RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
The Town of Newton, Sussex County, New Jersey

Prepared for the Town of Newton by the
Rutgers Cooperative Extension Water Resources Program

December 9, 2016

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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

The Town of Newton Impervious Cover Analysis

Located in Sussex County in northern New Jersey, the Town of Newton covers approximately 3.38 square miles south of Hampton Town. Figures 3 and 4 illustrate that the Town of Newton is dominated by urban land uses. A total of 58.4% of the municipality's land use is classified as urban. Of the urban land in the Town of Newton, 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 the Town of Newton 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 the Town of Newton. Based upon the 2007 NJDEP land use/land cover data, approximately 38.3% of the Town of Newton has impervious cover. This level of impervious cover suggests that the streams in the Town of Newton are likely non-supporting streams.

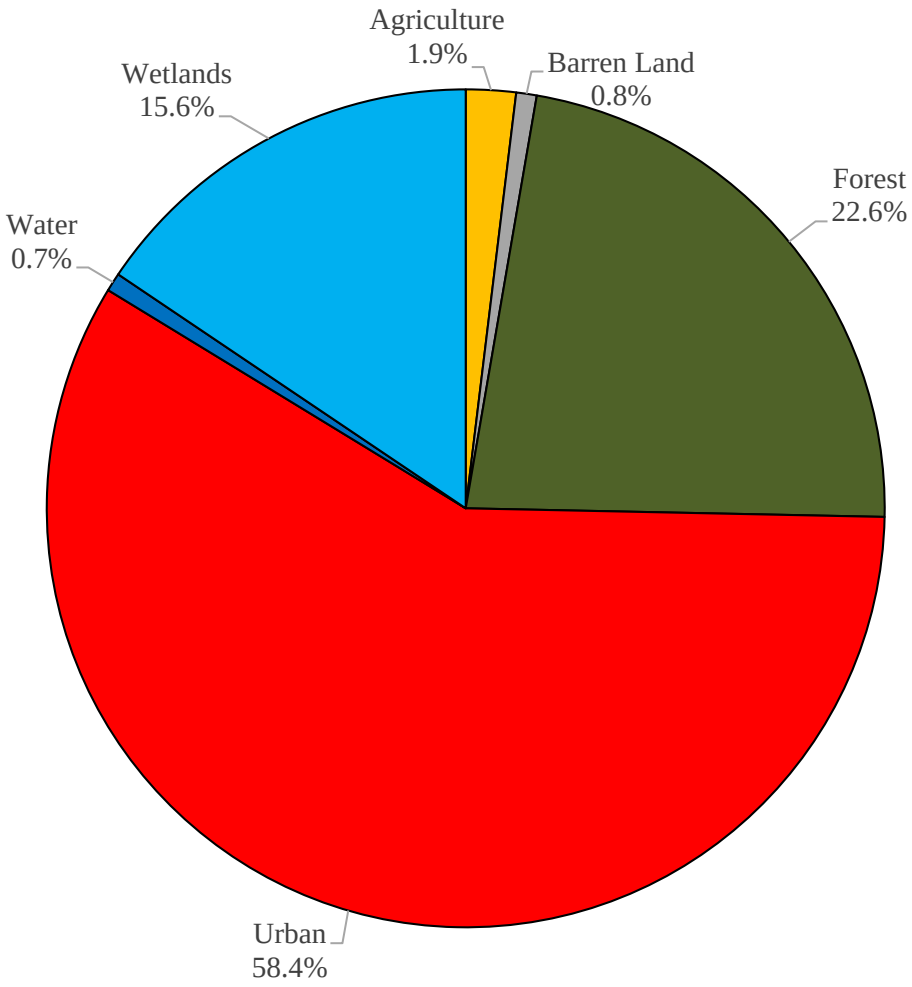


Figure 3: Pie chart illustrating the land use in the Town of Newton

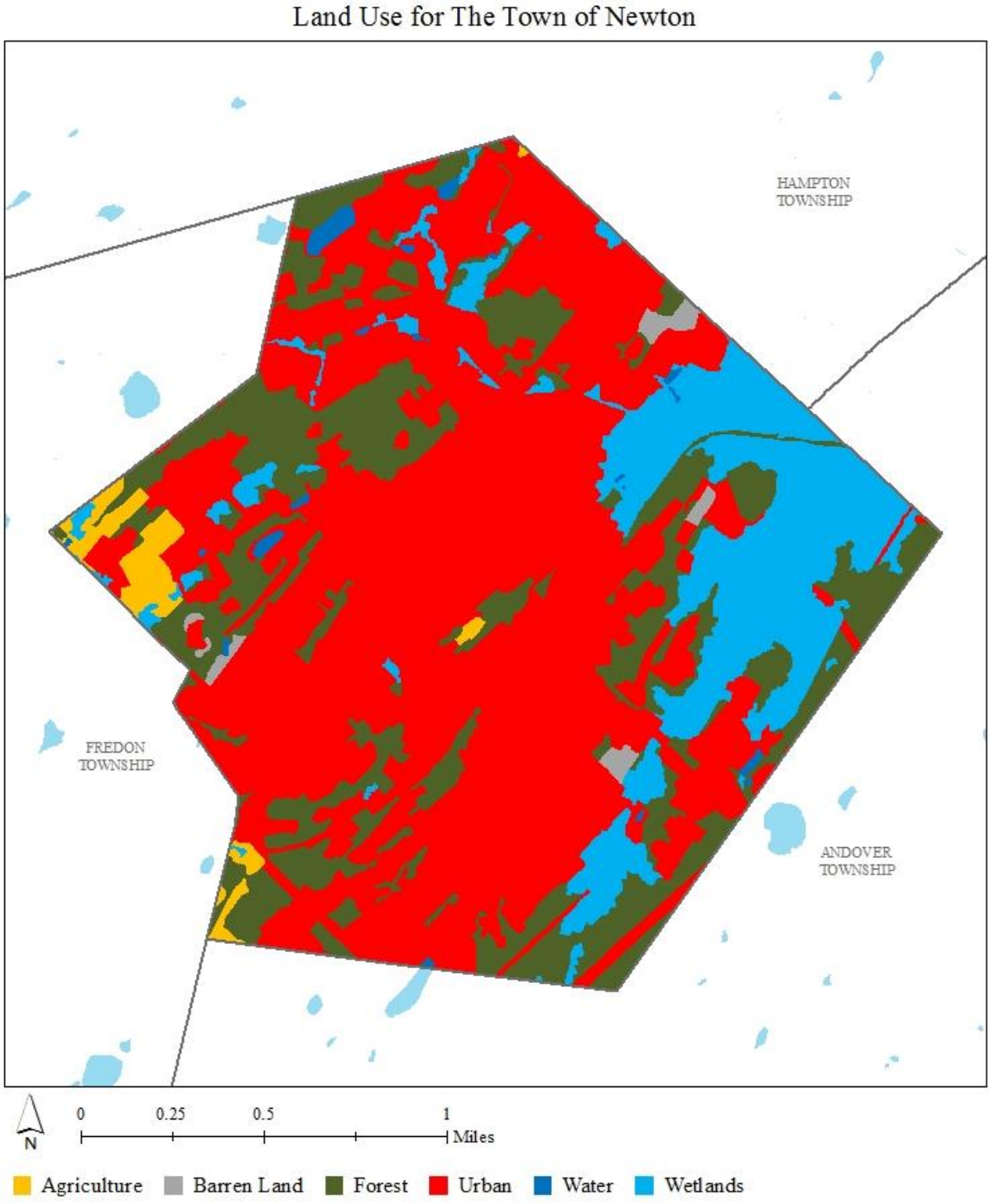


Figure 4: Map illustrating the land use in the Town of Newton

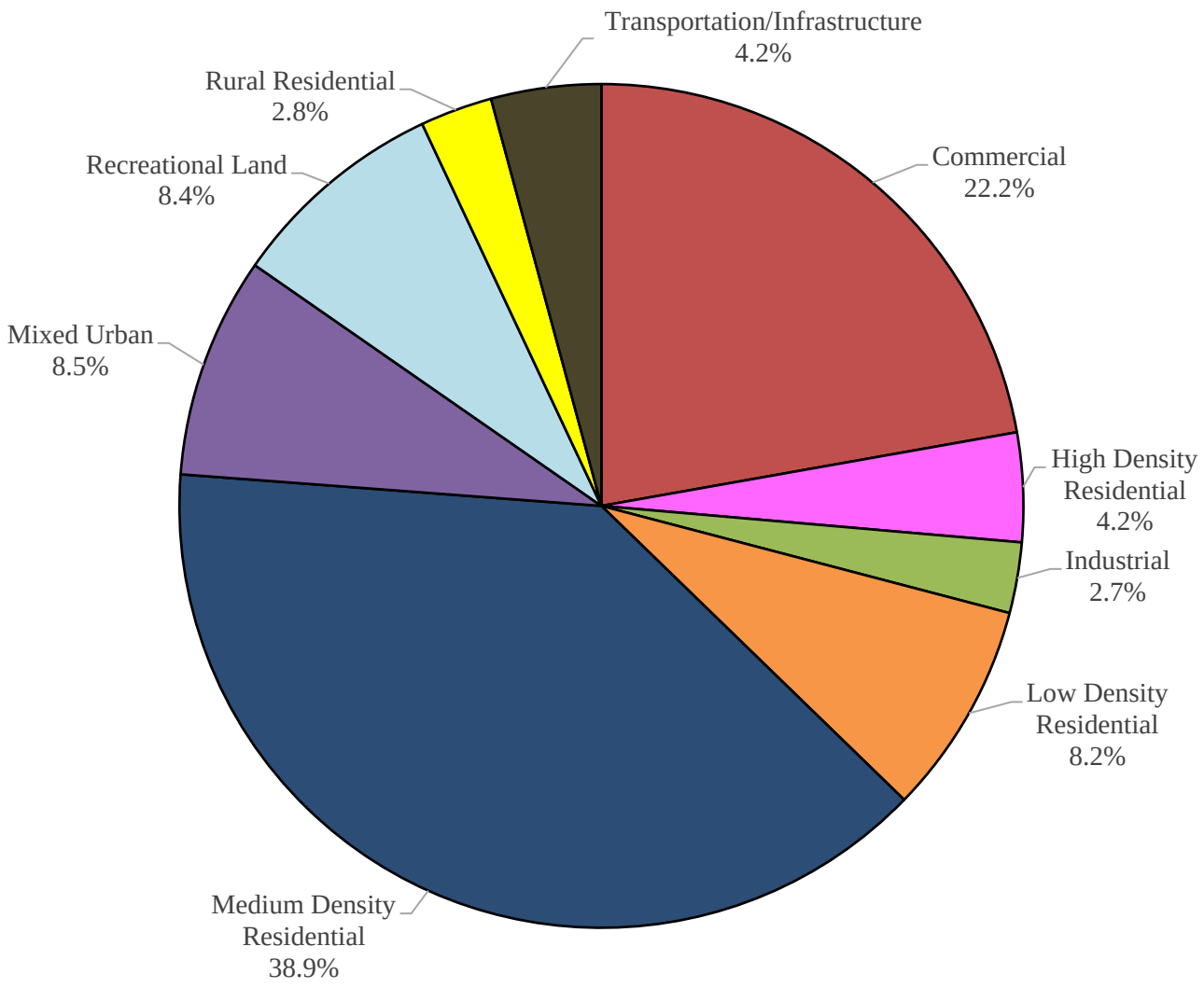


Figure 5: Pie chart illustrating the various types of urban land use in the Town of Newton

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within the Town of Newton (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 15.5% in the Pequest River subwatershed to 22.9% in the Paulins Kill 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 the Town of Newton, Sussex 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 (3.2 inches of rain), the 10-year design storm (4.7 inches of rain), and the 100-year design storm (7.6 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in the Town of Newton. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Paulins Kill subwatershed was harvested and purified, it could supply water to 145 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for the Town of Newton

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Paulins Kill	2,058.7	3.22	2,043.3	3.19	15.4	0.02	467.8	0.73	22.9%
Pequest River	105.1	0.16	105.1	0.16	0.00	0.00	16.2	0.03	15.5%
Total	2,163.9	3.38	2,148.5	3.36	15.4	0.02	484.1	0.76	22.4%

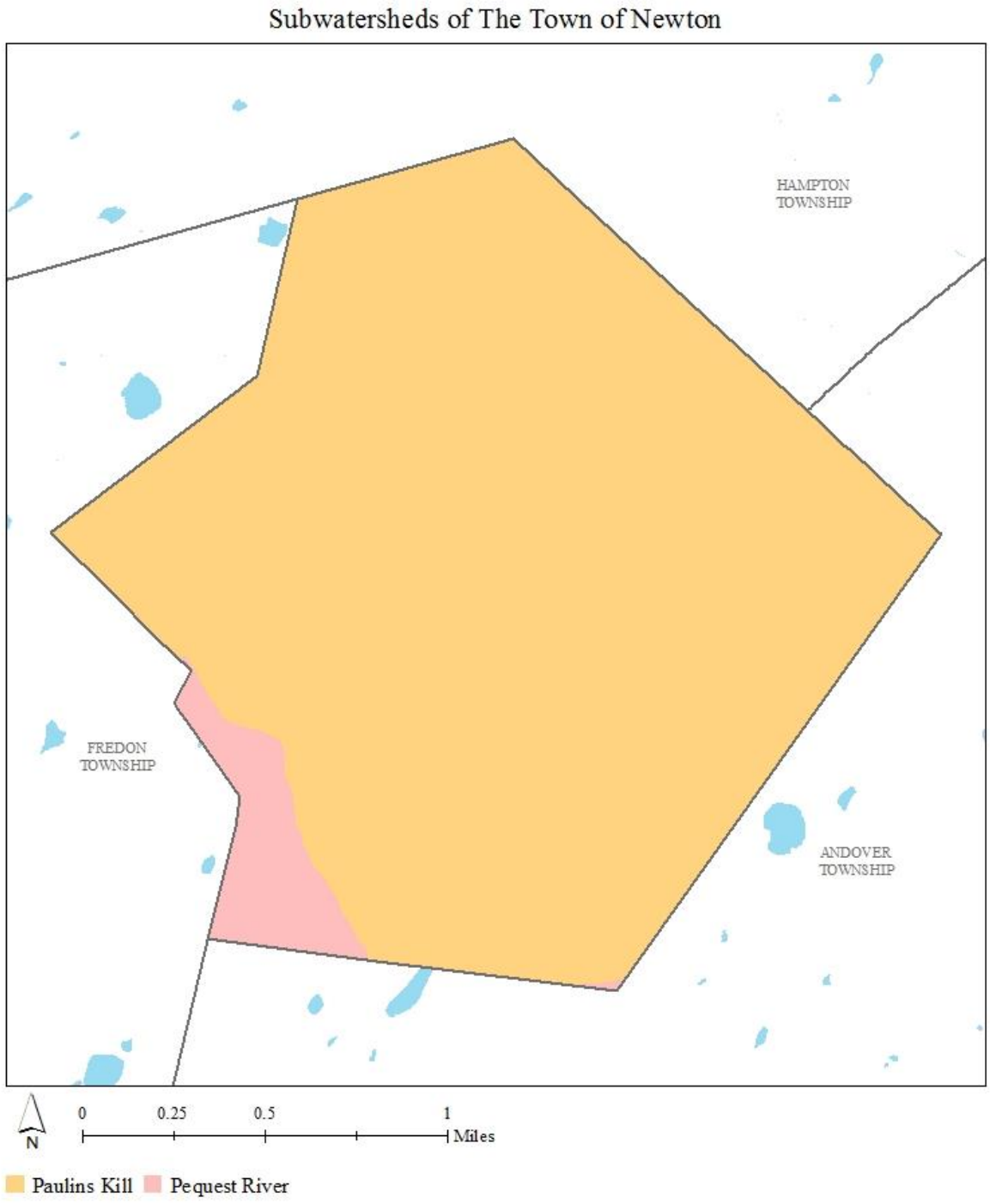


Figure 6: Map of the subwatersheds in the Town of Newton

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in the Town of Newton

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 (3.2") (Mgal)**	**Total Runoff Volume for the 10-Year Design Storm (4.7") (Mgal)**	**Total Runoff Volume for the 100-Year Design Storm (7.6") (Mgal)**
Paulins Kill	15.9	558.9	40.6	59.7	96.5
Pequest River	0.5	19.4	1.4	2.1	3.3
Total	16.4	578.4	42.1	61.8	99.9

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 the Town of Newton. 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 (3.2 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 the Town of Newton

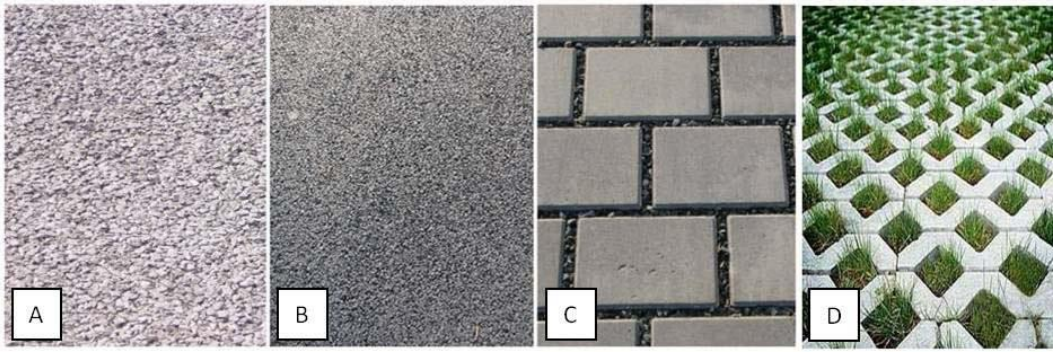
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Paulins Kill	46.8	53.1
Pequest River	1.6	1.8
Total	48.4	54.9

[2] Annual Runoff Volume Reduction =
Acres of IC 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 BMPs should be designed to capture the first 3.2 inches of rain from each storm. This would allow the BMP 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 the Town of Newton

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 the Town of Newton, 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

The Town of Newton 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

Town of Newton
Impervious Cover Assessment
Newton Covenant Reformed Church, 23 Thompson Street

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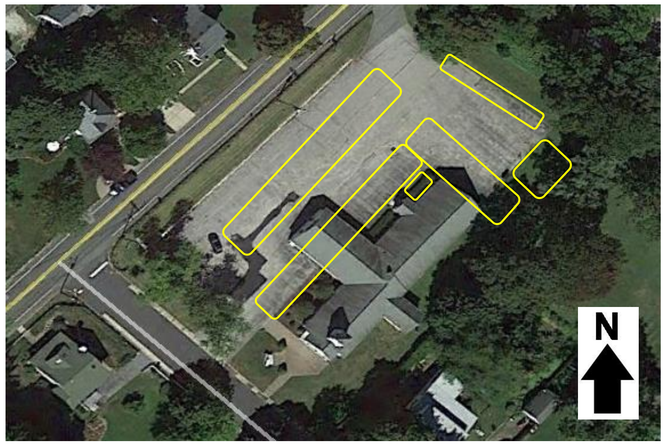
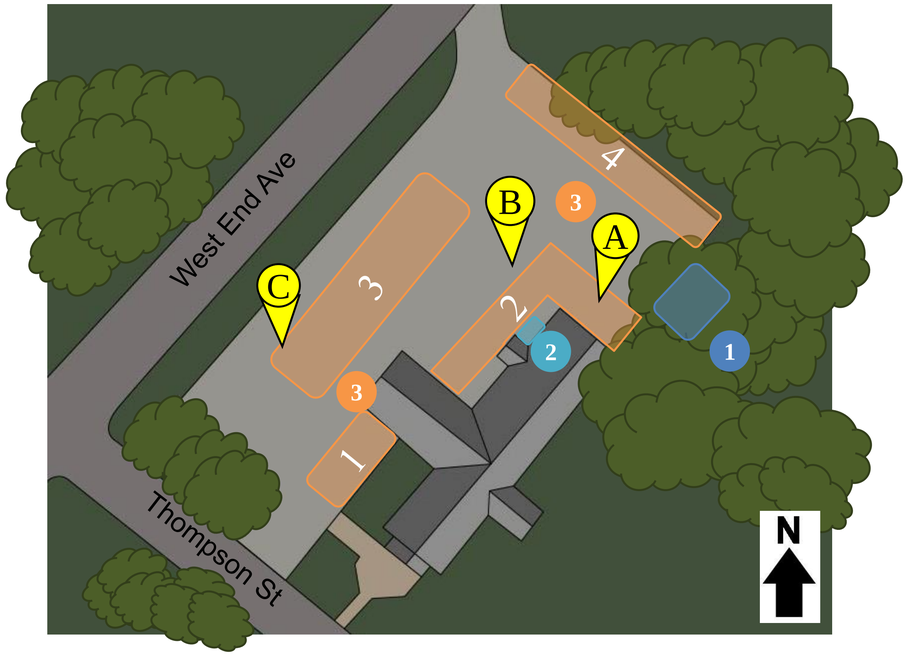
PROJECT LOCATION:



SITE PLAN:



A

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1 **BIORETENTION SYSTEM:** A bioretention system should be installed near the northeast corner of the building. A bioretention system will reduce runoff, allow stormwater infiltration, and decrease the amount of contaminants that reach the catch basin.

2 **RAIN BARREL:** The rain barrel will help capture the stormwater that drains from the building's rooftop. Connecting the downspouts to the rain barrel will allow the stormwater to be collected and used for gardening.

3 **POROUS PAVEMENT:** The parking lot is in poor condition. The spaces should be replaced with porous pavement to help capture stormwater runoff before going into the catch basins. Porous pavement promotes groundwater recharge and filters stormwater.

1 BIORETENTION SYSTEM

2 RAIN BARREL

3 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

Newton Covenant Reformed Church
Green Infrastructure Information Sheet

Location: 23 Thompson Street Newton, NJ 07860	**Municipality:** Town of Newton
	Subwatershed: Paulins Kill River
Green Infrastructure Description: bioretention systems (rain gardens) porous pavement rainwater harvesting system	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes TSS removal potential: yes stormwater peak reduction potential: yes	**Stormwater Captured and Treated Per Year:** rain barrel: 1,234 gal. porous pavement #1: 125,587 gal. porous pavement #2: 213,914 gal. porous pavement #3: 247,135 gal. porous pavement #4: 68,656 gal. rain garden : 122,460 gal.

Existing Conditions and Issues:
On the western corner of the church, water draining from a disconnected downspout has created a hole. The parking lot slopes down from the surrounding roads and is slightly degraded with one drainage basin at the northeast corner of the building. During storms, water flowing from the roads may enter the lot causing the drain to overflow.

Proposed Solution(s):
The disconnected downspout could be connected to a rainwater harvesting system preventing expansion of the hole and any possible effect on the building's foundation. Installation of pervious pavement in the parking spaces throughout, and a rain garden at the northeast corner will intercept and infiltrate rain water preventing overflow of the drainage basin.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 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 to the owners and members of the church and include them in bioretention system planting efforts to enhance cooperation and participation in the program. A cistern can be used to harvest rainwater which can be used for watering plants or other purposes which reduce the use of potable water for non-drinking purposes. The cistern would reduce the pollutant loading by 90% during the periods it is operational (i.e., it would not be used in the winter when there is a chance of freezing).

Possible Funding Sources:
Town of Newton
grants from foundations
Newton Covenant Reformed Church

Partners/Stakeholders:
Town of Newton
Newton Covenant Reformed Church clergy and parishioners
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
To capture the 1,234 gallons off of the building's roof, the cistern would be 80 gallons and cost approximately $160 to purchase and install. Installation of porous pavement is broken into four sections. The sections adjacent to the building would be 940 square feet for the east end and 2,150 square feet for the west end. Both would be have two feet of stone at $25 per square foot for a cost of $77,250. The other sections would be 6,050 square feet to the west and 1,730 to the east. Both would have a half foot stone layer at $15 per square foot for a cost of $116,550. The rain garden installed to capture the 122,460 gallons of runoff would need to be approximately 1,175 square feet. At $5 per square foot, the estimated cost of the rain garden is $5,875. The total cost of the project would be $199,835.

Town of Newton
Impervious Cover Assessment
Newton Firehouse # 1, 22 Mill Street

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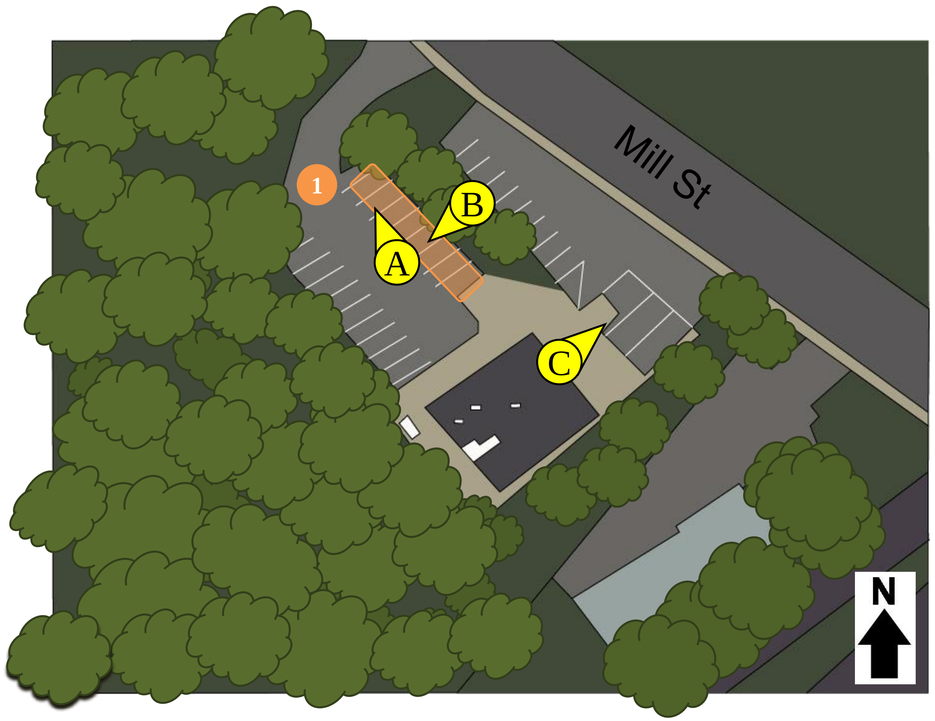
PROJECT LOCATION:

A

SITE PLAN:



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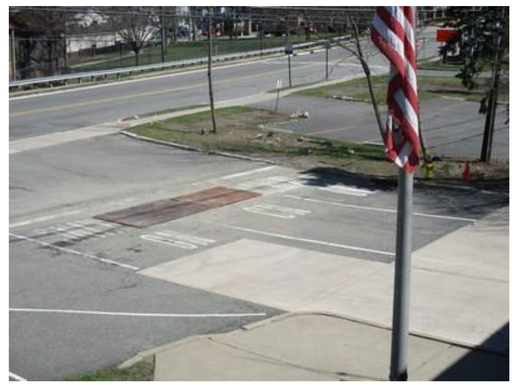


1 **POROUS PAVEMENT:** Putting porous pavement in the top parking lot stalls will help reduce the amount of runoff that is going into the inlet at the north east corner of the parking lot. Porous pavement promotes groundwater recharge and filters stormwater.

1 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

Newton Firehouse #1
Green Infrastructure Information Sheet

Location: 22 Mill Street Newton, NJ 07860	**Municipality:** Town of Newton
	Subwatershed: Paulins Kill River
Green Infrastructure Description: porous pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes TSS removal potential: yes stormwater peak reduction potential: yes	**Stormwater Captured and Treated Per Year:** porous pavement: 135,791 gal.

Existing Conditions and Issues:
The firehouse has an upper and lower parking lot. Half of the upper parking lot slopes to an inlet while the other half slopes down the driveway to Mill Street. During rainstorms, excess water flowing from the upper lot may cause the street to flood. On the lower lot, water flows across the parking area into a drainage basin at the southern end of the lot. The two lots are slightly degraded.

Proposed Solution(s):
Replacing the parking spaces with porous pavement in the upper parking area will reduce flooding risk by intercepting stormwater runoff. The captured water will infiltrate into soil promoting groundwater recharge.

Anticipated Benefits:
Porous pavement allows stormwater to penetrate though to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. Porous pavement systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS.

Possible Funding Sources:
Town of Newton
mitigation funds from local developers
local social and community groups

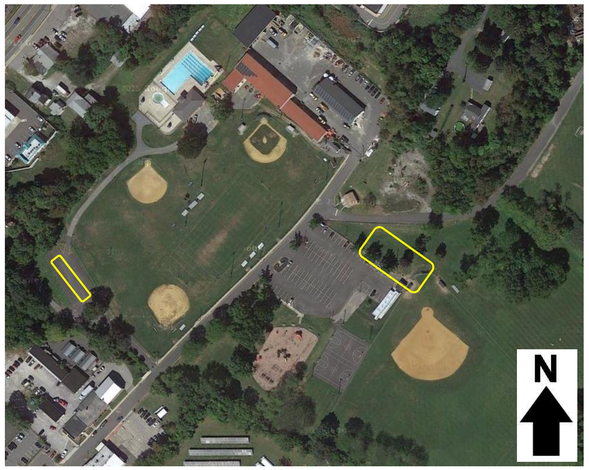
Partners/Stakeholders:
Town of Newton
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
The porous asphalt would cover 5,250 square feet and have a 2 foot/feet stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $28,875.

Town of Newton
Impervious Cover Assessment
Memory Park, 111 Moran Street

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



A

B

SITE PLAN:

1 **BIORETENTION SYSTEM:** A bioretention system should be installed near the north of the parking lot. A bioretention system will reduce runoff, allow stormwater infiltration, and decrease the amount of contaminants that reach the catch basin.

2 **POROUS PAVEMENT:** An existing gravel area can be redone with turf stone pavers to improve its ability to infiltrate. Additionally, parking spaces could be redone with porous pavement to help capture stormwater runoff. Porous pavement promotes groundwater recharge and filters stormwater.

1 BIORETENTION SYSTEM

2 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

C

Memory Park
Green Infrastructure Information Sheet

Location: 111 Moran Street Newton, NJ 07860	**Municipality:** Newton Town **Subwatershed:** Paulins Kill
Green Infrastructure Description: bioretention system (rain garden) porous pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes TSS removal potential: yes stormwater peak reduction potential: yes	**Stormwater Captured and Treated Per Year:** porous pavement: 291,170 gal. rain garden: 242,320 gal.

Existing Conditions and Issues:
The main eastern parking lot partly slopes toward its north end and otherwise flows into nearby catch basins in the roadways. In the smaller west lot, runoff flows either into adjacent grass areas or into a gravel patch of the parking lot.

Proposed Solution(s):
A rain garden can be implemented in the large grass area north of the eastern parking lot to capture, treat, and infiltrate runoff from the parking lot. In the west parking lot, the gravel section can be redone with porous pavement to capture runoff from the rest of parking lot.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 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. Porous pavement allows stormwater to penetrate though to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. Porous pavement systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS.

Possible Funding Sources:
Town of Newton
mitigation funds from local developers
local social and community groups

Partners/Stakeholders:
Town of Newton
local social and community groups
local residents
Rutgers Cooperative Extension

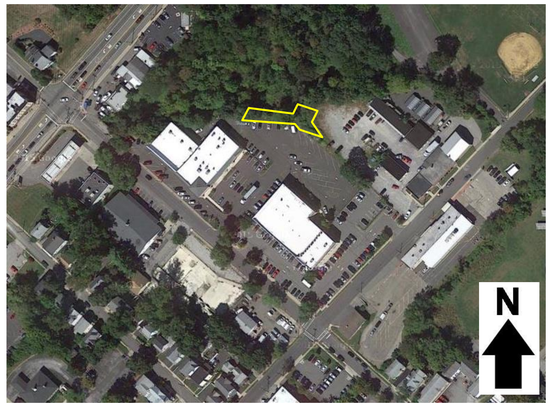
Estimated Cost:

A rain garden to capture the parking lot runoff would need to be approximately 2,325 square feet. At $5 per square foot, the estimated cost of the rain garden is $11,625.
The porous asphalt would cover 5,040 square feet and have a one foot stone reservoir under the surface. At $20 per square foot, the cost of the porous asphalt system would be $100,800.
The total cost of the project will thus be approximately $112,425.

Town of Newton
Impervious Cover Assessment
De Pasquale Plaza / Campbell's Small Engine Sales, 10 East Clinton Street

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

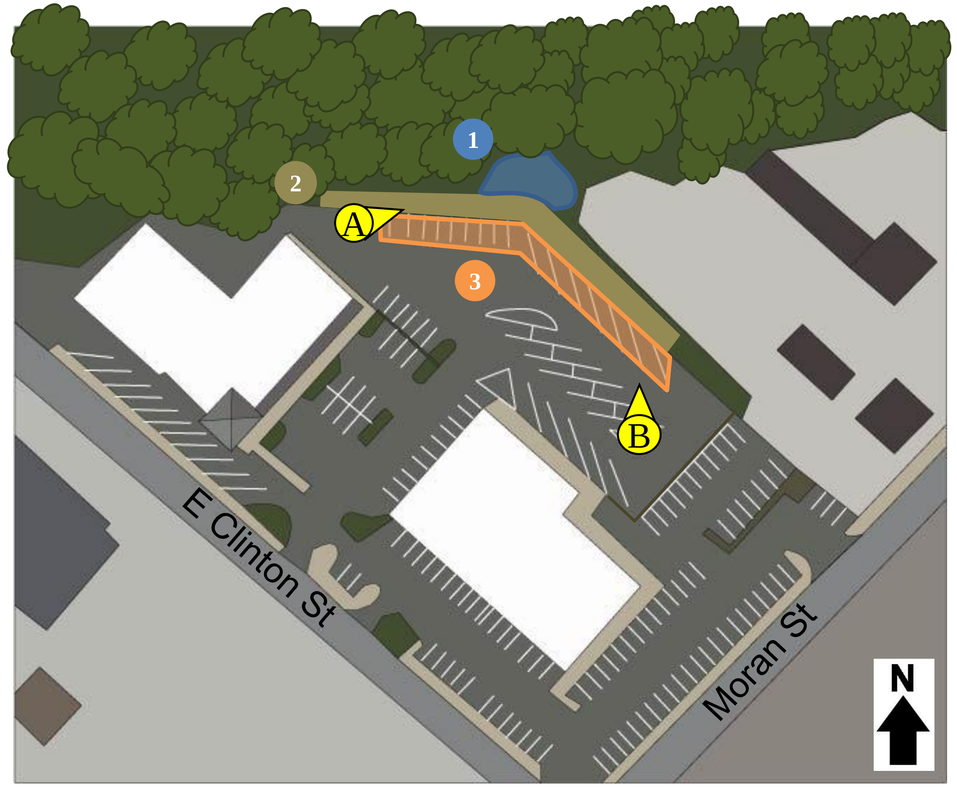


1 **BIORETENTION SYSTEM:** A bioretention system should be installed near the northeast corner of the building. A bioretention system will reduce runoff, allow stormwater infiltration, and decrease the amount of contaminants that reach the catch basin.

2 **BIOSWALE:** A bioswale is a vegetated system that will convey stormwater to the rain garden while removing sediment and nutrients and allowing for some infiltration.

3 **POROUS PAVEMENTS:** Porous asphalt can be utilized in the north strip of parking spaces. These surfaces are durable, but also allow water to infiltrate through the surface. They have an underlying stone layer to store stormwater runoff and allow it to slowly seep into the ground.

SITE PLAN:



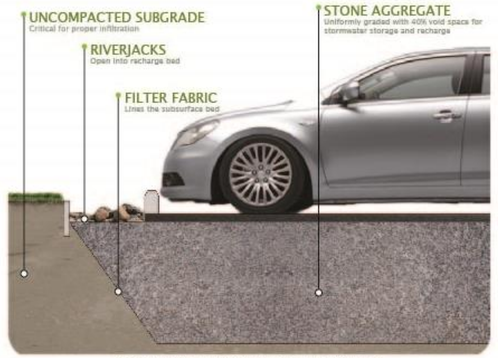
A

B

1 BIORETENTION SYSTEM

2 BIOSWALE

3 POROUS PAVEMENT



Location: 10 East Clinton Street Newton, NJ 07860	**Municipality:** Town of Newton
	Subwatershed: Paulins Kill
Green Infrastructure Description: bioretention system (rain garden) porous pavement bioswale	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes TSS removal potential: yes stormwater peak reduction potential: yes	**Stormwater Captured and Treated Per Year:** rain garden: 13,420 gal. porous pavement: 693,070 bioswale: 260,550 gal.

Existing Conditions and Issues:
The fairly large parking lot produces a large volume of runoff during storm events that on site drains toward the north end of the site into an existing drainage ditch in a small wooded area with no form of treatment for pollutants.

Proposed Solution(s):
The parking spaces can be repaved with a porous asphalt to instead capture the stormwater runoff from the parking lot. This system will capture some quantity of runoff with the remaining runoff able to overflow the system into a bioswale which will help filter and convey the water. The bioswale will lead into a rain garden which will retain the water allowing it to infiltrate slowly over time and allow for groundwater recharge.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 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. Porous pavement allows stormwater to penetrate though to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. Porous pavement systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioswale is a vegetated system that will convey stormwater to groundwater while removing sediment and nutrients.

Possible Funding Sources:
Town of Newton
mitigation funds from local developers
local social and community groups

Partners/Stakeholders:
Town of Newton
local social and community groups

local residents
Rutgers Cooperative Extension

Estimated Cost:

A rain garden to help capture the parking lot runoff would need to be approximately 350 square feet. At $5 per square foot, the estimated cost of the rain garden is $1,750.

The porous asphalt would cover 4,750 square feet and have a two foot stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $118,750.

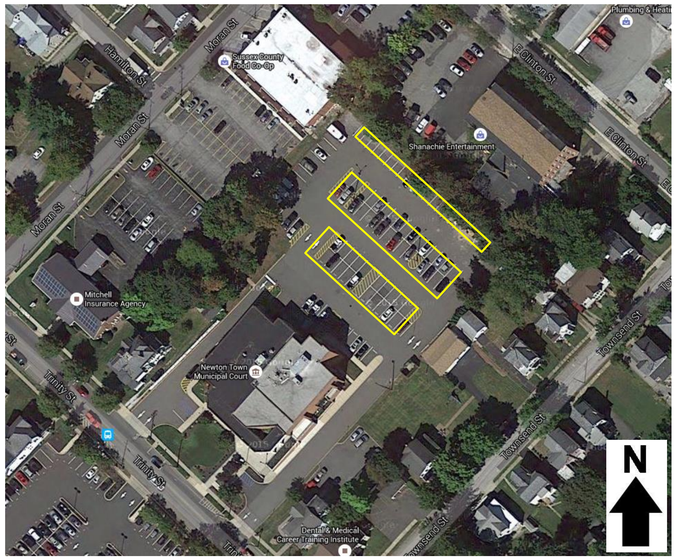
The bioswale would need to be 25 feet long and 10 feet wide (2,500 sq.ft.). At $5 per square foot, the estimate cost of the bioswale is $12,500.

The total cost of the project will thus be approximately $133,000.

Town of Newton
Impervious Cover Assessment
Newton Police Department and Municipal Building, 39 Trinity Street

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:

1 **BIORETENTION SYSTEM WITH TREES:** Two rain garden island's with trees can be implemented in the parking lot by converting the two rows of spaces to the northeast to angled parking to provide the needed space.

2 **POROUS PAVEMENTS:** Porous asphalt can be utilized in the northeast strip of parking spaces. These surfaces are durable, but also allow water to infiltrate through the surface. They have an underlying stone layer to store stormwater runoff and allow it to slowly seep into the ground.

A

B

1 BIORETENTION SYSTEM WITH TREES

2 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

C

Newton Police Department and Municipal Building
Green Infrastructure Information Sheet

Location: 39 Trinity Street Newton, NJ 07860	**Municipality:** Town of Newton
	Subwatershed: Paulins Kill
Green Infrastructure Description: bioretention system (rain garden) porous pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes TSS removal potential: yes stormwater peak reduction potential: yes	**Stormwater Captured and Treated Per Year:** rain garden: 122,980 gal. porous pavement: 539,870 gal.

Existing Conditions and Issues:
The large paved areas of the site generate a large volume of stormwater runoff that drains to the northeast end of the parking lot. An asphalt curb directs runoff into two catch basins that flow into existing stormwater management systems. Runoff from the building itself is directly connected to the storm sewer systems.

Proposed Solution(s):
The row of parking spaces at the northeast end be repaved with porous asphalt to capture stormwater runoff before reaching catch basins and allow filtration of pollutants and infiltration. The single row of spaces adjacent to this could be moved by converted the two rows of spaces in this aisle to angled parking. This would allow a reduced aisle width that would allow space for a bioretention system island which will intercept some of the runoff going to the porous pavement to increase the overall captured stormwater runoff.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 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. Porous pavement allows stormwater to penetrate though to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. Porous pavement systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS.

Possible Funding Sources:
Town of Newton
mitigation funds from local developers
local social and community groups

Partners/Stakeholders:
Town of Newton

local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:
A rain garden to capture the parking lot runoff would need to be approximately 1,180 square feet. At $5 per square foot, the estimated cost of the rain garden is $5,900. Additional costs for removal of asphalt and construction of the island are likely.
The porous asphalt would cover 3,700 square feet and have a 2 foot stone reservoir under the surface. At $ per square foot, the cost of the porous asphalt system would be $92,500.
The total cost of the project will thus be approximately $98,400.