Trees: Green Infrastructure for a Healthy Chesapeake Bay

Green Infrastructure Center

by Karen Firehock
www.gicinc.org

For the Chesapeake Bay Citizens Advisory Committee
May 24, 2023

The nonprofit Green Infrastructure Center (GIC) helps communities evaluate green assets and manage them to maximize ecology, economy and culture.

We do this by:

Mapping land cover and urban tree canopy

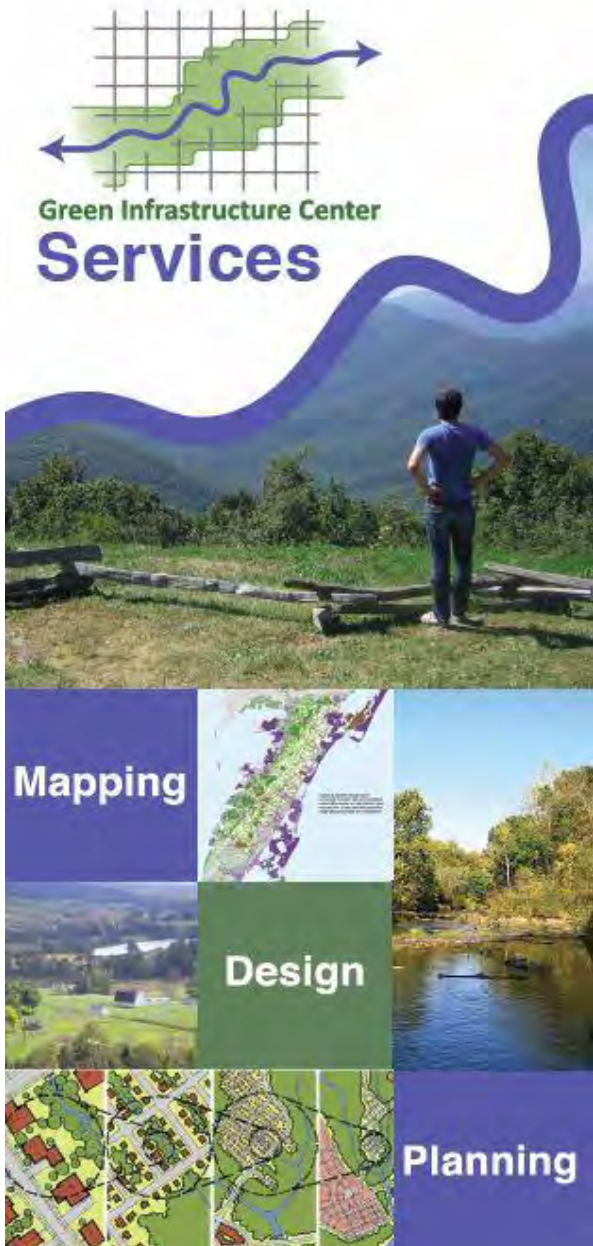
Modeling ecosystem benefits of forests

Mapping high value wildland habitats

Creating strategic green infrastructure plans

We test ideas on the ground with communities –
we turn those lessons into tools and technical support!

www.gicinc.org



Trees: the original 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.

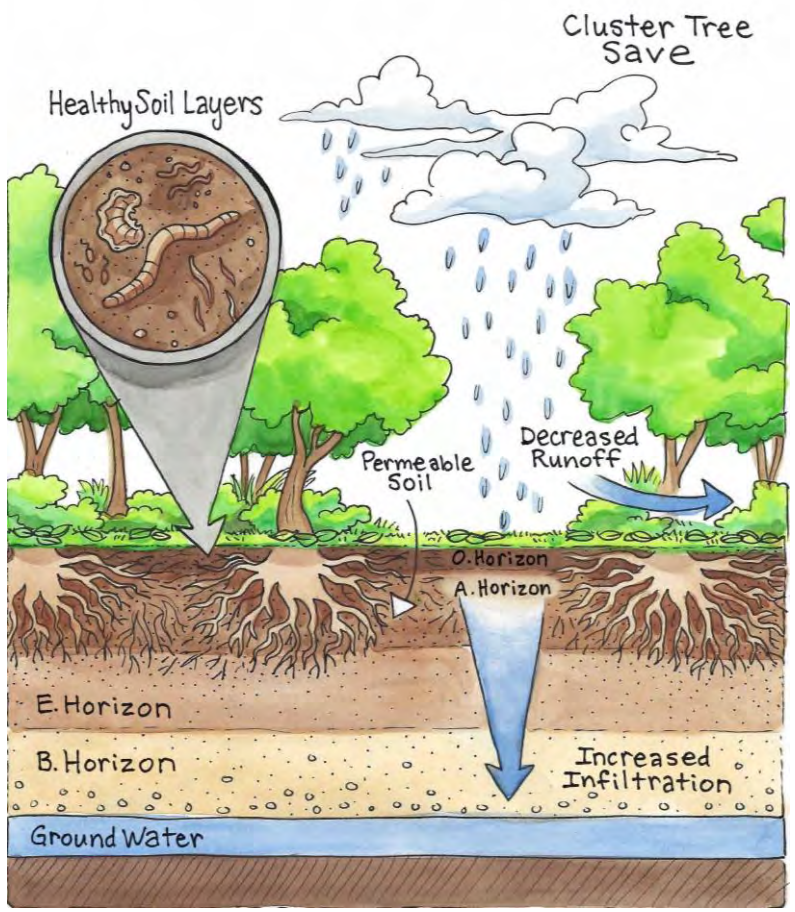
Estimate the value of a tree in your yard with itreemytree
https://mytree.itreetools.org/#/

Benefits of Trees and Forests

- Preserving biodiversity and wildlife habitat.
- Conserving working lands such as farms and forests, that contribute to the economy.
- Protecting and preserving water quality and supply.
- Providing cost-effective stormwater management and hazard mitigation.
- Improving public health, quality of life and recreation networks.

What does a tree need?

- Air (circulation)
- Light (photosynthesis)
- Water (growth)
- Nutrients (from soil and even the air)
- Space (roots and canopy need to spread out)
- Free from pests and diseases (watch out for these and treat as needed)



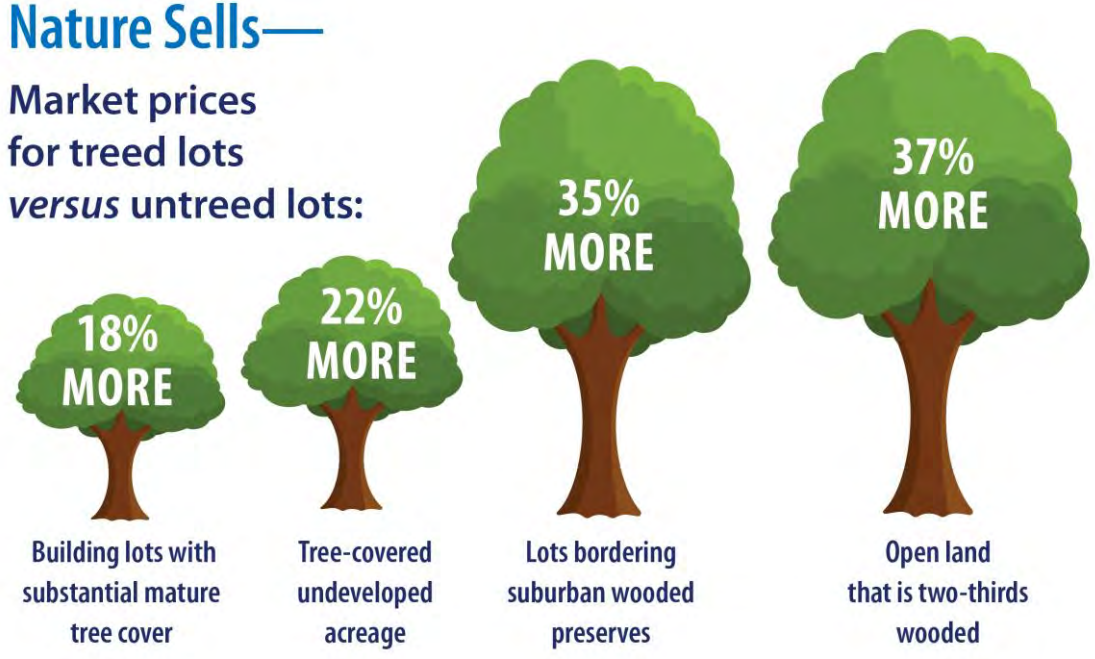
Urban trees also need watering the first few years to help them get established.

They should have some attention to pruning to ensure proper and safe form, to avoid issues like this one below.

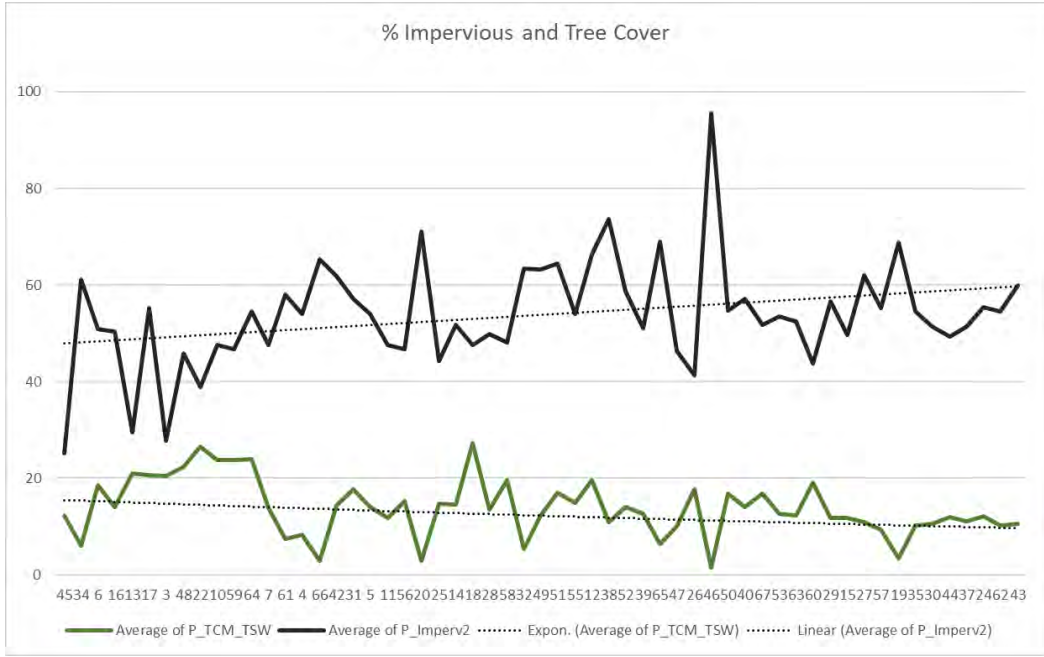
Check out Trees VA for more! https://treesvirginia.org/education/tree-planting

Trees add value to neighborhoods

Trees add value to properties, in improved real estate values, savings on air conditioning costs, lower heat island and even sequestering carbon!



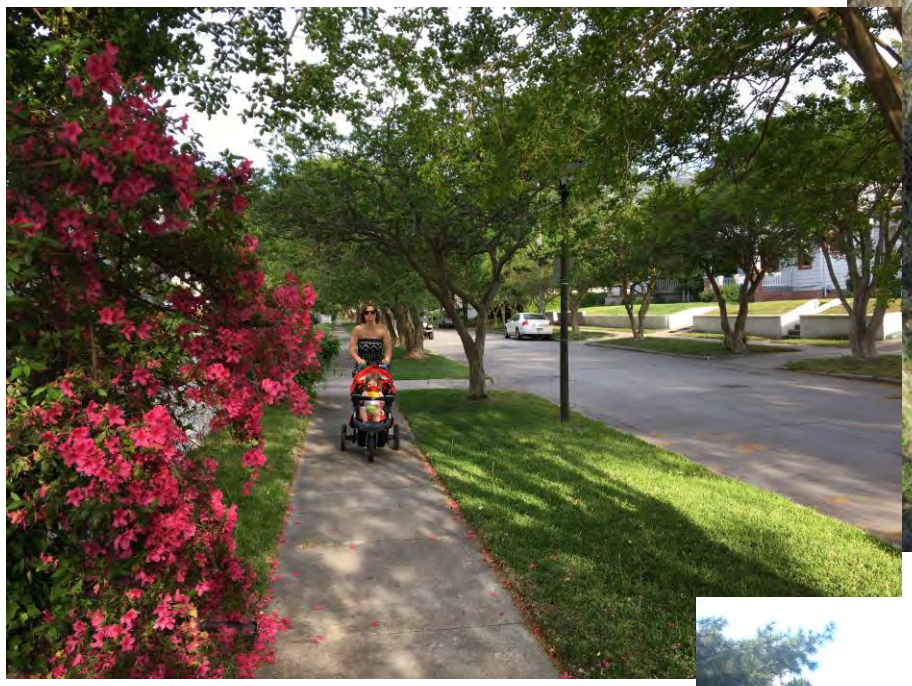
Source: Kathleen Wolf, 2007, *City Trees and Property Values.*

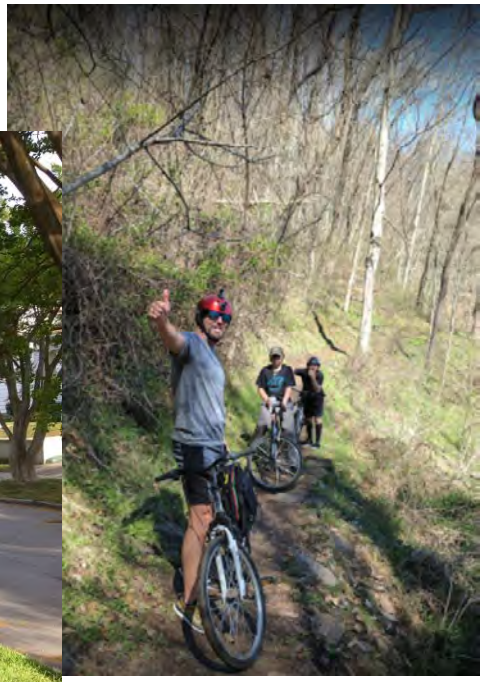


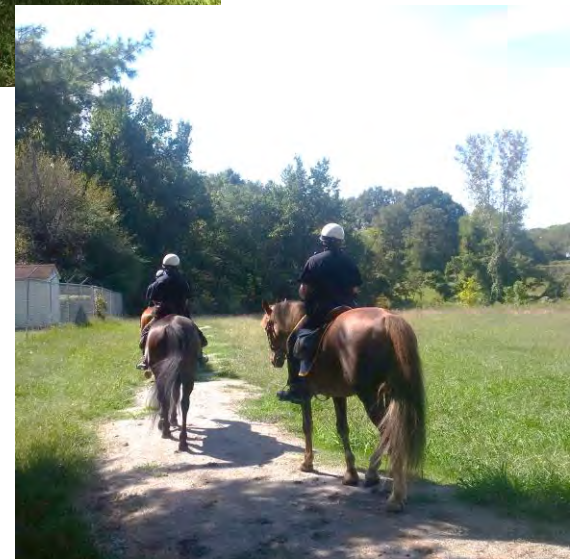
Decreases in tree canopy correlate to increased urban heating. Areas under trees are often 12 degrees cooler and neighborhoods are cooler too!

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

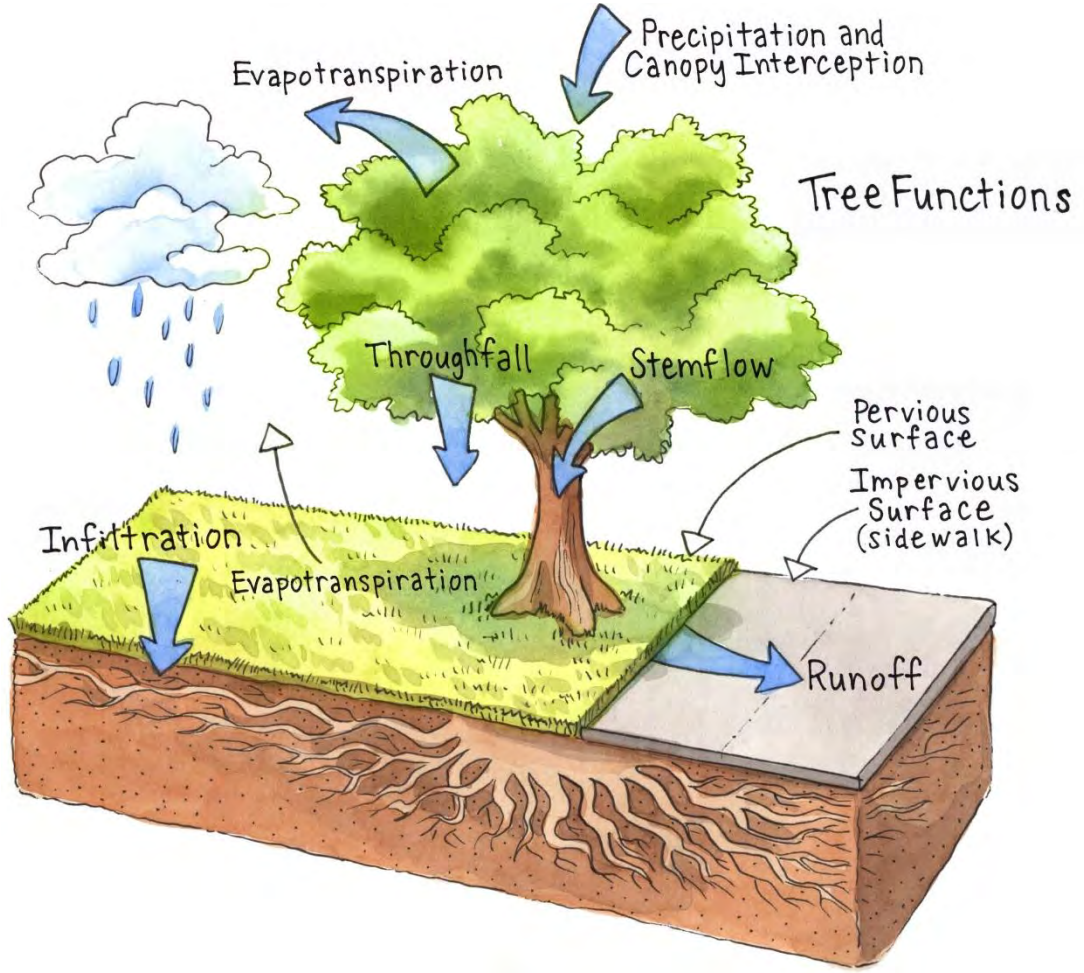
Small companies, especially those that are have well paid and skilled workforce place a strong importance on the "green" of the local environment.
Crompton Love and Moore, 1997

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 = $

Trees Soak Up and Clean Water

- 20% of annual rainfall or > retained in crown (Xiao et al., 2000)
- Delays runoff up to 3.7 hours
- ⇧ infiltration capacity of soils
- *A typical tree can intercept in its crown, between 760 gallons to 4000 gallons per tree per year, depending on species.*



Trees help with climate change impacts too!

Earth has about 3 trillion trees today and ***new trees could cover another 3.5 million square miles*** of our planet. That's enough trees to take up 830 billion tons of heat trapping carbon dioxide ~ equivalent to past 25 years of the carbon emissions so we need another trillion trees! (Journal *Science*)

"Planting ***25 million urban trees*** annually in the U.S. in urban areas could add an additional ***353 million tons of carbon storage***." Dr. David Nowak

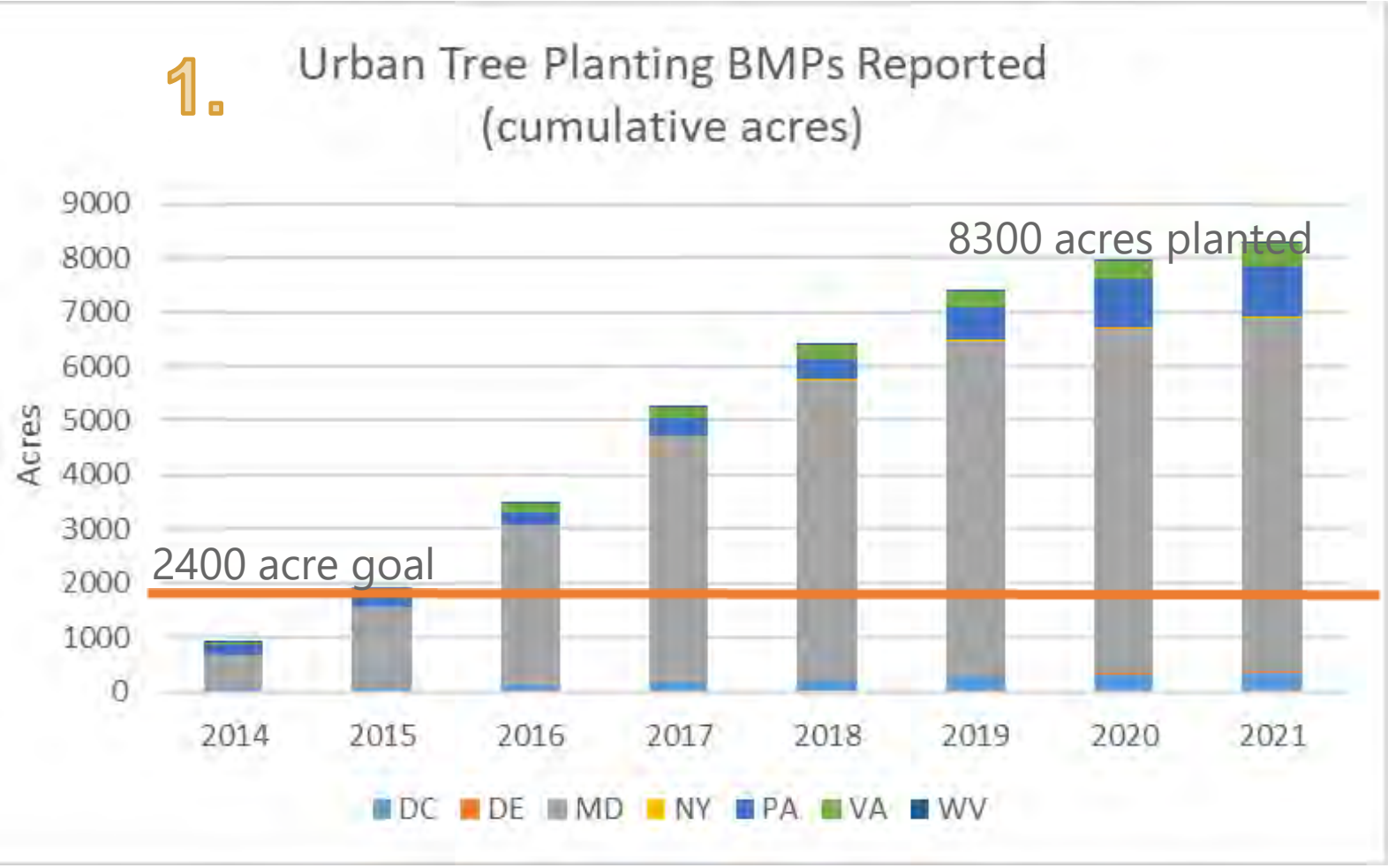
"While existing city trees already clean and cool the air for more than 50 million people, a global investment of $100 million per year in tree planting and maintenance ***could provide as many as 77 million people with cooler cities and offer 68 million people measurable reductions in fine particulate matter pollution***." *Robert McDonald, The Nature Conservancy*

But...we need to be concerned – our trees are in trouble!

Recent national data show urban and suburban tree canopy cover is trending downwards at a rate of about **175,000 acres lost per year** – approximately 36 million trees annually. As these trees are lost, so are the benefits they provide – **an economic loss of $96 million** per year (Nowak and Greenfield 2018).

How are we doing in the Chesapeake Bay Region?

1.

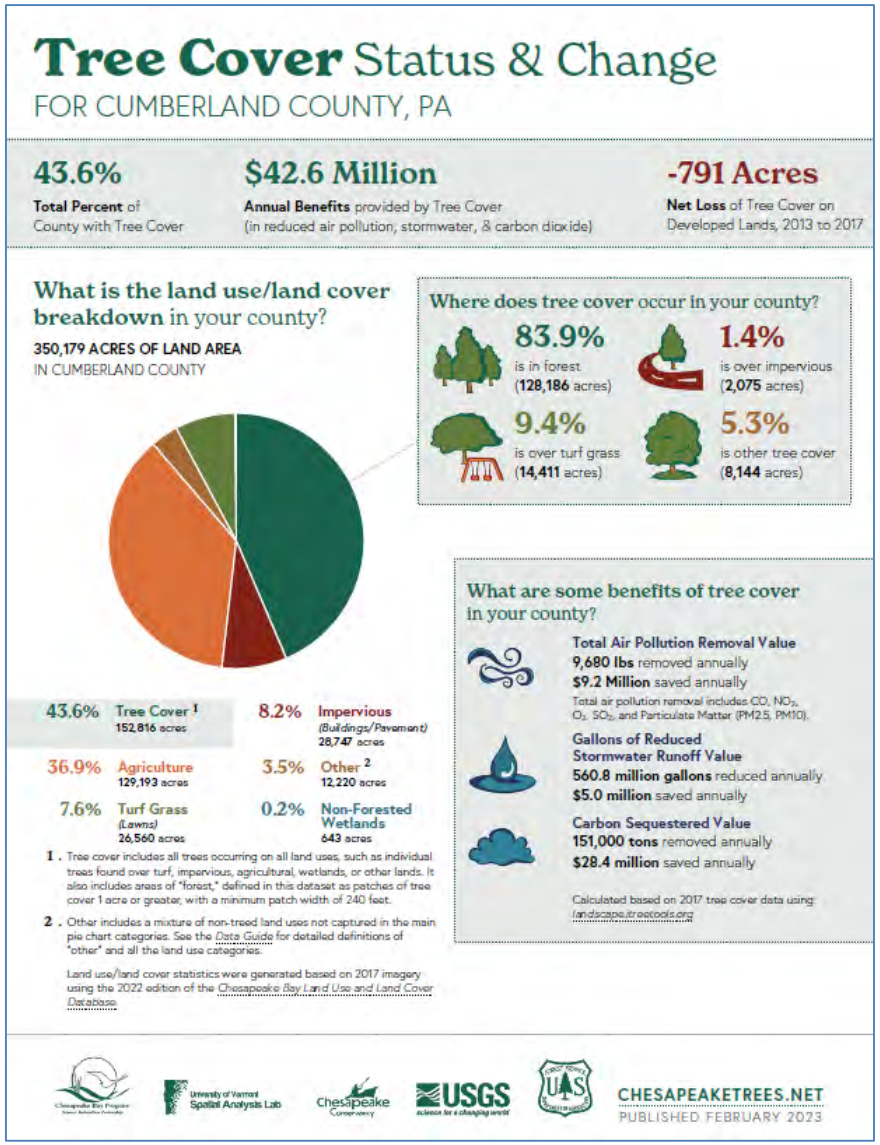


2.

Land Use/Land Cover Change Detected from Imagery

Tree Canopy Net Change in Census Places (2013/14-2017/18)	
Jurisdiction (CB Only)	**Net Change** (Acres)
Delaware	-28
DC	21
Maryland	-13,804
New York	78
Pennsylvania	-2,444
Virginia	-9,548
West Virginia	-107
Total	-25,832

New fact sheets available at the county scale…



Tree Cover Status & Change
FOR CUMBERLAND COUNTY, PA

43.6%
Total Percent of County with Tree Cover

$42.6 Million
Annual Benefits provided by Tree Cover (in reduced air pollution, stormwater, & carbon dioxide)

-791 Acres
Net Loss of Tree Cover on Developed Lands, 2013 to 2017

What is the land use/land cover breakdown in your county?

350,179 ACRES OF LAND AREA
IN CUMBERLAND COUNTY

43.6%	Tree Cover [1] 152,816 acres	8.2%	Impervious (Buildings/Pavement) 28,747 acres
36.9%	Agriculture 129,193 acres	3.5%	Other [2] 12,220 acres
7.6%	Turf Grass (Lawns) 26,560 acres	0.2%	Non-Forested Wetlands 643 acres

1. Tree cover includes all trees occurring on all land uses, such as individual trees found over turf, impervious, agricultural, wetlands, or other lands. It also includes areas of "forest," defined in this dataset as patches of tree cover 1 acre or greater, with a minimum patch width of 240 feet.
2. Other includes a mixture of non-treed land uses not captured in the main pie chart categories. See the *Data Guide* for detailed definitions of "other" and all the land use categories.

Land use/land cover statistics were generated based on 2017 imagery using the 2022 edition of the *Chesapeake Bay Land Use and Land Cover Database*.

Where does tree cover occur in your county?

- **83.9%** is in forest (**128,186** acres)
- **1.4%** is over impervious (**2,075** acres)
- **9.4%** is over turf grass (**14,411** acres)
- **5.3%** is other tree cover (**8,144** acres)

What are some benefits of tree cover in your county?

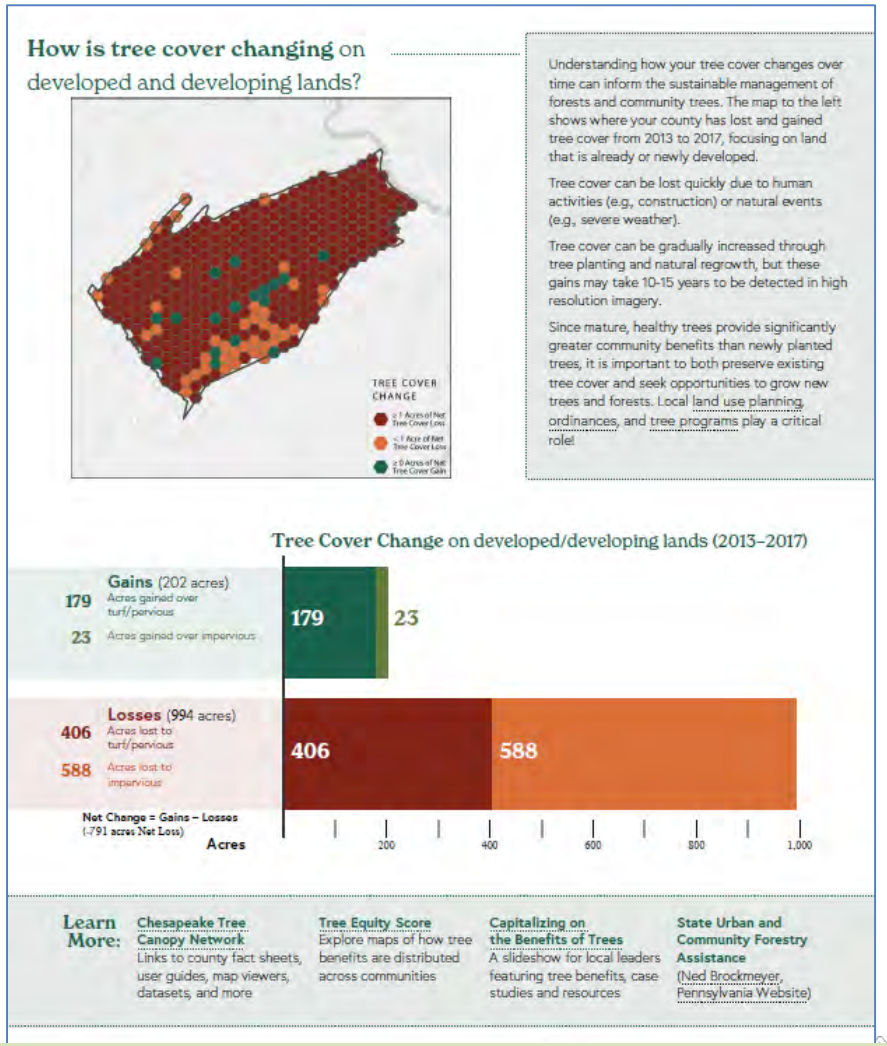
Total Air Pollution Removal Value
9,680 lbs removed annually
$9.2 Million saved annually
Total air pollution removal includes CO, NO_2, O_3, SO_2, and Particulate Matter (PM2.5, PM10).

Gallons of Reduced Stormwater Runoff Value
560.8 million gallons reduced annually
$5.0 million saved annually

Carbon Sequestered Value
151,000 tons removed annually
$28.4 million saved annually

Calculated based on 2017 tree cover data using: *landscape.treetools.org*

University of Vermont Spatial Analysis Lab · Chesapeake Conservancy · USGS · CHESAPEAKETREES.NET
PUBLISHED FEBRUARY 2023



How is tree cover changing on developed and developing lands?

Understanding how your tree cover changes over time can inform the sustainable management of forests and community trees. The map to the left shows where your county has lost and gained tree cover from 2013 to 2017, focusing on land that is already or newly developed.

Tree cover can be lost quickly due to human activities (e.g., construction) or natural events (e.g., severe weather).

Tree cover can be gradually increased through tree planting and natural regrowth, but these gains may take 10-15 years to be detected in high resolution imagery.

Since mature, healthy trees provide significantly greater community benefits than newly planted trees, it is important to both preserve existing tree cover and seek opportunities to grow new trees and forests. Local land use planning ordinances, and tree programs play a critical role!

Tree Cover Change on developed/developing lands (2013–2017)

Learn More:

- **Chesapeake Tree Canopy Network** — Links to county fact sheets, user guides, map viewers, datasets, and more
- **Tree Equity Score** — Explore maps of how tree benefits are distributed across communities
- **Capitalizing on the Benefits of Trees** — A slideshow for local leaders featuring tree benefits, case studies and resources
- **State Urban and Community Forestry Assistance** (Ned Brockmeyer, Pennsylvania Website)

https://chesapeaketrees.net/understand-your-canopy/

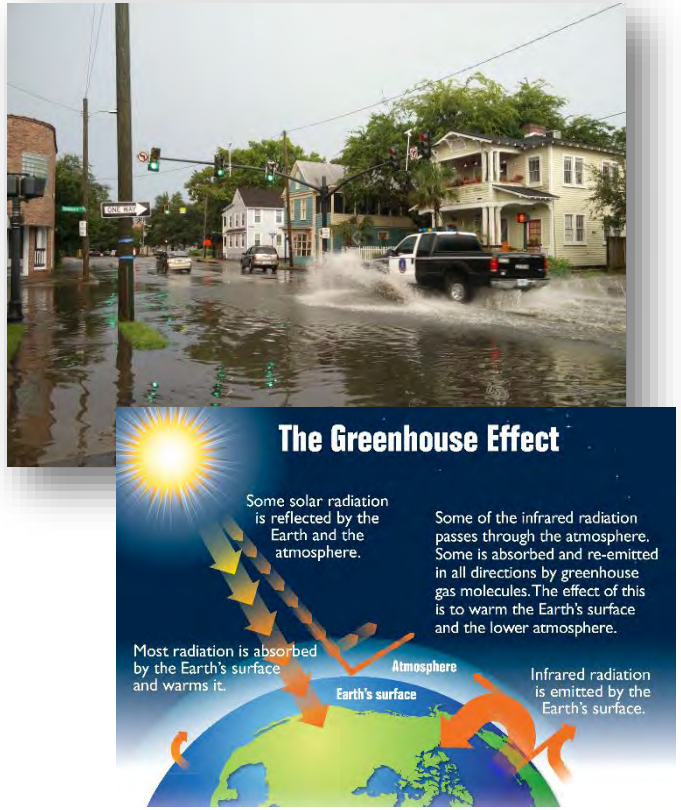
Did you know …One acre of pavement releases 36 times more runoff than a forest.

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).

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

It seems like flooding is happening more often? Why?

- ✓ Cities, towns and counties are becoming more impervious = more runoff.
- ✓ Weather events seem to be more extreme – we now use the term “rain bombs” to refer to high intensity, short duration storms.
- ✓ More pavement and more days of sun = hotter cities. This creates “micro-climates” where it actually now rains more in cities!
- ✓ Many cities will have more hot days which could mean even more flooding…



Flooding – is "natural"?

- ✓ Flooding is a normal event for most streams and rivers, and high tide flooding, especially during full moon cycles is not unexpected.
- ✓ Floods restore rich soils to floodplains and alluvial fans of coastal plains replenish land lost to erosion.

- ✓ But we have changed hydrology by channelizing rivers and trapping them in channels that create greater downstream velocities, instead of allowing floodwaters to spread out and then slowly dissipate.
- ✓ Many historic cities and towns were built along rivers for transportation…but we now are facing consequences as weather systems become more erratic. Check out your flood data at https://waterwatch.usgs.gov/

Water flow strategies

How do we make this…

function like this?

GIC has developed tools to use trees to mitigate/prevent stormwater and reduce floods!

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

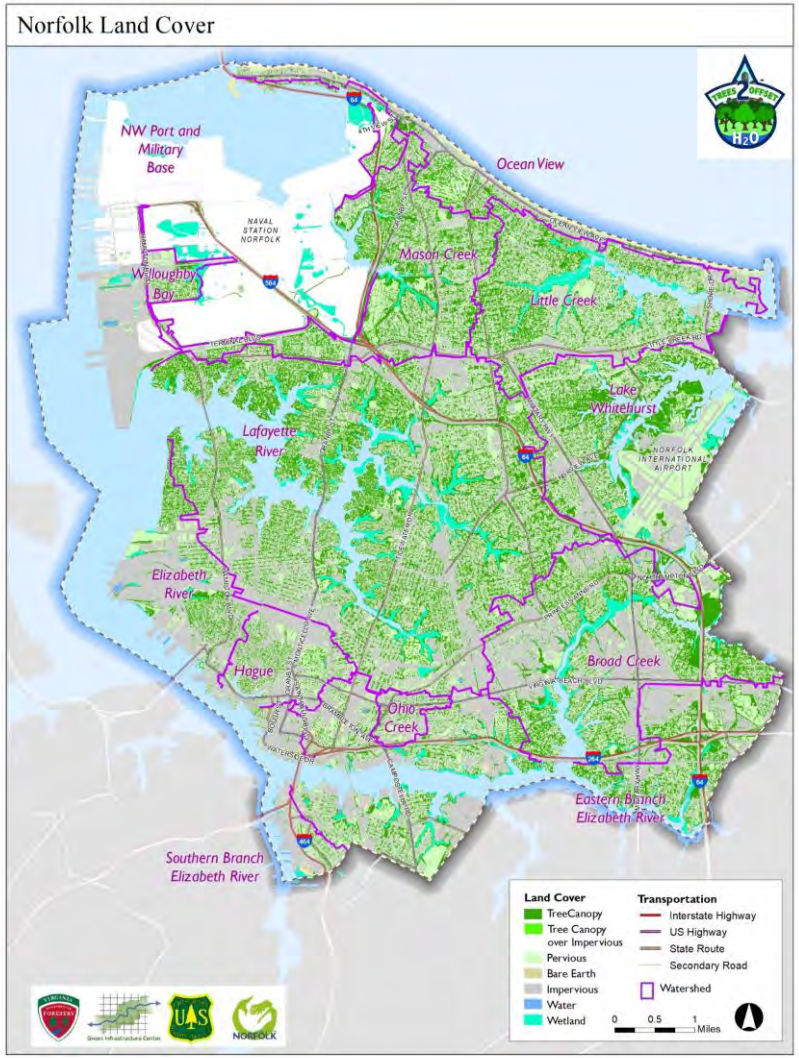
*GIC studied the role of trees for stormwater management in **6 states and 12 cities and built a model for stormwater uptake by trees.***
VA, AL, NC, SC, FL, GA

USFS funded this work.

How much stormwater do the trees uptake?

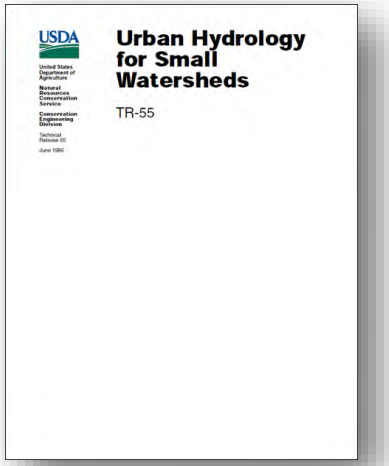
Benefits are typically modeled on a tree-by-tree basis. We need to be able to apply benefits on a per unit area basis…

We need to analyze trees based on the conditions of the setting and soils by watershed.



Tree Over Parking Lot

Tree Over Street



Tree Over Lawn

Tree Over Natural Forest Cover

Trees take up more or less water depending on their settings so GIC created high resolution 1 meter x 1 meter maps to account for conditions of the urban forest.

The GIC's stormwater calculator uses land cover and soils to model the benefit of maintaining or increasing urban canopy.

Harrisonburg, Virginia, USA* **Urban Tree Canopy Stormwater Model** **version July 2, 2019**

methodology is based upon the NRCS TR-55 method for small urban watersheds. It is used to provide better estimates using GIC's high-resolution land cover and modeling of potential canopy area.

					million gallons											
	TOTALS	26.6%	38.4%	7.9	5.7	1.6	34.8%									
	Statistics by Drainage Basin (current settings)							Variable								Variable
	Area	Current Tree Cover	Current Impervious Cover	Tree H_2O Capture	Increased H_2O w/xx% tree loss	Added H_2O Capture w/xx% PPA	Tree Cover Goal	Pick an Event	Pick a loss scenario		Converted Land			Canopy Added	Enter % to be planted
		%		*million gallons*			%	Event	% UTC loss	% FOS Loss	% Imperv	PCA	PPA	% of Land	% of PPA
1	Blacks Run	24.9%	41.6%	6.2	4.31	1.25	33%	1 yr / 24 hour	10%	10%	40%	40.9%	15.9%	8.0%	50%
2	Cooks Creek	33.4%	23.3%	1.1	0.91	0.21	43%	1 yr / 24 hour	10%	10%	40%	53.2%	19.8%	9.9%	50%
3	Dry Fork	37.1%	23.4%	0.5	0.37	0.06	45%	1 yr / 24 hour	10%	10%	40%	53.7%	16.6%	8.3%	50%
4	Linville Creek	21.1%	44.4%	0.1	0.04	0.02	29%	1 yr / 24 hour	10%	10%	40%	36.4%	15.3%	7.6%	50%
5	Mill Creek-North River	36.5%	34.2%	0.1	0.07	0.01	45%	1 yr / 24 hour	10%	10%	40%	53.5%	17.0%	8.5%	50%
6	Town of Keezletown-Cub Run	61.0%	0.7%	0.0	0.02	0.00	77%	1 yr / 24 hour	10%	10%	40%	93.9%	32.9%	16.5%	50%

The GIC's stormwater calculator also calculates changes in pollution loading from one land use to the next.

mwater Model version April 22, 2019

Canopy Stormwater Model estimates stormwater runoff yields for current and potential land cover. The
CS TR-55 method for small urban watersheds. It is used to provide better estimates using GIC's high-
of potential canopy area.

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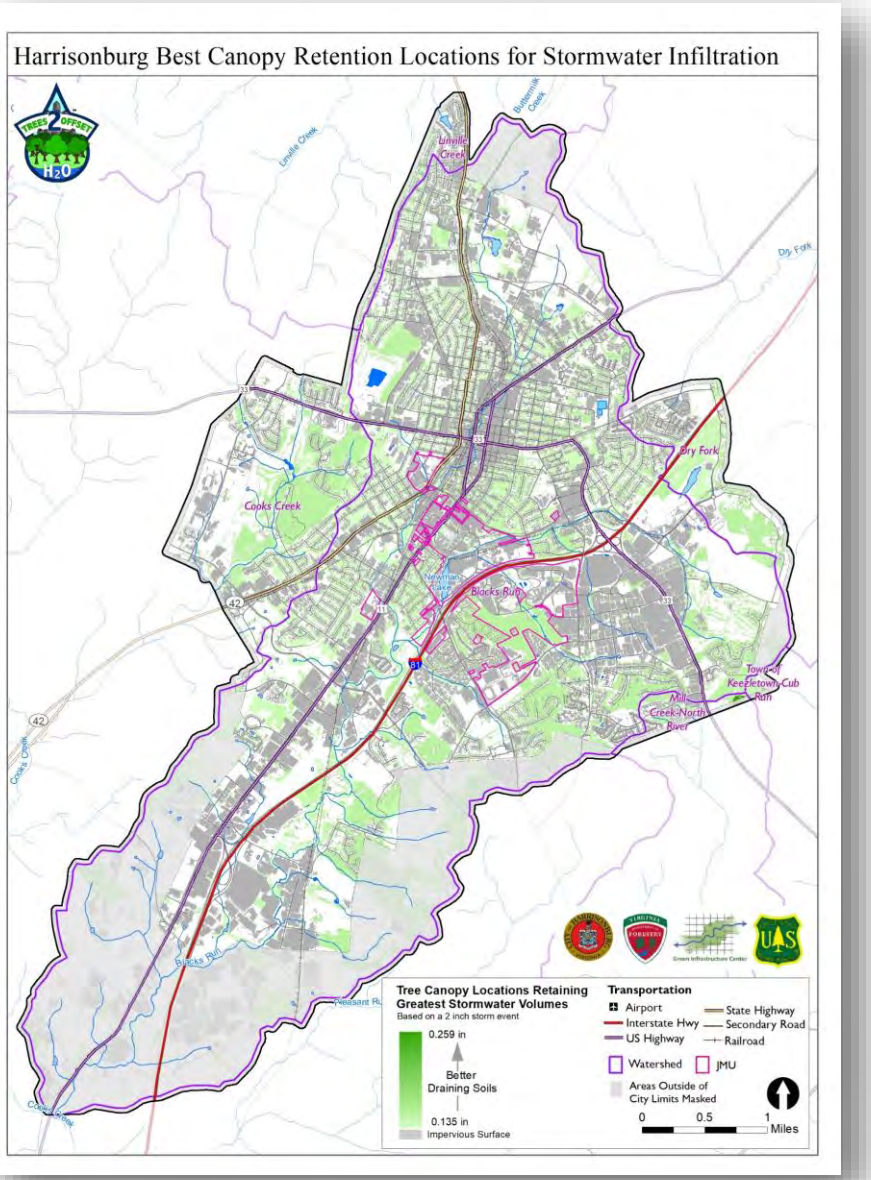
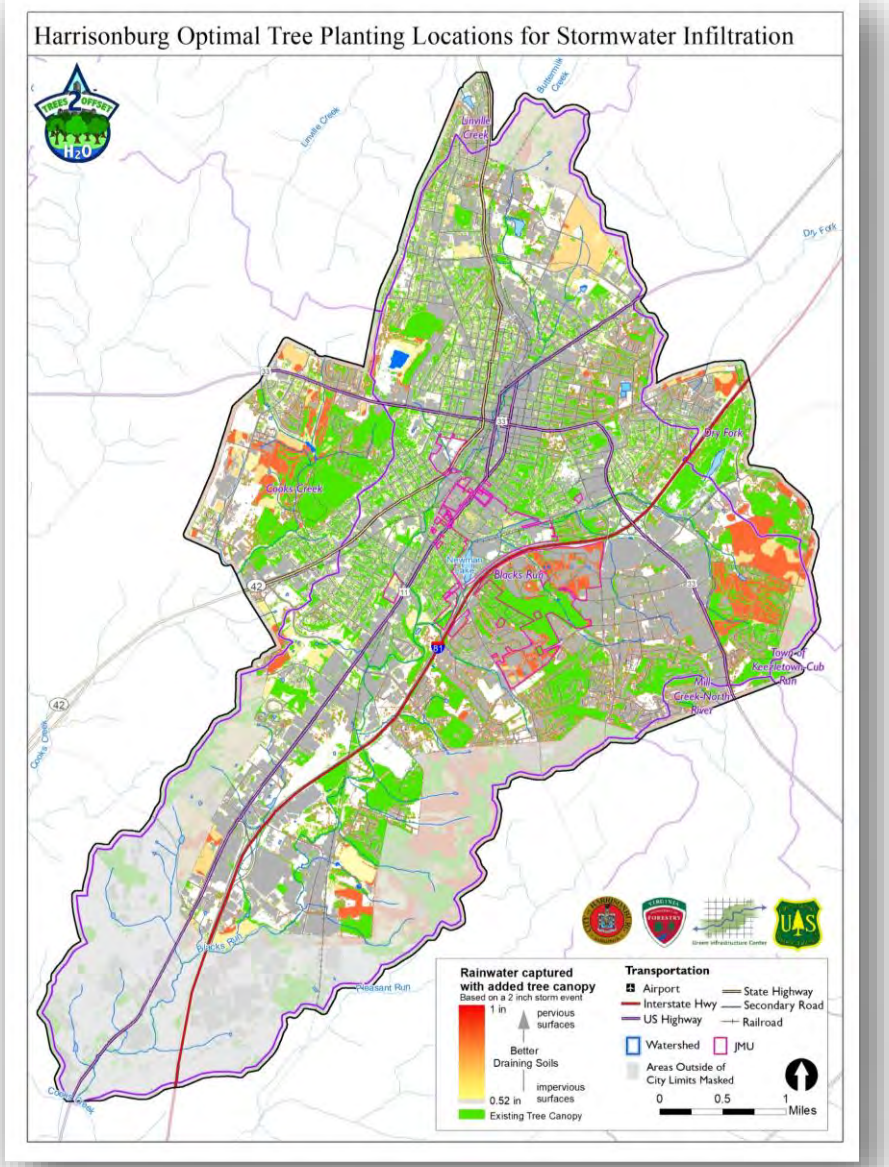
million gallons																							
101.9	851.3	55.2%									4809	8	371	10	774	17	-2236	-4	-85	-3	-191	-5
t settings)			Variable							Variable	Drainage Basin (current settings)											
Increased H_2O w/xx% tree loss	Added H2O Capture w/xx% PPA	Tree Cover Goal	Pick an Event	Pick a loss scenario		Converted Land			Canopy Added	Enter % to be planted	Non-Point Pollution Captured by Existing Trees (% = percent of total load without trees)						Change in Pollution Load from Landuse Variables (% = percent increase or decrease of total load)					
million gallons		%	Event	% UTC loss	% FOS Loss	% Imperv	PCA	PPA	% of Land	% of PPA	N lbs/yr	N (%)	P lbs/yr	P (%)	SED t/yr	SED (%)	N lbs/yr	N (%)	P lbs/yr	P (%)	SED t/yr	SED (%)
5.25	0.82	59%	1 yr / 24 hour	10%	10%	40%	66.0%	14.6%	7.3%	50%	4,323	9	337	11	656	16	-1,900	-4	-75	-3	-168	-5
7.26	0.88	58%	1 yr / 24 hour	10%	10%	40%	64.7%	12.6%	6.3%	50%	5,752	9	443	12	937	20	-2,428	-4	-91	-3	-202	-5
5.70	0.85	49%	1 yr / 24 hour	10%	10%	40%	55.0%	11.3%	5.7%	50%	4,674	7	352	9	856	17	-2,617	-4	-99	-3	-213	-5
0.83	0.11	37%	1 yr / 24 hour	10%	10%	40%	44.0%	13.5%	6.7%	50%	628	4	46	6	130	10	-606	-4	-25	-4	-52	-5
1.11	0.25	36%	1 yr / 24 hour	10%	10%	40%	44.3%	17.0%	8.5%	50%	783	4	61	5	121	5	-1,206	-6	-49	-4	-111	-5
1.58	0.04	68%	1 yr / 24 hour	10%	10%	40%	73.5%	10.7%	5.4%	50%	1,091	12	85	11	160	18	-21	0	0	0	0	0
1.89	0.22	62%	1 yr / 24 hour	10%	10%	40%	70.4%	16.4%	8.2%	50%	1,510	10	115	12	263	27	-469	-3	-20	-2	-39	-6
0.51	0.08	66%	1 yr / 24 hour	10%	10%	40%	73.9%	15.6%	7.8%	50%	437	11	34	13	72	30	-128	-4	-5	-2	-11	-7
0.21	0.04	70%	1 yr / 24 hour	10%	10%	40%	80.1%	19.7%	9.9%	50%	175	11	13	13	29	31	-56	-4	-2	-3	-5	-8
3.28	0.48	48%	1 yr / 24 hour	10%	10%	40%	54.3%	13.2%	6.6%	50%	2,529	7	193	9	435	15	-1,717	-5	-67	-3	-148	-6





Data can be translated into maps~

All planting areas are not created equal.

At left, best places to retain trees for stormwater uptake and at right, best places to plant them…

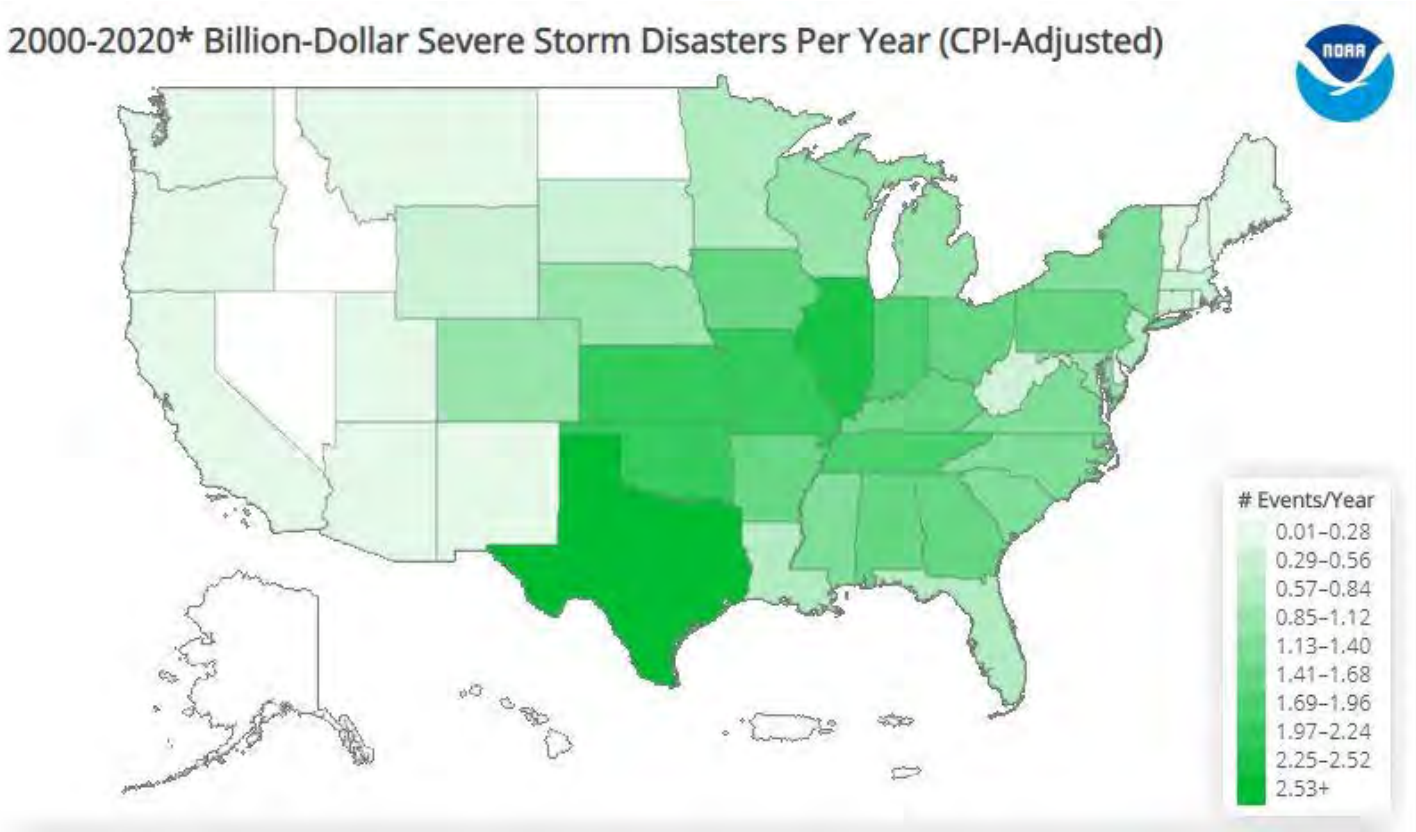
Climate Change Is An Increasing Challenge …

- 6X more billion-dollar severe storms during 2001–2022 (142 events) than prior 2 decades (25 events/1980–2000).
- Avg. cost of billon-dollar severe storms rose from $2.5 billion (1980–2000) to $15.4 billion (2001–2022).

https://www.climatecentral.org/climate-matters/severe-storm-supercell-and-tornado-trends-2023

- Rainfall rates likely increase with studies modeling 10-15% increase in rainfall rates within 100 km of the storm under a 2˚C warming scenario.
- Storm intensity globally will likely increase by 1-10% under a 2˚C warming scenario. This implies an increase in the destructive potential per storm assuming no reduction in storm size.

https://www.gfdl.noaa.gov/global-warming-and-hurricanes/



https://www.ncdc.noaa.gov/billions/mapping/freq-per-year/2000-2020

Have a plan to prepare for storms and to recover your canopy afterwards.

Why plan?

- Reduce tree canopy cover loss;
- Improve local, state, and federal information sharing;
- Coordinate response plans;
- Identify capacity and areas of need;
- Identify critical infrastructure; and
- Get reimbursed for debris removal and replacement for lost or damaged trees during federal major disaster declarations.

Storm Readiness

There are many ways you can better prepare your community's urban forest for future storms or events. This includes integrating urban forest management and planning into emergency response. Some top ways you can be better prepared are:

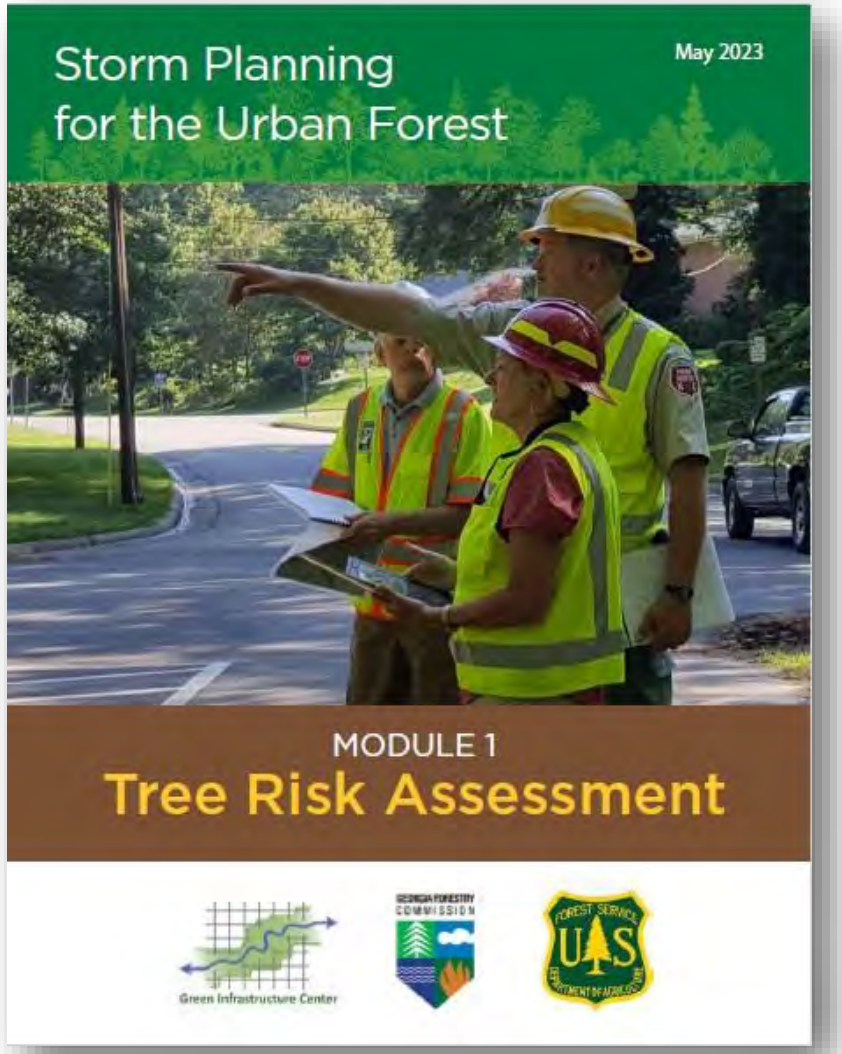
1. Conduct a tree risk assessment of public trees.
2. Develop standing contracts (also known as advanced readiness or pre- contracts).
3. Hire a consultant to develop a debris management plan, estimate debris amounts and identify and establish a debris management site.
4. Hold a mock event annually (staff may change!).

Tree Risk Assessment

Many communities have existing public tree inventories. Identifying and mitigating trees at risk of failure can increase public safety, reduce property damage, prevent canopy loss and reduce overall debris cleanup management and costs.

Tips for assessing risk for your community's public trees:

1. Identify Tree Risk Zones.
2. Conduct a Level-1 Risk Assessment in priority zones.
3. Make sure to only hire arborists with Tree Risk Assessment Qualification (TRAQ).
4. Identify areas for a Level 2 Assessment.
5. Integrate mitigation into maintenance over time.
6. Make sure to do routine maintenance and structural pruning.



FEMA Policy and Rules Play A Role …

US Flood Insurance Rates have been rising to dissuade people from living in places that flood by capturing the cost of rebuilding.

FEMA's Risk Rating 2.0 (10/2021) = cost reductions for 23% of existing policies across 50 states + D.C. ~1.2 million policies lower costs but 3.8 million policies likely increased.
https://www.valuepenguin.com/new-risk-rating-flood-insurance-rate-increases

Your community does not have to allow people to reside in the 100 year floodplain. In Albemarle County VA no habitation is allowed in the 100 year floodplain.

There is also a social equity concern here. Can everyone afford new policies? Can people afford to move or get out of harm's way?

Climate Refugees is a concern for the U.S. Many cities "buy out" – pay to relocate people living in dangerous flood zones.

High Risk Areas

ZONE	DESCRIPTION
A	**100-year Floodplain**, areas with a 1% annual chance of flooding. Because detailed analyses are not performed for such areas; no depths or base flood elevations are shown within these zones.
AE A1-30 (old format)	**100-year Floodplain**. The base floodplain where base flood elevations are provided. AE Zones are now used on new format FIRMs instead of A1-A30 Zones.
AH	**100-year Floodplain**, areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. flood elevations derived from detailed analyses are shown at selected intervals within these zones.
AO	**100-year Floodplain**, river or stream flood hazard areas, and areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet. Average flood depths derived from detailed analyses are shown within these zones.
AR	Areas with a temporarily increased flood risk due to the building or restoration of a flood control system (such as a levee or a dam).
A99	100-year Floodplain, areas with a 1% annual chance of flooding that will be protected by a Federal flood control system where construction has reached specified legal requirements. No depths or base flood elevations are shown within these zones.

Good codes are essential!

Here is a quick primer – essential codes and policies to have in place for a healthy urban forest.

Why are codes so important?

- ✓ We often focus more on tree planting than on tree saving!
- ✓ We overlook the needs for long term care of trees.
- ✓ Why do million tree campaigns sometimes fail? They often replace trees in the same inadequate space they failed in the first time around!
- ✓ However, planting campaigns are still a great idea – when done right!

https://www.tdworld.com/vegetation-management/article/21120273/arbor-day-foundation-announces-planting-locations-for-20-million-trees

This tree is in too small a planting area and the sidewalk is starting to crack.

Does your community have a robust tree ordinance?

Ideal Tree Ordinances Include the Following:

1) **A list of tree species appropriate for:**
   a. streets and rights of way
   b. parking lots
   c. parks and other public spaces
   d. yards and common lands within developments

2) **Standards for tree planting area—**
   sizing for tree wells, spacing, avoidance of utility conflicts, limits on tree damages and standards for diagonal trenching or root protection during construction (of adjacent sidewalks, streets, utilities).

3) **Bonding of trees required as part of site plans—**
   requiring full replacement for up to 2-3 years.

To find examples of these ordinances, see Section III and IV of this Toolkit.

We created a tiered system for what each city or town should have in place.

Essential Elements for Urban Tree Care Programs

Cities and towns vary according to which forest policy and practice elements are contained in their urban forestry programs – or they may not have a program at all. The following chart includes a list of key policies, programs and groups that should be in place for a successful urban tree care and management program. Many communities are aware of the Arbor Day Foundation's Tree City USA Program, which establishes a basic benchmark for urban forestry in cities and towns. However, some communities are not ready to meet that standard (e.g. they don't yet spend enough on urban forestry), while some have long ago achieved the status of "Tree City USA" and perhaps even won a "growth award" for program expansion...but even these cities can often do much more to ensure a well-funded and functioning program.

We have created the following four tiers: The "**tree**" being the most robust and desired outcome for a program. While, a small town may remain at the "**roots**" or "**sapling**" stage because of resource constraints, it could go all the way to the "tree" level by investing in its urban forest and establishing partnerships to make the canopy plan work. For examples of variations in programs, see the case studies in this chapter.

URBAN TREE CARE PROGRAM ELEMENTS & TIERS	Seeds	Roots*	Sapling	Tree
DATA NEEDED TO TRACK AND MANAGE TREES				
Map of public places where trees planted/managed	■	■	■	■
City/town tree maintenance records/expense reports		■	■	■
Tree Canopy (mapped for city/town)/ Tree Canopy estimated by i-Tree canopy)		■	■	■
Spatially-based Tree Canopy Data and Map (includes both existing canopy and open space locations for planting)				■
Tree Inventory (citywide, downtown, parks or other planning geography)				■
STAFFING -DESIGNATE CITY/TOWN DEPARTMENT OR CONSULTANT RESPONSIBLE FOR TREE WORK				
Named staff member/contractor tree care	■	■	■	■
Identify process/parties to remove hazard trees	■	■	■	■
Staff landscape architect, horticulturalist, forester, arborist*		■	■	■
City Arborist (certified by ISA)			■	■
Continuing education credits/staff attending trainings			■	■
Tree Risk Assessment Certified (TRAC) Staff				■
CODES GOVERNING TREE CARE, PLANTING OR REMOVAL				
Code designates responsible party for tree care/planting	■	■	■	■
Tree care ordinance (for removal or care of public trees)		■	■	■
Protect trees during/after construction (fencing, signage, retention, after care for newly planted trees)		■	■	■
Urban planting and landscaping standards			■	■
Tree removal permit for private property			■	■
Standards for street and RoW plantings, parking lots and plazas (including application of ANSI Standards for tree installation and maintenance)				■
Incentives for structural support such as Silva Cells™				■
Including trees as green infrastructure for stormwater, drinking water protection				■

*Meets TreeCityUSA requirement

URBAN TREE CARE PROGRAM ELEMENTS & TIERS	Seeds	Roots*	Sapling	Tree
PLANS				
Trees' importance mentioned in Comprehensive Plans	■	■	■	■
Urban forest maintenance and planting plan			■	■
Urban Forest Management Plan				■
Emergency Management Plan				■
Tree Recycling and Re-use Plan (Urban Wood Utilization Plan)				■
ENGAGEMENT				
Information on city website or town newsletter about city tree benefits and city contacts regarding tree care/planting.	■	■	■	■
Annual public education event for tree care/planting	■	■	■	■
Website about city trees, who to contact, basic benefits		■	■	■
Regular engagement events/education for new residents		■	■	■
Arbor Day Celebration		■	■	■
Advisory Group/Tree Board		■	■	■
Community Tree Planting Program/Volunteers/Partnership			■	■
Tree-focused Advocacy Group				■
FUNDING				
Funded program for tree care and maintenance	■	■	■	■
Spend at least $2 per capital on urban forestry/landscaping		■	■	■
Tree donation program				■

*Meets TreeCityUSA requirement

Overarching tree ordinance

Trees are often managed in a piecemeal fashion. There is a great deal of variability in where and how local governments enact tree policies and codes. Ordinances and policies affecting trees can be found in:

- ✓ The comprehensive plan
- ✓ Subdivision ordinances, cluster or conservation subdivisions (open spaces and common areas, yard trees and tree spacing and species)
- ✓ Parking lot standards (e.g. trees per number of spaces)
- ✓ Landscape buffers (vegetation between different uses such as residential and commercial or entry corridors)
- ✓ Street trees (types of, utility placement and conflicts, tree well design)
- ✓ Park and open space plans (land cover, playgrounds, natural areas versus manicured areas, greenways)
- ✓ Regulations governing tree protection during development (fencing to protect roots, placement of or access for utilities, erosion and sediment controls and more)
- ✓ Standards for tree canopy by zoning classes (e.g. residential and commercial)
- ✓ Regulations for local authority buildings – such as government centers and schools
- ✓ Entrance corridor regulations (tree placement)

If you want to increase or keep tree cover in your city or town or reduce runoff, ask if your policies are facilitating tree cover or more impervious area.

GIC's Trees and Stormwater Project has a Codes and Practices Audit Tool:

Do city policies allow too much impervious area and runoff?

Does the city mandate excessive parking area, overly wide streets?

Does the city provide incentives to reduce impervious area?

Can the city manage and expand the urban forest to soak up more water?

Are tree care and management well funded and implemented?

Does the city have a strategy for planting trees where they are most needed?

What to Look For! TSW Codes, Ordinances & Practices Tool

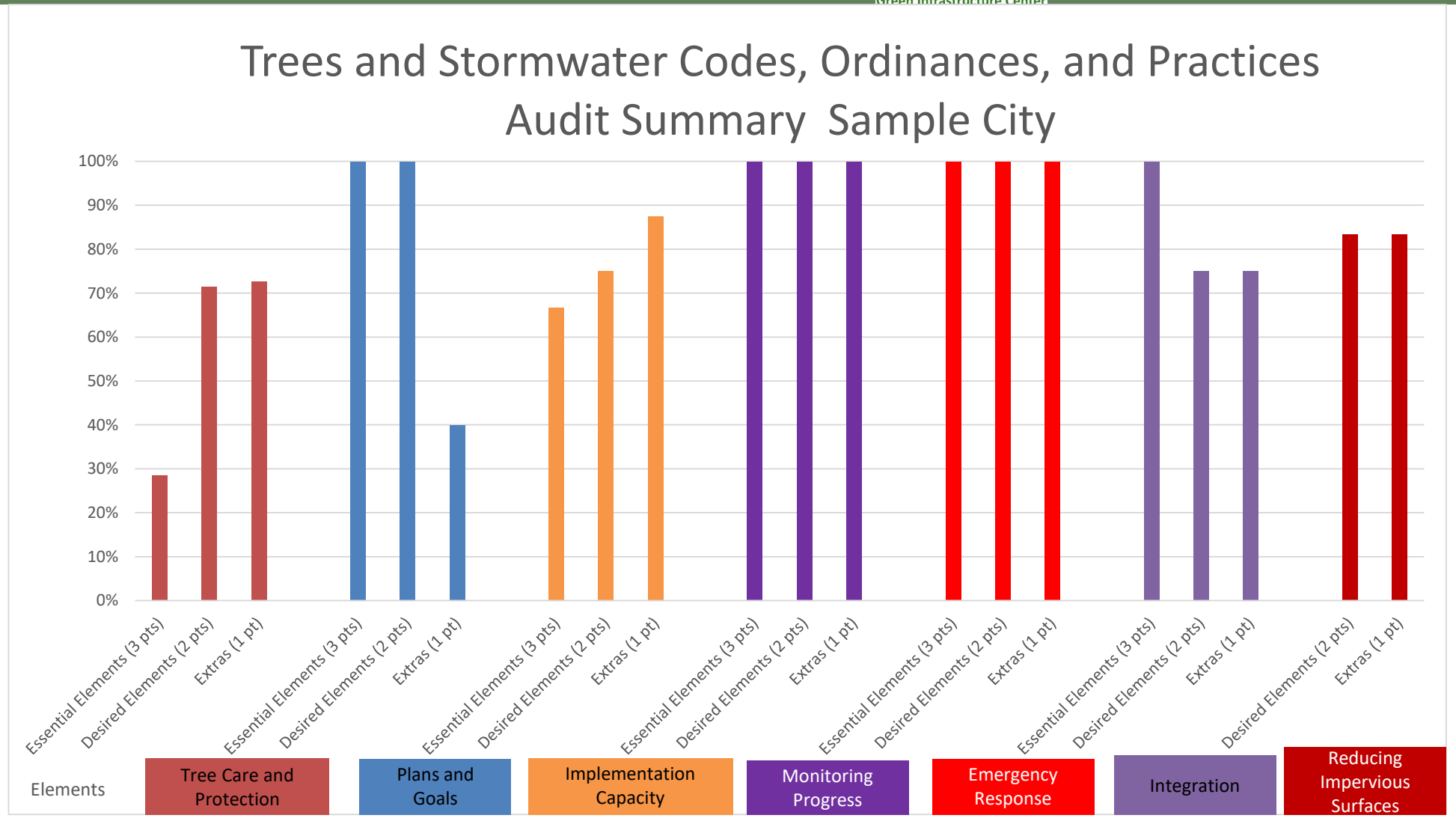
http://www.gicinc.org/trees_stormwater.htm

Trees and Stormwater Codes, Ordinances, and Practices Audit

TREE CARE AND PROTECTION

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 tree protection requirements, tree care practices and requirements on tree planting.

		Presenting of Jacksonville Comment	GIC Comments	Source	What to Look For	Score	Potential
Tree Protection							
Are other kinds of tree protection allowed/enforced (e.g. root pruning, mulch mats, aeration)?	No	In ord, not enforced.			Create root pruning, mulch matting, and aeration matting details. Require the inclusion of these details on all 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	0	1
Is there a penalty or planting requirement for removing a certain number of DBH inches in trees?	No		(Need to get a permit to remove protected trees.)		Set minimum canopy levels by zoning area. Incite a fine or planting requirement when tree removals exceed set levels. Municipalities using a fine or planting requirement when tree canopy coverage is lowered beyond set levels score one point. Municipalities not using a fine or planting requirement when canopy coverage is lowered	0	1
Are developers permitted to clear lot line to lot line? Are there incentives to not do this?	Yes, allowed		Must request an exemption to cut a protected tree. (Instead, require a minimum DBH inches per acre remain on site). From Comp Plan "The City shall encourage landowners and developers to protect or preserve Environmentally Sensitive Lands within developments, where feasible. Developers will be informed, through development review processes, and provided options for preservation of these areas." How often are exemptions to cut protected trees granted?	Sec. 656.1205 Zoning Code	Implement discouragements to the practice of lot line to lot line clearing. Municipalities employing effective discouragements for the practice of lot line to lot line clearing score one point. Municipalities not employing effective discouragements for the practice of lot line to lot line clearing score zero points.	0	1



Find audit tool here:

http://www.gicinc.org/trees_stormwater.htm

Trees and forests in policy

- The Comprehensive Plan (CP) sets the direction for the future growth and policies of a community. CP's updated ~ every 5 years.
- Zoning should be "in accordance with the comprehensive plan," so it is important that the CP indicate support for forest values in order to justify new legal tools or to expend resources (time, personnel and equipment) on urban or rural forests.
- Are forests and trees mentioned in the comprehensive plan?
- Does the CP include goals for trees (canopy goals, protecting trees before, during and after development)…?
- Are there master plans for areas of your community in the CP – if so do they mention/show trees?

Big tree saving gone wrong

Saving just big trees in filled wetlands….Only the large trees were required to be saved. This is from an ordinance in SC that required saving trees with 20" DBH but did not prevent filling in the wetland… So now the tree is below grade. The intention is good, but not the result. This also increases the total footprint of the development.

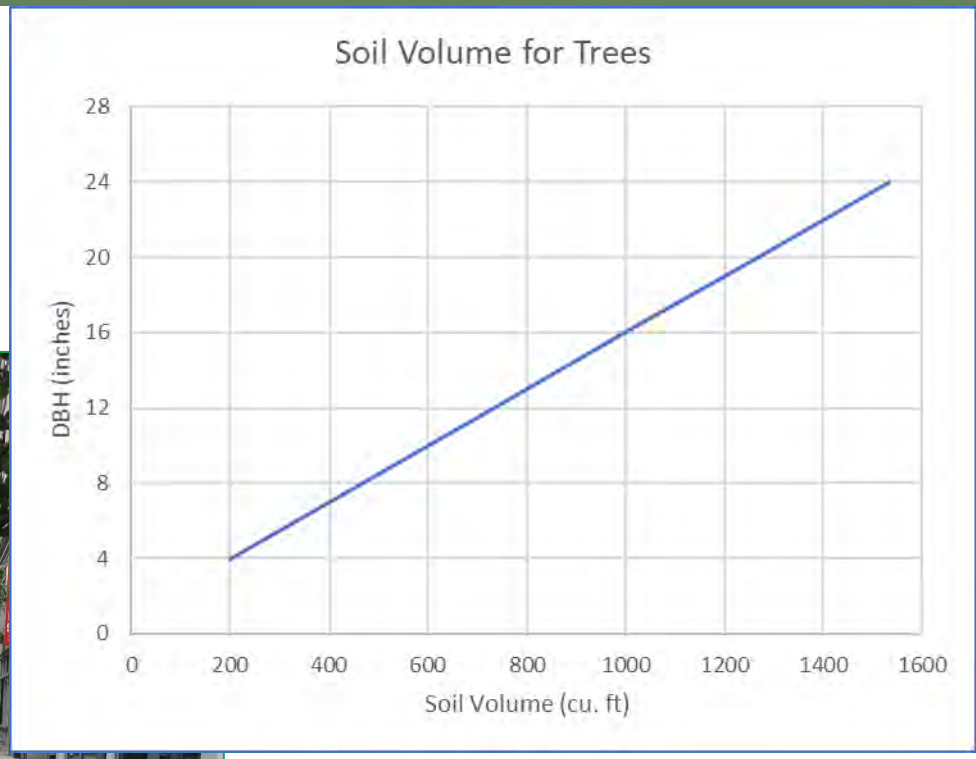
How long will this tree live? About 6-8 years tops!

Consider adaptive systems to allow for trees to get big.

This small tree has permeable pavers for high traffic areas.

The pavers can be removed as the trunk grows, while air and water can still reach the roots.

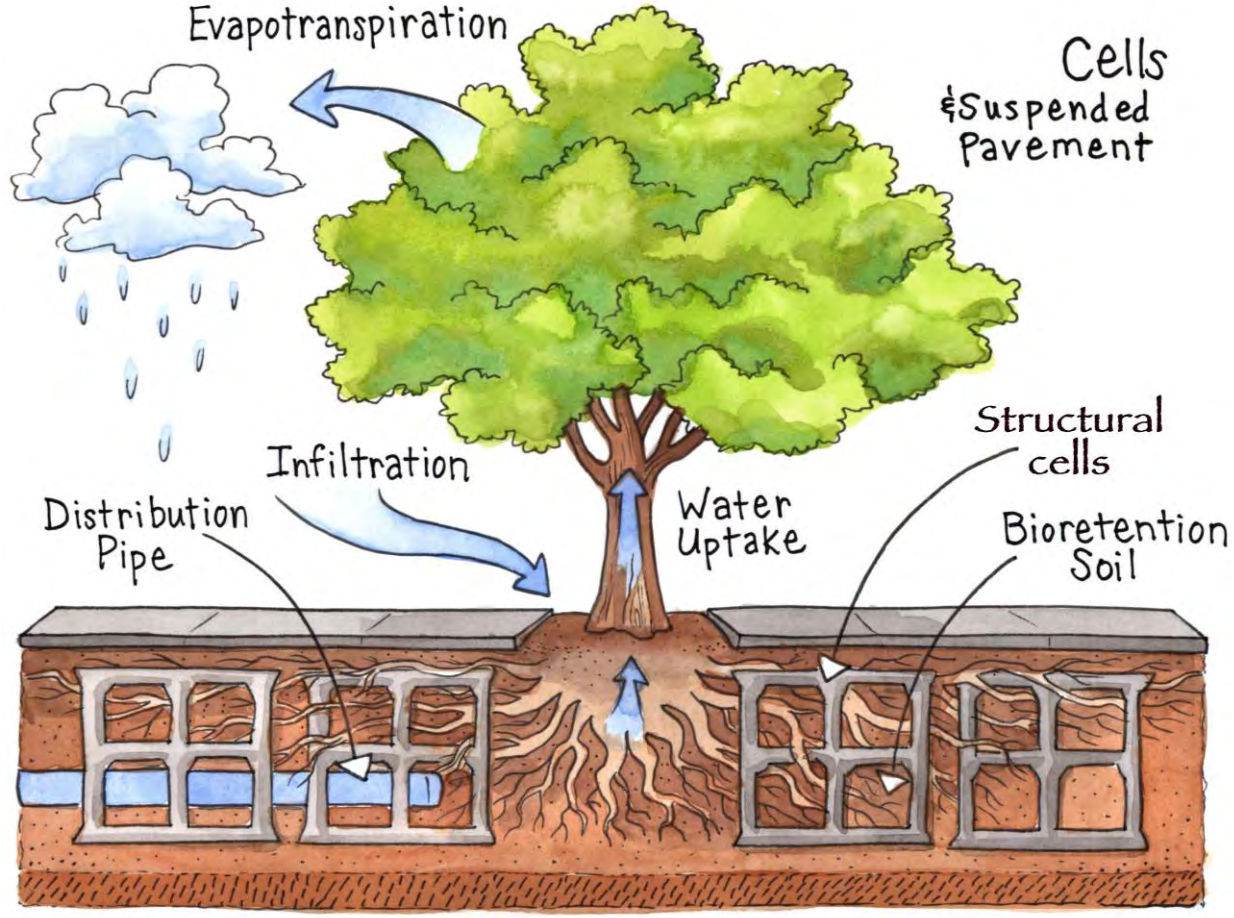
A general rule: 1000 cubic feet soil vol. per tree for large trees.



Tree Size	Planting Strip Width (minimum)	Open Soil Surface (minimum)	Total Soil Area based on 3' depth (minimum)
Small	4 ft.	16 ft.²	400 ft.³
Medium	6 ft.	25 ft.²	800 ft.³
Large	8 ft	25 ft.²	1,000 ft.³

Use structural supports to extend tree roots under pavement and use permeable pavement above.

Permeable pavers allow water to reach tree roots. Tree at left is planted with structural cells and permeable surface pavers that allow water through.



These trees were planted at the same time!

So what's the difference?

Well...
Trees at left have bigger openings but less underground soil volume and support.

https://greenblue.com/na/ Thanks to GreenBlue Urban for these images of their work.

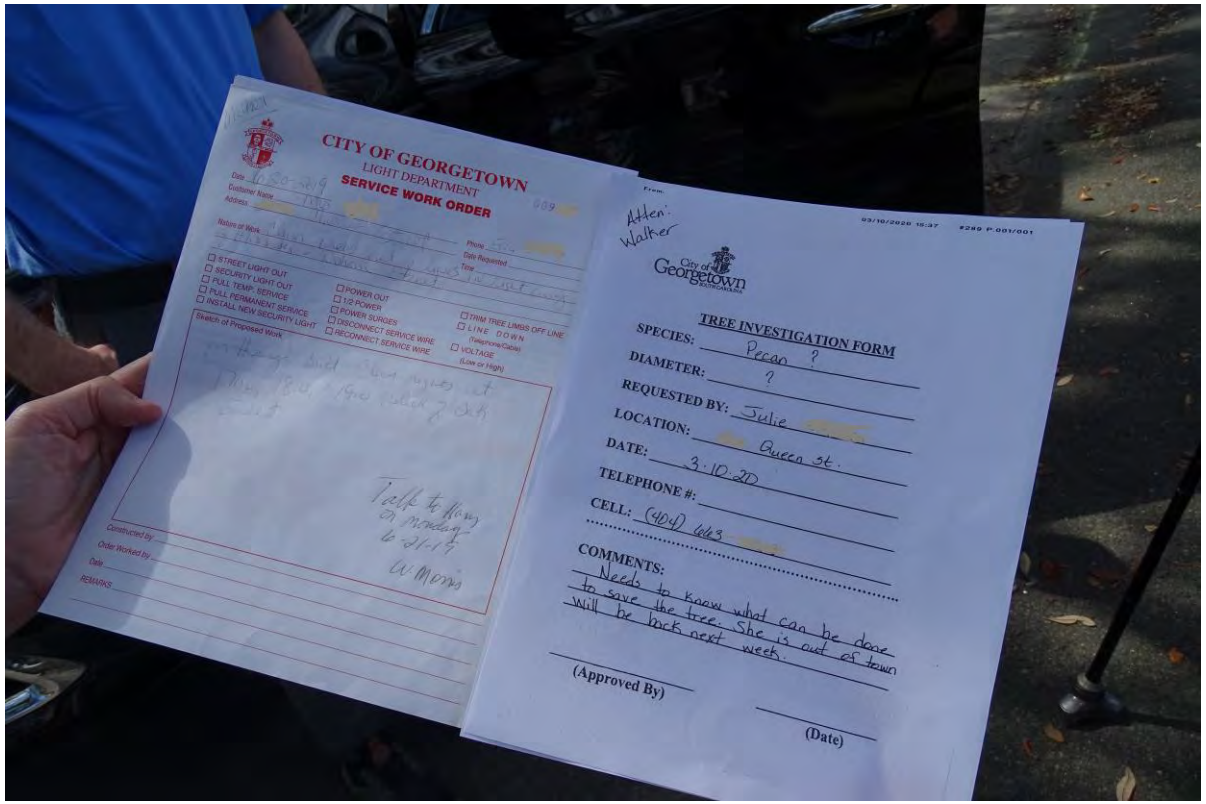
Underground supports can enable large trees even in tight spaces

The structural supports direct roots to where they are desired. They also can include spaces for utilities and protect them from roots too!

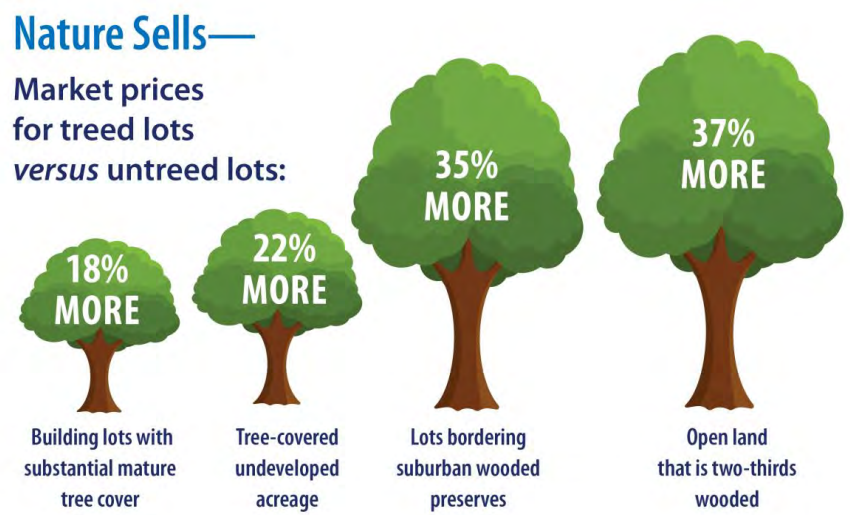
https://greenblue.com/na/

Thanks to GreenBlue Urban for these images of their work.

Tree removal permits



- Require a permit to remove trees – yes even on private property.
- Require a certified arborist review the request.
- Provide homeowners with information on the value of their trees!



Example Ordinances: Tree removal on public and private property

- Fox Chapel, PA

*If tree is larger than 6” DBH and is healthy **or** diseased, a permit must be obtained. No permission to remove a dead tree or less than 6” diameter.*

- Annapolis, MD

Tree conservation areas are front, side or rear yard setbacks of residential or commercial properties adjacent to a public right-of-way and trees within that greater than 5” DBH shall be removed except as provided for in this section

- Washington, DC.

Private property trees between 44” and 99.9” in circumference are Special Trees and require a Special Tree Removal Permit. Trees greater than 100” circumference are Heritage Trees and if healthy, cannot be removed.

DBH = at 4.5 feet above the ground

Tree removal penalties need to be severe.

Code Example: Where significant trees have been removed… in violation of this section:

Combined DBH of replacement trees is equal to or greater than three (3) times the

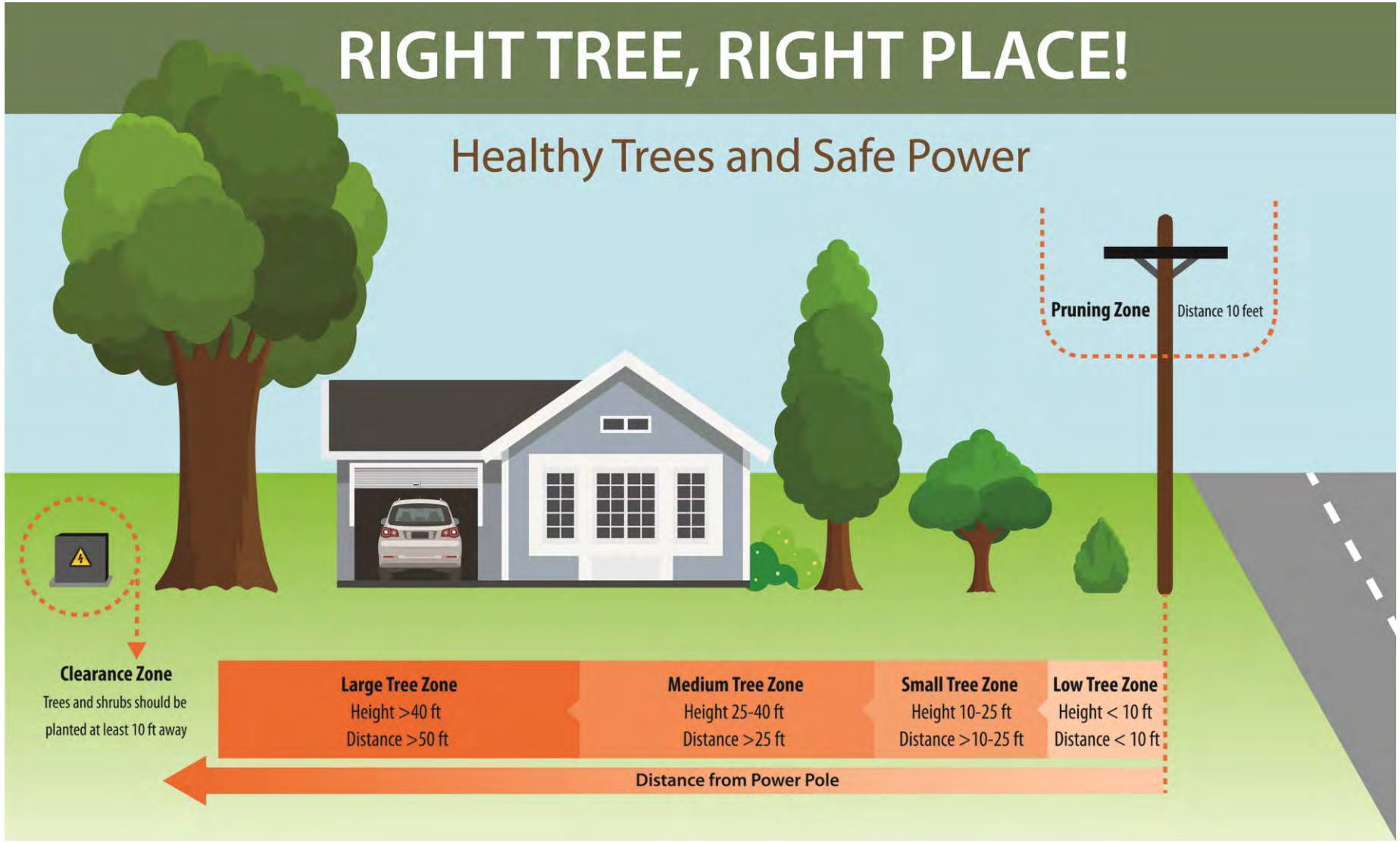
DBH of the tree removed.

Code Example: For trees removed unlawfully from all other properties (not single-family),

the Board is authorized to require up to ten (10) times the total D.B.H. of the tree(s)

removed.

Trees and utilities



Let's avoid this by not allowing large trees to be planted under utilities!

Example ordinances: trees & utilities

- Rock Hill, SC Sec. 28-61

It shall be the duty of any person planting or growing a public tree to: Place no tree so as to be, in the opinion of the forester, a traffic hazard or an interference with the overhead or underground public utilities. Prune trees so as not to cause a hazard and so that the minimum clearance of any overhanging portion is eight feet above any sidewalk and 14 feet above any street.

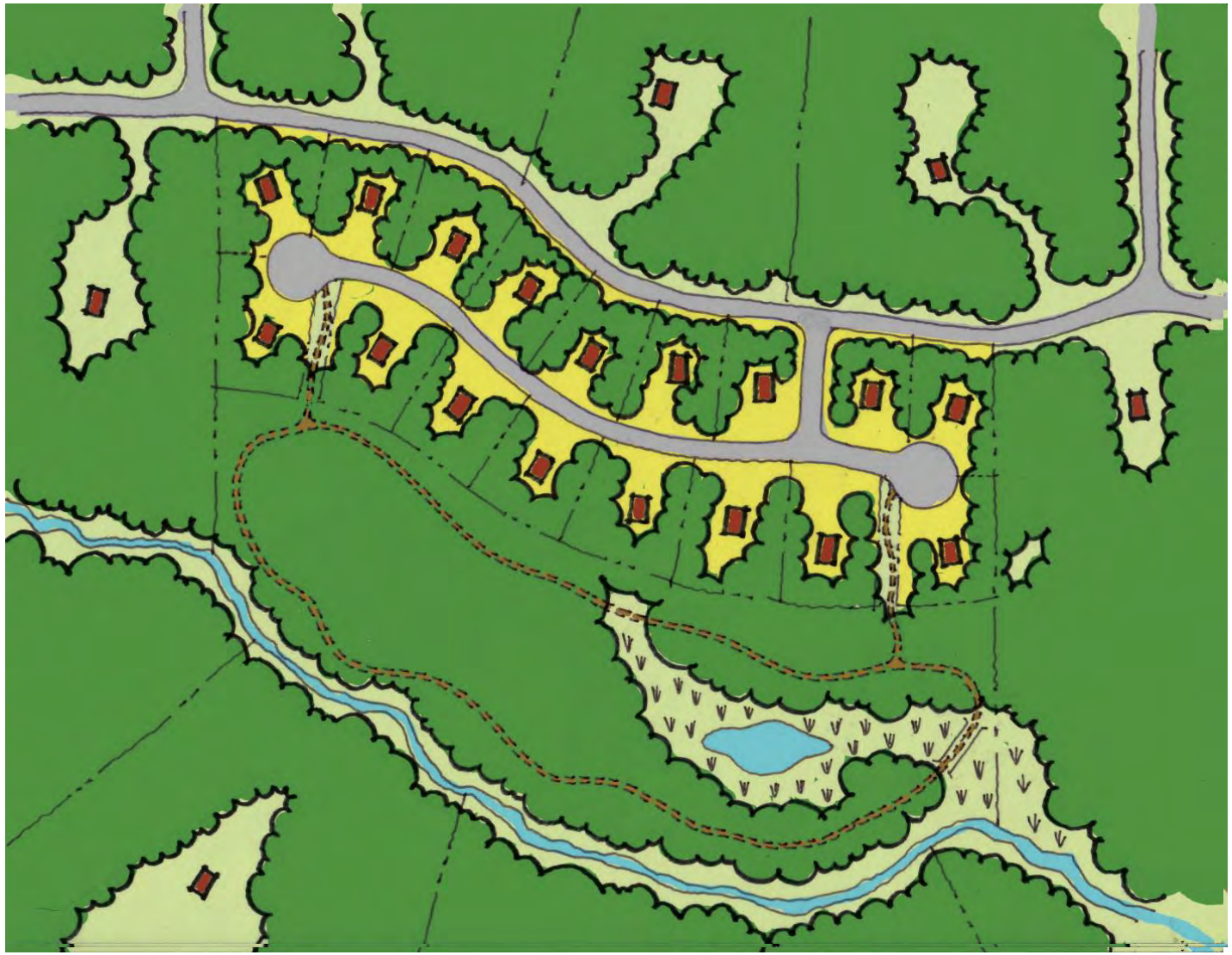
The City maintains a list of pre-approved species to be planted under overhead powerlines and utilities.

Work with developers to shrink the footprint.

- Do not permit lot line to lot line clearing. Require retention of healthy clusters of trees.
- Look for opportunities to minimize impervious surfaces by meeting with developers BEFORE plans are finalized and INCLUDE the urban forester/arborist on staff.
- Some communities require their arborist to sit in on/review tree plans for large developments!

Consider a cluster ordinance.

Can consider a density bonus too!

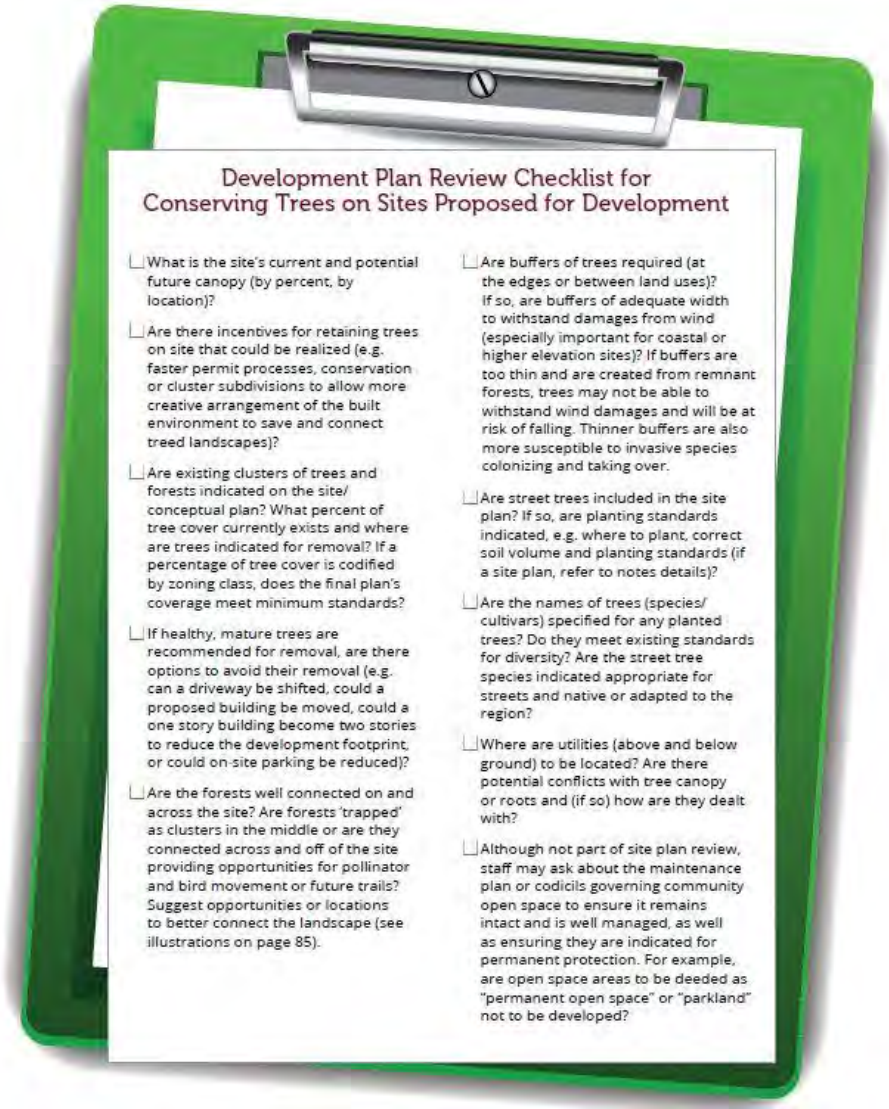


Protecting trees before development

Consider a waiting period between when land is cleared for forestry and when it is allowed to be developed.

If land is cleared before a conversation about tree saving, there is no option later.

Discuss site alterations – go taller not wider on buildings, consider shared parking, reduce parking requirements, etc.



Development Plan Review Checklist for Conserving Trees on Sites Proposed for Development

- What is the site's current and potential future canopy (by percent, by location)?
- Are there incentives for retaining trees on site that could be realized (e.g. faster permit processes, conservation or cluster subdivisions to allow more creative arrangement of the built environment to save and connect treed landscapes)?
- Are existing clusters of trees and forests indicated on the site/ conceptual plan? What percent of tree cover currently exists and where are trees indicated for removal? If a percentage of tree cover is codified by zoning class, does the final plan's coverage meet minimum standards?
- If healthy, mature trees are recommended for removal, are there options to avoid their removal (e.g. can a driveway be shifted, could a proposed building be moved, could a one story building become two stories to reduce the development footprint, or could on-site parking be reduced)?
- Are the forests well connected on and across the site? Are forests 'trapped' as clusters in the middle or are they connected across and off of the site providing opportunities for pollinator and bird movement or future trails? Suggest opportunities or locations to better connect the landscape (see illustrations on page 85).
- Are buffers of trees required (at the edges or between land uses)? If so, are buffers of adequate width to withstand damages from wind (especially important for coastal or higher elevation sites)? If buffers are too thin and are created from remnant forests, trees may not be able to withstand wind damages and will be at risk of falling. Thinner buffers are also more susceptible to invasive species colonizing and taking over.
- Are street trees included in the site plan? If so, are planting standards indicated, e.g. where to plant, correct soil volume and planting standards (if a site plan, refer to notes details)?
- Are the names of trees (species/ cultivars) specified for any planted trees? Do they meet existing standards for diversity? Are the street tree species indicated appropriate for streets and native or adapted to the region?
- Where are utilities (above and below ground) to be located? Are there potential conflicts with tree canopy or roots and (if so) how are they dealt with?
- Although not part of site plan review, staff may ask about the maintenance plan or codicils governing community open space to ensure it remains intact and is well managed, as well as ensuring they are indicated for permanent protection. For example, are open space areas to be deeded as "permanent open space" or "parkland" not to be developed?

Example Ordinances: Improper use of forestry to clear land and tree survey of site.

- Lexington County, SC Sec. 3.1.7

Development permits may be denied for a period of three years following a timber harvest if there was a willful intent… to circumvent any provision of the Landscape and Open Space Ordinance.

- Beaufort County, SC Sec. 5.11.100.C

Prior to any development approval, a tree survey of the areas in which building, clearing or construction activities are planned in accordance with:

The tree survey shall indicate species type and size (DBH), conducted by a certified professional and be less than 5 years old.

Canopy cover requirements

Have a minimum tree canopy coverage requirement by zoning class.

> **Example**: Any development or other activity subject to this Section shall retain a percentage of existing tree canopy on the site in accordance with Table XX.

If the coverage cannot be met on site, include provisions for how to meet it offsite [and have sites already identified for where you would like to plant them]. Consider a tree fund to pay "in lieu of." Provide for allowances to plant on private land too. Consider a tree mitigation bank.

Encourage saving large trees – give more credit for tree retention (one community only gave credit for new trees, so developers cut down trees and planted new ones to get the credit – a good intention gone wrong.)

Consider standards by basal area.

> **Example**: All new development except for the construction of any public street, pathway, drainage project, single family subdivision, athletic field, airport runway, golf course or minor utility and the redevelopment or alteration of existing development… shall include at least 900 adjusted caliper inches (ACI) of trees per acre of pervious surface area.

- Montgomery County, MD

Anyone required to obtain a county sediment control permit must comply with the Tree Canopy Law. See table at right. If area of disturbance exceeds 40,000 ft², minimum # of shade trees must be prorated using ratio of 15 trees per 40,000 ft².

Many cities such as Annapolis, MD require tree removal permits for non-construction reasons (e.g. diseased tree)

Area (sq. ft.) of the Limits of Disturbance		Number of Shade Trees Required
From	To	
1	6,000	3
6,001	8,000	6
8,001	12,000	9
12,001	14,000	12
14,001	40,000	15

- Fairfax County, VA

Any land disturbing activity, such as removing trees on more than 2,500 ft² of land requires a permit from Fairfax County. Submit tree conservation plans as part of all preliminary subdivision plats, construction plans, and grading plans and meet minimum canopy coverages (max is 30%)

https://library.municode.com/va/fairfax_county/codes/code_of_ordinances?nodeId=THCOCOFAVI1976_CH122TRCOOR (Fairfax has a special allowance to reach canopy coverage by 10 years, as opposed to 20 yrs.)

VA has a cap on canopy %s that can be required, generally:

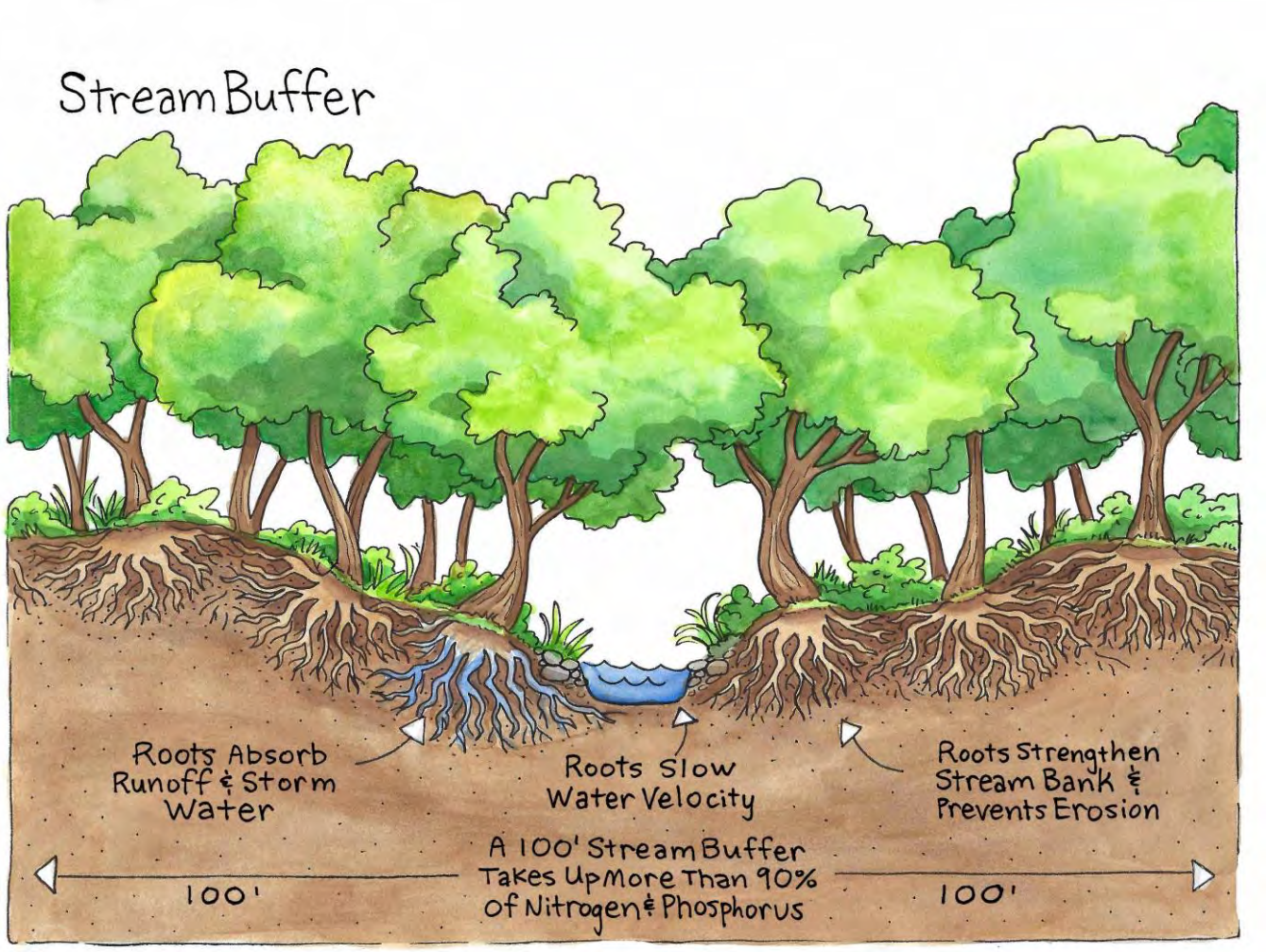
10% commercial

15% PUD

20 % most residential

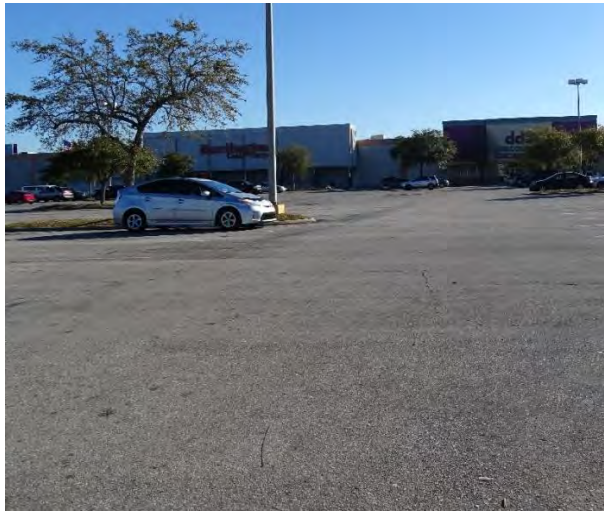
30% low density residential

Plant more stream buffers!



- Ag and forestry are usually exempted so need help from extension agents
- Can vary buffer widths – in rural areas use 100 ft. width, or in more urban areas with less room can have skinnier buffers.
- Removes the majority of Nitrogen, Phosphorus and Sediment from reaching the stream and holds banks in place.
- Big challenge: we don't have enough tree planting staff!

Reduce parking space requirements and increase parking lot perviousness and shade



Versus

- Some parking lots have excess spaces and therefore excess impervious surfaces and more stormwater runoff. Use variable spaces and parking maximums. Put a cap on how much parking per zone.
- Use Low Impact Development (LID) approaches to increase parking lot perviousness, trees to provide more shade and water capture and increase attractiveness.
- Require minimum trees per lot. **Example**: In lieu of landscape strips, landscape islands can be provided. No more than 6 consecutive parking stalls are permitted without a landscape island of at least 6 feet in width and extending the entire length of the parking stall. A minimum of one tree shall be planted in each landscape island.

Tree species lists

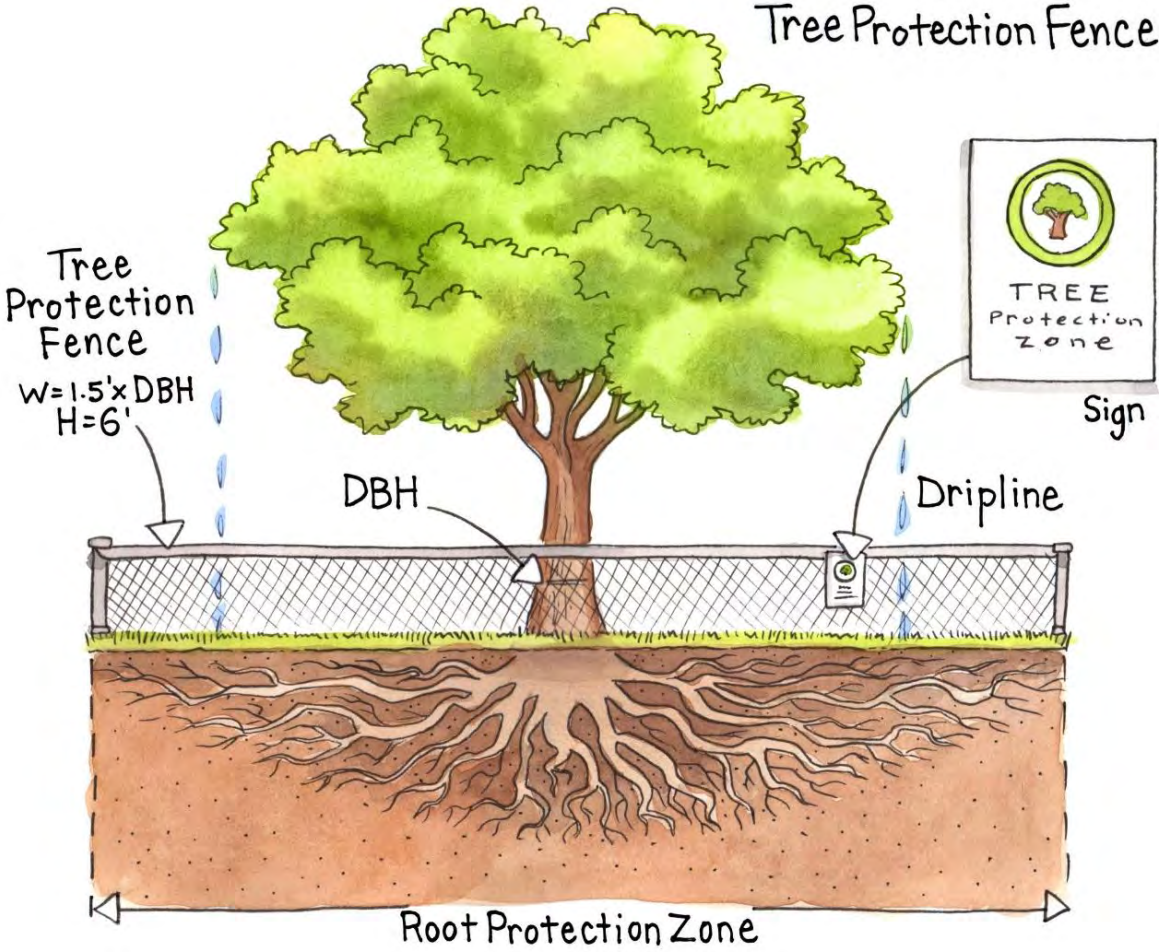
A big challenge for cities and towns – trees lists have problems:

- No list! (nothing in particular – dealer's choice!)
- Improper species on the list (e.g. Red Maples as street trees or Bradford Pears or even invasive species)
- An "okay" list but the top 3 trees keep being picked (try rotating them!)
- Consider a code that requires species diversity so that the same tree is not planted over and over. Require at least 4-5 species of trees and ensure that some are large canopy trees (not just dogwoods and crepe myrtles…)

Protecting trees during development

Protect trees and the root zone

- Use steel tree protection fencing in place of orange mesh where tree damage during construction is likely.
- Protect as much of the root zone as possible.
- Provide matting or other structures to support roots and avoid conflicts.
- Have multi-lingual signage.



Protect trees for several years after installation.

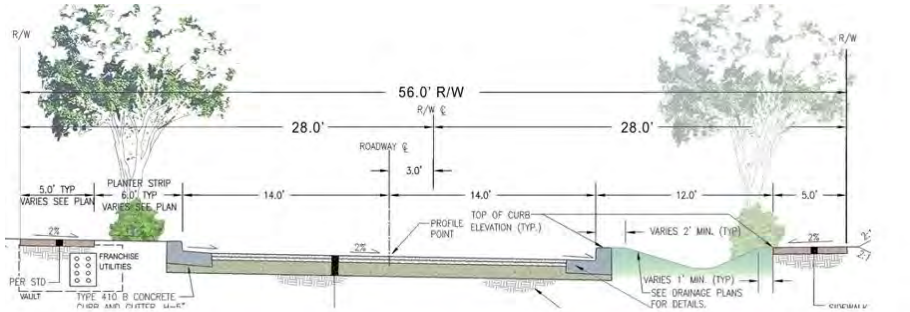
Consider bonding of trees. It is common to bond stormwater BMPs, so why not trees too? Some communities have adopted a 2-3 year bond, which is not released unless all trees are healthy! If not, they must be replanted.

This tree in a new mall is dying. There were no standards for tree well sizing, care or survival!

Redesign streets as "Complete Green Streets"

Complete green streets allow for

- ✓ Treatment of stormwater on site
- ✓ Reduction of urban heat island effect
- ✓ Beautification: increase in downtown foot traffic
- ✓ Habitat corridors

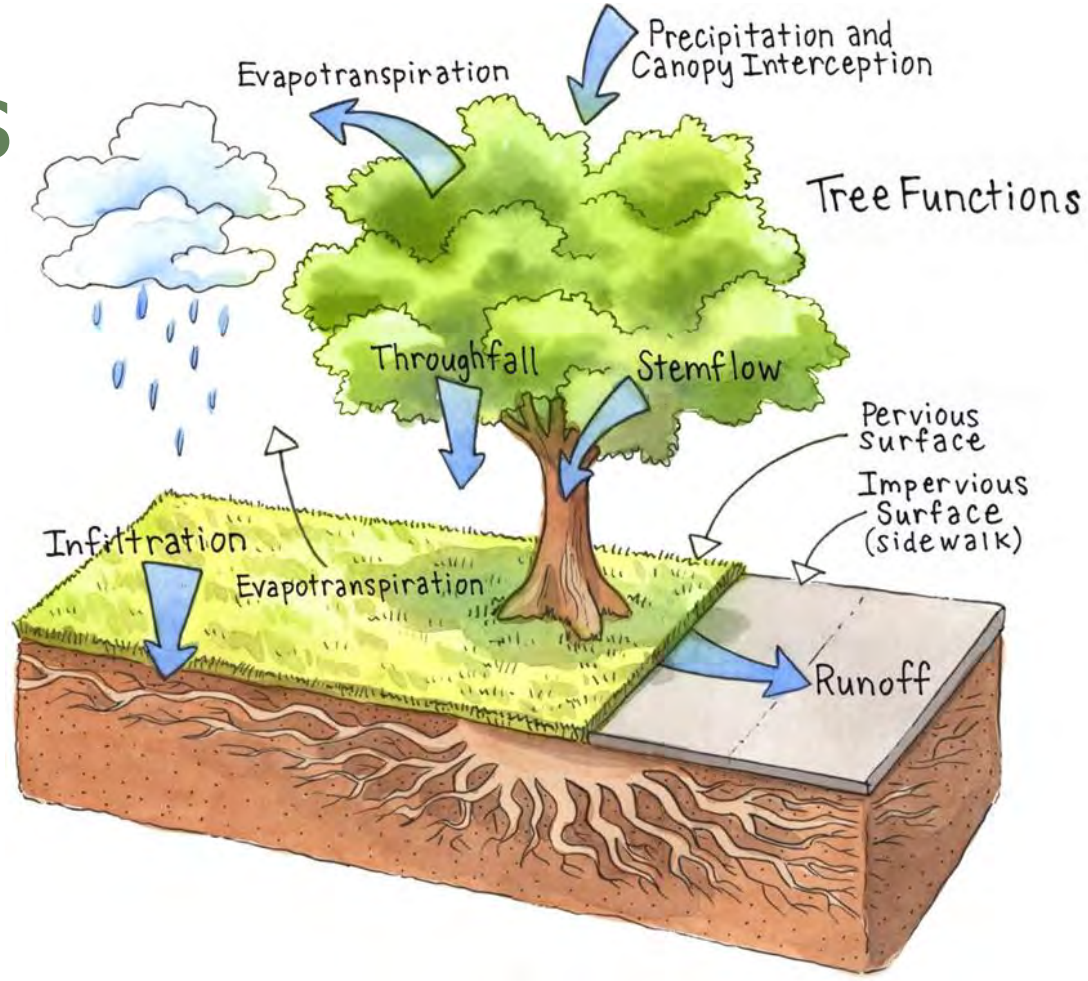


Link a city's urban trees to its stormwater infrastructure.

- Establish city trees' role as infrastructure to receive federal aid for post-storm clean up efforts.

- Credit urban trees in a stormwater utility fee to promote more urban tree plantings.

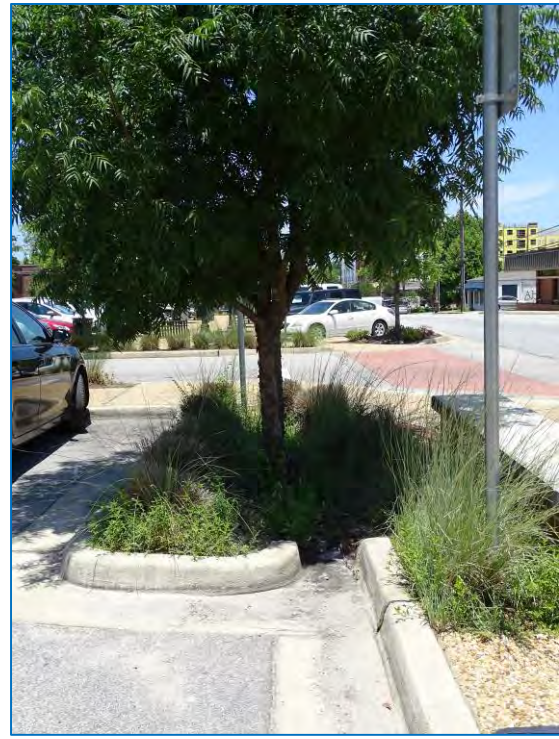
  For example, Harrisonburg VA now gives reductions in stormwater fees to property owners who plant trees!



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

Biggest question – how to use trees as a BMP?

- Center for Watershed Protection has tools to calculate vol. benefits per tree: https://www.cwp.org/making-urban-trees-count/
- Pine Lake, GA: 10 gallons of water credit per inch of the diameter at breast height (DBH) for preserving existing trees under 12” DBH, and 20 gallons of credit per inch of DBH for preserving existing trees over 12” DBH.
- Washington D.C.: 20 cubic feet for each preserved tree, and 10 cubic feet for each planted tree. Trees planted as part of BMP, e.g. bioswale get 10 cubic feet water credit. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6134866/
- Portland: ‘tree credit’ can be used to offset 10 percent of a site’s impervious surface as stormwater management and they also use trees in BMPs. https://www.portlandoregon.gov/bes/article/582102>



This tree in a bioswale helps filter and evaporate parking lot runoff in Auburn, AL

Larger landscape credits for trees as a BMP …

The Chesapeake Bay Program (CBP) developed BMPs for Chesapeake Bay Watershed Phase III Watershed Improvement Plan (WIP) targets.

Credit based on type of planting:

- Urban Canopy Expansion: 300 newly planted trees = 1 acre of urban tree canopy expansion.
- Urban Forest Planting: Converting turf grass to trees and must have contiguous planting and maintenance plan.
- Urban Forest Buffer: Contiguous planning of 100’ to 35’

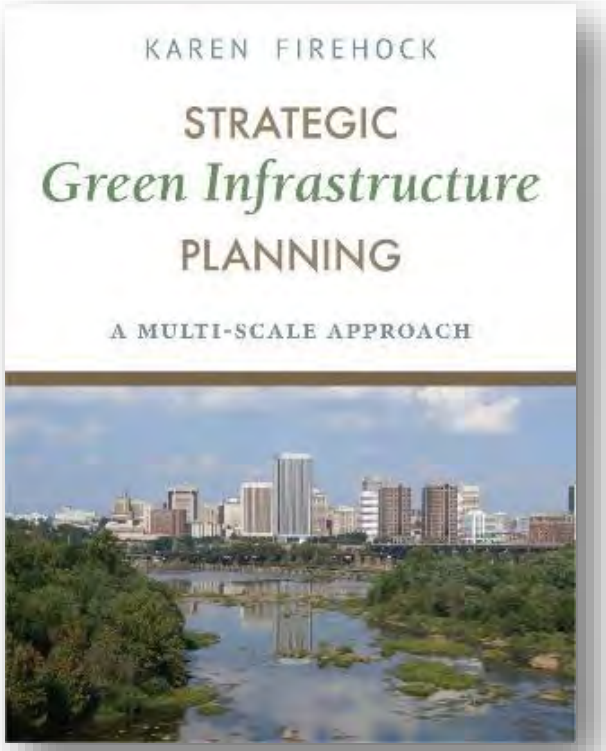
To get credit to remove N, P, Sed = trees planted/300 * reduction coefficient.

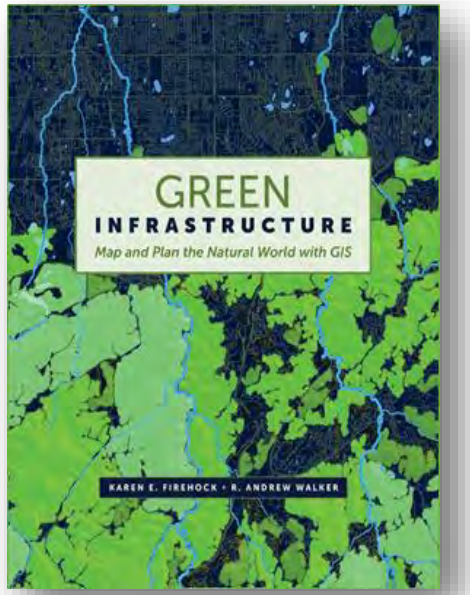
Jurisdiction	BMP	Nitrogen Average reduction per acre, Edge of tide (lbs/ac)	Phosphorus Average reduction per acre, Edge of tide (lbs/ac)	Sediment Average reduction per acre, Edge of tide (lbs/ac)
Virginia	Forest buffer	8.77	1.61	854
	Forest planting	7.33	1.16	451
	Tree planting - canopy	1.82	0.15	223

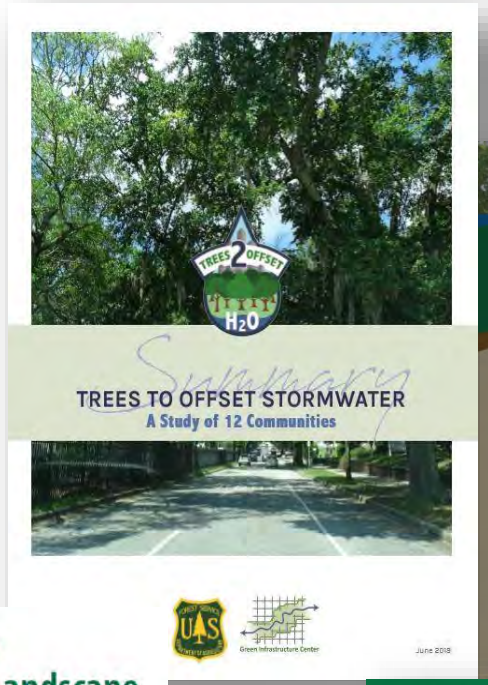
Tree planting.

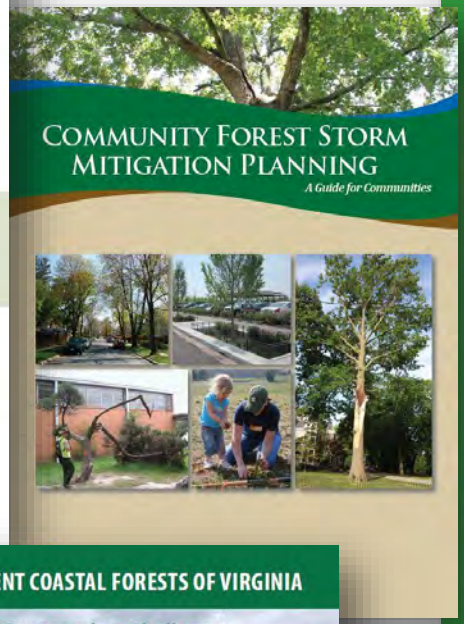
GIC's Tools!

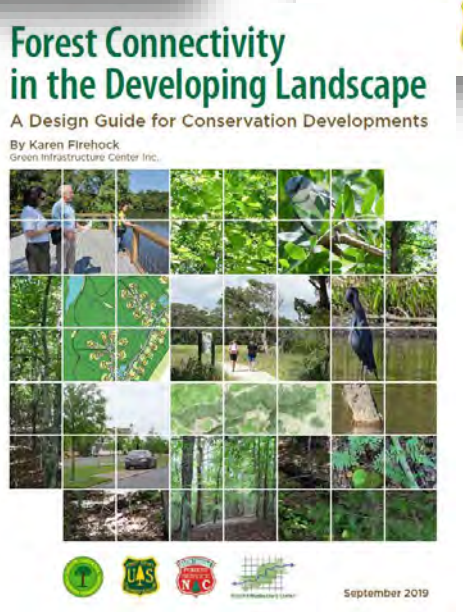
GREEN INFRASTRUCTURE CENTER INC.



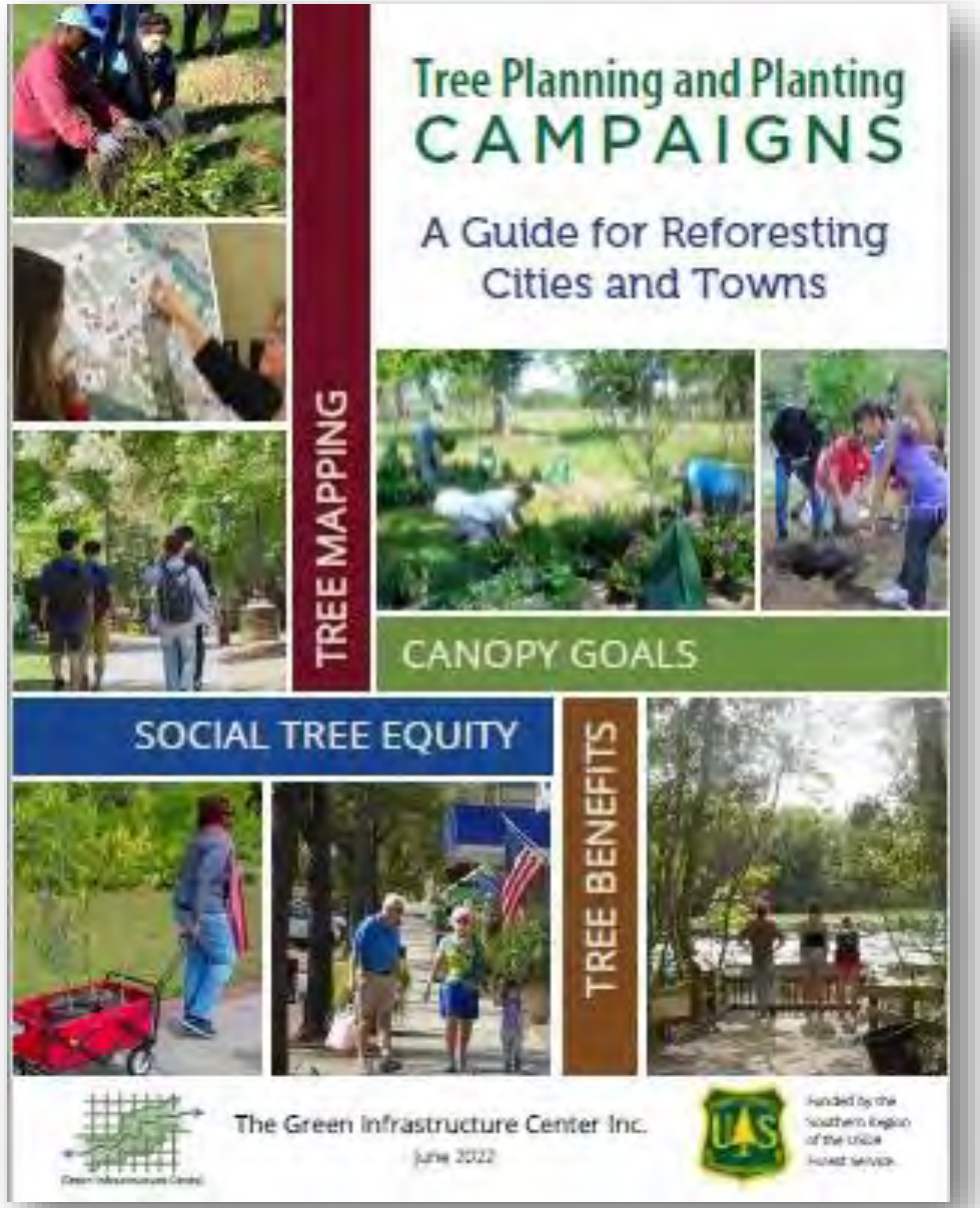








We have books, guides and tools for green infrastructure planning at the national, state and city scale. More publications at http://www.gicinc.org/resources.htm

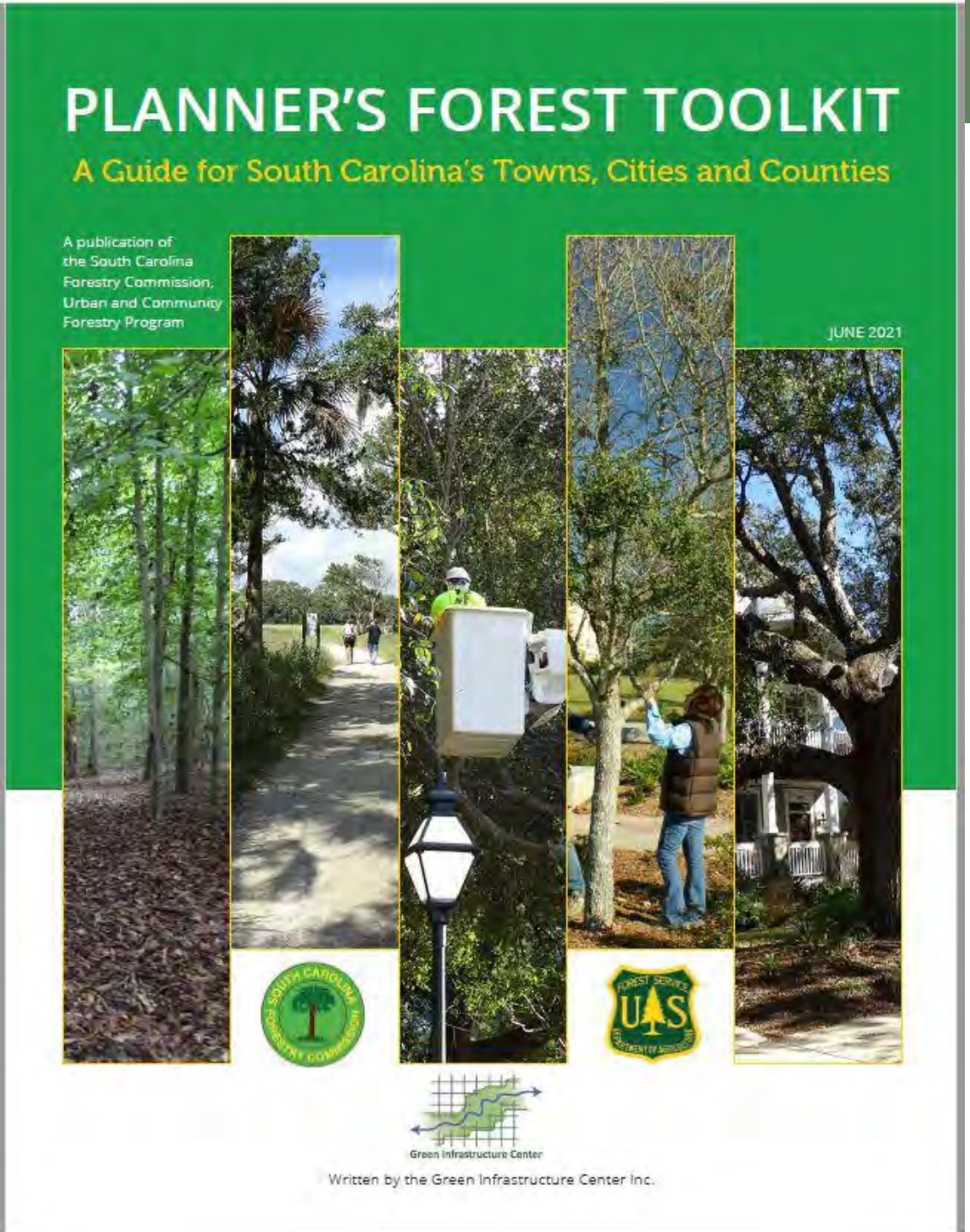


Our tree campaign guide is based on 15 years of testing and has all the arguments and methods for citizens and policy makers to break through; ***moving from wishes to direct action***.

This guide features our work and your work too! Highlighting the best methods, tools and tips from community-based urban forestry groups.

It also tackles pressing issues such as mapping urban heat islands, working in diverse communities and using the right data to make the case for urban forests!

http://www.gicinc.org/PDFs/TreePlantingCampaignGuide_GIC_June2022.pdf



GIC created a free workbook to describe all key tree codes and examples of them for South Carolina. It can be applied to any state as the codes are universal in application!

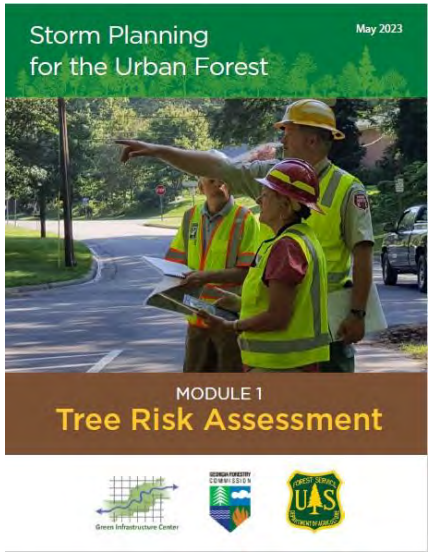
http://www.gicinc.org/PDFs/Planners_Forest Toolkit_2021.pdf

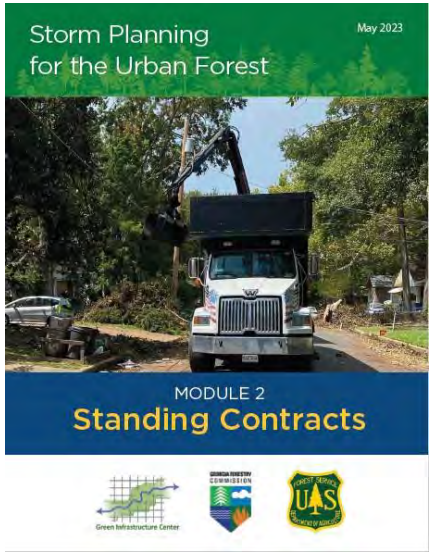
Download a free guide at the above link.

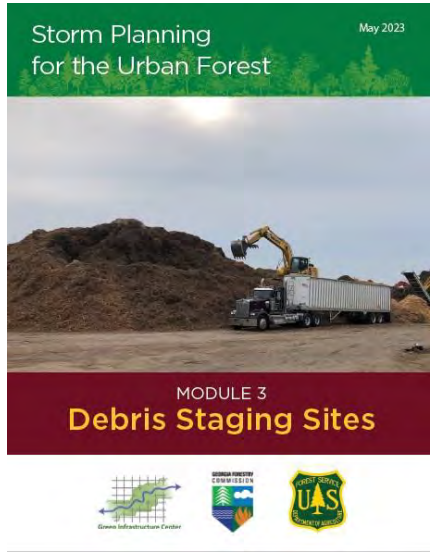
Thanks to the USDA Forest Service and the South Carolina Forestry Commission for funding this work!

Storm Planning Tools!

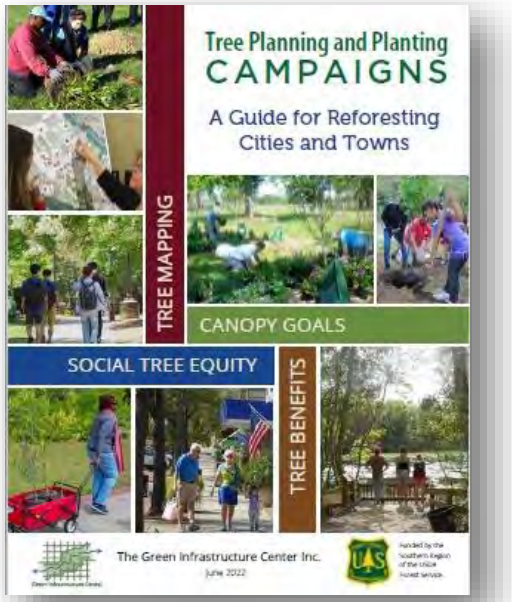
Coming soon to https://communityforestry.academy/

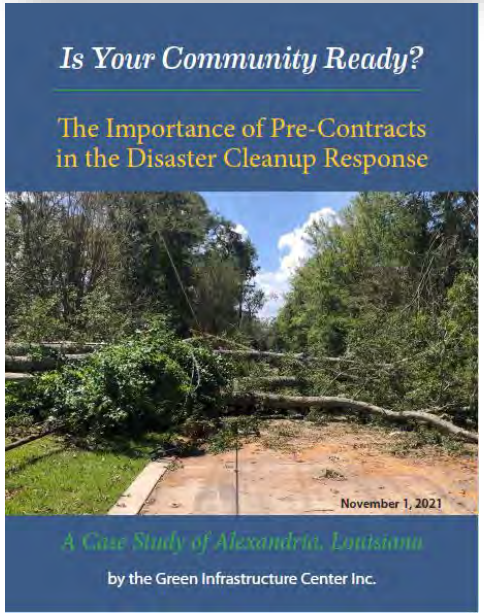




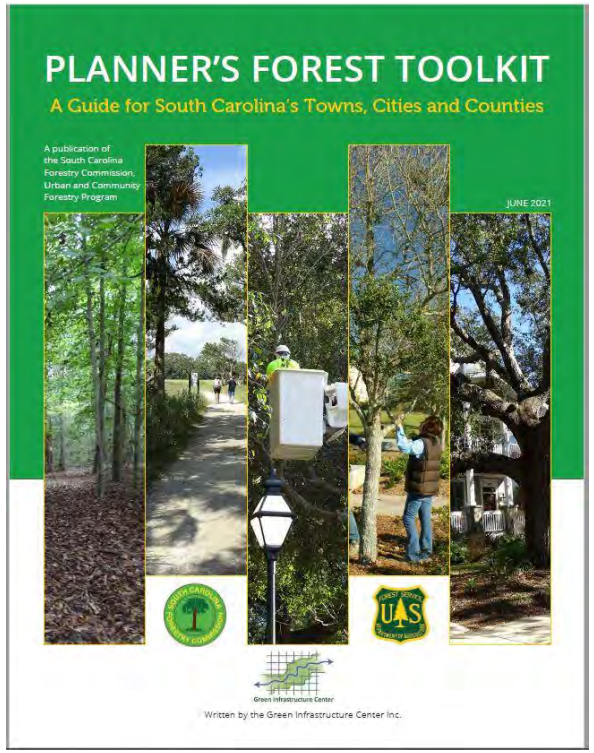


And also much more at www.gicinc.org

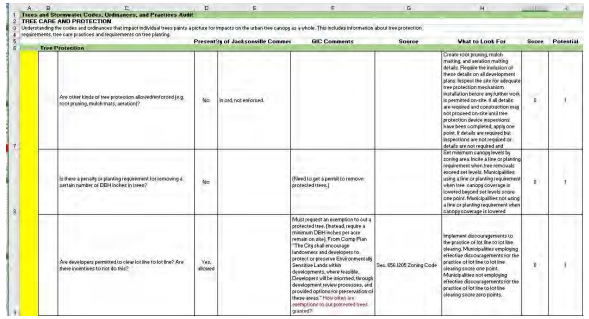




So, remember the free tools we featured today…get them!



See if codes are working for your trees!



Learn your tree cover!

Launch a planting campaign!

Questions? Be in touch if you'd like GIC to audit you codes or create an urban forest master plan!

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