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Ecological Benefits of Creating Stormwater Wetlands and Woodlands in Philadelphia, PA

Urban development and wetland loss have negatively impacted water quality. Natural areas and systems can help mitigate those impacts. With over two centuries of utilizing the Schuylkill River as a source of drinking water, Philadelphia has adapted from land preservation to wetland creation to achieve sediment Total Maximum Daily Load (TMDL) standards. This case study highlights how the innovation of constructed stormwater wetlands coupled with the restoration of forested natural areas provides water quality and ecological benefits.

Keywords

urban forest management, urban wetlands, ecological benefits, stormwater, green infrastructure

CONTEXT

Industrialization and combined sanitary and stormwater sewers caused numerous health problems in Philadelphia in the 18th and 19th centuries. In Philadelphia, the watershed park system was created to protect the creeks and rivers that the city relies on for drinking water. Preserving forested land adjacent to water bodies has limited benefit to water quality when stormwater inlets bypass greenspace and flow directly from the street to the creek. In recent years, the mitigating potential of natural areas has received increased attention. Anchored in the Clear Water Act of the 1970s, a sediment TMDL for the Wissahickon Creek watershed was developed in 2003. A Total Maximum Daily Load, or TMDL, is a prescriptive diet for reducing pollution from an impaired stream. By working toward the associated pollutant reductions of the identified water quality stressor (sediment in this case), a waterbody can function better and provide related ecosystem services. The City of Philadelphia responded by implementing stream restoration and constructing stormwater wetland projects to improve water quality. The innovative approach of co-creating wetlands and forested areas compounds benefits by reducing the amount of sediment entering the water source and providing native plant diversity.

GOAL

The goal was to create wetlands fed by stormwater to reduce the sediment load entering creeks at targeted locations. These constructed wetlands direct stormwater through a series of basins, utilizing cascading rocks and wetlands plants to slow the flow of stormwater, allow sediments to settle, and promote filtration.

A suite of native trees, shrubs, and herbaceous plants, known to have ecological benefits, were selected for the landscape plans to further Philadelphia Parks & Recreation’s overall goal of increasing plant diversity within natural park areas. A byproduct of these goals was developing a collaborative management strategy with the Philadelphia Water Department (PWD) leading the maintenance and monitoring of the hard infrastructure and PPR/FPC leading the vegetation management.

APPROACH

Driven by regulations within the Clean Water Act, a TMDL for sediment in the Wissahickon Creek was developed in 2003 by the EPA. Constructed stormwater wetlands began with a pilot project in Saylor’s Grove, a 3.3-acre section of passive-use park space that sits along Monoshone Creek, a tributary to Wissahickon Creek. A 1-acre stormwater treatment wetland was created, allowing the park to filter a portion of the 70 million gallons of annual stormwater pouring from its urbanized watershed.

This initiative continued with two additional wetlands created within the Wissahickon Watershed: Cathedral Run and Wise’s Mill wetlands. At each site, the design was to redirect stormwater that had entered inlets within residential neighborhoods into a system of basins,

swales, and wetlands before entering the respective stream tributary to Wissahickon Creek. This would allow sediment within the stormwater to settle before entering the stream and creek. In 2021, approximately 330 cubic yards (about 310,000 pounds) of sediment were removed from the Cathedral Run wetland. Two dredging events at Saylor Grove Wetland, once in 2010 and again in 2020, removed 350 cubic yards (334,000 pounds) and 1500 cubic yards (1.4 million pounds) of sediment, respectively. The first maintenance dredging of Wises Mill Wetland is tentatively scheduled for 2023. These statistics represent pollutants prevented from reaching Wissahickon Creek. If the pollutants were unabated, they would have contributed to the sedimentation of the creek, clogging critical aquatic habitats.

Parks and Recreation's specifications for native trees, shrub planting, and herbaceous seeding were incorporated into landscape plans to provide a plant palette capable of maturing into a forested wetland and forested upland habitat (See Table 1). Invasive plant management was initiated at the sites before construction (See Table 2).

Once constructed, there was a period of establishment for plant material and adjustments to site hydrologic conditions. Post construction, Fairmount Park Conservancy was the primary non-profit partner coordinating efforts to manage invasive plant species and infill plantings with Friends Groups and volunteers, in addition to contractor and city staff monitoring and management. Part of the management was developing an approach to native 'volunteer' woody and herbaceous vegetation. In many instances, these 'volunteers' were welcome, but selective management was required to protect spillways, berms, and inlet/outlet infrastructure.

There is greater biological diversity now than existed on the site prior to construction, resulting from the management of competing invasive vegetation, the establishment of original and supplemental plantings, and the 'volunteerism' of native plants.

The projects have achieved sediment reduction goals and increased plant diversity, albeit with greater than anticipated levels of management and maintenance.

RESOURCES

The constructed stormwater wetland pilot, Saylor Grove, which was partially funded through a Pennsylvania Department of Environmental Protection Growing Greener Grant and PWD capital funds. The total project cost for design and construction was approximately $700,000. The Wises Mill Run and Cathedral Run constructed stormwater wetlands that were funded through a PWD capital investment. These two projects were designed, bid, and constructed along with adjacent stream restoration work. The total cost for all project components was $560,000 for design and $1.8 million for construction.

KEY RESULTS

- Total Maximum Daily Load sediment reduction of 2,180 cubic yards and 2,044,000 lbs. to date from respective created wetlands.

- Increase in native plant diversity and management of invasive plant species.

- Community engagement (formation of long-term stewardship group). Wetland creation projects were completed with communities in mind, contributing to their overall success. The creation of the Saylor Grove stormwater wetland, for example, included a new trail around the wetland's perimeter, interpretive signage, and renovated seating areas. The space became a destination for birders, botanists, and neighbors seeking access to nature's beauty. The community responded in kind. Neighbors formed a "Friends of Saylor's Grove" volunteer group that continues to organize weekly cleanups and stewardship days and hosts free bird walks and nature talks for the community. Seventeen years after the wetland's creation, neighbors continue to volunteer countless hours towards our organization's missions of stewardship and education.

- Established a model of collaborative management. Project goals meaningfully contribute to each organization's stated mission. Broke silos created partnerships and important lines of communication among public agencies and our non-profit stakeholders. We continue to employ the collaborative management approach established through these projects, to the benefit of many added projects over the years.

Contact and additional resources:

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Table 1: Saylor Grove Constructed Wetland - Planting List

Scientific Name	**Common Name**
SHRUBS	
Alnus serrulata	smooth alder

Aronia melanocarpa	black chokeberry
Cephalanthus occidentalis	buttonbush
Clethra alnifolia	sweet pepperbush
Cornus amomum	silky dogwood
Cornus sericea	redosier dogwood
Lindera benzoin	spicebush
Salix discolor	pussy willow
Vaccinium corymbosum	highbush blueberry
Viburnum dentatum	arrowwood viburnum
TREES	
Acer rubrum	red maple
Betula nigra	river birch
Fraxinus americana	white ash
Juniperus virginiana	eastern red cedar
Quercus palustris	pin oak
HERBACEOUS PLUGS	
Asclepias incarnata	swamp milkweed
Aster novae-angliae	New England aster
Aster novi-belgii	New York aster
Calamagrostis canadensis	blue joint grass

Caltha palustris	marsh marigold
Carex stricta	tussock sedge
Carex vulpinoidea	fox sedge
Chelone glabra	turtlehead
Eupatorium perfoliatum	boneset
Helianthus angustifolius	Swamp sunflower
Hibiscus moscheutos	rosemallow
Juncus effusus	soft rush
Lobelia cardinalis	cardinal flower
Lobelia siphilitica	great lobelia
Vernonia noveboracensis	New York ironweed

Table 2: Saylor's Grove Wetland, Target Invasive Species (sorted by relative abundance)

Scientific Name	**Common Name**
Artemisia vulgaris	mugwort
Ampelopsis brevipedunculata	porcelainberry
Lythrum salicaria	purple loosestrife
Reynoutria japonica	Japanese knotweed

Typha sp	cattail
Morus sp	mulberry
Phragmites australis	common reed
Cirsium arvense	Canada thistle