GREEN INFRASTRUCTURE FEASIBILITY STUDY

WEST ORANGE

RUTGERS
New Jersey Agricultural Experiment Station

PASSAIC VALLEY SEWERAGE COMMISSION
"Protecting Public Health and the Environment"

ACKNOWLEDGEMENTS

Designed to highlight green infrastructure opportunities within the Township of West Orange, this document has been prepared by the Rutgers Cooperative Extension Water Resources Program with funding and direction by the Passaic Valley Sewerage Commission and the New Jersey Agricultural Experiment Station.

We would like to thank the Passaic Valley Sewerage Commission, the New Jersey Agricultural Experiment Station, and the Township of West Orange for their input and support in creating this document.

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"Protecting Public Health and the Environment"

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INTRODUCTION

In 2013 the Passaic Valley Sewerage Commission (PVSC) began a new initiative to assist the 48 municipalities across the five counties served by the PVSC with managing flooding and eliminating combined sewer overflows. PVSC is dedicated to leading efforts throughout the PVSC Sewerage District by using green infrastructure to intercept stormwater runoff, reduce combined sewer overflows (CSOs), manage existing water infrastructure, and minimize frequent flooding events. To help with this effort, PVSC has entered into a partnership with the Rutgers Cooperative Extension (RCE) Water Resources Program.

West Orange is a community with a municipal separate storm sewer system (MS4), meaning stormwater and wastewater are managed in two separate sets of piping and infrastructure. When it rains, stormwater runoff causes localized flooding and contributes to downstream flooding and negative water quality impacts. By using cost-effective green infrastructure practices, West Orange can begin to reduce the negative impacts of stormwater runoff, reduce pressures on the local infrastructure and protect the health of our waterways.

This feasibility study is intended to be used as a guide for the community of West Orange to begin implementing green infrastructure practices and demonstrate to residents and local leaders the benefits of and opportunities for better managing stormwater runoff.

Rutgers University professor, Tobiah Horton, reviews a rain garden design with a homeowner.

Source: prweb


Source: redbubble


Source: Heidi Sussman

WEST ORANGE

West Orange is located in Essex County and covers approximately twelve square miles. The city has a population of 46,207 according to the 2010 US Census. The township has a municipal separate storm sewer system (MS4). The township's drainage flows to both the Rahway River watershed and the Passaic River Basin.

WHAT IS STORMWATER?

When rainfall hits the ground, it can soak into the ground or flow across the surface. When rainfall flows across a surface, it is called "stormwater" runoff. Pervious surfaces allow stormwater to readily soak into the soil and recharge groundwater. An impervious surface can be any material that has been placed over soil that prevents water from soaking into the ground. Impervious surfaces include paved roadways, parking lots, sidewalks, and rooftops. As impervious areas increase, so does the amount of stormwater runoff. New Jersey has many problems due to stormwater runoff from impervious surfaces, including:

- POLLUTION: According to the 2010 New Jersey Water Quality Assessment Report, 90% of the assessed waters in New Jersey are impaired. Urban-related stormwater runoff is listed as the most probable source of impairment (USEPA, 2013). As stormwater flows over the ground, it picks up pollutants, including animal waste, excess fertilizers, pesticides and other toxic substances. These pollutants are carried to waterways.
- FLOODING: Over the past decade, the state has seen an increase in flooding. Communities around the state have been affected by these floods. The amount of damage caused also has increased greatly with this trend, costing billions of dollars over this time span.
- EROSION: Increased stormwater runoff causes an increase in stream velocity. The increased velocity after storm events erodes stream banks and shorelines, degrading water quality. This erosion can damage local roads and bridges and cause harm to wildlife.

A local reservoir


Purple Coneflower


Pervious pavers

To protect and repair our waterways, reduce flooding, and stop erosion, stormwater runoff has to be better managed. Impervious surfaces need to be disconnected with green infrastructure to prevent stormwater runoff from flowing directly into New Jersey's waterways. Disconnection redirects runoff from paving and rooftops to pervious areas in the landscape.

A community garden that harvests and recycles rainwater

Rain barrel workshop participants

A rain garden after planting

WHAT IS GREEN INFRASTRUCTURE?

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 produce a variety of environmental benefits. In addition to effectively retaining and infiltrating rainfall, these technologies 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 (USEPA, 2013).

GLOSSARY OF GREEN INFRASTRUCTURE TERMINOLOGY

A ***DISCONNECTED:***

Disconnected refers to channeling water from gutters and pipes that collect runoff to somewhere other than a sewer drain where it can be filtered.

B ***DEPAVING:***

Depaving is the process of removing hardscape such as asphalt or concrete.

C ***INFILTRATION:***

Infiltration occurs when water on the ground's surface is absorbed into the soil below. Plants promote infiltration.

D ***IMPERVIOUS SURFACE:***

An impervious surface is one that water cannot penetrate.

E ***RUNOFF:***

Runoff is water from precipitation that flows across land and paved surfaces before entering local waterways or sewer systems.

A

B

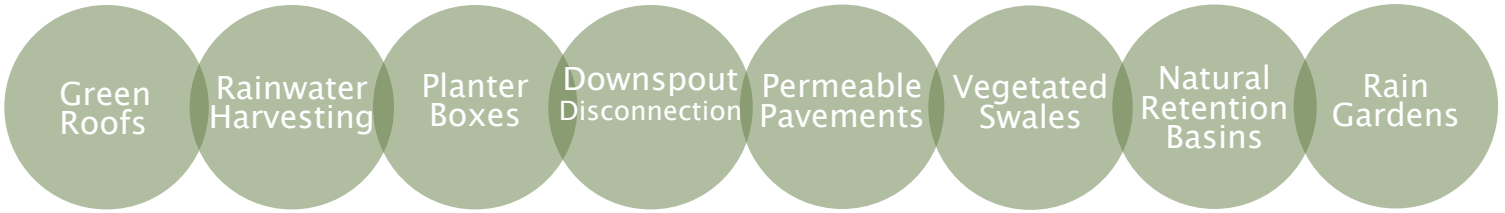
C

D

E

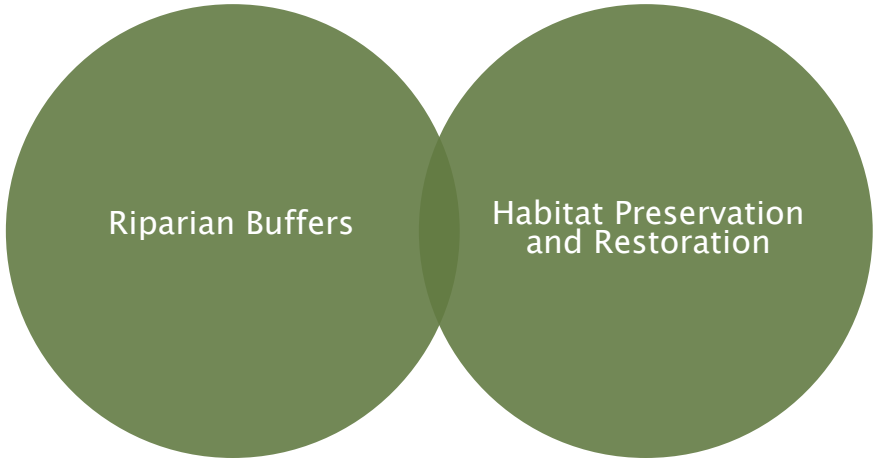
GREEN INFRASTRUCTURE STRATEGIES

SITE



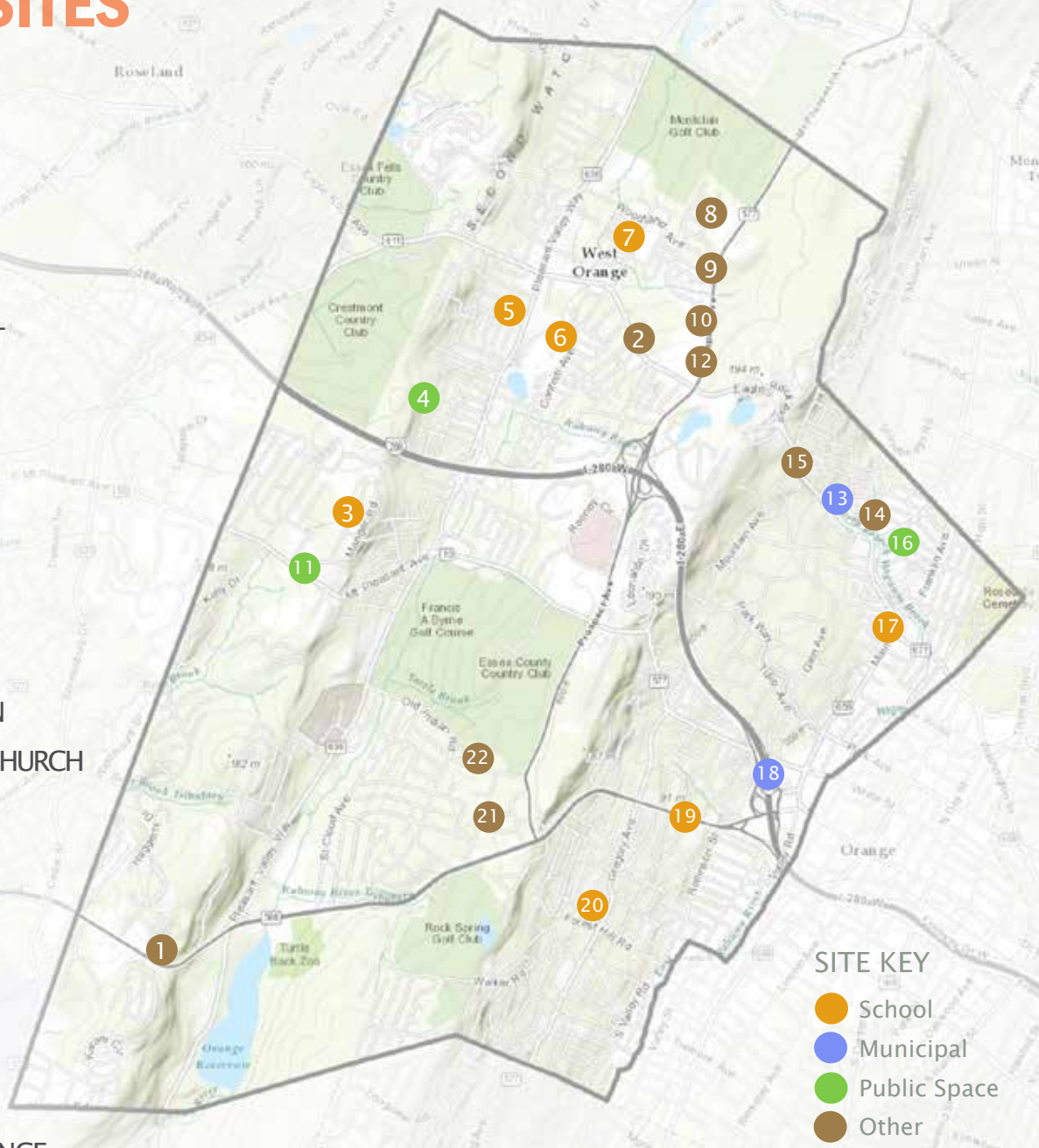
NEIGHBORHOOD

WATERSHED



POTENTIAL PROJECT SITES WITHIN STUDY AREA

1. MEDICAL OFFICE BUILDING
2. MAYFAIR FARMS
3. LIBERTY MIDDLE SCHOOL
4. DEGNAN PARK
5. PLEASANTDALE ELEMENTARY SCHOOL
6. WEST ORANGE HIGH SCHOOL
7. REDWOOD ELEMENTARY SCHOOL
8. MARRIOTT
9. THE MANOR
10. LEWELLYN DENTAL ASSOCIATES
11. O'CONNOR PARK
12. WHOLE FOODS MARKET
13. WEST ORANGE BOARD OF EDUCATION
14. OUR LADY OF LOURDES ROMAN CATHOLIC CHURCH
15. BETHANY CHURCH
16. COLGATE PARK
17. WASHINGTON ELEMENTARY SCHOOL
18. WEST ORANGE PUBLIC LIBRARY
19. SETON HALL PREPARATORY SCHOOL
20. GREGORY ELEMENTARY SCHOOL
21. ST. JOSEPH'S CHURCH
22. RESIDENTIAL ROADWAY / PRIVATE RESIDENCE

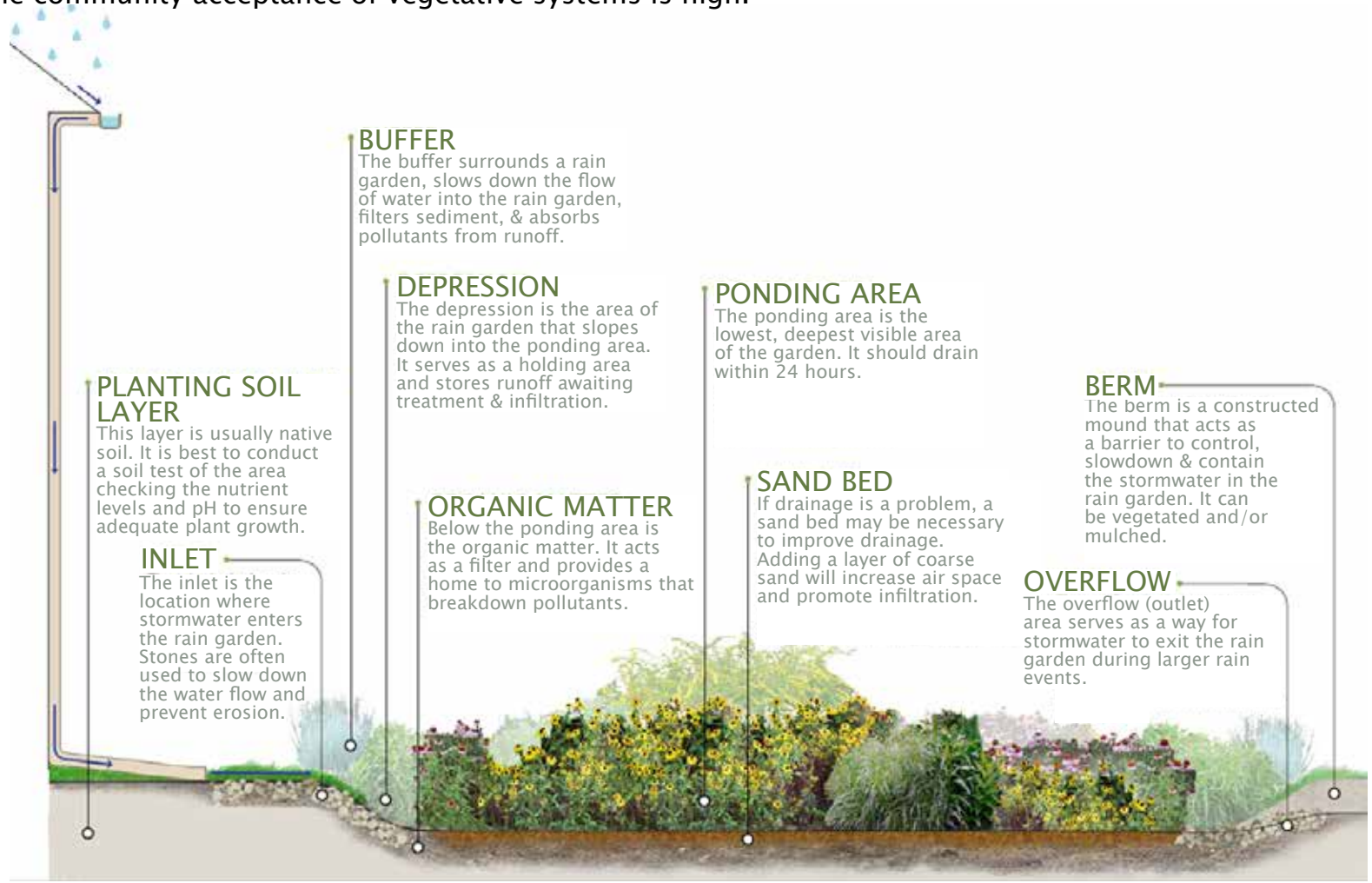



STATE OF
NEW JERSEY
DEPARTMENT OF
ENVIRONMENTAL
PROTECTION

GREEN INFRASTRUCTURE SYSTEMS

VEGETATED SYSTEMS

Vegetative systems primarily focus on reducing water quality impacts and less on reducing flooding. These systems are typically located close to the sources of runoff and can manage the smaller storms of several inches. The main treatment mechanisms are infiltration, filtration, and evapotranspiration. These systems do an excellent job at removing total suspended solids, nutrients and pathogens. Construction costs for vegetated systems are typically low to moderate when compared to other green infrastructure practices. Since these systems often can be incorporated into existing landscapes and enhance aesthetics, the community acceptance of vegetative systems is high.



RAIN GARDEN DIAGRAM

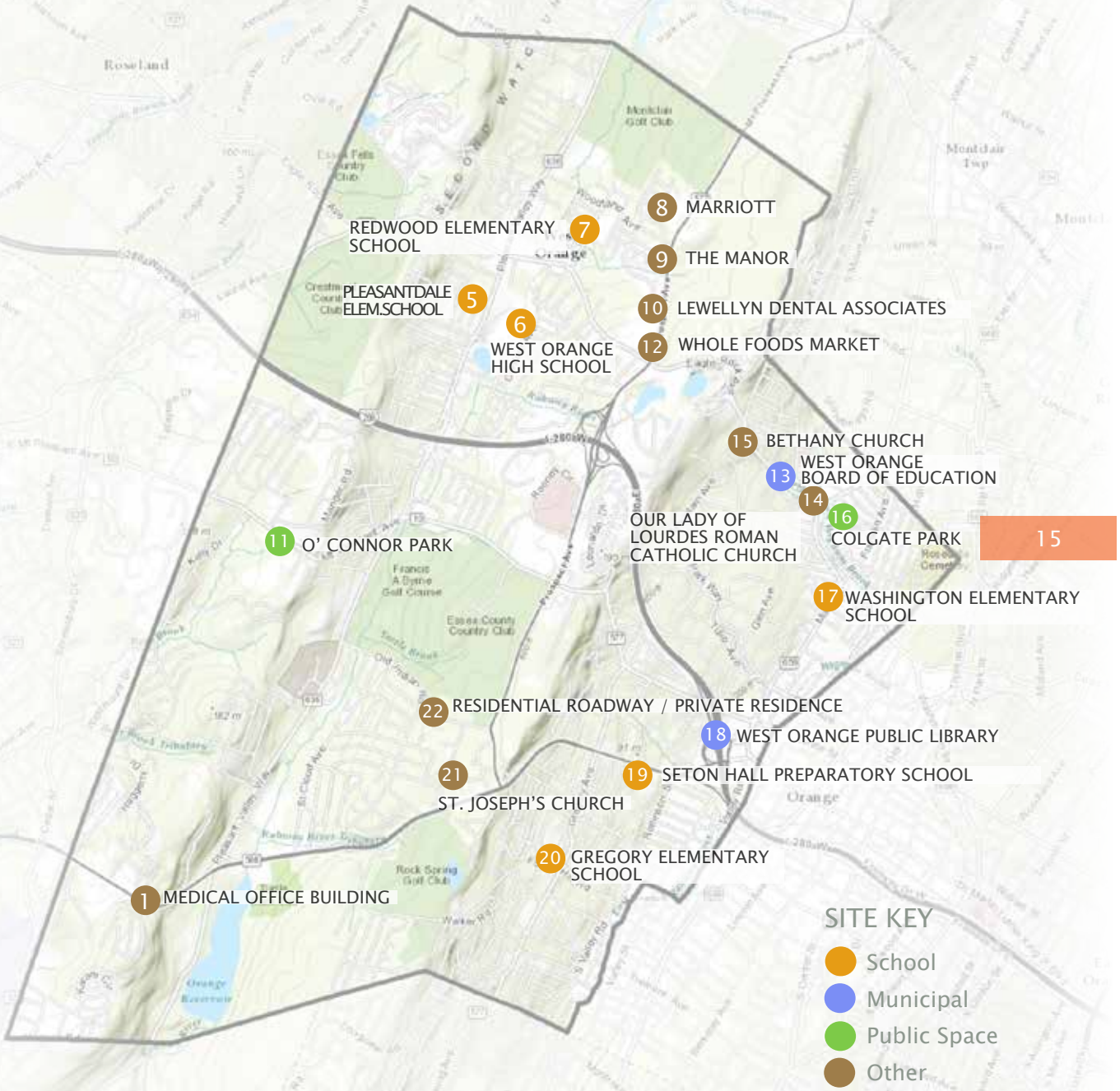
VEGETATED SYSTEM SUITABILITY

Rain gardens are shallow landscaped depressions designed to capture, treat, and infiltrate stormwater runoff. Rain gardens can be readily installed throughout a community to begin re-establishing the natural processes of the landscape. Rain gardens:

- Capture stormwater runoff, reducing soil erosion and sedimentation and the amount of water that flows to our streams and waterways during rain storms
- Protect water quality by filtering out and breaking down pollutants
- Infiltrate runoff and recharge groundwater supplies by providing base flow to nearby streams and waterways
- Enhance and increase green space and vegetated cover

Rain gardens are a simple way communities can begin to reduce stormwater runoff, manage flows to sewer systems, and protect water resources. Rain gardens can be placed in strategic locations to capture runoff from rooftops and paved areas, including:

- Homes
- Schools
- Churches
- Parking areas
- Community gardens



VEGETATED SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

VEGETATED SYSTEM SUITABILITY: EXAMPLE PROJECT SITE



The site is a medical office located at 741 Northfield Avenue. There is a detention basin on the south side of the building already treating stormwater. The area is steeply sloped, with water flowing to the southern side of the site. There are no visible downspouts on the building. There is a small patch of grass on the west side of the building that could be converted to a swale to slow stormwater runoff. It could also potentially be a rain garden.

RAINWATER HARVESTING SYSTEMS

Rainwater harvesting systems focus on the conservation, capture, storage and reuse of rain water. These systems are located close to residential and commercial buildings. Construction costs are low to moderate, depending on the size of the system, compared to other green infrastructure practices. Since these systems can be easily incorporated into the built landscape, the community acceptance of rainwater harvesting systems is moderate to high. Rainwater harvesting systems include rain barrels and cisterns.

RAIN BARREL DIAGRAM

INLET
Rainwater collected in gutters is released into the barrel here

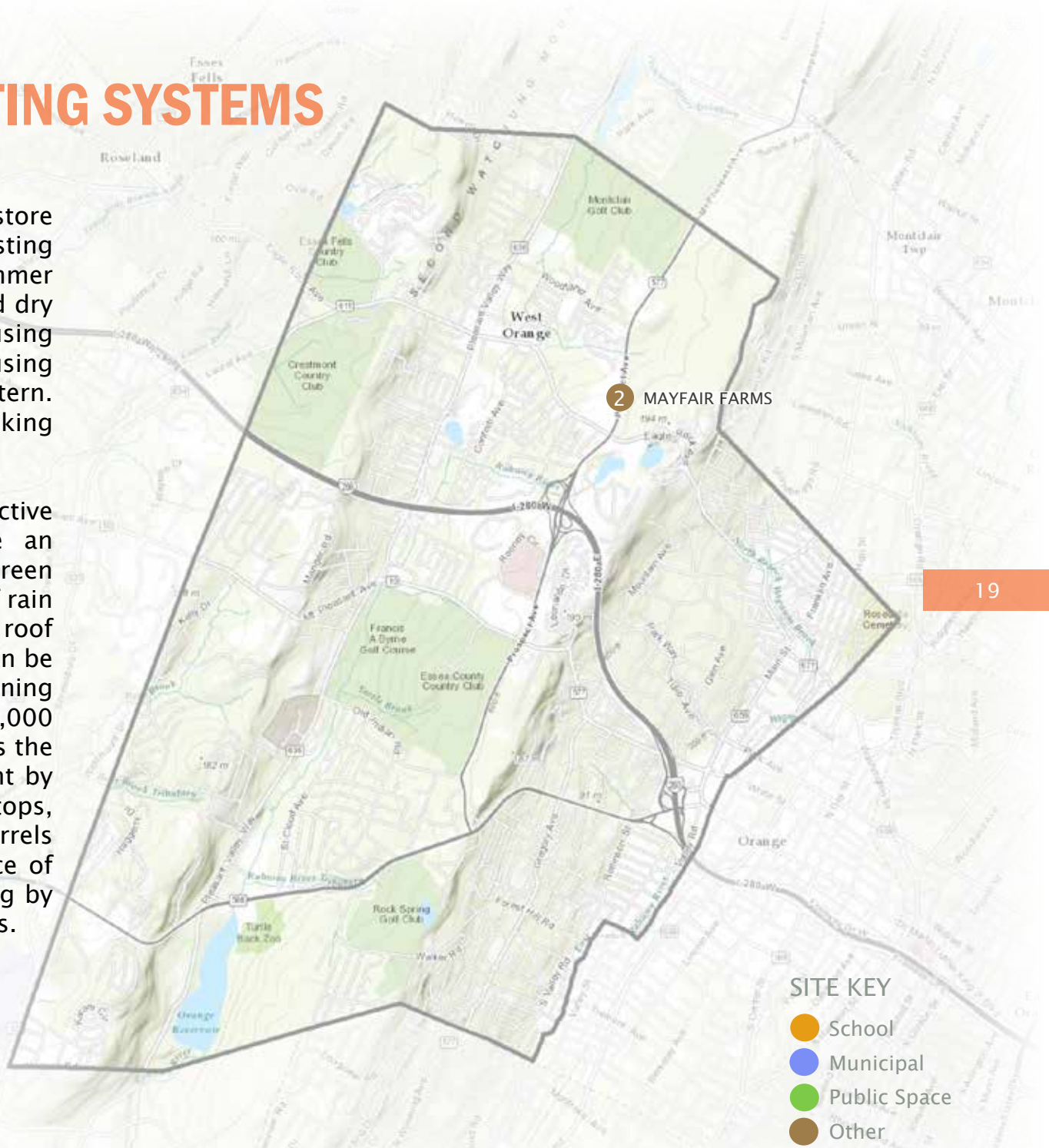
OVERFLOW OUTLET
Releases water when the rain barrel reaches capactiy

SPIGOT
Valve that opens and closes barrel's water flow

RAINWATER HARVESTING SYSTEMS SUITABILITY

Typical rainwater harvesting systems can store up to 5,000 gallons of water. Harvesting during the rainy months of spring and summer provides a source of water during hot and dry periods between rain storms. Instead of using potable water, residents can save money using the rainwater stored in a rain barrel or cistern. This also reduces the demand on drinking water supplies and related infrastructure.

Rain barrels and cisterns are an effective rainwater harvesting tool and can be an important element in a community-wide green infrastructure program. For every inch of rain that falls on an eight hundred square foot roof (20' x 40'), nearly 500 gallons of water can be collected. Over an entire year, water running off of this rooftop will total over 20,000 gallons. This sustainable practice reduces the impact a building has on the environment by harvesting stormwater runoff from rooftops, decreasing flow to sewer systems. Rain barrels and cisterns provide an alternative source of water for gardens, lawns, and landscaping by reducing the use of potable water supplies.



RAINWATER HARVESTING SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

RAINWATER HARVESTING SYSTEM SUITABILITY: EXAMPLE PROJECT SITE



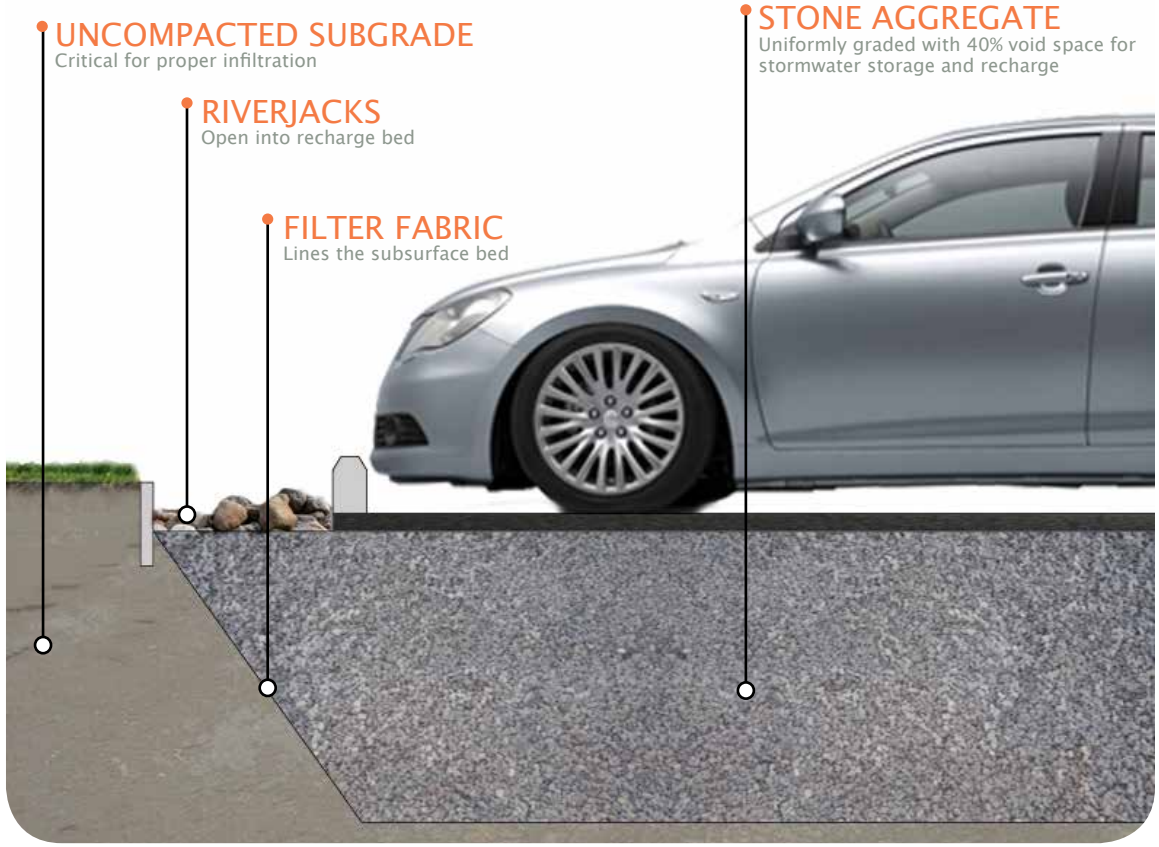
The site is Mayfair Farms located at 481 Eagle Rock Avenue. The site slopes from south to north and then from north to west. To the east of the main building is a community garden. It is attached to an older building that does not have any downspouts, a cistern may be able to capture roof runoff for watering the garden. On the west side of the main building is a well manicured grassed area. A swale may be added to this area to slow the flow of runoff from the building. The main building does not have any external downspouts.

STORAGE, QUANTITY, & INFILTRATION SYSTEMS

Storage, quantity, and infiltration systems primarily focus on storage. These systems are typically located close to runoff sources within residential, commercial and industrial landscapes. The main treatment mechanism is reducing peak flows of stormwater by storing it before it becomes runoff. Construction costs for storage, quantity, and infiltration are moderate to high when compared to other green infrastructure practices because they require more space and infrastructure and are more laborious to install. Since these systems can be seamlessly incorporated into the built environment and can manage a large quantity of water, the community acceptance of storage, quantity, and infiltration systems is high.

PERMEABLE PAVEMENT

- Underlying stone reservoir
- Porous asphalt and pervious concrete are manufactured without “fine” materials to allow infiltration
- Grass pavers are concrete interlocking blocks with open areas to allow grass to grow
- Ideal application for porous pavement is to treat a low traffic or overflow parking area



PERMEABLE PAVEMENT DIAGRAM

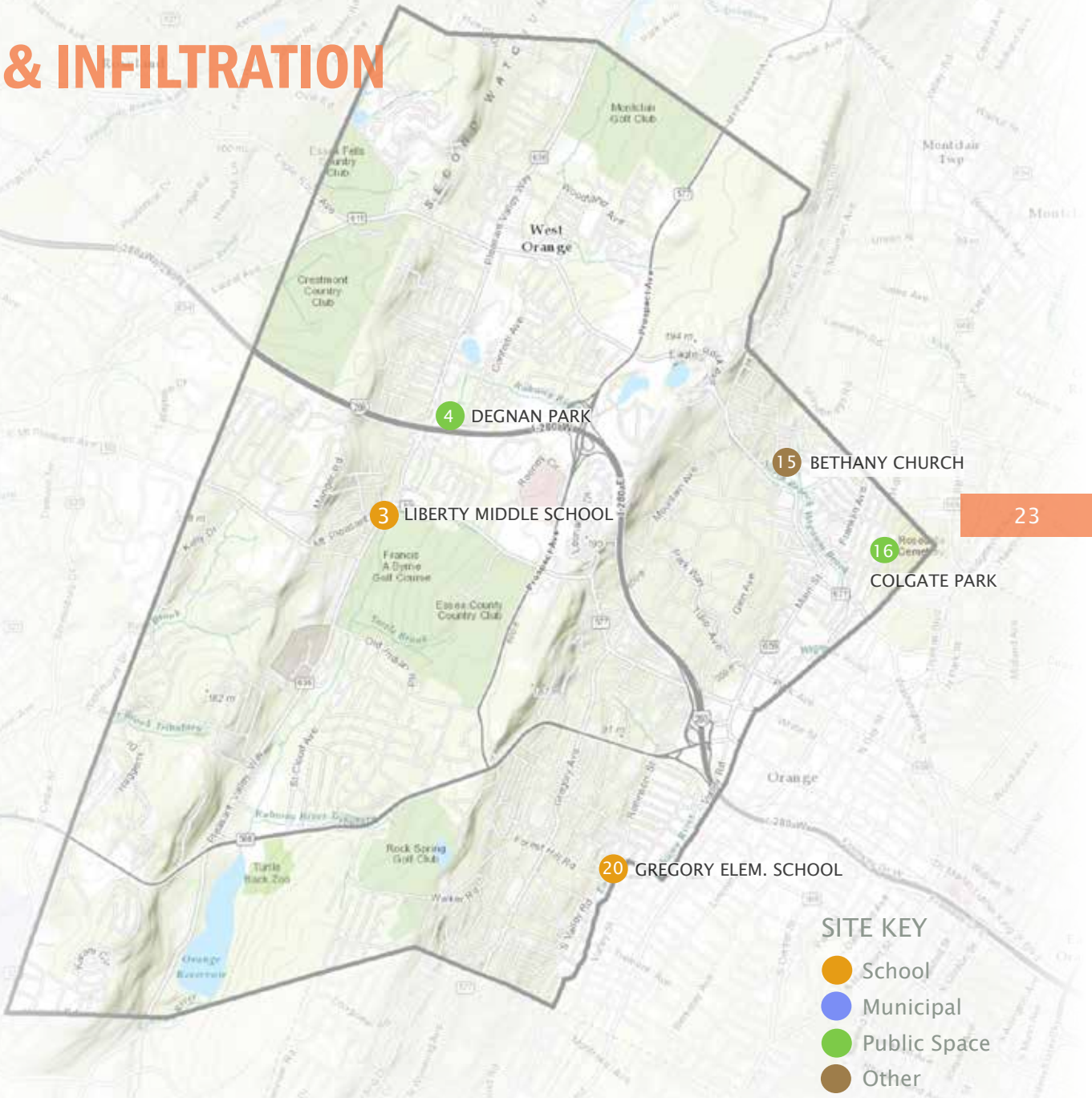
STORAGE, QUANTITY, & INFILTRATION SYSTEM SUITABILITY

Pervious paving systems are paved areas that produce less stormwater runoff than areas paved with conventional paving. These systems include:

- Permeable pavers
- Porous asphalt
- Pervious concrete

The paving material is placed over a bed of uniformly graded stone. The paving materials allow water to pass through and then infiltrate into the pore spaces of the underlying stone bed. The stored runoff then infiltrates over time into the uncompacted subgrade soils.

Stormwater planters are small, contained vegetated systems that collect and treat stormwater using a prepared soil media and mulch. These systems serve as small bioretention facilities filtering stormwater through layers of mulch, soil and plant root systems. Treated stormwater can then be infiltrated into existing surrounding soils as groundwater (infiltration planter) or, if infiltration is not appropriate, drainage pipes can discharge filtered stormwater into traditional storm sewer infrastructure (flow-through planter).



STORAGE, QUANTITY, & INFILTRATION SYSTEM SUITABILITY: EXAMPLE PROJECT SITE

STORAGE, QUANTITY, & INFILTRATION SYSTEM SUITABILITY: EXAMPLE PROJECT SITE



The site is Liberty Middle School located at 1 Kelly Drive. The site slopes to the east. The area is mostly impervious surface. Areas of pavement may need to be replaced in the near future, and pervious pavement could be an alternative. There are some visible downspouts on the building that discharge directly to lawn areas. These are opportunities for a rain garden project. There are also grassed areas sloping east which could incorporate swales to slow the flow of stormwater.


TREE
PLANTING

COMMUNITY ENGAGEMENT & EDUCATION

BUILD A RAIN BARREL WORKSHOP

With the Build a Rain Barrel Workshop, community members participate in a short presentation on stormwater management and water conservation and then learn how to build their own rain barrel. Workshop participants work with trained experts to convert 55 gallon plastic food-grade drums into rain barrels. They are quickly able to take an active role in recycling rainwater by installing a rain barrel at their house! Harvesting rainwater has many benefits including saving water, saving money, and preventing basement flooding. By collecting rainwater, homeowners are helping to reduce flooding and pollution in local waterways. When rainwater drains from hard surfaces like rooftops, driveways, roadways, parking lots, and compacted lawns, it carries pollution to our local waterways. Harvesting the rainwater in a rain barrel is just one of the ways homeowners can reduce rainwater from draining from their property and help reduce neighborhood flooding problems.

STORMWATER MANAGEMENT IN YOUR SCHOOLYARD

The *Stormwater Management in Your Schoolyard* program provides educational lectures, hands-on activities, and community-level outreach for students on the topics of water quality issues and stormwater management practices such as rain gardens and rain barrels. Program objectives include the exploration of various aspects of the natural environment on school grounds, the detailed documentation of findings related to these explorations, and the communication of these findings to the school community. As part of this program, several New Jersey State Core Curriculum Content Standards for science (5.1, 5.3, and 5.4), 21st-century life and careers (9.1, 9.3, and 9.4), and social studies (6.3) are addressed. Every school is unique in its need for stormwater management, so each school's *Stormwater Management in Your Schoolyard* program can be delivered in a variety of ways. This program can be tailored for grades K-8 or 9-12 and can be offered to meet a variety of schedules.




MAINTENANCE PROCEDURES

MAINTAINING WEST ORANGE'S GREEN INFRASTRUCTURE SYSTEMS

1. VEGETATED SYSTEMS
   - Rain Gardens
   - Stormwater Planters
   - Bioswales

2. RAINWATER HARVESTING
   - Rain Barrels
   - Cisterns

3. STORAGE, QUANTITY, AND INFILTRATION
   - Pervious Pavements
   - Underground Detention

4. COMBINATION OF STRATEGY TYPES

VEGETATED SYSTEM MAINTENANCE

RAIN GARDEN:

Weekly

- Water
- Weed
- Inspect for invasive plants, plant health, excessive sediment, and movement of sediment within the rain garden
- Observe the rain garden during rain events and note any successes (Example of success: stormwater runoff picks up oil and grease from the parking lot, flows through a curb cut, and into a rain garden; the rain garden traps the nonpoint source pollutants before they reach the nearby waterway)

Annually

- Mulch in the spring to retain a 3-inch mulch layer in the garden
- Prune during dormant season to improve plant health
- Remove sediment
- Plant
- Test the soil (every 3 years)
- Harvest plants to use in other parts of the landscape
- Clean debris from gutters connected to rain garden
- Replace materials (such as river rock and landscape fabric) where needed

STORMWATER PLANTER

- Very similar maintenance regime to rain gardens

BIOSWALE

- Very similar maintenance regime to rain gardens

RAINWATER HARVESTING SYSTEM MAINTENANCE

RAIN BARREL:

- Keep screen on top and a garden hose attached to the overflow to prevent mosquitoes- change screen every two years
- Remove debris from screen after storms
- Disconnect the barrel in winter- store inside or outside with a cover
- Clean out with long brush and water/dilute bleach solution (~3%)

CISTERN:

- In the fall prepare your cistern for the winter by diverting flow so no water can enter and freeze within the tank
- Weekly check: Check for leaks, clogs and other obstructions, for holes and vent openings where animals, insects and rodents may enter, repair leaks with sealant, and drain the first flush diverter / roof washer after every rainfall event
- Monthly check: Check roof and roof catchments to make sure no debris is entering the gutter and downspout directed into the cistern; keep the roof, gutters and leader inlets clear of leaves; inspect the first flush filter and all of its attachments, make any necessary replacements; inspect cistern cover, screen, overflow pipe, sediment trap and other accessories, make any necessary replacements

STORAGE, QUANTITY, & INFILTRATION SYSTEM MAINTENANCE

POROUS ASPHALT & CONCRETE:

- Materials cost is ~20-25% more than traditional asphalt or concrete
- Long-term maintenance is required by routine quarterly vacuum sweeping
- Sweeping cost may be off-set by reduced deicing costs
- Asphalt repairs can be made with standard asphalt not to exceed 10% of surface area
- Concrete repairs can be made with standard concrete not to exceed 10% of the surface area

UNDERGROUND DETENTION:

- Periodic inspections of the inlet and outlet areas to ensure correct operation of system
- Clean materials trapped on grates protecting catch basins and inlet area monthly
- Primary maintenance concerns are removal of floatables that become trapped and removal of accumulating sediments within the system; this should be done at least on an annual basis
- Proprietary traps and filters associated with stormwater storage units should be maintained as recommended by the manufacturer
- Any structural repairs required to inlet and outlet areas should be addressed in a timely manner on an as needed basis
- Local authorities may require annual inspection or require that they carry out inspections and maintenance




POTENTIAL PROJECT SITES


Porter Rd
Sunnyside Rd
636
Curtis Ave
Pleasant Valley Way
Hooper Ave
Bauer Dr
Canteret St
Conforti Ave
Crystal Ave
Suburban Dr
Fitzrandolph
Rahway



The site is Degnan Park located at 650 Pleasant Valley Way. The site slopes to the lake in the center of the property. The majority of the park is a natural area that does not require best management practices (BMPs). However, there are many geese and eroded areas around the lake and park so restoration around the pond would be beneficial.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- ☐ rain gardens
- ☐ curb cuts
- ☐ stormwater planters
- ☐ rain barrels
- ☑ buffers
- ☐ cisterns
- ☐ pervious pavement
- ☐ bioswales
- ☐ depaving


Greenwood Ave
Crestwood Dr
Stanford Ave
Stanford Ave
Swayze St
Pitney St
Pleasant Valley Way
636
636



The site is Pleasantdale Elementary School located at 555 Pleasant Valley Way. The south side of the building has connected downspouts which can be disconnected into an adjacent lawn. Additionally, the front lawn slopes to the east towards Pleasant Valley Way and the building has connected downspouts on the front. Rain gardens can be added to the front lawn of the building to intercept runoff. A bioswale could also be implemented to slow runoff in the same area.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving

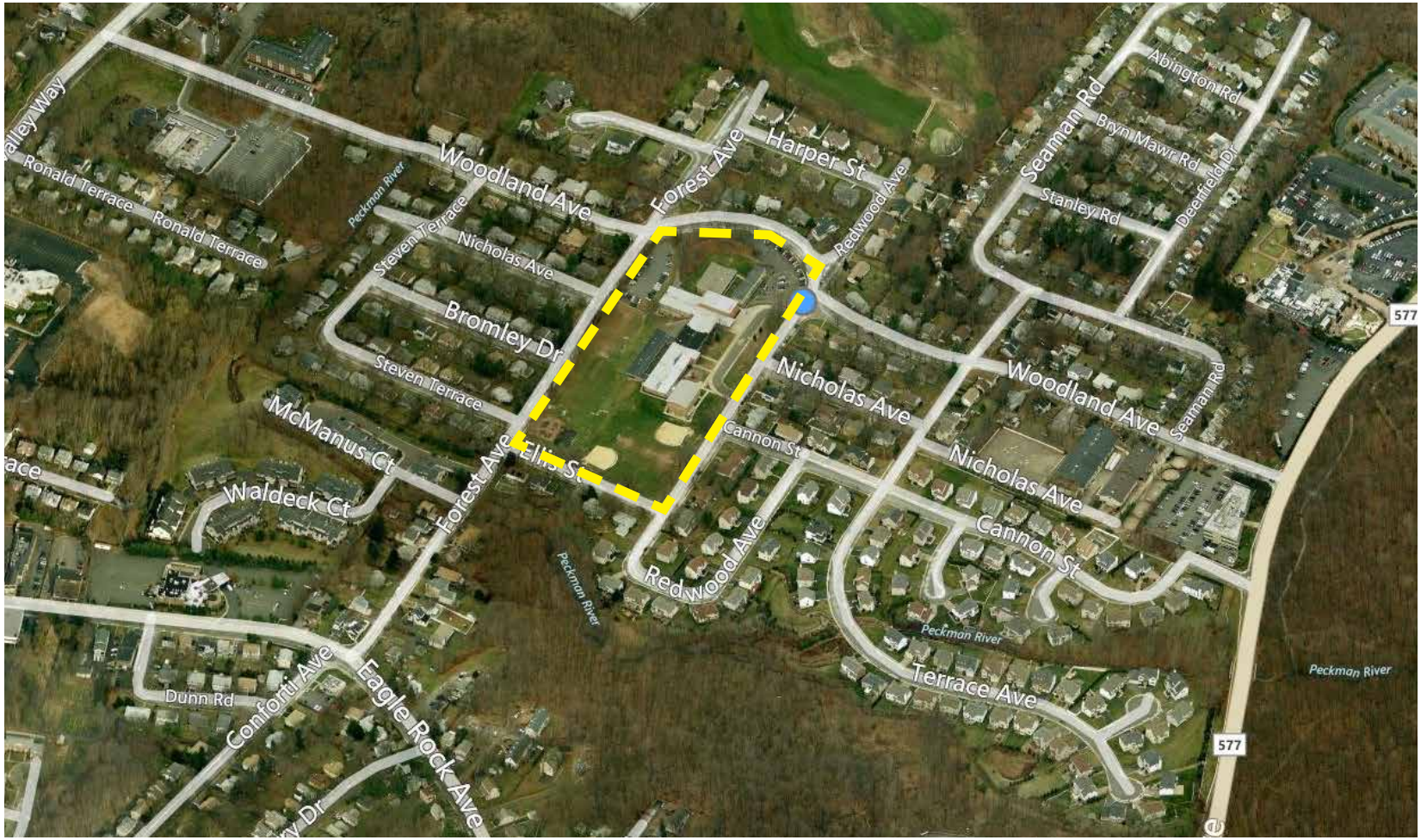
51 Conforti Avenue
West Orange, NJ 07052



The site is West Orange High School located at 51 Conforti Avenue. The slope on the site runs from west to east. The impervious surface is fairly new or well maintained. The building has exterior downspouts that are connected which can be disconnected into rain gardens. On the east side of the building is an area that could incorporate either rain gardens or bioswales.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving



75 Redwood Avenue
West Orange, NJ 07052



The site is Redwood Elementary School located at 75 Redwood Avenue. The slope of the site runs from east to west. In two areas in the front of the building there are connected downspouts which can be disconnected into rain gardens.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [ ] bioswales
- [ ] depaving


Abington Rd
Deerfield Dr
Prospect Ave
577
577
Eagle Rock Reservation



The site is the Marriott located at 107 Prospect Avenue. The parking lot slopes southwest. There is some sediment buildup in the west corner of the parking lot. On the south side of the building there are downspouts that discharge into landscaped plots. On the west side of the building are downspouts that discharge into landscaping as well as a lawn area. In these areas, downspouts can be redirected into rain gardens.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [ ] bioswales
- [ ] depaving


Bryn Mawr Rd
Deerfield Dr
Stanley Rd
Seaman Rd
577
577



The site is The Manor located at 111 Prospect Avenue. The site slopes eastward. The majority is pervious surface that is well maintained. The grassy areas of the site are already well manicured and maintained. Though there are some downspouts, they already discharge into plantings. The plantings could be enhanced into rain gardens.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [ ] bioswales
- [ ] depaving


Prospect
St
McCune Cir
Nicholas Ave
577



The site is Lewellyn Dental Associates located at 155 Prospect Avenue. The site slopes from north to south. The majority of the area is impervious cover that is well maintained. The building has no external downspouts. There are islands in the parking lot that can incorporate rain gardens or tree planter boxes to manage stormwater runoff from the parking lot.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [x] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [ ] bioswales
- [ ] depaving


280
McGuire Dr
Sussex Rd
Crestmont Rd
Hunterdon Rd
Morris Rd
Colonial Woods Dr
Cullen Dr
Ralph Rd
Manger Rd
Shelley Terrace
Lorelei Rd
Carolina Ave
Westwood Dr N
Carlson Rd
Merklin Ave
Ellison Ave
Mt Pleasant Ave
10
Manger Rd



The site is O'Connor Park located at 19 Ralph Road. The site is mostly natural. Along the walk to the tennis courts and hockey rink there is a lawn area that can be converted into a bioswale as stormwater flows south. Stormwater flows south. There is also an area near the basketball court that could treat runoff from the court with a rain garden.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving

The site is Whole Foods Market located at 235 Prospect Avenue. The majority of the site is impervious surface with no external downspouts along the buildings. The site slopes from west to east. There are islands that exist in the parking lot which can be retrofitted with curb cuts for rain gardens or bioswales to slow stormwater runoff flow.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving



The site is the West Orange Board of Education located at 179 Eagle Rock Avenue. The site slopes towards the east. The majority of the site is well maintained impervious pavement, and there are no external downspouts along the building. At the northern border of the site is a strip of lawn that could be converted to a bioswale or rain garden to slow the flow of stormwater runoff.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

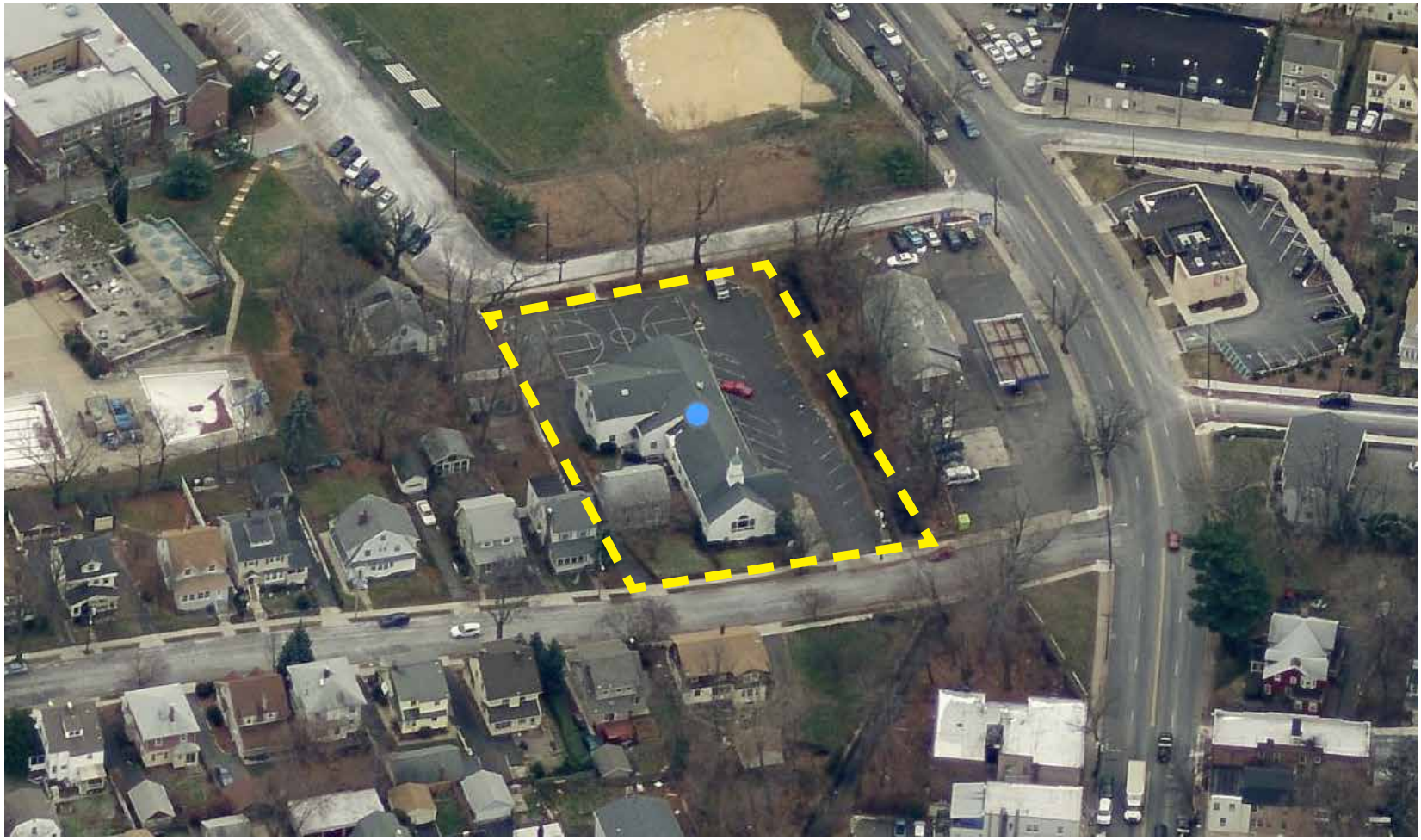
- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving



The site is Our Lady of Lourdes Roman Catholic Church located at 1 Eagle Rock Avenue. In the front of the church there is room for a rain garden. On the west side of the church is a thin strip of lawn that could be converted to a bioswale or rain garden where downspouts discharge to it. North of the church is the parking lot which has a steep embankment that is entirely paved and could be depaved. Areas on the side of the school have downspouts that could discharge into a rain garden.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving

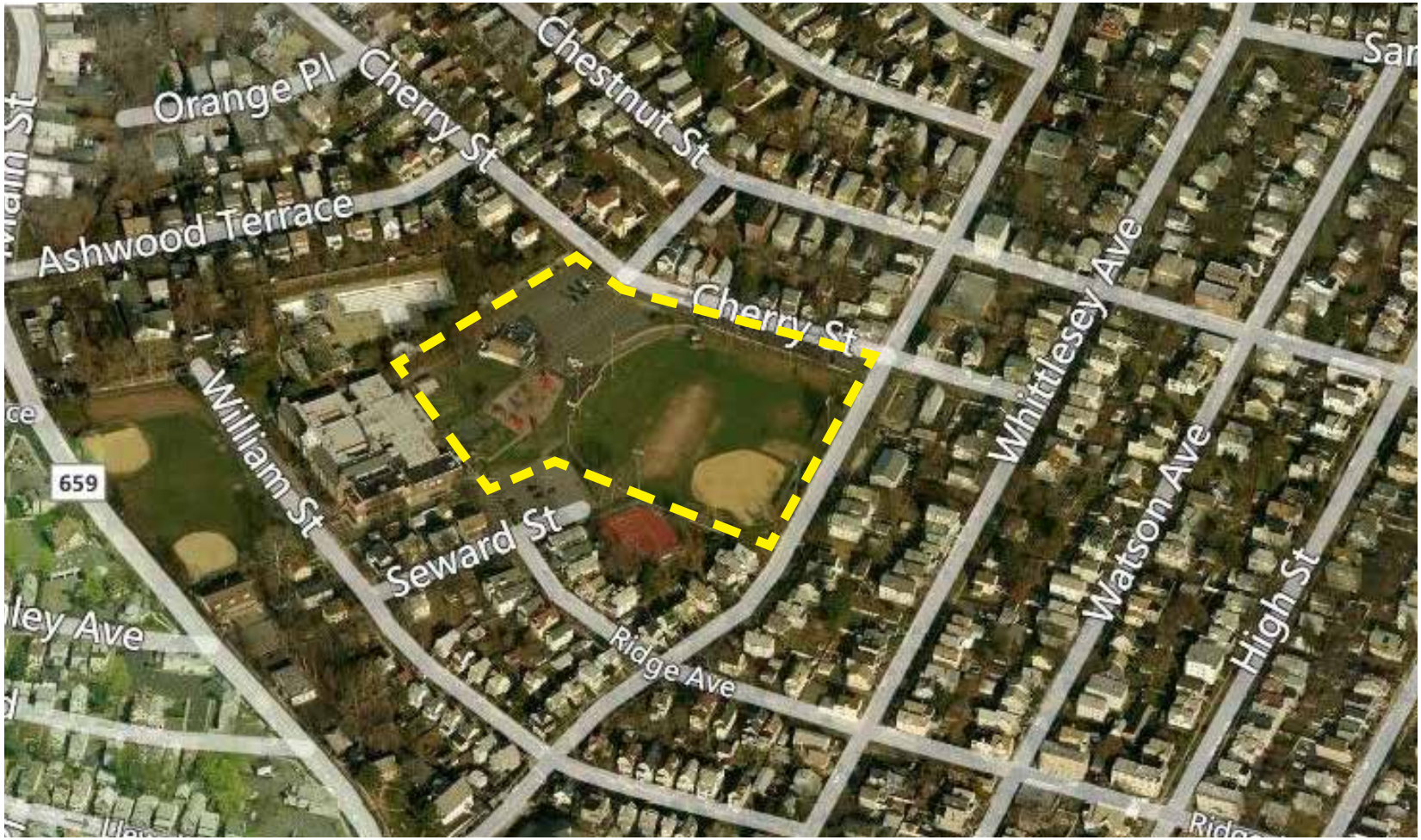




The site is Bethany Church located at 30 Ashwood Terrace. There is little to no slope on the site. On the west side of the site is a stream. There are downspouts on the west side of the building and a small grassy area that could be a converted to a bioswale. There is a slope from south to north in the front of the building. There are also downspouts off the front of the building that can be disconnected into rain gardens. The parking lot needs to be repaved; pervious pavement could be used as an alternative.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [x] bioswales
- [ ] depaving



COLGATE PARK

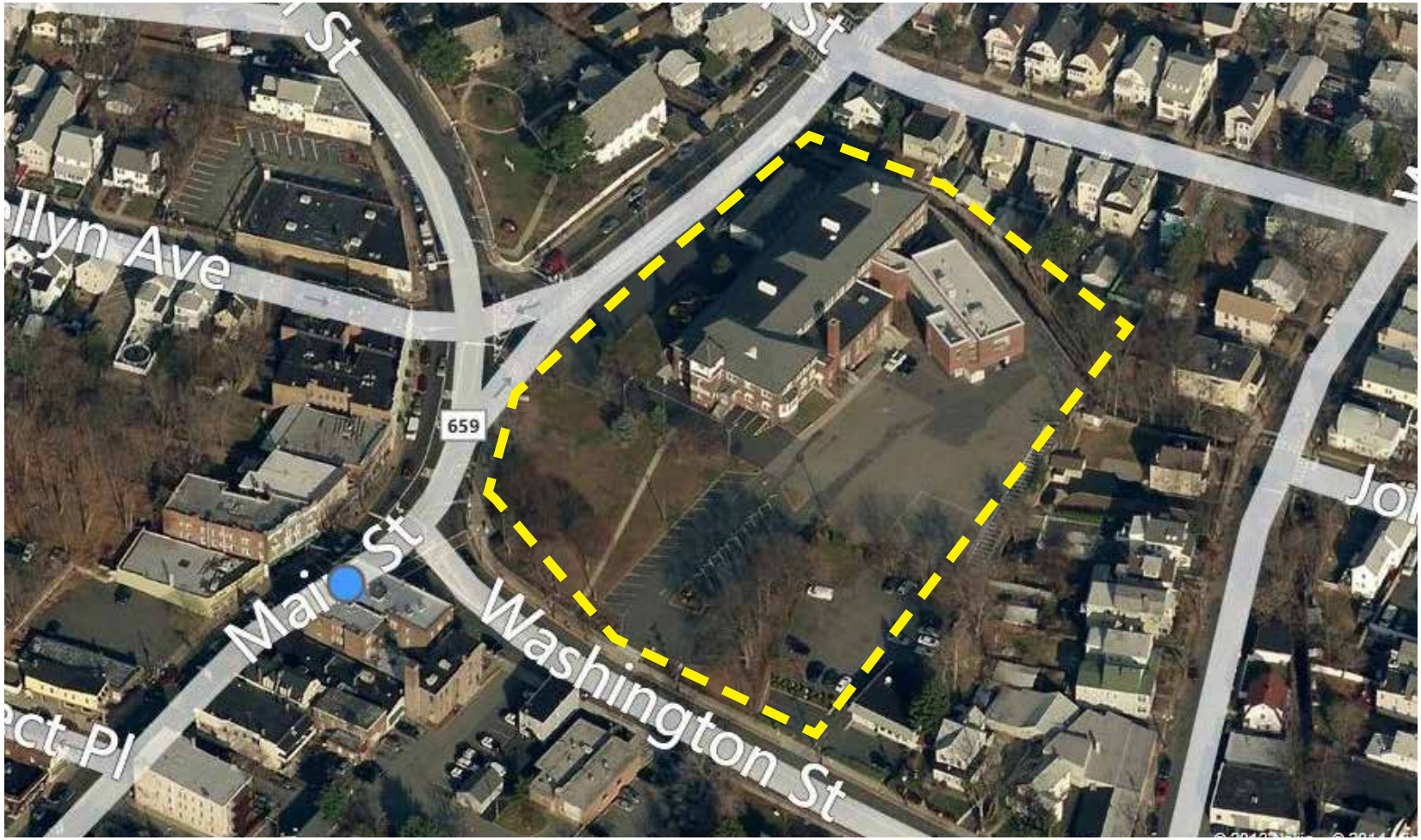
17 Franklin Avenue and Cherry Street
West Orange, NJ 07052



The site is Colgate Park located at the intersection of 17 Franklin Avenue and Cherry Street. The site slopes from the northwest to the southeast, from the parking lot onto the baseball field. The baseball field has outlying areas that are starting to show erosion. By putting in a bioswale or rain garden, stormwater can be better managed. There is also a possibility for a biowale in a small strip of lawn on the north side of the baseball field next to the path. Some of the pavement is starting to wear; consider replacing with pervious pavements.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [x] bioswales
- [ ] depaving


St
St
llyn Ave
659
Main St
Washington St
ct Pl



The site is Washington Elementary School located at 289 Main Street. At the front of the school there are already rain barrels on site. The site slopes south and west. On the south side of the site, a rain garden with curb cuts can be implemented to collect runoff from the pavement and parking lot.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [x] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [ ] bioswales
- [ ] depaving


Mt Pleasant Ave
Gaston St



The site is the West Orange Public Library located at 46 Mt. Pleasant Avenue. The site slopes from south to north and west to east. There are no external downspouts. There is evidence of mild erosion on the western parking lot entrance and along the front northern face of the lawn. A bioswale can be implemented to collect stormwater runoff.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- ☐ rain gardens
- ☐ rain barrels
- ☐ pervious pavement
- ☐ curb cuts
- ☐ buffers
- ☑ bioswales
- ☐ stormwater planters
- ☐ cisterns
- ☐ depaving


508
Rollinson St
Beverly Rd


The site is Seton Hall Preparatory School located at 120 Northfield Avenue. And the site is freshly paved. It slopes from northwest to southwest and from west to east, and also slightly south. There are no external downspouts on the school except for the locker room, which discharges directly to pavement. There is a very steep slope down towards a neighborhood. A bioswale can be installed to slow the flow of stormwater runoff.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- ☐ rain gardens
- ☐ curb cuts
- ☐ stormwater planters
- ☐ rain barrels
- ☐ buffers
- ☐ cisterns
- ☐ pervious pavement
- ☑ bioswales
- ☐ depaving


Walker
Winding Way
Lowell Ave
Gregory Ave
577
Gregory A



The site is Gregory Elementary School located at 301 Gregory Avenue. The site slopes from west to east. On the west side of the building there are connected downspouts that are surrounded by pavement. When the pavement requires replacement, pervious pavement should be considered. On the north side of the field, by the trailers, there is a connected downspout that could be routed into a rain garden.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [x] pervious pavement
- [ ] bioswales
- [ ] depaving


Northfield Ave
508
508
Benvenue Ave



The site is a parking lot for St. Joseph's Church located at 44 Benvenue Avenue. The parking lot is located at the Ridgeway Avenue entrance to the church. The site slopes from east to west directly draining into the adjacent strip of grass along the southwest end of the parking lot. A storm sewer drain, located in this grassy area, captures stormwater running off of the site. This is an ideal site for a rain garden. The garden can be built in the pre-exising grassy area, and the current sewer drain can be used as an overflow for the garden. There is no curb blocking the flow of water; therefore, no curb cuts will be needed.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [ ] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving

RESIDENTIAL ROADWAY / PRIVATE RESIDENCE

38 Old Indian Road
West Orange, NJ 07052



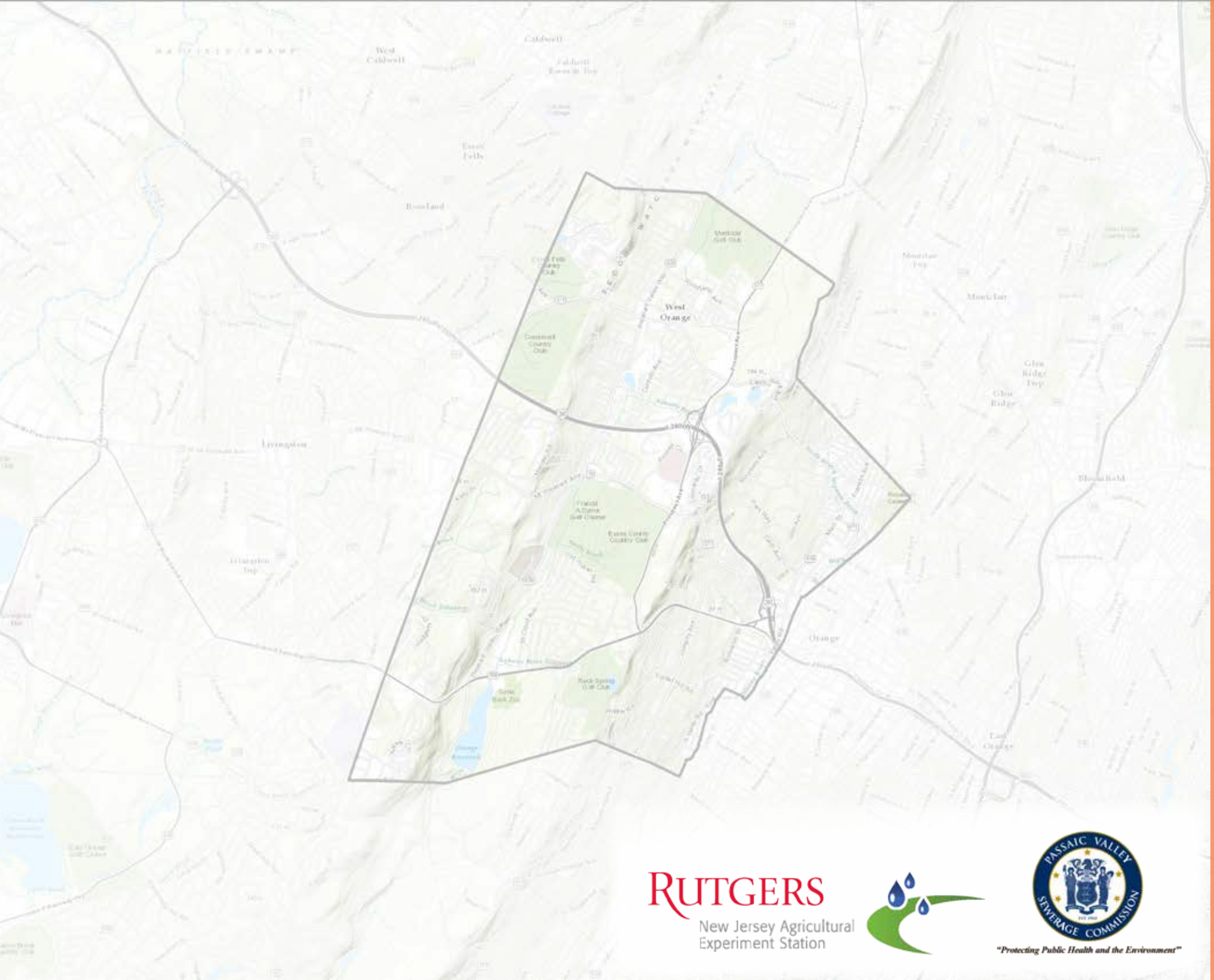
The site is a residential roadway located at 38 Old Indian Road. The roadway slopes down to 38 Indian Road from both the east and west causing the site to flood during rain events. This flooding can be reduced by making curb cuts along the edge of the roadway allowing stormwater to be diverted into rain gardens located on the front lawns of the adjacent private residences. A bioswale can also be constructed to help capture and slow the stormwater running off of the roadway.

SUITABLE GREEN INFRASTRUCTURE STRATEGIES:

- [x] rain gardens
- [x] curb cuts
- [ ] stormwater planters
- [ ] rain barrels
- [ ] buffers
- [ ] cisterns
- [ ] pervious pavement
- [x] bioswales
- [ ] depaving

RESIDENTIAL ROADWAY / PRIVATE RESIDENCE

38 Old Indian Road
West Orange, NJ 07052



RUTGERS
New Jersey Agricultural Experiment Station

PASSAIC VALLEY SEWERAGE COMMISSION

"Protecting Public Health and the Environment"