Trees and Stormwater Management

Valdosta, Georgia
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Time Allotted vs Audience Attention Span

![Bar chart showing presentation length vs. attention span. The chart indicates that the presentation length is significantly longer than the attention span.]}
Presentation Goals

Use Trees to Reduce:
- Stormwater Quantity
- Stormwater Pollution
- Infrastructure Needs
How Do Trees Mitigate Stormwater in Developed Communities?
What is Green Infrastructure?
What is Green Infrastructure?

"...is an approach to stormwater management that utilizes soils and vegetation to enhance and/or mimic the natural hydrological cycle processes of infiltration, evapotranspiration and reuse."

US Environmental Protection Agency (2008)
What is Infiltration?

*Infiltration is the process by which precipitation or water soaks into subsurface soils.*

- Reduces Sheet Flow
- Filters out Pollutants
Trees Promote Infiltration

• Tree Rooting Zones Provides an Ideal Environment for Infiltration.
  • Duff/Mulch
  • Sod
  • Permeable Materials
  • Herbaceous Vegetation
  • Non-Compacted Soil
What is Evapotranspiration?

• Significant source of atmospheric water vapor.

• Combination of:
  • Evaporation from the soil surface and water bodies plus ___
  • Transpiration from the leaf surfaces and the stomates of plants.
    • Cools the leaf surface
    • Moves water and nutrients up the trunk
Photosynthesis

6CO₂ + 6H₂O → Light → C₆H₁₂O₆ + 6O₂

Transpiration & Photosynthesis

Photosynthesis happens in the LEAVES of PLANTS.

Transpiration carries water to the leaves so that Photosynthesis can happen.

H₂O and minerals → CO₂ → O₂ → Sugar
Interception and Absorption

**Interception** = Stormwater that stays on the surfaces of the leaves and never reaches the ground before it evaporates.

**Absorption** = Stormwater that reaches the soil and is absorbed by tree roots.
Interception and Absorption

85% of a Tree’s Root Volume Lies Within Three Feet of the Soil Surface.
Without Interception and Absorption:

- Soil Becomes Saturated Faster
- Sheet Flow Volume Increases
- Dissolved Sediment and Pollutant Levels Increase
- Need for Stormwater Containment and Treatment Increases
Green Infrastructure vs Gray Infrastructure

*both provide benefits – both require maintenance*

<table>
<thead>
<tr>
<th>Green Infrastructure</th>
<th>Gray Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees</td>
<td>Storm Drains</td>
</tr>
<tr>
<td>Shrubs</td>
<td>Sewer Pipes</td>
</tr>
<tr>
<td>Herbaceous Plants</td>
<td>Retention Structures</td>
</tr>
<tr>
<td>Grasses</td>
<td>Pumps</td>
</tr>
<tr>
<td></td>
<td>Filters</td>
</tr>
<tr>
<td></td>
<td>Treatment Facilities</td>
</tr>
</tbody>
</table>
Can We Quantify the Potential Benefits?

Valdosta Championship Live Oak
940 Gallons/Year Avoided Runoff
20,232 Gallons/Year Total
Can We Quantify the Potential Benefits?

City of Gainesville, FL – 63 Square Miles – 135,000 Population

425 million gallons/yr avoided runoff - $3.8 million
Ecosystem Services include the amenities that the city’s tree population provides to community residents and visitors. These amenities can be described in both ecological and economic terms. Stormwater Reduction is the most economically valuable ecosystem service that trees growing in a developed setting provide.
What’s Our Strategy for Using Trees to Reduce Stormwater Runoff?

• Conserving Forested Areas
• Protecting Large Canopy Trees/Groups of Canopy Trees
• Retaining Pervious Surfaces
• Utilizing Pervious Materials
• Creating/Retaining Sufficient Sized Planting Spaces for Canopy Trees
• Right Tree/Right Place – Conflicts Between Trees & Infrastructure
• Invest in Keeping Trees Healthy
• Engineering Solutions
Conserving Forested Areas
Zero Lot Line Development
Protecting Canopy Trees During Construction

• It’s All About the Roots!
• Protect the Critical Protection Zone
  \[ \text{CPZ} = \text{DBH} \times 9 \]
• Fence the CPZ
• Prohibited Activities (Ideally)
  - Excavations
  - Trenching
  - Fill > 4 inches
  - Equipment Operation and Parking
  - Material Storage or Disposal

\[ \text{DBH} = 20” \]
\[ \text{CPZ} = 15 \text{ ft} \]
If You Have to Enter the CPZ:

• Protect the Trunk
• Leave the Pavement in Place
• Apply 8-12 inches Mulch over Geotextile
• Tunnel, Don’t Trench
Retain/Create Pervious Surfaces
Utilizing Pervious Materials

- Mulch
- Brick Pavers
- Permeable Pavers
- Gravel
- Pervious Concrete
- Asphalt
Brick
Gravel
Pervious Concrete
Not Good for Trees or Stormwater
Expand Your Mulch Bed
Stormwater Bumpout
Install Herbaceous Plants
Trees and Parking Lots

Needs More Trees!
---No Limerock under the Grass Island
---Swales Instead of Berms
Rain Garden
Trees and Medians
# Sufficient Sized Planting Spaces

<table>
<thead>
<tr>
<th>Tree Size</th>
<th>Rooting Space</th>
<th>Planting Strip Width</th>
<th>Space Between Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canopy</td>
<td>300 ft²</td>
<td>8-10 ft</td>
<td>30-35 ft</td>
</tr>
<tr>
<td>Mid-Stpy</td>
<td>150 ft²</td>
<td>6-8 ft</td>
<td>20-25 ft</td>
</tr>
<tr>
<td>Small</td>
<td>40 ft²</td>
<td>&gt;4 ft</td>
<td>&gt;10 ft</td>
</tr>
</tbody>
</table>
Insufficient Sized Planting Spaces
Structural Soil

- Stone particle
- Soil particle
- Air or water pore
- Stone contact points where load is transferred

**SMALL TREE**
mature crown spread = ~20' in diameter
- ~37' of CU-Soil™ & 100 ft of loam soil

**MEDIUM TREE**
mature crown spread = ~30' in diameter
- ~107' of CU-Soil™ & 100 ft of loam soil
- ~1450' of CU-Soil™

**LARGE TREE**
mature crown spread = ~40' in diameter
- ~2362' of CU-Soil™ & 100 ft of loam soil
- ~2500' of CU-Soil™
Suspended Pavement

Tree Trunk

Root System

Silva Cells
Tree Species Selection

*The larger the tree, the more stormwater it can manage.*
Which Species Provides the Most Runoff Avoidance?

<table>
<thead>
<tr>
<th>Species</th>
<th>Runoff Avoidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Poplar</td>
<td>620 gal/yr</td>
</tr>
<tr>
<td>Baldcypress</td>
<td>500</td>
</tr>
<tr>
<td>Redcedar</td>
<td>480</td>
</tr>
<tr>
<td>Slash Pine</td>
<td>400</td>
</tr>
<tr>
<td>Shumard Oak</td>
<td>350</td>
</tr>
<tr>
<td>Live Oak</td>
<td>300</td>
</tr>
<tr>
<td>Magnolia</td>
<td>275</td>
</tr>
</tbody>
</table>

All Trees are 20 inch dbh
Recommended Tree Species

- Live Oak
- Nuttall Oak
- Swamp Chestnut Oak
- Shumard Oak
- Yellow Poplar
- Southern Magnolia
- Sweetbay
- Sycamore
- Baldcypress
- Tupelo Gum
- Red Maple
- Ginko
- Hickories
- Winged Elm
- Slash Pine
- Redcedar
Sources of Information


• City of Philadelphia http://www.phillywatersheds.org/what_were_doing/green_infrastructure.


• “Up By Roots” by Jim Urban, ISA Website
Tree Risk Assessments
Tree Appraisals
Pre-Development Tree Evaluations
Expert Witness Testimony
On-site Tree Preservation
Arborjet Tree Injections
Natural Areas Management Planning
Street / Park Tree Inventory
Canopy Analysis
Urban Forest Management Planning
i-Tree Ecosystem Analysis
Grant & Ordinance Preparation
Educational Workshops
Urban Forestry Outreach & Promotion

Legacy Arborist Services

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