RUTGERS
New Jersey Agricultural Experiment Station

Draft

Impervious Cover Reduction Action Plan for Keyport Borough, Monmouth County, New Jersey

Prepared for Keyport Borough by the Rutgers Cooperative Extension Water Resources Program

February 10, 2016

Sea Grant
NJ Sea Grant Consortium

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Introduction

Located in Monmouth County in central New Jersey, Keyport Borough covers approximately 1.47 square miles west of North Brunswick. Figures 1 and 2 illustrate that Keyport Borough is dominated by urban land uses. A total of 77.1% of the municipality's land use is classified as urban. Of the urban land in Keyport Borough, high density 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 Keyport Borough into many unique land use areas, assigning a percent impervious cover for each delineated area. These impervious cover values were used to estimate the impervious coverage for Keyport Borough. Based upon the 2007 NJDEP land use/land cover data, approximately 37% of Keyport Borough has impervious cover. This level of impervious cover suggests that the streams in Keyport Borough are likely non-supporting streams.[1]

Methodology

Keyport Borough contains portions of three 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

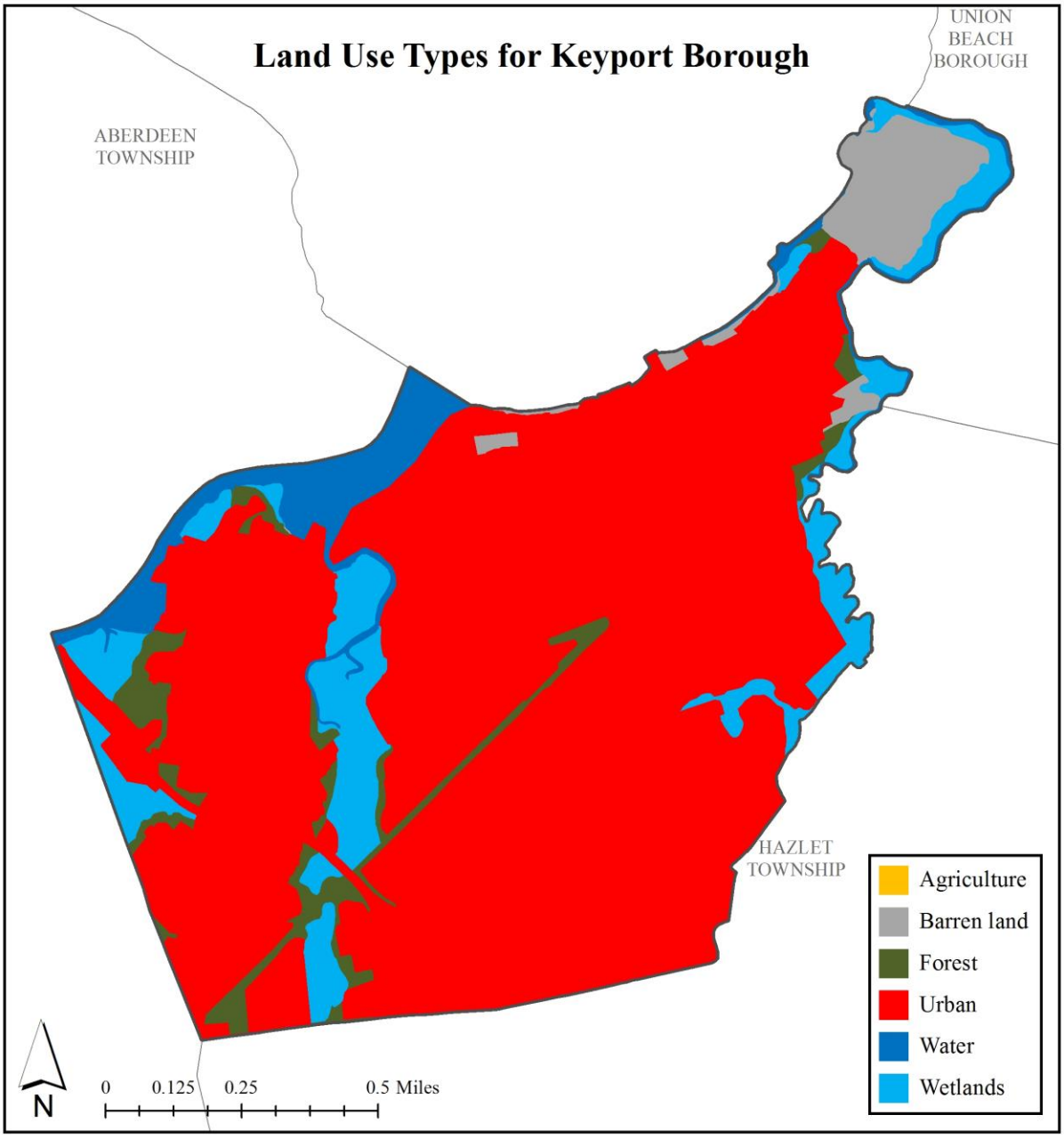


Figure 1: Map illustrating the land use in Keyport Borough

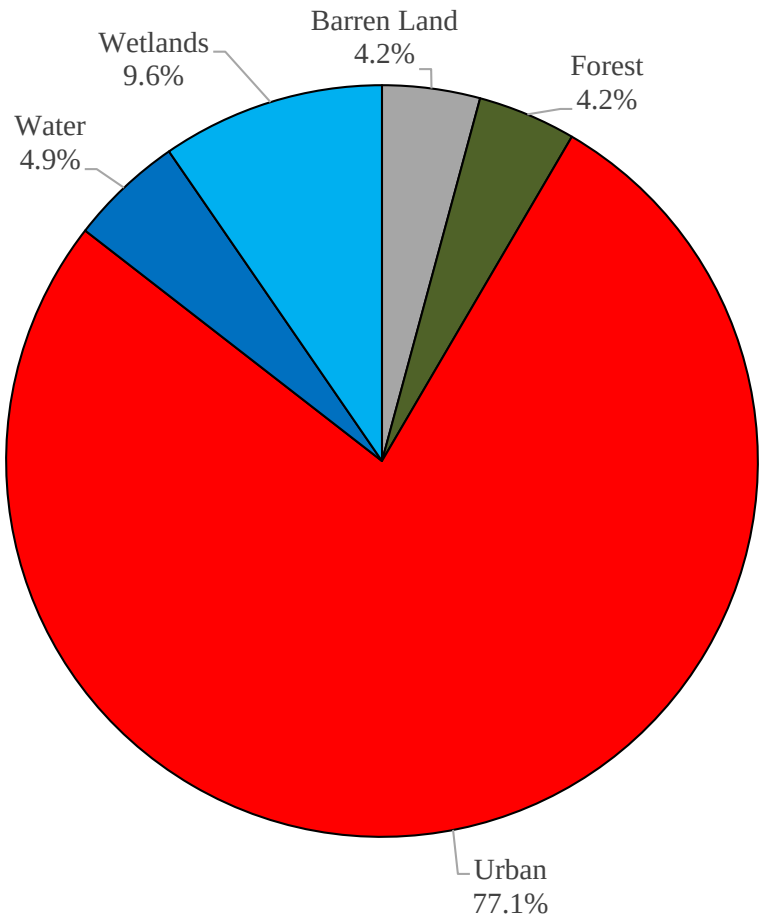


Figure 2: Pie chart illustrating the land use in Keyport Borough

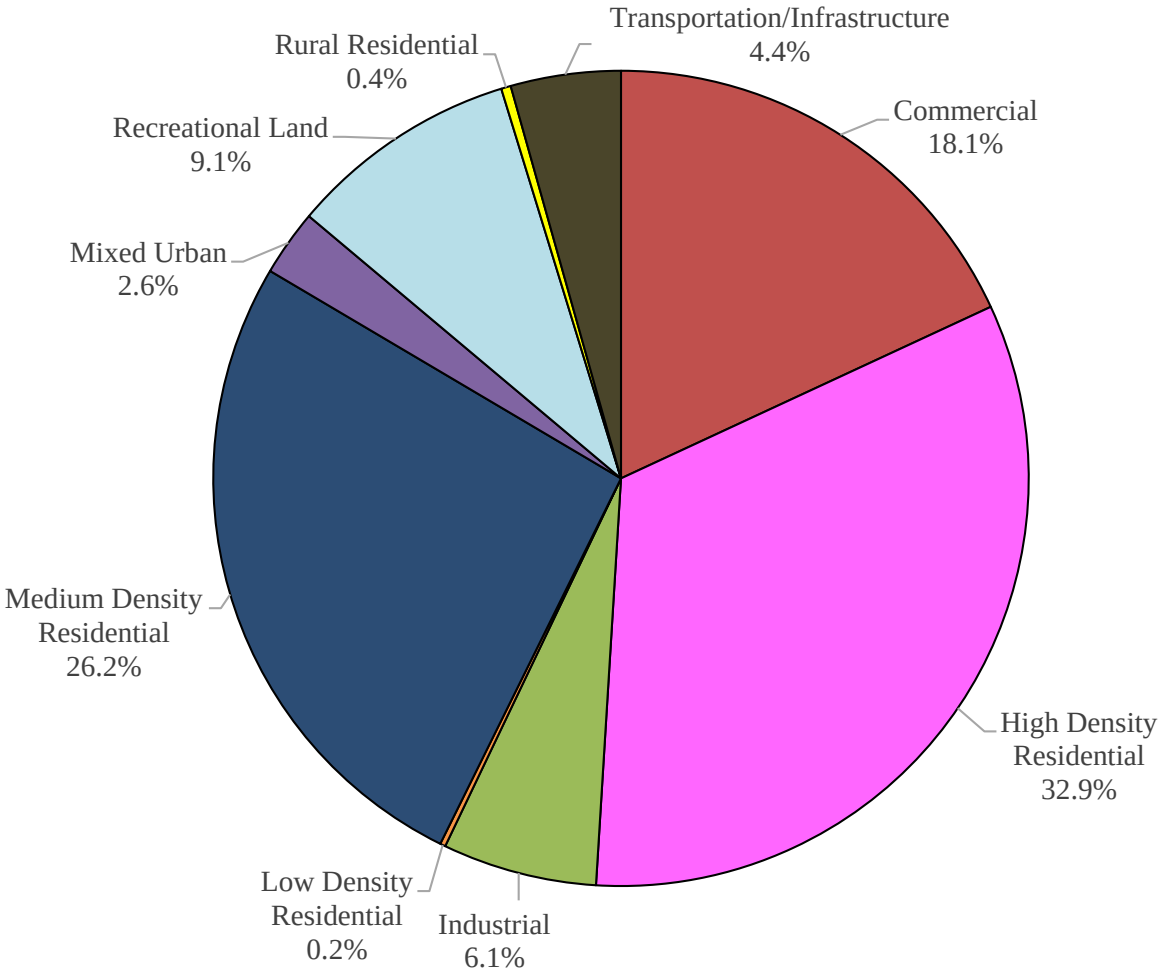


Figure 3: Pie chart illustrating the various types of urban land use in Keyport Borough

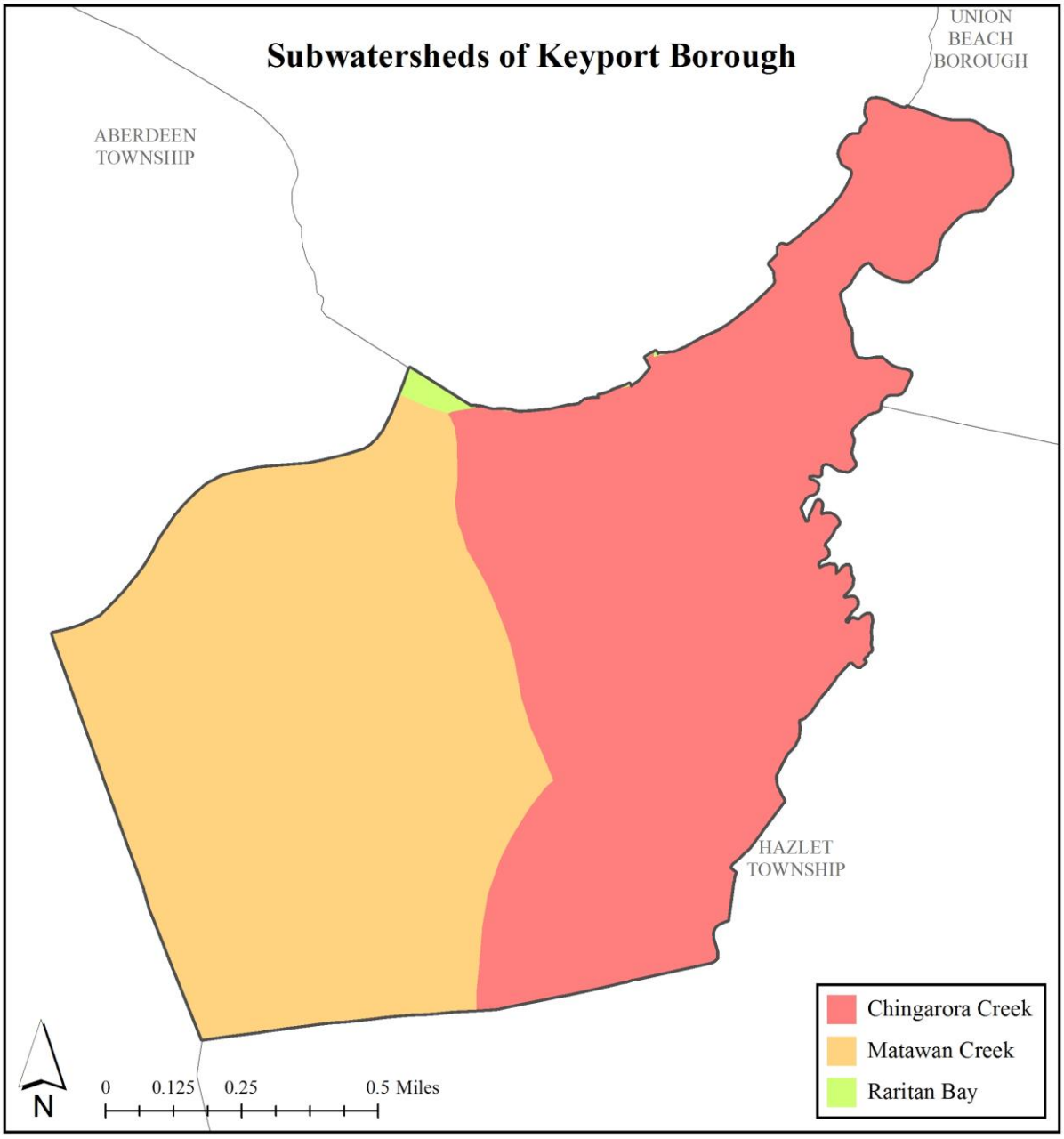


Figure 4: Map of the subwatersheds in Keyport Borough

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 Keyport Borough 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 Keyport Borough. Each practice is discussed below.

Disconnected downspouts

This is often referred to as simple disconnection. A downspout is simply disconnected, and 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

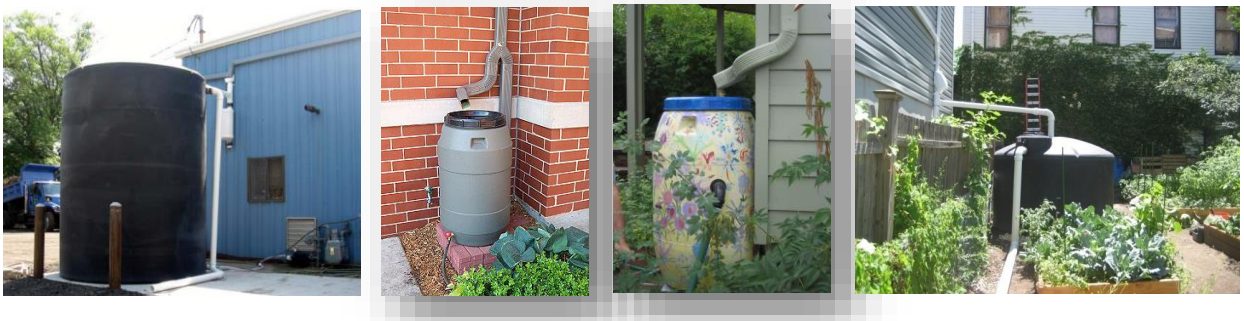
These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating a wildlife habitat while managing stormwater runoff. Bioretention systems also can be used in soils 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. Green Infrastructure Sites

KEYPORT BOROUGH: GREEN INFRASTRUCTURE SITES

SITES WITHIN THE CHINGARORA CREEK SUBWATERSHED:

1. Calvary United Methodist Church
2. Community Church of Keyport
3. Green Grove Gardens
4. Jesus the Lord Roman Catholic Church
5. Keyport Board of Education
6. Keyport Central School
7. Keyport Civic League
8. Keyport First Aid Squad
9. Keyport High School
10. Keyport Library
11. Lincoln Hose Company 1

SITES WITHIN THE MATAWAN CREEK SUBWATERSHED:

12. Gethsemane Lutheran Church
13. Saint Joseph's Catholic Church

b. Proposed Green Infrastructure Concepts

CALVARY UNITED METHODIST CHURCH

Subwatershed: Chingarora Creek

Site Area: 21,400 sq. ft.

Address: 41 Osborn Street
Keyport, NJ 07735

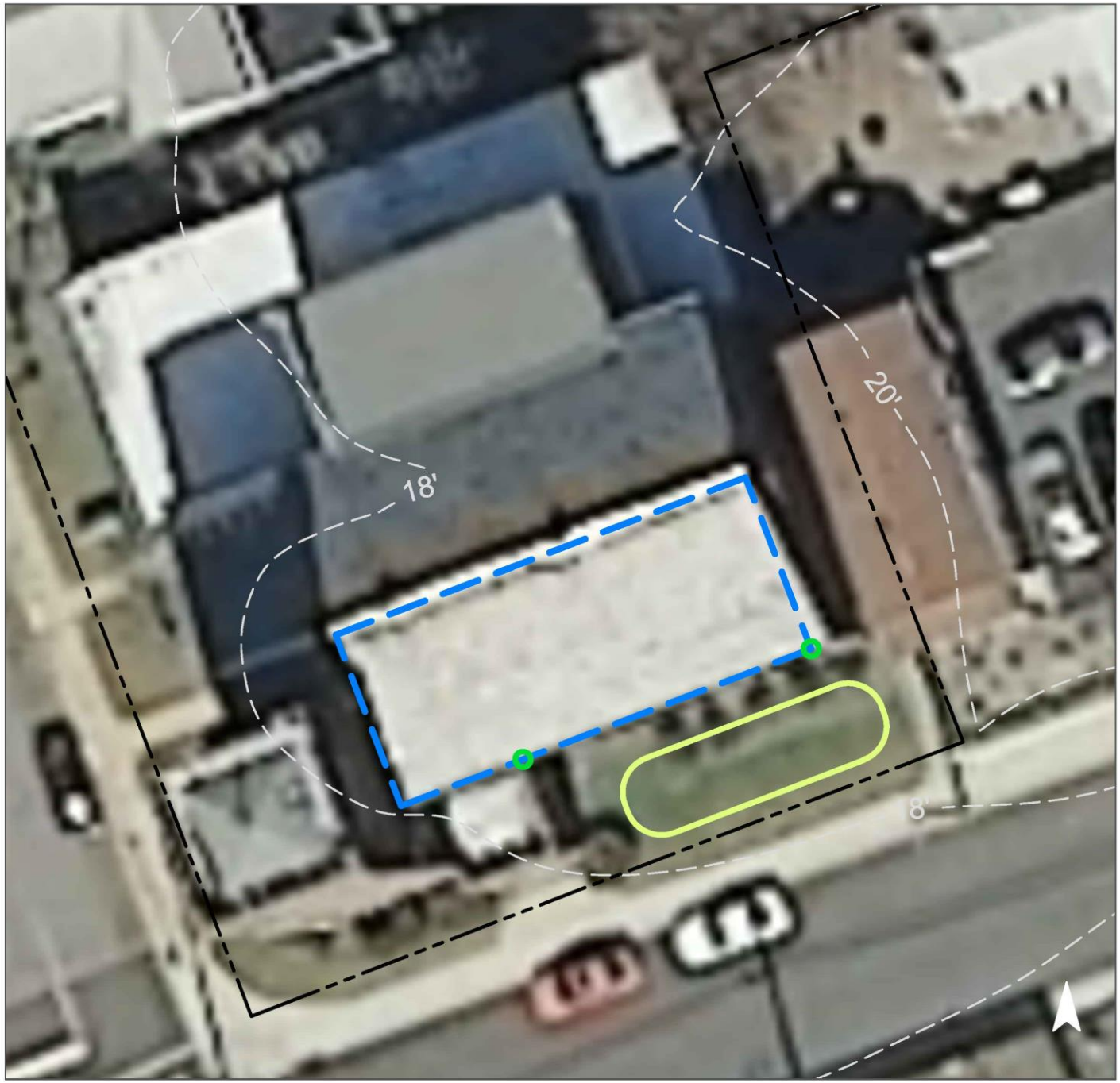
Block and Lot: Block 81, Lot 9

The installation of a rain garden adjacent to the church can capture, treat, and infiltrate roof runoff by disconnecting and redirecting nearby downspouts into it. 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"
50	10,700	0.5	5.4	49.1	0.008	0.29

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	0.044	7	3,351	0.13	425	$2,125

GREEN INFRASTRUCTURE RECOMMENDATIONS



Calvary United Methodist Church

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

0 10' 20'

COMMUNITY CHURCH OF KEYPORT

Subwatershed: Chingarora Greek

Site Area: 62,400 sq. ft.

Address: 125 Division Street
Keyport, NJ 07735

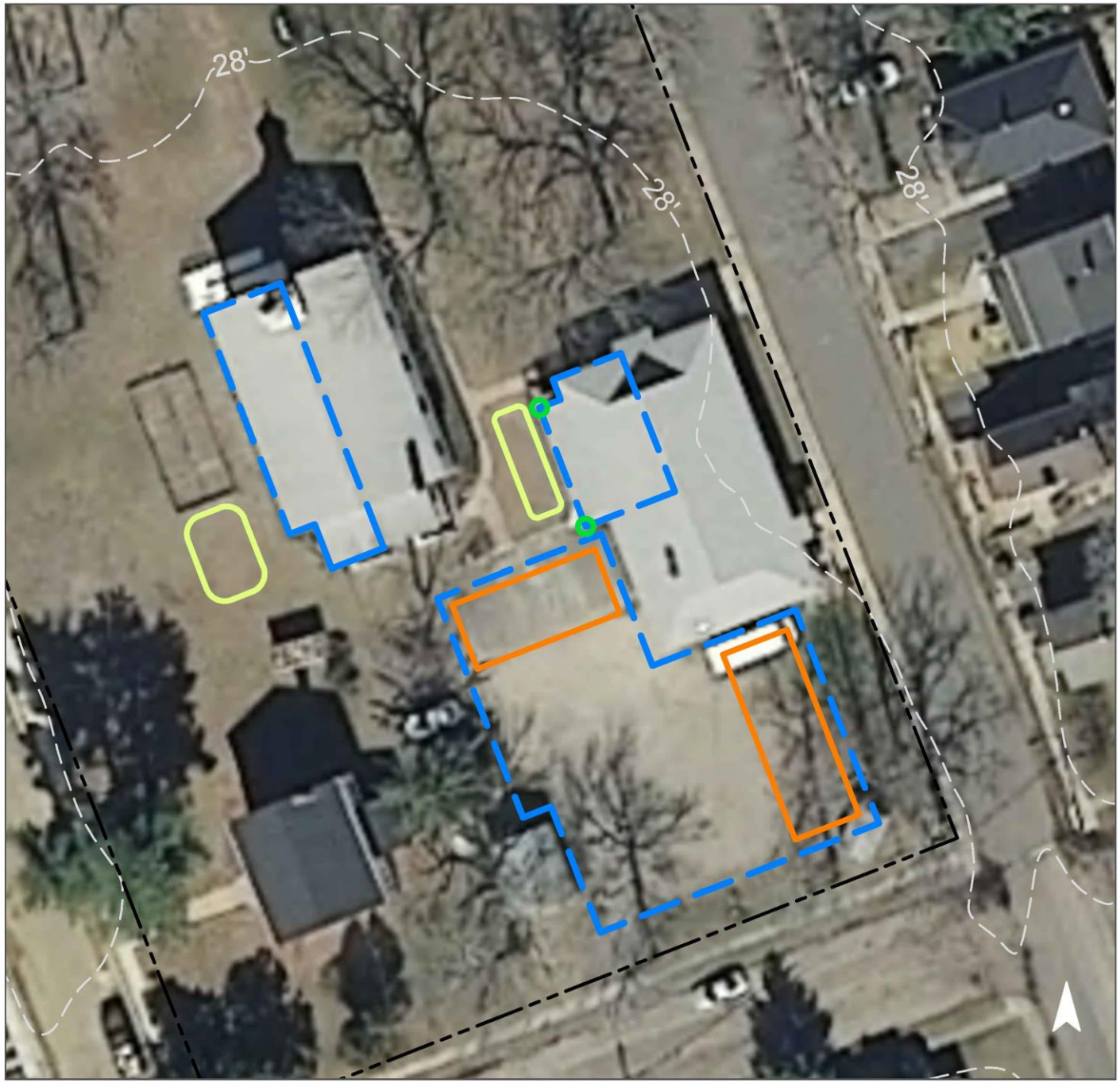
Block and Lot: Block 77, Lot 1

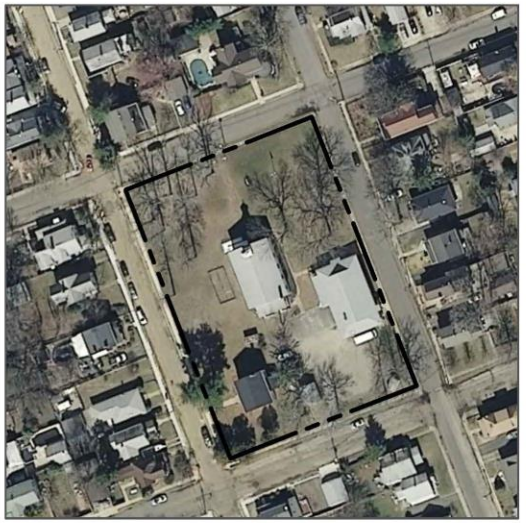
Parking spaces can be replaced with porous asphalt to capture and infiltrate stormwater. Installing rain gardens adjacent to the building can capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability 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"
25	15,600	0.8	7.9	71.6	0.012	0.43

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	0.064	11	4,884	0.18	600	$3,000
Pervious pavements	0.172	29	13,060	0.49	1,660	$41,500

GREEN INFRASTRUCTURE RECOMMENDATIONS





Community Church of Keyport

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

0 20' 40'

GREEN GROVE GARDENS

Subwatershed: Chingarora Creek

Site Area: 387,706 sq. ft.

Address: 99 Green Grove Avenue
Keyport, NJ 07735

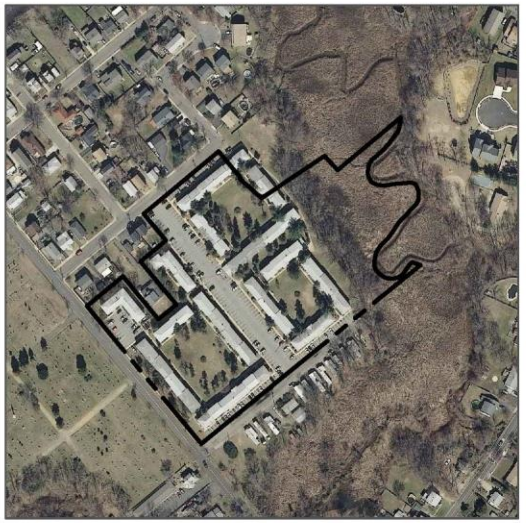
Block and Lot: Block 117, 134; Lot 1, 48-51

Parking spots can be replaced with porous asphalt to capture and infiltrate stormwater. Multiple rain gardens can be installed throughout the complex adjacent to the buildings 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"
44	169,783	8.2	85.7	779.5	0.132	4.66

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	0.374	63	28,334	1.06	4,680	$23,400
Pervious pavements	0.962	161	72,863	2.73	9,780	$244,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



Green Grove Gardens

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

0 50' 100'

JESUS THE LORD ROMAN CATHOLIC CHURCH

Subwatershed: Chingarora Creek

Site Area: 38,365 sq. ft.

Address: 123 Broad Street
Keyport, NJ 07735

Block and Lot: Block 60, Lot 5,8,9,29

A row of parking spaces 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.

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"
60	22,915	1.1	11.6	105.2	0.018	0.63

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	0.273	46	20,675	0.78	2,825	$70,625

GREEN INFRASTRUCTURE RECOMMENDATIONS

Jesus The Lord Roman Catholic Church

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

0 20' 40'

KEYPORT BOARD OF EDUCATION

Subwatershed: Chingarora Creek

Site Area: 14,100 sq. ft.

Address: 370 Broad Street
Keyport, NJ 07735

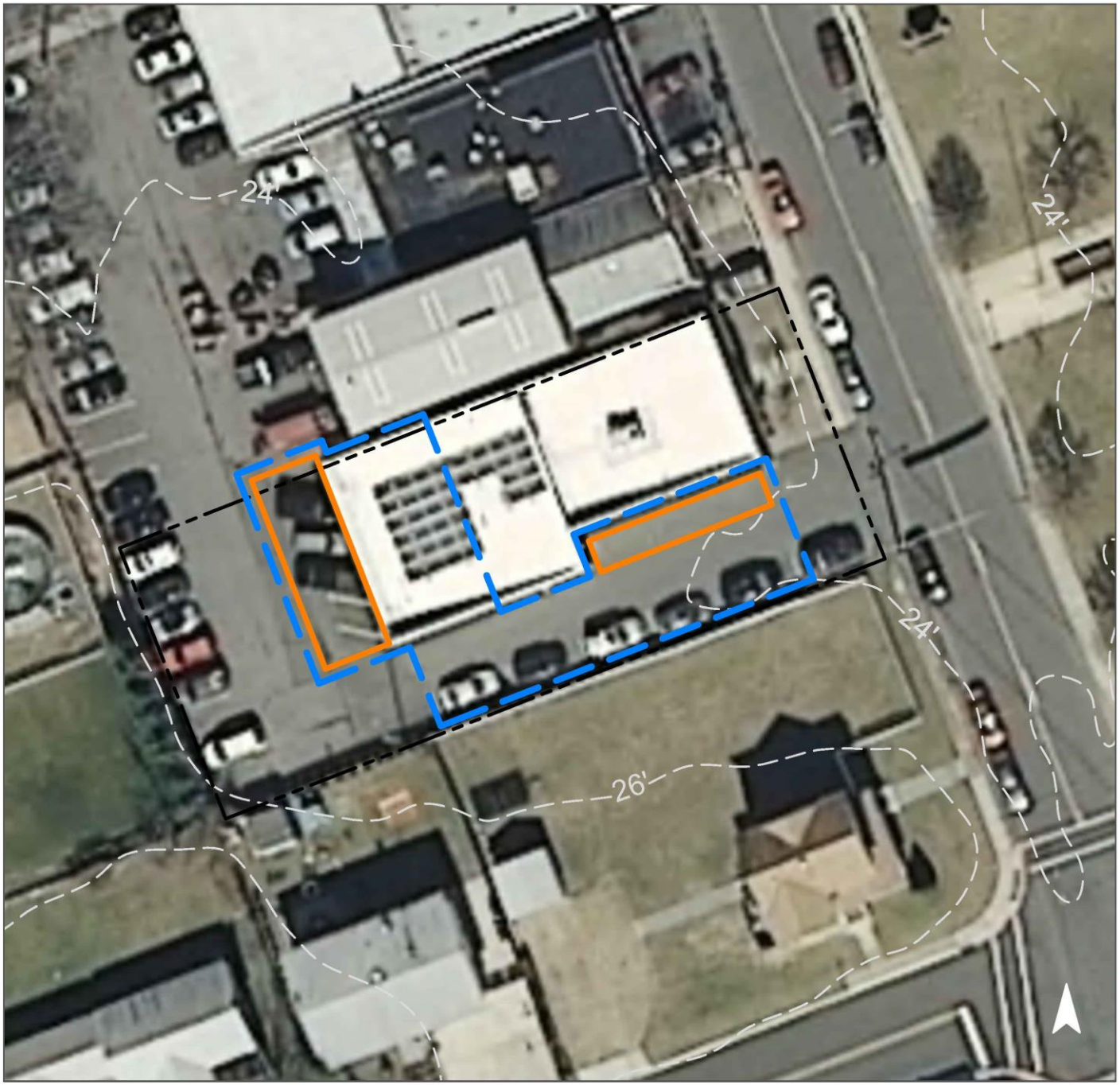
Block and Lot: Block 54, Lot 2,3,4,15

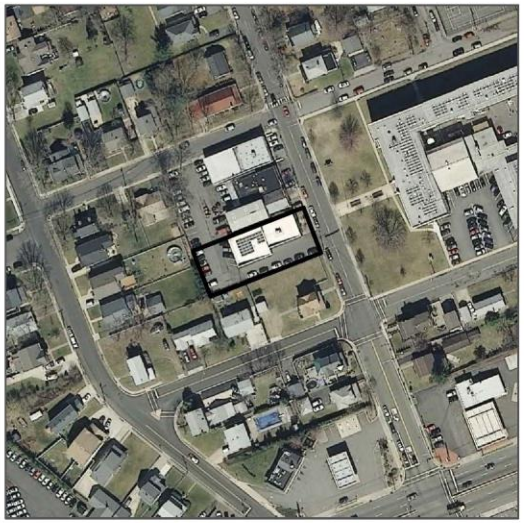
Sections of the parking lot can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
80	11,260	0.5	5.7	51.7	0.009	0.31

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	0.153	26	11,587	0.43	1,375	$34,375

GREEN INFRASTRUCTURE RECOMMENDATIONS





Keyport Board Of Education

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

0 20' 40'

KEYPORT CENTRAL SCHOOL

Subwatershed: Chingarora Creek

Site Area: 265,020 sq. ft.

Address: 335 Broad Street
Keyport, NJ 07735

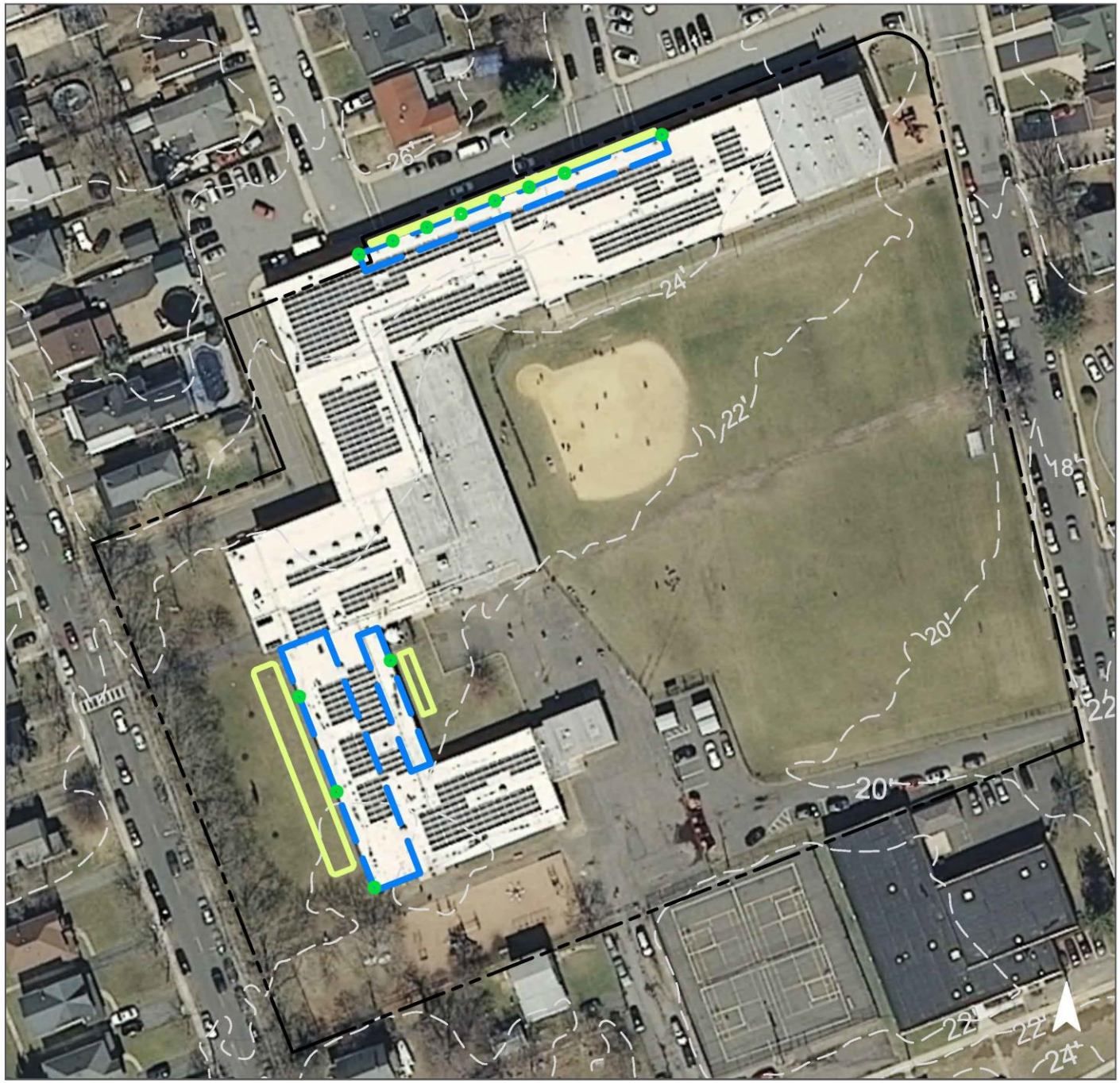
Block and Lot: Block 67, Lot 26

Rain gardens can be installed adjacent to the school to capture, treat, and infiltrate roof runoff by disconnecting and redirecting downspouts. 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"
49	128,975	6.2	65.1	592.2	0.100	3.54

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	0.241	40	18,236	0.68	2,955	$14,775

GREEN INFRASTRUCTURE RECOMMENDATIONS



Keyport Central School

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

0 50' 100'

KEYPORT CIVIC LEAGUE

Subwatershed: Chingarora Creek

Site Area: 22,193 sq. ft.

Address: 216 Atlantic Street
Keyport, NJ 07735

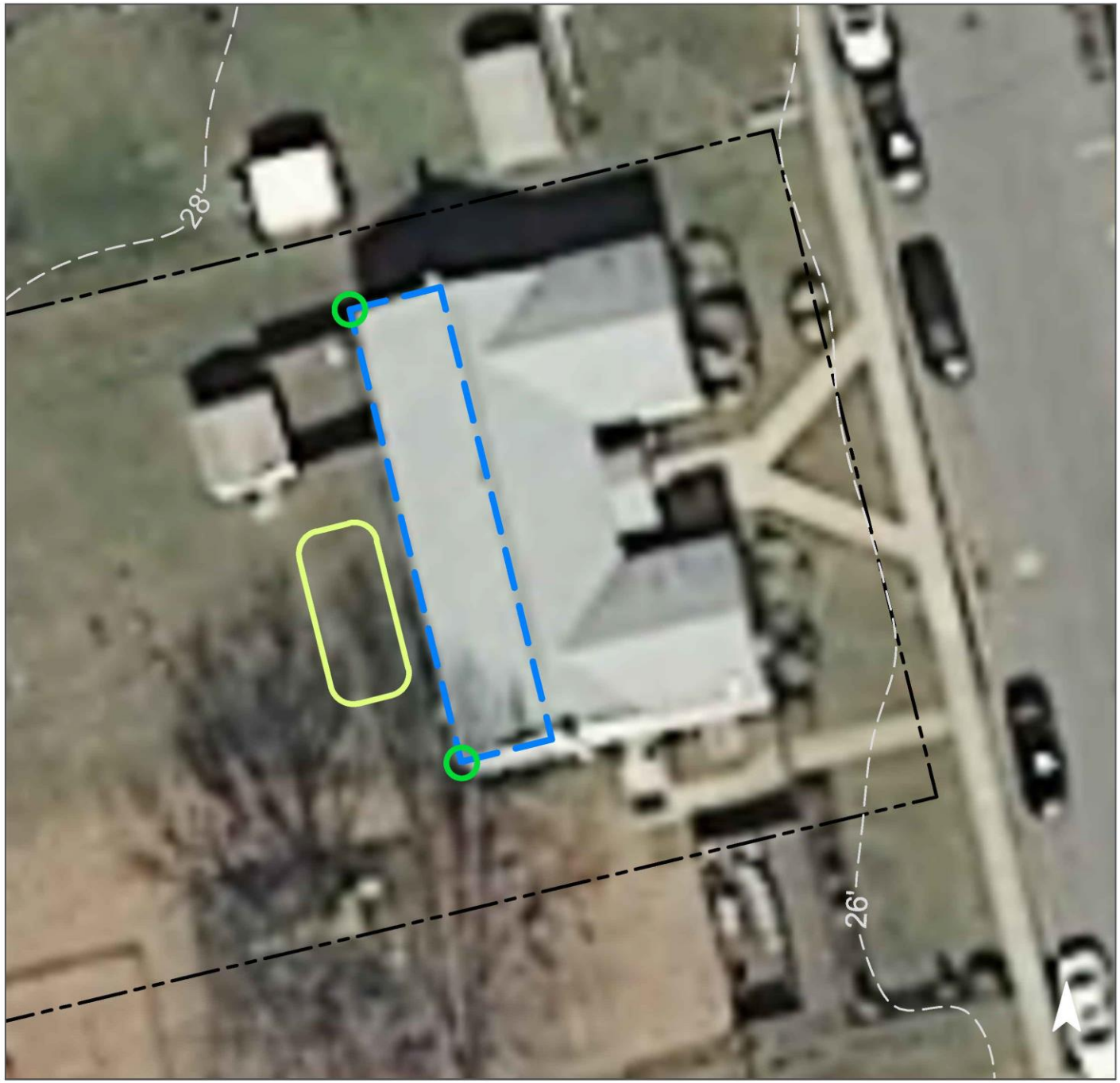
Block and Lot: Block 86, Lot 8

West of the building a rain garden can be installed to capture, treat, and infiltrate roof runoff by disconnecting and redirecting nearby downspouts into it. 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"
35	7,768	0.4	3.9	35.7	0.006	0.21

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	0.041	7	3,074	0.12	390	$1,950

GREEN INFRASTRUCTURE RECOMMENDATIONS



Keyport Civic League

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

0 10' 20'

KEYPORT FIRST AID SQUAD

Subwatershed: Chingarora Creek

Site Area: 25,754 sq. ft.

Address: 1927 Atlantic Street
Keyport, NJ 07735

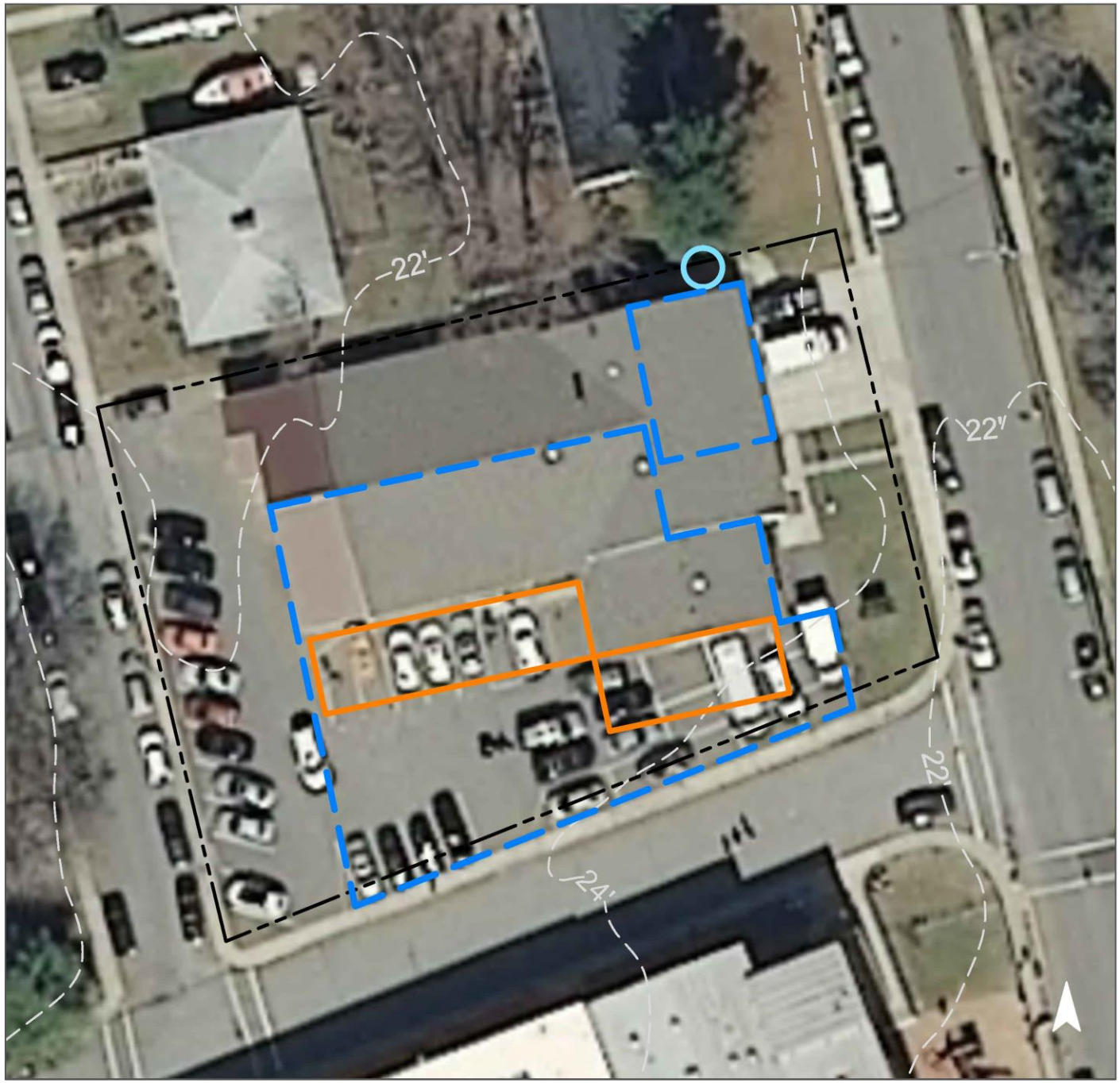
Block and Lot: Block 87, Lot 7,8

Parking spots can be replaced with porous asphalt to capture and infiltrate stormwater. Rainwater can be harvested by installing a cistern at the first aid squad. The water can be used for cleaning emergency vehicles. 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"
75	19,291	0.9	9.7	88.6	0.015	0.53

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	0.356	60	26,980	1.01	2,403	$60,075
Rainwater harvesting systems	0.033	5	2,000	0.09	2,000 (gal)	$4,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Keyport First Aid Squad

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

0 20' 40'

KEYPORT HIGH SCHOOL

Subwatershed: Chingarora Creek

Site Area: 158,060 sq. ft.

Address: 351 Broad Street
Keyport, NJ 07735

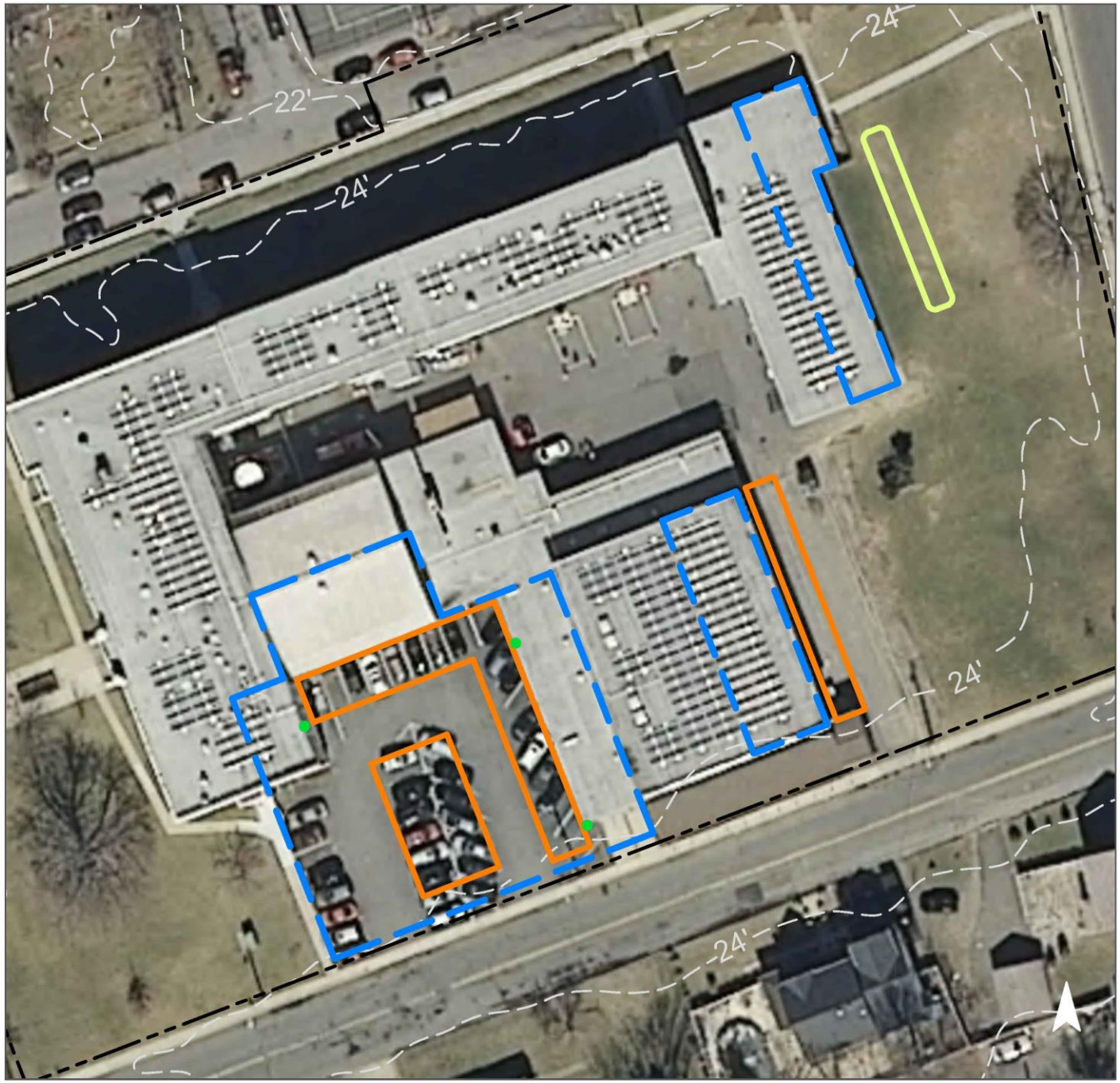
Block and Lot: Block 68, Lot 1

Parking spaces and an area of asphalt adjacent to the building can be replaced with pervious pavement to capture and infiltrate stormwater. In the turf grass east of the school a rain garden 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"
55	86,508	4.2	43.7	397.2	0.067	2.37

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	0.143	24	10,801	0.41	1,368	$6,840
Pervious pavements	0.586	98	44,386	1.67	10,308	$257,700

GREEN INFRASTRUCTURE RECOMMENDATIONS



Keyport High School

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

0 30' 60'

KEYPORT LIBRARY

Subwatershed: Chingarora Creek

Site Area: 10,900 sq. ft.

Address: 109 Broad Street
Keyport, NJ 07735

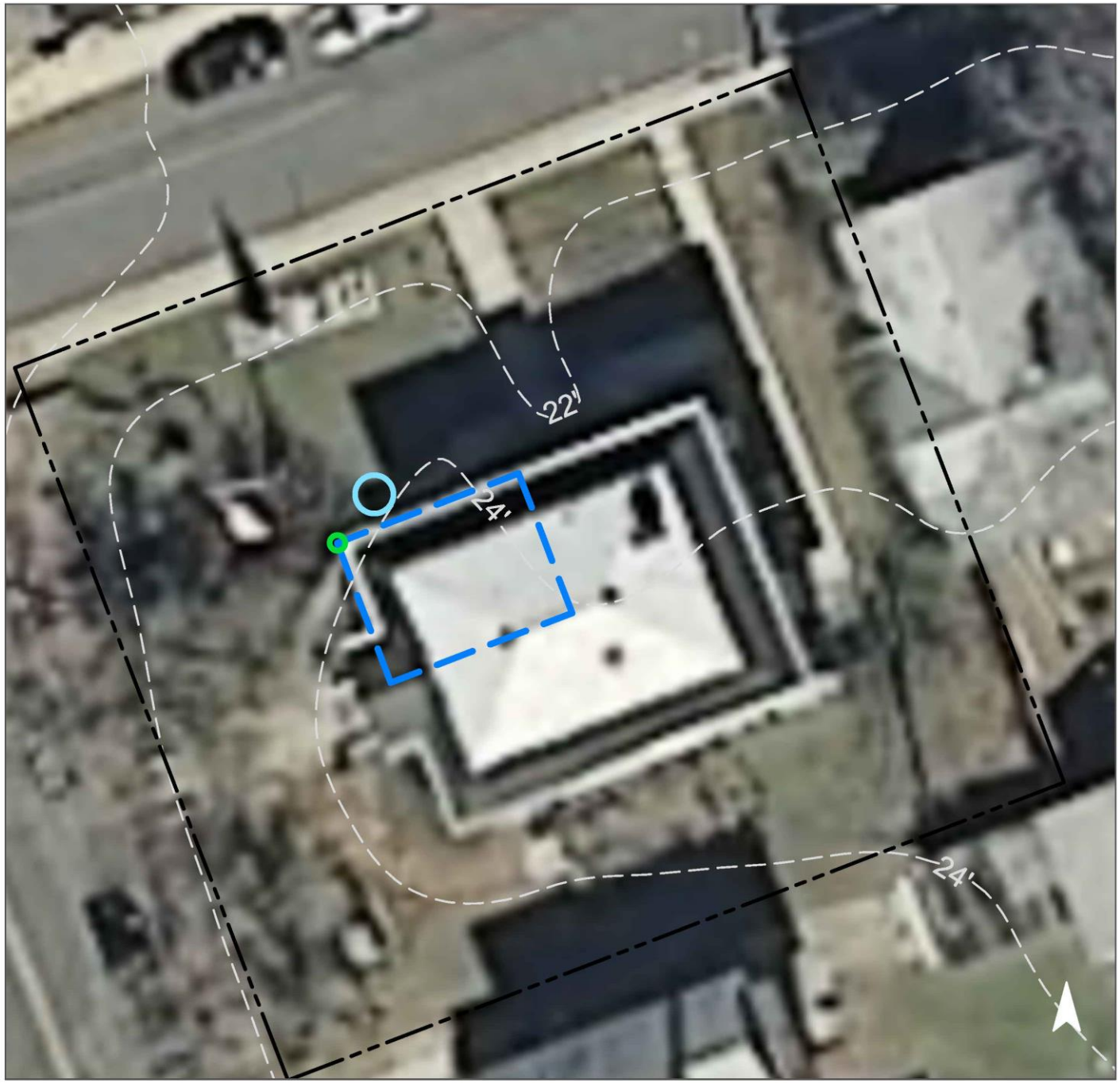
Block and Lot: Block 63, Lot 1

Rainwater can be harvested by installing a cistern at the library. The water can be used on the existing landscaping. 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"
57	6,226	0.3	3.1	28.6	0.005	0.17

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
Rain harvesting systems	0.013	2	800	0.04	800 (gal)	$1,600

GREEN INFRASTRUCTURE RECOMMENDATIONS



Keyport Library

- disconnected downspouts
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 10' 20'

LINCOLN HOSE COMPANY 1

Subwatershed: Chingarora Creek

Site Area: 15,307 sq. ft.

Address: 142 2ND Street
Keyport, NJ 07735

Block and Lot: Block 129, Lot 3,4

Rainwater can be harvested by installing a cistern at the fire company. The water can be used for cleaning emergency vehicles 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"
65	9,950	0.5	5.0	45.7	0.008	0.27

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
Rainwater harvesting systems	0.021	4	1,250	0.06	1,250 (gal)	$2,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Lincoln Hose Company 1

- disconnected downspouts
- rainwater harvesting
- drainage areas
- property line
- 2012 Aerial: NJOIT, OGIS

0 10' 20'

GETHSEMANE LUTHERAN CHURCH

Subwatershed: Matawan Creek

Site Area: 32,200 sq. ft.

Address: 60 Maple Place
Keyport, NJ 07735

Block and Lot: Block 45, Lot 2

Rain gardens can be installed adjacent to the church to capture, treat, and infiltrate roof runoff by redirecting nearby downspouts. 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"
35	11,270	0.5	5.7	51.7	0.009	0.31

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	0.086	14	6,515	0.24	825	$4,125

GREEN INFRASTRUCTURE RECOMMENDATIONS

Gethsemane Lutheran Church

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

0 20' 40'

SAINT JOSEPH'S CATHOLIC CHURCH

Subwatershed: Matawan Creek

Site Area: 200,501 sq. ft.

Address: 376 Maple Place
Keyport, NJ 07735

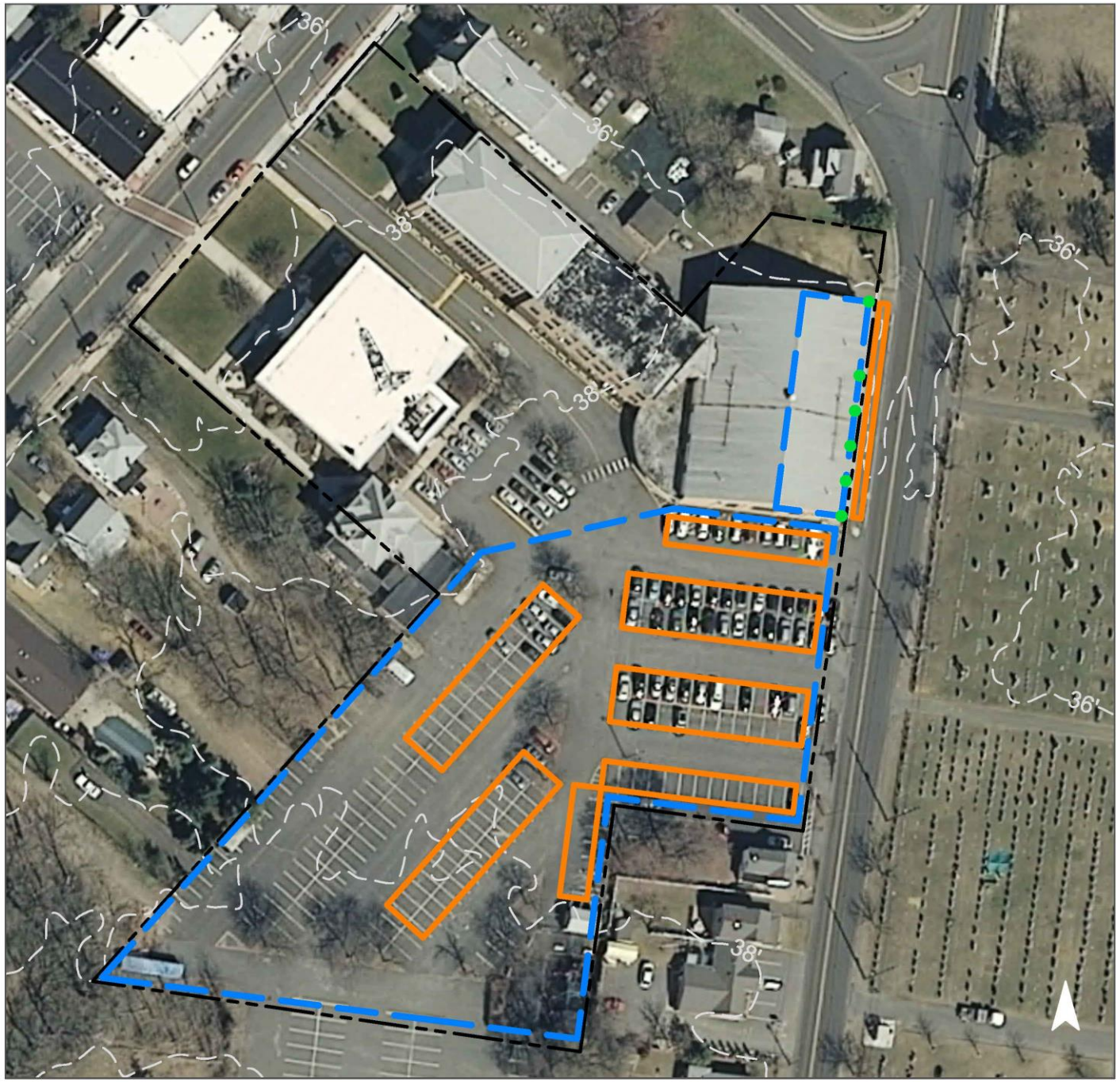
Block and Lot: Block 5, Lot 38

Parking spots can be replaced with porous asphalt to capture and infiltrate stormwater. A rain garden can be installed adjacent to the building 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"
84	168,070	8.1	84.9	771.7	0.131	4.61

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	1.472	246	422,657	4.19	15,112	$377,800

GREEN INFRASTRUCTURE RECOMMENDATIONS



Saint Joseph's Catholic Church

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

0 50' 100'

c. 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)
CHINGARORA CREEK SUBWATERSHED	**23.44**	**1,021,205**			**23.7**	**248.0**	**2,254.5**		**11.27**	**491,039**	**0.383**	**13.47**
Calvary United Methodist Church												
Total Site Info	0.49	21,400	81	9	0.5	5.4	49.1	50	0.25	10,700	0.008	0.29
Community Church of Keyport												
Total Site Info	1.43	62,400	77	1	0.8	7.9	71.6	25	0.36	15,600	0.012	0.43
Green Grove Gardens												
Total Site Info	8.90	387,706	117,134	1, 48-51	8.2	85.7	779.5	44	3.90	169,783	0.132	4.66
Jesus the Lord Roman Catholic Church												
Total Site Info	0.88	38,365	60	5,8,9,29	1.1	11.6	105.2	60	0.53	22,915	0.018	0.63
Keyport Board of Education												
Total Site Info	0.32	14,100	54	2,3,4,15	0.6	6.7	61.2	94	0.31	13,322	0.010	0.37
Keyport Central School												
Total Site Info	6.08	265,020	67	26	6.2	65.1	592.2	49	2.96	128,975	0.100	3.54
Keyport Civic League												
Total Site Info	0.51	22,193	86	8	0.4	3.9	35.7	35	0.18	7,768	0.006	0.21
Keyport First Aid Squad												
Total Site Info	0.59	25,754	87	7,8	0.9	9.7	88.6	75	0.44	19,291	0.015	0.53
Keyport High School												
Total Site Info	3.63	158,060	68	1	4.2	43.7	397.2	55	1.99	86,508	0.067	2.37
Keyport Library												
Total Site Info	0.25	10,900	63	1	0.3	3.1	28.6	57	0.14	6,226	0.005	0.17
Lincoln Hose Company 1												
Total Site Info	0.35	15,307	129	3,4	0.5	5.0	45.7	65	0.23	9,950	0.008	0.27

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)
MATAWAN CREEK SUBWATERSHED	**5.34**	**232,701**			**8.6**	**90.6**	**823.4**		**4.12**	**179,339**	**0.14**	**4.92**
Gethsemane Lutheran Church												
Total Site Info	0.74	32,200	45	2	0.5	5.7	51.7	35	0.26	11,270	0.009	0.31
Saint Joseph's Catholic Church												
Total Site Info	4.60	200,501	5	38	8.1	84.9	771.7	84	3.86	168,070	0.131	4.61

d. Summary of Proposed Green Infrastructure Practices

Summary of Porposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area		Recharge Potential	TSS Removal Potential	Max Volume Reduction Potential	Peak Discharge Reduction Potential	Size of BMP	Unit Cost	Unit	Total Cost	I.C. Treated
		Area (SF)	Area (ac)	(Mgal/yr)	(lbs/yr)	(gal/storm)	(cfs)	(SF)	($)		($)	%
	CHINGARORA CREEK SUBWATERSHED	**133,375**	**3.06**	**3.475**	**582**	**262,282**	**9.88**	**42,819**			**$768,965**	**27.2%**
1	**Calvary United Methodist Church**											
	Bioretention systems/rain gardens	1,698	0.04	0.044	7	3,351	0.13	425	5	SF	$2,125	15.9%
	Total Site Info	**1,698**	**0.04**	**0.044**	**7**	**3,351**	**0.13**	**425**			**$2,125**	**15.9%**
2	**Community Church of Keyport**											
	Bioretention systems/rain gardens	2,475	0.06	0.064	11	4,884	0.18	600	5	SF	$3,000	15.9%
	Pervious pavements	6,615	0.15	0.172	29	13,060	0.49	1,660	25	SF	$41,500	42.4%
	Total Site Info	**9,090**	**0.21**	**0.237**	**40**	**17,944**	**0.67**	**2,260**			**$44,500**	**58.3%**
3	**Green Grove Gardens**											
	Bioretention systems/rain gardens	14,355	0.33	0.374	63	28,334	1.06	4,680	5	SF	$23,400	8.5%
	Pervious pavements	36,910	0.85	0.962	161	72,863	2.73	9,780	25	SF	$244,500	21.7%
	Total Site Info	**51,265**	**1.18**	**1.336**	**224**	**101,197**	**3.79**	**14,460**			**$267,900**	**30.2%**
4	**Jesus the Lord Roman Catholic Church**											
	Pervious pavements	10,475	0.24	0.273	46	20,675	0.78	2,825	25	SF	$70,625	45.7%
	Total Site Info	**10,475**	**0.24**	**0.273**	**46**	**20,675**	**0.78**	**2,825**			**$70,625**	**45.7%**
5	**Keyport Board of Education**											
	Pervious pavements	5,870	0.13	0.153	26	11,587	0.43	1,375	25	SF	$34,375	44.1%
	Total Site Info	**5,870**	**0.13**	**0.153**	**26**	**11,587**	**0.43**	**1,375**			**$34,375**	**44.1%**
6	**Keyport Central School**											
	Bioretention systems/rain gardens	9,240	0.21	0.241	40	18,236	0.68	2,955	5	SF	$14,775	7.2%
	Total Site Info	**9,240**	**0.21**	**0.241**	**40**	**18,236**	**0.68**	**2,955**			**$14,775**	**7.2%**
7	**Keyport Civic League**											
	Bioretention systems/rain gardens	1,558	0.04	0.041	7	3,074	0.12	390	5	SF	$1,950	20.1%
	Total Site Info	**1,558**	**0.04**	**0.041**	**7**	**3,074**	**0.12**	**390**			**$1,950**	**20.1%**
8	**Keyport First Aid Squad**											
	Pervious pavements	13,667	0.31	0.356	60	26,980	1.01	2,403	25	SF	$60,075	70.8%
	Rainwater harvesting systems	1,250	0.03	0.033	5	2,000	0.09	2,000	2	gal	$4,000	6.5%
	Total Site Info	**14,917**	**0.34**	**0.389**	**65**	**28,980**	**1.10**	**4,403**			**$64,075**	**77.3%**
9	**Keyport High School**											
	Bioretention systems/rain gardens	5,471	0.13	0.143	24	10,801	0.41	1,368	5	SF	$6,840	6.3%
	Pervious pavements	22,486	0.52	0.586	98	44,386	1.67	10,308	25	SF	$257,700	26.0%
	Total Site Info	**27,957**	**0.64**	**0.728**	**122**	**55,187**	**2.08**	**11,676**			**$264,540**	**32.3%**

Summary of Porposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area		Recharge Potential	TSS Removal Potential	Max Volume Reduction Potential	Peak Discharge Reduction Potential	Size of BMP	Unit Cost	Unit	Total Cost	I.C. Treated
		Area (SF)	Area (ac)	(Mgal/yr)	(lbs/yr)	(gal/storm)	(cfs)	(SF)	($)		($)	%
10	**Keyport Library**											
	Rainwater harvesting systems	500	0.01	0.013	2	800	0.04	800	2	gal	$1,600	8.0%
	Total Site Info	**500**	**0.01**	**0.013**	**2**	**800**	**0.04**	**800**			**$1,600**	**8.0%**
11	**Lincoln Hose Company 1**											
	Rainwater harvesting systems	805	0.02	0.021	4	1,250	0.06	1,250	2	gal	$2,500	8.1%
	Total Site Info	**805**	**0.02**	**0.021**	**4**	**1,250**	**0.06**	**1,250**			**$2,500**	**8.1%**
	MATAWAN CREEK SUBWATERSHED	**59,805**	**1.37**	**1.558**	**261**	**429,172**	**4.43**	**15,937**			**$381,925**	**33.3%**
12	**Gethsemane Lutheran Church**											
	Bioretention systems/rain gardens	3,300	0.08	0.086	14	6,515	0.24	825	5	SF	$4,125	29.3%
	Total Site Info	**3,300**	**0.08**	**0.086**	**14**	**6,515**	**0.24**	**825**			**$4,125**	**29.3%**
13	**Saint Joseph's Catholic Church**											
	Pervious pavements	56,505	1.30	1.472	246	422,657	4.19	15,112	25	SF	$377,800	33.6%
	Total Site Info	**56,505**	**1.30**	**1.472**	**246**	**422,657**	**4.19**	**15,112**			**$377,800**	**33.6%**