Impervious Cover Assessment
for
Upper Deerfield Township, Cumberland County, New Jersey

Prepared for Upper Deerfield Township by the
Rutgers Cooperative Extension Water Resources Program

September 23, 2016

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

Upper Deerfield Township Impervious Cover Analysis

Located in Cumberland County in southern New Jersey, Upper Deerfield Township covers approximately 31.2 square miles west of Vineland. Figures 3 and 4 illustrate that Upper Deerfield Township is dominated by agriculture land uses. A total of 17.3% of the municipality's land use is classified as urban. Of the urban land in Upper Deerfield 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) 2012 land use/land cover geographical information system (GIS) data layer categorizes Upper Deerfield 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 Upper Deerfield Township. Based upon the 2012 NJDEP land use/land cover data, approximately 5.4% of Upper Deerfield Township has impervious cover. This level of impervious cover suggests that the streams in Upper Deerfield Township are likely sensitive streams.

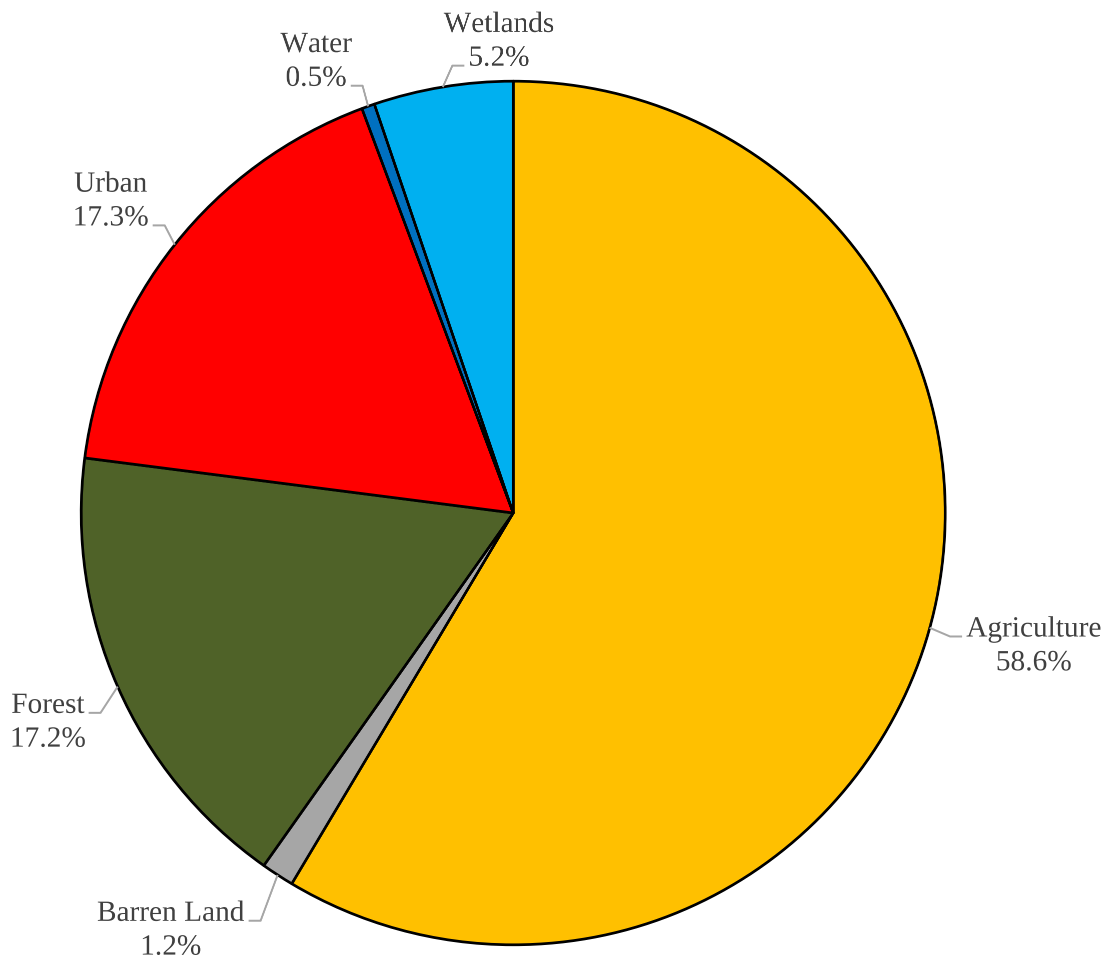


Figure 3: Pie chart illustrating the land use in Upper Deerfield Township

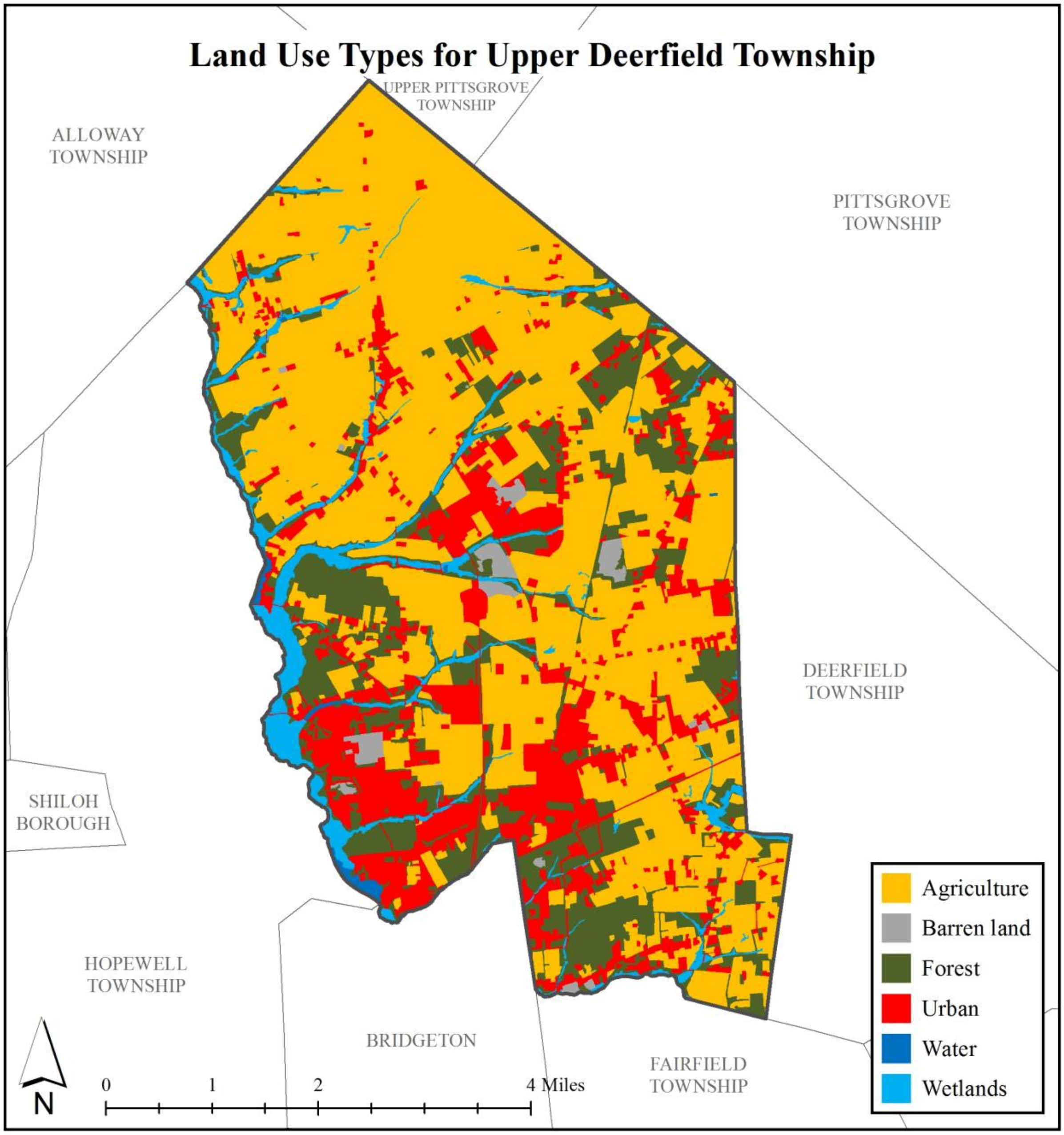


Figure 4: Map illustrating the land use in Upper Deerfield Township

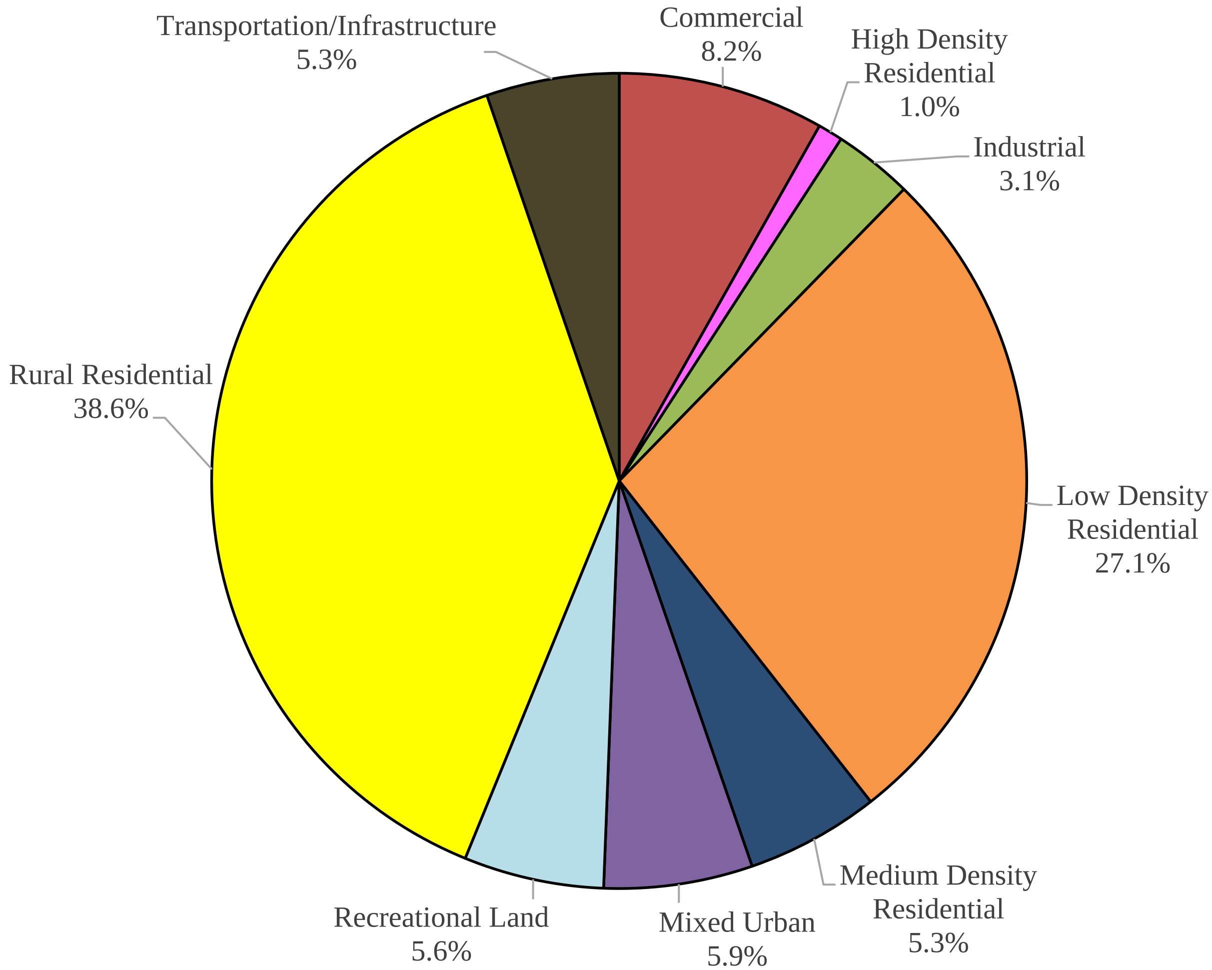


Figure 5: Pie chart illustrating the various types of urban land use in Upper Deerfield Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Upper Deerfield Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 3.2% in the Indian Run/Muddy Run subwatershed to 8.1% in the Muddy Run 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 Upper Deerfield Township, Cumberland 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 (8.8 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Upper Deerfield Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Cohansey River subwatershed was harvested and purified, it could supply water to 162 homes for one year[1].

[1] Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Upper Deerfield Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(ac)	(mi^2)	(%)
Cohansey River	8,798.1	13.75	8,714.1	13.62	84.1	0.13	521.3	0.81	6.0%
Indian Fields Branch/Jackson Run	2,204.6	3.44	2,202.8	3.44	1.8	0.00	102.8	0.16	4.7%
Indian Run/Muddy Run	1,405.4	2.20	1,403.8	2.19	1.6	0.00	45.2	0.07	3.2%
Lebanon Branch/Mill Creek	1,709.9	2.67	1,708.8	2.67	1.1	0.00	58.3	0.09	3.4%
Muddy Run	2,251.1	3.52	2,249.5	3.51	1.6	0.00	181.3	0.28	8.1%
Parsonage Run/Foster Run	3,720.1	5.81	3,712.5	5.80	7.6	0.01	173.7	0.27	4.7%
Total	20,089.2	31.39	19,991.4	31.24	97.8	0.15	1,082.6	1.69	5.4%

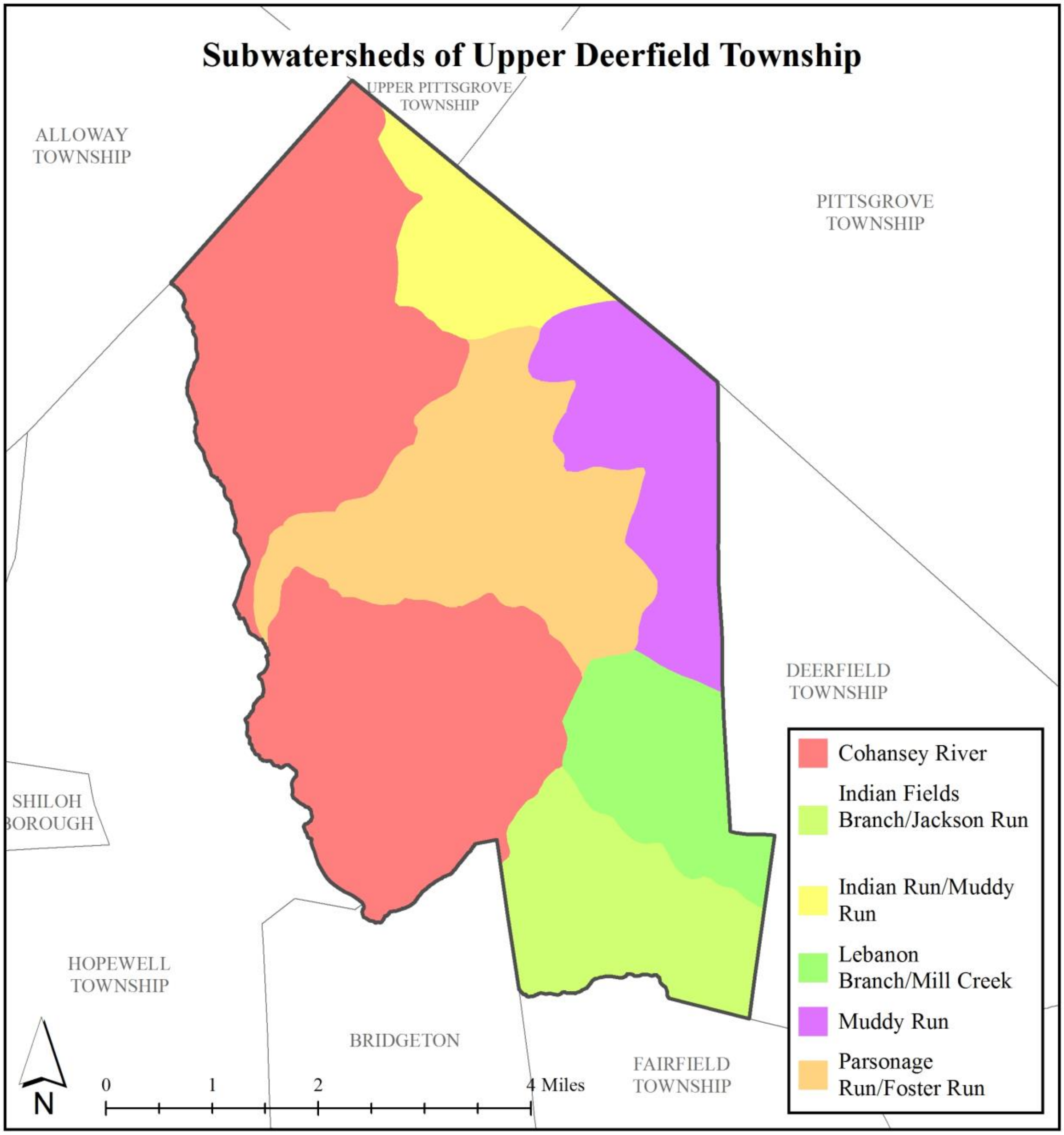


Figure 6: Map of the subwatersheds in Upper Deerfield Township

Table 2: Stormwater runoff volumes from impervious surfaces by subwatershed in Upper Deerfield 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 (3.3") (Mgal)	Total Runoff Volume for the 10-Year Design Storm (5.1") (Mgal)	Total Runoff Volume for the 100-Year Design Storm (8.8") (Mgal)
Cohansey River	17.7	622.4	46.7	72.1	124.5
Indian Fields Branch/Jackson Run	3.5	123.1	9.2	14.3	24.6
Indian Run/Muddy Run	1.5	53.8	4.0	6.2	10.8
Lebanon Branch/Mill Creek	2.0	69.3	5.2	8.0	13.9
Muddy Run	6.1	216.2	16.2	25.1	43.2
Parsonage Run/Foster Run	5.9	207.9	15.6	24.1	41.6
Total	36.7	1,292.7	97.0	149.8	258.5

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 Upper Deerfield 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 (3.3 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 Upper Deerfield Township

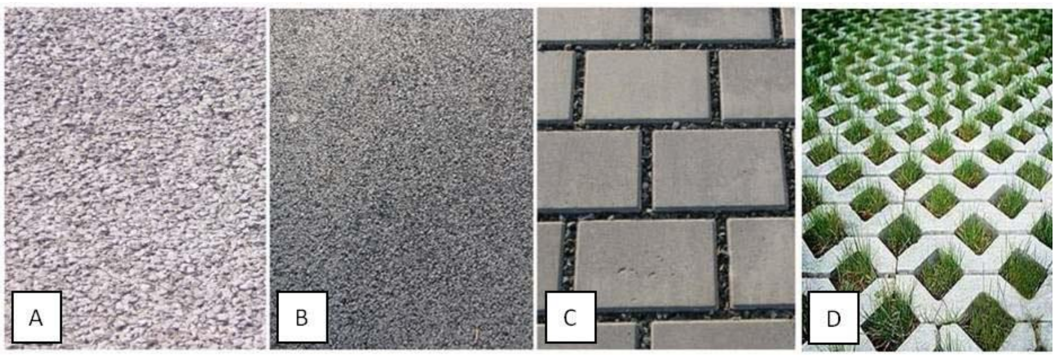
Subwatershed	**Recommended Impervious Area Reduction (10%) (ac)**	**Annual Runoff Volume Reduction [2] (MGal)**
Cohansey River	52.1	59.1
Indian Fields Branch/Jackson Run	10.3	11.7
Indian Run/Muddy Run	4.5	5.1
Lebanon Branch/Mill Creek	5.8	6.6
Muddy Run	18.1	20.5
Parsonage Run/Foster Run	17.4	19.7
Total	108.2	122.8

[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 3.3 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 Upper Deerfield 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 Upper Deerfield 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

Upper Deerfield 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

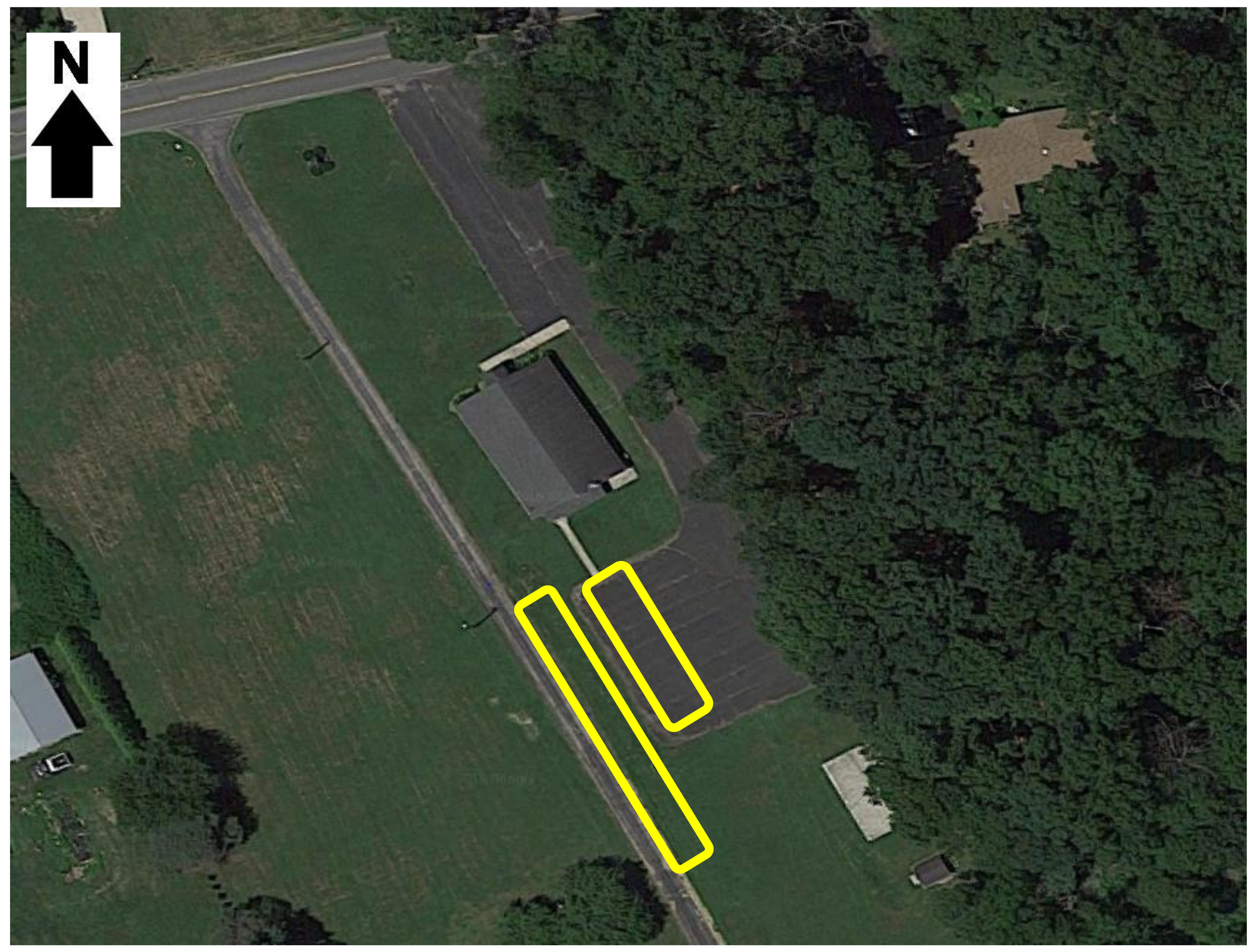
Examples of Impervious Cover Reduction Action Plan Projects

Concept Plans and Detailed Green Infrastructure Information Shee

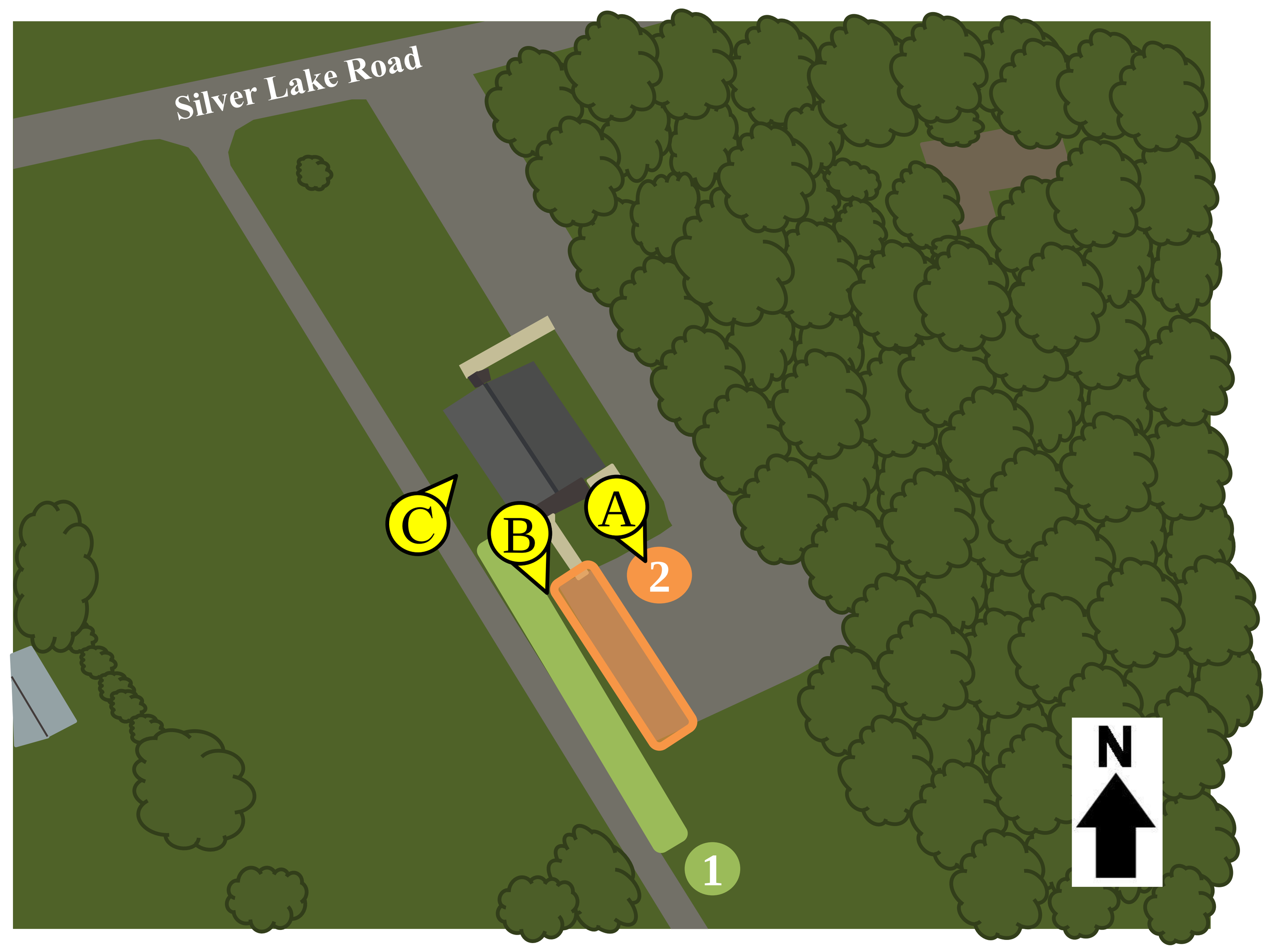
Upper Deerfield Township
Impervious Cover Assessment
Silver Lake Community Church, 152 Silver Lake Road

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:



A

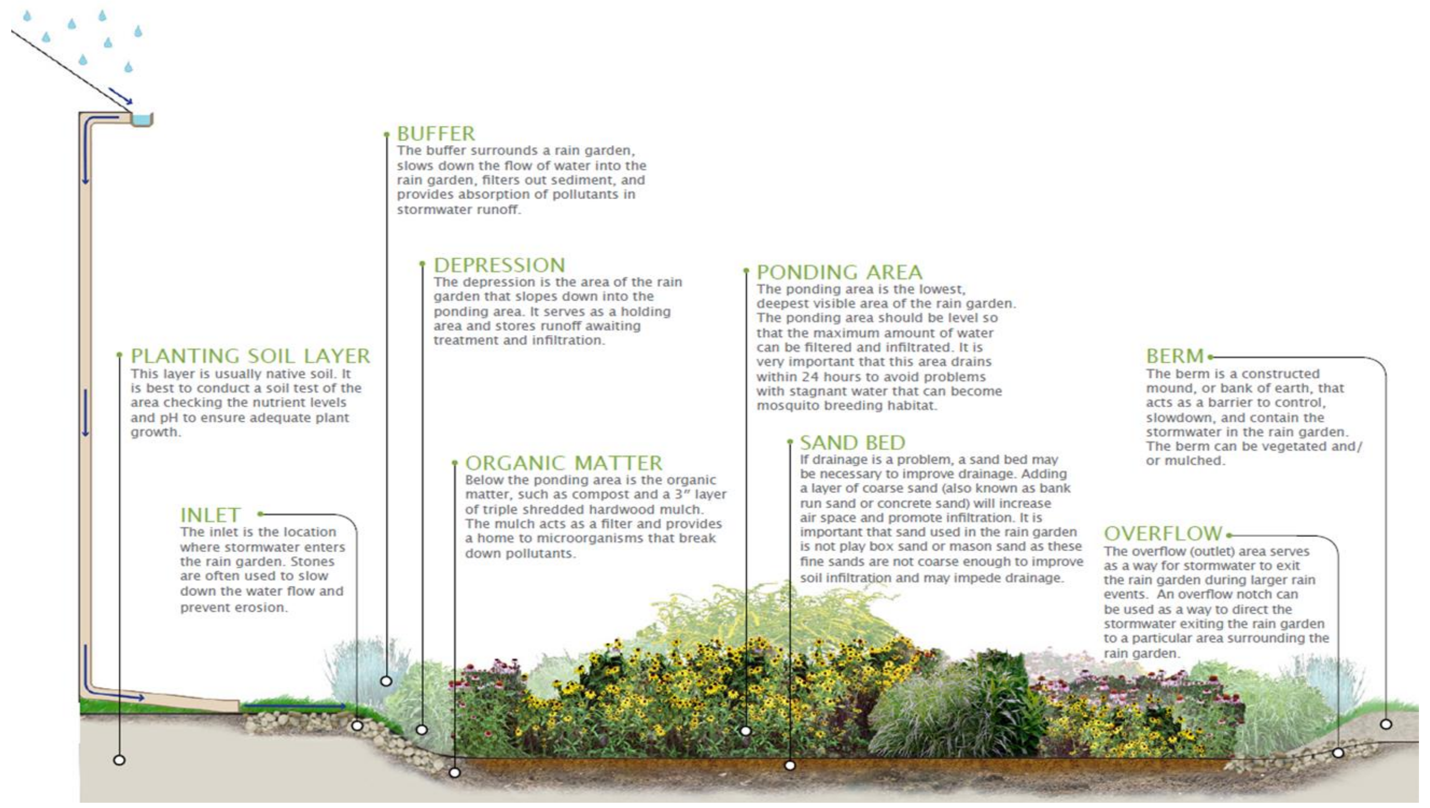
B

C

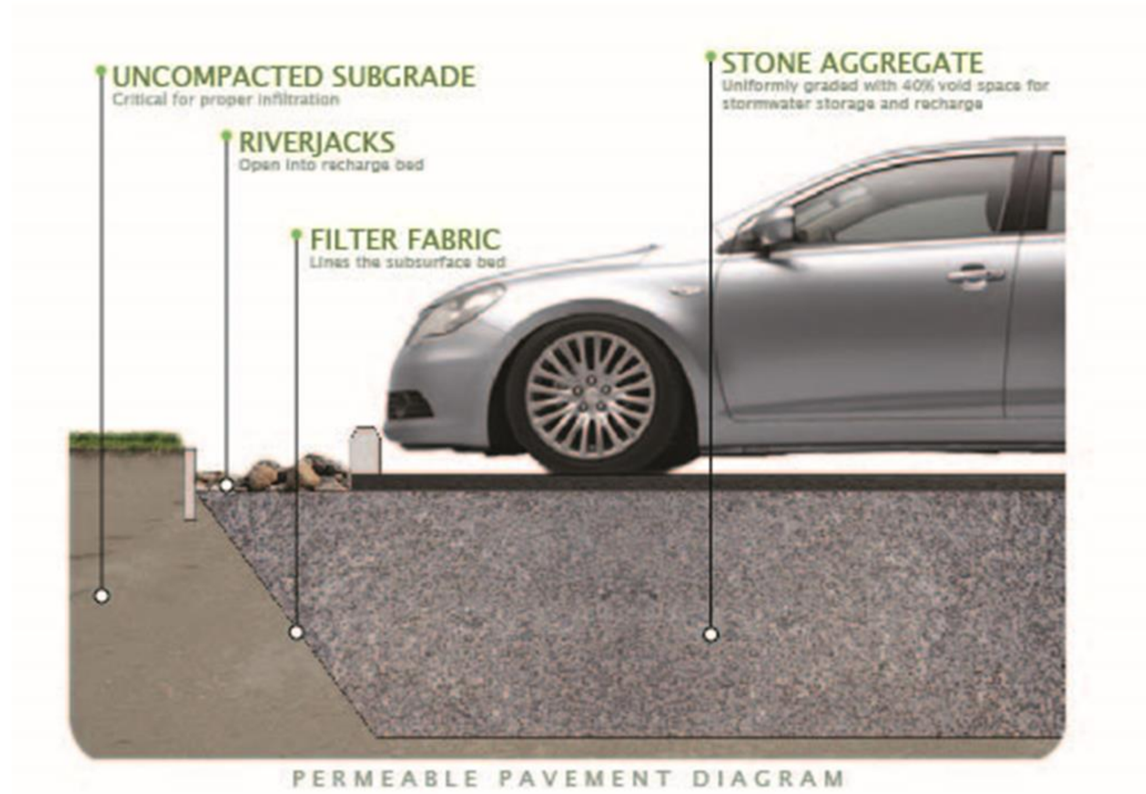
1 **BIORETENTION SYSTEMS:** Rooftop runoff from the northwest corner of the building that is currently conveyed down a small hill and into a depressed channel can be captured, treated, and infiltrated into a bioretention system. Bioretention systems can reduce sediment and nutrient loading to the local waterways while providing habitat for birds, butterflies, and pollinators.

2 **POROUS PAVEMENT:** A portion of the parking lot can be replaced with porous pavement. This will allow runoff generated by the parking lot to infiltrate.

1 BIORETENTION SYSTEM



2 POROUS PAVEMENT



Location: 152 Silver Lake Road Upper Deerfield, NJ 08302	**Municipality:** Upper Deerfield Township **Subwatershed:** Cohansey River
Green Infrastructure Description: bioretention system (rain garden) pervious pavement	**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: 120,897 gal. pervious pavement: 210,110 gal.

Existing Conditions and Issues:
There is a channel grooved into the turfgrass on the west side of the parking lot. It looks like runoff from the building and parking lot are draining directly into the channel. The edge of the parking lot is crumbling.

Proposed Solution(s):
A rain garden could be installed to capture a portion of the rooftop runoff. The rain garden could be constructed in the turf grass area along the west side of the parking lot. The downspouts on the west side of the building can be redirected into the rain garden. While the parking lot is in good condition, a section could be converted to pervious pavement to capture the runoff from the parking lot.

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 the parish.

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.

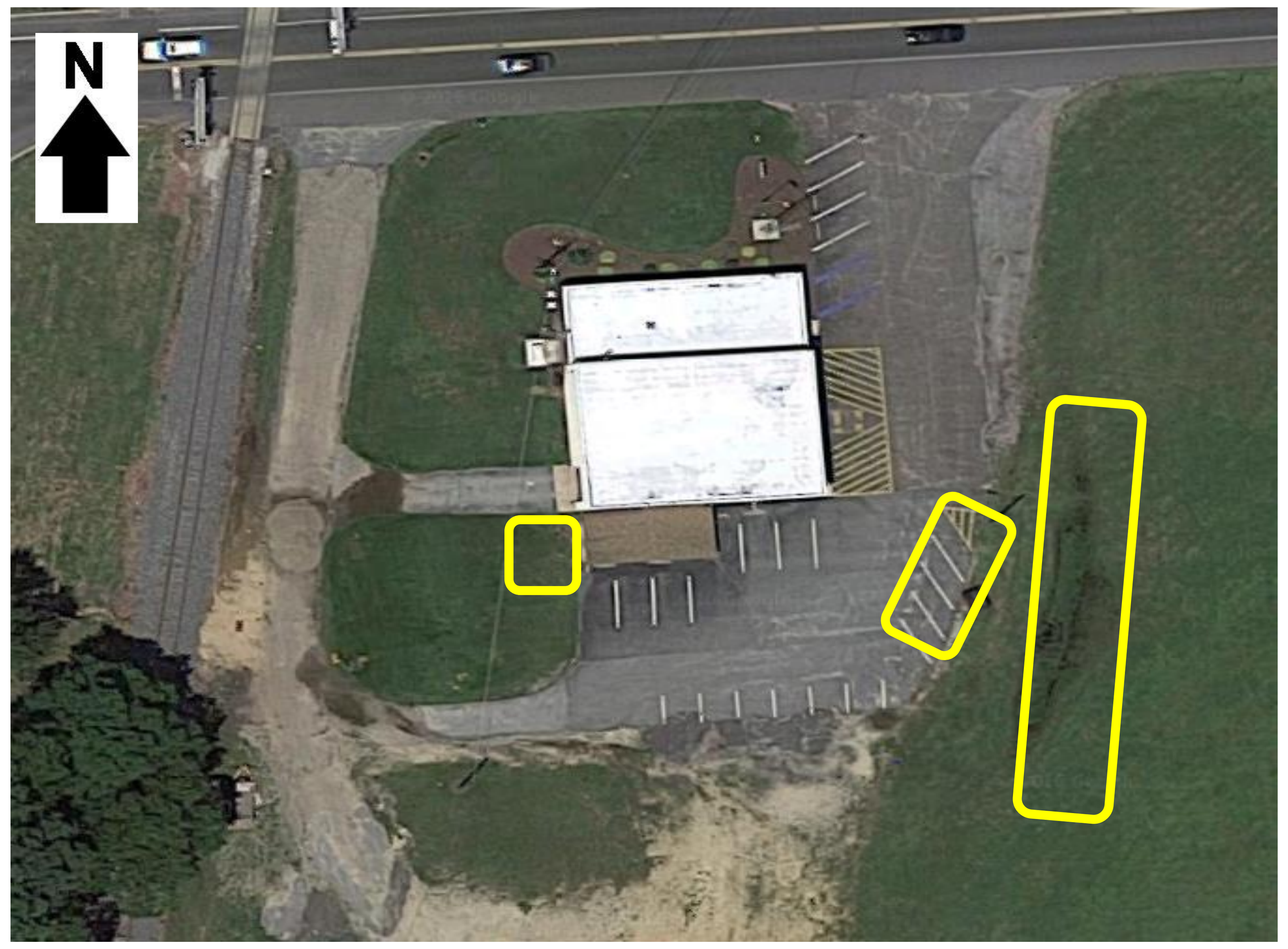
Possible Funding Sources:
Upper Deerfield Township
mitigation funds from local developers
NJDEP grant programs
local social and community groups
parish

Partners/Stakeholders: Upper Deerfield residents local community groups (Boy Scouts, Girl Scouts, etc.) parishioners Rutgers Cooperative Extension ANJEC
Estimated Cost: The rain garden would need to be approximately 1,160 square feet. At $5 per square foot, the estimated cost of the rain garden is $5,800. The pervious pavement would need to be approximately 1,440 square feet. At $25 per square foot, the estimated cost of the porous pavement is $36,000. The total cost of the project would be approximately $41,800.

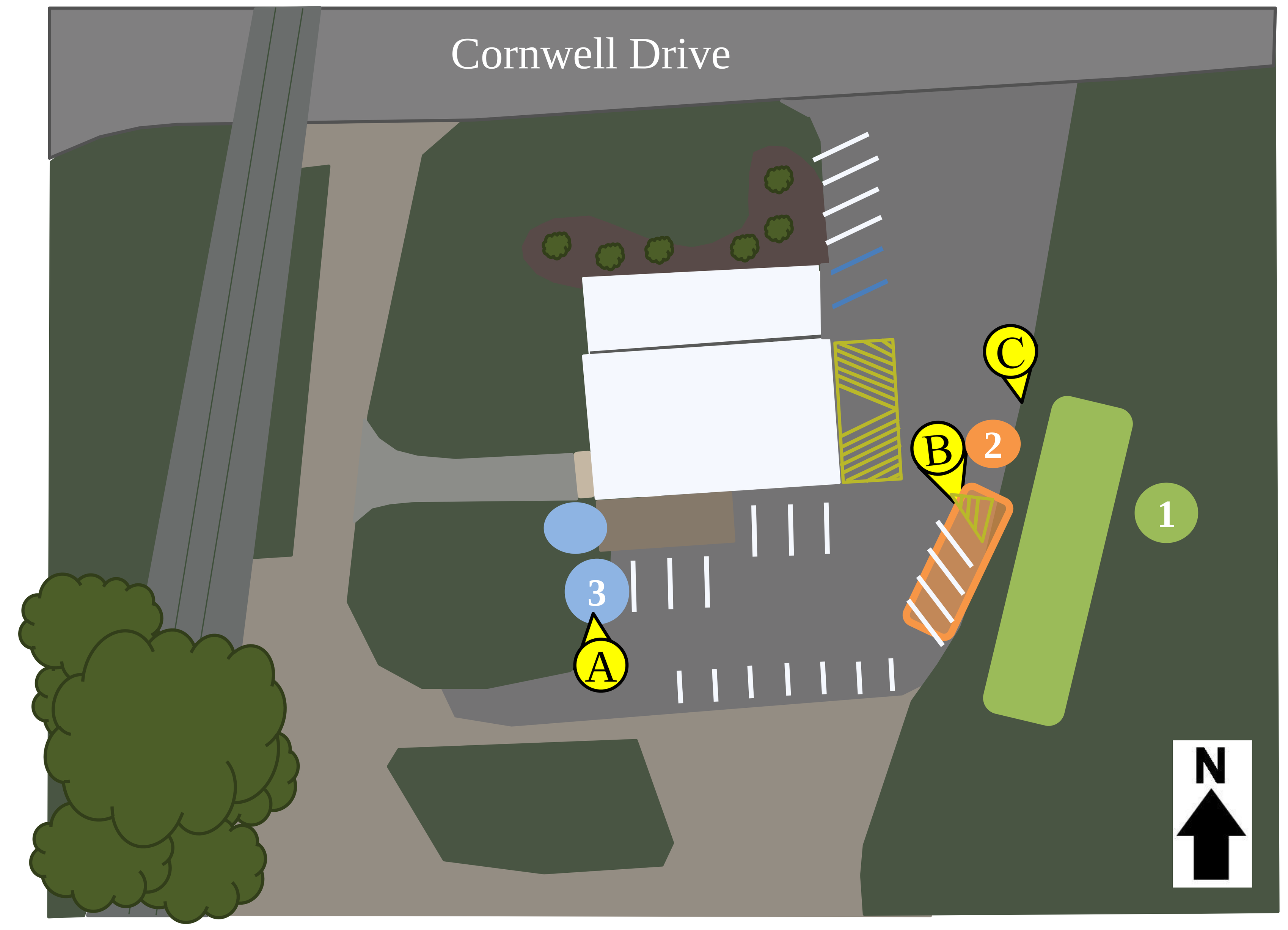
Upper Deerfield Township
Impervious Cover Assessment

Upper Deerfield Township Fire Department, 69 Cornwell Drive

PROJECT LOCATION:



SITE PLAN:



A

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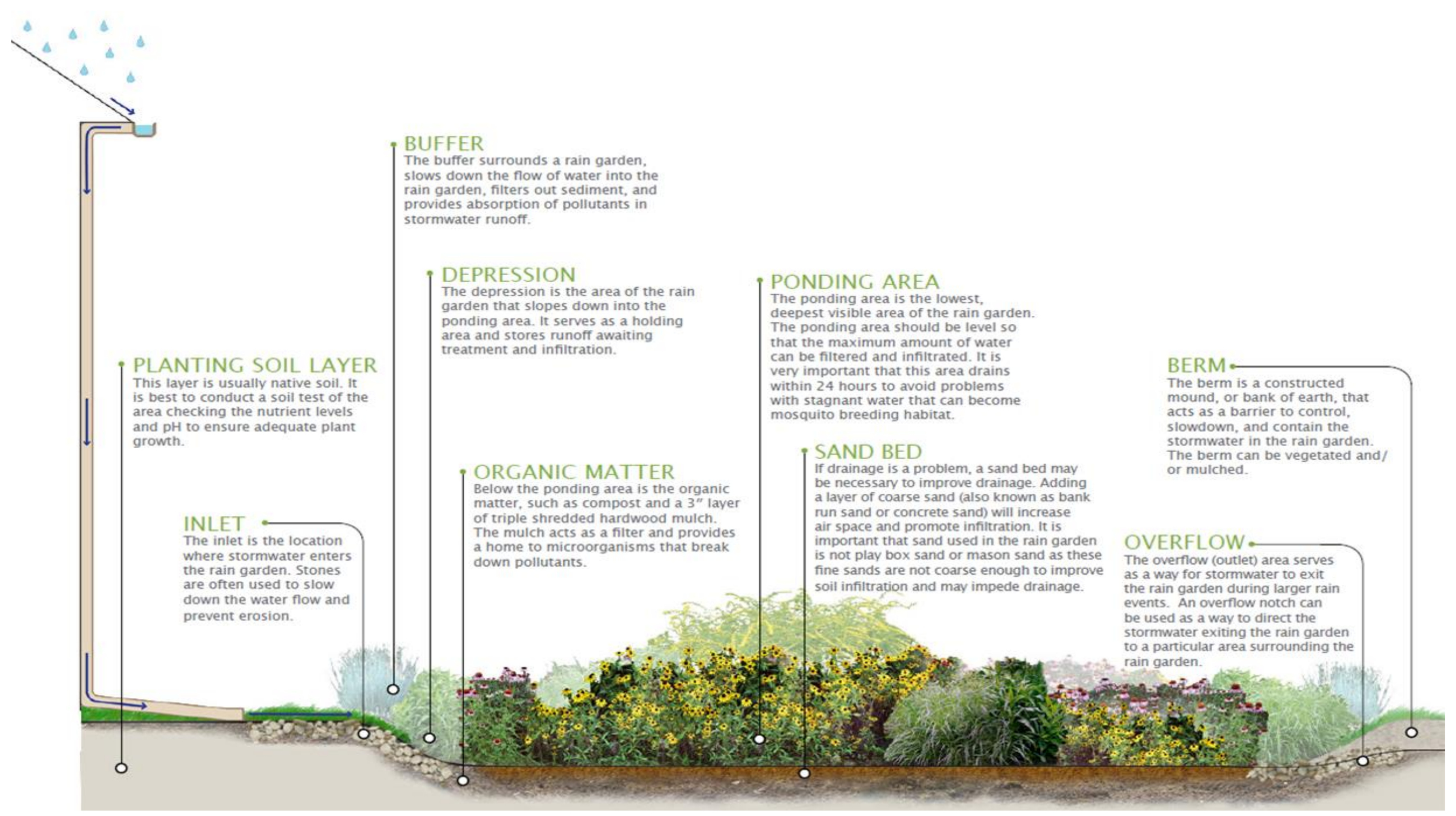
C

1 **BIORETENTION SYSTEMS:** A bioretention system can be installed in the eastern turf grass area, which can intercept runoff from the parking lot. The bioretention system can reduce sediment and nutrient loading to the local waterways and increase groundwater recharge. Building a bioretention system can also provide habitat for birds, butterflies, and pollinators.

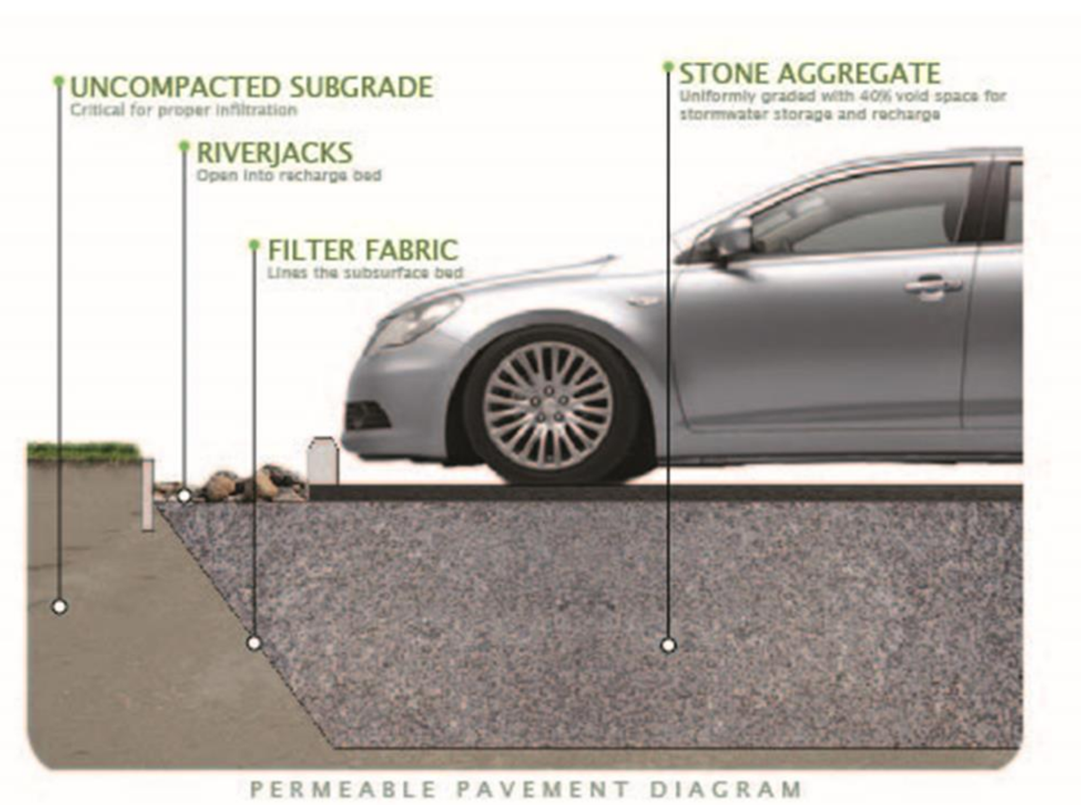
2 **POROUS PAVEMENT:** A portion of the eastern section of the parking lot can be repaved using porous pavement to allow parking lot runoff to infiltrate.

3 **RAINWATER HARVESTING SYSTEM:** Rainwater can be harvested from the southwest side of the building and stored in a cistern. The water can be used to wash emergency vehicles.

1 BIORETENTION SYSTEM



2 POROUS PAVEMENT



3 RAINWATER HARVESTING SYSTEM

Location: 69 Cornwell Drive Bridgeton, NJ 08302	**Municipality:** Upper Deerfield Township **Subwatershed:** Cohansey River
Green Infrastructure Description: bioretention system (rain garden) pervious pavement rainwater harvesting system	**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: 93,799 gal. pervious pavement: 145,910 gal. rainwater harvesting systems: 15,840 gal.

Existing Conditions and Issues:

Areas of the parking lot were eroded, and broken apart at the time of inspection. There were pools of standing water noted along the edge of the driveway.

There are impervious surfaces on this site that contribute to stormwater runoff and nonpoint source pollution. Runoff is carrying nonpoint source pollution directly to the sewer system, adding pressure on the sewer system and carrying with it pollutants from the rooftop.

Proposed Solution(s):

The parking lot can be repaved: converting parking spaces to porous pavement will help manage stormwater runoff on the site. A rain garden could be installed in the turfgrass east of the building to capture, treat, and infiltrate runoff from the pavement. Additionally, a cistern can be installed to harvest rainwater from the roof. The water can be used to wash emergency vehicles on the site.

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 community.

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.

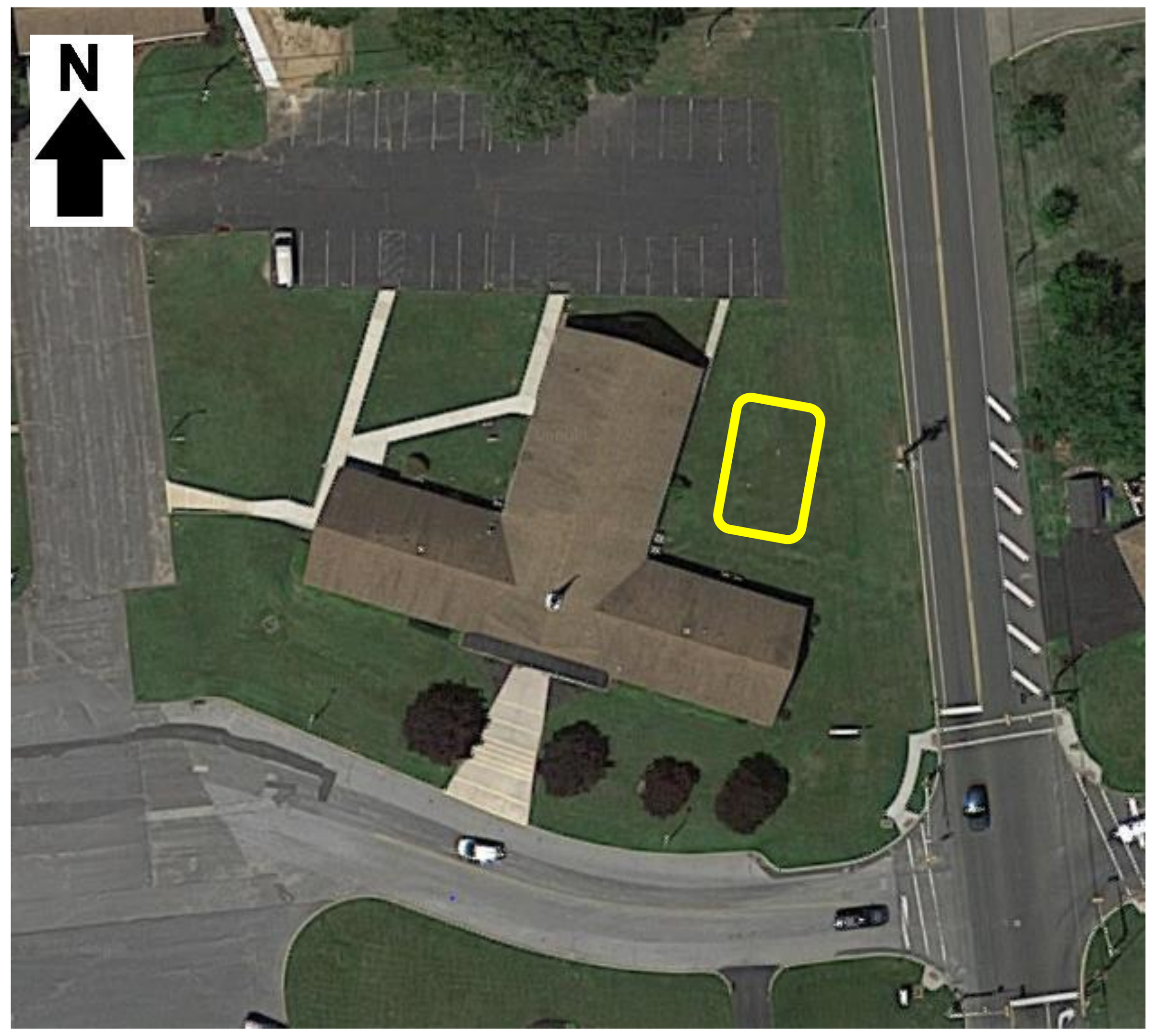
A cistern can be used to harvest rainwater which can be used for watering plants or other purposes which reduce the use of potable water for non-drinking purposes. The cistern would reduce the pollutant loading by 90% during the periods it is operational (i.e., it would not be used in the winter when 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 Upper Deerfield Township
Partners/Stakeholders: Upper Deerfield Township Rutgers Cooperative Extension ANJEC
Estimated Cost: The rain garden would need to be approximately 900 square feet. At $5 per square foot, the estimated cost of the rain garden is $4,500. The porous pavement would need to be approximately 1,000 square feet. At $25 per square foot, the estimated cost of the porous pavement is $25,000. The rainwater harvesting cistern would need to be approximately 1,000 gallons. The approximate cost of a cistern this size is $2,000. The total cost of the project would be approximately $31,500.

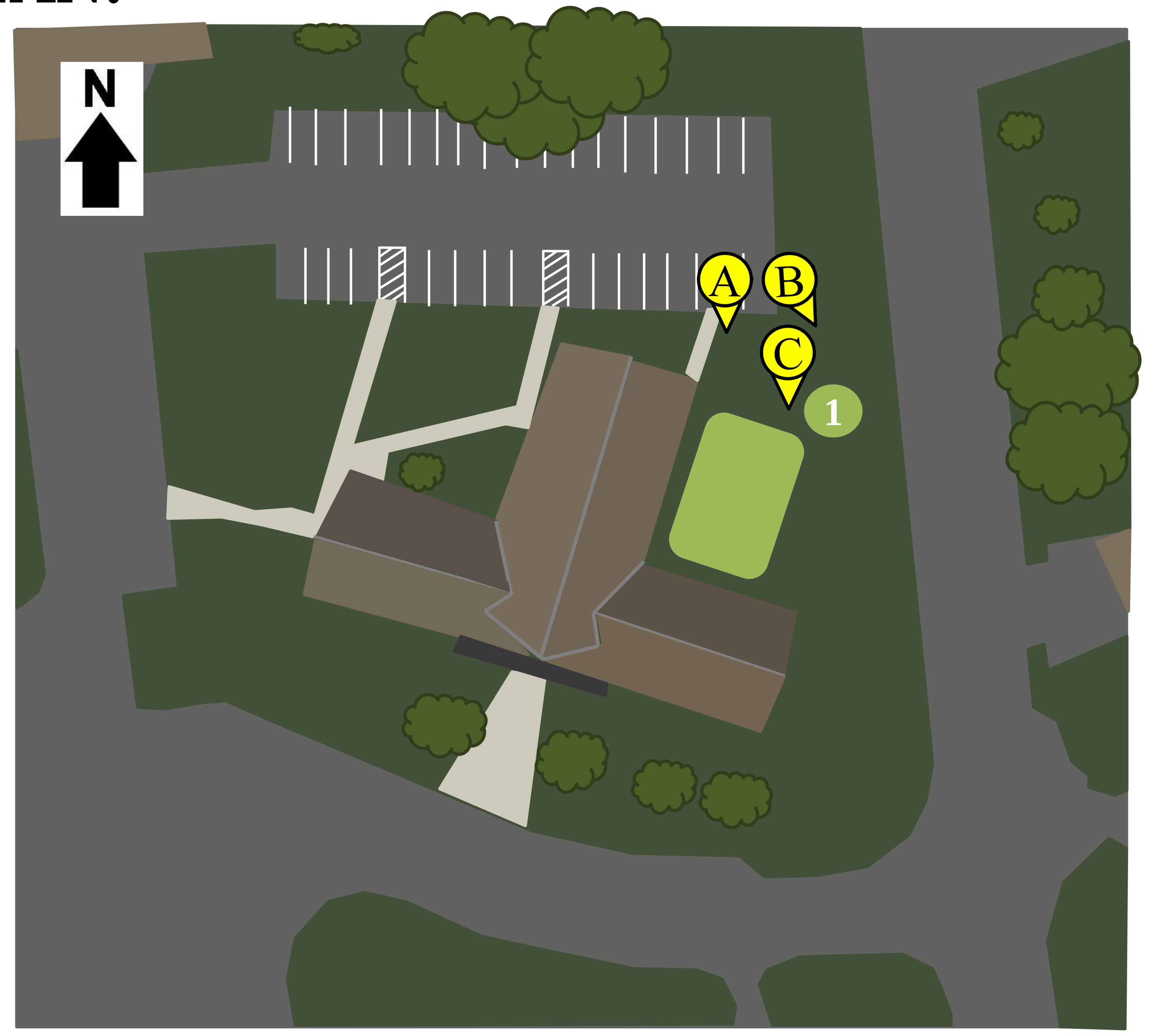
Upper Deerfield Township
Impervious Cover Assessment
First Wesleyan Church, 200 Laurel Heights Drive

RUTGERS
New Jersey Agricultural Experiment Station

PROJECT LOCATION:



SITE PLAN:



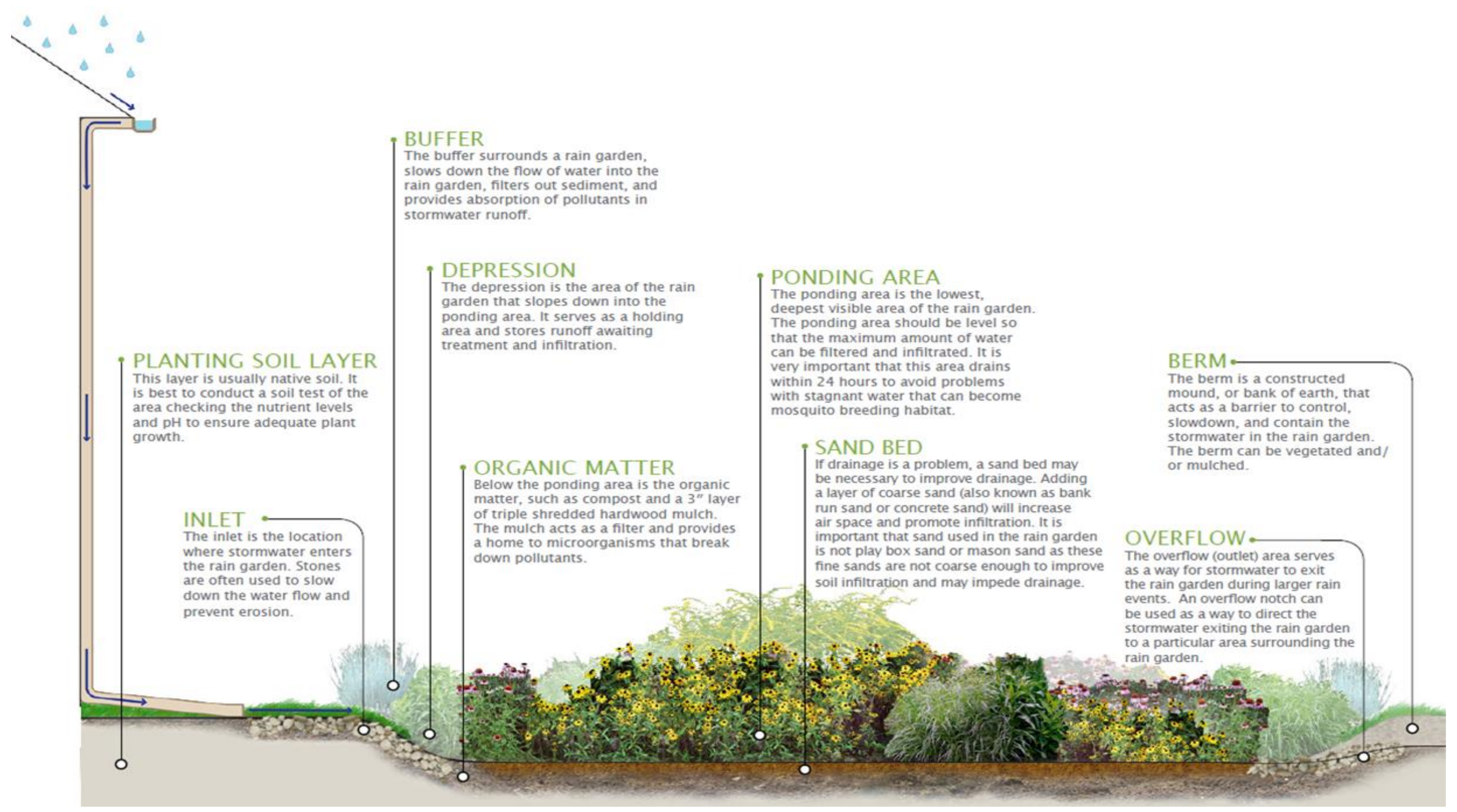
A

B

C

1 **BIORETENTION SYSTEMS:** A bioretention system can be installed in the turf grass on the northeast side of the church to capture, treat, and infiltrate runoff from the roof. The bioretention system can reduce sediment and nutrient loading to the local waterways and increase groundwater recharge. Building a bioretention system can also provide habitat for birds, butterflies, and pollinators.

1 BIORETENTION SYSTEM



First Wesleyan Church
Green Infrastructure Information Sheet

Location: 200 Laurel Heights Drive Bridgeton, NJ 08302	**Municipality:** Upper Deerfield Township **Subwatershed:** Cohansey River
Green Infrastructure Description: bioretention system (rain garden)	**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: 84,940 gal.

Existing Conditions and Issues:
There are large amounts of impervious surfaces on this site that contribute to stormwater runoff and nonpoint source pollution. The parking lot appeared to be paved recently and in good condition. Multiple downspouts around the church are directly connected to the sewer system.

Proposed Solution(s):
A rain garden could be installed on the northeast side of the building to capture, treat, and infiltrate runoff by disconnecting and redirecting the nearby downspouts to the rain garden.

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 parishioners.

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
Boy Scouts, Girl Scouts, or service project

Partners/Stakeholders:
Upper Deerfield Township
residents and parishioners
Rutgers Cooperative Extension
ANJEC

Estimated Cost:
The rain garden would need to be approximately 815 square feet. At $5 per square foot, the estimated cost of the rain garden is $4,075.