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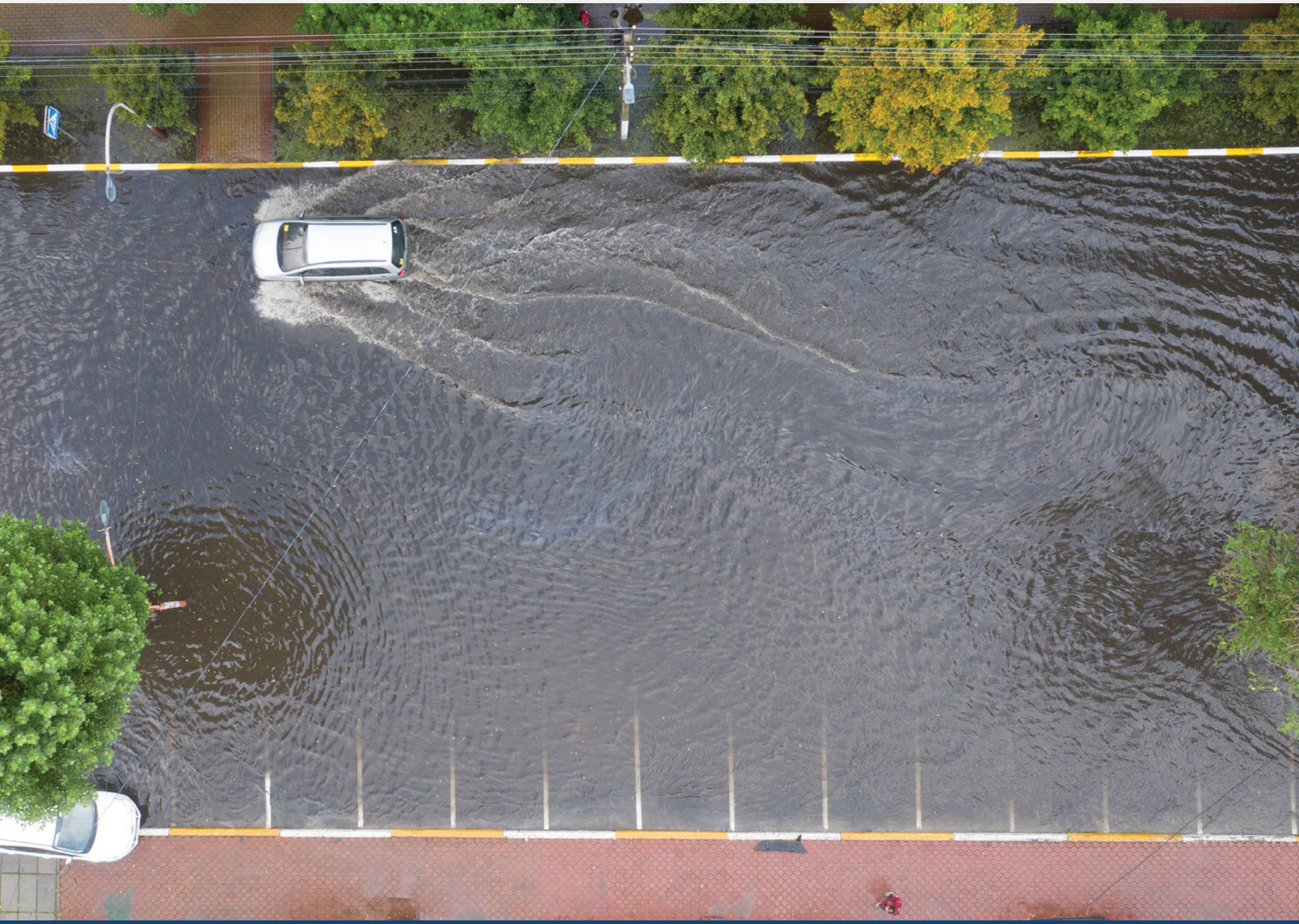
Untapped Potential: An Assessment of Urban Stormwater Runoff Potential in the United States

ADVANCING WATER RESILIENCE THROUGH EFFICIENCY AND REUSE

Executive Summary



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IN PARTNERSHIP WITH 2NDNATURE

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ABOUT THE PACIFIC INSTITUTE

Founded in 1987, the Pacific Institute is a global water think tank that combines science-based thought leadership with active outreach to influence local, national, and international efforts in developing sustainable water policies. From working with Fortune 500 companies to frontline communities, our mission is to create and advance solutions to the world's most pressing water challenges. Since 2009, the Pacific Institute has also acted as co-secretariat for the CEO Water Mandate, a global commitment platform that mobilizes a critical mass of business leaders to address global water challenges through corporate water stewardship. For more information, visit pacinst.org.

ABOUT 2NDNATURE

2NDNATURE Software Inc. is a pioneering force in geospatial science, dedicated to crafting cutting-edge solutions that empower municipalities, institutions, and corporate landowners to revolutionize their approach to stormwater management. Our mission is to bring peer-reviewed science in accessible map-based formats to inform more resilient land management decisions. With a widespread clientele across the United States, 2NDNATURE goes beyond conventional solutions, providing users with a comprehensive toolkit to understand their stormwater challenges, uncover opportunities, and transform stormwater into a valuable resource. We not only equip our clients to manage stormwater effectively but also enable them to communicate the substantial benefits of their investments with impact. For more information, visit 2ndnaturewater.com.

ABOUT THE AUTHORS

Pacific Institute

Bruk Berhanu

Bruk Berhanu is a Senior Researcher at the Pacific Institute. He works on national assessments of water efficiency and reuse feasibility and potential. Prior to joining the Pacific Institute, Bruk worked in the municipal water/wastewater utility industry where he supported long-range water and wastewater infrastructure planning, short- and long-range water demand forecasting, and water reuse feasibility assessments at multiple spatial scales. Bruk received a bachelor's degree in Civil and Environmental Engineering from the University of Pittsburgh, and a master's degree in Environmental & Water Resources Engineering and Public Affairs and doctorate in Civil Engineering from the University of Texas at Austin.

Morgan Shimabuku

Morgan Shimabuku is a Senior Researcher at the Pacific Institute. She conducts research on a wide range of water management issues, including solutions to water equity and access challenges, benefits and trade-offs of water management strategies, and a universal approach for measuring water resilience at the basin scale. Prior to joining the Pacific Institute, Morgan was a senior program manager at an environmental nonprofit in Colorado where she ran residential and commercial water conservation program operations in partnership with municipal water providers. Previously, she worked as a scientist at a water resource consulting firm and supported the PacFish/InFish Biological Opinion Effectiveness Monitoring Program of the US Forest Service as a stream technician. Morgan received a bachelor's degree in Environmental Studies and Geology from Whitman College and a master's degree from the Department of Geography at the University of Colorado, Boulder, where she studied climate change, hydrochemical cycling, and snow hydrology at the Institute of Arctic and Alpine Research.

Shannon Spurlock

Shannon Spurlock is a Senior Researcher at the Pacific Institute. Focusing on public policy & practice uptake, she develops and implements strategies for advancing policies and practices on priority topics for the organization, with a focus on scaling the integration of approaches with multiple benefits into public policy and planning. Prior to joining the Pacific Institute, Shannon ran a consulting business, where her projects included researching interagency collaboration among water utilities for the purpose of scaling water reuse and overseeing the development of a web-based tool that compared ratepayers' water rates across regions and utilities for the purpose of demonstrating affordability or lack thereof. Additionally, Shannon has extensive community-driven food systems experience and has led policy change at the local and state level. Shannon holds a bachelor's degree from the University of Colorado, Boulder and a master's degree in Nonprofit Management from Regis University.

Jessica Dery

Jessica Dery is a Research Associate at the Pacific Institute. Her work addresses impediments and incentives for the use of recycled water in agriculture by merging science, policy, and outreach to promote communication and trust. Jessica has worked on a variety of interdisciplinary projects related to water quality and water reuse including agriculture and food safety, water treatment technologies, power generation, and public perception. Her experience includes conducting synthesis research, co-developing outreach products, and working directly with agriculture communities, utilities, and regulatory agencies. She received a bachelor's degree in Microbiology from Arizona State University and a master's degree in Soil, Water, and Environmental Science from the University of Arizona.

Heather Cooley

Heather Cooley serves as Director of Research at the Pacific Institute. She conducts and oversees research on an array of water issues, such as sustainable water use and management, the connections between water and energy, and the impacts of climate change on water resources. Prior to joining the Pacific Institute, she worked at Lawrence Berkeley National Laboratory studying climate and land use change and carbon cycling. Heather received a bachelor's degree in molecular environmental Biology and a master's degree in Energy and Resources from the University of California, Berkeley. She has served on the California Commercial, Industrial, and Institutional Task Force, the California Urban Stakeholder Committee, and the California Urban Water Conservation Council's Board of Directors.

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Catherine Riihimaki

Catherine Riihimaki is an Earth scientist with extensive experience in fluvial geomorphology and climate change. Over her career, she has led research projects across the United States, focusing on water dynamics over both human and geologic timescales. As Research Director at 2NDNATURE, Catherine collaborates with experts from research institutions, municipalities, and stormwater organizations. Building off her previous positions in higher education as faculty and an administrator, she believes that it is imperative for all people to be engaged in solving environmental challenges.

Nicole Beck

Nicole Beck has a doctorate in aquatic chemistry and a career-long mission to bring science to decision-makers. She is motivated to apply her technical knowledge to develop practical science-based tools to inform land management decisions that protect our water resources. Her journey has landed her as the CEO of 2NDNATURE.

Gary Conley

Gary Conley is Chief Scientist at 2NDNATURE, leading a team that supports development of water quality modeling and effectiveness assessment tools that turn data into actionable knowledge. He combines expertise in hydrology, pollution dynamics, and applied math to develop watershed-based tools used by communities throughout the United States, with extensive experience helping local agencies mitigate water quality issues and develop plans to optimize multiple environmental benefits.

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Abbreviations

ADWR – Arizona Department of Water Resources
AFY – Acre-feet per year
AMA – Active Management Area
AR – Aquifer Recharge
ASR – Aquifer Storage and Recovery
AWBA – Arizona Water Banking Authority
CN – Curve Number
CSO – Combined Sewer Overflow
CWSRF – Clean Water State Revolving Fund
DWSRF – Drinking Water State Revolving Fund
HUC – Hydrologic Unit Code
INA – Irrigation Non-Expansion Area
M&I – Municipal and Industrial
(M)AR – (Managed) Aquifer Recharge
MGD – Millions of Gallons Per Day
MNGWPD – Metropolitan North Georgia Water Planning District
MS4 – Municipal Separate Storm Sewer System
MSA – Metropolitan Statistical Area
NLCD – National Land Cover Database
NPDES – National Pollution Discharge Elimination System
NRCS – Natural Resource Conservation Service
SCS – Soil Conservation Service
TELR – Stormwater Tool to Estimate Load Reduction
TWDB – Texas Water Development Board
US EPA – US Environmental Protection Agency
USGS – US Geological Survey
WRAP – Water Reuse Action Plan

Executive Summary

Water is a precious and vital natural resource that is fundamental for human and ecological health and economic prosperity. In communities across the United States, however, water scarcity is a growing risk due in part to natural hydrologic variability, population and economic growth, and the intensifying effects of climate change. Yet, traditional water sources, such as freshwater from rivers and streams and underground aquifers, are increasingly facing peak water limits. These constraints have led water providers to adopt water conservation and efficiency to reduce demand and develop new, alternative water supply strategies, such as reusing treated wastewater and capturing urban stormwater runoff. These strategies can help "close the gap" between existing and anticipated water supply and demand and support long-term water resilience.

Perspectives on stormwater are changing—and it is increasingly viewed as an asset. Stormwater capture projects are being implemented in a growing number of communities to augment and diversify water supplies, as well as reduce flooding and pollution of nearby waterways. When using green infrastructure, stormwater capture projects can also support community greening and mitigate urban heat island effects. Despite growing interest, greater uptake of stormwater capture is hindered by a lack of comprehensive data characterizing the national volumetric potential of stormwater runoff.

This assessment finds that the average annual stormwater runoff potential is 59.5 million acre-feet per year, equivalent to 53,100 million gallons per day.

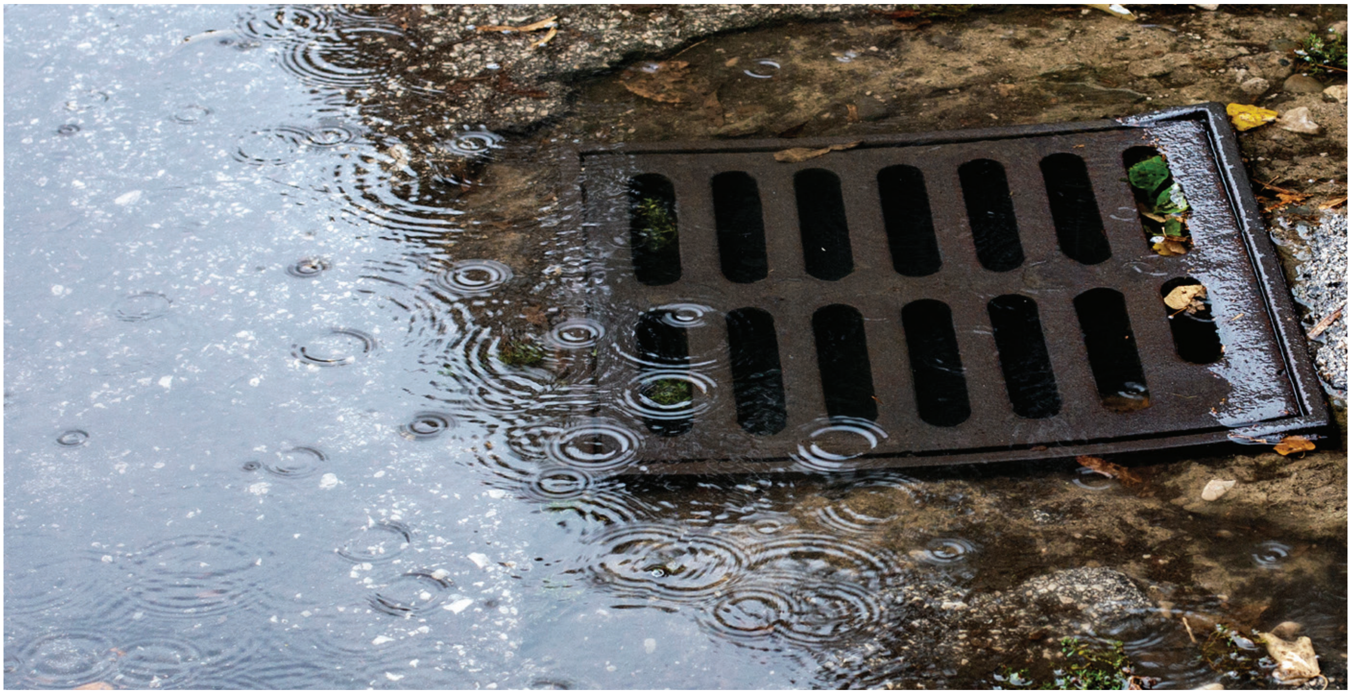
In this assessment, we quantify the volumetric potential for stormwater runoff in US Census Urban Areas across the entire United States. This assessment finds that the average annual volumetric potential for urban stormwater runoff is 59.5 million acre-feet per year (AFY), or 53,100 million gallons per day (MGD). This volume is equivalent to 93% of the water withdrawals for municipal and industrial uses in 2015, though not all of this runoff is necessarily feasible or desirable to capture. We estimate that 37% of this national volume (21.9 million AFY) is generated just in coastal areas, which presents an opportunity for increased stormwater capture in areas that are less likely to face challenges related to adverse impacts on downstream water rights holders.

We also examine potential uses of stormwater capture across four case examples that highlight opportunities to incorporate stormwater capture as a pathway to achieve water supply planning goals (Texas and North Georgia) and support water supply sustainability and resilience (Arizona and Minnesota). These examples can serve as models for increasing the role of stormwater capture as a water supply and resilience strategy for communities who have not previously considered stormwater capture as a viable alternative or are interested in increasing adoption of stormwater capture projects.

Our findings suggest that stormwater capture can serve an expanded role beyond its current level of implementation in Urban Areas across the United States, but this requires additional efforts by researchers, policymakers and regulatory bodies, and implementers (e.g. utilities, municipalities, landowners) to elevate the role of stormwater capture in the national conversation. Here, we offer recommendations for helping to realize this untapped potential of stormwater capture.

Quantify Regional, State, and Local Stormwater Capture Opportunities. Our results indicate that there are potentially large volumes of stormwater runoff available in urban communities across the United States. The amount of runoff that could be captured to meet local water needs will depend on a host of local factors, including precipitation and development patterns, feasibility of implementing stormwater capture in new development, redevelopment, and/or infrastructure retrofits, storage capacity, and water needs. More detailed assessments are needed at the regional, state, and local levels to determine the extent to which stormwater capture can help to augment and diversify water supplies in each area of interest.

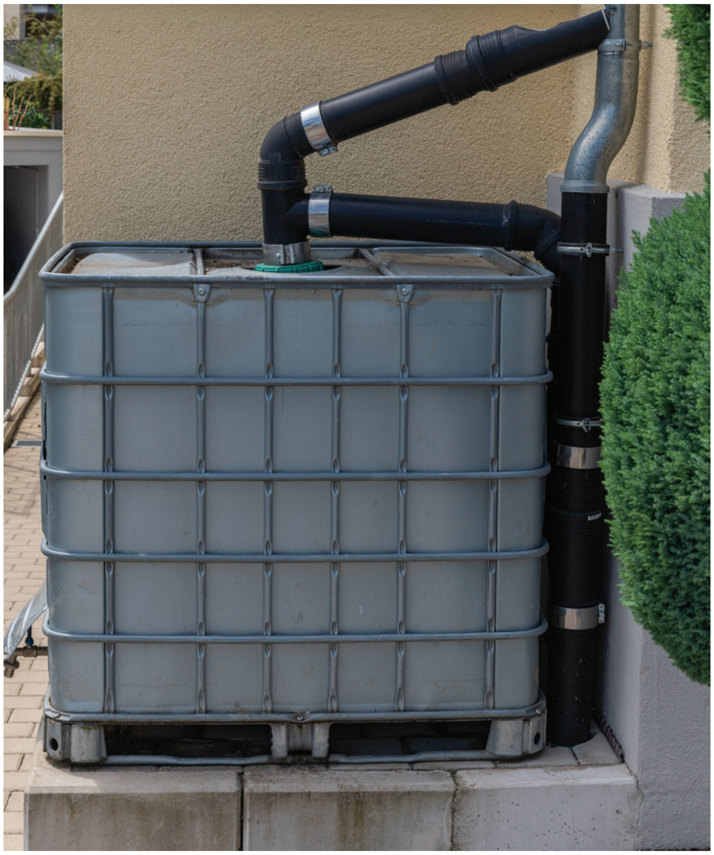
Develop National Guidelines for Stormwater Capture. Few states have regulations that directly address stormwater capture, creating uncertainty and confusion among practitioners and end users. Currently, a poorly defined patchwork of state and local regulations is being applied to the authorization of stormwater capture projects, often on a case-by-case basis. The absence of clear guidelines and/or regulatory frameworks for stormwater capture has inhibited development and implementation of stormwater capture projects in many states.



Pursue Regional Approaches and Interagency Coordination and Collaboration. Stormwater capture projects can be cost-prohibitive for a single municipality or water provider to pursue by themselves. Collaboration between entities within a watershed can provide additional capacity and funding that facilitate stormwater project financing and implementation. Taking a regional view of water supply development opportunities can help utilities and agencies take advantage of economies of scope and scale to address opportunities and challenges more effectively.

Expand Applications of Stormwater for Additional Uses. Stormwater, like any other alternative water supply, can be sufficiently treated to provide a fit-for-purpose water supply. In several areas, however, restrictions on use of captured stormwater that exclude indoor end-uses, such as toilet flushing or industrial use, can limit the efficacy of stormwater capture as a water supply. Increasing the amount of stormwater capture nationwide should entail expanding allowable uses of stormwater beyond the most common current uses (i.e., non-potable uses) to include potable and indoor applications. Model guidelines at both the state and federal levels can support this expansion.

Expand Funding and Financing Opportunities for Stormwater Capture. Most federal funding for water capital projects is provided through the Drinking Water State Revolving Fund (DWSRF) and the Clean Water State Revolving Fund (CWSRF) programs. Only a small fraction of these funds is allocated to stormwater projects. In most cases, state DWSRF programs have not considered stormwater capture projects eligible for financial support. In some cases, stormwater capture projects are eligible for SRF-related funding streams, but there are real and perceived barriers to accessing these funds, such as the absence of dedicated repayment sources necessary to access loans, the requirements for project design details with funding applications, uncertainty regarding eligibility for funding streams, and the inability to leverage additional funding sources for source water and environmental protection. Changes are needed to ensure that stormwater capture projects have equal access to DWSRF and CWSRF financing compared to other traditional and non-traditional water supply projects.



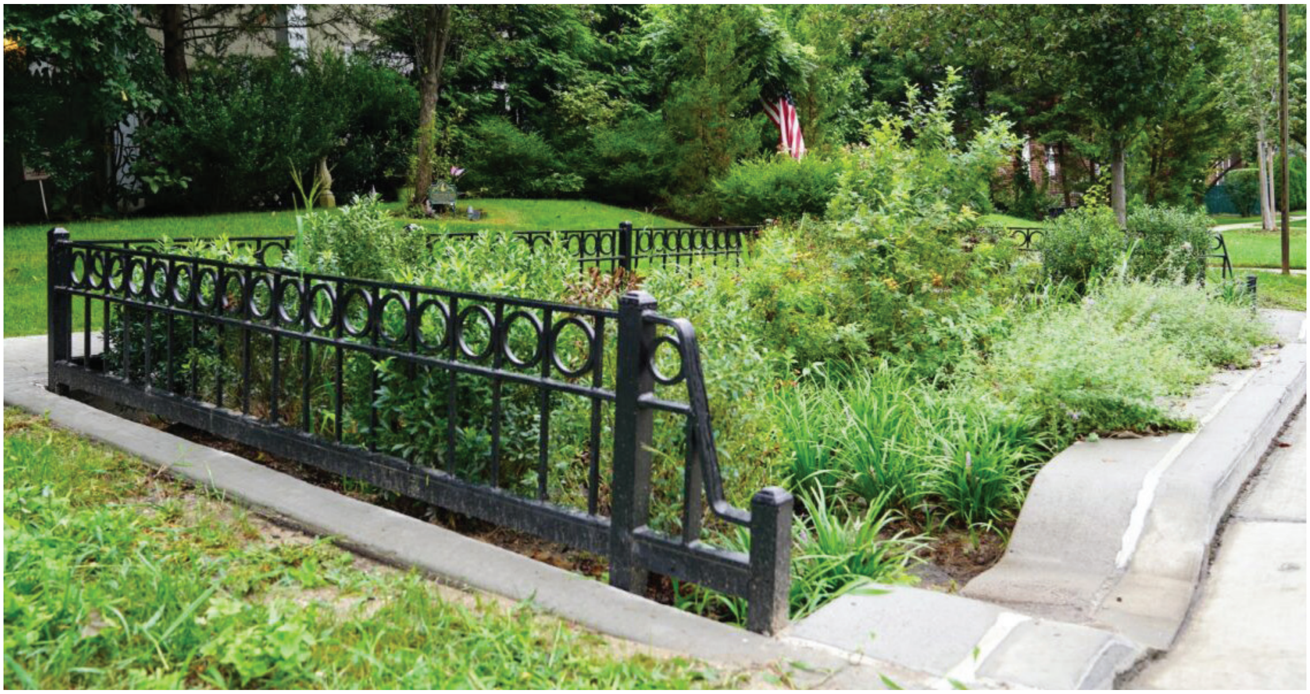
Improve Regional, State, and Local Planning to Support Integration of Water and Non-Water Benefits into Water Management and Investment Decisions. Capturing the untapped potential for stormwater capture, and other alternative water supplies, would benefit from a broader approach to regional, state, and local water supply and land use planning.

For example, state and regional entities can advocate for and establish methods for valuing multiple benefits when determining funding criteria for capital projects (e.g., SRF financing programs). Efforts to incorporate multiple benefits—both water and non-water—into water management and investment decisions can improve a project's financial viability and public acceptance while helping to minimize adverse and unintended consequences.

Facilitate Public-Private Stormwater Capture Projects. Privately owned land can represent a large volumetric potential for stormwater capture. Public-private partnerships (as well as public-public partnerships between public agencies and schools, parks districts, and other large public landowners) can leverage private sector capacity and investment to implement stormwater capture projects more quickly. Designing stormwater credit trading programs to specifically enable partnering across ownerships to encourage stormwater capture would help build local capacity. A comprehensive database of cost benchmarks for different types of stormwater capture can improve the accuracy of financial analyses used to select projects.

Support Use of Green Infrastructure and Reuse for Stormwater Capture Projects.
Although gray centralized conveyance infrastructure has traditionally been used for stormwater management, employing green infrastructure and reuse approaches for stormwater capture can help realize co-benefits (e.g., urban greening, reduced urban heat island effect, and flood risk reduction) that would not be produced by centralized approaches.

Investigate Research Gaps to Improve Efficacy of Stormwater Capture Projects. There remain important outstanding research questions that must be addressed to support even greater uptake of stormwater capture. State agencies, academics, water agencies, and community organizations all have a role to play in filling research gaps.



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