

## Salem Massachusetts Commercial Street Rain Gardens Case Study

Executive Summary - Salem Sound Coastwatch - June 18, 2024

To increase municipal capacity to effectively address non-point source pollution using Green Stormwater Infrastructure (GSI) practices, the [Massachusetts Office of Coastal Zone Management \(CZM\)](#) funded two capacity building projects implemented by Salem Sound Coastwatch. Three online products were developed to showcase Salem's North River rain gardens' success and challenges. These include this executive summary, an ESRI Story Map, and two videos (CZM CHWQ FY24). Lessons learned are shared to promote GSI's use in urban and coastal areas to increase equity and access to clean coastal waters. These products are available on the [Salem Sound Coastwatch](#) and [Greenscapes North Shore Coalition](#) websites, as are the GSI Inspection and Maintenance Training Videos created with earlier funding (CZM CPR FY21). These five videos provide the basic knowledge needed to conduct operations and maintenance (O&M) of bioretention areas, rain gardens, bioswales, and their associated gray infrastructure. The O&M videos cover specific infrastructures, their purpose, inspection procedure, and maintenance techniques. Links to the videos are provided under Resources.

The design and construction of the Commercial Street Rain Gardens were funded and successfully completed along the North River, under Salem's North River Low Impact Development Retrofit Project (CZM CPR FY13 and FY15). The City of Salem constructed infiltration and bioretention stormwater best management practices along Commercial Street to intercept urban runoff before it enters the waterway. The five rain gardens, including one with a bioretention cell, are shallow depressions with curb cuts that allow stormwater runoff to flow into the plant and soil system. They intercept urban runoff from the first ½ to 1 inch of rainfall, which is the source of the majority of "first flush" contaminants to the North River from vehicular traffic, commercial truck parking, frequent foot traffic, and pet walking. The plants also absorb nitrogen and phosphorus nutrients that MA DEP has established as contaminants of concern for the North River. The North River is an important habitat for rainbow smelt and American eel and is the largest freshwater contributor to Salem Sound. Reducing pollutants to the North River helps protect coastal and riverine habitat and water quality that are important for American eel and rainbow smelt spawning and survival.

GSI has proven to be a critical component in reducing nonpoint source pollution from stormwater. In 2019, Green infrastructure is defined in the Water Infrastructure Improvement Act<sup>1</sup> as "the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspire and reduce flows to sewer systems or to surface waters."<sup>2</sup>

Providing examples of successful GSI implementation in Massachusetts builds awareness and capacity that is needed by practitioners. Municipalities are required by the MA Municipal Separate Storm Sewer System (MS4) permit to reduce impervious cover and allow GSI practices by updating their local ordinances and regulations. The following lessons learned are a valuable resource as communities move forward with GSI.

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<sup>1</sup> Authenticated U.S. Government Information. Water Infrastructure Improvement Act. Public Law 115-436. 115<sup>th</sup> Congress. Jan 14, 2019. <https://www.congress.gov/115/plaws/publ436/PLAW-115publ436.pdf>

<sup>2</sup> US EPA <https://www.epa.gov/green-infrastructure/what-green-infrastructure>

## **GSI Accomplishments and Challenges Learned from the North River Rain Gardens**

The Commercial Street rain gardens have shown that GSI is an effective way to improve water quality and slow flooding while providing more livable green space. While every GSI must be site-specific in its design and implementation, lessons have been learned from the extensive years of practice at the Commercial Street rain gardens.

Planning GSI projects should be inclusive from the beginning. Project management and sound engineering are necessary but not sufficient to have a successful project. Engineers and landscape planners determine property ownership, buried utilities and obstructions within the project area, the drainage watershed, future climatic changes, and existing hydrology, soil, and drainage conditions to achieve the correct GSI design. During the design and planning stage, engaging stakeholders from multiple municipal departments and the community will lead to more successful GSI projects. Involving and considering community's needs, beliefs, and capacity from the beginning will increase acceptance and support.

Plants are crucial for rain garden success, and thus, the range of environmental and hydrological conditions that rain gardens experience is important to understand. The North River is a tidal river that has a history of overflowing its channel. In the past, most of the floods resulted from extreme precipitation events in the upper watershed. As sea level and storm surge increase, Commercial Street is experiencing more seawater flooding. The videos and Story Map explain how the plantings had to be reconsidered because of this increase in coastal flooding. Standard rain garden plants were replaced with salt marsh plants that are tolerant of rain, drought, and saltwater inundation. Given the changing climate and more chaotic weather patterns, installing plants that can survive in all these conditions becomes more critical, especially in coastal areas where sea level rise and storm surge may impact the site if not now, in the future.

Maintaining GSI requires different maintenance practices than traditional gray stormwater infrastructure. It is becoming a more common practice for landscape planners to incorporate GSI designs as a way of managing stormwater. The workforce tasked with maintaining these are generally left out of the planning stage. The design process should include an examination of the maintenance needs and include all stakeholders in the planning. Maintenance includes ensuring plant survival while controlling invasive ones. Cleaning the pretreatment aprons of trash and sediments (catch basin debris) is another unexpected job that needs to be done on a regular basis to preserve GSI functionality. Without functioning pretreatment, high quantities of sediment, trash, and debris will clog the system resulting in its inability to collect and properly filter stormwater, leading to costly repairs. Finding GSI techniques that facilitate maintenance is crucial for success. Maintenance should be a combined effort by the city workforce and the community. The videos and Story Map demonstrate these issues in more detail.

Municipal and community collaboration strengthens GSI projects. Salem Sound Coastwatch, a regional environmental non-profit, collaborated with city staff to assure the rain gardens' success by recruiting volunteers to help maintain the rain gardens: planting new plants, pulling invasive plants, and removing trash and debris. With stakeholder input, organizations like Salem Sound Coastwatch, can monitor the GSI, respond to crises, and devise potential innovations. Focused on improving natural resilience and water quality, the collaboration of municipal staff, community groups, and the public is crucial for the successful implementation of GSI and the subsequent functioning of these systems.

## Acknowledgements

Informing stakeholders about stormwater's effect on water quality and the multiple benefits of GSI is important ongoing work that needs to continue as capacity for more GSI projects is built. The Massachusetts Office of Coastal Zone Management's Coastal Habitat and Water Quality (CHWQ) Grant provides financial resources for projects that assess and treat stormwater impacts and support comprehensive habitat restoration planning. Capacity building activities, such as this project by Salem Sound Coastwatch, includes training for municipal staff, bylaw development, and case studies that support future implementation of green stormwater infrastructure. Their support funded the following resources and is greatly appreciated.

## Resources

The following Story Map and eight videos (videos available in English and Spanish) were funded by Massachusetts Office of Coastal Zone [Management Coastal Habitat and Water Quality \(CHWQ\) Grant Program](#).

1. [The Commercial Street Rain Gardens: Transforming raised landscape beds into effective green stormwater infrastructure along an urban river](#). Salem Sound Coastwatch ESRI Story Map. June 2024.
  2. [Building Rain Gardens to Treat Stormwater](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2024.
  3. [Rain Gardens at Work](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2024.
  4. [Commercial Street High Performance Biofiltration System: Exploring the High Performance Biofiltration System](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2022 [Spanish version](#)
  5. [Inspection & Maintenance of Rain Gardens](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2022 [Spanish version](#)
  6. [Catch Basin Filter Cartridge Replacement](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2022 [Spanish version](#)
  7. [Inspection & Maintenance of Catch Basins with Filter Bag Inserts](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2022 [Spanish version](#)
  8. [Exploring the High Performance Biofiltration System at Winter Island, Salem MA](#) Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2022 [Spanish version](#)
  9. [Exploring the Bioretention System at Forest River Park, Salem MA](#). Video by Salem Sound Coastwatch & Filmmaker Perry Hallinan. June 2022 [Spanish version](#)
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The following three videos were created by Salem Sound Coastwatch and Mary Melilli through a Greenscapes North Shore Coalition project funded by a FY2019 MassDEP MS4 Municipal Assistance Grant.

10. [Rain Garden Installation – Winter Island, Salem MA](#). This video documents and describes the installation of a rain garden that captures stormwater runoff from 2.5 acres of a coastal parking lot in Salem MA.
  11. [Municipal Solutions for Stormwater Problems](#). This video outlines two recently completed school renovations in which Low Impact Development was used to retain and clean stormwater on site.
  12. [Natural Solutions for Clean and Plentiful Water](#). This video discusses the importance of stormwater protection and many different GSI practices that can be used to keep water clean and plentiful.
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### **Challenges of mainstreaming green infrastructure in built environment professions**

Adriana A. Zuniga-Teran, Chad Staddon, Laura de Vito, Andrea K. Gerlak, Sarah Ward, Yolandi Schoeman, Aimee Hart & Giles Booth (2020) Challenges of mainstreaming green infrastructure in built environment professions, *Journal of Environmental Planning and Management*, 63:4, 710-732, DOI: 10.1080/09640568.2019.1605890.

To link to this article: <https://doi.org/10.1080/09640568.2019.1605890>

The Zuniga-Teran et al. (2020) peer-reviewed paper investigated challenges for effective GSI implementation. Their findings reflect the lessons learned from the Commercial Street rain gardens. This paper is worth reading if more support is needed for GSI projects to become inclusive of users, stakeholders and specialists, multi-functional (recreational and ecological uses), design standards, and maintenance commitments.