RUTGERS
New Jersey Agricultural
Experiment Station

Impervious Cover Reduction Action Plan
for
Hackensack, Bergen County, New Jersey

Prepared for Hackensack by the
Rutgers Cooperative Extension Water Resources Program

August 12, 2024

ACKNOWLEDGEMENTS:

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

RUTGERS
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THE CITY OF HACKENSACK

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Introduction

Located in Bergen County, New Jersey, Hackensack covers approximately 4.34 square miles. Figures 1 and 2 illustrate that Hackensack is dominated by urban land use. A total of 91.2% of the municipality's land use is classified as urban. Of the urban land in Hackensack City, commercial is the dominant land use (Figure 3).

The New Jersey Department of Environmental Protection's (NJDEP) 2020 land use/land cover geographical information system (GIS) data layer categorizes Hackensack into many unique land use areas, assigning a percent impervious cover for each delineated area. The impervious coverage for Hackensack was estimated by using the 2015 impervious cover layer from NJDEP. Approximately 70.8% of Hackensack has impervious cover. This level of impervious cover suggests that the streams in Hackensack are likely non-supporting waterways. [1]

Methodology

Hackensack contains a portion of five subwatersheds (Figure 4). For this impervious cover reduction action plan (RAP), projects have been identified in the Berry's Creek, Coles Brook / Van Saun Mill Brook, Hackensack River (Bellman's Creek to Fort Lee Road), and Hackensack River (Fort Lee Road to Oradell gage) subwatersheds. Aerial imagery initially was studied to identify potential project sites that contain extensive impervious cover. Field inspections were conducted to determine if viable options exist at the sites to reduce impervious cover or to disconnect impervious surfaces from draining directly to the local waterway or storm sewer system. During the field inspections, appropriate green infrastructure practices for the sites were recommended. Sites that already had green infrastructure 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.

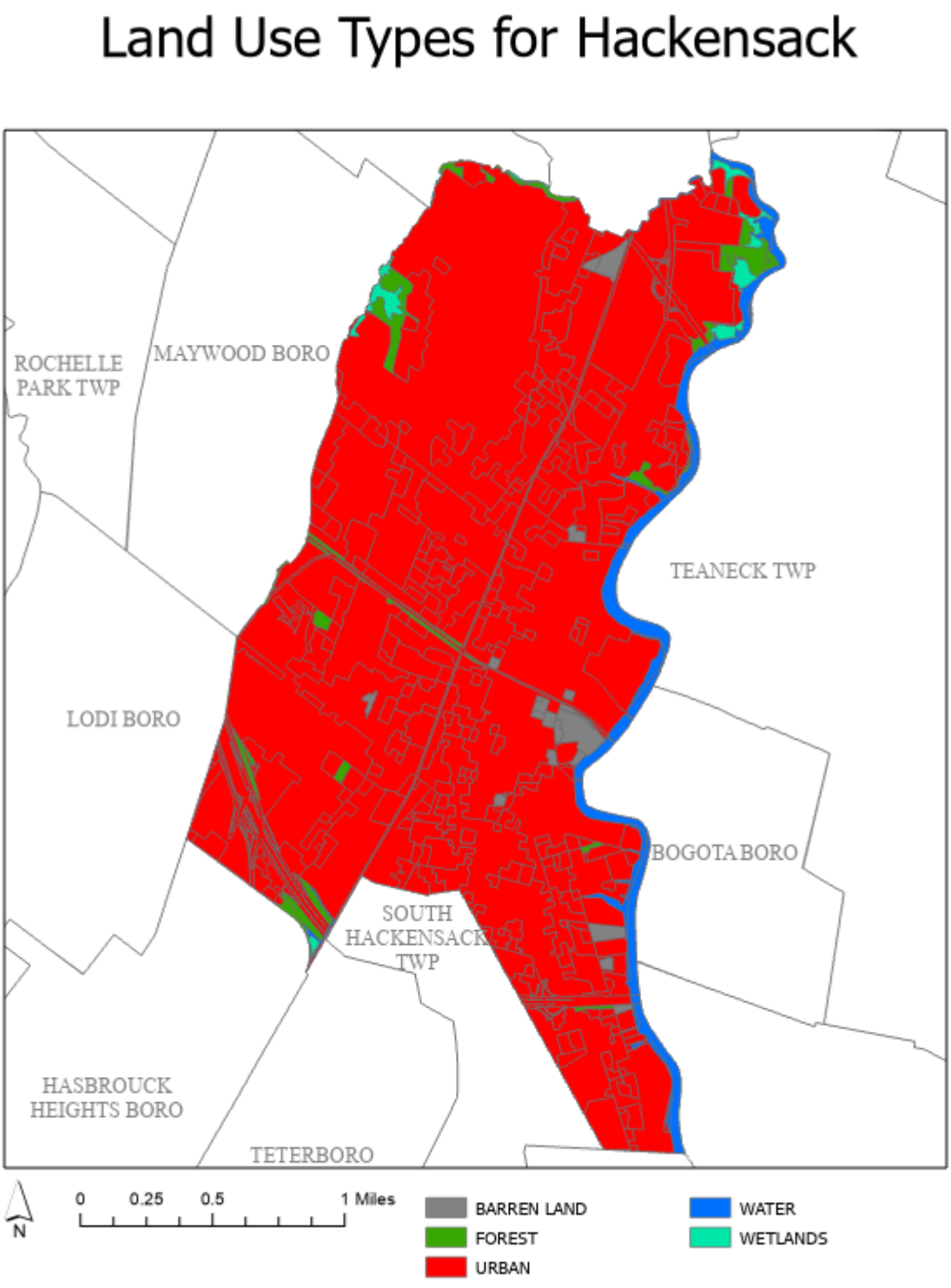


Figure 1: Map illustrating land use in Hackensack

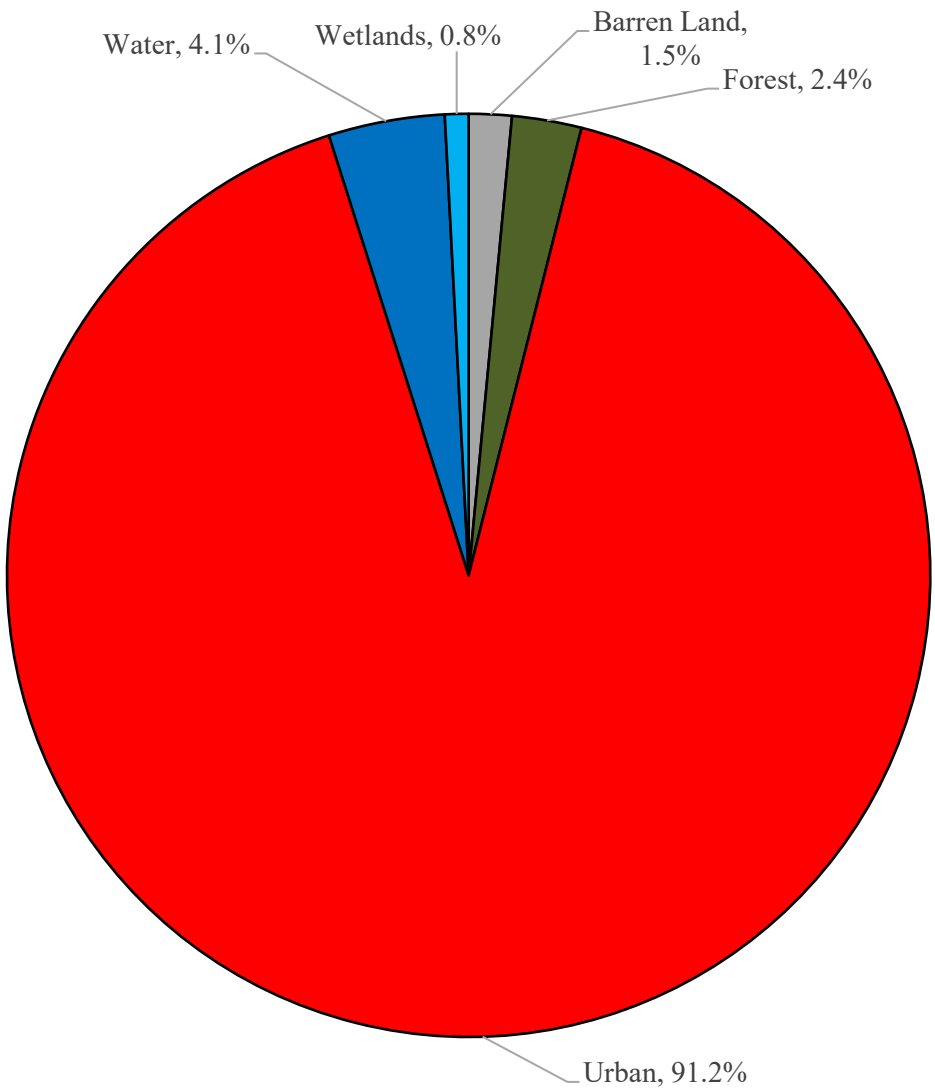


Figure 2: Pie chart illustrating the land use in Hackensack

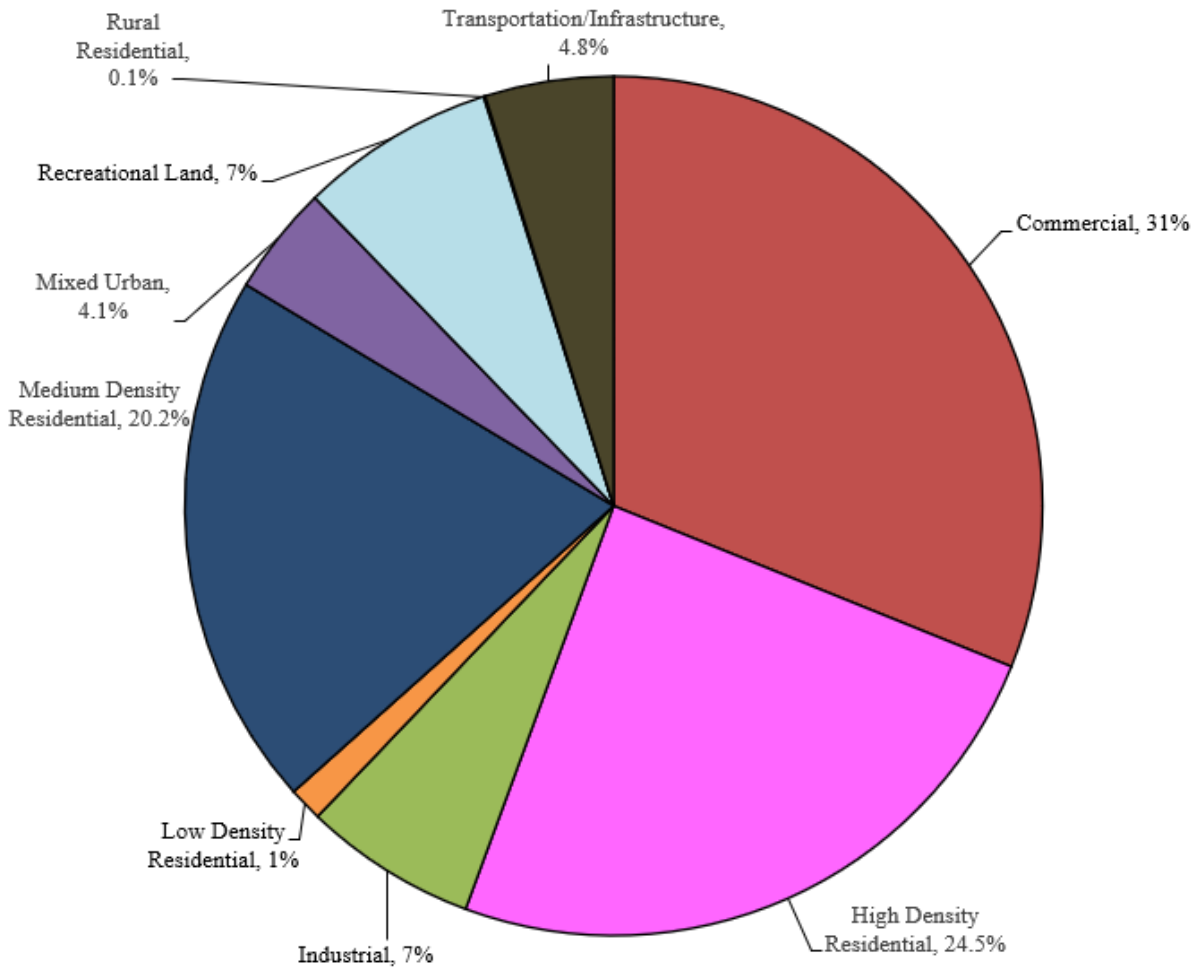


Figure 3: Pie chart illustrating the various types of urban land use in Hackensack

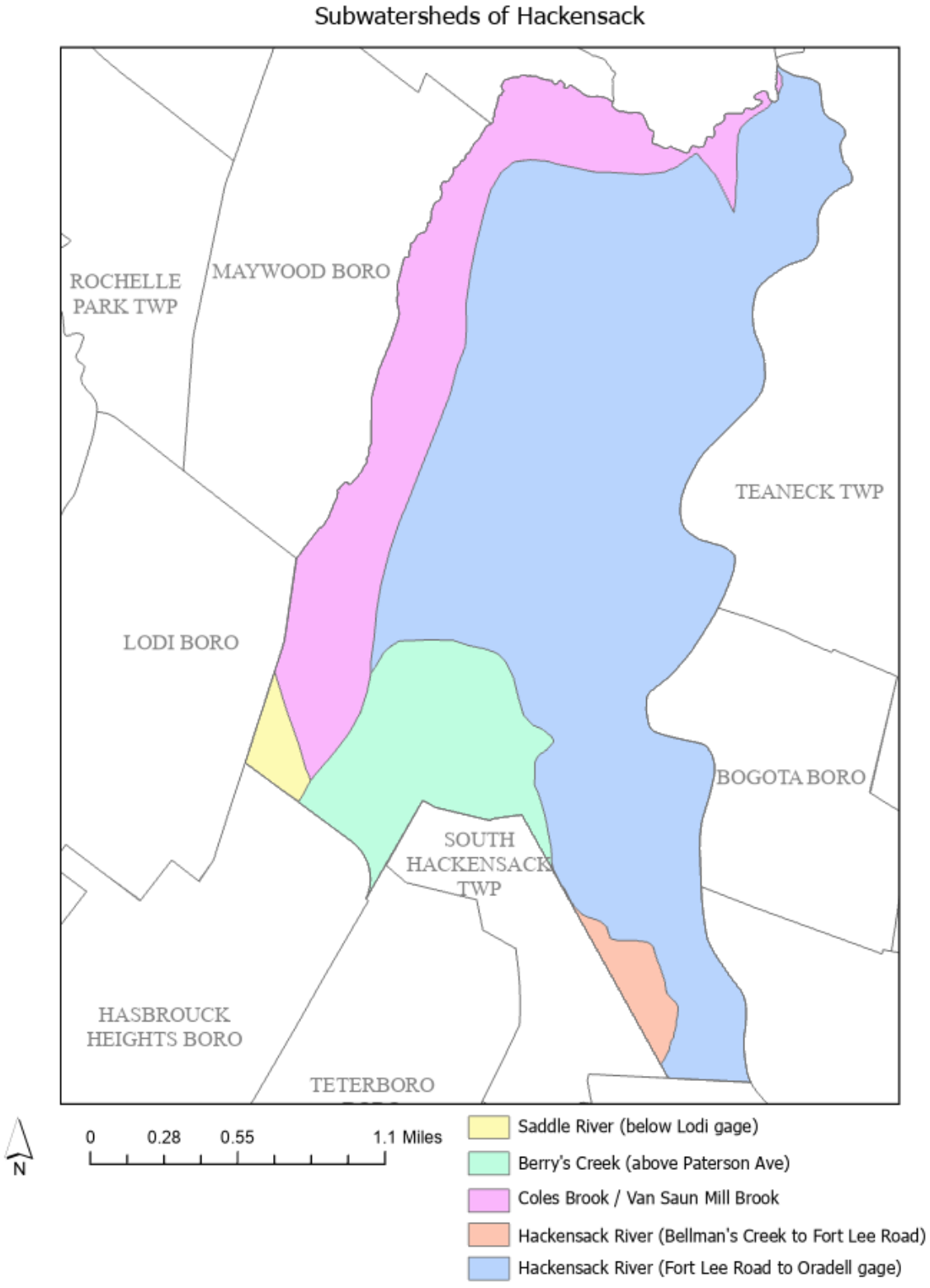


Figure 4: Map of the subwatersheds in Hackensack

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 New Jersey water quality design storm (1.25 inches of rain over two hours) and for the average annual rainfall total of 48.1 inches for Bergen County.

Preliminary soil assessments were conducted for each potential project site identified in Hackensack 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, allowing for the capture of 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, February 2004, Page 3-11.

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 principle, 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 yield 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 Hackensack. The practices are discussed below.

Disconnected downspouts

This is often referred to as simple disconnection. A downspout is simply disconnected 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 are designed with an underlying stone layer to retain stormwater runoff and allow it to slowly seep into the ground.




[3] United States Environmental Protection Agency (USEPA). 2015. Benefits of Green Infrastructure. http://www.epa.gov/greeninfrastructure/benefits-green-infrastructure

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.

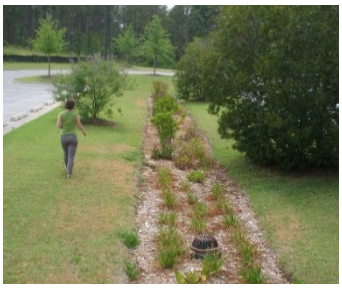
Downspout planter boxes

These are large wooden boxes that house a variety of water-retaining and/or filtering plants. When installed at the base of a downspout, water is captured by the plants which reduces stormwater runoff volume, provides a water source for the vegetation, and provides a small patch of habitat and food sources for birds and insects.

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. Bioswales are often designed for larger scale sites where water needs time to move and slowly infiltrate into the groundwater. Much like rain garden systems, bioswales can also be designed with an underdrain pipe that allows excess water to discharge to the nearest catch basin or existing stormwater system.

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. Tree filter boxes 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 with a focus 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, recharge potential, TSS removal potential, maximum volume reduction potential per storm, peak reduction potential, and estimated project costs are provided. This information will be especially useful in instances where proposed development projects cannot satisfy the New Jersey stormwater management requirements (N.J.A.C. 7:8).

Conclusion

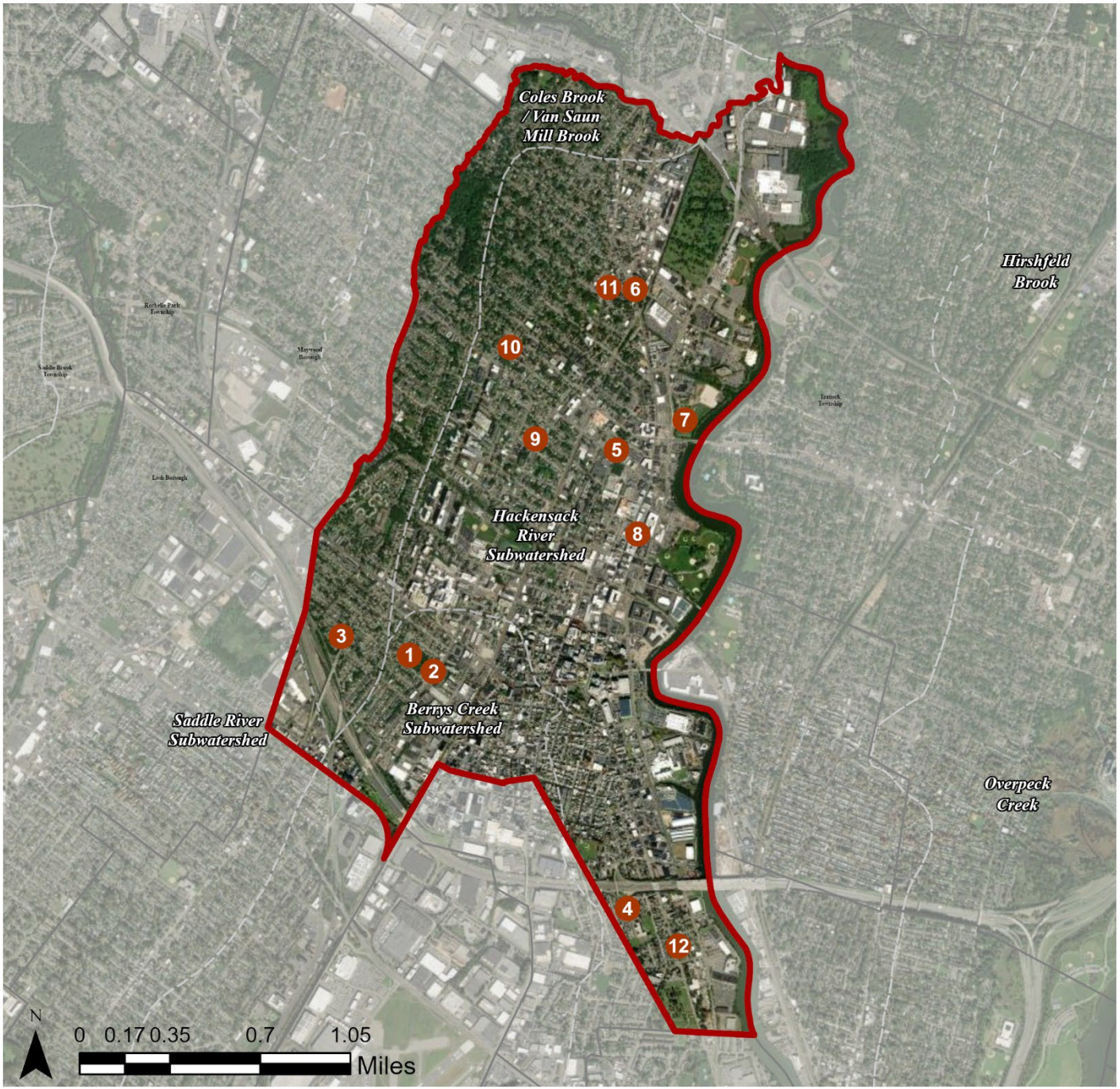
This impervious cover reduction action plan is meant to provide the municipality with a blueprint for implementing green infrastructure practices that will reduce the impact of stormwater runoff from impervious surfaces. These projects can be implemented through a wide variety of volunteer groups, such as Boy Scouts, Girl Scouts, Municipal Green Teams, corporate volunteerism, faith-based groups, school groups, watershed groups, and other active community organizations.

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 green infrastructure 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

HACKENSACK CITY: GREEN INFRASTRUCTURE SITES



SITES WITHIN THE BERRY'S CREEK SUBWATERSHED

1. Fanny Meyer Hillers School
2. Polify Road Park

SITES WITHIN THE COLES BROOK / VAN SAUN MILL BROOK SUBWATERSHED

3. Hackensack Fire Department Engine 2

SITES WITHIN THE HACKENSACK RIVER (BELLMAN'S CREEK TO FORT LEE ROAD) SUBWATERSHED

4. Immaculate Conception Roman Catholic Church

SITES WITHIN THE HACKENSACK RIVER (FORT LEE ROAD TO ORADELL GAGE) SUBWATERSHED

5. Bergen County Christian Academy
6. Fairmount Park
7. Johnson Park
8. Johnson Public Library
9. Majestic Lodge 153
10. Mt. Holiness Temple
11. Nuevo Amanecer Spanish Seventh-Day Adventist Church
12. St. Joseph's Roman Catholic Church

b. Proposed Green Infrastructure Concepts

FANNY MEYER HILLERS SCHOOL

Subwatershed: Berry's Creek

HUC14 ID: 02030103180060

Site Area: 156,449 sq. ft.

Address: 56 Longview Avenue
Hackensack, NJ 07601

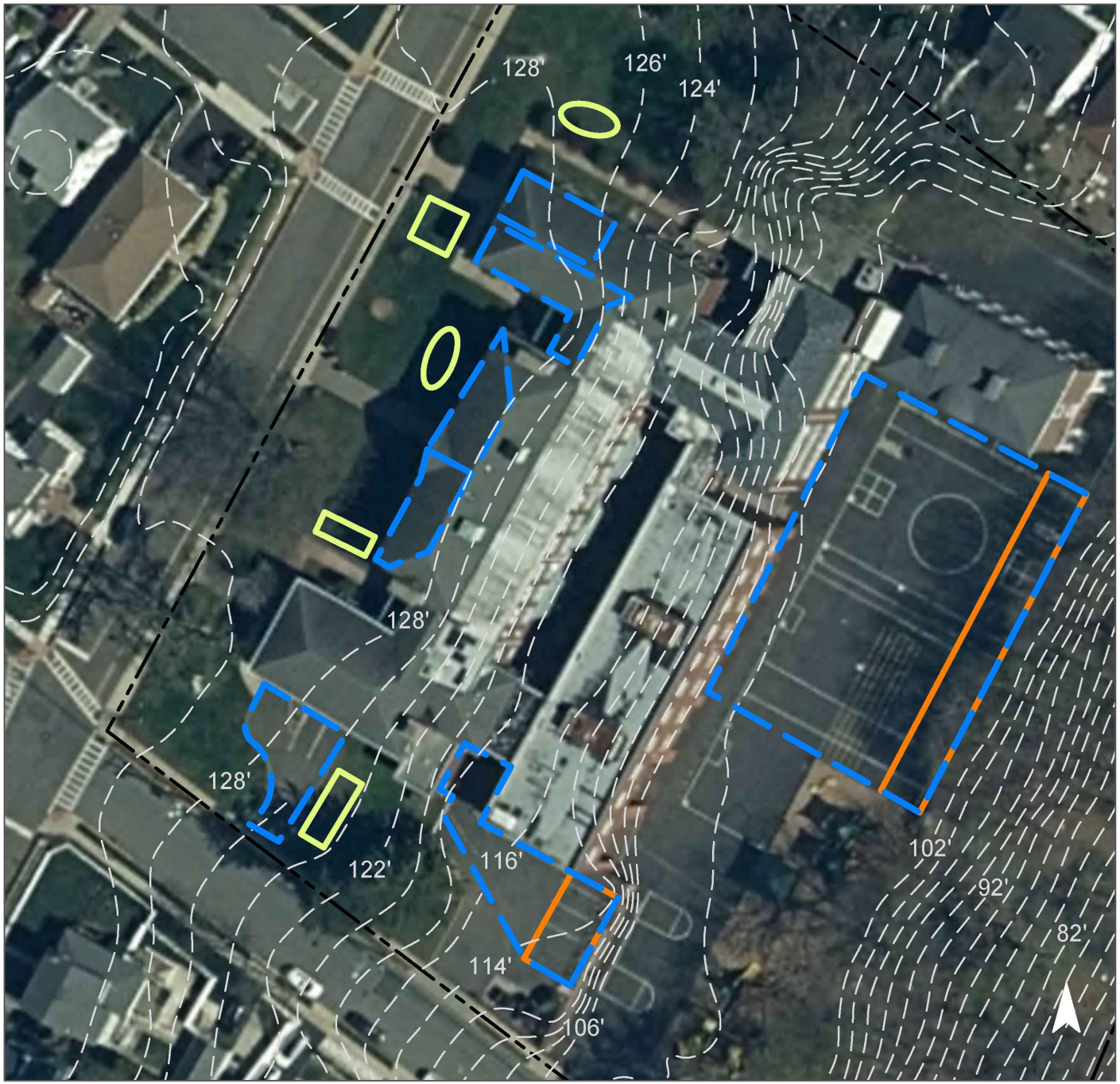
Block and Lot: Block 130, Lot 15

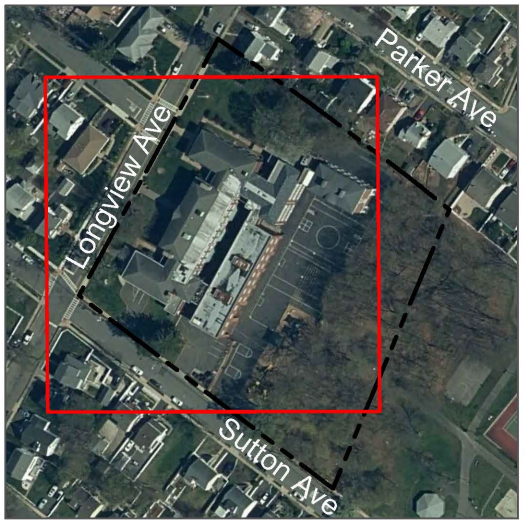
Rain gardens can be installed in various turfgrass areas around the building to capture, treat, and infiltrate the stormwater runoff from the rooftop. This will require redirecting downspouts beneath sidewalks. The existing parking spaces to the rear of the building and parts of the impervious playground can be converted into pervious pavement to capture and infiltrate the stormwater runoff from the asphalt. 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 48.1"
54	84,970	4.1	42.9	390.1	0.066	2.55

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	4,735	0.135	21	9,260	0.35	1,185	$11,850
Pervious pavement	16,125	0.459	70	31,530	1.18	3,255	$81,375

GREEN INFRASTRUCTURE RECOMMENDATIONS





Fanny Meyer Hillers School

- bioretention system
- pervious pavement
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 30' 60'

POLIFY ROAD PARK

Subwatershed: Berry's Creek

HUC14 ID: 02030103180060

Site Area: 116,599 sq. ft.

Address: 59 Polify Road
Hackensack, NJ 07601

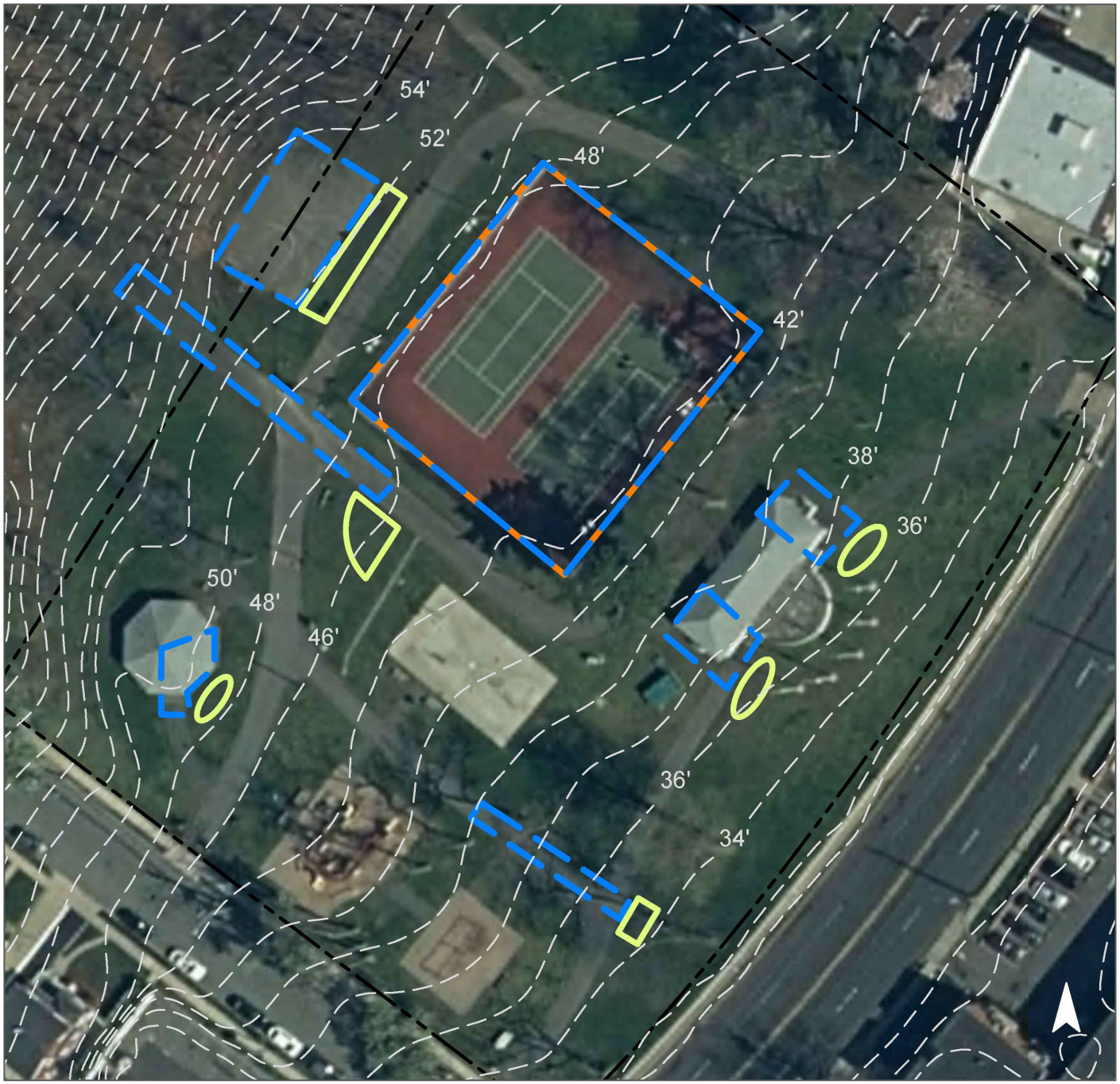
Block and Lot: Block 125, Lot 16

Multiple rain gardens can be installed in turfgrass areas to capture, treat, and infiltrate the stormwater runoff from the asphalt walkways, park building roof, and gazebo roof. A trench drain may be needed to intercept runoff on the walkway and redirect it to a rain garden. The existing tennis court can be converted into pervious pavement to capture and infiltrate the stormwater runoff that lands on the court. 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 48.1"
31	36,536	1.8	18.5	167.8	0.028	1.10

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	6,250	0.178	27	12,220	0.46	1,565	$15,650
Pervious pavement	13,120	0.374	57	25,660	0.96	13,120	$328,000

GREEN INFRASTRUCTURE RECOMMENDATIONS



Polify Road Park

- bioretention system
- pervious pavement
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 30' 60'

HACKENSACK FIRE DEPARTMENT ENGINE 2

RUTGERS New Jersey Agricultural Experiment Station

Subwatershed: Coles Brook / Van Saun Mill Brook

HUC14 ID: 02030103180010

Site Area: 17,810 sq. ft.

Address: 107 South Summit Avenue Hackensack, NJ 07601

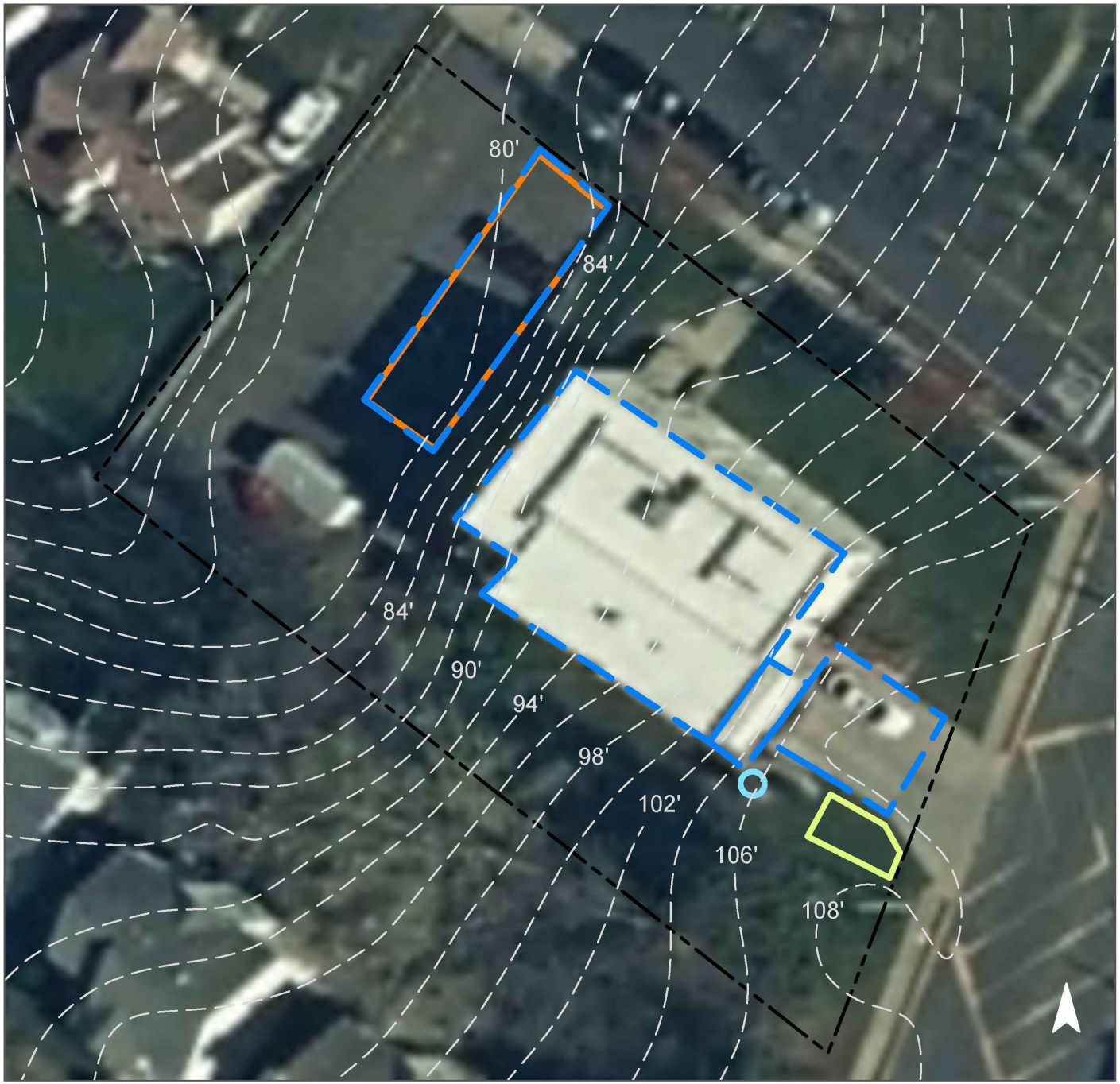
Block and Lot: Block 144, Lot 1

Stormwater runoff is directed from the roof to the turfgrass area behind the building via disconnected downspouts. The concrete wall separating the turfgrass area and parking lot contains multiple drainage outlets, directing water to the parking lot. The existing parking spaces can be converted into pervious pavement to capture and infiltrate the stormwater runoff before it goes into the nearby catch basin. A cistern can be installed to the front building to divert and detain the stormwater runoff from the rooftop for later non-potable reuse such as washing vehicles. A rain garden can be installed in front of the building to capture, treat, and infiltrate the stormwater runoff from the concrete driveway. This would require a trench drain. 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 48.1"
61	10,818	0.5	5.5	49.7	0.008	0.32

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	600	0.017	2	1,170	0.04	150	$1,500
Pervious pavement	3,910	0.111	17	7,640	0.29	970	$24,250
Rainwater harvesting	180	0.005	N/A	150	N/A	150 (gal)	$450

GREEN INFRASTRUCTURE RECOMMENDATIONS



Hackensack Fire Department Engine 2

- bioretention system
- rainwater harvesting
- pervious pavement
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 15' 30'

IMMACULATE CONCEPTION ROMAN CATHOLIC CHURCH

RUTGERS New Jersey Agricultural Experiment Station

Subwatershed: Hackensack River (Bellman's Creek to Fort Lee Road)

HUC14 ID: 02030103180050

Site Area: 32,335 sq. ft.

Address: 49 Vreeland Avenue Hackensack, NJ 07601

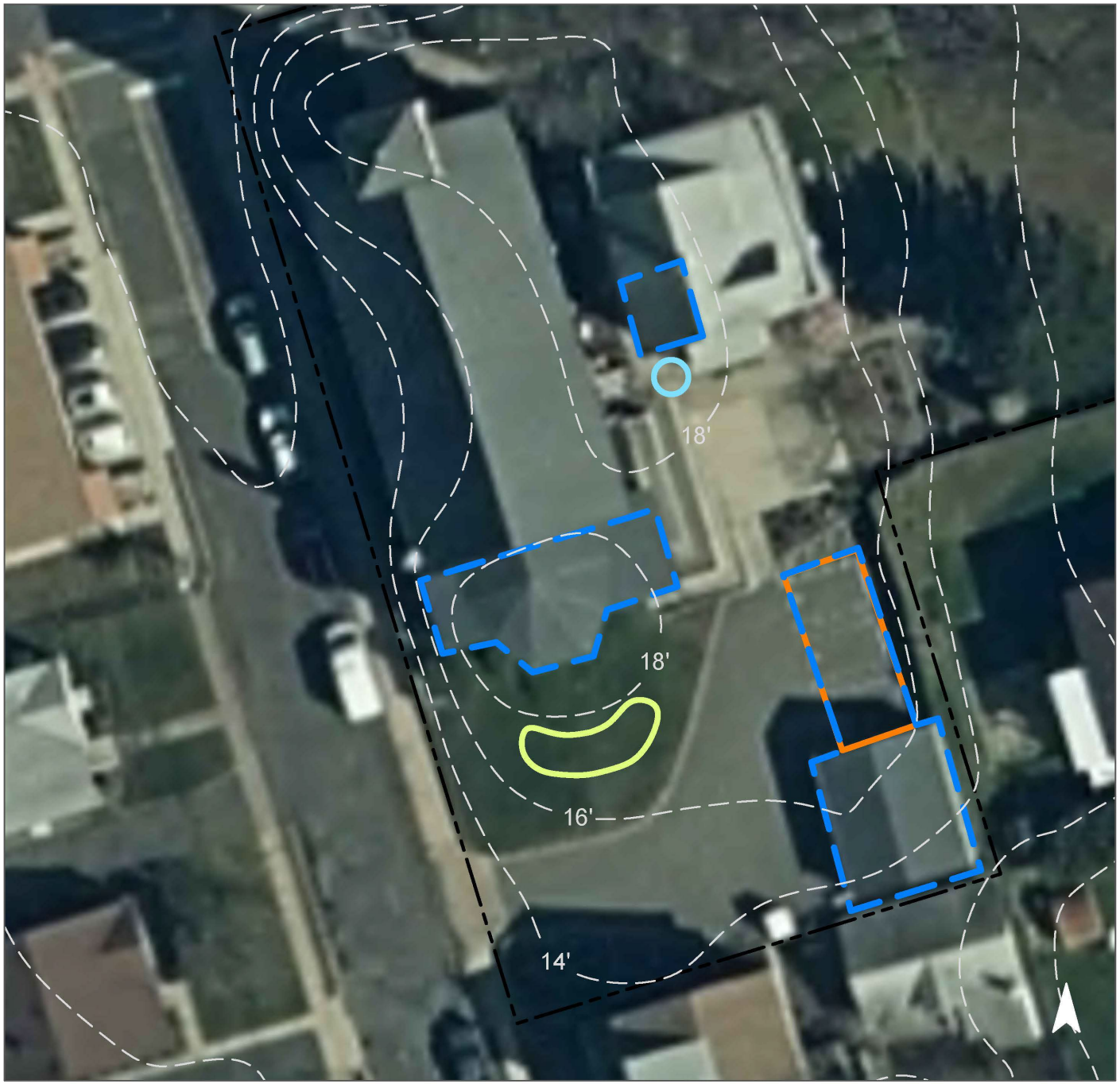
Block and Lot: Block 19, Lot 21

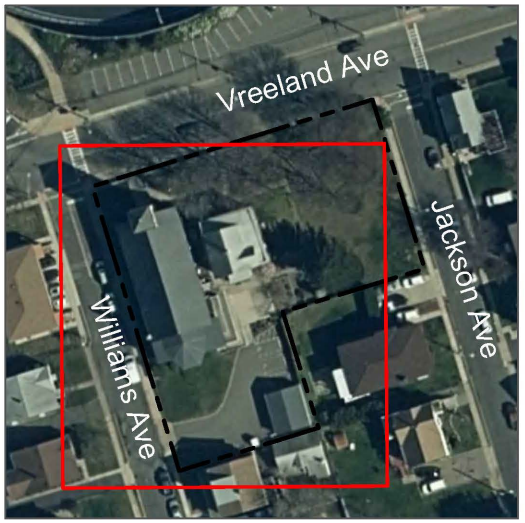
A rain garden can be installed in the turfgrass area behind the church to capture, treat, and infiltrate the stormwater runoff from the rooftop. This would require disconnecting downspouts. A cistern can be installed behind the eastern church building to divert and detain the stormwater runoff from the rooftop for later non-potable reuse such as watering a garden bed or washing a vehicle. The existing parking spaces behind the church buildings can be converted into pervious pavement to capture and infiltrate stormwater runoff from the pavement and the adjacent shed roof. The downspouts on the shed can be redirected to the porous pavement. 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 48.1"
64	20,600	1.0	10.4	94.6	0.016	0.62

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	900	0.026	4	1,760	0.07	225	$2,250
Pervious pavement	1,380	0.039	6	2,700	0.10	555	$13,875
Rainwater harvesting	190	0.005	N/A	150	N/A	150 (gal)	$450

GREEN INFRASTRUCTURE RECOMMENDATIONS





Immaculate Conception Roman Catholic Church

- bioretention system
- pervious pavement
- rainwater harvesting
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 15' 30'

BERGEN COUNTY CHRISTIAN ACADEMY

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 110,248 sq. ft.

Address: 15 Conklin Place & 92 Passaic Street Hackensack, NJ 07601

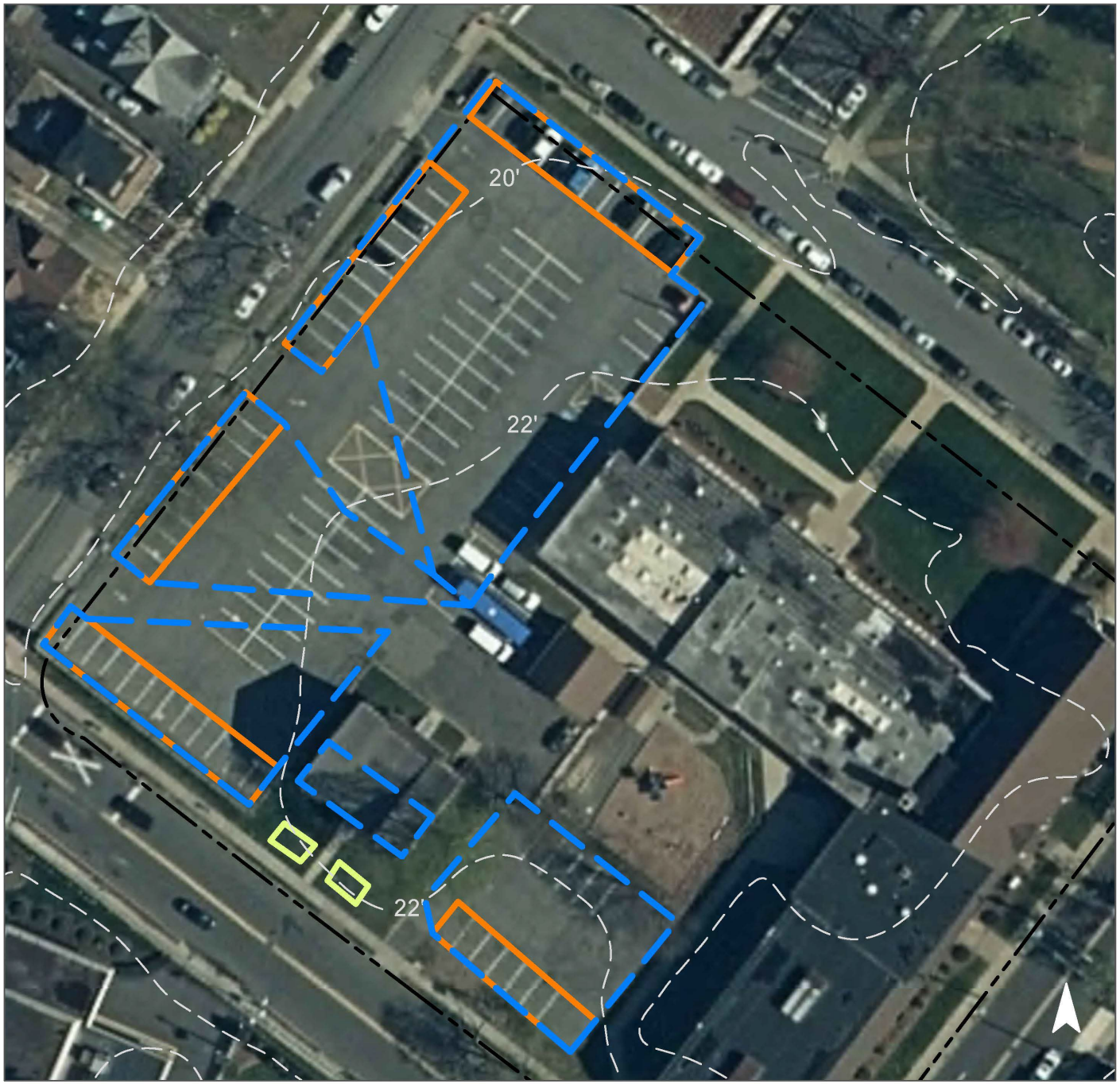
Block and Lot: Block 416, Lot 1 & Block 416, Lot 5

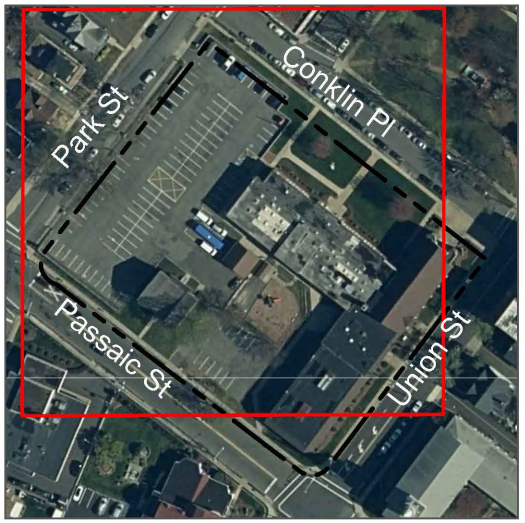
Rain gardens can be installed in the turfgrass areas in front of the building at 92 Passaic Street to capture, treat, and infiltrate the stormwater runoff from the rooftop. This would require disconnecting downspouts. The existing parking spaces around the perimeter of the main lot and in the small lot next to 92 Passaic Street can be converted into pervious pavement to capture and infiltrate the stormwater runoff from the asphalt. In the main lot, a trench drain can be constructed at the parking lot entrance to intercept runoff headed towards the street and redirect it to the porous pavement. 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 48.1"
82	90,668	4.4	45.8	416.3	0.071	2.72

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	990	0.028	4	1,940	0.07	250	$2,500
Pervious pavement	32,285	0.920	141	63,130	2.37	7,980	$199,500

GREEN INFRASTRUCTURE RECOMMENDATIONS





Bergen County Christian Academy

- bioretention system
- pervious pavement
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 30' 60'

FAIRMOUNT PARK

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 71,695 sq. ft.

Address: 19 Temple Avenue
Hackensack, NJ 07601

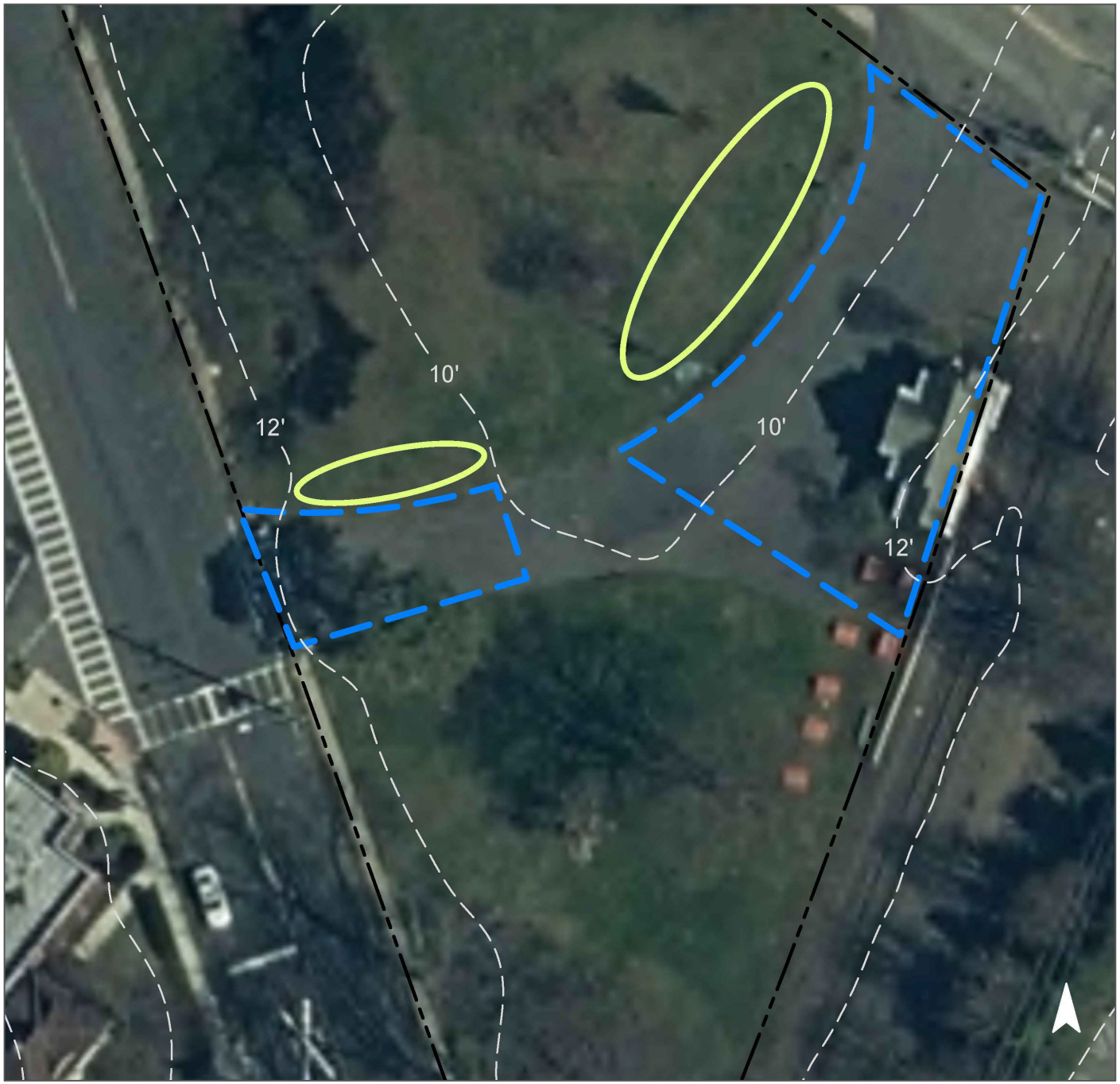
Block and Lot: Block 520, Lot 1

Rain gardens can be installed in the turfgrass areas along the driveway to capture, treat, and infiltrate the stormwater runoff from the pavement. A trench drain may be needed to intercept runoff and redirect it towards the 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 48.1"
24	16,881	0.8	8.5	77.5	0.013	0.51

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	9,055	0.258	40	17,710	0.67	2,265	$22,650

GREEN INFRASTRUCTURE RECOMMENDATIONS



Fairmount Park

- bioretention system
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 20' 40'

JOHNSON PARK

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 530,917 sq. ft.

Address: 452 River Street
Hackensack, NJ 07601

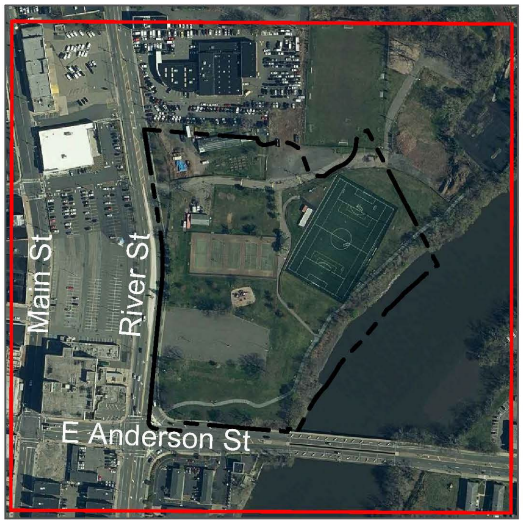
Block and Lot: Block 404, Lot 1

Multiple rain gardens can be installed in the turfgrass areas to capture, treat, and infiltrate the stormwater runoff from the parking lot, driveways, and building rooftops. Curb cuts will be needed to direct runoff to some of the systems. The system to the east of the parking lot can be built around existing catch basins in the turfgrass area. A trench drain will be needed to intercept and redirect runoff from the driveway to the northern rain garden. The existing tennis court can be converted into pervious pavement to capture and infiltrate the stormwater runoff from the court. A cistern can be installed by the northern green house to divert and detain stormwater runoff from the rooftop for later non-potable reuses such as watering the community garden. Downspouts can be built on to the greenhouse building and directed into the cistern. 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 48.1"
44	235,264	11.3	118.8	1,080.2	0.183	7.05

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	33,360	0.950	146	65,230	2.45	8,345	$83,450
Pervious pavement	27,945	0.796	122	54,640	2.05	27,945	$698,625
Rainwater harvesting	2,140	0.061	10	1,700	0.07	1,700 (gal)	$5,100

GREEN INFRASTRUCTURE RECOMMENDATIONS



Johnson Park Overall View

- bioretention system
- pervious pavement
- rainwater harvesting
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 100' 200'

GREEN INFRASTRUCTURE RECOMMENDATIONS

Johnson Park Page 1 of 2

- bioretention system
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 30' 60'

GREEN INFRASTRUCTURE RECOMMENDATIONS

Johnson Park Page 2 of 2

- bioretention system
- pervious pavement
- rainwater harvesting
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 30' 60'

JOHNSON PUBLIC LIBRARY

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 22,492 sq. ft.

Address: 274 Main Street
Hackensack, NJ 07601

Block and Lot: Block 312, Lot 18

Rain gardens can be installed in the turfgrass areas in front of the building to capture, treat, and infiltrate stormwater runoff from the rooftop. This will require disconnecting some downspouts. The existing walkway in front of the library can be replaced with porous pavers to capture and infiltrate the stormwater runoff from the walkway. The existing library staff parking spaces in the rear of the building can be converted to porous pavement to capture and infiltrate the stormwater runoff from the asphalt. Trench drains can be installed to intercept runoff from the asphalt and direct it towards the porous pavement. 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 48.1"
83	18,576	0.9	9.4	85.3	0.014	0.56

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Maximum Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Potential (cu. ft./second)	Estimated Size (sq. ft.)	Estimated Cost
Bioretention systems	1,160	0.026	4	1,790	0.07	230	$2,300
Pervious pavement	11,955	0.341	51	23,380	0.88	2,870	$71,750

GREEN INFRASTRUCTURE RECOMMENDATIONS

Johnson Public Library

- bioretention system
- pervious pavement
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 20' 40'

MAJESTIC LODGE 153

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 28,170 sq. ft.

Address: 351 1st Street
Hackensack, NJ 07601

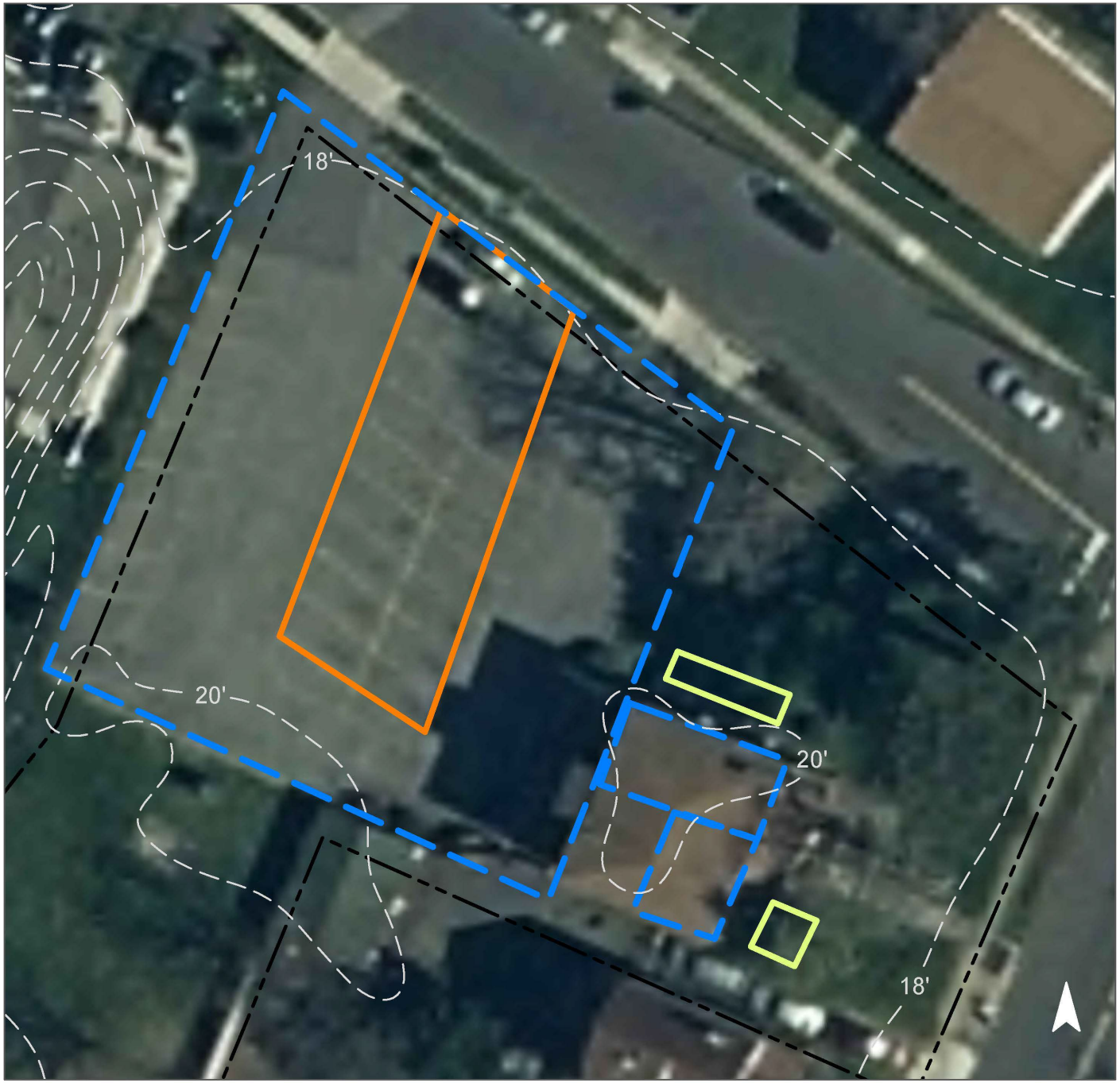
Block and Lot: Block 335, Lot 1

Rain gardens can be installed in the turfgrass areas around the building to capture, treat, and infiltrate the stormwater runoff from the rooftop. This will require disconnecting some downspouts. The existing parking spaces in the center of the parking lot can be converted into pervious pavement to capture and infiltrate the stormwater runoff from the asphalt. This will require multiple trench drains to intercept and redirect runoff from the edges of the parking lot to the center. 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 48.1"
53	15,069	0.7	7.6	69.2	0.012	0.45

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	915	0.026	4	1,790	0.07	230	$2,300
Pervious pavement	11,955	0.341	51	23,380	0.88	2,870	$71,750

GREEN INFRASTRUCTURE RECOMMENDATIONS



Majestic Lodge 153

- bioretention system
- pervious pavement
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 15' 30'

MT. HOLINESS TEMPLE

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 15,592 sq. ft.

Address: 320 Hamilton Place
Hackensack, NJ 07601

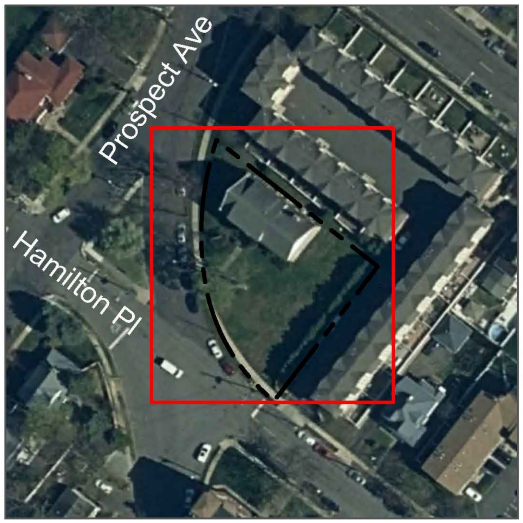
Block and Lot: Block 441, Lot 27

Rain gardens can be installed in the turfgrass areas around the building using the disconnected downspouts to capture, treat, and infiltrate the stormwater runoff from the rooftop. 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 48.1"
26	4,018	0.2	2.0	18.4	0.003	0.12

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	2,480	0.071	11	4,850	0.18	620	$6,200

GREEN INFRASTRUCTURE RECOMMENDATIONS



Mt. Holiness Temple

- bioretention system
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 15' 30'

NUEVO AMANECER SPANISH SEVENTH-DAY ADVENTIST CHURCH

RUTGERS New Jersey Agricultural Experiment Station

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 18,624 sq. ft.

Address: 45 Fairmount Avenue Hackensack, NJ 07601

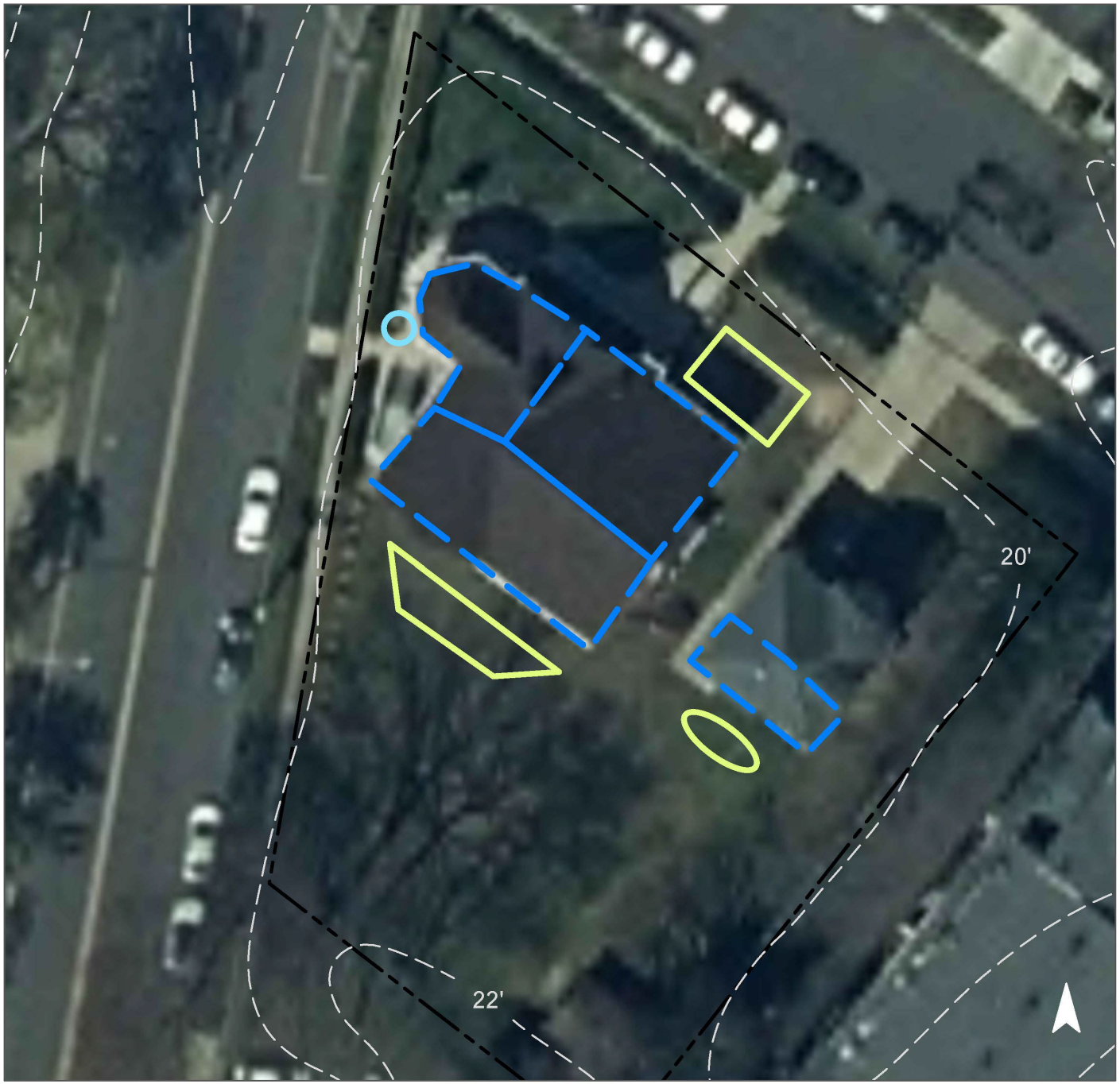
Block and Lot: Block 519, Lot 32

Rain gardens can be installed in the turfgrass areas around the buildings to capture, treat, and infiltrate the stormwater runoff from the rooftops. This will require disconnecting some downspouts. A cistern can be installed to the west of the building to divert and detain the stormwater runoff from the rooftop for later non-potable reuse such as watering a garden bed or washing a vehicle. 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 48.1"
40	7,479	0.4	3.8	34.3	0.006	0.22

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	2,520	0.072	11	4,930	0.19	630	$6,300
Rainwater harvesting	670	0.019	4	550	0.02	550 (gal)	$1,650

GREEN INFRASTRUCTURE RECOMMENDATIONS



Nuevo Amanecer Spanish Seventh-Day Adventist Church

- bioretention system
- rainwater harvesting
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 15' 30'

ST. JOSEPH'S ROMAN CATHOLIC CHURCH

RUTGERS New Jersey Agricultural Experiment Station

Subwatershed: Hackensack River (Fort Lee Road to Oradell gage)

HUC14 ID: 02030103180030

Site Area: 30,079 sq. ft.

Address: 460 Hudson Street
Hackensack, NJ 07601

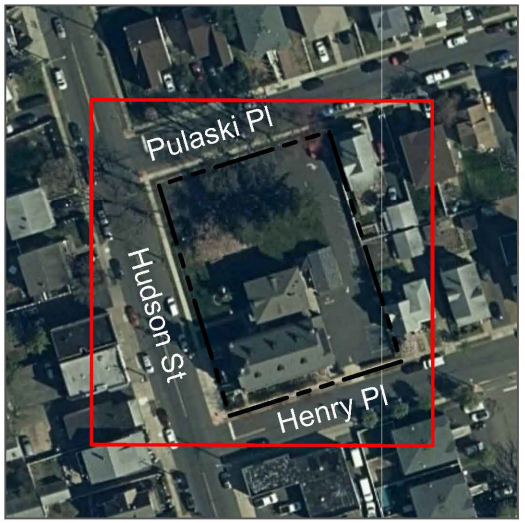
Block and Lot: Block 12, Lot 1

Rain gardens can be installed in the northern turfgrass area to capture, treat, and infiltrate the stormwater runoff from the rooftop. This will require disconnecting downspouts. A cistern can be installed in the alleyway between the buildings to divert and detain the stormwater runoff from the rooftop for later non-potable reuse such as watering the gardens. The existing parking spaces in the north of the parking lot can be converted into pervious pavement to capture and infiltrate the stormwater runoff from the asphalt. 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 48.1"
85	25,469	1.2	12.9	116.9	0.020	0.76

Recommended Green Infrastructure Practices	Drainage Area (sq. ft.)	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	870	0.025	4	1,700	0.06	220	$2,200
Pervious pavement	11,850	0.338	51	23,170	0.87	2,225	$55,625
Rainwater harvesting	1,210	0.034	6	950	0.04	950 (gal)	$2,850

GREEN INFRASTRUCTURE RECOMMENDATIONS



St. Joseph's Roman Catholic Church

- bioretention system
- pervious pavement
- rainwater harvesting
- captured drainage area
- property line
- 2020 Aerial: NJOIT, OGIS

0 20' 40'

c. Summary of Existing Conditions

Summary of Existing Conditions

	Subwatershed/Site Name/Total Site Info/GI Practice	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 (Avg.48.1") (cu.ft.)	Runoff Volumes from I.C. Water Quality Storm (1.25" over 2-hours) (Mgal)	Runoff Volumes from I.C. Annual (Avg.48.1") (Mgal)
	Berry's Creek (above Paterson Avenue) Sites	**6.27**	**273,048**				**2.79**	**121,506**	**5.9**	**61.4**	**557.9**	**12,657**	**487,035**	**0.095**	**3.64**
1	Fanny Meyer Hillers School Total Site Info	3.59	156,449	130	15	54	1.95	84,970	4.1	42.9	390.1	8,851	340,587	0.066	2.55
2	Polify Road Park Total Site Info	2.68	116,599	125	16	31	0.84	36,536	1.8	18.5	167.8	3,806	146,449	0.028	1.10
	Coles Brook / Van Saun Mill Brook Sites	**0.41**	**17,810**				**0.25**	**10,818**	**0.5**	**5.5**	**49.7**	**1,127**	**43,361**	**0.008**	**0.32**
3	Hackensack Fire Dept Engine 2 Total Site Info	0.41	17,810	144	1	61	0.25	10,818	0.5	5.5	49.7	1,127	43,361	0.008	0.32
	Hackensack River (Bellmans Creek to Fort Lee Road) Sites	**0.74**	**32,335**				**0.47**	**20,600**	**1.0**	**10.4**	**94.6**	**2,146**	**82,571**	**0.016**	**0.62**
4	Immaculate Conception Roman Catholic Church Total Site Info	0.74	32,335	19	21	64	0.47	20,600	1.0	10.4	94.6	2,146	82,571	0.016	0.62
	Hackensack River (Fort Lee Road to Oradell gage) Sites	**19.00**	**827,818**				**9.49**	**413,424**	**19.9**	**208.8**	**1,898.2**	**43,065**	**1,657,141**	**0.322**	**12.40**
5	Bergen County Christian Academy Total Site Info	2.53	110,248	416	1, 5	82	2.08	90,668	4.4	45.8	416.3	9,445	363,427	0.071	2.72
6	Fairmount Park Total Site Info	1.65	71,695	520	1	24	0.39	16,881	0.8	8.5	77.5	1,758	67,666	0.013	0.51
7	Johnson Park Total Site Info	12.19	530,917	404	1	44	5.40	235,264	11.3	118.8	1,080.2	24,507	943,018	0.183	7.05
8	Johnson Public Library Total Site Info	0.52	22,492	312	18	83	0.43	18,576	0.9	9.4	85.3	1,935	74,458	0.014	0.56
9	Majestic Lodge 153 Total Site Info	0.65	28,170	335	1	53	0.35	15,069	0.7	7.6	69.2	1,570	60,403	0.012	0.45
10	Mt Holiness Temple Total Site Info	0.36	15,592	441	27	26	0.09	4,018	0.2	2.0	18.4	418	16,104	0.003	0.12
11	Nuevo Amanecer Spanish Seventh-Day Adventist Church Total Site Info	0.43	18,624	519	32	40	0.17	7,479	0.4	3.8	34.3	779	29,978	0.006	0.22
12	St. Joseph's Roman Catholic Church Total Site Info	0.69	30,079	12	1	85	0.58	25,469	1.2	12.9	116.9	2,653	102,088	0.020	0.76

d. Summary of Proposed Green Infrastructure Practices

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area Area (SF)	Potential Management Area Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Pot. (2-YR Current) (cfs)	Size of BMP	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
	Berry's Creek (above Paterson Avenue) Sites	**40,230**	**0.92**	**1.146**	**175**	**78,670**	**2.95**				**$436,875**	**33.1%**
1	**Fanny Meyer Hillers School**											
	Bioretention systems	4,735	0.11	0.135	21	9,260	0.35	1,185	$10	SF	$11,850	5.6%
	Pervious pavement	16,125	0.37	0.459	70	31,530	1.18	3,255	$25	SF	$81,375	19.0%
	Total Site Info	20,860	0.48	0.594	91	40,790	1.53				$93,225	24.5%
2	**Polify Road Park**											
	Bioretention systems	6,250	0.14	0.178	27	12,220	0.46	1,565	$10	SF	$15,650	17.1%
	Pervious pavement	13,120	0.30	0.374	57	25,660	0.96	13,120	$25	SF	$328,000	35.9%
	Total Site Info	19,370	0.44	0.552	84	37,880	1.42				$343,650	53.0%
	Coles Brook / Van Saun Mill Brook Sites	4,690	0.10	0.133	19	8,960	0.33				$26,200	43.4%
3	**Hackensack Fire Dept Engine 2**											
	Pervious pavement	3,910	0.09	0.111	17	7,640	0.29	970	$25	SF	$24,250	36.1%
	Rainwater harvesting	180	0.00	0.005	0	150	0.00	150	$3	gal	$450	1.7%
	Total Site Info	4,690	0.10	0.133	19	8,960	0.33				$26,200	43.4%
	Hackensack River (Bellmans Creek to Fort Lee Road) Sit	**2,470**	**0.05**	**0.070**	**10**	**4,610**	**0.17**				**$16,575**	**12.0%**
4	**Immaculate Conception Roman Catholic Church**											
	Bioretention system	900	0.02	0.026	4	1,760	0.07	225	$10	SF	$2,250	4.4%
	Pervious pavement	1,380	0.03	0.039	6	2,700	0.10	555	$25	SF	$13,875	6.7%
	Rainwater harvesting	190	0.00	0.005	0	150	0.00	150	$3	gal	$450	0.9%
	Total Site Info	2,470	0.05	0.070	10	4,610	0.17				$16,575	12.0%
	Hackensack River (Fort Lee Road to Oradell gage) Sites	**146,795**	**3.38**	**4.182**	**642**	**282,390**	**10.62**				**$1,255,400**	**35.5%**
5	**Bergen County Christian Academy**											
	Bioretention systems	990	0.02	0.028	4	1,940	0.07	250	$10	SF	$2,500	1.1%
	Pervious pavement	32,285	0.74	0.920	141	63,130	2.37	7,980	$25	SF	$199,500	35.6%
	Total Site Info	33,275	0.76	0.948	144	65,070	2.44				$202,000	36.7%

Summary of Proposed Green Infrastructure Practices

	Subwatershed/Site Name/Total Site Info/GI Practice	Potential Management Area Area (SF)	Potential Management Area Area (ac)	Recharge Potential (Mgal/yr)	TSS Removal Potential (lbs/yr)	Max Volume Reduction Potential (gal/storm)	Peak Discharge Reduction Pot. (2-YR Current) (cfs)	Size of BMP	Unit Cost ($/unit)	Unit	Total Cost ($)	I.C. Treated %
6	**Fairmount Park**											
	Bioretention systems	9,055	0.21	0.258	40	17,710	0.67	2,265	$10	SF	$22,650	53.6%
	Total Site Info	9,055	0.21	0.258	40	17,710	0.67				$22,650	53.6%
7	**Johnson Park**											
	Bioretention systems	33,360	0.77	0.950	146	65,230	2.45	8,345	$10	SF	$83,450	14.2%
	Rainwater harvesting	2,140	0.05	0.061	10	1,700	0.07	1,700	$3	gal	$5,100	0.9%
	Total Site Info	63,445	1.46	1.807	277	121,570	4.57				$787,175	27.0%
8	**Johnson Public Library**											
	Bioretention systems	1,160	0.03	0.033	6	2,270	0.09	295	$10	SF	$2,950	6.2%
	Total Site Info	8,550	0.20	0.243	38	16,720	0.63				$94,700	46.0%
9	**Majestic Lodge 153**											
	Bioretention systems	915	0.02	0.026	4	1,790	0.07	230	$10	SF	$2,300	6%
	Pervious pavement	11,955	0.27	0.341	51	23,380	0.88	2,870	$25	SF	$71,750	79.3%
	Total Site Info	12,870	0.29	0.367	55	25,170	0.95				$74,050	85.4%
10	**Mt Holiness Temple**											
	Bioretention systems	2,480	0.06	0.071	11	4,850	0.18	620	$10	SF	$6,200	61.7%
	Total Site Info	2,480	0.06	0.071	11	4,850	0.18				$6,200	61.7%
11	**Nuevo Amanecer Spanish Seventh-Day Adventist Church**											
	Bioretention systems	2,520	0.06	0.072	11	4,930	0.19	630	$10	SF	$6,300	33.7%
	Rainwater harvesting	670	0.02	0.019	4	550	0.02	550	$3	gal	$1,650	9.0%
	Total Site Info	3,190	0.08	0.091	15	5,480	0.21				$7,950	42.7%
12	**St. Joseph's Roman Catholic Church**											
	Bioretention systems	870	0.02	0.025	4	1,700	0.06	220	$10	SF	$2,200	3.4%
	Pervious pavement	11,850	0.27	0.338	51	23,170	0.87	2,225	$25	SF	$55,625	46.5%
	Rainwater harvesting	1,210	0.03	0.034	6	950	0.04	950	$3	gal	$2,850	4.8%
	Total Site Info	13,930	0.32	0.397	61	25,820	0.97				$60,675	54.7%