RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Assessment
for
Perth Amboy, Middlesex County, New Jersey

Prepared for Perth Amboy by the
Rutgers Cooperative Extension Water Resources Program

November 26, 2014

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 cart ways could be converted to one-way cart 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

Perth Amboy Impervious Cover Analysis

Located in Middlesex County in central New Jersey, Perth Amboy covers approximately 4.7 square miles. Figures 3 and 4 illustrate that Perth Amboy is dominated by urban land uses. A total of 79.1% of the municipality's land use is classified as urban. Of the urban land in Perth Amboy, high density residential is the dominant land use (Figure 5).

The literature suggests a link between impervious cover and stream ecosystem impairment starting at approximately 10% impervious surface cover (Schueler, 1994; Arnold and Gibbons, 1996; May et al., 1997). Impervious cover may be linked to the quality of lakes, reservoirs, estuaries, and aquifers (Caraco et al., 1998), and the amount of impervious cover in a watershed can be used to project the current and future quality of streams. Based on the scientific literature, Caraco et al. (1998) classified urbanizing streams into the following three categories: sensitive streams, impacted streams, and non-supporting streams. Sensitive steams typically have a watershed impervious surface cover from 0 – 10%. Impacted streams have a watershed impervious cover ranging from 11-25% and typically show clear signs of degradation from urbanization. Non-supporting streams have a watershed impervious cover of greater than 25%; at this high level of impervious cover, streams are simply conduits for stormwater flow and no longer support a diverse stream community.

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Perth Amboy 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 Perth Amboy. Based upon the 2007 NJDEP land use/land cover data, approximately 52.6% of Perth Amboy has impervious cover. This level of impervious cover suggests that the streams in Perth Amboy are likely non-supportive streams.

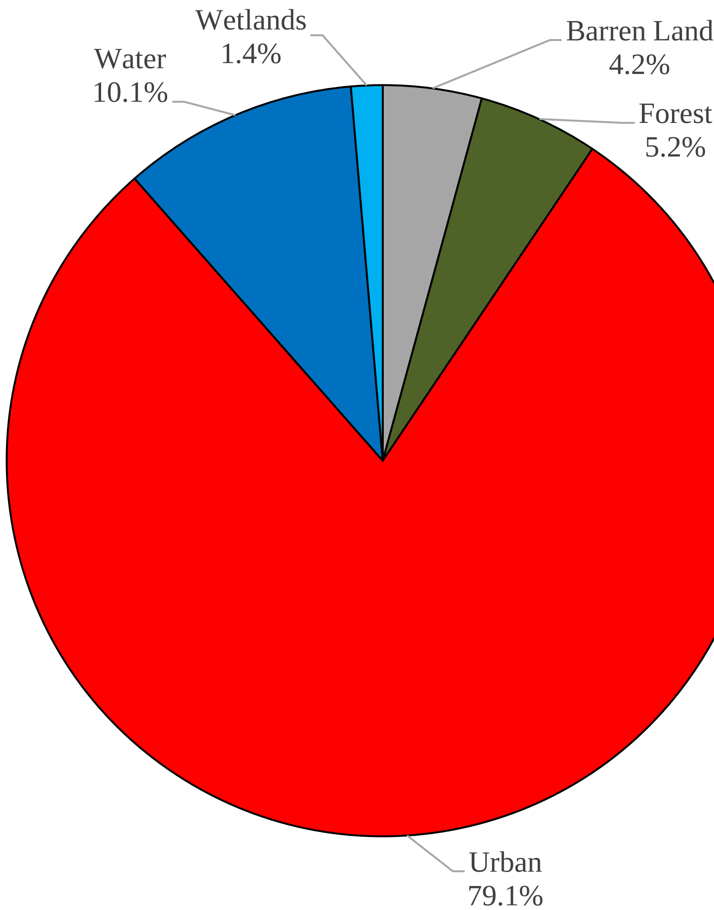


Figure 3: Pie chart illustrating the land use in Perth Amboy

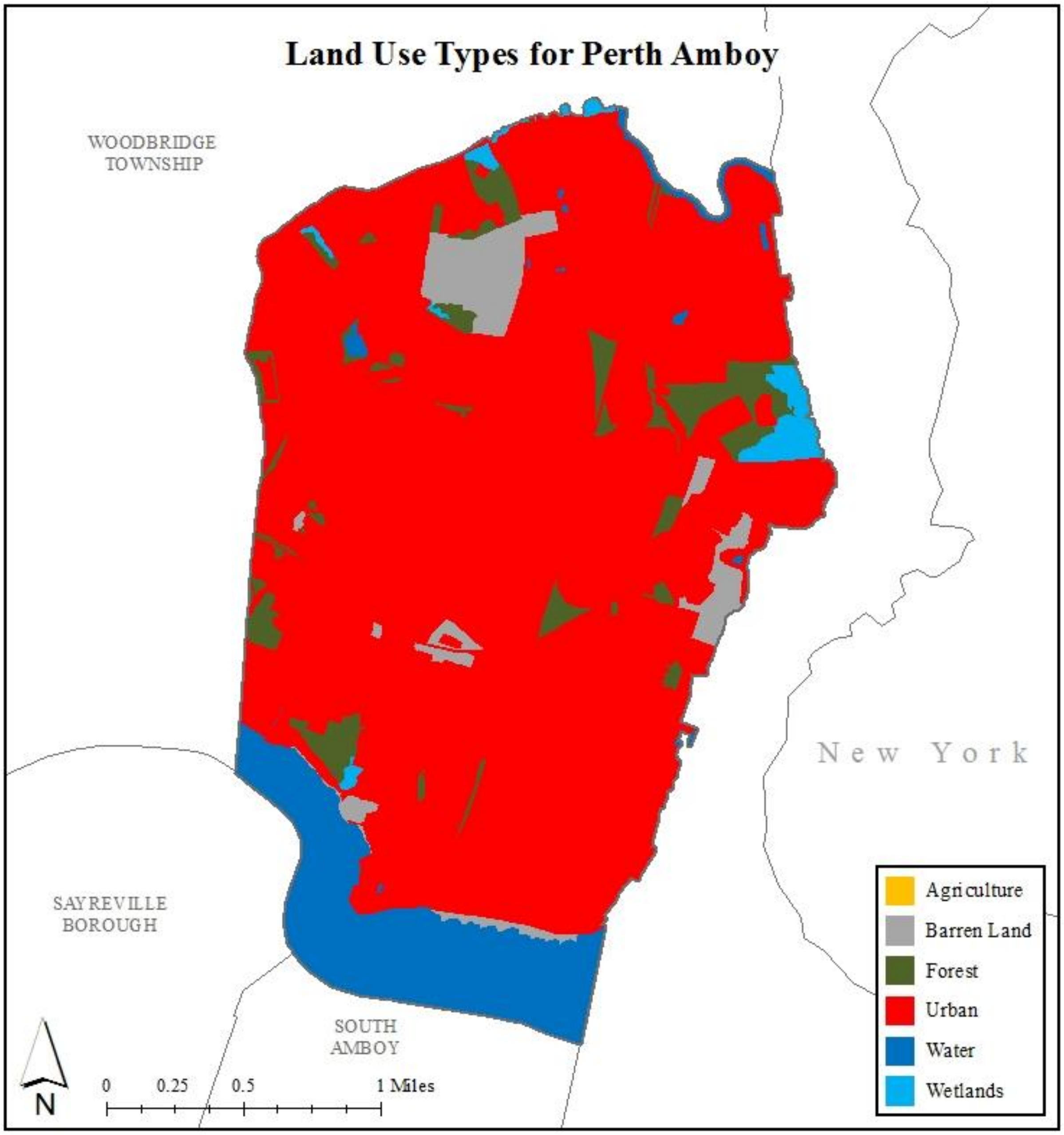


Figure 4: Map illustrating the land use in Perth Amboy

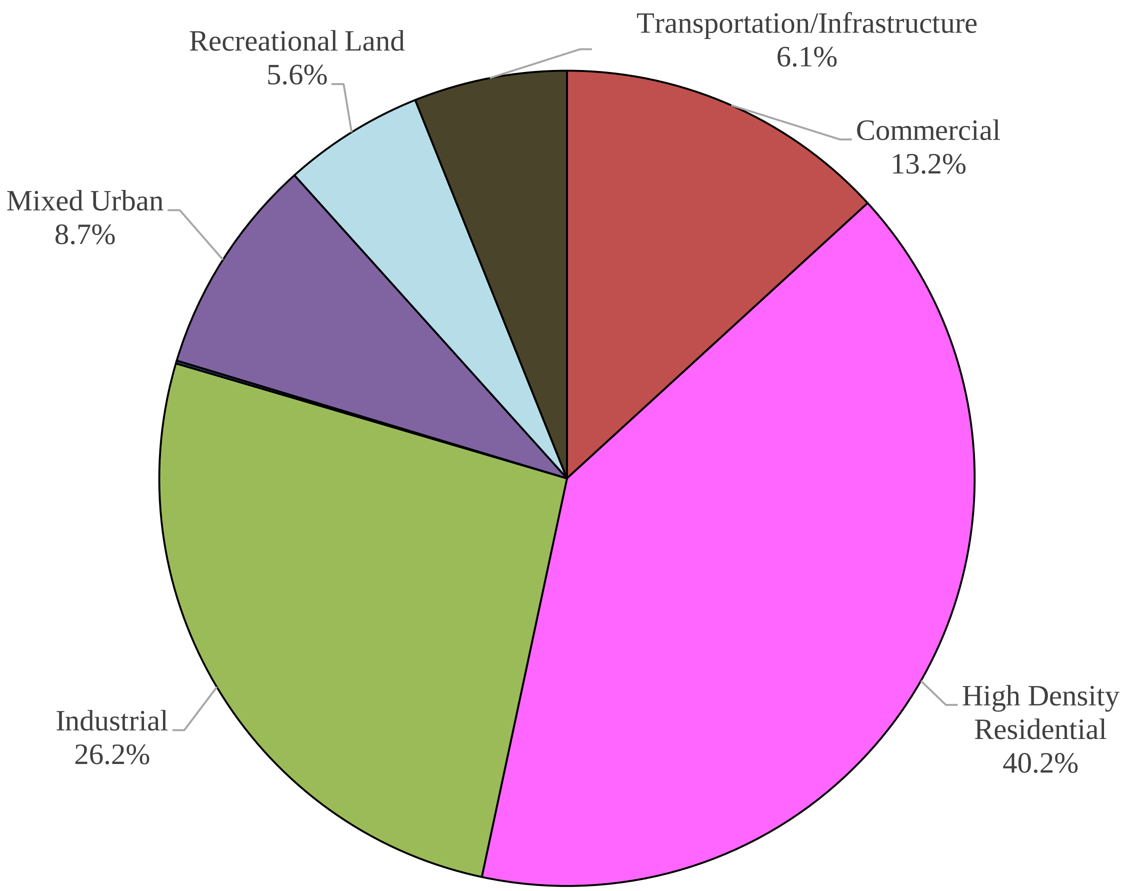


Figure 5: Pie chart illustrating the various types of urban land use in Perth Amboy

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Perth Amboy (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0% in the Raritan Bay subwatershed to 58.3% in the Lower Raritan River 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 Perth Amboy, Middlesex County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.3 inches of rain), the 10-year design storm (5.1 inches of rain), and the 100-year design storm (8.6 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Perth Amboy. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Arthur Kill subwatershed was harvested and purified, it could supply water to 176 homes for a year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Perth Amboy

Sub-watershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Arthur Kill Waterfront	1,098.53	1.72	1,093.37	1.71	5.15	0.01	567.61	0.89	51.91%
Raritan Bay	38.74	0.06	0.25	0.00	38.50	0.06	0.00	0.00	0.00%
Lower Raritan River	1,335.57	2.09	1,059.44	1.66	276.13	0.43	617.74	0.97	58.31%
Wood-bridge Creek	838.96	1.31	823.58	1.29	15.38	0.02	381.31	0.60	46.30%
Total	3,311.80	5.17	2,976.63	4.65	335.16	0.52	1,566.66	2.45	52.63%

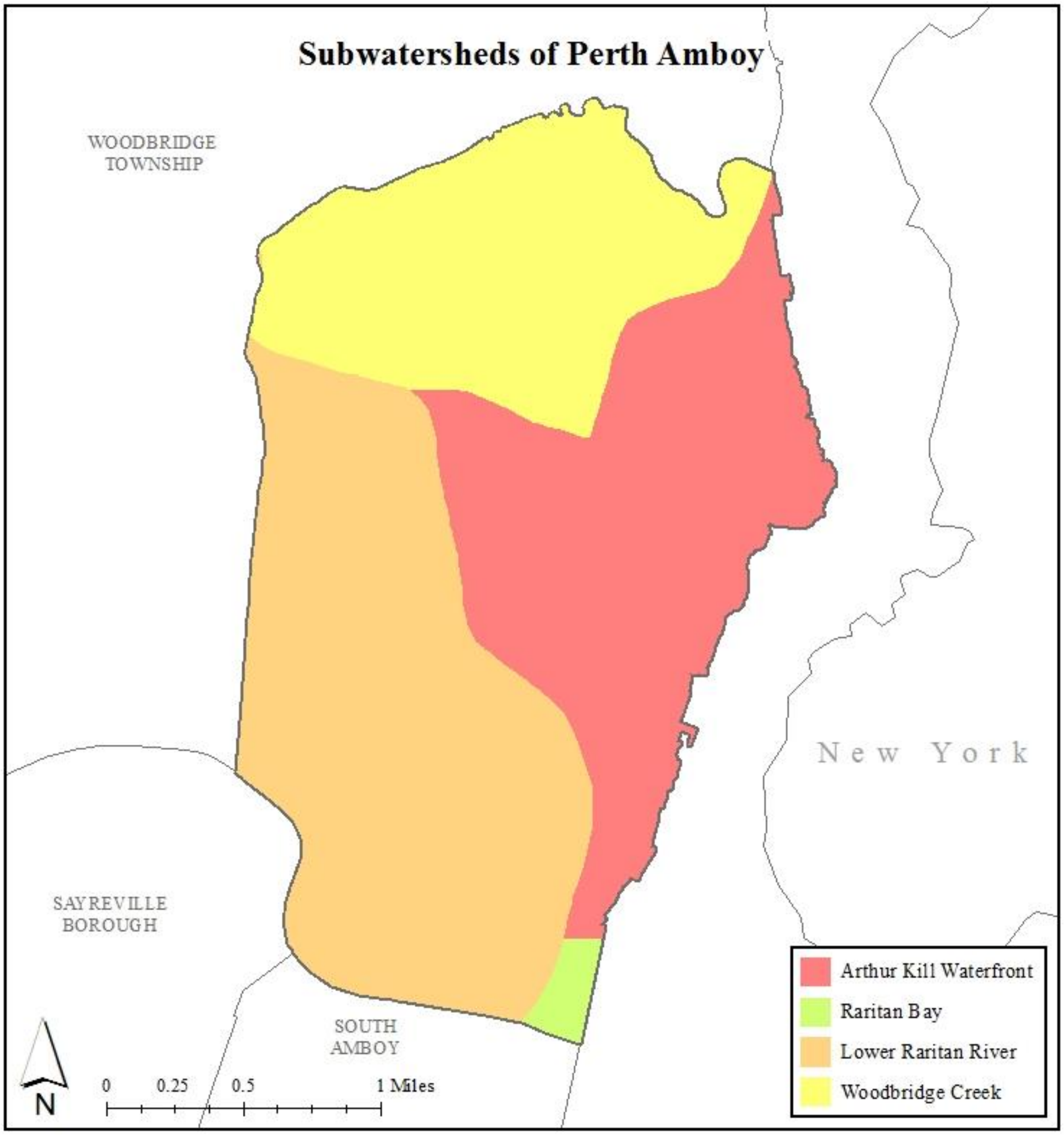


Figure 6: Map of the subwatersheds in Perth Amboy

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Perth Amboy

Subwatershed	**Total Runoff Volume for the 1.25" NJ Water Quality Storm (Mgal)**	**Total Runoff Volume for the NJ Annual Rainfall of 44" (Mgal)**	**Total Runoff Volume for the 2-Year Design Storm (3.3") (Mgal)**	**Total Runoff Volume for the 10-Year Design Storm (5.1") (Mgal)**	**Total Runoff Volume for the 100-Year Design Storm (8.6") (Mgal)**
Arthur Kill Waterfront	19.3	678.6	50.9	78.7	132.6
Raritan Bay	0.0	0.0	0.0	0.0	0.0
Lower Raritan River	21.0	738.3	55.4	85.6	144.3
Woodbridge Creek	12.9	455.2	34.1	52.8	89.0
Total	53.2	1,872	140.4	217.0	366

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 Perth Amboy. 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, there 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 Perth Amboy

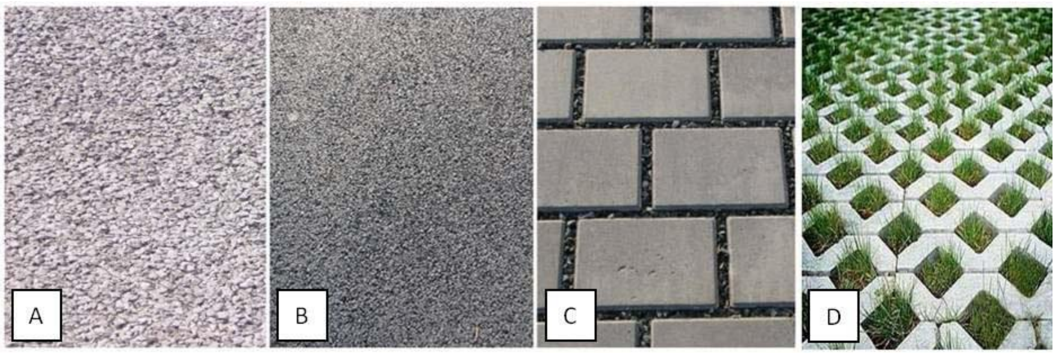
Subwatershed	Recommend Impervious Area Reduction (10%) (ac)	Annual Runoff Volume Reduction [2] (MGal)
Arthur Kill Waterfront	56.8	64.5
Raritan Bay	0	0.00
Lower Raritan River	61.8	70.1
Woodbridge Creek	38.1	43.2
Total	156.7	177.8

[2] Annual Runoff Volume Reduction =
Acres of impervious cover x 43,560 ft^2/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft^3) x (1 MGal/1,000,000 gal)
All green infrastructure should be designed to capture the first 3.3 inches of rain from each storm. This would allow the green infrastructure to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

There are four different types of permeable pavement systems that are commonly being used throughout the country to reduce the environmental impacts from impervious surfaces. These surfaces include pervious concrete, porous asphalt, interlocking concrete pavers, and grid pavers.

> "*Permeable pavement is a stormwater drainage system that allows rainwater and runoff to move through the pavement's surface to a storage layer below, with the water eventually seeping into the underlying soil. Permeable pavement is beneficial to the environment because it can reduce stormwater volume, treat stormwater water quality, replenish the groundwater supply, and lower air temperatures on hot days (Rowe, 2012).*"



Permeable surfaces: (A) pervious concrete, (B) porous asphalt, (C) interlocking concrete pavers, (D) grid pavers (Rowe, 2012)

Pervious concrete and porous asphalt are the most common of the permeable surfaces. They are similar to regular concrete and asphalt but without the fine materials. This allows water to quickly pass through the material into an underlying layered system of stone that holds the water allowing it to infiltrate into the underlying uncompacted soil.

Impervious Cover Disconnection Practices

By redirecting runoff from paving and rooftops to pervious areas in the landscape, the amount of directly connected impervious area in a drainage area can be greatly reduced. There are many cost-effective ways to disconnect impervious surfaces from local waterways.

- Simple Disconnection: This is the easiest and least costly method to reduce stormwater runoff for smaller storm events. Instead of piping rooftop runoff to the street where it enters the catch basin and is piped to the river, the rooftop runoff is released onto a grassed area to allow the water to be filtered by the grass and soak into the ground. A healthy lawn typically can absorb the first one to two inches of stormwater runoff from a rooftop. Simple disconnection also can be used to manage stormwater runoff from paved areas. Designing a parking lot or driveway to drain onto a grassed area, instead of the street, can dramatically reduce pollution and runoff volumes.

- Rain Gardens: Stormwater can be diverted into shallow landscaped depressed areas (i.e., rain gardens) where the vegetation filters the water and it is allowed to soak into the ground. Rain gardens, also known as bioretention systems, come in all shapes and sizes and can be designed to disconnect and treat 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 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 Perth Amboy

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 Perth Amboy, four 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

Perth Amboy 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

Perth Amboy City

Impervious Cover Assessment

Ukrainian Catholic Church of the Assumption, 684 Alta Vista Place

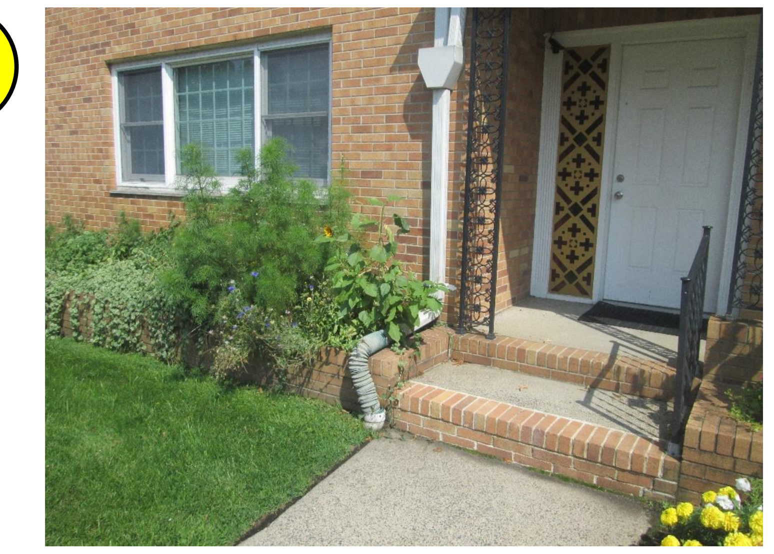
Assumption Catholic School, Meredith & Jacques Streets

RUTGERS New Jersey Agricultural Experiment Station

PROJECT LOCATION:

A

B



SITE PLAN:

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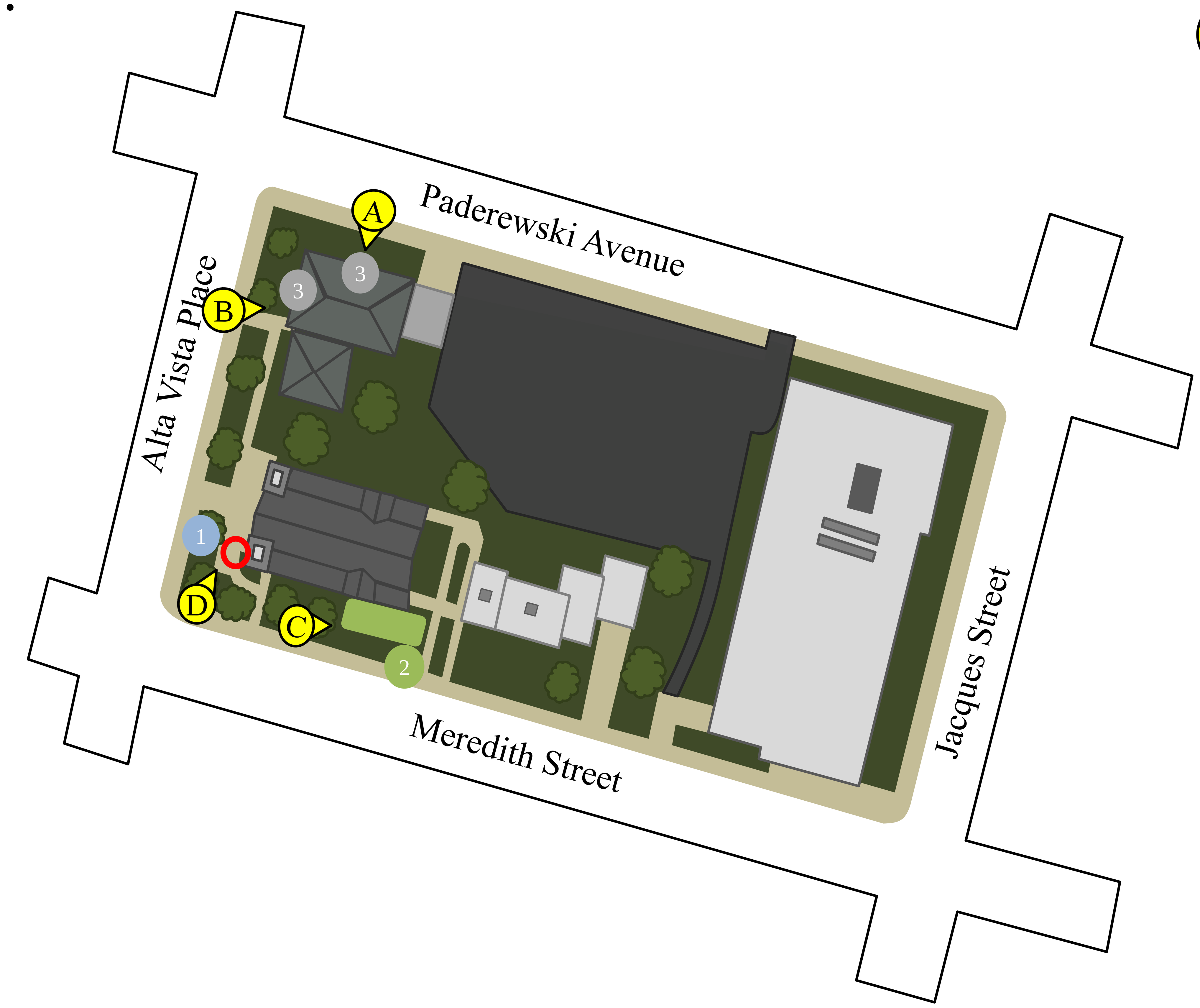

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1 **RAIN BARRELS:** Rain barrels can help capture the stormwater that drains from the building's rooftop. Connecting the church's downspouts to rain barrels will allow the stormwater to be collected and used for gardening.

2 **BIORETENTION SYSTEM:** On this property a rain garden can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

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

1 RAIN BARREL

2 BIORETENTION SYSTEM

3 DISCONNECTED DOWNSPOUTS

Ukrainian Catholic Church of the Assumption & Assumption Catholic School
Green Infrastructure Information Sheet

Location: Assumption Parish 684 Alta Vista Place Perth Amboy, NJ 08861 Assumption Catholic School Meredith & Jacques Streets Perth Amboy, NJ 08861	**Municipality:** City of Perth Amboy **Subwatershed:** Arthur Kill
Green Infrastructure Description: bioretention system (rain garden) rain barrel disconnecting/redirecting downspouts education program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (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:** disconnecting downspouts: 27,152 gal. rain barrel: 1,400 gal. rain garden: 41,037 gal.

Existing Conditions and Issues:
Identified existing conditions that can be improved include the side of the church on Meredith Street at the front on Alta Vista Place and at the building adjacent to the church on Paderewski Avenue. Near the corner of Alta Vista Place and Paderewski Avenue, there are three connected downspouts on the building's north side and an additional one on the west side. Near the corner of Alta Vista Place and Meredith Street, there is a disconnected downspout flowing into the street. On the side of the church there is a grassy area with trees and additional connected downspouts.

Proposed Solution(s):
The four connected downspouts on the building adjacent to the church could be disconnected to allow rainwater to flow into the grass. At the corner of Alta Vista Place and Meredith Street the disconnected downspout could be altered to flow into a rain barrel. On the Meredith Street side of the church, connected downspouts could be disconnected and directed into a bioretention system.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. This bioretention system would provide additional benefits such as aesthetic appeal and wildlife attraction to the local residents, parishioners, and students of the Assumption Catholic School. 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 the Perth Amboy Department of Public Works staff to launch educational programming. Rain barrels can be used to harvest rainwater which can be used for watering plants or other purposes which reduce the use of potable water for non-drinking purposes. The rain barrels would reduce the pollutant loading by 90% during the periods it is operational (i.e., it would not be used in the winter when there is a chance of freezing). The simple disconnection also would reduce the pollutant loading by 90%

since it will manage the water quality design storm of 1.25 inches of rain.

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

Partners/Stakeholders:
City of Perth Amboy
Assumption Parish/Assumption Catholic School
local community groups (Boy Scouts, Girl Scouts, etc.)
NY/NJ Baykeeper
Raritan Riverkeeper
Rutgers Cooperative Extension

Estimated Cost:
The rain garden on the south side of the property would need to be approximately 400 square feet. At $5 per foot, the estimated cost of the rain garden is $2,000. The rain barrel and simple disconnection of the downspouts have a very low cost and could be accomplished for several hundred dollars. The total project cost would be $2,500.

Perth Amboy City
Impervious Cover Assessment
James J. Flynn Elementary School, 850 Chamberlain Avenue

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

SITE PLAN:

N

1 **BIORETENTION SYSTEMS:** Trench drains will carry stormwater into bioretention systems or rain gardens. These rain gardens will capture, treat, and infiltrate roadway runoff and runoff from the grass area in front of the school. The existing catch basins will handle any overflow from the gardens. The rain gardens will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping to the school grounds. The gardens will also provide habitat for birds, butterflies, and pollinators. They can be incorporated into the elementary school science curriculum as well.

1 BIORETENTION SYSTEM

TRENCH DRAIN

James J. Flynn Elementary School

Green Infrastructure Information Sheet

Location: 850 Chamberlain Avenue Perth Amboy, NJ 08861	**Municipality:** City of Perth Amboy **Subwatershed:** Woodbridge Creek
Green Infrastructure Description: bioretention systems (rain gardens) trench drain youth education program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (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: 87,937 gal. rain garden #2: 87,937 gal. rain garden #3: 87,937 gal. rain garden #4: 87,937 gal.

Existing Conditions and Issues:

This site contains the building and associated connected parking lots on Chamberlain Avenue. The project focuses on the front of the building. There are areas on the front of the building to the left of the main entrance that slope directly toward the street and have catch basins within them. To the right of the main entrance there is an additional area that slopes toward the school containing eroded soil and a catch basin.

Proposed Solution(s):

The front of the building on Chamberlain Avenue could benefit from a series of bioretention systems to capture water from Chamberlain Avenue and from the lawn area in front of the school before it flows into the existing catch basins. A trench drain could be used to convey water from the street under the existing sidewalk. Finally, a stormwater education program can be conducted for the elementary students and teachers that attend this school.

Anticipated Benefits:

Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. This bioretention system would provide additional benefits such as aesthetic appeal and wildlife attraction to the local residents, employees, and students of James J. Flynn Elementary School. 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 the Perth Amboy Department of Public Works staff to launch educational programming.

Possible Funding Sources:

mitigation funds from local developers
NJDEP grant programs
grants from foundations
home and school association

Partners/Stakeholders:

City of Perth Amboy

students and parents local community groups (Boy Scouts, Girl Scouts, etc.) NY/NJ Baykeeper Raritan Riverkeeper Rutgers Cooperative Extension
Estimated Cost: Each rain garden would be 850 square feet in size. At $5 per foot, the estimated cost of each rain garden is $4,250. The total project cost would be $17,000.

Perth Amboy City
Impervious Cover Assessment
Robert N. Wilentz Elementary, 51 1st Street

Rutgers New Jersey Agricultural Experiment Station

A


B


C


PROJECT LOCATION:

SITE PLAN:

N

D


E


1 **BIORETENTION SYSTEMS:** Rain gardens can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. There are five areas proposed for the installment of bioretention systems to treat site runoff.

EDUCATIONAL PROGRAM: The RCE Water Resources Program, *Stormwater Management in Your Schoolyard*, can be delivered at Robert N. Wilentz Elementary School to educate the students about stormwater management and engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEMS

EDUCATIONAL PROGRAM

Robert N. Wilentz Elementary School
Green Infrastructure Information Sheet

Location: 51 1st Street Perth Amboy, NJ 08861	**Municipality:** Perth Amboy **Subwatershed:** Lower Raritan River
Green Infrastructure Description: bioretention systems (rain gardens) youth education program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (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: 130,277 gal. rain garden #2: 156,332 gal. rain garden #3: 78,166 gal. rain garden #4: 130,277 gal. rain garden #5: 83,377 gal.

Existing Conditions and Issues:
This site contains buildings, concrete walkways, and a parking lot. All of the impervious surfaces are directly connect to the storm sewer system. Additionally, the building has an internal downspout system that is connected directly to the stormwater system.

Proposed Solution(s):
Many of the impervious concrete walkways can be disconnected by directing stormwater runoff from these surfaces to bioretention systems (also known as rain gardens). In most cases, existing catch basins could be used to manage high flows and any overflow from the rain gardens. Finally, a stormwater education program can be conducted for the elementary students and teachers that attend this school.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. This bioretention system would provide additional benefits such as aesthetic appeal and wildlife attraction to the local residents, employees, and students of Robert N. Wilentz Elementary School. 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 the Perth Amboy Department of Public Works staff to launch educational programming.

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

Partners/Stakeholders:
City of Perth Amboy

students and parents local community groups (Boy Scouts, Girl Scouts, etc.) NY/NJ Baykeeper Raritan Riverkeeper Rutgers Cooperative Extension
Estimated Cost: For rain gardens 1, 2, 3, 4, and 5, the rain gardens are 1,250, 1,500, 750, 1,250, and 800 square feet in size, respectively. At $5 per square foot, the estimated cost of the rain gardens are $6,250, $7,500, $3,750, $6,250, and $4,000, respectively. The total project cost would be $27,750.

Perth Amboy City

Impervious Cover Assessment

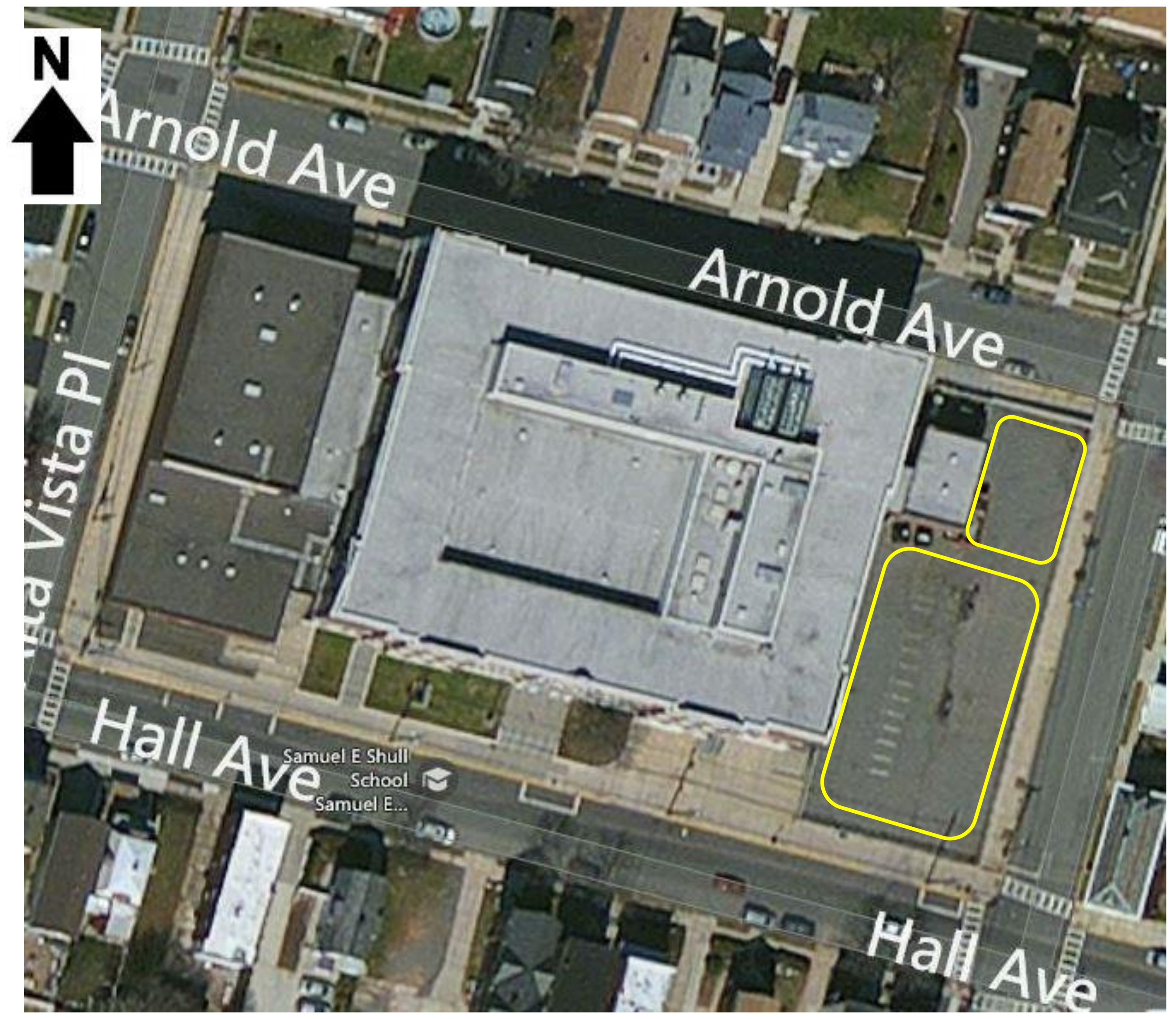
Samuel E. Shull Middle School, 380 Hall Avenue

A

B

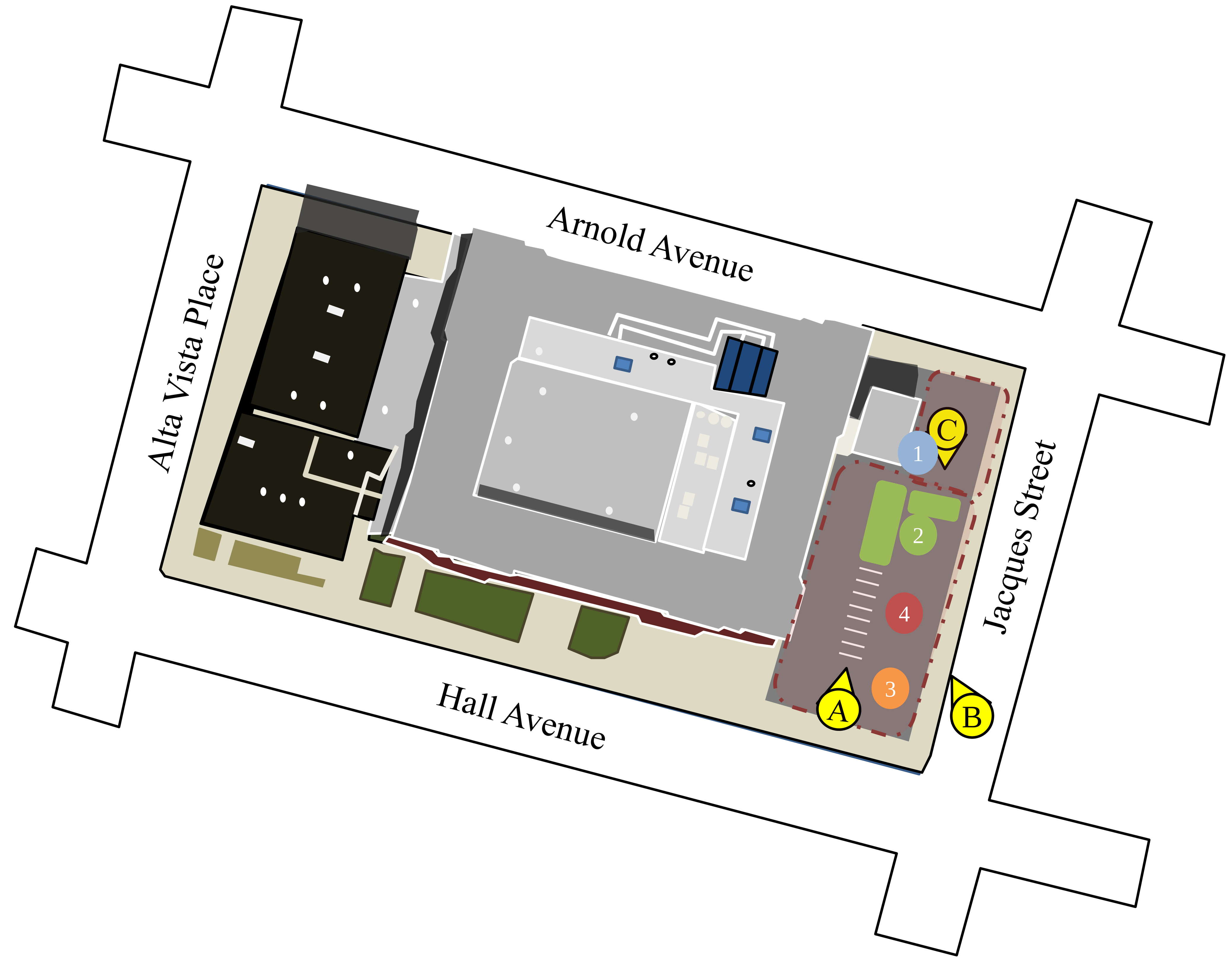
C

PROJECT LOCATION:



SITE PLAN:

N



1 **RAINWATER HARVESTING:** A cistern or a series of rain barrels will help capture the stormwater that drains from the building's loading dock rooftop. Connecting the loading dock downspouts to a rainwater harvesting device will allow the stormwater to be collected and used for landscaping.

2 **BIORETENTION SYSTEM:** On this property a bioretention system or rain garden can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge.

3 **POROUS ASPHALT**: Porous asphalt promotes groundwater recharge and filters stormwater.

4 **DEPAVING:** The parking lot adjacent to the school building will be depaved (i.e., asphalt will be removed). Depaving reduces impervious surfaces, allowing for infiltration, filtration, and treatment of nonpoint source pollution and adds green space.

1 RAINWATER HARVESTING SYSTEM

2 BIORETENTION SYSTEM

3 POROUS ASPHALT

4 DEPAVING

SOURCE: spontaneousinterventions.org

Samuel E. Shull Middle School
Green Infrastructure Information Sheet

Location: 380 Hall Avenue Perth Amboy, NJ 08861	**Municipality:** City of Perth Amboy **Subwatershed:** Arthur Kill
Green Infrastructure Description: depaving raised garden beds bioretention systems (rain gardens) rainwater harvesting (cistern) porous asphalt	**Targeted Pollutants:** total nitrogen (TN) total phosphorous (TP) 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:** raised garden beds: 10,761 gal. rain gardens: 27,827 gal. planters boxes: 4,872 gal. rainwater cistern: 13,181 gal. porous asphalt: 111,387 gal.

Existing Conditions and Issues:
This site focuses on the currently paved parking lot area on the buildings east side along Jacques Street. The area is currently entirely paved and in poor condition and has a retaining wall around the perimeter. The area experiences some pooling, and there are storm drains located at the northeast and southeast corners with most flow going to the southwestern drain. There are also dumpsters located straight back from the road entrance.

Proposed Solution(s):
The pavement in the entire area is planned to be removed and redone to provide a recreational area. At the northeast area, raised garden beds will be implemented with nearby seating. Small greenhouses are also planned to be installed in this area along with a rainwater cistern to capture runoff from the adjacent rooftop. A driveway will be done with porous asphalt straight back from the gate to allow garbage trucks to reach the existing dumpsters. A stone pathway will be made to get from the driveway to the garden beds. Bioretention systems will be implemented next to the dumpster to aid in hiding them as well as on both sides of the path near the garden beds. Along the rest of the side of the building planter boxes will be implemented. In the southeast corner, a basketball court could be constructed with porous pavement.

Anticipated Benefits:
The removal of the pavement will greatly reduce the area of impervious cover. Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits, such as enhanced wildlife and aesthetic appeal to the local residents, employees, and students of Samuel E. Shull Middle School. 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. Rain cisterns can harvest stormwater which can be used for watering the gardens, which cuts back on the 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). The porous asphalt system in the driveway and basketball court 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
grants from foundations
home and school association

Partners/Stakeholders:
City of Perth Amboy
students and parents
local community groups (Boy Scouts, Girl Scouts, etc)
NY/NJ Baykeeper
Raritan Riverkeeper
Rutgers Cooperative Extension

Estimated Cost:
The rain gardens would need to be approximately 267 square feet. At $5 per foot, the estimated cost of the rain gardens is $1,335. The planter boxes would be approximately 187 square feet. At $5 per foot, the estimated cost of the planter boxes is $935. The raised garden beds would need to be about 413 square feet. At $5 per foot, the estimated cost of the rain gardens is $2,065. The porous asphalt would cover 1,453 square feet for the driveway and 2,822 square feet for the basketball court and have a 0.5 foot stone reservoir under the surface. At $15 per square foot, the cost of the porous asphalt system would be $64,125. The cistern would be 1,000 gallons and cost approximately $2,000 to purchase and install. The total for the project would thus be $70,460.