Wrap Up: Restoring and Preserving Urban Tree Canopy for Stormwater Management in Apex, North Carolina

*Presentation to Town Council August 7, 2018*

Pilot Tree Canopy Project

GIC and state forestry agencies concerned about flooding and implementing cost effective solutions funded 12 communities in 6 states to develop pilot projects. These projects demonstrate how we can best utilize trees for stormwater management.

SC, NC, GA, FL, AL, VA

NC: Apex & Wilmington

Flooding in Apex
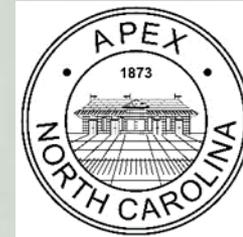
Project Goal

This project's goal was to help Apex 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.

This case booklet details our findings.

TREES TO OFFSET STORMWATER
Case Study 02: Apex, NC

July 2018

Trees: Create Healthy Communities

❑ Access to fitness opportunities. (addresses obesity, nature deficit disorders)

❑ Clean air – trees absorb pollutants, VOCs, filter runoff, cool the town. (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)

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 Apex

Trees:
The original – and <u>best</u> – 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.
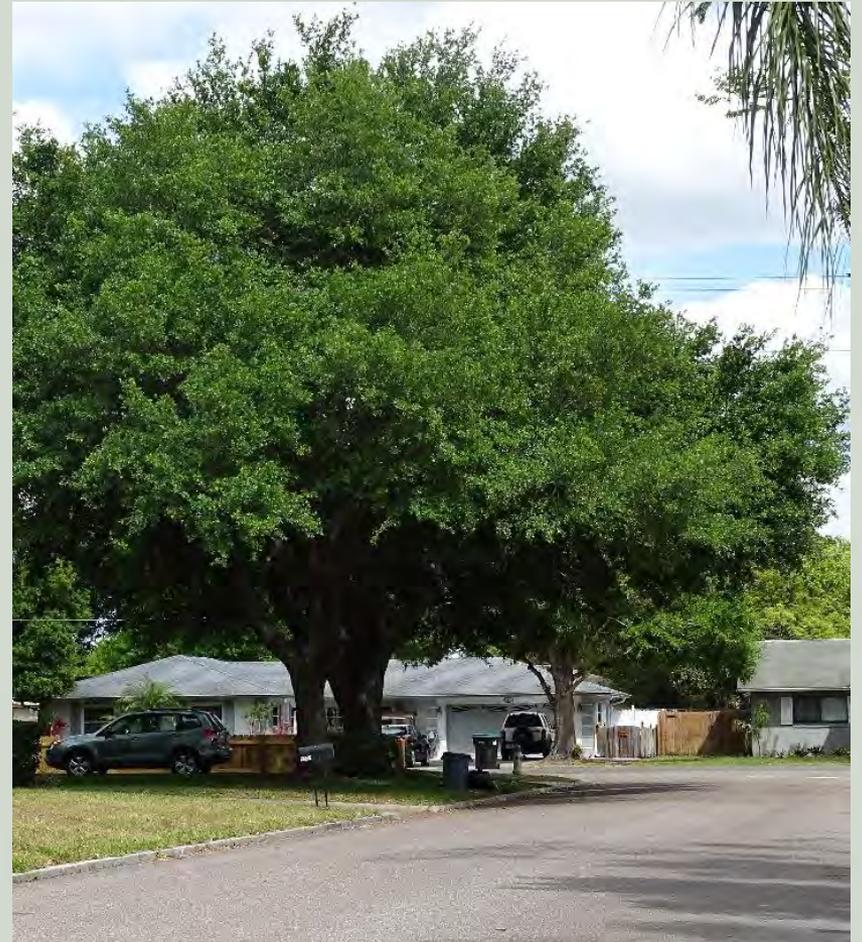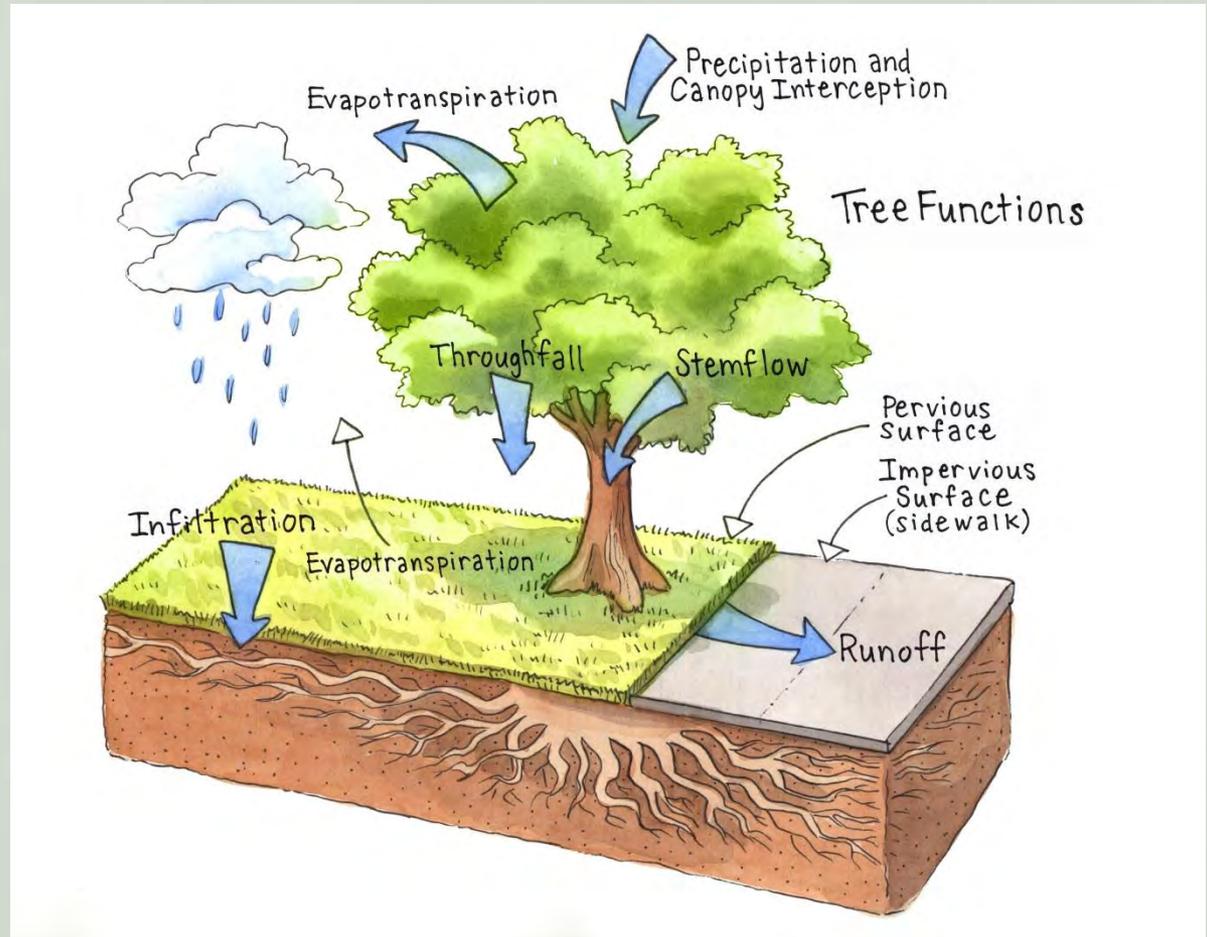
Urban Tree Canopy

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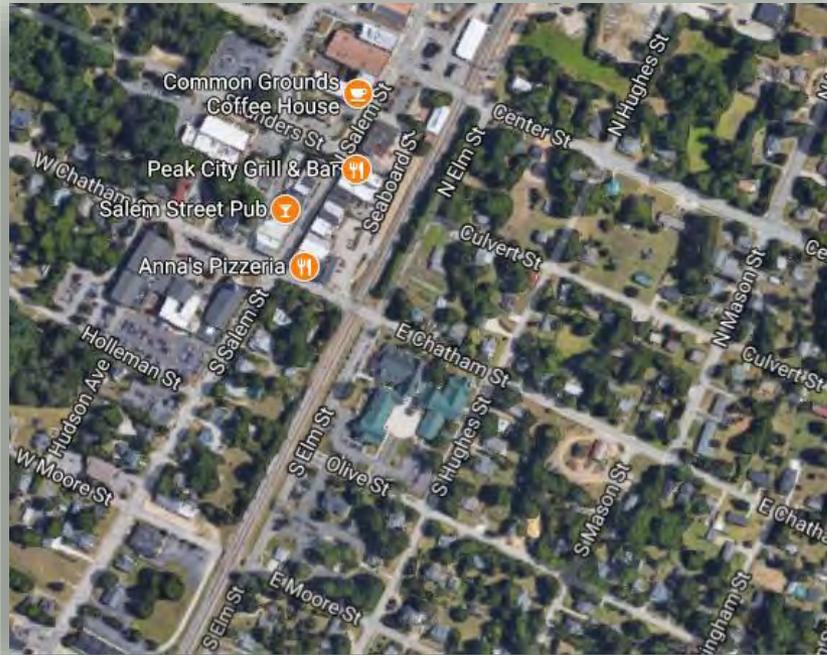(Xiao et al., 2000)

Delays runoff up to 3.7 hours

⬆️infiltration capacity of soils

Water flow strategies

How do we make this...   function like this?

Calculating Stormwater Uptake by Trees — It's complicated!

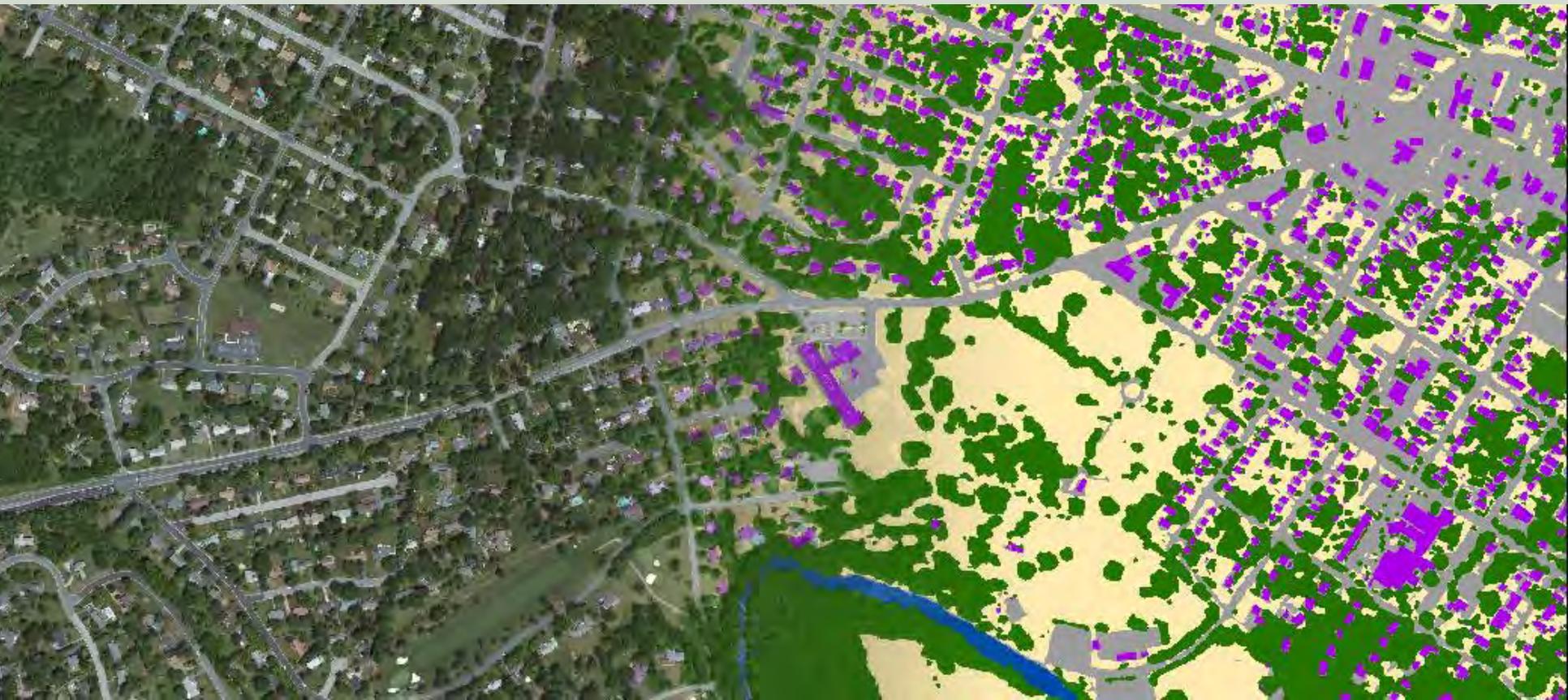Tree Over Parking Lot

Tree Over Natural Forest Cover

Tree Over Lawn

Tree Over Sidewalk

Using imagery to create new land cover map: what is impervious and pervious?

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).

Results!
Imperviousness = 27 %
tree canopy = 46%

Town of Apex Municipal Boundary

- Tree Canopy 46%
- Non-Tree Vegetation 22%
- Impervious 27%
- Bare Earth 5%
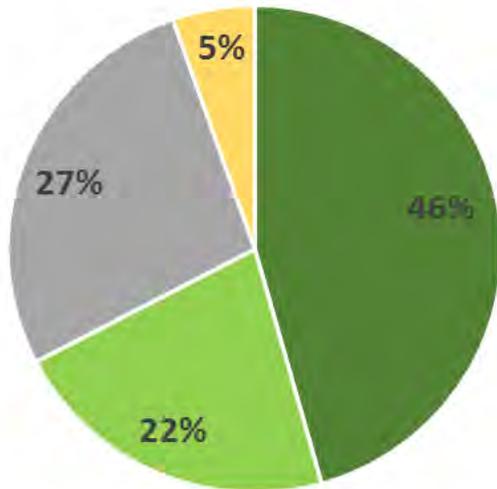
■ Tree Canopy ■ Non-Tree Vegetation ■ Impervious ■ Bare Earth

2030 Land Use Map Area

- Tree Canopy 59.3%
- Non-Tree Vegetation 22.5%
- Impervious 12.9%
- Bare Earth 5.2%
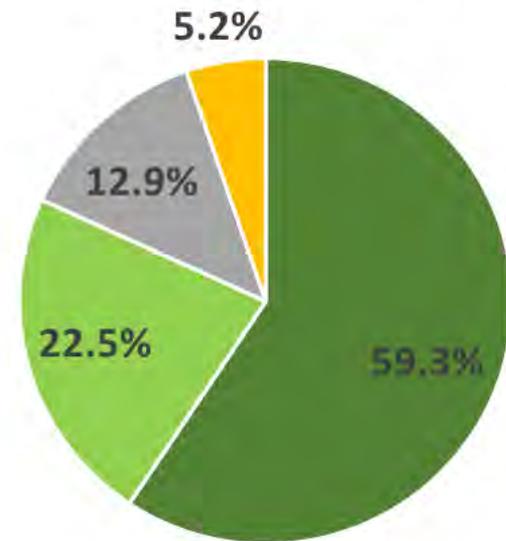
■ Tree Canopy ■ Non-Tree Vegetation ■ Impervious ■ Bare Earth

Apex Land Cover

Land Cover
- TreeCanopy
- Tree Canopy over Impervious
- Pervious
- Bare Earth
- Impervious
- Building
- Water

Reference Features
- H Hospital
- ★ Park
- School
- Watershed
- Unincorporated Area Masked

Transportation
- Airport
- US Highway
- State Highway
- Secondary Road
- Local Road
- Railroad

0   0.5   1 Miles
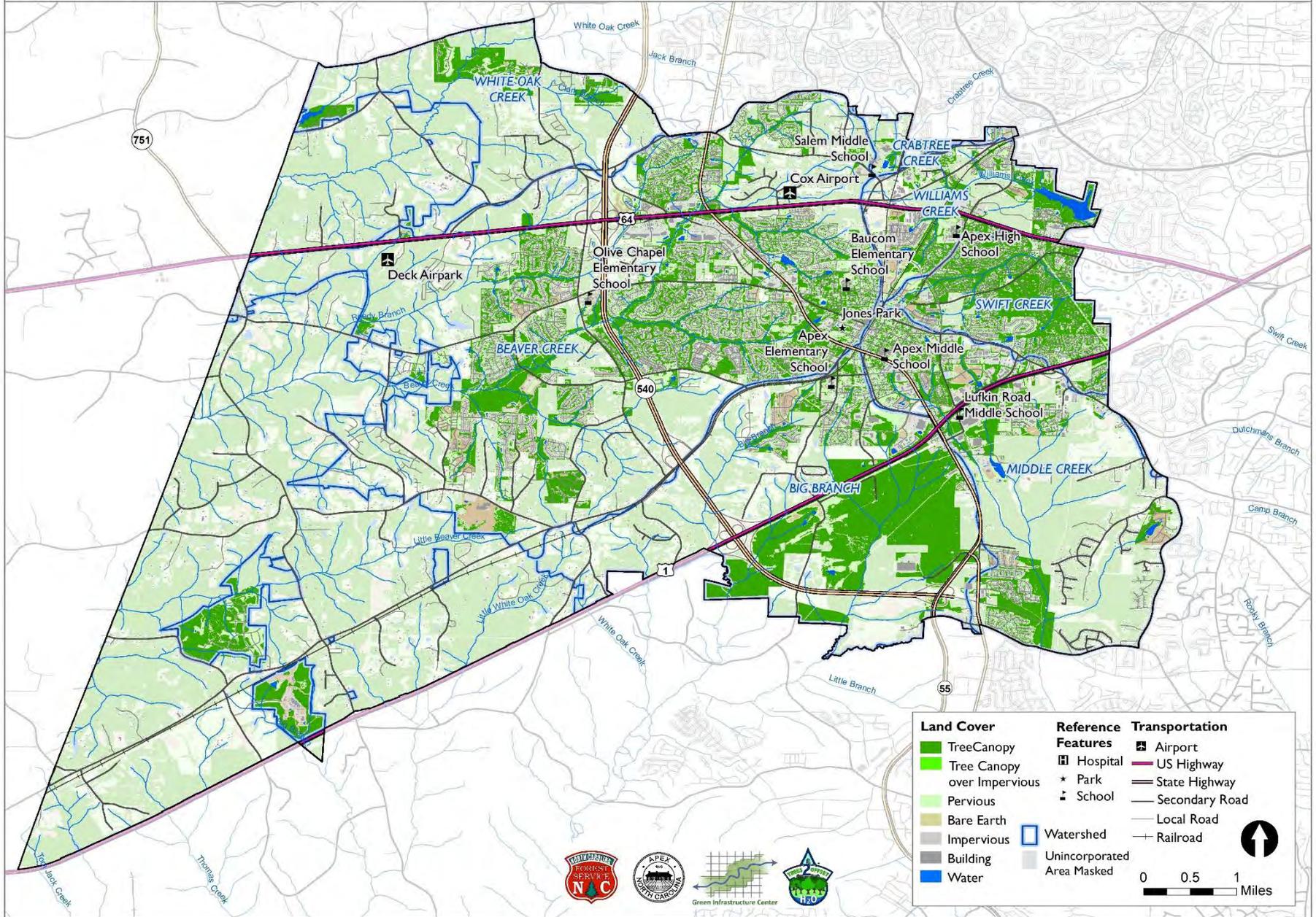
Apex Percent Street Tree Canopy

White Oak Creek
Jack Branch
WHITE OAK CREEK
Clark Branch
Crabtree Creek
751
Salem Middle School
CRABTREE CREEK
Cox Airport
Williams Creek
WILLIAMS CREEK
64
Baucom Elementary School
Apex High School
Olive Chapel Elementary School
Deck Airpark
SWIFT CREEK
Reedy Branch
Jones Park
Apex Elementary School
Apex Middle School
BEAVER CREEK
Swift Creek
Beaver Creek
540
Lufkin Road Middle School
Dutchmans Branch
Big Branch
MIDDLE CREEK
Camp Branch
Little Beaver Creek
BIG BRANCH
Little White Oak Creek
Rocky Branch
1
White Oak Creek
Little Branch
55
Tom Jack Creek
Big Branch
Thomas Creek

Percent of Street Covered by Tree Canopy (Witin 50ft)

- 0% - 5%
- 6% - 10%
- 11% - 15%
- 16% - 20%
- 21% - 25%
- 26% - 100%

☐ Watershed
Unincorporated Area Masked

Reference Features
- Ⓗ Hospital   ✈ Airport
- ★ Park   ┼ Railroad
- ⚑ School

0   0.5   1 Miles

FOREST SERVICE N C

APEX NORTH CAROLINA
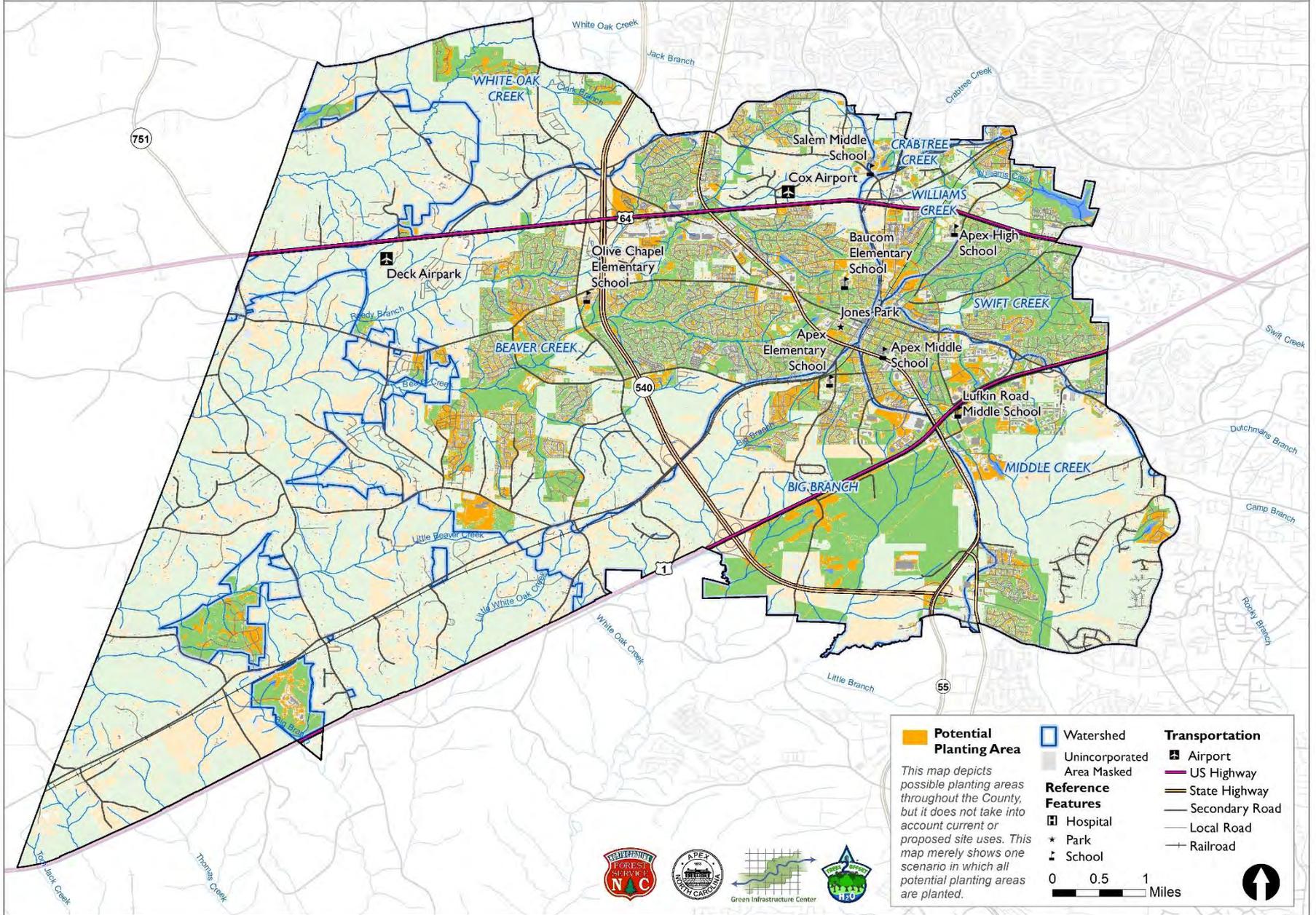
Green Infrastructure Center

H₂O

Where can we fit more trees? Possible Planting Area (PPA)

Future scenarios – Where can we plant trees for maximum benefits? For example, take up the most stormwater or revitalize a commercial corridor?
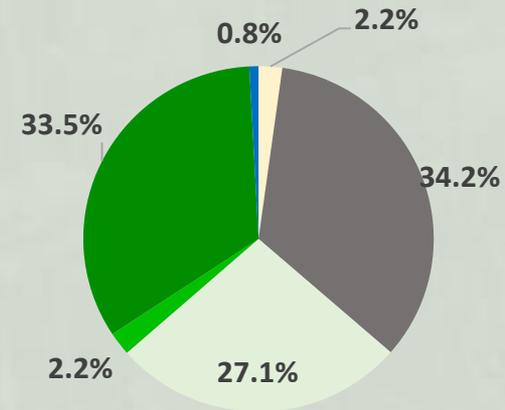
Apex Potential Planting Area

Land Cover
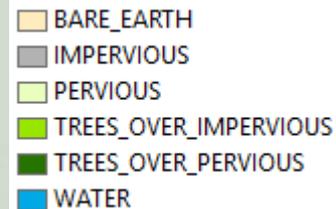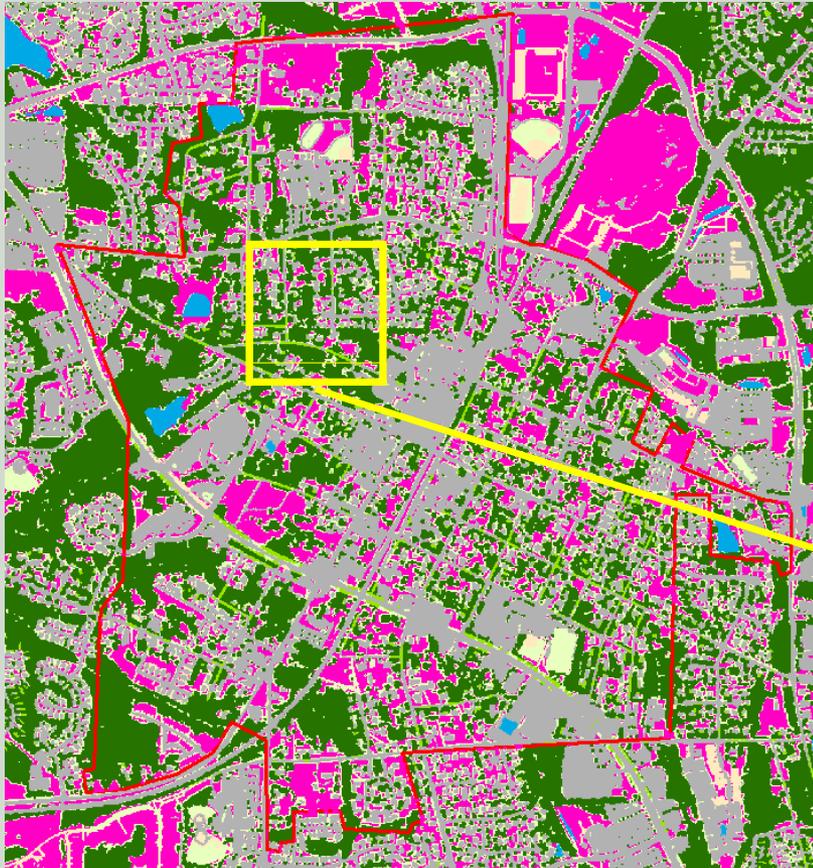## "Downtown Overlay" Example

NAIP
Leaf on Imagery
+
"Grey" Infrastructure

☐	BARE_EARTH
☐	IMPERVIOUS
☐	PERVIOUS
☐	TREES_OVER_IMPERVIOUS
☐	TREES_OVER_PERVIOUS
☐	WATER

0.8% 2.2%

34.2%

27.1%

2.2%

33.5%

Potential Planting Area
"Downtown Overlay" Example

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

Resulting in areas that CAN be planted

An additional 15.4% of the downtown area can be planted with Trees

Potential Canopy Area
"Downtown Overlay" Example

An additional 15.4% of downtown could be planted with trees
- Results in a 19.2% canopy increase.

If planting 20 and 40 foot diameter trees:
- 4401 trees with 40 feet diameter plus

- 5859 trees with 20 feet diameter

Stormwater Uptake Calculations:
What if canopy is lost to development

					1-inch storm
What if? -Loss of Canopy *Change % below*				**P**	1.00
		Land Cover Class		**Q (in)**	**Runoff (gals)**
30%		Tree over pervious		0.02	2,158,556
Increase in Runoff Yield		Tree over impervious		0.59	895,898
26%		Pervious		0.07	4,482,452
for 1-inch storm		Water			
Impervious Ratio*		Impervious		0.79	63,550,649
Change % below		Bare earth		0.63	10,035,310
65%					**81,122,865**
* portion of canopy loss that becomes impervious surface		**Terms**			
		CN	Curve number		
		S	Potential maximum retention (in)		
		Ci	Canopy interception term (in)		
		Ia	Initial abstraction (in)		
		P	Precipitation (in)		
		Q	Runoff (in)		

That's 811,000 bathtubs of stormwater!

Stormwater Uptake Calculations: Change Scenarios

….in the Unincorporated Area

		1-in storm
	P	1.00

What if? -Loss of Canopy *Change % below*	Land Cover Class	Q (in)	Runoff (gals)
30%	Tree over pervious	0.00	17,731
Increase in Runoff Yield	Tree over impervious	0.59	829,495
119%	Pervious	0.05	6,425,307
for i-inch storm	Water		
Impervious Ratio* *Change % below*	Impervious	0.79	24,472,949
65%	Bare earth	0.63	18,385,509
			50,130,990

* portion of canopy loss that becomes impervious surface

Terms	
CN	Curve number
S	Potential maximum retention (in)
Ci	Canopy interception term (in)
Ia	Initial abstraction (in)
P	Precipitation (in)
Q	Runoff (in)

That's half a million bathtubs of stormwater!

Stormwater Uptake Calculations: Change Scenarios

Modeling Possible Canopy Area and Stormwater Benefit in the Incorporated Area

					1-inch storm
				P	1.00
What If Analysis Percent of PCA Change % below			Land Cover Class	Q Runoff (in)	Runoff (gals)
30%			Tree over pervious	0.02	2,747,067
			Tree over impervious	0.59	4,104,173
			Pervious	0.07	1,940,962
			Water		
			Impervious	0.79	59,216,163
			Bare earth	0.63	10,035,986
					78,044,351
		Decrease in Runoff Yield		1.1%	923,554

That's 780,000 more bathtubs of stormwater!

Policy: Recommended code and policy improvements to reduce imperviousness and reduce runoff

Tree Plantings Along Streets

Current:

Potential:

Tree plantings are currently prohibited in rights-of-way.

Recommendation:

- Set standards for and allow tree plantings in ROWs
- Use removable pavers to allow for tree growth in tight spaces

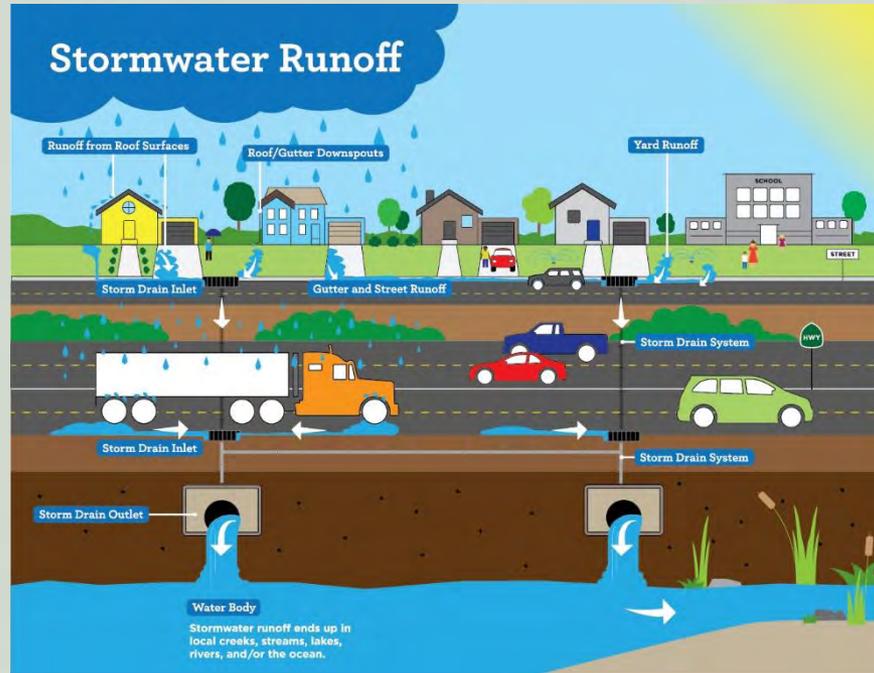# Tree Planting Lists

Versus

The Town and developers frequently plant non-natives.

Recommendation:

- Develop a list of trees that will thrive and benefit wildlife and insects in Apex
- Require that 60% of species planted on a site consist of natives
- Develop a list of trees that should not be planted under any circumstances

Stormwater Fee

Apex doesn't currently have a stormwater utility which could charge a fee per unit of stormwater generated.

Recommendation:

- Create a stormwater utility like other neighboring towns have
- Implement a stormwater fee (the greater the impervious area, the higher the fee)
- Provide credits for effectively managing stormwater onsite

Proactive Tree Work

Tree work conducted currently is generally reactive.

Recommendation:

- Identify, through tree risk assessments, the locations where pruning needs to occur before limbs damage property and grey infrastructure
- Request an increase in funds for proactive monitoring and management of the urban forest
- Keep detailed logs of tree work and locations

Urban Forestry Budget

Versus

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

- Request an increase in funds for monitoring and management of the urban forest.
- Prepare better for storms and increase public safety
- Fund more review of plans and better care for trees

Time for Questions?

END

Green Infrastructure Center Inc.

www.gicinc.org

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