Stormwater Institute

Rainfall to Results

THE FUTURE OF STORMWATER

Water Environment Federation
the water quality people

The Water Environment Federation (WEF) is a not-for-profit technical and educational organization of 36,000 individual members and 75 affiliated Member Associations representing water quality professionals around the world. Since 1928, WEF and its members have protected public health and the environment. As a global water sector leader, our mission is to connect water professionals; enrich the expertise of water professionals; increase the awareness of the impact and value of water; and provide a platform for water sector innovation.

PREFACE

The release of this report is the first action of the Water Environment Federation (WEF) Stormwater Institute. The institute and report are designed to help the stormwater sector address challenges by leveraging WEF's leadership, diverse membership, breadth of knowledge, and varied partnerships.

The growing issue of stormwater pollution coupled with regulatory pressure is driving the need for innovative solutions, training, technology verification, and progressive financing approaches.

In 2014, the National Stormwater Summit brought together stormwater leaders, practitioners, and agency representatives to discuss the concerns of this often under-recognized constituency. The consensus was for WEF to leverage its position as a leading water organization to help amplify the voice of the stormwater sector, provide a centralized hub for exploring collaborative opportunities, and to consolidate the latest stormwater research, information, and field expertise.

As a result, the WEF Stormwater Institute was created to be a center of excellence and innovation that will focus on addressing critical runoff management issues as a means to protect public health and the environment. The institute will work with the stormwater sector to identify cross-cutting issues; convene experts to assist with developing solutions; provide insights and leadership to policymakers; and help chart a new course toward a healthier and more sustainable stormwater sector.

The following report, *Rainfall to results: The future of stormwater*, intends to support this effort by setting a vision for the future of sustainable stormwater management. Based on input from stormwater professionals, this report charts a path forward for the sector with broad objectives and more specific actions for achieving a healthier water environment and more vibrant communities.

This report marks the beginning of an ongoing dialogue and a series of future meetings that will record new successes and challenges while refining the path forward.

Under the direction of the WEF Stormwater Institute
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EXECUTIVE SUMMARY

The practice of managing stormwater has evolved from carrying runoff away as fast as possible to, now, handling as much of it where it falls as possible. 2015 marks the 25th anniversary of the U.S. Environmental Protection Agency's stormwater permitting program. The sector has accomplished much and set the stage for even more meaningful progress.

Despite these efforts, stormwater is the only growing source of water pollution in many watersheds throughout North America. While the challenges of stormwater management appear to be vast, overcoming them creates opportunities to make gains beyond improving water quality. The sector has a unique opportunity to further advance sustainability, resiliency, and community livability. Stormwater is a maturing sector that is poised for major growth.

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On July 27 and 28, 2015, WEF convened a meeting of stormwater professionals from across the U.S. The Johnson Foundation at Wingspread cosponsored the meeting, which was held at their conference center in Racine, Wis. These stormwater sector leaders participated in a discussion that captured current trends and conditions in stormwater, as well as opportunities and pathways toward a sustainable and financially sound stormwater sector.

This report presents a vision for the future and six overarching objectives that will help achieve this vision. The vision conveyed here is formed not through consensus of the discussion participants, but through their shared input as described by WEF.

A VISION FOR THE FUTURE OF STORMWATER

In the future, all stormwater will be considered a resource and managed through an optimized mix of affordable and sustainable green, gray, and natural infrastructure. Pollutant source control and management of runoff volume will be pursued aggressively as a complement to traditional stormwater controls. Stormwater infrastructure will be funded fully and managed by a true utility with a comprehensive asset management plan that benchmarks for future success. Management techniques will improve continually through new science, experiences, technical innovations, and responsive regulations. Stormwater management will be part of doing business and part of community resiliency and quality of life. The community will value and understand the many benefits of stormwater infrastructure.

OBJECTIVES FOR STORMWATER SUCCESS

WORK AT THE WATERSHED SCALE

All communities will have integrated, watershed-scale assessments of water resources needs and challenges. Stormwater management efforts will be aligned with larger watershed priorities, while local governments maintain their land use authority. Communities will understand what is necessary to overcome these challenges and will have the technical and financial capacity to sustain stormwater operations.

Recommended actions

- Better connect stormwater needs and investments to other community priorities and long-range planning efforts across jurisdictions within watersheds.
- Understand and incorporate the co-benefits of stormwater controls into community decision-making at the watershed scale.

TRANSFORM STORMWATER GOVERNANCE

Stormwater regulations will stimulate stormwater control innovation and performance improvement by focusing on program outcomes. Permitting frameworks will embrace the long-term nature of solving stormwater challenges and encourage integrated approaches that support cost efficiencies. Stormwater institutions will be funded fully and serve as the focal point for stormwater management within the community.

Recommended actions

- Explore ways to emphasize stormwater program outcomes in permits and design and maintenance requirements.
- Support development of long-term, adaptive frameworks for stormwater management.
- Encourage integrated planning and management across all water services and departments.
- Catalyze further formation of stormwater utilities.
- Increase state agency capacity to support sustainable stormwater management.

SUPPORT INNOVATION AND BEST PRACTICES

A broad suite of verified stormwater controls and best practices will support confident planning and maintenance. Sharing experience gained by evaluating stormwater programs and controls will encourage further innovation.

Recommended actions

- Ensure up-to-date best practices information is readily available.
- Create an integrated, needs-driven stormwater research agenda.
- Improve development and deployment of innovative technologies.
- Increase the ability to analyze and value stormwater management on a multi-benefit basis.
- Advance the tools and methods necessary to support continual improvement of stormwater management.
- Support pollution prevention through source control efforts and retention-based systems.

MANAGE ASSETS AND RESOURCES

Stormwater systems will be maintained through robust asset management programs and supported by innovative information technology. A multidisciplinary workforce will support the proper design, installation, and inspection as well as operations and maintenance, repair, and timely replacement of stormwater infrastructure.

Recommended actions

- Expand deployment of comprehensive asset management programs for stormwater infrastructure.
- Integrate operations and maintenance planning with stormwater capital project development.
- Develop the use of automated information technology to support sustainable stormwater management.
- Support development of a diverse, highly skilled, and multidisciplinary stormwater workforce.

CLOSE THE FUNDING GAP

Communities will align stormwater management efforts with broader community goals to garner funding options and will have access to innovative financing opportunities. Elected officials will support the investments needed to meet sustainable stormwater management objectives.

Recommended actions

- Support communities in identifying stormwater funding needs, inventorying the funding currently available, and describing the gap.
- Identify funding sources for stormwater management and articulate how stormwater management can meet the requirements of available sources.
- Support communities in understanding and accessing the full range of stormwater funding and financing approaches.
- Reduce the cost of sustainable stormwater management.

ENGAGE THE COMMUNITY

Communities will value the contribution stormwater management makes to flood risk reduction, clean and safe water, climate resiliency, and other benefits. This understanding and regard will translate into the decision-making capacity and financial support needed for sustainable stormwater programs.

Recommended actions

- Improve the ability of the stormwater sector to engage various audiences.
- Encourage and support peer-to-peer information sharing between public officials on stormwater challenges, successes, and failures.

INTRODUCTION

On July 27 and 28, 2015, the Water Environment Federation convened a meeting of stormwater professionals from across the U.S. The Johnson Foundation at Wingspread cosponsored the meeting, which was held at their conference center in Racine, Wis. These stormwater sector leaders participated in a discussion that captured current trends and conditions in stormwater, as well as opportunities and pathways toward a sustainable and financially sound stormwater sector.

This report presents a vision for the future and six overarching objectives that will help achieve this vision. The vision conveyed here is formed not through consensus of the discussion participants, but through their shared input as described by the Water Environment Federation.

Each chapter begins with a forward-looking statement describing the ideal future of the stormwater sector. The chapters describe how the current state of stormwater affects these six overarching objectives. Each vision is supported by a series of concrete action items that build toward the overarching objectives and, ultimately, the vision—taking rainfall challenges and creating opportunities for results.

UNDERSTANDING STORMWATER

Ensuring thoughtful progress toward sustainably managed stormwater requires understanding why stormwater matters, how it differs from other water quality issues, what the sector has accomplished already, and what the path forward can hold.

In short, freshwater delivered through precipitation should be valued as a resource and an opportunity. Through holistic, watershed-based approaches, communities can use stormwater infrastructure investments as a catalyst to improve not only water quality but also the vibrancy and resiliency of urban areas.

Stormwater regulatory drivers and milestones in the U.S.

1978	1987	1990	1994	1999	2008	2011	2014
Nationwide Urban Runoff Program launches	Clean Water Act amendments address nonpoint source pollution	Phase I Municipal Separate Storm Sewer System permitting program established	Combined Sewer Overflow Control Policy published	Phase II Municipal Separate Storm Sewer System permitting program established	National Research Council releases report on urban stormwater management	Integrated Planning Framework developed	Proposed national stormwater rule deferred Green Infrastructure Collaborative formed Memorandum on stormwater permits and total maximum daily loads revised

WHY STORMWATER MATTERS

Stormwater is the only growing source of water pollution in many watersheds throughout North America. Urbanization and climate change exacerbate stormwater pollution, and, today, more than half the world's population lives in cities. Further, urban populations are expected to grow to nearly 70% by 2050, according to a 2014 report by the United Nations Department of Economic and Social Affairs.

While pristine landscapes retain, infiltrate, and delay the release of stormwater runoff to streams and rivers, urban areas decrease groundwater recharge and increase stormwater runoff. Issues of both water quality and quantity are further intensified by a changing climate that threatens both greater droughts and floods.

To illustrate this point, the U.S. Environmental Protection Agency (EPA) has stated that a natural watershed under average soil conditions infiltrates about 50% of the precipitation it receives, and another 40% is taken up by plants. In urban watersheds, however, as much as 55% of precipitation can become runoff.

In the conterminous U.S., roadways, rooftops, parking lots, and other impervious surfaces that prevent runoff from infiltrating the soil cover more than 103,600 km^2 (25.6 million ac)—an area nearly the size of Ohio—according to the 2006 National Land Cover Database.

This much cover means even small storms generate a large amount of runoff. For example, during a storm that drops 25 mm (1 in) of rain, the City of Baltimore, Md., can generate 2.65 million m^3 (700 million gal) of runoff—the equivalent of 1060 Olympic-sized swimming pools.

Just as problematic as the volume of water, however, are the pollutants it collects as it flows across the urban landscape. Urban surfaces are littered with sediments, pathogens, nutrients, and metals. When runoff carries these pollutants into streams and rivers, they can discourage recreational use, degrade aquatic habitats, and contaminate water supplies.

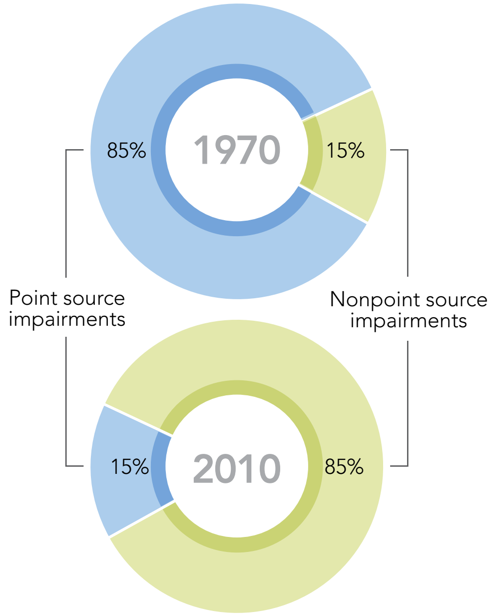
To put this issue in the context of environmental effect, in 1970, 85% of water quality impairments were associated with point-source pollution. The remaining 15% came from nonpoint sources such as agricultural and urban stormwater. Today, after significant advancements in wastewater treatment, these values have flipped—85% of impairments now stem from nonpoint and urban stormwater discharges. EPA's first administrator, William Ruckelshaus, pointed to this fact in a 2010 Wall Street Journal opinion article where he called stormwater runoff "the water quality issue of the day."

WHAT MAKES STORMWATER UNIQUE

Stormwater presents several unique challenges when compared to its more mature water sector counterparts of drinking water and wastewater. The root of many of these problems is that stormwater blurs the lines between a point and nonpoint source. Point sources have a discrete point of origin—usually the end of pipe—where measurements can be made and responsibility assigned. Nonpoint sources lack a discrete point of origin or responsibility.

Although stormwater runoff begins as a nonpoint source, it behaves as a hybrid. Some runoff enters waterways directly, but much of it also collects in underground pipes or sewers — some dedicated to stormwater and some combined with wastewater lines. Separate storm sewers typically deliver stormwater to waterways without treatment while combined sewers convey flow to water resource recovery facilities. The Clean Water Act governs municipal stormwater through the National Pollutant Discharge Elimination System (NPDES) program, which regulates point-source pollution.

The nonpoint nature of stormwater makes responsibility for its treatment and control hard to assign. Stormwater discharge, volume, and quality are intimately tied to land use. Human actions—from industrial processing and large-scale construction down to mowing a lawn or picking up after pets—all affect stormwater quality.



HOW STORMWATER HAS EVOLVED

2015 marks the 25th anniversary of the U.S. stormwater permitting program. The sector has accomplished much and set the stage for even more meaningful progress. The practice of managing stormwater has evolved from carrying runoff away as fast as possible to, now, handling as much of it where it falls as possible.

In 1978, EPA launched the Nationwide Urban Runoff Program, which found runoff contained much more pollution than expected. The program also determined that the first 13 mm (0.5 in.) of runoff — known as the "first flush" — carried most of these pollutants. This report helped shift the paradigm from drainage to capture and treatment.

Informed by the Nationwide Urban Runoff Program, the Clean Water Act Amendments of 1987 initiated EPA's first stormwater regulations in 1990 as part of the NPDES program. This program already regulated point sources — water resource recovery facilities and industrial facilities, for example. The change in 1990 expanded the program to cover municipal separate storm sewer systems (MS4s).

Phase I of this program focused on controlling runoff from medium to large urban areas with populations greater than 100,000 as well as industrial and construction sites larger than 2 ha (5 ac). Nearly 10 years later, EPA initiated Phase II, which expanded regulations to smaller communities, construction sites, and industrial facilities. The launch of the Phase II program expanded the number of MS4 communities from 750 to nearly 7500.

The Clean Water Act's Total Maximum Daily Load (TMDL) program also has become a significant regulatory driver for stormwater management efforts. A TMDL value is the maximum amount of a pollutant, such as sediment or nutrients, that a waterbody can receive and still meet water quality goals.

The Chesapeake Bay TMDL is the largest in the U.S. and a significant catalyst of stormwater efforts in the Northeast. Established in 2010, it requires Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia, and the District of Columbia all to achieve specific pollutant reductions in nitrogen, phosphorus, and sediment by 2025.

Combined sewer overflows (CSOs) are another important stormwater management driver. A popular approach in the mid-to-late 19th century was constructing combined sewers. Today, many communities struggle with the legacy design of these sewers, which include overflow points to prevent backup and flooding during storms. Currently, 772 U.S. cities face CSO issues, and many are spending billions of dollars under legally binding consent decrees to reduce CSO frequency and volume.

A popular approach to controlling CSOs is to build underground tunnels that store wet weather flows until they can be directed to a water resource recovery facility for treatment. These large-diameter tunnels can be miles long and cost billions of dollars to construct.

Nationwide, stormwater programs have made significant progress in addressing the effects of runoff. However, these efforts have been outpaced by urbanization.

The reality of the situation is that the current approach to stormwater management has not yielded significant water quality improvements — a fact recognized in the 2009 report, *Urban Stormwater Management in the United States*. This report by The National Research Council of the National Academy of Sciences recommends a focus on retention-based programs using low impact development (LID).

LID attempts to mimic natural hydrology and is best suited for new, suburban development. The term *green infrastructure* typically describes practices used in dense urban landscapes. The purpose of both LID and green infrastructure is to provide treatment by retaining stormwater onsite — especially for small storms that otherwise would transport "first flush" contaminants.

These practices use vegetation, soils, and natural processes to infiltrate water and make it available to plants. Green infrastructure most commonly encompasses site-scale practices, such as permeable pavement, bioretention, green roofs, and rainwater harvesting. However, green infrastructure can be employed at a watershed-scale in the form of enhanced riparian floodplain zones and wetlands that help to manage storm effects.

Though employed since the 1990s, EPA increasingly is encouraging LID within stormwater permits and as CSO control measures. Currently, stormwater permits for 17 states and the District of Columbia employ retention-based performance standards for new development and redevelopment.

WHERE OPPORTUNITIES EXIST WITHIN STORMWATER

While the challenges of stormwater management appear to be vast, overcoming them creates opportunities to make gains beyond just controlling stormwater. This is especially true when incorporating green infrastructure. Combining stormwater controls with other urban planning investments can lead to more vibrant communities, better climate change resilience, and cost savings.

Retention-based stormwater controls provide such co-benefits as improved human health and wellness, decreased urban heat island effect, habitat creation, and increased property values. These practices also can reduce the need for gray infrastructure and detention basins.

For example, Onondaga County, N.Y., uses green infrastructure in its legal obligations to decrease CSOs. The county's investments in LID are projected to total nearly $80 million and account for about one-third of total CSO reductions. This mixed green and gray approach could save the county up to $20 million compared to using traditional stormwater management techniques alone.

Communities also can use stormwater controls to improve climate resilience, which is the ability to adapt to and recover quickly from climate-change-related events. Climate change effects vary greatly across the world from more intense storms and rainfall to sea level rise to drought. But practices such as rainwater harvesting can both supply water and help to manage localized flooding; and living shorelines, coastal wetlands, and other natural infrastructure can help mitigate storm effects and prevent coastal erosion.

Likewise, bioretention facilities in arid or semiarid environments can capture and infiltrate rainfall to enhance groundwater resources. Augmenting groundwater in this way improves water supply security while also reducing localized flooding. In a water-rich climate, these same systems may be valued more for their ability to remove certain pollutants from water.

WHAT'S NEXT FOR STORMWATER?

Stormwater management has taken great strides from where it began. The sector now has a unique opportunity to advance sustainability, resiliency, and community livability. It is a maturing sector that is poised for major growth.

In the future, stormwater runoff will be managed through an optimized mix of affordable and sustainable green, gray, and natural infrastructure that integrates both community resiliency and quality of life. The steps outlined in this report will lead to stormwater management at a watershed scale that supports beneficial synergies and becomes a part of routine urban planning.

CHAPTER 1
A VISION FOR THE FUTURE OF STORMWATER

In the future, all stormwater will be considered a resource and managed through an optimized mix of affordable and sustainable green, gray, and natural infrastructure. Pollutant source control and management of runoff volume will be pursued aggressively as a complement to traditional stormwater controls. Stormwater infrastructure will be funded fully and managed by a true utility with a comprehensive asset management plan that benchmarks for future success. Management techniques will improve continually through new science, experiences, technical innovations, and responsive regulations. Stormwater management will be part of doing business and part of community resiliency and quality of life. The community will value and understand the many benefits of stormwater infrastructure.

Everyday actions affect stormwater quality; therefore, everyone can contribute to stormwater success. Engineered treatment systems represent one avenue, but public behavioral changes that emphasize water quality, shifts in manufacturing processes that limit toxins, or changes in land use planning policies that prioritize sustainability also play a role. Because the effects of stormwater are widespread, achieving this vision requires attention and action from stormwater professionals as well as all actors and disciplines within the community—from the general public to landscape architects to transportation officials.

Organizations tasked with stormwater management need support on several fronts. First, sustainable stormwater management requires a dedicated funding source and governance structure best supported by stormwater utilities. Second, by better understanding the challenges inherent in stormwater management as well as potential solutions, the public and elected officials will develop greater acceptance and appreciation of stormwater utilities.

These programmatic and financial resources are needed to implement long-term planning, design, construction, and operations and maintenance of stormwater controls. Key performance indicators, tied to comprehensive asset management, are needed to benchmark and continually improve storm-

TERMINOLOGY NOTE: STORMWATER CONTROLS

In this document, the term *stormwater controls* is used in place of the popular term *best management practice*. This terminology is consistent with the 2008 National Research Council report as well as the 2012 manual *Design of Urban Stormwater Controls* by the Water Environment Federation and American Society of Civil Engineers. The term stormwater control is intended to describe the function of devices designed and constructed to manage stormwater. The term emphasizes that stormwater controls are engineered devices and seeks to differentiate them from practices involving non-engineered approaches.

water investment outcomes. Developing these indicators will require attention to monitoring and evaluation of stormwater control performance.

Among stormwater programs, data and experiences from monitoring and evaluation should be shared to enable practitioners to make on-the-ground improvements. Stormwater treatment controls should be implemented systemically instead of in the limited and piecemeal manner currently used. Better information sharing will enable communities to install superior stormwater controls and reduce the risk of failure. A consistent approach to stormwater management that maintains flexibility for environmental and other factors also will drive economies of scale and decrease overall costs.

In turn, this information and research should feed into a flexible regulatory framework that supports innovation and promotes best practices.

These best practices will vary among green, gray, and natural infrastructure as well as pollutant source control. Green infrastructure offers a unique opportunity to improve the vibrancy of communities and engage with the public. Not only can the public utilize green infrastructure on private property, green infrastructure also can encourage greater engagement and appreciation of stormwater systems and waterways. In addition to filtering and treating runoff, green infrastructure reduces runoff volume, which prevents stormwater from carrying pollutants downstream.

To the same end, source control seeks to reduce pollutants that could mix with stormwater. Nonstructural controls focus on keeping pollutants out of stormwater through such efforts as spill prevention, pollutant containment plans, and street sweeping initiatives. Source controls go one step further by seeking to eliminate the original source or use of the pollutant. For example, the 2006 prohibition of coal-tar-based pavement sealants in Austin, Texas, has resulted in a substantial reduction in polycyclic aromatic hydrocarbon levels in sediments in Lady Bird Lake. Source control is a critical aspect of efficiently addressing stormwater quality concerns and will require national discussion about the relationship among stormwater management, land use planning, and stormwater pollutants.

To accomplish this vision for the future requires an action agenda of broad objectives and more specific actions. This report lays out six of these broad objectives and dedicates a chapter to each.

OBJECTIVES FOR STORMWATER SUCCESS

- Work at the watershed scale
- Transform stormwater governance
- Support innovation and best practices
- Manage assets and resources
- Close the funding gap
- Engage the community

Each objective focuses on specific actions. In addition, several themes cut across the objectives, including

- integrating stormwater with broader water resources and community planning;
- characterizing and optimizing the multiple benefits associated with stormwater management;
- establishing clear ownership for long-term operations and maintenance of stormwater controls;
- aligning stormwater controls and communications with community-needs-driven approaches that ensure stormwater investments receive local support;
- improving resiliency in the face of urbanization and climate change; and
- sharing data, lessons learned, and successes to improve implementation of stormwater controls and economies of scale.

> Sustainable stormwater management requires a dedicated funding source and governance structure best supported by stormwater utilities.

CASE STUDY

Philadelphia sees green in green infrastructure

The Philadelphia Water Department (PWD) in 2011 began a 25-year plan to improve local water quality mainly by reducing combined sewer overflows (CSOs). This $2.4 billion program, known as Green City, Clean Waters, touts green stormwater infrastructure as the primary solution to significantly reduce overflow volumes.

Green infrastructure attempts to mimic a watershed's natural hydrologic cycle using stormwater controls while beautifying the community by incorporating landscaping. Philadelphia's program seeks triple-bottom-line benefits—social, environmental, and economic—through stormwater controls. Examples of such controls include:

- rain gardens and bioretention basins,
- bioswales and stormwater wetlands,
- urban landscaping and tree planting,
- porous pavement and permeable pavers, and
- green roofs and rain barrels.

In addition to reducing overflow volumes, PWD expects the program will generate at least 250 green jobs and reap a $2 return on each dollar invested. This return on investment factors in such concepts as energy savings, air quality improvements, increased property values, increased community recreation, and reduced flooding.

Community outreach is critical to the success of these projects. Educating the public about green infrastructure benefits engages neighborhood groups and other stakeholders to advance projects. PWD found that schools, parks, public property, churches, recreation centers, and areas undergoing new development make ideal locations for introducing green infrastructure projects.

The city also began by selecting projects to coordinate with already planned roadway, water main, and sewer reconstruction projects. Working within larger projects prevents disrupting a community with construction a second time to install green infrastructure and can help defer costs. For example, reviewing already prepared project plans can reveal opportunities for green infrastructure without additional surveying. And, if a project already includes installation of new sidewalks and curbs, no or little extra cost comes from employing green infrastructure options.

Stephen C. Maakestad. "Philadelphia sees green in green infrastructure: Achieving triple bottom line benefits while reducing CSOs." *Water Environment & Technology*. July 2014 (Vol. 26, No. 7)

CHAPTER 2
WORK AT A WATERSHED SCALE

All communities will have integrated, watershed-scale assessments of water resources needs and challenges. Stormwater management efforts will be aligned with larger watershed priorities, while local governments maintain their land use authority. Communities will understand what is necessary to overcome these challenges and will have the technical and financial capacity to sustain stormwater operations.

Working at a watershed scale is critical to achieving the vision for sustainable stormwater management. Water is not bound by local, state, or even national boundaries. Rather, it operates within watershed boundaries in which all water, primarily directed by topography, flows to one place. Demands on water resources are growing, so effective management at the watershed scale is critical.

Effective stormwater solutions must address all regulated pollution sources and land uses within a watershed, including urban, suburban, and exurban areas. Ideally, pollutant loadings from agricultural areas will be addressed within the watershed context. However, lack of regulations governing runoff from agricultural lands currently limits the sector to voluntary and incentive-based approaches.

When communities and stakeholders cooperate, working at a watershed scale can create opportunities to share resources to achieve greater pollutant reductions than they could alone. Working together also enables communities to take further advantage of the economic, social, and environmental (the triple-bottom-line) benefits of stormwater management efforts. Aligning such priorities as transportation improvements, economic development, and open space planning with stormwater management objectives can deliver the greatest benefit at the lowest cost.

Working at a watershed scale can take many different forms and occur on any scale. These efforts can encompass just a few or many municipalities. Today, National Pollutant Discharge Elimination System permits serve as a link among some communities in the same watershed. Others communities are voluntarily participating in watershed planning as a strategy to achieve water resource goals. These strategies bring together the actions, participants, and resources needed to implement the plan.

However, experience shows that working at a watershed scale in either capacity can present difficulties. Creativity and flexibility is appropriate in structuring watershed-scale governance arrangements. Working at the watershed scale should not infringe on cities' land use authority or completely forgo their regulatory autonomy. Planning schedules and objectives also should align among all participants, and entities must trust each other and cooperate.

Working at a watershed scale can take many different forms and occur on any scale.

RECOMMENDED ACTIONS

ACTION 2.1

Better connect stormwater needs and investments to other community priorities and long-range planning efforts across jurisdictions within watersheds.

Runoff quality and volume are intimately tied to land use. Therefore, it is essential that stormwater management is coordinated across multiple agencies and departments within a watershed, from transportation to parks departments. Many opportunities exist to integrate stormwater controls within planned projects. Efforts should be made to better align scheduling and planning processes among departments throughout watersheds. Ideally, planning efforts should be integrated, or at least coordinated, so that projects can be conceived and designed to serve multiple community needs and optimize benefits.

For example, strategically placing distributed wastewater and stormwater systems together within economic corridors with high water demands creates opportunities to supplement the water supply through water reuse and stormwater harvesting. This pairing can decrease energy demands and greenhouse gas emissions associated with drinking water treatment and pumping.

To work together in this manner requires building local capacity to support cross-departmental planning and operations as well as balancing regulatory enforcement with economic and social incentives. Cross-departmental planning at the watershed scale will help communities garner stronger support for needed stormwater management investments, optimize overall community value, and maintain affordability.

ACTION 2.2

Understand and incorporate the co-benefits of stormwater controls into community decision-making at the watershed scale.

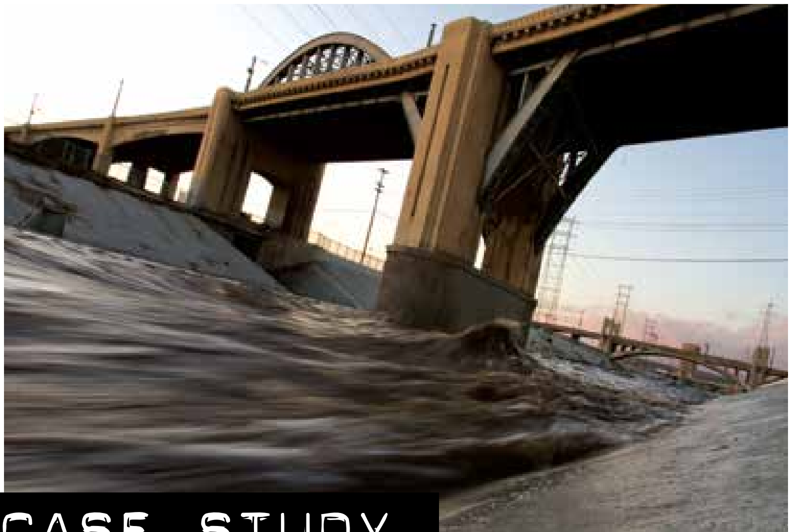
Stormwater management infrastructure has much to offer community redevelopment, quality of life, and climate resiliency efforts. Stormwater controls reduce flooding and improve water quality, thereby protecting drinking water supplies, wildlife habitats, and recreational areas. These benefits have monetary value. Improving water quality can cut costs for drinking water treatment and enhance recreational activities—such as fishing and boating—that are significant economic contributors.

Managing stormwater also presents unique opportunities to create landscapes that engage the public. For instance, municipalities have created stormwater treatment wetlands with walkways so that visitors can appreciate nature while reading signs that educate about the value of water.

Communities have used stormwater controls in urban renewal projects that repurpose underutilized spaces and connect communities. New York City created the iconic High Line, an elevated park with integrated green infrastructure atop a disused rail line. Research from Philadelphia shows that green infrastructure may even play a role in reducing crime.

By creating more vibrant spaces, communities can increase property values, improve human health, and address equity and environmental justice issues. The installation and maintenance of stormwater controls also presents a significant opportunity to increase entry-level, green jobs.

Yet these co-benefits often are not incorporated into community decision-making. To support this outcome, community stakeholders need easy-to-access, easy-to-articulate information on common co-benefits of stormwater controls.



CASE STUDY

Working at the watershed scale in Los Angeles County

The Los Angeles County municipal separate storm sewer system (MS4) permit encompasses Los Angeles County, the Los Angeles County Flood Control District, and 84 cities within the county's coastal watersheds. The permit covers an area of more than 7770 km^2 (3000 mi^2) and includes a vast drainage network serving all seven watershed management areas within the Los Angeles region. Information within the county's permit indicates that the region's MS4 exceeds 6900 km (4300 mi) of pipeline and also includes 804 km (500 mi) of open channel, 5600 km (3500 mi) of underground drains, and an estimated 88,000 catch basins.

The permit—issued in 2012 and largely upheld in 2015—treats stormwater as a resource for supplementing local water supplies. It also includes low impact development requirements, which instruct new and redeveloped areas to retain runoff onsite.

"This innovative permit not only advances water quality protection, it also incentivizes the management of stormwater as a significant resource—for water supply, urban greening, and other uses," said Felicia Marcus, chair of the California State Water Resources Control Board. "Our collective objective should be to use each scarce drop of water, and each local dollar, for multiple local benefits."

The permit also provides the option for municipalities to implement the permit on a watershed scale. This would incentivize integrated water management and combine water supply and water quality planning. The voluntary program enables permittees to address the highest watershed priorities, including receiving water limitations, total maximum daily load provisions, MS4 minimum control measures, and nonstormwater discharges.

Fulfilling requirements through watershed management programs enables watershed-based solutions; facilitates collaboration and cost-effectiveness; and better enables permittees to attract funding partners to build projects with multiple benefits.

ADDRESSING NONPOINT SOURCE POLLUTION

According to the U.S. Environmental Protection Agency (EPA), the nation reached a milestone in August 2014: 500 nonpoint source pollution-impaired waterbodies had been fully or partially restored. EPA expects that there will be nearly 600 restored waterbodies by the end of 2015.

However, water quality goals cannot be addressed adequately without the full cooperation of all pollution sources in a watershed. According to EPA, nonpoint source pollution is the primary source of impairment in more than 33,000 waters. This accounts for about three-quarters of all impaired waters for which total maximum daily loads (TMDLs) have been calculated. Nutrients and sediments are the most common nonpoint source pollutants. Nutrients in particular are a pollutant of growing concern responsible for algae blooms and dead zones. While the Clean Water Act's National Pollutant Discharge Elimination System regulates point sources, TMDLs arising from nonpoint sources must be reached using voluntary controls.

CHAPTER 3
TRANSFORM STORMWATER GOVERNANCE

Stormwater regulations will stimulate stormwater control innovation and performance improvement by focusing on program outcomes. Permitting frameworks will embrace the long-term nature of solving stormwater challenges and encourage integrated approaches that support cost efficiencies. Stormwater institutions will be funded fully and serve as the focal point for stormwater management within the community.

While many of the technologies needed to solve stormwater challenges are within reach, some significant institutional barriers remain. Regulations, governance, and institutions shape the landscape in which stormwater management decisions are made, and they should be structured to support sustainable stormwater approaches.

Communities must support new business and governance models. Local governments or stormwater authorities are, and should be, the focal point of stormwater implementation. These entities are responsible for planning, design, construction, operation, and maintenance of municipal stormwater infrastructure. Although federal, state, and regional agencies play important regulatory and funding roles, local governments best understand and can seek out the needs and desires of local stakeholders.

Most stormwater permits are written and issued at the state level. This has created a patchwork of permitting frameworks nationwide. The Clean Water Act, however, requires through municipal separate storm sewer system (MS4) permits that communities reduce pollutants to the maximum extent practicable. This standard is often achieved through implementation of stormwater control measures with assumed percent-removal performance. Communities are to achieve measurable goals in six areas, including public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention and good housekeeping.

Similarly, the 1994 CSO Control Policy of the U.S. Environmental Protection Agency (EPA) established nine minimum control measures wastewater collection systems had to meet to reduce combined sewer overflows (CSOs) and their effects. The measures include such actions as notifying the public of overflows, reducing litter in the combined sewer system, and monitoring CSOs in an effort to minimize these events. Communities with combined sewers also are required to develop long-term control plans that identify how they will implement the control measures and comply with the Clean Water Act.

Through these regulatory frameworks, negotiated activities become the measure of compliance. Basically, if a community does what it says it will do, then, by definition, it has complied with its MS4 permit. Measurement of water quality serves to guide an iterative process of ever-changing requirements, steering inexorably toward clean water.

The difficulty is that improving water quality is the real performance target, but achieving water quality objectives, such as total maximum daily load (TMDL) targets, is unlikely within defined permit schedules. Urban areas can retrofit with stormwater controls and implement them as development and redevelopment occur, but achieving water quality improvements is a long-term process.

For these reasons, community and regulatory expectations should align with on-the-ground realities. The regulatory environment should encourage policies that both push and measure incremental progress as well as clearly and deliberately work toward long-term goals.

RECOMMENDED ACTIONS

ACTION 3.1

Explore ways to emphasize stormwater program outcomes in permits and design and maintenance requirements.

Nationwide, current stormwater planning and management decisions for new development and redevelopment are driven by various regulatory standards and criteria. EPA recommends permit requirements that are more specifically tied to a measurable water quality target—for example, numeric requirements that attempt to mimic predevelopment conditions. Currently, 17 states and the District of Columbia are employing retention-based performance standards for new development and redevelopment. Others have incorporated numeric effluent limits or other quantifiable measures for addressing water quality impairments. However, none of these standards are without controversy.

Many communities are implementing stormwater permits with technology-based specifications for stormwater controls that are based on an assumed performance. However, neither federal law nor regulations specify this approach.

While this approach may simplify the path to meeting regulatory requirements, specifying certain approaches limits technical innovation. Additionally, stormwater controls will not necessarily perform the same way in different situations, and they certainly will not perform as expected if not maintained. This approach can lead to simply fulfilling regulatory obligations without regard for actual performance, which draws time and money away from more productive investments.

Shifting to a more comprehensive set of design goals and a focus on the outcomes of stormwater programs and controls can advance innovation and create better overall results. This approach does, however, raise a series of difficult and complex issues around monitoring as well as transformation of standards and design criteria for new development, redevelopment, and retrofits.

One issue is how to measure outcomes. Should measurement focus on changes in receiving water quality or monitored performance of stormwater controls? Either way, monitoring of these outcomes could prove challenging and costly. Within a watershed, there are many compounding factors that affect water quality, so it can be difficult to isolate the causes of impairment or improvement. There also is a lag between implementation of stormwater controls and water quality improvement.

Given the sector's maturity, non-attainment of outcomes should not result in non-compliance. Rather, monitoring should be a way to change incrementally the standard—not punish the willing. Management and permitting actions must evolve as experience leads to opportunities for improved practice and better-informed expectations.

Solving these issues will require openness to new approaches. The sector should consider moving away from the current project-by-project approach permitted on event-based assumptions. It should instead focus on larger investments in a systemic context that enable stormwater management efforts to achieve the greatest social and environmental benefits at the lowest cost. This shift will become more critical as TMDL requirements are integrated more regularly into MS4 permits.

To be successful, an outcomes-based approach would need to be viable for project scales ranging from a single site, to a neighborhood, to an entire watershed. The first steps in this process could be to develop a compendium of performance-based criteria, convene a group of stormwater experts and regulators to frame this needed transformation in more detail, and make additional and specific recommendations on how to move forward and what timeframe is needed to implement this transformation.

ACTION 3.2

Support development of long-term, adaptive frameworks for stormwater management.

The stormwater community recognizes that addressing stormwater needs and requirements is a long-term undertaking. Urban stormwater management is executed largely through MS4 permits that are issued at the state level as directed by EPA at the federal level. Permits often are renewed on 5-year cycles. Such a short cycle can make it difficult for water resources managers to plan for long-term investments. The cycle of permit renewal can undermine confidence that multiyear plans will remain intact and that plans can evolve as needed.

The sector should examine the flexibility inherent in such existing stormwater regulatory frameworks as MS4 permits and TMDLs.

Standards should be flexible to support individual community needs and goals. The product should be a permitting road map that strives toward such long-term goals as water quality improvements and flood reduction. Yet the road map also should establish a plan to track and measure incremental progress across multiple permit renewal cycles. The framework should be adaptive to support the development of incremental, short-term, achievable goals within individual permits. Long-term planning should support integrated, visionary plans to achieve sustainable stormwater management in ways that serve multiple community priorities and goals.

Equally important to developing adaptive frameworks is removing institutional and governance barriers to sustainable stormwater management. For instance, stormwater is an asset that can be maximized through harvesting and use, yet some local codes and ordinances, and even some state regulations, discourage or prohibit this use.

ACTION 3.3

Encourage integrated planning and management across all water services and departments.

While working at the watershed scale encompasses a broad range of partners, better cooperation is needed even within the water sector. Many communities are working to improve water quality under multiple Clean Water Act programs.

Integrated planning is a specific regulatory framework that allows communities to prioritize and align their strategies for meeting National Pollutant Discharge Elimination System permits. This approach encourages permitted cities to look across their entire range of water discharges to find and implement the most effective and cost-efficient approaches.

EPA established a framework for integrated stormwater and wastewater planning in 2011 and has supported several communities in piloting integrated planning efforts. Integrated planning should ensure communities receive the best overall value for their water resource investments. The stormwater community should actively advocate for and assist in broader implementation of integration concepts.

ACTION 3.4

Catalyze further formation of stormwater utilities.

Stormwater utilities provide a vitally important dedicated funding source and bonding capacity for community stormwater needs and priorities. Currently, the U.S. has between 1500 and 2000 stormwater utilities, according to a 2014 report on stormwater fees from Western Kentucky University. This means that only 20% to 25% of the 7500 MS4s nationwide have a dedicated funding source. However, progress in forming stormwater utilities has led to a solid base of best practices and experience that should be widely shared. Stormwater utilities are more common in the Great Lakes region, the Pacific Northwest, and Southern Atlantic states, according the Western Kentucky University report. Most commonly, these utilities levy fees based on impervious surface coverage.

Frequently, however, stormwater utilities — sometimes referred to as stormwater authorities — are just a funding mechanism rather than separate organizations within cities. Often, stormwater programs and controls are owned and operated by public works departments.

In addition to funding, stormwater utilities or municipal departments focused specifically on stormwater, play other vital roles. These entities serve as a focal point in the community to gather sustainable stormwater management champions from among citizens, developers, and city staff. The creation of stormwater utilities also creates additional opportunities to interact not only with water sector partners but also with city planners, nonprofits, floodplain specialists, and others.

Stormwater programs benefit greatly from having an entity responsible for planning, operating, maintaining, repairing, and replacing infrastructure. If paying a stormwater fee, customers expect a certain level of service. Stormwater utilities should be responsible for providing that level of service through proper asset management and for communicating the benefits.

Private sector entities, such as homeowner associations, have not been a reliable solution for long-term operation and maintenance of stormwater infrastructure. However, turnkey stormwater maintenance providers have emerged in the private sector to facilitate the inspection and maintenance of practices on private properties.

ACTION 3.5

Increase state agency capacity to support sustainable stormwater management.

In most cases, state agencies are responsible for writing and enforcing permits to enact Clean Water Act requirements. EPA carries this responsibility for some locations, including Idaho, Massachusetts, New Hampshire, New Mexico, Washington, D.C., Puerto Rico, federal facilities, and on tribal lands. EPA-issued permits often set the bar for the state-created permits. EPA also bears the responsibility for auditing state programs and compelling them to meet minimum program standards.

Through these permitting and enforcement actions, EPA and state agencies set the tone for stormwater management decisions and, therefore, play a role in supporting sustainable stormwater management. State programs, however, often are understaffed and face continuous budgetary pressure.

The stormwater sector should engage with state programs to identify stormwater and wet weather needs, and help state programs to meet those needs. Examples include supporting the development of joint technical training, providing information on innovative permitting approaches, or offering assistance with state stormwater manual updates.

> Although federal, state, and regional agencies play important regulatory and funding roles, local governments best understand and can seek out to the needs and desires of local stakeholders.

CASE STUDY

Integrated billing shows customers the value of water

Juggling several different water quality programs can overwhelm city budgets, but integrated planning can help restore affected watersheds more affordably. Even so, costs will rise.

For example, Portland, Maine, has to fund a combined sewer overflow abatement program; a municipal separate storm sewer system general permit plan; and a capacity, maintenance, operations and management plan. The city also initiated a drainage system assessment process. Portland predicted costs will double over the next 10 years.

To help the public understand and accept the increases, the city also integrated the part of the process that the customers see most directly: billing. The city changed both how it bills residents for water service and how it communicates about water projects. The focus now is on "the clean water story." Portland developed an integrated outreach plan to support this.

The outreach plan presents fee changes in the context of a broader investment in clean water and economic growth. The primary message for Portland — "Clean Water Equals Clean Growth" — does not isolate stormwater, combined sewer, or wastewater concerns, but instead speaks about broad investment in clean water.

In addition, specific changes made the billing itself more equitable. Portland added a stormwater fee based on the amount of runoff from a parcel. This will lower overall sewer rates for many high-water-use businesses and spread the burden for runoff, combined, and wastewater management more equitably. Linking fees to both water use and runoff volume is fairer fundamentally. This change also will lower annual sanitary sewer fees compared to what customers would experience without a change in the fee structure.

City staff will continue public outreach to maintain overall support and use the new and more equitable fee structure to support integrated plan implementation.

Zach Henderson and William Taylor. "The promised and the practical: A New England perspective on integrated planning and permitting." *Water Environment & Technology*. May 2015 (Vol. 27, No. 5)

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CHAPTER 4
SUPPORT INNOVATION AND BEST PRACTICES

A broad suite of verified stormwater controls and best practices will support confident planning and maintenance. Sharing experience gained by evaluating stormwater programs and controls will encourage further innovation.

To optimize stormwater management efforts, practitioners should share best practices and ensure manuals and other guidance are based on the latest research. Currently, there is a gap between research results and the information used to guide practitioners and local decision-makers. Likewise, maintenance practices sectorwide also can benefit greatly from sharing best practices and fostering innovation.

Nationwide, many research efforts are underway—both large- and pilot-scale. The results should be disseminated widely, including successes and failures. The data should be quality-controlled and presented consistently to make it easy to digest and put into use.

The assessment of different types of stormwater management options can be improved by using a consistent process and framework to verify performance of stormwater controls, including manufactured treatment devices. Enhanced modeling capabilities also will help stormwater professionals plan and design systems that optimize performance, improve infrastructure resiliency, and maximize co-benefits aligned with community priorities.

Finally, a focus on pollution prevention is more efficient than pollution treatment. Beyond engineered systems, the sector must cultivate new partnerships to focus on pollution prevention. Source-control efforts will require the sector to work at federal, state, and local levels to change regulations, materials used in the built environment, and behaviors that lead to pollution.

RECOMMENDED ACTIONS

ACTION 4.1

Ensure up-to-date best practices information is readily available.

The stormwater sector is in a dynamic state with accumulated knowledge and experience clearly pointing to the need to update guides and manuals that inform, and at times direct, the planning, design, construction, and maintenance of stormwater infrastructure. Currently, some state stormwater manuals have not been updated for as long as 10 years. Additionally, much of the guidance resides in hard-copy manuals that are updated every 3 to 5 years. Given the rapid advancements in stormwater controls and experiences of early adopters, researchers, and technology providers, manuals and guides have become outdated. This, in turn, has hindered opportunities for innovation and overall performance improvements.

Two areas of action emerge in response to this challenge. First, there is a need to prompt and support revisions to state stormwater manuals that currently contain outdated design requirements and guidance.

Second, stormwater manuals could be transformed into interactive, online training portals where users can virtually design systems and solve problems. Online manuals would be easier to update and could include easy-to-use, curated, unit-process-based information on stormwater controls. Not only would they support the optimized application and use of existing stormwater controls, the online manuals would address individual technologies as well as entire treatment trains, which are stormwater control sequences that enhance performance and provide redundancy.

Stormwater managers need the ability to assess potential management options based on situations and specific needs. For instance, if interested in metals treatment, the system should enable a direct comparison between the capabilities of various stormwater controls.

ACTION 4.2

Create an integrated, needs-driven stormwater research agenda.

The scope of expectations and requirements for stormwater management continues to grow, creating an ongoing need for new research and information. Although substantial stormwater research has been conducted and is underway, it requires additional guidance from an overall vision or a critical needs assessment. A stormwater research agenda should expand the ongoing efforts of many organizations to define stormwater research needs.

Given the crucial role stormwater research has played and must continue to play, the time is here to engage the stormwater community in a more formal and inclusive effort to define research needs and to coordinate research. The agenda should advance innovative technologies and emphasize long-term research to understand how stormwater controls perform over time.

Research funding agencies and organizations will look to this needs-driven research agenda developed by the stormwater community to determine what to fund.

INTERNATIONAL BMP DATABASE

The International Stormwater Best Management Practices (BMP) Database is an online resource with more than 530 case studies, performance analysis results, and tools focused on stormwater controls. The project is intended to provide research-based information to stormwater professionals to improve the design, selection, and performance of stormwater controls. The database is supported by a coalition of partners led by the Water Environment Research Foundation and includes the Federal Highway Administration, American Public Works Association, and the Environmental and Water Resources Institute of the American Society of Civil Engineers. Learn more at www.bmpdatabase.org/index.htm.

ACTION 4.3

Improve development and deployment of innovative technologies.

Regulatory and environmental drivers create the need in municipalities and other regulated entities for tools to meet stormwater sector challenges. Products and practices to manage and treat stormwater runoff, especially proprietary solutions, have been employed based on performance and maintenance information provided. In many instances, these data have not been evaluated or verified by independent third parties.

Across the U.S., a variety of state and regional programs now test, evaluate, and, in some cases, verify or certify product performance. The programs arose from a need to test proprietary devices in an equitable manner and to provide localities with guidance on what devices they can use and how the devices can be credited in a permit.

This, in turn, created a patchwork of diverse state and local requirements and an inconsistent approach to stormwater control testing, evaluation, and verification. While providing a valuable service, the patchwork nature, timeframe, and financial costs of testing programs can discourage innovative products from entering the market. The stormwater sector needs a set of common testing protocols to facilitate directly comparing options.

The sector should support both long-term research and demonstration projects that advance the state of knowledge related to stormwater controls. Additionally, the sector should create a more streamlined and efficient means to verify stormwater control performance, including those controls within a treatment train, to increase confidence in the performance of stormwater controls.

TESTING STORMWATER PRODUCTS AND PRACTICES

The Water Environment Federation (WEF) is developing recommendations for a national framework for the testing and evaluation of stormwater technologies. Called the Stormwater Testing and Evaluation for Products and Practices, or STEPP, program, this effort seeks to meet the growing need for affordable and effective stormwater management infrastructure and to overcome sector hurdles that restrain innovation in stormwater product and practice technology development.

The recent conclusion of the U.S. Environmental Protection Agency's Environmental Technology Verification program created a need for national leadership in the testing and evaluation of environmental technologies. Thirteen U.S. states have either developed, are developing, or have recognized other state- or regional-level testing and evaluation programs for stormwater products. This distributed effort, while helpful locally, hampers the effort to sell products at a national level and is a barrier to the growth of innovative and high-performing technology in the stormwater sector.

WEF expects to complete a final report outlining options for a national program by November 2015.

ACTION 4.4

Increase the ability to analyze and value stormwater management on a multi-benefit basis.

Stormwater management practices often provide multiple environmental, social, and economic benefits. However, these benefits can be difficult to quantify. The absence of robust and consistent methods for capturing and communicating these benefits can lead to an underinvestment in and lack of community support for important stormwater actions. One of the most important challenges and potentially productive paths toward effective incorporation of co-benefits is to develop coordinated crediting, guidance, and compliance paths across multiple regulatory programs at the local, state, and national levels.

Economic analyses can help prioritize stormwater management efforts, gain community or financial support for stormwater management options, increase participation by partners, and aid integration with capital improvement planning. Standard valuation practices also are needed to support additional stormwater funding and financing approaches based on ecosystem services, trading, banking, and crediting.

Communities that have effectively analyzed the value of potential stormwater efforts have developed both quantitative and qualitative metrics to capture the benefits of stormwater management. Whether focused on monetary, ecosystem, or other benefits, these valuations consider community priorities and values.

Many benefit valuation methods exist within the natural resources economics field, but these tools can be difficult for stormwater practitioners to apply. Given the critical importance of fully capturing and clearly communicating the benefits of stormwater investments, economic guidance for stormwater practitioners is needed.

ACTION 4.5

Advance the tools and methods necessary to support continual improvement of stormwater management.

Stormwater runoff can cause varying and complex issues across a watershed, from stream bank erosion to deteriorating stream ecology. Monitoring can help identify problems and set a baseline for background pollution. Modeling, on the other hand, can be used to assess potential solutions, both structural and nonstructural. Once those solutions are put into place, monitoring can help determine if they are working and further refine the models.

Both monitoring and modeling are important tools for benchmarking success and improving stormwater program performance. Updating commonly used models could help practitioners better predict the outcomes of their efforts. Stormwater professionals also need more standard monitoring methods and improved modeling capabilities to better understand the effect of different stormwater controls on water quality, flows, and other ecosystem services. Models also should capture multiple benefits, life-cycle analyses, integration across water resource areas, and the effects of climate change.

ACTION 4.6

Support pollution prevention through source control efforts and retention-based systems.

Source control is based on the idea that reducing pollutant loads is more efficient than treating those pollutants.

The stormwater sector has made progress on this issue. In 2010, California and Washington state passed regulations on the amount of copper in brake pads. This signaled a market shift for the automotive industry nationwide. In January 2015, the U.S. Environmental Protection Agency and others launched the Copper-Free Brake Initiative, a voluntary agreement to reduce the use of copper and other materials in motor vehicle brake pads. Likewise, urban fertilizer regulations and plastic bag fees in the Chesapeake Bay region seek to reduce common stormwater pollutants at the source.

Source control requires the work of partners at many levels. Efforts to support reforms that keep pollutants of concern, such as heavy metals and nutrients, out of stormwater will require the stormwater community to engage in a larger and more-focused effort at federal, state, and local levels.

Inversely, retention-based systems provide treatment and reduce runoff volume, which reduces the amount of runoff available to mix with pollutants. For instance, a detailed analysis of the performance of three neighborhood-scale green infrastructure projects by the New York City Department of Environmental Protection showed that street-side bioswales reduced flow to sewers by more than 20%. By reducing the volume of stormwater entering its combined sewers, New York is reducing the volume of combined sewer overflows.

The stormwater sector should encourage the installation of retention-based stormwater controls along with the conservation or creation of natural systems.

CASE STUDY

Image by Villanova Urban Stormwater Partnership

Better-than-expected performance transpires at Villanova University

At Villanova University (Villanova, Penn.), a mystery unfolded within the campus' green infrastructure practices. Bioretention facilities designed to control 25 to 50 mm (1 to 2 in) of rain managed 150 to 175 mm (6 to 7 in). During Superstorm Sandy, Villanova's sequence of stormwater controls—known as a treatment train—handled much of the storm's intense rain despite not being designed for it.

Researchers from the Villanova Urban Stormwater Partnership (VUSP) have dived into what factors contributed to this better-than-expected performance. They began by looking at the "runoff curve." This parameter predicts the amount of runoff generated by lawns and pavements. Based on this method, after a certain amount of rainfall, infiltration stops. However, Villanova researchers have discovered another factor at play.

They found evapotranspiration plays a much more powerful role than originally expected. Evapotranspiration refers to loss of water from soils both by evaporation and plant transpiration. Now the researchers are exploring how to exploit evapotranspiration in the design of green infrastructure practices. These findings may help alleviate concerns about the effectiveness of green infrastructure during back-to-back storm events.

As stormwater management is radically changing in the U.S., VUSP uses research to change good ideas and concepts into engineering practice. "It is good to build a rain garden but better to know how to optimize the design and what performance to expect over the long term," said Robert Traver, VUSP director.

Kristina Twigg. "Research advances low impact development techniques."
World Water: Stormwater Management. Fall 2013 (Vol. 1, No. 1)

CHAPTER 5
MANAGE ASSETS AND RESOURCES

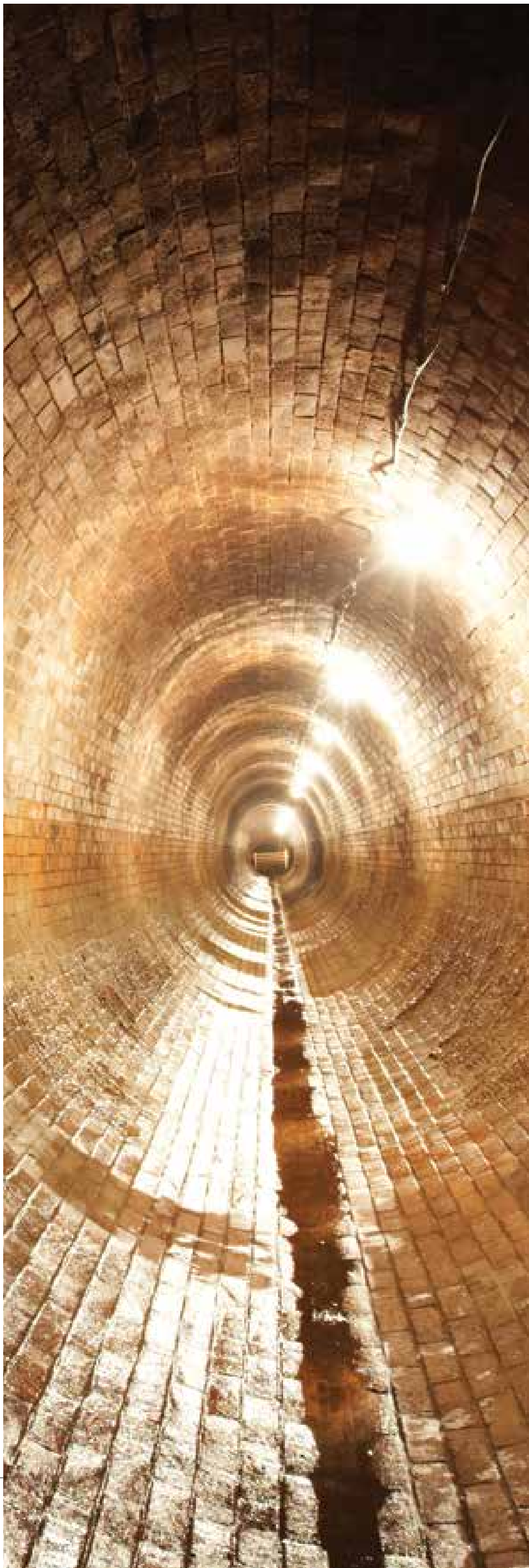
Stormwater systems will be maintained through robust asset management programs and supported by innovative information technology. A multidisciplinary workforce will support the proper design, installation, and inspection as well as operations and maintenance, repair, and timely replacement of stormwater infrastructure.

Inadequate attention to operations and maintenance and a lack of effective planning for repair and replacement are one of the biggest current weaknesses of stormwater management. All stormwater controls, regardless of type, require maintenance to function properly. Sustainable stormwater management requires the sector to address maintenance needs through an asset management framework. Asset management is important, particularly for stormwater systems, which often encompass many decentralized controls that are disparate in type and function.

Asset management takes into account the current state of assets, required levels of service, and the assets critical to overall system performance. It also requires stormwater managers to consider long-term maintenance and capital improvement needs and funding. Through asset management, the installation and maintenance of stormwater controls can be integrated fully into community planning. Stormwater managers can make more informed decisions about deploying limited human and monetary resources. Improved asset management also puts the sector on a path to improved benchmarking. By establishing key performance indicators and developing standard methods for collecting stormwater control performance data, stormwater managers can strive for continual improvement.

A well-trained, multidisciplinary workforce and the use of information technology will vastly improve asset management. In addition to flood control, stormwater management has added focuses on water quality and downstream channel protection. Reflective of these new dimensions and paradigm shifts in technology toward green infrastructure, the stormwater workforce must grow its size and its multidisciplinary skillsets.

Emerging technologies, such as drone aircraft and augmented reality systems, also should be used to aid stormwater professionals. Likewise, it now is possible to build low-cost, complex, and informed active control systems for stormwater systems. These systems can optimize existing infrastructure capacity and improve the performance of otherwise passive devices and structures.



RECOMMENDED ACTIONS

ACTION 5.1

Expand deployment of comprehensive asset management programs for stormwater infrastructure.

Stormwater managers must take a comprehensive approach to inventory, plan, operate, and maintain physical assets. This is crucial for stormwater systems that include a mix of traditional gray infrastructure, green infrastructure, and natural assets such as wetlands or restored streams. Additionally, green infrastructure and natural assets often are decentralized and may include elements on private property, making a comprehensive asset management plan even more important.

Asset management practices for stormwater should draw from successful techniques and best practices used in the water sector and other mature infrastructure sectors. However, asset management for stormwater also must address the unique complexities associated with stormwater infrastructure.

Though wastewater collection or water distribution systems can have different ownership, wastewater and drinking water utilities generally have clearly defined ownership and operational roles within their systems. In contrast, stormwater systems can include ponds, ditches, driveway culverts, and other systems that involve issues of land ownership.

Confusion over who owns and is responsible for maintaining stormwater assets complicates stormwater management. Issues of maintenance responsibility should be resolved as part of a comprehensive asset management approach. Installing or incentivizing stormwater controls on private property requires particular attention to provisions for long-term monitoring, operation, and maintenance.

Another unique challenge associated with stormwater is that natural assets and green infrastructure will change in composition and performance over time. For instance, vegetation matures and becomes more effective at taking up and evapotranspiring water.

Best practices for stormwater operation and maintenance and asset management are emerging. There exists the opportunity to capture these lessons and combine them with knowledge from other sectors. The stormwater community needs to be informed more broadly of the need for and benefits of asset management best practices.

ACTION 5.2

Integrate operations and maintenance planning with stormwater capital project development.

Lack of sustained operations and maintenance is a consistent challenge for stormwater programs across the U.S. The breakdown can begin as early as the capital project development stage. Three deficiencies contribute greatly to inadequate consideration of operations and maintenance during project planning: a lack of monitoring data and performance metrics for stormwater controls, a lack of information characterizing failure modes, and a lack of long-term maintenance needs and costs. This deficit inhibits effective evaluation of stormwater control alternatives based on life-cycle costs, and it reduces the technical and financial capacity to support ongoing stormwater infrastructure performance.

Further, the lack of reliable information on operations and maintenance and long-term costs is a significant barrier to the widespread implementation of innovative stormwater management techniques, especially green infrastructure. Many public works departments consider it fiscally imprudent to build certain stormwater controls without an accurate prediction of the full life-cycle costs.

The stormwater sector should emphasize the creation and sharing of operations and maintenance requirements for stormwater controls. This will enable the sector to make optimized stormwater management decisions and drive systems toward improved maintainability and long-term performance.

> Inadequate attention to operations and maintenance and a lack of effective planning for repair and replacement are one of the biggest current weaknesses of stormwater management.

ACTION 5.3

Develop the use of automated information technology to support sustainable stormwater management.

Drinking water and wastewater systems have long used real-time information technology, such as supervisory control and data acquisition systems, to monitor and control operations and maintenance. These applications should be used and developed further for stormwater infrastructure.

Stormwater infrastructure inherently is decentralized, and with performance demands increasing, real-time sensors and controls can play a critical role in cost-effectively transforming the nation's urban stormwater infrastructure. Real-time control technologies can improve the ability of stormwater controls to reduce runoff and combined sewer overflows in addition to maximizing stormwater harvesting.

Real-time controls can connect stormwater controls to the Internet and to one another to create a connected system that is more effective at the watershed scale. Accessing predictive information, such as weather forecasts, systems with real time controls can react automatically. A cistern could, for example, empty automatically before a storm to increase its capacity. Some automated systems also offer the ability to check system status online and relay commands. Real-time controls can reduce the size and expense of stormwater infrastructure by optimizing its capacity.

Information technology, such as drones, augmented reality, and information platforms, also have great potential to bring about positive change in the stormwater sector. These technologies can improve data collection and help stormwater managers more effectively use that data in design, maintenance, and construction of stormwater controls. Augmented reality is the live view of the environment supplemented or enhanced by computer images or information layers, such as the location of stormwater pipes or maintenance dates. Drones could be used to collect high-definition photographs and videos, map contours using light detection and ranging maps, place construction materials, and collect water samples—physically or via sensors.

LOW IMPACT DEVELOPMENT DESIGN COMPETITIONS

The Water Environment Federation (WEF) works to support and promote low impact development (LID) design competitions at local and national levels. These competitions improve LID expertise and adoption within the sector. The competitions give engineers, developers, landscape architects, and others a chance to gain experience with LID in a low-risk environment. Competitions also can break down perceived barriers to LID, such as performance and cost, and give the development and permitting community a chance to evaluate the benefits of using LID.

In 2013, WEF held a national workshop to convene representatives from organizations that had such competitions or were interested in holding them. Subsequently, WEF released a white paper offering an overview on various approaches to hosting an LID design competition, which can be downloaded at www.wef.org/lidcompetition.

ACTION 5.4

Support development of a diverse, highly skilled, and multidisciplinary stormwater workforce.

Stormwater management has undergone a substantial evolution. What began as a relatively straightforward focus on drainage has grown into the more complex issue of water quality. Adding to this complexity is the interconnectedness with wet weather effects on wastewater infrastructure. Further, using green infrastructure and natural systems requires different skillsets compared with traditional engineered systems. Such disciplines as landscape architecture, soil and plant science, and microbiology are required to design these practices to meet multiple objectives. Maintaining green infrastructure also requires specialized knowledge and an understanding of the systems' function. Operations and maintenance of green infrastructure, in particular, provides significant opportunity to expand entry-level, long-term green jobs within communities.

The evolution in stormwater management drives the need to attract, train, and retain a more diverse workforce. Action in this area should follow several key paths. First, a review of current training content could reveal gaps, provide an opportunity to develop a directory of learning opportunities, and reveal the potential for collaboration between groups. Second, establishing a career path could help potential stormwater professionals understand the training and skillsets required to move from one position to another as well as progress from entry-level to higher-level positions. Third, certification could ensure that professionals have the needed skills to perform stormwater management jobs while bolstering their credentials. Fourth, the sector needs recognition programs that acknowledge and award high-performing individuals, communities, and organizations. Finally, a leadership program is needed to impart the multidisciplinary skills necessary to successfully manage stormwater.

Training should follow a blended learning approach that combines opportunities to study online with conference education, networking opportunities, and hands-on training. Of particular interest are efforts that support and engage stormwater managers and key staff in "twinning" exercises. In these exercises, stormwater authorities visit peers or exchange staff to learn from the on-the-ground experiences of other authorities.

Image by Mark Garvin for the Community Design Collaborative

Other professionals, including builders, construction personnel, and field inspectors, also interface with stormwater controls and may be involved in their construction and maintenance. Outreach to these professionals is necessary to ensure systems are installed correctly.

CASE STUDY

Image by Capitol Region Watershed District

Optimizing stormwater infrastructure with real-time controls

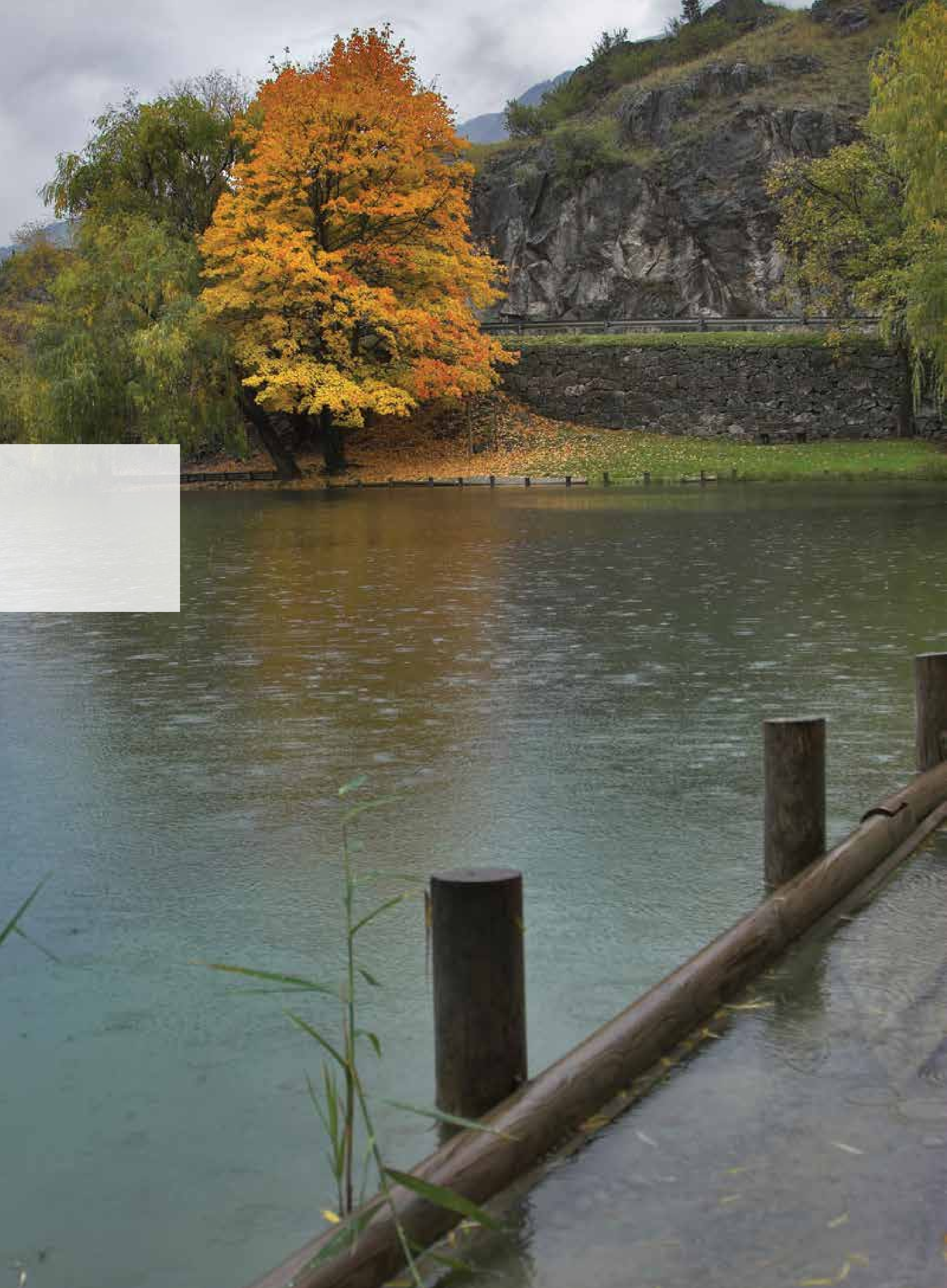
The Capitol Region Watershed District (St. Paul, Minn.) implemented an innovative technological solution to handle the flooding of a small, landlocked stormwater retention pond in Curtiss Field Park in the City of Falcon Heights, Minn.

The district installed a large detention and infiltration facility under a sports field adjacent to the stormwater pond. The system includes 119 m (390 ft) of large-diameter perforated pipe that stores and infiltrates floodwater from the pond. In advance of predicted storms, an optimized, real-time controller draws the pond down by half a meter (1.5 ft). This automated function has added 58% more capacity to the retention pond. With the real-time controller, the system achieves the same level of flood protection at half the cost of a second storage pipe, which was estimated to cost the district $140,000.

Through its connection to the Internet, the system controller monitors National Weather Service information, and begins to draw down the pond when a particular-sized storm is predicted at a predetermined percent probability. The draw-down thresholds can be changed as the district collects more data. At any time, staff can log in to the system remotely to monitor performance and modify programming.

Mark Doneux, administrator of the Capitol Region Watershed District, said this project is an example of how stormwater professionals can learn from the wider water sector by looking at how water and wastewater utilities use automation to save money and enhance operations.

Kristina Twigg. "Nine nationwide nonpoint solutions." *The Stormwater Report.* July 2015 (Vol. 5, No. 7)



CHAPTER 6
CLOSE THE FUNDING GAP

Communities will align stormwater management efforts with broader community goals to garner funding options and will have access to innovative financing opportunities. Elected officials will support the investments needed to meet sustainable stormwater management objectives.

Dedicated and adequate funding and financing consistently is identified as a top challenge facing the stormwater sector. The first step to address this challenge is for communities to determine their funding needs. Aligning stormwater management with other community priorities also opens additional funding opportunities from government and nonprofit sources.

Dedicated funding sources, such as a user-based stormwater fee or special service tax district, are essential to driving community investment in stormwater management. However, several innovative funding and financing approaches can help public dollars go farther. For instance, the private sector can be a source of significant investment through public–private partnerships, municipal bonds, and water quality trading programs.

Perhaps the most intuitive way to extend public investments is by improving cost efficiencies associated with sustainable stormwater management. Many communities are using green infrastructure to reduce the cost of long-term control plans and other Clean Water Act requirements. The stormwater sector also should further encourage large-scale investments in stormwater infrastructure. These investments can generate project savings through economies of scale in stormwater control design.

Further, by working at a watershed scale, communities can better identify low-cost opportunities to invest in stormwater infrastructure. Working at a watershed scale enables communities to reduce costs by bundling multiple, similar stormwater controls, encouraging regional projects, and incorporating stormwater controls into other planned community projects.

RECOMMENDED ACTIONS

ACTION 6.1

Support communities in identifying stormwater funding needs, inventorying the funding currently available, and describing the gap.

The stormwater community must have a realistic understanding of the true costs of achieving sustainable stormwater management. This involves inventorying current community stormwater infrastructure and the potential maintenance or replacement costs for those systems. Communities also must determine the additional infrastructure or programmatic changes needed to meet regulations or community goals. Comparing these calculated costs to the funding currently available reveals the size of the funding gap.

Wastewater and drinking water sectors conduct funding gap assessments. The assessments are well-publicized, and the funding gap has become a centerpiece of local, state, and national communication efforts. A similar effort is needed to advance support for stormwater investments. The Clean Watersheds Needs Survey of the U.S. Environmental Protection Agency (EPA) provides some valuable information regarding this gap. However, there is potential to augment this effort and to expand the information covered.

The stormwater funding assessment also should consider potential and actual returns provided by stormwater investments, including ancillary social and environmental community benefits.

ACTION 6.2

Identify funding sources for stormwater management and articulate how stormwater management can meet the requirements of available sources.

Stormwater efforts potentially can align with and support many community priorities associated with state, federal, and nonprofit funding sources. Examples include grants that address transportation, climate resiliency, urban redevelopment, environmental education, and habitat protection. Often, stormwater management co-benefits are the subject of separate federal and state programs and investment opportunities. In particular, programs at the U.S. Departments of Agriculture, Housing and Urban Development, Energy, Transportation, and Interior as well as the Federal Emergency Management Agency, EPA, and the U.S. Army Corps of Engineers present opportunities for multi-benefit projects. Several private foundations and nonprofits also provide grants related to the water environment and community co-benefits.

Stormwater managers need resources to help identify and value the multiple benefits of stormwater management while identifying overlaps with various funding programs. These resources should articulate how stormwater project scope, design, construction, and long-term operations and maintenance activities can best meet the objectives and requirements of available funding sources.

Stormwater advocates should encourage better alignment of funding sources at the federal level to encourage stormwater projects that provide multiple community benefits. One example is leveraging the Clean Water State Revolving Fund (SRF) to expand investments in stormwater infrastructure. The SRF has enabled states to provide more than $105 billion in grants and low-interest loans for critical water infrastructure needs.

However, as of 2008, less than 1% of SRF funds were used for stormwater or green infrastructure investments, yet some states are updating their SRF programs to encourage these investments. A 2014 report by EPA's Environmental Finance Advisory Board indicates that some SRFs now have the capacity to expand funding for green infrastructure projects by offering credit guarantees at triple-A ratings, which are the highest possible ratings assigned to bonds given when the issuer has an exceptional degree of creditworthiness. According to the report, each dollar of recycled SRF program equity can generate $3 to $14 of SRF guarantee capacity. This translates into $6 billion to $28 billion in potential green infrastructure funding capacity nationwide.

The private sector also should be encouraged to implement and maintain stormwater management projects that provide multiple benefits. These are stormwater controls that communities could count toward stormwater management goals while reducing financial burdens on local governments. Additionally, these controls would provide benefits to the developer. For instance, certain stormwater controls can add significant amenity value and help meet Leadership in Energy & Environmental Design point requirements. Research on urban stormwater management lakes, for instance, has shown that residents enjoy both tangible benefits, such as property value increases, and intangible benefits, such as recreation opportunities and a sense of community and belonging.

ACTION 6.3

Support communities in understanding and accessing the full range of stormwater funding and financing approaches.

If the stormwater sector is to fund sustainable stormwater management fully into the future, it must use existing funding sources better as well as explore new funding and financing approaches.

The sector must continue to advocate for user-fee-funded sources, such as stormwater utilities, authorities, and districts. Sustainable stormwater programs need these reliable long-term funding sources. Seed money for stormwater utilities could come from private loan programs as well as startup grants.

Municipal "water bond" measures could help finance community infrastructure needs. In July 2014, DC Water issued $350 million in taxable, green century bonds, marking several firsts for the utility and the municipal sector. Proceeds from the century bonds will finance a portion of the DC Clean Rivers Project, a massive $2.6 billion effort to reduce combined sewer overflows. Further, the Water Infrastructure and Resiliency Finance Center, launched in January 2015, created a new type of municipal bond to encourage public–private partnerships. In the stormwater sector, community-based public–private partnerships have come to the forefront as an innovative financing option. Public–private partnerships provide a way to accelerate and finance stormwater and green infrastructure investments. They can take many forms, including private property incentive programs and stormwater credit trading. Community-based public–private partnerships involve a contract between the public and private sector arranging financing, delivery, and typically long-term operations and maintenance of integrated green infrastructure. These partnerships focus investments on approaches that create local jobs, encourage economic growth and revitalization, and improve quality of life in urban and underserved communities.

> The stormwater community must have a realistic understanding of the true costs of achieving sustainable stormwater management.

Other financing opportunities that leverage private capital include impact investments that are intended to generate social and environmental benefits as well as financial return.

Water quality trading offers an innovative, market-based means of complying with Clean Water Act requirements. Through trading, regulated entities have the flexibility to reduce water pollution more cost-effectively by purchasing and using pollutant reduction credits generated by other sources in a watershed. Trading can accelerate the adoption of stormwater controls by nonregulated entities and on private property. In-lieu fee mitigation often is combined with trading where permittees can either purchase credits or pay an in-lieu fee. In this context, regulated entities pay to compensate for unavoidable environmental impacts. The money often is used to mitigate the environmental damage offsite. Mitigation banking is a similar concept in which an independent third-party entity speculatively and proactively restores a site. It then sells the restoration rights to a company or entity affecting the environment.

In 2003, the national mitigation banking rule created the legal certainty and standards needed to encourage and leverage private investment and market participants. Today, wetland mitigation banking is a growing $3 billion industry that is helping to achieve the national goal of no net wetland loss. Thanks to a shared vision and a federal mitigation rule, there now exist more than 1500 mitigation banks, protecting nearly 405,000 ha (1 million ac) of wetlands. A similar vision is needed if water quality trading is to be equally successful.

ACTION 6.4

Reduce the cost of sustainable stormwater management.

If sustainable stormwater management costs less, capital and operating dollars will go farther. As the stormwater sector matures, it must expand its mindset beyond customized project designs and, instead, develop standard project design templates for common stormwater management actions and contexts. Even if these standard designs require tailoring to specific circumstances, a well-tested starting point can reduce project costs significantly.

The sector should share openly stormwater management designs and data to encourage economies of scale. The sector can achieve cost efficiencies by planning for and bundling multiple, similar stormwater projects. Bundling stormwater contracts for design, construction, operation and maintenance, and monitoring across projects and across jurisdictions within a watershed can save money.

Incorporating stormwater controls into other community projects, such as parks or transportation improvement projects, also will create opportunities for savings. Project-level regulations also should evolve to support and provide credit for more cost-effective regional stormwater projects.

Removing public perception or regulatory barriers to rainwater harvesting and other stormwater controls also will reduce costs. For instance, developing the capacity to capture and use stormwater resources reduces pressure on community water supplies, especially in increasingly water-stressed areas, and saves energy associated with treatment and distribution. This effort also would require work to update or remove regulations, codes, and ordinances that hinder the use of stormwater as a resource.

As discussed in Action 6.3, nontraditional project delivery and market-based forces, such as public–private partnerships and stormwater trading schemes, are options for financing stormwater infrastructure. Additionally, these options often can reduce overall costs and time required to deliver stormwater management projects.

Image by Corvias Solutions

CASE STUDY

Public–private partnership saves time and money on stormwater retrofits

The Chesapeake Bay Total Maximum Daily Load requires Prince George's County to retrofit 6070 ha (15,000 ac) of impervious cover by 2025. However, a community-based public–private partnership (CBP3) is helping the county meet that aggressive schedule. The Clean Water Partnership, officially established in Nov. 2014, is a $100 million, 30-year CBP3 between Prince George's County and Corvias Solutions.

The community-based model allows the local government to retain authority of the program and funding, while enabling its private-sector partner to bring in private-sector innovation, aggregate challenges, and deliver efficiencies and funding.

During the partnership, the county will invest $100 million in an initial 3-year retrofit. Corvias will manage the design, construction, and long-term maintenance of stormwater management systems with the goal of retrofitting 810 ha (2000 ac) in approximately 3 years at an average cost of about $124,000 per impervious hectare ($50,000/ac). Additionally, Corvias will use small and minority-owned businesses for at least 35% of the total project. The public–private partnership is expected to create 5000 new entry-level, green jobs in the county.

The county estimates that the traditional procurement process would take 15 years to address all required retrofits at a cost of more than $2 billion, assuming 371,000 per hectare ($150,000/ac). .

However, the CBP3 approach is projected to accelerate the retrofit schedule while providing significant cost savings compared to the standard procurement process. With a standard procurement process, design services are procured first, and construction and maintenance bids follow separately. The CBP3 approach integrates these services, which enables the private partner to scale up for services rather than work on a project-to-project basis. Because the private partner is responsible for all stages, it is in its best interest to ensure designs can be easily constructed and that they are built properly in order to be easily maintained.

Seth Brown and Greg Cannito. "The rising challenge of stormwater."
World Water: Stormwater Management. February/March 2015 (Vol. 3, No. 1)

CHAPTER 7
ENGAGE THE COMMUNITY

Communities will value the contribution stormwater management makes to flood risk reduction, clean and safe water, climate resiliency, and other benefits. This understanding and regard will translate into the decision-making capacity and financial support needed for sustainable stormwater programs.

Stormwater proponents have faced substantial difficulty mustering local support for funding new and existing stormwater infrastructure. This has left existing infrastructure vulnerable to deterioration and made new initiatives difficult to launch.

Many communities face opposition to stormwater fees. A recent example comes from Maryland, where opponents of the fee labeled it a "rain tax." Poll results gathered by The Clean Water, Healthy Families Coalition showed that this negative framing swayed public attitudes. The results indicated that continued misinformation greatly enhanced opposition to the stormwater fee.

As stormwater management increases in scope and regulations evolve in expectation, public education on stormwater issues must keep pace. An educated public that values stormwater infrastructure is more likely to change its behaviors or invest in meeting stormwater management goals.

To improve public communication and engagement, stormwater managers must understand how stormwater goals align with audience motivations and interests. Determining what communities value and the willingness to pay for particular investments will aid communication efforts.

Sustainable stormwater management moves away from relying solely on regulatory drivers. Sustainable management looks to make stormwater efforts a means to create additional economically prosperous communities that have a higher quality of life and an improved environment. In these vibrant communities, stormwater controls help reconnect people to their environment.

Unlike wastewater and drinking water utilities, stormwater professionals have the added challenge and the unique opportunity to create interactive systems that engage and educate the public. For this reason, public safety near stormwater controls is essential. Because of the high visibility of some systems, a nonfunctioning system or one that has not been maintained is noticed quickly. However, successful projects have been shown to increase public support greatly.

The actions described below help stormwater professionals clearly communicate the triple-bottom-line benefits of effective stormwater management. Additionally, the stormwater sector should facilitate peer-to-peer information exchange among public officials and other stakeholders to increase support for sustainable stormwater management efforts.

RECOMMENDED ACTIONS

ACTION 7.1

Improve the ability of the stormwater sector to engage various audiences.

The national conversation about stormwater faces a watershed moment. Stormwater professionals must seize every opportunity to redefine the conversation about stormwater management. Every interaction with each customer, elected official, and community member is an opportunity for public engagement to contribute to the community's understanding of stormwater issues.

Stormwater management professionals need to engage effectively with public officials and decision-makers, stakeholders, and the general public. Stormwater discussions should be framed in the context of broader community values and priorities. Standard, but easily adaptable, information and training on the menu of stormwater management approaches and multiple benefits give stormwater professionals a place to start. Stormwater professionals should communicate how stormwater connects to economic development opportunities, flood risk management, clean water, sustainable water supply, climate resiliency, green job creation, and community amenities such as parks and open spaces.

Communities once relied on the media to share their stories. Now, however, outreach specialists increasingly have more tools to communicate the message about stormwater. Platforms such as social media offer the opportunity to engage the community in conversations. Likewise, many new tools can help determine if a message is being heard. Through digital analytics, outreach specialists can determine the reach of their messages.

To capture new audiences, stormwater professionals must expand the channels they use to communicate. Such channels include social media, blogs, and mobile applications. For instance, some mobile applications have turned the public into citizen scientists, encouraging them to report locations and send pictures of illicit discharges. These tools also are changing how stormwater managers communicate with stakeholders about planned projects. Discussion forums, online surveys, and websites with design plans, project schedules, and updates can supplement traditional community meetings.

Traditional media still hold much value. Print publications, radio, and television, in addition to newer channels, help to capture the full breadth of the audience. Interactions with professional media can amplify message reach and public engagement. Media and public engagement training can help stormwater professionals be effective in these interactions. Preparation is especially important to overcome common challenges or public misperceptions about stormwater.

Moving stormwater public education to mass media at regional and national levels will require broader strategies for funding these initiatives and cannot be driven solely by regulatory requirements at the local level.

ACTION 7.2

Encourage and support peer-to-peer information sharing between public officials on stormwater challenges, successes, and failures.

Peer-to-peer knowledge exchange is effective in advancing paradigm change. Nothing beats one elected official sharing his or her experiences with another to increase understanding, openness, and support for sustainable stormwater management. The stormwater community could accelerate learning and support by facilitating networks that allow for interdisciplinary information exchange around stormwater management successes and challenges.

The stormwater sector should provide a platform for public officials to share their experiences. This could include online or print outlets, such as publications or a case study repository. The stormwater sector also could establish peer-to-peer mentoring with sophisticated municipal separate storm sewer system communities or provide opportunities to learn and network at conferences.

STORMTV PROJECT PROVIDES LIBRARY OF VIDEO RESOURCES

In 2015, the Water Environment Federation (WEF) hosted its 4th annual StormTV Project. This social media campaign and video competition for innovative stormwater videos recognizes and highlights the work of stormwater professionals and builds a library of inventive stormwater programs, practices, products, and public outreach. Since the competition launched in 2012, WEF has collected 366 videos, most of which are directed toward a public audience. View an interactive map of the 2015 Public Education category submissions. Visit http://bit.ly/PEmapSTV15.

CASE STUDY

Promoting community involvement in stormwater incentive programs

The Metropolitan Planning Council in Chicago conducted a research study compiling literature about the successes and failures of existing stormwater incentive programs. The council sought to determine which elements of these programs worked and which did not.

The researchers found that one-on-one contact between private property owners and local agency staff, third-party contractors, nonprofits, or vendors often led to success. This was the case with Washington, D.C.'s RiverSmart Homes and The Conservation Foundation's (Naperville, Ill.) Foundation@Home programs. Involving property owners in stormwater solutions encouraged a sense of ownership in the projects and improved outreach when owners spoke of the programs to others.

The researchers also discovered that connecting stormwater incentive programs with stormwater utility fees and other user-based fees supplied a dedicated revenue stream, improving the longevity and sustainability of the program. For example, the Montgomery County, Md., RainScapes suite of programs is funded by a water quality protection charge and county property taxes. According to researchers, reinvesting those public funds directly into property owners can produce more positive results.

Finally, the researchers determined that including neighborhood groups and local nonprofits as outreach partners can provide an ear-to-the-ground factor that helps identify opportunities for potential program applicants as well as concerns with existing programs. The Conservation Foundation and the Center for Neighborhood Technology's (Chicago) RainReady Home service as well as nonprofit partners in Philadelphia; Kitchener, Ontario, Canada; and Washington, D.C., provide free or low-cost assessments of private properties, regularly make action recommendations, sometimes assist in planning and design of stormwater projects, and recommend contractors.

Abby Crisostomo, Josh Ellis, and Caroline Rendon. "Spurring stormwater solutions."
Water Environment & Technology. February 2015 (Vol. 27, No. 2)

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