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Milwaukee Goes Green and Grey for Stormwater Management

The Greenseams program has been working for more than a decade.

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By Margaret Buranen
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Milwaukee, WI, uses both green and grey infrastructure to cope with stormwater runoff volume and pollution. The approaches complement each other, especially when green infrastructure is designed on a watershed basis.

A major component of Milwaukee's green infrastructure is its Conservation Easement Program. This program started under Metropolitan Milwaukee Sewerage District's (MMSD's) then-director, Anne Spray Kinney.

After Kevin Shafer became MMSD's director, he oversaw the final planning work, established a long-range budget, fostered the initial purchases through the program, and got the public involved. He was enthusiastic about the program and its potential for managing stormwater, with one exception: He found the name "too cumbersome." Looking at a map of the city and its watersheds one day gave him a much better name for the program. Strips of undeveloped land amidst the urban and suburban areas "reminded me of a patchwork quilt and the rivers were the seams that held it together."

Greenseams was the name he chose for MMSD's new green infrastructure program that would manage stormwater in a natural way. Shafer knew that these areas of undeveloped land in the main four watersheds (Milwaukee, Menomonee, Oak Creek, and Root River) could work together in a more cost-effective way than would a traditional grey infrastructure of pipes and underground storage tanks alone.

"Ten years ago, the idea of a regional sewerage district using a program like Greenseams for stormwater management was relatively unheard of, but now MMSD is one of the leaders in using green infrastructure as a stormwater management tool," says David Grusznski, project coordinator for the Milwaukee Office of the Conservation Fund, which manages Greenseams for MMSD.

Greenseams would complement the traditional grey infrastructure of pipes and channels already in existence but inadequate to deal with the heaviest runoffs now, let alone the greater volume that the increased population and impervious surfaces of the future would bring.

Not that Milwaukee hadn't installed plenty of grey infrastructure over the years. MMSD has almost 30 miles of tunnels—some of them 32 feet in diameter—that hold as much as 521 million gallons of runoff until it can be sent

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through the wastewater treatment plant. The Deep Tunnels lie 300 feet below ground, blasted and drilled out of solid bedrock. Shafer has called the tunnel system "the biggest, most effective measure we took to reduce CSOs."

Another type of hard infrastructure is the harbor siphons. This \$138 million project saves room in the Deep Tunnels by getting more runoff into the Jones Island Waste Water Treatment Plant faster.

MMSD is making some older sewer lines last for another 50 years by adding liners filled with a special resin. Hot water is sent through the pipes to turn the resin as hard as fiberglass, sealing any cracks. This project saves millions of dollars and keeps residents happy because entire streets don't have to be torn up for weeks at a time.

But MMSD needed a broader approach to deal with stormwater, one that would focus on infiltration onsite and on prevention. The agency serves 28 communities within 420 square miles and seven watersheds. The service area's population is 1.1 million and growing.



Photo: The Conservation Fund
This former farm field is now part of the Greenseams program.



Photo: The Conservation Fund
Near the headwaters of the Menomonee River



Photo: MMSD/Milwaukee Public Information
Part of the Menomonee Valley Stormwater Park

Back-to-back floods in 1997 and 1998 from 1% probability storms caused major damage in MMSD communities. The June 1997, flood forced hundreds of Milwaukee residents to leave their homes, closed freeways, and resulted in \$90 million worth of damage. MMSW began buying and removing homes and other buildings in the areas that suffered the heaviest flooding. The department also built berms and flood walls.

Years with the heaviest storms forced MMSD to cope with 50 combined sewer overflows (CSOs) per year. Shafer and other city officials knew they had to do something and, as expensive as grey infrastructure is, they had to do something different. They knew that undeveloped land—which provides a natural green sponge to remove pollutants and absorb or slow the volume from heavy storms—would not stay vacant forever. The undeveloped land that was needed now for stormwater to infiltrate would be needed even more in the future. By then it would likely be developed or otherwise unavailable.

Protecting the watersheds in and around Milwaukee meant cleaner water beyond the metropolitan area. These watersheds drain into the Milwaukee, Menomonee, and Kinnickinnic rivers. They also drain into Lake Michigan.

Greenseams started in 2001. The program allows MMSD to purchase either undeveloped property or a permanent conservation easement to it. All but two properties have been outright purchases. Sales are voluntary only; no land is condemned.

Properties must be 25 acres or more to be included in Greenseams, unless they are adjacent to already preserved conservations lands, parks, or municipal open areas. Priority is given to properties that have water-absorbing (hydic) soils. One acre of hydic soil can hold 2 acre-feet of water.

To date, Greenseams has acquired 75 properties totaling more than 2,200 acres. These properties hold 1.325 billion gallons of water. Some of the land was in agricultural use and about 400 acres have been restored to a precultivated state.

Jessica Hrobar, a former project assistant for the Conservation Fund in Milwaukee, last year estimated that by the end of 2011, Greenseams would have acquired about 100 to 150 more acres, in six or seven pieces of property, bringing the total amount of Greenseams land to 2,400 acres.

Greenseams does more than acquire open land and leave it that way. More than 33,000 trees have been planted, to soak up rainfall and form riparian buffers that stabilize streambanks to prevent erosion. Greenseams is also part of MMSD's ongoing efforts to educate government officials and the public about stormwater.

“Working with the surrounding municipalities has been a key component to the Greenseams program,” noted Hrobar. “Many Greenseams sites have been transferred to the local town, city, or village and become part of their comprehensive open space plan.”

Greenseams has joined with area conservation organizations on particular projects. Such joint ventures offer MMSD additional opportunities to educate the public about stormwater. For example, the River Revitalization Foundation (RRF) has worked with Greenseams on the acquisition of two properties along the Milwaukee River in highly urban, developed areas. And Greenseams and the Ozaukee Washington Land Trust (OWLT) worked together to buy land in Mequon, including 34 acres of bald eagle habitat along Lake Michigan.

Greenseams has spent \$22 million, with \$8 million coming from state and federal programs. Its main funding comes from MMSD’s annual budget. Another major source of funding is the Knowles Nelson Stewardship Fund, which is administered by the Wisconsin Department of Natural Resources (DNR). This state program provides 50% matching grants to projects that involve the DNR, local governments, and various environmental nonprofit organizations.

The North American Wetlands Conservation Act (NAWCA) has also provided funding. The Wisconsin Coastal Management Program and the US Fish and Wildlife Service have funded restoration on some Greenseams properties.

The Conservation Fund is a national nonprofit organization that forms partnerships between various governmental and municipal agencies and environmental associations to protect land and water. Nationally it has helped to preserve 6.5 million acres of land and water. While Greenseams is The Conservation Fund’s first stormwater program, the organization has been involved in a number of similar greenbelt programs. One such program, the Ann Arbor (MI) Greenbelt Initiative, is designed to link parks, open areas, and working farms, to curb urban sprawl.

One Greenseams acquisition is 302 acres of a large wooded basin—a lowland forest ecosystem—that forms the headwaters of the Menomonee River, in the village of Germantown. Officially known as Wilderness Park, the site is known by residents as the Germantown Swamp.

“The swamp is one of the last remaining large open space complexes remaining in this highly urbanizing watershed,” said Hrobar. “While the majority of the core of the swamp is protected, additional acreage around the perimeter is proposed for future acquisition.” Preserving this type of wetland “is not only a cost-effective approach to managing future flooding downstream in the city of Milwaukee, it protects wildlife habitat and contributes to the overall quality of life in the Germantown area.”

Eventually the public will have access to parts of this area for hiking, cross country skiing, and birdwatching. Knowing that these open areas will stay that way and that former farmland will not be turned into hard concrete means a lot to the landowners who sell properties to Greenseams.

“I just like the idea so much more that it’s going to be maintained in a natural way,” says landowner Lawrence Hoerig. “My daughter especially said she’s so glad that it’s not going to be houses and she can walk down there later on and see where we used to work on the farm.”

Shafer’s favorite Greenseams site is on Victory Creek in Franklin. “It is approximately 75 acres of close to pristine wetlands and wooded areas,” he notes. This site adjoins a new office park development. “We were able to preserve this natural piece of property for flood control, and it also allows development to still occur. For me, it really shows that good environmental stewardship can go hand-in-hand with economic development.”

Wetlands and wetland restorations are a big part of Greenseams. Last year the program worked jointly with Ducks Unlimited, the Wisconsin DNR, and the National Fish and Wildlife Foundation to convert one piece of property from farmland back to its natural wetland state.

Another Greenseams acquisition, the 150-acre Ryan Creek headwaters area in the city of Franklin, is designated as a Wisconsin DNR Land Legacy Place. The area is part of the Big Muskego Lake Wildlife Area, a rare shallow lake ecosystem, which contains 2,260 acres of water, islands of cattail marsh, and wetlands dominated by cattails.

The eastern shore of Dumke Lake, 31 acres of wetland vegetation, is part of the pristine Ryan Creek headwaters area. The property’s previous owner was Edwin Dumke, who served as an alderman in Muskego for 24 years and died in 2008. An avid fisherman and birdwatcher, Dumke raised peacocks and pheasants on the land. Every autumn, millions of



Photo: The Conservation Fund
Marsh marigolds along a creek on Greenseams land

waterfowl visit the area on their migration to warmer climates.

Like other landowners who have sold their properties to Greenseams, Dumke's daughter is happy that her father's legacy will continue and that the land will never be built on. Former agricultural land will be returned to grassland and savanna, along with preservation of the wetland.



Photo: MMSD/Milwaukee Public Information
Boating on the Menomonee River

Despite its many potential benefits, Greenseams was not an immediate success with Milwaukee taxpayers and government officials. It began when green infrastructure and low-impact-development (LID) strategies were much less well known than they are today.

"Local municipalities and landowners had a hard time understanding why a sewerage district would be buying land for preservation purposes and what they would do with it," said Hrobar. "For example, many thought MMSD would create large detention basins or engineer large stormwater management projects."

Shafer recalls that some of the lack of popularity was "because people thought we would use condemnation [to acquire property]." The approach instead has been through voluntary purchases at full market value.

He adds that another possible reason for lack of enthusiasm for Greenseams was that MMSD was then "building approximately \$300 million worth of flood management for short-term needs, and we told the public that we needed to change the dynamic of adding impervious land cover with no thoughts on the consequences. It took awhile, but people began to see the wisdom of Greenseams."



Photo: MMSD/Milwaukee Public Information
Milwaukee area schoolteachers learn about stormwater.

Hrobar agreed. "It took a couple of years of education the public about why MMSD was implementing the Greenseams Program and what the long term vision was. Once Greenseams was able to acquire and restore a few properties we were successful at building trust within the community."

Greenseams is concentrating on projects in the most urban areas within the four major watersheds, where most suburban growth is expected. Shafer hopes to expand the program to less-populated areas. "I feel that is an ideal program that should be expanded into rural areas to help us to reduce the amount of nutrients and sediment that wash into our waterways."

He acknowledges that maintaining Greenseams during these times of tight budgets will be a challenge. "We are hoping to keep the program going forward through all of this. I would hope to continue to see approximately \$1 to \$1.5 million per year spent on the Greenseams program, but this is all subject to our budget."

For skeptics who doubt the cost effectiveness of green infrastructure, he says, "I believe that if you looked at

flooding from a watershed approach, you would find significant investments are necessary for typical flood management approaches such as detention ponds and channelization. Greenseams is an alternative that is more conducive to habitat preservation, increased recreation, and so on. When you look at the full gambit of benefits, Greenseams is a very cost-effective approach.”

Another argument in favor of programs such as Greenseams is that it’s cheaper to buy land in low-lying, flood-prone areas before development occurs on it than to buy homes and other buildings after they have been constructed and damaged by floods.

“Green infrastructure—green roofs, bioswales, rain gardens, rain barrels—is part of the larger sustainability program that is being partly paid for and promoted by MMSD,” says Shafer. “Greenseams is a component of that large sustainability program.”

Milwaukee’s green infrastructure includes a number of green roofs, such as those atop the Miller Coors building, the education center at the Mequon Nature Preserve, MMSD’s headquarters, the downtown public library, the Great Lakes WATER Institute, and Highland Gardens, a public housing complex with a 20,000-square-foot roof. Rockwell Automation’s Building 48 has the largest green roof at 48,500 square feet. MMSD authorized \$3.8 million for 14 green roof projects, known collectively as the 2010 Regional Green Roof Initiative.

Among the institutions that share the goal of keeping all of their stormwater onsite are the Urban Ecology Center and the University of Wisconsin-Milwaukee (UW-M). Located in the urban center of the city, the Urban Ecology Center has a strong sustainability education program for both homeowners and businesses. The center focuses on capture and reuse through a system of cisterns, rain barrels, rain gardens, a green roof, porous pavement, and a wet detention pond. Driveway runoff flows to rain gardens. Collected rainwater is used for toilets and irrigation. The university’s Zero Discharge Plan is a work in progress and much progress has been made as campus infrastructure is upgraded. MMSD worked with James Wasley, associate professor of architecture, to develop the plan, which became part of the university’s official campus master plan.

Campus components include green roofs on Sandburg Hall and the Golda Meir Library and a spiral garden with bioswales planted with native flowers, grasses, and sedges. Wasley’s students are actively involved in the various projects, receiving hands-on learning that benefits them, their school, and the community at large.

Wasley says of this stormwater learning, “I would guess that we are pretty unique in focusing on stormwater within a department of architecture. Some schools combine architecture and landscape architecture—they would be more likely to integrate the issue across both departments.”

UW-M faculty members are currently working on the Milwaukee Inner Harbor Project, which will propose ecological urban stormwater infrastructure as part of a vision of the redevelopment of the inner harbor, he notes. Students “will be building a sculptural system of cisterns to capture water from the UW-M Power Plant roof and feed it into the spiral garden.”

UW-M’s efforts to infiltrate its stormwater benefit the nearby suburb of Shorewood. The campus and the tree-lined village, one of the oldest in Milwaukee, share the same watershed. Shorewood is located between Lake Michigan and the Milwaukee River, and its proximity to downtown, community beach, and parks make it a highly desirable residential neighborhood. As a result of these advantages, it has the highest population density of any Wisconsin town, 13,400 residents in about 1 square mile.

Almost half of Shorewood is connected to a combined sewer (CS) system. Flooded basements have long plagued its residents, but the village couldn’t afford to build new sewers. In response to residents’ complaints, MMSD and Shorewood’s Department of Public Works launched a program, partially funded by MMSD, to keep stormwater out of the system. Some sewer lines were upgraded, but the main strategy to combat flooding was what the property owners would do themselves.

The program’s goal was simple: take 50% of the roof area out of the CS area. After an intensive public education campaign, more than 240 roofs and 985 downspouts were disconnected. That equivalent of 11 acres of impervious surface removed more than met the program’s goal. Rain gardens and rain barrels were also installed.

Shorewood residents, relieved that their basements stopped flooding and they didn’t have to pay a massive increase in taxes to make that so, have championed more green infrastructure in their community, including beach bluff restoration to manage erosion, a green alley project, and a new high school athletic field with zero discharge.

In March 2011, MMSD began the Private Property Inflow and Infiltration Reduction Program. This \$138 million program helps district homeowners pay for downspout and foundation drain disconnection, lateral repair and rehabilitation, and improved surface water drainage.

Green infrastructure is also growing at the Milwaukee County Zoo, which repaved many of its walking paths with

permeable paving brick. Runoff that doesn't infiltrate is piped to a rain garden area. A bioswale was installed along the northern border of the zoo's main parking lot to capture and treat runoff. Swales and buffers were added at various exhibits. The Education Center has a green roof.

Rainwater from the roofs of the primate house and the Australian building is captured and stored to wash walks and other areas. The zoo's used animal bedding and food waste no longer fills up the landfill. Growing Power, an urban farm organization, turns it, along with plant trimmings, into compost.



Photo: MMSD/Milwaukee Public Information
Hundreds of roofs and downspouts were disconnected from the combined sewer system in Shorewood.

The Menomonee River Valley has both development and stormwater management happening at the same time. A collective approach to the stormwater control centers on a 70-acre stormwater park, a natural way to control runoff and offer residents recreational opportunities. The stormwater park includes a constructed floodplain, river bank stabilization, bioretention areas, and restored prairie and woodlands. This community park contains a portion of the Hank Aaron State Trail. What was once a contaminated industrial area has been reclaimed. Residents have access to bike and walking/running paths and the Menomonee River.

Another location that combines recreation and environmental education for residents, wildlife habitat,

and stormwater management is the beautiful Mequon Nature Preserve. Located on the border of Ozaukee and Milwaukee counties, the preserve has 3 miles of winding hiking trails that connect with two other area trails.

More than 550 acres of farmland have been restored to presettlement beech and maple forests, ponds, and wetlands. The preserve's natural setting allows less runoff and cleaner water to flow into Trinity Creek, a tributary of the Milwaukee River.

Elm Grove is another Milwaukee community that suffered extensive flooding. Underwood Creek, which flows beside the city's park, became the solution instead of the problem. For this to happen, residents had to give up their park for a year and a half, so it could be rebuilt with stormwater management in mind. Workers enlarged the park's 3-acre pond to 9 acres to hold overflow from the creek, built dry detention basins, and added a box culvert and diversion pipe. Native plants on the pond's embankments, wooded floodplain areas, and grassy swales both add to the park's beauty and help manage stormwater by nature. For their patience, Elm Grove residents have far less stormwater and more recreational opportunities, including a walking path, more soccer fields, and a naturalized pond.

These projects in Milwaukee demonstrate that stormwater management isn't a matter of grey versus green infrastructure, or of a one-site versus a watershed-wide approach. Each strategy has a role to play. When selected and employed wisely, as seen in these examples, then the city and the region are better off.

"Rain gardens, rain barrels and other BMPs are an important part of urban stormwater management, but there needs to be a larger watershed approach where large wetland complexes and stream corridors in the urbanizing areas are protected from development pressures," says Grusznski. "These undeveloped corridors are a vital tool to managing upstream nutrient runoff and will slow the amount of runoff entering local waterways by retaining the water on site like nature intended it to."

As for grey infrastructure, he says, "Engineered stormwater solutions are a critical part of stormwater management; however, when combined with a natural approach, such as wetland preservation, they can complement the downstream engineered solutions."

Author's Bio: Margaret Buranen writes from Lexington, KY, on the environment and business, for several national publications.



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