



Mayor Keisha Lance Bottoms

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

Tamara Graham, Project Manager



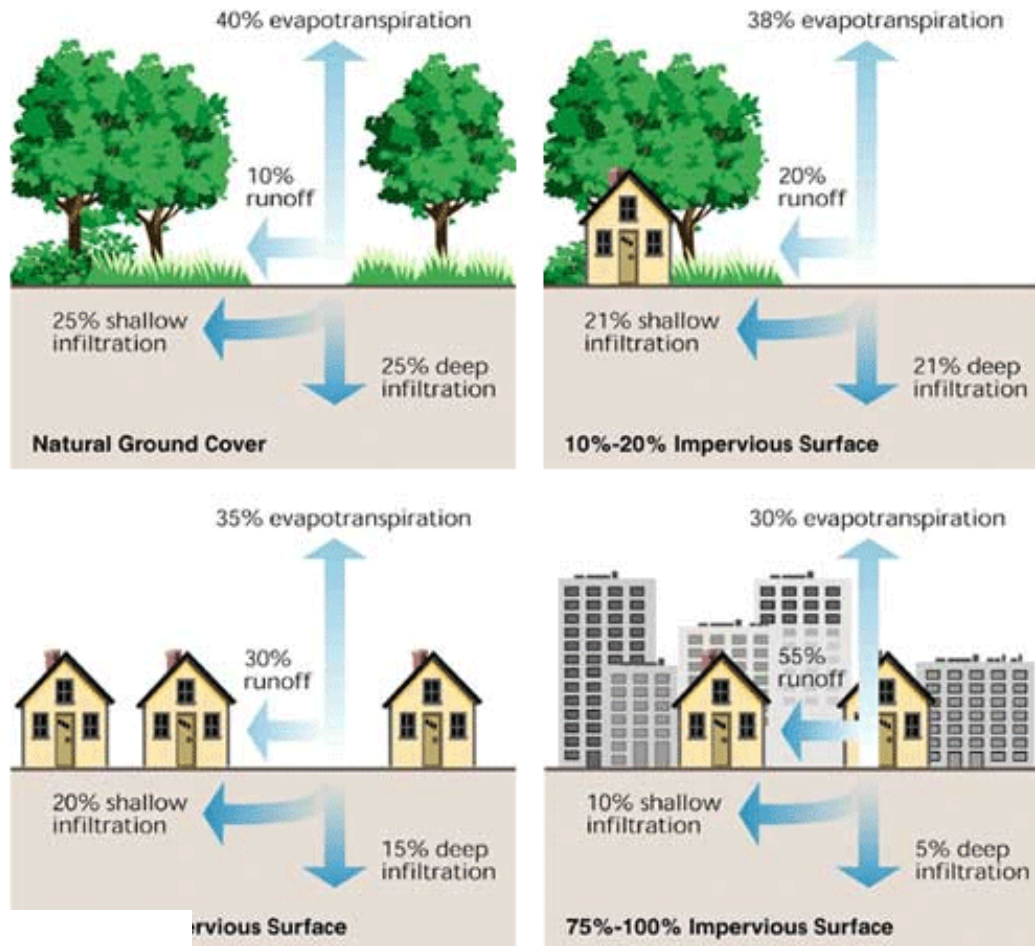
**Kishia L. Powell, Commissioner**  
Department of Watershed Management

8/19/2019





# How Urbanization Exacerbates Flooding







# Stormwater Issues are City-wide

## Damaged Infrastructure



## Street Flooding



## Water Quality Issues

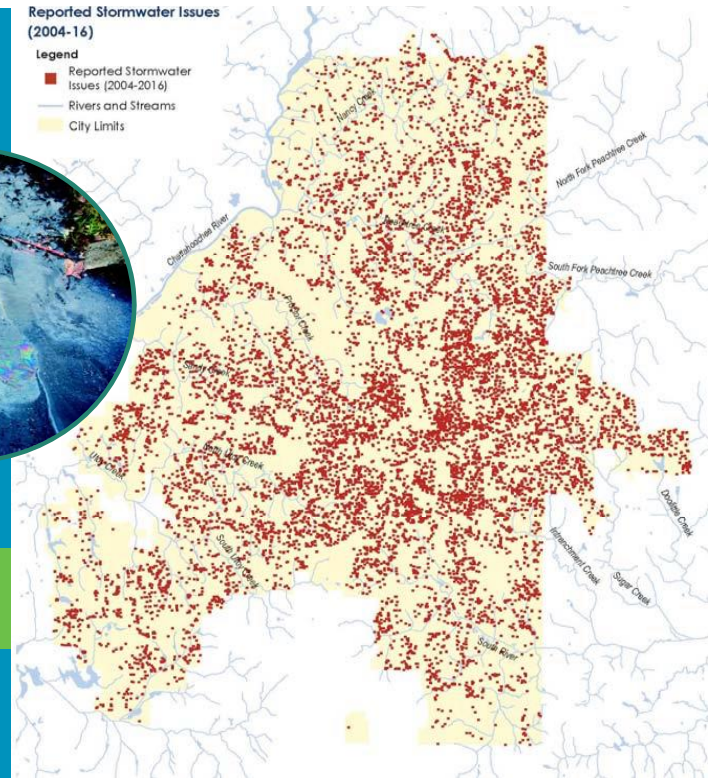


DWM receives about 1,300 complaints about stormwater issues every year.

Issues are city-wide.

Reported Stormwater Issues (2004-16)

- Legend
- Reported Stormwater Issues (2004-2016)
  - Rivers and Streams
  - City Limits





# Green Infrastructure Strategic Action Plan

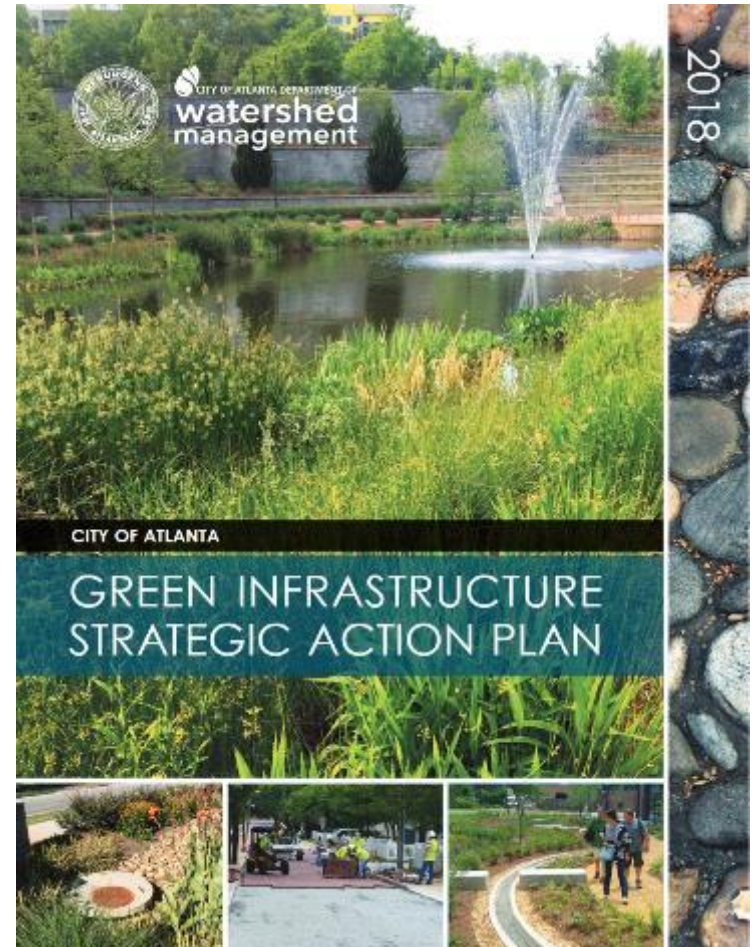
The City of Atlanta adopted the Department of Watershed Management's Green Infrastructure Strategic Action Plan in 2017

**Goals:** to integrate green infrastructure across city departments to manage stormwater and provide multiple co-benefits

**GREEN INFRASTRUCTURE GOAL:**

**225** Million Gallon  
Reduction of  
Runoff Annually

(Annual 1% reduction in volume  
of runoff from a 1" storm)





# What is Green Infrastructure?

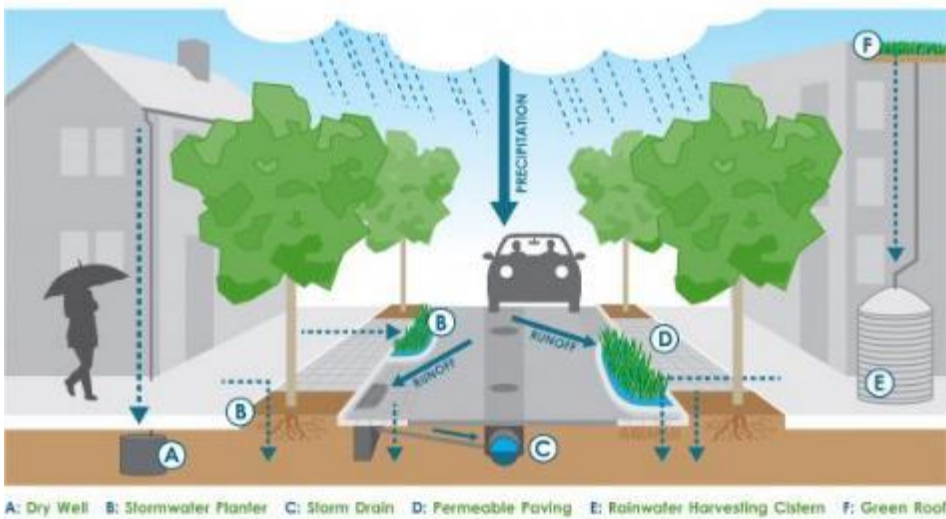
- An interconnected natural or engineered system that preserves or mimics undeveloped hydrologic functions
- Capture the first 1.0” of rainfall
  - Infiltration
  - Evapotranspiration (uptake of water by plants + evaporation)
  - Reuse through rainwater harvesting







# 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



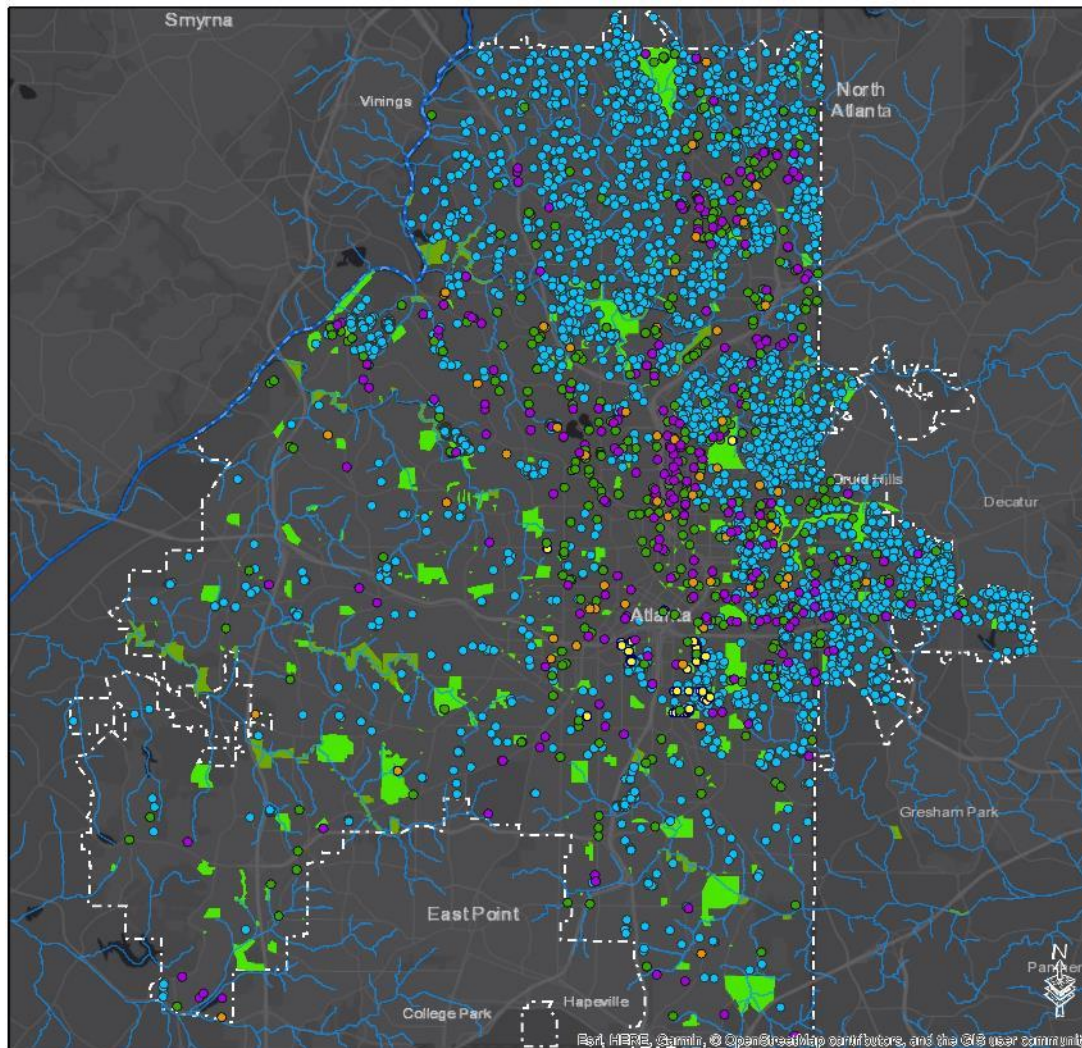
**Wet Pond**  
Historic Old 4<sup>th</sup> Ward  
Park



**Bioswale**  
Fernbank Museum



# GI on Private Properties



## Post-Development Stormwater Management Ordinance Map

### Legend

- Commercial- Completed
- Commercial- Under Construction
- Commercial- Not Started
- City-Owned Projects
- Residential Projects
- DWM Greenway
- DWM Greenspace
- Park

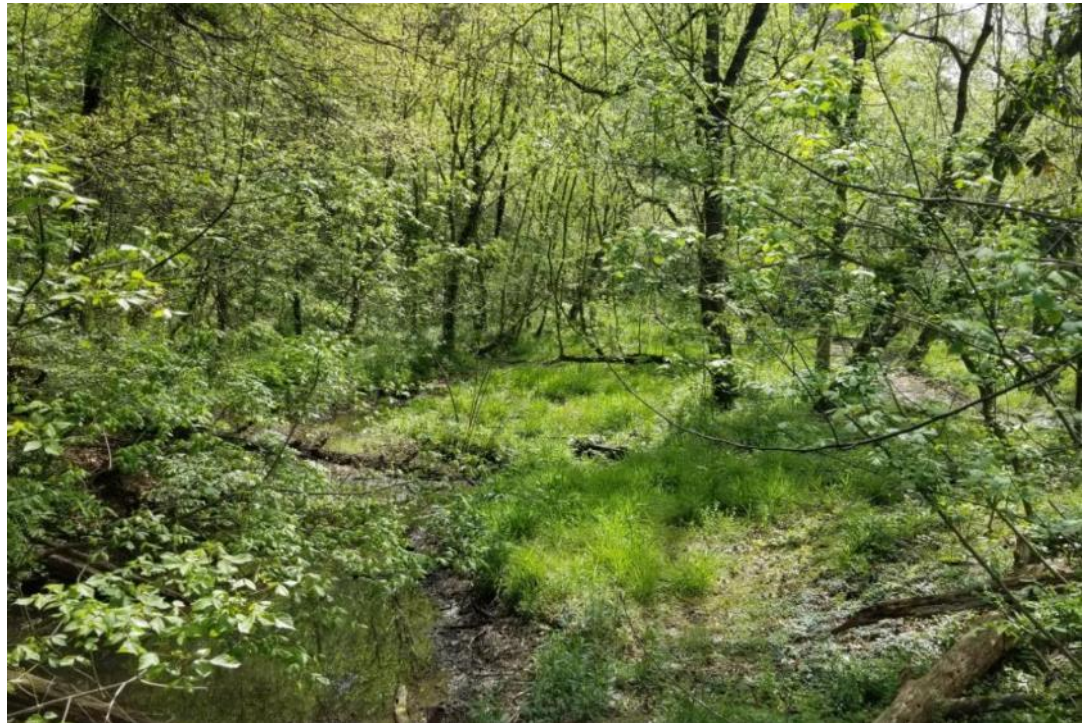




# Natural Green Infrastructure

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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.



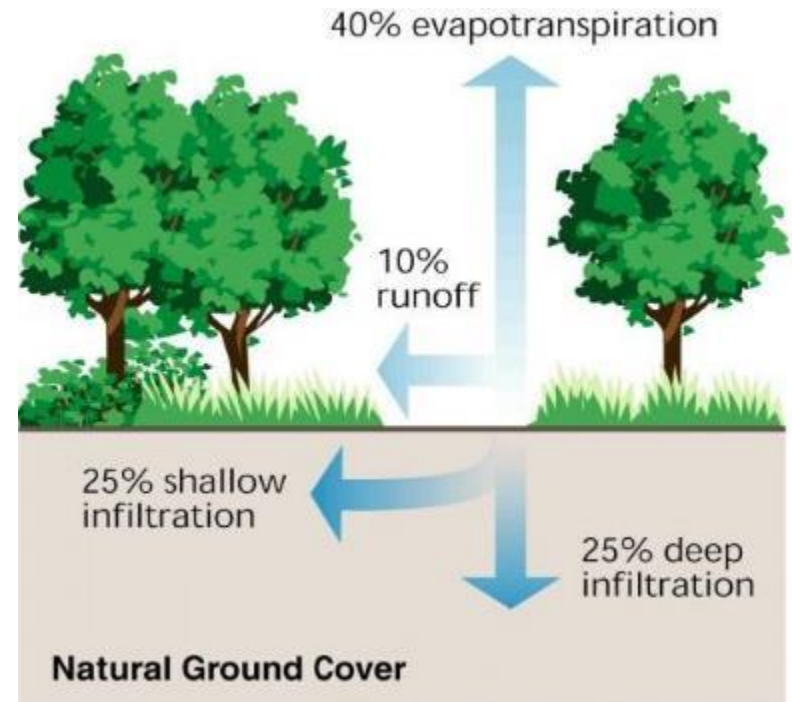




# Hydrology in a Natural Watershed



Very little runoff leaves a forest...





# Hydrology in a Natural Watershed

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The forest's dense canopy cover and layers of vegetation intercept raindrops, dissipating the impact of rain



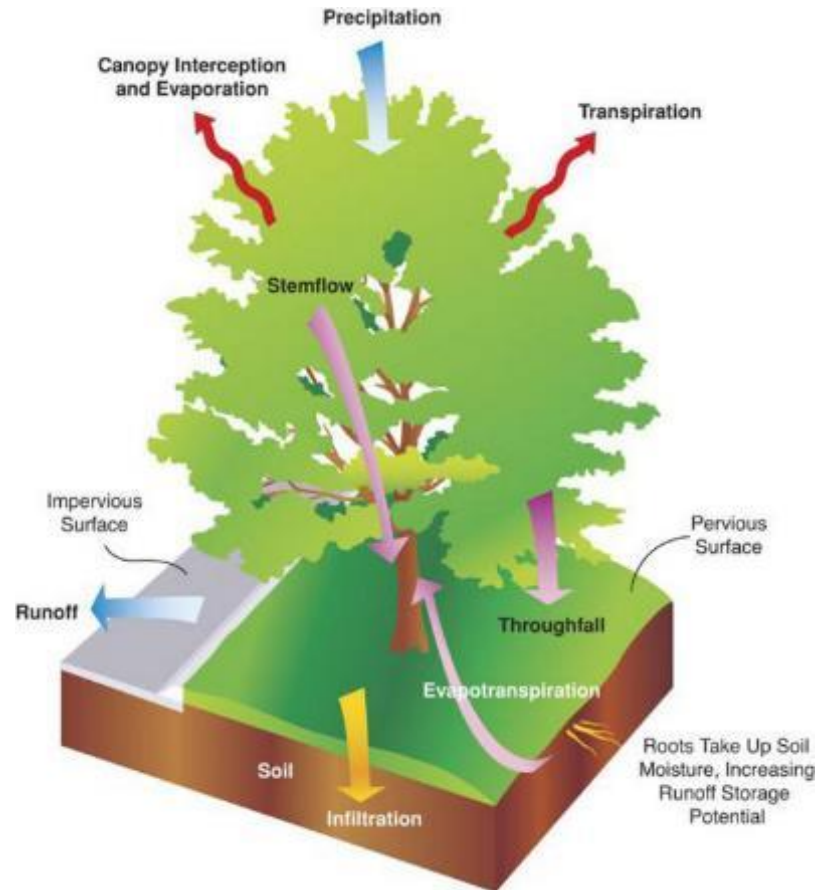
Moisture evapotranspires through the vegetation, cooling the air



# More Strategic Approach to Urban Watershed Forestry

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

**Invasive  
management**  
to meet  
recompense  
requirements

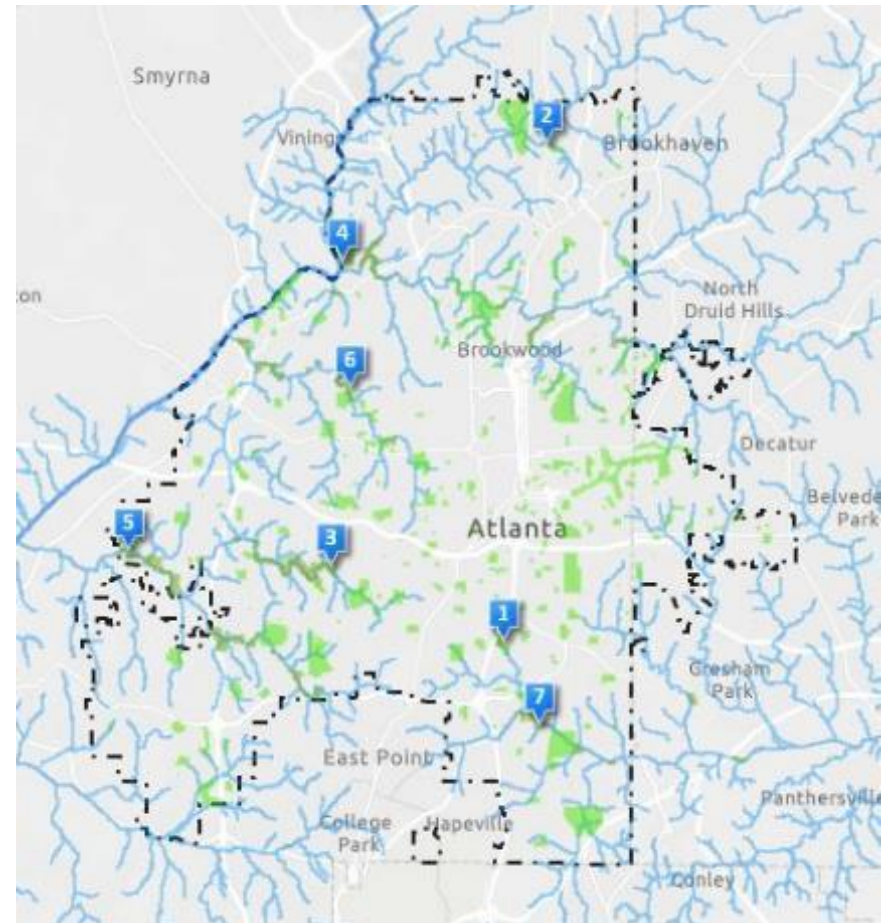
Identifying  
**“receiving sites”**  
for trees for  
renaturalization



# 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.

Property Category	Number of properties	Acres
Greenway-Consent Decree-Fee	99	767.43
Greenway-Consent Decree-CE	55	1,152.85
Greenway-non-Consent Decree-Fee	2	6.40
Greenway-non-Consent Decree-CE	2	23.56
Greenspace-FEMA	10	4.20
Greenspace-Other	5	13.80
<b>TOTAL</b>	<b>173</b>	<b>1,968.23</b>





# Greenway & Greenspace Properties

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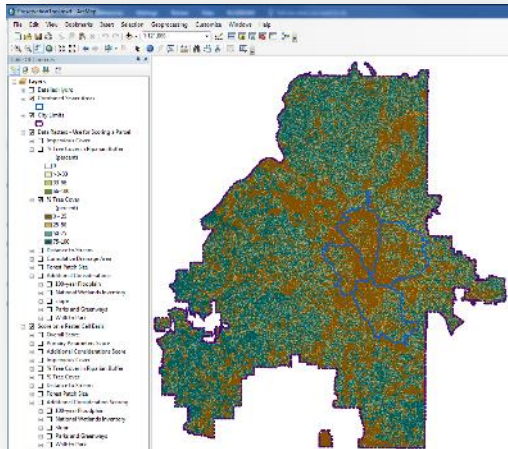




# Preservation Evaluation Tool

Tool consists of two components

- GIS for analysis
- Excel for evaluation and documentation



**Primary Parameters**

Select the values left column for the area of interest for each item below:

Existing	Proposed	Parameter	W	S	I	N	Weighting Factor	Score Range	
		Input parcels' impervious cover as percent	Impervious Cover	yards of parcel(s) size	yards of parcel(s) size	yards of parcel(s) size	yards of parcel(s) size	3	0-100
		Input parcels' average tree cover as percent	% Tree cover in riparian buffer	feet to tree canopy on parcel	feet to tree canopy on parcel	feet to tree canopy on parcel	feet to tree canopy on parcel	0.75	0-3.75
		Input parcels' average % tree cover	% Tree cover	Location (left forested cover on parcel)	open/low cover	open/low cover	open/low cover	2.25	0-11.25
		Input forest distance to stream that separates the parcel(s)	Distance to stream	Closest stream per 1000 feet	Closest stream per 1000 feet	Closest stream per 1000 feet	Closest stream per 1000 feet	1	0-5
		Input parcel(s) view impairment of upstream watershed	View in the watershed	Parcel(s) size (sq ft of stream watershed area)	Parcel(s) size (sq ft of stream watershed area)	Parcel(s) size (sq ft of stream watershed area)	Parcel(s) size (sq ft of stream watershed area)	2	0-100
		Select parcel(s) of largest forest patch that intersects or is adjacent to parcel(s)	Forest patch size	no small forest patch (1000 sq ft or smaller)	small med or large forest patch (10000-100000 sq ft)	small med or large forest patch (10000-100000 sq ft)	large forest patch (100000-1000000 sq ft)	4	0-100

**Score Summary**

Impervious Cover: 100  
 % Riparian Tree Cover: 100  
 % Tree Cover: 100  
 Distance to Stream (median in watershed): 100  
 Forest Patch Size: 100  
 Viewed Score: 0

**Additional Considerations**

Existing	Proposed	Score Adjustment	Yes	No
		Are yr FEM/ floodplain on the parcel(s)?	15	-10
		Wetlands on the parcel(s)?	15	-10
		Parcel(s) average slope > 1%?	15	-10
		Parcel(s) connects to existing park or greenways?	15	-10
		Existing parcel within 10 minute walk (0.2 mile) of the parcel(s)?	10	15
		Cost-sharing opportunity with another partner?	15	-5
		Maintenance sharing opportunity with another partner?	15	-10

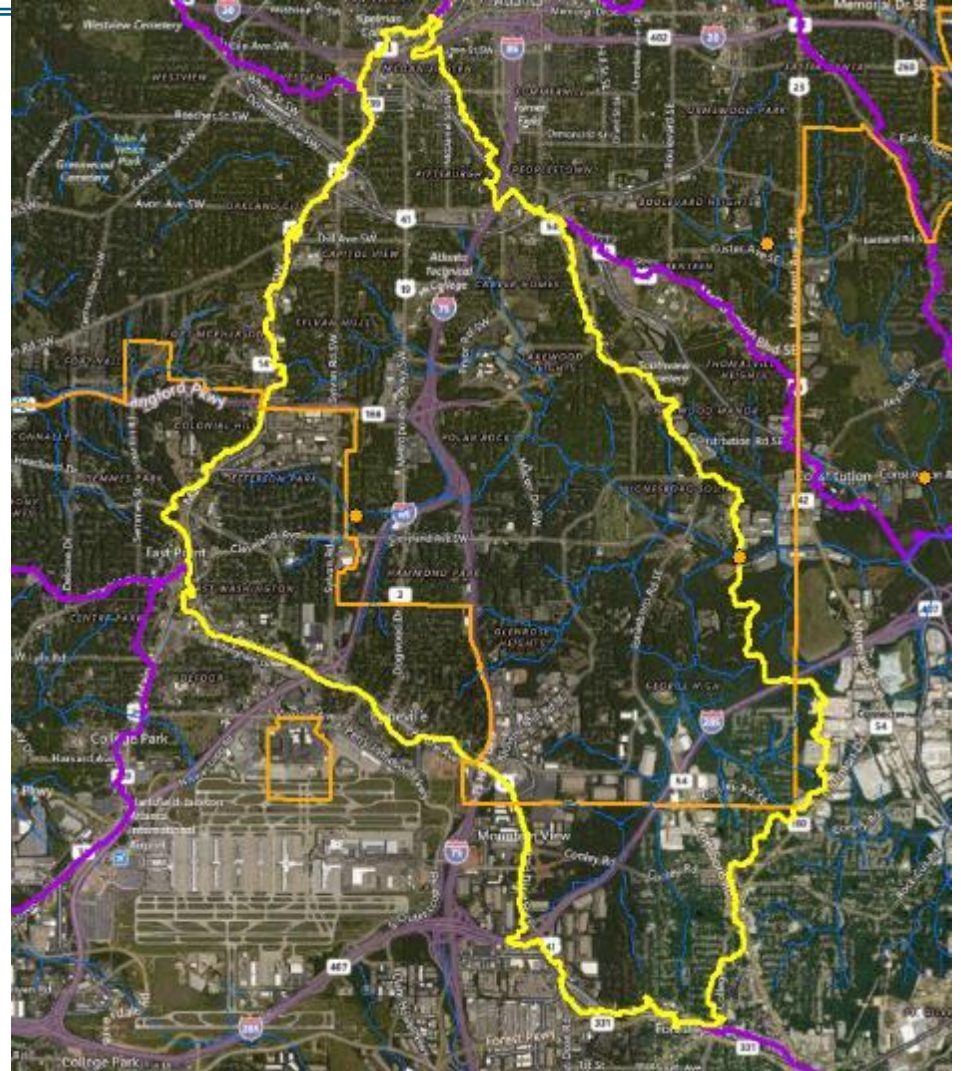
**INSTRUCTIONS:**

1. Fill in the Name and Location
2. Complete all yellow fields under the existing column. Refer to Preservation Evaluation Tool - Quick Start Guide for details on analysis methods for each parameter.
3. Complete the yellow fields under proposed if a proposed/improvised conditions assessment is needed, otherwise leave blank.



# i-Tree Hydro: South River Case Study

- Model area
  - Outlet at SOU-1 (USGS station 02203655)
  - 23.1 mi<sup>2</sup>
- Base model parameterization
  - Used additional parameterization developed by the forest service



Yellow boundary = i-Tree Study Area  
Purple boundary = watershed boundaries

# More Strategic Approach to Urban Watershed Forestry

Acquiring and  
Conserving  
high quality  
greenspaces

**Invasive  
management**  
to meet  
recompense  
requirements

Identifying  
**receiving zones**  
for trees for  
reforestation





# 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*



# More Strategic Approach to Urban Watershed Forestry

Tree ordinance has special provisions for DWM Consent Decree projects

Recompense can be met through:

- Invasive removal
- Planting live stakes, liners

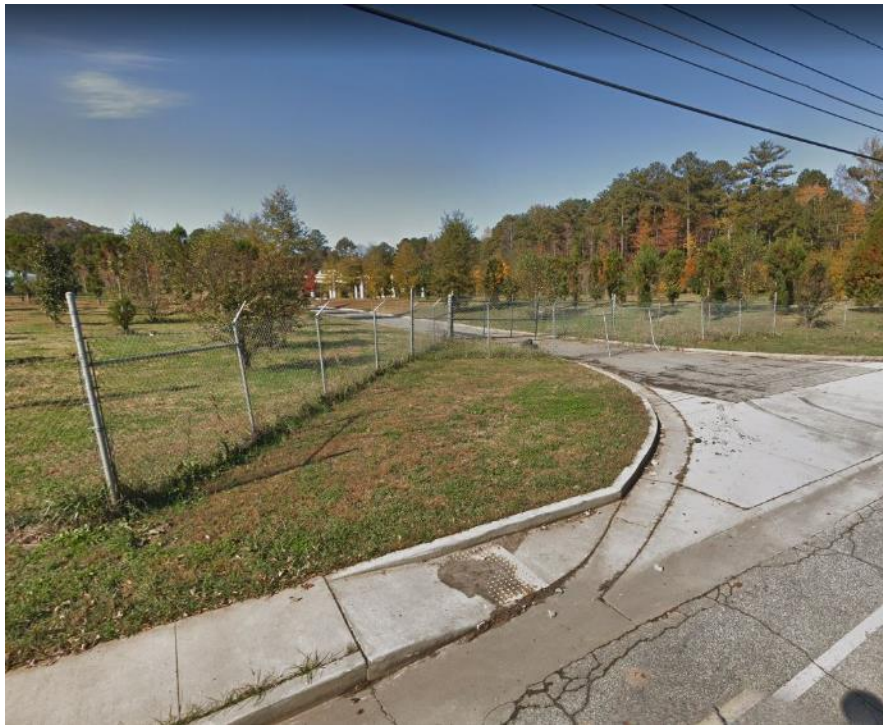






# Recompense site example DWM Properties

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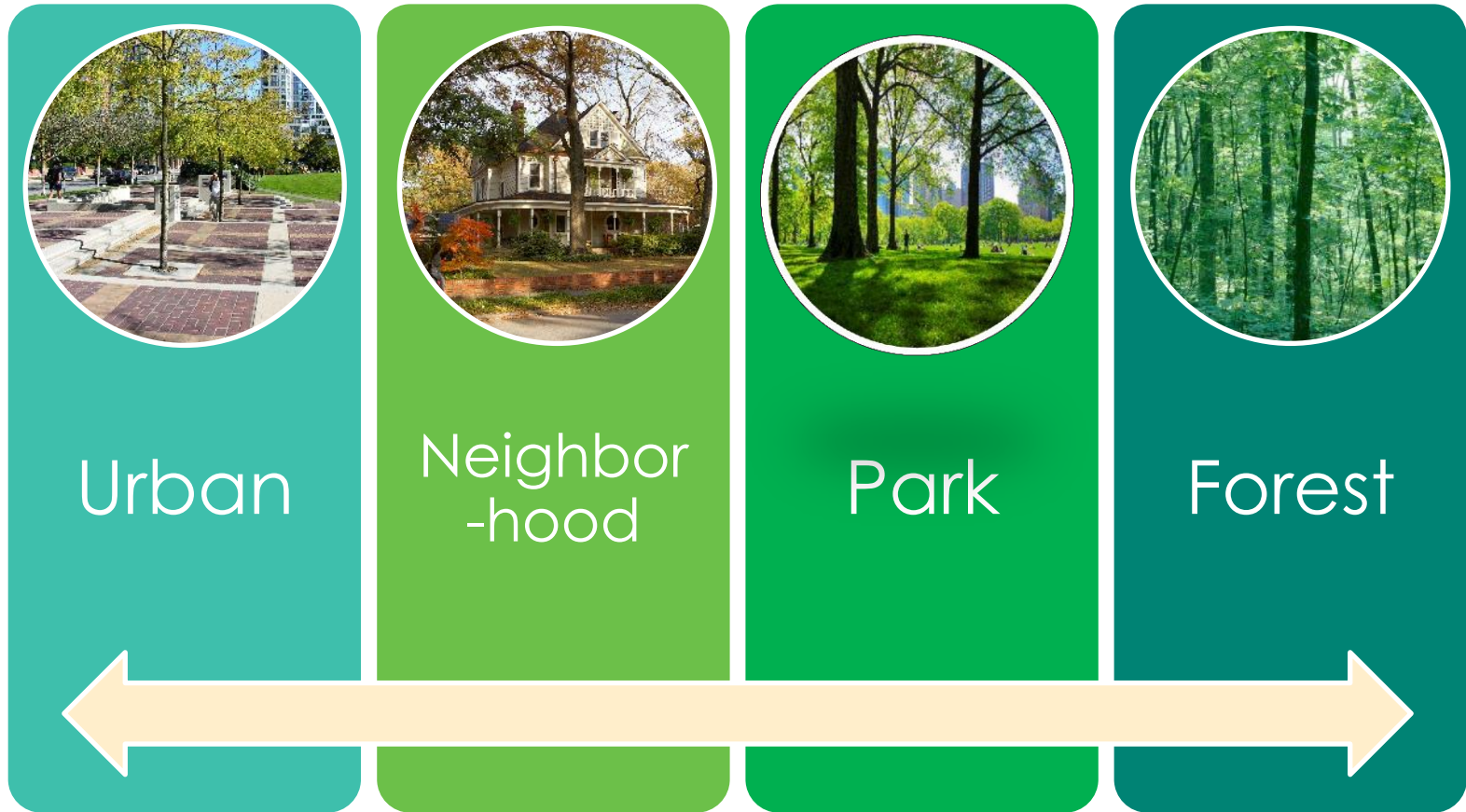


*South River Water Reclamation Plant*



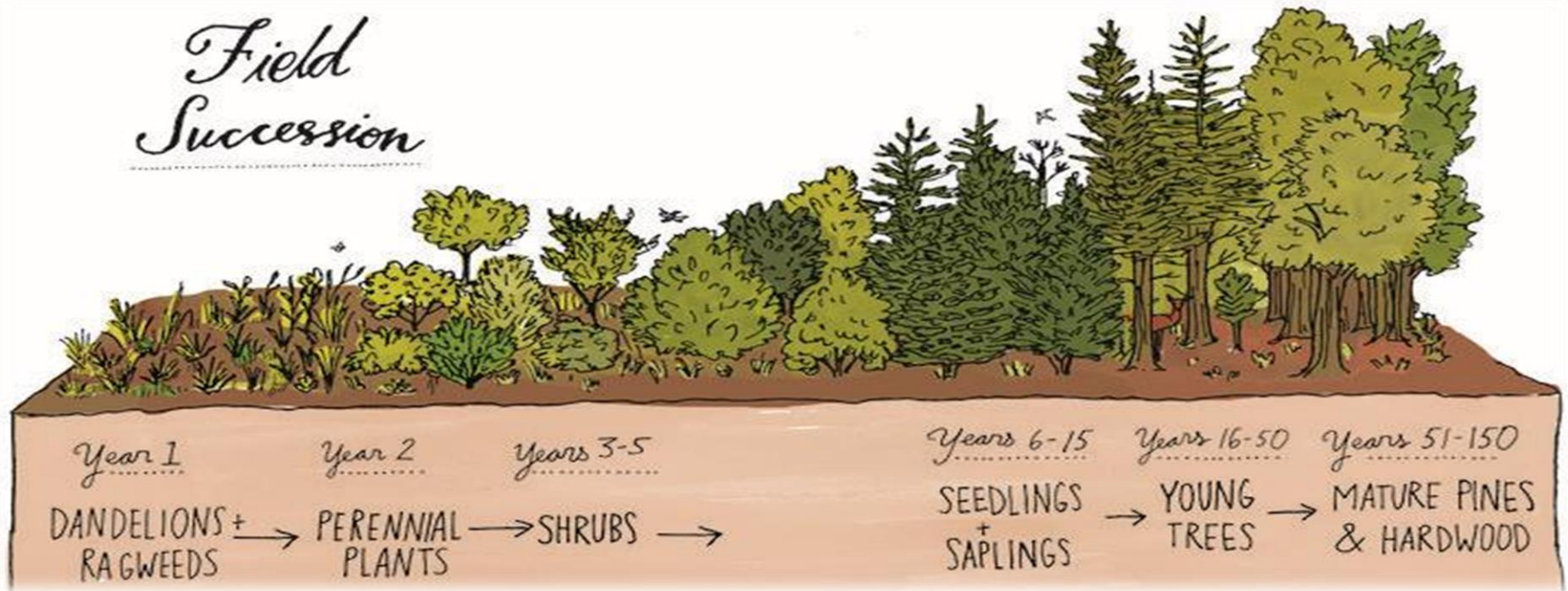


# Urban Forest “Continuum”





# Natural Ecological Succession



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



Original stream condition



Immediately after construction, 2013



Restored stream, summer 2015

## 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)



Constructed wetland, 1st season after planting, 2015





# “Jumpstarting” Succession



Immediately after construction, 2013

*Immediately after construction, 2013*



Restored stream, summer 2015

*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  
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high quality  
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**Invasive  
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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

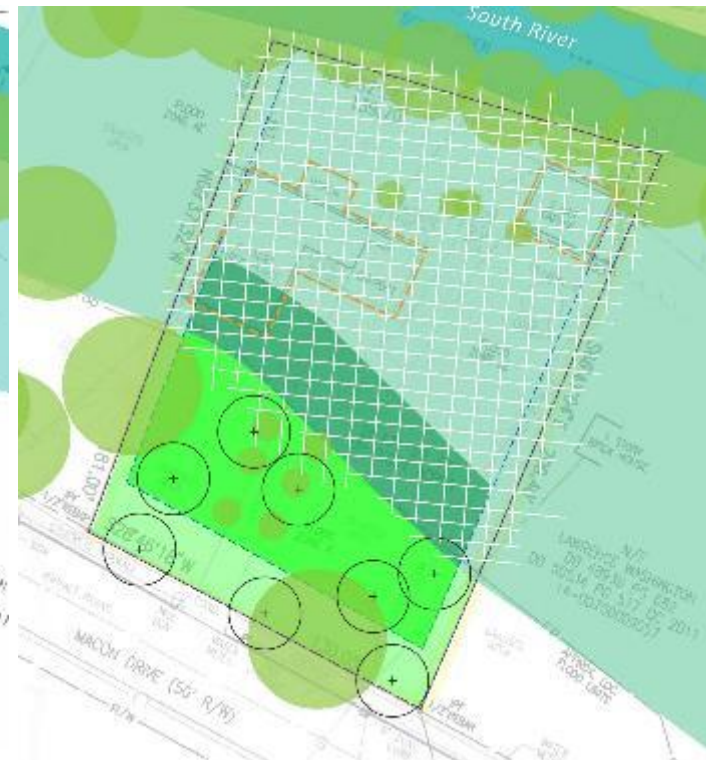






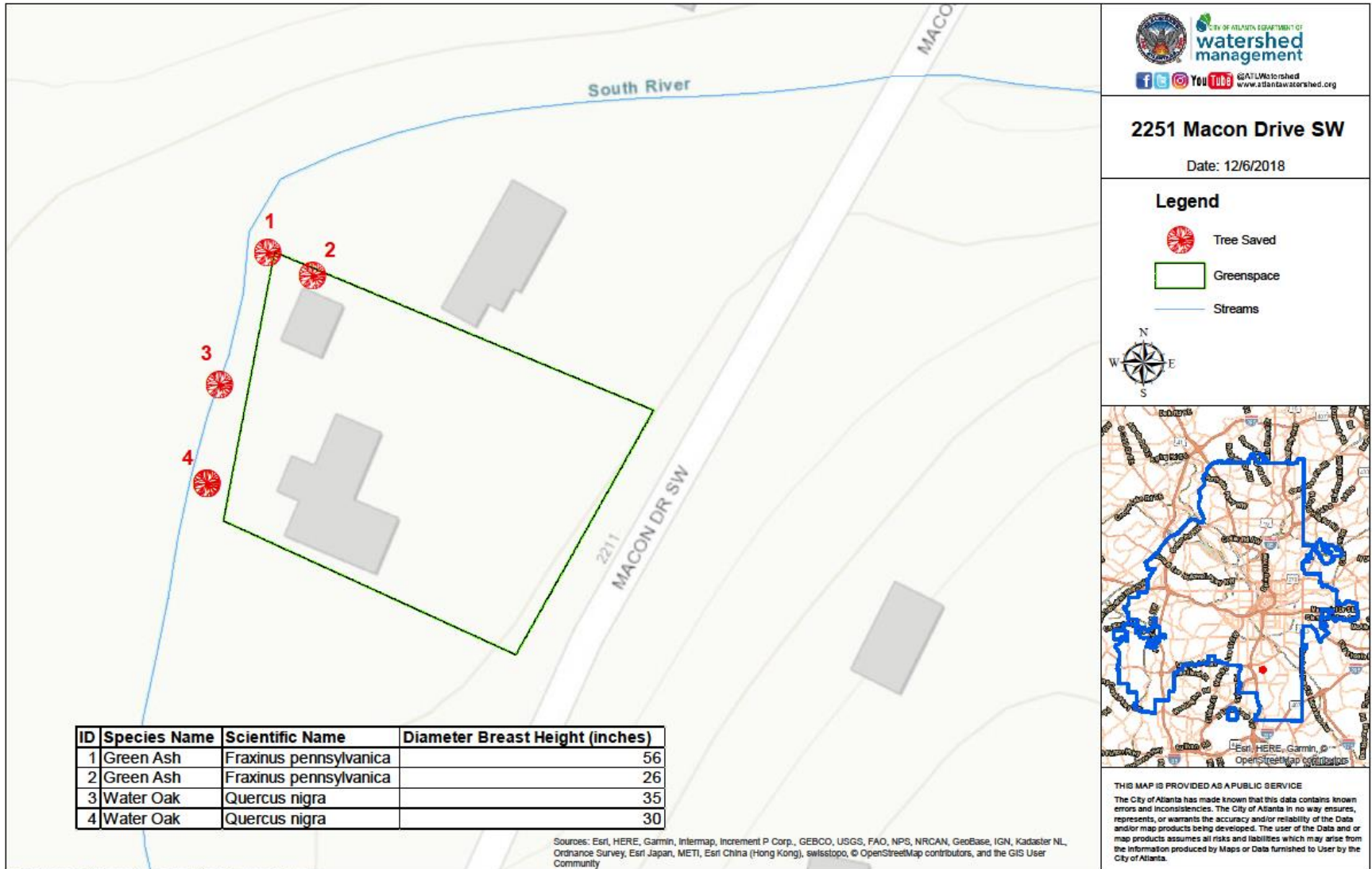
# Macon Drive Renaturalization Plan

-  Flood Limits
-  Existing Trees
-  Reforestation
-  Reforestation with shrub layer
-  Meadow (annual mow)
-  Turf (routine mowing)
-  Proposed Trees
-  Former structure





# Macon Drive Renaturalization







# 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

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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

Qty	Botanical Name	Common Name	Size	Tree Recompense Credits	unit
<b>Specimen/Street Trees</b>					
3	<i>Quercus falcata</i>	southern red oak	2" cal.	3	in
5	<i>Carya glabra</i>	pignut hickory	2" cal.	5	in
3	<i>Liquidambar styraciflua</i>	sweetgum	2" cal.	3	in
<b>Canopy Trees</b>					
12	<i>Liriodendron tulipifera</i>	tulip poplar	1" cal.	12	in
66	<i>Liriodendron tulipifera</i>	tulip poplar	whips	66	in
4	<i>Platanus occidentalis</i>	sycamore	1" cal.	4	in
12	<i>Platanus occidentalis</i>	sycamore	whips	12	in
4	<i>Liquidambar styraciflua</i>	sweetgum	1" cal.	4	in
12	<i>Liquidambar styraciflua</i>	sweetgum	whips	12	in
4	<i>Quercus nigra</i>	water oak	1" cal.	4	in
12	<i>Quercus nigra</i>	water oak	whips	12	in
<b>Mid-story trees</b>					
4	<i>Pinus taeda</i>	Loblolly pine	4 - 6'	4	in
12	<i>Pinus taeda</i>	Loblolly pine	7 gal.	12	in
4	<i>Ilex opaca</i>	American holly	4 - 6'	4	in
12	<i>Ilex opaca</i>	American holly	7 gal.	12	in
8	<i>Magnolia virginiana</i>	sweetbay magnolia	4 - 6'	8	in
16	<i>Magnolia virginiana</i>	sweetbay magnolia	7 gal.	16	in
4	<i>Ilex decidua</i>	possumhaw	7 gal.	4	in
12	<i>Ilex decidua</i>	possumhaw	3 gal.	12	in
<b>Shrubs</b>					
12	<i>Fothergilla gardenii</i>	fothergilla	3 gal		
12	<i>Calycanthus floridus</i>	sweetshrub	3 gal		
20	<i>Ilex verticillata</i>	winterberry	3 gal		
<b>Live stakes</b>					
84	<i>Salix nigra</i>	black willow			
84	<i>Cornus sericea</i>	red-osier dogwood			
<b>Total recompense credits</b>				<b>198</b>	in

## Saved Trees for Recompense credits

Species Name	Scientific Name	Diameter Breast Height (inches)
Green Ash	<i>Fraxinus pennsylvanica</i>	56
Green Ash	<i>Fraxinus pennsylvanica</i>	26
Water Oak	<i>Quercus nigra</i>	35
Water Oak	<i>Quercus nigra</i>	30
<b>Total recompense credits</b>		<b>147</b>

Total Recompense Credits=  
 Proposed Recompense Credits + Saved Recompense Credits  
 = 198 + 147 = 345 inches



# Natural Resources Management vs. Traditional Landscape Maintenance

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## **Conventional Maintenance**

“mow, blow and go....”



## **Natural Resources Management**

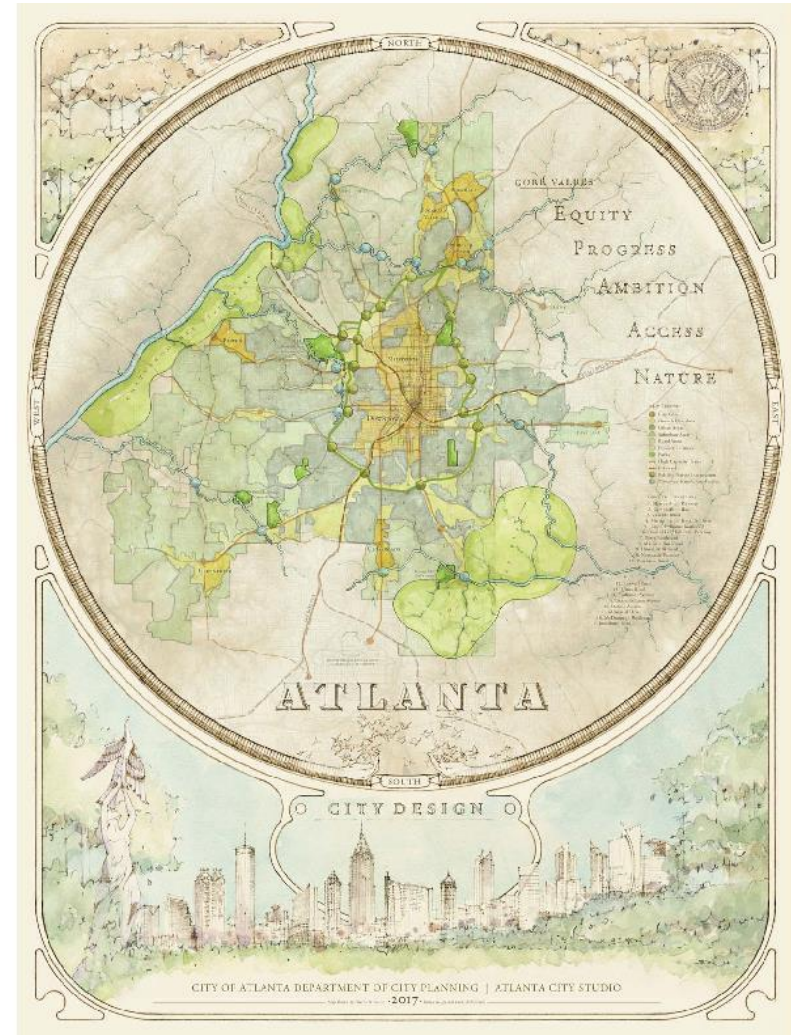
Controlling invasives, ecological restoration



# Moving Forward: Atlanta City Design Goals

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







# Atlanta City Design

## 5 Nature



Excerpt from *Atlanta City Design Plan, 2017*

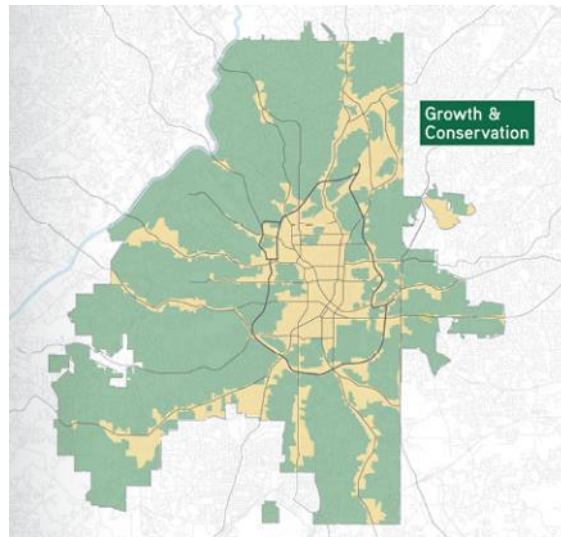
Our challenge for *nature* is to protect and expand the ecological value of our watersheds, forest and habitat in the face of rapid urbanization.



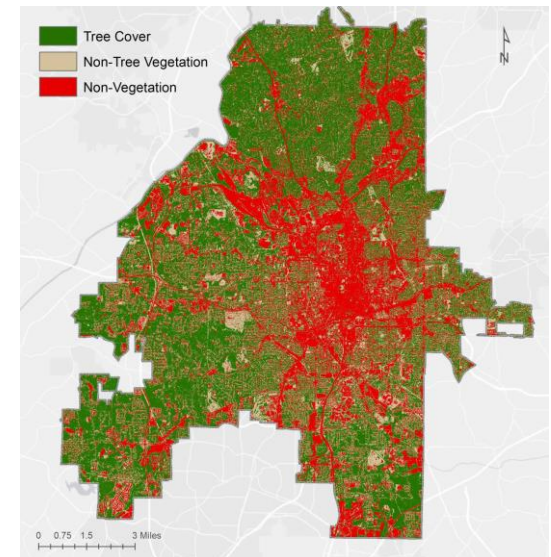
# Atlanta's Urban Canopy

## “The City in the Forest”

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



Areas of Growth & Conservation  
Atlanta City Plan



*\*Most of these trees are on private property*

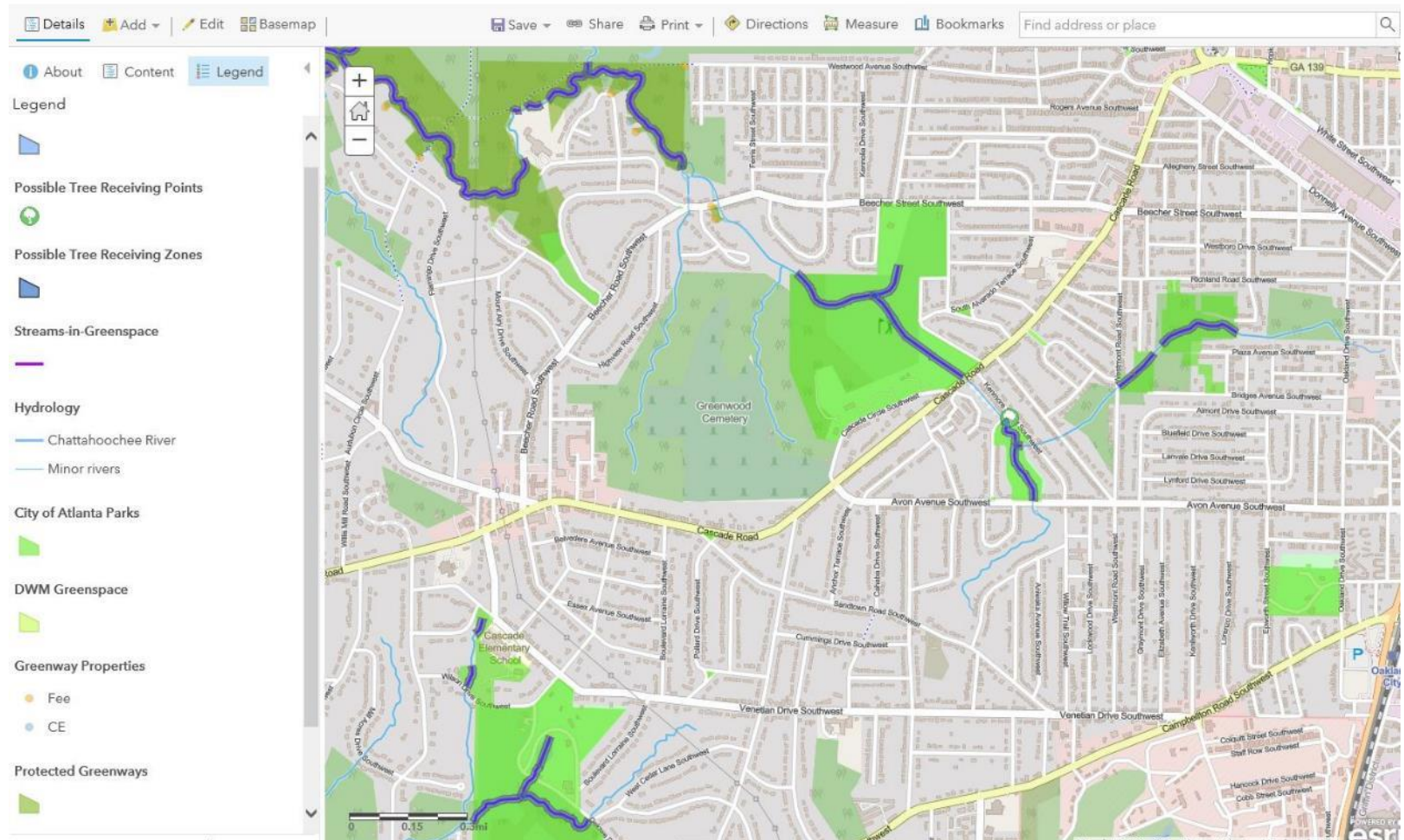




# Mapping Potential “Receiving Zones” City-Wide

Home ▾ Stream Buffer Restoration

New Map Tamara





# 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

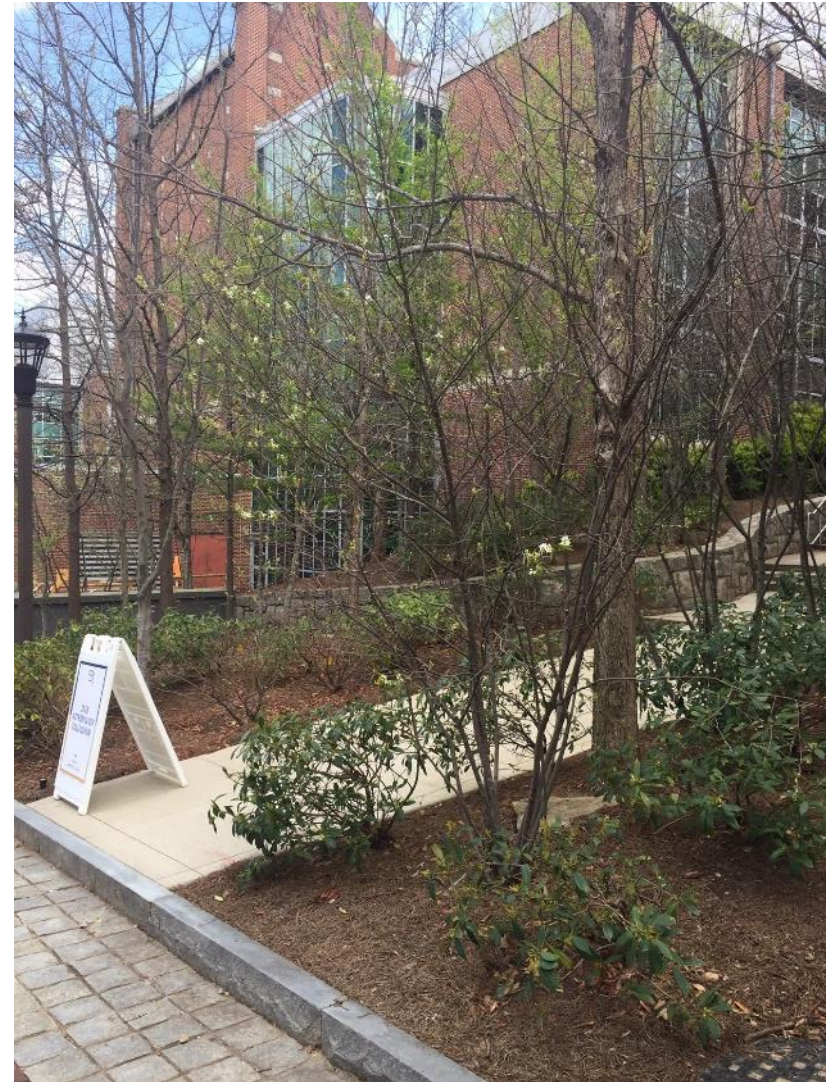




# Inspiration: GA Tech's Landscape Master Plan

Receiving Zones for trees:

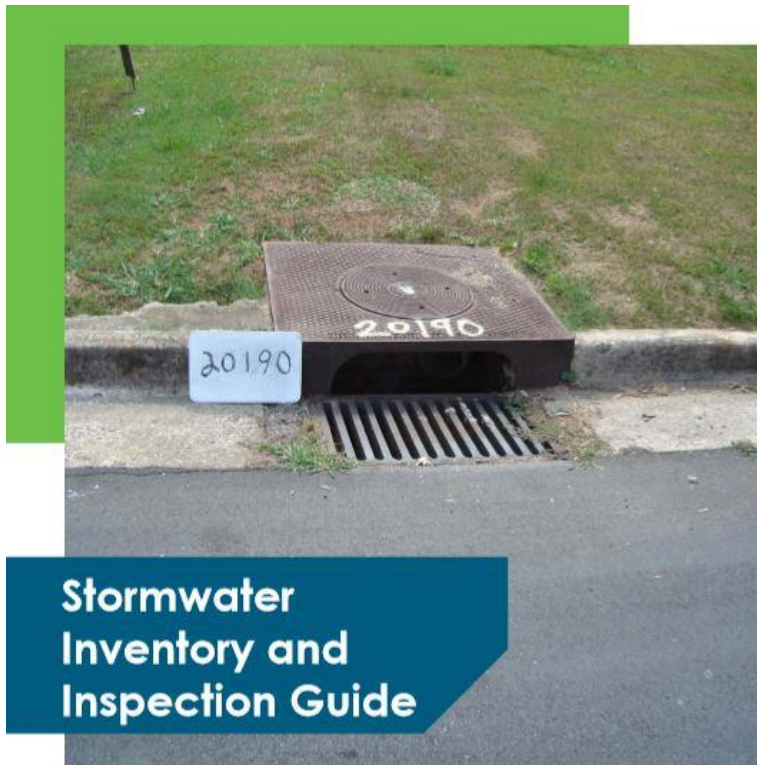
- Tighter spacing, staggered sizes
- diverse palette modeled on plant communities native to the Georgia Piedmont







# Trees are part of our stormwater infrastructure!



**Stormwater  
Inventory and  
Inspection Guide**

February 25, 2019 – Final DRAFT



## STORMWATER INVENTORY

### STRUCTURE TYPE

Evaluate the structure to identify one of the following stormwater structure types:

Hooded Catch Basin, Curb Inlet, Single Wing Catch Basin, Double Wing Catch Basin,  
Drop Inlet, Manhole, Flume, End of Pipe, Other

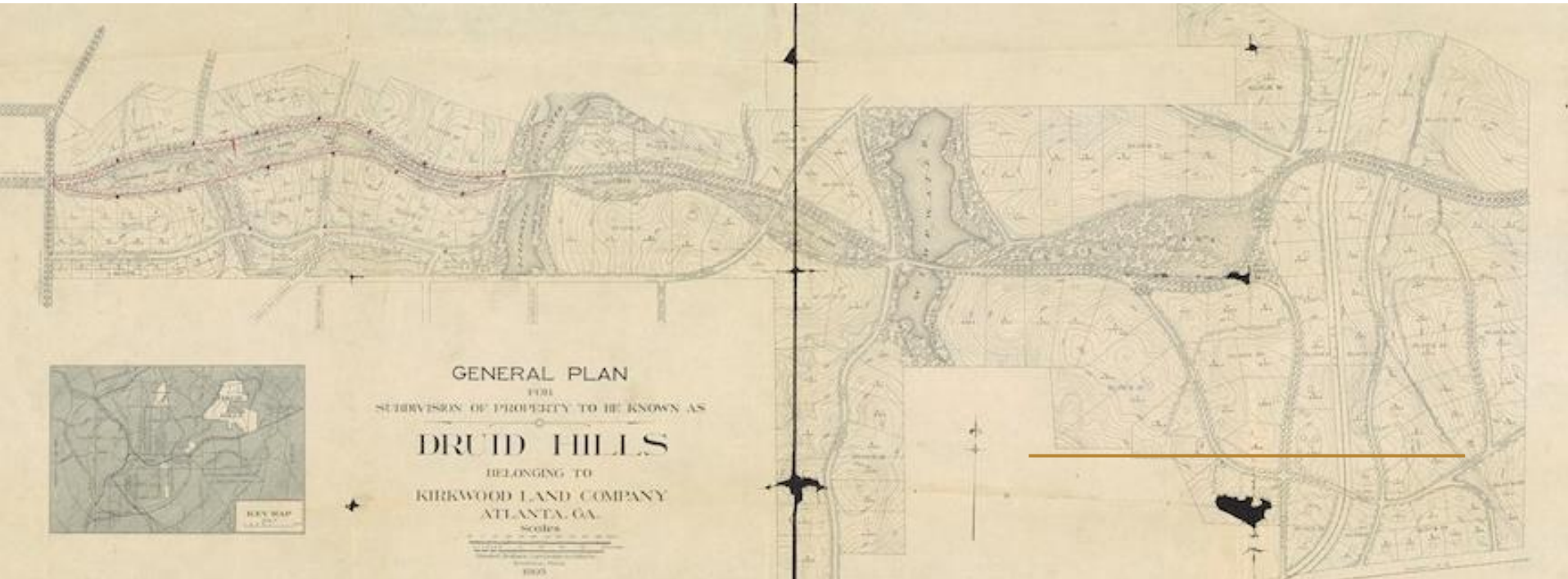
### Hooded Catch Basin







# Atlanta's Historic Green Infrastructure





# Atlanta: A City in the Forest



     @ATLWatershed  
[www.atlantawatershed.org](http://www.atlantawatershed.org)

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