U.S. Environmental Protection Agency Region 2

Assessing Green Infrastructure

February 5, 2015

Ensuring safe and clean water for all Americans

Healthy Watersheds Sustainable Communities

What is Green Infrastructure?

- "Green infrastructure" refers to an array of technologies, approaches, and practices that protect and use natural systems or systems engineered to mimic natural processes, to manage rain water as a resource, to solve combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs), enhance environmental quality and achieve other economic and community benefits.

- Green infrastructure stormwater management approaches and technologies are characterized by *infiltration*, *evapo-transpiration*, and *capture & use* of stormwater.

A Paradigm Shift:
Rain as a Resource, rather than a Waste

- Improved water quality
- Enhanced water supply
- Increased groundwater recharge and base flow
- Reduced flooding to improve stream hydrology
- Habitat preservation, creation

Green Infrastructure's Community Health Benefits

- Improved air quality
- Water supply enhancement
- Decreased urban heat island effects
- Community wellness, recreation & aesthetic benefits

Heat Island Effects Illustration

Green Infrastructure's Community Economic Benefits

- Energy savings
- Cost savings
- Preserving capacity of the wastewater collection system
- Jobs creation
- Enhanced property values and commercial districts; neighborhood stabilization; higher tax base

Piping to maximize infiltration , NH

Example Practices

Rain Garden, Maplewood, MN

- Bioretention
- Permeable pavement
- Alternative parking & street designs
- Green roofs
- Rainwater harvesting
- Urban trees & land conservation

Bioswale, North Charleston, SC

Residential Cistern, AZ

EPA Policy Guides and Tools

http://water.epa.gov/infrastructure/greeninfrastructure/

- BASICS
- TOOLS
- CASE STUDIES
- RESEARCH
- LIBRARY

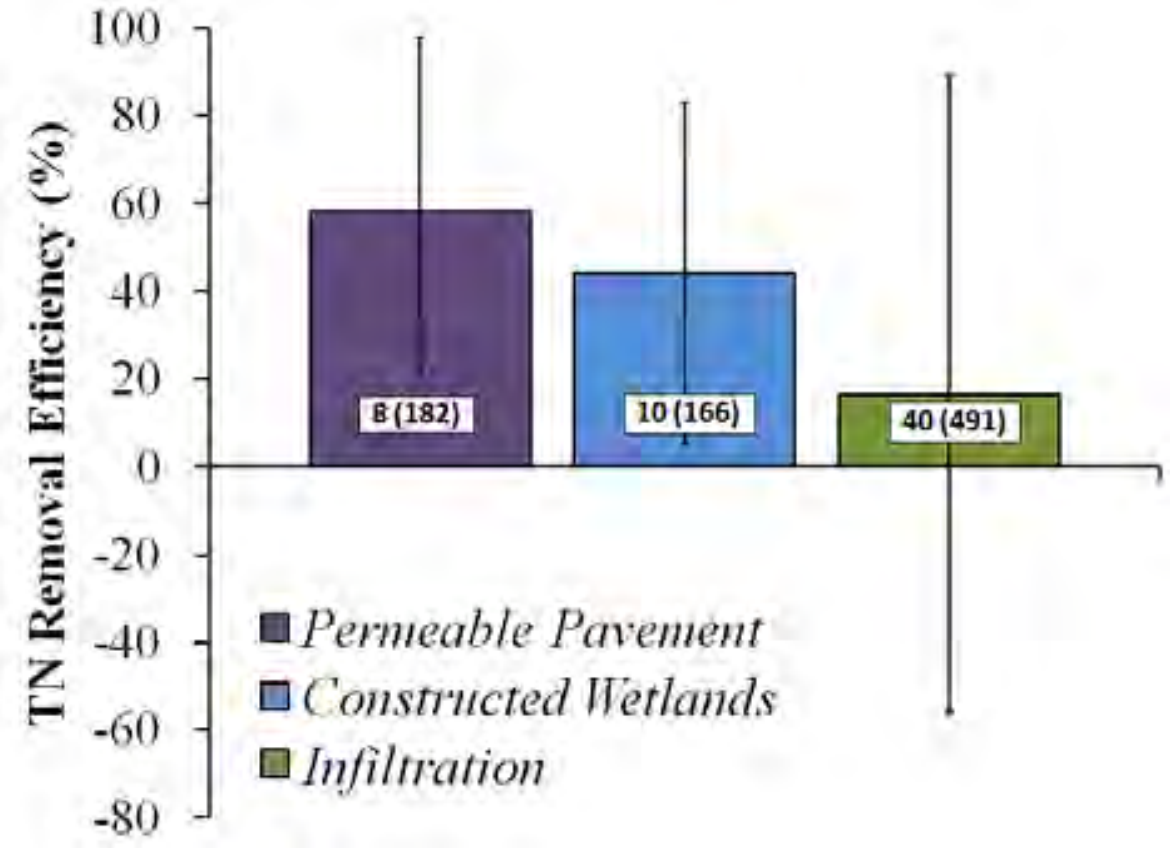
Assessment Perspectives

- Water Quality
- Cost Benefit
- Co-Benefits
- Performance

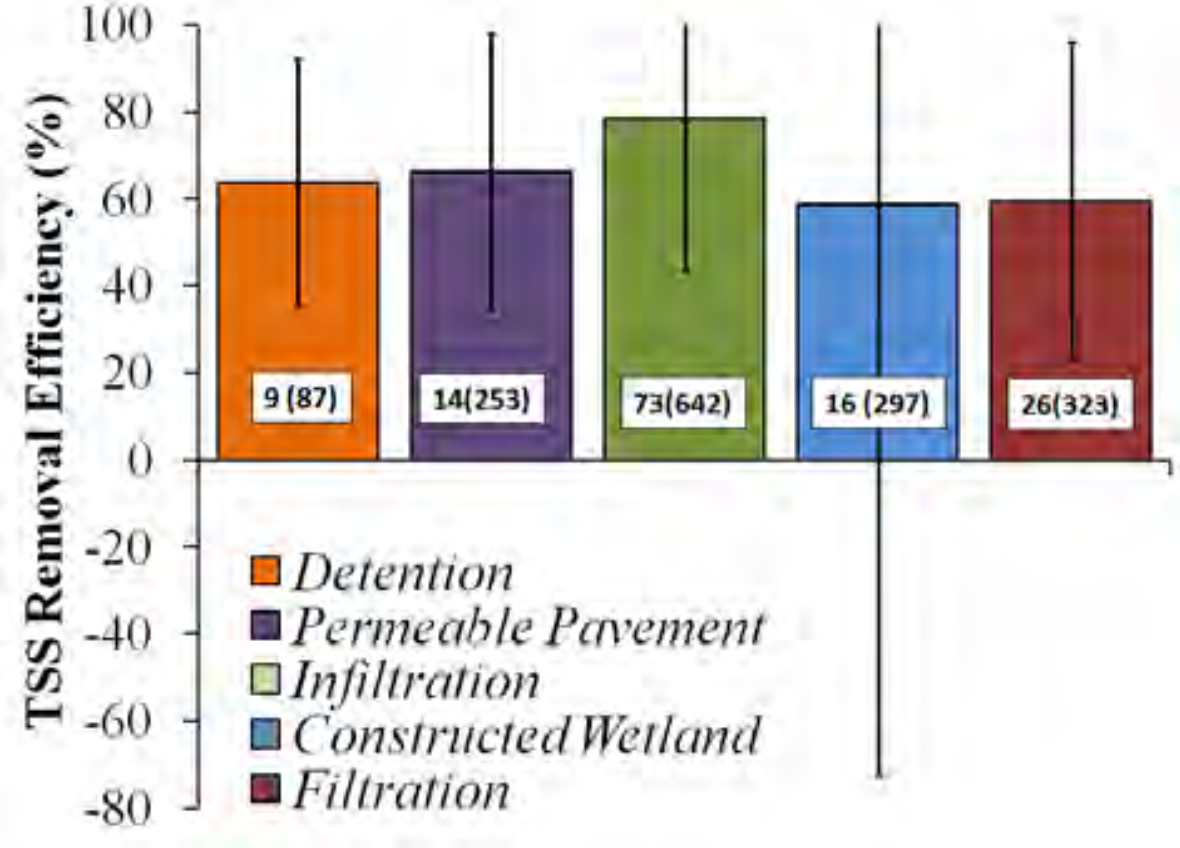
Water Quality

- GI Removes:
  - Nutrients
  - Total Suspended Solids
  - Metals
  - Bacteria
- Factors that impact monitoring data
  - Number of storms sampled
  - Computational method
  - Monitoring technique
- Factors that water quality
  - Design
  - Climate
  - Pollutant concentration
  - BMP age

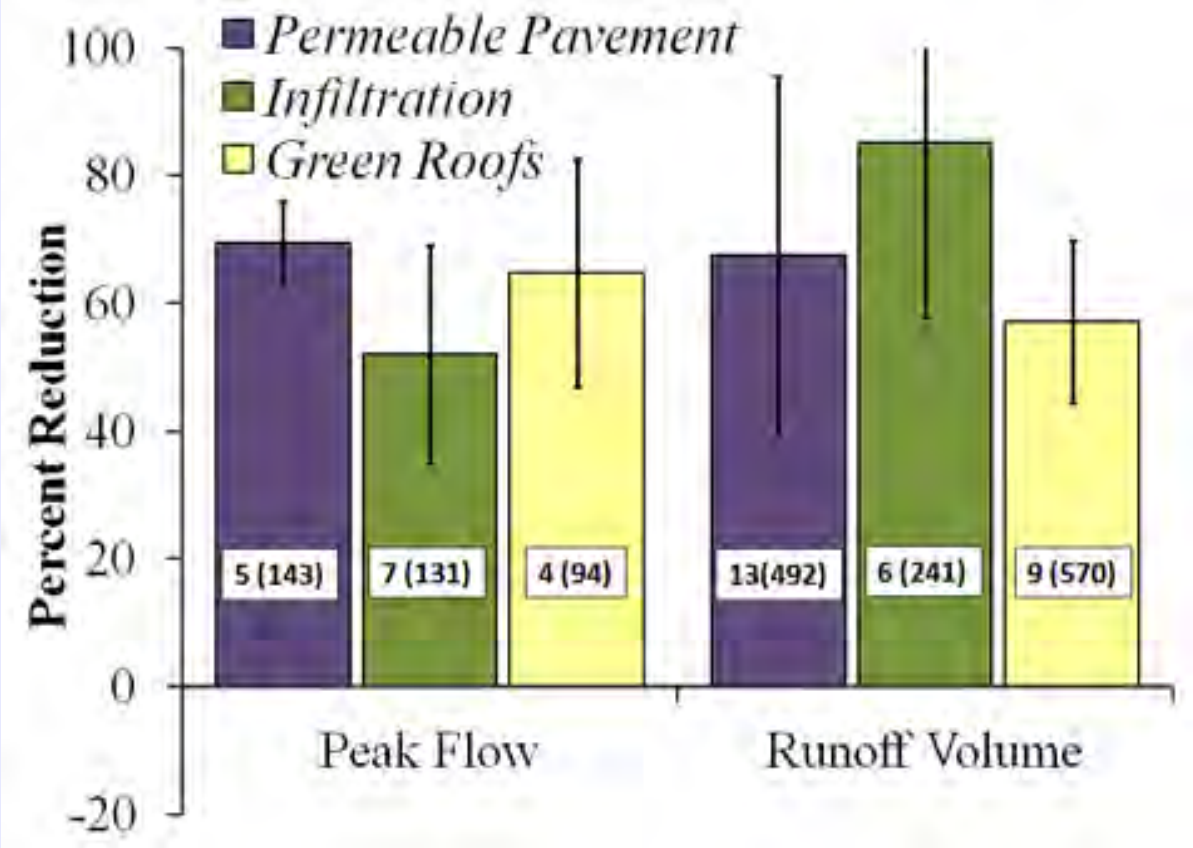
Effectiveness of GI in Reducing Total Nitrogen



Effectiveness of GI in Reducing Total Suspended Solids



Effectiveness of GI in Reducing Peak Flow and Volume



Assessing Runoff Reduction: EPA National SW Calculator

- Desktop application to estimate runoff.
- Site specific assessment.
- Seven GI practices can be evaluated.

Disconnection	Rain harvesting
Green roofs	Street Planters
Rain gardens	Infiltration basins
Porous Pavement	

- Utilizes soil conditions, topography, land cover, historic rainfall records and evaporation rates.

National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | LID Controls | Results

Options

Years to Analyze: 30

Event Threshold (inches): 0.50

Ignore Consecutive Days

Actions

Refresh Results

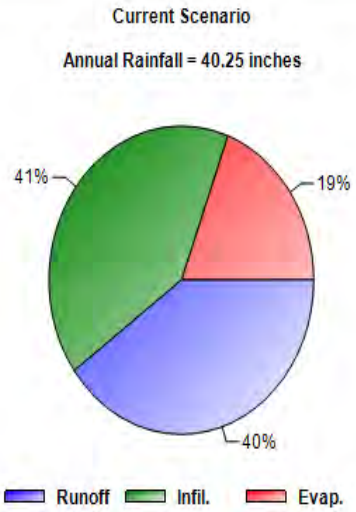
Use as Baseline Scenario

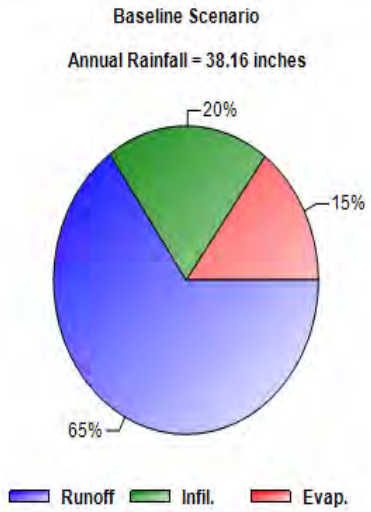
Remove Baseline Scenario

Print Results to PDF File

Reports

- Site Description
- Summary Results
- Rainfall / Runoff Frequency
- Rainfall Retention Frequency
- Runoff By Rainfall Percentile
- Extreme Event Rainfall / Runoff





Statistic	Current Scenario	Baseline Scenario
Average Annual Rainfall (inches)	40.25	38.16
Average Annual Runoff (inches)	15.89	24.94
Days per Year With Rainfall	24.05	21.69
Days per Year with Runoff	6.63	13.29
Percent of Wet Days Retained	72.44	38.71
Smallest Rainfall w/ Runoff (inc...	0.90	0.62
Largest Rainfall w/o Runoff (inc...	1.12	0.77
Max. Rainfall Retained (inches)	2.08	1.05

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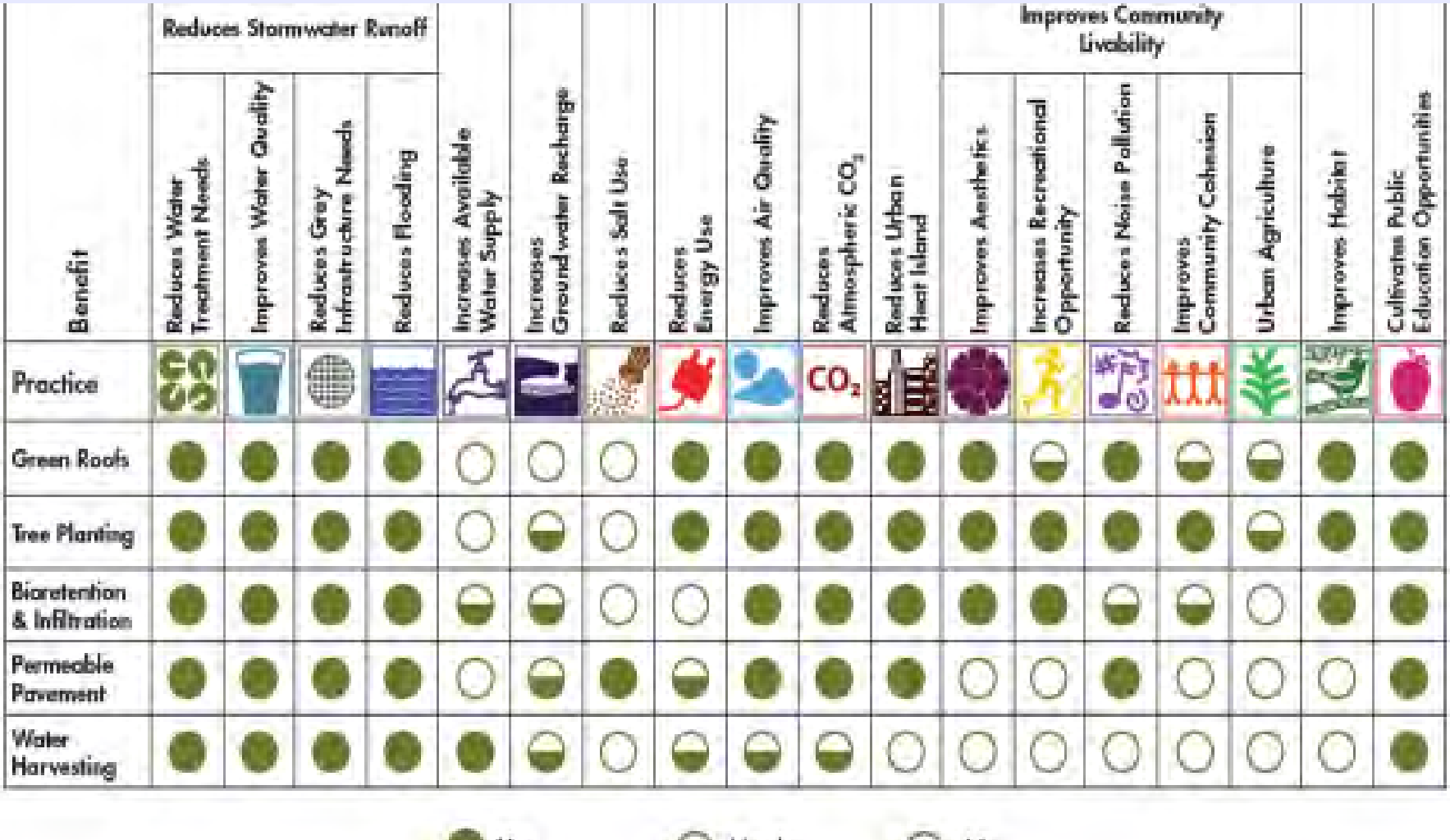
Cost Benefits of Low Impact Development Designs

Project Name and Location	Description	Cost Benefit
Poplar Street Apartments [1] Aberdeen, NC	• 270-unit apartment complex • Most of the curb-and-gutter systems were eliminated • Stormwater managed with a variety of LID BMPs	$175,000 in savings over conventional stormwater costs
Somerset [1] Prince George's County, MD	• Residential subdivision • Most of the site was designed with swales and rain gardens • Curbs and gutters were eliminated	Conventional: $2,456,843 LID Design: $1,671,461 Savings: $785,382 • Able to develop 6 additional lots • Decreased cost per lot by $4,000
Gap Creek [1] Sherwood, AR	• Residential subdivision • Drainage areas preserved • Greenbelts created for drainage area protection and recreation • Streets designed to follow land contour	• $2.2 million in additional profit • Lots sold for $3,000 more than competitors' lots • Able to develop 17 additional lots • Decreased cost per lot by $4,800
Kensington Estates [1] Pierce County, WA	• 103-lot residential development • Decreased roadway width • Porous paving • Cul-de-sacs with vegetated depressions in the center	Estimated cost savings of 20% of conventional construction costs
Circle C Ranch [1] Austin, TX	• Residential subdivision • Stormwater directed as sheet flow to a stream buffer • Four bioretention areas	Conventional: $250,000 LID Design: $65,000 Savings: $185,000 Additional savings from reduced storm drain pipe size and trenching depth
Green Roof Density Bonus [2] Portland, OR	Portland offers a density bonus of 5,000 ft_2 for installation of a green roof on a commercial property	An estimated $225 million in additional economic development generated since inception
Laurel Springs [3] Jackson, WI	• Residential subdivision • Developed using a clustered design Open space preserved • Grading and paving reduced	Conventional: $3,200,081 Conservation: $2,570,555 Savings: $629,526

Sources: [1] U.S. Environmental Protection Agency, 2005; [2] Liptan, 2007; [3] Winer-Skonovd et al., 2006.

The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits (Center for Neighborhood Technology and American Rivers, 2010)



Inspecting GI Practices

Inspections: During Construction

LOW IMPACT DEVELOPMENT CONSTRUCTION GUIDE

Credit Valley Conservation

http://www.creditvalleyca.ca/wp-content/uploads/2013/03/CVC-LID-Construction-Guide-Book.pdf

Inspections: After Construction

GREEN STORMWATER OPERATIONS AND MAINTENANCE MANUAL

Seattle Public Utilities

http://www.seattle.gov/util/groups/public/@spu/@usm/documents/webcontent/spu02_020023.pdf

Relationship of GI Agenda to other EPA efforts

- Urban Waters
- Environmental Justice
- Sustainable Communities
- Healthy Watersheds
- Climate Change
- Smart Growth
- Brownfields Redevelopment
- Stormwater Permits
- CSO Long Term Control Plans

Resorces

International Stormwater Best Management Practices (BMP) Database – This database summarizes the findings of more than 400 BMP studies. Users of the website can perform custom queries or download technical papers summarizing performance results. Four green infrastructure controls are included in the database: constructed wetlands, bioretention, swales, and porous pavement.

- http://www.bmpdatabase.org/performance-summaries.html

Resources

Center for Watershed Protection – Watershed Treatment Model: Estimate benefits from a wide range of stormwater runoff and pollutant removal practices

http://www.cwp.org/documents/cat_view/76-stormwater-management-publications.html

EPA's Nation Stormwater Calculator

A desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). Estimates are based on local soil conditions, land cover, and historic rainfall records.

http://www2.epa.gov/water-research/national-stormwater-calculator