Mitigation Matters: Policy Solutions to Reduce Local Flood Risk

This brief is one of 13 that examine state and local policies that have resulted in actions to mitigate flooding.

The black-eyed Susans and other greenery alongside a curb in a Milwaukee neighborhood help absorb excess water.

Milwaukee Uses Regulations to Support Nature-Based Solutions to Reduce Flooding

Land acquisitions and river restorations help capture stormwater

Overview

As the city of Milwaukee has grown over the past century, managers of its stormwater system have struggled to keep up with development. Heavy rains have overwhelmed the system, flooding nearby properties and polluting local waterways. In response, the city began in the early 2000s to try to curb flooding and reduce the need to treat wastewater with "green infrastructure:"[1] relying on open land, increased vegetation, and a range of equipment to capture water.

In 2013, the city worked with permitting authorities to set a goal of using green infrastructure to capture an additional 5 million gallons of stormwater and wastewater runoff,[2] the first of its kind in the U.S.[3] The city achieved this milestone about a year later and subsequently developed the capacity to store another 7 million gallons.

Deep tunnel system fixes one problem, but leaves others unsolved

In the 1960s, to collect and move stormwater away from neighborhoods, the precursor agency of the Milwaukee Metropolitan Sewerage District (MMSD) began lining local streams and rivers with concrete.[4] This hardening, however, ended up channeling the water during storms, causing it to run faster and higher—leading to more flooding.

In the 1970s, the state of Wisconsin and neighboring Illinois sued Milwaukee for failing to reduce its combined sewer overflows, which occur when systems collect rainwater and release it into waterways without enough treatment.[5] Milwaukee reached an agreement with Wisconsin to create a water pollution abatement program, which led to the construction of a deep tunnel system in 1993 at a cost of $1 billion.[6] MMSD expanded this system in 2010,[7] and it captures 98 percent of stormwater and wastewater before the runoff enters waterways.[8]

Yet despite having one of the highest rates of capture in the nation, Milwaukee residents still experienced flooding when rainwaters backed up before entering the tunnel system—and city officials expected the problem to worsen as the city grew.

MMSD's executive director, Kevin Shafer, said the city had to take action due to population growth, increased development, and a changing climate. "We knew that as we looked to the future, we would have higher flows."[9]

How Milwaukee Defines Green Infrastructure

Green infrastructure is landscaping, tools, or detention facilities that trap rainfall, allowing it to be filtered into the soil, evaporated by plants, or stored for beneficial use or delayed discharge.

Examples of green infrastructure include rain gardens, wetlands, green roofs, drainage channels called bioswales, water detention mechanisms that help with infiltration, trees, plants with deep roots, permeable surfaces, rain barrels, and cisterns.

Source: "Surface Water and Stormwater" (2019), https://www.mmsd.com/application/files/4215/5412/8237/Chapter_13_3-25-19.pdf.

Funding green infrastructure projects

In the late 1990s, to combat repeat flooding, MMSD began removing much of the concrete lining from waterways that had contributed to higher water levels,[10] replacing it with natural materials. In 1998, the agency spent $120 million to remove the concrete lining along Lincoln Creek, a 9-mile waterway in a densely populated section of Milwaukee that had flooded more than 4,000 times since the concrete lining was installed in 1960.[11] The agency replaced the concrete with a combination of grass, rocks, and native vegetation. The creek is now less likely to spill over its banks during heavy rainfall, and the natural buffers provide habitat for wildlife.[12]

In the early 2000s, MMSD began increasing its budget for such projects while drafting two strategies for combating stormwater: Vision 2035 and the Regional Green Infrastructure Plan.[13] Vision 2035, finalized in 2010, aims to use green spaces to capture the first half-inch of water—or 740 million gallons—every time it rains.[14]

The Regional Green Infrastructure Plan, adopted in 2013, recommended launching the Fresh Coast Guardians Resource Center, which opened in 2017.[15] The center provides homeowners, businesses, and localities with education materials, training, tools, grants, and assistance with writing grant applications for projects to help reach the goal of storing 740 million gallons of water.[16]

MMSD Statistics

- 1.1 million customers
- 28 municipalities
- 6 unique watersheds
- 411 square miles served
- 91 square miles of impervious areas

Sources: Milwaukee Metropolitan Sewerage District, "About Us," https://www.mmsd.com/about-us; Milwaukee Metropolitan Sewerage District, "Regional Green Infrastructure Plan" (2013), https://www.mmsd.com/static/MMSDGIP_Final.pdf.

Property acquisition and conservation

In 2000, MMSD created and funded another program, Greenseams, aimed at curbing flooding by protecting and expanding green space.[17] Through the program, the agency has purchased properties and restricted development in areas where it expects commercial and residential growth and along creeks and other waterways.[18] Greenseams has conserved 3,700 acres in Milwaukee and funded the planting of 123,000 trees, and hopes to acquire a total of 10,000 acres alongside rivers.[19]

More MMSD Flood Management Projects

MMSD turned its attention in the late 1990s to specific flood management projects, including Lincoln Creek, which drains an urban watershed mostly in Milwaukee. The agency's other flood management projects have included returning developed water systems to their natural conditions, enhancing habitats, acquiring flooded properties, creating more recreational open space with a flood management lens, and removing concrete channels. These efforts seek to involve communities and create employment opportunities. Some projects are fully funded by MMSD while the costs of others are shared by MMSD and project partners. Projects include:

- 30th Street Corridor: will provide three flood basins to store 40 million gallons of stormwater.
- Milwaukee County Grounds: created a 65-acre basin that can hold 315 million gallons of stormwater.
- Valley Park: created a levee and floodwall—providing buyouts for a number of homes in the process—and increased the overall size of the park.

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- Hart Park: created recreational space and flood levees and expanded the park from 20 to 50 acres.
- Kinnickinnic River: removed concrete, widened river channels, created riparian zones, landscaped steep slopes to prevent erosion, and built recreational trails.
- Schoonmaker Creek: removed concrete and restored natural creek beds, providing greater flood storage.

Source: Milwaukee Metropolitan Sewerage District, "Flood Management," https://www.mmsd.com/what-we-do/flood-management

MMSD Initiatives To Achieve 2035 Vision Integrated Management Goals

- Deep Tunnel: Work to achieve zero combined sewer overflows (CSOs).
- Greenseams: Acquire 10,000 acres or river buffers through Greenseams.
- Flood management projects: Work to achieve zero basement backups.
- Fresh Coast 740: Use green infrastructure to capture the first 0.5 inches of rainfall.
- NPDES permit: Use green infrastructure to capture 50 million gallons of rainfall + zero CSOs.

Sources: Milwaukee Metropolitan Sewerage District, "Regional Green Infrastructure Plan" (2013), https://www.mmsd.com/static/MMSDGIP_Final.pdf; State of Wisconsin Department of Natural Resources, "WPDES Permit" (2019), https://protect-us.mimecast.com/s/lvC5CgJkE8CYgBvZiNIBk2?domain=mmsd.com

Green infrastructure required in wastewater permit

In addition to flooding, overwhelmed stormwater systems can also cause water quality problems.[20] Unmanaged runoff picks up contaminants and enters waterways without proper treatment, leading to pollutant levels that potentially violate state and federal requirements. MMSD must follow requirements for stormwater and wastewater treatment set by the Wisconsin Department of Natural Resources (DNR) and the U.S. Environmental Protection Agency (EPA) through the National Pollutant Discharge Elimination System (NPDES) permit, which lets facilities discharge wastewater into bodies of water only if they comply with the permit requirements.[21]

In 2013, the Wisconsin DNR and EPA were concerned with higher phosphorus levels at MMSD's South Shore Water Reclamation Facility and combined sewer overflows. To address this pollution, the EPA and DNR suggested costly facility improvements as part of the city's NPDES permit renewal.[22] But MMSD did not believe that the suggestions would help lower the phosphorus levels and proposed a more cost-effective solution: using green space to capture rainwater and treating it naturally before it reaches the reclamation facility.[23]

Wisconsin DNR and EPA agreed, and in 2013, the permit with this green infrastructure requirement for water storage capacity—the first in the nation[24]—went into effect. The permit covered a five-year period and required enough natural solutions, such as open space, to store an additional 5 million gallons of water.[25] To quantify green infrastructure in its permit, MMSD measures the amount of water captured each time it rains.[26]

In March 2019, MMSD took further action to reduce the amount of stormwater that flows into Milwaukee's wastewater system. The agency revised a stormwater regulation to require property owners to add green infrastructure for any development or redevelopment that adds more than 5,000 square feet of impervious surfaces.[27]

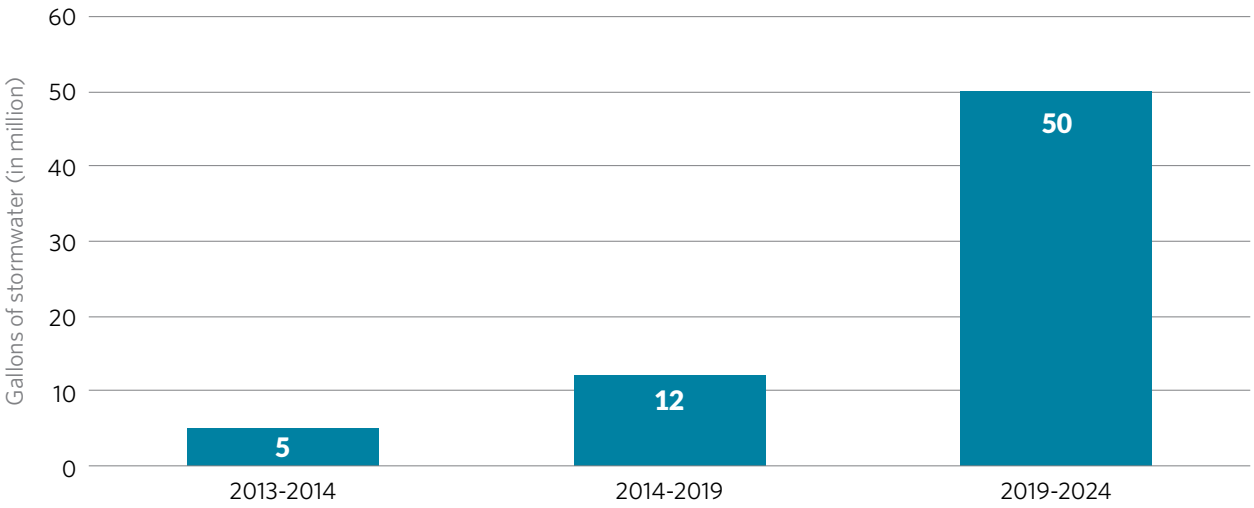
Progress toward achieving goals

Just over a year after MMSD's 2013 wastewater permit, the agency reached its goal of installing enough green infrastructure to handle 5 million gallons of water.[28] In 2014, Wisconsin DNR and EPA raised the permitting goal to 12 million gallons—an aim MMSD also surpassed.[29]

Figure 1

Milwaukee To Capture 50 Million Gallons of Stormwater With Green Infrastructure by 2024

Completed projects have exceeded 2013 and 2014 goals



Sources: State of Wisconsin Department of Natural Resources, "WPDES Permit" (2019), https://protect-us.mimecast.com/s/lvC5CgJkE8CYgBvZiNIBk2?domain=mmsd.com; State of Wisconsin Department of Natural Resources, "WPDES Permit" (2014), https://www.mmsd.com/application/files/3314/8302/3136/2013_Discharge_Permit_As_Modified_12112014.pdf.

To meet its permit requirements, MMSD has dedicated funding in its annual budget to support Greenseams, flood management projects, and Fresh Coast 740.[30] The efforts support buying land, greening roofs, planting trees to absorb rain, and installing pavement that can absorb water.[31] One acre of undeveloped property with wetlands or within the flood plain protected by the Greenseams program can store up to 651,000 gallons of water.[32]

Conclusion

In April 2019, MMSD renewed its wastewater and stormwater permit and set a new goal of 50 million gallons of green infrastructure capacity.[33] Deborah Nagle, an EPA director who served as the contact for the original 2013 permit, hailed MMSD's response to urban stormwater challenges. "MMSD is a leader in innovative and smart green infrastructure solutions that have improved the resiliency of their community addressing flooding and the public health hazards of stormwater."[34]

By setting ambitious goals for capturing stormwater and wastewater and achieving them, Milwaukee has become a national leader in the green infrastructure movement.

"Mitigation Matters: Policy Solutions to Reduce Local Flood Risk" examines policies in 13 locations: Arkansas; Brevard, North Carolina; Fort Collins, Colorado; Indiana; Iowa; Maryland; Milwaukee; Minnesota; Norfolk, Virginia; South Holland, Illinois; Vermont; Washington state; and Wisconsin.

To prepare the briefs, The Pew Charitable Trusts contracted with consulting engineering firm Dewberry, which identified a range of state and local policies across the U.S. that are helping to reduce flood risk. Local officials and disaster resilience experts provided input during the research process. Two external reviewers—Nate Woiwode, project manager of The Nature Conservancy's North American Risk Reduction and Resilience team, and Elizabeth Albright, assistant professor of the practice of environmental science and policy methods at Duke University's Nicholas School of the Environment—provided expert insight. Neither they nor their organizations necessarily endorse the conclusions.

Endnotes

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For further information, please visit:

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