PURE POTENTIAL

The Case for Stormwater Capture and Use

MARCH 2022

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CONTENTS

A CALL TO ACTION: NOTES FROM THE PLANNING TEAM

As America's water managers embrace the challenges of climate change and associated risks to water supply, a distinct focus to date has been on increasing supply through wastewater reuse and desalination. Increasingly, though, we are recognizing the great potential to harvest, treat, and use stormwater and rainwater to address supply vulnerabilities, improve water quality, reduce flooding risk, and achieve other co-benefits in urban areas. In some parts of the country, this potential is being realized through successful implementation of both small- and large-scale projects to harvest stormwater and rainwater for consumptive use. However, the understanding of stormwater capture and use (SCU) potential and challenges varies across the nation, and many areas could benefit from the experience and insights of early SCU adopters that have successfully implemented stormwater/rainwater harvesting projects. Interest in SCU is growing, but it is vital to build a better understanding of how its drivers, potential, and implementation challenges vary across different scenarios in order to effectively build our capacity to implement SCU across the nation.

To help increase awareness of SCU opportunities and build state and local capacity to pursue locally appropriate projects, the U.S. Environmental Protection Agency (EPA), National Municipal Stormwater Alliance, WateReuse Association, Water Environment Federation, and the Re-Inventing the Nation's Urban Water Infrastructure (ReNUWIt) research consortium organized five national webcasts and meetings in 2021 that culminated in an intensive national convening to explore these opportunities and challenges and identify priority actions to advance SCU in urban areas across the nation. The webcasts and web-based meetings gathered national experts in stormwater management to discuss SCU drivers, stormwater treatment standards, an evaluation of the co-benefits that SCU projects generate, and estimations of SCU potential. Building on this groundwork, a diverse group of national stormwater experts and thought leaders met in September 2021 at The Johnson Foundation at Wingspread to identify the highest priorities for building financial, regulatory, scientific, technical, and organizational capacity to pursue SCU while placing it within the broader context of integrated urban water management. Participants recognized that interest in and experience with SCU vary widely around the country, and that different practitioners will need different types of support depending upon local water management circumstances. Most importantly, the group concluded that SCU and integrated stormwater management must be a critical tool in the portfolio of options for promoting the design and management of resilient water management systems in urban communities.

This report lays the groundwork for establishing a unified community of practice around SCU and a strategic framework for coordinated action to address the most important challenges to widespread SCU implementation in urban areas. Where practicable, the report assigns specific organizations to lead key actions for helping stormwater managers build familiarity with effective SCU practices and developing local capacity for SCU implementation. The WRAP provides a vehicle for collaboration and onboarding of new actions focused on enabling consideration of SCU practices. Initial conversations have clarified a path forward for addressing SCU challenges and stakeholder groups have begun to act. There is no better time than now to leverage the national interest in SCU and the co-benefits these projects can provide. The authors hope that this report will serve as a resource to inform stormwater managers across the country about the benefits of SCU approaches, catalyze action, and stimulate a broader dialogue about how SCU fits within integrated water management approaches to become a critical component in broader strategies to advance a resilient water future.

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WHY STORMWATER CAPTURE AND USE?

SCU Drivers and Benefits

SCU, whether at an onsite, community, or watershed scale, offers an adaptive, multi-benefit approach to stormwater management that can create long-term, positive outcomes and contribute to the development of sustainable and climate-resilient communities. Recognizing that the opportunities and challenges associated with urban SCU are different than those associated with rural stormwater management, this report principally focuses on urban applications. A diverse range of drivers and benefits have fueled increasing interest in urban SCU, including water supply augmentation, water resilience, flood control, pollution control, community enhancement, and environmental benefits (see Figure 1 below).

The opportunities for SCU projects vary across the United States based on geography, climate, and project scale. For example, drivers for onsite and building-scale SCU are extremely localized and based on the values, resources, and conditions of infrastructure in a community (National Blue Ribbon Commission for Onsite Non-Potable Water Systems [NBRC for ONWS], 2018). Larger scale projects and projects in water-scarce regions tend to be motivated principally by a mix of water quality management and water supply/resilience interests, whereas SCU projects in water-rich regions are typically implemented principally for flood control and water quality purposes (e.g., regulatory compliance).

Stormwater managers across the United States have made significant progress in implementing a wide range of SCU projects contributing to the country's water reuse landscape, but there have been no comprehensive efforts to build national or regional capacity to capture and use stormwater until now. A more intentional and systematic approach to SCU implementation that aligns with other water management tools and is tailored based on local needs and interests would help accelerate solutions to water supply challenges, improve resources available to communities, and advance environmental and public health imperatives.

What Is SCU?

SCU is the management practice of collecting and using stormwater (water from precipitation runoff that reaches the ground), rainwater (precipitation that falls on roofs and is collected before reaching the ground, streets, and other impervious surfaces), and water in storm drain systems to achieve multiple co-benefits. Captured stormwater and rainwater can serve potable uses, such as aquifer recharge, as well as a wide range of non-potable uses, including irrigation, industrial supply, toilet flushing, washing, dust suppression, firefighting, and evaporative cooling, although treatment may be needed for some uses. SCU can be referred to as "stormwater harvesting" and may require storage and/or treatment before use, depending on the application. SCU practices are implemented at variable scales—from building to watershed—and designed to collect and store watershed-wide runoff during dry or wet weather conditions. Project examples are included in text boxes throughout this report to highlight various urban SCU approaches.

SCU and other terms as they are described here are only for the purposes of this report and are not intended to represent official definitions. While SCU can be a form of onsite reuse, this report is not focused on building-scale SCU due to the past and future work being completed by the NBRC for ONWS (see textbox on page 4, below).

Applying Lessons Learned from Onsite Non-Potable Water Systems:

Beginning in 2014, the NBRC for ONWS has committed to accelerating the development of ONWS through policy developments and applied science. To inform regulatory development for onsite reuse, the NBRC developed *A Guidebook for Developing and Implementing Regulations for Onsite Non-Potable Water Systems*. The document provides guidance for states and local jurisdictions on developing and implementing regulations and oversight programs for ONWS using the risk-based framework that the NBRC supported (Water Environment & Reuse Foundation, 2017). The purpose of the guidebook is to establish a consistent national approach for regulation and management of ONWS. It is intended for use by state and local public health regulators seeking guidance on establishing water quality criteria for ONWS. In addition to the guidebook, the NBRC for ONWS also developed template state legislation for establishing regulatory programs for onsite non-potable water systems.

Building off the guidebook and template state legislation, the NBRC is developing an operator certification program, planning approaches, and decision support tools to support the implementation of ONWS that are protective of public health. EPA has assisted in this effort by conducting research in risk assessment and through the development of the "Non-Potable Environmental and Economic Water Reuse" (NEWR) decision support tool to quantify the availability of alternative water sources—including rainwater—for building-scale reuse. The NBRC is continuing their work as part of WRAP Action 3.4 (Develop Research and Tools to Support the Implementation of Onsite Non-Potable Water Reuse Systems).

Furthermore, work is underway through WRAP Action 2.18 (Incorporate Water Quality and Onsite Reuse into Premise Plumbing Codes and Standards) to incorporate water quality research on onsite water treatment, storage, and delivery into building plumbing codes and standards at the national level, which local jurisdictions may then adopt. Local codes and requirements vary substantially across communities, and local expectations for onsite reuse are not clearly established in many jurisdictions. The objectives of this action include clarifying treatment targets for manufacturers of onsite treatment technologies to spur innovation in the marketplace and help ensure that the latest science and risk-based framework treatment benchmarks are incorporated into plumbing codes and standards to safely advance ONWS.

Seeing the potential benefit of ONWS, the city of Austin, Texas, passed ordinance updates in late 2021 requiring new, large commercial developments to tap into onsite water resources. Following the ordinance updates, developments submitting site plans must include a water benchmarking application, while large developments greater than 250,000 square feet in size will need to consult with Austin Water to discuss water efficiency requirements and incentives for alternative water use. In 2023, any development over 250,000 square feet requiring a site plan will be required to build an onsite water reuse system. City staff are monitoring the potential increases in housing costs that would be imposed by these requirements.

Because harvested rainwater and stormwater are among the primary sources of water for ONWS, there are a lot of synergies with broader SCU practices. The risk-based framework increasingly being used for ONWS can be adapted for SCU, while the operator certification program currently under development in WRAP Action 3.4 will help inform operational practices for SCU. For progress to continue on SCU, stormwater managers can look to the experiences in onsite reuse and gain valuable lessons on policy development, O&M, and applied science.

The Case for a Co-Beneficial Design

SCU projects providing multiple co-benefits beyond primary drivers can effectively address the interests of a range of stakeholders within a community or watershed, making the projects appealing to decisionmakers and stakeholders whose interests they serve when properly designed to meet local needs. Figure 1 contains a summary of many of the potential uses of harvested stormwater and the benefits those uses can provide. Evaluating and framing the full range of SCU co-benefits and tailoring the messaging to be sensitive to specific stakeholder and decisionmaker audiences are crucial to gaining support for expanding SCU capacity. Creating co-benefits also helps meet the needs of smaller or underserved communities (e.g., by creating jobs, reducing costs, and providing an alternative source of water). By engaging broad community interests early in project planning, SCU project developers can more effectively identify and integrate the interests of underserved populations in project design.

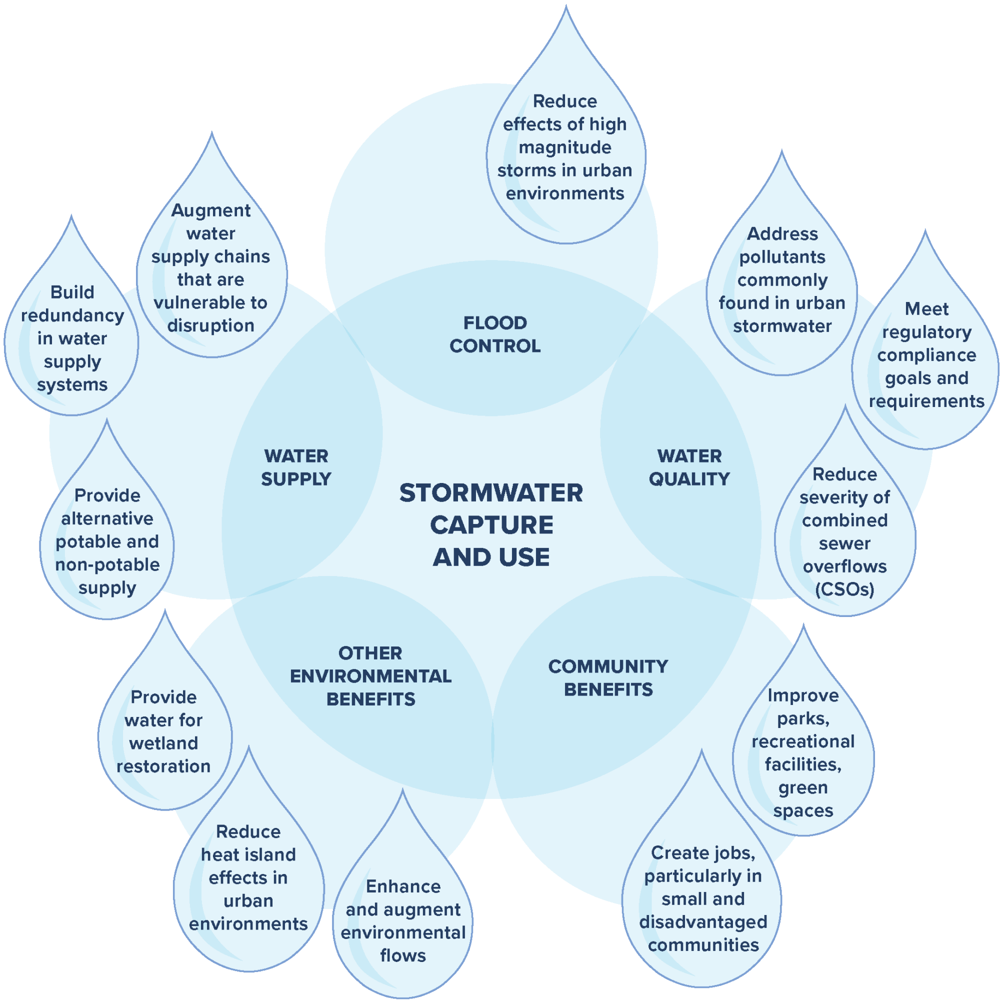
Like other new water supply sources, SCU projects can be relatively expensive to implement, particularly when compared to the average costs of existing water supplies and especially when project co-benefits are not considered. SCU project costs are highly variable and depend upon project size and design, the intended use of the captured stormwater, regulatory requirements, and other local conditions, such as siting constraints. SCU project costs tend to grow as treatment needs become more complex and constructed storage becomes necessary. Larger-scale SCU projects may offer lower unit costs (costs per volume of water provided) than smaller-scale projects. Several studies have found that SCU costs are similar to—or lower than—the costs of many alternative approaches for augmenting water supply, like wastewater recycling and seawater desalination (Cooley and Phurisamban, 2016; Southern California Water Coalition, 2018). New, conventional water supply augmentation projects (e.g., new storage reservoirs and groundwater pumping) are becoming less feasible due to limits of supply and environmental impacts (Gleick and Cooley, 2021). When factoring in various co-benefits from stormwater capture and use, SCU is becoming increasingly cost-competitive with traditional supply options (Dirringer et al., 2021). Moreover, when the value of environmental and community co-benefits of SCU projects is factored into assessments of their costs and benefits, SCU projects are often even more attractive than alternative supply augmentation approaches.

Lake Lawne Stormwater Reuse Facility, Orlando, Florida:

This multi-benefit project captures stormwater to supply non-potable water for landscape irrigation, reduce nutrient pollution, enhance park amenities, and improve habitat biodiversity. Conveyances to drainage canals collect stormwater from the residential, commercial, and industrial properties surrounding Lake Lawne. The Lake Lawne Stormwater Reuse Facility implements the converted canal system to impound untreated stormwater previously discharged directly into Lake Lawne and use the captured stormwater to irrigate adjacent greenspaces (Orange County Environmental Protection Division, 2019). Designing the project to provide co-benefits, including compliance with a 2008 Total Maximum Daily Load (TMDL) for nutrient pollutant loading to Lake Lawne, increased the attractiveness of the project to the public and local leaders and enabled the county to secure funding from multiple, diverse sources.

Aerial view of the Lake Lawne Stormwater Reuse Facility, which uses captured stormwater to irrigate adjacent greenspaces.

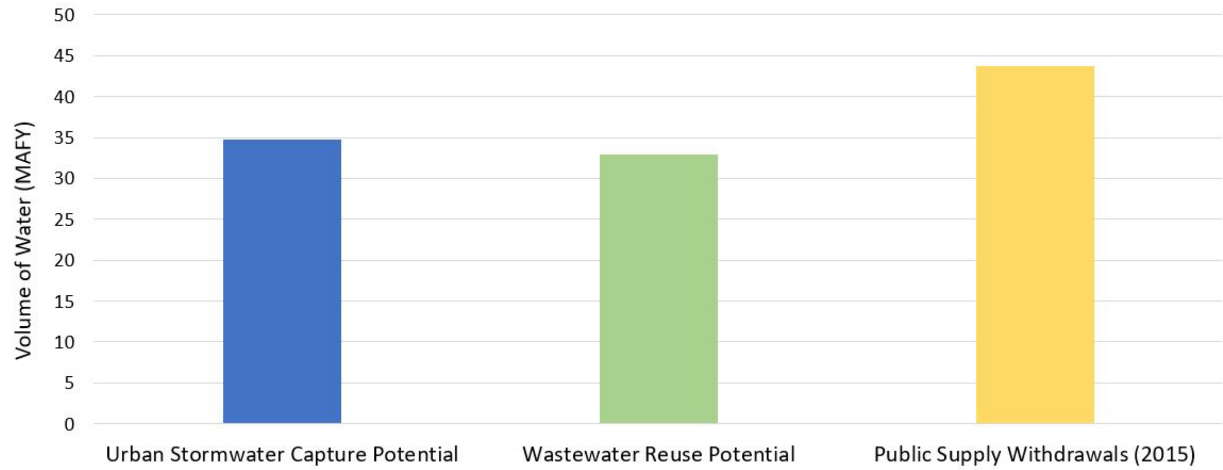
Figure 1: Urban SCU Drivers and Benefits



SCU POTENTIAL

As shown in Figure 2, the amount of urban stormwater potentially available for capture and use is about the same as the volume of treated municipal wastewater available for reuse and could yield enough supply to meet approximately three-quarters of total public supply withdrawals (Aguilar & Brown, 2020; EPA, 2004; Dieter et al., 2018). For the purposes of Figure 2, public supply withdrawals account for water withdrawn by public and private water suppliers that furnish water to at least 25 people or have a minimum of 15 connections. Public suppliers provide water for a variety of uses, such as domestic, commercial, industrial, thermoelectric-power, and public water use. Although more detailed estimates of SCU potential are needed at the local level, it is clear that stormwater harvesting could help meet local water needs. A national estimate of urban stormwater runoff that is currently being captured and used has not yet been developed; however, there is room to expand the practice of SCU. One recent analysis suggests less than 7 percent of municipal wastewater flows are being reused nationally (Rauch-Williams et al., 2018), and the portion of stormwater currently being harvested is estimated to be much less. Even though large amounts of stormwater are available for capture, the true volumes of stormwater available for capture are based on local factors, such as precipitation patterns, facility siting and treatment criteria, cost, local needs, and the capacity to store captured stormwater.

Figure 2: How Much Can Stormwater Capture Augment Supplies in the United States?



Sources	Aguilar & Brown (2020) and EPA (2004)	EPA (2004) and EPA (2016) (from EPA CWNS)	Total public supply withdrawals in 2015 (Dieter et al., 2018)

Understanding the opportunity for SCU at smaller geographical scales is important for raising awareness when communicating with public and private stakeholders and decisionmakers; establishing water management goals at the local, state, and regional levels; and developing tools/incentives to help promote SCU and the associated co-benefits. Quantifying the amount of stormwater that can be captured can help link SCU with other sustainable planning efforts—such as climate resiliency—and promote integrated water management strategies by fostering collaboration between stormwater/watershed planning groups and water and sanitation districts looking for alternative water supplies. Such collaborations can unlock additional resources for SCU implementation. The “Advance the Nation’s Commitment to SCU” section below recommends an action to develop more detailed estimates of SCU potential and implementation to better enable water resource managers to incorporate SCU into planning decisions.

Estimating SCU Potential Across Different Scales:

Researchers have applied several methods for estimating SCU potential at state, regional, and local scales to account for unique geographic characteristics and site-specific planning and design needs. Methodologies applied at larger scales provide snapshots of overall benefits and help inform or incentivize policy decisions. These methodologies use readily available data on precipitation, land perviousness, and assumptions on the amount of runoff that is realistically available for capture and use. SCU potential estimates at the watershed, neighborhood, or parcel scale require greater use of local stormwater characteristics, patterns, land use constraints, and surface or aquifer storage capacity to get accurate results (Garrison, et al., 2014; Fassman-Beck et al., 2020; Cooley, et al., 2022).

Time scales are an important consideration for SCU estimates, as volume can fluctuate significantly on a seasonal basis. A "common currency" or consistent metrics that track annual, seasonal, and storm-specific capacity can help stormwater managers communicate with various entities that can benefit from SCU projects.

STRATEGIC FRAMEWORK FOR CAPTURING THE OPPORTUNITY

Although estimating the volumetric potential for SCU can be useful in goal setting and communicating with decisionmakers, the motivation to pursue SCU solutions will not be based on capture potential alone. The ability to harness the full potential of this variable resource and implement SCU practices on a widespread scale requires an adaptive framework to tailor SCU approaches to address varying community needs while considering unique local circumstances and challenges. This framework should be developed to consider differences in local stormwater and development characteristics, environmental conditions, funding opportunities, regulatory constraints, public priorities and attitudes, and relationships between involved organizations and agencies. All actions should support community capacity to design and implement SCU projects that significantly aid in solving multiple communities' most pressing water management challenges at a time. The remaining sections of this report outline a strategic framework for the following priority elements. A comprehensive list of action recommendations, including possible lead organizations and timelines for completion, is included as "Appendix A" to this report. The recommended strategic framework has six main goal elements:

1. *Advance the Nation's Commitment to SCU.* Overarching leadership and communication are needed to further develop the nation's awareness of SCU potential and capabilities to increase SCU implementation. Building the nation's collective capacity through national-scale collaboration and information sharing will more efficiently enable practitioners to take advantage of the promise of SCU. EPA, state agencies, local stormwater managers, national organizations, researchers, consultants, and stakeholders need to take action to support and enable the emerging SCU community of practice.

2. *Build Trust and Understanding Through Partnerships*. SCU projects will ultimately be unsuccessful if they are designed and implemented within a stormwater silo. Competing organizational perspectives and a lack of understanding about SCU among drinking water, wastewater, and stormwater management agencies, in addition to other state and local agencies (e.g., departments of transportation, planning, zoning, fish and wildlife), make it difficult to incorporate SCU and, more broadly, stormwater management into locally integrated water management frameworks. These management agencies may not have a unified view about the value of SCU, and some may see SCU as being at odds with existing programs and utility operations. Realizing the full extent of community benefits that SCU can provide requires a partnership approach, and the promise of co-benefits can create opportunities for stormwater managers to collaborate with managers from other water enterprises, staff from other areas of government, private sector representatives, and public stakeholders. New and innovative communication approaches and tools are needed to better prepare stormwater managers to engage non-technical public decisionmakers and build support with fellow water managers and community stakeholder audiences to achieve support for SCU projects.

3. *Expand Funding Mechanisms*. Municipal stormwater programs tend to be underfunded compared to wastewater and drinking water programs and often have difficulty raising new funds, particularly when no dedicated revenue stream exists. Although water is considered "cheap," SCU costs compare favorably with alternative methods of

new water supply, and the relative cost effectiveness will likely continue to increase, particularly in arid climates (Luthy et al., 2019). Moreover, SCU projects are even more cost effective when the full range of co-benefits is considered. To address the perceived funding challenges for building SCU capacity, stormwater managers will need to define and persuasively communicate the economic case for implementing SCU projects and develop innovative strategies for leveraging federal, state, and private funding opportunities. Furthermore, stormwater managers may need to shift their perspectives and treat all scales of SCU as capital infrastructure projects on par with conventional systems to unlock capital funding mechanisms.

4. *Clarify Regulations, Policy, and Guidance*. While there are no federal regulations specific to stormwater capture and use, existing regulatory structures that may impact SCU include National Pollutant Discharge Elimination System (NPDES) permitting, state water rights, state water reuse rules, and local codes. These regulatory structures can create both barriers to and incentives for pursuing SCU. Federal, state, and local regulations can help build capacity for SCU planning and implementation by setting stormwater management targets and creating regulatory certainty to drive innovation. In many cases, the absence of regulatory drivers and certainty makes it more difficult for engineers and water managers to incorporate SCU into building- and watershed-scale planning. For example, uncertainty about whether new SCU technologies and strategies will be acceptable to regulators likely inhibits their use.

5. *Advance Science and Treatment Standards*. Treatment standards that are protective of public and ecosystem health and appropriate for designated uses are needed to ensure safe and affordable use of captured stormwater. Developing methodologies for determining fit-for-purpose treatment standards and water quality benchmarks for captured stormwater is complicated because different uses require different levels of treatment depending on human and aquatic life exposures (e.g., to address indirect exposure from non-potable uses, direct exposure to drinking water or food sources irrigated with stormwater, or ecosystem exposures where captured stormwater augments wetlands and streamflow). Treatment standards also need to account for varying pollutants present in stormwater in different locations due to variations in land use, seasonal differences in quality, and other unique local conditions. Methodologies for determining fit-for-purpose treatment standards for SCU ultimately rely on urban stormwater quantity, quality, and treatment performance data, which is often limited and not fully representative of local conditions. Ongoing work to tailor treatment standards to the different combinations of target uses and stormwater characteristics is needed to find the right balance between protection and affordability, inform better regulations, and build public confidence in the nation's capacity to safely use harvested stormwater.

Addressing SCU Research Priorities:

Under WRAP Action 7.2 and the effort to develop a coordinated national water reuse research strategy, The Water Research Foundation (WRF) "Project 4841: Assessing the State of Knowledge and Research Needs for Stormwater Harvesting" seeks to develop recommendations for stormwater harvesting projects and associated research needs based on an understanding of stormwater harvesting practices at local, regional, and state levels. To inform WRF Project 4841 and the broader national water reuse research strategy, "Appendix B" in this report contains a list of key research needs for addressing communication, financial, legal/regulatory, stormwater quality, technology, and organizational challenges to advancing consideration of SCU. The following sections of this report identify research needs that rise to the level of a priority action.

6. *Accelerate the Use of New Technologies and SCU Strategies*. Testing and validating the effectiveness of measurement, control, and treatment technologies and practices applied to SCU solutions will ensure current and future SCU projects are adequately protecting public and ecosystem health. Limitations in currently available data on the effectiveness of SCU in removing pollutants and capturing flow hamper application and acceptance of SCU practices. Understanding of the performance of SCU technologies and practices also varies, as access to objective testing and validation programs/processes is limited and evaluation of effectiveness in different settings remains uneven. These issues are particularly acute in regard to real-time sensing and controls, which hold great promise in SCU applications but are not widely applied to stormwater infrastructure, in part because practitioners and regulators lack sufficient understanding of their reliability and cost effectiveness.

1. Advance the Nation's Commitment to SCU

In addition to actions that address specific challenges, there is a need for overarching leadership and communication to build awareness of SCU opportunities among water managers at the federal, state, and local levels and among consultants, engineers, citizen groups, and researchers. Broader-scale actions should be taken to help meet this need and create ongoing mechanisms for coordination and information sharing.

Recommended Actions: Support and Develop the National SCU Community of Practice

1. EPA intends to explore establishing an internal leadership caucus to spread awareness of outputs and initiatives arising through this strategic action plan. Further engagement with Regional Water Division Directors and Office Directors within EPA's Office of Water will help bring SCU to the forefront of stormwater management conversations at the federal level and further support regional, state, and local SCU advancements. The group should also consider how SCU fits within the broader set of policies, programs, and investments EPA implements to advance stormwater management, effectively address key stormwater management, and integrate stormwater management into other water management sectors. EPA should also introduce SCU opportunities and needs into discussions with fellow federal agencies on water management responsibilities to help take advantage of resources, regulatory coordination, and support that other agencies can provide (e.g., the U.S. Fish and Wildlife Service, Bureau of Reclamation, U.S. Department of Agriculture Rural Development, Department of Energy, and the Federal Emergency Management Agency [FEMA]). Federal interagency coordination on SCU fits squarely within the role of the Water Reuse Interagency Working Group that was formally established by the Bipartisan Infrastructure Law (BIL) to advance water reuse across the United States (BIL Section 50218).

2. The national discussions of SCU opportunities and challenges over the past two years have revealed great interest across the nation in further developing the community of practice focusing on SCU implementation. The National Municipal Stormwater Alliance (NMSA), the WateReuse Association (WateReuse), the Water Environment Federation (WEF), WRF, and EPA should continue building a vibrant community of practice by seeking opportunities to showcase SCU successes and issues in national meetings of stormwater and water recycling practitioners, regulators, funders, and researchers and by creating additional training opportunities to help build technical capacity in specific areas of need.

3. As the drivers for SCU vary significantly in different regions of the country, building capacity for coordination and information sharing at regional levels would accelerate tailored approaches that are responsive to different SCU drivers and interests. To complement cross-cutting actions at the national and regional levels, practitioners should advance local and watershed-scale SCU visioning and planning to build understanding and commitment to developing SCU capacity.

Recommended Action: Develop More Detailed Estimates of SCU Potential and Implementation

Developing and applying more robust SCU estimation methods at national and regional scales will enable water resource managers to more easily make SCU assessments and decisions on the extent to which SCU should be incorporated into water resource planning and investments. EPA and national research organizations should invest in creating replicable methods for evaluating SCU potential, develop specific estimates at national and state scales, and widely share these estimates with water resource managers across the nation. These methods can also be used to derive local, watershed, and smaller-scale estimates to assist in specific community and project planning efforts. To complement and validate estimates of SCU opportunity, national stormwater organizations (e.g., NMSA, WEF) and interested states (e.g., California) should develop metrics (e.g., volume of water harvested) for tracking implemented stormwater capture projects and incorporating comparable measures of stormwater volumes being captured and used. Together, improved methods for estimating SCU potential and actual implementation can be used to highlight the opportunities to augment supply through harvesting and enable measurement of SCU contributions to water supplies over time.

2. Build Trust, Understanding, and Partnerships

Recognizing and communicating the multiple co-benefits that SCU systems provide is critical to fostering water sector partnerships and collaboration on SCU projects. To realize the full extent of SCU co-benefits, water managers will need to collaborate outside of the typical enterprise silos (e.g., drinking water, wastewater, and stormwater) and effectively communicate with non-technical public and private stakeholders. The following priority actions will help stormwater managers more effectively communicate to build understanding of SCU with water agencies, the private sector, political leaders, and public stakeholders. Building understanding will also help develop trust in a community's ability to harvest stormwater and generate the multiple co-benefits these projects can safely and efficiently achieve. As stormwater managers are at different stages of awareness about SCU possibilities, action is needed to help "beginners" get started in evaluating and implementing SCU opportunities in their communities. Other communities will need more advanced help in improving communication strategies and skills needed to successfully build community support for SCU programs.

Recommended Action: Develop a Beginner's Guide to Help Stormwater Managers Get Started With SCU

Many stormwater program managers are interested in, but unfamiliar with, the details about SCU opportunity and key steps in developing effective SCU projects and programs. EPA should partner with NMSA, WateReuse, and other organizations to develop a guide to getting started with SCU implementation. The guide will help practitioners evaluate SCU potential within specific communities, taking into account local stormwater and community characteristics, water management needs and goals, and community priorities. This resource will introduce stormwater managers to the range of SCU projects currently being implemented throughout the United States, illustrating the differences between centralized and decentralized projects and projects designed to supply potable and non-potable uses. A training curriculum should be developed with the guide that covers the basic features of SCU and other resources available to help stormwater managers get started (e.g., communication strategies and financing opportunities).

Recommended Action: Develop Strategies for Effectively Communicating SCU Co-Benefits Using "Words That Work"

Communicating the co-benefits of SCU projects in a manner that stakeholders understand and resonate with is an important step in designing projects that address community needs and a mechanism for building understanding and support for the project. Diverse tools can be tapped to engage stakeholders (e.g., social media, webcasts, etc.) and possible partners; however, successfully developing the proper message and identifying the right target audiences are key to success.

Determining the proper terminology to describe SCU in a way that resonates with public stakeholders and garners acceptance is a critical first step in developing SCU communication strategies. Terminology studies have been completed at local scales; however, a coordinated effort to identify effective language for stormwater and stormwater management approaches will help to build a common language and understanding. Investigating the terms that public stakeholders commonly use to describe SCU processes can help stormwater managers communicate effectively and build trust across the community. Compiling and disseminating these "words that work" will help SCU adopters effectively communicate SCU co-benefits across water enterprises and engage non-technical public and private stakeholders in the design of and support for projects. Equally important, stormwater managers need to find the right points of intersection with fellow agencies and present collaboration opportunities in ways that resonate with the other agencies' priorities and points of view.

Helping Practitioners Communicate Effectively:

Several existing resources identify language choices that enable more effective communications about SCU, such as *Water Reuse Context & Terminology* (WateReuse.org), *Talking About Water: Vocabulary and Images that Support Informed Decisions about Water Recycling and Desalination* (WateReuse.org), and *What Is Green Infrastructure? A Study of Definitions in U.S. City Planning*.

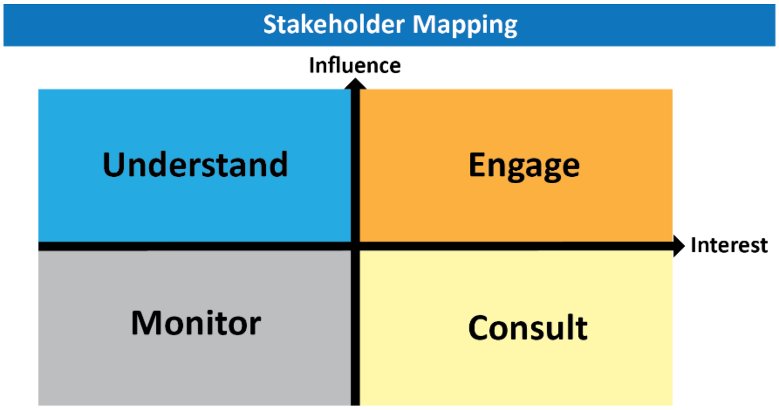
The Power of Plain Language:

Following an evaluation of stormwater control implementation, New York City changed how it described these projects to avoid jargon and use plan language. For example, "bioswales" became "rain gardens." These changes increased understanding and support for these management practices within the community.

A rain garden constructed along the side of a New York City street.

Providing stormwater managers with training programs focused on communication and stakeholder engagement strategies can equip managers with skillsets needed to successfully engage with non-technical decisionmakers and stakeholders throughout the SCU project development process to develop community support for SCU program implementation. For instance, helping stormwater managers understand how an audience will process data based on their level of interest and influence in a topic can lead to more effective engagement with peers and stakeholders (see Figure 3 below). Training programs can also help stormwater managers identify the right agency partners and connect with them in ways that appeal to other agencies' interests and priorities.

Figure 3: Stakeholder Mapping: Influence vs. Interest



How an audience will process data is linked to their interest and influence associated with a topic. Mapping the level of stakeholder interest and influence will help stormwater managers determine whether to monitor (low interest, low influence), understand (low interest, high influence), consult (high interest, low influence) or engage (high interest, high influence) a particular audience.

Recommended Action: Develop Frameworks for Building Broader Partnerships in Support of Regional-Scale SCU

Effective partnerships are accomplished by engaging the right audiences and organizations at the right stages in project development, including motivating, planning, building, operating, and decommissioning SCU systems. For example, water agencies may partner with agencies in neighboring communities, other water sector managers within the community, and non-governmental organizations during the planning and design phases of an SCU project that can provide project benefits to each community, department, and partner group. When searching for opportunities to finance SCU projects, stormwater managers may need to communicate with non-technical decisionmakers to build support. Once the project can be funded, it is important for stormwater managers to break out of their "comfort zones" and collaborate with partners that they may not be used to engaging with. Assessing opportunities and developing recommendations for creating interagency agreements and publicizing legal frameworks for cross-program collaboration will enable stormwater managers to successfully communicate across a diverse set of partners and implement regional-scale SCU projects.

WRAP Action 2.16:

WRAP Action 2.16 seeks to identify institutional challenges to water reuse, assess opportunities for interagency collaboration, and identify agreements and other legal models that support implementation of water reuse and other integrated water management projects among "water cycle" utilities. The report *Multi-Agency Water Reuse Programs: Lessons for Successful Collaboration* (March 2022) demonstrates how utility managers and other stakeholders can resolve challenges and select appropriate legal models to lead successful, interjurisdictional water reuse programs.

Partnering to Capture Dry Weather Flow in Orange County, California:

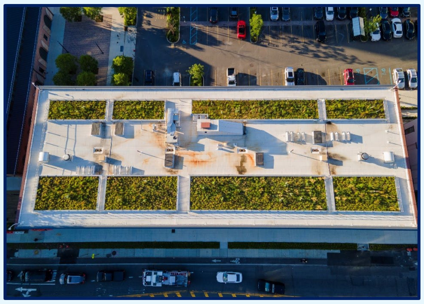
Urban storm drains often carry water during dry periods due to runoff from excessive irrigation, car washing, and other activities. Given the drought-driven need to diversify water supplies, municipalities and special districts in Orange County, California, are increasingly viewing stormwater as a potential resource rather than a regulatory liability. The County of Orange and Orange County Flood Control District are working with three wastewater and water districts to develop comprehensive stormwater capture opportunity studies to identify synergies between the stormwater and flood control system and treatment/transport/recycling capacity on a service area-wide basis. The goal is to develop comprehensive systems of diversions to capture and divert dry weather flows to the sanitary system to augment recycled water supplies. While diversions were originally used to address site-specific surface water quality issues, the evolution of water needs is setting the stage for their use in regional water supply planning and the conversion of a liability into a resource.

Recommended Action: Analyze Challenges and Opportunities to Integrating Public and Private Investments in SCU

Privately owned land makes up a significant portion of available land in urban settings and therefore represents significant opportunity for stormwater capture. However, construction, operation, and maintenance of SCU systems on private property can be more costly than conventional water systems. If landowners and businesses are not required to implement stormwater management measures during new development or redevelopment (per local post-construction regulations), then the additional cost of an SCU system can discourage these landowners and businesses from pursuing SCU. One strategy for overcoming this challenge is implementing utility incentives or rebates to encourage voluntary retrofits. Furthermore, private landowners and businesses may not have the technical expertise needed to properly design and maintain SCU systems, particularly if implemented onsite. Turnover of land ownership, where a new private entity with different business priorities inherits an onsite SCU system, presents long-term operations and maintenance (O&M) challenges. This can be further exacerbated by a lack of understanding of SCU systems, unclear permitting requirements, and potential delays in project approval, which are additional hurdles that can inhibit SCU projects. NPDES stormwater permits often include requirements for onsite post-construction stormwater management as a “minimum measure.” Public agency and private landowners are both responsible for compliance and therefore need effective mechanisms for coordination. Further analyzing the challenges and opportunities that public stormwater managers and private landowners face can help to develop partnerships between these entities and further integrate SCU solutions across individual parcels.

Financial Incentives for Private Landowners in New York City:

New York City’s new programs provide financial incentives through grants and rate discounts for private landowners to implement green infrastructure/SCU. Rate discounts of 25 percent of water and up to 76 percent of wastewater bills are offered to private industries that implement and maintain onsite SCU systems. The return on investment (ROI) for these systems may be eight to 10 years, but the rate discount is in perpetuity, which creates a financial incentive for private developers.



Green roofs at Admiral’s Row in Brooklyn, NY were funded, in part, by grants provided through New York City DEP’s Green Infrastructure Grant Program.

Alternative Project Delivery and Financing for SCU:

Stormwater infrastructure is traditionally implemented through a design-bid-build approach that may not be a good fit when siting a large number of distributed, varied projects, such as green stormwater infrastructure and SCU practices. When Prince George’s County, Maryland, began developing its plan to retrofit 15,000 impervious acres using gray and green stormwater infrastructure practices, the county worked with EPA Region 3 to develop a performance-based alternative project delivery framework called the “Community-Based Public-Private Partnership” (CBP3). This approach integrates project delivery services to reduce implementation costs and increase the pace of project delivery. A CBP3 program approach maximizes benefits to local workers and businesses by including performance-based targets for community workforce and small and minority-owned business utilization (EPA, 2021a). Retrofits on more than 2,000 impervious acres, including several SCU projects, have been implemented since the launch of the county's Clean Water Partnership CBP3 program in 2014 (The Clean Water Partnership, 2022). Green infrastructure retrofit costs through this approach are 30 percent less than traditional project delivery approaches. Attracted by the efficient delivery mechanism the CBP3 provides, the state of Maryland supported the program with $48 million in Clean Water State Revolving Fund (SRF) assistance—the largest Maryland SRF investment in stormwater. Using the CBP3 approach saved money, built local support, expanded available funding, and enabled rapid implementation of a large portfolio of green stormwater infrastructure projects in Prince George's County.

Using Rebates to Motivate Private Property Rainwater Harvesting:

The County of San Diego is facing requirements for dry weather flow elimination in 2021 and wet weather bacteria reductions in 2031. As an approach to eliminating dry weather flows and reducing bacteria discharges from wet weather, the county is using a human-centered design process to develop private property incentive programs as a cost-effective compliance strategy and encourage residents and businesses to better manage, capture, and use stormwater onsite. The Waterscape Rebate Program focuses on three types of projects: small residential and commercial parcels that want to harvest rainwater, large landscapes that need help navigating the incentive process from multiple agency programs, and partnerships with existing water efficiency programs from water supply agencies. Small-scale capture and use projects and "large landscape projects" implemented and approved within the first six months of the program are already helping the county achieve compliance targets by reducing runoff volume while simultaneously reducing water bills for residential and commercial property owners.

The program has led to new investments in multiple-benefit projects, such as a new partnership between the County of San Diego and the San Diego County Water Authority that includes a $4 million investment from the county in existing landscape incentive programs that produce water quality and supply benefits. A core feature of the program is a simple benefit calculator that quantifies performance for technical audiences like regulators and political audiences. Stacking incentives through partnerships helps water, wastewater, and stormwater managers increase the funding pool, leverage partner investments for better ROI, and cross-market to source participants.

Rain barrels on private parcels in San Diego County capture rainwater and hold it for later use such as on lawns, gardens or indoor plants.

3. Expand Funding and Financing Mechanisms

Stormwater programs are constantly competing with wastewater and drinking water programs for federal and state grant and loan opportunities. Thanks to recent initiatives—such as the BIL—funding opportunities for all water infrastructure, including SCU projects, have never been greater. Nonetheless, stormwater managers need to persuasively communicate the economic case for implementing SCU projects and develop innovative strategies for leveraging the robust federal, state, and private funding opportunities. The following actions are focused on evaluating SCU co-benefits to make the business case for implementing these projects and helping stormwater managers unlock stormwater financing opportunities.

Environmental Financial Advisory Board Report—Evaluating Stormwater Infrastructure Funding and Financing:

Section 4101 of the 2018 America's Water Infrastructure Act (AWIA) directed EPA to establish a stormwater infrastructure funding task force "to conduct a study on, and develop recommendations to improve, the availability of public and private sources of funding for the construction, rehabilitation, and operation and maintenance of stormwater infrastructure" to meet the requirements of the Clean Water Act (CWA). The task force's recommendations were framed under two overarching categories:

- Allocate new federal stormwater funding: There is a need for increased federal investment in stormwater infrastructure, with no offsets to other programs. Federal grants, loans, and new stormwater programs are needed to fund critical stormwater infrastructure in communities of all sizes across the country and support local funding sources.
- Provide stormwater funding education and technical assistance: Educating the public and elected officials on the need for stormwater funding is critical to the successful implementation of and community support for funding solutions. Many communities need technical assistance related to evaluating and securing funding and financing mechanisms.

Recommended Action: Evaluate and Publicize Methods for Characterizing and Monetizing the Co-Benefits Associated with SCU

Although some funding programs evaluate project proposals only in terms of their ability to deliver a single type of benefit (e.g., water quality improvements or water supply augmentation), funders are increasingly considering a wider range of project benefits. Evaluating and communicating the co-benefits of SCU projects with public stakeholders and decisionmakers is critical to build support for funding; identify opportunities to share costs; build community support for SCU projects; and promote equitable and transparent decision-making.

Co-benefits associated with SCU projects are often difficult to monetize; however, decision support tools are being implemented throughout the United States to begin monetizing the multiple co-benefits of stormwater infrastructure projects. For example, the recently released “Community-Enabled Lifecycle Analysis of Stormwater Infrastructure Costs” (CLASIC) (WRF, 2021a) and “Integrated Decision Support Tool” (I-DST) (Colorado School of Mines, 2022) decision support tools enable quantitative and qualitative analysis of project co-benefits. The newly released “Framework and Tool for Quantifying the Triple Bottom Line Benefits of Green Stormwater Infrastructure” (GSI-TBL) enables monetized estimates of project benefits to assist with the comparison of project costs and benefits at community and/or watershed scales (WRF, 2021b). These tools, used individually or collectively, can help to communicate the benefits that exist and can be realized by implementing SCU. While more robust methods for assessing co-benefits of SCU projects are now available, few stormwater managers are using these tools in project design and analysis. The developers of CLASIC, I-DST, and GSI-TBL should partner with EPA’s Office of Research and Development to develop and provide more directed outreach and training on the availability and use of these new tools to broaden their use in benefits evaluation. Project developers who use these tools to evaluate SCU projects should work with the tool developers to determine if the suite of SCU practices and technologies that these tools evaluate adequately represents the range of likely practices. A new WRAP action could further test the utility of these co-benefit evaluation tools to support SCU planning and create additional training.

Los Angeles County Evaluates Multiple Co-Benefits of Proposed Stormwater Capture Projects:

The county’s Safe, Clean Water Program uses a stakeholder-driven process to devise scoring criteria for evaluating potential project benefits. The scoring committee evaluates water quality, water supply, community benefit, and fund-leveraging criteria for each project. The committee evaluates water quality—the highest-weighted evaluating factor—by applying a cost-effectiveness ratio and considering project performance through modeling analysis of water quality and water supply augmentation benefits of prospective projects. The scoring committee also evaluates water supply cost-benefit, as well as estimates of water supply gained based on the county’s [Watershed Management Modeling System](). Community benefits, such as flood reduction, increased recreational benefits, and community support, are evaluated through a qualitative approach. This approach has enabled the county to gain community support for multi-benefit project funding, as funded projects usually provide direct community benefits in addition to less-visible water quality and supply benefits.

The proposed Franklin D. Roosevelt Park Regional Stormwater Capture Project plans to divert dry- and wet-weather flows from the Glen Avenue Drainage System and to provide pretreatment of water for infiltration to the groundwater basin.

Recommended Action: Clarify How Existing Financing Mechanisms Can Be Used to Pay for SCU Projects

The broader funding challenges and constraints that stormwater program managers face throughout the United States also constrain the ability of communities to pursue SCU (WEF Stormwater Institute, 2021). Stormwater managers are often unfamiliar with the full range of traditional and non-traditional funding sources and strategies currently available for financing SCU projects or how to access those opportunities. The following federal, state, and local financing mechanisms provide existing opportunities for stormwater managers to fund SCU initiatives:

Clean Water and Drinking Water SRF Programs:

The Clean Water (CW) and Drinking Water (DW) SRF programs provide opportunities for funding stormwater management and SCU projects (EPA, 2021b). However, challenges such as repayment expectations (since stormwater programs typically lack a dedicated revenue stream), legacy tendencies towards funding traditional wastewater treatment and drinking water supply projects, and lack of awareness/experience with the flexibilities available through the SRF programs have prevented stormwater managers from more broadly accessing these funding sources. The SRF programs have significant flexibilities that enable them to fund stormwater projects (e.g., principal forgiveness, reduced interest rates, and funding preference for green infrastructure and small/underserved community projects). For example, the CWSRF can provide flexible repayment structures that allow for lower repayments as a recycled water program matures, with higher repayments occurring later as rates approach the cost of service. The BIL provides additional SRF funding that can be used for SCU projects, as well as offering additional flexibility to states to provide more SRF funding through grants than they would with traditional SRF funding.

Implementation of these flexibilities varies by state, which may complicate communicating SRF funding possibilities to stormwater managers. As of 2020, less than 2 percent of CWSRF assistance has gone toward stormwater projects over the duration of the program (EPA, 2021c). Further guidance and case examples showcasing innovative SRF repayment approaches and highlighting the flexibilities in designing repayment structures will demonstrate that stormwater management projects, including SCU, are eligible for SRF funding. EPA should provide more information to clarify how these flexibilities apply to SCU.

Federal and State Grant Opportunities:

The multiple co-benefits associated with SCU projects make them attractive for a variety of grant funding opportunities, including the Sewer Overflow and Stormwater Reuse Municipal Grants (OSG) program and other programs in FEMA, the U.S. Department of Housing and Urban Development, and the U.S. Bureau of Reclamation. Additional funding for SCU projects may become available if the OSG program funding increases authorized in the BIL are appropriated in the future. Furthermore, public funding programs like California's Prop 1E and 84 programs specifically encourage multi-benefit projects, such as SCU. However, many stormwater managers are not fully aware of these funding opportunities, and access to funding search tools that better connect project proponents to the most promising potential funding sources would help communities assemble the funding needed for SCU projects. An improved funding search tool, such as the proposed funding search tool being implemented under [WRAP Action 6.1](), will enable communities to search for appropriate funding sources more efficiently.

Dedicated Revenue Streams:

Dedicated revenue streams, such as stormwater taxes and fees, are vital tools for financing community stormwater management initiatives. There may also be opportunities to apply revenue from drinking water, solid waste management, and other local fees to SCU projects under the right context. NMSA's "Building Excellence in Stormwater Management" toolbox provides useful guidance and resources to assist communities in establishing dedicated revenue streams for stormwater management.

Los Angeles County's Safe, Clean Water Program:

The passage of Measure W in 2018 created a comprehensive, regional plan to address how Los Angeles County captures water and how the county can reduce its reliance on imported water. Developed in collaboration with public health, environmental groups, cities, business, labor, and community-based organizations, the Safe, Clean Water Program will provide Los Angeles County with local, dedicated funding to increase their local water supply, improve water quality, and protect public health. The program will generate approximately $300 million per year from a special parcel tax of 2.5 cents per square foot of impermeable surface area—paved/built areas where rainfall cannot be absorbed into the ground and instead runs off as stormwater—on private property in the Los Angeles County Flood Control District (about $83 per year for the median home). The program also provides credits for property owners who have installed stormwater capture improvements.

Municipal Bonds and Governmental Accounting Standards Board (GASB) 62:

Municipal bonds have long been a financing mechanism that cities and utilities use to fund capital investments. This financing mechanism is available for all scales of SCU investments. GASB 62 clarified public accounting rules to better enable disaggregated natural infrastructure to access public debt financing to support stormwater and green infrastructure investment (Kelly et al., 2021). However, communities and bond counsels typically have not supported using public money on land that they do not control or own. More widespread use of the changes in accounting rules can help communities further leverage debt financing to support SCU projects on private land or implemented through public-private partnerships.

Organizations such as NMSA, WaterNow Alliance, and private communication groups are committed to clarifying and enabling wider adoption of existing financing mechanisms and strategies that can be applied to SCU. For example, WaterNow Alliance's "Tap into Resilience Toolkit" provides an interactive, customizable platform designed to help water leaders navigate tax, accounting, legal, and financial questions in order to initiate, implement, and scale sustainable solutions, including SCU, for their communities. Future actions to build off these initiatives may include development of guidance or training and focused outreach to stormwater managers.

Recommended Action: Clarify and Share Innovative SCU Financing Solutions

Many stormwater managers are unaware of new and innovative approaches to funding and financing capital costs and long-term O&M for SCU projects. Federal and/or state leadership to assist communities in understanding the various financing opportunities that can be applied to SCU implementation will be critical for building local capacity. Innovative financing mechanisms already being applied throughout the United States include "pay-for-performance" structures, debt financing, special utility districts, private property incentive fees, and tax abatement and rate discounts.

Allianz Field—Redeveloping the Snelling-Midway Site in Saint Paul, Minnesota:

When the City of Saint Paul and Minnesota United FC—the Twin Cities' newest professional sports franchise—announced plans for a soccer stadium on a 35-acre brownfield site, the Capitol Region Watershed District (CRWD) saw an opportunity to demonstrate stormwater innovation for thousands of district- and metro-area residents. Prior to stadium construction, all stormwater runoff from the site was untreated and flowed directly to the Mississippi River. The site's highly urbanized location, contamination, and lack of permeable surfaces have contributed to sediment and nutrient impairments in the river. Based on the site master plan, the City of Saint Paul, Minnesota United FC, and site owners RK Midway proposed construction of innovative green infrastructure practices, including comprehensive rainwater and stormwater capture and reuse systems, as well as tree trenches and rain gardens to help improve water quality, reduce use of potable water supplies, and enhance the city's tree canopy to reduce urban air temperatures and improve air quality.

To fund the green infrastructure and rainwater harvesting system, the city amended their legislative code to create green infrastructure stormwater management districts and authorized the collection of charges for payment of the capital and annual maintenance and operational costs. As the foundation for the capital costs for construction, the team and the city funded an amount of this combined system equivalent to the cost of the basic rate control and water quality requirements of the CRWD. In addition, the Metropolitan Council, the State Clean Water Fund, and the Capitol Region Watershed District provided grant funds. The city's share was paid out of revenue bond proceeds and will be paid back via the Green Stormwater Infrastructure ordinance. This ordinance enables the city to charge a connection fee to new developments that will rely on this new regional system, which is used to pay back the revenue bonds. For O&M, the city is able to use its existing stormwater utility fee, as well as a green infrastructure annual surcharge that generates revenue, to offset the cost of ongoing O&M.

Resilient NYC Partners Private Incentive Program:

New York City Department of Environmental Protection's (DEP) [Resilient NYC Partners] program expands private property incentives to build green infrastructure. The program was implemented through a $53 million third-party administrator contract with an engineering firm in May 2021. The third-party administrator framework helps scale private property retrofits by enabling expedient customer acquisition and green infrastructure practice siting through variety of project delivery options. The administrator can work with a property owner's existing design and construction team or manage the process entirely for property owners. The contract has a pre-determined stormwater volume-based incentive payment structure based on DEP's analysis of historic public and private green infrastructure retrofit costs and the availability of highly impervious sites across the city. The program goal is 250 greened acres in five years. The contract also includes $2 million in performance payments that scale up as more greened acres are delivered.

Effectively communicating the benefits of voluntary stormwater retrofits to private property owners will be key to the success of the program. DEP and its administrator have developed communication materials to demonstrate the benefits of participation in the program clearly and effectively.

Benefits of Voluntary Stormwater Retrofits for Private Property Owners

Stormwater utilities, fees, and taxes can be sustainable approaches to funding stormwater infrastructure projects, including SCU; however, many municipalities currently lack the capacity and political support to establish and garner the public and/or voter approval to create these funding structures. National guidance or training materials outlining different types of fee structures (e.g., stormwater fees/level of service fees) and strategies for establishing stormwater utilities and flood control districts will further help communities explore these opportunities for funding stormwater infrastructure projects.

Using Property Assessed Clean Energy (PACE) to Rapidly Scale Water Reuse Across Texas:

The National Wildlife Federation's Texas Coast and Water Program and Texas Water Trade's *Rapidly Scaling Water Reuse Across Texas: Using Property Assessed Clean Energy (PACE) Financing* report examine the potential of PACE financing to offset the upfront costs of onsite water reuse projects (where the storage, treatment and piping are all self-contained onsite) and the costs incurred by private landowners to connect to the centralized reclaimed water system (for example, dual plumbing a building to use water from the city's reclaimed water pipeline). In collaboration with the Texas PACE Authority and Austin Water, the report models the savings of various water reuse approaches for typical commercial and multi-family residential buildings to determine whether water reuse projects could meet stringent PACE financial tests. Its findings indicate that PACE is an effective tool for enabling water reuse projects, although the economics of these projects may require either utility rebates or co-financing with energy efficiency measures to meet the financial tests applied to PACE-financed projects. While this report is specific to Texas, it is relevant [anywhere PACE has been authorized] to fund water conservation efforts.

Recommended Action: Assist Small and Underserved Communities in Accessing Funding Opportunities

Due to a lack of resources and available staff time to plan and implement innovative water management practices, small and underserved communities throughout the United States may be disproportionately impacted by stormwater funding barriers. Recognizing the unique stormwater management challenges that small and underserved communities face—and developing resources to make it easier for these communities to access stormwater funding opportunities—will be critical to building local capacity for SCU in these areas. For example, the funding search tool under development pursuant to WRAP Action 6.1 would make it easier for communities to find specific funding opportunities for which they are eligible. Furthermore, as EPA and its partner agencies expand provision of technical and planning assistance to help connect small and underserved communities with available infrastructure funding through initiatives such as Justice40, it will be important to offer assistance for stormwater and SCU infrastructure planning and financing, including possible establishment of stormwater fees.

> WRAP Action 8.5:
>
> WRAP Action 8.5 is engaging underserved communities in rural areas to evaluate needs and opportunities to improve water security, sustainability, and resilience through water reuse, including SCU. Through this action, EPA is providing training and pilot technical assistance to address water recycling opportunities and implementation obstacles.

> EPA's Integrated Planning Policy:
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> The Water Infrastructure Improvement Act added a new Section 402(s) to the CWA to include the 2012 *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*. EPA describes an integrated plan as a process that identifies efficiencies from separate wastewater and stormwater programs to best prioritize capital investments and achieve its human health and water quality objectives.
>
> Recommended Action: EPA may consider broadening its integrated planning policy to embrace the full range of interrelated water enterprises and activities beyond permitting and compliance for wastewater and stormwater discharge regulation. Broadening the policy would encourage communities to consider the intersections between wastewater, stormwater, drinking water, flood control, and water reuse planning and help communities obtain planning resources, such as grants or loans, that can be applied in an integrated manner and at regional scales. Incentivizing regional planning and framing stormwater management within an integrated water management strategy would further enable stormwater managers to access a variety of federal and state funding sources.

4. Improve Regulations, Policy, and Guidance

Interest in SCU projects is often driven by regulatory drivers, such as the need to reduce water quality problems caused by stormwater discharges. Federal, state, and local regulations can help build capacity for SCU by creating incentives to use SCU as a compliance strategy and providing regulatory certainty to drive innovation. Federal leadership will be critical in establishing regulatory frameworks for SCU that can be customized at state and local scales. The following priority actions aim to address regulatory barriers to SCU consideration and take advantage of flexibilities to incentivize SCU implementation.

Recommended Action: Develop a Compendium of NPDES Permitting Approaches for SCU Applications

Municipal stormwater permits vary substantially across states. In most states, NPDES permits focus on implementation of minimum measures that, for the most part, do not address SCU potential. In addition, little guidance on how to address SCU in NPDES permits is available to states with program authorization. For municipal separate storm sewer system (MS4) permits that do address SCU, states may have difficulties in structuring permit provisions to credit implementation of SCU projects to meet water quality-based requirements.

Permitting authorities have substantial flexibility in establishing effluent limitations, compliance paths, and other provisions in NPDES permits. A white paper being developed under WRAP Action 2.6 discusses several of the permitting issues that may affect the ability to pursue wastewater recycling and SCU. It contains examples of how existing permit authorities have addressed these challenges in permits. Post-construction standards and water quality-based provisions in many MS4 permits have been structured to reduce polluted stormwater discharges by requiring or encouraging implementation of retention and detention practices that enable capture and use of stormwater. Discovering innovative solutions to refine NPDES permitting approaches and take advantage of permitting flexibilities (for stormwater and other water sources that integrated solutions may encompass) can help incentivize SCU planning and implementation within existing regulatory frameworks. Compiling and disseminating case studies on how states approach SCU within MS4 and wastewater discharge permits can help identify commonalities and best practices for leveraging SCU solutions. EPA's MS4 permit compendium series provides many examples of how NPDES permitting approaches and conditions can be applied.

EPA's Office of Wastewater Management should lead the development of this NPDES permitting compendium in coordination with the Association of Clean Water Administrators, National Association of Clean Water Agencies, and NMSA.

Incentivizing SCU in Industrial Stormwater Permits:

California's industrial stormwater general NPDES permit provides an alternative compliance path, enabling industrial facilities to partner with municipal stormwater managers to implement regional-scale projects incorporating SCU instead of relying solely on onsite stormwater controls (California State Water Resources Control Board, 2018). The state is now considering revisions to the permit to address industry concerns that certain requirements (e.g., limitations based on secondary maximum contaminant levels for metals) disincentivized SCU.

Recommended Action: Clarify How States Regulate Stormwater Capture and Use

SCU practitioners may be uncertain about which, if any, state reuse regulations apply to their projects. Few states have water reuse regulatory structures that directly address SCU. Some states, including California and Florida, are beginning to develop water reuse regulatory structures tailored for SCU; however, SCU projects have historically either been unregulated or subject to reuse regulatory requirements developed for other types of water use.

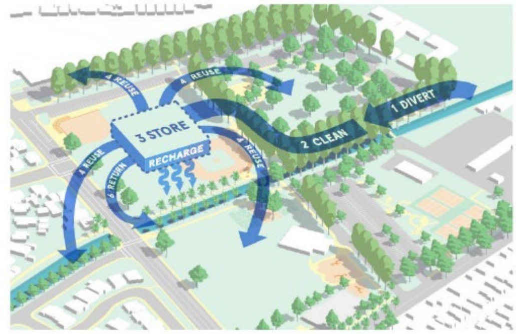
Permitting Approaches for Dry Weather Diversions:

Controlled diversions from storm drains into wastewater collection systems can increase flows in the wastewater management system that would be available for water reuse. The Orange County Sanitation District (OC San) and Los Angeles County Sanitation Districts developed policies and guidelines for accepting dry weather flows in sanitary sewers, requiring the stormwater management agency to obtain a diversion permit from the utility operating the sanitary sewer (County Sanitation Districts of Los Angeles County, 2014; OC San, 2019). The OC San diversion permit requires OC San to ensure its compliance with the source control provisions of its own NPDES permit.

The three water boards with NPDES permitting authority in coastal Southern California have not found it necessary to include more specific permit provisions in wastewater or stormwater permits that control how storm drain diversions to wastewater collection systems operate. The water boards concluded such provisions are unnecessary to ensure that discharge requirements are met.

Although local authorities are successfully implementing many dry-weather diversion projects, some concerns remain among stormwater and wastewater managers about how to permit diversion projects, define surveillance and monitoring expectations, share risk and liability, and distribute/share costs that warrant further evaluation and research.

Regulatory Drivers Leading to SCU Innovation in San Mateo County, California:



A schematic displaying how captures stormwater is stored and diverted for reuse throughout the Orange Memorial Park Stormwater Capture Project.

In 2015, the San Francisco Regional Water Quality Control Board issued the countywide Municipal Regional Stormwater Permit (MRP) to regulate stormwater discharges in San Mateo County. The MRP requires all permittees to implement green infrastructure improvements to reduce the amount of mercury and polychlorinated biphenyl (PCB) in stormwater discharges to the San Francisco Bay. The Orange Memorial Park Stormwater Capture Project was designed to provide water quality improvements and help meet the mercury and PCB requirements of the San Francisco Bay MRP. This regional stormwater capture project, the first of its kind in Northern California, diverts all dry-weather flow and the first flush of urban stormwater runoff from nearby Colma Creek into an underground system integrated within the park. Once water is diverted into the park, the system treats the water to remove trash, debris, and sediment. A large cistern under the sports field stores water for further treatment and disinfection so it can be used to meet irrigation and other non-potable demands, saving over 15 million gallons of potable water per year. When full, the cistern overflows into an infiltration gallery, which recharges 55 million gallons of groundwater every year.

The development of a compendium highlighting existing state regulatory frameworks pertaining to SCU would help clarify the range of regulatory approaches being applied to SCU. A comparison of SCU regulatory practices would assist in the potential development of national guidance and efforts by other states interested in developing SCU regulatory frameworks. Case studies highlighting regulations, policies, guidance, and permitting approaches that have helped advance the adoption of SCU may inspire other states and communities to adopt similar regulatory approaches. This action can be used to compliment the work currently being completed by EPA, the WateReuse Association, the Association of Clean Water Administrators, and the Association of State Drinking Water Administrators under WRAP Action 3.1 to compile pertinent information about existing state-level regulations currently in place for water reuse.

State and local stakeholders are also increasingly interested in ensuring that adequate in-stream flows are maintained to enable protection of ecosystem services when wastewater recycling and SCU projects are implemented. Obtaining the necessary approvals from state fish and wildlife departments in situations where downstream flows may be impacted by SCU implementation, particularly in water-scarce states, can be another challenge for stormwater practitioners looking to adopt SCU projects. EPA should consider developing a WRAP action addressing the relationships between water recycling activities and protection of in-stream environmental services through maintenance of minimum flows/ecological flows. This action could address both the issues associated with identifying appropriate environmental flow requirements and the capacity to use recycled wastewater and captured stormwater to augment in-stream flows (e.g., during dry periods of lower natural flow).

Google's Global Water Strategy:

In September 2021, Google announced that by 2030, it will replenish 120 percent of the water it consumes by continuing to address and advance the company's operational water sustainability efforts and investing in community water replenishment projects that improve the health of local watersheds where office campuses and data centers are located. Complementing its replenishment and watershed health goal, Google is committed to implementing water efficiency measures, adopting water reuse practices that enable the company to recycle potable water, treating water safely to meet water quality standards for non-potable reuse, and using alternative water suppliers from external sources.

Google has recognized through its work with local government and community organizations that water is (in part) a data problem. In response, Goggle is building tools to make data and technology more universally accessible, like providing technology solutions for global surface water insights and flood forecasting (e.g., the Global Surface Water Explorer).

Private land managers face unclear and, at times, conflicting requirements concerning stormwater management that can make it difficult to implement SCU on single parcels or to network SCU project planning across multiple ownerships. WaterNow Alliance and the University of California, Irvine (UCI) School of Law Center for Land, Environment, and Natural Resources (CLEANR) recently published a report—*Tap into Resilience: Pathways for Localized Water Infrastructure*—outlining recommendations and actions for how these regulatory issues can be addressed with respect to parcel-scale SCU and other decentralized strategies (Kelly et al., 2021). Further action is needed to help public and private land and stormwater managers navigate regulatory frameworks and collaborate more efficiently in carrying out SCU projects across ownerships and at larger geographic scales. Some companies and communities have recently initiated efforts to carry out more integrated water management approaches involving both public and private ownerships to achieve greater impact at watershed scales. EPA, NMSA, and interested companies should consider partnering to evaluate in greater detail the challenges public and private landowners face in building broader-scale SCU implementation partnerships and strategies for surmounting these barriers, drawing upon specific examples and initiatives where stormwater harvesting has succeeded at broader scales.

Recommended Action: Evaluate State Water Rights Constraints to SCU

State water rights law and implementation practices vary widely across states. Water rights regulations and determinations in many western states inhibit the ability to capture and use stormwater or rainwater based on a concern that capture and use impinges on downstream water rights dependent on that runoff (Luthy et al., 2019). Whether and how state water rights provisions enable or restrict stormwater managers' ability to pursue SCU is often unclear.

Innovative solutions may be needed to address SCU permitting constraints imposed by longstanding state water rights. EPA should consider partnering with states and water reuse proponents to systematically evaluate state water rights constraints to SCU (and wastewater recycling) at different scales and in different states to help build understanding of these challenges and strategies to address them.

Example State Water Rights Laws Applicable to SCU:

Colorado recently allowed the capture of rainwater from rooftop gutters for non-potable outdoor uses, only with rain barrels with a maximum combined capacity of 110 gallons (Luthy et al., 2019).

In Washington, a water right is needed to capture and divert any stormwater runoff for a consumptive use. Although there is a *de minimus* allowance for home-scale rain barrels, larger scale projects still need a water right.

New York City Proposed Unified Stormwater Rule:

New York City's Unified Stormwater Rule includes amendments to align stormwater requirements across the city, provide greater onsite stormwater management for new and redevelopment projects, and institute a retention-first approach. The amendments expand the city's Stormwater Permitting Program, setting new thresholds for compliance and a new retention-first approach for design of post-construction stormwater management practices. The rule also includes a *New York City Stormwater Manual* to provide guidance for permit applicants.

5. Advance Science and Treatment Standards

Clarifying whether and how captured stormwater needs to be treated before use is critical to enabling broader SCU implementation. Many jurisdictions are applying the risk-based framework and pathogen log reduction targets developed by the NBRC for ONWS to determine stormwater treatment needs. However, there are concerns that applying treatment standards developed to date based on this framework may be excessively stringent for SCU applications. Other stakeholders are concerned that existing pollutant reduction targets may be insufficiently attentive to the pollutants present in some stormwater. Important research is now underway to tailor development of risk-based treatment standards for SCU to consider stormwater characteristics and the ability of different SCU practices to provide necessary levels of treatment for the intended uses. This research will enable the development of guidance needed to inform treatment standards for SCU projects. These treatment standards should be tailored to local and regional settings to account for stormwater variability. Further research on the physical science of SCU and assessment of urban stormwater quality is needed to develop methodologies for determining fit-for-purpose treatment standards.

Recommended Action: Develop Guidance on Determining Treatment Standards for SCU Systems

Risk-based methods that can be used to develop treatment standards for stormwater harvesting are similar to methods used to develop standards applicable to wastewater recycling and other water quality-based standards. The conventional approach has been to select end-point target levels, which specify the acceptable threshold for a particular pollutant surrogate (e.g., fecal indicator bacteria). However, these surrogates poorly represent specific pathogens of concern and, therefore, associated infection risks. An alternative approach, described in the NBRC for ONWS risk-based framework, is to determine fit-for-purpose pathogen reduction targets based on source water characteristics and desired end uses. This approach helps evaluate how people are being exposed to pathogens in water and identify the pathogen reductions (e.g., log reduction targets) needed to protect human health at an acceptable risk level.

Adapting Risk-Based Frameworks for SCU Treatment Standards:

California is developing new regulations for stormwater, along with onsite rainwater, greywater, and blackwater recycling. With the help of an expert panel, the state is adapting the NBRC for ONWS' *Risk-Based Framework for the Development of Public Health Guidance for Decentralized Non-Potable Water Systems* to set log-reduction targets for each source water using available stormwater quality data.

Washington, D.C., Stormwater Standards and Innovation:

In 2013, Washington, D.C., adopted retention and detention-based standards and requirements for stormwater. To meet these standards, the district promotes a variety of green infrastructure practices, including SCU. In 2020, Washington, D.C., adopted the NBRC for ONWS log reduction targets as a simpler way for engineers to design and treat for specific SCU end uses. The Department of Energy & Environment continues to work with utility partners and the public health department to provide guidance to civil engineers on SCU standards, which has enabled more SCU innovation throughout the district. One such example of innovation can be found in the district's historic canal system, Canal Park, which implements a stormwater collection and reuse system to collect and treat stormwater that falls onsite. Collected stormwater meets up to 95 percent of the park's needs for irrigation, its ice rink, and its fountain, saving an estimated 1.5 million gallons per year.

Canal Park in Washington, D.C., incorporates cisterns, rain gardens, and bioretention tree pits to capture, treat, and reuse stormwater.

WRF Project 5034: Assessing the Microbial Risks and Potential Impacts from Stormwater Collection and Uses to Establish Appropriate Best Management Practices:

This project will synthesize existing research on stormwater microbial quality and treatment processes to develop a Stormwater Use Roadmap providing pragmatic guidance for design and operation of stormwater use systems. The guidance will address selection of appropriate log reduction targets based on quality of stormwater and intended end use, methodologies for monitoring stormwater microbial quality, and approaches for continuous monitoring of operational systems to ensure safe water is reliably delivered (WRF, 2021c).

Guidance is needed to assist researchers and practitioners in adapting the NBRC for ONWS risk-based framework to account for local and regional stormwater variability and selecting the correct tier within ranges of potential log reduction targets. Such guidance should differentiate between centralized aquifer recharge systems and storage and direct-use systems. The guidance should also focus on stormwater quality data and occurrence/fate of pollutants in urban stormwater runoff. In addition, through WRAP Action 3.1, EPA has released the "Regulations and End-Use Specifications Explorer" (REUSExplorer) that will compile existing state regulations for different water reuse applications—including onsite reuse.

EPA will work to compile and analyze this information and consider the development of best practices that could provide valuable information for SCU implementation.

Recommended Action: Bolster Research Pertaining to the Physical Science of SCU and Assessment of Urban Stormwater Quality

The following research needs are critical for the development of fit-for-purpose treatment standards for SCU applications.

- Augmentation of existing research efforts in determining human- and animal-sourced pathogen prevalence in stormwater is needed to help SCU practitioners more accurately determine actual risks to exposure depending on the catchment area and specific end use.
- Additional monitoring and analysis are warranted to evaluate how well the log reduction target approach that is applied to pathogens results in effective treatment for other problematic stormwater pollutants (e.g., metals, nutrients, and salts) and to better understand per- and polyfluoroalkyl substances (PFAS) and other constituents of emerging concern, such as hydrophilic organic compounds, in urban stormwater runoff.
- Evaluation of the quality of stormwater based on seasonality and different land uses—considering regional hydrological variability—is needed to account for local and regional settings in the development of treatment standards.

Successful communication and collaboration between researchers, regulators, and practitioners will be critical to developing and implementing locally tailored treatment standards for SCU that are both protective of public and ecosystem health and achievable by available and affordable stormwater management technologies. Special consideration and guidance may be warranted for applications of urban runoff for groundwater recharge, as urban stormwater for groundwater recharge poses the risk of groundwater contamination and requires robust data, careful design, and appropriate O&M to mitigate those risks (Luthy et al., 2019). An EPA "state of the science" report was published in 2021 summarizing the current scientific literature on aquifer recharge using stormwater (EPA, 2021d).

Developing SCU Treatment Standards in Minnesota:

At the direction of the Minnesota Legislature, several Minnesota state agencies, have engaged with wastewater and stormwater managers, researchers, and other stakeholders to evaluate regulatory and non-regulatory approaches to advancing water reuse and inform development of state policies and regulatory mechanisms. As part of this effort, the state agencies and stakeholders are evaluating SCU and associated potential health risks, treatment needs, and regulatory structures. A principal area of focus in these discussions is the collection of stormwater in retention ponds for use in landscape irrigation, which reduces groundwater withdrawals. As over-pumping of groundwater for landscape irrigation is a significant concern in the State, the Legislature enacted a law in 2017 that exempts certain SCU projects from having to obtain a state water appropriation permit.

A recent white paper studied the variability in stormwater quality and potential health risks from exposure to captured stormwater used for different purposes, including landscape irrigation. A risk-based framework developed by the NBRC for ONWS was evaluated by the Minnesota Department of Health (MDH) to assist evaluation of SCU-related health risks and treatment needs, taking into account a quantitative microbial risk assessment developed using Minnesota stormwater data. During engagement with stormwater managers and other stakeholders, concerns have been raised about the need to balance protection of public health from potential exposures to stormwater with the need to enable cost-effective SCU project implementation and avoid establishing excessively costly treatment requirements. Discussions are continuing based on this work to evaluate treatment needed for different uses, which could substantially affect the costs of regulatory compliance, and whether SCU practices should be regulated at the state or local level. In its white paper, MDH recommended establishing a broader workgroup to assist further research and development of a science-based regulatory framework for SCU in Minnesota (MDH, 2022).

A stormwater collection pond in a Minnesota neighborhood captures and temporarily stores stormwater runoff.

6. Accelerate the Use of New Technologies and SCU Strategies

Emerging technologies present opportunities to address stormwater quantity and quality challenges, meet fit-for-purpose standards for the particular use, and employ a uniquely skilled workforce that can be locally sourced within a community. The following actions are focused on testing and validating measurement, control, and treatment technologies for SCU applications, as well as assisting stormwater managers with selecting the right technologies for SCU systems.

Recommended Action: Support Expansion of SCU Technology Validation Processes to Ease Regulatory Acceptance

Developing a clear validation process for ensuring the effectiveness of control and treatment technologies will instill confidence that the available SCU technologies can achieve water quality fit for specific end uses. Implementing validation processes will depend upon the availability of robust data on technology performance in different settings and for different pollutants. It will be important to evaluate whether sufficient performance data are available representing a wide enough range of applications to enable robust practice evaluation and validation. Validation programs can help address data needs by carefully specifying data requirements to support evaluation of new and existing technologies.

Initiatives, such as the national Stormwater Testing and Evaluation for Products and Practices (STEPP) program and the American Society of Testing and Materials (ASTM) Committee E64 on Stormwater Control Measures, already exist to promote knowledge on stormwater control measure (SCM) testing, validation, and treatment standards. Furthermore, WRF's TechLink online platform provides a forum for accelerating the uptake and deployment of innovative technologies. Providing further support for these types of technology testing, validation, and adoption programs to expand and incorporate SCU technologies can be helpful in establishing validation processes that ease regulatory acceptance.

STEPP Program:

The STEPP program is an NMSA initiative housed in the NMSA National Center of Excellence for Stormwater Testing and Evaluation for Products and Practices. The STEPP program seeks to improve water quality via accelerating the adoption of innovative stormwater management technologies by removing current barriers to innovation, creating regulatory confidence, minimizing duplicative performance evaluation efforts, and establishing a nationwide framework for testing and evaluating both public domain and proprietary stormwater control measures.

ASTM Committee E64 on Stormwater Control Measures:

The scope of the committee is to stimulate research and develop test methods, specifications, practices, guides, and nomenclature for SCMs, including stormwater quality treatment; volume control; flow management; and runoff detention, retention, and capture and use. The committee supports the STEPP program and provides a platform for assessing SCM connections with existing standards and the development of new standards beyond STEPP.

WRF TechLink:

The TechLink online platform promotes interaction in the water sector that enables municipal and industrial water, wastewater, and stormwater agencies, as well as technology providers, consultants, academics, investors, federal agencies, non-governmental organizations, and others, to advance the uptake of innovation. There is an opportunity to incorporate more information on stormwater technologies into TechLink at this time.

Recommended Action: Update Existing National Stormwater Practice Databases to Support Validation of SCU System Performance

A nationally accessible database to store effectiveness data and validation results for new and existing SCU technologies would provide planners, developers, and stormwater managers with information necessary for selecting the right SCU technology/configuration for their situation and use. Such a database should focus on urban runoff and a suite of chemicals typically found in urban runoff that are mobile and persistent, including emerging contaminants such as PFAS and hydrophilic organic compounds. Expanding the capability of existing databases (e.g., the International Stormwater Best Management Practices [BMP] Database) to host these data would likely be more useful than creating a new database.

Recommended Action: Validate and Propagate Robust Sensing and Control Devices to Measure Water Quantity and Quality in SCU Systems

While significant progress has been made in using advanced stormwater sensing and control technologies, these technologies are not uniformly understood or accepted as best practices. Further validation of sensing and control devices that are internet-enabled to measure real-time water quantity and quality in SCU systems is needed to instill confidence in the performance of existing and future stormwater control and treatment technologies. Real-time, dynamic monitoring systems, such as Supervisory Control and Data Acquisition (SCADA) and other intelligent monitoring systems, are promising ways of collecting robust stormwater data. However, information and case examples of how these kinds of measurement systems are being implemented in SCU applications are not widely distributed.

Recommended Action: Identify Common SCU Technology Permutations to Enable Development of Standardized Design Plans and Review Processes

Standardized approaches to designing, approving, and implementing SCU projects can help reduce upfront planning costs for developers and make the review and approval process more manageable for stormwater managers and municipalities. Due to the wide variety of SCU approaches and stormwater treatment technologies available, the process of selecting, reviewing, and approving SCU design plans can be overwhelming for developers, stormwater managers, and municipal officials, which can inhibit the adoption of SCU approaches. Identifying common SCU technology permutations for developing more standardized plans can help streamline the design and approval phases of project development and make it easier for communities to adopt SCU solutions.

Orange County Water District Groundwater Replenishment System:

A selenium TMDL was promulgated for San Diego Creek, a major inland creek and flood control facility. The watershed sits over a historic terminal swamp area, where over millennia, selenium concentrated within the underlying soil. Groundwater seeping into the creek and storm drainpipes contain selenium at concentrations above water quality limits. However, given the lack of treatment options to remove selenium, dry-weather flow diversion to the sanitary system again provided a regulatory solution, as well as a water recycling opportunity. With this project, flows are diverted to OC San, which, in partnership with the Orange County Water District, operates the Groundwater Replenishment System (GWRS). The GWRS uses advanced treatment processes consisting of microfiltration, reverse osmosis, and ultraviolet light with hydrogen peroxide to purify treated wastewater and then use it to recharge the groundwater basin and supplement drinking water supplies.

The Orange County Water District GWRS uses a three-step advanced treatment process to produce high-quality water for replenishing the groundwater basin.

CONCLUSION: KEYS TO UNLOCKING SCU POTENTIAL

Over the past two years, a diverse group of stormwater practitioners intensively explored SCU interests, experiences, and development needs across the nation. These efforts revealed widespread interest in SCU, motivated by drivers and challenges that vary substantially. Many communities have achieved remarkable successes in implementing multi-benefit SCU projects and making SCU a central element in integrated local and regional water management. Although significant challenges to more widespread SCU implementation remain, practitioners identified and are working to improve strategies for surmounting financial, regulatory, scientific, technical, and social challenges that can make SCU implementation difficult. This report highlights some of the most important opportunities and needs for action to build the nation's SCU community of practice and make SCU a fully accepted tool in community water management planning. By implementing these actions, the nation's capability to unlock the full potential of SCU and accelerate its implementation can be realized.

Stanford University has recently constructed a large-scale SCU project on the west side of campus that comprises stormwater interceptors, swirl-type separators, sand filters, and a reverse pumping system that replenishes a nearby reservoir, Felt Lake. Captured stormwater allows for irrigation of sports fields while preventing hydromodification and increased runoff into San Francisquito Creek.

APPENDIX A: RECOMMENDED ACTIONS FOR ADDRESSING SCU NEEDS

NOTE: Lead organizations are named for the recommended actions in the following tables where information is available.

Building Trust, Understanding, and Partnerships

Recommended Action and Lead Organization(s)
Develop a resource document designed to assist stormwater managers that are unfamiliar with the basic concepts of SCU in pursuing these types of projects.
Leverage other actions in the WRAP to allow further dissemination of SCU resources and ideas. EPA should lead this action with support from WRAP action leaders.
Develop a communications "toolkit" that compiles best practices and tools for outreach and engagement associated with SCU project development and implementation. WateReuse is a potential partner for this action.
Compile and disseminate case studies of successful public-private partnership models for SCU implementation.
Analyze challenges that local public stormwater managers and private landowners face in integrating SCU activities onsite and across individual parcels.
Conduct a formalized study to develop more consistent SCU messaging and terminology at the national scale. This can be similar to the WateReuse study focused on vocabulary and images that support informed decisions about water recycling and desalination.
Create knowledge-sharing networks to facilitate SCU conversations with an eye toward under-resourced utilities and under-resourced stormwater management agencies. WRF, WateReuse, and EPA are potential leaders for this action.
Develop a suitability matrix depicting the range of SCU implementation strategies (including centralized vs. decentralized and aquifer recharge vs. capture and direct use) based on local typology and water availability dynamics.
Develop more detailed estimates of SCU potential and implementation.

Funding Mechanisms

Recommended Action and Lead Organization(s)
Support efforts to expand SCU investments through infrastructure funding and financing for both traditional and non-traditional approaches. This goal can be accomplished through training, education, engagement, and outreach to a variety of stakeholders. These efforts will leverage ongoing work by the partner organizations on information dissemination projects focusing on Government Accounting Standards Board (GASB 62) changes that better enable distributed natural infrastructure, as well as overall information on the potential for debt financing to support stormwater and green infrastructure investments. NMSA, WaterNow Alliance, and SGA Marketing are potential leaders for this action pending availability of resources.
Assess opportunities to revise or create new models under the SRF programs to be more tailored to stormwater programs (e.g., fewer restrictions on matching funds, grants and loans available for stormwater districts, or extra credits for SCU implementation).
Compile and disseminate case studies of innovative financing approaches for SCU system capital costs and long-term O&M.
Create grants to incentivize regional planning across water industries (e.g., stormwater, drinking water, and wastewater). Grant application procedures should be simple and intuitive.
Develop a funding checklist for developers working on different stages of SCU projects.
Develop guidance on effective strategies for successful stormwater utility/fee programs that can support SCU, building on existing tools in NMSA's National MS4 Online Resource.

Regulations, Policy, and Guidance

Recommended Action and Lead Organization(s)
Develop a compendium of NPDES permitting approaches for SCU applications. EPA's Office of Wastewater Management is a potential leader for this action.
Compile and disseminate regionally specific SCU updates, tools, and resources to assist communities within the same region (i.e., regions with similar landscapes and/or climates) with addressing water management challenges.
Compile and assess linkages in existing state regulatory frameworks, policies and guidance, and local ordinances that accelerate adoption of SCU planning and implementation.
Compile and disseminate onsite SCU operating permits that incorporate the NBRC for ONWS' risk-based framework.
Refine regulatory permit requirement frameworks to better enable SCU approaches, including direct use, injection, spreading basins, etc.
Develop a clearinghouse of stormwater BMP manuals and guidance on stormwater treatment systems that can be applied to SCU for direct use and aquifer storage projects.
Develop an internal EPA leadership caucus focused on SCU and the outcomes from this convening. EPA will lead this recommended action.
If new NPDES permits are required for stormwater discharges from commercial and industrial facilities, potentially incorporate language in the permit that incentivizes SCU at commercial, industrial, and institutional facilities as a compliance strategy. EPA, the state of California, and other designated states are potential leaders for this action.
Support efforts to develop template documents (e.g., codes, ordinances, planning and design, and specifications) that can more easily facilitate the local implementation of SCU practices, technologies, and approaches. NMSA is a potential leader for this action, with support from other partners.
Develop permitting training that illustrates the use of available regulatory flexibilities to address SCU compliance issues as an outgrowth of WRAP Action 2.6.

Science and Treatment Standards

Recommended Action and Lead Organization(s)
Develop design and treatment standards for drywells in California. The California State Water Resources Control Board should lead this action.
Develop guidance on fit-for-purpose treatment standards for SCU. Separate guidance should be provided for aquifer recharge vs. storage and direct use.
Prepare standard design plans for SCU systems that are certified (by a professional engineer) to meet specific treatment standards to help developers save on up-front "soft costs" and allow for streamlined review. Non-prescribed alternatives may be implemented if approved by a professional engineer as providing an equivalent level of treatment or better.

Technology Performance

Recommended Action and Lead Organization(s)
Expand the STEPP initiative to include SCU practices, technologies, and approaches to support the confidence in the performance. NMSA should lead this recommended action.
Where possible, include SCU practices, technologies, and approaches in efforts to develop standards through Committee E64 (Stormwater Control Measures) of the ASTM to support the STEPP initiative. NMSA should lead this recommended action.
Adapt existing International Stormwater BMP database to track and assist validation of the performance of existing SCU systems. This should focus on urban runoff and a suite of chemicals typically found in urban runoff that may be problematic depending on the end use. WRF, WateReuse, and grantees are potential leaders for this action.
Validate and propagate robust sensing and control devices that are internet-enabled to measure both water quantity and quality in SCU systems.
Develop a framework for SCU workforce development for underserved communities. New York City DEP is a potential leader for this action with possible support from the Johnson Foundation.

APPENDIX B: KEY SCU RESEARCH NEEDS

Building Trust, Understanding, and Partnerships

The following priorities were identified as key research needs for addressing organizational challenges and developing successful communication strategies.

- Evaluate models/frameworks for interagency, interjurisdictional, and public-private cooperation.
- Develop collaboration frameworks to facilitate cooperation across water enterprises (stormwater, drinking water, wastewater).
- Derive inter-organizational lessons learned from case studies and wastewater coordination studies (can build off the work being done under WRAP Action 2.16).
- Research "words that work" to communicate about specific SCU co-benefits to different audiences.
- Evaluate local efforts to build support for SCU and derive lessons learned to help others effectively build capacity.

Funding Mechanisms

The following priorities were identified as key research needs for addressing financial challenges for implementing urban SCU projects.

- Evaluate methods available to characterize co-benefits, especially difficult-to-quantify benefits like flood control, flow augmentation, and community economic benefits.
- Compile data and examples on SCU funding and financing approaches, including innovative approaches.
- Research opportunities and impediments to accessing SRF, OSG, and other funding sources (EPA's Section 319 Nonpoint Source Management Program, Community Development Block Grant, FEMA, Bureau of Reclamation, Department of Transportation, etc.)
- Identify potential innovative funding and public-private partnership (P3) approaches to funding SCU projects.
- Develop cost comparisons for SCU systems vs. wastewater recycling systems.
- Evaluate the feasibility and potential for trading and banking mechanisms for SCU.

Regulations, Policy, and Guidance

The following priorities were identified as key research needs for addressing regulatory challenges for implementing urban SCU projects.

- Evaluate state water rights constraints to SCU at different scales in different states.
- Evaluate and compare current approaches for setting stormwater treatment standards for fit-for-purpose applications.
- Evaluate NPDES and Underground Injection Control regulatory effects on the ability to pursue SCU (WRAP Actions 2.6 and 7.4).
- Evaluate legal frameworks for stormwater diversion to sanitary sewers that can supplement water recycling opportunities and publicize examples of local regulation of diversion projects.
- Evaluate strategies for creating regulatory incentives for SCU through MS4s and other legal mechanisms, such as alternative compliance paths in MS4 permits.
- Evaluate the effects of local codes on and enable networking across ownerships to develop SCU projects addressing stormwater from multiple parcels.
- Evaluate regulatory instruments for maintaining SCU assets.
- Evaluate the relationships between water recycling activities, including SCU, and ecosystem services, such as maintenance of minimum in-stream flows.
- Evaluate lessons learned from the wetlands mitigation banking community for potential application to SCU.

Science and Treatment Standards

The following priorities were identified as key research needs pertaining to the physical science of urban SCU and assessment of urban stormwater quality.

- Evaluate needs to identify treatment and performance standards for emerging contaminants in stormwater.
- Evaluate the quality of stormwater from different land uses considering regional hydrological variability.
- Evaluate risks to groundwater quality posed by different forms of stormwater used for infiltration and aquifer recharge.
- Evaluate the effects of large-scale and distributed SCU systems on stream/environmental flows.
- Develop risk-based frameworks and guidance for urban SCU, focusing on stormwater quality data and occurrence/fate of pollutants in stormwater.
- Evaluate methods for determining the effectiveness of distributed SCU systems in yielding claimed benefits at watershed scales.
- Collect better data on human pathogen prevalence in stormwater in different urban settings, along with chemical source trackers. Correlate the chemical source trackers to infrastructure condition, sanitary sewer materials and condition, and homeless populations.
- Develop pathogen indicators to evaluate human influences faster and more easily than quantitative microbial risk assessment (QMRA).
- Evaluate in-situ monitoring methods to flag the presence of pathogens in stormwater.
- Develop standard operating procedures for design of SCU systems (one for aquifer recharge and one for direct use).
- Consider a set of criteria (e.g., infrastructure condition, presence and location of wastewater collection systems, exposure for treated water, intended use) to qualify systems into a “minimum treatment requirement” bin.
- Evaluate the impacts of infrastructure condition and location (wastewater and stormwater) on stormwater quality (e.g., pathogens and human source trackers).

Technology Performance

The following priorities were identified as key research needs pertaining to the validation of control and treatment technologies incorporated in urban SCU systems.

- Evaluate the efficacy of existing stormwater treatment technologies and BMPs in removing bacteria, metals, organics, and sediment.
- Evaluate capacity of real-time monitoring and sensor technology to enable dynamic system operation to manage infrastructure and risks of pollutant introduction.
- Evaluate the potential for technology validation processes to ease regulatory acceptance.
- Evaluate long term O&M issues with SCU technologies and capacity to maintain designed treatment efficacy.
- Evaluate surface and subsurface storage options and capacity to retrofit existing infrastructure to enable storage.
- Evaluate cost and cost-effectiveness to assess cut points in terms of treatment feasibility.
- Identify common SCU technology combinations and permutations for developing standardized design plans and review processes.

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APPENDIX D: ACRONYMS

- ASTM – American Society of Testing and Materials
- AWIA – America's Water Infrastructure Act
- BIL – Bipartisan Infrastructure Law
- BMP – Best Management Practices
- CBP3 – Community-Based Public-Private Partnerships
- CLASIC – Community-Enabled Lifecycle Analysis of Stormwater Infrastructure Costs
- CRWD – Capitol Region Watershed District
- CSO – Combined Sewer Overflow
- CWA – Clean Water Act
- CWSRF – Clean Water State Revolving Fund
- DWSRF – Drinking Water State Revolving Fund
- EPA – U.S. Environmental Protection Agency
- FEMA – Federal Emergency Management Agency
- GASB – Governmental Accounting Standards Board
- GSI-TBL – Framework and Tool for Quantifying the Triple Bottom Line Benefits of Green Stormwater Infrastructure
- GWRS – Groundwater Replenishment System
- I-DST – Integrated Decision Support Tool
- MDH – Minnesota Department of Health
- MRP – Municipal Regional Stormwater Permit
- MS4 – Municipal Separate Storm Sewer System
- NBRC for ONWS – National Blue Ribbon Commission for Onsite Non-Potable Water Systems
- NEWR – Non-Potable Environmental and Economic Water Reuse Decision Support Tool
- NMSA – National Municipal Stormwater Alliance
- NPDES – National Pollutant Discharge Elimination System
- NYC DEP – New York City Department of Environmental Protection
- OC San – Orange County Sanitation District
- O&M – Operations and Maintenance
- OSG – Sewer Overflow and Stormwater Reuse Municipal Grants
- P3 – Public-Private Partnership
- PACE – Property Assessed Clean Energy
- PCB – Polychlorinated Biphenyl
- PFAS – Per- and Polyfluoroalkyl Substances
- QMRA – Quantitative Microbial Risk Assessment
- ReNUWIt – Re-Inventing the Nation's Urban Water Infrastructure
- REUSExplorer – Regulations and End-Use Specifications Explorer
- SCADA – Supervisory Control and Data Acquisition
- SCM – Stormwater Control Measure
- SCU – Stormwater Capture and Use

- SCWC – Southern California Water Coalition
- STEPP – Stormwater Testing and Evaluation for Products and Practices Program
- TMDL – Total Maximum Daily Load
- UCI CLEANR – University of California, Irvine, School of Law Center for Land, Environment, and Natural Resources
- WateReuse – WateReuse Association
- WEF – Water Environment Federation
- WRAP – Water Reuse Action Plan
- WRF – Water Research Foundation

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