Working with Nature to Manage Stormwater

PENNSYLVANIA LAND TRUST ASSOCIATION

The most effective tools to reduce the water pollution and flooding caused by stormwater runoff are green infrastructure, land conservation, and best management practices on farms.

Introduction

Stormwater runoff pollutes waterways and causes dangerous, damaging flooding. Nature-based stormwater management strategies allow the ground to absorb and filter stormwater, resulting in cleaner water and fewer, less severe floods.

Clean water and flood mitigation, in turn, provide a host of economic benefits. For example, clean water decreases water-treatment costs for communities and supports water activities like fishing and paddling that contribute $29 billion each year to the United States economy. Less frequent flooding saves communities billions of dollars in averted damage. Clean water also provides a host of environmental benefits (e.g., wildlife habitat) and health benefits (e.g., safe drinking water).

This guide outlines the three most effective nature-based stormwater management strategies—green infrastructure, land conservation, and best management practices (BMPs) on farms—and provides links to resources for each.

For resources focused on nature-based stormwater management more generally, see the Naturally Resilient Communities website.

Green Infrastructure

The term "green infrastructure" refers to features such as rain gardens and bioswales that reduce runoff by using vegetation and soil to absorb and filter stormwater. (It also refers to tools like rain barrels that can store stormwater for reuse.) Green infrastructure is especially effective—and necessary—in built environments, where it can serve as a cost-effective complement to (and sometimes substitute for) conventional stormwater infrastructure like storm drains and pipes, which often carry pollutants directly into waterways and easily overload during severe storms.

Green infrastructure components can be included in the design of new projects or incorporated into existing streetscapes and landscapes. Often, green infrastructure makes cities and neighborhoods more colorful and interesting. Green infrastructure installations can also provide hands-on educational opportunities close to home, school, or work for people of all ages to learn about water, soil, and wildlife.

Resources Looking at Green Infrastructure Broadly

- Green infrastructure resource library at ConservationTools.org
- *Green Infrastructure Guidelines*
- *Pennsylvania Stormwater Best Management Practices Manual*

- *The Value of Green Infrastructure*
- EPA green infrastructure webpage
- DCNR green stormwater infrastructure webpage

Green Infrastructure in Parks and Public Spaces

- *Resource Guide for Planning, Designing, and Implementing Green Infrastructure in Parks*
- *Green Infrastructure in Parks: A Guide to Collaboration, Funding, and Community Engagement*
- *Green Infrastructure Opportunities that Arise During Municipal Operations*
- "Top 10 Stormwater Best Management Practices for Parks"

Resources on Specific Types of Green Infrastructure

Follow the links for more detailed information about these different types of green infrastructure:

Constructed Wetlands

Marsh systems planted with vegetation designed to treat stormwater runoff.

- EPA constructed wetlands resource page
- "Virginia Stormwater Design Specification #13: Constructed Wetlands"

Filter Strips

Gently sloping strips of dense vegetation between paved areas that intercept and absorb stormwater.

- Vegetated filter strip fact sheets

Green Roofs

Roofs covered with a system of contained vegetation, waterproofing, and drainage designed to reduce the amount of stormwater entering gutters.

- EPA green roofs webpage
- "Planning by Design: Green Roofs"

Infiltration Basins

Basins with capacity to store excess water during storms, then filter it back into the ground through plants and soils.

- Infiltration basins BMP manual

Infiltration Berms

Mounds of compacted earth that can stop or redirect runoff and absorb stormwater.

- Infiltration berms fact sheet

Infiltration Trenches and Beds

Linear ditches or beds that collect runoff, often from roadsides or parking lots, and absorb it into highly porous soil.

- Infiltration trench BMPs fact sheet

Pervious Pavement

Pavement that allows stormwater to soak through it and into the ground rather than flowing across the surface and into sewers.

- EPA permeable pavement webpage
- PerviousPavement.org

Rain Barrels/Cisterns

Basins that capture stormwater before it reaches the ground, allowing it to be used later for things like watering lawns or washing cars.

- PennState Extension rain barrel webpage
- Reading (PA) rain barrel ordinance

Rain Gardens

Areas with native plants that absorb and filter stormwater but can also thrive in dry weather.

- EPA rain gardens webpage

Riparian Buffers

Vegetation planted along waterways that absorbs runoff and filters pollutants before they can enter the water.

- Riparian buffer protection ordinances and general resources.

Urban Trees

Besides benefits like shade and aesthetics, trees absorb and filter stormwater.

- *Stormwater to Street Trees: Engineering Urban Forests for Stormwater Management*
- *Tree Ordinance*

Vegetated Swales

Channels planted with trees, shrubs, or grasses that slow runoff and help absorb it into the ground; similar to rain gardens, but often larger and designed to manage runoff from a specific impermeable area like a parking lot.

- "An Introduction to Bioswales"
- Vegetated swales fact sheet

Land Conservation

Conserving land is an incredibly effective stormwater solution: Forests, wetlands, and other natural areas can filter and absorb massive amounts of stormwater, improving water quality and reducing flooding. Protecting a piece of open space from development reduces water pollution and flooding in the immediate area as well as downstream; conversely, paving over that land results in dirtier water and increased flood risk. For example, one study found that less than 5% of rain falling on forests runs off into waterways, compared to 95% for impermeable surfaces.

Land trusts and governments (local, state, and federal) may conserve land by acquiring and managing it or by acquiring conservation easements that limit use of the land to activities consistent with the easement's conservation purposes.

Establishment of conservation-oriented land-use ordinances and—of equal importance—consistent enforcement of the ordinances and adherence to the good land-use principles underpinning the ordinances in making decisions about individual developments can also provide some land conservation benefits.

See ConservationTools.org for a wealth of land conservation resources, including:

- Acquisition of land and easements resources
- Land-use planning resources
- Model documents

Agricultural BMPs

Runoff from farms carries chemical fertilizers, pesticides, and livestock waste into waterways, killing wildlife and making waterways unsafe for fishing, paddling, and swimming. Implementing best management practices (BMPs) on farms can drastically reduce this runoff and pollution.

While the focus of agricultural BMPs is protecting water quality, some BMPs also help mitigate flooding by absorbing more stormwater into the soil, reducing the volume of runoff flowing into waterways. These BMPs are described below. For a more detailed overview, see the guide *Turning Soils into Sponges*.

Riparian Buffers

Vegetated buffers that capture pollutants and reduce downstream flooding.

- Riparian buffer protection ordinances and general resources.

Cover Crops

Fields planted in crops year-round filter pollutants, stabilize the soil, and absorb far more water than fields left fallow.

- *Can Soil Save Us? Making the Case for Cover Crops as Extreme Weather Risk Management*

Conservation Tillage

Leaving crop residue on the soil surface (rather than tilling it into the ground) preserves organic matter in the soil, reducing erosion and allowing the ground to absorb more stormwater.

- USDA conservation tillage webpage

Irrigation Management

Improving the efficiency of irrigation systems to reduce the amount of excess water running off fields and into waterways.

- *Principles and Practices for Sustainable Water Management in Agriculture*

Erosion and Sediment Control

Sediment chokes biodiversity and clogs waterways, making floods more likely; stabilizing soil with vegetation or physical structures reduces the amount of sediment flowing into waterways.

- *Best Management Practices for Agricultural Erosion and Sedimentation Control*
- EPA erosion and sediment control handbook

The most recent version of this guide and related resources can be found online at ConservationTools.org/guides/166

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