A Report by a Panel of the

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION

Developing a New Framework for Community Affordability of Clean Water Services

U.S. Environmental Protection Agency

National Academy of Public Administration

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for the Environmental Protection Agency

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Developing a New Framework for Community Affordability of Clean Water Services

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The views expressed in this report are those of the Panel. They do not necessarily reflect the views of the Academy as an institution.

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Foreword

Over the past several years, the government's ability to provide affordable clean water services to communities and individuals has reached a critical juncture. Aging infrastructure, regulatory obligations and rising costs, and increasing economic segmentation in the United States have adversely affected both water utilities and the low-income customers who use are most vulnerable to water rate increases. The delivery of clean, affordable water requires collaboration across levels of government and the public and private sectors, given the fragmented nature of water governance in this country. Despite the complexity of these issues, numerous creative and innovative solutions have been implemented across the country and provide opportunities to optimize and revolutionize water service delivery operations in the coming years.

Against this backdrop, the Senate Appropriations Committee, in a committee report on FY 2016 legislative language, directed the Environmental Protection Agency (EPA) to contract with the National Academy of Public Administration (the Academy) to conduct an independent study to create a definition of, and framework for, community affordability of clean water. The recommendations of this report approach the task in four specific ways: 1) Revising the 1997 guidance document titled *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development*; 2) highlighting best practices for integrated planning, 3) identifying innovative solutions to further address affordability by lowering costs, and 4) discussing the best approaches to analyzing the costs and benefits. The Panel's recommendations will require sustained leadership at all levels of government in order to ensure that the nation's community water systems are able to protect the health of our environment and of our citizens.

As a congressionally chartered non-partisan and non-profit organization with over 850 distinguished Fellows, the Academy brings nationally-recognized public administration experts together to help public organizations address future challenges. We were pleased to conduct this study and appreciate the support of EPA leaders and industry stakeholders, all of whom provided important insight and context to inform this report.

I extend my earnest thanks to the members of the Academy Panel, who provided invaluable expertise and thoughtful analysis to this undertaking, and to the professional Study Team, led by Brenna Isman, that provided critical support on this project. I expect that this report will contribute to EPA's efforts to develop an updated framework for community affordability within the Office of Water as well as to their continued engagement with local partners in pursuit of innovative stormwater management solutions.

Teresa W. Gerton
President and Chief Executive Officer
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Acronyms

Academy	National Academy of Public Administration
AR	Affordability Ratio
BES	Bureau of Environmental Services
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
CAP	Consumer Assistance Plan
CBO	Congressional Budget Office
CBP3	Community Based Public Private Partnership
CDBG	Community Development Block Grant Program
CEQ	Council on Environmental Quality
CIFA	Council on Infrastructure Financing Authorities
CIP	Capital Improvement Plan
CPH	Cost Per Household
CPI	Consumer Price Index
CRS	Congressional Research Service
CSS	Combined Sewer System
CSO	Combined Sewer Overflows
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DDOE	DC Department of Energy and Environment
DWSRF	Drinking Water State Revolving Fund
ECHO	Enforcement and Compliance History Online
EFAB	Environmental Finance Advisory Board
EFC	Environmental Finance Center
EIB	Environmental Impact Bond
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAQ	Frequently Asked Questions
FCA	Financial Capability Assessment
FCI	Financial Capability Indicator
FCRA	Federal Credit Reform Act
FEMA	Federal Emergency Management Agency
FY	Fiscal Year
GAO	Government Accountability Office
GI	Green Infrastructure

GIS	Geographic Information System
GSE	Government Sponsored Enterprise
GSI	Green Stormwater Infrastructure
HUD	Department of Housing and Urban Development
IP	Integrated Planning
IP3	Integrated Planning and Permitting Policy
LGEAN	Local Government Environmental Assistance Network
LIHEAP	Low Income Home Energy Assistance Program
LIWAP	Low Income Water Assistance Program
LTCP	Long Term Control Plan
MADS	Maximum Annual Debt Service
MCDA	Multiple Criteria Decision Analysis
MCL	Maximum Contamination Level
MS4	Municipal Separate Storm Sewer Systems
MHI	Median Household Income
NEPA	National Environmental Policy Act
NLAC	National Level Affordability Criteria
NMC	Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
OCDWEP	Onondaga County Department of Water Environment Protection
OIG	Office of the Inspector General
OST	Office of Science and Technology
O&M	Operating and Management
OMB	Office of Management and Budget
OW	Office of Water
OWM	Office of Wastewater Management
PCI	Percent Capita Income
PFS	Pay for Success
PPP/P3	Public Private Partnerships
POTW	Publicly Owned Treatment Work
RI	Residential Indicator
SDWA	Safe Drinking Water Act
SRC	Stormwater Retention Credits
SRF	State Revolving Funds
TAP	Tiered Assistance Program
TBL	Triple Bottom Line
TEB	Tax-Exempt Bond

TIFIA	Transportation Infrastructure Finance and Innovation Act
TMDL	Total Maximum Daily Load
UAA	Use Attainability Analysis
UNC	University of North Carolina
USACE	United States Army Corps of Engineers
WIFIA	Water Infrastructure Finance and Innovation Act
WEF	Water Environment Foundation
WERF	Water Environment Research Foundation
WQS	Water Quality Standards
WQT	Water Quality Trading
WRAP	Water Residential Assistance Program
WRDA	Water Resources Development Act
WWT	Wastewater Treatment
WWFT	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

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Key Policy Documents and their Abbreviations

1994 CSO Control Policy

U.S. Environmental Protection Agency. "*Combined Sewer Overflow (CSO) Control Policy: Notice.*" 59 Fed. Reg. 18688 (April 19, 1994).

1995 Interim Economic Guidance

U.S. Environmental Protection Agency, Office of Water. "*Interim Economic Guidance for Water Quality Standards: Workbook.*" (EPA 823-B-95-002, March 1995.)

1997 FCA Guidance

U.S. Environmental Protection Agency, Office of Water, Office of Wastewater Management. "*Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development.*" (EPA 832-B-97-004.February 1997.)

2012 IP Framework

U.S. Environmental Protection Agency, Office of Enforcement. "*Integrated Municipal Stormwater and Wastewater Planning Approach Framework.*" (May 2012.)

2014 FCA Framework

U.S. Environmental Protection Agency, Office of Water, Office of Enforcement and Compliance Assurance. "*Financial Capability Assessment Framework for Municipal Clean Water Act Requirements.*" (November 2014.)

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Executive Summary

Communities and governments at all levels face growing challenges in effectively managing the water resources necessary to support growing populations, thriving residential, commercial, industrial, and agricultural sectors, and healthy and productive natural environments. Water utilities and the local communities that they serve play central roles in this effort. Water utilities must build and maintain infrastructure and operate the treatment plants that supply safe and clean drinking water to the community and that collect and discharge wastewater in an environmentally acceptable manner. In addition, decisions by communities, businesses, and individual citizens regarding the management of stormwater can mitigate or exacerbate the challenges faced by utilities in dealing with both wastewater and drinking water.

Two federal environmental statutes, both administered by the Environmental Protection Agency (EPA), establish programs that particularly pertain to the functions of water utilities. The Clean Water Act (CWA) establishes structures for regulating pollutant discharges into surface waters that are subject to federal regulatory jurisdiction, and water utilities' water discharges are generally permissible only under permits issued under the CWA. These permits limit discharges to levels necessary to ensure attainment of Water Quality Standards (WQS), which are established by states consistent with designated uses of the water body – which may include drinking water. The Safe Drinking Water Act (SDWA) authorizes national health-based standards that specify maximum contaminant levels in drinking water, which public water systems must satisfy, and requires states to conduct source water assessments as the first step in a preventive, multiple barrier approach to drinking water protection. Under both statutes, EPA, states and tribes, and water utilities all must work together to achieve the congressional objectives.

Some vitally important CWA and SDWA objectives can be quite expensive to meet. For communities and water utilities that face problems with affordability, Congress and EPA have developed programs to offer assistance with financing and to provide certain kinds of leeway with respect to timing and sequencing of CWA compliance activities. In the CWA context, EPA issued policies in the mid-1990's that focused on the development and approval of compliance schedules for communities that had trouble affording the control of combined sewer overflows (CSOs) (i.e., discharges of raw sewerage from certain kinds of sewerage infrastructure that overflow during heavy rains). Building on these original CSO-related policies, EPA has issued further guidance over the years to clarify (1) how a community's financial capability is measured, including the kinds of financial burdens that may be taken into account, (2) the kinds of CWA compliance that may be scheduled under the guidance, and (3) the kinds of CWA obligations and control measures that may be sequenced when a community engages in integrated planning.

The Academy conducted this study and developed this report in response to a congressional directive to update these EPA policies and guidance on affordability. Accordingly, the Panel used EPA's existing policies and guidance as a starting point, including the agency's initial focus on the affordability of controlling CSOs and the agency's potential application of these policies and guidance in the broader CWA context, which applies to all wastewater and stormwater discharges. However, in developing its analysis, findings, and recommendations, the Panel broadened its scope to address a broader range of water environmental issues, beyond the CWA issues currently pursued by EPA.

The collective responsibility for assuring clean, affordable water services for all Americans, and the challenges this poses for both communities and individuals, has garnered increasing attention in recent years for three principal reasons:

- Aging water infrastructure in the United States, with high costs associated with maintenance, upgrades, and replacements that are projected to surpass $1 trillion dollars in the next 25 years. These costs could triple the cost of household water bills.[1]

- Compliance with WQS, which apply to wastewater and stormwater discharges, adds to the above costs. In the context of enforcement, limits on the financial capability of communities only provide the basis for negotiating extended schedules for compliance with WQS. This may spread costs further over time, thereby keeping rates more affordable. However, through the development of integrated plans, the process could lead to cost reductions through the identification of more cost-effective and innovative solutions. These costs are separate from those of providing safe drinking water, which may require treatment or prevention of pollution from non-point sources that are beyond the control of urban areas.

- Affordability is an increasingly critical issue, particularly for low-income customers who are far more vulnerable to increased water costs. This greater vulnerability reflects both the greater share of their income that low-income users devote to paying for water services and the limited resources they have to respond to water rate increases. These water affordability issues have intensified over the last 15 years as water costs have risen more quickly than the Consumer Price Index and the costs of other utilities—except electricity, while lower income populations have experienced slower income growth.

All levels of government in the United States share in the responsibility for clean, affordable water, though their authority for doing so is notoriously fragmented. The principal responsibility

[1] American Water Works Association, *Buried No Longer: Confronting America's Water Infrastructure Challenge*, 2012.

for water resource policy, finance, operations, and enforcement historically has rested with state and local governments, which have employed a wide variety of institutional arrangements to meet their obligations. Historically, local governments and their citizens, as well nongovernmental water utilities, have borne the vast majority of the costs of providing clean water services. They continue to bear the brunt of the rising cost burden of clean water, especially as they work to comply with water quality standards, which are established by states under the Clean Water Act, subject to approval by the federal government. States are also feeling pressure, since they have the responsibility for determining the organizational and financial structure of water operations within their territories, and for ensuring that their citizens have clean affordable water.

It was not until after World War II that the federal government began to assume a share of responsibility for setting and enforcing water quality standards, and financing some portion of the cost of meeting those standards, in the interests of addressing water-related concerns that crossed state and local boundaries, as well as in the interest of the nation as a whole. The federal government has attempted to fulfill its responsibility by passing and enforcing laws and regulations, and providing financial support to assist in their implementation. Congress has passed the laws and appropriated the funds, principally by way of the Clean Water Act, while delegating responsibility for issuing and enforcing regulations, and administering some of the financing to the Environmental Protection Agency (EPA).

EPA continues to work toward achieving the goal of protecting America's waters in an increasingly complex environment which is often resource constrained. In carrying out its responsibility, EPA provides a definition and framework for community affordability, which communities and the EPA use to assess financial burdens and develop compliance schedules for meeting communities' Clean Water Act (CWA) objectives. While endeavoring to ensure that federal law is enforced, EPA also works with communities to find practical ways of meeting Water Quality Standards (WQS) at an affordable cost, in part by issuing guidance that is attuned to the practical realities, as well as the legal responsibilities, of state and local water authorities. The key components of EPA's current guidance include:

- *Interim Economic Guidance for Water Quality Standards–Workbook* (EPA-823-B-95-002, March 1995)
- *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development* (EPA 832 B-97-004, February 1997)
- *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* (May 2012)
- *Financial Capability Assessment Framework for Municipal Clean Water Act Requirements* (November 2014)

The Senate Appropriations Committee, in a report on FY 2016 legislation, directed EPA to enter into a one-year contract with the National Academy of Public Administration (the Academy) – an independent, nonpartisan, nonprofit organization chartered by the U.S. Congress – to conduct an independent study to create a definition and framework for community affordability. The Senate Committee further specified that the Academy would consult with stakeholders, review certain existing studies, and consider community funding experience, and would submit a report containing the Academy's findings, conclusions, and recommendations. The current definition and framework for community affordability consists of the procedures and analyses that EPA has adopted for developing compliance schedules to meet Clean Water Act (CWA) objectives – primarily Combined Sewer Overflow (CSO) controls, and the Academy was thus tasked with producing findings, conclusions, and recommendations that EPA can use in updating its community affordability procedures and analyses. Additionally, addressing the framework for community affordability includes the potential integrated planning process, which can provide the context in which to consider innovative solutions that can lower costs.

An Academy Panel of Fellows guided the work of the professional Study Team that encompassed a comprehensive literature review, over 100 stakeholder interviews, a stakeholder survey, and a roundtable table discussion. This research and analysis led to a deep understanding of the accomplishments, opportunities for improvement and promising practices of leaders in all levels of government who are working to provide clean, affordable water it its citizens. The data gathering also allowed the Panel and Study Team to gain insight into the perspectives of other stakeholders invested in successfully managing water issues throughout the country.

Panel Findings and Recommendations

As a result of this research the Panel developed a number of observations regarding the challenges and opportunities for delivering clean and affordable water to the nation's citizens. Some principal findings that informed the 21 recommendations in this report include:

- Many communities are struggling to comply with CWA and SDWA requirements while confronting not only the ongoing tension between providing clean *and* affordable water, but also a number of other financial challenges.

- The fragmented governance of the water industry and regulatory approaches at all levels of government add layers of complexity to the affordability equation and have resulted in formidable implementation challenges.

- There are considerably varied viewpoints and often a lack of common understanding of both the "why" and the "how to" improve clean water affordability efforts. Dynamic, two-way communication is not taking place consistently throughout all layers of water service delivery and regulation.

- Communities have implemented many innovative approaches to help address clean water affordability issues. There is not always clarity and direction on how to best foster continuation of these efforts to reduce specific infrastructure costs, secure more favorable financing, adopt more efficient and equitable rate structures, and other creative organizational and structural changes. EPA support is consistently described as a critical element for successful implementation and extension of these initiatives.

- The delineation between CWA and SWDA compliance creates bifurcated regulatory and organizational structures. Governance structures reflect separately-managed silos for drinking water, wastewater, and stormwater at all levels of government. While some utilities at the local level may manage all water in integrated fashion; others provide more limited water services. Nonetheless, users bear the costs of these services, whether they appear as a single or multiple water bills.

Focusing on Water Affordability Issues:

A key focus of this report is the Panel's assessment of EPA's community affordability framework for determining the financial capability of permittees to provide clean and affordable water services. The 1997 Guidance for Financial Capability Assessment and Schedule Development (1997 FCA Guidance) cited "the need to address the relative importance of environmental and financial issues when developing an implementation schedule for CSO controls to be contained in the LTCP,"[2] that is, the long term control plan developed and approved in either the National Pollutant Discharge Elimination System (NPDES) permit process or an enforcement process (e.g., consent decrees).

That 1997 FCA Guidance and the subsequent 2014 FCA Framework appropriately identified two critical components affecting clean water affordability issues – the user's ability to pay for clean water services and the utility or service provider's financial capability to deliver those services. The 1997 FCA Guidance identified a Residential Indicator (RI) to reflect a permittee's ability to pay higher costs for needed infrastructure investments based on the impact on its users, and a Financial Capability Indicator (FCI) to reflect the permittee's ability to obtain financing for and maintain those investments. The 1997 FCA Guidance also established specific metrics for permittees to use for both indicators, but also noted a willingness to consider supplementary data. The subsequent 2014 FCA Framework retained the original metrics for the RI and FCI components, but re-enforced EPA's flexibility in considering alternative metrics.

Water industry stakeholders supported both EPA's efforts to assess a permittee's financial capabilities in determining acceptable time frames for meeting clean water regulatory requirements and the distinction between users' ability to afford increased water costs and the service provider's ability to finance, manage, and maintain needed investments. However,

[2] 1997 FCA Guidance, page 6, citing the 1994 CSO Control Policy, 59 Fed. Reg. 18688, 18694 (April 19, 1994).

stakeholders identified serious deficiencies in the 1997 FCA Guidance's specific metrics for the RI and FCI components that limited their ability to effectively assess user affordability and permittee financial capability issues. Stakeholders have also proposed a range of alternative metrics to improve the original RI and FCI components while still maintaining their flexibility to provide supplementary data to identify any excessive financial burdens in meeting EPA proposed clean water compliance time schedules.

The Panel's recommendations acknowledge the stakeholder identified deficiencies in the 1997 FCA Guidance's specific metrics for the RI and FCI components and propose improvements to both components that will provide a better starting point for EPA and permittees to address clean water compliance schedule issues. The diverse organizational structures among clean water permittees and the varying economic and financial conditions they face require EPA to maintain its flexibility in considering alternative metrics. But EPA also needs an effective and equitable starting point for all permittees, since many communities lack the managerial and financial capacity to provide extensive additional supplementary data and economic modeling alternatives to demonstrate potential excessive burdens in meeting proposed compliance schedules.

Stakeholder input and literature research provided many examples of alternative metrics for identifying affordability issues for the most vulnerable users as well as the financial strength of the utilities. For the RI component, stakeholders agreed that

- Median Household Income (MHI) was an inadequate metric for identifying affordability issues for the most vulnerable low-income rate payers, and
- All water costs should be included in assessing rate payer burdens.

Stakeholders also agreed that the FCI component should focus on

- The financial strength of the utility providing clean water services; and
- The economic and social conditions affecting the utility's market area.

Stakeholder input also identified options for addressing a more effective threshold (or set of thresholds) for the various metrics proposed to assess low-income user affordability and utility financial strength issues. Threshold options varied from specific normative ones (e.g., operating revenues being profitable - greater than one, or incurring losses less than one) or utilizing sample averages to compare specific permittee affordability and financial strength issues. These are discussed in greater detail in Chapter 2 of the report.

To help EPA support the flexibility communities need to address their CWA obligations in an affordable way, the Panel recommendations proposed specific criteria any specific metric must satisfy. In addition, the Panel recommendations to improve the RI and FCI components identified the key elements for each component that need to be assessed using alternative

metrics. The Panel believes these recommendations will retain the flexibility EPA and permittees need while providing a more effective and equitable starting point for all permittees to resolve clean water compliance schedule issues.

The chart below (Figure 1) depicts the key components and elements the Panel recommends be included in an improved community affordability framework. Panel recommendations 1-5 will be key foundational elements to help EPA address community affordability concerns while enabling them to meet the goal of delivering clean, affordable water services to all citizens.

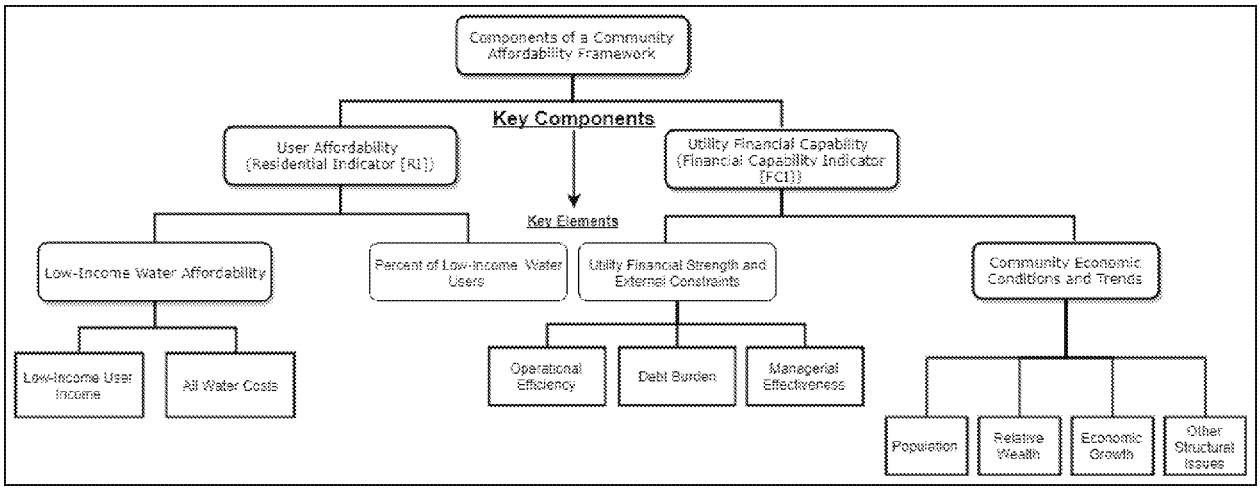

Figure 1. Components of a Community Affordability Framework (NAPA).

Panel Recommendation #1

The Environmental Protection Agency (EPA) should improve the metrics used for the Residential Indicator and Financial Capability Indicator components in the 1997 Financial Capability Assessment Guidance if it wants to establish a common starting point for all permittees while still considering supplementary permittee data in assessing a permittee's burden in meeting its Clean Water Act goals.

Since there is no perfect way to measure affordability and financial capability, the metrics used should meet the following criteria:

1. Readily available from publicly available data sources;
2. Clearly defined and understood;
3. Simple, direct, and consistent;
4. Valid and reliable measures, according to conventional research standards; and
5. Applicable for comparative analyses among permittees.

Panel Recommendation #2

To improve the 1997 Residential Indicator component, the elements defining the current component should be revised to:

1. Include all water costs, not just selected clean water costs, to include all drinking water and clean water costs – Combined Sewer Overflow control costs, stormwater costs, other sewer costs – as well as planned water infrastructure investments and any deferred costs of system operations and maintenance, in the burden assessment;
2. Focus on the income of low-income users most vulnerable to rate increases rather than Median Household Income;
3. Identify the size of the vulnerable users relative to the utility's total rate payer base; and
4. Avoid arbitrary normative thresholds to determine relative burdens.

Panel Recommendation #3

To improve the 1997 Financial Capability Indicator component, the current elements defining that component should be revised or refocused to:

1. Focus on the operational efficiency, debt burden, and managerial effectiveness of the utility supplying clean water services; and
2. Expand the socioeconomic components affecting the utility's market conditions to include trends in population, relative wealth, economic growth, and other economic structural problems in the community served by the utility.

Panel Recommendation #4

The Environmental Protection Agency should consider using the improved Financial Capability Assessment framework, in all of its clean and drinking water regulatory decision processes consistent with current statutory requirements.

Although the 1997 FCA Guidance and the 2014 FCA Framework indicated EPA's flexibility in considering alternative metrics for identifying excessive burdens, a number of stakeholders perceive that some regional EPA enforcement staff and state regulatory staff continue to rely primarily on the RI component and its 2% MHI measure to assess permittee burden in CSO

assessments. This stakeholder perceived inconsistency between stated EPA policy and policy implementation in the field is compounded by the lack of information on the number of CSO permittees found to have high burdens warranting some relief in compliance time frames and the amount of extended time schedule relief provided them, if any. This persistent stakeholder perception only reinforces the need for better communication of EPA policy and highlights the need for more effective follow-up and monitoring of regulatory actions taken in the field.

Panel Recommendation #5

The Environmental Protection Agency (EPA) should improve its two-way communication strategy with its regions, state regulators, and other stakeholders to assure formal, consistent, and clear messaging on policy changes, and effective monitoring and follow-up of clean water regulatory actions in the field.

Additionally, EPA should ensure that its management information system, at a minimum, provides the following information:

1. The number of permittees found to have high burdens;
2. The specific reasons for that finding; and
3. The degree of regulatory relief, in the form of lengthened compliance schedules, provided to those highly-burdened permittees.

Focusing on Integrated Planning:

For some time, communities have been working to meet regulatory requirements and make capital investments in an integrated fashion, recognizing the need to identify more cost effective sequencing and scheduling. With an eye toward more sustainable and comprehensive solutions for improving water quality and expanding the potential benefits, communities are drawing upon activities and analysis that provide detailed information regarding community impact, potential alternatives and detailed financial strategies for decision making. Integrated Planning (IP) is a voluntary planning process designed to assist communities in meeting their Clean Water Act (CWA) obligations by prioritizing and sequencing stormwater and wastewater project activities. As stated in the Integrated Municipal Stormwater and Wastewater Planning Approach Framework (2012 IP Framework)[3], it "will allow a municipality to balance CWA requirements in a manner that addresses the most pressing public health and environmental protection issues first." EPA established the 2012 IP Framework in May 2012 as a response to concerns that while EPA, states, and municipalities have achieved significant progress in implementing the CWA, there are still many factors stressing the implementation of key programs as currently, they often

[3] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework,* May 2012.

focus on each CWA requirement individually. The 2012 IP Framework is written broadly to allow community-specific flexibility in the development and adoption of integrated plans, identifying key operational principles, and providing municipalities opportunities to pursue more innovative cost-saving solutions to managing stormwater and wastewater requirements. As a result of a comprehensive integrated planning process, the conclusions or preferred actions identified can inform the permit, enforcement order, or consent decree processes. As the 2012 IP Framework states, "The integrated plan will be the starting point for development of appropriate implementation actions, which may include requirements and schedules in enforceable documents."[4] Additionally, this deliberate, data-informed process allows for more informed choices of innovative solutions. The stakeholder engagement and the rigorous decision analysis enable communities to identify the optimal suite of new technologies and approaches to stormwater management. Integrated planning allows for municipalities to pursue innovative projects with more knowledge about the potential benefits and a higher level of confidence that this is the correct approach for its citizens. The chart below (Figure 2) identifies a number of components in an Integrated Planning Process.

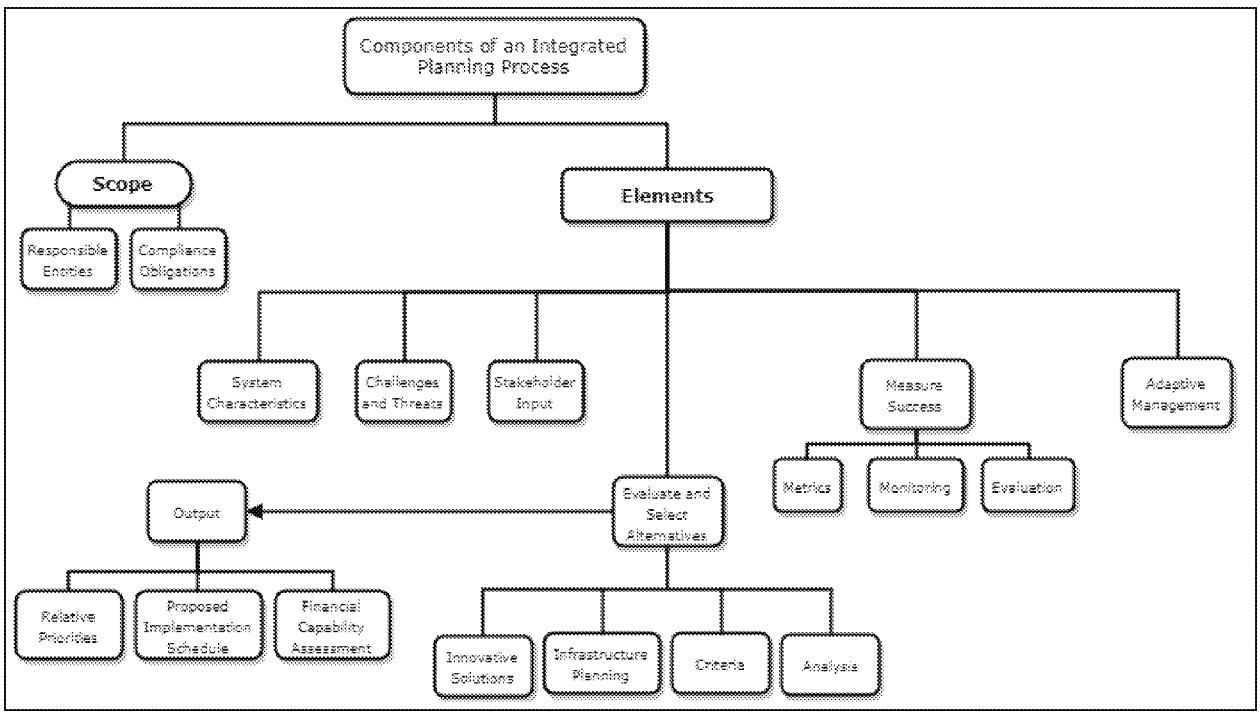

Figure 2. Components of an Integrated Planning Process (NAPA).

Due to the insight from the five communities that received technical assistance from EPA to develop elements of integrated plans for municipal wastewater and stormwater management

[4] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework,* May 2012.

(Burlington, Vermont, Durham, New Hampshire, Onondaga County, New York, Santa Maria, California, and Springfield, Missouri) as well as other communities pursuing some form of integrated planning, it became clear to the Panel that additional codification and communication is necessary. Many communities understand the value of the process, but are still unclear about how to progress in development and implementation. Additionally, communities are struggling with how to coordinate an integrated plan in a way that best addresses both Clean Water Act (CWA) as well as the Safe Drinking Water Act (SDWA) imperatives. Finally, communities remain uncertain about how EPA and state regulators will use the results of their integrated plan in resolving clean and drinking water environmental issues.

Panel Recommendation #6

The Environmental Protection Agency (EPA) should develop additional guidance that articulates expectations for implementation and maps out the "how" for both the communities as well as the front-line regulators. This guidance could include a centralized repository of lessons learned and technical assistance that municipalities could access in order to inform their own integrated planning implementation strategies. Making information that the five technical assistance recipients acquired available to all interested communities expands the value of that assistance and further demonstrates the value of EPA's investment. EPA should use both the recently developed Water Finance Clearinghouse and possibly a new website/portal to share this information. Similar to the Clearinghouse, any new site should allow approved contributors to submit information. Some key areas in which to provide information should include:

1. Case studies (both technical assistance recipients and other successful Integrated Planning efforts);
2. Information on availability of grants, loans, and technical assistance, as well as a community's local in-kind or cash match contribution to water-related projects (this information is currently in EPA's Water Finance Clearinghouse and may be linked to in a new site);
3. Links to other organization's resources for focused and specific Integrated Planning implementation guidance; and
4. The ability for communities to interact and share information with one another.

EPA will need to direct financial resources to support the Water Finance Clearinghouse and the development of any new information portal. Support for human capital to manage and monitor the information and participant engagement is important as well.

Panel Recommendation #7

The Environmental Protection Agency (EPA) should establish guidelines for developing flexibilities that allow compliance with Clean Water Act and Safe Drinking Water Act requirements within a timeframe that correlates with well-defined prioritization of community objectives, statutory and regulatory requirements, and integrated planning activities.

1. Much like the Ombudsman concept reflected in proposed Senate Bill 692 – Water Infrastructure Flexibility Act, this liaison between Headquarters and Regional EPA offices, states, and municipalities would provide a mechanism for aligning Water Quality Standards with the concerns and priorities of the local residents to optimize the value of each dollar of investment. This resource would also provide additional guidance to state and regional environmental oversight in order to ensure consistent application of flexibilities.
2. EPA will need to provide a consolidated review of the proposed Integrated Plan for consideration, which includes those impacted components.
3. An additional consideration is to use the Supplemental Environmental Projects policy, which currently provides accommodations for Integrated Planning activities in enforcement actions.

Panel Recommendation #8

An Environmental Protection Agency (EPA) effort to expand Integrated Planning guidelines should require that each Integrated Plan provide established criteria and a formalized agreement between the community and appropriate governmental authorities to guide communities toward compliance and shared responsibility for achieving both compliance and Water Quality Standards.

This Framework would require that each Integrated Plan include a set of requirements outlining responsible parties, deadlines for meeting requirements, and a clear identification of each stakeholder's responsibilities. Each Integrated Plan must be accompanied by a funding plan when submitted to regulators. In addition to the flexibility that Integrated Planning affords, additional incentives may include technical and planning support, and funding.

Focusing on Measuring Costs and Benefits:

In the development and approval of control measures for combined sewer overflows (CSOs) and for other pollution sources considered together in an integrated process, the proponents of a control plan and the regulators reviewing it will take account of benefits and costs at several

points in the process. Such consideration is called for both by regulatory requirements and policies and by governmental decision-making practices of plan proponents. Currently, communities often struggle with the process of identifying and analyzing benefits and costs associated with long-term control plans and integrated plans. There is a lack of clarity regarding optimal levels of effort and sophistication as well as how to expand beyond cost effectiveness in a way that truly illustrates a comprehensive set of environmental and health costs and benefits.

Panel Recommendation #9

In estimating and evaluating benefits and costs relevant to the development and consideration of control plans and integrated plans, the following principles should be considered:

1. Analytical effort should be commensurate with the issue's importance.
2. Simple cost effectiveness analysis should suffice for most individual Combined Sewer Overflow control issues.
3. More complex Integrated Plans may benefit from more extensive assessment of benefits and costs.
4. Distribution of benefits and costs among various populations should be considered.
5. Ancillary benefits and countervailing risks are often important and should be considered.
6. The impact of an extended implementation schedule on benefits and on costs, including any effect on how benefits and costs affect various groups differently, should be considered.
7. Retrospective evaluation of the benefits actually achieved and the costs actually incurred is often important for subsequent decision-making.

Panel Recommendation #10

The Environmental Protection Agency (EPA) should build on its existing efforts to make informational resources and other support and assistance available that would help both plan proponents and front-line regulators develop, review, and, eventually, agree on the assessments of costs and benefits needed to establish long-term control plans and integrated plans making best use of the flexibilities and opportunities offered under EPA's policies.

Identifying and Evaluating Innovative Solutions and Smart Practices:

The integrated planning process provides a context in which to identify and evaluate the feasibility and cost-effectiveness of innovative and more sustainable solutions for achieving compliance goals, as well as for providing other economic, social and environmental or Triple Bottom Line co-benefits that may make it possible to leverage additional funding sources. Costs of regulatory compliance and deferred maintenance, as well as the need to replace and upgrade aging water infrastructure, are all driving the development of new approaches and adoption of smart management practices that can lower costs. However, investment in innovation also presents risk and challenges for implementation as well as costs associated with developing and standardizing new procedures, all of which need to be carefully considered and evaluated.

A key challenge is that there is still a lack of full understanding and consistent practices for evaluating the benefits and cost of innovative stormwater management practices, and proven management practices that can guide implementation. Additionally, innovative and creative approaches to financing are not always widely understood and details of successful initiatives aren't broadly shared to facilitate replication. For example, stormwater, which remains a growing source of pollution, is beginning to be reduced by managing it at the source, using onsite innovative stormwater management practices, commonly referred to as "green infrastructure" to filter and regulate the flow of water, along with more integrated watershed management approaches. Inherent in this decentralized approach is the need for innovative institutional arrangements and management strategies. [5] Other types of innovative approaches include the use of smart technologies to reduce overflow events by optimizing the use of storage capacity in existing gray infrastructure systems and enable proactive maintenance through early detection of leaks. Finance mechanisms are also moving toward greater emphasis on providing performance and market-based incentives for pollution reduction and the development of new business models that reduce the cost of innovation. Some examples of these include Community-Based Public-Private Partnerships (CBP3s), and new funding models to support infrastructure investments.

Recommendations 11-20 focus on promising practices that utilize new technologies and approaches to managing stormwater, knowledge management strategies, performance-based incentives, market-based approaches, new business models, and creative financing mechanisms to supplement existing efforts.

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[5] Reese, A., *Stormwater Paradigms: An expert takes an irreverent look at how our ideas about stormwater have changed*, 2001. http://foresternetwork.com/daily/water/stormwater-management/stormwater-paradigms/; Reese, A., *Ten Emerging Stormwater Best Practices*, Stormwater 17(5), July 2016. http://foresternetwork.com/stormwater-magazine/sw-water/sw-stormwater/ten-emerging-stormwater-management-best-practices/

A common theme underlying recommendations 11-15 is enabling innovation through the development of new tools and methodologies for evaluation, policies, market infrastructure and other institutional capacities associated with financing and managing decentralized infrastructure that has very different characteristics from pipes and tunnels. These also indicate the different, complementary roles of EPA, state, and local governments.

Panel Recommendation #11

The Environmental Protection Agency (EPA) should continue to strengthen efforts to engage stakeholders and collaborate in the development of tools, standard methods, and policies that can foster better understanding of the benefits of innovative Stormwater Management practices, and in the ongoing review of lessons learned from their application, as a basis for updating these. Better understanding of these benefits can also provide the basis for partnerships and the ability to obtain funding from additional sources.

Panel Recommendation #12

The Environmental Protection Agency (EPA) should support innovation in water infrastructure management by working with communities to encourage and enable the use of practices that are consistent with generally accepted principles of good planning, and by institutionalizing the process of adaptive management in enforcement and permitting, as well as in planning. This is a process that involves monitoring, evaluation, learning from outcomes, and building on experience, thereby incentivizing innovation and the development of new capacities. The process should be supported through:

1. Financial assistance for planning and development activities, should be made available for early and comprehensive public engagement in these activities, so that stakeholders have an opportunity to gain understanding of the purpose of Green Stormwater Infrastructure and the importance of stewardship. This early engagement will also enable them to provide meaningful input into planning, design, and decision-making.

2. Use of place-based assessment, with stakeholder input, to identify appropriate locations for effective and implementable projects, as well as the potential for innovation and barriers to it that may need to be addressed.

3. Identification of opportunities to improve equity in the distribution of benefits by addressing Environmental Justice concerns.

4. Building capacity for proactive asset management including the evaluation of opportunities for investment in natural infrastructure to prevent increases in stormwater runoff and flooding.

Panel Recommendation #13

Markets for Stormwater Retention Credits (SRCs) are promising for growing cities with active real estate markets. The Environmental Protection Agency (EPA) should facilitate the adoption of these SRCs in other cities by providing guidance, technical assistance, and start-up grants to cities to enable them to build their capacity to develop and manage a credit market.

Inclusion of stormwater in water quality trading has the potential for significant cost savings and is worth considering where certain conditions can be met. EPA should work with states to identify places where these conditions can be met, (i.e., where there are opportunities for trading, upstream from impaired urban water bodies and water intakes, that can contribute to meeting their National Pollutant Discharge Elimination System permit and Total Maximum Daily Load requirements as well as protect drinking water) and determine what enabling legislation or regulations may be needed to support trading in these conditions. In addition to protecting water quality, agricultural best management practices can also allow for other economic and environmental co-benefits that provide the basis for partnerships and opportunities for additional funding.

Panel Recommendation #14

Local governments should improve communication about stormwater management, and the value of the user fee as a more equitable approach to paying for it, highlighting ways the fee has been successfully used to recover as well as reduce costs of managing stormwater and to mitigate repetitive flooding.

Because user fees can be significant, they need to be coupled with incentive programs that enable property owners to reduce stormwater fees in exchange for the adoption of green infrastructure practices. Local governments should also consider combining these types of fees with grants or loans for upfront costs on large non-residential properties. Since not all local governments have the authority from their states to charge these fees, enabling legislation should be considered in those states that do not have it.

Panel Recommendation #15

New business models such as Community-Based Public Private Partnerships (CBP3s) are promising. The Environmental Protection Agency (EPA) should encourage the carefully structured and appropriate experimentation with CBP3s through knowledge sharing activities that build critical government capacity to manage the process, and for strategic planning to guide project selection.

The limited federal resources available through EPA's Water Infrastructure Finance and Innovation Act (WIFIA) loan program and capitalization grants for the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) programs are not sufficient to meet the nation's substantial water infrastructure investment needs. The Panel finds, therefore, that it is critically important for EPA to ensure that these separate programs are used effectively to fund the highest priority water infrastructure investments. Collaboration between WIFIA and the SRFs can help ensure that these complementary programs work together to maximize funding available for critical, high-priority water infrastructure investments.

Panel Recommendation #16

An evaluation of any state use of Water Infrastructure Finance and Innovation Act (WIFIA) loans to expand their State Revolving Fund (SRF) lending activities is needed to compare the advantages and disadvantages of this leveraging technique relative to other leveraging techniques (e.g., tax exempt bonds). The evaluation can also identify potential program or statutory impediments to increasing SRF lending operations by leveraging WIFIA resources and assessing WIFIA's ability to meet its statutory goals by allocating some of its loan resources to increase SRF lending activity.

Panel Recommendation #17

Those proposing financial reforms to address local community and utility water infrastructure investment needs should focus on the most critical issue – additional resources to lower costs and provide greater access to long-term financing to meet water infrastructure investment needs.

Panel Recommendation #18

The Environmental Protection Agency (EPA) should ensure that the Water Finance Clearinghouse and technical assistance activities provided through the Water Infrastructure and Resiliency Finance Center (Water Finance Center) include sharing information on the risks, costs, and advantages of any innovative financial instrument being proposed with states and localities before those instruments are used.

EPA's Water Infrastructure and Resiliency Finance Center and the Environmental Finance Centers affiliated with universities in each of EPA's 10 regions have the analytical expertise to develop and provide that information.

Water affordability issues, primarily for low-income users, compound the complex choices utilities face in increasing water rates and/or revising their rate structures to meet their rising costs from infrastructure investment needs and EPA water regulatory requirements. The presence

of state statutory limitations on the ability of water utilities to adopt Consumer Assistance Plans (CAPs) or develop rate structures that could make water rates more affordable for financially distressed low-income users also add to low-income water affordability issues.

Panel Recommendation #19

> The Environmental Protection Agency (EPA) should work with local and state governments to eliminate barriers restricting utilities' ability to develop more efficient and equitable water rate structures, including specific Consumer Assistance Plans (CAPs) for financially distressed low-income ratepayers. EPA's Water Finance Center should continue to develop and disseminated information on CAPs to water industry stakeholders and other interested parties.

Panel Recommendation #20

> The Environmental Protection Agency's (EPA) Water Infrastructure and Resiliency Finance Center staff and the staff at the 10 Environmental Finance Centers should extend their work with local communities and utilities to help them apply those principles of equity, efficiency, effectiveness, transparency, and collectability in adopting more effective water rate structures and Consumer Assistance Plans to address increasing water affordability issues for low-income users.

Focusing on Performance Standards

A widely-accepted principle in regulatory policy is that performance standards are generally preferable to design standards. For decades, there has been a focus on addressing regulatory issues by specifying performance objectives, rather than the behavior or process in which compliance is achieved. Utilizing this approach, which focuses on outcomes rather than specifying the means to those ends, gives the regulated parties the flexibility to achieve regulatory objectives in the most cost-effective way manner and should provide for the achievement of the greatest water-quality benefits as quickly as financially feasible. Best practices and lessons learned that were shared by stakeholder and in research informed the Panel's final recommendation.

Panel Recommendation #21

The Environmental Protection Agency (EPA) should consider whether it is feasible and desirable to develop and apply performance standards against which the sufficiency of integrated plans would be evaluated. In developing such performance standards, EPA should consider the following components:

1. Under the performance standard, an integrated plan for compliance with National Pollutant Discharge Elimination System (NPDES) requirements (in addition to meeting other applicable conditions) should provide for the achievement of the greatest water-quality benefits as quickly as affordable.
2. Under the performance standard, an integrated plan for compliance with both NPDES and Safe Drinking Water Act requirements (in addition to meeting other applicable conditions) should provide for the greatest water-quality and drinking-water benefits as quickly as is affordable. Regulators should encourage and accept such a proposed one-water integrated plan only if they are willing and able to collaboratively apply equitable and principled criteria for reviewing and, if appropriate, approving the proposed choices among water-quality and drinking-water priorities.
3. The performance standard might list several specific conditions with which the proponents of a control plan should be required to demonstrate compliance, in such areas as:
    - Compliance with applicable statutory and regulatory requirements.
    - Methodology for constructing an acceptable implementation schedule.
    - Consideration of green infrastructure.
    - Use of available sources of financing to enhance affordability.
    - That the sequencing addresses higher-priority environmental or public-health risks soonest.
    - Avoidance or mitigation of any disproportionate adverse impacts on disadvantaged communities.

The Panel recognizes that there are a number of issues that have been raised that require response and support from beyond those at EPA headquarters and in the regions. They reflect a number of challenges that would need to be addressed by other actors, such as Congress and state and local

leadership. Often these are areas of focus that require legislative change and/or funding, champions or enablers to support and implement the actions, and a broader paradigm shift with a look toward a longer timeline in order to implement the recommendations in this report.

EPA continues to explore ways for communities to leverage funding and identify innovative efforts to reduce costs and provide new and expanded benefits. The Agency has engaged with states and localities as well as many other stakeholders such as non-governmental organizations, associations, academia, and business and industry groups in order to gain a deep understanding of what potential solutions exist.[6] EPA is well aware of the risk of waiting to address stormwater management concerns and is embracing the concept of long-term comprehensive answers to difficult questions. EPA has also made a concerted effort to implement communication with its stakeholders to ensure information sharing is taking place. The findings and recommendations of this report aim to supplement current actions and to assist EPA in providing continued valuable guidance and support to communities as they pursue clean, affordable water for their citizens.

[6] U.S. Environmental Protection Agency, *Memorandum, Community Solutions for Stormwater Management: A Guide for Voluntary Long-Term Planning*, October 26, 2016, https://www.epa.gov/sites/production/files/2016-10/documents/memo_long-term_stormwater_guide-508.pdf.

Chapter 1: Introduction

1.1 Introduction

Government has a responsibility to assure clean water services at an affordable cost to all of its citizens and to the community as a whole. Clean water means the production and distribution of safe and reliable drinking water to users, and the safe and reliable collection and disposal of wastewater in a manner that protects water ways, including streams, rivers, lakes, and bays.

In recent years, government responsibility for assuring clean water that is also affordable to both communities and individuals has become an increasing challenge for three principal reasons. First, water infrastructure in the United States is aging, which imposes additional operating costs for emergency repairs of underground pipes that have been permitted to deteriorate as a result of deferred maintenance. Upgrading or replacing aging infrastructure that is beyond repair also increases capital costs, as well as the operating costs required to support long-term capital financing. It is projected that over $1 trillion dollars will be needed in the next 25 years to replace systems built circa World War II, which could triple the cost of household water bills.[7]

Second, compliance with federal Water Quality Standards (WQS) under the Clean Water Act (CWA) requirements adds to the above costs. In addition, the need to control pollution from non-point sources may limit water quality improvements associated with controlling point sources. Although not regulated under the CWA, states may address non-point sources under state laws. They are also addressed through voluntary incentive-based programs, such as the USDA NRCS Environmental Quality Incentives (EQIP) program. In the context of enforcement, limits on the financial capability of communities only provide the basis for negotiating phased or extended schedules for compliance with WQS. The FCA is not intended to reduce costs or compliance obligations. Rather, it is used to determine the appropriate implementation schedule after EPA works with the municipality to determine what work needs to be done to come into compliance with the CWA. This may spread costs further over time, thereby keeping rates more affordable. However, through the development of integrated plans, the process could lead to cost reductions through the identification of more cost-effective and innovative solutions.

And third, affordability is an especially critical issue for low-income customers throughout the United States. According to an AWWA survey, rates for water and wastewater increased by 41% and 37% from 2008-2014.[8] Although average (mean) annual expenditures for water are generally low relative to other utilities, they represent a higher share of income for those with the lowest

[7] American Water Works Association, *Buried No Longer: Confronting America's Water Infrastructure Challenge*, 2012.

[8] U.S. Government Accountability Office, *Water Infrastructure: Information on Selected Midsize and Large Cities with Declining Populations*, September 2016.

20% of income.[9] In the past 15 years, costs of water have also risen three times faster than inflation, while household incomes have risen at a rate lower than inflation. In addition, there has been a decrease in the number of households in the middle income ranges, which reduces the usefulness of median income levels as an indicator of the financial condition of a community.[10] However, these mean values do not provide an indication of the greater challenge of affordability in inner cities with older infrastructure, that have a higher concentration of poverty and a diminishing rate base as a result of declining populations. For example, in Baltimore, which has an MHI of $39,386, and has had increases in water and sewer rates of close to 83% from 2010 to 2017; over 13% of the population and 27% of families have an annual income below $10,000. The overall percent of low-income householders is greater than the national average, while those in the higher income ranges are lower than the national average.[11] A recent study found that Census tracts at "high risk," for which current rates are a challenge, and Census tracts "at risk" from projected rate increases, are concentrated in urbanized areas, and that 23.5% of all American households are at risk. The study also found that the percentage of households for which water is unaffordable could triple, from 11.9% to 35.6% if water rates rise as projected.[12] Although unaffordability is not the only reason for water shutoffs and there is no comprehensive survey of these, reports from selected cities suggests that water shutoffs are on the rise. The most high-profile case is that of Detroit, where 50000 shutoffs have been reported since 2014. In Philadelphia, according to water department figures, 1 in 5 accounts have had water shut off at least once since 2012.[13] In Baltimore, 8000 shutoffs were reported in 2015, and 1400 in 2016. In 2017, notices were sent to customers with delinquent bills informing them that their homes could go to a tax sale.[14]

All levels of government in the United States share in the responsibility for clean, affordable water, though their authority for doing so is notoriously fragmented. The principal responsibility for water resource policy, finance, operations, and enforcement historically has rested with state and local governments, which have employed a wide variety of institutional arrangements to meet their obligations. In particular, local governments and their citizens, as well as nongovernmental water utilities, now bear the brunt of the rising cost burden of clean water, especially as they work to comply with state and federal water quality standards. States are also

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[9] U.S. Department of Labor, Bureau of Labor Statistics, *Consumer Expenditure Survey Table 1101. Quintiles of income before taxes: Annual expenditure means, shares, standard errors, and coefficients of variation*, 2016.

[10] Mumm, Jason and Julius Ciaccia, *Improving the Narrative on Affordability and the Measurements We Need to Take Us There*, Journal-American Water Works Association 109(5), 2017,: 42–48.

[11] City of Baltimore, Department of Public Works, *[reply to] NAPA Request for Information*, September 8, 2017.

[12] Mack, Elizabeth A., and Sarah Wrase, *A Burgeoning Crisis? A Nationwide Assessment of the Geography of Water Affordability in the United States*, PLOS ONE 12(1), January 11, 2017, doi:10.1371/journal.pone.0169488.

[13] Walton, Brett, *Philadelphia Water Rate Links Payments to Household Income*, Circle of Blue, May 16, 2017. http://www.circleofblue.org/2017/water-management/pricing/philadelphia-water-rate-links-payments-household-income/

[14] Weiner, Deborah, *Insurmountable bills lead to water shutoffs in Baltimore*, Baltimore Sun, February 13, 2017. *http://www.wbaltv.com/article/insurmountable-bills-lead-to-water-shutoffs-in-baltimore/8775838*

feeling pressure, since they have the responsibility for determining the organizational and financial structure of water operations within their territories, and for ensuring that their citizens have clean affordable water.

It was not until after World War II that the federal government began to assume a share of responsibility for setting and enforcing clean water standards, and financing some portion of the cost of meeting those standards, in the interests of water-related concerns that crossed state and local boundaries, as well as in the interest of the nation as a whole. The federal government has attempted to fulfill its responsibility by passing and enforcing laws and regulations, and providing financial support to assist in their implementation. Congress authorized the Environmental Protection Agency (EPA), under the CWA to issue and enforce regulations, and administer financing. However, average federal funding decreased by over half beginning in 1984, after the initial grant program was phased out, and converted to the capitalization of state revolving loan funds.

In carrying out its responsibility, EPA provides a definition and framework for community affordability, which communities and the EPA use to assess burden and develop compliance schedules for meeting communities' CWA objectives. While endeavoring to ensure that federal law is enforced, EPA also works with communities to find practical ways of meeting WQS at an affordable cost, in part by issuing guidance that is attuned to the practical realities, as well as the legal responsibilities, of state and local water authorities. The key components of EPA's current guidance and policy memos include:

- *Interim Economic Guidance for Water Quality Standards: Workbook* (EPA-823-B-95-002, March 1995)
- *Combined Sewer Overflows – Guidance for Financial Capability Assessment and Schedule Development* (EPA 832 B-97-004, February 1997)
- *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* (May 2012)
- *Financial Capability Assessment Framework* (November 2014)

The Senate Appropriations Committee, in FY 2016 legislative language, directed the Environmental Protection Agency (EPA) to contract with the National Academy of Public Administration (the Academy) —an independent, nonpartisan, nonprofit organization chartered by the U.S. Congress— "to conduct an independent study to create a definition and framework for community affordability." The Academy was thus tasked with recommending options for updating the current EPA definition and framework for community affordability.

For this task the Academy specifically focused on the 1997 document titled *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development*. In addition, the Academy was asked to consider potential opportunities for innovative solutions that may promote affordability through cost savings. This report reviews efforts underway to explore and implement integrated planning (IP), innovative stormwater management practices, and creative financial mechanisms that have the potential for significant cost savings, as well as increased cost-effectiveness.

1.1.1 The Clean Water Act: A National Goal of Clean, Affordable Water

The federal government first took a definitive interest in the growing problem of water pollution in 1948 when Congress passed the Federal Water Pollution Control Act (Public Law 80-845).[15] In 1972, in response to growing public awareness and concern for water pollution, as well as lack of action by states,[16] Congress amended the 1948 act, and the resulting revised law became known as the Clean Water Act (CWA).

The question of affordability was front and center in the 1972 legislative debate. After President Nixon vetoed the original Congressional legislation, two prominent senators responded forcefully. [17] Senator Edmund Muskie asked rhetorically:

> Can we afford clean water? Can we afford rivers and lakes and streams and oceans which continue to make possible life on this planet? Can we afford life itself? Those questions were never asked as we destroyed the waters of our Nation and they deserve no answers as we finally move to restore and renew them. These questions answer themselves.

And Senator Howard Baker asserted:

[15] U.S. Environmental Protection Agency, *History of the Clean Water Act*. https://www.epa.gov/laws-regulations/history-clean-water-act

[16] Houck, Oliver A, *Cooperative Federalism, Nutrients, and the Clean Water Act: Three Cases Revisited*, Environmental Law Reporter 44(10426), May 2014.

[17] Cited in: Adler et al 1993 The Clean Water Act 20 Years Later.

> I believe that the [act] is far and away the most significant and promising piece of environmental legislation ever enacted by Congress.... Of course, such an ambitious program will cost money – public money and private money. The bill vetoed by the President strikes a fair and reasonable balance between financial investment and environmental quality....If we cannot swim in our lakes and rivers, if we cannot breathe the air God has given us, what other comforts can life offer us?

Congress answered in the affirmative by overriding the presidential veto, and provided significant resources to municipalities to help them achieve the goals. From 1972 through 2016, total appropriations under the CWA and SDWA totaled over $94 billion. Of this, close to $41 billion was appropriated through 1984, under Title II of the CWA for construction of Wastewater Treatment Plants (WWTPs), as grants for up to 75% of project costs until 1981 when the federal share was reduced to 55%, with an exception for the use of innovative technologies. Under amendments to the CWA in 1987, these grants began to be phased out and were replaced by grants to states to capitalize the State Water Pollution Control Revolving Fund, commonly known as the Clean Water State Revolving Fund (CWSRF).[18]

So, the tension between federal clean water standards and the declining proportionate share of the costs required to meet those standards that the federal government was willing to shoulder added to the mounting cost burden on state and local government to assure clean affordable water services for their communities and citizens.

1.1.2 The Changing Realities of Water Infrastructure

Meanwhile, the practical realities of assuring clean, affordable water services were becoming ever more challenging to states and local communities.

Assuring clean water requires attention to the entire cycle of water flow and use, and to the natural and human infrastructure that supports it, from the protection of original sources in the ground, lakes, and rivers, to the extraction of "raw water" from those sources for human use, to its treatment and distribution to users (e.g. household and business establishments), and to the collection and safe disposal of wastewater (including both from users and also stormwater runoff.)

[18] U.S. Library of Congress, Congressional Research Service, *Clean Water Act: A Summary of the Law*. By C. Copeland, 2016.

Until the mid-19th century, private and municipal water systems typically paid little heed to the water cycle, invariably disposing of wastewater channeled through open ditches directly back into the ground or natural waterways. As population grew and urban areas became denser, more numerous, and more closely located to one another, the public health dangers posed by such practices became obvious, not least because of the actual disease and death they caused. The development of sewer systems, driven by concerns about sanitation in the 19th century, is credited as one of the most significant advances in public health. It also marked a shift, toward acceptance of public health as a public good rather than an individual responsibility, thereby bringing about a change the way cities are governed.[19]

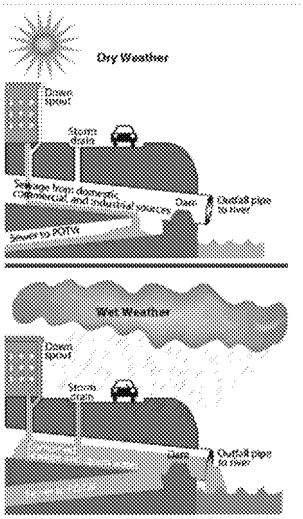

Figure 3. Schematic of a typical combined sewer system that discharges, directly to surface waters during wet weather. Source: EPA

When Combined Sewer Systems (CSS) were introduced in 1855 they represented a major improvement to the ditches that ran through urban areas and spilled sewage during wet weather events. A CSS gathers rainwater runoff, human waste, and industrial wastewater into one pipe for disposal. Originally, CSSs discharged directly into bodies of water, but in the early 20th century sewage treatment plants were introduced to treat the wastewater before discharge. During periods of dry weather, the CSS ordinarily has a low volume of water and waste, which the treatment plants can handle. However, during periods of rain, stormwater levels surge and the pipe can no longer handle the volume of water. The sewers were specifically designed with emergency outflow pipes to prevent backups into houses and buildings. This is similar to the overflow valve in old sinks and tubs to prevent overflow and can be seen in Figure 3. When capacity of the system is exceeded during a wet weather event the CSS discharges the untreated wastewater through the outfall pipe directly into the surface water source. This event is called a Combined Sewer Overflow (CSO) and involves the dumping of raw sewage into lakes, rivers, and coastal waters, which poses significant danger to public health and the environment.

Combined Sewer Systems exist in cities that span 32 states and serve over 40 million people. The majority of these systems are in Maine, New York, Pennsylvania, West Virginia, Ohio, Indiana, Michigan, and Illinois. In 2004, EPA reported that CSOs are a major concern for 772 cities and estimated that they release approximately 850 billion gallons a year of untreated wastewater and stormwater.

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[19] National Academy of Science, *The Future of Public Health*, 1988. Committee for the Study of the Future of Public Health; Division of Health Care Services, Institute of Medicine. ISBN: 0-309-58190-7. URL: http://www.nap.edu/catalog/1091.html; Melosi, M.V., *The Sanitary City: Urban Infrastructure in America from Colonial Times to the Present,* 2000.

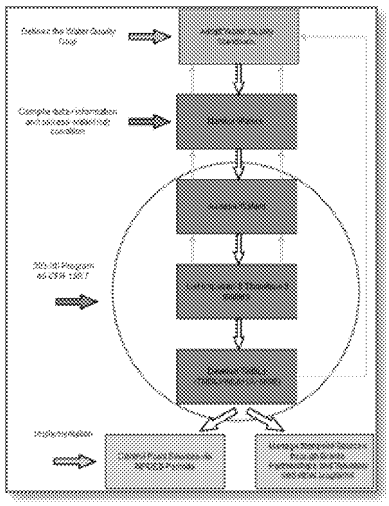

Figure 4. Water Quality-Based Approach of the Clean Water Act. Source: EPA

Consequently, aging public sewer systems have become a major concern in assuring clean water, and their maintenance, repair, and replacement became a major cost burden.

1.2 Regulatory History

As the regulatory obligations and costs have increased, federal funding has decreased. Local obligations have mounted because of this drop in federal spending and a spike in water-related costs. In the context of compliance with the Clean Water Act, affordability concerns have been driven primarily by the costs associated with CSO Long Term Control Plans (LTCPs) needed to prevent the discharge of raw sewage and ultimately meeting Water Quality Standards (WQS), which reflect the CWA goals of making our nation's waterways fishable and swimmable, where attainable. In addition to the implementation costs of CSO LTCPs, there are a number of additional costs driving growing concern about water affordability for water utilities providing water services and for their recipient customers.

Additional costs of meeting Water Quality Standards include those of achieving Total Maximum Daily Loads (TMDLs) which are established when technology-based effluent levels (TBELs) are not sufficient to meet the standards. TMDLs are developed for water bodies listed as impaired for each of the pollutants that contribute to the impairment, and are allocated among sectors as Waste Load Allocations (WLAs) for individual point sources. These WLAs provide the basis for Water Quality Based Effluent Limitations (WQBELs) which are incorporated into National Pollutant Discharge Elimination System (NPDES) permits. TMDLs also include Load Allocations (LA) for non-point sources but as these are not regulated under the CWA, they are not incorporated into NPDES permits. Instead, non-point sources are addressed through voluntary incentive programs and may be addressed through state laws. Among the key costs for meeting NPDES permit obligations are those of reducing discharges from Municipal Separate Storm Sewer Systems (MS4). Given large differences in cost between urban and agricultural BMPs, EPA also encourages states to allow water quality trading between point and non-point sources for WQBELs. However, these programs are nascent and face significant implementation challenges. In addition to WQS costs, there are also significant infrastructure lifecycle costs which include deferred maintenance and overdue replacement and upgrading of aging water infrastructure systems.

In addition, changes in water use patterns, and declining populations in inner cities and small communities reduce the rate base while many of the costs of providing services remain fixed. This last issue is one of the more significant challenges with respect to CSOs because so many CSSs are in small communities with fewer people on a line per mile and thus have a smaller rate

base, which results in less revenue to fund water infrastructure updates and compliance requirements. In addition to the issues outlined above, the fragmented governance of the water industry and regulatory approaches at all levels of government add layers of complexity to the affordability equation.

EPA released its Combined Sewer Overflow Control Policy in April 1994 (1994 CSO Control Policy), and the policy provided a national framework for the control of CSOs through the National Pollutant Discharge Elimination System (NPDES) permitting program, which was established in 1979 in the National Municipal Policy and Strategy document. The 1994 CSO Control Policy represented a "comprehensive national strategy to ensure that municipalities, permitting authorities, water quality standards authorities, and the public engage in a comprehensive and coordinated planning effort to achieve cost effective CSO controls that ultimately meet appropriate health and environmental objectives." This policy left municipalities with two general options: 1) replace the combined sewer systems; or 2) find a way to store and treat peak flows during wet weather events.

In March of 1995, EPA released the Interim Economic Guidance for Water Quality Standards: Workbook (1995 Interim Economic Guidance), which functioned as the umbrella economic guidance for all water quality standards (WQS) programs pursuant to Water Quality Standards Regulation (40 CFR 131). This regulation limits consideration of economic factors to the use attainability and anti-degradation provisions, for those impacts that result for treatment beyond that required by the technology-based regulations when these are not sufficient to meet WQS. The guidance was intended to help states and applicants understand the economic factors that may be considered and the different tests available for determining if a designated use can or cannot be attained without "substantial and widespread economic and social impacts" and whether the benefits of development "unquestionably outweigh the costs of lowering water quality." In practice, Use Attainability Analysis (UAA) is rarely done because it would lead to a change in the water quality standard, and implies acceptance of lower water quality in economically disadvantaged areas. However, UAA may also be used to support the granting of a temporary variance, so as to allow time to develop alternatives. This guidance provided a significant amount of flexibility if the permittee could demonstrate substantial and widespread economic impact through an economically viable method of analysis. In 2000, the consolidated appropriations for FY 2001 enacted that all permits, orders, or decrees issued must conform with the 1994 CSO Policy.

In February 1997, EPA released Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development (1997 FCA Guidance), which, as noted earlier, is a focal document for review in this study. Unlike the umbrella 1995 Interim Economic Guidance, the 1997 document applied exclusively to communities with CSOs. The 1997 guidance uses a two phase approach. The first phase calculates the Residential Indicator (RI) and the second phase calculates the Financial Capability Indicator (FCI). In this guidance, the RI uses 2% of a

municipality's Median Household Income (MHI) as a primary screener for distinguishing whether wastewater and CSO control costs would be a high or low burden on individual households and to trigger a conversation about negotiating a phased or extended compliance timeline. The FCI examines the debt, socioeconomic, and financial conditions of a permittee and evaluates their capacity to acquire and hold debt. However, there are significant limitations to the guidance's ability to identify burden and disparate impact to the community.

1.3 Regulatory Flexibility and Integrated Planning

In 2012, EPA released a memorandum on integrated planning (IP) titled *Achieving Water Quality through Integrated Municipal Stormwater and Wastewater Plans*. It discussed the May 2012 Integrated Municipal Stormwater and Wastewater Planning Approach Framework (2012 IP Framework), which was EPA's first attempt at introducing greater flexibility to the 1997 FCA Guidance. Early efforts to utilize the Guidance and use an integrated planning framework have illustrated communities' interest in addressing affordability in new and innovative ways. This programmatic approach to reducing burden can lead to higher levels of accountability for all who have a role in ensuring the community has affordable, clean water for its citizens. Conceptually, integrated plans enable municipalities to customize and prioritize their approach with data-informed decisions.

EPA's second attempt at flexibility was in 2014 when the agency released a guidance document that provided examples of other relevant financial or demographic information that can be considered to illustrate the unique or atypical circumstances faced by a permittee. This guidance document was titled *Financial Capability Assessment Framework for Municipal Clean Water Act Requirements* (2014 FCA Framework). In a memorandum releasing the 2014 FCA Framework, EPA expressed the rationale for the guidance to communities, saying "[it] provides examples of additional information that may help some communities provide a more accurate and complete picture of their financial capability as is envisioned in the FCA guidance."[20]

Although driven by the costs of Long-Term Control Plans for CSOs, the 1997 FCA Guidance for considering affordability was carried forward into a subsequent framework for IP which considers the costs of all wastewater and stormwater obligations under the CWA, and is to be consistent with TMDLs. At the time the 1997 FCA Guidance was developed, relatively few TMDLS had been approved. EPA had given priority to the regulation of point sources through the establishment of Best Available Technology standards. Concern with the increase in pollution from agricultural non-point sources and urban runoff, which remain the highest sources of water pollution, led to a series of citizen suits in the 1990s, and to the publication in 2000 of more comprehensive regulations for the preparation of TMDLs which established fixed

[20] U.S. Environmental Protection Agency, Memorandum from Deputy Assistant Administrator, Office of Water, and Assistant Administrator, Office of Enforcement and Compliance Assurance, *Financial Capability Assessment Framework for Municipal Clean Water Act Requirements*, November 24, 2014.

deadlines and required the preparation of implementation plans.[21] However, most of the now over 71,000 existing TMDLS were not approved until after 2008.[22] The 1997 FCA Guidance has not been applied to meeting broader TMDL objectives and there is little familiarity with it beyond municipalities with obligations to control CSOs.

The FCA Guidance and Framework and IP approach have primarily been used in the context of consent decrees, as part of federal enforcement actions. However, the 2012 IP Framework defines it to be applicable to both enforcement and NPDES permitting, which is carried out by the states to which authority for CWA regulation has been delegated. In testimony to Congress, states have expressed support for integrated planning as a way to establish priorities. However, they have also expressed concern about lack of clarity regarding both the state role in the process and how IP would work in the context of permitting. Some issues that could arise include how to accommodate schedules for activities beyond the 5-year permit term, and whether prioritization agreements would be vulnerable to legal challenges by third parties. A tradeoff between use in enforcement and permitting is that while enforcement actions allow for more flexibility, the permitting process provides greater transparency (beyond what is afforded in the initial 30 day public comment period of consent decrees). In this context, it is also important to consider the implications of innovative practices and creative financial mechanisms that have the potential for significant cost savings as well as increased cost-effectiveness.

Some of the interplay between enforcement and permits is illustrated by the City of Portland, Oregon, which began to develop its CSO program in 1991 in response to a citizen suit which alleged that discharges from 54 CSO outfalls were not covered by the 1994 NPDES permit and violated state water quality standards. In a draft 1990 permit, the state Department of Environmental Quality (DEQ) required the City to meet water quality standards at these discharge points. As this could not be done within the 5-year timetable of an NPDES permit, a separate compliance order was issued. The new permit listed all CSOs as permitted discharge points, and the City agreed to replace the CSO system over a 20 year period.[23]

1.4 The Potential for Innovative Solutions

The Integrated Planning Framework provides a process for identifying and evaluating the potential for innovative solutions that can lower costs and/or deliver additional benefits. This

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[21] Houck, O., *The Clean Water Act Returns (Again): Part I, TMDLs and the Chesapeake Bay,* Environmental Law Reporter 41(10208), 2011.

[22] U.S. Environmental Protection Agency, Water Quality Assessment and TMDL Information, *Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) National Summary of State Information, Cumulative Number of TMDLs* (1996 to 2017). https://ofmpub.epa.gov/waters10/attains_index.home

[23] United States Court of Appeals, Ninth Circuit. NORTHWEST ENVIRONMENTAL ADVOCATES, a Non-Profit Oregon Corporation; and Nina Bell, Plaintiffs-Appellants, v. CITY OF PORTLAND, Defendant-Appellee. No. 92-35044. Decided: June 07, 1995. http://caselaw.findlaw.com/us-9th-circuit/1316526.html

also provides an opportunity to consider the next generation of water infrastructure. Innovative solutions are considered in several categories: technical approaches related to management of stormwater, performance-based incentive mechanisms, market-based strategies, and creative financing mechanisms. In reviewing all of these arenas, the report identifies challenges to implementing innovative solutions, how they might be facilitated, and ways of dealing with their inherent risk.

Technical approaches to the management of stormwater have evolved from moving stormwater offsite to managing it at the source, using green practices that leverage the functionality of ecosystems to filter and regulate the flow of water while also providing economic and social as well as environmental, or triple-bottom-line benefits, which are not provided by underground pipes. Used as a complement to more conventional or "gray" infrastructure, green infrastructure has been shown to reduce costs in at least some cases. However, standard practices for comparison of green and gray approaches as well as place-based assessment of opportunities for using particular practices will be important in determining and selecting those that are most appropriate and cost-effective. As with other types of infrastructure, assessment is not limited to technical/engineering considerations, as these aspects interact with social, economic and environmental ones.

The decentralized and distributed nature of green infrastructure has implications for how it is managed and maintained as well as financed. Many aspects of management and maintenance are consistent with principles of good planning and collaborative adaptive management that are not always put into practice, such as early engagement of stakeholders. Finance mechanisms have evolved toward greater emphasis on performance-based incentives and returns on investments, new more equitable sources of revenue, potential for new or modification of existing funding mechanisms that can lower the costs of borrowing, and new utility business models that can enable utilities to share the costs of innovation with other utilities or lower costs, such as through generation of energy from recovered resources. Different types of trading mechanisms also have the potential to reduce costs.

Ultimately, the challenge is one of maintaining affordability while also recovering the full-costs of providing water services, which, in the absence of low-income assistance, is limited by low-income households' ability to pay. Rate structures themselves may place a disproportionate share of the burden on low-income households. The report also considers options for consumer assistance as well as more equitable rate structures.

1.5 Methodology of the Academy Study

The Study Team used an approach based upon multiple methodologies and incorporated data from multiple sources. The Study Team conducted an extensive review of literature, including legislation, regulatory guidance, and other relevant perspectives on environmental policy. The Study Team also administered a long-form electronic survey to local practitioners in order to garner a better understanding of the perceived strengths and weaknesses of the existing FCA guidance and the potential to reduce costs through innovative solutions. The survey was initially disseminated to a small group of stakeholders who then distributed the survey through their networks. The Study Team received 23 responses, many of which were collective responses by organizations or municipalities. The technical, focused nature of the FCA Guidance limited the number of responses from survey recipients. The Study Team conducted face-to-face and telephonic interviews with over 100 stakeholders to obtain more detailed explanations of the challenges communities are facing relative to affordability; to achieve a more comprehensive knowledge of innovative solutions to address water quality in an affordable manner; and to identify best practices and other studies to draw on for this report. Additionally, the Study Team hosted a stakeholder roundtable in an effort to understand broad perspectives of a diverse selection of stakeholders with a dedicated and sustained interest in providing affordable, clean water services to citizens.

In order to better understand challenges that municipalities are facing and the innovative solutions that are being generated at the local level, the Study Team made four site visits, which included:

- Springfield, MO – Integrated Planning Technical Assistance Recipient
  - Met with key stakeholders involved with their Integrated Plan Environmental Priorities Task Force.
- Onondaga County, NY – Integrated Planning Technical Assistance Recipient
  - Met with members of both Onondaga County and the city of Syracuse to better understand their Integrated Planning process and their Save the Rain initiative.
- Philadelphia, PA– Center for Watershed Protection Conference
  - Attended to better understand green infrastructure and stormwater project funding efforts in Philadelphia as well as other localities.
- King George County, VA– Local Government Advisory Committee to the Chesapeake Bay Executive Council
  - Attended meeting and presented information about the Academy Study in order to garner additional stakeholder input.

The information was initially synthesized to provide background and context to the Panel of five Academy Fellows (for more information on the Panel members, please see Appendix A) for ultimate determination of findings and recommendations. For more information regarding Study Team and Panel research and analysis processes, please see Appendix B.

1.6 The Challenges Being Faced

Communities and the water agencies that provide the crucial service of clean water to citizens will continue to experience constrained resources and will be challenged with making decisions about how to best respond to public health, environmental impact, and regulatory compliance obligations. This will all be addressed against the backdrop of a severely compromised infrastructure and the ongoing competing imperatives of each municipality.

EPA's methods for analyzing the affordability of federal mandates stemming from the Clean Water Act will continue to be tested; states and local entities will continue to identify new ways to address water quality concerns and economic shortfalls; and calls for further coordination across all levels of government will continue in order to attain the ultimate goal of delivering clean water services at an affordable rate to all communities. The continual discovery of innovative approaches to stormwater management, planning, and financing has, and will continue to produce new ways to optimize each taxpayer dollar and offer additional flexibilities to the permitting and enforcement procedures.

However, the clean water regulatory program has remained relatively unchanged in recent years and there are significant limitations on the authority of different government entities to address the sources of problems. For example, there is a variance across the nation in local government authority for land-use decisions and the utilization of revenue raising devices. This can limit control of local development patterns, the use of stormwater fees, and extend the effects of deferred maintenance.

Therefore, a key challenge is determining the options for improving water quality, but also who has authority and capability to act on these options. This is compounded by larger watersheds spanning multiple jurisdictions with problems that are covered by different legal authorities.

This fragmentation of authority is both vertical and horizontal. The vertical fragmentation is between federal, state, tribal, and local governments. The horizontal fragmentation is across agencies with different but overlapping and interdependent mandates, and across states and local governments that share watersheds. Given the citizen suit provisions of the Clean Water Act, critical roles are also played by citizen groups and the Courts in what Oliver Houck refers to as a "four-way arrangement of cooperative federalism."[24]

[24] Houck, Oliver A, *Cooperative Federalism, Nutrients, and the Clean Water Act: Three Cases Revisited*, Environmental Law Reporter 44(10426), May 2014.

Under the CWA, which covers wastewater discharges, EPA retains authority for enforcement (states are able to conduct enforcement as well), with permitting authority and responsibility for establishing water quality standards delegated to all but four states. However, this authority is limited to the control of point source discharges, which include discharges from MS4s. Non-point sources, such as agricultural runoff, which are the largest source of nutrient pollution, and which add to costs of water treatment in downstream urban areas, are only subject to voluntary controls, typically through various forms of cost-share agreements with farmers. Although drinking water and wastewater are all part of one water cycle, they are regulated under separate legislation, with drinking water protection falling under the Safe Drinking Water Act (SDWA). These are overseen by different congressional committees and different offices within and across agencies at federal and state levels.

A common purpose of affordable clean water services unites these various stakeholders. The Panel recognizes this, and aims to put these water affordability issues into a broader context that highlights and addresses the problems at hand in the clearest of terms.

The Panel also recognizes the substantial progress that EPA has made to address the issues of affordability as it relates to the compliance of the Clean Water Act, while maintaining a steadfast focus on the core mission of providing "protection from significant risks to human health and the environment where they live, learn and work"[25] and ensuring that all citizens have the clean, safe water to which they are entitled. The report will also identify opportunities for improvement in this endeavor with a look toward a comprehensive and diverse set of observations and recommendations for improvement.

The following chapters address the evolving challenges of the affordability issue and discuss several key mechanisms and approaches for responding to the problem. These mechanisms include utilizing flexibilities of schedule development (i.e., extending the compliance timeline via affordability assessments of burden); introducing programmatic efforts such as IP and innovative solutions to reduce the cost of compliance; and utilizing innovative financing instruments and strategies to manage the cost of capital.

[25] U.S. Environmental Protection Agency, *Our Mission and What We Do*. https://www.epa.gov/aboutepa/our-mission-and-what-we-do

Chapter 2: Water Affordability Issues – A Growing Concern

An array of water affordability issues currently confronts water utilities, their recipient customers, and water industry stakeholders in different ways. Water affordability issues from the utility or service provider's perspective center on the need to maintain, repair, and replace aging and deteriorating water infrastructure systems, provide safe and sanitary water services to its customers, and meet national water quality goals established in the Clean Water Act (CWA) and regulatory requirements mandated by the Safe Drinking Water Act (SDWA). Affordability from the customer or user perspective focuses on their ability to pay for essential water services while paying for other basic needs.

Several industry experts (Manuel Teodoro, Jon Davis, Eric Rothstein) prefer to use different terminology for utility and customer affordability issues. Teodoro and Davis use the term **financial capability** – "the ability of the utility to pay for the capital and operations cost associated with providing safe and reliable water and wastewater services" – for utility affordability issues. They define **affordability** as "the ability of individual customers to pay for water and wastewater services that are adequate to meet their basic needs, while maintaining the ability to pay for other essential costs."[26]

Utility Financial Capability Challenges

Utilities providing water services face a number of significant financial challenges while attempting to meet their national water quality goals. Those challenges that can diminish their financial capability to meet those goals include poor and aged condition of their water infrastructure, deferred maintenance, unequal distributions of costs and service requirements, declining rate bases, and low levels of federal assistance relative to other national infrastructure needs. Not all utilities face all of these challenges and the extent and severity of the challenges vary among those utilities facing specific challenges. But the cumulative effect of these financial challenges help explain the financial burdens many utilities bear in meeting both their water service requirements and water quality goals.

In its 2017 report on the state of U.S. infrastructure, the American Society of Civil Engineers (ASCE) rated the nation's clean water infrastructure a D+ and the nation's drinking water infrastructure a D. These quadrennial ratings have shown little improvement since 1998. ASCE notes that a D rating indicates a poor, at-risk condition for the infrastructure, reflecting below standard conditions and a large volume of systems approaching the end of their effective service life.

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[26] Davis, Jon, P. and Teodoro, Manuel, P., *Financial Capability and Affordability,* Chapter 22 in Water and Wastewater Financing and Pricing, Fourth Edition, ed. by George Raftelis. New York: Taylor & Francis p.443-466.

In light of the dismal ASCE infrastructure report card, local communities and their water utility service providers face substantial investment costs over the next 20 years to repair, replace, and improve their aging water infrastructure. EPA's latest quadrennial surveys indicate the total investment need for drinking water infrastructure to be $384.1 billion over the 2011-2030 period.[27] In 2012, an EPA report estimated clean water infrastructure needs to be $271 billion over the 20 year period of 2012-2031.[28] Additionally, the American Water Works Association (AWWA) developed an alternative survey of water infrastructure investment needs indicating drinking water investment needs and operations and maintenance costs over the next 25 years to be $1 trillion.[29]

In addition to the costs of updating water infrastructure, achieving CWA and SDWA goals adds substantial costs to the financial challenges local communities and their utility service provider's face. In its 2004 report to Congress on Combined Sewer Overflows (CSOs), EPA estimated that the costs required to achieve its goals for containing CSOs were over $50 billion, while the costs to control Sanitary Sewer Overflows over the next 20 years exceeded $88 billion.[30] This did not include additional costs for meeting other CWA and SDWA water quality goals outside of CSO control mandates.

Another facet of this problem is that these financial challenges are not evenly distributed among all utility service providers. Moreover, the diverse structure of the water industry compounds these aggregate financial challenges. According to EPA, there were more than 14,748 publicly owned treatment works (POTWs) serving 76% of the US population (238.2 million) in 2012. About 80% of these POTWs (11,571) serve small communities – those with populations under 10,000. These smaller POTWs serve an estimated 22.2 million people – about 7% of the US population. In addition, there were another 4,846 decentralized or satellite clean water systems serving 29.6 million users, but this was only about one half of the population served by small independent systems such as septic tanks, chemical toilets, etc.[31]

Many of these smaller utilities lack the rate base to pay for substantial new investment costs and may also lack access to capital markets to obtain necessary financing. Even some of the larger utilities, especially those in the Northeast and Midwest with declining populations and large fixed costs, face unique challenges as highlighted in a recent Government Accountability Office

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[27] U.S. Environmental Protection Agency, *Report to Congress: Drinking Water Infrastructure Needs Survey and Assessment,* April 2013.

[28] U.S. Environmental Protection Agency, *Report to Congress: Clean Watersheds Needs Survey*, January 2016.

[29] American Water Works Association, *Buried No Longer: Confronting America's Water Infrastructure Challenge,* 2013. (The differences in the estimated drinking water infrastructure investment costs between the AWWA survey and EPA's survey may reflect differences in the time frames covered [e.g. 20 versus 25 years], the sampling design and response rates for utilities surveyed, and the types of costs included [e.g. AWWA included O&M costs in their estimate].)

[30] U.S. Environmental Protection Agency, *Report to Congress: Impacts and Control of CSOs and SSOs*, August 2004, p. ES-10.

[31] U.S. Environmental Protection Agency, *Report to Congress: Clean Watersheds Needs Survey*, January 2016.

report.[32] Adding to these financial challenges is the declining federal share of water infrastructure costs over the last decade. As Dr. Richard Anderson has documented, "federal financial assistance to local government for public water and wastewater has been flat since the mid to late 1980s; and has declined as a proportion of total investment."[33] This declining federal share is only likely to continue given the federal fiscal challenges and impending budget reductions in domestic spending programs.

Figure 5, comparing federal infrastructure spending on various forms of infrastructure relative to state and local spending, documents the substantial burden localities bear for water infrastructure relative to other infrastructure spending. Clearly, the federal government spends less on water infrastructure needs relative to most other infrastructure. Local government continues to be the predominant source of spending on water and wastewater services, based on analyses of Census data on local government finances and expenditures. As Dr. Anderson has noted, "the local spending share on sewer is about 95 percent; and the local spending share on water supply is upwards of 99 percent."[34]

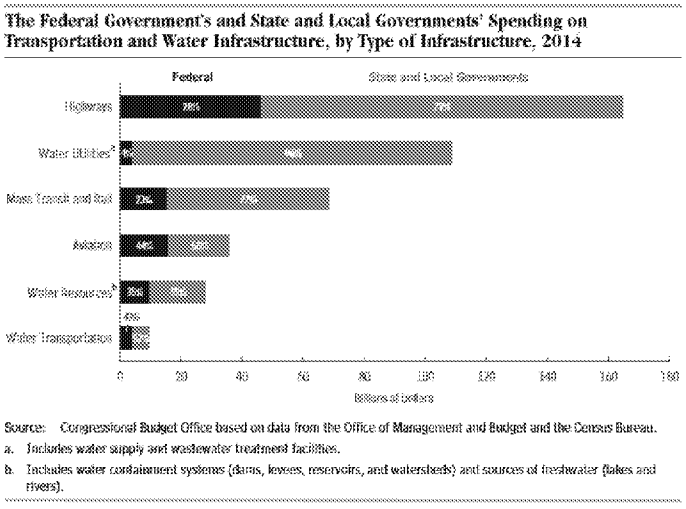

Figure 5. Difference in Federal/Local Spending on Water Infrastructure

[32] U.S. Congress. House. Committee on Energy and Commerce, Subcommittee on Environment and the Economy, *Water Infrastructure: Information on Selected Midsize and Large Cities with Declining Populations,* 114th Cong., September 2016.

[33] Anderson, Richard, F., *Trends in Local Government Expenditures on Public Water and Wastewater Services and Infrastructure: Past, Present and Future,* February 2010, p. iv.

[34] Anderson, *Growth in Local Government Spending on Public Water and Wastewater – But How much Progress Can American Households Afford*, April 2013 p. 6.

Ratepayer Affordability Issues

From the customer or user perspective, affordability reflects the user's ability to pay for the quality water services they expect to receive. These water services include both drinking and clean water services. Although recognized as a basic human right by the United Nations General Assembly through Resolution 64/292, water is not free.[35] In fact, the water industry generally operates on a "user pay" principle and many states require utilities to charge customers based on the costs of service provided. Yet, despite water affordability problems, in the aggregate, water costs are low relative to other utilities and consumer expenses.

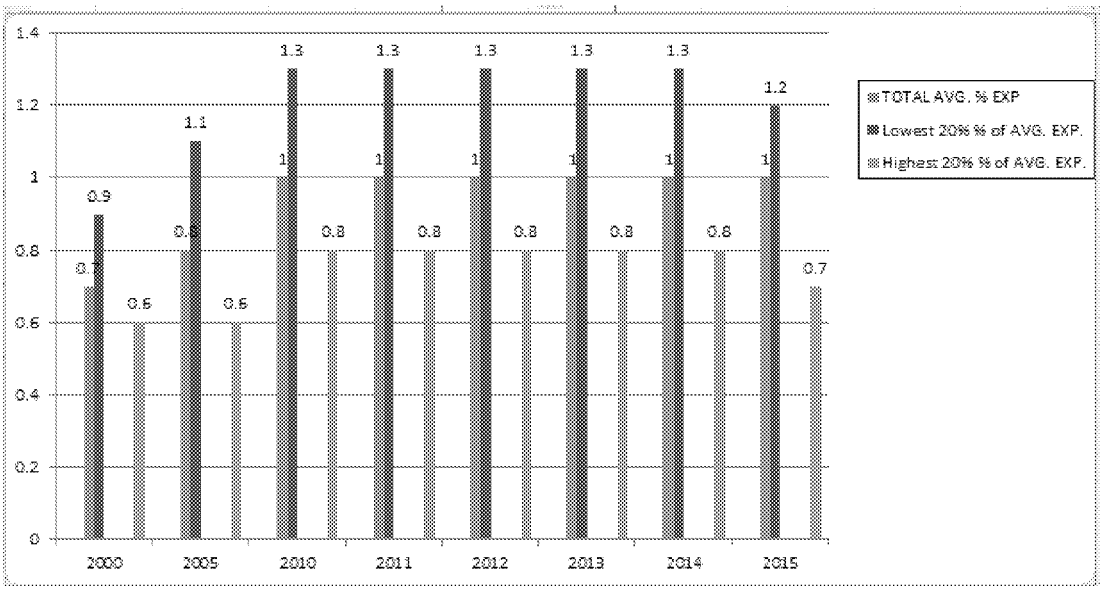

Figure 6. Percent of consumer expenditures on water and other services for lowest and highest income quintile consumers. Source: NAPA, based on Bureau of Labor Statistics data.

Low-income users' water bills account for a larger share of total low-income household expenditures than higher income households. Bureau of Labor Statistics (BLS) consumer expenditure data (Figure 6) indicate that the lowest income quintile commits 40% more of its total expenditures on water[36] than the highest income quintile.

Over the past 15 years, water rates have increased faster than the Consumer Price Index (CPI) and personal income levels. These adverse trends are even more pronounced for low-income users. As Figure 7 shows, low-income consumers – the lowest quintile – had their share of

[35] General Assembly Resolution 64/292, *The human right to water and sanitation,* A/64/PV.108, July 28, 2010, available from http://www.un.org/en/ga/64/resolutions.html

[36] The BLS consumer expenditure glossary defines consumer expenditures on water and other public services as "water and other public services, such as garbage and trash collection, sewerage maintenance, septic tank cleaning". Both drinking water and clean water costs are included in this consumer expenditure category.

expenditures for water and electricity increase substantially faster than higher income consumers over the 2003-2013 period.

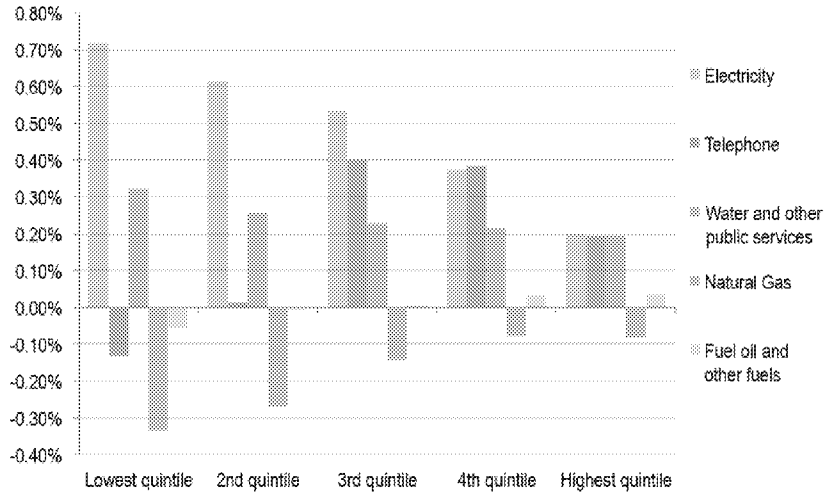

Figure 7. Changes in Percentage of Consumer Expenditures on Utilities by Income Quintile (2003-2013). Source: IPU-MSU based on BLS data, Beecher (2015).

Based on survey responses from their members (167 responses in their 2016 survey), the National Association of Clean Water Agencies (NACWA) has developed a cost of clean water index. These NACWA data, displayed in Figure 8, show that average annual service charges for clean water services have significantly outpaced annual CPI increases over the last 16 years. As the NACWA report notes, "from 2002 to 2016, the average annual service charge (for clean water services) has doubled from $239 to $479…(while) the CPI has increased only 33 percent."[37] This trend in increased clean water costs has had a particularly significant impact on low-income users. NACWA compared the national average annual clean water charges to national poverty level incomes for a family of four. "The average annual sewer charge of $479 (in 2016) represents 1.97% of the 2016 Federal poverty income threshold ($24,300) … and this proportion has risen from 1.3% in 2000."[38] National averages mask substantial variations among states, localities, and other geographical areas. But the NACWA data do indicate that the most economically vulnerable users – poverty households – may currently be facing clean water affordability problems that middle and higher income users are not confronting even using aggregate national averages. This is illustrated in the City of Baltimore, which has an MHI of $39,386 but where 26% of the population has income below the poverty line, and 12% below 50% of the poverty line.[39]

[37] National Association of Clean Water Agencies, *2016 Cost of Clean Water Index*, May 18, 2017, p. 1.
[38] Ibid., p. 1.
[39] City of Baltimore, Department of Public Works, *[reply to] NAPA Request for Information*, September 8, 2017.

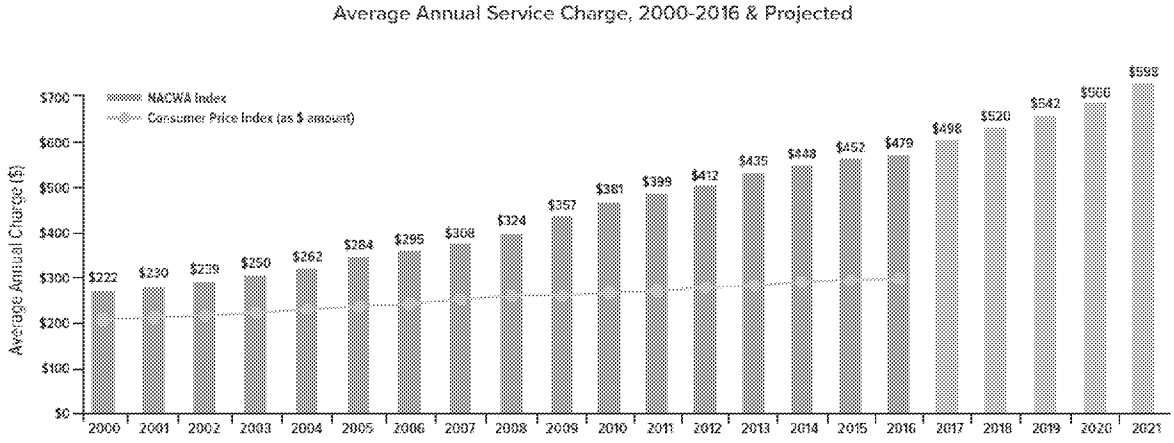

Figure 8. Average Annual Service Charge from 2000-2016 and Projected. Source: National Association of Clean Water Agencies, *2016 Cost of Clean Water Index*, May 18, 2017, p. 2.

Income trends over the past decade have also been more adverse for low-income households, as higher income households have realized the bulk of the income increases over that period. Consequently, these low-income households are more vulnerable to rate increases and potential service interruptions or cut-offs because they have fewer financial assets and resources and expend more of them on basic necessities, including water and wastewater services.

2.1 Balancing Financial Challenges with Water Quality Goals

Notwithstanding these affordability issues and other financial challenges confronting them, communities are tasked with achieving pollutant limits set by Water Quality Standards (WQS). Yet, CWA and SDWA, in establishing water quality goals, also acknowledged the need to recognize potential financial limitations confronting communities, utilities, and others charged with meeting those goals. For example, the SDWA [PL 104-182] states in Sec 3 8(c) – (the Congress finds that) "more effective protection of public health requires prevention of drinking water contamination through well-trained operating water systems with adequate managerial, technical, and ***financial capacity***." Section 9 further states that "compliance with the requirements of the SDWA continues to be a concern at public water systems experiencing technical and ***financial limitations***."

EPA policies and guidance on implementation of the CWA explicitly recognized the need to consider financial capabilities. These include: the National Combined Sewer Overflow (CSO) Control Strategy issued on August 10, 1989 (1989 CSO Control Strategy) and the Combined Sewer Overflow (CSO) Control Policy published on April 19, 1994 (1994 CSO Control Policy), which confirmed that CSO overflows were covered by the CWA and subject to National Pollutant Discharge Elimination System (NPDES) permit requirements.

The 1994 CSO Policy provided that implementation schedules for CSO controls could be phased, based on certain environmental priorities and on a permittee's financial capability,[40] and the Policy further elaborated by describing several economic and financial factors and stating that "such factors as" those should be considered in assessing financial capability.[41] The requirements of the 1994 Policy were subsequently enacted into law by reference in the CWA.[42]

In 1995, EPA provided more explicit guidance to assist states and permittee applicants in understanding the economic factors affecting permittee financial capability. The document was titled Interim Economic Guidance for Water Quality Standards: Workbook (1995 Interim Economic Guidance).[43] This Interim Economic Guidance distinguished between "financial impacts" and "socioeconomic impacts" – "the term 'financial impacts' refers to impacts on the entity or party that will pay for the pollution control whereas the term 'socioeconomic impacts' refers to changes in the social and/or economic conditions of the affected community."[44] The guidance also reflected EPA regulations requiring that adverse impacts warranting some regulatory relief must be both 'substantial' and 'widespread.' In short, "only demonstrating substantial financial impacts is not a sufficient reason to modify a use or grant a variance from water quality standards. Rather, the applicant must also demonstrate that compliance would create widespread socioeconomic impacts on the affected community."[45]

The Interim Economic Guidance proposed a two-part test. The first part examines whether the permittee can pay for the required investment by estimating costs per household or residential user. The second part examines the permittee's ability to obtain financing given its current financial strength and underlying socioeconomic conditions.

The 1994 CSO Policy and the subsequent Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development (1997 FCA Guidance) both recognized "the need to address the relative importance of environmental and financial issues when developing

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[40] 1994 CSO Control Policy, 59 Fed. Reg. 18688, 18694 (April 19, 1994).

[41] The 1994 CSO Control Policy states: "Construction phasing should consider: . . . / c. The permittee's financial capability including consideration of such factors as: / i. Median household income; / ii. Total annual wastewater and CSO control costs per household as a percent of median household income; / iii. Overall net debt as a percent of full market property value; / iv. Property tax revenues as a percent of full market property value; / v. Property tax collection rate; / vi. Unemployment; and / vii. Bond rating; / d. Grant and loan availability; / e. Previous and current residential, commercial and industrial sewer user fees and rater structures; and / f. Other viable funding mechanisms and sources of financing." Ibid.

[42] Section 402(q)(1) of the CWA, as codified at 33 U.S.C. § 1342(q)(1), states: "Each permit, order, or decree issued pursuant to this chapter after December 21, 2000, for a discharge from a municipal combined storm and sanitary sewer shall conform to the Combined Sewer Overflow Control Policy signed by the Administrator on April 11, 1994 (in this subsection referred to as the 'CSO control policy')." . Enacted by Public Law 106-554 (December 21, 2000).

[43] U.S. Environmental Protection Agency, Office of Water, *Interim Economic Guidance for Water Quality Standards–Workbook*, EPA-823-B-95-002, March 1995, https://www.epa.gov/sites/production/files/2016-03/documents/econworkbook-complete.pdf

[44] Ibid., 1-2

[45] Ibid., 1-5

an implementation schedule for CSO controls to be contained in the LTCP [long term control plan]"[46] developed and approved in either the NPDES permit process or other enforcement processes (e.g., consent decrees).

The 1997 FCA Guidance noted that "NPDES permitting authorities should consider the financial capability of permittees when reviewing CSO control plans."[47] More specifically, the 1997 FCA Guidance identified two separate components – the Residential Indicator (RI) to reflect a permittee's ability to pay higher costs based on the impact on its users, and the Financial Capability Indicator (FCI) to reflect the permittee's ability to obtain financing for and maintain the investment.

The Residential Indicator (RI) used to assess ratepayer impacts is the ratio of total annual wastewater and CSO control costs to median household income (MHI) in the service area, with ratios exceeding 2% deemed to be "high burden". The Financial Capability Indicator (FCI) used to assess a community's financial capacity includes six separate metrics to examine the community's financial condition, socioeconomic status, and financial management strength. The six measures are detailed in Figure 9 from EPA's 1997 FCA Guidance.

[46] 1997 FCA Guidance, page 6, referring to the 1994 CSO Control Policy, 59 Fed. Reg. 18688, 18694.
[47] U.S. Environmental Protection Agency, Office of Water, *Combined Sewer Overflows–Guidance for Long-Term Control Plan*, EPA 832-B-95-002, September 1995, p. 3-4, https://www3.epa.gov/npdes/pubs/owm0272.pdf

Indicator	Strong	Mid-Range	Weak
Bond Rating	AAA-A (S&P) Baa (Moody's)	BBB (S&P) Baa (Moody's)	BB-D (S&P) Ba-C (Moody's)
Overall Net Debt as a Percent of Full Market Property Value	Below 2%	2% - 5%	Above 5%
Unemployment Rate	More than 1 Percentage Point Below the National Average	+/- 1 Percentage Point of National Average	More than 1 Percentage Point Above the National Average
Median Household Income	More than 25% Above Adjusted National MHI	+/- 25% of Adjusted National MHI	More than 25% Below Adjusted National MHI
Property Tax Revenues as a Percent of Full Market Property Value	Below 2%	2% - 4%	Above 4%
Property Tax Collection Rate	Above 98%	94% - 98%	Below 94%

Figure 9. Permittee Financial Capability Indicator Benchmarks

The commonly-held principle in the water industry of user pay for water services ensures a degree of interdependence between the users' (the RI component) and the utilities/water service providers' (the FCI component) affordability issues. This is because the utilities must recover increased costs from users through higher water bills. Thus, the 1997 FCA Guidance combined both components to determine the severity of a permittee's financial burden imposed by the proposed CSO control costs.

The matrix in Figure 10 was also included in the 1997 FCA Guidance. The matrix suggests that if the FCI component was deemed weak, a local community or utility could be deemed highly-burdened even if the RI component did not exceed 2% MHI. However, many stakeholders continue to believe that many EPA regional and state enforcement staff focus exclusively on the RI component.

Permittee Financial Capability Indicators Score (Socioeconomic, Debt, and Financial Indicators)	Residential Indicator (Cost Per Household as % of MHI)		
	Low (Below 1.0%)	Mid-Range (Between 1.0 and 2.0%)	High (Above 2.0%)
Weak (Below 1.5)	Medium Burden	High Burden	High Burden
Mid-Range (Between 1.5 and 2.5)	Low Burden	Medium Burden	High Burden
Strong (Above 2.5)	Low Burden	Low Burden	Medium Burden

Figure 10. Financial Capability Matrix

2.2 Financial Capability Assessment (FCA) Guidance Limitations

2.2.1 Stakeholder Identified Residential Indicator (RI) Metric Deficiencies

Although the metrics EPA used for both RI and FCI components were extensively criticized by a wide range of stakeholders, the metrics for the RI component were the most severely challenged. The stakeholders challenging the adequacy and accuracy of the metrics for the 1997 RI component included EPA's Environmental Financial Advisory Board (EFAB), the Council of Mayors and other governmental entities, water industry groups including NACWA, AWWA, Water Environment Federation (WEF), academics (Jeff Rexhausen, Manuel Teodoro, Jon Davis, and Janice Beecher), consultants (Jason Mumm and Eric Rothstein), and other stakeholders.

Some of this RI criticism may also reflect the fact that the RI component was considered the first test in the 1997 FCA Guidance. If a permittee was not facing a high RI burden, the secondary measures for the FCI component alone would not be sufficient to warrant an extended regulatory compliance schedule. EPA noted from the start that the RI component was not really intended to address specific user affordability issues, but rather focused on an overall assessment of general user ability to bear higher costs and thus the ability of the permittee to assure capital markets of its ability to repay borrowings needed to finance the required CSO control investments.

Notwithstanding that caveat, stakeholders cited the following major deficiencies in the 1997 RI metric:

- *Not focused on the poor or most economically vulnerable users* – Using MHI did not accurately reflect the impact on the most vulnerable households, the low-income users least able to absorb higher water bills.

- *Incomplete water cost measure* – The RI numerator only included a limited set of wastewater costs, not all water (drinking and all wastewater) costs or water bills actually paid.

- *Basis of 2% threshold unknown and inherently subjective* – The 1997 FCA Guidance contained no methodological or theoretical explanation for the derivation of the 2% MHI threshold. Moreover, any normative threshold defining high burden or unaffordability of water rates is inherently suspect given the wide range of economic factors affecting affordability issues. As Stacy Isaac Berahzer at the University of North Carolina's Environmental Finance Center notes "there is no perfect way to measure affordability."[48]

- *Static metrics ignore critical trends* – The 2% threshold has been unchanged since the early 1990s, while water affordability issues for low-income users have intensified as water costs have increased faster than other utilities, CPI and income growth, and as lower-income households have suffered static income growth over the past decade.

BLS consumer expenditure data indicate that the lowest quintile share of expenditures on water increased over 40% from 2000, but still only spent 1.3% of total expenditures on 'water & other public services'. As shown in Figure 11, water CPI increases exceed actual water expenditures increases since users, even the lowest quintile, reduce water usage as prices increase.

[48] Walton, Brett, *Water Systems Need Investment and Affordability*, Circle of Blue, November 24, 2016, http://www.circleofblue.org/2016/united-states/water-systems-need-investment-affordability/

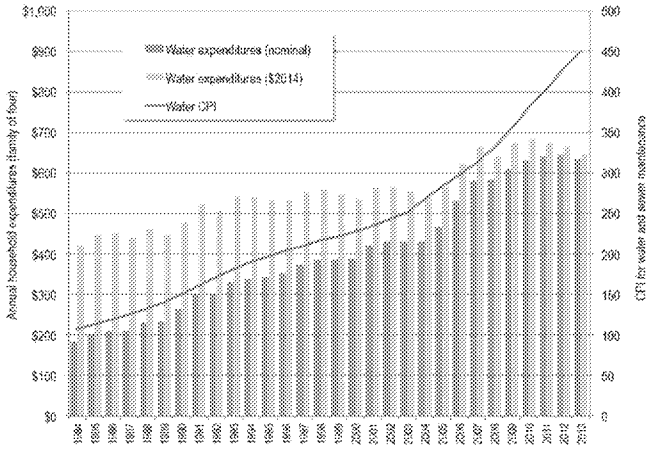

Figure 11. Expenditure and Price Trends for Water. Source: IPU-MSU, Beecher (2016).

2.2.2 Stakeholder Identified Financial Capability Indicator (FCI) Metric Deficiencies

Stakeholders also cited a number of limitations for the 1997 FCI metrics including:

- Utilities providing wastewater and other water services to local residents are often separate from, if not independent of, the local community and all of the FCI metrics focus on the community's financial, socioeconomic, and managerial conditions.
- Bond ratings may not exist for many of the smaller utilities and often have a scale bias.
- Several measures are highly correlated with each other or duplicate other measures.
- All the measures are "static" and do not reflect critical trends.
- The debt measures did not include revenue bond debt or other long-term obligations such as pension liabilities.

Clearly, a utility's ability to absorb increased costs depends upon its operating efficiency and current profitability, its outstanding debt burden, its other investment requirements to maintain or expand water services, and its ability to raise water rates. A utility that is currently meeting its total operating costs with its operating revenues is obviously better able to accommodate additional costs required to meet clean water goals than a utility incurring operating losses. Similarly, a utility with a low current debt burden is more likely to access capital markets to borrow and/or obtain a lower interest cost for any additional borrowing needed to meet clean water goal investment requirements than a utility with a higher debt burden. Where utilities face explicit statutory debt limitations, those with higher debt burdens may not even have a borrowing

alternative. Utilities that have deferred maintenance on their assets or have older assets with greater maintenance needs also are less likely to be able to absorb additional costs to meet clean water goals. Finally, utilities with statutory limitations on their ability to raise rates or with high current rates and a declining and/or poor ratepayer base will also face greater challenges in raising rates to fund any higher clean water goal costs than others. The 1997 FCI metrics did not directly measure any of these elements assessing the utility's financial strength, debt burdens and managerial capabilities or limitations – especially its ability to increase rates to generate additional revenues.

2.2.3 EPA's 2014 FCA Framework

In response to these stakeholder-identified limitations in its original 1997 FCA Guidance metrics EPA issued its 2014 Financial Capability Assessment Framework for Municipal Clean Water Act Requirements (2014 FCA Framework) that more clearly articulated the types of additional data communities could provide beyond the 1997 FCA Guidance metrics to document their burden in meeting current clean water costs. However, EPA retained the 1997 FCA Guidance metrics, while allowing communities to supplement that initial information. This was done for two reasons: 1) they wanted to have a common set of measures applicable to all communities to provide a consistent starting point; and 2) many smaller communities might not be able to afford or have the management capacity to develop and present more complex measures of their economic and financial burden.

The number of permittees designated as highly-burdened under either the original 1997 FCA Guidance or the 2014 FCA Framework is not known or clearly documented. A 2013 paper by NACWA asserted that, "before 2007 no major metropolitan permittee had been deemed to face a 'high burden' enabling schedule relief under the 1997 FCA Guidance. Since then, several communities (Honolulu, Kansas City, St Louis Metropolitan Sewerage District, Northeast Ohio Regional Sewer District and MSD Greater Cincinnati) have been acknowledged as facing such a burden and granted over 20-year compliance schedules."[49] These subsequent 'high burden' findings for these specific communities appeared to be due to extensive efforts to develop and present substantial additional supplementary data to document severe and widespread affordability issues and financial limitations.

In light of this, many stakeholders perceive that, in certain regions, EPA regional staff, state regulators, and enforcement staff still rely almost exclusively on the 2% MHI test for assessing a permittee's level of burden from mandated CSO control costs, notwithstanding EPA's view that EPA is providing flexibility to permittees in assessing financial capacity and excessive burden.[50]

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[49] National Association of Clean Water Agencies, *The Evolving Landscape for Financial Capability Assessment: Clean Water Act Negotiations and the Opportunities of Integrated Planning*, May 2013.

[50] EPA HQ enforcement staff note that HQ enforcement staff are involved in all judicial CD's and that this involvement provides an opportunity to share information on the resolution of individual CSO control disputes to help assure some consistency in individual CSO dispute resolutions among and within regions. This information

Several stakeholders cite this as a problem particularly in EPA's mid-west Region 5 (Illinois, Indiana, Michigan, Minnesota, Ohio and Wisconsin). But this may simply reflect the fact that Region 5 contains a significant percentage (over 46%) of the CSO permits[51] granted.

The Panel finds that EPA's 2014 FCA Framework, including the original 1997 FCA Guidance, appropriately distinguished between users' ability to pay – the RI component – and a utility/service provider's financial capabilities – the FCI component. EPA's 2014 FCA Framework did reaffirm its flexibility and willingness to consider additional data to assess the level of burden imposed on permittees, but still retained the original 1997 FCA Guidance metrics for both the RI and FCI components. The metrics used in the 1997 FCA Guidance to measure the RI and FCI components were inadequate metrics for assessing low-income ratepayers ability to pay and the financial conditions of the utility providing wastewater services.

2.2.4 A Desired Common Starting Point

Consistent with their 2014 FCA Framework EPA asserts they will continue to remain flexible in allowing permittees to submit additional supplementary data to document their claims that the required investments to meet CWA goals impose an excessive burden. However, EPA believes it needs to maintain a simple, transparent formulation for its FCA guidance to ensure a common starting point for all permittees, even though EPA will consider supplementary data in determining the level of burden imposed on the permittee.

This belief acknowledges that both sides of the negotiation require simple, readily available, and clearly understood metrics for the RI and FCI components in any updated FCA framework. One reason for establishing a common starting point is the need to ensure that the smaller systems that lack the necessary resources and expertise to develop more complex and sophisticated models are not disadvantaged at the start of the negotiation. In other words, a common starting point helps to assure all permittees consistent consideration at the start of any negotiation.

The deficiencies in the metrics used for the RI and FCI components in the 1997 FCA Guidance, cited by various stakeholders and described above, limit the ability of those metrics to establish an acceptable and equitable common starting point.[52] Given these limitations, EPA will need some improved metrics to provide a useful common starting point for all permittees.

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sharing, however, appears to be on an informal basis, not through an established, formal management information system and is not shared with others, especially other permittees. The lack of a formal management system containing these types of data makes it difficult to evaluate the consistency and equitability of all negotiated CSO control CDs.

[51] U.S. Environmental Protection Agency, *Report to Congress: Impacts and Controls of CSOs and SSOs*, August 2004. (Figure 4-1, p 4-14 indicates that region 5 had 387 of the 828 CSO permits granted.)

[52] As the 1997 FCA Guidance memo notes [p7] "the financial indicators do provide a common basis for financial burden discussions between the permittee and EPA and state NPDES authorities". Both the 1997 FCA Guidance and the 2014 FCA Framework also encourage permittees to submit supplemental data, but there remains the strong desire to have a common, simple starting point that is equitable for all permittees.

Some EPA staff are concerned about the adverse impact on current consent decrees if the current FCA framework is substantially revised. Since the 1997 FCA Guidance was used during the negotiation of most consent decrees and hasn't been changed in 20 years, any significant changes to that Guidance could change the burden assessment for specific litigants, thus generating demands to reopen their consent decrees. This, in turn, could significantly increase workloads for regional EPA and state enforcement staff. Some have also noted that, if any proposed changes to EPA's FCA policies are inconsistent with the requirements of the 1994 CSO Control Policy that have been enacted into law,[53] those proposed policy changes would be permissible only if allowed by statutory amendment.

2.3 Alternatives for improving current metrics for RI and FCI

2.3.1 Stakeholder Proposed Alternative Residential Indicator Metrics

Many of the stakeholders who criticized the 1997 RI metrics used by EPA have also proposed alternative metrics to improve the effectiveness of the RI component in measuring user affordability issues. Most have focused on the need to examine the impact on the most vulnerable users – low-income users. Many have also suggested a change in the numerator of the RI metric to include additional water costs beyond the limited wastewater treatment and CSO costs in the original 1997 formulation. Others have raised questions about the basis of the threshold used to determine the degree of burden – more specifically the appropriateness (much less the derivation) of the 2% of MHI standard. Some have also suggested including additional elements within the RI components to reflect the extensiveness of low-income users' impact and a dynamic element to assess potential changes in current conditions.

The RI Options table compares the 1997 RI component metrics to the slight changes in the 2014 revisions and to alternatives proposed by various stakeholders that suggest different changes in the costs measured, the household or user income used, and other measures to determine high or excessive user burden.

[53] As noted above, the requirements of the 1994 Policy were enacted into law by reference in section 402(q)(1) of the CWA, 33 U.S.C. § 1342(q)(1).

Residential Indicator Alternatives			
Options	**WATER COSTS INCLUDED**	**HOUSEHOLD INCOME**	**OTHER METRICS**
EPA 1997 Formula	CSO/SSO Costs	Median Household Income (MHI)	• Cost/MHI greater than 2% = High burden
EPA 2014 Framework	CSO/SSO Costs + Stormwater Costs	MHI	• **Supplementary data** o Quintile income distribution national average o Poverty rates and trends • **Supplementary data** o Clean water costs per income quintile
EFAB 2007	All Water Costs	Income by Quintile	• Projected water costs and income levels • Composite metric including Poverty rate and Income distribution
EFAB 2014	All Water Costs	Income by Quintile Income by geographic area (e.g., Census tracts)	• **Trends and projections of costs and income** • **Composite metric including** o Poverty rate + income distribution o Cost of living differences o Housing cost burden (renters + owners) o Non-residential user impacts
Mayors/AWWA 2013	Average Water Bill	Income by Quintile Income for poor, elderly, or renters Income for poor areas	• Non-discretionary expenses as % of income by Quintile • Poverty Rate • High Housing Cost Burden • Percentage of the population eligible for LIHEAP
NACWA 2013	Projected Water Bill	Income by Quintile—especially Lowest Quintile (LQI) projected	• Burden on Sub-populations within service area

Figure 12. Residential Indicator Alternatives

More Comprehensive Cost Measures

Most of these alternatives propose that the costs included in the RI component be expanded beyond those used in the 1997 FCA Guidance or the 2014 FCA Framework to include either all clean water costs, or average water bills paid (thus including drinking water as well as all clean water costs).Total water costs can include proposed investments for maintenance, repair or expansion of current water infrastructure as reflected in approved capital improvement plans and planned expenditures to address deferred maintenance or maintenance backlogs. Some alternatives propose projecting current total water costs to incorporate these planned investments and other likely costs increases. While the specific metrics may vary, there is a general consensus that the 1997 RI metric did not include all critical water costs that the utility faces and includes in ratepayer water bills. In short, the RI component does not include all water costs borne by ratepayers, particularly low-income users.[54] For simplicity, these total water costs are

[54] Given the diversity of organizational structures within the water industry, not all wastewater utilities provide both waste water and drinking water services. However, even when users receive drinking water and waste water services from separate utilities, they still must pay both water bills. The total water bill burden remains the same

usually formulated as an average cost per household or user. But using an average total water cost or average water bill can overstate water costs for lower income users, since water usage increases with income levels.[55] Unfortunately, it is not clear if utilities have readily available data on actual bills paid by lower-income users. However, if EPA chooses to compare the revised individual utility RI to some group average (e.g., state or regional averages), this may mitigate the bias, since utilities within the comparison group are likely to have a similar bias.

Another factor to consider is that the average water bill or average total water costs, including proposed CSO control costs, may not reflect the total water costs actually paid by users, if the community subsidizes water costs through general fund transfers. While the user-cost principle and the substantial other demands on local budgetary resources suggest such transfers are unlikely to be widespread and/or extensive, the actual extent of such broader taxpayer subsidization of utility water costs is not readily available. Despite these caveats, including a broader measure of total water costs in the RI metric has wide support among stakeholders.

Measuring Low-Income User Affordability

Most stakeholder suggested alternatives emphasize the importance of a better household or user income measure than MHI to identify the impact of water rate increases on the most vulnerable users – low income households in the local service area. Perhaps the most critical and consistent criticism of the 1997 RI component was its use of MHI to examine user affordability issues. Clearly, MHI is too broad an income measure to reflect the impact of water rate increases on low-income users. While several alternatives suggest using the income for the lowest quintile – this actually represents the median for the two lowest quintiles – others have suggested some variation of poverty income levels as a better indicator of the impact on low-income users than the current MHI measure.

It is important to note, as multiple stakeholders maintain, that any form of household income measure does not address water affordability issues for low income renters who may not have separate water bills and who may be a substantial portion of the service area's low-income users.[56] Unfortunately, it is not clear if water usage differs significantly between low-income renters and homeowners, nor how rents adjust to increases in water rates. Several studies have indicated significant price elasticity for water rates. Thus, users reduce their water consumption in response to rate increases. Since many renters are not charged directly for their water usage, their consumption may not be as sensitive to rate increases as low-income homeowners or other users who are billed directly for their water use. Notwithstanding this caveat, stakeholders agree

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for users -- whether combined or two separate bills -- and this is one of the two critical components – RI and FCI -- in assessing financial burden.

[55] Osann, Ed, *Flawed Analysis Muddies the Water on Water Affordability*, National Resource Defense Council, June 20, 2016, https://www.nrdc.org/experts/ed-osann/flawed-analysis-muddies-water-water-affordability

[56] Ibid.

that use of MHI masks the severity of potential affordability issues for economically vulnerable low-income users.

Extent of Low-Income Affordability Issues

Several of the alternatives for improving RI metrics also include an additional adjustment to measure not only the severity of low-income water affordability issues, but also how widespread or extensive those issues are among all users within the utility's service area. As noted earlier, EPA's guidance for considering some possible extended regulatory compliance schedules requires that the adverse impact on users be both 'substantial' and 'widespread'. A common metric used to assess the extensiveness of low-income user affordability is the percentage of poverty in the local service area.

Even wealthy communities can contain "pockets of poverty" or distressed neighborhoods, where low-income users could face severe water affordability issues. However, it is important to focus on communities with substantial poverty problems, indicating that the low-income user burden is not only substantial but widespread as well. Extensive poverty in a service area can also indicate the presence of other significant economic structural issues adversely affecting the utility's market conditions.

The 2% Threshold

Since the start of this review, Academy staff have sought an explanation for the derivation of this simple, widely applied 2% of MHI standard for determining excessive burden for clean water users. Several analysts have speculated about the origins of that elusive standard, but no definitive methodological basis for the standard has emerged.[57] The standard is not consistent with BLS consumer expenditure data presented earlier in this chapter. It also appears inconsistent with economic theory that would suggest that water and sewer expenditures must be weighed against both the costs of a range of other basic necessities (e.g., housing, food, health care, clothing, energy, transportation) and available discretionary income to determine the severity of impact from water rate increases. As Dr. Teodoro has succinctly stated, "the 2% standard appears to emerge from the agency's (EPA's) 1997 guidelines on Combined Sewer overflow compliance schedule (EPA 1997) though that document offers no theoretical or empirical rationale for the 2.0 standard."[58]

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[57] EPA maintains that the 2% standard was developed using data developed circa 1988 to support EPA's then Office of Policy, Planning and Evaluation's [OPPE] Municipality's Ability to Pay Model. Costs of wastewater services as a percentage of household income were calculated and the 2% threshold presumably represented two standard deviations from the average expenditure per household. No documentation describing this methodology, the size of the data sample, the source data, and the actual statistical distribution developed was available for further review. The stability of that analysis over a multiple year period is also unknown, but the trends discussed previously show the importance of updating that initial distribution and analysis.

[58] Teodoro, Manuel P., *Draft Working Paper: Measuring Household Affordability for Water and Sewer Utilities*, June 2017, p. 4.

Even if there were a sound methodological or theoretical basis for the 2% standard, that standard has remained the same since its publication in 1997. But there have been significant changes over the last 20 years that render that static 1997 standard suspect. As shown earlier in this chapter, water rates have increased faster than the Consumer Price Index and income levels over this period. Moreover, income levels for the lower income groups have not increased commensurately with higher income levels, yielding a less vertically equitable income distribution. This failure to adjust to changes over time is another deficiency in the fixed 2% standard and may be one reason why some stakeholders have suggested comparing an individual utility's revised RI to some group average RI to accommodate such potential changes. While there is merit in having a simple, clear standard, that merit is vitiated if there is no empirical or theoretical basis for the standard.

Trends and/or Projections for Key RI Metrics

Finally, another alternative includes the trends in low-income users' costs and incomes, and in area poverty rates to provide a dynamic component to the RI metric. Two permittees may have the same current condition, but the one with an adverse growth trend may be facing a greater challenge than the one with a positive growth trend and perhaps an expectation that the current condition will improve. However, assuming past trends will continue can be problematic unless the reasons for those trends are well understood and can be projected with some degree of confidence. The analyses needed to support such extrapolations may exceed the capabilities of some of the smaller utilities thereby disadvantaging them relative to other utilities seeking relief or adjusted compliance schedules due to claimed affordability issues.

More Elaborate Alternatives

Some academics and water consultants have proposed more elaborate methodologies for defining water affordability issues and improving the RI metric. Both approaches require use of more detailed Census data and additional computations or assumptions that could prove challenging for smaller, less sophisticated utilities. One methodology proposed by Jason Mumm of StemTech – the Weighted Average Residential Index or WARi – involves the "calculation of the weighted-average financial burdens across all income levels, in all Census tracts in a given utility's service area."[59] An alternative RI metric proposed by Professors Teodoro and Davis, is their Affordability Ratio (AR). The AR ratio compares the cost of minimum water services per member of the user household to the available disposable household income after other basic needs have been met. "The numerator of the AR is the price of basic (water) service to a customer, which varies depending on the utility's rates, the per-person volume of service that is considered necessary to maintain health and the number of people occupying the given household. The denominator is the customer's disposable income, which varies depending upon on the customer's after-tax income, less the costs of essential goods and services, such as

[59] Mumm, Jason and Ciaccia, Julius, *Improving the Narrative on Affordability and the Measurements We Need to Take Us There*, American Water Works Association Journal 109(5), 2017, p. 44.

housing, food, health care, and home energy."[60] While these and other creative methodologies illustrate the types of supplementary data that some permittees may want to introduce to document their claim of an extensive excess RI burden, they appear to require additional assumptions and/or additional detailed data and analysis that may exceed the capability or resources of many permittees.

Another alternative not included in either the RI or FCI alternatives tables is one that would not update the 1997 FCA Guidance and instead rely on an approved local integrated plan to set priorities and timetables for meeting CWA and even SDWA water goals. The local integrated plan will reflect the local community's and its utility's financial capability to undertake a full range of investments to improve water infrastructure, reduce CSOs or other pollutants, and meet other community needs while avoiding imposing excessive burdens on local ratepayers and taxpayers. The need to update the 1997 FCA Guidance in this instance will depend upon how EPA plans to use the FCA Guidance in assessing the priorities established in the local integrated plan. The relationship between EPA's FCA Guidance and local integrated plans is discussed more fully in the next chapter.

2.3.2 Stakeholder Proposed Alternative FCI Metrics

Several stakeholders have also proposed different metrics for improving the 1997 FCI Guidance's components. Many of these options for alternative FCI metrics focus on measures of the financial health and strength of the utility providing clean water services and on the underlying market conditions affecting its service area. The organizational structures of water utilities and their relationship to the local community/jurisdiction served vary substantially. Some are privately-owned, while many are publicly owned. Some serve multiple local jurisdictions, while some jurisdictions have multiple utilities. Some publicly owned utilities are independent entities within the local jurisdiction and others are departments within the local jurisdiction's governmental structure. In addition to these organizational differences, the types of water services provided by local water utilities can vary. Some utilities provide a full range of clean water and drinking water services; others may provide only a limited set of clean water services.

These organizational and structural complexities only reinforce the need to focus on the financial strength of the utility providing clean water services. This need is consistent with perhaps the most critical key criticism of the current FCI metrics – the focus of the 1997 FCA Guidance FCI metrics only on the financial strength and socioeconomic conditions for the local jurisdiction.

Alternative metrics proposed by stakeholders to measure the utility's financial strength generally focus on three critical elements: 1) operational efficiency; 2) debt burden; and 3) management effectiveness. But stakeholders also recognize that a utility's financial strength and health can be

[60] Davis, Jon, P. and Teodoro, Manuel, P., *Financial Capability and Affordability,* Chapter 22 in Water and Wastewater Financing and Pricing, Fourth Edition, ed. by George Raftelis. New York: Taylor & Francis p. 455.

affected by key socioeconomic conditions in the utility's market or service area. As the table on the following page illustrates, there are different metrics for assessing all of these critical elements determining a utility's financial strength.

FINANCIAL CAPABILITY INDICATOR ALTER				
	FINANCIAL CONDITION		FINANCIAL MANAGEMENT	
	Operating Ratio	**Debt Burden**	**Collection Rate**	**Other**
EPA 1997 METRIC		• Debt/Total Property Value • Go Bond Rating	Property Tax Collection Rate	Property Total Revenue/ Total Property Value
EFAB METRIC	• Operational Revenue/Operational Costs • Total Operational Revenue • Revenue & Number of Users (size of system • Cash + Liquid Assets/Operational Costs	• Debt Asset + Working Capital • Debt/Use • Net Revenue/ • Yearly Debt Service	Water Bill Collection Rate	Bad Water Debt/Total Water Accounts
MAYORS/ AWWA2013 **METRIC**	Trend in local Revenue	• Total long-term debt +obligations /Total Property Value • Legal Debt Ceiling	Utility Collection Rates	

Figure 13. Financial Capability Indicator Alternatives

NATIVES			
	SOCIO ECONOMIC CONDITIONS		
	Popula-tion Change	**Wealth/ Growth**	**Structural Problems**
		Local Median Household Income(MHI) /National MHI	Local Unemploy-ment/ National Unemploy-ment
		Income Distribution	• % Poverty • Top 10 Rate Payers Share Total Revenue
			• Local Unemployment/ • Nat'l. Unemploy-ment • Local Un-employment • % Poverty • % HI Housing Costs

FINANCIAL CAPABILITY INDICATOR ALTER				
	FINANCIAL CONDITION		FINANCIAL MANAGEMENT	
	Operating Ratio	Debt Burden	Collection Rate	Other
***NACWA 2013* METRIC**	• Projected Operational Revenue & Projected Operational Costs • Projected Misc/ Revenue	• Projected Net Revenue For Investments • Projected Debt Service	• Trends in bad accounts • Late and unpaid bills Permits	
JOSEPH KANE/ BROOKINGS	OP Revenue/OP Costs	Debt/ Asset		
MOODY's METRIC	• Cash + Liquid Assets/Operational Cost • Total OP Costs (Size Of System)	• Debt/Operational Revenue • Net Revenue/Yearly Debt Service • Net Assets/Yearly Depreciation	Willing & Able to raise rates (Judgment)	Implement long-term (10 Year) Capital Plan

Figure 13. Financial Capability Indicator Alternatives (cont.)

RNATIVES			
	SOCIO ECONOMIC CONDITIONS		
	Popula-tion Change	**Wealth/ Growth**	**Structural Problems**
		Income Distribution	• % Poverty + Trend • Local Unemploy-ment + Trend
	Pop Change 2005-2015	MHI Change 2005-2015	% Low-income Relative to Sample Average
		Local MHI/ National MHI	• Legal Limit On Net Revenue/ Yearly Debt Service • Reserve requirements

Operational Efficiency

Operational efficiency is a critical determinant of the financial strength and health of the utility. Efficient operations enhance the ability of the utility to reduce operating costs and maintain, if not increase, operating revenues to help ensure that operating revenues can fund operating costs. Operating efficiency also improves the ability of the utility to respond to unanticipated emergencies thereby maintaining its financial health. As Moody's notes, "the financial health of a utility determines its flexibility to respond to contingencies, its resilience against potential short-term shocks, and its cushion against a long-term unfavorable trend."[61]

A common, simple measure of a utility's operational efficiency is its operating ratio (Operating Revenues/Operating Costs) or net profitability. An operating ratio greater than 1 (profitability) is a common normative standard that some have suggested be used for the threshold to determine potential financial burden issues. An operating ratio less than 1, indicating operating losses, would indicate possible economic stress for the utility. Alternative measures of utility operating efficiency include days of cash on hand and debt service coverage, which is net income available for debt service/annual debt service.[62]

Debt Burden

The FCI component in EPA's 1997 FCA Guidance acknowledged the importance of debt burden by including two metrics to assess the local jurisdiction's debt burden – its bond rating and its general obligation debt outstanding as a percent of its full market property value. However, as many stakeholders have noted, what is more pertinent is the debt burden of the utility, given the existing complex organizational structures and varying relationships between the utility and the local jurisdiction or jurisdictions it serves. Utility debt burden is one of the key elements used by Moody's and other rating agencies to develop revenue bond ratings for utilities. As Moody's notes, "a utility's debt profile determines its leverage and fixed costs. Systems that carry a lot of debt have less ability to reduce costs if demand shrinks… A greater debt burden may also prohibit a utility from funding necessary capital upgrades."[63]

Stakeholders have also proposed several ways to measure a utility's debt burden. Total long term debt can be compared to:

- the total value of assets;
- the number of ratepayers; or
- total revenues– a variant of the debt service coverage ratio.

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[61] Moody's Investor Service, *Rating Methodology: US Municipal Utility Revenue Debt*, December 15, 2014, p. 12.
[62] U.S. Environmental Protection Agency, Environmental Financial Advisory Board, *EFAB Analysis and Recommendations on: Draft Financial Capability Assessment Framework*, September 16, 2014, p. 12.
[63] Moody's op.cit. p. 14.

Some alternatives suggest using bond rating standards of rating agencies to establish debt burden threshold standards, while others have suggested comparing the debt burden ratio to some group average.

Management Effectiveness

In most instances, one would expect management effectiveness and operational efficiency to be highly correlated. Effective management should produce an operationally efficient utility. But there are circumstances when these two elements can diverge. Unforeseen contingencies can temporarily disrupt operational efficiency. Similarly, a new effective management team may need to be brought in to overcome current operational inefficiencies. In developing its utility revenue bond ratings, Moody's distinguishes explicitly between management effectiveness and the financial strength of the utility, "Utility management refers to the dynamics of setting rates, planning for capital spending, budgeting for annual expenditures, and complying with environmental regulations. The scorecard captures two crucial aspects of management: rate setting and capital planning."[64]

Unlike metrics for a utility's operating efficiency or debt burden, there is no obvious, simple metric to measure a utility's management effectiveness, but the Environmental Financial Advisory Board (EFAB) has suggested water bill delinquencies or collection rates. This assumes that a well-run utility is likely to have a higher than average water bill (willing and able to raise rates to cover costs) with a high collection rate and a positive trend or at least stable collection rates. Moody's relies on judgmental assessments about the utility management's ability to adjust rates periodically to maintain a stable, sufficient revenue stream and to develop and implement a long-term capital improvement plan to meet both its own investment needs and those required to achieve regulatory goals.

Community Demographic and Economic Conditions

There are a range of metrics suggested for community demographic and economic conditions that affect the utility's underlying market conditions. The most frequently proposed include population growth/decline; relative wealth; economic growth; and structural economic issues (e.g. extent of poverty, diversity of area employment or income sources). Population change will highlight declining areas with shrinking rate bases (e.g., rust belt urban areas with unique problems like excess capacity, infrastructure re-investment needs, and a declining rate base or smaller systems with a limited rate base initially).

Metrics proposed for relative wealth include using MHI or per capita income (PCI) relative to state, national, or other group averages (MHI/State MHI or PCI/State PCI).

Stakeholders have suggested various metrics for economic growth – usually changes in income (MHI or PCI) or total employment. Other measures include change in employment/population

[64] Ibid., p. 15.

ratio, change in unemployment rate, and relative unemployment rates – local area unemployment rates divided by state or national unemployment rates. Higher labor force participation rates (employment/population ratios) are assumed to indicate a stronger local economy that is better able to absorb rate increases; declining rates may indicate structural economic problems or an increasing dependency ratio, either of which suggests less ability to absorb rate increases. Again, several stakeholders suggest comparing a particular market area's economic growth to a group average [e.g state, regional, or national growth rates].

Many stakeholders argue for both a relative unemployment rate comparison and the trend in unemployment rates to be included. Structural economic issues can include high relative poverty rates, high relative unemployment rates, low relative labor force participation rates, or highly concentrated employment in a single employer or economic sector.

The FCI Options table compares the 1997 FCI metrics to several alternatives, including an EFAB suggestion. The EFAB and other stakeholder alternatives focus on data from the utility, except for the socioeconomic data. Some also include more trend data providing a more dynamic assessment of the utility's financial strength and health.

2.3.3 NAPA Recommended Changes to Improve EPA's FCA Guidance

The review of various alternative metrics proposed by stakeholders to improve the effectiveness of the RI and FCI components in identifying the potential financial and economic burdens imposed on utilities and their customers/users produced two observations. The first is the need to change the focus of the elements defining each component. For example, most stakeholders agree that the RI should include a broader set of water costs and focus on low-income user incomes. The second is the range of specific metrics available for those revised defining elements.

EPA's desire to provide flexibility to permittees in defining and identifying their potential financial and economic burdens while also assuring a common and consistent starting point for all permittees presents a difficult challenge. That challenge is compounded by the multiplicity of metrics available to improve the effectiveness of the RI and FCI components in EPA's 1997 FCA Guidance. One way to address that challenge and reconcile the need for consistency and flexibility is to establish standards or criteria for the metrics permittees use in developing a common starting point in the assessment of their financial and economic burdens.

Panel Recommendation #1

The Environmental Protection Agency (EPA) should improve the metrics used for the Residential Indicator and Financial Capability Indicator components in the 1997 Financial Capability Assessment Guidance if it wants to establish a common starting point for all permittees while still considering supplementary permittee data in assessing a permittee's burden in meeting its Clean Water Act goals.

Since there is no perfect way to measure affordability and financial capability, the metrics used should meet the following criteria:

1. Readily available from publicly available data sources;
2. Clearly defined and understood;
3. Simple, direct, and consistent;
4. Valid and reliable measures, according to conventional research standards; and
5. Applicable for comparative analyses among permittees.

Applying these standards or criteria to the metrics permittees use in developing revised and improved RI and FCI components to document the extent and severity of their economic and financial burdens should produce several useful outcomes. First, permittees will have some flexibility in selecting specific metrics for their RI and FCI components. Second, the metrics selected can be easily verified by regulatory enforcement staff and readily understood by both sides in the initial negotiations. Accessibility and simplicity should also ensure that the range of acceptable metrics does not exceed the capabilities and resources of all permittees.

The Panel believes that the current RI component can be improved to address many of its previously identified critical limitations.

Panel Recommendation #2

To improve the 1997 Residential Indicator component, the elements defining the current component should be revised to:

1. Include all water costs, not just selected clean water costs, to include all drinking water and clean water costs – Combined Sewer Overflow control costs, stormwater costs, other sewer costs – as well as planned water infrastructure investments and any deferred costs of system operations and maintenance, in the burden assessment;
2. Focus on the income of low-income users most vulnerable to rate increases rather than Median Household Income;
3. Identify the size of the vulnerable users relative to the utility's total rate payer base; and
4. Avoid arbitrary normative thresholds to determine relative burdens.

The specific metrics used for each of these revised or refocused elements can vary, so long as they meet the standards or criteria identified in Panel Recommendation #1. Thus, to expand the water costs included in the revised RI component, permittees can use average total water costs per household, average water bills paid, or average water bills paid by the segment of users identified as most vulnerable to water rate increases, if such detailed billing data are readily available. Planned water infrastructure investments and expenditures for any deferred maintenance in approved utility capital improvement plan may also be included in this expanded total water cost measure. Similarly, permittees can use various metrics to identify incomes of their most vulnerable users, including poverty level income, income of the lowest quintile or quartile, or some alternative income measure that meets the recommended standards/criteria.

These recommended improvements to the RI component ought to provide a more accurate assessment of the water affordability issues confronting the most vulnerable users. While this in turn may increase the number of permittees with a high burden, the extent of that impact is difficult to determine since we don't know the number of permittees currently designated as highly-burdened. The improved RI component may produce an increase in permittee requests to reopen existing consent decrees governing CSO controls. This increase in workload may be offset to some degree by a possible lower number of permittees needing to present more detailed and extensive data to document their critical low-income user water affordability issues.[65] The

[65] NAPA staff acknowledge that the recommendation to include a measure of the percent of the rate payer base considered most vulnerable to rate increases [e.g. the local poverty rate] in the RI component could increase workload slightly for some permittees, but the possible need for fewer permittees to submit substantial additional supplementary data to document excessive burden due to low-income affordability issues should provide some

change in the elements above would increase the focus of EPA regulatory relief through extended compliance schedules on communities with a disproportionate number of low income users, resulting in delayed environmental benefits for all residents in those communities. Further analysis of this potential tradeoff will need to take place.

The Panel also believes that the current FCI component in EPA's 1997 FCA Guidance can be improved or refocused to more accurately reflect the financial capabilities and limitations of the utility providing wastewater services.

Panel Recommendation #3

To improve the 1997 Financial Capability Indicator component, the current elements defining that component should be revised or refocused to:

1. Focus on the operational efficiency, debt burden, and managerial effectiveness of the utility supplying clean water services; and

2. Expand the socioeconomic components affecting the utility's market conditions to include trends in population, relative wealth, economic growth, and other economic structural problems in the community served by the utility.

Again, permittees have a range of specific metrics available for each of these revised or refocused defining elements of the FCI component. For example, utility debt burden metrics could include various debt ratios – debt per asset value, debt per ratepayer or user, and debt per total revenue. Any of these debt ratios would satisfy the Panel's recommended standards or criteria.

It is likely that the improved FCI component will increase the number of 'highly-burdened' permittees requiring some regulatory time schedule relief, but the extent of that increase is unclear. Any increase in the number of 'highly-burdened" permittees may also increase the need to reopen previous agreements on CSO controls and could delay the achievement of specific WQS goals. Likewise, such an increase should reduce the burden on permittees to document current water affordability issues and financial capability limitations.

2.4 Other Changes to Improve FCA Guidance Use

EPA's 1997 FCA Guidance has recognized the need to balance achieving CWA clean water goals for CSOs with the utility's and/or the community's financial capability to incur the additional costs required to meet them within a specified time frame. Stakeholders have supported the concept and need for an effective FCA guidance. Their concerns have focused

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workload reductions. The extent of those reductions is uncertain, since the number of permittees currently deemed high burdened remains unknown.

primarily on the inadequacy of the metrics used for the RI and FCI components. However, several stakeholders have raised two additional issues that need to be addressed once the FCA guidance metrics are improved as recommended:

1. Extending the improved FCA guidance to a broader range of EPA water regulatory actions; and

2. Ensuring that the improved FCA guidance is being applied consistently and equitably among EPA's regions.

2.4.1 Extending the FCA Guidance

To date, EPA has used the FCA guidance principally in its issuance of 828 active CSO permits to 746 communities/utilities (at the time of this report's publishing). Many of these permits are established through consent decrees rather than EPA's permitting process. In addition, EPA regional staff and headquarters enforcement staff have often been directly involved in many CSO consent decree negotiations, whereas EPA delegates regulatory review and permit approval to the states for other clean water regulatory actions. While CSO consent decrees impose additional costs on communities/utilities to meet required water quality standards (WQS) within specified time frames, utilities and communities also must bear the costs of meeting WQS TMDL obligations under NPDES permits issued by state regulatory staff for their point source discharge facilities (e.g., POTWs).

Academy stakeholder interviews revealed little awareness or use of the FCA guidance in issuing NPDES permits for POTWs. If a financially distressed utility has affordability issues and is unable to bear the additional costs required to meet its CSO WQS goals, it is likely to be similarly challenged in meeting its other clean water WQS goals. Indeed, if the financially distressed utility also provides drinking water services, it may confront similar affordability and financial capability issues in meeting its SDWA regulatory requirements.

In short, low-income user water affordability issues and utility financial capability limitations are not unique to only CSO WQS goals. Any additional costs imposed on utilities to meet other CWA clean water goals can raise similar affordability and financial capability issues. Additional costs required to meet drinking water requirements under the SDWA can also raise these same issues.[66] As noted earlier in this chapter, the SDWA explicitly acknowledged the need to

[66] EPA has had under review its National Level Affordability Criteria (NLAC) for determining whether treatment technologies for complying with drinking water regulations are available at a cost affordable for small drinking water systems – those serving 10,000 or fewer customers. The NLAC methodology was published by EPA in 1998.TheNLAC's current methodology uses Census data from representative communities served by small drinking water systems to determine its 'affordability threshold' of 2.5% of MHI. In two separate reports, EPA's Science Advisory Board (December 2002 report) and the National Drinking Water Advisory Council (July 2003 report) have recommended changes to that threshold involving either a different income measure, a different threshold percentage, or other approaches to improving the current system. To date, no small system has satisfied the NLAC threshold, since EPA has found affordable compliance technologies for small drinking water systems

consider financial limitations and capabilities in requiring utility/community compliance with SDWA rules.

Some of the recommended changes to improve the effectiveness of the RI and FCI components in EPA's 1997 FCA Guidance facilitate EPA's opportunity to apply this improved FCA framework to a broader range of water environmental issues than just CSO controls. In particular, the inclusion of all water costs in the improved RI component creates the possibility of using this improved FCA framework to address not only all CWA goals but SDWA goals as well.

Panel Recommendation #4

> The Environmental Protection Agency should consider using the improved Financial Capability Assessment framework, in all of its clean and drinking water regulatory decision processes consistent with current statutory requirements.

This recommendation for EPA to adopt a broader, more holistic perspective in pursuing all its water quality goals is consistent with the 'One-Water' concept advocated by a number of water industry stakeholders. Chapter 6 contains a more complete discussion of this 'One-Water' concept. Extending the improved FCA framework to a broader range of clean and drinking water regulatory issues would also reinforce the effectiveness and impact of EPA's efforts to encourage the use of local integrated planning to meet clean water WQS goals.

2.4.2 Consistent Use of Improved FCA Framework

As noted earlier in this chapter, there remains a persistent view among a number of stakeholders that many regional EPA enforcement staff and state regulatory staff continue to rely primarily on the RI component and its 2% MHI measure to assess permittee burden in CSO assessments. This inconsistency between stated EPA policy and policy implementation in the field is compounded by the lack of information on the number of CSO permittees found to have high burdens warranting some relief in compliance time frames and the amount of extended time schedule relief provided them, if any.

This basic information is essential for any assessment of the impact of the FCA framework on CSO regulatory decisions. The number of CSO permittees found to have a high burden can help determine whether the FCA framework is effective in identifying affordability and financial capability problems. If the FCA framework identifies no highly-burdened permittees, the metrics used may be inadequate, unless one believes that there are no water affordability issues or financial capability limitations. Similarly, if the framework identifies an excessive number of

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for all the drinking water regulations promulgated since 1986. In 2006 EPA issued a federal register notice seeking public comments on possible revisions to the NLAC small system threshold, but no action has yet been taken. There does not appear to be a similar affordability test for large drinking water systems.

highly burdened permittees, it is possible that the metrics are too lax. Such data would also reassure EPA HQ that the FCA framework is being applied consistently among all regions.

It is also impossible to evaluate the appropriateness of any compliance schedule relief that may be provided without information on the number of highly-burdened permittees identified by the FCA framework. In short, EPA HQ was not able to confirm whether compliance schedule decisions in the field reflect a consistent application of the FCA framework and an equitable resolution of scheduling issues among all permittees. The Panel recognizes that there are confidentiality requirements that apply to enforcement actions. However there was no clear identification of a management information system that captured this information.

During this review of the EPA FCA framework, efforts to determine how many permittees or utilities seeking to resolve CSO control issues were found to have high burdens under either the original 1997 FCA Guidance or the revised 2014 Framework were inconclusive. Without that basic information, it was impossible to determine what relief in regulatory time schedules EPA regional and state regulatory staff provided to highly-burdened permittees or utilities. The persistent stakeholder perception that the 1997 FCA Guidance is not being consistently applied in the field only reinforces the need for better communication of EPA policy and highlights the need for more effective follow-up by EPA HQ to monitor regulatory actions taken in the field.

Stakeholders have expressed concerns about inconsistent application of the FCA framework among and within its regions by regional and state regulatory and enforcement staff. This will require both:

- Improving EPA's communication strategy to convey revised EPA policies to permittees, other stakeholders, regional, and state regulatory staff; and,
- Expanding EPA's management information system to monitor how regional and state staffs implement the new policy and adjust regulatory implementation schedules to accommodate highly burdened permittees and utilities.

Panel Recommendation #5

The Environmental Protection Agency (EPA) should improve its two-way communication strategy with its regions, state regulators, and other stakeholders to assure formal, consistent, and clear messaging on policy changes, and effective monitoring and follow-up of clean water regulatory actions in the field.

Additionally, EPA should ensure that its management information system, at a minimum, provides the following information:

1. The number of permittees found to have high burdens;
2. The specific reasons for that finding; and
3. The degree of regulatory relief, in the form of lengthened compliance schedules, provided to those highly-burdened permittees.

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Chapter 3: Integrated Planning Process

Integrated Planning is a voluntary planning process designed to assist communities in meeting their Clean Water Act (CWA) obligations by prioritizing and sequencing stormwater and wastewater project activities. As stated in the "Integrated Municipal Stormwater and Wastewater Planning Approach Framework." (2012 IP Framework), it "will allow a municipality to balance CWA requirements in a manner that addresses the most pressing public health and environmental protection issues first." Its purpose is to allow communities to address those water quality issues that pose the greatest environmental impacts in the order of severity. This process also enables communities to optimize the value of limited infrastructure dollars and reflects a disciplined approach to decision making. It is important to clarify that integrated planning (IP) is not about exchanging or substituting one water quality objective for another. It provides a data-informed methodology for determining the optimal order for investing limited funds.

Some critical benefits of integrated planning are that it:

- allows for flexible sequencing and scheduling;
- has the capacity to meet requirements more efficiently, maximizing community resources;
- realizes greater environmental benefits more quickly;
- builds public and stakeholder support utilizing outreach and community input on priorities; and
- enables the use of more multi-benefit solutions.

3.1 Background on EPA 2012 IP Framework

EPA established the 2012 IP Framework[67] as a response to concerns that while EPA, states, and municipalities have achieved significant progress in implementing the CWA, there are still many factors stressing the implementation of key programs as currently, they often focus on each CWA requirement individually. Acknowledging that this may not be the ideal method for addressing these stressors and recognizing the unintended consequences of constraining a

[67] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*, May 2012.

municipality from addressing its most serious water quality issues first, EPA published the 2012 IP Framework.

The 2012 IP Framework is written broadly to allow community-specific flexibility in the development and adoption of integrated plans, identifying key operation principles, and providing municipalities opportunities to pursue more innovative cost-saving solutions to managing stormwater and wastewater requirements. The Integrated Planning and the Financial Capability Assessment Frameworks are intended to be used in a coordinated fashion. The 2012 IP Framework also provides guidance regarding how the integrated plan should include proposed implementation schedules developed by the municipality and an assessment of the municipality's financial capability.

3.2 How Communities Have Used Integrated Planning

On October 10, 2014, EPA announced $335,000 in technical assistance (TA) for five communities to develop elements of integrated plans for municipal wastewater and stormwater management. The five communities selected are highlighted below.

3.2.1 Burlington, Vermont

When selected, the city of Burlington had begun developing community-based evaluation criteria using social, economic, and environmental factors to identify and prioritize potential wastewater, combined sewer system, and stormwater projects.

Burlington completed a community survey via an internal web format and discovered a number of valuable lessons for attempting to quantify benefits of environmental initiatives. They are also building a Geographic Information System (GIS) map identifying the locations in need of replacement or upgrade of water infrastructure. Key to integrating activities, the city will then overlay the road construction schedule map and other city operation maps to drive the "Dig Once" strategy. Burlington, like the other TA recipients, emphasized the importance of communicating to the community what their dollar was doing and how it was being stretched as far as possible, leading to better possibilities for more walkability and green space.

3.2.2 Durham, New Hampshire

The town of Durham and the University of New Hampshire have collaborated to create an integrated plan, or permit using information on pollution tracking and accounting systems to focus on cross-jurisdictional coordination and methods to credit point versus nonpoint pollution controls.

The Integrated Permit idea for the town of Durham began in 2010 in anticipation of an upcoming permit renewal for Durham's wastewater treatment facility (WWTF). When the Oyster River Integrated Watershed Plan for Nitrogen Load Reductions was derived in July 2014, it included collaboration and burden sharing between the town of Durham and the University of New Hampshire. The two entities collaborated by using information on pollution tracking and

accounting systems to focus on cross-jurisdictional coordination and methods to credit point versus nonpoint pollution controls for several reasons.

Both Durham and UNH share in the use and the operating costs of Durham's WWTF, which discharges to the tidal portion of the Oyster River and, having adjacent regulated urbanized areas, are subject to EPA's MS4 Stormwater General Permit. Another motivation for both entities to become involved in IP is because almost half (47 percent) of the estimated annual watershed load or approximately 17.3 tons is associated with sources located within the town and UNH's campus area.

The initial idea for an Integrated Plan in 2010 was to "trade one for the other." Instead of requiring 3 mg/l monthly average total nitrogen WWTP effluent limit, resources would be put into nonpoint source (NPS) pollution reduction. EPA's response indicated that both point source and NPS reductions need to occur to achieve state water quality standards; however, an I-Permit could provide more flexibility in how the Project Partners achieve their overall target reduction. Given the overlapping requirements between the two permit programs (i.e., wastewater and MS4), the Town and UNH decided that an Integrated Permit approach would result in greater economic and environmental benefits and eliminate duplication of efforts.

EPA and the New Hampshire Department of Environmental endorse Durham's and UNH's proposed I-Permit approach. However, EPA-Region 1 representatives indicated challenges due to the limited flexibility contained in the Clean Water Act (CWA). The Project Partners may be required to include a Limit of Technology (LOT) nitrogen effluent limit of 3 mg/L in the NPDES permit in order to meet the necessary combined point source and NPS nitrogen reduction target allocation for Durham and UNH regardless of whether NPS and stormwater control measures may be equally or even more effective than WWTP changes in reducing nitrogen loads. Having to meet this LOT requirement may reduce the Project Partner's incentive to pursue additional innovative and cost effective NPS and stormwater measures or to pursue an Integrated Permit as an alternative to separate WWTP and MS4 permits. Due to the possibility that meeting the overall nitrogen reduction goals for Durham/UNH may be less expensive if costs include pursuing limit of technology at the wastewater treatment plant, stakeholders are currently examining the Integrated Permit in this context.

3.2.3 Onondaga County, New York

The Onondaga County Department of Water Environment Protection is working with multiple municipal separate storm sewer systems (MS4s) and other stakeholders to develop priorities and evaluate proposed wastewater and stormwater projects. In 2009, Onondaga County received the go-ahead from a federal judge to forgo plans to build three sewage plants and instead reduce sewer overflows with trees, green roofs, permeable pavement, and underground overflow containment tanks that hold sewer overflows until they can be treated by existing treatment plants.

The Syracuse Environmental Finance Center has assembled a training manual for resiliency to include weather, climate, economic changes, and demographic changes. The county and city have engaged a variety of stakeholders within the community to collaboratively problem solve and have used green infrastructure (GI) as a vehicle for this. The *Save the Rain* program engaged the community to replace impermeable pavement, provide more useable green space, and to tackle challenges such as replacing sewer lines and efforts to more effectively and efficiently zone neighborhoods for infrastructure improvements. Onondaga has taken on bigger financing packages so that they could more effectively demonstrate benefit in the aggregate.

Onondaga has embraced the IP TA and worked to address the New York Smart Growth Public Infrastructure Policy Act which, in part, states:

Universal Citation: NY Env Cons L § 6-0105 (2016)

> 6-0105. State smart growth public infrastructure policy. It is the purpose of this article to augment the state's environmental policy by declaring a fiscally prudent state policy of maximizing the social, economic and environmental benefits from public infrastructure development through minimizing unnecessary costs of sprawl development including environmental degradation, disinvestment in urban and suburban communities and loss of open space induced by sprawl facilitated by the funding or development of new or expanded transportation, sewer and wastewater treatment, water, education, housing and other publicly supported infrastructure inconsistent with smart growth public infrastructure criteria.

3.2.4 Santa Maria, California

The city of Santa Maria continues to develop methods to identify, evaluate, and select water resource management projects that address multiple wastewater, stormwater, and other water quality issues, pursuing an Integrated Plan as a key driver.

Santa Maria's Integrated Plan and collaborative approach allowed them to allocate scarce resources (water, in this case) to places it would be most beneficial. A key example of this is a re-routing of nitrogen-rich water to be used for irrigation instead of treatment in an expensive plant. They have developed a secondary irrigation line system connected to high nitride wells to provide water for recreation purposes. This process also pulls the high nitride water out of the groundwater basin and puts it to use, recognizing that not all uses for water require the same treatment and that they care deeply about their water supply beyond the permits, requirements, and compliance.

3.2.5 Springfield, Missouri

The city of Springfield, Greene County, and City Utilities of Springfield are developing a benefits analysis of water resources to use for an Integrated Plan, spanning this across water, air, and solid waste concerns and requirements.

Springfield has practiced robust stakeholder engagement by employing the approach that "no news is bad news." Additionally, they used videos to help citizens understand what they were doing and why they were doing it. When engaging the public, Springfield utilized a variety of storytelling maps that displayed the interconnections of the infrastructure projects. In effect, they made a game out of the water system.

The city of Springfield has looked to a diverse group of community members to socialize the value of environmental vigilance including elementary education and local places of worship. Several successful outreach exercises that raised awareness were their stormwater mural program and the art reveal rain barrel contest.

While each of these communities differ from one another in a number of ways (e.g., population size, demographics, organization of local government and jurisdiction), they all have benefited from community outreach and engagement, the methodical and data-informed approach to identifying priorities, and determining how their constrained resources can go further. They all have articulated some level of challenges with coordinating across multiple water divisions (and, at times, other media) and could all benefit from additional guidance from the regulators that oversee their efforts.

For more information about each community, see Appendix E: Community Spreadsheet.

3.2.6 The City of Baltimore, Maryland

A number of communities have independently embarked on IP, taking different approaches to prioritizing and sequencing key activities to improve water quality and in some cases other environmental media as well. Baltimore, Maryland is one of the first communities to respond to the 2012 IP Framework by preparing an Integrated Plan to apply flexibility in addressing municipal governments' Clean Water Act obligations. The City's IP initiative was a joint effort of the Bureau of Water and Wastewater and the City's Program Management Team responsible for the City's Wet Weather Compliance Program, with contracting support from a joint venture of two water engineering firms, MWH Global and Louis Berger Water Services, Inc.

The City utilized what was eventually identified as a quadruple Triple Bottom Line (TBL) methodology to evaluate and prioritize capital improvement projects (adding a fourth category "Project Implementation and Efficacy" to the traditional TBL Environmental, Social and Economic categories) in order to identify a robust case for a modification of their 2002 Consent Decree and to enable the extension of compliance deadlines for SSO elimination and allowing for completion of improvements with greater environmental benefits.

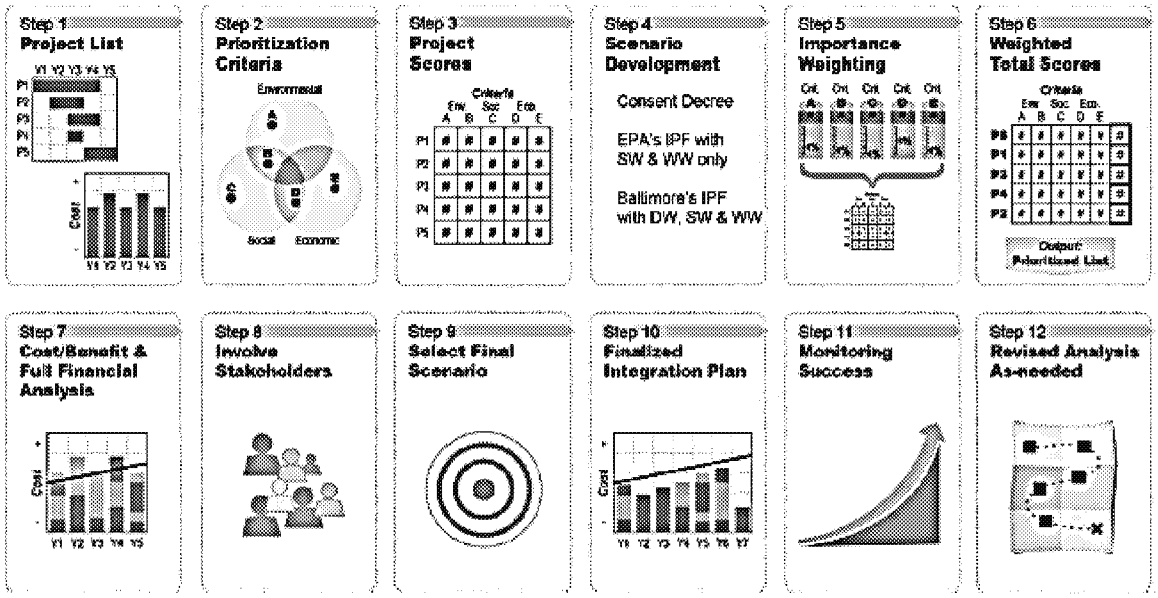

Figure 14. Baltimore's Integrated Planning Framework Process. Source: City of Baltimore Integrated Planning Framework presentation on August 28, 2013.

The above graphic reflects the framework for developing a consolidated list of Capital Improvement Plan (CIP) projects for the water, wastewater, and surface water divisions and the ongoing work to evaluate and reassess as necessary. The overall integrated planning CIP Project List currently totals 1,414 projects, which were grouped into 205 project bundles, with a total estimated cost of $7.9 billion, that could then be evaluated for benefits that included environmental, social, economic, and project efficacy criteria. This produces a master list, from which each of the three distinct utilities (water, wastewater and stormwater) develops their own prioritized list, because each of these must operate without profit or loss to other City funds. The City of Baltimore has been anxious to see an even greater level of integration in EPA's planning framework by folding together not just the needs related to the CWA, but also drinking water and water supply issues covered under the Safe Drinking Water Act ("SDWA").[68]

Weighted importance was calculated and then applied to three overall scenarios:

- Baltimore IP Unconstrained Scenario – Reflecting the City's preferred CIP projects, including water, wastewater, and surface water (i.e., stormwater) and is based on City-defined needs and budget constraint schedules.

- EPA IP Constrained Scenario – Reflecting a regulatory-driven CIP project selection and prioritization process for wastewater and stormwater projects only.

[68] Chow, R., Searles, S., Cardoch, L., McLamarrah J., *Baltimore Integrated Planning Framework Development,* 2012. Paper presented at the Water Environment Federation Technical Exhibition and Conference.

- Current Situation Scenario – Reflecting the baseline scenario as it is modeled to reflect current conditions where regulatory considerations substantially drive project prioritization to the exclusion of other considerations.

As a result of this process, two funding scenarios were developed to address schedule requirements and considerations:

- All-in: All projects are completed based on current schedule requirements and considerations.
  - Projects cumulative water rate increases of over 260%; over 130% between FY 2013, FY 2014.
- Alternative financial analysis: held rate increases at a constant of 9%, reaching cumulative increases of 180% by FY 2024.
  - This would require a time extension to December 31, 2024 for initiation of the last project under initial prioritization order and would require modification of the consent decree.

Although work on the Integrated Plan informed negotiations, and EPA determined that it was appropriate to spread costs over a longer period of time in light of affordability considerations, it was not actually used in the proposed modification of the 2002 consent decree that was announced in June of 2016 by EPA, DOJ, and MDE, and filed in federal court in September 2017. The proposed modification includes two phases. The Phase I work anticipates reducing wet weather overflows by 83% within five years. Baltimore will then assess the performance of the completed projects and monitor rainfall and flow in its collection system to develop a Phase II plan, which will be due by December 2022. The modified consent decree requires that Phase II must be completed by December 2030. [69]

Baltimore also found that the IP process is effective for ongoing evaluation of infrastructure investments and has established an iterative process of reevaluating the criteria and importance weighting as a basis for selection of projects for the capital budget. As a resuylt of the process, the City also established an Office of Asset management in 2013, to conduct strategic planning over the infrastructure lifecycle, which has developed a model to assess infrastructure conditions and criticality. This model has enabled proactive repairs that avoided pipe ruptures and disruption of service, as well as preventive maintenance.[70]

In the spring of 2017, Baltimore was completing an $800 million upgrade of its largest sewage treatment plant and, simultaneously, beginning a $160 million project to retrofit a drinking water

[69] U.S. Environmental Protection Agency, *News Release: Agreement Requires Baltimore City to Address Sanitary Sewer Overflows*, September 6, 2017, https://www.epa.gov/newsreleases/agreement-requires-baltimore-city-address-sanitary-sewer-overflows

[70] City of Baltimore, Department of Public Works, *[reply to] NAPA Request for Information*, September 8, 2017.

reservoir and of realigning a critical section of its sewer system. As the city was looking to IP to play a part in addressing affordability challenges by giving weight to the most pressing public health impacts and providing systematic evaluation tools, the Director of Public Works for Baltimore City, Rudolph Chow, testified before the Senate Committee on Environment and Public Works and shared his perspective on this initiative.[71] He stated that "Local jurisdictions understand their holistic system needs better than anyone." He reiterated the need to identify the most urgent needs of the community and referred to then Mayor Stephanie Rawlings-Blake's sentiment that "when everything is a priority, nothing is a priority."

While many communities have assessed the role of IP and found it to be a useful approach to addressing complex regulatory and environmental challenges, not every community has determined that it is the appropriate fit. For example, the small town of Bangor, Maine has a population of approximately 33,000 residents and a MHI of $36,013, as of 2014. Bangor has had CSOs under consent decree for decades and also has several wastewater-system needs that are not under the CDs. These include MS4 control measures, a treatment plant, and pump station operation & maintenance. Bangor considered IP and established a potential vision for implementing, to which EPA and DOJ were open. However, the compliance schedule in the CD would be expanded to make the MS4, the treatment plant, and other CWA activities subject to stipulated penalties. This led leaders in Bangor to eschew the use of an Integrated Plan to avoid the risk of adding projects to the CD and potential financial penalties.

3.2.7 Other Integrated Planning Approaches

Other communities are utilizing an IP approach in order to better prioritize and manage resources more effectively. For example, Portland, Oregon has been developing a system plan for all stormwater management using a risk-based approach to assess conditions and identify high priority areas where the consequences and likelihood of failure can be reduced. It is guided by their Watershed Plan, which was developed in 2005 and provides guidance for identifying projects that can meet multiple regulatory requirements in an integrated way.[72] Similarly, a group of MS4 communities in York County, Pennsylvania, have combined efforts under the umbrella of a county-level planning commission to develop a single plan and prioritize projects, which enables them to reduce planning costs. Their Integrated Water Resources Plan was created to develop a long-range integrated water resources planning document that can be used by the entities who share watershed boundaries within and around the County. The plan ties together the issues that are related to water resources, provides a usable and understandable process which

[71] City of Baltimore, *Testimony of Rudolph S. Chow, P.E., before the Committee on Environment and Public Works, U.S. Senate*, April 7, 2016.

[72] City of Portland, Oregon, *Citywide Systems Plan: Proposed Draft,* July 2014, https://www.portlandoregon.gov/bps/article/497435

incorporates existing laws, data, reports, plans, and organizations, as well as providing the user with data and analysis concerning the future of York County water resources.[73]

Some states are utilizing a similar approach to manage water resources throughout the state. The North Carolina Water and Wastewater Infrastructure Master Plan, although it is not titled an Integrated Plan, takes a similar approach to planning the state's strategy for maximizing the impact of their investments and enabling continued viability of the state's water infrastructure. Specifically, the infrastructure management component involves long-term master planning which includes:

- knowing the risks of failure of key water infrastructure components;
- taking proactive approaches and making informed decisions to construct, operate, maintain, and renew/replace infrastructure that will minimize long-term costs; and
- having funding in place so that the right investments are made at the right time.[74]

The graphic below illustrates the interrelationship between infrastructure, organizational and financial management, and the nexus that reflects a path for viable water and wastewater utility systems. North Carolina recognizes the importance of this approach at a state level.

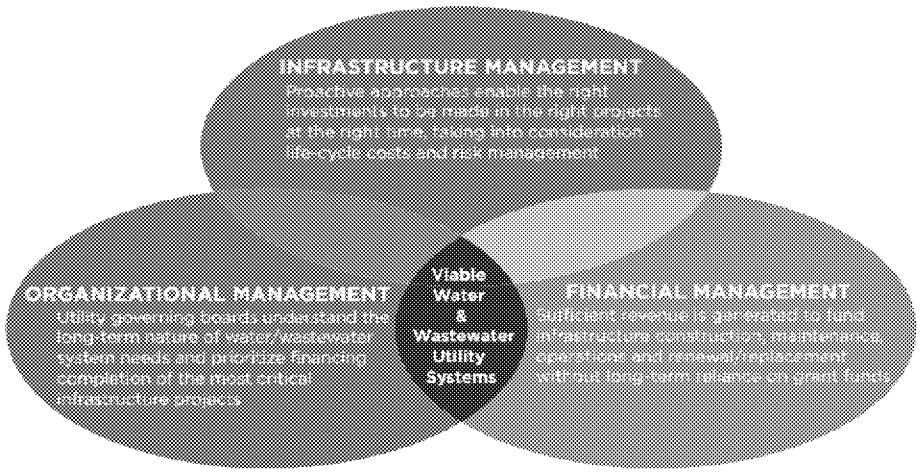

Figure 15. North Carolina Department of Environmental Quality, State Water Infrastructure Authority, *North Carolina's Statewide Water and Wastewater Infrastructure Master Plan: The Road to Viability*, 2017, p. 15.

3.3 Assessment of EPA Use of Integrated Planning

While the intention of the 2012 IP Framework was to provide communities with flexibility to prioritize and sequence needed water infrastructure investments so that limited public dollars can

[73] York County Planning Commission, Pennsylvania, *Integrated Water Resources Plan*, March 2011.
[74] North Carolina Department of Environmental Quality, State Water Infrastructure Authority, *North Carolina's Statewide Water and Wastewater Infrastructure Master Plan: The Road to Viability*, 2017.

be invested in ways that each municipality finds most valuable, there has been a lack of clarity on a number of issues, including EPA and state regulatory roles in reviewing and approving or recommending changes to locally-developed integrated plans. EPA shared that the voluntary Integrated Planning process is a helpful planning tool for municipalities, and that integrated plans (or elements of an integrated plan) can be incorporated into enforceable mechanisms such as NPDES permits or CWA settlements. EPA has approved modifications to existing consent decrees to incorporate elements of integrated plans that have been voluntarily developed by municipalities.

EPA and local governments have clashed over the agency's reliance on administrative orders or judicially approved consent decrees to codify integrated pollution reduction plans, rather than through modification of CWA permits. City and town officials say that they would prefer the compliance flexibility afforded through permits, rather than to legally-binding consent decrees (and penalties) that result from the noncompliance with CWA requirements. EPA has stated that both enforcement and permits are necessary, depending on individual circumstances.[75]

3.4 Stakeholder Proposed Reforms

On January 12, 2017, the Water Quality Improvement Act – H.R. 465 was introduced with a goal of allowing local governments to work with their state and EPA to prioritize investment in wet weather overflows and flooding collectively, rather than individually. The bill directs that the Administrator shall establish a comprehensive and flexible IP process and permitting process for municipal wastewater and stormwater management that will help municipalities comply with the requirements of this Act by enabling municipalities to identify the most cost-effective and protective approaches to comply with such requirements, and prioritize their investments in addressing such requirements.

Local leadership (e.g., membership in National League of Cities and National Association of Counties) has expressed support for this bill because it would enable the codification of various EPA memorandums on water tools and affordability. It also provides additional support for local governments that undertake IP to incorporate green infrastructure components into municipal stormwater, combined sewer overflow (CSO), and other water plans in a more cost effective way.

In written testimony to the House Transportation and Infrastructure Committee Subcommittee on Water Resources & Environment May 18, 2017, Pete Buttigieg, Mayor of South Bend Indiana highlighted the potential value of legislation to address the issue of identifying a path forward (other than civil penalties) for "local governments who develop an integrated plan and put good faith efforts and reasonable further progress into improving their water."

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[75] U.S. Library of Congress, Congressional Research Service, *EPA Policies Concerning Integrated Planning and Affordability of Water Infrastructure*, March 14, 2017. By J. Ramseur.

This bill reflects an interest in expanding the role of IP, but also articulates the concern of many that there is currently not a collaborative model that assists local, state, and federal partnership in evaluating the most effective use of funds to address the most urgent environmental concerns. The bill is the most recent example of efforts to assist municipalities in addressing the challenge of prioritizing wastewater infrastructure needs and correlated compliance issues. In 2015, the Clean Water Compliance and Ratepayer Affordability Act was introduced and proposed that the Administrator "carry out a pilot program to work with municipalities that are seeking to develop and implement integrated plans to meet their wastewater and stormwater obligations under the Federal Water Pollution Control Act, and for other purposes."

3.5 Integrating Water

The Panel recognizes that EPA's 2012 Integrated Planning Framework does adopt an integrated water approach to some, limited extent. EPA highlights the fact that drinking water needs and costs may be considered under the 1997 FCA Guidance and 2014 FCA Framework and may be relevant to schedule development, and EPA stated that it is open to considering a Drinking Water Investment Plan to complement the 2012 Integrated Planning Framework.[76] The Framework further states that a municipality's environmental compliance costs related to all environmental media, and, indeed, any kinds of financial burdens faced by the community, may be relevant to schedule development. The 2014 FCA Framework explains that municipalities can submit additional information that may be relevant to schedule development, including data on the municipality's "other costs or financial obligations, such as those that relate to drinking water or other infrastructure, that significantly affect a permittee's ability to raise revenue."

The 2012 IP Framework explains that "NPDES requirements for separate sanitary sewer systems, combined sewer systems, municipal separate storm sewer systems and at wastewater treatment plants may be included in an integrated plan.... In addition, integrated plans may address source water protection efforts that protect surface water supplies, and/or nonpoint source control through proposed trading approaches or other mechanisms." The 2012 IP Framework does not address the question of whether or how a community's financial capability or overall financial health might be taken into account in setting implementation schedules under the Safe Drinking Water Act or under any other environmental statute, and whether such non-CWA implementation schedules might be incorporated into the same Integrated Plan. A broader discussion of a One Water policy is discussed in Chapter 6 as some stakeholders have proposed that, if a community could set priorities and schedules for satisfying Safe Drinking Water Act requirements as well as CWA requirements in the same integrated plan, such a One Water approach would offer opportunities to address a range of regulatory requirements, provide multiple water quality benefits, and make strategic capital investments to maintain, repair, and build infrastructure.

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[76] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning: Frequently Asked Questions*, July 15, 2013, p. 4.

3.6 Panel Recommendations

The 2012 IP Framework (as well as subsequent communications from EPA) established a compelling case for IP. Communities pursuing an Integrated Plan have articulated a need for a more holistic approach to address water (and at times additional environmental media) in order to prioritize investments and consolidate planning. The 2012 IP Framework provides information in four areas: Background, Principles, Elements of an Integrated Plan, and Implementation. The majority of the document builds the case for IP and answers *why* a community should consider this innovative and holistic approach. It does not provide detail regarding *how* to implement the plan and navigate obstacles.

A common sentiment that was heard from stakeholders within communities that embraced the process is that they are currently struggling with coordinating their approach. The "stovepiped" organizational structures and bureaucracies that do not enable coordination of planning initiatives across CWA and at times, SDWA requirements, that exist both at the local and state levels as well as with EPA regional and headquarters offices. Input from IP communities suggests that the front-line regulators (this can be a state or regional environmental organization) often are unclear about how to assist communities to implement or monitor IP efforts. One community discussed the enthusiasm its regional overseer had for an Integrated Plan, but when the development plan was submitted, there was no clear path forward. In essence, the regulatory authority "did not know what to do with the plan."

Panel Recommendation #6

The Environmental Protection Agency (EPA) should develop additional guidance that articulates expectations for implementation and maps out the "how" for both the communities as well as the front-line regulators. This guidance could include a centralized repository of lessons learned and technical assistance that municipalities could access in order to inform their own integrated planning implementation strategies. Making information that the five technical assistance recipients acquired available to all interested communities expands the value of that assistance and further demonstrates the value of EPA's investment. EPA should use both the recently developed Water Finance Clearinghouse and possibly a new website/portal to share this information. Similar to the Clearinghouse, any new site should allow approved contributors to submit information. Some key areas in which to provide information should include:

1. Case studies (both technical assistance recipients and other successful Integrated Planning efforts);
2. Information on availability of grants, loans, and technical assistance, as well as a community's local in-kind or cash match contribution to water-related projects (this information is currently in EPA's Water Finance Clearinghouse and may be linked to in a new site);
3. Links to other organization's resources for focused and specific Integrated Planning implementation guidance; and
4. The ability for communities to interact and share information with one another.

EPA will need to direct financial resources to support the Water Finance Clearinghouse and the development of any new information portal. Support for human capital to manage and monitor the information and participant engagement is important as well.

A key obstacle to pursuing and implementing IP has been the conflict with coordinating regulations. The Water Environment Research Foundation (WERF) conducted a Survey of Community Insights on Integrated Planning (December 2016 WERF Survey) and the most common obstacle encountered by those respondents who have previously or are currently pursuing IP was regulatory issues.[77] While the IP approach is an "analytical and data-informed process" that allows municipalities to sequence stormwater and wastewater projects in a way that prioritizes the most significant human health and environmental needs first, the 2016 WERF

[77] Rexhausen, Jeff, *Slideshow: 2016 Survey on Community Insights on Integrated Planning*, Economics Center of University of Cincinnati, Water Environment Research Foundation, December 2016.

Survey respondents listed "concerns of additional obligations" as a barrier to integration, suggesting that there are opportunities to improve the coordination of regulatory requirements.

Currently, a common concern that has been articulated by multiple interviewees is that although there is support for the concept of Integrated Planning, inconsistent flexibility has been provided to allow for reprioritizing activities in order to sequence activities that will result in the biggest environmental impact. The 2016 WERF Survey also found that over 85% of respondents felt that regulators were unwilling to balance CWA requirements with other environmental issues.[78] While it is mentioned in the 2012 IP Framework that "sufficient flexibility should be provided in enforcement orders to allow for adaptive management approaches" there is no other reference to the need for flexibility in addressing integrated needs of the CWA and other human health efforts. While EPA has approved modifications to existing consent decrees to incorporate IP, stakeholders have reported diverse perceptions of willingness by all parties involved (e.g., the Department of Justice, the state) to make the modification.

Panel Recommendation #7

The Environmental Protection Agency (EPA) should establish guidelines for developing flexibilities that allow compliance with Clean Water Act and Safe Drinking Water Act requirements within a timeframe that correlates with well-defined prioritization of community objectives, statutory and regulatory requirements, and integrated planning activities.

1. Much like the Ombudsman concept reflected in proposed Senate Bill 692 – Water Infrastructure Flexibility Act, this liaison between Headquarters and Regional EPA offices, states, and municipalities would provide a mechanism for aligning Water Quality Standards with the concerns and priorities of the local residents to optimize the value of each dollar of investment. This resource would also provide additional guidance to state and regional environmental oversight in order to ensure consistent application of flexibilities.
2. EPA will need to provide a consolidated review of the proposed Integrated Plan for consideration, which includes those impacted components.
3. An additional consideration is to use the Supplemental Environmental Projects policy, which currently provides accommodations for Integrated Planning activities in enforcement actions.

IP is a programmatic approach to reducing burden, focusing the efforts on the outcomes, and creating an opportunity for communities to design those outcomes for themselves. The IP

[78] Ibid.

approach does not remove the obligation to comply with the CWA, nor does it reduce regulatory or permitting standards. Under the integrated planning approach, the outcome is always the same (compliance with the CWA). The integrated planning approach does not remove the obligation to comply with the CWA, nor does it reduce regulatory or permitting standards. Rather, the integrated planning approach allows municipalities to identify efficacies and maximize resources by looking at their stormwater and wastewater obligations under the CWA holistically. It also shifts some of the responsibility and accountability on the performers – those who are making the implementation decisions as opposed to the regulators. With established priorities and sequenced actions designed to meet regulatory requirements, address infrastructure investments, and achieve high levels of water quality and safety, communities will move toward these goals as rapidly as they can in order to meet the objectives that they have set for themselves. A community's motivation to do this might be to avoid perceived constraints of a consent decree, should the goals not be met within the agreed-upon time frame.

Panel Recommendation #8

An Environmental Protection Agency (EPA) effort to expand Integrated Planning guidelines should require that each Integrated Plan provide established criteria and a formalized agreement between the community and appropriate governmental authorities to guide communities toward compliance and shared responsibility for achieving both compliance and Water Quality Standards.

This Framework would require that each Integrated Plan include a set of requirements outlining responsible parties, deadlines for meeting requirements, and a clear identification of each stakeholder's responsibilities. Each Integrated Plan must be accompanied by a funding plan when submitted to regulators. In addition to the flexibility that Integrated Planning affords, additional incentives may include technical and planning support, and funding.

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Chapter 4: Measuring and Considering Benefits and Costs

In the development and approval of control measures for combined sewer overflows (CSOs) and for other pollution sources considered together in an integrated process, the proponents of a control plan and the regulators reviewing it will take account of benefits and costs at several points in the process. Such consideration is called for both by regulatory requirements and policies and by governmental decision-making practices of plan proponents. These stages will be briefly described in section 4.1, in order to illustrate the nature and importance of such benefit and cost considerations.

Following that review, section 4.2 will identify several general principles and practices that may be applicable and useful in measuring and presenting benefits and costs for such decisions. This discussion will ascertain such practices and principles by reviewing applicable guidance from federal agencies, as well as by reviewing several selected studies of the benefits and costs associated with major federal environmental regulations.

Finally, section 4.3 will discuss how the increasing flexibility and complexity of applicable EPA policy makes greater demands on the effort and resources both of the proponents of control plans and integrated plans and of the front-line regulators who must review and evaluate those proposed plans.

4.1 The Role of Benefits and Costs in making decisions under the Community Affordability Guidance and the Integrated Planning (IP) Process

EPA's guidance on community affordability and on integrated planning describes ways in which benefits and costs should be assessed and taken into account at three stages in the process: in selecting CSO control measures, in establishing an implementation schedule for such measures, and in selecting and prioritizing control initiatives to be part of an integrated plan. In addition, when governmental entities build or back major infrastructure projects to control water pollution, they must generally consider benefits and costs, particularly those involving environmental impacts of the project, under federal, state, or local environmental policy statutes.

4.1.1 Selecting CSO controls

When municipalities propose measures to control CSOs, states EPA's guidance, one consideration should be an evaluation of costs and performance.[79] The evaluation should generally identify the point of diminishing returns, which EPA refers to as the "knee of the

[79] U.S. Environmental Protection Agency, Office of Water, *Combined Sewer Overflows: Guidance for Long-Term Control Plan*, EPA-832-B-95-002, September 1995, at pages 3-31 to 3-42, 3-49 to 3-79, https://www3.epa.gov/npdes/pubs/owm0272.pdf. See also, EPA, "Combined Sewer Overflow (CSO) Control Policy: Notice," 59 Fed. Reg. 18688, 18693 (April 19, 1994), section II.C.5.

curve." EPA's guidance also says that, under some circumstances, the evaluation would include more formal benefit-cost analysis with dollar values assigned to environmental impacts.

EPA also encourages municipalities to use green infrastructure as part of the control plan and EPA advises that, in this context, a benefit-cost analysis, rather than just an analysis of cost, may be particularly useful because green infrastructure may yield a variety of environmental, public-health, and social benefits at relatively low cost.[80]

4.1.2 Establishing an Implementation Schedule

As discussed earlier, municipalities that are obligated to control CSOs, but that have limited financial capability, may seek approval of a phased or extended implementation schedule. In such situations, EPA's guidance explains, the schedule is established through a negotiation process involving the permittee and EPA and state NPDES authorities, and the negotiation will involve several kinds of costs and benefits that may result from the choice between expeditious versus phased or extended implementation.[81] Generally, according to this guidance from EPA, the base-line time period for the implementation schedule would be defined by "the time required for normal engineering and construction practices."[82] Since implementation in a more expedited manner than the "normal" practices would generally be expected to sharply raise implementation costs, an initial cost-related consideration would be to ascertain the length of time required to complete the work using normal engineering and construction practices.

Starting with this baseline, however, EPA's guidance explained that "environmental and financial considerations can influence the time allowed to complete the CSO controls." To extend implementation timing beyond the baseline, "schedules can lengthen by phasing construction of the CSO controls when financial considerations create a financial burden. The primary financial consideration which usually results in an extended implementation schedule with passed construction is the financial capability consideration." Thus, the costs of expeditious implementation of the project, and the reduced costs expected to result from a phased or extended implementation schedule), would generally be measured in terms of the community's financial capability, as discussed in detail earlier.

On the other side of the negotiation are the environmental benefits of expeditious implementation. As EPA stated in its February 1997 FCA Guidance, "The implementation schedule would always give high priority to addressing the environmental considerations involving discharges to sensitive areas and use-impaired water bodies. The CSO controls for

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[80] U.S. Environmental Protection Agency, Green Infrastructure, *Green Infrastructure Cost-Benefit Resources*, https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources.

[81] U.S. Environmental Protection Agency, Office of Water, Office of Wastewater Management, *Combined Sewer Overflows–Guidance for Financial Capability Assessment and Schedule Development*, EPA-832-B-97-004, February 1997 (1997 FCA Guidance), https://www3.epa.gov/npdes/pubs/csofc.pdf.

[82] Ibid., 48.

these discharges would be constructed as expeditiously as possible."[83] (According to EPA, sensitive areas are identified by the NPDES permitting authorities and include locales with swimming or other primary-contact recreation, shellfish beds, drinking water supplies, and waters with threatened and endangered species and their habitats.[84] Areas are considered use-impaired if water quality standards are not being met resulting in recurring adverse impacts on aquatic life, human health, or aesthetics.[85]) In other words, EPA established a rule-of-thumb that the benefits of expeditious implementation are particularly compelling in cases of discharge to sensitive areas or to use-impaired water bodies, and such situations support requiring compliance as expeditiously as possible.

4.1.3 Integrated Planning

As discussed previously, EPA recommends that municipalities consider addressing the Clean Water Act requirements in a region through a single integrated plan. EPA has issued this guidance in the form of a memorandum issued October 27, 2011;[86] a Framework dated May 2012 and circulated June 5, 2012;[87] and a set of Frequently Asked Questions (FAQs) dated July 15, 2013.[88] This guidance instructs that benefits and costs be considered that are similar to, but more varied than, those specified in the earlier guidance on establishing CSO implementation schedules.

As for the relative costs of expeditious implementation of various components of an integrated plan, the Framework and FAQs advise that the plan should include a financial strategy and capability assessment for each entity participating in a plan, and that the 1997 FCA Guidance and other relevant EPA and state tools be used as guides; but the 2012 IP Framework further advises that a plan should "[m]aximize the effectiveness of funds through analysis of alternatives and the selection and sequencing of actions." The 2012 IP Framework also calls for the

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[83] Ibid., 43.

[84] Ibid., 44; U.S. Environmental Protection Agency, Watershed Academy Web, *Introduction to the Clean Water Act*, p. 50, https://cfpub.epa.gov/watertrain/pdf/modules/introtocwa.pdf.

[85] EPA's 1997 guidance on financial capability and schedule development, above, at pages 44-45; U.S. Environmental Protection Agency, *Water Quality Standards: Regulations and Resources, Supplemental Module: Listing Impaired Waters and Developing TMDLs*, https://www.epa.gov/wqs-tech/supplemental-module-listing-impaired-waters-and-developing-tmdls.

[86] U.S. Environmental Protection Agency, Office of Water and Office of Enforcement and Compliance Assistance, *Achieving Water Quality Through Integrated Municipal Stormwater and Wastewater Plans*, Memorandum, October 27, 2011, https://www.epa.gov/sites/production/files/2015-10/documents/memointegratedmunicipalplans_0.pdf.

[87] U.S. Environmental Protection Agency, Office of Water and Office of Enforcement and Compliance Assistance, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*, Memorandum, June 5, 2012, distributing U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning Approach Framework*, May 2012, https://www.epa.gov/sites/production/files/2015-10/documents/integrated_planning_framework.pdf.

[88] U.S. Environmental Protection Agency, *Integrated Municipal Stormwater and Wastewater Planning: Frequently Asked Questions*, July 15, 2013, https://www.epa.gov/sites/production/files/2015-10/documents/sw_integratedmunicipal_planning_faq.pdf.

consideration of "disproportionate burdens on portions of the community," the risk of which would seem to increase in plans that encompass broader geographical areas covering several regulated entities and several pollution sources. The FAQs also specify that, in comparing alternative control measures, total life-cycle costs, not just construction costs, should be considered.

As for the benefits of expeditious implementation of various plan components, the integrated-planning guidance documents advise that the 1997 FCA Guidance remains relevant, thereby reiterating the importance of the two high-priority situations (i.e., discharge to sensitive areas and discharge to use-impaired water bodies). But the documents also call for the consideration of the range of environmental and public-health benefits. The Integrated Planning Framework advises that, in selecting alternatives and proposing implementation schedules, the integrated plan should address "projected pollution reductions, benefits to receiving waters and other environmental and public health benefits associated with each alternative."

The FAQs also advise that a plan may incorporate investments needed to implement final and anticipated TMDLs, in order to facilitate appropriate investment. Moreover, the 2012 IP Framework mentions that, in enforcement actions, an integrated plan might include measures that support EPA's mission, even if not otherwise mandatory – such as children's health, environmental justice, innovative technology, and a number of other priorities – that may be taken into account by the regulator in exercising enforcement discretion.[89]

4.1.4 Governmental Projects Impacting the Environment

Development and approval of major pollution-control projects, like other major governmental projects, must generally include consideration of benefits and costs and sometimes must include a rigorous analysis of the benefits and costs of the proposal and of alternatives. In the case of governmental actions or projects that significantly affect the environment, a focused analysis of the environmental impacts may be required under the federal National Environmental Policy Act (NEPA), under similar state or local environmental policy statutes, or both.

Many CSO and other Clean Water Act control measures that have federal funding or loan guarantees or that require new-source NPDES permits or require other federal approvals would be considered federal actions under NEPA.[90] In addition, a substantial number of state and local

[89] At the end of the Framework, EPA cites the agency's Supplemental Environmental Projects Policy, the latest version of which was issued attached to a memorandum dated March 10, 2015. https://www.epa.gov/sites/production/files/2015-04/documents/sepupdatedpolicy15.pdf.

[90] See, e.g., Environmental assessment for the DC's Clean Water Project: https://www.dcwater.com/sites/default/files/ART_EA.pdf. See, generally, JT Maughan, *Environmental Impact Analysis: Process and Methods*. CRC Press, the Taylor & Francis Group, LLC. 2014. P. 244-245 (available at Google Books, https://books.google.com).

jurisdictions have similar state or local environmental policy statutes that may apply to measures to control CSOs or otherwise to meet CWA requirements.[91]

The regulations of the Council on Environmental Quality (CEQ) implementing NEPA specify that a wide range of environmental consequences must be considered in an Environmental Impact Statement (EIS) for both the proposed action and alternatives, including both direct and indirect effects of the project and including impacts on energy use, depletable resources and conservation, urban quality, and historic and cultural resources.[92] To determine whether a proposed project would have a substantial impact on the environment, an environmental assessment should likewise address a wide range of possible kinds of consequences, to ascertain whether any of them would be significant.

The proposal and alternatives, including measures to mitigate any impacts, must be considered in sufficient detail that "reviewers may evaluate their comparative merits."[93] The requirements under state or local environmental policy laws may vary; for example, the California Environmental Quality program requires the agency to show that each environmental effect has been mitigated, if feasible; and, if any significant effects remain, the agency must explain why the benefits of the project "outweigh" the remaining significant effects.[94]

The CEQ regulations caution against undue reliance on monetary costs and benefits, including estimations of the monetary value of costs and benefits that are not ordinarily expressed in monetary terms. In an EIS, "the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations."[95] Indeed, when a cost-benefit analysis is prepared, which would emphasize monetized or otherwise quantified values, then the EIS must "discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values and amenities." Furthermore, the EIS "should at least indicate those considerations, including those not related to environmental quality, which are likely to be relevant and important to a decision."[96]

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[91] CEQ, "State and Local Jurisdictions with NEPA-like Environmental Planning Requirements," https://ceq.doe.gov/laws-regulations/states.html; CEQ, *Nepa and CEQA: Integrating Federal and State Environmental Reviews* (February 2014), https://ceq.doe.gov/docs/ceq-publications/NEPA_CEQA_Handbook_Feb2014.pdf. See, e.g., Seattle final EIS under state SEPA: https://books.google.com/books?id=bfA0AQAAMAAJ&pg=PA38&lpg=PA38&dq=costs+benefits+cso&source=bl&ots=o4FOeujB1c&sig=tV-7zi3mSAjkx86c1Kadfb_EVPI&hl=en&sa=X&ved=0ahUKEwj2hZiSu-7UAhXFFz4KHR_RABoQ6AEIYDAI#v=onepage&q=costs%20benefits%20 cso&f=false.

[92] 40 CFR §1502.16.

[93] 40 CFR §1502.14(b).

[94] California Code of Regulations, title 14, §§15093, 15126.

[95] 40 C.F.R. §1502.23.

[96] Ibid.

4.2 Applicable principles and practices for estimating and considering benefits and costs

The provision in the Senate Appropriations Committee's report that mandated this study included an instruction for the Academy to, among other things –

> [R]eview existing studies of the costs and benefits associated with major regulations under such laws as the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, the Comprehensive Environmental Response, Compensation, and Liability Act, and the Resource Conservation and Recovery Act . . . .[97]

Accordingly, the Panel has reviewed several such studies of the benefits and costs of major regulations under these statutes,[98] as well as government-wide guidance on how federal agencies should conduct such studies. (The term "major regulation" was not defined in the committee's report and does not have a commonly understood definition, but OMB uses the term "major rule" to refer to proposed or final rules that have an impact of $100 million or more annually or meet certain other thresholds triggering a more rigorous analysis of the regulatory impacts.[99])

From the review of these studies and this guidance material, as well as academic articles and other expert opinions on the subject, the Panel has identified several general principles and practices that may warrant consideration as being particularly applicable and useful for the

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[97] Senate Report No. 114-70, June 23, 2015 (page 54).

[98] The Panel reviewed studies associated with major regulations under the following environmental statutes:

- Under the Clean Air Act (CAA): EPA, Office of Air Quality Planning and Standards, "Regulatory Impact Analysis: Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Commercial and Industrial Solid Waste Incineration Units," February 2011, https://www.regulations.gov/document?D=EPA-HQ-OAR-2003-0119-2493; associated with rule at 76 *Fed.Reg.*15704 (March 21, 2011).
- Under the Clean Water Act (CWA): EPA, Office of Water, "Benefit and Cost Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category," EPA-821-R-15-005 September 2015, https://www.epa.gov/sites/production/files/2015-10/documents/steam-electric_benefit-cost-analysis_09-29-2015.pdf, associated with rule at 80 *Fed.Reg.* 67838 (Nov. 3, 2015).
- Under the Safe Drinking Water Act (SDWA): EPA, Office of Water, "Economic and Supporting Analyses: Short-Term Regulatory Changes to the Lead and Copper Rule," EPA-815-R0-7022, September 2007, https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100150Y.txt, associated with rule at 72 *Fed.Reg.* 57782 (Oct. 10, 2007).
- Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): EPA does not promulgate major regulations to implement CERCLA.
- Under the Resource Conservation and Recovery Act (RCRA): Prepared for EPA, Office of Underground Storage Tanks, "Assessment of the Potential Costs, Benefits, And Other Impacts Of The Final Revisions To EPA's Underground Storage Tank Regulations," April 2015, https://www.epa.gov/sites/production/files/2015-07/documents/regs2015-ria.pdf, associated with rule at 80 *Fed.Reg.* 41566 (July 15, 2015).

[99] OMB uses this definition of "major rule" in its annual "Report to Congress on the Benefits and Costs of Federal Regulations and Agency Compliance with the Unfunded Mandates Reform Act." See, *e.g.*, the 2016 draft report, at page 1, https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/legislative_reports/draft_2016_cost_benefit_report_12_14_2016_2.pdf. The term "major rule" is also defined in the Congressional Review Act, 5 U.S.C. § 804(2), and OMB's definition encompasses rules that meet that statutory definition.

estimation and consideration of benefits and costs of proposed controls within the Community Affordability Framework and the IP Process. These key principles will be described in the following discussion.

4.2.1 Principle of Proportionality

Designing a study of benefits and costs, gathering the data, and then analyzing and presenting the results all require time and resources; and the amount of time and resources should not be out of proportion to the expected benefit of the additional information. For the development of federal regulations, national law and policy establish two-tier systems that require agencies to commit far greater amounts of time and resources above certain thresholds of regulatory importance. Major rules, which, as noted above, are generally defined as having an annual impact of $100 million or more, generally may be proposed or finalized only after the agency has prepared and issued rigorous assessments of regulatory impacts, including benefits and costs.[100]

Agencies issuing regulations that do not meet the threshold still must assess and consider the benefits and costs, but the assessments need not be so rigorous. Likewise, as discussed above, NEPA and some similar state and local environmental policy statutes also establish two-tiered systems, under which governmental actions or projects that have a significant environmental effect must be supported by detailed analysis of the effects, and efforts to mitigate the effects, for the proposal and reasonable alternatives.

A general "principle of proportionality," which is far more nuanced than the two-tier distinction between major rules and non-major rules, has been applied for the assessment of benefits and costs of proposed regulations and other governmental actions. To help federal agencies meet a variety of analytic requirements for their proposed and final rules, OMB has issued a body of "best practices," including the general principle that –

> the amount of analysis (whether scientific, statistical, or economic) that a particular issue requires depends on the need for more thorough analysis because of the importance and complexity of the issue, the need for expedition, the nature of the statutory language and the extent of statutory discretion, and the sensitivity of the net benefits to the choice of regulatory alternatives.[101]

EPA restated this general principle of proportionality in a comprehensive set of guidelines for preparing economic analyses generally, and EPA recommended adherence to this principle "in

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[100] Similar $100-million-dollar per year thresholds are established under Executive Order 12866, "Regulatory Planning and Review," September 30, 1993, published at 58 Federal Register 51735 (October 4, 1993); the Unfunded Mandates Reform Act, 2 U.S.C. §1532; and Subtitle E of the Small Business Regulatory Enforcement Fairness Act of 1996, 5 USC §804(2).

[101] Office of Management and Budget, *Economic Analysis of Federal Regulations Under Executive Order No. 12866*, Memorandum for members of the Regulatory Working Group, January 11, 1996, https://www.whitehouse.gov/omb/memoranda_rwgmemo.

all cases."[102] In academic writing, this principle has also been expressed in the most general terms, that the expenditure of effort and resources should reflect the expected value of the information to be garnered, taking account of such factors as the size of the initiative under consideration, the extent to which information might affect outcomes, and the context and relevance of the affected outcomes.[103]

4.2.2 Sufficiency of Cost Effectiveness

For selecting a control measure for a single CSO, consideration of cost effectiveness should generally be sufficient, without additional evaluation of the benefits. Determining the "knee of the curve," as mentioned above, is a relatively straight-forward form of cost effectiveness analysis, for which EPA has provided detailed guidance because this method is often well-suited to selecting CSO controls.[104] For a site where storage technology has been selected for CSO control, the cost will generally increase relatively uniformly as size increases, until limits on space or other constraints impose an upper limit on maximum size. EPA's guidance promoting this straight-forward analytic approach of "knee of the curve" applies an accepted engineering strategy for getting the "best bang for the buck."[105]

The policy decision to control CSOs has been established by Congress in the Clean Water Act and EPA in its implementing regulations; and, under general principles of benefit and cost analysis, an assessment of cost effectiveness should usually be sufficient when all that's left is to determine an efficient means of meeting a pre-determined goal.[106] In its 2003 guidance to federal agencies on assessing the costs and benefits of proposed major regulations, OMB likewise identified cost effectiveness analysis as a methodology "designed to compare a set of regulatory actions with the same primary outcome."[107]

OMB's policy also calls upon agencies to conduct a cost-benefit analysis for major rules, in addition to a cost effectiveness analysis, whenever possible. But that approach, which OMB makes applicable to major regulations, does not seem appropriate for site-specific decisions regarding control measures for CWA requirements and integrated planning. A major rule with a

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[102] U.S. Environmental Protection Agency, Office of Policy, National Center for Environmental Economics, *Guidelines for Preparing Economic Analyses*, December 17, 2010, updated May 2014, p. 1-2 to 1-3, https://www.epa.gov/environmental-economics/guidelines-preparing-economic-analyses.

[103] Richard O. Zerbe, Jr., et al. *Toward Principles and Standards in the Use of benefit-Cost Analysis: A summary of work,* November 10, 2010. https://evans.uw.edu/sites/default/files/public/Final-Principles-and%20Standards-Report.pdf.

[104] U.S. Environmental Protection Agency, *Manual: Combined Sewer Overflow Control*, EPA-625-R-93-007, September 1993, p. 21-22.

[105] H. Eisner, *Systems Engineering: Building Successful Systems*, Morgan & Claypool Publishers, 2011, p. 48-50 (cited pages available at https://books.google.com).

[106] Zerbe, above, at page 35, explained that, in situations where the fundamental the policy choice is already made, cost-effectiveness analysis is generally an appropriate methodology to help decide how that chosen policy should be achieved.

[107] Office of Management and Budget, Circular A-4, *Regulatory Analysis*, September 17, 2003 (part D), https://obamawhitehouse.archives.gov/omb/circulars_a004_a-4.

$100-million annual effect is of a far larger scale than such site-specific projects and, therefore, a far greater analytic effort may generally be justified for the rule than for the project. In addition, a key reason for OMB's requirement that major rules be supported by both a cost-benefit analysis and cost effectiveness analysis is "the larger objective of analytical consistency in estimating benefits and costs across regulations and agencies" and such an effort to achieve consistency across regulations and across agencies is not needed or appropriate for the various decentralized project-decisions needed for individual control measures and integrated control plans.

4.2.3 Additional Analysis of Benefits and Costs Where Appropriate

Though the assessment of benefits and costs needed for the selection of conventional control measures for a CSO situation may be relatively straightforward, a more extensive assessment of benefits and costs may be needed for development of a plan involving a large or complex infrastructure project or the integration of several pollution sources and controls into a single plan. When NEPA or a similar state or local law applies to a proposal, an assessment or analysis of a wide variety of environmental impacts must be developed and presented, often including evaluation of the anticipated impact-reductions from various mitigation options, as well as evaluation of the advantages and disadvantages of reasonable alternatives to the proposed action. For example, DC Water is seeking approval of a complex system of tunnels, diversion sewers, and overflow facilities to address CSO outflows to the Anacostia River and, incidentally, to control persistent street floods and basement sewer backups in the affected part of the city. Because much of the proposed facilities would be on or affecting federal agencies' lands, those agencies and DC Water prepared an extensive environmental assessment describing the environmental impacts of the proposal, including consideration of alternatives to the proposed project and ways to mitigate the adverse impacts.[108] The assessment addresses the effects on water quality, of course, and also on soils, vegetation, wildlife, wetlands, land use, human health and safety, cultural resources, aesthetics, the use and experience of visitors and residents, and National Park Service resources.

For a plan that sets implementation priorities for the control of more than one source, some assessment of benefits is needed. EPA's 1997 FCA Guidance for scheduling the control of CSOs offered a relatively simple rule-of-thumb: because of the relatively large harm to the environment from CSOs that discharge to sensitive water bodies or to use-impaired waters, expeditious implementation of those controls must be the highest priority. For other CSOs, depending on a municipality's financial capability, the municipality may be able to justify a more extended implementation schedule.[109]

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[108] U.S. Department of the Interior, National Park Service, *Environmental Assessment for the District of Columbia Water and Sewer Authority's Anacostia River Projects*, May 12, 2010, https://www.dcwater.com/sites/default/files/ART_EA.pdf.

[109] EPA's 1997 Guidance, note [52] above, p. 57

Especially for integrated planning, municipalities may find it helpful to conduct more sophisticated analysis of the benefits to be gained from various options. EPA's 2012 IP Framework states that, in choosing among alternatives, the plan should consider the "benefits to receiving waters and other environmental and public health benefits associated with each alternative."[110]

For characterizing the benefits from Clean Water Act compliance, a number of methodologies have been developed to attribute a dollar value to achieving improved water quality – such as by estimating consumption costs for water-based recreation as a proxy for the value of a recreational-water resource; by comparing the market value of houses as the measure of the value of neighboring water ecosystems; or by conducting a survey to ask people how much they would be willing to pay for cleaner water. Municipalities can refer to the extensive work that has been done in academia,[111] as well as by EPA,[112] for help in estimating the benefits of various control options under consideration in the development and justification of an integrated plan.

4.2.4 Distributional Effects

Distributional effects may also be important. EPA's May 2012 Integrated Planning Framework specifically provides that the implementation schedules in a plan should address "potential disproportionate burdens on portions of the community." It may often be important for a community to understand the disparate impacts of a plan more broadly – "how both benefits and costs are distributed among populations of particular interest," including, if distributional impacts are important, a description of "the magnitude, likelihood, and severity of impacts on particular groups." Distributional impacts, especially those that disproportionately affect racial or ethnic minorities or economically disadvantaged populations, can implicate values and can have social consequences above and beyond any monetary costs and benefits.

Distributional effects on human health are often assessed separately for children and the elderly, as well as for minorities and disadvantaged populations. Economic effects on employment and on small businesses are also often singled out. (Subsistence fisheries could be a population of particular concern.) Among potential environmental benefits and adverse impacts, the need to protect endangered species often receives particular attention.

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[110] Framework, June 5, 2012.

[111] For example, Chris Moore et al., "Valuing Ecological Improvements in the Chesapeake Bay and the Importance of Ancillary Benefits," *Journal of Benefit-Cost Analysis*, June 15, 2017, https://doi.org/10.1017/bca.2017.9; B. Keeler and others, "Linking Water Quality and Well-Being for Improved Assessment and Valuation of Ecosystem Services," Proceedings of the National Academy of Sciences, vol. 109, page 18619 (Nov. 6, 2012), http://www.pnas.org/cgi/doi/10.1073/pnas.1215991109; M. Wilson and S. Carpenter, "Economic Valuation of Freshwater Ecosystem Services in the United States: 1971 – 1997," *Ecological Applications,* vol. 9, page 772 (1999).

[112] Study for CWA Electric Power Generator rule [see note 102 above]; U.S. Environmental Protection Agency, Office of Policy, *Guidelines for Preparing Economic Analyses*, December 17, 2010, updated May 2014, chap. 7, https://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0568-50.pdf/$file/EE-0568-50.pdf.

4.2.5 Ancillary Benefits and Countervailing Risks

Ancillary benefits and countervailing risks may be significant and should be considered. The government-wide policies on preparation of major federal regulations call upon agencies to take account of not only the direct benefits and costs (i.e., the intended benefits and the costs of compliance), but also the ancillary benefits (i.e., favorable impacts other than the intended benefit) and countervailing risks (i.e., adverse consequences other than the costs of compliance). EPA's guidance likewise calls for consideration of ancillary benefits and countervailing risks (though without using those terms.) For example, EPA's guidance on green infrastructure encourages the use of cost-benefit analysis to highlight the variety of environmental, economic, and community benefits.

Likewise, EPA's Integrated Planning Framework provides that a plan, in identifying costs and benefits associated with each alternative, should include not only costs and projected pollution reductions and receiving-water benefits, but also other environmental and public health benefits, as well as any potential disproportionate burdens on portions of the community. Indeed, ancillary benefits can constitute a substantial portion of the beneficial effects of reducing water pollution. For example, states containing part of the Chesapeake Bay Watershed must implement pollution-control plans to protect the Bay, but about half of the measured benefits arise from improvement in freshwater lakes throughout the watershed, which are not the intended purpose of the plans.

Guidance for development of major federal regulations also calls for agencies to estimate the monetary value of ancillary benefits and countervailing risks and to consolidate those amounts in a single estimate of total net benefits. This estimate, along with any other benefits that are not monetized, would then be compared to the costs in the agency's determination whether the benefits justify the costs.

However, to monetize ancillary benefits and countervailing risks, and consolidate them in a single estimate of net benefits may not generally be an appropriate requirement for decisions under EPA's Community Affordability Guidance and the 2012 IP Framework. For example, among the examples of cost-benefit analyses of green infrastructure that EPA presented to assist communities in their decision-making, EPA included one that does not monetize a range of environmental, social, and public health benefits, but that applies a "triple bottom line" approach.

As explained in the study referenced by EPA, a TBL approach reflects the fact that the relevant public institutions are intended to serve values "beyond the traditional financial bottom line," and the analysis therefore provides a "perspective that reflects all three bottom lines: financial, social, and environmental." The consistent cost-benefit approach that OMB policy applies for major federal regulations do not seem appropriate for such site-specific projects, for the reasons expressed above.

4.2.6 Timing of Implementation

The timing of implementation can substantially affect the magnitude of benefits and costs. Agencies' decisions in setting the compliance dates for proposed major federal regulations is frequently a matter of controversy, and OMB's government-wide guidance explains that the selection of such dates can have a very large effect on both the benefits and the costs resulting from the regulation: "Benefits may vary significantly with different compliance dates where a delay in implementation may result in substantial loss in future benefits (e.g., a delay in implementation could result in a significant reduction in spawning stock and jeopardize a fishery). Similarly, the cost of a regulation may vary substantially with different compliance dates for an industry that requires a year or more to plan its production runs."[113] This hypothetical example in the context of major federal regulations is also instructive to the scheduling of Clean Water Act controls. An extended implementation schedule might defer the environmental and public-health benefits of the pollution control, and could, under certain circumstance, result in irreparable harm to a body of water or human health; but, on the other hand, an implementation schedule that allows inadequate lead-time could add substantially to the cost of engineering and construction and of financing, and can conflict with the funding of other, higher-priority needs of the community.

As discussed above, the benefits arising to a community from improved water quality can be very substantial, and can often be measured in monetary terms if the circumstances warrant the investment of analytical resources to conduct the analysis. Accordingly, an extended implementation schedule for discharge controls may result in reduced benefits to the community, which may be measured in terms of time period when during which the community will not reap the benefits of clean water.

Moreover, if discharge of contaminated wastewater causes harm to human health, an extended implementation schedule can result in substantial losses measured in terms of both the monetary and human costs of disease. For example, several studies have shown that discharge of untreated urban runoff onto public beaches, or other sources of pathogen contamination in swimmable waters, are linked to a number of adverse health effects, such as gastrointestinal illness, respiratory illness, and eye and ear ailments.[114] In addition to the harm to businesses and members of the public from curtailed recreational activities, the public health costs can be substantial. For example, a study a few years ago found that illnesses associated with coastal water pollution at two California beaches imposed a public health burden of $3.3 million per

[113] Office of Management and Budget, Circular A-4, *Regulatory Analysis,* September 17, 2003.

[114] Dwight, R.H., D.B. Baker, et al., *Health effects associated with recreational coastal water use: Urban versus rural California*, American Journal of Public Health, vol. 94(4), p. 565-567, 2004, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1448299.

year.[115] Sewer backups into homes and neighborhoods are also of special concern due to the risk of illness that can result from human exposure to raw sewerage, in addition to the cost and disruption from the damage to buildings and other facilities.[116]

Even if an extended compliance schedule does not cause harm to public health or irreparable harm to the environment, benefits provided sooner are generally more valuable to people than benefits provided later. This effect can be represented mathematically, by attributing a dollar value to the benefit and then applying a discount rate to calculate a reduction, or it can be described in non-monetary terms. Likewise, even if expeditious funding of control measures is not impracticable, costs incurred earlier are more of a burden that costs incurred later. Especially if costs are spread out over an extended implementation period, and if environmental benefits only occur upon completion, the net effect of the delay will tend to be negative. Moreover, due to demographic change over time, extending an implementation schedule will tend to alter which individuals would bear the cost and enjoy the benefits of the control measures and might affect disparate impacts.

4.2.7 Retrospective Review of Benefit and Cost Assessments

Retrospectively reviewing benefit and cost assessments can be valuable. Assessments of benefits and costs prepared to develop or support a proposed regulation or proposed pollution-control measures are, of course, prepared prospectively, estimating what the benefits and costs will be after future implementation. However, academic writing, expert commentary, and government-wide policy are giving increasing attention to the value of retrospective review – looking back after implementation – of benefits and costs.

Retrospective review of regulations is seen as offering related benefits. A regulation that is not yielding the benefits anticipated or that is costing more than expected may be appropriately considered for revision or repeal. Also, patterns ascertained about discrepancies between the estimates of benefits before, versus after, implementation, may suggest ways that future prospective estimation methods could be improved.

Some have proposed that new regulations should include provisions for generation and collection of data that would facilitate eventual retrospective review of the regulation. Some expert commentary raises concerns about requiring agencies to conduct retrospective review of existing regulations. For example, due to the very tight budgets of regulatory agencies, some argue that the resources for retrospective review would detract from the agencies' ability to address other pressing priorities.

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[115] Dwight, R.H., L.M. Fernandez, et al., *Estimating the economic burden from illnesses associated with recreational coastal water pollution – a case study in Orange County, California*, American Journal of Public Health, vol. 76(2), p. 95-103, 2005, http://www.sccoos.org/docs/ScienceDirect-JofEnv.pdf.

[116] U.S. Environmental Protection Agency, Office of Civil Enforcement, *EPA Enforcement: Preventing Backup of Municipal Sewerage into Basements, Enforcement Alert*, EPA-325-N-06-001, September 2006, https://www.epa.gov/sites/production/files/documents/enfpreventingbackups-basement0609.pdf.

With respect to control plans under the Clean Water Act, EPA's current Integrated Planning Framework requires that integrated plans make provision for retrospective review. Each plan should have processes for evaluating the performance of planned projects, including monitoring the effectiveness of controls and other aspects of the plan, and for developing updates and improvements for the plan. Retrospective review of a plan's performance can provide essential information for effective adaptive management, by enabling the plan to be adjusted iteratively and more information becomes available.[117] These requirements seem appropriate to seek the benefits of retrospective review, though the corresponding demand on the resources of both the communities and the front-line regulators must be acknowledged.

Based on a review of applicable EPA guidance, of existing studies of the costs and benefits associated with several major environmental regulations, of requirements and guidance applicable to federal agencies conducting such studies, and of other academic and expert literature, several general principles can be identified that plan proponents and regulators should consider for the preparation and review of successful Integrated Plans.

Panel Recommendation #9

In estimating and evaluating benefits and costs relevant to the development and consideration of control plans and integrated plans, the following principles should be considered:

1. Analytical effort should be commensurate with the issue's importance.
2. Simple cost effectiveness analysis should suffice for most individual Combined Sewer Overflow control issues.
3. More complex Integrated Plans may benefit from more extensive assessment of benefits and costs.
4. Distribution of benefits and costs among various populations should be considered.
5. Ancillary benefits and countervailing risks are often important and should be considered.
6. The impact of an extended implementation schedule on benefits and on costs, including any effect on how benefits and costs affect various groups differently, should be considered.

[117] Adaptive management is a strategy "that aims to create flexible resource management policies that can be adjusted as project outcomes are better understood and as stakeholder preferences change." National Academies of Sciences, Engineering, and Medicine, *Adaptive Management for Water Resources Project Planning*, 2002, Chapter 1, Report Purpose and Scope, https://www.nap.edu/read/10972/chapter/3#13.

4.3 Increasing Complexity and the Commensurate Need for Greater Technical Resources and Assistance

EPA's early 1994 CSO Control Policy and 1995 Interim Economic Guidance allowed for decisions based on relatively simple and straightforward assessments of benefits and costs. The appropriate control could often be selected through a "knee of the curve" cost effectiveness analysis; a municipality could seek to demonstrate its need for an extended implementation schedule by demonstrating a lack of financial capability; and, on the other side of the negotiation, EPA's 1995 Interim Economic Guidance offered two high environmental priority situations – discharges to a sensitive area or to a use-impaired body of water – that the front-line regulator from EPA's regional office or a state NPDES agency could cite in arguing that expeditious implementation was necessary.

However, as applicable EPA policies become more flexible and sophisticated – for example, with the emphasis on IP– the amount of analytic effort and resources needed to fully take advantage of that flexibility increase. For example, for a municipality to include green infrastructure in its control plan, EPA recommends that the value of such infrastructure can best be presented by an analysis of both the costs and benefits. IP involves comparative assessments of the environmental and other benefits, the direct and indirect costs (such as potentially disproportionate burdens), and the relative affordability concerns for control measures to address more than one violation and potentially involving more than one community. The processes for measuring success and working toward improvements, as required in EPA's 2012 IP Framework for integrated planning, would require ongoing effort and resources.

Indeed, the implementation of the recommendations in this report, while intended to make EPA's policies even more flexible and efficient, may also increase the amount of analytic effort and resources needed by permittees and regulators to take advantage of that flexibility and efficiency. (As later discussed, in Chapter 5, the Panel makes a recommendation that EPA develop standard methods to collect data that can be used to account for benefits and costs of green infrastructure and the distribution of those benefits and costs, and a standard approach to making comparisons between green and gray options.)

Especially in light of the tight budgets faced by many local governments, financial constraints may impose significant limits on the ability of municipalities to take advantage of the flexibilities offered. The situation faced by front-line regulators in EPA's regional offices and in state NPDES agencies is also particularly problematic, because they also face severe budgetary constraints, but cannot control the timing and amount of analytic material presented to them by permittees for review and approval.

EPA has taken certain steps to make information available to help permittees and front-line regulators manage the preparation and review of benefit and cost assessments. For example, to help communities identify useful analytic methodologies, EPA has published on its website

samplings of cost analyses and cost-benefit analyses used by communities in support of their use of green infrastructure.[118] EPA has also partnered with the International City/County Management Association to establish a "one stop shop" for local governments called the Local Government Environmental Assistance Network (LGEAN). The LGEAN website references resources in a range of environmental subject areas including wastewater, stormwater, and drinking water; and, for each of these areas, the LGEAN website includes cross references to various state, local, and non-governmental organizations.[119] Stakeholder organizations such as these,[120] as well as educational, research, and policy institutes,[121] can also collect, develop, and share information resources to facilitate use and review of the available flexibilities. Making information and other support in this area available for both permittees and front-line regulators would be important to help put into practice the flexibilities and efficiencies offered by EPA's policy.

As the applicable EPA policies become more flexible and sophisticated, and as the proponents of control plans and front-line regulators need to deploy more analytic effort and resources to take advantage of that greater flexibility, the need for technical information and assistance from EPA headquarters and others will continue to grow.

Panel Recommendation #10

The Environmental Protection Agency (EPA) should build on its existing efforts to make informational resources and other support and assistance available that would help both plan proponents and front-line regulators develop, review, and, eventually, agree on the assessments of costs and benefits needed to establish long-term control plans and integrated plans making best use of the flexibilities and opportunities offered under EPA's policies.

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[118] U.S. Environmental Protection Agency, Green Infrastructure, *Green Infrastructure Cost-Benefit Resources*, https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources.

[119] Local Government Environmental Assistance Network, About LGEAN, http://www.lgean.org/index.cfm.

[120] See, e.g., resource organizations referenced by LGEAN in the areas of wastewater, stormwater, and drinking water (http://www.lgean.org/water/wastewater.htm#orgs, http://www.lgean.org/water/stormwater.htm#orgs, http://www.lgean.org/water/drinking.htm#orgs).

[121] See, e.g., the Center for State, Local, and Regional Environmental Programs of the Environmental Law Institute, https://www.eli.org/center-state-local-and-regional-environmental-programs; the program on "Developing Resilient Urban Water Systems" at the Wheeler Water Institute of Berkeley Law School, https://www.law.berkeley.edu/research/clee/research/wheeler/developing-resilient-urban-water-systems/; the project on "Smart Grid Water Technology" at the Nicholas Institute for Environmental Policy Solutions of Duke University, https://nicholasinstitute.duke.edu/focal-areas/smart-water-grid-technology; the Hydroinformatics Research Group at Oregon State University, http://research.engr.oregonstate.edu/hydroinformatics/current-projects.

Chapter 5: Other Innovative Solutions and Smart Practices

Costs of regulatory compliance and deferred maintenance, as well as the need to replace and upgrade aging water infrastructure, are driving the development of innovative solutions and adoption of smart management practices that can lower costs. This situation provides an opportunity to consider the next generation of water infrastructure along with new approaches that might equitably deliver clean and affordable water, while also delivering social, economic, and other environmental or Triple Bottom Line (TBL) co-benefits.

However, the adoption of new and innovative practices can also present significant financial and public health risks.[122] Although EPA's authority is limited to enforcement of the Clean Water Act (CWA), EPA, along with other government agencies at all levels, can play important enabling roles in addressing these challenges. Innovative practices can, in turn, help to reconcile the tension between often competing CWA goals of providing both clean and affordable water.

Technical approaches or paradigms for managing stormwater and wastewater have progressed as existing technologies were found to be no longer adequate, and then, in response to their unintended consequences and new policies. These polices (such as the CWA) often reflect changes in social values. Wastewater and stormwater management has evolved from moving the water offsite via ditches and pipes, (combined and untreated to rivers and streams) toward moving sewage to treatment plants, and the development of separate pipes that route stormwater to streams. However, raw sewage continues to reach rivers in overflow events from the older combined sewers. Stormwater, which remains a growing source of pollution, is beginning to be reduced by managing it at the source, using onsite innovative stormwater management practices, commonly referred to as "green infrastructure", that leverage the functionality or "services" provided by ecosystems - to filter and regulate the flow of water, along with more integrated watershed management approaches.[123] Use of smart technologies also reduces overflow events by optimizing the use of storage capacity in existing gray infrastructure systems and can enable proactive maintenance through early detection of leaks. However, legacy systems remain and existing approaches to managing storm and wastewater stitch together all of the above approaches.

Finance mechanisms are also moving toward greater emphasis on providing performance-based incentives for pollution reduction and the development of new business models that reduce the cost of innovation. Notable examples of these are Community-Based Public-Private Partnerships

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[122] Hawkins, G., *How to Drive Innovation in Water. Or, it's the 3Ps, not P3!,* 2017, www.georgehawkins.net/moonshot.

[123] Reese, A., *Stormwater Paradigms: An expert takes an irreverent look at how our ideas about stormwater have changed,* 2001, http://foresternetwork.com/daily/water/stormwater-management/stormwater-paradigms/; Reese, A., *Ten Emerging Stormwater Best Practices,* Stormwater vol. 17(5), July 2016, http://foresternetwork.com/stormwater-magazine/sw-water/sw-stormwater/ten-emerging-stormwater-management-best-practices/.

(CBP3s), a modification of the Public-Private Partnership (P3) approach that is intended to leverage operational efficiencies of the private sector in meeting regulatory requirements in ways that support economic development, improve the quality of life in local communities, and drive innovation. Although definitions of traditional P3s vary widely, a key distinction of a P3 is that it can bundle construction, operation, and maintenance, thereby providing the contractor with an incentive to consider and minimize lifecycle costs.[124] While in theory a common sense approach, in practice it has been a challenge to align interests and incentives among all partners and manage the process so as to assure that the right projects are selected for the right purpose.[125]

One utility is beginning to recover investments in innovation through a new business model that enables it to share new practices with other utilities, thereby reducing costs of innovation that would otherwise be prohibitive for smaller utilities. Among new practices used to recover costs of providing clean water is the use of resource recovery technologies to generate energy. But, these new approaches do not eliminate the need for new investments, and exist side-by-side with existing rate structures. These place low-income populations at an increasing disadvantage as the cost of service rises and becomes less affordable for greater numbers of water users who face shut-offs.

The types of approaches considered in this chapter include technological innovations, trading, incentive programs, asset management, new business models, and finance mechanisms. Given rising costs and constraints on rate-payers, the chapter also considers experiences in providing low-income assistance. The discussion draws on case studies (included in full in Appendix F) that illustrate particular challenges and various types of creative and innovative solutions that have worked for particular communities. Many of these cases also reflect various forms of institutional innovation through the adoption of smart practices which are consistent with generally-accepted planning principles and which are not necessarily new but that have faced a variety of barriers to adoption.

5.1 Technological Innovation

5.1.1 Green Stormwater Infrastructure

Innovative stormwater management practices, commonly known as "Green Stormwater Infrastructure" (GSI), represents a paradigm shift from moving stormwater away from the built environment via ditches and pipes, to controlling it at the source, where it can instead provide a variety of benefits. In addition to providing clean water, GSI can reduce urban heat island effects and air pollution, recharge groundwater, provide recreational and aesthetic benefits, increase

[124] Engel, E., Fischer R., and Galetovic A., *Public-Private Partnerships to Revamp U.S. Infrastructure*, 2011. Discussion Paper 2011-02, The Hamilton Project, The Brookings Institution.
[125] Chase, B., *Public Private Partnerships in the United States: Evolving Market and New Opportunities*, 2011. Working Paper #53 Collaboratory for Research on Global Projects, Stanford CA.

property values, and drive economic development. In other words, these practices may be designed to also provide a TBL return on investment.

In urban areas, at the scale of individual lots, GSI involves the use of practices that mimic or take advantage of natural systems by enabling water to either infiltrate the soil, be intercepted by vegetation prior to reaching the ground – from which it evaporates— or be captured and released slowly from various types of natural or built retention structures that regulate flow. At a somewhat larger scale, these practices may also include restoration of floodplains and wetlands for their ability to store floodwater. At a landscape scale, it may also include protection of strategically selected natural areas where anticipated development could lead to increases in stormwater runoff, flooding, and other impacts, as well as to higher costs of providing water infrastructure and treatment, and that may help to meet other objectives such as protection of endangered species, and recreational and aesthetic values. This is consistent with a broader definition of green infrastructure, not limited to stormwater management, as: "a strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for America's communities and people."[126]

In developed urban areas, use of GSI practices tends to be driven by the cost of compliance with water quality standards and/or in response to basement sewage backups and repetitive flooding. When used as a complement to the more conventional or "gray" infrastructure it reduces the volume of stormwater entering Combined Sewer Systems (CSSs), and in at least some cases, has enabled the use of smaller pipes in Combined Sewer Overflow (CSO) Long Term Control Plans (LTCP), thereby reducing capital costs. Examples include: Portland OR, Philadelphia, Syracuse, and Cincinnati. In Washington DC, it did not actually reduce total costs but enabled the city to negotiate a five-year extension of the compliance schedule and lower rate increases. Given that green infrastructure consists of smaller projects that can be completed more quickly than deep underground tunnels, it also begins to provide more immediate benefits that increase incrementally, as the projects are built.[127] In Separate Storm Sewer System (MS4) areas, green infrastructure reduces the erosion of streams and helps to maintain water quality.

Challenges

Green infrastructure practices are diverse, and there are a number of challenges associated with their adoption. Therefore, a key consideration is in the selection of practices that are appropriate

[126] Benedict, Mark A., and Edward T. McMahon, *Green Infrastructure: Linking Landscapes and Communities*, 2006 2nd edition, Washington, DC: Island Press.

[127] DC Water 2015, Clean Rivers Project *https://www.dcwater.com/clean-rivers-project*; and Long-Term Control Plan Modification for Green Infrastructure. Executive Summary. https://www.dcwater.com/sites/default/files/green-infrastructure-exec-summary.pdf

in a particular place. Special challenges associated with green infrastructure, which are addressed in the chapter recommendations, are as follows.

Demonstrating benefits:

There is a lack of standard practices for evaluating and comparing gray and green infrastructure and for quantifying their co-benefits, particularly the role of GSI in stimulating long-term economic development. Utilities may find it difficult to justify the use of water-related revenue to quantify benefits and monitor outcomes that are beyond the scope of their management objectives, and cannot invest in green infrastructure in places where it is not a priority for stormwater management. However, as illustrated in the Portland case study, co-benefits can make it possible to establish partnerships and to leverage funding from entities that may have an interest in accounting for benefits beyond water quality, and to thereby adopt a more holistic watershed approach. It is also in the interest of local governments to understand and monitor long-term economic development benefits of these activities.

An economic analysis of environmental, social, and economic, or TBL, benefits was significant in making the case for Philadelphia's ambitious Green City Clean Waters (GCCW) program, but is not granular enough to use to support ongoing project planning and siting decisions. A more granular approach is used by the city of Portland where the use of cost-benefit analysis to compare green and gray options has become standard practice in evaluating public infrastructure projects.

The TBL analysis for Philadelphia compared the costs and benefits of capturing runoff from 50% of impervious surfaces using green infrastructure to a 30-foot diameter tunnel option, and estimated a net benefit of $2846.4 million for green infrastructure, compared with $122 million for gray.[128] Expected benefits included employment in green jobs (approximately 250 people/year), increases in recreational opportunities and property values, a reduction of heat-related fatalities that is attributed to shade, reduction of heat-absorbing pavement and rooftops, and water vapor emissions, health benefits of improved air quality, energy savings, and water quality and habitat improvements. The analysis also found a higher willingness-to-pay per household for the additional water quality and habitat improvements that would not be provided by the tunnel option.[129]

An analysis of the economic benefits of the first five years of the program by the Sustainable Business Network of Greater Philadelphia (SBN) found that the program has in fact delivered

[128] Stratus Consulting, *Final Report: A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds*, 2009, Prepared for Howard M. Neukrug, Director, Office of Watersheds, City of Philadelphia Water Department, under contract to Camp Dresser and McKee.

[129] Ibid.

many of these benefits.[130] For example, stormwater management regulations for development were found to have helped catalyze a best-in-class GSI industry cluster for which annual growth was estimated at 13.8% from 2013-2014. Estimated economic impacts were almost $60 million, generating nearly $1 million in local tax revenue, and supporting 430 local jobs. The study also found positive impacts on nearby property values – which had an aggregate gain of $1.3 billion, resulting in annual property tax increase of $18 million, significant reductions in violence and criminal activity, improved physical health as a result of increased recreational opportunities, and improvements in social equity. The environmental benefit of green space was estimated at $10.5 million per year as a result of water quality improvement, aquatic habitat enhancement, wetlands enhancement and creation, and air pollutant removal.

In Portland Oregon, in the "Tabor to the River" program, which is addressing sewer system deficiencies and basement sewer backups in a neighborhood served by the combined sewer system, cost-benefit analysis demonstrated that costs could be reduced by $63 million (from $144 to $81 million) by combining green infrastructure with traditional (pipe) solutions.[131] Co-benefits of green infrastructure projects have enabled the Bureau of Environmental Service (BES) to build partnerships and leverage additional sources of funding. For example, in the Foster Floodplain project, BES received a FEMA Pre-Disaster Mitigation grant for disaster avoidance and collaborated with Portland Parks and Recreation to buy out repeatedly flooded properties for floodplain restoration, and make the natural area an amenity for the neighborhood. Since the housing is affordable in this area, and federal flood insurance rates are going up, they are also engaging in a broader collaborative effort with the Portland Housing Bureau, Prosper Portland (the City's economic development office), and other agencies and community groups to take a holistic approach to floodplain-related issues that are impacting the area north of the floodplain. In the short-term, the group is working to stabilize households threatened by the rising cost of flood insurance. The group is also developing a long-term strategy to add floodplain storage that reduces the footprint of the 100-year flood on scarce commercial/industrial land and historic residential neighborhoods.

The Crystal Springs restoration project is another example of the ability to attract other partners because of co-benefits. In this case, the replacement of culverts not only provided better stormwater conveyance but also enabled fish passage. Therefore, additional funding was leveraged from several partners including the USACE and Portland Parks and Recreation, enabling BES to take a holistic watershed approach. They have often done cost shares with Parks and Recreation to provide amenity values.

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[130] Sustainable Business Network of Greater Philadelphia, Green Stormwater Infrastructure Partners, *The Economic Impact of Green City, Clean Waters: The First Five Years*, 2016.

[131] Portland, Oregon, Bureau of Environmental Services, *Tabor to the River Program*, www.portlandoregon.gov/bes/47591 (accessed 6-21-2017).

These co-benefits demonstrate the importance of partnerships and their ability to leverage additional, non-rate funding for activities that protect water quality. In particular, they illustrate the importance of combining stormwater and flood management, and building infrastructure that is resilient to more intense and less predictable storms. An analysis by NRDC suggests that reforms to the National Flood Insurance Program to enable routine buyouts of low value "Severe Repetitive Loss Properties" (SRLPs) to restore floodplains, rather than routine repair and rebuilding of these 30,000 properties, at an estimated cost of $5.5 billion since the program's inception in 1978 through 2015, could be a significant source of funding for managing stormwater and maintaining water quality.[132]

Although cost savings and additional co-benefits have been demonstrated in several cities, at least one jurisdiction found that, when including operations and maintenance, the costs of green infrastructure would be the same as for gray and the Integrated Plan suggests that upfront costs are higher.[133]

Early stakeholder engagement

Early engagement of stakeholders is critical to enable them to understand the purpose of green infrastructure and to enable them to have meaningful input in planning, design, and decision-making. As is illustrated in the Portland case study, this may require a change in the project funding cycle so that funds for community engagement are available well in advance.

The Green Streets Steward program was developed to engage volunteers to help with more regular maintenance of green street facilities and reduce city costs. To date, volunteers have adopted more than 400 green streets throughout the city. In typical capital improvement projects, BES invests 1% of the total budget in public involvement beginning 6 months in advance of a project. For Tabor to the River projects, the bureau directed up to 3% of the capital budget toward public involvement and started outreach efforts 18 months in advance of construction. In this case, they asked for 3% for public involvement and started outreach efforts 18 months in advance of construction. This expanded outreach was critical to project success because of the visibility of the green infrastructure and impacts – such as parking and aesthetics – to the neighborhood. BES plans to apply this early more comprehensive engagement approach in other project areas that integrated green infrastructure and deliver multi-benefit projects.

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[132] Moore, R., *Seeking Higher Ground: How to break the cycle of repeated flooding with climate-smart flood insurance reforms*, 2017, https://www.nrdc.org/experts/rob-moore/seeking-higher-ground-climate-smart-solutions-flooding.

[133] Akron, Ohio, *Integrated Plan,* http://www.akronwaterwaysrenewed.com/documents/integrated-plan.aspx.

Project siting

Project siting challenges vary across public and private property. For example, some specific challenges for siting projects in New York City include: street conditions, subsurface conditions, contaminated soils, utility conflicts, and other construction, either in the public right of way or on adjacent property. Some of these can be overcome through good planning, with improved coordination of activities between different government entities and utilities. One approach to addressing siting challenges is a participatory assessment and planning process developed by the Rutgers Cooperative Extension Service Water Resources Program in which the goal is to identify shovel-ready projects, appropriate to a particular location, that has neighborhood champions, and can attract funding or investment.[134] A key challenge to siting projects on private property is identification of lowest cost opportunities and engaging property owners. This is typically done through various types of incentive programs. The DC Stormwater Retention Credit Trading program also provides opportunities for third party project developers who can achieve economies of scale by engaging large or multiple property owners and aggregating projects which is discussed further in section 5.2.1.

Inflexible and outdated policies and regulations

Adoption of green infrastructure has typically been harder for the early adopters, in part due to lack of experience to build and because of outdated policies and regulations at all levels of government. Many stakeholders also report a lack of flexibility in enforcement procedures where the preference has been for pipes and tunnels, which are believed to provide more certainty than green infrastructure with respect to performance.

Because of the resources and effort required to negotiate consent decrees in the enforcement process, it is also difficult and time-consuming to reopen and modify them if more cost-effective approaches are developed. For example, Washington DC invested $14 million in exploring the potential for green infrastructure, which then enabled them to modify a 2005 consent decree to a hybrid approach that was finally approved in 2015. Success was attributed to being stubborn and persistent (as well the ability to fund the exploration of potential).

Faced with a lawsuit in 1991, Portland OR may have been the earliest to propose and adopt green infrastructure to reduce the costs of CSO control. Although EPA did not initially approve a proposal for smaller interceptor sewer pipes in conjunction with green infrastructure, the Portland BES adopted a proactive experimental approach during the planning process for their National Pollutant Discharge Elimination System (NPDES) permit applications – with emphasis on research, modeling, monitoring, and evaluation of pilot projects to identify more effective ways to manage stormwater using innovative green technologies. By implementing these on public properties they were also able to demonstrate their effectiveness prior to city-wide

[134] Rutgers Cooperative Extension Service Water Resources Program, *Keep the Rain from the Drain*, http://www.water.rutgers.edu/Projects/NJFuture/NJFuture.html.

implementation. The initial plan identified a set of cornerstone projects that were designed to remove significant amounts of stormwater from the combined sewer system prior to constructing the tunnels.[135] Key among these was the disconnection of residential downspouts. At a cost of $13 million, this project alone reduced the volume of stormwater by 20% (1.2 billion gallons per year), reducing capital costs of CSO construction by $300 million. Other cornerstone projects were the installation of stormwater sumps and sedimentation manholes to collect and infiltrate street runoff and trap sediment; stream diversion from the CS area, removing 165 million gallons; and sewer separation in some areas.

A common problem with many local stormwater management regulations is that they are inflexible and outdated because they simply require water to be removed from roadways as quickly as possible. Reviewing and updating development codes and standards enables appropriate flexibility in design and can lead to greater private investment in green infrastructure in the process of development and redevelopment. In Philadelphia, which has an estimated redevelopment rate of 1%, the City estimates that 5,000 to 6,000 acres will be greened over the course of the GCCW program just through redevelopment.

Portland developed a Stormwater Management Manual in 1999, which provides policy and design requirements for stormwater management throughout the city. The requirements in the manual apply to all development, redevelopment, and improvement projects within the city on private and public property impacting over 500 square feet of impervious surface, and prioritized the use of green (vegetated) facilities. The manual is periodically updated to incorporate innovations and build on experience, with the next major revisions expected in 2019. It reflects what have now become standard practices for development and redevelopment and is part of a broader asset management strategy.

Among the innovations added to Portland's stormwater management toolbox are different configurations of green streets. Portland was among the early developers of green streets, initially working with private developers to find creative solutions for managing stormwater runoff. With $7 million in funding through EPA's Innovative Wet Weather program, in 2003, Portland began piloting evaluating new configurations of green streets. For example, the city developed green streets for industrial areas designed to reduce conflicts with bike lanes, and maximize parking. After demonstrating these would work, green streets became a standard practice, and there are now close to 2000 throughout the city.

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[135] Water Environment Research Foundation, *Case Study: Portland Oregon – Building a Nationally Recognized Program Through Innovation and Research*, 2009, https://www.werf.org/liveablecommunities/studies_port_or.htm.

Addressing environmental justice and equity concerns,

As part of a good planning process, it is important to identify, evaluate, and consider the consequences of targeted infrastructure improvements that can potentially facilitate economic and social conditions that adversely affect low-income rate payers. Environmental Justice (EJ) challenges were evident in several cases during the Study Team's research. Among the stakeholder observations was that persistent flooding, infrastructure needs, and lack of access to potable safe drinking water often overlap with persistent aspects of segregation. Wealth and population factors are strongly tied to infrastructure need and completed improvements. Four factors (taxable property, taxable sales, income, and population fluctuation) stand out in relation to both needs and the ability to meet those needs.

An example is Freeport, Illinois where persistent flooding from stormwater and a rising river has disproportionate effects on a marginalized and historically segregated community. The city is under a consent decree, and decided to follow community recommendations to make this the first point of investment. Portland, Oregon is also addressing recurrent flooding in poor and minority neighborhoods and is aware of concerns with the potential for green infrastructure as a potential driver of gentrification, and is applying an equity lens to its forthcoming Stormwater System Plan, which will guide future bureau investments. However, because the CSS is mostly confined to the historic inner city neighborhoods, which also tend to be relatively affluent, many green investments have been made in economically privileged and rapidly gentrifying neighborhoods. The bureau is concentrating some green investments, such as tree planting, in traditionally underserved communities, where stormwater management and socioeconomic needs overlap. Although further green investments need to serve stormwater management and risk-based priorities, community partnerships are helping the bureau work beyond its traditional scope and develop projects that have multiple benefits.

In Syracuse, green infrastructure was driven by Environmental Justice concerns, as it was first adopted as an alternative to end of the pipe treatment plants to manage CSO outfalls in poor and minority neighborhoods. And in Philadelphia, an important component of the GCCW program is ensuring city-wide access to green spaces for all citizens through the Green 2015 Action Plan, for which the goal is to add 500 acres of parkland by transforming vacant and underused land, and to have a patch of parkland within a 10-minute walk from anywhere in the city [136] An additional key component of the program is a partnership with PowerCorpsPHL, an AmeriCorps program, through which the City trains at-risk youth and provides opportunities for them to gain

[136] Hogan, Dianna M., Carl D. Shapiro, David N. Karp, and Susan M. Wachter, *Urban Ecosystem Services and Decision Making for a Green Philadelphia,* U.S. Geological Survey, 2014. http://dx.doi.org/10.3133/ofr20141155.

work experience and job placement support. As of the fifth year of the program, 24 individuals were reported to have gained permanent employment through the PowerCorpsPHL program.[137]

Proactive asset management

Another challenge highlighted in the Study Team's research was that the costs of regulatory compliance are in addition to those of a backlog of deferred maintenance of aging infrastructure, suggesting the need to build greater capacity for a proactive, asset management approach that considers lifecycle costs of infrastructure and to prioritize activities based on an assessment of risk. The planning process should also include evaluation of opportunities for investment in natural infrastructure so as to prevent increases in stormwater runoff and increase resilience of the water infrastructure system. Examples of these approaches are found in the Portland and Washington DC case studies, and elsewhere.

Portland is currently developing a Stormwater System Plan for all stormwater management using a risk-based approach to assess conditions and identify high priority areas where the consequences and likelihood of failure can be reduced. It is guided by the Portland Watershed Management Plan developed in 2005, which provides guidance for identifying projects that can meet multiple regulatory requirements in an integrated way.

Portland's approach also includes investment in multiple-benefit natural infrastructure projects (i.e., property acquisition) where this enables them to reduce repetitive flooding as well as avoid higher costs of development in areas where land is not suitable for it. For example, the 63-acre Foster Floodplain Natural Area project, acquired properties from 60 families over 15 years through its Willing Seller Acquisition Program in a previously rural-residential neighborhood that was flooded an average of every other year by nearby Johnson Creek. Buildings and roads were removed from the floodplain, along with 50,000 cubic yards of soil and other material. More than 80,000 native plants were brought in and the creek was restored to a more natural state, providing 140 acre feet of flood storage, which is expected to reduce flooding to once every 6-8 years. Since completion, the project area has not flooded following flood stage storms that normally would have flooded Foster Road.

Another program that engages in property acquisition to store floodwaters and improve water quality is Greenseams, a partnership between the Milwaukee Metropolitan Sewer District and the Conservation Fund that was started in 2001, in response to damages from back-to-back storms in 1997 and 1998. To date, 3,511 acres have been acquired from 106 willing sellers in areas

[137] Philadelphia Parks and Recreation, *Green 2015: An Action Plan for the First 500 Acres*, 2011, http://planphilly.com/green2015.

expected to have major growth. The goal is to increase flood storage capacity by 1.3 billion gallons, thereby protecting Milwaukee Metropolitan Sewer District structural flood management projects. Conservation and amenity values have made it possible for the program to attract over $10 million in additional partner and grant funding.[138]

DC Water reduced a 300-year replacement cycle for water infrastructure to a 100-year cycle, at a cost of $40 million a year, by adding a fixed monthly Water System Replacement Fee to customers' bills in 2016. The residential fee ranges from $6.30 to $9.67 per month depending on meter size and average flow, with higher rates for larger meters in multi-family and non-residential buildings.[139]

Managing risk:

An ultimate challenge is that of managing risk in the context of complexity. As for other types of infrastructure, green infrastructure is "coupled" in that it relies on complex interactions among technological, social, economic, and environmental systems. Being distributed in small projects on public and private property adds an additional layer of complexity that has implications for how it is managed and suggests the need for institutional innovation. In addition to engineering aspects involved in designing and building a project, GI also involves siting on various types of public and private property, planning, maintenance, monitoring, and finance, all of which add more elements of uncertainty and risk.

As part of a one water approach, Philadelphia has established partnerships and is sharing knowledge and experience related to stormwater management with smaller upstream jurisdictions that are a significant source of wastewater effluent and stormwater runoff.[140] In the course of this review, the team also became aware of a number of learning networks, such as the Green Infrastructure Leadership Exchange, and the Urban Waters Learning Network, which play important roles in sharing knowledge associated with green infrastructure development. Government can play an important role in enabling innovation by sharing risks that are associated with it and supporting capacity-building through these types of learning networks.

5.1.2 Smart Technologies

Some jurisdictions are looking for ways to reduce costs using new smart technologies. Prominent examples are Syracuse, New York and South Bend, Indiana, which have used sensor technologies in two different ways.

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[138] Milwaukee Metropolitan Sewer District, Greenseams, 2017, https://www.mmsd.com/what-we-do/flood-management/greenseams.

[139] DC Water, *Water System Replacement Fee*, https://dcwater.com/system-replacement-fee (accessed 7-11-2017)

[140] Couillard, E., M.D. Hesson, K. Anderson, C. Crockett, and M.E. McCarty, *Philadelphia's One-Water Approach Starts with Source Water Protection*, Journal AWWA 107(4), 2015, p. 62–71.

In South Bend, sensors in pipes enable real-time monitoring of flows so that they can be redirected for storage in areas where there is excess capacity, thereby optimizing the capacity of the existing system and reducing the need for expansion. An investment of $6 million in this system, "CSOnet", has enabled the city to avoid costs of $20 million for conventional civil engineering projects to separate sewer lines. [141]

In Syracuse, which faces a backlog of deferred maintenance, water main sensors, along with testing and replacement of non-functioning valves, enable more proactive management of old pipes by detecting leaks before they become breaks. This minimizes disruption as well as cost in repairing water main breaks. In addition, data science and predictive modeling to assign risk scores provide the basis for an early warning system that enables potential breaks to be addressed proactively and prevented. Lastly, following the "dig once" approach, better construction coordination of repair work among utilities also reduces costs and disruption. [142]

Panel Recommendation #11

The Environmental Protection Agency (EPA) should continue to strengthen efforts to engage stakeholders and collaborate in the development of tools, standard methods, and policies that can foster better understanding of the benefits of innovative Stormwater Management practices, and in the ongoing review of lessons learned from their application, as a basis for updating these. Better understanding of these benefits can also provide the basis for partnerships and the ability to funding from additional sources.

[141] City of South Bend, CSOnet, https://www.southbendin.gov/government/content/csonet.
[142] City of Syracuse, Innovation Team, *Infrastructure Final Report*, August 2016, http://www.innovatesyracuse.com/infrastructure.

Panel Recommendation #12

The Environmental Protection Agency (EPA) should support innovation in water infrastructure management by working with communities to encourage and enable the use of practices that are consistent with generally accepted principles of good planning, and by institutionalizing the process of adaptive management in enforcement and permitting, as well as in planning. This is a process that involves monitoring, evaluation, learning from outcomes, and building on experience, thereby incentivizing innovation and the development of new capacities. The process should be supported through:

1. Financial assistance for planning and development activities, should be made available for early and comprehensive public engagement in these activities, so that stakeholders have an opportunity to gain understanding of the purpose of Green Stormwater Infrastructure and the importance of stewardship. This early engagement will also enable them to provide meaningful input into planning, design, and decision-making.

2. Use of place-based assessment, with stakeholder input, to identify appropriate locations for effective and implementable projects, as well as the potential for innovation and barriers to it that may need to be addressed.

3. Identification of opportunities to improve equity in the distribution of benefits by addressing Environmental Justice concerns.

4. Building capacity for proactive asset management including the evaluation of opportunities for investment in natural infrastructure to prevent increases in stormwater runoff and flooding.

5.2 Trading

5.2.1 Stormwater Retention Credit Trading

Per NRDC, the most common and straightforward way for cities to capture benefits from Green Infrastructure on private property is by mandating on-site stormwater retention as a condition for construction permit approval for certain projects.[143] This is the context in which the term "stormwater credit trading" usually arises. The credit trading programs allow property owners who are subject to the aforementioned on-site retention mandate to meet a portion of their requirement by purchasing stormwater "credits" from other property owners rather than building

[143] National Resource Defense Council, *Issue Brief: Stormwater Credit Trading Programs,* February 2016, https://www.nrdc.org/sites/default/files/stormwater-credit-trading-programs-ib.pdf.

all of the GI needed to meet the requirement on their own property. These programs are becoming increasingly popular because of the inherent flexibility a trading program provides. NRDC argues that when designed properly, these programs can "create equal or better water quality outcomes than a simple on-site retention requirement."[144] They also create opportunities for third parties who can identify project opportunities and develop credits that can then be sold to developers to meet their obligations, thereby also bringing investments to the more vulnerable and economically challenged communities, which have lower property values and provide the lower cost opportunities for green infrastructure projects.

An example of stormwater credit trading is the Washington DC Stormwater Retention Credit Trading Program, which has evolved to become a hybrid program that combines trading with incentives and also enables a type of Performance-Based P3. This program enables regulated developers, whose projects disturb over 5000 square feet, to meet up to half of their obligation, meeting a 1.2-inch retention standard, through the purchase of Stormwater Retention Credits (SRC). These are credits generated by other owners who are able to go above and beyond the retention standard at a lower cost.[145] SRCs must be certified and inspected by the DC Department of Energy and Environment (DDOE), to ascertain that they adhere to specified best management practices, that they are consistent with an approved stormwater management plan, and that there is a maintenance agreement or contract in place. In the past year, 78,731 credits were traded at an average price of $2.04 per gallon. Alternatively, developers may pay a higher in-lieu fee, currently $3.61, that is used by DDOE to fund GI projects, and which is based on average costs to DDOE for the full range of project types.[146] Through an SRC Purchase Agreement program, DOEE also allows third party developers who are able to generate these at a lower cost, to sell credits directly to DOEE, thereby establishing a price floor that leverages private investment by increasing investor confidence. In effect, this establishes a Performance-Based Public Private Partnership with multiple service providers.[147]

Each SRC represents 1 gallon of offsite retention volume and may be traded and used to meet retention obligations anywhere in the District, with the exception of the Anacostia Waterfront Development Zone, where 1.25 SRCs are required to offset one gallon stormwater runoff elsewhere in the city. In addition to lowering costs to developers, trading in SRCs is expected to shift retention projects from regulated sites with high retention costs, typically located in the

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[144] Ibid., 3.

[145] District of Columbia, Department of Energy and Environment, Stormwater Retention Credit Trading Program, https://doee.dc.gov/src.

[146] Branosky, E., *From Gray to Green: Stormwater Trading in Washington DC. River Network River Voices*, 2016. https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/DC%20SRC%20trading_July%202015%20River%20Voices.pdf; Van Wye, B., *Making stormwater retrofits pay,* August 2012, http://chesapeakestormwater.net/wp-content/uploads/downloads/2012/08/Making-stormwater-retrofits-pay-Aug12.pdf.

[147] DC Department of Energy and Environment, *DOEE Announces $12,750,000 for Innovative Program to Incentivize Cost-Effective Green Infrastructure*, 2016, https://doee.dc.gov/node/1160582.

downtown core areas of the city that drain to tidal areas of the Anacostia and Potomac rivers, to less densely developed sites in the tributary watersheds which are often not covered by stormwater regulations because they tend to be below the size threshold that triggers regulatory requirements. This will provide more water quality protection for tributaries in the MS4 permit areas not served by tunnels being built to capture CSOs, as well as bring aesthetic benefits of green infrastructure to less affluent areas.[148] It is also expected to incentivize the identification of least cost projects on private properties, and could enable the City to lower its own costs by purchasing SRCs on the market.

A key constraint on this approach is the limited supply of credits, which may require real estate developers to acquire credits year-by-year or pay higher in-lieu fees, and to sell properties at a depressed price due to ongoing compliance obligations. This is because property owners do not always have the knowledge, space, or capacity to undertake the projects needed to generate them. However, the requirement for on-site stormwater retention for new development and redevelopment, combined with stormwater fees or drainage charges on existing properties, creates an opportunity for third party project developers. Project developers can aggregate small projects or seek out opportunities to partner with large property owners to achieve economies of scale and generate larger quantities of credits. They can then sell to real estate developers with banked credits sufficient to pre-comply the property for 30 years. This also transfers financial risk to the third project developer, which is responsible for maintaining the project. Owners of land where projects are sited benefit from reduced stormwater fees. Depending on their agreement with the project developer, they may also receive a share of revenues or royalties from the sale of credits.

One such third-party initiative is the establishment of District Stormwater LLC, a new collaborative entity established and managed by Naturevest and Encourage Capital. With an initial investment of $1.7 million in impact investment funds by Prudential Financial, this entity identifies owners of large properties that are not subject to the new on-site stormwater retention requirement who would have an interest in such projects. A proof-of-concept project currently underway is with an urban cemetery that has high fees for stormwater runoff – when completed, The Nature Conservancy expects to be the largest provider of credits in this market.

Another third party initiative is the Anacostia Waterfront Trust Rainpay program, which partnered with the Progressive National Baptist Convention (PBNC) to build a raingarden at the site of their headquarters, which is located on a tributary of the Anacostia, Watts Branch, which is also vulnerable to increases in flooding, and is in an MS4 area. The site also hosts a school, thereby providing opportunities for education and outreach to PNBC–affiliated churches that collectively represent over 2.5 million Baptists. The rain garden retains stormwater runoff in a

[148] Van Wye, 2012.

storm of up to 1.7 inches, from a roof, parking lot, and driveway, generating 11,165 credits a year and was certified by DDOE in May 2017. [149]

As the concept is proved, it is expected to become a blueprint for a number of other cities who have already expressed interest.[150] However, there appears to be a need for guidance and assistance in setting up these kinds of market structures and in doing the kinds of analysis needed to determine if it is appropriate in a particular city as it will depend on the level of development activity.

5.2.2 Water Quality Trading

Water quality trading (WQT) efforts are included within the potential scope of an integrated plan. Although WQT offers the potential for significant cost-savings, and for multiple benefits as well as to provide an incentive for the voluntary participation of the non-point source agricultural sector (which is not regulated under the CWA), these efforts are nascent, especially with respect to inclusion of the stormwater sector. However, it is of high interest to stakeholders because the costs of Best Management Practices (BMPs) for urban stormwater are significantly higher than those for agriculture and WWTPs.

For example, in the integrated plan considered by stakeholders in Onondaga County (discussed in Chapter 3), WQT was among the options considered because of the potential for significant cost savings for meeting requirements of the phosphorus TMDL for Lake Onondaga. In this case, agriculture accounts for 24% of phosphorus compared with 19% from MS4 and 8% from CSO areas. Available funding for agricultural BMPs, through the Onondaga County Soil and Water Conservation District is $165 million annually, compared with $3 million needed over a five-year period to address agricultural non-point source runoff, and a current project backlog of $1 million. Costs for agricultural and forestry BMPs range from $12 to $126 per pound, compared with $742 to $8,764 per pound for stormwater management BMPs, and $500 to $800 per pound for additional phosphorus removal at WWTPs. However, there is no New York state statute that enables trading.

A set of case studies by World Research Institute and Chesapeake Bay Project[151] examined the inclusion of stormwater in trading efforts in three different jurisdictions in Maryland and Virginia, within the Chesapeake Bay watershed, where the stormwater sector accounts for 67% of the estimated $28 billion cost of TMDL compliance, while contributing 16% of the Nitrogen

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[149] District of Columbia, Department of Energy and Environment, *SRC Case Study: Rainpay's SRC – Generating Rain Garden Project at the Progressive Baptist National Convention Headquarters*, 2017, https://doee.dc.gov/node/1260111.

[150] Leatherman, C., *Interview: Kahlil Kettering*, 2017, The Nature Conservancy Magazine. https://www.nature.org/magazine/archives/kahlil-kettering.xml.

[151] Jones, C., McGee B., Epstein L., Fisher E., Sanner P., and Gray E. 2017, *Nutrient trading by municipal stormwater programs in Maryland and Virginia: Three case studies*. Working Paper. Washington, DC: World Resources Institute, http://www.wri.org/publication/nutrient-trading.

and 17% of the Phosphorus load. The only active trading program among these is in Virginia, which has an established state-wide trading program and began to allow the MS4 sector to engage in trading in 2012 for credits generated from non-point sources. Maryland announced the intent to include MS4s in a planned WQT program to help Phase I communities meet the requirement to retrofit 20% of existing impervious cover. The jurisdictions examined in the case study were Arlington County in Virginia, and Montgomery and Queen Anne's Counties in Maryland.

The nascence of these efforts hinges on a host of significant obstacles that prevent programs from gaining traction. Officially, EPA considers WQT an option for compliance with water quality based effluent limitation in a National Pollutant Discharge Elimination System (NPDES) permit. EPA suggests that "WQT can provide greater flexibility on the timing and level of technology a facility might install, reduce overall compliance costs, and encourage voluntary participation of non-point sources within the watershed. Trading can provide ancillary environmental benefits such as carbon sinks, flood retention, riparian improvement, and habitat."[152] The official EPA trading policy is from 2003, when EPA issued the Water Quality Trading Policy to "provide guidance to states, interstate agencies, and tribes to assist them in developing trading programs."[153]

For stormwater management, it may be difficult in practice to meet required conditions, such as that it not contribute to the impairment of local water quality and provide benefits that are in addition to existing practices. For example, trading between MS4 permittees and WWTPs that have already been upgraded would not pass the additionality test. However, in the aforementioned case study of Arlington County in Virginia, the study sees merit in the approach due to specific local circumstances:[154]

- Arlington County is predominantly urbanized and has no opportunity for trading with the agricultural sector within or near the county;
- Arlington County only wants to use credits as a temporal bank as they cannot achieve compliance in the required time-frame but is committed to achieving on-the-ground reductions with urban BMPs; and
- the point source facility is performing at double what is required by the standard.

[152] U.S. Environmental Protection Agency, *Overview on Water Quality Trading*, https://www.epa.gov/npdes/water-quality-trading.
[153] U.S. Environmental Protection Agency, *Frequently Asked Questions about Water Quality Trading*, https://www.epa.gov/npdes/frequently-asked-questions-about-water-quality-trading.
[154] Jones, et al, 2017.

A key trade-off is between market size and geographic specificity. As a general rule, markets are more efficient with more buyers and sellers who use a common and well-defined unit of trade. Among the challenges is that unless credits are purchased within a watershed upstream from a particular urban area, local water quality can be affected and those paying for the credits will not directly benefit, which may limit particular markets to relatively small areas. Credits within the watershed would also have to be available for all of the pollutants covered in the TMDL. Agricultural BMPs typically generate credits for Nitrogen, Phosphorus and Total Suspended Solids, and would not offset discharges of toxic substances or bacteria – a key concern associated with CSOs. In the Arlington County case study, the proposed trade would only be for nutrients, and would not address the County's sediment reduction requirements.[155] MS4 permits, which are typically technology-based, would have to incorporate numerical units and be consistent. In Montgomery County, the case study suggests merit in trading because agricultural credits are available upstream from the urbanized area and it can help to achieve more restrictive bay-wide TMDL targets.[156] A major obstacle is the need for numerical targets in the MS4 permit, which currently only specifies reduction targets in terms of a percentage of impervious surface to be retrofitted.

Other obstacles to WQT include programmatic costs and complexity associated with implementing and maintaining practices, and activities associated with the development, certification and marketing of credits. These activities include the development of protocols for verification and monitoring, and the establishment of credit registries and trading platforms. An example of an important initiative in this area is the Conservation Innovation Grants (CIG), made available as part of the United States Department of Agriculture (USDA) Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP). This initiative leverages matching funds and has been a significant source of support for projects that engage agricultural producers and other stakeholders in the development of new and more cost-effective ways to protect water quality, as well as in the development of the market infrastructure needed to enable WQT. Given the multiple benefits of practices that protect water quality (such as carbon sequestration, and habitat conservation and increased agricultural productivity with reduced costs through more efficient use of fertilizers) they offer the potential to attract additional partners and funding sources.

One particularly innovative WQT project made possible by grants from EPA and USDA, which were more than matched by project partners, is the Ohio River Basin (ORB) Trading Project, which was initiated by the Electric Power Research Institute in 2007. This is an interstate program that has engaged three states - Ohio, Indiana and Kentucky, and has the potential for future expansion to other states in the ORB. In addition to federal and state agencies, it has also engaged farmers, electric power plants, wastewater treatment plants, and agricultural and

[155] Jones, et al, 2017.
[156] Jones, et al, 2017.

environmental organizations. As of the most recent project update in early 2016, accomplishments included the development of a program framework and trading plan that was agreed to by the three states, the installation of conservation practices in 30 projects, the establishment of an online credit registry, and the sale of initial credits in pilot trades which generated revenue that was reinvested in conservation projects. The credits were used to meet corporate sustainability goals and retired rather than to meet compliance obligations because EPRI is a non-profit research institution, and would need to transfer the pilot effort to an appropriate organization that could sell credits for compliance purposes. While use of credits for compliance is an option, more stringent numeric nutrient criteria are needed to drive demand sufficient to justify the effort. Stormwater credits have not been pursued because they would require rule changes and, to date, there has not been a clear demand from permit holders in the basin. With current funding, the project is now integrating forestry BMPs into the initiative, and pilot testing "stacked" credits for water quality and greenhouse gas reduction benefits, which result from reduced fertilizer application.

Panel Recommendation #13

Markets for Stormwater Retention Credits (SRCs) are promising for growing cities with active real estate markets. The Environmental Protection Agency (EPA) should facilitate the adoption of these SRCs in other cities by providing guidance, technical assistance, and start-up grants to cities to enable them to build their capacity to develop and manage a credit market.

Inclusion of stormwater in water quality trading has the potential for significant cost savings and is worth considering where certain conditions can be met. EPA should work with states to identify places where these conditions can be met, (i.e., where there are opportunities for trading, upstream from impaired urban water bodies and water intakes, that can contribute to meeting their National Pollutant Discharge Elimination System permit and Total Maximum Daily Load requirements as well as protect drinking water) and determine what enabling legislation or regulations may be needed to support trading in these conditions. In addition to protecting water quality, agricultural best management practices can also allow for other economic and environmental co-benefits that provide the basis for partnerships and opportunities for additional funding.

5.3 Incentive Programs

In the face of increasing urban development, municipalities are forced to innovate and reduce the stormwater impact of impervious surfaces but are only able to develop projects on public

properties.[157] Various forms of incentive programs have therefore been established to drive the adoption of green infrastructure practices on private properties. Among these are stormwater utility fee structures, which many jurisdictions have adopted to finance stormwater management, and which often include discounts or rebates for customers who implement specific practices.[158] These incentive programs also enable cities to build and use stormwater controls on new and existing properties that are not covered by stormwater requirements. The programs are particularly useful when used to target specific locations to reduce CSOs, or MS4 areas that are not served by tunnels built to capture CSOs that discharge other types of pollution associated with stormwater runoff. Another important aspect of incentive programs is that they involve the community and engage the recipients of stormwater infrastructure.

EPA identifies five primary types of incentive programs:

- Development incentives;
- Grants;
- Rebates and installation financing;
- Awards and recognition programs; and
- Stormwater utility fee discounts.

An additional type of incentive program includes the Public-Private Partnership (P3) and the Community-Based P3 (CBP3), which offer incentives through various forms of performance-based contracting, and which are further discussed in the next section on new business models. According to the Water Environment Federation, development incentives include expedited permitting, decreased fees, zoning upgrades, reduced stormwater requirements, and other benefits to developers planning to use green infrastructure.

One example of development incentives is in Philadelphia where "projects with 95% or more of the impervious area disconnected from the combined or separate storm sewer can qualify for a fast track review process in which the stormwater management section of the project will be reviewed within five days of submittal. This option provides time and costs savings for the project and comes at low or no costs for the city."[159]

Grant-based incentive programs aim to promote green infrastructure practices through low-impact development competitions and by funding projects on private property directly. One

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[157] Water Environment Research Foundation, *Livable Communities Toolbox*, https://www.werf.org/liveablecommunities/toolbox/incentives.htm.

[158] U.S. Environmental Protection Agency, *Getting to Green: Paying for Green Infrastructure*, EPA 842-R-14-005, December 2014.

[159] Water Environment Research Foundation, *Livable Communities Toolbox*, https://www.werf.org/liveablecommunities/toolbox/incentives.htm.

notable example of a grant-based incentive program is the Green Improvement Fund in Onondaga County, NY. This fund "provides grant funding to commercial properties that install green infrastructure practices in specific sewer districts."[160] Through this initiative, the County has provided new green roofs and refurbished dilapidated parking lots, thereby improving properties where owners could not afford to do this. It is part of a broader CSO abatement initiative that seeks to eliminate 946,353 meters^3 (250 million gallons) of CSOs by 2018.

Rebate and installation financing programs are incentive programs that "include funding, tax credits, and reimbursements to property owners who install green infrastructure."[161] These programs usually supply a pre-determined list of installation options like cisterns, permeable pavement, or green roofs.[162] One example is in Montgomery County, Maryland, which runs the RainScapes Rewards program. This is "funded by the county's Water Quality Protection Charge (a stormwater utility fee charged to property owners) and issues rebates up to $2,500 for residential projects and $10,000 for commercial, multi-family, or institutional projects that meet specific design criteria."[163]

Stormwater utility fees charged to property owners can provide a dedicated stream of revenue that can be used to finance stormwater management activities. If tied to an area of impervious surface or some measure of the amount of stormwater generated, consistent with a user-pays principle, they are more equitable than flat fees and rate structures that do not separate stormwater from other wastewater charges. Discounts or rebates on the fee, in exchange for managing stormwater onsite, are often used to provide incentives for doing this on private property. Examples of the use of these types of fee discounts as incentives include the Portland Clean River Rewards program, which provides a discount of up to 100% of the charge for managing on-site stormwater runoff.[164] In Philadelphia, up to 80% credit is provided for management of 1" of stormwater onsite, which would reduce the fee on a one-acre parcel from $5600/year to as low as $1100. The Stormwater Management Incentives Program (SMIP) provides grants of up to $100,000 per acre for projects on non-residential private properties. To encourage more green infrastructure projects on private property, which have a lower cost, in 2014 the City also established the Green Acre Retrofit Program (GARP) as a way to identify the lowest-cost opportunities for these projects by enabling private contractors to identify and bundle projects, and compete for public grants to fund them.[165] A review of the program by NRDC

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[160] Ibid.
[161] Ibid.
[162] Water Environment Federation and Seattle Public Utilities, and King County Wastewater Treatment Division offer this.
[163] U.S. Environmental Protection Agency, *Getting to Green: Paying for Green Infrastructure*, EPA 842-R-14-005, December 2014.
[164] City of Portland, Bureau of Environmental Services, *Clean River Rewards Program Overview*, https://www.portlandoregon.gov/bes/article/390568.
[165] City of Philadelphia, Water Department, *Stormwater Grants*, http://www.phila.gov/water/wu/stormwater/Pages/Grants.aspx.

found that contractors also have difficulty identifying these opportunities and resulted in recommendations to develop a platform through which they can connect with interested property owners.[166]

A 2016 survey by Western Kentucky University[167] identifies 1,600 utilities across the US, with 100 or more stormwater utilities within seven states. Of these,

- 739 were based on the average amount of impervious surface for a single family residential parcel, or Equivalent Residential Unit (ERU);
- 231 used a flat fee; and
- 228 used tier fees - a single fee for a range of impervious area.

In at least some states, there is no enabling legislation for these to be adopted. The WKU survey shows that 10 states have no fee programs, and singles out five of these that have been among the hardest hit by flooding, where a fee could help support flood mitigation projects: Louisiana, Mississippi, New York, New Jersey, and Connecticut.

Establishment of these fees has encountered significant vocal opposition, along with legal challenges.[168] In at least some cases, such as in Maryland, these fees have been branded as a "rain tax". However, a statewide poll by OpinionWorks LLC, Annapolis MD found that, after being provided with basic facts about the fee and its purpose, support doubled from 23% to 46%, and outweighed the opposition, which dropped from 40% to 35%, with the remainder having no opinion.[169] These findings underscore the importance of public outreach to demonstrate the need for the fee, which should be supported by a cost-of-service study, with a clear explanation of its purpose and benefits.

As such fees may entail a large shift in costs to businesses and other non-residential properties with large parking lots for which they do not pay water bills, it is important to couple these fees with programs that provide grants, loans, and technical assistance for upfront costs that can enable them to manage stormwater onsite and reduce their fees. In locations with active real-estate markets, these types of properties may also be ideal for generating credits that can be

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[166] Valderrama, A., *Spurring Entrepreneurship and Innovation in Stormwater Markets,* 2016. Natural Resources Defense Council, Washington DC. https://www.nrdc.org/resources/spurring-entrepreneurship-and-innovation-stormwater-markets

[167] Campbell, C.W., Dymond R.L. and Dritschel A., *Western Kentucky University Stormwater Utility Survey 2016,* 2016, https://www.wku.edu/engineering/civil/fpm/swusurvey/swusurvey-2016draft11-7-2016hq.pdf.

[168] National Association of Clean Water Agencies, *Navigating Litigation Floodwaters: Legal Considerations for Funding Municipal Stormwater Programs*, 2014, http://stormwater.wef.org/2015/01/nacwa-releases-analysis-legal-challenges-stormwater-fees/.

[169] Water Environment Federation, *Negative framing of "Rain Tax" Sways Public Opinion, Stormwater Report*, April 27, 2015, http://stormwater.wef.org/2015/04/negative-framing-rain-tax-sways-public-opinion/.

traded and produce a revenue stream. This is being done by third party green infrastructure project developers in the DC Stormwater Retention Credit Trading Program, who can reduce costs through economies of scale.

A report from a workshop of the National Network on Water Quality Trading identified several obstacles to incentive-based approaches:

- Sufficient participation;
- Sufficient financial incentive to cover installation, opportunity cost, and maintenance;
- Sufficient funding; and
- Political/statutory barriers to raising fees.

There are several ways the report suggests these can potentially be overcome, including:

- Layer on other incentives such as technical assistance;
- Reduce barriers to participation by streamlining burdensome administrative processes;
- Market the program in relation to interests of the property owner, (e.g., reduced localized flooding);
- Conduct outreach that builds awareness of impacts and a culture of stewardship; and
- Provide upfront capital for low-cost financing and include robust maintenance agreements.

Panel Recommendation #14

Local governments should improve communication about stormwater management, and the value of the user fee as a more equitable approach to paying for it, highlighting ways the fee has been successfully used to recover as well as reduce costs of managing stormwater and to mitigate repetitive flooding.

Because user fees can be significant, they need to be coupled with incentive programs that enable property owners to reduce stormwater fees in exchange for the adoption of green infrastructure practices. Local governments should also consider combining these types of fees with grants or loans for upfront costs on large non-residential properties. Since not all local governments have the authority from their states to charge these fees, enabling legislation should be considered in those states that do not have it.

5.4 New Business Models

Recognizing that the status quo is untenable, and in response to changing conditions, utilities are actively seeking new and transformative business models, that enable innovation and support their role as clean water agencies. In a vision for a "Water Resources Utility of the Future"[170] that encompasses many of the types of initiatives discussed in this chapter, utilities see themselves as managers of valuable resources and partners in local economic development by providing multiple TBL benefits.

Among these new business models is one that enables utilities to share innovative practices with other utilities, enabling them to recover at least some of their investments in innovation, and reducing costs and risks of innovation for other utilities for which the upfront costs would have otherwise been prohibitive. DC Water formed "Blue Drop" a non-profit and stand-alone affiliate in which DC Water is the only member and enables them to generate non-ratepayer revenue. Blue Drop markets consulting services to other utilities. In addition to providing a return to DC Water, this lowers the significant upfront costs of innovation to the smaller less efficient utilities and enables all utilities to share in upfront costs for work that would be duplicative.[171]

Activities of Blue Drop include providing consulting services to other utilities for setting up green infrastructure programs, based on experience developing the National Green Infrastructure Certification program, which was developed by DC Water in partnership with Water Environment Federation (WEF), by awarding them a $1 million contract to develop and launch it. The initial focus of the program was on certification for entry-level jobs in green infrastructure construction, maintenance, and inspections; to fulfill a need for employees with the new skill sets required for GI and provide them with a career path. In addition to DC Water, 14 other communities supported the development and launch of the program who each paid $50,000, of which $40,000 was paid back to DC Water for having fronted the initial cost to develop the program with the contract to WEF. In the long-term, the intention is for it to be led by a third party. The initiative now has 14 partners – as a result, DC Water has been reimbursed for over half of the upfront costs. The national scope provides an additional benefit to participants in that it gives them a more portable skill, enabling them to work in participating cities. Additional certification levels for higher-level positions are being considered. So far, 108 people have completed 35 hours of training and passed the certification exam to be awarded certifications. The program aims to be connected to the job market through contractor requirements to hire from the program and meet hiring goals.

Among the innovative practices being adopted by several utilities is the use of resource recovery technologies to generate energy, which can account for up to 40% of an average sewer bill, and

[170] National Association of Clean Water Agencies, Water Environment Research Foundation, Water Environment Federation, *Water Resources Utility of the Future: A Blueprint for Action*, August 2016.
[171] Blue Drop Performance Soil, https://www.bluedrop.com/.

create products such as fertilizers, all of which help to recover or reduce costs of providing clean water. For example, "Bloom Soil" is produced by DC Water from biosolids recovered from the Blue Plains Resource Recovery Facility, and then marketed by Blue Drop.[172] In New Jersey, the Camden County Municipal Utilities Authority (CCMUA) is taking several steps toward becoming a net-zero facility, and to be able to operate off-grid by 2020. These include energy conservation measures, upgrades to more energy efficient technologies, a combined heat and power system that uses sewage heat recovery and converts sludge to biogas that is then converted to electricity that will provide 60% of the plant's energy budget. Solar panels provide an additional 10%. In addition, removal of stormwater from the system using green infrastructure reduces pumping costs.[173] The Gresham, Oregon wastewater treatment plant achieved net zero emissions in 2015 and now produces more energy than it consumes, providing a savings of $500,000 a year in avoided electricity costs. Methane from digesters is burned in a cogeneration facility that produces thermal and electric energy. FOG (Fats Oils and Greases) collected from area restaurants that would have had to pay to have it hauled away, boosts the generation of biogases by 55% and solar panels provide 8% of energy generation.[174]

A number of local governments are exploring ways to leverage investment and efficiencies of the private sector for project delivery, and have established new forms of P3s. Traditional Public Private Partnerships, or "P3s" include performance-based contracts that may enable public entities to leverage efficiencies of the private sector in financing, delivery, long term operations and maintenance of public infrastructure. By bundling these into a single contract, the contractor also has an incentive to consider and minimize lifecycle costs. Key challenges identified include the need for better processes of identifying, evaluating, prioritizing, selecting, and structuring suitable investment-ready projects that support a broader strategic plan as well as management of the entire process to ensure that objectives of the Partnership are met.[175]

EPA evaluated these and proposed modifications to better meet requirements of the Clean Water Act, in a Community-Based P3 (CBP3). As discussed in the beginning of the chapter, the key distinguishing features of a CBP3 are a focus on driving investment in green infrastructure in ways that support local economic growth and improved quality of life in urban and under-served communities. According to EPA estimates, this approach can bring the cost of retrofits from an

[172] Bloom Soil, www.bloomsoil.com.
[173] Camden County Municipal Utilities Authority, *Energy Self-Sufficiency*, http://www.ccmua.org/?page_id=3247.
[174] City of Gresham Oregon, *Wastewater Treatment Plant*, https://greshamoregon.gov/Wastewater-Treatment-Plant/.
[175] World Economic Forum and The Boston Consulting Group, *Strategic Infrastructure Steps to Prepare and Accelerate Public-Private Partnerships*, May 2013.

average of $150,000 down to $80,000 per acre treated and shorten the implementation timeline by up to 40%.[176]

The Prince George's County Clean Water Partnership (CWP) is the most prominent and pioneering example of the CBP3 approach.[177] The structure of the partnership is defined in a 30-year performance-based master agreement between the County and the private entity, Corvias LLC, that is designed to meet the TMDL and MS4 permit requirements by developing green infrastructure projects in ways that also provide benefits for economic development, engage the community, and provide educational opportunities.[178]

Recognizing the challenge of affordability, and that the risks associated with maintaining the status quo had exceeded those of innovation, the County selected this approach in order to be able to leverage the operational efficiencies and flexibility of the private sector, as well as share risk and reduce costs. Following a "Design-Build-Operate-Maintain" business model, rather than issuing separate contracts for each of these phases, the contractor is responsible for maintenance of the projects for a 30-year period, which is roughly the anticipated life of green infrastructure assets. The contract also provides performance based incentives, and expands the amount of acres to be retrofitted if specific performance metrics are achieved. Metrics used to measure success in economic development include local small business participation, employment of county residents, and mentoring and incubation of existing and small businesses who are engaged in the project as subcontractors. The County oversees the contract and funds it with revenue from the "Clean Water Fee" – a stormwater utility fee adopted by the County in 2013.[179]

The Clean Water Partnership is reported to have realized costs between $40,000 and $60,000 per acre treated, a significant reduction compared to traditional costs.[180] As a relatively new initiative that started in 2015, these costs may reflect the least cost opportunities that tend to be prioritized. The initiative has improved efficiency in procurement and project delivery, and has played an important role in developing the local work force. However, it has received mixed reviews from civic watershed organizations, who have found it challenging to coordinate their efforts with the

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[176] U.S. Environmental Protection Agency, U.S. EPA Region 3, Water Protection Division, *Community Based Public-Private Partnerships (CBP3s) and Alternative Market-Based Tools for Integrated Green Stormwater Infrastructure: A Guide for Local Governments*, April 2015.

[177] The Prince George's County Clean Water Partnership. https://thecleanwaterpartnership.com/

[178] *Master Program Agreement for the Urban Stormwater Retrofit Program Public-Private Partnership Between Prince George's County, Maryland and Corvias Prince George's County Stormwater Partners, LLC*, March 2015, https://thecleanwaterpartnership.com/wp-content/uploads/2016/08/Master-Program-Agreement-MPA.pdf.

[179] Prince George's County Department of the Environment, *Prince George's County's Approach to Meeting Regulatory Stormwater Management Requirements Using a Community-Based Public-Private Partnership Business Model*, 2016, https://thecleanwaterpartnership.com/wp-content/uploads/2016/06/PGC-CBP3-Clean-Water-Partnership.pdf.

[180] Lueckenhoff, D. and Brown S., *Public-Private Partnerships Beneficial for Implementing Green Infrastructure*, 2015. Bloomberg BNA: Water Law & Policy Monitor. Bureau of National Affairs. http://stormandstream.com/wp-content/uploads/2014/01/CBP3_BNA_Insights_Article_July_2015.pdf.

partnership, and who have concerns with respect to transparency, and a need for a strategic plan that guides project selection. The project is expected to provide a basis for learning as it matures and can be more fully evaluated.

More generally, and in addition to EPA's work in developing and promoting the CBP3 approach to funding stormwater management programs,[181] EPA offers information and technical assistance to communities that may be interested in a variety of different kinds of public and private partnerships that can be used for procuring needed water infrastructure.[182] For example, EPA's Water Finance Center collaborated with the University of North Carolina (UNC) Environmental Finance Center to explore a number of alternative models by which communities can use public-private partnerships for water infrastructure. UNC's published report provides an in-depth examination of nine such projects,[183] and, based on UNC's work, EPA issued a summary document.[184] As explained there and in other resource materials,[185] under these arrangements the government sponsor retains ownership of the infrastructure asset, while the private sector assumes some substantial amount or responsibility and risk in delivering and managing the asset. Although the contract price would generally be higher, the arrangement may be desirable if the contractor is better able to manage or mitigate the risk. EPA, in its explanatory document, identified the four most common varieties of partnership used for water infrastructure: Design Build (Construction Manager at Risk); Design Build Finance; Design Build Operate Maintain; and Design Build Finance Operate Maintain.[186] (CBP3 arrangements, discussed above,

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[181] U.S. Environmental Protection Agency, U.S. EPA Region 3, Water Protection Division, *Community Based Public-Private Partnerships (CBP3s) and Alternative Market-Based Tools for Integrated Green Stormwater Infrastructure: A Guide for Local Governments*, April 2015.

[182] U.S. Environmental Protection Agency, *Leading Edge Financing for Water Infrastructure*, https://www.epa.gov/waterfinancecenter/leading-edge-financing-water-infrastructure.

[183] University of North Carolina, School of Government, Environmental Finance Center, *The Financial Impacts of Alternative Water Project Delivery Models: A Closer Look at Nine Communities,* March 2017, https://efc.sog.unc.edu/reslib/item/financial-impacts-alternative-water-project-delivery-models-closer-look-nine-communities.

[184] U.S. Environmental Protection Agency, Water Infrastructure and Resiliency Finance Center, *Perspective: 'The Financial Impact of Alternative Water Project Delivery Models' in the Water Sector*, February 2017, https://www.epa.gov/sites/production/files/2017-03/documents/epa_p3_perspective_final_2.24.17.pdf.

[185] See U.S. Department of the Treasury, Office of Economic Policy, *An Economic Framework for Comparing Public-Private Partnerships and Conventional Procurement*, May 2016, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2784728; A.A. Boardman et al., *Comparative Analysis of Infrastructure Public-Private Partnerships*, Journal of Comparative Policy Analysis: Research and Practice, vol 17, p. 441-447, November 2016, http://dx.doi.org/10.1080/13876988.2015.1052611; Organization for Economic Cooperation and Development, *Recommendation of the Council on Principles for Public Governance of Public-Private Partnerships*, May 2012, https://www.oecd.org/governance/budgeting/PPP-Recommendation.pdf.

[186] U.S. Environmental Protection Agency, Water Infrastructure and Resiliency Finance Center, *Perspective: 'The Financial Impact of Alternative Water Project Delivery Models' in the Water Sector*, February 2017, p. 3, EPA described these arrangements:

- Design Build (Construction Manager at Risk) – the construction manager is obligated to deliver the project at the bid cost and thereby absorbs the construction risk.
- Design Build Finance – not only weds the design and build phases together as one deliverable, but also includes privately sourced financing, which may be useful if the sponsor faces capital-access constraints.

would come within the latter two categories, as the contractor is responsible for the entire life-cycle of the project.) EPA also notes that public-private partnerships frequently involve alternative revenue models, such as -- standard user fee (the service provider sets and collects fees), revenue-sharing (revenues are shared with the contractor), availability payment (the fee to the contractor is paid only if the assets meet contracted quality and performance standards), and profit- or risk-sharing (caps on the contractor's return on investment, or limits contractor's receipts based on productivity, or receipt by the sponsor of a share of the contractor's profit, etc.).[187] The use of such various models for infrastructure procurement can substantially affect the community's debt burden and the utility's rate structure, and operating efficiency, and may thereby affect the factors that are part of a financial capability assessment of the community.

Panel Recommendation #10

> New business models such as Community-Based Public Private Partnerships (CBP3s) are promising. The Environmental Protection Agency (EPA) should encourage the carefully structured and appropriate experimentation with CBP3s through knowledge sharing activities that build critical government capacity to manage the process, and for strategic planning to guide project selection.

5.5 Finance Mechanisms

Finance mechanisms can help communities and utilities meet the affordability challenge they face in meeting their CWA goals by lowering the costs of financing long-term investments or providing access to broader capital markets to secure financing that may not currently be available. In assessing the effectiveness of existing or proposed finance mechanisms, it is important to consider not only their relative costs, but the distribution of those costs among communities, water users, and other entities (e.g., different levels of government).

5.5.1 The Role and Evolution of State Revolving Funds (SRFs)

In 1987, amendments to the CWA created the Clean Water State Revolving Fund (CWSRF) program to replace the terminated EPA municipal wastewater treatment plant construction grant program that had provided federal support for local clean water infrastructure needs. Then, in 1996, amendments to the SDWA created the Drinking Water State Revolving Fund program

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- Design Build Operate Maintain – the contractor delivers the project design and the project, and operates and maintains the facility as well. EPA notes that, "[s]ince the contract establishes the parameters by which the service provider will be compensated, the design of the project should fully factor in future operating and maintenance costs and efficiencies."
- Design Build Finance Operate Maintain – the purpose of this model is to incentivize the contractor that is responsible for delivering the entire lifecycle of the project, including the finance component.

[187] Ibid. See also, U.S. Department of the Treasury, Office of Economic Policy, *Expanding the Market for Infrastructure Public Private Partnerships*, April 2015, p. 10-26.

(DWSRF) to replicate the CWSRF and provide federal support through the states for local drinking water infrastructure needs.

Since the end of EPA's construction grant program, these state revolving fund (SRF) programs have been the major source of federal and state financial support for meeting community and utility water infrastructure investment needs throughout the nation. Both of the SRF programs have received annual EPA grants, with a 20% state match, to capitalize state revolving loan funds that use the proceeds to make loans to local utilities to help fund their water infrastructure investment needs. Through capitalizing these SRFs, the expectation was that they would provide a permanent source of funding support independent of future federal grant support.[188] The SRFs would retain the interest and loan payments from their outstanding loans and use those funds to make new loans.

Since 1988, federal grants have contributed about $41 billion of capitalization to the CWSRFs, with the 20% state match accounting for another $7.6 billion in capitalization funds. Total capitalization of the CWSRFs through 2016 is almost $49 billion. The DWSRFs have received total capitalization funds of $21.8 billion through 2016 (with $18.4 billion in federal and $3.4 billion in state funds).

The allocation of federal capitalization grant funds to the states differs for the DWSRF and CWSRF. For the DWSRF, the federal allocation of funds reflects the relative investment need of each state based on EPA's latest quadrennial survey of drinking water infrastructure investment needs. The federal allocation of funds to support CWSRF capitalization grants to the states involves some combination of population and need factors, but as the EPA 2016 Report to Congress notes, "the weighting and factors that were used to establish the formula for the original (1988) allotment are not known."[189] This same report noted that the allotment formula had not been changed in 30 years and, given the changes in population and infrastructure investment needs over that period, concluded that "most states do not currently receive appropriated funds in proportion to their reported needs or population." [190]

While the bulk of these SRF funds are to be used to provide loans to localities and utilities in order to meet the water infrastructure investment needs, primarily those needed to meet CWA and SDWA goals, there are some set-asides established. Many of the DWSRF set-asides are established by statute in the SDWA[191]. However, subsequent appropriations acts have adjusted

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[188] The CWA contained this intent explicitly.

[189] U.S. Environmental Protection Agency, *Report to Congress: Review of the Allotment of the Clean Water State Revolving Fund*, EPA-830-R16-001, May 2016, p. 1.

[190] Ibid.

[191] The principal set- asides include the following:

- There is a set aside (the higher of 2% or $20 million) of federal DWSRF grants for Indian tribes and Alaskan Natives, and a minimum allocation of 1% of DWSRF funds for each state, including D.C.

some of these DWSRF set-asides. For the CWSRFs, the set-asides have been primarily established in appropriation acts.

A key financial set-aside for both SRFs is the authority to provide 'additional subsidies' primarily through loan forgiveness to help economically disadvantaged communities. The SDWA authorized states to use up to 30% of their DWSRF funds to provide 'additional subsidies' but subsequent appropriations acts have varied the amounts available for DWSRF 'additional subsidies.' Since 2009 the ARRA and subsequent individual appropriations acts have provided CWSRFs different amounts for 'additional subsidies,' For FY 2016 and FY 2017, CWSRFs had to allocate at least 10% of their federal capitalization grants for 'additional subsidies' but could also allocate up to an additional 30% for that purpose. States are also authorized to transfer up to 33% of their annual allotments between the two SRFs. Cumulative transfers between the two funds produced a net transfer of $360.4 million to the DWSRF as of 2016.

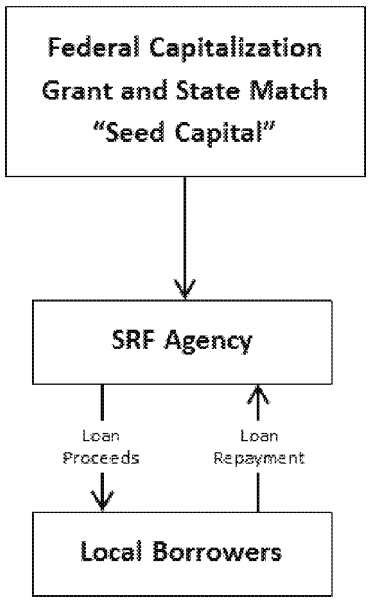

Figure 16. SRFs and the Direct Loan Approach. Source: CIFA (2002) p.71.

5.5.2 Current SRF Operations

The federal statutes establishing the SRF programs provided states flexibility and latitude in how they choose to structure and manage these programs. As the Council of Infrastructure Financing Authorities (CIFA) has noted "no one state SRF program is identical to the other. Each has unique characteristics,

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- EPA must also set-aside $2 million of DWSRF funds to monitor certain contaminants in small and medium systems.
- Recent CWSRF appropriations have included statutory language setting aside 2% or $30 million for direct grants to Indian tribes.
- EPA may set-aside up to $30 million for state training and certification reimbursements and up to 2% of annual funds ($15 million cap) for technical assistance to small systems, but these have not been used in recent years, because other funding sources were available.
- States must make 15% of their annual DWSRF loans to small systems serving 10,000 or fewer persons to the extent they have applied,
- States may also use the higher of up to 4% of DWSRF allotments, $400,000, or 1/5th of 1% of the net position for their fund for their administrative expenses and up to another 10% for training, technical assistance, and personnel development activities.
  States may use up to 2% of their DWSRF grants for small systems technical assistance and up to 15% for assistance to systems for capacity development and source water protection activities.

either in its financial structure or its administration, allowing [it] to adapt to the state's individual needs and administrative characteristics."[192]

In addition to differing financial structures, states have pursued different financial strategies and operating procedures for their SRF programs. The majority of states (29) have opted to leverage their capitalization grants by using tax exempt bond proceeds to support their lending activity, while 21 have chosen the more conservative direct loan approach.

Figure 16 depicts the general financial activities for SRFs following the direct loan approach. The SRF makes the annual federal and state funding (capitalization grants) available as loans to local borrowers. The interest rate on many of these loans is set at below-market-rates to attract borrowers and to lower their costs in undertaking infrastructure investments to meet water quality goals. Principal and interest repayments from outstanding loans are returned to the SRF and become available for future loans.

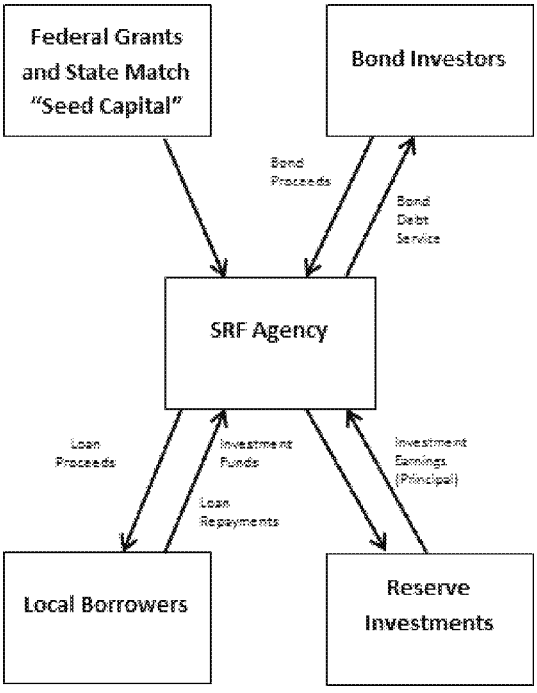

Figure 17. SRF's and the 'Leveraging' Approach. Source: CIFA, (2002) p. 73.

The deeper the interest rate subsidy, the smaller the repayment flows to the SRF from the loans issued and hence the fewer the number of additional loans that can be made in future years from the original capitalization grants. Deep subsidization – for example, zero interest loans and/or principle forgiveness – will sharply curtail, if not totally eliminate, loan repayments for those specific loans. On the other hand, EPA staff believe interest rate subsidies are needed to encourage local utilities and communities to seek SRF loans for critical environmental protection projects.

Figure 17 depicts the general financial activities for SRFs choosing a "leveraging" strategy. The SRF undertakes two separate actions before issuing any loans to local borrowers (communities or utilities). First, they invest the capitalization grant funds in safe instruments to collateralize the

[192] Council of Infrastructure Financing Authorities and U.S. Environmental Protection Agency, *State Revolving Fund: Training Manual*, September 2002, p. 47.

tax exempt bonds they will issue. Then they will issue tax exempt bonds (TEBs) and use those proceeds to make loans to local communities and utilities. Both additional actions will incur additional administrative costs, especially bond issuance fees and other bond administrative expenses. Interest income from the invested capitalization grants assures bond holders that bonds will be repaid and allows the SRF to issue some loans with interest rates below the TEB rates.[193]

5.5.3 Summary Financial Data

The tables on the following pages present a national summary of annual operating revenues, expenses, and net worth for the CWSRFs and DWSRFs in 2015 and 2016 plus the amount of outstanding loans, cumulative federal and state capitalization funds, and additional subsidies provided through 2016.

In 2016, the CWSRFs in the aggregate had net operating revenues of $127 million.

[193] Some state CWSRFs now have sufficient retained earnings from prior loan originations to use those resources to invest in safe instruments to collateralize tax exempt bonds and can allocate some or all of their capitalization grants to new direct loans. In these instances, those SRFs are using a blended lending strategy.

NATIONAL AGGREGATE SRF INCOME STATEMENT				
	[$ in MILLIONS]			
	CWSRF		DWSRF *	
	FY 2015	FY2016	FY 2015	FY2016
Operating Revenue				
Investment interest	296.3	250.3	67.3	60.1
Loan interest	997.1	1004.9	294	293.8
Total	1293.3	1255.1	361.3	353.9
Operating Expenses				
Bond Interest	915.8	874.5	150.3	141.3
Net Refunding			38.4	61.2
Bond Fees	21.8	19.9	6.9	7
Administration	55	58.4		
Additional Subsidy	130.5	175	193.2	208.6
Principle Forgiveness	103.9	133.4	193.2	208.6
Negative Interest	0	0		
Grants	26.5	41.6		
Total	1123.1	1127.8	388.8	418.1
Net Operating Income	170.2	127.3	-27.5	-64.2
Net Income				
Federal Grants	1715.7	1505.7	951.7	1039
State Match	150	162.2	86.8	118.5
Net SRF Transfers	7.6	-7.9	-7.6	7.9
Total	1873.2	1660	1030.9	1165.4
Change in Net Assets	2043.4	1787.3	1003.4	1101.2
		0		
Net Assets	46421.5	48208.8	15932.3	17033.5

Figure 18. National Aggregate SRF Income Statement[194]

[194] CWSRF data from: U.S. Environmental Protection Agency, *2016 Annual Report: Clean Water State Revolving Fund Programs*, tables on p. 12-15. DWSRF data from: U.S. Environmental Protection Agency, 2016 DWSRF National Summary Data, and National and State Data Roll-up Tables, and data from EPA staff. *DWSRF data do not include activities in separate DWSRF funds for set aside activities. (e.g, Administrative costs of $35.3M in 2015 and $34M in 2016 included in separate funds). Annual fee income of $51.1M in 2015 and $54.7M in 2016 included in separate funds.

Total operating revenues were $1255.1 million, with $1005 million from interest on outstanding loans and $250.3 million from interest on investments. Total operating expenses were $1127.8 million from the following items:

- $874 million from bond interest expenses (includes both "leveraging" TEBs and state TEBs used to pay their 20% match);
- $175 million in additional subsidies – primarily principle forgiveness ($133.4 million) for disadvantaged communities;
- $58.4 million for administration; and
- $19.9 million for bond fees.

The total net assets of CWSRF programs increased $1787.3 million to $48.2 billion in 2016. This increase reflected net operating income of $127.3 million plus additional federal capitalization grants and state matching funds of $1667.9 million in 2016.

Total assets for the CWSRF programs in 2016 were $67.6 billion. Outstanding loans to local utilities and communities accounted for $50.3 billion, while investments for bond collateral and working capital accounted for another $17 billion. Total CWSRF liabilities in 2016 were $19.4 billion – $18.8 billion in "leveraged' bonds and $0.6 billion in state match bonds. Net worth (net assets) was $48.2 billion, the difference between the two.

Given their shorter history, DWSRF programs have much smaller operating revenues, expenses, and net assets or net worth than CWSRFs. Likewise, the EPA capitalization grants for the DWSRFs are much smaller than for CWSRFs. Despite their smaller overall size, the DWSRF programs have provided higher levels of additional subsidy – primarily principal forgiveness – than the CWSRFs. This may reflect both the higher level of additional subsidy payments authorized for DWSRFs and the greater number of very small drinking water utilities compared to the number of utilities providing sewer, stormwater, and other clean water services. In addition, CWSRF's were not authorized to provide additional subsidies (e.g. loan forgiveness) until 2009.

The DWSRFs incurred net operating losses in both 2015 and 2016, with losses increasing to $64 million in 2016. These DWSRF net operating losses reflect two basic differences from CWSRF operations. First, due to accounting differences, not all operating revenues are included in this DWSRF loan fund. Second, and most important, DWSRF additional subsidies are much larger both in absolute amounts and relative to federal capitalization grants than CWSRF additional subsidies. Net assets for DWSRFs in 2016 were $17 billion[195] – about 1/3 the level of CWSRF

[195] EPA accounting for the DWSRFs differs from the CWSRFs because of the multiple set-asides for DWSRFs. There are other funds that account for these set-aside activities and these funds have additional net assets derived

net assets. For both SRFs, cumulative federal capitalization grants accounted for the majority of the SRFs net assets.

NATIONAL AGGREGATE SRF BALANCE SHEET				
	[$ in MILLIONS]			
	CWSRF		DWSRF*	
	FY 2015	FY2016	FY 2015	FY2016
ASSETS				
Cash & Investments	12424.6	12960.4	4886.4	4967.6
Bond Reserve Investments	4389.9	4035.6	803.6	751.9
Loans Outstanding	48956.2	50322.5	14820.2	15797.3
Unamortized Bond Fees	254.3	248.6	72.4	69.3
Total Assets	65665	67567	20582.7	21586
LIABILITIES				
State Bonds Outstanding	598.8	604.5	243	235.1
"Leveraged" Bonds Outstanding	18644.8	18753.8	4407.4	4317.5
Total Liabilities	19243.6	19358.3	4650.4	4552.6
NET WORTH/NET ASSETS	46421.4	48208.7	15932.3	17033.5
Federal Grants	37743.5	39249.2	14004.9	15043.9
State Match Funds	5329.4	5491.6	2468.7	2587.2
Retained Earnings [Net Income]	3860.5	3987.8		
Net SRF Transfers	-511.9	-519.8	352.5	360.4
Other Net Assets			-893.8	-958

Figure 19. National Aggregate SRF Balance Sheet[196]

5.5.4 Need for Continued, If Not Increased Federal Support

EPA and a range of stakeholders have cited the success of the SRF programs as an effective intergovernmental model for meeting local infrastructure investment needs while also addressing national water quality goals. As noted in chapter 2, EPA surveys indicate these clean and

from the federal and state capitalization grants allocated to them. For example, total federal capitalization grants amount to 18.4B of which only $17B appear in the DWSRF loan fund.

[196] CWSRF data from: U.S. Environmental Protection Agency, *2016 Annual Report: Clean Water State Revolving Fund Programs*, tables on p. 12-15. DWSRF data from: U.S. Environmental Protection Agency, 2016 DWSRF National Summary Data and National and State Data Roll-up Tables. *DWSRF data do not include activities in separate DWSRF funds for set aside activities. Cumulative Federal Grant contributions were $17517.5M in 2015 and $18352.4 in 2016. Cumulative State Grant Contributions were $3293.8M in 2015 and $3449.7 in 2016. Cumulative net income of $1700.1M in 2015 and $1867.4M in 2016 in other DWSRF funds.

drinking water infrastructure investments needs amount to $271 billion for clean water and $384.1 billion for drinking water infrastructure investment needs over the next 20 years. These substantial remaining water infrastructure investment needs among U.S. communities and their water service providers (utilities), including the costs required to meet CWA and SDWA water quality goals, will require continued federal and state funding for the SRF.

Annual SRF net revenues are not yet sufficient to sustain annual lending activities at current levels, much less increase them to meet these substantial remaining investment needs. Although annual federal funding levels have declined from their peak levels in the 2009-2011 period, in 2017 federal capitalization grants for both the CWSRF and DWSRF programs was $2.3 billion. Continued federal fiscal stress and budgetary pressure for domestic discretionary spending reductions may jeopardize even this level of federal support. While the proposed 2017 budget maintained capitalization grant support for both the CWSRFs and the DWSRFs, future funding levels may depend upon Administration infrastructure spending proposals and the form such initiatives might take.

5.5.5 Water Infrastructure Finance and Innovation Act

Borrowing to pay for long-term water infrastructure investments makes both economic and financial sense. Borrowing to fund long-term investments satisfies a basic public finance principle – pay as you use – to ensure that future users (beneficiaries) contribute to some of the costs of long-lived assets that they will use. Some other benefits include:

- Borrowing allows future users to bear some of the costs of the infrastructure investments they will be using, thereby providing some intergenerational equity among water users.
- SRFs already recognize these economic and financial advantages by issuing loans to utilities to fund their infrastructure investments.
- Those SRFs using the "leveraging" model also rely on borrowed funds (TEBs) to fund local utility loans.
- Many states meet their 20% SRF match requirement using bond proceeds rather than cash.

Financing long-termed assets with borrowing makes eminent economic sense, especially in the current historically low interest-rate environment. Not only are current real interest costs low (nominal rates adjusted for inflation), but these financing costs may be even less burdensome in the future if inflation and interest rates increase. As Figure 20 documents, long-term borrowing rates (Treasury 30 year rates) have been below 4% since 2010 and are currently 2.84% (June 2017), levels that haven't been approached in the last 35 years.

Figure 20. 30-Year Constant Maturity Treasury Rates. Source: Federal Reserve Economic Data

The Water Infrastructure Finance and Innovation Act (WIFIA) of 2014 authorized a new federal program to provide direct federal loans to help finance water-related infrastructure of national or regional significance. Congress provided a $30 million appropriation in 2017 to initiate the program. EPA has created an office to administer the program and applications for these federal loans have already been received. These direct federal loans are intended to supplement, not replace, SRF loans for local clean and drinking water infrastructure investments. EPA plans to use $5 million of the appropriation for administrative expenses and the remaining $25 million as a "federal credit subsidy" to support between $2.5 and $5 billion in new loans. This estimated range of new loans reflects WIFIA's cost-sharing requirement for its federal loans. By statute, WIFIA loans can only support 49% of the total project cost; the remaining 51% is the required matching investment. This distinction between the amount of direct loans provided – $2.5-$5 billion – and the federal appropriation required for that level of activity – $25 million – reflects the change in federal budgeting for direct loan programs due to the Federal Credit Reform Act of 1990 (FCRA). Under the FCRA, the federal budget provides only a "credit subsidy"—essentially a loan loss reserve – for the new loans to be made. This credit subsidy thus reflects the expected defaults from the loans issued the estimated recovery from any defaults, and any explicit interest subsidy below the Treasury borrowing rate provided with these direct loans. This distinction between the loan program level and the federal appropriation required is critically important in the current constrained federal budget environment.

The current WIFIA credit subsidy estimates do not include any assumed explicit interest rate subsidies. Thus, these federal direct loans are expected to be provided at the Treasury borrowing rate. The WIFIA "cost-sharing" provision –WIFIA contribution limited to 49% of project costs—is expected to improve program performance and produce lower default rates, since the project's other sources of financing will share the risk of any potential default. Although intended to support local investment needs directly, discussion at the CIFA Federal Policy Conference in April 2017 indicated that EPA staff may try to coordinate WIFIA lending operations with SRF lending operations in several ways.

Recognizing that the WIFIA program is intended to complement current SRF lending operations, one suggested approach to co-ordinate these independent lending operations is to jointly fund selected infrastructure investment projects. The WIFIA "cost-sharing" provision would require the SRF loan share to cover 51% of the project costs with the WIFIA loan funding the remaining 49%. This would allow both programs to support critical, high-priority water infrastructure investment projects that might not otherwise proceed because the total costs exceeded SRF capabilities or because other capital market resources may not be available at acceptable costs or terms.

Another suggested approach was to provide some WIFIA loans to the SRFs directly to support a portfolio of SRF proposed loans. The WIFIA loan would provide up to 49% of the costs of the portfolio of loans the SRF planned to issue. These additional WIFIA loan resources would thus allow the SRFs to increase their lending activity substantially. In essence, the SRFs that sought this WIFIA support would be using these pooled WIFIA resources to leverage their lending activities funded just as some use TEBs to leverage their lending operations.

5.5.6 Advantages of Federal Loan Support

Long-term Treasury rates remain below comparable maturity rates for tax exempt municipal bonds, thus reducing costs to borrowers. This pattern has prevailed since 2010 as shown in Figure 21. Consequently, WIFIA loans at Treasury rates will reduce current water infrastructure financing costs for those projects that would have been financed by local utility or community TEBs. WIFIA loan rates may also be lower than SRF loans that are not explicitly subsidized (i.e. offered at below market rates). (In June of 2017, the 20-year Bond Buyer index rate was 3.53% compared to 20-year constant maturity Treasury rate of 2.6%.)

Figure 21. 20-Bond Buyer Index Compared to 20-Year Treasury Bonds. Source: Data via the Bond Buyer 20-Bond GO Index.

The table below shows the weighted average of DWSRFs interest rates for direct loans to local communities and utilities relative to state market rate (presumably TEB rate) weighted averages and 30-year constant maturity Treasury rates. The maturities for the DWSRF and state rates are not known, but are likely to be shorter maturities than the 30-year Treasuries. The interest rate "subsidy" offered by DWSRFs in 2016 was 180 basis points, substantially lower than the "subsidy" provided between 2000 and 2010.[197] While the 30-year Treasury rate would provide an average subsidy of 44 basis points relative to the 2016 state average market rate, this interest subsidy would not be as large as the 2016 average DWSRF subsidy of 180 basis points. Aggregate average CWSRF interest rates have been below 2% since 2013 and averaged 1.6% in 2016, slightly lower than 2016 DWSRF average rates. If WIFIA were authorized to provide subsidized loans and chose to do so, WIFIA loan rates could be reduced to the SRF average. However, this would require a larger WIFIA credit subsidy to support the same level of WIFIA loans.

[197] These DWSRF interest rates shown in the table and the resulting below market rate subsidy do not include the effect of "additional subsidies" due to loan forgiveness. Thus the total annual subsidy provided is larger than the interest rate subsidy shown in Figure 19. The discussion of average subsidy simply reflects the difference between market rates and the interest rates charged by the SRFs – the standard economic concept of interest subsidy. EPA also provides "additional subsidies" primarily through principal forgiveness – converting loans to grants – for economically distress local utilities and communities.

Comparative Interest Rates					
	2000	2005	2010	2015	2016
DWSRF weighted averages	2.9	2.2	1.9	1.6	1.7
State market weighted averages	5.8	4.9	4.4	3.8	3.5
DWSRF "average subsidy"	2.9	2.7	2.5	2.2	1.8
30 Year Treasury	5.46	4.51	4.34	3.01	3.06
Difference State market	0.34	0.39	0.06	0.79	0.44
Difference DWSRF weighted average	2.56	2.31	2.44	1.41	1.36

Figure 22. Comparative Interest Rates [198]

Using some WIFIA loans to directly support additional SRF lending activity presents some interesting opportunities. Discussions at the CIFA Federal Policy Conference in April 2017 suggested this could reduce WIFIA administrative costs, since WIFIA staff would not have to process, evaluate, and monitor individual loans, but could rely on SRFs to perform those functions – activities that they already perform. Most importantly, in the current constrained federal budgetary environment, it may be easier to secure additional support for expanded SRF lending activities by seeking additional credit subsidy appropriations for WIFIA than additional capitalization grants.

Given the substantial water infrastructure investment needs and the limited federal resources available through both WIFIA and the SRF programs, it is critically important to ensure that these separate federal resources are used effectively to fund the highest priority water infrastructure investments. Using WIFIA loans in conjunction with SRF loans to jointly fund specific investment projects or a portfolio of SRF loans is one way to coordinate these separate lending operations.

[198] DWSRF data from U.S. Environmental Protection Agency 2016 National Roll-up data and 30-Year Treasury from FRB St Louis FRED data base.

Panel Recommendation #16

An evaluation of any state use of Water Infrastructure Finance and Innovation Act (WIFIA) loans to expand their State Revolving Fund (SRF) lending activities is needed to compare the advantages and disadvantages of this leveraging technique relative to other leveraging techniques (e.g., tax exempt bonds). The evaluation can also identify potential program or statutory impediments to increasing SRF lending operations by leveraging WIFIA resources and assessing WIFIA's ability to meet its statutory goals by allocating some of its loan resources to increase SRF lending activity.

5.6 Other Financing Reforms

A wide variety of specific financing reforms have been proposed to help local utilities and communities bear the costs of meeting their CWA water quality goals and fund the associated long-term investments required for those and other capital improvement needs. These reforms typically involve one of three generic approaches;

1. New organizational structures or programs to improve the allocation of capital resources to water infrastructure needs;

2. New investment instruments to provide access to a broader set of capital markets (e.g. potential investors) or to lower current water infrastructure investment costs; or

3. An expansion or removal of barriers that restrict the use of current financial assistance programs supporting water infrastructure investments.

In some instances, specific financial reform proposals can involve more than one approach. For example, Congress has just funded the new Water Infrastructure Finance and Innovation Act program (WIFIA) for 2017, but proposals have been advanced to increase funding to the fully authorized level and to remove or relax certain current program restrictions.

5.6.1 Organizational Structures

There have been various proposals to create a Federal Infrastructure Bank to provide additional federal support for a wide variety of state and local infrastructure projects, including water infrastructure. The need for a new organizational structure to provide federal funding for water infrastructure projects is not clear. The new WIFIA program already provides federal support (loans) for larger water infrastructure projects and the state revolving funds for clean and drinking water – the CWSRFs and DWSRFs – already serve as "banks" supplying loans for local water infrastructure investments using federal capitalization grants. This Federal Infrastructure Bank reform would require new authorizing legislation and an appropriation to provide any new federal support.

A variant to the Federal Infrastructure Bank, or perhaps an alternative structure for the Bank, is the proposal to create a Government Sponsored Enterprise (GSE) for water infrastructure investments modeled after the two housing GSEs – Fannie Mae and Freddie Mac. In the housing industry, these GSEs were created to help lower the cost of long-term mortgage financing and to overcome perceived market barriers to supplying long-term financing through the use of guarantees. As the discussion in the next section will illustrate, the plethora of creative financial instruments to help meet water infrastructure financing needs do not suggest the presence of significant market barriers. Capital markets are far more extensive and sophisticated than they were in the 1930s when Fannie Mae was created.

In addition to these two financial organizational structures, there have been proposals to create organizational entities to help broaden the focus of water pollution issues beyond the boundaries of local communities and utilities to include a watershed or river basin approach. These proposals can involve inter- as well as intra-state issues and address a broader range of issues than improving access to long-term capital financing. They are examined in a separate section of this chapter.

Proposals to create a Low-income Water Assistance Program (LIWAP) modeled after the Low Income Home Energy Assistance Program (LIHEAP) are an indirect way to help local communities and utilities pay for needed water infrastructure investments. Water affordability issues, especially for low-income users, have become an increasingly important concern for local communities and utilities. Utilities must be able to repay their long-term borrowings, and affordability issues can impede that ability. Again, this LIWAP proposal is reviewed more thoroughly in the section on alternative rate structures and consumer assistance programs in this chapter.

The current organizational structures used to provide EPA funding support for local water infrastructure investment needs – the CWSRFs, the DWSRFs, and WIFIA – enjoy broad support among water industry stakeholders. Other federal programs in HUD (e.g., Community Development Block Grants), the Department of Agriculture (e.g., Rural Utility Service Grants and Loans), and the Army Corps of Engineers also provide federal support for local water infrastructure investment needs. From the water industry stakeholders' perspective, the critical issue is not the lack of organizational structures to provide federal resource support, but the amount of federal resources provided through the current structures.

The need for new financial organizational structures to help local communities and utilities obtain low cost, long-term capital financing appears to be far less critical than the need for additional federal financial support for water infrastructure investments.

Panel Recommendation #17

> Those proposing financial reforms to address local community and utility water infrastructure investment needs should focus on the most critical issue – additional resources to lower costs and provide greater access to long-term financing to meet water infrastructure investment needs.

5.6.2 New Financial Instruments

Capital markets and financial consultants have been creative in developing new financial instruments to help local communities and utilities secure new sources of capital financing and/or lower their investment costs. Social impact bonds, performance-based environmental impact bonds, and Green Infrastructure bonds have been issued to help specific localities meet unique financial challenges. Many of these creative instruments require substantial upfront analysis and planning, as well as some statutory flexibility. For example, the performance-based Environmental Impact Bond (EIB) issued for DC Water's Clean Rivers GI project required pre- and post-construction monitoring of runoff using flow meters, and modeling of alternative outcomes before the bond could be structured to share risks appropriately.[199] Since investors were asked to accept a variable-return based on the performance of the green infrastructure investments being financed, these data and analyses were needed to help define performance results and understand the risks of under and over performance.[200] The costs of these analyses and data development activities must be considered in addition to other bond development costs in assessing the net benefit to the locality from targeted bonds, such as EIBs.

Several water industry stakeholders have also proposed lengthening the terms of water infrastructure bonds and loans to match the long-term expected life of the structures being financed. While longer terms for financial instruments will increase the total interest costs for the particular project, annual interest costs will be lower and these costs will be shared more equitably with future users thereby providing greater intergenerational equity. Matching investment terms more closely to the expected life of the financed projects would appear to meet both efficiency and equity concerns assuming expected life estimates are reliably accurate.

An example of an extended term bond is the "century bond" recently issued by DC Water. DC Water believes their "century bond" achieved several objectives. It reduced the annual costs for funding the long-term infrastructure investment, thus helping to address affordability issues. It also provided a greater measure of intergenerational equity by allowing future users to bear some

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[199] Quantified Ventures, *World's First Environmental Impact Bond to Reduce Stormwater Runoff and Combined Sewage Overflows in Washington, D.C.*, http://www.quantifiedventures.com/dc-water.

[200] North, J. and Gong, G., *DC Water Environmental Impact Bond*, 2017. Harvard University, Kennedy School of Government, Performance Lab, https://govlab.hks.harvard.edu/files/siblab/files/dc_water_eib_project.pdf.

of the costs of the water infrastructure they will be using throughout the expected useful life of the long-lived asset.

Some stakeholders have also suggested that the SRFs or the federal government provide loan guarantees to help reduce the cost of local bond financing or provide access to capital markets for high risk communities or utilities with a low or non-existent credit rating. SRFs may be reluctant to issue state guarantees to high risk borrowers, since the risk of defaults would be much higher than on their own loan portfolio and could jeopardize their own hard-earned and closely-guarded high (often AAA) credit rating.

From the federal government perspective, a new loan guarantee program would appear to be less advantageous than a direct loan program. First, under FCRA, loan guarantees require the same credit subsidy appropriation as a direct loan with comparable terms and default risks. Thus, the federal budgetary impact is the same. From the borrower's perspective, the loan guarantee is likely to be more costly than the direct federal loan, since the reduction in interest rates for the guaranteed bond is not likely to produce an interest rate lower than the Treasury rate for a comparable maturity. Second, administrative costs are also likely to be higher for the guarantee program, since the community or utility would incur the issuance fees and other bond administrative costs while the federal government would incur administrative costs for risk assessment, processing, and monitoring program performance for the guarantees.

Finally, a number of communities have adopted different forms of P3s to obtain access to private financial resources to fund their water infrastructure investments. While these P3s' borrowing costs may not always be lower than the locality's own costs, they often provide ancillary benefits, including greater efficiency in constructing the project and/or operating the facility that may exceed or offset any higher borrowing costs. However, the private borrowing costs usually exceed those offered by the SRFs. In addition, some communities face political issues when seeking to "privatize" the delivery of basic services. The various forms of P3s used by communities are reviewed in another section of this chapter.

5.6.3 Barriers to Effective Financing

AWWA, among others, has proposed some reforms to the newly initiated WIFIA program. One proposal was to eliminate the limitation on the amount of total project costs that can be funded by the WIFIA loan – i.e. the cost sharing feature of the program. Since the program has just received a funding appropriation and has not issued its first loan, it is not possible to assess the impact of this cost sharing feature on the program. However, the demand for WIFIA loans appears to exceed the supply of loans that can be supported at current funding levels. In its first funding round, the WIFIA program received 43 letters of interest requesting more than $6 billion in credit assistance, far more demand than the program can support at its FY 2017 appropriated level.

Other suggestions have addressed perceived barriers to the use of tax exempt financing. Proposals to provide federal guarantees to tax exempt bonds have been vigorously opposed by the Treasury Department and others. These past objections reflect concern about the impact on federal borrowing costs that guaranteed tax exempt bonds may exert. In addition, these guarantees appear to be inferior instruments to direct Treasury loans as explained above.

The Panel finds that capital markets are able to develop a wide range of financial instruments to help local communities and utilities lower their investment costs or expand their access to new investment resources. But the costs, as well as the benefits of these new instruments, need to be fully understood. This is especially important for small localities with limited financial expertise.

Local communities and utilities need to understand the risks and returns from any of these new financing instruments the same as private investors making their own investment choices.

Panel Recommendation #18

The Environmental Protection Agency (EPA) should ensure that the Water Finance Clearinghouse and technical assistance activities provided through the Water Infrastructure and Resiliency Finance Center (Water Finance Center) include sharing information on the risks, costs, and advantages of any innovative financial instrument being proposed with states and localities before those instruments are used.

EPA's Water Infrastructure and Resiliency Finance Center and the Environmental Finance Centers affiliated with universities in each of EPA's 10 regions have the analytical expertise to develop and provide that information.

5.7 Rate Structures, Affordability, and Consumer Assistance Programs

Numerous economists, consultants, and other stakeholders have noted the growing concern over water affordability in the U.S. As noted in Chapter 2, water and sewer bills have increased faster than the CPI and household incomes since 2000. The impact of these trends has been most pronounced for low-income households or users. Water utility bills constitute a much larger portion of low-income household budgets. BLS consumer expenditure data indicate that water and other utilities account for decreasing amounts of consumer expenditures as incomes increase. Consequently, water rate increases have a more severe impact on low-income users.

Low-income users are not only less able to accommodate rate increases, but are also more vulnerable to other financial crises leading to higher likelihood of missed bill payments. Census data confirm that low-income users are far more likely to have difficulty paying utility bills and face service interruption or disconnections. "One 1995 Census study, for example, reported that while 9.8% of non-poor families could not pay their utility bills in full, 32.4% of poor families

could not do so."[201] Extended non-payment of utility bills can result in service interruptions and disconnections. The incidence of these problems is also higher among low-income users. As another Census study noted, "while 1.8% of non-poor families had their electric and/or natural gas service disconnected for nonpayment, 8.5% of poor families suffered this same deprivation."[202]

5.7.1 Water Rate Fundamental Principles

Water utilities are well aware of the impact their water bills have especially on their most economically vulnerable customers – low-income users. However, they also note that their water rate structures are driven by two underlying public finance principles – user pay or benefits principle and full cost recovery. The challenge occurs in determining who pays those costs. The potential conflict between the user pay or benefits principle and affordability issues emerges when low-income users cannot afford their full cost recovery water rates.

Whether publicly or privately owned, water utilities have traditionally relied upon revenues from their users to fund their operating and long-term capital costs. This reliance on own source revenues has increased as federal support for water infrastructure projects has declined or shifted from grants to loans. The termination of the EPA construction grant program to finance water infrastructure projects in the late 1990s and subsequent shift to SRF loans, albeit often subsidized, has reinforced that reliance and highlighted increased concerns about water affordability. State laws and/or public utility commissions have also limited water utility flexibility in developing opportunities to cross-subsidize certain user groups within their rate structures to help reduce affordability issues for low-income users while still generating sufficient revenue to meet their operating and capital costs.

5.7.2 Competing and Conflicting Water Pricing Goals

As Professor Manuel Teodoro acknowledges, "utilities generally design retail service rates with two main goals in mind: (1) revenue stability – the amount and reliability of sales revenues collected, and (2) equity – the degree to which customers' bills reflect the cost of their relative service requirements. A third goal, conservation pricing, has emerged in recent years as another important goal in water rate design."[203] Revenue stability is essential in helping utilities adhere to the full cost recovery principle. The equity goal reflects a utility's effort to meet the user pay or benefits principle. But affordability issues can limit the utility's ability to pursue that user pay principle.

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[201] Fisher, Sheehan & Colton, *A Water Affordability Program for the Detroit Water and Sewerage Department*, FSC's Law and Economics Insights 5(1), 2005, p. 28-29.
[202] Ibid., p. 29.
[203] Teodoro, Manuel P., *Tailored Rates*, AWWA Journal 94(10), October 2002, p. 54.

These three water pricing goals can encounter other conflicts, especially since utilities have experienced greater price elasticity than expected when raising rates to meet higher costs.

Customers do respond to higher water prices by reducing their use of water services. While this response helps achieve the conservation goal, it increases revenue volatility – thus jeopardizing the revenue stability goal. Indeed, water usage per household has declined over the past decade in response to the increase in water rates, leading some analysts to conclude that the water industry is an increasing cost industry. As Dr. Janice Beecher has observed, "water supply in general is a rising-cost industry. The combination of declining sales (as water rates increase) and rising costs, along with the movement toward full cost pricing, is placing considerable pressure on utility water rates."[204]

This conflict among water pricing goals and the need for increased revenues to meet higher costs manifests itself among utilities in very different economic markets with different structural conditions. Very small utilities with high fixed costs or impending investments needs and a limited ratepayer base present very different challenges than larger utilities in declining areas (e.g. "rust belt" cities) that also face large fixed costs and/or impending investment needs and a declining ratepayer base. But water affordability issues compound the complex choices these and other utilities face in increasing water rates and/or revising their rate structures to meet their rising costs.

5.7.3 Limited Consumer Assistance Programs

Water utilities would obviously prefer to avoid the additional costs incurred when financially distressed low-income users face service interruptions and terminations from non-payment of their water bills. Some utilities have created various forms of consumer assistance programs (CAPs) to help avoid those costs and provide eligible ratepayers financial assistance in affording their water bills. EPA's Water Finance Center conducted a survey of 795 water and wastewater utilities and found that only about 30% had some form of CAP. [205] Moreover, many existing water CAPs are limited in size due to a number of restrictions. Some rely on voluntary contributions to fund their CAPS since they are unable to use own source revenues to fund them. The recent report from the staff at the Environmental Finance Center (EFC) at the University of

[204] Beecher, Janice, *Declining Water Sales and Utility Revenues: A Framework for Understanding and Adapting*, White Paper for Water Rates Summit, August 2012, p. 4.

[205] U.S. Environmental Protection Agency, Water Infrastructure and Resiliency Finance Center, *Drinking Water and Wastewater Utility Customer Assistance Programs,* April 2016, p. 2. This WIRFC report indicated that the EPA surveyed 795 wastewater and drinking water utilities and found that only 30% of those surveyed had some form of CAP.

North Carolina (UNC) found that, "the vast majority of utility CAPs around the country tend to be rather small with limited ability to meet the needs of their at-risk low-income customers."[206]

This is strikingly different from the situation for many gas and electric utilities. As the National Consumer Law Center has noted, "while states require the electric and gas companies provide discounts to their low-income customers and telephone discounts are also available to poor consumers nationwide, most states lack any requirement that water/wastewater utilities provide a discount program to low-income customers."[207]

This lack of state support for water utility CAPs or rate discounts for low-income users is compounded by the presence of statutory limitations on the ability of water utilities to implement specific CAPs or develop rate structures that could make water rates more affordable for financially distressed low-income users. Research by the Environmental Finance Center staff at the University of North Carolina indicates that in developing CAPs or other types of rate relief for their most vulnerable users, "utilities must navigate a complex, confusing, and often ambiguous legal framework that varies considerably from state to state."[208] Adding to the complexity is the fact that different regulatory or legal restraints may apply to different types of utilities (e.g., privately vs. publicly-owned) even within the same state. "Private utilities, government-owned utilities, and non-profit water utilities often fall under different economic regulatory frameworks that influence their ability to use rate revenues to fund CAPs."[209]

As the attached state maps from the UNC EFC report reveal, UNC EFC research also indicates that 20 to 40 states either explicitly prohibit water utility rate-funded CAPs or have statutes that pose potential challenges to them.

The Panel finds that developing more efficient and equitable water rate structures and explicit CAPs focused on low-income users can only benefit both the water utilities and their most vulnerable users to meet affordability issues and reduce the costs of providing high quality water and wastewater services.

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[206] University of North Carolina, School of Government, Environmental Finance Center, *Navigating Legal Pathways to Rate-funded Customer Assistance Programs: A Guide for Water and Wastewater Utilities,* July 2017, p. 7.

[207] National Consumer Law Center, *Review and Recommendations for Implementing Water and Wastewater Affordability Programs in the US,* March 2014, p. 5.

[208] UNC, SOG, Environmental Finance Center, Ibid, p. 7.

[209] Ibid., p. 7.

Panel Recommendation #19

The Environmental Protection Agency (EPA) should work with local and state governments to eliminate barriers restricting utilities' ability to develop more efficient and equitable water rate structures, including specific Consumer Assistance Plans (CAPs) for financially distressed low-income ratepayers. EPA's Water Finance Center should continue to develop and disseminated information on CAPs to water industry stakeholders and other interested parties.

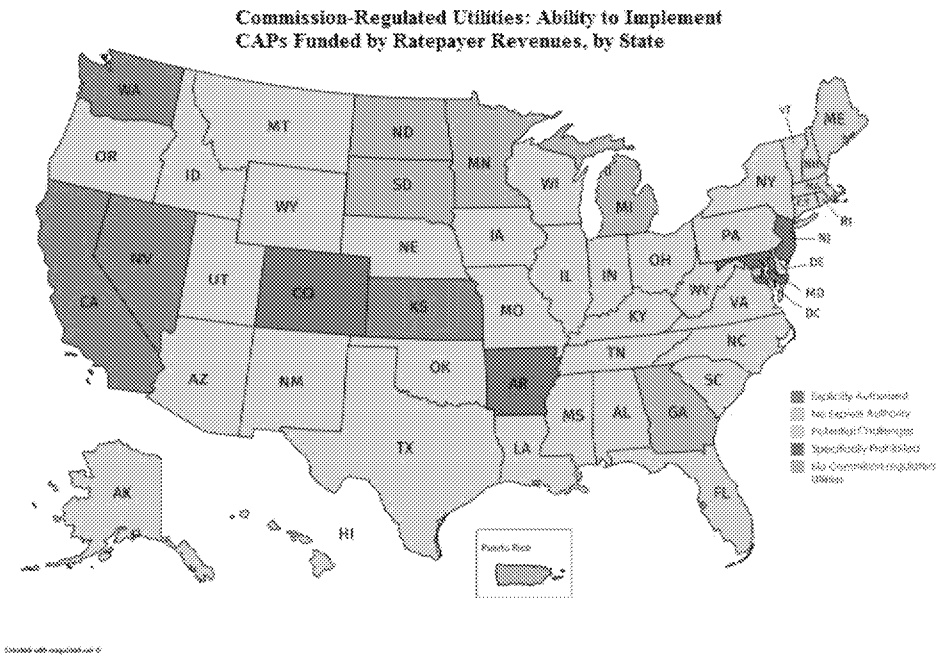

Figure 23. State CAP limitations for Commission Regulated Utilities [210]

[210] University of North Carolina, School of Government, Environmental Finance Center, *Navigating Legal Pathways to Rate-funded Customer Assistance Programs: A Guide for Water and Wastewater Utilities,* July 2017, p. 7.

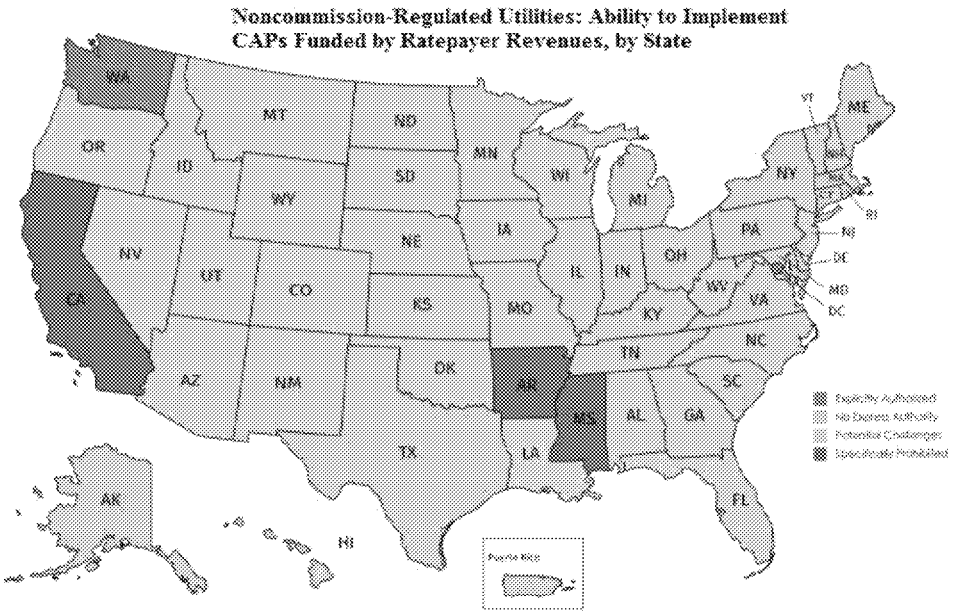

Figure 24. State CAP limitations for Noncommission-Regulated Utilities. [211]

5.7.4 Current Innovative Rate Structure Alternatives

Despite this complex, conflicting, and restrictive state legal and regulatory environment, a number of local utilities have begun to implement alternative water rate structures that can encourage conservation, provide additional revenues, and reduce water costs for low-income users who use less water than other ratepayers. "During the past two decades, conservation-oriented inclining block rate structures have steadily gained popularity in the US as utilities look to provide a financial incentive to conserve water and offer relief to conservative customers."[212] These tiered rate structures start with a small initial block rate but then increase water prices in the higher tiers as water consumption increases. Others have experimented with setting some sewer charges separate from water charges and usage. This is an attempt to expand the ratepayer base and to charge those who impose sewer costs without necessarily using water. As discussed in a previous section, separate sewer charges, especially stormwater fees, can also provide these users an incentive to control stormwater flows on their properties or take other actions to reduce their use of sewer services. Prime examples include parking lot owners with large impermeable surfaces and developer construction sites with storm water run-off issues.

Rate structures vary widely among local utilities, reflecting not only their specific financial needs and the income distribution of their users but also the regulatory and legal environment facing them. The UNC report states that "the vast majority of water and wastewater utilities in the US

[211] Ibid., p. 7.
[212] Teodoro, Manuel P., *Tailored Rates*, AWWA Journal 94(10), October 2002, p. 55.

have rate structures that are classified as "Uniform", "Increasing Block", or "Decreasing Block."[213] Most of these rate structures have an initial fixed base-charge that may be assessed regardless of the amount of water services used, or for some standard, common usage amount. These structures also include an additional 'volumetric charge' that is based on actual water usage. For the uniform structure, the volumetric charge is the same for each increment of water used. The increasing or inclining block rate has a higher rate for each additional increment of water used, while the decreasing or declining block rate has lower rates for each additional increment.

A number of utilities have attempted to use an increasing or inclining rate structure to both encourage conservation and help address affordability issues for low-income and low utilization users. DC Water's CAP program, initiated in 2009, provides an example of how that approach can work. DC Water's CAP uses the same income eligibility standards in the Federal LIHEAP program to qualify for its program. If users are eligible for LIHEAP assistance, they are eligible for DC Water's CAP. Under DC Water's CAP the first four cubic feet of water and sewer usage is free. In addition, several of the fixed charges in the user's water bill are also free.[214] George Hawkins, DC Water's CEO, has also noted that the DC Water CAP program has been supported by all DC ratepayers since there has been no opposition to the CAP at more than 74 DC Water rate hearings over the past few years. DC Water has more recently introduced an additional lifeline rate for residential users to address affordability issues for seniors on fixed incomes who are less able to accommodate water rate increases. These lifeline rates provide a discount on the first four cubic feet of water and wastewater use for eligible seniors and have proved successful in lowering their water costs and encouraging conservation.

Philadelphia has a severe and extensive water affordability issue since its poverty rate of more than 26% substantially exceeds the national poverty rate and the poverty rate in Pennsylvania. Philadelphia created the first water rate program that is based on annual user income. Philadelphia modified its Water Residential Assistance program (WRAP) with a new Tiered Assistance Program (TAP) with legislation passed in December 2015. TAP relies on federal poverty income levels that vary by size of household to determine user eligibility for TAP. Water rates vary depending on user income and household size with rates increasing at higher income levels. As Brett Walton, Circle of Blue reporter, noted,[215] TAP water rates vary as follows:

- 2% of monthly income for users with income below 50% of federal poverty levels;

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[213] University of North Carolina, School of Government, Environmental Finance Center, *Navigating Legal Pathways to Rate-funded Customer Assistance Programs: A Guide for Water and Wastewater Utilities,* July 2017, p. 166.

[214] DC Water has also reduced its reliance on volumetric charges by increasing its reliance on fixed charges to improve revenue stability.

[215] Walton, Brett, *Philadelphia Water Rate Links Payments to Household Income,* Circle of Blue, May 16, 2017.

- 2.5% of monthly income for users with income between 51% and 100% of federal poverty levels;
- 3% of monthly income for users with incomes between poverty levels and 150% of poverty levels.

Since most of these low-income users had water bill arrearages, those arrearages and arrearage payments will be suspended for users enrolled in TAP. The TAP also addresses several deficiencies in Philadelphia's previous WRAP that will be phased out and replaced by TAP. The WRAP program required that rate payers be behind on their water bills and must be homeowners. TAP eliminates these requirements.

As water utilities consider changes in the water rate structures to help address affordability issues for their most vulnerable user, they may want to apply basic guiding principles for establishing effective, equitable, and efficient public finance systems. A National League of Cities report – *Toward a System of Public Finance For the 21st Century* – defines a set of principles that can be applied in assessing the adequacy and appropriateness of municipal tax rates.

The Panel finds that these key public finance guiding principles are appropriate for assessing proposed changes to water rate structures. These include equity among income groups and intergenerational users, efficiency in encouraging conservation in the use of water services, effectiveness in meeting revenue needs and stabilizing future revenue streams, and administrative transparency and collectability.

Panel Recommendation #20

The Environmental Protection Agency's (EPA) Water Infrastructure and Resiliency Finance Center staff and the staff at the 10 Environmental Finance Centers should extend their work with local communities and utilities to help them apply those principles of equity, efficiency, effectiveness, transparency, and collectability in adopting more effective water rate structures and Consumer Assistance Plans to address increasing water affordability issues for low-income users.

Chapter 6: Other Issues to Consider

The Panel recognizes that there are a number of issues that have been raised that require response and support from the broader community and that would need to be addressed by other actors, such as Congress and state and local leadership. Often these issues require legislative change and/or funding, champions or enablers to support and implement the actions, and a broader paradigm shift with a look toward a longer timeline in order to implement the recommendations in this report. What's listed in this chapter include concepts or approaches to be explored as EPA, states and local communities, and other key stakeholders continue to pursue affordable, clean water for the all.

6.1 Performance Standards for Integrated Plans

As discussed in Chapter 3, the Panel has found that integrated planning can, in appropriate situations, yield substantial benefits, by enabling communities to achieve the greatest benefit to the environment and public health at the lowest cost. Accordingly, the Panel recommended that EPA consider requiring that integrated planning proponents should work to develop their plan before seeking regulatory approval of any deferred implementation schedules whenever feasible. Currently, there are not performance standards against which the sufficiency of integrated plans would be evaluated that can guide the development of outcome-based tools that inform decision making.

A widely accepted principle in regulatory policy is that performance standards are generally preferable to design standards. For example, an executive order on "Regulatory Planning and Review," which was issued in September 1993 and has been applied by every Administration since then, states that federal regulatory agencies shall, "to the extent feasible, specify performance objectives [performance standards], rather than specifying the behavior or manner of compliance that regulated entities must adopt [design standards]."[216] In guidance to agencies issued in 2003 and still in effect, OMB explained why performance standards are generally better (due to the flexibility and cost effectiveness for the regulated parties) but also noted a frequent drawback, which is the cost of assuring compliance.

> ***"Performance Standards Rather than Design Standards"***
>
> "Performance standards express requirements in terms of outcomes rather than specifying the means to those ends. They are generally superior to engineering or design standards because performance standards give the regulated parties the flexibility to achieve regulatory objectives in the most cost-effective way. In general, you should take into

[216] Executive Order 12866 of September 30, 1993, "Regulatory Planning and Review," Sections 1(b) and 1(b)(8), published at 58 *Federal Register* 51735 (Oct. 4, 1993).

account both the cost savings to the regulated parties of the greater flexibility and the costs of assuring compliance through monitoring or some other means."[217]

In contrast, the published views of academic writers and government officials have emphasized that performance standards should not be considered a one-size-fits-all principle for designing regulatory programs.[218] Such standards may be desirable under some circumstances but not others, and, in certain situations, the best approach may be a hybrid that combines elements of both performance and design requirements.

The descriptions of the circumstances under which performance standards may be effective, and the circumstances under which design standards or a hybrid approach may be preferable, can provide a useful roadmap for considering how EPA's Community Affordability Guidance and Integrated Planning Process may be redesigned.

A performance standard that "simply codifies a broad societal objective" allows regulated parties the greatest "discretion in how they will meet the ultimate objective."[219] Therefore, a starting point would be to articulate what is the broad societal objective that the Community Affordability Guidance and Integrated Planning Process are intended to serve.

At a minimum, they are intended to bring individual CSOs into compliance with EPA's NPDES discharge requirements as soon as possible. However, to apply a single performance standard uniformly to multiple pollution sources has been found generally to "miss opportunities for flexibility and costs savings."[220] In fact, EPA's current community affordability and integrated planning guidance already recognizes the value of applying different guidelines to different sources. For a CSO that discharges to a sensitive water body or use-impaired receiving waters, EPA's February 1997 CSO guidance for schedule development states that the municipality's affordability difficulties are given relatively less weight than for a CSO that does not impact a sensitive water body or use-impaired waters. Likewise, EPA's 2012 IP Framework states that a plan should deploy the available financial resources to address the highest-priority water-quality

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[217] Office of Management and Budget, Circular A-4, to the heads of executive agencies and establishments, *Regulatory analysis*, September 17, 2003, https://www.whitehouse.gov/omb/circulars_a004_a-4#c.

[218] C. Coglianese, J. Nash, and T. Olmstread, *Performance-Based Regulation: Prospects and Limitations in Health, Safety, and Environmental Protection*, Regulatory Policy Program Report No. RPP-03 (2002), John F. Kennedy School of Government, Harvard University, https://www.hks.harvard.edu/m-rcbg/Events/Papers/RPPREPORT3.pdf ("Harvard Kennedy School Report"); L. Bennear and C. Coglianese, *The Performance of Regulatory Performance Standards,* The Regulatory Review, Penn Program on Regulation, May 8, 2012, https://theregreview.org/2012/05/08/the-performance-of-performance-standards; P. Swire, "Safe Harbors and a Proposal to Improve the Community Reinvestment Act, *Virginia Law Review*, vol. 79, p. 349 (March 1993), http://peterswire.net/archive/pssafe~1.htm (Introduction and Conclusion only); A. Morrison, "Case law, Systematic Law, and a Very Modest Suggestion," U. of Michigan Public Law Research Paper No. 361, *Statute Law Review*, volume 35(2), p. 159-180, (July 18, 2013, revised August 7, 2014), https://ssrn.com/abstract=2295245.

[219] Harvard Kennedy School Report, above, at p. 5.

[220] Bennear & Coglianese, "Performance Standards," above.

problems first. Multiple stakeholders have suggested that currently, integrated plans are not being consistently evaluated in an effective manner. The Panel recognizes the value of improving the approach by which integrated plans can be evaluated.

Panel Recommendation #21

The Environmental Protection Agency (EPA) should consider whether it is feasible and desirable to develop and apply performance standards against which the sufficiency of integrated plans would be evaluated. In developing such performance standards, EPA should consider the following components:

1. Under the performance standard, an integrated plan for compliance with National Pollutant Discharge Elimination System (NPDES) requirements (in addition to meeting other applicable conditions) should provide for the achievement of the greatest water-quality benefits as quickly as affordable.
2. Under the performance standard, an integrated plan for compliance with both NPDES and Safe Drinking Water Act requirements (in addition to meeting other applicable conditions) should provide for the greatest water-quality and drinking-water benefits as quickly as is affordable. Regulators should encourage and accept such a proposed one-water integrated plan only if they are willing and able to collaboratively apply equitable and principled criteria for reviewing and, if appropriate, approving the proposed choices among water-quality and drinking-water priorities.
3. The performance standard might list several specific conditions with which the proponents of a control plan should be required to demonstrate compliance, in such areas as:
    - Compliance with applicable statutory and regulatory requirements.
    - Methodology for constructing an acceptable implementation schedule.
    - Consideration of green infrastructure.
    - Use of available sources of financing to enhance affordability.
    - That the sequencing addresses higher-priority environmental or public-health risks soonest.
    - Avoidance or mitigation of any disproportionate adverse impacts on disadvantaged communities.

Variations that may exist among the water-pollution sources being controlled and the trade-offs inherent in trying to address the highest priority sources first. The panel has identified criteria for EPA to consider when developing a performance standard for the review and approval of municipalities' Clean Water Act (CWA) integrated plans, and the Panel suggests that the performance standard might be stated in language such as the following:

> *An integrated plan for compliance with NPDES requirements is acceptable if;*
> *(1) all pollution sources covered by the plan will come into compliance;*
> *(2) the greatest water-quality benefits will be achieved as quickly as is affordable, and*
> *(3) all statutory and regulatory requirements applicable to the pollution sources covered by the plan will be complied with.*

As discussed earlier, communities may be able to gain even greater flexibility and ability to craft cost-effective solutions by developing one-water integrated plans, under which the proponents review all of their outstanding clean-water and drinking water challenges and then set priorities on how available financial resources should be deployed to address the highest-priority wastewater and drinking water problems first. EPA might use language such as the following to establish a performance standard for the review and approval of proponents' one-water integrated plans, addressing both clean-water and drinking water requirements:

> *An integrated plan for compliance with NPDES and Safe Drinking Water Act (SWDA) requirements is acceptable if;*
> *(1) all pollution sources and public water systems covered by the plan will come into compliance;*
> *(2) the greatest water-quality and drinking water benefits will be achieved as quickly as is affordable; and*
> *(3) all statutory and regulatory requirements applicable to the pollution sources and public water systems covered by the plan will be complied with.*

For this approach to work, the regulatory offices at all levels of government that implement, apply, and enforce clean water and drinking water requirements must collaboratively apply equitable and principled criteria for reviewing and approving the choices among water quality and drinking water priorities addressed in the proposed plan.

While a generally stated performance standard may offer the regulated parties the greatest flexibility and opportunity to choose cost-effective solutions, this approach may also make both regulators and regulated entities uncomfortable with the amount of discretion they must exercise in developing plans and in determining whether each individual situation meets the standard.[221] It

[221] See, generally, Harvard Kennedy School Report, note [218] above, at p. 10; Bennear & Coglianese, "Performance Standards," note 218 above.

therefore seems desirable to increase the level of specificity somewhat by adopting a hybrid approach such as by stating certain factors that a plan must address in order to demonstration that the performance standard is satisfied. Based on the Panel's review, the Panel suggests that factors such as the following may be appropriate:

A demonstration that an integrated control plan satisfies the performance standard must show, at least, the following;

- *In the implementation schedule for a pollution source or a public water system,*
  - *the baseline is the time needed for normal design and construction of the control measures;*
  - *additional time may be included in an implementation schedule if necessary because of affordability; and*
  - *such additional time must be minimized for a pollution source or public water system that, respectively, causes relatively greater water-quality harm or poses relatively greater public health risk.*
- *Green infrastructure must be considered and, if it would contribute to compliance while also saving money that would enhance overall affordability of the plan, must be deployed.*
- *All available sources of financing, including innovative financing solutions, must be considered and, if useful, deployed to enhance overall affordability of the plan.*
- *Integrated planning must be undertaken to address the higher-priority environmental or public-health risks soonest, thereby enhancing the affordability of controls for lower-priority sources.*
- *Consideration must be given to disproportionate adverse impacts on disadvantaged communities, and any such impacts must be mitigated to the extent possible.*

Further application of a hybrid approach may be desirable to address the costs and burdens of compliance and implementation. Performance-based standards may impose increased costs on regulated parties, "particularly small firms, because firms must search for ways to meet regulatory standards. Some firms may simply prefer to be told exactly what to do, rather than incur costs to identify steps needed to achieve a performance standard."[222] Applying performance-based standards can also create similar challenges for regulators. "Performance-based standards depend on the ability of government agencies to specify, measure, and monitor performance, and reliable and appropriate information about performance may sometimes be

[222] Ibid., p. 7.

difficult if not impossible to obtain."[223] Regulators also are "frequently uncomfortable with the discretion inherent in loosely specified performance-based standards."[224]

One way to provide greater specificity is to start by requiring compliance with specific design requirements, "but to add to the regulation so-called equivalency clauses or provisions for alternative compliance mechanisms. These provisions effectively allow firms to 'opt out' of the prescriptive standard if they can demonstrate that they can achieve a comparable level of performance through other means."[225]

A version of this approach is what EPA uses in its current community affordability guidance. To accommodate municipalities that prefer a simple approach, especially smaller entities that may not have the resources or desire to design and conduct their own economic study to demonstrate the extent of their financial capability, EPA's 1997 FCA Guidance establishes relatively straightforward measures in the form of the Residential Index and the Residential Indicator and Community Financial Indicator, with specified percentage thresholds representing specified degrees of financial capability. EPA also believes that requiring the use of these indicators provides a common baseline for all municipalities that want to present an argument about their financial capability. But EPA's 2014 FCA Framework also welcomes municipalities to develop and submit additional information, if they wish, to bolster the demonstration about financial capability. This option might be considered a kind of "equivalency" option, allowing the municipality to develop and apply a different way of achieving the same compliant result.

However, as discussed in Chapter 3, the Panel has found that the desired flexibility that EPA seeks by this equivalency option has largely been lost, because front-line regulators often insist on applying the specified financial indicators and percentage thresholds, without giving enough credit to a municipality's proposed alternative way of demonstrating its limited financial capability. To address this problem, a different regulatory design might put greater emphasis on the flexibility offered by the performance standard. This approach would begin by requiring compliance with the performance standard stated in general terms, and would then offer municipalities the alternative option of complying with the specific financial indicators and percentage thresholds, which might be termed as "guidance" suggesting ways to comply,[226] or as a "safe harbor" guaranteeing "favorable treatment automatically."[227]

Under these approaches, the regulator would review a submitted control plan under a generally stated performance standard that allows phased or extended implementation schedules if the plan

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[223] Ibid., p. 2.

[224] Ibid., p. 10.

[225] Ibid., p. 8.

[226] Ibid., p. 7.

[227] Swire, "Safe Harbors," above. See, also, Morrison, "Modest Suggestion," above.

demonstrates that extra time is necessary because of affordability (and provided that the other applicable conditions are satisfied). The municipalities submitting the plan would be free to design and document their affordability demonstration however they wish, provided they show that the plan provides the greatest overall water-quality and drinking water benefits as quickly as can be afforded. Alternatively, if the municipalities choose to rely on a simpler and less-flexible approach, they could rely on the specific affordability indices and thresholds that EPA may specify as guidance or as a safe harbor. (The Panel's recommendations for improving those indices were stated earlier in Chapter 2.) Moreover, if a municipality's design of their own demonstration of financial capability is deemed inadequate, then the regulator could insist that the specified indices be used.

While inviting municipalities to design and document their own demonstration of financial capability, EPA's 2014 FCA Framework should specify what financial information the municipalities must make available for review. This clarity and predictability would help assure the municipalities that the front-line regulator will not have too much discretion, while it would also reassure the front-line regulators that they will receive the information they need to reach a sound decision on the application. And as is the case, generally, when information is required to demonstrate compliance, the "principle of proportionality" should apply so that the amount of information required for a municipality to demonstrate affordability would be commensurate with the size and importance of the implementation-plan issue under consideration.

6.2 One Water Approach

The discussions throughout this report that include outcomes as they relate to both clean and drinking water considerations highlight the issue of an integrated water policy or "one water" to which it is often referred. This is an approach to thinking about and managing water resources in all their forms as an integrated whole. It seeks to address the full water cycle – surface water, groundwater, drinking and industrial water, wastewater, and stormwater – and calls upon all sectors of users, providers, governmental leaders, and regulators to adopt an integrated planning approach to managing this vital resource. The arenas for action include water utilities, local government, industries, agriculture, regional conservation efforts, and others.

Because of the historic fragmentation of the governmental and non-governmental organizations that manage and use water resources, a One Water approach faces significant political, administrative, and economic obstacles,[228] but the goal of addressing the management of water resources in a holistic and integrated manner is widely accepted by those working in the field. For example, EPA's Office of Water cited the quest of the U.S. Water Alliance "for a national

[228] See, for example, BH Thompson, Jr., "A Federal Act To Promote Integrated Water Management: Is The Czma A Useful Model?", 42 *Environmental Law* 201, March 15, 2012. https://law.lclark.edu/live/files/11180-421thompsonpdf.

water vision with 'one water' at its core" as a key outside initiative that helped EPA craft its own planning to support technology for ensuring sustainability of water resources.[229]

Some stakeholders have proposed that, if a community could set priorities and schedules for satisfying SDWA requirements as well as CWA requirements in the same Integrated Plan, such a One Water approach would offer opportunities to address a range of regulatory requirements, provide multiple water quality benefits, and make strategic capital investments to maintain, repair, and build infrastructure. Under this view, decisions regarding water utility management should be approached with a systems mindset that encompasses the full water cycle and larger infrastructure systems. Advocates for a One Water policy maintain an all-encompassing water approach recognizes the true cost of water and allows for more accurate pricing, respects a holistic water ecosystem, and can be instrumental in achieving multiple benefits, with an eye on addressing an integrated natural system in an integrated fashion.[230]

However, as a practical matter, challenges related to siloed organizational structures and regulatory and statutory requirements present obstacles to such an approach. The complex structure of regulations with overlapping responsibilities and jurisdictions that currently exist for drinking water, wastewater, and stormwater management would present challenges to the development, approval, and enforcement of such a broad integration.[231]Also, some have expressed concern that, if schedules for SDWA compliance and for CWA compliance are negotiated as part of a single Integrated Plan, the greater public salience of drinking water issues may cause those issues to eclipse important but less salient water-quality issues. There is also a concern that integrating the water systems can create a consequence of disparate impact for users. Citizens are entitled to both clean surface waters and clean drinking water, and extended compliance schedules for different pollution control requirements may impact entirely different populations.

Currently, organizational structures at the EPA headquarters and regional levels (as well as in many state and local offices) are bifurcated to reflect the CWA and SDWA directives and therefore create challenges when addressing an integrated water approach. The Office of Wastewater Management is expected to prioritize meeting CWA requirements, while the Office of Ground Water and Drinking Water is expected to prioritize meeting SDWA goals. In addition,

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[229] U.S. Environmental Protection Agency, Office of Water, *Promoting Technology Innovation for Clean And Safe Water: Water Technology Innovation Blueprint – Version 2*, April 2014, p. 16. https://www.epa.gov/sites/production/files/2014-04/documents/clean_water_blueprint_final.pdf

[230] Triple bottom line (or otherwise noted as TBL or 3BL) is an accounting framework with three parts: social, environmental (or ecological) and financial. Many organizations have adopted the TBL framework to evaluate their performance in a broader perspective to create greater business value.

[231] US Water Alliance, *One Water Roadmap: The Sustainable Management of Life's Most Essential Resource,* 2016. http://uswateralliance.org/sites/uswateralliance.org/files/publications/Roadmap%20FINAL.pdf.

the stovepipes of drinking and clean water at all levels layer in additional challenges as it relates to day-to-day implementation of service delivery and regulation.

6.3 Intergenerational Equity

Funding of the current and future infrastructure needs and regulatory requirements requires attention to the intergenerational equity issues that surround the community's financing mechanisms. The question that must be asked is "does the payment for the assets align with the use of the assets?" Stakeholders have raised the concern that the lifecycle of the bonds and loans often put an inequitable burden on a smaller segment of the population due to deferred maintenance and not meeting the obligations of compliance and/or enforcement. Just as there are intergenerational equity concerns related to environmental sustainability issues, communities have looked to develop funding strategies that align with the life of the asset in order to offset inequitable financial burden on residents. The example previously mentioned of the Municipal bond which has a duration of more than 30 years, or in the case of the Century Bond, has an amortization period of 100 years, reflect the importance of addressing the costs over the long term and spreading these costs across multiple generations. Similarly, there is a need to ensure that the benefits of clean, fishable, and swimmable, where attainable, water cover residents now and in the future. There is a need to look beyond the horizon in order to ensure that the decisions being made by leaders now do not adversely affect those who will be impacted decades from now.

6.4 Addressing the Need for More Supporting and Enabling Resources

Many of the recommendations made in this report call on EPA to provide guidance and assistance to communities and state regulators in order to address the issues of achieving both affordability and water quality. These are not activities that can take place without a great deal of support and enabling factors.

There is a tremendous opportunity to draw upon the knowledge and expertise of national stakeholder organizations or other appropriate non-federal organizations that may be in a position to develop and make available informational resources and assistance useful to both permittees and front-line regulators. Much like this report recommends development and expansion of knowledge sharing, there are scenarios in which those outside of the public sector may be able to take a more partnership-like role and in essence share some of their technical assistance in a managed, transparent way in order to provide clarity on how to address affordability frameworks, to embrace and implement smart practices, and to plan both short and long-term strategies for meeting community needs.

Workforce training will be critical to the future success of EPA and its partners. Key skills sets will include technical proficiency in environmental policy, urban planning, civil and water engineering, public budgeting and management, and data analysis. Analyzing data also requires

that EPA has the right access to the necessary data and the appropriate data analytic tools in order to inform critical decision-making.

Another enabling factor will be the role of legislative branch. Congress will play a key role in enacting legislation that supports both imperatives of affordability and water quality and that does so in a way that doesn't create additional mandates without the funding to support their implementation. Many of the cutting edge technologies and more creative finance mechanisms will only be possible if there is access to technology and an embracing of innovation. Along with effective knowledge management and stakeholder engagement, there are components of the federal government that can enable this innovation. The recent establishment of the Office of American Innovation within the White House offers a new opportunity for the executive branch to shepherd new ideas and foster an innovative energy that can address regulatory and process reform, creating transformational infrastructure projects, and modernizing information technology. There are also opportunities to incorporate changes and process improvements into guidance that is being shared by the Office of Management and Budget in efforts to improve efficiency and effectiveness.

6.5 Conclusion

The Panel recognizes the efforts that EPA has undertaken to develop and improve necessary affordability guidance and to assist the states and local communities in delivering clean, affordable water to its citizens. These challenges reflect a complex set of issues EPA has been called upon to address. The fragmented set of authorities and regulatory approaches addressing CWA as well as SDWA requirements create both financial and governance pressures at multiple levels and can lead to inefficient processes. Efforts to manage across organizational silos (at all levels of government) to address drinking water, wastewater, and stormwater do not always align with community efforts to plan and sequence activities and investments in an integrated fashion. EPA continues to provide information about how to best utilize integrated planning as a key mechanism to inform decision making and to look for ways to improve this process. The agency's work to address new and innovative approaches to improving water quality standards reflects forward-looking efforts to positively affect the health and safety of citizens. The ongoing efforts to improve municipality leader's ability to assess and respond to concerns of community and individual affordability illustrate the commitment to responsive, accountable government at all levels.

Appendix A: Panel and Study Team Biographies

PANEL OF ACADEMY FELLOWS

Stanley J. Czerwinski, *Panel Chair*: Chief Operating Officer, National Governors Association; Director, Office of Administration & Finance, National Governors Association. Former positions at the U.S. Government Accountability Office: Director, Intergovernmental Relations, Controller; Associate Director, Environmental Protection. Former Assistant Director, Superfund Program; Project Director, Hurricane Andrew Task Force.

Elizabeth Fretwell: Senior Vice President, Switch. Former City Manager, City of Las Vegas. Former positions for the City of Las Vegas: Deputy City Manager; Assistant City Manager. Former Director, Intergovernmental Relations, City of Henderson; Strategic Issues Manager, Management Analyst II & I, Clark County.

R. Scott Fosler: Mayor, Town of Chevy Chase, MD; Former Visiting Professor and Roger C. Lipitz Senior Fellow, Center for Public Policy and Private Enterprise, School of Public Policy, University of Maryland. Former President, National Academy of Public Administration; Vice President and Director of Government Studies, Committee for Economic Development (CED); Member and President, Montgomery County (Maryland) Council; President, Washington Metropolitan Council of Governments; Senior Fellow, Johns Hopkins University Institute for Policy Studies; Assistant to Executive Director, National Commission on Productivity; Senior Staff, Institute of Public Administration.

Greg Lindsey: Professor, Hubert H. Humphrey School of Public Affairs, University of Minnesota. Former positions with the University of Minnesota: Executive Associate Dean; Interim Dean. Positions with Indiana University Purdue University: Professor and Associate Dean, School of Public and Environmental Affairs; Director, Center for Urban Policy and the Environment. Former Senior Fulbright Scholar, National Fisheries University, Nha Trang Vietnam. Chief, Policy, Planning, and Regulation Development Division, Maryland Department of Environment.

Michael A. Pagano: Dean, College of Urban Planning and Public Affairs, University of Illinois at Chicago. Former Director and Professor, Graduate Program in Public Administration,

University of Illinois at Chicago; Member, Intergovernmental Issues Panel, U.S. Government Accountability Office; Former Director of Graduate Studies, Department of Political Science, Miami University; Lincoln Government Fellow, National League of Cities.

STUDY TEAM

Joseph P. Mitchell, III, *Director of Academy Programs* – Dr. Mitchell leads and manages NAPA's studies program and serves as a senior advisor to NAPA's President and CEO. He has served as Project Director for past Academy studies for the Government Printing Office, the U.S. Senate Sergeant at Arms, USAID/Management Systems International, the National Park Service's Natural Resource Stewardship and Science Directorate, and the USDA Natural Resources Conservation Service. During his 16 years at the Academy, Dr. Mitchell has worked with a wide range of federal cabinet departments and agencies to identify changes to improve public policy and program management, as well as to develop practical tools that strengthen organizational performance and assessment capabilities. As the Academy's studies director, he has provided executive-level leadership, project oversight, and subject matter expertise to over 50 highly regarded organizational assessments and studies, consulting engagements, and thought leader engagements. He holds a Ph.D. from the Virginia Polytechnic Institute and State University, a Master of International Public Policy from The Johns Hopkins University School of Advanced International Studies, a Master of Public Administration from the University of North Carolina at Charlotte, and a B.A. in History from the University of North Carolina at Wilmington.

Brenna Isman, *Project Director* – Brenna supports the Academy as a Project Director and Senior Advisor. She leads and advises projects that provide organizational assessment, strategic plan development, and performance improvement guidance to Federal agencies as well as Offices of the Inspector General and other regulator organizations. Brenna's consulting experience includes both public and private sector clients in areas of stakeholder engagement, organizational development, and communication strategy. Prior to joining the Academy, Brenna was a Senior Consultant for the Ambit Group and a Consultant with Mercer Human Resource Consulting facilitating effective organizational change and process improvement. She holds a Masters of Business Administration from American University and a Bachelor of Science in Human Resource Management from the University of Delaware.

Kenneth F. Ryder Jr., *Senior Fellow and Senior Advisor* – Ken held the position of Executive Director for Research and Analysis in the Office of Thrift Supervision at the U.S. Department of the Treasury. Ken also held former positions with the U.S. Office of Management and Budget as the Deputy Associate Director of the Housing, Treasury and Finance Division; as Deputy Associate Director in the Special Studies Division with Economics and Government; as Branch Chief of the Housing Branch in the Treasury, Commerce and Housing Division; and as Senior

Management Associate of the Management Division in the National Security and International Affairs Department. Ken's other positions include a former staff economist for the Rand Corporation; Economist at Manpower Requirements; and Directorate at OASD.

Lawrence B. Novey, *Senior Advisor* – Larry served with the Senate Committee on Homeland Security and Governmental Affairs for seventeen years, the last 4 years as Chief Counsel for Governmental Affairs. While there he led and managed the committee's legislative and oversight agenda on government management and aspects of homeland security. Larry also served at the Congressional Office of Compliance, at EPA, and on detail to OMB. While at these agencies he structured and drafted regulations and procedures to implement new legislation in areas of pollution control, terms and conditions of employment, and the permitting of large industrial projects. He also coordinated the legal review of proposed regulations and of other agency initiatives; and conducted studies on topics related to employees' rights and protections. While in private practice, Larry practiced at large international firms in Washington, D.C. and New York City. He advised and assisted companies and trade associations regarding environmental regulatory compliance and assessed environmental liabilities in connection with corporate transactions. Larry holds an undergraduate degree from Harvard College, and J.D. from Columbia Law School.

Sylvia Tognetti, *Senior Adviser* – Sylvia returns to the Academy as a Senior Advisor for the Environmental Protection Agency Community Affordability and Bureau of Safety and Environmental Enforcement Projects. In 2000, she worked briefly with the Academy as a Research Associate in the final stages of a study of innovation in environmental protection at the EPA. She also teaches World Physical and Cultural Geography courses as an adjunct professor at the University of the District of Columbia Community College. Prior to attending graduate school, she held positions at the National Academy of Sciences - National Research Council, and the former Congressional Office of Technology Assessment. Since completing an MA in geography at the University of Maryland, she has consulted with a variety of non-profit and multi-lateral organizations as well as a private firm on matters of science and policy associated with land and water and climate change. Her work resulted in several reports and publications, including a chapter in the Millennium Ecosystem Assessment, for which she served as a lead author. She also held a position with the World Resources Institute's Food, Forests and Water program, Natural Infrastructure for Water initiative, helping to build the case and develop strategies for increased public and private investment in conservation and restoration of forests, wetlands and other ecosystems for their natural infrastructure values.

Elijah C. Evans, *Research Associate* - Elijah is a Research Associate at the Academy. In addition to project work, Elijah leads digital analytics and other communication projects at the Academy, and staffs the Working Capital Fund Symposium. In December 2016, Elijah received a B.S. in Convergence Journalism and Political Science from Abilene Christian University. His undergraduate thesis addressed the future of digital engagement and best digital engagement practices for small firms.

Melissa Wood, *Intern* – Melissa is a rising Junior at the University of South Carolina pursuing a Bachelor's degree in International Studies with a minor in Social Work and Economics.

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Appendix B: Methodology/Research Gaps

The Academy convened an expert Panel of five Fellows with broad knowledge and expertise in urban and environmental planning, urban finance, infrastructure, capital budgeting, intergovernmental issues, city management, regional development, and other relevant federal government and academic expertise. The Panel provided ongoing guidance and counsel to a five person Study Team who conducted the research, following a structured methodology. (See Appendix A for biographical information on Panel and Study Team members.) The Study Team approached its research in a multi-faceted and phased manner. The first phase consisted of rigorous research, analysis, and interviews. During this phase, the team conducted extensive research and analysis of EPA guidance documents, SRF data, and other public documents about EPA and their stakeholders from a wide variety of sources. The Study Team also interviewed over 100 individuals, including EPA and other federal agency officials; state and local government officials; officials from the five recipients of the EPA Technical Assistance; and various other stakeholders and stakeholders groups. (See Appendix C for the full list.) The Study Team conducted one round of long-form electronic interviews that collected 23 in-depth responses from a variety of stakeholders around the country. The Study Team visited Onondaga County, NY and Springfield, MO, which were two recipients of EPA Technical Assistance for Integrated Planning. These visits included interviews with a variety of stakeholders and tours of relevant infrastructure sites. Finally, the Study Team conducted an extensive literature review, including legislation, regulatory guidance, and other relevant perspectives on water affordability. The second phase of the process involved a stakeholder roundtable and briefing with relevant parties at EPA. The Study Team convened a group of stakeholders at the Academy headquarters for a roundtable. The roundtable acted as a sounding board for the Study Team to collect stakeholder feedback of initial findings on key topics like affordability, affordability metrics, innovative solutions, and others. The EPA briefing was similar to the roundtable and allowed the Study Team to get EPA's first impression of the preliminary findings. Throughout this phased process, the Panel advised the Study Team on direction and content. The third phase of the project process involved significant drafting, debate, and revisions of the report between the expert Panel and the Study Team.

George Washington University MPA Program Capstone Report

The Capstone is the culminating project for candidates in the Master of Public Policy and Master of Public Administration degree program at the George Washington University's Trachtenberg School of Public Policy and Public Administration. Completed in the last semester of the program, the Capstone provides an opportunity for students to synthesize and apply their academic and professional experiences through a substantial and relevant pro-bono project with an organizational partner/client, for example, a nonprofit or government agency. Over the course of 8-10 weeks, students act as consultants to the client, conducting extensive research and analysis, providing valuable assessments, evaluations, reports and recommendations to organizations working locally and around the world.

This specific capstone report contributed to the National Academy of Public Administration's efforts to fulfill a congressional request to "conduct an independent study to create a definition and framework for community affordability."

To do this, the GWU research team assessed the current efforts of localities, water utilities, and clean water permitting authorities to reduce CSOs, to implement the EPA's FCA guidance, and to leverage innovative solutions and financial assistance programs. Below is a summary of the report's findings and the potential limitations to our research.

Capstone Findings

"Great variability exists in CSO reduction strategies at the state level. This may be due to the fact that states agencies, which generally act as the NPDES permitting authorities charged with regulating CSOs, lack a unified national reduction strategy. There is not even coordination of reduction efforts between states in the same EPA regions. CSO communities have not extensively used the 2014 FCA Framework or the process of setting priorities through integrated planning. This is primarily because the majority of CSO reduction plans predate the updated guidance. Communities have hesitated to interrupt approved implementation plans to accommodate new and untested guidance. Increased coordination between EPA regions and the states during negotiations over the development of long-term control plans (LTCPs) and enforcement standards would allow communities to more freely implement integrated planning, innovative solutions, and effective CSO reduction efforts in a cohesive manner across the nation." –GW Capstone Team

Potential Limitations

"The limited data EPA publishes on CSO control efforts are frequently out of date and sometimes contradict regional and state data. The EPA often does not provide enough information to fully understand events surrounding a locality's CSO reduction efforts. There is a scarcity of academic literature that analyzes the impacts of the 1997 FCA Guidance on community affordability and CSO control. Government agencies and advocacy organizations publish much of the extant literature that is relevant to this topic. State and EPA regional officials were often unfamiliar with the EPA/NAPA initiative to update the FCA and thus were reluctant to provide complete and candid responses to the team's inquiries. The current political climate could have contributed to this reluctance." –GW Capstone Team

The Study Team concurs with the GW Capstone Team assessment that there are significant data gaps regarding CSO control efforts. The Study Team notes that the lack of nationwide CSO control data and data detailing nationwide burden per the 1997 affordability guidance contributes to the complex nature of the affordability problem. It is difficult to solve a problem when the specifics of the problem are unknown.

Stakeholder Survey – April 2017

A survey was distributed to a diverse group of external stakeholders in order to gain perspective regarding the EPA Community Affordability Framework, Innovative Solutions to address both water quality concerns as well affordability and included questions about IP as well as Cost Benefit Analysis.

Stakeholders invited to participate include the following:

American Public Works Association, American Society of Civil Engineers, American Water Works Association & Research Foundation, American Rivers, Association of Metropolitan Water Agencies, Chesapeake Bay Program, City of Springfield Missouri, City of Durham, New Hampshire, City of Burlington, Vermont, City of Santa Maria, California, Clean Water Action Project, Clean Water Construction Coalition, Council of Infrastructure Financing Authorities, Environmental Financial Advisory Board, Government Finance Officers Association ,Green Infrastructure Leadership Exchange, International City/County Management Association, National Association of Clean Water Agencies, National Association of Counties, National Association of Water Companies, National Drinking Water Advisory Council's Affordability Work Group, National League of Cities, National Rural Water Association - Local Government Advisory Committee, National Governors Association, National Resources Defense Council, Onondaga County, New York, Philadelphia Water Authority, Urban Waters Federal Partnership, US Conference of Mayors, US Water Alliance, Washington, DC Water

These organizations were encouraged to share the surveys to their members, where appropriate as well to those who they identified as thought leaders with direct experience in these topic areas. Questions included:

- The 1997 Residential Indicator (RI) of more than 2% of median household income (MHI) accurately measures the impact of wastewater costs on disadvantaged or vulnerable households/taxpayers.
    - Strongly Agree
    - Agree
    - Disagree
    - Strongly Disagree
    - No Opinion/No basis for judgment

- Should the MHI be replaced? If so, what alternative should be used?

- Yes (If yes, please describe what alternative you suggest, in the Other Box
- No
- Other

- Is the 2% benchmark appropriate for assessing high household/ratepayer burden? If not, what is a more accurate benchmark?
  - Yes
  - No (If no, please discuss a more accurate benchmark in the Other Box below.)
  - Other

- Should the costs measured in the RI be expanded? If so, what other costs should be included?
  - Yes (If yes, please detail what costs should be included, in the Other Box below.)
  - No
  - Other

- The 1997 Financial Capability (FCI) (6 data elements for debt burden, socioeconomic conditions, and financial operations) accurately measures a community's/permittee's ability to afford the costs of investments needed to achieve Clean Water Act (CWA) goals.
  - Strongly Agree
  - Agree
  - Disagree
  - Strongly Disagree
  - No opinion/No basis for judgment

- Should EPA's Affordability Framework include both impacts on households and community/permittee financial capability in assessing the burden of proposed CWA costs?
    - Only household burden
    - Only community/permittee financial capability
    - Either household burden or community/permittee financial capability
    - Both household burden and community/permittee financial capability combined

- Has EPA's revised 2014 guidance, which identifies other data elements communities/permittees can present, improved the ability of EPA's Affordability Framework to identify highly burdened communities/permittees or households?
    - Extremely
    - Very much
    - Somewhat
    - Not at all
    - No opinion

- Should EPA apply this Affordability Framework to other community/permittee environmental issues [e.g., meeting drinking water or clean air goals]? If so, what should be included and why?
    - Yes (If yes, please discuss what should be included, in the Other Box below.)
    - No
    - Other

- Have EPA regions and the states applied this more flexible 2014 Affordability Framework consistently for all communities/permittees in their area? If not, what changes are needed to assure greater consistency among permittees?
    - Can we contact you for more information? If so, please enter your email below.

- How should the Financial Capability Indicator component in EPA's 1997 Affordability Framework be changed to better measure a community's/permittee's ability to afford the costs of investments needed to achieve CWA goals?
    - Open Ended

- Are there any additional changes the EPA should make to their revised 2014 guidance that would improve the ability of EPA's Affordability Framework to assess the financial capability of communities/permittees to bear proposed CWA investment costs and their impact on household ratepayers?
    - Open Ended
- In 2012, the EPA updated its 1997 guidance in a memorandum titled Integrated Municipal Stormwater and Wastewater Planning Approach Framework. This survey section examines your interaction with the 2012 guidance.
- To what degree has the 2012 guidance changed your approach to developing and implementing effective integrated plans to meet specific CWA water quality standards?
    - It has significantly changed our approach
    - It has moderately changed our approach
    - It has little impact on our approach
    - It has had no impact on our approach
    - No opinion

- In your experience, how consistent has this guidance been applied among the EPA regions and by the individual states involved in issuing NPDES permits and/or consent decrees?
    - Extremely
    - Moderately
    - Not at all
    - No opinion

- How can EPA and/or individual states better facilitate the integrated planning process when reviewing and approving the plans developed by you or your members?
    - Open Ended
- What changes, if any, should EPA make to its current guidance to improve the use, effectiveness, and consistency of its integrated planning process?
    - Open Ended

- To what degree does the current guidance consider both costs and benefits of proposed CWA investments?
    - Extremely accurate
    - Very accurate
    - Mildly accurate
    - Not accurate
    - No opinion

- In assessing a community's/permittee's ability to afford the proposed CWA investment costs, should the EPA include costs and benefits for other community investments to meet other EPA environmental goals?
    - Yes (If yes, please explain in Other Box below.)
    - No (If no, please explain in Other Box below.)
    - Other

- What changes, if any, should EPA make to ensure all costs and benefits of proposed CWA investments are assessed?
    - Open Ended

- What categories of innovative solutions for reducing costs or helping to meet CWA water quality goals have you or your members implemented/proposed?
    - Green Infrastructure
    - Innovative Financing
    - Integrated Planning
    - Regionalization
    - Alternative rate structures/consumer assistance programs
    - N/A

- Have you been able to determine the net benefits derived from the solutions you have implemented?
    - Yes
    - No
    - N/A

- Are there impediments to implementing the innovative solutions you have proposed?
    - Yes
    - No
    - N/A

- What changes do EPA or the states need to make to help communities/permittees identify and implement innovative solutions and address impediments for reducing costs or facilitating the achievement of CWA goals? Please discuss below.
    - Open Ended

Responses to the survey were extremely comprehensive but came from a small number of respondents (23 responses were received, however some reflected a consolidated set of responses

from multiple members of the same organization.) While the low response rates would not deem the survey results as statistically sound, the Study Team was able to synthesize the findings (particularly in the open-ended questions) in a manner that informed the study work.

Stakeholder Roundtable – June 1, 2017

For the stakeholder roundtable discussion, the Study Team hosted participants* from National Association of Clean Water Agencies, National County Managers, National Association of Counties, National League of Cities, US Council of Mayors, National Resources Defense Council, National Rural Water Association, Brookings Institute, American Water Works Association, Skeo, Center for Progressive Reform.

*Additional organizations were invited to attend and were unable or chose not to attend.

The Study Team conducted a facilitated conversation between the panelists to expand on questions regarding meeting affordability goals as well as proposed solutions to address these challenges. The conversation allowed the Study Team to build on initial research to gain additional perspective regarding the current affordability framework and how the definition and financial capability calculation can better identify the most burdened members of communities. The Study Team also gained insight into other avenues for improving water quality affordably and how to better understand and analyze costs and benefits relative to water affordability issues. The roundtable discussion also included feedback regarding findings of the Survey. Some overarching concepts that were expressed include:

- The 2% MHI that municipalities and regulators consistently rely on is not an effective measure of affordability as a singular metric.
- Once localities use the 2% measure, they often feel as if they are locked into it from a regulatory perspective.
- There is a disconnect between HQ/Regions/Municipalities that has come from the complexity of implementation.
- Municipalities lack the economic and technical capacity to understand that they can engage with EPA for more flexibility in how they carry out the process.
- There was an emphasis throughout the roundtable on place-based analysis.
- The FCI indicator values should try to forecast what a community would look like in 20 years and consider emerging trends that could take place.
- There is a consensus that an IP process brings parties together and helps to overcome barriers.

- An important message to convey to Congress is that EPA needs more resources to build technical capacity and build towards capacity.
- State oversight and engagement is necessary to make sure that key rate making practices are being considered.
- Enterprise financing must maintain its integrity, and not pull funds from the water enterprise for other local services (example of Flint, MI was discussed).
- States must be an essential third party in ratemaking and in the affordability discussion.

Appendix C: Participating Individuals and Organizations

(Titles and positions listed are accurate as of the time of the Academy's most recent contact.)

The Study Team met with approximately 121 stakeholders through formal interviews and meetings. The Academy would like to thank these individuals for their contributions.

American Water Works Association
Ardnt, Aurel—Board Treasurer
Holmes, Tommy—Director of Legislation
Mehan, G. Tracy III—Executive Director, Government Affairs
Via, Steven—Director, Federal Relations

Burlington, Vermont
Moir, Megan—Assistant Director of Public Works, Director of Water Resources

DC Water
Bezak, Bethany—Green Infrastructure Manager, DC Water
Hawkins, George—CEO and General Manager, DC Water
Lisle, John—Chief of External Affairs, DC Water

Durham, New Hampshire
Janelle, Bill—Associate Vice President Facilities, University of New Hampshire
Lynch, Mike—Director of Public Works, Durham
O'Keefe, Matt—Director of Energy and Utilities, University of New Hampshire
Selig, Todd—Town Administrator, Durham
Talon, April—Town Engineer, Durham

Environmental Protection Agency
EPA Office of the Inspector General
Butler, Katie —Director of Water Evaluations
Copper, Carolyn—Assistant Inspector General for Program Evaluation
Municipal Enforcements Branch
Denton, Loren—Chief
Office of Enforcement and Compliance Assurance
Gonzalez, Sarah— Attorney-Adviser, Water Enforcement Division
Theis, Joseph—Deputy Director

Office of Groundwater and Drinking Water
Grevatt, Peter C.—Director
Kochman, Miriam—Financial Analyst, Drinking Water State Revolving Fund
Rubin, Howard E.—Senior Program Analyst, Drinking Water State Revolving Fund
Office of Science and Technology
Keating, Jim—Associate Branch Chief, Water Quality Standards
Russo, Gary—Environmental Scientist
Office of Water
Fontaine, Tim—Budget Director
Shapiro, Mike—Director, Office of Water
Office of Wastewater Management
Billah, Mohammed—Environmental Engineer
Brubaker, Sonia—Program Manager, Water Infrastructure Resiliency and Finance Center
Connor, Timothy—Chemical Engineer
Covington, John—Senior Financial Analyst, Water Infrastructure Resiliency and Finance Center
Danesi, Robin—Environmental Scientist
Frace, Sheila—Deputy Director
Gebhardt, Jim—Director, Water Infrastructure Resiliency and Finance Center
Kloss, Christopher—Chief
Sawyer, Andrew—Director
Stein, Raffael— Director, Water Infrastructure Division
Weiss, Kevin—Chemical Engineer
Region 5
Perdomo, Susan—Associate Regional Counsel
Prichard, Gary—Associate Regional Counsel
Region 9
Smith, David—Chief

Government Accountability Office
Gomez, J. Alfredo—Director, Natural Resources and Environmental Issues
Thomas, Swati Sheladia—Senior Analyst

National Association of Clean Water Agencies
Andrews, Nathan Gardner—Chief Advocacy Officer
Hornback, Chris—Chief Technical Officer
Krantz, Adam—CEO
Sinicropi, Patricia—Senior Director, Legislative Affairs

National Association of Counties
Ufner, Julie—Associate Legislative Director (Environment, Energy and Land Use)

National League of Cities
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U.S. Conference of Mayors
Anderson, Rich—Senior Advisor, Urban Water Council
Arakawa, Alan—Mayor, City of Maui (HI)
Berger, David J—Mayor, City of Lima (OH)
Buttigieg, Pete—Mayor, Southbend (IN)

Cooper, Joy—Mayor, Hallandale Beach (Fl)
Cownie, Frank—Mayor, City of Des Moines (IA)
Gray, Richard—Mayor, Lancaster (PA)
Horrigan, Dan—Mayor, City of Akron (OH)
McNally, John—Mayor, City of Youngstown (OH)
Sheahan, Judy—Assistant Executive Director
Tisdahl, Elizabeth—Mayor, City of Evanston (IL)
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Cameron, Diane—Cameron and Associates
Cammarata, Marc—Director, Office of Watersheds, Philadelphia Water
Coad, Gail—Principal, Industrial Economics
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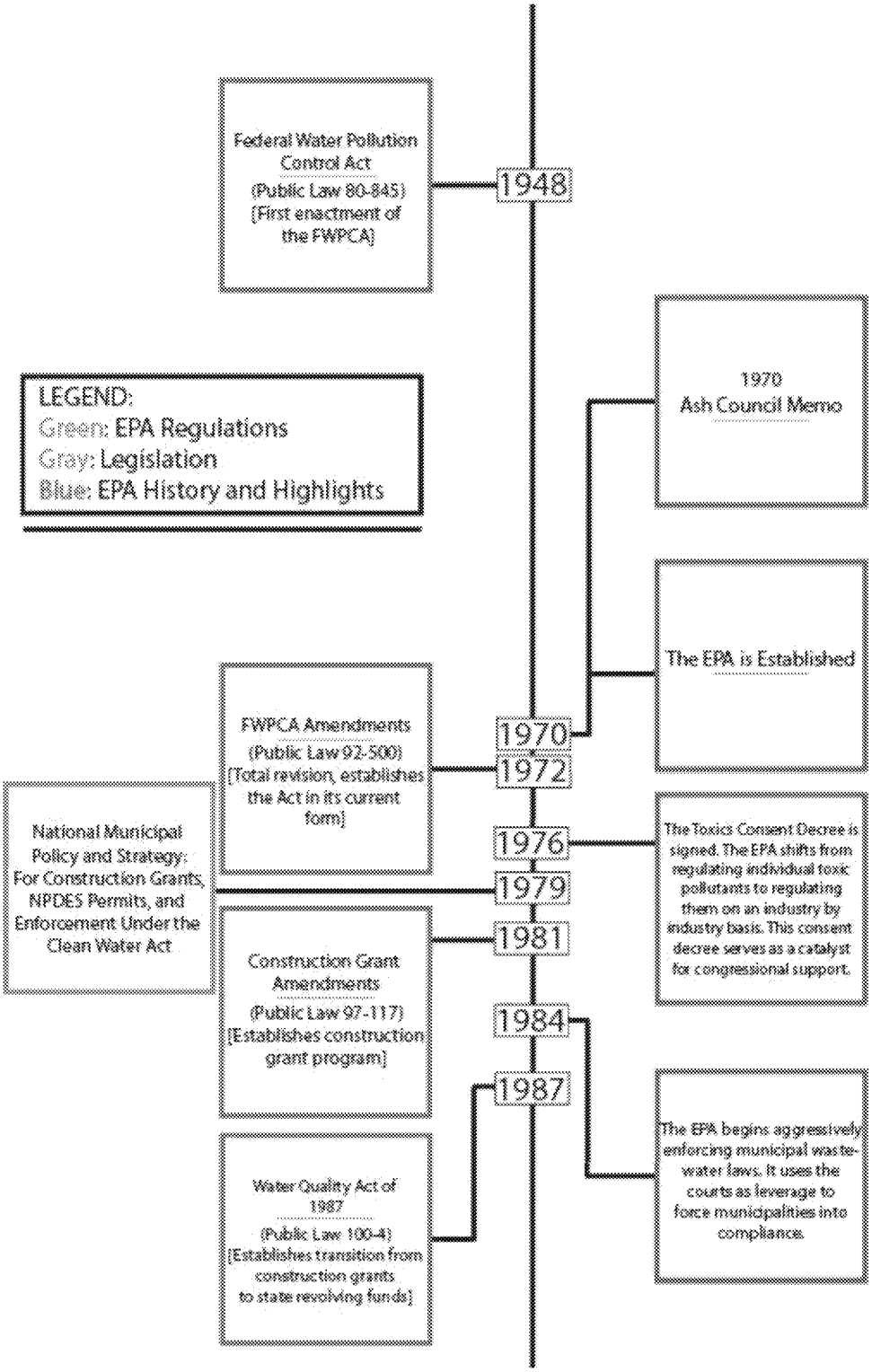
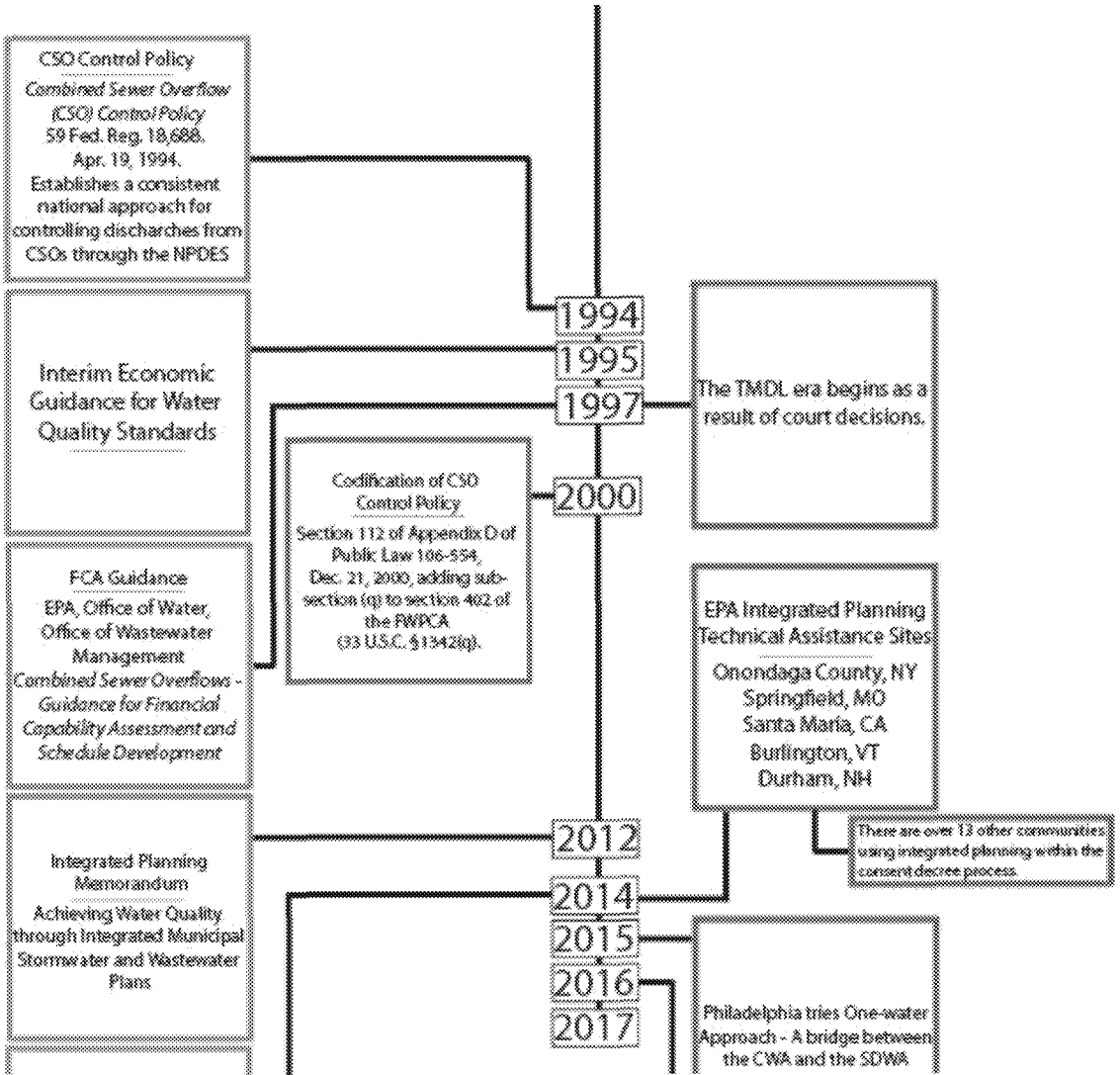
Appendix D: Legislative and Regulatory History Timeline




CSO Control Policy
Combined Sewer Overflow (CSO) Control Policy
59 Fed. Reg. 18,688. Apr. 19, 1994.
Establishes a consistent national approach for controlling discharches from CSOs through the NPDES
Interim Economic Guidance for Water Quality Standards
FCA Guidance
EPA, Office of Water, Office of Wastewater Management
Combined Sewer Overflows - Guidance for Financial Capability Assessment and Schedule Development
Integrated Planning Memorandum
Achieving Water Quality through Integrated Municipal Stormwater and Wastewater Plans
1994
1995
1997
2000
2012
2014
2015
2016
2017
Codification of CSO Control Policy
Section 112 of Appendix D of Public Law 106-554, Dec. 21, 2000, adding sub-section (q) to section 402 of the FWPCA (33 U.S.C. §1342(q).
The TMDL era begins as a result of court decisions.
EPA Integrated Planning Technical Assistance Sites
Onondaga County, NY
Springfield, MO
Santa Maria, CA
Burlington, VT
Durham, NH
There are over 13 other communities using integrated planning within the consent decree process.
Philadelphia tries One-water Approach - A bridge between the CWA and the SDWA


2014 FCA Memorandum
Assessing Financial Capability for Municipal Clean Water Act Requirements
National Academy of Public Administration contracts with the EPA

Appendix E: Community Spreadsheet

Community	Description of Environmental Challenge	Business Case/Primary Benefit Sought	Too
City of Springfield, Missouri • Population - 167, 319. (Approximately 300,000 people are living working, and/or studying everyday) • Median household income is $33,557. • 9.9% of families and 15.9% of the population are below the poverty line	The Springfield-Greene County region, is located in the Ozarks, and relies heavily on recognizes the that the quality environmental resources are especially important since much of our economic development, tourism, and overall quality of life is directly tied into the quality of the air, water, and land. An amended consent state decree directs the city to take all necessary measures to achieve compliance with respect to the goals of eliminating Wet-weather SSOs from WCTS and prohibited bypasses at the WWTFs.	Springfield's Integrated Plan will take a holistic look (across water, air and land) at each of its environmental needs and prioritize investments based on the most effective solutions to address the most pressing problems that matter most to the community. By looking at the big picture of environmental compliance, the optimal set of environmental benefits can be provided in a manner that is affordable to citizens.	

is Utilized	Innovative Solutions	Status of Plan
• Multiple-criteria Decision Analysis • Sustainable Return on Investment • Adaptive Management • Geographic Information System for information sharing	• Acquisition and preservation of riparian corridors • Replacing and minimizing the use of "hard" infrastructure (concrete channels, pipes) by using green infrastructure such as vegetated channels, and retrofitting detention basins • The City and James River Basin Partnership engaged local artists to paint storm drain murals to educate the public about stormwater. View the Storm Drain Reveal Brochure • Engaging local community partners such as schools and churches to address environmental challenges.	IP for the Environment – Environmental Priorities Task Force Report was finalized February 3, 2015.

Appendix E: Community Spreadsheet (cont.)

Community	Description of Environmental Challenge	Business Case/Primary Benefit Sought	Tools Utilized	Innovative Solutions	Status of Plan
Onondaga County, NY • Population - 467,026 • Median Household Income - $51,507 • 14.7% of the County lives below the poverty line but 1 in 2 children lives below the poverty line within the city of Syracuse (which is part of Onondaga County)	New York is a home rule state which provides general powers of local governments to adopt and amend local laws. Within the County of Onondaga is the city of Syracuse and 35 other small municipalities, all with separate decision making authority. County is addressing CWA requirements that include: • Stormwater permit requirements • Wastewater plant permit requirements • Combined sewer overflows • Total Maximum Daily Load	• To address stormwater and wastewater with a single decision-making process • Consolidates the various goals, priorities, actions and outcomes desired of separate Clean Water Act requirements into one planning exercise	Multiple-criteria Decision Analysis • Environmental Performance • Life Cycle Costs • Supplemental Benefits	• A 2009 Consent order reversed a county requirement to build a series of sewage plants along tributaries of the lake and instead reduce sewer overflows with trees, vegetated roofs, rain gardens, and permeable pavement and rain barrels.	IP has not been implemented, however a number of innovative, cross jurisdictional efforts continue.

Appendix E: Community Spreadsheet (cont.)

Community	Description of Environmental Challenge	Business Case/Primary Benefit Sought	Tools Utilized	Innovative Solutions	Status of Plan
City of Santa Maria, California • Population - 103,410 • The average cost of living is 13% lower than the average of California and 19% higher than the national average. • 21.2% of city residents are in poverty. • Cost of housing is 38% higher than the national average.	Current regulatory requirements that result from urbanization and pollutant loading from upstream sources include: • NPDES permits issued under CWA • Waste Discharge Requirements issued under Porter-Cologne Water Quality Control Act • TMDLs • Post-Construction Stormwater Requirements for Development Projects in the Central Coast Region, • Groundwater management obligations • Safe Drinking Water Act Standards	To help focus the City's efforts and prioritize its resources, the City has worked with the Central Coast Regional Water Quality Control Board develop an Integrated Plan that will consolidate, in one place, all of the City's water quality requirements and outline the specific and measurable steps the City will take to achieve compliance with those requirements.	Initial Ranking Tool to identify criteria for comparing and prioritizing and evaluating potential projects. Cost/Load Removed analysis – to determine the estimated benefits and costs of pollutant removal projects.	Woodchip biofilter to convert nitrate from drainage water into harmless nitrogen gas.	While supportive of the IP effort, Regional Water Board is struggling with determining how to allow for and enable the integration across the diverse jurisdictions.

Appendix E: Community Spreadsheet (cont.)

Community	Description of Environmental Challenge	Business Case/Primary Benefit Sought	Tools Utilized	Innovative Solutions	Status of Plan
Town of Durham and University of New Hampshire • Population of 14,638 • Median Household Income - $51,697 • Overall cost of living index is 5% higher than the New Hampshire average and 28% higher than the U.S. average.	Both the Town and UNH are also subject to EPA's MS4 Stormwater General Permit having adjacent regulated urbanized areas that also drain to the Oyster River estuary. There are overlapping requirements for wastewater and MS4 permits lead to duplication of efforts and inefficiencies.	A balanced approach to using nonpoint source control measures in combination with a modest Waste Water Treatment Facility upgrade could achieve similar if not greater nitrogen load reductions in a more cost-effective and sustainable manner.	Watershed based modeling approach.	• Incorporated stormwater regulations with low impact development incentives • Retrofitted a bio-retention structure in downtown parking lot • Partnered with High School to build 1,000 square foot rain garden	Durham continues to work with EPA on permit language

Appendix E: Community Spreadsheet (cont.)

Community	Description of Environmental Challenge	Business Case/Primary Benefit Sought
City of Burlington, Vermont • Population - 42,417 • Median Household Income – $42,677 • Ranked 49th in Vermont for livability due to high cost of living	CWA programs include: • 3 permitted WWTPs, each with separate and combined sewer, and remaining CSOs; • Phase II MS4 with requirements to develop Flow Restoration Plans for 3 stormwater impaired watersheds The Lake Champlain Phosphorus TMDL is currently being revised by the EPA, and Burlington is expected to receive additional regulatory requirements related to phosphorus reductions	This effort would "kick start Integrated Municipal Stormwater and Wastewater Planning in Burlington and provide the foundational elements for the successful completion of an Integrated Plan that can serve as a mechanism for meeting various human health and CWA objectives in a way which maximizes the environmental, social/community, and cost benefits (triple bottom line). It can also provide a model for similarly sized smaller communities across the nation, as well those in Vermont with similar water quality challenges.

Tools Utilized	Innovative Solutions	Status of Plan
Multiple-criteria Decision Analysis • Environmental Performance • Life Cycle Costs • Supplemental Benefits	• Stormwater Infrastructure Plan identifying retrofit opportunities throughout the watershed. • Green infrastructure toolbox • Comprehensive plan for green infrastructure retrofit opportunities.	Updated drafts of their report were submitted to EPA while Burlington continues to pursue a suite of strategies for implementing IP.

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Appendix F: Case Studies

Portland

Portland has played a pioneering role in the development of green infrastructure, which enabled the city to reduce the size of pipes needed in their Combined Sewer Overflow (CSO) control program and insure the capacity of the system for 30 years. Construction of Portland's CSO controls took place between 1991 and 2011, and reduced CSOs from 50 events per year to an average of four overflows per winter. Previously, the sewer system used to overflow into local waterways during even small rain events with accumulations as little as one-tenth of an inch; now the system can handle over one inch of rain without overflowing.

The $1.4 billion cost of the CSO program was financed by ratepayers via stormwater and sanitary utility fees, which make up approximately two-thirds of the average household combined water/sewer bill. The City continues to make payments on the CSO program debt, and also faces costs for deferred maintenance of other elements of the system. A 2008 "Gray to Green" initiative allocated $50 million from stormwater management fees for installation of complementary green infrastructure over five years.

Green infrastructure practices continue as part of a post-2011 facilities plan to further reduce CSOs while also keeping pace with increases in stormwater associated with growth. These have now become standard practices for development and redevelopment and are part of a broader asset management strategy. Portland is currently developing a Stormwater System Plan for all stormwater management using a risk-based approach to assess conditions and identify high priority areas where the consequences and likelihood of failure can be reduced. It is guided by the Portland Watershed Management Plan developed in 2005, which provides guidance for identifying projects that can meet multiple regulatory requirements in an integrated way.

These activities were initiated in response to a 1991 lawsuit by non-profit Northwest Environmental Advocates which alleged that CSOs were not covered by the existing NPDES permit and therefore constituted a violation of the Clean Water Act. CSOs discharge points were incorporated into a new permit issued by the Oregon Department of Environmental Quality in 1991. However, given that it was not feasible to meet the requirements within the five-year permit term, a separate Compliance Order was issued in which Portland agreed to a 20-year timetable to reduce CSOs.[232]

Although EPA did not initially approve a proposal for smaller interceptor sewer pipes in conjunction with green infrastructure, the Portland Bureau of Environmental Services adopted a proactive experimental approach during the planning process for their NPDES permit

[232] NWEA v Portland, decision of June 7 1995, United States Court of Appeals, Ninth Circuit. No. 92-35044. http://caselaw.findlaw.com/us-9th-circuit/1316526.html#sthash.U5GulqF5.dpuf

applications – with an emphasis on research, modeling, monitoring, and evaluation of pilot projects to identify more effective ways to manage stormwater using innovative green technologies. By implementing these on public properties they were also able to demonstrate effectiveness prior to city-wide implementation. The initial plan identified a set of cornerstone projects that were designed to remove significant amounts of stormwater from the combined sewer system prior to constructing the tunnels.[233] Key among these was the disconnection of residential downspouts. At a cost of $13 million, this project alone reduced the volume of stormwater by 20% (1.2 billion gallons per year), reducing capital costs of CSO construction by $300 million. Other cornerstone projects were the installation of stormwater sumps and sedimentation manholes to collect and infiltrate street runoff and trap sediment; stream diversion from the CS area, removing 165 million gallons; and sewer separation in some areas.

Key innovations:

- Portland was among the early developers of green streets, initially working with private developers to find creative solutions for managing stormwater runoff. With $7 million in funding through EPA's Innovative Wet Weather Programs, in 2003 Portland began piloting and evaluating new configurations of green streets. For example, the city developed green streets for industrial areas designed to reduce conflicts with bike lanes, and maximize parking. After demonstrating these would work, green streets became a part of Portland's stormwater management toolbox, and there are now close to 2000 throughout the city.

- Portland implemented the "Tabor to the River" program to address sewer system deficiencies and basement sewer backups in a neighborhood served by the combined sewer system. A pre-design cost benefit analysis indicated that combining green infrastructure with traditional gray (pipe) solutions could reduce project costs by $63 million (from $144 to $81 million).[234] Evaluation and integration of green and gray options is now becoming standard practice in developing public infrastructure projects.

- In typical capital improvement projects, BES invests 1% of the total budget in public involvement beginning six months in advance of a project. For Tabor to the River projects, the bureau directed up to 3% of the capital budget toward public involvement and started outreach efforts 18 months in advance of construction. This expanded outreach was critical to project success because of the visibility of the green infrastructure and impacts – such as parking and aesthetics - to the neighborhood. BES plans to apply this early more comprehensive engagement approach in other project areas that integrate green infrastructure and deliver multi-benefit projects.

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[233] Water Environment Research Foundation, *Case Study: Portland Oregon – Building a Nationally Recognized Program Through Innovation and Research*, 2009.

[234] Portland Bureau of Environmental Services, *Tabor to the River Program,* www.portlandoregon.gov/bes/47591.

- The City of Portland developed its first Stormwater Management Manual (SWMM) in 1999, which provides policy and design requirements for stormwater management throughout the city. The requirements in the manual apply to all development, redevelopment, and improvement projects within the city on private and public property impacting over 500 square feet of impervious surface, and prioritized the use of green (vegetated) facilities. The manual is periodically updated to incorporate innovations and build on experience, with the next – major revisions expected in 2019.

- Portland's approach to stormwater management includes investment in natural infrastructure. The 63-acre Foster Floodplain Natural Area project, completed in 2012, is a key example of Portland's multiple-benefit natural infrastructure projects. Previously a rural-residential neighborhood that was flooded an average of every other year by nearby Johnson Creek, the City acquired properties from 60 families over 15 years through its Willing Seller Acquisition Program. Buildings and roads were removed from the floodplain, along with 50,000 cubic yards of soil and other material. More than 80,000 native plants were brought in and the creek was restored to a more natural state. Foster Floodplain Natural Area is now a much-visited nature park that helps manage the most frequent floods, provides habitat for wildlife such as bald eagles and red-legged frogs, and has improved the water quality of Johnson Creek, a salmon stream in the heart of Portland.

- Co-benefits of green infrastructure projects have enabled the Bureau of Environmental Services (BES) to build partnerships and leverage additional sources of funding.

    - A FEMA Pre-Disaster Mitigation grant helped fund the aforementioned Foster Floodplain project and BES collaborated with Portland Parks and Recreation to make the natural area an amenity for the neighborhood. BES is now collaborating with the Portland Housing Bureau, Prosper Portland (the City's economic development office), and other agencies and community groups to take a holistic approach to floodplain-related issues that are still impacting the area north of Foster Floodplain. This group is working in the short term to stabilize households threatened by the rising cost of flood insurance, and developing a long-term strategy to add floodplain storage that reduces the footprint of the 100-year flood on scarce commercial/industrial land and historic residential neighborhoods.

    - The Crystal Springs restoration project is another example of the ability to attract other partners because of co-benefits - in this case, replacement of culverts not only provided improved stormwater conveyance but also enabled fish passage. Additional funding was leveraged from several partners including the USACE and Portland Parks and Recreation, which supported inclusion of recreation amenities.

- Tree planting for stormwater management provides additional health and other socioeconomic benefits, such as reduced heat island effect and increased home values.

Currently, BES's tree planting efforts are focused in historically underserved low income communities and communities of color, which tend to have lower rates of tree canopy cover.

- The Green Streets Steward program was developed to engage volunteers to help with more regular maintenance of green street facilities and reduce city costs. To date, volunteers have adopted more than 400 green streets throughout the city.

Some challenges:

Portland is aware of concerns about green infrastructure as a potential driver of gentrification and is applying an equity lens to its forthcoming Stormwater System Plan, which will guide future bureau investments. To date, the threats of CSOs and basement sewer backups in the combined sewer system have been major drivers of BES's green infrastructure investments. Because the combined sewer system is mostly confined to the historic inner city neighborhoods, which also tend to be relatively affluent, many green investments have been made in economically privileged and rapidly gentrifying neighborhoods. The bureau is concentrating some green investments, such as the tree planting, in traditionally underserved communities, where stormwater management and socioeconomic needs overlap. Further green investments need to serve stormwater management and risk-based priorities, but community partnerships are helping the bureau work beyond its traditional scope and develop projects that have multiple benefits.

Philadelphia

The Philadelphia Green City Clean Waters initiative, approved by EPA in April 2012, is investing $2.2 billion over a 25-year period to avoid the need to increase the capacity of sewer tunnels and treatment plants to avoid overflows from combined sewers that make up 60% of the city sewer system. Of this, $1.67 billion will be invested in green infrastructure, $345 million in wet weather treatment plant upgrades, and $420 million in an adaptive management or "flexible spending category" which can be targeted towards measures found to be the most efficient as the program progresses.[235] It was the first agreement to substitute green for gray infrastructure in stormwater management and is expected to reduce the cost of CSO control by $8 billion compared with the use of a gray approach.[236]

The plan was supported by an economic analysis of environmental, social and economic or "Triple Bottom Line Benefits" which compared costs and benefits of capturing runoff from 50% of impervious surfaces using green infrastructure to a 30-foot diameter tunnel option, and

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[235] PWD 2011 *Amended Green City, Clean Waters: The City of Philadelphia's Program for Combined Sewer Overflow Control – Program Summary*. Amended June 1, 2011. http://www.phillywatersheds.org/doc/GCCW_AmendedJune2011_LOWRES-web.pdf

[236] Ballard Spahr – Environmental Law Institute 2016 Fifth Annual Green Infrastructure Conference, October 13, 2016, https://www.youtube.com/watch?v=NLByX3ZmhPQ&feature=youtu.be.

estimated a net benefit of $2846.4 million for green, compared with $122 million for gray. [237] Expected benefits cited in the program document included employment in green jobs (approximately 250 people/year), increases in recreational opportunities and property values, a reduction of heat-related fatalities as a result of that is attributed to shade, reduction of heat-absorbing pavement and rooftops, and water vapor emissions, health benefits of improved air quality, energy savings, and water quality and habitat improvements.[238] The original analysis also found a higher Willingness-To-Pay per household for the additional water quality and habitat improvements that would not be provided by the tunnel option.[239]

As part of this initiative, the City set a target of "greening", i.e., the ability to capture 1" of rainfall from 10,000 impervious acres. As of the fifth anniversary of the program, it had exceeded its 5-year target with 837 Greened Acres that reduce stormwater runoff by 1.5 billion gallons a year.[240] However, the program only receives compliance credit for projects on public property that the city maintains, which total only 179.7 acres.[241]

Program funds target publicly owned land including buildings, streets and rights-of-way. New stormwater rules are expected to leverage private investment as redevelopment occurs. At an estimated redevelopment rate of 1%, the City estimates that 5,000 to 6,000 acres will be greened over the course of the GCCW program. Incentives for private property owners are provided through reductions in the stormwater fee for adoption of specific practices to manage stormwater onsite. Up to 80% credit is provided for management of 1" of stormwater, which would reduce the fee on a one-acre parcel from $5600/year to as low as $1100. The Stormwater Management Incentives Program (SMIP) provides grants of up to $100,000 per acre for projects on non-residential private properties. To encourage more green infrastructure projects on private property, which have a lower cost, in 2014 the City also established the Green Acre Retrofit Program (GARP) as a way to identify the lowest-cost opportunities for these projects by enabling private contractors to identify and bundle projects, and compete for public grants to fund them.[242] A review of the program by NRDC found that contractors also have difficulty identifying these

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[237] Stratus Consulting, *Final Report: A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds*, 2009, Prepared for Howard M. Neukrug, Director, Office of Watersheds, City of Philadelphia Water Department, under contract to Camp Dresser and McKee.

[238] PWD 2011.

[239] Stratus Consulting 2009.

[240] Philadelphia Water Department, Green City, Clean Waters, http://phillywatersheds.org/what_were_doing/documents_and_data/cso_long_term_control_plan; 5 Down, 20 to Go: Celebrating 5 Years of Cleaner Water and Greener Neighborhoods – www.Phillywatersheds.org/5down

[241] Ballard Spahr – Environmental Law Institute 2016 Fifth Annual Green Infrastructure Conference, October 13, 2016 https://www.youtube.com/watch?v=NLByX3ZmhPQ&feature=youtu.be

[242] City of Philadelphia Water Department, *Stormwater Grants*. http://www.phila.gov/water/wu/stormwater/Pages/Grants.aspx

opportunities and resulted in recommendations to develop a platform through which they can connect with interested property owners.[243]

An important component is insuring city-wide access to green spaces for all citizens through the Green 2015 Action Plan, for which the goal is to add 500 acres of parkland with the goal of having a patch of parkland within a 10-minute walk from anywhere in the city [244] An additional key component is a partnership with PowerCorpsPHL, an AmeriCorps program, through which the City trains at risk youth, provides opportunities for them to gain work experience, and job placement support. As of the fifth year of the program, 24 individuals were reported to have gained permanent employment through the PowerCorpsPHL program.[245]

Key innovations and accomplishments achieved in the course of the program:
An analysis of the economic benefits of the first five years of the program by the Sustainable Business Network of Greater Philadelphia (SBN) found[246]:

- Stormwater management regulations for development helped catalyze a best-in-class GSI industry cluster for which annual growth was estimated at 13.8% from 2013-2014. Estimated economic impacts were almost $60m. It currently supports 430 local jobs, and generates nearly $1million in local tax revenue.
- 60 current GSI Partners have 1,600 employees and aggregate annual revenues of $189 million.
- Innovative stormwater management products developed by local companies have led to export opportunities.
- Projects had positive impacts on nearby property values – which had an aggregate gain of $1.3 billion, resulting in annual property tax increase of $18 million.
- Significant reductions in violence and criminal activity.
- Recreational opportunities improved physical health. Other benefits were improved mental and emotional health and aesthetic.

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[243] Valderrama, A., *Spurring Entrepreneurship and Innovation in Stormwater Markets*, 2016. Natural Resources Defense Council, Washington DC.
[244] Hogan, Dianna M., Carl D. Shapiro, David N. Karp, and Susan M. Wachter. *Urban Ecosystem Services and Decision Making for a Green Philadelphia.* U.S. Geological Survey, 2014. http://dx.doi.org/10.3133/ofr20141155.

[245] Ballard Spahr – Environmental Law Institute 2016.
[246] Green Stormwater Infrastructure Partners, *The Economic Impact of Green City, Clean Waters: The First Five Years*. Sustainable Business Network of Greater Philadelphia, 2016.

- Estimated per acre environmental benefit of green space, $10.5M/year in the form of: water quality improvement, aquatic habitat enhancement, wetlands enhancement and creation, air pollutant removal.

- Public investment in GSI of $1.2b over life of GCCW (25 years) is expected to induce additional private investment via regulation and incentives which are expected to produce an impact of $3.1 billion, support 1000 jobs a year, and generate $2 million a year in tax revenue.

The program advances social equity by generating more accessible on ramps to find employment and contracting opportunities. A majority of the projects are in relatively low income neighborhoods where they provide amenities.

Challenges and future directions of the program:

- Establishment of Community and Performance-Based Public-Private Partnerships (CBP4s) that enable the City to leverage private sector investment and efficiencies as appropriate

- Leverage partnerships by aligning PWD green infrastructure projects with capital investments e.g., in other improvements of schools and parks, in order to be able to do complete projects.

- Coordinate infrastructure planning with other sectors of the city to reduce costs

- Standardize best practices through the development of manuals and updating regulations

- Ability to develop GI projects on large, non-city properties such as schools, faith-based and academic institutions by enabling them to reduce costs, e.g., through reductions in stormwater fees and energy savings.

- Use of smart technologies for monitoring at scale to reduce maintenance costs and demonstrate program effectiveness

- Integrate CSO controls with measures to address flooding and climate change

As part of a One Water approach, Philadelphia has also established partnerships and is sharing knowledge and experience related to stormwater management with smaller upstream jurisdictions which are a significant source of wastewater effluent and stormwater runoff.[247]

[247] Couillard, E., M.D. Hesson, K. Anderson, C. Crockett, and M.E. McCarty. *Philadelphia's One-Water Approach Starts with Source Water Protection,* Journal AWWA 107(4), 2015, p. 62–71.

Other cities that have been able to modify their consent decrees to incorporate green infrastructure include New York City,[248] Washington DC,[249] Buffalo,[250] and Kansas City.[251] However it can require significant effort and resources to reopen and renegotiate existing consent decrees, and a significant investment of resources can be required to make the case for a green infrastructure plan. For example, as noted below, Washington DC invested $14 million in exploring the potential for green infrastructure that enabled them to modify a 2005 consent decree to a hybrid approach that was approved in 2015.

Washington DC

Washington DC initiated development of its Long Term Control Plan in 1998, which led to agreement on a consent decree in 2005, which had a price tag of $2.6 billion to build 3 tunnels to control CSOs that discharge 3.2 billion gallons a year.

In 2009, with a capital budget projected to expand from $200 to $550 million in 2012, combined with $950 million in costs for regulatory obligations at the Blue Plains treatment facility, DC Water initiated a Customer Assistance Program subsidized by rate payers, in which those who have met qualifications for the Low Income Energy Assistance Program are automatically qualified for water bill assistance. With a rise in fixed vs. volumetric costs, lifeline rates were also established for residential ratepayers, which discounts the first 4 CCFs of water used, thereby also providing a conservation incentive. In 2011, with an investment of $14 million, DC also began to explore the potential for Green Infrastructure with triple bottom-line benefits. This provided the basis for reopening of the consent decree. Given that DC has many households with low and high incomes with comparatively low proportion of middle income households, use of median household income as an affordability measure was not representative of community impacts. As a result, DC Water presented additional analysis of affordability to EPA which demonstrated that costs were well over 2% for the lower quintiles, to make the case for modification of the consent decree. The consent decree was modified to a gray-green hybrid plan in 2016[252] in which GI and targeted sewer separation enable the upper portions of the Potomac tunnel to be shortened. A planned Rock Creek tunnel, with a capacity of 9.5 MG, was eliminated, and replaced with GI.

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[249] DC Water 2015, Clean Rivers Project *https://www.dcwater.com/clean-rivers-project*; and Long-Term Control Plan Modification for Green Infrastructure. Executive Summary. https://www.dcwater.com/sites/default/files/green-infrastructure-exec-summary.pdf

[250] U.S. Environmental Protection Agency, *EPA Approves Buffalo Sewer Authority's Plan to Reduce Sewage and Water Pollution in Niagara River,* 2014. https://yosemite.epa.gov/opa/admpress.nsf/0/F62F59FBDAEE3ABD85257CBA005A497E

[251] U.S. Environmental Protection Agency, *Consent Decree: City of Kansas City, Missouri*, 2011, https://www.epa.gov/enforcement/consent-decree-city-kansas-city-missouri.

[252] DC Agreement to Implement Green Infrastructure to Control Combined Sewer Overflows Entered in Federal Court; January 15, 2016. https://dcwater.com/whats-going-on/news/dc-agreement-implement-green-infrastructure-control-combined-sewer-overflows

The 2016 modified consent decree maintains more affordable rates by extending the implementation schedule by 5 years, reducing typical residential sewer bills from $1675 to $1200 per year, projected for year 2032. However, use of green infrastructure to manage 498 impervious acres will enable water quality and co-benefits to begin in 2017 rather than when tunnel projects were to have been completed in 2025 in the unmodified consent decree. This is expected to reduce CSOs by 96%, reduce the chance of flooding from 50% to 7% in the Northeast Boundary area, and also reduce nitrogen discharges to the Chesapeake Bay by 1 million pounds per year.[253]

Key innovations developed in the course of the program:

- Issuance of a Century Bond that matches the term of the loan to the life of the asset. This increases intergenerational equity by spreading costs that date back a century and go forward a century.

- Issuance of a Pay-for-Performance Environmental Impact Bond: DC Water issued the first Environmental Impact Bond to fund DC Clean Rivers GI project, which targets Rock Creek. Brokered by Quantified Ventures, Goldman Sachs and the Calvert Foundation are investing $25 million for GI installations managing 20 impervious acres.[254] The amount repaid to investors is contingent on the impact of green infrastructure, as indicated by a comparison of baseline to after GI measurements, which is measured by flow meters. Payments are higher if green infrastructure facilities over perform because this potentially reduces the amount of GI needed to manage CSOs. Issued as a municipal bond, it is the first Pay for Success (PFS) bond in the environmental space, and largest PFS investment.[255]

- Green Jobs Training and Certification program was developed in partnership with the Water Environment Federation (WEF)WERF, awarding them a $1 million contract to develop and launch the program. The initial focus was on entry level jobs in construction, maintenance, and inspection, to fulfill a need for employees with the new skill sets required for green infrastructure and also provide them with a career path. In addition to DC Water, 14 other communities supported the development and launch of the program, who each paid $50,000, of which $40,000 was paid back to DC Water for having fronted the initial cost to develop the program with the $1 million contract to WEF. In the long-term, the intention was for it to be led by a third party. The initiative now has 14 partners – as a result, DC Water has been reimbursed for over half of the upfront costs. The national scope provides an additional benefit to participants in that it gives them a more

[253] DC Water 2015, Clean Rivers Project *https://www.dcwater.com/clean-rivers-project*; and Long-Term Control Plan Modification for Green Infrastructure. Executive Summary. https://www.dcwater.com/sites/default/files/green-infrastructure-exec-summary.pdf

[254] Quantified Ventures N.D. World's First Environmental Impact Bond to Reduce Stormwater Runoff and Combined Sewage Overflows in Washington, D.C. http://www.quantifiedventures.com/dc-water

[255] North, J. and Gong, G., *DC Water Environmental Impact Bond*, 2017, Harvard Kennedy School Government Performance Lab. https://govlab.hks.harvard.edu/files/siblab/files/dc_water_eib_project.pdf

portable skill, enabling them to work in participating cities. They are considering additional certification levels for higher level positions. So far, 108 people have completed 35 hours of training and passed the certification exam to be awarded certifications. The program aims to be connected to the job market through contractor requirements to hire from the program and meet hiring goals.

- DC Stormwater Retention Credit Trading Program: Enables property developers to meet requirements for onsite stormwater retention by buying stormwater credits from other property owners who are able to exceed requirements, rather than do it all on their own property, or pay an in-lieu fee that is equivalent to the average cost to the city to develop green infrastructure projects. It also incentivizes the identification of least-cost opportunities on private property by third party project developers, who can aggregate green infrastructure projects or work with large property owners to generate a larger volume of credits at a lower cost than the in-lieu fee, which can then be sold to real estate developers. By purchasing credits from third party project developers, the city lowers its own cost, and effectively establishes a performance-based Public-Private Partnership with multiple service providers.[256]

- Formed "Blue Drop" a non-profit and stand-alone affiliate in which DC Water is the only member, which enables them to generate non-ratepayer revenue. Blue Drop markets consulting services to other utilities. In addition to providing a return to DC Water, this lowers the significant upfront costs of innovation to the smaller less efficient utilities and enables all utilities to share in upfront costs for work that would be duplicative.[257]

- Resource recovery: began to produce "Bloom Soil" from biosolids recovered from the Blue Plains Resource Recovery Facility, which is marketed by Blue Drop. [258]

- Reduced a 300-year replacement cycle for water infrastructure to a 100 year one, at a cost of $40 million a year, by adding a fixed monthly Water System Replacement Fee to customers' bills in 2016. The residential fee ranges from $6.30 to $9.67 per month depending on meter size and average flow, with higher rates for larger meters in multi-family and non-residential buildings[259]

Some challenges:

- It is difficult to hold those who install a green infrastructure project responsible for initial maintenance; currently a minimum of one-year maintenance requirement is included in DC Water's GI contracts.

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[256] DC Department of Energy and Environment. Stormwater Retention Credit Trading Program https://doee.dc.gov/src

[257] Blue Drop Performance Soil. https://www.bluedrop.com/

[258] Bloomsoil. www.bloomsoil.com

[259] DC Water, Water System Replacement Fee. https://dcwater.com/system-replacement-fee.

- DC has a small customer base relative to the metro region that is served. CSO pipes are only in DC and they cannot spread costs to suburban ratepayers unless they can show flows from suburbia in the overflow pipes.

A general observation observed across these and other case studies was that it is harder for early adopters. Success is attributed to being stubborn and persistent.

Smart Technology Case Studies

South Bend Indiana

Some jurisdictions have been able to lower costs of CSO control using sewer optimization technology in combination with other approaches. An example is the City of South Bend Indiana, which avoided costs of $120 million for conventional civil engineering projects to separate sewer lines by investing $6 million in "CSOnet". This is a network of smart sensors and valves that enable real-time monitoring of flows in the sewer system so that use of storage capacity in existing pipes can be optimized by redirecting flows.[260]

The City has also conducted feasibility analysis for other ways to reduce total estimated costs of the CSO LTCP, by also using green infrastructure in combination with real-time controls, as a complement to conventional methods. The current Mayor is now seeking to reopen the Consent Decree to be able to adopt a plan that would reduce costs of the LTCP from $700 to $200 million which would reduce costs relative to average sewer bill from 3.7 to 2% of MHI.[261] With a population of just 100 million, and high poverty rates, increases in rates were already leading to increases in water shut-offs.

Syracuse New York

Syracuse faces a backlog of deferred maintenance of its underground water and sewer lines, many of which are over 100 years old and contribute to CSO events, which need to be controlled under a Consent Decree with Onondaga County. Syracuse is one of 36 governments in the County. Given that New York is a home rule state, land use authority and management of collection sewers resides with each of these 36 local jurisdictions. However, under an Inter-Municipal agreement, Syracuse supports the County in meetings its regulatory obligations in exchange for funding assistance.

With a grant from Bloomberg Philanthropies, Syracuse formed an Innovation Team or "i-Team" that undertook several initiatives that enable the city to be more proactive in addressing the challenge of deferred maintenance. Water main sensors, along with testing and replacement of non-functioning valves enable the city to isolate the locations of breaks in the pipes and identify

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[260] City of South Bend, CSOnet, https://www.southbendin.gov/government/content/csonet.

[261] Parrot, J., *South Bend hopes to spend millions less on sewers*, South Bend Tribune, May 9, 2017. http://www.southbendtribune.com/news/local/south-bend-hopes-to-spend-millions-less-on-sewers/article_55fb3cf6-3fd8-5016-a16f-4d2808ea8271.html

the closest water main valves, which minimizes disruption as well as cost in repairing water main breaks. Data science and predictive modeling to assign risk scores provide the basis for an early warning system that enables potential breaks to be addressed proactively and prevented. Lastly, following the "dig once" approach, better construction coordination of repair work among utilities also reduces costs and disruption. [262]

[262] City of Syracuse, Innovation Team, *2016 Infrastructure Final Report*, http://www.innovatesyracuse.com/infrastructure.

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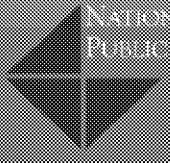

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