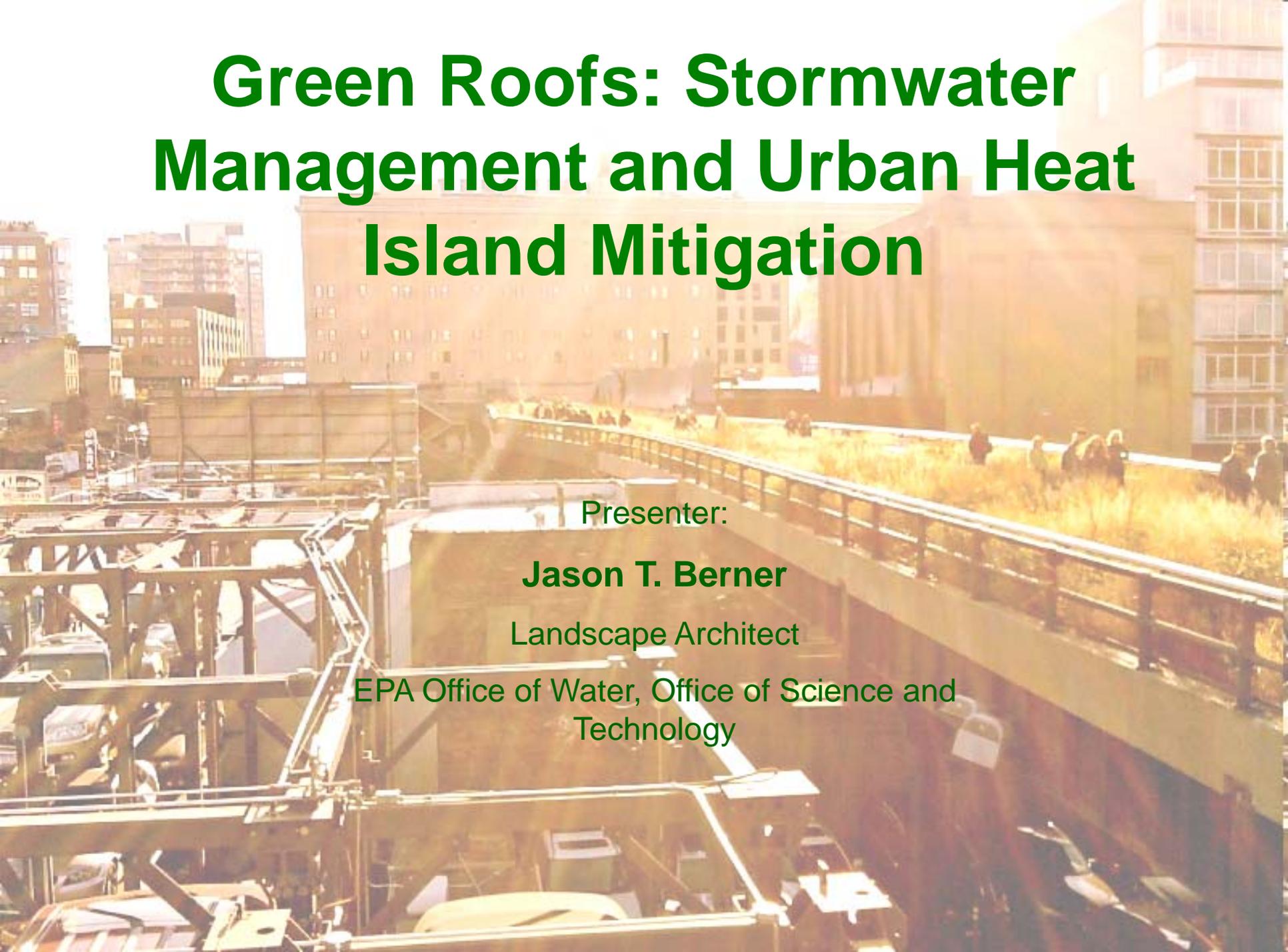


Green Roofs: Stormwater Management and Urban Heat Island Mitigation

A photograph of a city rooftop garden. In the foreground, there is a metal structure, possibly a staircase or walkway. To the right, a long, narrow path with a metal railing runs along the edge of a rooftop garden filled with tall, golden-brown grasses. Several people are walking along this path. In the background, there are several multi-story buildings, including a prominent brick building. The sky is clear and bright, suggesting a sunny day.

Presenter:

Jason T. Berner

Landscape Architect

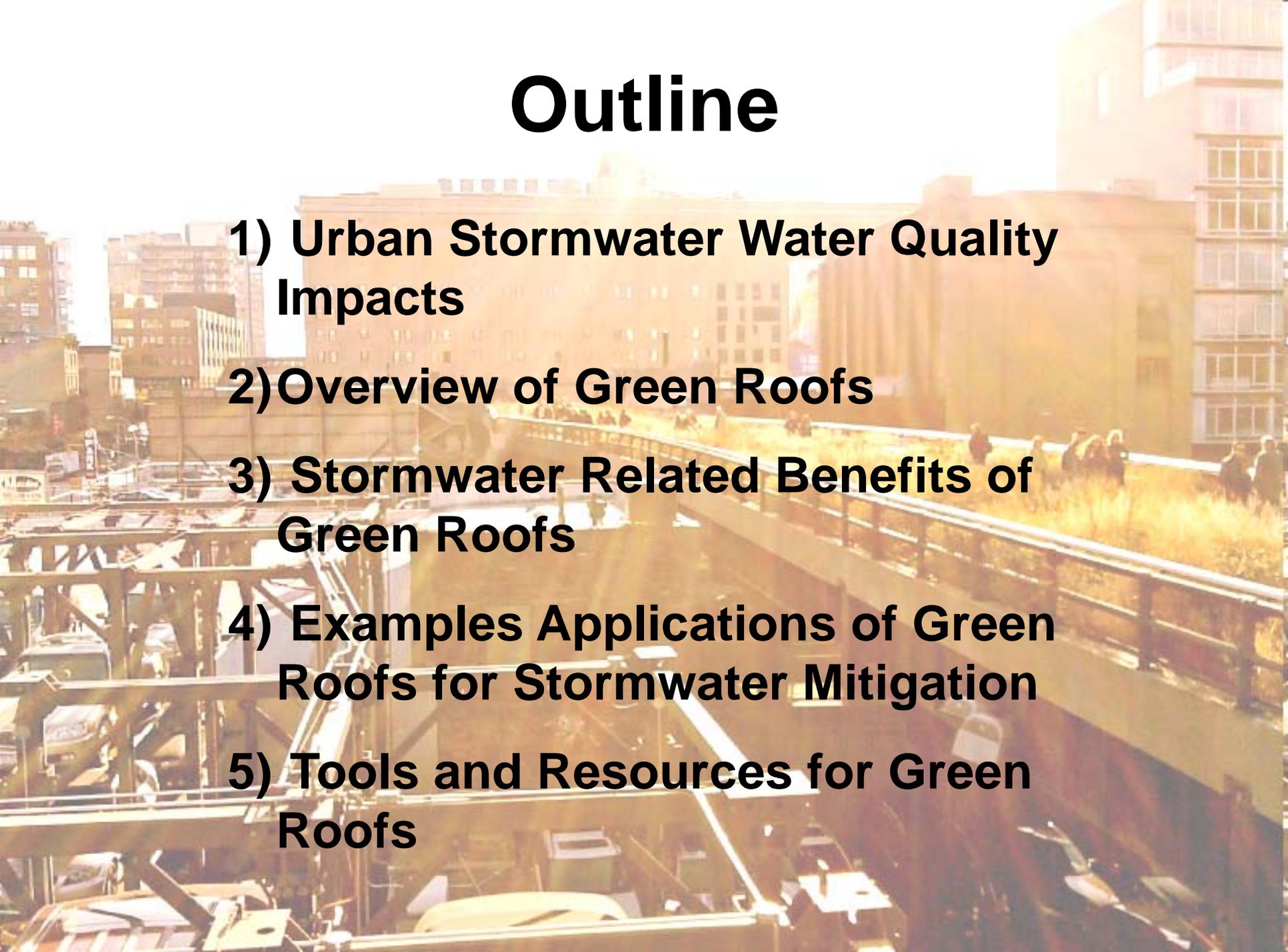
EPA Office of Water, Office of Science and
Technology

Jason Berner

- **National Stormwater Team member**
- Environmental Impacts & Benefits Assessments
- Water Quality Modeling
- Urban Planning and Policy Analysis

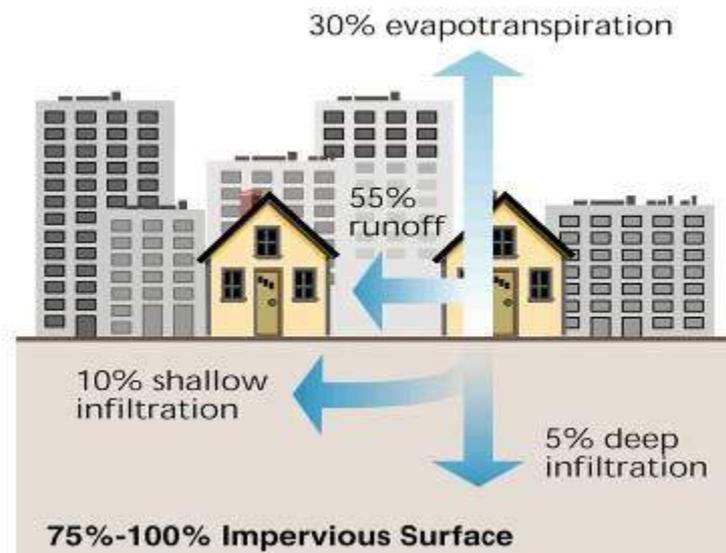
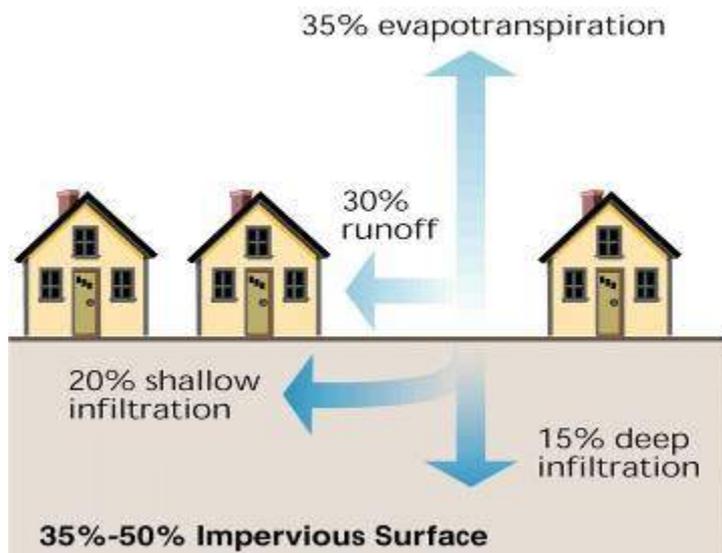
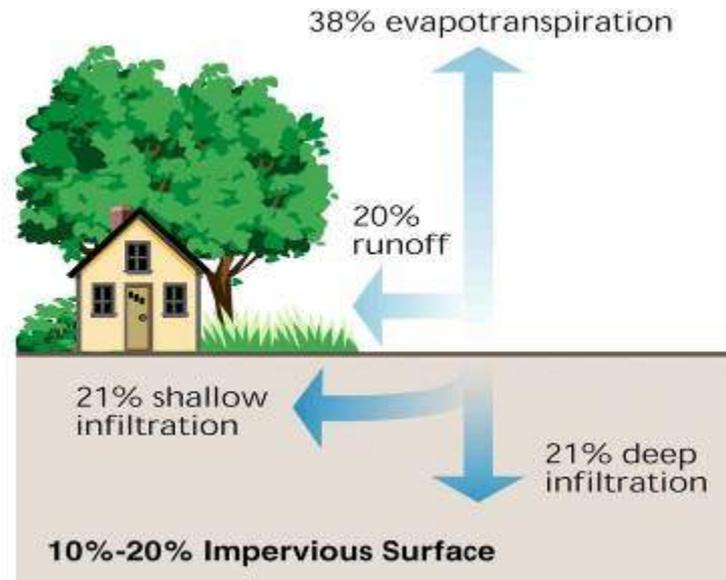
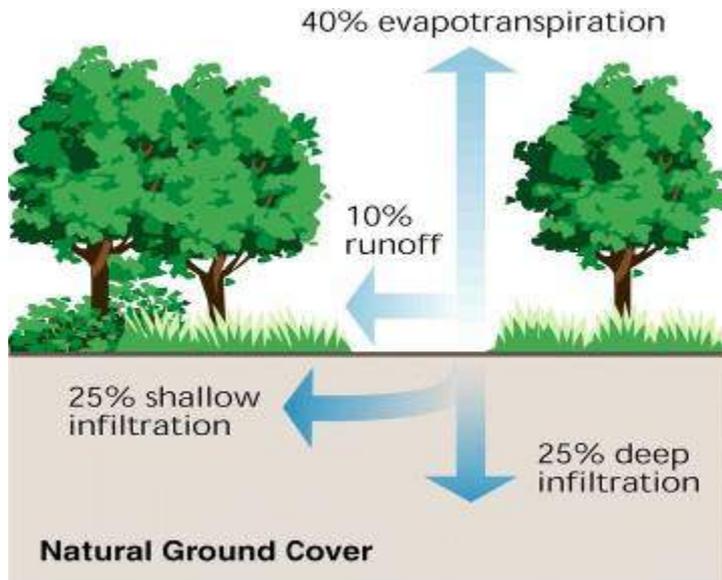


Outline

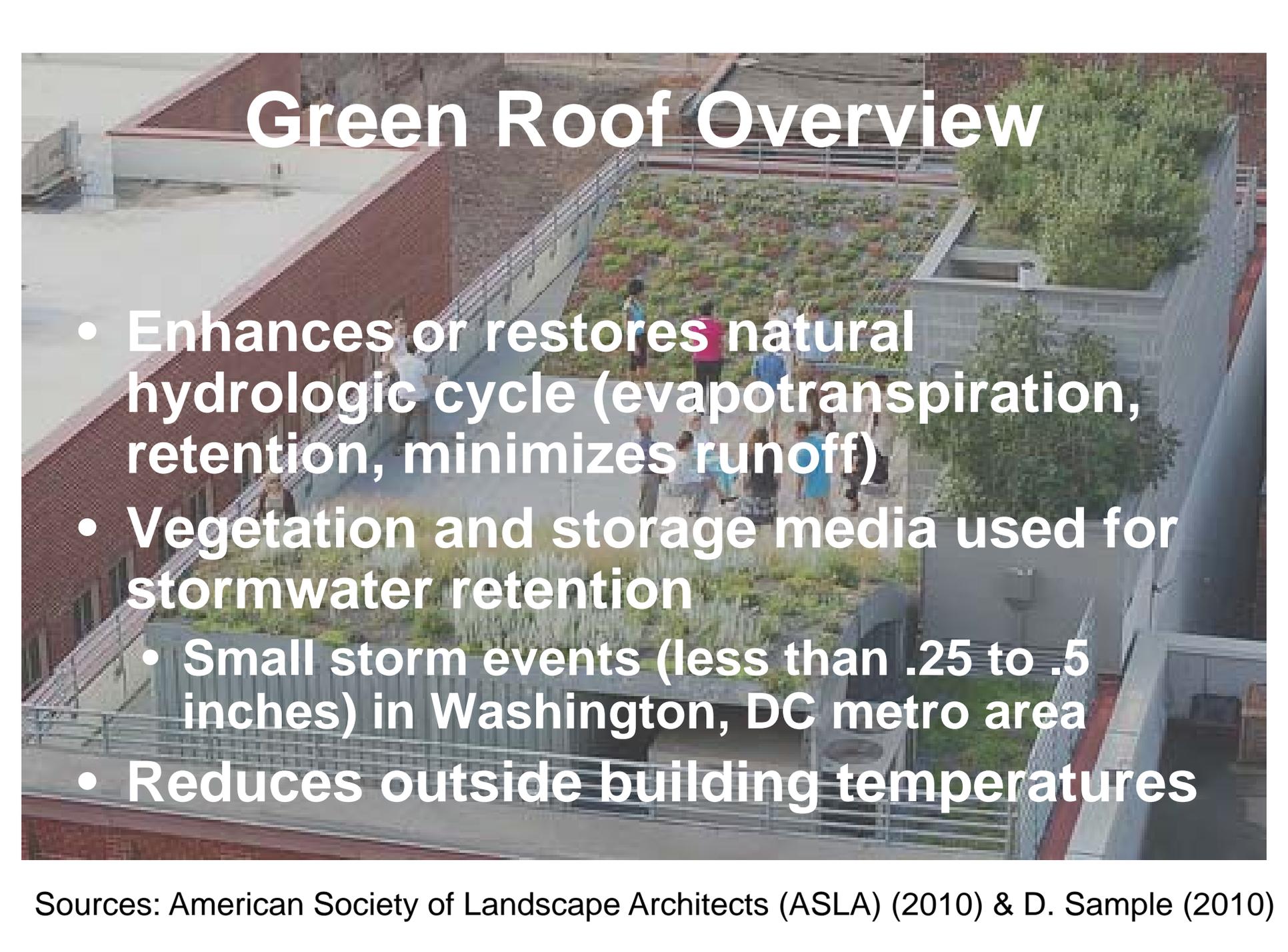


- 1) Urban Stormwater Water Quality Impacts**
- 2) Overview of Green Roofs**
- 3) Stormwater Related Benefits of Green Roofs**
- 4) Examples Applications of Green Roofs for Stormwater Mitigation**
- 5) Tools and Resources for Green Roofs**

Water Quantity Impacts: Changes in Land-Water Linkages



Green Roof Overview

An aerial photograph of a large green roof on a multi-story building. The roof is covered with a variety of green plants, including grasses and small trees. Several people are walking on the roof, and there are some structures and railings visible. The building's facade is made of red brick.

- Enhances or restores natural hydrologic cycle (evapotranspiration, retention, minimizes runoff)
- Vegetation and storage media used for stormwater retention
 - Small storm events (less than .25 to .5 inches) in Washington, DC metro area
- Reduces outside building temperatures

Types of Green Roofs

- **Extensive:** light vegetation, sedums and grasses
- **Intensive:** medium size vegetation, including shrubs and small woody plants

A photograph of a hybrid green roof. The foreground is a wooden deck. The roof is covered with a dense layer of low-growing, green and yellow plants. In the background, a red brick building with arched windows is visible under a clear blue sky.

Hybrid green roof

A photograph of an intensive green roof. The roof is covered with a dense layer of medium-sized green plants, including shrubs and small woody plants. A grey brick wall is visible in the background, and a blue building is partially visible on the right side.

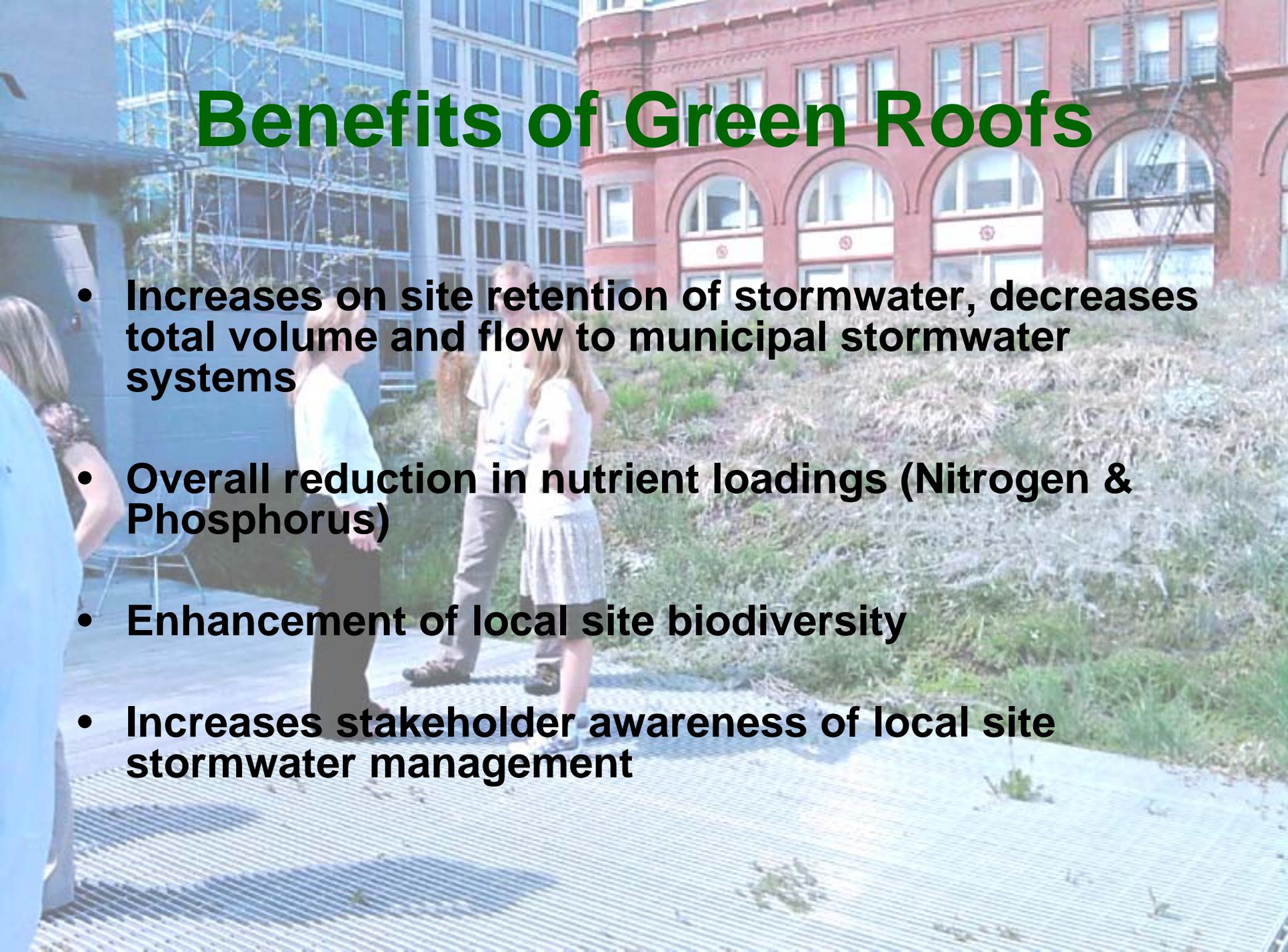
Intensive green roof

Applications of Green Roofs

- **New Development**
- **Redevelopment**
- **Retrofits**
- **Commercial, Residential, Industrial, and Institutional Building Types**

New Development, Commercial Building, Washington, DC

Benefits of Green Roofs



- **Increases on site retention of stormwater, decreases total volume and flow to municipal stormwater systems**
- **Overall reduction in nutrient loadings (Nitrogen & Phosphorus)**
- **Enhancement of local site biodiversity**
- **Increases stakeholder awareness of local site stormwater management**

Benefits of Green Roofs

- Increase aesthetic appeal and property value of property
- Minimal maintenance costs
- Less replacements than conventional roofs
- Possible tax incentives, stormwater utility fees



Examples of Green Roofs

A 3D architectural rendering of a multi-story building with a green roof. The roof is covered in lush green vegetation, and the building's facade is visible on the right side. The rendering is shown from an elevated perspective, looking down at the roof and slightly to the side.

- **American Society of Landscape Architects (ASLA) Green Roof, Washington, DC (Commercial Building Retrofit)**
- Monitored stormwater runoff reduction and temperature reductions
 - Retention of 76.7 % of 11.83 inches rain during 1st data collection period (Summer – Fall)

Examples of Green Roofs

- **City Hall, Chicago, IL (institutional retrofit)**
- **Planted in 2000, with over 150 species of plants (extensive and intensive)**
- **Green Roof able to retain 75% of 1 inch rain event**

Sources: City of Chicago (2010):

http://www.cityofchicago.org/city/en/depts/doe/supp_info/chicago_s_city_hallrooftopgarden.html

<http://wildnewjersey.tv/2009/05/28/wild-new-jersey-exclusive-green-roof-offers-native-habitat-at-dodge-office-on-morristown.aspx>

Wild New Jersey (2008):

Examples of Green Roofs

- **DC Green Build Out Model (Casey Trees & LimnoTech)**
 - **Scenarios of how Green Roofs and Trees could be used to mitigate stormwater discharges throughout Washington, DC**
 - **Stormwater Runoff volume reductions up to 10% city-wide**

Washington, DC: 2002

Washington, DC: 2025



Managing Wet Weather with Green Infrastructure

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Green Infrastructure

Green Roofs

Managing Wet Weather with Green Infrastructure

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure management approaches and technologies infiltrate, evapotranspire, capture and reuse stormwater to maintain or restore natural hydrologies. See [examples of green infrastructure and design approaches](#).

At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are critical components of green infrastructure. In ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and

On a smaller scale, green infrastructure practices include rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses, such as toilet flushing and landscape irrigation.

- **Green Roofs for Healthy Cities (green roof industry association website):**

- <http://www.greenroofs.org/>

- **EPA Green Infrastructure Technologies and Approaches**

- <http://cfpub.epa.gov/npdes/greeninfrastructure/technology.cfm>

- **EPA Stormwater Menu of BMPs**

- <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm>

How Does Green Infrastructure Benefit the Environment?

Green Infrastructure is associated with a variety of environmental, economic, and human health benefits, many of which go hand-in-hand with one another. The benefits of green infrastructure are particularly accentuated in urban and suburban areas where green space is limited and environmental damage is more extensive. Green infrastructure benefits include:

Reduced and Delayed Stormwater Runoff Volumes - Green infrastructure reduces stormwater runoff volumes and reduces peak flows by utilizing the natural retention and absorption

- Types, Applications, & Design Approaches
- Case Studies
- News
- Green Infrastructure Partnership
- Regulatory Integration
- Research
- Models & Calculators
- Municipal Links
- Funding Opportunities
- Links
- Training & Conferences
- Contacts
- Green Infrastructure Home
- Stormwater Home
- Nonpoint Source Home
- Combined Sewer Overflows Home
- Smart Growth Home
- GreenScapes Home
- Brownfields
- Climate Change

Hot Topics

[Green Jobs Training Catalog \(PDF\)](#)

[Green Infrastructure Training](#)



The documents on this site are best viewed with Acrobat 5.0

CALCULATOR

Tools & Resources for Green Roofs

Getting Started | Lot Information | Predevelopment | Runoff Reduction Goal | Conventional Development | Green Improvements | Advanced Options

Getting Started

The National Green Values™ Calculator is a tool for quickly comparing the performance, costs, and benefits of Green Infrastructure, or Low Impact Development (LID), to conventional stormwater practices. The GVC is designed to take you step-by-step through a process of determining the average precipitation, stormwater runoff, and runoff reduction goal, defining the impervious areas of your site under a conventional development scheme, and then choosing from a range of Green Infrastructure Best Management Practices (BMPs) to find the combination that meets the necessary runoff volume reduction goal.

• Design Tools:

- EPA Models:
 - **SWMM (stormwater management model)**
 - **SUSTAIN (System for Urban Stormwater Treatment and Analysis Integration Model): GIS-based with SWMM**



RESULTS

The Green Stormwater BMP(s) applied in this scenario **decrease** the site impermeable area by **42.9%** and capture **300%** of the runoff volume required. Compared to conventional approaches, the green practices in this scenario will **decrease** the total life-cycle construction and maintenance costs by **8%** (in net present value).

• Stormwater Calculators:

- **Green Values National Stormwater Management Calculator (Center for Neighborhood Technology)**
- **Virginia Runoff Reduction Method (BMP design spreadsheet, VA Dept. Conservation & Recreation)**

Thank You, Questions??

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Website: <http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm>

Source: Clean Air Through Green Roofs (2008): <http://cleanerairforcities.blogspot.com/2009/08/green-roofs-do-require-maintenance.html>

