RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Assessment for Pennsville Township, Salem County, New Jersey

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

March 27, 2018

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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 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

Pennsville Township Impervious Cover Analysis

Pennsville Township is located in Salem County, New Jersey and covers approximately 24.84 square miles west of Mannington. Figures 3 and 4 illustrate that Pennsville Township is dominated by wetlands land uses. A total of 23.3% of the municipality's land use is classified as urban. Of the urban land in Pennsville Township, medium density residential is the dominant land use (Figure 5).

The literature suggests a link between impervious cover and stream ecosystem impairment (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. Schueler (1994, 2004) developed an impervious cover model that classified "sensitive streams" as typically having 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. Schueler et al. (2009) reformulated the impervious cover model based upon new research that had been conducted. This new analysis determined that stream degradation was first detected at 2 to 15% impervious cover. The updated impervious cover model recognizes the wide variability of stream degradation at impervious cover below 10%. The updated model also moves away from having a fixed line between stream quality classifications. For example, 5 to 10% impervious cover is included for the transition from sensitive to impacted, 20 to 25% impervious cover for the transition between impacted and non-supporting, and 60 to 70% impervious cover for the transition from non-supporting to urban drainage.

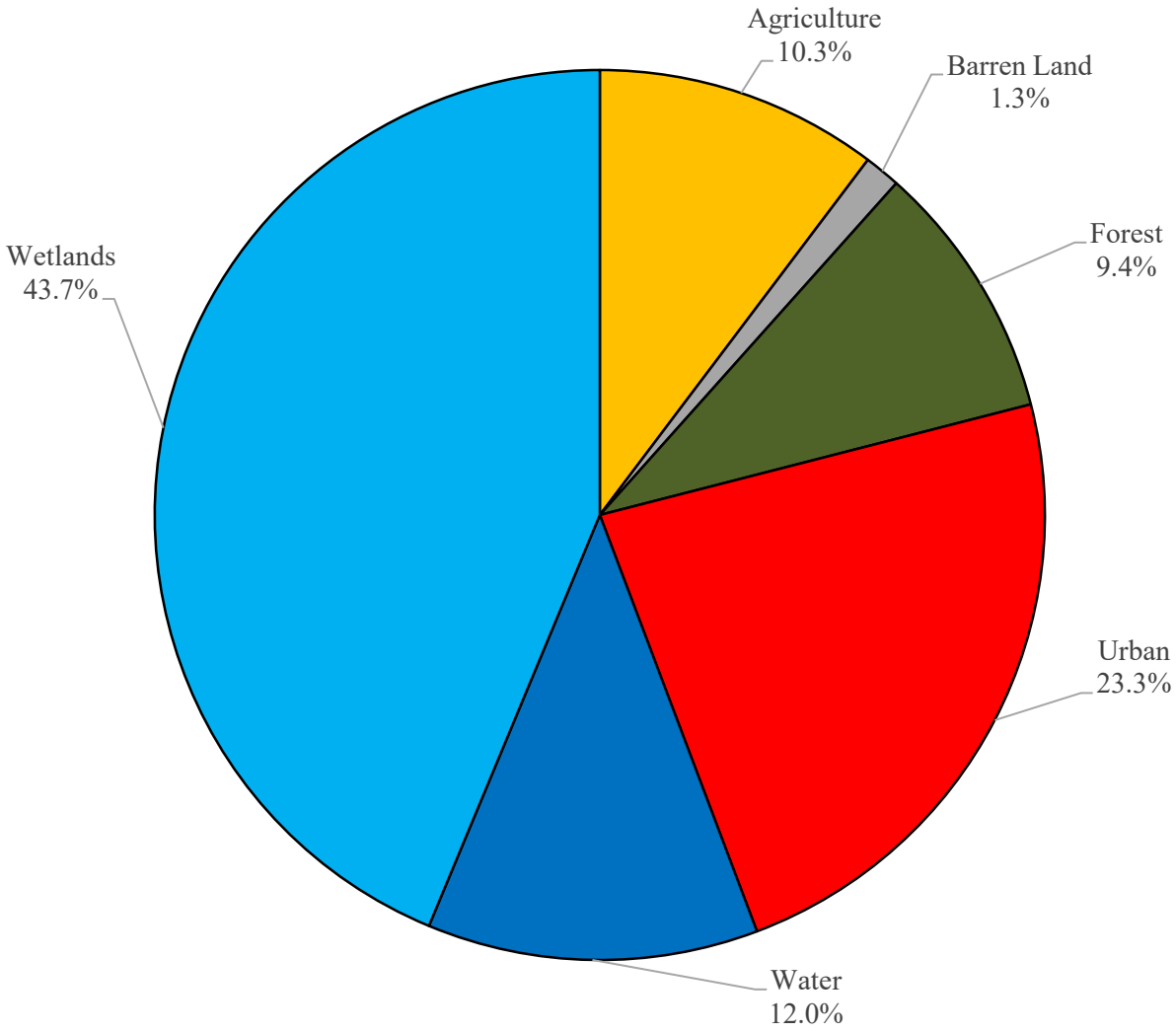


Figure 3: Pie chart illustrating the land use in Pennsville Township

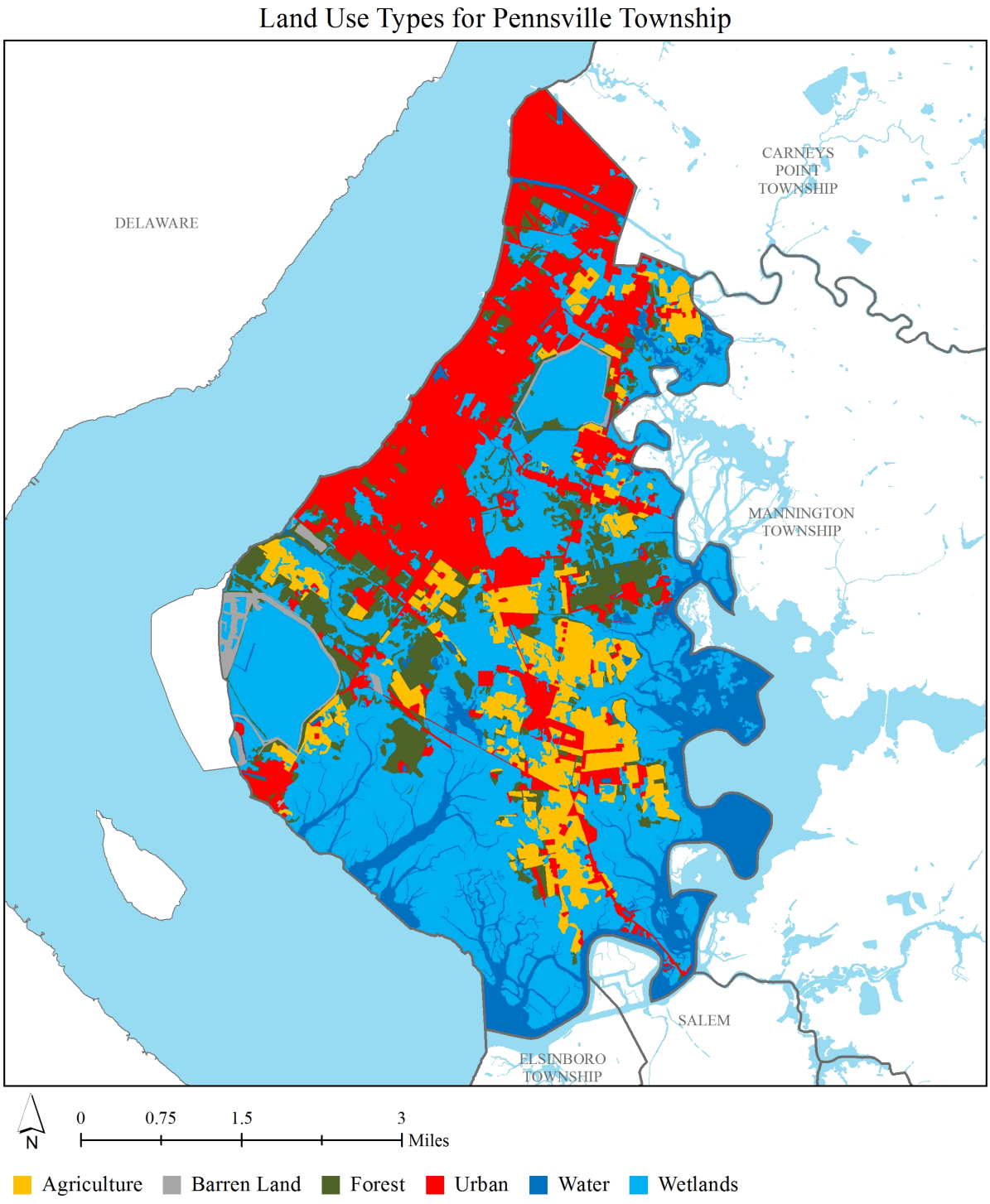


Figure 4: Map illustrating the land use in Pennsville Township

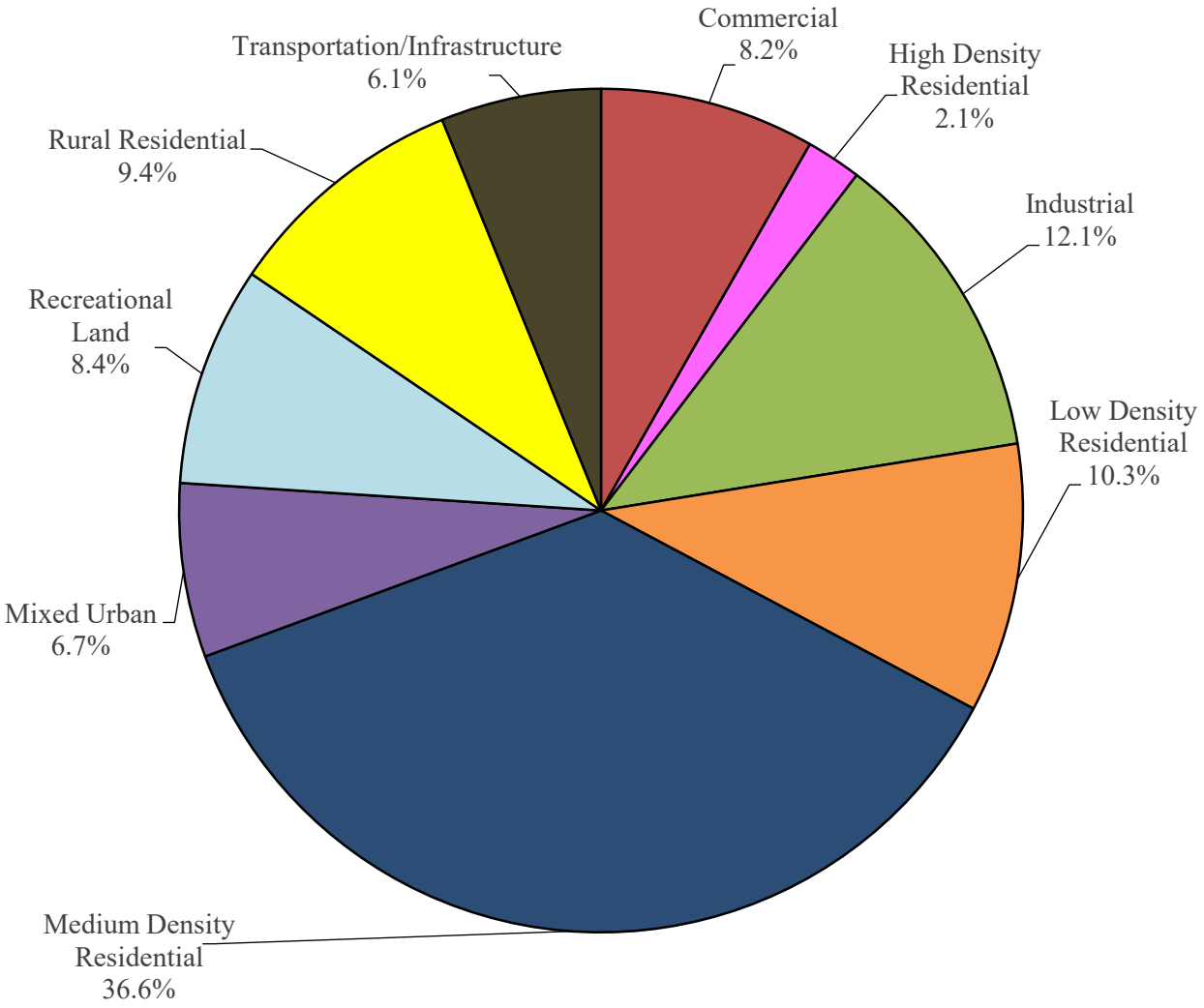


Figure 5: Pie chart illustrating the various types of urban land use in Pennsville Township

The New Jersey Department of Environmental Protection's (NJDEP) 2012 land use/land cover geographical information system (GIS) data layer categorizes Pennsville 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 Pennsville Township. Based upon the 2012 NJDEP land use/land cover data, approximately 7.8% of Pennsville Township has impervious cover. This level of impervious cover suggests that the streams in Pennsville Township are likely sensitive streams.

Water resources are typically managed on a watershed/subwatershed basis; therefore, an impervious cover analysis was performed for each subwatershed within Pennsville Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 5.9% in the LDVR Tributaries/Marsh Pit subwatershed to 29.8% in the LDVR Tributaries/Oldman's Creek. 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 Pennsville Township, Salem County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.3 inches of rain), the 10-year design storm (5.0 inches of rain), and the 100-year design storm (8.5 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Pennsville Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Salem River subwatershed was harvested and purified, it could supply water to 140 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Pennsville Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
LDVR Tributaries / Oldman's Creek	1,021.2	1.60	1,000.2	1.56	20.9	0.03	297.8	0.47	29.8%
LDVR Tributaries / Marsh Pit	6,244.3	9.76	5,894.3	9.21	350.0	0.55	345.3	0.54	5.9%
Salem River	8,633.7	13.49	7,095.0	11.09	1538.7	2.40	449.8	0.70	6.3%
Total	15,899.1	24.84	13,989.5	21.86	1909.6	2.98	1092.9	1.71	7.8%

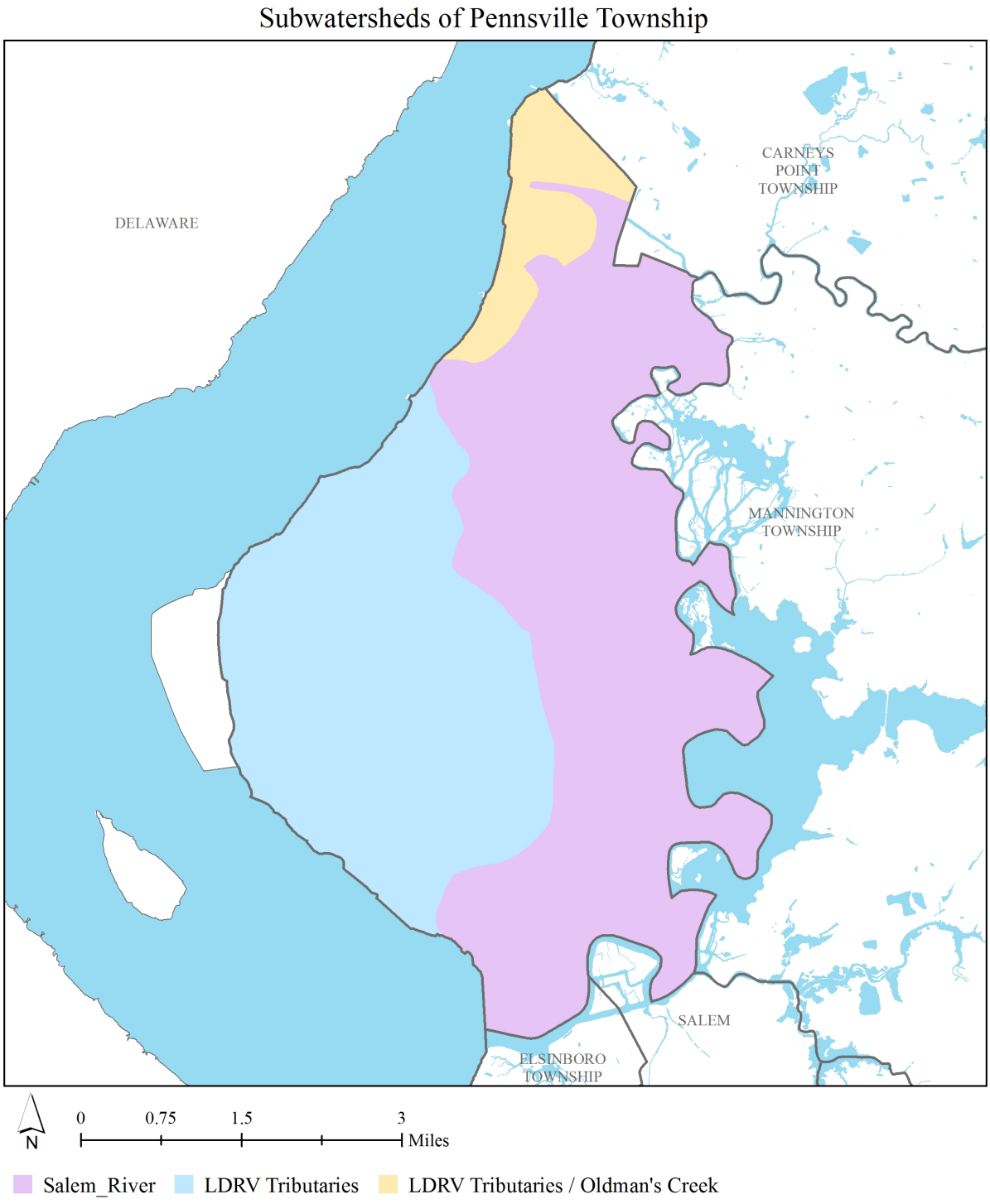


Figure 6: Map of the subwatersheds in Pennsville Township

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

Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (Mgal)	Total Runoff Volume for the NJ Annual Rainfall of 44" (Mgal)	Total Runoff Volume for the 2-Year Design Storm (3.3") (Mgal)	Total Runoff Volume for the 10-Year Design Storm (5.0") (Mgal)	Total Runoff Volume for the 100-Year Design Storm (8.5") (Mgal)
LDVR Tributaries / Oldman's Creek	10.1	355.8	26.4	40.4	68.3
LDVR Tributaries / Marsh Pit	11.7	412.5	30.6	46.9	79.2
Salem River	15.3	537.4	39.8	61.1	103.2
Total	37.1	1,305.7	96.7	148.4	250.8

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

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

Elimination of Impervious Surfaces

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

Table 3: Impervious cover reductions by subwatershed in Pennsville Township

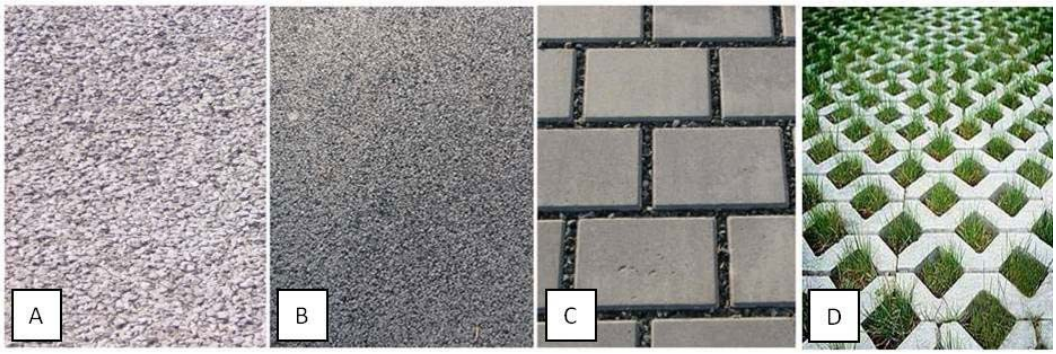
Subwatershed	Recommended Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction [2] (MGal)
LDVR Tributaries / Oldman's Creek	29.8	33.8
LDVR Tributaries / Marsh Pit	34.5	39.2
Salem River	45.0	51.1
Total	109.3	124.0

[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 3.3 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 Pennsville 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 Pennsville 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

Pennsville 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

Concept Plans and Detailed Green Infrastructure Information Sheets

Pennsville Township
Impervious Cover Assessment
Pennsville Babe Ruth Field, 2 Sanderlin Road

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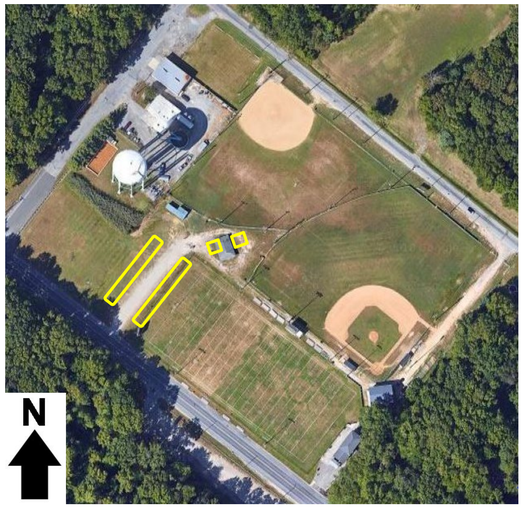
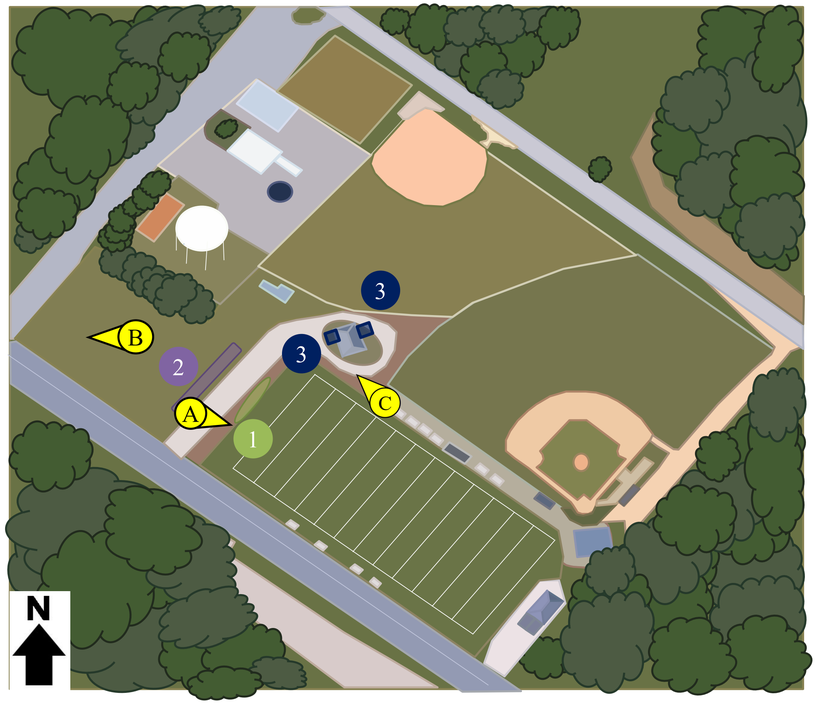
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:



A

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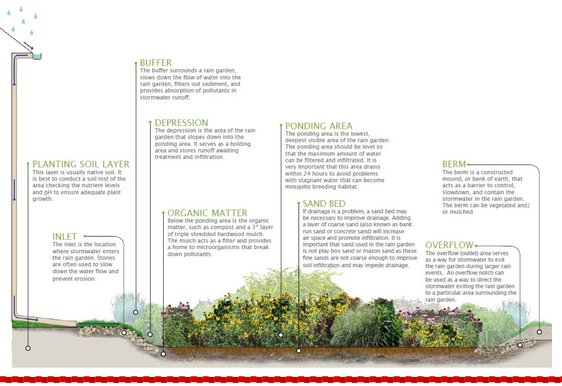
C

1 **BIORETENTION SYSTEM:** A rain garden can be installed alongside the football field behind the scoreboard. Rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

2 **BIOSWALE:** A bioswale is a vegetated system that conveys stormwater to catch basins while removing sediment and nutrients.

3 **DOWNSPOUT PLANTER:** These are wooden boxes with plants installed at the base of a downspout that provide an opportunity to beneficially reuse rooftop runoff.

1 BIORETENTION SYSTEM



2 BIOSWALE

3 DOWNSPOUT PLANTER

Pennsville Babe Ruth Field
Green Infrastructure Information Sheet

Location: 2 Sanderlin Road Pennsville, NJ 08070	**Municipality:** Pennsville Township
	Subwatershed: LDRV tribs (Marsh Pt-MainvSt Pennsville)
Green Infrastructure Description: bioretention system (rain garden) bioswale downspout planter	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes total suspended solids removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system: 1,090 gal. bioswale: 56,280 gal downspout planter box: 6,660 gal

Existing Conditions and Issues:
Ponding water was noted on both sides of the dirt road next to Pennsville Midget Football Field as well as erosion present on the dirt roads around the field. Ponding water was also observed behind the scoreboard.

Proposed Solution(s):
A bioswale can be built in the western corner of the fields to mitigate the flooding currently occurring within the area. A bioretention system can be installed behind the scoreboard to help stormwater to infiltrate there as well. Five downspout planters can be built to help capture and infiltrate the runoff to reduce the pooling of stormwater draining from the roof of the concession stand building.

Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), this system is estimated to reduce TN by 30%, TP by 60%, and TSS by 90%. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal, to the local residents of Pennsville Township. This may also be used as a demonstration project for Pennsville's Public Works staff to launch educational programming.

The bioswale will capture, treat, and infiltrate stormwater reducing TN by 30%, TP by 60%, and TSS by 90%.

Planter boxes will take in runoff from downspouts and achieve similar reductions in TN, TP, and TSS as the bioretention systems.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Pennsville Township
local social and community groups

Pennsville Babe Ruth Field
Green Infrastructure Information Sheet

Partners/Stakeholders:
Pennsville Township
local community groups
residents
athletes
Rutgers Cooperative Extension

Estimated Cost:
A rain garden to capture the field runoff would need to be approximately 1,100 square feet. At $5 per square foot, the estimated cost of the rain garden is $5,500.

The bioswale would need to be 135 feet long and 4 feet wide (540 sq.ft.). At $5 per square foot, the estimate cost of the bioswale is $2,700.

The downspout planter box is 2 feet by 6 feet and the estimated cost of each planter box is $1,000 for a total cost of $5,000.

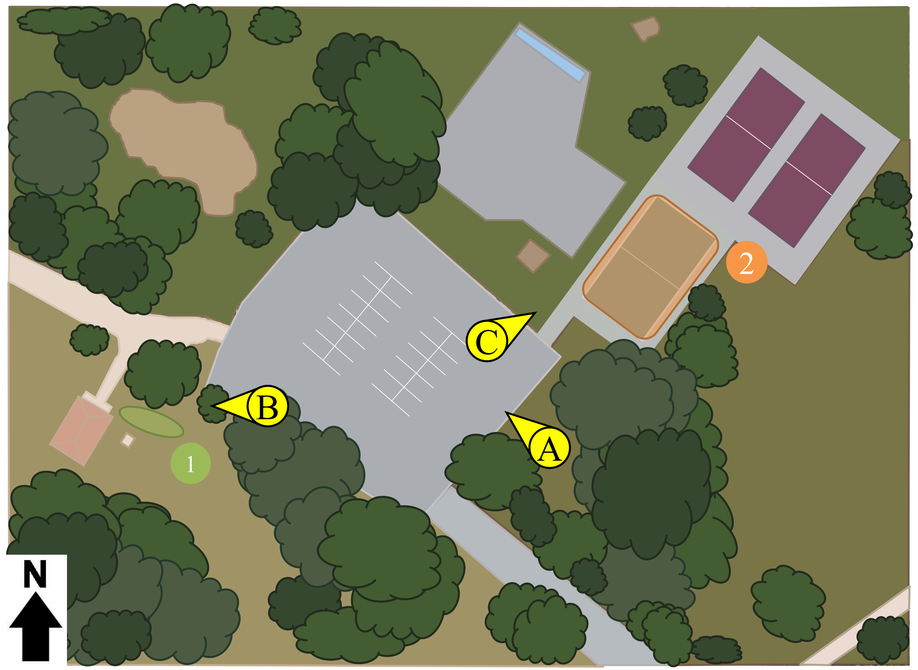
The total cost of the project will thus be approximately $13,200.

Pennsville Township
Impervious Cover Assessment
Riverview Beach Park, 5 North Broadway

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

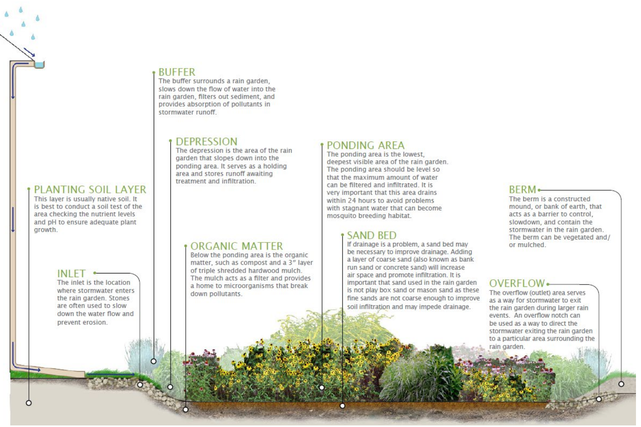
SITE PLAN:



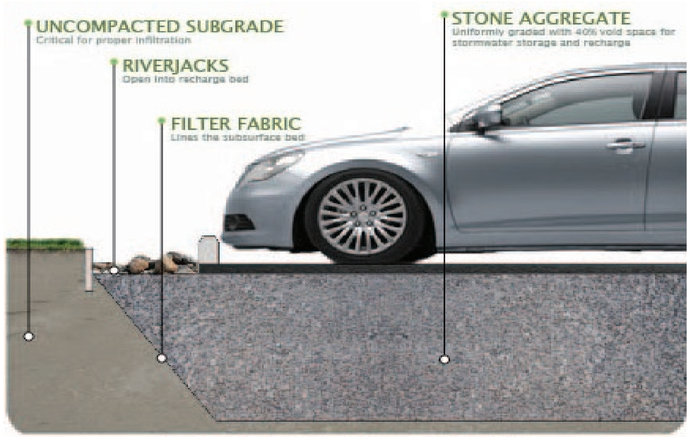
1 **BIORETENTION SYSTEM:** A rain garden can be installed in the turfgrass area adjacent to the restrooms. With a catch basin located near the front of the restroom building, the rain garden can be built between the building and catch basin to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

2 **PERVIOUS PAVEMENT:** The basketball court can be redone using pervious pavement to promote groundwater recharge and filter stormwater.

1 BIORETENTION SYSTEM



2 PERVIOUS PAVEMENT



PERMEABLE PAVEMENT DIAGRAM

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Riverview Beach Park
Green Infrastructure Information Sheet

Location: 5 North Broadway Pennsville, NJ 08070	**Municipality:** Pennsville Township **Subwatershed:** Salem River
Green Infrastructure Description: bioretention system (rain garden) disconnecting downspouts pervious pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes total suspended solids removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system: 29,700 gal. pervious pavement: 111,000 gal

Existing Conditions and Issues:
Erosion is present on edges of the parking lot and around the tennis courts. Pooling of water occurs on the southwest side and on the east side of the main parking lot. A catch basin is located in the southwest section of the parking lot that captures rooftop runoff from the restroom building.

Proposed Solution(s):
Installing pervious pavement in place of the existing basketball court will help infiltrate stormwater from the surrounding area and also serve as a demonstration project. Installation of a rain garden at the southwest corner of the main parking lot will help to mitigate flooding and capture runoff from the roof of the restroom building, which currently flows into a catch basin.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to reduce TN by 30%, TP by 60%, and TSS by 90%. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal to the local residents of Pennsville Township. This may also be used as a demonstration project for Pennsville's Public Works staff to launch educational programming.

Pervious pavement allows stormwater to penetrate 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

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Pennsville Township
local social and community groups

Partners/Stakeholders:
Salem County
Pennsville Township
local community groups
residents
Rutgers Cooperative Extension

Estimated Cost:
A rain garden to capture the roof runoff would need to be approximately 400 square feet. At $5 per square foot, the estimated cost of the rain garden is $2,000.

The porous asphalt would cover 4,260 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 $106,500.

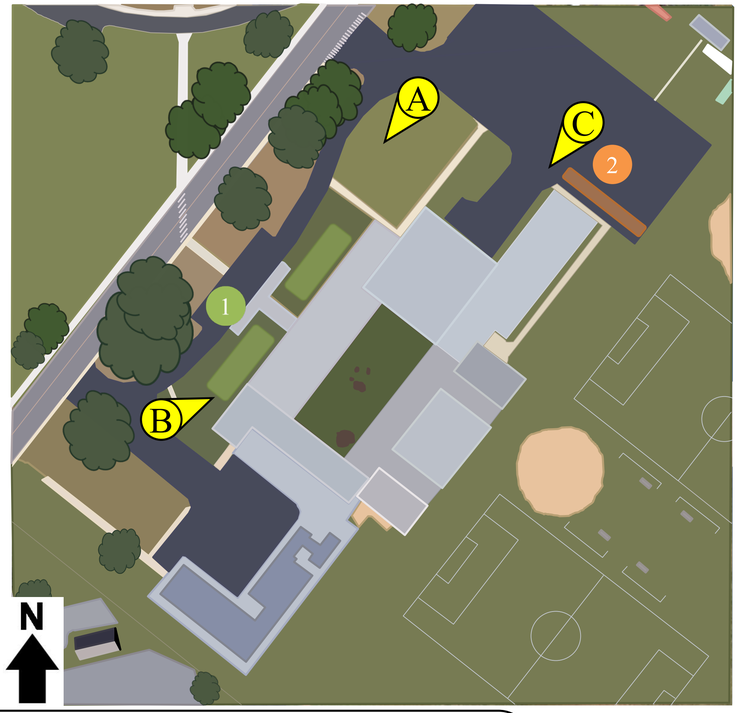
The total cost of the project will thus be approximately $108,500.

Pennsville Township
Impervious Cover Assessment
Pennsville Middle School, 4 William Penn Avenue

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

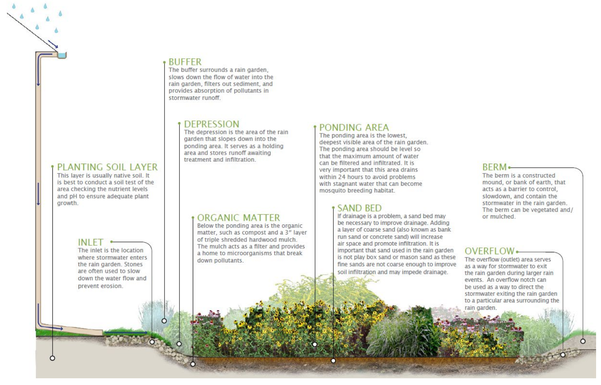
SITE PLAN:



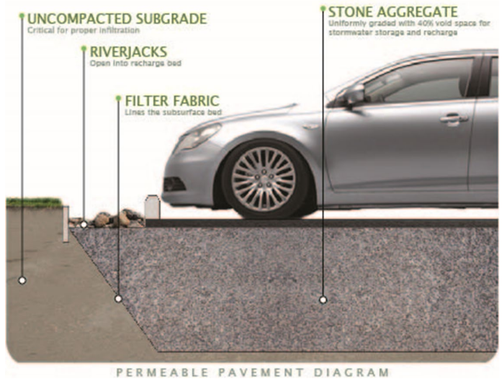
1 **BIORETENTION SYSTEM:** Two rain gardens can be built in the turfgrass area near the main entrance to capture runoff from the front of the building while also providing aesthetic value. The rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

2 **PERVIOUS PAVEMENT:** Pervious pavement can be installed in the northern parking lot to capture runoff from the parking lot and roof. Pervious pavement promotes groundwater recharge and filters stormwater.

1 BIORETENTION SYSTEM



2 PERVIOUS PAVEMENT



PERMEABLE PAVEMENT DIAGRAM

A

B

C

Pennsville Middle School
Green Infrastructure Information Sheet

Location: 4 William Penn Avenue Pennsville, NJ 08070	**Municipality:** Pennsville Township
	Subwatershed: Salem River
Green Infrastructure Description: bioretention system (rain garden) pervious pavement	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes total suspended solids removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system # 1: 247,530 gal. bioretention system # 2: 247,530 gal. pervious pavement: 382,490 gal.

Existing Conditions and Issues:
Connected downspouts direct rainwater directly to the storm sewer system. The land has a large area of impervious cover consisting of parking lots, sidewalks, and driveways.

Proposed Solution(s):
Installation of two mirrored bioretention systems in the front of the school near the entrance will catch the stormwater from the roof. Pervious pavement can be installed in the northern parking lot and will provide pervious cover for runoff to infiltrate.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to reduce TN by 30%, TP by 60%, and TSS by 90%. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal, to the local residents of Pennsville Township. Rutgers Cooperative Extension could additionally present the *Stormwater Management in Your Schoolyard* program to students and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for Pennsville's Public Works staff to launch educational programming.

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

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Pennsville Township
local social and community groups

Pennsville Middle School
Green Infrastructure Information Sheet

Partners/Stakeholders:
Pennsville Township
local community groups
faculty, students, and parents
Rutgers Cooperative Extension

Estimated Cost:
Rain garden #1 would need to be approximately 2,400 square feet. At $5 per square foot, the estimated cost of the rain garden is $12,000. Rain garden #2 would need to be approximately 2,400 square feet. At $5 per square foot, the estimated cost is $12,000.

The porous asphalt would cover 2,680 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 $67,000.

The total cost of the project will thus be approximately $91,000.