

Stormwater Credits for Trees: Chesapeake Bay Case Study

Quick facts

Where: Chesapeake Bay Watershed
(DC, DE, MD, NY, PA, VA, WV)

When: Adopted in 2016 as approved Total Maximum Daily Load Best Management Practice (BMP) credits by Federal and State agencies

What:

- » BMP credits are earned for urban tree canopy expansion for dispersed plantings over turf or impervious surface and urban forest planting for full reforestation.
- » Tree canopy is mapped and credited as a land use class in the Chesapeake Bay model, with reduced pollutant loading relative to turf or impervious cover.
- » States get credit for newly planted trees for 10 years, after which the tree canopy is tracked directly through high-resolution imagery.

Overview

In 2010, the U.S. Environmental Protection Agency (EPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL)—or “pollution diet”—to reduce the amount of nitrogen, phosphorus, and sediment entering the Bay through the region’s waterways. The TMDL covers 64,000 square miles that stretch across parts of six States and the District of Columbia. Each of these jurisdictions has committed to reaching ambitious pollutant load reductions by 2025, as documented in phased watershed implementation plans. In order to track and credit progress towards these targets, the States and the District of Columbia must provide detailed reporting of the number and type of approved BMPs implemented on all agricultural and urban lands.

While the Chesapeake Bay TMDL and modeling tools have always assigned low pollutant loading rates to

forest land cover, they did not have a way to account for and credit the water quality value of urban tree canopy (individual and small patches of trees in developed areas not large enough to be classified as forest). Thanks to investments by the Chesapeake Bay Program partners in high-resolution land cover data, distinct mapping of forest, urban tree canopy over turf, and urban tree canopy over impervious cover became available in 2016.

A BMP expert panel was convened in 2015 to provide recommendations on how urban tree canopy (including urban tree planting) should be credited in the TMDL context. All documentation of the literature, modeling approaches, and crediting decisions are provided in the [report the panel developed](#) (Law and Hanson 2016). Following review and revision with Federal, State, and other stakeholders, a new BMP credit for urban tree canopy expansion, as well as a higher credit for urban forest planting (i.e., reforestation of developed/turf areas) were officially adopted in 2016 for use in the TMDL. Having tree BMP credits approved for use in the TMDL has helped incentivize the District of Columbia and other local jurisdictions to include tree planting targets as part of their Municipal Separate Storm Sewer System (MS4) permits.

The science behind it

The tree canopy BMP expert panel, with support from the Center for Watershed Protection, completed a thorough literature review on the water quality benefits of urban trees and existing tree crediting approaches. Hynicka and Divers (2016) constructed a water-balance modeling approach to estimate pollutant loading rates for tree canopy over turf grass, tree canopy over impervious cover relative to turf, and impervious cover without trees. To account for spatial and temporal variation in precipitation, 11 years (2005 to 2015) of daily weather data were used from each of 8 regional locations spanning the Chesapeake Bay Watershed. The relative pollutant load reductions are summarized in [Table 1](#).

Table 1. Tree canopy relative land use loading rate reductions in total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in relation to underlying land use cover

Land use	Total nitrogen reduction (%)	Total phosphorus reduction (%)	Total suspended solids (TSS) reduction (%)
Canopy over turf	23.8	23.8	5.8
Canopy over roads	8.5	11.0	7.0
Forest	85.0	90.7	81.6*

*Percent reduction is based on an average Municipal Separate Storm Sewer System (MS4) land use loading rate for sediment. Source: Hynicka and Divers 2016.

The expert panel used a variety of tree species, growth, and mortality scenarios in i-Tree Forecast to establish an average canopy acreage credit per tree planted (144 square feet per tree, or approximately 300 trees per acre).

How the credit works

Under the Chesapeake Bay modeling and TMDL framework, every acre of land in the watershed has a designated land use class and associated pollutant loading rate, based on high-resolution land cover mapping, other datasets, and best available science. Like many BMPs in the TMDL framework, the urban tree canopy BMPs are credited based on a *land use change* or the conversion of a given acreage of land from a higher loading land use (e.g., turf grass or impervious cover) to a lower loading land use (urban tree canopy or forest). For these land use change BMPs, States, and local governments track and report the total acreage of each BMP implemented on an annual basis, and the Chesapeake Bay modeling tools calculate the resulting pollutant reductions.

References

- Hynicka, J.; Divers, M. 2016. Relative reductions in non-point source pollution loads by urban trees. In: Recommendations of the expert panel to define BMP effectiveness for urban tree canopy expansion. Ellicott City, MD: Center for Watershed Protection and Chesapeake Stormwater Network: 1-26. <https://owl.cwp.org/mdocs-posts/recommendations-of-the-expert-panel-to-define-bmp-effectiveness-for-urban-tree-canopy-expansion/>. (8 October 2018).
- Law, N.; Hanson, J. 2016. Recommendations of the expert panel to define BMP effectiveness for urban tree canopy expansion. Ellicott City, MD: Center for Watershed Protection and Chesapeake Stormwater Network. 237 p. <https://owl.cwp.org/mdocs-posts/recommendations-of-the-expert-panel-to-define-bmp-effectiveness-for-urban-tree-canopy-expansion/>. (8 October 2018).

The urban tree canopy expansion BMP includes tree planting projects on developed land that increase the tree canopy overlying turf or impervious surfaces but do not create forest-like conditions. Trees do not have to be planted in a single contiguous area. Trees planted in a riparian forest buffer or as part of a structural BMP, such as bioretention practices, are not included; these are tracked under separate BMP credits. Each tree planted is given credit for creating 144 square feet of urban tree canopy (equivalent to 300 trees per acre), which reflects average growth at 10

years after planting. The credit is calculated within the Chesapeake Bay model based on the percentage reduction in nitrogen, phosphorous, and sediment pollutant loads relative to the underlying land use cover.

The urban forest planting BMP includes projects that create forest-like conditions. Trees must be planted in a contiguous area specified in a documented planting and maintenance plan and conform to the State's planting density and associated standards for forest conditions. Urban forest planting BMPs result in a change of land use from turf grass to forest land. The credit for this BMP is calculated based on the difference between the land use loading rate of turf grass and forest land across the acreage of the urban forest planting.

For both BMP credits, the credit expires after 10 years, at which point the canopy coverage is assumed to be tracked and directly credited as a land use through new high-resolution imagery/land use data.

For more information on crediting trees in the context of stormwater management, refer to the suite of resources developed by the Center for Watershed Protection on [Making Urban Trees Count](#).

Adapted from: U.S. Department of Agriculture, Forest Service. 2020. Urban forest systems and green stormwater infrastructure. FS-1146. Washington, DC. 23 p. https://www.fs.usda.gov/sites/default/files/fs_media/fs_document/Urban-Forest-Systems-GSI-FS-1146.pdf

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