Natural Infrastructure for Sustainable Stormwater Management

Improving Freshwater Quality Sources and Addressing Climate Change Impacts in Southwest Nova Scotia through Enhancing Green Space and Community Engagement

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March 2024

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Executive Summary

Climate change is anticipated to have significant impacts on both water quality and quantity, which will be felt globally and locally in Southwest Nova Scotia (SWNS). Nova Scotia Environment anticipates a higher demand for freshwater resources, making the conservation of freshwater resources an important step in climate change adaptation.

In 2021, the Clean Annapolis River Project (CARP) secured funding from Environment and Climate Change Canada's EcoAction Community Funding Program to implement a project that engages Canadian communities and clearly demonstrates measurable, positive results for freshwater. The overarching objectives of "Natural Infrastructure for Sustainable Stormwater Management Across SWNS" were to achieve tangible environmental results, engage the community, increase awareness, increase capacity in communities, and promote sustainable outcomes and engagement following project completion. To implement this project and increase its geographical impact, CARP partnered with Coastal Action, a not-for-profit organization based in Mahone Bay on the South Shore of Nova Scotia.

Between the spring of 2022 and the spring of 2024, four installations of natural infrastructure (NI) have been completed, along with four targeted public sessions. Nearly 1.3 million litres of stormwater have been diverted from municipal sewer systems, over 20,000 individuals have been reached, and the framework for future work has been established.

The success of these efforts was a result of a high degree of collaboration among community organizations, local government, homeowners, local businesses, and schools.

The Role of Stormwater in Southwest Nova Scotia

Stormwater Management

Stormwater is water that comes from precipitation events and snow/ice melts. It can either soak into the ground and soil (known as infiltration), it can be held on the ground's surface and evaporate, or it can runoff into nearby streams, rivers, and other water bodies.

In natural landscapes, such as forests, this natural cycle of infiltration, evaporation, and runoff, naturally manages and filters stormwater. However, in developed environments (ex. towns and cities), stormwater is collected from impermeable surfaces (surfaces that don't allow water to pass through) such as roofs, roads, and sidewalks. It is then transported through grey infrastructure, such as drains, sewers, pipes, culverts, and other water-carrying systems.

Most of the grey infrastructure in SWNS leads to combined sewer systems. Combined sewers are piping systems that share pipes between sewage systems and rainwater drains. This type of stormwater management infrastructure aims to evacuate runoff as quickly as possible, thereby reducing the risk of flooding in targeted areas. However, these traditional systems are not designed to handle the anticipated increase in storm events and surges resulting from climate change. Consequently, there is a risk of overburdening established infrastructure, potential flooding, and combined sewer overflows.

Enhancing stormwater management practices in Nova Scotia is crucial for safeguarding the health of communities and the environment. Freshwater quality has already been a substantial issue throughout Nova Scotia, and water quality concerns are only expected to increase in frequency and severity with the forecasted changes to the climate and environment. Implementing small-scale projects in communities across the province and country can make a big difference in how water affects these areas and how water is affected.

Freshwater Quality Impacts

In developed environments, stormwater ends up carrying trash, sediment, bacteria, heavy metals, and other pollutants that it picks up from the landscape as it travels over hardscapes and developed lands. These pollutants degrade the water quality of the receiving water bodies and water sources used by local communities.

Freshwater bodies in SWNS are frequently challenged by high E.Coli levels due to excess nutrients entering the water. These nutrients accumulate from runoff travelling over agricultural land as well as from livestock wading directly in waterways.

These water quality impacts are then worsened by combined sewer systems. During heavy rainstorms, when these pipes become overburdened by increased stormwater volume, the infrastructure experiences combined sewer overflows (CSOs). CSOs lead to raw sewage mixing with flood water and ending up in surrounding watercourses and water bodies leading to surges in E.Coli levels.

Higher flows of stormwater in waterways can also cause erosion, leading to increased sediment in water, as well as flooding in streams which damages habitat, property, and infrastructure.

Sustainable Stormwater Management

Traditionally, stormwater management has mainly focused on the collection and processing of stormwater without directly addressing the aforementioned issues and factors. In contrast, sustainable stormwater management aims to:

- Maintain the health of water bodies such as lakes and streams,
- Prevent flooding and erosion,
- Protect aquatic species, and
- Sustain healthy sources of water for local communities by mitigating the impacts of urban development.

For these reasons, CARP is determined to improve stormwater management and support the shift toward more sustainable practices throughout the province.

Two methods by which communities can address these concerns and sustainably manage stormwater in the changing climate are through the use of natural infrastructure and low-impact development.

Natural infrastructure (NI) refers to water management that protects, restores or mimics the natural water cycle using natural features (American Rivers, 2017). Natural infrastructure can be combined with traditional grey infrastructure to create a more resilient, financially stable, and less polluting way of managing stormwater runoff.

- *Examples of NI include rain gardens, bioswales, tree planting, and wetlands.*

Low Impact Development (LID) is a subset of approaches that utilize smaller-scale sustainable infrastructure. "LID refers to designing and implementing practices that can be employed at the site level to control stormwater and strive to replicate the pre-development hydrology of the site (Dickinson, 2013)".

- *Examples of LID include permeable pavers, rain barrels & cisterns, French drains, and the removal of hardscape.*

Project Overview

EcoAction Community Funding Program & Parameters

In 2021, CARP secured funding through Environment and Climate Change Canada's (ECCC) EcoAction Community Funding Program. This program provides funding to non-profits and non-government organizations (NGOs) to conduct local action-based projects to improve the environment and build capacity within communities to carry out similar actions in the future.

Specifically, EcoAction funds projects that:

- Lead to tangible environmental results;
- Engage the community to improve the environment;
- Increase environmental awareness;
- Increase capacity in communities; and
- Result in sustainable outcomes and engagement following project completion.

For this particular funding cycle, CARP needed to pursue a project that focused on improving freshwater quality by either removing harmful substances from freshwater or by restoring and protecting freshwater ecosystems. This priority motivated the creation of a project focused on improving stormwater management throughout the province.

Goals & Objectives

Aligned with EcoAction's priorities and parameters, the overarching goal of this project was to undertake action-based activities in three target areas (sites), resulting in measurable, positive impacts on the freshwater environment. Additionally, the project aimed to engage the community, enhance awareness and capacity within communities and promote sustainable outcomes and engagement following project completion. CARP's specific site goals were to address locally recognized freshwater quality issues and build climate resilience, within the context of stormwater management, through the use and promotion of NI. These goals were broken into objectives and sub-objectives to clearly measure the success of all efforts (Table 1).

Table 1. Project objectives, sub-objectives, units, and target quantities as laid out at the outset of the project.

Objective	Sub-Objective	Unit of Measure	Target Quantity
Produce measurable positive results for the environment	Reduce/divert toxic or harmful waste from entering freshwater systems	# of Kilograms	120
	Focus planting on Indigenous plants, trees and shrubs planted	# of plants/trees/shrubs planted (% of which are indigenous)	1000 (85%)
	Reduce water consumption/divert stormwater from municipal systems	# of liters	1,237,460
	Install natural infrastructure elements at three sites	# of installed structures	3
Provide opportunities for community members to take action	Engage volunteers in project activities	# of volunteers participating directly in project	75
	Engage local businesses and contractors for project services	% of businesses and contractors used that are local to area of project site	100
	Engage youth volunteers in project activities	# of youth volunteers	50
	Deliver workshops with focus audience groups on the topics of natural infrastructure, stormwater management, climate change, and water quality and their interrelation	# of workshops	5
Lead to results and engagement that will be sustained after the completion of the project.	Creation of Educational Materials for distribution	Type of Material	Home Resource Kit
	Provide recommendations to site hosts for future improvements in stormwater management	# of partnerships where recommendations were provided	2
	Distribute resources and information on project components, importance, and outcomes to online audience	# of individuals reached	20,000
	Secure agreement for maintenance to occur on project sites to ensure survival of planted vegetation	Ratio of site maintenance confirmation to number of sites	3:3

Partners and Site Hosts

To broaden the impact of this project, CARP partnered with Coastal Action, an environmental not-for-profit organization also working in the Southwest Nova Scotia region. Coastal Action's main headquarters are based in Mahone Bay on the South Shore. As a "boots on the ground" organization with a mission to protect and restore the environment, Coastal Action has led and contributed to incredible projects across the province, including extensive work in improving stormwater management on a community level. CARP has successfully partnered with Coastal Action on many projects in the past with wide-ranging focus areas.

In collaboration with Coastal Action, CARP identified three site hosts and selected three project sites where NI would be implemented (Table 2).

Table 2. Site hosts, locations, and concerns identified and selected for project work.

Project Partner	Site Host	Site Location	Stormwater Concern
CARP	Town of Digby	Town park located behind Digby General Hospital (44.6156, -65.7606)	Road Salt from surrounding parking lots with no substantial treatment prior to stormwater entering storm drains. Poor drainage in sections of park resulting in pooling water.
CARP	Beacon United Yarmouth	Church property adjacent to parking lot and community garden (43.8425, -66.1154)	Poor drainage resulting in mismanagement of stormwater, infrastructure damage, and water pooling. Lack of natural infrastructure to divert stormwater to – all stormwater flows directly into municipal system (large burden due to area of hardscape on site).
Coastal Action	Town of Bridgewater & Bridgewater Farmer's Market	Bridgewater Memorial Arena (44.3759, -64.5248)	Property consists almost entirely of hardscape (with only exception being a rain garden installed on site by Coastal Action in 2021) resulting in a significant lack of stormwater infiltration. Site contributing to burden on municipal system.

To formally partner and receive services through the program, each site host was required to submit an expression of interest as well as commit to in-kind contributions to match the funding that would be applied to the respective sites. In-kind contributions typically come from providing excavation services, staff/representative time, equipment, and/or access to resources (ex. Water).

Timeline & Constraints

The main project constraints centered around timelines, distance to project sites, budget, seasonal conditions, and staffing resources.

The project timeline was determined by funding schedules, with certain deliverables required to adhere to fiscal year deadlines. CARP was provided with an approved work plan during grant approval, outlining the necessary deliverables for each year of the project's two-year duration, spanning from March 2022 to March 2024. Annual progress reporting was required at the end of March 2023, at the project's halfway mark.

Additional timeline constraints stemmed from stakeholder involvement. Approval from municipal council members was necessary for CARP's project site in Digby, as the work was part of a larger park development plan. Similarly, the Town of Bridgewater went through a review process for Coastal Action's planned implementation. For CARP's site in Yarmouth, the project design and details needed approval from committee members at Beacon United, who, as volunteers had varying availability due to multiple responsibilities.

Another constraint arose in the first year of the project when one of CARP's original site hosts fell through, necessitating the selection of a new host and project location. The new site host, located in Yarmouth, was at the very edge of CARP's typical working radius. Increased travel time and distance (1 hour and 30 minutes, 130km) put a strain on resources and limited the amount of work effectively completed during site visits.

Budget is always a factor to consider when undertaking a project. For this project, budget allocations posed a significant constraint, with a higher percentage of funding allocated towards contacting services than materials. This limited the purchase of mature plants with high survival rates, requiring alternative compensation methods such as calls for plant donations.

Seasonal and weather conditions also posed challenges. Planting, integral to the project, had limited timing windows in late spring and early fall to optimize survival rates (avoiding extreme heat and cold). With project planning occupying the initial spring and fall periods, only one of each remained for full project construction.

Finally, staffing resources were constrained as CARP is a non-profit organization reliant on available funding for staff hires. This can lead to a higher likelihood of changes in project leadership, personnel shortages, and loss of knowledge during position transfer.

Methodology

To successfully achieve our objectives and navigate all factors impacting project work, efforts were guided by task prioritization and categorization. To accomplish the physical deliverables of the project (ie. NI planning and implementation), a stepwise work plan and detailed schedule were developed, outlining all necessary steps within the project's process. This work plan was tracked using Microsoft Planner and served as a reference point for monitoring deliverable progress throughout the project's duration (Figure 1).

For the capacity-building deliverables, elements of each objective were similarly tracked in Microsoft Planner, with main work strategies centered around a combination of annual task lists, stakeholder networking, and information management systems. (See simplified example – Figure 2).

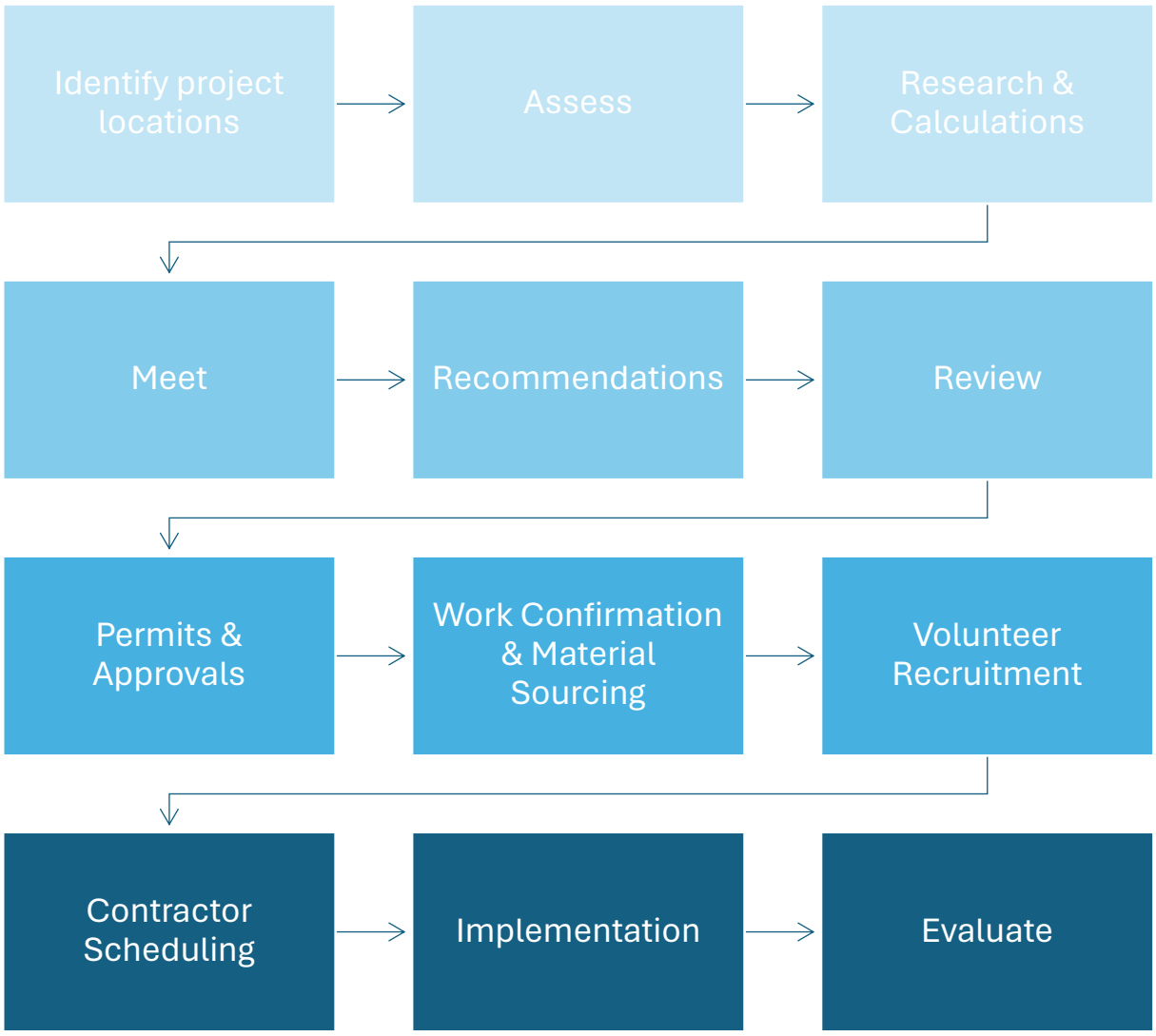

Figure 1. Stepwise work plan for implementing natural infrastructure at project sites. Further clarification below.

1. Identify project locations – refers to property and site host selection.
2. Assess – refers to site assessments during initial site visits, consisting of evaluating the state of the property, values at risk, percentage of green space to impermeable surface, "problem areas", drainage patterns, current stormwater sources and outlets.
3. Research & Calculations – research on potential natural infrastructure elements, low-impact development options, local materials and service providers, annual rainfall, stormwater flow calculations, quantity of impermeable surfaces (roofs, parking lots, etc), seasonal trends, growing seasons, weather/temperature conditions, native vegetation, and identifying expertise needs.
4. Meet – refers to meetings with site hosts, contractors, consultants, and project staff to formulate a plan.
5. Recommendations – refers to the provision of recommended implementation options on project sites, as well as suggestions for future work.
6. Review – refers to the cyclical process of reviewing plans, discussing scope, deliberating recommended options, adjusting project details.
7. Permits & Approvals – refers to acquiring any permits and/or necessary approvals for project work.
8. Work Confirmation & Material Sourcing – refers to the final confirmation of project elements and design and the engagement of local material and service providers for construction.
9. Volunteer Recruitment – refers to the outreach and engagement of volunteers to participate in project implementation and natural infrastructure construction.
10. Contractor Scheduling - refers to the scheduling of contracted services for natural infrastructure construction.
11. Implementation – refers to the physical construction of natural infrastructure elements and realization of project objectives.
12. Evaluate – refers to the post-completion site assessment to ensure survivability, maintenance, and successful function of implemented elements.

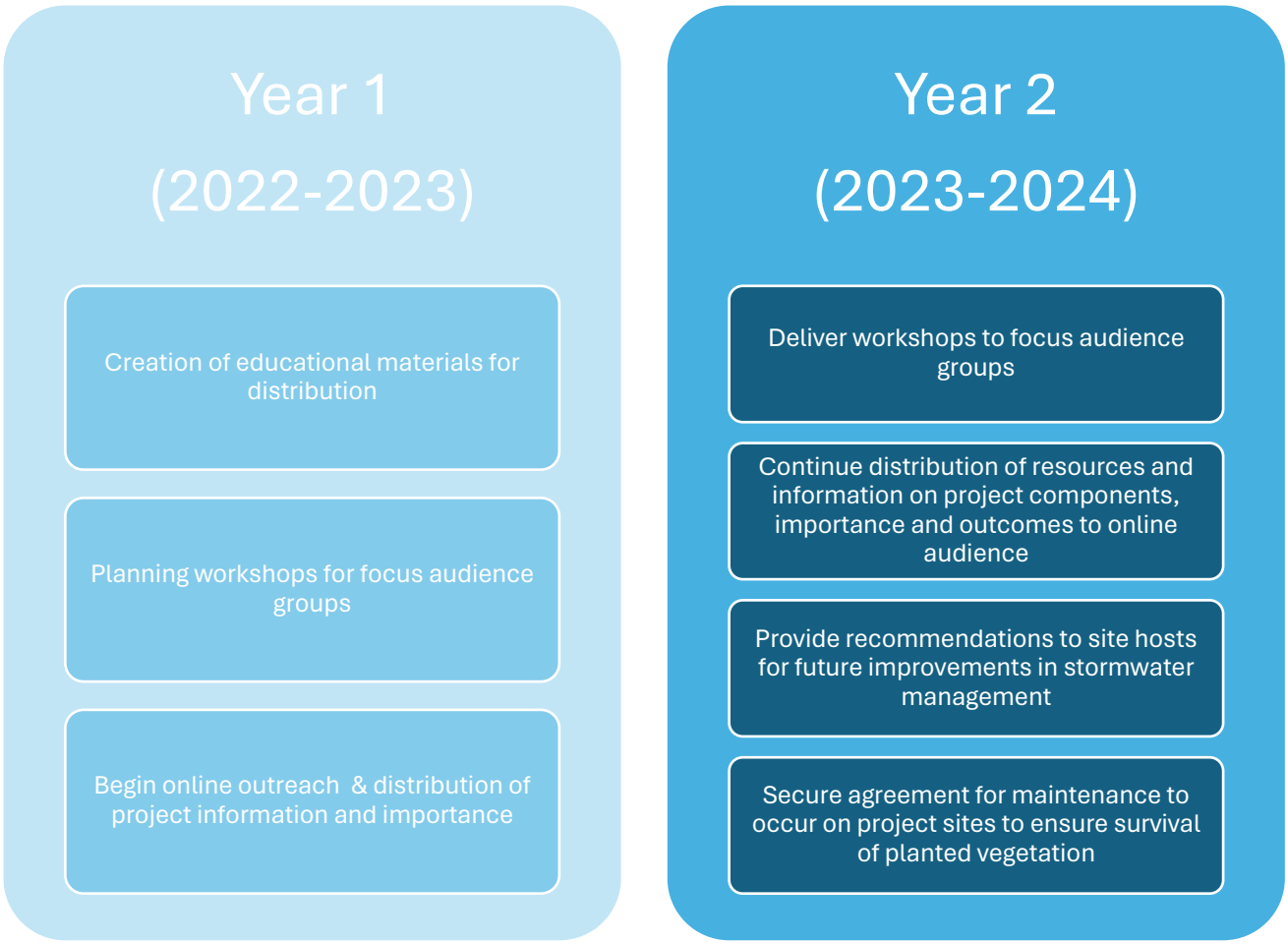

Figure 2. Annual task list breakdown. Simplified overview version.

Results

In conclusion, CARP's efforts to enhance sustainable stormwater management by implementing NI across SWNS have been highly successful.

As previously mentioned, the primary objective of this project was to complete action-based activities in three designated target areas (sites) to achieve measurable, positive impacts on the freshwater environment, engage the community, raise awareness and capacity within communities, and promote sustainable outcomes and engagement following project completion. All target quantities were met, if not exceeded, during the project's duration (Table 3).

Measurable Positive Environmental Results

- 1,267,477 litres of stormwater were diverted away from municipal sewer systems, resulting in approximately 163 kilograms of harmful waste reduction in freshwater systems.
- Four rain gardens ranging from 50-90 square meters each were constructed, comprising over 1000 water-tolerant plants (900 of which are native to SWNS).
- 150 square meters of hardscape/impermeable concrete surface was depaved, providing access for stormwater to penetrate the ground below.

Figure 3. Left: 50 square meter rain garden constructed in Yarmouth at Beacon United.

Figure 4. Right: 150 square meter rain garden constructed at Bridgewater Memorial Arena.

Figure 5. Left: An 80 square meter and 90 square meter rain garden constructed for the Town of Digby behind the hospital.

Community Engagement

- Four workshops, including presentations, field sessions, webinars, and pre- and post-evaluation surveys, were conducted with university students, municipal staff members, homeowners, and local business owners.
- A total of 75 volunteers and 55 youth volunteers directly participated in project activities.
- Two 1000-litre cisterns were donated and provided to project partners to intercept and collect stormwater from building roofs.

Figure 6. Top: Slides from outreach presentations with homeowners and local businesses.
Middle: Workshop was completed with Acadia University's Environmental & Sustainability Studies first-year course 'Sustainable Community Development'. Volunteers supporting planting at the Digby park rain gardens in fall 2023.
Bottom: Volunteers conducting maintenance on constructed rain gardens to promote growth. Two 1000L cisterns that Acadian Seaplants Ltd. donated to project work in Yarmouth.

Increase Awareness and Capacity in Communities

- Educational home resource kits were developed and distributed in both print and electronic formats to share information about climate change impacts, stormwater management, and water conservation in the SWNS context (Appendix A).
- A special issue newsletter on sustainable stormwater management reached over 800 individuals, generating additional interest in the project and creating consultation opportunities outside of the original project scope (homeowner assessments, planting strategies, public sessions).
- Communication activities on social media reached over 18,000.

Promote Sustainable Outcomes and Engagement Post-Project Completion

- An educational interpretive panel on the function of natural infrastructure was installed at one of the project sites where community members had expressed the least awareness of sustainable stormwater management.
- A kick-starter property assessment package, providing recommended retrofit options, was developed in collaboration with a water resource engineering firm and provided to one of the project site hosts to bolster ongoing improvement efforts on-site.
- Consultation was provided on a municipal park plan, successfully securing the inclusion of two additional natural infrastructure elements (two bioswales) in the park's design.

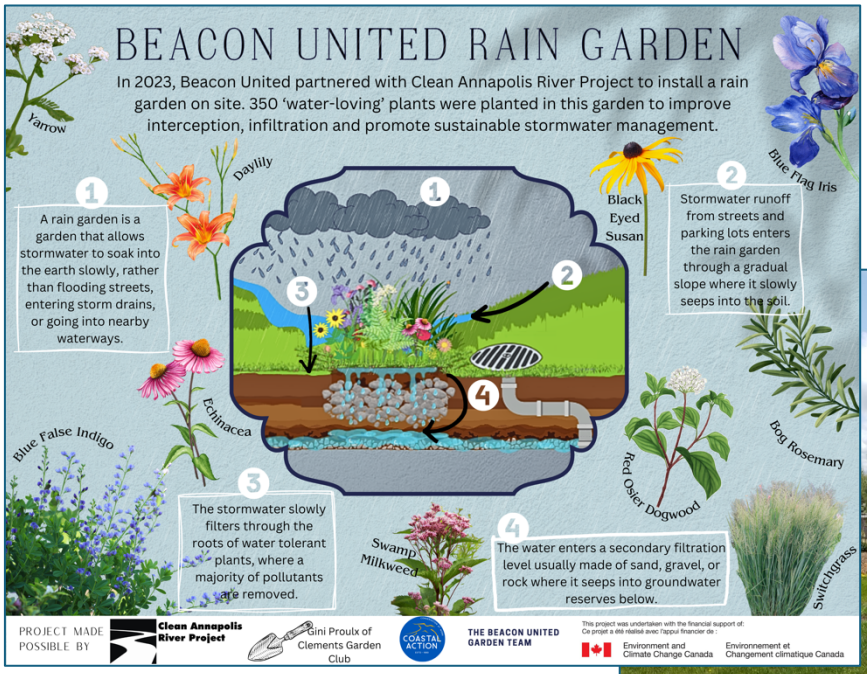

Figure 7. Left: Rain Garden Interpretive Panel to be installed at the Beacon United Yarmouth site in April 2024. This is one of many signs CARP has produced for stormwater education since 2019 (see below).

Table 3. Project objectives results, comparison with target quantities and actual quantities.

Objective	Sub-Objective	Unit of Measure	Target Quantity	Actual Quantity
Produce measurable positive results for the environment at the end of the project	Reduce/divert toxic or harmful waste from entering freshwater systems	# of Kilograms	120	163
	Focus planting on Indigenous plants, trees and shrubs planted	# of plants/trees/shrubs planted (% of which are indigenous)	1000 (85%)	1000 (90%)
	Reduce water consumption/divert stormwater from municipal systems	# of liters	1,237,460	1,267,477
	Install natural infrastructure elements at three sites	# of installed structures	5	4
Provide opportunities for community members to take action	Engage volunteers in project activities	# of volunteers participating directly in project	75	75
	Engage local businesses and contractors for project services	% of businesses and contractors used that are local to area of project site	100	100
	Engage youth volunteers in project activities	# of youth volunteers	50	55
	Deliver workshops with focus audience groups on the topics of natural infrastructure, stormwater management, climate change, and water quality and their interrelation	# of workshops	3	4
Lead to results and engagement that will be sustained after the completion of the project.	Creation of Educational Materials for distribution	Type of Material	Home Resource Kit	Home Resource Kit & Interpretive Panel
	Provide recommendations to site hosts for future improvements in stormwater management	# of partnerships where recommendations were provided	2	2
	Distribute resources and information on project components, importance, and outcomes to online audience	# of individuals reached	20,000	21, 555
	Secure agreement for maintenance to occur on project sites to ensure survival of planted vegetation	Ratio of site maintenance confirmation to number of sites	3:3	3:3

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Appendix A

Home Resource Kit

HOME RESOURCE KIT

Stormwater Management and Water Conservation

This project was undertaken with the financial support of:
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Clean Annapolis River Project

COASTAL ACTION
CONSERVATION AT WORK
ESTD · 1993

This work was supported by:
Environment and Climate Change Canada's EcoAction Community Funding Program

This project was undertaken with the financial support of:
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ECCC's EcoAction Community Funding Program provides financial support to non-profit and non-government organizations for Canadian communities to take on local action-based projects that produce measurable, positive effects on the environment and to build the capacity of communities to sustain these activities in the future.

https://www.canada.ca/en/environment-climate-change/services/environmental-funding/ecoaction-community-program.html

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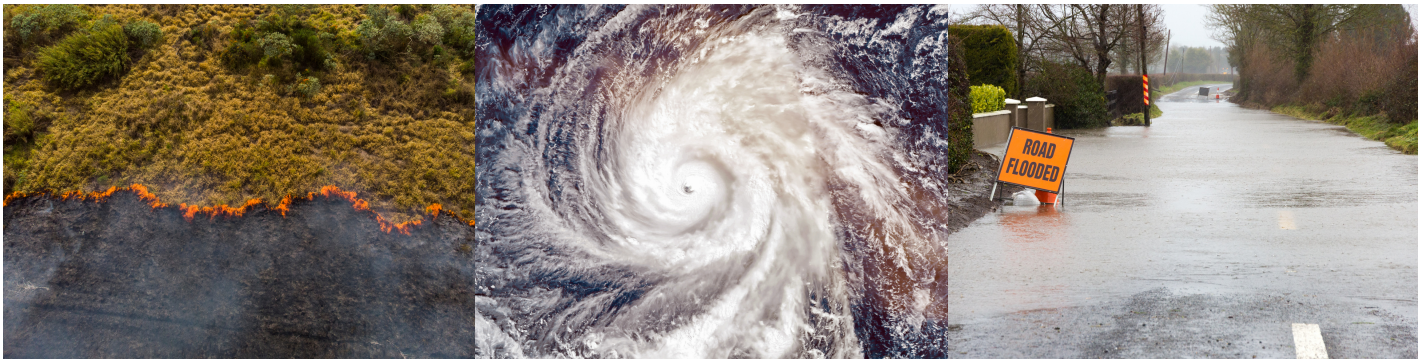
Managing Water in Response to a Changing Climate in Southwest Nova Scotia

What is climate change?

Climate change is the result of long-term weather patterns being altered. These changes can be the result of natural processes such as modulations in solar cycles or volcanic eruptions, or the result of human activities that release carbon dioxide and other greenhouse gasses. The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods”.

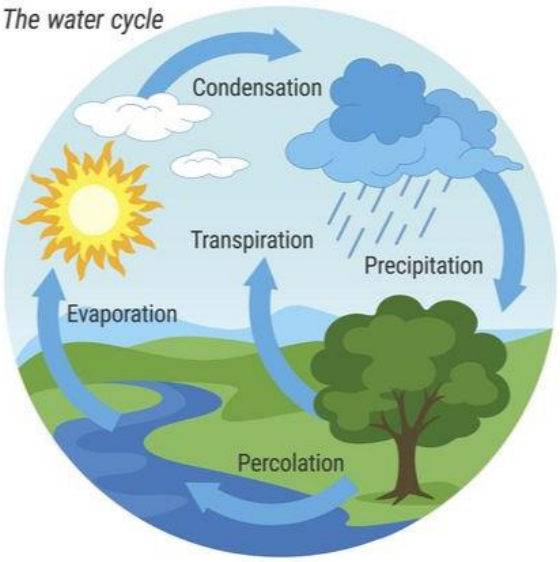
There is consensus among the scientific community that Earth is currently experiencing human-caused or “anthropogenic” climate change. The Intergovernmental Panel on Climate Change (2015) has stated that... ”human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems.”



Nova Scotia's climate is warming. It is possible that precipitation, temperature, and wind patterns will continue to change for decades, affecting the way communities throughout Southwest Nova Scotia manage their natural resources and infrastructure, and also changing the lives of people who depend on these resources and assets to survive. Currently Nova Scotians are responding to known and potential impacts of climate change in two ways: mitigation - reducing greenhouse gas emissions, and adaptation. (Nova Scotia Environment, 2014)

Climate Change and Water

Climate change is expected to have significant impacts on both water quality and quantity which will be felt globally and locally in Southwest Nova Scotia. Understanding how water flows through systems on Earth is important for understanding how we will be impacted by climate change.



Source: https://www.worldatlas.com/articles/what-is-the-water-hydrologic-cycle.html

Water cycle

The water cycle describes the continuous movement of water on, above and below the surface of the earth. The processes that comprise the water cycle include:

Evaporation: As water is heated by the sun, surface molecules become sufficiently energized to break free of the attractive force binding them together, and then evaporate and rise an invisible vapour in the atmosphere.

Transpiration: Water vapour is also emitted from plant leaves by a process called transpiration. Every day an actively growing plant **transpires** 5 to 10 times as much water as it can hold at once.

Condensation: As water vapour rises, it cools and eventually **condenses**, usually on tiny particles of dust in the air. When it condenses it becomes a liquid again or turns directly into a solid (ice, hail or snow). These water particles then collect and form clouds.

***Precipitation*:** Precipitation in the form of rain, snow and hail comes from clouds. Clouds move around the world, propelled by air currents. For instance, when they rise over mountain ranges, they cool, becoming so saturated with water that water begins to fall as rain, snow or hail, depending on the temperature of the surrounding air.

Runoff: Excessive rain or snowmelt can produce overland flow to creeks and ditches. Runoff is the visible flow of water in rivers, creeks and lakes as the water stored in the basin drains out.

Percolation: Some of the precipitation and snow melt moves downwards and **percolates** or **infiltrates** through cracks, joints and pores in soil and rocks until it reaches the water table where it becomes groundwater.

Southwest Nova Scotia's Changing Climate

The province of Nova Scotia is almost completely surrounded by water, making the ocean a major influence on our climate.

About 70% of the population in Nova Scotia lives along our 7600km of coastline making populations particularly vulnerable to impacts such as sea-level rise, severe storm events, and storm surge. This will result in damage to homes and businesses and other infrastructure through flooding and erosion. (Nova Scotia Environment, 2009)

According to Charles Bourque, Professor of Hydrology and Meteorology at the University of New Brunswick, Southwest Nova Scotia could see a 24% rise in mean temperature by 2040 (CBC, 2016).

Nova Scotia Environment also anticipates a higher demand for freshwater resources, making the conservation of freshwater resources an important step in climate change adaptation.

Declines in surface water can lead to increased issues with water quality as contaminants become more concentrated and increasing water temperatures create conditions suitable for algal blooms and other pathogens. This will affect the water resources that are available for tourism and recreation, municipal water supplies, agriculture, freshwater fisheries, etc. (Nova Scotia Environment, 2014).

Nova Scotia’s freshwater supplies could also potentially be at greater risk from pollution due to increased runoff caused by heavy rain and snow events, bacteria outbreaks (parasites in warmer water conditions), and contamination of drinking water in wells (saltwater intrusion – sea level rising above water table) (Nova Scotia Environment, 2014).

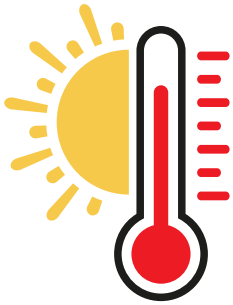
https://www.thestar.com/news/canada/2011/01/06/nova_scotia_storm_damage_totals_13_million_and_counting.html

Storm surge in Cow Bay, NS

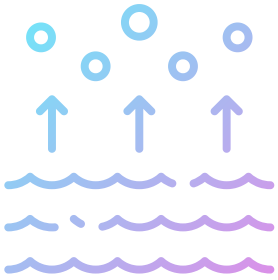
http://www.novaweather.net/Flood_2003/Flood_Hw y101b.jpg

Highway 101

Southwest Nova Scotia's Changing Climate



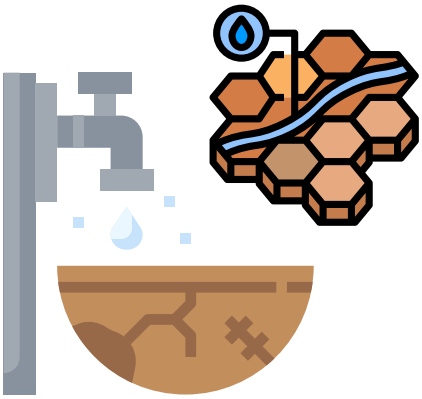
Higher average temperatures



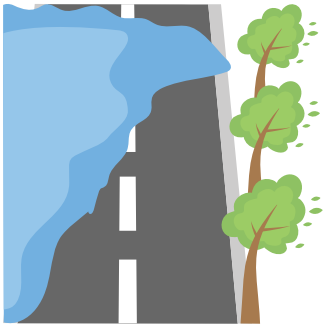
More evaporation resulting in lower surface and ground water and more water in the atmosphere

More frequent and severe storm events

Increased risk of seasonal drought conditions



Lower surface water levels and water tables making water availability an issue for the region



Increased rates of runoff and increased risk of flooding

Role of Water Conservation and Stormwater Management in Climate Change Adaptation

Adaptation to climate change requires collective action, including actions taken at the household or business level. Improved **stormwater management** and **water conservation** are two areas that offer many opportunities for action at an individual or community scale.

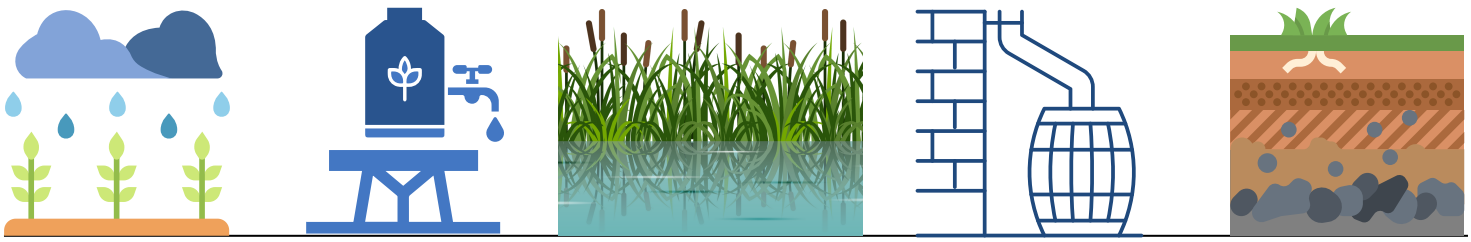
Stormwater management
In developed areas, surface runoff is traditionally conveyed directly into receiving water bodies, such as rivers, lakes, streams or the ocean. Water is collected from roads, roofs and other impermeable surfaces and transported through stormwater infrastructure such as drains, pipes, culverts and other water-carrying systems. This type of stormwater management infrastructure aims to evacuate runoff as quickly as possible, reducing the risk of flooding in targeted areas.

However, these traditional systems are not designed to handle increased storm events and surges, as projected due to climate change. This factor leads to overburdening of established infrastructure, risks of flooding, and potential for combined sewer overflows.

Two methods by which communities can address these concerns and sustainably manage stormwater in the changing climate are through the use of natural infrastructure and low-impact development.

Natural infrastructure refers to water management that protects, restores or mimics the natural water cycle using natural features (American Rivers, 2017). Natural infrastructure can be combined with traditional grey infrastructure to create a more resilient, financially stable, and a less polluting way of managing stormwater runoff.

Low Impact Development (LID) is a subset of approaches that utilize smaller-scale sustainable infrastructure. “LID refers to designing and implementing practices that can be employed at the site level to control stormwater and strive to replicate the pre-development hydrology of the site (Dickinson, 2013)“.



Water Conservation

As previously discussed, although Nova Scotia will experience more precipitation as a result of climate change, there may be an even higher rate of evaporation due to warmer temperatures resulting in an overall decline in water levels. This may mean reduced water levels in surface waters (eg. lakes, ponds) and a lowered water table, where well water is obtained. As a result, communities may face water shortages and droughts.

Water conservation includes all the policies, strategies and activities to sustainably manage freshwater resources, protect the hydrosphere, and meet the current and future human demand. By conserving water we can reduce the pressure placed on this limited resource and better manage the risk of water shortages during drought conditions.

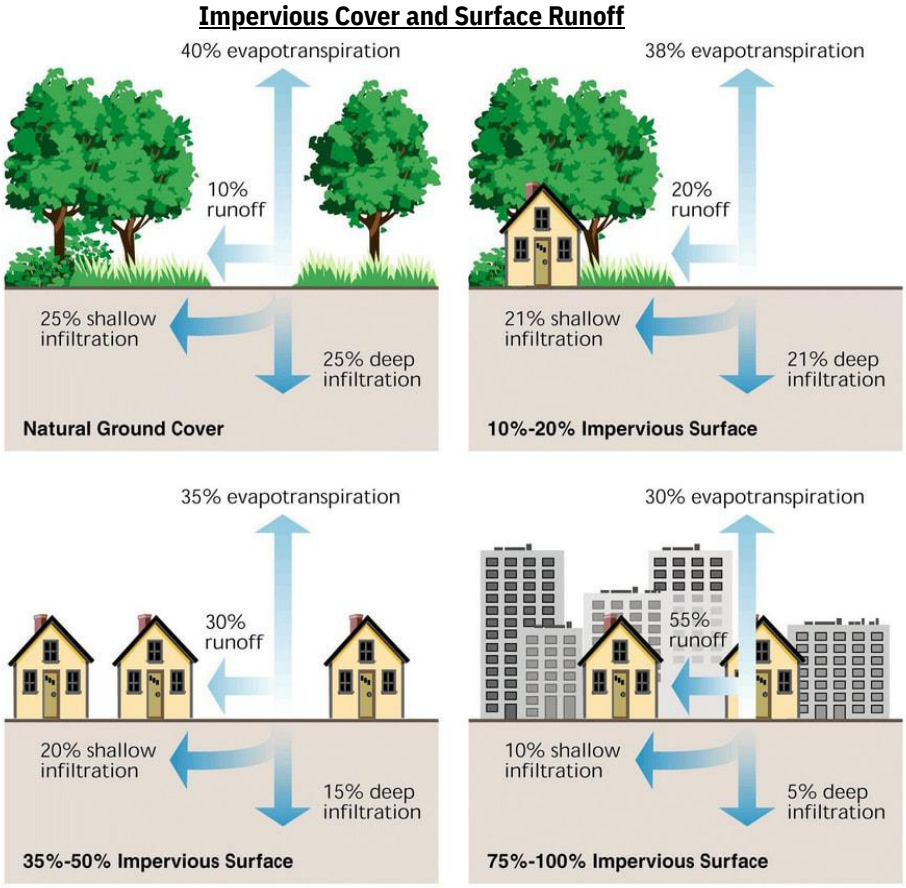
Solution Focused

Throughout this resource kit you will find information and resources on natural infrastructure, low-impact development, and water conservation techniques. The practices and strategies provided are accessible and successful at multiple scales. Whether you are a renter, homeowner, business owner, municipality, community group, student, or activist these options are available to you and can make a big difference for you and your local area's water quality.

CARP and Coastal Action have worked with many communities throughout southwest Nova Scotia to implement the projects and techniques you will read about. The ***Success Stories*** section at the end of this kit provides highlights and information on our previous work. If you are interested, have questions, or would like to find out more, our contact information can be found on the back of this booklet. We look forward to hearing from you!

Stormwater Best Management Practices

Stormwater Management



Stormwater is water that originates during precipitation events and snow/ice melts. Stormwater can soak into the soil (infiltrate), be held on the surface and evaporate, or runoff and end up in nearby streams, rivers, or other water bodies (surface water).

In natural landscapes such as forests, the soil absorbs much of the stormwater and plants help hold stormwater close to where it falls. In developed environments, water is collected from roads, roofs and other impermeable surfaces and transported through stormwater infrastructure such as drains, pipes, culverts and other water carrying systems. The stormwater carries trash, sediment, bacteria, heavy metals and other pollutants from the landscape, degrading the quality of the receiving waters. Higher flows can also cause erosion and flooding in streams, damaging habitat, property and infrastructure.

Stormwater management reduces the negative impacts of stormwater runoff. Sustainable stormwater management aims to maintain the health of water bodies such as lakes and streams, prevent flooding and erosion, protect aquatic species, and sustain healthy sources of water for humans by mitigating the effects of urban development.

What can you do at home & in your community?

Many of our municipal sewage systems in the Annapolis watershed use combined sewage and stormwater collection. Combined sewer systems collect sewage from houses, businesses, etc. as well as surface runoff. During high-intensity precipitation or snowmelt events, the amount of stormwater collected by these combined systems can exceed the capacity of the sewage treatment plant they are connected to, resulting in untreated sewage waste overflowing into receiving waters (Clean Annapolis River Project).

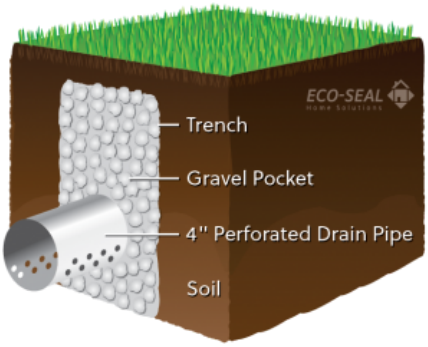
Strategic landscaping alterations can help you significantly manage stormwater on your property. By doing so, you can reduce potential flooding of your property, help minimize negative impacts on lakes, streams and other receiving waters, harvest rainwater for additional uses (watering gardens, times of drought, etc.) and help to recharge the groundwater.

Listed below are Natural Infrastructure elements, Low Impact Developments, and best management practices for stormwater that you can consider for your home. (*Make sure to obtain any required permits prior to undertaking work)*

Constructed/Restored Wetlands

Wetlands recycle nutrients, filter certain pollutants, recharge groundwater, and provide habitat for fish and wildlife. They also reduce peak flows and flood damage, provide storage, and mitigate erosion. In developed areas, wetlands can collect and counteract the increased runoff from roofs, pavement, and other impervious surfaces.

Landowners in the Annapolis Valley have previously partnered with Ducks Unlimited Canada to restore wetlands or construct wetlands on their properties. https://www.ducks.ca/resources/landowners/



French Drain System/ Perforated Pipes

The purpose of a french drain system is to promote infiltration and redirect the water to a more suitable location (e.g. catch basin or rain garden).

A french drain is a trench that is dug below ground level, lined with geotextile fabric (preventing matter from clogging the holes in pipe), and filled with clear stone/gravel with a perforated pipe sitting in the middle of the trench.

A perforated pipe is designed to allow water to enter or exit through small holes or slots along the pipe.

Photo source: https://envirocareonline.com/how-to-build-an-exterior-french-drain-system/

Depaving / Removal of Impervious Surfaces

Depaving is the process of removing hard surfaces such as concrete and asphalt, and "freeing" the soil - allowing the surface water the chance to infiltrate into the ground. By removing pavement and creating gardens, polluted runoff is reduced and groundwater is then recharged.

Photo source: https://floodlist.com/protection/depave-community-based-approach-storm-water-management

Rain Barrels

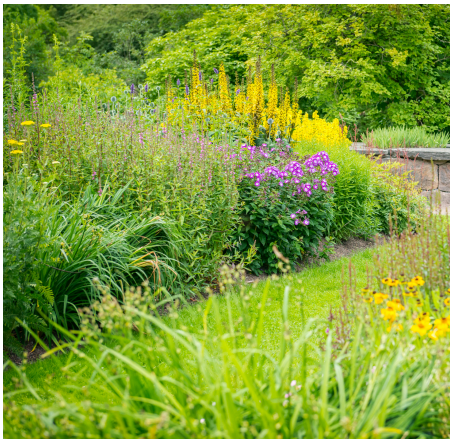
Rain barrels collect, redirect and store rainwater from your roof to be used for other purposes on your property. The collected water can be used to:

- Water your lawn, garden, or indoor plants
- Wash your car, boat, muddy shoes etc...

Photo source: Canva

Cisterns

A rain cistern is essentially a larger rain barrel. Usually connected to a building/structure's eavestrough downspout, it can be located above or below ground and is primarily used for landscaping. It may also be used indoors as part of a grey-water system for flushing toilets and washing machines. For use of collected rainwater on edible plants, it is required that the storage container undergo regular water quality testing.



Rain Gardens

Rain gardens are planted depressions or landscaped holes that allow stormwater runoff from impervious urban areas, like roofs, driveways, walkways, parking lots, and compacted lawn areas, the opportunity to be absorbed. They reduce rain runoff by allowing stormwater to soak into the ground (as opposed to flowing into storm drains and surface waters) ultimately improving water quality. They are usually planted using plants that can withstand flood and drought conditions.

Photo source: Canva

Bioswales, Grass Swales, Infiltration Trenches

Bioswales and *grass swales* are vegetated channels that direct water downhill to a destination point such as a rain garden. The stormwater is filtered along the way, through gravel and grass/soil layers, promoting infiltration. *Infiltration trenches* are excavated channels that are lined with geotextile fabric and filled with stone to promote water infiltration.

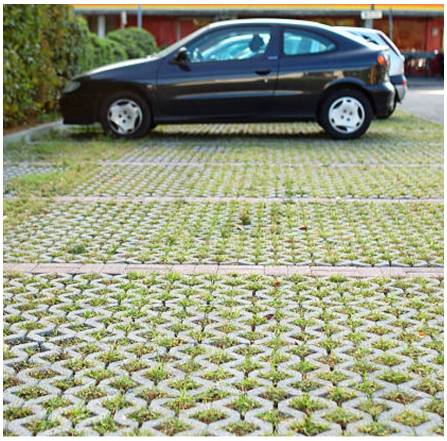
Photo source: https://fknursery.com/rain-gardens-and-bioswales/

Tree & Shrub Planting

Tree roots take up water and help to prevent flooding and erosion. Their leaf canopies act as a buffer and reduce erosion caused by falling rain. Trees capture the surface water runoff and release it back into the atmosphere through evapotranspiration - contributing to the hydrologic cycle.

It is important to choose highly water tolerant and absorbent trees/shrubs when using them for stormwater management. Common species used are Red Maple, Willows, White Cedar, and Ash trees.

Photo source: Canva



Permeable Pavers

Permeable pavers are a great way to reduce impervious surfaces on your property without losing valuable footprint for other uses (ex. driveways, patios, walkways, etc...). Permeable pavers include a range of options, such as inter-locking paving blocks, permeable asphalt and cement, and vegetated cement grids. Permeable asphalt/cement have a porous binder, whereas inter-locking paving blocks have built-in spacing and a cement or stone grid with vegetation growing in a sandy soil medium between the guidelines. (Bluenose Coastal Action Foundation, 2016)

Photo source: Canva

Soil Enhancement

Soil amendments are specific organics and inorganics that can be used to improve the soil's physical properties in order to increase water storage capacity and allow plants to flourish. It is important to know what type of soil you are dealing with (clay, silt, sand) in order to properly choose which amendments to use/add. Examples of amendments:

- Organic: *compost, wood chips, manure, peat moss, etc.*
- Inorganic: *gravel, lime, etc.*

Photo source: Canva

Redirecting your Downspout and/or Lot Grading

Downspouts transport the water on your roof to the ground, directing it away from the foundation. To prevent flooding, it is recommended that you extend your downspout at least six feet from your foundation. You should release this water into vegetated areas on your property such as a wet pond or a rain garden, or redirect it into a cistern or rain barrel to harvest the rainwater at a later date.

Lot grading alters the slope of a property to direct water away from buildings and redirects it towards areas where water retention is preferred. Any graded areas should be revegetated in order to prevent erosion on site and promote water infiltration during storm events.

Photo source: Canva

Water Conservation Best Management Practices

The importance of water conservation in southwest Nova Scotia

Although we expect to see more precipitation as a result of climate change, there may be an even higher rate of evaporation due to warmer temperatures resulting in an overall decline in water levels. This may mean reduced water levels in surface waters (eg. lakes, ponds) and a lowered water table.

In the summer and fall of 2016, Southwestern Nova Scotia (NS) experienced moderate to severe drought conditions, with data from provincial observation wells showing historical lows or below normal water levels (Kennedy, 2017). “It is estimated that over 1000 private well users in Southwestern NS experienced water shortages because of the drought, especially well users relying on dug wells for domestic water supply (Kennedy, 2017).”

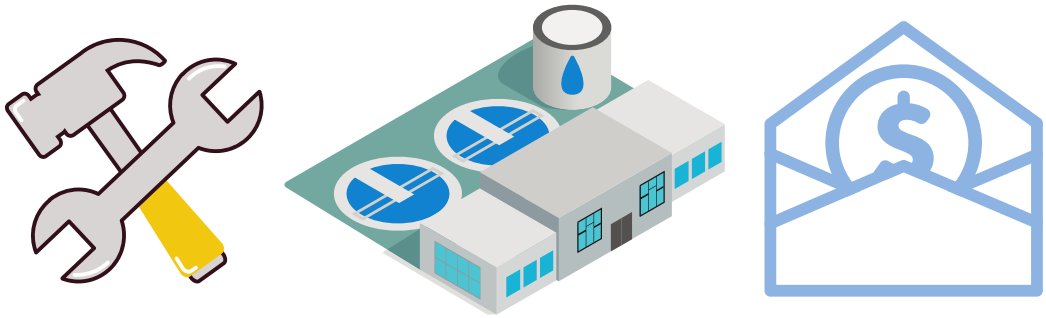
Prolonged summer drought conditions and changes in precipitation regimes may also create challenges for users that rely on surface water for their regular operations, such as farmers who use water for irrigation or livestock watering, plant nurseries or home gardeners.

Economic benefits of water conservation (Nova Scotia Environment)

Save money on your water and sewer bills

Save money on your power bills by using less energy to heat and pump water

Make your home sewage disposal system last longer by not overloading it.



Delay and prevent the expansion of costly water and wastewater treatment plants which can save money on taxes

How can you conserve water?

Water conservation includes all the policies, strategies and activities to sustainably manage freshwater resources, protect the hydrosphere, and meet the current and future human demand.

Homeowners interested in conserving water can implement physical water conservation infrastructure into their home water systems in addition to following lifestyle best management practices.

Physical water conservation measures involve the use of simple devices and technology that can be installed in your home, such as:

Low -flush / Dual-flush Toilets
A dual-flush toilet is a variation of the flush toilet that uses two buttons or a handle mechanism to flush different amounts of water.

Low-flow Faucet Aerator
The aerator acts as a sieve, separating a single flow of water into many tiny streams which introduces the air into the water flow. Also as there is less space for the water to flow through, the water flow is reduced, resulting in water savings.

Toilet Tank Displacers
A toilet tank displacement device is an object you place into your toilet tank to take up room. Less space in your tank means it takes less water to fill up, so you can save water with every flush.

Best Management Practices (BMPs)

Changes to everyday practices and behaviours play a critical role in meeting water conservation objectives.

BMPs for outdoor water use:

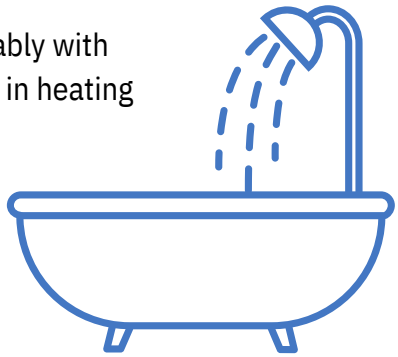
- Don't water lawn and garden if rainfall has been sufficient (established lawns only need about 2.5cm/week)
- Water early in the morning or in the evening to limit evaporation
- Situate sprinklers to avoid watering paved surfaces and instead only lawns and gardens
- Check hoses and sprinklers regularly for leaks
- Don't mow your lawn shorter than 6-8 cm (longer grass has more protection for roots and will retain water better)
- Leave grass clippings when you mow (they return nitrogen to the soil and make for a healthier lawn)
- Aerate lawn yearly to better allow percolation of water into the soil
- Water plants with harvested rainwater from rain barrels
- Use mulch in your garden to protect against water evaporation and decrease the frequency of watering
- Plant native plants that are adapted to the climate and require less water
- Manage stormwater using a rain garden to filter runoff and aid in restoring groundwater
- Decrease stress on wells by collecting water from your roof into a rain barrel and using it for irrigating lawn and garden
- Avoid using the hose to clean the driveway, sweep it instead
- When washing your car, use a bucket of soapy water to wash (only use the hose for the last rinse or wash it while it's raining!)
- Put a cover on your swimming pool to reduce evaporation

BMPs for indoor water use:

Toilets (single biggest user of water)

- Replace a toilet that is older than 10 years with a new ultra-low-flush toilet and reduce water use by 15-20 percent.
- Retrofit an older toilet to use less water with a specifically designed flapper valve that closes more quickly, a dual-flush device, a toilet dam or a tank insert that displaces water.
- Only flush when necessary ("When it's yellow, let it mellow...etc")
- Repair toilet leaks promptly (check for a leak by putting a few drops of food colouring in the tank. Without flushing, see if the food colouring moves from the tank into the bowl. If it does - you have a leak. Also, check for leaks around the base of the toilet and repair them promptly.)
- Ensure that the float ball is properly adjusted so the tank water level does not exceed the height of the overflow tube. Periodically examine whether the plunge ball and flapper valve in the tank are properly "seated" and replace parts when necessary.
- Finally, consider replacing a water toilet with a composting toilet and reduce total water use by 30 percent!

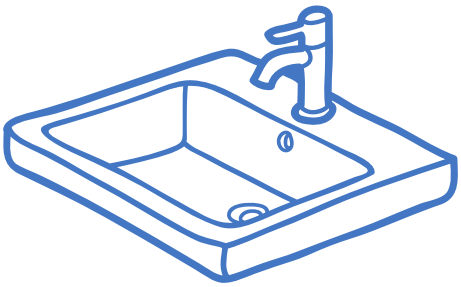
Showers



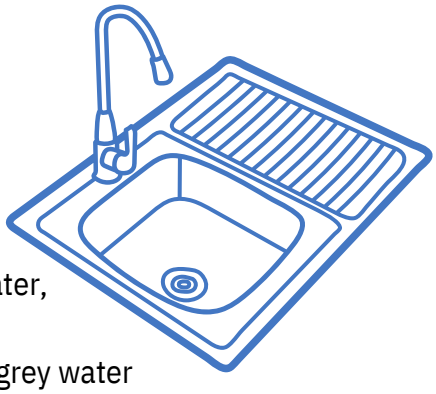
- Install low-flow shower heads or adjustable flow reducer devices, preferably with shut-off buttons (saves 25 percent of shower water and about $100/year in heating costs)
- Short showers use less water than baths
- Turn taps off snugly so they don't drip
- Promptly repair leaks

Bathroom Sinks

- Install an aerator and/or a water flow-reducer attachment on your faucets
- Turn taps off snugly so they don't drip
- Promptly repair leaks in and around your taps (one leak can waste several thousand litres of water each year - enough to fill a swimming pool or stress out your leaching bed)
- Use a partly filled sink rather than running water for shaving or washing hands
- Turn off the water between wetting your toothbrush and rinsing



Kitchen Sinks



- Put a pipe wrap on basement hot water pipes so heated water arrives at your tap more quickly.
- When hand-washing dishes, don't run water continuously.
- Wash dishes in a partly filled sink and rinse in a second partly filled sink or with the spray attachment.
- Wash fruits and vegetables in a partly filled sink, not under running water, and rinse quickly under the tap.
- In summer, wash dishes, fruits and vegetables in a basin and put this grey water on trees and bushes.
- In winter, try using used dishwater on house plants. However, don't store used water

Dishwashers

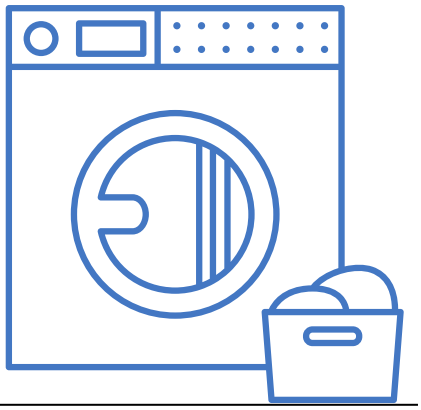
- Wash only full loads in the dishwasher, use the short or water/energy conserver cycle and let dishes dry on their own (following these practices can also mean using less water than hand washing).
- If replacing your washer, choose a high-efficiency model.

Refrigerators

- Keep a pitcher of chilled water in the fridge to avoid waiting for cold water to arrive at your tap.

Laundry

- Wash only full loads in the washing machine.
- Use suds-saver, short cycle and load size features.
- Promptly repair any leaks.
- Select a front-loading washer the next time you replace your machine (they generally use much less water than top-loading machines). Also if replacing your washer, choose a high-efficiency model.
- Spread your laundry out over the week (consider doing one or two loads on laundry day versus several loads on the same day).



Stormwater Management Success Stories

Success Stories

Over the years, CARP has been dedicated to improving the way stormwater is managed throughout Southwest Nova Scotia. Through a partnership with Coastal Action and funding from Environment and Climate Change Canada, we have successfully implemented projects at more than 10 sites and conducted home assessments across 7 municipalities.

Low-Impact Development Success

In 2019 CARP and Coastal Action partnered with three local businesses to install 1000L rainwater cisterns, allowing for the capture of surface runoff and displacing the use of municipally treated water. Cubitaner Cisterns were donated by Acadian Seaplants Ltd. and repurposed as rainwater collection and storage systems. An educational interpretive panel was installed in a publicly visible area at each of these businesses, highlighting the role of rain capture as a water conservation and stormwater management technique.

Ragged Robin Nursery (pre-work)

Ragged Robin Nursery (post-work)

Bunchberry Nursery

Summerland Plant Nursery

Business partners included Bunchberry Nursery, Summerland Plant Nursery, Ragged Robin Farm & Nursery, Sweet Fern Farm, and Wayward Farm. An educational interpretive panel was installed in a publicly visible area at each of these businesses, highlighting the role of rain capture as a water conservation and stormwater management technique.

Natural Infrastructure Success

NSCC - Middleton

CARP partnered with Nova Scotia Community College (NSCC) in Middleton to construct two rain gardens and a dry creek bed to channel surface water and runoff in 2018. Additional work and maintenance for this site was then completed in 2019. This project was undertaken as part of an initiative to establish stormwater management demonstration sites across the province.






Raquette Pond - Town of Digby

Another demonstration site was implemented in partnership with the Town of Digby at Frank Mackintosh Memorial Park in 2019. Three rain gardens were constructed around Raquette Pond to intercept stormwater runoff from surrounding impervious surfaces (roads, sidewalks) prior to the water entering nearby waterbodies. CARP has continued to conduct maintenance on these gardens each year since their completion.



Bridgewater Memorial Arena - Bridgewater

In 2022, Coastal Action partnered with the Town of Bridgewater to implement a Depave Paradise project and install a rain garden at the Bridgewater Memorial Arena.

The project involved the removal of over 200 m2 of unused pavement and the installation of native plants to aid in the absorption of stormwater runoff from surrounding impervious services, such as the parking lot and nearby building. Over 300 plants were planted in the rain garden with the help of community volunteers, including youth from local schools.

'Hospital Hill' Park - Town of Digby

In 2018, CARP partnered with the Town of Digby to improve stormwater management at their park site located behind Digby General Hospital. Surrounded by impervious surfaces and characterized by hills and valleys, this site experiences large volumes of overland runoff and drainage issues. Working with the natural topography, CARP developed a plan to address multiple problem areas throughout the park.

Post rain event at site in Digby (pre-project implementation)

Design & Implementation

A complex of six rain gardens, a bioswale, and raised bed were designed and constructed on site. These natural infrastructure features are contributing to a larger initiative by the Town of Digby to create a new public green space.

Current & Future Success

Currently, CARP and Coastal Action are working with municipalities and community groups to implement natural infrastructure projects for stormwater management to be completed by the end of 2023. These exciting projects have been made possible through Environment and Climate Change Canada's EcoAction Program.

CARP is thrilled to be expanding upon the work we have accomplished at 'Hospital Hill' park. Working with the Town of Digby, we will be collaborating on their development plans for the site and ensuring that stormwater management remains at the forefront of design. CARP will then construct any natural infrastructure elements included within the site plans.

In CARP's newest partnership, we are addressing the large volume of runoff coming from Beacon United's roof in the Town of Yarmouth. This project will collect a portion of the rainwater to be reused in the community garden on site and then redirect the rest away by way of a bioswale. This work aims to reduce the pressure on municipal sewer systems and mitigate flooding issues within the building.

Our partner Coastal Action is building a rain garden at the Memorial Arena in Bridgewater. This rain garden will be the second on site, the first was also constructed by Coastal Action in 2022. Their work is implementing a dual system of stormwater management by depaving sections of impervious surfaces on site while also creating a garden that will intercept runoff, filter water, and recharge groundwater.

For more information on ways to manage stormwater or to get involved in CARP's work, contact us at:

Clean Annapolis River Project
314 St. George Street,
Annapolis Royal, NS B0S 1A0
Phone: (902) 532-7533 | Email: carp@annapolisriver.ca
www.annapolisriver.ca

Appendix A - Sources:

All images used are provided from contributing partners or Canva unless indicated/sourced otherwise.

Managing Stormwater in Southwest Nova Scotia's Changing Climate

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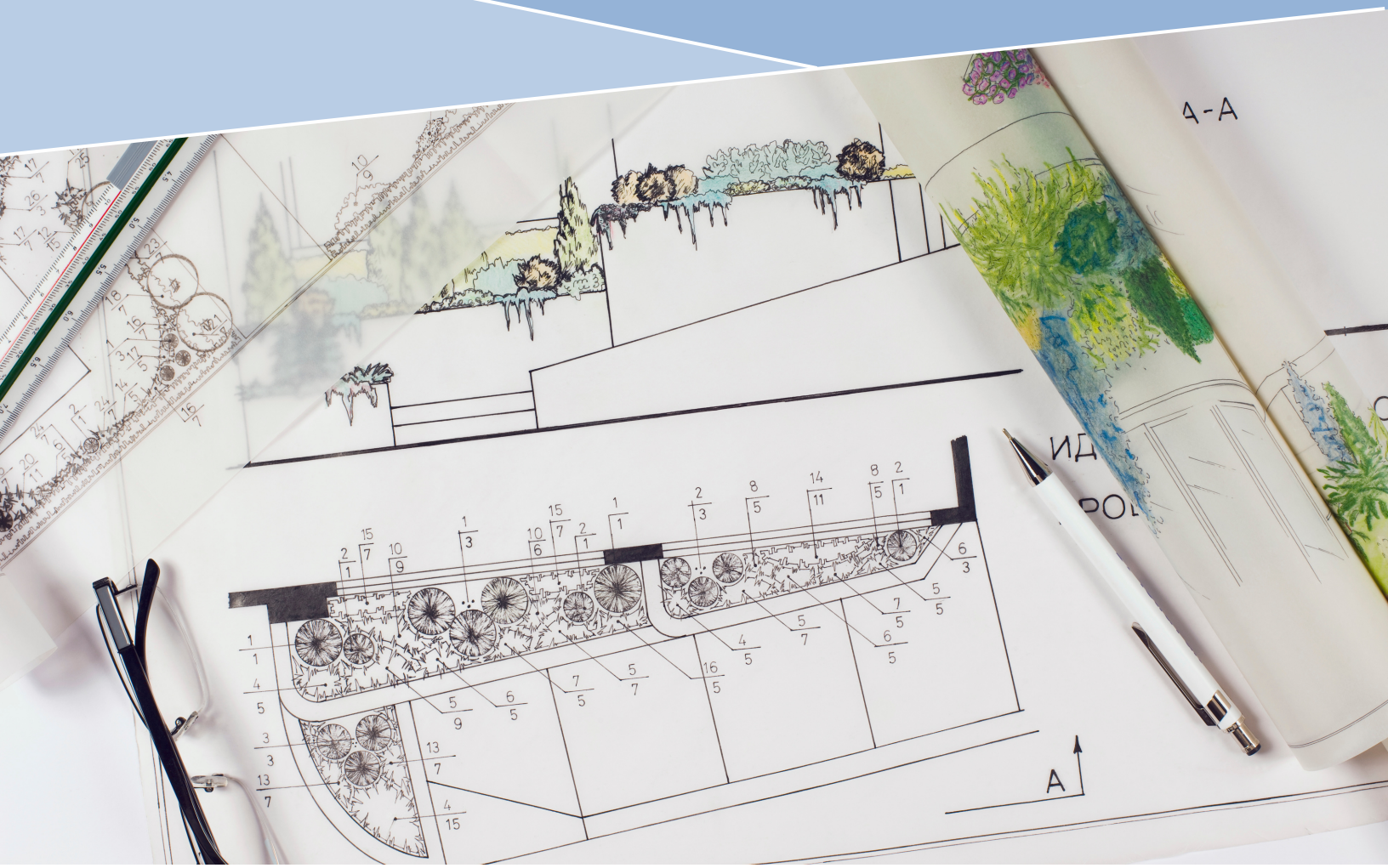


Appendix B

Pre- and Post- Evaluation Surveys

Clean Annapolis River Project

Pre-Survey Description: Please answer the following questions to help inform our team of what level of awareness you currently have surrounding natural infrastructure and stormwater management. Thank you for your time and we hope you enjoy the presentation!

1. Have you heard about Clean Annapolis River Project before?
    a. Yes
    b. No
    c. Maybe
2. Would you be able to describe what stormwater is to someone else?
    a. Yes
    b. No
    c. Maybe
3. Would you be able to describe what stormwater management is?
    a. Yes
    b. No
    c. Maybe
4. Could you name a natural infrastructure element?
    a. Yes
    b. No
    c. Maybe
5. Could you name a low impact development element?
    a. Yes
    b. No
    c. Maybe
6. Are wetlands considered stormwater management?
    a. Yes
    b. No
    c. Maybe
7. Why is sustainable stormwater management important?
    a. Climate Change
    b. Cost Savings
    c. Flood management
    d. Water Quality
    e. All of the above

Clean Annapolis River Project

Post Survey Description: Thank you for taking the time to complete this survey on your experience learning about stormwater management and natural infrastructure. This will help our team improve on workshop and webinar delivery going forward.

1. Did you know that stormwater management impacted water quality in freshwater ecosystems and in our communities?
    a. Yes
    b. No
    c. Maybe
2. Would you be able to describe what sustainable stormwater management is to someone else?
    a. Yes
    b. No
    c. Maybe
3. Would you be able to describe what natural infrastructure is?
    a. Yes
    b. No
    c. Maybe
4. Would you be able to describe what low-impact development is?
    a. Yes
    b. No
    c. Maybe
5. Are wetlands an important part of managing stormwater?
    a. Yes
    b. No
    c. Maybe
6. Do you think natural infrastructure (ex. Rain gardens, bioswales) could be implemented in the Town of Middleton's future plans?
    a. Yes
    b. No
    c. Maybe
7. Do you have any further comments about this presentation:

_____

_____

_____

_____

Appendix C

CARP Newsletter: Stormwater Special Feature

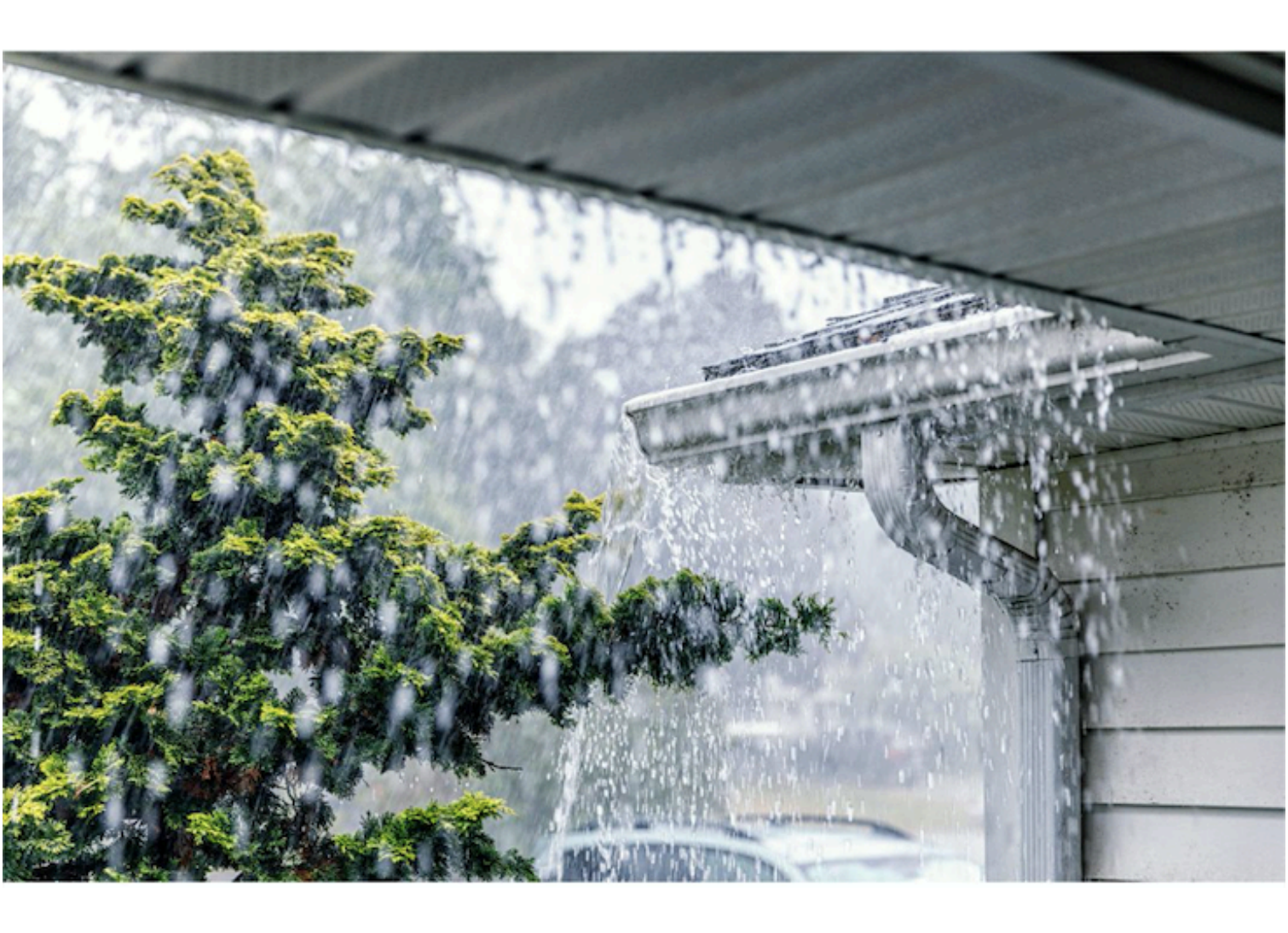
It's raining, it's pouring, and CARP staff are working!

Special Feature: Sustainable Stormwater Management

WHAT'S INCLUDED

What is stormwater?

Stormwater is water that originates during precipitation events (ex. rain storms) and snow/ice melts. Stormwater can soak into the soil (infiltrate), be held on the surface and evaporate, or runoff and end up in nearby streams, rivers, or other water bodies (surface water).



Current Stormwater Management (SWM) & the Issues

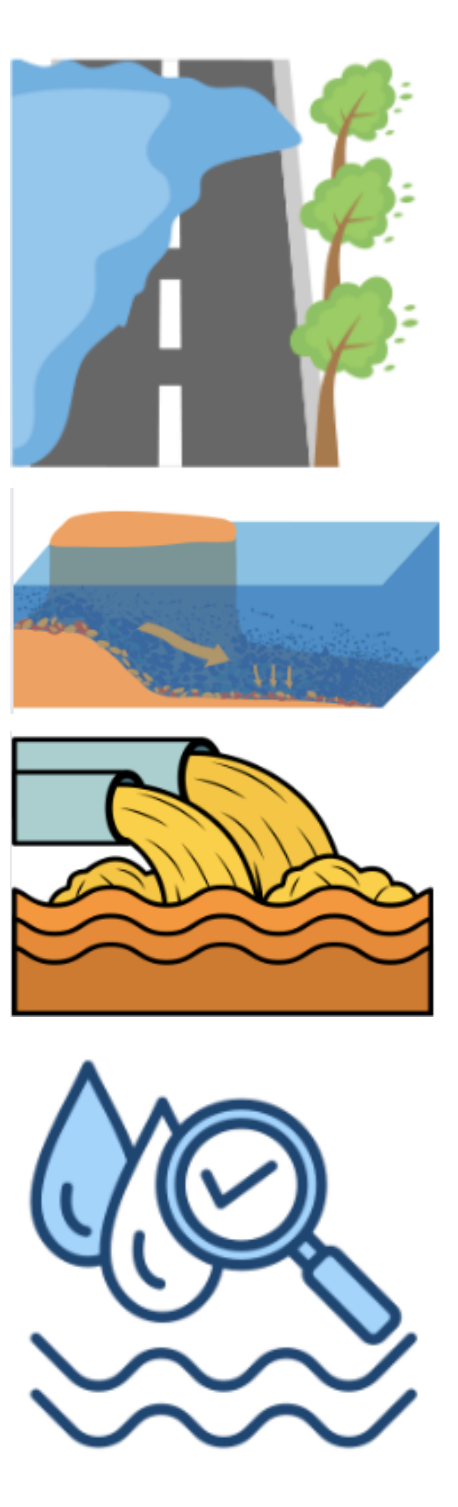
In natural landscapes such as forests, this cycle of **infiltration**, **evaporation**, and **runoff** manages and naturally filters stormwater.

Whereas, in developed environments (ex. Towns, Cities), stormwater is collected from roads, roofs, and other **impermeable surfaces** (surface you cannot get through) and transported through what we call **grey infrastructure** such as drains, pipes, culverts, and other water carrying systems. Stormwater in developed areas ends up **carrying trash, sediment**, **bacteria, heavy metals** and other **pollutants** from the landscape, which logically degrades the water quality of the receiving water bodies.

This water quality issue is then made worse because a majority of the stormwater **grey infrastructure** throughout southwest Nova Scotia leads to combined sewers. **Combined sewers** are piping systems that share pipes between the sewage systems and rainwater drains.

When there are heavy rainstorms and these sewers are **overburdened** by too much water our infrastructure experiences what are called **Combined Sewer Overflows.** This leads to raw sewage mixing with flooding water and ending up in surrounding watercourses and water bodies leading to **major issues with E.Coli.**

We also experience increases in E.Coli from excess nutrients picked up through overland runoff from agricultural land and livestock wading directly in water. Higher flows can also cause **erosion and flooding** in streams, **damaging habitat, property and infrastructure.**



Traditionally, stormwater management focusses mainly on collection and processing of stormwater without addressing all of these other issues and factors. Whereas, sustainable stormwater management aims to maintain the health of water bodies such as lakes and streams, prevent flooding and erosion, protect aquatic species, and sustain healthy sources of water for humans by mitigating the effects of urban development.

What does sustainable SWM look like?

There are 2 main methods that we typically refer to and use:

- **Natural Infrastructure** (NI)
- **Low Impact Development** (LID)

NI uses existing, restored, or enhanced ecosystems to generate infrastructure outcomes either on its own or in combination with built infrastructure (like LID).

NI can provide protection against a range of climate change hazards, such as coastal flooding, riverine flooding, extreme heat in urban areas, and drought, as well as generate co-benefits such as species habitat and recreational opportunities.

The following diagrams were developed by the International Insitute for Sustainable Development (IISD) to exemplify how Ni & LID can be implemented across our landscape:

CARP's Previous Work in SWM:

Since the early 2000s, CARP has partnered with local businesses, organizations, communities, and municipalities to carry out sustainable SWM improvements such as:

- Rain barrel installation
- Tree planting
- Rain garden construction
- Cistern installation
- Wetland restoration
- Home assessment program

To successfully complete these projects, CARP collaborated with the following partners:

Coastal Action, Town of Digby, Bunchberry Nursery, Ragged Robin Farm & Nursery, Summerland Plant Nursery, Nova Scotia Community College (NSCC) Middleton, Sweet Fern Farm, Wayward Farm

NI Element Highlight: Rain Gardens

One of the most common forms of natural infrastructure are rain gardens. Rain gardens can be thought of as "engineered gardens". A rain garden is a garden that allows stormwater to soak into the earth slowly, rather than flooding streets, entering storm drains, or going into nearby waterways. Stormwater runoff from streets and parking lots enters the rain garden through a gradual slope where it slowly seeps into the soil.

The stormwater slowly filters through the roots of water tolerant, or "water-loving" plants, where a majority of pollutants are removed. The water enters a secondary filtration level usually made of sand, gravel, or rock where it seeps into groundwater reserves below.

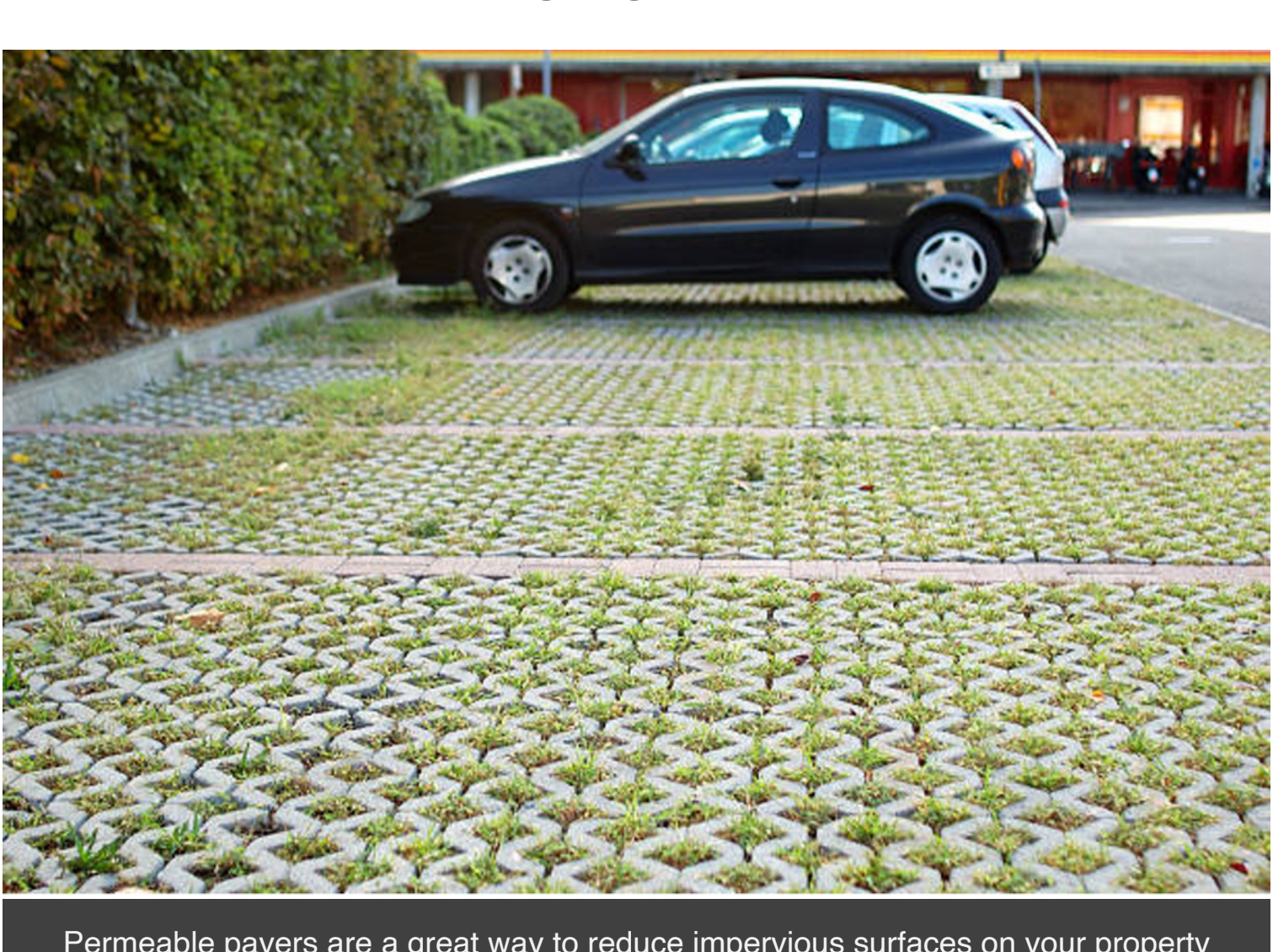
These engineered gardens are easy to implement, cost efficient, and aesthetically pleasing. For all of these reasons, the Clean Annapolis River Project has constructed multiple rain gardens throughout southwest Nova Scotia.

"Water-Loving" (Water Tolerant) Plants

When we construct rain gardens, plant bioswales, and implement NI, we typically choose a variety of vegetation that can tolerant a wide range of moisture conditions, from flood to drought. Emphasis is made on selecting native vegetation and plants that serve multiple purposes (ex. pollinator species). Check out the list below to discover some of our favourites!

1. Red Osier Dogwood
2. Bog Rosemary
3. Blue False Indigo
4. Daylilies
5. Swamp Milkweed
6. Blue Flag Iris
7. Switchgrass
8. Black Eyed Susan
9. Common Yarrow
10. Echinacea

LID/NI Element Highlight: Permeable Pavers

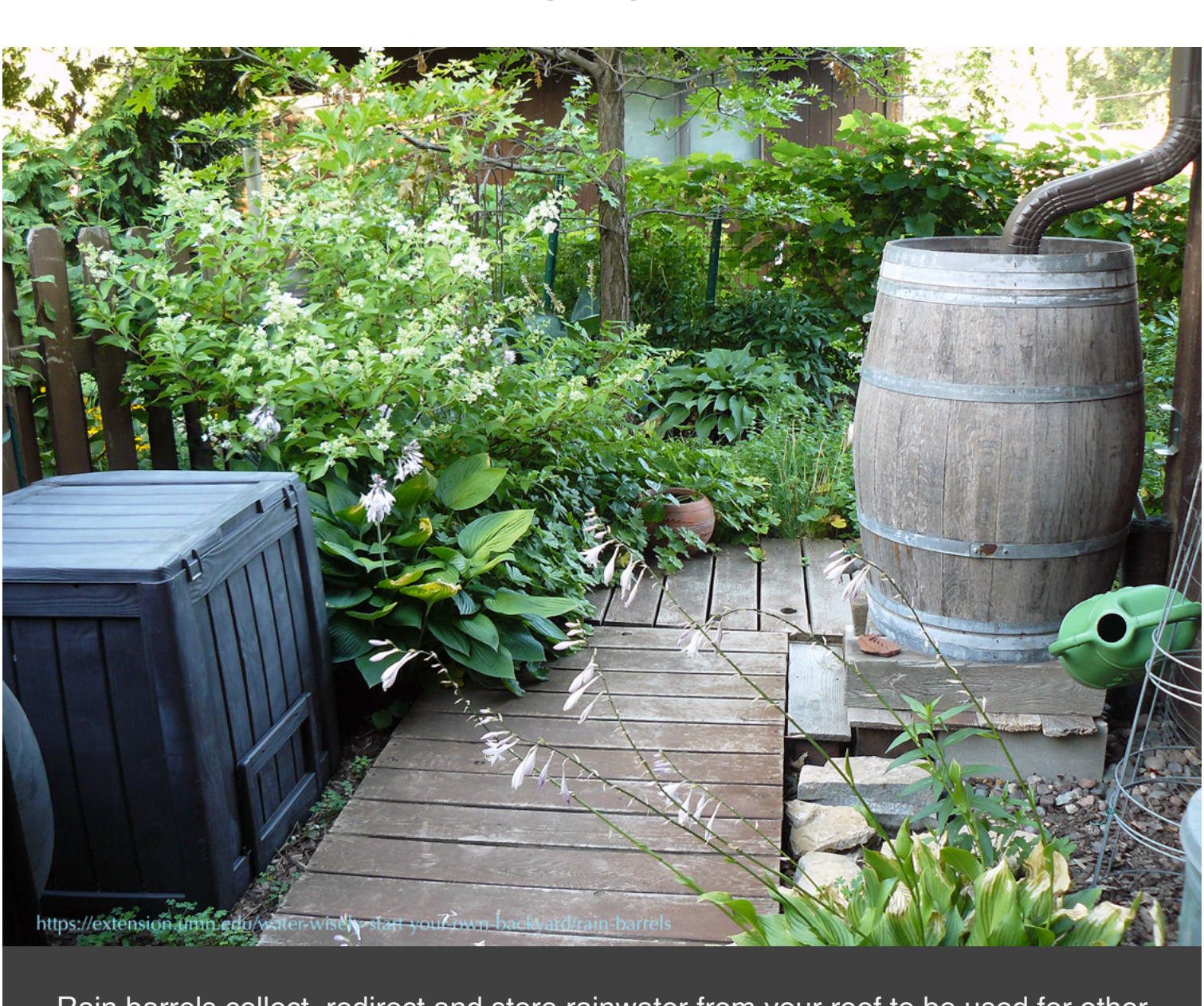


Permeable pavers are a great way to reduce impervious surfaces on your property without losing valuable footprint for other uses (ex. driveways, patios, walkways, etc...). Permeable pavers include a range of options, such as inter-locking paving blocks, permeable asphalt and cement, and vegetated cement grids. Permeable asphalt/cement have a porous binder, whereas inter-locking paving blocks have built-in spacing and a cement or stone grid with vegetation growing in a sandy soil medium between the guidelines.

Want to take it a step further?

Removing hardscape, or impervious surfaces, in sections can provide a point of access for stormwater to reach the ground below. This method also provides opportunities for greening up your neighbourhood, reclaiming natural landscapes, and improving overall aesthetics!

LID Element Highlight: Rain Barrels



Rain barrels collect, redirect and store rainwater from your roof to be used for other purposes on your property. Rain barrels can be made of plastic, wood, stone, ceramic, or even clay. Plastic rain barrels are generally the least expensive, lightweight, and easy to clean. Whereas, the stone, ceramic, and clay barrels are more decorative, heavier, and usually more expensive. They may hold less rainwater than plastic barrels, but they can be ideal for small gardens. The collected water can be used to:

Water your lawn, garden, or indoor plants, or wash your car, boat, muddy shoes etc...

NI Element Highlight: Wetlands

Wetlands are amazing forms of natural infrastructure. Wetlands are areas of land that are wet for all, or a portion, of the year. They tend to have soils that drain poorly and support water-loving plants such as cattails, sedges, rushes, blue flag iris, willows, and dogwoods.

Wetlands (preserved, restored, or constructed) play a critical role in sustainable design strategies to manage stormwater. They are integral parts of stormwater projects in both urban and open or undeveloped areas throughout our landscape due to the many services they provide to our communities and environment.

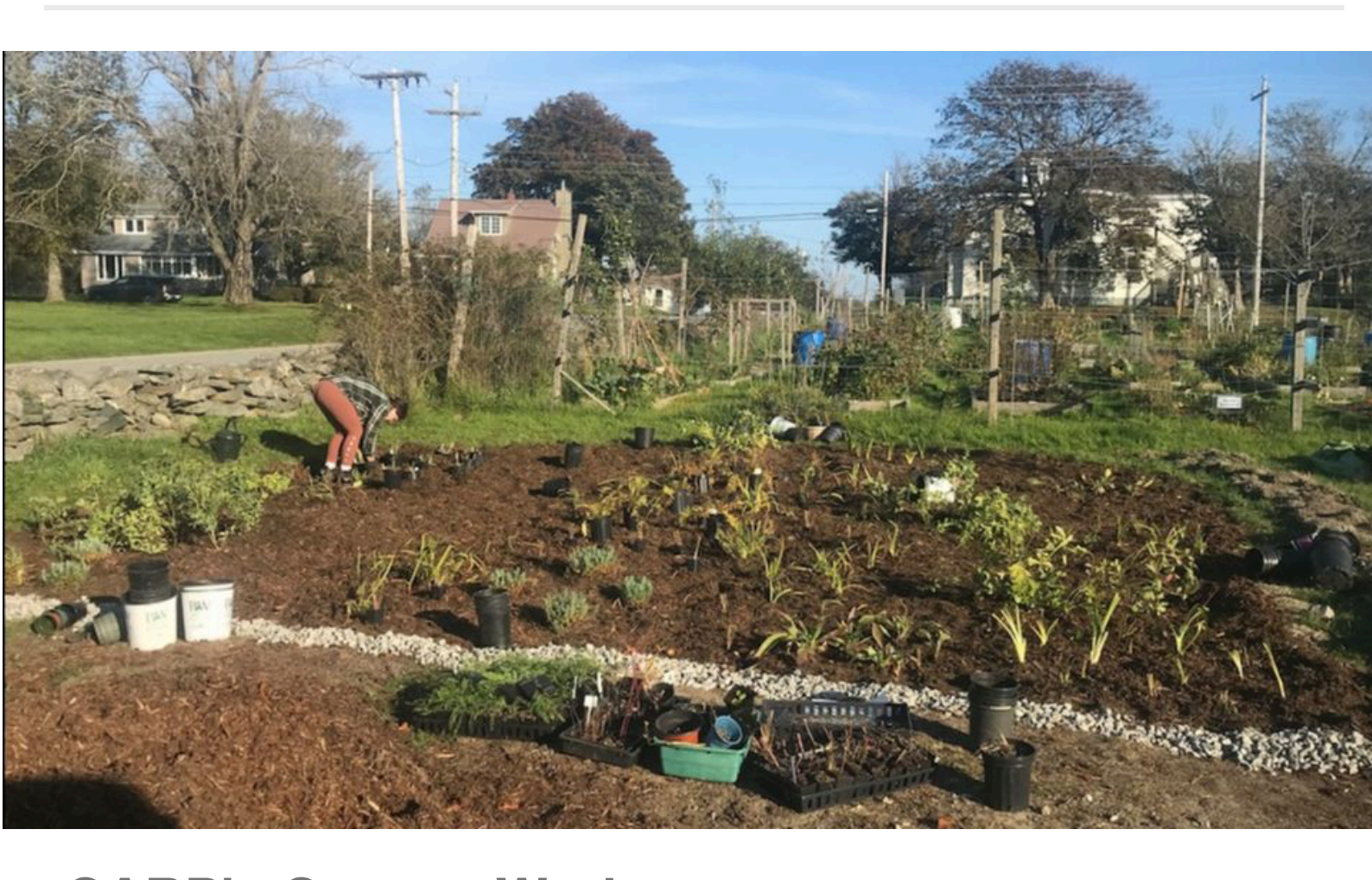
Wetlands recycle nutrients, filter certain pollutants, recharge groundwater, and provide habitat for fish and wildlife. They also reduce peak flows and flood damage, provide water storage, and mitigate erosion.

In addition to water quality and water quantity benefits, wetlands capture carbon. They are one of the most diverse and productive ecosystems in Canada.

Constructed or restored/preserved wetlands can also be combined with low-impact development to effectively manage stormwater in urban areas.

The wetland pictured above was restored through a CARP project spearheaded by Katie Mclean in the Town of Middleton.

Middleton Wetland Details!



CARP's Current Work in SWM:

In 2021, CARP secured funding through Environment and Climate Change Canada's **EcoAction Community Funding Program** to further conduct stormwater management work. We are currently partnered with the **Town of Digby** and **Beacon United** in Yarmouth to implement natural infrastructure, low impact development, and advise on sustainable stormwater management for future projects.

This fall we constructed two rain gardens behind the Digby General Hospital, each over 80 square meters and comprising of over **500 plants**. In addition, we consulted on future implementation of natural infrastructure to be incorporated into the park's design.

We also constructed a 50 square metre **rain garden** at Beacon United in Yarmouth, planting over **350 "water-loving" plants**, to improve drainage on site, as well as procured two 1000L cistern totes to improve collection and redirection of stormwater on the property. CARP is also **advising on future improvements** for the property and its ability to manage stormwater sustainably with the support of Snow Owl Consulting.

For both projects, we received support and generous donations from local businesses and members of the community.

Special thanks to Acadian Seaplants Ltd, Gini Proulx of the Clements Garden Club, David Trefry Excavating Ltd, and Keir Anthony Ltd.

Project Partner Update!

Our partners, Coastal Action, have also been hard at work this fall installing a rain garden in the Town of Bridgewater. This included **removing impermeable pavement** from a section of no longer used parking lot at a local community space. This location, the **Bridgewater Memorial Arena**, is where the community gathers for their weekly Farmer's Market.

Once the area was depaved and prepared with absorptive soils, Coastal Action then hosted a **TD Tree Days** event and welcomed **30 volunteers** to help plant approximately **250 native trees, shrubs, and herbaceous perennials!**

TD staff, members of local garden clubs, and community members all came together for a wonderful afternoon of improving stormwater management within the town. The finished installation is the second rain garden at this site and compliments another rain garden installed in 2022. These two natural infrastructure installations work together to **filter and absorb nearly 7,000 m³ of stormwater runoff every year!**

To check out Coastal Action's current initiatives and find out more about their upcoming projects, visit their website www.coastalaction.org, or follow them on Instagram and Facebook @coastalaction!

This project was undertaken with the financial support of:
Ce projet a été réalisé avec l'appui financier de :
Environment and Climate Change Canada / Environnement et Changement climatique Canada

Want to know more?

Home Resource Kit & Project Webpage