

Getting Ahead of the Storm – Understanding and Implementing Green Infrastructure

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How do we manage water on the land?

History and habits

- Drainage – move water Away
- Old habits are hard to break
- Opportunity to better integrate water management with habitat and other goals



Key trends and drivers

- Water quality goals -- regulations based on US Clean Water Act (1972)
- *Point-source discharges* of pollution were original focus of Clean Water Act
- Wastewater overflows include
 - Combined sewer overflows (CSOs)
 - Sanitary sewer overflows (SSOs)
- Green infrastructure to retain water and slow it down can be part of the solution



Trends and drivers, continued

- *Non-point sources* of pollution carried in runoff is a newer focus c. 1990
 - Soil and sediment
 - Nutrients and pathogens – septic systems, fertilizer, pet waste, leaves, leaky sewers, agricultural runoff, etc.
 - Automotive chemicals – oil, antifreeze, etc.
 - Road salt
 - Lawn & turf chemicals – fertilizer, pesticides, herbicides
- Stormwater management regulations are largely aimed at managing non-point sources of pollution
- Green infrastructure is effective at removing pollutants



Trends and drivers, continued

- Flooding
 - Green infrastructure can reduce runoff in storms
 - In bigger storms, green infrastructure can reduce damage in smaller watersheds and in site- & neighborhood-scale drainage areas
 - *Pervious paving* can potentially manage the 100-year storm
 - Green infrastructure can be more resilient in floods



Taconic Headquarters, NY State Parks



Stewart International Airport

How did we get here?

Impervious surfaces change a watershed's basic properties & damage essential functions

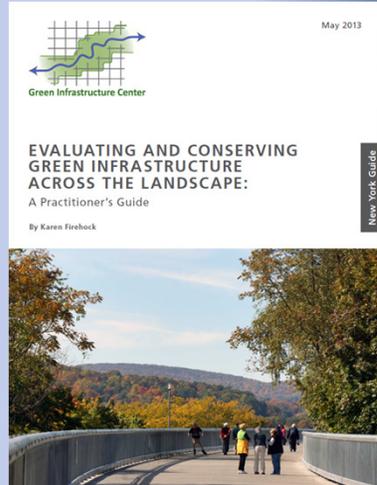
Pavement and buildings prevent infiltration of water into the soil so

- Groundwater recharge is reduced
- This depletes base flow to feed streams in dry weather
- Increased runoff volumes and velocity causes stream erosion



Defining green infrastructure...

- *Site-scale* practices for stormwater management include rain gardens, bioretention, rainwater harvesting and reuse, pervious pavement, street trees, vegetated swales aka bioswales, riparian buffer protection and restoration, green roofs, green walls, downspout disconnection, stream daylighting, etc.
- *Landscape-scale* green infrastructure includes protection of open space, river corridors and connected floodplains and wetlands, forests, and agricultural land

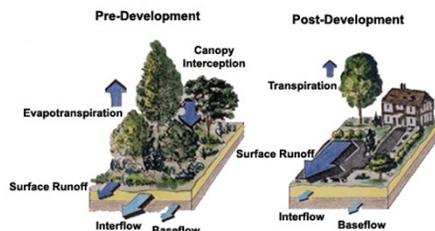


NY Guide includes case study of Ulster County Green Infrastructure Center Inc. www.gicinc.org

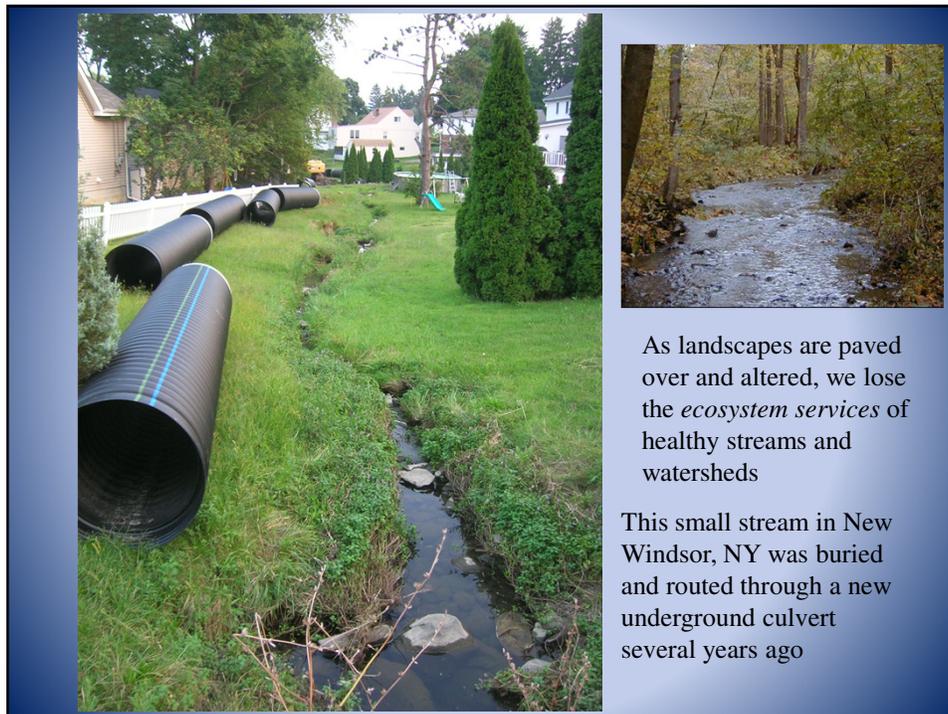
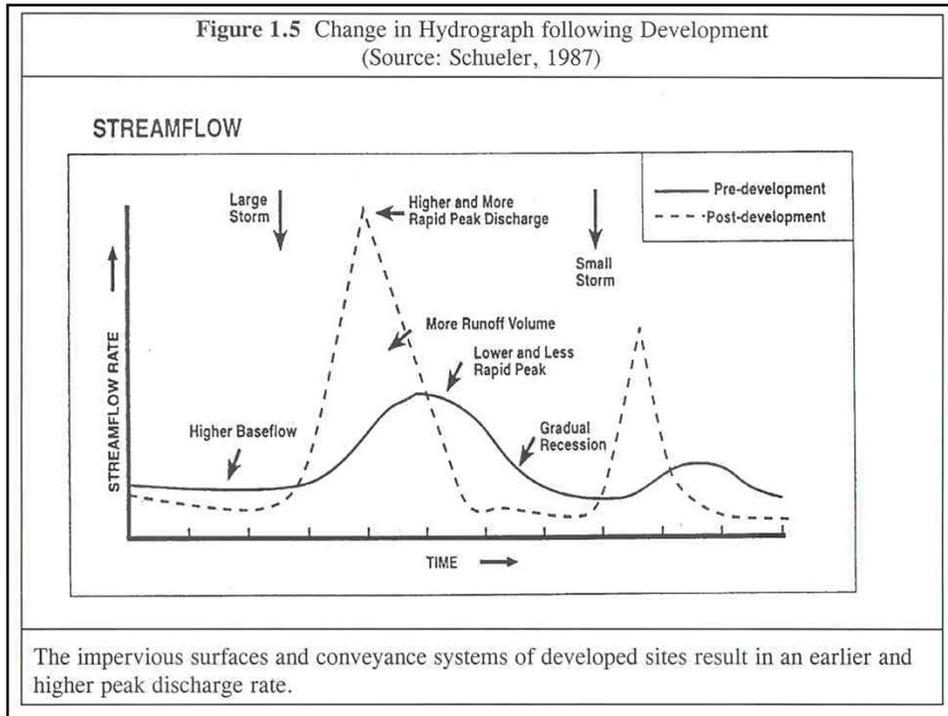
Changes in watershed hydrology due to urbanization



Changes in Hydrology Due to Development Water Balance



Graphic above by Chris Cox, College of Agriculture and Life Sciences at Virginia Tech, from Federal Stream Corridor Restoration Handbook
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/natl/natl/water/manage/restoration/?cid=nr-143_026903





The same stream in New Windsor after it was buried. Restoring streams by “daylighting” them is a form of green infrastructure.

Green infrastructure

- Paradigm shift – *don't* move the water away!
 - Spread it out
 - Slow it down
 - Soak it in

Swale with curb cut at shopping center in upstate NY



Green roof at Beacon Institute
Beacon NY



Multiple benefits of green infrastructure

Unlike single-purpose gray infrastructure investments, green infrastructure can provide many benefits that go beyond managing water and protecting water quality:

- Cooling streets, parking areas and buildings in urban areas by reducing *urban heat island* impacts
- Reduced energy use and public health benefits
- Contributes to aesthetic quality
- Reduced rates of certain crimes
- Safety improvements – less icing in parking areas
- Mental and emotional health, including faster healing times after surgery
- Increased property values



Photo courtesy of Marilyn Wyman, Cornell Cooperative Extension of Columbia and Greene Counties

Philadelphia Green Infrastructure Plan Triple Bottom Line benefits

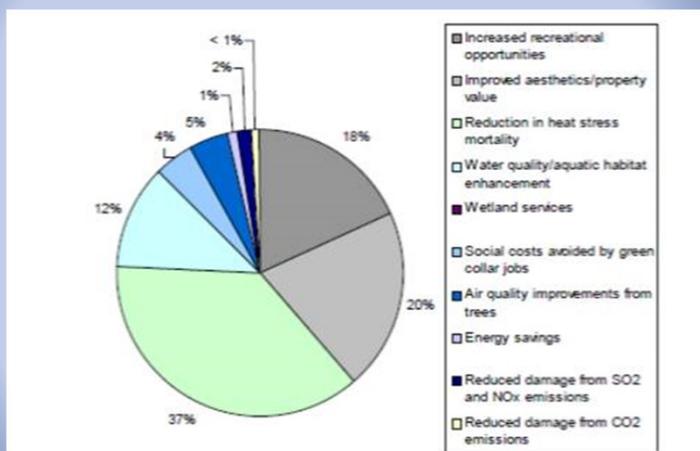


Figure 5.2. Shares of City-wide present value benefits of key CSO options: Cumulative through 2049.

Green roof at Kaplan Hall at SUNY-Orange in Newburgh



Photo taken on guided tour of upper roof in August 2011



SUNY-Orange Green Roof -- April 2012

Rain garden at SUNY-Orange in Middletown



Built in partnership with Orange County Soil & Water District and Cornell Cooperative Extension of Orange County. Photo taken May 2012

Lamont-Doherty Earth Observatory in Rockland County

Melting snow drains away, avoiding re-freezing and reducing icy conditions



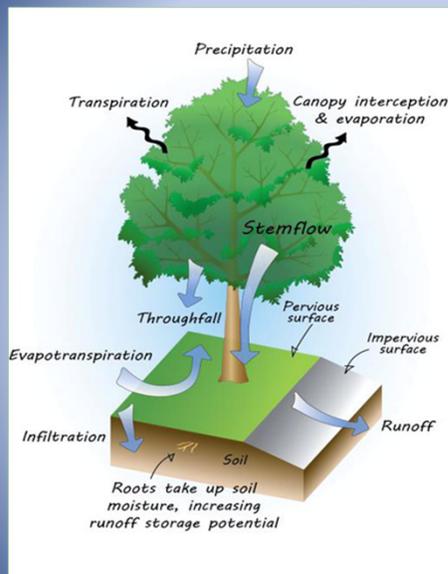
Patrick O'Reilly P.E., at LDEO in spring of 2013

“But pervious paving won’t stand up to freezing conditions.” Actually...



Pervious asphalt is on left side of this photo and conventional paving on right. Note the cracking in conventional paving used for entrance ramp seven years after it was built.

Street trees are green infrastructure



Taken at Beacon Sloop Club in May 2007 (this example may not fit NYS DEC design specifications)

Urban Horticulture Institute, Cornell University



Green Wall designed by Patrick Blanc along the rue d'Alsace in Paris completed in 2008. Published in the NY Times Magazine on March 30, 2010



Saw Mill River in downtown Yonkers after daylighting project, Nov. 2012



Rain Garden at the Ulster County Department of the Environment office in Kingston, NY. Completed in 2011 based on a design by Barbara Restaino, RLA, LEED AP, as part of the Hudson Valley Regional Council Green Infrastructure Planning project. Photos courtesy of Barbara Restaino.



After Completion - January 2001

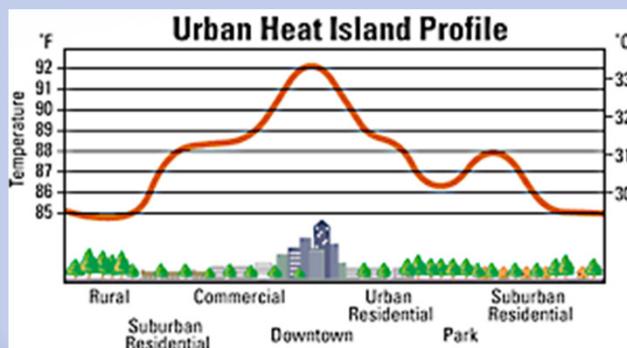


Neighborhood streets narrowed with flat curbs and more stormwater infiltration areas added

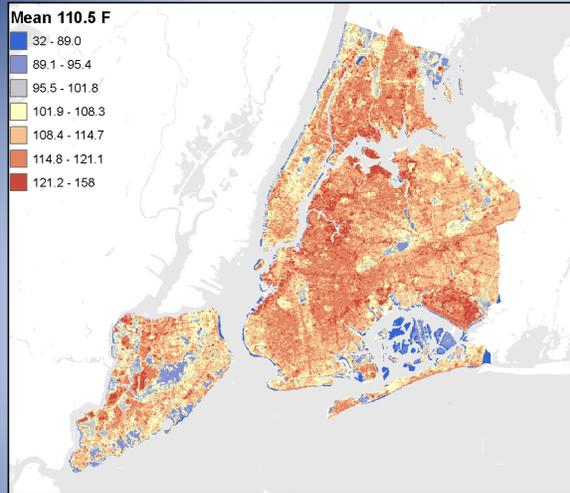
Benefits of forests and trees

- Water – quality and quantity
- Wood products, food, biodiversity
- Energy – efficiency, cooling, renewable energy, reduction of urban heat island – shading, windbreaks and evapotranspiration (ET)
- Health – stress reduction, walkability, heat island mitigation, immune system benefits
- Livability and safety in cities – crime reduction
- Economic benefits – ecosystem services, increased business traffic, stormwater reduction in wastewater systems

Urban heat island and global warming



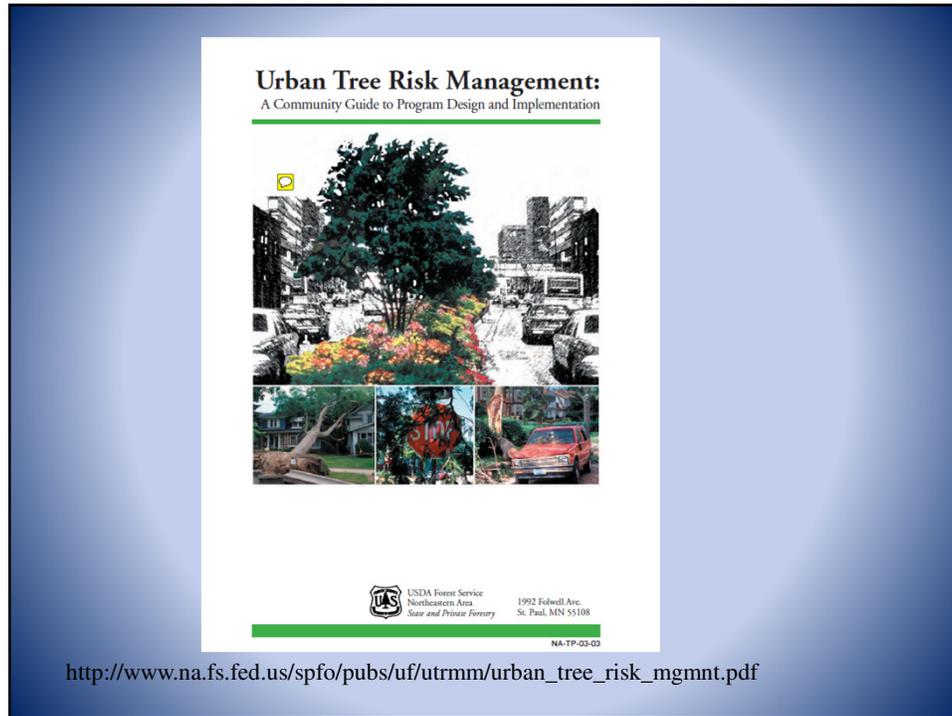
Urban Heat Island and Global Warming – Patrick Kelly, US EPA 2007



Surface temperatures in New York City on August 14, 2002, taken by Landsat satellite. From *Mitigating New York City's Heat Island with Urban Forestry, Living Roofs and Light Surfaces*, NYSERDA, by co-P.I.s Rosenzweig, Solecki and Slosberg 2006.

Trees - risks and challenges

- Lack of awareness and understanding of benefits and management needs
- Management is inadequate in many communities
- Irene and Lee in 2011, and Sandy in 2012 – widespread tree damage with resulting debris
- Fear of trees – pro-active cutting without adequate risk assessment
- Invasive species, fragmentation of ownership, etc.



Urban & rural forests – regional perspective

- Many benefits are documented in literature
- Lack of awareness, need for more education and training
- Trees are seen by some as a problem
- Good educational resources for rural forest and tree management; fewer resources for urban forests in mid-Hudson region
- Next steps – education and demonstration projects



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For more information visit:

<http://hudsonvalleyregionalcouncil.org/>

<http://www.cunysustainablecities.org/>

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