Stormwater Runoff Reduction Plan

Milford, Connecticut

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UCONN | COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

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SUMMARY

During the summer of 2018, a team of UConn students and Extension faculty performed an evaluation of potential stormwater enhancement opportunities in the Town of Milford, CT. The process involved a desktop analysis and field visits to determine where potential green stormwater infrastructure installation opportunities existed on publicly owned land parcels. Calculations were performed to determine the potential stormwater and pollution reduction benefits from each of the proposed installations. If all projects identified in the report were implemented, 96,608 sq ft of impervious cover would be disconnected from the stormwater drainage system. This means that an estimated 2,456,935 gallons of untreated stormwater, 16.4 pounds of nitrogen, and 1.175 pounds of phosphorus would be prevented from entering local streams annually.

IN THIS REPORT...

Included are recommendations for green stormwater infrastructure practices at 11 sites in the town of Milford. Each site is introduced with an aerial photo from Google Maps and includes its address, total impervious area to be disconnected from the stormwater system, and the subregional watershed. Soil type was assessed through the USDA web soil survey for properties and qualities most suitable for green infrastructure. Soil testing would be required to further analyze the permeability of substrate at each site. Following the introduction is an ArcGIS map displaying all options for the site along with a CT ECO map showing impervious surface types. Each option is then individually displayed with an ArcGIS map of the recommended practice, detailed description of our recommendations, and an informational table. Each table shows an estimated drainage area, our recommended green infrastructure, annual gallons of runoff treated, nitrogen and phosphorus pollution reduction amounts, and the suggested size of each practice. These estimations were calculated based on the drainage area, annual rainfall estimates specific to Connecticut, and literature export values.

IMPERVIOUS SURFACES & RUNOFF

Impervious surfaces, including roads, rooftops, parking lots, and other developments do not allow water to penetrate through them. Natural surfaces, such as grass, leaf litter, vegetated areas, or dirt areas absorb a significant portion of water from precipitation and runoff. Once water penetrates the ground, it then flows into surface water bodies or is recharged into groundwater aquifers. When natural surfaces are replaced with impervious surfaces, the water cycle is disrupted. As a result, soil infiltration decreases, while surface runoff increases substantially, and is often diverted into stormwater management systems and discharged directly into the local water bodies. Runoff over impervious surfaces collects pollutants, and causes flooding and erosion that negatively affect the water quality of local water bodies. To prevent a decrease in water quality, runoff can to be disconnected from the stormwater management system by implementing green infrastructure practices that reduce or convert impervious practices. For instance, downspouts on buildings and large areas of impervious surface can be designed to direct runoff into rain gardens and bioretention areas, box planters, tree box filters, or rain barrels. Previously impervious surfaces (roads, parking lots, pathways) can be converted into pervious surfaces using pervious alternatives to traditional materials.

COMMON GREEN INFRASTRUCTURE PRACTICES

Rain Gardens and Bioretention System

Pervious Pavement

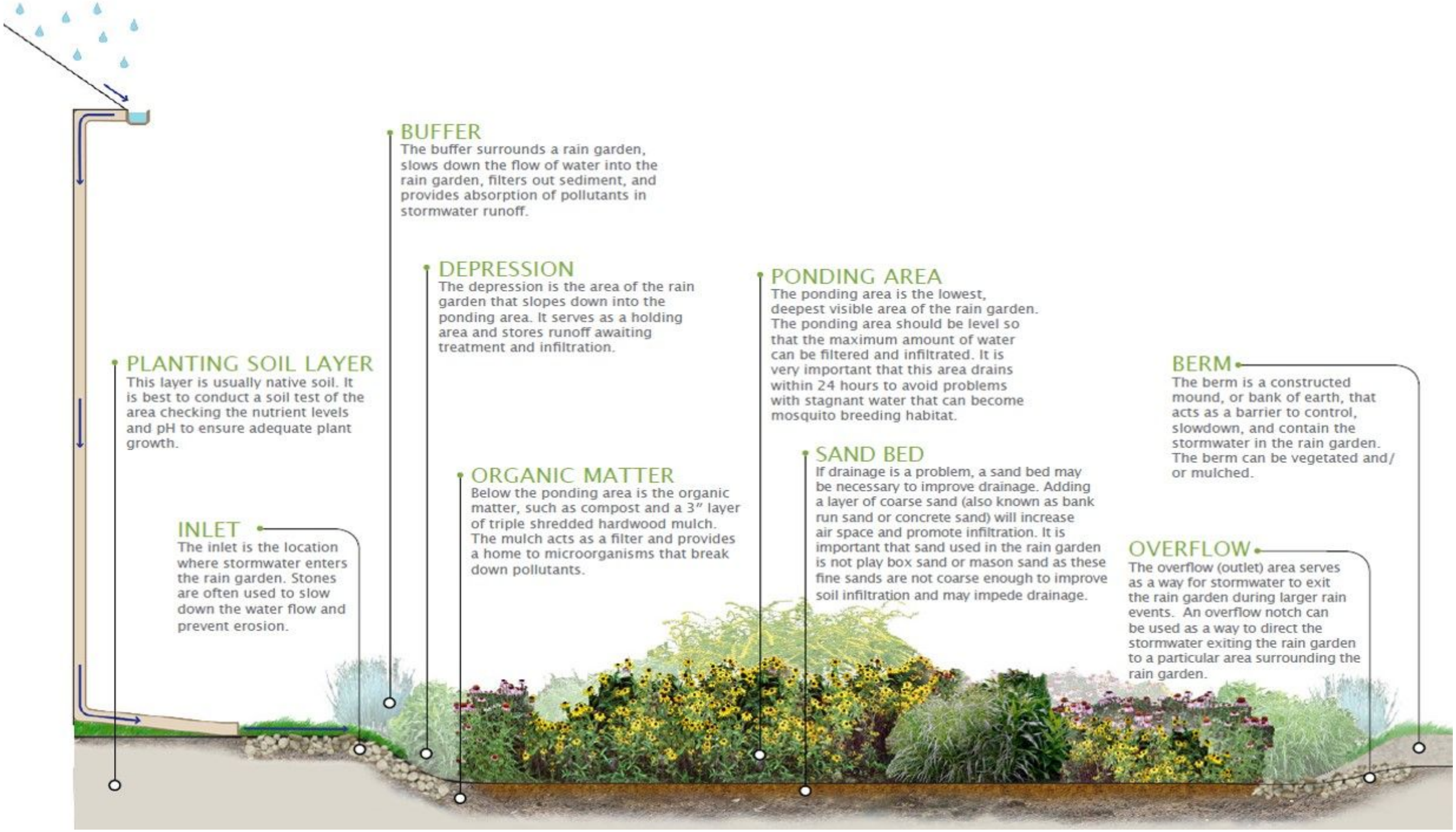
Tree Box Filters

Rainwater Harvesting Planters

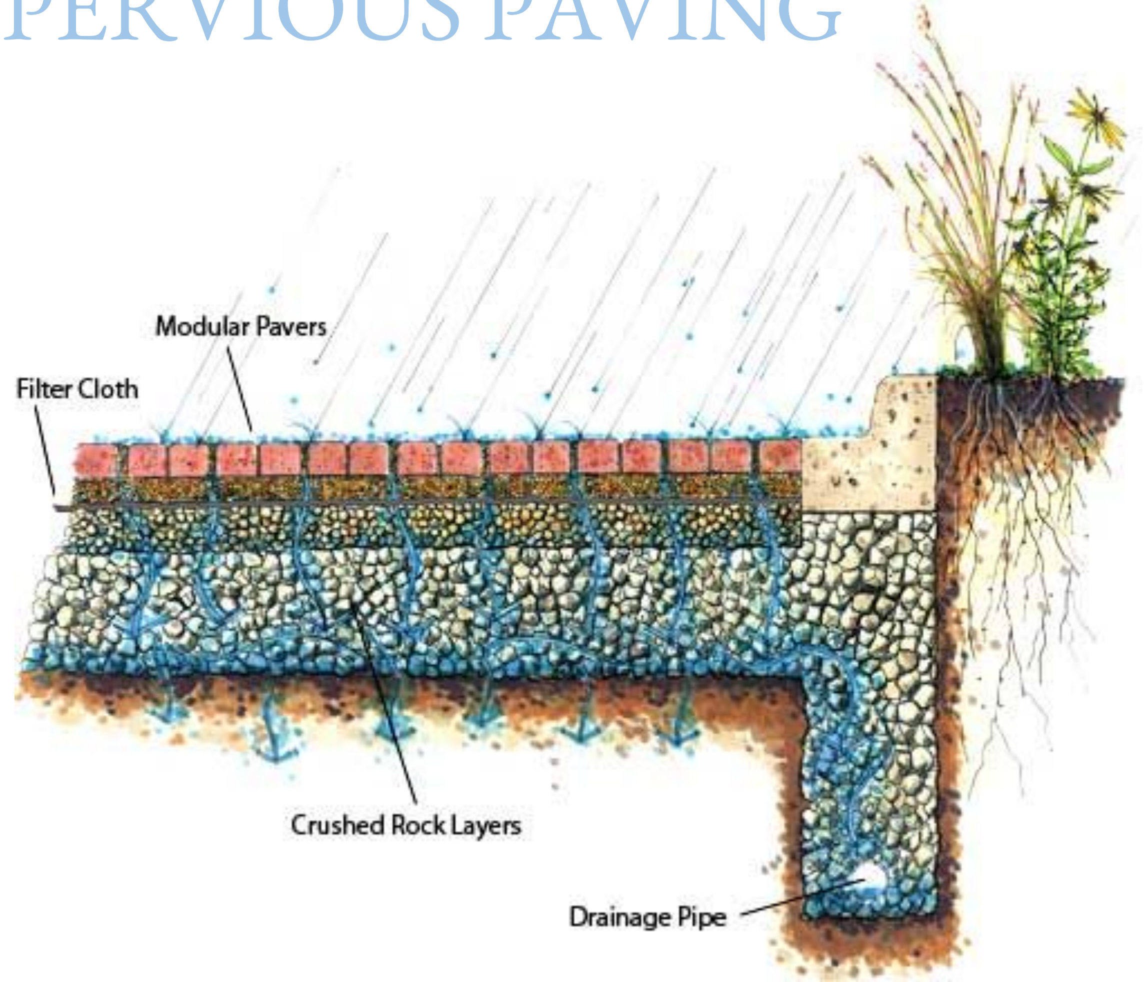
RAIN GARDENS

A **rain garden** is a piece of green infrastructure designed to capture precipitation runoff from an impervious surface. By doing so, water is allowed to percolate into the ground rather than directly entering stormwater management systems. They are usually built adjacent to the impervious area in question and are depressed approximately around 6 inches, depending on how much area is available. Rain gardens not only help to reduce pollution of local waters, but also add to the aesthetic appeal and biodiversity of urban areas.

When built next to a parking lot, one or more sections of curb is cut and water is directed through a path composed of cobble or gravel to minimize erosion. If implemented next to a building, gutters can direct water into the garden. From here, the water is either taken up by plants or enters the soil, and eventually, the water table via percolation. Appropriate plants for a rain garden tend to be shrubs or grasses that are tolerant to drought, flooding, and exposure to high salt concentrations. Ideally, these gardens are planted with hardy native perennials to minimize the need for maintenance. A **bioretention** is an enlarged rain garden specifically engineered to handle larger quantities of water.


BUFFER
The buffer surrounds a rain garden, slows down the flow of water into the rain garden, filters out sediment, and provides absorption of pollutants in stormwater runoff.
DEPRESSION
The depression is the area of the rain garden that slopes down into the ponding area. It serves as a holding area and stores runoff awaiting treatment and infiltration.
PONDING AREA
The ponding area is the lowest, deepest visible area of the rain garden. The ponding area should be level so that the maximum amount of water can be filtered and infiltrated. It is very important that this area drains within 24 hours to avoid problems with stagnant water that can become mosquito breeding habitat.
PLANTING SOIL LAYER
This layer is usually native soil. It is best to conduct a soil test of the area checking the nutrient levels and pH to ensure adequate plant growth.
BERM
The berm is a constructed mound, or bank of earth, that acts as a barrier to control, slowdown, and contain the stormwater in the rain garden. The berm can be vegetated and/ or mulched.
SAND BED
If drainage is a problem, a sand bed may be necessary to improve drainage. Adding a layer of coarse sand (also known as bank run sand or concrete sand) will increase air space and promote infiltration. It is important that sand used in the rain garden is not play box sand or mason sand as these fine sands are not coarse enough to improve soil infiltration and may impede drainage.
ORGANIC MATTER
Below the ponding area is the organic matter, such as compost and a 3" layer of triple shredded hardwood mulch. The mulch acts as a filter and provides a home to microorganisms that break down pollutants.
INLET
The inlet is the location where stormwater enters the rain garden. Stones are often used to slow down the water flow and prevent erosion.
OVERFLOW
The overflow (outlet) area serves as a way for stormwater to exit the rain garden during larger rain events. An overflow notch can be used as a way to direct the stormwater exiting the rain garden to a particular area surrounding the rain garden.

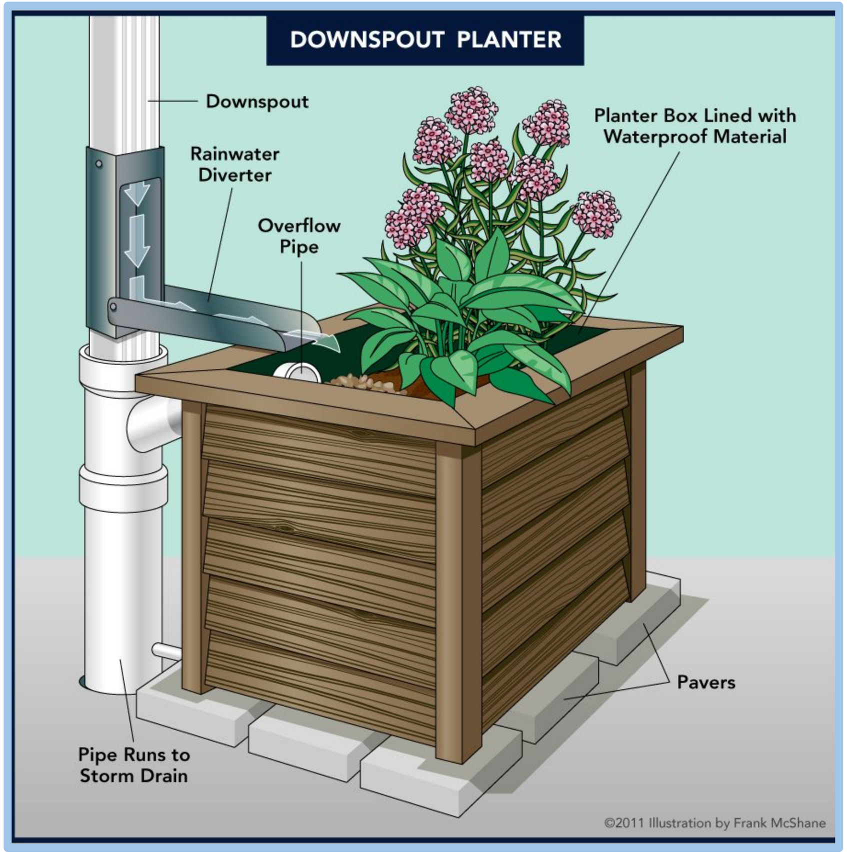
PERVIOUS PAVING



Pervious paving is an alternative to traditional asphalt or concrete that allows for the infiltration of water. Ideal locations for pervious paving are relatively flat areas that take on a fair amount of water from surrounding impervious surfaces during storm events. Pervious asphalt needs to be replaced less often than traditional asphalt. As a result of the material being porous, it is less susceptible to seasonal expansion and contraction than traditional asphalt. This reduces the occurrence of frost heaves and seasonal cracks and prolongs its lifespan. Pervious paving is the most costly green infrastructure practice as it covers a large area and maintenance is required. Maintenance practices include cleaning techniques such as pressure washing and vacuum sweeping to dislodge sand, dirt, leaves and other debris that infiltrate the void structure of the pervious concrete and inhibit its permeability.

Pervious paving often reduces the need for snow removal as well. With traditional concrete and asphalt, water from melted snow cannot infiltrate so it often freezes into black ice or acts as runoff and takes salt with it. Pervious paving allow this water to enter the ground, resulting in a decreased need for salting as well as less cost for snow removal maintenance. This not only puts less stress on the stormwater management system, but relevies local aquatic ecosystems as well.

PLANTERS



A downspout **planter** is essentially a raised, decorative rain garden that is composed of gravel, soil and vegetation. Planters can be customized to fit a certain size or shape depending on the desired aesthetic and the amount of roof runoff it receives. Planters can be constructed from brick, plastic, wood, concrete, or other common materials. They are usually connected to downspouts of buildings in order to utilize rainwater to irrigate vegetation within the planter. This decreases the amount of runoff water that usually enters a municipal stormwater management system.

TREE BOX FILTERS

Tree box filters are an aesthetically pleasing green infrastructure practice that directs stormwater runoff through soil and other substrates with excellent filtration qualities before allowing it to enter municipal stormwater systems. Stormwater runoff flowing over impervious sidewalks and roads enter the tree filter box through a grate. Once inside the box, the water infiltrates through a special soil mixture, a mulch layer, and a shrub or tree root system that are specifically designed to filter out pollutants and contaminants.

RAINWATER HARVESTING

Rainwater harvesting is the diversion of water from gutters and downspouts which would otherwise end up in the municipal stormwater management system. Roof runoff is fed into large **cisterns** which retain the water until it can be repurposed for garden watering, domestic use, fire protection and a variety of other ways. Not only does this aid in reducing runoff and the issues that come with that, but it also reduces stress on private well and municipal water supplies. Cisterns are usually situated beside buildings where gutters drain water from the roof.

Both the amount of water needed as well as the area of impermeable surface are important to pay attention to when deciding how large a cistern to install. The size of the cistern also dictates what material it should be made of. For small drainage areas, PVC is appropriate, but as the size increases steel or even concrete may be necessary. Depending on the anticipated use of the water, a filter may be imperative to prevent contaminants from entering the cistern. Maintenance practices include relocation of cisterns in the winter months to prevent them from freezing.

SITE SELECTION & APPROACH

Before visiting sites, team members used various aerial imagery tools to view locations within each town to determine possible sites suitable for green infrastructure practices. The focus was towards sites under municipal control that would otherwise allow for quick installation of practices while also serving to educate the public.

On location, sites and site specific recommendations were selected based on suitability for implementation of green infrastructure practices. The factors used included slope of surrounding land, land available for use, location of existing storm drains, location of above ground and underground obstructions (large trees, pipes, utilities, etc.), and whether or not some form of green infrastructure practice was already in place.

SITES MAP

1. Orange Avenue School
2. Jonathan Law High School
3. Meadowside Elementary School
4. Calf Pen Meadow School
5. East Shore Middle School
6. Live Oaks Elementary School
7. Mathewson Elementary School
8. Orchard Hill Elementary School
9. Pumpkin Delight Elementary School
10. Harborside Middle School
11. Joseph A. Foran High School

TOP FIVE SITES FOR MILFORD

The top five sites for Milford were selected based on the same criteria as the site specific recommendations as well as, the visibility from high traffic areas, the educational aspect, the amount of disconnection, and the practicality of implementing the green infrastructure practice.

1. Meadowside Elementary School
2. Calf Pen Meadow School
3. East Shore Middle School
4. Live Oaks Elementary School
5. Orchard Hills Elementary School

If all top five site projects were implemented, 21,002 sq ft of impervious cover will be disconnected from the stormwater drainage system. This means that 603,374 gallons of untreated stormwater, 3.634 pounds of nitrogen, and 0.258 pounds of phosphorus will be prevented from entering local water bodies annually.

Site 1: ORANGE AVENUE SCHOOL

LOCATION:

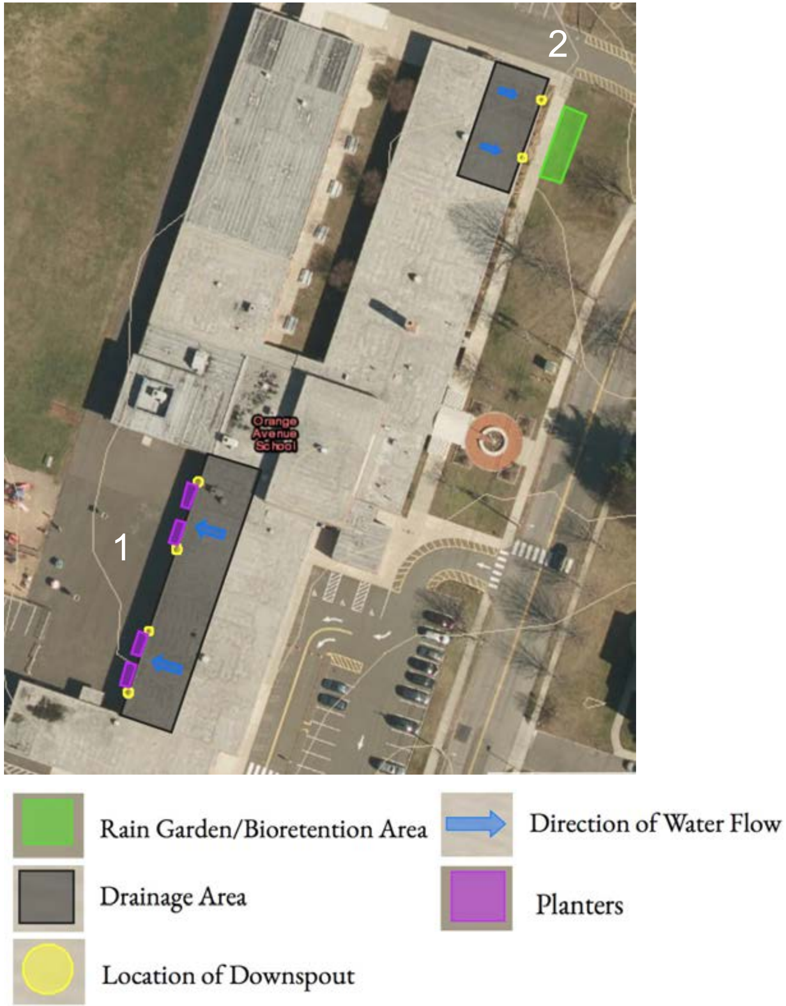
260 Orange Avenue Milford, CT

IMPERVIOUS AREA:

7,370 sq ft

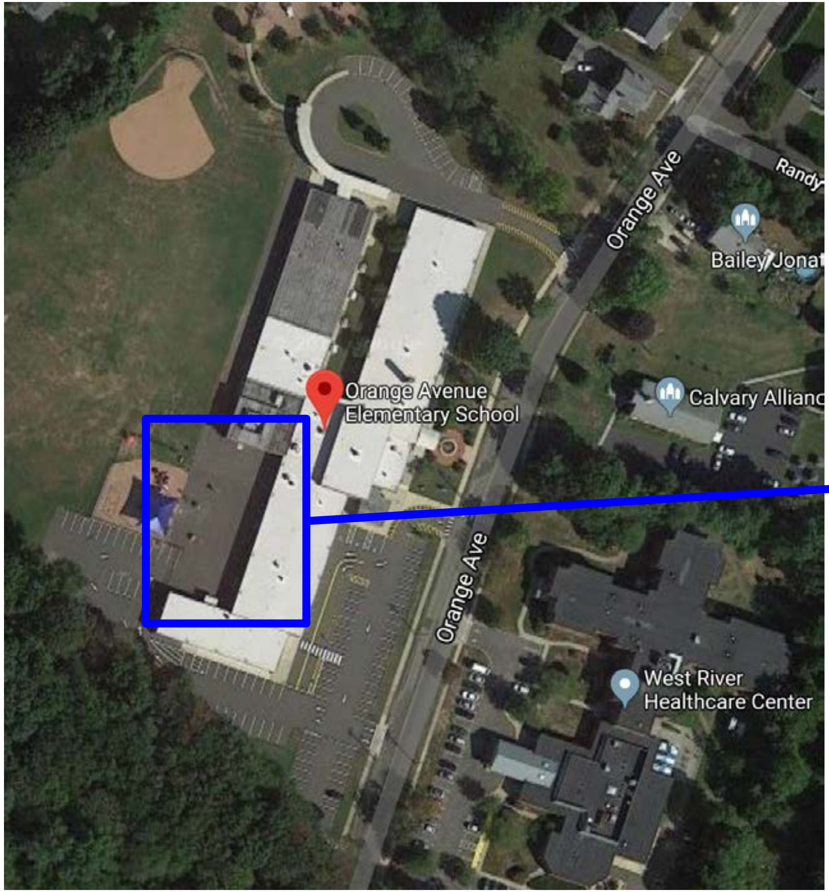
SUBREGIONAL WATERSHED:

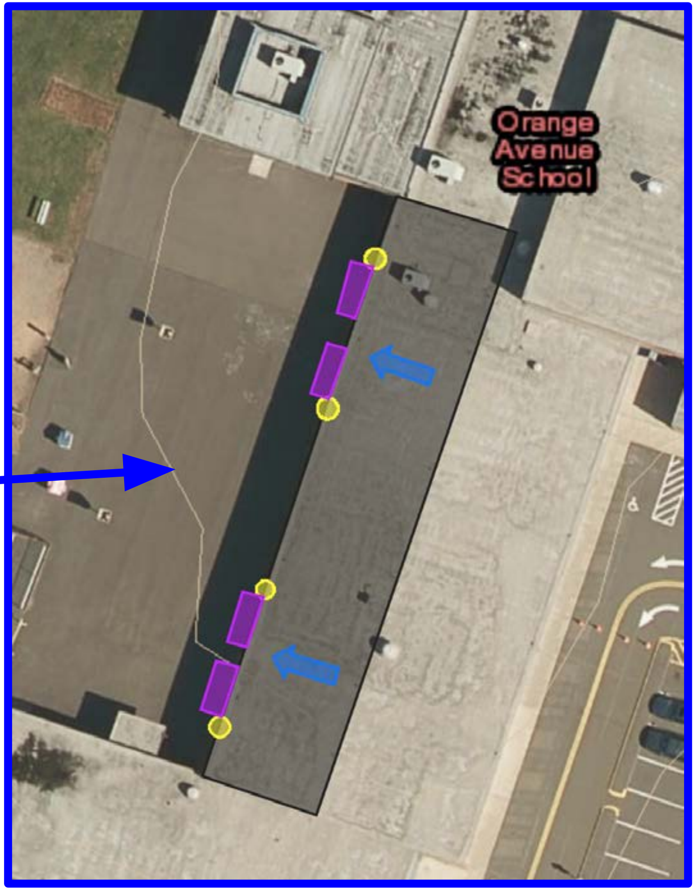
Wepawaug River;5307 to the West, Indian River;5306 to the East


2
Orange Avenue School
1
Rain Garden/Bioretention Area
Direction of Water Flow
Drainage Area
Planters
Location of Downspout


Buildings
Roads
Parcel Boundaries
Other Impervious
Not Impervious

ORANGE AVENUE SCHOOL
Option 1: Southwest Side of School

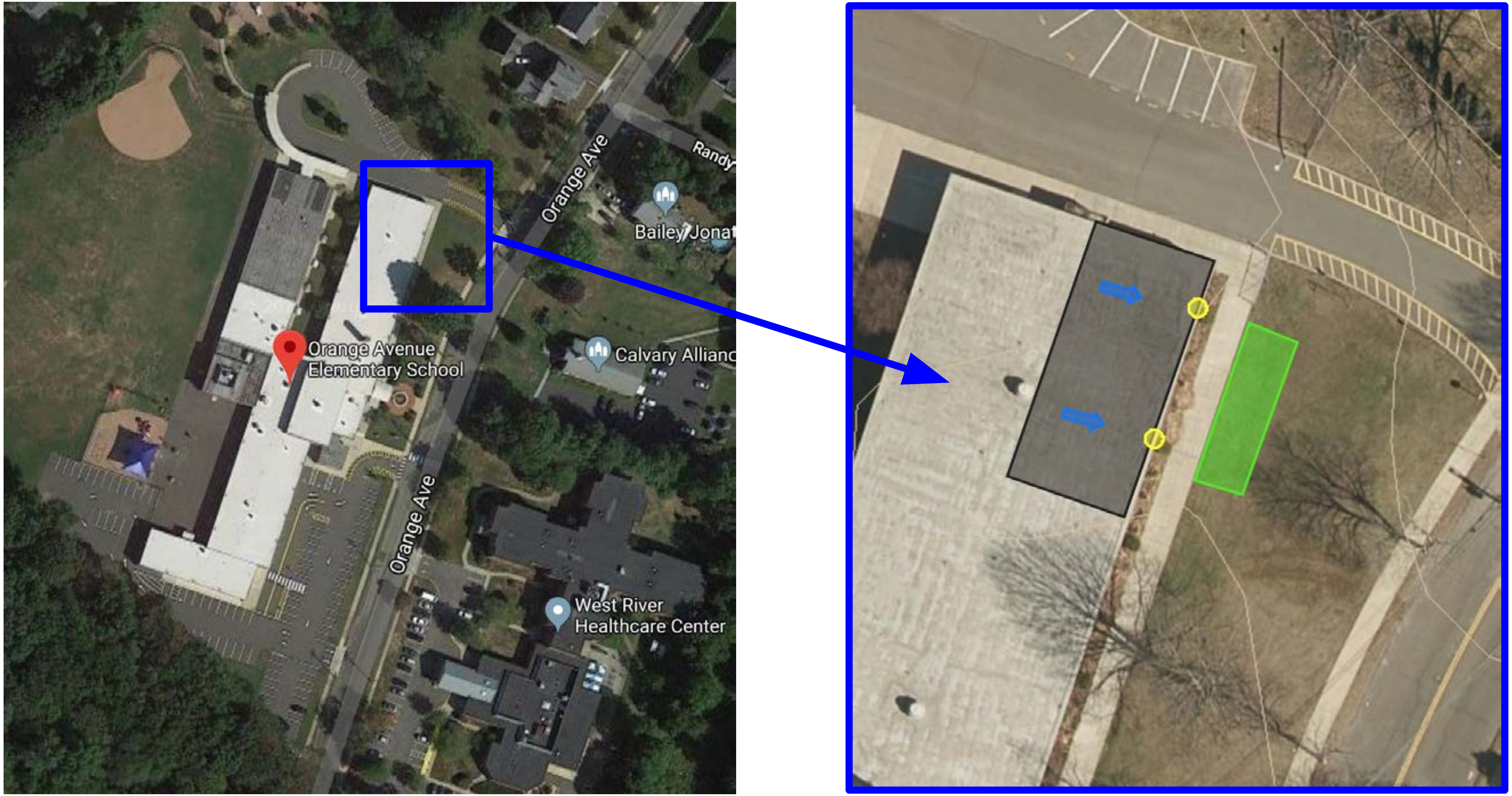




Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (# Planters)
5,100	Planters	129,703	0.882	0.063	4

Although these four downspouts are technically disconnected from the stormwater system, school faculty mentioned that water discharged from the downspouts runs over the paved play area and often freezes over the winter, making it too dangerous to walk on. We recommend that the downspouts be re-designed to direct water into several large planters along this wall. Stormwater from the roof would then aid in watering the planters. An additional option may be to replace a strip of asphalt closest to this wall with pervious asphalt. By itself, this could help keep ice formation at bay, but in addition to the planters, this could act as an overflow to catch water that drains from the planter boxes.

ORANGE AVENUE SCHOOL
Option 2: Northeast Corner of School



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
2,270	Rain Garden	57,731	0.393	0.028	380

This area has great potential for a rain garden. The two downspouts at this location currently direct roof runoff into the stormwater system. These two downspouts could be disconnected, and a pipe can be used to direct water under the existing sidewalk and into a rain garden. This high visibility area receives a lot of foot traffic, making it ideal for a community rain garden project.

Site 2: JONATHAN LAW HIGH SCHOOL

LOCATION:

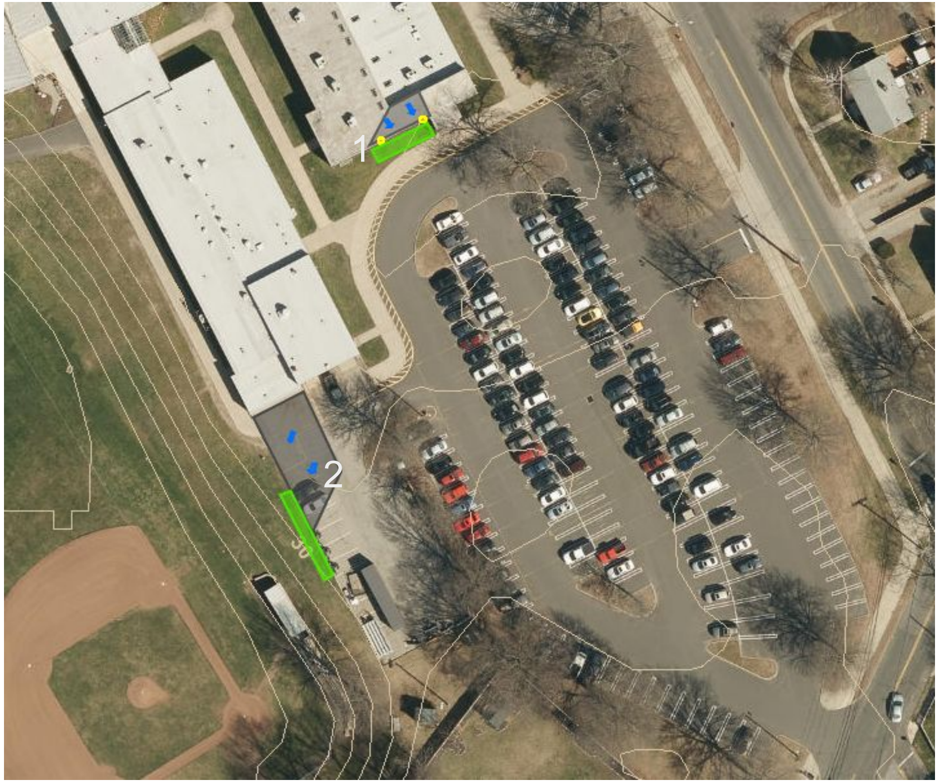
20 Lansdale Avenue Milford, CT

IMPERVIOUS AREA:

2,377 sq ft

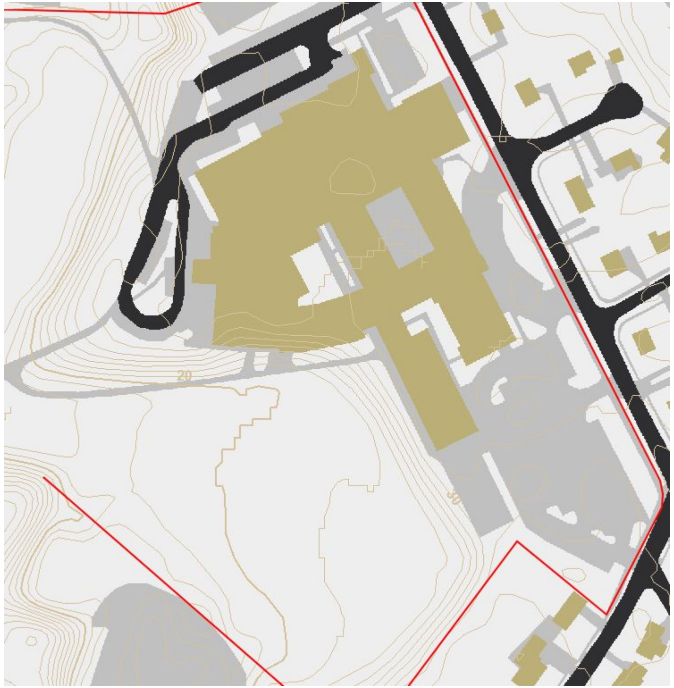
SUBREGIONAL WATERSHED:

South Central Shoreline; 5000



Rain Garden/Bioretention Area
Direction of Water Flow
Drainage Area
Location of Existing Storm Drains
Location of Downspout

Buildings
Roads
Parcel Boundaries
Other Impervious
Not Impervious



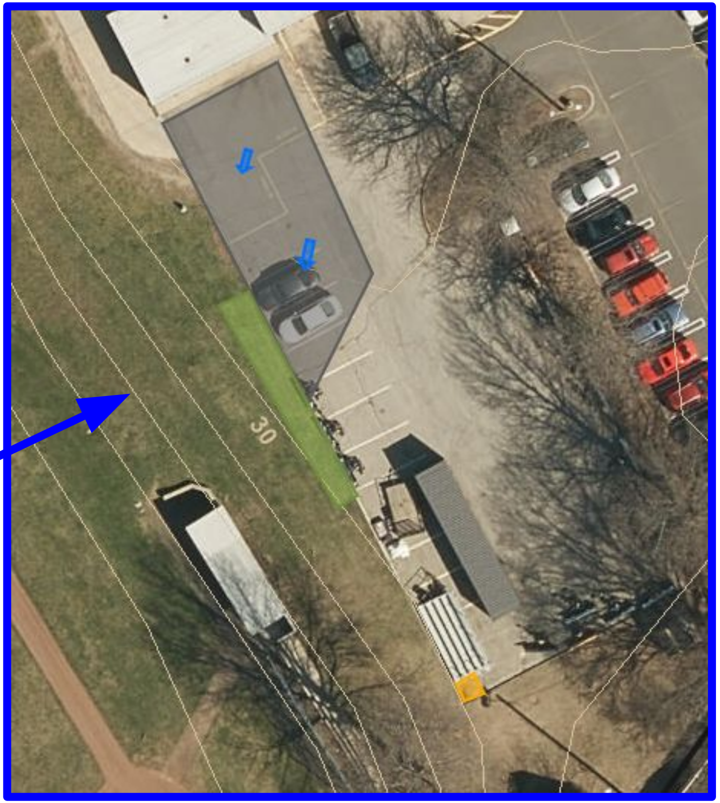
JONATHAN LAW HIGH SCHOOL
Option 1: East Side of School

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
446	Rain Garden	11,344	0.077	0.005	74

For this location we suggest building a rain garden along the sidewalk of the south of the building. There seems to be enough space between the building and the sidewalk to build a rain garden large enough to handle the water from the roof. The visibility here would be excellent as it is adjacent to the student parking lot.

JONATHAN LAW HIGH SCHOOL

Option 2: South Parking Lot



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,931	Rain Garden	49,116	0.334	0.024	322

For this location we recommend cutting the curb and implementing a rain garden along the parking lot. The entire parking lot slopes towards a storm drain at the southern end and is also slightly pitched to the west. There isn't enough space to treat the entire parking lot, but part of it could be handled by the space available.

Site 3: MEADOWSIDE ELEMENTARY SCHOOL

LOCATION:

80 Seeman's Lane Milford, CT

IMPERVIOUS AREA :

4,775 sq ft

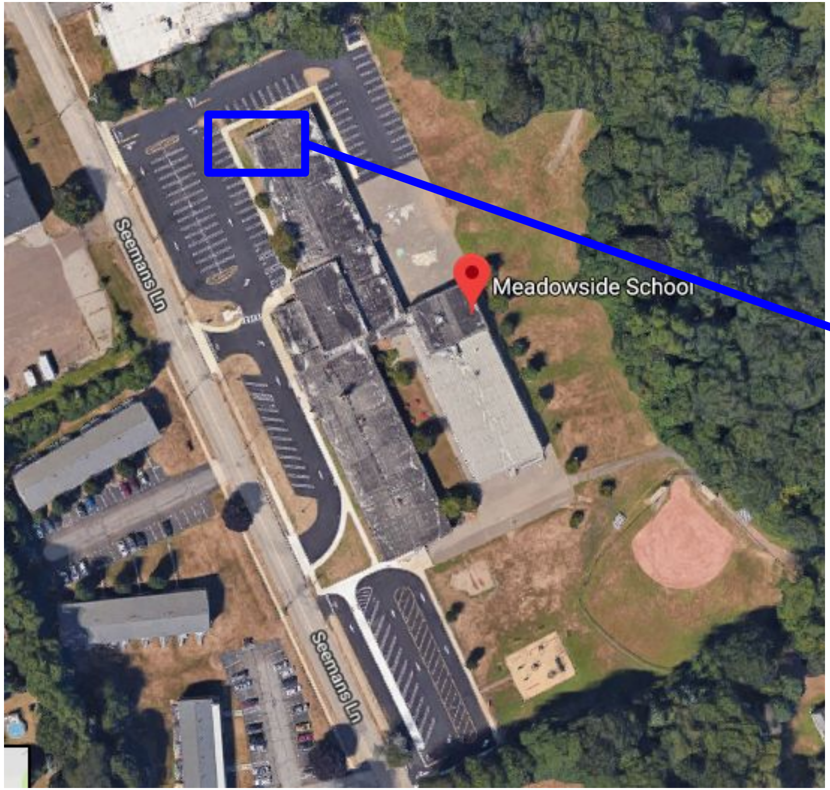
SUBREGIONAL WATERSHED:

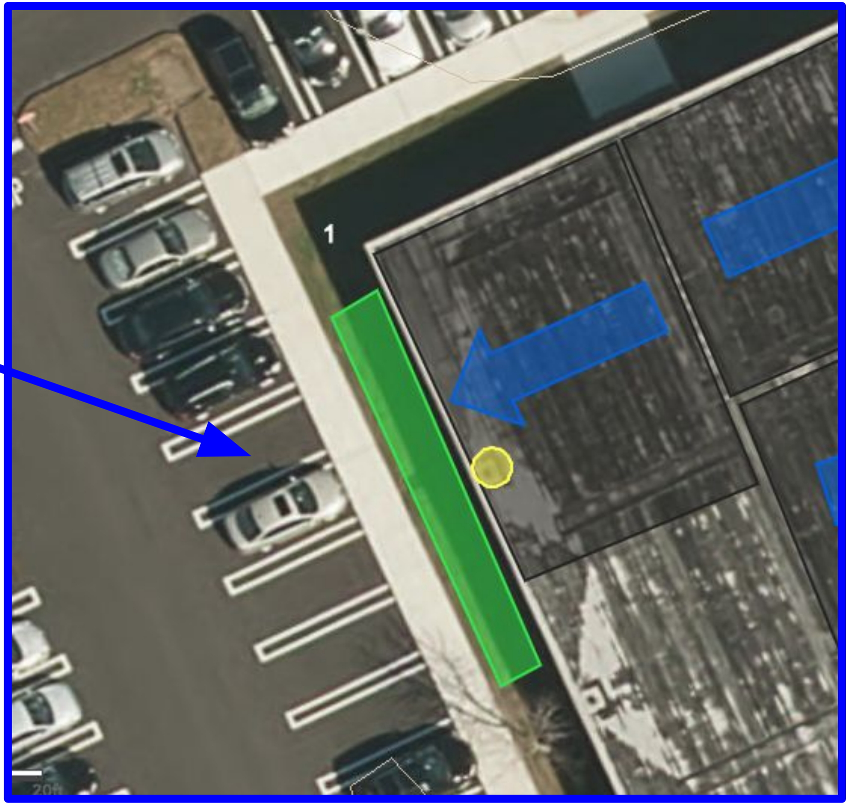
South Central Shoreline; 5000


1
2
3
4
Meadowside School
60
Rain Garden/Bioretention Area
Direction of Water Flow
Drainage Area
Rain Barrel/Cistern
Location of Downspout


Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious
60
70
50

MEADOWSIDE ELEMENTARY SCHOOL
Option 1: Northern Front Side

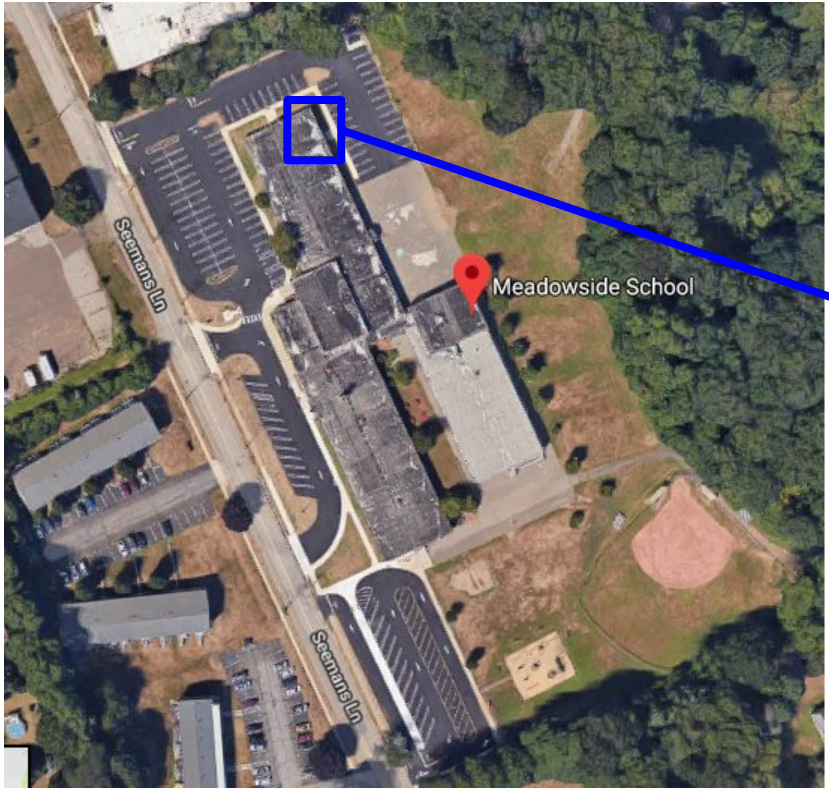


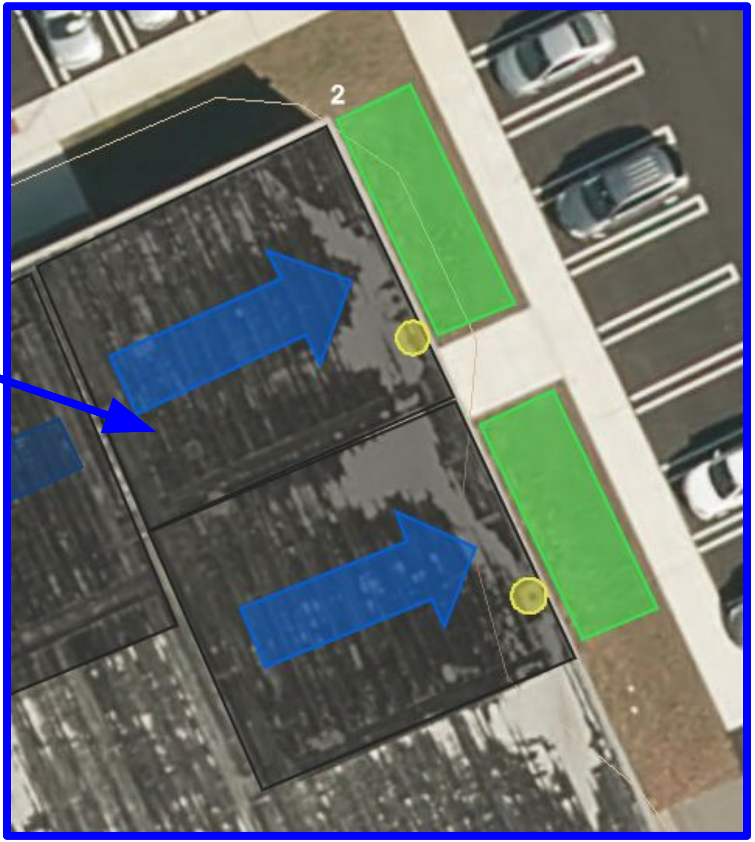


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,401	Rain Garden	35,630	0.242	0.017	233

Our recommendation here is to disconnect a downspout and lead it to feed a rain garden that would be built between the building and the sidewalk. The basin that is currently in the grass area could be used as an overfill for the rain garden itself if the soil is not permeable enough. This location in the front of the school will help to educate the community and students on green infrastructure practices.

MEADOWSIDE ELEMENTARY SCHOOL
Option 2: Northern Back Side



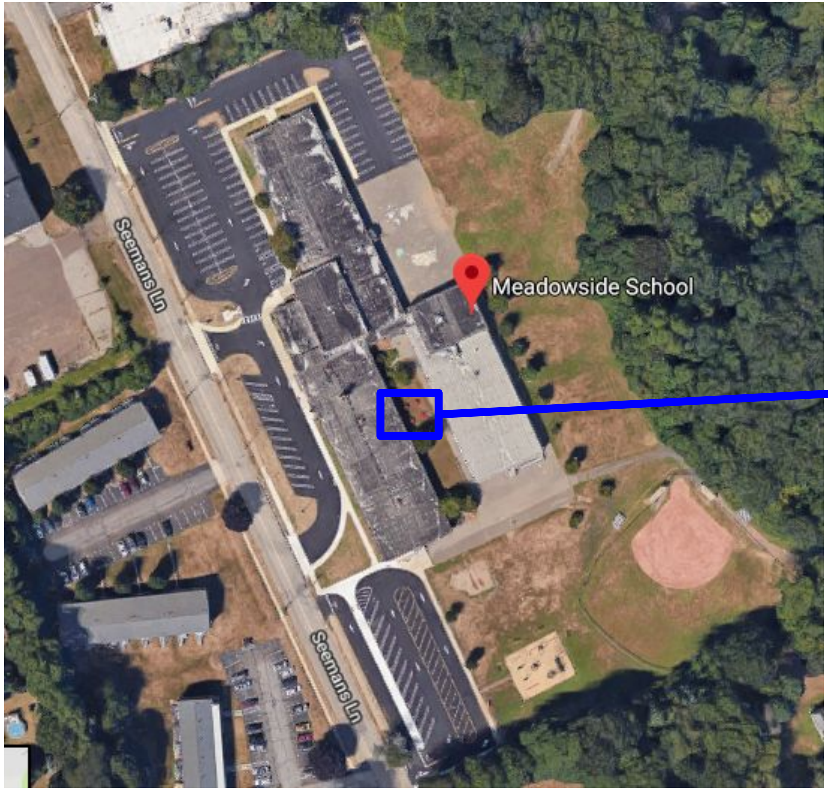


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,303	Twin Rain Gardens	33,138	0.225	0.016	218



This location alongside the school could be used to create two separate rain gardens that would be twin in size. If the two downspouts on each side of the sidewalk are disconnected, the runoff from the roof could be used to feed the gardens rather than be directed into the stormwater system.

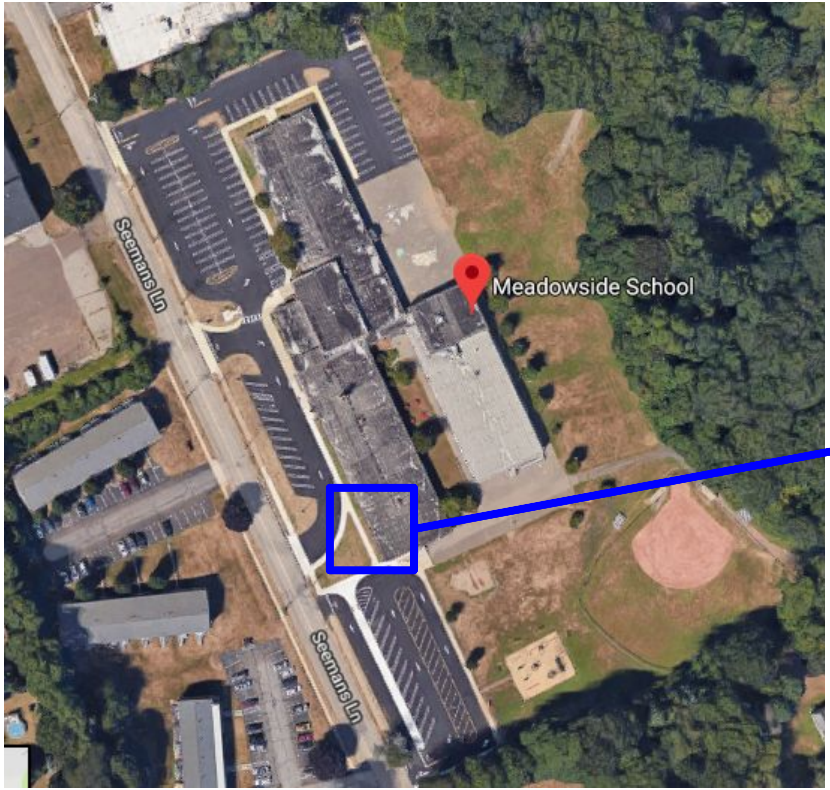
Option 3: Courtyard Garden Area

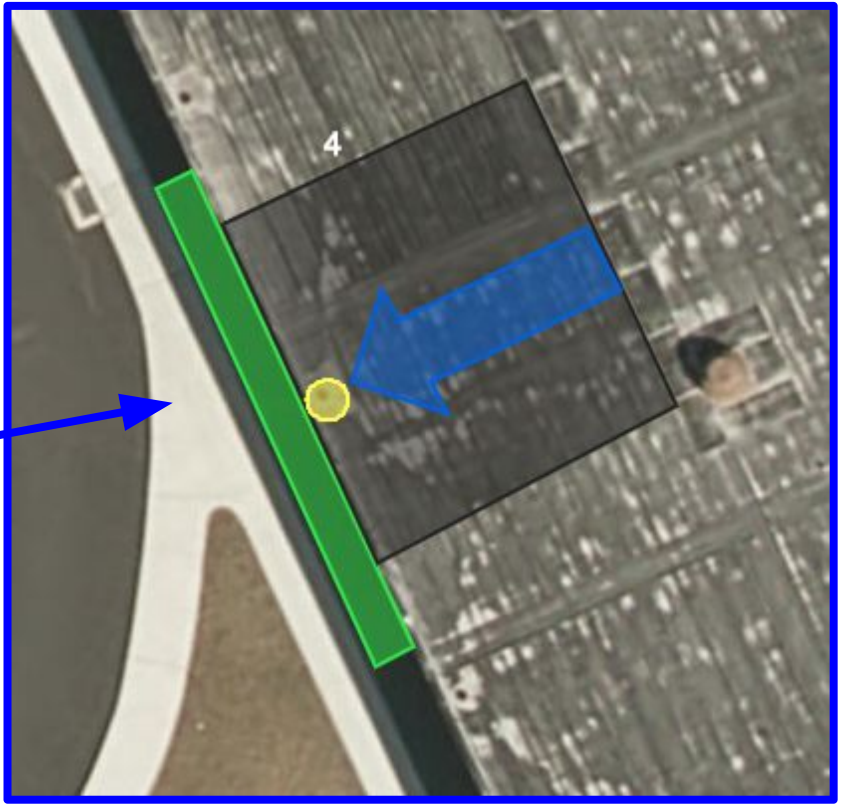


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (gallons)
1,022	Cistern	25,992	0.177	0.013	55

This courtyard in the middle of the school is an ideal location for a cistern to collect water. Although already disconnected from the stormwater system, there are many downspouts that empty into the area. In the center, there is a community garden where the area is maintained well and plants are composted. The cistern could bring an educational aspect into the garden.

MEADOWSIDE ELEMENTARY SCHOOL
Option 4: Southern Front Side





Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,049	Rain Garden	26,678	0.181	0.013	174

The suggestion for this area is to disconnect one of the downspouts to lead into a rain garden. The runoff from the roof could be used to water a garden that will help infiltrate the vegetation of plants and soils. This will eventually lead into the natural groundwater system, rather than flow into a stormwater system.

Site 4: CALF PEN MEADOW SCHOOL

LOCATION:

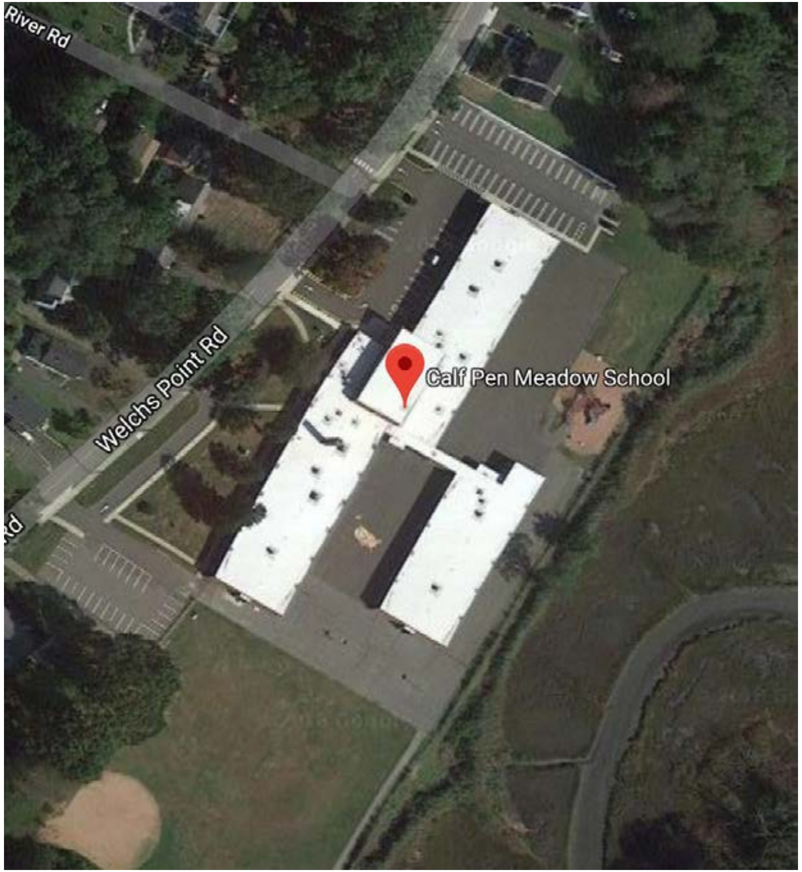
395 Welch's Point Road Milford, CT

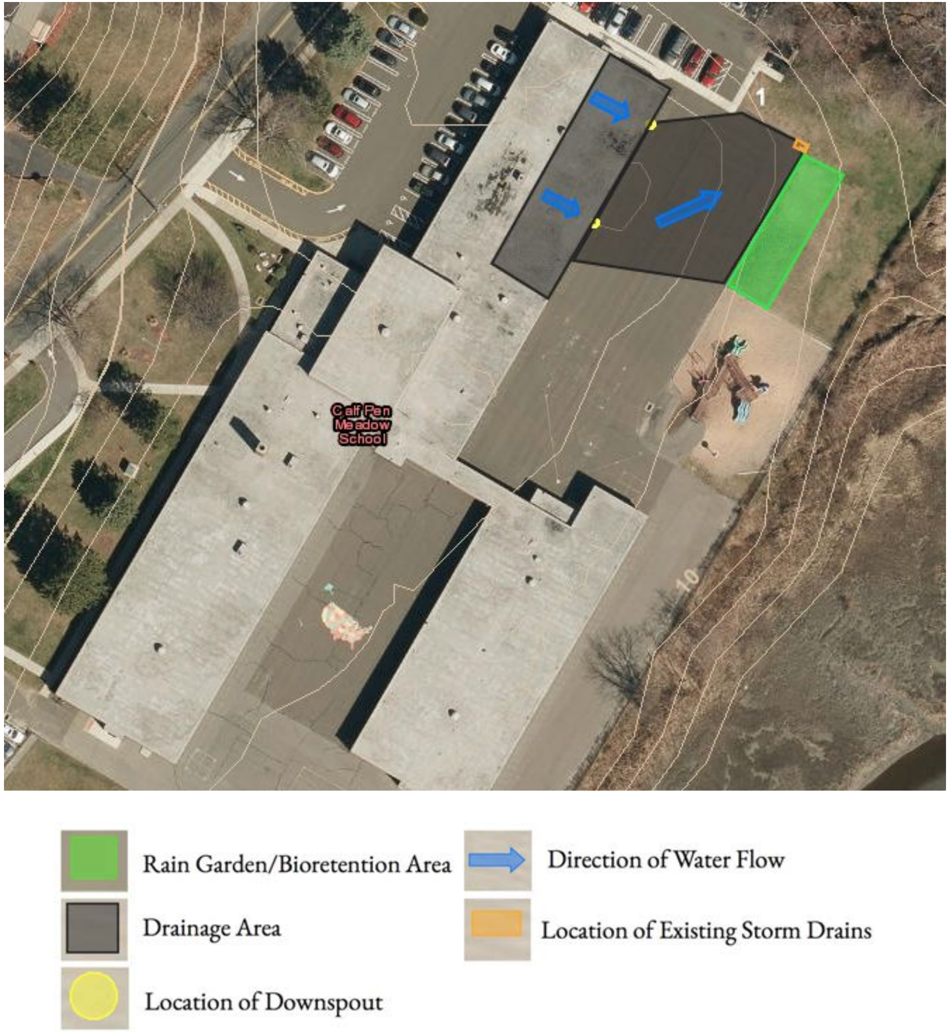
IMPERVIOUS AREA:

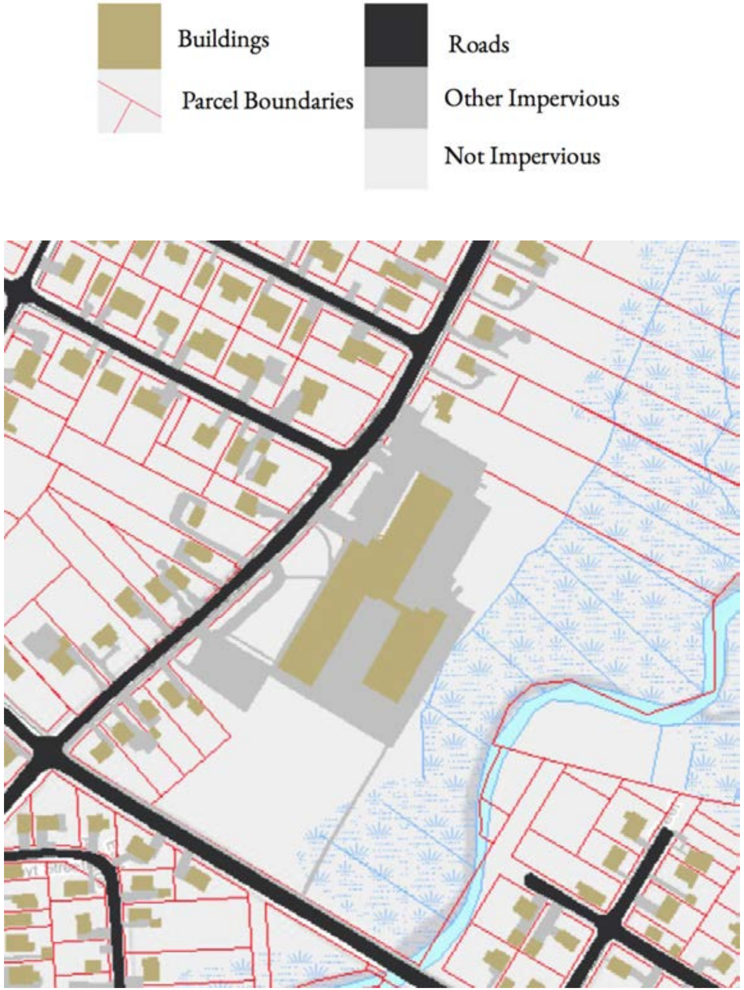
11,330 sq ft

SUBREGIONAL WATERSHED:

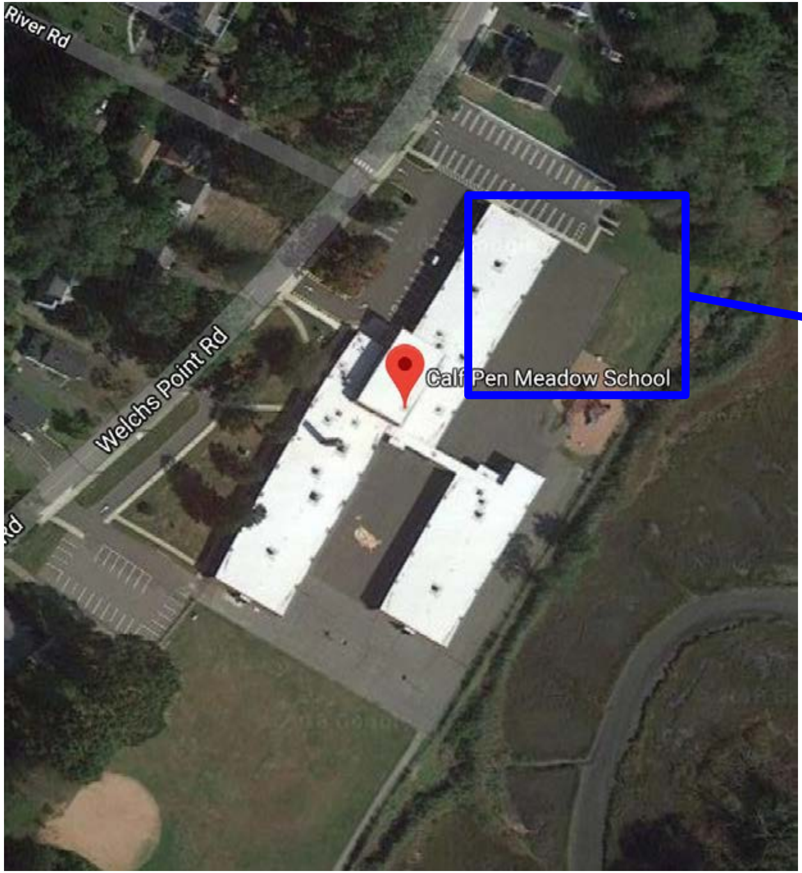
South Central Shoreline; 5000




1
10
Calf Pen Meadow School
Rain Garden/Bioretention Area
Direction of Water Flow
Drainage Area
Location of Existing Storm Drains
Location of Downspout


Buildings
Roads
Parcel Boundaries
Other Impervious
Not Impervious

CALF PEN MEADOW SCHOOL
Option 1: Southeast Facing Playground



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
11,330	Rain Garden	288,145	1.960	0.139	1,890

This one storm drain receives a significant portion of runoff from both the roof and the paved area. The 2 downspouts are disconnected directly, but the runoff does flow to the storm drain in the corner. We recommend constructing a large rain garden designed to divert water away from the storm drain, which we believe directly discharges into the Calf Pen Meadow Creek.

Site 5: EAST SHORE MIDDLE SCHOOL

LOCATION:

240 Chapel Street Milford, CT

IMPERVIOUS AREA:

4,470 sq ft

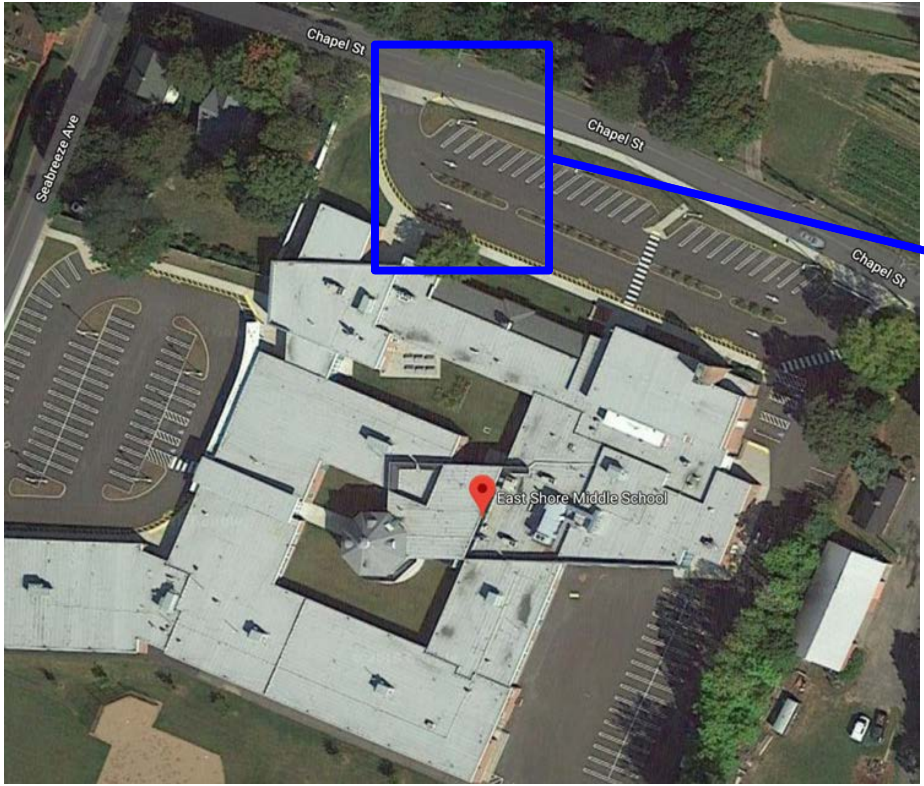
SUBREGIONAL WATERSHED:

South Central Shoreline; 5000


1
2
3
East Shore Middle School
Rain Garden/Bioretention Area
Drainage Area
Direction of Water Flow
Location of Downspout


Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious

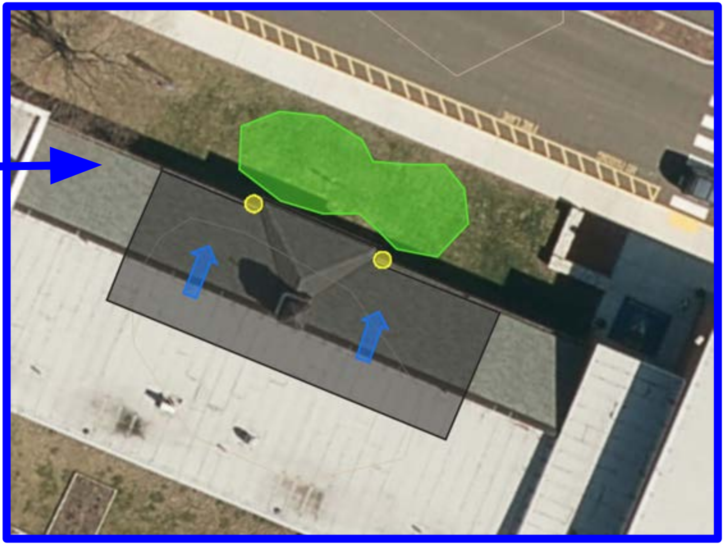
EAST SHORE MIDDLE SCHOOL
Option 1: Far Left Parking Lot Island



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,330	Rain Garden	33,830	0.230	0.016	220

Stormwater runoff drains from the school building towards the center islands. The angle at which the far left island receives water, lack of utilities and lack of deeply rooted trees make this center island a great area to create a depressed rain garden to allow stormwater to infiltrate and to keep it from puddling further downstream.

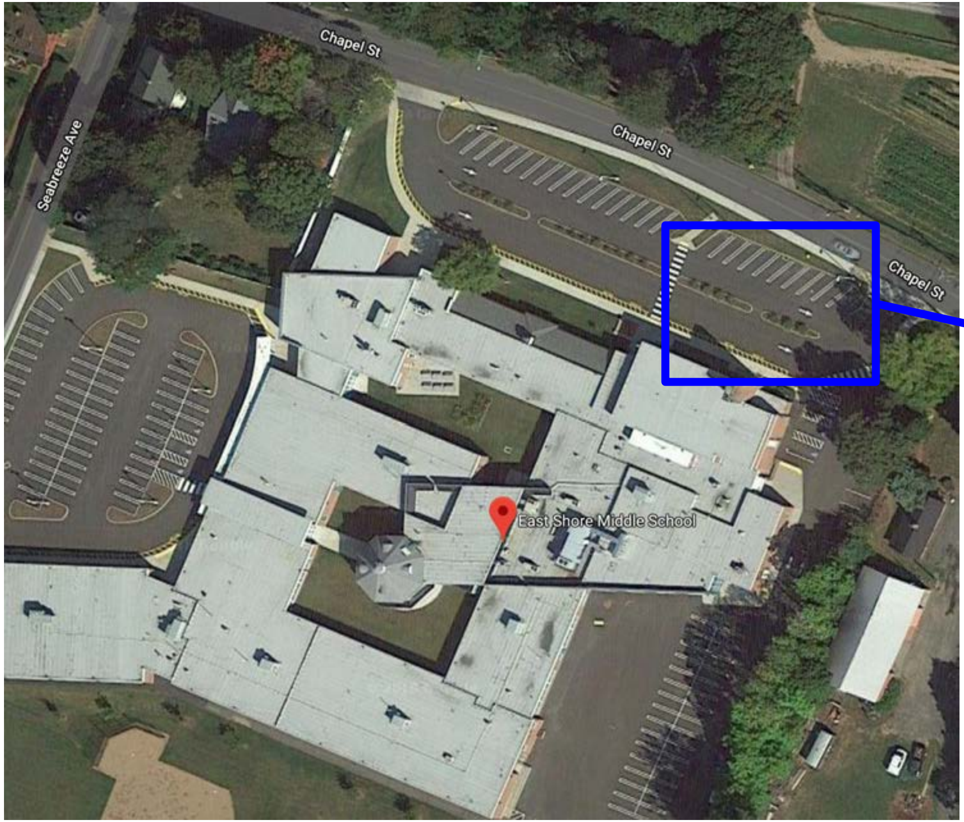
EAST SHORE MIDDLE SCHOOL
Option 2: Front Entrance



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,290	Rain Garden	32,800	0.223	0.016	215

The two downspouts on either side of the center windows could be disconnected and positioned to feed the roof runoff into a landscaped rain garden.
This front and center location would beautify the entrance of the school and bring further visibility to green infrastructure practices in public spaces.

EAST SHORE MIDDLE SCHOOL
Option 3: Far Right Parking Lot Island



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,850	Rain Garden	47,050	0.320	0.023	310

As with the first option, stormwater runoff drains from the school building towards the center islands. There does not appear to be any obstructions in the way of digging up this far right center island and installing a depressed rain garden.

Site 6: LIVE OAKS ELEMENTARY SCHOOL

LOCATION:

575 Merwin Avenue Milford, CT

IMPERVIOUS AREA:

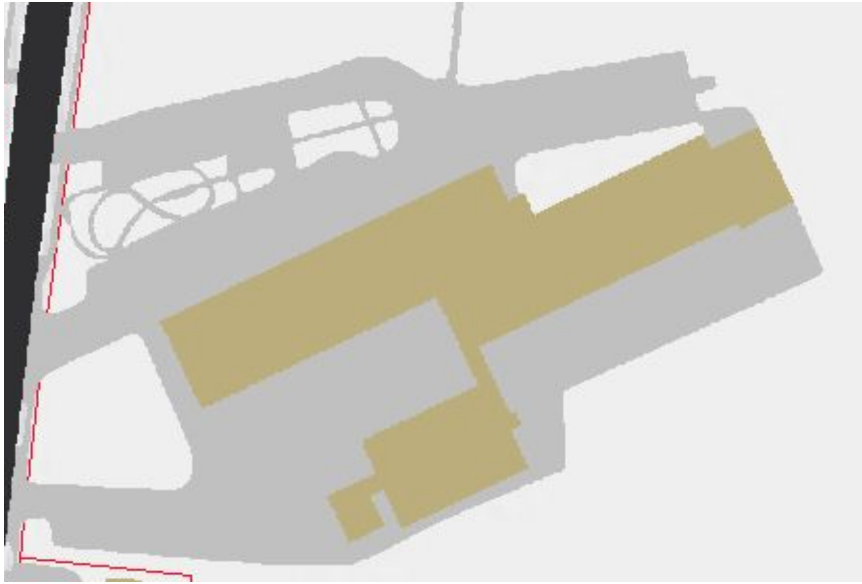
12,374 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000

Rain Garden/Bioretention Area
Drainage Area
Location of Downspout
Direction of Water Flow
Planters

Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious



Option 1: Western Parking Lot

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
7,378	Rain garden	187,637	1.276	0.091	1,230

This option involves cutting the curb in multiple places and leading the runoff from this parking lot into a rain garden. This would divert the water away from the storm drain. There is a large grass area alongside the area in front of another garden that would be perfect for the rain garden. This school already has multiple gardens so another, educational one would be useful here.

LIVE OAKS ELEMENTARY SCHOOL
Option 2: Northeast Front Entrance

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
4,665	Rain Garden	118,386	0.805	0.057	583

Our recommendation for this location is to disconnect 3 downspouts that currently lead to the stormwater system. If they are disconnected, they could be lead to a rain garden in the front of the school for both a green focus and educational perspective.

Option 3: Southern Concrete Playground

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (# Planters)
331	Planter	8,418	0.057	0.004	1

This recommendation involves disconnecting a damaged downspout that is currently connected to the stormwater system. The downspout and gutter seem to be broken, creating a pool of water by the door and flooding of the sidewalk. If this downspout is replaced and reconnected to feed a planter alongside the building, it will redirect the runoff from the roof into a garden rather than into a storm drain.

Site 7: MATHEWSON ELEMENTARY SCHOOL

LOCATION:

466 West River Street Milford, CT

IMPERVIOUS AREA:

3,707 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000

Rain Garden/Bioretention Area

Drainage Area

Location of Downspout

Direction of Water Flow

Location of Existing Storm Drains

Buildings

Parcel Boundaries

Roads

Other Impervious

Not Impervious

MATHEWSON ELEMENTARY SCHOOL
Option 1: Island in the Middle of Bus Drop Off

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
3,707	Bioretention	94,289	0.641	0.045	618

For this location we recommend cutting the curb and building a rain garden on this island. This would be able to handle the majority of the water from the north end of the bus drop off. The visibility in the location would be great and there is more than enough space to handle the runoff.

Site 8: ORCHARD HILL ELEMENTARY SCHOOL

LOCATION:

185 Marino Drive Milford, CT

IMPERVIOUS AREA:

3,496 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000

Rain Garden/Bioretention Area

Drainage Area

Direction of Water Flow

Location of Downspout

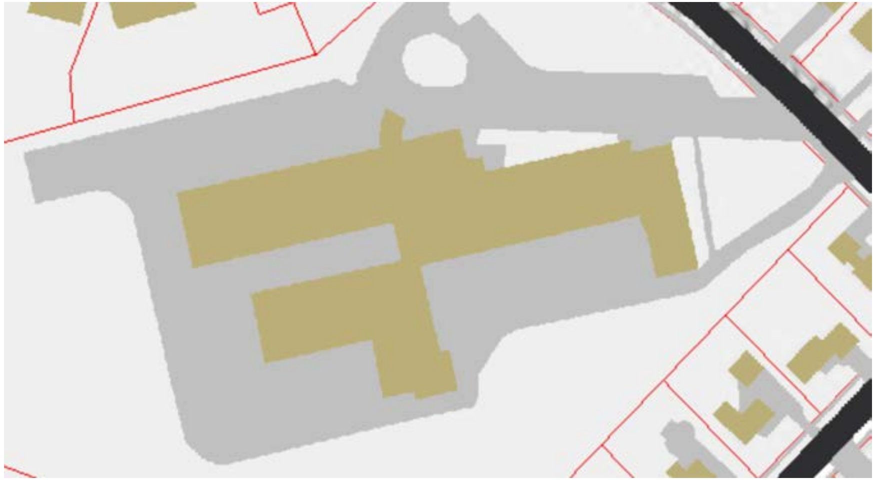
Buildings

Parcel Boundaries

Roads

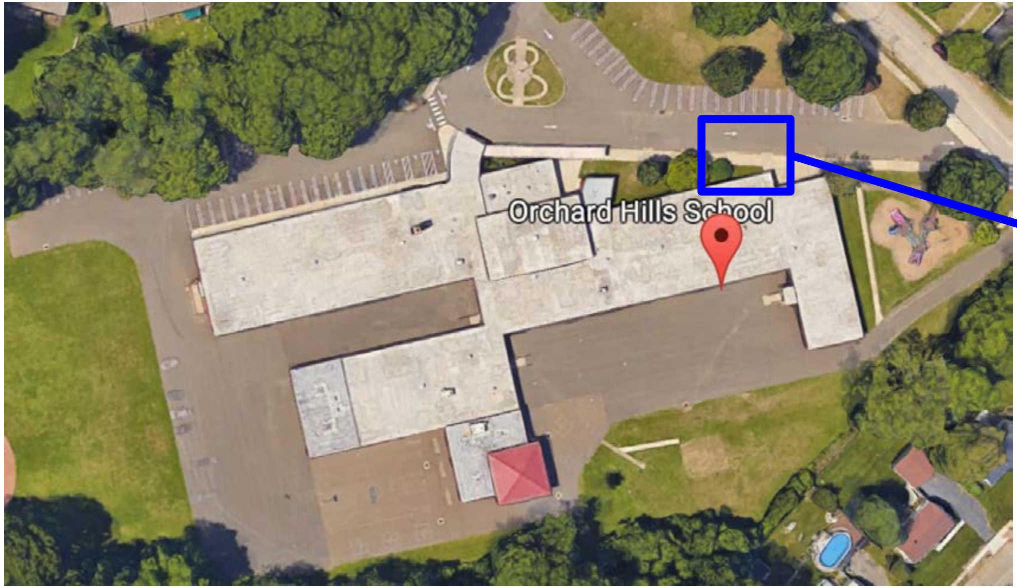
Other Impervious

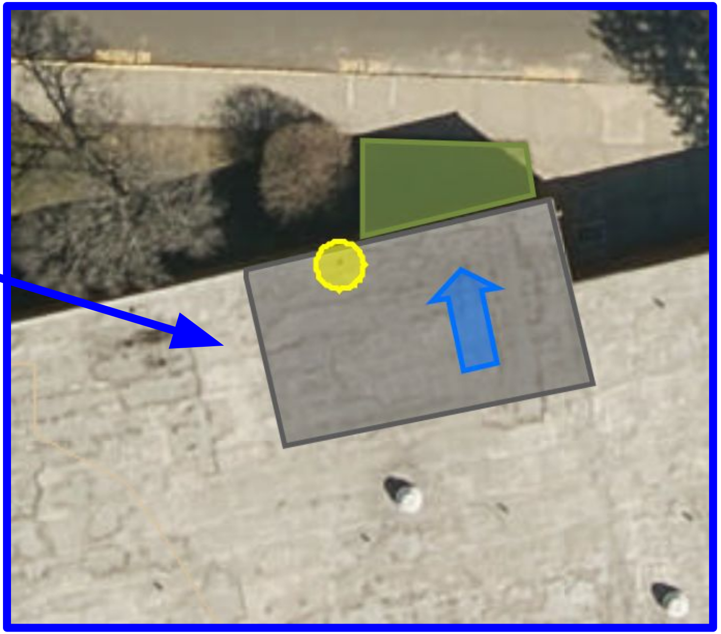
Not Impervious



ORCHARD HILLS ELEMENTARY SCHOOL

Option 1: North Side of School

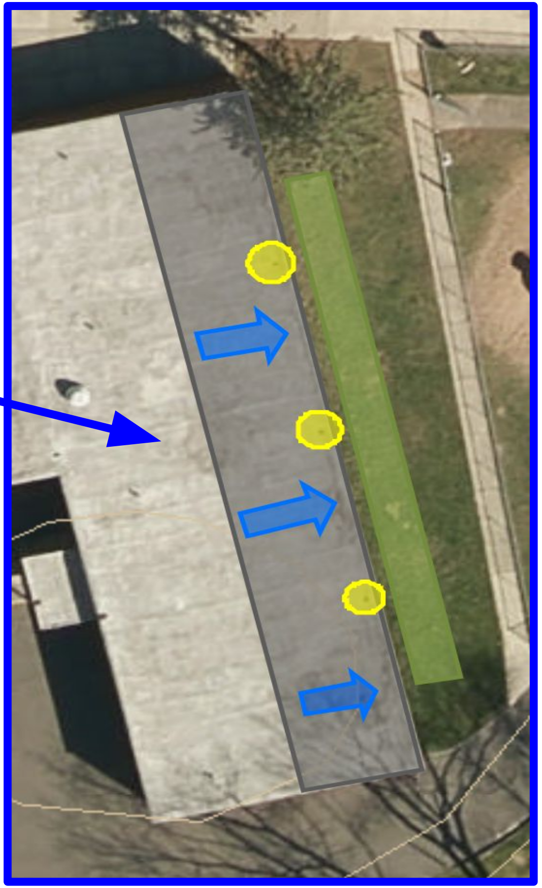




Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
1,171	Rain Garden	29,768	0.203	0.014	195

Here, we recommend putting a rain garden in the front of the school to disconnect a downspout from the stormwater system. The downspout could be led into a garden using large rocks that would help flow to the garden without eroding the grass. Once in the garden the water would naturally infiltrate into the ground.

ORCHARD HILLS ELEMENTARY SCHOOL
Option 2: Northeast Side of School



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
2,326	Rain Garden	59,155	0.402	0.029	387

At this location we recommend implementing a rain garden that would collect the water draining off the roof. This rain garden would disconnect three downspouts from the storm water system.

This is also an ideal location since it is a large area, has high visibility, and could be an educational opportunity for students to learn about green infrastructure practices.

Site 9: PUMPKIN DELIGHT ELEMENTARY SCHOOL

LOCATION:

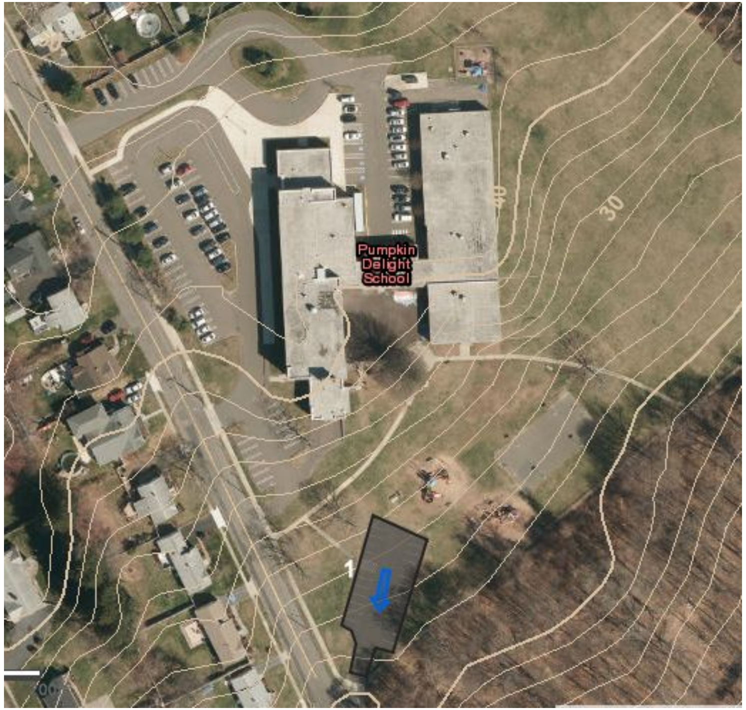
24 Art Street Milford, CT

IMPERVIOUS AREA:

7,942 sq ft

SUBREGIONAL WATERSHED:

Housatonic River; 6000



Direction of Water Flow

Drainage Area

Buildings

Parcel Boundaries

Roads

Other Impervious

Not Impervious

PUMPKIN DELIGHT ELEMENTARY SCHOOL
Option 1: Southern Lower Parking Lot

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
7,942	Permeable Pavement	201,981	1.374	0.097	7,942

For this site we recommend replacing this lower lot with permeable pavement. Although it already seems to be disconnected from the stormwater system, the runoff is creating a small pond at the end of the road to which the lot exits. If the parking lot is able to infiltrate its rainwater back into the ground, it will help prevent more runoff from reaching the road.

Site 10: Harborside Middle School

LOCATION:

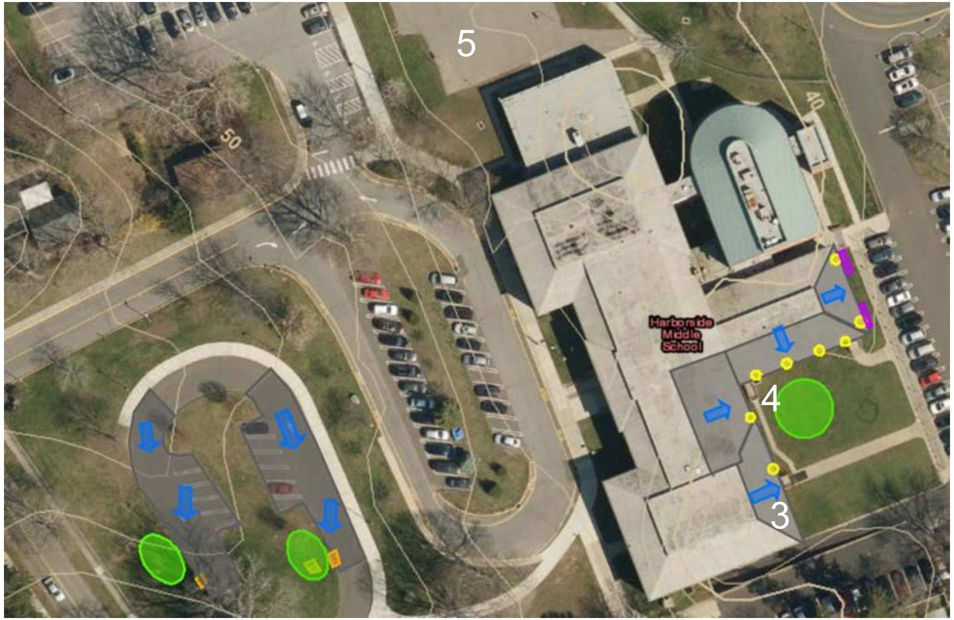
175 High Street Milford, CT

IMPERVIOUS AREA:

12,935 sq ft

SUBREGIONAL WATERSHED:

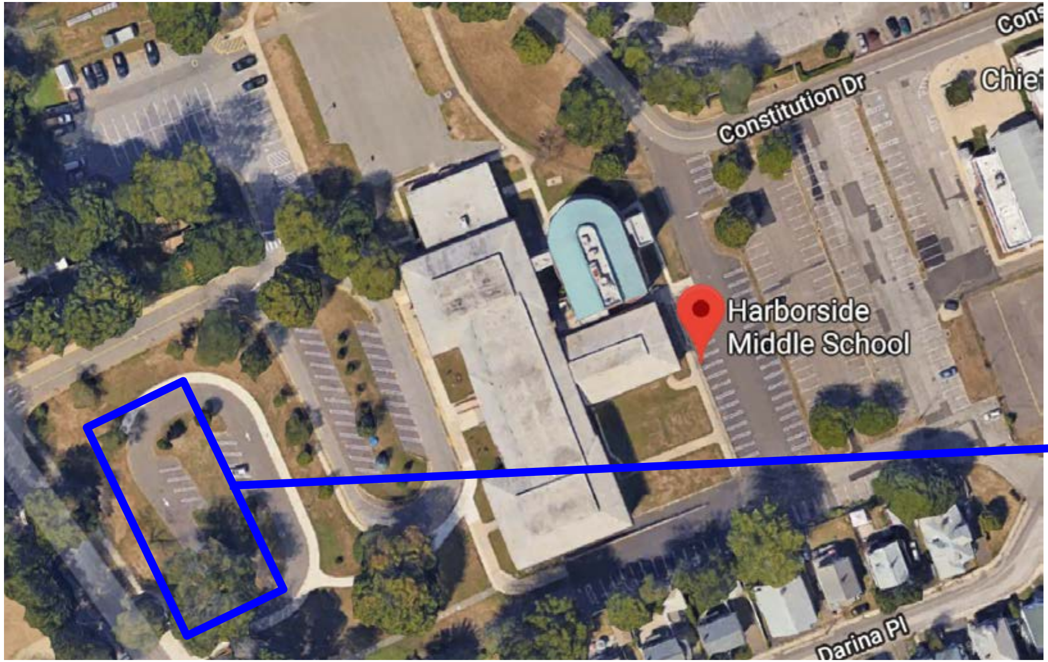
Wepawaug River; 5307

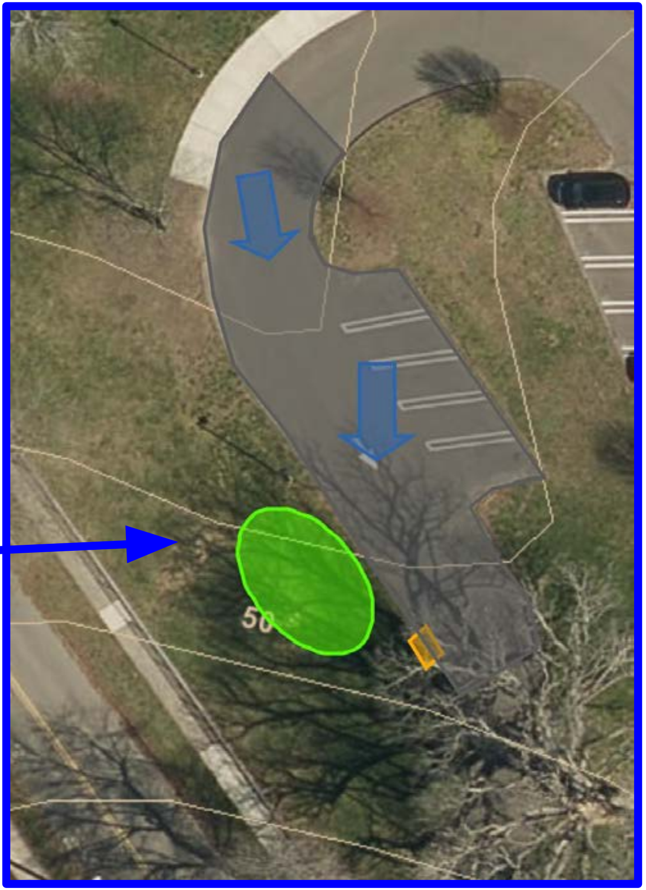


Rain Garden/Bioretention Area
Drainage Area
Direction of Water Flow
Location of Downspout
Location of Existing Storm Drains
Planters

Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious

HARBORSIDE MIDDLE SCHOOL
Option 1: Southwestern Side of Bus Loop

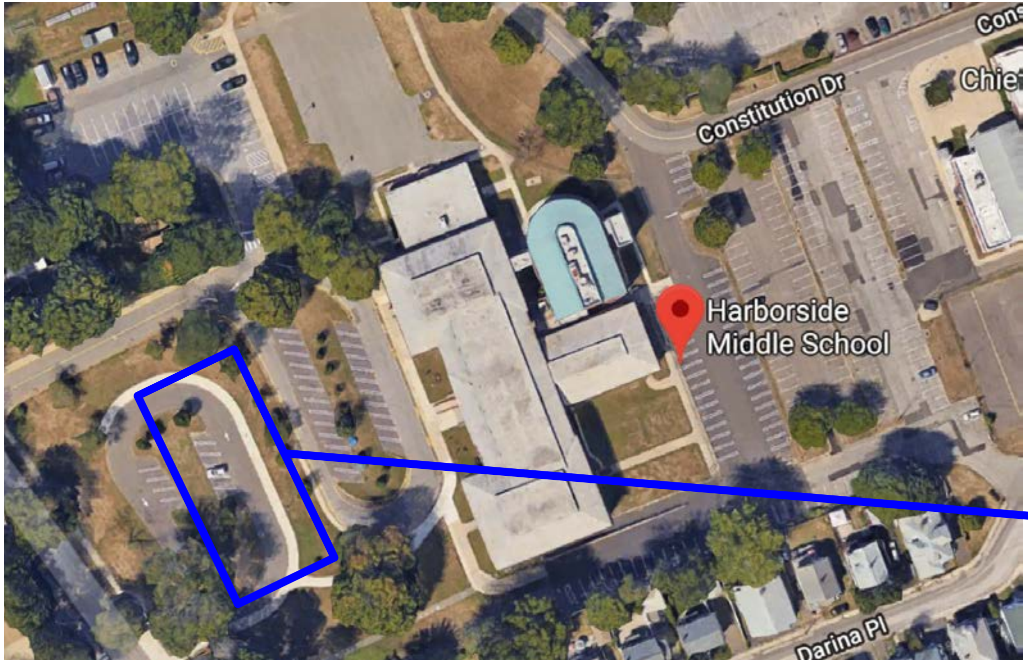


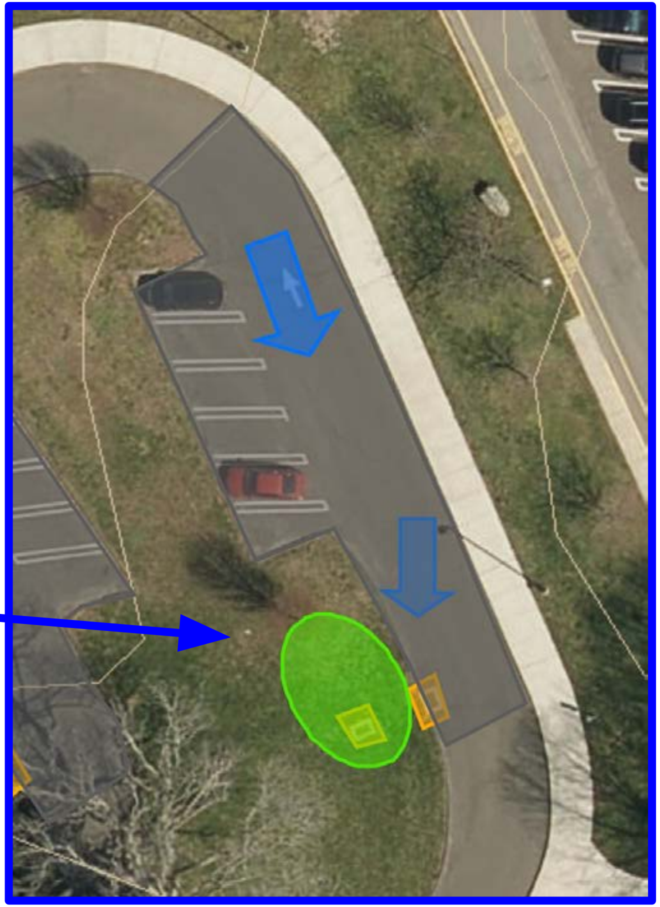


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
3,623	Rain Garden	92,145	0.627	0.044	604

This picture shows a storm drain that collects water running down the bus loop. If curb cuts were to be placed before the storm drain on the left side of the loop, a rain garden would collect the water instead. This water would infiltrate into the native soils instead of going into the storm water system. It is also in a highly visible area.

HARBORSIDE MIDDLE SCHOOL
Option 2: Southeastern Side of Bus Loop

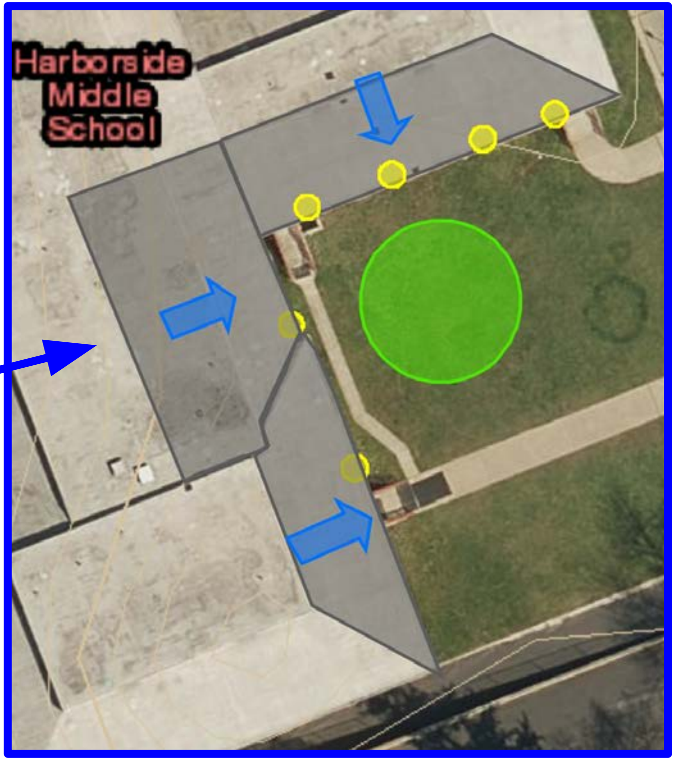




Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
3,549	Rain Garden	90,251	0.614	0.044	592

On the other side of the bus loop is another opportunity for a rain garden. Water would be collected in the center using curb cuts that would direct the water to the garden. The site is ideal because the existing drain, on the grass, could be used as an overflow during intense rainstorms to prevent flooding.

HARBORSIDE MIDDLE SCHOOL
Option 3: Southeastern Side of the School

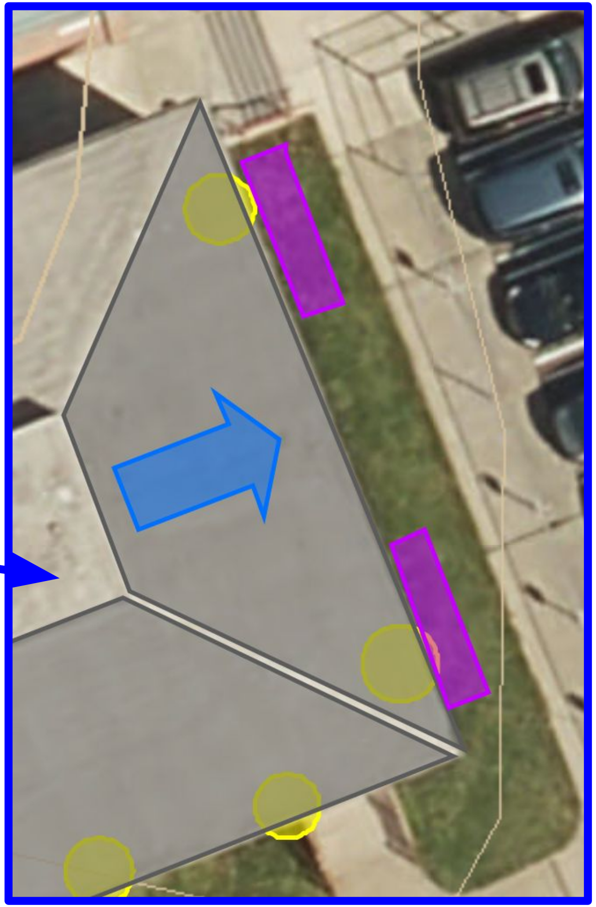


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
5,006	Rain Garden	127,318	0.866	0.061	834

This location is currently a large open grass area that has six downspouts draining onto it. If this area were to be replaced with a rain garden the downspouts could be disconnected from the storm water system. For the downspouts shown in the picture we suggest implementing trench drains or channeling the water underneath the sidewalk to prevent the water from flowing over the sidewalk, for safety reasons.

HARBORSIDE MIDDLE SCHOOL

Option 4: East Side of School



Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
757	Planters	19,252	0.131	0.009	126

At this back entrance are two downspouts that could be disconnected using planters. We recommend planters since the drainage area is smaller and they could easily fit in the space provided. Although, this is another suitable location for a rain garden we recommended the planters for a different green infrastructure option.

Site 11: JOSEPH A. FORAN HIGH SCHOOL

LOCATION:

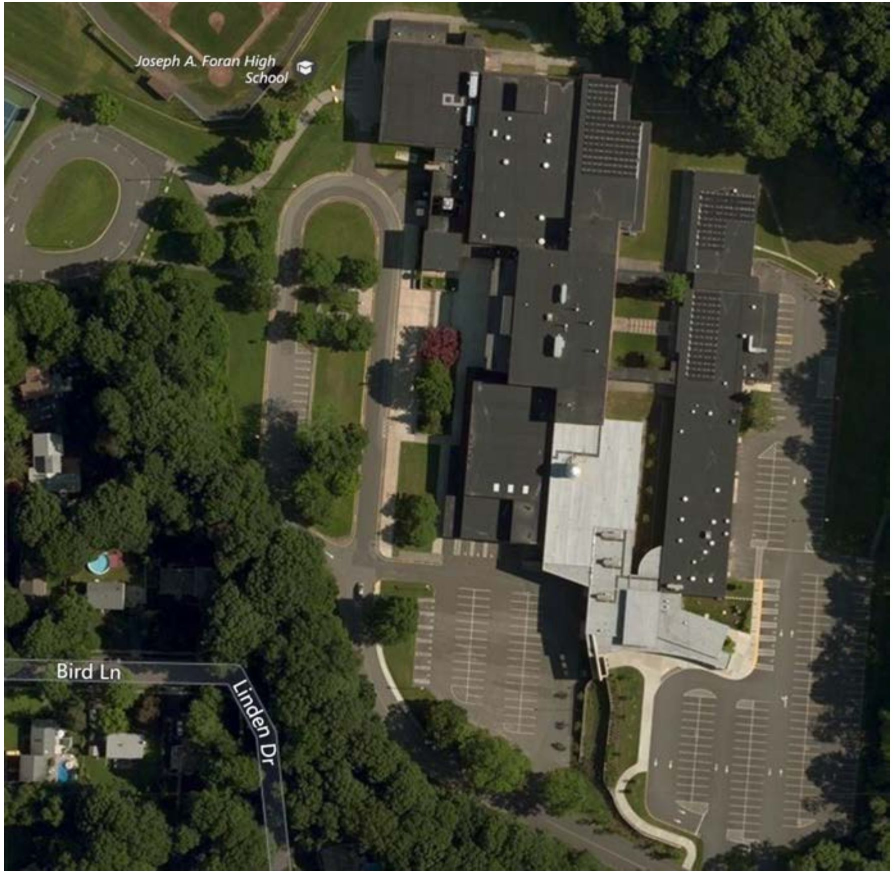
80 Foran Road Milford, CT

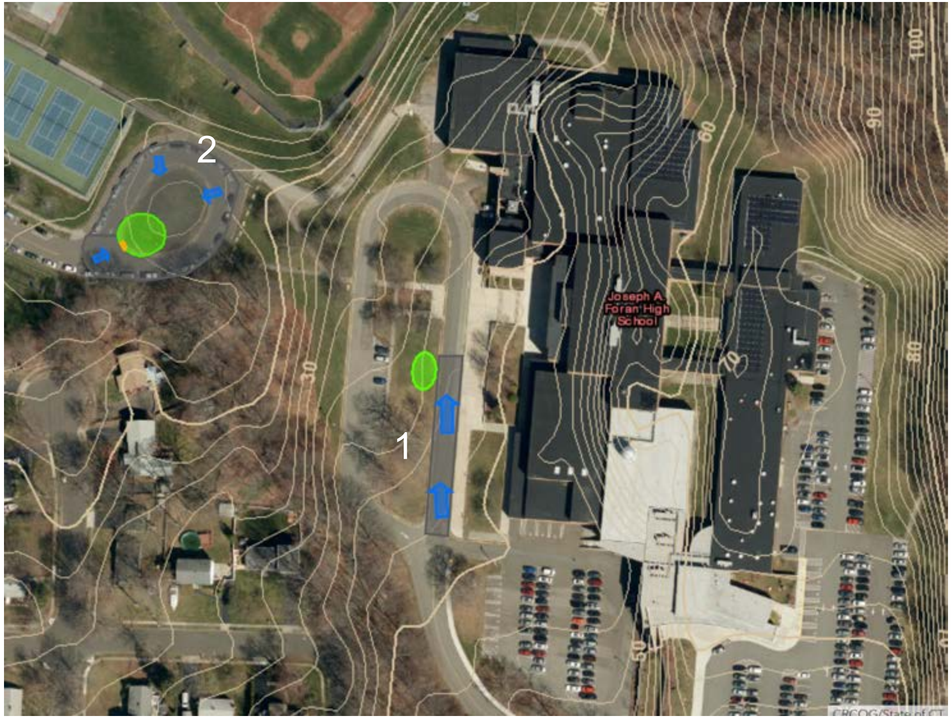
IMPERVIOUS AREA:

25,325 sq ft

SUBREGIONAL WATERSHED:

South Central Shoreline; 5000





Rain Garden/Bioretention Area

Drainage Area

Location of Existing Storm Drains

Direction of Water Flow

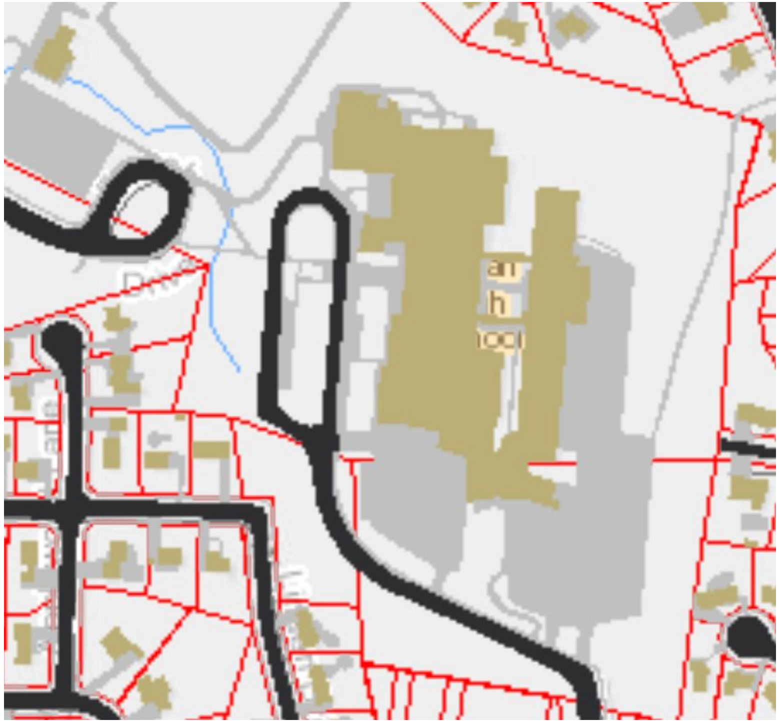
Buildings

Parcel Boundaries

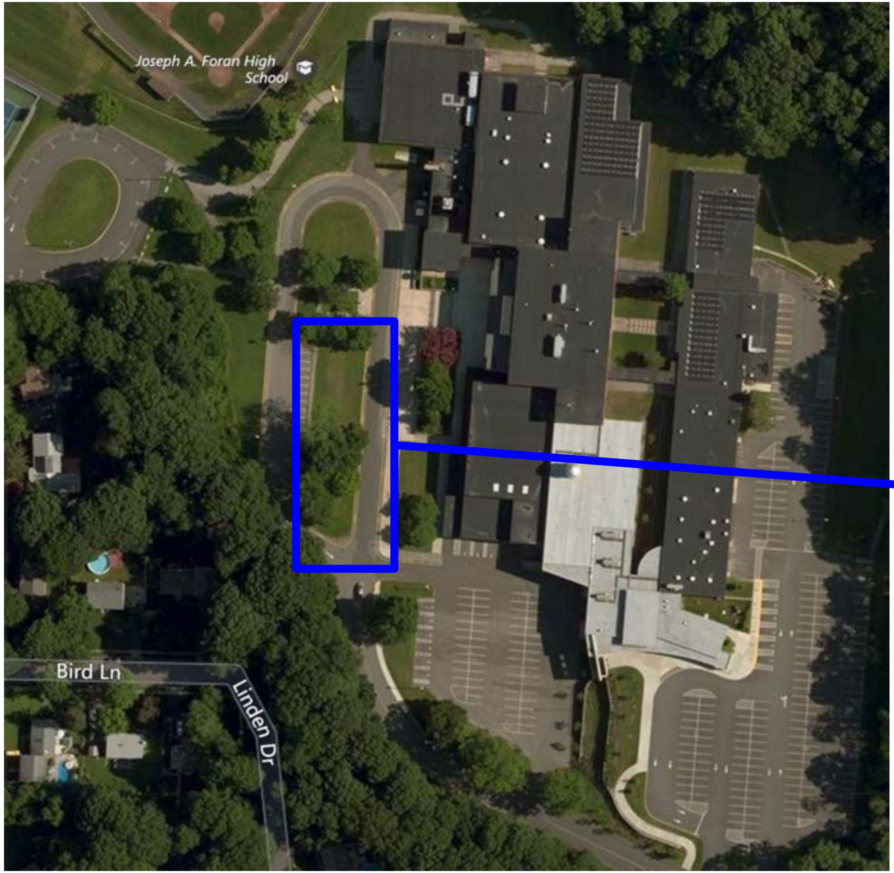
Roads

Other Impervious

Not Impervious



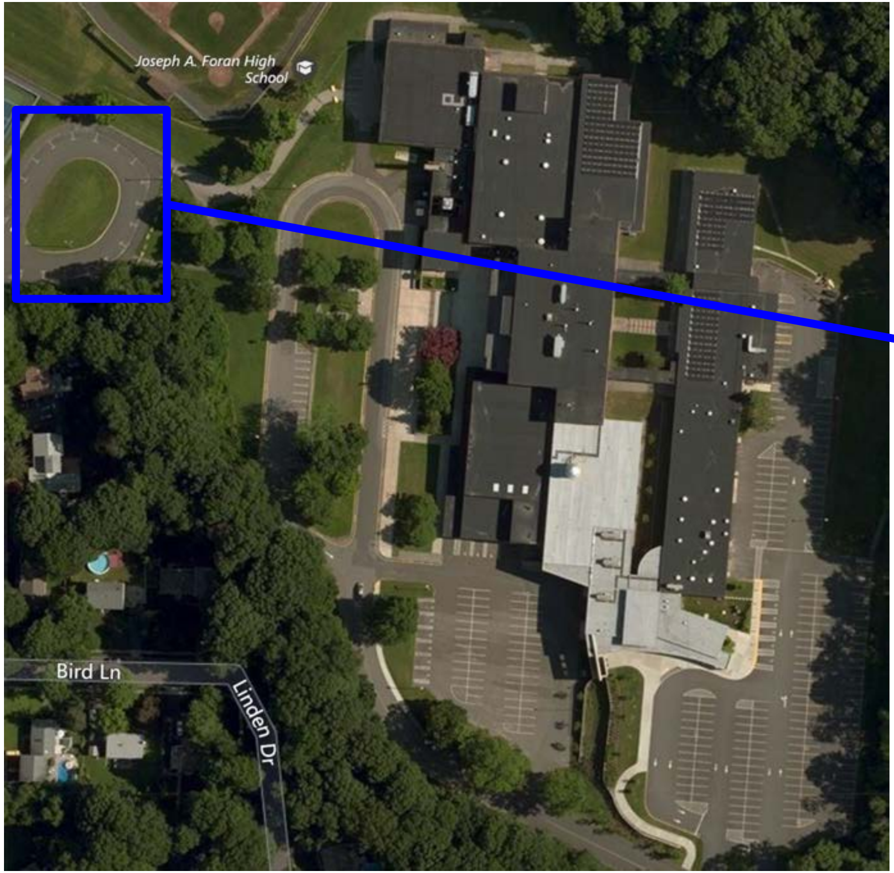
JOSEPH A. FORAN HIGH SCHOOL
Option 1: Southwestern Part of Bus Loop

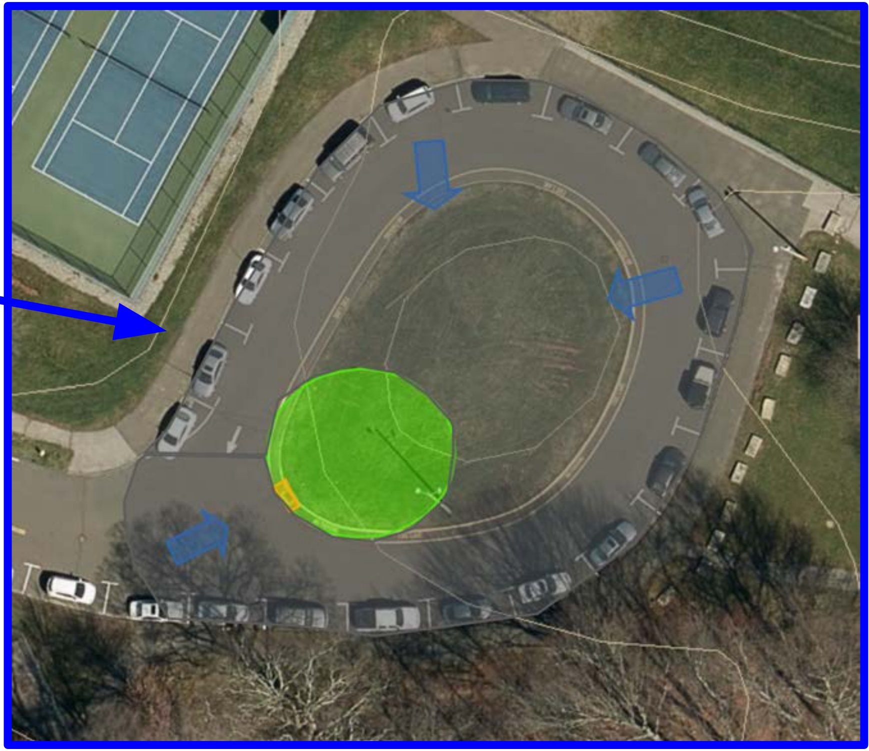


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
5,948	Rain Garden	151,270	1.030	0.073	991

At this location we recommend implementing a rain garden in the middle section of the bus loop. Water from the bus loop drains to this area naturally. The rain garden would infiltrate into the native soils instead of going into the storm water system.

JOSEPH A. FORAN HIGH SCHOOL
Option 2: Mound Parking Lot





Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
19,377	Rain Garden	492,791	3.35	0.238	1,614

This location was requested to be considered for green infrastructure practices during the expansion of parking spaces and the elimination of the mounded grass circle. Here we recommend implementing a rain garden as a barrier that could utilize the existing drain as an overflow. This rain garden would be placed so that it does not take away any parking spaces to the lot.

CONTACT & PARTNERS

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