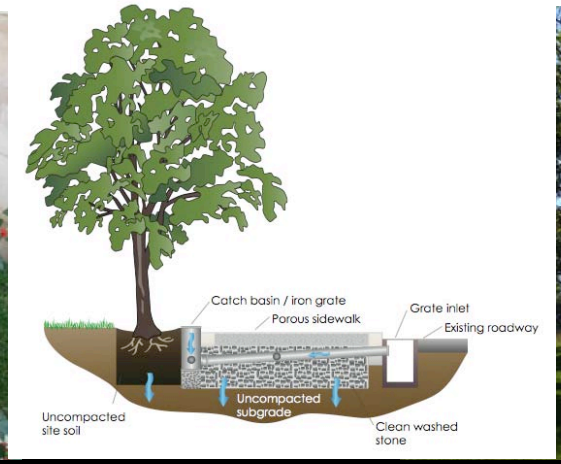
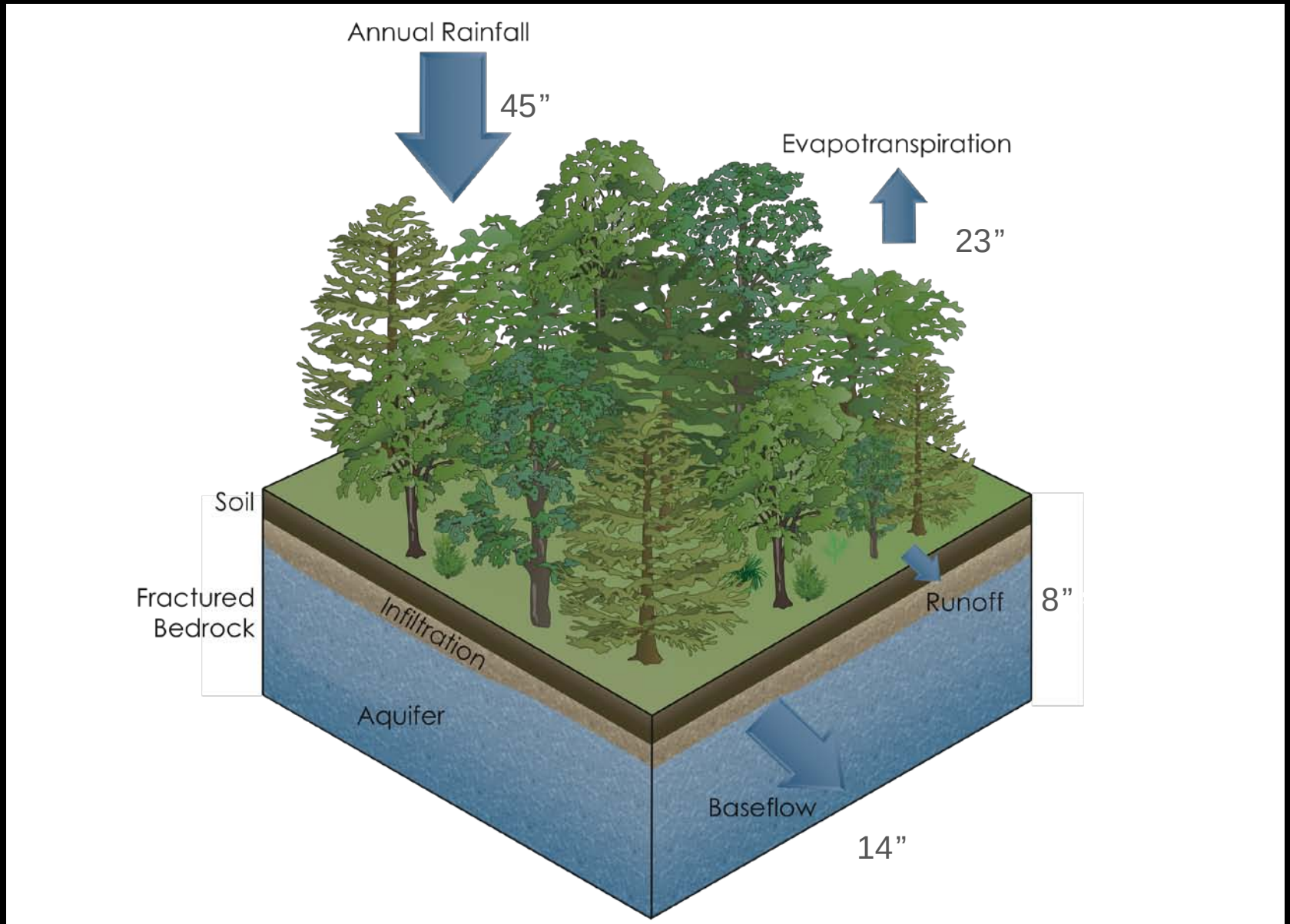
New Directions in Stormwater:
Reconnecting Water, Soils and Vegetation



Michele Adams, P.E. LEED AP

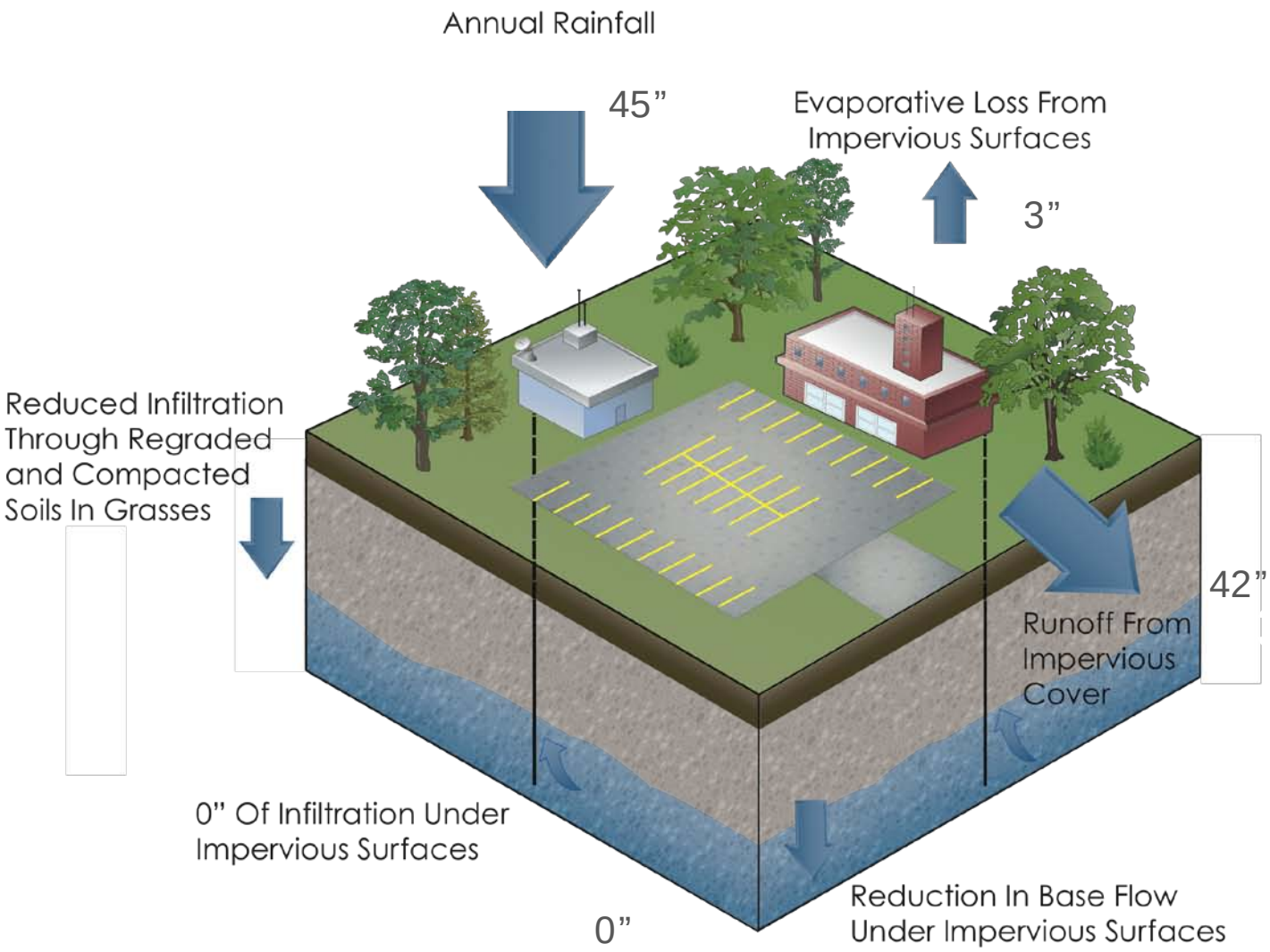
Meliora Environmental Design, LLC
Meliora: Latin for "always better"

Annual Water Cycle for an Average Year




JCPenney

Altered Water Cycle for an Average Year



The way we have been designing for stormwater does <u>not</u> prevent flooding.

And wastes a resource:

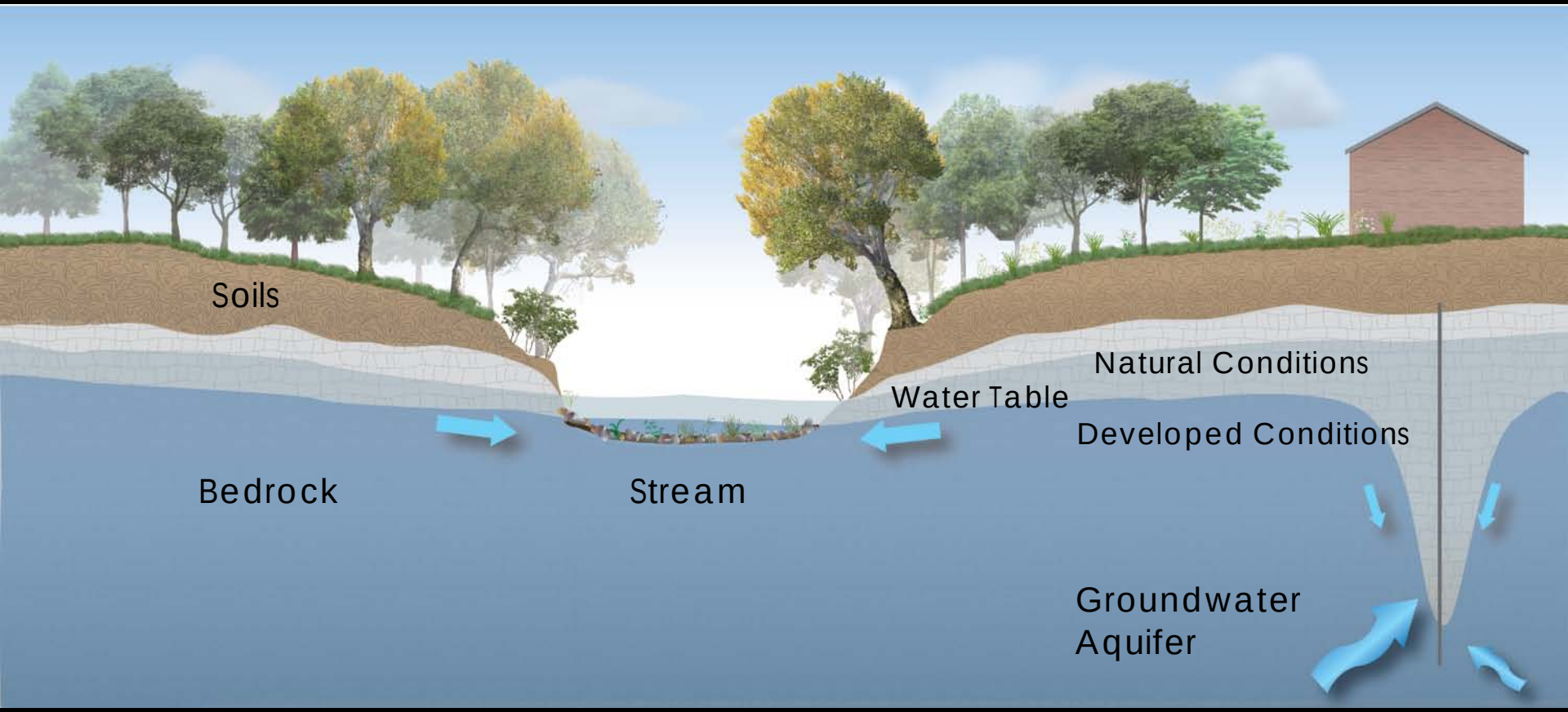
Too much water erodes streams

Very hot / very cold runoff destroys stream life

Loss of baseflow

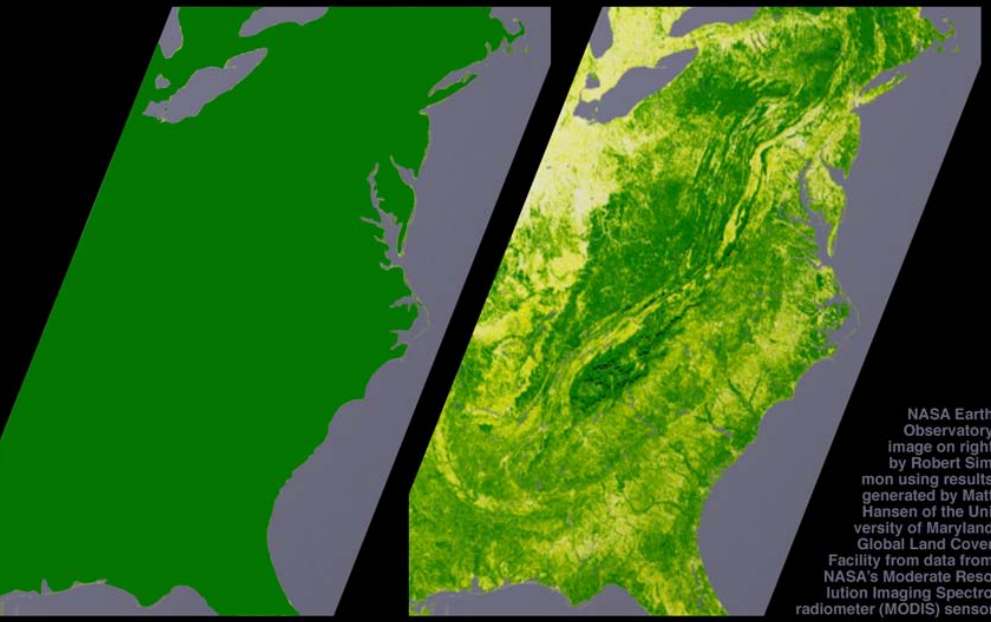
Valley Creek: 200 Detention Basins

Groundwater recharge keeps ours streams flowing and our wells pumping.



It wants to be a forest

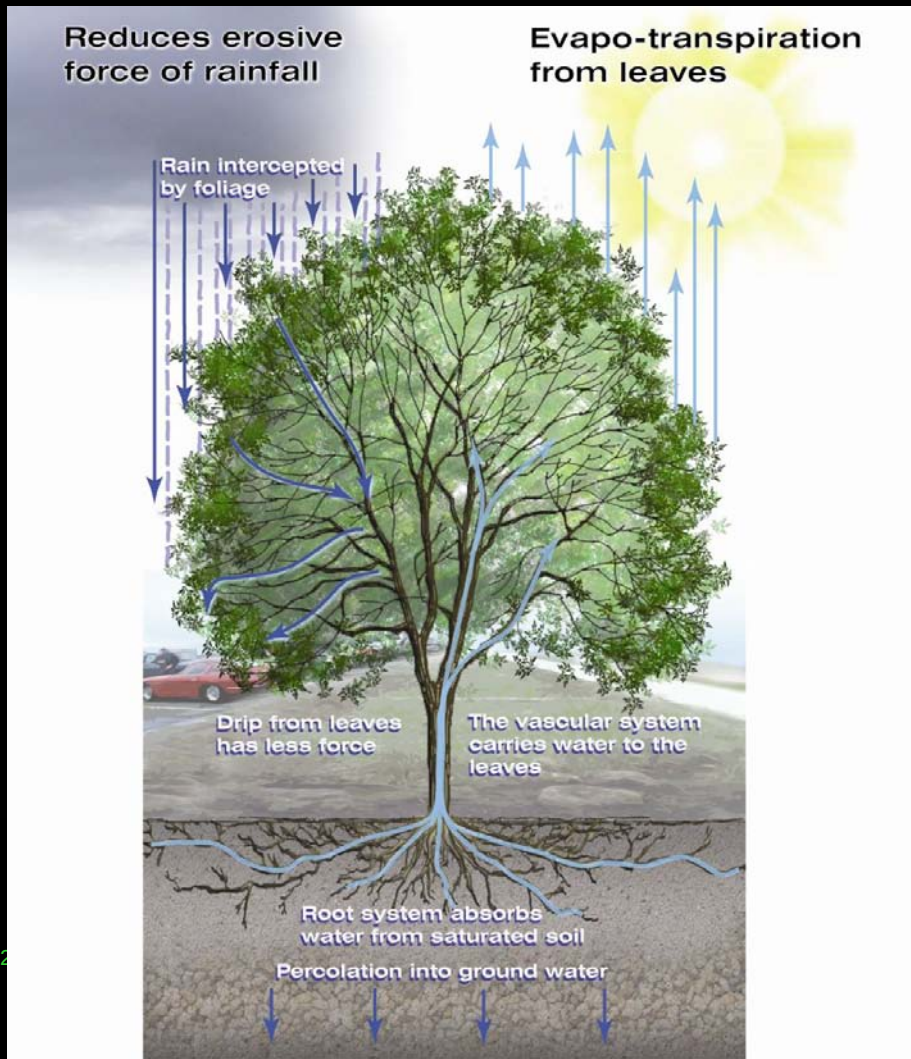
99% of North America was covered by forest from the Atlantic shoreline to the prairies of the Great Plains.
Today only fragments remain.



Pre-European settlement **Present**

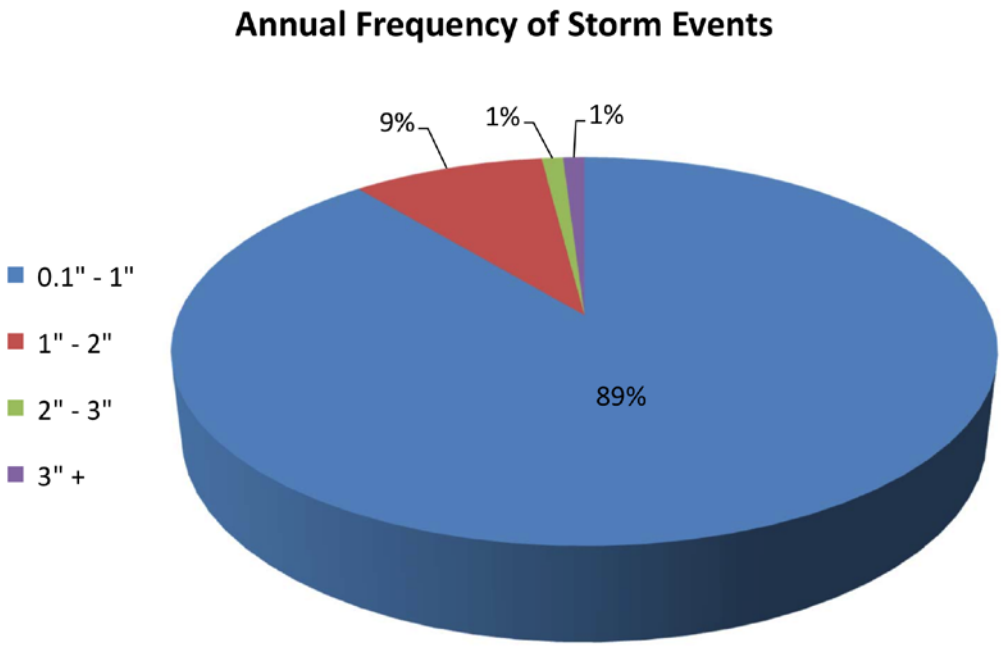
http://earthobservatory.nasa.gov 14 October 2

Image by Viridian LS Studio

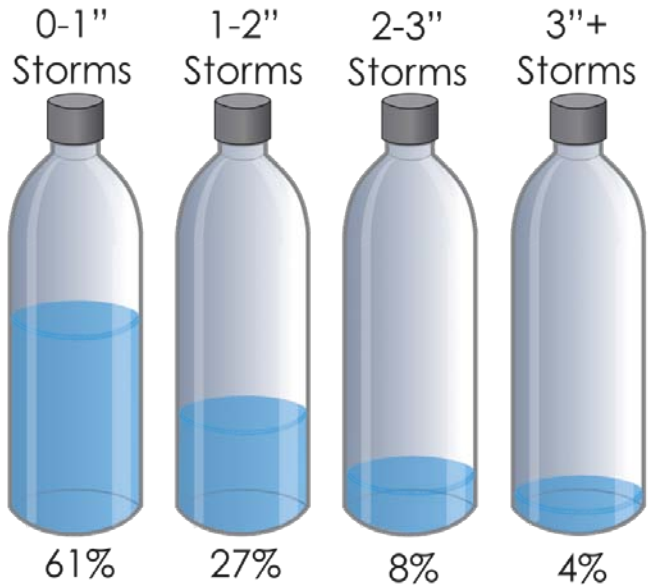


Two important observations:

Frequency: Most of the time, it rains 1 inch or less



Annual Percentages of Volume from Storms



Volume: 96% of the annual rainfall volume of 45 inches is from storms 3 inches or less

Green Infrastructure

- Integrated into the Built Environment
- Paths, Parking, Landscape, Street Trees, Playfields
- Importance of Soil and Vegetation
- Small and Large Storms - Volume
- Sustainable
- Maintenance and Cost

Low Impact Development

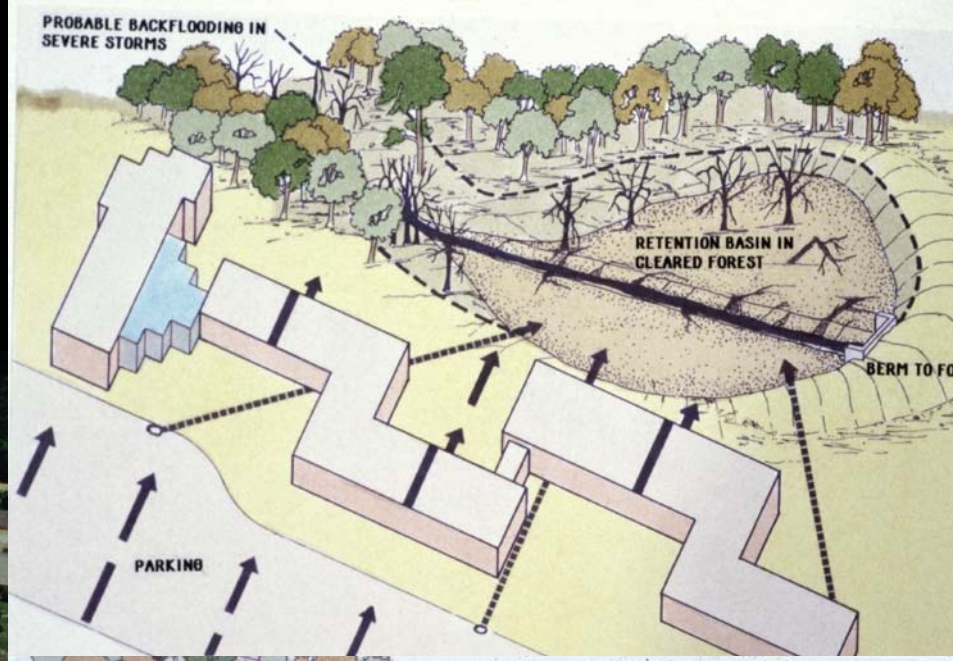
"Allow natural infiltration to occur as close as possible to the original area of rainfall. By engineering terrain, vegetation, and soil features to perform this function, costly conveyance systems can be avoided and the landscape can retain more of its natural hydrologic function."

National Association of Home Builders

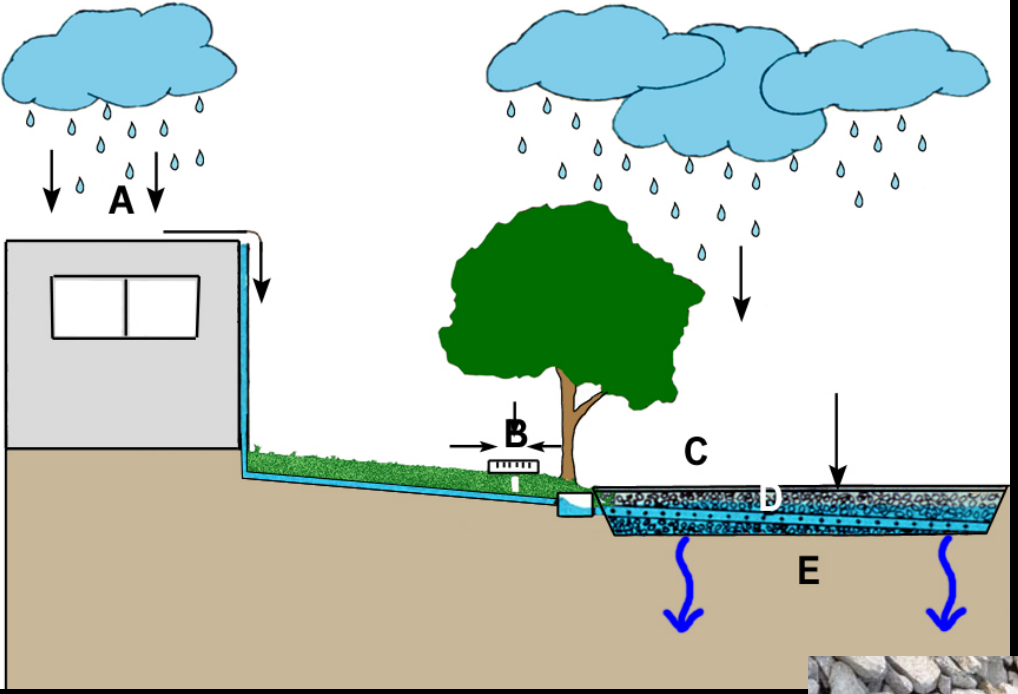
Some Built Examples…..

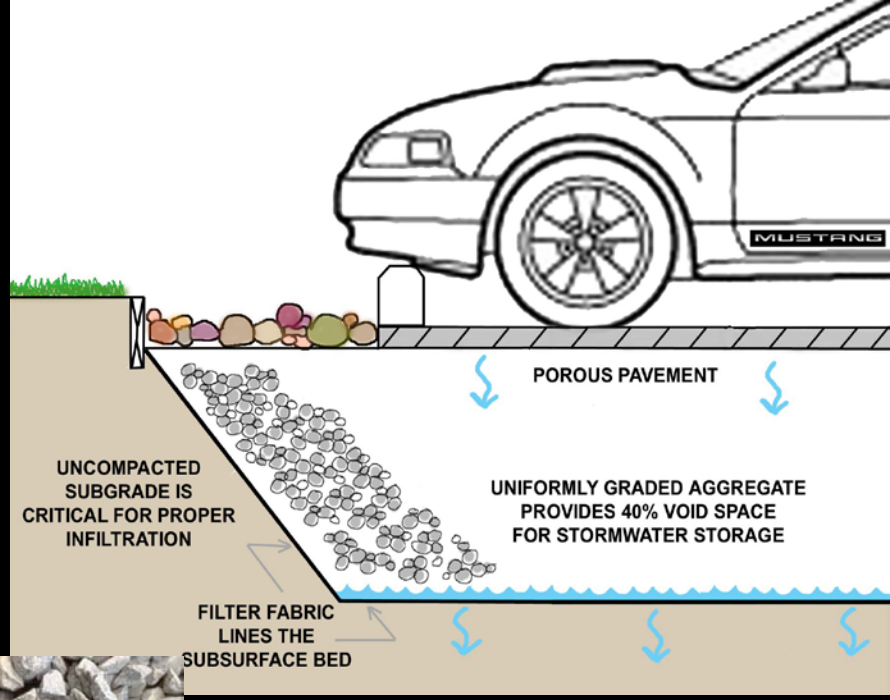
- Office
- New Suburban Residential
- New Suburban Commercial
- Retrofit Basin
- Urban Retrofits

DuPont Barley Mills Office Complex 1986



- Preserve Woodlands
- Reduce Site Disturbance


A
B
C
D
E


MUSTANG
POROUS PAVEMENT
UNCOMPACTED SUBGRADE IS CRITICAL FOR PROPER INFILTRATION
UNIFORMLY GRADED AGGREGATE PROVIDES 40% VOID SPACE FOR STORMWATER STORAGE
FILTER FABRIC LINES THE SUBSURFACE BED

Porous Asphalt Walkways

Swarthmore College

Grey Towers
National Forest Service

Penn State University Park
Porous Concrete Sidewalks

Villanova University
Porous Concrete Plaza


McDonald's
DRIVE-THRU
McDonald's

Commercial: Valley Square Mixed-Use Development

- New “Town” Center
- Wegmans
- Hotel
- Retirement

- Pervious asphalt, stormwater infiltration beds, vegetated swales, rain gardens.

Valley Square

Warrington, PA

- Protected Areas
- Porous Pavement
- Bio-retention

Valley Square Town Center Environmental Benefits

- Protected existing stream corridor and associated wetlands.
- Groundwater recharge maintains baseflow for stream and wetland.
- Reduced extreme floods by 67 percent (Act 167).

Porous Pavement

Infiltration Bed below

Standard Asphalt

Bioretention for Water Quality

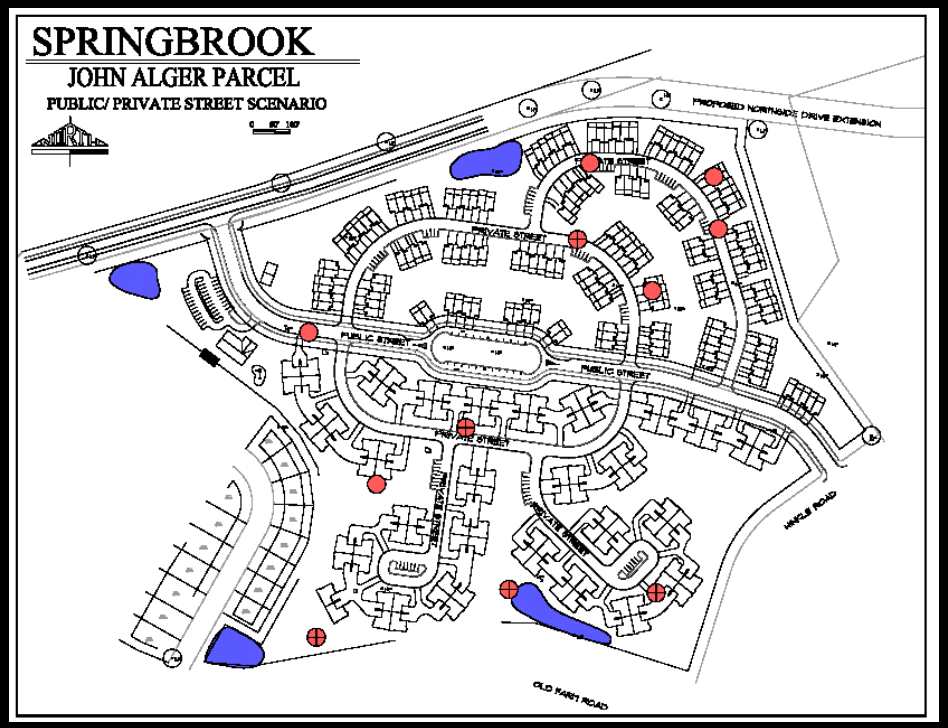
Green Infrastructure Connection

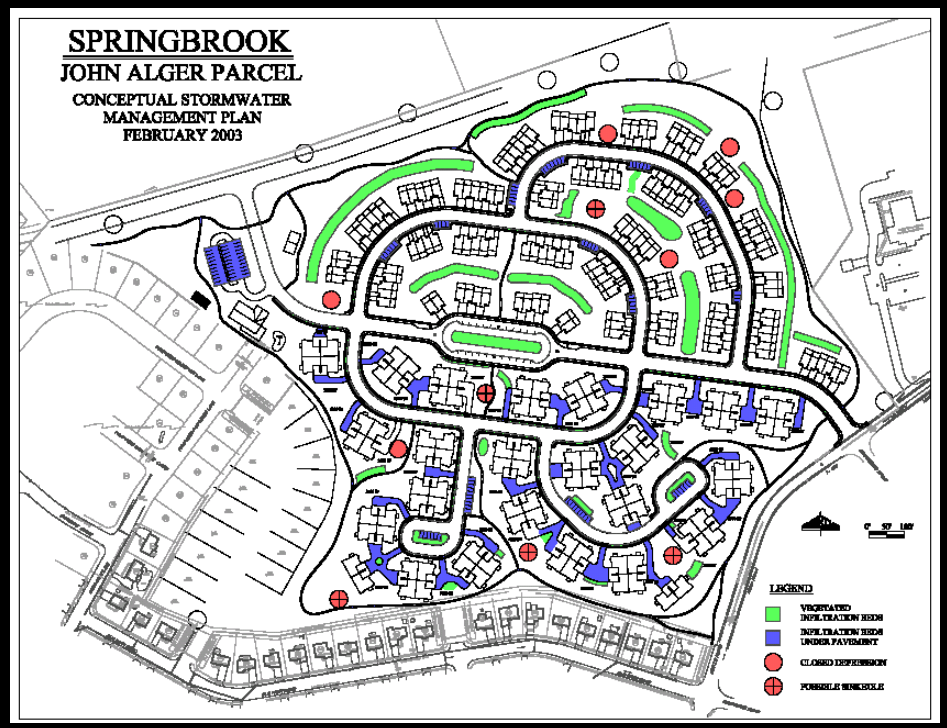
- Initial Treatment of Road Runoff

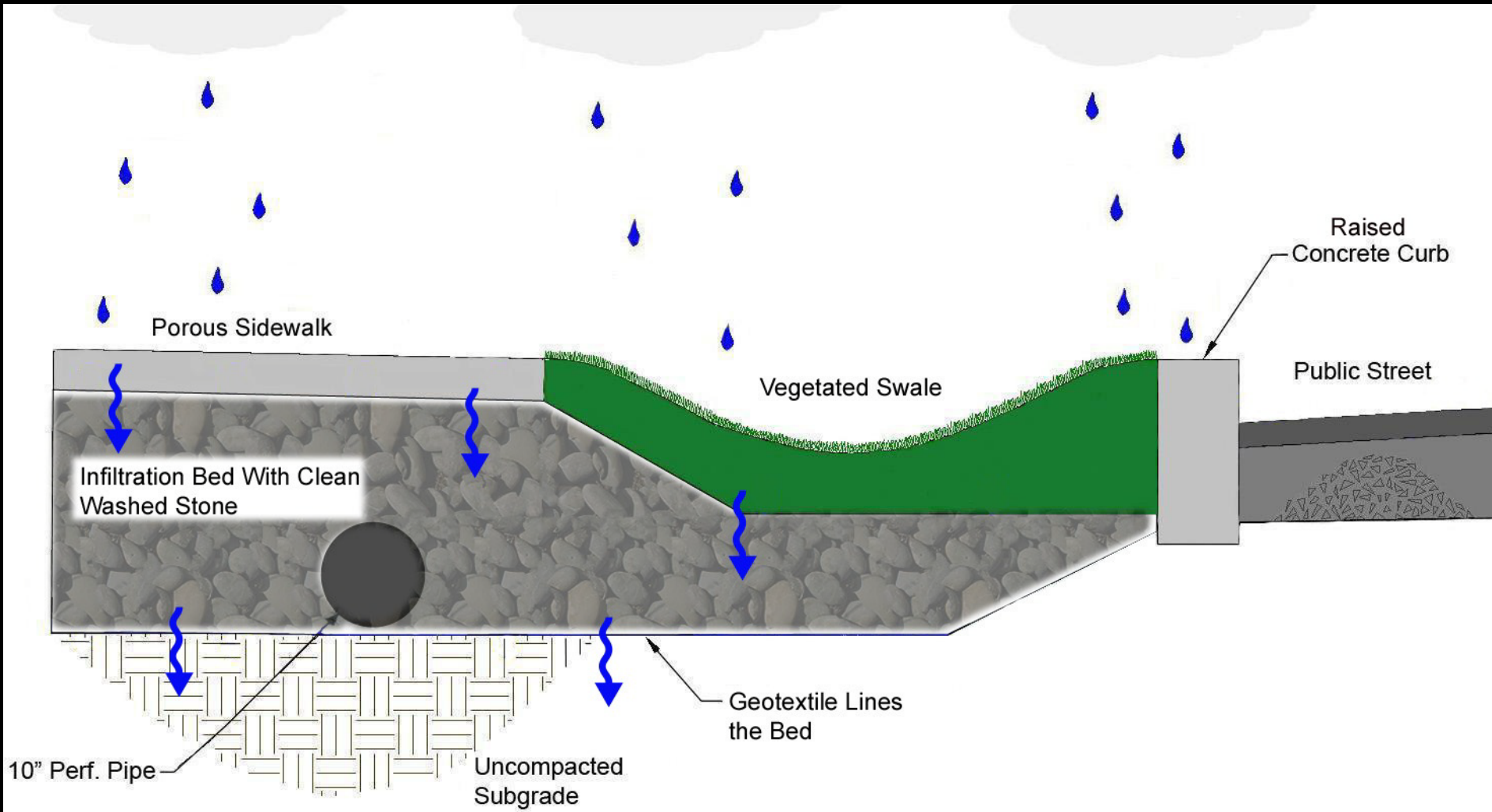
- Flows to Infiltration Beds

New Residential: Village at Springbrook

- High Density Residential
- 59 acres
- 269 homes:
- 146 Townhouses
- 96 Quads
- 17 Singles
- Sinkholes and limestone







Integration of Stormwater into Urban Streetscape
Porous Sidewalk and Swale with Raised Curb


TA30


CAT
TA30
312C CAT


CAT


PENNSY SUPPLY

Rain gardens

- Formal Plantings
- Maintained by Landscape Firm

Townhomes

- Disconnect Downspout
- Infiltration Meadow

East Whiteland Basin Retrofit

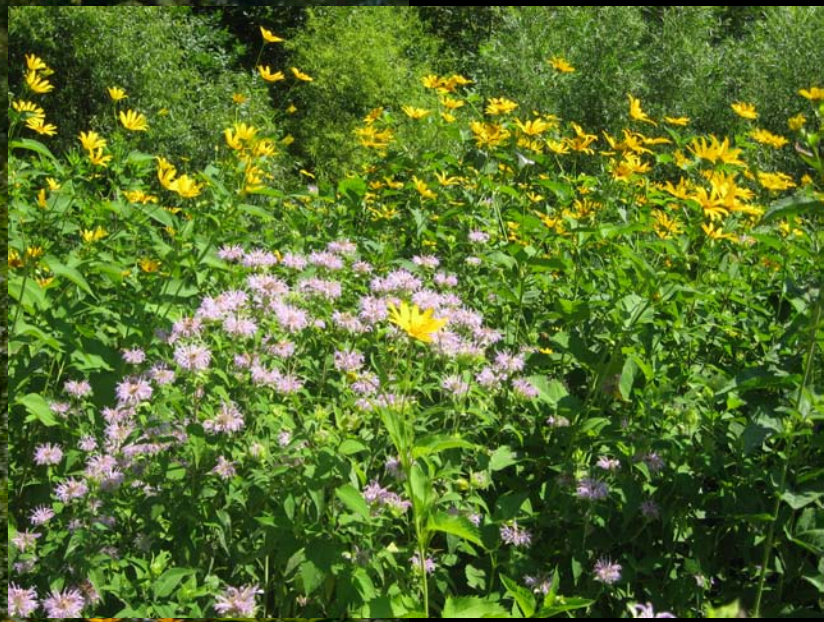
Improve Water Quality, Reduce Flooding, Reduce Erosion

Installation – April 2006

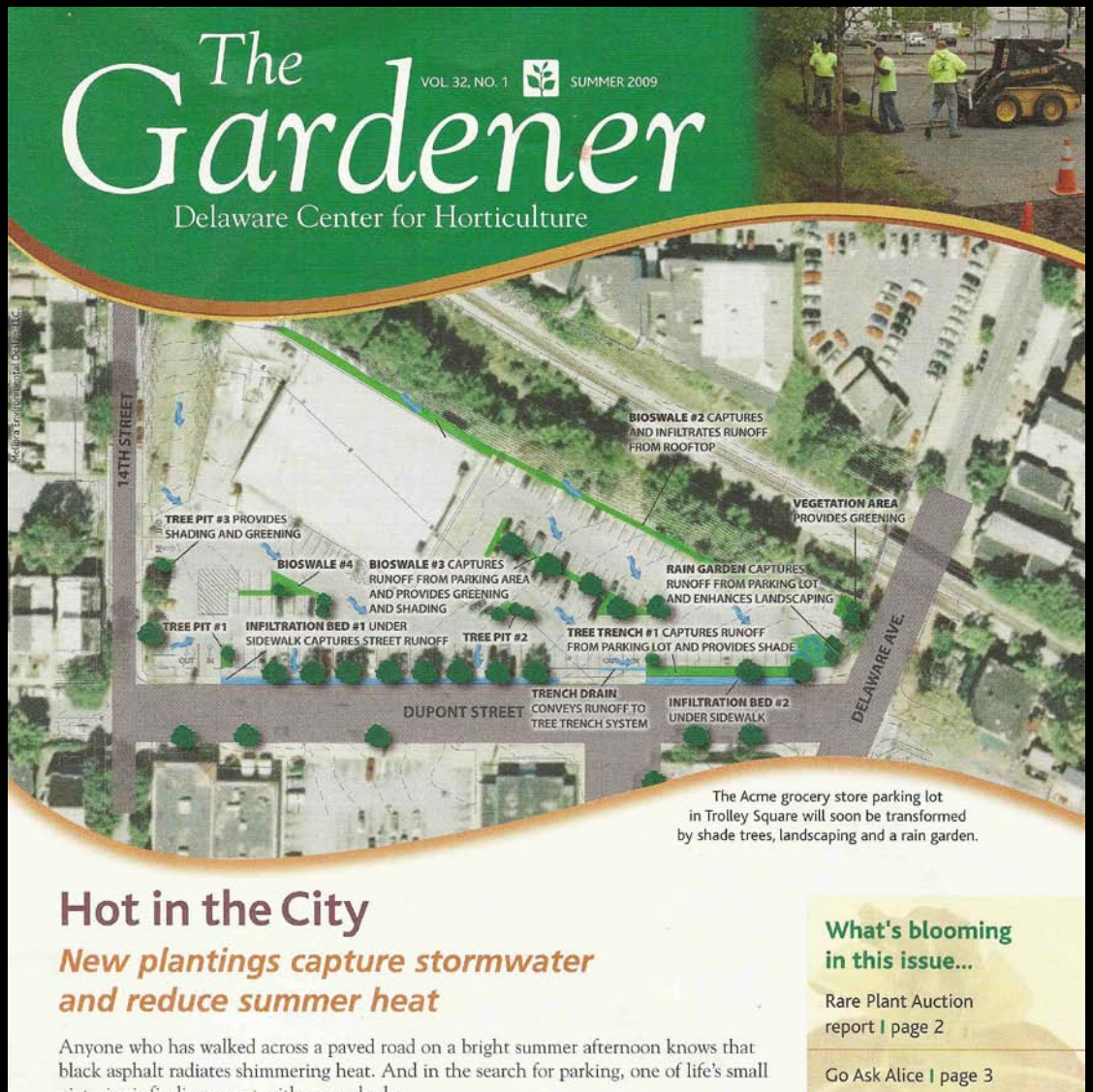
Modify the outlet – hold small storms (1”)

East Whiteland Basin Retrofit

Site Assessment – May 2007



Urban Commercial Retrofit: Urban Grocery Store in Wilmington



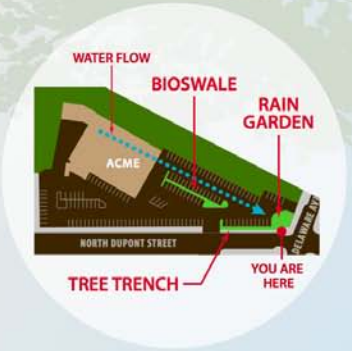
- City and Delaware Horticultural partnership
- Urban Heat Island Cooling
- Capture 1” from Street and Store

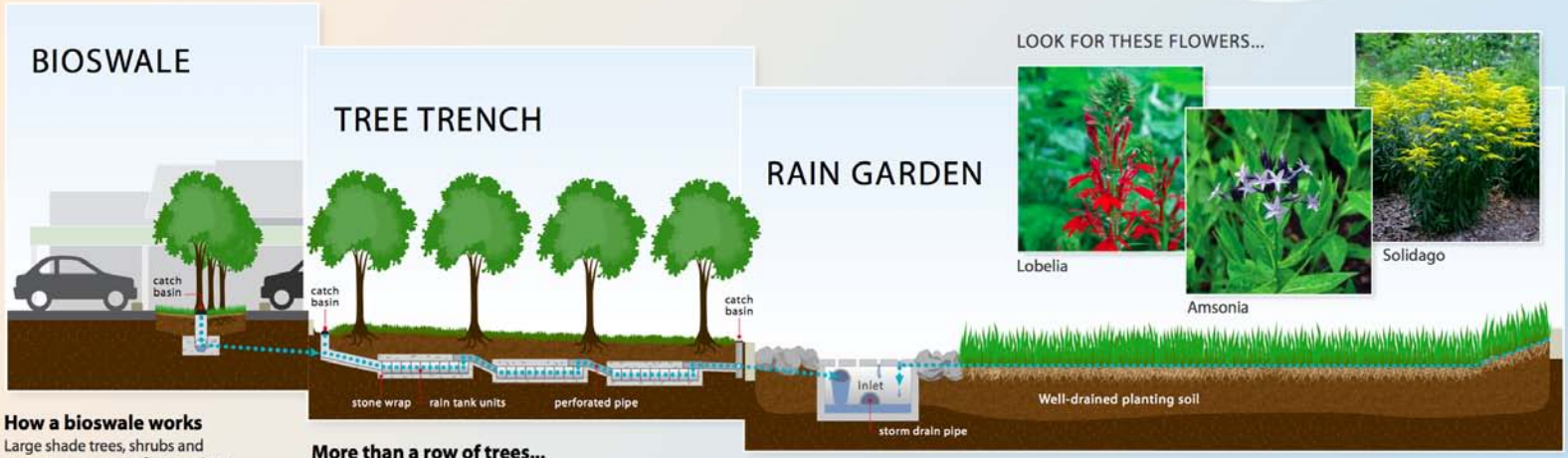
Landscaping for Rainwater Management

A special system to reduce the water in our storm drains is hidden in this parking lot. Can you see it?

When Trolley Square was first built, pipes were installed under the street to carry both rainwater and sewage out to the Brandywine River. Small streams were also buried in pipes and redirected through the same plumbing as the rain and sewage. For instance, a stream called Rattlesnake Run is flowing under your feet.

Today the pipes are routed through a treatment plant, but in heavy rains, the combined system is overwhelmed and polluted water still dumps directly into the river. In this parking lot, trees and a series of underground holding tanks are filtering, absorbing and slowing down the rainwater before it enters our storm drains.





LOOK FOR THESE FLOWERS...

Lobelia

Amsonia

Solidago

How a bioswale works

Large shade trees, shrubs and grasses capture rain flowing down the parking lot. Roots of these plants filter and absorb the first phase of water. A small catch basin at the low end gathers overflow.

More than a row of trees...

Buried under a row of large shade trees along Dupont Street are three stepped storage tanks. They are connected to the bioswale overflow by a pipe under the parking lot. The storage tanks are open at the bottom, allowing rain to slowly soak back into the soil and water the trees.

What is a rain garden?

This rain garden collects water from two directions: the extra water flowing down the parking lot plus overflow from the storage tanks in the tree trench. If this low area fills up during heavy rain, it eventually enters the storm pipes. An assortment of shrubs, grasses and flowering plants has been specially selected to tolerate a wide range of water conditions — from completely dry to temporarily submerged.

THE DCH Delaware Center for Horticulture
People and Plants · Grow With Us

PROJECT SPONSORS

- New Castle County Conservation District
- US Forest Service
- City of Wilmington - Office of Economic Development
- City of Wilmington - Department of Public Works
- DE Department of Natural Resources & Environmental Control
- Acme
- Delaware Nature Society
- US Environmental Protection Agency

Learn more: TheDCH.org


ACME

Greening Greenfield School - Philadelphia

Aerial looking East


STOP
BONNERS