RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Assessment
for
South River Borough, Middlesex County, New Jersey

Prepared for South River Borough by the
Rutgers Cooperative Extension Water Resources Program

February 2, 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

South River Borough Impervious Cover Analysis

Located in Middlesex County in central New Jersey, South River Borough covers approximately 2.9 square miles. Figures 3 and 4 illustrate that South River Borough is dominated by urban land uses. A total of 76.2% of the municipality's land use is classified as urban. Of the urban land in South River Borough, medium density residential is the dominant land use (Figure 5).

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

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes South River Borough into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for South River Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 33.6% of South River Borough has impervious cover. This level of impervious cover suggests that the streams in South River Borough are likely non-supporting streams.

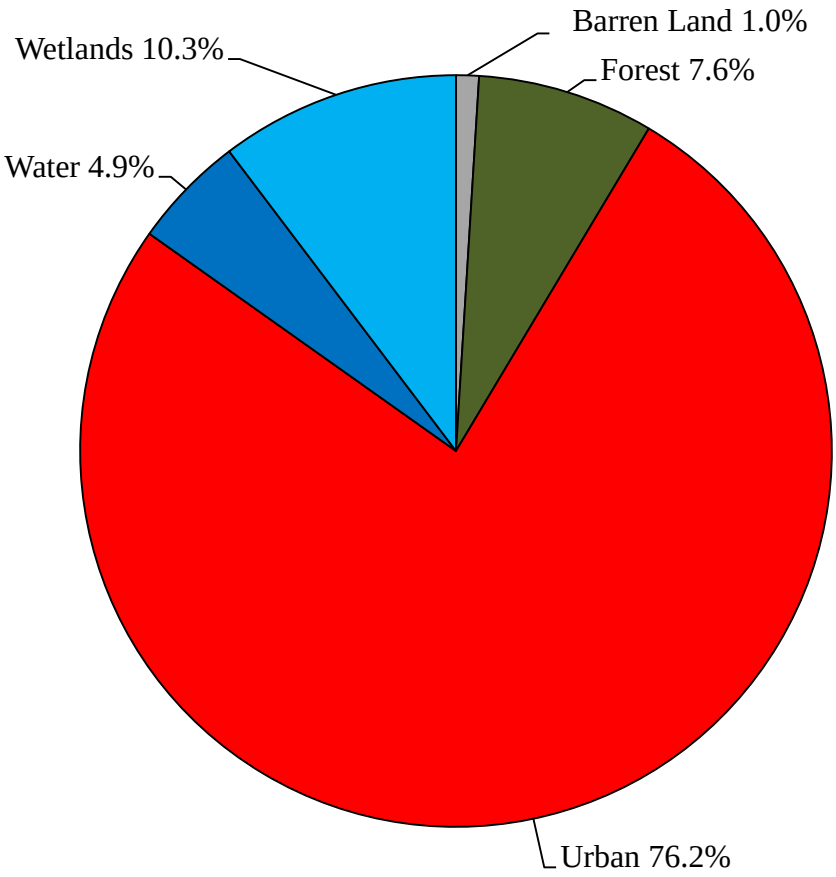


Figure 3: Pie chart illustrating the land use in South River Borough

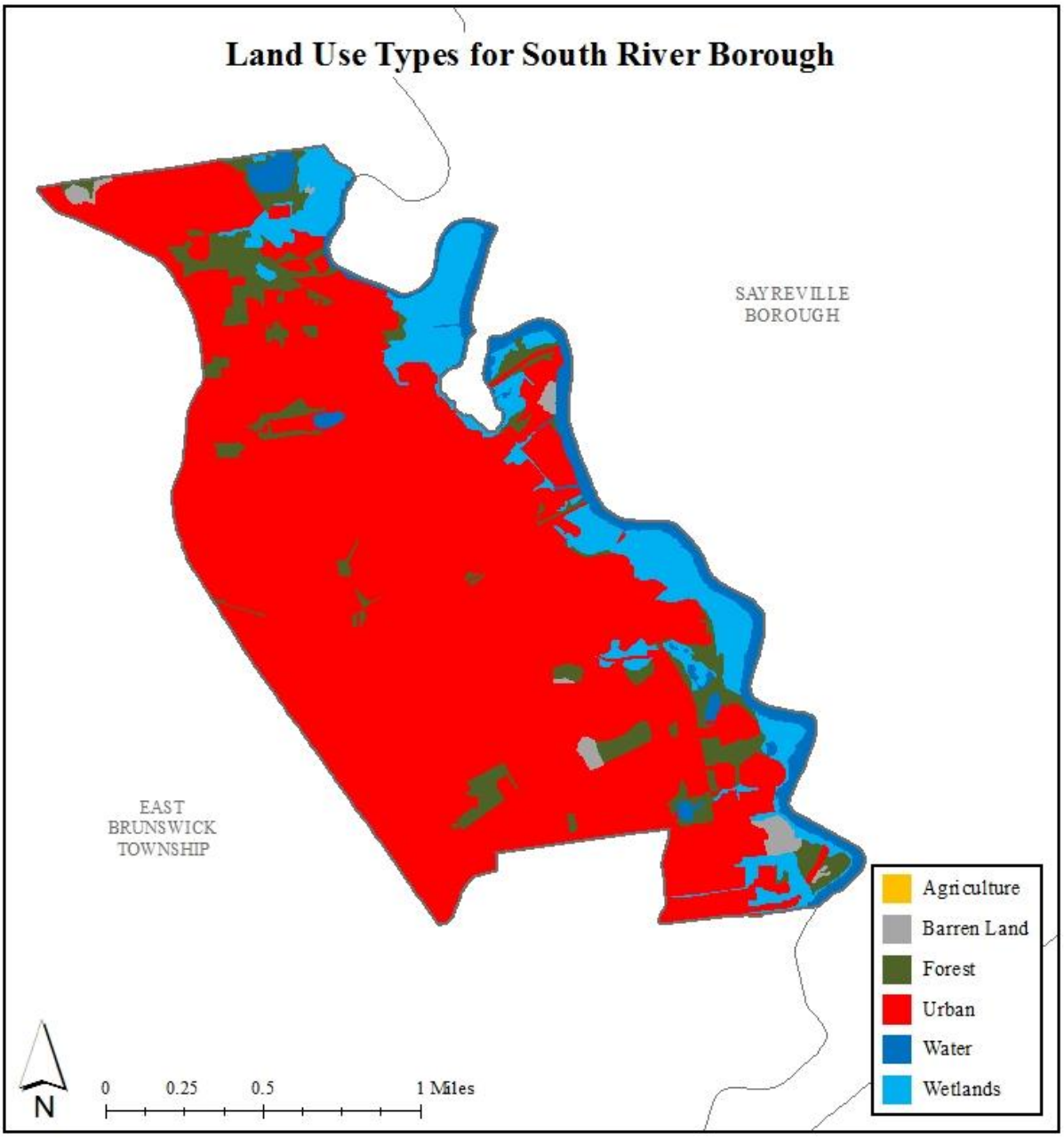


Figure 4: Map illustrating the land use in South River Borough

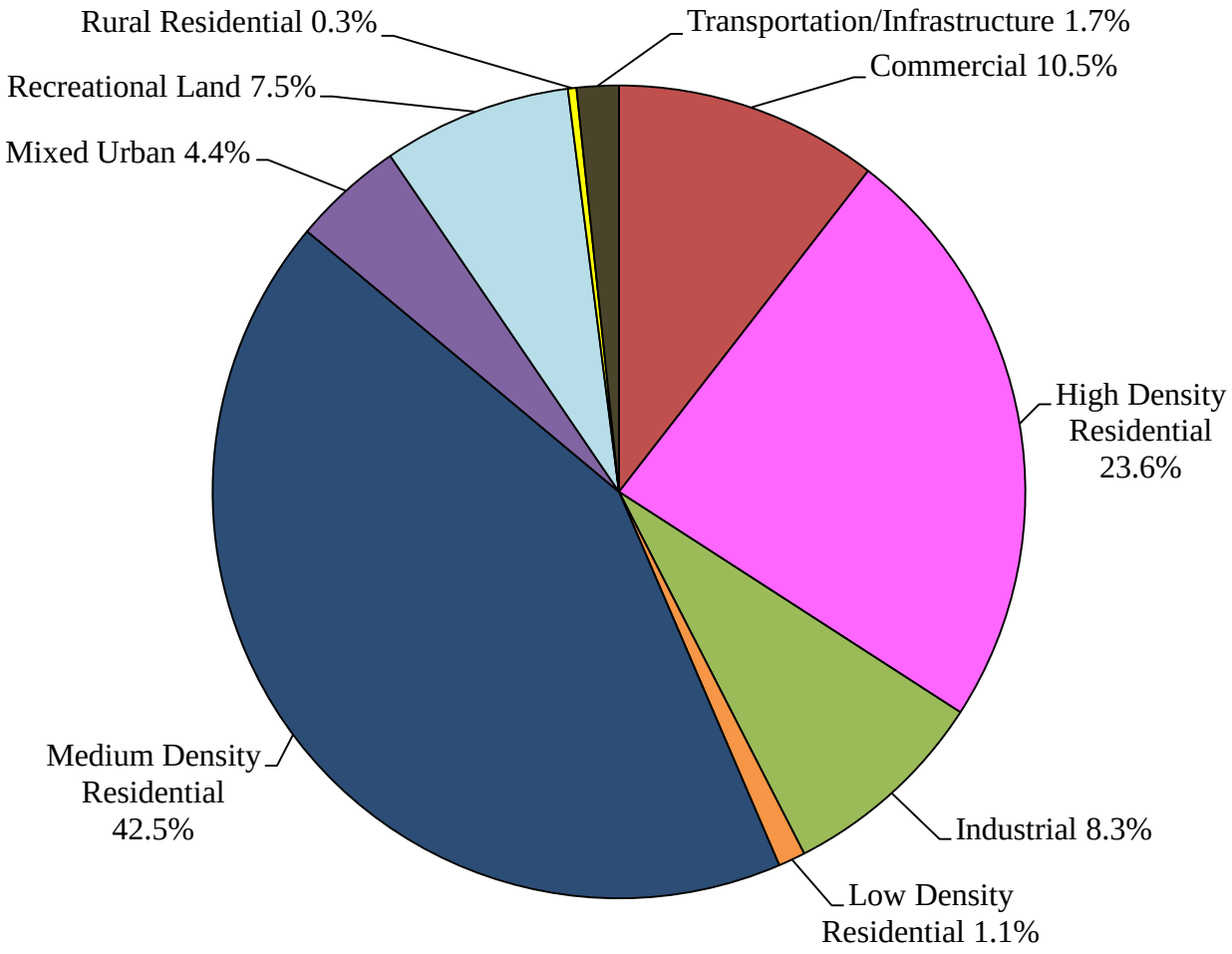


Figure 5: Pie chart illustrating the various types of urban land use in South River Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within South River Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0.00% in the Lower Raritan River subwatershed to 41.4% in the Lawrence 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 South River Borough, 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 South River Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the South River subwatershed was harvested and purified, it could supply water to 183 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for South River Borough

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Lawrence Brook	19.5	0.03	19.5	0.03	0.00	0.00	8.07	0.01	41.4%
Lower Raritan River	0.64	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.00%
South River	1,852.8	2.90	1,762.1	2.75	90.70	0.14	589.73	0.92	33.5%
Total	1,873.0	2.93	1,781.7	2.78	91.34	0.14	597.80	0.93	33.6%

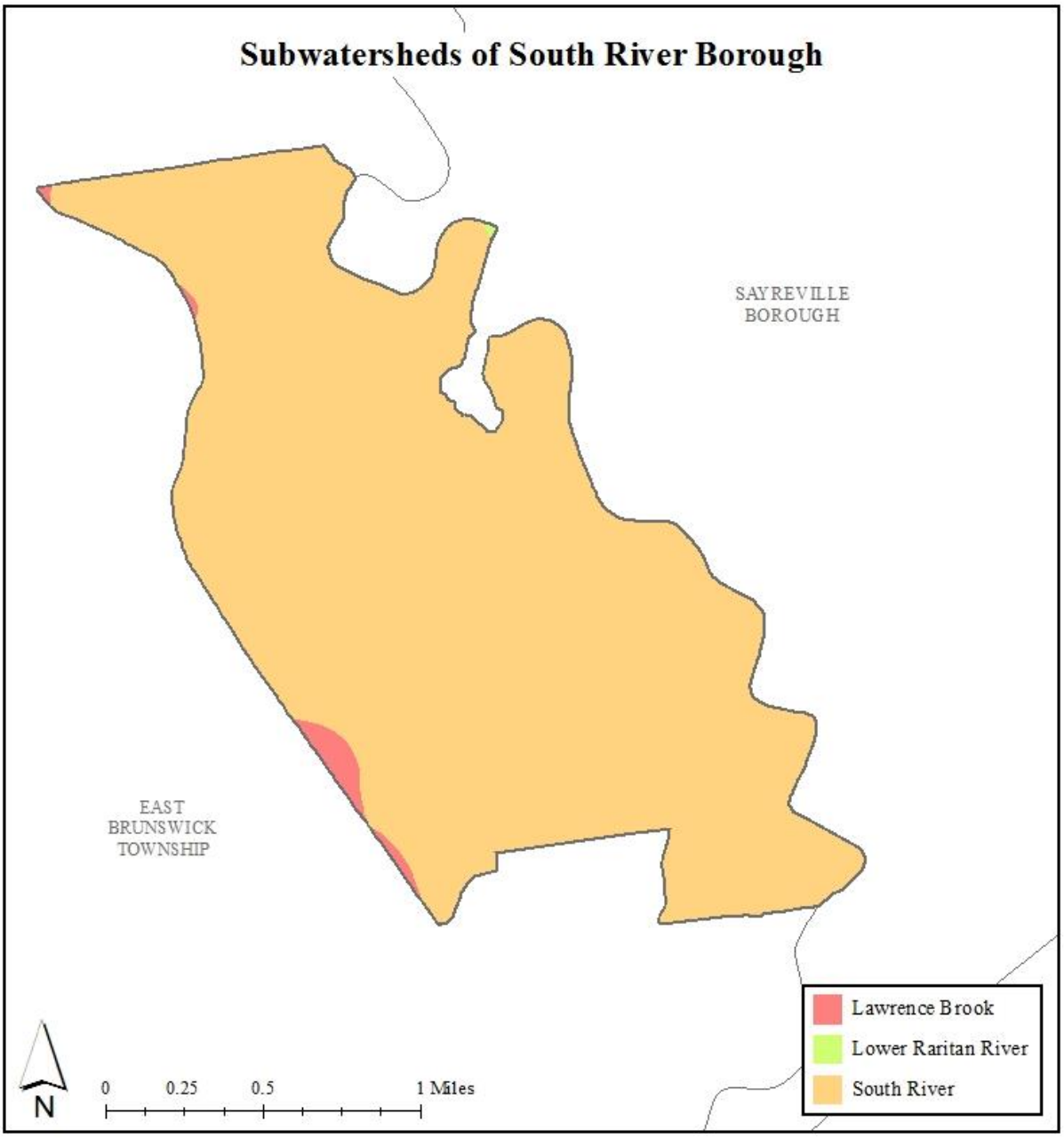


Figure 6: Map of the subwatersheds in South River Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in South River Borough

Subwatershed	**Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)**	**Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)**	**Total Runoff Volume for the 2-Year Design Storm (3.3") (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)**
Lawrence Brook	0.3	9.6	0.7	1.1	1.9
Lower Raritan River	0.0	0.0	0.0	0.0	0.0
South River	20.0	704.6	52.8	81.7	137.7
Total	20.3	714.2	53.6	82.8	139.6

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 South River Borough. While it may be difficult to eliminate paved areas or replace paved areas with permeable pavement, it is relatively easy to identify impervious surfaces that can be disconnected using green infrastructure practices. For all practical purposes, disconnecting an impervious surface from a storm sewer system or a water body is an "impervious area reduction." The RCE Water Resources Program recommends that all green infrastructure practices that are installed to disconnect impervious surfaces should be designed for the 2-year design storm (3.3 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 South River Borough

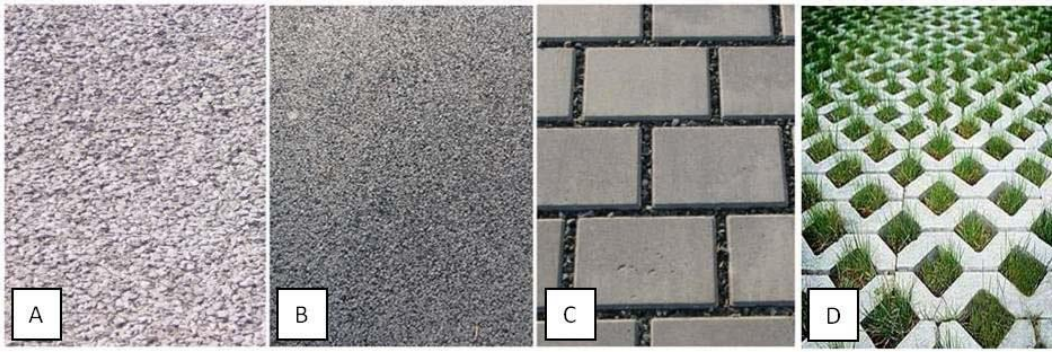
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Lawrence Brook	0.8	0.9
Lower Raritan River	0.0	0.0
South River	59.0	66.9
Total	59.8	67.8

[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 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 South River Borough

To address the impact of stormwater runoff from impervious surfaces, the next step is to identify opportunities in the municipality for eliminating, reducing, or disconnecting directly connected impervious surfaces. To accomplish this task, an impervious cover reduction action plan should be prepared. Aerial photographs are used to identify sites with impervious surfaces in the municipality that may be suitable for inclusion in the action plan. After sites are identified, site visits are conducted to photo-document all opportunities and evaluate the feasibility of eliminating, reducing or disconnecting directly connected impervious surfaces. A brief description of each site discussing the existing conditions and recommendations for treatment of the impervious surfaces is developed. After a number of sites have been selected for inclusion in the action plan, concept plans and detailed green infrastructure information sheets are prepared for a selection of representative sites.

For South River Borough, three sites have been included in this assessment. Examples of concept plans and detailed green infrastructure information sheets are provided in Appendix A. The detailed green infrastructure information sheets describe existing conditions and issues, proposed solutions, anticipated benefits, possible funding sources, potential partners and stakeholders, and estimated costs. Additionally, each project has been classified as a mitigation opportunity for recharge potential, total suspended solids removal, and stormwater peak reduction. Finally, these detailed green infrastructure information sheets provide an estimate of gallons of stormwater captured and treated per year by each proposed green infrastructure practice. The concept plans provide an aerial photograph of the site and details of the proposed green infrastructure practices.

Conclusions

South River Borough can reduce flooding and improve its waterways by better managing stormwater runoff from impervious surfaces. This impervious cover assessment is the first step toward better managing stormwater runoff. The next step is to develop an action plan to eliminate, reduce, or disconnect impervious surfaces where possible and practical. Many of the highly effective disconnection practices are inexpensive. The entire community can be engaged in implementing these disconnection practices.

References

Arnold, C.L. Jr. and C.J. Gibbons. 1996. Impervious Surface Coverage The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association* 62(2): 243-258.

Caraco, D., R. Claytor, P. Hinkle, H. Kwon, T. Schueler, C. Swann, S. Vysotsky, and J. Zielinski. 1998. Rapid Watershed Planning Handbook. A Comprehensive Guide for Managing Urbanizing Watersheds. Prepared by Center For Watershed Protection, Ellicott City, MD. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds and Region V. October 1998.

May, C.W., R.R. Horner, J.R. Karr, B.W. Mar, E.G. Welch. 1997. Effects of Urbanization on Small Streams in the Puget Sound Lowland Ecoregion. *Watershed Protection Techniques* 2(4): 483-493.

Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30.
http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf

Rowe, A., 2012. Green Infrastructure Practices: An Introduction to Permeable Pavement. Rutgers NJAES Cooperative Extension, FS1177, pp. 4.
http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1177

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques* 1(3): 100-111.

United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.
http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ

Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

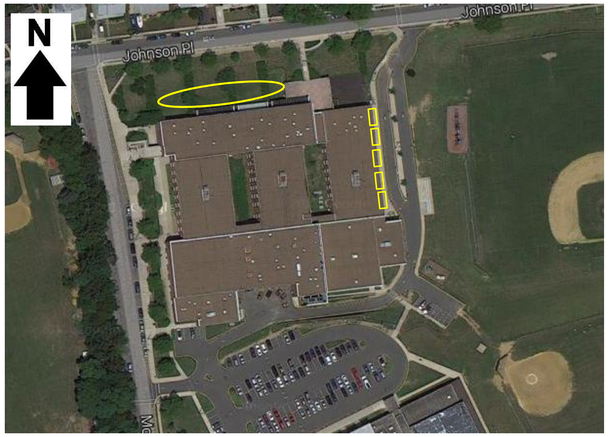
South River Borough
Impervious Cover Assessment
South River Elementary School, 81 Johnson Place

RUTGERS
New Jersey Agricultural Experiment Station

A

B

PROJECT LOCATION:



SITE PLAN:

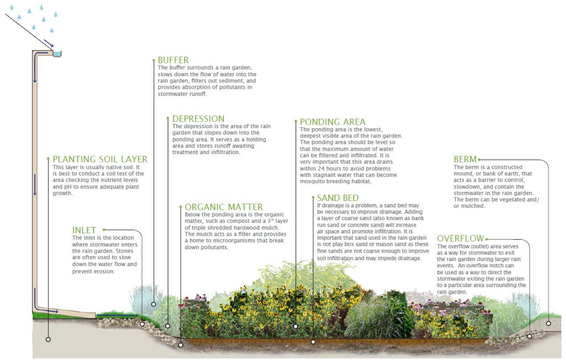
N

1 **BIORETENTION SYSTEM:** A bioretention system could be installed along the northern side of the building after disconnecting downspouts. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reaches catch basins.

2 **DOWNSPOUT PLANTER BOX:** Downspout planter boxes could be installed along the eastern side of the building to collect water from the nearby downspout. Downspout planter boxes reduce runoff and allow water to slowly infiltrate while being treated for pollutants.

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

1 BIORETENTION SYSTEM



2 DOWNSPOUT PLANTER BOX

EDUCATIONAL PROGRAM

South River Elementary School
Green Infrastructure Information Sheet

Location: 81 Johnson Plaza South River, NJ 08882	**Municipality:** South River Borough **Subwatersheds:** South River
Green Infrastructure Description: bioretention system (rain garden) downspout planter boxes educational program	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system: 187,600 gal. five downspout planter boxes: 7,000 gal.

Existing Conditions and Issues:
This site contains impervious surfaces including driveways, walkways, parking areas, and a large school complex. These impervious surfaces (primarily the school and its parking areas) are directly connected to a storm sewer system. The lawn south of Johnson Place slopes towards the school where there are six directly connected downspouts. There are five directly connected downspouts along the eastern side of the school nearest to Johnson Place.

Proposed Solution(s):
One cumulative bioretention system (or three separate bioretention systems) could be installed in the grass along the northern edge of the school. This system would help manage the stormwater runoff from the school building and lawn between the school and Johnson Place more effectively. Five downspouts on the eastern side of the building could be disconnected and routed to downspout planter boxes.

Anticipated Benefits:
Since bioretention systems are 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 habitat and aesthetic appeal. Downspout planter boxes will reduce runoff and allow water to slowly infiltrate while being treated for pollutants. Rutgers Cooperative Extension could additionally present the *Stormwater Management in Your Schoolyard* program to students. This may also be used as a demonstration project for the South River Borough Department of Public Works staff to launch educational programming.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
South River Borough

South River Elementary School
local social and community groups

Partners/Stakeholders:
South River Borough
South River Elementary School
students, parents, faculty, and staff
local social and community groups
Rutgers Cooperative Extension

Estimated Cost:
The bioretention system would need to be approximately 1,800 square feet. At $5 per square foot, the estimated cost of this bioretention system is $9,000. Disconnecting the six downspouts for this bioretention system would cost an additional $1,500 at $250 per disconnection. Five downspout planter boxes would cost $1,500 at $300 per planter box. The total cost of the project will be approximately $12,000.

South River Borough
Impervious Cover Assessment
South River Public Library, 55 Appleby Avenue

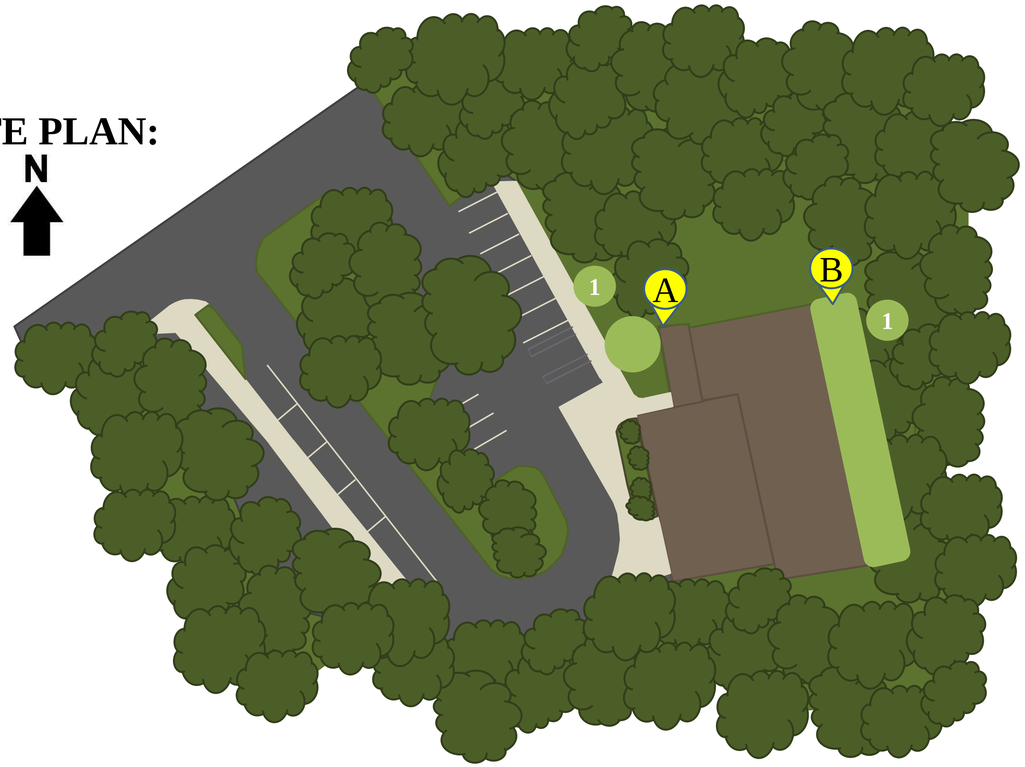
RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

A

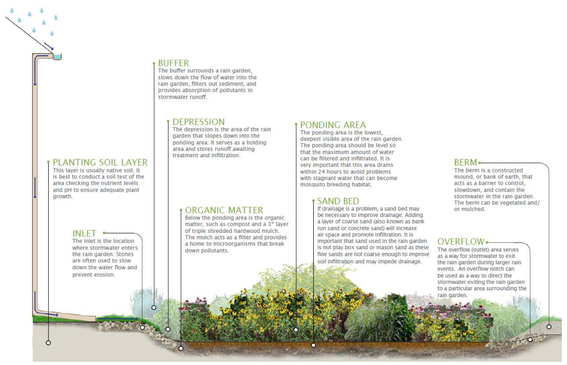
B

SITE PLAN:



1 **BIORETENTION SYSTEM:** Bioretention systems could be installed at the northern corner and along the eastern side of the library. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reaches catch basins.

1 BIORETENTION SYSTEM



South River Public Library
Green Infrastructure Information Sheet

Location: 55 Appleby Avenue South River, NJ 08882	**Municipality:** South River Borough **Subwatershed:** South River
Green Infrastructure Description: bioretention systems (rain gardens)	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system #1: 14,590 gal. bioretention system #2: 31,270 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, walkways, parking areas, and a library. These impervious surfaces are directly connected to a storm sewer system. There is a connected downspout in a grass area at the northwestern corner of the library. On the east side of the building, there are three connected downspouts and a catch basin for runoff.

Proposed Solution(s):
Two bioretention systems could be installed at this site to treat runoff from the library's roof and enhance the site's aesthetic quality. Bioretention system #1 would be installed at the northwestern corner of the building. Bioretention system #2 would be installed along the eastern side (rear) of the building.

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. A bioretention system would also provide ancillary benefits, such as enhanced wildlife habitat and aesthetic appeal.

Possible Funding Sources:
NJDEP grant programs
South River Borough
South River Library
local social and community groups

Partners/Stakeholders:
South River Borough
South River Library

local social and community groups
Rutgers Cooperative Extension

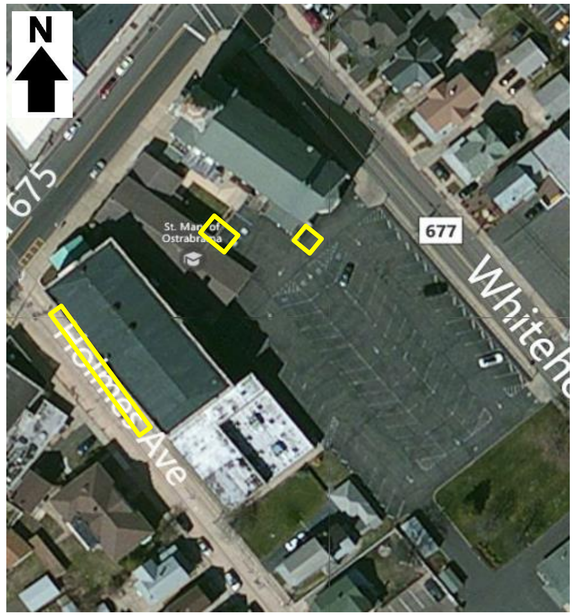
Estimated Cost:

Bioretention system #1 need to be approximately 140 square feet. At $5 per square foot, the estimated cost of this bioretention system is $700. One downspout would be disconnected and routed to this system, which adds $250 to its estimated cost. Bioretention system #2 would need to be approximately 300 square feet. At $5 per square foot, the estimated cost of this bioretention system is $1,500. Three downspouts would be disconnected and routed to this system, which adds $750 to its estimated cost. The total cost of the project will be approximately $3,200.

South River Borough
Impervious Cover Assessment
Parish of St. Mary of Ostrabrama, 30 Jackson Street

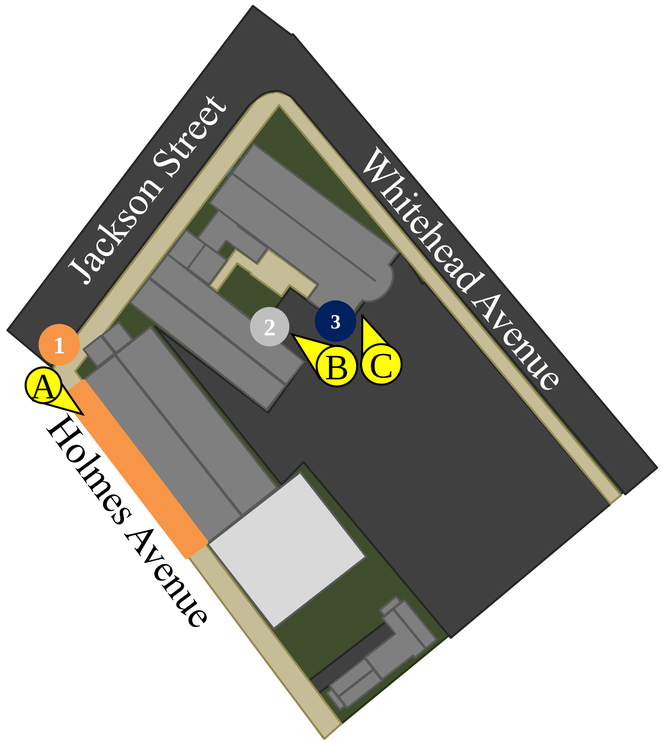
RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:

N



A

B

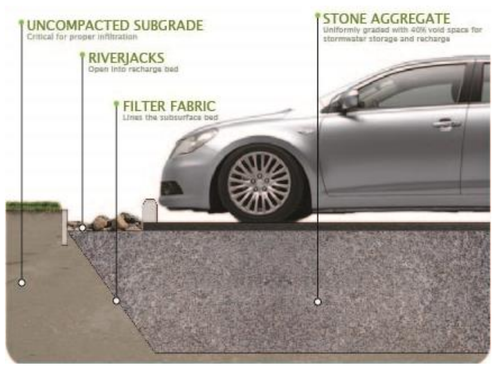
C

1 **POROUS PAVEMENT:** Porous pavement can be installed on the sidewalk along Holmes Avenue to collect roof runoff from existing disconnected downspouts. Porous pavement promotes groundwater recharge and filters stormwater.

2 **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.

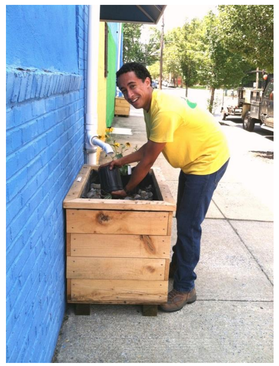
3 **DOWNSPOUT PLANTER BOX:** A downspout planter box could be installed at three existing disconnected downspouts to collect runoff from the roof. Downspout planter boxes reduce runoff and allow water to slowly infiltrate while being treated for pollutants.

1 POROUS PAVEMENT



2 DISCONNECTED DOWNSPOUTS

3 DOWNSPOUT PLANTER BOX



Parish of St. Mary of Ostrabrama
Green Infrastructure Information Sheet

Location: 30 Jackson Street South River, NJ 08882	**Municipality:** South River Borough **Subwatershed:** South River
Green Infrastructure Description: disconnected downspouts porous pavement downspout planter box	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** disconnected downspouts: 22,220 gal. downspout planter box: 1,400 gal. porous pavement: 134,970 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, walkways, parking areas, and multiple buildings. These impervious surfaces are directly connected to a storm sewer system. The site's impervious surfaces produce stormwater runoff during rain events. There are multiple downspouts on the school that empty onto the sidewalk on Holmes Avenue. There is a downspout on the southern corner of the church that empties almost directly into a catch basin for the parking lot. There are also several directly connected downspouts on the building between the church and the school.

Proposed Solution(s):
The sidewalk along the school at Holmes Avenue can be converted into porous pavement to prevent erosion and collect runoff. The two connected downspouts in the existing garden can be disconnected and allowed to flow and drain into the garden. The downspout in the parking lot can be routed to a downspout planter box.

Anticipated Benefits:
The simple disconnection would reduce the pollutant loading by 90% since it will manage the water quality design storm of 1.25 inches of rain. A downspout planter box would harvest runoff from the roof of the church to water plants. Porous pavement allows stormwater to penetrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. These systems are expected to achieve a 95% pollutant load reduction for TN, TP, and TSS.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
South River Borough

Parish of St. Mary of Ostrabrama
local social and community groups

Partners/Stakeholders:
South River Borough
Parish of St. Mary of Ostrabrama
local community groups (Boy Scouts, Girl Scouts, etc.)
American Littoral Society
Rutgers Cooperative Extension

Estimated Cost:
The disconnection of the two downspouts would require approximately 190 square feet of available space and cost approximately $500. The downspout planter box would cost approximately $300 to purchase and install. The porous pavement would cover approximately 1,850 square feet and have a 1 foot deep stone reservoir under the surface. At $20 per square foot, the cost of this system would be approximately $37,000. The total cost of the project will be approximately $37,800.