Purpose:
- Advocate for the use of regulatory incentives where new, and existing trees, are given stormwater treatment credits.

Topics:
- Ecological services of trees
- Trees as BMPs
- BMPs with trees
- Tree canopy design issues
An irony of stormwater design:

We remove trees (and other vegetation) to create impervious surface...
...then we remove more trees to create facilities to treat stormwater to mitigate for the loss of tree cover!

(MassDOT)
Our Challenge:
How to more carefully consider the ecological functions of trees, and integrate *Tree Canopy* into the design of projects and their stormwater management systems.
If trees have stormwater benefits...

Existing mature tree growth on the embankment down slope from highway.
Can structural stormwater BMPs fully compensate for tree-clearing (which maximizes business visibility)?
Ecological Services of Trees

Municipal Forest Resource Analysis: New York City (Center for Urban Forest Research, 2007)

- Tree inventory & benefit analysis quantified:
  - Energy savings
  - CO2 reduction
  - Air pollutant reduction
  - Property value increase
  - Stormwater runoff reduction

Source: CUFR 2007
Annually, trees provide $121.9 million in ecological services for NYC.
- $209 per tree
- $5.60 in benefits for every $1.00 for tree planting and care

Trees provide $35.6 million annual savings in treating stormwater, because of rainfall interception
- Average runoff reduction of 1432 gallons per tree per year
In Central Massachusetts, a 12-inch Red Maple…

- Intercepts 1353 gallons of water per year;
- Equals 3.8 inches of runoff reduction over the area of the tree’s canopy.

National Tree Benefit Calculator
https://www.arborday.org/calculator/index.cfm
In addition to interception/evaporation, trees reduce runoff by:

- Uptake and transpiration from the ground
- Enhancing infiltration into the ground
- Roots binding soil, preventing erosion and associated accelerated runoff

Source: Tree City USA Bulletin No. 55
Arbor Day Foundation
New England stormwater programs now generally address:

- Flooding
- Peak rates
- Water quality treatment
- Recharge
- Channel protection (in some cases)
- Runoff reduction (in some cases)

None of these programs directly addresses loss or restoration of “ET” – a major hydrologic function of mature trees.
Other Ecological Services of Trees

- Uptake of stormwater contaminants
- Thermal moderation of runoff
- Wildlife habitat enhancement
- Noise attenuation
Designing with Tree Canopy

Integrating tree canopy into site design (including MassDOT roads):

- Trees as BMPs
- BMPs with Trees
Use trees for runoff reduction:

- Introduction, restoration, or preservation of individual trees
- Preservation/restoration of forested landscape
- Incentives for implementation of these measures
Trees as BMPs: Canopy Trees for Runoff Reduction

Instead of this…

(Using Trees to Reduce Stormwater Runoff - Center for Watershed Protection/USDA Forest Service)

…this

(Alex92287 – Flickr.com)
Trees as BMPs: Canopy Trees for Runoff Reduction

Should we provide credits for planting new trees…

(Community College of Vermont)
Trees as BMPs: Forest Cover for Runoff Reduction

...and preserving existing canopy?
Simply adjusting runoff coefficients will not fully account for benefits of trees.

We should explore incentives to promote the use of canopy trees and forest cover in the landscape.

Potential credits for:
- Urban trees – existing and new
- Forest cover – preservation or restoration
Trees as BMPs: Examples of Credit Systems

- City of Philadelphia, PA stormwater program:
  - Water Quality Volume reduction for individual trees located close to pavement
  - Existing tree preservation (canopy within 20 feet)
  - New tree installation (canopy within 10 feet)
  - Must comply with specified standards

- City of Portland, OR
  - Comparable program, different standards and clearances
Pennsylvania DEP Stormwater Management Program

- Credits for both individual trees and forest cover
- Water quality volume reduction credit for *existing tree canopy* within 100 feet of impervious surface
- Water quality volume reduction credit for *each new tree* within project site
- Must comply with specified standards
Trees as part of vegetation-based treatment practices:

- Vegetated filter practices
  - Pavement disconnection credits
  - Vegetated buffers
- Stormwater Wetlands
- Bioretention Areas
- Water Quality Swales
- Dry and Extended Detention Basins
BMPs with Trees

Urban Watershed Forestry Manual
Part 1: Methods for Increasing Forest Cover in a Watershed

Urban Watershed Forestry Manual
Part 2: Conserving and Planting Trees at Development Sites

Urban Watershed Forestry Manual
Part 3: Urban Tree Planting Guide

Wooded Wetland

USDA Forest Service
Urban Watershed Forestry Manual
Alternating Planting Along Conveyance or Treatment Swale

USDA Forest Service
Urban Watershed Forestry Manual
Tree Check Dams for Swales

USDA Forest Service
Urban Watershed Forestry Manual
Instead of this...

...this

Except for the “dam” and any wet pools, every surface of the detention basin is “fair territory” for tree planting.

(Using Trees to Reduce Stormwater Runoff - Center for Watershed Protection/USDA Forest Service)

(MassDOT)
Tree Canopy Design Issues

- Maintenance
  - Benefits (e.g., trees and other plantings control snow drift)
  - Issues (e.g., safety concerns with leaf litter and debris)
- Leaf litter and phosphorus loading
- Shading and freezing
- Driver recovery areas and sight clearances
- Pavement integrity versus tree survival
Tree Canopy Design Issues

- Tree installation/preservation may be inconsistent with specific design requirements
  - Safety
    - Recovery zones clear of physical hazards
    - Cleared areas for unobstructed sight lines
  - Pavement integrity and other structural criteria
    - e.g., potential for damage by tree roots
Driver clear zones: Balancing safety with tree cover

How much “clear zone” is enough? (context sensitive)

(MassDOT)

(D. Nyman/CEI)
Trees versus Pavement

Will the tree destroy the pavement...

...or will the pavement kill the tree?

(MassDOT)

(Using Trees to Reduce Stormwater Runoff- Center for Watershed Protection/USDA Forest Service)
Tree versus pavement...

Linear tree pits

USDA Forest Service, 2006
Urban Watershed Forestry Manual

( Photo: MassDOT)
Tree versus pavement...

Clustered plantings...

(rusticroadlandscaping.com)

(MassDOT)
Tree versus pavement...

- Suspended pavement
- Structural cells
- Structural soil
- Stormwater tree pits
- Permeable pavement

http://www.davey.com/media/183712/Stormwater_to_Street_Trees.pdf
Where are we going?

(Pine Hills, Plymouth MA)
Questions?

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