Stormwater

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GRADE COMPARISON

2025: D

2021: D

Photo: Urban Drainage System

STORMWATER

EXECUTIVE SUMMARY

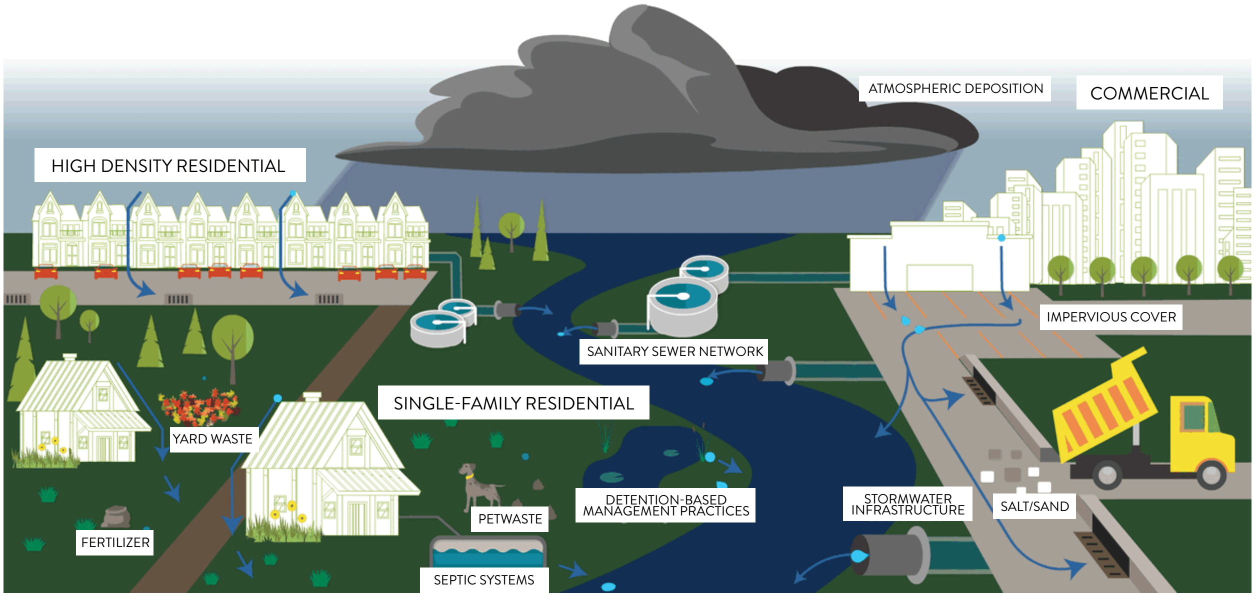
Across the U.S., stormwater utilities are working to manage the infrastructure that conveys rain or snowmelt from communities to nearby bodies of water. However, over the last decade, the length of impaired rivers and streams has increased from about 424,000 miles in 2010 to more than 588,000 miles in 2019, and in 2022, more than 703,000 miles. Although some of this may be attributable to increased monitoring and more stringent state-level assessment criteria, more than 60% of the nation's stormwater utilities have explained that aging infrastructure poses a significant concern for their long-term needs. To locally fund growing capital and maintenance costs, stormwater utilities are increasing fees as the average bill across the country is on the rise, though it is not keeping pace with the demands. Nationally, the U.S. Environmental Protection Agency's 2022 Clean Watershed Needs Survey (CWNS) estimated the 20-year need for large stormwater systems (Municipal Separate Storm Sewer Systems) had increased from $23.8 billion in 2012 to $115.3 billion a decade later. To address this need, Congress passed the Infrastructure Investment and Jobs Act in 2021 and the Inflation Reduction Act in 2022 with $46 billion in new funding for the stormwater, wastewater, and drinking water sectors between 2022 and 2026. While this funding has been useful, it still leaves a significant gap.

BACKGROUND

Stormwater runoff is the rain or snowmelt that travels over impervious surfaces, as well as landscaped or agricultural areas, that is then collected and carried into streams, rivers, lakes, bays, or oceans. No comprehensive national database of stormwater infrastructure exists, yet a 2021 estimate suggests there are 3.5 million miles of storm sewers, 270 million storm drains, and 2.5 million stormwater treatment assets across the country.[1,2,3,4,5,6,7] As the area covered by impervious surfaces expands at a rate of 1% every five years, impacts of stormwater runoff increase and can lead to urban flooding. [8,9,10,11]

An impervious surface reduces the natural movement of rainfall into groundwater, which is called infiltration. As cities develop, the area of natural, vegetated landscape is reduced, typically because it is replaced by roads, buildings, parking lots, and other features that do not facilitate infiltration.[12]

Stormwater Runoff in Urban Watersheds



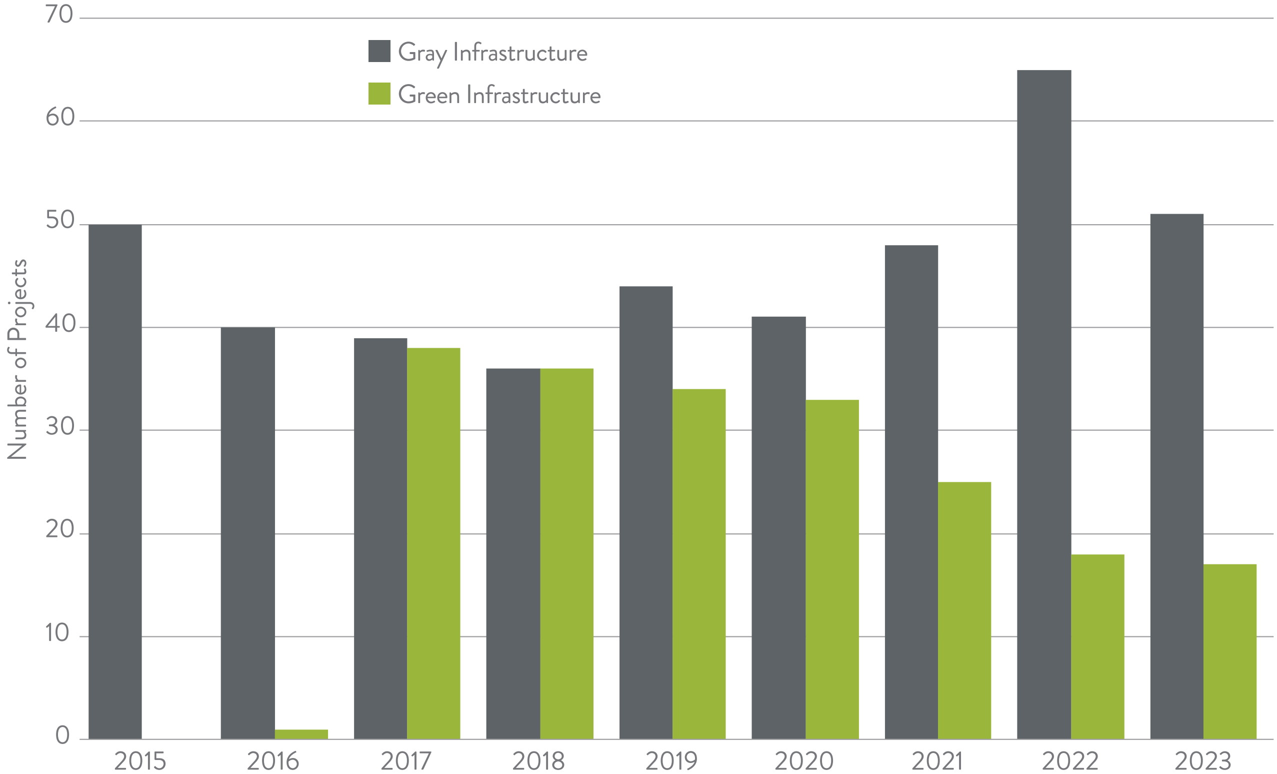
Source: *U.S. Geological Survey, "Stormwater Runoff in Urban Watersheds," 2023*

CAPACITY

In 2023, the U.S. Global Change Research Program published the Fifth National Climate Assessment and identified that intense, single-day precipitation events have been on the rise for the last few decades. While heavier precipitation does not necessarily mean the total amount of precipitation is increasing everywhere, it does mean the occurrences exhibit more of a "flash" or severe effect.[13] These changes to the frequency and intensity of precipitation strain the current capacity of the nation's stormwater infrastructure. In turn, implications exist for future design capacities of new and recently upgraded systems.

Stormwater infrastructure can take many forms, including piped systems, detention basins, ditches, canals, channels, and roadway conveyance systems. In recent years, green stormwater infrastructure has been incorporated into new developments, retrofitted alongside older systems, and coupled with traditional "gray infrastructure" to maximize the benefits from naturalized hydrologic conditions by using vegetation, soils, site grading, and natural filtration processes.[14] Green infrastructure, for example, rain gardens, constructed wetlands, vegetative buffers, roadway bioswales, and permeable pavements, provides benefits by reducing runoff, minimizing erosion, and contributing to water quality improvements.[15] Since 2015, the number of green and gray stormwater infrastructure projects funded by the Clean Water State Revolving Fund Program (CWSRF) has grown with gray infrastructure projects outpacing the implementation of green infrastructure in recent years.[16] Although green infrastructure is critical in addressing localized drainage and water quality, these systems cannot provide sufficient capacity to manage large-scale stormwater events.[17]

Change Over Time in the Number of Green and Gray Stormwater Infrastructure Projects Funded by the CWSRF Program



Source: U.S. Environmental Protection Agency, "Clean Water SRF Program Information National Summary," 2023

The U.S. EPA developed a classification of stormwater systems called Municipal Separate Storm Sewer Systems (MS4s) to address stormwater discharge from large urban or suburban areas. MS4s are publicly owned, discharge into U.S. waters, and are regulated by the EPA under the National Pollution Discharge Elimination System (NPDES) program. Apart from EPA regulations, states, counties, and local governments may require stormwater management practices through local ordinances, building codes, and development plans. According to the EPA, there are 855 Phase I MS4s (typically, medium or large cities and certain counties) and 6,695 Phase II MS4s (typically, smaller systems and other non-traditional systems) across numerous cities and counties subject to MS4 discharge regulations.[18]

Phase I (855)

medium and large cities or counties with populations of 100,000 or more.

Phase 2 (6,695)

smaller systems in urbanized areas such as public universities, departments of transportation, and hospitals.

CONDITION, OPERATION AND MAINTENANCE

Stormwater systems are designed to capture and move runoff to nearby bodies of water. However, performance efficiency and effectiveness can deteriorate as systems age. In the Water Environment Federation's (WEF) 2022 National MS4 Needs Assessment, more than 60% of surveyed stormwater utilities (643) cited aging infrastructure and workforce/staffing needs as critical challenges to properly functioning systems.[19]

To influence the performance of operation and maintenance (O&M) practices and ensure routine inspections, the MS4 NPDES permitting process has worked as an effective regulatory lever. Under the NPDES program, all MS4s are required to have maintenance plans for their stormwater systems. From 2018 to 2021, the number of stormwater utilities developing and implementing maintenance plans has increased from 38% to 42%. More MS4 Phase I respondents indicated having a stormwater asset management plan than the MS4 Phase II group, with 63% and 35%, respectively.[20]

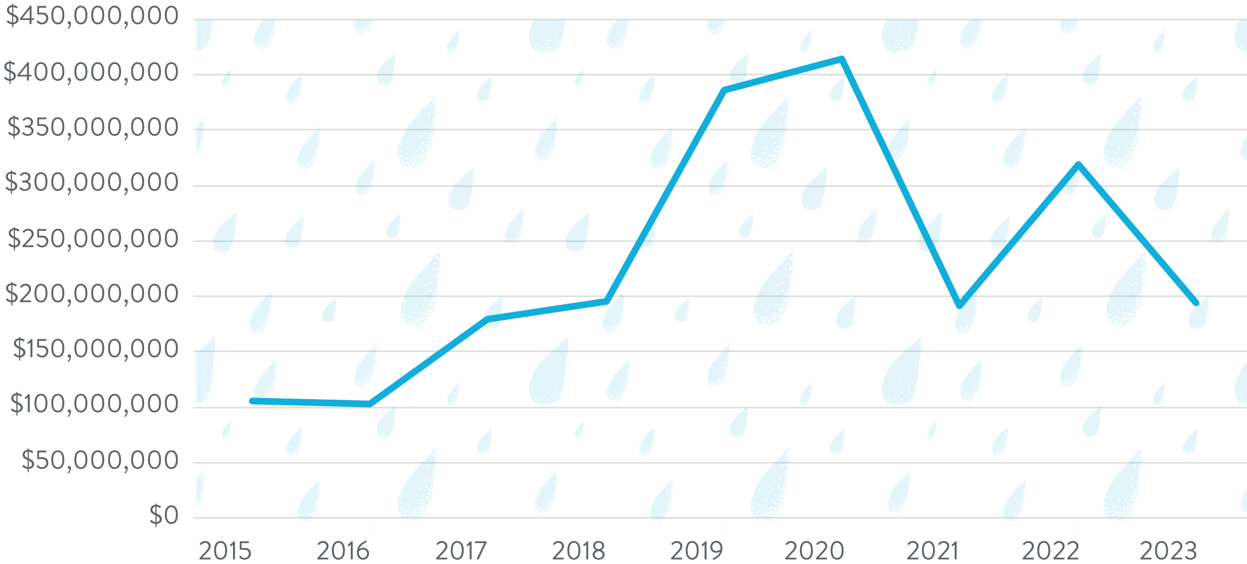
Stormwater assets may be implemented, owned, and managed by various public or private entities such as state or local governments, individual or corporate property owners, or homeowners' associations. When private entities, cooperatives, and individual homeowners are responsible for O&M, organizations can be ill-prepared or unaware of their sometimes expensive stormwater O&M responsibilities. A few consequences of deferred maintenance are the potential increase in the likelihood of urban flooding and threats to water quality. In the U.S., the length of impaired rivers and streams increased from about 424,000 miles in 2010 to more than 588,000 in 2018 to over 703,000 in 2022.[21] However, the EPA expects state agencies to set their own criteria for water quality monitoring and assessment. This includes the frequency of data collection, methods for analyses, and approach to impairment classification. As such, the increases may be due to higher reporting frequencies or more stringent water quality assessment criteria, among other factors.[22,23]

FUNDING AND FUTURE NEED

In 2021, the IIJA was enacted, soon followed by IRA in 2022, adding new funding of $46 billion to assist stormwater, wastewater, and drinking water sectors from 2022 to 2026. However, this funding is primarily focused on modest increases to low-interest loan programs.[24,25]

Around the same time, according to the EPA's 2022 CWNS, the 20-year capital improvement need was estimated at $115.3 billion for all MS4s and unregulated communities, an increase from $23.8 billion estimated in 2012.[26] Although the reported value does not encompass all stormwater infrastructure needs, it expands the scope of stormwater projects incorporated in the CWNS. The expanded scope includes the impacts of changing stormwater management requirements and the effects that more impervious surfaces have on the volume of stormwater utilities must manage. Overall, the recent funding, though helpful, does not meet the projected needs of the CWNS.

Change Over Time in the Amount of Federal Funding for Stormwater Infrastructure Projects Supported by the CWSRF Program

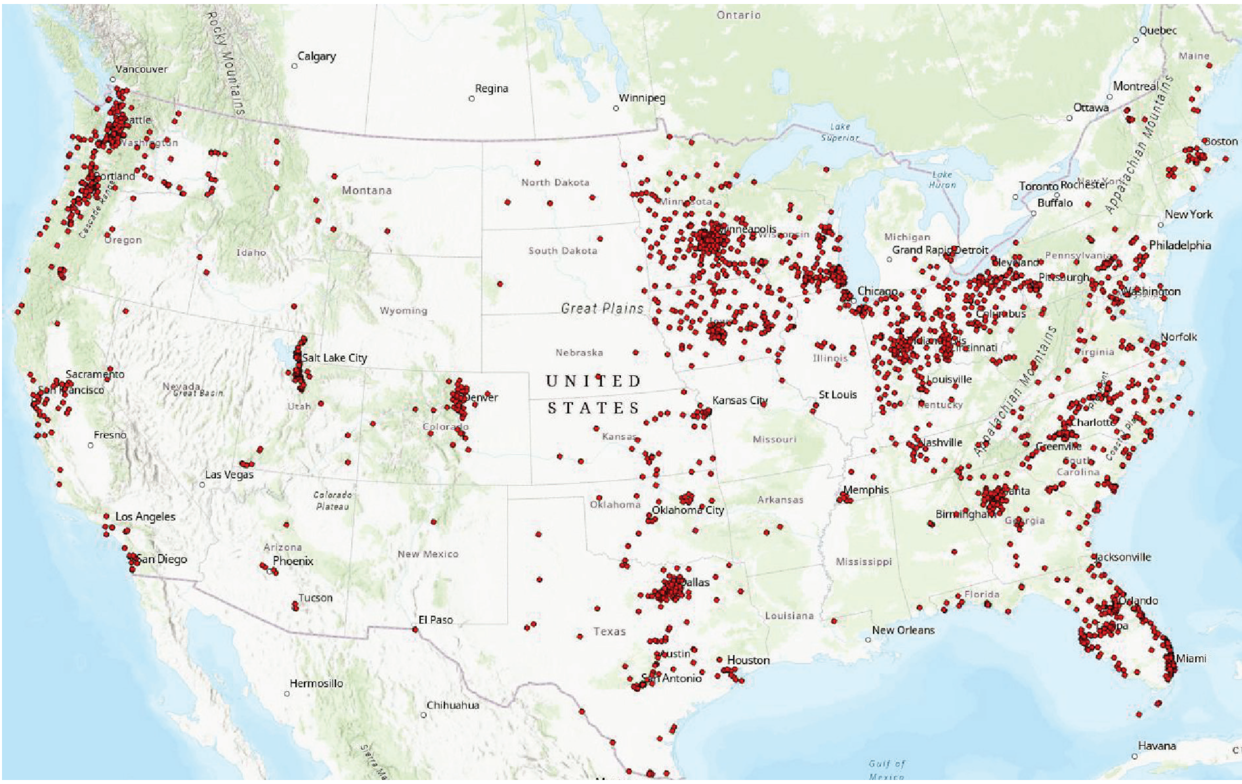


Source: U.S. Environmental Protection Agency, "Clean Water SRF Program Information National Summary," 2023

Stormwater utilities support a wide variety of community sizes and geographies. For instance, utilities provide services to populations as small as 80 households to more than 10 million people, with the average utility serving about 16,000 people. These services are provided in varied contexts, including coastal, midwestern, and mountainous areas across urban, suburban, and rural settings.[27] Further, as diverse as the nation's stormwater landscape is, so is the sector's approach to funding and financing the infrastructure's current and future needs. Mechanisms for bringing together financial resources include generating local revenue through stormwater fees, applying for state and federal grants and financing, and accessing non-traditional funding streams.

Stormwater rates are critical for financially supporting utilities, but average bills vary significantly nationwide. According to 87% of utilities surveyed, stormwater rates are primarily determined by using impervious areas to estimate stormwater charges. However, land use and parcel attributes are dynamic and frequently subject to change, so utilities are being stretched to consider best practices for managing and analyzing data to effectively inform revenue generation and billing. At the same time, 54% of the utilities indicate they do not have a defined protocol to update and maintain the data that support an adaptive approach to stormwater billing.[28]

U.S. Stormwater Utilities



Source: Campbell, Warren, and Emily G. Davis, "Western Kentucky University Stormwater Utility Survey 2023," 2023

Although the average household bill for stormwater is increasing, it is not keeping pace with utilities' growing capital and maintenance costs.[29] According to Western Kentucky University's 2023 stormwater report, for a single-family home, the average monthly stormwater fee increased from $5.34 in 2018 to $6.06 in 2023.[30] Likewise, Black & Veatch's 2021 stormwater research determined nearly the exact value for the average monthly fee at $6.08.[31] Of the utilities that responded to B&V's 2021 Stormwater Utility Survey, 31% indicated the funding they currently generate is inadequate to meet both their O&M and capital revenue requirements, whereas 42% shared that they can cover all their O&M but only limited levels of capital needs.[32]

PUBLIC SAFETY AND INNOVATION

Data from the National Oceanic and Atmospheric Administration (NOAA) shows show an increase in the frequency and severity of disasters costing greater than $1 billion. From 2010 to 2019, there were more than 130 major disaster events; more recently, from 2019 to 2023, nearly the same number of major disasters (102) were recorded. Flooding is within the top three most costly and common threats to communities.[33] However, for communities with limited resources, additional vulnerabilities may exist. For instance, some low-income communities experience long-term flood risks, making them particularly vulnerable to the dynamic between increased rainfall intensity, rainfall frequency, and development of impervious surfaces.[34] Therefore, as stormwater infrastructure and design regulations are more carefully considered, communities become more protected from costly urban flooding, and waterways are safeguarded from significant water quality impacts.

One way of addressing design and planning needs for state and local infrastructure, especially in a especially as precipitation patterns shift, is the expected release of Atlas 15, NOAA's Precipitation Frequency Standard.

While this innovative tool will not be fully available until 2027, pilot outputs are being released on a rolling basis. Currently, Atlas 14 includes data used to assess floodplains, size sewers, design best management practices, and establish safe estimates of stormwater moving through urban and suburban landscapes. The next iteration of this tool will build on Atlas 14 through the critical inclusion of extreme weather in its assessments. Furthermore, the precipitation frequency estimates will be developed for the entire U.S. and its territories, accounting for temporal trends in historical observations and future climate model projections over time. Such information will be necessary for more informed design and planning of critical infrastructure such as the nation's stormwater systems.[35]

RESILIENCE

Impacts from climate change will present more frequent extreme weather across the nation.[36] Therefore, stormwater infrastructure resilience is reflected by an optimized mix of green, gray, and natural infrastructure; land-use planning and urban growth; updated asset management and emergency action plans; and, in water-scarce areas, the productive reuse of stormwater.[37,38]

To withstand the variable effects of extreme weather, stormwater infrastructure is increasingly developed with a context-sensitive approach that leverages a localized understanding of flood risk, land-use practices, and regulatory expectations. This approach informs the design, siting, and long-term sustainability of the stormwater systems. These localized approaches to resilience are often published in an emergency action plan, which aids a stormwater utility in handling all types of emergencies. In 2021, only 29% of the B&V Stormwater Survey respondents from MS4 Phase II indicated having an emergency response plan.[39] Similarly, WEF's MS4 survey revealed that only 26% of municipalities use updated design standards and specifications to address extreme weather and stormwater resilience.[40]


Photo: Irina Ukrainets

Stormwater

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RECOMMENDATIONS TO RAISE THE GRADE

- Establish a database of the nation's stormwater assets.
- Develop a stormwater-specific funding and financing program based on best practices from the existing Clean Water State Revolving Fund and ensure stormwater infrastructure is fully eligible to receive funding and financing from federal programs supporting drinking water and wastewater infrastructure.
- Develop a comprehensive publicly facing education campaign on the true costs, savings, risks, and avoided hazards associated with resilient stormwater investments; disseminate these details through broadly accessible platforms.
- Develop state-based peer-to-peer partnerships to build local government capacity to create and manage stormwater utilities that sustainably fund, operate, maintain, assess, and, when necessary, expand stormwater infrastructure.
- Stormwater infrastructure and design regulations must be carefully considered to protect communities from costly urban flooding and waterways from significant water quality impacts.
- Establish a grant program for 21st century technical career training for "green collar jobs" in the stormwater sector that recruit the next generation's talent and mainstream tools for data-driven decision-making, such as asset management software, life-cycle cost analysis, and affordable rate structuring.
- Expand the inclusion of current and forecasted climate variability in codes and standards for the design, operation, maintenance, and expansion of stormwater infrastructure, and routinely provide funding to NOAA to update the climate data.
- Communities should create stormwater utilities that institute rates reflecting the true cost of treating and handling stormwater runoff.
- Encourage stormwater systems consisting of a combination of gray, green, and natural infrastructure and ensure these options are a mainstream part of the planning and development process nationwide.
- Address point source and nonpoint-source pollution through a watershed approach that encourages regional coordination to improve impacts from stormwater-induced flooding.

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