Natural Green Infrastructure and Stormwater Benefits of Atlanta’s Urban Tree Canopy

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Atlanta Watersheds and Sewersheds
How Urbanization Exacerbates Flooding

Natural Ground Cover
- 40% evapotranspiration
- 10% runoff
- 25% shallow infiltration
- 25% deep infiltration

10%-20% Impervious Surface
- 38% evapotranspiration
- 20% runoff
- 21% shallow infiltration
- 21% deep infiltration

20% shallow infiltration
- 35% evapotranspiration
- 30% runoff
- 15% deep infiltration

75%-100% Impervious Surface
- 30% evapotranspiration
- 55% runoff
- 10% shallow infiltration
- 5% deep infiltration
Stormwater Issues are City-wide

DWM receives about 1,300 complaints about stormwater issues every year.

Issues are city-wide.

**Goals:** to integrate green infrastructure across city departments to manage stormwater and provide multiple co-benefits.
What is Green Infrastructure?

- An interconnected natural or engineered system that preserves or mimics undeveloped hydrologic functions

- Capture the first 1.0” of rainfall
  - Infiltration
  - Evapotranspiration (uptake of water by plants + evaporation)
  - Reuse through rainwater harvesting
Green Infrastructure Strategic Action Plan

Mimics natural hydrology with Engineered Green Infrastructure

+ Conserves & expands network of Natural Green Infrastructure
Engineered Green Infrastructure

Systems such as:

- rain gardens
- green roofs
- permeable pavement, and
- cisterns

that are designed to capture and treat stormwater runoff by replicating the natural drainage systems of undeveloped land.
Engineered GI Projects

Green Roof
City Hall

Rainwater Harvesting
Southface

Rain Garden
Adair Park

Permeable Pavers
Urban Market at Howell Mill

Stormwater Bump-out
Whitehall Terrace

Stormwater Planters
Boone Blvd Green Street

Wet Pond
Historic Old 4th Ward Park

Bioswale
Fernbank Museum
GI on Private Properties

Post-Development Stormwater Management Ordinance Map

Legend
- Commercial: Completed
- Commercial: Under Construction
- Commercial: Not Initiated
- City-Owned Projects
- Residential Projects
- DIYM Greenway
- DIYM Green space
- Park
Preserving and restoring a network of protected forests, wetlands, riparian buffers, floodplains, and other vegetated areas, is a highly efficient means of protecting water quality and watershed health.
Very little runoff leaves a forest...
The forest’s dense canopy cover and layers of vegetation intercept raindrops, dissipating the impact of rain. Moisture evapotranspires through the vegetation, cooling the air.
Maximize Ecosystem Services of Trees for Stormwater Management:

- Canopy interception and evaporation
- Transpiration
- Stemflow
- Throughfall
- Infiltration
More Strategic Approach to Urban Watershed Forestry

Acquiring and Conserving high quality greenspaces

Identifying “receiving sites” for trees for renaturalization

Invasive management to meet recompense requirements
Natural Green Infrastructure

COA DWM presently owns and manages 1,900+ acres of protected Greenway and Greenspace properties in 12 watersheds around the City and metro area.

<table>
<thead>
<tr>
<th>Property Category</th>
<th>Number of properties</th>
<th>Acres</th>
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<tbody>
<tr>
<td>Greenway-Consent Decree-Fee</td>
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<td>767.43</td>
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<tr>
<td>Greenway-Consent Decree-CE</td>
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<td>1,152.85</td>
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<td>Greenway-non-Consent Decree-Fee</td>
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<td>6.40</td>
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<tr>
<td>Greenway-non-Consent Decree-CE</td>
<td>2</td>
<td>23.56</td>
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<tr>
<td>Greenspace-FEMA</td>
<td>10</td>
<td>4.20</td>
</tr>
<tr>
<td>Greenspace-Other</td>
<td>5</td>
<td>13.80</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>173</strong></td>
<td><strong>1,968.23</strong></td>
</tr>
</tbody>
</table>
Preservation Evaluation Tool

Tool consists of two components
- GIS for analysis
- Excel for evaluation and documentation
i-Tree Hydro: South River Case Study

- Model area
  - Outlet at SOU-1 (USGS station 02203655)
    - 23.1 mi²
- Base model parameterization
  - Used additional parameterization developed by the forest service
More Strategic Approach to Urban Watershed Forestry

- Acquiring and Conserving high quality greenspaces
- Identifying receiving zones for trees for reforestation
- Invasive management to meet recompense requirements
Tree Recompense

As a public utility, DWM’s work can unfortunately sometimes negatively impact the urban forest.

City’s Tree ordinance requires recompense for these impacts. 
Recompense, caliper inch planted for caliper inch destroyed.

Sewer lines typically follow natural drainage ways.

Cook Park regional stormwater project.
Tree ordinance has special provisions for DWM Consent Decree projects

Recompense can be met through:
  – Invasive removal
  – Planting live stakes, liners
Recompense site example
DWM Properties

South River Water Reclamation Plant
Urban Forest “Continuum”

Urban - Neighborhood - Park - Forest
Southeastern Piedmont Forest is incredibly productive ecologically, naturally regenerating from abandoned farm field to oak hickory forest in 150 years.
McDaniel Branch Watershed Improvement Project

2 Project Components (completed 2015):
- 1000 LF stream restoration (319 grant)
- Constructed stormwater ponds and wetlands (USACE)

Benefits:
- Restored stability and function to a degraded urban tributary of the South River
- Created 7 acres of wildlife habitat from an empty demolition site overgrown with invasive plants. (Audubon Wildlife Sanctuary Certification pending)
- Public nature preserve (site/trail design in progress)
“Jumpstarting” Succession

Immediately after construction, 2013

Restored stream, summer 2015

McDaniel Branch Stream Restoration, Atlanta
Invasive Management

- Trees Atlanta mapping and invasive removal
- Targeted invasives:
  - Japanese hops (yellow)
  - Kudzu (red and yellow)
- Mature trees saved:
  - est. +/- 20 24” avg. cal. trees
Environmental Education and Community Engagement

• Interpretive signage
  – Delineates extents of mowing
  – Shows that management is “intentional”
Certified as an Audubon Wildlife Sanctuary

Co-benefits:

• Supports biodiversity
• Opportunities for recreation
• Enhances water quality
• Capacity relief

Certified by the Atlanta Audubon Society as an Audubon Wildlife Sanctuary in October 2018
More Strategic Approach to Urban Watershed Forestry

- Acquiring and Conserving high quality greenspaces
- Invasive management to meet recompense requirements
- Identifying “receiving sites” for trees for renaturalization
Example of a “Receiving Site”: Macon Drive Greenspace

DWM Greenspace property – located in floodplain

- .43 acres
- South River frontage
- Impervious surfaces removed
- Acquired and protected as riparian buffer greenspace
Macon Drive Renaturalization Plan
Macon Drive Renaturalization

Legend
- Tree Saved
- Greenspace
- Streams

**2251 Macon Drive SW**
**Date:** 12/6/2018

**Species Name** | **Scientific Name** | **Diameter Breast Height (inches)**
--- | --- | ---
1 Green Ash | Fraxinus pennsylvanica | 56
2 Green Ash | Fraxinus pennsylvanica | 26
3 Water Oak | Quercus nigra | 35
4 Water Oak | Quercus nigra | 30
Macon Drive Renaturalization

**Trees:**
- tulip poplar
- sycamore
- sweetgum
- American holly

**Understory:**
- possumhaw
- fothergilla

**Live stakes on bank:**
- black willow
- red osier dogwood
Macon Drive Renaturalization

Allow natural ecological succession to occur

- New plantings tighter spacing, staggered sizes, native plants
- Buffer enhancement
- Ongoing management for invasives
# Macon Drive Renaturalization

## Proposed Plant Schedule & Recompense Credits

<table>
<thead>
<tr>
<th>Qty</th>
<th>Botanical Name</th>
<th>Common Name</th>
<th>Size</th>
<th>Tree Recompense Credits</th>
<th>unit</th>
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</thead>
<tbody>
<tr>
<td></td>
<td><strong>Specimen/Street Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Quercus falcatia</td>
<td>southern red oak</td>
<td>2&quot; cal.</td>
<td>3</td>
<td>in</td>
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<tr>
<td>5</td>
<td>Carya glabra</td>
<td>pignut hickory</td>
<td>2&quot; cal.</td>
<td>5</td>
<td>in</td>
</tr>
<tr>
<td>3</td>
<td>Liquidambar styraciflua</td>
<td>sweetgum</td>
<td>2&quot; cal.</td>
<td>3</td>
<td>in</td>
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<tr>
<td></td>
<td><strong>Canopy Trees</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>12</td>
<td>Liriodendron tulipifera</td>
<td>tulip poplar</td>
<td>1&quot; cal.</td>
<td>12</td>
<td>in</td>
</tr>
<tr>
<td>66</td>
<td>Liriodendron tulipifera</td>
<td>tulip poplar</td>
<td>whirls</td>
<td>66</td>
<td>in</td>
</tr>
<tr>
<td>4</td>
<td>Platanus occidentalis</td>
<td>sycamore</td>
<td>1&quot; cal.</td>
<td>4</td>
<td>in</td>
</tr>
<tr>
<td>12</td>
<td>Platanus occidentalis</td>
<td>sycamore</td>
<td>whirls</td>
<td>12</td>
<td>in</td>
</tr>
<tr>
<td>4</td>
<td>Liquidambar styraciflua</td>
<td>sweetgum</td>
<td>1&quot; cal.</td>
<td>4</td>
<td>in</td>
</tr>
<tr>
<td>12</td>
<td>Liquidambar styraciflua</td>
<td>sweetgum</td>
<td>whirls</td>
<td>12</td>
<td>in</td>
</tr>
<tr>
<td>4</td>
<td>Quercus nigra</td>
<td>water oak</td>
<td>1&quot; cal.</td>
<td>4</td>
<td>in</td>
</tr>
<tr>
<td>12</td>
<td>Quercus nigra</td>
<td>water oak</td>
<td>whirls</td>
<td>12</td>
<td>in</td>
</tr>
<tr>
<td></td>
<td><strong>Mid-story trees</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pinus taeda</td>
<td>Loblolly pine</td>
<td>4 - 6&quot;</td>
<td>4</td>
<td>in</td>
</tr>
<tr>
<td>12</td>
<td>Pinus taeda</td>
<td>Loblolly pine</td>
<td>7 gal.</td>
<td>12</td>
<td>in</td>
</tr>
<tr>
<td>4</td>
<td>Ilex opaca</td>
<td>American holly</td>
<td>4 - 6&quot;</td>
<td>4</td>
<td>in</td>
</tr>
<tr>
<td>12</td>
<td>Ilex opaca</td>
<td>American holly</td>
<td>7 gal.</td>
<td>12</td>
<td>in</td>
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<tr>
<td>8</td>
<td>Magnolia virginiana</td>
<td>sweetbay magnolia</td>
<td>4 - 6&quot;</td>
<td>8</td>
<td>in</td>
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<tr>
<td>16</td>
<td>Magnolia virginiana</td>
<td>sweetbay magnolia</td>
<td>7 gal.</td>
<td>16</td>
<td>in</td>
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<tr>
<td>4</td>
<td>Ilex decidua</td>
<td>possumhaw</td>
<td>7 gal.</td>
<td>4</td>
<td>in</td>
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<tr>
<td>12</td>
<td>Ilex decidua</td>
<td>possumhaw</td>
<td>3 gal.</td>
<td>12</td>
<td>in</td>
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<tr>
<td></td>
<td><strong>Shrubs</strong></td>
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<tr>
<td>12</td>
<td>Fothergilla gardenii</td>
<td>fothergilla</td>
<td>3 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Calycanthus floridus</td>
<td>sweetshrub</td>
<td>3 gal</td>
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<td></td>
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<td>20</td>
<td>Ilex verticillata</td>
<td>winterberry</td>
<td>3 gal</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td><strong>Live stakes</strong></td>
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<tr>
<td>84</td>
<td>Salix nigra</td>
<td>black willow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>84</td>
<td>Cornus sericea</td>
<td>red-osier dogwood</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## Saved Trees for Recompense Credits

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Scientific Name</th>
<th>Diameter Breast Height (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Ash</td>
<td>Fraxinus pennsylviana</td>
<td>56</td>
</tr>
<tr>
<td>Green Ash</td>
<td>Fraxinus pennsylviana</td>
<td>26</td>
</tr>
<tr>
<td>Water Oak</td>
<td>Quercus nigra</td>
<td>35</td>
</tr>
<tr>
<td>Water Oak</td>
<td>Quercus nigra</td>
<td>30</td>
</tr>
</tbody>
</table>

**Total Recompense Credits**

\[
\text{Total Recompense Credits} = \text{Proposed Recompense Credits} + \text{Saved Recompense Credits} = 198 + 147 = 345 \text{ inches}
\]
Natural Resources Management vs. Traditional Landscape Maintenance

Conventional Maintenance
“mow, blow and go....”

Natural Resources Management
Controlling invasives, ecological restoration
DWM is seeking to be a lead partner in City’s larger goals of meeting targets for maintaining and expanding the City’s urban canopy cover:

- Invasive removal
- Renaturalization
- Buffer enhancements
Our challenge for *nature* is to protect and expand the ecological value of our watersheds, forest and habitat in the face of rapid urbanization.
Atlanta’s Urban Canopy

“The City in the Forest”

Atlanta's Urban Tree Canopy cover is 47.9%, among highest of major cities in the country.*

*Most of these trees are on private property
Mapping Potential “Receiving Zones” City-Wide
Inspiration: GA Tech’s Landscape Master Plan

- Identifies potential sites on campus for reforestation – “forest patches”

Figure 6-17: Utility-free Areas for Potential Reforestation
Inspiration: GA Tech’s Landscape Master Plan

Receiving Zones for trees:
• Tighter spacing, staggered sizes
• Diverse palette modeled on plant communities native to the Georgia Piedmont
Trees are part of our stormwater infrastructure!
Atlanta’s Historic Green Infrastructure