



Draft

**Impervious Cover Assessment
for
Marlboro Township, Monmouth County, New Jersey**

*Prepared for Marlboro Township by the
Rutgers Cooperative Extension Water Resources Program*

February 4, 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

Marlboro Township Impervious Cover Analysis

Located in Monmouth County in central New Jersey, Marlboro Township covers approximately 30.4 square miles. Figures 3 and 4 illustrate that Marlboro Township is dominated by urban land uses. A total of 52.0% of the municipality's land use is classified as urban. Of the urban land in Marlboro 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 streams typically have a watershed impervious surface cover from 0 – 10%. Impacted streams have a watershed impervious cover ranging from 11-25% and typically show clear signs of degradation from urbanization. Non-supporting streams have a watershed impervious cover of greater than 25%; at this high level of impervious cover, streams are simply conduits for stormwater flow and no longer support a diverse stream community.

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Marlboro 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 Marlboro Township. Based upon the 2007 NJDEP land use/land cover data, approximately 14.9% of Marlboro Township has impervious cover. This level of impervious cover suggests that the streams in Marlboro Township are likely impacted.

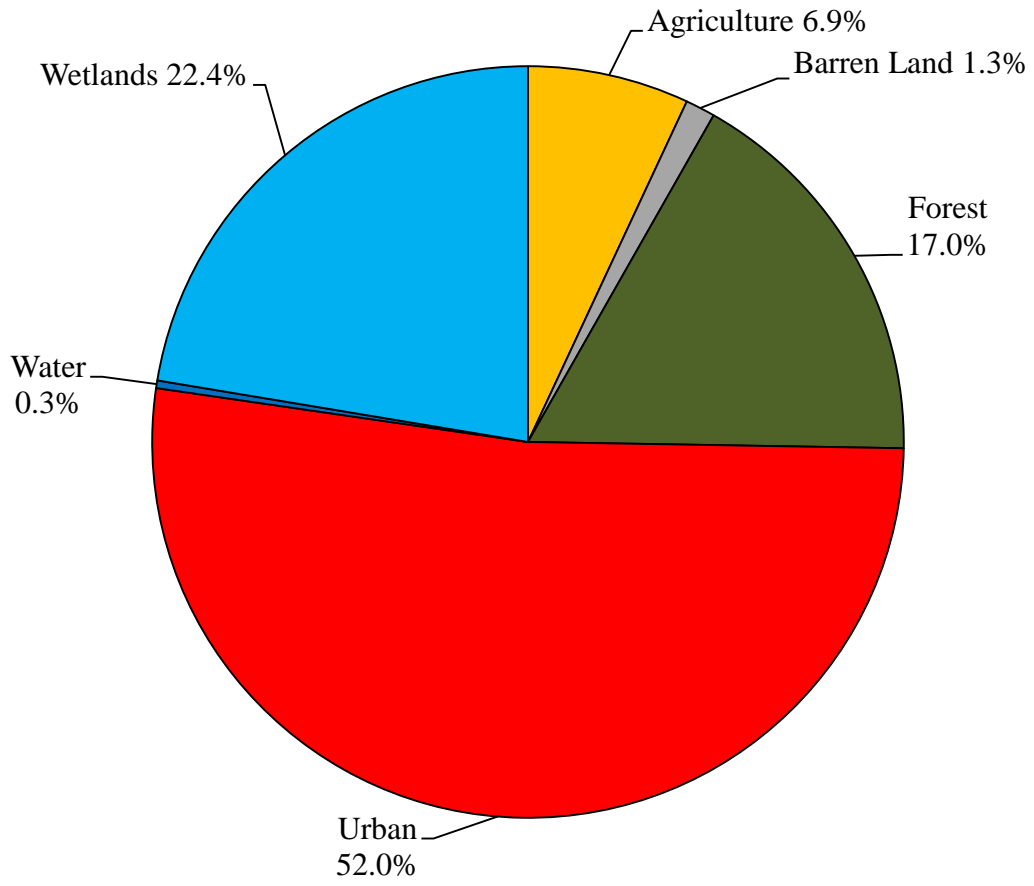


Figure 3: Pie chart illustrating the land use in Marlboro Township

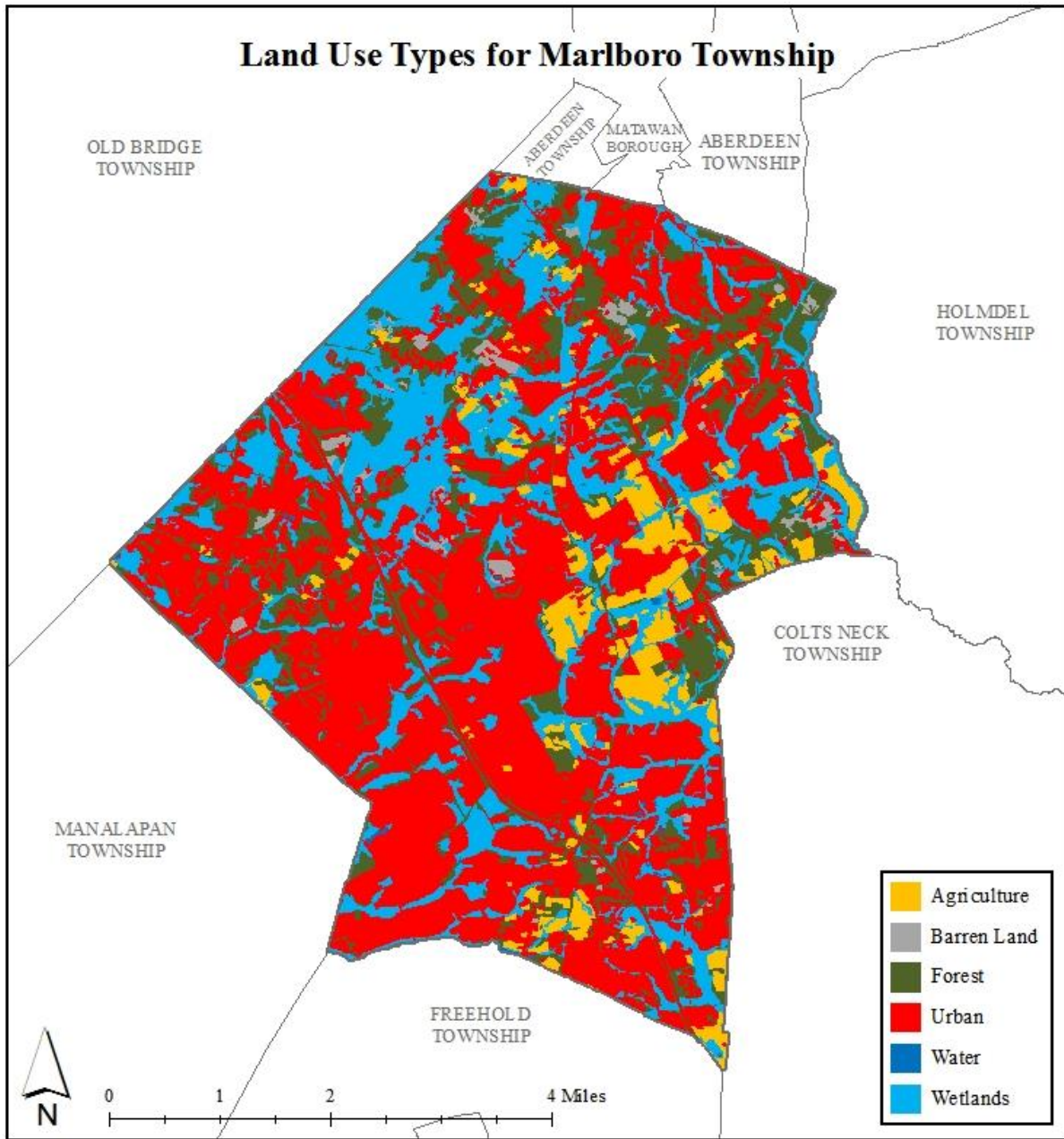


Figure 4: Map illustrating the land use in Marlboro Township

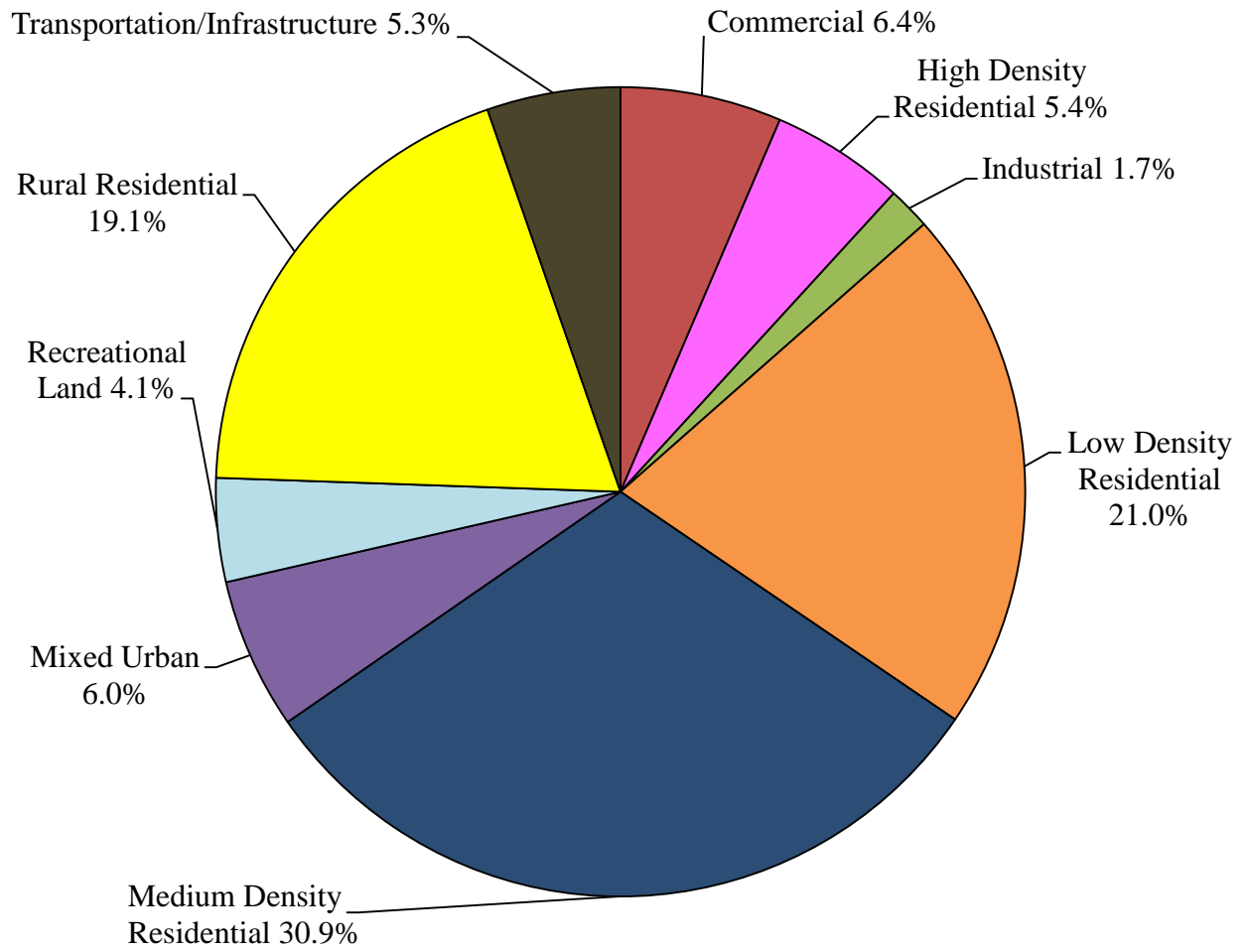


Figure 5: Pie chart illustrating the various types of urban land use in Marlboro Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Marlboro Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 5.93% in the Willow Brook subwatershed to 28.9% in the Barclay 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 Marlboro Township, Monmouth 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 (3.4 inches of rain), the 10-year design storm (5.2 inches of rain), and the 100-year design storm (8.9 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Marlboro Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Deep Run subwatershed was harvested and purified, it could supply water to 228 homes for one year¹.

¹ Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Marlboro Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(ac)	(mi ²)	(%)
Barclay Brook	740.7	1.16	738.2	1.15	2.53	0.00	213.7	0.33	28.9%
Big Brook	3,418.1	5.34	3,400.9	5.31	17.2	0.03	504.3	0.79	14.8%
Deep Run	5,740.9	8.97	5,722.3	8.94	18.6	0.03	736.2	1.15	12.9%
Matawan Creek	1,910.6	2.99	1,908.4	2.98	2.22	0.00	270.6	0.42	14.2%
Matchaponix Brook	961.6	1.50	960.9	1.50	0.69	0.00	210.3	0.33	21.9%
McGellairds Brook	3,313.3	5.18	3,300.5	5.16	12.9	0.02	718.0	1.12	21.8%
Willow Brook	2,357.5	3.68	2,349.6	3.67	7.91	0.01	139.3	0.22	5.93%
Yellow Brook	1,034.6	1.62	1,032.8	1.61	1.87	0.00	100.4	0.16	9.72%
Total	19,477.4	30.4	19,413.6	30.3	63.8	0.10	2,892.7	4.52	14.9%

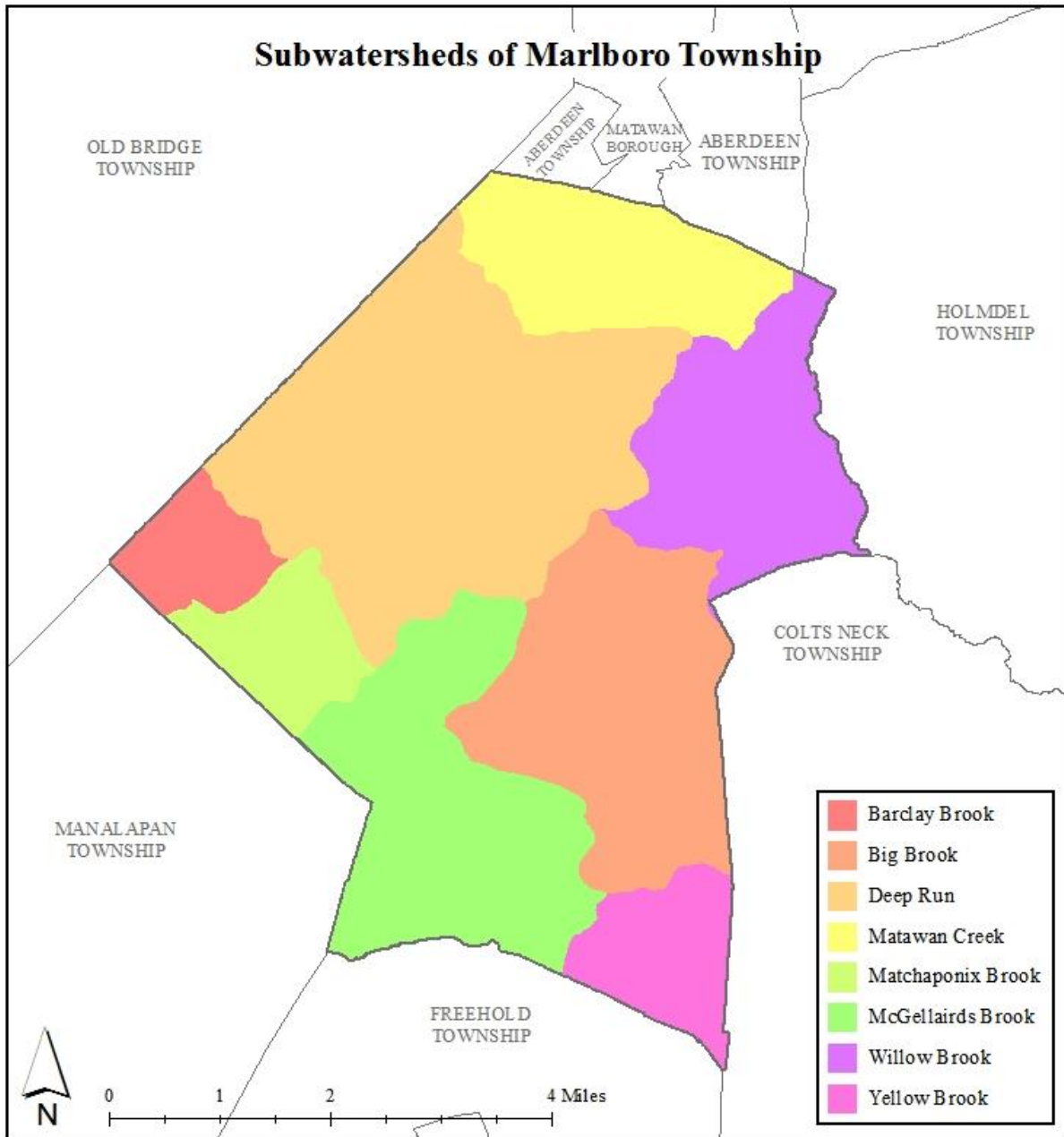


Figure 6: Map of the subwatersheds in Marlboro Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Marlboro 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 (3.4") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.2") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.9") (MGal)
Barclay Brook	7.3	255.3	19.7	30.2	51.6
Big Brook	17.1	602.5	46.6	71.2	121.9
Deep Run	25.0	879.6	68.0	103.9	177.9
Matawan Creek	9.2	323.3	25.0	38.2	65.4
Matchaponix Brook	7.1	251.3	19.4	29.7	50.8
McGellairds Brook	24.4	857.8	66.3	101.4	173.5
Willow Brook	4.7	166.4	12.9	19.7	33.7
Yellow Brook	3.4	119.9	9.3	14.2	24.3
Total	98.2	3,455.9	267.1	408.4	699.0

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 Marlboro 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 (3.4 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 Marlboro Township

Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction ² (MGal)
Barclay Brook	21.4	24.2
Big Brook	50.4	57.2
Deep Run	73.6	83.6
Matawan Creek	27.1	30.7
Matchaponix Brook	21.0	23.9
McGellairds Brook	71.8	81.5
Willow Brook	13.9	15.8
Yellow Brook	10.0	11.4
Total	289.3	328.3

² Annual Runoff Volume Reduction =

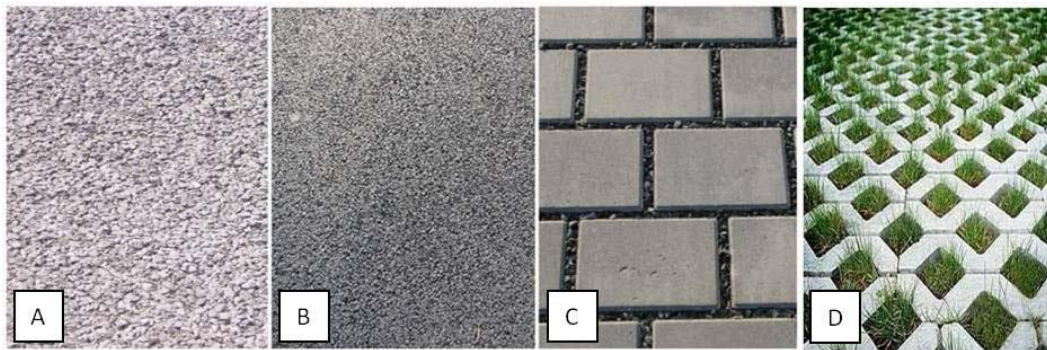
Acres of impervious cover x 43,560 ft²/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft³) x (1 MGal/1,000,000 gal)

All green infrastructure should be designed to capture the first 3.4 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 Marlboro 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 Marlboro 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

Marlboro 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

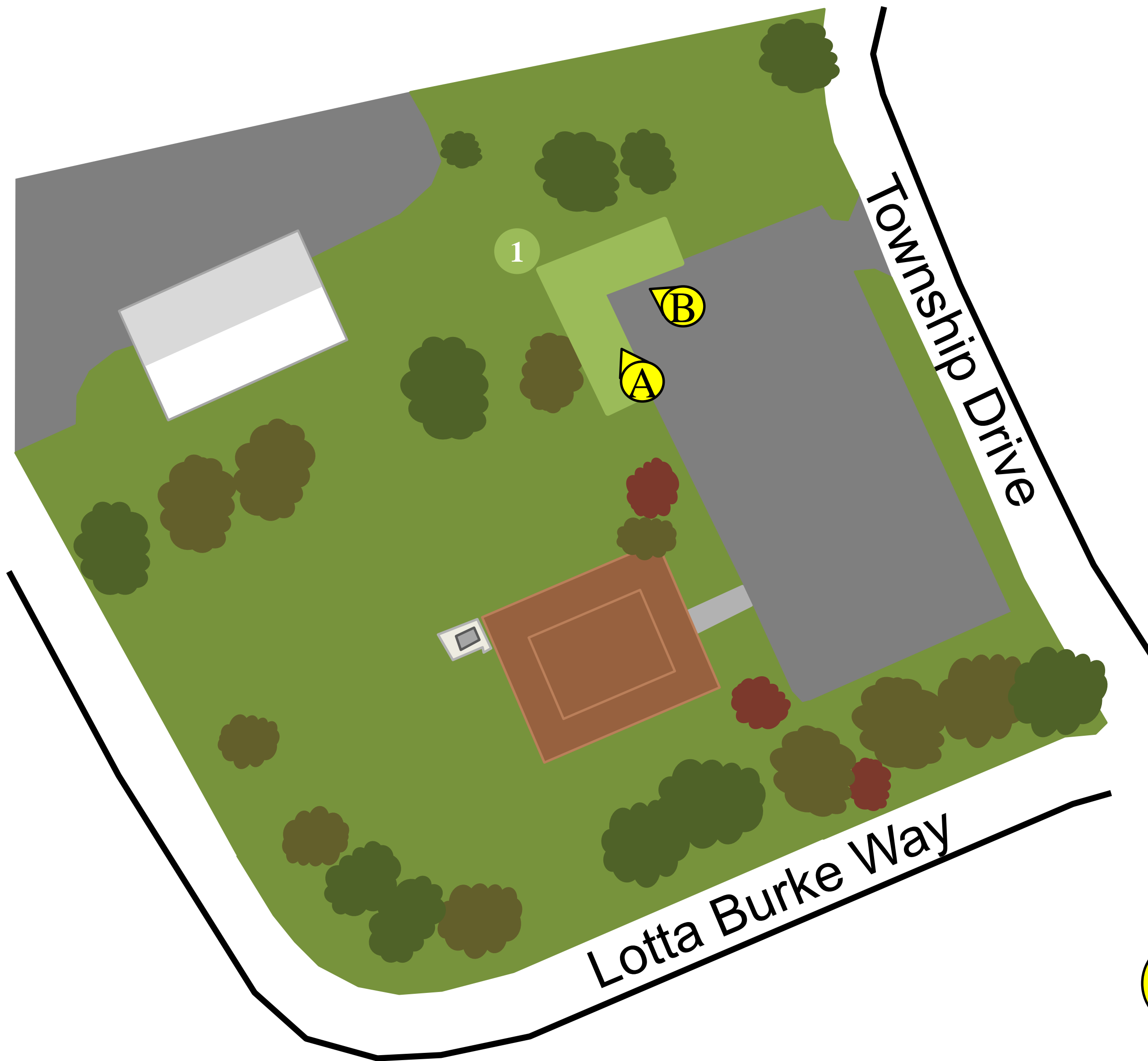
Examples of Impervious Cover Reduction Action Plan Projects Concept Plans and Detailed Green Infrastructure Information Sheets

Marlboro Township Impervious Cover Assessment

Early Learning Center, 1980 Township Drive

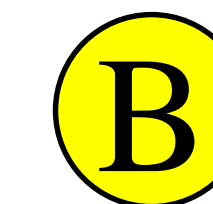
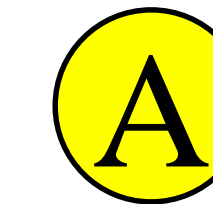
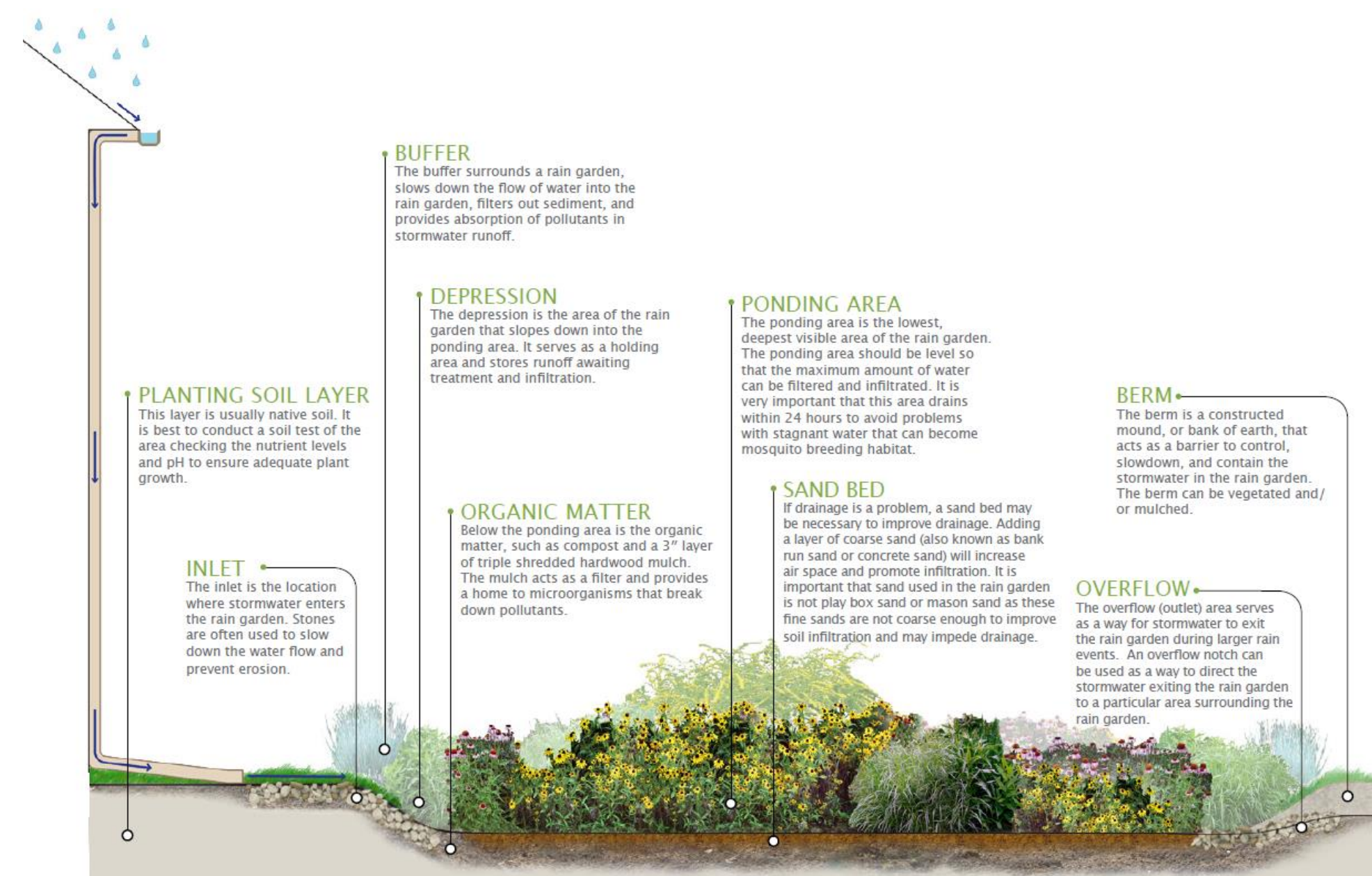
PROJECT LOCATION:

SITE PLAN:



1 BIORETENTION SYSTEM: A bioretention system could be installed in the grass at the northwestern corner of the parking lot. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reaches catch basins.

1 BIORETENTION SYSTEM



Marlboro Early Learning Center
Green Infrastructure Information Sheet

<p>Location: 1980 Township Drive Marlboro, NJ, 07746</p>	<p>Municipality: Marlboro Township</p>
<p>Green Infrastructure Description: bioretention system (rain garden)</p>	<p>Subwatershed: McGellairds Brook</p> <p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Stormwater Captured and Treated Per Year: bioretention system: 229,300 gal.</p>
<p>Existing Conditions and Issues: This site contains several impervious surfaces including a driveway, a parking lot, and a building. The site's impervious surfaces produce stormwater runoff during rain events. The area of interest at this site is the grass area between the Early Learning Center and the Department of Public Works at the northwestern corner of the parking lot. There were several signs of erosion at this location at the time of the site visit – gullies, eroded lawn, slumping soil, debris, etc. Based on tire tracks observed at the time of the site visit, it seems that this area was used as an access point for the Department of Public Works. The parking lot is graded so that stormwater flows to this corner of the lot. This presents a flooding problem for the Department of Public Works parking lot below.</p>	
<p>Proposed Solution(s): A bioretention system could be installed at this site to capture, treat, and infiltrate stormwater runoff from the parking areas and enhance the site's aesthetic quality. The proposed system would be installed in the grass at the northern corner of the parking lot. Due to the erosion that has occurred at this site, it may be beneficial to install a rock swale below the rain garden.</p>	
<p>Anticipated Benefits: Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), this system is estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits such as enhanced wildlife habitat and aesthetic appeal.</p>	
<p>Possible Funding Sources: mitigation funds from local developers NJDEP grant programs Marlboro Township Marlboro Early Learning Center local social and community groups</p>	

Marlboro Early Learning Center
Green Infrastructure Information Sheet

Partners/Stakeholders:

Marlboro Township
Marlboro Early Learning Center
local social and community groups
parents and staff
Rutgers Cooperative Extension

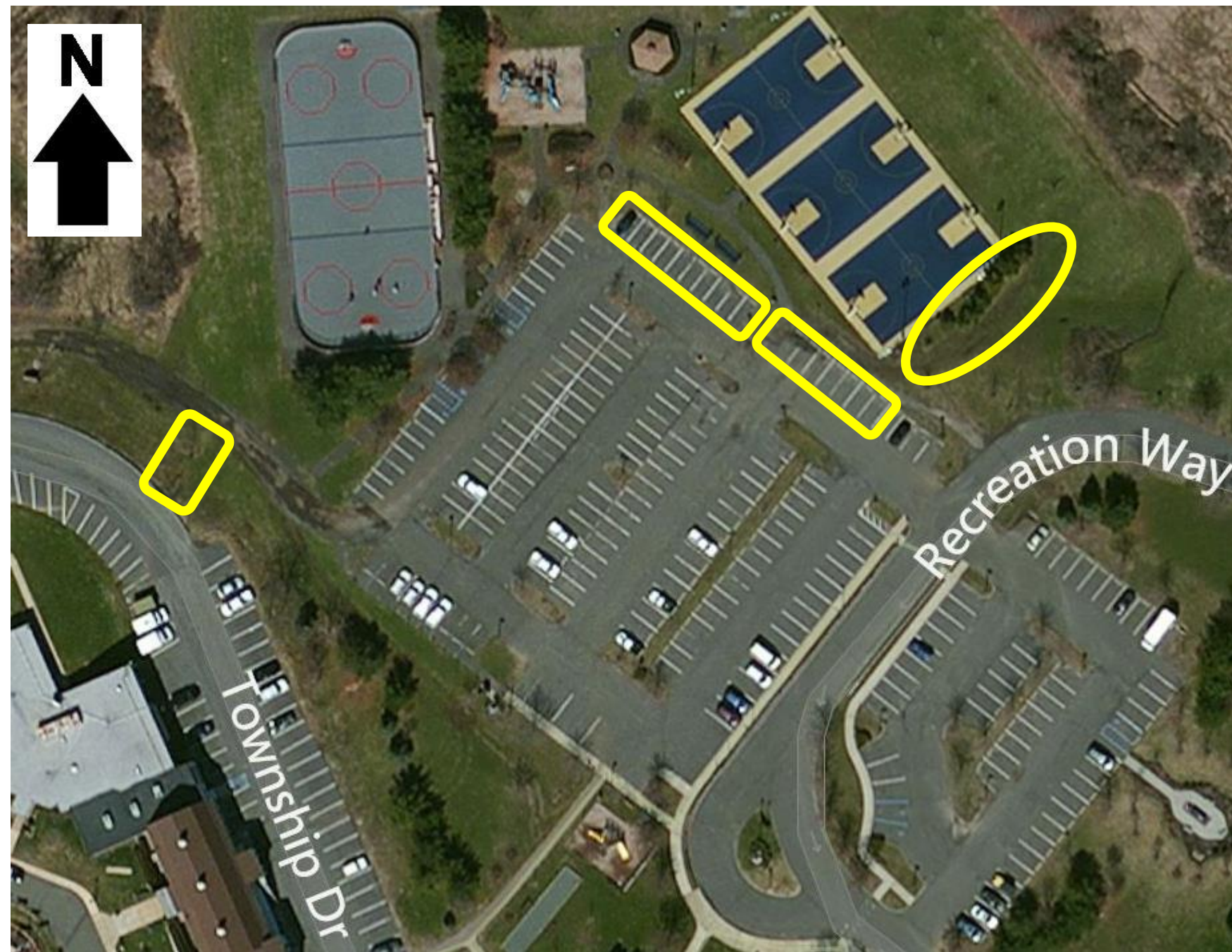
Estimated Cost:

The bioretention system would need to be approximately 2,200 square feet. At \$5 per square foot, the estimated cost of this bioretention system is \$11,000.

Marlboro Township Impervious Cover Assessment

Recreation Center, 1996 Recreation Way

PROJECT LOCATION:



A



B



C



D

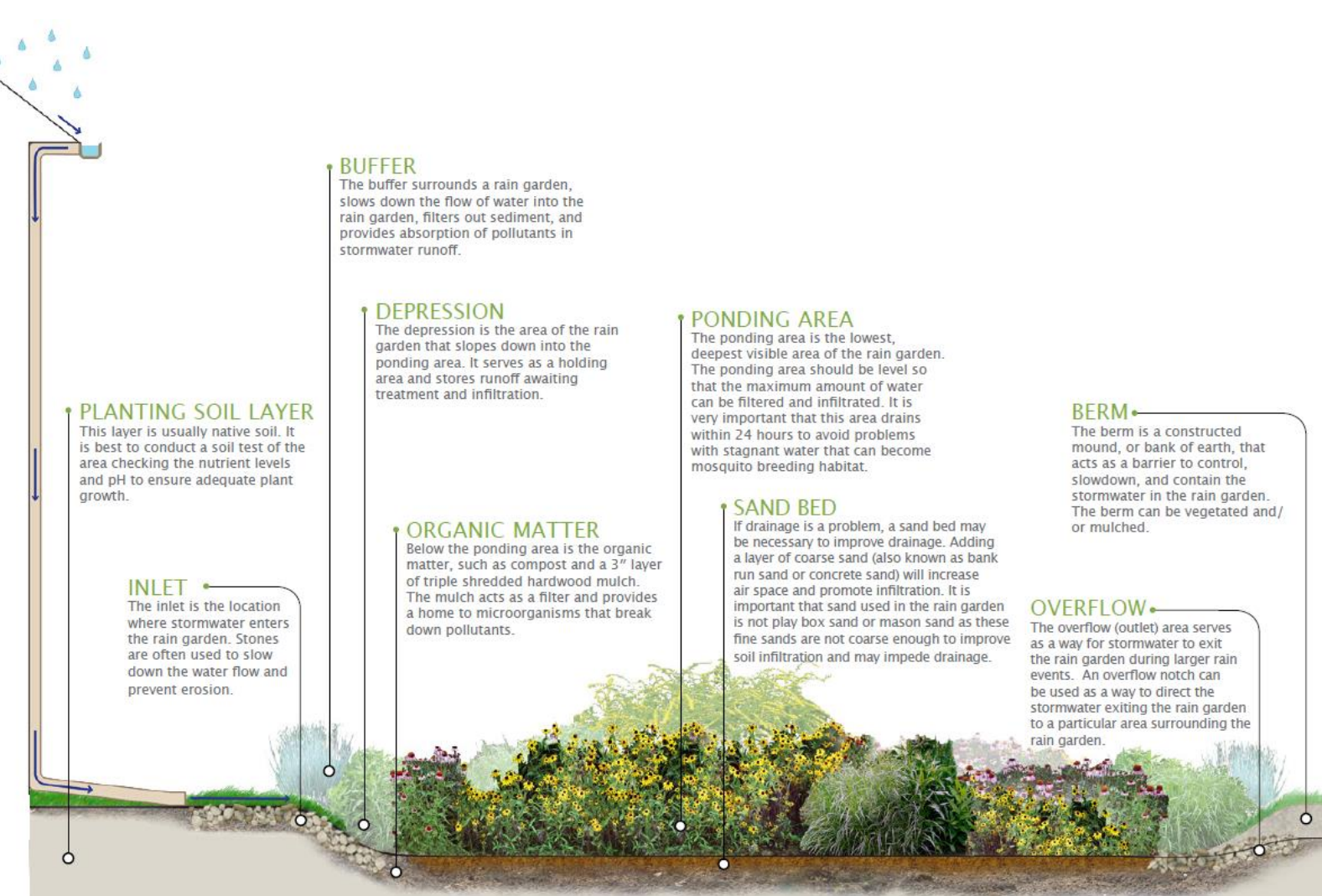


SITE PLAN:



- 1 **BIORETENTION SYSTEM:** A terraced bioretention system could be installed on a hill leading down from a Township Drive parking lot to a gravel road below. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reaches nearby wetland habitat.
- 2 **BIOSWALE:** A bioswale could be installed to the east of the basketball courts. A bioswale is a vegetated system that will convey stormwater from the parking lot to the grass while removing sediment and nutrients.
- 3 **POROUS PAVEMENT:** Two areas of porous pavement could be installed along the northern edge of the Recreation Center parking lot. Porous pavement promotes groundwater recharge and filters stormwater.

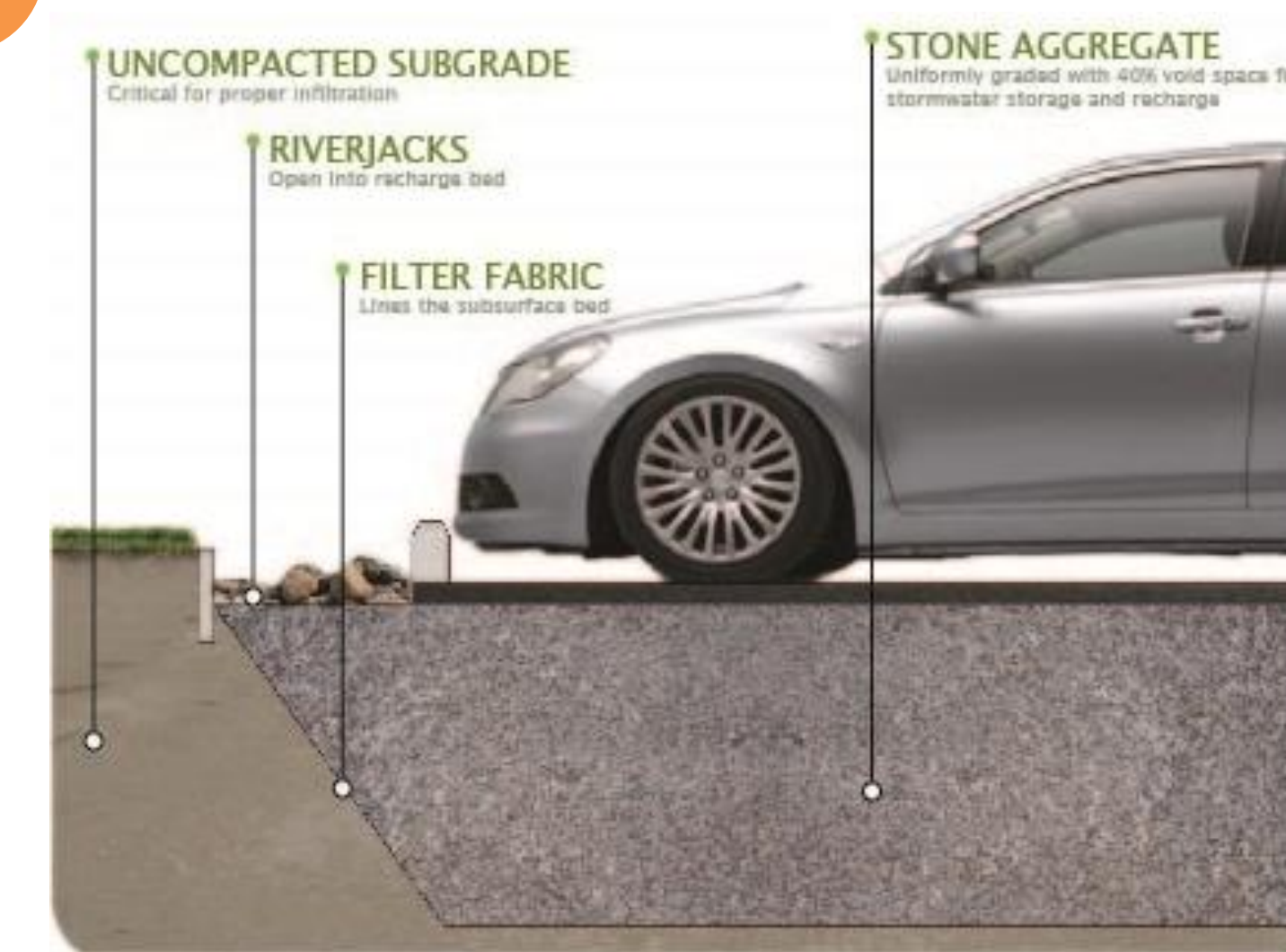
1 BIORETENTION SYSTEM



2 BIOSWALE



3 POROUS PAVEMENT



Marlboro Township Recreation Center
Green Infrastructure Information Sheet

<p>Location: 1996 Recreation Way Marlboro, New Jersey, 07746</p>	<p>Municipality: Marlboro Township</p>
<p>Green Infrastructure Description: bioretention system (terraced rain garden) bioswale porous pavement</p>	<p>Subwatershed: McGellairds Brook</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p> <p>Stormwater Captured and Treated Per Year: bioretention system: 104,200 gal. bioswale: 114,600 gal. porous pavement #1: 144,100 gal. porous pavement #2: 36,500 gal.</p>
<p>Existing Conditions and Issues: This site contains several impervious surfaces including driveways, walkways, parking areas, buildings, basketball courts, a hockey rink, and other surfaces. The site's impervious surfaces produce stormwater runoff during rain events. An extensive site investigation of the Recreation Center was conducted. The main area of interest at this site is the Recreation Way parking lot. This lot is in poor condition, especially near the basketball courts and in the centermost areas of the parking spaces. Runoff flows to the northeast near the basketball courts, which have received loads of sediment and debris. There is a gully/swale carved by erosion that runs along the eastern side of the basketball court. In the grass area to the south of the parking lot there is a natural swale carved by runoff. It appears to flow from east to west bringing water from the areas to the south to the gravel road to the west. The gravel road (which leads to the middle school sports fields) is compacted and borders nearby wetland area. Alongside this road on the west there is an outfall and a severely eroded gully on a grass hill.</p>	
<p>Proposed Solution(s): A terraced rain garden (bioretention system) could be installed along the grass hill between Township Drive and the gravel road to the middle school sports fields. A grass channel on the eastern side of the basketball courts could be transformed into a bioswale. Two parking areas could benefit from porous pavement systems.</p>	
<p>Anticipated Benefits: Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), this system is estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits such as enhanced wildlife habitat and aesthetic appeal. The porous pavement systems will achieve</p>	

Marlboro Township Recreation Center
Green Infrastructure Information Sheet

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%.

Possible Funding Sources:

mitigation funds from local developers
NJDEP grant programs
Marlboro Township
Marlboro Township Recreation Center
local social and community groups

Partners/Stakeholders:

Marlboro Township
Marlboro Township Recreation Center
local social and community groups
residents of Marlboro
Rutgers Cooperative Extension

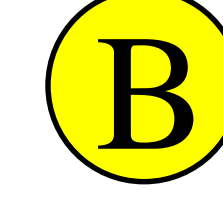
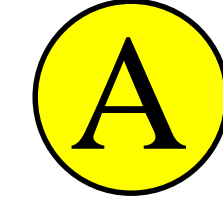
Estimated Cost:

The bioretention system would need to be approximately 1,000 square feet. At \$5 per square foot, the estimated cost of this bioretention system is \$5,000. The bioswale would be approximately 1,100 square feet. At \$5 per square foot, the estimated cost of this bioretention system is \$5,500. Porous pavement system #1 would cover approximately 1,620 square feet and have a 3 feet deep stone reservoir under the surface. At \$30 per square foot, the cost of the porous pavement system is \$48,600. Porous pavement system #2 would cover approximately 1,440 square feet and have a 2 feet deep stone reservoir under the surface. At \$25 per square foot, the cost of the porous pavement system is \$36,000. The total cost of the project will be approximately \$95,100.

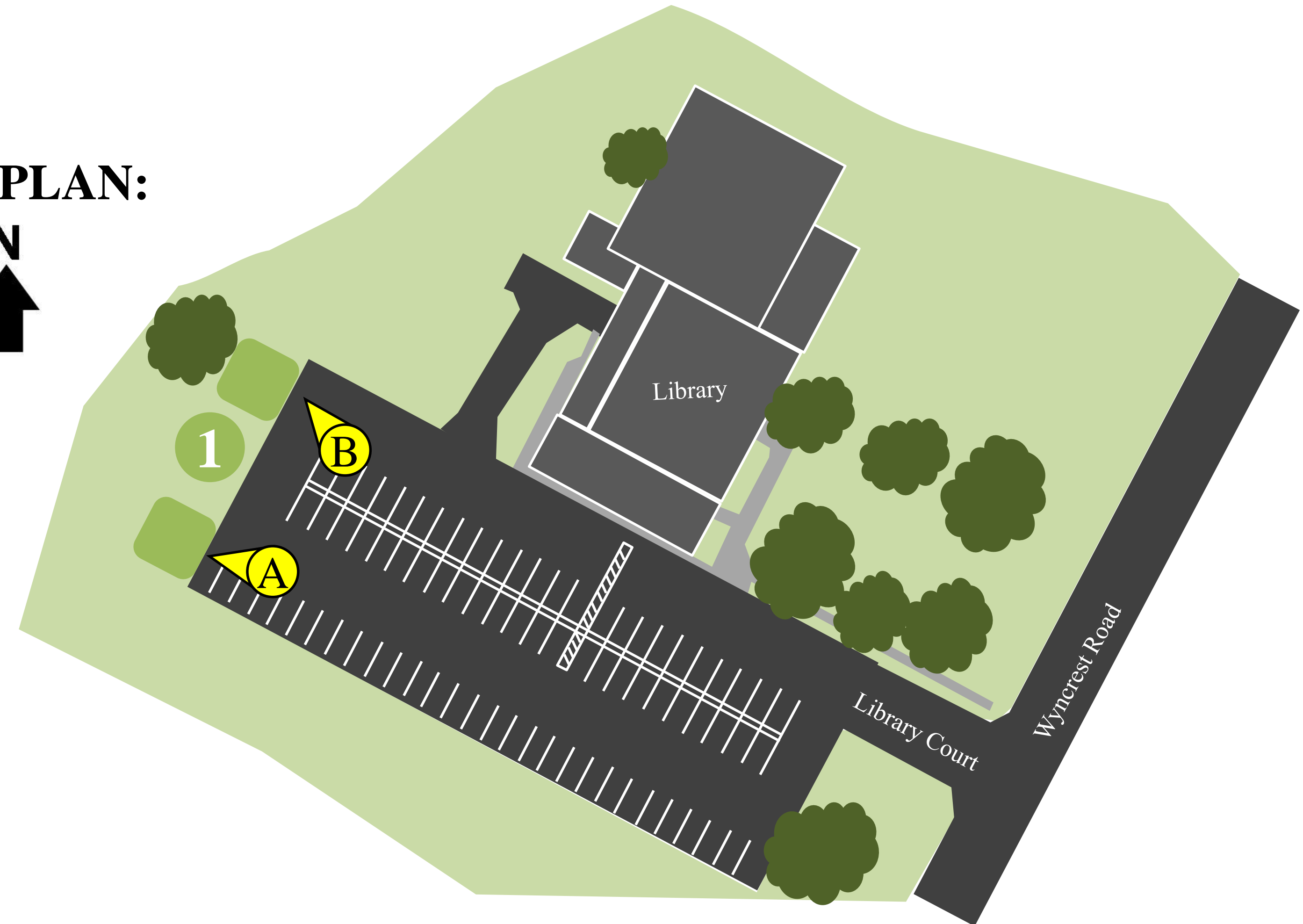
Marlboro Township Impervious Cover Assessment

Marlboro Public Library, 1 Library Court

PROJECT LOCATION:



SITE PLAN:



1 BIORETENTION SYSTEMS: Two bioretention systems could be installed on the turf grass area adjacent to the western portion of the library parking lot. These systems will capture and treat the existing runoff entering this area during rain storm events. Bioretention systems will reduce the peak flow of runoff, reduce erosion, and allow stormwater infiltration, decreasing the amount of contaminants that reaches local waterways.

EDUCATIONAL PROGRAM: The RCE Water Resources Program's *Stormwater Management in Your Backyard* program can be delivered at the Marlboro Free Public Library to educate citizens about stormwater management and engage them in designing and building rain gardens.

1 BIORETENTION SYSTEM



EDUCATIONAL PROGRAMS



Marlboro Public Library
Green Infrastructure Information Sheet

<p>Location: 1 Library Court Marlboro, New Jersey, 07746</p>	<p>Municipality: Marlboro Township</p>
<p>Green Infrastructure Description: bioretention systems (rain gardens)</p>	<p>Subwatershed: McGellairds Brook</p>
<p>Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p>Targeted Pollutants: total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff</p> <p>Stormwater Captured and Treated Per Year: bioretention system #1: 156,300 gal. bioretention system #2: 156,300 gal.</p>
<p>Existing Conditions and Issues: This site contains several impervious surfaces including a driveway, walkways, a parking area, and a library complex. These impervious surfaces are directly connected to a storm sewer system. The site's impervious surfaces produce stormwater runoff during rain events. The library's land parcel occupies a portion of land along Newman Springs Road and Wyncrest Road, which is mostly grass. It is just southeast of a natural waterway. The library's parking lot is the largest impervious surface at this site. The lot's stormwater flows to its northwestern edge, where its two corners open to turf grass.</p>	
<p>Proposed Solution(s): Two bioretention systems could be installed at this site to treat runoff from the parking lot and enhance the site's aesthetic quality. Each system would be installed in the grass near a corner of the parking lot's northwestern edge. Together, these systems could treat half of the parking lot's total runoff.</p>	
<p>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. A bioretention system would also provide ancillary benefits such as enhanced wildlife habitat and aesthetic appeal. Rutgers Cooperative Extension could additionally present the <i>Stormwater Management in Your Backyard</i> program to residents and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for the Marlboro Township Department of Public Works staff to launch educational programming.</p>	
<p>Possible Funding Sources: mitigation funds from local developers NJDEP grant programs</p>	

Marlboro Public Library
Green Infrastructure Information Sheet

Marlboro Township
Marlboro Public Library
local social and community groups

Partners/Stakeholders:

Marlboro Township
Marlboro Public Library
local social and community groups
local residents
Rutgers Cooperative Extension

Estimated Cost:

Bioretention system #1 would need to be approximately 1,500 square feet. At \$5 per square foot, the estimated cost of this bioretention system is \$7,500. Bioretention system #2 would need to be approximately 1,500 square feet. At \$5 per square foot, the estimated cost of this bioretention system is \$7,500. The total cost of the project will be approximately \$15,000.