

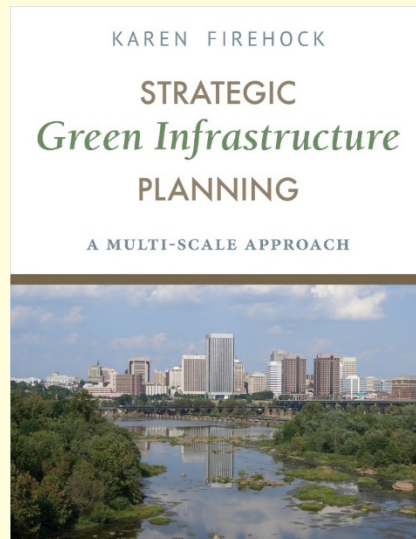
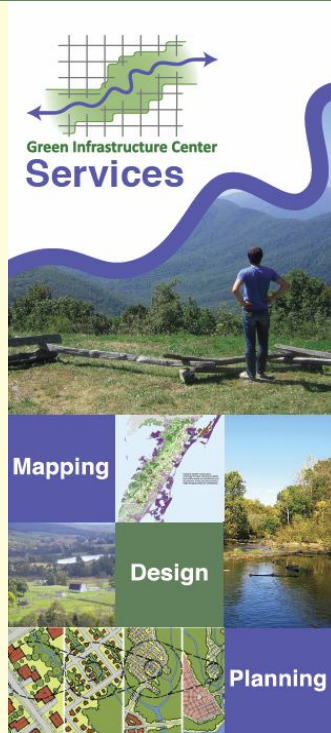
Benefits of Healthy Urban Forests – Trees as Green Infrastructure



Karen Firehock, Executive Director

*Mayors' Innovation Project Summer Meeting
August 2018*





The GIC helps communities evaluate their green assets and manage them to maximize ecological, economic and cultural returns. We do this by:

Building landscape models

Teaching courses and workshops

Research into new methodologies

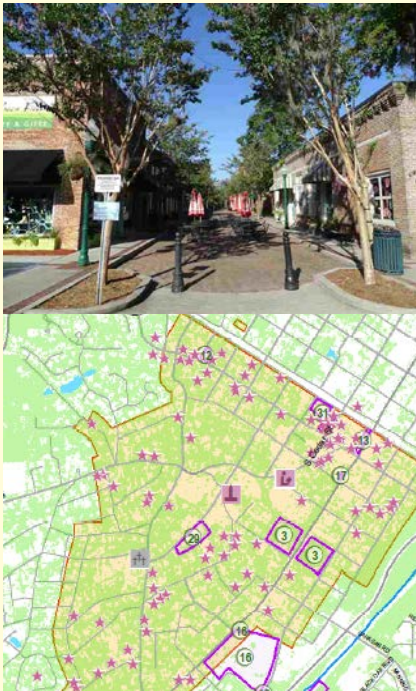
Creating community green infrastructure plans

www.gicinc.org find our projects here!

Some case examples of recent work in urban landscapes...

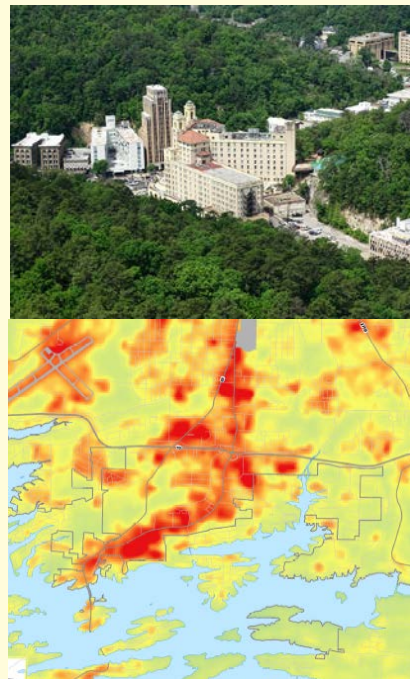
Summerville, SC

Re-linking nature and history in a rapidly developing town



Hot Springs, AR

Revitalizing a city at the intersection of history, health and nature



Jersey City, NJ

Building the case for green infrastructure in a post-hurricane Sandy urban environment

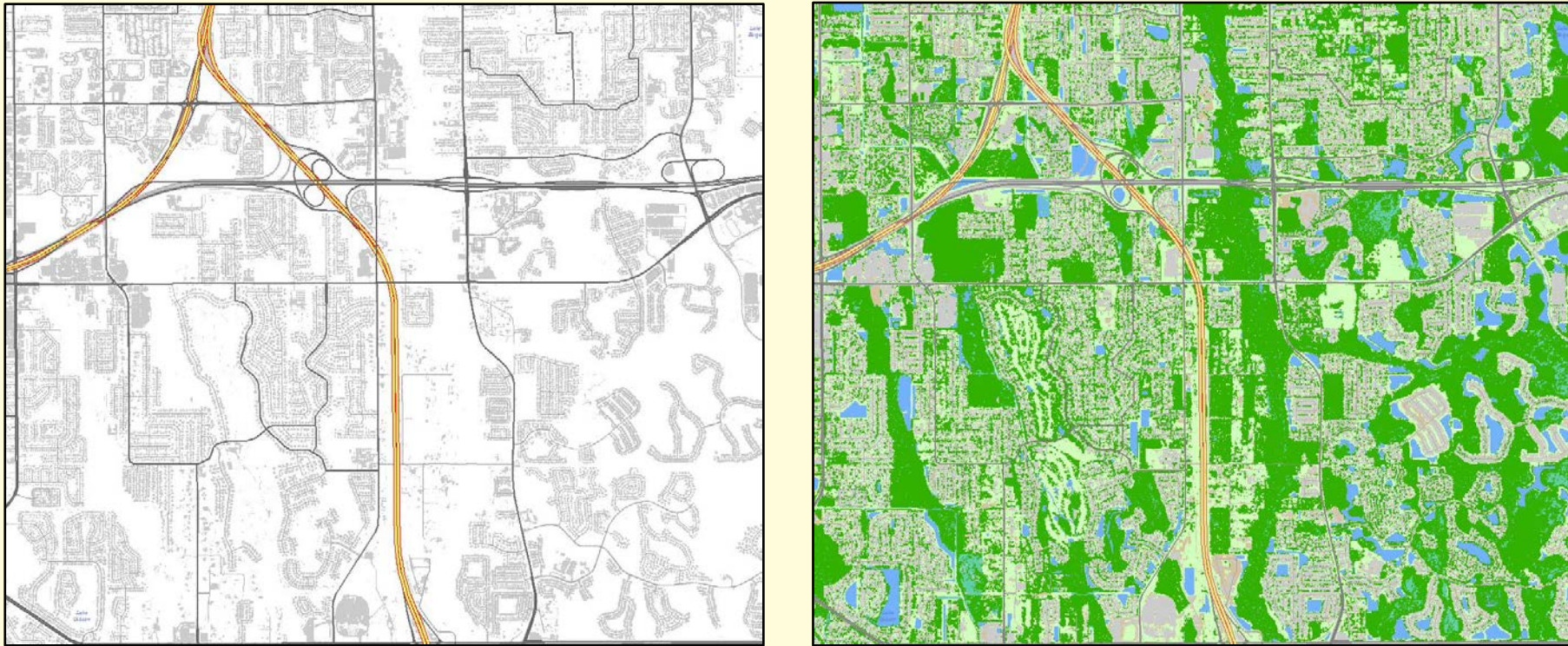


Richmond, VA

Urban revitalization in a post-industrial city – regreening, regrowing urban environment



What is green infrastructure?



Left shows the gray infrastructure including buildings and roads (left). Classified high-resolution satellite imagery (right) adds a green infrastructure data layer (trees and other vegetation) .

Green Infrastructure Definition Expands

In 1994, Florida coined the term *green infrastructure* to describe its wetlands, rivers, dunes, and forest habitats. In 2006, EPA added BMPs such as raingardens to the definition. The key is to first consider natural infrastructure (trees, forests, rivers) protect them and connect them, build in the least impactful manner, then mitigate impacts. So, *first conservation, then mitigation.*



Rain gardens



Permeable pavers



Filterra Boxes

Today

1. Trees as Green Infrastructure
2. Urban Forest Benefits and Challenges
3. Example Trees and Stormwater Project



Trees have many benefits!

- ☐ Trees clean air – trees absorb pollutants, VOCs, filter runoff, cool the county.
- ☐ Well being and mental health - -people heal faster when they can see or access green.
- ☐ Less crime occurs near trees.
- ☐ People will exercise if they can access green where they work or live.
- ☐ People shop longer and more often in tree-lined retail areas and spend about 12 % more.
- ☐ Companies, especially those that are have well paid and skilled workforce place a strong importance on the “green” of the local environment.



Urban Forests Need to Be Connected! The problem of clusters that don't look beyond parcel boundaries...



Project Example



Funded by USFS
Southern Region

The GIC partnered with 6 states to demonstrate the role of trees as green infrastructure. The goal is to reduce flooding and to clean the water!

SC, NC, GA, FL, AL, VA = 12 cities large to small, from mountains to coast!

Project Outcomes

- ✓ Map the city's urban forest and planting areas.
- ✓ Link urban forest systems to urban stormwater management.
- ✓ Calculate stormwater uptake by trees
- ✓ Recommend how a city can adopt new programs, codes, processes to better integrate the city's trees as part of stormwater management
- ✓ Write a case booklet and presentation detailing methodology, lessons, best practices available free to learn from!



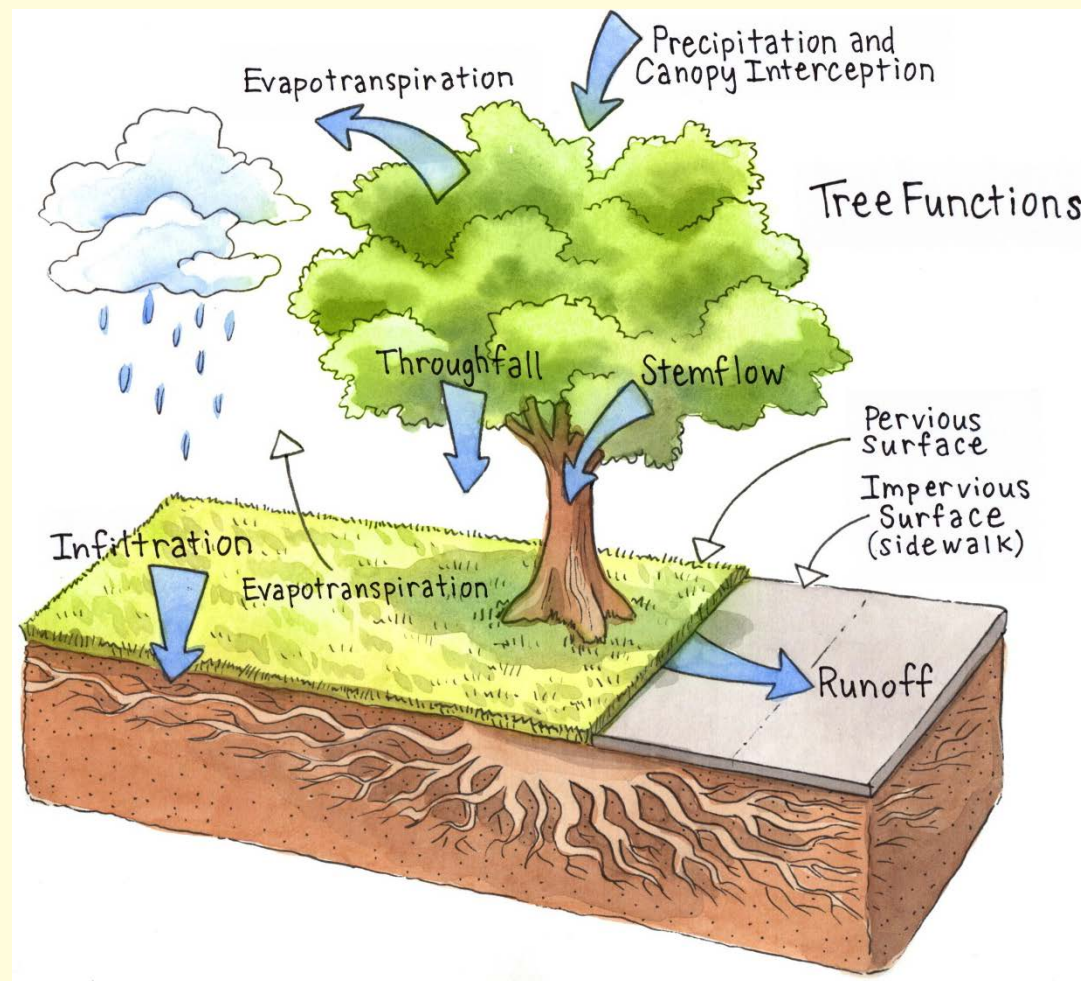
A summary report of all 12 cities in winter 2019 + Tools for Use!

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



Trees: the original – and best – green stormwater infrastructure!

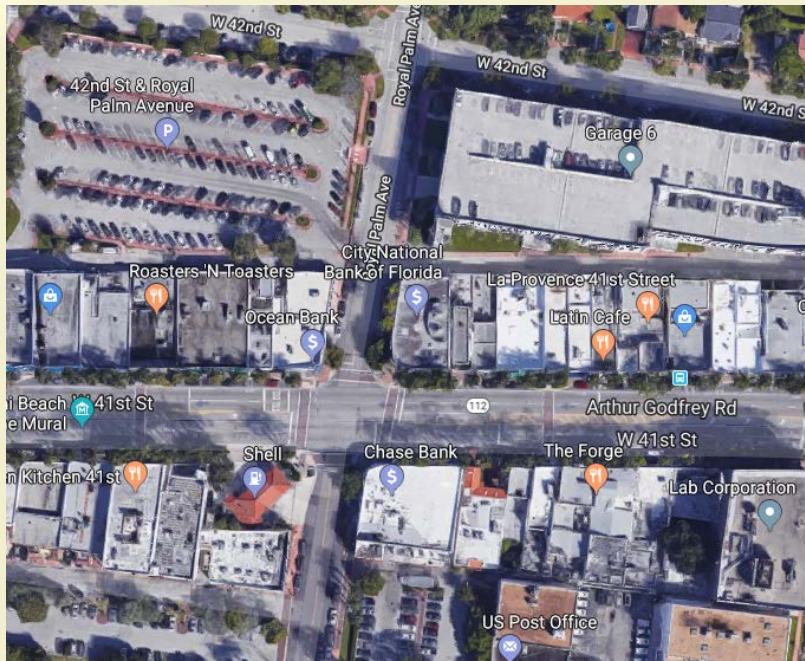
Trees give us cleaner air, shade, beauty and stormwater benefits at a cost that is far cheaper than engineered systems!

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.



Water Flow Strategies

How do we make this...



function like this?



Mapping Urban Canopy is Key!

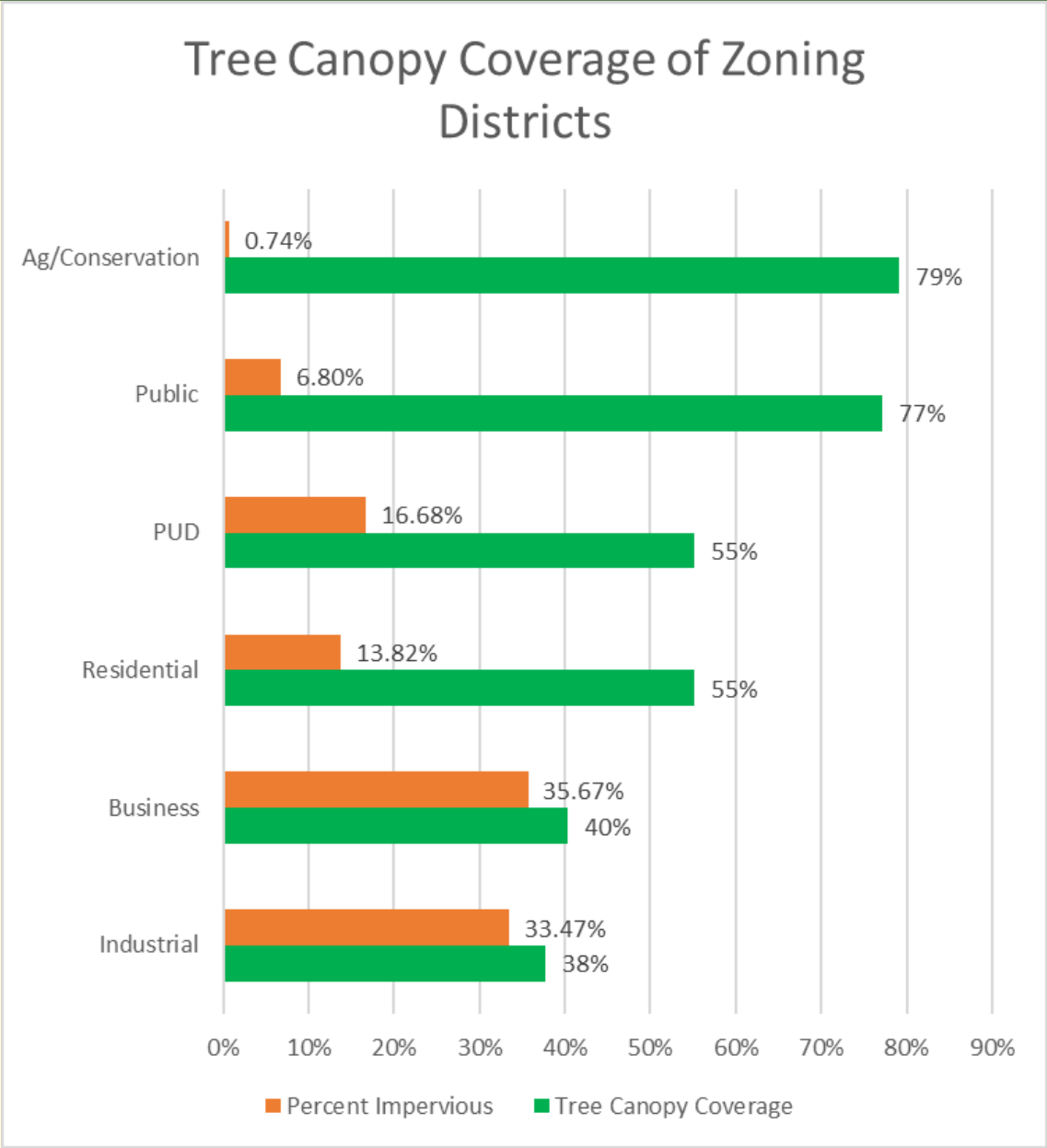
Image classification is the process of breaking an image into discrete 'classes', with one of the most common applications being to identify land use classes (urban, agriculture, forest, etc.)



Where Can We Fit Trees?

Possible Planting Areas





Analysis:
Canopy varies greatly. so even if it is good citywide, it may be deficient in certain zoning types or neighborhoods.

We account for the complexities of urban forests – what is the setting?



Tree Over Lawn



Tree Over Parking Lot



Tree Over Street



Tree Over Natural Forest Cover

Forestry Work Group Study

Tree canopy works to reduce the proportion of precipitation that becomes stream and surface flow, also known as *water yield*.

The Hynicka and Divers study (1996) modified the water yield equation of the SCS model by adding a canopy interception term (C_i), resulting in:

$$R = \frac{(P - C_i - I_a)^2}{(P - C_i - I_a) + S}$$

Where R is runoff

P is precipitation

I_a is the initial abstraction,

S is the potential maximum retention after runoff begins for the subject land cover. ($S = 1000/CN - 10$)

Recommendations of the Expert Panel to Define BMP Effectiveness for Urban Tree Canopy Expansion

Karen Capiella, Sally Claggett, Keith Cline, Susan Day, Michael Galvin, Peter MacDonagh,
Jessica Sanders, Thomas Whitlow, Qingfu Xiao



Accepted conditionally by Forestry Work Group, June 23, 2016
Approved by Watershed Technical Work Group, DATE TBD
Final Approval by Water Quality Goal Implementation Team, DATE TBD

Prepared by
Neely L. Law, PhD, Center for Watershed Protection, Expert Panel Chair
Jeremy Hanson, Virginia Tech, Expert Panel Coordinator

GIC Developed a Stormwater Calculator

St. Johns River Drainage Basin						
Event (pick)	P (in)	Source				
Mean annual / 24 hour	4.5	Orange County 24 hour Rainfall Distribution				
Existing Landcover						
	acres	%	Ci	Q Runoff (in)	Runoff / acre (cf)	Capture M gallons
Bare Earth	2,603	2.4%		3.80	334	
Forested open space	13,991	13.0%		2.53	1,192	750
Forested wetland	24,851	23.1%		2.65	2,225	1,245
Impervious	1,177	1.1%		4.30	171	
Pervious	31,433	29.2%		2.65	2,808	
Trees over pervious	18,134	16.8%	0.000	2.71	1,660	880
Trees over Impervious	15	0.0%	0.000	4.30	2	0.08
Water	4,383	4.1%		4.50	665	
Wetlands	11,048	10.3%		4.50	1,677	
totals	107,635				10,732	2,875
Percent tree canopy	61.8%		0.000	Set Ci term	842	10% <- Set loss %
Percent Impervious	1.3%			increased stormwater (million gallons)		60% <- Set % impervious
Hydrologic Soil Group						
acres						

Stormwater Calculator Example

Potential Landcover - Increased Tree Cover

	acres	%	Runoff / acre (cf)	Capture M gallons
Bare Earth	1,314	1.2%	168	
Forested open space	36,467	33.9%	3,106	4,121
Forested wetland	24,902	23.1%	2,229	2,886
Impervious	1,177	1.1%	171	
Pervious	4,726	4.4%	422	
Trees over pervious	23,603	21.9%	2,160	2,744
Trees over Impervious	15	0.0%	2	2
Water	4,383	4.1%	665	
Wetlands	11,048	10.3%	1,677	
totals	107,635		10,601	9,752

Percent tree canopy **max** **92.2%** **Goal %** **69% <- Set Goal!**

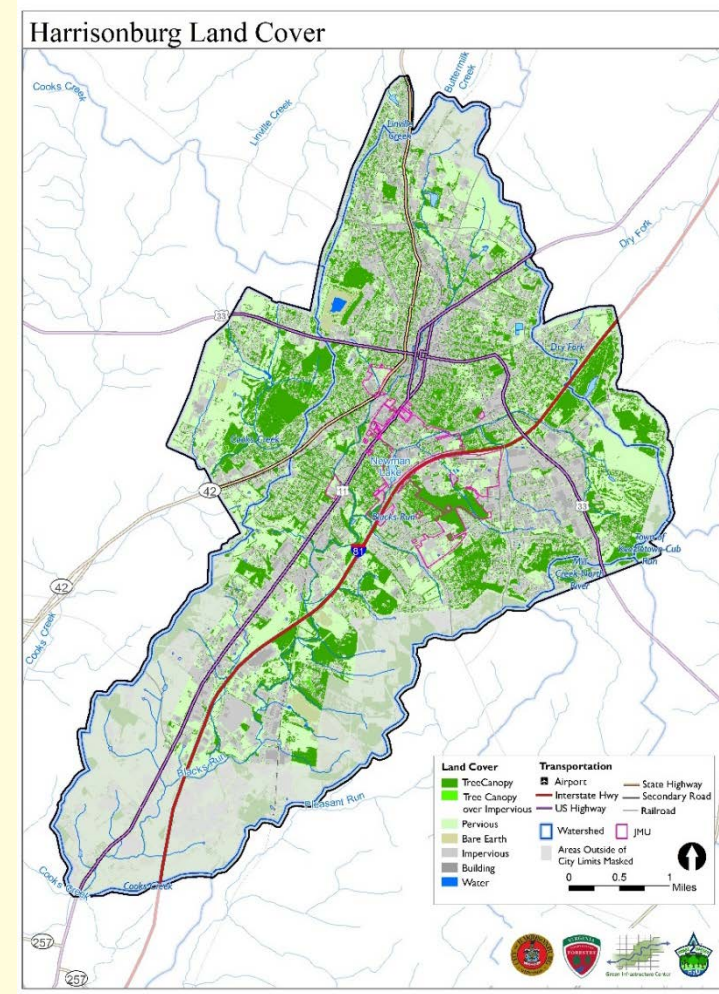
Percent Impervious **1.3%**

1,719 **Increased H2O Captured
million gallons**

Use The Tool To Develop Tree Canopy Goals by Watershed.

Knowing the current tree canopy coverage and possible planting area, develop tree canopy goals for the community.

- Determine how tree canopy coverage goals will be met.
- Determine benchmarks for and ensure adequate funding for achievement of tree canopy coverage goals.





Policy and Planning Tools!

Codes and Policy Audits answer two questions:

Do city policies allow too much impervious area?

For example does the city mandate excessive parking area?

Does it provide incentives to reduce impervious area?

Can the city manage and expand the urban forest?

For example, are tree care and management well funded and implemented?

Does the city have a strategy for planting trees in areas most in need?

A large spreadsheet is used to track each city.

Examples of recommended changes next...

	A	B	C	D	E	F	G	H	I	J
1	Trees and Stormwater Code Audit									
2	TREE CARE AND PROTECTION									
3	Understanding the codes and ordinances that impact individual trees paints a picture for impacts on the urban tree canopy as a whole. This includes information about									
4	tree protection requirements, tree care practices and requirements on tree planting.									
5				Present?	Municipality Comments	Reviewer Comments	Source	What to Look For	Score	Potential Score
6	Tree Protection									
7			Are tree inventories required when greater than 10,000 square feet of land is being disturbed? What DBH trees must be inventoried?	Yes		A tree survey is required for all development sites and includes hardwood trees 18" caliper and over in the RCA and on buffers on-site. The inventory must also be completed 50' offsite and include all trees 18" caliper and over. It is recommended to extend this requirement to softwoods as well and to all areas, not only those in RCA and buffer areas.	UDO 8.1.3C2d	Include hardwoods 18" and over, softwoods 24" and over, and understory species 8" and over in tree inventories of proposed development properties. Require inventories of the entirety of the property including 100' offsite from all property boundaries. Require correct species identification, DBH size, and, general condition description. Municipalities which include the above requirements, score one point.	0	1
8			Is tree protection fencing required (TPF) on public property? Is it required on private property?	Yes		Tree protection fencing is required within the RCA and in areas designated as tree save areas. Fencing is to be placed at 1 foot away from the trunk per inch in caliper radius. Add tree protection signage to better communicate with the public.	UDO 8.1.2(G)	Require tree protection fencing on public and private property. Municipalities which require tree protection fence on both public and private property score two points. Municipalities which require tree protection fence on public property score one point. Municipalities which do not require tree protection fence at all score zero points.	2	2
9			Are other kinds of tree protection allowed/enforced (e.g. root pruning, aeration, vertical mulching)?	Not specified		The UDO states that "protection measures must adhere to generally accepted good design standards and practices."	UDO 8.1.3(G)(2)(c)	Create root pruning, mulch matting, and aeration matting details. Require the inclusion of these details on development plans. Inspect the site for adequate tree protection mechanism installation before any further work is permitted on-site. If all details are required and construction may not proceed on-site until tree protection device inspections have been completed, apply one point. If details are required but inspections are not required or details are not required and inspections are not required, apply zero points.	0	1

Urban Forestry Data Collection and Monitoring



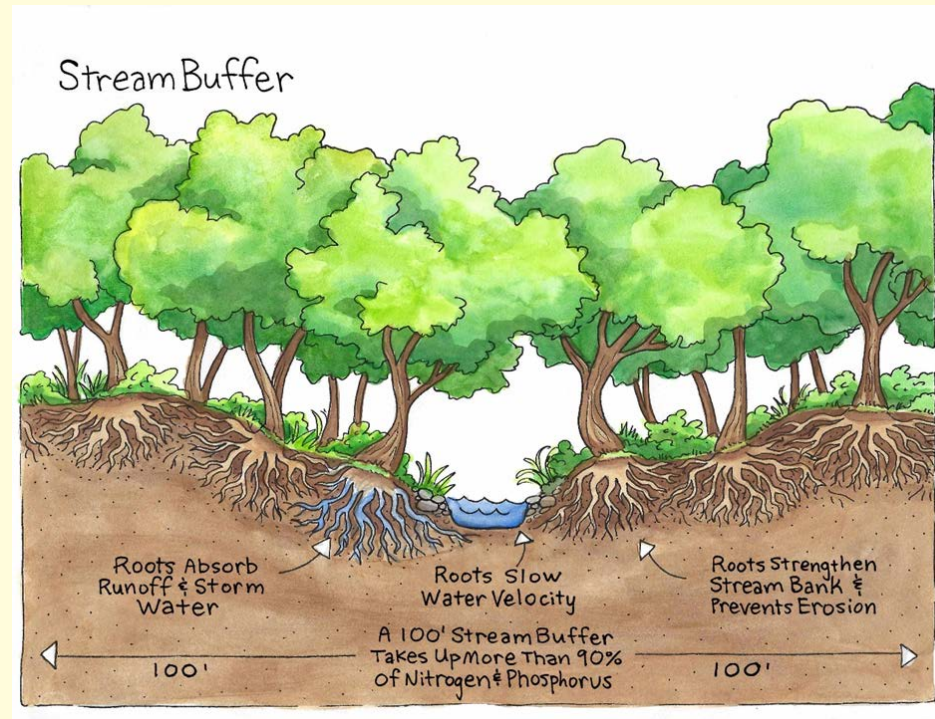
Versus



Planning for the urban forest first requires understanding its composition and distribution.

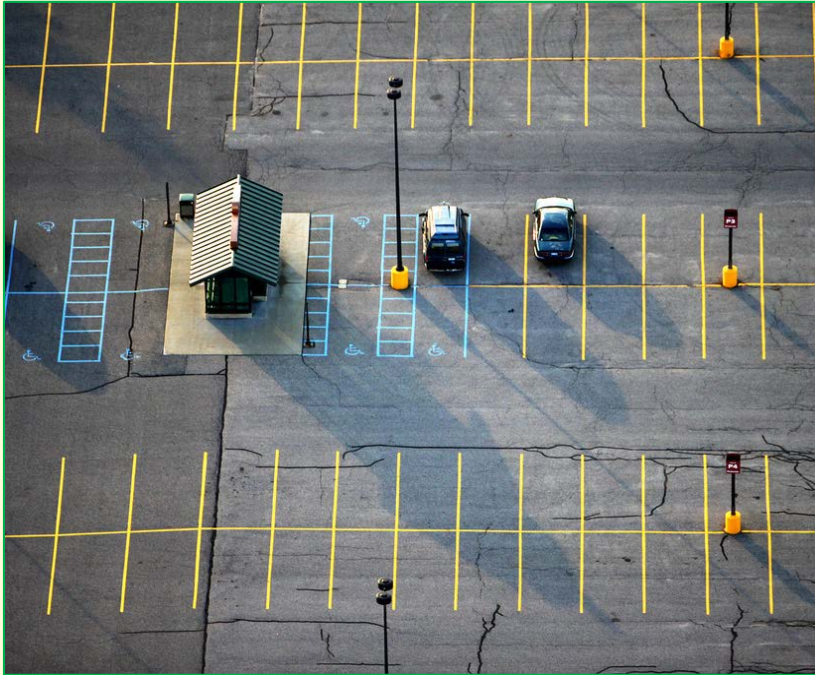
- Use an urban forestry software to collect urban forestry data
- Implement the data collection process as a part of the urban forestry program
- Note: This recommendation would require additional funding.

Adopt a stream buffer ordinance



A 100-foot wide buffer removes more than 90% of nitrogen, phosphorus and sediment from overland runoff. It can be narrower depending on available space!

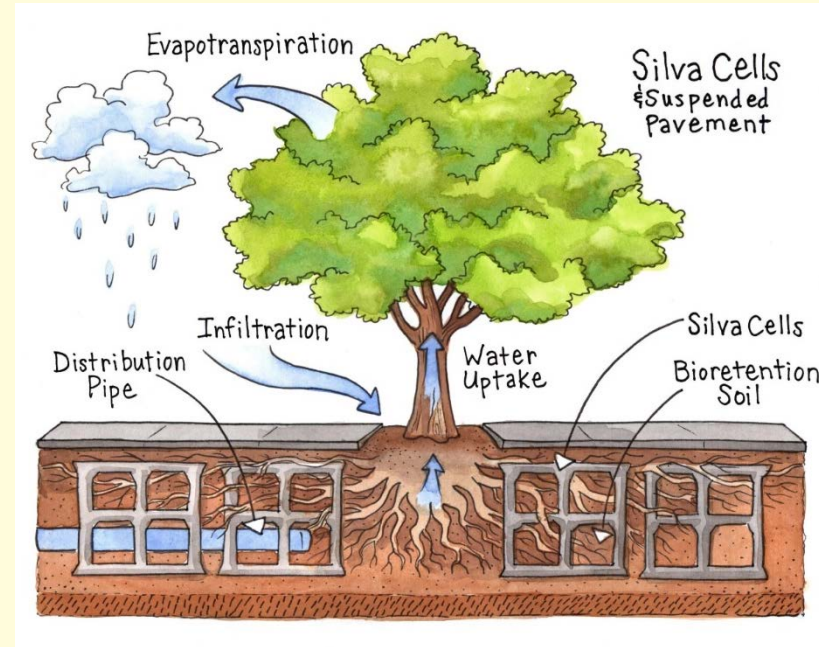
Changing Codes Example: Reduce Imperviousness in Parking Lots



How?

- Match parking requirements to demand and sizing requirements
- Add trees to parking lots – shaded pavement lasts longer!

Accommodate Large Trees



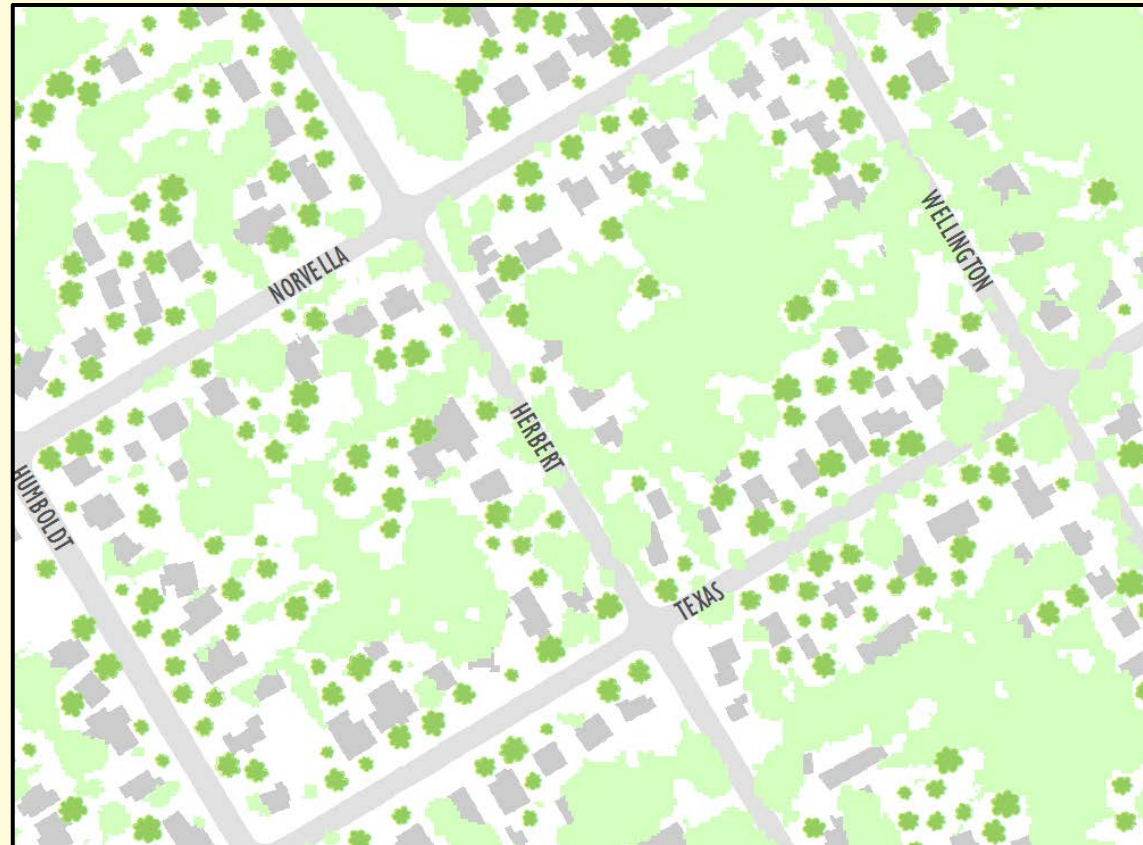
Larger trees offer greater benefits – so think carefully when setting planting goals for streets!

Consider using suspended pavement systems, rather than just choosing small trees! Trees will pay back your investment!

Example Strategy: Plant trees on private lands

Individuals actions can make a big impact!

- ~**47,500** parcels with single family homes
- ~**31,000** of these have room for at least 1 tree
- If everyone planted a single tree, they would intercept **62 million gallons** of rainwater every year (1.5 million bathtubs!)



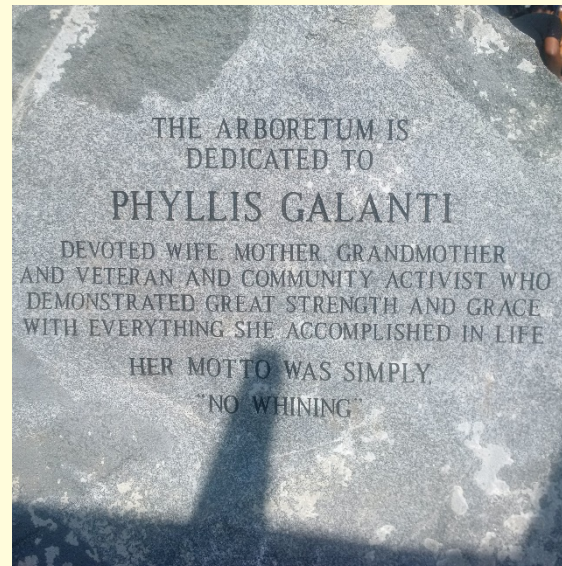
Each tree icon represents a possible tree planting location that avoids buildings, underground utilities, and other infrastructure. Tree spacing is 30 feet.

Engage the Community in the Solution! Once we have data, it's time for action! Tree plantings, nature trails, stream buffers, teaching!



Design and plant special projects to make a difference!

GIC created an Arboretum at the McGuire Veterans Hospital in Richmond VA



End