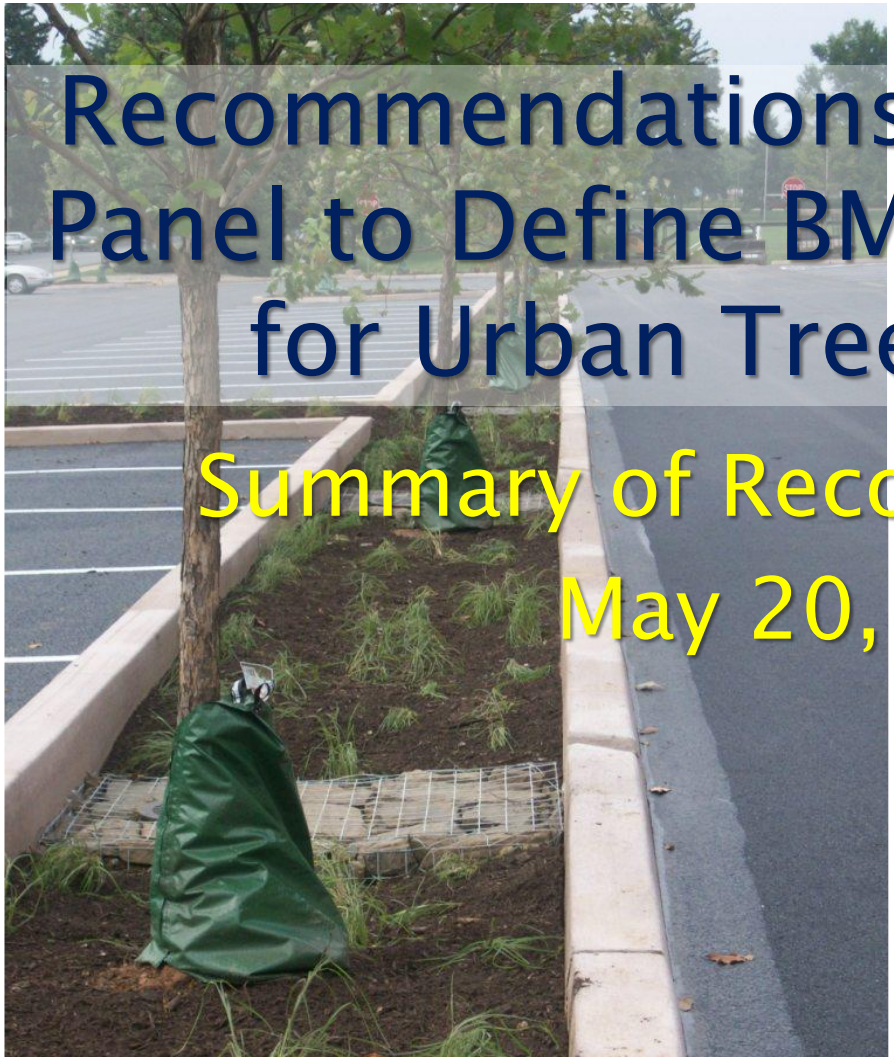
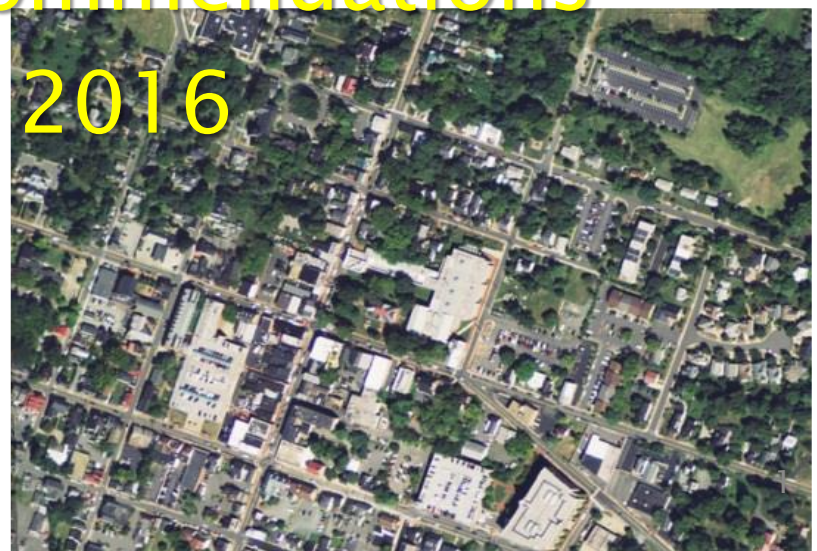
Welcome to the webinar! Please note that participants on the phone line are automatically muted. You may not hear anything until the presenters start the webinar at 10:00AM.





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

Summary of Recommendations

May 20, 2016

Webinar logistics: can you hear us now?

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  - Dial-in: 866 299 3188
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- Participants on the conference line will be muted automatically to avoid disruptions. We will instruct you when you may un-mute during the Q&A.
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Some notes before we get started

- **Please DO NOT put the conference line on hold at any time, for any reason.** If you need to take another call, please hang up and dial back in.
- Remember that any references to the report (figures, tables, page numbers, etc.) are to the May 3rd, 2016 version (draft for CBP review). These labels/numbers may change as revisions are made.
- The report is still considered DRAFT until approved by the Water Quality Goal Implementation Team (WQGIT). More info on this process will be provided later in the presentation.
- We will respond to questions after completion of the slides, but please type your questions into the chat box as we go. You're encouraged to use the slide numbers to help us better respond to specific questions about a statement/slide.
- **We are recording this webinar.**

Today's speakers

- Neely Law, PhD
  Center for Watershed Protection

- Jeremy Hanson
  Virginia Tech, CBPO

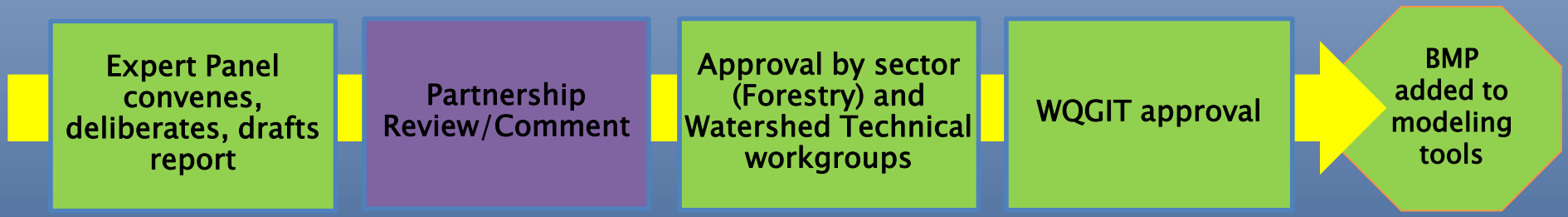
Overview

- Background
  - The BMP Protocol
  - The panel and its charge
- The panel's recommendations
- Accountability: reporting, tracking and verification
- Future research and management needs
- Timeline for review/approval of the report
- Q&A

The BMP Protocol

- All expert panels follow the Water Quality Goal Implementation Team's *Protocol for the Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model*, AKA the "BMP Protocol"
  - http://www.chesapeakebay.net/publications/title/bmp_review_protocol
- BMPs are often revisited as new science becomes available

BMP Panel process at a glance



Panel Scope

- Recommendations for Phase 6 CBWM only
- Convened at request of FWG to determine nutrient and sediment reductions for expanded urban tree canopy
- Review of existing urban tree planting credit
- Literature review
- * Provide input on the development of land use loading rates for tree canopy land uses

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)
Ari Daniels	Center for Watershed Protection
Marcia Fox	DE DNREC (WTWG rep)
Ken Hendrickson	EPA Region 3 (Regulatory Support)
Jeff Sweeney	EPA, CBPO (CBP modeling team rep)

P6 Land Uses as defined by CBP

Forest Land Use

- Minimum canopy area of 9m^2 (~97 ft^2) and minimum height of 5m (16.4 ft)
- Forests include contiguous patches of trees that are greater than or equal to 1-acre, corresponding to a patch of trees with a minimum internal radius of 36m
- Generally 20m – 30m away from non-road impervious surfaces (e.g., structures, driveways, and parking lots) in developed areas and ~ 10m away from non-road impervious surfaces in rural areas.

P6 Land Uses as defined by CBP

Tree Canopy Land Use (new land use)

- Minimum canopy area of 9m^2 (~97 ft^2) and minimum height of 5m (16.4 ft)
- Two subclasses: i) tree canopy over impervious; and ii) tree canopy over turfgrass.
- Trees are included in one of these two classes if they overtop roads, driveways, or parking lots or if they are within 20m – 30m of non-road impervious surfaces in developed areas or within 10m of non-road impervious surfaces in rural areas.
- The two tree canopy land uses include the majority of trees located in developed areas and all trees adjacent to rural structures.

Table 2. Preliminary estimates of tree canopy land uses acreage in the Phase 6 CBWM (Beta 1 vers.)

Land Use	CSS (ac)	MS4 (ac)	Non-Regulated (ac)	Total (ac)	% Tree Land use of Developed Land uses
Tree Canopy Over Impervious	732	50,589	102,679	154,000	3
Tree Canopy Over Turfgrass	14,051	383,829	344,748	742,628	14

Urban tree canopy BMP

- Actions and/or program elements that result in expanded tree canopy through the maintenance of existing tree canopy and, or an increase in trees in the urban landscape.
- Urban tree planting only
- Tree canopy as forest buffers and trees that are planted as part of a structural BMP *do not apply*

Expanded tree canopy

- Defined by FWG BMP Verification Guidance as the overall percent of tree cover in a geographically defined locality on developed land.

BMP Performance Measure *

- Credit as a land use change given new tree canopy land uses
- Load reduction based on the relative land use loading rate for the tree canopy land use (TC over impervious or TC over pervious)
- Cumulative credit

** Only apply starting with Phase 6, replacing the Phase 5.3.2 BMP for Tree Planting (Urban)*

UTC BMP Credit

Requires two pieces of information

1) N, P and S reduction
2) Area of tree canopy (TC) associated with tree planted

Estimated lbs reduced/yr = Tree Canopy Acreage of Trees Planted X % loading rate of TC land use X underlying TC land use loading rate (lb/ac)

UTC BMP Credit

Requires two pieces of information

1) N, P and S reduction
2) Area of tree canopy (TC) associated with tree planted

Estimated lbs reduced/yr = Tree Canopy Acreage of Trees Planted (ac) X % loading rate of TC land use X underlying TC land use loading rate (lb/ac)

N, P and S reduction

Water Quality Benefits of Urban Tree Canopy

- Relative Reductions in Non-Point Source Pollution Loads by Urban Trees (Appendix B)
  - Approved by WQ GIT, March 2016
- Literature Review and Synthesis
  - Section 4; Appendix C

Relative Reductions in Non-Point Source Pollution Loads by Urban Trees

- 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 Divers 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

Literature Review & Synthesis

- Focus on hydrologic benefits
  - Interception, Evapotranspiration, Infiltration, Runoff Reduction
- Water Quality
  - Runoff
  - Leaf Litter
- Additional Benefits
  - E.g., air quality, habitat, urban heat island

UTC BMP Credit

Requires two pieces of information

1) N, P and S reduction

2) Area of tree canopy (TC) associated with tree planted

Estimated lbs reduced/yr = Tree Canopy Acreage of Trees Planted (ac) X % loading rate of TC land use X underlying TC land use loading rate (lb/ac)

Review of Current Credit

- Urban Tree Planting Credit
  - Land use change from pervious to forested land use
  - 100 trees planted equivalent to 1-acre forested land use
- Lacking documentation & too generous
- Need a credit method more representative of urban planting and growing conditions
- "Every tree Counts"

Modeling Approach

"What is the average canopy area for every tree planted?"

- Modeling approach adopted to provide objective evaluation of tree canopy given numerous factors affecting tree growth (and canopy area)
- Use of i-Tree Forecast to estimate average annual canopy area and growth

i-Tree Forecast

- Part of the i-Tree suite of modeling tools
  - Released Spring 2016 as part of i-Tree ECO version 6
  - *https://www.itreetools.org/resources/manuals/Ecov6_ManualsGuides/Ecov6Guide_UsingForecast.pdf*
- Empirical-based model (population project model), while process model for environmental outputs
- Model application and description can be found in:
  - Nowak, D. et al 2013a. Assessing Urban Forest Effects and Values: the Greater Kansas City Region. US Forest Service, Newtown Square, PA.
  - Nowak, D. et al 2013b. Assessing Urban Forest Effects and Values: Toronto's Urban Forest. US Forest Service, Newtown Square, PA.

i-Tree Forecast:
Tree Growth & Mortality

Model parameters used to estimate annual growth for *individual tree species*

- **Growth Rate**
  - Species
  - Location (Climate)
  - Crown Light Exposure
- **Mortality Rate**
  - Condition/Health of tree, or User input
  - Tree "size class"
  - Diameter Breast Height (DBH)

i-Tree Forecast: Output

- Growth Rate
  - Species
  - Location (Climate)
  - Crown Light Exposure

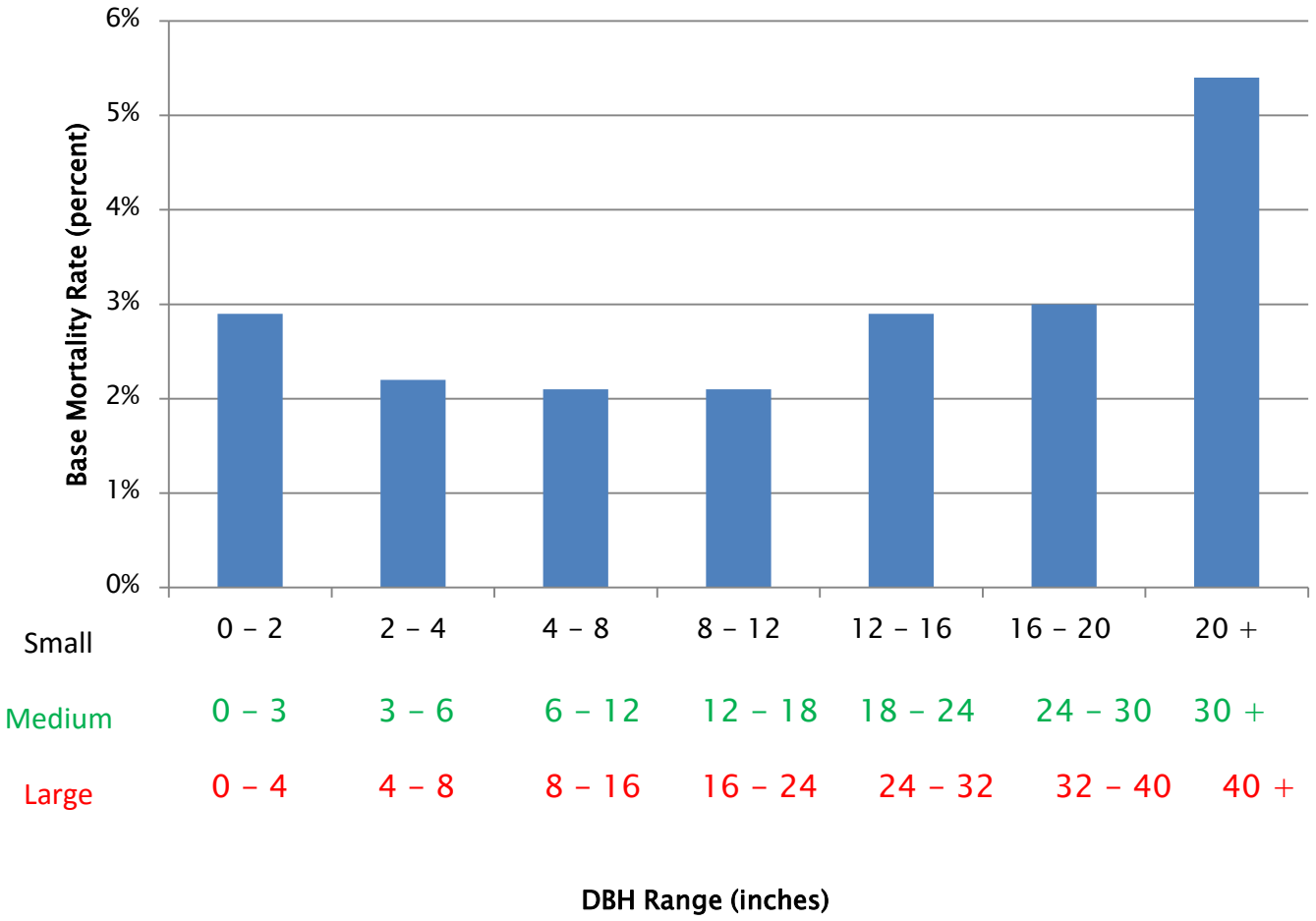
*Tree height, crown height, crown diameter**

- Mortality Rate
  - Condition/Health of tree, or User input
  - Tree "size class"
  - Diameter Breast Height (DBH)

Number of trees remaining

* Used to calculate canopy area

Base Mortality Rate by DBH Range for each size class

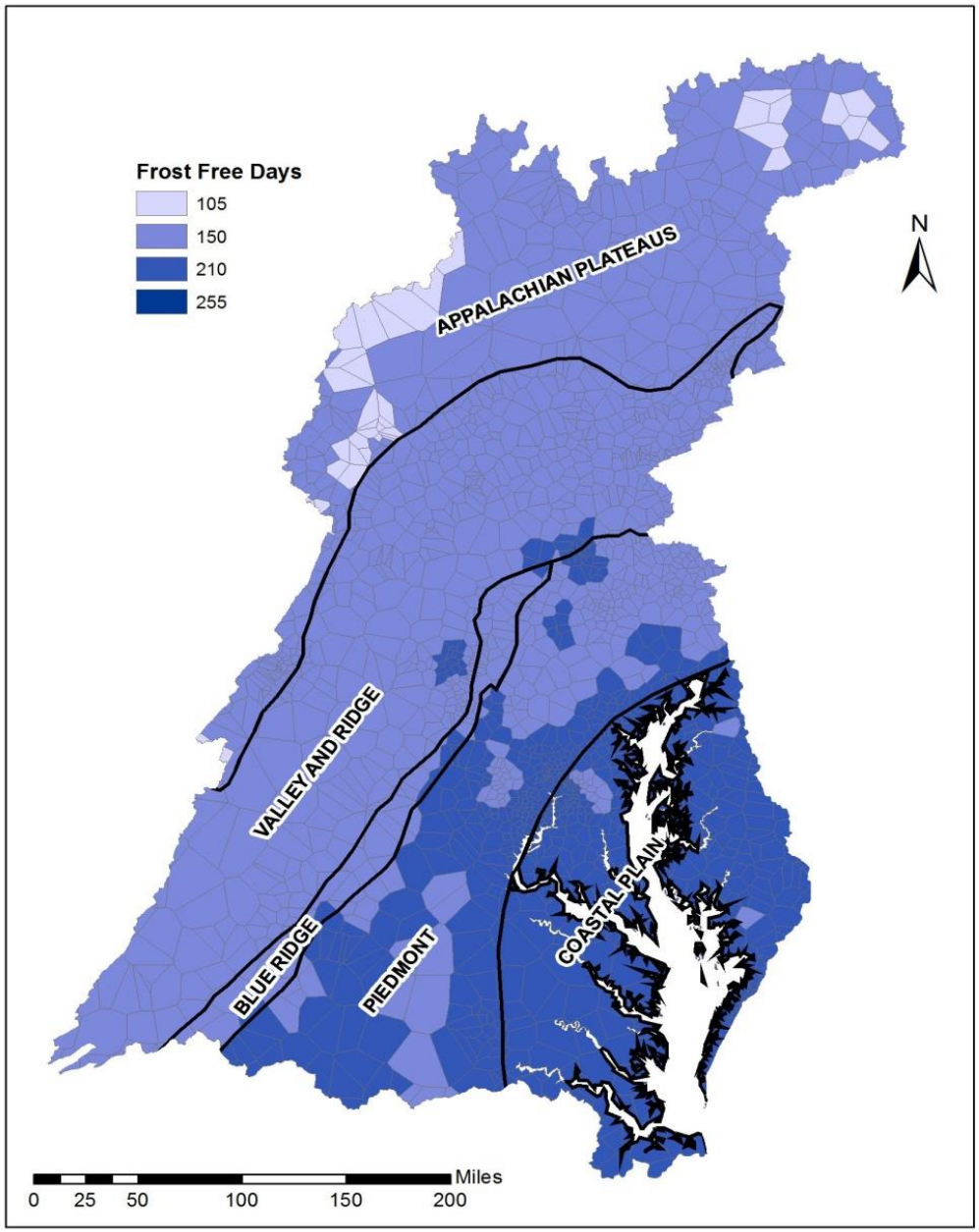


From Nowak et al 2103a, b

- Model scenarios based on Expert Panel input
  - 4 climate areas + 1 Baywide 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)

Climate Regions in the i-Tree Forecast Simulations

- Climate region is defined as the number of "frost-free days" (i.e., length of the growth season)
- Expert Panel application of i-Tree Forecast was aspatial



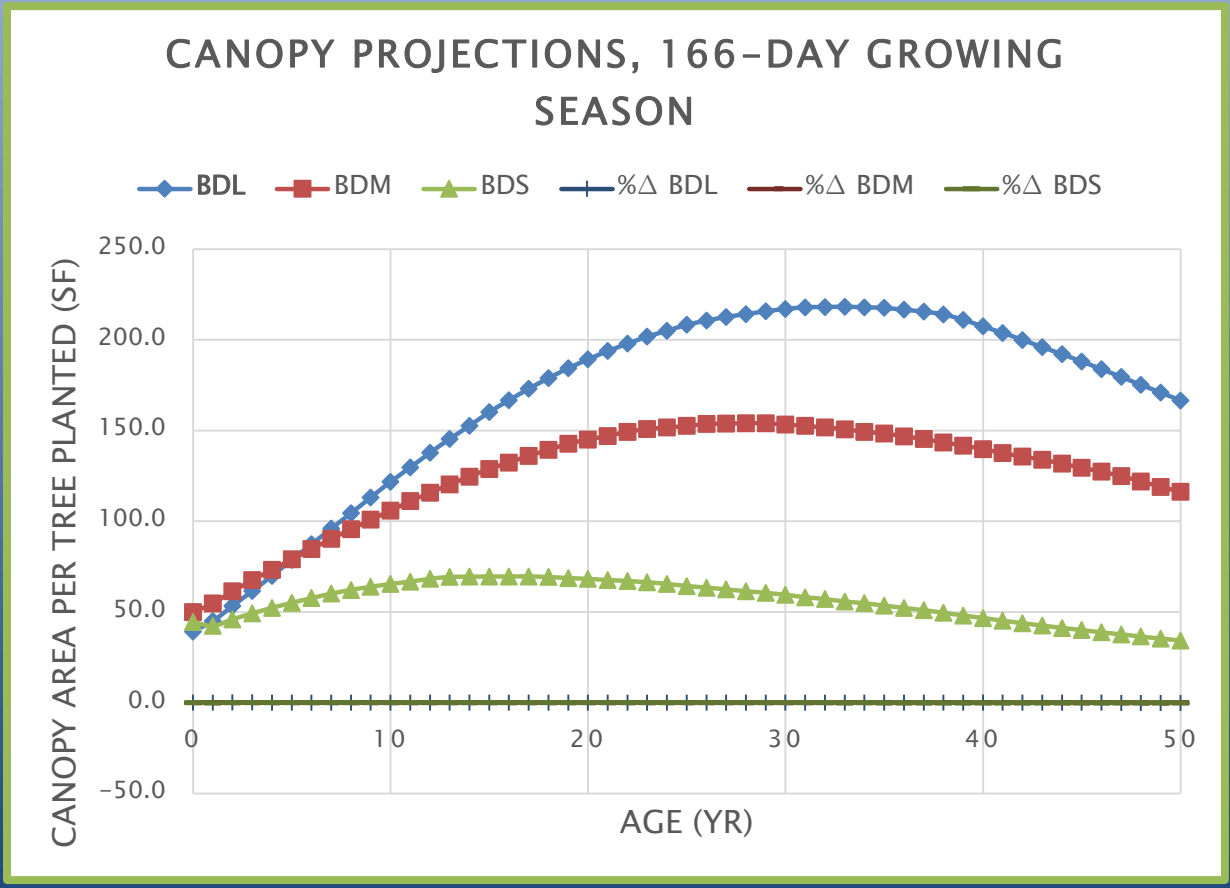
- Model scenarios based on Expert Panel input
  - 4 climate areas + 1 Baywide average
  - 1” DBH at planting
  - Tree in good condition at planting
  - 2.5% and 5% mortality
  - 20 tree species
  - Crown light exposure (park-like and open space type conditions)

- Simulated 10,000 trees per cohort
  - A cohort is defined as a group of trees which all have the exact same set of input parameters.
- Simulations included 40 cohorts per climate region
  - 20 species, 2 crown light exposure conditions) for analysis and includes approximately 10,000 trees per cohort.

★ Canopy area per tree planted is given by:

(Canopy area per surviving tree) x (Number of surviving trees) / (Number of trees originally planted)

Example Output for Broadleaf Tree Species Modeled*



BDL = broadleaf large; BDM = broadleaf medium; BDS = broadleaf small

Note: Similar output shown in Figure 4 of report.

i-Tree Forecast Output:
Canopy Area for Single Tree Planted

For example, estimated canopy area (ft^2)for "default tree" after 10-years after planting for the 3 climate areas

Table 10. Projected average canopy area (ft^2) for a single tree planted for specified growth period using a 5% mortality rate (a) and 2.5% mortality rate (b).

a) Default Broadleaf (ft^2), 5% mortality			
Age	150 FFD	166 FFD	210 FFD
	Valley Ridge and Appalachian Physiographic Region	Chesapeake Bay-wide	Coastal and Piedmont Physiographic Region
5	74	79	92
10	104	114	144
25	160	180	239

i-Tree Forecast Output:
Canopy Area for Single Tree Planted

Table 10. Projected average canopy area (ft^2) for a single tree planted for specified growth period using a 5% mortality rate (a) and 2.5% mortality rate (b).

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	Valley Ridge and Appalachian Physiographic Region	Chesapeake Bay-wide	Coastal and Piedmont Physiographic Region
5	74	79	92
10	104	114	144
25	160	180	239
b) Default Broadleaf(ft^2), 2.5% mortality			
5	85	90	105
10	132	144	182
25	271	304	399

i-Tree Forecast Output: Canopy Area for Single Tree Planted (with # trees per acre)

a) Default Broadleaf (ft^2), 5% mortality			
Age	150 FFD	166 FFD	210 FFD
	Valley Ridge and Appalachian Physiographic Region	Chesapeake Bay-wide	Coastal and Piedmont Physiographic Region
5	74 (590)*	79 (550)	92 (470)
10	104 (420)	114 (380)	144 (300)
25	160 (270)	180 (240)	239 (180)
b) Default Broadleaf(ft^2), 2.5% mortality			
5	85 (510)	90 (400)	105 (420)
10	132 (330)	144 (300)	182 (240)
25	271 (160)	304 (140)	399 (110)

* Number of trees per acre

Recommendations for UTC BMP Credit

Decision Rule for Tree Canopy as a BMP and as a Land Use

- Trees will require a minimum of 10 years growth after planting to reach an area necessary to be captured by high resolution imagery and mapped as a land use.
- Based on this decision rule, trees planted for BMP credit in 2016 and onward will continue to be tracked as a BMP through 2025.
- The next two potential cycles for high resolution imagery mapping are likely 2017/18 and 2022/23.

Recommendations for UTC BMP Credit

Lifespan of Annual BMP Credit

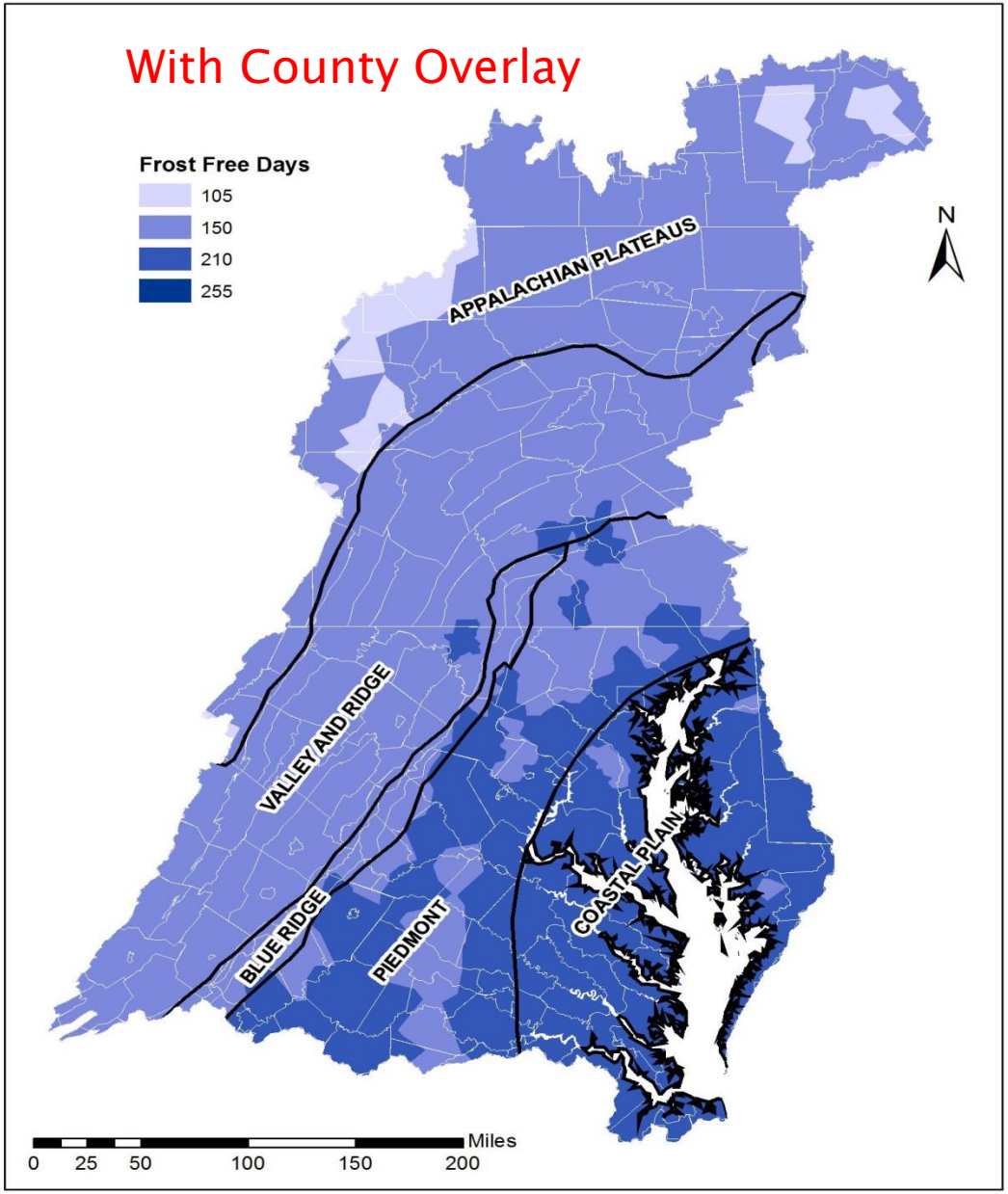
- Unlike other structural BMPs that have a credit duration due to their expected practice lifespan, urban trees on average have an expected lifespan between 15-28 years
- The lifespan of the BMP credit is based on the time period until it is mapped as a land use based on high resolution imagery (i.e., minimum of 10 years of growth after planting).
- This BMP would not be eligible for renewal in the National Environmental Information Exchange Network (NEIEN) once it is classified as a land use to avoid double counting of tree canopy acreage.

Recommendations for UTC BMP Credit

Information for Reporting and Tracking BMP

- Default broadleaf tree as a representative tree to report and track
- This recommendation does not limit the type of trees that are eligible for credit. The credit applies to all tree types
- The Expert Panel recommends the Baywide climate of 166 FFD days be used as guidance to provide an average metric for project tree canopy growth.
  - i-Tree Forecast output finds climate has marginal effect on tree growth up to 10 years;
  - Avoids complexities of multiple FFDs within a single county

With County Overlay



Recommendations for UTC BMP Credit

Metric for Translating Trees Planted to Urban Tree Canopy Acreage

- The credit for the default broadleaf tree for the Bay-wide climate is 144 square feet for every tree planted (300 trees per acre).
- Annual BMP acreage credit based on 10 years of projected growth after planting. The minimum 10 years of projected growth was chosen:
  - To assure that trees planted can be identified through high resolution imagery
  - Represents a mid-point in the projected lifespan of the tree that best aligns with the 2025 planning timeframe to have "projects in the ground"
  - Trees planted in 2016 and after will receive the full BMP credit these trees are "over-credited." On the other hand, the trees that survive and continue growing beyond 10 years will be "under-credited."
  - Provides assurance that the continued growth of trees post 2025 will work to maintain the nutrient and sediment caps after the TMDL is met.

Qualifying Conditions

- 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.

Section 6. Accountability

- Expert Panel does not envision any *unintended consequences*
- Current assumption of no net change in load attributed to leaf litter a "placeholder" for future research.
- Decision rule to avoid *double-counting* of existing tree canopy (mapped land uses) and new tree canopy from BMP

Verification

- Verification is an important process to ensure BMPs implemented continue to function to receive credit
- Review of 2014 guidance given update to CBWM with new tree canopy land uses and BMP credit method
- Panel advises Partnership to consider the following:
  - Current verification does not align with recommended credit method that directly accounts for mortality as credit method
  - Updates to tree canopy land use using high resolution imagery is the most objective verification process

Section 7: Future Research & Management Needs

Research

1) Evaluate the effect of tree canopy, non-forested lands on water quality.
2) There is a need for collection of multi-year field data that explicitly measures nutrient fluxes associated with areas of tree canopy.
3) CBP partnership can consider whether to adjust, drop, or keep this land-use/BMP as presently recommended for future model versions.
4) Support research to characterize and quantify the impact of leaf litter on nutrient contributions to the urban mass balance
5) Continued research on the effect of soils on tree canopy growth in urban watersheds.

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) The UTC BMP credit be reevaluated after 2025 to account for the increase in credit post 2025 as trees mature
4) Develop BMP's that address the conservation and maintenance of existing tree canopy.

Thank you

Timeline

- **Tues. May 3**: Report released for review/comment
- **Wed. May 4**: Forestry Workgroup (FWG). Introductory briefing to FWG for panel's methods/recommendations.
- **Fri. May 20**: Today's webinar.
- **Wed. June 1**: FWG Follow-up briefing/discussion if needed, but unable to seek approval as comments will still be coming in.
- **Thurs. June 2**: Briefing to Watershed Technical Workgroup (WTWG)
- **Thu. June 9**: Initial 30-day comment period closes. Comments on the report should be submitted to Jeremy Hanson (jchanson@vt.edu) by close of business.

Timeline (continued)

- **Thu. June 9**: Initial 30-day comment period closes. Comments on the report should be submitted to Jeremy Hanson (jchanson@vt.edu) by close of business.
- **Thurs. June 23:** (Rescheduled) FWG. Seek FWG approval.
- **Thurs. July 7**: WTWG conference call. Earliest potential date to seek WTWG approval, depending on status and timing of FWG approval.
- **Tues. July 19**: Briefing to Urban Stormwater Workgroup.
- **Thurs. August 4**: Seek WTWG approval if earlier approval is not possible given the schedules of the workgroups.
- **Mon. August 8** or **Mon. August 22**: Potential dates for seeking WQGIT approval, depending on FWG and WTWG approval status and schedule.

Q&A

- First we'll review written questions from the chat box. Then we'll take verbal questions from participants. Please do not un-mute until asked to do so.
  - #6 to un-mute
  - *6 to mute. Please remember to mute when finished with your question. This will limit background noise on our recording. Thank you.

THANK YOU FOR JOINING US

Comments on report are request by close of business on Thursday, June 9. Comments should be submitted to Jeremy Hanson (jchanson@vt.edu).

Contact Jeremy with questions following today's webinar.

The webinar recording will be placed on the calendar entry soon:

http://www.chesapeakebay.net/calendar/event/23958/