RUTGERS
New Jersey Agricultural Experiment Station

Draft

Impervious Cover Reduction Action Plan for Fair Haven, Monmouth County, New Jersey

Prepared for Fair Haven by the Rutgers Cooperative Extension Water Resources Program

June 10, 2016

Sea Grant
NJ Sea Grant Consortium

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Introduction

Located in Monmouth County in central New Jersey, Fair Haven is approximately 4.17 square miles in size. Figures 1 and 2 illustrate that Fair Haven Borough is dominated by urban land use. A total of 69.2% of the municipality's land use is classified as urban. Of the urban land use in Fair Haven, medium density residential is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection (NJDEP) 2007 land use/land cover geographical information system (GIS) data layer categorizes Fair Haven 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 Fair Haven. Based upon the NJDEP 2007 land use/land cover data, approximately 27.3% of Fair Haven has impervious cover. This level of impervious cover suggests that the streams in Fair Haven are likely non-supporting streams.[1]

Methodology

Fair Haven contains portions of two 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

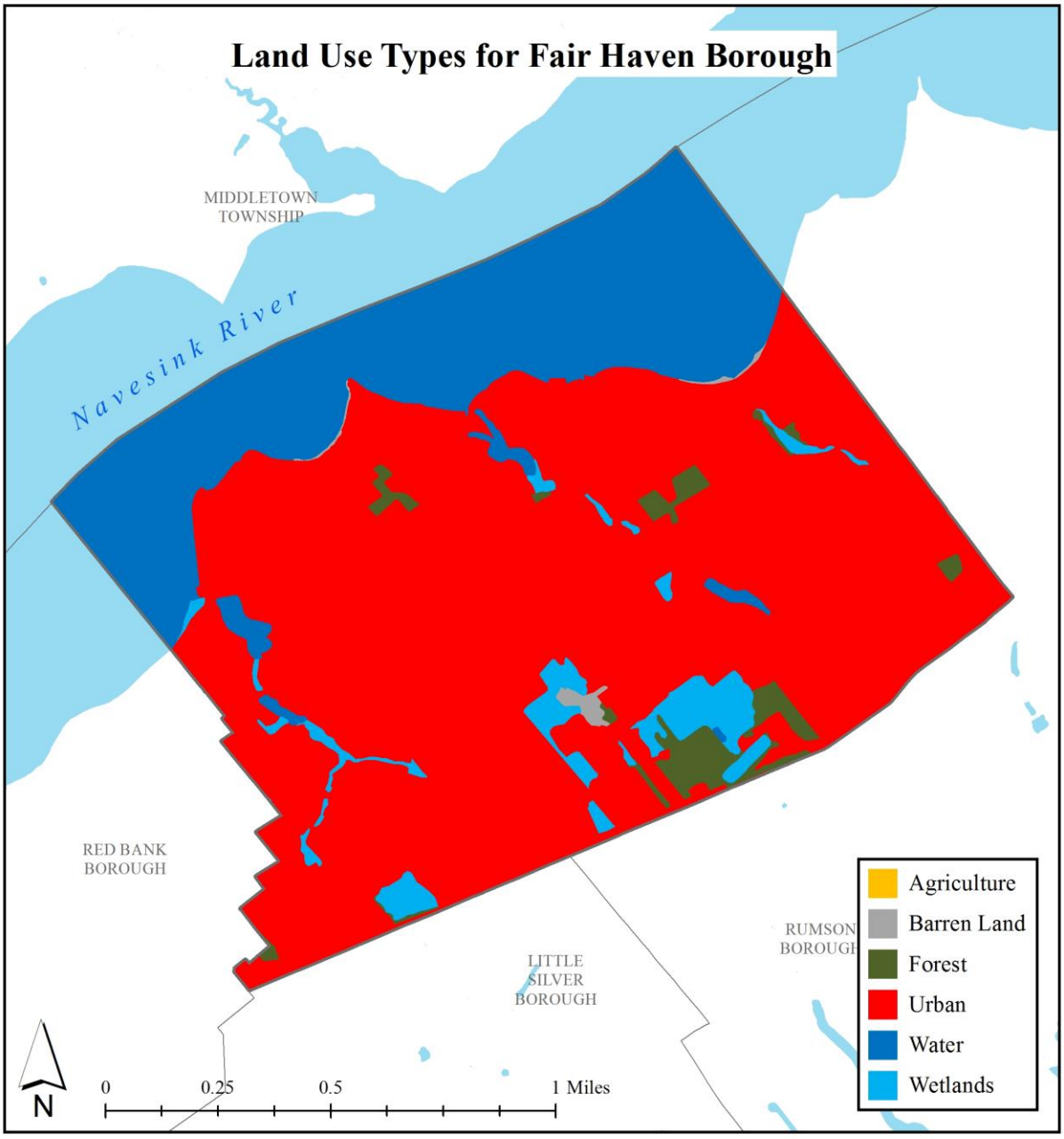


Figure 1: Map illustrating the land use in Fair Haven

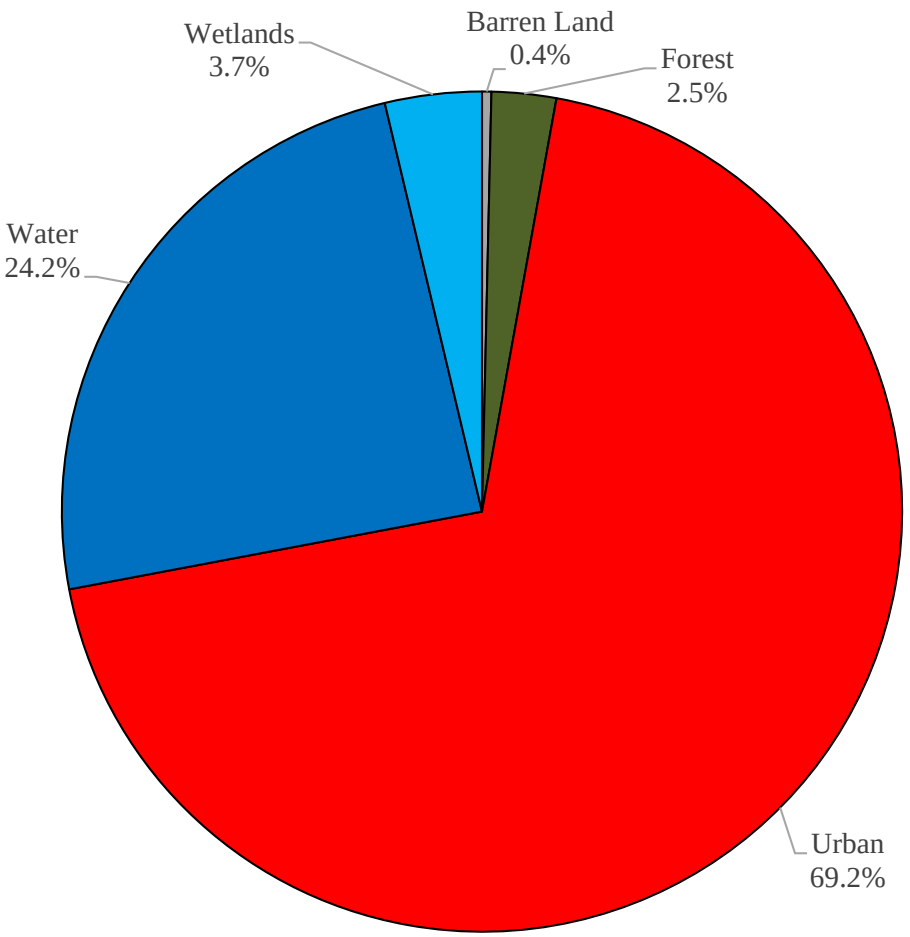


Figure 2: Pie chart illustrating the land use in Fair Haven

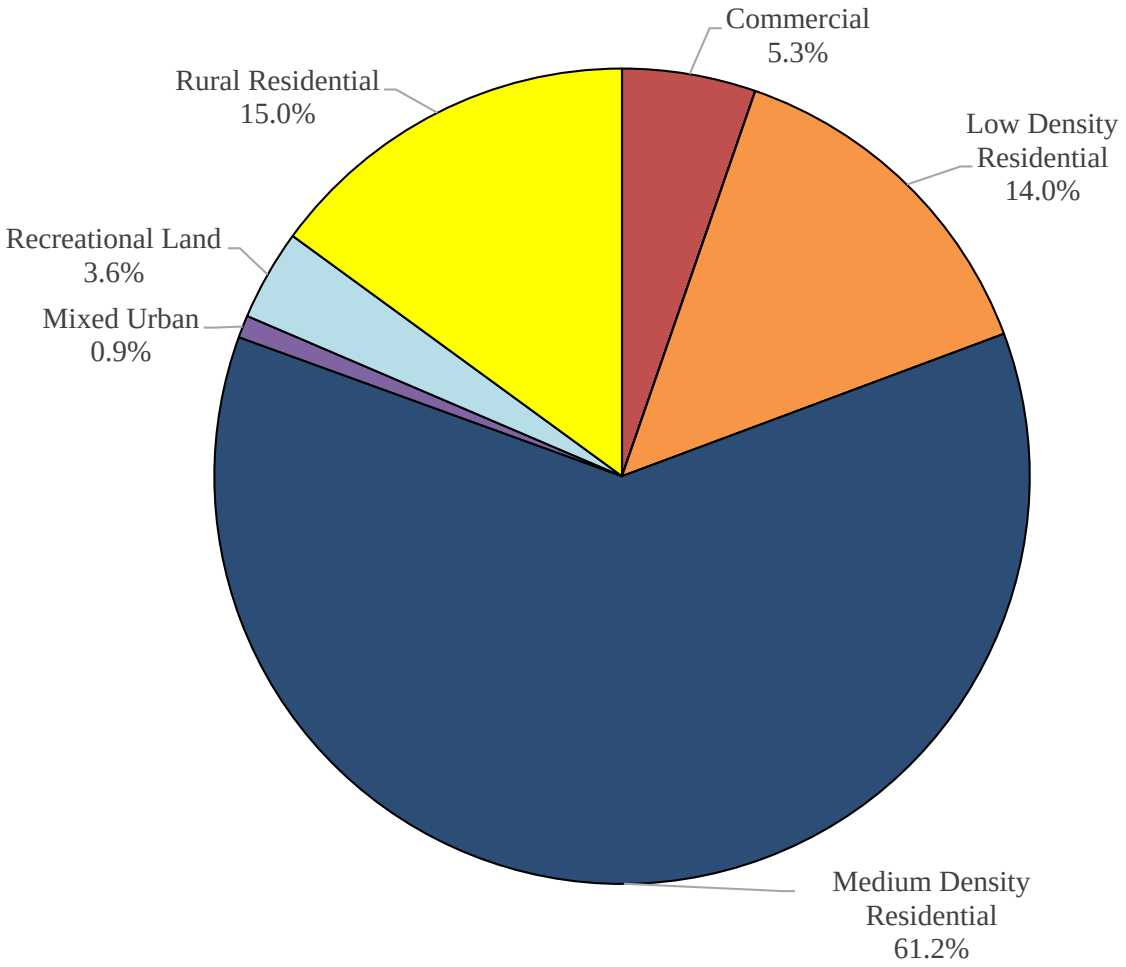


Figure 3: Pie chart illustrating the various types of urban land use in Fair Haven

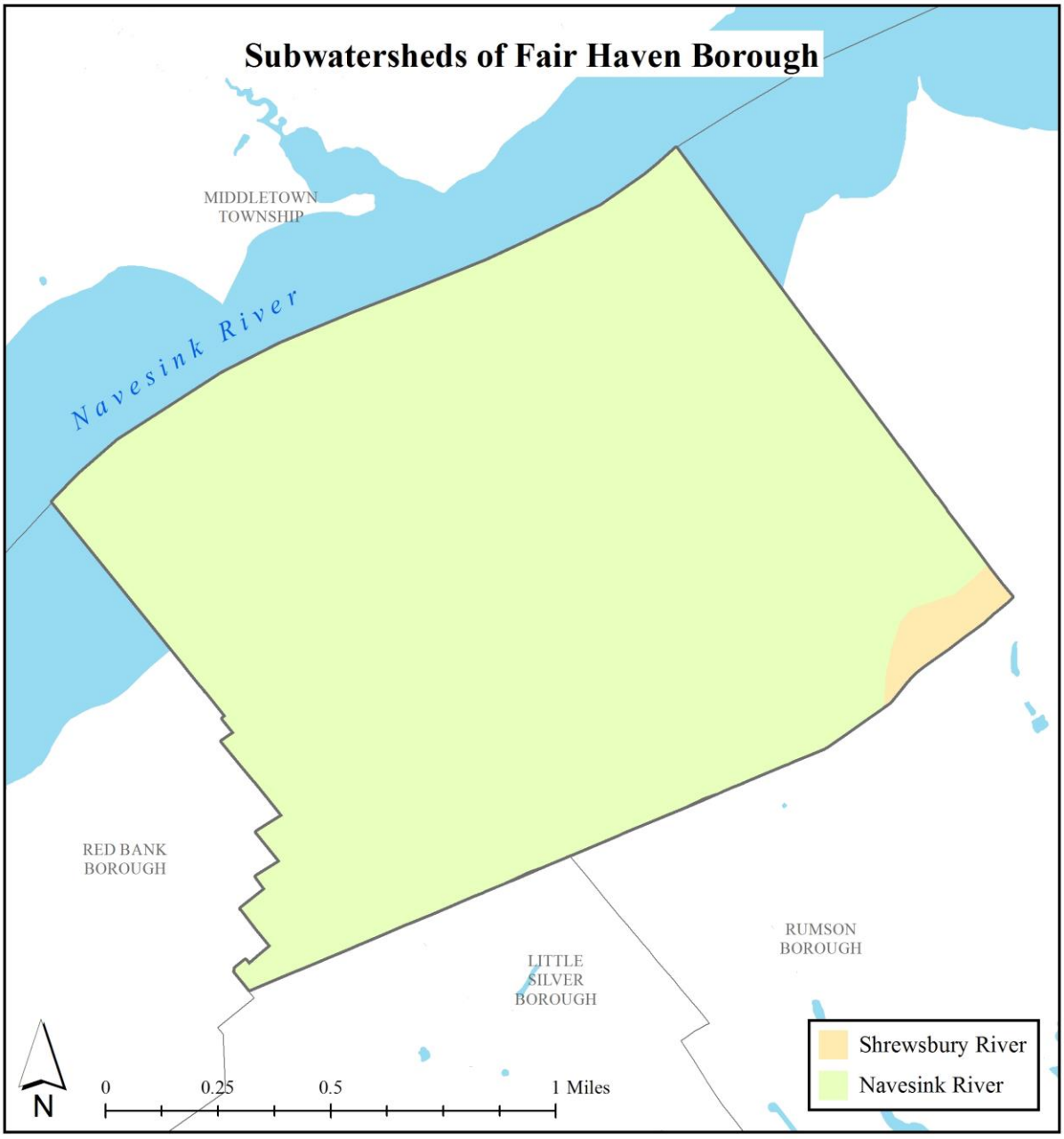


Figure 4: Map of the subwatersheds in Fair Haven

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 Fair Haven 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.

Fir

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 Fair Haven. 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

[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

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.

Bioretention systems/rain gardens

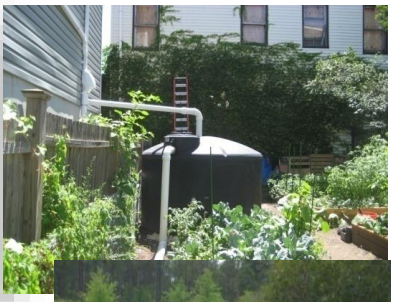
These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating a wildlife habitat while managing stormwater runoff. Bioretention systems also can be used in soils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

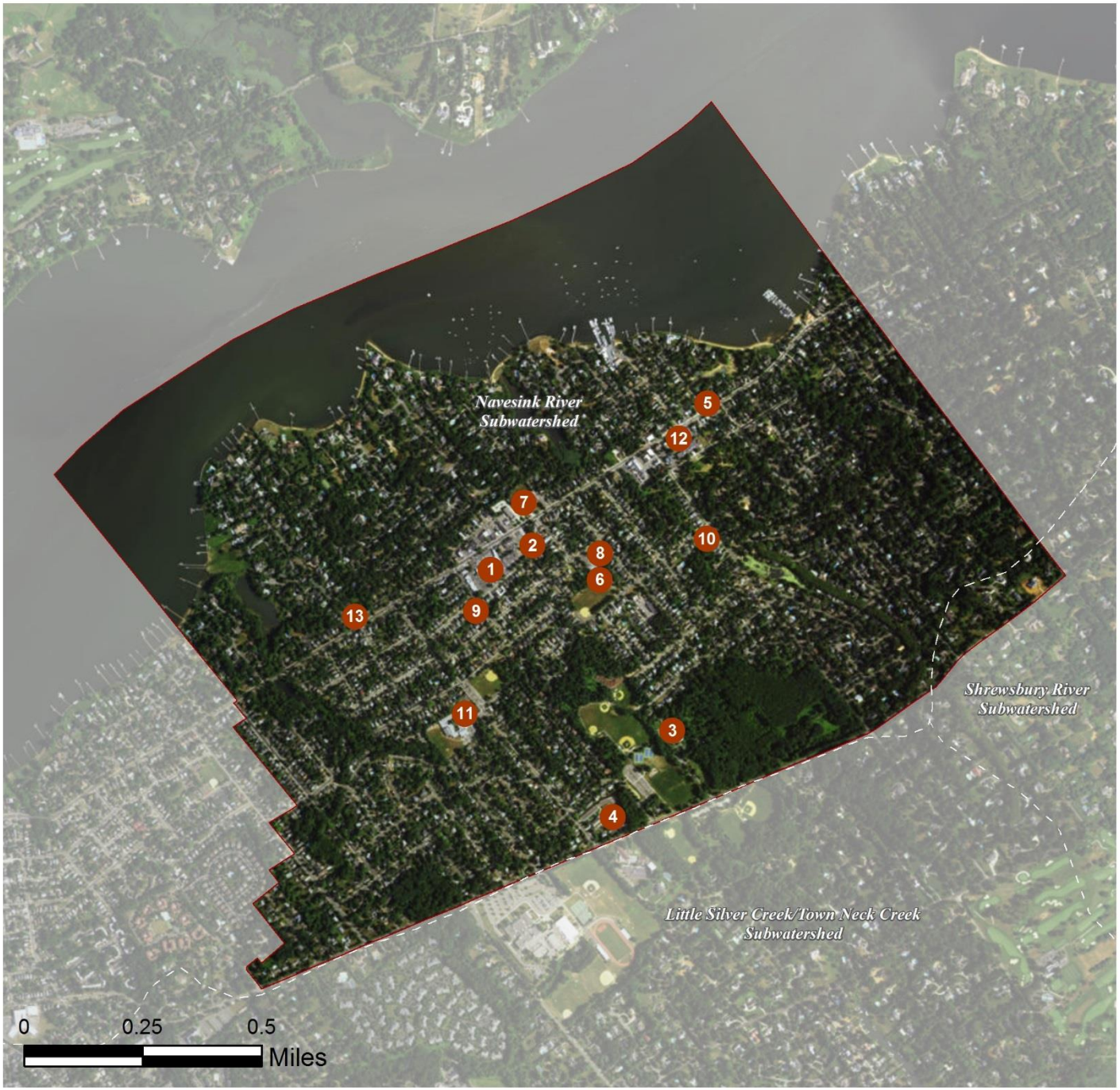
Conclusion

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

FAIR HAVEN BOROUGH: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE NAVESINK RIVER SUBWATERSHED:

1. ACME Shopping Center/Fair Haven Martial Arts
2. Boynton & Boynton Insurance
3. Christ Church United Methodist Church
4. Church of the Nativity
5. Fair Haven Animal Hospital
6. Fair Haven Police Department
7. Fair Haven Volunteer Fire Company
8. Fisk Chapel AME Church
9. Kingdom Hall of Jehova's Witnesses
10. Knights of Columbus
11. Knollwood School
12. Smart Start Preschool
13. Two Rivers Animal Hospital

b. Proposed Green Infrastructure Concepts

ACME SHOPPING CENTER / FAIR HAVEN MARTIAL ARTS

Subwatershed: Navesink River

Site Area: 191,219 sq. ft.

Address: 576 River Road
Fair Haven, NJ 07704

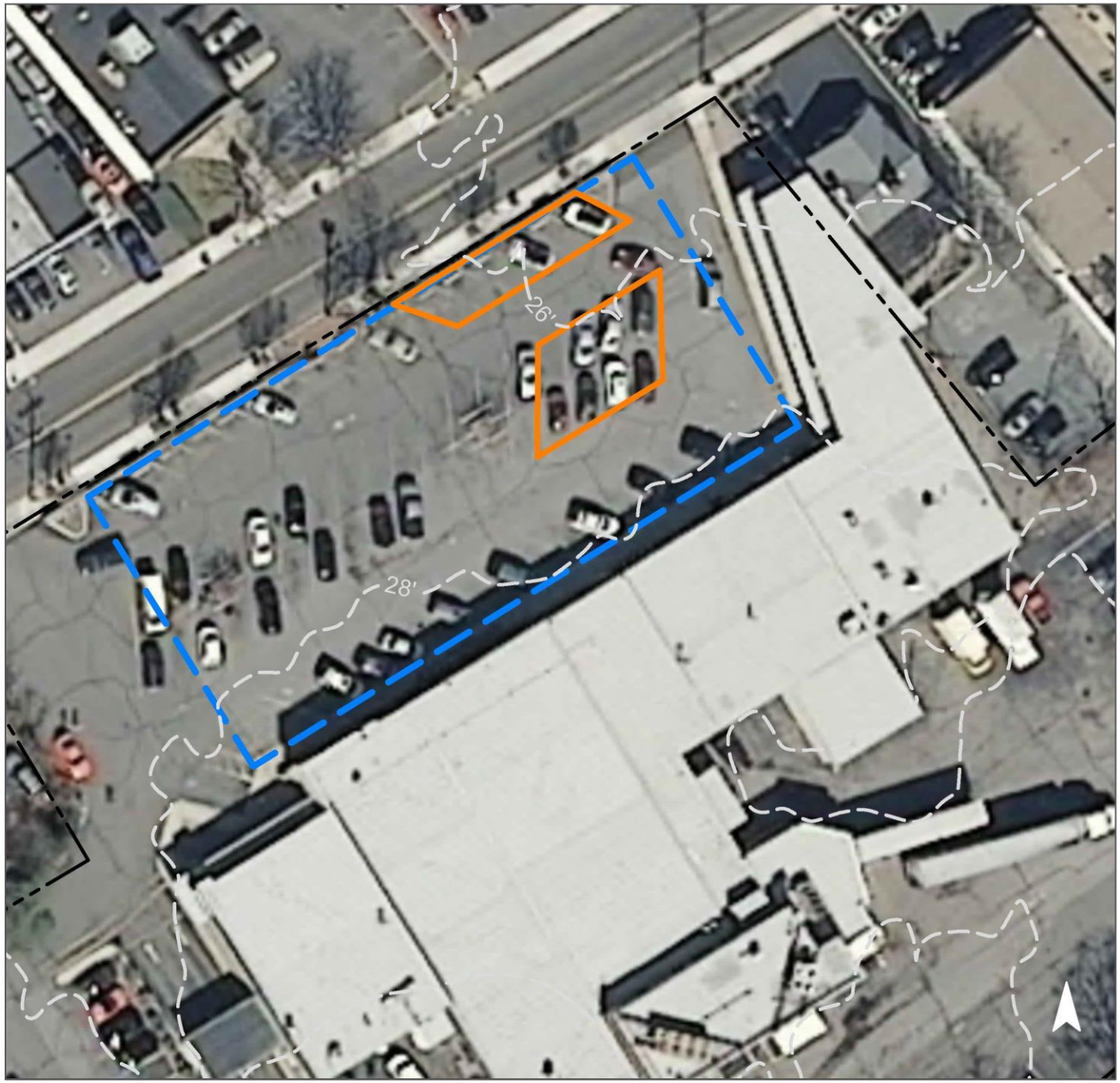
Block and Lot: Block 32, Lot 2

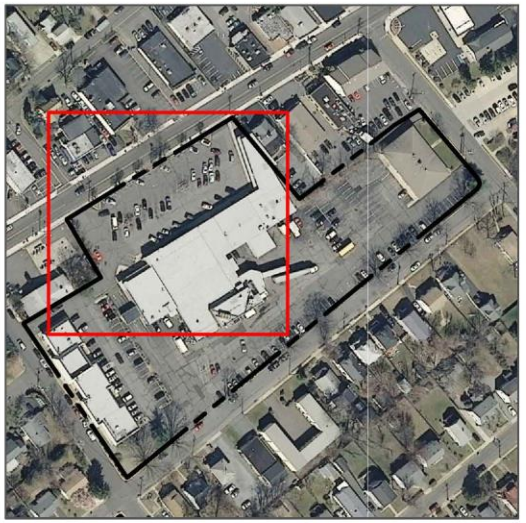
Parking spots in the ACME and Fair Haven Martial Arts parking lots can be replaced with porous asphalt to capture and infiltrate stormwater. A rain garden can be installed adjacent to the Fair Haven Martial Arts building to capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests 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"
90	172,097	8.3	86.9	790.2	0.134	4.72

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	0.024	4	1,855	0.07	235	$1,175
Pervious pavements	0.953	160	38,181	1.43	5,100	$127,500

GREEN INFRASTRUCTURE RECOMMENDATIONS



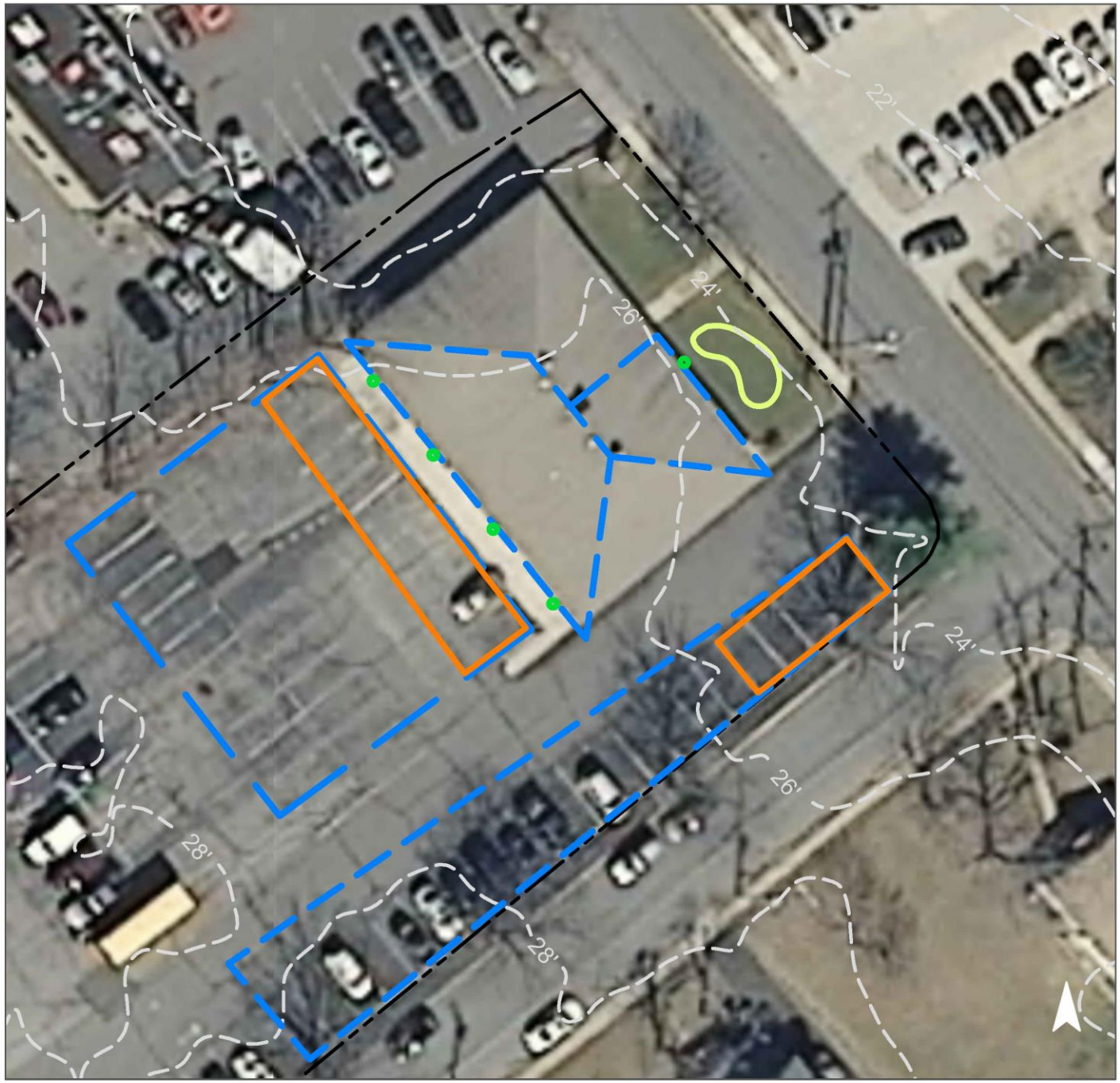


ACME

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

0 25' 50'

GREEN INFRASTRUCTURE RECOMMENDATIONS



Fair Haven Martial Arts

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

0 20' 40'

BOYNTON & BOYNTON INSURANCE

Subwatershed: Navesink River

Site Area: 29,422 sq. ft.

Address: 21 Cedar Avenue
Fair Haven, NJ 07704

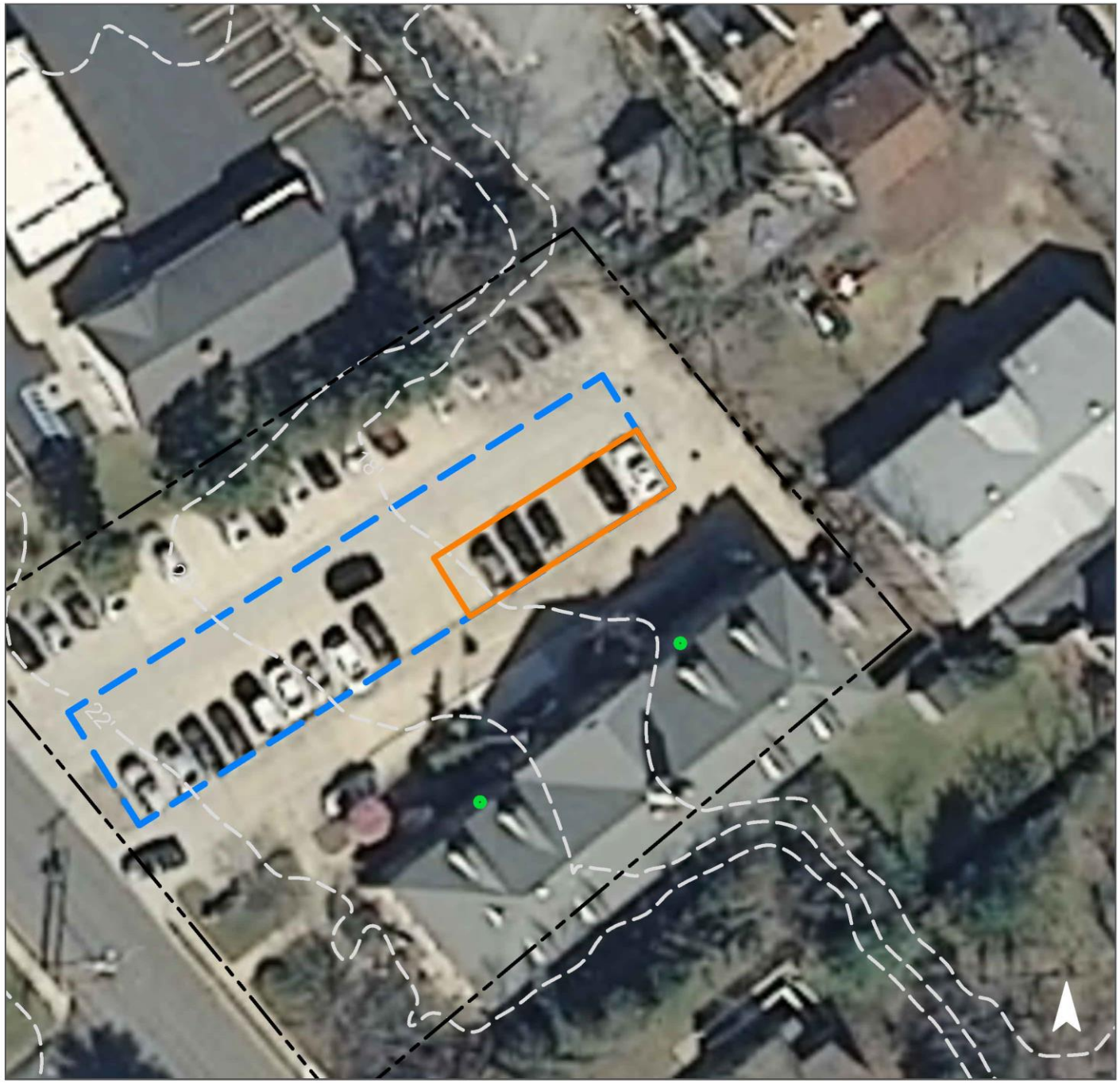
Block and Lot: Block 31, Lot 13

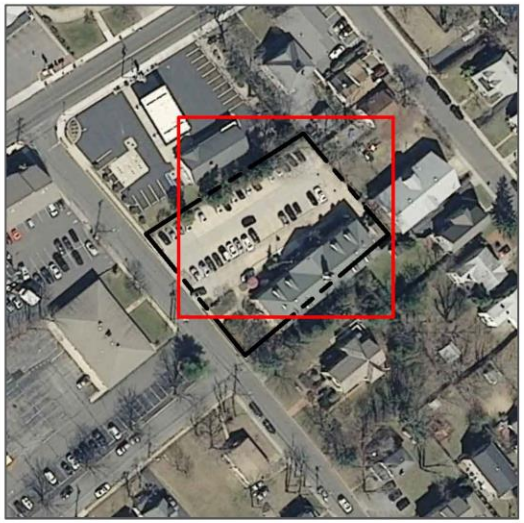
Parking spots north of the building can be replaced with porous asphalt to capture and infiltrate stormwater. Downspouts can be disconnected and redirected into existing vegetation. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
90	26,443	1.3	13.4	121.4	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
Pervious pavements	0.150	25	11,393	0.43	1,000	$25,000

GREEN INFRASTRUCTURE RECOMMENDATIONS





Boynton & Boynton Insurance

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

0 50' 100'

CHRIST CHURCH UNITED METHODIST

Subwatershed: Navesink River

Site Area: 219,992 sq. ft.

Address: 300 Ridge Road
Fair Haven, NJ 07704

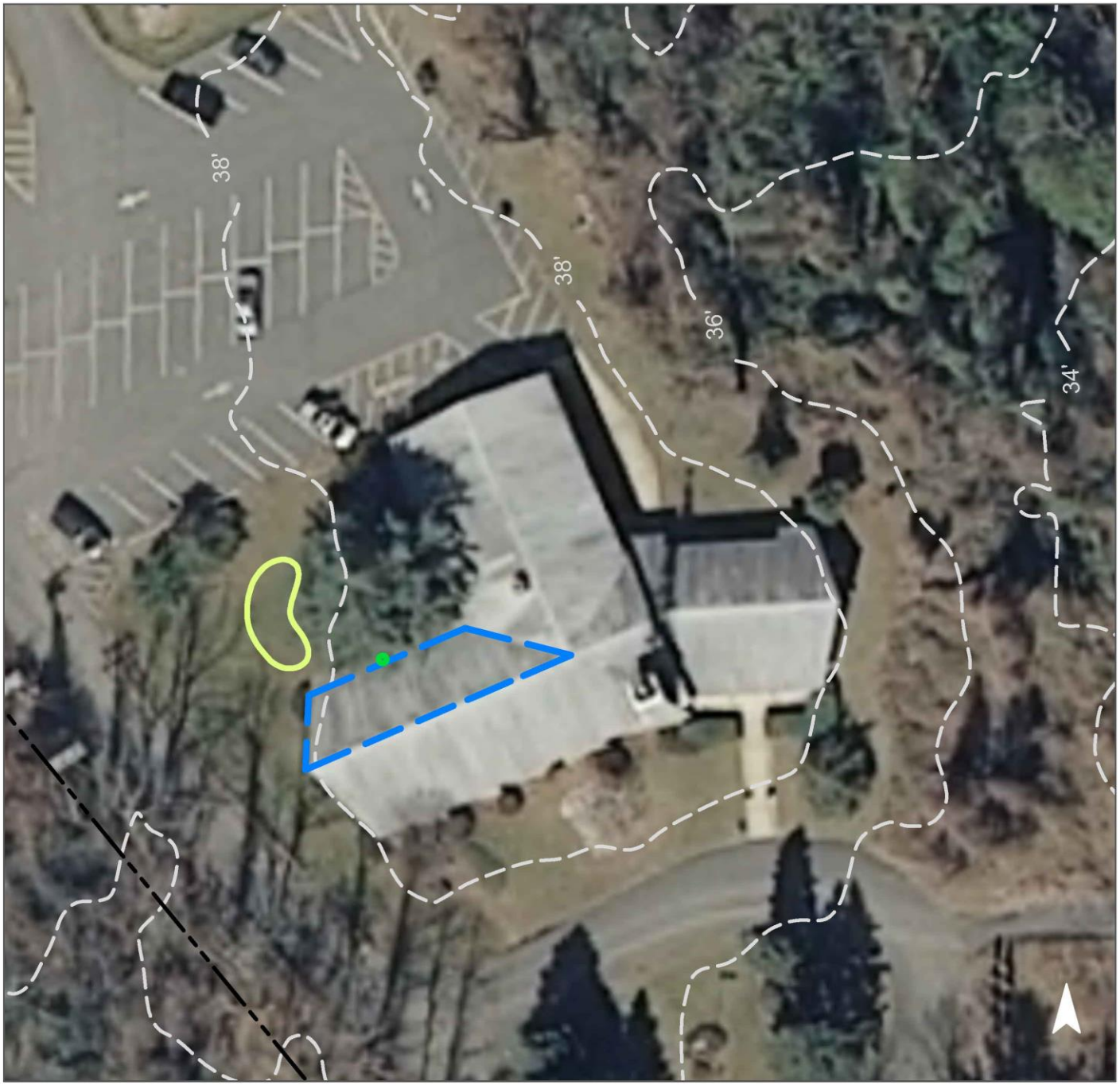
Block and Lot: Block 77, Lot 107

Installing a rain garden adjacent to the building can 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"
16	34,954	1.7	17.7	160.5	0.027	0.96

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	0.027	5	2,080	0.08	265	$1,325

GREEN INFRASTRUCTURE RECOMMENDATIONS



Christ Church United Methodist

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

0 20' 40'

CHURCH OF THE NATIVITY

Subwatershed: Navesink River

Site Area: 270,032 sq. ft.

Address: 180 Ridge Road
Fair Haven, NJ 07704

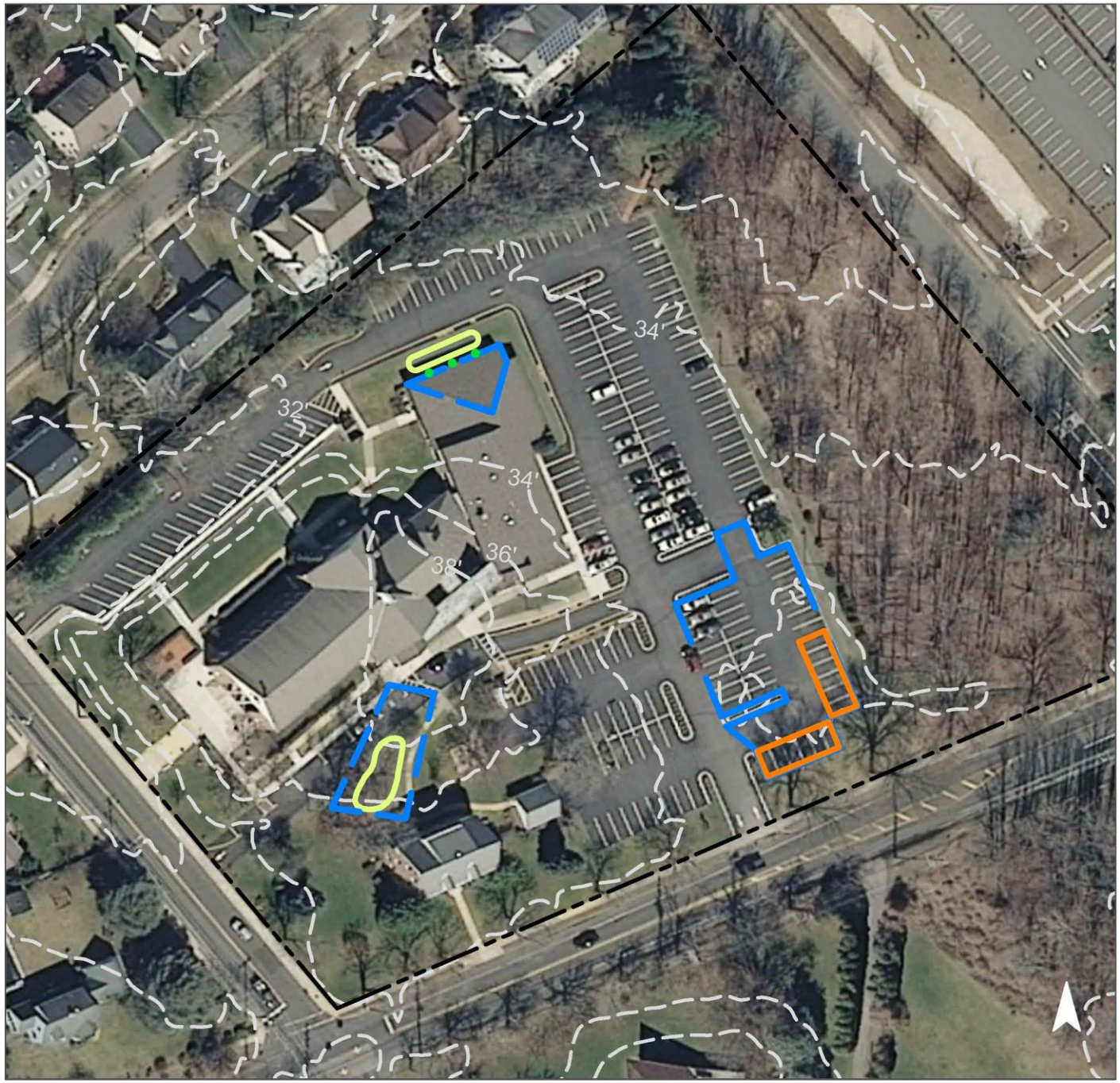
Block and Lot: Block 77.2, Lot 6

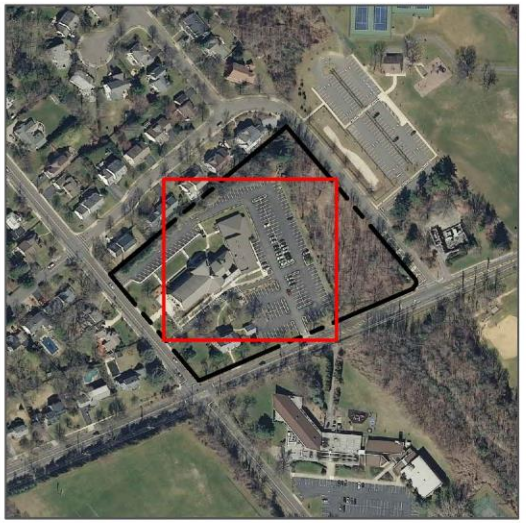
Two rain gardens can be installed adjacent to the church to capture, treat, and infiltrate roof runoff. Parking spots south east of the church can be made porous to capture and infiltrate runoff from the parking lot. A preliminary soil assessment suggests that the soils have suitable drainage characteristics 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	120,045	5.8	60.6	551.2	0.094	3.29

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	0.124	21	9,410	0.36	1,200	$6,000

GREEN INFRASTRUCTURE RECOMMENDATIONS





Church of the Nativity

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

0 50' 100'

FAIR HAVEN ANIMAL HOSPITAL

Subwatershed: Navesink River

Site Area: 8,918 sq. ft.

Address: 823 River Road
Fair Haven, NJ 07704

Block and Lot: Block 51, Lot 21.1

Installing a rain garden adjacent to the building can 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"
86	7,657	0.4	3.9	35.2	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	0.010	2	763	0.03	100	$500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Fair Haven Animal Hospital

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

0 10' 20'

FAIR HAVEN POLICE DEPARTMENT

Subwatershed: Navesink River

Site Area: 131,916 sq. ft.

Address: 35 Fisk Street
Fair Haven, NJ 07704

Block and Lot: Block 39, Lot 20

Parking spots west of the building can be replaced with porous asphalt to capture and infiltrate stormwater. A rain garden can be built 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"
39	51,406	2.5	26.0	236.0	0.040	1.41

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	0.023	4	1,773	0.07	225	$1,125
Pervious pavements	0.289	48	9,351	0.35	1,980	$49,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Fair Haven Police Department

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

0 20' 40'

FAIR HAVEN VOLUNTEER FIRE COMPANY

Subwatershed: Navesink River

Site Area: 104,506 sq. ft.

Address: 645 River Road
Fair Haven, NJ 07704

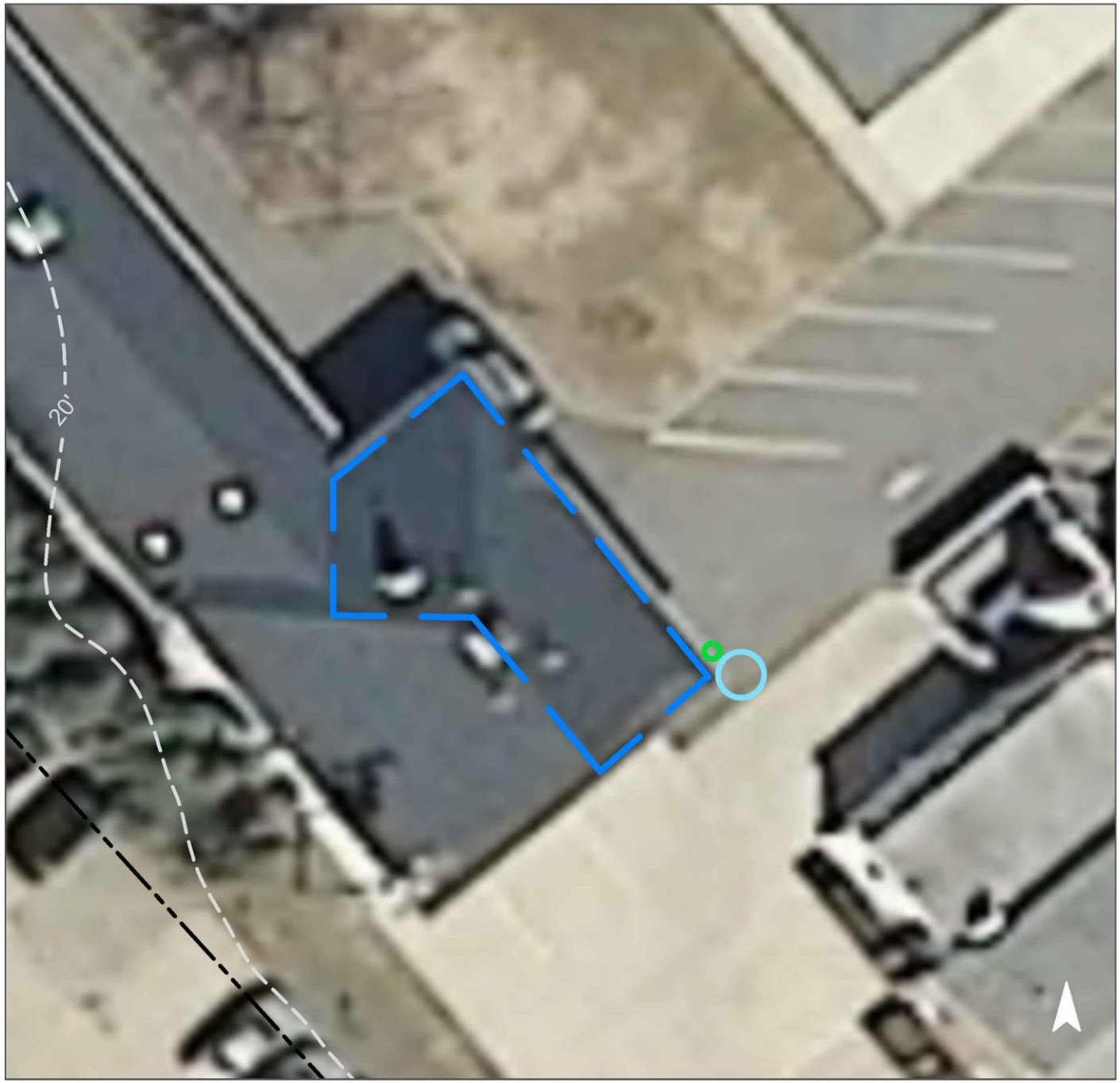
Block and Lot: Block 25, Lot 9

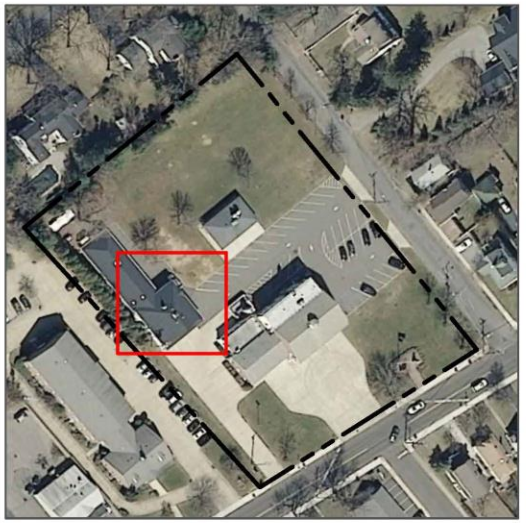
A cistern can be installed to harvest rainwater from the roof. The water can be used for watering gardens, washing vehicles, or for other non-potable uses. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
42	44,350	2.1	22.4	203.6	0.035	1.22

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	0.030	5	2,446	0.08	1,000 (gal)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS





Fair Haven Volunteer Fire Co.

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

0 10' 20'

FISK CHAPEL AME CHURCH

Subwatershed: Navesink River

Site Area: 35,428 sq. ft.

Address: 38 Fisk Street
Fair Haven, NJ 07704

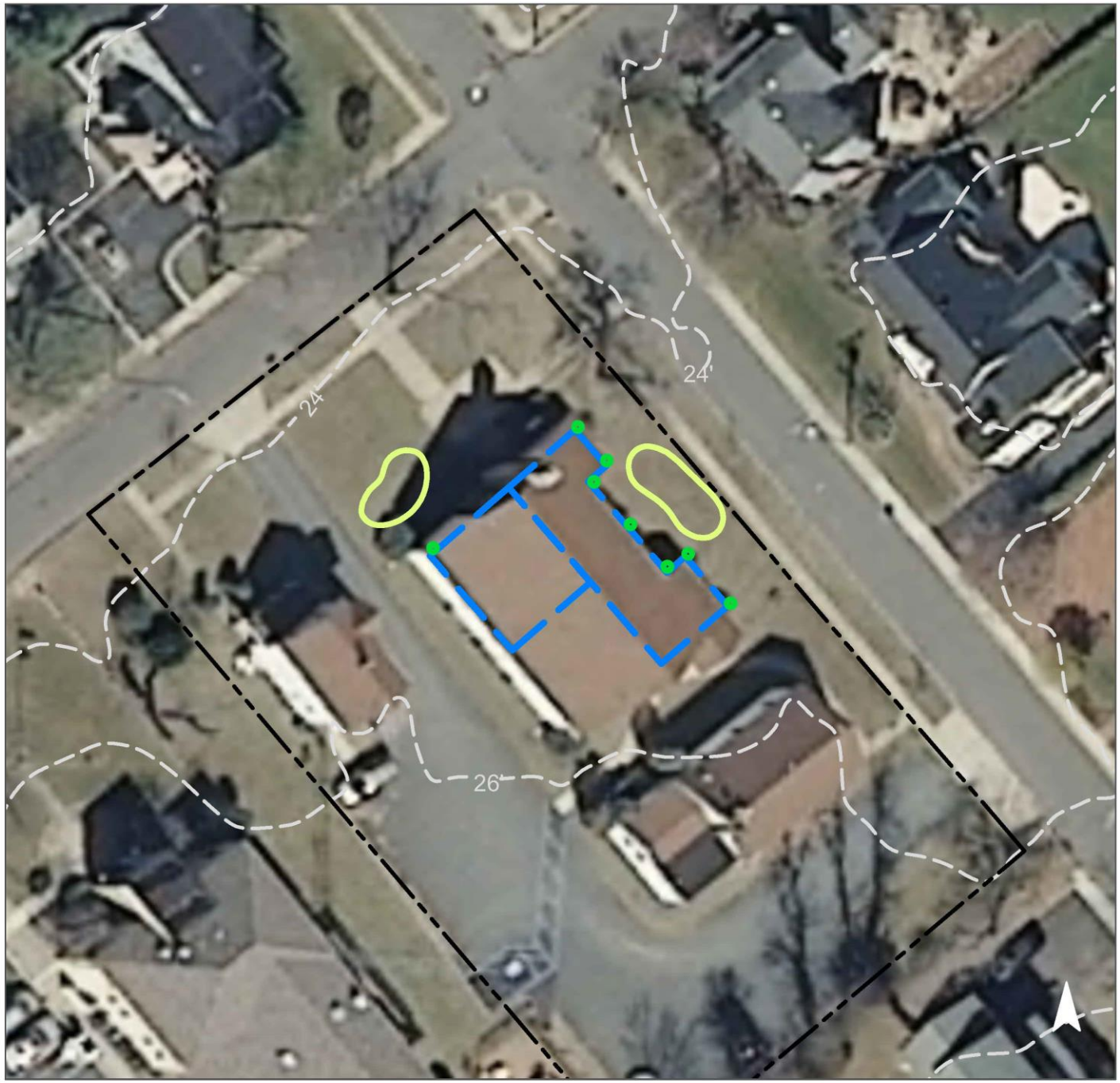
Block and Lot: Block 39, Lot 11

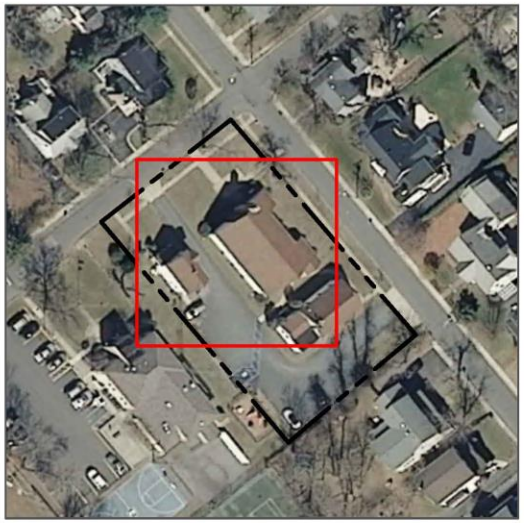
Two rain gardens can be installed, one east of the church and one northwest of the church to capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
38	13,538	0.7	6.8	62.2	0.011	0.37

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	0.055	9	4,159	0.16	5285	$2,625

GREEN INFRASTRUCTURE RECOMMENDATIONS





Fisk Chapel AME Church

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

0 20' 40'

KINGDOM HALL OF JEHOVAH'S WITNESSES

Subwatershed: Navesink River

Site Area: 13,079 sq. ft.

Address: 58 Forman Street
Fair Haven, NJ 07704

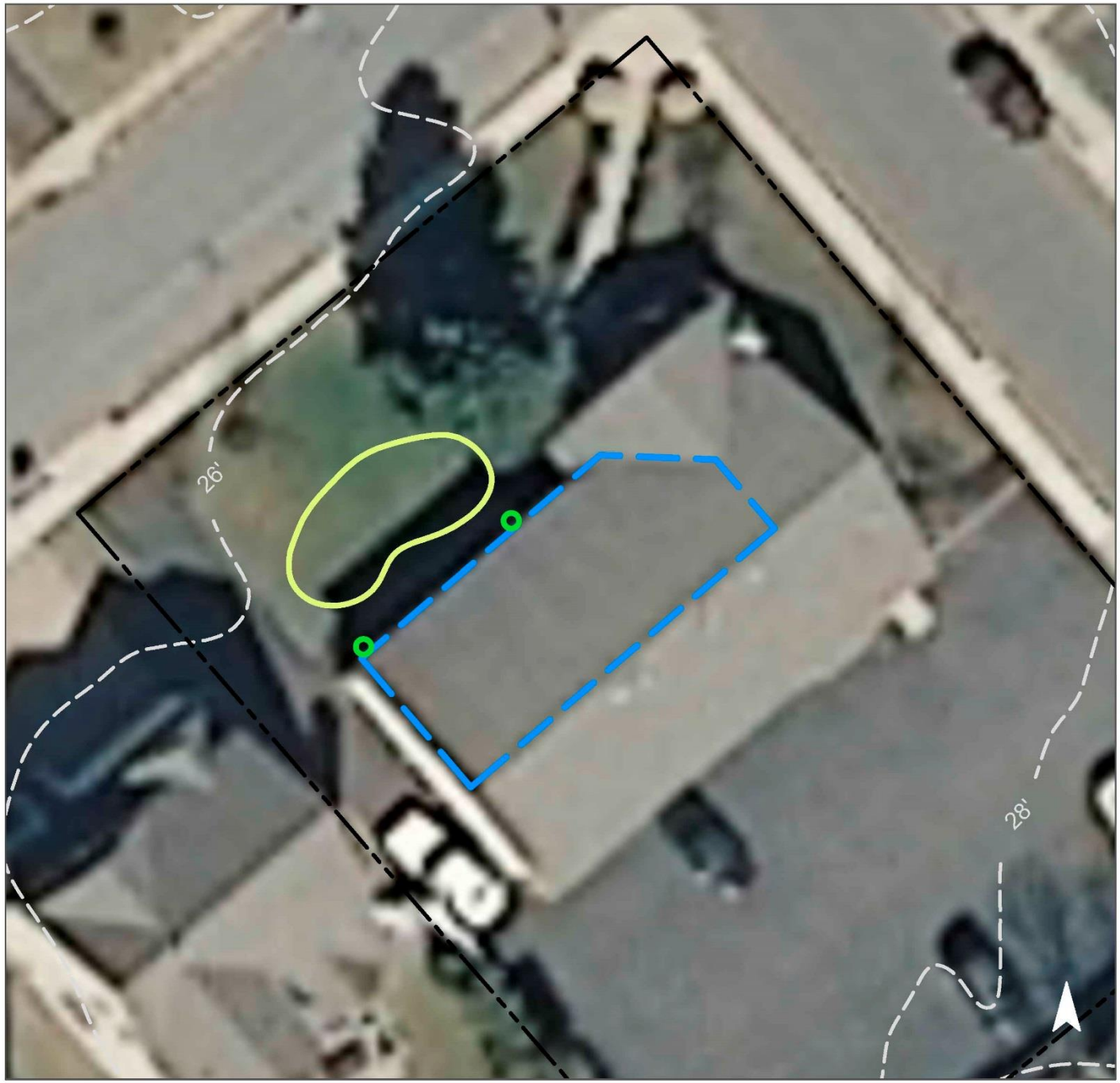
Block and Lot: Block 34, Lot 19

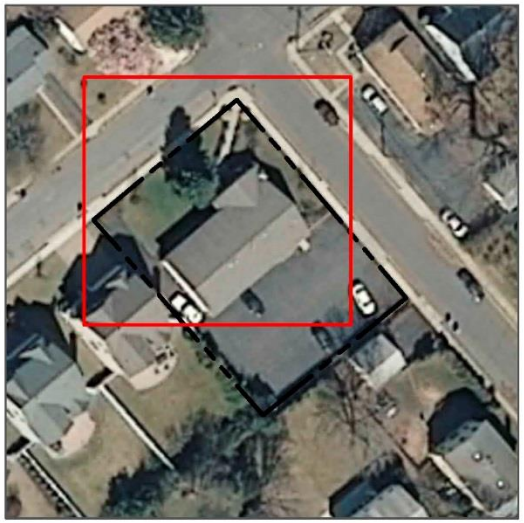
A rain garden can be installed adjacent to the hall to capture, treat, and infiltrate roof runoff. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
90	11,771	0.6	5.9	54.0	0.009	0.32

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	0.031	5	2,364	0.09	300	$1,500

GREEN INFRASTRUCTURE RECOMMENDATIONS





Kingdom Hall of Jehovah's Witnesses

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

0 10' 20'

KNIGHTS OF COLUMBUS

Subwatershed: Navesink River

Site Area: 25,315 sq. ft.

Address: 200 Fair Haven Road
Fair Haven, NJ 07704

Block and Lot: Block 42, Lot 5

Parking spots north of the 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.

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	8,859	0.4	4.5	40.7	0.007	0.24

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	0.036	6	2,700	0.10	245	$6,125

GREEN INFRASTRUCTURE RECOMMENDATIONS

Knights of Columbus

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

0 10' 20'

KNOLLWOOD SCHOOL

Subwatershed: Navesink River

Site Area: 45,944 sq. ft.

Address: 224 Hance Road
Fair Haven, NJ 07704

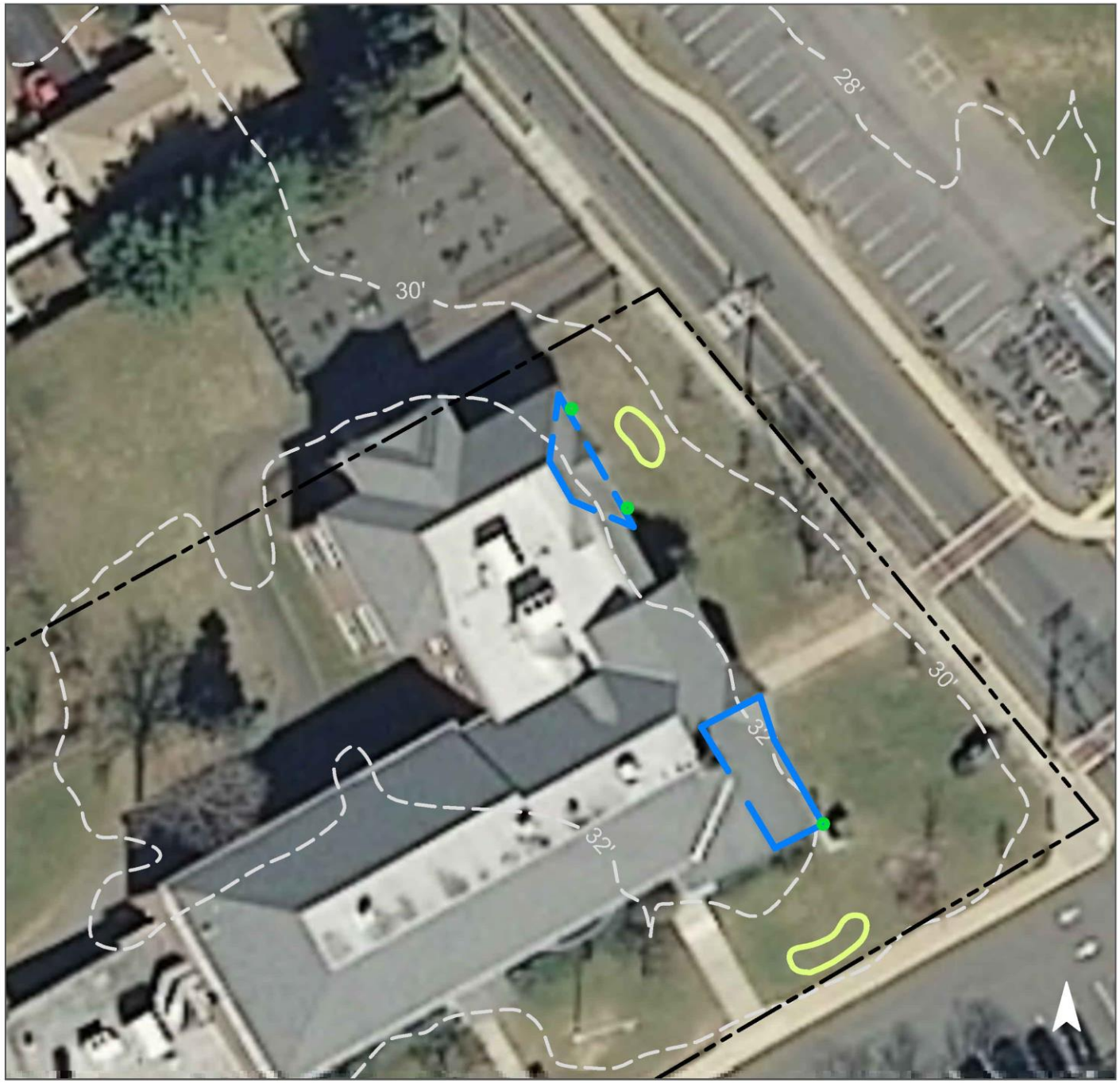
Block and Lot: Block 12, Lot 95

Installing rain gardens adjacent to the school on the south and east sides can 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"
80	36,755	1.8	18.6	168.8	0.029	1.01

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	0.022	4	554	0.02	200	$1,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Knollwood School

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

0 20' 40'

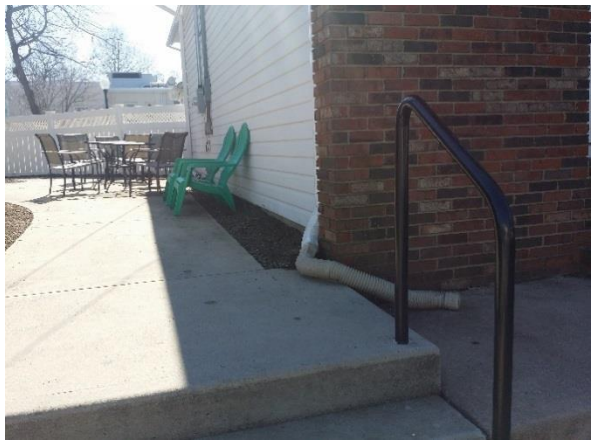
SMART START PRESCHOOL

Subwatershed: Navesink River

Site Area: 10,337 sq. ft.

Address: 786 River Road
Fair Haven, NJ 07704

Block and Lot: Block 52, Lot 6

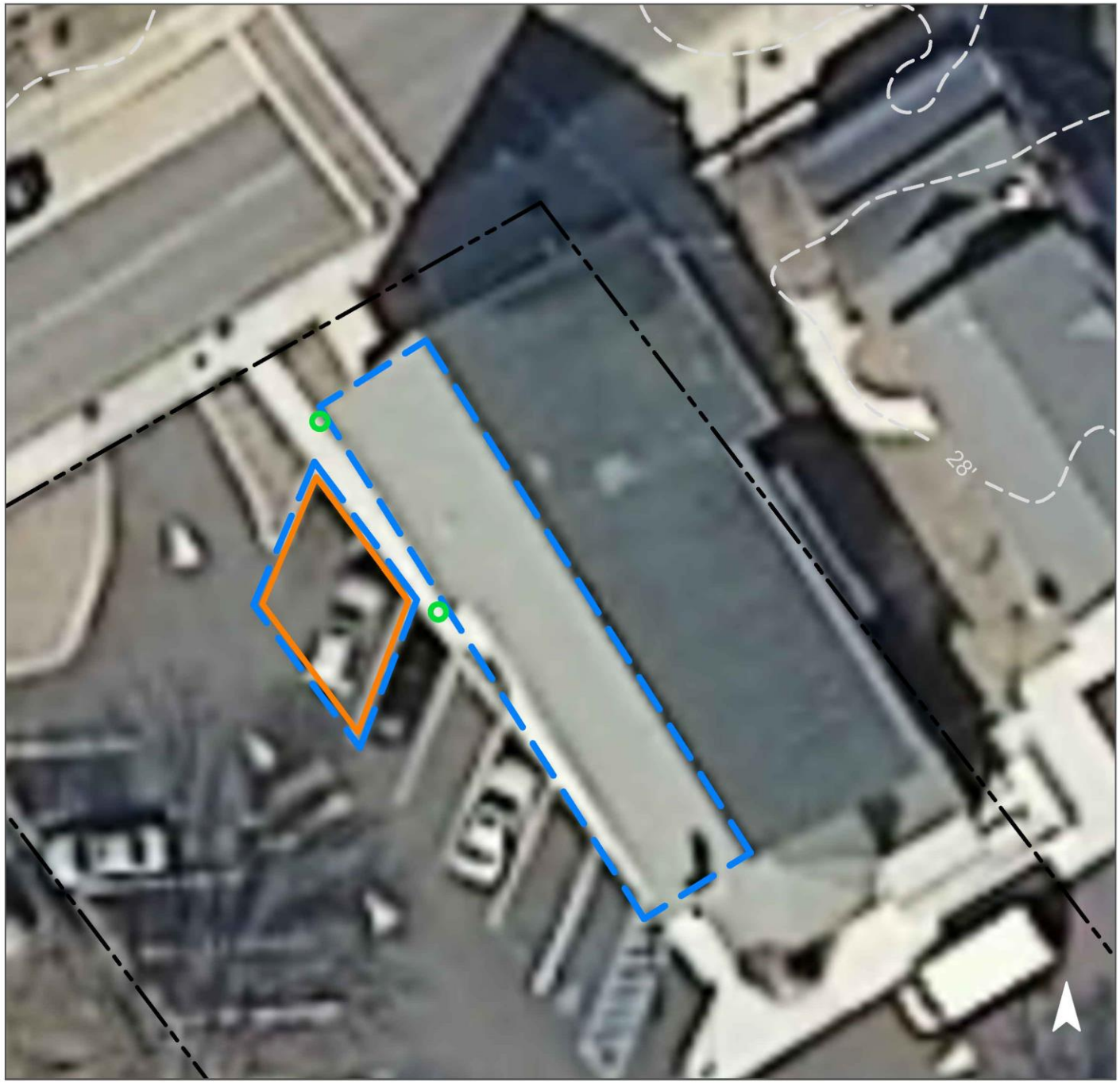


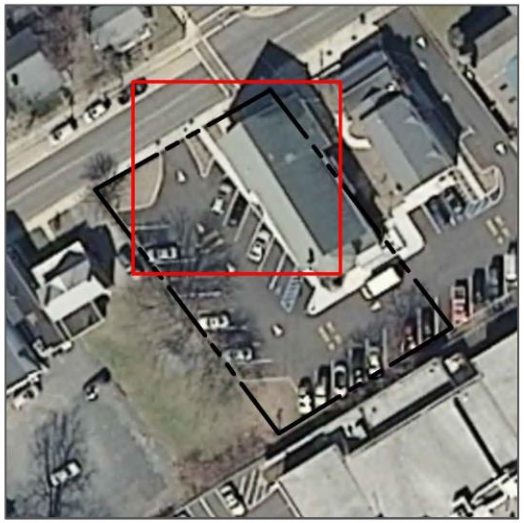
Parking spots west of the building can be replaced with porous asphalt to capture and infiltrate stormwater. A preliminary soil assessment suggests that the soils have suitable drainage characteristics for green infrastructure.

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"
90	9,303	0.4	4.7	42.7	0.007	0.26

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	0.045	7	1,047	0.04	305	$7,625

GREEN INFRASTRUCTURE RECOMMENDATIONS





Smart Start Preschool

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

0 10' 20'

TWO RIVERS ANIMAL HOSPITAL

Subwatershed: Navesink River

Site Area: 26,024 sq. ft.

Address: 457 River Road
Fair Haven, NJ 07704

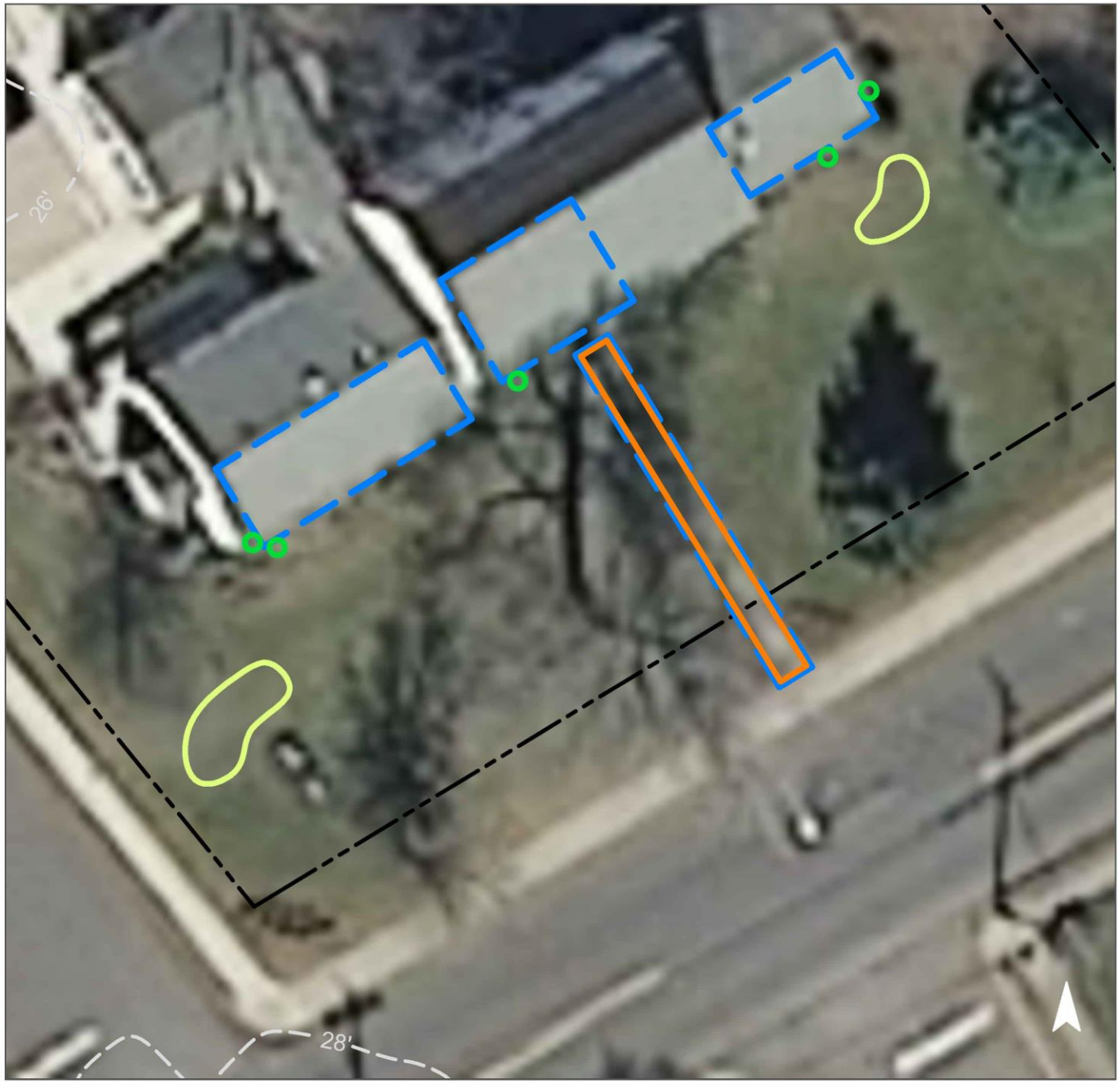
Block and Lot: Block 23, Lot 4

The sidewalk from the building to the road can be replaced with pervious pavement to capture and infiltrate stormwater. Rain gardens can be installed off of the southeast and southwest corners of the hospital 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"
30	7,807	0.4	3.9	35.8	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	0.015	3	1,167	0.05	150	$750
Pervious pavements	0.029	5	2,207	0.08	200	$5,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Two Rivers Animal Hospital

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

0 10' 20'

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 (SF)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
NAVESINK RIVER SUBWATERSHED	**25.53**	**1,112,133**			**26.3**	**275.2**	**2,502.2**		**544,987**	**0.425**	**14.95**
ACME Shopping Center/ Fair Haven Martial Arts											
Total Site Info	4.39	191,219	32	2	8.3	86.9	790.2	90	172,097	0.134	4.72
Boynton & Boynton Insurance											
Total Site Info	0.68	29,422	31	13	1.3	13.4	121.4	90	26,443	0.021	0.73
Christ Church United Methodist											
Total Site Info	5.05	219,992	77	107	1.7	17.7	160.5	16	34,954	0.027	0.96
Church of the Nativity											
Total Site Info	6.20	270,032	77.2	6	5.8	60.6	551.2	44	120,045	0.094	3.29
Fair Haven Animal Hospital											
Total Site Info	0.20	8,918	51	21.1	0.4	3.9	35.2	86	7,657	0.006	0.21
Fair Haven Police Department											
Total Site Info	3.03	131,916	39	20	2.5	26.0	236.0	39	51,406	0.040	1.41
Fair Haven Volunteer Fire Company											
Total Site Info	2.40	104,506	25	9	2.1	22.4	203.6	42	44,350	0.035	1.22
Fisk Chapel AME Church											
Total Site Info	0.81	35,428	39	11	0.7	6.8	62.2	38	13,538	0.011	0.37
Kingdom Hall of Jehovah's Witnesses											
Total Site Info	0.30	13,079	34	19	0.6	5.9	54.0	90	11,771	0.009	0.32
Knights of Columbus											
Total Site Info	0.58	25,315	42	5	0.4	4.5	40.7	35	8,859	0.007	0.24
Knollwood School											
Total Site Info	1.05	45,944	12	95	1.8	18.6	168.8	80	36,755	0.029	1.01
Smart Start Preschool											
Total Site Info	0.24	10,337	52	6	0.4	4.7	42.7	90	9,303	0.007	0.26

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 (SF)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
Two Rivers Animal Hospital											
Total Site Info	0.60	26,024	23	4	0.4	3.9	35.8	30	7,807	0.006	0.21

d. Summary of Proposed Green Infrastructure Practices

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area		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 %
		Area (SF)	Area (ac)									
	NAVESINK RIVER SUBWATERSHED	**69,860**	**1.64**	**1.865**	**312**	**91,449**	**3.44**	**13,030**			**$238,750**	**12.8%**
1	**ACME Shopping Center/ Fair Haven Martial Arts**											
	Bioretention systems/rain gardens	940	0.02	0.024	4	1,855	0.07	235	5	SF	$1,175	0.5%
	Pervious pavements	36,570	0.84	0.953	160	38,181	1.43	5,100	25	SF	$127,500	21.2%
	Total Site Info	**37,510**	**0.86**	**0.977**	**164**	**40,036**	**1.50**	**5,335**			**$128,675**	**21.8%**
2	**Boynton & Boynton Insurance**											
	Pervious pavements	5,775	0.13	0.150	25	11,393	0.43	1,000	25	SF	$25,000	21.8%
	Total Site Info	**5,775**	**0.13**	**0.150**	**25**	**11,393**	**0.43**	**1,000**			**$25,000**	**21.8%**
3	**Christ Church United Methodist**											
	Bioretention systems/rain gardens	1,055	0.02	0.027	5	2,080	0.08	265	5	SF	$1,325	3.0%
	Total Site Info	**1,055**	**0.02**	**0.027**	**5**	**2,080**	**0.08**	**265**			**$1,325**	**3.0%**
4	**Church of the Nativity**											
	Bioretention systems/rain gardens	4,760	0.11	0.124	21	9,410	0.36	1,200	5	SF	$6,000	4.0%
	Total Site Info	**4,760**	**0.11**	**0.124**	**21**	**9,410**	**0.36**	**1,200**			**$6,000**	**4.0%**
5	**Fair Haven Animal Hospital**											
	Bioretention systems/rain gardens	385	0.01	0.010	2	763	0.03	100	5	SF	$500	5.0%
	Total Site Info	**385**	**0.01**	**0.010**	**2**	**763**	**0.03**	**100**			**$500**	**5.0%**
6	**Fair Haven Police Department**											
	Bioretention systems/rain gardens	900	0.02	0.023	4	1,773	0.07	225	5	SF	$1,125	1.8%
	Pervious pavements	11,080	0.25	0.289	48	9,351	0.35	1,980	25	SF	$49,500	21.6%
	Total Site Info	**11,980**	**0.28**	**0.312**	**52**	**11,124**	**0.42**	**2,205**			**$50,625**	**23.3%**
7	**Fair Haven Volunteer Fire Company**											
	Rainwater harvesting system: cistern	1,170	0.03	0.030	5	2,446	0.08	1,000	2	gal	$2,000	2.6%
	Total Site Info	**1,170**	**0.03**	**0.030**	**5**	**2,446**	**0.08**	**1,000**			**$2,000**	**2.6%**
8	**Fisk Chapel AME Church**											
	Bioretention systems/rain gardens	2,110	0.05	0.055	9	4,159	0.16	525	5	SF	$2,625	15.6%
	Total Site Info	**2,110**	**0.05**	**0.055**	**9**	**4,159**	**0.16**	**525**			**$2,625**	**15.6%**

Summary of Proposed 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)	($)		($)	%
9	**Kingdom Hall of Jehovah's Witnesses**											
	Bioretention systems/rain gardens	1,200	0.03	0.031	5	2,364	0.09	300	5	SF	$1,500	10.2%
	Total Site Info	**1,200**	**0.03**	**0.031**	**5**	**2,364**	**0.09**	**300**			**$1,500**	**10.2%**
10	**Knights of Columbus**											
	Pervious pavements	1,370	0.03	0.036	6	2,700	0.10	245	25	SF	$6,125	15.5%
	Total Site Info	**1,370**	**0.03**	**0.036**	**6**	**2,700**	**0.10**	**245**			**$6,125**	**15.5%**
11	**Knollwood School**											
	Bioretention systems/rain gardens	835	0.02	0.022	4	554	0.02	200	5	SF	$1,000	2.3%
	Total Site Info	**835**	**0.02**	**0.022**	**4**	**554**	**0.02**	**200**			**$1,000**	**2.3%**
12	**Smart Start Preschool**											
	Pervious pavements	1,710	0.04	0.045	7	1,047	0.04	305	25	SF	$7,625	18.4%
	Total Site Info	**1,710**	**0.04**	**0.045**	**7**	**1,047**	**0.04**	**305**			**$7,625**	**18.4%**
13	**Two Rivers Animal Hospital**											
	Bioretention systems/rain gardens	590	0.01	0.015	3	1,167	0.05	150	5	SF	$750	7.6%
	Pervious pavements	1,120	0.03	0.029	5	2,207	0.08	200	25	SF	$5,000	14.3%
	Total Site Info	**1,710**	**0.04**	**0.045**	**7**	**3,374**	**0.13**	**350**			**$5,750**	**21.9%**