Green Infrastructure for Stormwater Management in Syracuse, New York

Atlantic States
Legal Foundation, Inc.

Onondaga County Department of
WATER
ENVIRONMENT
PROTECTION

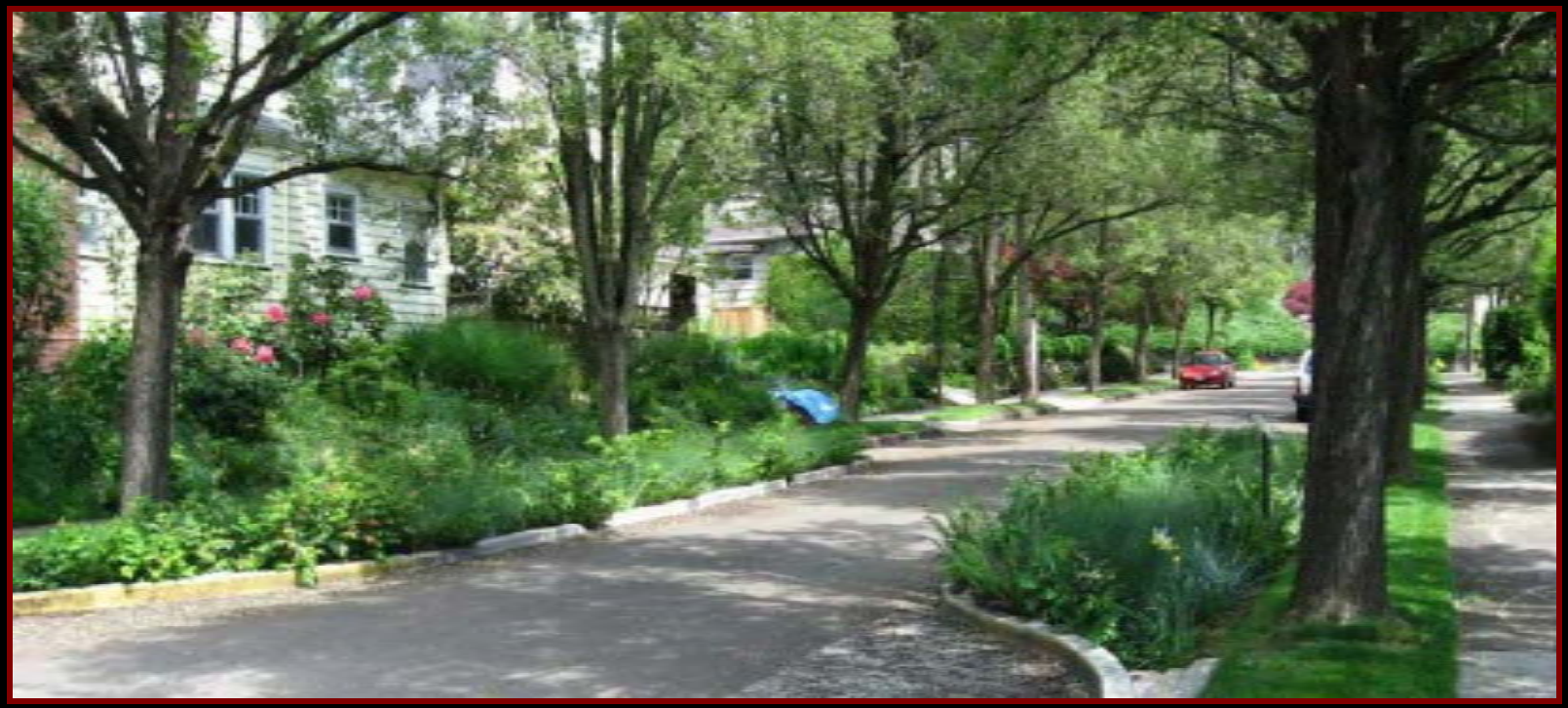
SYRACUSECoE
EXCELLENCE IN ENVIRONMENTAL & ENERGY INNOVATIONS

SECTION I

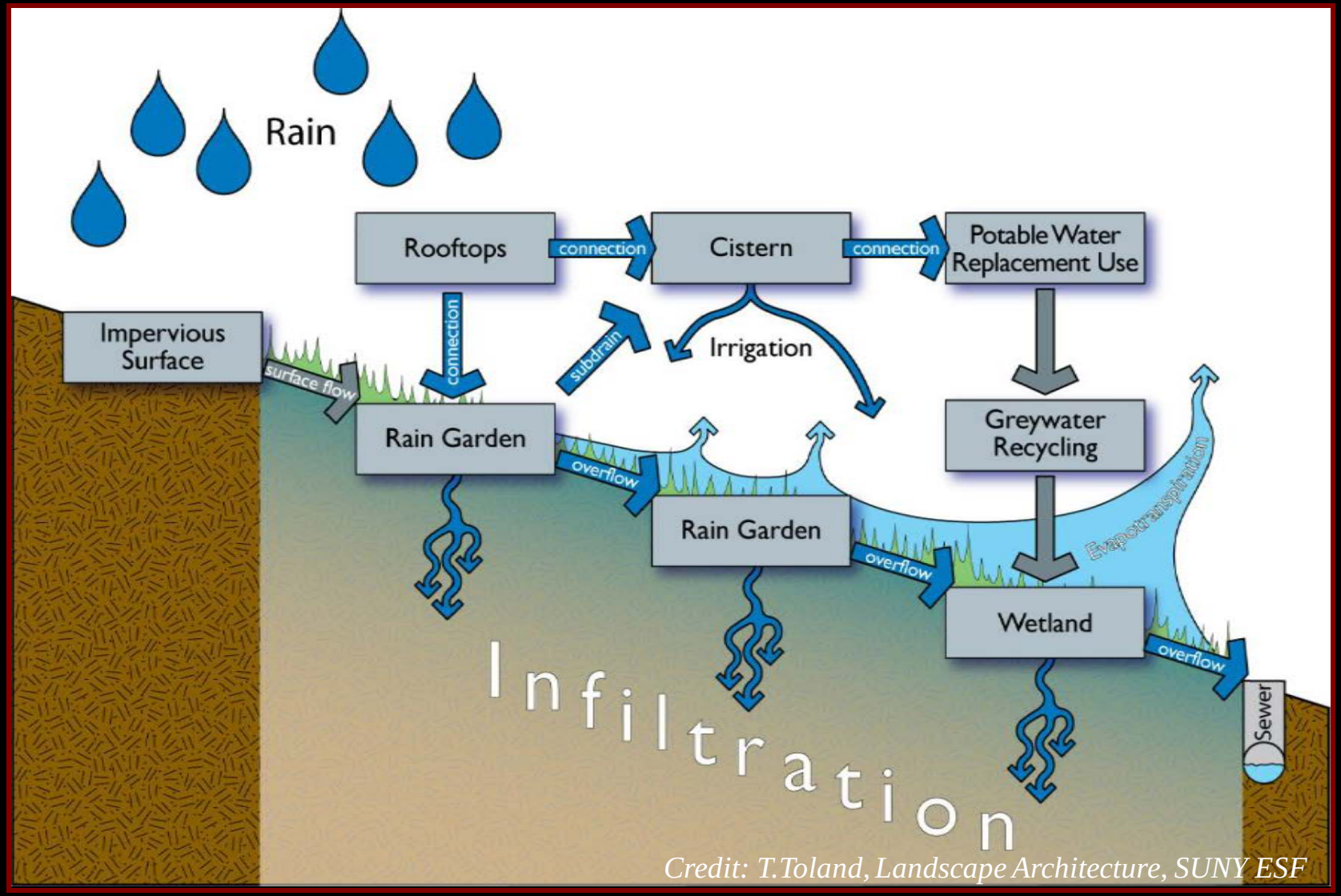
Green Infrastructure Technologies

What is Green Infrastructure?

- ***Green Infrastructure*** refers to the ecological processes, both natural and engineered, that act as living infrastructure. Green Infrastructure elements are planned and managed primarily for stormwater control, but also exhibit social, economic and environmental benefits.

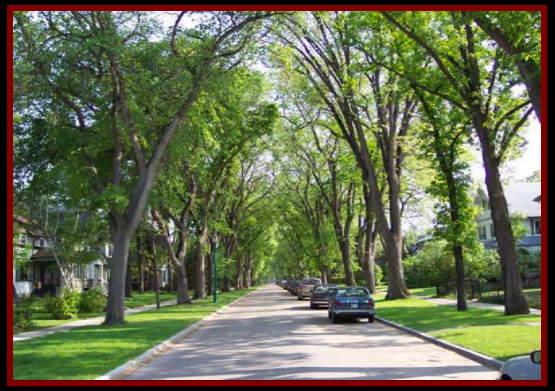


Green Infrastructure Systems



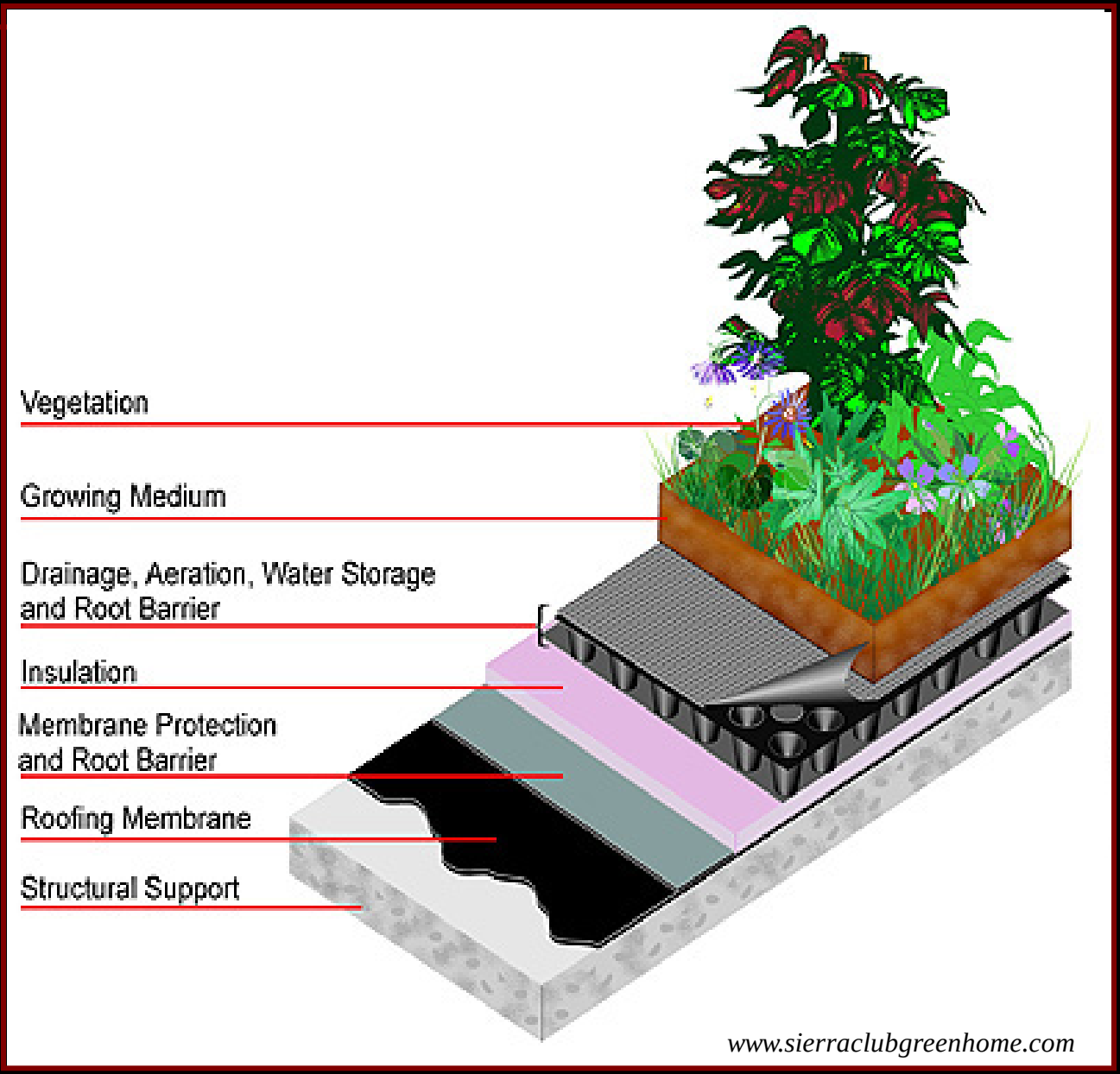
Example Applications of Green Infrastructure

- Bioretention/Vegetated Infiltration
  - Green roofs
  - Rain Gardens
  - Vegetated curb extensions
  - Tree trenches
  - Stormwater Planter
- Rain Capture/Re-use
  - Cisterns/rain barrels
- Permeable Pavement
  - Parking Lot/Sidewalks/Sport Courts
- Urban Forestry
- Green Streets
  - Combinations of the above



Green Roofs

- Typical Layers of Green Roof



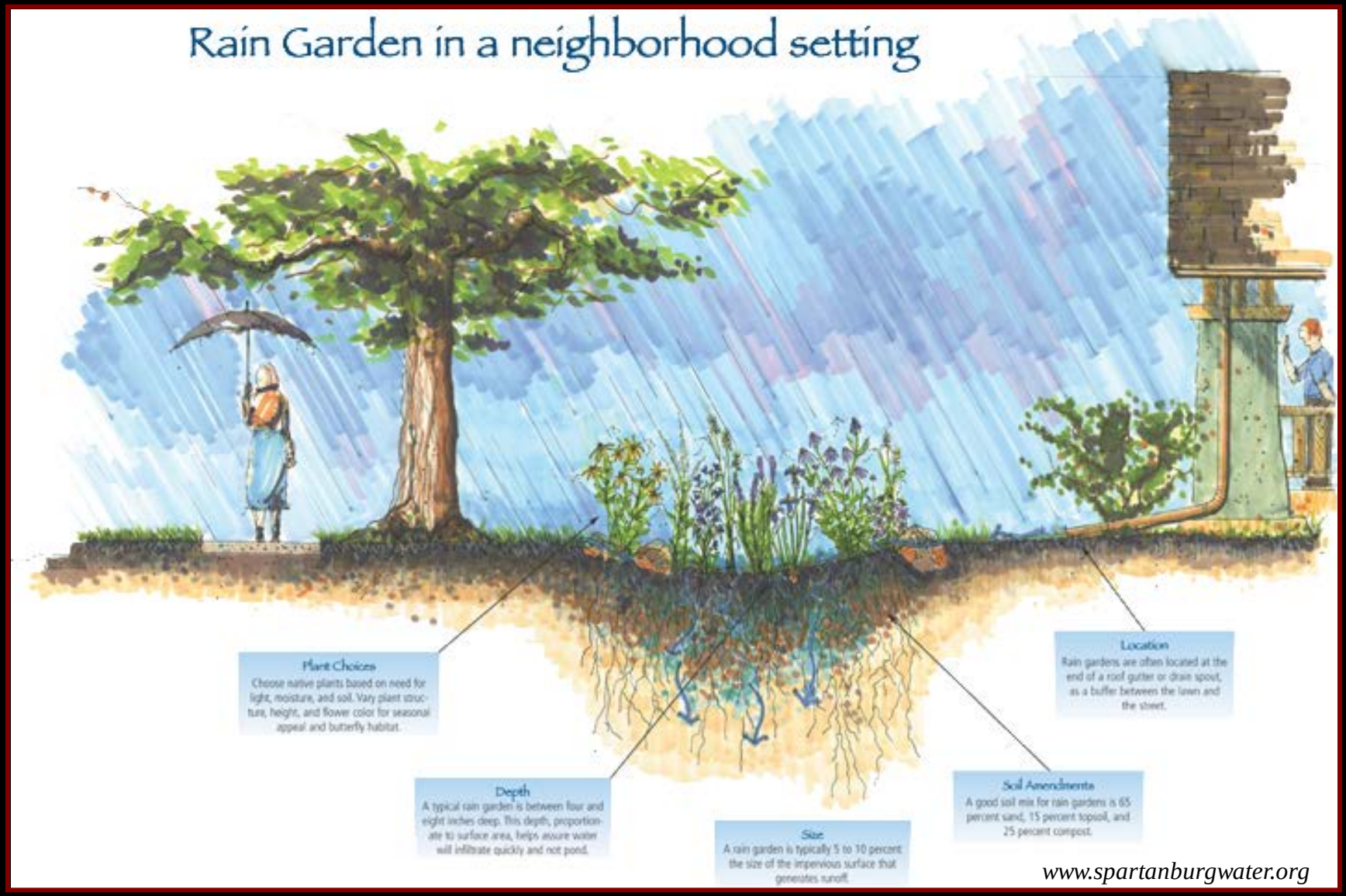
Green Roofs

- Can Be as Big as the one on the top of the Chicago City Hall Building …

Green Roofs

- … or as small as this on a dog house …

Rain Gardens



Rain Gardens

Vegetated Curb Extension

NE Siskiyou Green Street, Portland, Oregon. *Photo by Kevin Robert Perry.*

Bioswales/Vegetated Trenches

Stormwater Planters

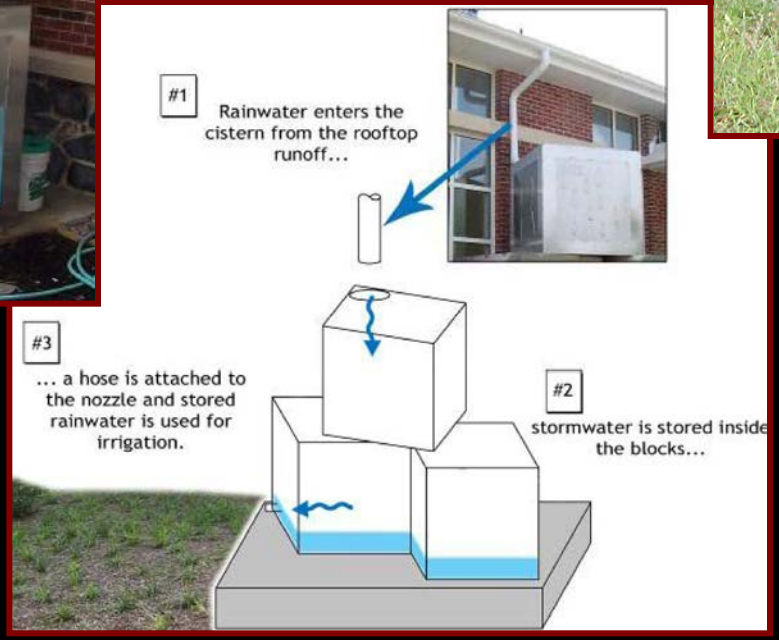
NE Siskiyou Green Street, Portland, Oregon.
Photo by Kevin Robert Perry.

Vegetated Planter at Portland State University.
Photo by Martina Keefe.

Rain Barrels and Cisterns

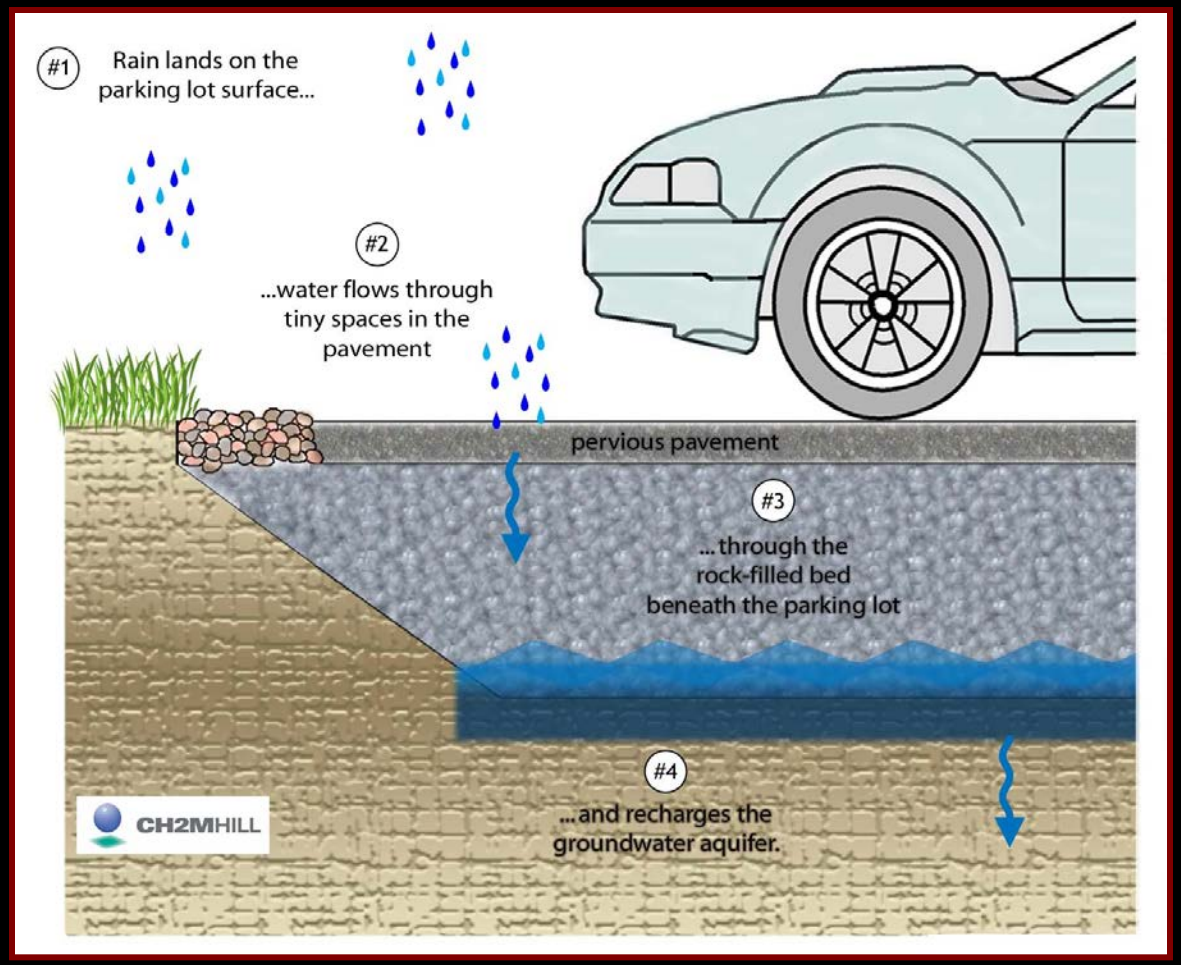
- *Disconnecting Downspouts*

- Rain Cistern



- Rain Barrel

Permeable Pavement



Porous Asphalt Cross Section (no curb)

CH2MHILL

Green Streets

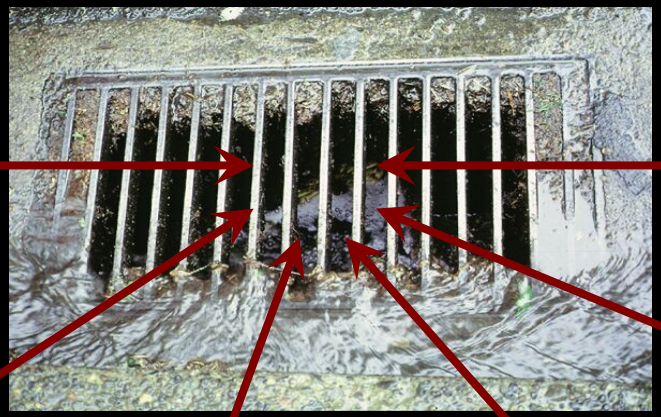
NE Siskiyou Green Street, Portland, Oregon. *Photo by Kevin Robert Perry.*

- A street that uses vegetated facilities to manage stormwater runoff at its source is referred to as a Green Street.
- A Green Street is a sustainable stormwater strategy that meets regulatory compliance and resource protection goals by using a natural systems approach to manage stormwater, reduce flows, improve water quality and enhance watershed health. *www.portlandonline.com*

SECTION II
How Can Green Infrastructure Help Syracuse?

Stormwater Issues

- *Surface Run-off and Water Pollution in Urban Environment*

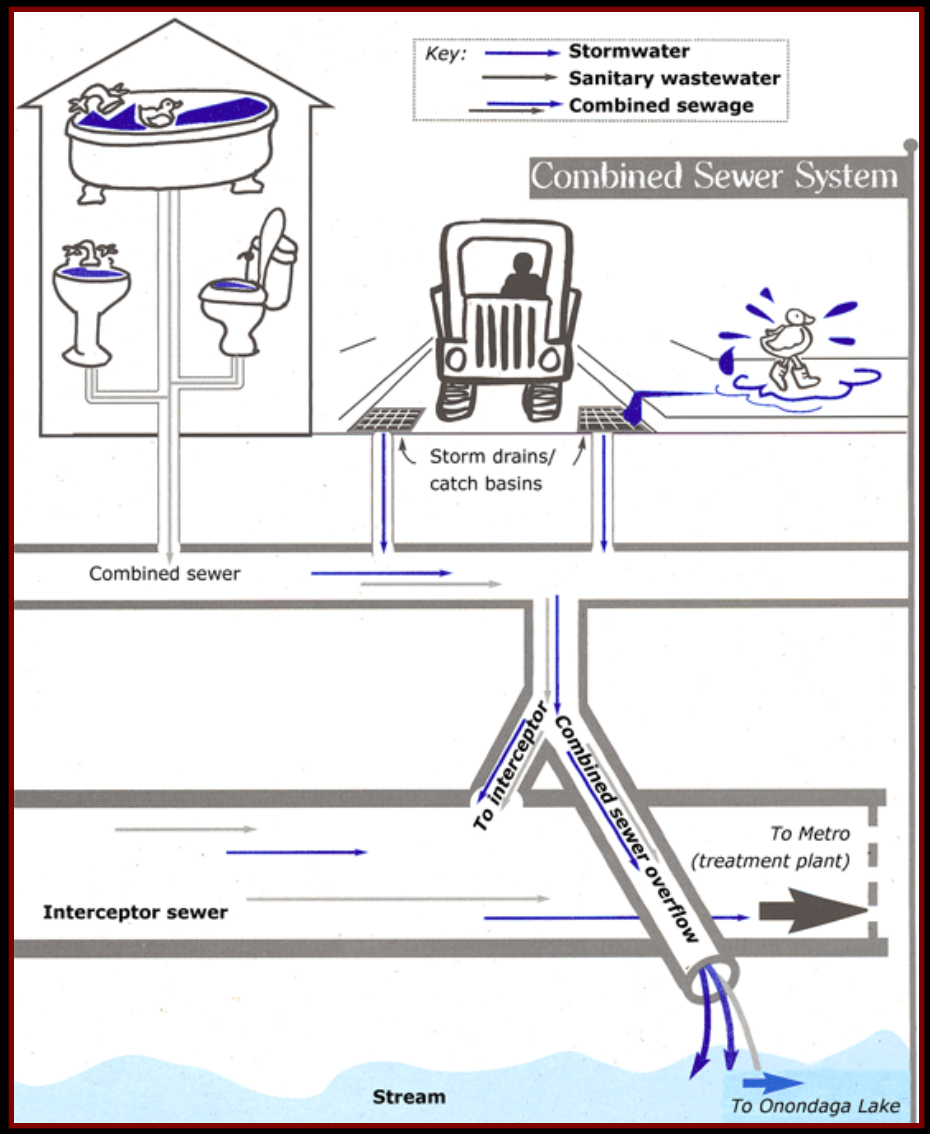


Credit: Nancy Stoner, NRDC

- Urban impervious surfaces generate extraordinary stormwater run-off, which brings various pollutants from urban environment to sewer system and may discharge directly into streams, rivers and lakes as overflow.

Stormwater Issues - *CSO*

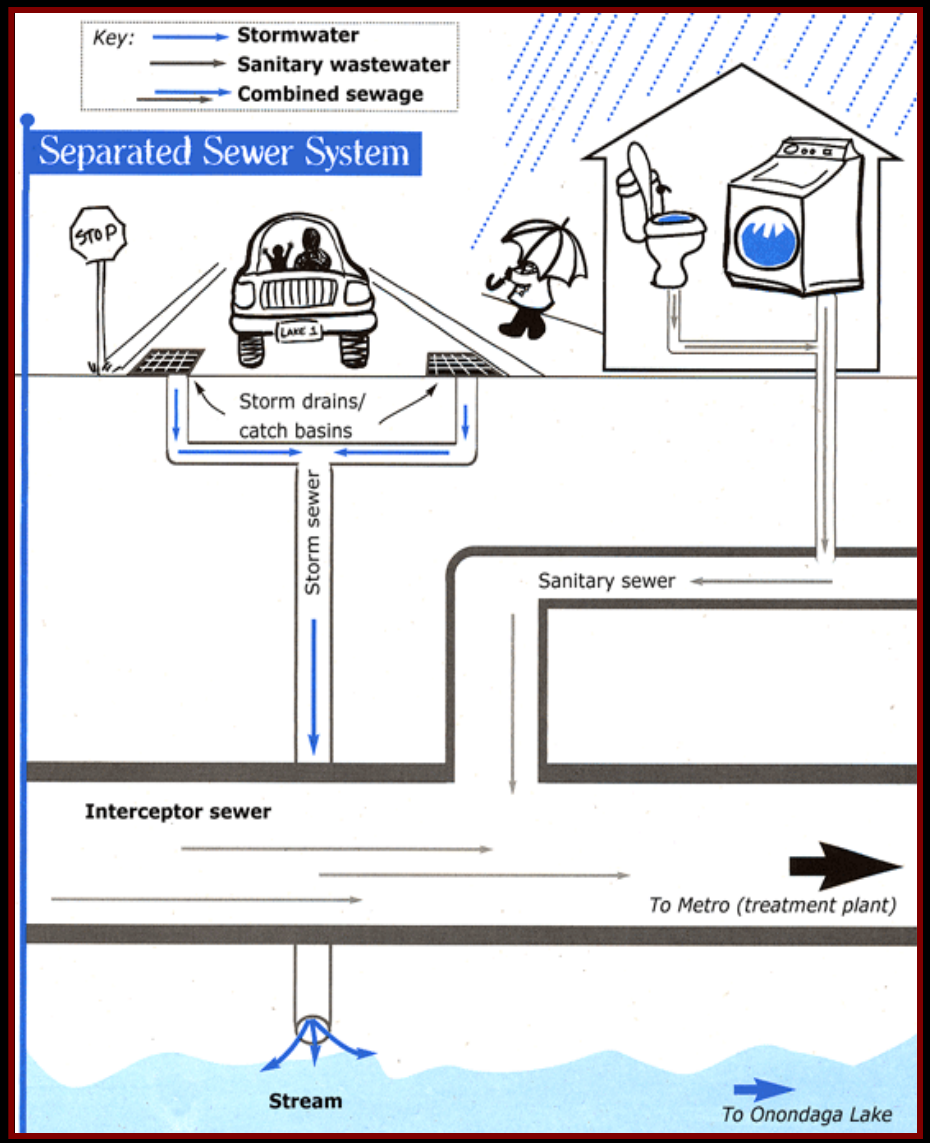
- Combined sewer systems are sewers that are designed to collect rainwater runoff, domestic sewage, and industrial wastewater in the same pipe. Combined sewer systems are designed to overflow occasionally and discharge excess wastewater (Combined Sewer Overflow) directly to nearby streams, rivers, or other water bodies.
- 637 milion gallons of untreated combined sewage in Syracuse is currently discharged per year into Onondaga Lake. *(CH2M HILL)*



- Combined Sewer System *www.ongov.net*

Stormwater Issues - *CSO*

- In 1998, under an Amended Consent Judgment (ACJ), Onondaga County began to abate combined sewer overflows (CSO) from impacting tributaries that enter Onondaga Lake by using traditional methods of conveyance pipes and treatment facilities (gray infrastructure).



- Separated Sewer System

Gray Infrastructure for CSO Abatement

The Metropolitan Wastewater Treatment Plant (Metro)

Installing the 144-inch pipe near Midland RTF (June 2006)

In the past few years in Onondaga County

- Over 13 sewer separation projects were completed
- Construction of the Midland and Hiawatha Regional Treatment Facilities were completed
- Five floatable control facilities
- Proposed construction of RTF's in Clinton and Harbor Brook Sewer Sheds

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Green Infrastructure as a Component of Comprehensive Stormwater Management Plan

Rendering of a bioretention area & park on a vacant property at Near Westside, Syracuse.
Credit: Alexander Shisler from Atlantic States Legal Foundation, Inc.

- The green infrastructure techniques are not supposed to solve the stromwater problems single-handedly.
- However, incorporating green infrastructure into stormwater management system can delay and reduce the volume of "peak flow“, which will consequently reduce the CSO volume and make the gray infrastructure more workable.

Green Infrastructure as a Component of Comprehensive Stormwater Management Plan

Green infrastructure REDUCES…

- Flooding
- Erosion
- Stormwater runoff volume
- Stormwater pollutant loadings
- CSOs
- Gray infrastructure operation, maintenance, energy and treatment costs

Green Infrastructure IMPROVES…

- Water quality
- Air quality
- Neighborhood aesthetics
- Habitat and biodiversity
- Recreational and Educational opportunities
- Property values
- Community health and vitality

Gray-Green Infrastructure Program for Onondaga County

A Balanced Approach to Abating CSO and More:

- **Gray Infrastructure**

  Additional projects planned for:

  - Clinton Sewershed: Storage at Trolley Lot
  - Erie Boulevard Storage System Improvements
  - Franklin Sewershed: Storage at Schiller Park or alternate location
  - Midland Sewershed: Connect CSO 044 to RTF

CH2MHILL

Gray-Green Infrastructure Program for Onondaga County

A Balanced Approach to Abating CSO and More:

- **Green Infrastructure**
  - 26 individual demonstration project prototypes were developed
  - Design and Implementation processes are underway
  - Projects will demonstrate:
    - Green Infrastructure Designs that can be readily applied to Onondaga County and repeated
    - Benefit to Water Quality
      - Green Infrastructure manages pollutants “at the source” and prevents migration to the lake
    - Benefit to Community
      - Green Infrastructure improves neighborhood aesthetics, quality of life and is an investment that people desire

Gray-Green Infrastructure Program for Onondaga County

Onondaga County's approach to Implementing green infrastructure

- The Save-the-Rain program developed to implement green infrastructure throughout the community. Program highlights:
  - Public Education and Outreach campaign
  - Urban Forestry Grant in Clinton sewershed
  - Demonstration Projects moving forward including green roofs, porous pavement, rain gardens, planter boxes, tree trenches and rain barrels
  - Development of matching grant program for "green" projects on private properties

SECTION III Case Study
Green Infrastructure for Stormwater Management in North America

This section is adapted from the presentation, ***Rooftops to Rivers***, by Nancy Stoner from Natural Resources Defense Council (NRDC)

Chicago, Illinois

Chicago City Hall Green Roof. *Photo courtesy of Roofscapes, Inc.*

- More than 80 green roofs totaling over 1 million square feet.
- A 2003 study found green roof runoff volume was less than half that of conventional roofs.
- Temperatures above the Chicago City Hall green roof average 10° to 15°F lower than a nearby black tar roof. August temperature difference can be as much as 50°F. Estimated annual energy savings of $3,600.

Chicago, Illinois (cont.)

Green Bungalows. *Photo courtesy of the Chicago Department of the Environment.*

- Subsidized rain barrel program used to reduce basement flooding and CSO volume.
- Downspout disconnection projected to reduce CSO peak flow in target area by 20%.
- Green bungalow initiative to retrofit four historic bungalows with green technologies. Average energy savings of 15% - 49%.

Milwaukee, Wisconsin

MMSD Green Roof. *Photo courtesy of MMSD.*

- Green roofs, bioretention and rain barrels used to reduce combined sewer inflow.
- Green infrastructure expected to reduce CSO volume by 14-38%.

Milwaukee, Wisconsin (cont.)

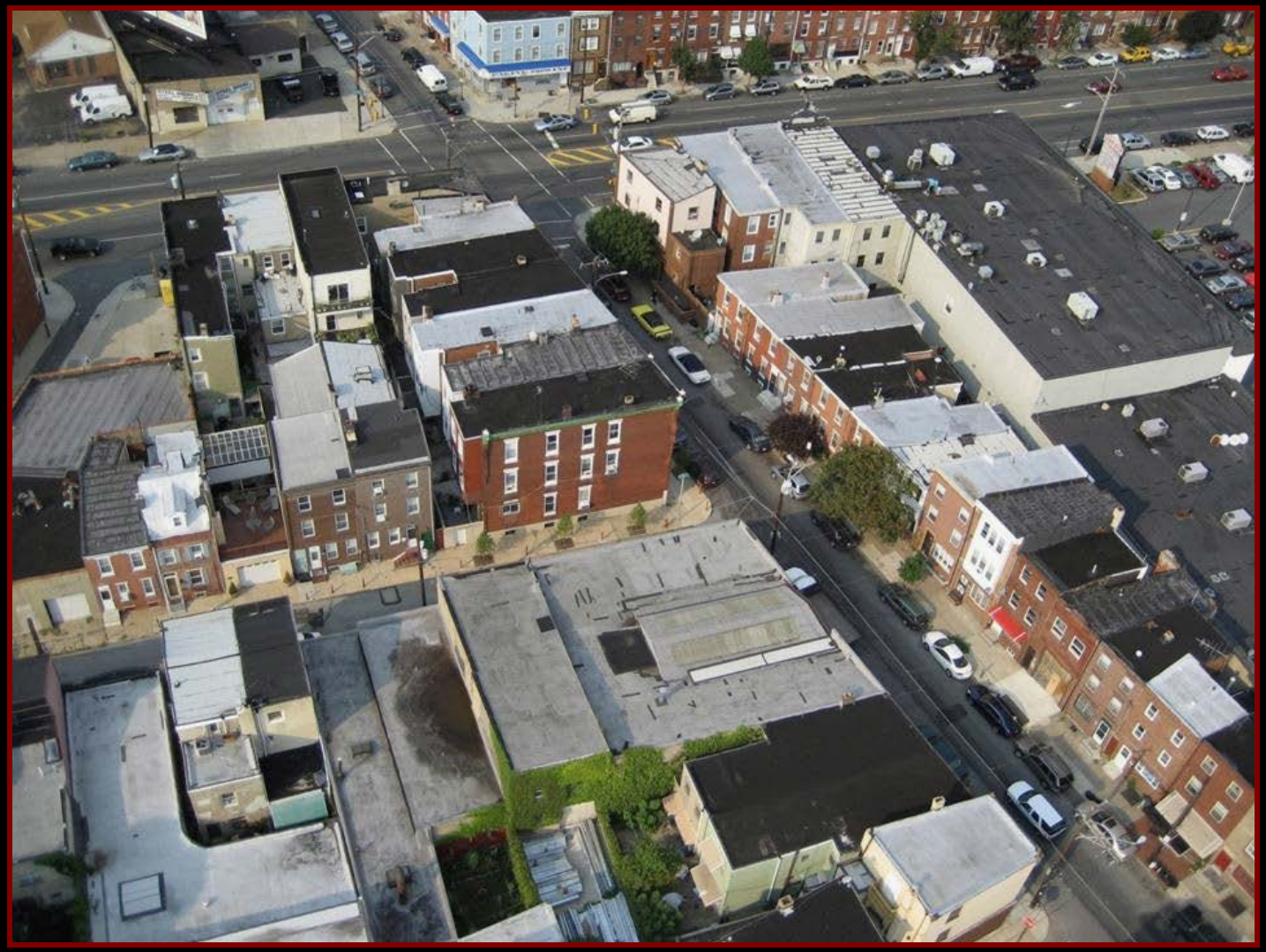
Green Seams Watershed Protection Strategy

Photos courtesy of Kevin Shafer, Milwaukee Metropolitan Sewerage District

- $27 million supplemental environmental project funds conservation easements and a greenways initiative.

Philadelphia, PA

Clean Water – Green City Initiative (Before)



Philadelphia, PA

Clean Water – Green City Initiative (After)

Portland, Oregon

- City code requires on-site stormwater management for new and re-development.
- Subsidized downspout disconnection program.
  - 45,000 participating households.
  - Infiltrates 1 billion gallons of rainwater annually.

Vegetated Planter at Portland State University.
Photo courtesy of Martina Keefe.

Portland, Oregon (cont.)

Vegetated Curb Extensions. *Photo courtesy of the Portland Bureau of Environmental Services.*

- Vegetated Curb Extensions
- Flow testing demonstrated 88% reduction in peak flow and 85% reduction in CSS inflow for 25-year storm event.
- Sufficient to protect local basements from flooding.
- Project cost $15,000 and required two weeks to install.

Portland, Oregon (cont.)

Hamilton Apartments Ecoroof.
Photo courtesy of the Portland Bureau of Environmental Services.

- Green Roofs
- Zoning bonus allows additional building square footage for buildings with a green roof.
- Two years of monitoring demonstrated that 58% of annual and nearly 100% of warm season rainfall was retained.
- Modeling of 300 block downtown area with eco-roofs showed 32% stormwater reduction, 6.5% energy reduction, and 1% heat island effect reduction.

Seattle, Washington
Natural Drainage Systems

2nd Avenue SEA Street. *Photo courtesy of Seattle Public Utilities.*

- Bioretention Swales
- Stormwater source control.
- Monitoring has demonstrated 99% reduction in stormwater runoff.
- No measured runoff since December 2002.

Seattle, Washington (cont.)
Natural Drainage Systems

- Cascade Channels
- End-of-Pipe Control
- Monitoring demonstrates 75% reduction in stormwater runoff volume and 60% reduction in peak flow.
- Modeling estimates that cascade system retains three times as much stormwater and held stormwater 2.5 times longer than original drainage ditch.

Cascade Drainage System.
Photo courtesy of Seattle Public Utilities.

Seattle, Washington (cont.)

King Street Center

- Rainwater Harvesting
- Over 16,000 gallons of storage at 327,000 ft2 King Street Center used for toilets and irrigation.
- Provides 60% (1.4 million gallons) of toilet flushing water annually.

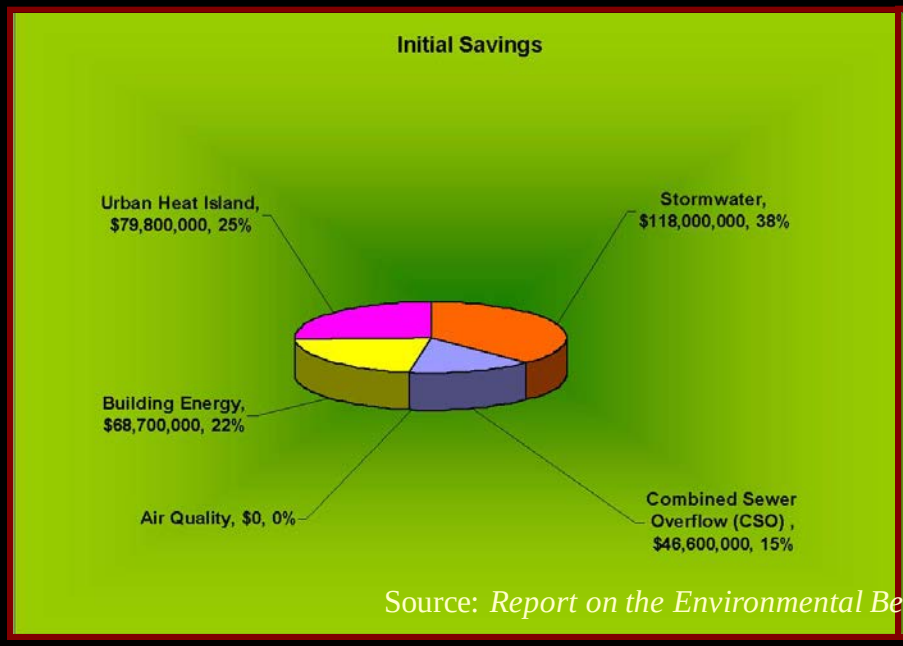
King Street Center.

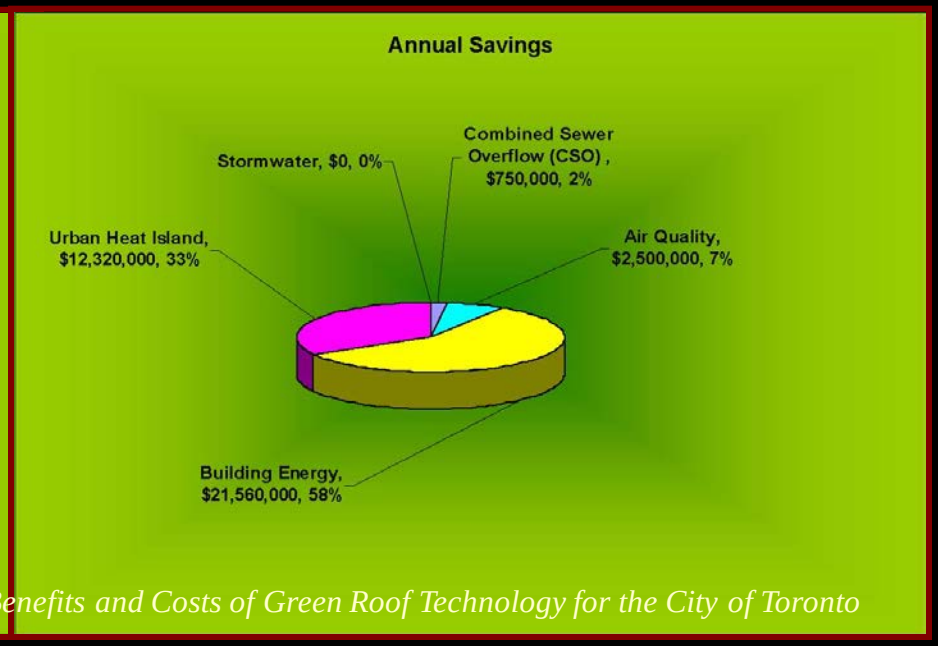
Toronto, Ontario

Chester Springs Marsh *Source: City of Toronto: www.toronto.ca.*

- City provides free downspout disconnection
- Extensive stream restoration efforts include rehabilitating wetlands and vegetated areas.
- More than 100 green roofs have been installed in the city, which reduce roof runoff by more than 50%.

Toronto, Ontario (cont.)





Source: *Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto*

- Ryerson University study modeled impacts of installing green roofs on all city roofs >3,750 ft^2.
  - Would result in 12,000 acres of green roofs – 8% of total city land area.
  - Estimated nearly $270 million in municipal capital cost savings and more than $30 million of annual savings.

Vancouver, British Columbia

Country Lane. *Photo courtesy of City of Vancouver Greenways Program.*

- Uses naturalized streetscapes, infiltration bulges and Country Lanes to manage stormwater from roadways.
- Street design projected to reduce annual runoff 90%.
- Installed natural biofiltration systems to manage and treat stormwater before it enters sensitive salmon waters.

Vancouver, British Columbia (cont.)

Greenway. *Photo courtesy of City of Vancouver Greenways Program.*

- The city has integrated its LID program with its greenways program, which was designed to create green city corridors and improve pedestrian access and safety throughout the city.
- Community groups donate time to maintain vegetated areas that manage stormwater

Washington, D.C.
Casey Trees study

Photo courtesy of CaseyTrees, Washington, DC

- Green roofs of 195 million sq. ft., tree coverage of 57% of the city, and tree boxes of at least 6 X 20 ft. together would:
  - Prevent 1.2 billion gallons of stormwater from entering the sewer system
  - Reduce CSO volume by 22% and frequency by 6.7%
  - Reduce stormwater volume by 10%
  - Provide CSO volume reductions of more than 20% for some sewersheds

Hudson Riverkeeper Study
Sustainable Raindrops, March 2007

The Solaire green roof. *Photo courtesy of Green Roofs for Healthy Cities.*

- Redirecting 50% of $2.1 billion projected costs for hard infrastructure to control 5.1 billion gallons of CSO to rain gardens, street trees, green roofs, and rain barrels would:
  - capture an additional billion gallons of CSO
  - reduce annual stormwater treatment costs by 50%
  - reduce air pollution, including 3,000 tons of carbon dioxide
  - increase property values, aesthetics, and sense of community