



**Impervious Cover Assessment  
for  
Hampton Township, Sussex County, New Jersey**

*Prepared for the town of Hampton Township by the  
Rutgers Cooperative Extension Water Resources Program*

November 7, 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 has also 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

### **Hampton Township Impervious Cover Analysis**

Located in Sussex County in northern New Jersey, Hampton Township covers approximately 25.5 square miles. Figures 3 and 4 illustrate that Hampton Township is dominated by forest land uses. A total of 16.0% of the municipality's land use is classified as urban. Of the urban land in Hampton 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 streams 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 Hampton 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 Hampton Township. Based upon the 2012 NJDEP land use/land cover data, approximately 3.3% of Hampton Township has impervious cover. This level of impervious cover suggests that the streams in Hampton Township are likely sensitive streams.

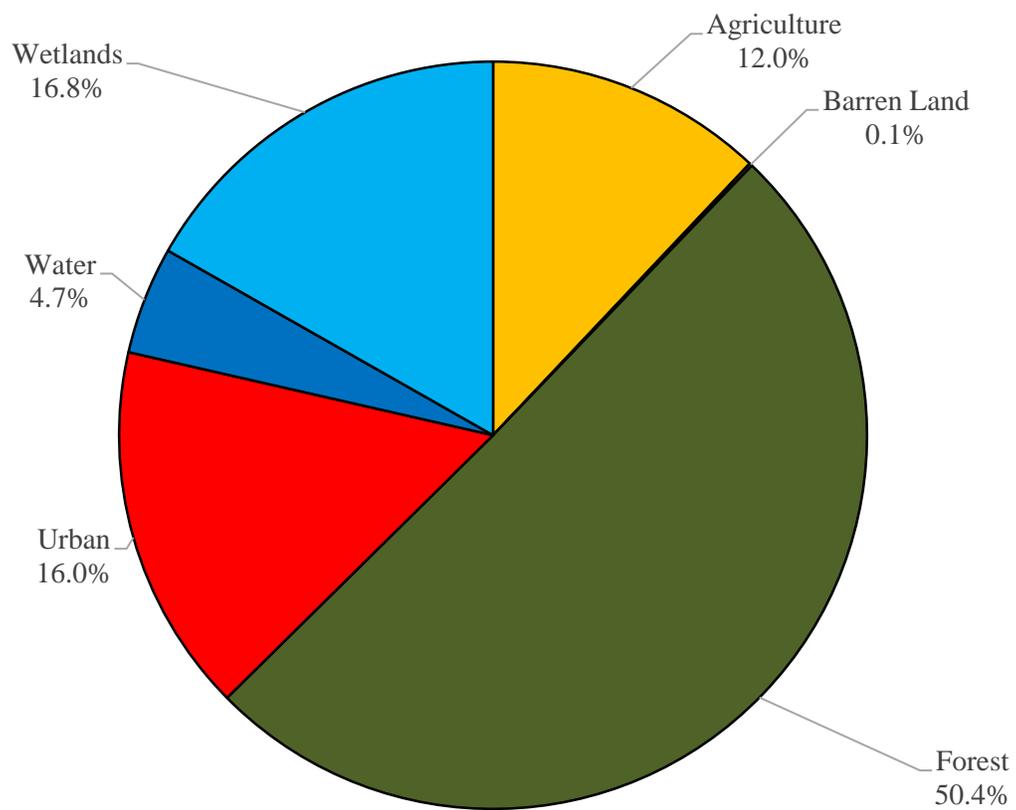


Figure 3: Pie chart illustrating the land use in Hampton Township

# Land Use for Hampton Township

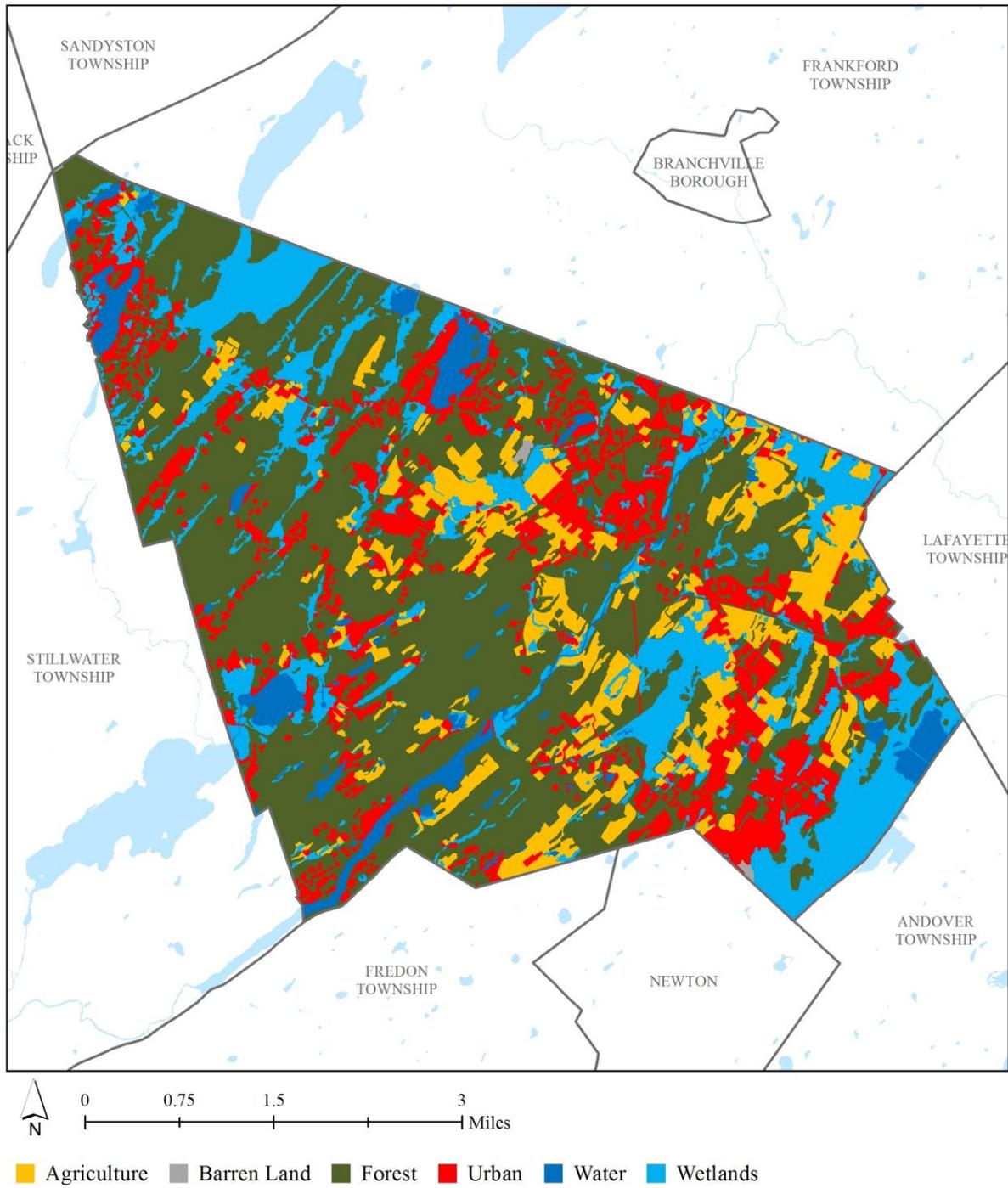


Figure 4: Map illustrating the land use in Hampton Township

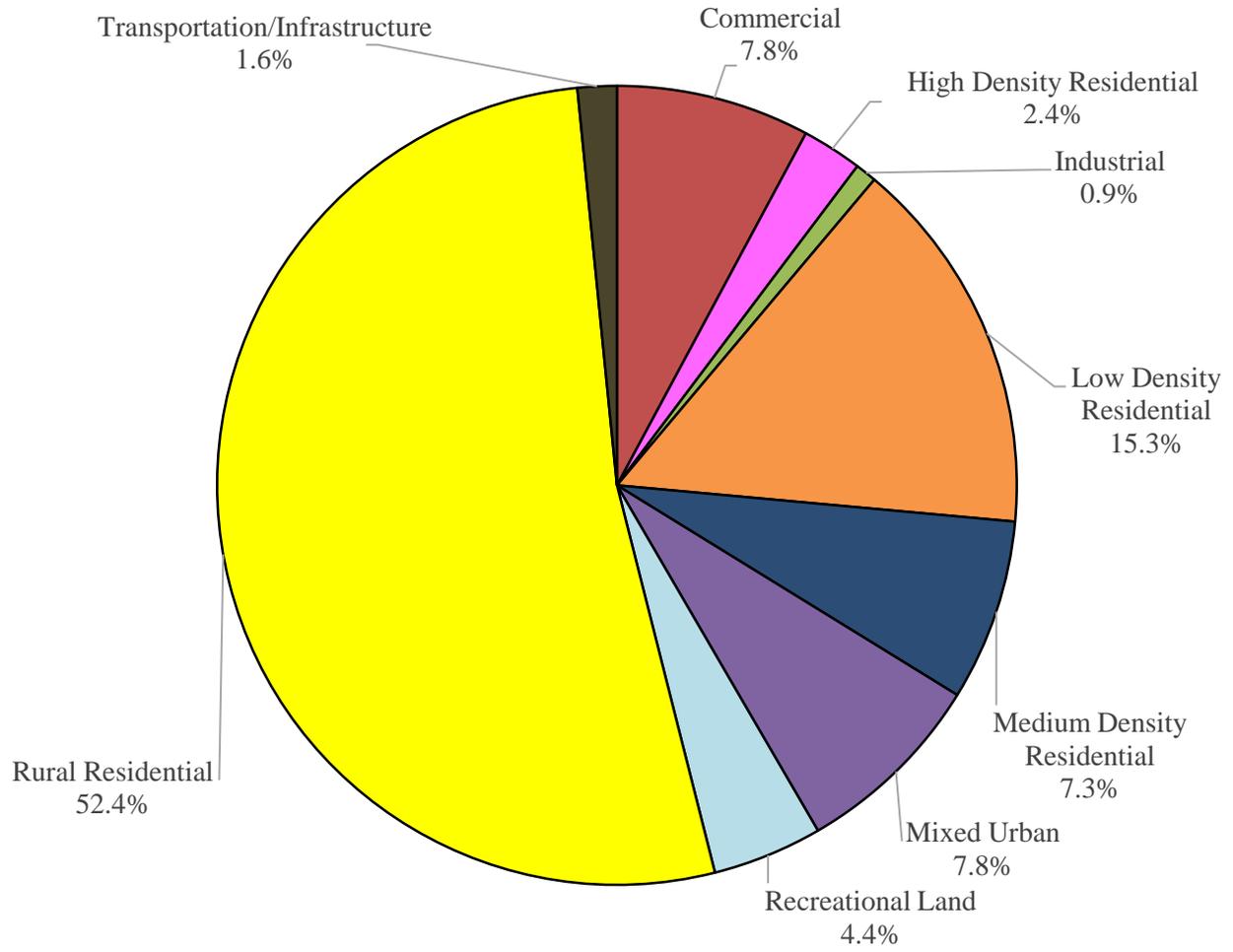


Figure 5: Pie chart illustrating the various types of urban land use in Hampton Township

Water resources are typically managed on a watershed/subwatershed basis; therefore an impervious cover analysis was performed for each subwatershed within Hampton Township (Table 1 and Figure 6). On a subwatershed basis, impervious cover ranges from 0.0% in the Flat Brook subwatershed to 4.1% in the Paukins Kill 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 Hampton Township, Sussex 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 (3.2 inches of rain), the 10-year design storm (4.7 inches of rain), and the 100-year design storm (7.6 inches of rain). These runoff volumes are summarized in Table 2. A substantial amount of rainwater drains from impervious surfaces in Hampton Township. For example, if the stormwater runoff from one water quality storm (1.25 inches of rain) in the Paulins Kill subwatershed was harvested and purified, it could supply water to 104 homes for one year<sup>1</sup>.

---

<sup>1</sup> Assuming 300 gallons per day per home

Table 1: Impervious cover analysis by subwatershed for Hampton Township

Subwatershed	Total Area		Land Use Area		Water Area		Impervious Cover		
	(ac)	(mi <sup>2</sup> )	(ac)	(mi <sup>2</sup> )	(ac)	(mi <sup>2</sup> )	(ac)	(mi <sup>2</sup> )	(%)
Flat Brook	3.0	0.01	3.0	0.01	0.0	0.00	0.0	0.00	0.0%
Lake Kemah Tributaries	2,359.1	3.69	2,207.8	3.45	151.3	0.24	75.4	0.12	3.4%
Paulins Kill	8,512.2	13.30	8,148.6	12.73	363.6	0.57	336.2	0.53	4.1%
Swartswood Lake & Tributaries	5,430.5	8.49	5,186.1	8.10	244.4	0.38	108.5	0.17	2.1%
Total	16,304.8	25.48	15,545.6	24.29	759.2	1.19	520.0	0.81	3.3%

# Subwatersheds of Hampton Township

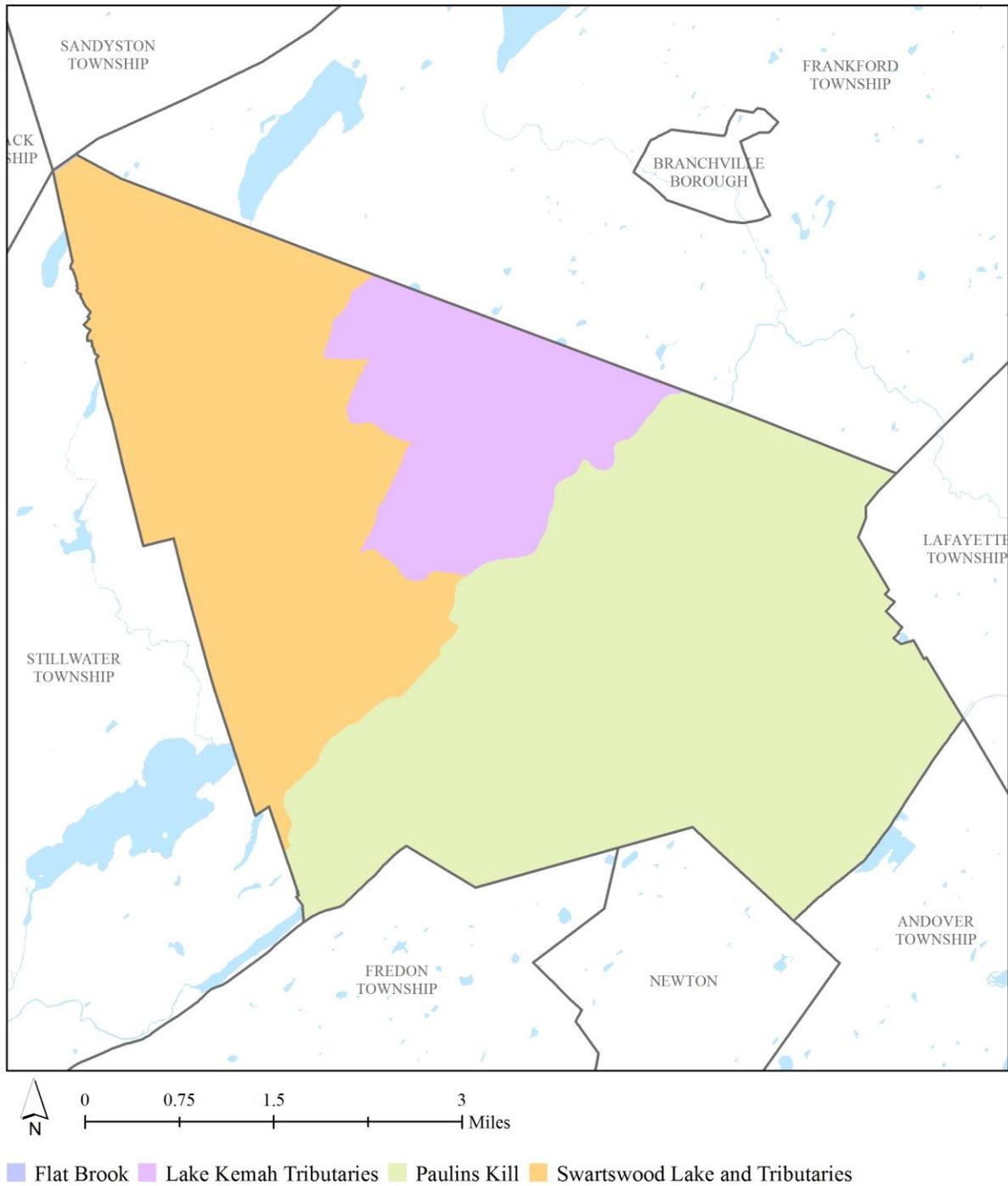


Figure 6: Map of the subwatersheds in Hampton Township

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

<b>Subwatershed</b>	<b>Total Runoff Volume for the 1.25" NJ Water Quality Storm (MGal)</b>	<b>Total Runoff Volume for the NJ Annual Rainfall of 44" (MGal)</b>	<b>Total Runoff Volume for the 2-Year Design Storm (3.2") (MGal)</b>	<b>Total Runoff Volume for the 10-Year Design Storm (4.7") (MGal)</b>	<b>Total Runoff Volume for the 100-Year Design Storm (7.6") (MGal)</b>
Flat Brook	0.0	0.0	0.0	0.0	0.0
Lake Kemah Tributaries	2.6	90.1	6.6	9.6	15.6
Paulins Kill	11.4	401.6	29.2	42.9	69.4
Swartswood Lake & Tributaries	3.7	129.6	9.4	13.8	22.4
Total	17.7	621.3	45.2	66.4	107.3

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 Hampton 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 (3.2 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 Hampton Township

<b>Subwatershed</b>	<b>Recommended Impervious Area Reduction (10%) (ac)</b>	<b>Annual Runoff Volume Reduction<sup>2</sup> (Mgal)</b>
Flat Brook	0.0	0.0
Lake Kemah Tributaries	7.5	8.6
Paulins Kill	33.6	38.2
Swartwood Lake & Tributaries	10.8	12.3
Total	52.0	59.0

---

<sup>2</sup> Annual Runoff Volume Reduction =

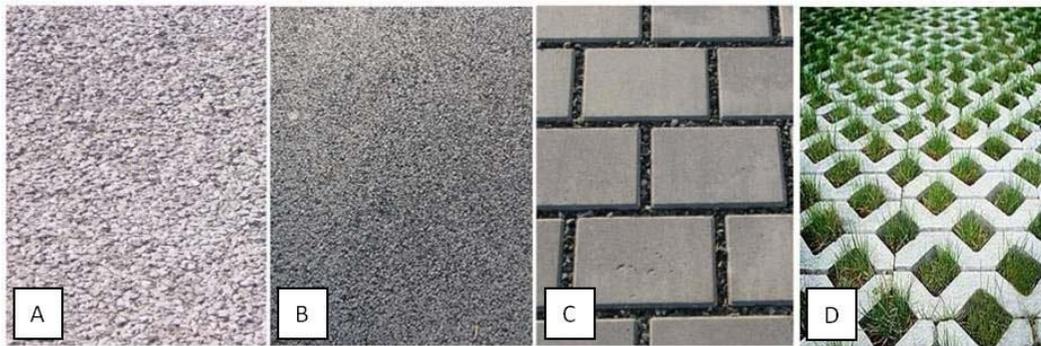
Acres of IC x 43,560 ft<sup>2</sup>/ac x 44 in x (1 ft/12 in) x 0.95 x (7.48 gal/ft<sup>3</sup>) x (1 MGal/1,000,000 gal)

All BMPs should be designed to capture the first 3.2 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 Hampton 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 Hampton 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**

Hampton 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.

## **References**

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

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

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

Nowak, D. J., and E. J. Greenfield, 2012. Trees and Impervious Cover in the United States. *Landscape and Urban Planning* 107 (2012): 21-30.

[http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs\\_2012\\_nowak\\_002.pdf](http://www.nrs.fs.fed.us/pubs/jrnl/2012/nrs_2012_nowak_002.pdf)

Rowe, A., 2012. Green Infrastructure Practices: An Introduction to Permeable Pavement. Rutgers NJAES Cooperative Extension, FS1177, pp. 4.

<http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1177>

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

United States Environmental Protection Agency (USEPA), 2013. Watershed Assessment, Tracking, and Environmental Results, New Jersey Water Quality Assessment Report.

[http://ofmpub.epa.gov/waters10/attains\\_state.control?p\\_state=NJ](http://ofmpub.epa.gov/waters10/attains_state.control?p_state=NJ)

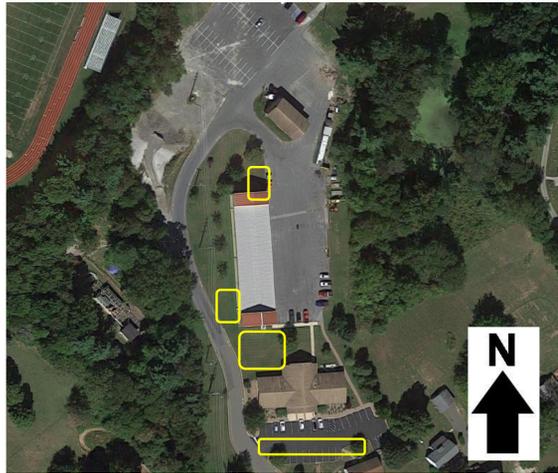
## **Appendix A**

### **Examples of Impervious Cover Reduction Action Plan Projects Concept Plans and Detailed Green Infrastructure Information Sheets**

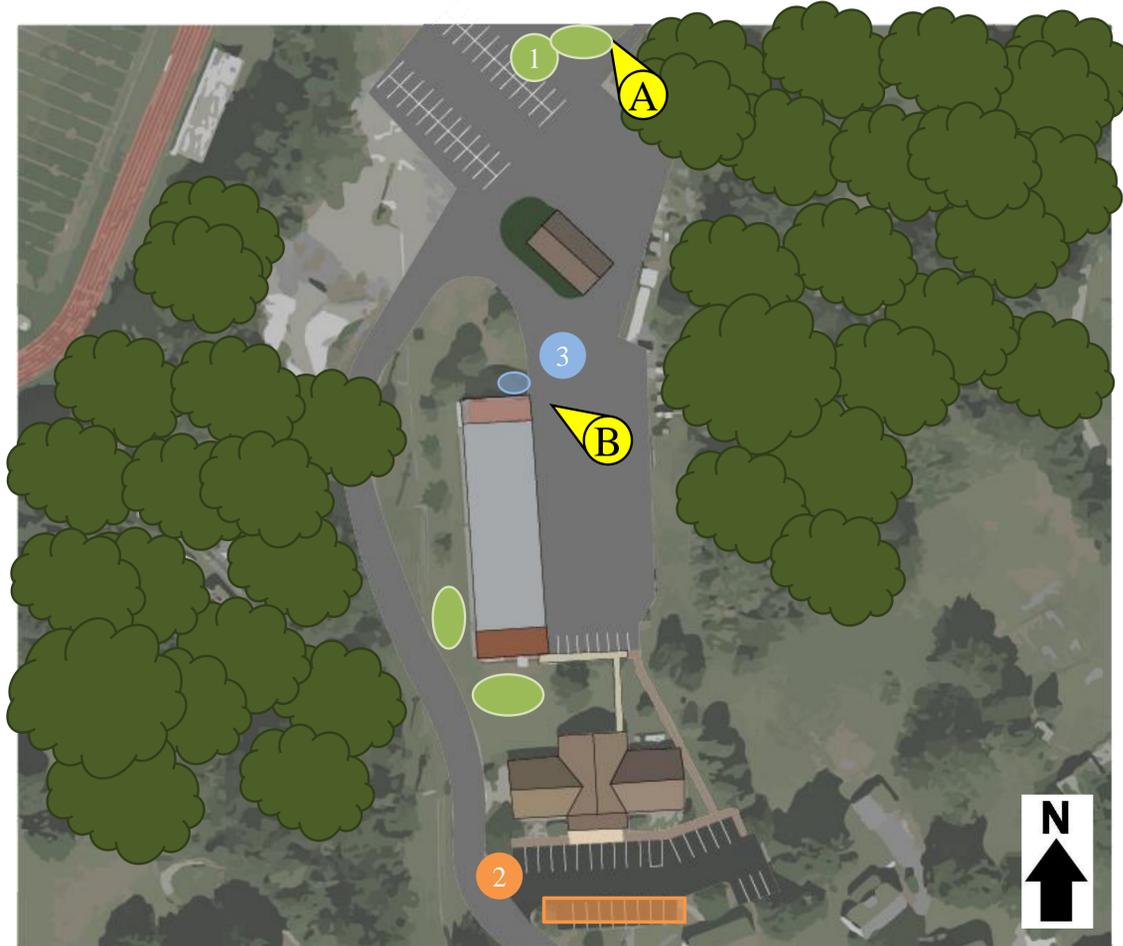
# Hampton Township Impervious Cover Assessment

*Hampton Township Municipal Building, 1 Rumsey Way*

## PROJECT LOCATION:



## SITE PLAN:



A



B



- 1 **BIORETENTION SYSTEM:** Bioretention systems could be installed on the north side of the south building to capture runoff from a disconnected downspout. An additional rain garden can capture runoff from a covered picnic area. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach the catch basin.
- 2 **POROUS PAVEMENT:** Porous pavement could be added to the first row of parking spaces to help capture sheetflow off the parking lot. Porous pavement promotes groundwater recharge and filters stormwater.
- 3 **RAINWATER HARVESTING SYSTEM:** These systems capture rainwater, mainly from rooftops, in cisterns or rain barrels. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses.

### 1 BIORETENTION SYSTEM



### 2 POROUS PAVEMENT



### 3 RAINWATER HARVESTING SYSTEM



Hampton Township Municipal Building  
Green Infrastructure Information Sheet

<p><b>Location:</b> 1 Rumsey Way Newton, NJ 07860</p>	<p><b>Municipality:</b> Hampton Township</p> <p><b>Subwatershed:</b> Paulins Kill</p>
<p><b>Green Infrastructure Description:</b> bioretention system (rain garden) porous pavement rain harvesting system (rain barrel/cistern)</p>	<p><b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff</p>
<p><b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p><b>Stormwater Captured and Treated Per Year:</b> rain garden #1: 28,270 gal. rain garden #2: 33,870 gal. rain garden #3: 70,740 gal. porous pavement: 216,910 gal. rain harvesting system: 14,070 gal.</p>
<p><b>Existing Conditions and Issues:</b> The downspouts on the buildings are connected to the ground and flow right into the sewer system. The parking lot provides a fair amount of asphalt. This contributes to the stormwater runoff and flooding by having more impervious surfaces.</p>	
<p><b>Proposed Solution(s):</b> Two rain gardens can be built adjacent to the building in the middle to capture, treat, and infiltrate roof runoff. Another rain garden can be built at a picnic area to the north. A cistern can be installed to harvest rainwater from the northeastern corner of the building. Parking spots in front of the southern building can be replaced with porous asphalt to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.</p>	
<p><b>Anticipated Benefits:</b> 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 of Hampton.</p> <p>Porous pavement allows stormwater to penetrate 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.</p> <p>Rain barrels and cisterns can harvest stormwater which can be used for watering plants, or other purposes which cuts back on 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 it is operational (i.e., it would not be used in the winter when there is a chance of freezing).</p>	

Hampton Township Municipal Building  
Green Infrastructure Information Sheet

---

---

**Possible Funding Sources:**

Hampton Township  
mitigation funds from local developers  
local social and community groups  
home and school associations

**Partners/Stakeholders:**

Hampton Township  
local social and community groups  
local residents  
Rutgers Cooperative Extension

**Estimated Cost:**

Rain garden #1 would need to be approximately 300 square feet. At \$5 per square foot, the estimated cost is \$1,500.

Rain garden #2 would need to be approximately 325 square feet. At \$5 per square foot, the estimated cost is \$1,625.

Rain garden #3 would need to be approximately 700 square feet. At \$5 per square foot, the estimated cost is \$3,500.

The porous asphalt would cover 1,670 square feet and have a 2-foot stone reservoir under the surface. At \$25 per square foot, the cost of the porous asphalt system would be \$41,750.

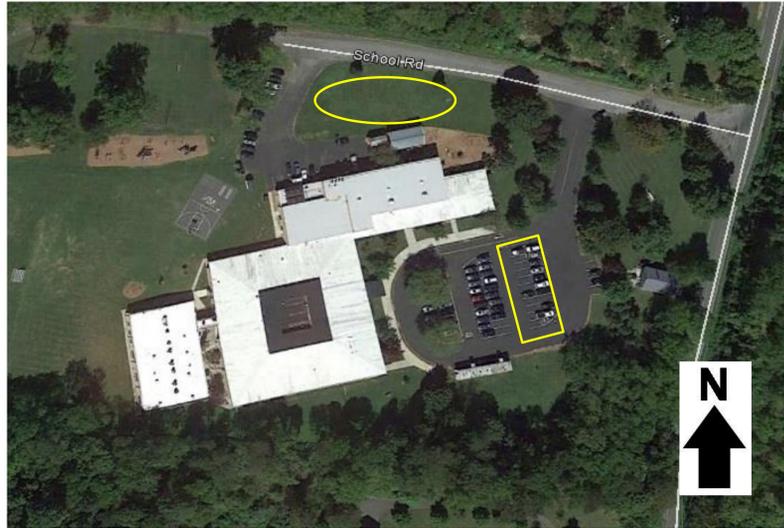
The cistern would be 1,000 gallons and cost approximately \$2,000 to purchase and install.

The total cost of the project will thus be approximately \$50,375.

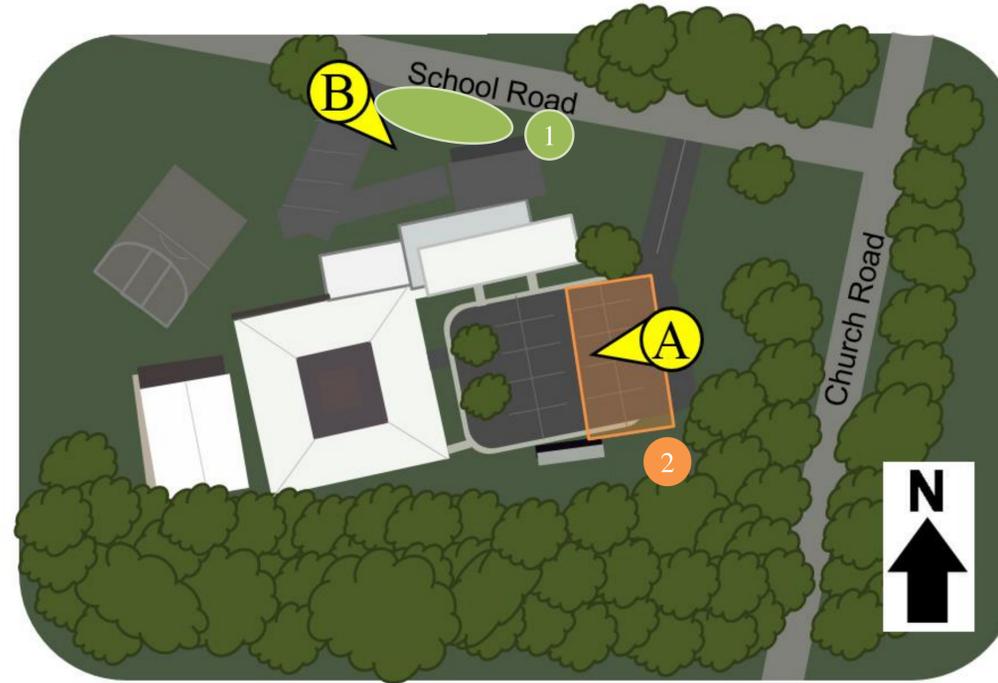
# Hampton Township Impervious Cover Assessment

*Marian Emmons McKeown School, 1 School Road*

## PROJECT LOCATION:



## SITE PLAN:



A



B



- 1 **BIORETENTION SYSTEM:** Bioretention systems can be installed on the north side of the building to capture runoff from a disconnected downspout. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach the catch basin.
- 2 **POROUS PAVEMENT:** Porous pavement can be added to the first row of parking spaces to help capture sheet flow off of the parking lot. Porous pavement promotes groundwater recharge and filters stormwater.

## 1 BIORETENTION SYSTEM



## 2 POROUS PAVEMENT



Marian Emmons McKeown School  
Green Infrastructure Information Sheet

<p><b>Location:</b> 1 School Road Newton, NJ 07860</p>	<p><b>Municipality:</b> Hampton Township</p>
<p><b>Green Infrastructure Description:</b> bioretention systems (rain gardens) porous pavement</p>	<p><b>Subwatershed:</b> Paulins Kill River</p> <p><b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff</p>
<p><b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p><b>Stormwater Captured and Treated Per Year:</b> rain garden : 529,970 gal. porous pavement: 509,120 gal.</p>
<p><b>Existing Conditions and Issues:</b> This site contains several impervious surfaces including driveways, walkways, and a parking lot. These impervious surfaces are directly connected to a storm sewer system. The school's main parking lot is relatively flat, and the pavement is slightly degraded throughout the property.</p>	
<p><b>Proposed Solution(s):</b> Rain gardens should be installed at the north side of the school adjacent to School Road along the large lot. The rain garden would capture runoff from the paved area and rooftop. Porous pavement could cover the parking spaces on the eastern half of the lot to capture, treat, and infiltrate runoff from the other half.</p>	
<p><b>Anticipated Benefits:</b> 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. This bioretention system would provide additional benefits such as aesthetic appeal and wildlife habitat. Rutgers Cooperative Extension could present the <i>Stormwater Management in Your Schoolyard</i> program to students and include them in bioretention system planting efforts to enhance the program.</p> <p>Porous pavement allows stormwater to penetrate 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.</p>	
<p><b>Possible Funding Sources:</b> Hampton Township mitigation funds from local developers local social and community groups home and school associations</p>	

Marian Emmons McKeown School  
Green Infrastructure Information Sheet

---

**Partners/Stakeholders:**

Hampton Township  
students and parents  
local social and community groups  
local residents  
Rutgers Cooperative Extension

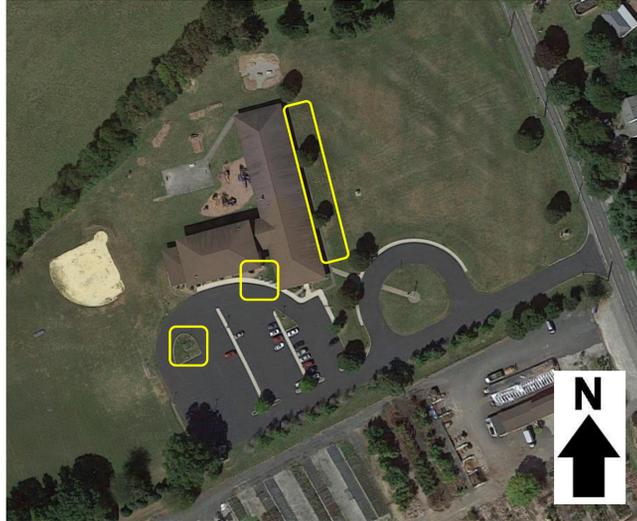
**Estimated Cost:**

At the McKeon School, the rain garden would be installed adjacent to School Road, along the large lot. The rain garden would need to be approximately 4,070 square feet. At \$5 per square foot, the estimated cost of the rain garden is \$20,350. The porous asphalt would cover 3,910 square feet and have a 2-foot stone reservoir under the surface. At \$25 per square foot, the cost of the porous asphalt system would be \$97,750. The total cost of the project would be approximately \$118,100.

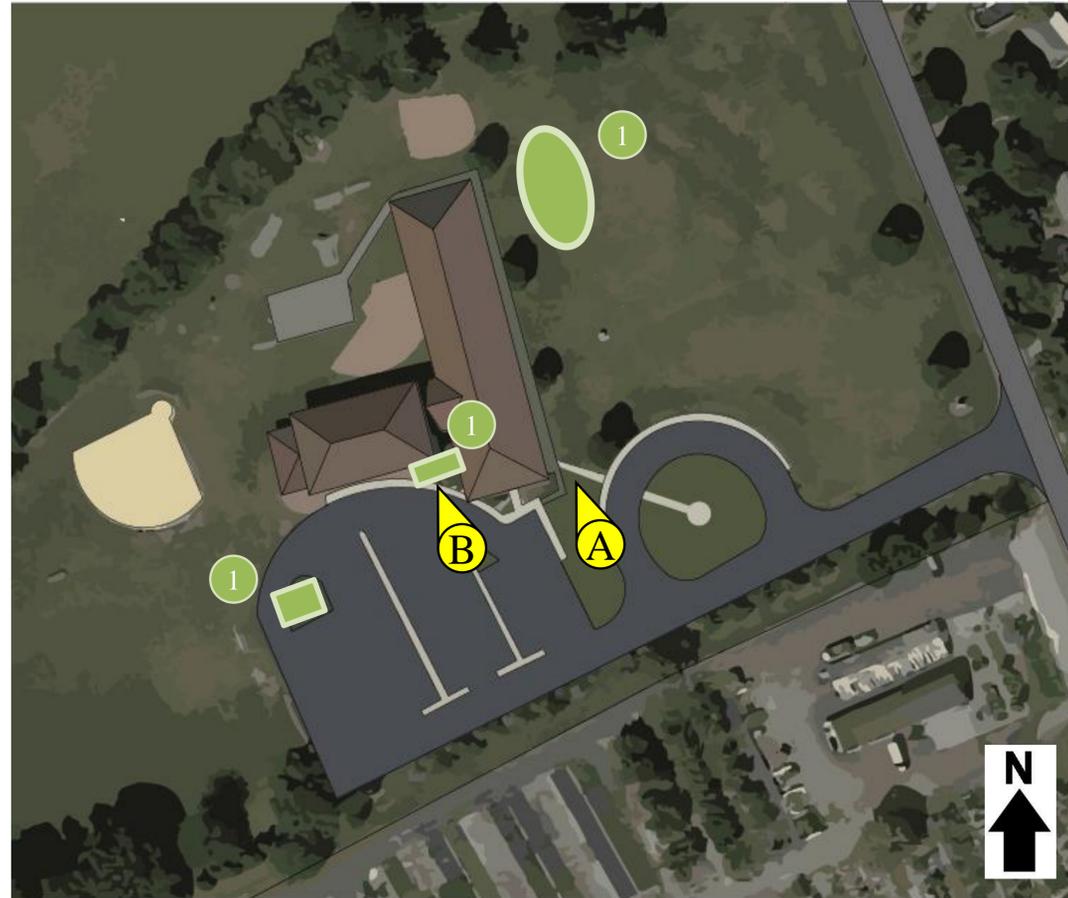
# Hampton Township Impervious Cover Assessment

*Northwest Christian School, 92 County Road 519*

## PROJECT LOCATION:



## SITE PLAN:



**A**



**B**



**1 BIORETENTION SYSTEM:** Bioretention systems could be installed on the north side of the building to capture rooftop runoff by disconnecting downspouts. A bioretention system can be installed by the eastern side of the parking lot to capture rooftop runoff. A bioretention system will reduce runoff and allow stormwater infiltration, decreasing the amount of contaminants that reach the catch basin.

## 1 BIORETENTION SYSTEM



Northwest Christian School  
Green Infrastructure Information Sheet

<p><b>Location:</b> 92 County Road 519 Newton, NJ 07860</p>	<p><b>Municipality:</b> Hampton Township</p> <p><b>Subwatershed:</b> Paulins Kill River</p>
<p><b>Green Infrastructure Description:</b> bioretention system (rain garden)</p>	<p><b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff</p>
<p><b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p><b>Stormwater Captured and Treated Per Year:</b> rain garden #1: 203,880 gal. rain garden #2: 29,700 gal. rain garden #3: 52,110 gal.</p>
<p><b>Existing Conditions and Issues:</b> The school has a large amount of paved area and rooftops that contribute to large volumes of stormwater runoff. The downspouts of the building are directly connected to the sewer system instead of running over lawn space where it could infiltrate.</p>	
<p><b>Proposed Solution(s):</b> Installing rain gardens adjacent to the building's east and south faces and in the parking island can capture, treat, and infiltrate roof runoff and parking lot runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.</p>	
<p><b>Anticipated Benefits:</b> 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 of Hampton.</p> <p>Porous pavement allows stormwater to penetrate 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.</p>	
<p><b>Possible Funding Sources:</b> Hampton Township mitigation funds from local developers local social and community groups home and school associations</p>	
<p><b>Partners/Stakeholders:</b> Hampton Township students and parents local social and community groups local residents Rutgers Cooperative Extension</p>	

Northwest Christian School  
Green Infrastructure Information Sheet

---

**Estimated Cost:**

Rain garden #1 would need to be approximately 1,955 square feet. At \$5 per square foot, the estimated cost is \$9,775.

Rain garden #2 would need to be approximately 285 square feet. At \$5 per square foot, the estimated cost is \$1,425.

Rain garden #3 would need to be approximately 500 square feet. At \$5 per square foot, the estimated cost is \$2,500.

The total cost of the project will thus be approximately \$13,700.

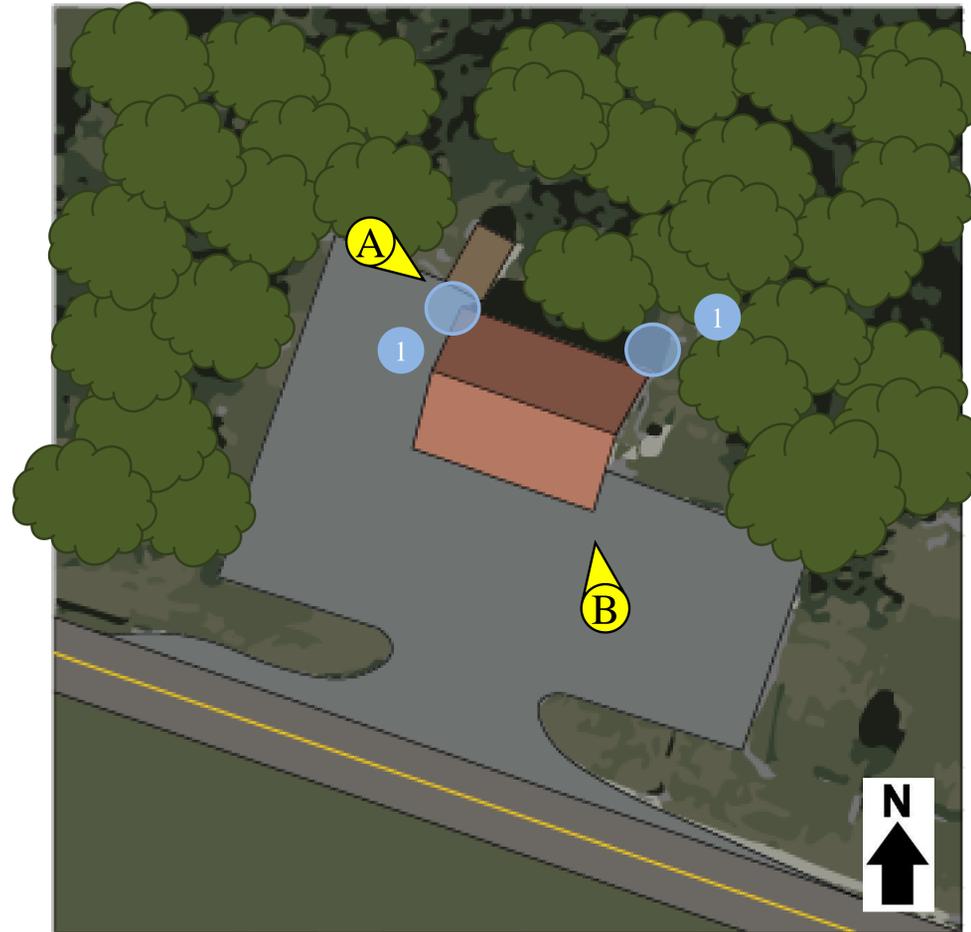
# Hampton Township Impervious Cover Assessment

*Hampton Township Fire Department, 189 Hasley Road*

## PROJECT LOCATION:



## SITE PLAN:



A



B



**1 RAINWATER HARVESTING SYSTEMS:** These systems capture rainwater, mainly from rooftops, in cisterns or rain barrels. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses.

## 1 RAINWATER HARVESTING SYSTEM



Hampton Township Fire Department  
Green Infrastructure Information Sheet

<p><b>Location:</b> 189 Hasley Road Newton, NJ 07860</p>	<p><b>Municipality:</b> Hampton Township</p>
<p><b>Green Infrastructure Description:</b> rain harvesting system (rain barrel/cistern)</p>	<p><b>Subwatershed:</b> Paulins Kill River</p> <p><b>Targeted Pollutants:</b> total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS) in surface runoff</p>
<p><b>Mitigation Opportunities:</b> recharge potential: yes stormwater peak reduction potential: yes TSS removal potential: yes</p>	<p><b>Stormwater Captured and Treated Per Year:</b> rain harvesting system #1: 16,970 gal. rain harvesting system #2: 16,970 gal.</p>
<p><b>Existing Conditions and Issues:</b> A large portion of the site is covered in asphalt which contributes to a higher volume of stormwater runoff and flooding during storms.</p>	
<p><b>Proposed Solution(s):</b> Rainwater can be harvested by installing cisterns near the back corners of the building. The water can then be used for watering gardens, washing vehicles, or for other non-potable uses. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.</p>	
<p><b>Anticipated Benefits:</b> Rain barrels and cisterns can harvest stormwater which can be used for watering plants or other purposes which cuts 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 it is operational (i.e., it would not be used in the winter when there is a chance of freezing).</p>	
<p><b>Possible Funding Sources:</b> Hampton Township mitigation funds from local developers local social and community groups home and school associations</p>	
<p><b>Partners/Stakeholders:</b> Hampton Township local social and community groups local residents Rutgers Cooperative Extension</p>	
<p><b>Estimated Cost:</b> The cisterns would be 1,500 gallons each and cost approximately \$6,000 to purchase and install both.</p>	