**Impervious Cover Assessment
for
Mount Arlington Borough, Morris County, New Jersey**

*Prepared for Mount Arlington Borough by the
Rutgers Cooperative Extension Water Resources Program*

August 10, 2016

WILLIAM PENN
FOUNDATION

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 has also 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

Mount Arlington Borough Impervious Cover Analysis

Located in Morris County in northern New Jersey, Mount Arlington Borough covers approximately 2.80 square miles south of Sparta Township. Figures 3 and 4 illustrate that Mount Arlington Borough is dominated by urban land uses. A total of 47.3% of the municipality's land use is classified as urban. Of the urban land in Mount Arlington Borough, 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) 2012 land use/land cover geographical information system (GIS) data layer categorizes Mount Arlington Borough 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 Mount Arlington Borough. Based upon the 2012 NJDEP land use/land cover data, approximately 22.7% of Mount Arlington Borough has impervious cover. This level of impervious cover suggests that the streams in Mount Arlington Borough are likely impacted streams.
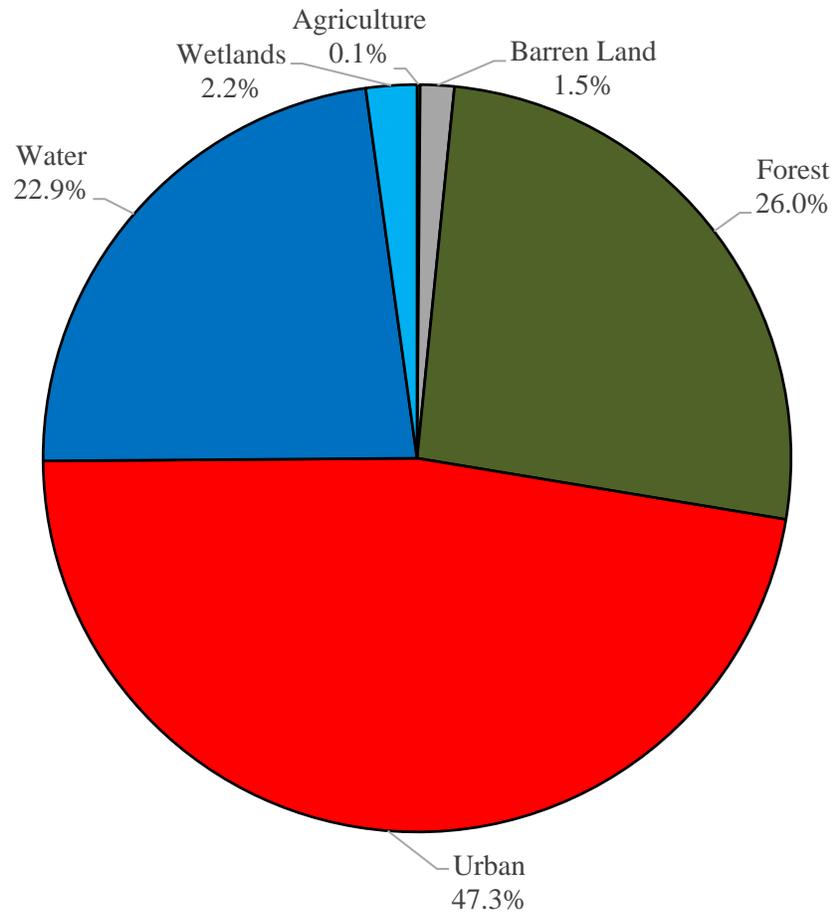
Figure 3: Pie chart illustrating the land use in Mount Arlington Borough

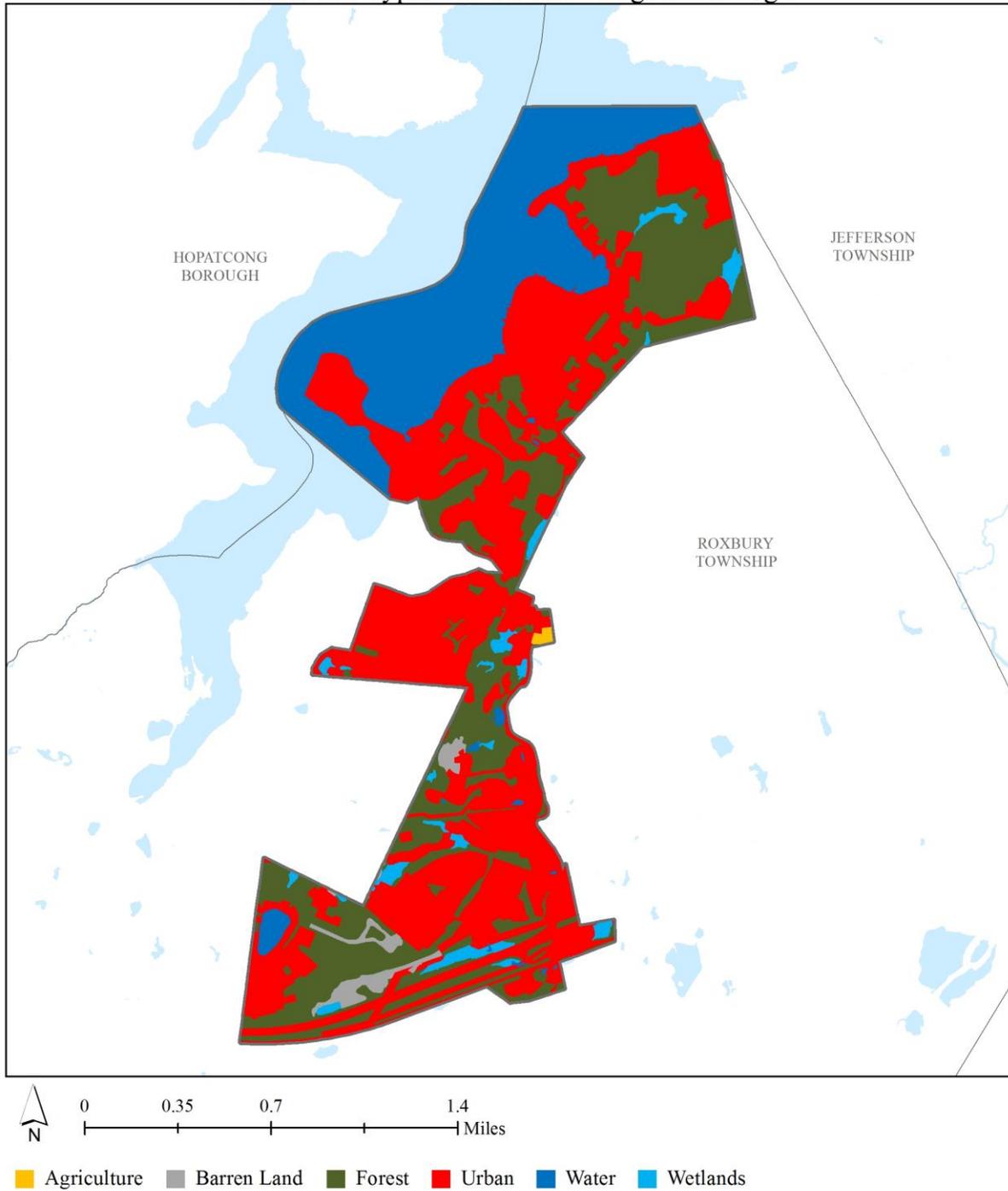# Land Use Types for Mount Arlington Borough

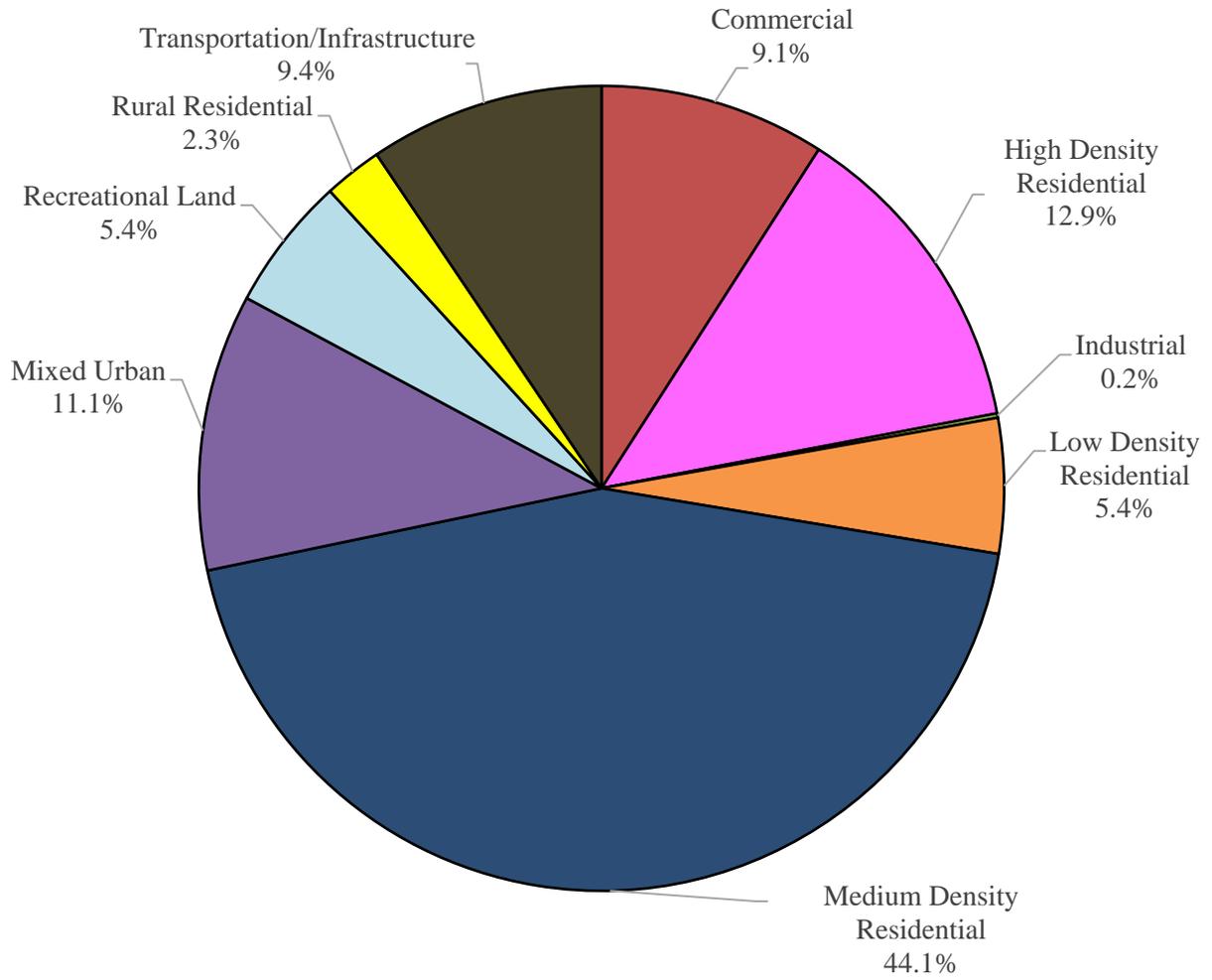Figure 4: Map illustrating the land use in Mount Arlington Borough

Figure 5: Pie chart illustrating the various types of urban land use in Mount Arlington Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Mount Arlington Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0.6% in the Rockaway River subwatershed to 23.8% in the Lake Hopatcong 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 Mount Arlington Borough, Morris 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 (3.5 inches of rain), the 10-year design storm (5.2 inches of rain), and the 100-year design storm (8.3 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Mount Arlington Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Lake Hopatcong subwatershed was harvested and purified, it could supply water to 50 homes for one year[1].

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[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Mount Arlington Borough

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi²)	(ac)	(mi²)	(ac)	(mi²)	(ac)	(mi²)	(%)
Drakes Brook	83.2	0.13	74.3	0.12	8.9	0.01	15.5	0.02	20.8%
Lake Hopatcong	1,083.4	1.69	685.2	1.07	398.3	0.62	162.8	0.25	23.8%
Lamington River	578.3	0.90	574.3	0.90	4.1	0.01	135.6	0.21	23.6%
Rockaway River	49.7	0.08	49.7	0.08	0.0	0.00	0.3	0.00	0.6%
Total	1,794.7	2.80	1,383.4	2.16	411.3	0.64	314.2	0.49	22.7%

Subwatersheds of Mount Arlington Borough

HOPATCONG
BOROUGH

JEFFERSON
TOWNSHIP

ROXBURY
TOWNSHIP

0   0.35   0.7   1.4
Miles

N

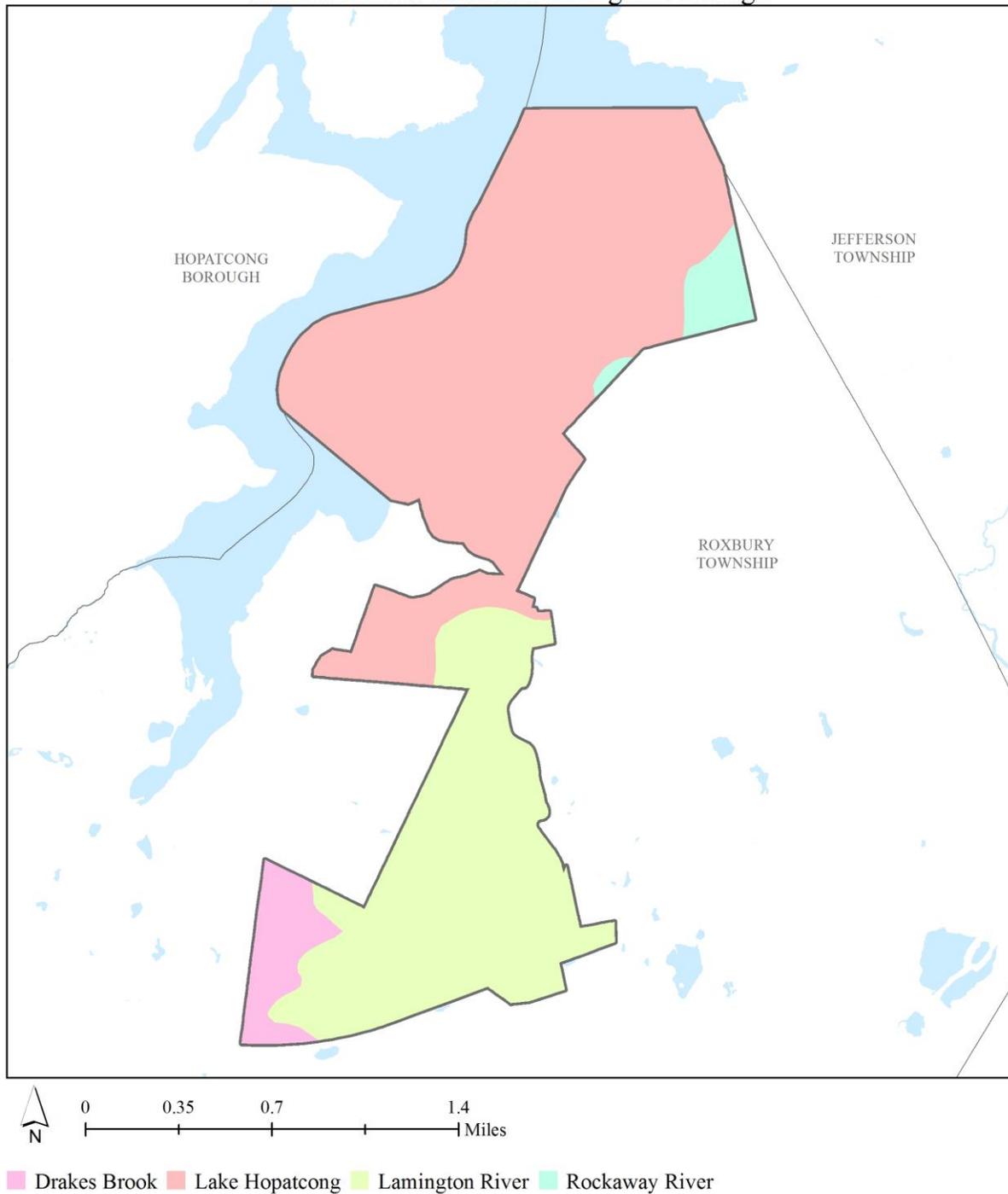Drakes Brook   Lake Hopatcong   Lamington River   Rockaway River

Figure 6: Map of the subwatersheds in Mount Arlington Borough

10

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Mount Arlington Borough

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 (3.5") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.2") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.3") (MGal)
Drakes Brook	0.5	18.5	1.5	2.2	3.5
Lake Hopatcong	5.5	194.5	15.5	23.0	36.7
Lamington River	4.6	162.0	12.9	19.1	30.6
Rockaway River	0.0	0.4	0.0	0.0	0.1
Total	10.7	375.4	29.9	44.4	70.8

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 Mount Arlington Borough. 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 (3.5 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 Mount Arlington Borough

Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction[2] (Mgal)
Drakes Brook	1.6	1.8
Lake Hopatcong	16.3	18.5
Lamington River	13.6	15.4
Rockaway River	0.0	0.0
Total	31.4	35.7

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[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 3.5 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)."*
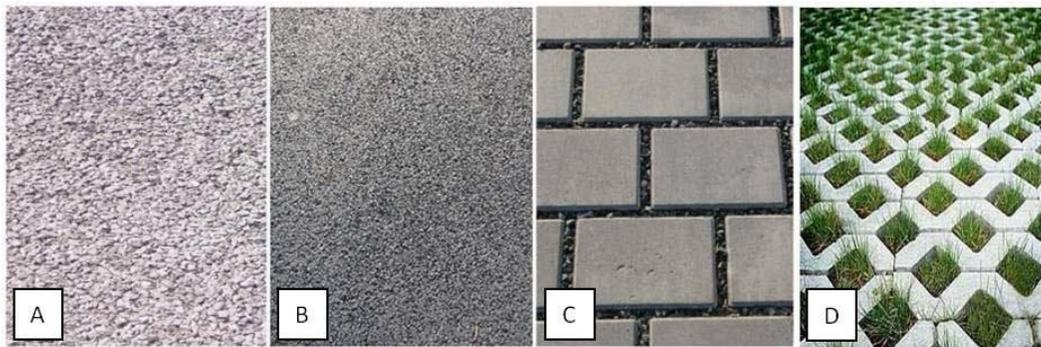
Permeable surfaces: (A) pervious concrete, (B) porous asphalt, (C) interlocking concrete pavers, (D) grid pavers (Rowe, 2012)

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

14

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.

15

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 Mount Arlington Borough

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 Mount Arlington Borough, 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

Mount Arlington Borough 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

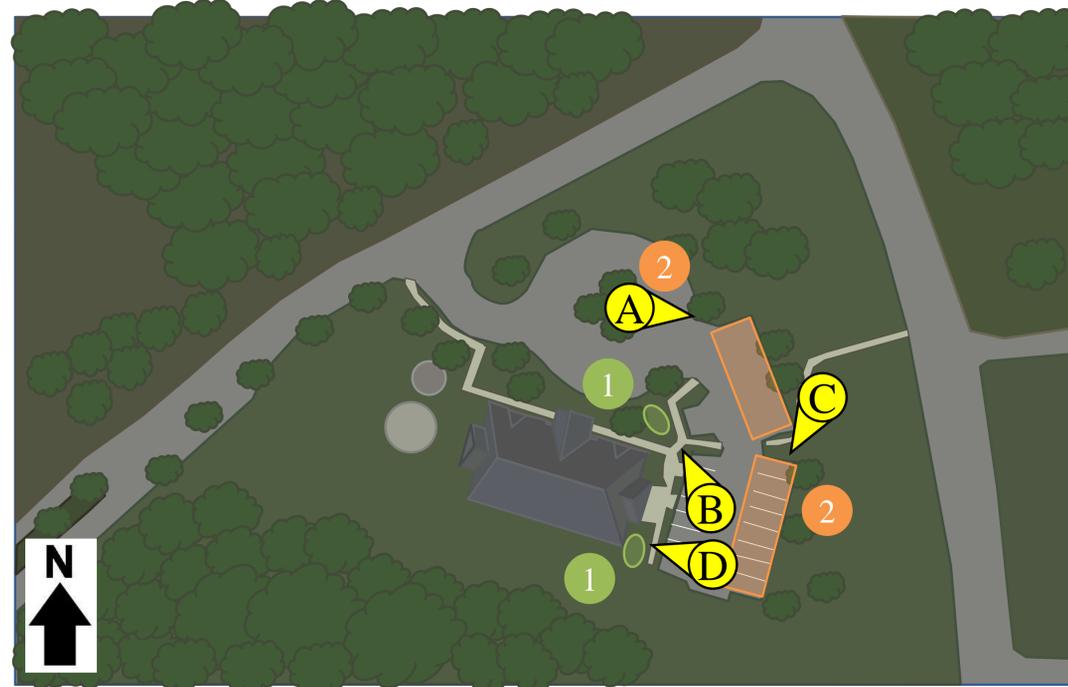**Concept Plans and Detailed Green Infrastructure Information Sheets**

Mount Arlington Borough
Impervious Cover Assessment
Mount Arlington Public Library, 333 Howard Boulevard

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

N

SITE PLAN:

N

1 BIORETENTION SYSTEMS: Rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. Two rain gardens can be installed alongside the library building.

2 POROUS PAVEMENT: The parking spaces can be replaced with porous pavement. Porous pavement promotes groundwater recharge and filters stormwater.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's, *Stormwater Management in Your Backyard*, can be delivered at Mount Arlington Public Library to educate the residents about stormwater management and engage them in building the bioretention systems.
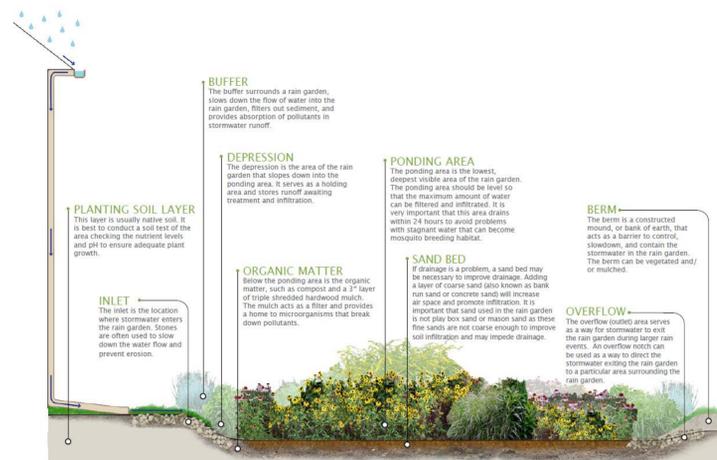
1 BIORETENTION SYSTEM

2 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

EDUCATIONAL PROGRAM

A

B

C

D

Location: 333 Howard Boulevard Mount Arlington, NJ 07856	Municipality: Mount Arlington Borough
	Subwatershed: Lake Hopatcong
Green Infrastructure Description: bioretention systems (rain gardens) 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 #1: 2,660 gal. rain garden #2: 10,420 gal. porous pavement #1: 136,920 gal. porous pavement #2: 11,6530 gal.

Existing Conditions and Issues:
Stormwater runoff generated by the parking lot is being directed to catch basins without being given the opportunity to infiltrate. The library's connected downspouts do not allow rooftop runoff to infiltrate. There are open, grassed areas nearby some of these connected downspouts.

Proposed Solution(s):
A bioretention system can be installed in the grassed area near the northeast corner of the library. A second bioretention system can be built in the grass area near the southeast corner of the building. The downspouts of the building would be rerouted into these gardens to allow stormwater from the rooftop to be managed by the systems. In the parking lot, the parking spaces could be replaced with porous asphalt to manage the parking lot's runoff (northeast section #1, southeast section #2).

Anticipated Benefits:
Since the bioretention systems and porous pavement would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.5 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. The bioretention systems would provide additional benefits such as aesthetic appeal, erosion control, and wildlife habitat.

Possible Funding Sources:
Mount Arlington Borough
mitigation funds from local developers
NJDEP grant programs
grants from foundations

Partners/Stakeholders:
Mount Arlington Borough
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 250 square feet in size. At $5 per square foot, the estimated cost of the rain garden would be $1,250. Rain garden #2 would need to be approximately 100 square feet in size. At $5 per square foot, the estimated cost of the rain garden would be $500. Porous pavement #1 is 1,300 square feet in size. At $25 per square foot, the estimated cost of the porous pavement is $32,500. Porous pavement #2 is 1,460 square feet in size. At $25 per square foot, the estimated cost of the porous pavement is $36,500. The total cost of the project is approximately $70,750.

Mount Arlington Borough
Impervious Cover Assessment
Mount Arlington Borough Police, 520 Altenbrand Avenue

RUTGERS
New Jersey Agricultural
Experiment Station

A

B

C

PROJECT LOCATION:

Altenbrand Ave
Altenbrand Ave
N Glen Ave
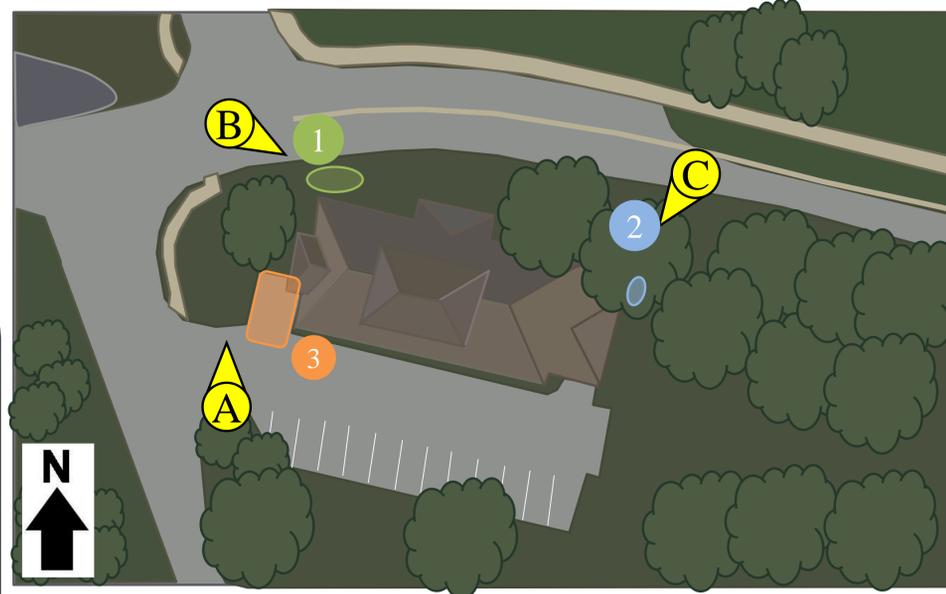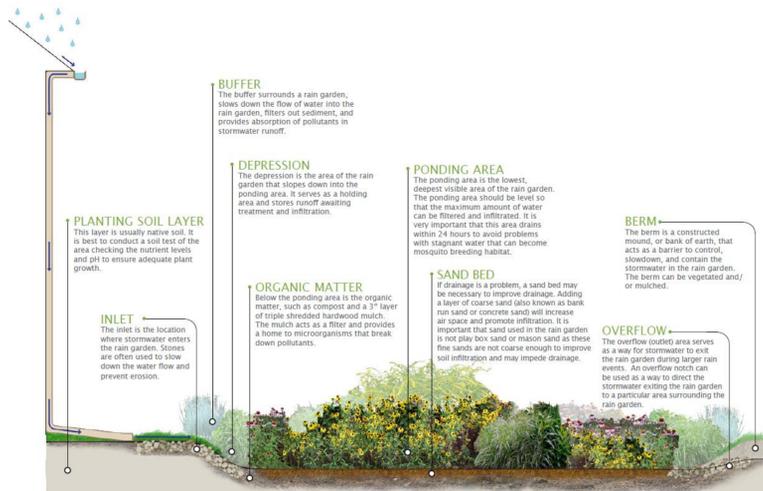nere Ave
Mt Arlington Boro Police

N

SITE PLAN:

B 1
C 2
3
A
N

1 **BIORETENTION SYSTEMS:** A rain garden can be installed in the turfgrass area alongside Altenbrand Avenue. Rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

2 **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the roof of the building and stored in a cistern. The water can be used to wash vehicles and to water the existing landscaping.

3 **POROUS PAVEMENT:** Parking spaces adjacent to the building can be replaced with porous pavement. Porous pavement promotes groundwater recharge and filters stormwater.
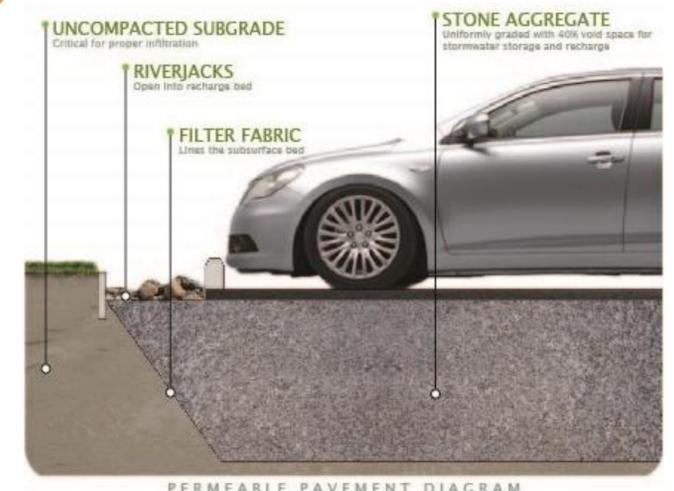
1 BIORETENTION SYSTEM

2 RAINWATER HARVESTING SYSTEM

3 POROUS PAVEMENT

PERMEABLE PAVEMENT DIAGRAM

| Location:
520 Altenbrand Avenue
Mount Arlington, NJ 07856 | Municipality:
Mount Arlington Borough |
| | Subwatershed:
Lake Hopatcong |
| 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 garden: 38,820 gal.
porous pavement: 26,580 gal.
rainwater harvesting system: 4,875 gal. |

Existing Conditions and Issues:
The building and parking lot are impervious surfaces that generate stormwater runoff. Stormwater runoff from Altenbrand Avenue is directed into a catch basin without any possibility for infiltration.

Proposed Solution(s):
A bioretention system can be installed in the turfgrass area alongside Altenbrand Avenue. A curb cut would allow this system to manage runoff from the street. Porous pavement can be implemented in the two parking spaces to the west of the building by redirecting runoff from the building's rooftop on it. A rainwater harvesting system can be set up next to the garage to collect and store rain water for use in washing vehicles or watering existing landscaping.

Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.5 inches of rain over 24 hours), this system is estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. This system would provide additional benefits such as aesthetic appeal, erosion control, and wildlife habitat.

Porous pavement allows stormwater to infiltrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS as the bioretention system.

Cisterns can harvest stormwater which can be used for watering plants, or other purposes which cuts back on use of potable water for nondrinking purposes. Since the rainwater harvesting system would be designed to capture the first 1.25 inches of rain, it 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 chance of freezing).

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
grants from foundations

Partners/Stakeholders:
Mount Arlington Borough
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

Estimated Cost:
The rain garden would be 255 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $1,275. The porous pavement would be 250 square feet and cost $25 per square foot for an estimated cost of $6,250. The stormwater harvesting system is designed to contain 1,000 gallons. At $2 per gallon, the estimated cost of the stormwater harvesting system is $2,000. The total cost of the project is approximately $9,525.
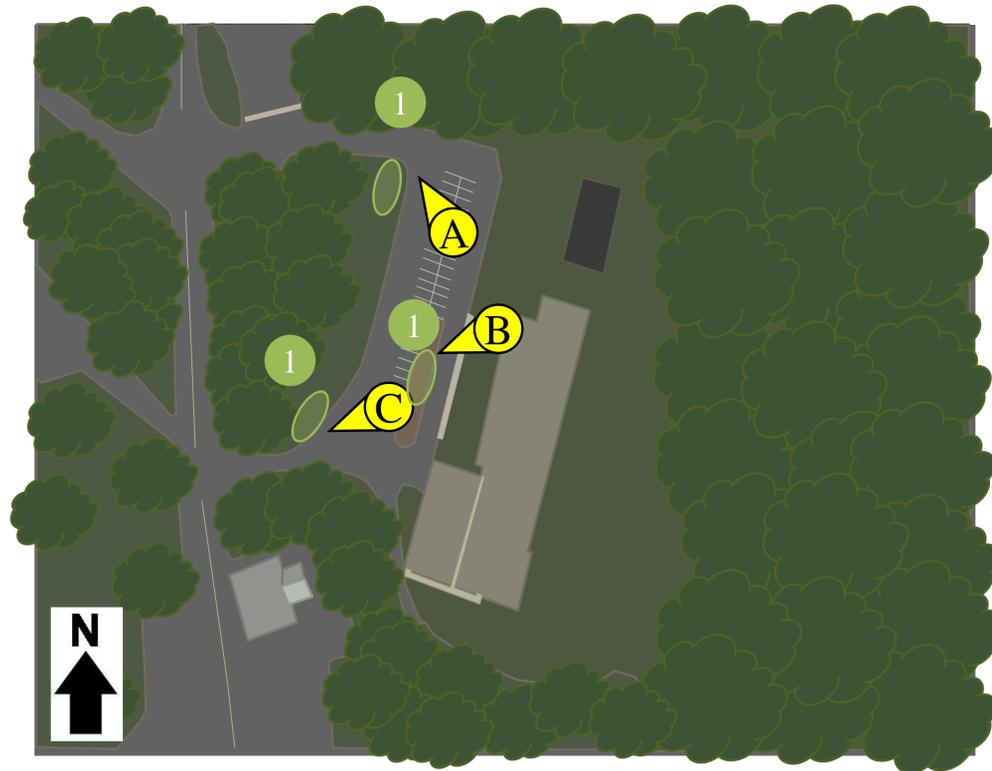
Mount Arlington Borough
Impervious Cover Assessment
Edith M. Decker Elementary School, 446 Howard Boulevard

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

N

SITE PLAN:

N
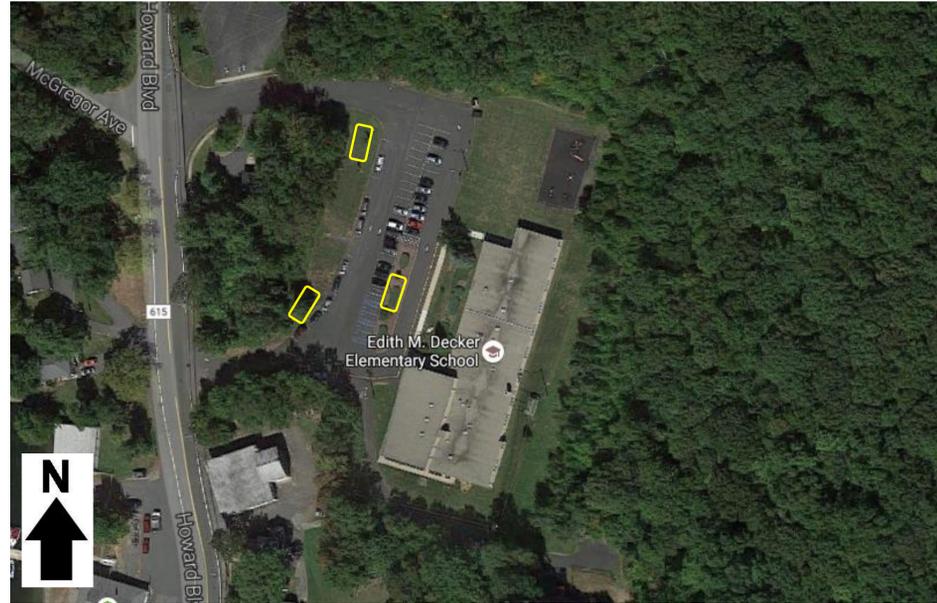
BIORETENTION SYSTEMS: Two rain gardens can be installed in the grass area alongside the west end of the parking lot. Another rain garden can be built in the island located in the parking lot. Rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's, *Stormwater Management in Your Schoolyard*, can be delivered at Edith M. Decker Elementary School to educate the students about stormwater management and engage them in building the bioretention systems.

A

B

C

1 BIORETENTION SYSTEM

EDUCATIONAL PROGRAM

Location:	**Municipality:**
446 Howard Boulevard Mount Arlington, NJ 07856	Mount Arlington Borough
	Subwatershed: Lake Hopatcong

Green Infrastructure Description:	**Targeted Pollutants:**
bioretention systems (rain gardens)	total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff

Mitigation Opportunities:	**Stormwater Captured and Treated Per Year:**
recharge potential: yes TSS removal potential: yes stormwater peak reduction potential: yes	rain garden #1: 239,709 gal. rain garden #2: 107,609 gal. rain garden #3: 42,470 gal.

Existing Conditions and Issues:
A portion of this site's surface area is covered with asphalt which generates runoff during storm events. This stormwater runoff enters the grass area alongside the parking lot and is causing erosion issues.

Proposed Solution(s):
Two bioretention system can be installed in the grass area along the west side of the parking lot. Bioretention system #1 would be toward the north end and #2 toward the southern end. The inlet channels of these systems would be lined with river stone to help prevent erosion. A third bioretention system can be built in the island located in the parking lot.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.5 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. These systems would provide additional benefits such as aesthetic appeal, erosion control, and wildlife habitat.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
grants from foundations
home and school associations

Partners/Stakeholders:
Mount Arlington Borough
local community groups (Boy Scouts, Girl Scouts, etc.)
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 2,300 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $11,500. Rain garden #2 would need to be approximately 1,050 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $5,250. Rain garden #3 would need to be approximately 410 square feet in size. At $5 per square foot, the estimated cost of the rain garden is $2,050. The total cost of the project is approximately $18,800.