RUTGERS
New Jersey Agricultural
Experiment Station

Draft

Impervious Cover Reduction Action Plan
for
Union City, Hudson County, New Jersey

Prepared for Union City by the
Rutgers Cooperative Extension Water Resources Program

March 30, 2017

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Introduction

Located in Hudson County in northern New Jersey, Union City covers approximately 1.29 square miles. Figures 1 and 2 illustrate that Union City is dominated by urban land uses. A total of 97.2% of the municipality's land use is classified as urban. Of the urban land in Union City, high density residential is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection's (NJDEP) 2012 land use/land cover geographical information system (GIS) data layer categorizes Union City 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 Union City. Based upon the 2012 NJDEP land use/land cover data, approximately 70.4% of Union City has impervious cover. This level of impervious cover suggests that the streams in Union City are likely non-supporting streams. [1]

Methodology

Union City 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

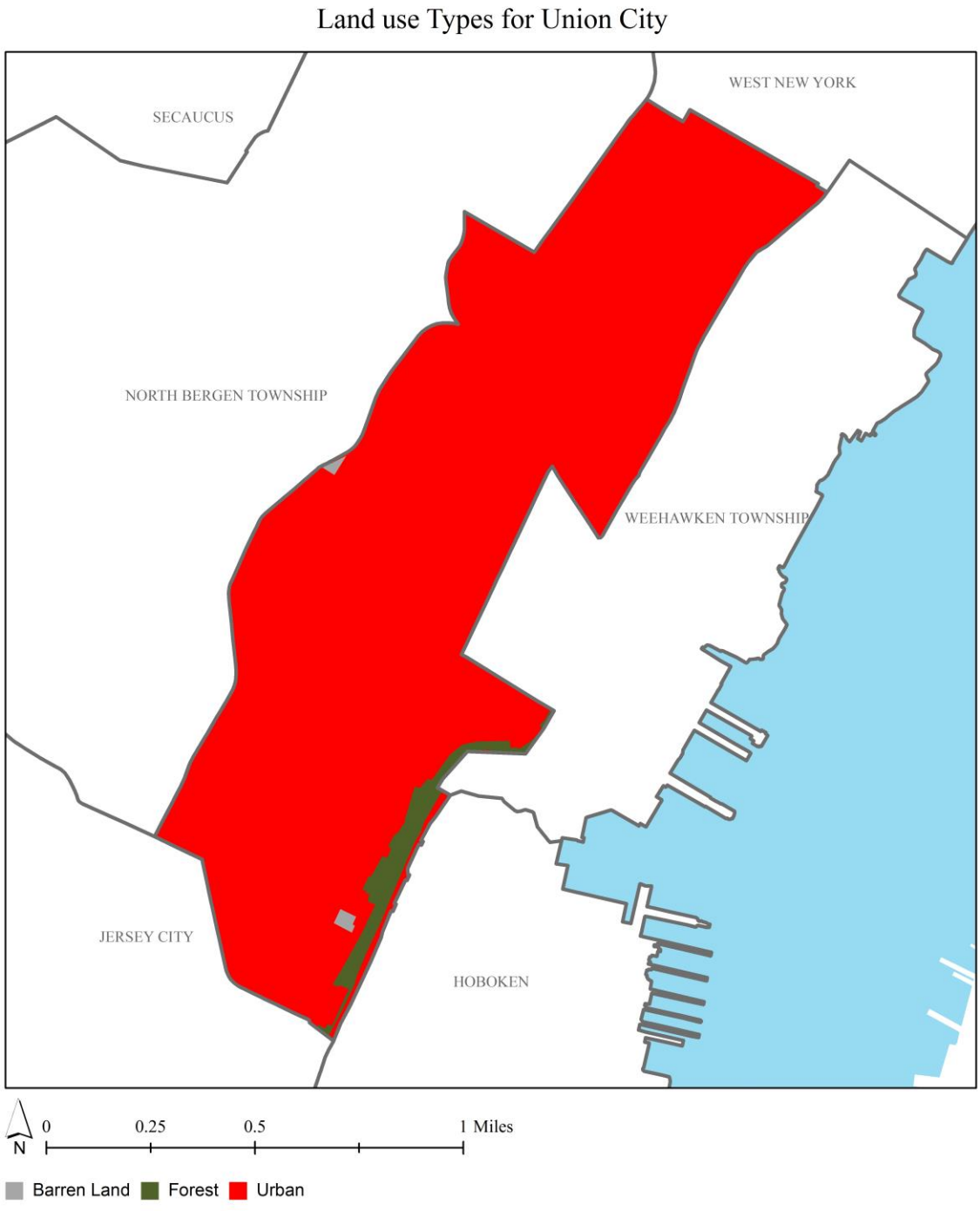


Figure 1: Map illustrating the land use in Union City

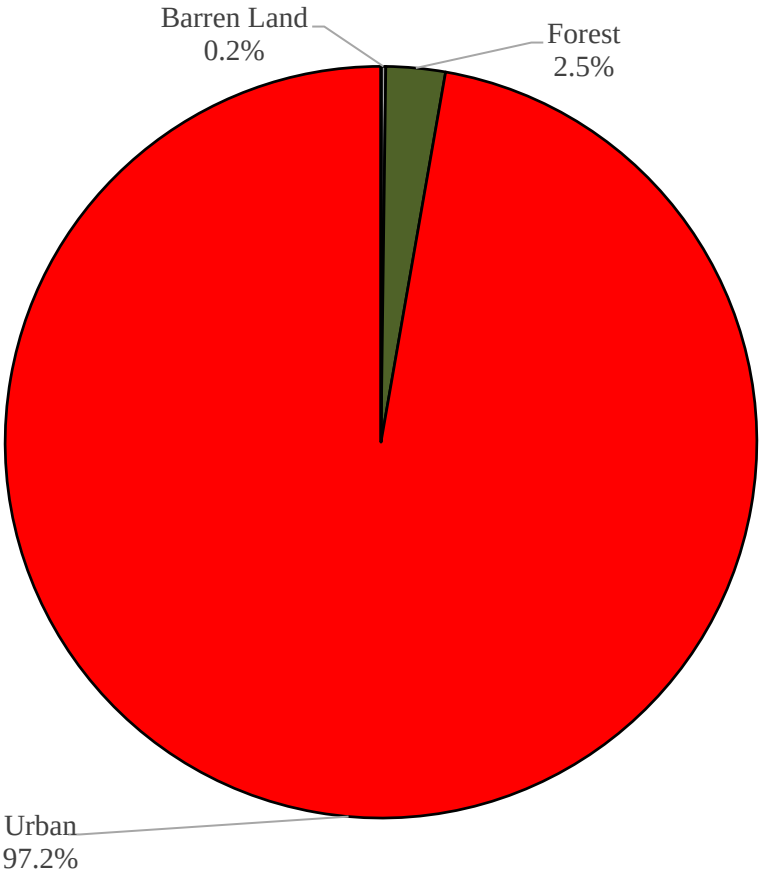


Figure 2: Pie chart illustrating the land use in Union City

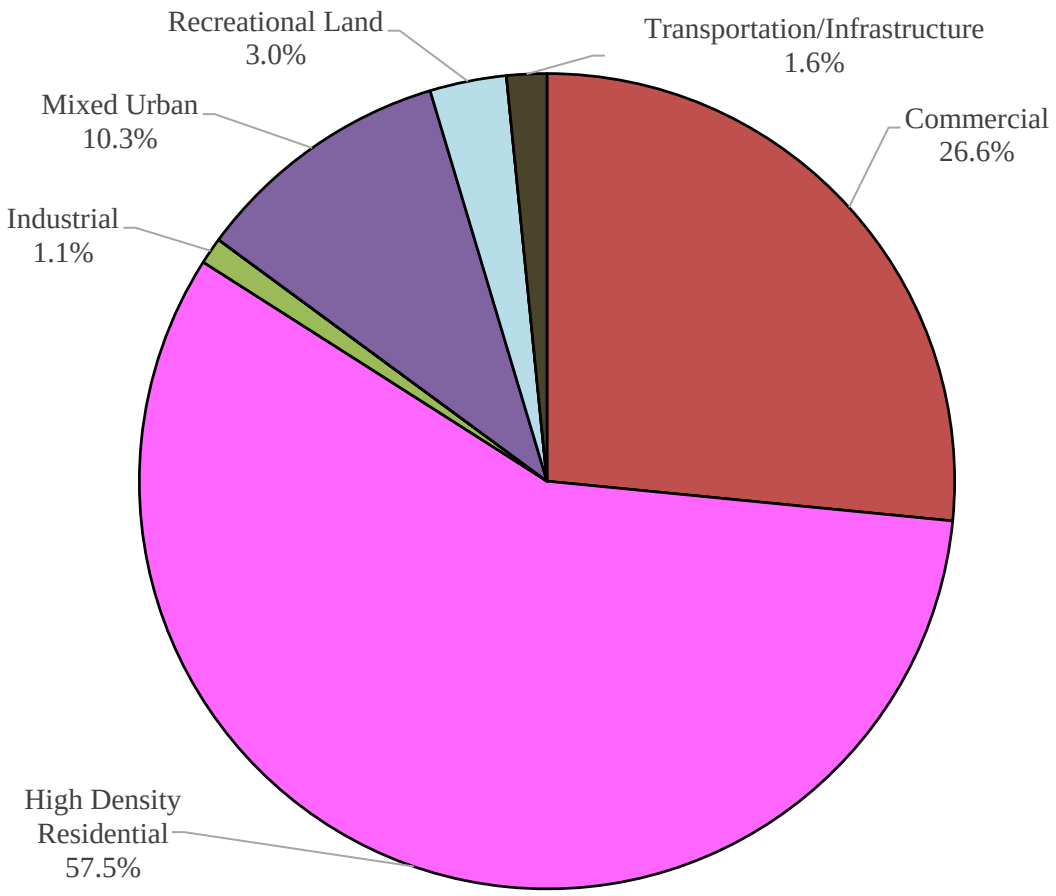


Figure 3: Pie chart illustrating the various types of urban land use in Union City

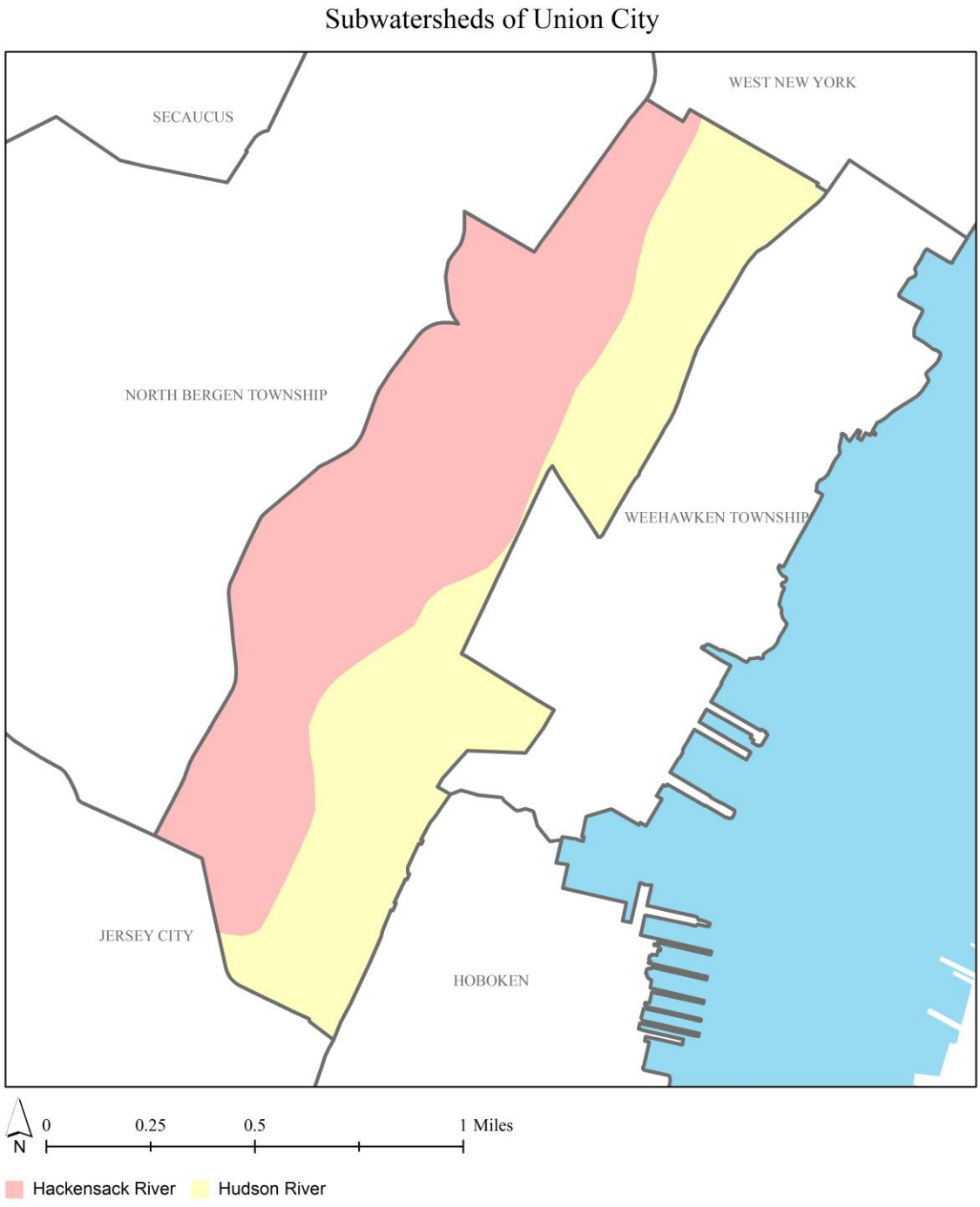


Figure 4: Map of the subwatersheds in Union City

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 2012 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 Union City 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 Union City. 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

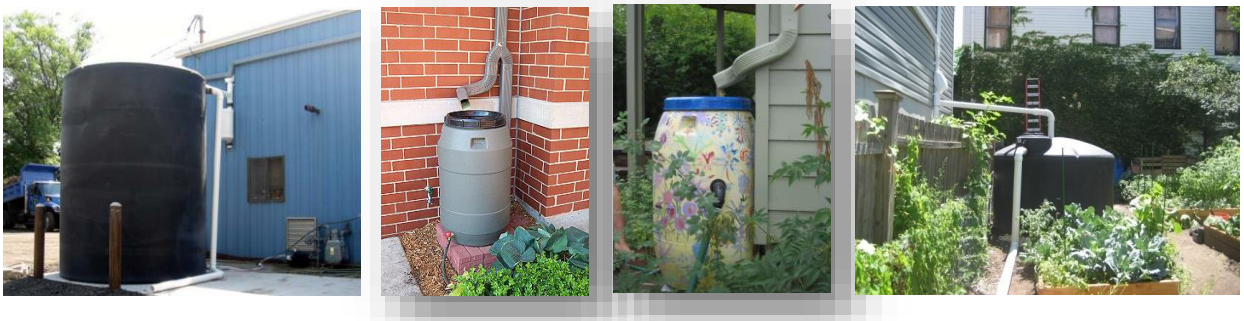
These are landscaped features that are designed to capture, treat, and infiltrate stormwater runoff. These systems can easily be incorporated into existing landscapes, improving aesthetics and creating wildlife habitat while managing stormwater runoff. Bioretention systems also can be used in soils that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

Attachment 1 contains information on potential project sites where green infrastructure practices could be installed. The recommended green infrastructure practices 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

UNION CITY: GREEN INFRASTRUCTURE SITES

SITES WITHIN THE HACKENSACK RIVER SUBWATERSHED:

1. Ellsworth Park
2. Gilmore School
3. Hudson Korean Presbyterian Church and Monastery
4. Jose Marti Freshman Academy and Union City Public Library
5. Saint Anthony of Padua Catholic Chuch and Elementary School
6. Saint Augustine School
7. Thomas Edison Elementary School and Bruce D. Walter Recreation Center
8. Union City Parking Authority: 6th and West Street Parking Lot
9. Union City Parking Authority: 8th-10th Street Parking Lot
10. Union City Parking Authority: 25th Street Parking Lot
11. Union City Parking Authority: 35th-36th Street Parking Lot
12. Union City Parking Authority: 36th-37th Street Parking Lot
13. Union City Parking Authority: 37th-38th Street Parking Lot
14. Union City Parking Authority: 41st-42nd Street Parking Lot
15. Union City Parking Authority: 44th-45th Street Parking Lot

SITES WITHIN THE HUDSON RIVER SUBWATERSHED:

16. Grace Episcopal Church
17. Union City Parking Authority: 12th-13th Street Parking Lot

b. Green Infrastructure Concepts

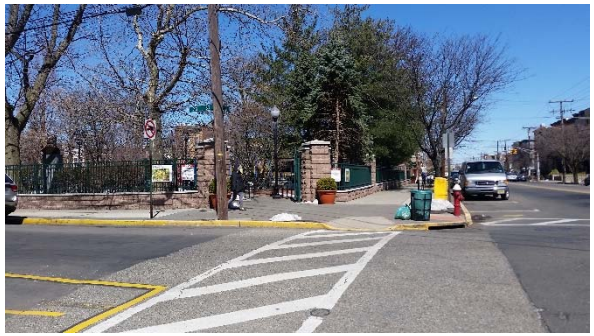
ELLSWORTH PARK

Subwatershed: Hackensack River

Site Area: 70,617 sq. ft.

Address: 23rd and New York Avenue
Union City, NJ 07087

Block and Lot: Block 126, Lot 1



Stormwater planters can be installed to capture, treat, and infiltrate 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"
40	28,247	1.4	14.3	129.7	0.022	0.77

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
Stormwater planters	0.105	18	7,705	0.29	360	$135,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Ellsworth Park

- stormwater planter
- drainage area
- property line
- 2015 Aerial: NJOIT, OGIS

0 30' 60'

GILMORE SCHOOL

Subwatershed: Hackensack River

Site Area: 57,834 sq. ft.

Address: 815 17th Street
Union City, NJ 07087

Block and Lot: Block 83, Lot 10

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
66	38,189	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
Pervious pavement	0.089	15	6,501	0.24	3,400	$85,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Gilmore School

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

0 30' 60'

HUDSON KOREAN PRESBYTERIAN CHURCH AND MONASTERY

Subwatershed: Hackensack River

Site Area: 264,088 sq. ft.

Address: 2019 West Street
Union City, NJ 07087

Block and Lot: Block 108, Lot 1.03

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
70	184,980	8.9	93.4	849.3	0.144	5.07

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
Pervious pavement	0.638	107	46,843	1.76	10,000	$250,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Hudson Korean Presbyterian Church and Monastery

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

0 50' 100'

JOSE MARTI FRESHMAN ACADEMY AND UNION CITY PUBLIC LIBRARY

Subwatershed: Hackensack River

Site Area: 262,052 sq. ft.

Address: 1800 Summit Avenue
Union City, NJ 07087

Block and Lot: Block 108, Lot 1.04

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
88	230,672	11.1	116.5	1,059.1	0.180	6.33

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	0.031	5	2,297	0.09	300	$1,500
Pervious pavement	0.219	37	16,061	0.60	2,700	$67,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Jose Marti Freshman Academy and Union City Public Library

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

0 50' 100'

SAINT ANTHONY OF PADUA CATHOLIC CHUCH AND ELEMENTARY SCHOOL

Subwatershed: Hackensack River

Site Area: 78,883 sq. ft.

Address: 615 8th Street
Union City, NJ 07087

Block and Lot: Block 34, Lot 1.01

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	74,938	3.6	37.8	344.1	0.058	2.06

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	0.014	2	995	0.04	130	$650
Pervious pavement	0.573	96	42,063	1.58	4,100	$102,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Saint Anthony of Padua Catholic Church and Elementary School

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

0 30' 60'

SAINT AUGUSTINE SCHOOL

Subwatershed: Hackensack River

Site Area: 54,169 sq. ft.

Address: 615 8th Street
Union City, NJ 07087

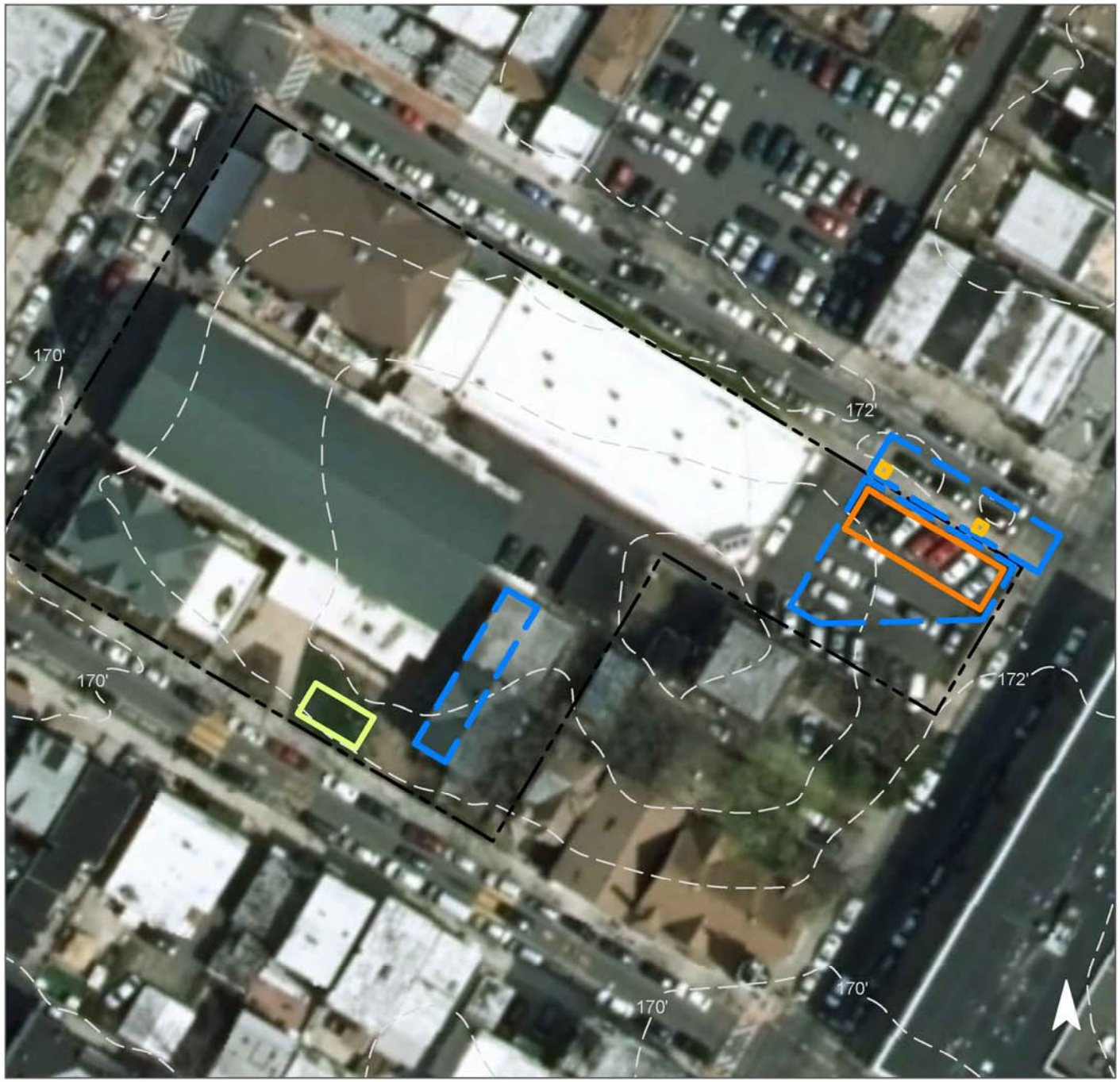
Block and Lot: Block 231, Lot 1

A bioretention system can be installed to capture, treat, and infiltrate rooftop runoff. Parking spaces can be replaced with pervious pavement to capture and infiltrate stormwater. Two tree filter boxes can be installed along the street to treat 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"
85	46,044	2.2	23.3	211.4	0.036	1.26

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
Bioretention system	0.031	5	2,244	0.08	370	$1,850
Pervious pavement	0.085	14	6,201	0.23	1,270	$31,750
Tree filter box	n/a	6	n/a	n/a	32	$20,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Saint Augustine School

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

0 30' 60'

THOMAS EDISON ELEMENTARY SCHOOL AND BRUCE D. WALTER RECREATION CENTER

Subwatershed: Hackensack River

Site Area: 120,330 sq. ft.

Address: 507 West Street
Union City, NJ 07087

Block and Lot: Block 17, Lot 1

Parking spaces and a basketball court can be replaced with pervious pavement to capture and infiltrate stormwater. A preliminary soil assessment suggests that more soil testing would be required before determining the soil's suitability for green infrastructure.

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	114,149	5.5	57.7	524.1	0.089	3.13

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 pavement	0.417	70	30,595	1.15	8,700	$217,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Thomas Edison Elementary School and Bruce D. Walter Recreation Center

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

0 50' 100'

UNION CITY PARKING AUTHORITY: 6TH AND WEST STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 132,393 sq. ft.

Address: 613 West Street
Union City, NJ 07087

Block and Lot: Block 22, Lot 1.01

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
91	120,934	5.8	61.1	555.3	0.094	3.32

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
Pervious pavement	0.938	157	68,828	2.59	9,500	$237,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 6th and West Street Parking Lot

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

0 50' 100'

UNION CITY PARKING AUTHORITY: 8TH-10TH STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 29,497 sq. ft.

Address: 720 8th Street
Union City, NJ 07087

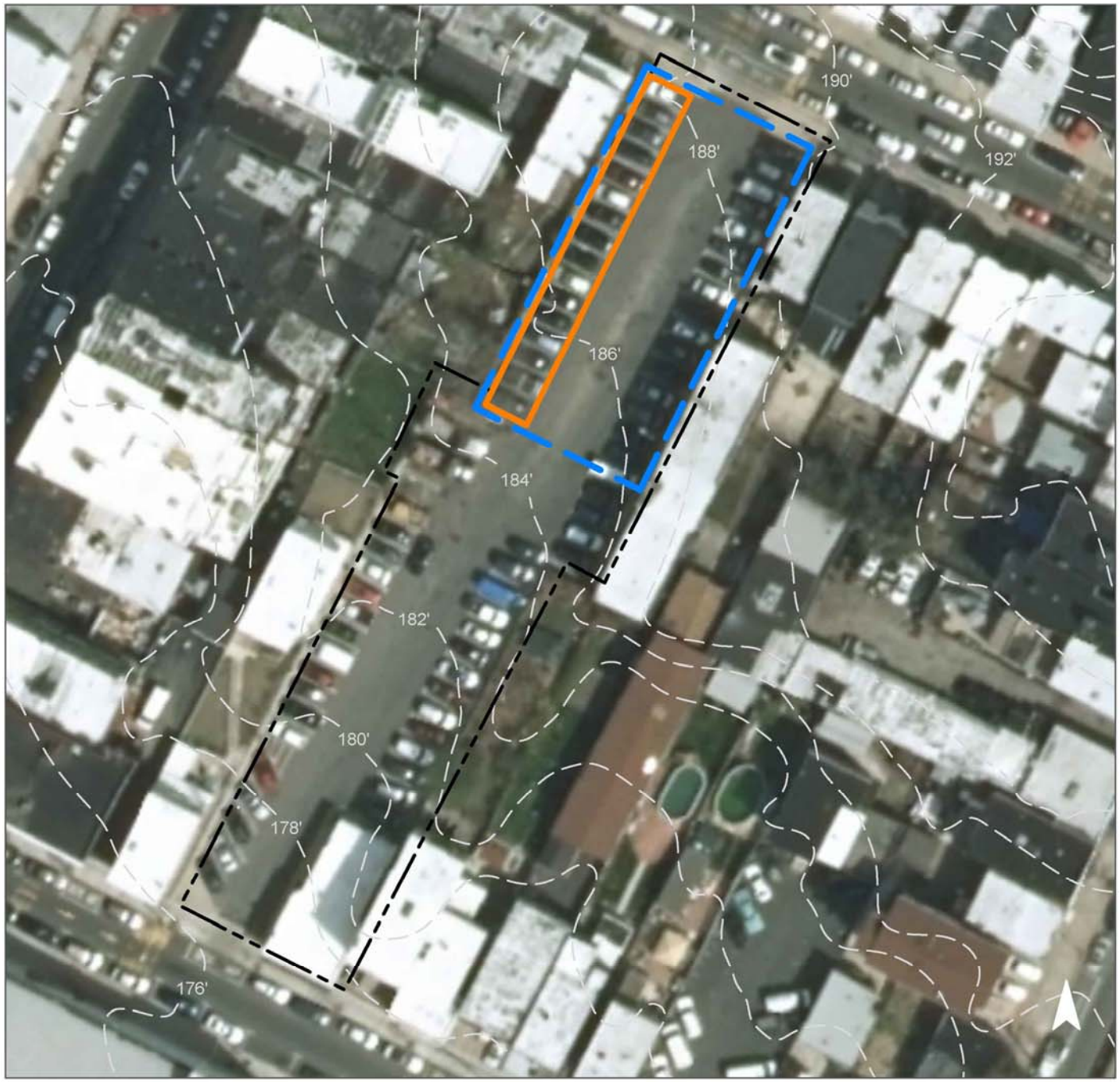
Block and Lot: Block 42, Lot 9

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
94	27,673	1.3	14.0	127.1	0.022	0.76

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 pavement	0.287	48	21,035	0.79	2,600	$65,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Union City Parking Authority: 8th-10th Street Parking Lot

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

0 30' 60'

UNION CITY PARKING AUTHORITY: 25TH STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 7,932 sq. ft.

Address: 513 25th Street
Union City, NJ 07087

Block and Lot: Block 137, Lot 11

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
94	7,454	0.4	3.8	34.2	0.006	0.20

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 pavement	0.125	21	9,179	0.34	3,500	$87,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 25th Street Parking Lot

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

0 25' 50'

UNION CITY PARKING AUTHORITY: 35TH-36TH STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 29,411 sq. ft.

Address: 516 35th Street
Union City, NJ 07087

Block and Lot: Block 213, Lot 28

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	27,941	1.3	14.1	128.3	0.022	0.77

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 pavement	0.618	103	45,317	1.70	6,900	$172,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 35th-36th Street Parking Lot

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

0 30' 60'

UNION CITY PARKING AUTHORITY: 36TH-37TH STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 30,086 sq. ft.

Address: 516 36th Street
Union City, NJ 07087

Block and Lot: Block 218, Lot 17

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	28,562	1.4	14.4	131.1	0.022	0.78

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 pavement	0.300	50	21,985	0.83	7,900	$197,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 36th-37th Street Parking Lot

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

0 30' 60'

UNION CITY PARKING AUTHORITY: 37TH-38TH STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 14,835 sq. ft.

Address: 516 37th Street
Union City, NJ 07087

Block and Lot: Block 219, Lot 22

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
92	13,641	0.7	6.9	62.6	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
Pervious pavement	0.091	15	6,695	0.25	2,300	$57,500

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 37th-38th Street Parking Lot

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

0 30' 60'

UNION CITY PARKING AUTHORITY: 41ST-42ND STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 26,752 sq. ft.

Address: 520 41st Street
Union City, NJ 07087

Block and Lot: Block 239, Lot 20

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	25,413	1.2	12.8	116.7	0.020	0.70

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavement	0.612	103	44,928	1.69	7,000	$175,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 41st-42nd Street Parking Lot

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

0 30' 60'

UNION CITY PARKING AUTHORITY: 44TH-45TH STREET PARKING LOT

Subwatershed: Hackensack River

Site Area: 26,705 sq. ft.

Address: 413 45th Street
Union City, NJ 07087

Block and Lot: Block 256, Lot 8

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
95	25,370	1.2	12.8	116.5	0.020	0.70

Recommended Green Infrastructure Practices	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Pervious pavement	0.102	17	7,458	0.28	1,200	$30,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 44th-45th Street Parking Lot

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

0 30' 60'

GRACE EPISCOPAL CHURCH

Subwatershed: Hudson River

Site Area: 26,727 sq. ft.

Address: 3901 Park Avenue
Union City, NJ 07087

Block and Lot: Block 233, Lot 17

Bioretention systems can be installed to capture, treat, and infiltrate rooftop runoff. A cistern can be installed to capture and harvest rainwater to be reused for the 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"
55	14,700	0.7	7.4	67.5	0.011	0.40

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	0.012	2	883	0.03	115	$575
Rainwater harvesting system	0.005	1	150	0.01	150 (gal.)	$300

GREEN INFRASTRUCTURE RECOMMENDATIONS

Grace Episcopal Church

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

0 30' 60'

UNION CITY PARKING AUTHORITY: 12TH-13TH STREET PARKING LOT

Subwatershed: Hudson River

Site Area: 8,706 sq. ft.

Address: 314 12th Street
Union City, NJ 07087

Block and Lot: Block 62, Lot 14

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

Impervious Cover		Existing Loads from Impervious Cover (lbs/yr)			Runoff Volume from Impervious Cover (Mgal)	
%	sq. ft.	TP	TN	TSS	For the 1.25" Water Quality Storm	For an Annual Rainfall of 44"
94	8,218	0.4	4.2	37.7	0.006	0.23

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 pavement	0.180	30	13,196	0.50	3,000	$75,000

GREEN INFRASTRUCTURE RECOMMENDATIONS

Union City Parking Authority: 12th-13th Street Parking Lot

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

0 30' 60'

c. Summary of Existing Conditions

Summary of Existing 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)
	HACKENSACK RIVER SUBWATERSHED	**27.68**	**1,205,585**			**47.9**	**502.1**	**4,564.8**		**22.82**	**994,207**	**0.775**	**27.27**
1	**Ellsworth Park**												
	Total Site Info	1.62	70,617	126	1	1.4	14.3	129.7	40	0.65	28,247	0.022	0.77
2	**Gilmore School**												
	Total Site Info	1.33	57,834	83	10	1.8	19.3	175.3	66	0.88	38,189	0.030	1.05
3	**Hudson Korean Presbyterian Church and Monastery**												
	Total Site Info	6.06	264,088	108	1.03	8.9	93.4	849.3	70	4.25	184,980	0.144	5.07
4	**Jose Marti Freshman Academy and Union City Public Library**												
	Total Site Info	6.02	262,052	108	1.04	11.1	116.5	1,059.1	88	5.30	230,672	0.180	6.33
5	**Saint Anthony of Padua Catholic Chuch and Elementary School**												
	Total Site Info	1.81	78,883	34	1.01	3.6	37.8	344.1	95	1.72	74,938	0.058	2.06
6	**Saint Augustine School**												
	Total Site Info	1.24	54,169	231	1	2.2	23.3	211.4	85	1.06	46,044	0.036	1.26
7	**Thomas Edison Elementary School and Bruce D. Walter Recreation Center**												
	Total Site Info	2.76	120,330	17	1	5.5	57.7	524.1	95	2.62	114,149	0.089	3.13
8	**Union City Parking Authority: 6th and West Street Parking Lot**												
	Total Site Info	3.04	132,393	22	1.01	5.8	61.1	555.3	91	2.78	120,934	0.094	3.32
9	**Union City Parking Authority: 8th-10th Street Parking Lot**												
	Total Site Info	0.68	29,497	42	9	1.3	14.0	127.1	94	0.64	27,673	0.022	0.76
10	**Union City Parking Authority: 25th Street Parking Lot**												
	Total Site Info	0.18	7,932	137	11	0.4	3.8	34.2	94	0.17	7,454	0.006	0.20
11	**Union City Parking Authority: 35th-36th Street Parking Lot**												
	Total Site Info	0.68	29,411	213	28	1.3	14.1	128.3	95	0.64	27,941	0.022	0.77

Summary of Existing 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)
12	**Union City Parking Authority: 36th-37th Street Parking Lot**												
	Total Site Info	0.69	30,086	218	17	1.4	14.4	131.1	95	0.66	28,562	0.022	0.78
13	**Union City Parking Authority: 37th-38th Street Parking Lot**												
	Total Site Info	0.34	14,835	219	22	0.7	6.9	62.6	92	0.31	13,641	0.011	0.37
14	**Union City Parking Authority: 41st-42nd Street Parking Lot**												
	Total Site Info	0.61	26,752	239	20	1.2	12.8	116.7	95	0.58	25,413	0.020	0.70
15	**Union City Parking Authority: 44th-45th Street Parking Lot**												
	Total Site Info	0.61	26,705	256	8	1.2	12.8	116.5	95	0.58	25,370	0.020	0.70
	HUDSON RIVER SUBWATERSHED	**0.81**	**35,433**			**1.1**	**11.6**	**105.2**	**149**	**0.53**	**22,918**	**0.018**	**0.63**
16	**Grace Episcopal Church**												
	Total Site Info	0.61	26,727	233	17	0.7	7.4	67.5	55	0.34	14,700	0.011	0.40
17	**Union City Parking Authority: 12th-13th Street Parking Lot**												
	Total Site Info	0.20	8,706	62	14	0.4	4.2	37.7	94	0.19	8,218	0.006	0.23

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	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)	($)		($)	%
	HACKENSACK RIVER SUBWATERSHED	**203,845**	**4.68**	**5.273**	**888**	**386,930**	**14.53**	**72,262**			**$1,935,750**	**20.5%**
1	**Ellsworth Park**											
	Stormwater planters	4,030	0.09	0.105	18	7,705	0.29	360	375	SF	$135,000	14.3%
	Total Site Info	**4,030**	**0.09**	**0.105**	**18**	**7,705**	**0.29**	**360**			**$135,000**	14.3%
2	**Gilmore School**											
	Pervious pavement	3,400	0.08	0.089	15	6,501	0.24	3,400	25	SF	$85,000	8.9%
	Total Site Info	**3,400**	**0.08**	**0.089**	**15**	**6,501**	**0.24**	**3,400**			**$85,000**	8.9%
3	**Hudson Korean Presbyterian Church and Monastery**											
	Pervious pavement	24,500	0.56	0.638	107	46,843	1.76	10,000	25	SF	$250,000	13.2%
	Total Site Info	**24,500**	**0.56**	**0.638**	**107**	**46,843**	**1.76**	**10,000**			**$250,000**	13.2%
4	**Jose Marti Freshman Academy and Union City Public Library**											
	Bioretention system	1,200	0.03	0.031	5	2,297	0.09	300	5	SF	$1,500	0.5%
	Pervious pavement	8,400	0.19	0.219	37	16,061	0.60	2,700	25	SF	$67,500	3.6%
	Total Site Info	**9,600**	**0.22**	**0.250**	**42**	**18,357**	**0.69**	**3,000**			**$69,000**	4.2%
5	**Saint Anthony of Padua Catholic Chuch and Elementary School**											
	Bioretention system	520	0.01	0.014	2	995	0.04	130	5	SF	$650	0.7%
	Pervious pavement	22,000	0.51	0.573	96	42,063	1.58	4,100	25	SF	$102,500	29.4%
	Total Site Info	**22,520**	**0.52**	**0.587**	**98**	**43,058**	**1.62**	**4,230**			**$103,150**	30.1%
6	**Saint Augustine School**											
	Bioretention system	1,175	0.03	0.031	5	2,244	0.08	370	5	SF	$1,850	2.6%
	Pervious pavement	3,245	0.07	0.085	14	6,201	0.23	1,270	25	SF	$31,750	7.0%
	Tree filter box	1,475	0.03	n/a	6	n/a	n/a	32	10000	box	$20,000	3.2%
	Total Site Info	**5,895**	**0.14**	**0.115**	**25**	**8,446**	**0.31**	**1,672**			**$53,600**	12.8%
7	**Thomas Edison Elementary School and Bruce D. Walter Recreation Center**											
	Pervious pavement	16,000	0.37	0.417	70	30,595	1.15	8,700	25	SF	$217,500	14.0%
	Total Site Info	**16,000**	**0.37**	**0.417**	**70**	**30,595**	**1.15**	**8,700**			**$217,500**	14.0%

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)	($)		($)	%
8	**Union City Parking Authority: 6th and West Street Parking Lot**											
	Pervious pavement	36,000	0.83	0.938	157	68,828	2.59	9,500	25	SF	$237,500	29.8%
	Total Site Info	**36,000**	**0.83**	**0.938**	**157**	**68,828**	**2.59**	**9,500**			**$237,500**	29.8%
9	**Union City Parking Authority: 8th-10th Street Parking Lot**											
	Pervious pavement	11,000	0.25	0.287	48	21,035	0.79	2,600	25	SF	$65,000	39.7%
	Total Site Info	**11,000**	**0.25**	**0.287**	**48**	**21,035**	**0.79**	**2,600**			**$65,000**	39.7%
10	**Union City Parking Authority: 25th Street Parking Lot**											
	Pervious pavement	4,800	0.11	0.125	21	9,179	0.34	3,500	25	SF	$87,500	64.4%
	Total Site Info	**4,800**	**0.11**	**0.125**	**21**	**9,179**	**0.34**	**3,500**			**$87,500**	64.4%
11	**Union City Parking Authority: 35th-36th Street Parking Lot**											
	Pervious pavement	23,700	0.54	0.618	103	45,317	1.70	6,900	25	SF	$172,500	84.8%
	Total Site Info	**23,700**	**0.54**	**0.618**	**103**	**45,317**	**1.70**	**6,900**			**$172,500**	84.8%
12	**Union City Parking Authority: 36th-37th Street Parking Lot**											
	Pervious pavement	11,500	0.26	0.300	50	21,985	0.83	7,900	25	SF	$197,500	40.3%
	Total Site Info	**11,500**	**0.26**	**0.300**	**50**	**21,985**	**0.83**	**7,900**			**$197,500**	40.3%
13	**Union City Parking Authority: 37th-38th Street Parking Lot**											
	Pervious pavement	3,500	0.08	0.091	15	6,695	0.25	2,300	25	SF	$57,500	25.7%
	Total Site Info	**3,500**	**0.08**	**0.091**	**15**	**6,695**	**0.25**	**2,300**			**$57,500**	25.7%
14	**Union City Parking Authority: 41st-42nd Street Parking Lot**											
	Pervious pavement	23,500	0.54	0.612	103	44,928	1.69	7,000	25	SF	$175,000	92.5%
	Total Site Info	**23,500**	**0.54**	**0.612**	**103**	**44,928**	**1.69**	**7,000**			**$175,000**	92.5%
15	**Union City Parking Authority: 44th-45th Street Parking Lot**											
	Pervious pavement	3,900	0.09	0.102	17	7,458	0.28	1,200	25	SF	$30,000	15.4%
	Total Site Info	**3,900**	**0.09**	**0.102**	**17**	**7,458**	**0.28**	**1,200**			**$30,000**	15.4%

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)									
	HUDSON RIVER SUBWATERSHED	**7,550**	**0.17**	**0.197**	**33**	**14,228**	**0.54**	**3,265**			**$75,875**	**32.9%**
16	**Grace Episcopal Church**											
	Bioretention system	460	0.01	0.012	2	883	0.03	115	5	SF	$575	3.1%
	Rainwater harvesting	190	0.00	0.005	1	150	0.01	150	2	gal	$300	1.3%
	Total Site Info	**650**	**0.01**	**0.017**	**3**	**1,033**	**0.04**	**265**			**$875**	4.4%
17	**Union City Parking Authority: 12th-13th Street Parking Lot**											
	Pervious pavement	6,900	0.16	0.180	30	13,196	0.50	3,000	25	SF	$75,000	84.0%
	Total Site Info	**6,900**	**0.16**	**0.180**	**30**	**13,196**	**0.50**	**3,000**			**$75,000**	84.0%