RUTGERS
New Jersey Agricultural Experiment Station

Draft

Impervious Cover Assessment for West Long Branch Borough, Monmouth County, New Jersey

Prepared for West Long Branch Borough by the Rutgers Cooperative Extension Water Resources Program

February 8, 2016

Sea Grant
NJ Sea Grant Consortium

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

West Long Branch Borough Impervious Cover Analysis

Located in Monmouth County in central New Jersey, West Long Branch Borough covers approximately 2.9 square miles west of the City of Long Branch. Figures 3 and 4 illustrate that West Long Branch Borough is dominated by urban land uses. A total of 90.6% of the municipality's land use is classified as urban. Of the urban land in West Long Branch Borough, rural residential and medium density residential are the dominant land uses (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 West Long Branch 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 West Long Branch Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 32.3% of West Long Branch Borough has impervious cover. This level of impervious cover suggests that the streams in West Long Branch Borough are likely non-supporting.

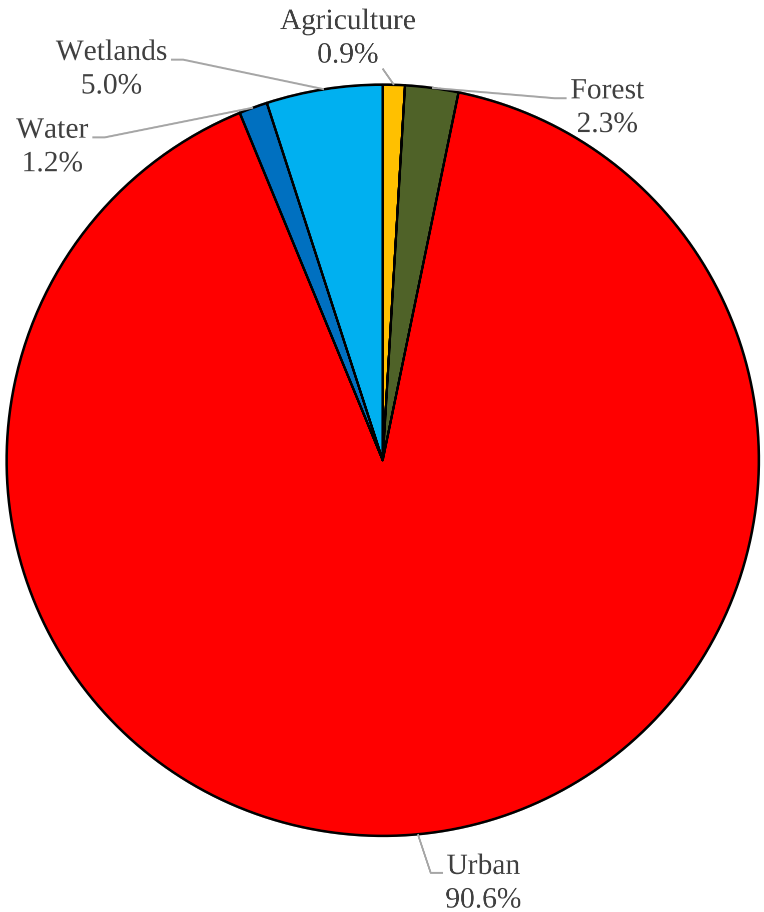


Figure 3: Pie chart illustrating the land use in West Long Branch Borough

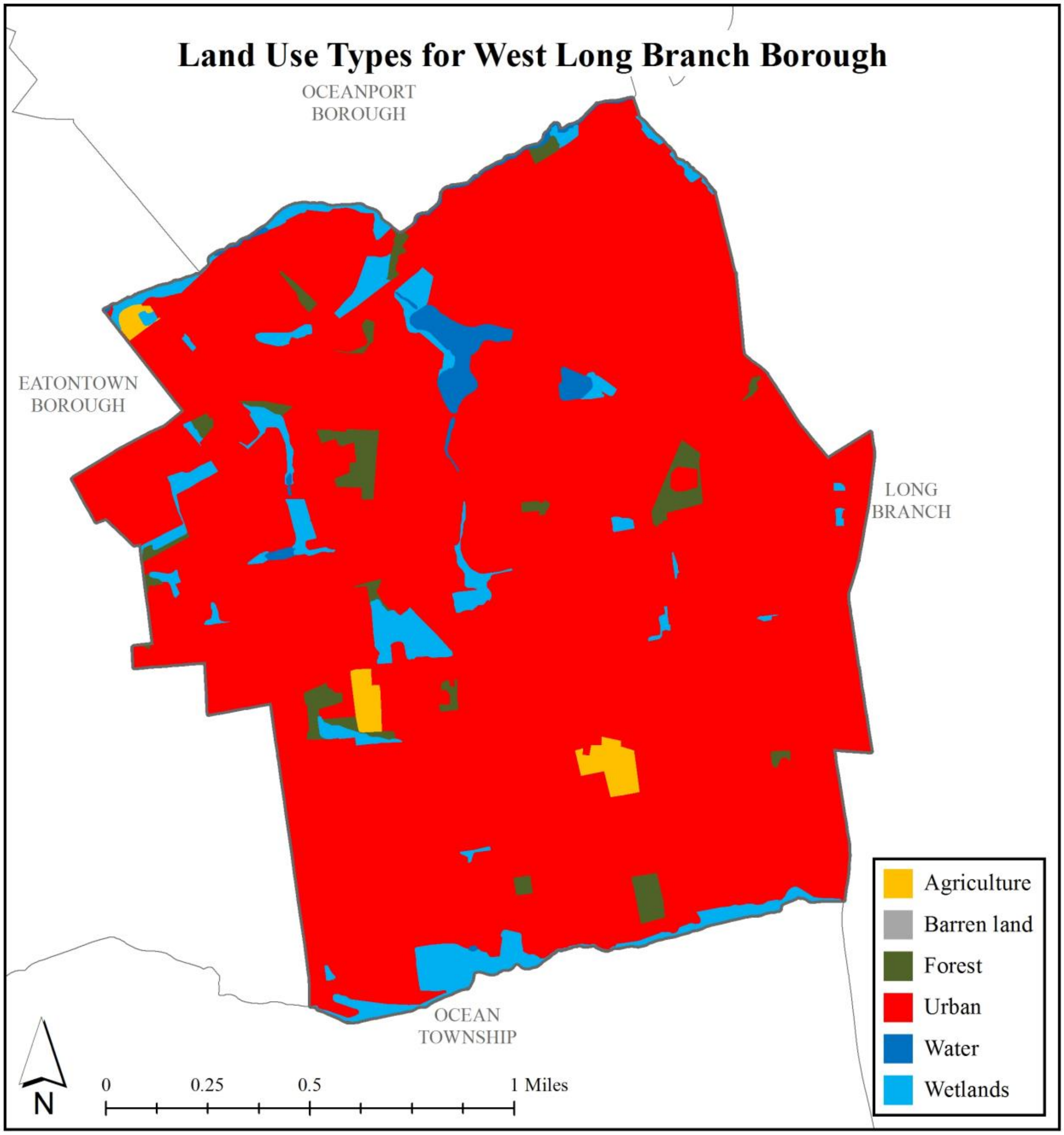


Figure 4: Map illustrating the land use in West Long Branch Borough

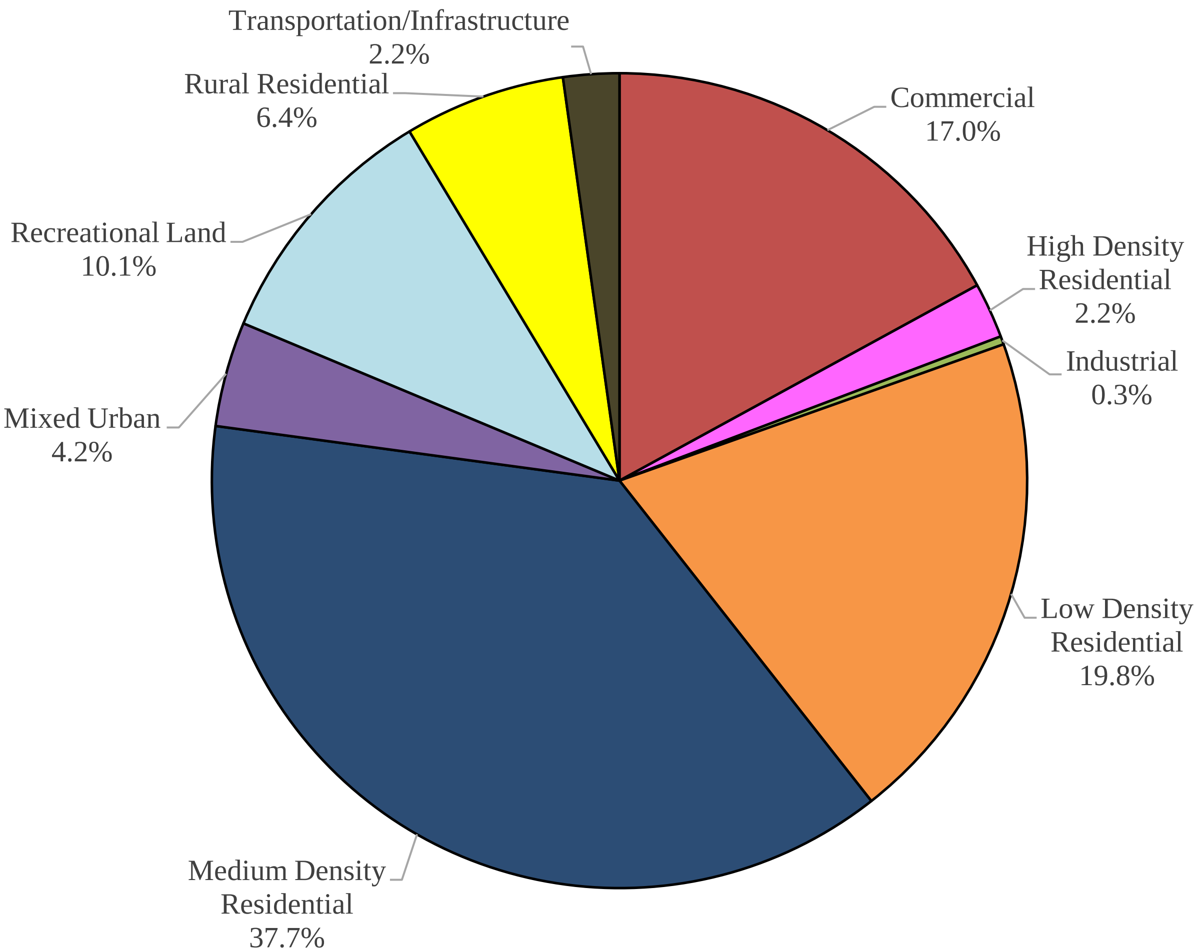


Figure 5: Pie chart illustrating the various types of urban land use in West Long Branch Borough

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within West Long Branch (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 35.2% in Branchport Creek Watershed to 26.3% in Whale Pond Brook subwatershed. Evaluating impervious cover on a subwatershed basis allows the municipality to focus impervious cover reduction or disconnection in 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 West Long Branch, Monmouth 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 (5.2 inches of rain), and the 100-year design storm (8.9 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater is running off of impervious surfaces in West Long Branch. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Branchport Creek Watershed was harvested and purified, it could supply water to 135 homes for a year[1].

[1] Assuming 300 gallons per day per home.

Table 1: Impervious cover analysis by subwatershed for West Long Branch

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Branchport Creek	1,255.9	1.96	1,233.5	1.93	22.4	0.04	434.7	0.68	35.3%
Whale Pond Brook	594.4	0.93	594.2	0.93	0.2	0.00	156.1	0.24	26.3%
TOTAL	1,850.3	2.89	1,827.7	2.86	22.6	0.04	590.9	0.92	32.3%

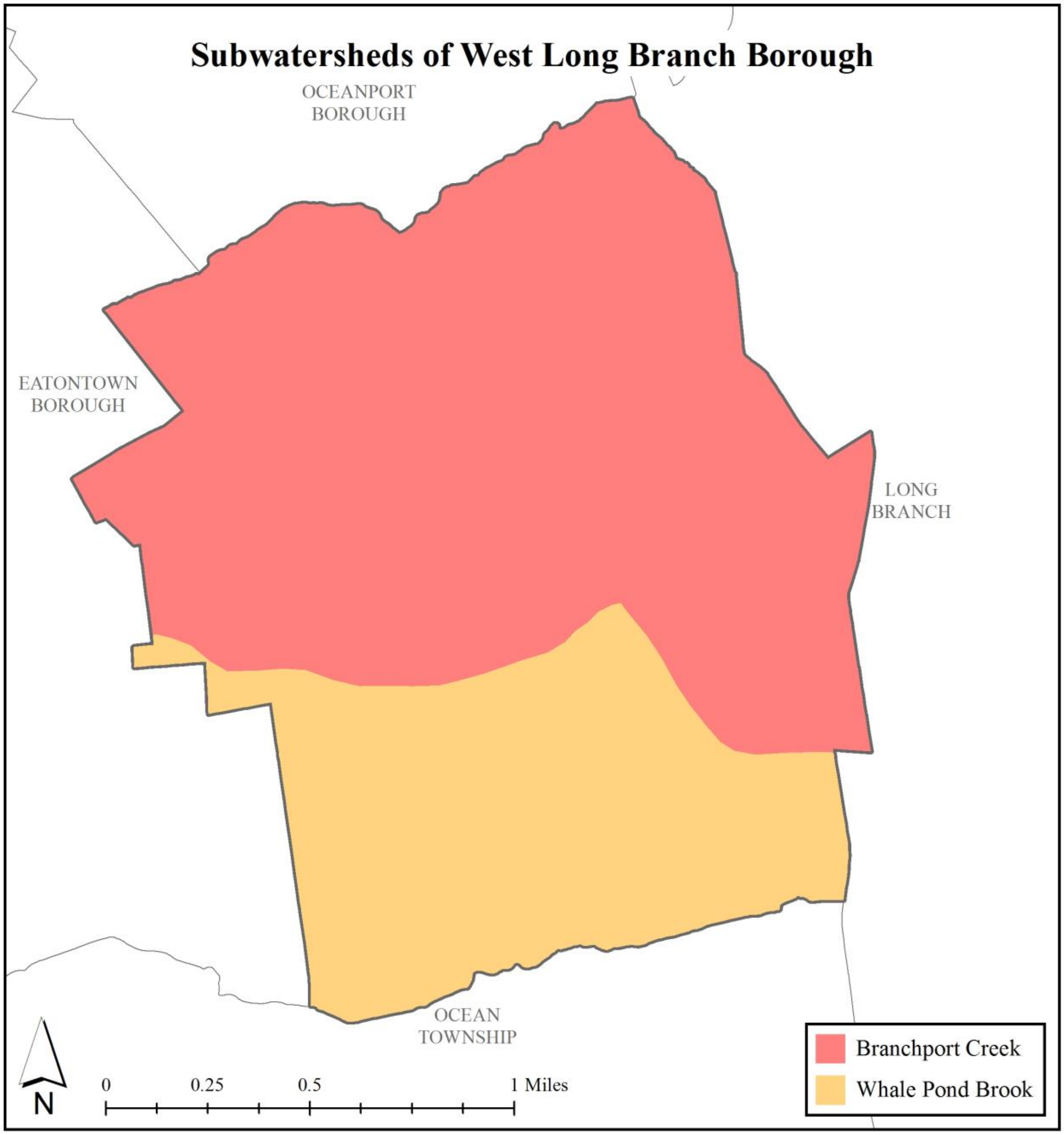


Figure 6: Map of the subwatersheds in West Long Branch Borough

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in West Long Branch 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 (3.4") (Mgal)	Total Runoff Volume for the 10-Year Design Storm (5.2") (Mgal)	Total Runoff Volume for the 100-Year Design Storm (8.9") (Mgal)
Branchport Creek	14.8	519.4	40.1	61.4	105.1
Whale Pond Brook	5.3	186.5	14.4	22.0	37.7
TOTAL	20.1	705.9	54.5	83.4	142.8

The next step is to set a reduction goal for impervious area in each subwatershed. Based upon the Rutgers Cooperative Extension (RCE) Water Resources Program's experience, a 10% reduction would be a reasonably achievable reduction for these subwatersheds in West Long Branch 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 (3.4 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 West Long Branch Borough

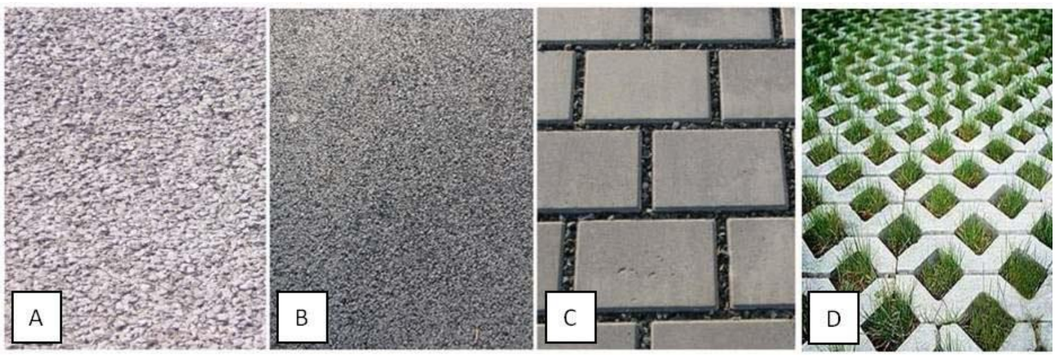
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Branchport Creek	43.6	3.8
Whale Pond Brook	15.6	1.4
TOTAL	59.2	5.2

[2] Annual Runoff Volume Reduction =
Acres of IC x 43,560 ft^2/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft^3) x (1 MGal/1,000,000 gal)
All BMPs should be designed to capture the first 3.4 inches of rain from each storm. This would allow the BMP to capture 95% of the annual rainfall of 44 inches.

Pervious Pavement

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

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



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

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

Impervious Cover Disconnection Practices

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

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

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

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

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

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

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

Examples of Opportunities in West Long Branch 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 West Long Branch 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

West Long Branch 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

West Long Branch Borough
Impervious Cover Assessment
Betty McElmon Elementary School, 20 Parker Road

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PROJECT LOCATION:

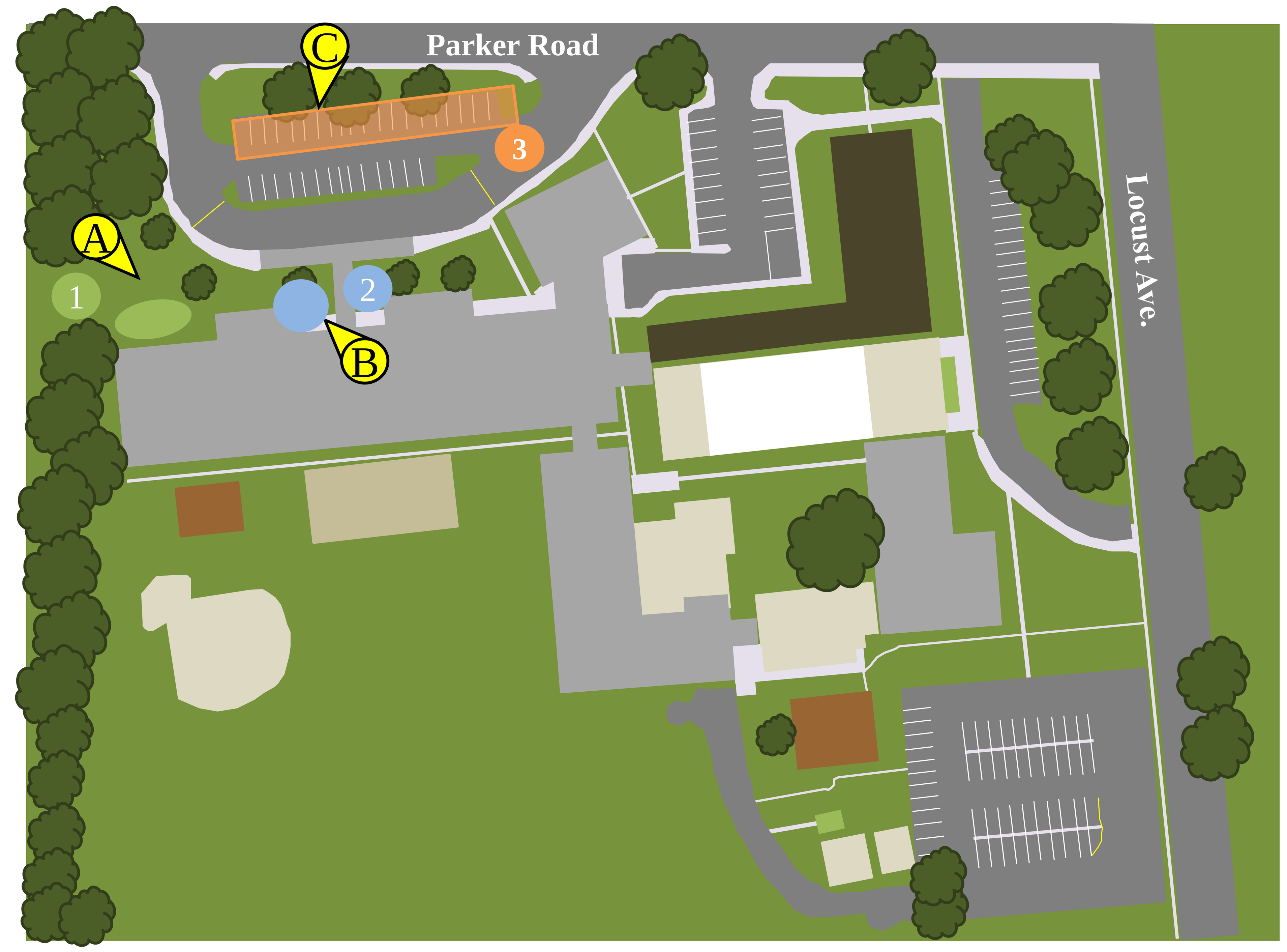
A

B

C

SITE PLAN:

N



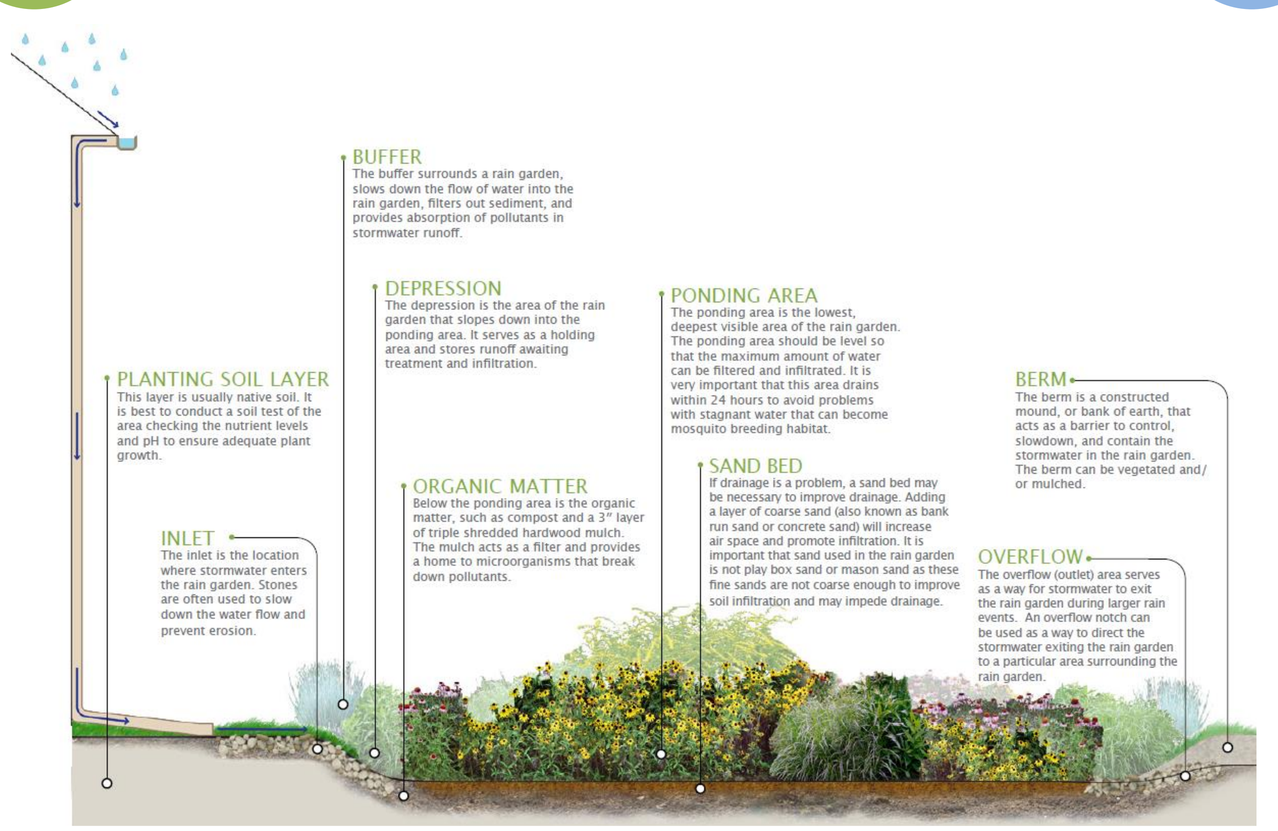
1. **BIORETENTION SYSTEM:** A rain garden can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. This site has an area where downspouts can be disconnected, and a rain garden implemented.

2. **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the roof of the building and stored in a cistern. The water can be used for gardening and landscaping around the school.

3. **PERVIOUS PAVEMENT:** Portions of the northwest parking lot can be converted to pervious pavement. This can allow for infiltration of runoff from the parking lot.

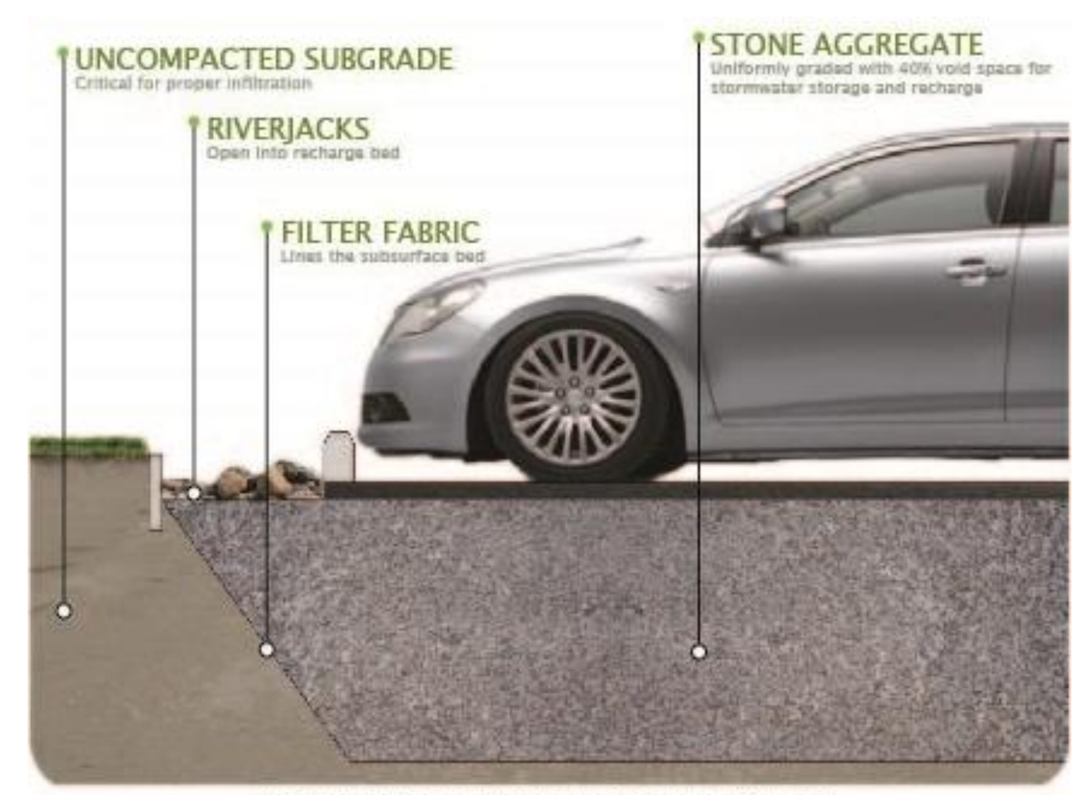
EDUCATIONAL PROGRAM: The RCE Water Resources Program, *Stormwater Management in Your Schoolyard*, can be delivered at Betty McElmon Elementary School to educate the students about stormwater management and engage them in designing and building the bioretention systems.

1 BIORETENTION SYSTEM



2 RAINWATER HARVESTING SYSTEM

3 PERVIOUS PAVEMENT



EDUCATIONAL PROGRAM

Location: 20 Parker Rd West Long Branch, NJ 07764	**Municipality:** West Long Branch Borough
Green Infrastructure Description: bioretention system (rain garden) rainwater harvesting system pervious pavement educational program	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden: 152,000 gal. cistern: 32,188 gal. pervious pavement: 170,150 gal.

Existing Conditions and Issues:
The school is in good condition with no major issues. There are some turf grass areas surrounding the school that can be used for rain gardens.

Proposed Solution(s):
A bioretention system or rain garden could be installed to capture some of the parking lot runoff. The rain garden would be constructed in the grassy area bordering the northwest side of the building. This bioretention system would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. A cistern could be installed on the north side of the building to capture water from a downspout, and the runoff captured can be used for gardening or landscaping around the community center. The far set of parking spaces across from the north side of the building can be converted to pervious pavement to capture runoff. Pervious pavement will treat the stormwater runoff and slowly allow it to infiltrate into the ground. Rutgers Cooperative Extension (RCE) Water Resources Program could additionally present the *Stormwater Management in Your Schoolyard* program to students and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for West Long Branch's Public Works staff to launch educational programming.

Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), the system is 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 students, teachers, and parents. The pervious pavement system will achieve the same level of pollutant load reduction for TN, TP and TSS. The cistern can harvest stormwater which can be used for watering plants, or other purposes which cut back on the use of potable water for nondrinking purposes. Since the rainwater harvesting system would be designed to capture the first 1.25 inches of rain, it would reduce the pollutant loading by 90% during the periods/seasons it is operational (i.e., it would not be used in the winter when there is chance of freezing).

Possible Funding Sources: West Long Branch Borough West Long Branch School Board Mitigation funds from local developers NJDEP grant programs
Partners/Stakeholders: NJ Sea Grant Local community groups (Boy Scouts, Girl Scouts, etc.) American Littoral Society Rutgers Cooperative Extension NY/NJ Baykeeper
Estimated Cost: The rain garden would need to be approximately 1,500 square feet. At $5 per square foot, the estimated cost of the rain garden is $7,500. The cistern would be 2,000 gallons and cost approximately $4,000 to purchase and install. The pervious pavement would cover 3,800 square feet and have a two foot stone reservoir under the surface, costing $115,000. The total cost would be approximately $126,500.

West Long Branch Borough
Impervious Cover Assessment
West Long Branch Community Center, 116 Locust Avenue

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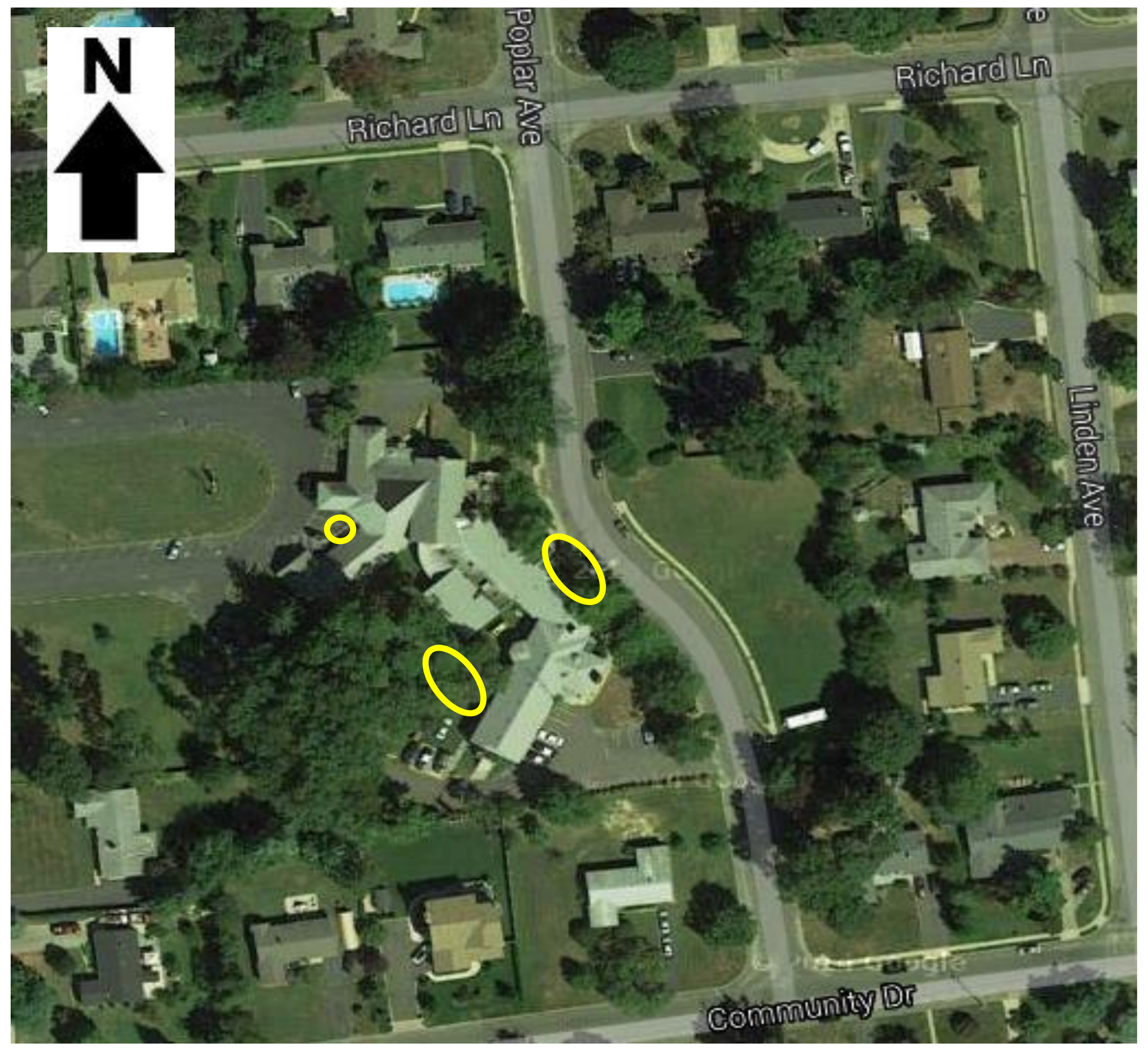
PROJECT LOCATION:



SITE PLAN:

A

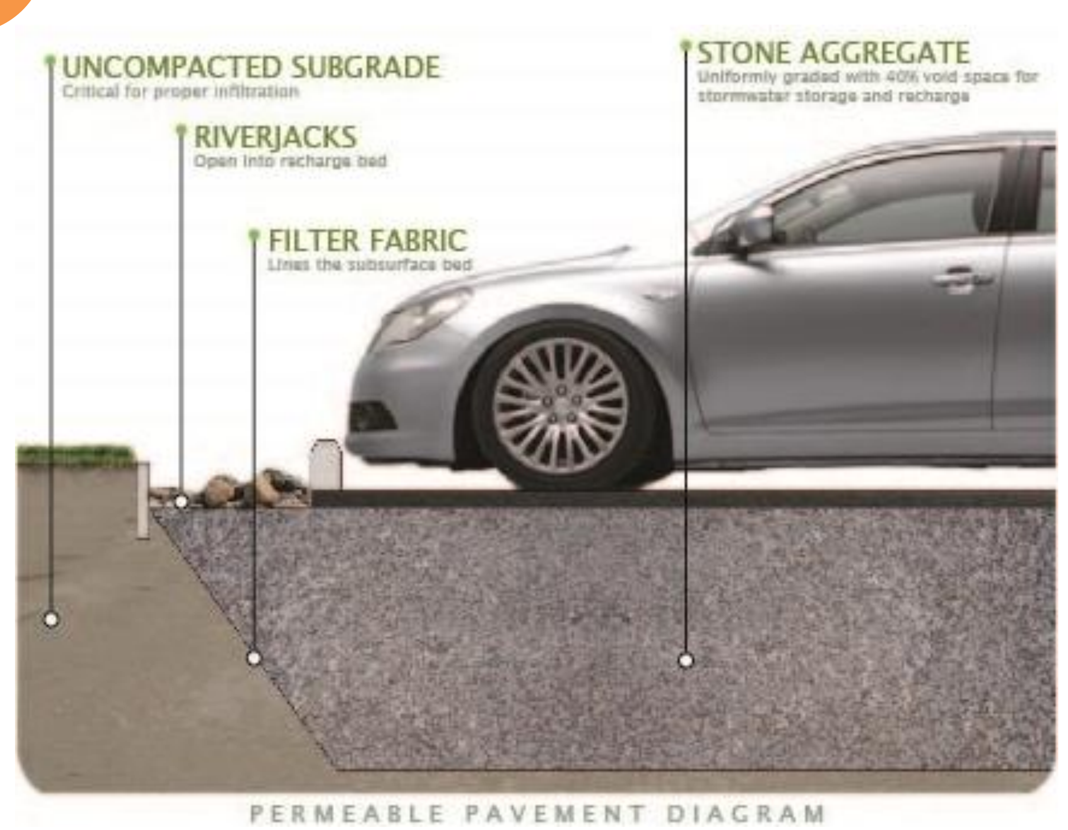
B

1 **BIORETENTION SYSTEMS:** Rain gardens will be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. This site has multiple areas where downspouts can be disconnected, and rain gardens implemented.

2 **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the roof of the building and stored in a cistern. The water can be used for gardening and landscaping around the community center.

EDUCATIONAL PROGRAM: The RCE Water Resources Program, *Stormwater Management in Your Schoolyard*, can be delivered at West Long Branch Community Center to educate township residents about stormwater management and engage them in designing and building the bioretention systems.

1 PERVIOUS PAVEMENT



2 RAINWATER HARVESTING SYSTEM

EDUCATIONAL PROGRAM

Location: 116 Locust Ave West Long Branch, NJ 07764	**Municipality:** West Long Branch Borough
Green Infrastructure Description: bioretention systems (rain gardens) rainwater harvesting system educational program	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden #1: 45,336 gal. rain garden #2: 91,845 gal. cistern: 4000 gal.

Existing Conditions and Issues:
The complex is surrounded by some grass areas which are somewhat eroded due to water flow. Many of the downspouts are disconnected and flow into the turf grass or parking lot.

Proposed Solution(s):
Bioretention systems could be installed to capture some of the rooftop runoff. The first rain garden would be constructed in the turf grass area on the southwest side of the building. The downspouts on this side of the building can be redirected into the garden. The second rain garden would be constructed along the east side of the building. The downspouts on this side of the building can be redirected into the garden. These bioretention systems would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. A cistern can be put near the west entrance of the building, and the runoff captured can be used for gardening or landscaping around the community center. Rutgers Cooperative Extension (RCE) Water Resources Program could additionally present the *Stormwater Management in Your Schoolyard* program to residents and include them in bioretention system planting efforts to enhance the program. This may also be used as a demonstration project for West Long Branch's Public Works staff to launch educational programming.

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. Bioretention systems would also provide ancillary benefits such as enhanced wildlife and aesthetic appeal to the residents. Cisterns can harvest stormwater which can be used for watering plants, or other purposes which cut back on the use of potable water for nondrinking purposes. Since the rainwater harvesting system would be designed to capture the first 1.25 inches of rain, it would reduce the pollutant loading by 90% during the periods/seasons it is operational (i.e., it would not be used in the winter when there is chance of freezing).

Possible Funding Sources:
West Long Branch Borough

Mitigation funds from local developers NJDEP grant programs
Partners/Stakeholders: NJ Sea Grant Residents Local community groups (Boy Scouts, Girl Scouts, etc.) American Littoral Society Rutgers Cooperative Extension NY/NJ Baykeeper
Estimated Cost: The first rain garden would need to be approximately 435 square feet. At $5 per square foot, the estimated cost of the rain garden is $2,175. The second rain garden would need to be approximately 880 square feet. At $5 per square foot, the estimated cost is $4,400. The cistern would hold 500 gallons of water and cost approximately $1,000 to purchase and install. The total cost would be approximately $7,575.

West Long Branch Borough
Impervious Cover Assessment
West Long Branch Home Security Alarm Systems, 185 NJ-36

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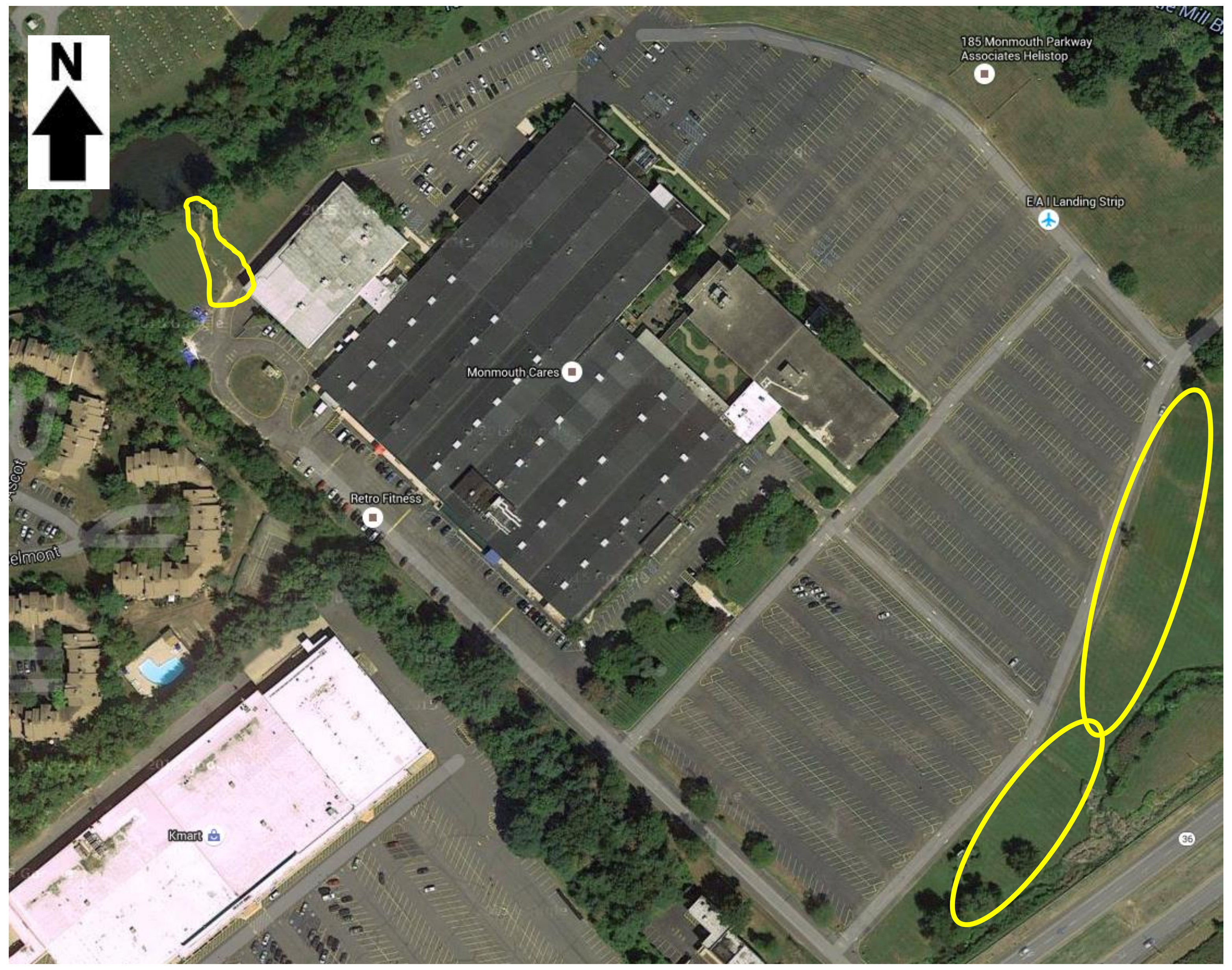
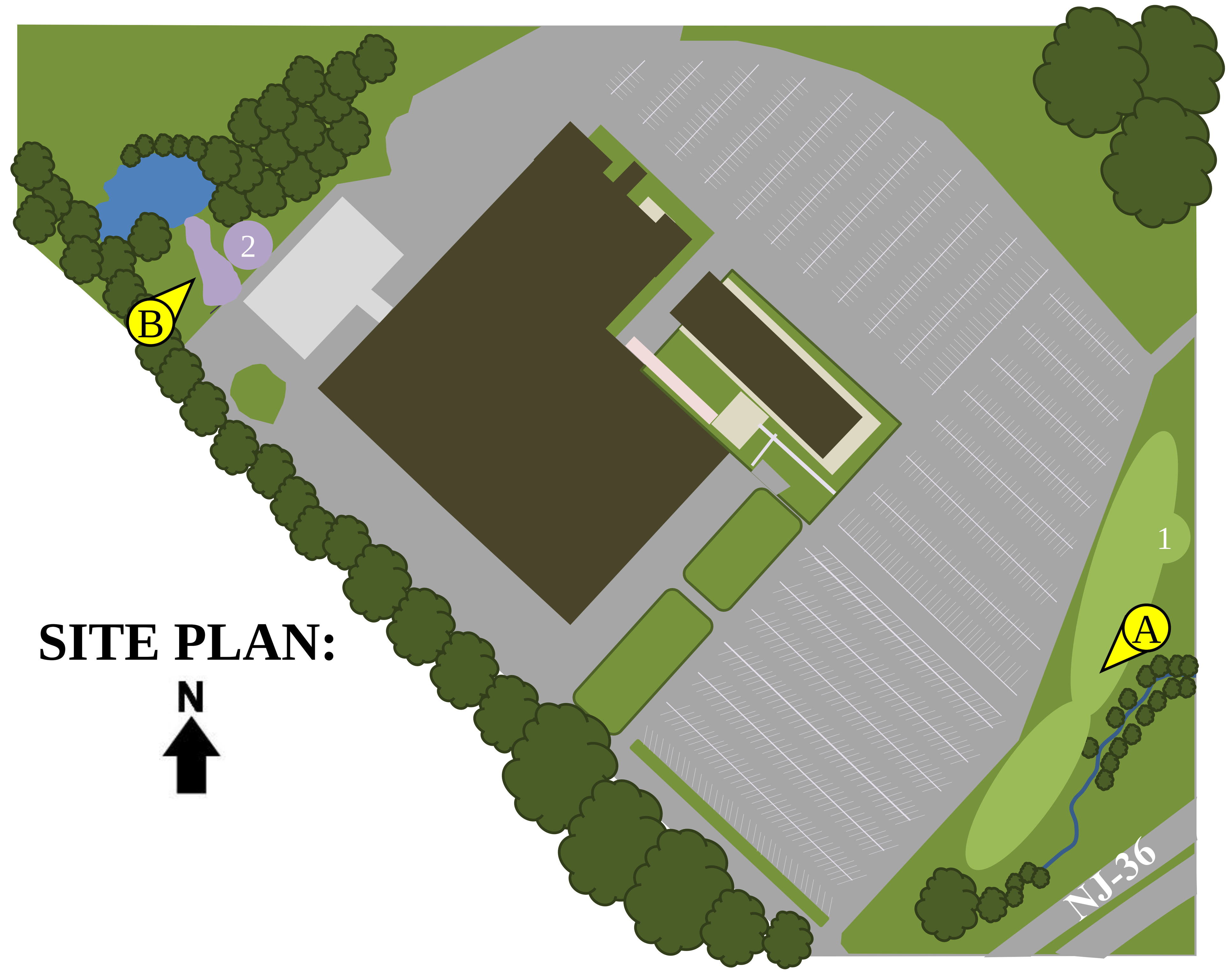
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:



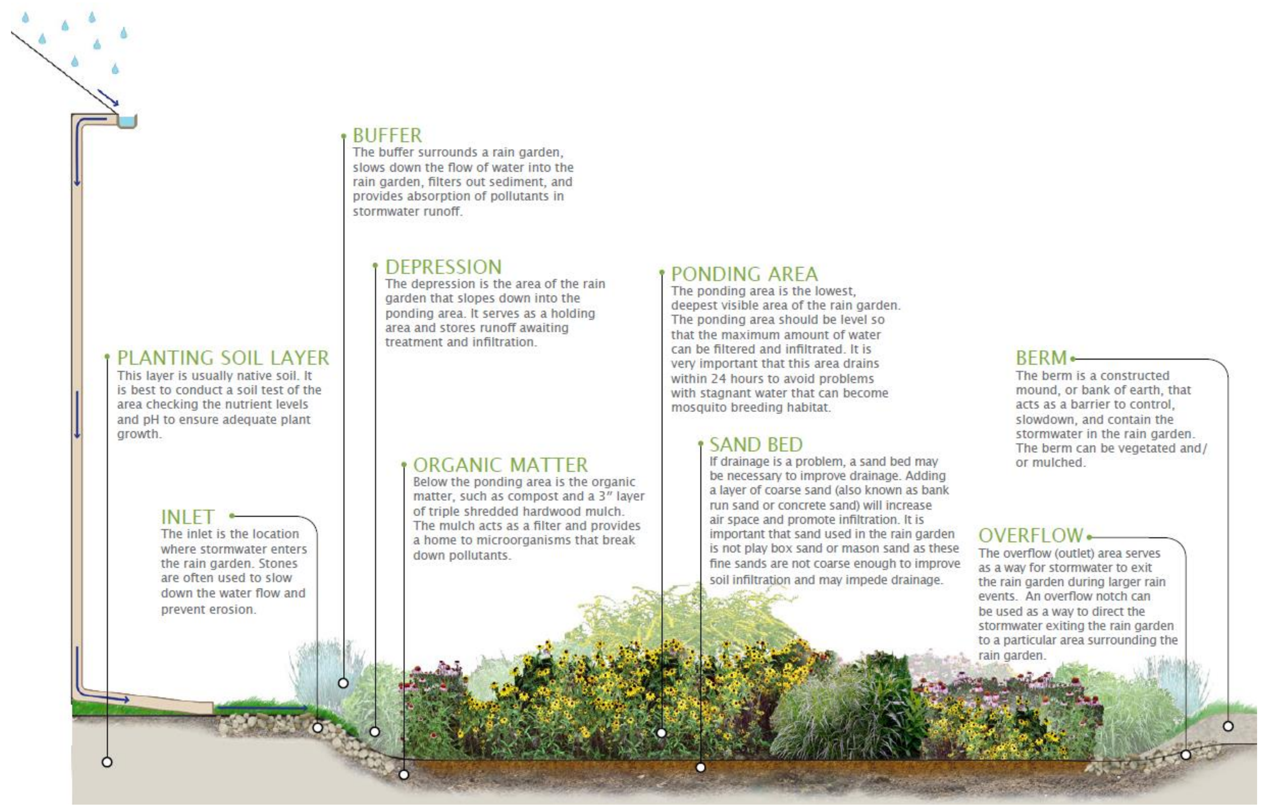
A

B

1 **BIORETENTION SYSTEM:** A rain garden can be used to reduce sediment and nutrient loading to the local waterway and increase groundwater recharge. This site has a turf grass area where a rain garden can be built to catch runoff from the parking lot.

2 **BIOSWALE:** A bioswale is a vegetated system that conveys stormwater while removing sediment and nutrients. It can be installed in the eroded canal.

1 BIORETENTION SYSTEM



2 BIOSWALE

Location: 185 NJ-36 West Long Branch, NJ 07764	**Municipality:** West Long Branch Borough
Green Infrastructure Description: bioretention system (rain garden) bioswale	**Targeted Pollutants:** total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff
Mitigation Opportunities: recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes	**Stormwater Captured and Treated Per Year:** rain garden: 8,207,430 gal. bioswale: 541,430 gal.

Existing Conditions and Issues:
The vast parking lot is surrounded by a turf grass area with a small brook. On the northwest side of the building, the brook flows into a small pond. Both the brook and the pond have buffers, but these buffers are missing in some areas. Additionally, there is a severely eroded channel which brings runoff from the parking lot into the pond.

Proposed Solution(s):
A bioretention system or rain garden could be installed to capture some of the parking lot runoff. The rain garden would be constructed in the turf grass area bordering the southeast side of the parking lot. This bioretention system would capture, treat, and infiltrate the stormwater runoff, thereby reducing localized flooding and improving water quality. A bioswale (vegetated area) can be installed in the eroded channel to restore the landscape and reduce runoff into the pond.

Anticipated Benefits:
Since the bioretention system would be designed to capture, treat, and infiltrate the entire 2-year design storm (3.4 inches of rain over 24 hours), the system is 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 students, teachers, and parents. The bioswale will capture, treat, and infiltrate stormwater reducing TN by 30%, TP by 60%, and TSS by 90%.

Possible Funding Sources:
West Long Branch Borough
Mitigation funds from local developers
NJDEP grant programs

Partners/Stakeholders:
NJ Sea Grant
Local community groups (Boy Scouts, Girl Scouts, etc.)
American Littoral Society
Rutgers Cooperative Extension
NY/NJ Baykeeper

Estimated Cost:
The rain garden would need to be approximately 78,750 square feet. At $5 per square foot, the estimated cost of the rain garden is $393,750. The bioswale would need to be 5,200 square feet. At $5 per square foot, the estimated cost of the bioswale is $26,000. The total cost would be approximately $419,750.