RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Assessment for Sayreville Borough, Middlesex County, New Jersey

Prepared for Sayreville 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

Sayreville Borough Impervious Cover Analysis

Located in Middlesex County in central New Jersey, Sayreville Borough covers approximately 17.6 square miles south of Woodbridge Township. Figures 3 and 4 illustrate that Sayreville Borough is dominated by urban land uses. A total of 52.4% of the municipality's land use is classified as urban. Of the urban land in Sayreville 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 Sayreville 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 Sayreville Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 23.5% of Sayreville Borough has impervious cover. This level of impervious cover suggests that the streams in Sayreville Borough are likely impacted.

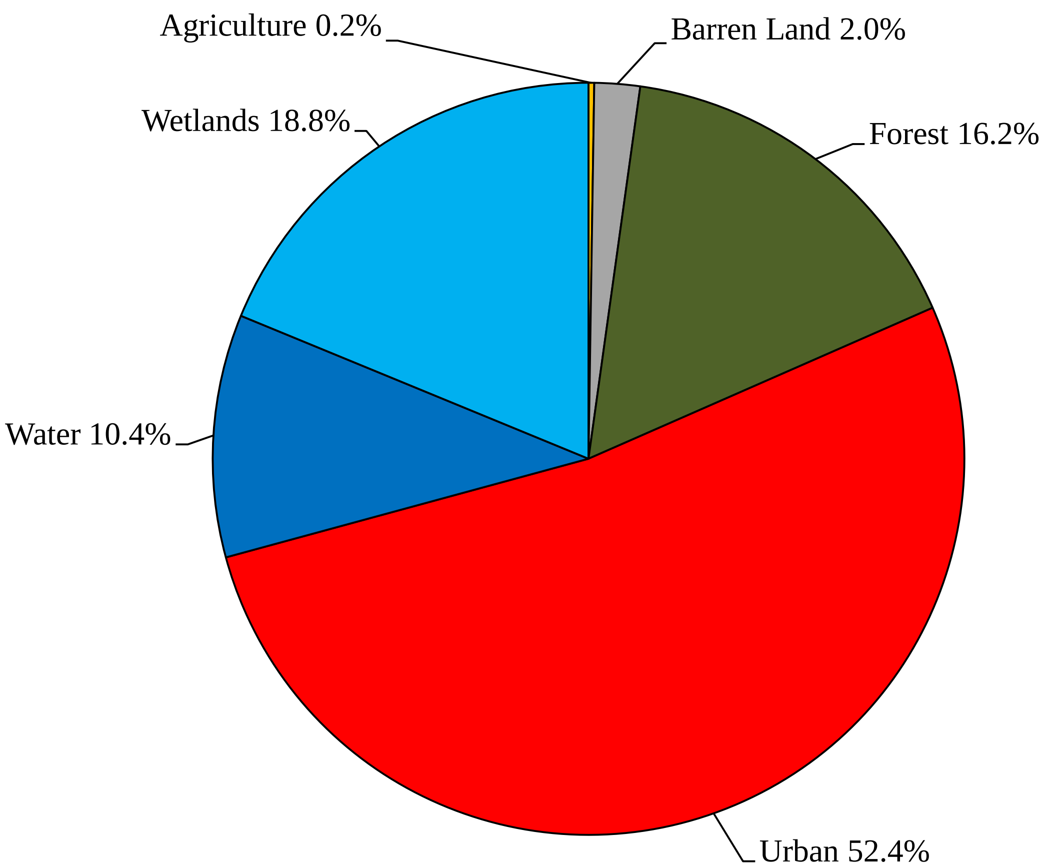


Figure 3: Pie chart illustrating the land use in Sayreville Borough

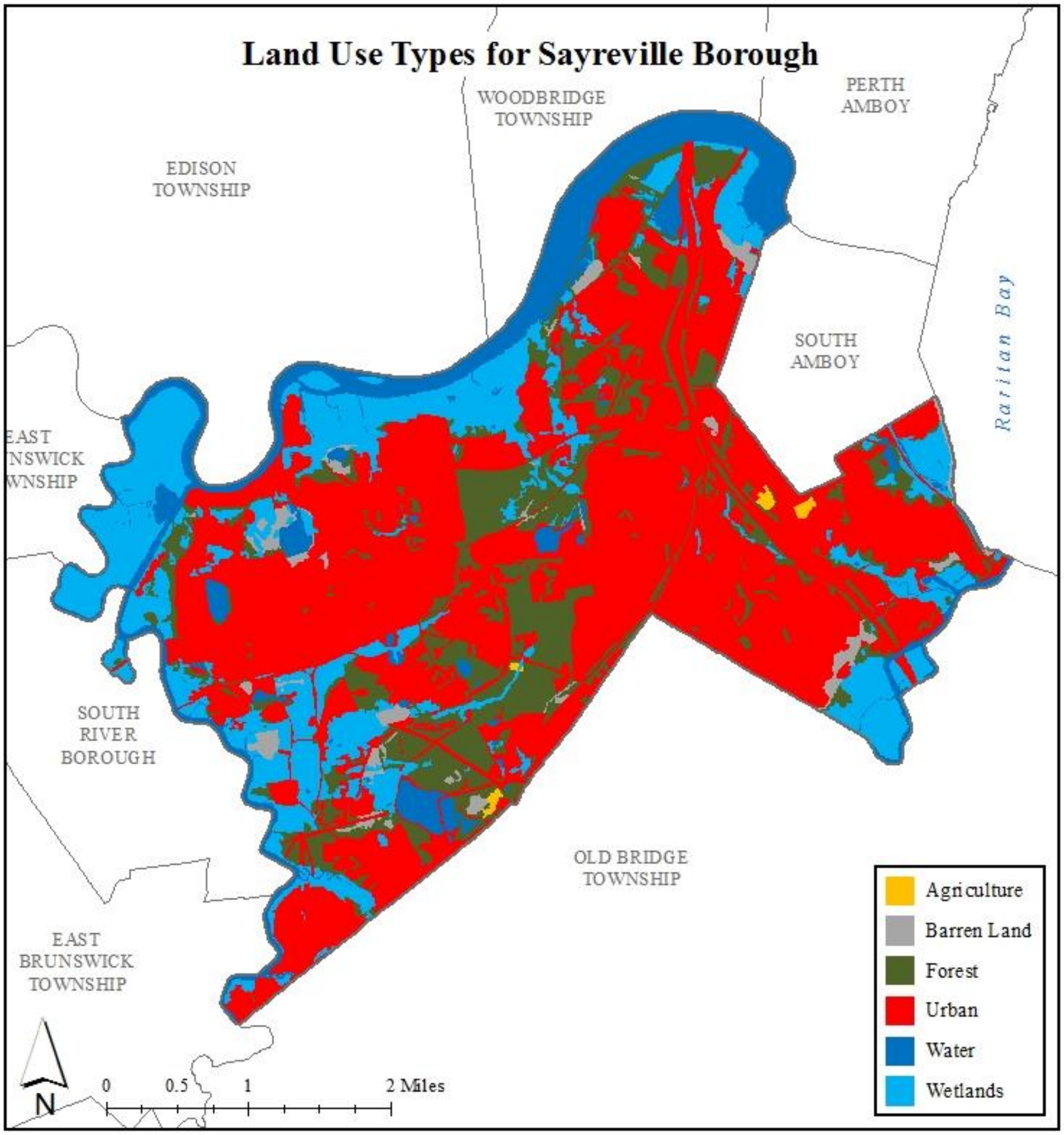


Figure 4: Map illustrating the land use in Sayreville Borough

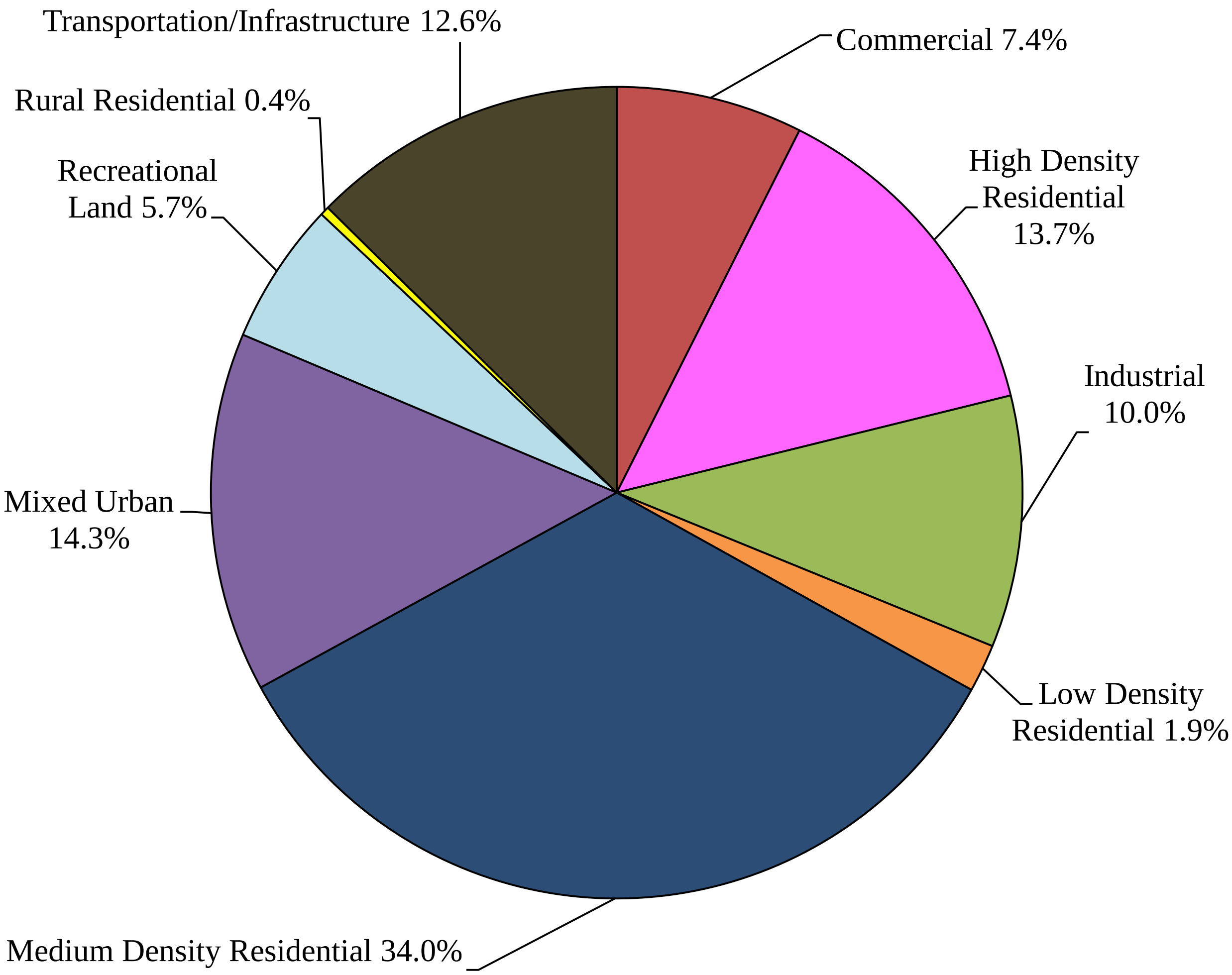


Figure 5: Pie chart illustrating the various types of urban land use in Sayreville Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Sayreville Borough (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0% in the Raritan Bay subwatershed to 33.8% in the Tenant 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 Sayreville 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 Sayreville Borough. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Lower Raritan River subwatershed was harvested and purified, it could supply water to 388 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Sayreville Borough

Subwatershed	**Total Area**		**Land Use Area**		**Water Area**		**Impervious Cover**		
	(ac)	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(ac)**	**(mi^2)**	**(%)**
Cheesequake Creek / Whale Creek	1,868.2	2.92	1,796.4	2.81	71.9	0.11	537.7	0.84	29.9%
Deep Run	22.4	0.04	20.0	0.03	2.43	0.00	6.27	0.01	31.3%
Raritan Bay	0.55	0.00	0.54	0.00	0.01	0.00	0.00	0.00	0.00%
Lower Raritan River	5,881.8	9.19	5,002.9	7.82	878.9	1.37	1,252.0	1.96	25.0%
South River	3,167.8	4.95	2,952.1	4.61	215.6	0.34	464.9	0.73	15.8%
Tennent Brook	310.9	0.49	306.1	0.48	4.85	0.01	103.6	0.16	33.8%
Total	11,251.7	17.6	10,078.0	15.8	1,173.7	1.83	2,364.4	3.69	23.5%

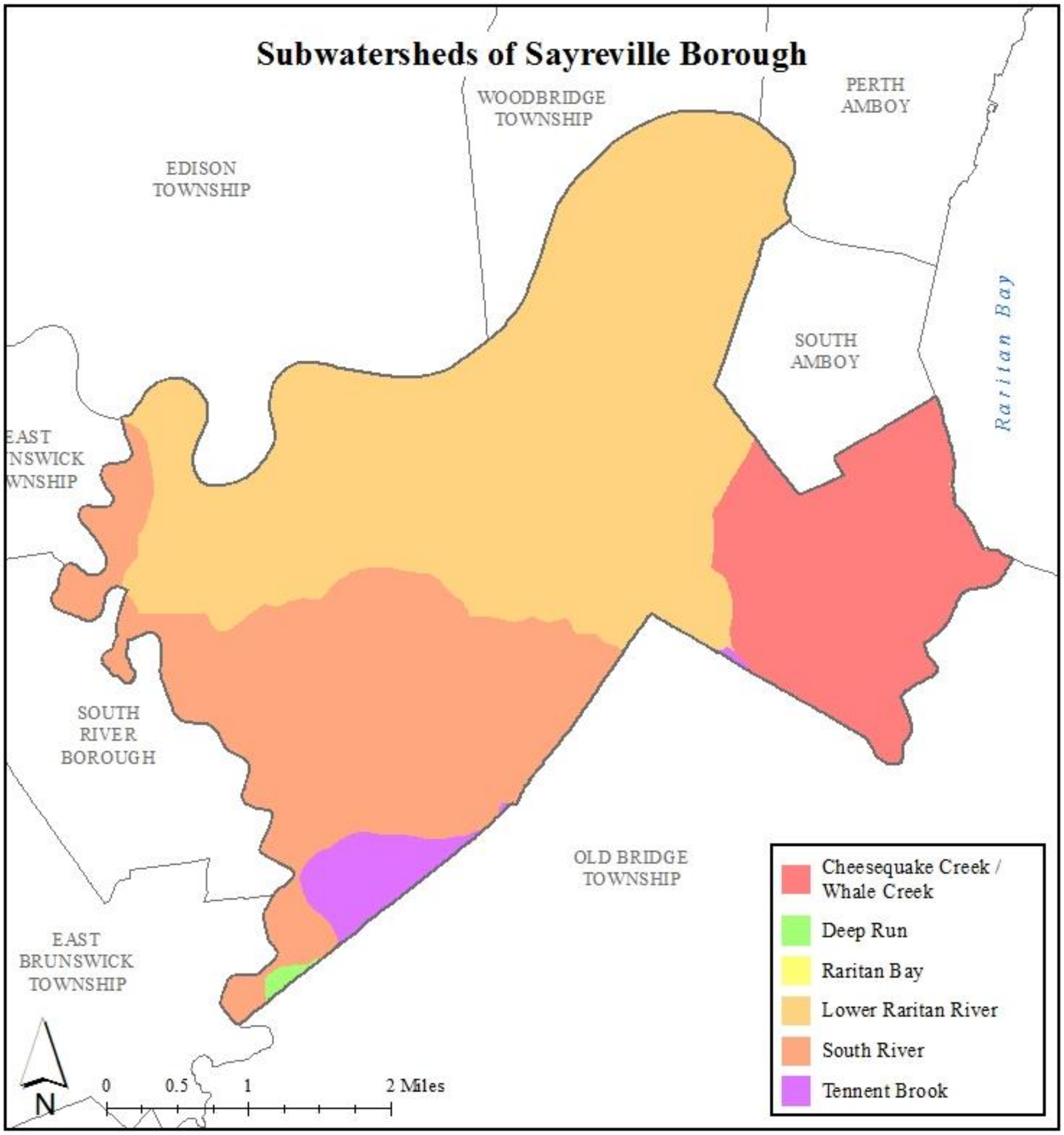


Figure 6: Map of the subwatersheds in Sayreville Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Sayreville 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)**
Cheesequake Creek / Whale Creek	18.3	642.4	48.2	74.5	125.6
Deep Run	0.2	7.5	0.6	0.9	1.5
Raritan Bay	0.0	0.0	0.0	0.0	0.0
Lower Raritan River	42.5	1,495.8	112.2	173.4	292.4
South River	15.8	555.4	41.7	64.4	108.5
Tennent Brook	3.5	123.7	9.3	14.3	24.2
Total	80.2	2,824.8	211.9	327.4	552.1

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 Sayreville 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 Sayreville Borough

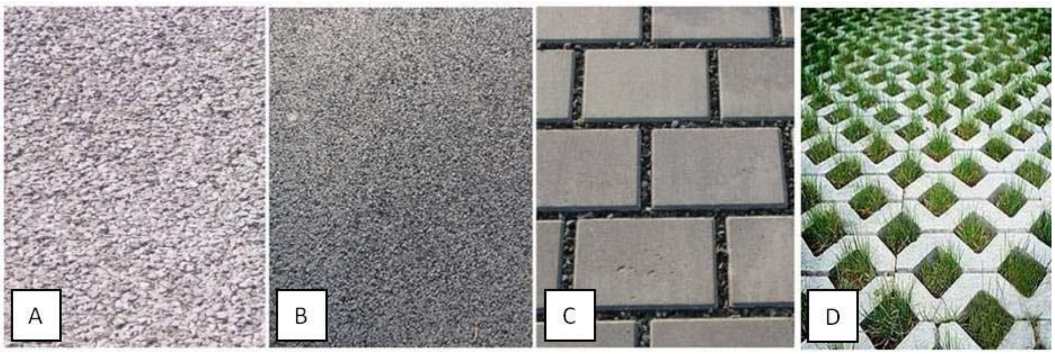
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Cheesequake Creek / Whale Creek	53.8	61.0
Deep Run	0.6	0.7
Raritan Bay	0.0	0.0
Lower Raritan River	125.2	142.1
South River	46.5	52.8
Tennent Brook	10.4	11.8
Total	236.4	268.4

[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 Sayreville 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 Sayreville 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

Sayreville 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.

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Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Sheets

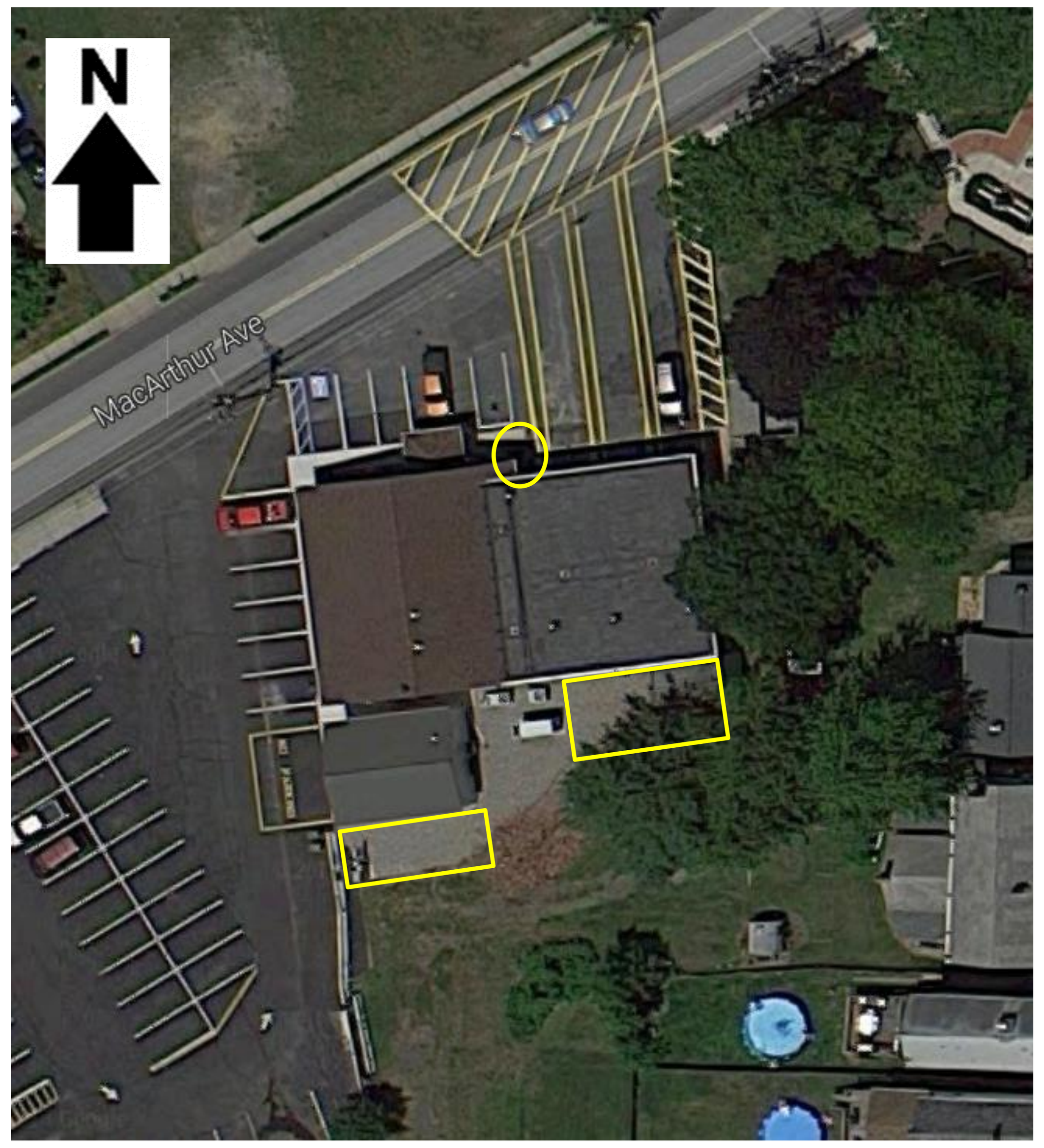
Sayreville Borough
Impervious Cover Assessment
Sayreville Engine Co. #1, 260 MacArthur Avenue

RUTGERS
New Jersey Agricultural Experiment Station

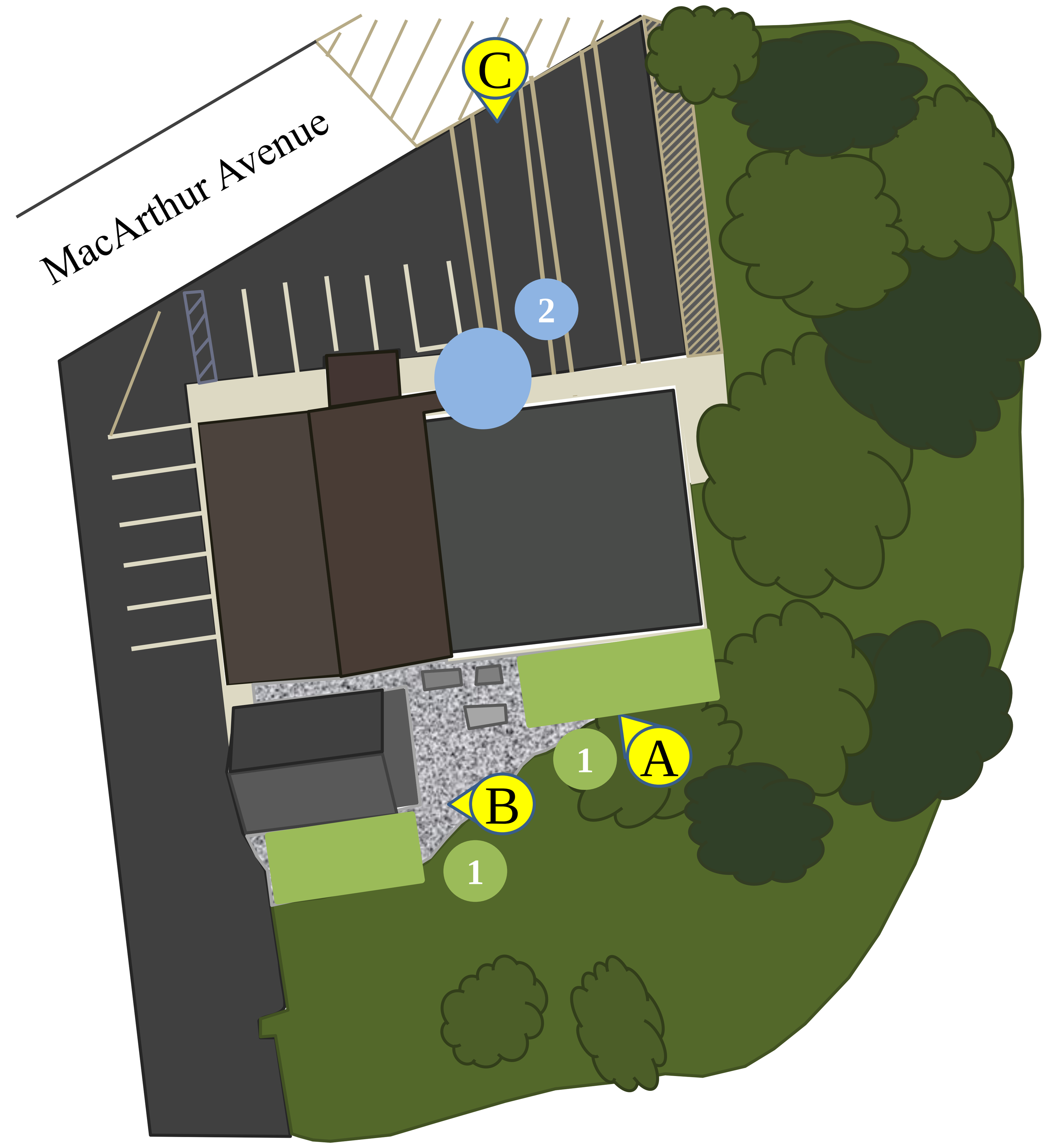
A


B


PROJECT LOCATION:



SITE PLAN:



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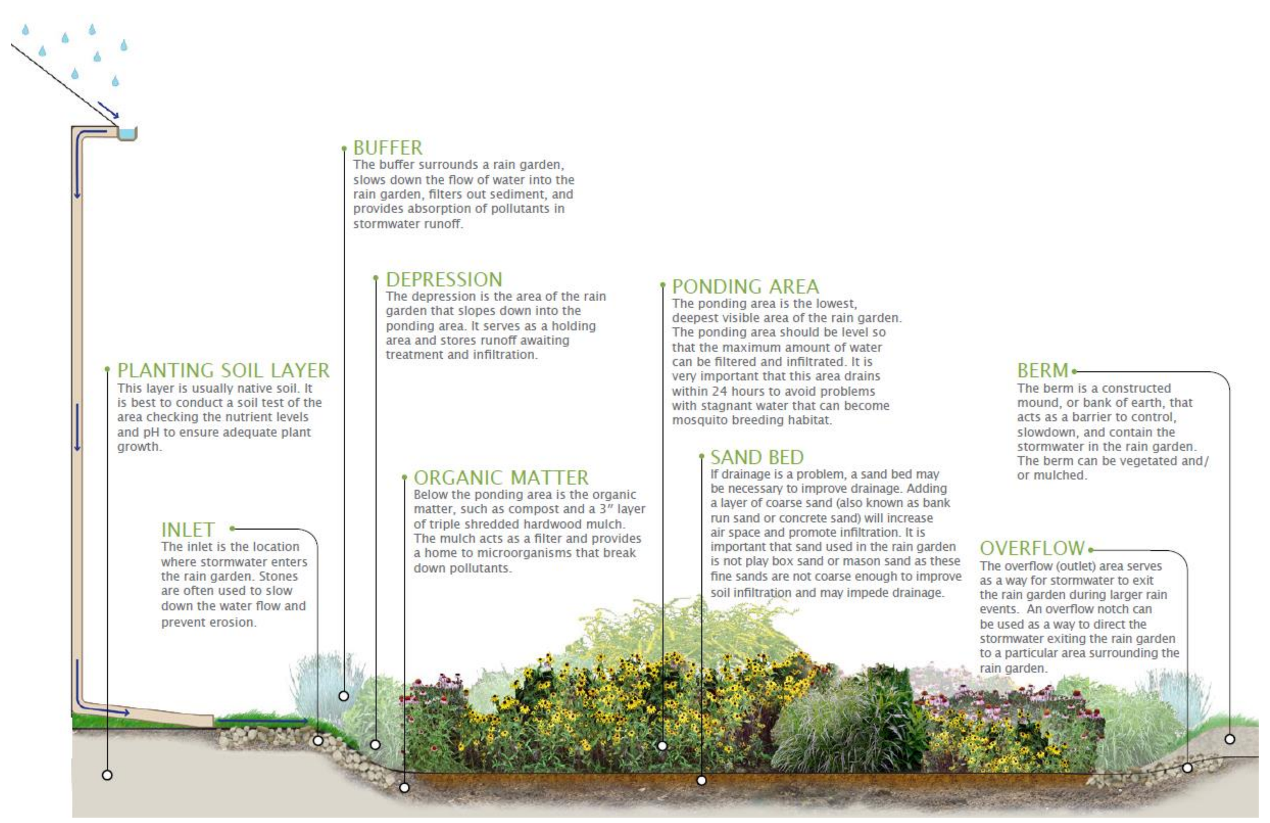
1 **BIORETENTION SYSTEM:** A bioretention system could be installed along the back of the building to manage stormwater coming from three downspouts. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants reaching catch basins.

2 **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the roof of the building and stored in cisterns. The water will be used to wash fire trucks.

1 BIORETENTION SYSTEM



2 RAINWATER HARVESTING SYSTEM

Sayreville Engine Co. #1
Green Infrastructure Information Sheet

Location: 260 MacArthur Avenue Sayreville, NJ 08872	**Municipality:** Sayreville Borough **Subwatershed:** Lower Raritan River
Green Infrastructure Description: bioretention system or rain garden rainwater harvesting system disconnecting downspout	**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: 20,844 gal. rain garden #2: 22,408 gal. rainwater harvesting system: 20,586 gal.

Existing Conditions and Issues:
In the back on the building on the left side there is one disconnected downspout that flows directly onto a gravel area. Adjacent to this area on the right, there are two connected downspouts in a gravel and grass area. In the front of the building by the garage where the trucks are held there is a disconnected downspout that flows directly onto the driveway where the trucks enter and exit. Since this downspout carries runoff from half of the roof, the driveway can easily become flooded and eroded.

Proposed Solution(s):
In the back of the building, a bioretention system (#1) can be installed to receive the runoff from the disconnected downspout. The two connected downspouts could be disconnected and routed to another bioretention system (#2) to collect roof runoff. In the front of the building, the disconnected downspout can be allowed to flow into a slim line cistern.

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 cistern can harvest rainwater to be used to wash the fire trucks, water plants, or other purposes which reduce the use of potable water for non-drinking purposes. The cistern 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
Sayerville Borough

Partners/Stakeholders:
Sayerville Borough
local community groups (Boy Scouts, Girl Scouts, etc.)
NY/NJ Baykeeper
Raritan Riverkeeper
Rutgers Cooperative Extension

Estimated Cost:
The disconnected downspouts would need approximately 180 square feet for disconnection and cost about $500. Rain garden #1 would need to be approximately 200 square feet. At $5 per square foot, the estimated cost is $1,000. Rain garden #2 would need to be approximately 220 square feet. At $5 per square foot, the estimated cost is $1,100. The slim line cistern would need to be approximately 1,500 gallons and would cost approximately $3,000. The total cost of the project would be $5,600.

Sayreville Borough
Impervious Cover Assessment
Sayreville Borough Hall, 167 Main Street

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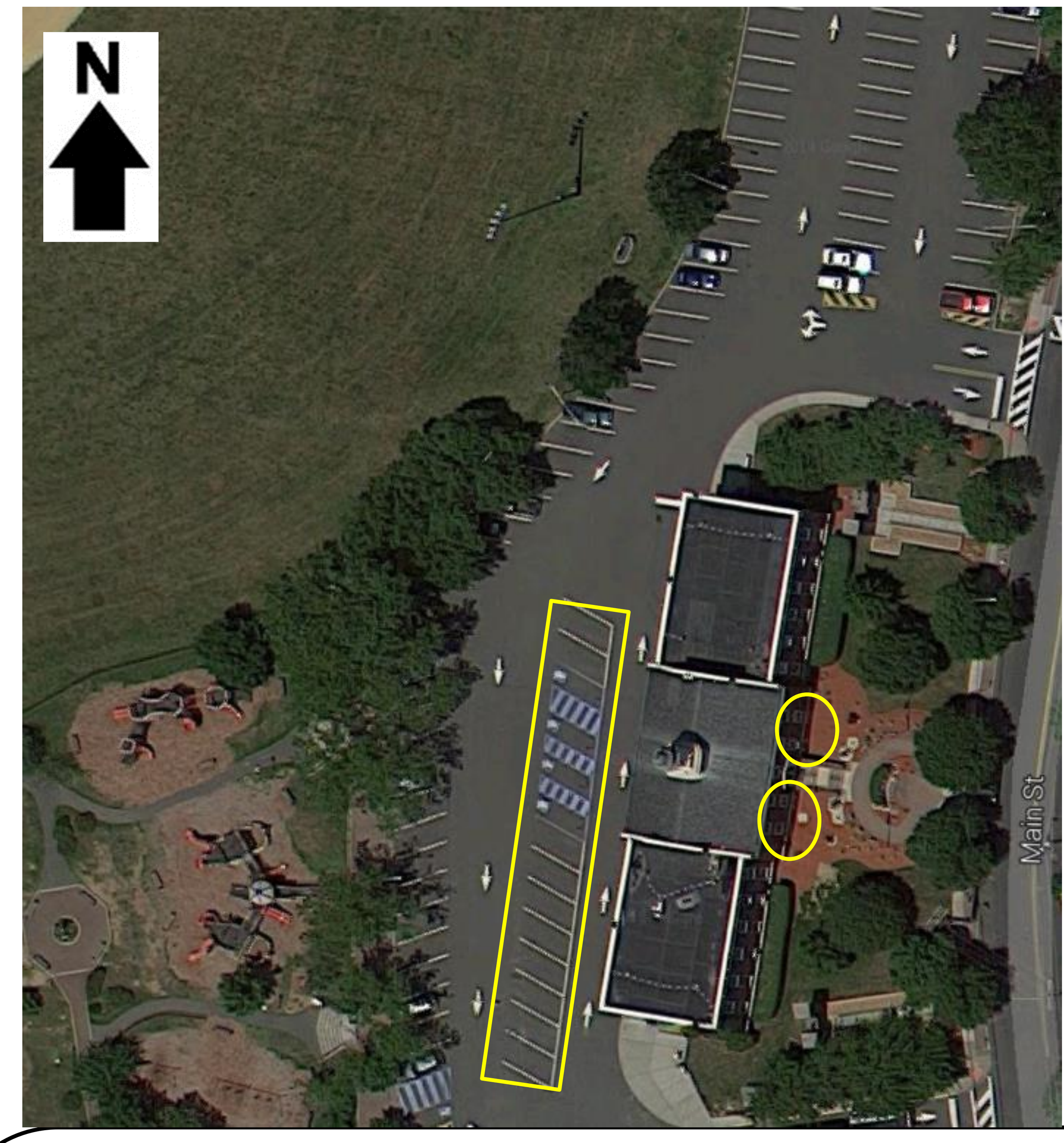
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



A

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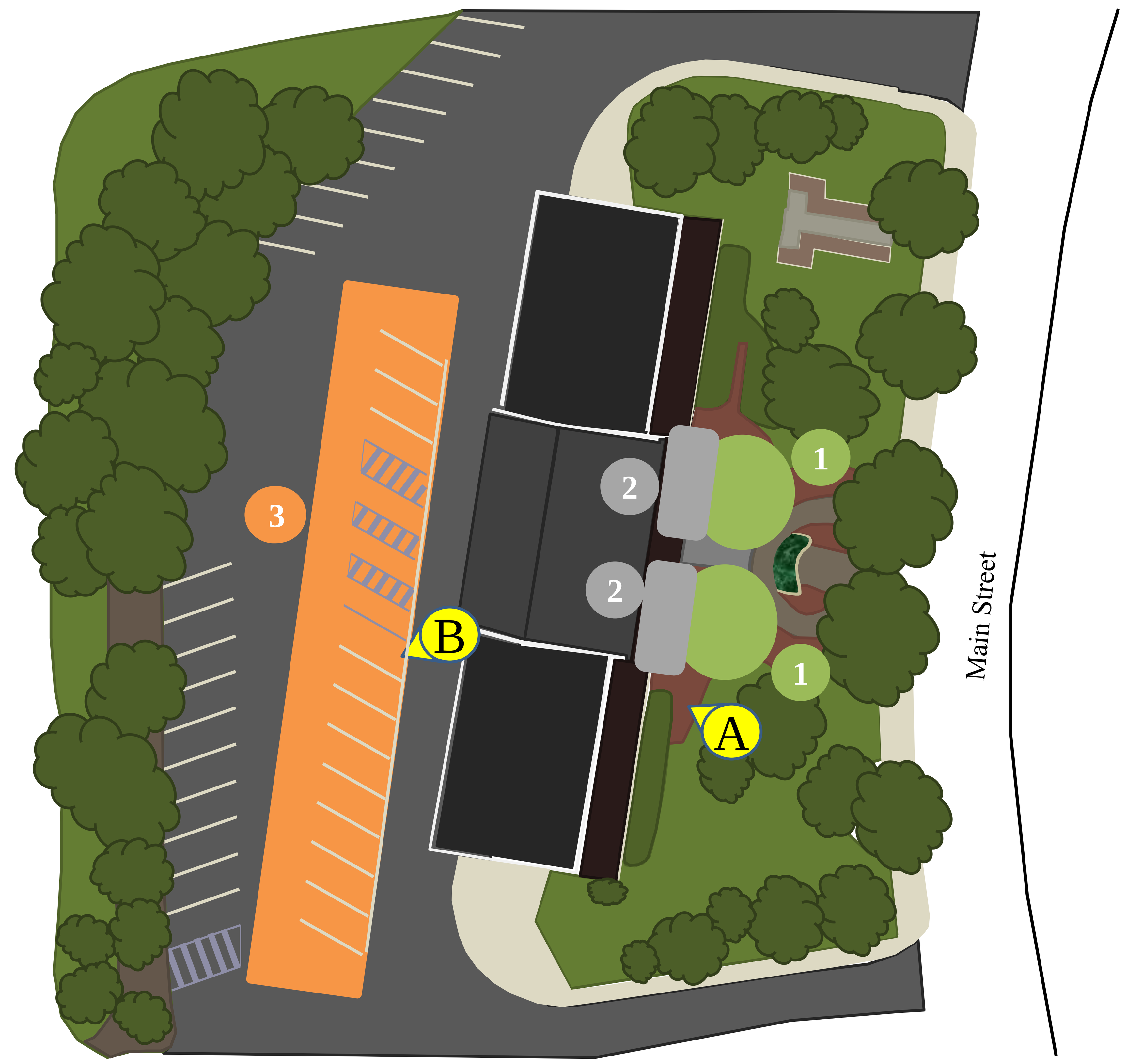
SITE PLAN:

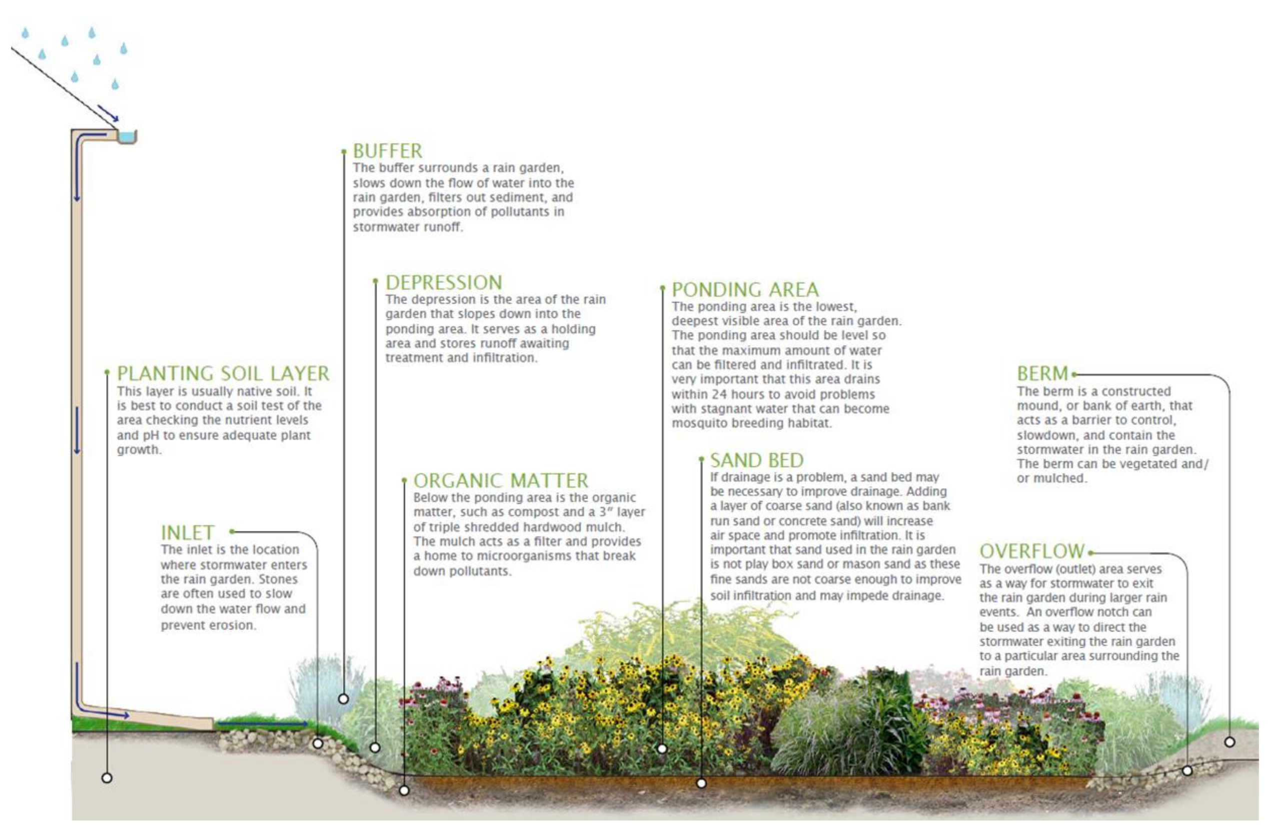


1. **BIORETENTION SYSTEM:** Bioretention systems could be installed on either side of the entrance of the building after disconnecting three downspouts. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants reaching catch basins.

2. **POROUS PAVEMENT:** Porous pavement promotes groundwater recharge and filters stormwater.

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 BIORETENTION SYSTEM



2 DISCONNECTED DOWNSPOUTS

3 POROUS PAVEMENT

Sayreville Borough Hall
Green Infrastructure Information Sheet

Location: 167 Main Street Sayreville, NJ 08872	**Municipality:** Sayerville Borough **Subwatershed:** Raritan River Lower
Green Infrastructure Description: bioretention system (rain garden) disconnecting downspouts porous pavement	**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 total suspended solids removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system #1: 20,844 gal. bioretention system #2: 20,844 gal. porous pavement: 355,707 gal.

Existing Conditions and Issues:
The impervious surfaces at this site include a rooftop and paved areas that contribute to stormwater runoff volumes and nonpoint source pollution to local waterways. Along the back of the building, there is a large mulched garden area with three connected downspouts on each side of the building's rear entrance. In the parking lot area, the existing pavement has been worn down and eroded.

Proposed Solution(s):
The downspouts at the back of the building could be disconnected to flow into the gardens rather than straight into the stormwater sewer systems. Additionally, the existing garden could be converted into a rain garden on each side of the entrance (north #1, south #2) to more effectively capture, treat, and allow the infiltration of stormwater. In the parking lot closest to the building, a strip of porous pavement could be installed in the parking spots to capture and infiltrate stormwater runoff from the parking lot before it reaches the storm drain.

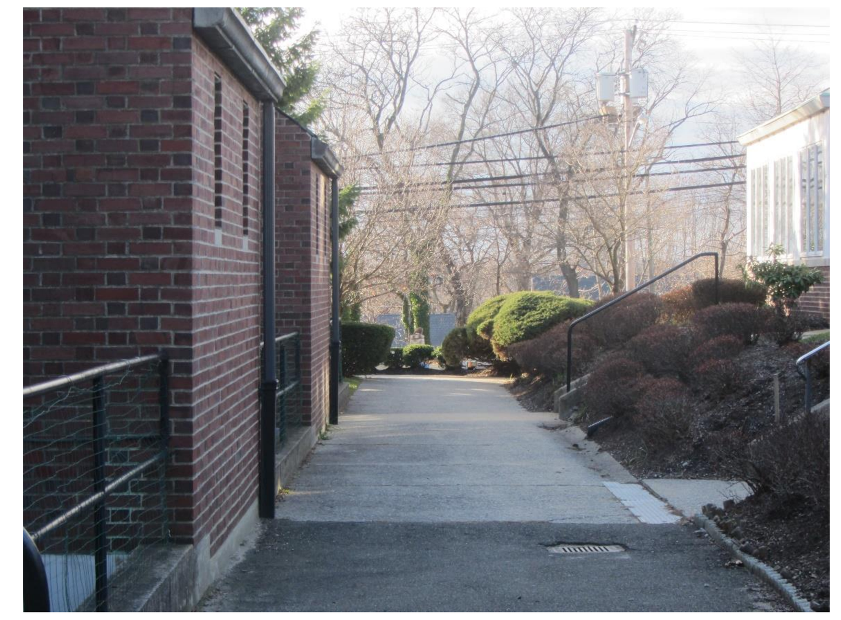
Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.3 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits, such as enhanced wildlife habitat and aesthetic appeal. Porous pavement allows stormwater to infiltrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The porous pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS as the bioretention system.

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

Sayreville Borough Local social and community groups
Partners/Stakeholders: Sayreville Borough Sayreville Borough Hall local community groups Rutgers Cooperative Extension
Estimated Cost: Rain garden #1 and #2 would each need to be approximately 200 square feet. At $5 per square foot, the estimated cost for both is $2,000. Disconnecting the downspouts will cost about $250 each for a total cost of $1,500. The porous asphalt would cover 2,800 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 $70,000.The total cost of the project will thus be approximately $73,500.

Sayreville Borough
Impervious Cover Assessment
Our Lady of Victories Roman Catholic Church, 42 Main Street

A

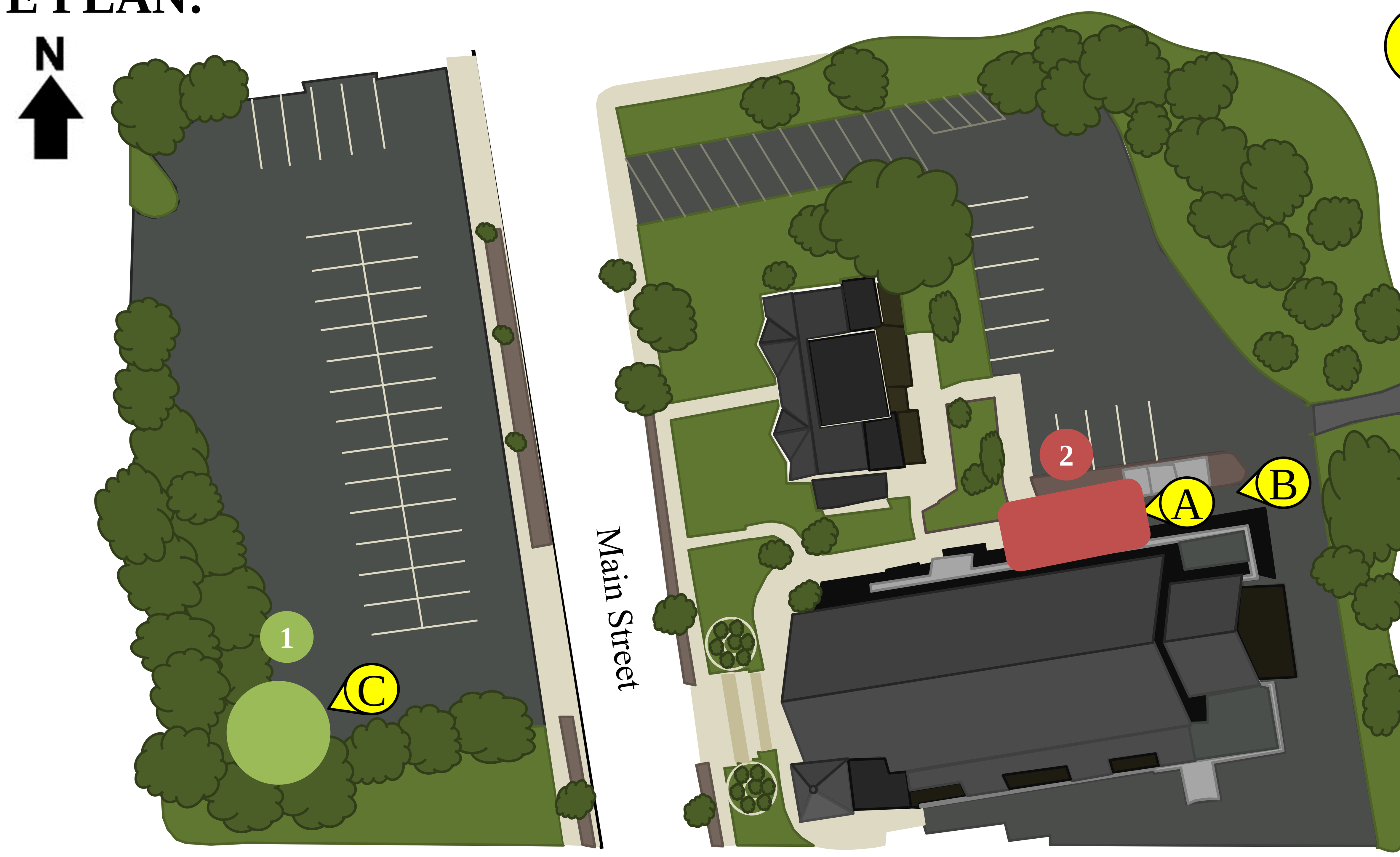


B

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:

SITE PLAN:

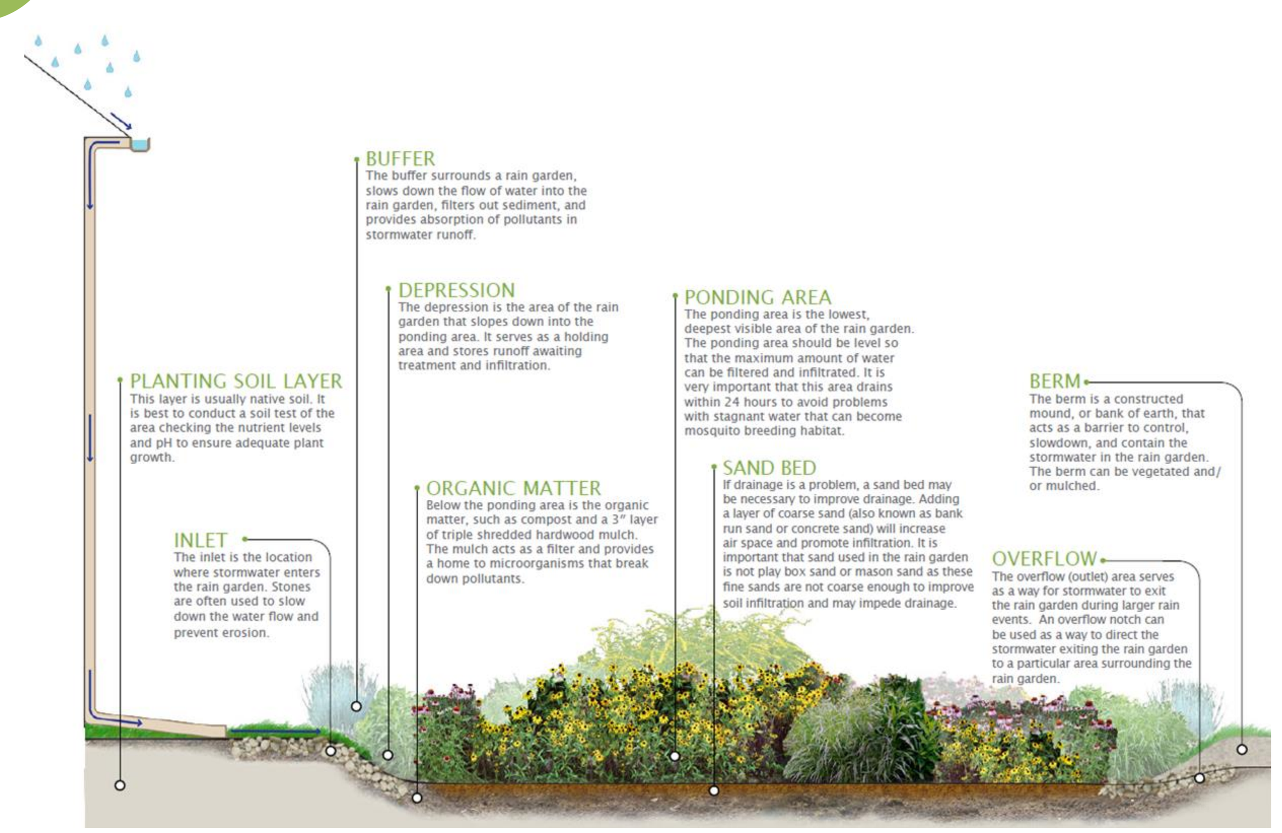


C

1 **BIORETENTION SYSTEM:** A bioretention system could be installed at the corner of the large parking lot where the pavement is sloped towards a catch basin. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants reaching catch basins.

2 **GRASS PAVERS:** The use of grass pavers promotes groundwater recharge and filters stormwater.

1 BIORETENTION SYSTEM



2 GRASS PAVERS

Location: 42 Main Street Sayreville, NJ 08872	**Municipality:** Sayreville Borough **Subwatershed:** Raritan River Lower
Green Infrastructure Description: bioretention system (rain garden) grass pavers	**Targeted Pollutants:** total nitrogen (TN), total phosphorous (TP), 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: 26,055 gal. grass pavers: 100,157 gal.

Existing Conditions and Issues:
Impervious surfaces at this site include rooftops and paved areas that contribute to stormwater runoff volumes and nonpoint source pollution to local waterways. The church has a parking lot across the street which contains a damaged storm drain at its southwest corner. On the north face of the church, there are two connected downspouts, and across the pavement there is a small wall with drainage holes.

Proposed Solution(s):
In the parking lot, the area can be depaved and a bioretention system built in its place to capture runoff from the parking lot. The existing storm drain can be repaired to use as an overflow. This will allow for the capture, treatment, and infiltration of stormwater from the parking lot. At the north face of the church, the two connected downspouts can be disconnected, and the paved area can be turned into an area with grass pavers. This will allow for the capture of stormwater runoff from the disconnected downspouts as well as from the wall with drainage holes.

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 and aesthetic appeal to the local residents and members of the congregation of Our Lady of Victories Roman Catholic Church. The grass pavers would have a stone reservoir beneath them to store the stormwater and slowly let it infiltrate into the ground. The system would contain an underdrain so larger rainfall events could bypass the system.

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

Partners/Stakeholders:
Sayreville Borough
Our Lady of Victories Roman Catholic Church
local community groups
residents and parishioners
Rutgers Cooperative Extension

Estimated Cost:
A rain garden to capture the parking lot runoff would need to be approximately 250 square feet. At $5 per square foot, the estimated cost of the rain garden is $1,250. Disconnecting the downspouts will cost about $250 each for a total cost of $500. The grass pavers will cover approximately 730 square feet and have a two foot stone reservoir under the surface. At $25 per square foot, the cost of the grass paver system would be $18,250. The total cost of the project will thus be approximately $20,000.