RUTGERS
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Draft

Impervious Cover Reduction Action Plan
for
Manchester Township, Ocean County, New Jersey

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

March 26, 2020

WILLIAM PENN
FOUNDATION

ACKNOWLEDGEMENTS:

This document has been prepared by the Rutgers Cooperative Extension Water Resources Program, with funding and direction from the William Penn Foundation and the New Jersey Agricultural Experiment Station, to highlight green infrastructure opportunities within Manchester Township. We would like to thank the William Penn Foundation, the New Jersey Agricultural Experiment Station, and Manchester Township for their input and support in creating this document.

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New Jersey Agricultural Experiment Station

WILLIAM PENN FOUNDATION

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Introduction

Located in Ocean County, New Jersey, Manchester Township covers approximately 82.69 square miles. Figures 1 and 2 illustrate that Manchester Township is dominated by forest land use. A total of 17.6% of the municipality's land use is classified as urban. Of the urban land in Manchester Township, high density residential is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection's (NJDEP) 2015 land use/land cover geographical information system (GIS) data layer categorizes Manchester 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 Manchester Township. Based upon the 2015 NJDEP land use/land cover data, approximately 8.7% of Manchester Township has impervious cover. This level of impervious cover suggests that the streams in Manchester Township likely range from sensitive to impacted streams. [1]

Methodology

Manchester Township contains portions of fifteen subwatersheds (Figure 4). For this impervious cover reduction action plan, projects have been identified in five 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] Schuler, T.R., L. Fraley-McNeal, and K. Cappiella. 2009. Is Impervious Cover Still Important? Review of Recent Research. *Journal of Hydrologic Engineering* 14 (4): 309-315.

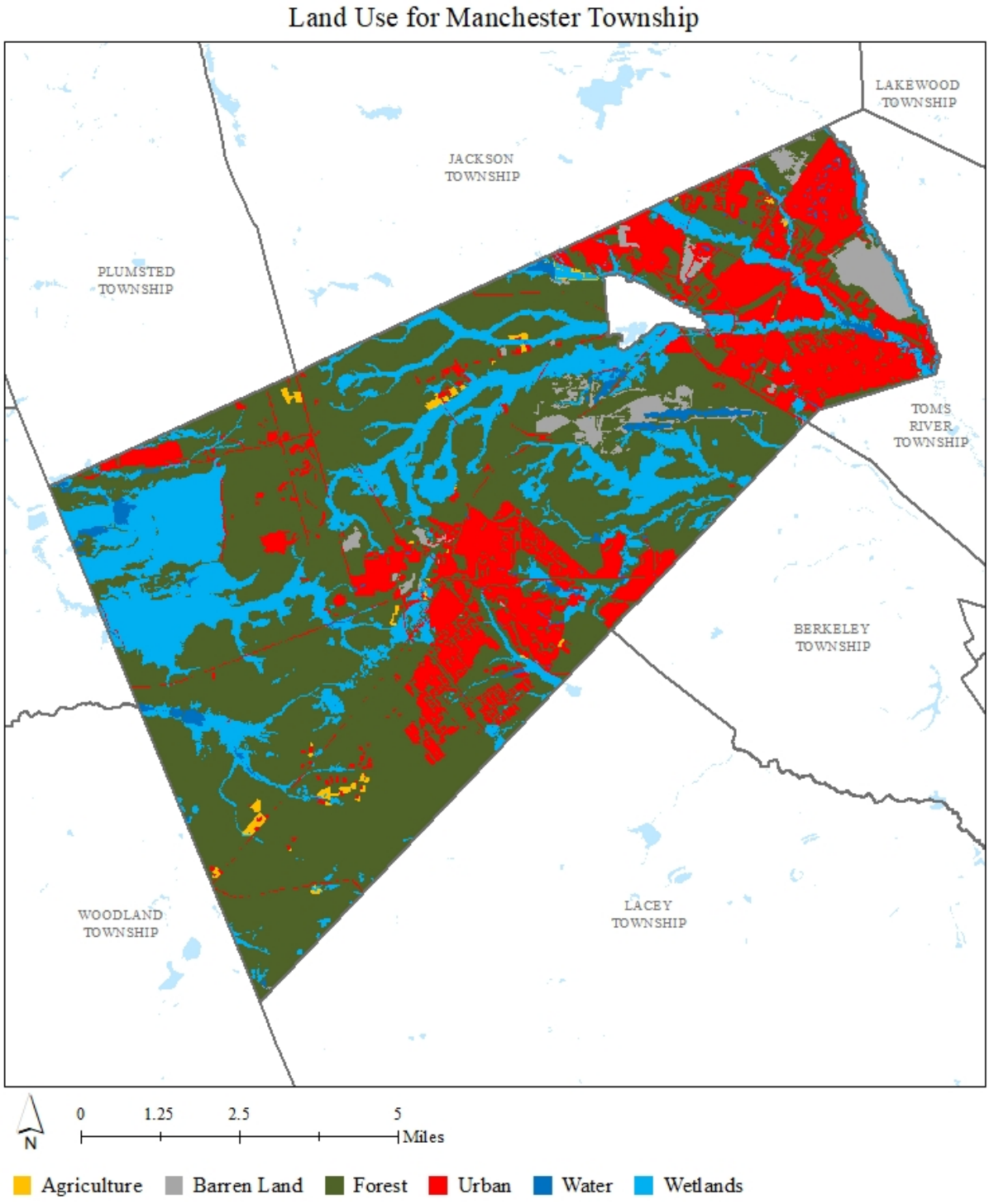


Figure 1: Map illustrating the land use in Manchester Township

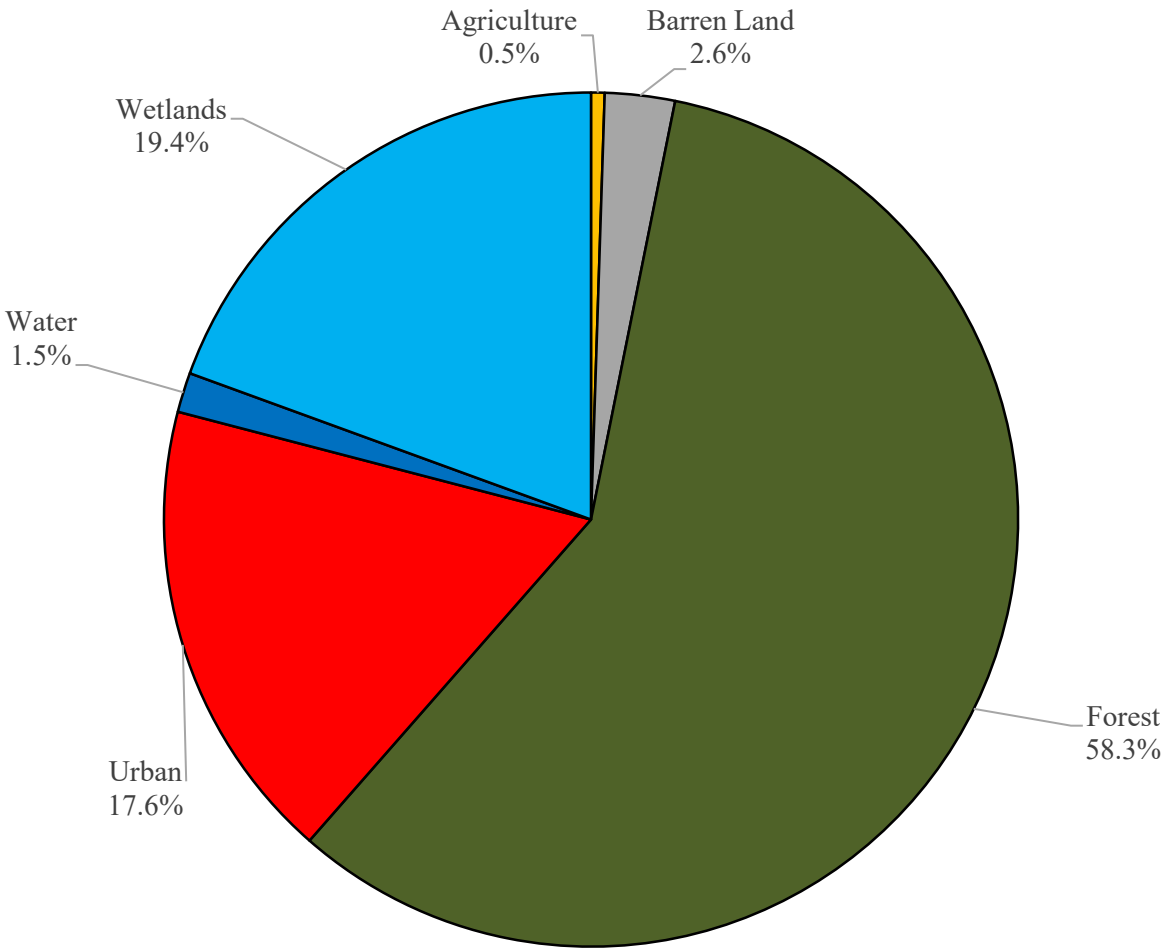


Figure 2: Pie chart illustrating the land use in Manchester Township

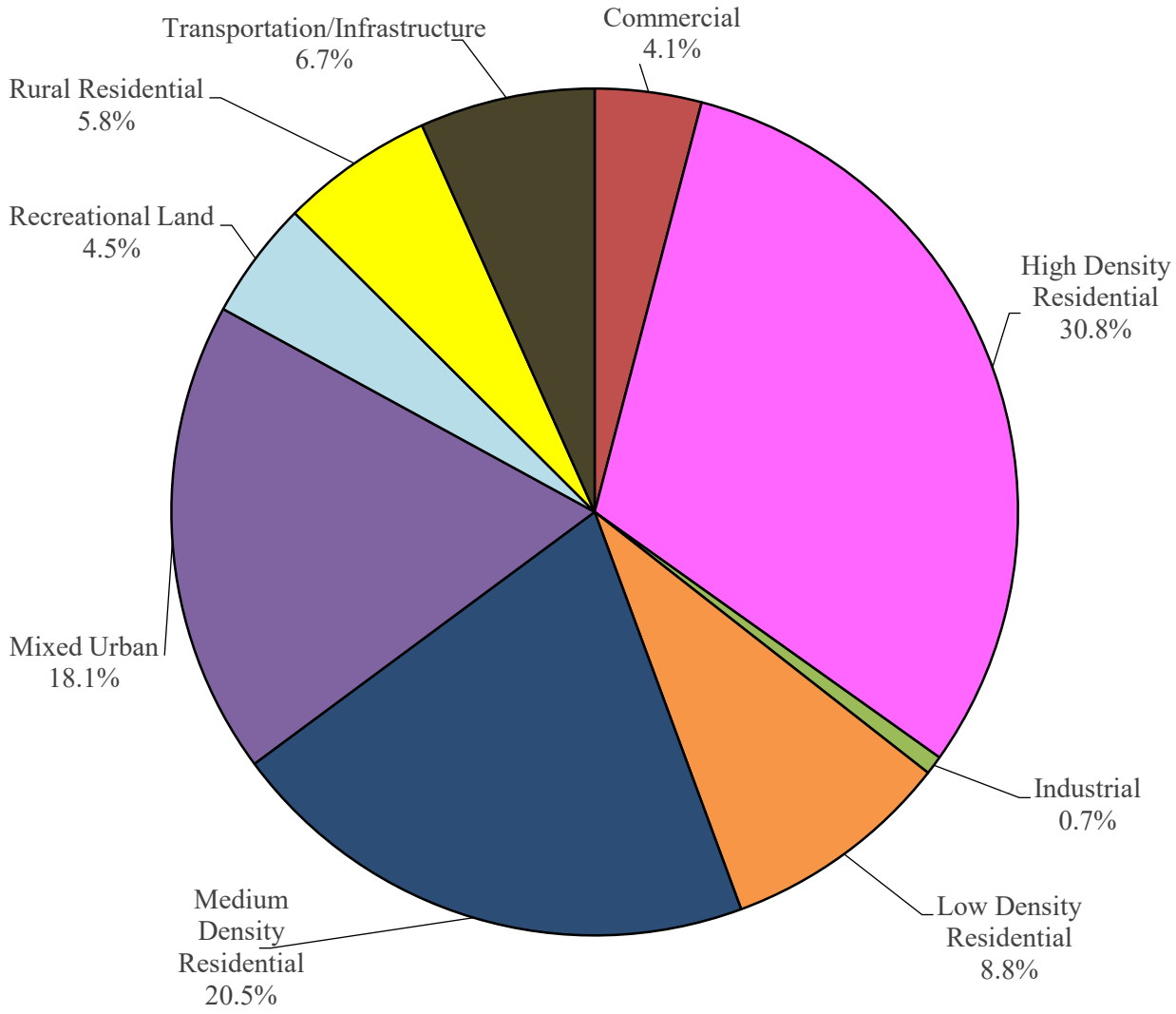


Figure 3: Pie chart illustrating the various types of urban land use in Manchester Township

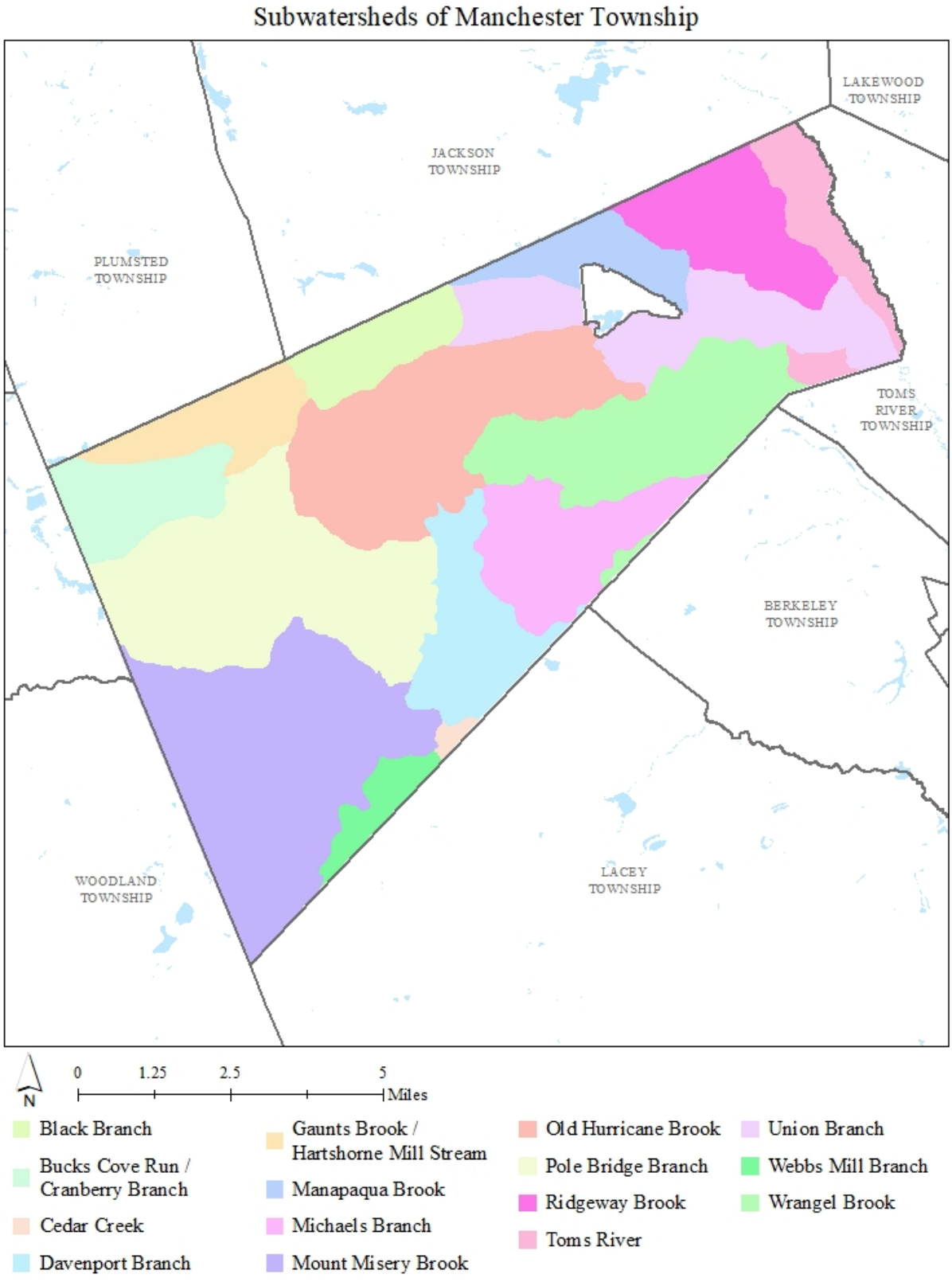


Figure 4: Map of the subwatersheds in Manchester Township

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 2015 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 Manchester 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 Bernardsville. 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 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.

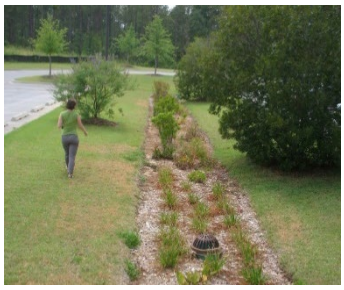
Downspout planter boxes

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

Appendix A contains information on potential project sites where green infrastructure practices could be installed as well as information on existing site conditions. The recommended green infrastructure practices and the drainage area that the green infrastructure practices can treat are identified for each potential project site. For each practice, the recharge potential, TSS removal potential, maximum volume reduction potential per storm, the peak reduction potential, and estimated costs 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

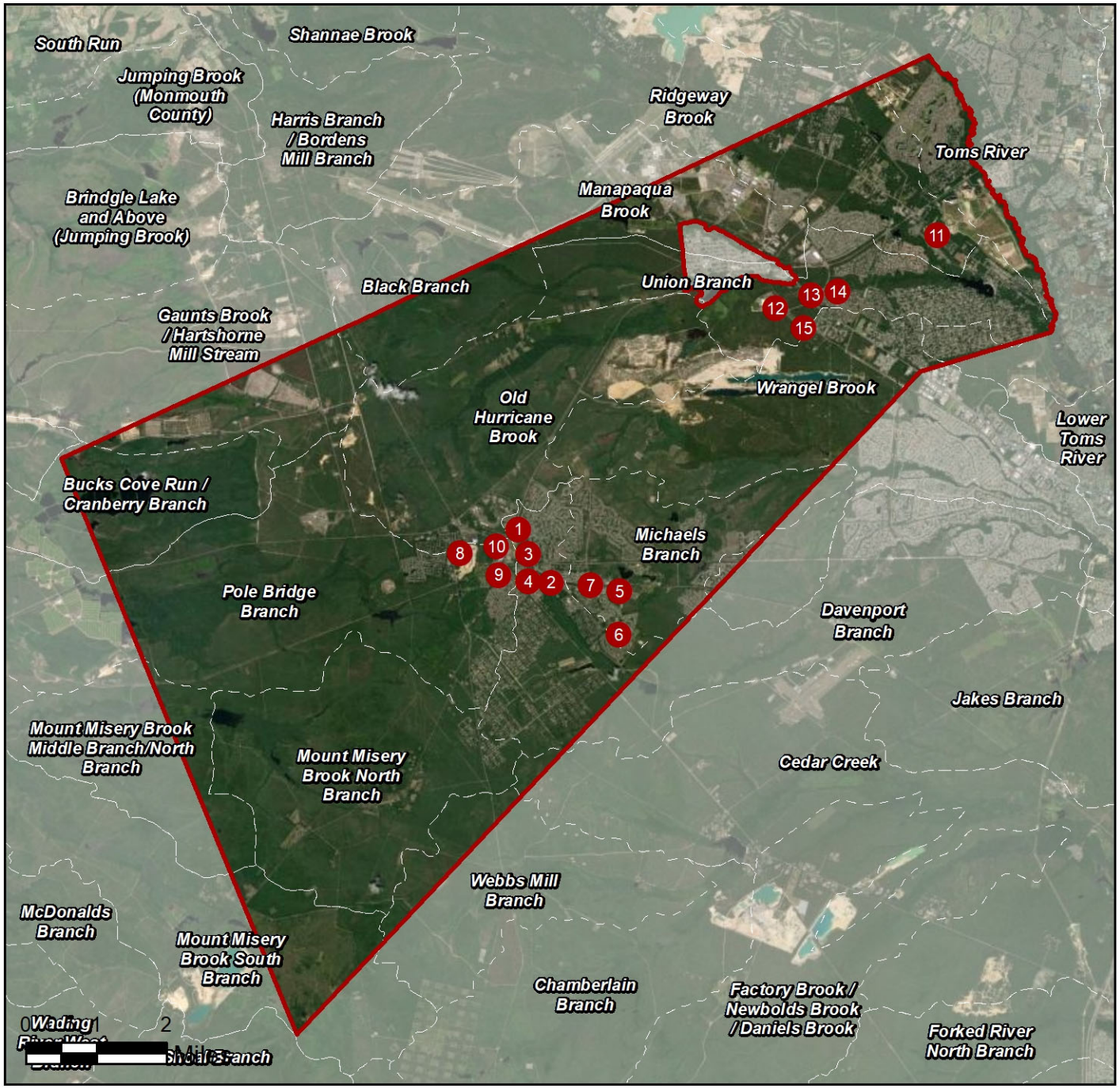
This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented by a wide variety of people such as boy scouts,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

Appendix A: Climate Resilient Green Infrastructure

a. Green Infrastructure Sites

MANCHESTER TOWNSHIP: GREEN INFRASTRUCTURE SITES



Sites Within The Davenport Branch Subwatershed

1. Bowker Park
2. Carmona-Bolen Home For Funerals
3. Whiting Bible Church
4. Whiting Volunteer First Aid

Sites Within The Michaels Branch Subwatershed

5. Crestwood Village Veterinary Clinic
6. Saint Elizabeth Ann Seton Church
7. Whiting United Methodist Church

Sites Within The Pole Bridge Branch Subwatershed

8. Manchester Board Of Education
9. Whiting Fire Station
10. Whiting Pharmacy

Sites Within The Ridgeway Brook Subwatershed

11. Manchester Township Middle School & Ridgeway Elementary School

Sites Within The Union Branch Subwatershed

12. Manchester Township High School
13. Manchester Township Police Department and Division of Social Services
14. Ocean County Library
15. Summit Park

b. Proposed Green Infrastructure Concepts

BOWKER PARK

Subwatershed: Davenport Branch

Site Area: 438,139 sq. ft.

Address: 315 Manchester Avenue
Whiting, NJ 08759

Block and Lot: Block 86.1, Lot 1

Parking spaces in the parking lot to the west of the baseball field can be converted to porous pavement to capture and infiltrate stormwater runoff from the asphalt. A rain garden can be installed in the turfgrass area near the dugout to capture, treat, and infiltrate stormwater runoff from the road. 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	69,616	3.4	35.2	319.6	0.054	1.91

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 system	0.226	38	16,600	0.62	2,170	$10,850
Pervious pavement	0.114	19	8,390	0.32	880	$22,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

BOWKER PARK

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

CARMONA-BOLEN HOME FOR FUNERALS LLC

Subwatershed: Davenport Branch

Site Area: 221,058 sq. ft.

Address: 66 Lacey Road
Manchester, NJ 08759

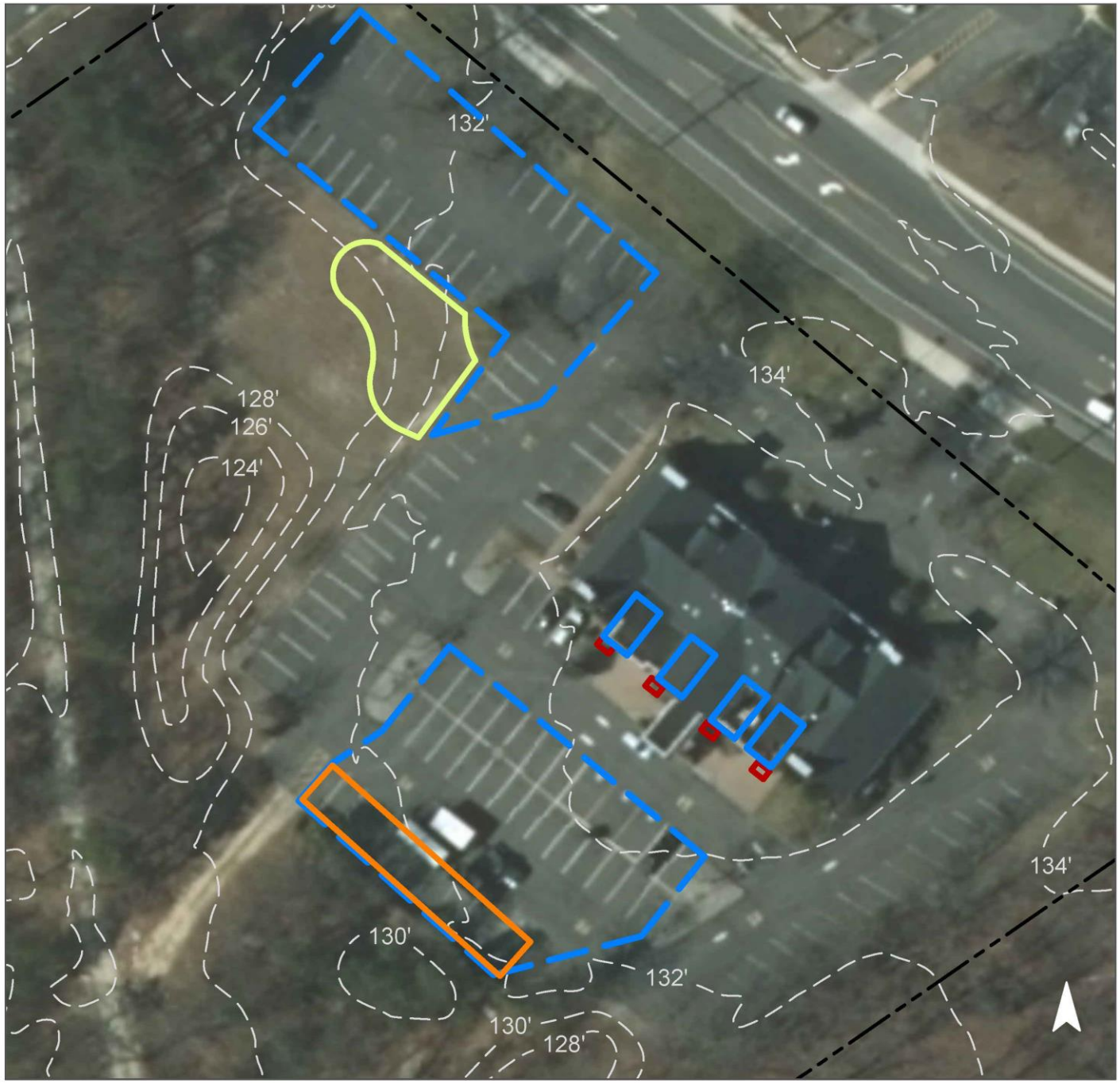
Block and Lot: Block 100, Lot 5

Parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the asphalt. A rain garden can be installed in the turfgrass to capture, treat, and infiltrate stormwater runoff from the parking lot. Planter boxes can be placed under downspouts where there is not have enough room to install a rain garden. 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"
17	38,174	1.8	19.3	175.3	0.030	1.05

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 system	0.026	4	1,910	0.07	2,500	$12,500
Pervious pavement	0.273	46	20,020	0.75	1,870	$46,750
Planter boxes	n/a	3	n/a	n/a	4 (boxes)	$4,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



CARMONA-BOLEN HOME FOR FUNERALS LLC

- bioretention system
- pervious pavement
- planter box
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

WHITING BIBLE CHURCH

Subwatershed: Davenport Branch

Site Area: 116,105 sq. ft.

Address: 95 Lacey Road
Whiting, NJ 08759

Block and Lot: Block 86.1, Lot 7.01

Rain gardens can be installed in the turfgrass area near the entrances of the building to capture, treat, and infiltrate stormwater runoff from the roof. Planter boxes can be placed under downspouts where there is not enough room to install a rain garden. 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	58,332	2.8	29.5	267.8	0.045	1.60

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	0.105	18	7,730	0.29	1,010	$5,050
Planter boxes	n/a	2	n/a	n/a	3 (boxes)	$3,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

WHITING BIBLE CHURCH

- bioretention system
- planter box
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

WHITING VOLUNTEER FIRST AID

Subwatershed: Davenport Branch

Site Area: 54,999 sq. ft.

Address: 82 Lacy Road
Whiting, NJ 08759

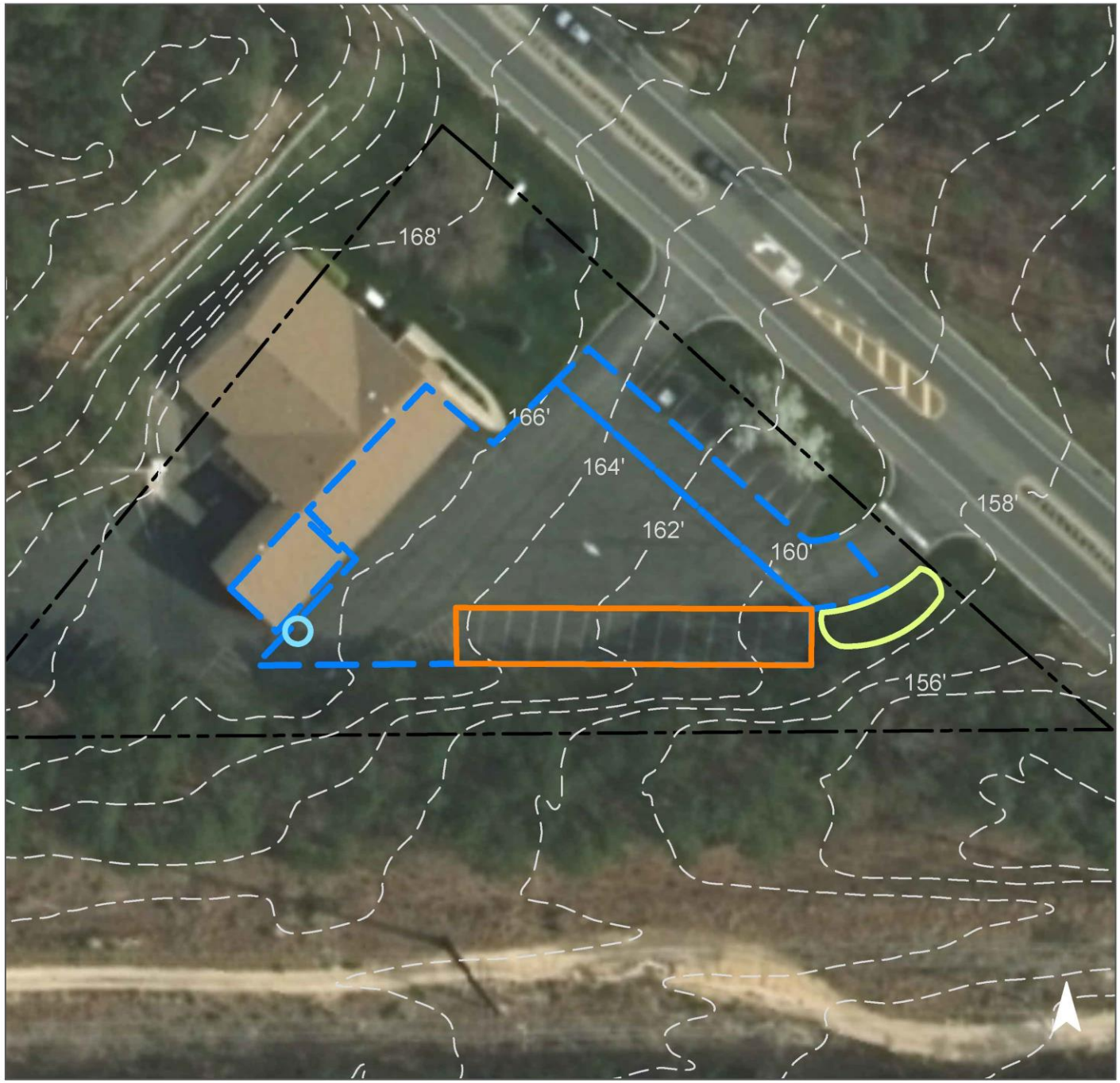
Block and Lot: Block 86, Lot 5

The parking spaces on the south side of the parking lot can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. A cistern can be installed at the back corner of the building to capture runoff from the rooftop and can be used for washing vehicles. A rain garden can be placed in the southeastern corner of the lot to help capture, treat, and infiltrate stormwater 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"
48	26,472	1.3	13.4	121.5	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 system	0.075	13	5,510	0.21	720	$3,600
Pervious pavement	0.404	68	29,670	1.12	3,060	$76,500
Rainwater harvesting	0.026	4	780	0.03	780 (gal)	$1,560

GREEN INFRASTRUCTURE RECOMMENDATIONS



WHITING VOLUNTEER FIRST AID

- bioretention system
- pervious pavement
- rainwater harvesting
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

CRESTWOOD VILLAGE VETERINARY CLINIC

Subwatershed: Michaels Branch

Site Area: 114,098 sq. ft.

Address: 56 Schoolhouse Road
Whiting, NJ 08759

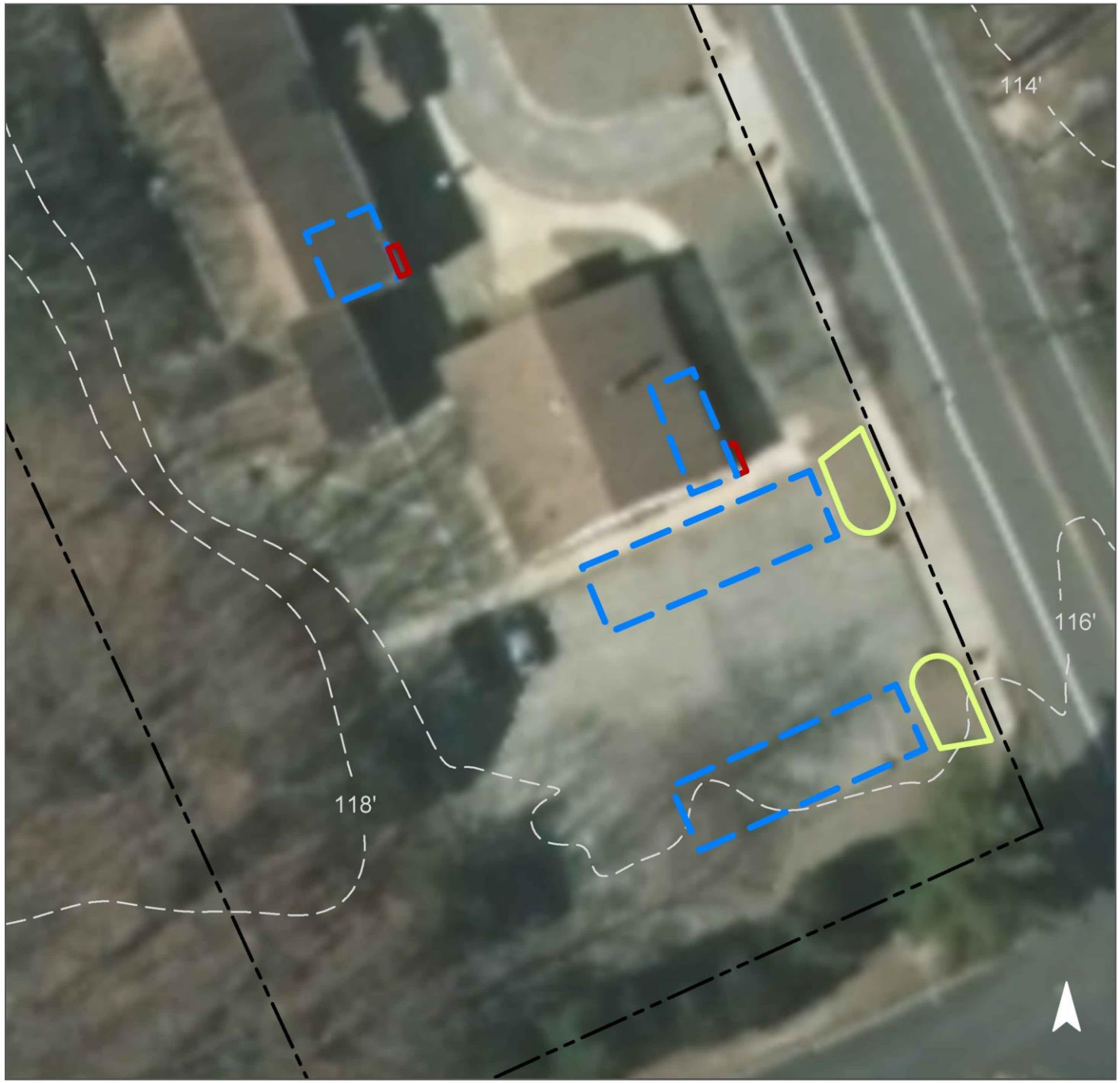
Block and Lot: Block 98, Lot 7

Rain gardens can be installed in the turfgrass islands at the entrance to the parking area to capture, treat, and infiltrate stormwater runoff from the parking lot. Planter boxes can be placed under downspouts where there is not enough room to install a rain garden. 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"
70	79,838	3.8	40.3	366.6	0.062	2.19

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	2,600	0.10	340	$1,700
Planter boxes	n/a	2	n/a	n/a	2 (boxes)	$2,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



CRESTWOOD VILLAGE VETERINARY CLINIC

- bioretention system
- planter box
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 15' 30'

SAINT ELIZABETH ANN SETON CHURCH

Subwatershed: Michaels Branch

Site Area: 365,996 sq. ft.

Address: 30 Schoolhouse Road
Manchester, NJ 08759

Block and Lot: Block 98.06, Lot 26

Parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. Rain gardens can be installed in the turfgrass area on the eastern corner to capture, treat, and infiltrate stormwater runoff from the lot and in front of the building to capture rooftop 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"
60	221,348	10.7	111.8	1,016.3	0.172	6.07

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	0.126	21	9,220	0.35	1,205	$6,025
Pervious pavement	1.058	177	77,620	2.92	7,250	$181,250

GREEN INFRASTRUCTURE RECOMMENDATIONS

SAINT ELIZABETH ANN SETON CHURCH

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

WHITING UNITED METHODIST CHURCH

Subwatershed: Michaels Branch

Site Area: 254,756 sq. ft.

Address: 55 Lacey Road
Whiting, NJ 08759

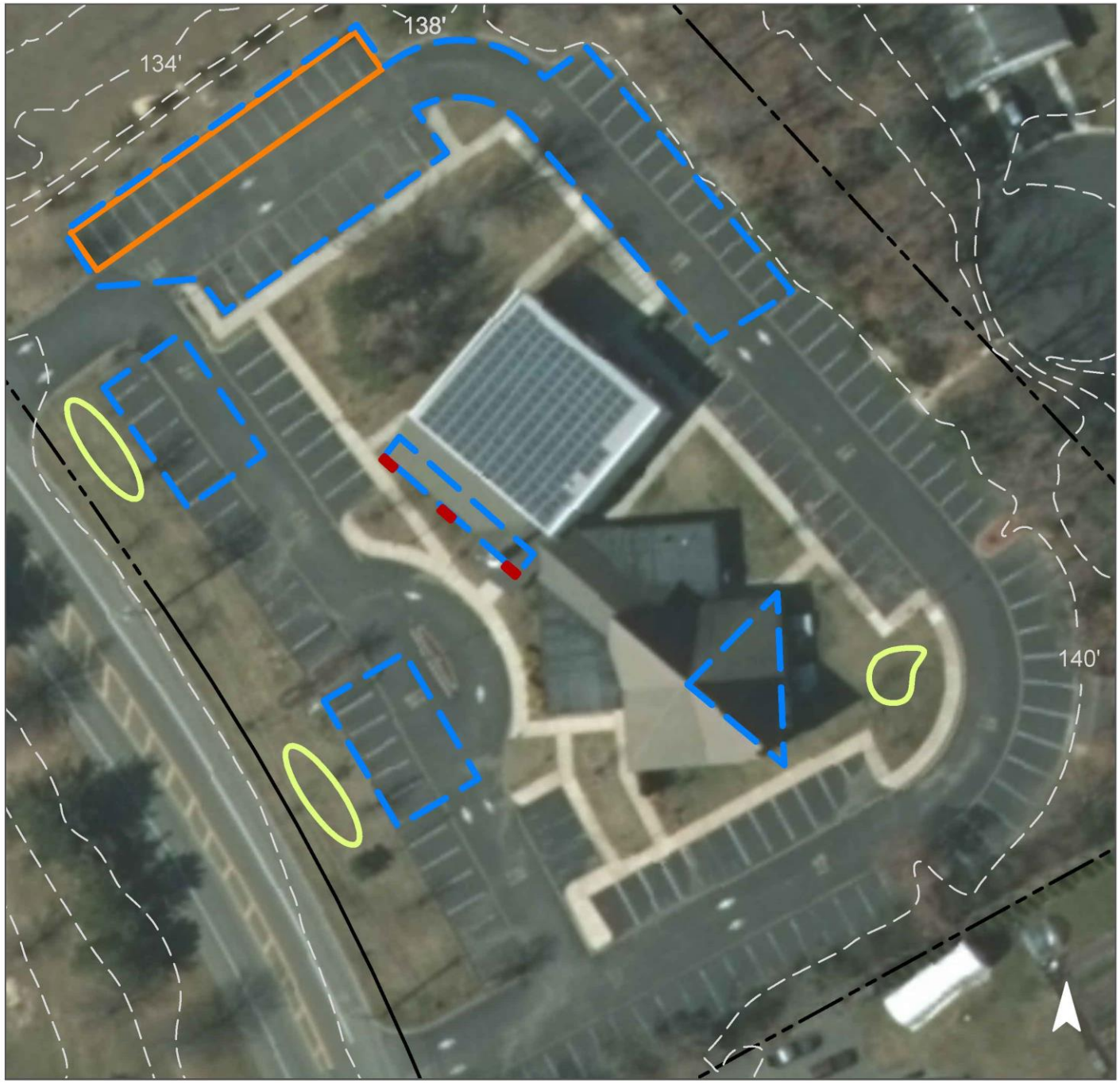
Block and Lot: Block 98, Lot 25

Parking spaces in the parking lot north of the building can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. Rain gardens can be installed in the turfgrass areas adjacent to the building to capture, treat, and infiltrate stormwater runoff from the roof. Planter boxes can be placed under downspouts where there is not enough room to install a rain garden. 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	112,530	5.4	56.8	516.7	0.088	3.09

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	0.139	23	10,170	0.38	1,330	$6,650
Pervious pavement	0.359	60	26,340	0.99	2,460	$61,500
Planter boxes	n/a	2	n/a	n/a	3 (boxes)	$3,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



WHITING UNITED METHODIST CHURCH

- bioretention system
- pervious pavement
- planter box
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

MANCHESTER BOARD OF EDUCATION

Subwatershed: **Pole Bridge Branch**

Site Area: **444,647 sq. ft.**

Address: **121 County Road 539**
Whiting, NJ 08759

Block and Lot: **Block 109, Lot 3**

Rain gardens can be installed to capture, treat, and infiltrate stormwater runoff from the parking lot. Cisterns can be installed to capture runoff from the rooftops and can be used for washing 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"
34	152,289	7.3	76.9	699.2	0.119	4.18

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
Bioretention systems	0.104	17	7,610	0.29	995	$4,975
Rainwater harvesting	0.067	11	2,000	0.08	2,000 (gal)	$4,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

MANCHESTER BOARD OF EDUCATION

- bioretention system
- rainwater harvesting
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

WHITING FIRE STATION

Subwatershed: Pole Bridge Branch

Site Area: 96,945 sq. ft.

Address: 120 Lacey Road
Whiting, NJ 08759

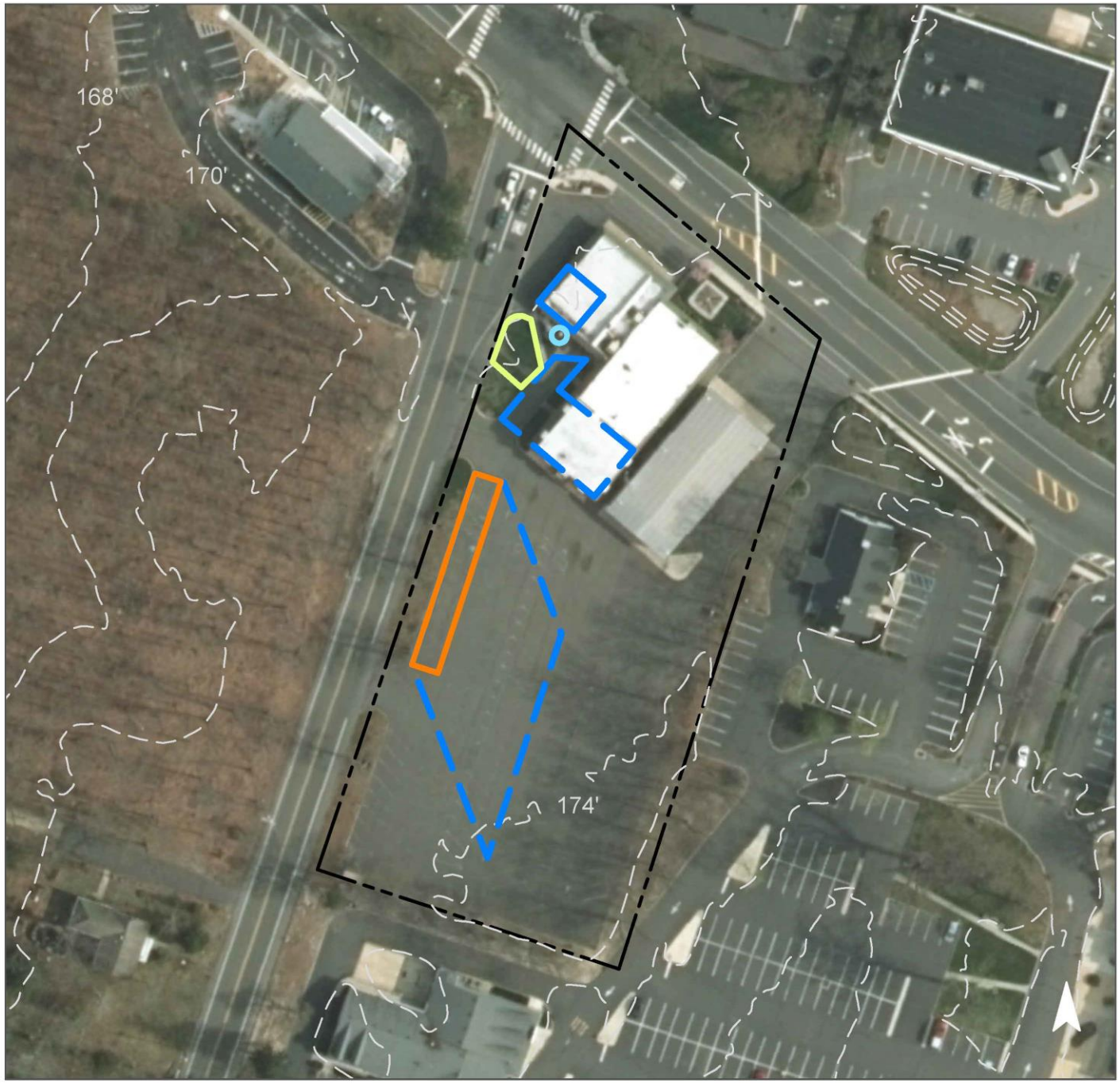
Block and Lot: Block 108, Lot 1

Parking spaces in the parking lot to the south of the building can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. A rain garden can be installed in the turfgrass area west of the building to capture, treat, and infiltrate stormwater runoff from the roof. A cistern can be installed to capture and reuse stormwater runoff from the building's roof. 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	87,443	4.2	44.2	401.5	0.068	2.40

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 system	0.100	17	7,340	0.28	960	$4,800
Pervious pavement	0.346	58	25,370	0.95	2,370	$59,250
Rainwater harvesting	0.026	4	780	0.03	780 (gal)	$1,560

GREEN INFRASTRUCTURE RECOMMENDATIONS



WHITING FIRE STATION

- bioretention system
- pervious pavement
- rainwater harvesting
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

WHITING PHARMACY

Subwatershed: Pole Bridge Branch

Site Area: 40,169 sq. ft.

Address: 200 Lacey Road
Whiting, NJ 08759

Block and Lot: Block 109, Lot 17

Parking spaces in the parking lot can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. A rain garden can be installed in the turfgrass area southeast of the building to capture, treat, and infiltrate stormwater runoff from the roof. 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	36,036	1.7	18.2	165.5	0.028	0.99

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	0.018	3	1,340	0.05	175	$875
Pervious pavement	0.148	25	10,880	0.41	1,000	$25,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

WHITING PHARMACY

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 25' 50'

MANCHESTER TOWNSHIP MIDDLE SCHOOL & RIDGEWAY ELEMENTARY SCHOOL

Subwatershed: Ridgeway Brook

Site Area: 1,879,432 sq. ft.

Address: 2759 Ridgeway Road
Manchester, NJ 08759

Block and Lot: Block 86.1, Lot 1

Parking spaces in the parking lot to the north of the building can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. Several rain gardens can be installed in the turfgrass areas surrounding the parking lot to capture, treat, and infiltrate stormwater runoff from the lot. Planter boxes can be placed under downspouts where there is not enough room to install a rain garden. 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"
25	469,032	22.6	236.9	2,153.5	0.365	12.86

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	0.633	106	46,420	1.74	6,070	$30,350
Pervious pavement	0.521	87	38,250	1.44	5,670	$141,750
Planter boxes	n/a	6	n/a	n/a	7 (boxes)	$7,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

MANCHESTER TOWNSHIP MIDDLE SCHOOL & RIDGEWAY ELEMENTARY SCHOOL

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

MANCHESTER TOWNSHIP HIGH SCHOOL

Subwatershed: **Union Branch**

Site Area: **4,026,275 sq. ft.**

Address: **101 South Colonial Drive**
Manchester, NJ 08759

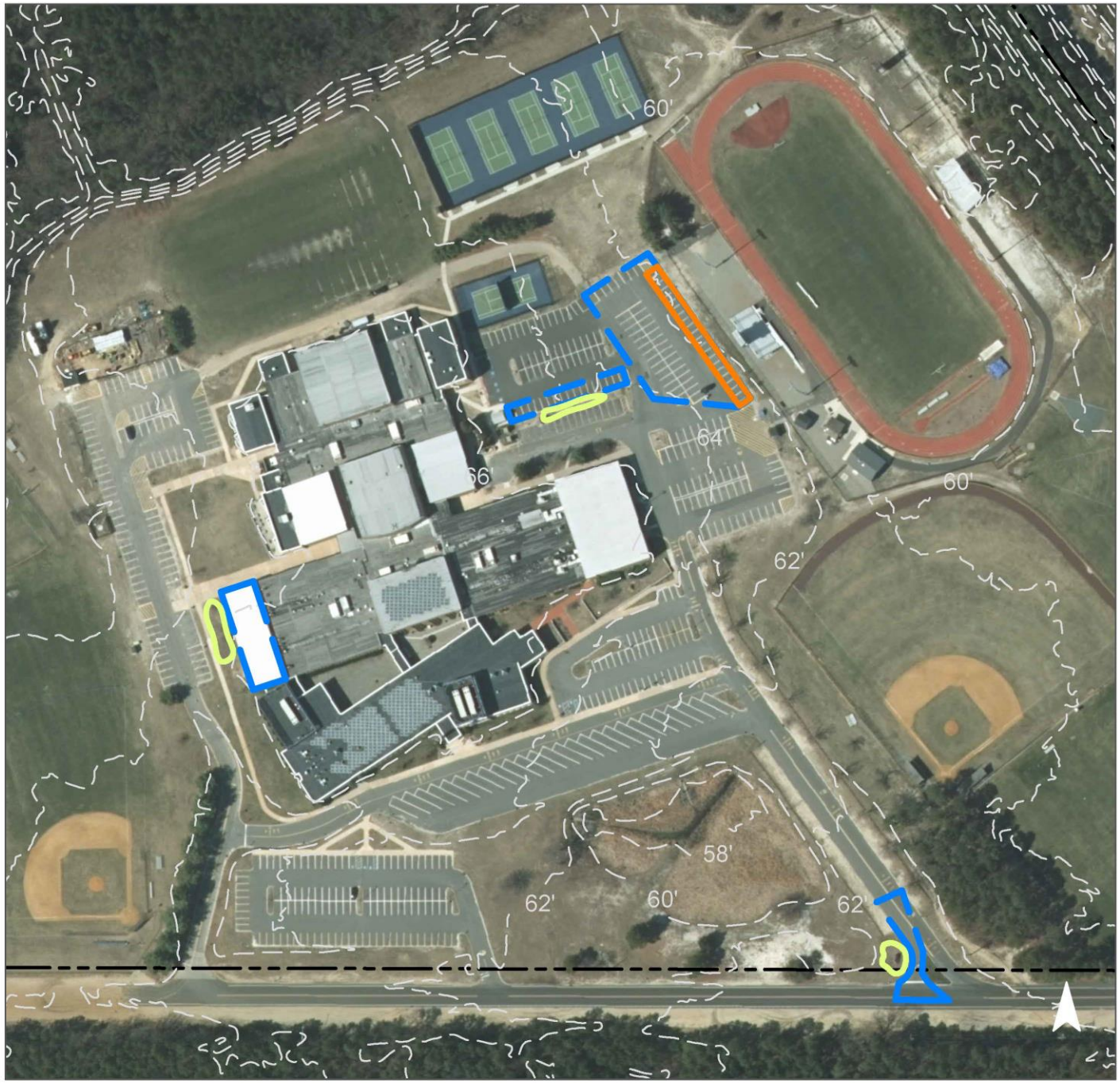
Block and Lot: **Block 75.01, Lot 87**

A section of parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. Rain gardens can be installed in various locations to capture, treat, and infiltrate stormwater runoff from the roof or parking lot. 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"
17	682,225	32.9	344.6	3,132.3	0.532	18.71

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	0.575	96	42,220	1.59	5,520	$27,600
Pervious pavement	0.554	93	40,680	1.53	3,800	$95,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



MANCHESTER TOWNSHIP HIGH SCHOOL

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 100' 200'

MANCHESTER TOWNSHIP POLICE DEPARTMENT AND DIVISION OF SOCIAL SERVICES

Subwatershed: Union Branch

Site Area: 418,886 sq. ft.

Address: 1 South Colonial Drive
Manchester, NJ 08759

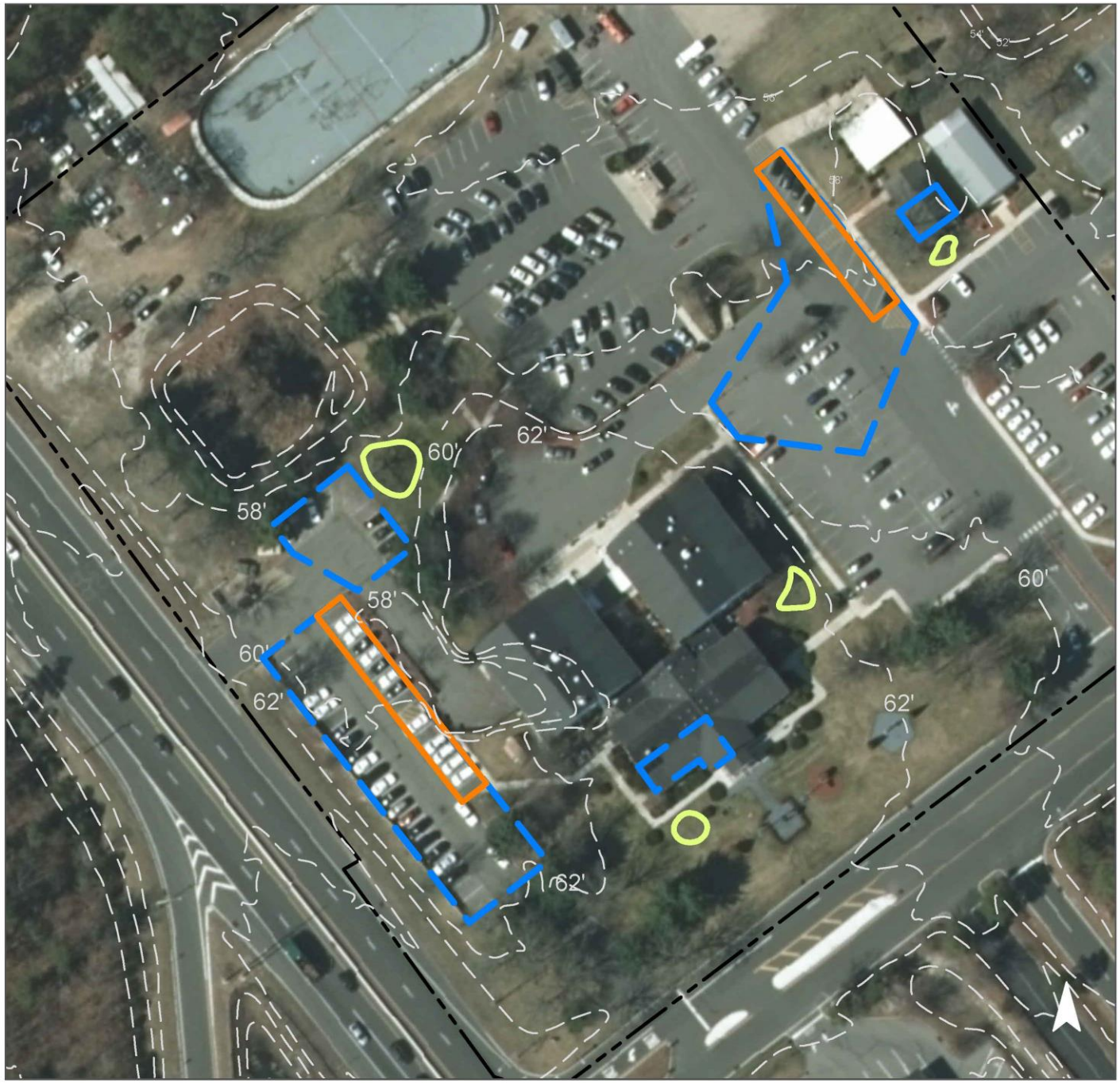
Block and Lot: Block 48, Lot 1

Two sections of parking spaces can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. Rain gardens can be installed in the turfgrass areas to capture, treat, and infiltrate stormwater runoff from the roof and 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"
52	217,696	10.5	109.9	999.5	0.170	5.97

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	0.192	32	14,110	0.53	2,295	$11,475
Pervious pavement	0.737	123	54,100	2.03	5,600	$140,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



MANCHESTER TOWNSHIP POLICE DEPARTMENT AND DIVISION OF SOCIAL SERVICES

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 50' 100'

OCEAN COUNTY LIBRARY

Subwatershed: Union Branch

Site Area: 217,696 sq. ft.

Address: 21 Colonial Drive
Manchester, NJ 08759

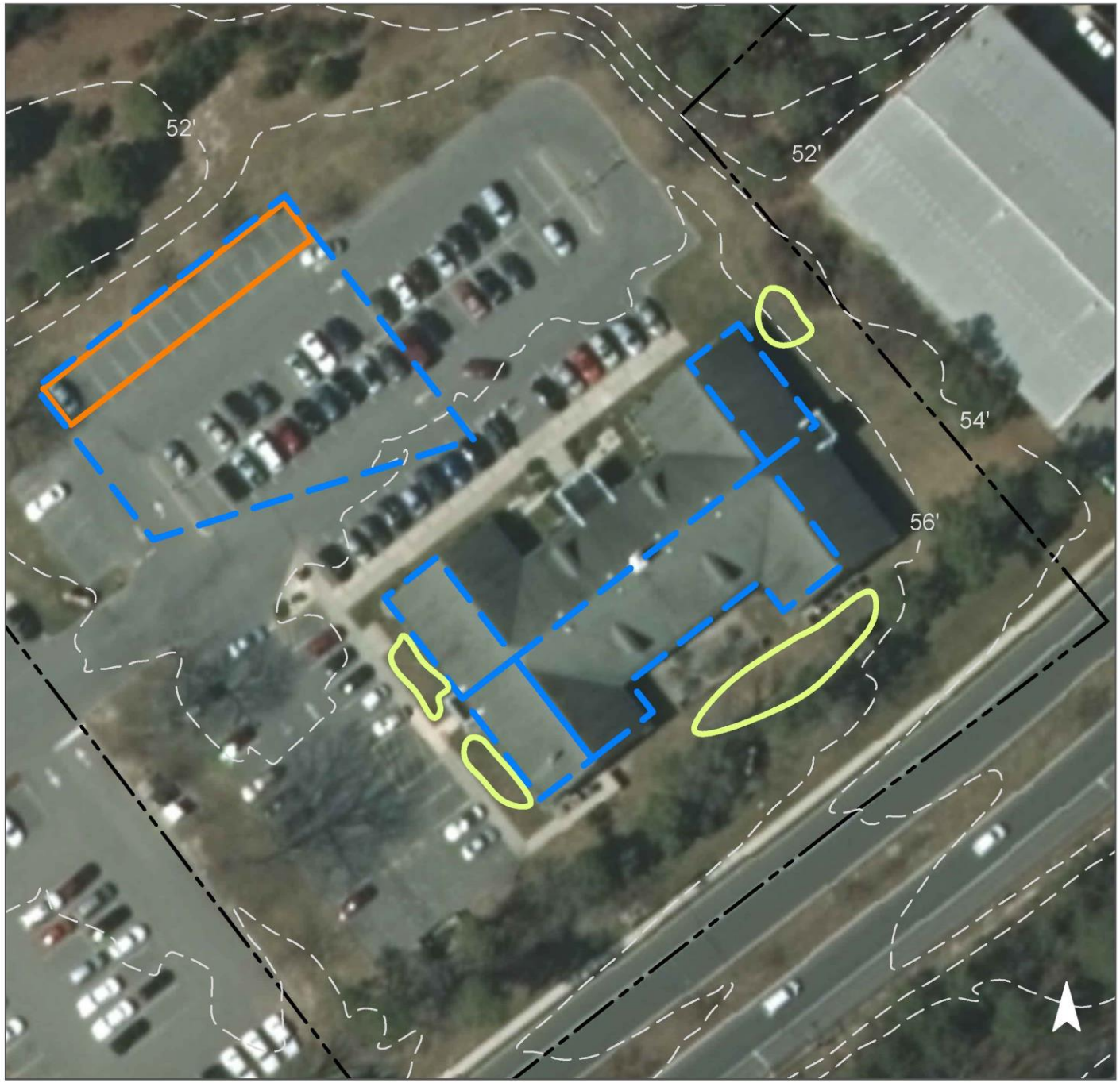
Block and Lot: Block 48, Lot 2

Parking spaces in the parking lot can be converted to porous pavement to capture and infiltrate stormwater runoff from the parking lot. Rain gardens can be installed in the turfgrass areas around the building to capture, treat, and infiltrate stormwater runoff from the roof. 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"
36	79,153	3.8	40.0	363.4	0.062	2.17

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
Bioretention systems	0.239	40	17,550	0.66	2,290	$11,450
Pervious pavement	0.314	53	23,020	0.86	2,150	$53,750

GREEN INFRASTRUCTURE RECOMMENDATIONS



OCEAN COUNTY LIBRARY

- bioretention system
- pervious pavement
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

SUMMIT PARK

Subwatershed: Union Branch

Site Area: 704,033 sq. ft.

Address: 23 Alexander Avenue
Manchester, NJ 08759

Block and Lot: Block 75.01, Lot 104

A rain garden can be installed in the turfgrass area north of the parking lot to capture, treat, and infiltrate stormwater runoff from the 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"
14	100,161	4.8	50.6	459.9	0.078	2.75

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
Bioretention system	0.066	11	4,860	0.18	635	$3,175

GREEN INFRASTRUCTURE RECOMMENDATIONS

SUMMIT PARK

- bioretention system
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 25' 50'

c. Summary of Existing Conditions

Summary of Existing Conditions

	Subwatershed/Site Name/Total Site Info/GI Practic	Area (ac)	Area (SF)	Block	Lot	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Existing Annual Loads (Commercial) TP (lb/yr)	TN (lb/yr)	TSS (lb/yr)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (cu.ft.)	Runoff Volumes from I.C. Annual (cu.ft.)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
	Davenport Branch Sites	**19.06**	**830,301**				**4.42**	**192,594**	**9.3**	**97.3**	**884.3**	**20,062**	**706,179**	**0.150**	**5.28**
1	**Bowker Park**														
	Total Site Info	10.06	438,139	86.1	1	16	1.60	69,616	3.4	35.2	319.6	7,252	255,258	0.054	1.91
2	**Carmona-Bolen Home for Funerals LLC**														
	Total Site Info	5.07	221,058	100	5	17	0.88	38,174	1.8	19.3	175.3	3,976	139,971	0.030	1.05
3	**Whiting Bible Church**														
	Total Site Info	2.67	116,105	86.01	7.01	50	1.34	58,332	2.8	29.5	267.8	6,076	213,885	0.045	1.60
4	**Whiting Volunteer First Aid**														
	Total Site Info	1.26	54,999	86	5	48	0.61	26,472	1.3	13.4	121.5	2,758	97,064	0.021	0.73
	Michaels Branch	**16.87**	**734,849**				**9.50**	**413,716**	**19.9**	**208.9**	**1,899.5**	**43,095**	**1,516,957**	**0.322**	**11.35**
5	**Crestwood Village Veterinary Clinic**														
	Total Site Info	2.62	114,098	98	7	70	1.83	79,838	3.8	40.3	366.6	8,316	292,739	0.062	2.19
6	**Saint Elizabeth Ann Seton Church**														
	Total Site Info	8.40	365,996	98.06	26	60	5.08	221,348	10.7	111.8	1,016.3	23,057	811,608	0.172	6.07
7	**Whiting United Methodist Church**														
	Total Site Info	5.85	254,756	98	25	44	2.58	112,530	5.4	56.8	516.7	11,722	412,610	0.088	3.09
	Pole Bridge Branch Sites	**13.36**	**581,761**				**6.33**	**275,768**	**13.3**	**139.3**	**1,266.2**	**28,726**	**1,011,148**	**0.215**	**7.56**
8	**Manchester Board of Education**														
	Total Site Info	10.21	444,647	109	3	34	3.50	152,289	7.3	76.9	699.2	15,863	558,394	0.119	4.18
9	**Whiting Fire Station**														
	Total Site Info	2.23	96,945	108	1	90	2.01	87,443	4.2	44.2	401.5	9,109	320,623	0.068	2.40
10	**Whiting Pharmacy**														
	Total Site Info	0.92	40,169	109	17	90	0.83	36,036	1.7	18.2	165.5	3,754	132,131	0.028	0.99
	Ridgeway Brook Sites	**43.15**	**1,879,432**				**10.77**	**469,032**	**22.6**	**236.9**	**2,153.5**	**48,857**	**1,719,784**	**0.365**	**12.86**
11	**Manchester Township Middle School & Ridgeway Elementary School**														
	Total Site Info	43.15	1,879,432	31	2	25	10.77	469,032	22.6	236.9	2,153.5	48,857	1,719,784	0.365	12.86
	Union Branch Sites	**123.21**	**5,366,891**				**24.78**	**1,079,236**	**52.0**	**545.1**	**4,955.2**	**112,420**	**3,957,199**	**0.841**	**29.60**

Summary of Existing Conditions

	Subwatershed/Site Name/Total Site Info/GI Practic	Area (ac)	Area (SF)	Block	Lot	I.C. %	I.C. Area (ac)	I.C. Area (SF)	Existing Annual Loads (Commercial) TP (lb/yr)	TN (lb/yr)	TSS (lb/yr)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (cu.ft.)	Runoff Volumes from I.C. Annual (cu.ft.)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Mgal)
12	**Manchester Township High School**														
	Total Site Info	92.43	4,026,275	75.01	87	17	15.66	682,225	32.9	344.6	3,132.3	71,065	2,501,493	0.532	18.71
13	**Manchester Township Police Department and Division of Social Services**														
	Total Site Info	9.62	418,886	48	1	52	5.00	217,696	10.5	109.9	999.5	22,677	798,220	0.170	5.97
14	**Ocean County Library**														
	Total Site Info	5.00	217,696	48	2	36	1.82	79,153	3.8	40.0	363.4	8,245	290,228	0.062	2.17
15	**Summit Park**														
	Total Site Info	16.16	704,033	75.01	104	14	2.30	100,161	4.8	50.6	459.9	10,433	367,257	0.078	2.75

d. Summary of Proposed Green Infrastructure Practices

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practic	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	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
	Davenport Branch Sites	**49,485**	**1.14**	**1.250**	**215**	**90,610**	**3.41**				**$185,810**	**25.7%**
1	**Bowker Park**											
	Bioretention system	8,680	0.20	0.226	38	16,600	0.62	2,170	$5	SF	$10,850	12.5%
	Pervious pavement	4,390	0.10	0.114	19	8,390	0.32	880	$25	SF	$22,000	6.3%
	Total Site Info	**13,070**	**0.30**	**0.341**	**57**	**24,990**	**0.94**				**$32,850**	**18.8%**
2	**Carmona-Bolen Home for Funerals LLC**											
	Bioretention system	1,000	0.02	0.026	4	1,910	0.07	2,500	$5	SF	$12,500	2.6%
	Pervious pavement	10,470	0.24	0.273	46	20,020	0.75	1,870	$25	SF	$46,750	27.4%
	Planter boxes	860	0.02	n/a	3	n/a	n/a	4	$1,000	box	$4,000	2.3%
	Total Site Info	**12,330**	**0.28**	**0.299**	**53**	**21,930**	**0.82**				**$63,250**	**32.3%**
3	**Whiting Bible Church**											
	Bioretention systems	4,040	0.09	0.105	18	7,730	0.29	1,010	$5	SF	$5,050	6.9%
	Planter boxes	645	0.01	n/a	2	n/a	n/a	3	$1,000	box	$3,000	1.1%
	Total Site Info	**4,685**	**0.11**	**0.105**	**20**	**7,730**	**0.29**				**$8,050**	**8.0%**
4	**Whiting Volunteer First Aid**											
	Bioretention system	2,880	0.07	0.075	13	5,510	0.21	720	$5	SF	$3,600	10.9%
	Pervious pavement	15,520	0.36	0.404	68	29,670	1.12	3,060	$25	SF	$76,500	58.6%
	Rainwater harvesting	1,000	0.02	0.026	4	780	0.03	780	$2	gal	$1,560	3.8%
	Total Site Info	**19,400**	**0.45**	**0.505**	**85**	**35,960**	**1.36**				**$81,660**	**73.3%**
	Michaels Branch Sites	**66,950**	**1.54**	**1.716**	**291**	**125,950**	**4.74**	**0**			**$262,125**	**16.2%**
5	**Crestwood Village Veterinary Clinic**											
	Bioretention systems	1,360	0.03	0.035	6	2,600	0.10	340	$5	SF	$1,700	1.7%
	Planter boxes	430	0.01	n/a	2	n/a	n/a	2	$1,000	box	$2,000	0.5%
	Total Site Info	**1,790**	**0.04**	**0.035**	**8**	**2,600**	**0.10**				**$3,700**	**2.2%**
6	**Saint Elizabeth Ann Seton Church**											
	Bioretention systems	4,820	0.11	0.126	21	9,220	0.35	1,205	$5	SF	$6,025	2.2%
	Pervious pavement	40,600	0.93	1.058	177	77,620	2.92	7,250	$25	SF	$181,250	18.3%
	Total Site Info	**45,420**	**1.04**	**1.183**	**198**	**86,840**	**3.27**				**$187,275**	**20.5%**

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practic	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	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
7	**Whiting United Methodist Church**											
	Bioretention systems	5,320	0.12	0.139	23	10,170	0.38	1,330	$5	SF	$6,650	4.7%
	Pervious pavement	13,775	0.32	0.359	60	26,340	0.99	2,460	$25	SF	$61,500	12.2%
	Planter boxes	645	0.01	n/a	2	n/a	n/a	3	$1,000	box	$3,000	0.6%
	Total Site Info	**19,740**	**0.45**	**0.498**	**86**	**36,510**	**1.37**				**$71,150**	**17.5%**
	Pole Bridge Branch Sites	**31,040**	**0.71**	**0.809**	**135**	**55,320**	**2.09**				**$100,460**	**11.3%**
8	**Manchester Board of Education**											
	Bioretention systems	3,980	0.09	0.104	17	7,610	0.29	995	$5	SF	$4,975	2.6%
	Rainwater harvesting	2,560	0.06	0.067	11	2,000	0.08	2,000	$2	gal	$4,000	1.7%
	Total Site Info	**6,540**	**0.15**	**0.170**	**29**	**9,610**	**0.37**				**$8,975**	**4.3%**
9	**Whiting Fire Station**											
	Bioretention system	3,840	0.09	0.100	17	7,340	0.28	960	$5	SF	$4,800	4.4%
	Pervious pavement	13,270	0.30	0.346	58	25,370	0.95	2,370	$25	SF	$59,250	15.2%
	Rainwater harvesting	1,000	0.02	0.026	4	780	0.03	780	$2	gal	$1,560	1.1%
	Total Site Info	**18,110**	**0.42**	**0.472**	**79**	**33,490**	**1.26**				**$65,610**	**20.7%**
10	**Whiting Pharmacy**											
	Bioretention system	700	0.02	0.018	3	1,340	0.05	175	$5	SF	$875	1.9%
	Pervious pavement	5,690	0.13	0.148	25	10,880	0.41	1,000	$25	SF	$25,000	15.8%
	Total Site Info	**6,390**	**0.15**	**0.166**	**28**	**12,220**	**0.46**				**$25,875**	**17.7%**
	Ridgeway Brook Sites	**45,790**	**1.05**	**1.154**	**199**	**84,670**	**3.18**				**$179,100**	**9.8%**
11	**Manchester Township Middle School & Ridgew**											
	Bioretention systems	24,280	0.56	0.633	106	46,420	1.74	6,070	$5	SF	$30,350	5.2%
	Pervious pavement	20,005	0.46	0.521	87	38,250	1.44	5,670	$25	SF	$141,750	4.3%
	Planter boxes	1,505	0.03	n/a	6	n/a	n/a	7	$1,000	box	$7,000	0.3%
	Total Site Info	**45,790**	**1.05**	**1.154**	**199**	**84,670**	**3.18**				**$179,100**	**9.8%**
	Union Branch Sites	**102,805**	**2.36**	**2.679**	**448**	**196,540**	**7.38**				**$342,450**	**9.5%**

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practic	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	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
12	**Manchester Township High School**											
	Bioretention systems	22,080	0.51	0.575	96	42,220	1.59	5,520	$5	SF	$27,600	3.2%
	Pervious pavement	21,280	0.49	0.554	93	40,680	1.53	3,800	$25	SF	$95,000	3.1%
	Total Site Info	**43,360**	**1.00**	**1.130**	**189**	**82,900**	**3.12**				**$122,600**	**6.4%**
13	**Manchester Township Police Department and D**											
	Bioretention systems	7,380	0.17	0.192	32	14,110	0.53	2,295	$5	SF	$11,475	3.4%
	Pervious pavement	28,300	0.65	0.737	123	54,100	2.03	5,600	$25	SF	$140,000	13.0%
	Total Site Info	**35,680**	**0.82**	**0.930**	**156**	**68,210**	**2.56**				**$151,475**	**16.4%**
14	**Ocean County Library**											
	Bioretention systems	9,180	0.21	0.239	40	17,550	0.66	2,290	$5	SF	$11,450	11.6%
	Pervious pavement	12,040	0.28	0.314	53	23,020	0.86	2,150	$25	SF	$53,750	15.2%
	Total Site Info	**21,220**	**0.49**	**0.553**	**93**	**40,570**	**1.52**				**$65,200**	**26.8%**
15	**Summit Park**											
	Bioretention system	2,545	0.06	0.066	11	4,860	0.18	635	$5	SF	$3,175	2.5%
	Total Site Info	**2,545**	**0.06**	**0.066**	**11**	**4,860**	**0.18**				**$3,175**	**2.5%**