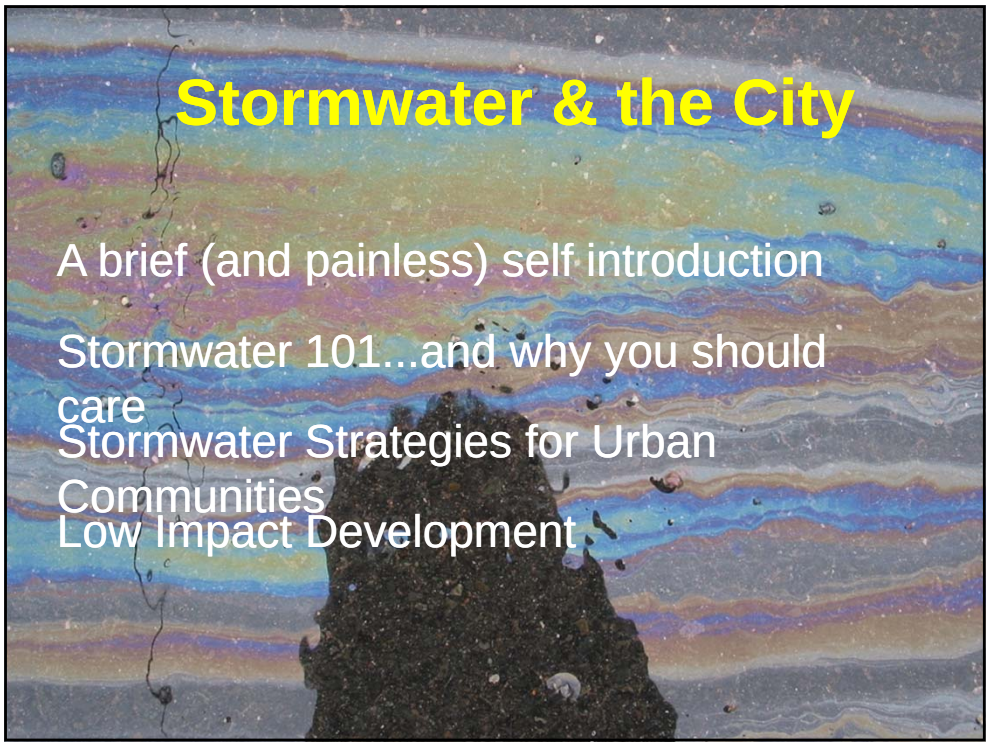

Stormwater & the City
An introduction to the land /water connection, stormwater issues, and newfangled solutions
Hartford Rain Garden Training
November 4 & 5, 2010
Image © 2010 DigitalGlobe
Google


Stormwater & the City
A brief (and painless) self introduction
Stormwater 101...and why you should care
Stormwater Strategies for Urban Communities
Low Impact Development

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The Center for Land Use Education and Research

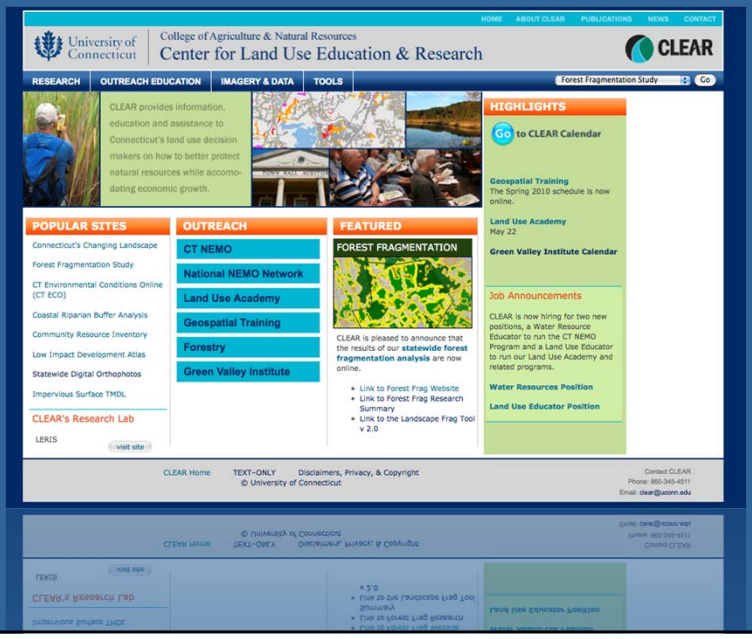
Research, Tools & Training, Outreach

CLEAR
Center for Land Use Education & Research

- Lab for Earth Resource Information Systems
- NEMO
- National NEMO Network
- Geospatial Technology Extension Program
- Green Valley Institute
- Land Use Planning Program
- Land Use Academy
- Extension Forestry Program

University of Connecticut
College of Agriculture and Natural Resources

clear.uconn.edu



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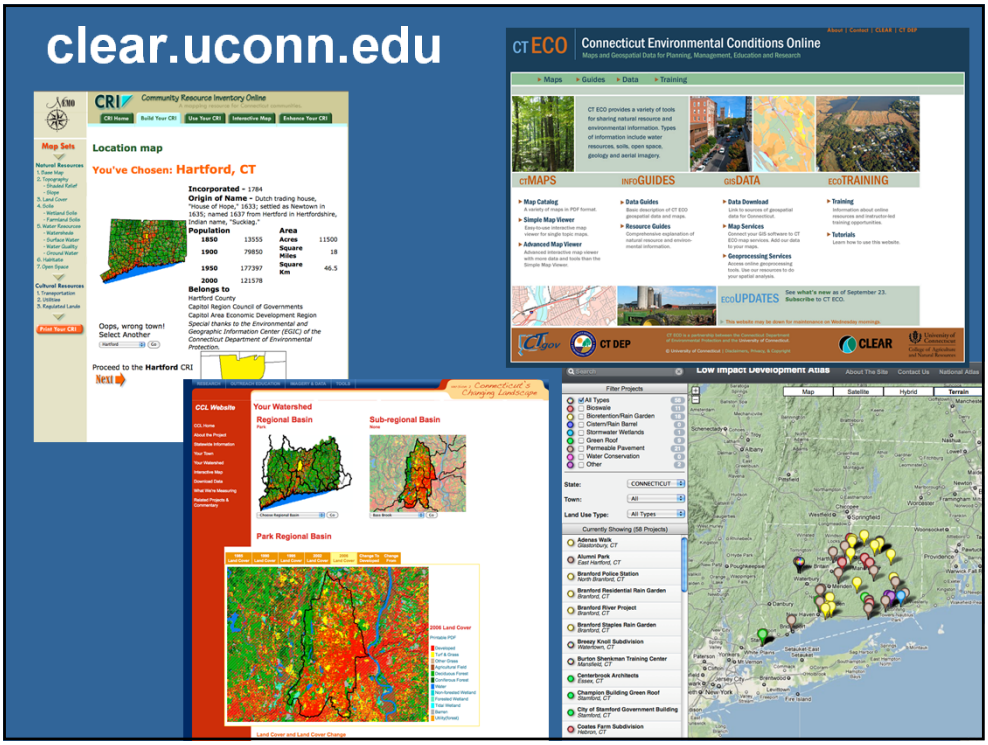

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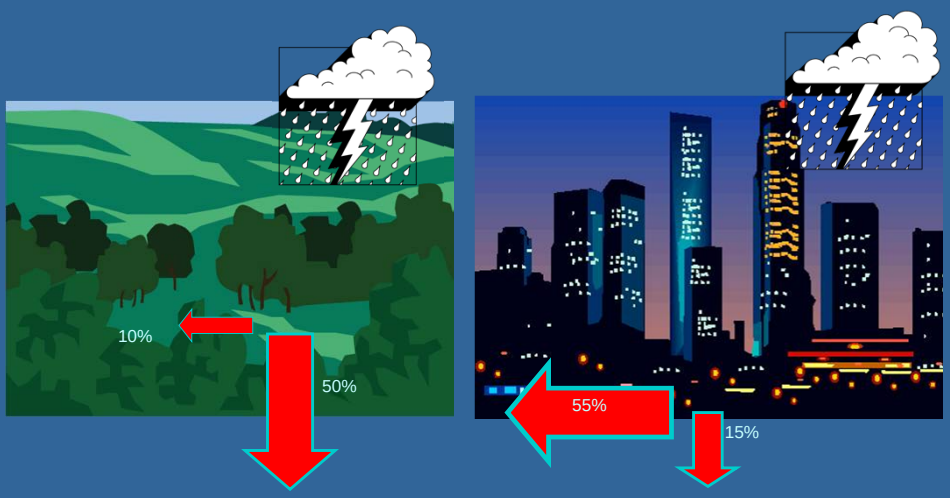
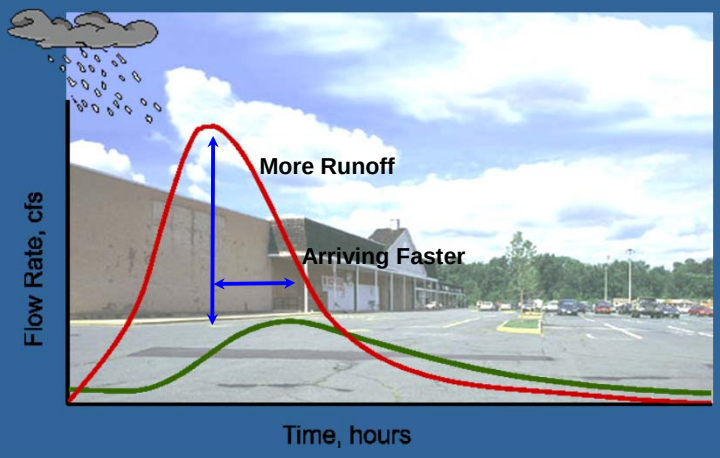
Impacts of Development on the Water Cycle (using the cheesiest graphics possible)



Hydrologic Impacts of Development



Water Quantity Impacts of Development

flooding

erosion

10

Water Quantity Impacts of Development

Estimated groundwater lost to runoff, 1982-1997

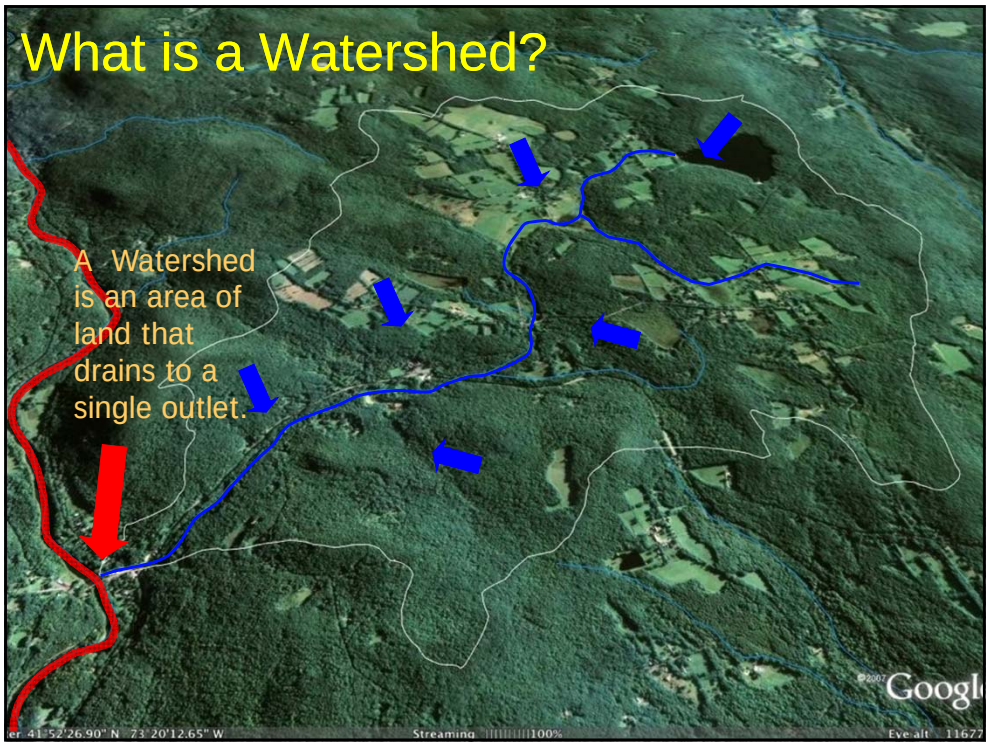
- Atlanta – 56.9 to 132.8 billion gallons
- Boston – 43.9 to 102.5 billion gallons
- Seattle – 10.5 to 24.6 billion gallons

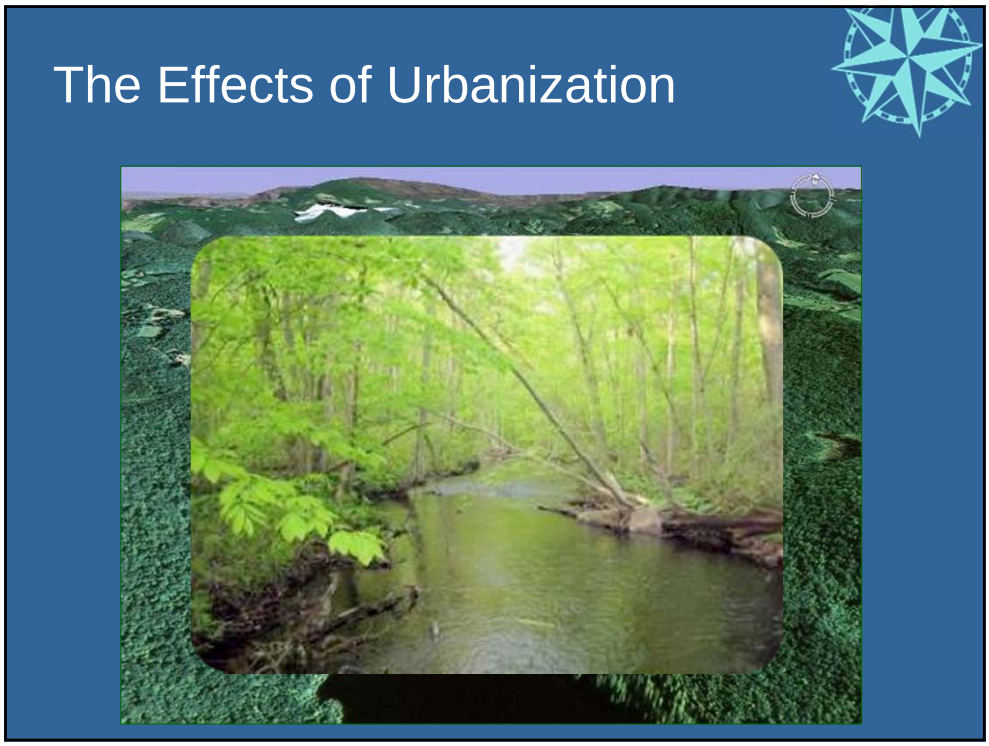
American Rivers, 2002

11

Water Quality Impacts of Development

- Nutrients
- Pathogens
- Debris
- Toxic Contaminants
- Sediment
- Thermal Stress
- Etc., etc., etc.


What is a Watershed?
A Watershed is an area of land that drains to a single outlet.


The Effects of Urbanization

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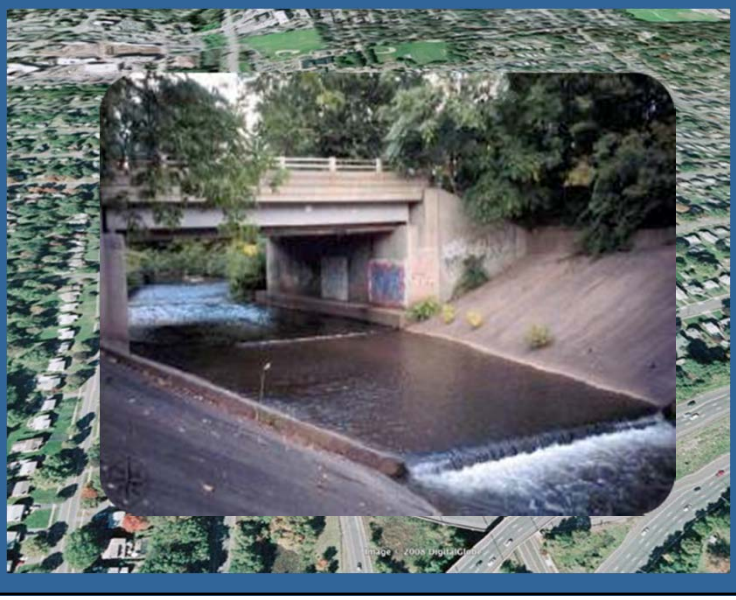
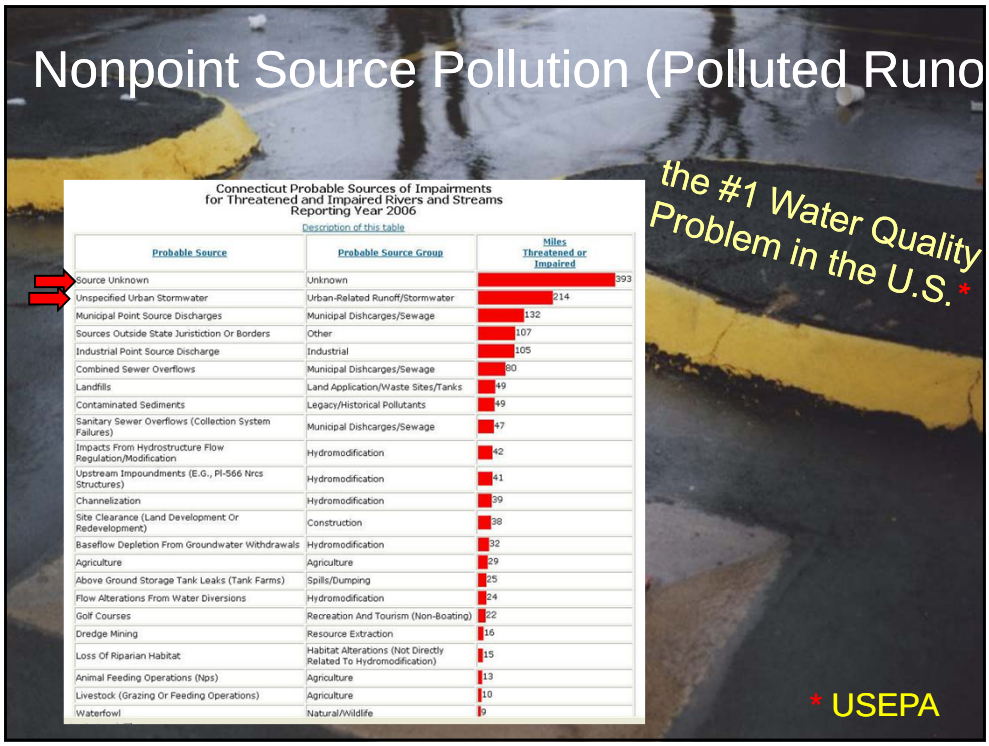
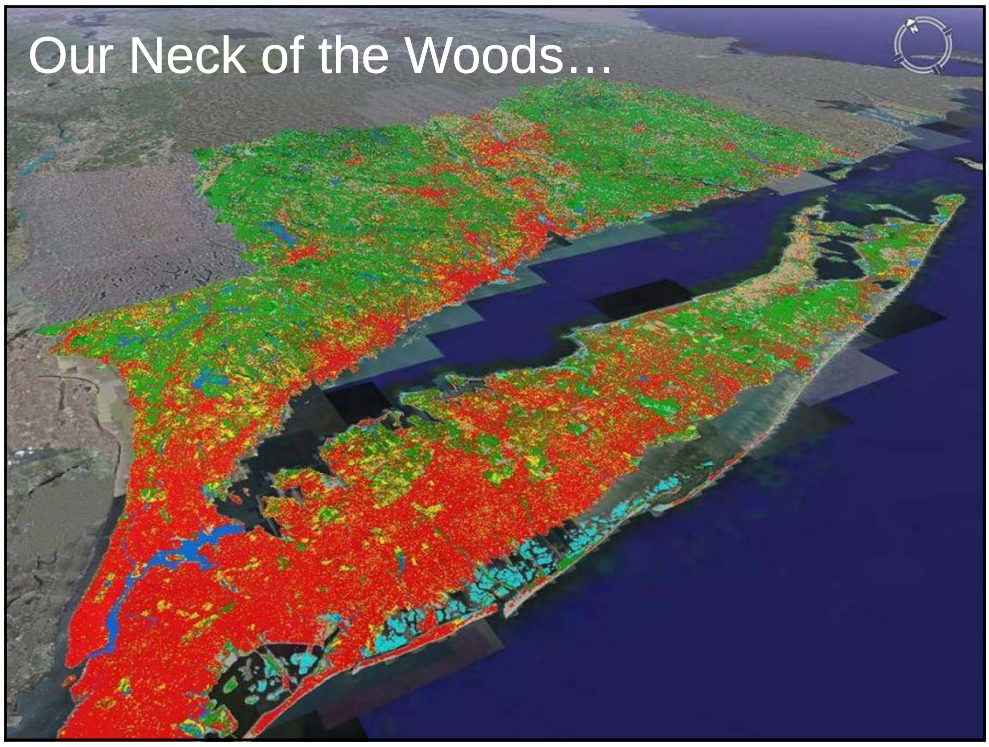


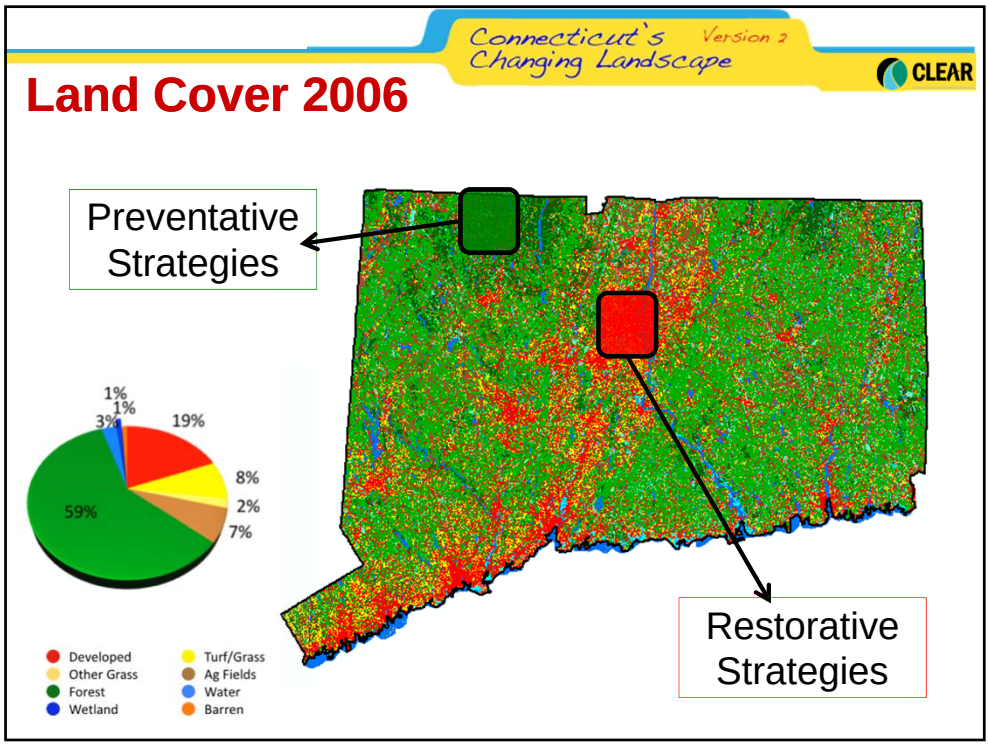


Connecticut Probable Sources of Impairments for Threatened and Impaired Rivers and Streams Reporting Year 2006

Description of this table

Probable Source	Probable Source Group	Miles Threatened or Impaired
Source Unknown	Unknown	393
Unspecified Urban Stormwater	Urban-Related Runoff/Stormwater	214
Municipal Point Source Discharges	Municipal Dishcarges/Sewage	132
Sources Outside State Juristiction Or Borders	Other	107
Industrial Point Source Discharge	Industrial	105
Combined Sewer Overflows	Municipal Dishcarges/Sewage	80
Landfills	Land Application/Waste Sites/Tanks	49
Contaminated Sediments	Legacy/Historical Pollutants	49
Sanitary Sewer Overflows (Collection System Failures)	Municipal Dishcarges/Sewage	47
Impacts From Hydrostructure Flow Regulation/Modification	Hydromodification	42
Upstream Impoundments (E.G., Pl-566 Nrcs Structures)	Hydromodification	41
Channelization	Hydromodification	39
Site Clearance (Land Development Or Redevelopment)	Construction	38
Baseflow Depletion From Groundwater Withdrawals	Hydromodification	32
Agriculture	Agriculture	29
Above Ground Storage Tank Leaks (Tank Farms)	Spills/Dumping	25
Flow Alterations From Water Diversions	Hydromodification	24
Golf Courses	Recreation And Tourism (Non-Boating)	22
Dredge Mining	Resource Extraction	16
Loss Of Riparian Habitat	Habitat Alterations (Not Directly Related To Hydromodification)	15
Animal Feeding Operations (Nps)	Agriculture	13
Livestock (Grazing Or Feeding Operations)	Agriculture	10
Waterfowl	Natural/Wildlife	9


Our Neck of the Woods…


Connecticut's Changing Landscape
Version 2
CLEAR
Land Cover 2006
Preventative Strategies
Restorative Strategies
1%
1%
3%
19%
8%
2%
7%
59%
Developed
Other Grass
Forest
Wetland
Turf/Grass
Ag Fields
Water
Barren

Restorative Strategies for Urban Communities

1. Reduce & disconnect stormwater pathways
2. Emphasize multifunctional green space
3. Maximize redevelopment opportunities
4. Rehabilitate trees & soils
5. Restore stream buffers

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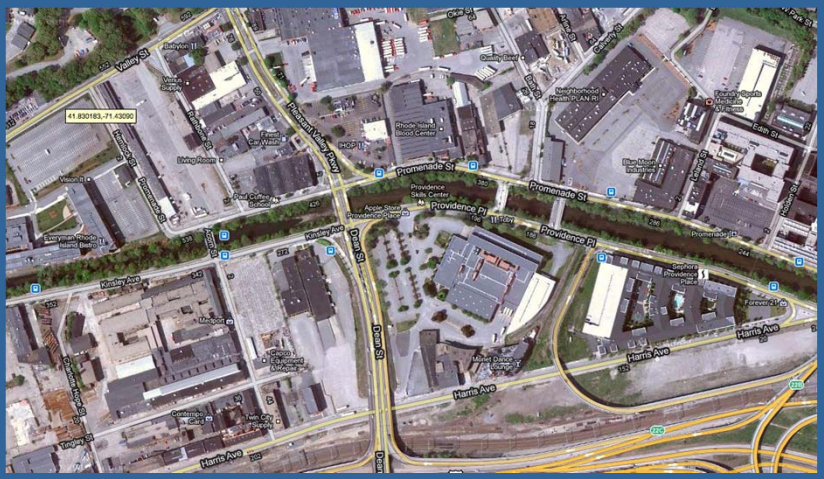
Stream Restoration

Providence, RI



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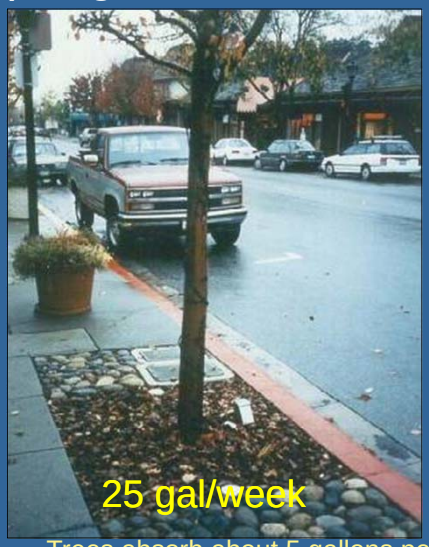
Compacted Soils

Lawn areas in suburban and urban settings and along road and driveway edges are almost sure to be compacted, reducing infiltration capacity

Urban trees as stormwater sponges



Trees absorb about 5 gallons per inch in diameter (caliper inch) every week.

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Heritage Park Development Minneapolis, MN

Heritage Park redevelopment in Minneapolis was built on a 145-acre site that formerly contained public housing developments. The emphasis is on stable, mixed-income affordable and sustainable urban neighborhood on the western edge of Minneapolis' downtown area.

Heritage Park Development Minneapolis, MN

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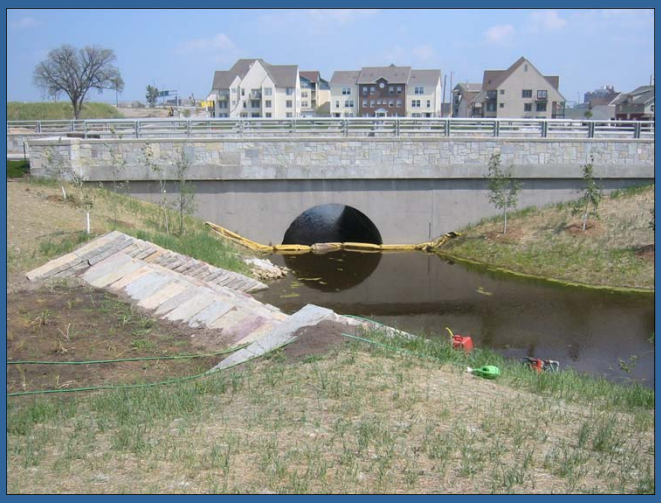
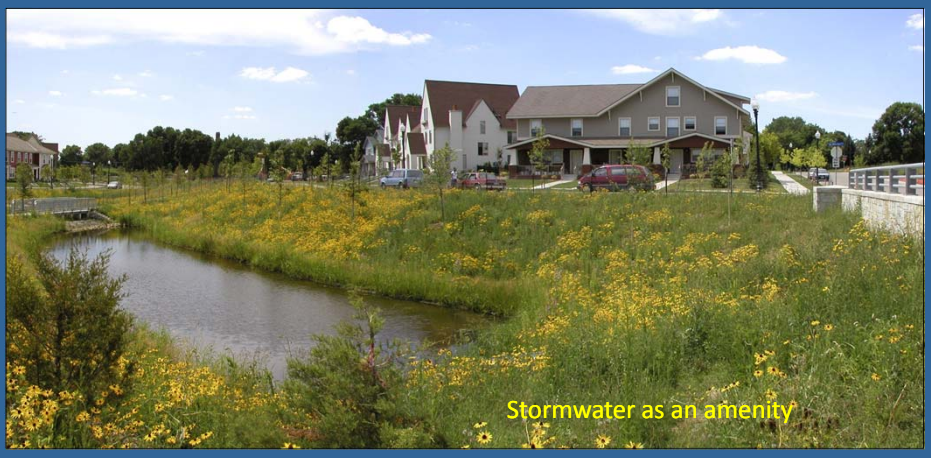


Heritage Park Development Minneapolis, MN



Restorative Strategies for Urban Communities

1. Reduce & disconnect stormwater pathways
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Multifunctional Gray Spaces

Porous asphalt school playground, West Philadelphia, PA

Multifunctional Green Spaces

Hunter Park rehabilitation plan, Nine Mile Run, PA

From Ferguson et al., Stormwater magazine July 2001

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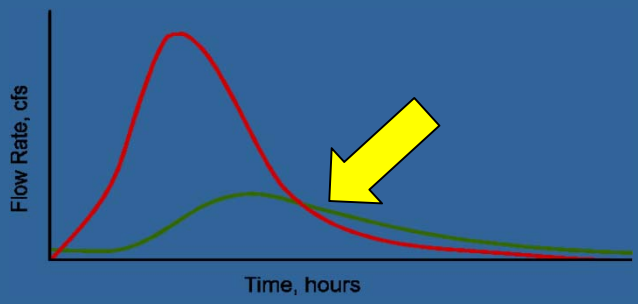
A site design strategy intended to maintain or replicate a site's natural hydrology through the use of small-scale controls integrated throughout the site to manage runoff as close to its source as possible



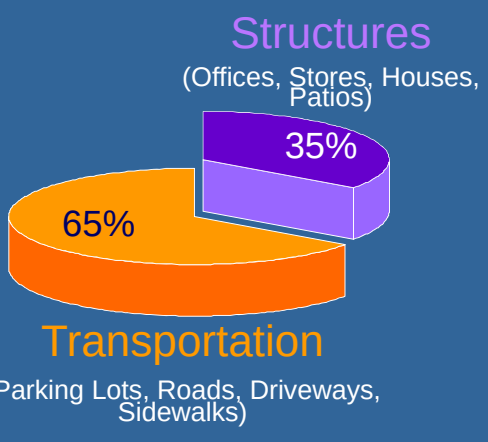
Key LID Concepts

- Preserve the pre-development hydrology
- Site-level stormwater control
- Deal with the Water Quality Volume (first 1" of rainfall)
- Minimize disturbance on site
- Use a "treatment train" approach to stormwater
- Maximize travel time
- Treat stormwater as a resource rather than a waste product

Many LID practices use soil and vegetation to retain, reduce and process runoff

The Impervious Surface Budget in Urban Areas

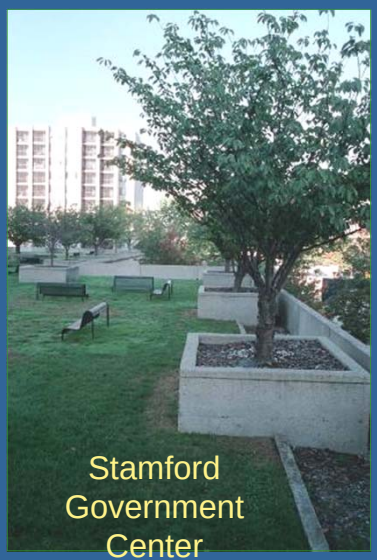
A way to think about LID practices



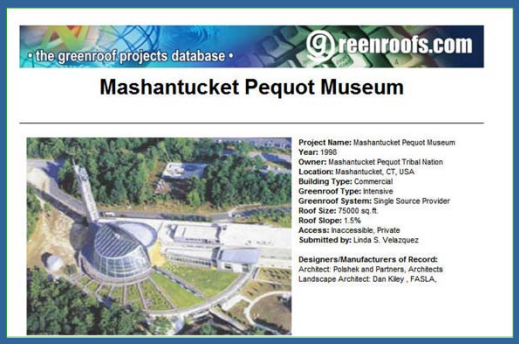
Roof Runoff

Intensive Green Roofs

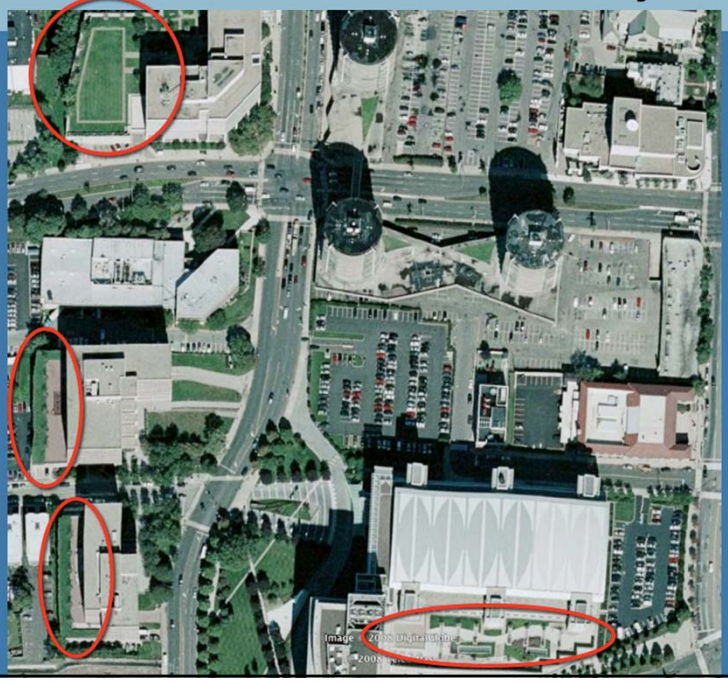
Intensive Green Roofs in CT



Stamford Government Center



Stamford: "Green Roof" City



Extensive Green Roofs

Extensive Green Roofs in CT


Sculpture Building, Yale

NEW HAVEN BUS SHELTER

Building Owner: City of New Haven

Client: Paragon Construction

Location: New Haven, CT

GreenGrid® Size: 360 ft^2

Installation Contractor: Paragon Construction

Landscape Design: Weston

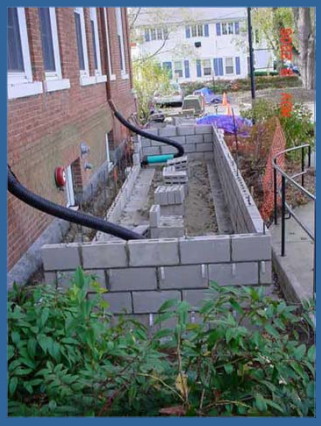
Rooftop System: Extensive

Status: Completed October 2007

Located on Church and Temple Street, this is one of the five new bus shelters topped with a GreenGrid roof.

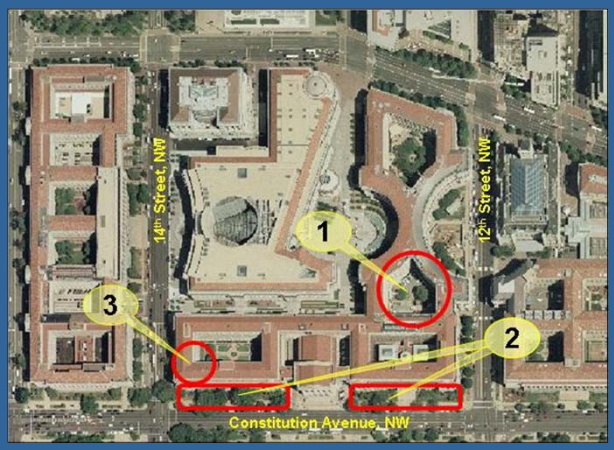
Disconnecting Roof Runoff

Disconnecting roof runoff downspouts: stormwater planters



Harvesting water: cisterns

Underground cisterns at EPA HQ, Washington DC



- Six 1,000-gallon cisterns each measuring 6 feet in diameter.
- EPA West building irrigation requirements: 7,500 gallons per week during summer months.

Cisterns in CT

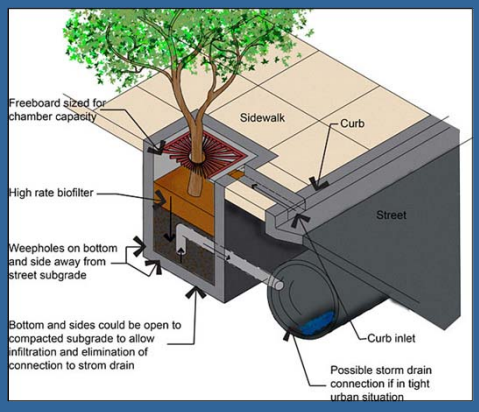
Sculpture Building, Yale has a 5,000 gallon cistern that collects excess runoff from roof and grounds, and is used for toilet flushing

Road runoff

Green Streets

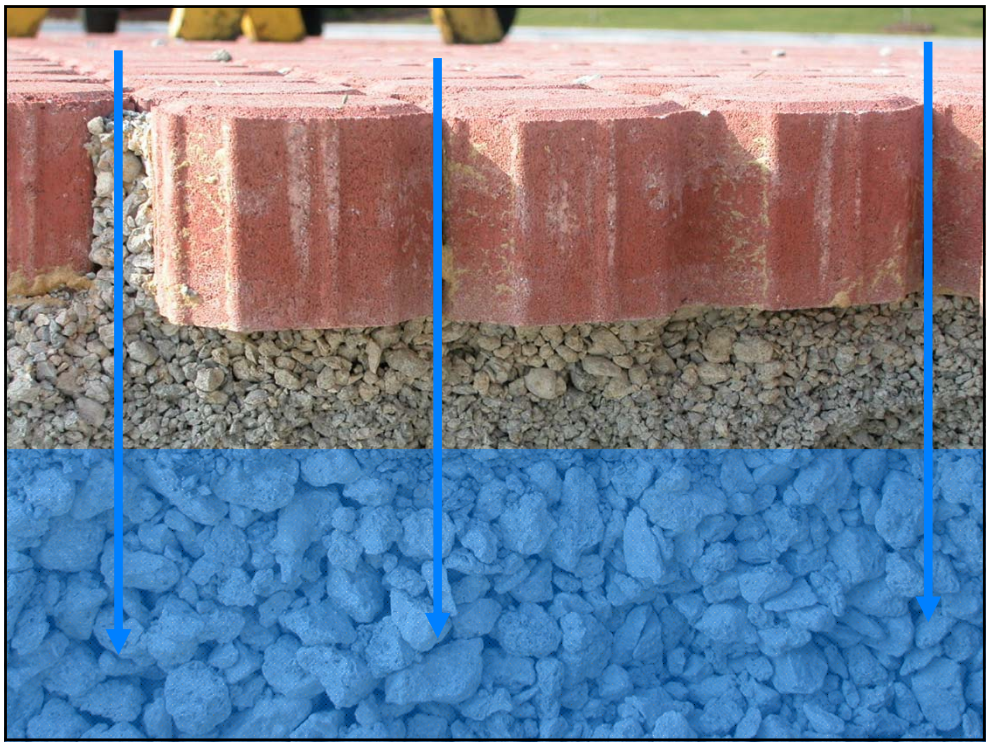
Portland, OR "Green Streets" Program

Tight urban spaces: tree box filters



Parking Lot Runoff

Alternatives to Traditional Pavement



Pervious parking: grass & gravel paving

Pervious parking: grass & gravel paving

Pervious parking: grass & gravel paving


Porous Concrete
Field House Parking Lot
UConn campus

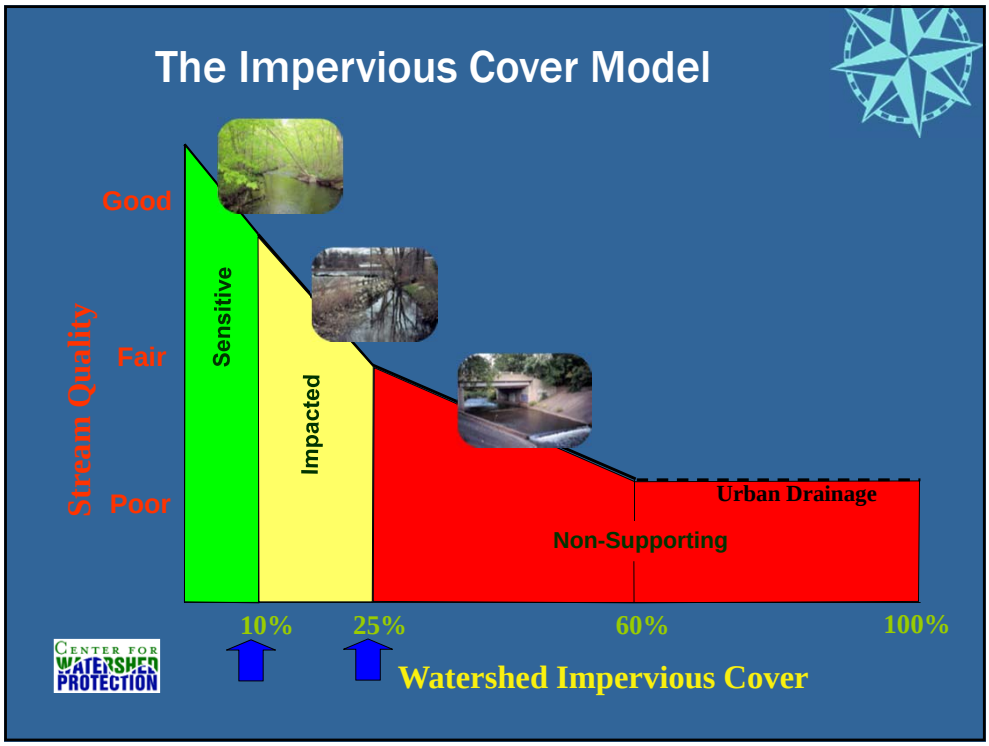

Porous asphalt
Towers Dorm Complex
UConn campus

Porous parking with traditional pavement in travel lanes

"Big Box" Target and Loew's development in Greenland, NH

Bioretention

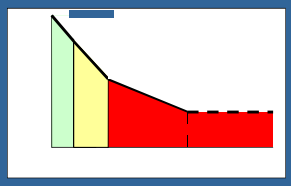
Rain Gardens (Finally!)


The Impervious Cover Model
Good
Fair
Poor
Stream Quality
Sensitive
Impacted
Urban Drainage
Non-Supporting
10%
25%
60%
100%
Watershed Impervious Cover
Center for Watershed Protection

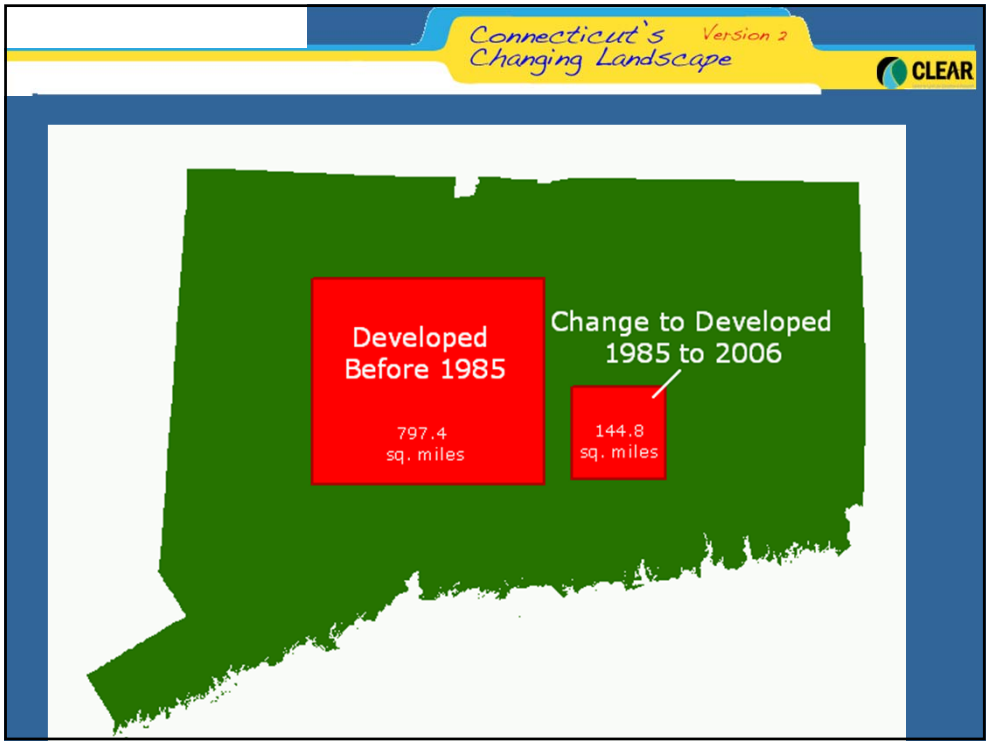
The Strength of the Evidence

More than 200 studies have been done on the relationship between IC and stream quality:

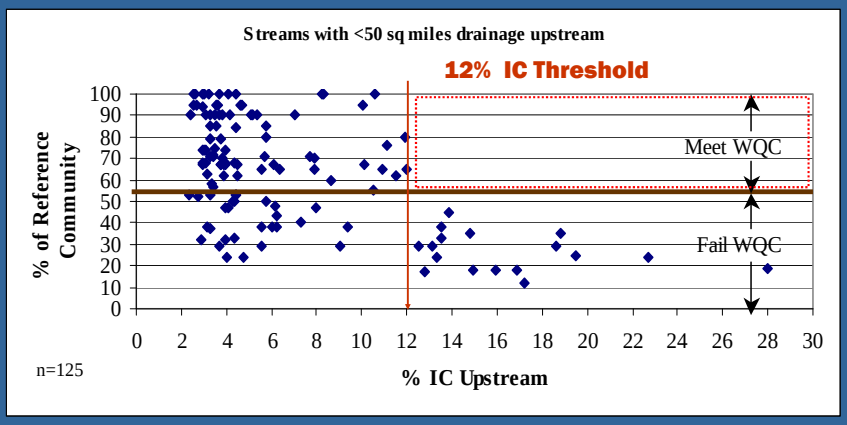
- Geomorphic (stream form) indicators
- Hydrologic Indicators
- Stream Habitat Indicators
- Water Quality Indicators
- Aquatic Diversity Indicators



CENTER FOR WATERSHED PROTECTION



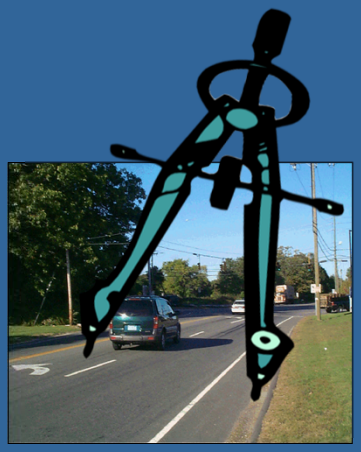
And in Connecticut?

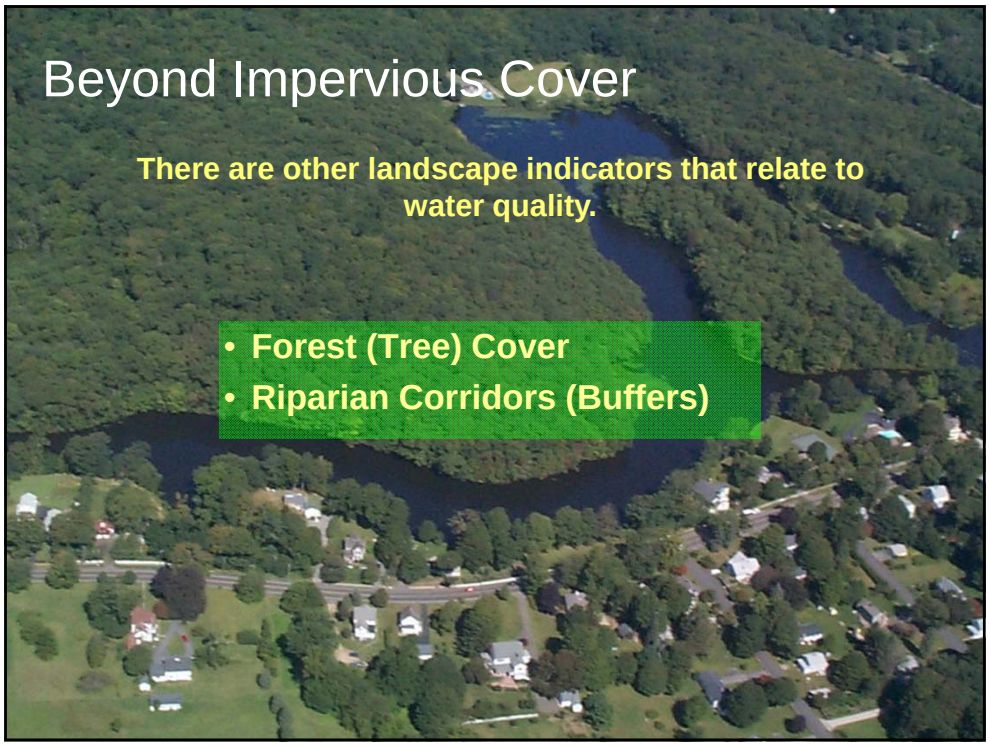


% of Reference Community compares 7 metrics- Taxa Richness, Modified HBI , Scraper/Filterer, EPT/Chironomidae, % Dominant Taxa, EPT Index, Community Loss

Impervious Surface as an Indicator

1. it simplifies complex impacts but is based on solid science
2. it's tangible & measurable
3. it's generated by local land use regulations

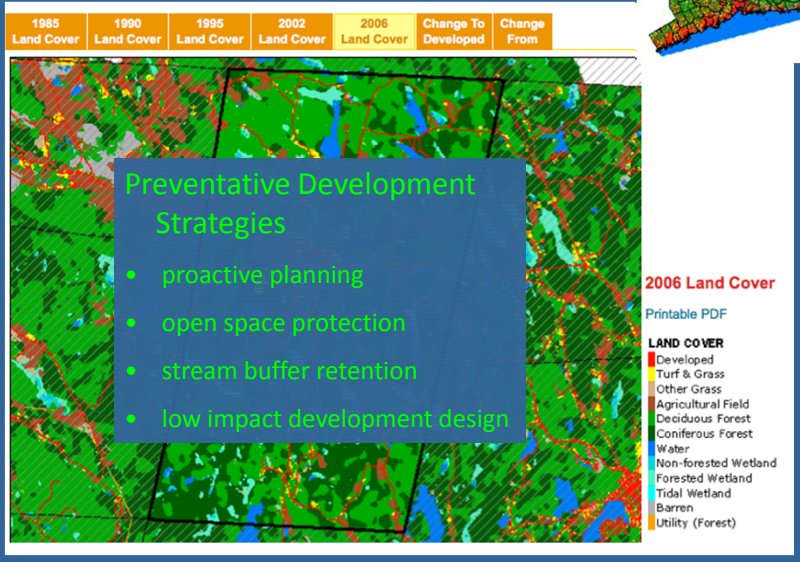



Beyond Impervious Cover
There are other landscape indicators that relate to water quality.
• Forest (Tree) Cover
• Riparian Corridors (Buffers)


Land Cover as indicator…
Forest cover
Impervious cover
Turf cover
Riparian corridor cover

Norfolk

5% developed

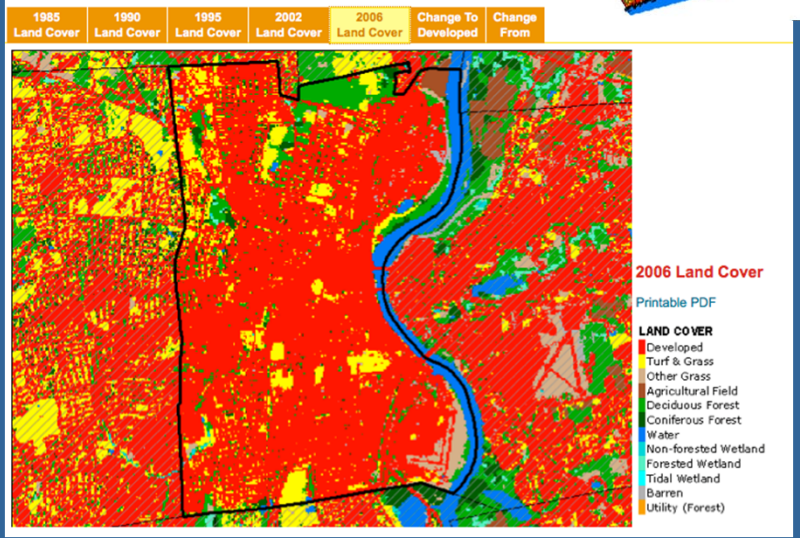


Preventative Development Strategies

- proactive planning
- open space protection
- stream buffer retention
- low impact development design

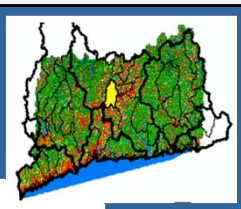
Hartford

72% developed

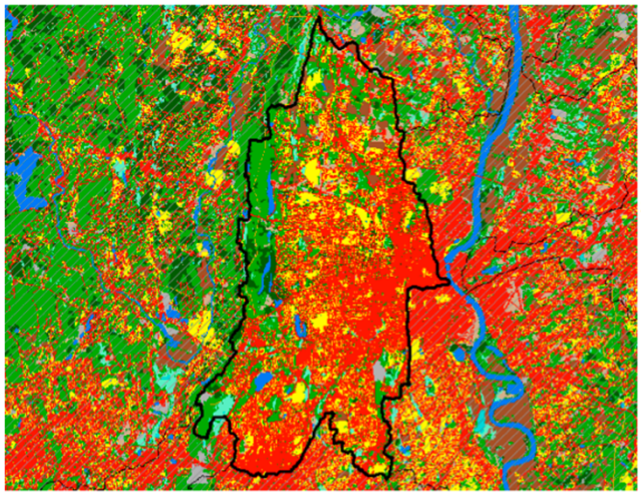


Park River Watershed

46% developed



1985 Land Cover | 1990 Land Cover | 1995 Land Cover | 2002 Land Cover | 2006 Land Cover | Change To Developed | Change From



2006 Land Cover

Printable PDF

- Developed
- Turf & Grass
- Other Grass
- Agricultural Field
- Deciduous Forest
- Coniferous Forest
- Water
- Non-forested Wetland
- Forested Wetland
- Tidal Wetland
- Barren
- Utility(forest)