RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
Edison Township, Middlesex County, New Jersey

Prepared for Edison Township by the
Rutgers Cooperative Extension Water Resources Program

February 1, 2015

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

Edison Township Impervious Cover Analysis

Located in Middlesex County in central New Jersey, Edison Township covers approximately 30.6 square miles west of Woodbridge. Figures 3 and 4 illustrate that Edison Township is dominated by urban land uses. A total of 72.9% of the municipality's land use is classified as urban. Of the urban land in Edison Township, medium 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 steams 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 Edison Township 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 Edison Township. Based upon the 2007 NJDEP land use/land cover data, approximately 36.2% of Edison Township has impervious cover. This level of impervious cover suggests that the streams in Edison Township are likely non-supporting streams.

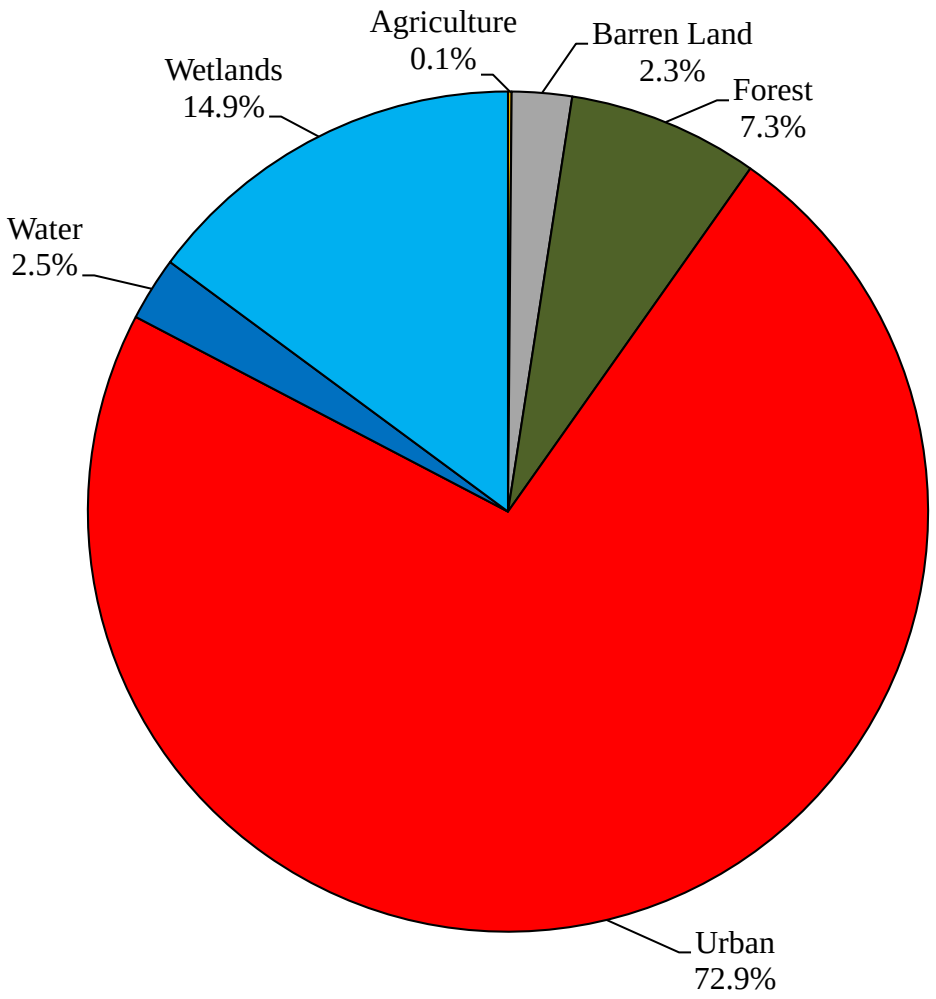


Figure 3: Pie chart illustrating the land use in Edison Township

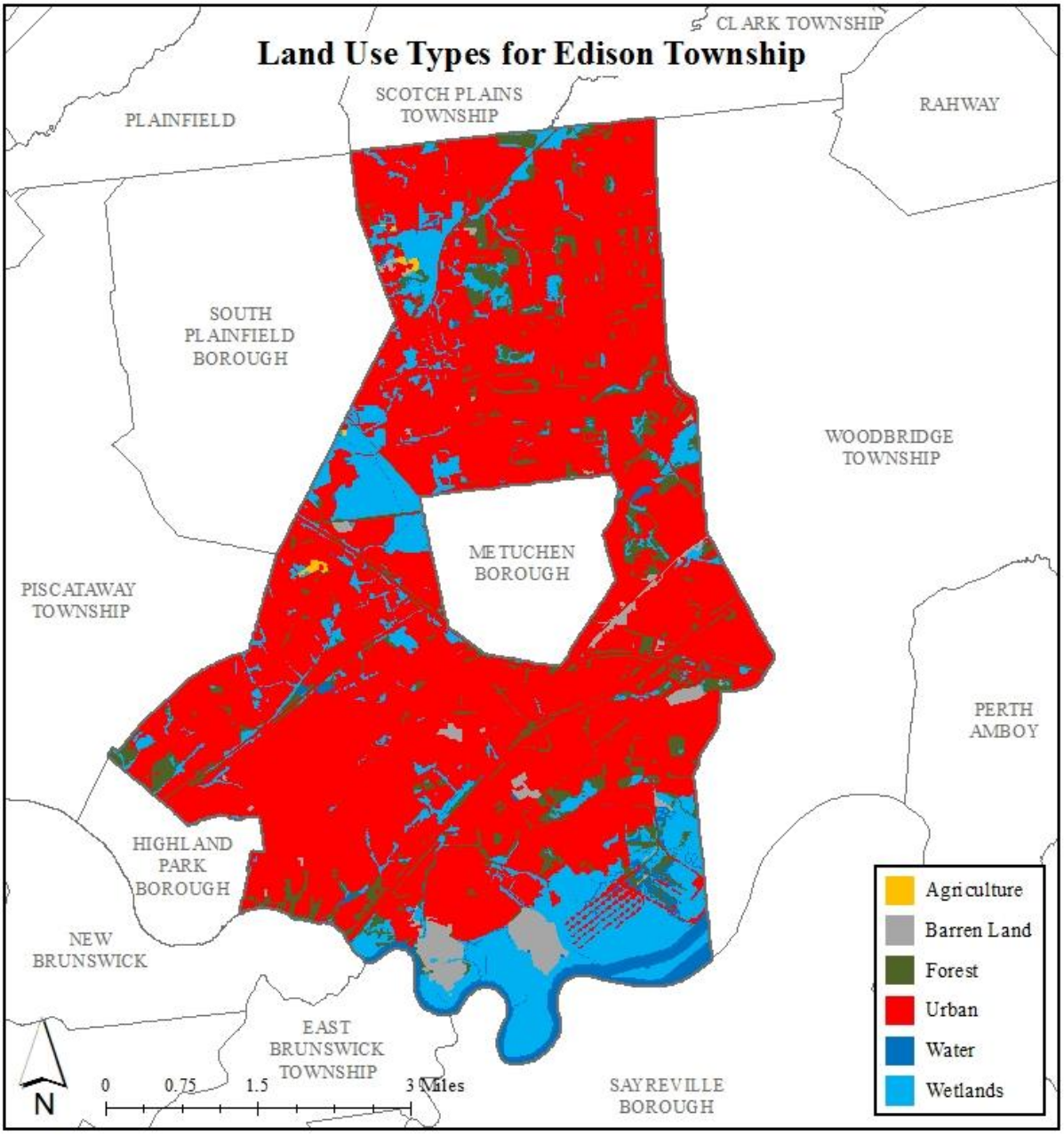


Figure 4: Map illustrating the land use in Edison Township

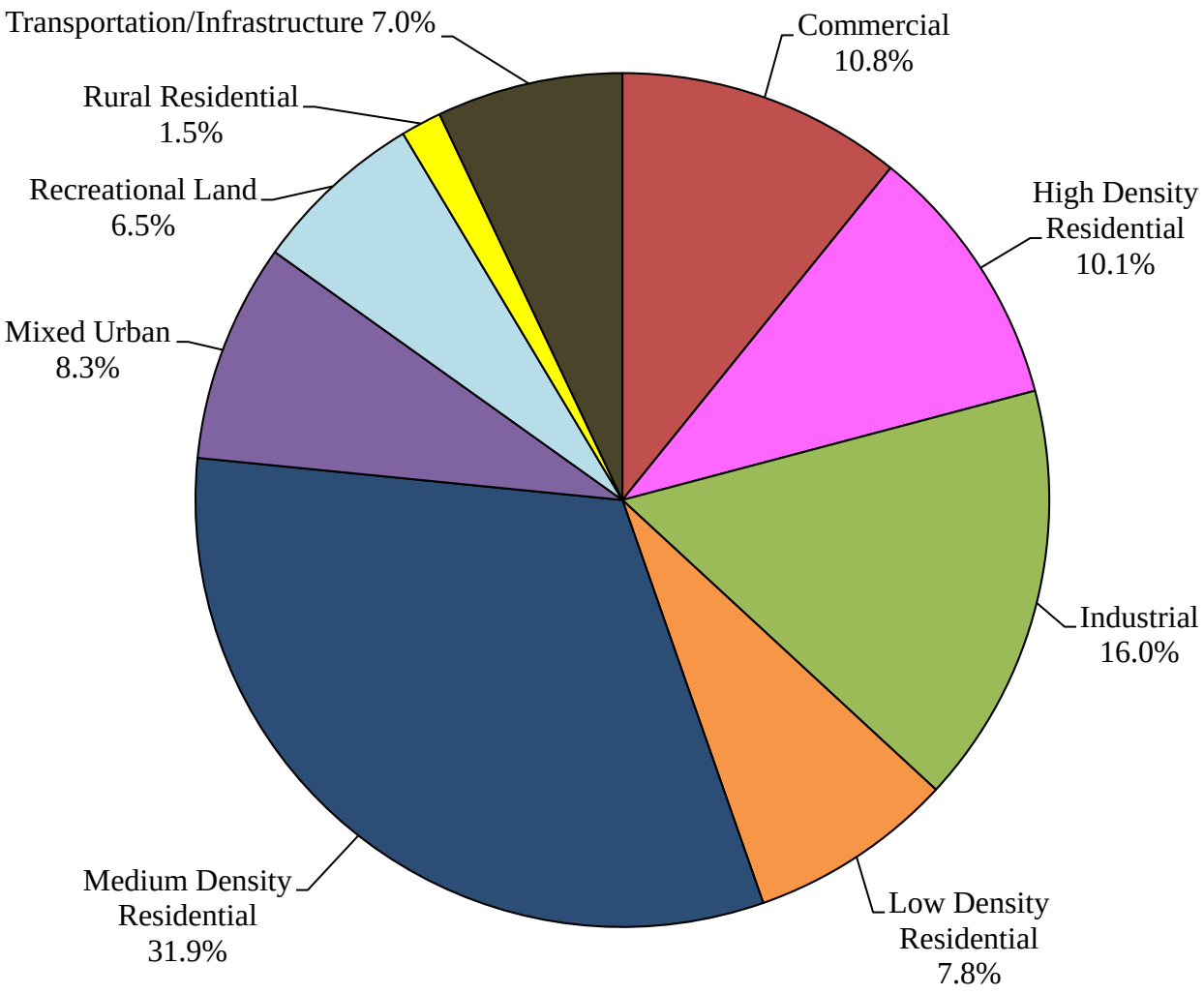


Figure 5: Pie chart illustrating the various types of urban land use in Edison Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Edison Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 26.1% in the Rahway River Robinson's Branch subwatershed to 47.8% in the Ambrose Brook 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 Edison Township, 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 Edison Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Lower Raritan River subwatershed was harvested and purified, it could supply water to 310 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Edison Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Ambrose Brook	1,626.7	2.54	1,612.7	2.52	14.0	0.02	770.7	1.20	47.8%
Mill Brook/Martins Creek	3,510.9	5.49	3,495.6	5.46	15.2	0.02	1,647.1	2.57	47.1%
Rahway River South Branch	2,278.4	3.56	2,263.5	3.54	14.9	0.02	808.7	1.26	35.7%
Rahway River Robinson's Branch	3,116.9	4.87	3,103.9	4.85	13.0	0.02	809.6	1.26	26.1%
Lower Raritan River	3,445.5	5.38	3,118.0	4.87	327.4	0.51	999.6	1.56	32.1%
Red Root Creek/ Crows Mill	2,371.1	3.70	2,285.6	3.57	85.5	0.13	823.7	1.29	36.0%
Bound Brook	3,261.9	5.10	3,250.4	5.08	11.5	0.02	1,065.5	1.66	32.8%
Total	19,611.3	30.6	19,129.8	29.9	481.5	0.75	6,924.8	10.8	36.2%

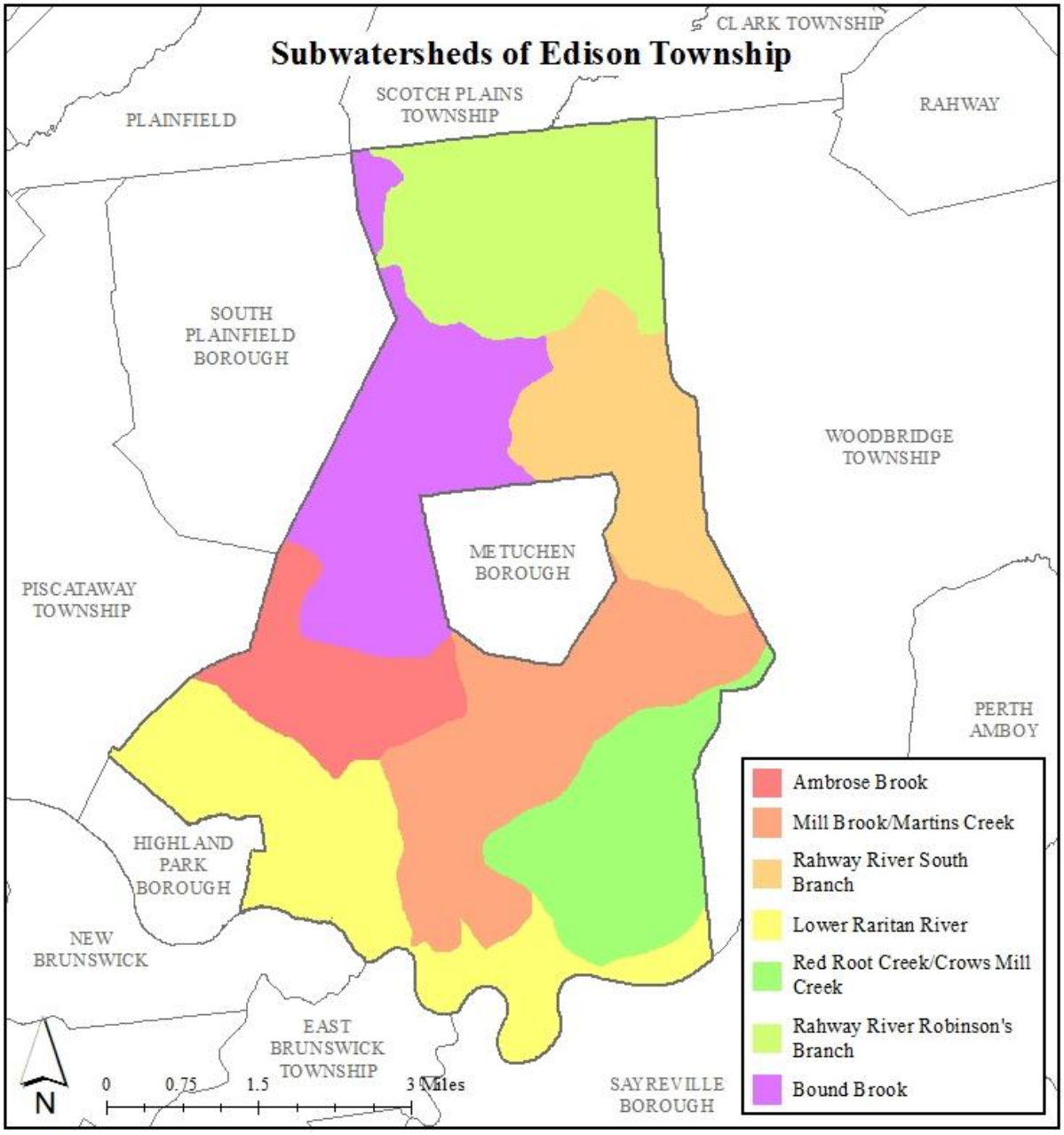


Figure 6: Map of the subwatersheds in Edison Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Edison Township

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)
Ambrose Brook	26.2	920.8	69.1	106.7	180.0
Mill Brook/ Martins Creek	55.9	1,967.8	147.6	228.1	384.6
Rahway River South Branch	27.4	966.1	72.5	112.0	188.8
Rahway River Robinson's Branch	27.5	967.2	72.5	112.1	189.0
Lower Raritan River	33.9	1,194.2	89.6	138.4	233.4
Red Root Creek/Crows Mill	28.0	984.1	73.8	114.1	192.3
Bound Brook	36.2	1,273.0	95.5	147.5	248.8
Total	235.0	8,273.1	620.5	958.9	1,617.0

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 Edison Township. 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 Edison Township

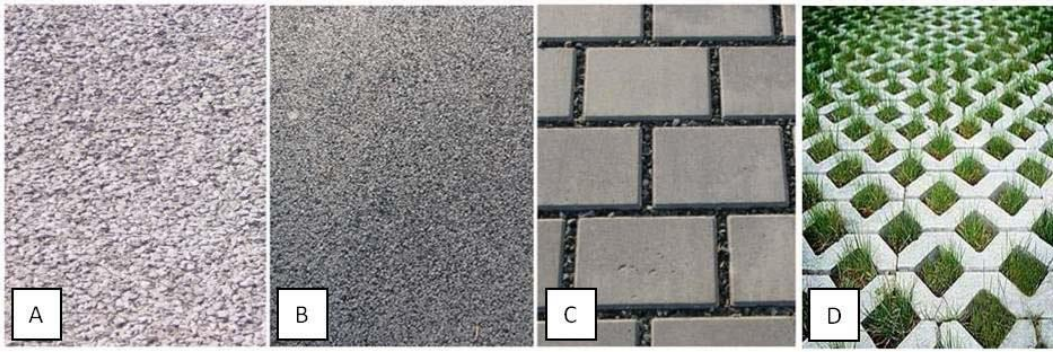
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Ambrose Brook	77.1	87.5
Mill Brook/ Martins Creek	164.7	186.9
Rahway River South Branch	80.9	91.8
Rahway River Robinson's Branch	81.0	91.9
Lower Raritan River	100.0	113.4
Red Root Creek/ Crows Mill	82.4	93.5
Bound Brook	106.6	120.9
TOTAL	692.5	785.9

[2] Annual Runoff Volume Reduction =
Acres of impervious cover x 43,560 ft^2/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft^3) 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 Edison Township

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 Edison Township, 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

Edison Township 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.

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Appendix A

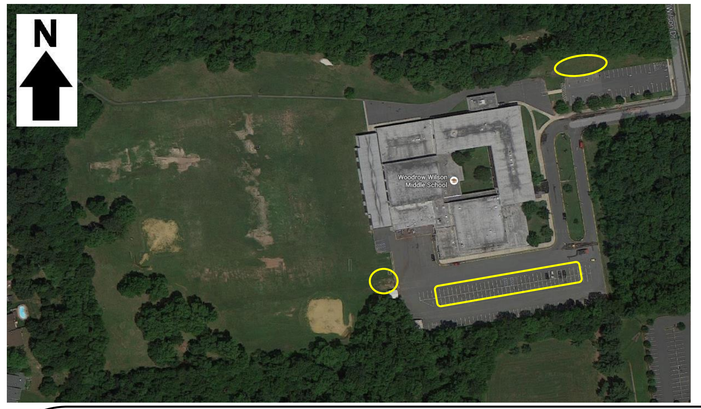
Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

Edison Township
Impervious Cover Assessment
Woodrow Wilson Middle School,
50 Woodrow Wilson Drive

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:

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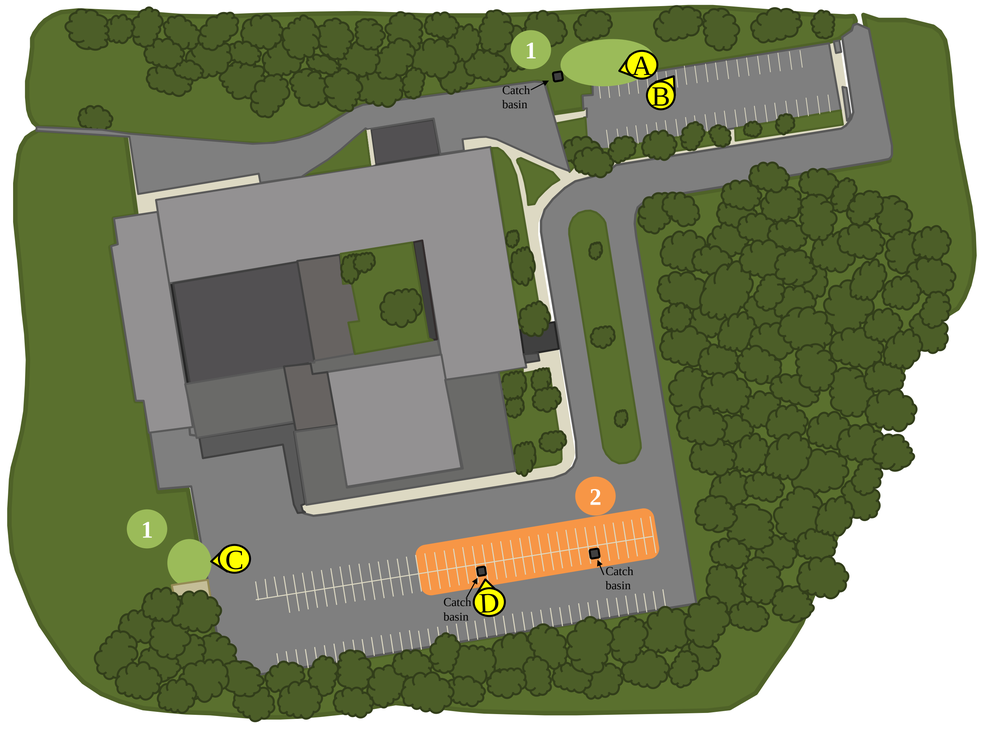


A

B

C

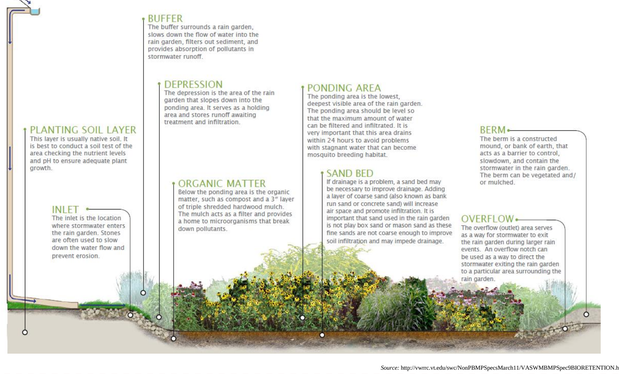
D

1 **BIORETENTION SYSTEMS:** Bioretention systems or rain gardens could be used in two areas on this property to capture, treat, and infiltrate a portion of the runoff from the parking lots. At the proposed location of the northern rain garden there is an existing catch basin that can act as an overflow for the system. The rain gardens will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping on the school grounds. The gardens will also provide habitat for birds, butterflies, and pollinators.

2 **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and will allow for the infiltration of runoff from the parking lot.

EDUCATIONAL PROGRAM: The *Stormwater Management in Your Schoolyard* educational program can be delivered at the school to educate the students about stormwater management and engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEM



Source: http://vwrrc.vt.edu/swc/NonPBMPSpecsMarch11/VASWMBMPSpec9BIORETENTION.html

2 POROUS PAVEMENT

Source: http://www.mytorontohomeimprovement.com/wp-content/uploads/2008/08/permeable-pavement.JPG

EDUCATIONAL PROGRAM

Woodrow Wilson Middle School
Green Infrastructure Information Sheet

Location: 50 Woodrow Wilson Drive Edison, NJ 08820	**Municipality:** Edison Township **Subwatershed:** South Fork of Bound Brook
Green Infrastructure Description: bioretention system (rain garden) porous pavement youth educational program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge Potential: yes stormwater peak reduction potential: yes TSS Removal Potential: yes	**Stormwater Captured and Treated Per Year:** northern rain garden: 203,230 gal. southern rain garden: 185,510 gal. porous pavement: 1,090,420 gal.

Existing Conditions and Issues:

There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff carries nonpoint source pollution, such as sediments, nutrients, oil, and grease to local waterways. Most of the impervious surfaces are directly connected to the storm sewer system through a variety of catch basins. Additionally, the building has an internal downspout system that is connected directly to the stormwater system. Areas of pooling water and eroded soils were noticed in various areas throughout the property, indicating the need for improved stormwater management.

Proposed Solution(s):

Bioretention systems could be installed to capture a portion of the runoff from the property's paved areas. The northern rain garden would capture, treat and infiltrate runoff from a portion of the northern parking lot, utilizing the current catch basin as an overflow during heavy storm events. The southern rain garden would mitigate the current pooling issues in the grassed areas by intercepting runoff from the parking lot and allowing it to infiltrate. Any overflow from this garden would continue out into the grassed area. While the parking lot is in fair condition, a section could be converted to porous pavement to capture a large portion of the parking area runoff. Porous pavement would treat the stormwater runoff and slowly allow it to infiltrate into the ground.

Anticipated Benefits:

Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS. These bioretention systems would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal. Rutgers Cooperative Extension could present the *Stormwater Management in Your Schoolyard* 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 the Edison Township Department of Public Works staff to launch educational programming.

Possible Funding Sources:
mitigation funds from local developers
NJDEP Grant Programs: 319(h) and 604(b)
local community groups (Boy Scouts and Girl Scouts)

Partners/Stakeholders:
Woodrow Wilson Middle School
Edison Township
Rutgers Cooperative Extension
students and parents

Estimated Cost:
The northern rain garden would need to be approximately 1,950 square feet, and the southern rain garden would need to be approximately 1,780 square feet. At $5 per square foot, the estimated cost of these rain gardens are $9,750 for the northern rain garden and $8,900 southern rain garden. The proposed section of porous pavement is approximately 7,475 square feet and requires a stone reservoir approximately 2 foot in depth. At $25 per square foot the estimated cost of installing the porous pavement section is $188,875. The total estimated cost for this project is $207,525.

Edison Township
Impervious Cover Assessment
John Adams Middle School, 1081 New Dover Road

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New Jersey Agricultural Experiment Station

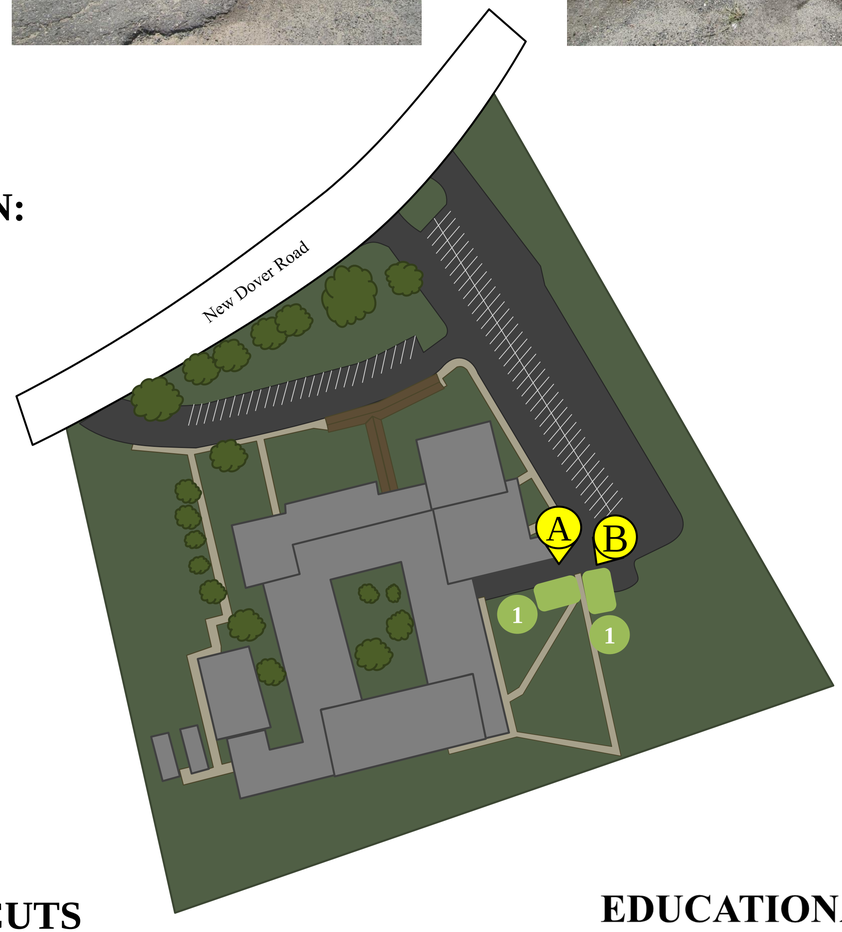
PROJECT LOCATION:

A

B

SITE PLAN:

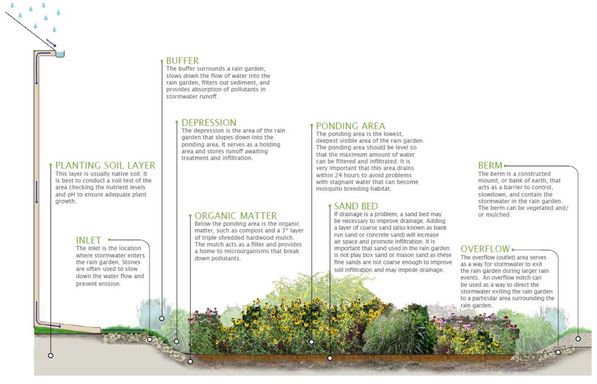
N



1 **BIORETENTION SYSTEMS:** Bioretention systems or rain gardens could capture, treat, and infiltrate runoff from the school's parking lot. The existing catch basins could handle any overflow from the gardens. The rain gardens will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping on the school grounds. The gardens will also provide habitat for birds, butterflies, and pollinators. Curb cuts should be installed to allow runoff to flow into the bioretention systems.

EDUCATIONAL PROGRAM: The *Stormwater Management in Your Schoolyard* educational program can be delivered at the school to educate the students about stormwater management and engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEM



CURB CUTS

EDUCATIONAL PROGRAM

John Adams Middle School
Green Infrastructure Information Sheet

Location: 1081 New Dover Road Edison, NJ 08820	**Municipality:** Edison Township
	Subwatershed: Robinsons Brook/Rahway River
Green Infrastructure Description: bioretention system youth educational program curb cuts	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** western rain garden: 41,689 gal. eastern rain garden: 109,432 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces at this site including building rooftops and pavement that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff is carrying nonpoint source pollution such as sediments, nutrients, oil, and grease to local waterways. The stormwater runoff from the large parking lot has caused erosion of the soil and pavement in the area of discharge.

Proposed Solution(s):
A portion of the large parking lot's runoff can be effectively managed through the installation of bioretention systems at the south end of the lot. Stormwater will be conveyed to these systems through multiple curb cuts. These bioretention systems would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. These systems will provide the ancillary benefit of beautifying the school grounds while providing habitat for birds, butterflies and pollinators. The bioretention systems will not only provide benefit to the local ecosystem, but will also provide an educational opportunity for students.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. This bioretention system would provide additional benefits such as aesthetic appeal and wildlife habitat. Rutgers Cooperative Extension could present the *Stormwater Management in Your Schoolyard* 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 the Edison Township Department of Public Works staff to launch educational programming.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
local social and community groups (Boy Scouts and Girl Scouts)

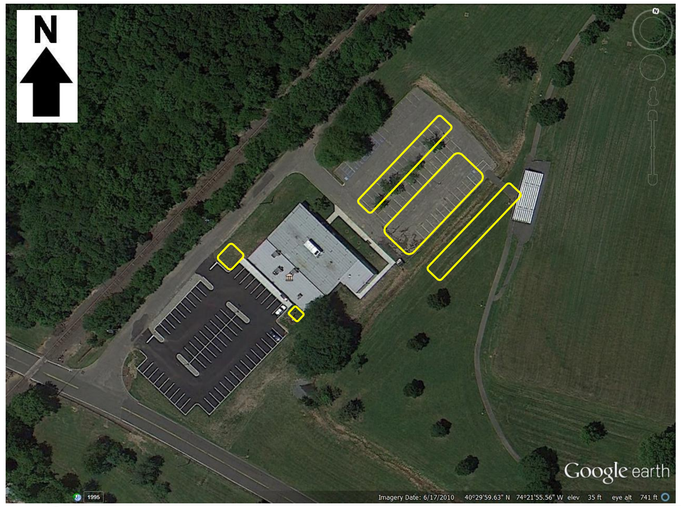
Partners/Stakeholders:
John Adams Middle School
Edison Township
Rutgers Cooperative Extension
students and parents

Estimated Cost:
The eastern and western bioretention systems would need to be approximately 1,050 and 400 square feet. At $5 per square foot, the estimated cost of these rain gardens are $5,250 and $2,000, respectively. The total estimated cost for this project is $7,250.

Edison Township
Impervious Cover Assessment
Middlesex County Police Academy, 11 Patrol Road

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

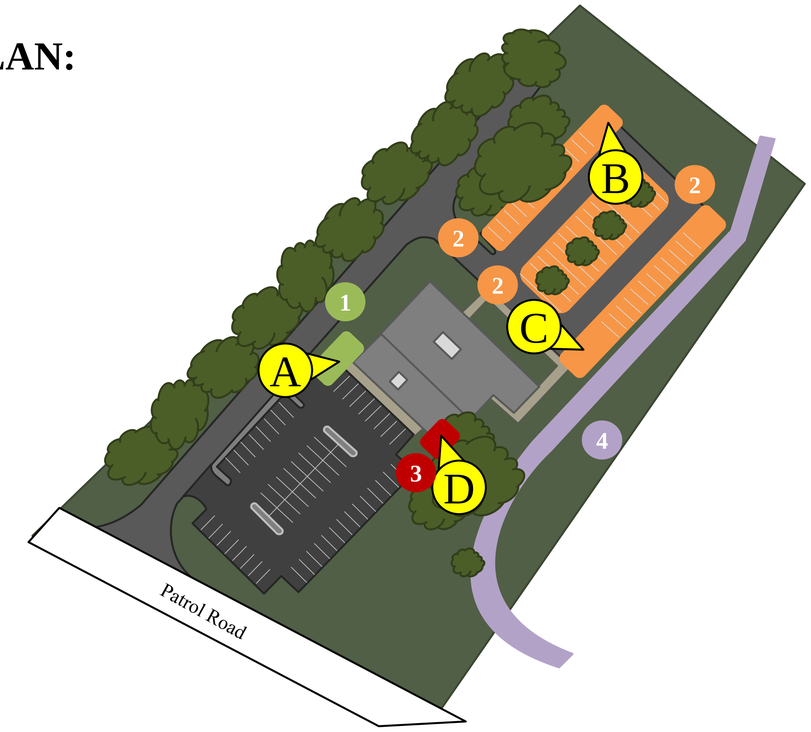


A

B

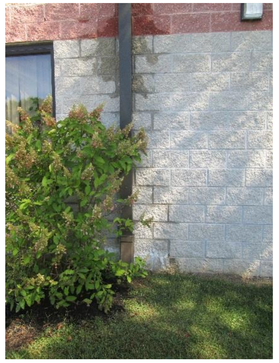
SITE PLAN:

N



C

D



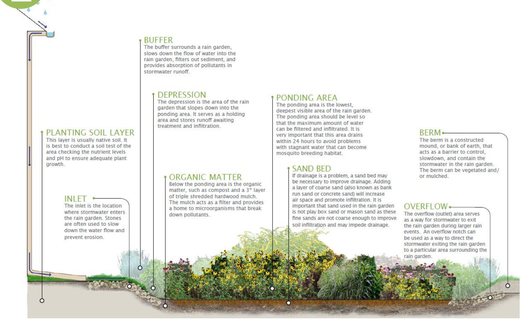
1 **BIORETENTION SYSTEM:** A bioretention system or rain garden will capture, treat, and infiltrate runoff from a portion of the building's rooftop and the parking lot. The rain garden will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping. The garden will also provide habitat for birds, butterflies, and pollinators.

2 **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and will allow for the infiltration of runoff from the parking lot.

3 **DISCONNECTED DOWNSPOUTS:** Downspouts can be disconnected to allow rainwater to flow into grassed areas which will help remove pollutants and allow stormwater to infiltrate into the ground.

4 **BIOSWALE RETROFIT:** A bioswale is a vegetated system that conveys stormwater to a waterway while removing sediment and nutrients. The current bioswale can be retrofitted with native plants to more effectively treat runoff from the parking lot.

1 BIORETENTION SYSTEM



2 POROUS PAVEMENT

3 DISCONNECTED DOWNSPOUTS

4 BIOSWALE RETROFIT

Middlesex County Police Academy
Green Infrastructure Information Sheet

Location: 11 Patrol Road Edison, NJ 08820	**Municipality:** Edison Township
	Subwatershed: Red Root Creek/Crows Mill Creek
Green Infrastructure Description: bioretention system (rain garden) porous pavement disconnected downspout bioswale	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden: 85,983 gal. porous pavement: 630,122 gal. disconnected downspout: 9,874 gal. bioswale: 833,770 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces at this site that contribute to stormwater runoff volumes and nonpoint source pollution. Runoff is carrying nonpoint source pollution, such as sediments, nutrients, oil, and grease to local waterways. Most of the impervious surfaces are directly connect to the storm sewer system through a variety of catch basins. Additionally, the building has an external downspout system that is connected directly to the stormwater system. The rear parking lot has areas of sediment buildup and appears to be deteriorating due to inadequate stormwater management. There is a drainage ditch adjacent to the property which shows signs of deterioration.

Proposed Solution(s):
Porous pavement can effectively manage the stormwater runoff associated with the rear parking lot. Porous pavement will treat the stormwater runoff and slowly allow it to infiltrate into the ground. The bioretention system or rain garden can be constructed in the front corner of the building, intercepting a portion of the front parking lot runoff. Disconnecting the downspouts can allow water from the rooftop of the building to naturally infiltrate into the ground or be treated by the rain garden. The current drainage ditch can be retrofitted with local plants to create a bioswale, which will revitalize its ability to treat stormwater. This combination of systems will capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS. The bioswale would reduce TN by 30%, TP by 60%, and TSS by 90%. The bioretention systems and bioswales would also provide ancillary benefits such as enhanced wildlife and aesthetic.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs like 319(h) and 604(b)
local social and community groups

Partners/Stakeholders:
Middlesex Police Academy
Edison Township
Rutgers Cooperative Extension

Estimated Cost:
Simple disconnection of the currently connected downspouts is estimated to cost $250. The rain garden proposed for this property will need to be approximately 830 square feet. At $5 per square foot, the estimated installed cost of this rain garden is $4,150. The proposed sections of porous asphalt have a total area of approximately 7,000 square feet and requires a stone reservoir approximately 1.5 foot in depth. At $22.50 per square foot, the estimated cost of installing the porous pavement section is $157,500. The bioswale would need to be approximately 8,000 square feet. At $5 per square foot, the bioswale would cost approximately $40,000 to construct. The total estimated cost of this project is $201,900.