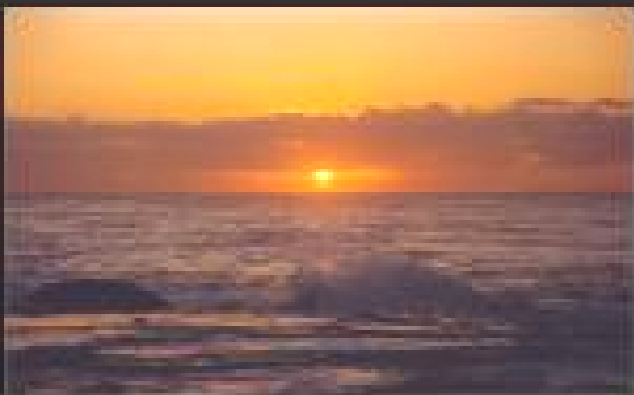


urban watershed forestry concepts



CENTER FOR
WATERSHED
PROTECTION





what if...

- ... property tax rates were based in part on your imperviousness and tree cover?
- ... community trees were part of a local public utility based on their water, air and energy benefits
- ... local comprehensive plans focused on maintaining forest cover in addition to planning future development?
- ... trees and forest cover received proper credits in stormwater design and permitting?

“Urban Watershed Forestry”

“Watershed forestry *is the use of forests and the practice of forestry to protect, restore, and sustain water quality, water flows, and the health and function of watersheds.”* (WFAP federal register)

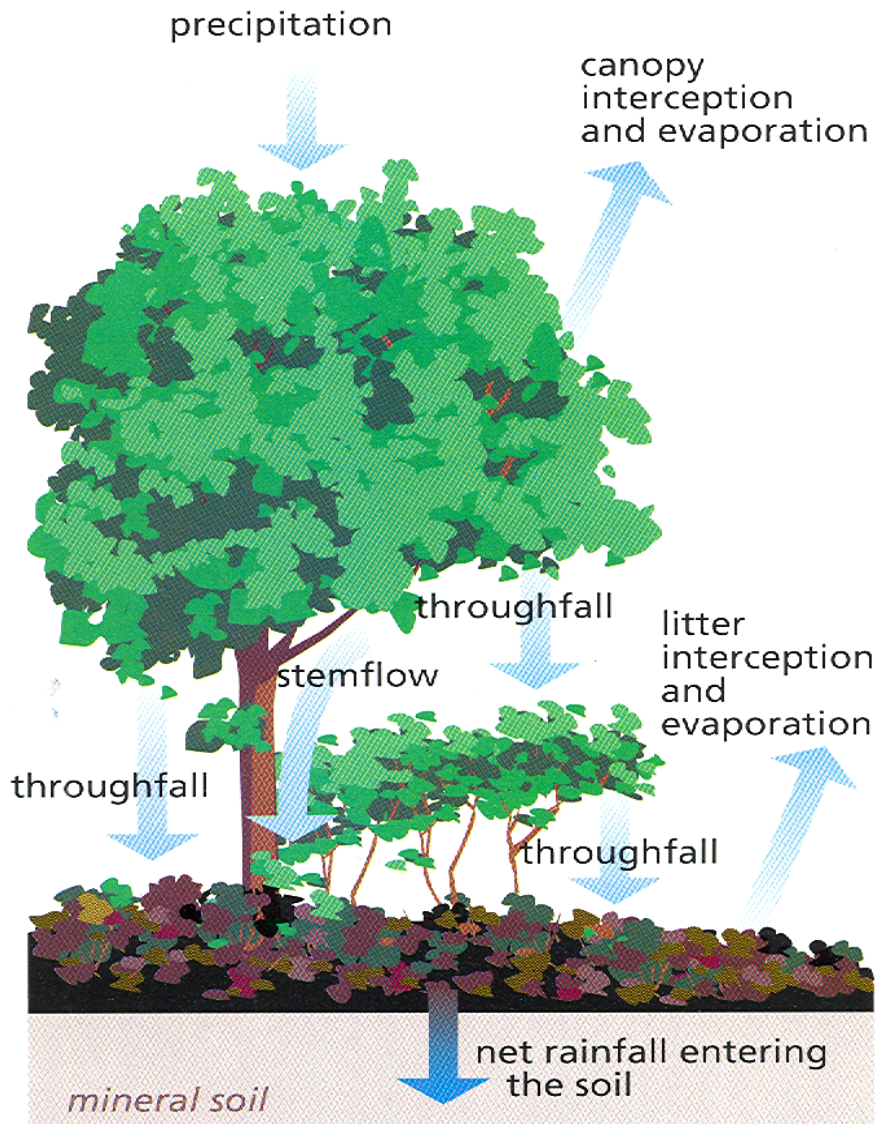
“Urban iswell....urban - developed and developing areas”



watershed health: how is it measured?

- ✓ ability to intercept and store rainfall and runoff
- ✓ ability to moderate stream flow
- ✓ ability to hold on to and recycle nutrients
- ✓ soils are protected from erosion
- ✓ supports a healthy aquatic systems
- ✓ has the capacity for self-repair

the forest hydrologic cycle



Source: Federal Interagency
Stream Restoration Working
Group, 1998

by the numbers...

■ **Rainfall Interception**

- 10 - 40% of annual rainfall (Zinke, 1967)
- Canopy interception ave. 35-40% (Calder 1990, 2003)
- Even in winter? Yes!
 - 15% for a deciduous tree (Xiao et al 2000).
 - 27% for an evergreen species (Xiao et al 2000).

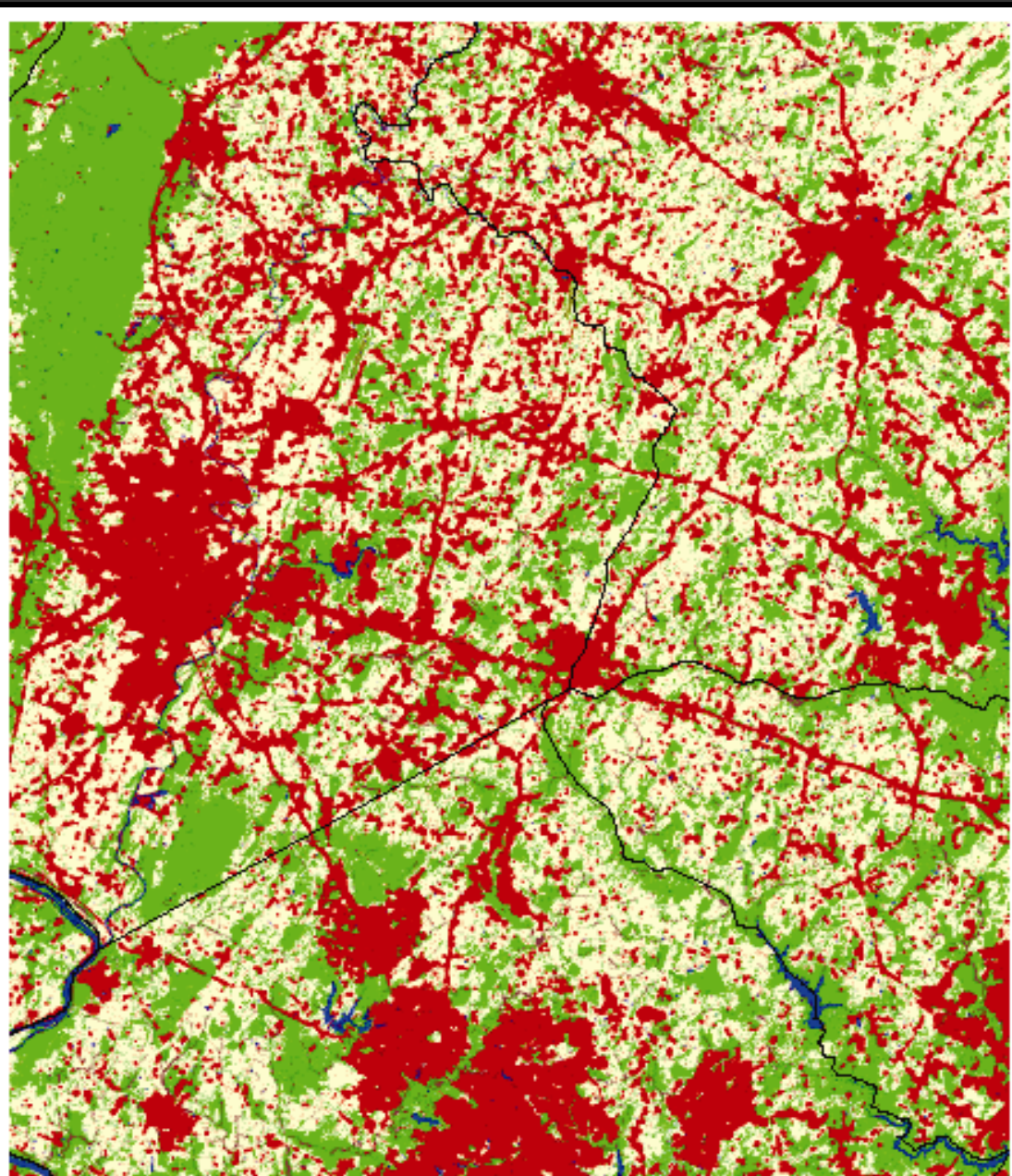
■ **Infiltration**

- 12.4 in/hr for forest, 4.4 in/hr for lawn
- 1.9 in/hr for suburban development (Kays, 1982)
- Disturbed soils show only 35% of the infiltration rate of soils with intact profiles (Kelling et al, 1975)



watershed health is tied, in part, to forests...

- total amount of forest & tree canopy
- retention of “critical” forest & tree canopy
 - riparian forests & wetlands
 - steep slopes/erodible soils/headwaters, etc.
 - disconnect or cover impervious features
- condition of forest (health/age/growth)
- how well it is managed and maintained?



2030, If we
continue along
current trends.

130% increase in
these counties;

loss of 21% of
remaining forests.

Increase of 30% in
stormwater runoff.

**What will our
watersheds and
streams look
like?**

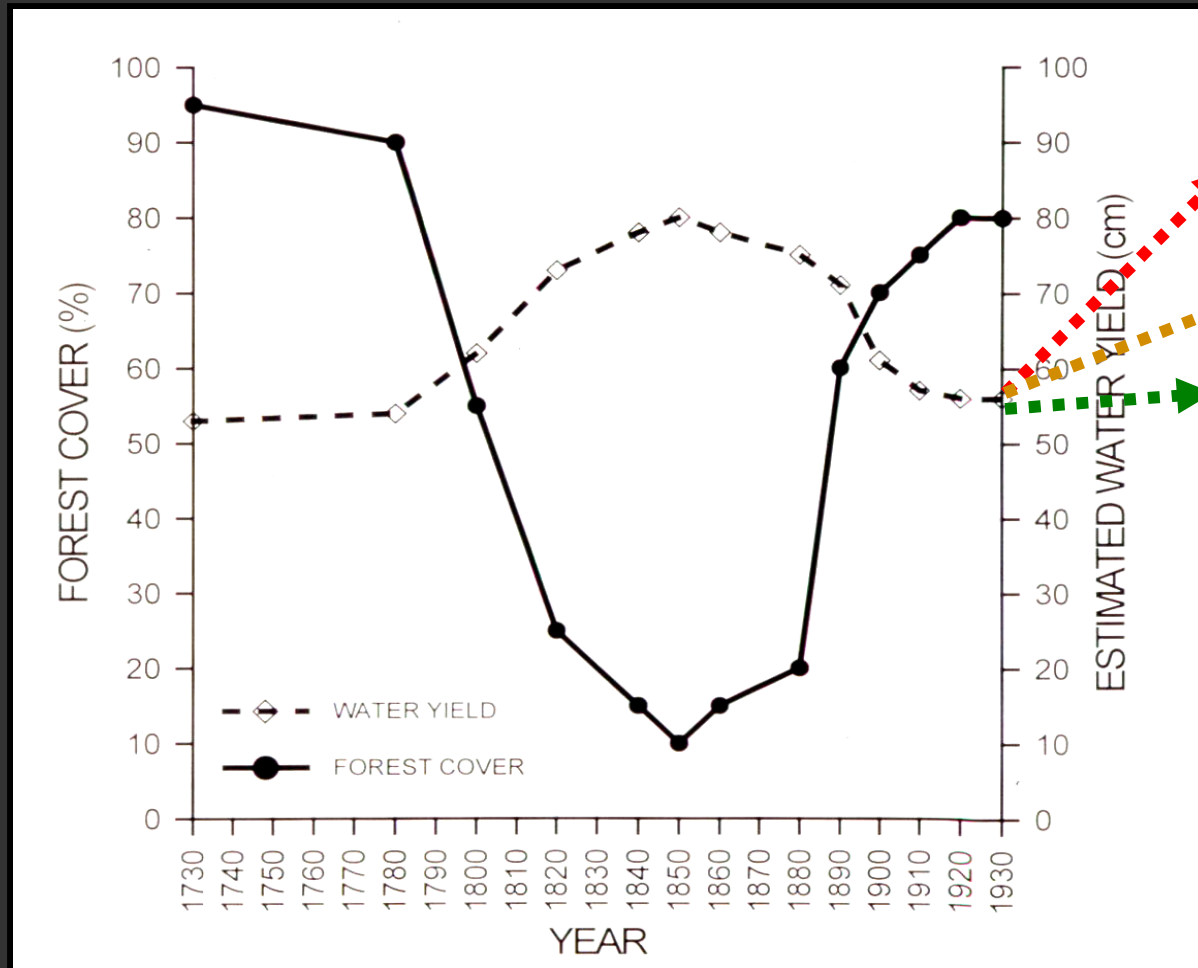
“It’s like déjà vu all over again.”



Source: Barten et al., 2001, J. Forestry 99(3):23-30; Data sources: O’Keefe and Foster 1998, Steele 1999; Alerich 2000

Water yield = f (land use) [%forest]

Water quality = f (land use + water yield) %forest



(Barten and Watson, unpub. data)

? ? ?
**Impacts on
streams,
water
supplies,
fish, etc.**

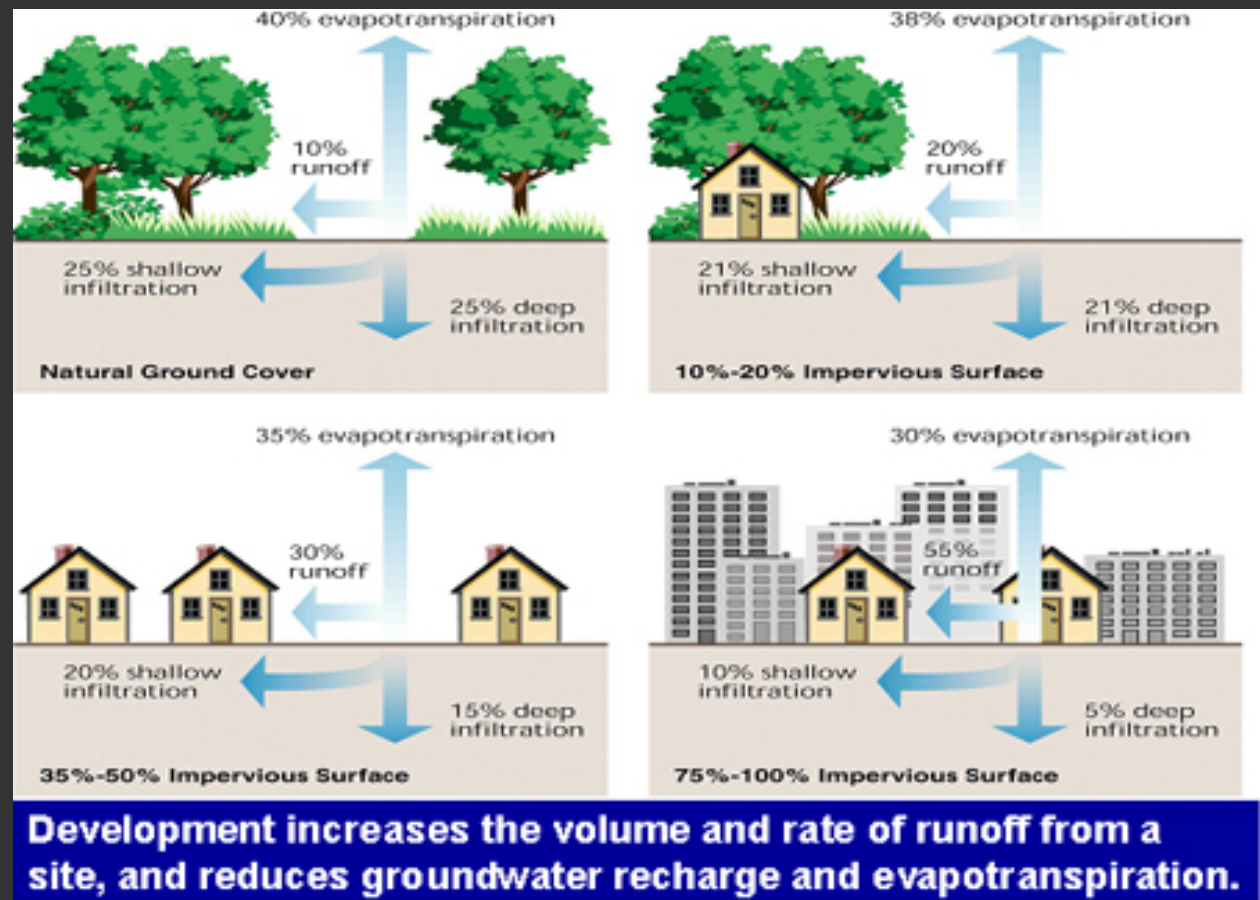


“with the disappearance of the forest
all is changed.”

Man and Nature,
George Perkins Marsh, 1864

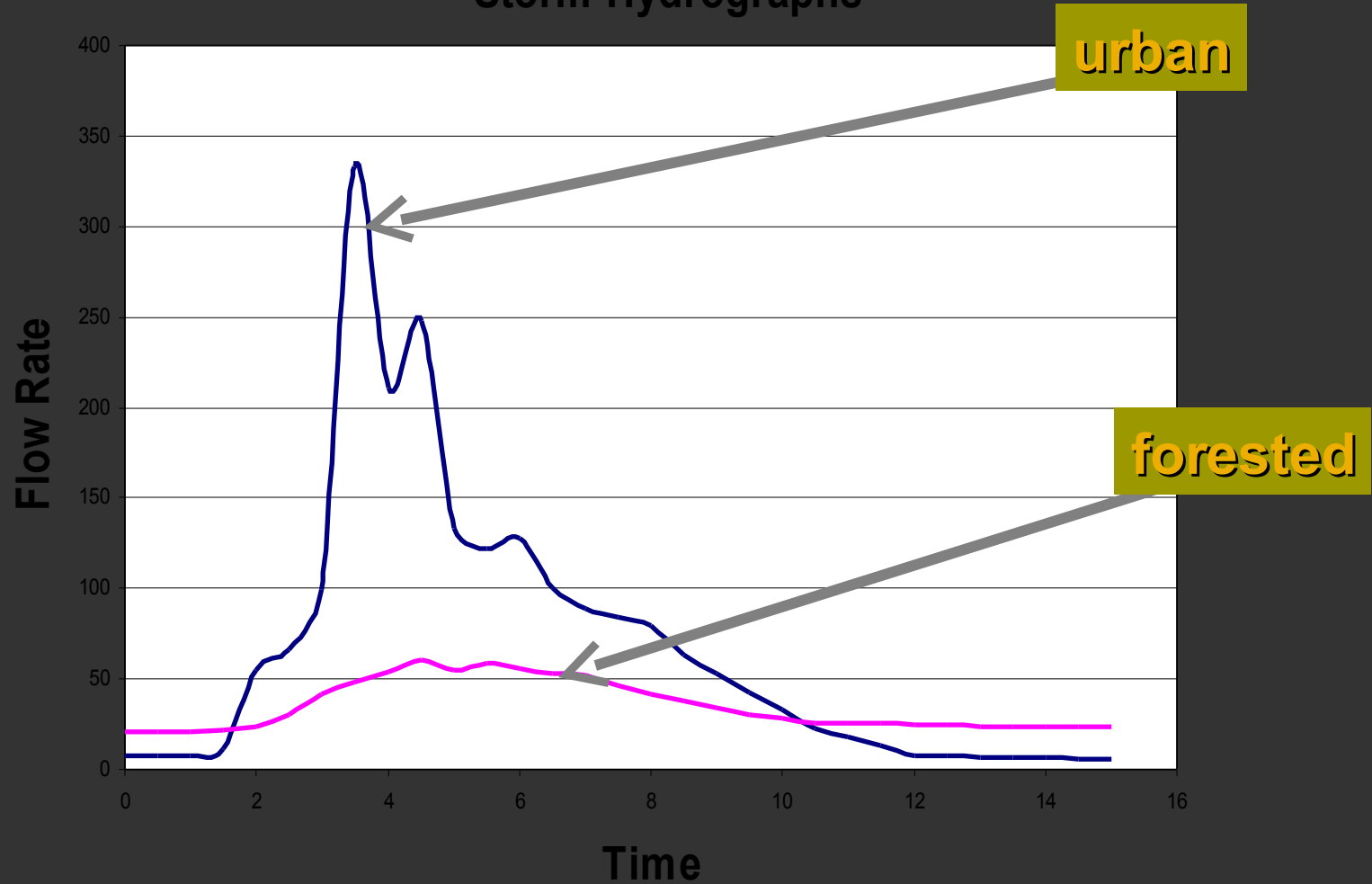


changes in urban hydrology on a local scale

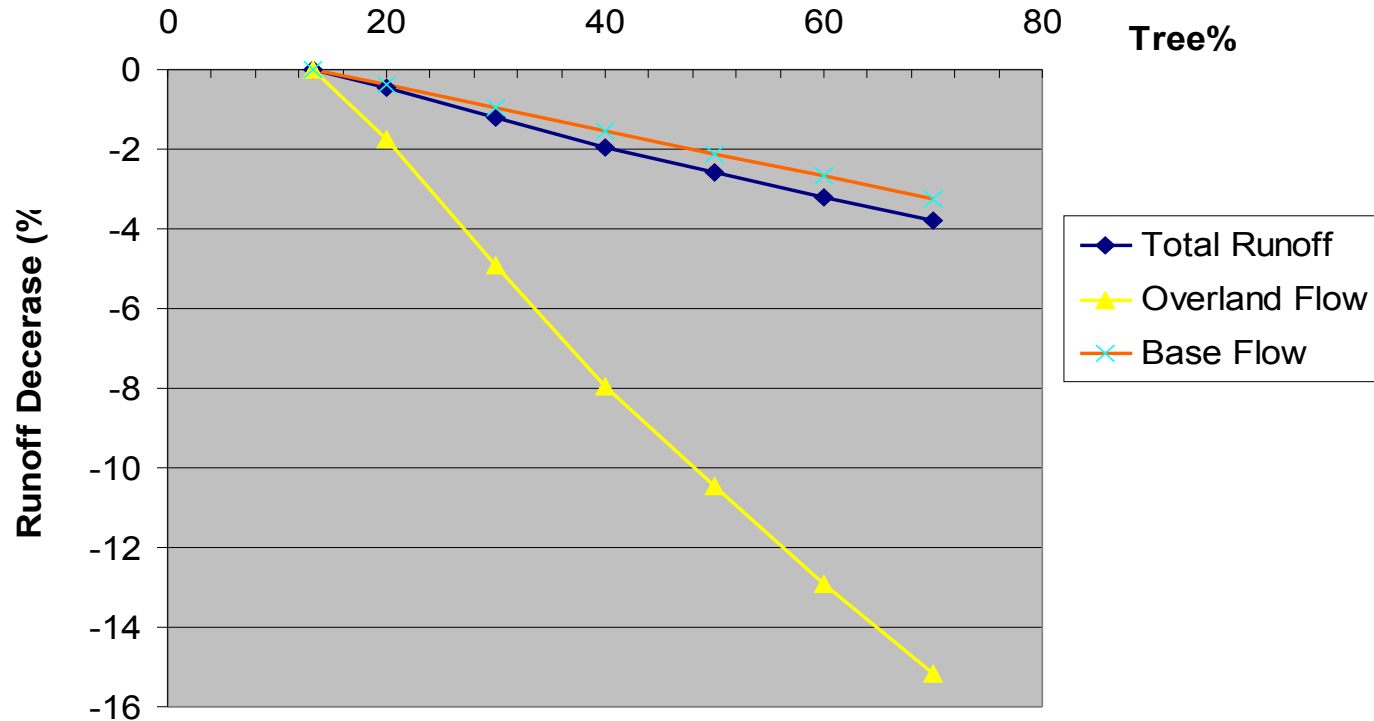


the water balance – $Q = P - ET + ^AS$

Urban vs Forested Storm Hydrographs



Modeling the effects of urban tree canopy on flow and water quality..



Urban Forest Effect on Runoff Generation

(LAI = 5.0, Connected Impervious Area = 21%)

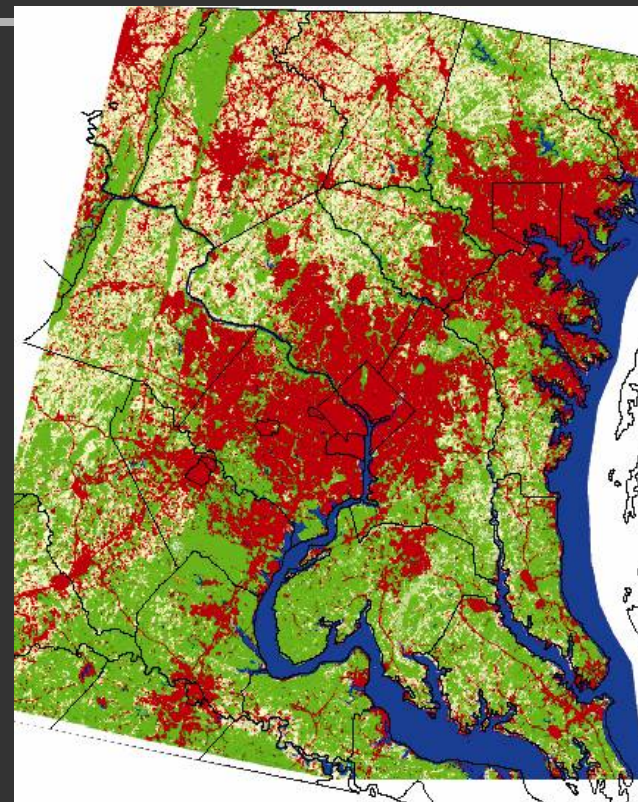
Jun Wang, David J. Nowak*, Theodore A. Endreny; SUNY-College of Environmental Science Forestry, *USFS-Northeastern Research Station

If 1 inch of rain in Baltimore produces an average of 500,000,000 gallons of runoff. A loss of 10% tree canopy means 10-20 million gallons more to treat.



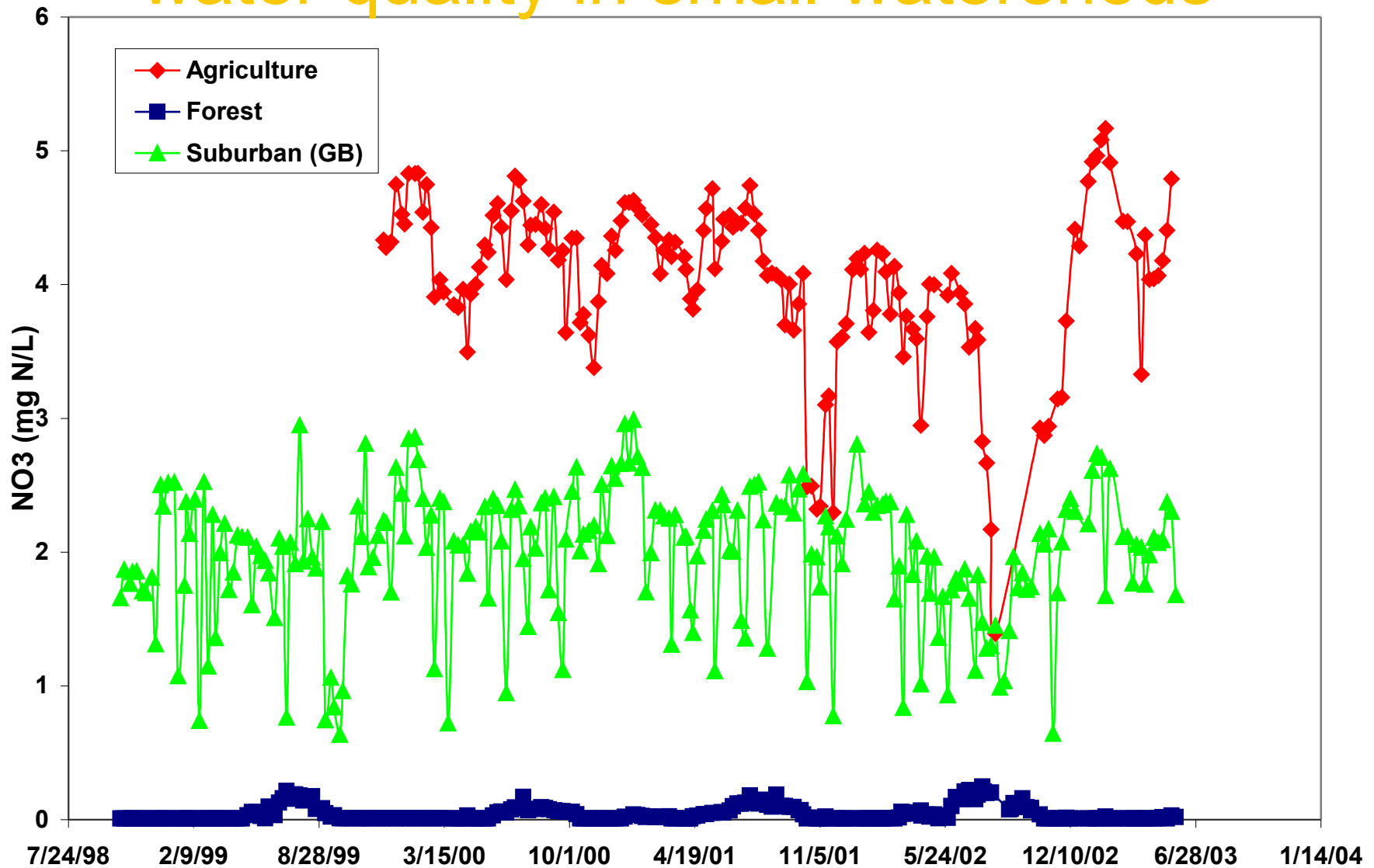
primary nps pollution sources

- **agriculture** –produces 30-80% of N and P loadings
- **urban** –produces 10-20% of N and 15-30% of P for non-point sources; and 10-30% of N&P for point sources
- **forests** –produce less than 10% of N (air effect) and less than 2 % of P



urban pollution is the fastest growing source

water quality in small watersheds

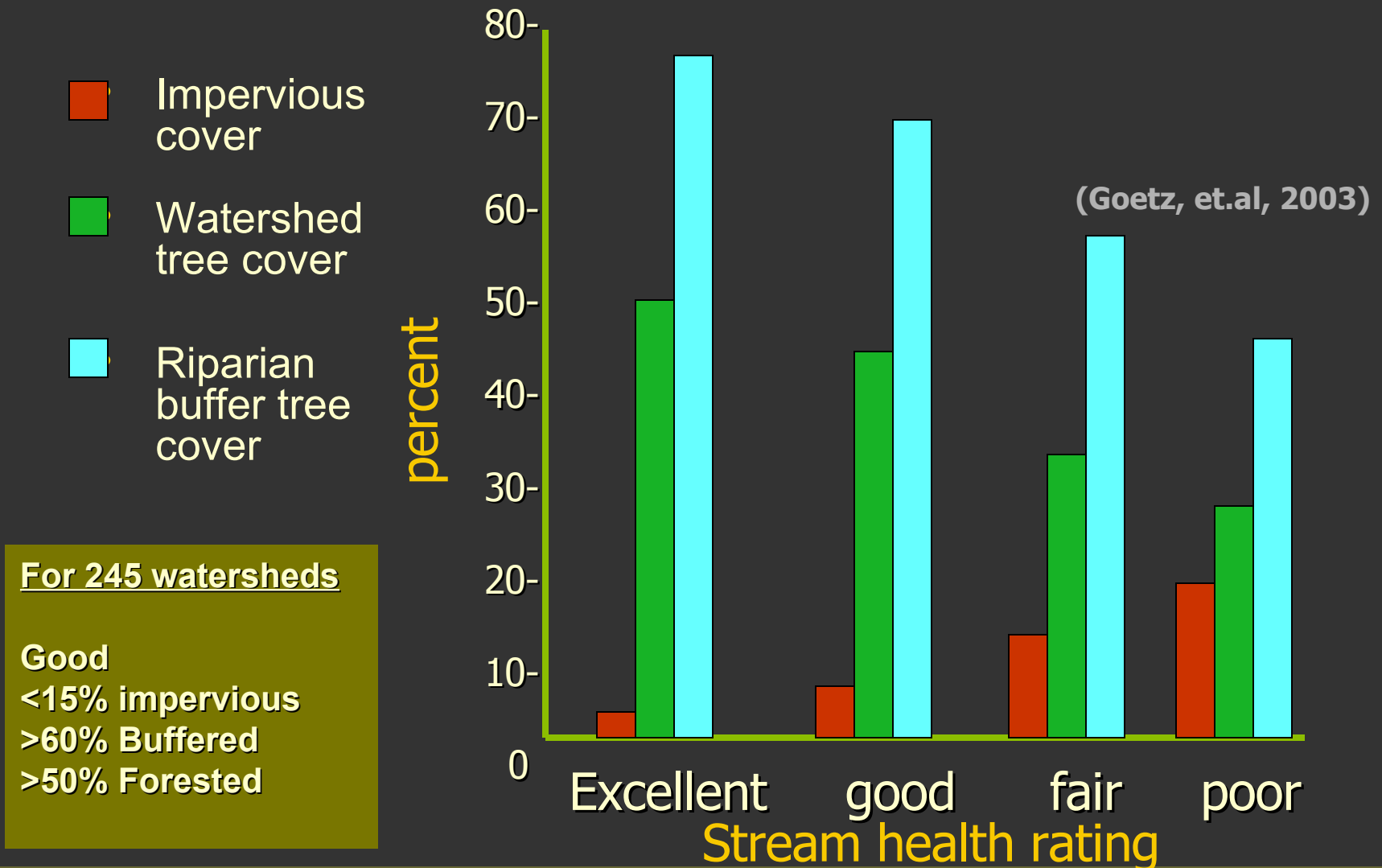


Groffman et al. 2004

Test watershed results: reductions in runoff *(total)* and pollutants *(t/total hours)* due to tree canopy

Watershed	Tree canopy	% decline in runoff per % inc. in canopy	TSS	TP	TKN	NO2 NO3
Accotink	32	.1	40.3	.19	1.1	0.39
Baisman Run	69	.2	4.5	.02	0.1	0.04
Gwynns Falls	27	.1	44.9	.21	1.2	0.44
Mill Creek	7	.2	12.3	.06	0.3	0.12
Rock Creek	27	.2	136.8	.65	3.7	1.34
Toby Creek	54	.2	41.5	.20	1.1	0.41
14 Mile	29	.6	32.8	.16	0.9	0.32

influence of forests and imperviousness on the health of streams (IBI)



In summary.... watershed effects of forest loss



- Less trees – more runoff
- Impervious cover linked to physical stream degradation (5-15%)
- Loss of stream biological health – constant drought/flood cycles
- Turf and impervious generates more pollutants than forest.
- Air quality declines & pollutant deposition increases
- Remaining forest cover is fragmented and quality is reduced



stormwater
runoff is the
number one
factor in the
decline of urban
streams and
decreasing urban
water quality !



old news

- The first models for predicting runoff appeared in the 1800s and used runoff coefficients to account for
- different land use and land covers.
 - The Rational Method (Mulvaney 1851)
 - Peak Discharge = Runoff Coefficient x Rainfall x Basin Area
 - Runoff Coefficients:
 - Forested ground is typically assigned a value of near 0.
 - Pavement is given values approaching 100 percent
- But why emphasize trees in particular versus other stormwater practices?

trees are the original “multi-taskers”

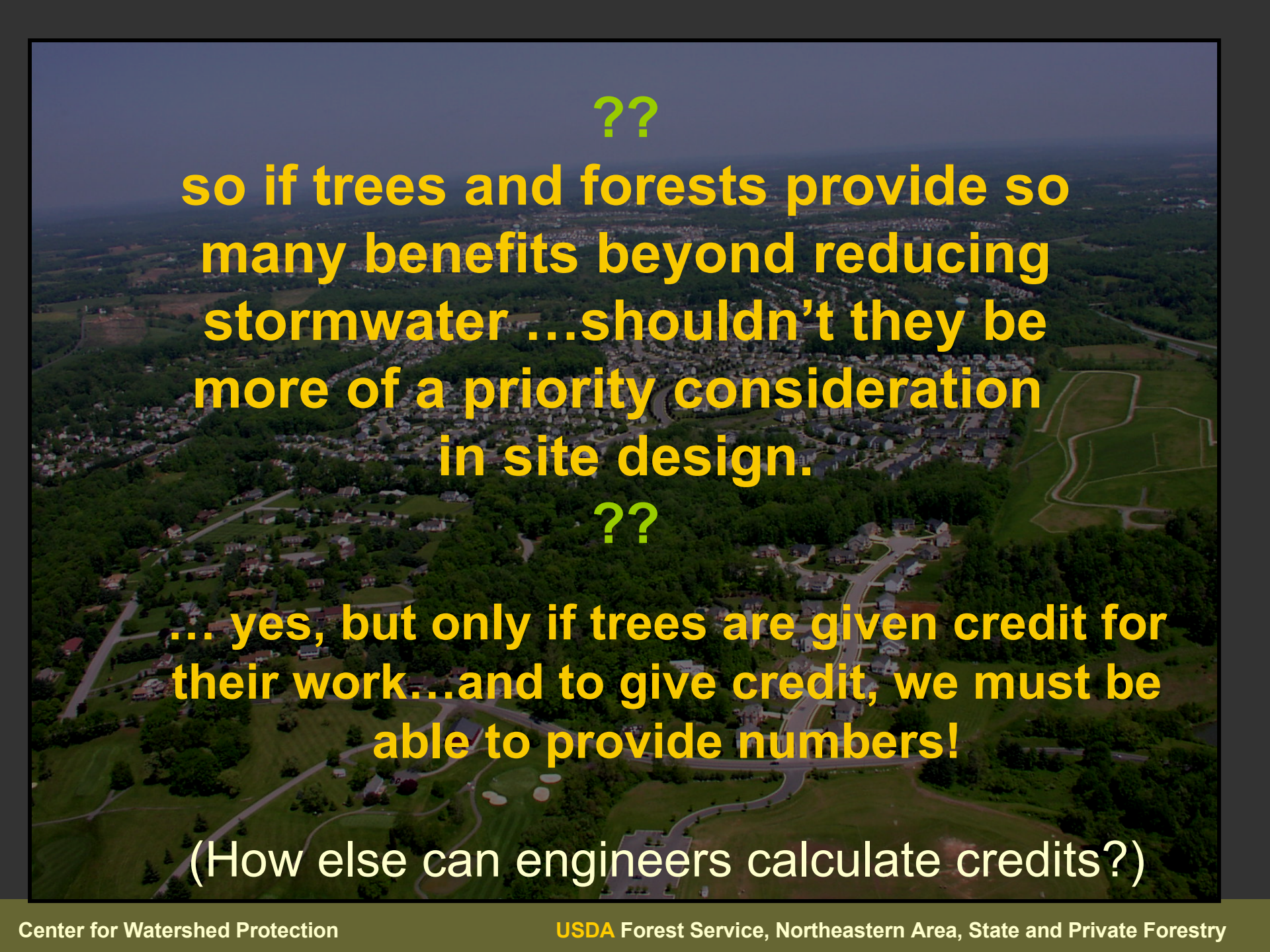
- save energy
- improve air quality
- provide habitat
- better quality of life
- neighborhood stability
- aesthetic values
- increase property value
- reduce noise
- good for business



Photo by Guy Kramer



USDA Forest Service Urban Watershed Forestry Manual, Part 1

An aerial photograph of a suburban neighborhood with green trees and houses. The image is used as a background for the text.

??

so if trees and forests provide so many benefits beyond reducing stormwater ...shouldn't they be more of a priority consideration in site design.

??

... yes, but only if trees are given credit for their work...and to give credit, we must be able to provide numbers!

(How else can engineers calculate credits?)

don't trees get some credit already?

- ✓ not in most municipalities
- ✓ not enough to matter to most developers.
- ✓ not enough to equal their true value



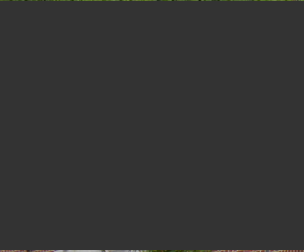


why urban watershed forestry?

- integrate urban and community forestry and watershed planning and management.
- set watershed goals for the urban forest
- create more functional urban landscapes in terms of hydrology
- build tools to assess, protect, and enhance urban green space as a part of storm water mgmt.

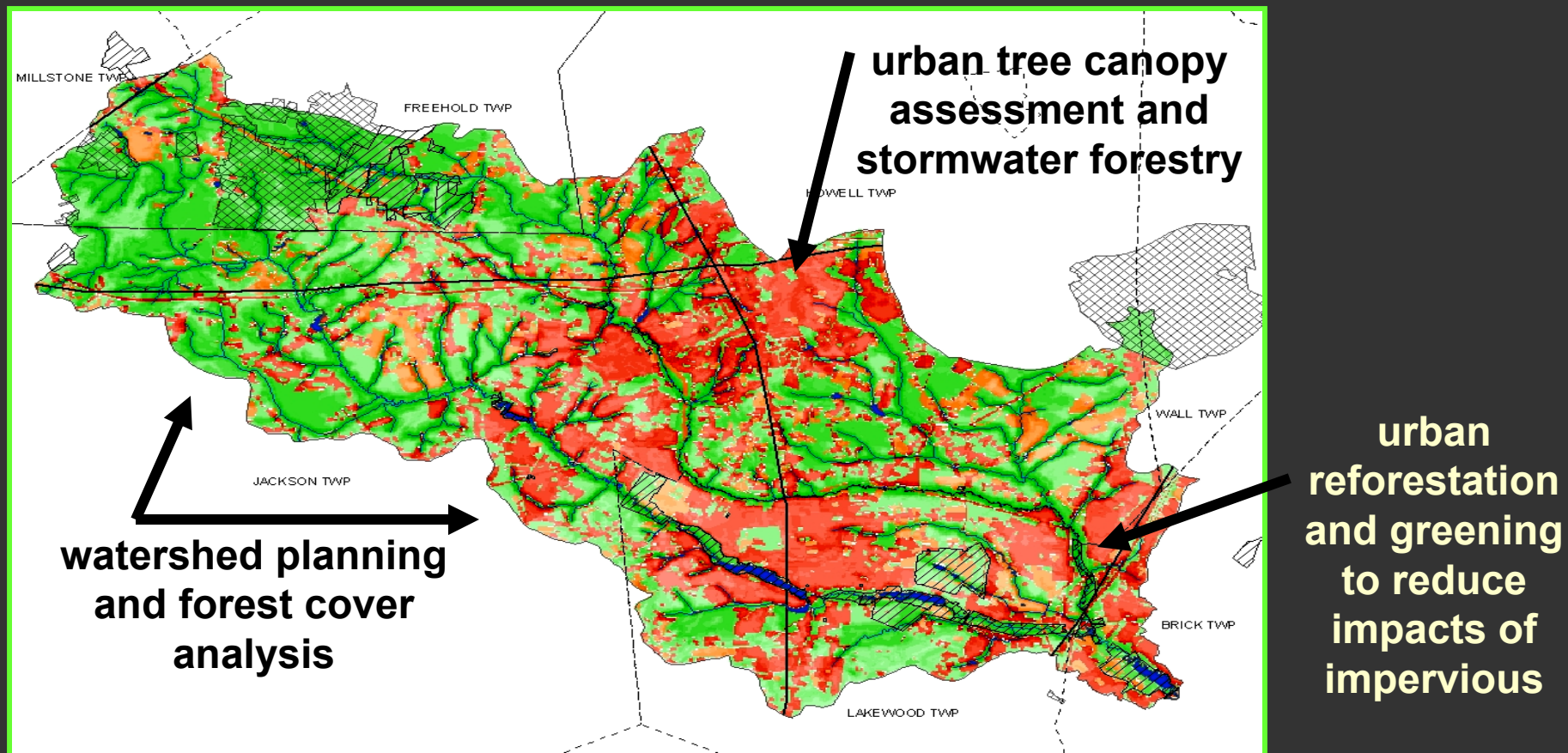


objectives:



- preserve forests and natural vegetation in watersheds
- enhance urban & suburban tree canopy
- protect trees at development sites
- reclaim vacant lands and reduce turf
- increase the use of trees in stormwater practices

Urban watershed forestry seeks to address issues along the gradient of land use



urban foresters as watershed managers

trees & stormwater: some conclusions

- Watershed health is linked to the amount of forest in the watershed and its distribution.
- Increases in tree cover and tree size will result in reduced total runoff and peak runoff rates (10% = 2-5%)
- Tree canopy has a greater effect on small storm events than on large storm events (2 year storm frequency)
- Effects on runoff are greatest when urban trees are large and well-established (site quality).
- Trees and stormwater management practices can coexist if planned and designed from the start.

challenges...

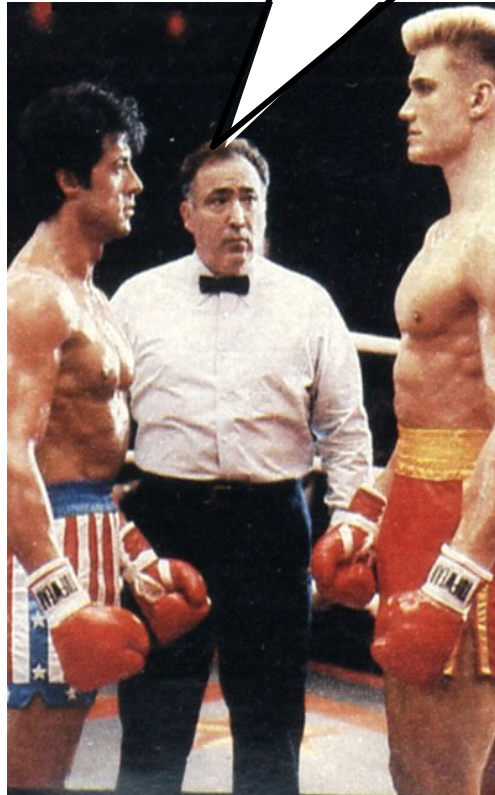
Urban Foresters

Leftover disturbed areas are not the only place for trees

We can retain valuable trees that improve watershed functions

We can use trees in SW practices if we design it differently

Now remember, you have to work together



Engineers/Planners

We need wider streets and curbs

Keep the trees in the park, we need the tax revenue

Don't worry, we'll come back and plant trees later.

urban watershed forestry manual series

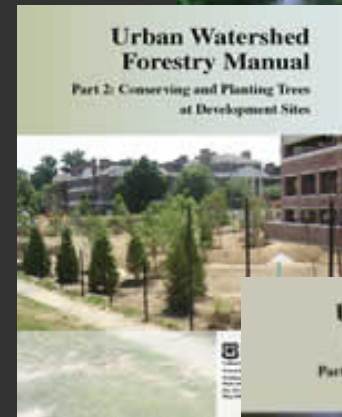


a base of techniques,
approaches, and
references to build on

- from watershed...
- to community...
- to subdivision...
- to site scale

urban watershed forestry manual series

- ✓ **part 1:** Methods for Conserving forest cover in a watershed
- ✓ **part 2:** Conserving & Planting Trees at Development Sites
- ✓ **part 3:** Urban Tree Planting Guide



Available for download @ www.cwp.org and www.na.fs.fed.us/watershed/



"A town is saved, not more by the righteous citizens within it, than by the woods that surround it..."



-Henry David Thoreau, 1862