



**Impervious Cover Assessment
for
New Brunswick City, Middlesex County, New Jersey**

*Prepared for New Brunswick City by the
Rutgers Cooperative Extension Water Resources Program*

December 16, 2014

Introduction

Pervious and impervious are terms that are used to describe the ability or inability of water to flow through a surface. When rainfall hits a surface, it can soak into the surface or flow off the surface. Pervious surfaces are those which allow stormwater to readily soak into the soil and recharge groundwater. When rainfall drains from a surface, it is called "stormwater" runoff (Figure 1). An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the volume of stormwater runoff.



Figure 1: Stormwater draining from a parking lot

New Jersey has many problems due to stormwater runoff, including:

- **Pollution**: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired, with urban-related stormwater runoff listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants including animal waste, excess fertilizers, pesticides, and other toxic substances. These pollutants are then able to enter waterways.
- **Flooding**: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused also has increased greatly with this trend, costing billions of dollars over this time span.

- Erosion: Increased stormwater runoff causes an increase in the velocity of flows in our waterways. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

The primary cause of the pollution, flooding, and erosion problems is the quantity of impervious surfaces draining directly to local waterways. New Jersey is one of the most developed states in the country. Currently, the state has the highest percent of impervious cover in the country at 12.1% of its total area (Nowak & Greenfield, 2012). Many of these impervious surfaces are directly connected to local waterways (i.e., every drop of rain that lands on these impervious surfaces ends up in a local river, lake, or bay without any chance of being treated or soaking into the ground). To repair our waterways, reduce flooding, and stop erosion, stormwater runoff from impervious surfaces has to be better managed. Surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

Green infrastructure is an approach to stormwater management that is cost-effective, sustainable, and environmentally friendly. Green infrastructure projects capture, filter, absorb, and reuse stormwater to maintain or mimic natural systems and to treat runoff as a resource. As a general principal, green infrastructure practices use soil and vegetation to recycle stormwater runoff through infiltration and evapotranspiration. When used as components of a stormwater management system, green infrastructure practices such as bioretention, green roofs, porous pavement, rain gardens, and vegetated swales can produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies can simultaneously help filter air pollutants, reduce energy demands, mitigate urban heat islands, and sequester carbon while also providing communities with aesthetic and natural resource benefits (USEPA, 2013).

The first step to reducing the impacts from impervious surfaces is to conduct an impervious cover assessment. This assessment can be completed on different scales: individual lot, municipality, or watershed. Impervious surfaces need to be identified for stormwater management. Once impervious surfaces have been identified, there are three steps to better manage these surfaces.

1. ***Eliminate surfaces that are not necessary.*** For example, a paved courtyard at a public school could be converted to a grassed area.
2. ***Reduce or convert impervious surfaces.*** There may be surfaces that are required to be hardened, such as roadways or parking lots, but could be made smaller and still be functional. A parking lot that has two-way car ways could be converted to one-way car ways. There also are permeable paving materials such as porous asphalt, pervious concrete, or permeable paving stones that could be substituted for impermeable paving materials (Figure 2).
3. ***Disconnect impervious surfaces from flowing directly to local waterways.*** There are many ways to capture, treat, and infiltrate stormwater runoff from impervious surfaces. Opportunities may exist to reuse this captured water.



Figure 2: Rapid infiltration of water through porous pavement is demonstrated at the USEPA Edison New Jersey test site

New Brunswick City Impervious Cover Analysis

Located in Middlesex County in central New Jersey, New Brunswick City covers approximately 5.8 square miles east of Franklin. Figures 3 and 4 illustrate that New Brunswick City is dominated by urban land uses. A total of 76.8% of the municipality's land use is classified as urban. Of the urban land in New Brunswick City, high density residential is the dominant land use (Figure 5).

The literature suggests a link between impervious cover and stream ecosystem impairment starting at approximately 10% impervious surface cover (Schueler, 1994; Arnold and Gibbons, 1996; May et al., 1997). Impervious cover may be linked to the quality of lakes, reservoirs, estuaries, and aquifers (Caraco et al., 1998), and the amount of impervious cover in a watershed can be used to project the current and future quality of streams. Based on the scientific literature, Caraco et al. (1998) classified urbanizing streams into the following three categories: sensitive streams, impacted streams, and non-supporting streams. Sensitive streams typically have a watershed impervious surface cover from 0 – 10%. Impacted streams have a watershed impervious cover ranging from 11-25% and typically show clear signs of degradation from urbanization. Non-supporting streams have a watershed impervious cover of greater than 25%; at this high level of impervious cover, streams are simply conduits for stormwater flow and no longer support a diverse stream community.

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes New Brunswick City into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for New Brunswick City. Based upon the 2007 NJDEP land use/land cover data, approximately 49.1% of New Brunswick City has impervious cover. This level of impervious cover suggests that the streams in New Brunswick City are likely non-supporting streams.

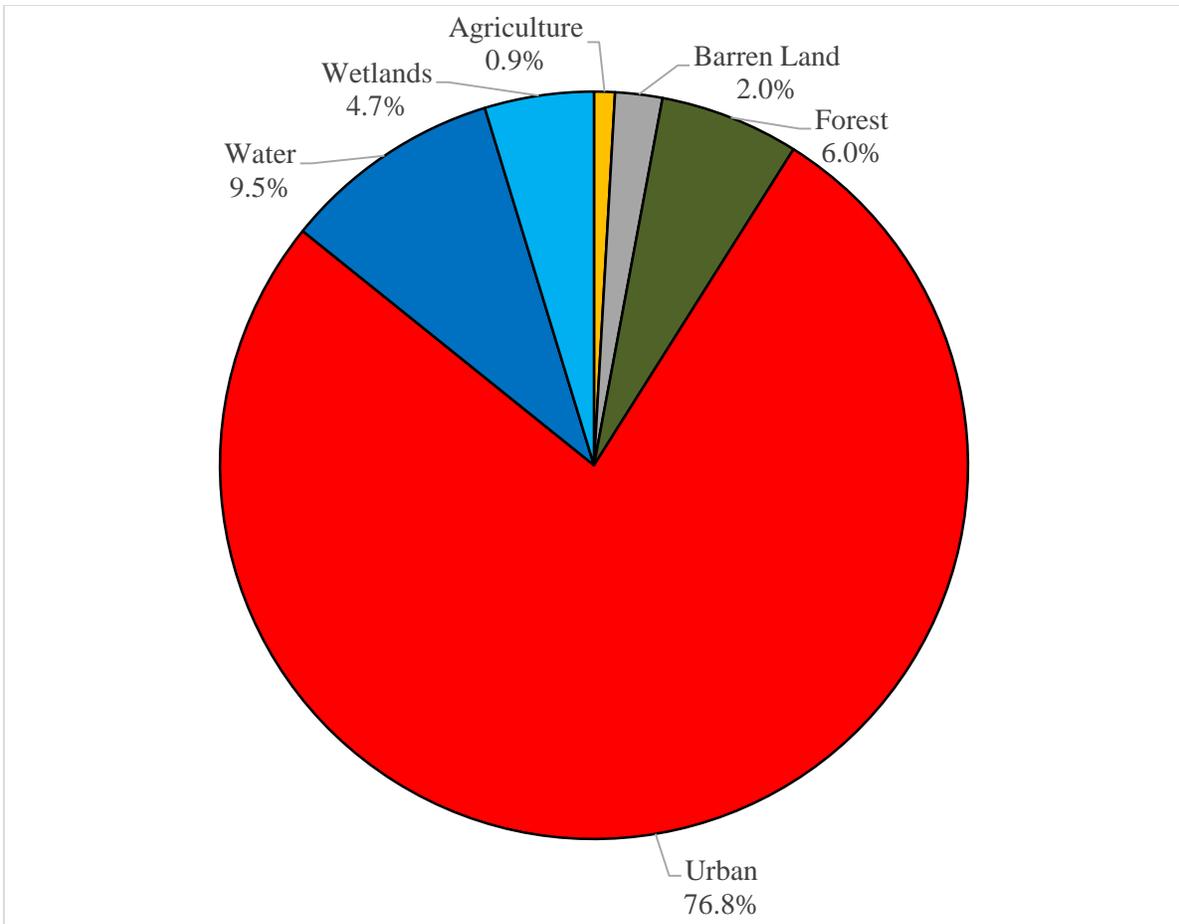


Figure 3: Pie chart illustrating the land use in New Brunswick City

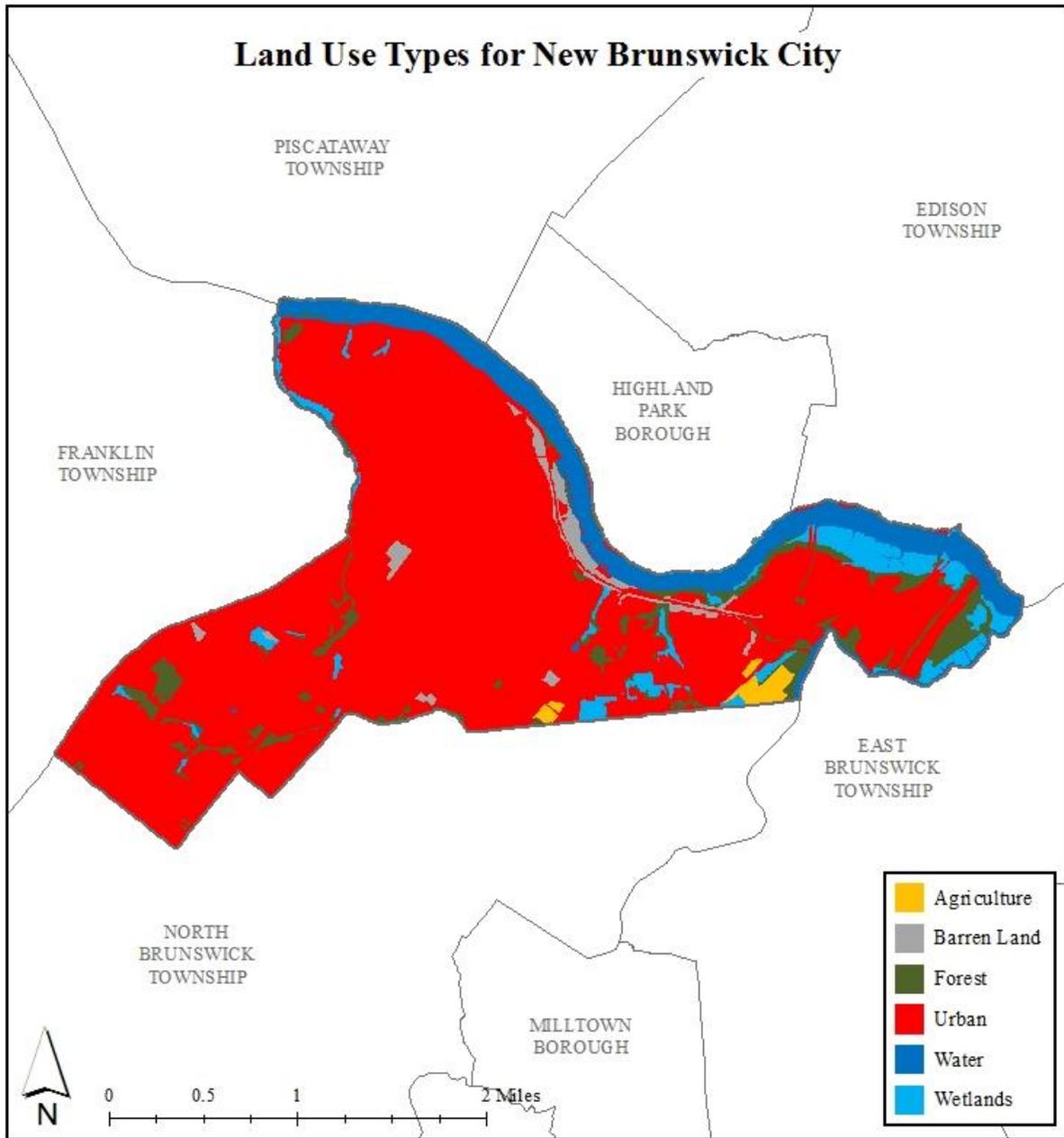


Figure 4: Map illustrating the land use in New Brunswick

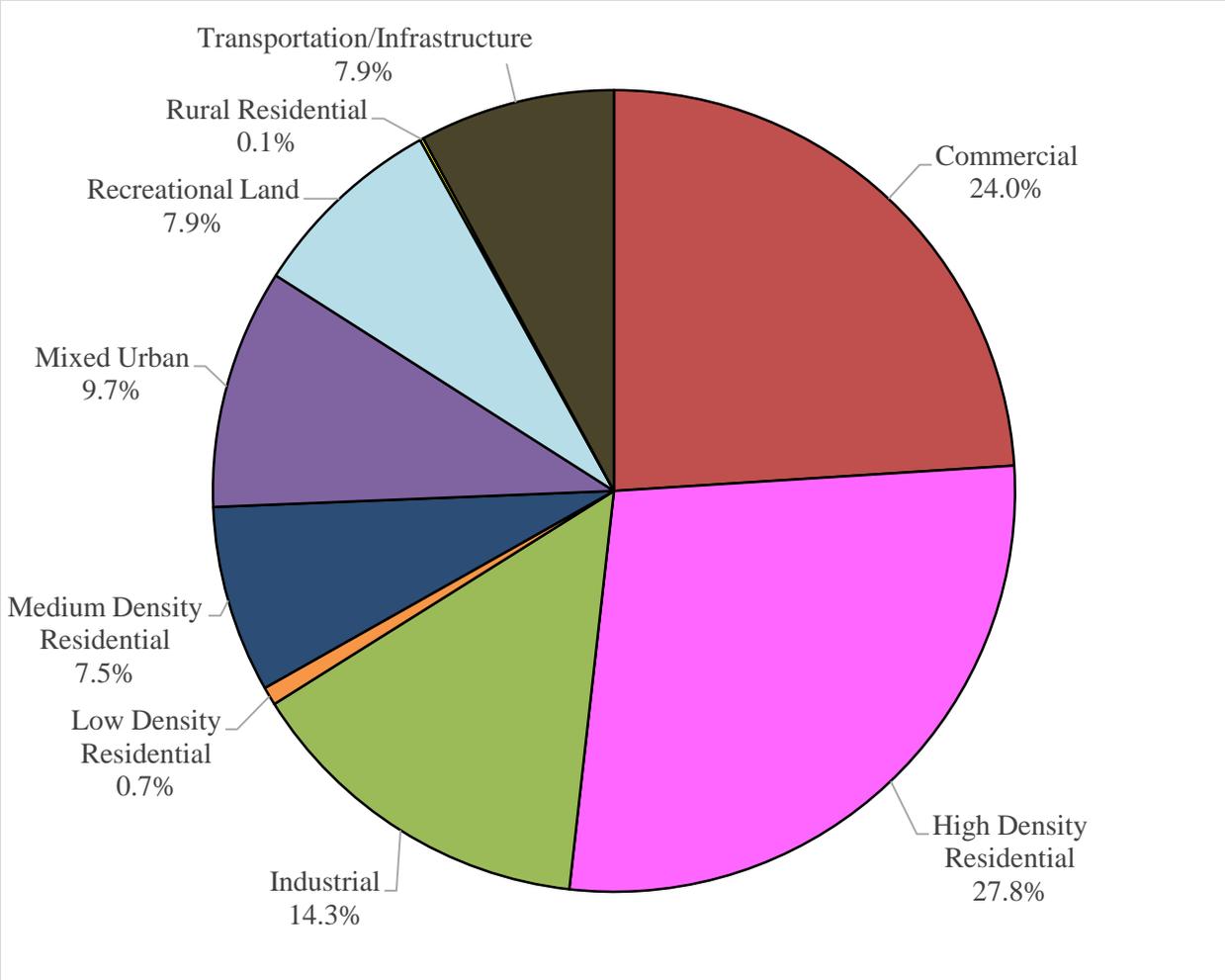


Figure 5: Pie chart illustrating the various types of urban land use in New Brunswick

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within New Brunswick (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 33.6% in the Lawrence Brook subwatershed to 54.4% in the Mile Run subwatershed. Evaluating impervious cover on a subwatershed basis allows the municipality to focus impervious cover reduction or disconnection efforts in the subwatersheds where frequent flooding occurs.

In developed landscapes, stormwater runoff from parking lots, driveways, sidewalks, and rooftops flows to drainage pipes that feed the sewer system. The cumulative effect of these impervious surfaces and thousands of connected downspouts reduces the amount of water that can infiltrate into soils and greatly increases the volume and rate of runoff that flows to waterways. Stormwater runoff volumes (specific to New Brunswick City, Middlesex County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.3 inches of rain), the 10-year design storm (5.1 inches of rain), and the 100-year design storm (8.6 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in New Brunswick City. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Mile Run Watershed was harvested and purified, it could supply water to 253 homes for one year¹.

¹ Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for New Brunswick

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(%)
Lawrence Brook	482.7	0.75	468.3	0.73	14.4	0.02	157.4	0.25	33.6%
Mile Run	1,503.6	2.35	1,499.5	2.34	4.10	0.01	815.3	1.27	54.4%
Lower Raritan River	1,699.9	2.66	1,368.2	2.14	331.6	0.52	675.5	1.06	49.4%
Total	3,686.2	5.76	3,336.1	5.21	350.2	0.55	1,648.2	2.58	49.4%

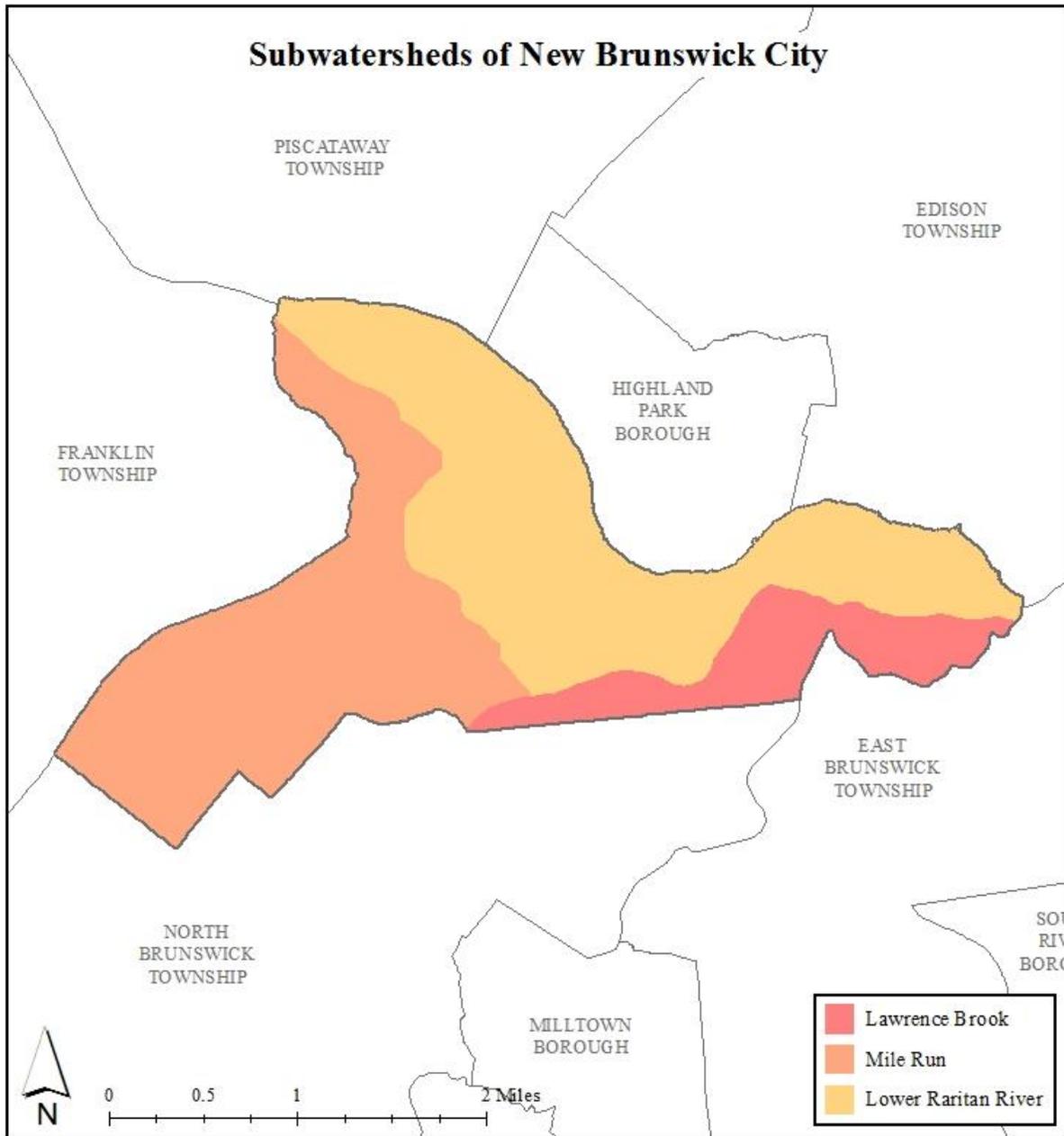


Figure 6: Map of the subwatersheds in New Brunswick

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in New Brunswick City

Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)	Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)	Total Runoff Volume for the 2-Year Design Storm (3.3") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.1") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.6") (MGal)
Lawrence Brook	5.3	188.0	14.1	21.8	36.8
Mile Run	27.7	974.0	73.1	112.9	190.4
Lower Raritan River	22.9	807.0	60.5	93.5	157.7
Total	55.9	1,969.1	147.7	228.2	384.9

The next step is to set a reduction goal for impervious area in each subwatershed. Based upon the Rutgers Cooperative Extension (RCE) Water Resources Program's experience, a 10% reduction would be a reasonably achievable reduction for these subwatersheds in New Brunswick City. While it may be difficult to eliminate paved areas or replace paved areas with permeable pavement, it is relatively easy to identify impervious surfaces that can be disconnected using green infrastructure practices. For all practical purposes, disconnecting an impervious surface from a storm sewer system or a water body is an "impervious area reduction." The RCE Water Resources Program recommends that all green infrastructure practices that are installed to disconnect impervious surfaces should be designed for the 2-year design storm (3.3 inches of rain over 24-hours). Although this results in management practices that are slightly over-designed by NJDEP standards, which require systems to be designed for the New Jersey water quality storm (1.25 inches of rain over 2-hours), these systems will be able to handle the increase in storm intensities that are expected to occur due to climate change. By designing these management practices for the 2-year design storm, these practices will be able to manage 95% of the annual rainfall volume. The recommended annual reductions in runoff volumes are shown in Table 3.

As previously mentioned, once impervious surfaces have been identified, the next steps for managing impervious surfaces are to 1) eliminate surfaces that are not necessary, 2) reduce or convert impervious surfaces to pervious surfaces, and 3) disconnect impervious surfaces from flowing directly to local waterways.

Elimination of Impervious Surfaces

One method to reduce impervious cover is to "depave." Depaving is the act of removing paved impervious surfaces and replacing them with pervious soil and vegetation that will allow for the infiltration of rainwater. Depaving leads to the re-creation of natural space that will help reduce flooding, increase wildlife habitat, and positively enhance water quality as well as beautify neighborhoods. Depaving also can bring communities together around a shared vision to work together to reconnect their neighborhood to the natural environment.

Table 3: Impervious cover reductions by subwatershed in New Brunswick City

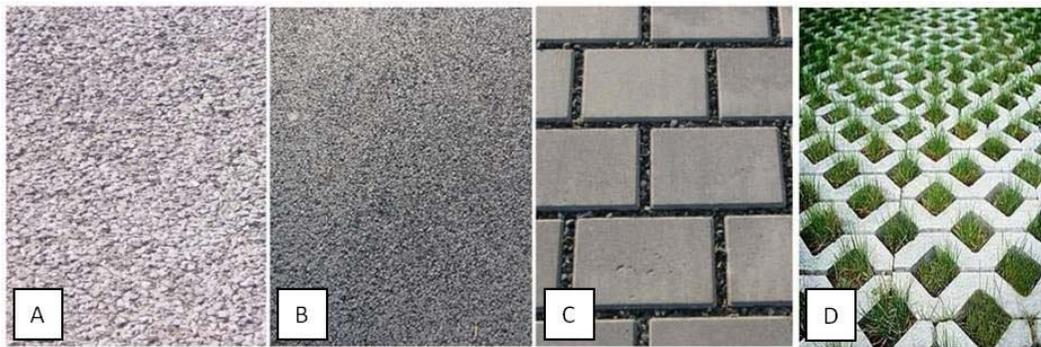
Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction ² (MGal)
Lawrence Brook	15.7	17.9
Mile Run	81.5	92.5
Lower Raritan River	67.6	76.7
Total	164.8	187.1

² Annual Runoff Volume Reduction =
 Acres of impervious cover x 43,560 ft²/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft³) x (1 MGal/1,000,000 gal)
 All green infrastructure should be designed to capture the first 3.3 inches of rain from each storm. This would allow the green infrastructure to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

There are four different types of permeable pavement systems that are commonly being used throughout the country to reduce the environmental impacts from impervious surfaces. These surfaces include pervious concrete, porous asphalt, interlocking concrete pavers, and grid pavers.

“Permeable pavement is a stormwater drainage system that allows rainwater and runoff to move through the pavement’s surface to a storage layer below, with the water eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce stormwater volume, treat stormwater water quality, replenish the groundwater supply, and lower air temperatures on hot days (Rowe, 2012).”



Permeable surfaces: (A) pervious concrete, (B) porous asphalt, (C) interlocking concrete pavers, (D) grid pavers (Rowe, 2012)

Pervious concrete and porous asphalt are the most common of the permeable surfaces. They are similar to regular concrete and asphalt but without the fine materials. This allows water to quickly pass through the material into an underlying layered system of stone that holds the water allowing it to infiltrate into the underlying uncompacted soil.

Impervious Cover Disconnection Practices

By redirecting runoff from paving and rooftops to pervious areas in the landscape, the amount of directly connected impervious area in a drainage area can be greatly reduced. There are many cost-effective ways to disconnect impervious surfaces from local waterways.

- **Simple Disconnection**: This is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Instead of piping rooftop runoff to the street where it enters the catch basin and is piped to the river, the rooftop runoff is released onto a grassed

area to allow the water to be filtered by the grass and soak into the ground. A healthy lawn typically can absorb the first one to two inches of stormwater runoff from a rooftop. Simple disconnection also can be used to manage stormwater runoff from paved areas. Designing a parking lot or driveway to drain onto a grassed area, instead of the street, can dramatically reduce pollution and runoff volumes.

- Rain Gardens: Stormwater can be diverted into shallow landscaped depressed areas (i.e., rain gardens) where the vegetation filters the water, and it is allowed to soak into the ground. Rain gardens, also known as bioretention systems, come in all shapes and sizes and can be designed to disconnect a variety of impervious surfaces (Figure 7).



Figure 7: Rain garden outside the RCE of Gloucester County office which was designed to disconnect rooftop runoff from the local storm sewer system

- Rainwater Harvesting: Rainwater harvesting includes the use of rain barrels and cisterns (Figures 8a and 8b). These can be placed below downspouts to collect rooftop runoff. The collected water has a variety of uses including watering plants and washing cars. This practice also helps cut down on the use of potable water for nondrinking purposes. It is important to divert the overflow from the rainwater harvesting system to a pervious area.



Figure 8a: Rain barrel used to disconnect a downspout with the overflow going to a flower bed



Figure 8b: A 5,000 gallon cistern used to disconnect the rooftop of the Department of Public Works in Clark Township to harvest rainwater for nonprofit car wash events

Examples of Opportunities in New Brunswick City

To address the impact of stormwater runoff from impervious surfaces, the next step is to identify opportunities in the municipality for eliminating, reducing, or disconnecting directly connected impervious surfaces. To accomplish this task, an impervious cover reduction action plan should be prepared. Aerial photographs are used to identify sites with impervious surfaces in the municipality that may be suitable for inclusion in the action plan. After sites are identified, site visits are conducted to photo-document all opportunities and evaluate the feasibility of eliminating, reducing or disconnecting directly connected impervious surfaces. A brief description of each site discussing the existing conditions and recommendations for treatment of the impervious surfaces is developed. After a number of sites have been selected for inclusion in the action plan, concept plans and detailed green infrastructure information sheets are prepared for a selection of representative sites.

For New Brunswick City, three sites have been included in this assessment. Examples of concept plans and detailed green infrastructure information sheets are provided in Appendix A. The detailed green infrastructure information sheets describe existing conditions and issues, proposed solutions, anticipated benefits, possible funding sources, potential partners and stakeholders, and estimated costs. Additionally, each project has been classified as a mitigation opportunity for recharge potential, total suspended solids removal, and stormwater peak reduction. Finally, these detailed green infrastructure information sheets provide an estimate of gallons of stormwater captured and treated per year by each proposed green infrastructure practice. The concept plans provide an aerial photograph of the site and details of the proposed green infrastructure practices.

Conclusions

New Brunswick City can reduce flooding and improve its waterways by better managing stormwater runoff from impervious surfaces. This impervious cover assessment is the first step toward better managing stormwater runoff. The next step is to develop an action plan to eliminate, reduce, or disconnect impervious surfaces where possible and practical. Many of the highly effective disconnection practices are inexpensive. The entire community can be engaged in implementing these disconnection practices.

References

Arnold, C.L. Jr. and C.J. Gibbons. 1996. Impervious Surface Coverage The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association* 62(2): 243-258.

Caraco, D., R. Claytor, P. Hinkle, H. Kwon, T. Schueler, C. Swann, S. Vysotsky, and J. Zielinski. 1998. Rapid Watershed Planning Handbook. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared by Center For Watershed Protection, Ellicott City, MD. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V. October 1998.

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.G. Welch. 1997. Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. *Watershed Protection Techniques* 2(4): 483-493.

Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30.
http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf

Rowe, A., 2012. Green Infrastructure Practices: An Introduction to Permeable Pavement. Rutgers NJAES Cooperative Extension, FS1177, pp. 4.
<http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1177>

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques*1(3): 100-111.

United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.
http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

Appendix A

Examples of Impervious Cover Reduction Action Plan Projects Concept Plans and Detailed Green Infrastructure Information Sheets

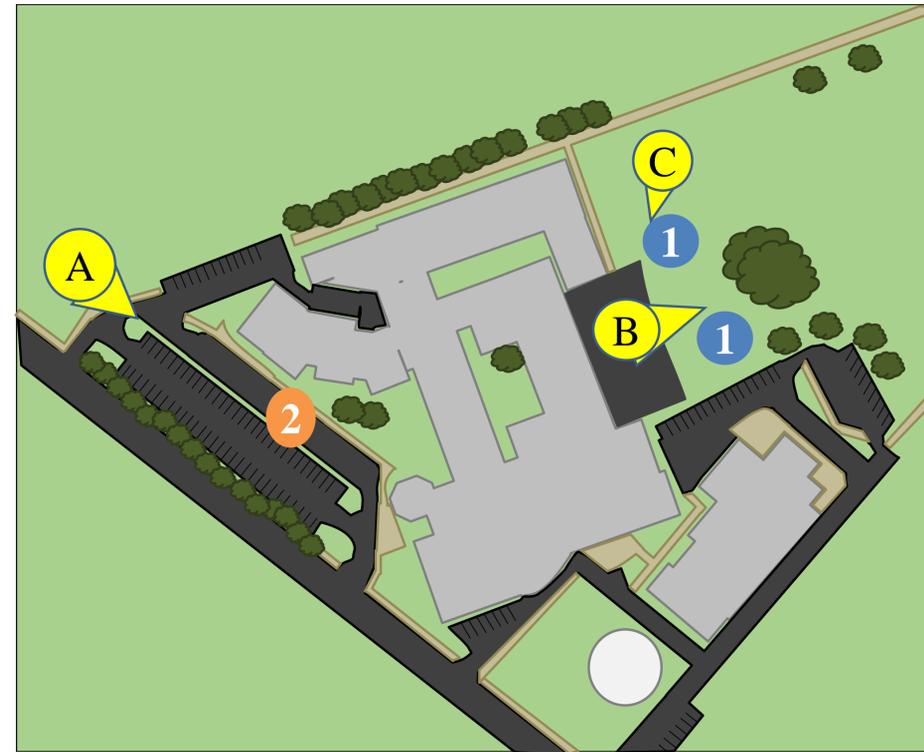
New Brunswick City Impervious Cover Assessment

McKinley Community School, 15 Van Dyke Avenue

PROJECT LOCATION:



SITE PLAN:



- 1 BIORETENTION SYSTEM:** Bioretention systems should be installed at the rear of the building to capture runoff from the nearby pavement. This will reduce runoff by allowing stormwater to infiltrate naturally and decrease the amount of polluted runoff that goes to the local waterways.
- 2 TREE BOXES:** Tree boxes can be installed in the parking strips to catch the first flush of stormwater and treat the stormwater prior to discharge to the storm sewer system.
- 3 EDUCATIONAL PROGRAM:** The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* can be delivered at the McKinley Community School to educate the community's students about stormwater management and to engage them in designing and building the bioretention systems.

A



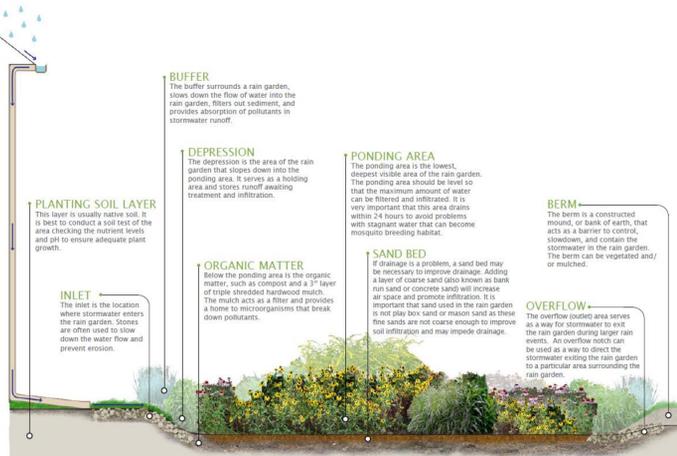
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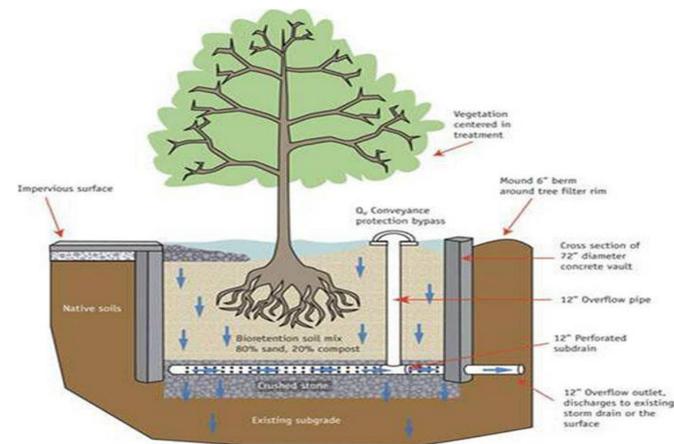
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1 BIORETENTION SYSTEM



2 TREE BOX



3 EDUCATIONAL PROGRAM



McKinley Community School
Green Infrastructure Information Sheet

<p>Location: 15 Van Dyke Avenue New Brunswick, NJ 08901</p>	<p>Municipality: New Brunswick City Subwatershed: Mile Run</p>
<p>Green Infrastructure Description: storm water tree islands with curb cuts bioretention system (rain garden)</p>	<p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Stormwater Captured and Treated Per Year: stormwater tree islands: 648,595 gal. bioretention systems: 260,500 gal.</p>
<p>Existing Conditions and Issues: This site is located on Van Dyke Avenue and focuses on the front parking lot and grassy area behind the school. At the front parking lot there are several grass islands along the lot. At the back of the building, there is a large paved area adjacent to a large grassy area.</p>	
<p>Proposed Solution(s): At the front parking lot, the grass islands could be converted into stormwater tree islands with storm water planters and curb cuts added to allow them to absorb stormwater before entering the nearby storm drains. At the rear of the building, two bioretention systems could be installed to capture runoff from the large paved area.</p>	
<p>Anticipated Benefits: A bioretention system is estimated to achieve a 30% removal rate for TN and a 60% removal rate for TP (NJDEP BMP Manual). TSS loadings may be reduced by up to 80%. If these bioretention systems are designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), these systems will prevent approximately 95% of the TN, TP and TSS from flowing directly into local waterways. A bioretention system would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to the local residents, employees, and students of McKinley Community School. Rutgers Cooperative Extension could additionally present the <i>Stormwater Management in Your Schoolyard</i> program to students and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for New Brunswick's Department of Public Works staff to launch educational programming. Curb cuts allow stormwater runoff to flow into the vegetated areas and bioretention systems rather than flow into catch basins.</p>	
<p>Possible Funding Sources: mitigation funds from local developers NJDEP grant programs</p>	
<p>Partners/Stakeholders: New Brunswick City McKinley Community School Rutgers Cooperative Extension</p>	

McKinley Community School
Green Infrastructure Information Sheet

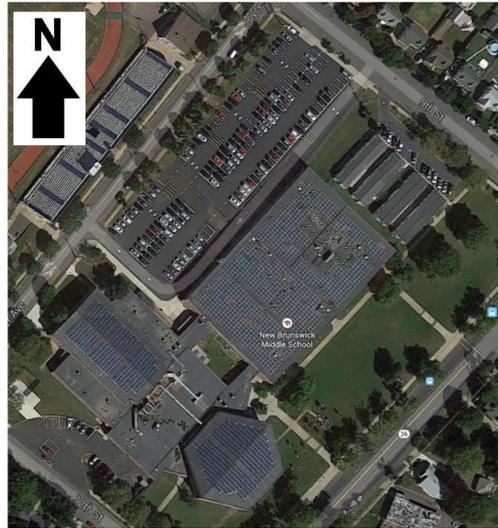
Estimated Cost:

There is 5,800 ft² available for the implementation of stormwater planters. At \$25/ft², the estimated total cost of the tree island planters is \$145,000. The bioretention systems in the rear of the building require 2,500 ft² to treat the runoff from the paved area. At \$5/ft², the estimated cost for the system is \$12,500. The total estimated cost for the project is \$157,500.

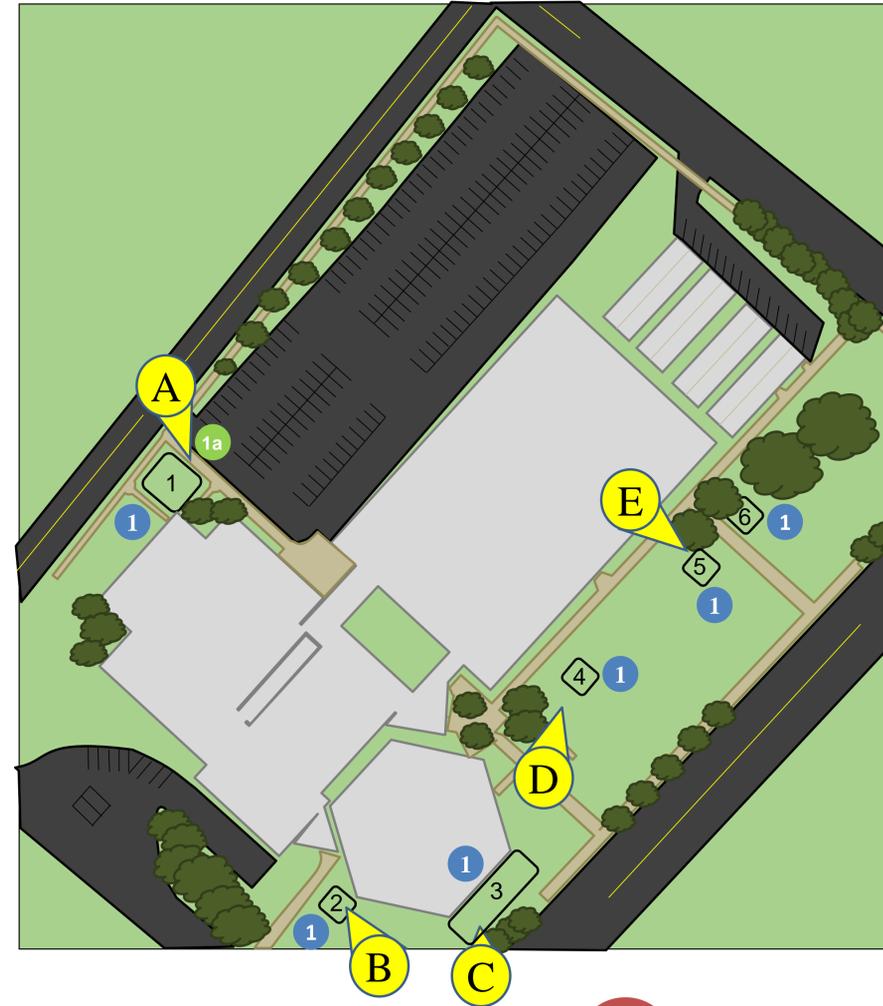
New Brunswick City Impervious Cover Assessment

New Brunswick Middle School, 1125 Livingston Avenue

PROJECT LOCATION:



SITE PLAN:



1 BIORETENTION SYSTEM: In the rear of the building, trench drains will carry stormwater into a bioretention system or rain garden from the parking lot. There are four additional areas around the school where rain gardens would be effective. These rain gardens will capture, treat, and infiltrate parking lot runoff and runoff from the grass area in front of the school. The existing catch basins will handle any overflow from the gardens. The rain gardens will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping to the school grounds. The gardens will also provide habitat for birds, butterflies, and pollinators.

1a TRENCH DRAIN: Trench drains would allow the parking lot runoff to drain into bioretention system #1.

2 EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Schoolyard* can be delivered at the McKinley Community School to educate the community's students about stormwater management and to engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEM



1a TRENCH DRAIN



2 EDUCATIONAL PROGRAM



New Brunswick Middle School
Green Infrastructure Information Sheet

<p>Location: 1125 Livingston Avenue New Brunswick, NJ 08901</p>	<p>Municipality: New Brunswick City</p>
<p>Green Infrastructure Description: bioretention systems (rain gardens) trench drains</p>	<p>Subwatershed: Mile Run</p> <p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes total suspended solids removal potential: yes</p>	<p>Stormwater Captured and Treated Per Year: bioretention systems #1: 202,528 gal. bioretention systems #2: 38,849 gal. bioretention systems #3: 207,453 gal. bioretention systems #4: 144,529 gal. bioretention systems #5: 137,312 gal. bioretention systems #6: 90,777 gal.</p>
<p>Existing Conditions and Issues: This site includes the area between Livingston and Joyce Kilmer Avenues and 9th and 12th Streets. At the building's southwest corner there is a connected downspout with a nearby grassy area. At the corner just northeast of here, there is another connected downspout with a nearby grassy area. At the south end of the parking lot near the previous area, there is some cracking and sedimentation. Near the far south, southwest face, there is a large grassy area with a storm drain. At the far south southeast face, there are three connected downspouts near a large grassy area. Along the southwest face to the right of the main entrance, there are three grassy areas with storm drains.</p>	
<p>Proposed Solution(s): At the locations with connected downspouts, these downspouts could be disconnected, and bioretention systems could be constructed to absorb the stormwater. At the locations with storm drains, bioretention systems could be constructed, and the storm drains could serve as an overflow. In the parking lot area, either a strip of porous asphalt or curb cuts with stormwater planters could be implemented to ameliorate the cracking problems and absorb runoff from the parking lot.</p>	
<p>Anticipated Benefits: A bioretention system is estimated to achieve a 30% removal rate for TN and a 60% removal rate for TP (NJDEP BMP Manual). TSS loadings may be reduced by up to 80%. If these bioretention systems are designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), these systems will prevent approximately 95% of the TN, TP and TSS from flowing directly into local waterways. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal to the local residents, employees, and students of New Brunswick Middle School. Rutgers Cooperative Extension could additionally present the <i>Stormwater Management in Your Schoolyard</i> program to students and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for New Brunswick's Department of Public Works staff to launch educational programming. Trench drains allow stormwater runoff to flow into the vegetated areas and bioretention systems rather than flow directly into catch basins.</p>	
<p>Possible Funding Sources: mitigation funds from local developers</p>	

New Brunswick Middle School
Green Infrastructure Information Sheet

NJDEP grant programs

Partners/Stakeholders:

New Brunswick City

New Brunswick Middle School

Rutgers Cooperative Extension

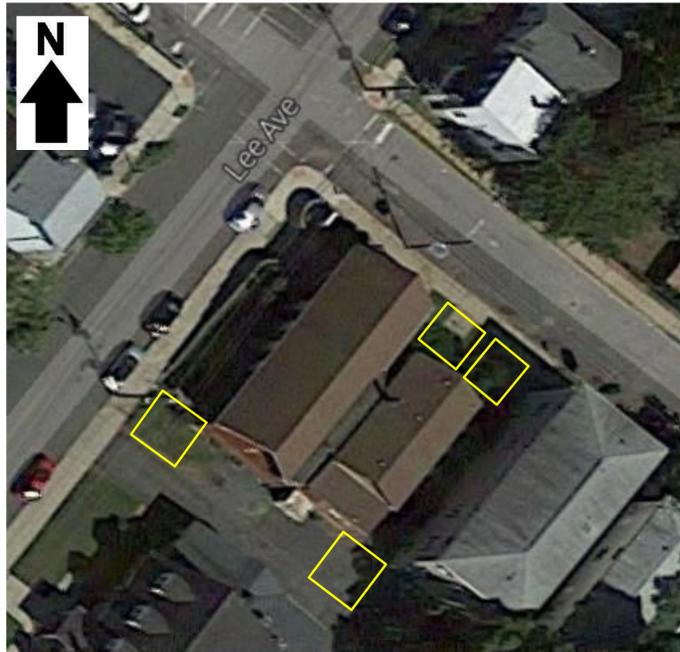
Estimated Cost:

Rain gardens 1, 2, 3, 4, 5 and 6 are 1,950 ft², 380 ft², 2,000 ft², 1,400 ft², 1,350 ft², and 900 ft², respectively. At \$5/ft², the estimated cost of the rain gardens are \$9,750, \$1,900, \$10,000, \$7,000, \$6,750, and \$4,500, respectively. The total estimated cost of the proposed project is \$39,900.

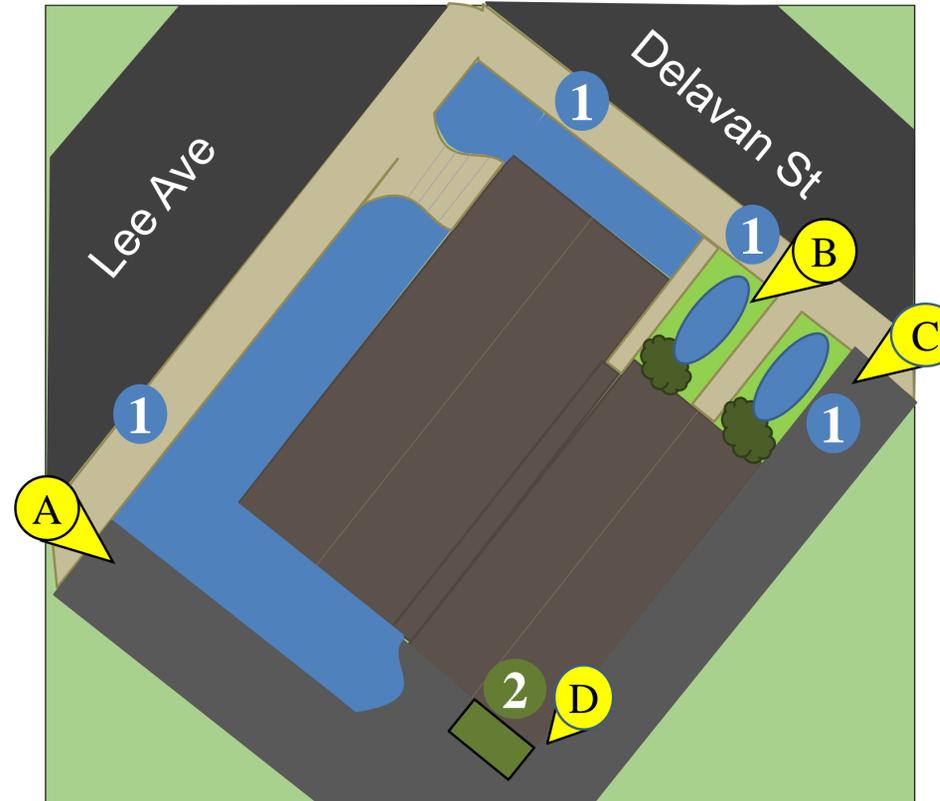
New Brunswick City Impervious Cover Assessment

Saint Alban's Episcopal Church, 131 Lee Avenue

PROJECT LOCATION:



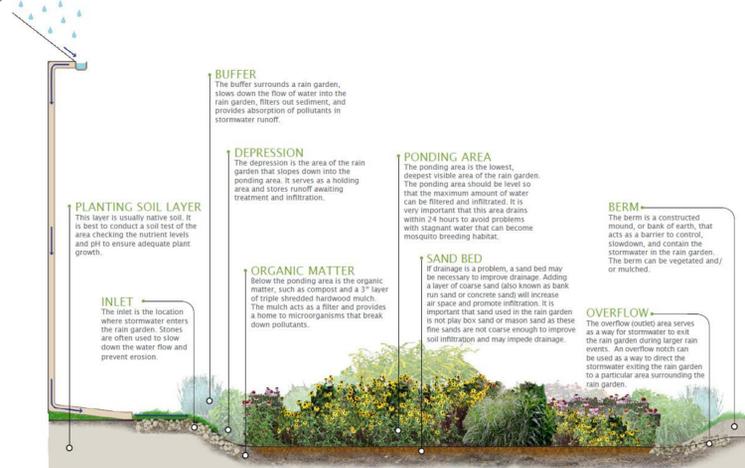
SITE PLAN:



1 BIORETENTION SYSTEM: Bioretention systems should be installed in the large lawn on the northeast side of the parking lot, in the grass near the southwest side of the parking lot, and near the back of the building where existing downspouts can be disconnected. Bioretention systems will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach catch basins.

2 PLANTER BOX: A planter box should be installed at the southeast corner of the building to collect water from the nearby downspout. Planter boxes reduce runoff and allow water to slowly infiltrate while being treated for pollutants.

1 BIORETENTION SYSTEM



2 PLANTER BOX



Saint Alban's Episcopal Church
Green Infrastructure Information Sheet

<p>Location: 131 Lee Avenue New Brunswick NJ 08901</p>	<p>Municipality: New Brunswick City</p>
<p>Green Infrastructure Description: bioretention systems (rain gardens) planter box disconnecting downspouts</p>	<p>Subwatershed: Raritan River</p> <p>Targeted Pollutants: Total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Stormwater Captured and Treated Per Year: bioretention systems: northeast rain gardens (1) & (2): 6,514 + 16,154 = 22,668 gal. southwest rain garden (3): 18,551 gal. planter box: 7,331 gal. disconnecting downspouts: 7,850 gal.</p>
<p>Existing Conditions and Issues: This site is located right on the corner of Lee Avenue and Delevan Street. At the building's northwest corner, there is a connected downspout near an existing garden. Near the northeast corner, there are two grassy areas. The one to the right when facing the building has nearby connected downspouts. The one to the left has erosion near the paved adjacent area with a nearby downspout. At the southwest corner, there is a downspout. Near the southwest corner, there is a grassy area with nearby downspouts.</p>	
<p>Proposed Solution(s): At the northwest corner, the connected downspout could be disconnected to flow into the garden with possible permeable pavers or rocks to aid infiltration. Near the northeast corner, both areas could have nearby connected downspouts disconnected and bioretention systems built in the grassy areas to aid in absorbing the stormwater from the downspouts as well as reduce some erosion. At the southeast corner, the downspout could be allowed to flow into an installed planter box. At the southwest corner, a bioretention system could be constructed with nearby connected downspouts disconnected to flow into the system.</p>	
<p>Anticipated Benefits: A bioretention system is estimated to achieve a 30% removal rate for TN and a 60% removal rate for TP (NJDEP BMP Manual). TSS loadings may be reduced by up to 80%. If these bioretention systems are designed to capture and infiltrate stormwater runoff from the 2-year design storm (3.3 inches of rain over 24 hours), these systems will prevent approximately 95% of the TN, TP and TSS from flowing directly into local waterways. A bioretention system would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to the local residents and members of the congregation of Saint Alban's Episcopal Church. The disconnected downspout will allow water to penetrate into the ground naturally, promoting groundwater recharge, rather than being sent straight into the stormwater management system.</p>	

Saint Alban's Episcopal Church
Green Infrastructure Information Sheet

Possible Funding Sources:

mitigation funds from local developers
NJDEP grant programs

Partners/Stakeholders:

New Brunswick City
Saint Alban's Episcopal Church
Rutgers Cooperative Extension

Estimated Cost:

Rain garden 1, 2 and 3 require 65 ft², 155 ft², and 180 ft², respectively to accommodate their respective drainage areas. At \$5/ft² the estimated cost of the rain gardens are \$325, \$775, and \$900, respectively. Simple disconnection has an associated cost estimate of \$250 for the property. The planter box proposed has an estimated cost of \$300 for purchase and installation. The total estimated cost for this project is \$2,550.