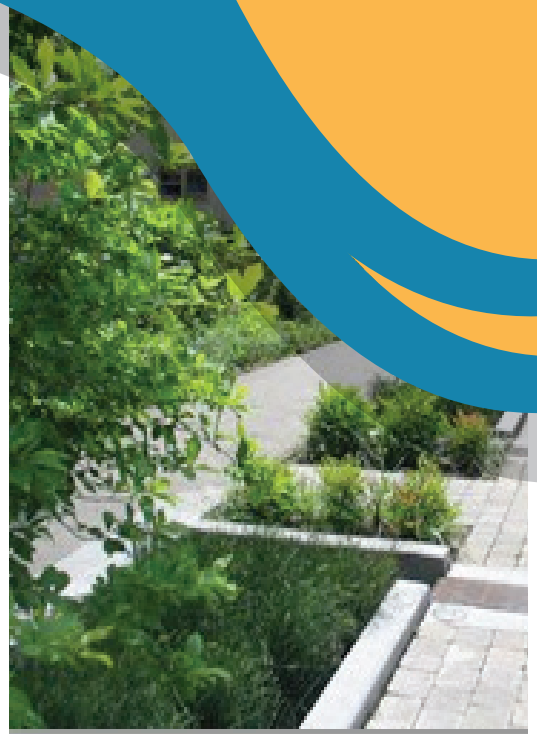

New Jersey A·I·M·S^4

Advanced *and* Integrated Menu of Strategies for Sustainable Sewer *and* Stormwater Systems

Guide to Options for Effective Sewer and Stormwater Management

JERSEY WATER WORKS

Smart infrastructure. Strong communities.

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About Jersey Water Works

Jersey Water Works is a collaborative effort working to transform New Jersey's inadequate water infrastructure through sustainable, cost-effective solutions that provide communities with clean water and waterways; healthier, safer neighborhoods; flood and climate resilience; local jobs; and economic growth. For more information, visit www.jerseywaterworks.org. The materials presented in this document were selected and written by the preparers and contributing authors and do not necessarily reflect the views of all reviewers or researchers.

While many of the actions in this guide may be relevant and useful for compliance with regulatory requirements, the guide is not a regulatory guidance document, and completion of any one action or group of actions within the document does not guarantee permit compliance. Wherever there may be conflict between permit requirements and the suggestions of this guide, the permit requirements should be followed.

For more information, contact:

Chris Sturm

csturm@njfuture.org

www.jerseywaterworks.org

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Achieve better results at a lower cost: Sewer and stormwater systems are devising "win-win" strategies to improve cost efficiency *and* deliver better environmental and community benefits. The New Jersey A·I·M·S4 program offers a handy guide to a full menu of valuable methods to make it easier to achieve these results.

All sewer and stormwater infrastructure system managers grapple with the challenge of delivering modern services, addressing aging infrastructure and meeting regulatory requirements, all with limited resources. Each system has many opportunities to go beyond the minimum and use both industry-standard and innovative, practical approaches to lower life-cycle costs and multiply the benefits of capital investments. Not only is it possible; it can build the support from ratepayers and elected officials that is necessary for successful initiatives.

New Jersey A·I·M·S4 is a menu of actions that facilitates broader adoption of effective strategies to managing **sewer and stormwater** infrastructure systems to achieve the following objectives:

- To empower municipalities and utilities that own, operate and maintain sewer and stormwater infrastructure with methods that deliver results beyond those achieved through regulatory compliance;
- To help elected officials, sewer utility/department leadership and staff, planners and engineers select projects and practices that achieve high benefits at low life-cycle costs;
- To provide a framework for municipalities, departments and utilities to self-evaluate their performance in sewer and stormwater management;
- To set the foundation for a future awards program that recognizes municipalities and utilities that employ strategies for tested and/or innovative solutions to issues of urban water management; and
- To empower advocates seeking stronger, healthier communities and built and natural environments.

New Jersey A·I·M·S4 offers tools to minimize life-cycle costs for municipalities and utilities, while improving the environment, economy and quality of life.

Certain sewer and stormwater management strategies can provide additional benefits, such as flood mitigation, cleaner air and water, reduced asthma rates and improved public health, additional green space, recreational opportunities and aesthetic benefits, lower air temperatures and associated reductions in energy bills, green jobs and economic development, as well as community revitalization.

How to Use New Jersey A·I·M·S4

Goals▪Gaps▪Actions▪Methods

1. **Identify specific goals – for cost efficiency, permit compliance, infrastructure maintenance, system optimization, environmental protection, and community benefits.**
2. **Think about the gaps between identified goals and current system performance.**
3. **Review the New Jersey A·I·M·S4 Guide to Effective Sewer and Stormwater Management to identify those actions that can best help to bridge the gaps, and are affordable.**
4. **Take advantage of the methods offered in the guide, including resource documents, examples and the Strategy Checklist.**

Each municipality and utility knows its enterprise best and must choose the most appropriate steps forward.

Goals of New Jersey A·I·M·S4

The program seeks economic, environmental and community benefits through the following goals:

- **Lower the life cycle costs of sewer and stormwater systems**
- **Leverage green and gray infrastructure investments**
- **Empower fiscal responsibility, sustainable capital investment, and prioritization of sewer and stormwater infrastructure investments based on the triple bottom line approach**
- **Reduce the volume of water entering sewer and stormwater systems**
- **Optimize the function of existing sewer and stormwater system assets**
- **Reduce the frequency and severity of sewer overflow events**
- **Mitigate the frequency and severity of localized flooding associated with sewer and stormwater infrastructure**
- **Maximize co-benefits for environmental and public health to advance quality of life**

Navigating New Jersey A·I·M·S4

The program includes a ***Guide to Options for Effective Sewer and Stormwater Management*** as well as a ***Strategy Checklist*** to help utilities or municipalities that own, maintain and operate sewer and stormwater infrastructure to track their progress. The Strategy Checklist is provided in *Appendix A*.

The six strategies in the guide include effective **actions** from which communities, municipalities and utilities can select to improve cost efficiency and deliver better environmental and community benefits. Each action has a set of **methods** that *offer more detail or guidance*, and a set of **resources** that *facilitate achievement*.

This collection of resources is not meant to be exhaustive or authoritative. Resources include reports, guidance documents, case studies, and models or examples that are provided to inform municipalities and utilities, and to assist them in completing the actions included in the guide.

Once a set of actions has been selected, the Strategy Checklist can be used as a work plan that keeps track of the steps to achieve each action, including identifying entities and individuals responsible for leading or assisting to complete specific actions, and assigning tasks with deadlines. Responsible individuals may include staff and officials from the municipality, utility, community groups or others.

Understanding New Jersey A·I·M·S4

New Jersey A·I·M·S4 is intended to provide easily accessible and well-organized resources for municipalities and utilities seeking to achieve cost-effective, beneficial sewer and stormwater management.

The program encourages implementation of the practices included in the guide through use of the checklist. However, it is not meant to be prescriptive or restrictive. New Jersey A·I·M·S4 understands that each municipality and utility is different; therefore:

- New Jersey A·I·M·S4 is not a one-size-fits-all program. The guide is flexible, and seeks to offer options for a diverse range of communities and managers of sewer and stormwater infrastructure, who will need to assess the applicability, impact, affordability and political feasibility of each action.
- Not all actions and recommendations will be applicable to every sewer and stormwater utility or department.
- Some actions and recommendations are well-established industry best practices, while others are more cutting edge and are proposed to encourage innovation.
- The guide is not exhaustive, and communities are encouraged to implement other strategies not included in the guide. This guide will be a living document that can grow and evolve based on input from the field.

New Jersey A·I·M·S4 is intended to ***complement, leverage and/or add value to regulatory requirements.*** Several of the actions in the New Jersey A·I·M·S4 Guide generally correspond to topics covered in NJDEP Municipal Stormwater Permits, CSO Permits, and NJPDES Rules. Many of these actions may be relevant and useful to achieve compliance with regulatory requirements; however, A·I·M·S4 actions as written are not permit conditions and the guide is not a regulatory guidance document. While it is expected that utilities and municipalities would implement actions that may

also assist in meeting regulatory mandates, completion of the actions included in the New Jersey A·I·M·S⁴ program does not guarantee permit compliance. Wherever there may be conflict between permit requirements and the suggestions of this guide, the permit requirements should be followed. A general "crosswalk" between New Jersey A·I·M·S⁴ actions and corresponding sections in NJDEP permits that topically relate to these Actions are provided below. *Appendix 2* provides a detailed crosswalk.

Planning and Understanding Gray and Green Infrastructure Systems

- ***Tier A:*** Section F Statewide Basic Requirements, Subsection 6; Section E Stormwater Program and Stormwater Pollution Prevention Plan; Section F.3.a.v. Operations & Maintenance of Private Storemwater BMPs; Section F.7. Maintenance of municipal stormwater BMPs and catch basins
- ***Tier B*:** Section E Stormwater Program
- ***CSO Permit*:** Part IV.F.1 Proper operation and regular maintenance programs for the sewer system and the CSOs; Part IV.G.6. Operational Plan; Part IV.G.8 Implementation Schedule; Part IV.G.1. Characterization Monitoring and Modeling of the Combined Sewer System; Part IV.G.4 Evaluation of Alternatives

Implementation and Optimization of Gray and Green Infrastructure Systems

- ***Tier A:*** Section E Stormwater Program and Stormwater Pollution Prevention Plan; Section H Deadlines and Certifications; Section F.3.a.v. Operations & Maintenance of Private Storemwater BMPs; Section F.6. Inspections; Section F.7. Maintenance of municipal stormwater BMPs and catch basins
- ***Tier B*:** Section H Deadlines and Certifications
- ***CSO Permit*:** Part III Monitoring Requirements, Part IV.F.1. Proper operation and regular maintenance programs for the sewer system and the CSOs; Part IV.F.2 Maximum use of the collection system for storage; Part IV.F.4 Maximization of flow to the POTW for treatment; Part IV.F.5 Prohibition of CSOs during dry weather; Part IV.F.6. Control of solid and floatable materials in CSOs; Part IV.F.9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls; Part IV.G.4. Evaluation of Alternatives; Part IV.G.9. Compliance Monitoring Program (CMP)

Integrated Sewer and Stormwater Management

- ***Tier A:*** Section E Stormwater Program and Stormwater Pollution Prevention Plan; Section F. Compliance for Private Stormwater BMPs
- ***Tier B***: Section E Stormwater Program
- ***CSO Permit:*** Part IV.D.1. CSO Submittal Requirements; Part IV.D.3. Long Term Control Plan (LTCP) Submittal Requirements; Part IV.G.2. Public Participation Process; Part IV.G.3. Consideration of Sensitive Areas; Part IV.G.4 Evaluation of Alternatives; Part IV.G.10. Permittee's LTCP Responsibilities

Green Infrastructure

- ***Tier A***: Section E Stormwater Program and Stormwater Pollution Prevention Plan; Section F Statewide Basic Requirements (SBRs)
- ***Tier B***: Section E Stormwater Program; Section F Statewide Basic Requirements (SBRs); Section F.2 Post Construction Stormwater Management
- ***CSO Permit***: Part IV.F.7. Implementation of Pollution Prevention Measures; Part IV.G.1. Characterization Monitoring and Modeling of the Combined Sewer System; Part IV.G.2. Public Participation Process; Part IV.G.4 Evaluation of Alternatives

Public Participation and Partnerships

- ***Tier A***: Section F Statewide Basic Requirements (SBRs); Section F.2. Public Notice Requirements
- ***Tier B***: Section F Statewide Basic Requirements (SBRs)
- **CSO Permits**: Part IV.F.7. Implementation of Pollution Prevention Measures; Part IV.F.8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts; Part IV.G.2. Public Participation Process

Financial and Institutional Capacity

- ***CSO Permit***: Part IV.F.1. Proper Operation and Regular Maintenance Program Requirements; Part IV.G.5. Cost/Performance Considerations

Why New Jersey A·I·M·S⁴?

The program aims to be a "win-win" for municipalities and utilities that seek to achieve both regulatory compliance and lower life cycle costs of infrastructure. A·I·M·S⁴ seeks to:

- **Assist in permit compliance. Completing certain actions included in the A·I·M·S⁴ program may assist toward achieving compliance with regulatory requirements but does not guarantee permit compliance.**
- **Lower life-cycle costs and capital-program budgets through actions that achieve effective system optimization and integrated sewer and stormwater management**
- **Achieve fiscal sustainability through strategies that build financial and institutional capacity**
- **Foster partnerships with the community such that utilities and municipalities are more than good neighbors, but are actively working with their constituents to achieve common goals**
- **Encourage the utility of the future that goes beyond conventional permit compliance to make a positive difference in the environment and quality of life in our communities.**

Strategies and Actions

STRATEGY 1: Planning and Understanding Gray and Green Infrastructure Systems

Strategy 1 aims to ensure that the municipality or utility has a solid understanding of its system assets, operations, and needs, with a comprehensive and financially sustainable plan for future improvements.

Asset management lies at the core of Strategy 1 – understanding existing system assets, how they function, and their criticality. Key information is provided to the municipality or utility and the public by a current digital map and inventory of sewer and stormwater infrastructure that locates and characterizes system assets. The map and inventory establishes necessary baseline information that factors into the subsequent planning actions included in this strategy.

Several types of plans, which can be separate or combined documents, lay the groundwork for capital improvement planning. The operations & maintenance (O&M) plan provides for preventive maintenance, system monitoring, and prioritization of cost-effective improvements to maintain the integrity of the system in a state of good repair. Building on the O&M plan, the asset-management plan provides an inventory, condition and criticality assessment of system assets, while the system-optimization strategy identifies system limitations and prioritizes improvements to increase system functionality and efficiency.

The system evaluation projects future demand risks, while the capacity management plan ensures that the system can meet these future needs effectively. In addition to demand risks, the hazard mitigation, resiliency and response plan works with adopted multi-jurisdictional hazard mitigation plans or local resiliency efforts to assess the risk to infrastructure systems from climate change; accounts for emergency equipment to minimize service interruptions; and prioritizes improvements to mitigate risk to critical infrastructure assets.

The municipality or utility's capital improvement plan integrates all capital investments or projects, operations, budgets, and cost-benefit analyses included in the previous plans into a holistic and financially sustainable schedule of integrated improvements.

Ideally, all plans are regularly updated, and include an implementation agenda with an annual budget, funding, assignment of responsible parties, performance measures, and both short- and long-term outlook.

Actions		*Methods*	*Resources*
1.1	The municipality/utility maintains a *digital* **map and inventory** of green and gray stormwater and sewer infrastructure.	☐ The *secure* GIS map and inventory characterizes existing and proposed wastewater, combined, and stormwater system gray and green infrastructure, including the following assets (and their features), as applicable: – collection areas, such as sewersheds and watersheds (direction of flows) – catch basins (with or without water quality hoods) – manholes (diameter, depth, rim and invert elevations, material type, date built) – collection system pipes including trunk and interceptor sewers (diameter, length, direction of flow, material type, slope, invert elevations date built),or regulators, – pump stations (number of pumps, capacities, performance curves, make and model link to drawings if available), emergency generators, and force mains (diameter, material type, length, locations of air release, and vacuum valves) – treatment systems (plants) – outfalls (CSO and MS4) – structural and non-structural stormwater BMPs (i.e., facilities that treat stormwater) – green infrastructure facilities ☐ The secure GIS map and inventory is updated regularly to incorporate new and rehabilitated infrastructure through project as-built drawings and specifications.	Sample Webmap for Sanitary Sewer Network New Jersey ArcGIS Stormwater Outfall Mapping

Actions		Methods	Resources
		☐ The *secure* GIS map and inventory is made available to appropriate government agencies and is not available to the public. Permission may be granted to entities concerned or involved with developing green or gray solutions for sewer systems/CSOs, such as technical consultants, universities It provides a unique identifier, location description, construction information (i.e., age, size, materials and maintenance history to the extent known), condition, and criticality for every mapped feature. ☐ The public GIS map and inventory includes mapping (of all components that do not raise security issues) and generalized descriptions and is provided through an open source web platform such as ArcGIS.com. ☐ The public GIS map interfaces with a public notification system alerting the public to real-time CSOs, SSOs, and water quality advisories (see 5.1)	
1.2	The municipality/utility has adopted a *comprehensive* ***electronic*** **operations and maintenance (O&M)** program for green and gray stormwater and sewer infrastructure systems.	☐ The O&M program describes existing and planned programs for prioritizing sewer and stormwater infrastructure preventive maintenance, and any plans for improving the system, as needed, to maintain the integrity of the system. ☐ The O&M program addresses criteria and results for short-term and long-term prioritization of corrective actions based on structural or other deficiencies identified during preventive maintenance activities. ☐ The O&M program provides for periodic objective calculation of the degree of I/I to determine its level of excessiveness and, where excessive I/I is identified, provide for the means of eliminating that excessive I/I. ☐ The O&M program provides for comprehensive real-time surveillance/monitoring of the sewer system to allow the operator/owner to quickly identify and respond to system blockages and other causes of dry weather overflows, sanitary sewer overflows and basement backups. ☐ The O&M program determines whether a fats, oils and grease (fog) control program is needed, if applicable. if so, the program includes a FOG control program as an appendix, which identifies sections of the sewer system subject to grease blockages based on blockage history, line investigation and inspection of FOG dischargers (such as restaurants), and establishes a cleaning maintenance schedule for each section. ☐ The O&M program outlines an implementation agenda with an annual capital budget, funding, responsible parties, as well as short- and long-term outlook. ☐ The O&M program includes an O&M manual as an appendix, which details standard operating procedures for completing scheduled preventive maintenance of sewer and stormwater infrastructure in accordance with the manufacturer's recommendations,	Green City, Clean Waters: Green Infrastructure Maintenance Manual Development Process Plan Green City, Clean Waters: Green Infrastructure Maintenance Manual Regular Inspection and Maintenance Guidance for Bioretention Systems / Tree Filters Regular Inspection and Maintenance Guidance for Porous Pavements Accelerating Cost-Effective Green Stormwater Infrastructure: Learning from Local Implementation NJDEP Stormwater Management Maintenance Guidance

Actions		Methods	Resources
		corrective maintenance procedures and system improvement measures outlined in the O&M program. The O&M manual also identifies operational protocols for routine and emergency conditions that address energy and materials conservation, employee and public safety, and continued operations. ☐ The O&M program includes key performance indicators and discusses how implementation will be monitored, and performance indicators will be tracked. ☐ The O&M program provides a framework for collecting information that can subsequently be used to optimize operations. ☐ The O&M program is updated as new assets are placed into operation. ☐ The O&M program establishes policies to ensure proper functionality and O&M of gray and green infrastructure systems on private property (see 2.1, 4.2, 4.4).	
1.3	The municipality/utility has adopted a *system-wide* **asset management** plan for green and gray stormwater and sewer infrastructure.	☐ The asset management plan includes an inventory of system assets (see 1.1), each asset's condition and criticality to the overall system. ☐ The asset management plan outlines a formal condition assessment process that performs periodic condition assessments based on asset criticality, likelihood of failure, and consequences of failure for each system asset, at minimum inspecting 10-15% the collection system annually, to determine the location and extent of problem areas and prioritizes preventive maintenance and capital investments. ☐ The asset management plan identifies structural deficiencies, and recommends a system renewal and replacement planning program of prioritized short-term and long-term actions to address them. ☐ The asset management plan defines performance indicators, and discusses how implementation will be monitored and performance indicators will be tracked. ☐ The asset management plan outlines an implementation agenda with funding, responsible parties, and timeframes for phased implementation. ☐ The asset management plan evaluates staffing needs, training requirements, and succession planning (see 6.1).	NJDEP Asset Management Guidance and Best Practices EPA Field Demonstration of Condition Assessment Technologies for Wastewater Collection Systems 2015 Bellevue, WA Storm and Surface Water System Plan, Chapter 8: Asset Management 2013_EPSD_City of Grand Rapids Stormwater Asset Management Plan WERF: What Level of Asset Management?
1.4	The asset management plan identifies a *system-wide* **optimization strategy** of green and gray stormwater and sewer infrastructure.	☐ For wastewater systems that include CSOs or SSOs, a thorough characterization of the existing sewer collection and treatment systems is performed to obtain a comprehensive understanding of existing system limitations and causes of CSOs and SSOs, inflow and infiltration and cross-connections in its sewer system. This includes the development of a list of the most to least critical system needs in order to prioritize the action plan for improvements and updates.	Optimization Modeling for Sewer Network Management Water Effective Utility Management (EUM) Resources SUSTAIN Applications for

Actions		Methods	Resources
		☐ The system-wide optimization strategy assesses the system's water balance, water footprint and carbon footprint (see 2.7, 3.1). ☐ The system-wide optimization strategy identifies opportunities for modifying existing system assets to gain efficiency, maximize flood mitigation and pollution reduction, minimize net water and energy demands, and recommends a program of prioritized short-term and long-term actions to achieve them (see 2.3, 2.7). ☐ For wastewater systems, a system evaluation has been conducted to identify hydraulic restriction(s) that could be removed to reduce sewer backup and overflow events, as applicable (CSOs or SSOs). ☐ For stormwater systems, a hydrologic and hydraulic analysis has been conducted to identify system capacity or flow restriction(s), and the recommendations of the plans above (see 1.2, 1.3) are modeled in relation to impacts on flows in rivers and tributary streams. ☐ The optimization strategy clearly identifies roles for responsible parties, including public entities and private developers. ☐ The optimization strategy includes performance indicators and discusses how implementation will be monitored, and performance indicators will be tracked.	Mapping and Modeling Green Stormwater Infrastructure Water Footprint Network Water Footprint: A New Concept for Sustainable Water Utilities United Utilities: Water and Carbon Footprint
1.5	The municipality/utility regularly **projects demands** for future sewer and stormwater service, potential growth and future demand risks; and has adopted a **system evaluation** and **capacity evaluation analysis** to address these needs, if applicable.	☐ A process to regularly assess the current and future capacity requirements for infrastructure systems has been established. ☐ A system evaluation has been completed to determine current and future capacity needs and risks (e.g., structural, systemic, revenue, natural hazard, altered demand projections) for infrastructure systems. ☐ The system evaluation aggregates baseline data required to estimate future demand and system capacity requirements, including demographic forecasts, projected changes in per capita residential water demand, land use plans, redevelopment plans, and major site plans or developments; and projects future system demand estimates at several intervals through 2040 (2050 if demographic forecasts are available). ☐ The system evaluation evaluates potential impacts from climate change and watershed development, such as, sea level rise, increased precipitation or storm severity, power loss, and an expanding floodplain, and the potential for sudden loss of system capacity due to component failure. ☐ The Capacity Management Plan addresses flows and potential impacts on downstream communities.	Planning Guidelines for Water Supply and Sewerage OC LAFCO Sewer and Water Infrastructure Report Water Infrastructure in New Jersey's CSO Cities: Elevating the Importance of Upgrading New Jersey's Urban Water Systems Ripple Effects: The State of Water Infrastructure in New Jersey Cities & Why it Matters Waste Less, Pollute Less: Using Urban Water Conservation to Advance Clean Water Act Compliance

Actions		Methods	Resources
		☐ The system evaluation analyzes the potential impacts of projected demand on system capacity, resilience, revenues and capital needs. ☐ A capacity management plan has been developed that prioritizes short and long term capital improvements required to address capacity needs through 2040 (2050, if feasible). ☐ The capacity management plan accounts for increases in demand, ensuring that adequate capacity exists in all portions of the collection system, the system can handle peak flows, and downstream areas that will receive stormwater or wastewater from new connections can handle the additional flow. The plan also accounts for offsetting decreases in demand, resulting from standards and incentives driving the use of more water-efficient fixtures and appliances and other water conservation practices. ☐ The capacity management plan outlines an implementation agenda with funding, responsible parties, and timeframes for phased implementation. ☐ The capacity management plan includes performance indicators and discusses how implementation will be monitored, and performance indicators will be tracked. ☐ A routine system evaluation and capacity assessment process has been established to re-evaluate capacity needs and risks for infrastructure systems every two years, and update the capacity management plan accordingly.	
1.6	The municipality/utility has adopted a *system-wide* **hazard mitigation resiliency, and response plan** for green and gray stormwater and sewer infrastructure.	☐ The hazard mitigation, resiliency and response plan has been adopted that assesses the risk to infrastructure systems by determining the exposure and vulnerability of system assets to all future hazards, as applicable. ☐ The risk assessment defines hazards consistently with adopted multi-jurisdictional hazard mitigation plans or local resiliency efforts, as applicable; all relevant plans are cross-referenced. ☐ The risk assessment evaluates system-wide risk at five-year intervals for a specified timeframe such as 35 years, considering potential impacts from climate change, including coastal flooding, increased precipitation or storm severity, wind, and heat. Where capital projects or assets have a lifetime exceeding the chosen timeframe a longer planning horizon should be used for those system components as feasible (i.e., 50 year climate projections). ☐ The hazard mitigation, resiliency and response plan prioritizes short and long term capital improvements required to mitigate risk to critical infrastructure assets and system-wide through at least 2050 in the most cost-effective manner based on lifecycle costs and key performance indicators.	NYC Wastewater Resiliency Plan NJDEP Auxiliary Power Guidance and Best Practices U.S. EPA Climate Resilience Evaluation & Awareness Tool (CREAT) NJDEP Emergency Response Preparedness /Planning Guidance and Best Practices Baltimore Office of Sustainability: The Disaster Preparedness and Planning Project

Actions		Methods	Resources
		☐ The plan outlines equipment to handle emergencies, stand-by power, and spare/replacement parts intended to minimize interruptions in service, including power outages. ☐ The hazard mitigation, resiliency and response plan outlines an implementation agenda with funding, responsible parties, and timeframes for phased implementation. ☐ An appendix outlines how the most critical spare parts are either kept in inventory or have a clear and quick path to procurement. ☐ The plan includes an overflow emergency response plan as an appendix, which outlines notification procedures, response, reporting and impact mitigation. ☐ The hazard mitigation, resiliency and response plan includes performance indicators and discusses how implementation will be monitored, and performance indicators will be tracked.	
1.7	The municipality/utility regularly adopts a **capital improvement plan** (CIP) and **budget** that integrate and budget for all relevant capital project recommendations for green and gray stormwater and sewer systems.	☐ The CIP integrates all recommended green and gray sewer and stormwater infrastructure projects, capital investments, operations, budgets, and cost-benefit analyses included in the O&M program (see 1.2), asset management plan and optimization strategy (see 1.3, 1.4), system evaluation and capacity management plan (see 1.5), hazard mitigation resiliency, and response plan (see 1.6), integrated plan (see strategy 3), green infrastructure plan (strategy 4), and CSO long term control plan, if applicable. ☐ For municipalities, the CIP refers to the CIP for the municipality as a whole, such that green and gray sewer and stormwater improvements are incorporated into other municipal projects, routinely and cost-effectively. ☐ The CIP outlines the ongoing funding for all rehabilitation or replacement of infrastructure systems, and upgrading of systems to meet regulatory requirements and system needs. ☐ The CIP describes and budgets for capital improvements anticipated in the next 1-5 years, 5-10 years, and 10-20 years. ☐ The CIP identifies other funding sources to be leveraged for implementation (see 6.3). ☐ Costs in the CIP account for planning, design, construction, initial inspection, and operations & maintenance of new or rehabilitated facilities. ☐ The CIP is regularly updated as implementation occurs and priorities change.	Water Infrastructure that Works for Cities: Best Practices & Considerations for Preparing Long Term Control Plans to Combined Sewer Overflows

STRATEGY 2: Implementation and Optimization of Gray and Green Infrastructure Systems

Strategy 2 focuses on effective implementation of the recommendations and future system improvements detailed in the planning documents developed in Strategy 1, and to ensure reliable, efficient energy and water systems.

Through implementation of the O&M plan and establishing preventive maintenance programs, the municipality or utility ensures that its sewer and stormwater systems are working in a state of good repair. Application of asset-management planning and system-optimization strategies builds further upon proper system maintenance to improve system functionality and efficiency.

Use of a system evaluation and capacity management plan ensures that the system continues to meet present needs and has adequate capacity to accommodate future demand. Implementation of the system-wide hazard mitigation, resiliency, and response plan reduces future risk to critical infrastructure and system assets associated with hazards and climate change.

Comprehensive implementation of the capital-improvement plan, combined with the routine funding and re-evaluation of the plan and its associated budget, ensures an integrated approach to implementation of all plans and recommended projects in Strategy 1.

Beyond implementation of the plans in Strategy 1, Strategy 2 also seeks to employ redundant energy systems, and/or renewable energy measures, to maximize energy and water conservation while providing standby power for critical operations during severe weather events.

Actions		*Methods*	*Resources*
2.1	The municipality/utility ensures that its sewer and stormwater systems are in a *state of good repair* by implementing its comprehensive **O&M program**(s) for gray and green infrastructure, and has established preventive maintenance programs to enhance the O&M of these systems (see 1.2).	☐ Per the O&M program, the following high priority and cost effective preventive maintenance activities are conducted regularly, in accordance with the manufacturer's recommendations, as applicable: – Scheduled cleaning of collection system infrastructure including (catch basins) with a higher frequency in those areas with a history of collection system blockages – Root control in areas that are known to suffer damage due to root intrusion – Investigation and resolution of sewer back-ups in residences and businesses, collection system overflows due to blockages, and odor complaints from customers – Routine testing, exercising and maintenance of pumps, emergency generators, air release and vacuum valves, regulators and other equipment with moving parts – Routine inspection and maintenance of all green infrastructure assets and systems, in coordination with other agencies or private property owners as applicable (see 4.2) – Odor control including the maintenance of chemical injection systems, carbon filters, etc. – Digital tracking systems for maintenance activity records to support appropriate analysis and reporting – GIS based data management systems to gather information on blockages, operational problems ☐ Information gathered in maintenance tracking and data management systems is reviewed regularly by system managers for re-evaluation of prioritization. ☐ Implementation is actively monitored and performance indicators are routinely tracked and met per the O&M program, as applicable: – Positive ratio of scheduled collection system cleaning to unplanned collection system cleaning	NJDEP Stormwater Management Maintenance Guidance U.S. EPA Stormwater O&M Fact Sheet Preventive Maintenance

Actions		Methods	Resources
		– Percentage reduction in sewer back-ups in residences and businesses, collection system overflows due to blockages, and odor complaints from customers – Response time to address maintenance requests ☐ No backlog of repair, rehabilitation, and replacement projects; or significant reduction in backlog toward a five-year goal of no backlog (from the date of the initial O&M program). ☐ Per the O&M program, compliance with policies to ensure proper O&M of gray and green infrastructure systems on private property is enforced (see 1.2, 4.2, 4.4).	
2.2	The municipality/utility ensures that its sewer and stormwater systems are *functioning properly* by implementing its system-wide **asset management plan**(s) for gray and green infrastructure (see 1.3).	☐ Per the asset management plan, high priority and cost effective measures to understand system performance, improve and maintain system function are implemented, as applicable: – Routine inspections and condition assessments of all assets with a process to address defects, damage, or other identified problems – Routine flow monitoring for capacity analysis – Smoke testing, dye testing, and exfiltration testing to monitor/reduce inflow and infiltration (I/I) – Uniform condition assessment based on inspection data – Maintenance of records to support appropriate analysis and reporting – Rehabilitation actions to address each deficiency – FOG Control Program addresses blockage "hot spots" through more frequent cleaning, targeted outreach, and additional regulation of FOG dischargers ☐ Implementation is actively monitored and performance indicators are routinely tracked and met per the asset management plan, as applicable: – Reduction in localized flood events ▪ *For a CSO municipality/utility, reduction in number of overflow events (volume, frequency, and duration)* – Avoided emergency repair costs – Avoided costs of extended service disruptions due to a catastrophic failure – Avoided business losses, neighborhood disruption and restoration costs due to environmental and property damage from a catastrophic failure, sewer backups, etc. – Avoided public health costs (i.e. injury, death, disease transmission) from catastrophic failure, sewer backups, etc. – Improved planning and prioritization of rehabilitation and replacement projects due to condition assessment information and improved estimates of service life – Avoided costs of premature replacement or rehabilitation of pipes, pumps and other system components	NYC State of the Sewers Report NEIWPCC Optimizing Operation, Maintenance, and Rehabilitation of Sanitary Sewer Collection Systems NJDEP Stormwater Management Maintenance Guidance NJDEP Stormwater Management Measures Maintenance Plan & Field Manuals NJDEP Stormwater Management Stormwater Training WERF Seattle Public Utilities Risk-Based Asset Management Case Study

Actions		Methods	Resources
2.3	The municipality/utility improves the efficiency of its sewer and stormwater systems by implementing its system-wide **optimization strategy(ies)** for gray and green infrastructure (see 1.4).	☐ Per the optimization strategy, high priority and cost effective measures to optimize system efficiency are implemented, as applicable: – Removing extraneous flows through effective inflow and infiltration (I&I) controls such as pipe lining, pipe repairs, pipe replacement, watertight manhole covers, manhole lining, tide gate repair/replacement, and identification and elimination of cross connections between storm and sanitary sewers ▪ *For a CSO municipality/utility, identify the I&I reductions with the biggest impact on CSO flow reductions at the lowest cost, such as I&I reductions in upstream communities to increase treatment capacity for CSO flows* – Reducing flow volumes in combined sewer systems through water conservation programs, as applicable – Eliminating illegal discharges to sewers and stormwater systems (e.g. sump pump connections to collection systems), which identifies illegal or unapproved system connections, notifies property owners with illegal connections, requires, requests or provides a financial incentive for the correction, and establishes and employs protocols and legal mechanisms for enforcement – Industrial pretreatment program to control metals and toxic parameters that may upset treatment plant and/or reduce viability of beneficial reuse of biosolids – Controlling FOG from restaurants and hotels – Reducing energy demand of stormwater and wastewater processes through energy conservation and efficiency measures ☐ Implementation is actively monitored and performance indicators are routinely tracked and met per the optimization strategy, using annual, seasonal and trend data as appropriate. – Percentage reduction in energy demand or utility costs – Percentage reduction in the number or volume of overflow events, as applicable, (CSO and SSO), distinguishing between dry weather overflows and wet weather overflows – Percentage reduction in pollutants released – Percentage reduction in the number or volume of localized flooding events – Reduction in impacts to beach closures and shellfishing	NJDEP New Jersey Stormwater Best Management Practices Manual U.S. EPA, Optimal Stormwater Management, Plan Alternatives: A Demonstration Project in Three Upper Charles River Communities
2.4	The municipality/utility *ensures adequate capacity* for future demand and accounts for future demand risks by implementing its **system evaluation and capacity management plan**, if applicable (see 1.5).	☐ Per the capacity management plan, high priority and cost effective measures to ensure sufficient system capacity are implemented, as applicable: – Capacity is available for additional flows due to development, redevelopment and population increases in developed areas ☐ Implementation is actively monitored and performance indicators are routinely tracked and met per the system evaluation and capacity management plan.	U.S. EPA, Guide for Evaluating Capacity, Management, Operation, and Maintenance Programs at Sanitary Sewer Collection Systems

Actions		*Methods*	*Resources*
2.5	The municipality/utility *reduces system vulnerability* and *mitigates the risk to critical infrastructure* associated with hazards and climate change by implementing its system-wide **hazard mitigation, resiliency, and response plan** (see 1.6).	☐ Per the hazard mitigation, resiliency and response plan, high priority and cost effective measures to reduce system vulnerability and mitigate risk to critical infrastructure are implemented, as applicable: – Municipality/utility has auxiliary power equipment to ensure continued, effective operation of systems to maintain service for the duration of any power outage – Contingency equipment (e.g. portable pumps, generators) is available to support an effective response to emergency conditions – Spare/replacement parts are kept in inventory to minimize equipment/facility interruption in the event of an unplanned failure – System assets are protected from submersion during flood events – Utility personnel have safe operating conditions during natural hazard events ☐ Implementation is actively monitored and performance indicators are routinely tracked and met per the hazard mitigation, resiliency, and response plan, as applicable. – Average time to respond to an overflow event – Days or hours per year of (partial or entire) system outages	U.S. EPA Climate Ready Water Utilities Program NJDEP Auxiliary Power Guidance and Best Practices
2.6	The municipality/utility routinely funds its *capital improvement budget* to implement gray and green infrastructure improvements in its **capital improvement plan** (see 1.7) and also its **integrated plan**, if applicable (see 3.6).	☐ A capital improvement budget is adopted annually to provide appropriate funding to address the priority needs for each year. ☐ The capital improvement budget demonstrates that the resources provided will be adequate for an acceptable delivery of services to the public, including capital replacement. ☐ A public summary of the CIP is routinely updated and provided through the municipality/utility website. ☐ A public CIP inventory is developed which characterizes projects in the CIP, and is linked to the public and secure GIS map and inventory of system assets (see 1.1). ☐ The secure CIP GIS map and inventory provides a unique identifier, location description, project status, project funding, responsible parties, and timeframe for implementation for every mapped feature (see 1.1). ☐ The condition and criticality of system assets are updated in the secure GIS Map and Inventory following implementation of CIP projects. ☐ Implementation is actively monitored and performance indicators are routinely tracked and met per the Integrated Plan, if applicable. ☐ Procurement issued for projects under the CIP places emphasis on the selection of professionals that will develop innovative approaches for providing an effective CSO elimination program that minimizes costs to local government, wastewater utilities and ratepayers while achieving the best solutions for each community that also achieve water quality improvements.	City of San Jose Sewer System Management Plan City of Richmond Sewer Management Plan City and County of San Francisco 2030 Sewer System Management Plan Model RFP for New Jersey Combined Sewer Overflow Long Term Control Plans

Actions		*Methods*	*Resources*
2.7	The municipality/utility has implemented conservation measures, redundant energy systems, and/or renewable energy measures, if applicable, to **minimize net water and energy demands**.	☐ Water conservation and internal reuse programs are implemented at treatment plant(s) and other system assets (see 1.4). ☐ Energy conservation measures are implemented at treatment plant(s), pumping stations and other system assets (see 1.4), such as: – Biogas conversion to electricity via anaerobic digestion – Energy efficient HVAC systems at treatment plants and large scale pump stations. – Usage of energy efficient motors, such as variable frequency drives on pumps and blowers – Usage of energy efficient lighting fixtures, windows, doors, and insulation – Participation in utility load shedding and/or smart grid programs, – Installation of alternative energy solar panels or wind turbines – Bioenergy or use of plasma gasification – Usage of sewer lines as heat exchangers ☐ Stand by power is available for critical operations to prevent service disruption during hazard events. ☐ System assets are energy efficient. ☐ System energy assets are protected from severe weather events. ☐ Additional measures are undertaken, as applicable, to minimize the system's water footprint and carbon footprint (see 1.4, 3.1). ☐ Performance indicators are routinely tracked and met, such as: – Energy usage (gas and electric) per MGD rates equivalent to benchmark utilities. – Response times for power outages. – Disruption of service due to power outages.	Village of Ridgewood Wastewater Treatment Plant Atlantic County UA Bioenergy Project U.S. EPA Energy Efficiency in Water and Wastewater Facilities NRDC Water Efficiency Saves Energy ACEEE Water Services

STRATEGY 3: Integrated Water Management

Strategy 3 aims to integrate water management across systems, as well as with ongoing community efforts, planning and capital projects; leveraging these investments as opportunities to implement effective water management strategies.

This strategy focuses on achieving collaboration on water management issues, as well as incorporating water management solutions with projects that have quality of life and other municipal or community objectives.

To do so, this strategy provides methods for a municipality to comprehensively assess its needs, opportunities and constraints for integration of water management. The assessment identifies local issues and sensitive environments that would benefit from effective water management (e.g., areas of localized flooding or impaired water bodies) and overlays them with local opportunities for non-standard sewer and stormwater management projects to meet these needs (e.g., opportunities to install green infrastructure on public property), as well as constraints to project implementation (e.g., geology or land-use context). This action provides baseline mapping intended to inform other actions within Strategy 3.

It also provides actions and methods to meet some of the needs that are likely to be identified through the assessment (e.g., reducing flows into combined sewer systems), which could be achieved by developing a water conservation program, collaborating regionally for upstream reduction of inflows, or developing design standards and construction specifications that exceed existing regulatory requirements.

Ultimately, the purpose of this strategy is to consider and manage water as a complete system, from source to user to wastewater to returned resource, so that management of each component achieves a high level of practical utility, environmental protection, energy efficiency and social benefit, at a minimum lifecycle cost.

Actions		*Methods*	*Resources*
3.1	The municipality has conducted an **assessment of needs, opportunities and constraints** for integrated water management.	☐ Local needs for integrated water management are identified and mapped, including: – Impaired water bodies (parameters, impacts) – Areas of localized flooding (“hot spots”) that require mitigation – Areas of basement flooding – Areas or populations that experience public health impacts from localized flooding – Areas of repetitive flood losses that require mitigation or structure removal – Historic stream systems that have been channelized or diverted to storm sewers – Areas with inadequate flow capacity for water or sewage – Quality of life concerns related to water management issues – Beach closures, fish/shellfish consumption bans and other losses of recreational opportunities – Physical degradation of stream channel integrity due to high stormwater volumes and velocities – Air quality and air pollution reduction – Urban heat island effect ☐ Local opportunities for integrated water management are identified and mapped, including: – Community facilities, parks, natural resources, public rights-of-way, fishing access and public property where potential projects could occur – Hydraulic connectivity of these locations to areas of localized flooding or water pollutant sources, and existing infrastructure	New York Rising Community Reconstruction Plans New Jersey State Development and Redevelopment Plan: Infrastructure Needs Assessment City of South Heart Municipal Infrastructure Needs Assessment New Jersey Hydrology Primer New Jersey Web Soil Survey NJDEP Sample Municipal Stormwater

Actions		Methods	Resources
		– Stream restoration through riparian restoration or stream "daylighting" – Related municipal objectives ☐ Constraints for integrated water management are identified and mapped, including: – Subsurface geology, such as soil permeability and composition, depth to bedrock and groundwater, and slopes – Land use context – Impervious surfaces and topography – Bridge and culvert structures – Encroachment into floodplains, open channels, and lack of preserved riparian corridors ☐ All mapped features above are added to both the public and secure GIS map and inventory. ☐ The public GIS map and inventory with these features is provided through an open source web platform such as ArcGIS.com. ☐ The municipality's goals for water quality are identified and understood. ☐ The sewer system planning process actively involves the public and considers the impacts of the sewer system upon water quality and waterbody goals and objectives. ☐ Water supply and/or wastewater systems are evaluated to identify valuable and viable opportunities to reduce overall water, carbon and energy footprints (see 1.4, 2.7), as a means of reducing stress on natural resources, creating cost savings, and providing community benefits (e.g. the ability to operate during power outages), such as the following: – Energy conservation, wastewater to energy systems, renewable energy options, etc. – Internal and external beneficial water reuse systems and other approaches to reduce water demands associated with the utilities, reduce the need for treatment plant capacity expansions, augment water supplies or restore freshwater resources – Resource extraction (e.g., nutrients, minerals, saleable by-products) from effluent and sludge associated with water supply and wastewater treatment facilities – Reduced wastewater production from water supply treatment facilities (e.g., backwash water)	Management Plan NJ Final 2012 303 (d) List of Water Quality Limited Waters NJ Stormwater Guidance for the Development of Municipal Mitigation Plans USEPA Water: Sustainable Infrastructure: Determining Energy Usage Water Research Foundation, Toolbox for Water Utility Energy and Greenhouse Gas Emission Management Water Research Foundation, Water Footprinting in the Urban Water Sector: Executive Summary
3.2	The municipality/utility adopts and implements an effective **water conservation program**.	☐ Water conservation goals and objectives are established to reduce net costs for both water supply and sewer system management, and to reduce stresses on water supply sources. ☐ The water conservation program includes a water conservation ordinance that requires new development, rehabilitation and retrofit projects to employ low-flow fixtures consistent with the U.S. EPA WaterSmart certified water saving fixtures, as applicable. ☐ The water conservation program includes retrofits of public facilities with U.S. EPA WaterSmart certified water saving fixtures, as applicable.	Water Conservation Leadership Guide: Issues for Local Officials to Consider Saving Water Partnership Rebates Delaware River Basin Commission

Actions		Methods	Resources
		☐ The water conservation program employs effective alerts, "give aways," rebates or other incentives such as: – Drinking water conservation rate structure with inclining block rates (i.e., escalates charges after minimum amounts for necessary uses) – Sewer rates are volumetric (i.e., with metered drinking water usage as surrogate for wastewater usage), and are based on a rate structure that encourages conservation – Upgraded water meters that assess data daily for leak identification – Monthly drinking water and wastewater billing (rather than yearly or quarterly) to provide for more accurate usage charges and greater knowledge by users to reinforce price signals for water – Monthly customer notifications for major increases in water consumption, indicating leaks or excessive use, with requirements for leak repair for customer laterals – Real-time customer notifications through social media or email for increases in water consumption beyond the hourly average – Soil moisture or precipitation-based control devices for lawn irrigation systems – Cash rebates, utility bill credits, or subsidized costs to purchase and install U.S. EPA Water Smart certified water saving fixtures -per individual fixture, household, business etc. (i.e., $50 off a low-flow toilet, 50% of the installed cost of a low-flow sprinkler system) Technical assistance to install U.S. EPA Water Smart certified water saving fixtures – Providing rain barrels for rainwater harvesting ☐ The water conservation program includes policies and/or programs to promote harvesting of stormwater to use for non-potable purposes (e.g., landscape irrigation) in place of municipal drinking water. ☐ Implementation is actively monitored and performance indicators for water conservation are routinely tracked and met: – Reductions in residential and commercial water consumption toward levels equivalent to utility benchmarks within a five year period from initial implementation – Reduction in residential and commercial ratio of growing season to non-growing season water consumption toward levels equivalent to benchmark systems within a five year period from initial implementation – Annual water loss audits of the drinking water system are conducted using AWWA's "M-36" methodology, in order to reduce water needs and identify cost-effective opportunities to reduce leakage from drinking water delivery pipes (as undetected subsurface leakage from aging pipes can contribute to infiltration into wastewater collection systems).	Water System Audits and Water Loss Control
3.3	The municipality/utility **collaborates regionally on water**	☐ Stormwater and sewer flows are effectively addressed through cooperation and regional coordination between utilities and their hydraulically connected municipalities.	The Prairie Crossing Project

Actions		Methods	Resources
	management issues and projects with other municipalities or utilities in shared sewersheds or watersheds, if applicable.	▪ *For a CSO municipality/utility, cooperate in the development and implementation of a regional long term control plan* ▪ *For a CSO municipality/utility, identify ways to maximize utilizing the existing sewage treatment plant capacity, which might include I&I reductions in upstream municipalities* ☐ A regional framework for managing wastewater or stormwater has been established among hydraulically connected communities, such as a task force, board, network, or other coordination platform that: – Outlines opportunities and protocols for regular coordination and communication – Has common goals and objectives for flood mitigation and water quality in shared watershed – Prioritizes collective short-term and long-term regional actions to address shared water management issues – Outlines an implementation agenda with funding, responsible parties, and timeframes for phased implementation ☐ Cooperate on a regional basis to identify cost-effective shared services, such as: – Stormwater and Sewer collection system inspection – Water Sampling and Monitoring	Chesapeake Stormwater Network San Francisco Bay Region Water Quality Control Board North Central Texas Regional Stormwater Management Program Monterey Bay Stormwater & Education Alliance Seattle Saving Water Partnership Philadelphia Water Department: Your Watershed
3.4	The municipality **integrates water management** issues and projects with quality of life **and other community objectives**.	☐ The municipality incorporates green and gray infrastructure improvements into other municipal projects, routinely and cost-effectively. ☐ Water management issues are addressed in efforts, programs, and actions with other related community objectives to address quality of life issues, such as: – Public health – Equity – Environmental justice – Neighborhood character and aesthetics – Open space, parks and recreation – Parking and transportation – Land use planning and urban design – Waterfront spaces ☐ Stakeholder groups are identified that address other related community objectives. ☐ Opportunities for collaboration among other related community objectives are identified and	The City Project Ironbound Community Corporation WERF: Institutional Innovation for Integrated 'One' Water Management-

Actions		Methods	Resources
		implemented, as applicable, such as: – Groundwater recharge and water balance – Water conservation – Energy conservation and renewable energy production – Reduction in greenhouse gas emissions and carbon footprint ☐ The implementation agenda for the regional framework is incorporated into applicable municipal and utility plans and budgets, as applicable.	
3.5	The municipality/utility has adopted **design and construction standards and specifications** for public and private water infrastructure.	☐ Design standards are adopted for the installation of new sewer systems or rehabilitation and repair of existing sewer systems that meet and exceed the 10 State Standards for wastewater, to the extent feasible within the requirements of the Residential Site Improvement Standards (RSIS, N.J.A.C. 5:21). ☐ Design standards are adopted for the installation of new stormwater infrastructure or rehabilitation and repair of existing systems that meet and exceed criteria set in the New Jersey Stormwater Best Management Practices Manual, such as design standards for low impact development and green infrastructure measures (see 4.4). ☐ Design standards encourage and facilitate the use of green infrastructure for stormwater management whenever feasible (see 4.4). ☐ Design criteria include specifications such as pipe materials, minimum diameter, design capacity, minimum cover, strength, minimum slope, trench and backfill, structure standards, treatment of water quality volume, and minimum groundwater recharge. ☐ Design standards include procedures and requirements for inspecting and quality control and quality assurance testing the installation of new infrastructure. ☐ Design standards are ecologically sensitive, maximizing the habitat, water, and air quality benefits of new infrastructure.	New Jersey Stormwater Best Management Practices Manual U.S. EPA Green Infrastructure Design and Implementation Resources Stormwater Manufactured Treatment Devices Low Impact Development Standards for Puget Sound Washington, D.C. DDOT Green Infrastructure Standards Sacramento County Stormwater Design Standards Washington Water Crossings Design Guidelines

Actions		*Methods*	*Resources*
3.6	The municipality has developed an **integrated plan** for combined sewer infrastructure to prioritize water quality improvements, if applicable. (See also 3.7)	☐ The integrated plan has been approved by the NJDEP (and, as applicable, U.S. EPA). ☐ The municipality uses the integrated plan to prioritize regulatory compliance efforts in a manner that prioritizes infrastructure improvements that provide high environmental and public health benefits and clean water at a low cost (i.e., "bang for the buck"). ☐ The municipality uses the integrated plan to maximize the effectiveness of infrastructure dollars through a comprehensive approach that employs innovative technologies, an analysis of alternatives and the selection and sequencing of actions. ☐ The integrated plan includes performance indicators or benchmarks, discusses how implementation will be monitored, performance indicators will be tracked, and adaptive management will be employed throughout implementation.	U.S. EPA Integrated Municipal Stormwater and Wastewater Plans

STRATEGY 4: Green Infrastructure

Strategy 4 aims to leverage the added benefits of green infrastructure in conjunction with gray-infrastructure investments, making green infrastructure a driving force in water management for stormwater and combined sewer systems.

While Strategy 3 seeks to develop a general needs, opportunities and constraints assessment that can integrate water management into community goals, Strategy 4 seeks to develop a strategic plan specifically targeted at green-infrastructure investments, and integrate green infrastructure into other plans and capital projects (e.g., roadways, sidewalks, parks) across municipal departments and agencies.

To facilitate broad adoption of green infrastructure, actions and methods are provided for building public understanding of green-infrastructure implementation, developing a green jobs and job training program for green-infrastructure installation and maintenance, and encouraging property owners or developers to manage stormwater on-site through green infrastructure.

Similar to the plans in Strategy 1, ideally the green-infrastructure strategic plan would be updated regularly, and include an implementation agenda with an annual budget, funding, assignment of responsible parties, performance measures, and both short- and long-term outlook.

Actions		*Methods*	*Resources*
4.1	The municipality has adopted a community-driven **strategic plan for green infrastructure** implementation.	☐ The strategic plan for green infrastructure identifies goals and objectives related to flooding, MS4 pollution, combined sewer overflows (if applicable), and community objectives developed through a process of public outreach and stakeholder engagement. ☐ Hydrologic and hydraulic modeling have been utilized to assess the runoff volume and water quality benefits of implementing green infrastructure, inform site selection and evaluate locations to identify optimal sites for green infrastructure interventions, as well as establish performance metrics (recognizing that site-specific engineering feasibility analysis and design would be required for each project). ☐ The strategic plan for green infrastructure identifies green infrastructure siting opportunities and constraints, based on factors such as parcel ownership (including public property such as parks, buildings, parking areas, roads, and vacant lots; as well as private property), slope, parcel size, soil type, groundwater contamination, land use and community input. Evaluation of constraints should incorporate a combination of available data with selective field evaluations, especially for major sites. ☐ The strategic plan for green infrastructure identifies the green infrastructure measures that provide high obtainable benefits at low lifecycle costs at various scales, for specific project sites, areas, watersheds or sewersheds. Benefits and costs are assessed in a manner that addresses financial and non-financial issues. ☐ The strategic plan for green infrastructure identifies the potential for reduction of CSOs and MS4 pollution by sewershed utilizing the optimum green infrastructure measures. ☐ The strategic plan for green infrastructure prioritizes the optimum short and long term green infrastructure projects that achieve program objectives. ☐ The strategic plan for green infrastructure outlines an Implementation agenda with incentives, funding or financing mechanisms, responsible parties, and timeframes for phased implementation.	New York City Green Infrastructure Plan MMSD Fresh Coast Green Solutions Plan Hoboken Green Infrastructure Strategic Plan Vermont Green Infrastructure Strategic Plan Lancaster Green Infrastructure Plan

Actions		Methods	Resources
		☐ The strategic plan for green infrastructure includes performance benchmarks for stormwater capture and/or impervious acres retrofitted, flow modifications, pollution reduction and neighborhood benefits; and discusses how implementation will be monitored. ☐ Per the strategic plan for green infrastructure, high priority and cost effective measures to optimize system efficiency are implemented, as applicable, and performance benchmarks are met. ☐ The Green Infrastructure Strategic Plan identifies maintenance requirements including frequency and responsible parties (see 1.2, 2.1, 4.4).	
4.2	The municipality **integrates green infrastructure into other** plans **and capital projects** across municipal departments and agencies.	☐ Green infrastructure has been integrated into ongoing and proposed master plans and redevelopment plans, land use and development ordinances (see 4.4), public development projects, resurfacing programs and inter-agency capital improvement programs. ☐ Projects use good models and data sources to determine the optimum green infrastructure measures to address areas of public concern. ☐ Cooperative funding arrangements have been established with other departments and agencies for budget efficiencies and cost savings. For example, municipal capital projects leverage green infrastructure with conventional infrastructure investments by integrating the optimum green infrastructure measures into new, rehabilitated or retrofitted community facilities such as: – Green streets, roadways and highways – Streetscape and parking facilities – Parks and other dedicated open space – Public buildings, facilities and schools – Vacant lots ☐ O&M of green infrastructure systems is coordinated across agencies, with defined responsibilities for maintenance of each capital project that incorporates green infrastructure (see 2.1).	Case Studies in Integrated Water Resource Management Urban BMP Database
4.3	The municipality has an **effective program for building public understanding of green infrastructure** benefits and support for green infrastructure implementation (see 5.3).	☐ The municipal education program builds public understanding of green infrastructure benefits through a website, print and social media presence, public education and student education. ☐ The municipal education program includes targeted outreach to the private development and real estate community. ☐ The municipal education program builds public understanding of the types of green infrastructure measures through publicly visible Demonstration Projects that are selected, sited, and installed in partnership with community organizations and their members and contain educational signage. ☐ The municipal education program builds public understanding of the water quality and retention benefits of green infrastructure measures through monitoring mechanisms of Demonstration Projects	Fresh Coast 740 Milwaukee Green Infrastructure Philadelphia Green City, Clean Waters

Actions		Methods	Resources
		to evaluate performance over a 5-year period. ☐ The municipal education program builds public understanding of green infrastructure maintenance practices and the need for routine maintenance by regularly maintaining Demonstration Projects (i.e., weeding, trash removal, and excess sediment removal). ☐ The municipal education program builds understanding of the multiple benefits of green infrastructure that accrue to the public and to private property owners.	
4.4	Property owners and developers are **required and/or encouraged to manage stormwater on-site** and employ green infrastructure.	☐ A campaign for green infrastructure builds public understanding of residential and commercial site-level green infrastructure measures, and their benefits to property owners, including practices such as: – Minimizing impervious surfaces, clustering, and low-impact development – Planted "islands" in parking lots and around the perimeter of parking lots; and reductions in on-site parking requirements – Downspout disconnections – Rain gardens – Green roofs – Permeable pavement – Tree planting – Bioswales ☐ The municipality has adopted stormwater management regulations that encourage (or require) green infrastructure on private property but do not conflict with state, city, or local stormwater regulations. These include, as applicable (see 3.5): – A stormwater ordinance that applies to redevelopment or new development projects that exceed 5,000 square feet of impervious surface or land disturbance, while ensuring that the ordinance and other local codes do not restrict the use of GI (e.g. EPA's Water Quality Scorecard can assist municipal agencies in evaluating local regulations) – A stormwater management ordinance that establishes an on-site stormwater retention standard requiring a Surface Water Quality Design Volume (SWQDv) equal to the runoff from the 1.25-inch, 2-hour rainfall event for major developments. Where it is technically infeasible to retain the full SWQDv, the major development shall use bioretention with an underdrain, constructed wetlands, or other practice that relies on vegetation and soil for water quality treatment, to treat 1.5 times the volume of the SWQDv that is not retained on-site – A stormwater management ordinance that applies to establishes tiered performance requirements for different land uses or classes of development, with most stringent requirements on major (5,000 square feet and larger) land-disturbing activities – A stormwater management ordinance that allows for the use of off-site retention through in-lieu fees	Sustainable Jersey Model Stormwater Control Ordinance for Municipalities (forthcoming) Seattle RainWise Program Washington, DC Stormwater Fee RiverSmart Rewards Program Austin Case Study to Fund Stormwater Programs Santa Monica Case Study to Fund Stormwater Programs NRDC: Rooftops to Rivers Codes, Ordinances and Funding for Green Infrastructure U.S. EPA Green Parking Lot

Actions		Methods	Resources
		– A stormwater management ordinance that stipulates routine inspection and maintenance requirements, including frequency and responsible parties – A stormwater management ordinance that encourages monitoring of individual green infrastructure installations to measure performance – A master plan that recommends green infrastructure, low-impact development and preservation of open space, riparian corridors and floodplains – Incentive zoning that offers increased floor-to-area (FAR) ratios, special use permits, or area variances for construction of public green infrastructure projects – Performance zoning that offers increased floor-to-area (FAR) ratios for on-site retention through green infrastructure that exceeds the local stormwater management regulations set forth above. – Special zoning "stormwater retention districts" that stipulate geographic areas with on-site retention standards or regulations through green infrastructure that exceed the local stormwater management regulations set forth above – Stormwater fees based on area of impervious coverage on-site (potentially using tiered rate structures or average area of impervious coverage fees for residential properties) with dedicated revenues toward public green infrastructure projects ☐ The municipality provides an incentive program to encourage (or require) green infrastructure installation on private properties that includes, as applicable: – Grant awards and matching funding programs that subsidize the cost of implementing green infrastructure for private property owners – Offer percentage discounts off utility fees for volumes of stormwater treated or retained through green infrastructure – Offer credits for volumes of stormwater treated or retained through green infrastructure that can be traded in an open market to others who use them to meet regulatory requirements, with dedicated revenues toward public green infrastructure projects – Offer rebates for green infrastructure implementation, tree planting, and low-impact design improvements – Provide technical assistance in the form stormwater reduction audits to identify changes that private property owners can make to treat or retain stormwater – Site plan and subdivision review processes that offer expedited reviews for developments that exceed the local stormwater management regulations set forth above ☐ The municipality establishes policies and monitoring systems that require O&M of gray and green infrastructure systems on private property to ensure proper functionality (see 1.2, 2.1, 4.2).	Resource Guide EPA Water Quality Scorecard: Incorporating Green Infrastructure Practices at the Municipal, Neighborhood, and Site Scale The Green Edge, How Commercial Property Investment in Green Infrastructure Creates Value Getting the Green Out: Key Findings and Recommendations from NRDC Workshops on Promoting Green Stormwater Infrastructure on Commercial Property
4.5	The municipality/utility **offers green jobs and job training** to local workers for green	☐ A green jobs training program has been established in partnership with local educational institutions, community groups and/or nonprofit organizations.	Staying Green and Growing Jobs

Actions		Methods	Resources
	infrastructure installation and maintenance.	☐ The green infrastructure program employs local workers in constructing and maintaining green infrastructure projects.	
4.6	The municipality/utility employs **adaptive management** to assess green infrastructure progress.	☐ The municipality/utility conducts routine performance assessments of green infrastructure progress every five years to monitor benefits on a neighborhood, sewershed or watershed scale. ☐ In response to the findings of the performance assessment, the municipality/utility adjusts the targets, goals and objectives in its green infrastructure plan to achieve an optimal balance between green and gray infrastructure (see 4.1).	Water Infrastructure That Works for Cities Best Practices and Considerations for Preparing Long Term Control Plans to Control Combined Sewer Overflows

STRATEGY 5: Public Participation and Partnerships

Strategy 5 aims to engage the public actively in decision-making for sewer and stormwater management issues, since public participation and citizen empowerment are vital for broad adoption of strategies for effective water management.

To educate a diverse set of stakeholders effectively in sewer and stormwater management issues, the implementation of a comprehensive public-awareness campaign is the first step. One part of the campaign can be an associated action to develop a recognized local "brand" for sewer and stormwater management efforts, enabling the public easily to identify issues, projects and solutions related to water management.

The remaining actions in this strategy seek to engage stakeholders in decision-making and empower them to implement the actions included in this guide. Key to empowerment is the participatory development and implementation of a robust public-participation plan with mechanisms for stakeholder engagement in decision-making.

Actions to supplement the public-participation plan are provided, including methods to partner with existing community organizations for education, project implementation and maintenance; and to provide for meaningful ratepayer and stakeholder input and engagement in decision-making regarding sewer and stormwater management projects.

Actions		*Methods*	*Resources*
5.1	The municipality/utility has a **comprehensive public awareness campaign** for educating and empowering a diverse set of stakeholders in sewer and stormwater management issues.	☐ A public education campaign for sewer and stormwater management has been developed and is implemented with targeted measures for residential water management, addressing issues such as: – Water conservation practices (see 3.2) – Design standards (see 3.5) – Residential Green Infrastructure Measures and their benefits (see 4.3) – On-site retention of stormwater and reduction in impervious cover (see 4.4) – CSO causes and impacts on basement flooding and residential sewer backups as applicable – Water quality impacts of household items, lawn chemicals, street litter, illegal dumping, and pet waste – Control of kitchen grease and impacts of flushable wipes – Native plants ☐ A public education campaign for water management has been developed and is implemented with targeted measures for nonresidential, to encompass commercial, industrial, recreational users, water management tailored for local businesses, addressing issues such as: – Water conservation practices in landscaping, restaurant, hospitality and industrial processes (see 3.2) – Design standards (see 3.5) – Large scale Green Infrastructure Measures and their benefits (see 4.3) – On-site retention of stormwater, groundwater recharge, and reducing in impervious cover (see 4.4) – Green jobs training (see 4.5) – Programs that encourage actions by property owners, such as River Friendly Programs – CSO causes and impacts on receiving water bodies and the environment as applicable ☐ Curricula for sewer and stormwater management, focusing on water conservation and green	Rutgers Water Resources Program Pilot Water & Sewer Education Program in Newark, Sussex Avenue School Southwestern Wisconsin Watersheds Trust Sweet Water Campaign NJ Water Supply Authority River Friendly Program Stony Brook-Millstone Watershed Association River Friendly Program NJDEP CSO Community

Actions		Methods	Resources
		infrastructure, has been developed and implemented at public schools, private schools, higher education, job placement/education programs, childcare facilities, parks, etc. ☐ The municipality and health agencies are made aware (preferably through real-time monitoring and use of web based mapping systems/social media) of the locations and times of sanitary or combined sewer overflows and possible impaired water conditions (see 1.1). ☐ Materials and resources included in the public education campaign above are provided in multiple languages, as appropriate for the municipality.	Collaboration Lesson: Green Infrastructure and Low Impact Development Techniques
5.2	The municipality/utility has a **robust public participation plan for stakeholder partnership** and regularly provides for **meaningful ratepayer and stakeholder input and engagement in decision-making** regarding sewer and stormwater management projects.	☐ Stakeholders are actively engaged as partners in the development of the public participation plan that ensures they are proactively engaged in the decision-making process in a meaningful way. ☐ Stakeholders are actively engaged as partners in decision-making for water management projects and efforts, beginning early in the planning process and continuing throughout, using interactive feedback mechanisms such as: – Surveys – Social Media – Websites – Real-time customer (i.e., ratepayer) notifications – Interactive customer relations platforms for ratepayers. – Public meetings that utilize a variety of formats, including interactive design charrettes – Formal advisory committees – Ongoing engagement with community-based organizations ☐ Interviews or focus groups are regularly conducted with key stakeholders, such as the municipal council, residents, businesses, and nonprofit or community groups, including environmental commissions and Green Teams, as applicable. ☐ Stakeholders have opportunities to actively engage in the development of plans, projects and programs, through existing venues and additional means as appropriate. This includes engagement in both the setting of goals and the methods for achieving those goals. ☐ Proposed plans are explained clearly to non-technical audience and are made available online for review and comment, on a timeline that provides an opportunity for public feedback to influence final decisions (i.e., not after decisions have been made and it is too late to make substantive changes). ☐ Decision-makers are transparent in explaining, in detail, how public comments and concerns have been addressed in final decisions. ☐ The community engagement methods above are provided in multiple languages, as appropriate for the municipality.	Newark DIG Camden SMART An Agenda for Change for New Jersey's Urban Water Infrastructure Chartering New Waters: Developing an Agenda for Change for New Jersey's Urban Water Infrastructure Seattle Public Utilities Water System Advisory Committee Arnstein's Ladder of Citizen Participation Institute of Development Studies Participatory Methods

Actions		Methods	Resources
5.3	The municipality/utility **empowers community organizations** to achieve a combination of improvements to sewer and stormwater management systems and community needs through locally directed programs.	☐ Water management issues have been integrated into other related ongoing public outreach efforts and planning processes and vice versa. ☐ Partnerships have been established with stakeholder community organizations to collaborate throughout the water management project lifecycle: planning, design, construction, maintenance. ☐ Direction, guidance or training has been provided to community organizations for how to site, design, implement, and maintain green infrastructure or other water management investments. ☐ Community organizations are engaged in understanding and addressing needs, opportunities and constraints for program improvement.	Fostering Collaboration for Urban Water Infrastructure NJDEP Combined Sewer Overflow Center for Urban Pedagogy
5.4	The municipality/utility has **developed a recognized local "brand"** for sewer and stormwater management efforts.	☐ A "brand" has been developed to build public awareness around water management issues. A regional brand may be used where integrated sewer and stormwater management is being conducted at a larger scale, such as a watershed. ☐ The water management brand has been marketed through strategies such as a logo, website, and social media. ☐ A public website provides opportunities for engagement such as free mapping tools, FAQ, comment forms, mechanism for reporting issues and obtaining feedback on response (feedback from rate payers on responses to issues, or blockages, flooding, etc.), as well as educational information. ☐ The “brand” and all materials or resources are provided in multiple languages, as appropriate for the municipality.	Clean Water Baltimore Fresh Coast 740 Milwaukee Green Infrastructure

STRATEGY 6: Financial and Institutional Capacity

Strategy 6 helps ensure that sewer and stormwater utility functions are properly and efficiently funded, life-cycle costs are minimized, the triple-bottom-line approach is employed, and adequate institutional capacity is available to implement effective strategies for sewer and stormwater management. The triple bottom line considers economics, environmental sustainability, and community or social factors as criteria for cost-benefit analysis.

Within this strategy, life-cycle costing and the triple-bottom-line approach provide methods for project prioritization that encourage municipalities or utilities to consider all costs and benefits over the project life cycle, resulting in higher benefits for infrastructure investments at lower costs. It provides actions and methods for funding and financing that leverage public resources through collaboration, to ensure that infrastructure investments are fiscally sustainable and that rates are affordable.

It also provides methods for developing an organizational structure, management systems and personnel resources that build institutional capacity so that funding, projects and programs for effective sewer and stormwater management can be implemented successfully.

Actions		*Methods*	*Resources*
6.1	The municipality/utility has an organizational structure, management systems and personnel resources that ensures its **institutional capacity** to implement integrated sewer and stormwater management projects.	☐ The organizational structure, resources, and management have been evaluated to identify staff resource needs, management system improvements, and opportunities for human resource efficiency; this evaluation is reflected in the Asset Management Plan (see 1.3). ☐ The organization has a sufficient and trained staff, a forward-looking transition plan, and efficient management systems. ☐ A training program has been established and is implemented that provides regular training for its staff to advance the skills necessary to perform proper operations and maintenance, to provide timely and effective emergency response, and to incorporate recognized safety practices. ☐ The training program is routinely adapted as system components are upgraded or new best practices are available, and ranges from special classes or seminars in innovative practices, certification programs, and informal training. ☐ The governing body of the municipality/utility has a sound understanding of the wastewater or stormwater system, as relevant, including the primary finding of all plans and major implications for budgeting and management.	U.S. EPA Effective Utility Management Primer
6.2	The municipality/utility prioritizes projects by **considering all costs and benefits over** the **project life cycle**.	☐ A life cycle cost analysis is employed for all capital investments that considers upfront planning, engineering and design, capital construction costs, operational and maintenance (O&M) and any renewal and replacement costs over time. ☐ Cost effectiveness analysis (CEA) is applied to identify the least cost preferred investment alternatives that are subject to a full cost benefit analysis (CBA). ☐ A triple bottom line, or another comparable multi-variable cost-benefit analysis is employed for all capital investments, that considers co-benefits such as: – Energy savings	EPA Cost Benefit Resources Center for Neighborhood Technology Value of Green Infrastructure WERF BMP and

Actions		Methods	Resources
		– Air quality improvements (criteria air pollutants, NO_X, SO_X, $PM_{2.5}$), – Greenhouse gas reductions (CO_2, CH_4) – Environmental benefits (ecosystem services , e.g., treatment wetlands for tertiary treatment providing wetland habitat) – Health benefits (reductions in pathogens or asthma, disease vectors, prescription meds in treatment trains, avoided cost of illness, heat island effect reductions, mental health improvements) – Water quality benefits (e.g., nutrient removal (surface water), salt water intrusion management to aquifers/groundwater – Increased property values – Fiscal impact management savings to agency (e.g., reduced rates, O&M, taxes), providing stable revenue stream – Social benefits to keep rates affordable while providing quality services, and equitable rate structures ☐ A comprehensive evaluation of the cost/benefits of a variety of CSO controls (source reduction, collection system, storage, treatment) has been performed in order to reduce or eliminate CSOs. ☐ Post construction monitoring programs are developed and implemented to measure progress in improving water quality and to assess the effectiveness of CSO and other sewer system controls.	LID Whole Life Cost Models: Version 2.0
6.3	The municipality/utility **leverages public and private resources through collaboration** with other funding interests or partners such as private, public and nonprofit entities, where appropriate.	☐ Partnerships have been established to implement innovative sewer and stormwater management projects that employ mutually beneficial means to achieve effective water management, such as: – Public-Nonprofit Partnership (i.e., Camden SMART) – Public-Private Partnership (i.e., Prince George's County Urban Retrofit Project, Philadelphia's Greened Acres Retrofit Project) – Public Financing Partnership (i.e., NJEIFP Projects) – Community based Public-Private Partnerships (CBP3s) – Crowd-sourced funding mechanisms ☐ Incentive programs have been established for private investment in water management, such as: – Payment-in-lieu programs – Options for developers pay into regional stormwater facilities – Enhanced infrastructure financing districts – Financial incentives for green infrastructure retrofits on private property, such as grants, rebates, property tax credits – Where a stormwater fee has been established (see 6.4), credits are available to property owners who install stormwater retrofits to reduce runoff into the sewer system	Corvias Announces Public-Private Partnership Agreement with Prince George's County Camden Smart NJEIT CWA SRF Projects NJDEP The New Jersey Environmental Infrastructure Financing Program CBP3s &

Actions		Methods	Resources
			Alternative Market-Based Tools for Integrated Green Stormwater Infrastructure Wanted: Green Acres IOBY Crowd Funding for Neighborhood Projects
6.4	The municipality/utility has sound, reliable finances and **ensures fiscal responsibility** to consumers.	☐ Reliable, consistent, and sufficient funding sources are provided for both the operating budget and capital replacement plan. ☐ The municipality/utility sets pricing to cover infrastructure costs over the full life-cycle of system assets. ☐ Sewer and stormwater departments/utilities have taken measures to ensure fiscal responsibility, such as: – Adopting a formal operating budget and expenditure plan that details the annual cost of running the collection system and/while maintaining fiscal solvency – Maintaining transparent and reliable utility finances – Establishing a user-supported rate-paying structure, commonly known as an enterprise fund or utility fund (which for a municipal utility is separate from general fund revenue sources) – Imposing capital facilities charges for regional facilities constructed to serve specific service areas – Preventing diversion of funds to the municipal general budget ☐ A stormwater fee has been established based on a measure of stormwater generation such as impervious coverage (with credits available for properties installing green infrastructure retrofits), as applicable. ☐ The municipality/utility evaluates the use of shared-services for sewer system operation and maintenance.	U.S. EPA Funding Stormwater Programs Natural Resources Defense Council: Stormwater Strategies Community Responses to Runoff Pollution Facilitating Fees
6.5	Sewer and stormwater **rates are affordable**.	☐ The municipality/utility evaluates the impact of rates on ratepayers, with attention to low-moderate income populations.	City of Junction City Rate Payer Assistance

Actions		Methods	Resources
		☐ A ratepayer assistance mechanism is provided so that low income families are able to pay sewer rates. ☐ Rate structures are based on full-cost pricing over the full life cycle of utility assets, including projects in the Capital Improvement Plan (see 1.8). ☐ Sewer rates are volumetric (i.e., with metered drinking water usage as surrogate for wastewater usage), and based on a rate structure that encourages conservation. ☐ The municipality/utility has used all other applicable actions included in Strategies 1-5 to improve efficiency, reduce costs, and leverage additional resources.	Program Water Research Foundation: Utility Finance EPA Water: Sustainable Infrastructure Affordability Considerations