Cacapon Institute

Protecting rivers and watersheds since 1985.

Trees 101
All the Benefits and More

What healthful impacts can a tree have?

Can one tree in the city compare to a forest of trees?

Trees provide oxygen and shade but you might be surprised at all their benefits

Trees fight free radicals
Stave off asthmas
Improve cognitive skills
And make us happy.

Chesapeake Bay Program
Science. Restoration. Partnership.

FOREST SERVICE U.S. DEPARTMENT AGRICULTURE

WEST VIRGINIA DIVISION OF FORESTRY

Potomac Watershed Partnership

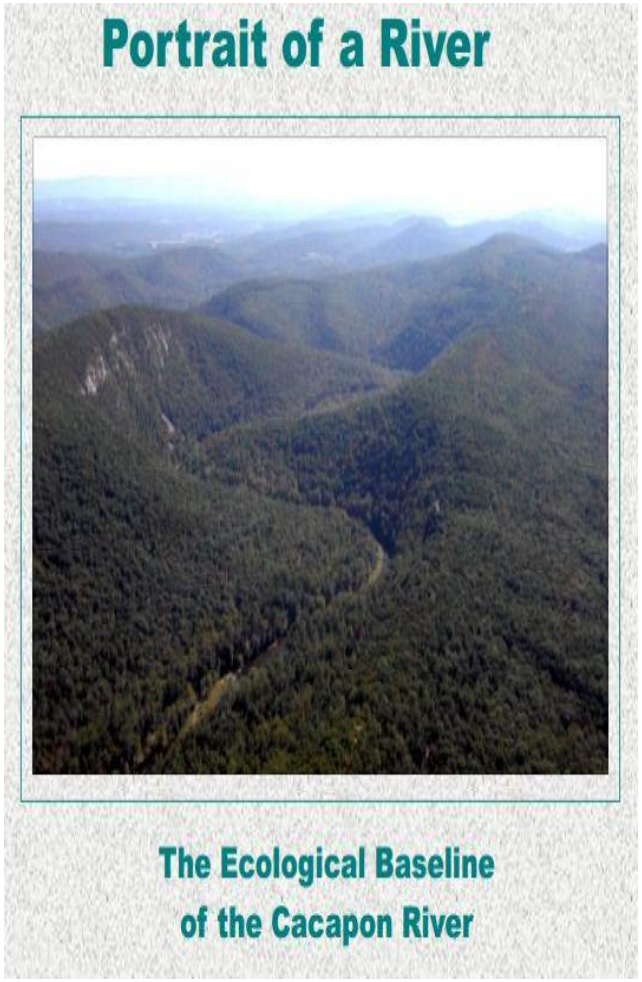
T[illegible]he answer!

Trees 101
All the Benefits and More

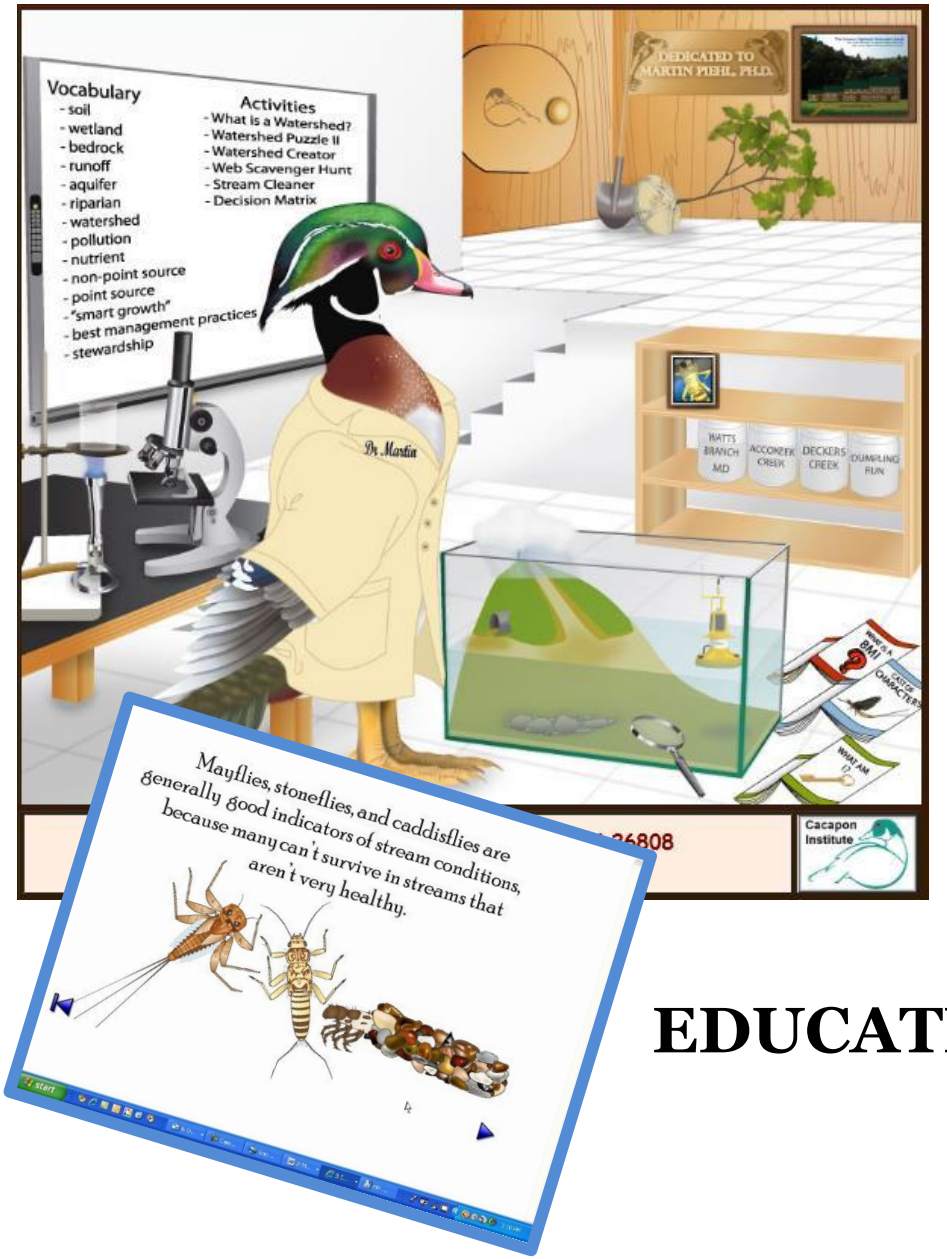
FRANK F. RODGERS
EXECUTIVE DIRECTOR
CACAPON INSTITUTE
ISA CERTIFIED ARBORIST #MA-4468A

Cacapon Institute

FROM THE CACAPON TO THE POTOMAC TO THE CHESAPEAKE BAY, WE PROTECT RIVERS AND WATERSHEDS USING SCIENCE AND EDUCATION



SCIENCE



EDUCATION

WEST VIRGINIA
Project CommuniTree

Potomac Headwaters
PHLOW
Leaders Of Watersheds
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Can one tree in the city compare to a forest of trees?

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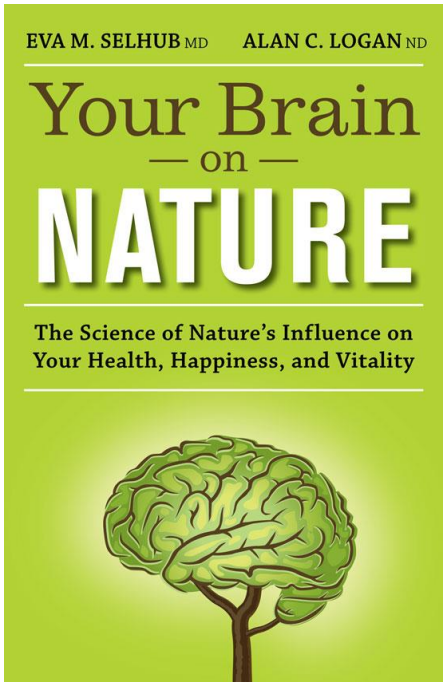


Can a city compare to a forest of trees?

Shinrin-Yoku—Forest Bathing

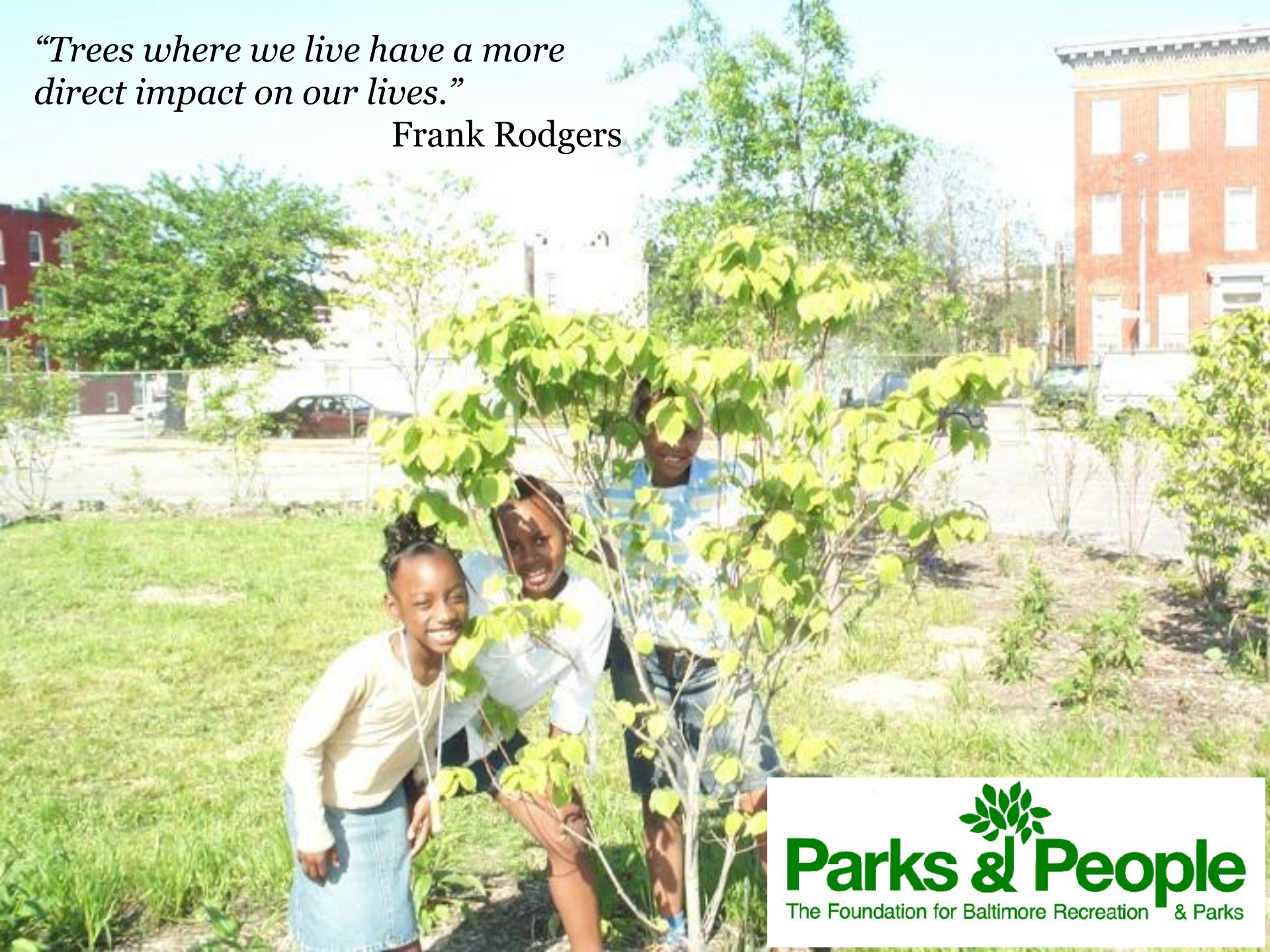
It is not so much for its beauty that the forest makes a claim upon men's hearts, as for that subtle something, that quality of air, that emanation from old trees, that so wonderfully changes and renews a weary spirit. —Robert Louis Stevenson

Franklin Square ES, Baltimore, MD, "Reading Circle" came from students who desired an outdoor classroom.

Trees provide oxygen and shade but you might be surprised at all their benefits. Trees fight free radicals, stave off asthmas, improve cognitive skills, and more.

"Trees where we live have a more direct impact on our lives."

Frank Rodgers



Parks & People

The Foundation for Baltimore Recreation & Parks

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T[illegible]he answer!

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What is "Urban Forestry"?

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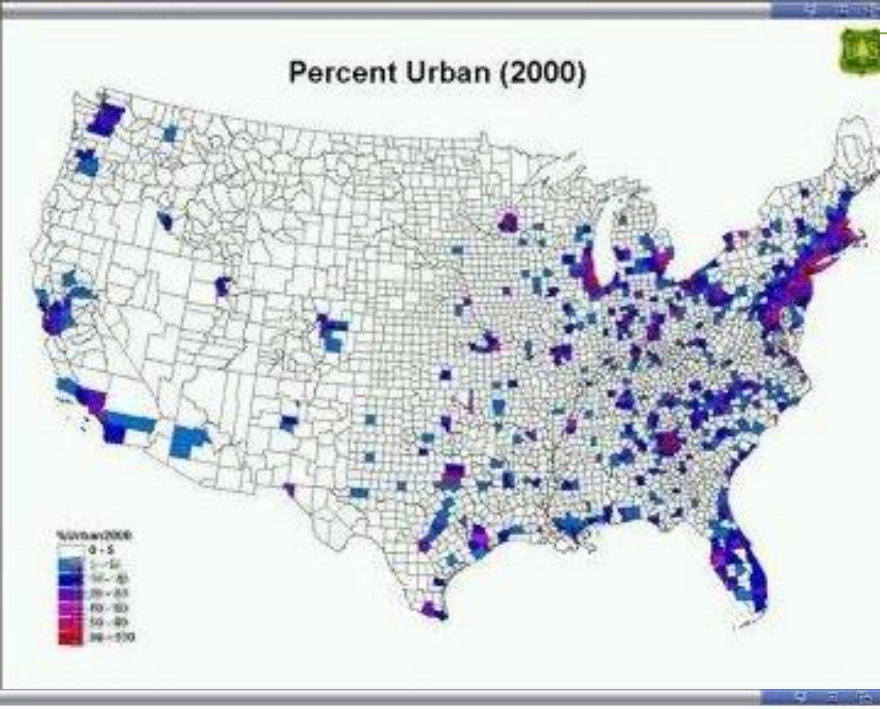
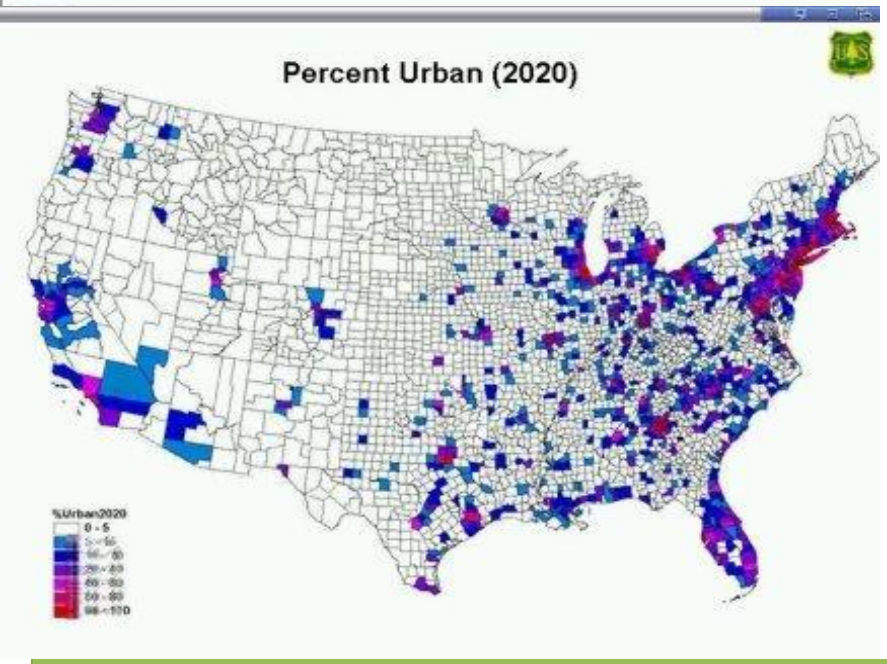


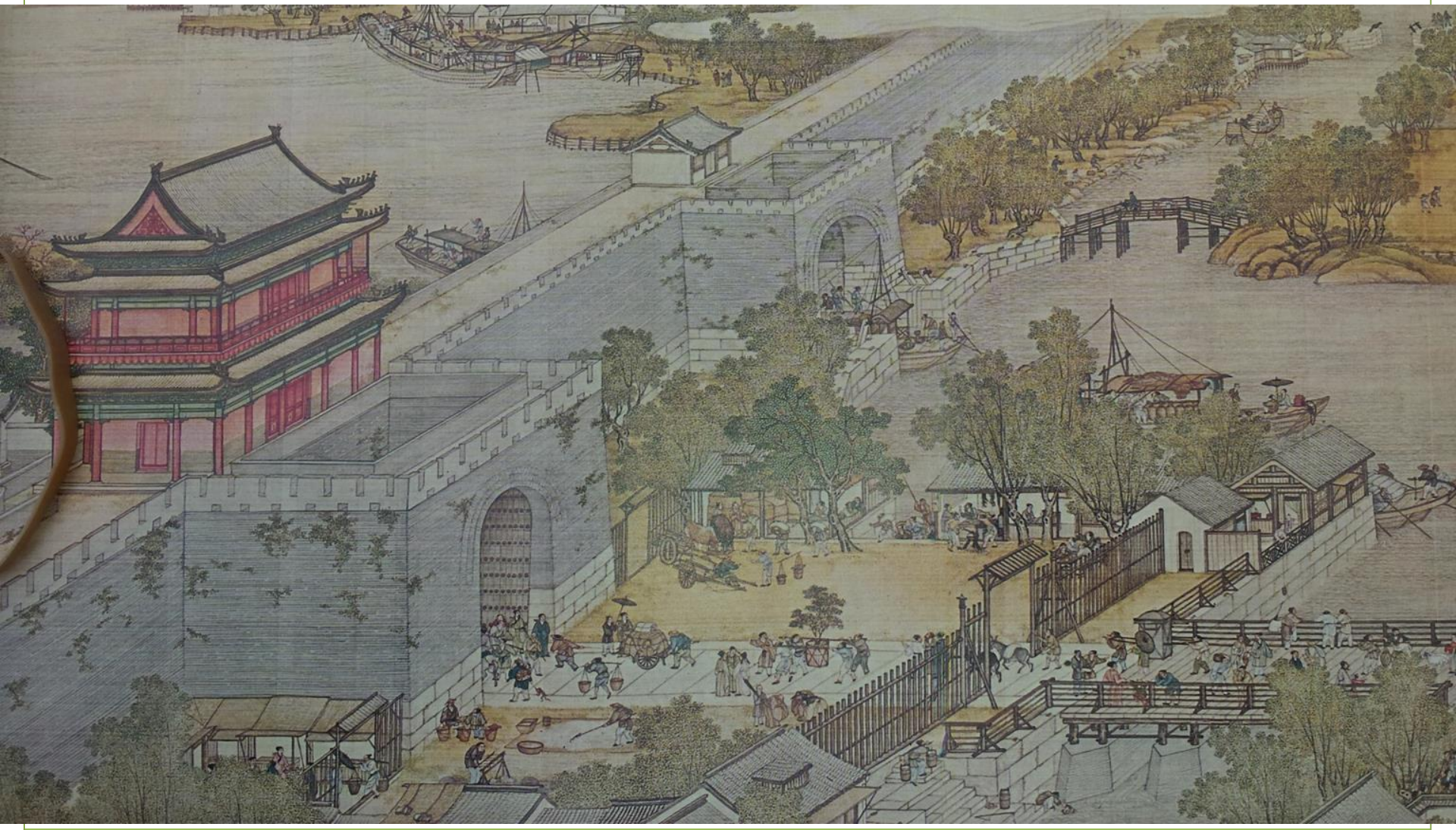


Why "urban forestry"?

USDA Forest Service
Northern Research Station

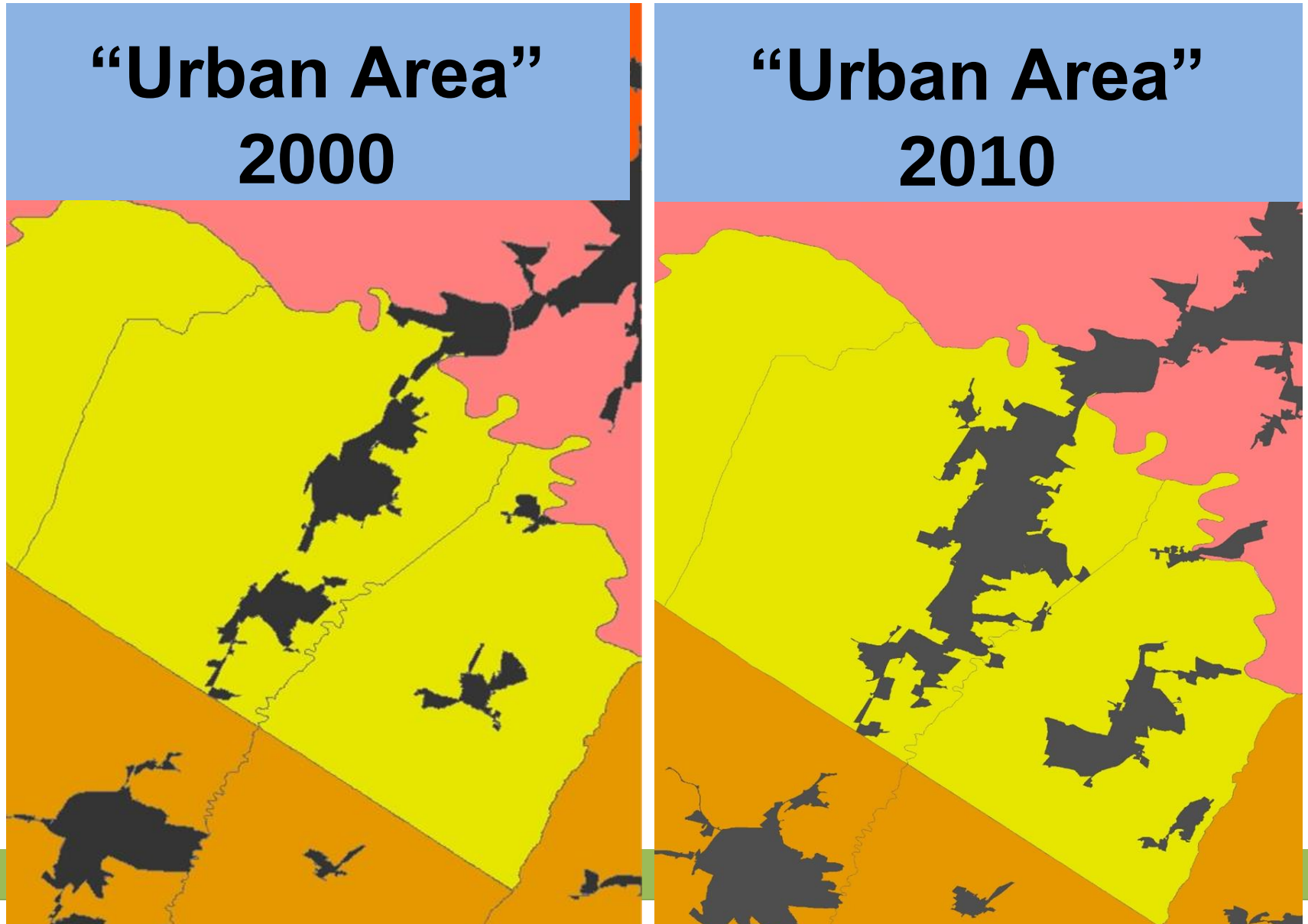
"Envision a region where trees and natural resources support a high quality of life; wildlife, fish, and plant communities thrive; clean water abounds; and people work together to sustain and restore the health of forests."

"Along the River During the Qing Ming Festival" (1736)



"Along the River During the Qing Ming Festival" Sung Dynasty life originally painted by Zhang Zeduan's (1085–1145)

Martinsburg, WV, has the fastest rate of urban land cover growth in the Bay Watershed.



What are Urban Forests?

- Urban Forests are all of the trees that we live with. The trees that grace our:
  - Parks
  - Schools
  - Places of Worship
  - Streets
  - Neighborhoods
- Provide benefits to people and to the environment

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What are the benefits (AKA "ecosystem services") of urban & community forestry ?

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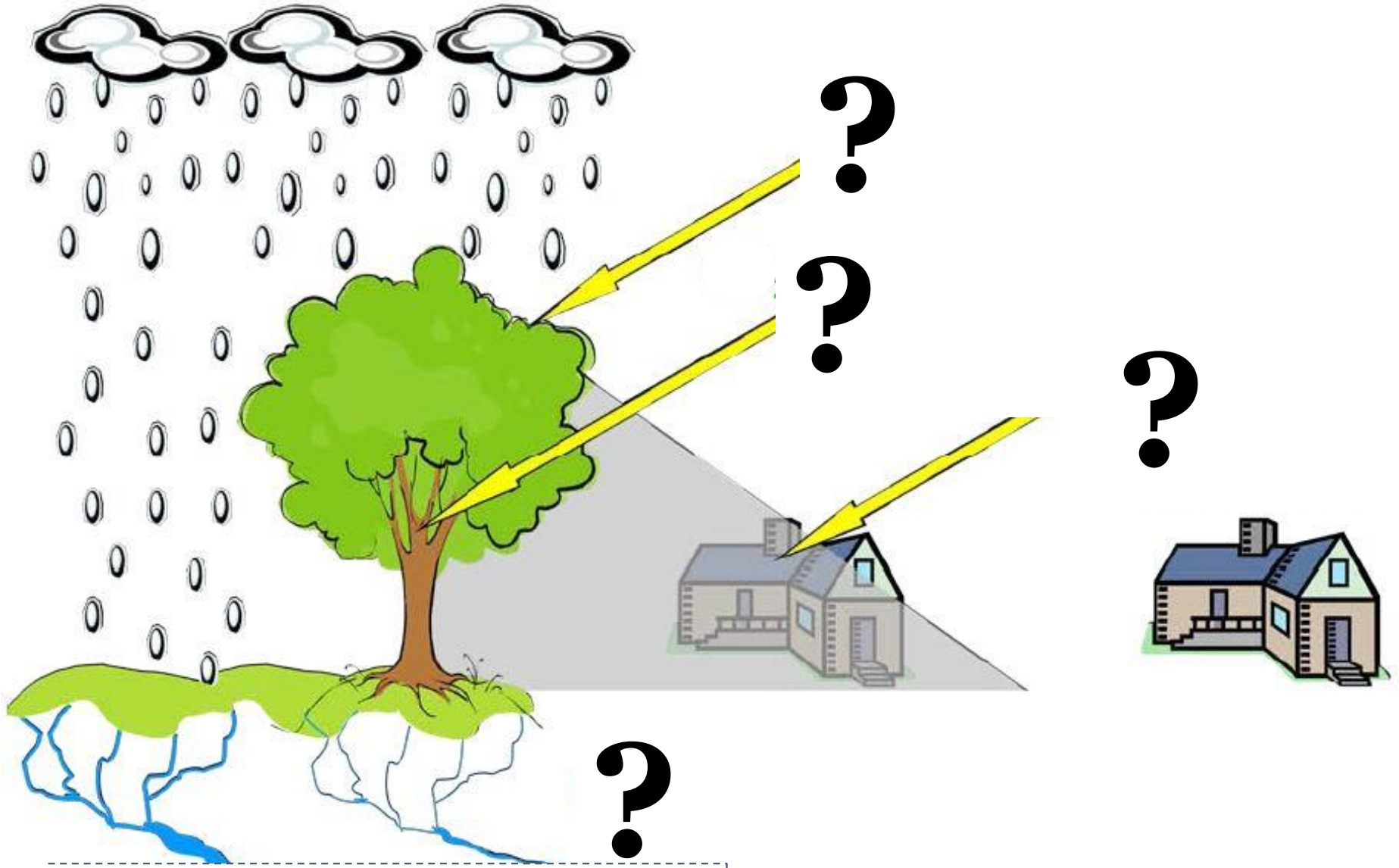
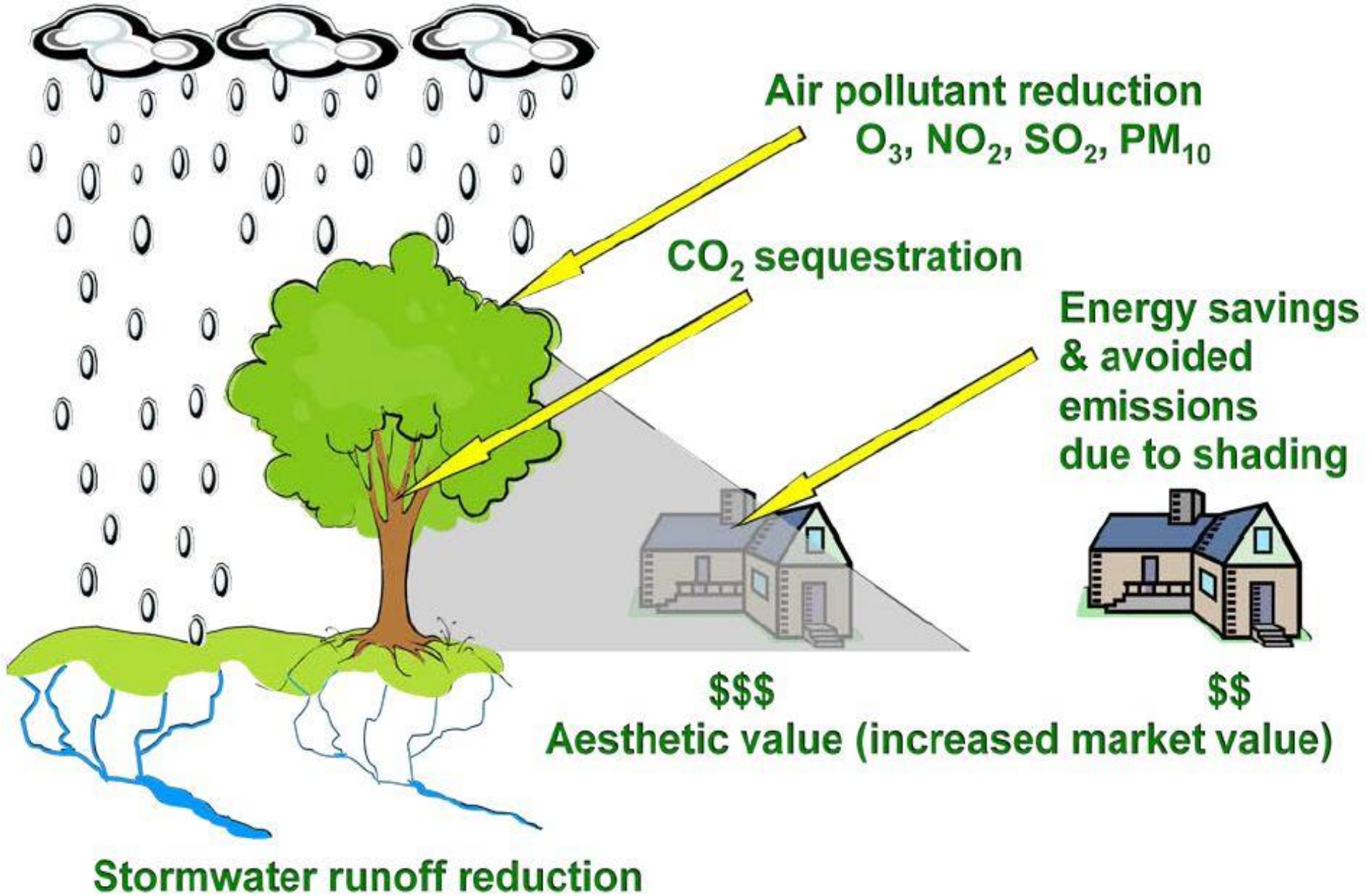
Ecosystem services provided by urban trees



Ecosystem services provided by urban trees



Energy savings & avoided emissions due to shading

$$

$$$

Aesthetic value (increased market value)

$$$

$$

Aesthetic value (increased market value)

What are the benefits?

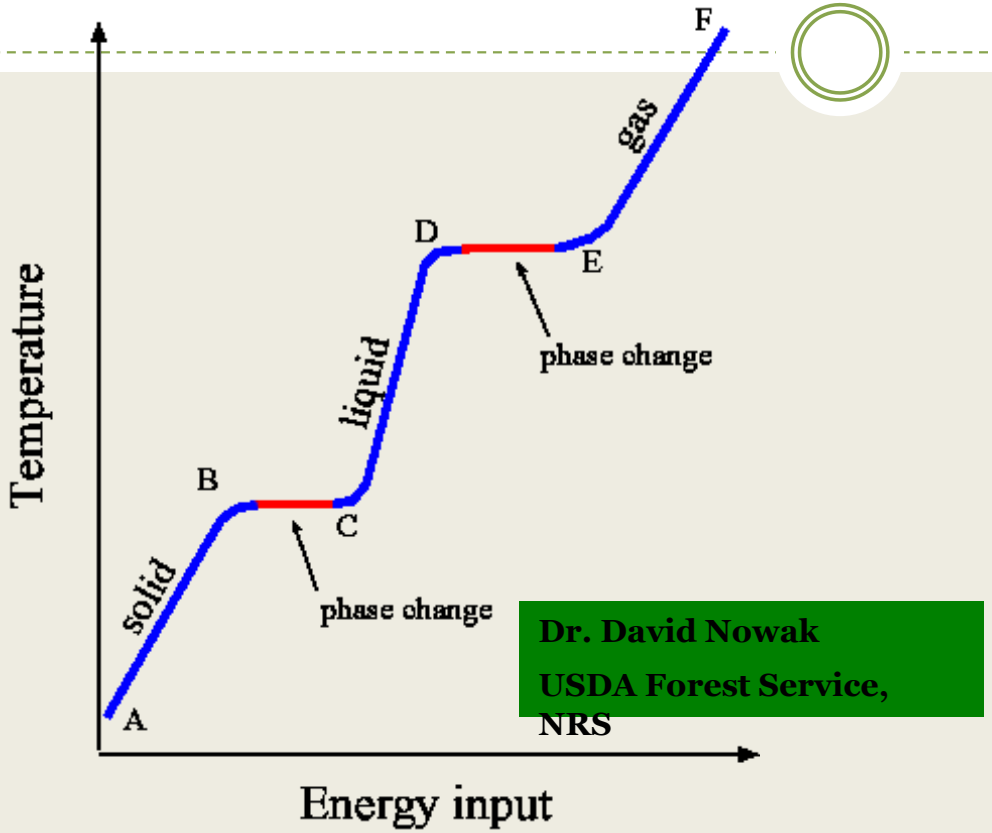
T. Temperature

R. Runoff

E. Energy

E. Environment

Latent Heat of Vaporization

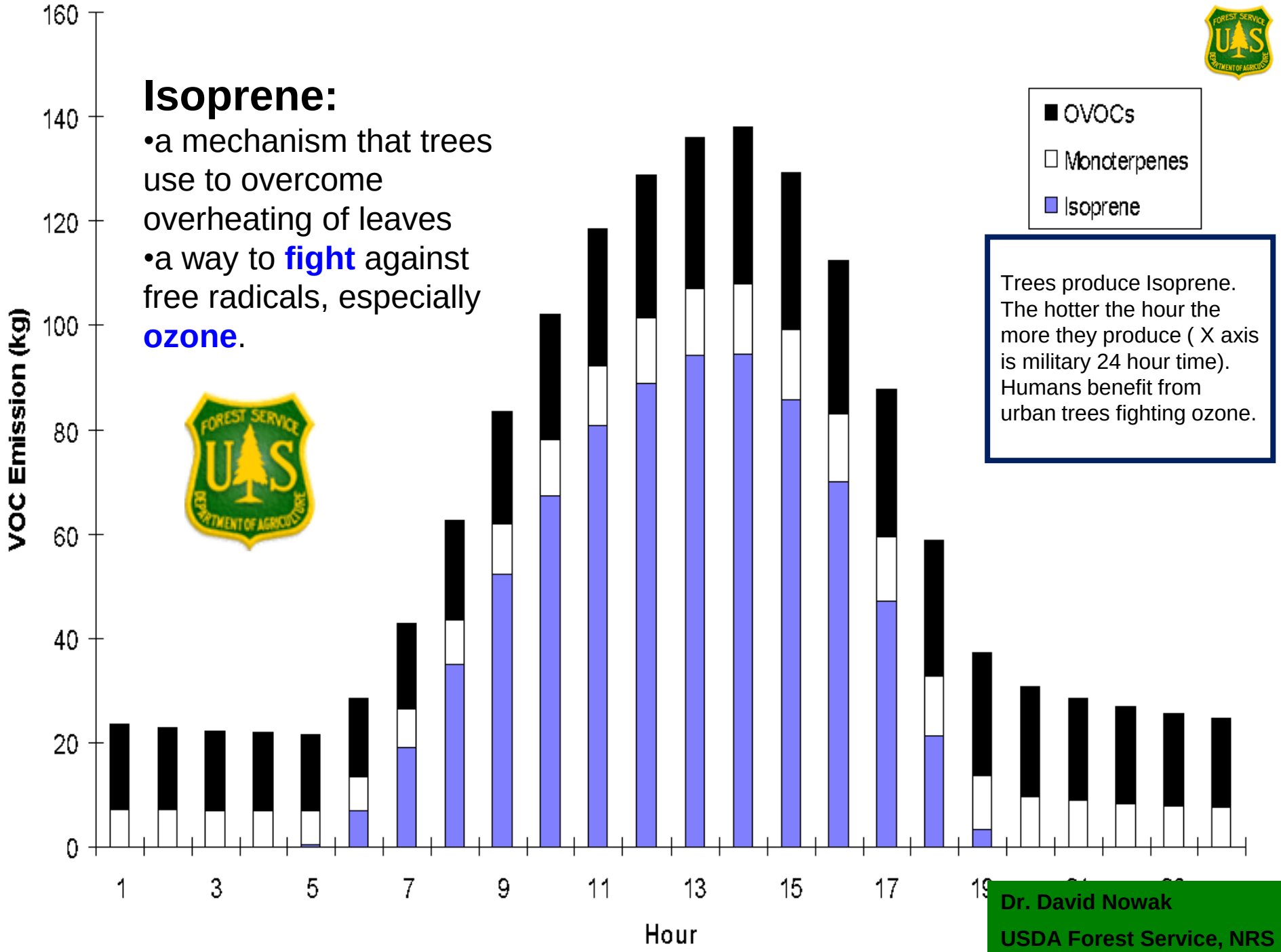


Dr. David Nowak
USDA Forest Service, NRS

Heat of vaporization for water = 539 cal / g

Isoprene:

- a mechanism that trees use to overcome overheating of leaves
- a way to **fight** against free radicals, especially **ozone**.



Trees produce Isoprene. The hotter the hour the more they produce (X axis is military 24 hour time). Humans benefit from urban trees fighting ozone.

Dr. David Nowak

USDA Forest Service, NRS

Isoprene are the building blocks of monoterpenes that, in turn, produce essential oils – the smells of pine and sap.

Isoprenes are one of the reasons trees produce a healthy environment.

Isoprenes give off a blue color and are why the Blue Ridge is blue.

What are the benefits?

- **Urban Flash floods kill 40 people per year, 45% involve cars; 40% outside of floodplain**

Source: FEMA / NOAA

T. Temperature

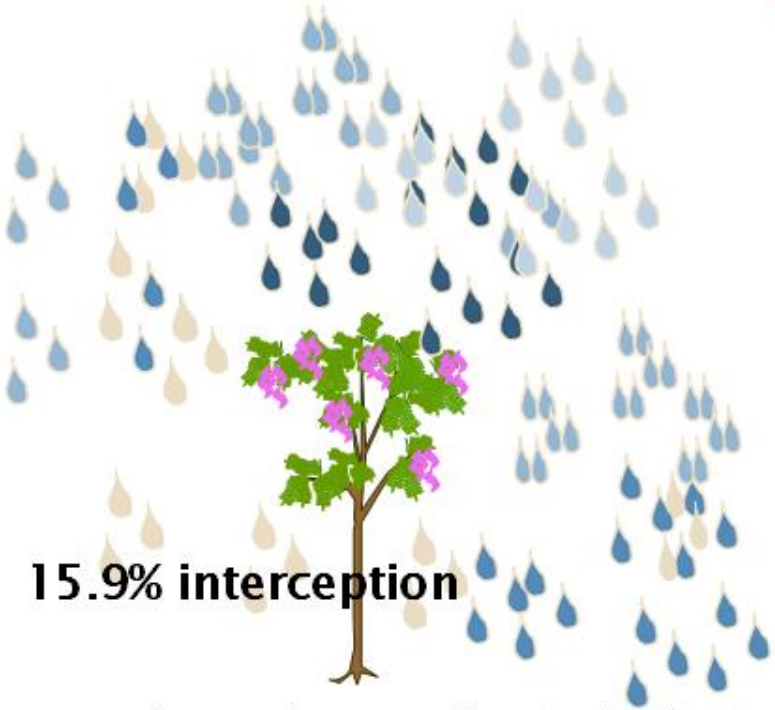
R. Runoff

E. Energy

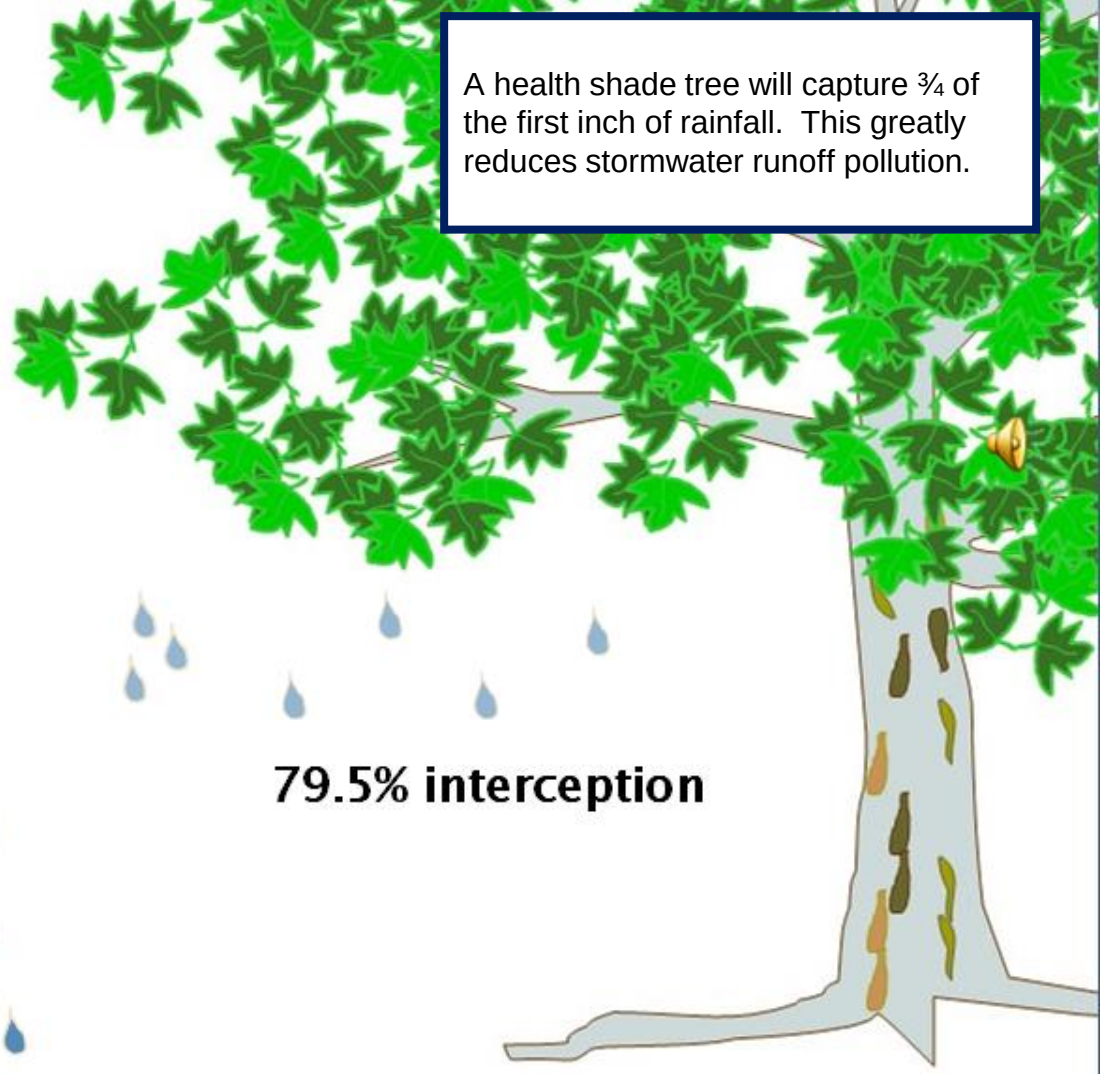
E. Environment

A health shade tree will capture ¾ of the first inch of rainfall. This greatly reduces stormwater runoff pollution.

~1 inch rainfall event (24 h)



Jacaranda mimosifolia (~2" caliper)

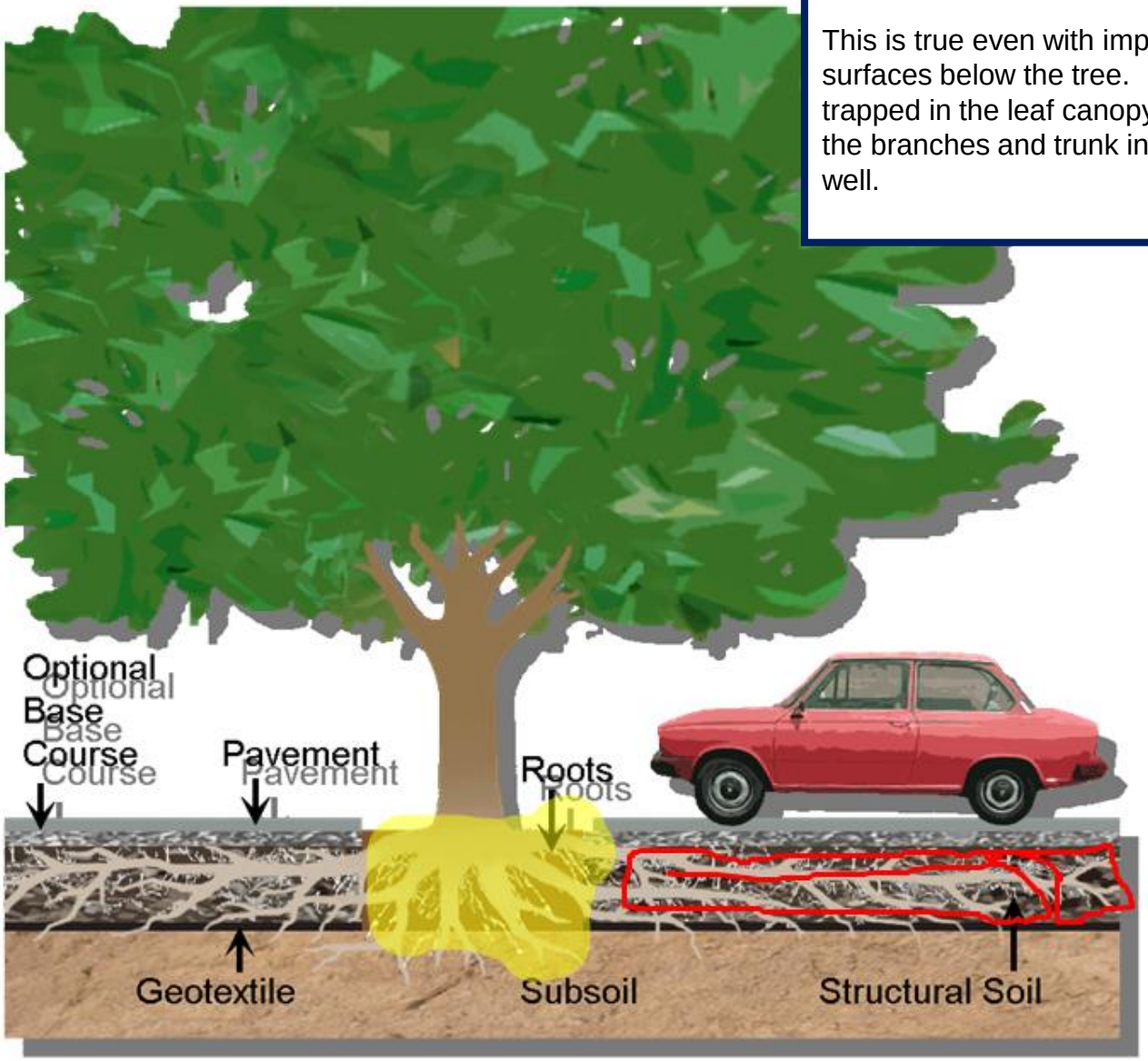


Platanus ×acerifolia

Dr. Susan Day, VA Tech.

Xiao Q., and E.G. McPherson. 2003. Rainfall interception by Santa Monica's municipal urban forest. Urban Ecosystems

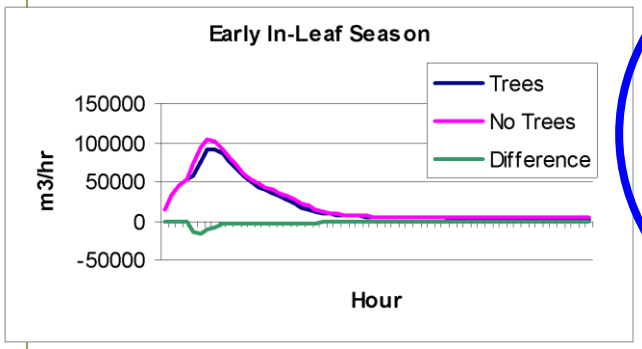
This is true even with impervious surfaces below the tree. Rain is trapped in the leaf canopy, runs down the branches and trunk into the tree well.

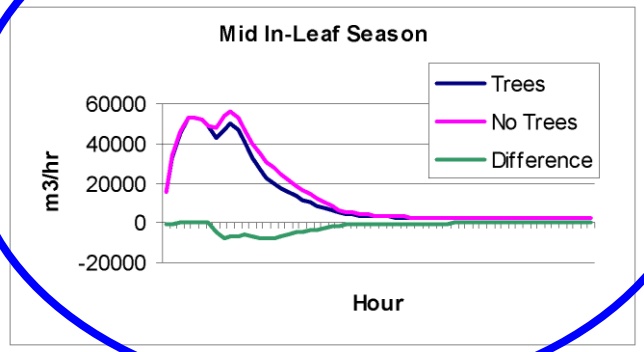


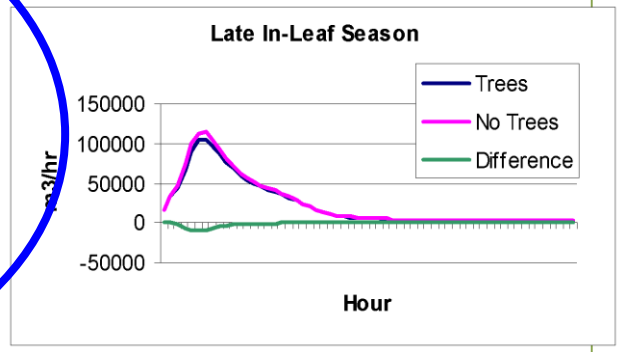
Dr. Susan Day, VA Tech.

Accotink – Storm Simulations

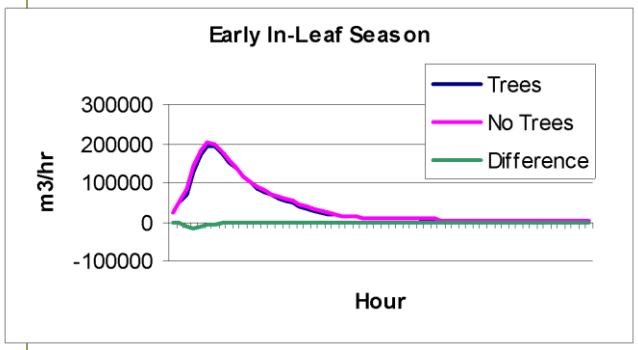
2 year storm

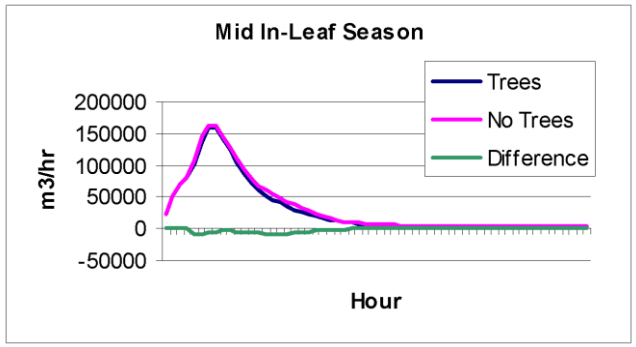


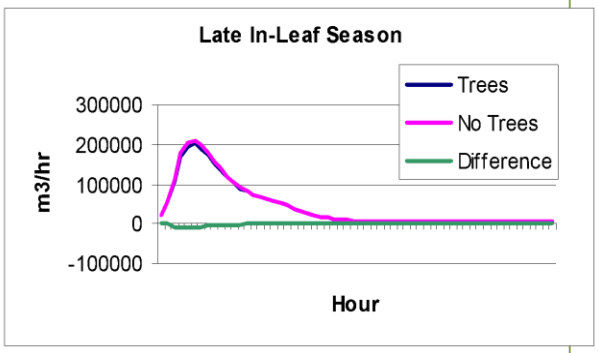




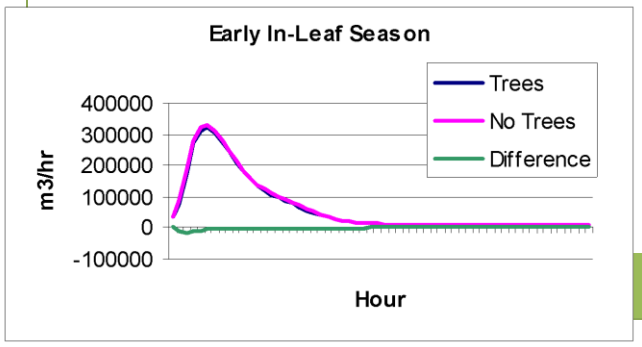
10 year storm

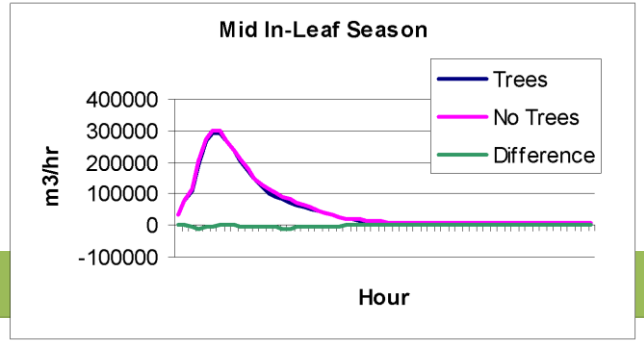


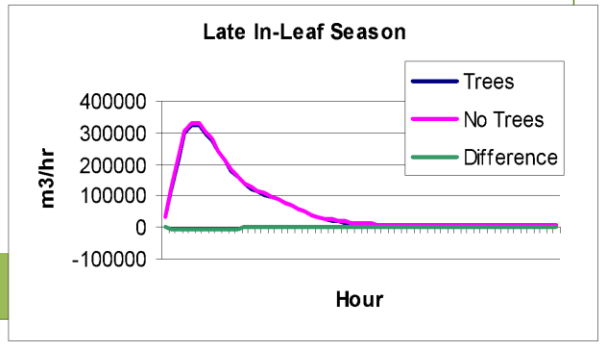




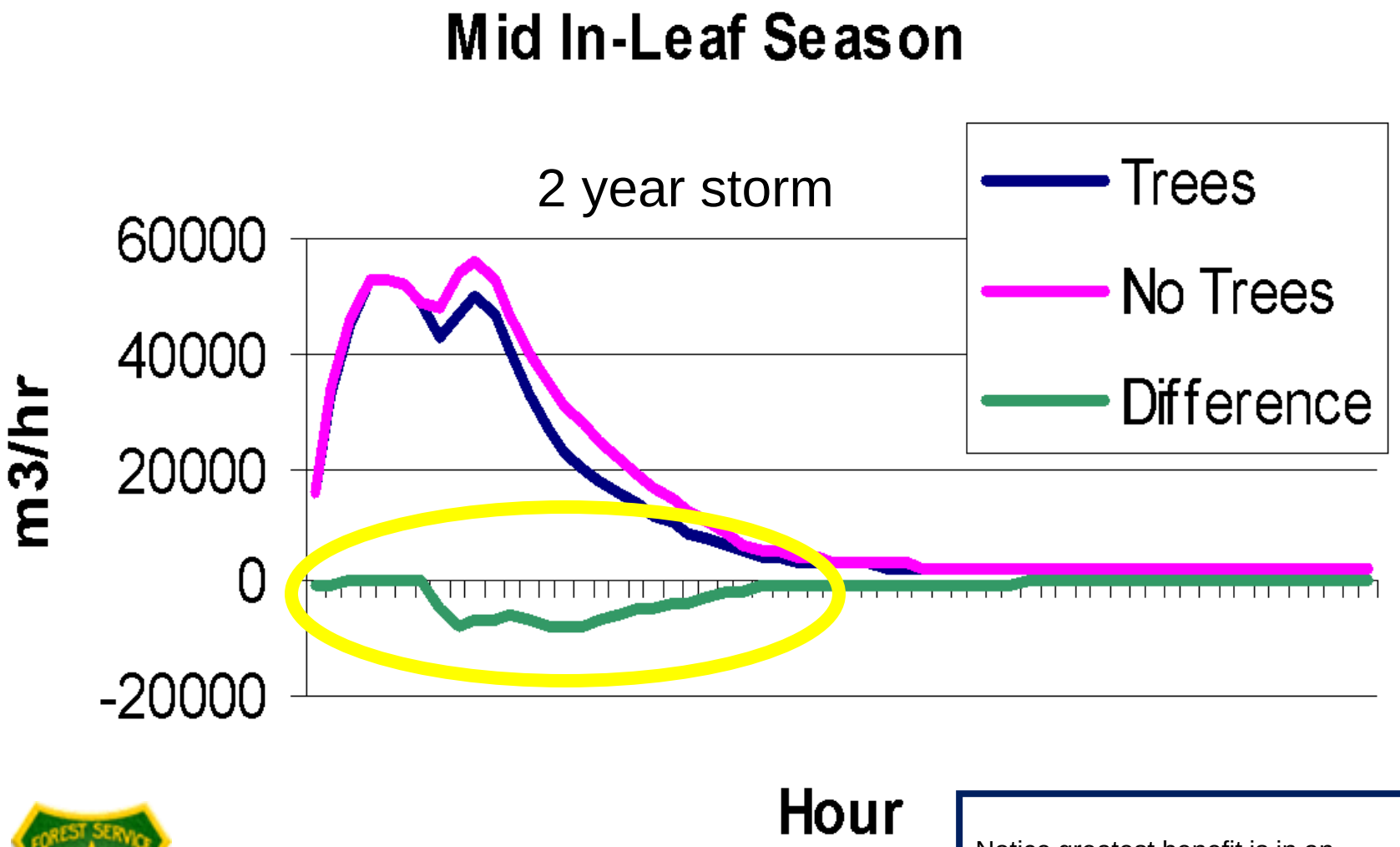
50 year storm







Accotink – Storm Simulations



Notice greatest benefit is in an "average storm" event. Trees offer the greatest benefit when we most often need it, a common rain shower.

What are the benefits?

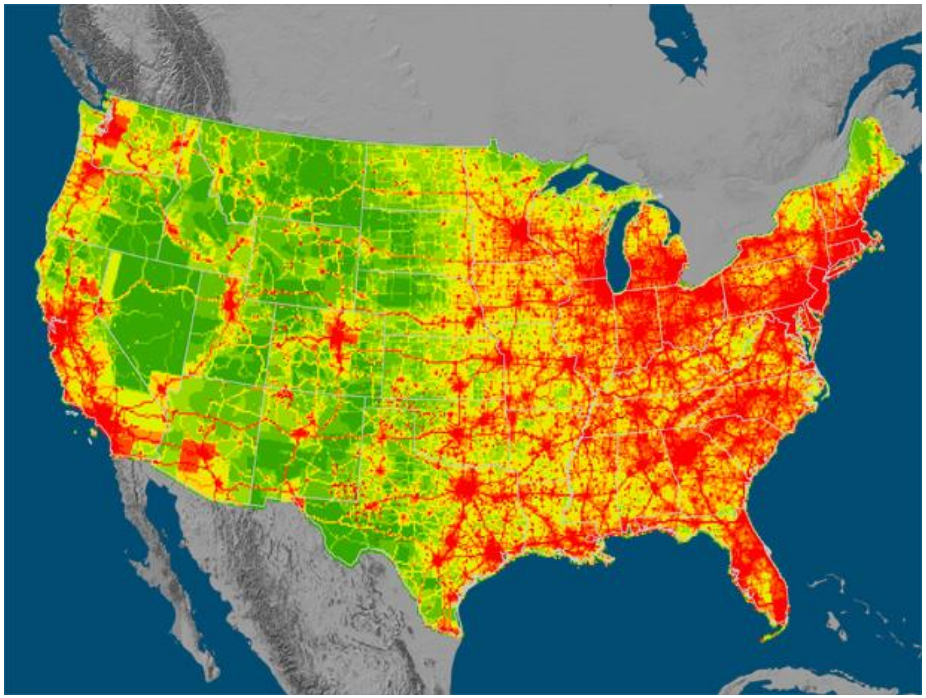
Energy savings and pollution removal potential of trees.

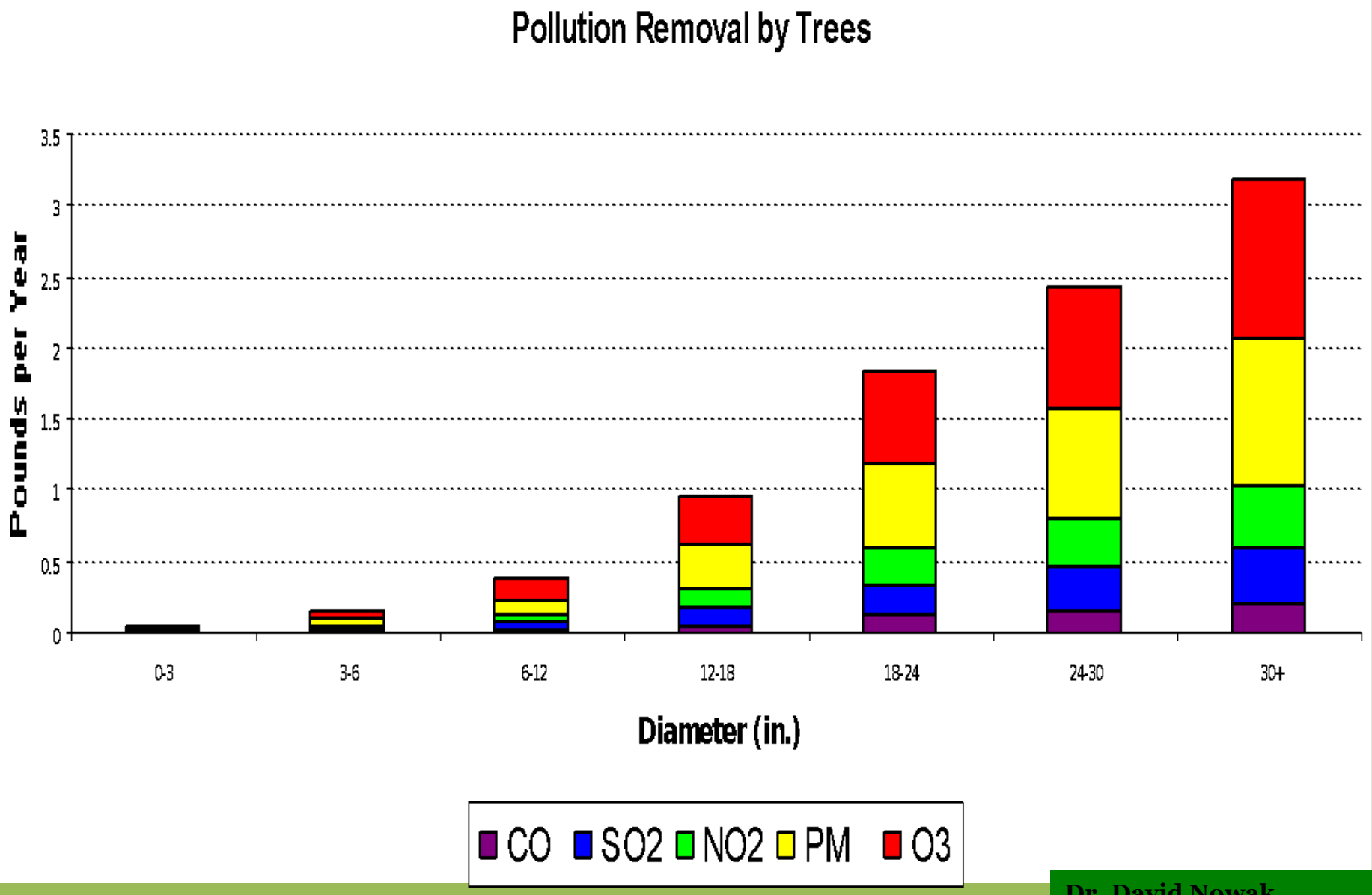
T. Temperature

R. Runoff

E. Energy

E. Environment





Dr. David Nowak

USDA Forest Service,

https://youtu.be/jlz_rZH1lYk

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Urban stressors.

Tree structure & growth.

Tree Planting.

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Urban Stressors

- Invasive plants, Insects and Diseases
- Urban & Suburbanization
  - Sprawl
    - Impervious surfaces
    - Infrastructure

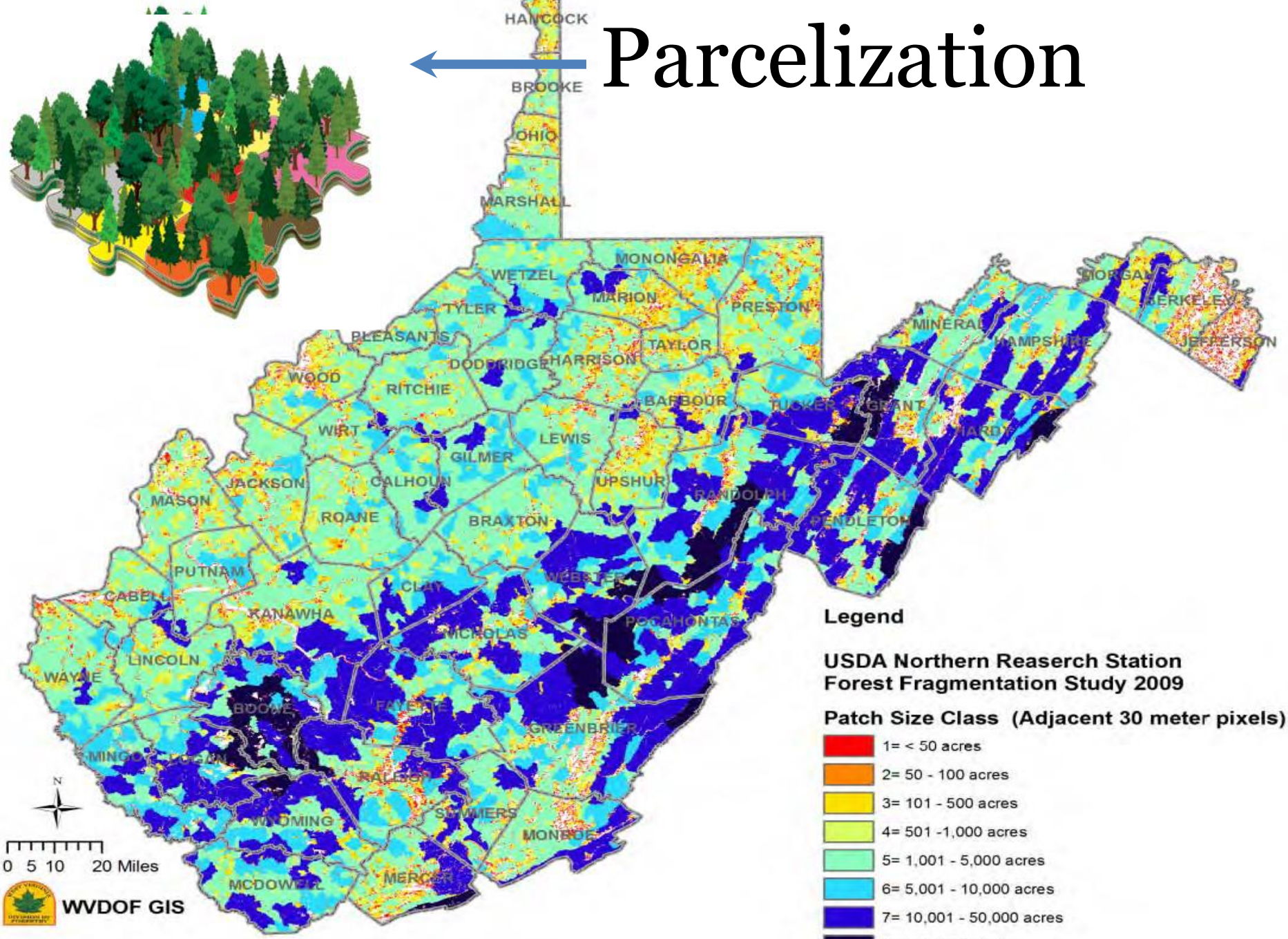
Human Pressure

- Overabundant Deer
- Unsustainable harvests
- Climate change
  - Fire
  - Drought
  - Disease
  - Flood
  - (Acid Rain)

“The Chesapeake Bay watershed has lost forestland at a rate of 100 acres per day since the mid-1980s.”

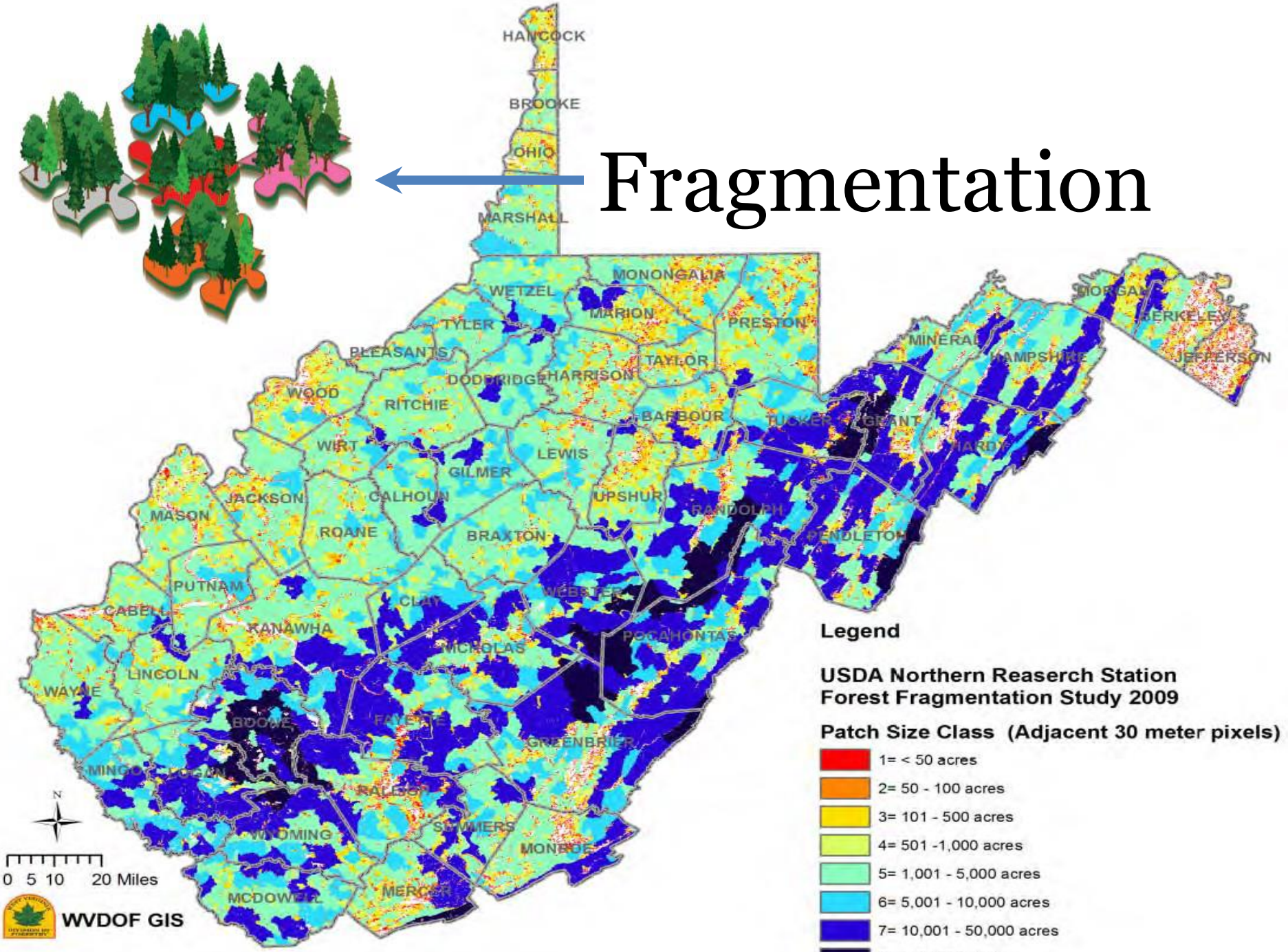
State of the Chesapeake Forests
The Conservation Fund, 2006

Parcelization



Map 3: Forest Patch Size in West Virginia (Riemann et al., 2009).

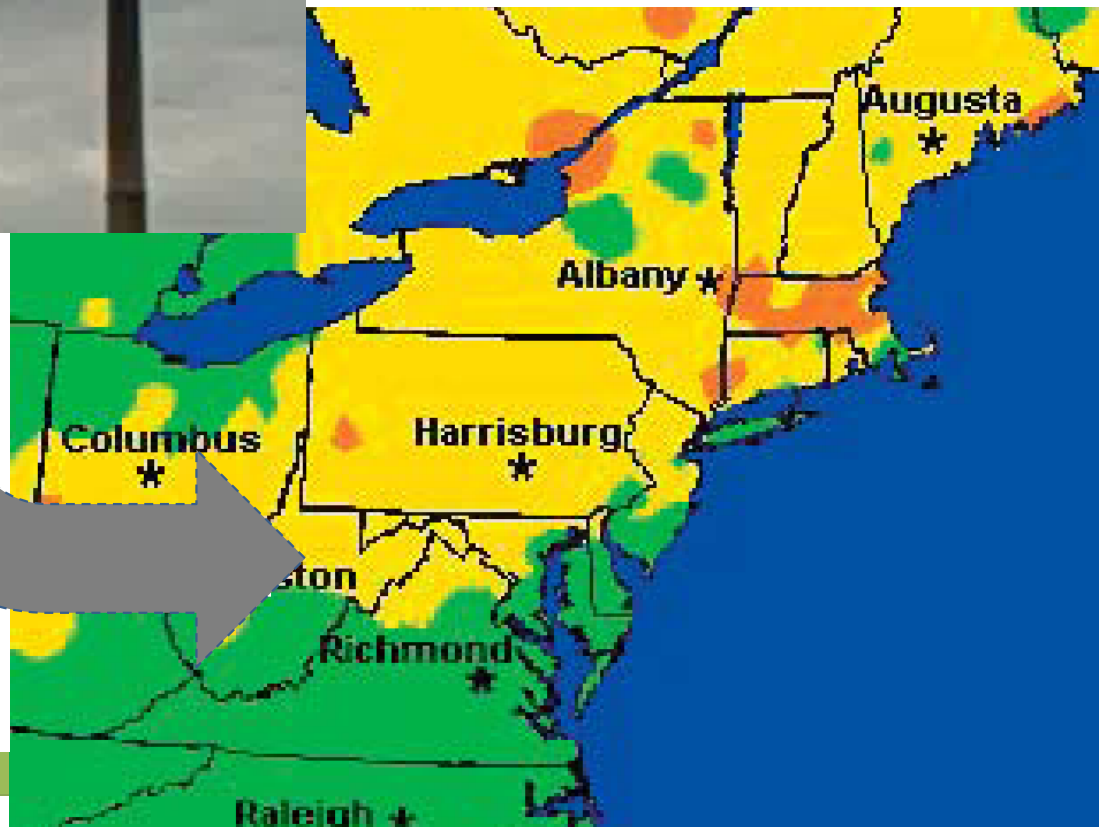
Fragmentation

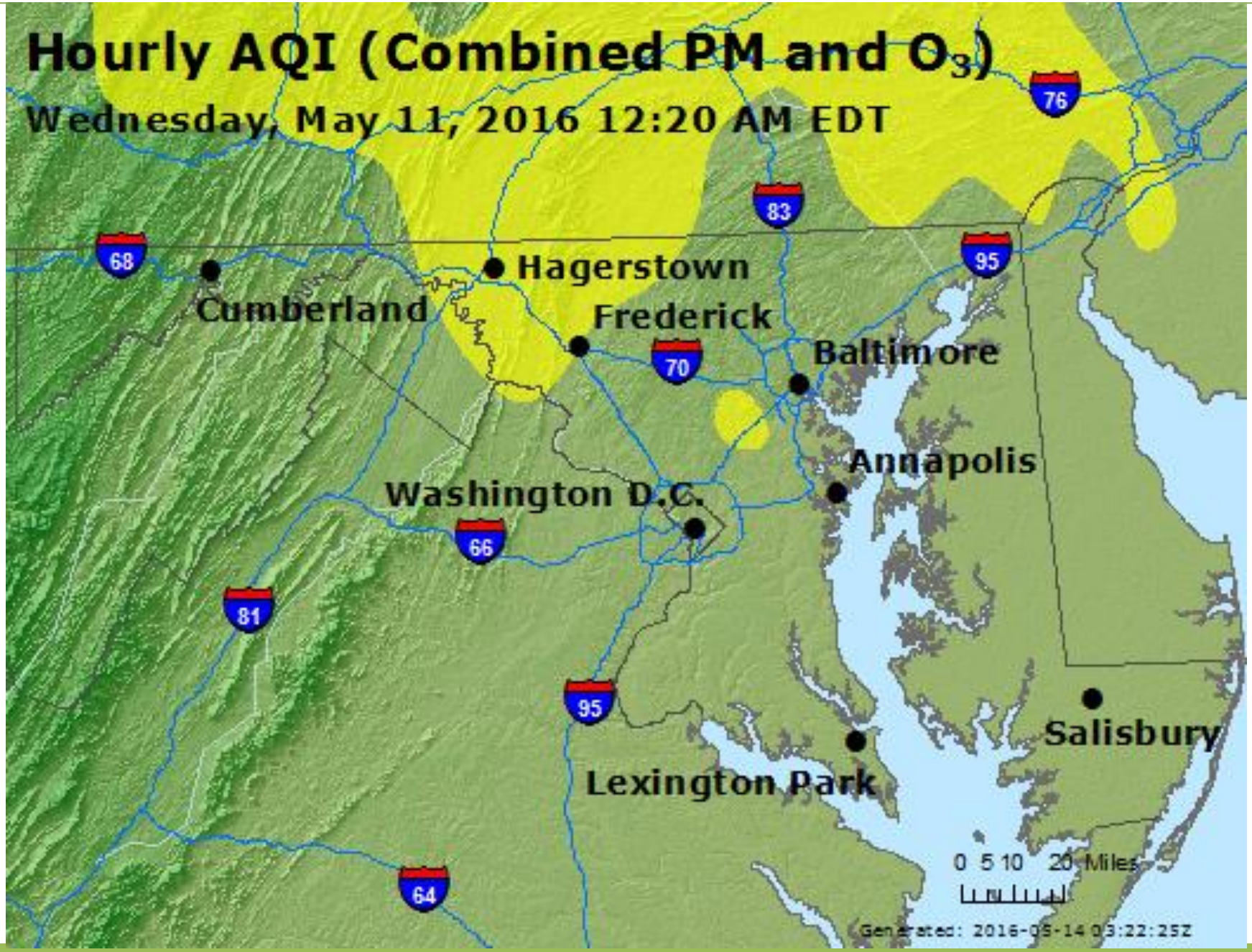


Map 3: Forest Patch Size in West Virginia (Riemann et al., 2009).

WV and the Chesapeake Bay. Up to 15% of nitrogen is from the west.

Jefferson County's air is worse than Baltimore or D.C.'s air.




Hourly AQI (Combined PM and O_3)
Wednesday, May 11, 2016 12:20 AM EDT
76
83
68
95
Hagerstown
Cumberland
Frederick
70
Baltimore
Annapolis
Washington D.C.
66
81
95
Salisbury
Lexington Park
64
0 5 10 20 Miles
Generated: 2016-05-14 03:22:25Z

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Forest Service U.S. Department of Agriculture

West Virginia Division of Forestry

Potomac Watershed Partnership

Trees grow up side down and inside out.

Sugars from the canopy flows down into the trunk and roots.

Injuring
aka “Pruning”

Compartmentalization

Of

Decay

In

Trees

Because trees grow inside out they can survive disease, decay, and injury.

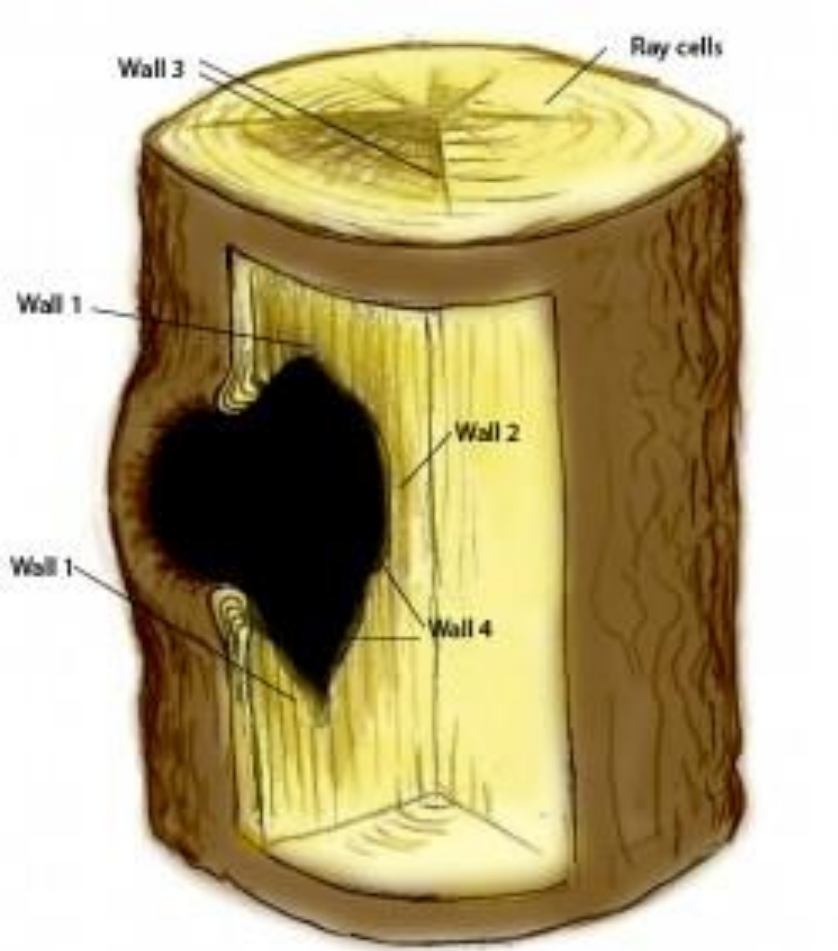
Compartmentalization

Of

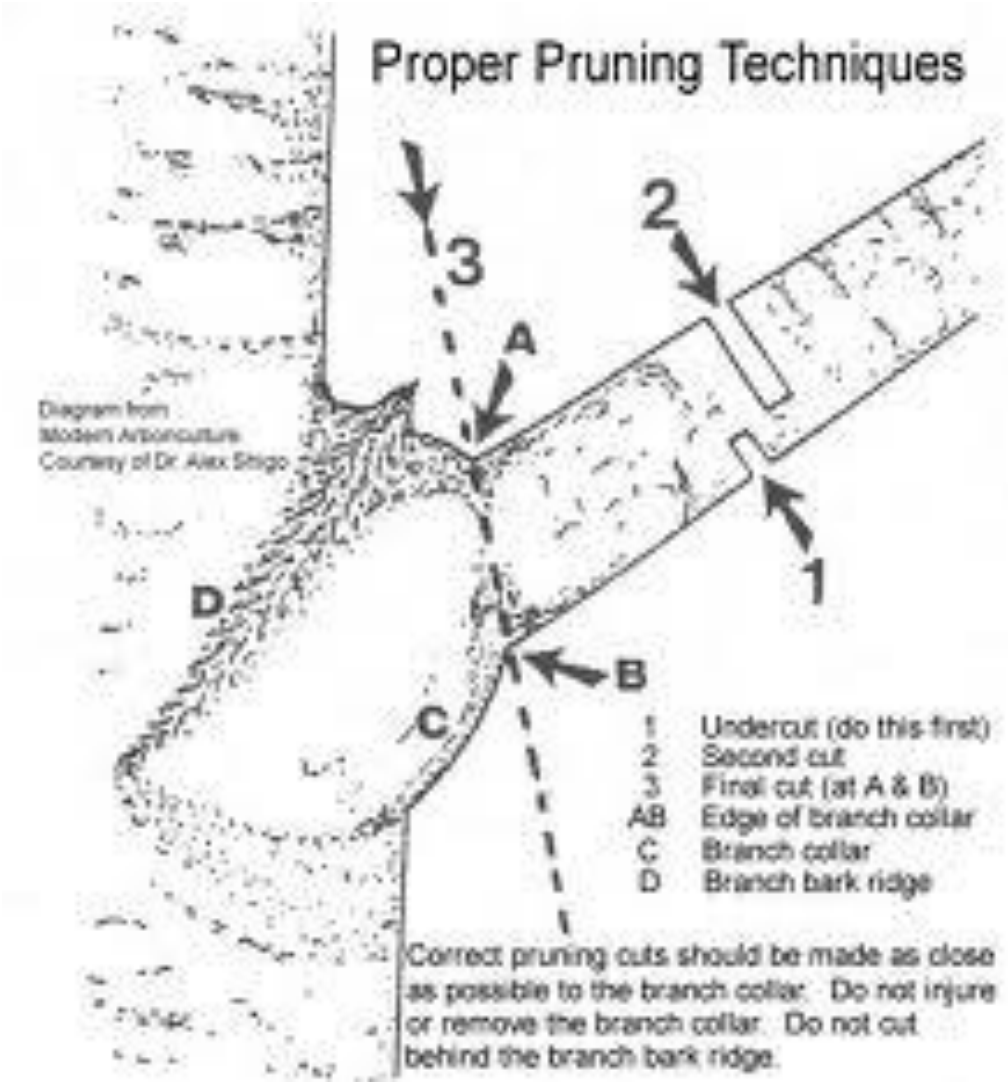
Decay

In

Trees



Compartmentalization Of Decay In Trees



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Tree "size"

Bare Root Seedlings
Cheapest option available through WV nursery, but small & low survival rates

Containerized
More expensive then seedlings, but higher survival and easy to move

Balled & Burlapped
Most expensive and hard for volunteers, but more immediate impact

Stock Size
B & B – Ball & Burlap

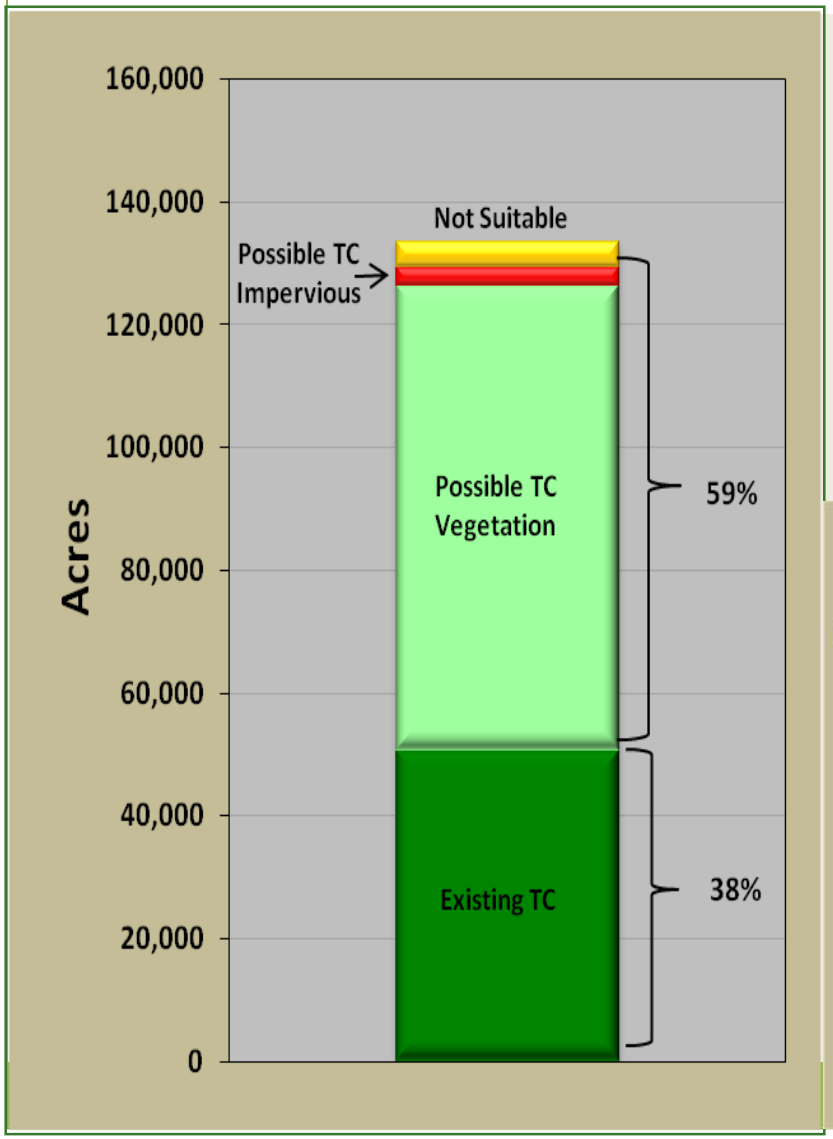
Stock Size - Containerized

Turf to Trees

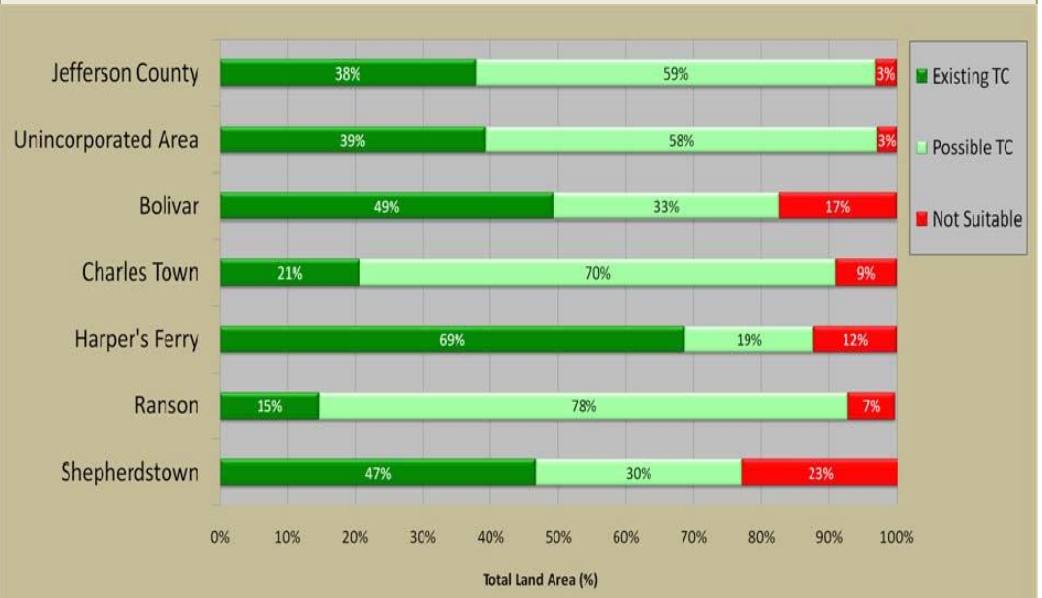

END
MOWING

Turf to Trees

Jefferson County Tree Canopy **Goal**

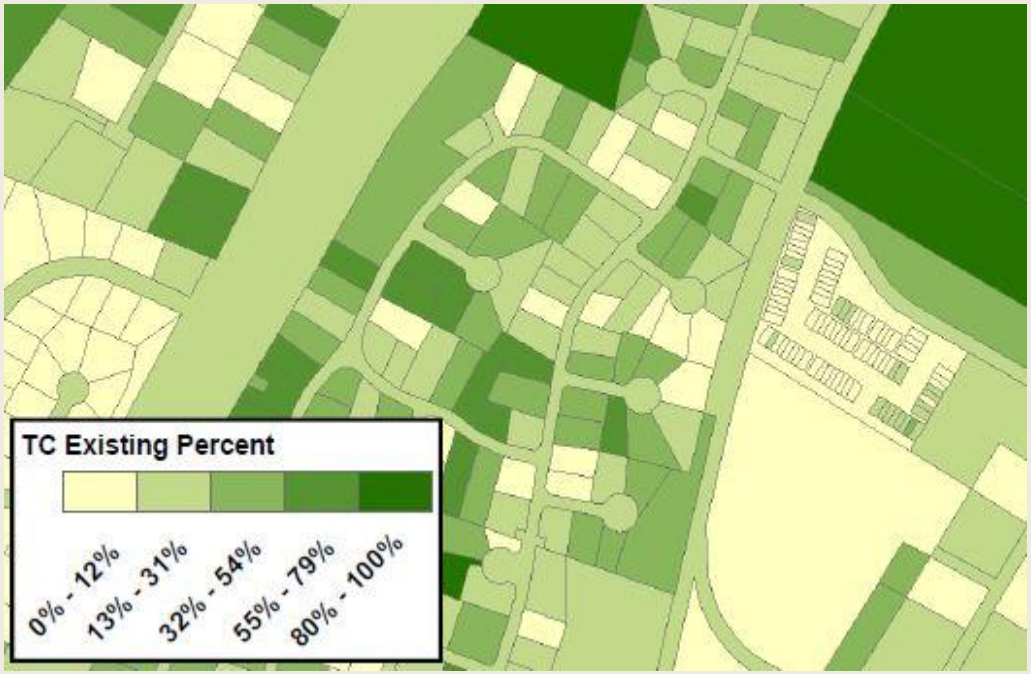


- Increase to **40%** in **20** year span (2030) equals **~143 acres/year**
  - Assuming zero net loss in current canopy



Berkeley County UTC Study

- Same Methodology as Jefferson County
- However, also had Property Parcels!
- Plan and Goals have not yet been set by county
- Additional analyses…



Berkeley County UTC Study Results

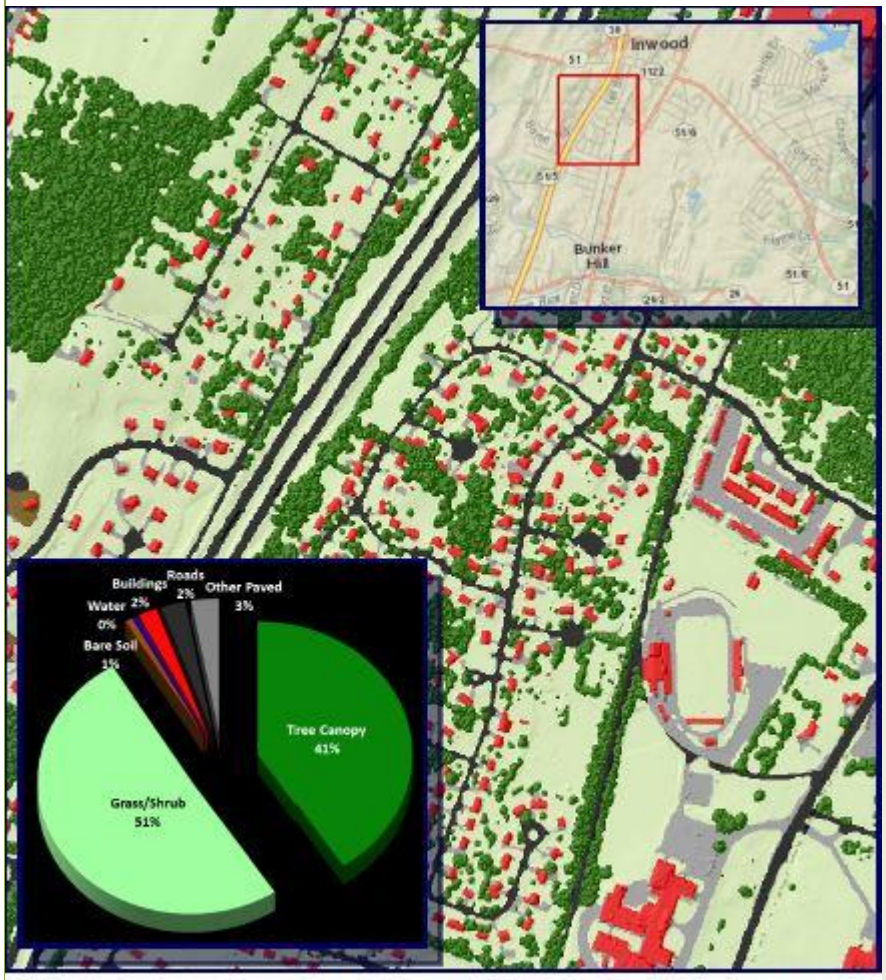


Figure 1: Land cover derived from high-resolution imagery for Berkeley County, WV

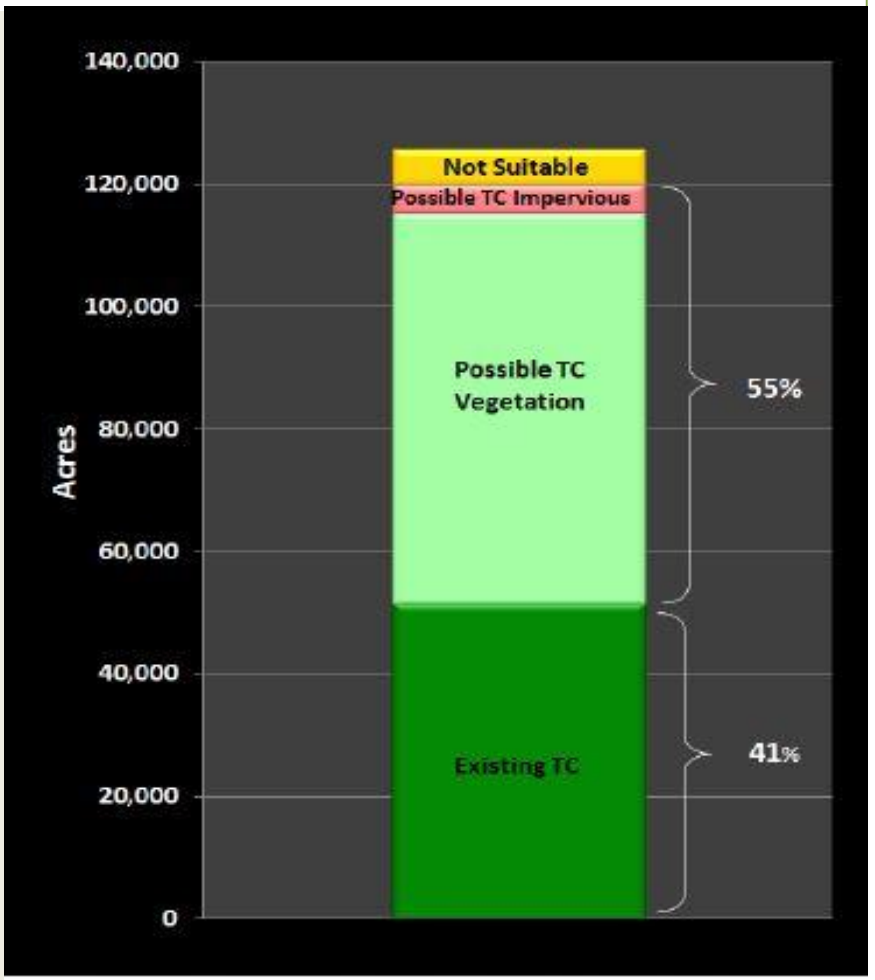


Figure 2: TC metrics for southeastern Berkeley County based on % of land area covered by each TC type.

Patch Size

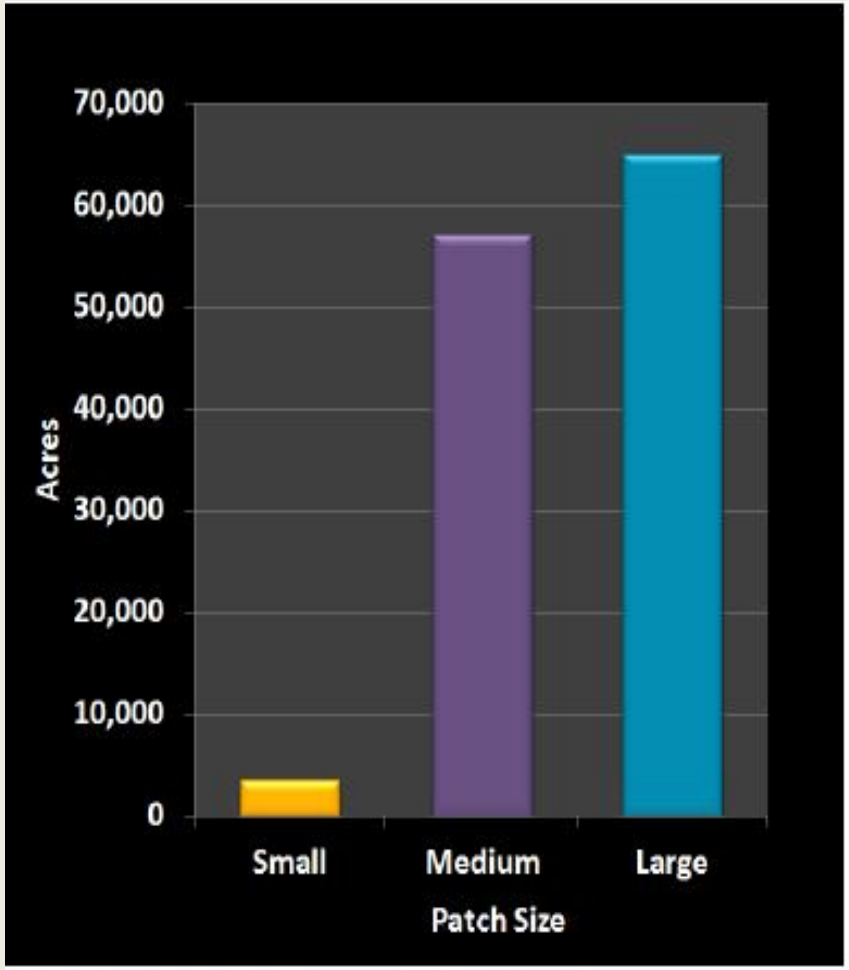


Figure 6: Forest Patch sizes summarized by area.

Figure 7: Large scale example of tree canopy classified by patch size.

Landuse Categories

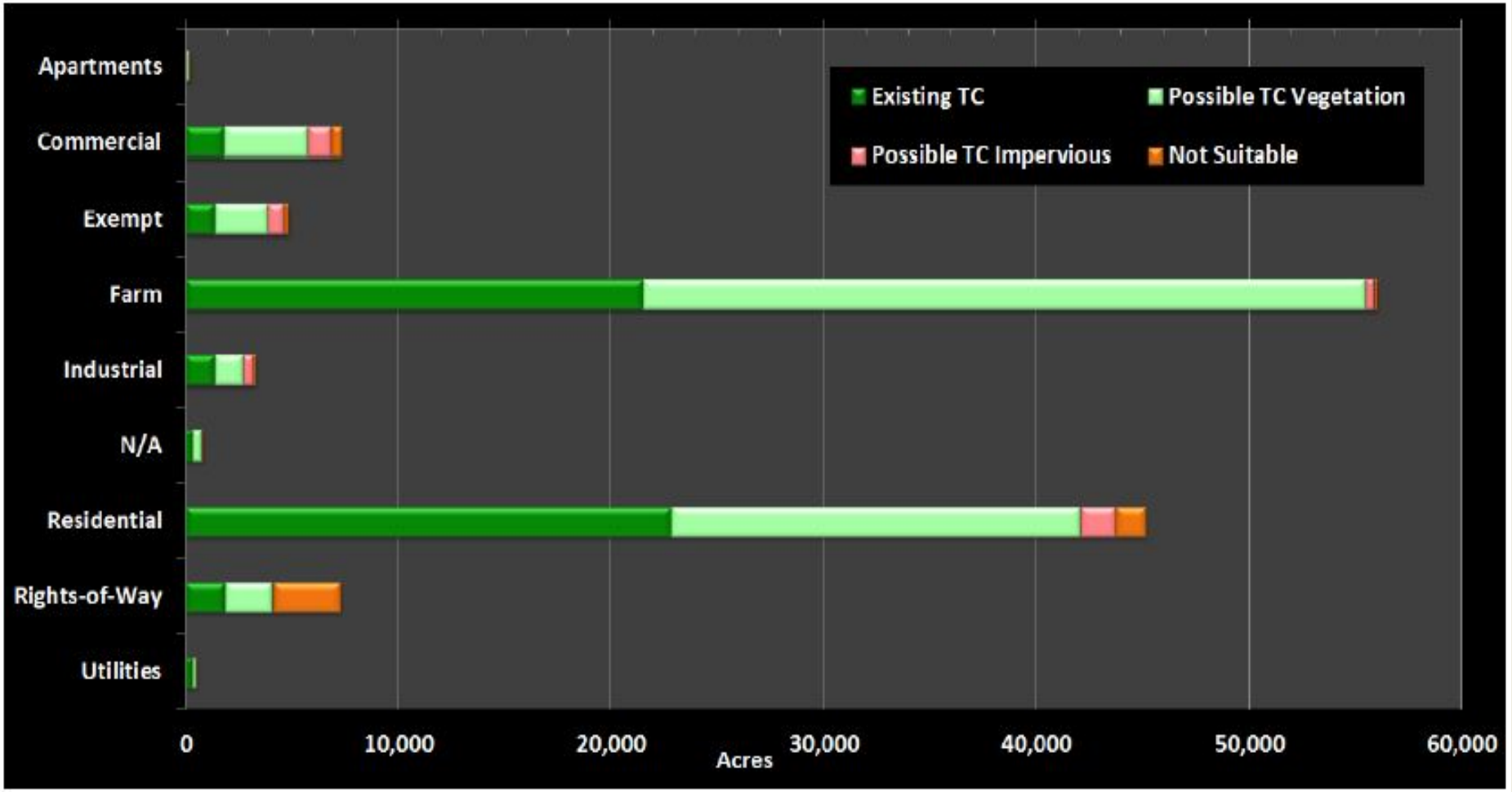
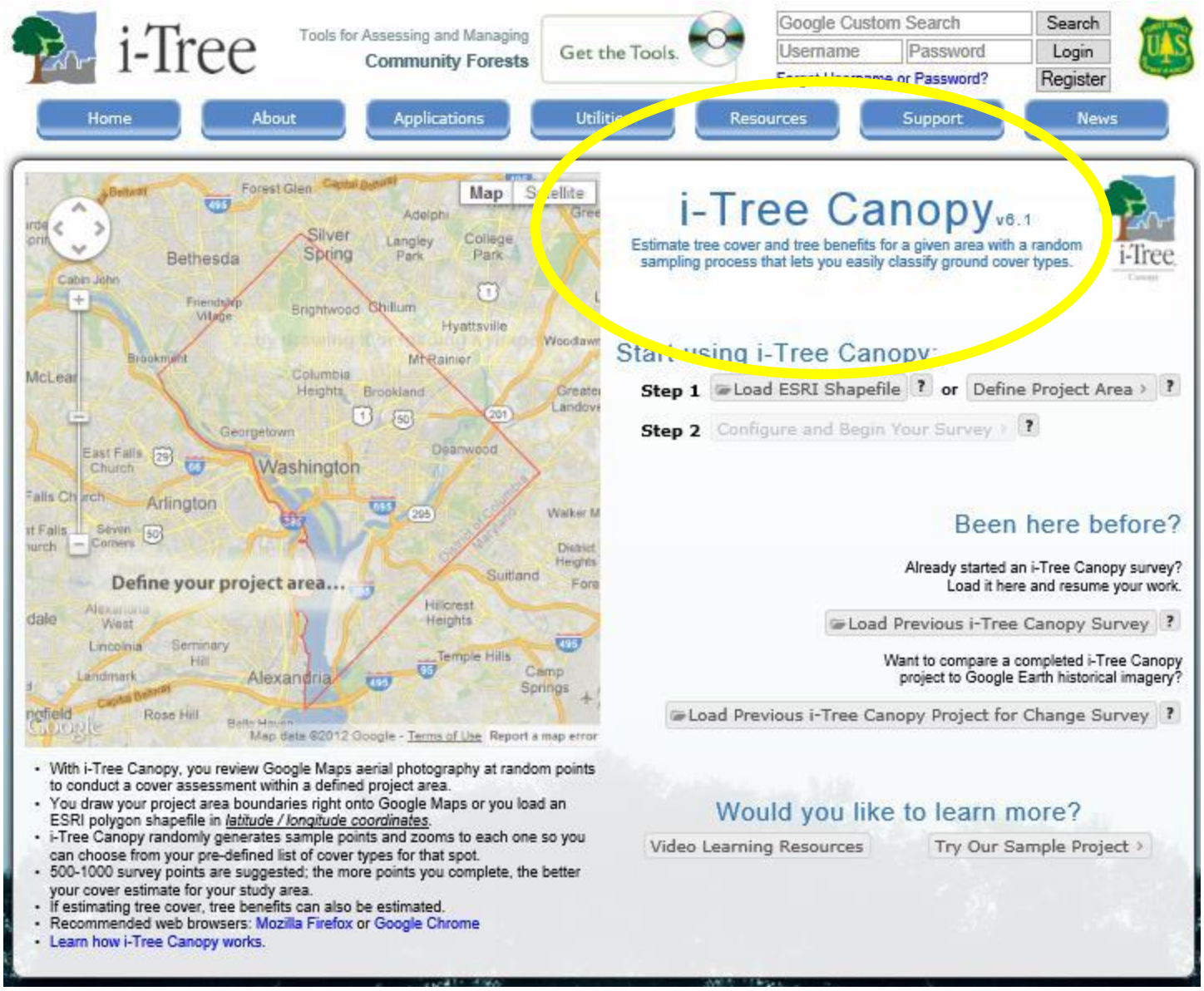
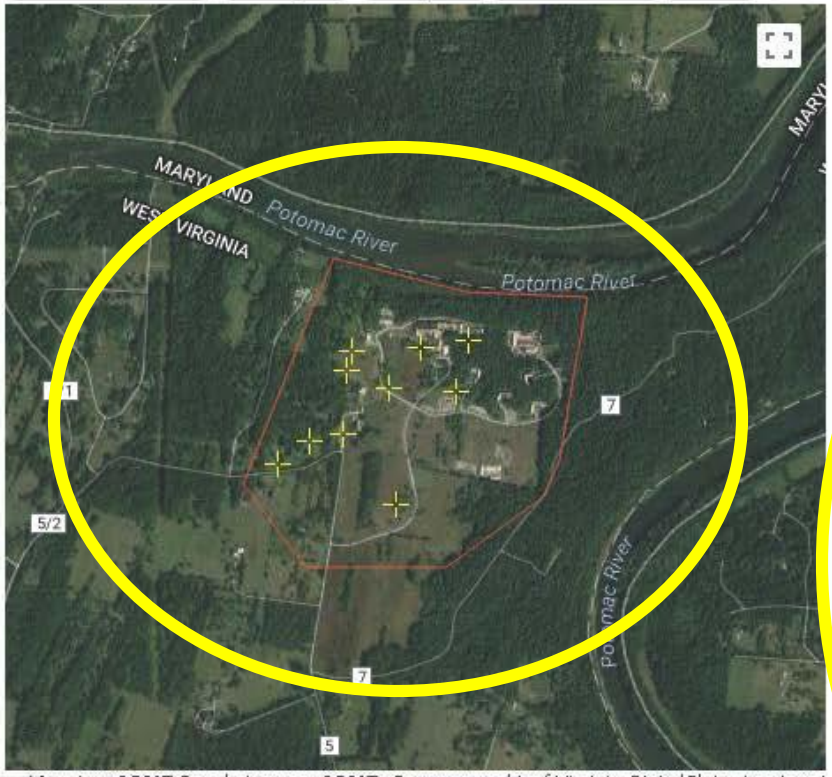


Figure 8: Tree Canopy (TC) metrics summarized for each zoning district.


i-Tree
Tools for Assessing and Managing
Community Forests
Get the Tools.
Google Custom Search
Search
Username
Password
Login
Register
Home
About
Applications
Utilities
Resources
Support
News
Map
Satellite
Define your project area...
i-Tree Canopy v6.1
Estimate tree cover and tree benefits for a given area with a random sampling process that lets you easily classify ground cover types.
Step 1
Load ESRI Shapefile
or
Define Project Area
Step 2
Configure and Begin Your Survey
Been here before?
Already started an i-Tree Canopy survey? Load it here and resume your work.
Load Previous i-Tree Canopy Survey
Want to compare a completed i-Tree Canopy project to Google Earth historical imagery?
Load Previous i-Tree Canopy Project for Change Survey
With i-Tree Canopy, you review Google Maps aerial photography at random points to conduct a cover assessment within a defined project area.
You draw your project area boundaries right onto Google Maps or you load an ESRI polygon shapefile in latitude / longitude coordinates.
i-Tree Canopy randomly generates sample points and zooms to each one so you can choose from your pre-defined list of cover types for that spot.
500-1000 survey points are suggested; the more points you complete, the better your cover estimate for your study area.
If estimating tree cover, tree benefits can also be estimated.
Recommended web browsers: Mozilla Firefox or Google Chrome
Learn how i-Tree Canopy works.
Would you like to learn more?
Video Learning Resources
Try Our Sample Project

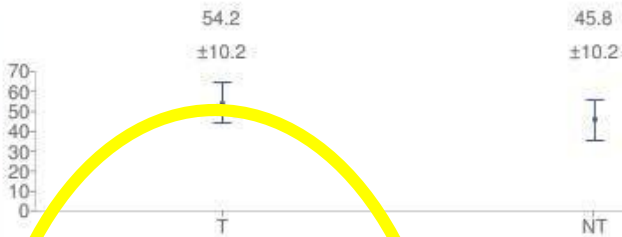
How It Works [1] | Report [2] | Export | Start Over | Exit [3]



Remember, the more points you survey, the lower your Standard Error, and the more precise your sampling will be. More points surveyed provide for a better estimation of Land Cover across your study area.

i-Tree Canopy v6.1

Percent Cover (±SE)



Id	Cover Class	Latitude	Longitude
1	Tree	39.48288	-77.81329
2	Non-Tree	39.48370	-77.81180
3	Non-Tree	39.48632	-77.80995
4	Tree	39.48748	-77.80410
5	Non-Tree	39.48398	-77.81019
6	Non-Tree	39.48554	-77.80462
7	Non-Tree	39.48710	-77.80973
8	Tree	39.48723	-77.80636
9	Tree	39.48134	-77.80761
10	Tree	39.48567	-77.80792

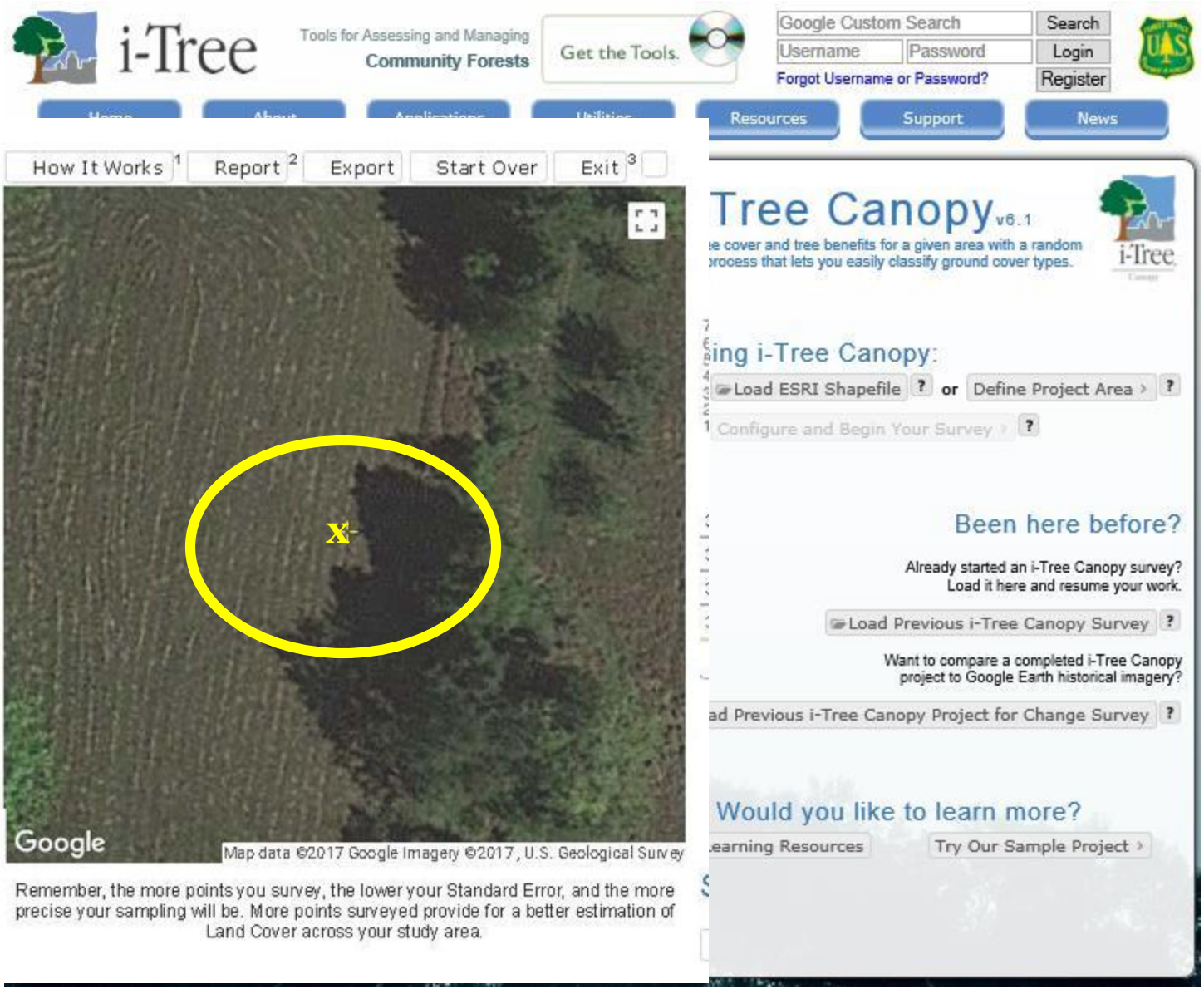
Page 1 of 3 View 1 - 10 of 25

Save Your Data

Save Data Save Early. Save Often. Don't lose your project data!

Links

1. http://canopy.itreetools.org/resources/iTree_Canopy_Methodology.pdf
2. http://canopy.itreetools.org/report.php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Tree Canopy v6.1
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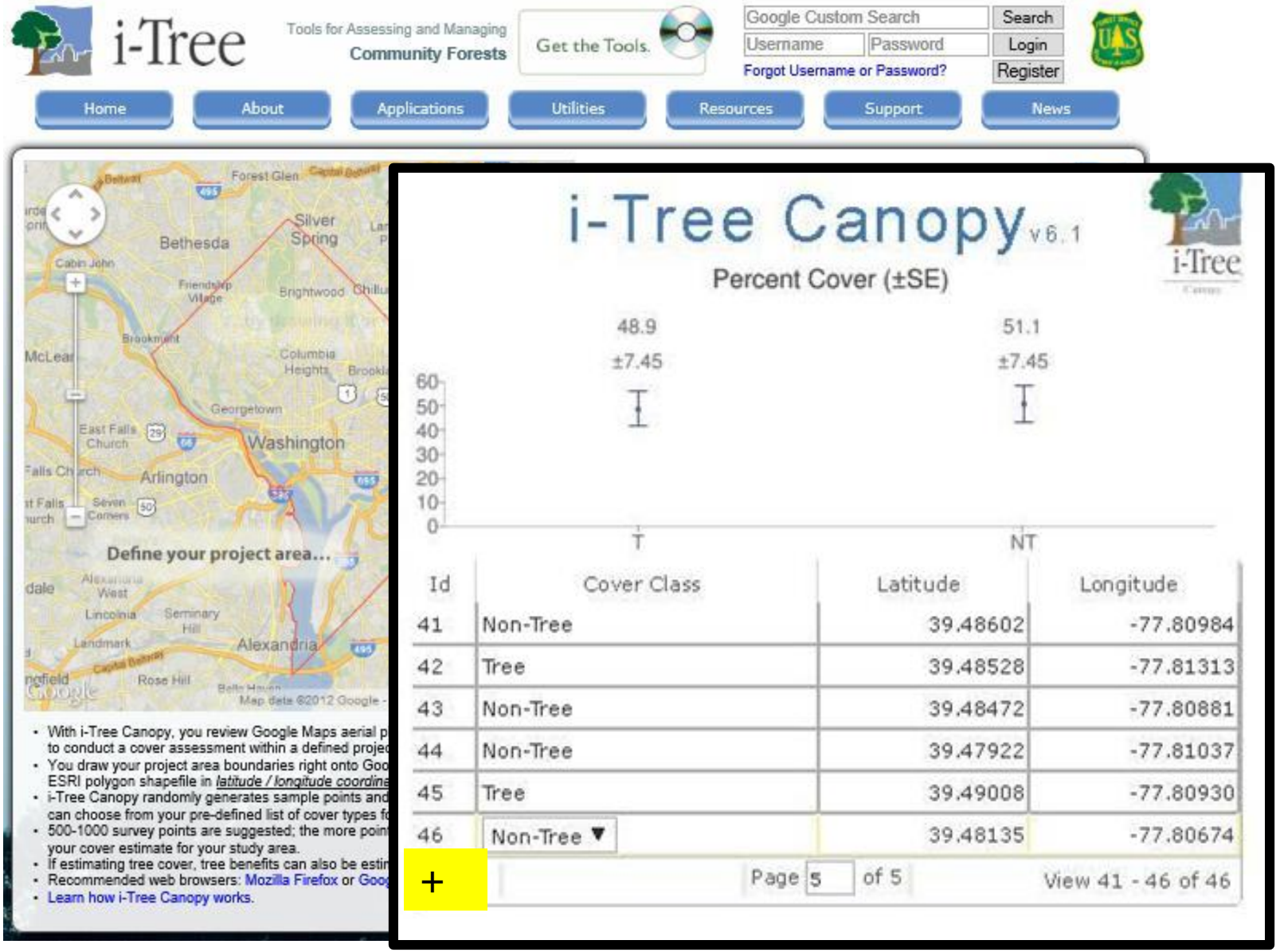
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51.1
±7.45
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20
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Latitude
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41
Non-Tree
39.48602
-77.80984
42
Tree
39.48528
-77.81313
43
Non-Tree
39.48472
-77.80881
44
Non-Tree
39.47922
-77.81037
45
Tree
39.49008
-77.80930
46
Non-Tree
39.48135
-77.80674
Page 5 of 5
View 41 - 46 of 46

i-Tree

Tools for Assessing and Managing
Community Forests

Get the Tools.

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Forgot Username or Password? | Register

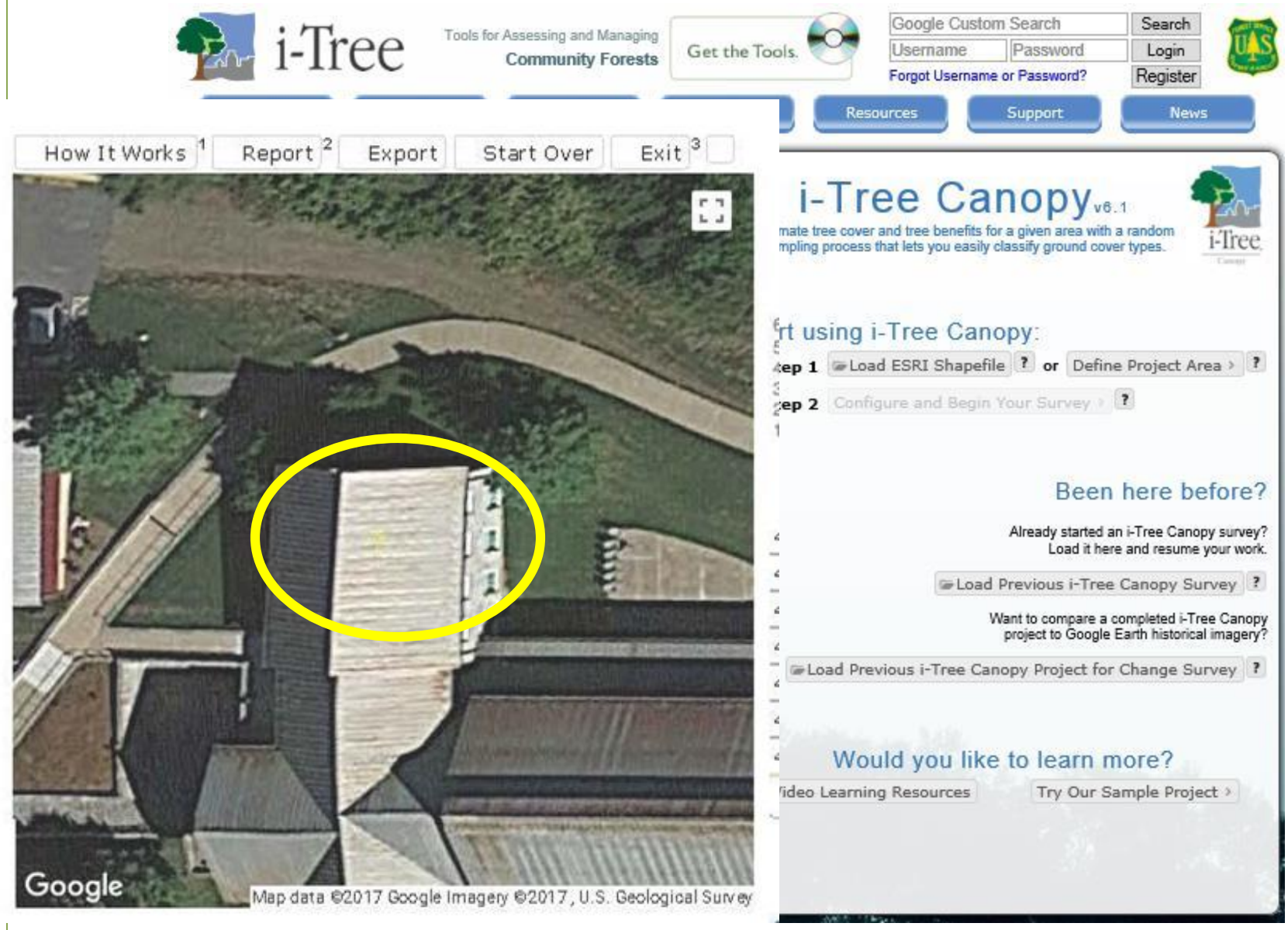
How It Works [1] | Report [2] | Export | Start Over | Exit [3]

i-Tree Canopy v6.1

Percent Cover (±SE)

Id	Cover Class	Latitude	Longi
41	Non-Tree	39.48602	
42	Tree	39.48528	
43	Non-Tree	39.48472	
44	Non-Tree	39.47922	
[illegible]	Tree	39.49008	
46	Non-Tree	39.48135	
47	Non-Tree ▼	39.48806	

Page 5 of 5 View 41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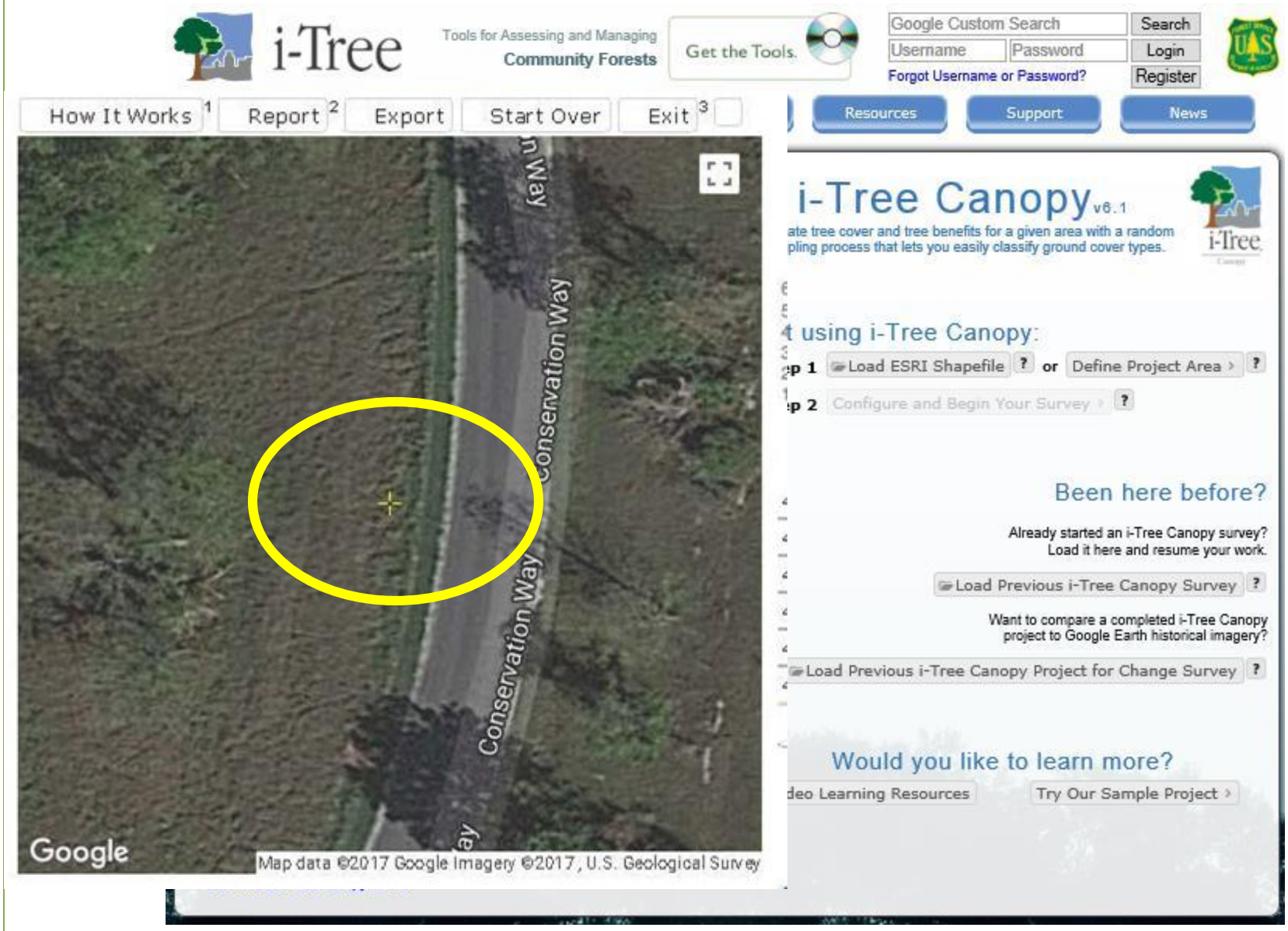
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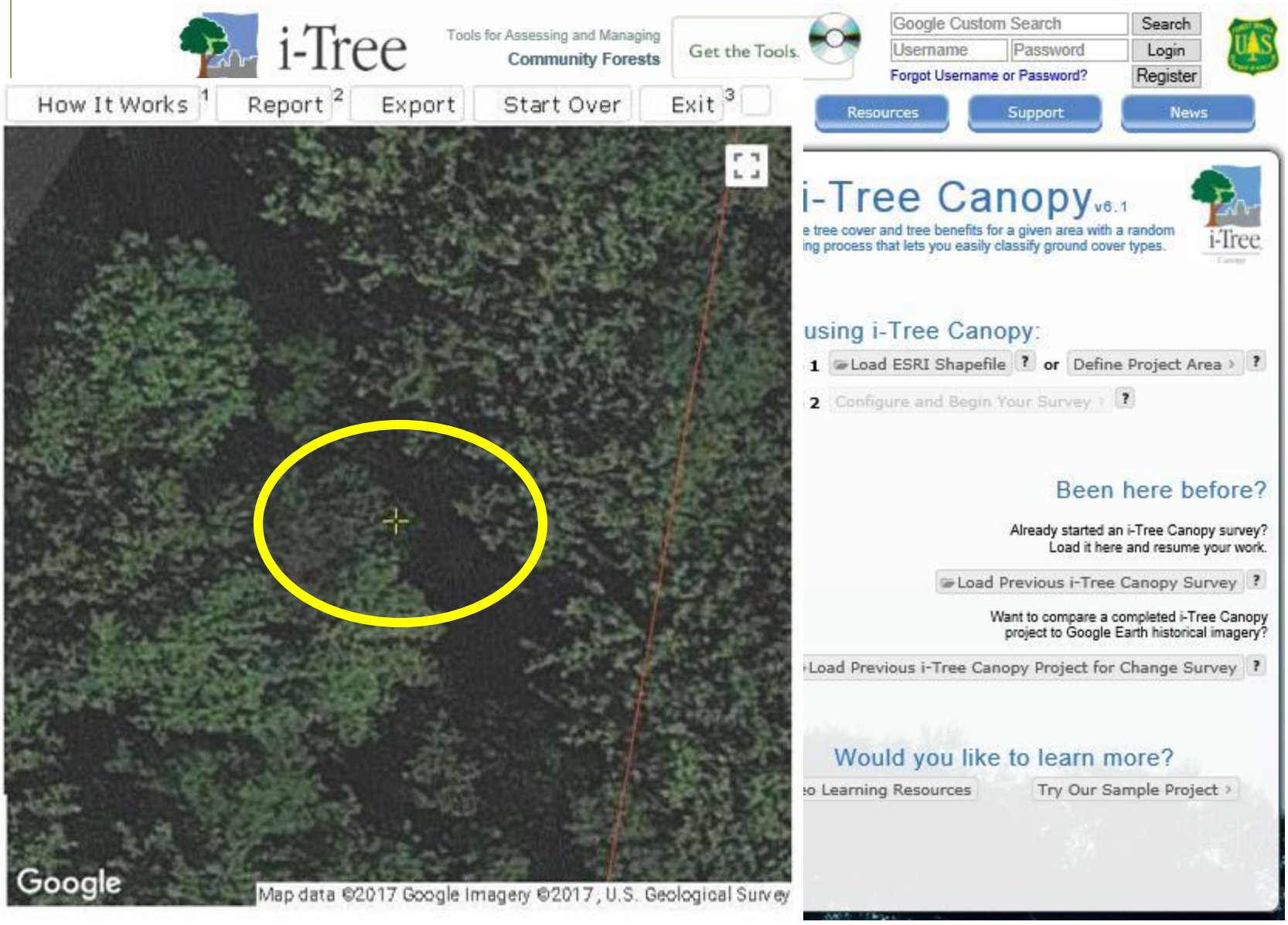
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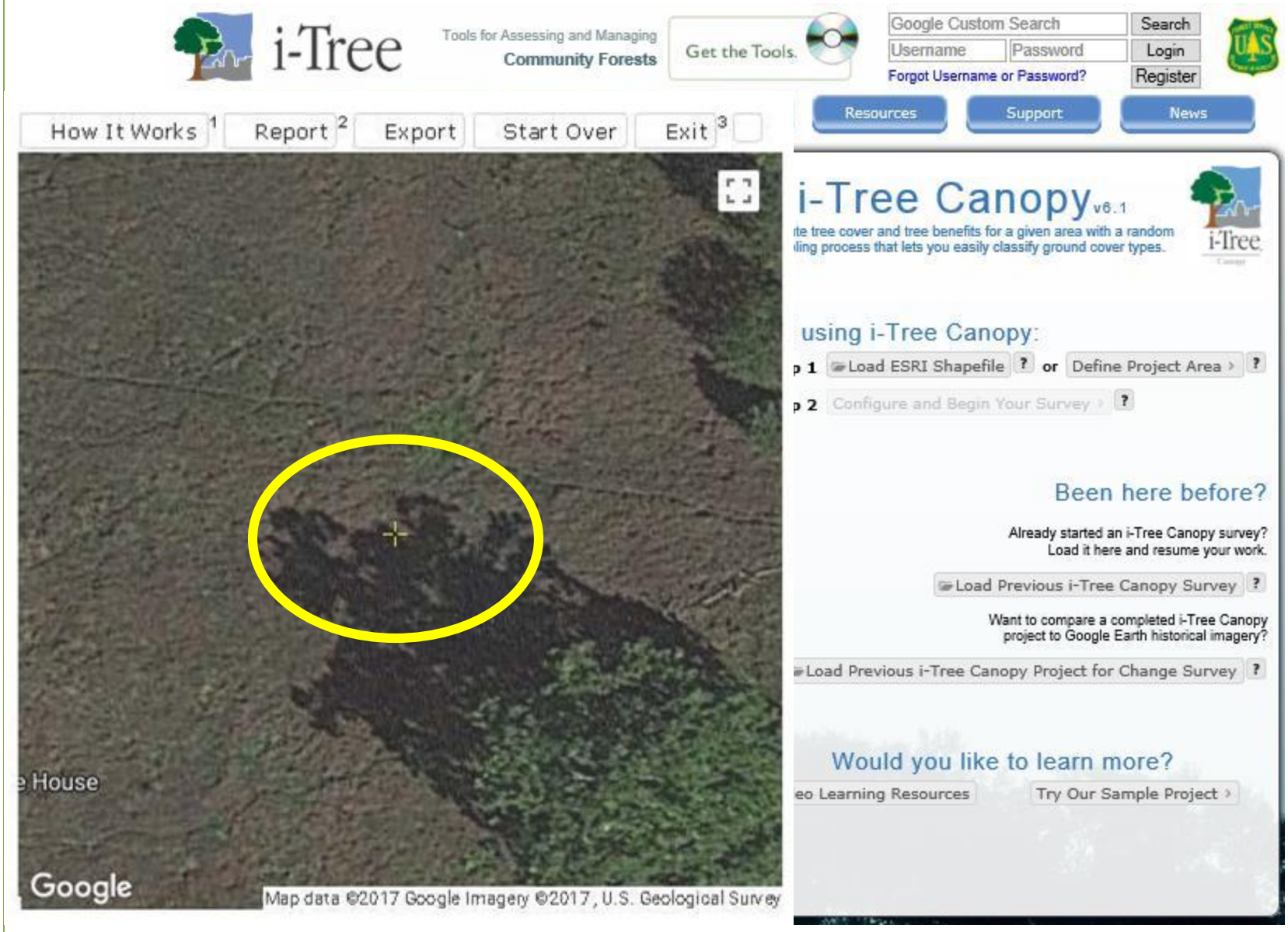
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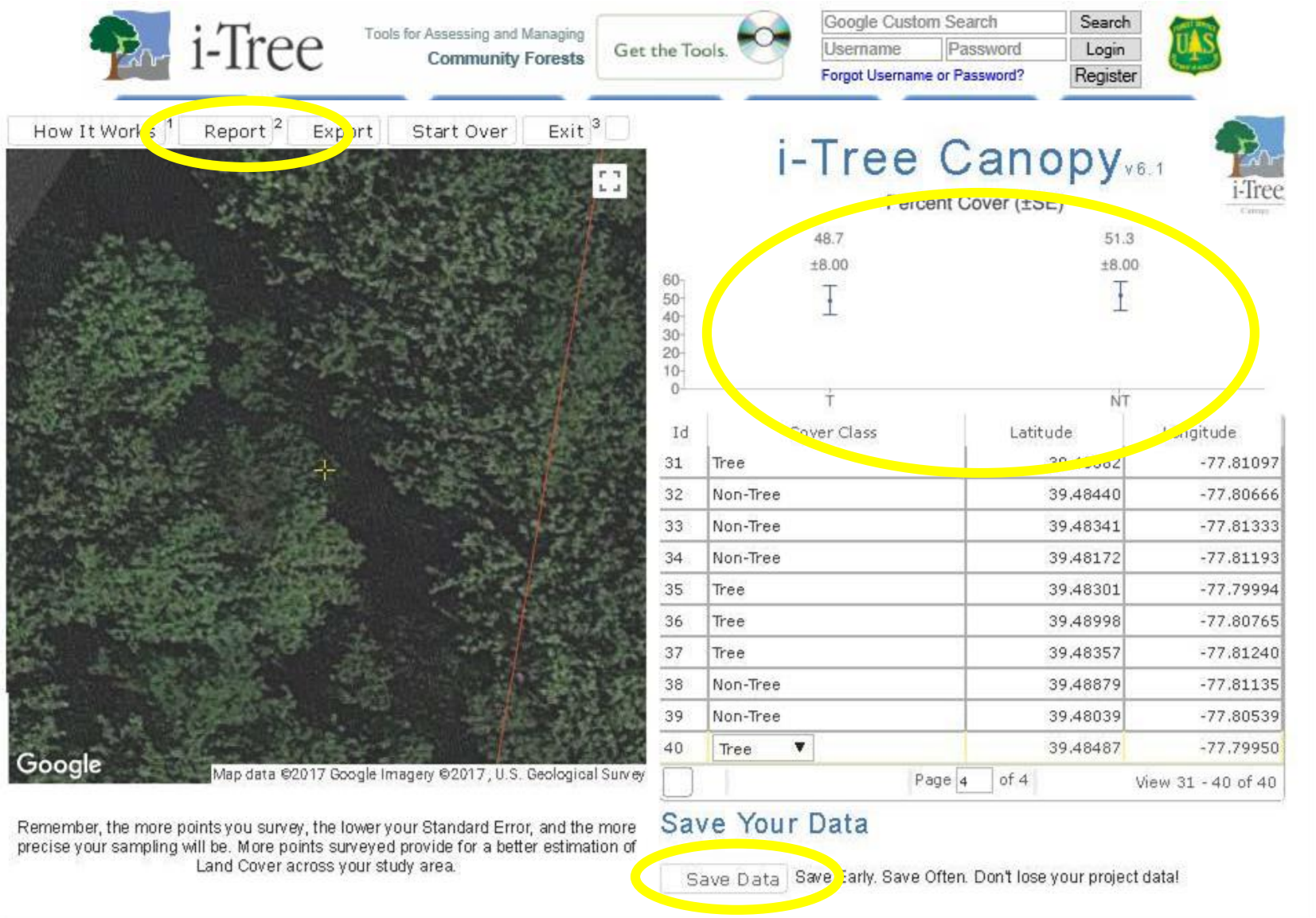
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31 Tree -77.81097
32 Non-Tree 39.48440 -77.80666
33 Non-Tree 39.48341 -77.81333
34 Non-Tree 39.48172 -77.81193
35 Tree 39.48301 -77.79994
36 Tree 39.48998 -77.80765
37 Tree 39.48357 -77.81240
38 Non-Tree 39.48879 -77.81135
39 Non-Tree 39.48039 -77.80539
40 Tree 39.48487 -77.79950
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Tree Benefit Estimates

Abbr.	Benefit Description	Value (USD)	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	6.86 USD	±1.29	161.88 lb	±30.40
NO2	Nitrogen Dioxide removed annually	11.81 USD	±2.22	882.70 lb	±165.74
O3	Ozone removed annually	615.26 USD	±115.53	4.40 T	±0.83
PM2.5	Particulate Matter less than 2.5 microns removed annually	1,271.85 USD	±238.81	427.18 lb	±80.21
SO2	Sulfur Dioxide removed annually	2.06 USD	±0.39	556.25 lb	±104.45
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	446.66 USD	±83.87	1.47 T	±0.28
CO2seq	Carbon Dioxide sequestered annually in trees	31,554.61 USD	±5,924.91	895.03 T	±168.06
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	795,589.92 USD	±149,385.46	22,566.49 T	±4,237.24

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and USD/T/yr: CO 0.902 @ 85.08 USD | NO2 4.917 @ 26.86 USD | O3 48.968 @ 140.47 USD | PM2.5 2.379 @ 5,975.67 USD | SO2 3.098 @ 7.45 USD | PM10 16.403 @ 304.43 USD | CO2seq 9,970.817 @ 35.38 USD | CO2stor is a total biomass amount of 251,395.359 @ 35.38 USD*
Note: Currency is in USD
Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

About i-Tree Canopy

The concept and prototype of this program were developed by David J. Nowak, Jeffery T. Walton and Eric J. Greenfield (USDA Forest Service). The current version of this program was developed and adapted to i-Tree by David Ellingsworth, Mike Binkley, and Scott Maco (The Davey Tree Expert Company).

Limitations of i-Tree Canopy

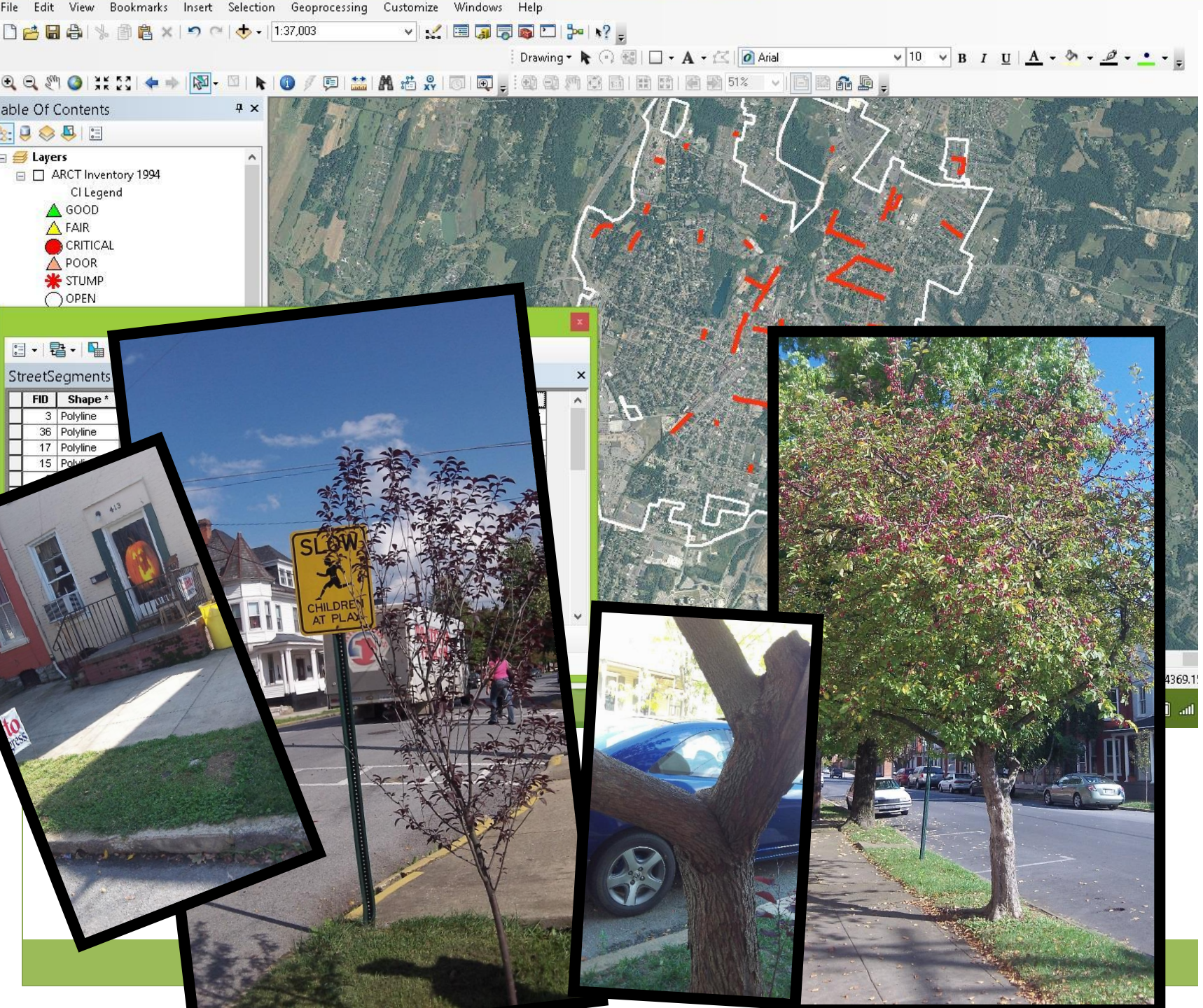
The accuracy of the analysis depends upon the ability of the user to correctly classify each point into its correct class. As the number of points increase, the precision of the estimate will increase as the standard error of the estimate will decrease. If too few points are classified, the standard error will be too high to have any real certainty of the estimate.

A Cooperative Initiative Between:

DAVEY Arbor Day Foundation SMA ISA Casey Trees

i-Tree Streets - INPUTS

- Users input information:
  - City Information:
    - Municipal Budget
    - Population
    - Total Land Area
    - Total liner miles of streets
  - Maintenance Costs
    - Pruning, planting, etc.
  - Benefit Prices
    - Electricity ($/kWh)
    - Natural gas ($/therm)
    - CO2($/lb)
    - Stormwater Interception ($/gal)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CRITICAL
POOR
STUMP
OPEN
StreetSegments
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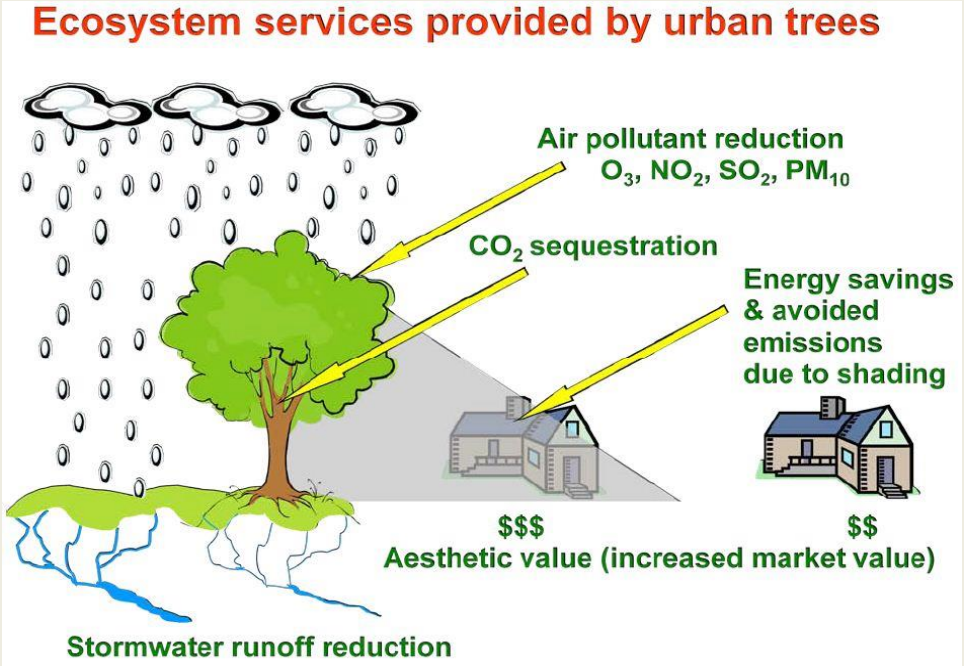
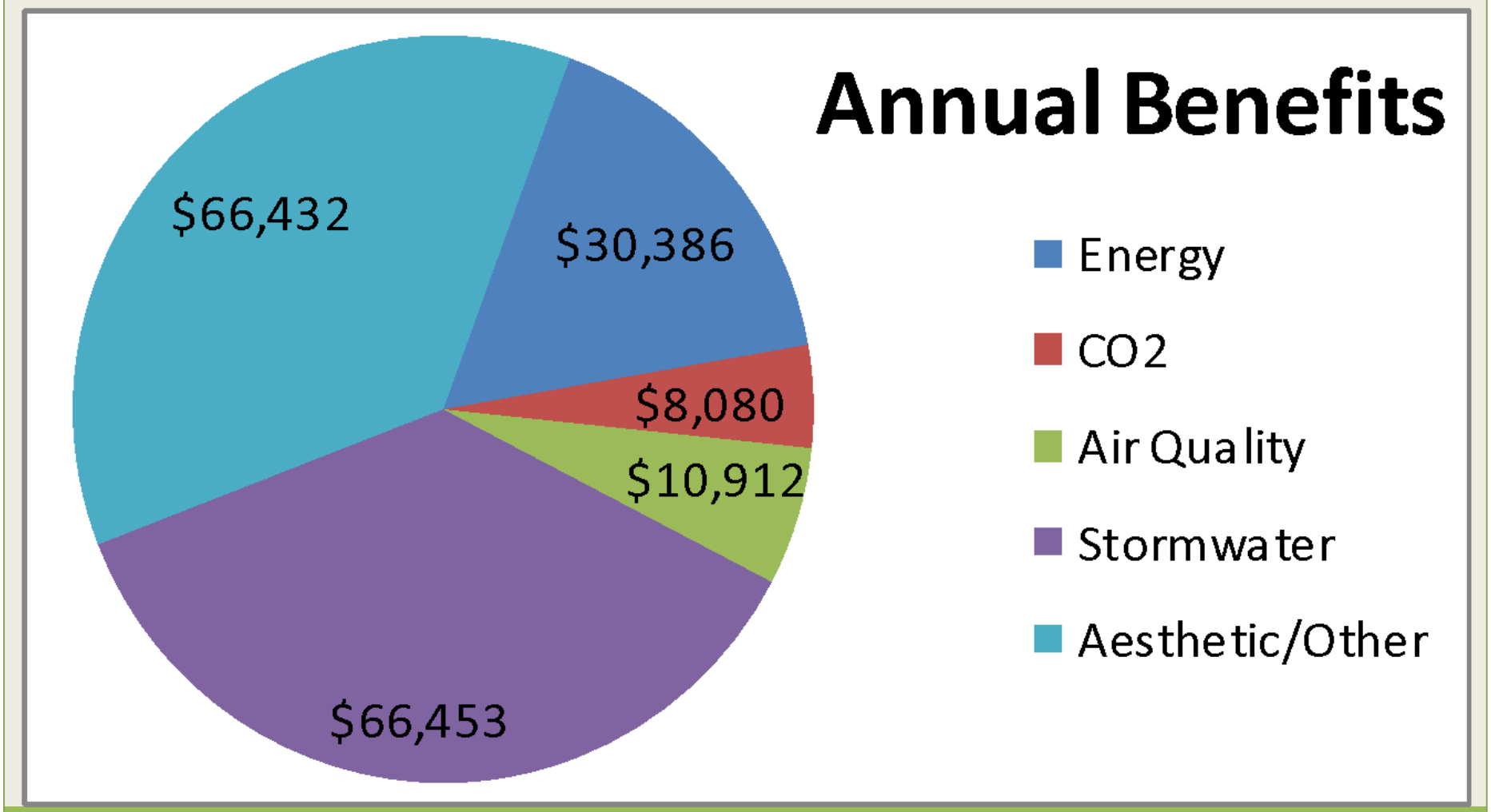
3 Polyline
36 Polyline
17 Polyline
15
SLOW
CHILDREN AT PLAY
MARTINSBURG

i-Tree Streets - Function

Function of Martinsburg's Street Trees	
Stormwater	**Rainfall Intercepted (Gallons)** 2,451,986
Air Quality	**Net Emissions Captured (lbs)** 3,863
Energy Savings	**Electricity Reduced (MWh)** 307
C02 Reduction	**Net C02 Sequestered (lbs)** 1,077,312



i-Tree Streets - Value

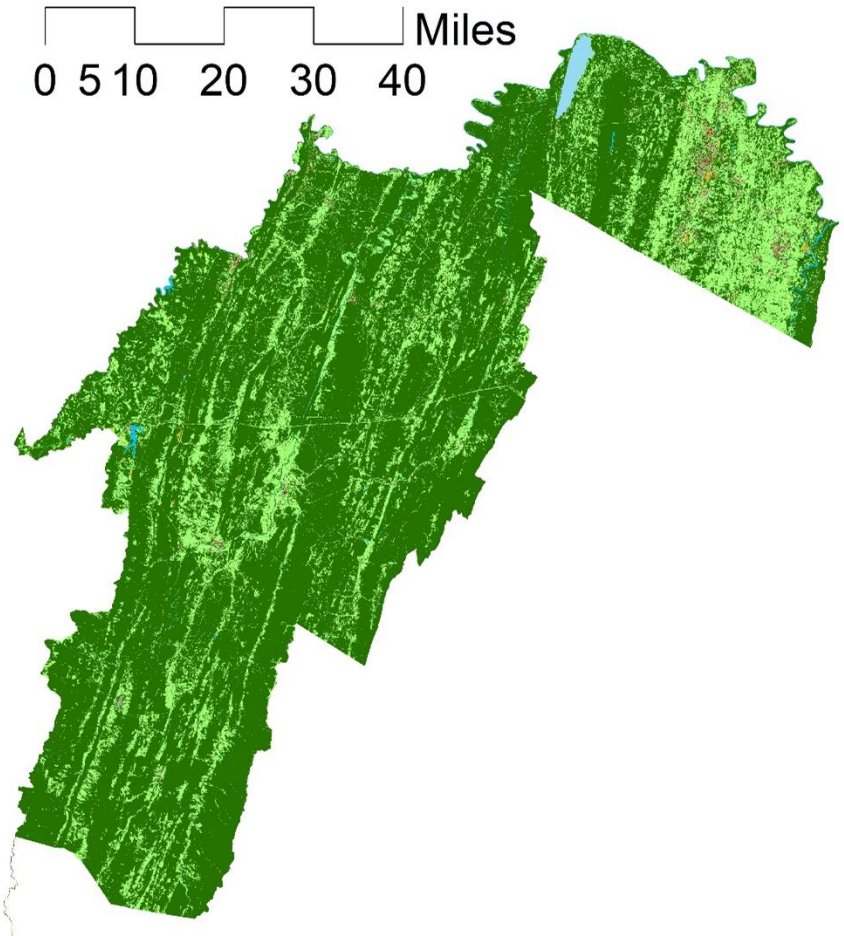


i-Tree Streets - Net Annual Benefits

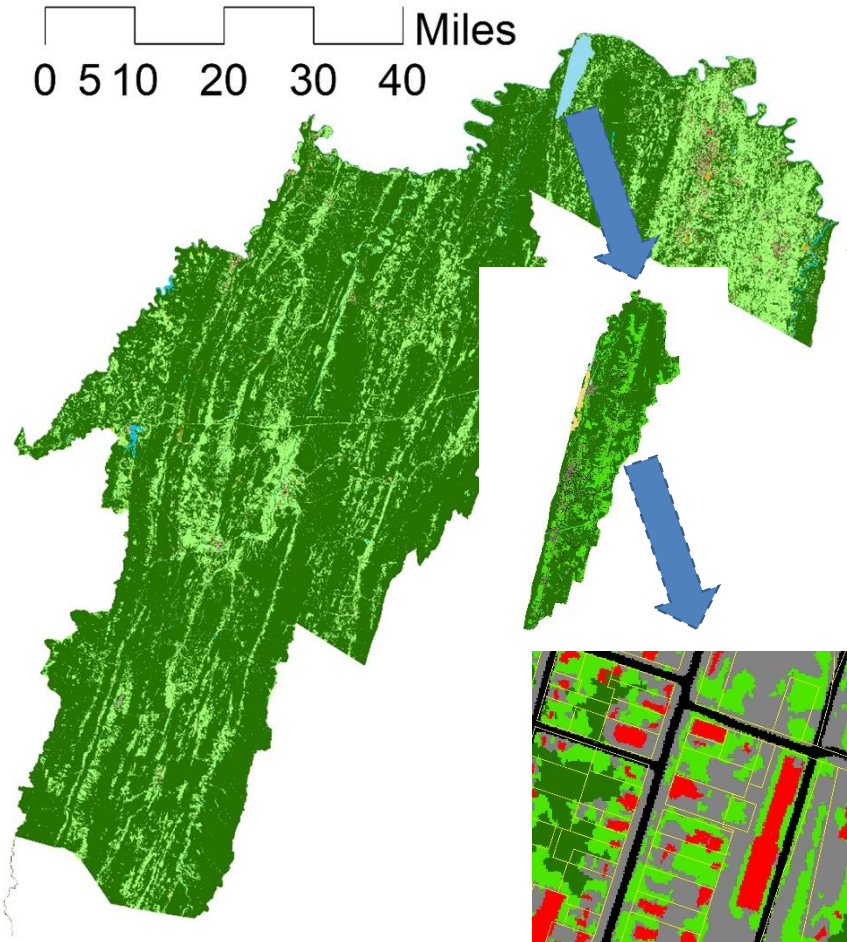
Benefits ($)			
Benefits	**Benefits Provided ($)**	**$/Tree**	**$/Capita**
Energy	$30,386	$17.17	$1.74
CO2	$8,080	$4.56	$0.46
Air Quality	$10,912	$6.16	$0.62
Stormwater	$66,453	$37.54	$3.80
Aesthetic/Other	$66,432	$37.53	$3.80
Total Benefits	**$182,263 (±50,850)**	**$103 (±28.73)**	**$10.42 (±2.91)**
Costs ($)			
Equipment	$12,505	$7.05	$0.71
Labor	$5,752	$3.24	$0.33
Tree Maintenance	$2,000	$1.13	$0.11
Total Costs	**$20,257**	**$11.42**	**$1.15**
Benefit : Cost Ratio			
Net Benefits	**$162,006 (±50,850)**	**$91.58 (±28.73)**	**$9.27 (±2.91)**
Benefit-Cost Ratio	**$9.0 (±2.51)**		

Chesapeake Conservancy

EXPLORE. CONSERVE. INNOVATE.

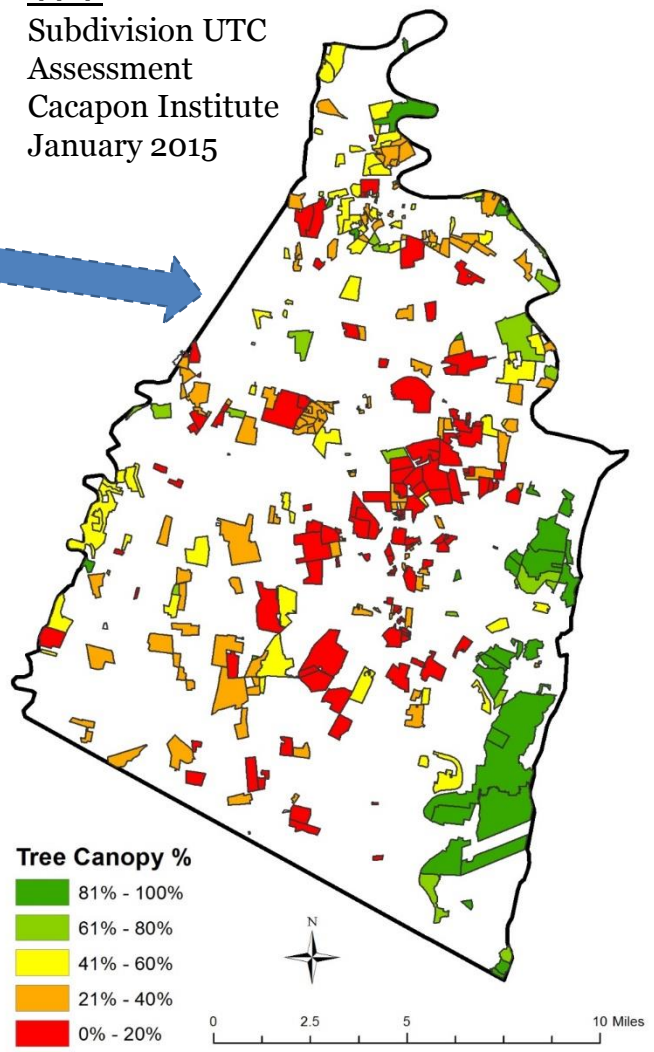


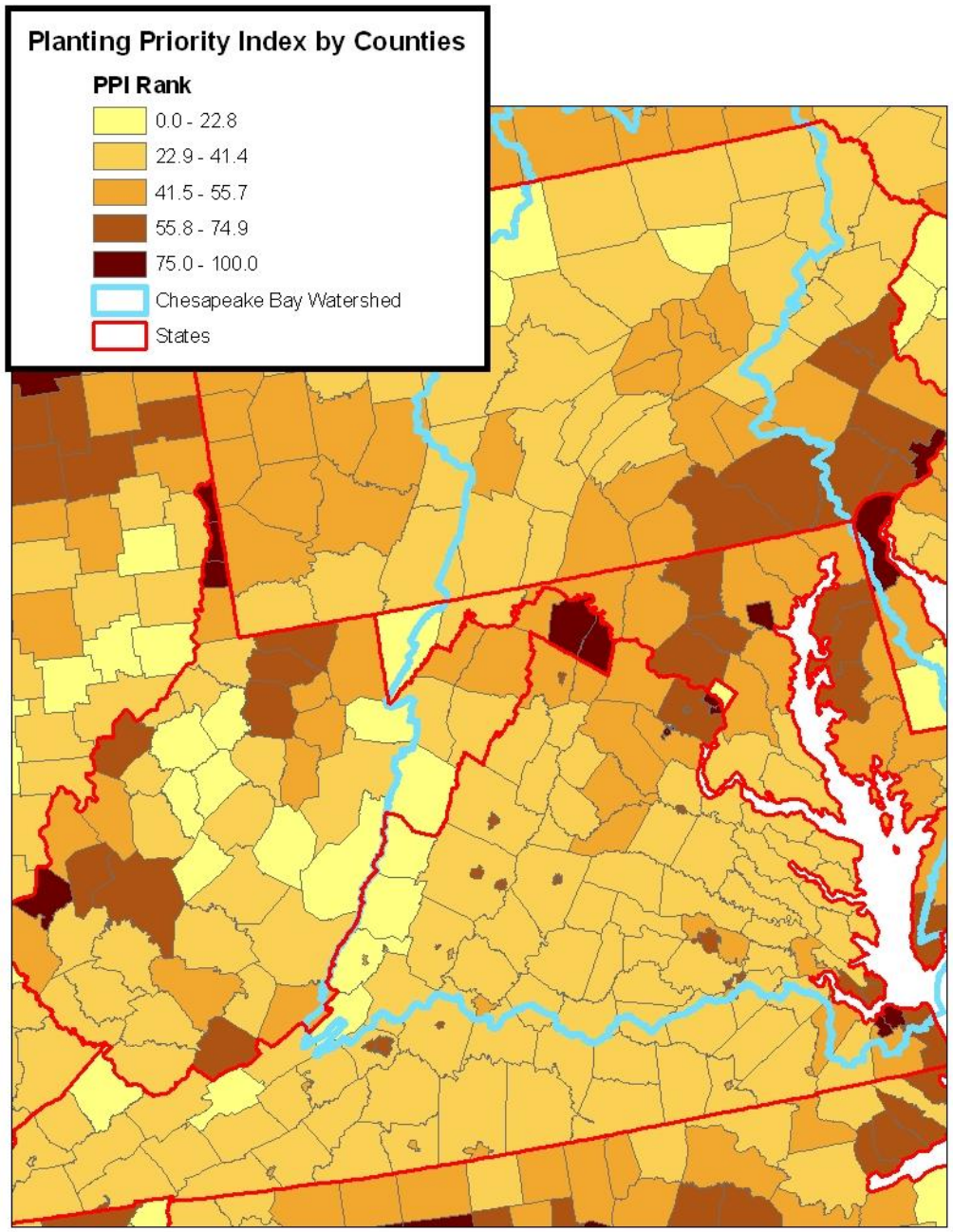
http://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/



Jefferson County, WV

Subdivision UTC Assessment
Cacapon Institute
January 2015





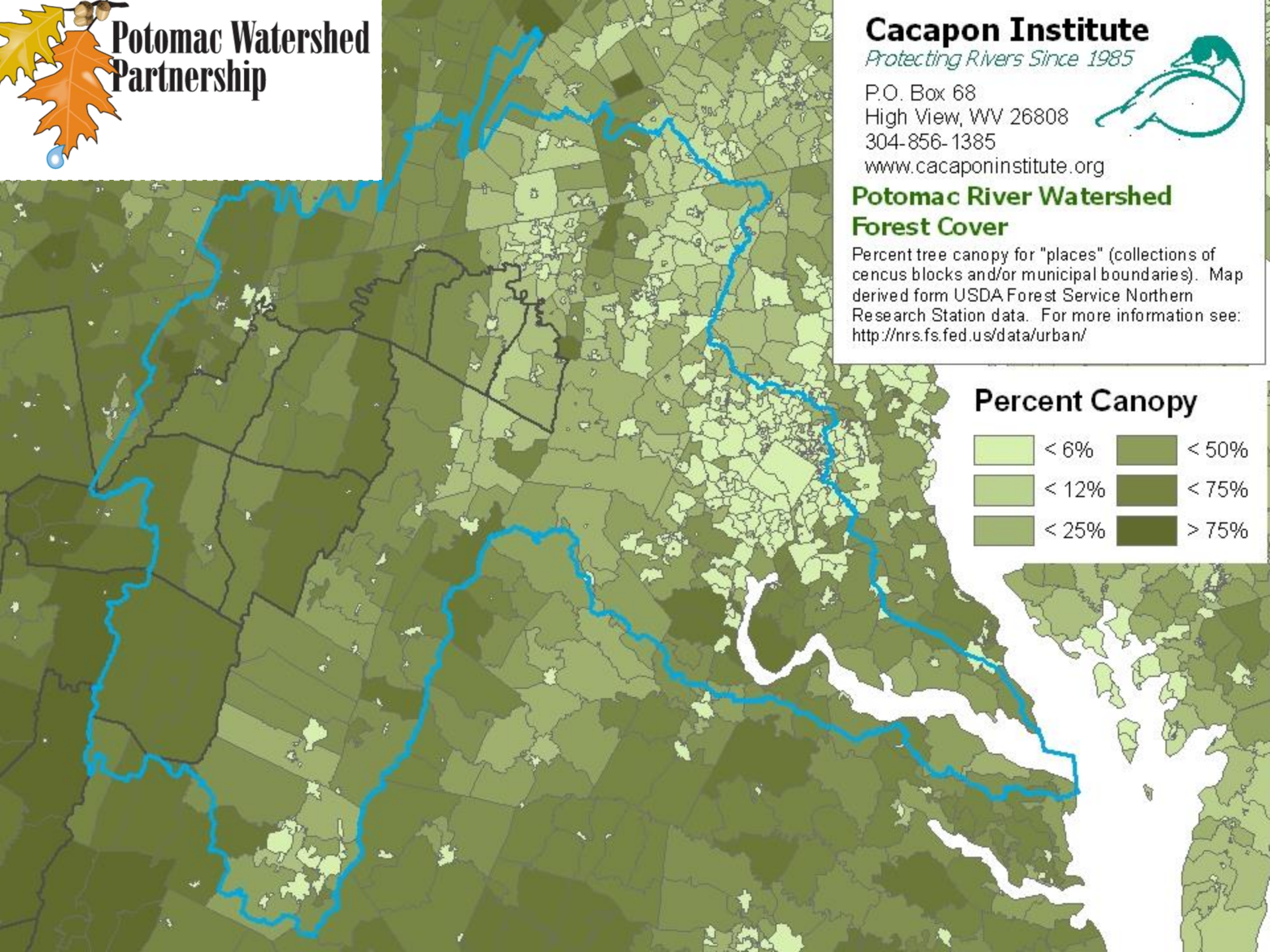
>750,000 acres lost since 1982, primarily to sprawling development.

36% vulnerable to development.

60% fragmented by housing subdivisions, farms, and other human uses.

40% occurs within the wildland-urban interface.

Increasing "parcelization"
~70% of all family forest owners holding less than 10 acres.


Potomac Watershed Partnership
Cacapon Institute
Protecting Rivers Since 1985
P.O. Box 68
High View, WV 26808
304-856-1385
www.cacaponinstitute.org
Potomac River Watershed Forest Cover
Percent tree canopy for "places" (collections of cencus blocks and/or municipal boundaries). Map derived form USDA Forest Service Northern Research Station data. For more information see: http://nrs.fs.fed.us/data/urban/
Percent Canopy
< 6%
< 12%
< 25%
< 50%
< 75%
> 75%

Chesapeake Conservancy

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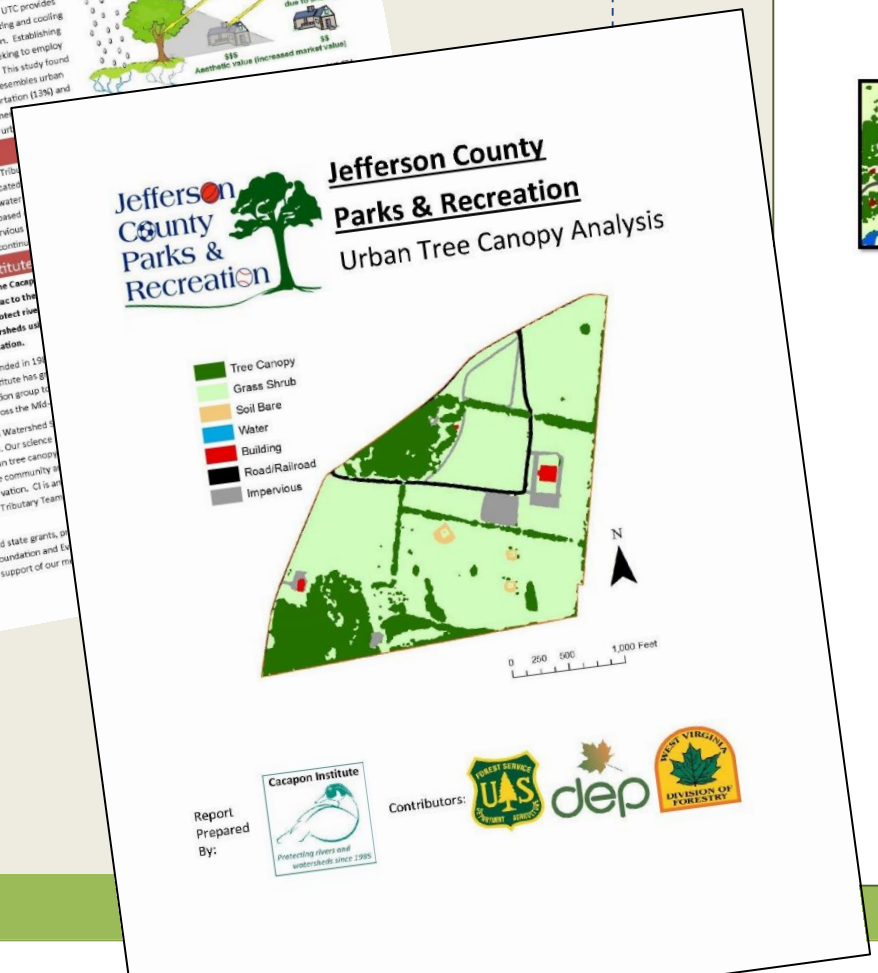
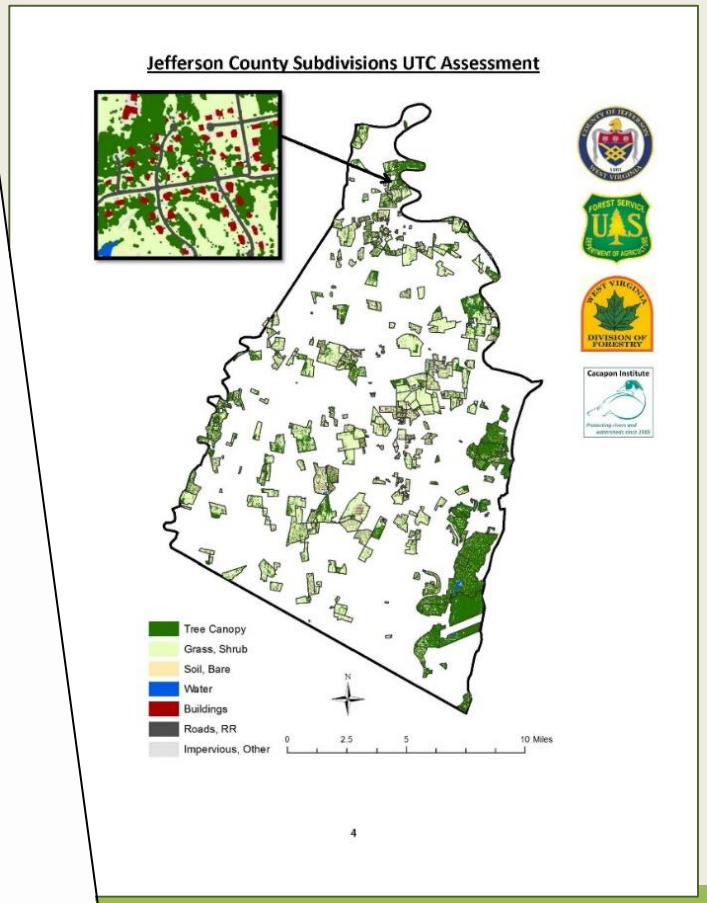
http://chesapeakeconservancy.org/conservation-innovation-center/high-resolution-data/land-cover-data-project/



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Middle Fork Ln
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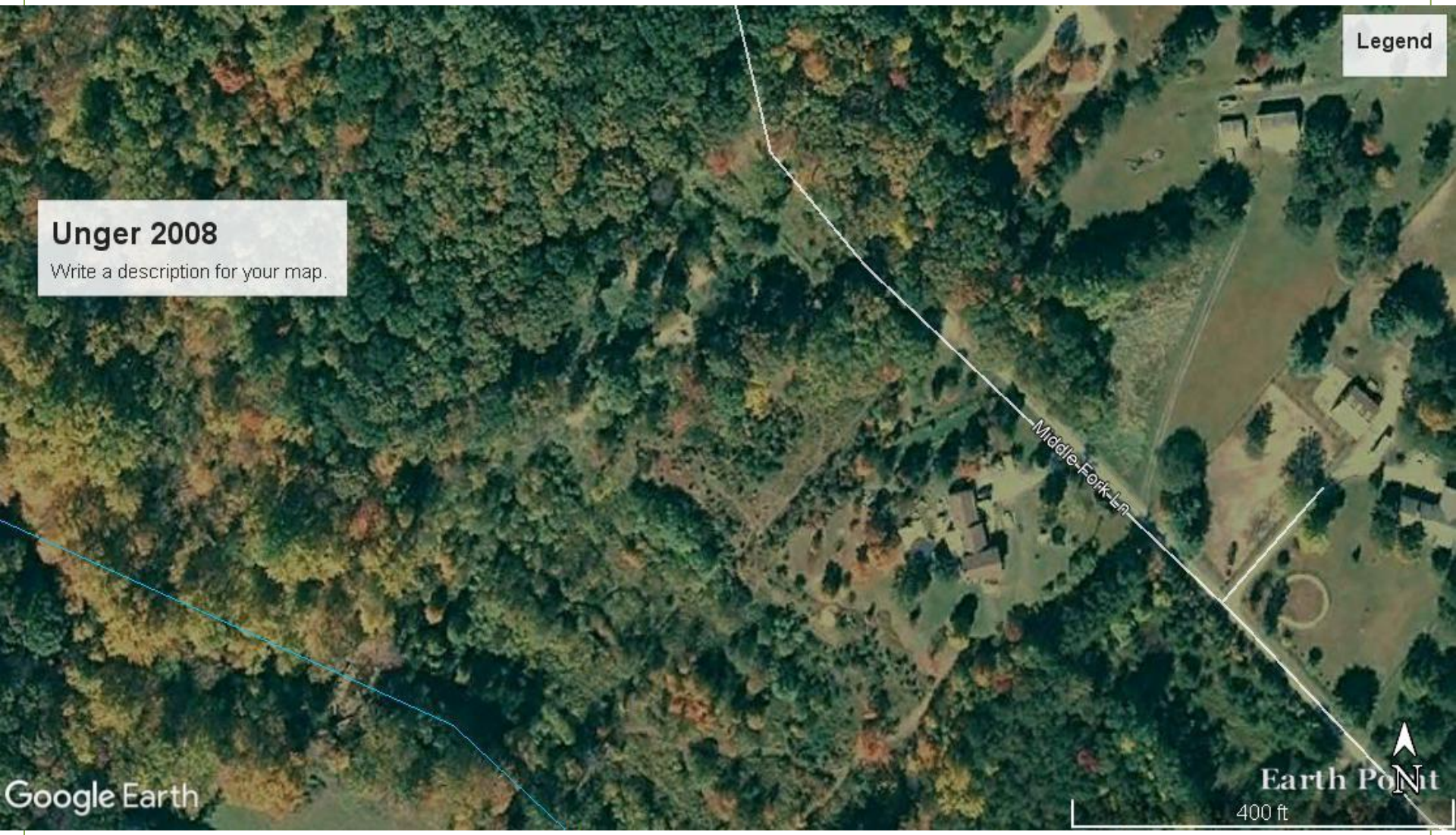
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Google Earth
400 ft
N


Unger 2016
Write a description for your map.
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Middle Fork Ln
Google Earth
Earth Point
400 ft
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Contact Information

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