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Experiment Station

Draft

Impervious Cover Assessment for Raritan Township, Hunterdon County, New Jersey

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

February 3, 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

Raritan Township Impervious Cover Analysis

Located in Hunterdon County in central New Jersey, Raritan Township covers approximately 37.7 square miles. Figures 3 and 4 illustrate that Raritan Township is dominated by urban land uses. A total of 43.6% of the municipality's land use is classified as urban. Of the urban land in Raritan Township, rural 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 Raritan Township into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for Raritan Township. Based upon the 2007 NJDEP land use/land cover data, approximately 8.9% of Raritan Township has impervious cover. This level of impervious cover suggests that the streams in Raritan Township are likely sensitive streams.

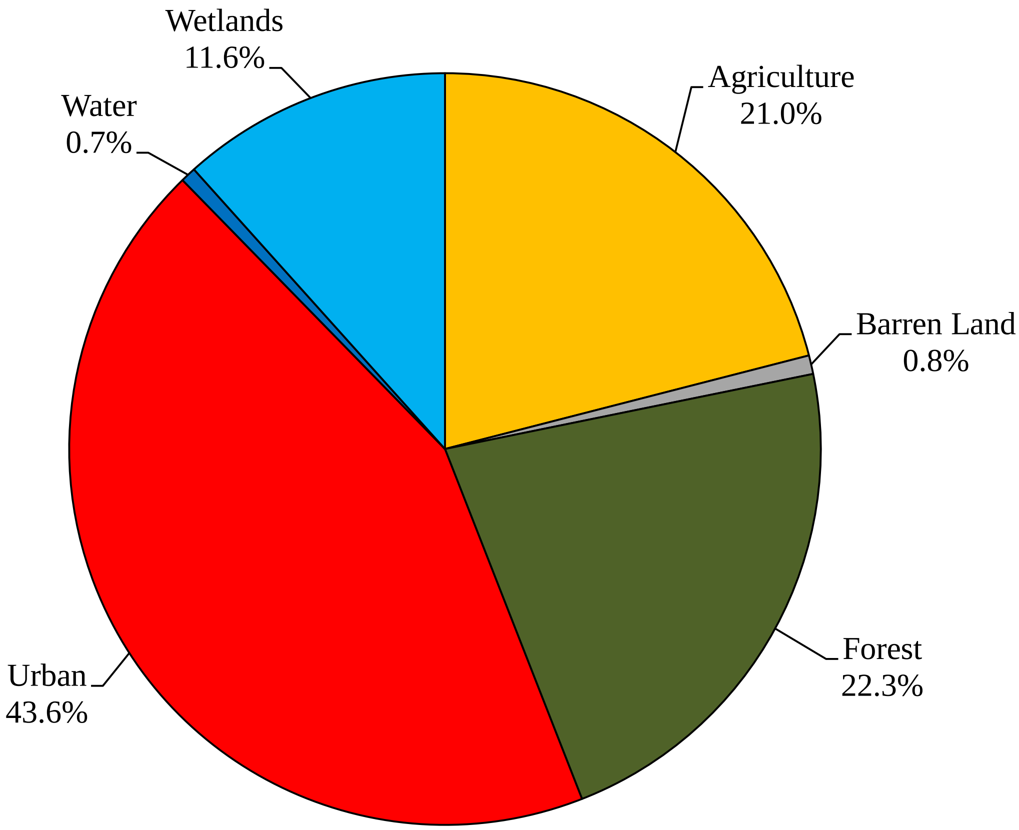


Figure 3: Pie chart illustrating the land use in Raritan Township

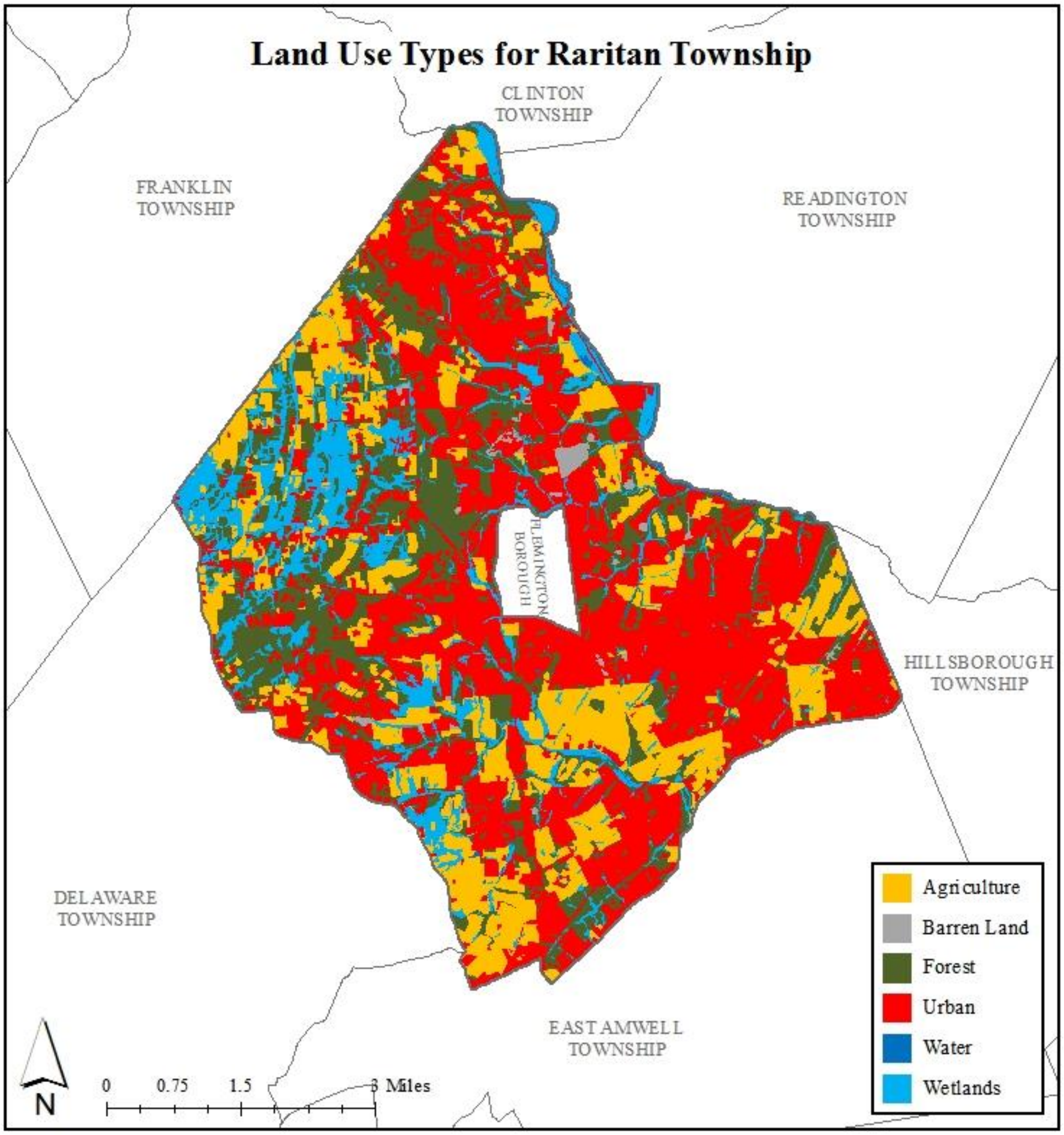


Figure 4: Map illustrating the land use in Raritan Township

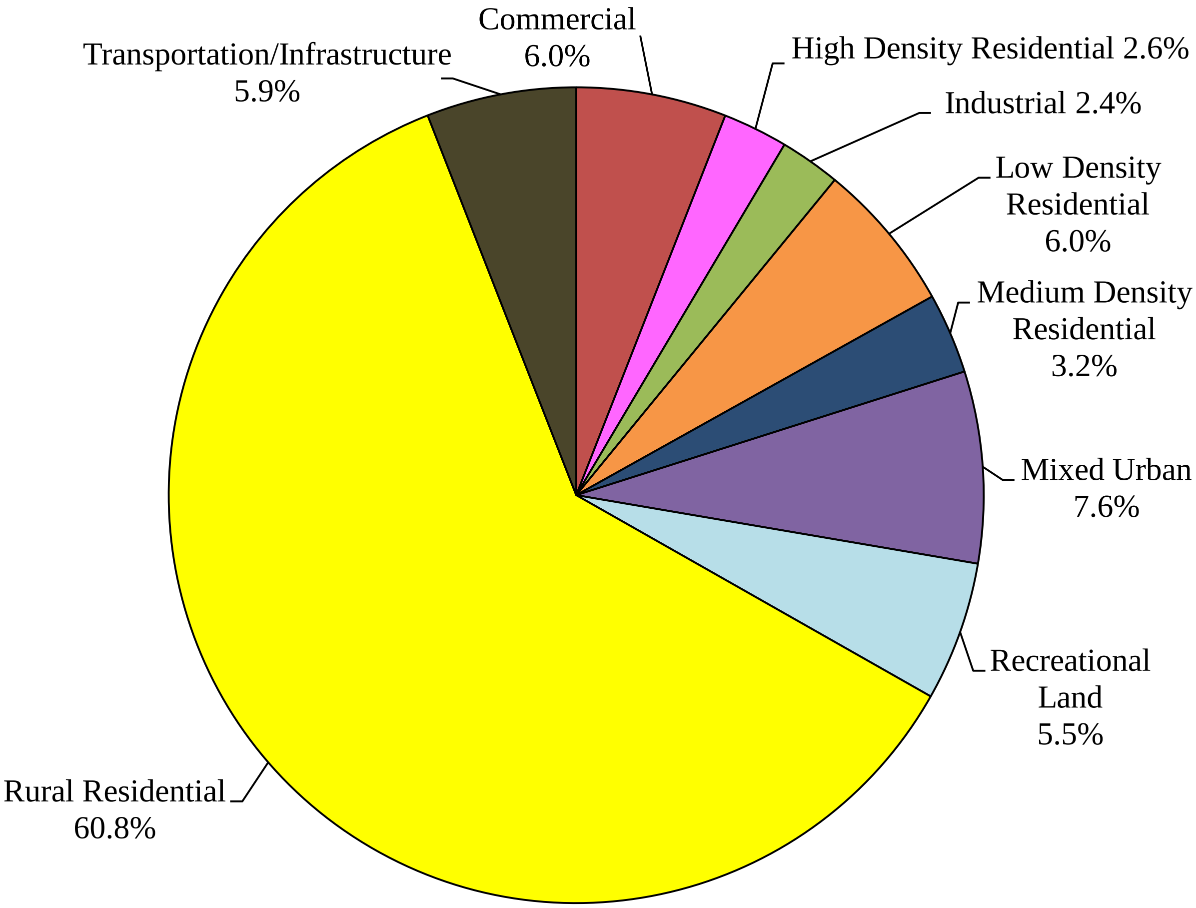


Figure 5: Pie chart illustrating the various types of urban land use in Raritan Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each Raritan River subwatershed within Raritan Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 1.4% in the Wickecheoke subwatershed to 12.4% in the Raritan River South Branch 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 Raritan Township, Hunterdon County) associated with impervious surfaces were calculated for the following storms: the New Jersey water quality design storm of 1.25 inches of rain, an annual rainfall of 44 inches, the 2-year design storm (3.4 inches of rain), the 10-year design storm (5.0 inches of rain), and the 100-year design storm (8.0 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Raritan Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Raritan River South Branch subwatershed was harvested and purified, it could supply water to 332 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Raritan Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Neshanic River	4,085.9	6.38	4,059.2	6.34	26.7	0.04	334.7	0.52	8.3%
First Neshanic River	3,205.6	5.01	3,194.2	4.99	11.4	0.02	368.9	0.58	11.6%
Second Neshanic River	3,286.9	5.14	3,281.7	5.13	5.22	0.01	208.6	0.33	6.4%
Third Neshanic River	1,620.9	2.53	1,603.2	2.50	17.7	0.03	96.7	0.15	6.0%
Back Brook	1.70	0.00	1.70	0.00	0.00	0.00	0.14	0.00	8.2%
Plum Creek	877.3	1.37	877.2	1.37	0.09	0.00	23.6	0.04	2.7%
Raritan River South Branch	8,744.9	13.7	8,655.2	13.5	89.7	0.14	1,073.0	1.68	12.4%
Wickecheoke Creek	2,271.1	3.55	2,262.0	3.53	9.11	0.01	31.8	0.05	1.4%
Total	24,094.3	37.7	23,934.3	37.4	159.9	0.25	2,137.5	3.34	8.9%

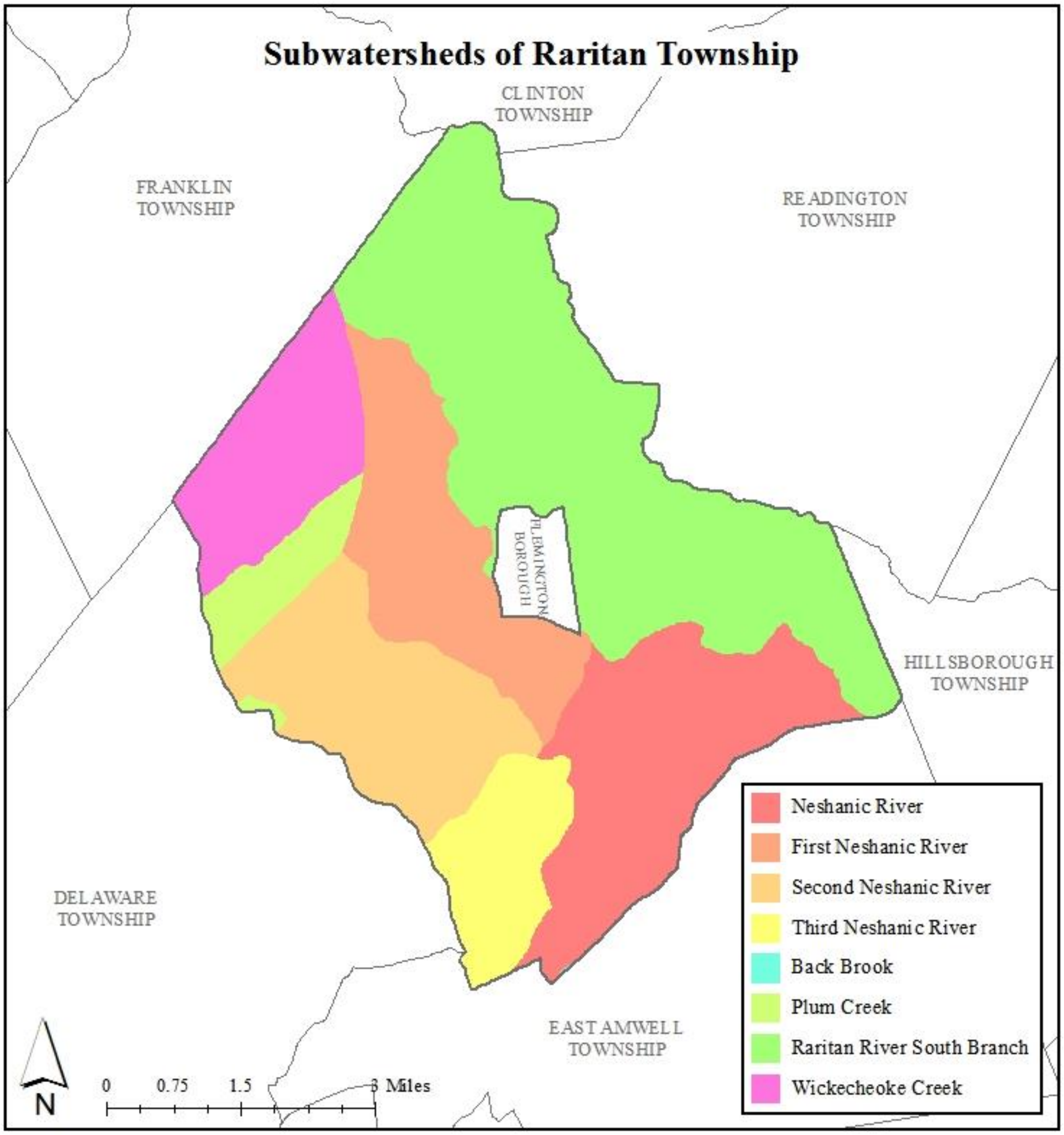


Figure 6: Map of the subwatersheds in Raritan Township

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

Subwatershed	Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)	Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)	Total Runoff Volume for the 2-Year Design Storm (3.4") (MGal)	Total Runoff Volume for the 10-Year Design Storm (5.0") (MGal)	Total Runoff Volume for the 100-Year Design Storm (8.0") (MGal)
Neshanic River	11.4	399.9	30.9	45.4	72.7
First Neshanic River	12.5	440.7	34.1	50.1	80.1
Second Neshanic River	7.1	249.2	19.3	28.3	45.3
Third Neshanic River	3.3	115.6	8.9	13.1	21.0
Back Brook	0.0	0.2	0.0	0.0	0.0
Plum Creek	0.8	28.2	2.2	3.2	5.1
Raritan River South Branch	36.4	1,281.9	99.1	145.7	233.1
Wickecheoke Creek	1.1	38.0	2.9	4.3	6.9
Total	72.5	2,553.7	197.3	290.2	464.3

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 Raritan Township. While it may be difficult to eliminate paved areas or replace paved areas with permeable pavement, it is relatively easy to identify impervious surfaces that can be disconnected using green infrastructure practices. For all practical purposes, disconnecting an impervious surface from a storm sewer system or a water body is an "impervious area reduction." The RCE Water Resources Program recommends that all green infrastructure practices that are installed to disconnect impervious surfaces should be designed for the 2-year design storm (3.4 inches of rain over 24-hours). Although this results in management practices that are slightly over-designed by NJDEP standards, which require systems to be designed for the New Jersey water quality storm (1.25 inches of rain over 2-hours), these systems will be able to handle the increase in storm intensities that are expected to occur due to climate change. By designing these management practices for the 2-year design storm, these practices will be able to manage 95% of the annual rainfall volume. The recommended annual reductions in runoff volumes are shown in Table 3.

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

Elimination of Impervious Surfaces

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

Table 3: Impervious cover reductions by subwatershed in Raritan Township

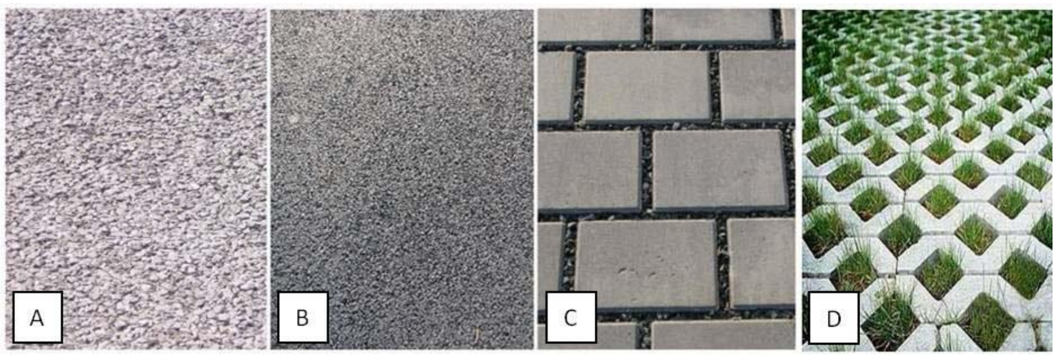
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Neshanic River	33.5	38.0
First Neshanic River	36.9	41.9
Second Neshanic River	20.9	23.7
Third Neshanic River	9.7	11.0
Back Brook	0.0	0.0
Plum Creek	2.4	2.7
Raritan River South Branch	107.3	121.8
Wickecheoke Creek	3.2	3.6
Total	213.7	242.6

[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 3.4 inches of rain from each storm. This would allow the green infrastructure to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

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

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



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

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

Impervious Cover Disconnection Practices

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

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

- Rain Gardens: Stormwater can be diverted into shallow landscaped depressed areas (i.e., rain gardens) where the vegetation filters the water, and it is allowed to soak into the ground. Rain gardens, also known as bioretention systems, come in all shapes and sizes and can be designed to disconnect a variety of impervious surfaces (Figure 7).

Figure 7: Rain garden outside the RCE of Gloucester County office which was designed to disconnect rooftop runoff from the local storm sewer system

- Rainwater Harvesting: Rainwater harvesting includes the use of rain barrels and cisterns (Figures 8a and 8b). These can be placed below downspouts to collect rooftop runoff. The collected water has a variety of uses including watering plants and washing cars. This practice also helps cut down on the use of potable water for nondrinking purposes. It is important to divert the overflow from the rainwater harvesting system to a pervious area.

Figure 8a: Rain barrel used to disconnect a downspout with the overflow going to a flower bed

Figure 8b: A 5,000 gallon cistern used to disconnect the rooftop of the Department of Public Works in Clark Township to harvest rainwater for nonprofit car wash events

Examples of Opportunities in Raritan Township

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

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

Conclusions

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

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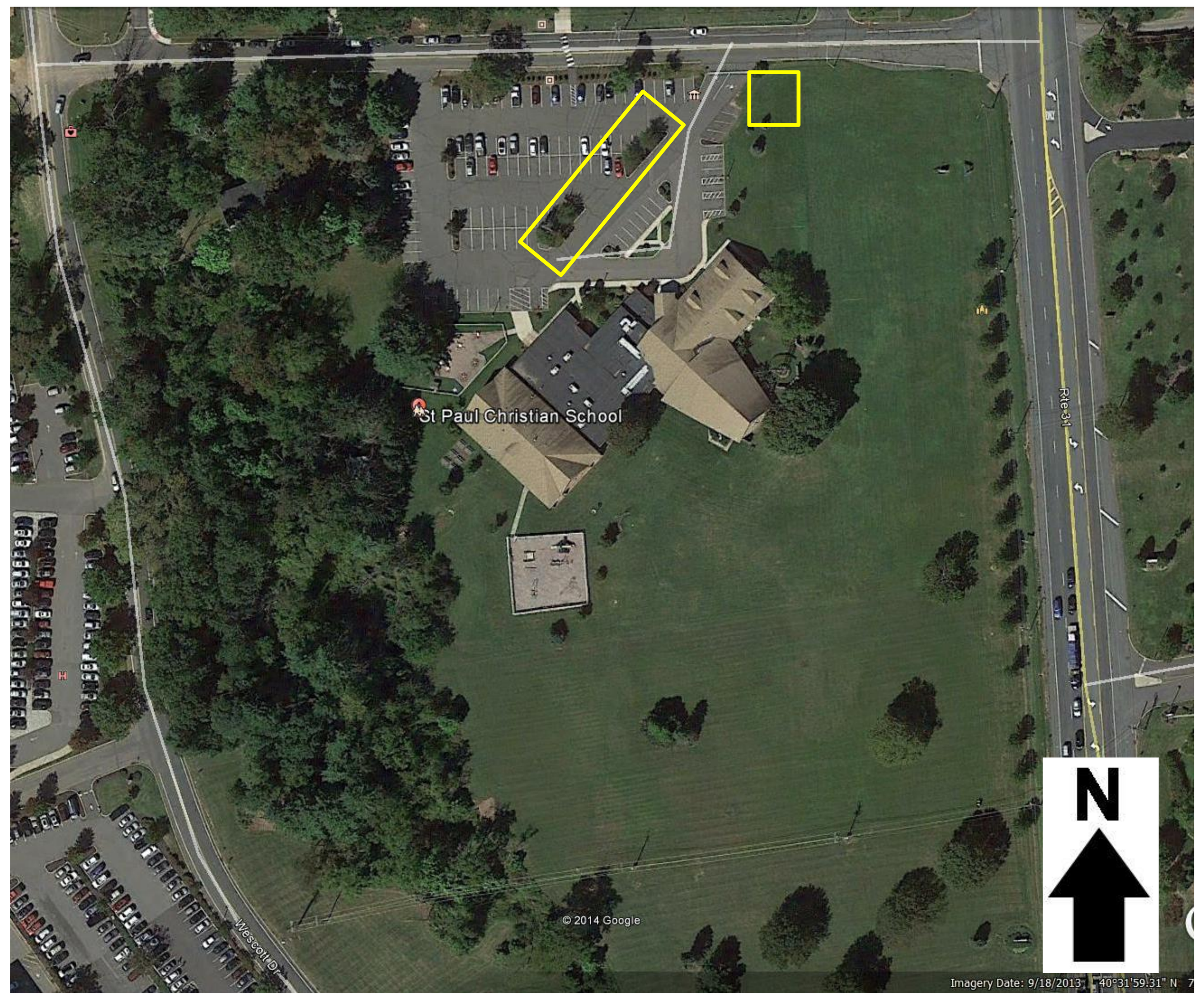
Appendix A

Examples of Impervious Cover Reduction Action Plan Projects

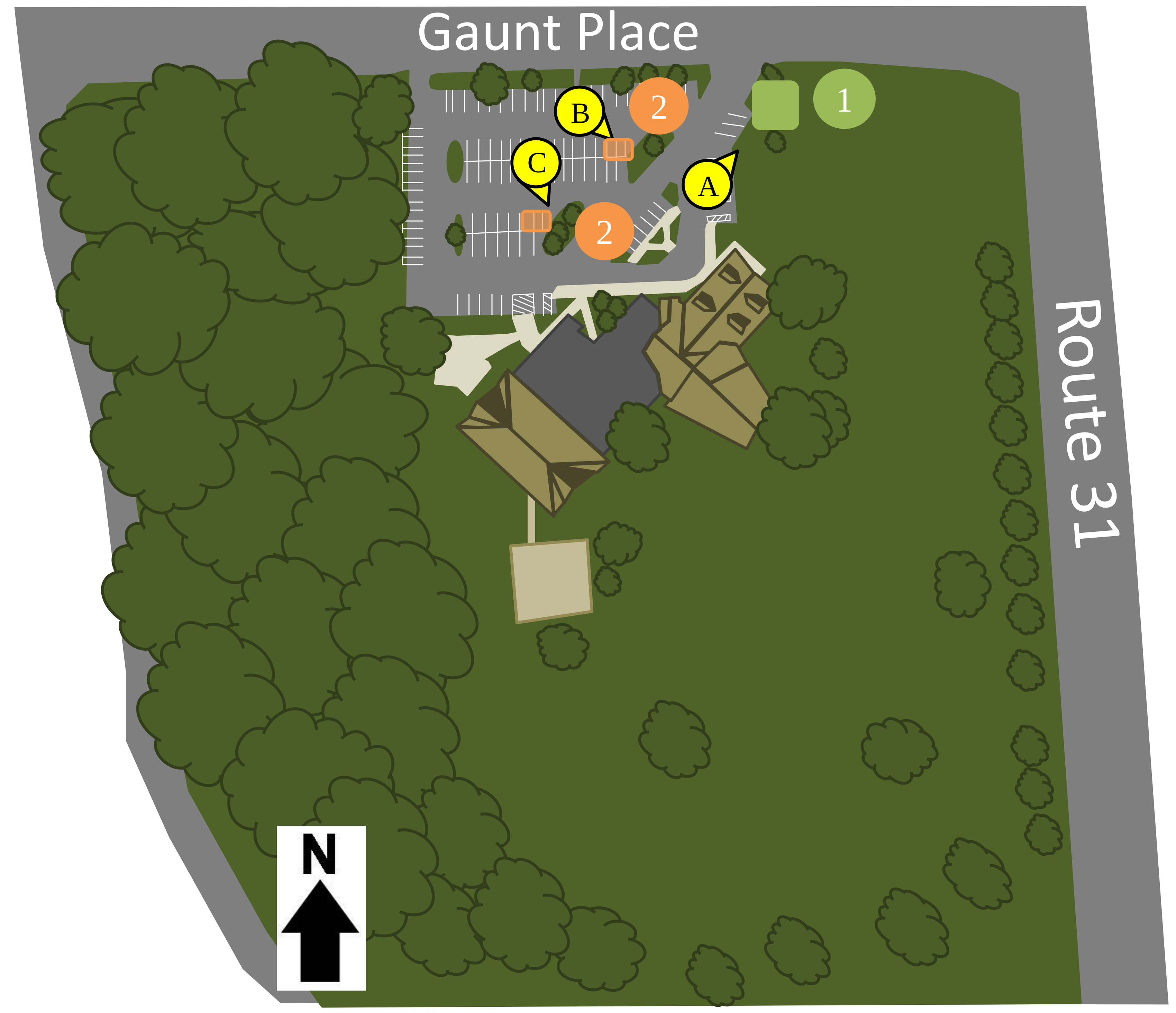
Concept Plans and Detailed Green Infrastructure Information Sheets

Raritan Township – Hunterdon County
Impervious Cover Assessment
St. Paul Lutheran Church – St. Paul Christian School, 201 State Route 31

PROJECT LOCATION:



SITE PLAN:



A

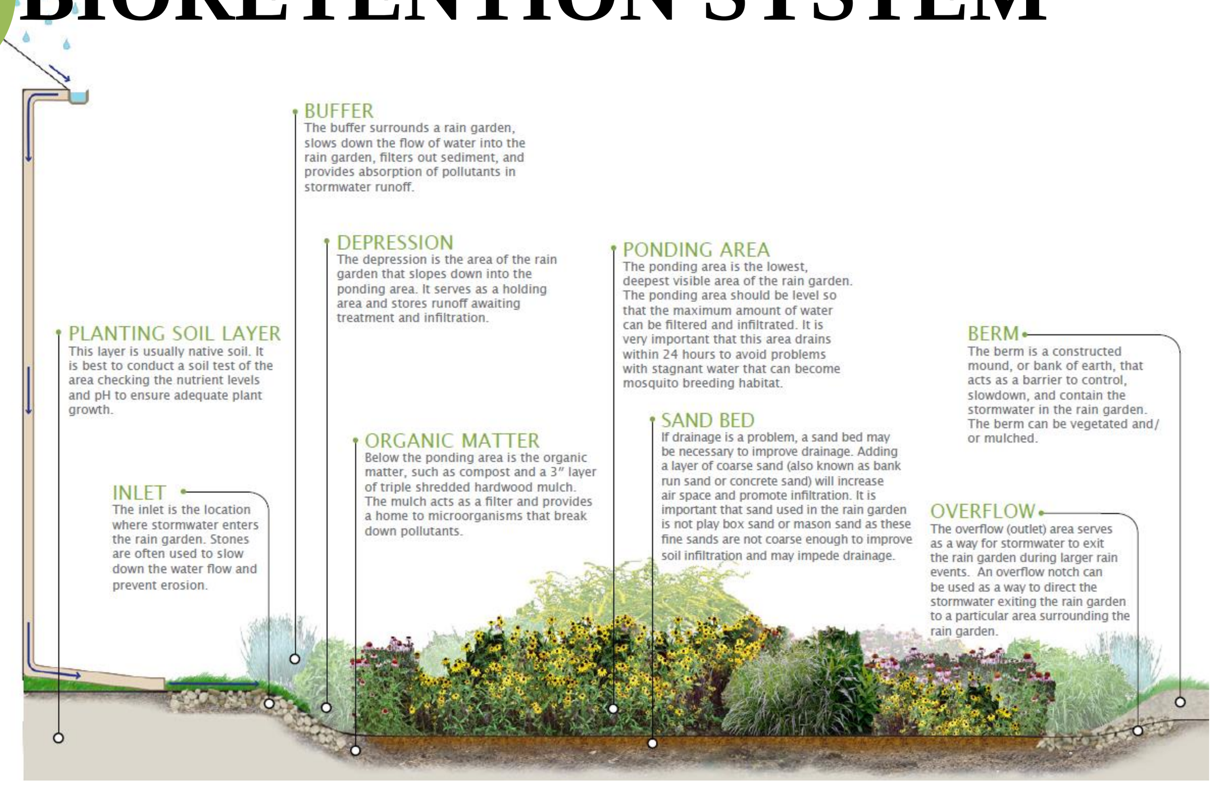
B

C

1 **BIORETENTION SYSTEM:** A bioretention system could be installed in the northeast parking area which would help capture stormwater runoff from the parking lot. The bioretention system will reduce sediment and nutrient loading to the local waterway.

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

1 BIORETENTION SYSTEM



2 POROUS PAVEMENT

Location: 201 State Route 31 Flemington, NJ 08822	**Municipality:** Raritan Township **Subwatershed:** Raritan River South Branch
Green Infrastructure Description: bioretention system (rain garden) 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 TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** bioretention system: 15,600 gal. porous pavement #1: 52,500 gal. porous pavement #2: 52,500 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, parking areas, and a church. These impervious surfaces are directly connected to a storm sewer system. The site's extensive impervious surfaces produce stormwater runoff during rain events. Additional factors such as impermeable surfaces, inadequate roof drainage, and poor soil quality may contribute to the generation of stormwater runoff. This site hosts a church and a kindergarten/early elementary school. The parking lot is graded to the east with some variation between northeast and southeast. There are two large islands in the center of the parking lot and adjacent to the drive running through it. Sediment and debris accumulates in the inside corners of these islands where catch basins are located. The island in the south/central area of the lot has a telephone pole and other utilities. The grass along the borders of several parking spaces in the northeastern corner of the lot seem to be badly eroded. There is a swale that runs along the eastern and northern edges of the property.

Proposed Solution(s):
One bioretention system could be installed at this site to treat runoff from the parking area and enhance the site's aesthetic quality. This system would be installed in the northeastern corner of the lot near the entrance to Gauntt Place. A rain garden at this location would prevent further erosion of the lawn near the eastern parking spaces of the lot. Two porous pavement systems could be installed within the parking lot to intercept stormwater prior to reaching the existing catch basins. Both systems would encompass two parking spaces (or 360 square feet) in front of the lot's two eastern parking islands. It may also be possible to retrofit the swale running along the northern and eastern edges of the property with bioretention soil and enhanced vegetation.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary

benefits, such as enhancing the site's wildlife habitat and aesthetic appeal. Porous pavement allows stormwater to penetrate through to soil layers which will promote groundwater recharge as well as intercept and filter stormwater runoff. The system is expected to achieve a 95% pollutant load reduction for TN, TP, and TSS.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Raritan Township
St. Paul Lutheran Church
local social and community groups

Partners/Stakeholders:
Raritan Township
St. Paul Lutheran Church
local social and community groups
local residents
Rutgers Cooperative Extension

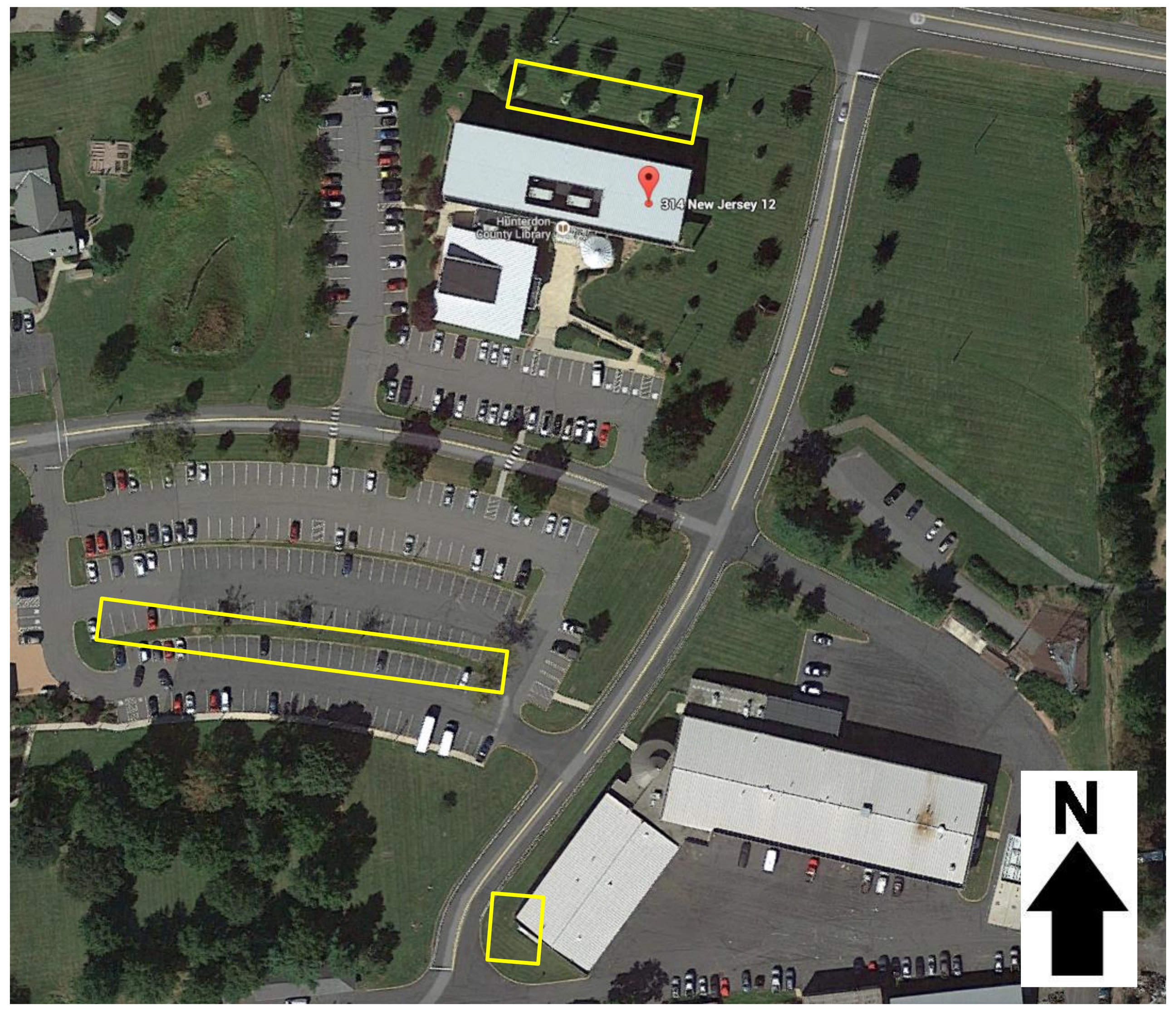
Estimated Cost:
The bioretention system would need to be approximately 150 square feet. At $5 per square foot, the estimated cost of this bioretention system is $750. Porous pavement system #1 would cover two parking spaces (360 square feet) and have a 2 feet deep stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $9,000. Porous pavement system #2 would cover two parking spaces (360 square feet) and have a 2 feet deep stone reservoir under the surface. At $25 per square foot, the cost of the porous asphalt system would be $9,000.The total cost of the project will thus be approximately $18,750.

Raritan Township – Hunterdon County

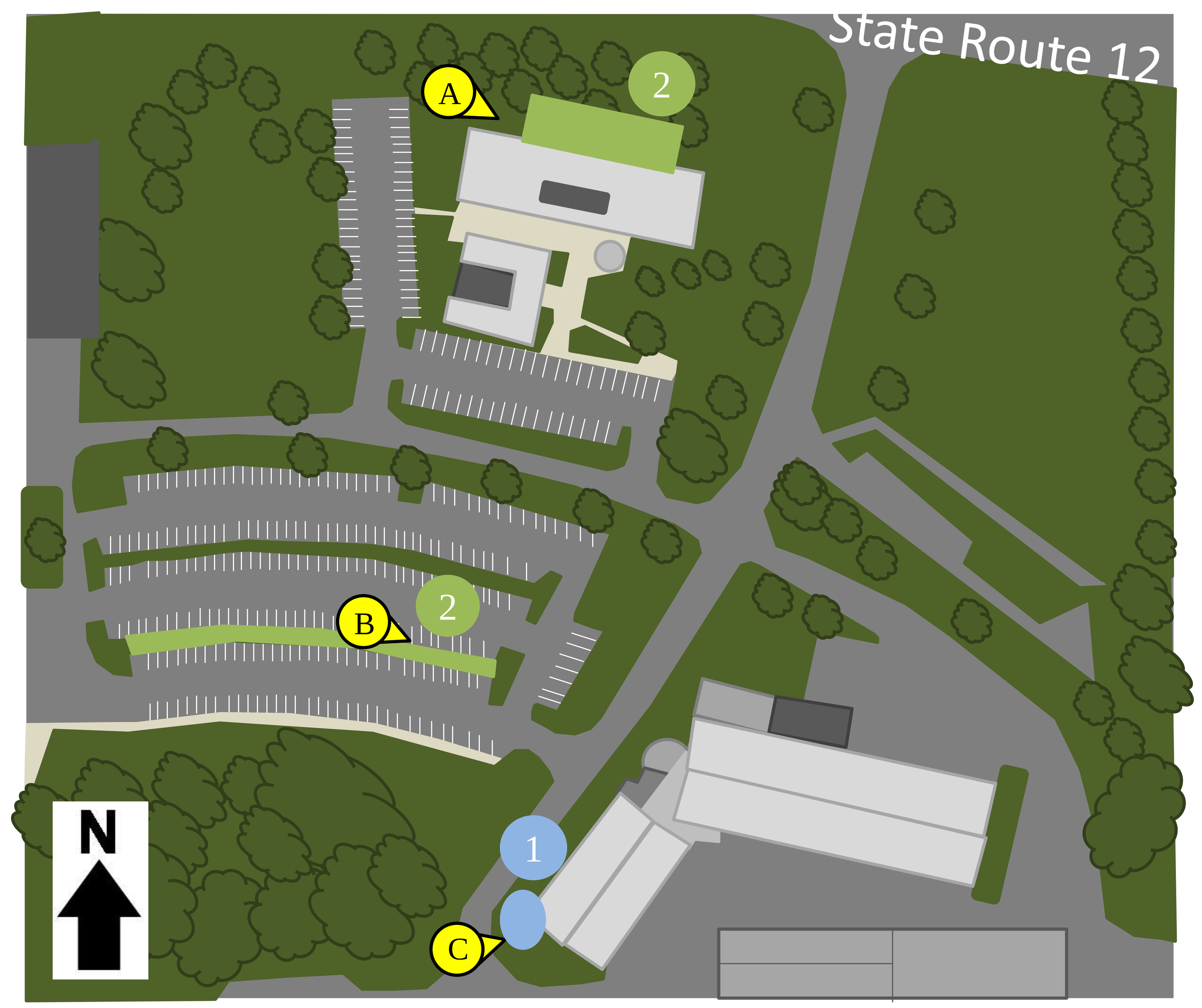
Impervious Cover Assessment

Hunterdon County Complex, 314 State Route 12

PROJECT LOCATION:



SITE PLAN:



A

B

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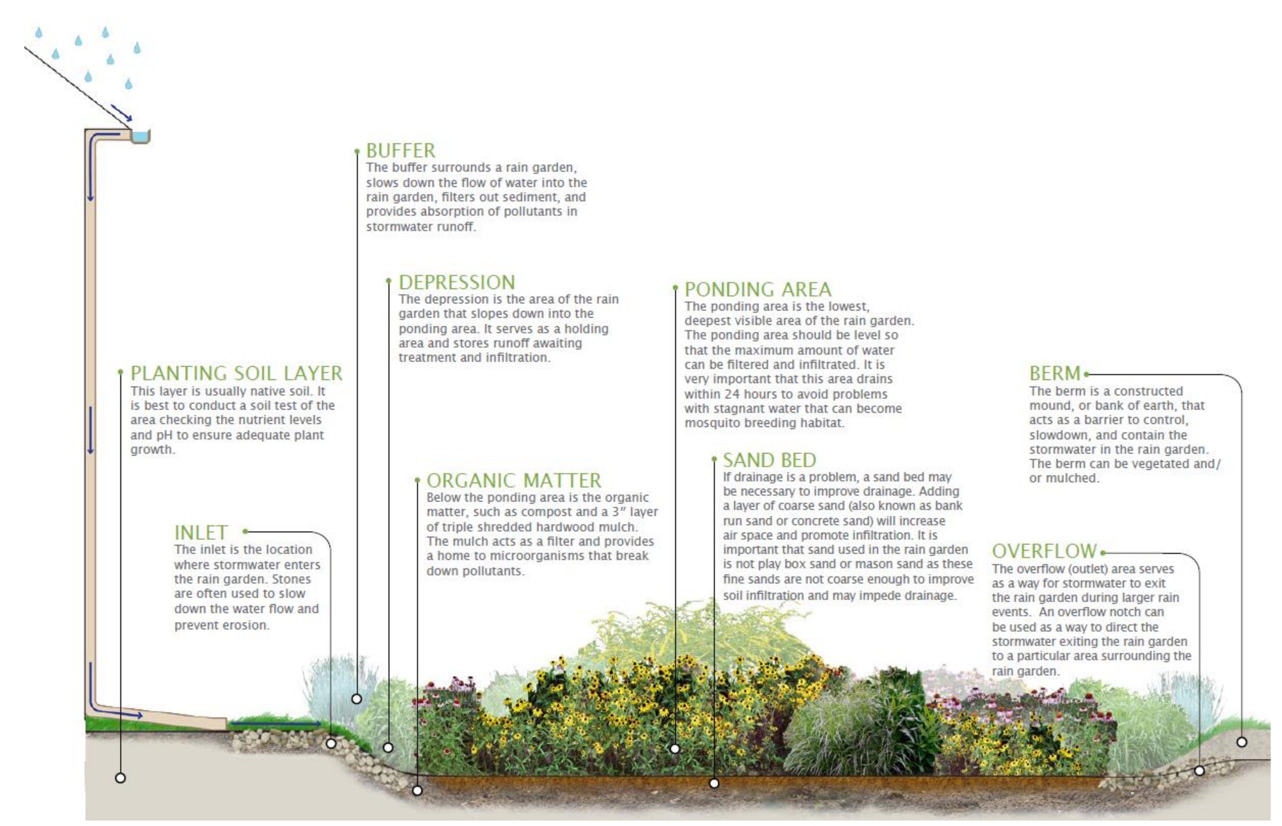
1 **RAINWATER HARVESTING SYSTEM:** A cistern could capture rainwater harvested from the roof of the building located parallel to the main road of the complex. The harvested water could be used to wash county trucks.

2 **BIORETENTION SYSTEM:** A bioretention system could be installed in the southernmost parking median with curb cuts to allow the flow of runoff into the bioretention system. Downspouts on the northern face of the building could be redirected into a second bioretention system to reduce runoff and allow stormwater infiltration. The bioretention systems will reduce sediment and nutrient loading to the local waterway while providing beautiful landscaping to the municipal complex. It will also provide habitat for birds, butterflies, and pollinators.

1 RAINWATER HARVESTING SYSTEM

2 BIORETENTION SYSTEM



CURB CUTS

Location: 314 State Route 12 Flemington, NJ 08822	**Municipality:** Raritan Township **Subwatershed:** Second Neshanic River
Green Infrastructure Description: bioretention systems (rain gardens) rainwater harvesting system (cistern)	**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: 312,700 gal. bioretention system #2: 109,400 gal. cistern: 115,700 gal.

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, walkways, parking areas, and several large buildings. These impervious surfaces are directly connected to a storm sewer system. The site's extensive impervious surfaces produce stormwater runoff during rain events. Additional factors such as impermeable surfaces, inadequate roof drainage, and poor soil quality may contribute to the generation of stormwater runoff. Seven downspouts from the county office complex are directly connected. There is landscaping and drains located on the northern side of the building. There is a long parking median in the parking lot. Several of the buildings to the southeast have sizable roofs.

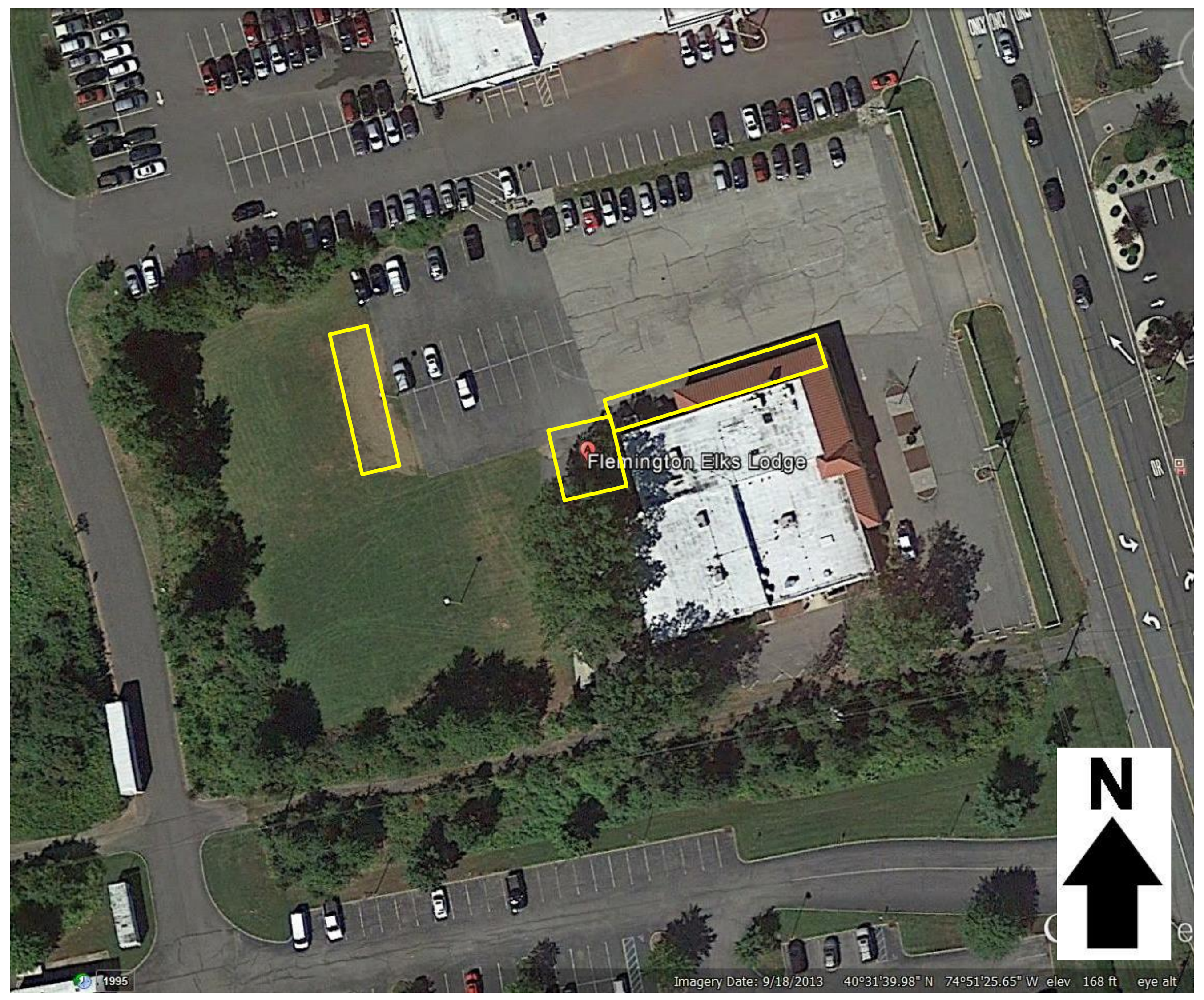
Proposed Solution(s):
One bioretention system could be installed along the northern face of the Hunterdon County Complex to collect and treat the runoff from the building's northern roof and enhance the site's aesthetic quality. There is plenty of available space behind this building for a 3,000 square foot bioretention system, but there is some existing landscaping. Seven downspouts would be routed to this system. A second bioretention system could be installed within the southernmost parking median parking lot to treat its stormwater runoff. This bioretention system would require curb cuts along its northern edge. The stormwater from the building located parallel to the main road of the complex could be managed by a 7,500 gallon cistern. This system would require at least four downspouts to be disconnected.

Anticipated Benefits:
Since the bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary benefits, such as enhancing the site's wildlife habitat and aesthetic appeal. Since the rainwater harvesting system (the cistern) would be designed to capture the first 1.25 inches of rain, it would

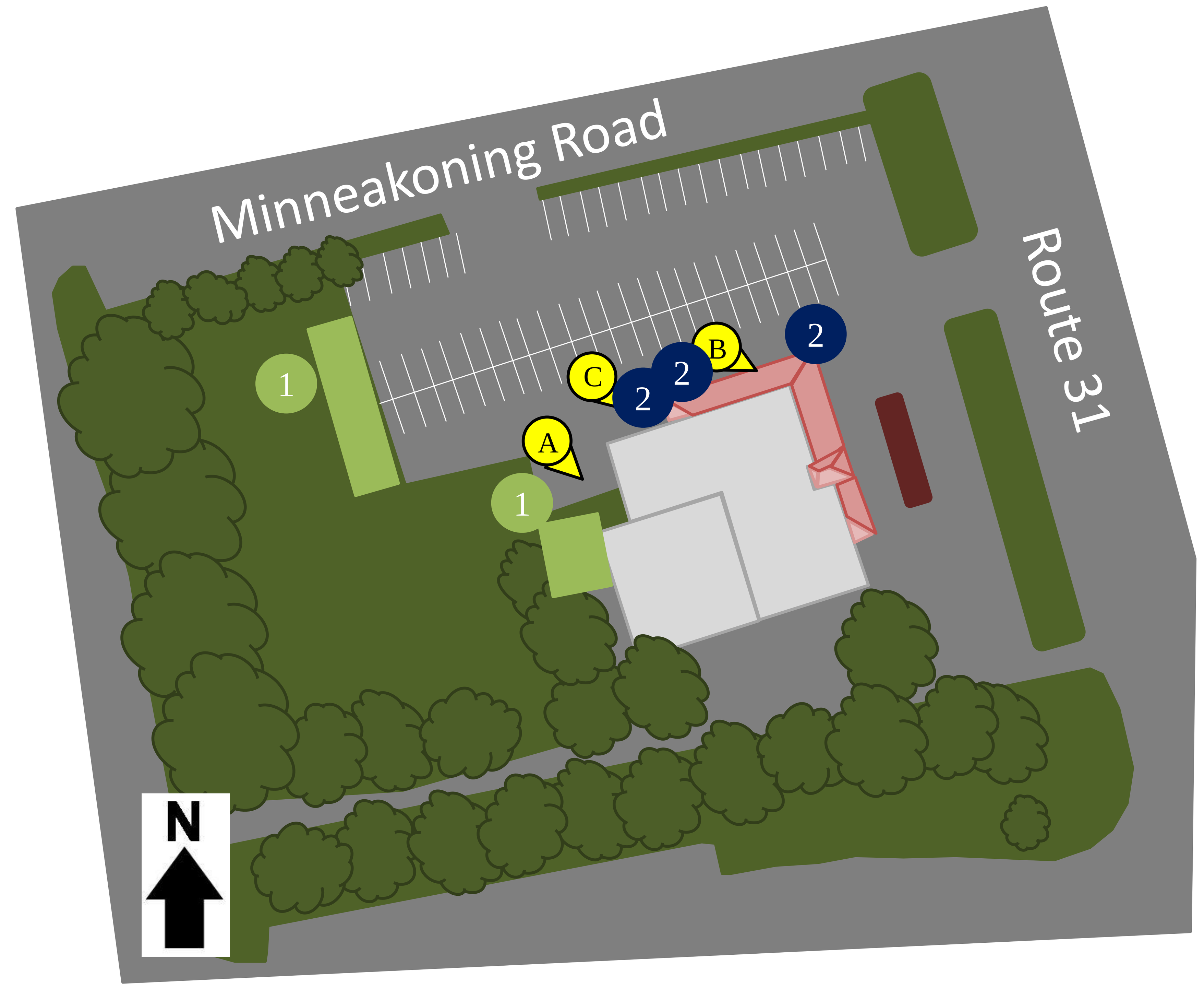
reduce the pollutant loading by 90% during the periods when it is operational (i.e., it would not be used in the winter when there is a chance of freezing). The rainwater harvested from the roofs of the building could be used for washing county vehicles.
Possible Funding Sources: mitigation funds from local developers NJDEP grant programs Hunterdon County local social and community groups
Partners/Stakeholders: Hunterdon County Raritan Township local social and community groups Hunterdon County employees residents Rutgers Cooperative Extension
Estimated Cost: Bioretention system #1 would need to be approximately 3,000 square feet. At $5 per square foot, the estimated cost of the bioretention system is $15,000, plus an additional $1,750 to disconnect / reroute seven downspouts that would feed the system. Bioretention system #2 would need to be approximately 1,050 square feet. At $5 per square foot, the estimated cost of this bioretention system is $5,250. he cistern would be 7,500 gallons and cost approximately $16,000 to purchase and install. The total cost of the project will thus be approximately $38,000.

Raritan Township – Hunterdon County
Impervious Cover Assessment
Elks Lodge,165 State Route 31

PROJECT LOCATION:



SITE PLAN:



A

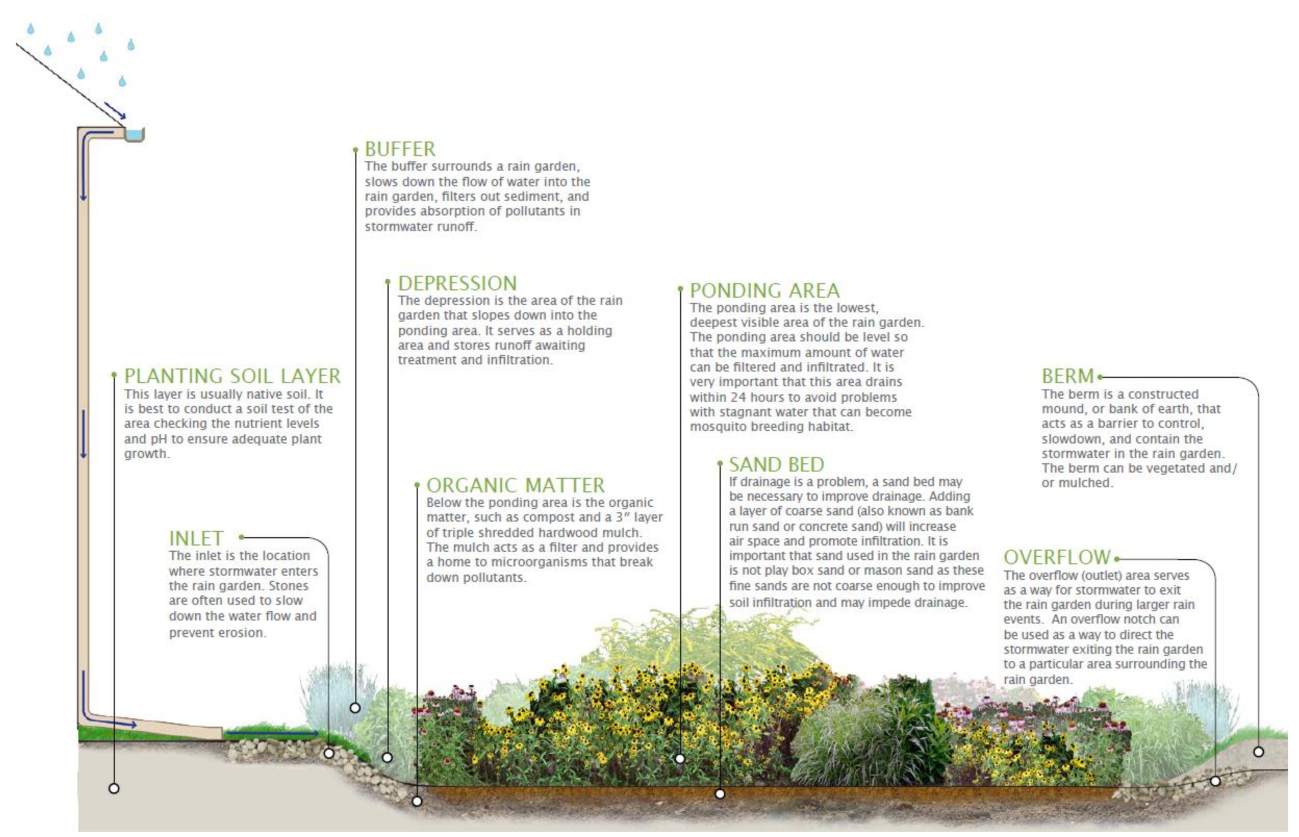
B

C

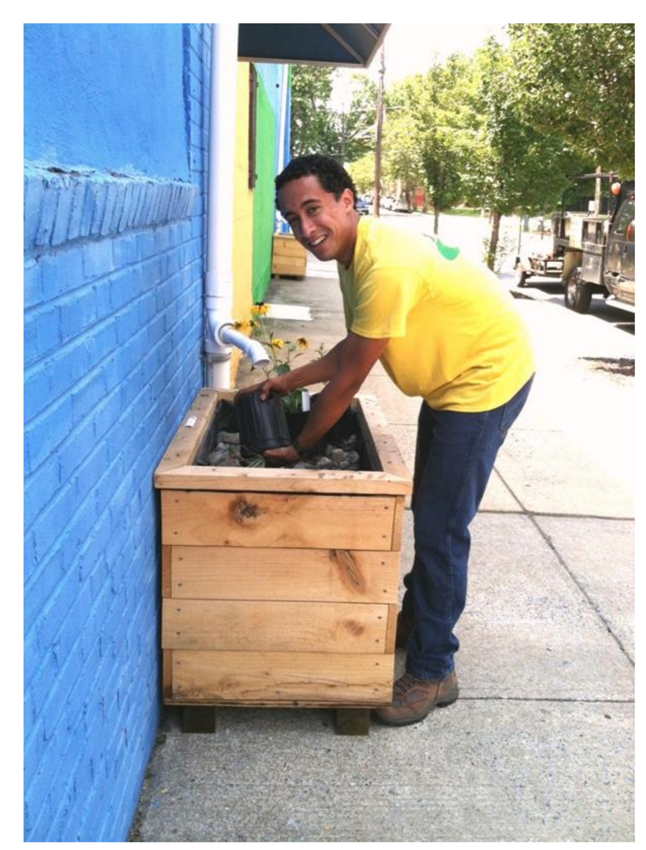
1 **BIORETENTION SYSTEM:** Bioretention systems could be installed in the grass near the southwest side of the parking lot and near the back of the building where existing downspouts can be disconnected. Bioretention systems will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach catch basins.

2 **DOWNSPOUT PLANTER BOX:** Downspout planter boxes could be installed on the northern face of the building to collect water from the downspouts. Downspout planter boxes reduce runoff and allow water to slowly infiltrate while being treated for pollutants.

1 BIORETENTION SYSTEM



2 DOWNSPOUT PLANTER BOX



Elks Lodge
Green Infrastructure Information Sheet

Location: 165 State Route 31 Flemington, NJ 08822	**Municipality:** Raritan Township **Subwatershed:** Raritan River South Branch
Green Infrastructure Description: bioretention systems (rain gardens) downspout disconnection 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:** bioretention system #1: 114,600 gal. bioretention system #2: 156,300 gal. downspout planter boxes: 4,200 gal. (each stormwater planter: 1,400 gal.)

Existing Conditions and Issues:
This site contains several impervious surfaces including driveways, parking areas, and a building. These impervious surfaces are directly connected to a storm sewer system. The site's extensive impervious surfaces produce stormwater runoff during rain events. Additional factors such as impermeable surfaces, inadequate roof drainage, and poor soil quality may contribute to the generation of stormwater runoff. This site is adjacent to Route 31 (on the east) and an auto dealer (on the north). The pavement was in fair condition at the time of the site visit. There are downspouts on every corner of the building. There are three downspouts on the northern side of the building, but there is also a guard rail, air conditioner(s), a stairway, and a dumpster present. On the western side of the building there is turf grass with a pine tree. Two downspouts are near this turf grass area, and a third downspout could be directed into this space. The downspout near the rear door of the building runs directly onto the parking lot. All of the other downspouts observed were directly connected to the storm sewers. An inspection of the site via aerial imagery revealed an eroded area of grass at the western edge of the parking lot.

Proposed Solution(s):
One bioretention system (#1) could be installed at this site to capture runoff from the roof of the building and enhance the site's aesthetic quality. This system would be installed on the west side of the building in the grass area and have two downspouts routed to it. A second bioretention system (#2) could be installed in a dirt area along the western end of the parking lot. Downspouts could be routed to three downspout planter boxes along the northern face of the building.

Anticipated Benefits:
Since bioretention systems would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), these systems are estimated to achieve a 95% pollutant load reduction for TN, TP, and TSS. A bioretention system would also provide ancillary

benefits, such as enhancing the site's wildlife habitat and aesthetic appeal to the visitors and members of the Elks Lodge. Downspout planter boxes would harvest runoff from the roof of the building to water ornamental plants.

Possible Funding Sources:
mitigation funds from local developers
NJDEP grant programs
Raritan Township
Flemington Elks Lodge
local social and community groups

Partners/Stakeholders:
Raritan Township
Flemington Elks Lodge
local social and community groups
members, supporters, and family of the Elks Lodge
Rutgers Cooperative Extension

Estimated Cost:
Bioretention system #1 would need to be approximately 1,100 square feet. At $5 per square foot, the estimated cost of this system is $5,500, plus an additional $500 to disconnect/redirect two downspouts. Bioretention system #2 would need to be approximately 1,500 square feet. At $5 per square foot, the estimated cost of this system is $7,500. Each downspout planter box would cost approximately $300 to purchase and install. Three downspout planter boxes have been proposed for this site. The total cost of the proposed downspout planter boxes is $900. The total cost of the project would be approximately $14,400.