LONG-TERM SOLUTIONS FOR

Stormwater Management

Rochester, New Hampshire

Incorporating Stormwater Management into Broader Community Goals

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Executive Summary

Rochester, New Hampshire is one of four communities that participated in a U.S. Environmental Protection Agency (EPA) technical assistance effort to begin planning for stormwater management on a more long-term basis. These communities worked with EPA to synchronize planned and future activities with long-term stormwater planning.

Through a technical assistance effort, the city and EPA worked together to identify several of the city's long-term stormwater goals and develop a framework to implement them and engage stakeholders throughout the process. The city and EPA collaborated during a two-day onsite meeting in Rochester and held numerous calls throughout the technical assistance effort to identify goals, establish strategies to achieve each goal, and document the strategies in a long-term plan. Rochester participants included attendees from the Public Works and Planning and Development Departments. The effort resulted in this plan, which identifies the following goals for Rochester's stormwater management over the next 20 to 30 years:

Rochester's Long-Term Stormwater Goals	
	Achieve efficient stormwater infrastructure operations and maintenance (O&M) by developing and implementing a complete asset management program.
	Implement a long-term finance strategy to support the stormwater program.
	Establish and enforce effective community policies for development and redevelopment that integrate stormwater standards and green infrastructure considerations.
	Integrate green infrastructure and effective stormwater opportunities into public projects.
	Revitalize the cornerstone waterways of Rochester to meet community needs and provide benefits.

These goals align with a variety of other community master planning, development, recreation, and transportation goals that the city already has or is planning to pursue. The city updated its downtown master plan in 2020 and incorporated many of the stormwater concepts and goals developed during this long-term stormwater planning process. By taking a comprehensive approach to stormwater management, the city can prioritize capital investments in stormwater infrastructure to protect human health and the environment, while minimizing costs and meeting bigger-picture goals. By working with stakeholders to pursue the long-term stormwater plan's goals, the city will:

- Save money by aligning stormwater upgrades with other infrastructure and development projects.
- Engage with community members to continuously convey priorities and hear directly from those who will benefit from the city's goals.

- Improve drainage and reduce pollution with reliable infrastructure, which will attract and sustain residents and businesses in the community.
- Build an attractive community where residents can eat, live, work, play, fish, and canoe in their own backyards.
- Provide certainty and predictability to developers.
- Identify and pursue new opportunities for financing.

This plan outlines multiple "key actions" to achieve incremental progress toward each goal over time. The plan focuses on community-based solutions for stormwater management that city department supervisors, decision-makers, and key stakeholders may use to demonstrate the value of stormwater management in improving public infrastructure, the environment, and the overall quality of life for residents of Rochester.

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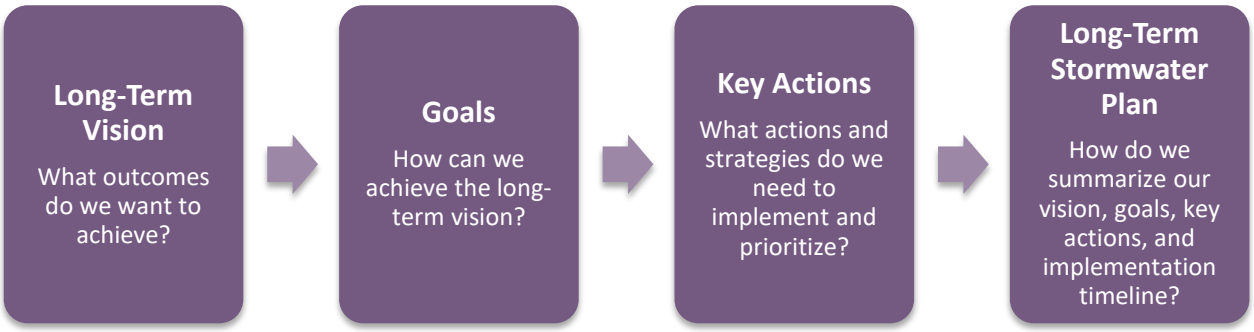
1. Introduction

Rochester, New Hampshire, affectionately known as the Lilac City, is looking for more resilient, cross-cutting, and community-based solutions to better manage stormwater for current and anticipated community needs. The city of Rochester, with technical assistance from the U.S. Environmental Protection Agency (EPA), has developed this voluntary long-term stormwater plan that outlines key actions to achieve stormwater goals. These actions will help the city achieve a broader community vision of economic and cultural development and environmental sustainability. The city and EPA began the collaboration with a two-day onsite meeting in Rochester and held numerous calls throughout the technical assistance effort to identify goals, establish strategies to achieve each goal, and document the strategies in a long-term plan. The key actions and goals in this plan also help the city meet permit requirements. Through this plan, Rochester can provide community amenities while protecting human health and the environment, complying with permits, promoting development, and minimizing costs through effective asset management. The city may pursue a comprehensive approach, working with different city departments and community stakeholders to achieve its long-term vision. Rochester and EPA discussed the following types of questions to develop this plan:



To meet the city's vision, Rochester plans to pursue key actions and achieve the following goals over the next 20 to 30 years:

	Achieve efficient stormwater infrastructure operations and maintenance (O&M) by developing and implementing a complete asset management program.
	Implement a long-term finance strategy to support the stormwater program.
	Establish and enforce effective community policies for development and redevelopment that integrate stormwater standards and green infrastructure considerations.
	Integrate green infrastructure and effective stormwater opportunities into public projects.
	Revitalize the cornerstone waterways of Rochester to meet community needs and provide benefits.

Although the goals in this plan are stormwater focused, they are closely linked to broader community goals that promote smart development and economic growth, revitalize the city's downtown corridor, assist with permit compliance, and improve public health and well-being. Appendix A provides a table summarizing community goals that existed at the start of this planning process. Throughout the long-term stormwater planning process additional community plans and associated goals were updated. The goals in this plan align with and support the objectives of the current community plans shown in Table 1.

Table 1. Stormwater Opportunities in Community Plans

Plan	Goals and Opportunities to Incorporate Stormwater
Downtown Master Plan (2020)	This plan describes a downtown vision for the city, its businesses, and its citizens. The plan outlines seven initiatives that the key actions in this long-term stormwater plan can help fulfill: • Infrastructure analysis and coordinated investment, with a specific focus on complete and green streets, integrating green infrastructure, and tactical urbanism. • Arts and culture as a downtown anchor. • A tax increment financing (TIF) district. • Riverwalk and waterfront connections. • The economic development commission. • Land use regulations and architectural guidelines. • Partnership and collaboration. Green infrastructure and stormwater management is included as a key component throughout the themes, initiatives, and recommended actions of the Downtown Master Plan.
Capital Improvement Plan (fiscal year 2021 proposed capital budget)	Although there are several proposed standalone stormwater projects, other non-stormwater-specific projects could provide opportunities to incorporate stormwater management. These projects are related to economic development, public buildings, sewer systems, roads, sidewalk improvement/replacement, pavement rehabilitation, and preservation.
Rochester Riverwalk Master Plan (update underway 2020)	This plan provides conceptual designs for a riverwalk through various sections of the city. The designs include hard surfaces, green buffers along the edge of the path, and pocket parks at various locations. The plan does not articulate stormwater management, but stormwater management practices, particularly green infrastructure, could be integrated into the riverwalk design.
City of Rochester Master Plan: Transportation (2020)	The actions identified do not include specific stormwater management improvements, but the design plans for streetscape, sidewalk, bike path, and intersection improvements could include stormwater management and green infrastructure practices. This plan references the master plans developed from the 2018 Greening America's Communities design charette.
Rochester Economic Development Strategic Plan Update (2018)	This revision and status update to the 2005 plan includes implementation actions, one of which is Downtown Action #13, to invest in upgraded infrastructure and city services to improve neighborhoods in and around downtown. This includes investments in water, sewers, drainage, streets, sidewalks, and community policing. Green infrastructure could be integrated into this action to address drainage as well as provide additional benefits that would

Plan	Goals and Opportunities to Incorporate Stormwater
	serve economic development, such as improving streetscapes, cooling urban heat islands, and providing natural spaces and parks.
Greening America's Communities design charette (2018)	This charette outlines a variety of designs and green infrastructure opportunities that could be incorporated into two sites: North Main Street and a public parking lot (see Appendix B).
Great Bay (2020)	This is a collaborative vision for environmental improvements to the Great Bay estuary, whose watershed contains the city of Rochester. One of the four goals under this vision is to "collaborate to reduce pollution" and calls for local communities to implement "innovative local ordinances to reduce stormwater pollution."
City of Rochester Recreation Master Plan (2011)	The plan's action items include various improvements to city-owned recreational properties. Improving stormwater management and integrating green infrastructure can functionally enhance these sites.
Land Use Master Plan (2002)	This plan includes actions related to improving water quality and infrastructure. Updates could reflect more recent attention to improving water quality through stormwater management and integrating green infrastructure into new development and redevelopment.

1.1 Community Background

Rochester is in Strafford County, Hew Hampshire, along the border of New Hampshire and Maine. It is about 35 miles east of the state capital, Concord. It is one of the largest cities in New Hampshire. Rochester began as an industrial town with a strong manufacturing sector. Today, the city maintains a manufacturing presence in the aerospace and textile industries (City of Rochester, n.d. [a]) and provides employment in the medical, public, and retail sectors (New Hampshire Employment Security, 2021). According to the U.S. Census, Rochester had a population of 31,526 in 2019 (U.S. Census Bureau, n.d.).

1.1.1 Stormwater

Rochester spans 45.4 square miles across the rolling hills and rivers of southeast New Hampshire (U.S. Census Bureau, n.d.) and receives an annual average rainfall of 46 inches (U.S. Climate Data, n.d.). In terms of existing stormwater management, Rochester owns and operates a municipal separate storm sewer system (MS4) that collects and transports stormwater via a network of city-owned ditches, drains, and pipes. Figure 1 shows the city's designated MS4 area (EPA, 2008). Stormwater discharges from Rochester's MS4 are covered under the New Hampshire Small MS4 General Permit (Permit No. NHR041000) issued by EPA. The stormwater collected by MS4s is not treated at the city's wastewater treatment plant (WWTP); instead, it goes directly to local waterways that eventually flow into either the Cocheco River, which runs through the city, or the Salmon Falls River, which runs along the city's eastern boundary. Both rivers are considered impaired by E. coli and are included in New Hampshire's statewide total maximum daily load for bacteria-impaired waters (NHDES, 2010). The city's waterways are shown in Figure 2.

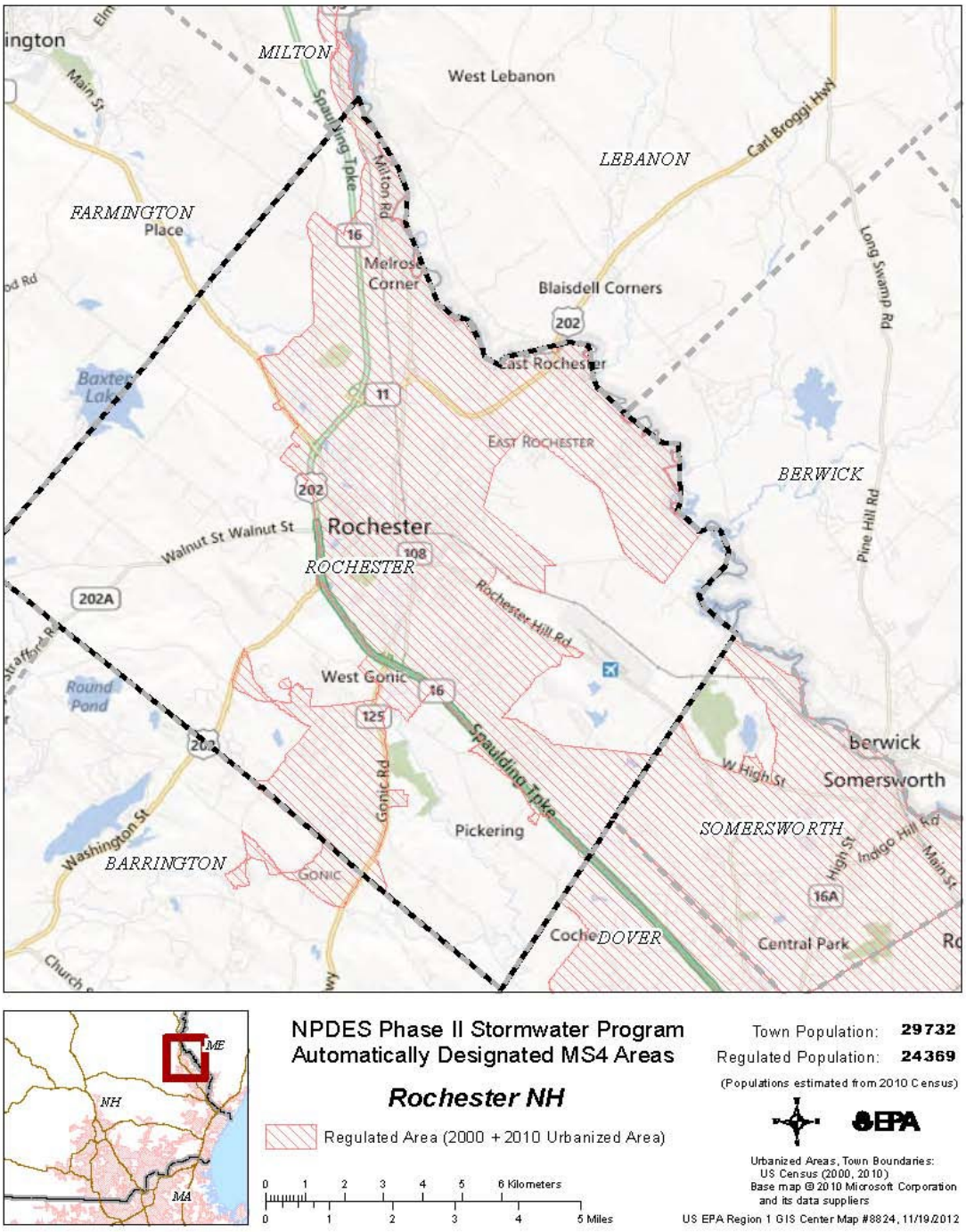


Figure 1. Urbanized Area Map of Rochester

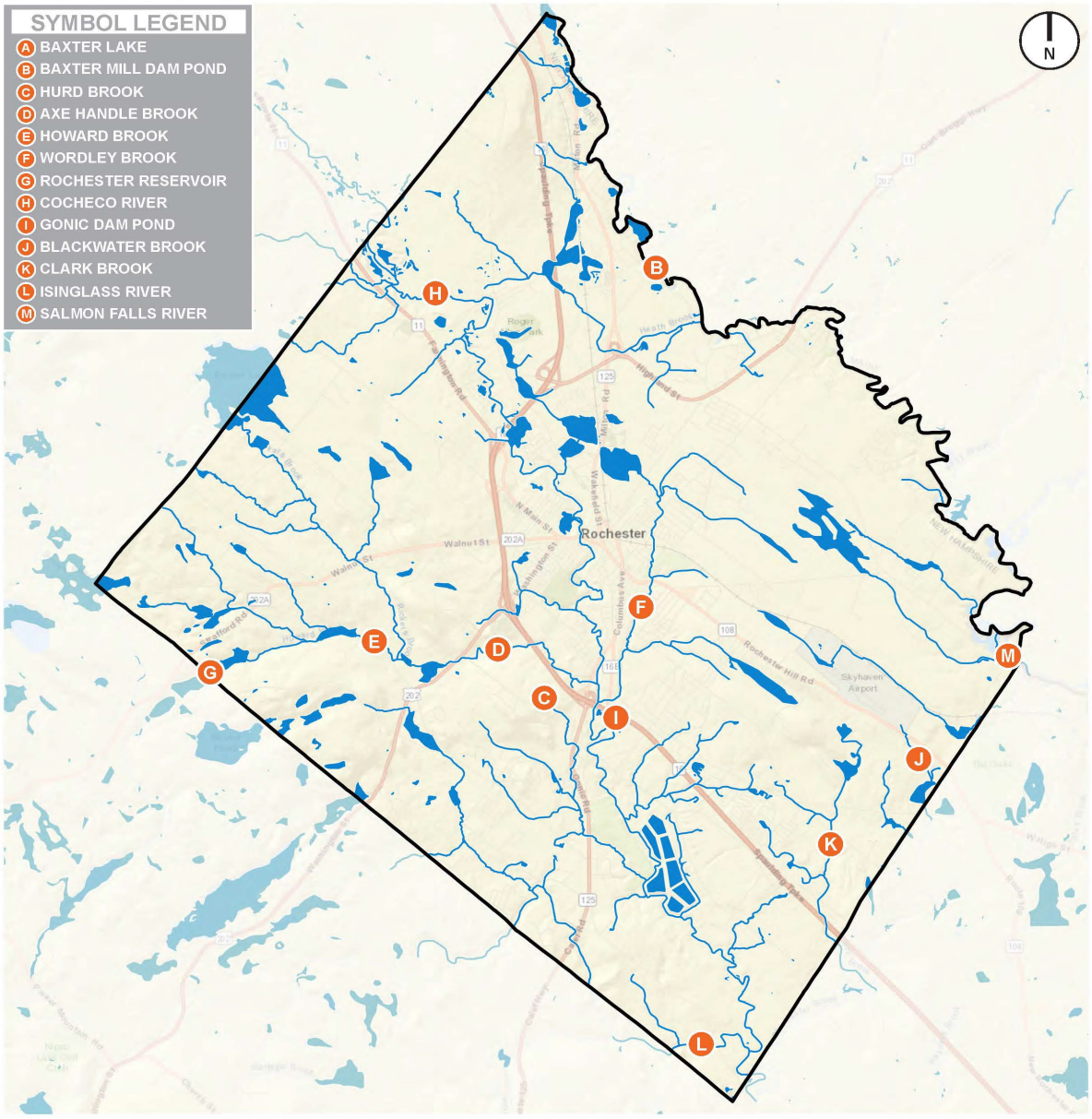


Figure 2. Local Water Bodies in Rochester

The stormwater runoff from Rochester directly impacts the health of the Great Bay. The Cocheco and Salmon Falls Rivers flow into the Great Bay estuary, which is both a freshwater and saltwater system. The Great Bay estuary is one of 28 estuaries in EPA's National Estuary Program, which protects and improves the water quality of estuaries because of their diverse habitats (EPA, 2018). According to the 2018 report *State of Our Estuaries,* 12 of the 16 environmental indicators for the Great Bay estuary had "cautionary or negative trends," meaning that the health of the Great Bay estuary is under stress from a variety of factors, including impervious surfaces and nutrient loading (PREP, 2018).

The University of New Hampshire (UNH) Stormwater Center and the New Hampshire Department of Environmental Services (NHDES) established the Great Bay Pollution Tracking and Accounting Pilot

Project (PTAPP). The goal of PTAPP is to provide a tool for communities in the Great Bay estuary to track activities and sources that affect pollutant loads. The PTAPP database is available for public use (UNH Stormwater Center, 2010).

Drinking Water

The city's drinking water supply comes from a combination of groundwater and surface water. The primary source of drinking water is surface water from the Rochester Reservoir, which is sent to Rochester's surface water treatment facility. The secondary source is groundwater treated at the Cocheco Well treatment plant. Together, these facilities can supply 5.5. million gallons per day of treated drinking water (City of Rochester, n.d. [b]).

Wastewater

The city owns and operates a WWTP to treat sewage collected from homes and business and transported to the WWTP through its separate sanitary sewer system. The plant has a capacity of 10 million gallons per day, though it typically operates at an average of 5 million gallons per day. During a May 22, 2017, working meeting between EPA and the city, the city estimated that slightly more than half of its residents have homes with sanitary sewer pipes that flow to the WWTP, though efforts are underway to increase the proportion of the population served. Residents that are not served by the WWTP primarily have septic systems. Because the WWTP discharges to the Cocheco River, which flows to the Great Bay estuary, it is required to provide nutrient reductions in addition to basic organics removal. Given the anticipated increase in treatment volume (from a growing population and increase in service), as well as the high cost of nutrient control strategies at the plant, the city is interested in identifying less expensive nutrient control options throughout the watershed, including managing runoff with green infrastructure.

1.2 Financial Capacity

Rochester is a small town with limited financial resources. The city has a stormwater program but no dedicated program funding. The city votes annually on the current stormwater program budget, which is approximately $300,000 and supported by the general fund. Given the need for long-term financial sustainability, the city is interested in developing a dedicated fund and has even discussed the possibility of implementing a stormwater utility in conjunction with the neighboring communities of Dover and Portsmouth.

Priority Areas for Revitalization in Rochester

- ✓ Downtown
- ✓ The "Gap" (the entrance to the historic downtown)
- ✓ The Cocheco Riverwalk

Rochester also looks for opportunities to attract businesses, revitalize the city, and grow the local economy while also providing community amenities. Figure 3 shows a map of Rochester's downtown economic revitalization zone (City of Rochester, 2020).

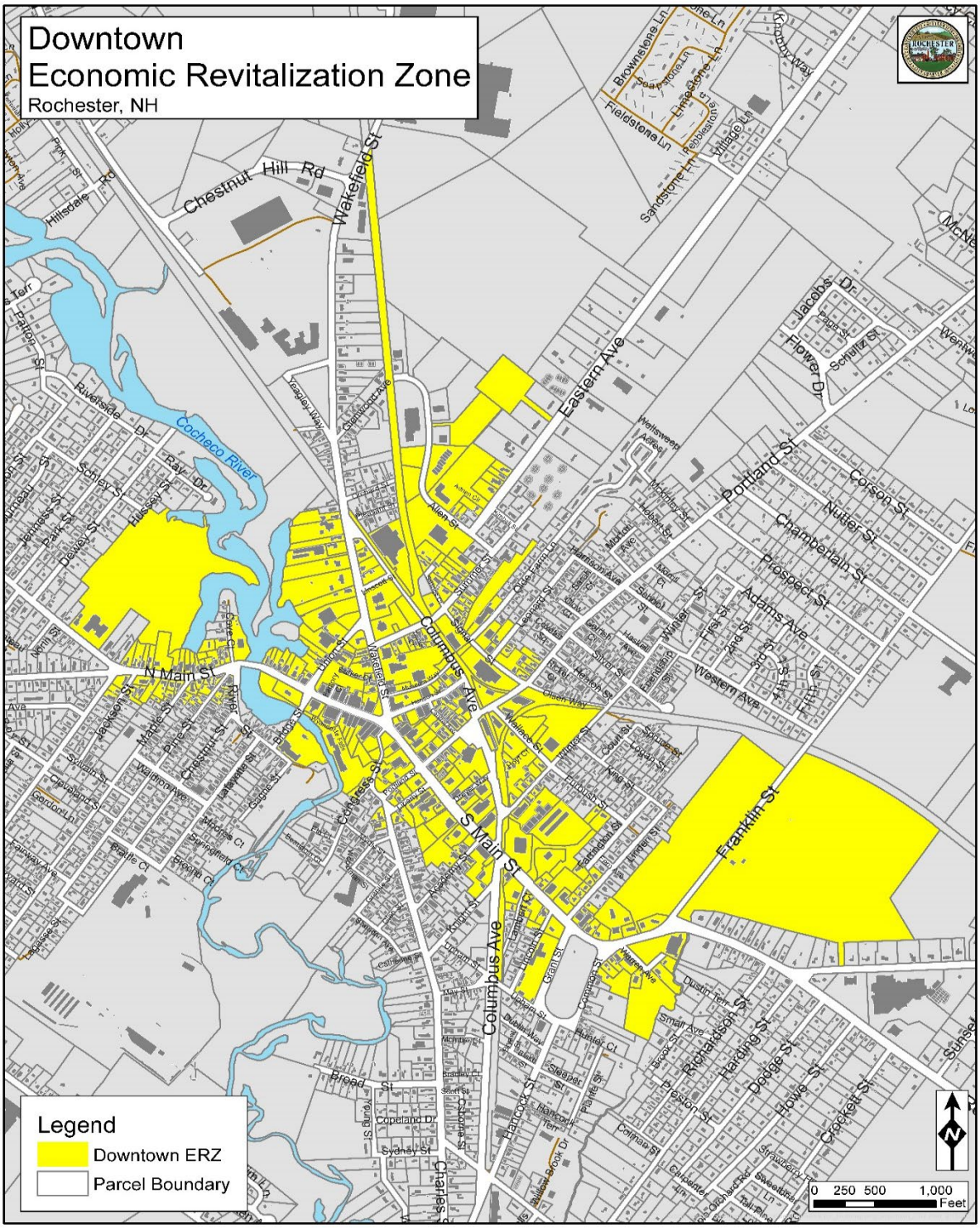


Figure 3. Downtown Economic Revitalization Zone in Rochester

1.3 Challenges

Long-term stormwater planning will help Rochester identify sustainable and comprehensive solutions—including green infrastructure and asset management. These solutions will address many of the challenges the city faces (see Figure 4 below), protect human health, improve water quality, manage stormwater as a resource, and support other economic benefits and quality-of-life attributes that enhance the vitality of the city.

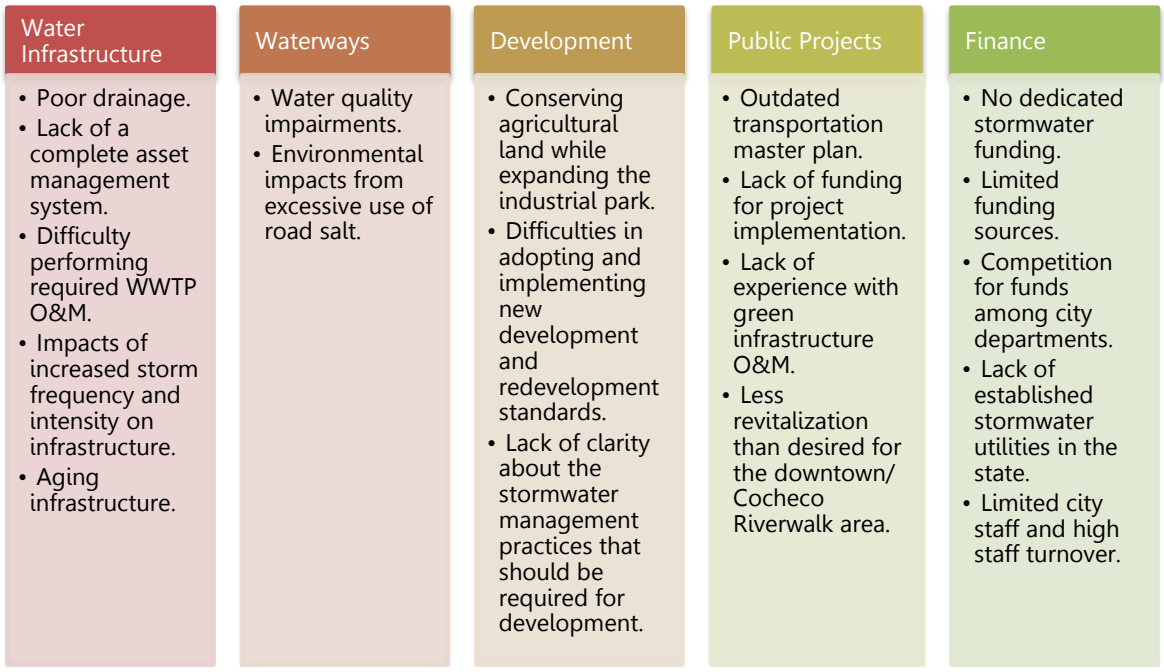


Figure 4. Challenges in Rochester[1]

1.4 Vision

During a meeting facilitated by EPA, the city worked with various city departments and stakeholders to establish five key vision statements that serve as the goals for the long-term stormwater plan. The vision statements were developed by reviewing a compiled list of city challenges and creating statements that summarized "end states" the city desires to achieve. To focus this initial long-term stormwater planning effort, the city pared a longer list of vision statements down to the following five:

- Stormwater infrastructure O&M are efficiently managed.
- The stormwater program is funded at a level that meets its functional needs.
- The city and the stormwater program have prepared for and supported growth and increased development, which support economic and environmental goals.
- Public projects incorporate green infrastructure.
- Rochester's waterways are valued as community assets.

[1] The city identified these challenges in conjunction with EPA.

The city then identified five overarching goals that support each vision statement (Figure 5). Each goal will help the community better address the current challenges related to infrastructure, waterways, development, public projects, and finance. The following sections outline the key actions that Rochester plans to take to achieve each goal.[2] Since community priorities may change over time, the plan's key actions and timelines are intended to be a flexible framework for incremental progress toward the long-term vision.

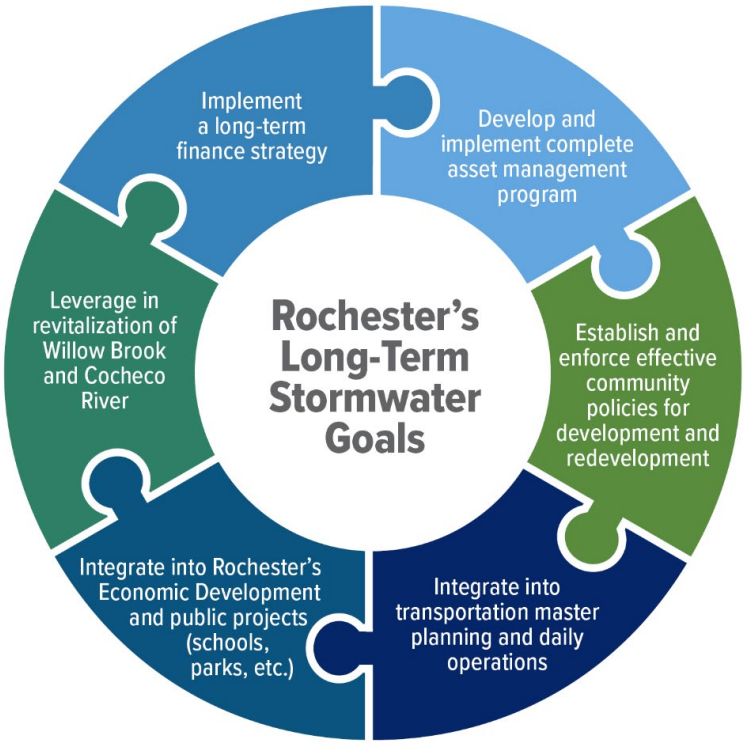


Figure 5. Rochester's Long-Term Stormwater Goals

This plan's vision also supports Rochester's downtown vision statement: "The many pocket parks, planting strips, and trees incorporated in the streetscape and parking lot upgrades, and in new development projects, not only provide important green space, but they also ensure the Downtown is attractive and inviting. This commitment to integrated green infrastructure is also a reminder of Rochester's resilience as a community."

[2] The goal to revitalize Rochester's cornerstone waterways does not have standalone key actions in the plan because the other goals and key actions inherently contribute to this goal.

2. Goal—Know Your Assets: Develop and Implement an Asset Management Program

To improve the quality, efficiency, and cost-effectiveness of services to its citizens, Rochester has taken steps to establish a comprehensive asset management program. Rochester obtained funding from the Clean Water State Revolving Fund (CWSRF) to support initial asset management activities. The city worked with a contractor in 2016 on critical data collection and planning activities. The key actions associated with asset management and the city's progress toward each are summarized in Table 2 below.

Asset management emphasizes a long-term, proactive focus on maintaining and sustaining assets, rather than a short-term, reactive approach. Asset management programs (and their associated plans) are scalable and can be simple or complex, depending on the size, sophistication, and resources of the entity developing and implementing the program. Stormwater assets include the equipment, buried and visible infrastructure (gray and green), land and natural systems, and other components needed to manage and treat stormwater.

Understanding level of service (LOS) is key to asset management. LOS articulates the service the community wants their assets to provide and the level at which those assets perform. Regulatory requirements, expectations and recommendations from customers/stakeholders, historical and current asset performance, and projected asset capabilities (given their current condition) typically drive LOS. LOS goals will ultimately determine how to spend money. Quantitative performance measures can help evaluate performance against LOS and inform asset management.

Asset management refers to a strategic, comprehensive approach to managing the long-term sustainability of assets and achieving desired LOS and regulatory requirements in the most cost-effective way possible.

An **asset management program** refers to the full suite of data-driven actions and procedures put in place across an organization to successfully manage assets.

A written **asset management plan** serves as a tool and resource for implementing the asset management program and documents the information and procedures guiding program's implementation over time.

An asset management program provides many benefits for stormwater services:

- Protecting community assets:
  - Providing a method to prioritize the city's most critical projects.
  - Protecting assets from premature failure through proper O&M.
  - Reducing instances of flooding in the city in the near term through proactive O&M activities and long-term actions to improve drainage capacity and manage aging infrastructure.
  - Increasing the city's resiliency and ability to reduce impacts of increased storm events on infrastructure.
- Saving money:
  - Reducing the need for emergency asset replacement costs, which are often much higher than planned costs.
  - Understanding the cost of a stormwater asset over the course of its useful life.

  - Gathering data to inform adequate budgets for operations, capital projects, and user rates (if established in the city).
  - Increasing collaboration and coordination across the city's water, wastewater, and stormwater programs and with other public departments (e.g., transportation, parks, and recreation).
- Saving time:
  - Better forecasting the timing of when assets within the system will need to be replaced.
  - Establishing a robust approach to planning and investment, driven by comprehensive and current data.

It is important to maintain stormwater assets designed to provide water quality treatment. These types of assets include green infrastructure, such as bioretention and tree trenches. If these assets fall into disrepair, they may not achieve the intended and calculated pollutant reductions. Asset inventory development could include compiling data about pollutant load reductions. The city's evaluation of asset performance and condition could confirm the functionality of stormwater assets that provide water quality treatment.

Opportunities for Resource Efficiency

Collecting data to build an asset inventory and implement an asset management program can provide valuable information and save time and money across municipal programs. Likewise, ongoing routine activities may provide excellent opportunities to collect important data on asset location and condition without investing more resources or staff time. For example:

- Quantitative and qualitative data on asset location, type, condition, and risk can help other efforts with voluntary and required tracking/reporting (e.g., the state's PTAPP), help the city more quickly analyze and justify stormwater projects and funding, and help the city provide more transparent oversight and management of critical infrastructure.
- City staff can continuously collect data on asset location and condition during routine maintenance activities (e.g., catch basin cleaning and street sweeping).
- Asset management programs can also include tracking estimated pollutant load reductions and costs attributed to particular stormwater controls to provide the city with additional information for planning purposes.

More broadly, comprehensive stormwater asset management—particularly when coupled with parallel efforts across water sector and other public services—can provide the following community-wide economic, environmental, and social benefits:

- Enhanced long-term economic sustainability and growth, through the provision of reliable, cost-effective public services and reduced flooding.
- Potentially significant long-term cost savings, through proactive maintenance, data-driven decision making on the timing and type of infrastructure investments, and avoided costs.

- Improved and sustained integrity and quality of the city's natural environment and infrastructure, improving quality of life.
- Meeting or exceeding the expectations of Rochester residents and businesses to provide high-quality public services, such as stormwater and water quality management.

Table 2 below describes the key actions associated with establishing and implementing a comprehensive asset management program. The table also indicates the status of each activity in Rochester, as of 2020.

Table 2. Key Asset Management Program Actions and Status

Key Action Components	Summary	2020 Status
Develop program scope, goals, objectives, and timeline; establish asset management task force	Identify goals and objectives up front to guide program development. Engage cross-sector representatives to serve as leaders and champions for program development and implementation.	Rochester had contractor assistance to compile and develop tools for evaluating key asset data (as described below). Broader data management needs are being coordinated across the drinking water, sewer, and stormwater sectors. In 2020, the city upgraded to an ArcGIS enterprise system with locally hosted servers and acquired asset management software that will significantly improve and enhance the city's stormwater planning and prioritization moving forward.
Develop an asset inventory	Compile key data on all assets to begin evaluating the current condition, sizing, status, and scope of relevant assets across the city.	Rochester's contractor conducted an initial review of existing data sources, including geographic information system (GIS) data, aerial photos, inspection reports, and other relevant data. It has compiled asset data (type, age, material, location, size, etc.) and integrated them into an asset management risk analysis tool. The city purchased asset management software and is working on implementing it.
Evaluate asset condition and performance	Document and/or inspect each asset to the extent possible to assess and rate its current condition.	Rochester's contractor developed a risk analysis tool that assesses likelihood of failure, consequence of failure, and business risk exposure for each documented asset.
Estimate asset value, remaining useful life, and replacement cost	Evaluate the current condition and maintenance history of each asset and estimate the cost of replacing the asset.	Rochester's contractor developed a risk analysis tool that can estimate replacement costs for some assets. Rochester has invested in asset management software that will track the history of repair/replacement work for specific assets over time. In the future, work order requests will be made through and tracked via the software.
Establish LOS and associated performance measures	Articulate the service that the city wants to provide using its assets and how the city wants the assets to perform; establish performance measures to track progress against goals over time.	Rochester's contractor developed draft LOS goals, including objectives and drivers, as well as measures for assessing performance against established goals.

Key Action Components	Summary	2020 Status
Assess asset criticality and risk	Evaluate assets in terms of their likelihoods/probabilities of failure and the consequences of failure to prioritize the most critical assets.	The risk analysis tool includes quantitative likelihood and consequence of failure scores for documented assets and plots assets on a risk map to identify the most critical needs.
Optimize capital and O&M costs and prioritize investments (life cycle costing)	Evaluate how to provide sustainable service and meet the established LOS at the lowest cost.	This action is under consideration and may occur in the future. Contractor scope includes developing a preliminary life cycle cost analysis for all recommended rehabilitation projects, including maintenance recommendations and an associated maintenance plan.
Develop a funding strategy	Identify funding (e.g., community and supplemental/external funding) for necessary O&M and capital improvement activities.	This action is under consideration and may occur in the future. Contractor scope includes developing a financial implementation plan to evaluate the financial impact of proposed improvements on utility and tax rates over 10 years.
Document activities in a written plan	Document the information and procedures guiding the asset management approach and implementation over time.	This action is under consideration and may occur in the future.
Conduct training, education, and outreach	Conduct continuous internal and external education and outreach to engage relevant staff and demonstrate the value of asset management to decision-makers and the community.	This action is underway. Contractor scope includes developing a written summary of asset management actions and presenting an update on activities conducted to date to the city's Public Works Committee.
Continuously evaluate and improve	Revisit, evaluate, and revise the asset management approaches as needed over time.	This action is to be determined, based on the outcome of the contractor's efforts. The city hopes to add another 0.5 full-time equivalent (FTE) dedicated to water sector asset management in the future.

The following resource provide additional information and tools for asset management:

- *Asset Management: A Best Practices Guide. EPA 816-F-08-014*

3. Goal—Deliver Sustainable Stormwater Services: Meet the City's Stormwater Funding Needs

For many communities across the country, identifying the true costs associated with specific program activities can be challenging. This is particularly true for the costs of stormwater services; stormwater services are often integrated or combined with services provided through multiple municipal departments and programs, such as public works, engineering, planning, wastewater, transportation, waste management, and more. Without an accurate picture of the costs of stormwater program activities—and their associated financial, environmental, and social benefits—stormwater managers face a steep challenge making the case for stormwater investments to the public and elected officials.

In addition, many stormwater programs are implemented based on the funding they receive, not the funding they need. This approach may seem the most realistic, as it is based on what the community can afford and acknowledges competing needs. However, it can institutionalize subpar program design and implementation that limits the city's ability to improve incrementally and eventually achieve important long-term goals.

Stormwater programs that are funded through general funds, like Rochester's, or other non-dedicated revenue sources compete for funds with other local programs. Therefore, funding is unreliable from year to year. Unlike drinking water or wastewater services, stormwater services typically do not have a dedicated source of revenue. However, this appears to be changing; an increasing number of communities have established local or regional stormwater utilities and/or additional fee programs.

Table 3 below outlines a general approach that can help Rochester define the scope of stormwater services to ultimately develop and implement a finance strategy. The approach also includes continuous evaluation of the appropriateness of current rates/fees and options for generating additional revenue.

Table 3. Sustainable Funding Key Action Components and Timeline

Key Action Components	Timeline	2020 Status
Identify all activities that comprise the city's stormwater services and that require resources	Within one year	Underway
Collect budget information to determine the current and last five years of stormwater budgets, revenue sources, and actual expenditures	Within one year	Underway
Estimate stormwater program costs for the next five to 15 years	Within one year	Not started
Identify available city program funding and financing options	Within one year, then annually	Underway
Identify available external funding sources and processes to take advantage of those funding opportunities	Within two years, then annually	Underway

Key Action Components	Timeline	2020 Status
Create plan for establishing a sustainable funding approach for the stormwater program	Within five years	Not started

3.1 Key Action—Assess Revenue and Expenditures

Program costs vary depending on the program's size and complexity but typically include labor, O&M, capital costs, and miscellaneous costs (e.g., equipment, materials) for infrastructure and program implementation. To sustainably support a successful stormwater program, the city must understand the investment required to provide a desired LOS and meet regulatory requirements. As Rochester works to identify all activities associated with providing stormwater services, the city could begin by identifying stormwater program activities (e.g., street sweeping, winter road maintenance, waste management) that other city departments already conduct and fund (or activities considered sewer or stormwater services that have multiple benefits across city departments). This can identify opportunities to improve efficiency, increase organizational effectiveness, and save money.

Coordinate with Others

- ✓ Coordinating across city departments can help identify stormwater needs that can be integrated into broader projects (e.g., surface transportation) and that are eligible for funding from the Department of Transportation and other agencies.
- ✓ The *New England Environmental Finance Center* can provide resources, technical support, and training on stormwater finance.

Rochester's current stormwater management plan only lists activities that the Department of Public Works (DPW) performs, presumably because it is the department responsible for implementing the plan. However, other citywide opportunities could be incorporated that are not yet identified in the plan.

3.2 Key Action—Evaluate Funding and Financing Options

While funding for Rochester's stormwater activities comes from the city's general fund, a variety of funding and financing options can support the budget of a successful sewer and stormwater program. In addition to the city's current stormwater and connection fees, other potential mechanisms are stormwater utilities, property taxes/general funds, grants, bonds, low-interest loans, system development charges, public-private partnerships (P3s), market-based approaches, and regional approaches.

These mechanisms can be used as standalone options or in combination with others. The funding source may dictate how its resources can be used. Different types of funding may be allocated to pay for different types of activities (e.g., a one-time capital project versus ongoing O&M costs). The Rochester DPW has identified the establishment of a stormwater enterprise fund as one potential future funding option.

The following general considerations may be helpful when evaluating the most appropriate source of funding or financing for a stormwater-related need:

- What is the scope of the need, and what implications does this have for eligibility for a funding or financing source?
- What is the timeframe for the need, and does it align with the timeframe for securing funding or financing from the source?
- Are there other related needs that the city is planning to address soon (e.g., surface transportation, resilience, wastewater), and can the proposed funding or financing mechanism be used to address stormwater needs at the same time?
- How competitive is the funding or financing option? Has the city successfully obtained funding or financing from this source in the past, or have other local communities done so?
- Does the city have the capacity and support for taking on debt to address the need?
- Can the city meet funding match requirements, if relevant?
- Does the city have the staff, technical resources, and capacity necessary to meet all needs associated with securing funding or financing through the identified source (e.g., grant-writing experience, understanding of eligibility and reporting requirements, community outreach to build support)?
- Does the funding or financing source cover costs associated with long-term project success (e.g., O&M, monitoring and assessment)?
- Are there regulatory barriers at the local or state level that must be addressed to use the funding or financing option?
- Are there other organizations eligible for relevant funding or financing with which the city can coordinate (e.g., local 501[c][3] nonprofit organizations)?

Forming a Local and Regional Stormwater Utility

The New Hampshire Department of Environmental Services (NHDES) stormwater *website* has resources for forming a stormwater utility, including benefits, New England-based case studies, feasibility studies from New Hampshire communities, and more.

Some communities have joined together to form regional stormwater authorities to save money and address cross-boundary stormwater management concerns. More information on forming regional stormwater utilities, including case studies, is available in *Regional and Municipal Stormwater Management: A Comprehensive Approach* (Harvard Law School, 2014).

The tables in Appendix C include examples of applicable federal funding/financing sources that the city could consider. Additionally, more information on stormwater funding and financing mechanisms can be found in the EPA's *Water Finance Clearinghouse*. Table 4 outlines municipal funding sources and mechanisms.

Table 4. Municipal Funding Sources/Mechanisms

Source	Description	Administered By
P3s	A P3 is a contractual arrangement between a public entity and a private-sector entity for "delivery of a service or facility for public use," with the goal of sharing "the skills and assets of each sector (public and private)" in delivering that service, as well as the "risks and rewards potential in the delivery of the service and/or facility."[3] In a P3, the public entity retains ownership of utility assets. Stormwater P3s can take many different forms, including credit trading, performance contracts, and lease-like agreements.[4]	The municipality; for more information on stormwater P3s, see EPA's *resource page on community-based P3s*
Green bonds	Green bonds are a municipal financing mechanism designed to fund projects that have positive environmental benefits. Green bonds can be general obligation or revenue bonds and can attract impact/socially responsible investors who may not otherwise invest in municipal bonds. Water climate bonds are a subset of green bonds; they fund water infrastructure projects that improve sustainability and resilience. The first certification standards for water climate bonds were released in May 2018.[5]	The municipality; for more information, see the National Resource Defense Council's *How to Issue a Green Muni Bond* handbook
Environmental impact bonds	Like green bonds, municipalities can use environmental impact bonds to fund projects with positive environmental outcomes. However, the return to investors is determined by the extent to which the project is successful (i.e., the extent to which the project meets established targets/thresholds for environmental outcomes, such as water quality improvements). DC Water issued the first-ever environmental impact bond to fund a green infrastructure stormwater runoff management effort.[6]	The municipality

Source: EPA, 2017.

EPA's *Water Finance Clearinghouse* is a searchable database for sanitary sewer, stormwater, drinking water, and other relevant funding sources from federal, state, local, and other programs. Resources and information on available funding sources, including state-specific contact information, are updated regularly.

[3] The National Council for Public-Private Partnerships. 2012. Testing Tradition: Assessing the Added Value of Public-Private Partnerships. Available at *http://www.ncppp.org/wp-content/uploads/2013/03/WhitePaper2012-FinalWeb.pdf*.

[4] P3 Water Summit. 2018. Public-Private Partnerships: A New Solution for Age Old Stormwater Problems? Available at *https://s3.amazonaws.com/bizzabo.users.files/116443/206198/677655/P3%20Stormwater_White%20Paper_2018.final.pdf*.

[5] Climate Bonds Initiative. 2018. The Water Infrastructure Criteria Climate Bonds Standard. Available at *https://www.climatebonds.net/standard/water*.

[6] Goldman Sachs. 2016. DC Water Environmental Impact Bond. Available at *http://www.goldmansachs.com/media-relations/press-releases/current/dc-water-environmental-impact-bond-fact-sheet.pdf*.

Example P3 Program: Prince George's County, Maryland Clean Water Partnership

In March 2015, Prince George's County, Maryland entered a first-of-its-kind, innovative community public-private partnership aimed to meet the requirements of the Chesapeake Bay total maximum daily load, called the Clean Water Partnership. The partnership looks to finance, design, build, operate, and maintain a large-scale stormwater green infrastructure retrofit program. The Clean Water Partnership is designed to promote innovation, improve stormwater infrastructure, and commit to impacting the local economy through targeted "local" disadvantaged subcontractor development and utilization. The county has a contract with a private partner who is compensated to install and maintain stormwater management practices that meet certain performance goals for 30 years. For more information, visit the *Clean Water Partnership website*.

3.3 Key Action—Integrate Life Cycle Costing into the Planning Process

Life cycle costing is a key component of any asset management program. It evaluates how to provide sustainable services and meet the established LOS at the lowest cost. The goal of life cycle costing is to identify the level of maintenance required to achieve the maximum useful life of each asset and to replace the most critical assets before failure. While robust life cycle costing may be a mid- to long-term goal for the city, any information gathered during the ongoing asset management process should be fully integrated into the city's current budgeting and capital improvement planning exercises for stormwater services.

The city's contractor provided an initial capital improvement planning exercise as part of its ongoing services. This information directly informs how much, where, and when investment is needed. Like other planning activities, life cycle costing can start simple (e.g., with an estimate of expected annual costs) and evolve over time to allow for more sophisticated projections and scenario modeling.

Life cycle costing should consider all costs associated with an asset: early-stage planning and design; construction or purchase; O&M, upgrades, repair, or rehabilitation; and removal or disposal. This includes anticipated costs associated with asset failure and downtime, as well as financial or accounting considerations such as asset depreciation.

The following resources provide additional information and tools for life cycle costing:

- *Life Cycle Cost Projection Tool* (Water Environment and Research Foundation).
- *Determine Life Cycle & Replacement Costs* (Step 4 of Fundamentals of Asset Management training; EPA).
- *Asset Life Cycle Management: Case Studies on Asset Life Cycle Cost Modelling* (Asset Management Council [Australia]).

4. Goal—Increase Stormwater Management Options: Improve Development and Redevelopment Policies

The amount of developed land in Rochester has increased significantly over the years. Most of this development is residential, with commercial development occurring in core areas and along major roads—like Route 125, North Main Street, and Route 11—and industrial development occurring in industrial parks. Development and redevelopment policies are important because they outline project requirements that prevent or reduce local flooding and protect natural resources like green space and waterways. Strategic stormwater development and redevelopment policies promote desirable development that also improves and protects water resources. These types of policies help meet clean water standards by improving the quality and reducing the quantity of runoff. Development and redevelopment policies can also protect infrastructure and increase resiliency by promoting better stormwater management.

Chapter 218 of the city code, Stormwater Management and Erosion Control, contains Rochester's stormwater development and redevelopment policies. Chapter 218 requires no increase in the rate or volume of runoff from developed sites. The city's 2021 Site Plan Regulations and 2018 Subdivision Regulations require the use of low impact development to the maximum extent practicable. The key actions in the following sections are ways in which the city can improve current policies to promote development that supports Rochester's goals for economic growth and improved water quality. The key actions in this plan also support the following recommendations from the city's 2020 Downtown Master Plan:

- "Removing regulatory barriers and streamlining the development review process will make it more clear and predictable, and in the end will attract greater development interest. This should include clear design standards and design review processes for developers, architects, and engineers."
- "Adopt a Complete/Green Streets Policy to ensure all streets are designed to accommodate diverse transportation modes to the greatest extent possible."

Rochester has identified a downtown economic revitalization zone (Figure 3) that allows eligible businesses to apply for tax credits for projects that improve infrastructure and create jobs in a designated area. As Rochester looks to the future, it plans to optimize opportunities for stormwater management in conjunction with other community goals like revitalization. The city is looking to both improve routine operations and focus on high-visibility areas to show growth and demonstrate revitalization investment.

4.1 Key Action—Update Regulatory Codes and Ordinances

Local codes, regulations, and legal authorities provide clarity to developers and are a mechanism to protect the environment. Unfortunately, local codes and ordinances often contain barriers to implementing green infrastructure. Making it possible for developers to incorporate better site design principles and manage stormwater with green infrastructure can protect waterways and make the community more inviting. Rochester could take the steps outlined in Table 5 to ensure that its codes and ordinances meet local, state, and federal requirements and encourage the use of innovative stormwater management practices, including green infrastructure.

This Key Action Helps Rochester:

- ✓ Comply with its National Pollutant Discharge Elimination System (NPDES) MS4 permit.
- ✓ Streamline all stormwater regulations in one place.
- ✓ Comply with New Hampshire Alteration of Terrain (AoT) requirements governing stormwater management and erosion and sediment controls on large construction sites.
- ✓ Meet Great Bay nutrient reduction goals defined by EPA through NPDES wastewater discharge permits in the region to address nutrient impairment of the Great Bay estuary.

Updating key elements of local codes to remove barriers to using green infrastructure and to encourage or require consideration or use of green infrastructure design and practices allows developers to integrate green infrastructure into local streets and parking areas. Some design elements that might be incorporated into local codes include:

- Allowing narrower lanes for certain street types (i.e., residential).
- Allowing alternative forms and decreased dimensions of residential driveways and parking areas.
- Formally integrating green infrastructure into standard roadway construction and retrofit practices.
- Reducing/revising parking requirements to meet the level of demand and allow flexible arrangements (shared parking, off-site parking, etc.) to meet parking standards.
- Requiring substantial landscaping in parking lot settings to manage and reduce stormwater runoff.

Many communities have regulatory codes that inadvertently prevent engineers from incorporating green infrastructure or reducing impervious cover. These types of barriers should be identified and removed. These barriers include the following scenarios:

- Inconsistencies in codes may allow for certain green infrastructure elements in one code but then require, for example, excessive parking spaces in another section of the code. Some codes may require a vegetated buffer between parking areas but then prohibit the use of that buffer to provide stormwater management.
- There may be a lack of cooperation or consistency in regulation among different city departments or boards that makes it difficult for project designers to pursue new ideas.

- The existing code may include detailed stormwater management standards that prescribe gray infrastructure and preclude the use of vegetated practices, or standards that do not provide any incentive for the use of green infrastructure.
- Maintenance agreements or inspection requirements may be unclear or written such that they do not accurately apply to green infrastructure.
- Municipal staff and volunteer board and commission members may be unfamiliar with green infrastructure and require training to effectively review and regulate project designs.

For more information on barriers to green infrastructure, visit EPA's *"Barrier Busters" fact sheet series*.

Table 5. Regulatory Code and Ordinance Key Action Components and Timeline

Key Action Components	Timeline	2020 Status
Work with stakeholders and local officials to identify code and ordinance updates that would help meet Rochester's current regulatory (NPDES and AoT), environmental, and social goals.	Within five years	Complete
Review current local codes and ordinances and identify locations where there are opportunities to incorporate requirements that support resiliency.	Within five years	Not started
Update the city's site plan regulations, subdivision regulations, and Chapter 218 (Stormwater Management and Erosion Control) of the city ordinances, such that Chapter 218 details all stormwater requirements and the site plan and subdivision regulations reference these requirements. Having all the requirements in one place makes them more accessible and streamlined for the city and applicants. Include a provision requiring applicants to perform or reference a green infrastructure site suitability assessment and include it in their permit applications.	Within five years	Underway
Update Chapter 218 to meet 2017 New Hampshire MS4 and 2017 AoT requirements. The city could use the *Model Stormwater Standards for Coastal Watershed Communities* (prepared by the UNH Stormwater Center and the Rockingham Planning Commission) as a guide.	Within one year, and as necessary	Complete
Develop a report summarizing current street design and parking lot guidelines for managing new impervious cover in accordance with the MS4 permit in local codes and ordinances. This report will help the city identify barriers and/or gaps where revisions to the local codes and ordinances may be required to better manage runoff from streets and parking lots).	Within five years	Not started
Provide training to municipal staff and volunteer board and commission members on green infrastructure design, maintenance, and implementation to help them implement and enforce new codes.	Within five years	Not started
Update codes and ordinances to include an off-site compliance program for redevelopment (Section 4.3).	Within 10 years	Not started

Key Action Components	Timeline	2020 Status
Update codes and ordinances to include incentives for retrofits and redevelopment of private properties (Section 4.4).	Within 10 years	Not started
Review and update codes and ordinances to remove barriers to implementing green infrastructure and low impact development.	Within 10 years	Not started
Review codes and ordinances at least every 5 to 10 years to identify updates that would help meet Rochester's regulatory, environmental, and social goals.	Within 10 years	Not started

The following resources provide model language for local codes that allows, encourages, and requires green infrastructure in new development and redevelopment. The resources also can assist communities in evaluating their own codes to understand how they currently prevent, allow, encourage, or require green infrastructure practices in land development design.

The following are resources on evaluating local codes and ordinances for barriers to and opportunities for green infrastructure:

- *Barriers to Green Infrastructure in the Hudson Valley: An Electronic Survey of Implementers* (Hudson River Estuary Program, New York State Department of Environmental Conservation).
- *Green Infrastructure Barriers and Opportunities in Dallas, Texas: An Evaluation of Local Codes, Ordinances, and Guidance* (EPA 800-R-14-006, 2014).
- EPA's *Land Use and Green Infrastructure Scorecard* (EPA 833R23002, 2023).

The following resource contains example language to update local codes and ordinances:

- *Model Stormwater Standards for Coastal Watershed Communities* (Southeast Watershed Alliance, 2012).

4.2 Key Action—Update Standards of Infrastructure Design

Rochester's Standards of Infrastructure Design were last revised in 2018. They contain design standards for potable water, sanitary sewer, storm sewer, and highway infrastructure. The design standards lack requirements for stormwater management practices aimed at improving water quality and providing groundwater recharge. By updating the design standards, the city can customize them for stormwater management designs that fit the city's landscape and are easy to maintain. Updating the Standards of Infrastructure Design provides consistency and clarity to developers and engineers about which stormwater management practices they may incorporate into their projects. It can also reduce development project review time for the city and developers.

Standards of Infrastructure Design Should:

- Establish the minimum standards for the design of city infrastructure.
- Address issues related to construction, development, and redevelopment projects.
- Provide submittal requirements and approval processes for permits.
- Establish flow rates, runoff volume, and pollutant load/concentration and performance.

Table 6. Standards of Infrastructure Design Key Action Components and Timeline

Key Action Components	Timeline	2020 Status
Research existing stormwater design standards that the city may deem relevant, including the *New Hampshire Stormwater Manual*, New Hampshire *AoT Regulations, UNH Stormwater Center design and construction specifications,* and standards from other local municipalities.	Within five years	Not started
Update the Standards of Infrastructure Design to include stormwater management design and guidance consistent with local/state/federal regulations as well as Rochester's goals.	Within five years	Not started
Update the Standards of Infrastructure Design to include guidance on designing infrastructure to be resilient to changes in climate (e.g., temperature, flooding, precipitation, storm events).	Within 10 years	Not started
Update the Standards of Infrastructure Design to include green infrastructure and landscaping techniques with low maintenance requirements.	Within 10 years	Not started
Require public and private development projects within the city to follow the Standards of Infrastructure Design.	Within 10 years	Not started
Review and update the Standards of Infrastructure Design at least every 5 to 10 years to ensure they meet Rochester's regulatory, environmental, and social goals.	Within 10 years	Not started

For more information, see:

- *New Hampshire Stormwater Manual* (NHDES, 2008).
- *Alteration of Terrain (AoT) Regulations (Env-Wq 1500)* (NHDES Env-Wq 1500, 2017).
- *New Hampshire Small MS4 General Permit* (EPA, 2017).
- *UNH Stormwater Center* (UNH, 2021).

4.3 Key Action—Establish an Off-Site Stormwater Management Program

Rochester frequently grants waivers exempting stormwater management requirements for projects that cannot easily meet local, state, or federal stormwater post-construction requirements for water quality and quantity. Without careful planning, granting waivers could lead to a lack of stormwater management on waivered sites, leading to increased flooding and overwhelmed city storm sewers during storm events. When it comes to stormwater management, every drop counts.

This Key Action Helps Rochester:

- ✓ Meet regulatory compliance under the NPDES MS4 permit.
- ✓ Reduce the number of waivers issued for redevelopment projects.
- ✓ Meet Great Bay nutrient reduction goals.

The burden to maintain and upgrade city infrastructure to accommodate increased flows falls on the city. An off-site stormwater management program can help reduce this burden by allowing applicants who cannot meet the stormwater post-construction regulatory requirements on their sites to pay an in-lieu fee, purchase/use credits to meet requirements, or directly implement a stormwater management project at an alternate off-site location. For these options to meet the New Hampshire MS4 permit requirements, the resulting off-site stormwater management project must be implemented within the same watershed (U.S. Geological Survey Hydrologic Unit Code 10 or smaller) as the impacting project. This can help the city improve infrastructure and/or water quality to offset impacts associated with development. An off-site stormwater management program also provides additional compliance flexibility for applicants.

An off-site stormwater management program may include the following types of options:

- Direct off-site stormwater management: Pollutant removal requirements are met in a location other than the redevelopment site but within the same watershed (typically within the U.S. Geological Survey Hydrologic Unit Code 10 or smaller).
- Payment in lieu: The developer pays a fee to offset a redevelopment project's inability to meet the city's stormwater standards. The city ultimately uses this fee to implement improvement projects in the same watershed.
- Credit system: Developers can earn credits by exceeding stormwater management requirements. Credits generated can be traded, sold, or banked for future use. For example, a project that can treat a greater area than required would generate excess credits, which other project applicants in the watershed could then purchase.

Direct off-site stormwater management, item one in the list above, may fit into one of the options summarized in Table 7. Each option has its own level of complexity and involvement from city personnel. See additional resources about off-site stormwater management on *EPA's Alternative Site Stormwater Management website*.

Table 7. Off-Site Stormwater Management Program Options

Offsite Stormwater Options	Description	Role of the City	Level of City Involvement
Option 1: Developer-driven on private property	Developer initiates site identification, selection, design, construction, and maintenance with approval from the city.	Review and verify the activities of the developer. Ensure O&M agreements are in place and executed by developer.	Low
Option 2: Developer-driven on public property	Developer initiates site identification, selection, design, and construction with approval from the city.	Review and verify the activities of the developer. Provide O&M services.	Medium
Option 3: City-facilitated	City assumes an active facilitation role, possibly identifying and selecting projects.	Facilitate the process of identifying and selecting off-site projects, without assuming direct responsibility for design and construction (however, the city may guide design and construction). Ensure O&M agreements are in place and executed by developer.	High

Table 8 summarizes key actions that the city may consider, to develop and implement an off-site stormwater management program.

Table 8. Off-Site Stormwater Management Program Key Action Components and Timeline

Key Action Components	Timeline	2020 Status
Determine city motivation, drivers, interests, priorities, and resources for an off-site stormwater management program (e.g., reduce waivers, reduce burden on city infrastructure, provide opportunity to retrofit existing properties).	Within one year	Not started
Determine what program options meet the level of effort the city can commit (this may change over time).	Within five years	Not started
Determine city code and ordinance requirements that would need to be adopted to allow an off-site stormwater management program (e.g., enabling authority, bylaws, performance bonds to ensure stormwater management practices are installed correctly and properly maintained, maintenance agreements).	Within five years	Not started
Conduct a feasibility study for the off-site stormwater management program. The feasibility study should communicate the need, statistics on the frequency that city requirements aren't met, and the timing of the program. The study will help ensure city management, city leaders, and the public understand and support the program.	Within five years	Not started

Key Action Components	Timeline	2020 Status
Develop an off-site stormwater management program. This program may determine: how an applicant demonstrates an inability to meet requirements, the minimum level of onsite management required, the threshold at which off-site management is required, the types of management that are allowable (i.e., off-site, in-lieu fee), how to select locations for off-site stormwater management projects (if applicable), maintenance responsibilities for off-site stormwater projects, and program administration.	Within 10 years	Not started
Develop a regulatory framework for an off-site stormwater management program.	Within 10 years	Not started
Seek necessary approvals for an off-site stormwater management program.	Within 10 years	Not started
Develop a list of locations for off-site stormwater management projects or determine payment in lieu.	Within 10 years	Not started
Implement and enforce an off-site stormwater management program.	Within 10 years	Not started

For more information, see:

- *Guidance for Developing an Off-Site Stormwater Compliance Program for Redevelopment Projects in Massachusetts* (Center for Watershed Protection, 2018).
- *"Chapter 4: Framework for Evaluating Off-Site Mitigation Options"* in *A Watershed Approach to Mitigating Stormwater Impacts* (National Cooperative Highway Research Program, 2017).
- *Model Stormwater Standards for Coastal Watershed Communities* (Southeast Watershed Alliance, 2012).
- *EPA's Off-Site Stormwater Management website (includes descriptions, potential benefits, case studies, and other resources related to off-site stormwater management)*

4.4 Key Action—Establish Incentive Mechanisms for Using Green Infrastructure

Successful and comprehensive stormwater programs demonstrate flexibility and incorporate a variety of approaches to manage stormwater, such as infrastructure improvements, restoration, incentives, and regulations. Incentive programs are great tools for promoting voluntary implementation of stormwater controls on private properties. Incentive programs encourage property owners and developers who may not be required to manage stormwater—or who may want to reduce impact fees (if the city chooses to implement one)—to improve stormwater management on their properties. Incentive programs can also recognize voluntary efforts. Outreach efforts encouraging input from the private sector and residents may improve an incentive program.

Incentive programs may be implemented separately or in conjunction with regulations. An incentive program could allow Rochester to target priority areas within the city that have known stormwater

issues and introduce innovative technologies without creating additional mandates or regulations for private property.

Four types of incentive programs that encourage implementation of stormwater management include:

- Development incentives: Provide an expedited permit path if a project includes green infrastructure. Regulations could be written such that green infrastructure is authorized as the preferred stormwater management approach. Furthermore, if applicants propose to include gray infrastructure, they could be required to demonstrate the need for gray infrastructure approaches over green ones.
- Awards and recognition programs: Offer grants or recognition awards to encourage green infrastructure and better site design.
- Fee discounts: Offer a discount on an impact fee, utility fee, or tax (should the city choose to implement one) if a project reduces impervious cover or pollutant load from a property.
- Rebates and installation financing: Provide credits or funding that encourage creative solutions for reducing stormwater runoff. For example, the city may offer rain barrels for purchase to residents or materials to install rain gardens.

This Key Action Helps Rochester:

- ✓ Meet Great Bay nutrient reduction goals.
- ✓ Provide water quality treatment and reduce the volume of existing impervious cover.
- ✓ Reduce demand on the city's infrastructure.
- ✓ Reduce flooding in the city.
- ✓ Provide additional benefits for public health, aesthetics, heat island cooling, and air quality.

Green Permit Program, Chicago, Illinois

Chicago's Department of Construction and Permits has created an incentive that encourages developers to include environmentally conscious design elements by promising them savings in both time and money. Architects, developers, and building owners can be part of an expedited permit process by adding elements of green building strategies and technologies from a menu of items created by the Department of Construction and Permits; projects admitted into the Green Permit Program can receive permits in fewer than 30 business days, as opposed to the 60 to 90 days normally allotted for permit issuance. Participants that display a particularly high level of green strategy can possibly have consultant code review fees waived as well.

Innovative Stormwater Measures Rebate Program, Palo Alto, California

Palo Alto offers:

- ✓ A $50 rebate for the purchase and installation of a rain barrel to collect and harvest rainwater runoff from rooftops.
- ✓ A rebate of $1.50 per square foot for the installation of permeable pavement to reduce stormwater runoff from driveways, walkways, patios, and parking lots.
- ✓ A rebate of 15 cents per gallon for the purchase and installation of a cistern to collect and harvest rainwater from rooftops and site runoff.

Rebates are limited to $1,000 per single-family home and $10,000 for commercial/industrial sites.

Table 9 summarizes key steps that the city may consider, to develop and implement incentive mechanisms.

Table 9. Incentive Mechanism Key Action Components and Timeline

Key Action Components	Timeline	Status
Determine the motivation and drivers within the city for each incentive mechanism being considered.	Within five years	Not started
Research and review incentive programs (*see Tables 1 and 2* in *Managing Wet Weather with Green Infrastructure: Municipal Handbook—Incentive Mechanisms*).	Within five years	Not started
Determine the thresholds for participation in an incentive mechanism and the types of incentives for which a property owner/developer would be eligible.	Within five years	Not started
Conduct a feasibility study for incentive mechanisms. This study should include outreach (e.g., workshops, one-on-one conversations) to determine the goal of the incentive (e.g., reduce impervious cover, reduce stormwater volume), types of incentive mechanisms that would be applicable in the city to its private property owners, and the process for implementing each incentive.	Within five years	Not started
Develop an incentive program. This program may include identifying how an applicant receives an incentive, the threshold that determines compliance, the types of incentives that are allowable, and the maintenance responsibilities of implementation projects.	Within 10 years	Not started
Implement a communication and outreach plan to ensure that stakeholders are aware of the regulatory incentives and are encouraged to take advantage of them.	Within 10 years	Not started
Develop a regulatory framework for the incentive mechanisms.	Within 10 years	Not started
Create a brand name to distinguish the mechanisms for residents.	Within 10 years	Not started
Seek necessary approvals for each incentive mechanism.	Within 10 years	Not started
Implement incentive mechanisms.	Within 15 years	Not started
Train contractors to install, implement, maintain, and promote stormwater projects.	Within 15 years	Not started
Review and update incentive mechanisms every five years.	Within 15 years	Not started

For more information, see:

- *Five Types of Green Infrastructure Incentive Programs* (The Water Research Foundation).
- *Managing Wet Weather with Green Infrastructure: Municipal Handbook—Incentive Mechanisms* (EPA, 2009).
- *Five Communication Tips for Stormwater Incentive Programs* (University of North Carolina Environmental Finance Center, 2017).

5. Goal—Lead By Example: Integrate Green Infrastructure Into Public Projects

As outlined in the introduction of this plan, Rochester is working to integrate green infrastructure practices into the landscape throughout the city to meet broader community goals, while improving environmental outcomes via increased green space, better stormwater management, better water quality, and a variety of benefits that gray infrastructure practices do not offer. Using green infrastructure can help the city meet its MS4 permit requirements and protect and improve the health of its existing waters. Green infrastructure can provide welcoming environments in downtown central streets and tree-lined streets, traffic-calming via curb bump-outs, pervious pavements, green linkages to neighboring areas, dual-purpose open spaces for special events, and beautiful plants and scenery for all to enjoy.

With such a wide variety of green infrastructure practices to choose from, there is a practice for every setting, from a small sidewalk or right-of-way in the urban downtown area to an existing public park or parking lot. However, the most cost-effective and technically effective green infrastructure practices for the city will be those that are best suited to the physical site characteristics of a property, avoid existing site constraints, and are integrated into an existing public parcel (e.g., a park, parking lot, or streetscape) or planned public project. For example, the city could incorporate stormwater management into the types of public projects that it currently performs, as listed on its website: road safety improvements, the creation of public works facilities, roundabouts, sewer projects, and street area improvements.

This Key Action Helps Rochester:

- ✓ Reduce localized minor flooding.
- ✓ Improve aesthetics.
- ✓ Preserve and create public green space.
- ✓ Create and enhance habitat.
- ✓ Improve air quality.
- ✓ Reduce the heat island effect.
- ✓ Recharge groundwater.

As a starting point, the city plans to integrate consideration of green infrastructure into a public project design process and identify areas that are most suitable for green infrastructure. The key actions in this plan also support the following goals that are excerpted from Rochester's Downtown Master Plan:

- *"The most visible aspect of this initiative will be the changes to the roadways and streetscapes in Downtown, but these improvements should also signal the big changes that have taken place below the surface. This will be accomplished to some degree by integrating green infrastructure solutions that collect and filter stormwater and can accommodate large street trees.*
- *The city should evaluate the potential for green street investments to transform the public realm and create economic, social, and environmental benefits for all street users.*
- *Invest in a vibrant pedestrian realm by adding outdoor gathering spaces (plazas, etc.), seating, lighting, green infrastructure/landscaping/planters, bike lanes, and pedestrian pathways.*
- *Given that approximately half of Downtown is currently impervious surface, the Downtown's proximity to the river, the need for green space in Downtown, and the need to disconnect and update the stormwater infrastructure, there is a real opportunity for expanding green infrastructure in the Downtown area. Additionally, these techniques will assist the city in meetings its goals for MS4 permit compliance, which regulates stormwater pollution in cities.*

- *As streets are redesigned, plant street trees and construct other green infrastructure systems into the Downtown street network.*
- *Complete the design improvements outlined for the municipal parking lot located on Union Street, as outlined in the 2016 Greening America's Cities report.*
- *Identify pedestrian connections and green infrastructure projects that radiate from the Riverwalk."*

Current Stormwater Requirements for Public Projects in Rochester

Rochester is not required to install or evaluate whether green infrastructure is feasible for public projects such as streetscape improvements, park and open space improvements, road reconstruction, facility improvements, or public housing site renovations. Public projects are considered "traditionally governmental in nature" and are not required to conform to local regulations, including regulations that define the permitting process and design or performance standards (RSA 674:54 in the New Hampshire planning and zoning statutes). Regulating stormwater management for public projects occurs at the state level through the AoT rules (AoT, Env-Wq 1500). AoT rules only apply if the project disturbs more than 100,000 square feet of land or more than 50,000 square feet if any of the disturbance is within the protected shoreland subject to RSA 483-B jurisdiction.

However, the New Hampshire NPDES MS4 permit requires permittees such as Rochester to identify opportunities for stormwater improvements on public property to lay the groundwork for future implementation. City project managers and staff must take advantage of planned new development and redevelopment projects and identify ways to integrate green infrastructure into designs.

5.1.1 Leading by Example with the Public Project Design Process

Not only can publicly installed green infrastructure projects improve stormwater management and provide a multitude of benefits, but they also can serve as examples to others. Public projects, regardless of size, can be great opportunities for the city to demonstrate the process and benefits of using green infrastructure. All publicly installed green infrastructure can serve as pilot projects, providing learning opportunities for the city, the business community, and residents while also improving the community. Integrating green infrastructure into the design of planned public projects will increase green infrastructure's visibility in Rochester, which will help encourage private developers and property owners to use green infrastructure in their own projects.

5.1.2 Identifying Areas with the Most Suitable Conditions

Looking across an entire community to determine where green infrastructure will work best can be daunting, but a targeted search for existing areas with conditions suitable for green infrastructure practices can be immensely helpful. With a baseline understanding of where different types of green infrastructure may be suitable, Rochester can make more informed and timely decisions, which will increase the likelihood that green infrastructure practices are successfully installed as part of public projects.

Most communities implement green infrastructure as standalone projects. Institutionalizing procedures to look for and prioritize opportunities within existing and future planned projects is key to saving money and reaping multiple benefits from projects. Preemptively identifying areas that are

most suitable for green infrastructure can help determine where green infrastructure can make the biggest difference. Once the city identifies a refined list of areas, it can further investigate and develop design concepts for selected sites.

Table 10 below presents a stepwise list of key actions to integrate green infrastructure into public projects and identify suitable areas for implementation. The city should repeat these key actions regularly to continually evaluate priorities and identify opportunities as landscapes, city agendas, regulatory requirements, and development evolve.

Table 10. Public Project Green Infrastructure Key Action Components and Timeline

Key Action Components	Timeline	2020 Status
Identify public parcels and projects. Prepare and maintain a current list of upcoming municipal projects and public parcels.	Ongoing	Complete for 2019
Assess areas that are potentially suitable for green infrastructure. Pre-screen areas using GIS to assess suitability for different types of green infrastructure practices.	Ongoing	Complete for 2019
Investigate sites and develop design concepts. Perform a site investigation to verify the site conditions reflected in the GIS site suitability assessment, observe drainage conditions, and determine whether there are any other potential challenges or additional opportunities at the site. Sketch out concept designs for different green infrastructure improvements at the site, whether integrated into a larger project or simply undertaken as standalone retrofit projects.	As needed	Not started
Develop and update procedures to implement green infrastructure. Develop and regularly update an implementation plan for the various projects that are identified.	As needed	Not started
Develop an O&M plan for public green infrastructure. A plan ensures that O&M responsibilities for public green infrastructure practices are clearly identified, assigned, and tracked over time.	As needed	Not started

5.2 Key Action—Identify Public Parcels and Projects

5.2.1 Public Parcel Identification

As noted above, green infrastructure can be applied in a variety of settings, including public parcels. Incorporating green infrastructure into these public areas not only improves stormwater management in the community, but it also complements the architecture in the downtown area and brings a more natural appearance to some public spaces. Figure 6 shows the array of city-owned parcels and identifies the regulated MS4 area as a point of reference.

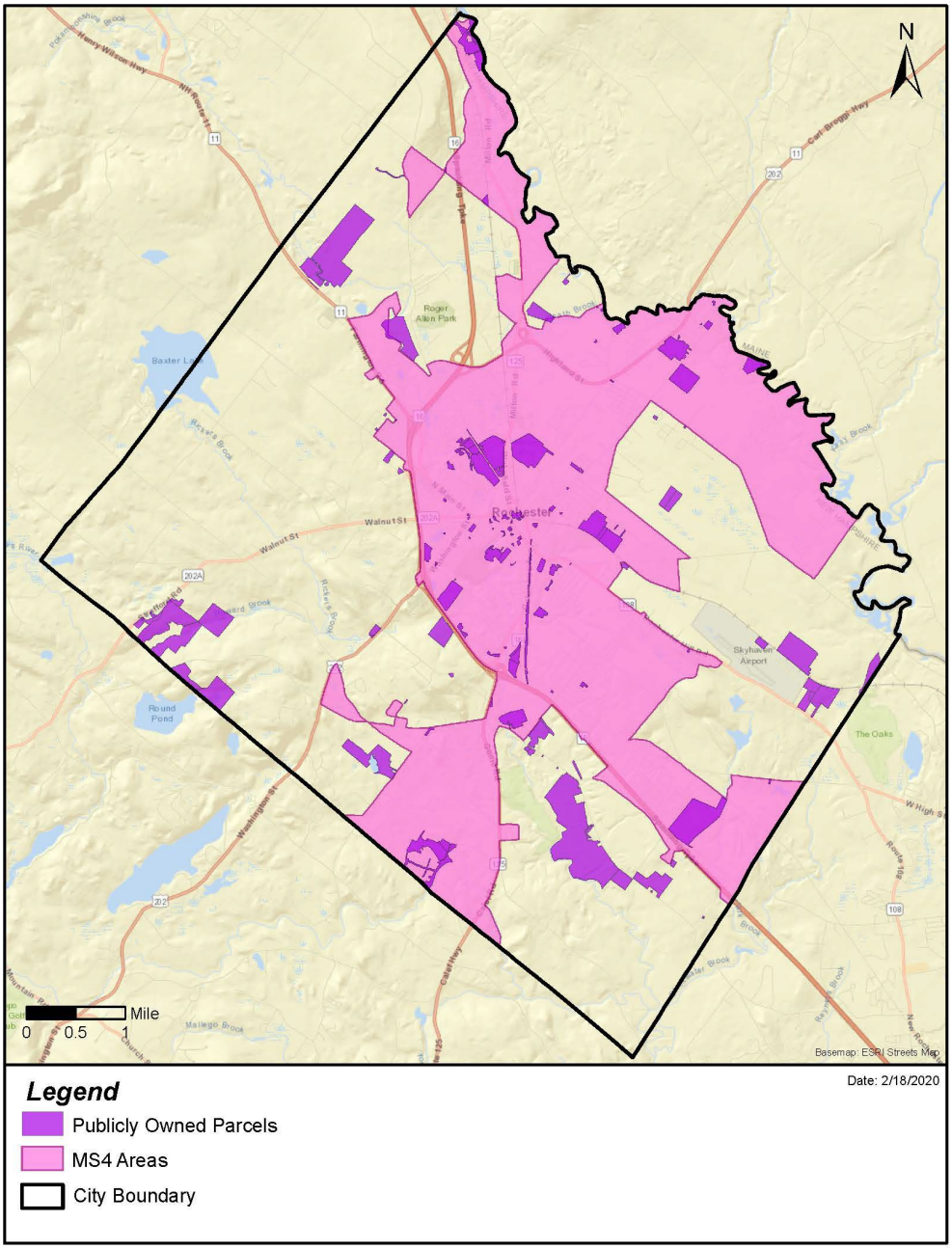


Figure 6. City-Owned Parcels and Regulated MS4 Area Map

5.2.2 Public Project Identification

Green infrastructure is an integral part of site design, rather than an afterthought to be tacked on at the end of the core project design. An important step in being prepared for green infrastructure implementation opportunities is to be actively aware of upcoming public projects and to consider whether those project sites, or portions thereof, might be suitable for green infrastructure. In this way, the city can integrate green infrastructure into the early stages of project planning, when site layout is

being contemplated. The city should look across departments to gain a more complete view of upcoming projects to determine if opportunities exist to incorporate stormwater management practices.

At the initiation of this stormwater planning process, Rochester staff identified a list of upcoming public projects that the DPW was planning for the next one to two years. These are projects that the city had already identified through prior processes and that DPW was beginning to pursue. These projects include streetscape improvements, construction of new facilities, and improvements to public lands for public parks and open space access. In identifying these projects, Rochester considered its capital improvement plan, public works projects on public property that were already in the department's workplan, and other municipal implementation plans that would guide upcoming public property improvements in the future. Rochester identified the following public projects to evaluate in this assessment:

- Wakefield Street reconstruction: This project site is on Wakefield Street, extending approximately from Chestnut Hill Street in the north down to Union Street in the south.
- Woodman Myrtle neighborhood: This is a network of roads, including short dead-end roads, within a small residential neighborhood surrounded by open space.
- Woodman Myrtle neighborhood (park element): At the end of the Woodman Myrtle neighborhood is an open space area next to the William Allen School that is partially bounded by the Cocheco River.

Figure 7 shows the three public project sites with delineated project boundaries where the city, through the DPW, is planning to undertake site improvements in the future.

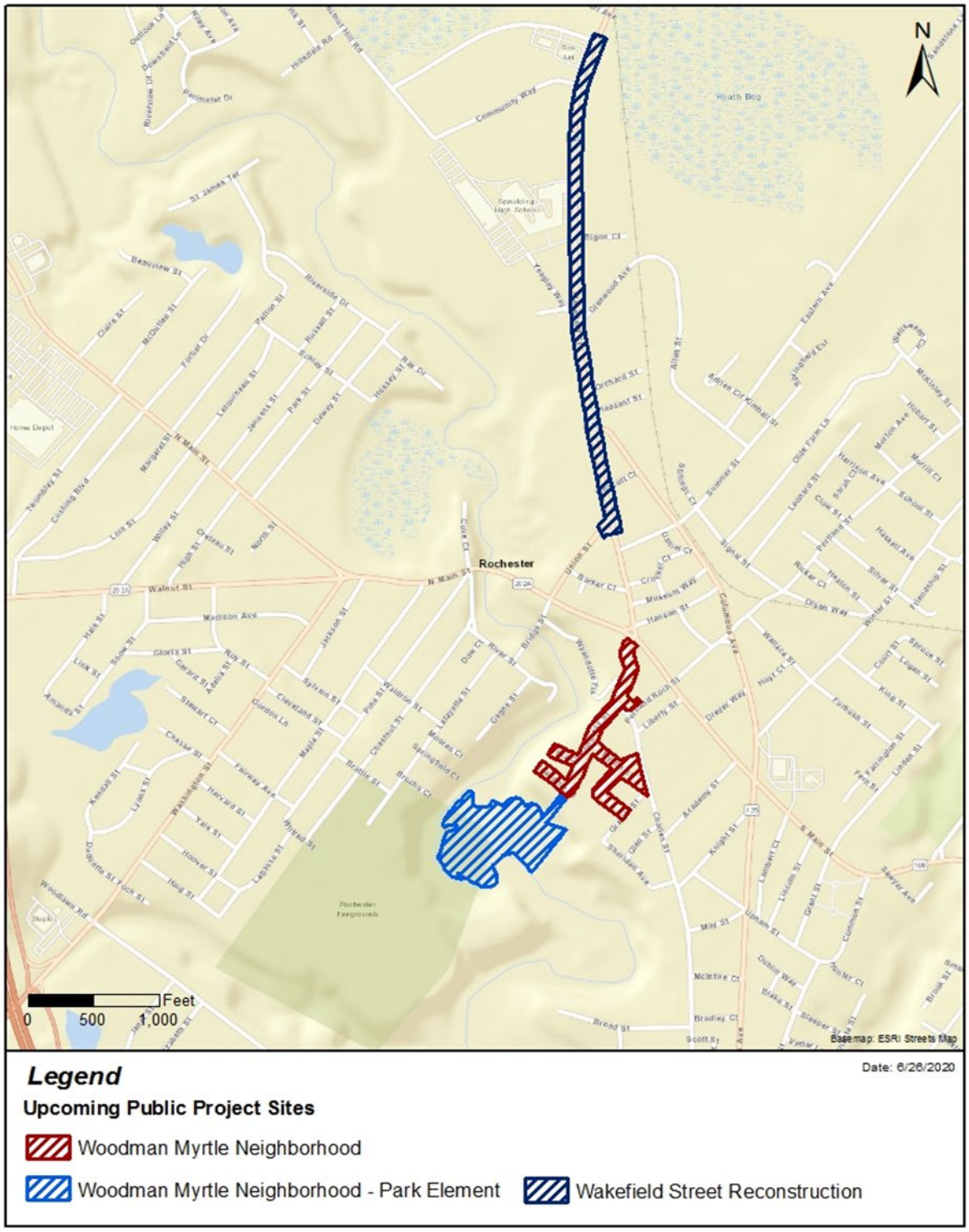


Figure 7. Upcoming Public Project Site Locations Map

An annual review and update of the projects list is recommended. Multiple city departments should update and contribute to this list, such as the DPW, Department of Recreation and Arena, Department of Buildings and Grounds, Department of Planning and Development, and School Department Building and Grounds Office, since those departments all undertake projects on public property. The project list should also include planned projects from the most current versions of city capital and master planning initiatives.

Include Green Infrastructure: It's Easier Than You Think!

Identifying projects with green infrastructure opportunities is easier than you think! The flexibility of green infrastructure design means that it can be a part of most projects. The site suitability assessment maps discussed in the next key action can be referenced to quickly identify locations for green infrastructure opportunities that overlap with capital improvement and master planning project sites.

A GIS map or other list that identifies upcoming planned public projects in the queue, as well as the responsible city departments, should be kept current and readily available to the various city departments. This will help to facilitate coordination and communication among departments so the city can readily identify and seize green infrastructure opportunities when they arise. The next key action describes how the city can identify and assess the potential suitability of parcels and proposed public project sites for different types of green infrastructure. This type of assessment will help the city more efficiently target its site investigation efforts for green infrastructure implementation.

5.3 Key Action—Assess Potential Site Suitability for Green Infrastructure

Not only can geographic information help the city understand where upcoming and potential city project sites are located, it can also help the city assess how suitable a site's physical characteristics are for green infrastructure. This type of assessment is a useful planning exercise because it allows the city to prioritize locations with greater suitability potential.

5.3.1 Rochester's Assessment Results

EPA conducted a desktop GIS-based site suitability assessment across the entire city. Appendix D provides the methodology to perform the assessment. The assessment looked at the suitability of sites for two different categories of green infrastructure—infiltrating and non-infiltrating practices—each of which relies on a slightly different set of site characteristics to function most effectively. The site characteristics considered in an assessment depend on the data availability, reliability, and accuracy for a given location, and generally include:

- Slope
- Hydrologic soil group
- Location within a buffer to a water body
- Flood zone or drinking water supply protection area
- Soil contamination
- Location relative to an impaired water body
- Existence of paved or pervious area

Infiltrating practices must be installed where underlying native or amended soil allows site stormwater runoff to soak into the ground. Many green infrastructure practices, such as bioretention areas, bioswales, and tree trenches, can be designed as either infiltrating or non-infiltrating practices to accommodate the specific site conditions where they are being installed (e.g., whether an underdrain system and/or liner is needed).

The assessment results are presented as maps, one for each category of green infrastructure, in which each pixel in the map grid is color-coded according to its calculated site suitability score. The assessment results are presented on a scale from least potentially suitable (red) to most potentially suitable (green) for the targeted category of green infrastructure practices. It should be noted that red color-coding does not preclude the successful installation of green infrastructure; it indicates the location may be less suitable based on the chosen criteria and desktop-screening compared to a location with green coloring. The site suitability score is a way for city staff to prioritize which projects and project locations to pursue further.

Figure 8 presents the mapped results of the assessment in Rochester. A GIS map has also been provided to the city. Areas in the east and west edges of Rochester are likely less suitable for infiltrating practices, primarily due to less permeable soils (hydrologic soil group D soil) and steeper slopes. Therefore, non-infiltrating green infrastructure may be better suited to those locations. There is a substantial opportunity for infiltrating practices in Rochester, including in the central downtown area and the north–south corridor in the center of each map.

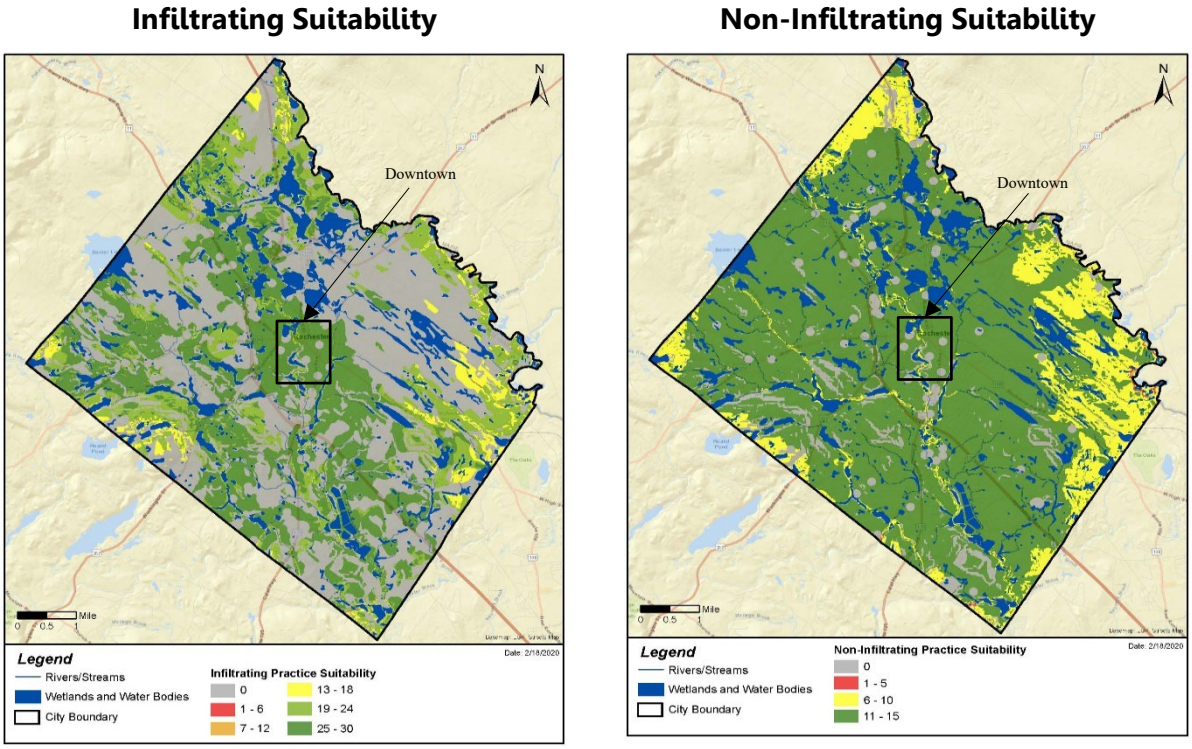
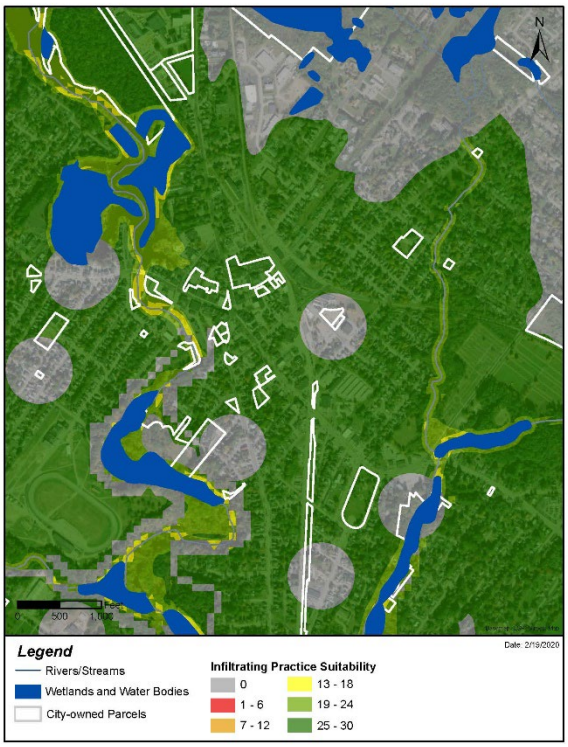


Figure 8. Infiltrating and Non-Infiltrating Practice Suitability Map

Rochester is particularly interested in understanding green infrastructure site suitability in its downtown area. In this area, green infrastructure opportunities can be more challenging to identify and implement due to dense development, even though these areas generate significant stormwater runoff. Figure 9 shows the green infrastructure site suitability assessment results for downtown Rochester. The public parcels are outlined in each map. In most cases, the city-owned parcels are suitable for both infiltrating and non-infiltrating practices, but in general, a broader area is suitable for non-infiltrating practices. This makes sense because the site characteristic criteria for infiltrating practices are slightly more constraining than those for non-filtrating practices. The good news is that the site suitability assessment identified a variety of green infrastructure options available for city-owned parcels. Ultimately, site visits and site investigations will further clarify these results when the city pursues a specific project location.

Infiltrating Suitability



Non-Infiltrating Suitability

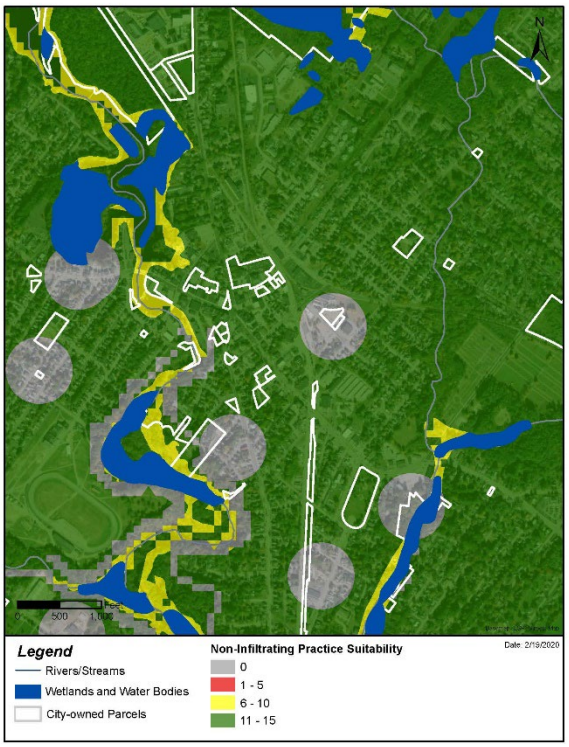


Figure 9. Infiltrating and Non-Infiltrating Green Infrastructure Suitability Results for Downtown Rochester

5.3.2 Continuing to Reference and Revise Assessment Results

As stated earlier, many municipal green infrastructure projects are undertaken opportunistically. For those cases, site suitability maps can provide a basic assessment of the project site, identify which category of green infrastructure practices may be best suited for the location, and identify where at the site to focus those efforts. The site suitability maps also indicate areas where the city could pursue retrofit projects or standalone green infrastructure demonstration projects due to the benefits and likelihood of successful installation.

The methodology may be used to assess both private and public parcels for potential site suitability for green infrastructure. The site suitability map can be a useful reference for private developers considering which types of green infrastructure practices might be suitable for their sites. The city can use these suitability maps to encourage private developers to consider green infrastructure practices in their designs in accordance with Chapter 218 of Rochester's local ordinance governing stormwater management and erosion control. The city can also use the maps to assist project designers as they develop concepts for stormwater management. If the city were to adopt an off-site stormwater management program within its local ordinance, this site suitability map could also assist in identifying off-site opportunities.

Aligning with Other Objectives

- Using the methodology presented in Appendix D to assess the potential suitability of sites for green infrastructure can directly help the city prioritize opportunities for stormwater improvements on public properties.
- Installing green infrastructure in public projects aligns with priorities in the city's stormwater management plan.
- A well-placed green infrastructure retrofit project serves as great public education resource.

Additionally, these assessment maps can help designers and planners to consider up front which types of green infrastructure practices might be best suited to the site. Green infrastructure can and should be integrated into site layout at an early stage in the design to ensure that the design preserves, takes advantage of, and places buildings outside of suitable areas to the extent possible.

To advise both private and public projects, it is recommended that Rochester continue to use this methodology and refine the data inputs as new data becomes available or community priorities change. For example, in Rochester, accurate depth to groundwater data was not available for the assessment. Such data can provide a useful additional criterion to evaluate site suitability for infiltrating green infrastructure practices, which often require a minimum clearance of 2 to 4 feet from the bottom of the practice to the seasonal high groundwater. If such data becomes available, the assessment could be redone to provide more accurate results. The maps do not need to be recreated for every project, but rather they can serve as a standing reference until new data is available or site conditions change considerably.

Many additional desktop tools and methodologies are available to help communities assess and plan for green infrastructure implementation. These tools require varied levels of technical knowledge and data input and are targeted to a variety of specific goals, mostly related to calculating the pollutant removal anticipated from a set of stormwater management practices.

One tool that may be of interest to Rochester is the EPA Region 1 Stormwater Optimization Tool (Opti-Tool). The Opti-Tool allows the user to evaluate options to determine the best mix of stormwater controls in a geographic area to achieve quantitative water resource goals.

Green Infrastructure Screening and Selection

The *EPA Green Infrastructure Modeling Toolkit* includes many tools and models to help communities identify and evaluate which green infrastructure practices and combinations could be effective.

The *Green Infrastructure Wizard* is a web application that provides communities with information about EPA green infrastructure tools and resources.

The *Watershed Management Optimization Support Tool* is a software application that allows users to screen a wide range of management practices for cost-effectiveness and economic sustainability.

Performance Simulation and Modeling

Visualizing Ecosystem Land Management Assessments is a computer software model to help regional planners and land managers determine which green infrastructure practice would be most effective for improving water quality in streams, estuaries, and groundwater.

The *Storm Water Management Model* is a simulation model that communities can use for stormwater runoff reduction planning, analysis, and the design of combined sewers and other drainage systems.

The *National Stormwater Calculator* is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). It allows users to learn about the ways that green infrastructure practices, like rain gardens, can prevent water pollution in their neighborhoods.

The *Green Infrastructure Flexible Model* is a computer program that evaluates the performance of urban stormwater and agricultural green infrastructure practices. Users can build conceptual models of green infrastructure to predict hydraulic and water quality performance under given weather scenarios.

EPA Region 1's *Opti-Tool* is a desktop application combining GIS and spreadsheet analysis that allows users to evaluate options and determine the best mix of structural stormwater management practices, including green infrastructure, to achieve quantitative water resource goals.

5.4 Key Action—Perform Site Investigations and Develop Design Concepts

Once potentially suitable sites are identified through the desktop GIS-based site suitability assessment, the next step is to investigate the sites to identify additional constraints and opportunities that may not be visible using GIS data alone. For example, data on the location of utilities may not be available in GIS but can often be readily observed at the site and may determine whether a green infrastructure practice is feasible at a specific location. In addition, a site visit may reveal a change in land use or slope that is not reflected in the latest GIS data or a stormwater-related impact, such as sediment buildup or erosion, that may influence the design or selection of green infrastructure practices. This site investigation is also an opportunity to begin sketching out

conceptual designs for potential green infrastructure practices at the site, particularly if the project is a retrofit or renovation of an existing site.

A conceptual design of a green infrastructure practice can range from a handwritten sketch using a Sharpie marker to an aerial photo or a sketch on a tablet with mobile GIS and sketch capabilities. The design should identify 1) a location that is the appropriate size for the proposed practice, 2) a feasible way to direct water into the practice, and 3) a feasible mechanism for discharging water from the practice via infiltration, underdrain connection to existing infrastructure, or overflow. The concept design should consider the estimated size of the contributing drainage area to the site and the basic treatment and/or detention volume. Even though the assumptions made in the concept sketch are estimates, a designer or engineer with stormwater management experience should make them.

Stormwater Management Opportunities Come in Many Functions, Shapes, and Sizes

Locations throughout New England use innovative approaches to integrate green infrastructure into developed landscapes. The restoration work in the *Berry Brook watershed* in Dover, New Hampshire and in the *Mystic River and Buzzards Bay Watersheds* in Massachusetts are examples of effective smaller-capacity stormwater control systems that provide water quality and other benefits. These case studies also demonstrate the process of evaluating pollutant load reduction and the cost-effectiveness of green infrastructure practices on the ground.

In keeping with the theme of leading by example, the city could also consider establishing a policy that green infrastructure practices on public properties should be designed to the same standards required for private projects. Therefore, any green infrastructure projects and the associated broader site improvements that the city undertakes—whether streetscape projects, park renovations, or new facilities—could strive to meet the performance standards in Chapter 218, including the revisions recommended in Section 4 of this plan.

5.5 Key Action—Develop and Update Procedures to Implement Green Infrastructure

The city can convert the green infrastructure site suitability assessment, site visit, and concept plan into action by developing procedures for implementing green infrastructure into public projects. Implementing green infrastructure requires funding, creativity, an understanding of municipal processes, and the ability to take advantage of opportunities when they arise. The city should revisit and update these procedures often—annually if possible, but at least every few years. These procedures will enable the city not only to be opportunistic with green infrastructure implementation as capital projects come along, but also to make standalone projects feasible.

The green infrastructure site suitability assessment described above and in Appendix D will produce a mapped list of potential green infrastructure implementation locations with recommended practice types and concept design sketches. This master list of green infrastructure projects within the city, a specific watershed, or neighborhood can serve as the basis for an implementation plan. Table 11 presents the city's list of public projects to demonstrate what the initial stages of the implementation plan might look like. Recommended green infrastructure practices were identified based on the area-

weighted average suitability scores for each project site (see Appendix D) and a review of the geographic distribution of suitability scores across each project site. An implementation plan following a more robust planning process could contain more detail, including implementation status tracking.

Multiple city departments should help develop the implementation timeline, such as the DPW, Department of Recreation and Arena, Department of Buildings and Grounds, Department of Planning and Development, and School Department Building and Grounds Office, since these departments all undertake projects on public property. The city can assign timeframes or actual implementation deadlines to these sites, based on how they align with known public project schedules or other development timelines. This implementation plan can also serve as a basis for grant applications, so the city is prepared for funding opportunities when they arise. The implementation timeline will be an estimate, but having a basic schedule helps keep the projects on the city's radar.

Table 11. Implementation Plan Template for Rochester Public Projects

Project Name	Recommended Practice1	Responsible Department	Timeframe
Wakefield Street reconstruction	This project site is well-suited for infiltrating or non-infiltrating practices. Permeable pavement might be considered along the roadway and/or sidewalks. Small surface filtration practices such as bump-outs with bioretention systems, tree trenches, and sand filters could be considered along the road right-of-way.	DPW	Short (one to two years)
Woodman Myrtle neighborhood	This project site is equally well-suited for infiltrating or non-infiltrating practices. Permeable pavement might be considered along the roadway and/or sidewalks. Small surface filtration practices such as bump-outs with bioretention systems, tree trenches, and sand filters could be considered along the road right-of-way. The aerial photograph of the site shows that the edges of the northern sections of the project along Myrtle Way are currently large connected paved parking areas; infiltration could be an innovative way to reduce and infiltrate the stormwater generated in these areas.	DPW	Medium (three to five years)
Woodman Myrtle neighborhood (park element)	This project site contains a central area that is suitable for infiltrating or non-infiltrating practices, although it is somewhat better-suited to non-infiltrating practices. This may be an appropriate location for a constructed wetland to treat runoff from adjacent paved areas, given it is within a forested park adjacent to an existing wetland system.	DPW, DRA, DBG[2]	Long (six to 10 years)

Table Notes:
[1] Recommended practices are advisory in nature. The ultimate recommendations would include specific practices following deliberations by the city.
[2] DRA: Department of Recreation and Arena, DBG: Department of Buildings and Grounds

The implementation timeline should be updated on an annual to five-year basis to note projects that have been implemented and add new projects to the list. New projects could be added by revisiting the desktop green infrastructure suitability assessment as needed, developing an updated list of

public projects where green infrastructure might be incorporated, performing site visits, developing concept sketches, and assigning a timeline for implementation.

5.6 Key-Action—Develop and Integrate an O&M Process for Public Green Infrastructure

Green infrastructure, like all infrastructure, must be maintained to function properly over time and provide the planned services and benefits. When the implementation plan (described above) identifies green infrastructure, the city should begin to consider who will be responsible for regular maintenance of the green infrastructure practice.

It can be difficult to centralize green infrastructure maintenance. Green infrastructure can cross the somewhat traditional boundaries between landscaping and drainage or highway infrastructure. Therefore, it can potentially fail to receive required maintenance because it does not completely fall within a specific category of operations. In addition, it can be challenging to designate one department responsible for maintenance because various green infrastructure may be dispersed throughout properties traditionally maintained or operated by different municipal departments, such as the DPW, Department of Recreation and Arena, Department of Buildings and Grounds, Department of Planning and Development, and School Department Building and Grounds Office. Some communities allocate green infrastructure maintenance responsibilities based on which department manages a parcel, and other communities allocate citywide maintenance responsibilities to one department, such as the DPW.

Regardless of who is responsible for maintenance, it is important to keep records of green infrastructure for which the city is responsible, just as for traditional infrastructure like streets and bridges. As part of that record, each green infrastructure practice should have a documented O&M procedure that identifies and records long-term responsibilities and activities. The O&M procedures should clearly define what the maintenance processes are, what equipment is required, and who is responsible for the maintenance. It is also helpful to include an estimate of the annual budget needed to perform the maintenance, so that the budget can be incorporated into the annual operating budget of the department and the city. This type of information is a key part of asset management (see Section 2). In addition, the city could develop a condition index and rating scale to document the condition of green infrastructure practices over time to help plan for repairs and replacement. Figure 10 shows an index and rating system currently used to index roadway pavement condition and aid in operations projections and budgeting (City of Rochester, 2017).

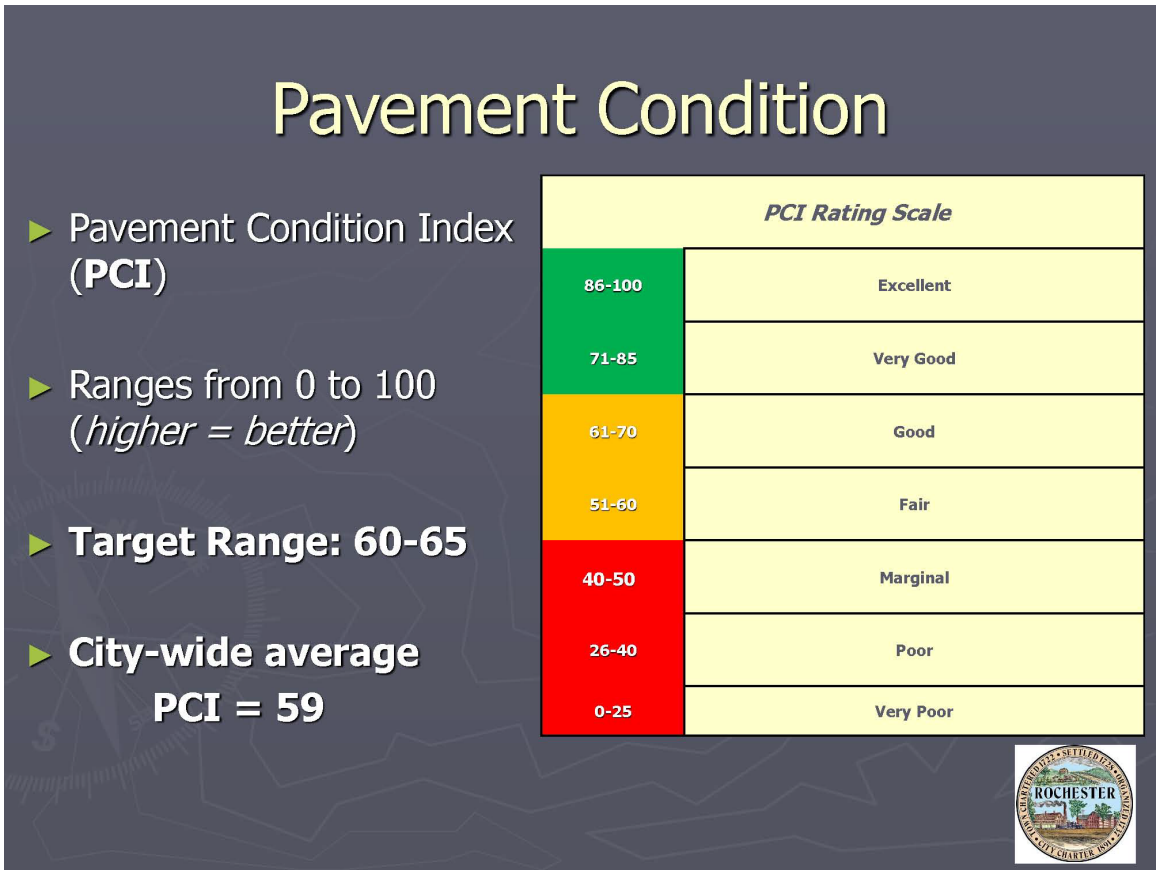


Figure 10. Pavement Condition Index and Rating Scale Currently Used in Rochester, New Hampshire

The city could consider using a worksheet like the one below to develop its asset management system:

Infrastructure Name/Code	Condition/Rating	Maintenance Schedule	Maintenance Type	Pollutant Load Reduction Estimates

The city should also track the pollutant-removal effectiveness of public green infrastructure. Rochester could use a tool such as the PTAPP online database, which is currently under development by the NHDES, the UNH Stormwater Center, and the regulated communities. The tracking element of this tool (data entry and database) is active and available for use by regulated communities; it allows communities to track impervious cover and stormwater management of new development and redevelopment projects. The pollutant accounting element is still under development.

6. Prioritizing Key Actions

Each of the key actions identified in this plan will help the city meet its long-term goals. Since Rochester cannot work on every key action simultaneously, the city could use prioritization metrics (examples in Table 12) to rank key actions and help identify which key actions to work on first.

Table 12. Prioritization Metrics

Metric	Definition
Positive community impacts	Long-term impacts that the key action will have on community members. Positive impacts may include preservation of open space, sidewalks, bike lanes, traffic calming, and addition of green space. A high ranking demonstrates a positive impact on the community.
Adaptability	Ability for the key action to adapt to long-term changes, including climate change, regulatory changes, and policy change. This metric also represents the key action's ability to be scaled within the community. A high ranking demonstrates that the key action has a high potential to adapt to long-term changes.
Strong community interest/support	Based on stakeholder input, strong support and interest from the community. A high ranking demonstrates that the community supports the key action and wants the city to pursue it.
Water quality improvement	Extent to which the key action benefits water quality and meets the city's regulatory and community goals. A high ranking demonstrates that the key action provides a great water quality benefit.
Addressing of environmental/social justice	The addressing of environmental and social justice issues, such as historical inequality, the protection of current uses by socioeconomic class, or effects on an already impacted area. A high ranking demonstrates that the key action will protect or address environmental and social issues.
Low capital cost	Implementation that requires a low capital cost from the city. A high ranking indicates that the key action has a relatively low capital cost, whereas a low score represents a higher capital cost for the city.
Minimal O&M	Implementation that requires a minimal level of effort for O&M from the city. A high ranking indicates that the key action requires minimal effort to operate and maintain.
Funding available	Availability of outside funds, such as grants or loans, to assist the city with implementation of the key action. A high ranking indicates that significant funding sources are available to the city.
Support for regulatory compliance	Helping the city comply with regulations, such as meeting nutrient targets under a NPDES wastewater discharge permit or NPDES MS4 permit. A high ranking indicates that the key action will assist the city in meeting its regulatory obligations.

Rochester could assign each metric an unweighted score of low (1), medium (2), or high (3). The city may choose to weight the metrics using a multiplier to distinguish those that may be more important based on community priorities. Table 13 is a template that the city could use to identify and summarize key action priority rankings. The first row is an example of what a completed row might look like after the city completes its priority ranking exercise.

Table 13. LTSW Plan Key Action Prioritization Template

LTSW Plan Goals	LTSW Plan Key Actions	Prioritization Metrics (H = High; M = Medium; L = Low)									Key Action Priority Score
		Positive Community Impacts	Adaptability	Strong Community Interest/ Support	Water Quality Improvement	Addressing of Environmental/ Social Justice	Low Capital Cost	Minimal O&M	Funding Available	Support for Regulatory Compliance	
Example Goal	*Example Key Action*	*H (3)*	*H (3)*	*L (1)*	*L (1)*	*L (1)*	*L (1)*	*M (2)*	*H (3)*	*M (2)*	*17 M*
Asset management program	Develop and implement an asset management program to evaluate asset condition, performance, value, remaining useful life, and replacement cost										
Finance	Assess revenue and expenditures										
	Evaluate funding and finance options										
	Integrate life cycle costing into the planning process										
Development and redevelop-ment policies	Update regulatory codes and ordinances										
	Update Standards of Infrastructure Design										
	Establish an off-site stormwater management program										
	Establish incentive mechanisms for										

LTSW Plan Goals	LTSW Plan Key Actions	Prioritization Metrics (H = High; M = Medium; L = Low)									Key Action Priority Score
		Positive Community Impacts	Adaptability	Strong Community Interest/ Support	Water Quality Improvement	Addressing of Environmental/ Social Justice	Low Capital Cost	Minimal O&M	Funding Available	Support for Regulatory Compliance	
	using green infrastructure										
Integrate green stormwater management practices into public projects	Identify public parcels and projects										
	Assess potential site suitability for green infrastructure										
	Perform site investigations and develop design concepts										
	Develop and update procedures to implement practices										
	Develop an O&M plan for public green infrastructure										

Rochester would then assign a score to each metric based on its high, medium, or low designation and chosen weighting (if applicable). For each key action row, Rochester would sum the scores of each metric to obtain a key action priority score. With nine metrics, the range of key action priority scores is from 9 (if every metric was given a low priority of 1) to 27 (if every metric was given a high priority of 3). Rochester could then identify which key action priority scores equate to an overall low, medium, or high priority for implementation (see Table 14 for an example breakout).

Table 14. Example Score Ranges for Priority Score Ranking

Key Action Score Range	Key Action Priority
9 to 14	Low
15 to 19	Medium
20 to 27	High

This prioritization exercise can help the city stagger and organize the implementation of key actions based on ranked priority. The city may choose to revisit the prioritization ranking process as needed to adjust the metrics or weightings based on Rochester's current needs and priorities. This process is meant to be iterative throughout the implementation of key actions to support the long-term stormwater planning process.

7. Integrating Community Feedback Into City Decision Making

Stakeholder engagement and outreach are essential to successful implementation of community policies and programs. Effective and deliberate stakeholder engagement is an overarching keystone of this plan. Identifying key stakeholders and then thoughtfully involving those target audiences opens channels of communication that allow the city to fully consider community members' views. Rochester should make stakeholder engagement an integral piece of each key action to achieve the larger long-term stormwater plan vision. See Table 15 for an excerpted list of stakeholder categories.

In 2018, Rochester participated in a **Greening America's Community** project. See Appendix B for a project description summarizing the engagement and resulting design options the city may pursue.

Table 15. Categories of Stakeholders

Stakeholder Category	Description	Examples
People who live, work, play, or worship at or near a resource	Those whose everyday lives and well-being are directly connected to a resource or issue. This group is essentially made up of the "neighbors" of the issue, and they should be invited to participate because their everyday lives may be impacted.	Residents, resource users, businesses, community and civic organizations, interest groups and nongovernmental organizations, government, and Native American tribes
People interested in the resource, its users, its use, or its non-use	Those who assign values to a resource and are concerned about the ways resources are used. This group includes those who extract value from resources, as well as those more interested in conserving or protecting resources. This group should be invited to participate because of sheer interest in the resource or issue.	Businesses, resource users, interest groups and nongovernmental organizations, community and civic organizations, government, and Native American tribes
People interested in the processes used to make decisions	Those deeply interested in the legal and procedural aspects of an issue. This group includes those who want to ensure that all relevant policies and procedures are observed in reaching a decision. They should be involved because of their attention to procedural detail and their ability to derail a process or litigate final decisions.	Interest groups and nongovernmental organizations, government, the media, residents, and Native American tribes
People who are financially involved	Those whose money is directly or indirectly used to fund resource management through taxes, fees, and other means. This group wants to ensure that money is spent wisely and should be invited to participate because the government is accountable for how it spends public dollars.	Residents, resource users, businesses, and government
People who represent citizens or are legally responsible for public resources	Those who have the legal authority and obligation to manage natural resources. Members of this group want to ensure the best final decision is reached and should be invited to participate because it is their duty.	Government

Source: NOAA, 2015, Table 1

Effective approaches to public engagement differ depending on where a community is in the planning process. For example, at the beginning of developing a plan, stakeholder engagement can (and should) be open-ended so as not to limit feedback and instead allow active listening. Residents,

business owners, and advocates can share their ideas and opinions in a way that is open, presenting a broad range of feedback. This is the "listening phase" in the plan development process, where policymakers and other leaders step back to let stakeholders put forth their ideas and priorities and express their concerns. The community can then consider that feedback to develop a plan. Once the community develops a plan and approves an action agenda, the nature of public engagement changes. Assuming the plan reflects what was discussed earlier in the process, engagement shifts to maintaining awareness, fostering support, and building capacity within the community to get things done.

The city of Rochester's long-term stormwater plan provides a platform for implementation. The city has developed a list of key actions, and the community must now build support and capacity toward executing these strategies. Engagement will therefore require a multi-layered approach. On one level, the city needs to continue communicating an overarching message about the importance of and the benefits associated with stormwater management. On another level, the city needs to develop engagement strategies specifically designed to execute individual key actions from the plan. Many of the strategies developed in this plan could fall short or fail if the community in and around Rochester does not maintain a shared sense of values regarding stormwater management. Political officials and city management are expected to seek funding and staff resources to move various initiatives forward. Without general widespread support from the community, these items may not make it into the city budget, stormwater projects may not be prioritized, and valuable opportunities may be lost.

As part of its efforts, the city should explain why action is necessary, what improvements the community can expect to see, and how the city will fund the actions and implement multifaceted cost-saving approaches as much as possible. As a first action, Rochester should identify the groups and individuals to engage.

7.1 General Awareness and Education

A general awareness and education campaign, as the name suggests, is designed to connect with the public on a regular basis using a variety of media and different methods of engagement. This type of engagement is used to reach the greatest number of people with the clearest message. As a result, crafting and effectively deploying key messages can be challenging.[7] Developing targeted key messages and organizing outreach activities (e.g., in-person events, surveys, social media) can build awareness about the long-term stormwater plan and key actions, inform the public about the city's activities, communicate the value and benefits of the proposed strategies, access local knowledge and experience, create buy-in for infrastructure investment expenditures, and identify potentially contentious issues or deal-breakers.

Developing Key Messages

The city of Rochester will need to identify a short series of key messages that remain consistent over the course of public discussion. When developing key messages, the city should consider what will

[7] A general awareness and educational campaign has the principle of "broad appeal" at its core. This approach is in contract with *targeted* awareness and educational campaigns, which are discussed further below.

resonate with residents, business owners, and decision-makers over the long term and what type of messages will reach the broadest audience. The messages should:

1. Frame the problem: Depending on the audience, there are many ways to define the problem related to stormwater, and the city should carefully consider its options. For example, it may be tempting to frame the problem as a compliance issue related to MS4. While compliance is clearly a benefit from the long-term stormwater plan, framing the overarching problem in this manner may not connect with the average resident or business owner; however, it would be important to include if talking to city officials. If talking with external groups, an alternative way to frame the problem is to focus on the Cocheco River and other places tied to the city's rich history, local arts, and traditions. For example, the Cocheco River runs through the center of the city and is a prominent resource that many people value highly; 'making the river healthy' is a way of framing the problem that may connect more personally with a broad audience.
2. Identify the source of the problem: This message focuses the audience on stormwater management and is therefore critical. When crafting this message, it is important to pay close attention to the language being used and to stay away from words that the broadest audience may not clearly understand. As an example, compare the two statements in the text box:

> ***Statement 1****: Stormwater runoff collects heavy metals, bacteria, nutrients, and other pollutants as it travels across impervious surfaces during a rainstorm. Much of the stormwater runoff generated in the city eventually travels to the Cocheco River, loading the river with high levels of pollutants that can impair water quality, create human health risks, and compromise aquatic habitat.*
>
> ***Statement 2****: When rain falls on rooftops and city streets, it runs down the road and through pipes to the Cocheco River. Along the way, this "stormwater runoff" picks up pollution and eventually carries it into the river. Stormwater runoff often makes the river unhealthy and unsafe. It is the number one source of pollution to the Cocheco River.*

While the content of both statements is accurate, the second message will be much more effective at reaching the broadest audience and "connecting the dots" between stormwater and the river's health.

- Identify the benefits of fixing the problem: When thinking about benefits, the most obvious place to start is by answering the problem statements already developed as key messages. For example, regarding water quality:
  - Treating stormwater will address the number one source of pollution in our rivers and streams.
  - Cleaner rivers, streams, and ponds are beneficial to wildlife and provide us with places to swim, boat, and fish.

These messages are also an opportunity to expand the discussion and introduce ideas that the average resident or business owner may not consider but that are important to city decision-makers and officials:

- The city is legally bound to comply with its MS4 permit.
- An important component of stormwater management will include "greening" the city with additional trees and landscaped areas that help to manage stormwater runoff.

These key messages will help establish a collective understanding of the issue. Stakeholders will be able to focus on a clearly stated and easily defined problem, understand the cause, and be ready to hear about potential solutions.

7.2 Deploying Key Messages

7.2.1 Techniques

In a general awareness and education campaign, getting key messages out into the public realm occurs regularly through a variety of channels. The channels chosen for a long-term stormwater plan will vary and shape the presentation and format of the messages.

Table 16. Different Techniques to Deploy Key Messages

Media	Description	Pros	Cons
Social media	Using Facebook, Instagram, Twitter, or other platforms to post key messages (or portions of key messages).	Very low cost. Ease of implementation. Quickly digestible message. Potential to access high numbers of people in a very short period.	Difficult to control the conversation. Consider using social media exclusively to direct people to the website. Older audiences may not participate in social media.
Local newspaper/ community newsletter	Publishing op-ed pieces or feature series.	Very low cost. Potential to reach an audience that is not social media-savvy. Ability to circulate stories and op-ed submissions using social media or the website.	Can generate negative content once on social media. Some people may not read articles or op-ed submissions.
Special events	Having educational stations and materials at special events with high foot traffic; one-time events or more frequent events (e.g., farmers' markets).	Printed material combined with face-to-face engagement. Personal interaction to reinforce key messages.	Exposure can be limited depending on how often the event occurs and how many people attend. Printed material can be expensive.
Local access television/ radio	Interviews on local-access radio shows or pre-recorded ads that convey key messages.	Very low cost for appearances. High level of exposure if local television or radio are popular.	May be difficult to secure an appearance. Producing short videos requires expertise and can be expensive.
Posters/fliers	Posters or fliers posted in high-foot-traffic areas or at public transit locations.	Potential to be visually compelling and establish a project brand. Effective way to publicize the website and key messages.	Designing high-quality posters and fliers requires expertise. Printed material can be expensive.

Media	Description	Pros	Cons
			Static material can become outdated.
Website	A dedicated website for the stormwater plan that puts general key messages "out in front."	Low cost. Highly accessible and visually compelling resource. Adaptability over time.	Web design and maintenance requires some expertise.
Listserv group	A group of email addresses designated to receive periodic announcements about a particular issue.	Low cost. Easy sign-up via the plan's website. Ability to deliver content from other media types (news articles, social media posts, etc.) through email.	May take time to develop a high volume of participants.

Partnerships

Raising awareness and educating the public about issues like stormwater management is easier if there are partners willing and able to help. Organizations that use many of the techniques listed in Table 7-1 already exist, and the city can discuss with them how to share resources to bolster efforts.

Rochester is heavily involved in collaborative efforts throughout the Piscataqua–Salmon Falls Watershed. As a member of the Seacoast Stormwater Coalition, Rochester works with other communities in the region to meet NPDES MS4 permit requirements. Rochester is also a member of the Piscataqua Region Estuaries Partnership (PREP), which works to protect water quality and habitat in the Great Bay and Hampton Seabrook estuaries. PREP has developed a five-year plan titled *Great Bay 2020,* which identifies long-term goals and strategies to support a healthy estuary, based on collaborative science and environmental stewardship (PREP, 2018).

As part of its general campaign for awareness and education, the city can collaborate with these other organizations in a variety of ways. Table 17 lists the techniques from Table 16 with descriptions of how collaboration might work.

Potential Partners in Engagement and Education

- ✓ Community: City of Dover, City of Portsmouth, Farmington.
- ✓ Local: Riverwalk Committee, Recreation Department, Public Works Department, Police Department, Community Development Director.
- ✓ Federal: CWSRF (NHDES), U.S. Department of Housing and Urban Development (HUD).
- ✓ State: NHDES, UNH, Southeast Watershed Alliance.
- ✓ Regional: Seacoast Stormwater Coalition, Salmon Falls River Watershed Collaborative, New England Environmental Finance Center, Great Bay Community College, PREP.

Table 17. Collaboration Opportunities for Different Engagement Techniques

Media	Description
Social media	Groups can follow one another, connect through hashtags, and share each other's posts.
Local newspaper	Groups can develop op-eds collaboratively (co-author) or, if there is a series of articles, takes turns leading authorship.
Special events	Groups can share table/display space and share costs where appropriate.
Local access television/radio	Individuals from two or more groups can appear together in interviews or serve on a panel. Where appropriate, groups could share costs to produce educational videos.
Posters/fliers	Other groups may have access to graphic designers or printing infrastructure that could be shared.
Website	The city's website (or webpage) could link to other groups and vice versa.
Listserv group	Different groups generally do not share email lists. However, groups can forward emails or encourage members to sign up for multiple lists.

7.3 Targeted Awareness and Education

The goals of general awareness and education campaigns include keeping issues "fresh" within the community, focusing the message, and educating people that may be new to the issue with fundamental facts and messages. This type of awareness campaign should be consistent and consider the level of effort needed to be successful. However, when implementing the long-term stormwater plan, there will be many times when engaging different groups and individuals becomes critical to executing one or more of the strategies within the plan. These stakeholders may have very specific interests or concerns that need to be addressed, and the engagement strategies used in these situations must be tailored to those interests. For example, a city manager may be interested in the plan's financial impacts, high school students may be interested in recreation opportunities, and homeowners may be interested in possible fee changes. To understand the full range of interests and concerns, it is important to review the strategies in the plan and attempt to identify the different stakeholders and their interests for each one.

The key actions in this long-term stormwater plan fall under four goals, and each requires support at different levels within the community. Table 18 shows the four goals and the key actions associated with each. For each goal and key action, the primary decision-makers and other interested parties are identified. Using these as target stakeholders, a potential list of suitable strategies is provided. This table is for illustration purposes and should be used and modified by city staff moving forward.

Table 18. Sample Matrix Connecting Stormwater Implementation Strategies to Stakeholder Interests and Engagement Strategies

Goal	Key Action(s)	Primary Decision-Makers	Example Groups to Work With	Potential Engagement Strategies
Develop and implement an asset management program	Fund and perform the study	City manager, city council	Taxpayers, mayor, other city departments with assets to manage	1. Develop basic educational material for public consumption that describes what an asset management program is and how it will benefit Rochester. Distribute via appropriate media. 2. Task contractor hired to develop the asset inventory with educating all relevant departments. 3. Provide regular, short reports and face-to-face updates to the city manager, mayor, and city council on the progress of the study.
Sustainably fund the city's stormwater program	Assess revenue and expenditures Evaluate funding and financing options Integrate life cycle costing into the planning process	City manager, city council, DPW	Taxpayers, legal department, other city departments with activities that can provide co-benefits	1. Develop basic educational material for city council explaining why this is important. Build on key messages from general awareness campaign. Distribute via appropriate media. 2. Develop a list of benefits that connects with each interested party. 3. Develop a public survey to gauge opinion relative to different financing mechanisms. 4. To the extent possible, package the results of this investigation in a summary document that presents clear aggregate expenditures related to a stormwater program. Answer the question "How much will it cost, and what will we gain from it?" 5. Develop case study examples of other community programs to provide credibility. 6. Provide examples of funding mechanisms and why they may or may not be good fits for Rochester (see funding source table). 7. Provide regular, short reports and face-to-face updates to the city manager, mayor, and city council on the progress of the study. 8. Conduct public educational sessions that provide opportunity for Q&A. 9. Develop a newspaper article to educate readers and consider an appearance on local television or radio. 10. Use e-blast announcements to drive readers to the website where educational material is posted.
Improve development and redevelopment policies	Update regulatory codes and ordinances	Planning board, city council	Mayor, developers, property owners, environmental groups, Office of Economic and Community	1. Develop basic educational material for city council explaining why this is important. Build on key messages from general awareness campaign. Distribute via appropriate media. 2. Develop a list of benefits that connect with each interested party. 3. To the extent possible, package the results of this research in a summary document that presents clear aggregate expenditures

Goal	Key Action(s)	Primary Decision-Makers	Example Groups to Work With	Potential Engagement Strategies
	Update Standards of Infrastructure Design	Planning board, DPW	Development, Conservation Commission, Codes and Ordinances Committee, city legal department	related to a stormwater program. Answer the question "How much will it cost, and what will we gain from it?" 4. Develop case study examples of other community programs to provide credibility. 5. Provide examples of funding mechanisms and why they may or may not be good fits for Rochester (see funding sources in Section 3). 6. Provide regular, short reports and face-to-face updates to the city manager, mayor, and city council on the progress of the study. 7. Develop a newspaper article to educate readers and consider an appearance on local television or radio. 8. Use e-blast announcements to drive readers to the website where educational material is posted.
	Develop an off-site stormwater compliance program	City manager, planning board, city council		
	Implement incentive mechanisms	City manager, planning board, city council, DPW		
Integrate green infrastructure practices into public projects	Identify public parcels and projects	City manager, DPW, Buildings and Grounds, Parks and Facilities, Conservation Commission	Taxpayers, mayor, Public Works and Buildings Committee, schools, neighbors next to parks	1. Publicize the selection of sites along with a schedule for improvements on all applicable media (e.g., website, social media, e-blast). 2. Provide regular, short reports and face-to-face updates to the city manager, mayor, and city council on the progress of the study. 3. Conduct public site visits and neighborhood meetings where improvements will be made.
	Assess potential site suitability			
	Research and develop design concepts			
	Develop green infrastructure procedures			
	Develop an O&M manual for green infrastructure projects			

7.4 How Is Successful Stakeholder Engagement Measured?

Stakeholder engagement is often an exercise in trial and error. While the city of Rochester has engaged the public for other initiatives, the city may need to assess and perhaps revise techniques that have been effective in the past to maintain effectiveness. Over the course of implementing the long-term stormwater plan, the city will need to measure the success of stakeholder engagement and outreach. It can be difficult to directly measure the success of stakeholder engagement in stormwater management or water quality outcomes because there are so many contributing factors. However, the effectiveness of stakeholder engagement efforts can be assessed by how well efforts reach the targeted stakeholders. Using various metrics to measure the success of stakeholder engagement will help the city assess whether it needs to take a different approach or make a correction mid-course. Metrics to consider include:

- Media tracking and social media impressions—number of articles placed in local and regional media both supporting and opposing city initiatives; social media posts (Twitter, Facebook, etc.).
- Document downloads—number of views/downloads of documents from a website.
- E-blast monitoring—number of "opens" and "reads."
- Meeting attendance and contact information collection (if willing to share)—number of attendees at public meetings.
- Public comment tracking, if applicable—number collected, broken down by positive/negative.
- Survey responses, if applicable—number of responses and percentage of positive/negative.

7.5 Executing the Engagement Plan

The city plans to conduct stakeholder outreach throughout the long-term stormwater plan's implementation. This will include both general and targeted engagement, as needed. Throughout the process, Rochester may need to update its stakeholder list, identify new stakeholders, refine key messages, and alter engagement tactics to remain effective. New products will require development (e.g., posters), website content will need revision, the city council and other groups will need updates, and numerous other activities will be required.

To assist with long-term stakeholder outreach, the city may choose to develop a formal stakeholder engagement strategy document that outlines the city's approach to the steps described in Sections 7.1 through 7.3. This document can use the tables provided in these sections as a starting point, but it would require regular review and revision as conditions change. Ultimately, the city would identify responsible parties for each of the strategies identified in the plan, and one individual or a small group would provide oversight. This group could comprise a new long-term stormwater plan implementation committee or a less formal "engagement team." Responsibilities could include, but would not be limited to:

1. Developing and revising key messages.
2. Developing and maintaining a formal stakeholder engagement strategy that includes feedback mechanisms to periodically check in with stakeholders for any revisions.

3. Executing a general awareness and education campaign.
4. Identifying additional partners interested in assisting with the engagement strategy.
5. Identifying target stakeholders for both general and targeted engagement as needed.
6. Assigning responsibilities and continuing to revise the roles of different team members and engagement partners as they relate to the stakeholder engagement strategy.
7. Measuring the success of different engagement strategies and revising as necessary.

8. Continually Assess and Improve Where Needed: Evaluate the Effectiveness of Plan Implementation

To make meaningful plan modifications and track progress over time, Rochester should develop a process to periodically evaluate the performance and success of the outcomes from each key action. Establishing performance criteria and metrics for each key action and then tracking metrics will allow the city to evaluate overall plan effectiveness. Understanding effectiveness will help the city:

- Make operational decisions.
- Evaluate whether goals are being achieved.
- Identify priorities and the best uses of resources and aligning budgets.
- Provide accountability on how well a goal or program is functioning over time.
- Provide information needed for grant applications.
- Facilitate communication among different stakeholders.
- Provide a framework to integrate wastewater and stormwater planning and goal-setting processes.
- Track cost savings from key action implementation.

The city may continue to identify opportunities to update key actions and integrate new community goals based on the city's evolving priorities. Throughout the implementation of this plan, the city may engage with stakeholders to convey the benefits and performance of the plan as progress is made toward each goal. Table 19 presents examples of performance criteria and measurements of effectiveness.

Aligning with Other Objectives

Long-term stormwater plan metrics may also be applicable to MS4 annual reporting and tracking requirements.

Table 19. Examples of Key Action Performance Criteria and Effectiveness Measurements

Key Action Example	Performance Criteria Example	Measurement of Effectiveness Example
Develop an asset inventory	Development and use of a comprehensive database of the stormwater management assets in the city.	Total number of stormwater and green infrastructure practices that the city has mapped and inventoried. Percentage of stormwater and green infrastructure practices that the city has mapped and inventoried. Amount by which the number of stormwater and green infrastructure practices in good/excellent condition exceeds those in poor/failing condition. Pollutant load reductions due to stormwater management practices implemented.
Update regulatory codes and ordinances	Increase in the number of green infrastructure practices installed on privately owned land.	Number of green infrastructure practices installed.

Key Action Example	Performance Criteria Example	Measurement of Effectiveness Example
	Reduced nitrogen and total suspended solids loading.	Acres of new development and redevelopment projects implemented according to updated regulatory codes and ordinances.
Update Standards of Infrastructure Design	Decrease in project review time by the city.	Amount of time it takes to review projects.
Establish an off-site stormwater program	Decrease in number of stormwater management waivers issued by the city for redevelopment projects.	Number of waivers issued by the city to applicants who can't meet stormwater management redevelopment criteria. If the city establishes an off-site stormwater program, metrics like: Number of sites that participate in the off-site stormwater program. Pollutant load estimates from sites participating in the off-site stormwater program.
Implement green infrastructure on public parcels	Increase in the number of green infrastructure practices installed on publicly owned land.	Number of green infrastructure practices installed.
	Decrease in the number of directly connected impervious acres on publicly owned land.	Number of impervious acres that are disconnected through implementation of green infrastructure practices on publicly owned land.
	Money saved by improving stormwater management systems through existing capital improvement projects.	Number of capital improvement projects that incorporate stormwater management improvements. Cost savings related to incorporating stormwater management into existing projects compared to pursuing standalone stormwater projects.

Rochester's long-term stormwater plan is meant to be a living document that is reviewed and revised through an adaptive management approach. Figure 11 presents a typical adaptative management approach that the city could follow. As new or additional data are acquired (through such things as expanded asset management analyses, future project planning, and stormwater or water quality monitoring), the plan and key actions may be refined. The city should use the results of an evaluation of the plan's effectiveness to modify the plan, key actions, and priorities as needed to achieve the greatest and earliest project benefits at an affordable cost. Remember that successful adaptive management requires the involvement of people from multiple city departments and groups. This will help ensure that refinements to the plan and/or key actions are well informed and align with current city processes and plans as they evolve.

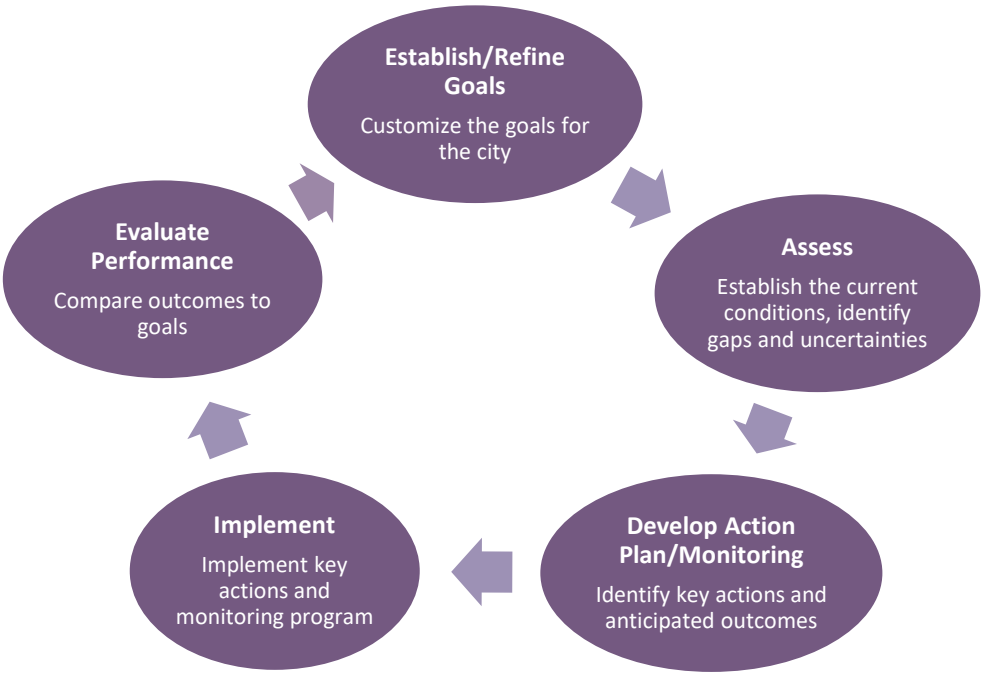


Figure 11. Rochester's Adaptive Management Approach

The city may consider the following:

1. Every two years, the city could evaluate data, information, and input obtained through the stakeholder engagement process and propose revised schedules, goals, and key actions to add to or remove from the plan.
2. Starting one year after a key action, the city can evaluate project assessment information, including monitoring data, to determine the need for additional projects.
3. The city may update the plan when regulatory changes influence the goals, schedule, or key actions.

The plan has been structured such that the city could modify or identify additional key actions while using the tools in the plan to rank and evaluate the projects. Should the city's priorities change, the tools can be modified to incorporate the changing conditions and the key action prioritization can be reevaluated.

9. Conclusion

Over the next several years, Rochester intends to follow and pursue the key actions outlined in this guide to achieve its long-term stormwater goals. The city has already implemented asset management software, updated codes and ordinances, and identified green infrastructure opportunities for public parcels. Rochester intends to leverage green infrastructure to manage stormwater more effectively, comply with its MS4 permit, and improve water quality. Pursuing the key actions in this plan will help the city achieve multiple environmental, economic, and community benefits while meeting the community's regulatory requirements and master planning vision.

The long-term stormwater plan serves as a vision for stormwater management in Rochester. City engineers, planners, economic developers, business and finance staff, and other city employees can use the plan collaboratively when discussing projects or making financial decisions. By taking a comprehensive approach to stormwater management, the city can prioritize capital investments in stormwater infrastructure to achieve the Clean Water Act's human health and water quality objectives, while minimizing costs.

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Appendix A

EXISTING COMMUNITY GOALS AT THE START OF THE LONG-TERM STORMWATER PLANNING PROCESS

At the start of this long-term stormwater planning process, EPA and Rochester reviewed existing plans to identify community goals related to stormwater management. The table below summarizes the list of existing community goals. This information was used to inform the vision and goals outlined in this long-term stormwater plan.

Community Plan/Document/Source	Summary of Existing Community Goals
Community long-term stormwater plan kickoff call (2016)	Work on master plans for the city's WWTP, water plant, and stormwater.
	Update transportation master plan.
	Perform an overall pavement condition assessment.
	Create a stormwater enterprise fund to sustain funding on an annual basis.
	Incorporate green infrastructure into areas that are being developed.
	Identify high-priority areas/locations for stormwater retrofits.
	Identify which types of green infrastructure would be successful in the city, especially from a long-term management perspective (i.e., maintenance).
	Explore the feasibility of off-site stormwater credit opportunities for developers.
	Identify opportunities for an updated new development standard.
	Identify actions the city can take to improve existing city infrastructure; specifically, look at revitalizing downtown.
	Create a more bike-friendly community.
	Explore the feasibility of developing a dedicated fund for stormwater.
	Develop a plan to help justify stormwater expenses and outline the funds that should be dedicated annually to meet stormwater goals.
	Continue to build upon and maintain an asset management plan.
Guidelines and Standard Operating Procedures: Illicit Discharge Detection and Elimination and Pollution Prevention/Good Housekeeping for Stormwater Phase II Communities in New Hampshire (2006)	Provide a commonly accepted set of technical standards and guidance on stormwater management measures to control the quantity and quality of stormwater produced by municipal activities, new development, and redevelopment.
	Meet stormwater phase II regulations.
	Use targeted stormwater management practices within the watershed, with the long-term goal of consistent application by all regulated entities within the watershed.
	Improve the water quality of New Hampshire's lakes, ponds, streams, rivers, and estuaries.
	Identify cost savings for MS4s through proper and timely maintenance of stormwater systems.
	Promote behavior that will improve water quality in the coastal watersheds and other watersheds in New Hampshire.
Final Report: New Hampshire Statewide Total Maximum Daily Load (TMDL) for Bacteria Impaired Waters (2010)	Address bacterial pollution in the surface waters of New Hampshire, including rivers and streams, impoundments, lakes and ponds, estuaries, and the Atlantic Ocean.
	Promote, encourage, and inform local community action to improve water quality and protect public health by addressing sources of bacterial contamination.

Community Plan/Document/Source	Summary of Existing Community Goals
Stormwater Management and Erosion Control ordinance	Provide for the health, safety, and general welfare of the citizens of the city of Rochester by regulating discharges into the city's stormwater drainage system, water bodies, streams, and wetlands in a manner compliant with the requirements of state and federal law, including the provisions of the Federal Stormwater Management Legislation for MS4s.
	Prohibit unpermitted discharges into the stormwater drainage system.
	Set forth the legal authority and procedures to carry out all inspection, monitoring, and enforcement activities necessary to ensure compliance with this ordinance and applicable state and federal law.
	Establish design and construction standards for stormwater drainage systems that will result in the construction of systems that are compliant with this ordinance and state and federal laws. Incorporate such standards into the existing standards and review processes governing new construction in site plan and subdivision review, as well as building permits that implicate the requisite disturbance of the site.
Model Stormwater Standards for Coastal Watershed Communities (2012)	Control nonpoint source pollution from future development.
	Mitigate and reduce nonpoint source and stormwater pollution from existing development.
	Manage the quality and quantity of surface water and groundwater resources.
	Provide a cost-effective way of managing stormwater infrastructure and water resources for the maximum benefit.
	Manage ecosystem services that humans rely on and sustain them into the future.
	Consider projected changes in climate (temperature, flooding, precipitation, storm events) in the design, siting, and implementation of stormwater infrastructure and other investments.
	Make use of technological advances in data collection and analysis to enable regulators, researchers, resource managers, and municipalities to track changes in pollutant loading and sources, water quality trends, land use changes, and the cause-and-effect relationships among them; this will allow for implementation of adaptive management strategies.
	Coordinate tracking and accounting methodologies to ensure municipalities receive credit for existing pollutant reduction strategies and future reductions or preventative strategies that demonstrate compliance with federal and state requirements and permits.
Stormwater Management Assessment and Opportunities for the Willow Brook Watershed, Rochester, New Hampshire (2012)	Address the declining water quality of Willow Brook and central Rochester caused by runoff from urbanization and increases in impervious cover.
Great Bay 2020 (2016)	Build a culture of environmental stewardship.
	Collaborate to reduce pollution.
	Connect actions to results through collaborative science.
	Protect and restore critical lands and habitats.

Appendix B

GREENING AMERICA'S COMMUNITIES

Rochester—Workshop Description

The city of Rochester hosted a three-day design charrette in early July 2018. The purpose of the design charrette was to modify initial design options created for two different focus areas by the design team and provide direction for the creation of final design options. The design team created initial designs based on information provided by city staff prior to the design team site visit. As part of the charrette, the design team facilitated two public meetings and three focus group meetings. Each focus group meeting brought together a unique group of stakeholders to discuss different aspects of each of the two focus areas and the initial design concepts.

The first public meeting presented community members with an explanation of each design option. Following the formal presentation, guests were encouraged to visit several booths set up at the facility. Each booth was accompanied by a design team member and displayed a 24 by 36-inch board with one of the design options on it. Community members were then asked to write down comments, preferences, and concerns on sticky notes and stick them on the corresponding design board.

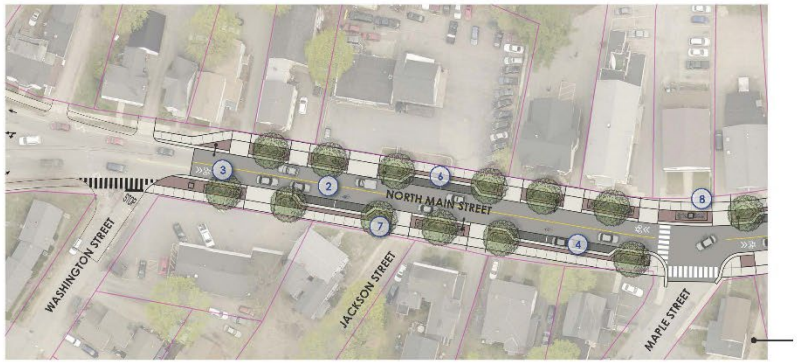
The first focus group meeting discussed the focus areas and how design options could affect and provide for economic development. Meeting attendees included members of the Strafford Regional Planning Commission, Rochester Main Street Economic Development Agency, and Profile Bank, as well as city employees.

The second focus group meeting discussed the focus areas and how design options could affect and enhance green infrastructure and landscape opportunities. Meeting attendees included members of the Rochester Main Street Economic Development Agency, Rochester Conservation Commission, and Strafford Regional Planning Commission, as well as city employees including maintenance staff.

The third and final focus group meeting discussed the focus areas and how design options could affect and enhance multimodal transportation. Meeting attendees included members of the Strafford Regional Planning Commission, the Rochester Opera House director, and city employees.

The final public meeting presented community members with new design options that had been created based on information and priorities that the design team gathered from the previous charrette meetings. The designs were well received, and the design team was directed to continue refining the revised design options into final design options.

MASTER PLAN



→ Plan continued from previous page

legend:

- Concrete sidewalk
- Asphalt surface
- Pervious pavers (pattern 'A')
- Pervious pavers (pattern 'B')
- Stormwater planter
- Street light
- Vinyl wrapped utility box
- Location of before/after rendering

design components:

1 Pine Street / River Street Intersection
The intersection has been realigned to keep Pine Street Traffic from entering directly onto North Main Street. The intersection has also been raised to a tabletop with bollards separating vehicular and pedestrian spaces.

2 Travel lanes
Travel lanes remain one lane of traffic running each way on North Main Street. One-way traffic along Pine Street has been switched, and now runs one-way to the northeast.

3 Shared-use lanes
Sharrows are painted on the drive lanes to indicate that this portion of North Main Street is to be shared with bicycle traffic in the travel lanes.

FOCUS SITE ONE: NORTH MAIN STREET

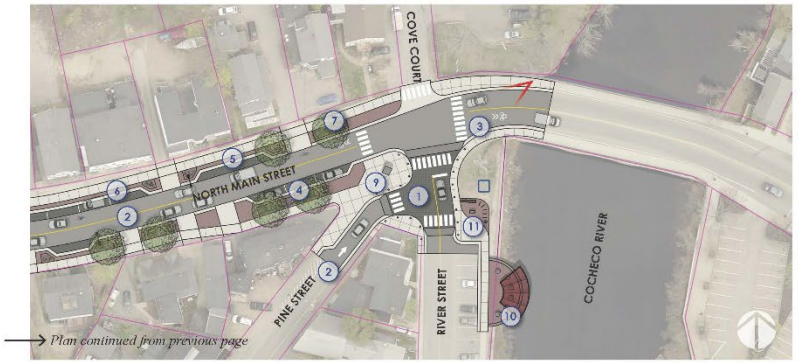


Figure 4: This plan shows the design concept for focus site one.

4 Parking
Parallel parking spaces are located throughout this portion of North Main Street.

5 Bus stop
A bus stop remains at this location.

6 Pervious surfacing
Pervious pavers are used at on-street parallel parking spaces and between curb and sidewalk to capture stormwater runoff and filter out pollutants.

7 Stormwater planters
Stormwater planters near intersections and driveways provide space for street plantings and trees while capturing stormwater runoff and filtering out pollutants.

8 Public art
Planters provide space to display public art along North Main Street.

9 Neighborhood monument
A monument and plaza space at the intersection of North Main Street and River Street creates an entrance for the historic "French Town" neighborhood.

10 River overlook
A platform with stone benches and a shade structure overlooks the Cocheco River.

11 Trailhead
A trailhead and comfort station connects to the larger city trail system.

PERSPECTIVE

Figure 5: Current condition of North Main Street just west of the Cocheco bridge, facing west.

Figure 6: Design concept for North Main Street. The perspective shows two lanes of traffic with shared use lanes, a reconfigured River Street and Pine Street intersection as a pervious paver tabletop, a neighborhood monument, pervious paver parallel parking spaces, stormwater planters, splash guard behind curb, historic lighting and wayfinding signage.

FOCUS SITE ONE: NORTH MAIN STREET

TYPICAL STREET SECTION

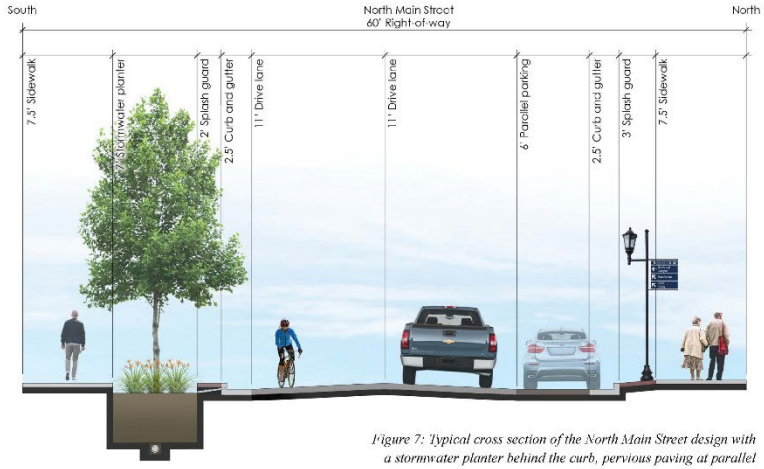


Figure 7: Typical cross section of the North Main Street design with a stormwater planter behind the curb, pervious paving at parallel parking spaces, a pervious paving splash guard behind the curb and historic street lights with directional signage.

MASTER PLAN

Figure 11: This plan shows the design concept for focus site two.

legend:

- Concrete sidewalk
- Asphalt surface
- Pervious pavers (pattern 'A')
- Pervious pavers (pattern 'B')
- Boardwalk over planter
- Stormwater planter
- Regular planter
- Street light
- Location of before/after rendering

design components:

1. **Parking lot access**
   Access to the parking lot has been moved further north to allow for a maximum number of parking spaces and pedestrian area behind North Main Street businesses.

2. **Business access**
   Access to the north business remains at this location.

3. **Pervious surfacing**
   Pervious pavers are used at parking spaces and at patio spaces to capture stormwater runoff and filter out pollutants.

4. **Parking spaces**
   Parking spaces have been reconfigured to maximize pedestrian space behind businesses and create safer pedestrian / vehicular conditions.

5. **Dumpster enclosure**
   A property adjacent to the parking lot could be used as a space for a dumpster enclosure and screening vegetation.

6. **Pedestrian patio**
   Additional space behind North Main Street businesses has been transformed into pedestrian patio spaces.

7. **Stormwater planters**
   Stormwater planters run along Union Street and down the center of the parking lot. They provide space for street plantings and trees while capturing stormwater runoff and filtering out pollutants. Pedestrian crossings are located at various places to allow for pedestrian access across the planter.

8. **Trailhead**
   A trailhead with a low seatwall, bike racks and a kiosk with directional signage has been placed near the center of the parking lot.

9. **Above ground planter**
   Granite above ground planters provide a buffer between pedestrian spaces and the parking lot while providing seating opportunities and space for vegetation and shade trees.

10. **Moveable planters**
    Movable planters help create spaces while providing a more complete buffer between pedestrian areas and the parking lot.

11. **Pedestrian access**
    Access to the parking lot from Wakefield Street has been reduced to only pedestrian traffic. A paver pattern and lighted bollards provide a safe and appealing space for pedestrians.

12. **Crosswalks**
    Crosswalks have been realigned to better connect nearby public spaces.

13. **Corner plaza**
    The corner of North Main Street and Union Street has been converted to a more traditional pedestrian plaza with pervious pavers and planters.

14. **Private access**
    Access from the parking lot to the private residence remains at this location.

FOCUS SITE TWO: PUBLIC PARKING LOT

PERSPECTIVE

Figure 12: Current condition of public parking lot behind North Main Street businesses.

Figure 13: Design concept for public parking lot. The perspective shows an expanded pedestrian area behind North Main Street businesses with granite above ground planters, shade trees, a pervious paver courtyard, wayfinding signage, pervious paver parking spaces, and enhanced vegetation screening along Union Street.

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Appendix C

SUMMARY OF POTENTIAL FEDERAL FUNDING OPPORTUNIITES

U.S. Environmental Protection Agency (EPA)

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Clean Water State Revolving Fund (CWSRF)	Using a combination of federal and state funds, the program provides loans to construct municipal wastewater facilities, control nonpoint sources of pollution, build decentralized wastewater treatment systems, create green infrastructure projects, protect estuaries, and fund other water quality projects. *Financing Green Infrastructure: A Best Practices Guide for the Clean Water State Revolving Fund* (2015) highlights successful case studies and examples of ways CWSRF programs can prioritize green infrastructure projects for funding by implementing priority point systems, program set-asides, and marketing strategies for state programs. For more information, see the "*Green Infrastructure Approaches to Managing Wet Weather with Clean Water State Revolving Funds*" fact sheet (2008).	• Prineville, Oregon needed to increase its wastewater treatment capacity. After receiving a grant to study a pilot wetland for wastewater treatment, the city designed the 120-acre Crooked River Wetlands Complex to reduce instream water temperature and augment stream flow to meet the effluent limits in its NPDES wastewater permit. The project includes more than 2 miles of riparian improvements and 5.4 miles of new recreational trails. It also serves as an outdoor classroom. In addition, the wetland wastewater treatment system cost $54 million less than the projected cost of a new treatment facility. • Hoboken, New Jersey received $4.2 million in low-interest CWSRF financing from the New Jersey Environmental Infrastructure Financing Program to establish a citywide stormwater management campaign and green infrastructure initiative. The funding established two parks to better handle stormwater flows, which include underground detention systems, permeable paving, rain gardens, and bioswales. The 1-acre and 6-acre parks provide green space while also filtering and diverting up to 1.2 million gallons of stormwater runoff to the city's sewer system for treatment.
Water Infrastructure Finance and Innovation Act (WIFIA)	WIFIA is a federal credit program administered by EPA for *eligible water and wastewater infrastructure projects*, including stormwater and green infrastructure projects.	In 2018, the WIFIA program invited 39 entities with projects in 16 states and Washington, DC to apply for more than $5 billion in WIFIA loans. Several of the selected projects include stormwater: • The Coachella Valley, California Stormwater Channel Improvement Project was invited to apply for $22 million in funding to improve stormwater channels to

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
		increase their capacity to capture and convey stormwater, reduce stormwater runoff to the surrounding areas, and help the district meet design standards. • The City of Indio, California and parts of the unincorporated county were invited to apply for $29 million in funding for a 3.3-mile regional stormwater channel conveyance facility to manage and capture stormwater and reduce reoccurring runoff and debris. • DeKalb County, Georgia was invited to apply for $251 million in funding to rehabilitate and repair an aging wastewater collection and treatment system to comply with its December 2011 Sanitary Sewer Overflow Consent Decree.
Brownfields Grants	The Brownfields Program provides direct funding for brownfields assessment, cleanup, revolving loans, environmental job training, technical assistance, training, and research.	*Cincinnati's South Fairmount/Lick Run Project* used the Brownfields and Land Revitalization Programs to fund the Lick Run Watershed Strategic Integration Plan. The plan provides an "implementation road map" that outlines opportunities associated with a green infrastructure approach. EPA is working with other federal partners to leverage investments in the South Fairmount community (e.g., housing development, floodplain management, transportation improvements).
Section 319 Nonpoint Source Grant Program	Grant program funding goes to states to reduce nonpoint source pollution (pollution caused by rainfall running over the ground and carrying pollutants—including trash, oil and grease, and fertilizers—into nearby waterways). EPA's most recent program *guidance* recognized the "importance of green infrastructure… in managing stormwater" and supported awarding funding to green infrastructure projects.	The District of Columbia Department of Energy and Environment used Section 319 funding to partially fund remediation of the *Watts Branch* watershed in northeast DC. Watts Branch suffered from severe erosion and sediment pollution due to frequent flooding. The department led a project to restore the stream bed and control flooding through tree and shrub plantings, regrading of the stream bed, and upstream low impact development practices to manage impervious surface runoff.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Urban Waters Small Grants Program	Program funding goes to communities to improve the quality of urban waters while simultaneously stimulating neighborhood revitalization. The Urban Waters Small Grants Program has a focus on underserved communities, defined as "communities with environmental justice concerns and/or susceptible populations." The program funding can be used specifically for innovative or new green infrastructure practices that improve water quality. State, local, and tribal governments; universities; and nonprofit organizations are eligible to apply.	• The Constitutional Rights Foundation, in partnership with Los Angeles Waterkeeper and the University of California, Los Angeles, was awarded more than $59,000 to work with four high schools in Los Angeles County. College-aspiring students were taught how to collect data related to trash and industrial stormwater pollution. Seniors from the University of California, Los Angeles's environmental sciences bachelor's program served as peer mentors and role models for participants. At the end, students presented their findings. • Heal the Bay was awarded $60,000 to monitor bacterial water pollution at two recreational zones in the Los Angeles River. Water quality findings are made available to the public in an annual *River Report Card*. Results of the study will be used to make recommendations to agencies and watershed stakeholders for improving water quality and protecting public health.
Drinking Water State Revolving Fund	The Drinking Water State Revolving Fund is a low-interest revolving loan program to help water systems and states achieve the health protection objectives of the Safe Drinking Water Act.	Baltimore, Maryland used Drinking Water State Revolving Fund funding to replace an existing open finished reservoir with a new enclosed 35-million-gallon reservoir, which was covered with a green roof to improve runoff water quality and reduce runoff volume.
Superfund Program	Superfund sites placed on the National Priorities List are eligible for federal funding for site cleanup, resilience, and green remediation.	The Butterworth #2 Landfill Superfund site is in Grand Rapids, Michigan, where landfill operations contaminated groundwater and soil. After cleanup was done, the city held public meetings to work with community and recreation organizations on reuse planning. In 2009, the city extended a bike trail across the site. EPA has also worked with the city to evaluate the site's capacity to support a solar energy

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
		facility. The solar redevelopment is currently on hold, as the city is reevaluating power needs for its WWTP.

U.S. Department of Housing and Urban Development (HUD)

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Community Development Block Grant (CDBG)	CDBG is designed to create jobs, increase economic activity, and increase property values. Green infrastructure and stormwater projects fit into this scope because urban tree planting can increase economic activity in a commercial district and green infrastructure can increase property values by mitigating flooding and improving neighborhood aesthetics.	• Detroit, Michigan used $8.9 million in CDBG funds in 2014 to create a major flood prevention and economic development program. The program demolishes blighted properties; landscapes and plants trees on 200 vacant lots to improve stormwater management and neighborhood aesthetics; and installs infrastructure that directs stormwater to new bioretention basins. • Chicago, Illinois used CDBG funding to put a new green roof on its historic cultural center.
Section 108 Loan Guarantee Program	This program allows future CDBG allocations to be used to guarantee loans for neighborhood revitalization projects, including construction and installation of public facilities and infrastructure. Section 108-guaranteed projects can incorporate green infrastructure into their designs and construction.	Through a CDBG loan, the City of Indio, California has been able to allocate funding to the design, engineering, and construction of public infrastructure improvements in its low- and moderate-income neighborhoods. Residents help prioritize the improvements. Activities have included tree planting and street, sidewalk, and park improvements.
Community Development Block Grant Disaster Recovery Program (CDBG-DR)	This program provides federal aid to states post-disaster. Funds can be used for a variety of community development activities that benefit low- and moderate-income people, reduce blight, or address an urgent community need. In rehabilitating housing and constructing public amenities, cities may be able to incorporate green	Columbia, South Carolina received a $19.99 million grant from CDBG-DR following a 1,000-year flood in October 2015. The grant helped the city of Columbia recover and build resiliency. Among other projects, the CDBG-DR funds were used to promote green infrastructure, such as swales and rain gardens; plant buffer areas around water courses; promote pervious parking surfaces; and encourage preservation of sensitive environmental areas.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
	infrastructure techniques (like street trees and permeable pavements) into street design.	
Sustainable Communities Regional Planning Grants	These grants support metropolitan and multijurisdictional planning efforts to integrate housing, land use, economic and workforce development, transportation, and infrastructure investments. They are designed to empower jurisdictions to consider the interdependent challenges of economic competitiveness and revitalization, social equity, inclusion and access to opportunity, energy use and climate change, and public health and environmental impacts.	The *Green Infrastructure and the Sustainable Communities Initiative* report provides case studies of 30 local governments that have used HUD Sustainable Communities Regional Planning Grants or Community Challenge Planning Grants to fund green infrastructure programs. Generally, grantees have planned for climate resilience by identifying strategic areas to implement stormwater management practices, with a dual approach to stormwater management that uses both traditional gray infrastructure and green infrastructure. Although the HUD Sustainable Communities Initiative grant programs have not received appropriations since 2011, the case studies provide excellent examples of how local governments can combine various funding streams to pay for green infrastructure programs.
Community Challenge Planning Grants	These grants foster reform and reduce barriers to achieving affordable, economically vital, and sustainable communities. Such efforts may include amending or replacing local master plans, zoning codes, and building codes, either on a jurisdiction-wide basis or in a specific neighborhood to promote mixed-use development, affordable housing, the reuse of older buildings for new purposes, and similar activities that promote sustainability at the local or neighborhood level.	The City of Pittsburgh, Pennsylvania combined a HUD Community Challenge Planning Grant with a U.S. Department of Transportation Investment Generating Economic Recovery II grant to fund the planning of the Allegheny Riverfront Green Boulevard project.

U.S. Department of Homeland Security, Federal Emergency Management Administration (FEMA)

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Hazard Mitigation Grant Program	The Hazard Mitigation Grant Program provides post-disaster federal aid to states to mitigate the risks of future disasters and fund flood mitigation projects, including the acquisition and relocation of flood-prone properties and soil stabilization projects, like the installation of vegetative buffer strips. Accounting for the full benefits of green infrastructure projects under the Hazard Mitigation Grant Program has been much easier since FEMA amended its policy to include "ecosystem services" benefits for green open space, riparian areas, and other land use types.	*New Orleans, Louisiana* used Hazard Mitigation Grant Program funding for its post-Katrina rebuilding process, including the reconstruction of the city's stormwater infrastructure. Although the New Orleans stormwater plan calls for a significant expansion of green infrastructure to manage the city's chronic flooding, the city initially had difficulty demonstrating the benefits of green infrastructure under FEMA's required cost-benefit analysis because it 1) lacked the data to demonstrate potential flood losses avoided and 2) could not count many of green infrastructure's environmental benefits.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Pre-Disaster Mitigation (PDM) Grant Program	Mitigation planning is a key process used to break the cycle of disaster damage, reconstruction, and repeated damage. PDM grants offer funding for sustained pre-disaster natural hazard mitigation programs. The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters. This program awards planning and project grants. It provides opportunities for raising public awareness about reducing future losses before disaster strikes. PDM grants are funded annually by congressional appropriations and are awarded on a nationally competitive basis.	*Spokane County, Washington* often has heavy rainstorms, and post-storm flash flooding is common. In 2016, the county was awarded PDM funding to improve road drainage to Hazard Road, northwest of the city of Spokane, after a flash flood washed out a section of the roadway the year before. The flood damaged a section of the road with 14 culverts. Instead of simply repairing or replacing the culverts, the county applied for funding to implement a combination of gray and green techniques, including adding vegetation to stabilize the soil against erosion and to improve the health of the stream. By incorporating green approaches, the project cost less than simply replacing the culverts would have, stabilized the soil against erosion, and improved the health of the stream. The county's decision to include green infrastructure mitigation elements is ultimately what allowed FEMA to fund the project.
Flood Mitigation Assistance (FMA) Grant Program	The FMA Grant Program aims to reduce or eliminate claims under the National Flood Insurance Program. FMA grants provide funding to states, territories, federally recognized tribes, and local communities for projects and planning that reduce or eliminate the long-term risk of flood damage to structures insured under the National Flood Insurance Program. FMA funding is also available for management costs. Congress appropriates funding annually. FMA grants require state, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving	In fiscal year 2018, $1.6 million in FMA funding was available to help state, tribal, territorial, and local governments reduce or eliminate claims under the National Flood Insurance Program. Eligible project activities included: • Infrastructure protective measures. • Floodwater storage and diversion. • Utility protective measures. • Stormwater management. • Wetland restoration/creation. • Aquifer storage and recovery. • Localized flood control to protect critical facilities. • Floodplain and stream restoration. • Water and sanitary sewer system protective measures.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
	certain types of non-emergency disaster assistance, including funding for hazard mitigation assistance projects. Generally, local communities will sponsor applications on behalf of homeowners and then submit the applications to their states. All FMA grant applications must be submitted to FEMA by a state, U.S. territory, or federally recognized tribe. Refer to the current *hazard mitigation assistance guidance* for detailed information on the FMA program and on the *mitigation plan requirement*.	

U.S. Department of Defense, Army Corps of Engineers

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Planning Assistance to States	The Corps of Engineers can help states, local governments, other non-federal entities, and eligible tribes prepare comprehensive plans for the development, utilization, and conservation of water and related land resources. Typical studies are only at the planning level of detail; they do not include detailed design for project construction. The program can encompass many types of studies dealing with water resource issues. Types of studies conducted in recent years under the program include water supply/demand, water conservation, water	In 1999, the Corps of Engineers was authorized to study the Boston, Massachusetts Muddy River to determine if flood risk management and environmental restoration improvements were in the federal interest. Following the corps' 2001 draft evaluation report, environmental dredging of sediment, preservation and restoration of historic park shorelines, and preservation of vegetation in construction areas were recommended.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
	quality, environmental/conservation, wetlands evaluation/ restoration, dam safety/failure, flood damage reduction, coastal zone protection, and harbor planning. Efforts under this program are cost-shared on a 50 percent federal/50 percent non-federal basis. The study sponsor has the option of providing in-kind services for its share of the study cost.	

U.S. Department of Transportation

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants	RAISE grants fund investments in road, rail, transit, and port projects. These grants have been awarded to projects that included green infrastructure components. These grants were previously known as Better Utilizing Investments to Leverage Development grants and Transportation Investment Generating Economic Recovery discretionary grants.	In 2018, the Siouxland Regional Transit System in Sioux City, Iowa was awarded $7 million to construct a new facility for bus maintenance and storage. The facility also includes green building materials and techniques such as stormwater retention, reuse of natural rainwater for irrigation, and water recycling for restrooms and bus washing.
Federal Highway Administration Surface Transportation Block Grant (STBG) Transportation	STBG provides funding for "transportation alternatives," including "off-road trail facilities for pedestrians, bicyclists, and other non-motorized forms of transportation." STBG funding can be used to pay for green infrastructure	The *Southeast Michigan Council of Governments* used the transportation alternatives set-aside in STBG funding in 2015 from the State of Michigan to fund the Detroit–Inner Circle Greenway Railroad Acquisition, which included 1) installing green infrastructure such as green streets and bioretention and 2) repurposing 8.3 miles of abandoned railway near Detroit.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Alternatives Set-Aside	components of trails and sidewalks, such as permeable pavements.	
Federal Highway Administration Congestion Mitigation and Air Quality Improvement (CMAQ) Program	The CMAQ Program allocates federal funding for infrastructure projects that reduce congestion and improve air quality. Bicycle transportation and pedestrian walkways are eligible uses of the money; they can be designed to include green infrastructure features, such as permeable surfaces for trails, and bioswales and bioretention for areas adjacent to trail surfaces.	The City of Santa Fe's *Acequia Trail Underpass project* used CMAQ funding in 2017–2018 via the New Mexico Department of Transportation to construct a bicycle underpass (along an abandoned rail line) under federal highway U.S. 284/85 to improve the safety of pedestrians and bicyclists crossing one of the city's busiest and most congested intersections. The project installed low impact development drainage basins that capture and infiltrate 100 percent of the onsite stormwater up to the 100-year storm, as well as other green infrastructure elements such as soil-enhanced swales and landscaping to improve site permeability.
Federal Highway Administration National Highway Performance Program	The National Highway Performance Program supports the national highway system in constructing new facilities and ensuring that investments of federal aid funds in highway construction support progress toward the performance targets in a state's asset management plan. States may transfer up to 50 percent of National Highway Performance Program funds to the STBG, Highway Safety Improvement Program, and CMAQ Program (see above for more details).	

U.S. Department of Agriculture

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Rural Development Water and Environmental Programs	Water and Environmental Programs are exclusively focused on the water and waste infrastructure needs of rural communities with populations of 10,000 or fewer. The programs provide technical assistance and financing for development of drinking water, waste disposal, and stormwater systems in rural areas.	In 2016, the Pine Ridge Indian Reservation, South Dakota was awarded $1.97 million for a new community center, which is the first phase of a three-part solution to improve environmental and human health, increase jobs, and make housing more affordable. The master plan includes using potable water more productively by embedding strategies in streets and buildings to collect rainwater for use. Additionally, the plan will implement roadside bioswales, culverts, rain gardens, and storm drain inlets.
Rural Development Water and Waste Disposal Loan and Grant Program	This program provides funding for clean and reliable drinking water systems, sanitary sewage disposal, sanitary solid waste disposal, and stormwater drainage to households and businesses in eligible rural areas.	The *City of Bowdle, South Dakota* received a $1.172 million loan and a $400,000 grant for improvements to the water and sewer collection system. The city will replace outdated water and sewer lines along Main Street. This will help address inflow and infiltration caused by deficiencies in the sewer system and replace outdated waterlines. Local funds will also be used.
U.S. Forest Service Urban and Community Forestry Program	The Urban and Community Forestry Program is a cooperative program that focuses on the stewardship of urban natural resources, providing grants for urban forestry projects.	Campbell Creek, which flows from the Chugach Mountains to Cook Inlet through the heart of Anchorage, Alaska, creates a 70-square-mile watershed that is home to five species of salmon, rainbow trout, moose, bears, and beavers. The loss of vegetation and pervious surfaces, as well as polluted runoff, degrade aquatic and wildlife habitat and increase flooding risks. Anchorage is reconstructing the trail with help from the Urban and Community Forestry Program. This presents a perfect opportunity to share resources to restore the riparian area and create low-impact access.

U.S. Department of the Treasury

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
New Markets Tax Credit Program	This program encourages private investment in a range of project types in distressed areas (e.g., real estate or business development projects). Awards are allocated to nonprofit and private entities based on their proposals for distributing the tax benefits.	In 2013, a nonprofit investor partnered with The Freshwater Trust to *finance a project* that restored 30 miles of streamside vegetation in Oregon. This green infrastructure solution created shade and offset the increasingly warm temperature of the river, which was negatively affecting native fish populations.

U.S. Department of Energy

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Energy Efficiency Savings—Tax Incentives and Rebates	Green infrastructure can be integrated into project design to claim tax incentives and rebates.	Eugene, Oregon built a new biofuel station on an abandoned gas station site that included a green roof, bioswales, and rain gardens. Nearly $250,000 worth of tax credits reduced income and sales tax for the private company that built and operated the project.
Weatherization and Intergovernmental Program	The Weatherization and Intergovernmental Program provides grants, technical assistance, and information tools to states, local governments, community action agencies, utilities, tribes, and U.S. territories for their energy programs. The funding can be used to encourage installation of green infrastructure—such as green roofs—as part of the weatherization process.	Through the Better Buildings Challenge, a Silver Spring, Maryland multifamily residential building, *The Pearl*, has been designed to include 1,250 square feet of vegetated green roof with a uniquely integrated solar photovoltaic array. This design is projected to save more than $150,000 annually in energy costs.

U.S. Department of the Interior, National Park Service

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Rivers, Trails and Conservation Assistance Program	The Rivers, Trails, and Conservation Assistance Program assists community-led natural resource conservation and outdoor recreation initiatives. Program staff provide guidance to communities on conserving waterways, preserving open space, and developing trails and greenways.	The communities of Midlothian, Oak Forest, and Crestwood, Illinois received funding to prepare the Natalie Creek Trail from Oak Forest to Blue Island. The trail proposal came out of Midlothian's planning to alleviate flooding through a Metropolitan Water Reclamation District project (now underway). This regional trail will have both on-road and off-road sections connecting five Illinois communities.

U.S. Department of Commerce

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
Economic Development Administration: *Public Works and Economic Adjustment Assistance Programs*	These programs support a range of business and industrial development activities—including infrastructure development—that create or retain jobs. Economic Development Administration-capitalized revolving loan funds encourage new business development in economically distressed communities.	In September 2019, the Economic Development Administration awarded a $1.8 million grant to the city of *West Plains, Missouri* to make critical infrastructure improvements, including constructing stormwater detention basins to help protect the local business community from flooding.
National Oceanic and Atmospheric Administration: *Community-Based Restoration Program*	This program, which began in 1996, seeks to inspire and sustain local efforts to restore coastal habitat. It has funded more than 2,000 projects in the United States, Canada, the Caribbean, and the Pacific Islands. These projects have restored more than 86,000 acres of habitat and opened more than 3,800 stream miles for fish passage.	Ducks Unlimited was awarded $825,000 to restore estuarine and coastal dune habitat in California. The project will restore more than 800 acres of Eel River estuary habitat to help recover Endangered Species Act-listed salmon. The project will also increase resilience to storm events and sea level rise, reestablish a healthy ecosystem, and provide habitat for juvenile migratory fish to grow.

PROGRAM	PROGRAM DESCRIPTION	EXAMPLES OF FUNDED PROJECTS
National Oceanic and Atmospheric Administration: *Coastal Resilience Grants Program*	This competitive grant program funds projects that are helping coastal communities and ecosystems prepare for and recover from extreme weather events, climate hazards, and changing ocean conditions. All project proposals undergo a rigorous merit review and selection process by a panel of subject matter experts from across the United States that include representatives from government, academia, and private industry.	The Northeast Regional Association of Coastal and Ocean Observing Systems was awarded $456,257 in match grants to document and predict coastal storm impacts and increase the implementation of sustainable, nature-based infrastructure approaches (living shorelines). The project also fills high-priority data and capacity gaps, develops tools for decision-making, and improves communications and outreach.

Sources:
Georgetown Climate Center. n.d. Federal Funding. Available at *http://www.georgetownclimate.org/adaptation/toolkits/green-infrastructure-toolkit/federal-funding.html*.
U.S. EPA. 2021. Green Infrastructure Funding Opportunities. Available at *https://www.epa.gov/green-infrastructure/green-infrastructure-funding-opportunities*.

Appendix D

GREEN INFRASTRUCTURE SITE SUITABILITY METHODOLOGY

Site Suitability Assessment for Green Infrastructure

Rochester, New Hampshire

May 2021

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Cover page photo credits clockwise from top left: Photo by Ken Gallager on Wikimedia; Photo by EPA; Photo by EPA; Photo by AlexiusHoratius on Wikimedia; Photo by EPA

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Summary

This document is intended to guide planners, engineers, and technical staff through a geographic information system (GIS) based analysis to help identify opportunities to improve stormwater management by implementing green infrastructure. This document serves two purposes:

- It **provides a methodology** for using GIS to assess the suitability of sites in Rochester, New Hampshire, for green infrastructure. Rochester's planners, engineers, and technical staff can use this methodology to find opportunities to improve stormwater management across the city. Other cities may find the methodology useful in their own communities.
- It **demonstrates the use** of this methodology, providing results based on currently available information for Rochester, New Hampshire.

Installing green infrastructure can enhance infiltration, reduce localized flooding, improve water quality, recharge groundwater, improve site aesthetics, and increase the resiliency of the city's landscape.[1] These benefits support Rochester's larger community goals, specifically for reviving their downtown. With targeted and proactive planning that leverages goals across city departments, the implementation of green infrastructure is an effective way to use often limited community resources to gain a broader range of benefits to support Rochester's larger community goals.

Because green infrastructure has the design flexibility to be installed at almost any site. This methodology provides a set of criteria that will help Rochester further investigate and prioritize each site's (specifically public parcels) potential for implementing green infrastructure practices that provide a range of benefits.

This document's GIS-based methodology groups green infrastructure into two categories, based on function and site requirements:

- Infiltrating practices
- Non-infiltrating practices

Each category provides a different set of water quality and quantity benefits and requires a unique combination of physical site conditions to work properly. Green infrastructure can be designed, sized, and adapted to almost any location. Assessment results will change depending on what data are available, what criteria Rochester uses, and how the city prioritizes those criteria within the methodology.

By carrying out an assessment using this document's framework, communities can identify sites where beneficial conditions for a category of green infrastructure align with the city's needs for the areas around those sites. This will give the city screening-level results—key information to inform the city's decision-making and planning. This framework is flexible and adjustable if the city revisits its priorities. It does not identify all potential sites where practices can be implemented across the city. Rather, it can help Rochester prioritize sites with the best potential to investigate further. This type of

[1] https://www.epa.gov/green-infrastructure/performance-green-infrastructure and https://www.epa.gov/green-infrastructure/benefits-green-infrastructure

siting capability complements the 2020 *Downtown Master Plan,* which explicitly includes the use of green infrastructure as a key element for the city's long-term vision.

To illustrate the use of this document's methodology, a site suitability assessment has been carried out for Rochester, using available data and criteria established by the city. Rochester's assessment results are shown via heat maps with planning-level information about where green infrastructure may be suitable. The maps demonstrate that many areas of the city are suitable for both infiltrating and non-infiltrating green infrastructure. However, non-infiltrating practices are suitable in a slightly broader range of locations because they are not restricted by soil permeability.

1. Introduction

The city of Rochester, New Hampshire, is actively working to improve stormwater management and reduce the amount of sediment and nutrients that flow into its local waterways. This document presents a methodology to help the city screen sites for their potential physical suitability for different categories of green infrastructure. Installing green infrastructure on public and private property can help improve water quality, increase groundwater recharge, reduce flooding, and reduce infiltration and inflow.

This assessment considers the physical conditions of a site, based on available geospatial data such as slope, depth to bedrock, hydrologic soil group (HSG), and other characteristics, and provides screening-level information that can help the city prioritize its efforts.

Different green infrastructure practices have different functions and require specific site characteristics for successful implementation. Using this methodology, site suitability assessments are performed separately for infiltrating and non-infiltrating green infrastructure.

Infiltrating: These practices store stormwater and allow it to infiltrate into the underlying soil and groundwater. They help reduce the volume and flow rate of stormwater runoff and remove pollutants. They may also provide aquifer recharge and flood mitigation.

Non-infiltrating: These practices store stormwater but do not allow it to infiltrate into the underlying soil and groundwater. Like infiltrating practices, they help reduce the volume and flow rate of stormwater runoff and remove pollutants.

Infiltrating and non-infiltrating green infrastructure also have different benefits, depending on designed functionality, specified materials, and physical location. For example, practices that infiltrate water into the ground provide the added benefits of groundwater recharge and, in many cases, flood mitigation. Many green infrastructure practices, such as bioretention areas, bioswales, and tree trenches, can be designed as either infiltrating or non-infiltrating practices to accommodate the site conditions (e.g., requiring an underdrain system and/or liner) where they are installed.

Green Infrastructure

"Green infrastructure" (as defined by the Clean Water Act) is the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest or reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters. These practices mimic natural conditions of a site to reduce the negative impacts that challenge urbanized areas and contribute to CSOs. Green infrastructure, such as bioretention, tree boxes, and permeable pavements, is included in the assessment categories of infiltration and biofiltration stormwater management practices. These practices can be attractive elements of the landscape. Figure 1 on page 4 shows a variety of installed green infrastructure.




Green Infrastructure Examples

Clockwise from top left:

- ✓ Tree box
- ✓ Bioswale
- ✓ Tree trench
- ✓ Constructed wetland
- ✓ Permeable pavement
- ✓ Infiltration basin
- ✓ Bioretention system



Figure 1. Green Infrastructure Examples

Table 1 lists examples of infiltrating and non-infiltrating green infrastructure and its associated benefits.

Table 1. Benefits of Infiltrating and Non-Infiltrating Green Infrastructure

Green Infrastructure Practice	Category		Potential Benefits							
	Infiltrating	Non-Infiltrating	Aquifer Recharge	Flood Mitigation	Water Quality Treatment	Habitat Creation and/or Preservation	Cooling/ Reduced Heat Island Effect	Reduced Need for Deicers	Reduced Roadway Spray and Noise	Air Quality Improvement
Bioretention/bioswale *(no underdrain/liner)*	✓		✓	✓	✓	✓	✓			✓
Bioretention/bioswale *(with underdrain/liner)*		✓		✓	✓	✓	✓			✓
Tree trench *(no underdrain/liner)*	✓		✓	✓	✓	✓	✓			✓
Tree trench *(with underdrain/liner)*		✓			✓	✓	✓			✓
Tree box *(no underdrain/liner)*	✓		✓	✓	✓	✓	✓			✓
Tree box *(with underdrain/liner)*		✓			✓	✓	✓			✓
Permeable pavement/pavers *(no underdrain)*	✓		✓	✓	✓		✓	✓	✓	
Permeable pavement/pavers *(with underdrain)*		✓		✓	✓		✓	✓	✓	
Sand or media filter *(no underdrain/liner)*	✓		✓	✓	✓		✓			
Sand or media filter *(with underdrain/liner)*		✓		✓	✓		✓			
Infiltration chamber	✓		✓	✓	✓		✓			
Infiltration basin	✓		✓	✓	✓	✓	✓			
Infiltration trench	✓		✓	✓	✓		✓			
Constructed wetland		✓		✓	✓	✓	✓			✓

2. Methodology

This screening-level site suitability assessment is a desktop geographic information system (GIS) analysis that uses a set of physical criteria to assess the potential suitability of sites for green infrastructure to enhance infiltration, reduce localized flooding, improve water quality, recharge groundwater, improve site aesthetics, and increase the resiliency of the landscape in ways that not only meet stormwater management needs but also support Rochester's broader community vision. This analysis evaluates physical site suitability for two categories of green infrastructure, based on the primary physical processes and site conditions that define them:

- Infiltrating practices
- Non-infiltrating practices

These green infrastructure categories were chosen to reflect the interests of Rochester but could be adjusted for other communities along with the methodology framework.

Five physical site suitability assessment steps are outlined below.

- Step 1 describes how to identify the physical characteristics that will be used as criteria to assess the most suitable sites for each green infrastructure category.
- Step 2 describes how the criteria established in Step 1 are either excluded or rated for the analysis.
- Step 3 describes the mechanics of the suitability analysis, which uses a simple equation to compute a suitability score in GIS for each pixel in the data grid across the city.
- Step 4 describes the development of heat maps to visually display physical site suitability scores.
- Step 5 discusses how to use the maps generated in Step 4 to identify potentially suitable green infrastructure for chosen locations.

Once the assessment results are produced, lenses such as land ownership (public versus private lands), location in relationship to the regulated municipal separate storm sewer system (MS4) area, location within drainage areas contributing to areas prone to flooding, or locations of planned city projects can be added to the output maps to further prioritize future investigation efforts. The developed maps can be used as a screening and decision support tool to distinguish which sites in the city may be better suited for each category of green infrastructure.

2.1 Step 1: Identify Physical Site Characteristics for Site Suitability Assessment

The first step of the site suitability assessment is to compile a list of physical site characteristic data. The feasibility of implementing green infrastructure depends in part on a location's physical site characteristics such as soil permeability, slope, and flood zone locations. A community can map these physical site characteristics in GIS using data that are publicly available or generated by the community. Table 2 and Table 3 contain the full set of physical site characteristics data that were sought for use as criteria in the Rochester screening assessments. The names of the GIS data layers in the tables are specific to the Rochester data source and naming conventions will vary in each community.

Table 2 lists the available data for Rochester at the time of this analysis. Table 3 lists additional data that were not available at the time of this analysis, but that Rochester could use if they become available. For each characteristic used in the assessment, the tables provide the data file name and source, as well as a description of how it is relevant to site suitability for green infrastructure implementation. For several characteristics, the tables provide additional technical references to support and expand upon this information.

Table 2. Rochester Site Characteristics Used in Site Suitability Assessment

Physical Site Characteristic	GIS Data Layer	Source	Considerations for Green Infrastructure Implementation
Soil permeability	SSURGO Database for NH017	U.S. Natural Resources Conservation Service	More permeable such as sand and gravel, categorized as hydrologic soil group (HSG) A soils, have a higher capacity for infiltration. Sites with less permeable soils (HSG C and D) may also reduce some runoff volume and pollutant loading and replenish groundwater storage reservoirs. Recharge can be particularly important during times of drought in Rochester. In less permeable soils, smaller capacity green infrastructure practices, including biofiltration and shallow filtration, may be considered. Non-infiltrating green infrastructure practices may be suitable in any HSG. **Additional Technical Reference(s):** The water quality treatment and runoff reduction performance of different types of green infrastructure practices are related to runoff volumes, soil types, and associated infiltration rates. The 2017 New Hampshire National Pollutant Discharge Elimination System (NPDES) MS4 Permit, Appendix F, includes nomographs presenting these relationships.
Water bodies and associated buffers	Nhwetlandsbase NHDFlowline	NH GRANIT National Hydrography Dataset (NHD)	Wetlands, lakes, ponds, streams, rivers, and their associated buffers are protected from development and certain activities by state and local wetland protection regulations: • Shoreland Water Quality Protection Act NH (RSA483-b) • City of Rochester Zoning Ordinance, Section 42.12 Conservation Overlay District These regulations together provide a 75-foot buffer to large rivers (Cocheco, Salmon Falls, and Isinglass Rivers) and a 50-foot buffer to wetlands and smaller streams and rivers. Site conditions, the ecological goal of maintaining a natural vegetated buffer, and regulatory provisions are likely to make installation of larger green infrastructure practices within these buffers less desirable than outside them. However, installation within a buffer zone of a water body or wetland, where water quality treatment is desired, may be more appropriate for biofiltration or shallow filtration types of green infrastructure. In addition, preservation of natural lands, also considered to be a green infrastructure approach, should be highly prioritized within these buffers for water quality protection, flood mitigation, groundwater recharge, and habitat protection. Infiltration in areas beyond these buffers provides for a longer flow path prior to emergence in surface waters. **Additional Technical Reference(s):** EPA, 1996, Protecting Natural Wetlands: A Guide to Stormwater Best Management Practices

Physical Site Characteristic	GIS Data Layer	Source	Considerations for Green Infrastructure Implementation
Flood hazard zones	National Flood Hazard Layer	Federal Emergency Management Agency	Green infrastructure infiltrating practices should generally be constructed in areas outside mapped flood hazard zones (Zones D or X) so that any future floods will not damage them. In addition, wet, poorly drained soils and shallow groundwater depths within those flood zones may render the site unsuitable for green infrastructure infiltrating practices. If water quality practices are desired, biofiltration or shallow filtration types of green infrastructure practices are flexible in design and may be considered within flood zones, but areas outside the flood zone are more desirable sites for all practices. Preservation of natural lands, which is a green infrastructure approach, can be highly prioritized within flood zones to protect flood capacity and protect habitat.
Source water protection (groundwater and surface water)	Water supply data	New Hampshire Department of Environmental Services (NHDES)	The *New Hampshire Alteration of Terrain Manual* and the Alteration of Terrain regulations describe the specific site and source control conditions that must be met to use stormwater practices that infiltrate or discharge within water supply protection areas. EPA Region 1's presentation, "EPA Stormwater Rules, Stormwater Infiltration, and Drinking Water," provides an overview of relevant regulations in New England.
Impaired water bodies	Impaired water bodies	NHDES	Implementing green infrastructure practices in watersheds with impairments provides water quality benefits. **Additional Technical Reference(s):** The 2017 New Hampshire NPDES MS4 Permit includes nomographs relating the performance of a variety of green infrastructure practices to different soil types and runoff volumes.
Contaminated sites	Remediation sites, remediation areas	NHDES	Infiltration should be avoided at sites with contaminated soils, because the increased movement of water through the soils and into the groundwater can mobilize contaminants. Therefore, it is important to design green infrastructure practices to prevent them from coming into contact with contaminated soils. To be conservative and account for uncertainties about specific contamination risks, the screening assessment is performed with the understanding that it is more desirable to implement green infrastructure practices outside these areas. Most remediation sites in this NHDES database are recorded as point data. Due to uncertainty in the degree to which the mapped data points represent the exact contamination location, a 400-foot buffer was applied around each remediation site or area to expand the extent of the estimated contamination area. The 400-foot buffer is based on the most stringent stormwater

Physical Site Characteristic	GIS Data Layer	Source	Considerations for Green Infrastructure Implementation
			management practice for groundwater protection required by the NHDES. A small percentage of remediation sites are recorded by parcel. To be conservative, the entire parcel is assumed to be contaminated. The database contains both active and closed contamination sites. This analysis only includes actively managed sites. The following types of active remediation sites are recorded in Rochester, New Hampshire: leaking underground storage tanks, on-premise use facility containing fuel oil, actual/potential discharge of hazardous materials, hazardous water project, underground storage tank program, initial response spill, existing landfill or landfill closure, subsurface wastewater disposal system, municipal/commercial stump or demolition dump, underground injection control, unlined wastewater lagoon, and lined landfill. A full record can be accessed on the NHDES website. **Additional Technical References:** The EPA Brownfields Program developed Design Principles for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas, which explains how to integrate green infrastructure into brownfields redevelopment projects when these larger opportunities arise.
Slope	National Elevation Dataset 1×1 Degree, 2017	U.S. Geological Survey	For this analysis, and in accordance with the screening process described in the *New Hampshire Stormwater Manual, Volume 2* (2008), sites with greater than 15 percent slopes were not considered suitable for green infrastructure implementation. Sites with a shallow slope (less than 15 percent) are better able to capture rainfall on site and slow stormwater runoff to provide more opportunities for infiltration. Smaller green infrastructure practices and shallow filtration types can be considered for use at sites with greater slopes and faster flows, although any sites above a 15 percent slope will be challenging. **Additional Technical Reference(s):** Volumes 1, 2 and 3 of the New Hampshire Stormwater Manual EPA helped Pittsburgh consider how to implement green infrastructure in settings with steep slopes. Through this effort, EPA produced the document *Addressing Green infrastructure Design Challenges in the Pittsburgh Region Steep Slopes* (2012) to illustrate innovative design adaptations, such as step pools, terraced infiltration, and others.
Impervious cover	Impervious Surfaces in the Coastal	NH GRANIT	Impervious cover generates runoff and prevents rainwater from infiltrating into the ground. Impervious cover includes paved areas as well as buildings. The amount of impervious area on a

Physical Site Characteristic	GIS Data Layer	Source	Considerations for Green Infrastructure Implementation
	Watersheds of NH and ME—High Resolution 2015		parcel can limit the area available for the implementation of surface green infrastructure practices. However, impervious areas can also be retrofitted with facilities for underground infiltration or detention of stormwater. These areas most commonly include parking lots but could also include sidewalks and paths in some cases. In addition, reducing impervious area can help to manage stormwater in urban areas because it reduces the volume of stormwater runoff generated at a site. **Additional Technical Reference(s):** The Federal Highway Administration developed *Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring*, which includes some helpful ideas about practice selection and site considerations in highly impervious areas. EPA's *Managing Wet Weather with Green Infrastructure, Municipal Handbook: Green Streets* (2008) provides useful considerations for reducing stormwater generation on streets and improving infiltration and water quality treatment.
Land use	Land Use 2015 – Southeastern New Hampshire	NH GRANIT	Land use data are used in this analysis to estimate parking lot areas within certain land use categories. Land use is also a useful piece of information when further evaluating the feasibility of a potential implementation site and the contributing area. In addition, land use data are important for estimating the expected pollutant loading in runoff from a site and for determining the green infrastructure practices that might be appropriate to manage that runoff.
Parcel boundaries	Parcels2017	Rochester	Parcels provide a unit of assessment for the site assessment.

Table 3. Additional Site Characteristics to Consider in Site Suitability Assessment When Data Are Available

Physical Site Characteristic	GIS Data Layer	Source	Considerations for Green Infrastructure Implementation
Depth to groundwater or bedrock	SSURGO Database for NH017	U.S. Natural Resources Conservation Service	The depth to groundwater and depth to bedrock are constraints that define the ability of many green infrastructure practices to function effectively. Infiltrating practices require minimum depths to groundwater and bedrock usually in the range of 3 to 4 feet. Depth to bedrock can also restrict the ability to construct practices, because construction in bedrock can be very expensive or cost prohibitive. Areas with certain minimum depths to bedrock and/or groundwater can be excluded from consideration for some green infrastructure practices, other than surface biofiltration practices. Depth to groundwater and bedrock can also be used to prioritize sites, as a greater depth ensures the green infrastructure can better function and is easier to construct. The data set for Rochester appeared uncomplete as it exhibited considerable uncertainty and inaccuracy; it was therefore excluded in the analysis. **Additional Technical Reference(s):** Minnesota Pollution Control Agency, 2017, Minnesota Stormwater Manual – Shallow Groundwater Minnesota Pollution Control Agency, 2017, Minnesota Stormwater Manual – Shallow Soils and Shallow Depth to Bedrock
Surficial geology	Surficial Geology—Quad 140, 154, 155	NH GRANIT	Surficial geology typically provides additional understanding of the potential for infiltration, especially in areas where soils are characterized as urban land. These data were not available for Rochester and were not included in the analysis.
Existing stormwater management practices		Applicable municipality records	Existing stormwater practices, such as detention ponds, can be relatively easy locations for green infrastructure retrofits because water is already draining to the site. This data layer was not used in the analysis because no GIS data layer is available.
Existing utilities		Applicable municipality records	The location of existing utilities (water, sewer, gas, electric, etc.) can provide challenges to the installation of green infrastructure practices and may render a retrofit impractical. These data were not used in the analysis because GIS data layers were not available.

2.2 Step 2: Establish Exclusion Criteria, Rated Criteria, and a Rating System

Once the physical site characteristic data is gathered, the community should establish which criteria will be excluded versus rated. For rated criteria, a range of ratings specific to each category of green infrastructure (infiltrating and non-infiltrating) should be set up. The community will use this rating system to calculate a location-specific site suitability score in GIS (Step 3). The sections below describe the exclusion criteria and rated criteria, which are also identified in Table 4 and Table 5. The following sections describe the exclusion and rating processes.

2.2.1 Exclusion Criteria

These criteria are used to exclude sites with certain characteristics from the assessment. Some conditions render a site ineffective or overly challenging for green infrastructure. For example, sites within water bodies are excluded in the Rochester assessment (refer to Table 2 for further explanation). Exclusion criteria are applied by assigning a rating of 0 to excluded areas. Some exclusions remove areas that the city does not want to target. For example, infiltration within areas of contaminated soils and/or groundwater poses an unacceptable risk to pollution migration. Rochester could exclude those areas when those data become available by assigning a rating of 0 to areas with contamination and a rating of 1 to all other areas. In the equation used to compute the suitability score in Step 3, exclusion criteria are applied as multipliers (i.e., a 0 rating will result in a 0 overall suitability score). General types of exclusion criteria for each category of green infrastructure are shown with check marks in Table 4 below. Specific exclusion criteria parameters are provided in Table 6 through Table 9.

Table 4. Exclusion Criteria for Each Green Infrastructure Category

Exclusion Criteria	Infiltrating	Non-Infiltrating
Areas within water bodies	✓	✓
Contaminated Sites	✓	✓
Steep slope	✓	✓
Soils with low permeability	✓	

2.2.2 Rated Criteria

Criteria that are not exclusions receive ratings between 1 and 5. Higher ratings indicate more suitability for the green infrastructure category under assessment. In cases where a data set includes "no data" for some areas, the "no data" entries receive ratings of 3 so that they do not unduly influence the overall scoring. Rated criteria are added and contribute cumulatively to the suitability score (Step 3).

In many cases, a rating of 1 does not prevent the successful installation of green infrastructure, but it does indicate that further investigation into site suitability should be pursued. The city may adjust or weight the ratings as needed in the future to reflect a different emphasis on certain criteria, or to

ensure that the resulting suitability scores are meaningfully distributed. This process is intended to be iterative and repeatable.

General types of rated criteria for each category of stormwater management practice are shown with check marks in Table 5 below. Rated criteria are given a rating between 1 and 5 depending on criteria parameters outlined in Table 6 through Table 9.

Table 5. Rated Criteria for Each Green Infrastructure Category

Rated Criteria	Infiltrating	Non-Infiltrating
HSG A, B, C	✓	
Buffer to water bodies	✓	
FEMA flood zone	✓	✓
Water supply protection zone	✓	
Drainage area to impaired water bodies	✓	✓
Slope	✓	✓

2.2.3 Different Exclusions and Ratings for Green Infrastructure Categories

The key exclusion and rated criteria for each green infrastructure category are summarized below and presented in Table 6 and Table 7.

For example, each physical site characteristic is assigned either an exclusion rating of 0 or 1 (with 0 being excluded and 1 being included) or a rating between 0 and 5 (with 5 being assigned to the most desirable characteristic and 1 being the least desirable, yet still feasible). Rochester may adjust or weight the criteria ratings as needed in the future to reflect a different emphasis on certain criteria, or to ensure that the resulting suitability scores are meaningfully distributed. This process is intended to be customizable, iterative, and repeatable.

Infiltrating Practices

Infiltrating practices (Table 6) use temporary surface or underground storage to allow captured stormwater to exfiltrate into underlying soils. Higher ratings are applied to the remaining areas with the following criteria:

- Greater buffer distance from water bodies and wetlands
- Location outside versus inside flood zones
- Location outside versus inside water supply protection zones
- Location inside versus outside the drainage area of an impaired waterbody
- Lower slope

Areas with the following characteristics are excluded from this assessment for infiltrating practices:

- Water bodies
- Documented contamination
- Slopes greater than 15 percent
- Low-permeability soils (indicated by HSG D)

Table 6. Criteria Ratings for Infiltrating Practice Site Suitability Assessment

Rating[a]	Infiltrating Practice Exclusion Criteria				Infiltrating Practice Rated Criteria					
	Water Bodies	**Contaminated Sites[b]**	**Steep Slope[c]**	**Soils HSG**	**Soils HSG**	**Buffer to Water Body[d]**	**FEMA Flood Zone**	**Water Supply Protection Zone[e]**	**Impaired Water Bodies[f]**	**Slope[g]**
0 (exclusion)	Inside wetland, lake, or river	Within documented contaminated parcel or 400 ft buffer around point source contamination	>15%	HSG D (+A/D, B/D, C/D)						
1	Outside wetland, lake, or river	No known contamination	<15%		HSG C	Inside 50 ft of wetlands, water bodies, and most rivers and 75 ft of larger rivers	Zones A, AE	Inside well, surface water, or groundwater protection zone	Outside drainage area of impaired water body	12% to 15%
2										8% to 12%
3					HSG B (+no data)	Within 50 ft to 150 ft of large water bodies				4% to 8%
4										2% to 4%
5					HSG A	Outside 50 ft of wetlands and small water bodies, 150 ft of large water bodies, 50 ft of most rivers, and 75 ft of larger rivers	All other zones	Outside well, surface water, or groundwater protection zone	Within drainage area of impaired water body	0% to 2%

[a] The ratings apply to each criterion individually, not to all the criteria for a given site. For example, a site can have a rating of 2 for one criterion and a rating of 5 for another.

[b] Based on NHDES, WD-DWGB 22-4 (2009) Best Management Practices (BMPs) for Groundwater Protection.

[c] Based on the *New Hampshire Stormwater Manual (Volume 2).*

[d] Based on the New Hampshire Shoreland Water Quality Protection Act, NH RSA483-b, and the City of Rochester Zoning Ordinance, Section 42.12: Conservation Overlay District.

[e] A water supply protection zone includes the following areas mapped in New Hampshire: designated wellhead protection area, water supply intake protection area, and source water protection area.

[f] Based on NHDES Impairment Categories 4 and 5.

[g] Based on the *New Hampshire Stormwater Manual (Volume 2).*

Non-infiltrating Practices

Non-infiltrating practices (Table 7) use temporary surface or underground storage to allow captured stormwater to exfiltrate into an underdrain that ties into storm sewer infrastructure. Higher ratings are applied to the remaining areas with the following criteria:

- Location outside versus inside flood zones
- Location inside versus outside the drainage area of an impaired waterbody
- Lower slope

Areas with the following characteristics are excluded from this assessment for non-infiltrating practices:

- Water bodies
- Documented contamination
- Slopes greater than 15 percent

Table 7. Criteria Ratings for Non-Infiltrating Practice Site Suitability Assessment

Rating[a]	Non-Infiltrating Practice Exclusion Criteria			Non-Infiltrating Practice Rated Criteria		
	Water Bodies	**Contaminated Sites[b]**	**Steep Slope[c]**	**FEMA Flood Zone**	**Impaired Water Bodies[d]**	**Slope[e]**
0 (exclusion)	Inside wetland, lake, or river	Within documented contaminated parcel or 400 ft buffer around point source contamination	>15%			
1	Outside wetland, lake, or river	No known contamination	<15%	Zones A, AE	Outside drainage area of impaired water body	12% to 15%
2						8% to 12%
3						4% to 8%
4						2% to 4%
5				All other zones	Within drainage area of impaired water body	0% to 2%

[a] The ratings apply to each criterion individually, and do not represent a set of criteria that together characterize a given site. For example, a given site can have a rating of 2 for one criterion and a rating of 5 for another criterion.

[b] Based on NHDES, WD-DWGB 22-4 (2009) Best Management Practices (BMPs) for Groundwater Protection.

[c] Based on the *New Hampshire Stormwater Manual (Volume 2).*

[d] Based on NHDES Impairment Categories 4 and 5.

[e] Based on the *New Hampshire Stormwater Manual (Volume 2).*

2.3 Step 3: Perform Site Suitability Scoring

Site suitability scores are computed in GIS at every assessed location based on the criteria ratings established in Step 2 for both green infrastructure categories (infiltrating and non-infiltrating). The site suitability scores incorporate the exclusion criteria and the rated criteria according to the scoring equations below. Exclusion criteria ratings are multiplied together and then multiplied by the sum of the rated criteria.

The User Can Adjust These Scores and Scoring Equations

These scores and equations were developed by EPA in conjunction with city of Rochester. The data and scores used in this assessment can be updated as needed in future iterations of the analysis, using the same methodology framework.

The overall format of each of the scoring equations is as follows:

suitability score = product of exclusion criteria ratings × sum of criteria with ratings

Scoring Equation: Infiltrating Green Infrastructure

infiltrating suitability score = water bodies x contaminated sites x steep slope x HSG D soils × HSG soils + buffer to water bodies + FEMA flood zone + water supply protection zone + drainage area to impaired water bodies + slope

total possible infiltrating suitability score = 30

Scoring Equation: Non-Infiltrating Green Infrastructure

non-infiltrating suitability score = water bodies x contaminated sites x steep slope × FEMA flood zone + drainage area to impaired water bodies + slope

total possible non-infiltrating suitability score = 15

2.4 Step 4: Map Site Suitability

Once calculated, the site suitability scores can be presented on a map. Scores can be grouped into ranges to create a "heat map," with colors showing suitability for each green infrastructure category. The GIS processes required to calculate the site suitability scores across the study area for infiltrating and non-infiltrating practices are presented in Figure 2 and Figure 3 below. The GIS data are transformed to apply the criteria ratings and then compute the suitability scores to develop the final physical site suitability heat maps. The common methods of GIS data transformation used in this process are:

- **Buffer.** Create a zone around a set of map elements using a set distance.

- **Clip.** Overlay map layers on top of one another, then extract only that area of a map that is within the polygon or polygons defined by one of the data layers.
- **Exclude.** Overlay map layers on top of one another, then exclude only that area of the map that is outside a polygon or polygons defined by one of the data layers.
- **Rate.** Assign a rating score to individual pixels or polygons based on a given characteristic.
- **Union.** Overlay one map layer on top of another and combine two types of map features into one feature to create a new map layer.
- **Dissolve.** Merge different features of a map into one feature to create a new map layer.

The flow charts in the figures below serve as a guide for a GIS analyst to recreate this assessment process and revise it in the future as needed, so that the city can employ this methodology as data and priorities evolve.

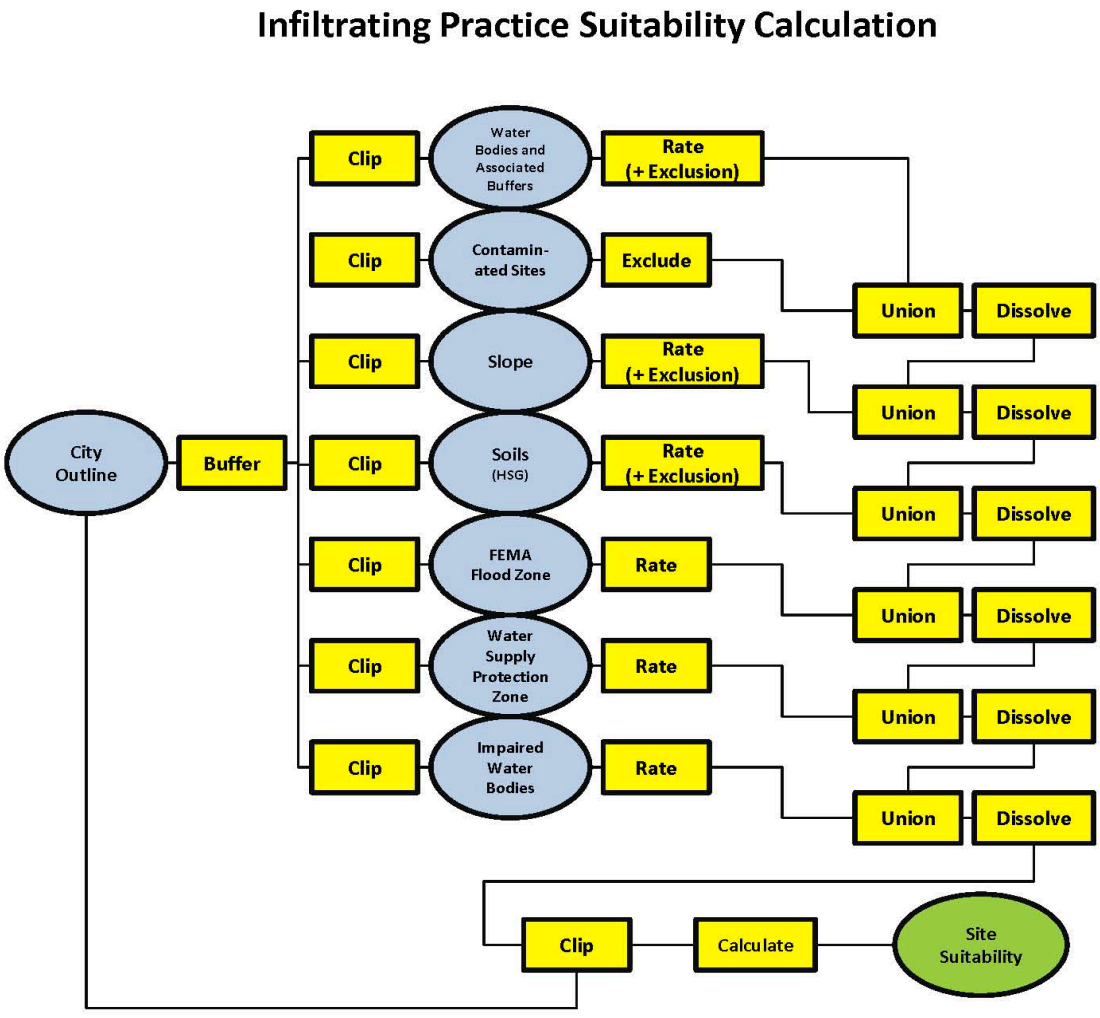

Figure 2. Flow Chart: GIS Suitability Assessment Process for Infiltrating Green Infrastructure

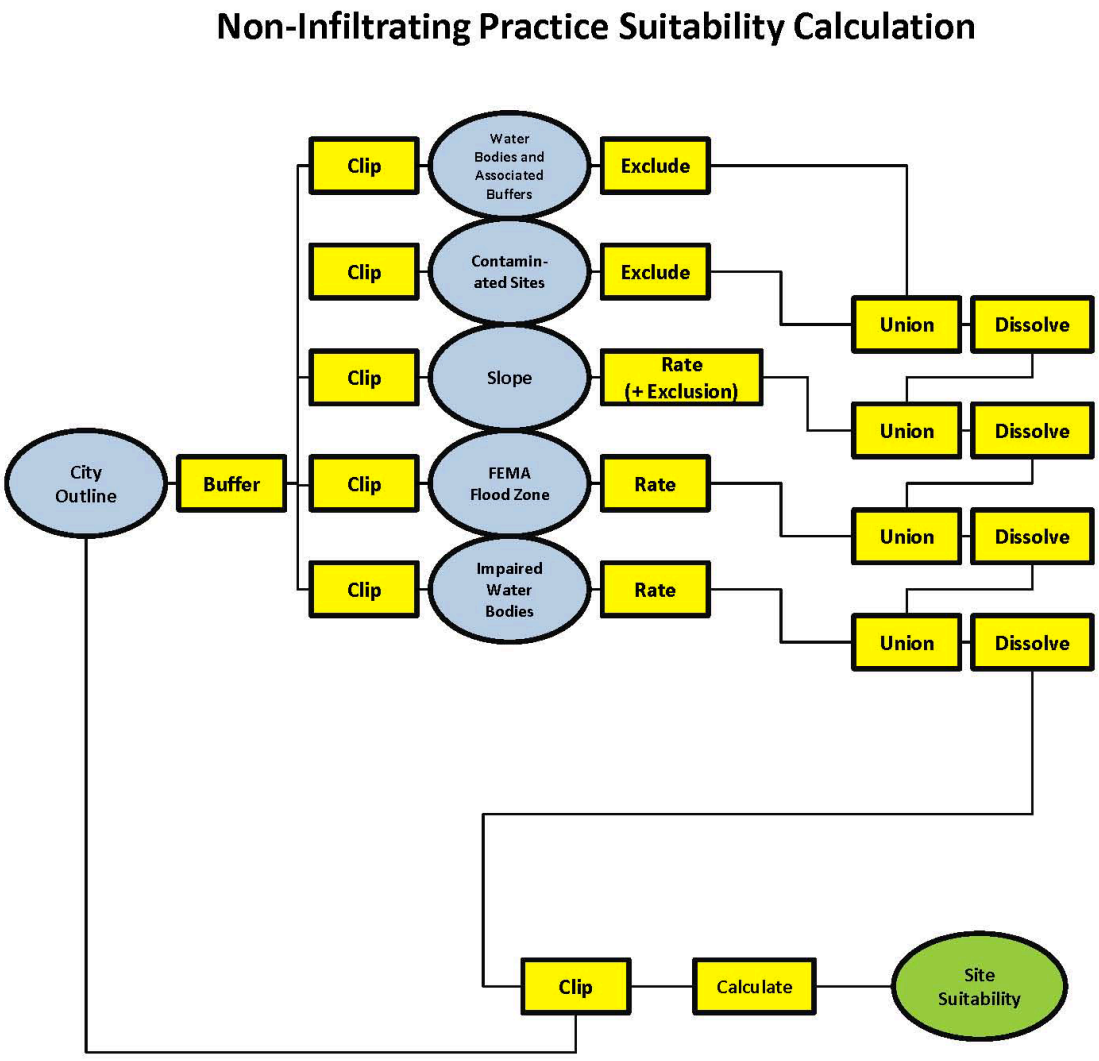

Figure 3. Flow Chart: GIS Suitability Assessment Process for Non-Infiltrating Green Infrastructure

The output from this process is a map in which each pixel in the map grid is assigned a final suitability score. Those scores are grouped into categories and color coded to define differing levels of suitability.

2.5 Step 5: Evaluate Site Suitability Assessment Results

The maps generated in Step 4 can be used to evaluate the suitability of parcels or sites for the implementation of infiltrating and non-infiltrating green infrastructure.

2.5.1 Lenses

Several additional data layers representing geographic, physical, or regulatory characteristics can be applied to the assessment maps as "lenses" through which the user can further evaluate the results.

Lenses are not rated or included in the computation of the suitability score, but they add context to help the user evaluate the site suitability results. Lenses are typically boundaries for a targeted suitability assessment. For example, Rochester established the lenses in Table 8 to enhance the assessment. Additional lenses could be established depending on Rochester's desired goals and priorities.

Table 8. Rochester Lenses for Interpreting Targeted Results

Lens	GIS Data Layer	Source	Considerations for Assessment
Public parcel ownership	Parcels 2017	City of Rochester	Public parcels may be easier or less costly than private parcels for the city to retrofit with green infrastructure practices or to conserve as open space. Retrofits on private parcels require a partnership with the private landowner or a regulation to require the improvements. Parcel ownership is used as a lens for further evaluating sites, following the initial assessment analysis.
MS4 regulated area	2010 Census urbanized areas	NHDES	The city may be interested in evaluating whether a site is located within the regulated MS4 area because green infrastructure practices may help the community meet MS4 permit requirements. The MS4 regulated area is used as a lens for further evaluating sites, following the initial assessment analysis.
Anticipated public project sites	(Created for this analysis)	City of Rochester	The city of Rochester staff developed a preliminary list of anticipated public capital improvement projects—which it will design in the next one to five years—that could potentially integrate green infrastructure practices. City staff delineated the approximate boundaries of these project sites, which include parcels as well as public road rights-of-way. The site screening assessment results can be evaluated with an eye toward these public project sites, to inform project planning and facilitate the incorporation of green infrastructure. This information is generated through discussion with city staff members who are knowledgeable about the capital improvement plan, as well as upcoming roadway, parks, and other maintenance efforts city. As project plans change over time, this data layer should be updated as needed.

Mapped results can be evaluated within GIS (recommended for parcel-specific investigations) or by printing suitability maps for each green infrastructure category, with or without lenses. Printed maps from Rochester's assessment are included in Section 4 below to provide a visual example of the methodology outputs and how they were used to evaluate site suitability results.

3. Evaluating Site Suitability Assessment Results for Rochester

The site suitability maps can be evaluated and analyzed individually and through a variety of lenses to answer specific questions of interest to the community. In Rochester, the city was interested in evaluating the suitability of sites within the MS4 regulated area and publicly owned parcels, which were added as lenses and are described in Sections 4.2 and 4.3, respectively. Rochester was also interested in assessing the locations of anticipated public projects, which are discussed in Section 4.4. City staff can continually update this information and use it as an ongoing point of reference when projects develop on city property or when the city wants to implement additional green infrastructure.

3.1 Site Suitability Across Rochester

Citywide maps (Figure 4 and Figure 5) showing site suitability for the two green infrastructure categories were prepared for Rochester using the methodology described in Section 3. Rating scores were assigned to each pixel across the maps and then color coded. The higher the rating score the higher the potential suitability. In each figure, the assessment results are presented on a scale from least potential suitability (red) to most potential suitability (green) for the targeted category of green infrastructure. A red color coding does not preclude the successful installation of green infrastructure; it simply indicates that the location may be less suitable than a green location based on the chosen criteria and desktop screening.

The city can use each map to evaluate which category of green infrastructure may be the most suitable for implementation at a given site. The Rochester figures demonstrate that many areas of the city are suitable for both infiltrating and non-infiltrating green infrastructure. However, non-infiltrating green infrastructure is suitable in a slightly broader range of locations because it is not restricted by HSG D soils. Figures showing the individual criteria used in the site suitability assessments, color coded according to the assigned rating values, are included in Attachment 1 for reference.

Challenges with Suitability Scoring on Public Roadways

This analysis treats all streets within the city of Rochester as one public parcel due to the nature of the GIS data layer for parcels. This results in one suitability score for the entire street network. Although this medium-level score likely approximates a realistic score for most streets within the city, a more in-depth analysis is necessary to properly rank individual streets or sections of streets against other public parcels. This can be done by dividing the streets into individual polygons (or parcels) for analysis.

3.2 Site Suitability Within the MS4 Area

The assessment results indicate that there are many potential opportunities within the MS4 area for both infiltrating and non-infiltrating practices to improve water quality, reduce stormwater volumes and velocities, and reduce erosion. The city can use the assessment results presented in Figure 4 and Figure 5 to consider where to pursue implementation of green infrastructure within the MS4 regulated area. Figure 6 presents the boundary of the MS4 regulated area.

3.3 Site Suitability Within Publicly Owned Parcels

Figure 6 also shows the location of publicly owned parcels. These sites can be visually cross-referenced with Figure 4 and Figure 5 when reviewing results on paper, or overlaid on the output maps in desktop GIS at an appropriate scale, to see whether a parcel or portion of a parcel may be potentially suitable for green infrastructure implementation.

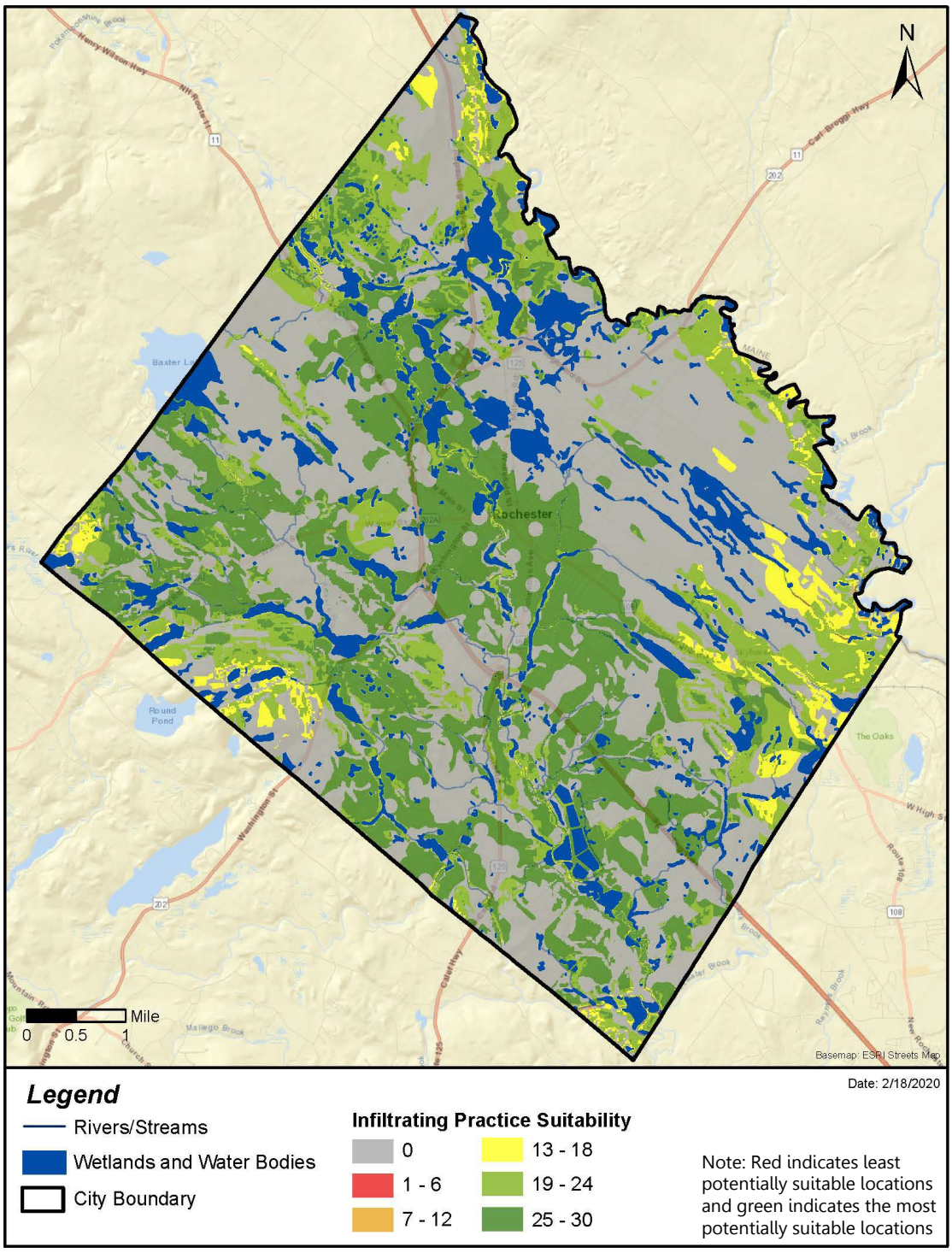

Figure 4. Infiltrating Practice Suitability

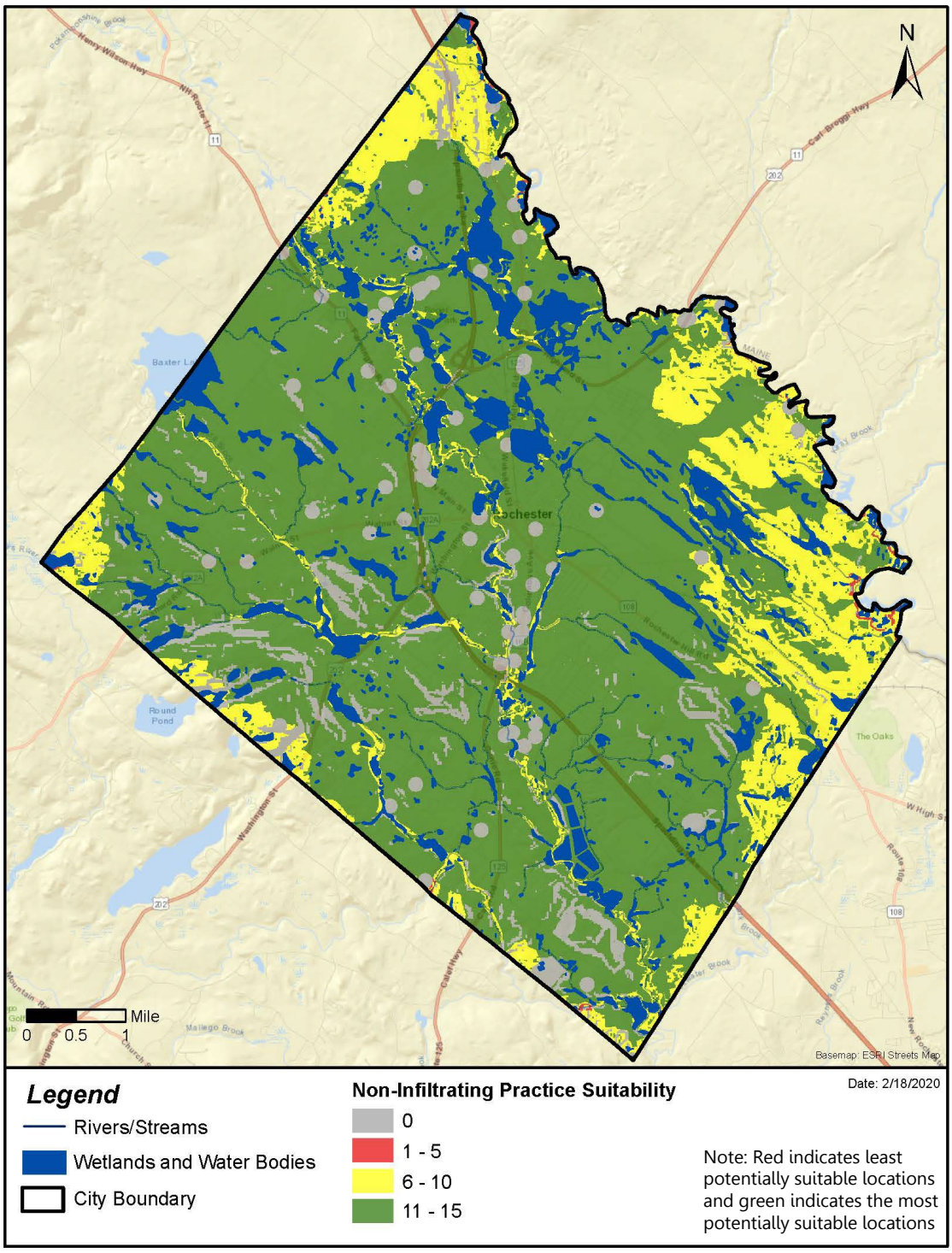

Figure 5. Non-Infiltrating Practice Suitability

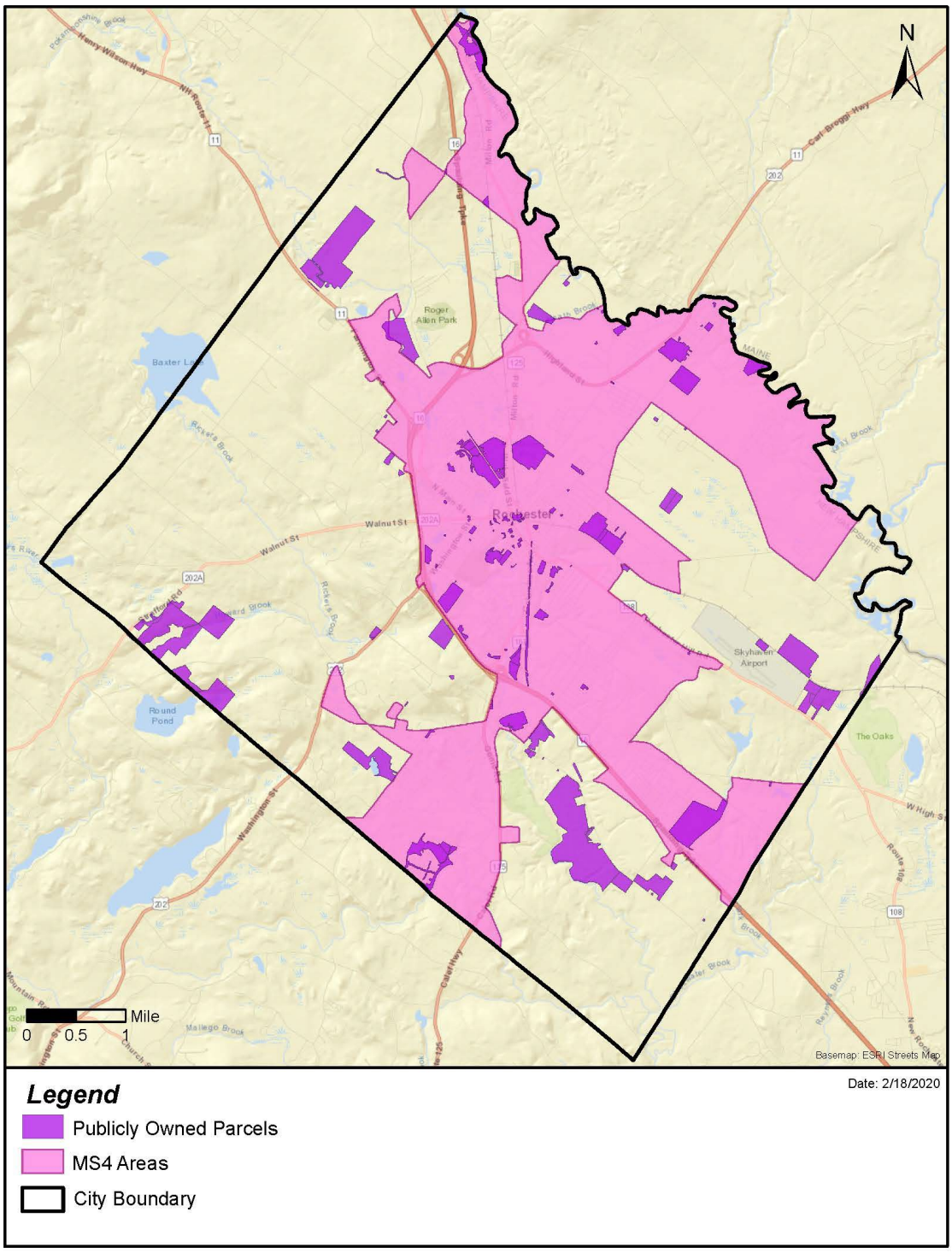

Figure 6. Lenses for Additional Assessment

3.4 Overall Suitability Ranking of Public Project Sites

The city of Rochester identified the locations of three anticipated public project sites[2] and delineated these locations in a GIS shape file for analysis. The proposed public project sites are:

- **Wakefield Street reconstruction**. This project site is on Wakefield Street, extending approximately from Chestnut Hill Street in the north down to Union Street in the south.
- **Woodman Myrtle neighborhood**. This is the network of roads, including short dead-end roads, within a small residential neighborhood surrounded by open space.
- **Woodman Myrtle neighborhood (park element)**. At the end of the Woodman Myrtle neighborhood is an open space area that is partially bounded by the Cocheco River and is next to the William Allen School.

Public project sites differ from parcel boundaries because they include the specific portions of parcels and roads where disturbance is anticipated during project implementation. This is important because two public projects are streets, which need a defined outline to receive an accurate suitability score. An area-weighted average suitability score was generated for each green infrastructure category for the public project sites. These scores are summarized in Table 9.

Table 9. Site Suitability Scores for Selected Public Projects

Project Name	**Infiltrating Practice Score** (weighted average score and % of total possible score)	**Non-Infiltrating Practice Score** (weighted average score and % of total possible score)
Wakefield Street reconstruction	24 (80%)	12 (80%)
Woodman Myrtle neighborhood	25 (83%)	12 (80%)
Woodman Myrtle neighborhood (park element)	6 (20%)	6 (40%)
TOTAL POSSIBLE SCORE	**30**	**15**

Figure 7 and Figure 8 show the locations of the public project sites, with both the weighted average scores as well as the spatial distribution of the total suitability scores across the sites for each green infrastructure category. These figures can help the city assess which categories of green infrastructure may be appropriate for specific areas within the public project boundaries, inform the site layout and stormwater management concepts developed for these projects, and guide the city in further integrating green infrastructure into the public project designs as they progress.

The assessment results show varying levels of suitability between the two categories of green infrastructure for each public project site. Two of the three public project sites (all except Woodman Myrtle neighborhood park element) are potentially well suited for either infiltrating or non-infiltrating

[2] The two public project sites that were the subject of the EPA Greening America's Communities Grant design charrette effort were excluded from the analysis.

green infrastructure. In addition, a closer examination of the distribution of the suitability scores within the public project boundaries demonstrates that one internal portion of the Woodman Myrtle neighborhood park element shows a high suitability score for infiltrating practices.

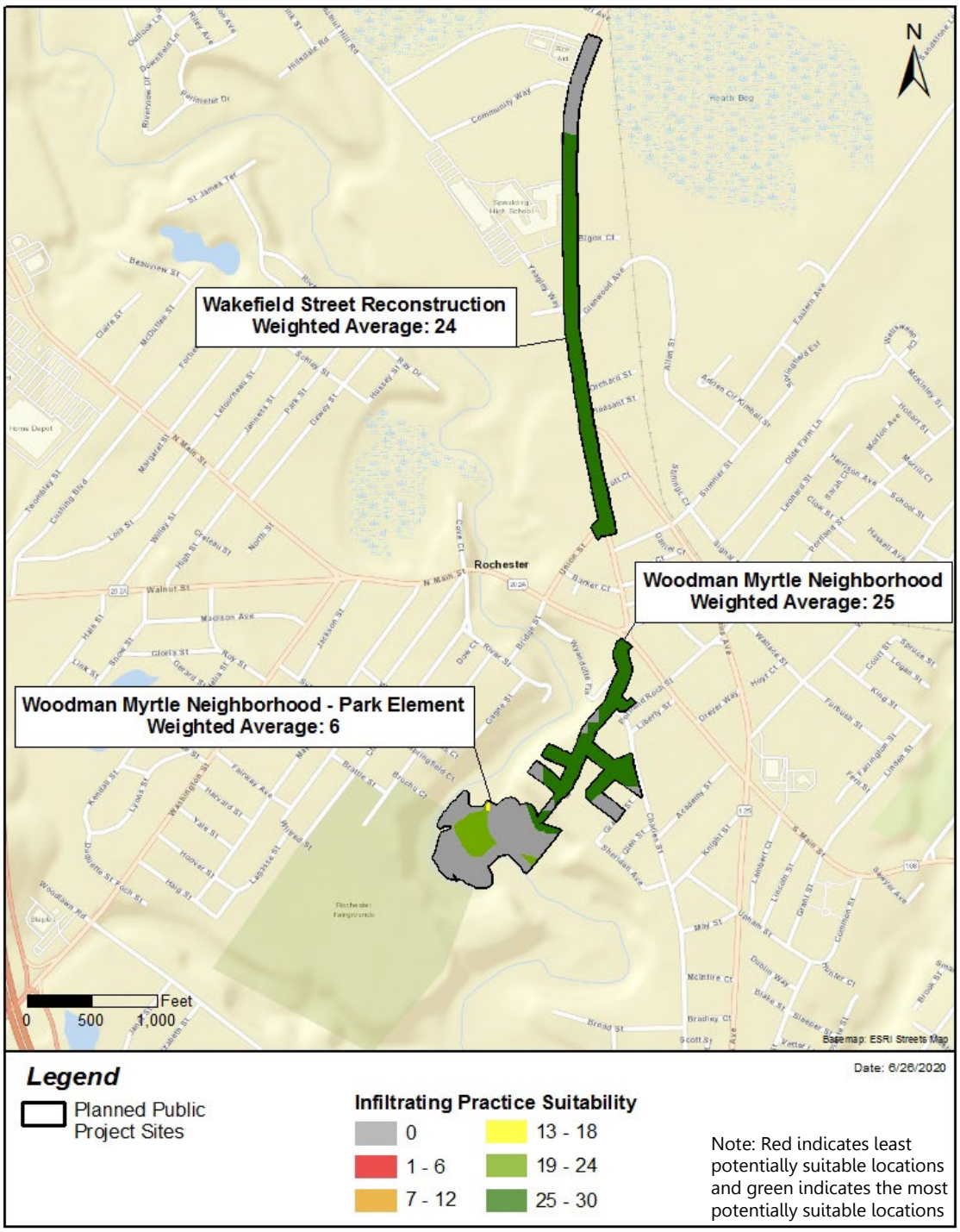

Figure 7. Planned Public Projects Infiltrating Practice Suitability

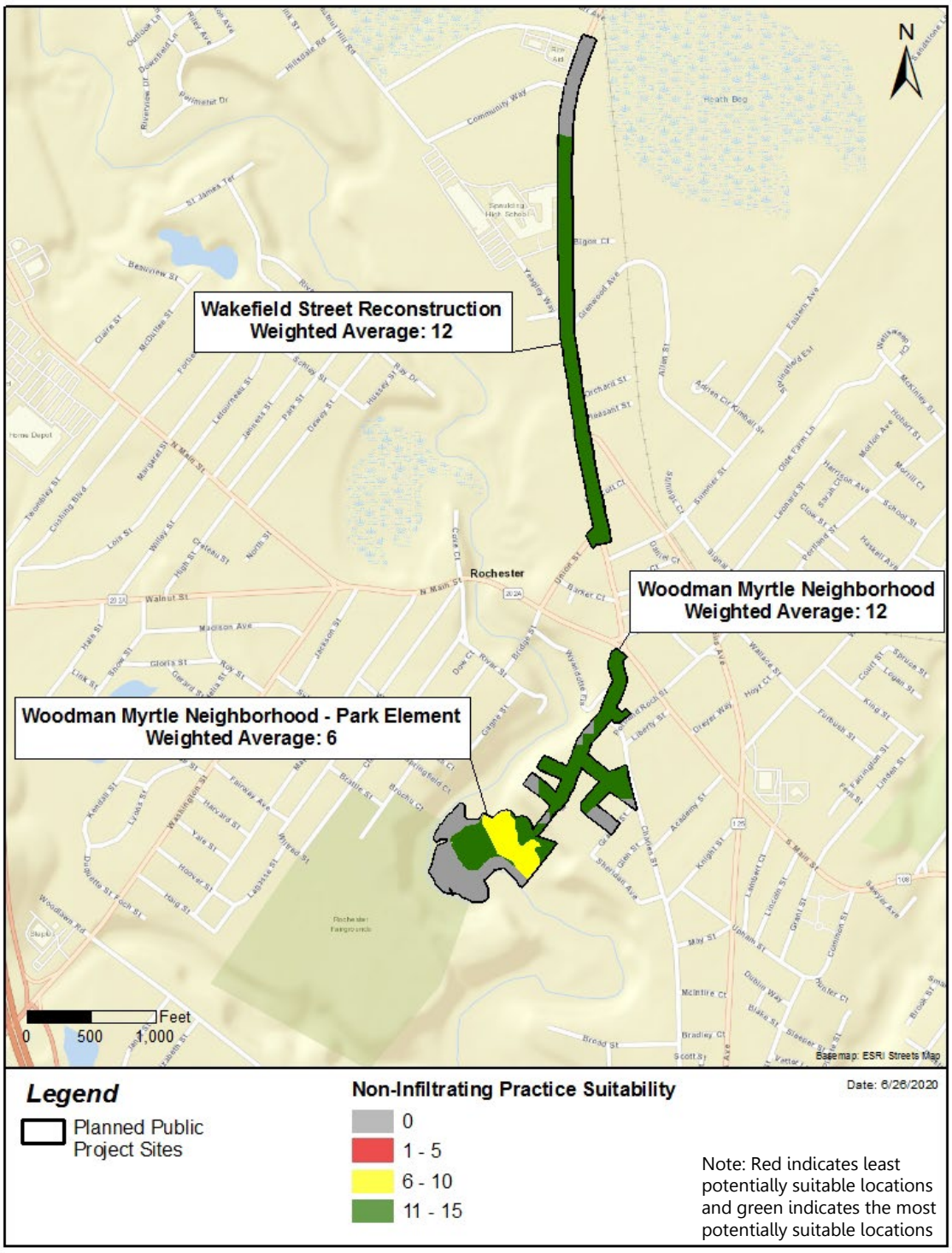

Figure 8. Planned Public Projects Non-Infiltrating Practice Suitability

4. Next Steps: Building on the Site Suitability Assessment

The site suitability assessment methodology described in this document can be used to guide the city toward targeted and informed green infrastructure implementation. This methodology helps the city narrow in on where to further investigate and pursue green infrastructure opportunities. It also provides a process that the city can repeat to assess suitability under different criteria ratings as desired or as additional data become available (e.g., surficial geology data in Rochester).

The results of this assessment are screening-level only and should not be interpreted as prohibiting certain types of green infrastructure in areas that score low in the suitability assessment. Rather, the mapping outputs and site scores relative to each other help to focus limited city funds and efforts on areas that appear to be more suitable based on the chosen criteria, scoring, and city priorities. Using this methodology to perform assessments provides a logical pathway forward when the city desires green infrastructure implementation.

4.1 Targeted Desktop Analysis

The site suitability assessment and evaluation lenses can identify a variety of potential sites where green infrastructure might be suitable. There may also be locations that surprisingly did not appear on the heat maps as good spots for green infrastructure. A more detailed review of each data layer that went into the assessment can provide important insight into the assessment results for a given parcel. An aerial photo can also provide context and help to clarify what land use and site conditions exist at the site. Other available GIS data layers can also be incorporated. For example, the city might choose to include GIS mapping of the sanitary and storm sewer mains to augment the site suitability assessment data.

4.2 Field Investigation and Concept Design

Once potentially suitable green infrastructure sites are identified through the GIS-based site suitability assessment and targeted desktop analysis, the next step is to investigate these sites in person to identify additional constraints and opportunities that may not be visible using GIS data alone. For example, a site visit may reveal:

- Information on utilities for which the GIS has no data.
- A change in land use that is not reflected in the latest GIS data.
- An impact, such as sediment buildup, erosion, or prevalence of an invasive species, that may influence the design or selection of green infrastructure.

Site investigations are also an opportunity to begin sketching out conceptual designs for potential green infrastructure at the site, particularly if the project is a retrofit or renovation of an existing site. A conceptual design can be a sketch using a marker on an aerial photo, or a sketch on a tablet computer that may have mobile GIS capabilities. The idea is to identify:

- A location that is the appropriate size for the proposed green infrastructure.
- A feasible mechanism for draining water into the practice.
- A feasible mechanism for discharging water from the practice via infiltration, underdrain connection to existing infrastructure, or overflow.

The concept design should take into consideration an estimate of the size of the site's contributing drainage area and the basic treatment and/or detention volume. All the assumptions made in the concept sketch are estimates but should be made by a designer or engineer with stormwater management experience. An organized site visit effort following the site assessment phase can result in a well-documented plan of green infrastructure implementation opportunities throughout a neighborhood, basin, or city boundary.

Stormwater Management Opportunities Come in Many Functions, Shapes, and Sizes

Innovative approaches are used in locations throughout the country to integrate green infrastructure into developed landscapes. The restoration work in the Berry Brook watershed in Dover, New Hampshire, and the Mystic River and Buzzards Bay Watersheds in Massachusetts are examples of the effectiveness of smaller-capacity stormwater control systems that provide water quality and other benefits. These case studies also demonstrate the process of evaluating pollutant load reduction and cost effectiveness of green infrastructure on the ground.
(For more information on the restoration projects mentioned above, visit https://www.unh.edu/unhsc/berry-brook-project and https://www3.epa.gov/region1/npdes/stormwater/ma/opti-tool-case-study-demo-buzzards-bay-watershed.pdf.)

4.3 Estimating Benefits

This type of site suitability assessment lays the groundwork for a community to consider the combined water quality benefits of implementing stormwater management practices at scale across a neighborhood, a basin, or the community. Once the suitability assessment identifies potential sites and basic concepts are developed, the community can begin to estimate the potential stormwater water quality treatment, flood mitigation, infiltration, and detention improvements at each site. These estimates can be combined and evaluated to see which combinations of practices in which locations might be most effective. A host of modeling tools can be employed for this purpose, ranging in complexity and data intensity. An overview of green infrastructure modeling tools for planning and design can be found at https://www.epa.gov/green-infrastructure/green-infrastructure-modeling-tools. Links to more detailed information about specific tools and models are summarized in the call-out box below.

Green Infrastructure Screening and Selection

The **EPA Green Infrastructure Modeling Toolkit** includes many tools and models to help communities identify and evaluate which green infrastructure and combinations could be effective.

The **Green Infrastructure Wizard** is a web application that provides communities with information about EPA green infrastructure tools and resources.

The **Watershed Management Optimization Support Tool** is a software application that allows users to screen a wide range of management practices for cost-effectiveness and economic sustainability.

Performance Simulation and Modeling

Visualizing Ecosystem Land Management Assessments is a computer software model to help regional planners and land managers determine which green infrastructure practice would be most effective for improving water quality in streams, estuaries, and groundwater.

The **Storm Water Management Model** is a simulation model that communities can use for stormwater runoff reduction planning, analysis, and the design of combined sewers and other drainage systems.

The **National Stormwater Calculator** is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). SWC allows users to learn about the ways that green infrastructure, like rain gardens, can prevent water pollution in their neighborhoods.

The **Green Infrastructure Flexible Model** is a computer program that evaluates the performance of urban stormwater and agricultural green infrastructure practices. Users can build conceptual models of green infrastructure to predict hydraulic and water quality performance under given weather scenarios.

EPA Region 1's **Stormwater Optimization Tool** is a desktop application combining GIS and spreadsheet analysis that allows users to evaluate options and determine the best mix of structural stormwater management practices, including green infrastructure, to achieve quantitative water resource goals.

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4.4 Leveraging Analysis Results

This type of preliminary green infrastructure opportunity assessment positions the city to pursue and take advantage of available grants and other funding mechanisms to design and install green infrastructure. Communities are encouraged to think broadly about where they search for implementation funding sources, including sources geared toward water quality improvements, stormwater management, parks improvement, public-private partnerships, climate change resilience, urban revitalization, transportation projects (including green streets and "road diets"), and even historic restoration.

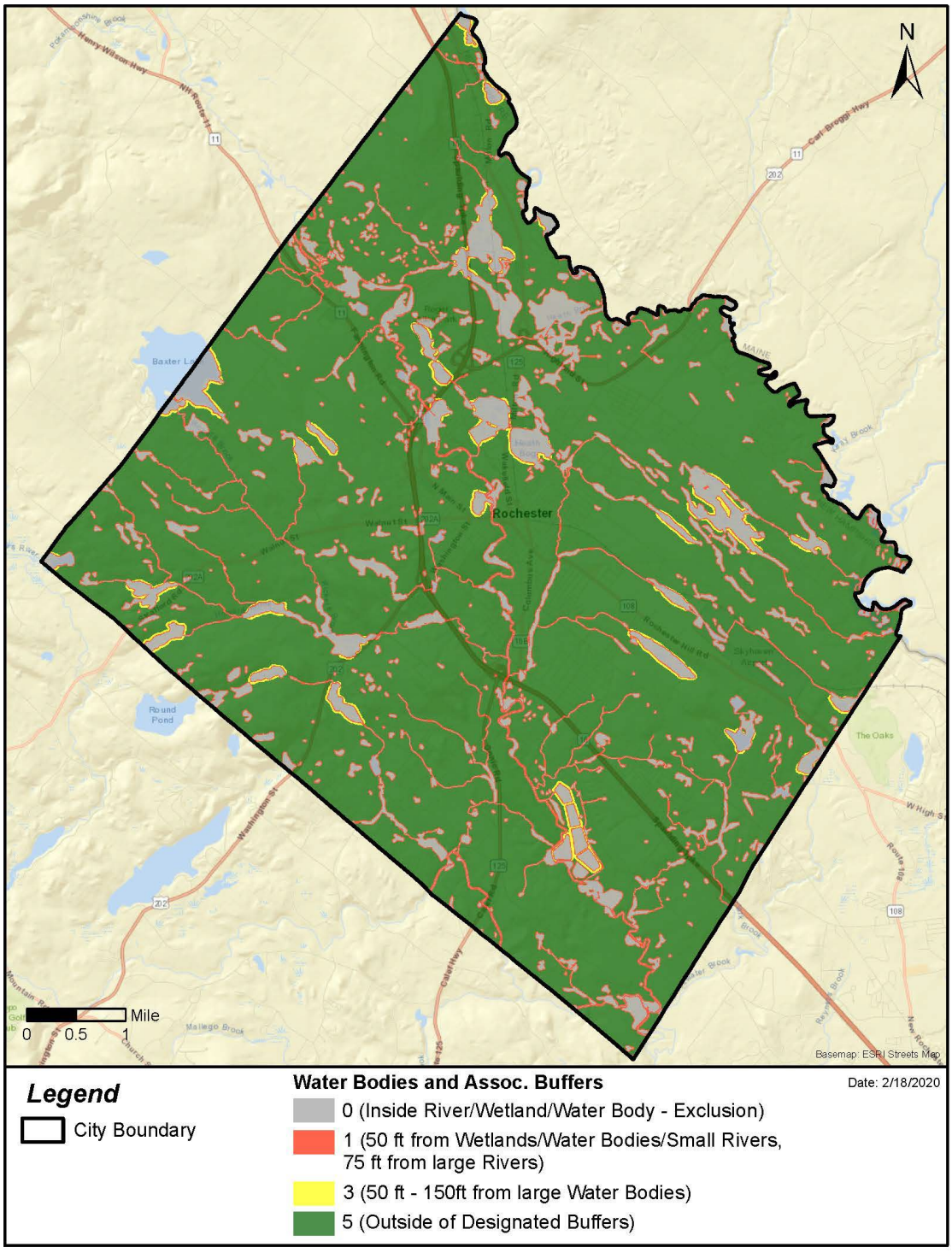
This type of analysis identifies multiple stormwater management and green infrastructure opportunities that could be 'bundled' together to pursue funding for more than one project at a time. For example, communities could apply for funding from the Clean Water State Revolving Fund (CWSRF) to implement multiple opportunities within a given neighborhood or watershed, or multiple opportunities that include a uniform set of stormwater management practices or a uniform set of property types (public parks, residential sites, schools, municipal facilities, historic properties, etc.). For more information about stormwater funding resources and opportunities, visit: EPA's Water Finance Clearinghouse and EPA's Green Infrastructure Funding Opportunities webpages.

In addition, Rochester may be interested in using the Opti-Tool developed by EPA Region 1 as it moves forward with green infrastructure planning. The Opti-Tool allows users to evaluate the best mix of structural stormwater practices, including green infrastructure, to achieve quantitative water

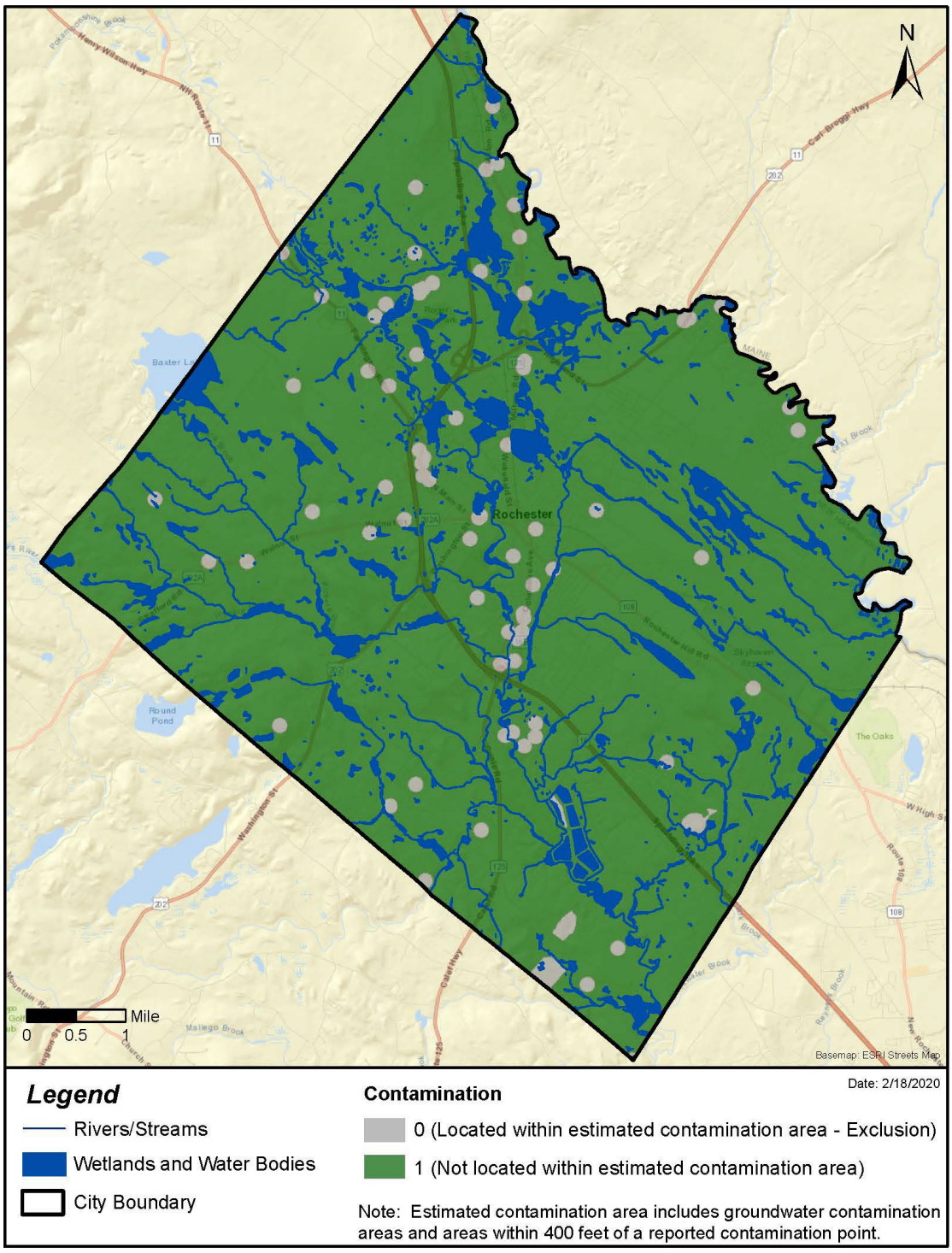
resource goals. The tool uses regional data to calculate pollutant load reductions from stormwater management practices and green infrastructure, such as infiltrating systems, biofiltration, and gravel wetlands.

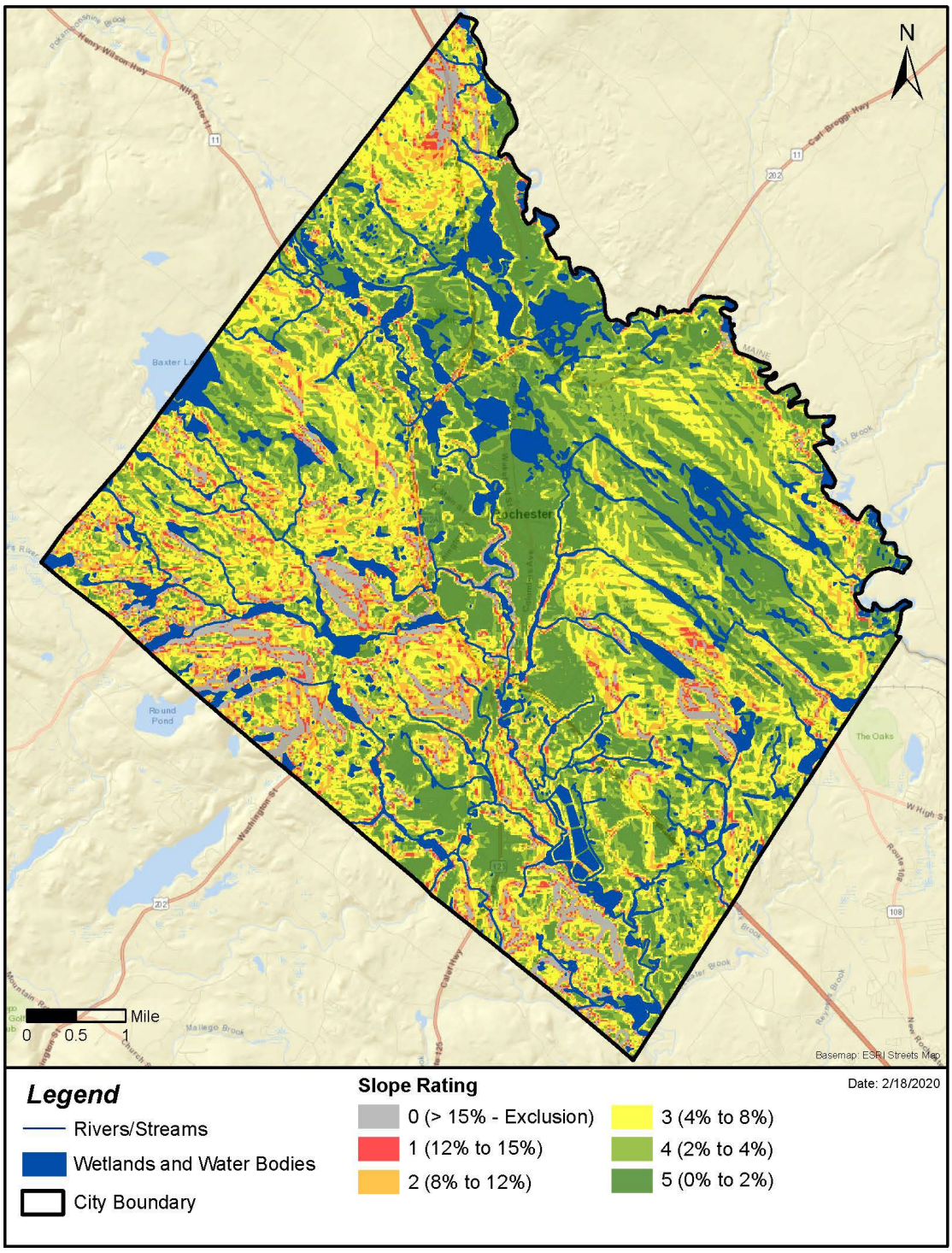
Thanks to their multiple benefits, green infrastructure can be integrated into projects to support goals such as revitalization, historic preservation and restoration, habitat creation, localized flooding reduction, or park improvement. The benefits are often experienced by adjacent landowners as well as residents throughout the community, making the value of these projects even greater. In some cases, stakeholders may be interested in supporting a project through a public-private partnership in which the private entity helps fund, finance, or provide space for a project.

Attachment 1: Rating and Exclusion Maps for Each Assessment Criterion

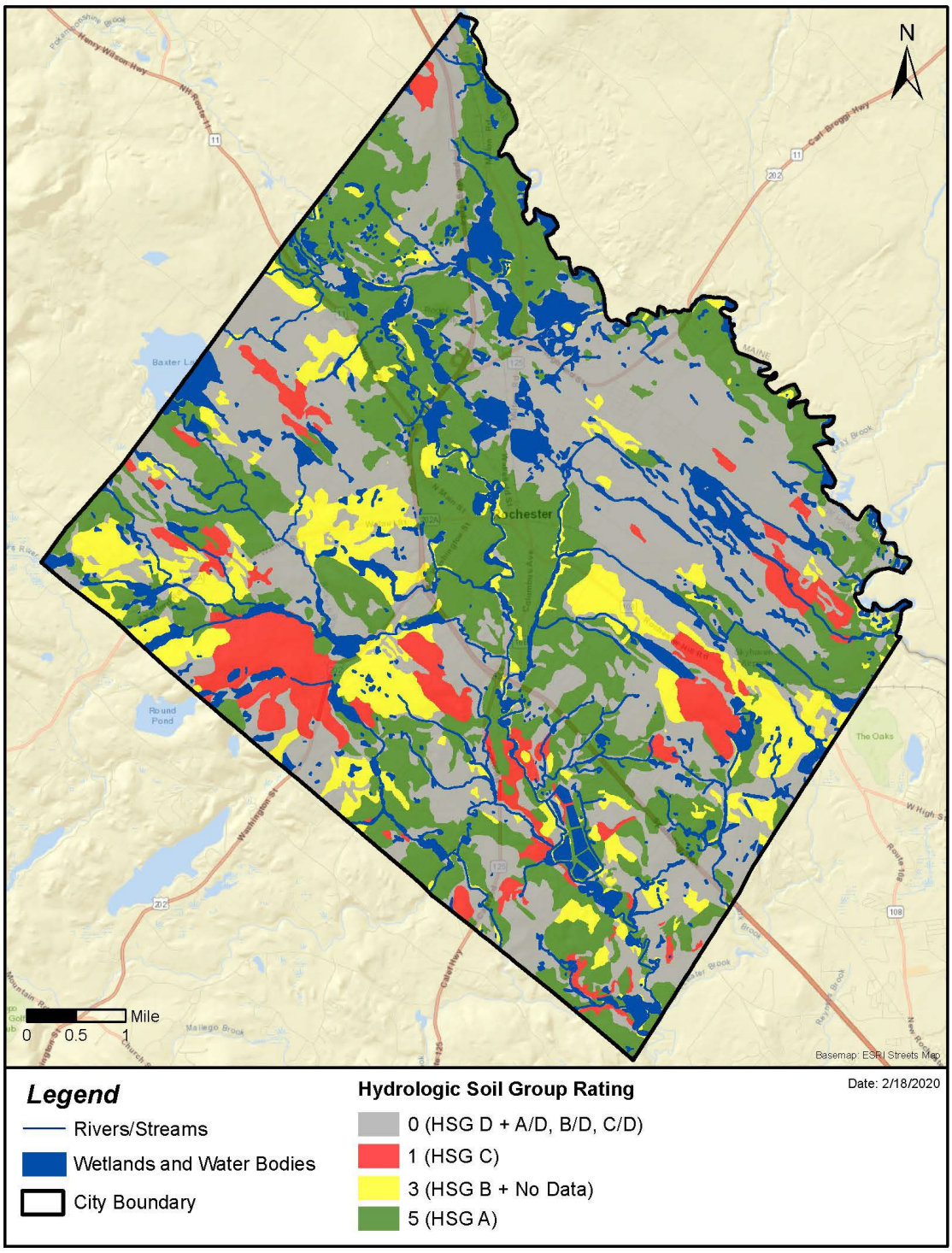


Note: Red indicates least potentially suitable locations and green indicates the most potentially suitable locations

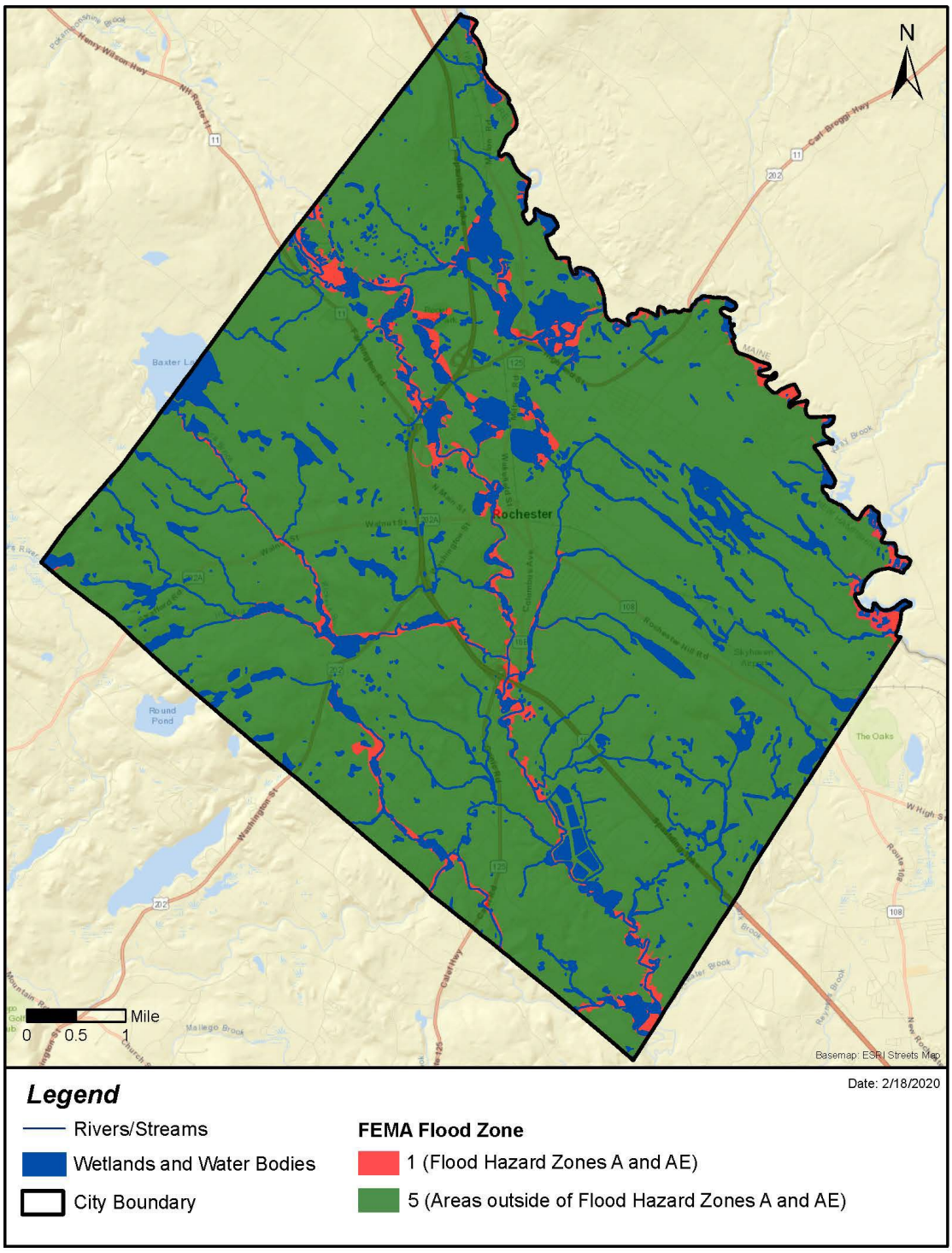

N
Rochester
Baxter Lake
Round Pond
Mallego Brook
Mile
0
0.5
1
Basemap: ESRI Streets Map
Date: 2/18/2020
Legend
Rivers/Streams
Wetlands and Water Bodies
City Boundary
Contamination
0 (Located within estimated contamination area - Exclusion)
1 (Not located within estimated contamination area)
Note: Estimated contamination area includes groundwater contamination areas and areas within 400 feet of a reported contamination point.

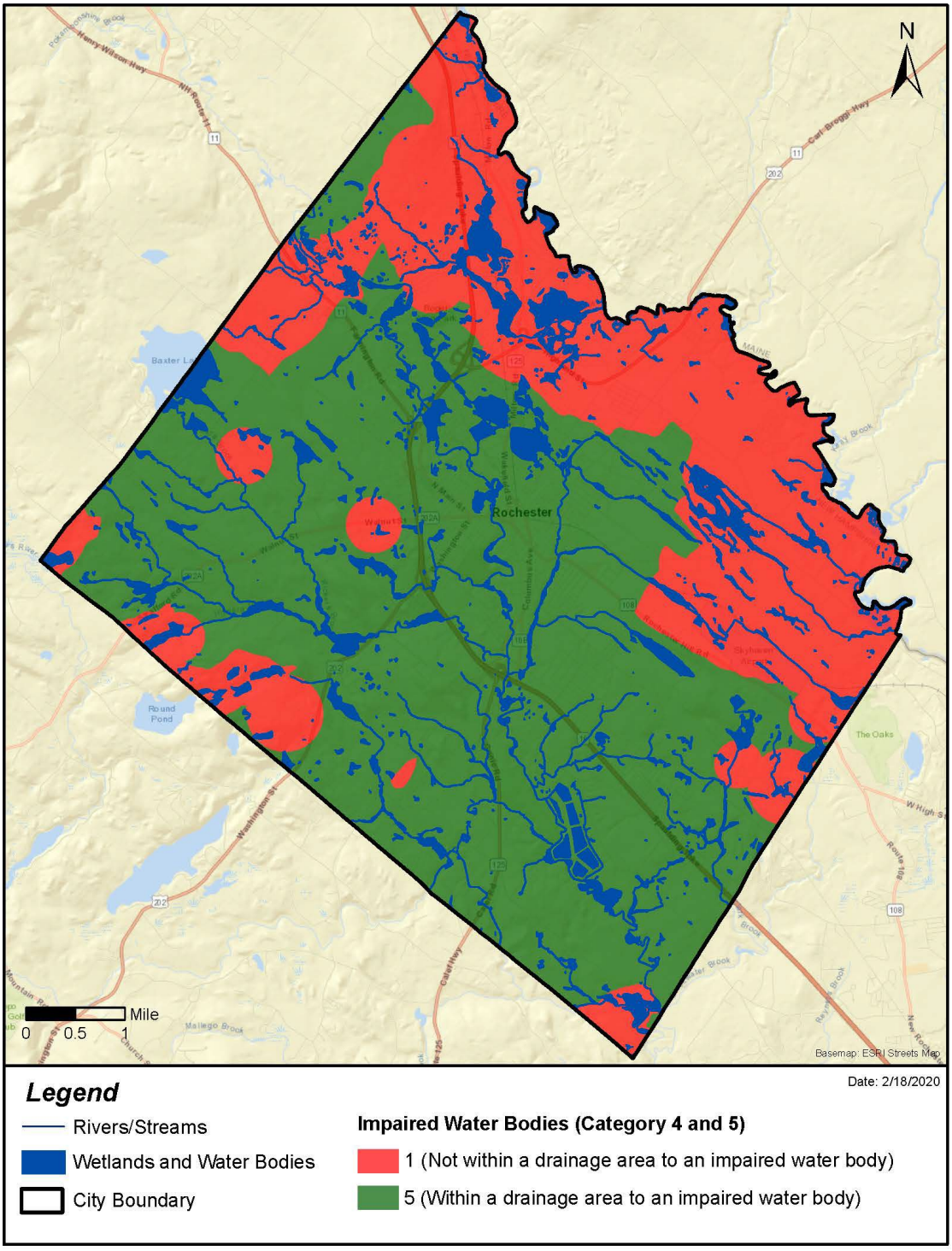


Note: Red indicates least potentially suitable locations and green indicates the most potentially suitable locations



Note: Red indicates least potentially suitable locations and green indicates the most potentially suitable locations


N
Rochester
Mile
0 0.5 1
Basemap: ESRI Streets Map
Date: 2/18/2020
Legend
Rivers/Streams
Wetlands and Water Bodies
City Boundary
FEMA Flood Zone
1 (Flood Hazard Zones A and AE)
5 (Areas outside of Flood Hazard Zones A and AE)


N
Rochester
Baxter Lake
Round Pond
Mallego Brook
Mile
0 0.5 1
Basemap: ESRI Streets Map
Date: 2/18/2020
Legend
Rivers/Streams
Wetlands and Water Bodies
City Boundary
Impaired Water Bodies (Category 4 and 5)
1 (Not within a drainage area to an impaired water body)
5 (Within a drainage area to an impaired water body)