IN YOUR COMMUNITY

Trees in developed areas may be found in a variety of locations. Transportation corridors, sidewalks, parking lots, private yards or landscaped areas, or public places are common locations where individual to small groups of trees may be planted. Tree planting activities in these areas would be examples where the Urban Tree Canopy Expansion BMP would be applicable as the trees are not intended to result in forest-like conditions, yet provide some water quality and other environmental benefits.

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QUESTIONS & COMMENTS

EXTRA SLIDES

Tree Canopy Land Uses (Phase 6)

- **Tree canopy land uses** describe tree canopy with a managed understory (developed)
- 2 subclasses

i) Tree Canopy Over Impervious   ii) Tree Canopy Over Turfgrass

How much "Tree Canopy Land Use" is there in the Bay?

- Tree Canopy Over Impervious
- Tree Canopy Over Turfgrass
- Excludes tree canopy as existing forests, buffers and non-developed land uses

Preliminary estimates of tree canopy land uses acreage in the
Phase 6 CBWM (Beta 1 vers.)

Land Use	Total (ac)	Tree Canopy Land use as % of Developed Land uses
Tree Canopy Over Impervious	154,000	3
Tree Canopy Over Turfgrass	742,628	14

Area of tree canopy associated with trees planted

- **Use of i-Tree Forecast to estimate average annual canopy area and growth**

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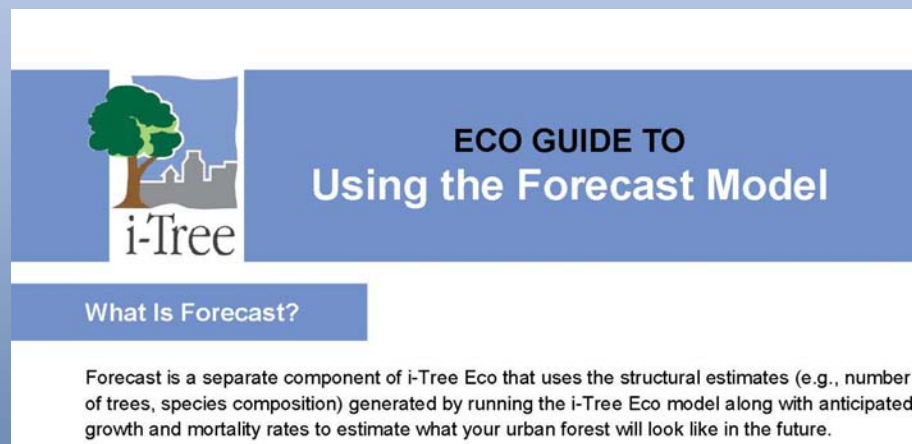
Creditable Area for Urban Tree Canopy Expansion BMP

- ## Model scenarios
    - 4 climate areas + 1 Bay-wide average
    - 1" DBH at planting
    - Tree in good condition at planting
    - 20 tree species
    - 2.5% and 5% mortality
    - Crown light exposure (park-like and open space type conditions)

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i–Tree Forecast

Base Mortality Rate by DBH Range for each size class
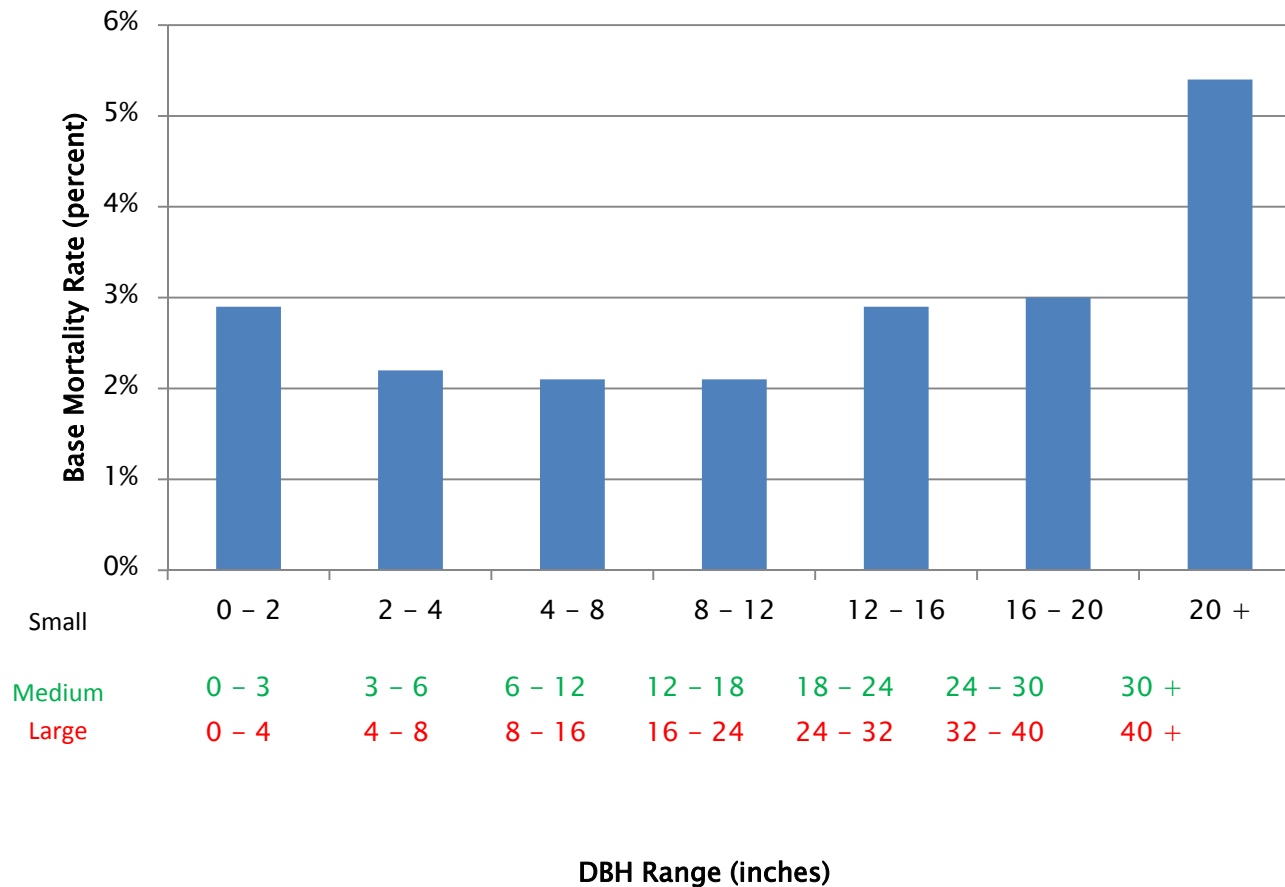
Source: Nowak et al 2013a, b

Example Output for Broadleaf Tree Species Modeled

CANOPY PROJECTIONS, 166–DAY GROWING SEASON

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