Preserving Urban Tree Canopy for Stormwater Management in Wilmington, North Carolina

Presentation to Wilmington City Council
Monday Feb. 4, 2019

Green Infrastructure Center

CITY OF WILMINGTON NORTH CAROLINA

NORTH CAROLINA FOREST SERVICE NC

Today

1. Project Overview
2. Trees are Green Infrastructure
3. Results of Spatial Analysis Codes Findings
4. Community Input
5. Infiltration Maps

Green Infrastructure and Wildlife in North Carolina

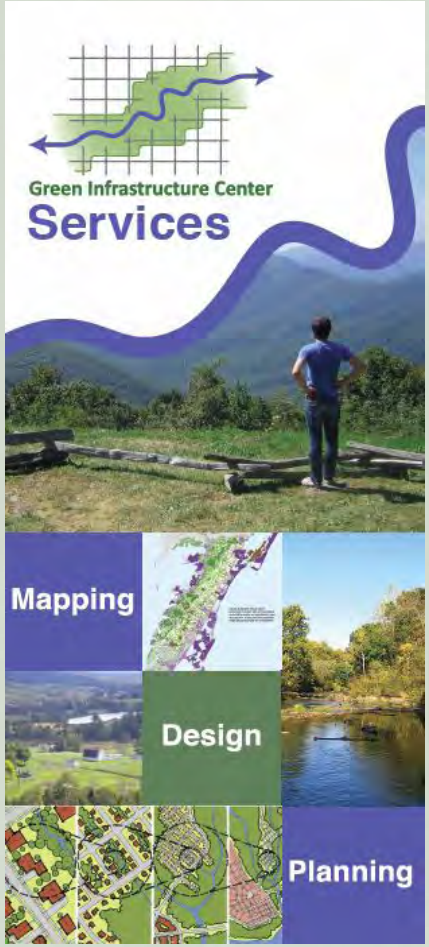
Pilot Tree Canopy Project

GIC and state forestry agencies concerned about flooding and implementing cost effective solutions have funded 6 states to develop pilot projects. These projects demonstrate how we can best utilize trees for stormwater management.

Flooding along Water Street in Wilmington

6 southern states:

SC, NC, GA, FL, AL, VA



Who are the project partners?

The Green Infrastructure Center and the North Carolina Forest Service sponsored the project!

The GIC is the technical service provider. The GIC helps communities evaluate green assets and manage them to maximize ecology, economy and culture. We:

Provide community assistance

Build landscape models

Teach courses and workshops

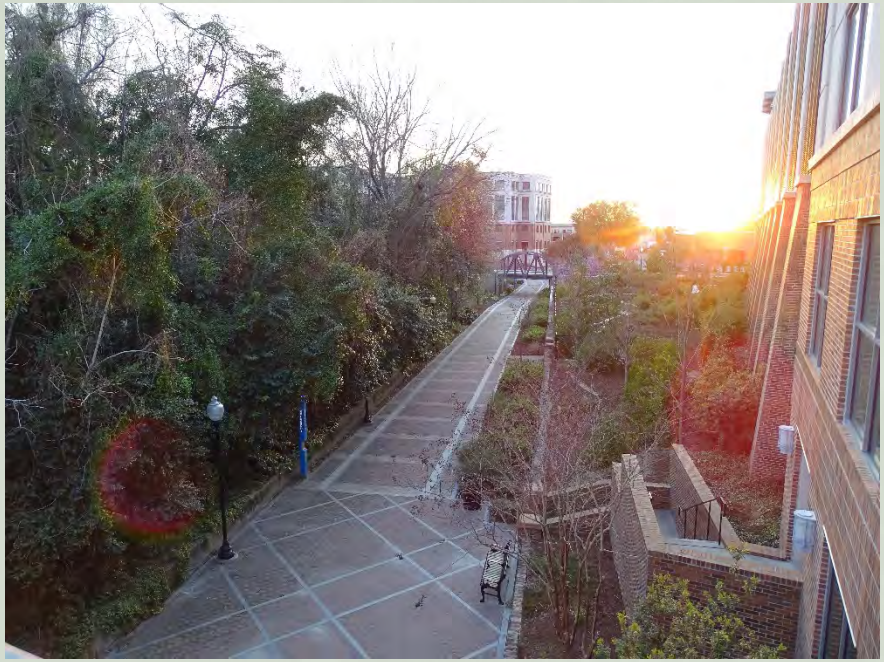
Research new methods

www.gicinc.org

Project Goals

This project is helped Wilmington map, evaluate, protect and restore its urban forests for improved stormwater management and clean water.

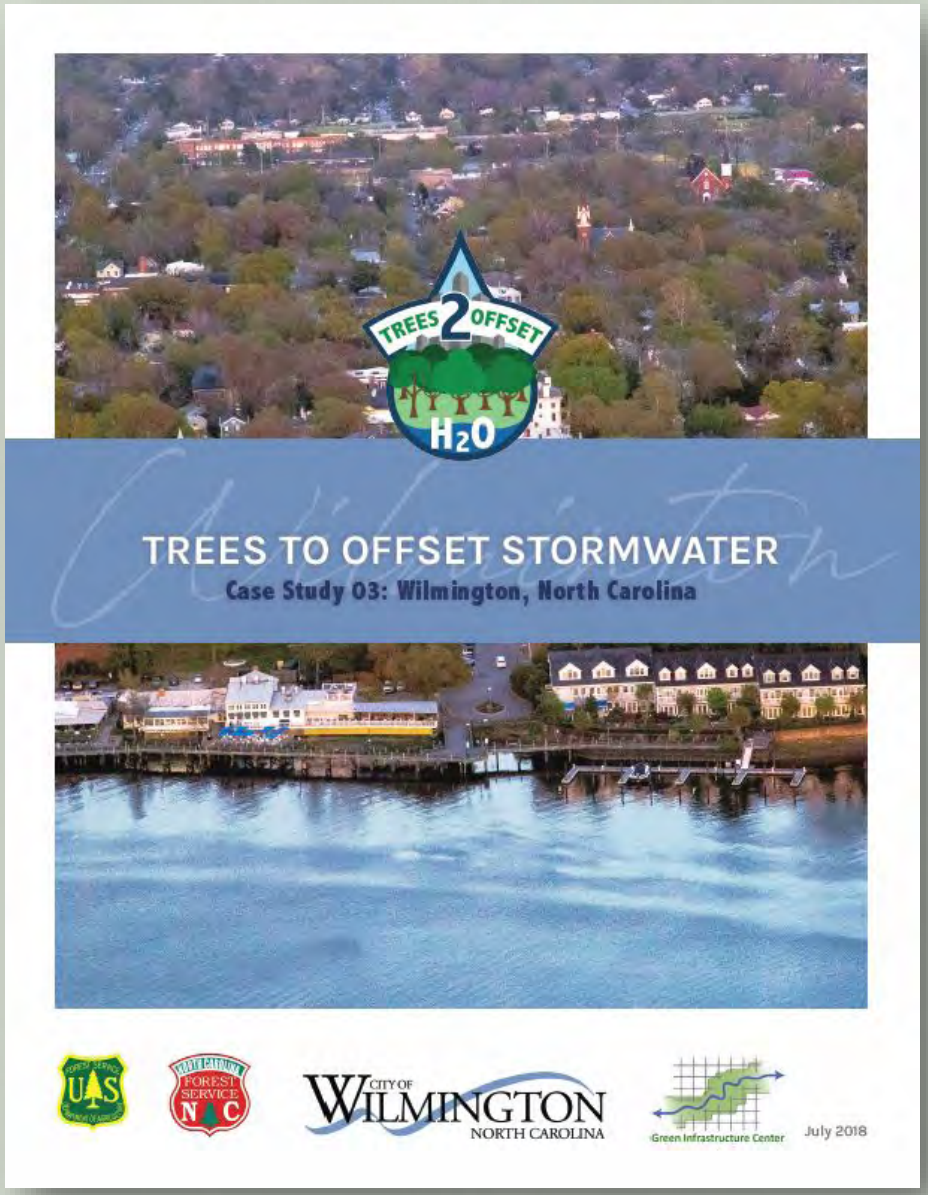
Urban forests are a vital tool in managing and reducing runoff.



Urban Forest in Wilmington

Project Outcomes

- ✓ Map of the urban forest and possible planting areas.
- ✓ Tools to link the urban forest systems to urban stormwater management.
- ✓ Recommendations for programs, codes, processes to better manage the urbab forest and reduce runoff.
- ✓ Sharing the work – a case booklet – at right!



Water flow strategies

How do we make this...

function like this?

This parking lot could be retrofitted so we get less of this …

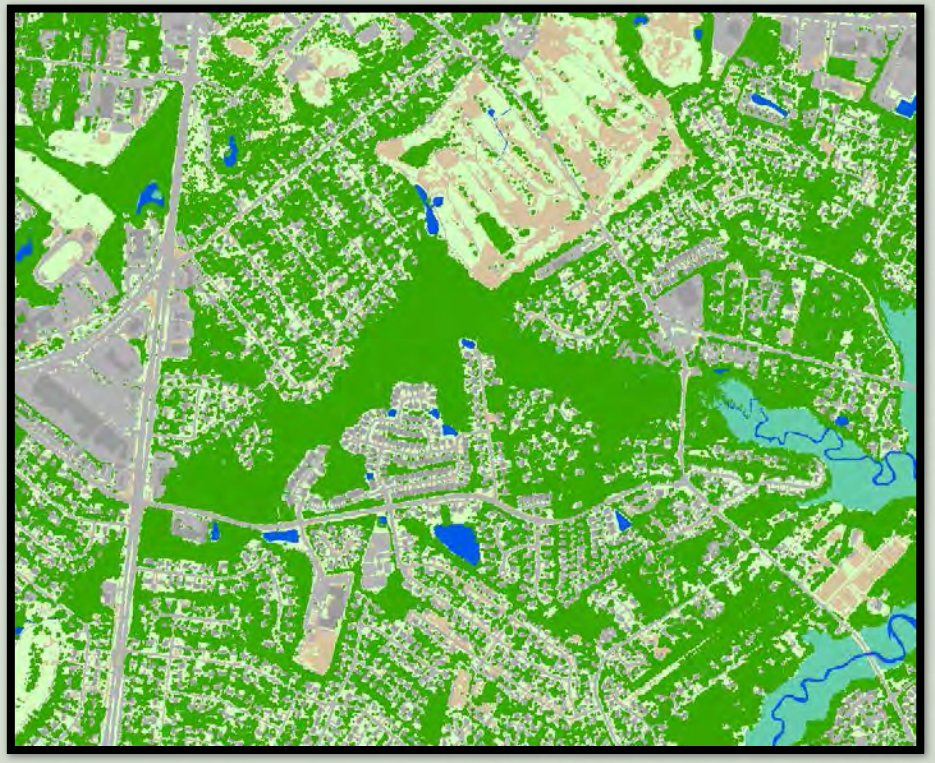
One acre of pavement releases 36 times more runoff than a forest.

During a rainfall event of one inch, one acre of forest will release 750 gallons of runoff, while a parking lot will release 27,000 gallons.

(PennState Extension).

Flooding in Wilmington, NC

What is green infrastructure?



Map of a portion of Wilmington showing gray infrastructure including buildings and roads (left). Classified high-resolution satellite imagery (right) adds a green infrastructure data layer (trees and other vegetation) .

Trees: the original – and best – green infrastructure!

Trees give us cleaner air, shade, beauty and stormwater benefits at a cost that is far cheaper than engineered systems!

Estimates for the amount of water a typical street tree can intercept in its crown, range from 760 gallons to 4000 gallons per tree per year, depending on species.

Trees: Create Healthy Communities

- Access to fitness opportunities. (addresses obesity, nature deficit disorders)
- Clean air – trees absorb pollutants, VOCs, filter runoff, cool the city. (combat asthma)
- Well being and mental health - - people heal faster when they can see or access green. (hospitals need this for patients, reduces absenteeism of workers)
- Less crime occurs near trees. (issue especially for downtowns and public housing areas)
- Employees will exercise if they can access green where they work and on the way to work. (addresses employee health)

Urban Tree Canopy Values

Trees provide more attractive areas for development, historic districts, commercial areas opportunities for people to interact with nature.

A study by the University of Washington found that people shopped longer and more often in tree-lined retail areas and spent about 12 percent more money.

Trees = more tax revenue even in developed commercial districts!

Job Development

Small companies, especially those that are have well paid and skilled workforce place a strong importance on the “green” of the local environment.
Crompton Love and Moore, 1997

The creative class: artists, media, lawyers, analysts, make up 30 percent of the U.S. workforce and they place a premium on outdoor recreation and access to nature.
Florida, 2002

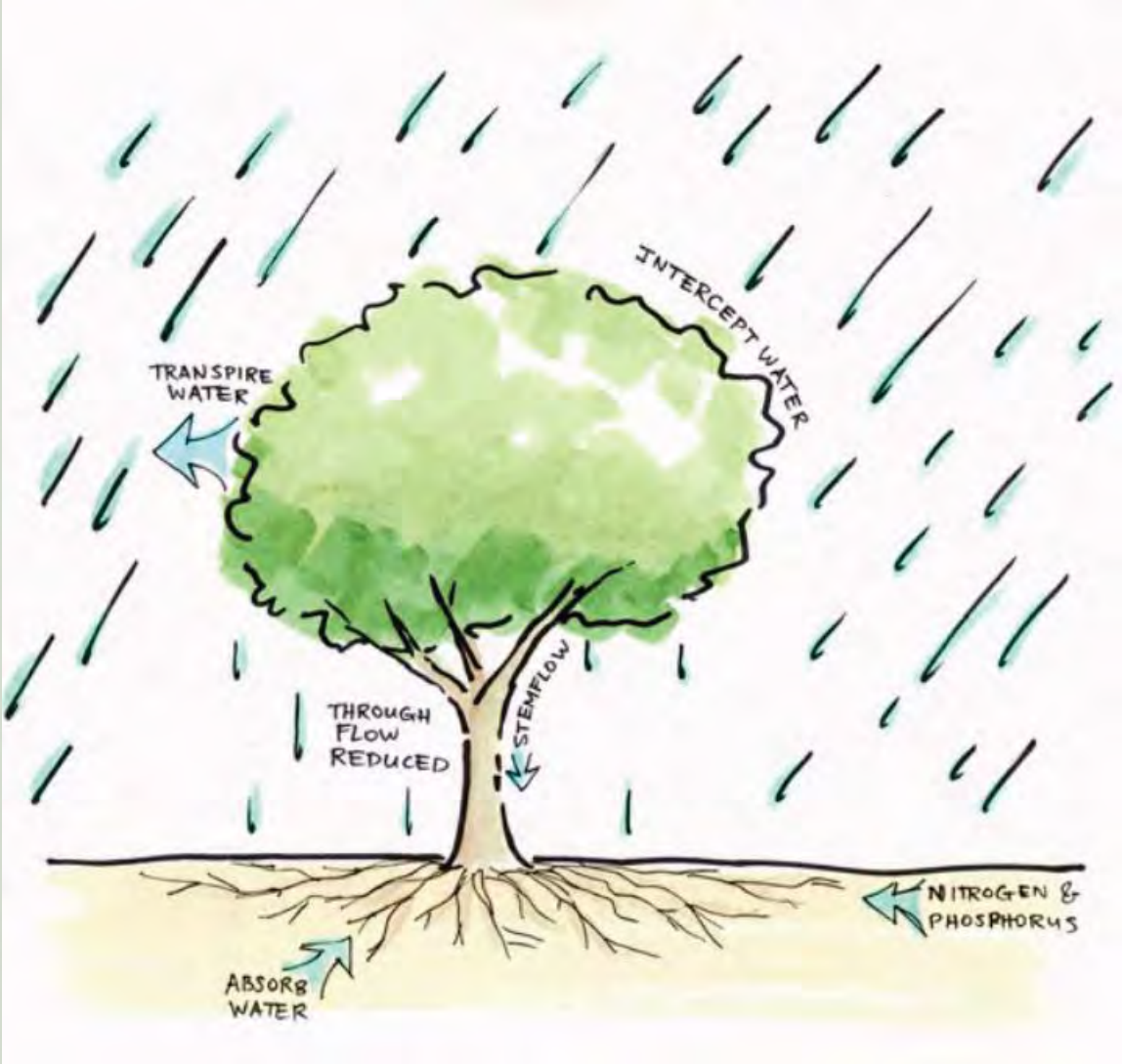
Trees and parks attract better paid jobs and thus a better tax base = $

Urban Tree Canopy

20% of annual rainfall or > retained in crown
(Xiao et al., 2000)

Delays runoff up to 3.7 hours

↑ infiltration capacity of soils



Calculating Stormwater Uptake by Trees – It's complicated!

Tree Over Parking Lot

Tree Over Natural Forest Cover

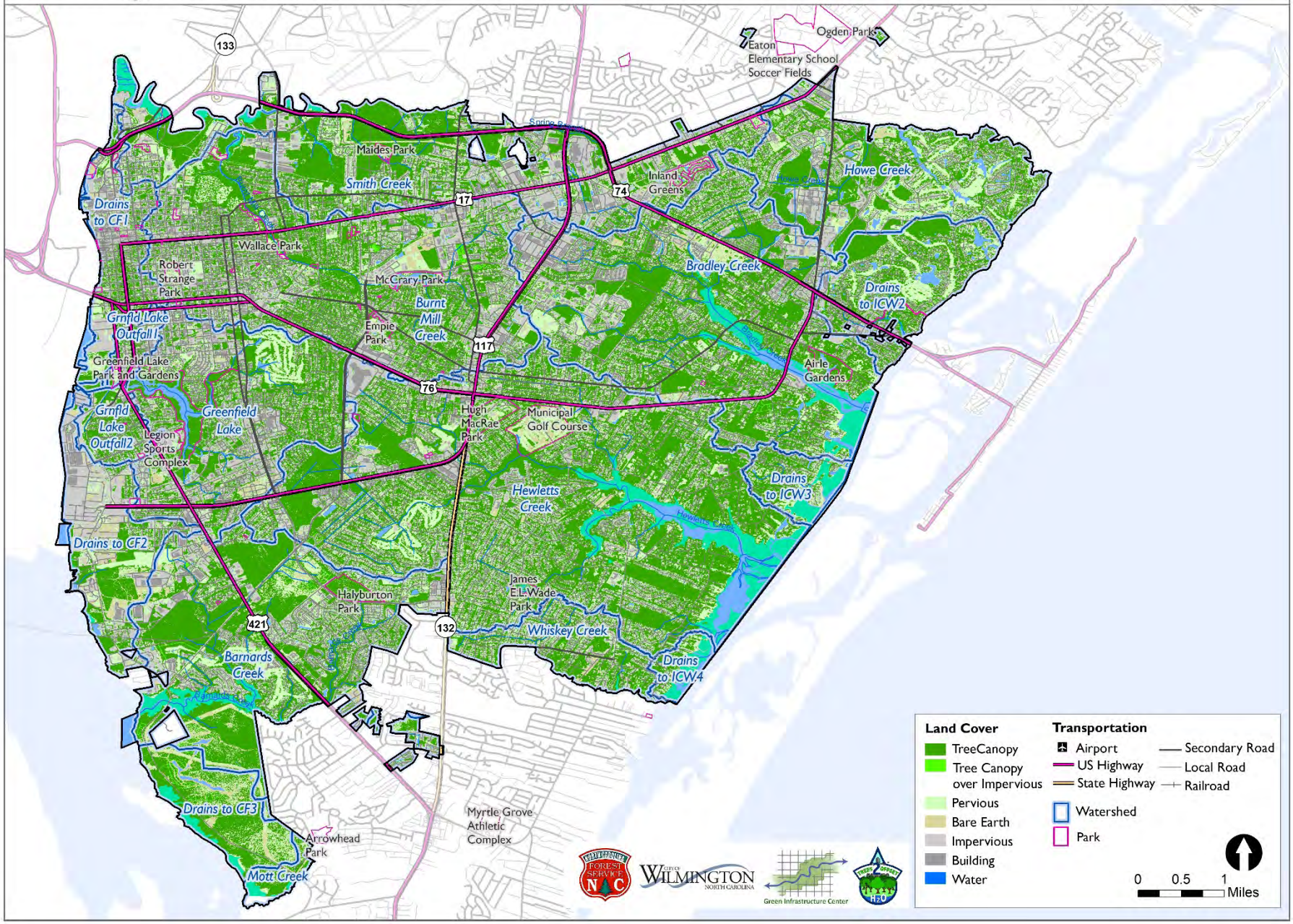
Tree Over Lawn

Tree Over Street and Sidewalk

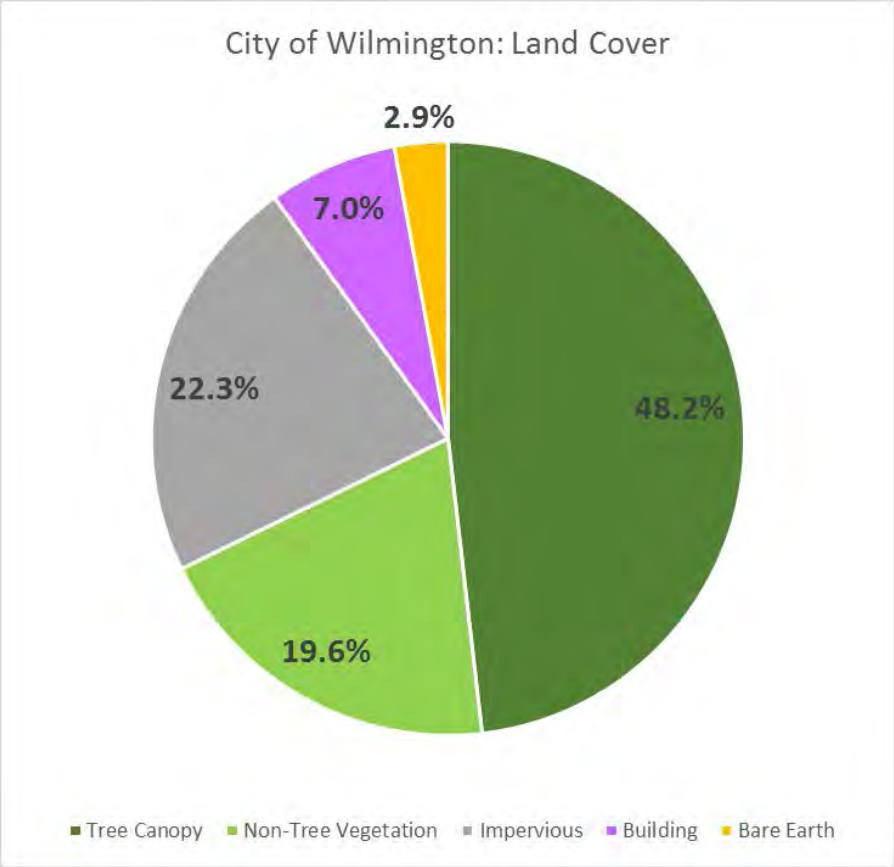
How Much Canopy Do We Have? Using Image Classification

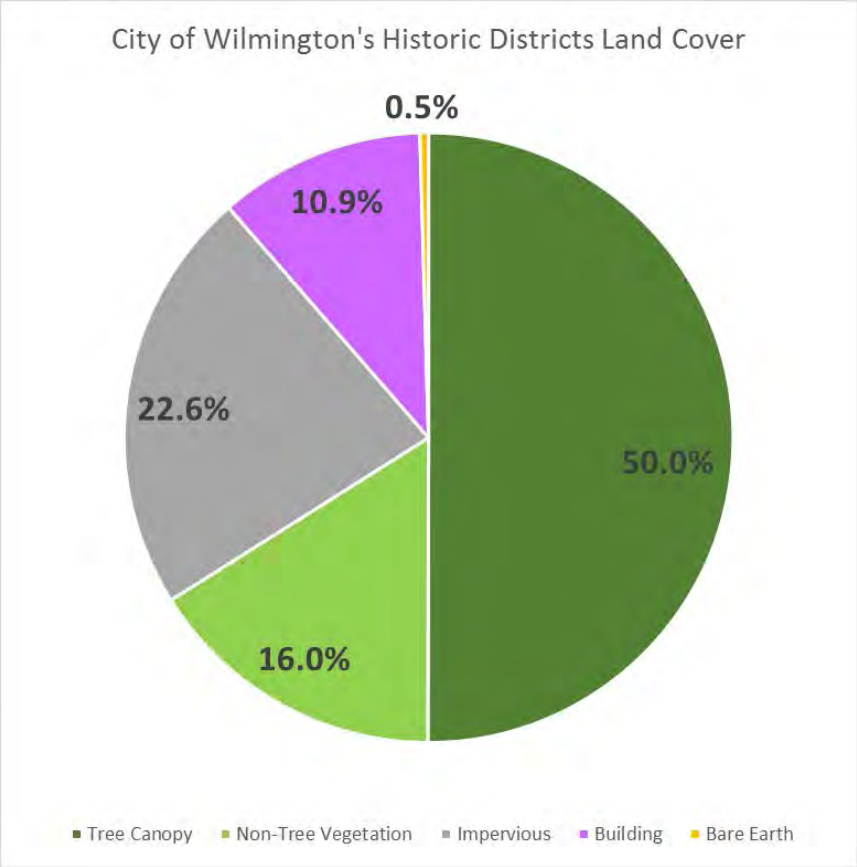
Image classification is the process of breaking an image into spatial land coverages (including tree canopy, other vegetation, impervious surfaces such as buildings, streets and parking lots).

Wilmington Land Cover

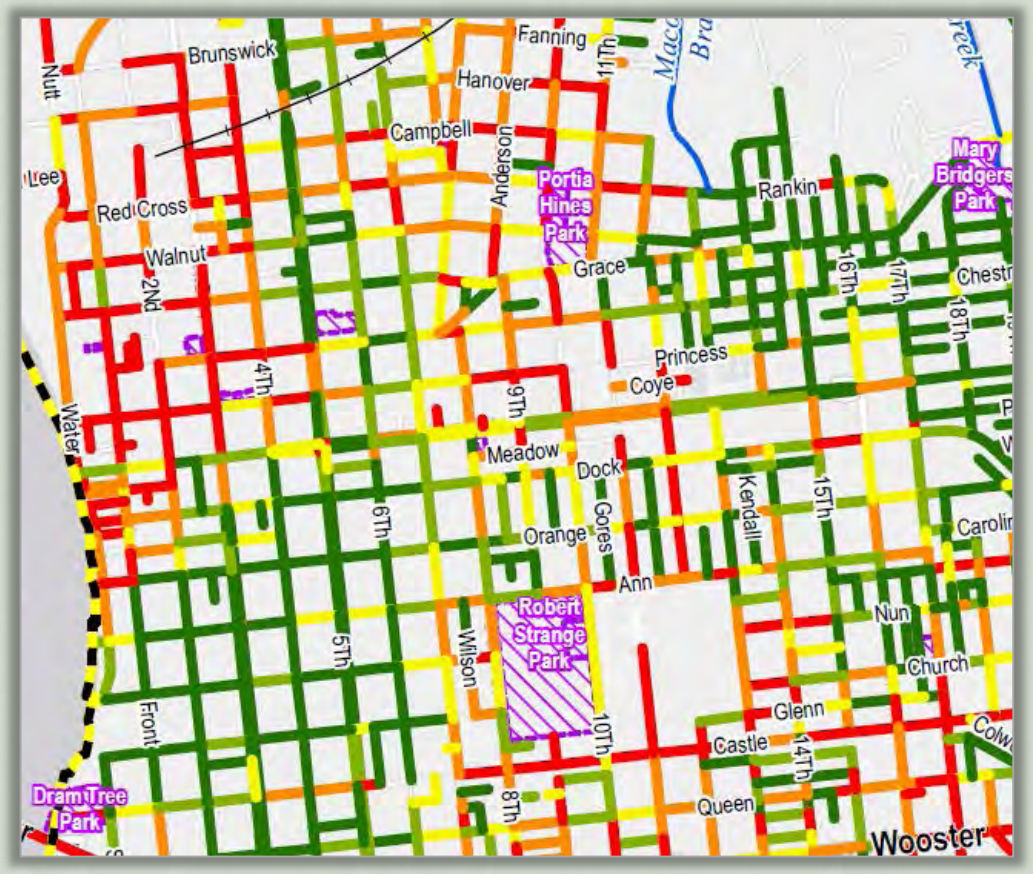


Results!
How well canopied are we?





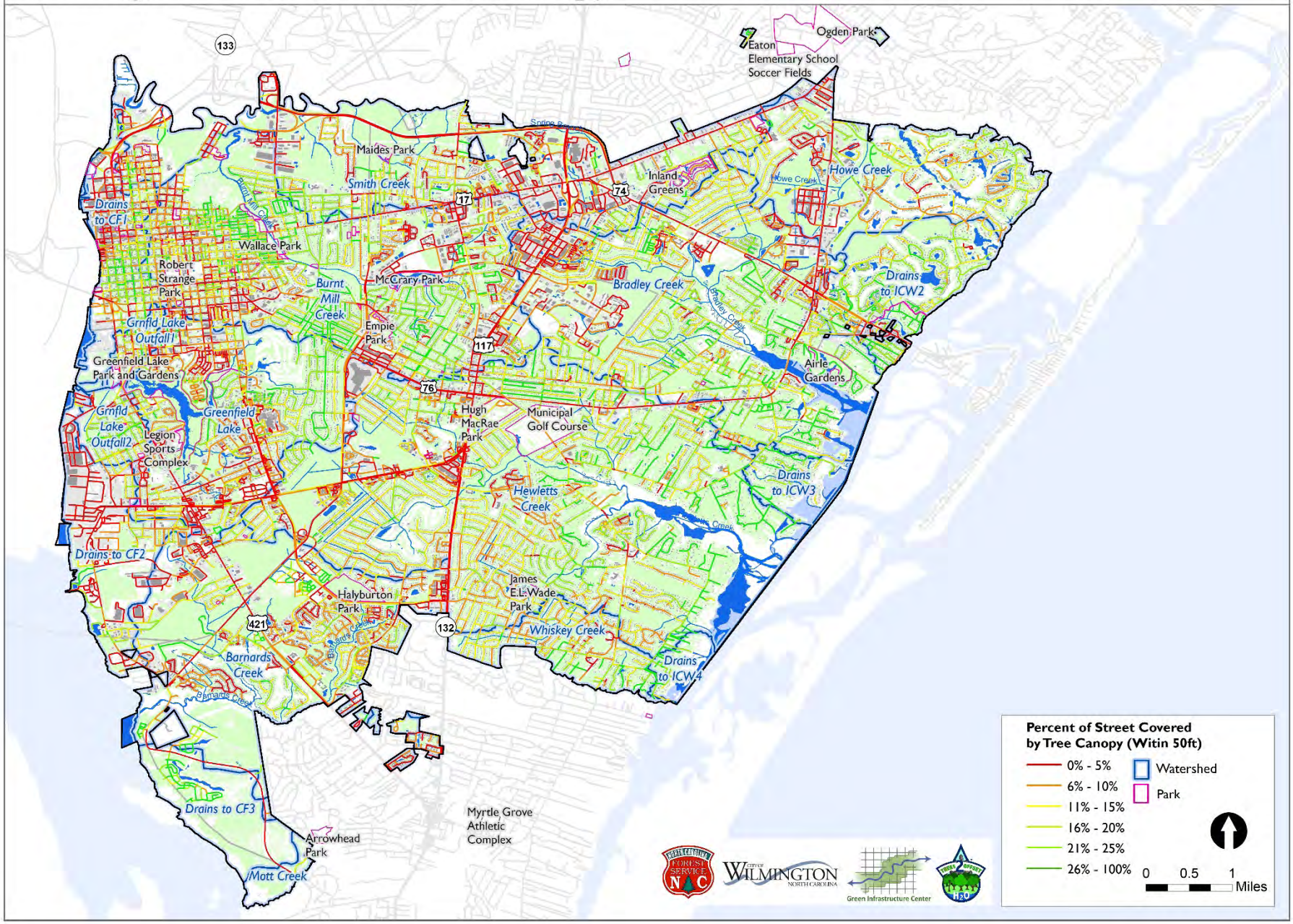
We did a street by street analysis. How green are the city's streets?



Tree Canopy Coverage (within 50 feet of street centerline)

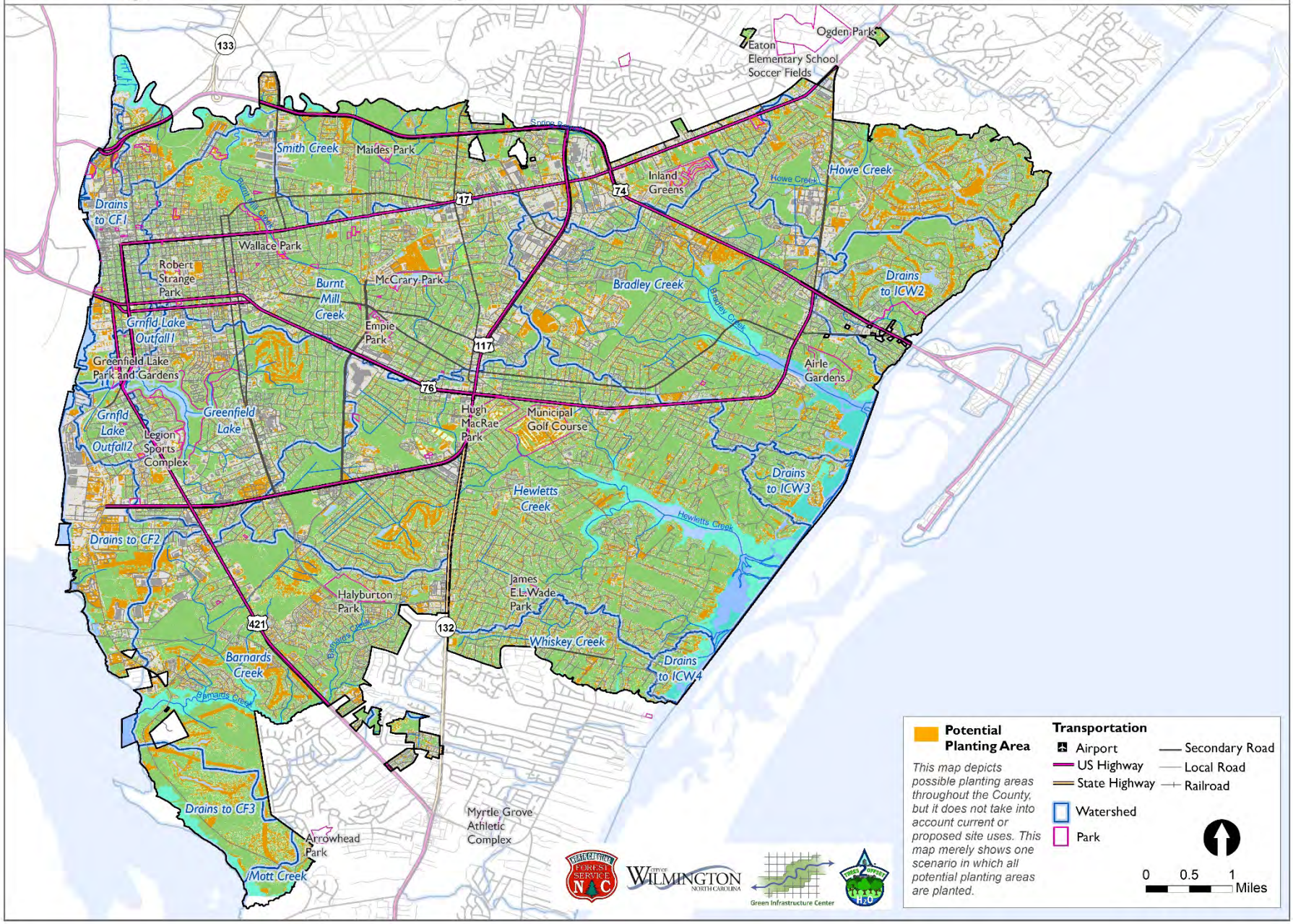
- 0% - 10%
- 10.1% - 20%
- 20.1% - 30%
- 30.1% - 40%
- 40.1% - 100%

Wilmington Percent Street Tree Canopy

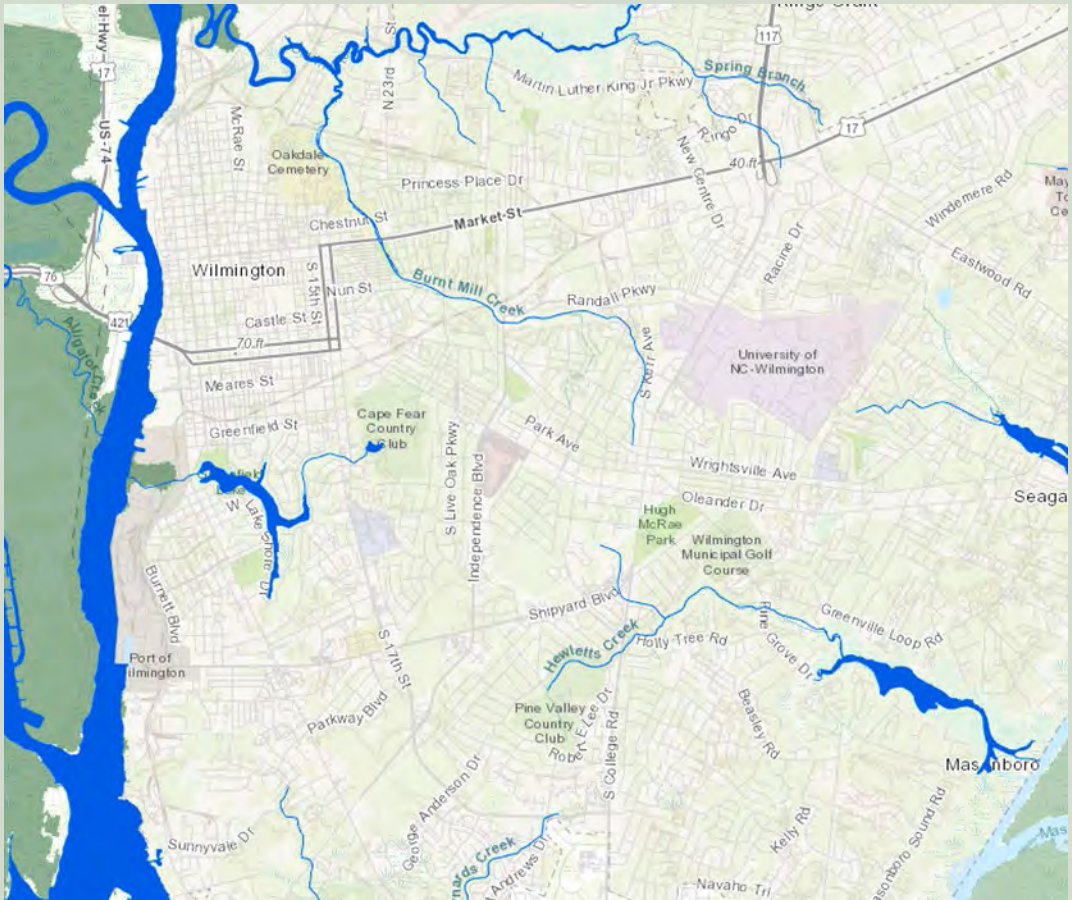


Possible Planting Area vs. Potential Tree Canopy

Wilmington Potential Planting Area

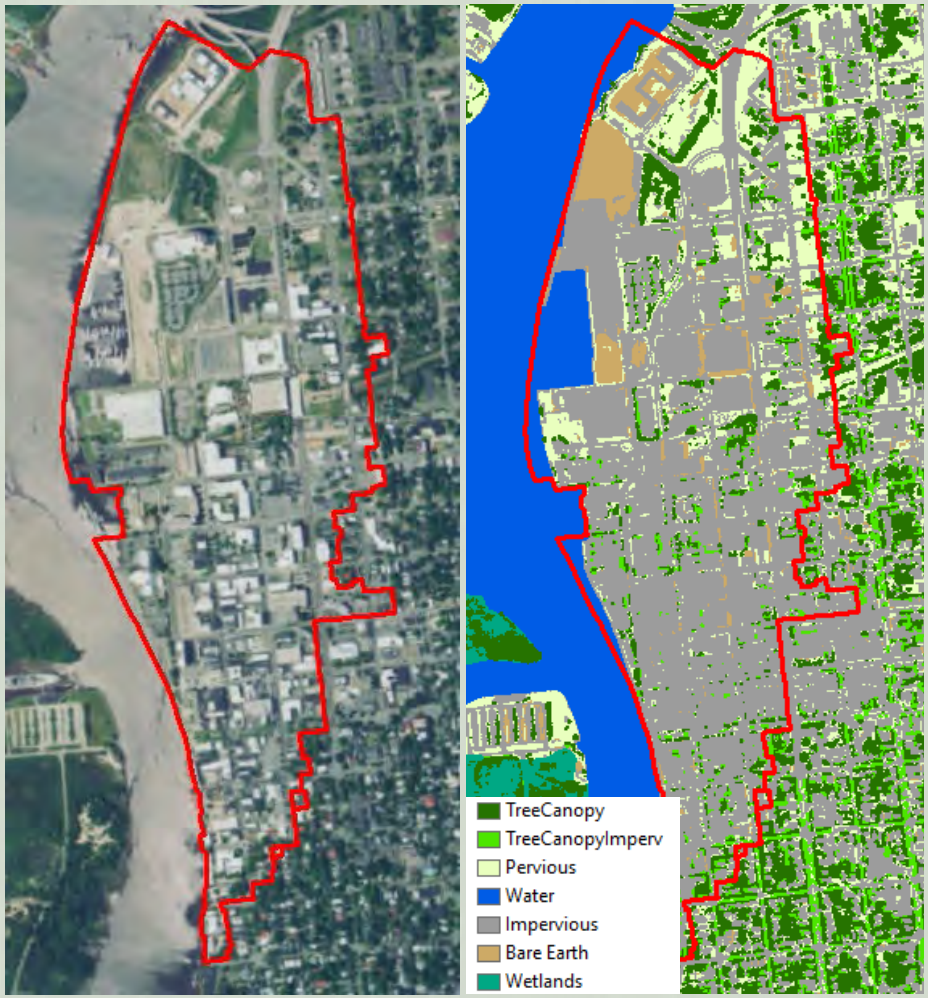


Spatial Data: What did the team find when analyzing land cover?



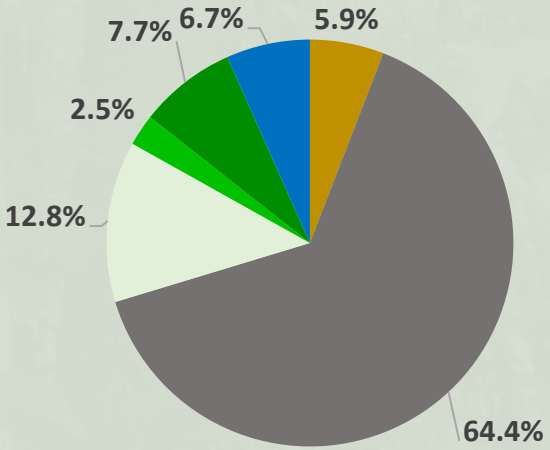
Land Cover

Central Business District



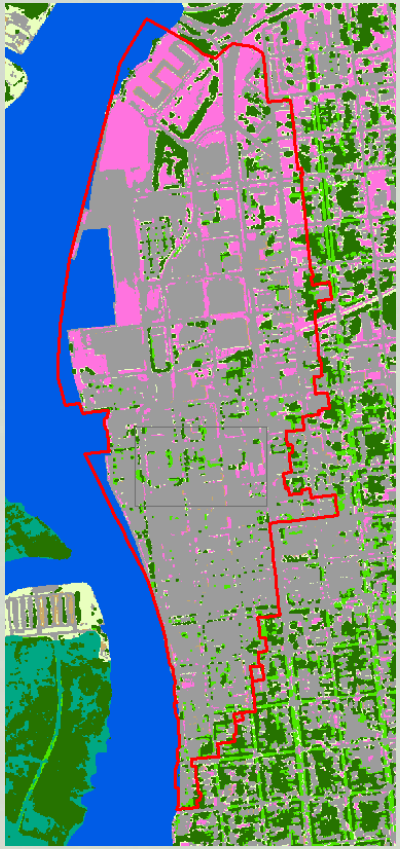
Source Data Creating LandCover Layer

- NAIP – Leaf on Imagery
- "Grey" Infrastructure *from existing sources and identified from Imagery.*



The two inputs are combined. Key class includes Landcover over Impervious Surfaces.

Total Tree Canopy is **10.2%** of AOI



Potential Planting Area

Central Business District

Areas that CAN NOT be planted are excluded	
Wetlands	Ballfields
Roads	Canal
Waterbodies	Cemeteries
Stormwater Ponds	Floating/Emergent Aquatic Vegetation
Stormwater Pipes	Golf courses
Sidewalks	Industrial Cooling Pond
Airports	Isolated Freshwater Swamp
Canals	Marshes
Parks and Trails	Rock Quarries
Railroads	Sandhill Lake
Buildings	Sawgrass
	Sinkhole Lake

14.3% more of downtown area can be planted with trees

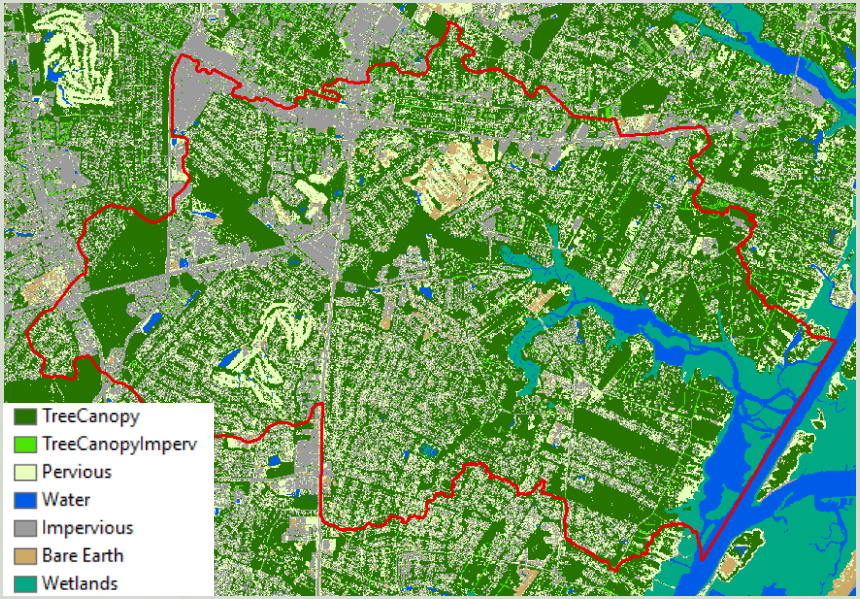
Resulting in Areas that CAN be Planted

Using a Tree Planting Scenario expecting to get 20 and 40 foot diameter trees that would be:

5,936 Trees with 40 feet diameter
plus
10,662 Trees with 20 feet diameter

Potential Planting Area

Hewletts Creek



Creating LandCover Layer

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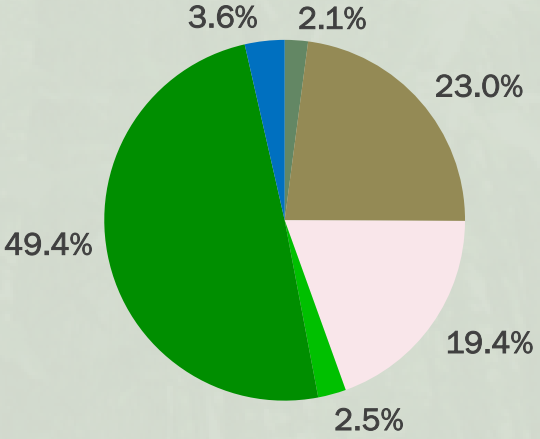
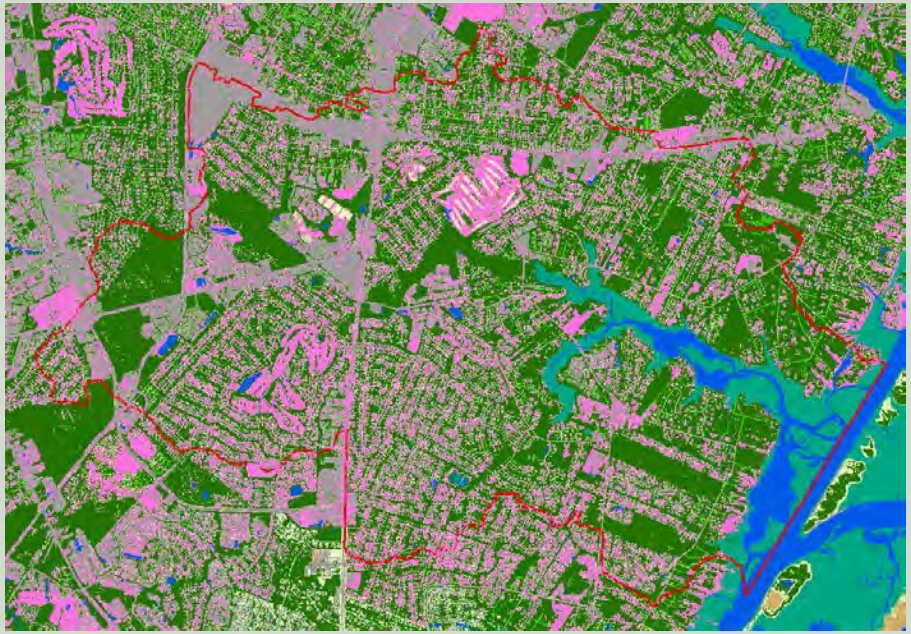


Total Tree Canopy is **52.9%** of AOI

Potential Planting Area

Hewletts Creek



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Resulting in Areas that CAN be Planted

An additional 10.9% of The Downtown area can be planted with Trees

Stormwater Uptake Calculations: Change Scenarios

Modeling Increased Development in the Incorporated Area

Saturated (Y/N)?	
Y	
What if? -Loss of Canopy *Change % below*	
20%	urban trees
30%	woodland trees
Increase in Runoff Yield	
18%	
for 1-inch storm	
Impervious Ratio* *Change % below*	
65%	
* portion of canopy loss that becomes impervious surface	

Canopy Loss Scenario Landcover (acres)				
				Runoff (gals)
Current	Scenario			
11,518	9,215			4,059,455
1,002	801			12,740,481
2,775	1,943			469,246
6,223	7,390.49			14,059,925
-				-
9,313	11,481			246,524,536
923	923			15,798,080
31,753	**31,753**			**293,651,722**
				Stormwater Runoff Inc (gal)
				44,387,251

That's 443,872 bathtubs of stormwater!

Stormwater Uptake Calculations: Change Scenarios

Modeling Possible Canopy Area and Stormwater Benefit in the Incorporated Area

Saturated (Y/N)?									**1-inch storm**
Y								**P**	1.00
What If Analysis Percent of PCA Change % below 35%				**Land Cover Class**				**Q Runoff (in)**	**Runoff (gals)**
				Tree over pervious				0.02	6,629,306
				Tree over impervious				0.59	28,944,734
				Woodlands				-	-
				Pervious				0.07	5,123,203
				Water					
				Impervious				0.79	182,377,660
				Bare earth				0.63	15,798,080
									238,872,984
		Decrease in Runoff Yield						1.5%	3,637,021

That’s 36,370 bathtubs of stormwater!

Canopy Coverage

Let's Maintain the Canopy We Have

This will require:

- ✓ **New Planting**
- ✓ **Reducing Impacts from Development**
- ✓ **Taking More Proactive Care of Our Trees**

Policy: What Proposed Code Changes did the Team Develop?

Tree Risk Assessments

ISA BMP – Likelihood Matrix

Likelihood of Failure	Likelihood of Impacting the Target			
	Very Low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Currently, advance tree risk assessments are prohibited from being performed in Wilmington.

- Allow and require the completion of tree risk assessments in the city
- Increase frequency of assessments in densely populated areas

Tree Maintenance

Currently, due to budget restraints, tree maintenance is reactive only. Performing proactive tree maintenance can reduce tree damage to property or grey infrastructure.

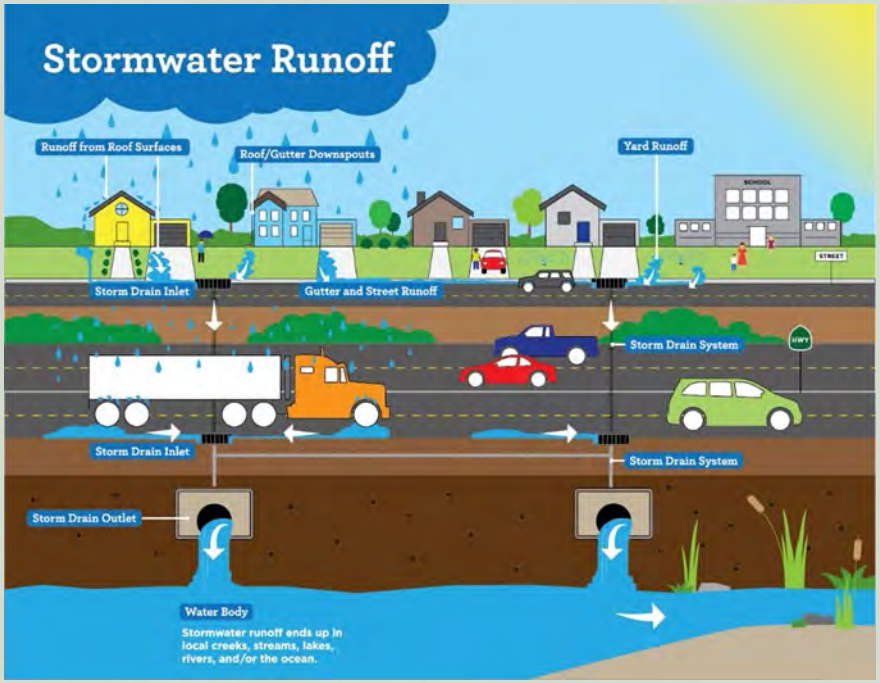
- Perform proactive tree maintenance
- Develop and adhere to a tree maintenance schedule

Enforcement Staff

There are not enough staff people to adequately carry out ordinance requirements.

- Hire five additional staff people to conduct tree protection inspections, tree risk assessments and tree planting/landscape inspections.

Stormwater Utility Fee Reductions



Properties treating all or most of stormwater on-site pay the same fee as properties who direct all stormwater into the drain.

- Develop a fee reduction system which incorporates trees as fee reduction mechanisms

Curb and Gutter Requirements

Where feasible, stormwater should be treated in swales along roadsides as opposed to funneled directly into gutters

- Develop guidelines which specify when vegetated swales can be used in the place of curb and gutter
- Allow vegetated swales to be used in the place of curb and gutter when all site conditions outlined in guidelines are met

Parks, Urban Forestry and GIS

There is currently a GIS staff person in most departments, excluding the Parks and Urban Forestry Department.

- Hire/assign a GIS specialist to the Parks and Urban Forestry Department
- Perform (in-house or contracted out) a tree canopy assessment every four years.
- Analyze urban tree canopy data by watershed, neighborhood, and by zoning to inform department activities and potentially policy.

Urban Forestry Budget

Versus

The city does not have enough funds to manage a thriving urban forest.

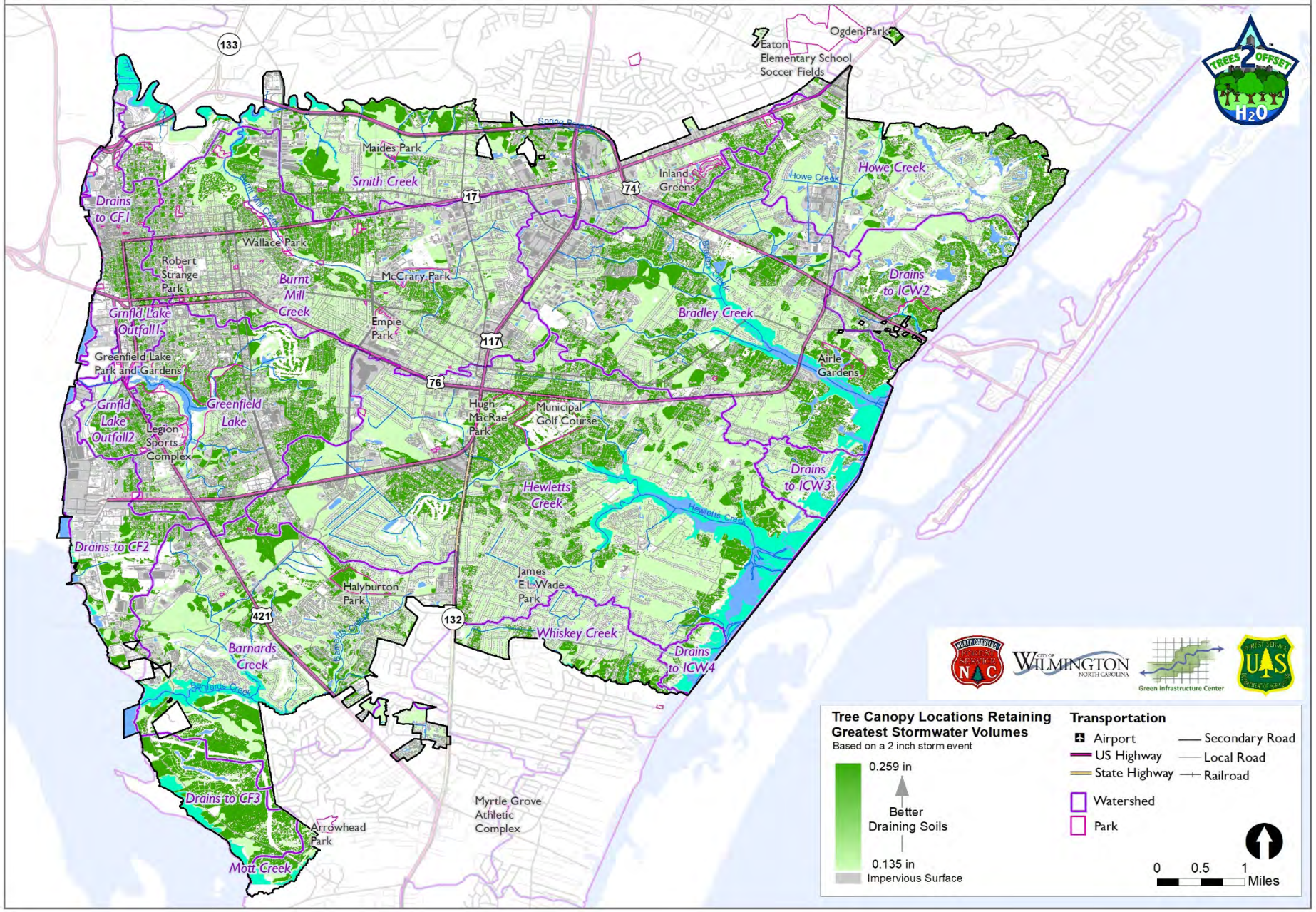
- Request an increase in funds for monitoring and management of the urban forest.

Community Input

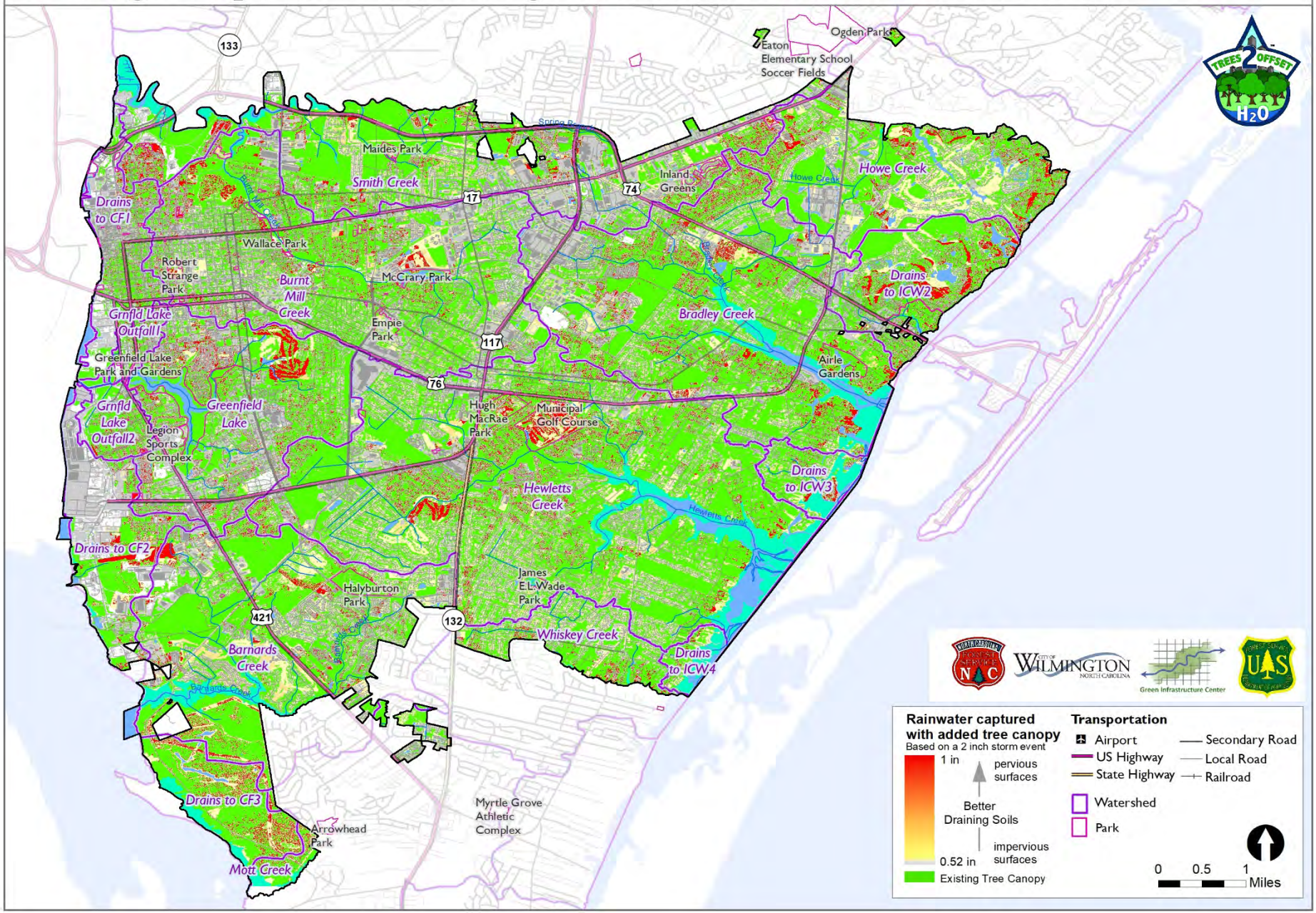
Community members were given a chance to vote for their top recommendations. Here are the results!

- Increase the urban forestry management budget.
- Assign a GIS person (mapping) to Parks/Forestry.
- Maintain canopy (48.2 % in the historic district, 50% in the city).
- Increase enforcement staff to fulfill ordinance.
- Require tree risk assessments of public trees.
- Allow credit for tree planting to reduce stormwater utility fee.
- Allow/install roadside bioswales with trees.
- Develop an emergency plan to replant trees after storms.

Wilmington Best Canopy Retention Locations for Stormwater Infiltration



Wilmington Optimal Tree Planting Locations for Stormwater Infiltration



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