RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Reduction Action Plan for Raritan Township, Hunterdon County, New Jersey

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

November 16, 2015

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Introduction

Located in Hunterdon County in central New Jersey, Raritan Township covers approximately 37.7square miles. Figures 1 and 2 illustrate that Raritan Township is dominated by urban land uses. A total of 43.6% of the municipality's land use is classified as urban. Of the urban land in Raritan Township, rural residential is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection's (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Raritan Township into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for Raritan Township. Based upon the 2007 NJDEP land use/land cover data, approximately 8.9% of Raritan Township has impervious cover. This level of impervious cover suggests that the streams in Raritan Township are likely sensitive streams.[1]

Methodology

Raritan Township contains portions of eight subwatersheds (Figure 4). For this impervious cover reduction action plan, projects have been identified in each of these watersheds. Initially, aerial imagery was used to identify potential project sites that contain extensive impervious cover. Field visits were then conducted at each of these potential project sites to determine if a viable option exists to reduce impervious cover or to disconnect impervious surfaces from draining directly to the local waterway or storm sewer system. During the site visit, appropriate green infrastructure practices for the site were determined. Sites that already had stormwater management practices in place were not considered.

[1] 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

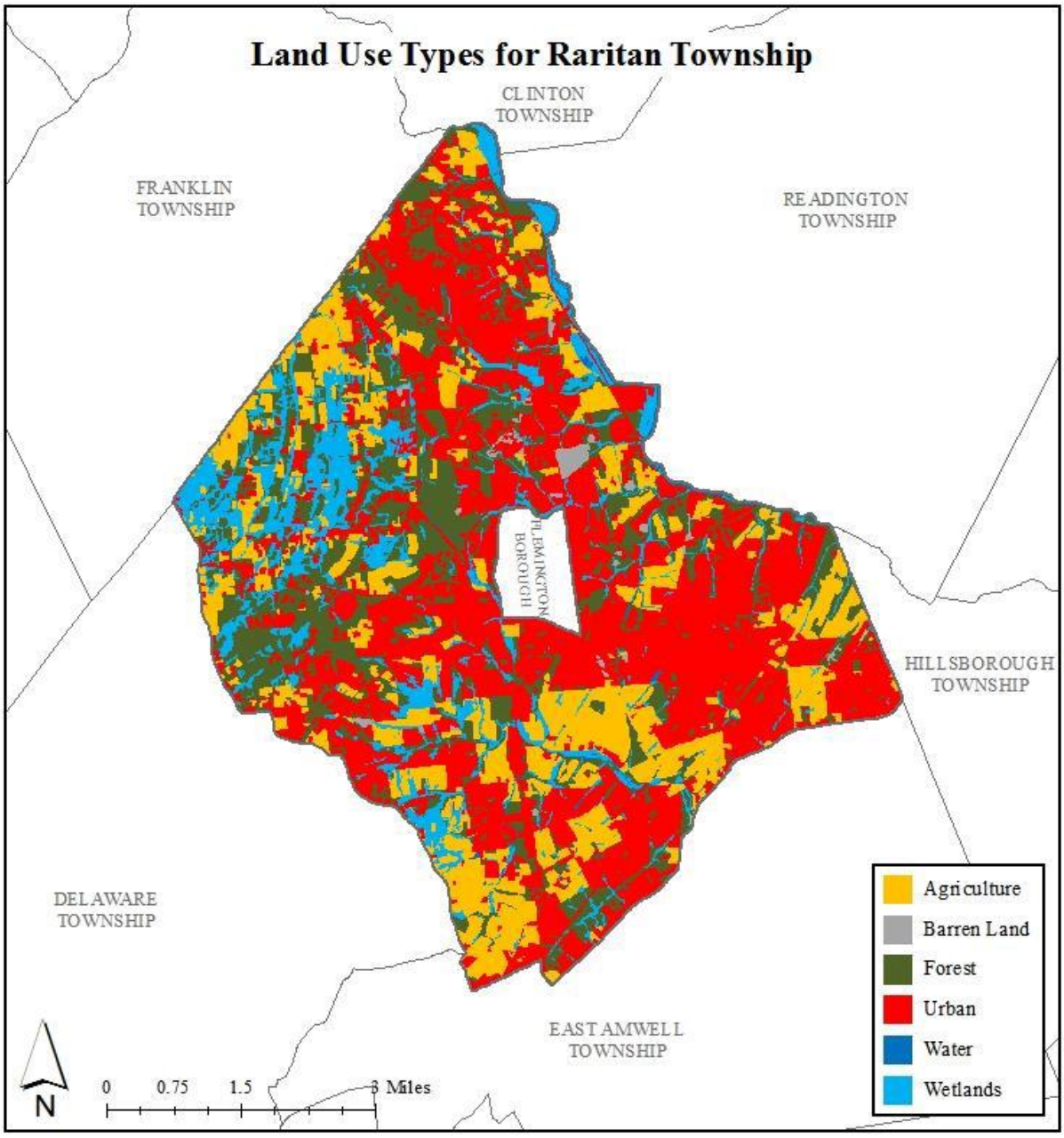


Figure 1: Map illustrating the land use in Raritan Township

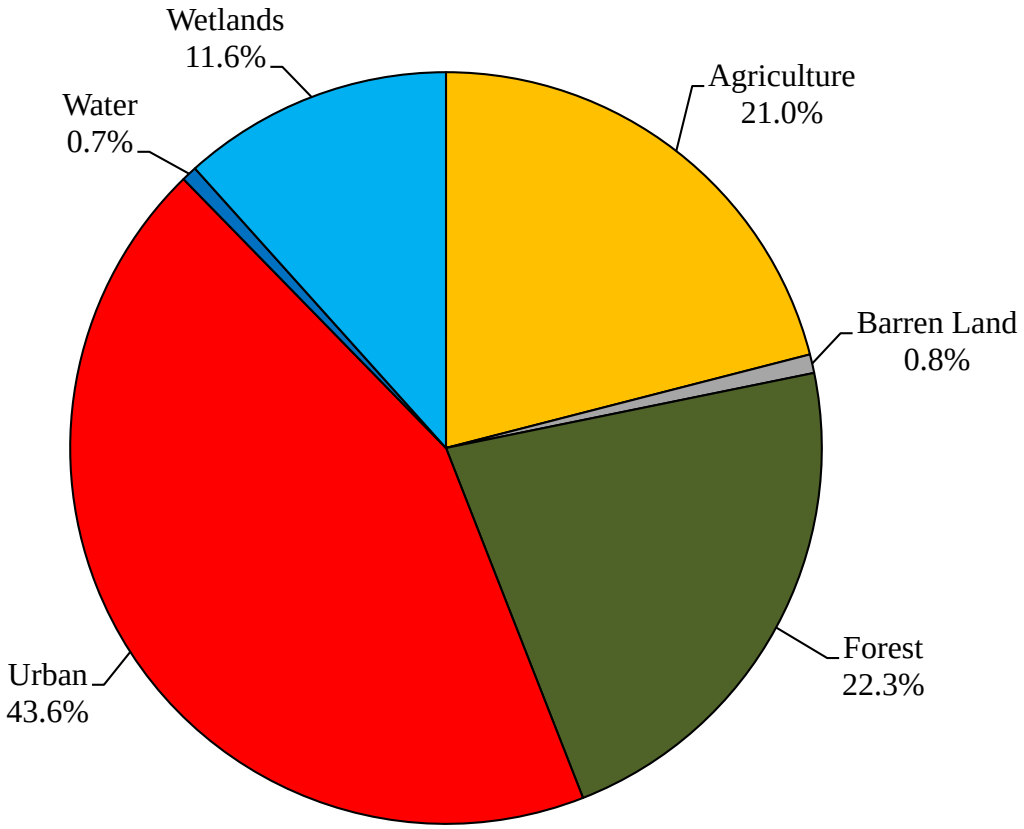


Figure 2: Pie chart illustrating the land use in Raritan Township

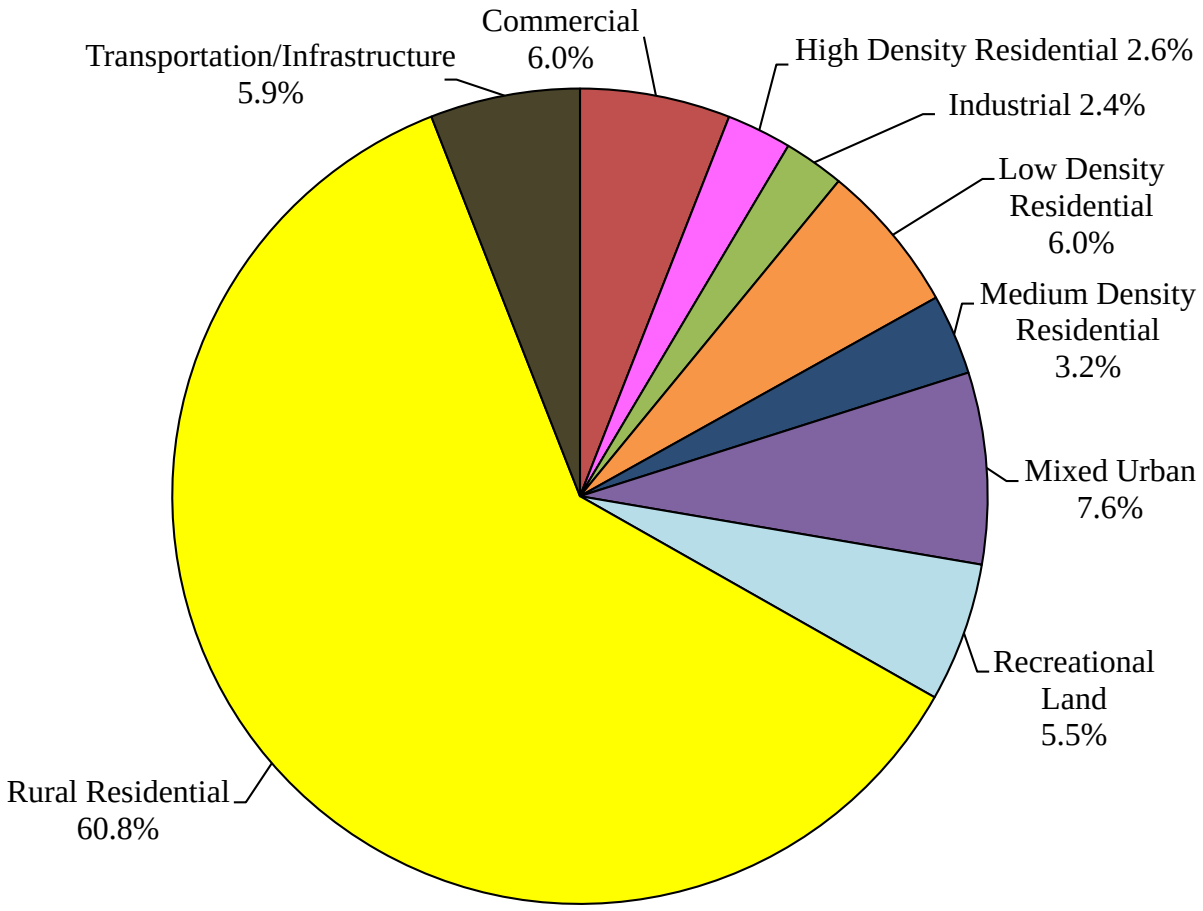


Figure 3: Pie chart illustrating the various types of urban land use in Raritan Township

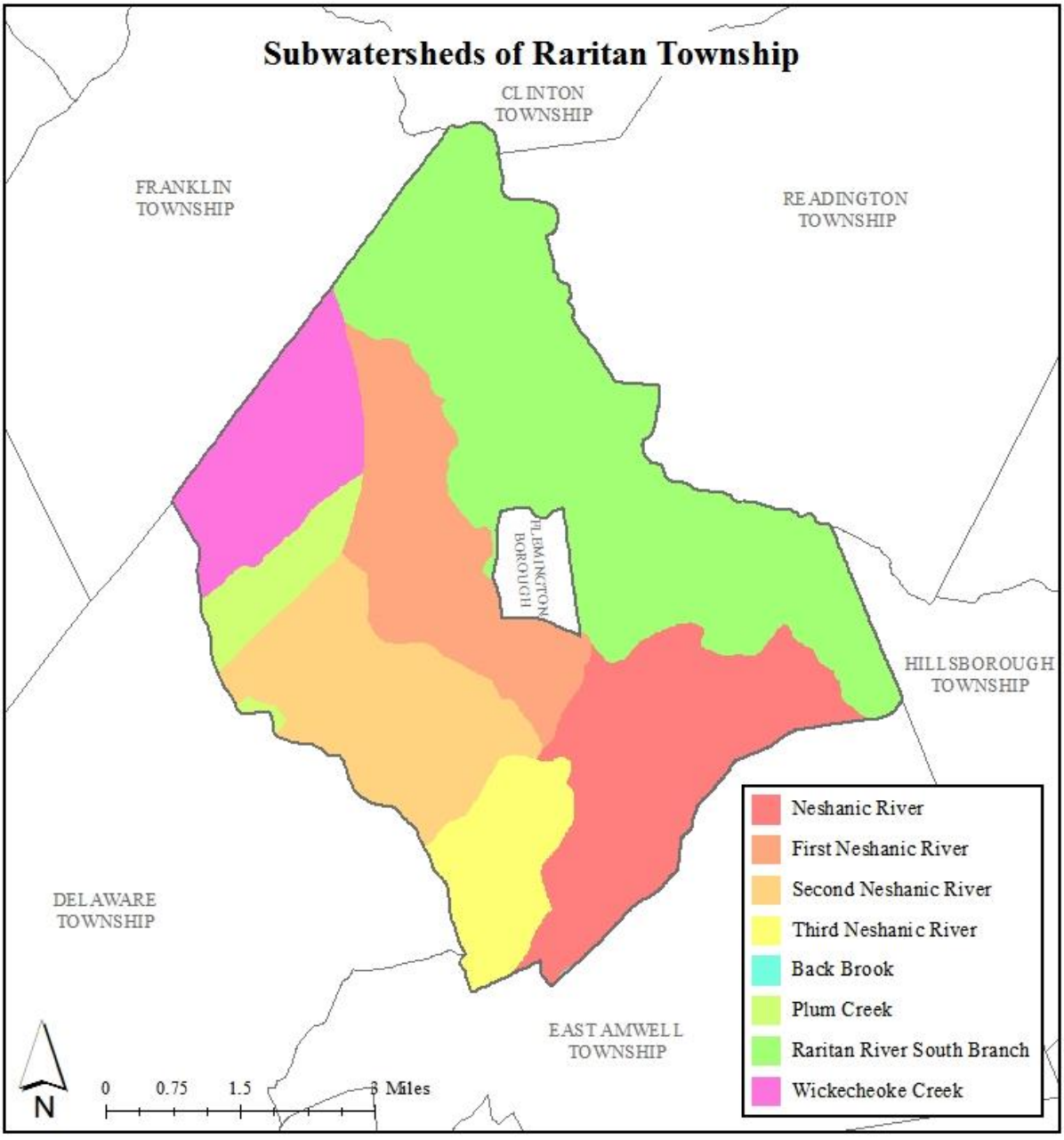


Figure 4: Map of the subwatersheds in Raritan Township

For each potential project site, specific aerial loading coefficients for commercial land use were used to determine the annual runoff loads for total phosphorus (TP), total nitrogen (TN), and total suspended solids (TSS) from impervious surfaces (Table 1). These are the same aerial loading coefficients that NJDEP uses in developing total maximum daily loads (TMDLs) for impaired waterways of the state. The percentage of impervious cover for each site was extracted from the 2007 NJDEP land use/land cover database. For impervious areas, runoff volumes were determined for the water quality design storm (1.25 inches of rain over two-hours) and for the annual rainfall total of 44 inches.

Preliminary soil assessments were conducted for each potential project site identified in Raritan Township using the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey, which utilizes regional and statewide soil data to predict soil types in an area. Several key soil parameters were examined (e.g., natural drainage class, saturated hydraulic conductivity of the most limiting soil layer (K_{sat}), depth to water table, and hydrologic soil group) to evaluate the suitability of each site's soil for green infrastructure practices. In cases where multiple soil types were encountered, the key soil parameters were examined for each soil type expected at a site.

For each potential project site, drainage areas were determined for each of the green infrastructure practices proposed at the site. These green infrastructure practices were designed to manage the 2-year design storm, enabling these practices to capture 95% of the annual rainfall. Runoff volumes were calculated for each proposed green infrastructure practice. The reduction in TSS loading was calculated for each drainage area for each proposed green infrastructure practice using the aerial loading coefficients in Table 1. The maximum volume reduction in stormwater runoff for each green infrastructure practice for a storm was determined by calculating the volume of runoff captured from the 2-year design storm. For each green infrastructure practice, peak discharge reduction potential was determined through hydrologic modeling in HydroCAD. For each green infrastructure practice, a cost estimate is provided. These costs are based upon the square footage of the green infrastructure practice and the real cost of green infrastructure practice implementation in New Jersey.

Table 1: Aerial Loading Coefficients[2]

Land Cover	TP load (lbs/acre/yr)	TN load (lbs/acre/yr)	TSS load (lbs/acre/yr)
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agriculture	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

[2] New Jersey Department of Environmental Protection (NJDEP), Stormwater Best Management Practice Manual, 2004.

Green Infrastructure Practices

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 practices 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[3]. A wide range of green infrastructure practices have been evaluated for the potential project sites in Raritan Township. Each practice is discussed below.

Disconnected downspouts

This is often referred to as simple disconnection. A downspout is simply disconnected, prevented from draining directly to the roadway or storm sewer system, and directed to discharge water to a pervious area (i.e., lawn).

Pervious pavements

There are several types of permeable pavement systems including porous asphalt, pervious concrete, permeable pavers, and grass pavers. These surfaces are hard and support vehicle traffic but also allow water to infiltrate through the surface. They have an underlying stone layer to store stormwater runoff and allow it to slowly seep into the ground.




[3] 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

Bioretention systems/rain gardens

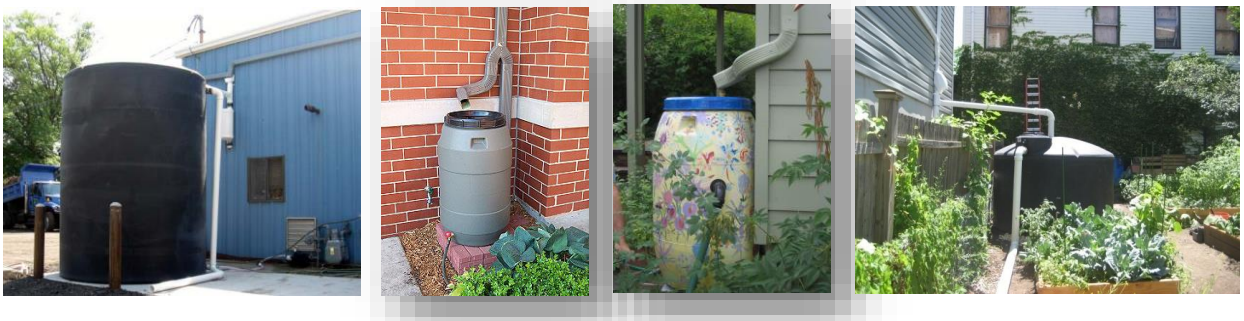
These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating a wildlife habitat while managing stormwater runoff. Bioretention systems also can be used in soils that do not quickly infiltrate by incorporating an underdrain into the system.

Downspout planter boxes

These are wooden boxes with plants installed at the base of a downspout that provide an opportunity to beneficially reuse rooftop runoff.

Rainwater harvesting systems (cistern or rain barrel)

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.



Bioswale

Bioswales are landscape features that convey stormwater from one location to another while removing pollutants and providing water an opportunity to infiltrate.

Stormwater planters

Stormwater planters are vegetated structures that are built into the sidewalk to intercept stormwater runoff from the roadway or sidewalk. Many of these planters are designed to allow the water to infiltrate into the ground while others are designed simply to filter the water and convey it back into the stormwater sewer system.

Tree filter boxes

These are pre-manufactured concrete boxes that contain a special soil mix and are planted with a tree or shrub. They filter stormwater runoff but provide little storage capacity. They are typically designed to quickly filter stormwater and then discharge it to the local sewer system.

Potential Project Sites

Attachment 1 contains information on potential project sites where green infrastructure practices could be installed. The recommended green infrastructure practice and the drainage area that the green infrastructure practice can treat are identified for each potential project site. For each practice, the recharge potential, TSS removal potential, maximum volume reduction potential per storm, and the peak reduction potential are provided. This information is also provided so that proposed development projects that cannot satisfy the New Jersey stormwater management requirements for major development can use one of the identified projects to offset a stormwater management deficit. [4]

[4] New Jersey Administrative Code, N.J.A.C. 7:8, Stormwater Management, Statutory Authority: N.J.S.A. 12:5-3, 13:1D-1 et seq., 13:9A-1 et seq., 13:19-1 et seq., 40:55D-93 to 99, 58:4-1 et seq., 58:10A-1 et seq., 58:11A-1 et seq. and 58:16A-50 et seq., *Date last amended: April 19, 2010*.

Conclusion

This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented by a wide variety of people such as boy scouts, girl scouts, school groups, faith-based groups, social groups, watershed groups, and other community groups.

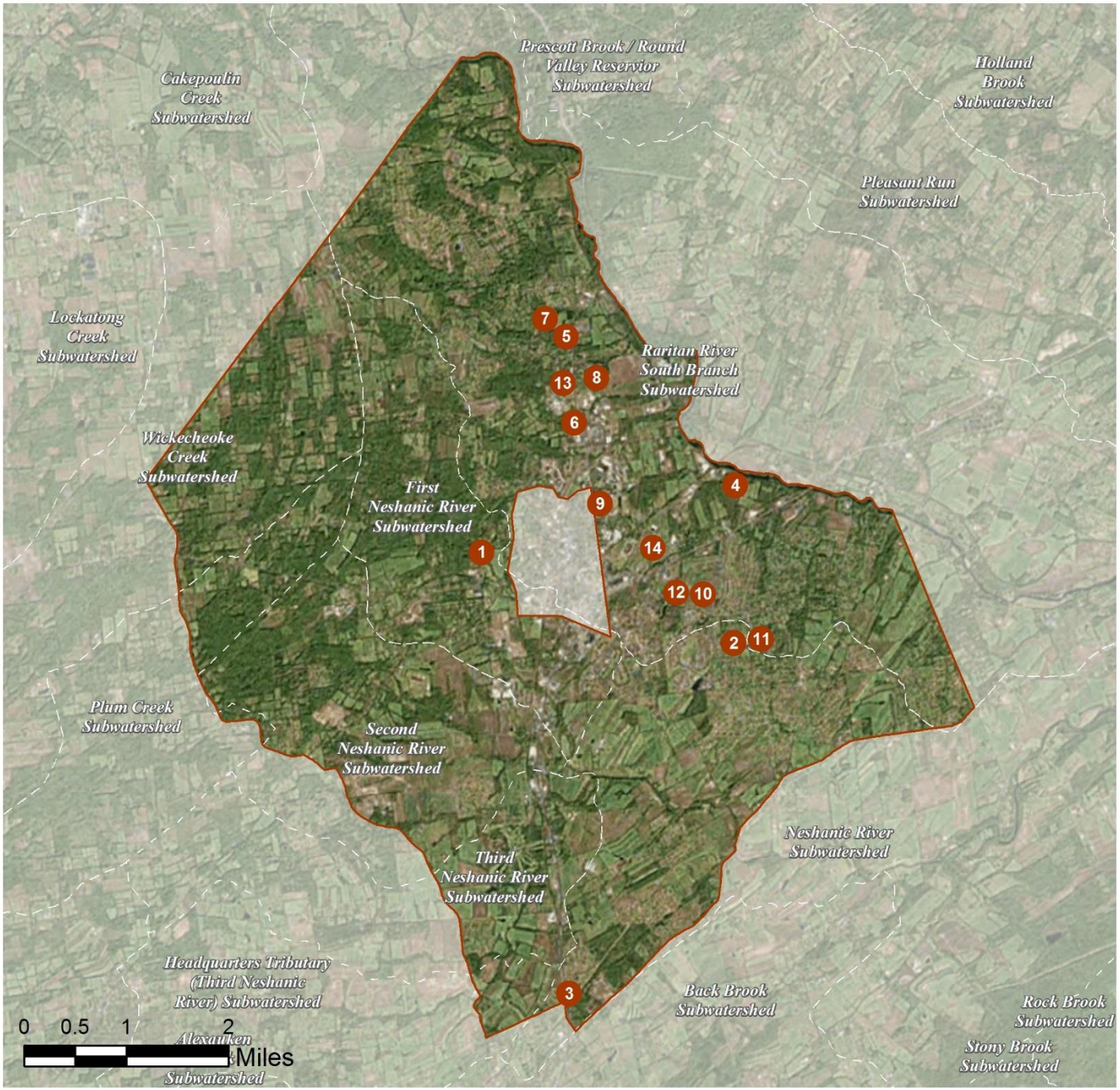
Additionally, development projects that are in need of providing off-site compensation for stormwater impacts can use the projects in this plan as a starting point. The municipality can quickly convert this impervious cover reduction action plan into a stormwater mitigation plan and incorporate it into the municipal stormwater control ordinance.

a. Overview Map of the Project

RARITAN TOWNSHIP: CLIMATE RESILIENT GREEN INFRASTRUCTURE FOR THE RARITAN BASIN

b. Green Infrastructure Sites

RARITAN TOWNSHIP: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE FIRST NESHANIC RIVER SUBWATERSHED:

1. Mine Brook Park

SITES WITHIN THE NESHANIC RIVER SUBWATERSHED:

2. Barley Sheaf Elementary School
3. Calvary Orthodox Presbyterian

SITES WITHIN THE RARITAN RIVER SOUTH BRANCH SUBWATERSHED:

4. Aspen Ice At Flemington
5. Central Hunterdon Baptist Church
6. Flemington Elks Lodge
7. Francis A. Desmares Elementary School
8. Hunterdon Care Center
9. Hunterdon Central High School
10. J.P. Case Middle School
11. Loyal Order of Moose
12. Saint Anna Greek Orthodox Church
13. Saint Paul Lutheran Church
14. US Post Office

c. Proposed Green Infrastructure Concepts

MINE BROOK PARK

Subwatershed: First Neshanic River

Site Area: 580,124 sq. ft.

Address: 20-24 Old Crouton Road
Flemington, NJ 08822

Block and Lot: Block 49, Lot 2.01

At the south end of the park a rain garden can be installed near the parking lot to increase biodiversity, capture, treat, and infiltrate parking lot runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
8	46,561	2.2	23.5	213.8	0.036	1.28

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.283	47	21,430	0.80	2,865	$14,325

GREEN INFRASTRUCTURE RECOMMENDATIONS

Mine Brook Park

- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

BARLEY SHEAF ELEMENTARY SCHOOL

Subwatershed: Neshanic River

Site Area: 1,374, 421 sq. ft.

Address: 80 Barley Sheaf Road
Flemington, NJ 08822

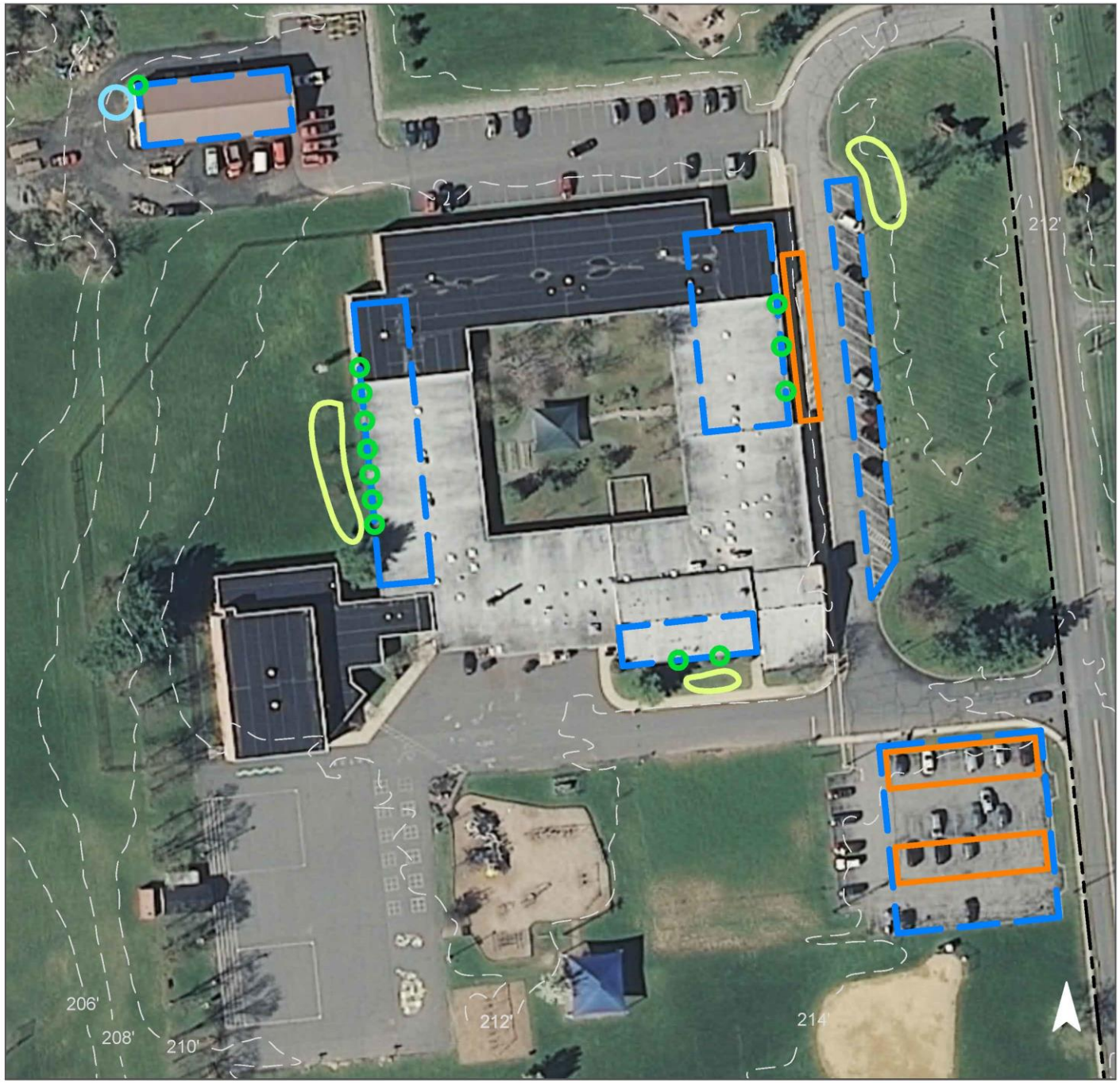
Block and Lot: Block 72.15, Lot 25

Rainwater can be harvested by installing a cistern at the garage in the northwest corner of the site for cleaning school busses or for conducting car wash fundraisers. Bioretention systems can be built around the school to capture, treat, and infiltrate rooftop and parking lot runoff. Pervious pavement can be used to replace an existing sidewalk as well as a couple of rows of parking spaces to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
19	267,646	12.9	135.2	1,228.9	0.209	7.34

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.350	59	26,509	0.99	3,130	$15,650
Pervious pavements	0.528	88	40,003	1.50	6,202	$155,050
Rainwater harvesting systems	0.102	17	4,000	0.29	4,000 (gal)	$8,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Barley Sheaf Elementary School

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

CALVARY ORTHODOX PRESBYTERIAN

Subwatershed: Neshanic River

Site Area: 257,577 sq. ft.

Address: 24 U.S. 202
Ringoes, NJ 08551

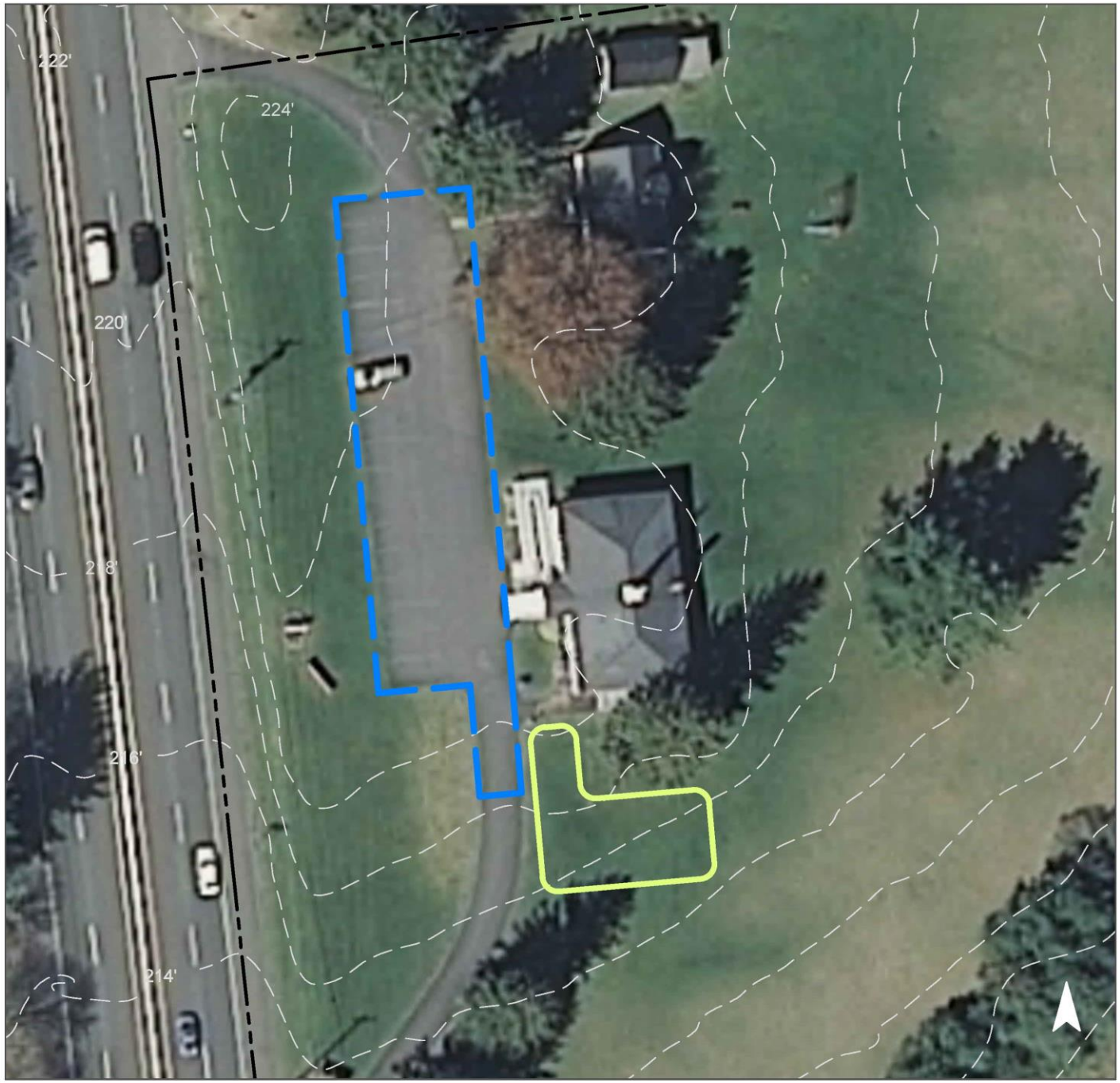
Block and Lot: Block 97, Lot 19

On the east side of the driveway a rain garden can be installed to increase biodiversity, capture, treat, and infiltrate parking lot runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
9	23,889	1.2	12.1	109.7	0.019	0.66

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.147	25	11,115	0.42	1,408	$7,040

GREEN INFRASTRUCTURE RECOMMENDATIONS



Calvary Orthodox Presbyterian

- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

ASPEN ICE AT FLEMINGTON

Subwatershed: Raritan River South Branch

Site Area: 471,852 sq. ft.

Address: 426 Case Boulevard
Flemington, NJ 08822

Block and Lot: Block 36.01, Lot 17

Porous asphalt can be installed to replace existing parking spaces, which will provide an opportunity for parking lot and roof runoff to infiltrate. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
53	250,762	12.1	126.6	1,151.3	0.195	6.88

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavements	1.721	288	13,038	0.49	12,956	$323,900

GREEN INFRASTRUCTURE RECOMMENDATIONS

Aspen Ice at Flemington

- disconnected downspouts
- pervious pavements
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

CENTRAL HUNTERDON BAPTIST CHURCH

Subwatershed: Raritan River South Branch

Site Area: 1,090,880 sq. ft.

Address: 325 New Jersey 31
Flemington, NJ 08822

Block and Lot: Block 8, Lot 16

There is a drainage basin behind the church. Bioretention systems can be installed to capture, treat, and infiltrate parking lot runoff as well as reduce the volume of stormwater entering the sewer system. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
6	68,010	3.3	34.3	312.3	0.053	1.87

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.672	112	50,901	1.91	6,326	$31,630

GREEN INFRASTRUCTURE RECOMMENDATIONS

Central Hunterdon Baptist Church

- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

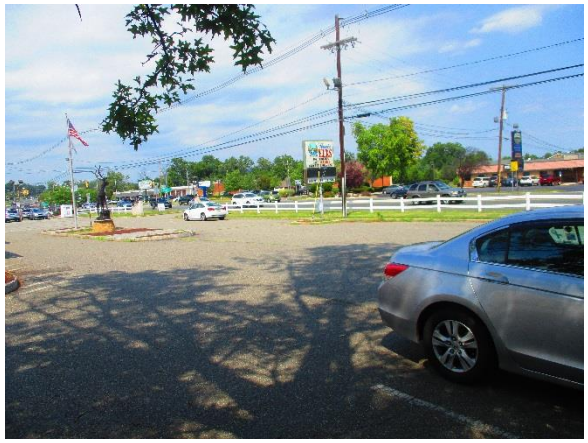
FLEMINGTON ELKS LODGE

Subwatershed: Raritan River South Branch

Site Area: 100,210 sq. ft.

Address: 165 New Jersey 31
Flemington, NJ 08822

Block and Lot: Block 15, Lot 24

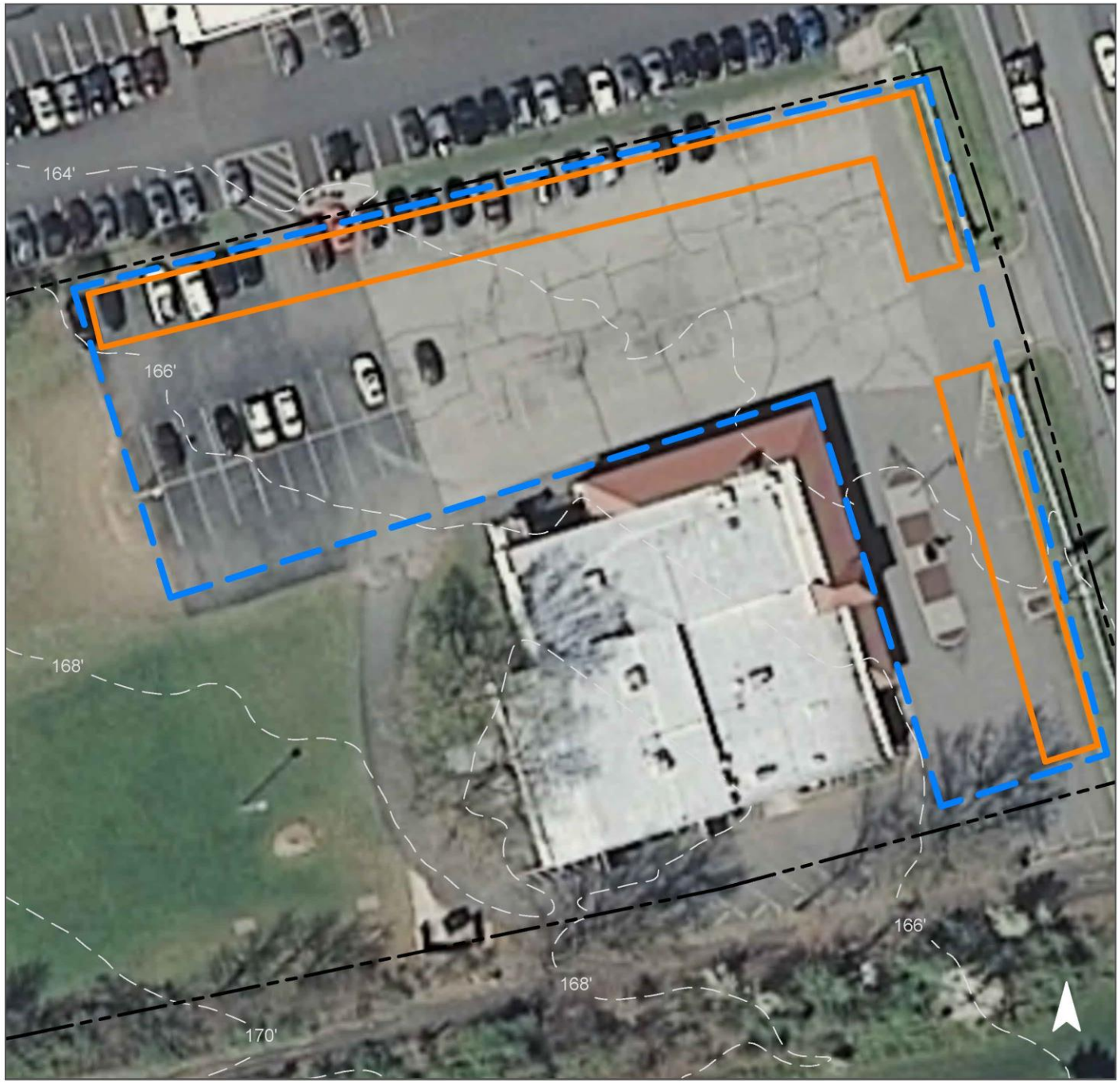


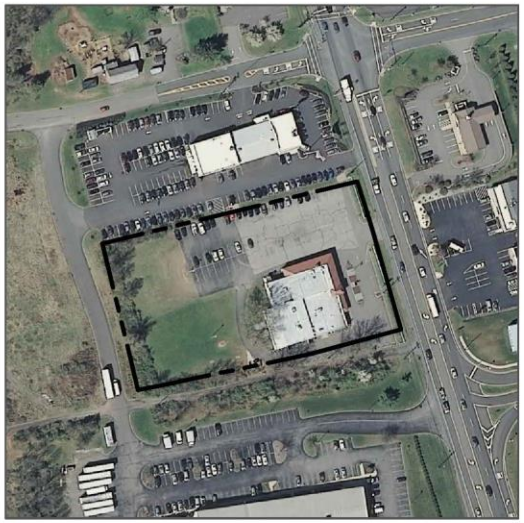
The parking lot showed signs of erosion at the time of the assessment. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
64	63,959	3.1	32.3	293.7	0.050	1.75

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavements	0.940	157	71,247	2.67	8,109	$202,725

GREEN INFRASTRUCTURE RECOMMENDATIONS





Flemington Elks Lodge

- pervious pavements
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

FRANCIS A. DESMARES ELEMENTARY SCHOOL

Subwatershed: **Raritan River South Branch**

Site Area: **1,368,523 sq. ft.**

Address: **16 Old Clinton Road**
Flemington, NJ 08822

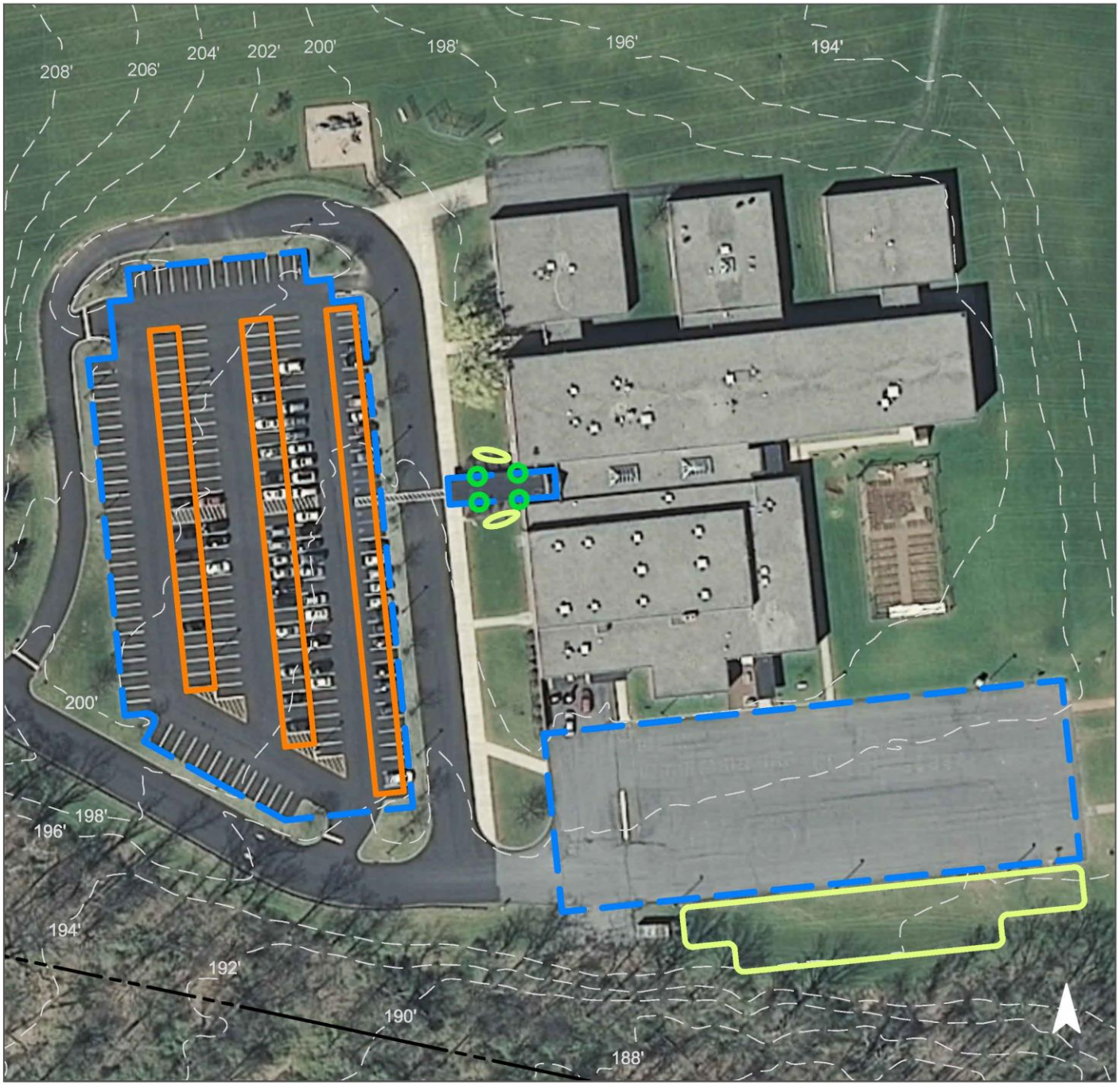
Block and Lot: **Block 8, Lot 8.03**

The front entrance can have two rain gardens installed on either side to capture, treat, and infiltrate runoff from the roof. A third rain garden can be installed to mange runoff generated by the parking lot located south of the school. Parking space can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
18	239,641	11.6	121.0	1,100.3	0.187	6.57

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	1.072	179	81,233	3.05	10,539	$52,695
Pervious pavements	1.594	267	120,765	4.53	15,646	$391,150

GREEN INFRASTRUCTURE RECOMMENDATIONS



Francis A. Desmares Elementary School

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

HUNTERDON CARE CENTER

Subwatershed: Raritan River South Branch

Site Area: 709,844 sq. ft.

Address: 1 Leisure Court
Flemington, NJ 08822

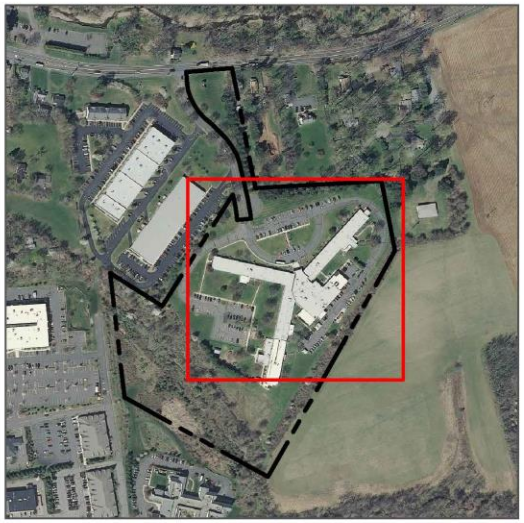
Block and Lot: Block 16, Lot 14.01

Bioretention systems can be installed to capture, treat, and infiltrate rooftop runoff. Rows of parking spaces in the lot located in the southwest corner of the site can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
26	181,809	8.8	91.8	834.8	0.142	4.99

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.125	21	9,455	0.36	1,567	$7,835
Pervious pavements	0.684	114	51,806	1.94	6,885	$172,125

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hunterdon Care Center

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

HUNTERDON CENTRAL HIGH SCHOOL

Subwatershed: Raritan River South Branch

Site Area: 3,319,613 sq. ft.

Address: 84 New Jersey 31
Flemington, NJ 08822

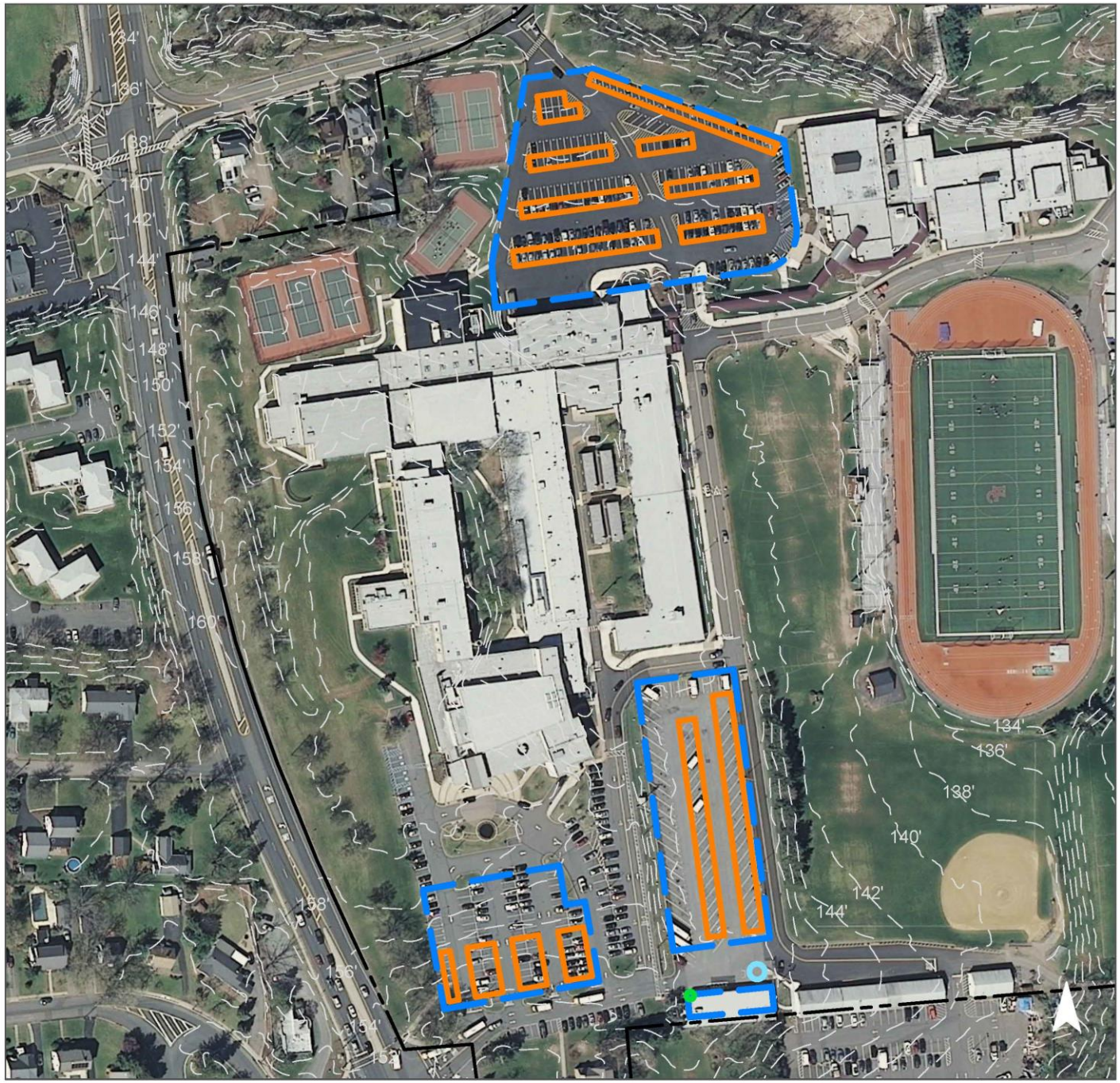
Block and Lot: Block 27, Lot 3

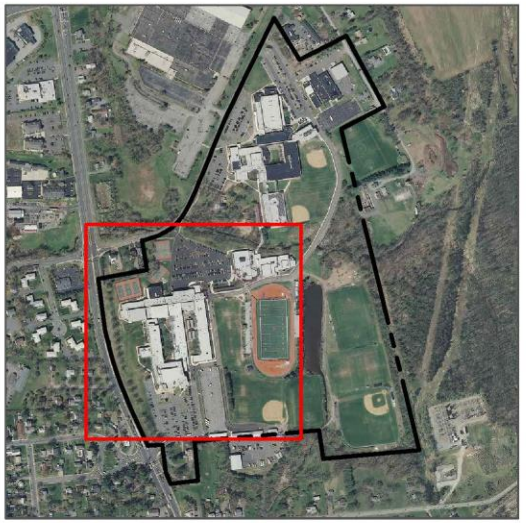
The numerous large parking lots on the site can have multiple rows of parking spaces replaced with porous asphalt to infiltrate stormwater runoff. Rainwater can be harvested by installing a cistern at a building located south of the school. The water can be used for cleaning school busses or for conducting car wash fundraisers. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
39	1,282,566	61.8	647.8	5,888.7	0.999	35.18

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavements	7.534	1,261	570,784	21.43	70,107	$1,752,675
Rainwater harvesting systems	0.086	14	3,000	0.24	3,000 (gal)	$6,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



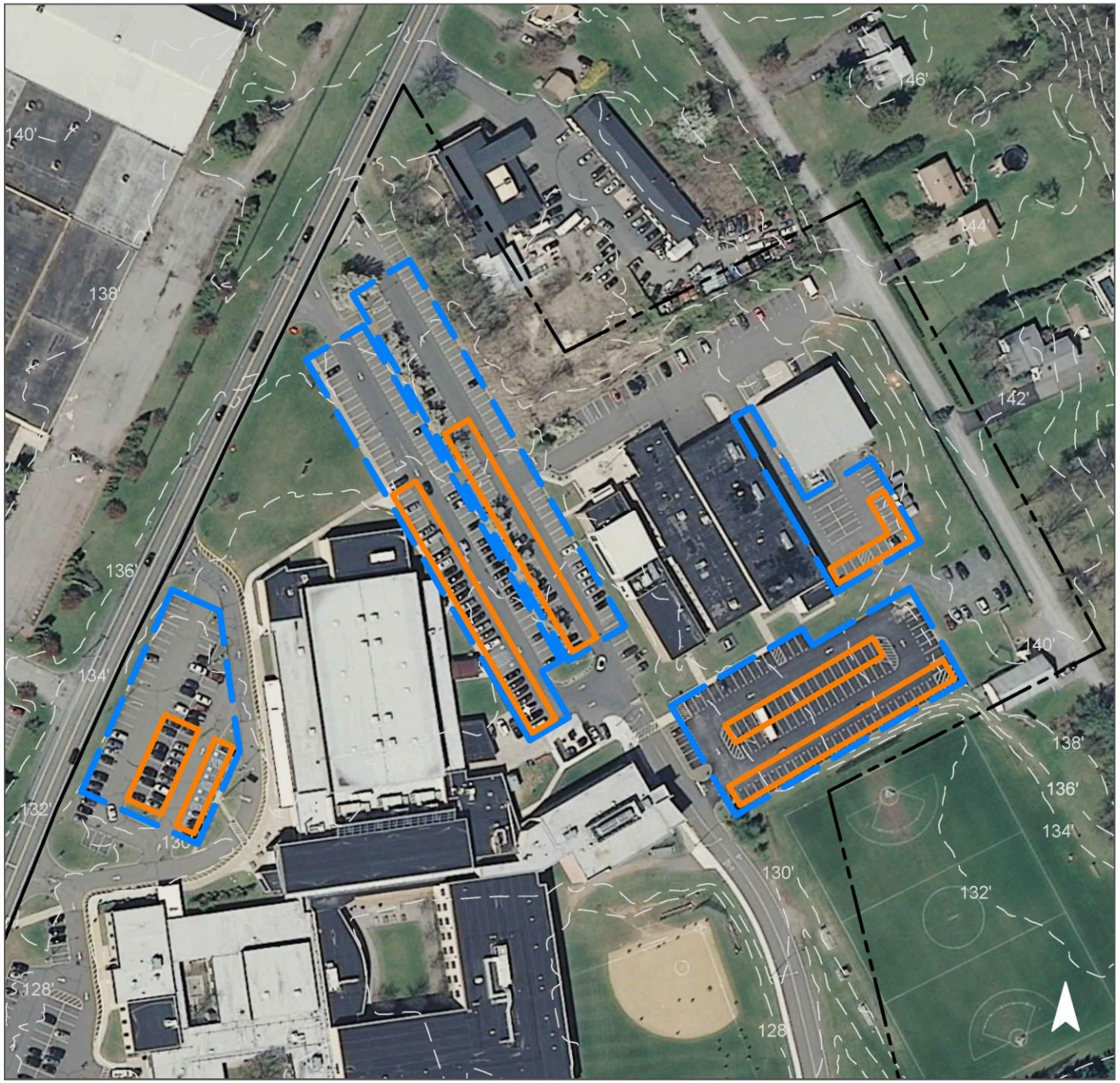


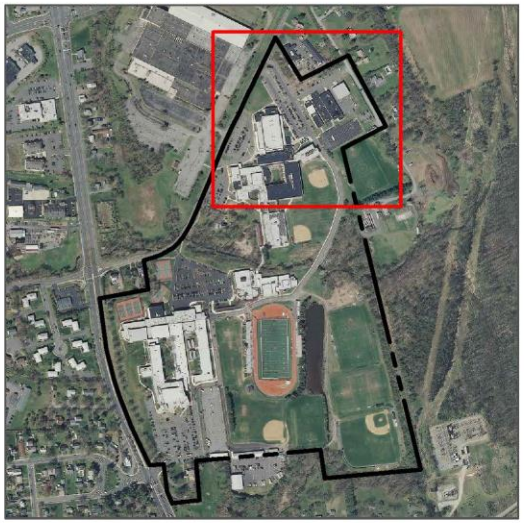
Hunterdon Central High School Lower

- downspout disconnection
- pervious pavements
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 100' 200'

GREEN INFRASTRUCTURE RECOMMENDATIONS





Hunterdon Central High School Upper

- pervious pavements
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 75' 150'

J.P. CASE MIDDLE SCHOOL

Subwatershed: Raritan River South Branch

Site Area: 1,781,369 sq. ft.

Address: 301 Case Boulevard
Flemington, NJ 08822

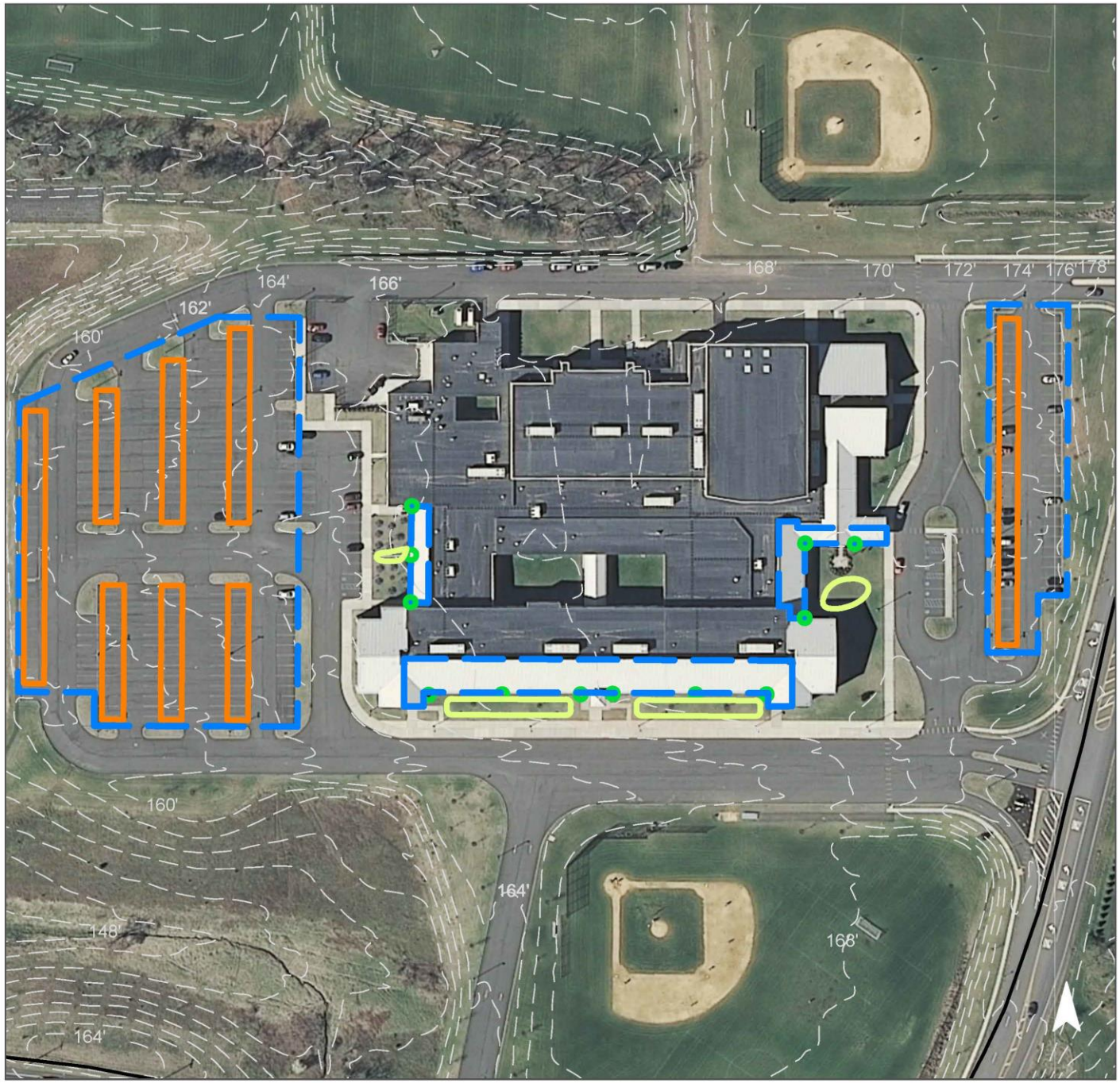
Block and Lot: Block 40, Lot 5.03

Bioretention systems can be installed to capture, treat, and infiltrate rooftop runoff. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
27	489,612	23.6	247.3	2,248.0	0.381	13.43

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.474	79	35,889	1.35	4,944	$24,720
Pervious pavements	3.249	544	246,144	9.24	29,638	$740,950

GREEN INFRASTRUCTURE RECOMMENDATIONS



J.P. Case Middle School

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 75' 150'

LOYAL ORDER OF MOOSE

Subwatershed: Raritan River South Branch

Site Area: 84,121 sq. ft.

Address: 81 Barley Sheaf Road
Flemington, NJ 08822

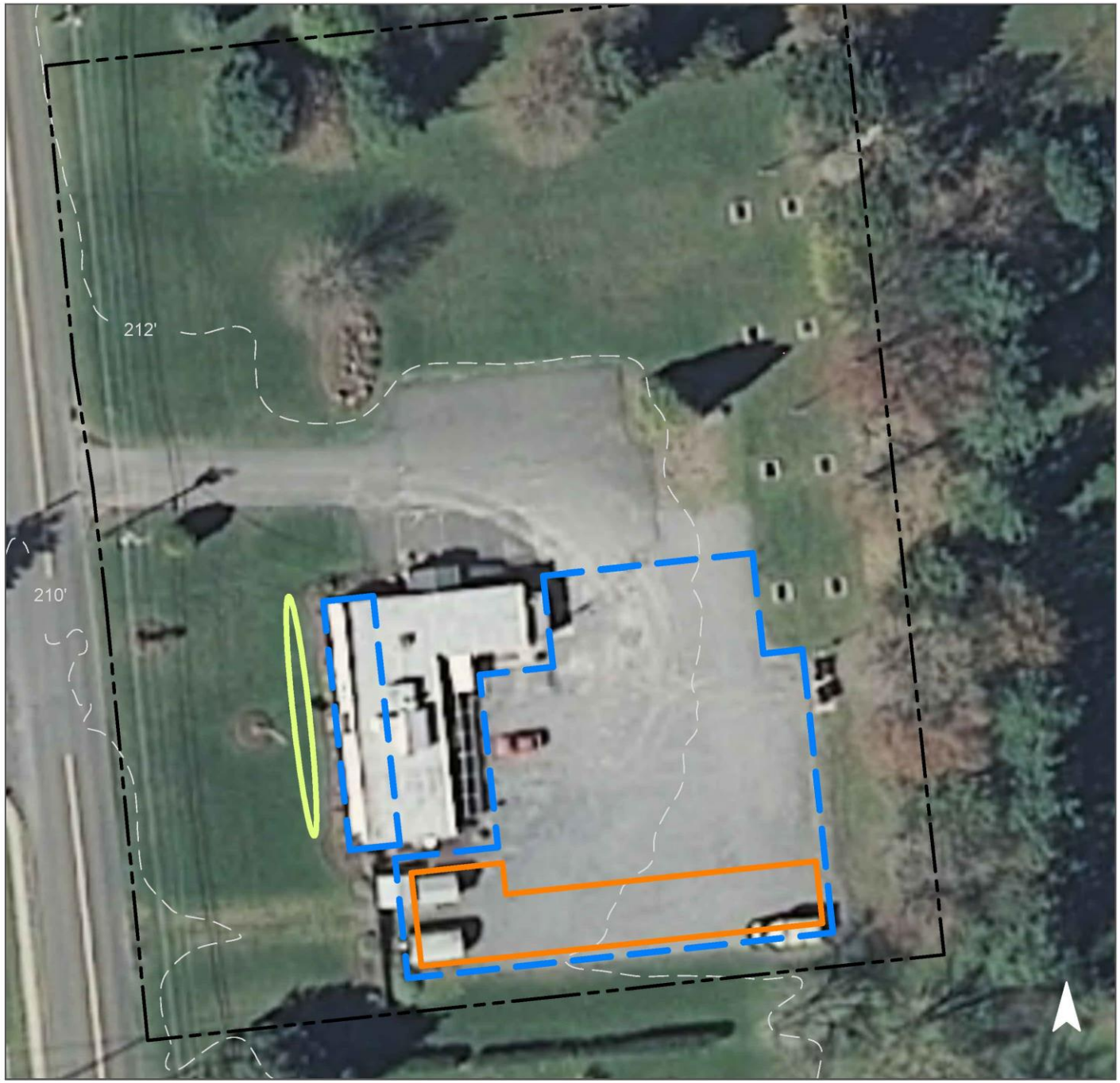
Block and Lot: Block 79.04, Lot 52

Pervious pavement can be used to replace a portion of the parking lot to provide stormwater with an opportunity to infiltrate. On the west side of the building a bioretention system can be installed to capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
32	26,763	1.3	13.5	122.9	0.021	0.73

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.035	6	2,663	0.10	331	$1,655
Pervious pavements	0.354	59	26,853	1.01	3,017	$75,425

GREEN INFRASTRUCTURE RECOMMENDATIONS



Loyal Order of Moose

- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

SAINT ANNA GREEK ORTHODOX CHURCH

Subwatershed: Raritan River South Branch

Site Area: 470,053 sq. ft.

Address: 85 Voorhees Corner Road
Flemington, NJ 08822

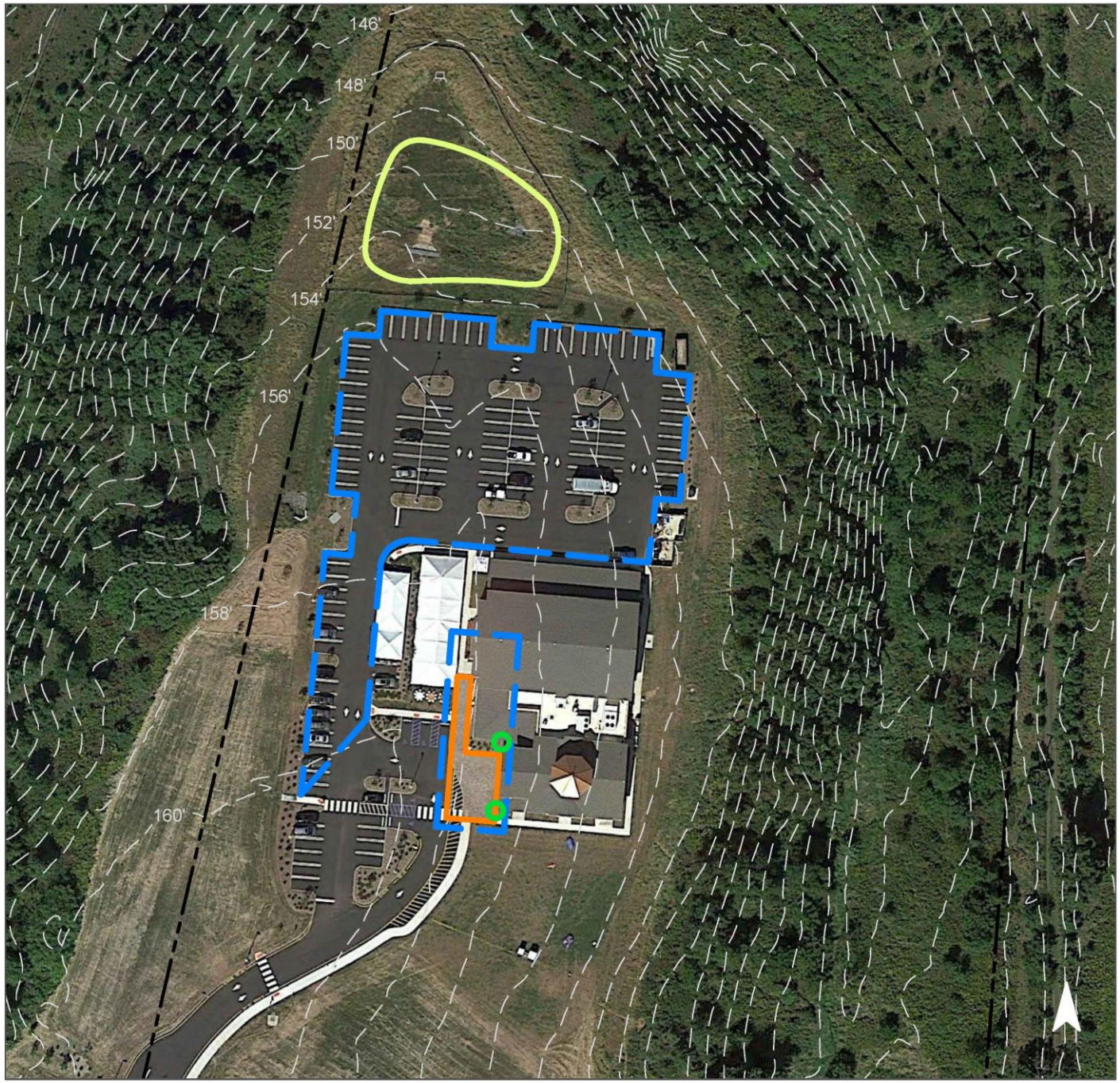
Block and Lot: Block 40, Lot 5.02

A bioretention system can be installed north of the parking lot to capture, treat, and infiltrate runoff generated by the parking lot. The brick walkway can be replaced with pervious pavement to capture and infiltrate roof runoff. A preliminary soil assessment suggests that the soil is suitable for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
20	96,180	4.6	48.6	441.6	0.075	2.64

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.953	160	72,227	2.71	9,226	$46,130
Pervious pavements	0.149	25	11,272	0.42	1,837	$45,925

GREEN INFRASTRUCTURE RECOMMENDATIONS



Saint Anna Greek Orthodox Church

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

SAINT PAUL LUTHERAN CHURCH

Subwatershed: Raritan River South Branch

Site Area: 404,645 sq. ft.

Address: 201 New Jersey 31
Flemington, NJ 08822

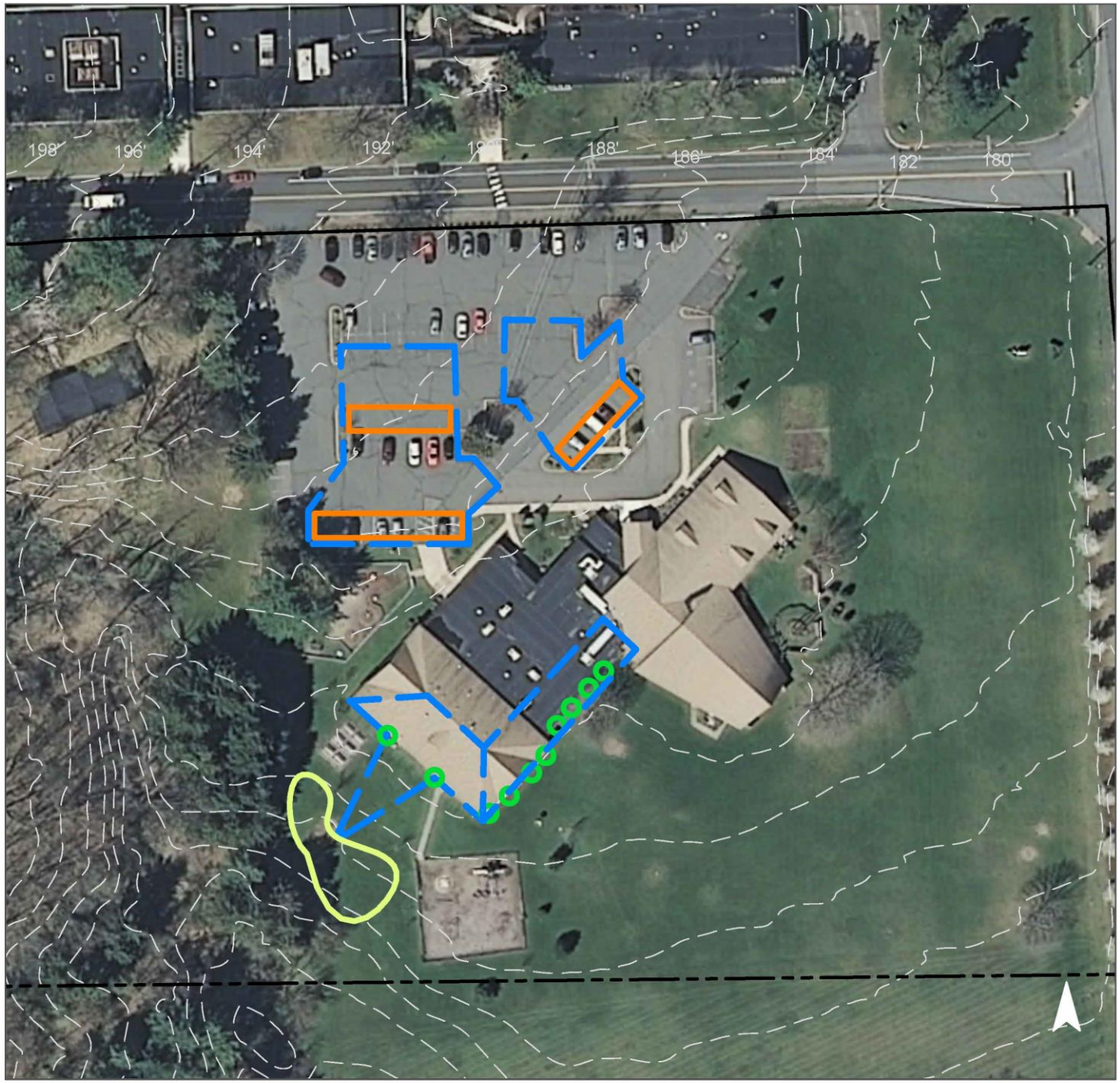
Block and Lot: Block 15.07, Lot 2

A detention basin located south of the church can be converted into a bioretention system for increased infiltration and biodiversity. It would be able to capture, treat, and infiltrate rooftop runoff by disconnecting and redirecting multiple downspouts. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
21	86,086	4.2	43.5	395.3	0.067	2.36

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.238	40	18,012	0.68	3,263	$16,315
Pervious pavements	0.445	74	33,705	1.27	3,460	$86,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Saint Paul Lutheran Church

- disconnected downspouts
- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 50' 100'

US POST OFFICE

Subwatershed: Raritan River South Branch

Site Area: 86,823 sq. ft.

Address: 4 Kings Court
Flemington, NJ 08822

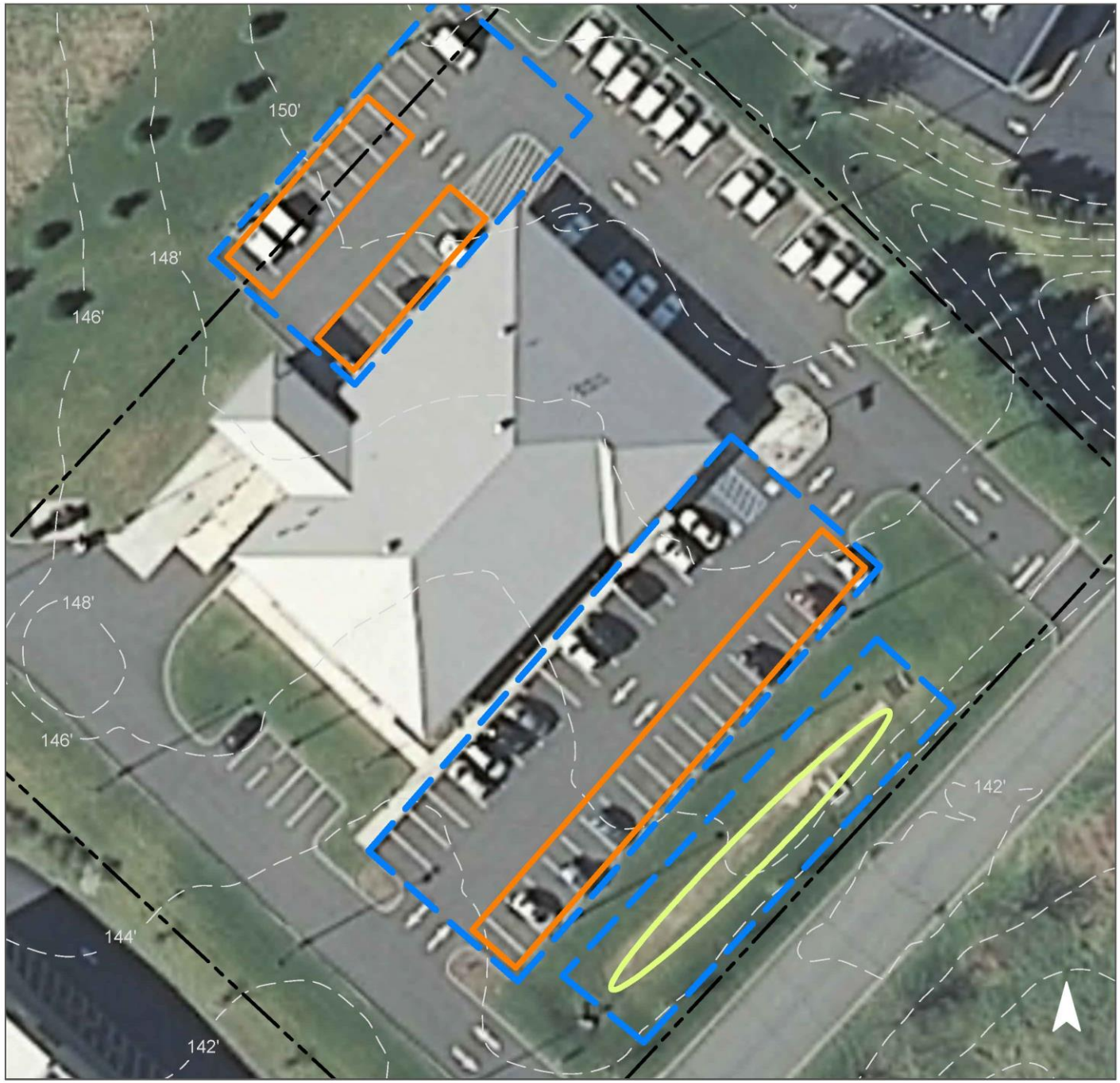
Block and Lot: Block 36.03, Lot 9

Stormwater is currently directed to an existing detention basin. The detention basin can be converted into a bioretention system to increase infiltration of stormwater from connected downspouts and increase biodiversity. Parking spaces can be replaced with porous asphalt to infiltrate water before it gets to the detention basin. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
71	61,896	3.0	31.3	284.2	0.048	1.70

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	0.133	22	10,038	0.38	1,243	$6,215
Pervious pavements	0.148	25	11,220	0.42	1,802	$45,050

GREEN INFRASTRUCTURE RECOMMENDATIONS



US Post Office

- pervious pavements
- bioretention / rain gardens
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 25' 50'

d. Summary of Existing Conditions

Summary of Existing Site Conditions

Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	Existing Annual Loads TP (lb/yr)	Existing Annual Loads TN (lb/yr)	Existing Annual Loads TSS (lb/yr)	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
FIRST NESHANIC RIVER SUBWATERSHED	**13.32**	**580,124**			**2.2**	**23.5**	**213.8**		**1.07**	**46,561**	**0.036**	**1.28**
Mine Brook Park												
Total Site Info	13.32	580,124	49	2.01	2.2	23.5	213.8	8	1.07	46,561	0.036	1.28
NESHANIC RIVER SUBWATERSHED	**37.47**	**1,631,998**			**14.1**	**147.2**	**1,338.5**		**6.69**	**291,535**	**0.227**	**8.00**
Barley Sheaf Elementary School												
Total Site Info	31.55	1,374,421	72.15	25	12.9	135.2	1,228.9	19	6.14	267,646	0.209	7.34
Calvary Orthodox Presbyterian												
Total Site Info	5.91	257,577	97	19	1.2	12.1	109.7	9	0.55	23,889	0.019	0.66
RARITAN RIVER SB SUBWATERSHED	**227.00**	**9,887,933**			**137.3**	**1,438.0**	**13,072.9**		**65.36**	**2,847,284**	**2.219**	**78.09**
Aspen Ice At Flemington												
Total Site Info	10.83	471,852	36.01	17	12.1	126.6	1,151.3	53	5.76	250,762	0.195	6.88
Central Hunterdon Baptist Church												
Total Site Info	25.04	1,090,880	8	16	3.3	34.3	312.3	6	1.56	68,010	0.053	1.87
Flemington Elks Lodge												
Total Site Info	2.30	100,210	15	24	3.1	32.3	293.7	64	1.47	63,959	0.050	1.75
Francis A. Desmares Elementary School												
Total Site Info	31.42	1,368,523	8	8.03	11.6	121.0	1,100.3	18	5.50	239,641	0.187	6.57
Hunterdon Care Center												
Total Site Info	16.30	709,844	16	14.01	8.8	91.8	834.8	26	4.17	181,809	0.142	4.99
Hunterdon Central High School												
Total Site Info	76.21	3,319,613	27	3	61.8	647.8	5,888.7	39	29.44	1,282,566	0.999	35.18
J.P. Case Middle School												
Total Site Info	40.89	1,781,369	40	5.03	23.6	247.3	2,248.0	27	11.24	489,612	0.381	13.43

Summary of Existing Site Conditions

Subwatershed/Site Name/Total Site Info/GI Practice	Area (ac)	Area (SF)	Block	Lot	Existing Annual Loads TP (lb/yr)	Existing Annual Loads TN (lb/yr)	Existing Annual Loads TSS (lb/yr)	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
Loyal Order of Moose												
Total Site Info	1.93	84,121	79.04	52	1.3	13.5	122.9	32	0.61	26,763	0.021	0.73
Saint Anna Greek Orthodox Church												
Total Site Info	10.79	470,053	40	5.02	4.6	48.6	441.6	20	2.21	96,180	0.075	2.64
Saint Paul Lutheran Church												
Total Site Info	9.29	404,645	15.07	2	4.2	43.5	395.3	21	1.98	86,086	0.067	2.36
US Post Office												
Total Site Info	1.99	86,823	36.03	9	3.0	31.3	284.2	71	1.42	61,896	0.048	1.70

e. Summary of Proposed Green Infrastructure Practices

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area Area (SF)	Potential Management Area Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cfs)	Size of BMP (SF)	Unit Cost ($)	Unit	Total Cost ($)	I.C. Treated %
	FIRST NESHANIC RIVER SUBWATERSHED	**10,855**	**0.25**	**0.283**	**47**	**21,430**	**0.80**	**2,865**			**$14,325**	**23.3%**
1	**Mine Brook Park**											
	Bioretention systems/rain gardens	10,855	0.25	0.283	47	21,430	0.80	2,865	5	SF	$14,325	23.3%
	Total Site Info	**10,855**	**0.25**	**0.283**	**47**	**21,430**	**0.80**	**2,865**			**$14,325**	**23.3%**
	NESHANIC RIVER SUBWATERSHED	**43,245**	**0.99**	**1.127**	**189**	**81,627**	**3.20**	**14,740**			**$185,740**	**14.8%**
2	**Barley Sheaf Elementary School**											
	Bioretention systems/rain gardens	13,428	0.31	0.350	59	26,509	0.99	3,130	5	SF	$15,650	5.0%
	Pervious pavements	20,267	0.47	0.528	88	40,003	1.50	6,202	25	SF	$155,050	7.6%
	Rainwater harvesting systems	3,920	0.09	0.102	17	4,000	0.29	4,000	2	gal	$8,000	1.5%
	Total Site Info	**37,615**	**0.86**	**0.980**	**164**	**70,512**	**2.78**	**13,332**			**$178,700**	**14.1%**
3	**Calvary Orthodox Presbyterian**											
	Bioretention systems/rain gardens	5,630	0.13	0.147	25	11,115	0.42	1,408	5	SF	$7,040	23.6%
	Total Site Info	**5,630**	**0.13**	**0.147**	**25**	**11,115**	**0.42**	**1,408**			**$7,040**	**23.6%**
	RARITAN RIVER SB SUBWATERSHED	**789,465**	**18.12**	**20.570**	**3,443**	**1,440,252**	**54.20**	**193,565**			**$4,027,965**	**27.7%**
4	**Aspen Ice At Flemington**											
	Pervious pavements	66,033	1.52	1.721	288	13,038	0.49	12,956	25	SF	$323,900	26.3%
	Total Site Info	**66,033**	**1.52**	**1.721**	**288**	**13,038**	**0.49**	**12,956**			**$323,900**	**26.3%**
5	**Central Hunterdon Baptist Church**											
	Bioretention systems/rain gardens	25,786	0.59	0.672	112	50,901	1.91	6,326	5	SF	31630	37.9%
	Total Site Info	**25,786**	**0.59**	**0.672**	**112**	**50,901**	**1.91**	**6,326**			**31,630**	**37.9%**
6	**Flemington Elks Lodge**											
	Pervious pavements	36,094	0.83	0.940	157	71,247	2.67	8,109	25	SF	$202,725	56.4%
	Total Site Info	**36,094**	**0.83**	**0.940**	**157**	**71,247**	**2.67**	**8,109**			**$202,725**	**56.4%**

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area Area (SF)	Potential Management Area Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cfs)	Size of BMP (SF)	Unit Cost ($)	Unit	Total Cost ($)	I.C. Treated %
7	**Francis A. Desmares Elementary School**											
	Bioretention systems/rain gardens	41,152	0.94	1.072	179	81,233	3.05	10,539	5	SF	$52,695	17.2%
	Pervious pavements	61,178	1.40	1.594	267	120,765	4.53	15,646	25	SF	$391,150	25.5%
	Total Site Info	**102,330**	**2.35**	**2.666**	**446**	**201,998**	**7.58**	**26,185**			**$443,845**	**42.7%**
8	**Hunterdon Care Center**											
	Bioretention systems/rain gardens	4,791	0.11	0.125	21	9,455	0.36	1,567	5	SF	$7,835	2.6%
	Pervious pavements	26,243	0.60	0.684	114	51,806	1.94	6,885	25	SF	$172,125	14.4%
	Total Site Info	**31,034**	**0.71**	**0.809**	**135**	**61,261**	**2.30**	**8,452**			**$179,960**	**17.1%**
9	**Hunterdon Central High School**											
	Pervious pavements	289,155	6.64	7.534	1,261	570,784	21.43	70,107	25	SF	$1,752,675	22.5%
	Rainwater harvesting systems	3,284	0.08	0.086	14	3,000	0.24	3,000	2	gal	$6,000	0.3%
	Total Site Info	**292,439**	**6.71**	**7.620**	**1,276**	**573,784**	**21.67**	**73,107**			**$1,758,675**	**22.8%**
10	**J.P. Case Middle School**											
	Bioretention systems/rain gardens	18,180	0.42	0.474	79	35,889	1.35	4,944	5	SF	$24,720	3.7%
	Pervious pavements	124,697	2.86	3.249	544	246,144	9.24	29,638	25	SF	$740,950	25.5%
	Total Site Info	**142,877**	**3.28**	**3.723**	**623**	**282,033**	**10.59**	**34,582**			**$765,670**	**29.2%**
11	**Loyal Order of Moose**											
	Bioretention systems/rain gardens	1,348	0.03	0.035	6	2,663	0.10	331	5	SF	1655	5.0%
	Pervious pavements	13,603	0.31	0.354	59	26,853	1.01	3,017	25	SF	$75,425	50.8%
	Total Site Info	**13,603**	**0.31**	**0.354**	**59**	29,516	1.11	**3,017**			**$75,425**	**50.8%**
12	**Saint Anna Greek Orthodox Church**											
	Bioretention systems/rain gardens	36,591	0.84	0.953	160	72,227	2.71	9,226	5	SF	$46,130	38.0%
	Pervious pavements	5,712	0.13	0.149	25	11,272	0.42	1,837	25	SF	$45,925	5.9%
	Total Site Info	**42,303**	**0.97**	**1.102**	**185**	**83,499**	**3.13**	**11,063**			**$92,055**	**44.0%**
13	**Saint Paul Lutheran Church**											
	Bioretention systems/rain gardens	9,123	0.21	0.238	40	18,012	0.68	3,263	5	SF	$16,315	10.6%
	Pervious pavements	17,073	0.39	0.445	74	33,705	1.27	3,460	25	SF	$86,500	19.8%
	Total Site Info	**26,196**	**0.60**	**0.683**	**114**	**51,717**	**1.95**	**6,723**			**$102,815**	**30.4%**

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area Area (SF)	Potential Management Area Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cfs)	Size of BMP (SF)	Unit Cost ($)	Unit	Total Cost ($)	I.C. Treated %
14	**US Post Office**											
	Bioretention systems/rain gardens	5,087	0.12	0.133	22	10,038	0.38	1,243	5	SF	$6,215	8.2%
	Pervious pavements	5,683	0.13	0.148	25	11,220	0.42	1,802	25	SF	$45,050	9.2%
	Total Site Info	**10,770**	**0.25**	**0.281**	**47**	**21,258**	**0.80**	**3,045**			**$51,265**	**17.4%**