Greening the Region

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The *Greening the Region* project would not have been possible without the selfless efforts of thousands of community volunteers. We are proud to say that the list of dedicated contributors is large and ever-growing, and we sincerely appreciate the contribution of every individual, in making Saint John a more natural and resilient city.

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SAINT JOHN

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Introduction

Climate change in Saint John, New Brunswick is recognized as an emergent risk to residents, infrastructure, and habitats. In 2019 the City of Saint John (the "City") declared a climate emergency and has committed to actions to reduce emissions as well as adapt to an already changing climate. Within the past five years, the City has faced two major riverine floods, countless inland floods following heavy rainfall, and the loss of multiple mature trees following post-tropical storm events. Work to mitigate these risks will be an ongoing process and ACAP Saint John has built upon the momentum of a successful climate change adaptation plan to build resilience to climate impacts through on-the-ground community green infrastructure projects. This year's project, *Greening the Region,* continued this work and demonstrated to the community that natural solutions to climate change make Saint John a more diverse, healthy, and adaptable city.

Green Infrastructure Primer

Green infrastructure (GI) refers to stormwater management methods that mimic the natural processes by promoting natural infiltration and water retention rather than methods that focus on directing surface runoff into water treatment facilities, storage ponds, or natural systems (Buckland-Nicks, 2016). The appearance of GI may vary from site to site and may include a combination of approaches (Figure 1).

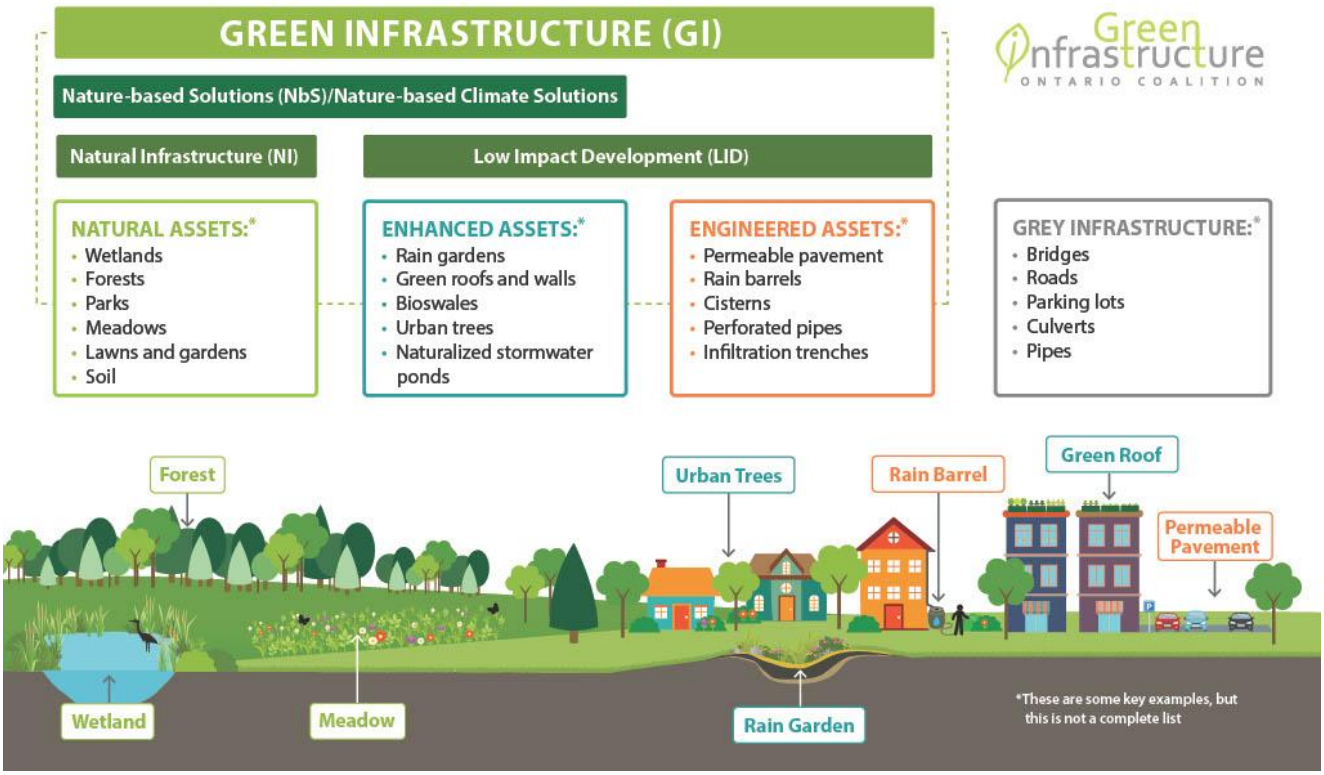

Figure 1: A review of green infrastructure types and examples (Tozer et al, 2022).

ACAP Saint John continues to use GI with a focus on managing stormwater and reducing inland flooding. In many areas, urban development has created impermeable surfaces that limit the natural flow of water, creating large volumes of runoff and challenging the existing stormwater management system. Research has shown that the implementation of GI significantly mitigates flooding risk in urban spaces (Depietri and McPhearson, 2017). Additionally, statistics demonstrate that within watersheds with more than 25% impermeable surfaces, the likelihood of a 1 in 100-year flood is increased to a likelihood of 1 in 5-years; meaning that more frequent flooding will be experienced in areas where natural infiltration processes are limited (Trice, 2017). Studies continue to be published demonstrating the success of GI and further supporting the inclusion of GI in stormwater management planning.

There are a range of benefits that GI can bring to a community. Environmentally, the use of GI can help reduce the impacts of climate change through flood management, urban cooling, and greenhouse gas reduction while also increasing water and air quality, recharging groundwater, and increasing urban biodiversity (Tozer et al., 2022). There are many social and economic co-benefits that come along with implementation of GI including improved mental health and cost savings. For municipalities, GI and natural asset restoration can be more cost-effective to maintain than engineered structures (Depietri and McPhearson, 2017). As GI projects continue to be implemented in Saint John, the range of benefits received will increase, creating a more resilient, healthy, and sustainable environment.

Climate Change Context

As the climate continues to change, the City of Saint John will experience an increase in temperatures, changes to annual precipitation patterns, more severe riverine and coastal flooding, and frequent extreme weather events (Table 1).

Table 1: Climate change projections for the greater Saint John area (ACAP Saint John, 2020).

Category	Projections:
Temperature	● Mean annual temperature increases by 3.5°C by 2071-2100 compared to 1970-2000. ● Average winter temperature above -1°C by 2071-2100. ● Up to 70 annual hot days (25°C +) by 2071-2100. ● Annual freeze-thaw days increase from 82 to 87 by the year 2070.
Precipitation	● Annual rainfall increases by 85 mm by the year 2100 compared to 1970-2000. ● Precipitation patterns become more erratic and rainfall intensity increases by 10%. ● Approximately 21 more rain days by 2070-2100.
Extreme Weather	● Increased severity and frequency of summer convective storms and ice storms. ● Increased severity and frequency of flooding from extreme rainfall, mid-winter thaws, ice breakups, and ice-jam flooding. ● Increased forest fire occurrence in Canada: 25% by 2030, 75-140% by 2100. ● Higher severity of drought: water deficit of 110% by the year 2080. ● Windstorm frequency increases by 8-15% (by the year 2050).
Sea Level Rise	● Saint John sea level rise of 86 cm +/- 38 cm from 2010 to 2100. ● Annual storm surge levels increase by 0.8 m compared to 2010. ● 1 in 100-year storm levels increase by 1.3 m by 2100 compared to 2010. ● Current coastal erosion rates of 0.59-0.99 m/yr.

The impacts were assessed through a risk and vulnerability assessment in the *Saint John Climate Change Adaptation Plan* (2020). The adaptation plan identifies impact statements for climatic

changes and assigns a risk rating and vulnerability score. Saint John is especially vulnerable to spring freshet flooding (high vulnerability) as well as habitat loss and infrastructure damage due to flooding (medium-high vulnerability) (Table 2). Implementing GI in the City of Saint John can reduce vulnerability by building new habitat, protecting infrastructure, absorbing precipitation runoff, regulating temperatures, and improving air quality.

Table 2: A sample of risks and vulnerabilities identified in the Saint John Climate Change Adaptation Plan (ACAP Saint John, 2020).

Risk Rating	Climatic Change	Impact Statement	Vulnerability Ranking
Medium - High	Increased Precipitation	Higher spring freshet flooding due to increased precipitation	5 (High)
	Sea level rise	Increased risk of habitat loss due to coastal squeeze	4 (Medium-high)
Medium	Increased precipitation	Damages to infrastructure/ properties due to localized flooding	4 (Medium-high)
	Increased temperature	Increased risk of heat stress on vulnerable populations due to extreme heat	3 (Medium)
	Increased temperature	Reduced health quality due to a reduction in air quality	3 (Medium)

Climate Change Adaptation Plan Goals

The *Saint John Climate Change Adaptation Plan*, completed by ACAP Saint John in 2020, addresses the risks that climate change poses to the City. An Action Register was developed to implement adaptation actions and was divided into eight objectives. The objectives of the Action Register include:

- Objective 1: Integrate climate change impacts into community planning.
- Objective 2: Reduce shoreline erosion & promote natural infrastructure.
- Objective 3: Protect natural spaces, local habitats & migration routes.
- Objective 4: Provide public education on how to deal with the impacts of climate change.
- Objective 5: Reduce the impact of climate change on human health.
- Objective 6: Support vulnerable groups to increase adaptive capacity.
- Objective 7: Increase resilience to flooding & sea level rise.
- Objective 8: Increase resilience to extreme weather (ACAP Saint John, 2020).

This project addresses Objective 4-25 from the adaptation plan to provide “education on green infrastructure and ID design to manage the impacts of climate change through pilot projects and workshops” (ACAP Saint John, 2020).

Projects

This year’s project involved the completion of the Depave Paradise site at Seaside Park, and marks ACAP Saint John’s first green infrastructure installation on the East Side of the City achieved through collaboration with Glen Falls School. The work also involved several tree plantings around the city to build resilience to climate change impacts. These GI projects have

allowed ACAP Saint John to protect the local environment through communication and awareness, and through the hands-on involvement of students and volunteers.

A. Seaside Park Pollinator Garden

In April 2022, ACAP Saint John hosted an information session to engage the community and incorporate local opinions into the design of the Seaside Park Depave Paradise site. The depave component of the project (completed in fall 2021) removed over 130 m^2 of unused asphalt from the park creating space for new greenery. The engagement session supported the development of a pollinator garden and helped identify the types of plants and features that would be best suited for the site. In June, a volunteer event was coordinated where 22 community members helped to create berms, plant over 200 native plants, and learn about the importance of pollinators and biodiversity in urban areas (Figure 2 and 3).

Figure 2: Volunteers during the pollinator garden planting event, June 2022.

Figure 3: Group photo after completing the pollinator garden, June 2022.

The garden is identified as part of the Butterflyway Project, a national network of native gardens in urban areas coordinated through the David Suzuki Foundation. The list of native plants used for the pollinator garden can be found in Appendix A. Overall, this project was a huge success and ACAP Saint John has received much appreciation for creating a beautiful garden in the community.

In fall 2022, ACAP Saint John worked with the Community Coordinator at Seaside Park Elementary School to arrange for an outdoor educational opportunity with several classes. The students came across the street to Seaside Park where ACAP Saint John staff discussed the purpose of the garden and facilitated an activity focused on ecosystem connectivity. Over 150 students were engaged and ACAP Saint John received a positive response from the staff, who expressed interest in continuing this education in the future.

B. Glen Falls School

ACAP Saint John worked directly with Glen Falls School to complete an educational stormwater management project in the schoolyard where students and staff were able to get involved. The work involved completion of a rain garden, tree planting, and a two pilot infiltration trenches that will work together to soak up rainwater around the schoolyard. These activities were completed with the support of amazing volunteers and the school's maintenance staff. On Thursday October 6th, students from Glen Falls School were invited to join ACAP Saint John in planting the rain garden alongside 50 volunteers from New Brunswick Community College (NBCC) Saint John's Educational Assistant program who came to plant trees and begin work on the infiltration trenches. The experience was about getting individuals outdoors and giving them hands-on work to complete. Overall, the event successfully engaged the community and provided an educational opportunity that can be continued in years to come.

The rain garden was designed to capture runoff from paved surfaces around the field. The parking lot and paved play area are directly contributing to the stormwater challenges as these surfaces do not allow rainwater to flow naturally into the earth. Before the planting event, the maintenance crew from the school helped to remove six inches of material and a bioretention soil mixture (70% sand, 15% soil and 15% compost) was brought into the garden site. This soil mixture has a higher infiltration rate and can allow for water to flow freely into the earth rather than pooling at the surface. On the day of the event, classes were invited out one at a time to help plant 132 native plants in the garden. ACAP Saint John staff were present to introduce the organization and to talk to the students about the purpose of a rain garden and why we were doing this work. With support from the NBCC volunteers, the students were given gloves and tools, and had the chance to participate in planting the garden (Figure 4). The planting engaged over 120 Glen Falls students, many of which were very eager to help and excited about the garden, as well as 60 students from NBCC Saint John.

Figure 4: Left: Students working to plant the rain garden in the schoolyard. Right: The Glen Falls rain garden at the end of the event, October 2022.

The rain garden is also part of the Butterflyway Project. Native plants play an important role in sustaining local ecosystems and are beneficial for these types of gardens since they are adapted to this region's climate and tolerate wet or dry conditions. The list of native plants used for the Glen Falls rain garden can be found in Appendix B.

Volunteers from NBCC were an incredible support for the event, not only in helping with the younger students during the garden planting, but also for their efforts in completing the tree planting and infiltration trenches. Six large trees were planted around the schoolyard to help soak up water. Silver maple and red oak species were planted since they are tolerant to water and will thrive in this wet environment.

The infiltration trenches are a new design for ACAP Saint John and involved removing impermeable material from the schoolyard and replacing it with rock and sand that would allow more drainage. One of the largest challenges that was identified in the schoolyard was the impermeability of the subsurface. Although the rain garden and trees can help absorb the water, the major issue is the clay-based soil that is commonly observed in this area. Clay soils have a low permeability meaning that water does not flow easily though them, resulting in the pooling of water that is experienced following a rainstorm. The water can stand for several days due to the low permeability creating less than ideal conditions for the schoolyard. With this knowledge ACAP Saint John completed a review of techniques to address this challenge and determined that an infiltration trench may provide relief in the areas where water tends to pool.

A site visit following a rainfall event allowed ACAP Saint John to identify potential sites for the pilot, specifically looking at areas where water was unable to drain. To trial the idea, two infiltration trenches were created at a depth of 3 feet (Figure 5). A 1.5 ft depth of drainage rock was added on top of a landscape fabric barrier in the base of the trench. A second barrier of fabric was staked

above the rock before approximately 1 ft of sand was added. The fabric will keep the permeable materials in place to increase the infiltration capacity. Topsoil and grass seed were added to the top to level the trench to the surrounding schoolyard. Over the next year ACAP Saint John and school staff will be observing the trench areas to see the effect that increased infiltration may have on the stormwater challenges.

Figure 5: Infiltration trenches installed at Glen Falls School. Left: Full depth of 3ft was removed. Middle: Rock was filled at the base, to increase infiltration. Right: Sand was filled in with topsoil and grass seed.

Overall, the work completed in collaboration with Glen Falls School has provided a multitude of educational opportunities and on-the-ground volunteer opportunities. ACAP Saint John received additional support for this work through the TD Friends of the Environment program and is grateful for the support of all funders. Additionally, a large part of this success is due to the Glen Falls school staff and maintenance crew who were cooperative and helpful throughout the project. ACAP Saint John will continue this partnership with Glen Falls School to help monitor the site and coordinate educational opportunities for the students.

C. Community Tree Plantings

As part of the *Greening the Region* project, ACAP Saint John planted over 1,400 trees across five sites. Planting trees is a relatively low-cost and low-barrier method of implementing green infrastructure in a variety of locations. These plantings address multiple climate change risks and will build community resilience while also creating a healthier and more beautiful City (Table 3, Figure 6).

Table 3: Trees planted in climate change risk areas in Saint John, NB in 2022.

Site	# Trees	Climate Change Risks
Seaside Park	12	Increasing temperatures & heavy precipitation
Montgomery Crescent Park	12	Heavy precipitation
Irving Oil Field House	6	Heavy precipitation & contaminants
Marsh Creek Forebay	1,080	Heavy precipitation & sea level rise
City of Saint John Snow Dump	361	Heavy precipitation & increased storm severity
Total	**1,471**	

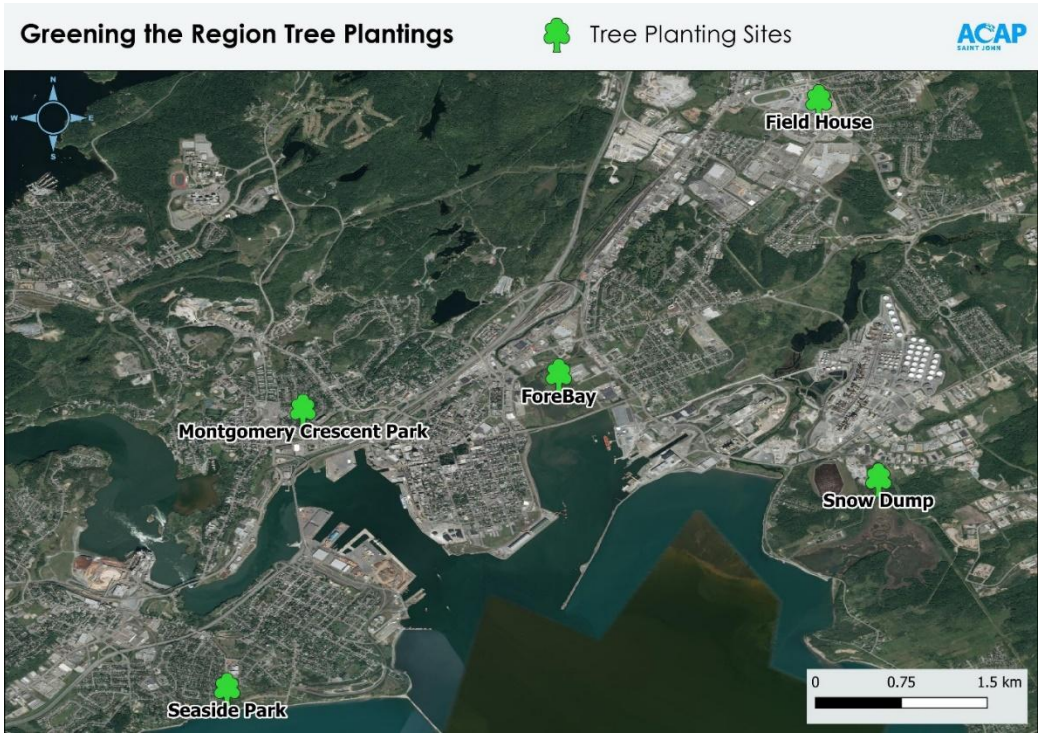

Figure 6: Map of tree planting sites throughout Saint John.

Trees contribute a variety of ecosystem services to communities, including air and water filtration, soil stabilization, stormwater management, wildlife habitat, aesthetic value, and temperature regulation. In this project, ACAP Saint John planted native species in areas they are adapted for and where they will thrive. For example, silver maple was planted at Montgomery Crescent Park since this species is tolerant to wet areas and the park is low-lying and often wet. Other native tree species planted during the project include red maple, red oak, red spruce, and white birch, to name a few.

A variety of tree sizes were planted ranging from small plugs to larger caliper trees. At three public spaces including Montgomery Crescent Park, Seaside Park, and the Irving Oil Field House trail, 30 large trees were planted to absorb stormwater and provide shade. The larger trees were chosen for these sites since the space is limited and to increase chance of survival. As a precaution, guards were placed along the exposed trunk to protect the tree in the coming years

(Figure 7). Planting trees at these sites will build resilience to increasing temperatures and heavy rainfall events while improving local green space for the community.

Figure 7: Tree planting along the trail at the Irving Oil Field House.

At the City of Saint John Snow Dump site on Bayside Drive, over 350 trees were planted in two volunteer plantings engaging 16 community members. The property is largely an impervious gravel surface surrounded on three sides by unmaintained grassed areas. Hazen Creek runs along one edge of the property and has little riparian vegetation. During winter, the site is used to store snow that is removed from urban roadways and parking lots. This snow is often polluted with litter and road salt which are carried away in the meltwater during the spring. Planting trees around the site is important for capturing and filtering pollution from the runoff before it enters wetlands and waterways. The trees will help absorb meltwater around the site and are essential for building resilience to climate change. As increasing amounts of snow create larger volumes of runoff and warmer temperatures result in rapid melting, these trees will act to cool the area, absorb water, and will also provide habitat spaces for wildlife.

Within the Marsh Creek Forebay, ACAP Saint John coordinated three planting events, engaging 61 volunteers, and planting over 1,000 trees. Marsh Creek is one of the largest urban watersheds in Saint John and is impacted by industrial and commercial areas. Large volumes of runoff are channeled through the system into the Forebay before flowing out into the Bay of Fundy. The site

is impacted by increasing precipitation and sea level rise, and has a history of contamination resulting in degraded habitat and water quality. The trees planted at this site will have many benefits including stormwater management, flood resilience, habitat creation, and coastal marsh restoration. Overall, the trees planted throughout this project will help to address climate change impacts while building a healthier and more sustainable community.

Conclusion

Over the 2022 field season, ACAP Saint John worked with the community to incorporate unique GI solutions into the urban environment. Throughout these events, ACAP Saint John explained the connection of this work to climate change impacts and the benefits that GI has for increasing resiliency in the City of Saint John. Overall, the project engaged over 400 individuals and installed two native gardens, planting over 300 native plants and over 1,400 trees. ACAP Saint John has had the opportunity to pilot stormwater methods and demonstrate that GI is an effective method for climate change adaptation. Through this work, ACAP Saint John has generated discussions with community members, City councillors and institutions, and will continue to move this work forward in Saint John.

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Appendix A: Seaside Park Pollinator Garden Native Plant List

Plant Name	Quantity
Aster (*Aster* sp.)	16
Swamp Milkweed (*Asclepias incarnata*)	20
Turtle Head (*Chelone obliqua*)	16
Summer phlox (*Phlox paniculate)*	10
Bee balm (Mixed variety)	16
Creeping thyme (*Thymus serpyllum*)	12
Yellow violet (*Viola pubescens*)	24
Blue eyed grass (*Sisyrinchium montanum*)	5
Sweetgrass (*Hierochloe odorata)*	10
Blue flag iris *(Iris versicolor*)	25
Speedwell (*Veronica*)	4
Beard Tongue (*Penstemon*)	5
Obedient plant (*Physostegia*)	7
Liatris (*Liatris spicata)*	4
Yarrow (*Achillea millefolium)*	2
Cardinal flower (*Lobelia cardinalis*)	4
Anemone (*Anemone, L*)	2
SHRUBS	
Highbush blueberry (*Vaccinium corymbosum)*	10
Wild rose (*Rosa virginiana*)	12
Witch hazel (*Hamamelis virginiana*)	3
Wild raisin (*Viburnum cassinoides*)	3
Nannyberry (*Viburnum lentago*)	3
TOTAL	213

Appendix B: Glen Falls Rain Garden Native Plant List

Native Plant Species	**Quantity**
Cordgrass (*Spartina pectinata)*	10
Joe Pye Weed *(Eutrochium purpureum)*	15
Turtle Head (*Chelone obliqua*)	15
Ostrich fern and lady fern (*Matteuccia struthiopteris, Athyrium filix-femina)*	11
Blue flag iris *(Iris versicolor*)	15
Boneset (*Eupatorium perfoliatum)*	17
Common Rush (*Juncus effusus*)	10
Swamp Milkweed (*Asclepias incarnata*)	15
Bee balm *(Monarda)*	15
Black Eyed Susan (*Rudbeckia hirta)*	15
Sweetgrass (*Hierochloe odorata)*	4
TOTAL	132