NATIONAL ASSOCIATION OF STATE FORESTERS

Urban Forests and Stormwater Briefing Paper

Prepared by the Urban and Community Forestry Green Stormwater Infrastructure Committee
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Trees as Tools to Improve Water Quality

Water quality is deteriorating in waterbodies across the Nation, and urban stormwater is part of the problem. In a natural, undeveloped landscape, rain and snowmelt trickles into the ground to moisten the soil and recharge groundwater that feeds lakes, rivers, and streams. In an urban environment, compacted soil and impervious surfaces reroute precipitation over streets and into underground pipes. An important measure of the degree of urbanization in a watershed is the amount of impervious surface that dominates the landscape. As impervious surface increases in a watershed, more rainfall is converted to runoff (figure 1). This collected stormwater runoff is laden with sediment and pollutants and channeled straight into nearby rivers and lakes. To make matters worse, many cities and towns direct stormwater into sewer systems that also pipe sanitary sewage. When these combined systems reach capacity, both sewerage and stormwater flow directly into waterbodies, pollutants and all.

Well-planned and maintained urban forests offer opportunities for communities to address water quality goals while creating public spaces that deliver social and economic value. As State and local governments strive to meet regulatory water quality requirements, they should be informed about how protecting and managing urban trees and forests as green stormwater infrastructure can address water quality problems. A green infrastructure approach to stormwater management entails bringing together built and natural elements, and valuing water as a limited and precious resource rather than as waste or a problem. Urban woodlands, street trees, vegetated swales, green roofs, and rain gardens are all part of a network of green stormwater infrastructure that provides multiple water quality and other co-benefits – for which State Forestry has authorities and technical expertise to support.

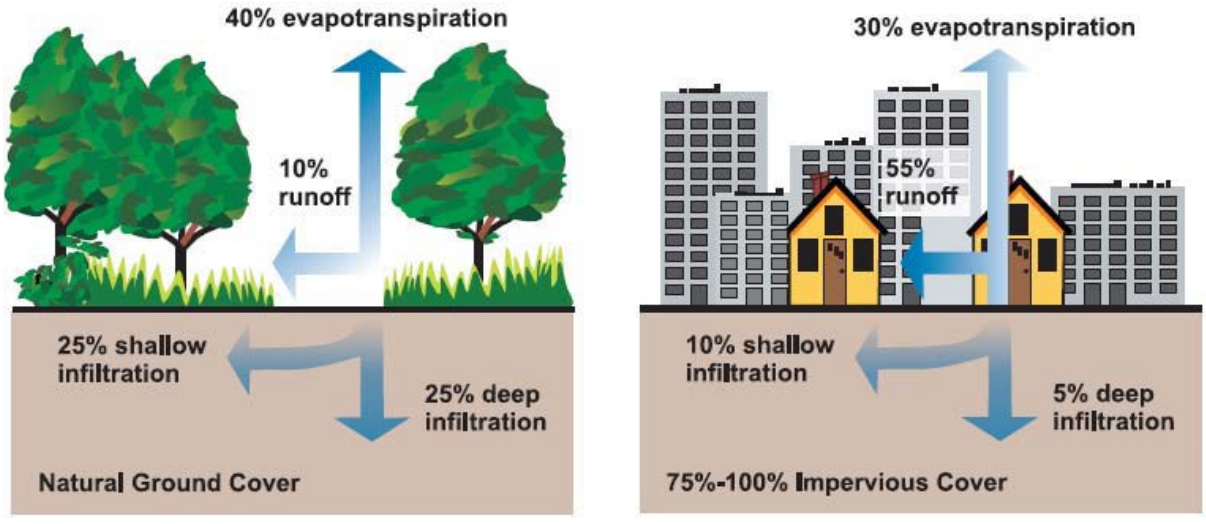

Figure 1. Effects of impervious surfaces on runoff and infiltration. (EPA 2003)

The Importance of Urban Trees and Forests for Urban Stormwater Management

Some of the best and most cost-effective stormwater management practices involve urban trees and forests. Leaves and upper branches capture and store rainfall in the canopy, reducing the volume of stormwater that reaches the ground and transferring it back into the atmosphere through evapotranspiration. Tree roots and leaf litter increase infiltration capacity of the soil, and some pollutants in stormwater runoff can even undergo chemical transformation into less harmful substances when tree roots absorb them. Studies show that watersheds with higher percentages of tree cover are associated with better water quality. The many environmental benefits of urban trees and forests inform the underlying principle of green stormwater infrastructure planning: to preserve existing tree and forest cover, and increase the available space for new trees and other green stormwater infrastructure practices – all activities that support State Forest Action Plans.

The conventional method of collecting and conveying stormwater in developed areas consists of a system of inlets and underground pipes (storm sewers). This "gray infrastructure" is engineered and largely underground until it is overwhelmed and overflows directly into adjacent waterbodies. Green stormwater infrastructure treats or manages stormwater and pollutants by mimicking the natural hydrology of a watershed rather than relying entirely on rapid conveyance of runoff in underground pipe systems directly to waterways. Green stormwater infrastructure intercepts, holds, slows down, and treats stormwater as close to its source as possible.

By bringing parts of natural hydrologic systems into urban designs, we can replicate natural mechanisms that reduce or slow down the flow of stormwater and allow it to be cleaned by plants and soil. Green stormwater infrastructure planning also recognizes that each site is unique, both in constraints and opportunities, and applicable design solutions must reflect the context. By aiming to reduce the amount of impervious cover and seeing every surface as an opportunity to capture water, an integrated design can emerge that is not only effective, but pleasant to experience.

Green stormwater infrastructure improves the **quality** of stormwater runoff by:

- Utilizing engineered combinations of vegetation and soil media to remove pollutants and reduce sediment in stormwater before discharge to natural waterways, and
- Reducing the velocity of stormwater via a decentralized and distributed set of practices to slow the rate of flow into a conventional storm sewer system and/or into the aquatic environment.

Green stormwater infrastructure reduces the **quantity** of water destined for sewer systems by:

- Minimizing impervious surface area in urban areas, which increases infiltration;
- Minimizing impact on existing vegetation and natural hydrologic conditions;
- Using permeable treatments where feasible; and
- Intercepting rainfall with the addition of tree canopies and other layers of vegetation.

Meeting Water Quality Goals with Urban Forests

State and local governments across the Nation must manage urban stormwater runoff to meet Federal regulations through the Clean Water Act. They are required to identify the source of pollutants, develop methods for reducing stormwater volumes in streams and outflows, and take action to improve downstream water quality. The benchmark used to define impaired waters is the Total Maximum Daily Load (TMDL), the total pollutant loading that a waterbody can receive and still meet water quality standards. If a town's separate storm sewer system (MS4) contributes a pollutant of concern to a listed,

impaired waterbody, the municipality must modify their program to meet State and Federal TMDL regulations.

Federal, State, and local governments are increasingly accepting green stormwater infrastructure as an effective component in meeting regulatory water quality requirements. Urban and community forestry programs that plant and care for trees and forests are viewed as cost-effective green stormwater infrastructure strategies for maintaining the health of urban watersheds, improving water quality, and reducing the size and cost of water storage and treatment systems.

Three goals can be applied to manage community stormwater with urban trees and forests:

- **PROTECT** undeveloped forests.
- **ENHANCE** the health, condition, and function of trees and forest fragments in and around developed areas.
- **REFOREST** open land and paved spaces through active replanting and natural regeneration, and incorporating green stormwater infrastructure practices into new development, retrofit, and redevelopment projects.

Approaching urban forestry and stormwater management from a green stormwater infrastructure perspective means that trees and forests are part of a dynamic and complex system full of opportunities to meet environmental goals, and build community and place.

With these goals and practices in mind, State Forestry Agencies have the skills, knowledge, and expertise to help communities achieve results in stormwater management and water quality downstream.