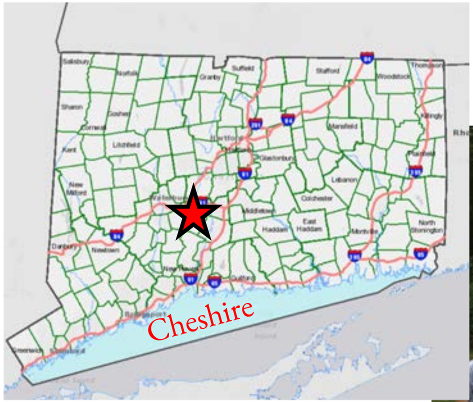
Stormwater Runoff Reduction Plan

Cheshire, Connecticut



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UCONN | COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

PROJECT TEAM

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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 Cheshire, 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 are implemented, 58,887 sq ft of impervious cover will be disconnected from the stormwater drainage system. This means that 1,497,632 gallons of untreated stormwater, 10.187 pounds of nitrogen, and 0.7208 pounds of phosphorus will be prevented from entering local water bodies annually.

IN THIS REPORT…

Included are recommendations for green stormwater infrastructure practices at ___ sites in the town of Cheshire. 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

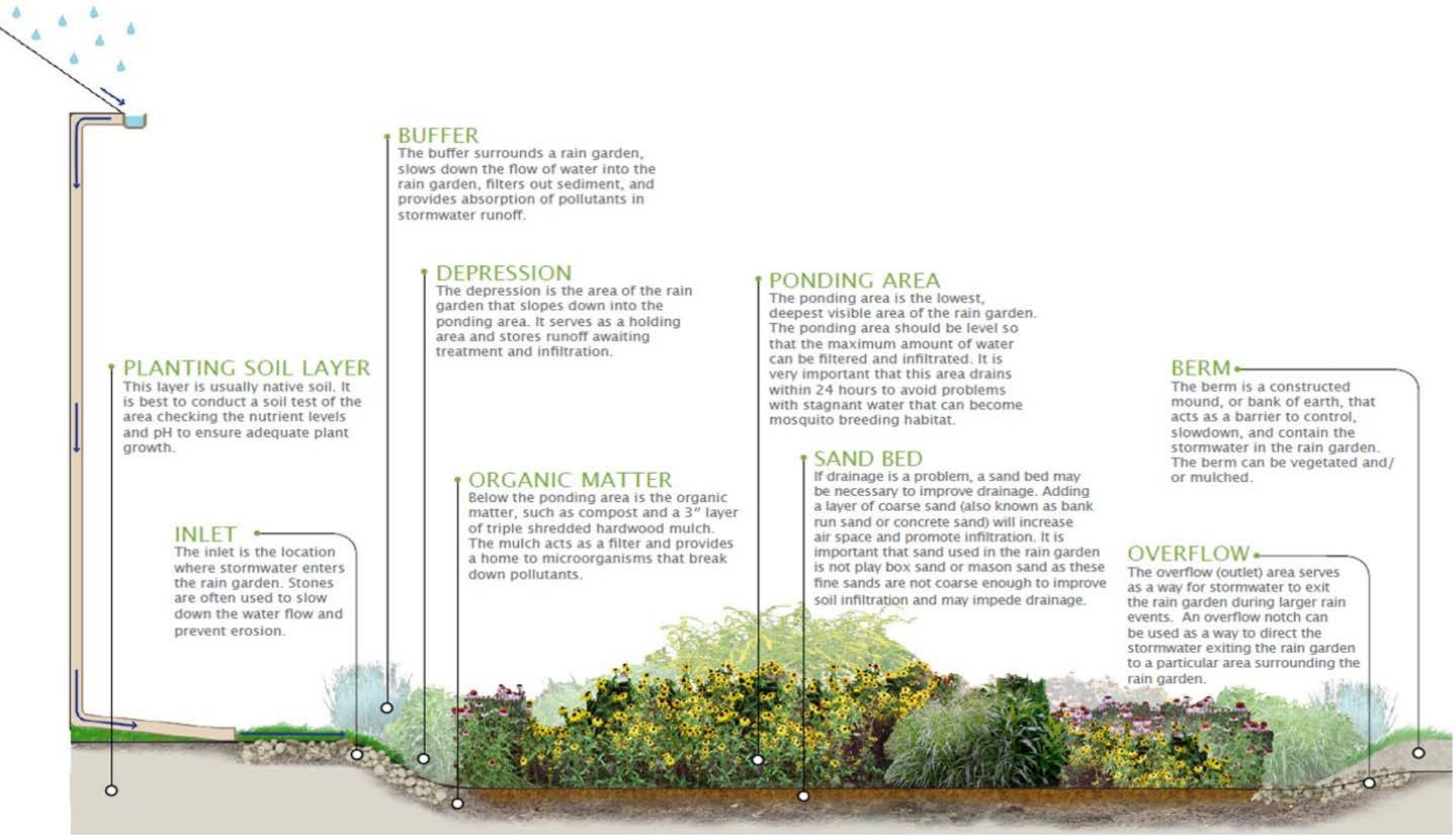
Rainwater Harvesting

Planters

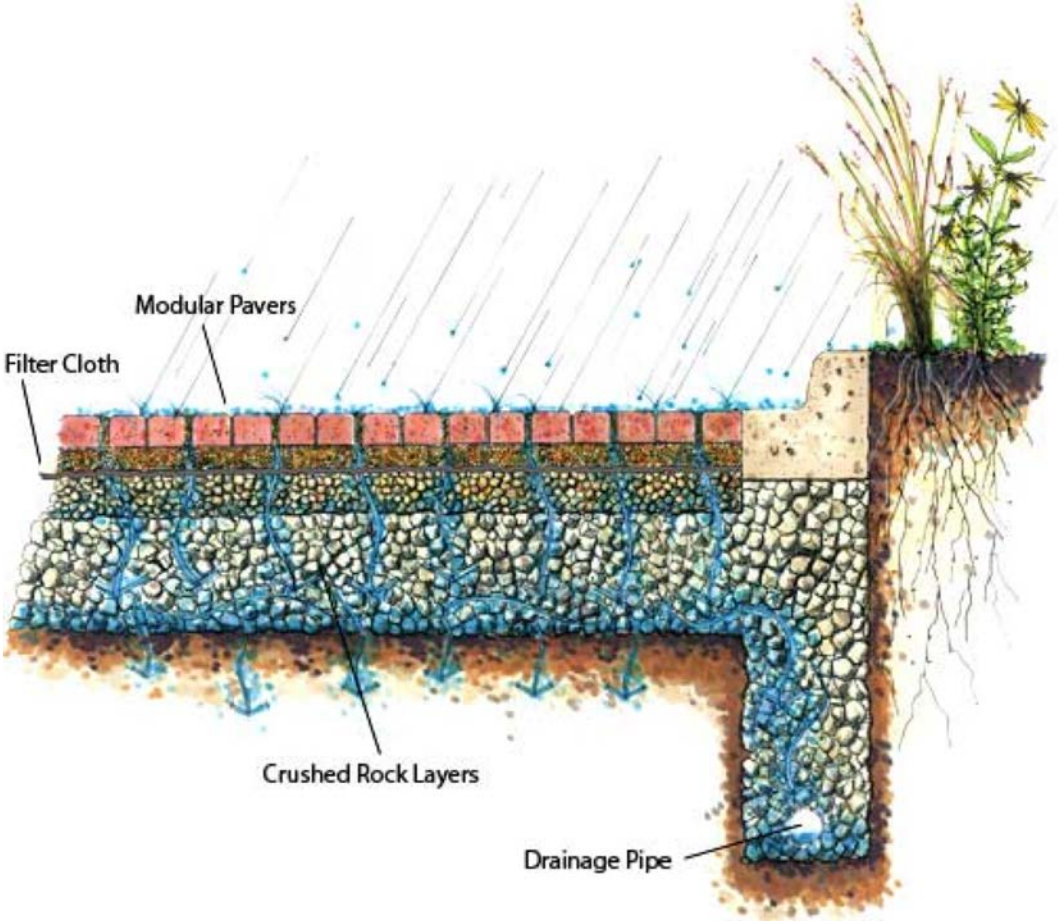
RAIN GARDENS

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

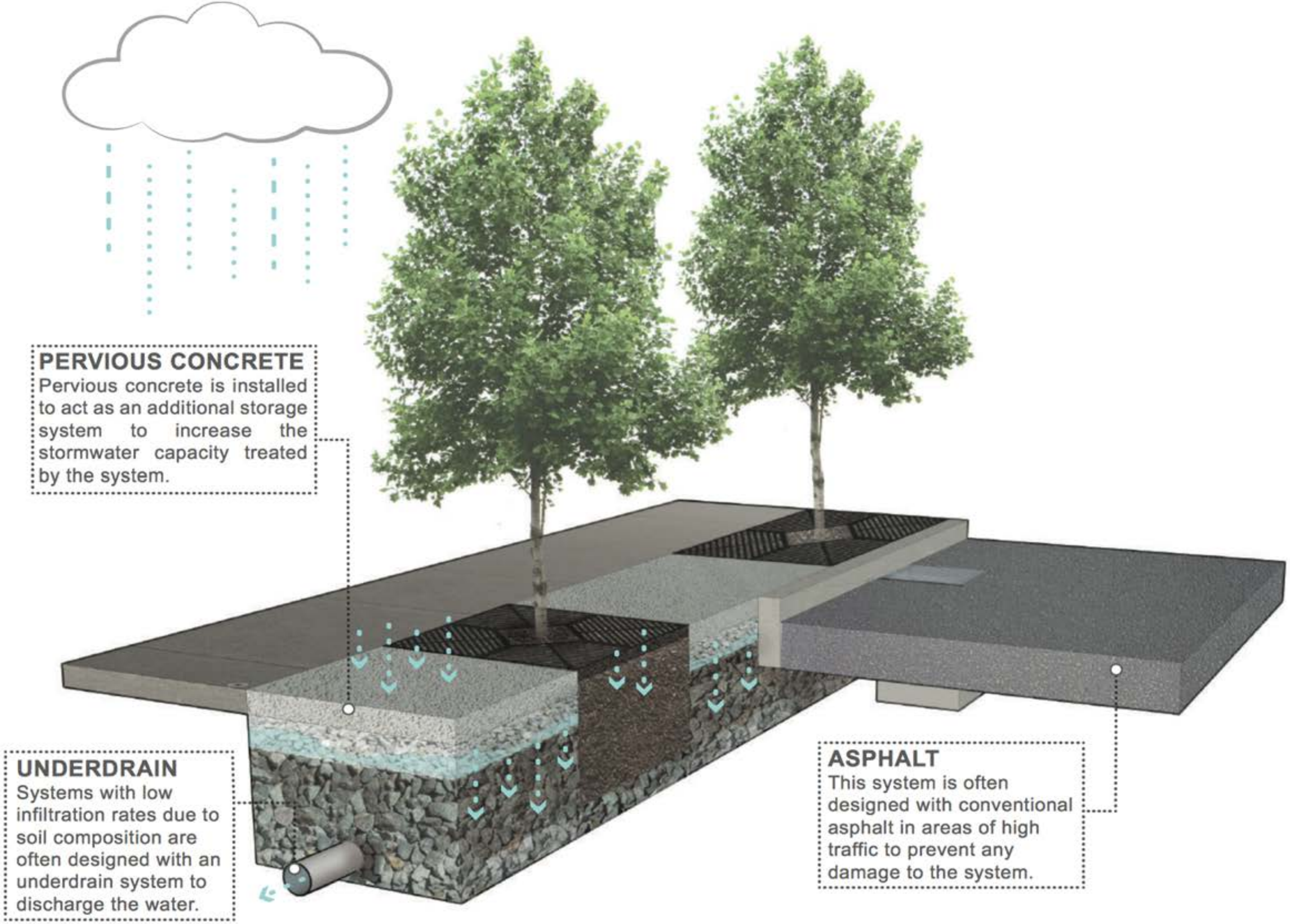


Pervious paving is an alternative to traditional asphalt or concrete that allows for the infiltration of water. Ideal locations for pervious paving are relatively flat areas that take on a fair amount of water from surrounding impervious surfaces during storm events. Pervious asphalt needs to be replaced 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.

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.


PERVIOUS CONCRETE
Pervious concrete is installed to act as an additional storage system to increase the stormwater capacity treated by the system.
UNDERDRAIN
Systems with low infiltration rates due to soil composition are often designed with an underdrain system to discharge the water.
ASPHALT
This system is often designed with conventional asphalt in areas of high traffic to prevent any damage to the system.

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.

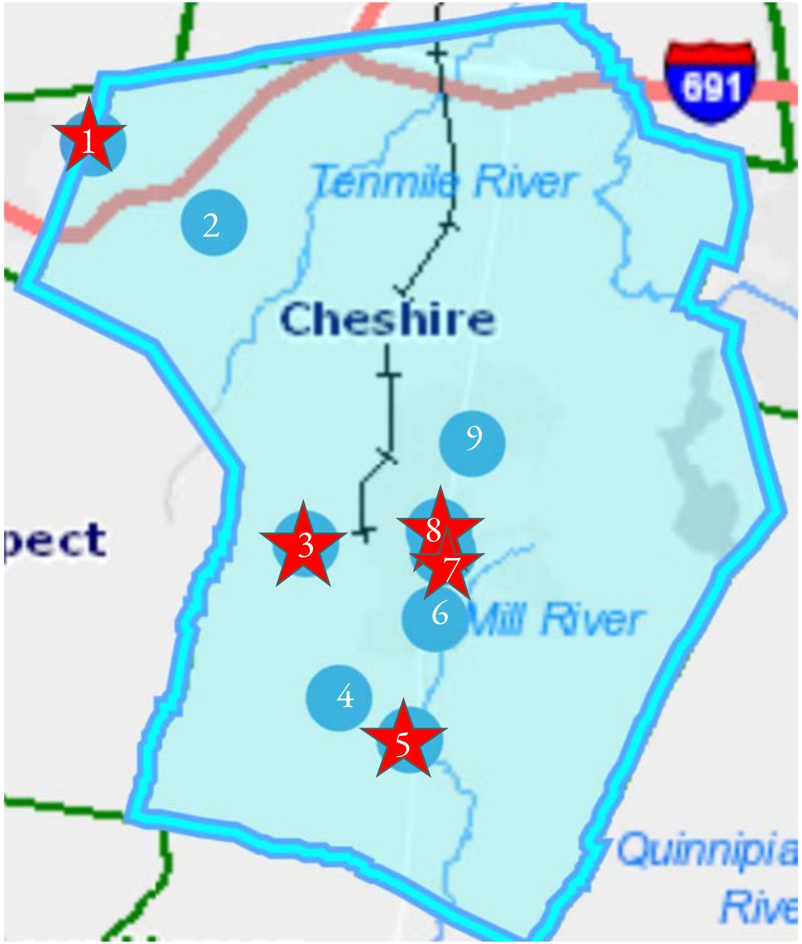
Both the amount of water needed as well as the area of impermeable surface are important to pay attention to when deciding how large a cistern to install. The size of the cistern also dictates what material it should be made of. For small drainage areas, PVC is appropriate, but as the size increases 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. This included following contour lines provided by ArcGIS, and images from Google Maps to locate possible disconnection sites.

On location, site specific recommendations were selected based on suitability for implementation of green infrastructure practices. Whether or not a site was suitable depended on factors such as 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. Company 2 Fire Department
2. Darcey School
3. Doolittle Elementary School
4. Norton School
5. Cheshire Station 3
6. Bartlem Recreational Area
7. Cheshire Town Hall
8. Cheshire Public Schools Office
9. Highland School

TOP FIVE SITES FOR CHESHIRE

The top five sites for Cheshire 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. Company 2 Fire Department
2. Doolittle Elementary School
3. Cheshire Town Hall
4. Cheshire Fire Station 3
5. Cheshire Public Schools Office

If all top five site projects were implemented, 19,942 sq ft of impervious cover will be disconnected from the stormwater drainage system. This means that 508, 418 gallons of untreated stormwater, 3.448 pounds of nitrogen, and 0.245 pounds of phosphorus will be prevented from entering local water bodies annually.

Site 1: COMPANY 2 FIRE DEPARTMENT

LOCATION:

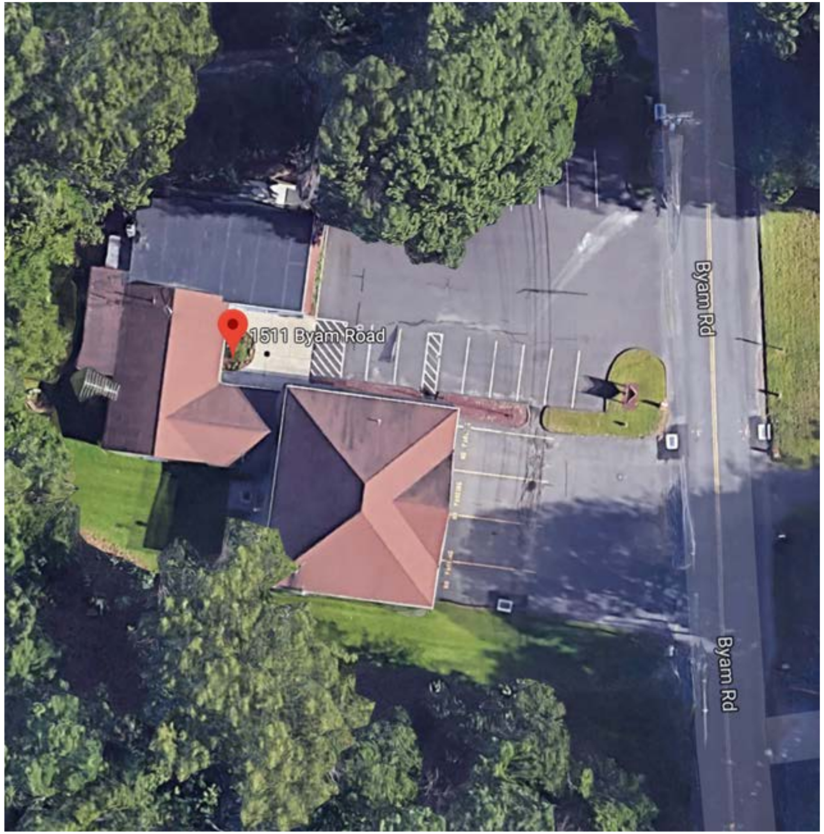
1511 Byam Road, Cheshire CT 06410

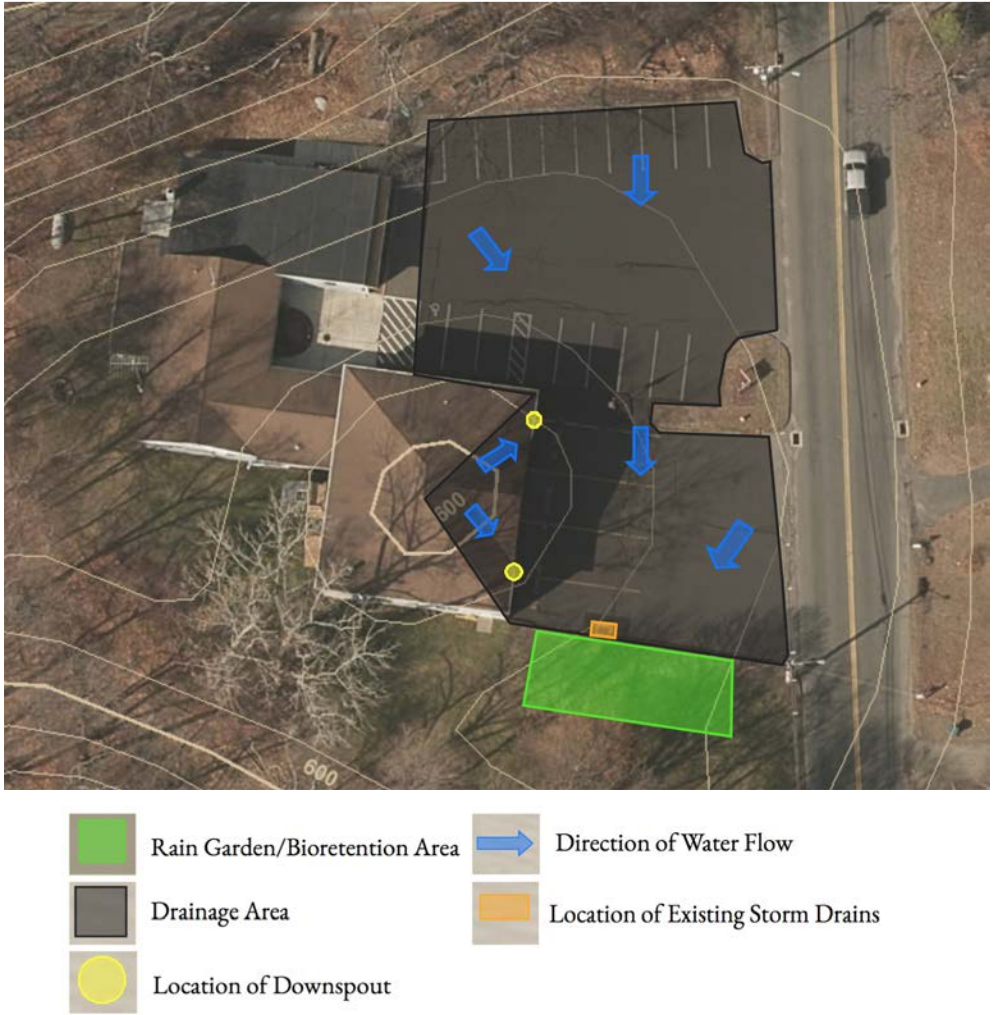
IMPERVIOUS AREA:

12,170 sq ft

SUBREGIONAL WATERSHED:

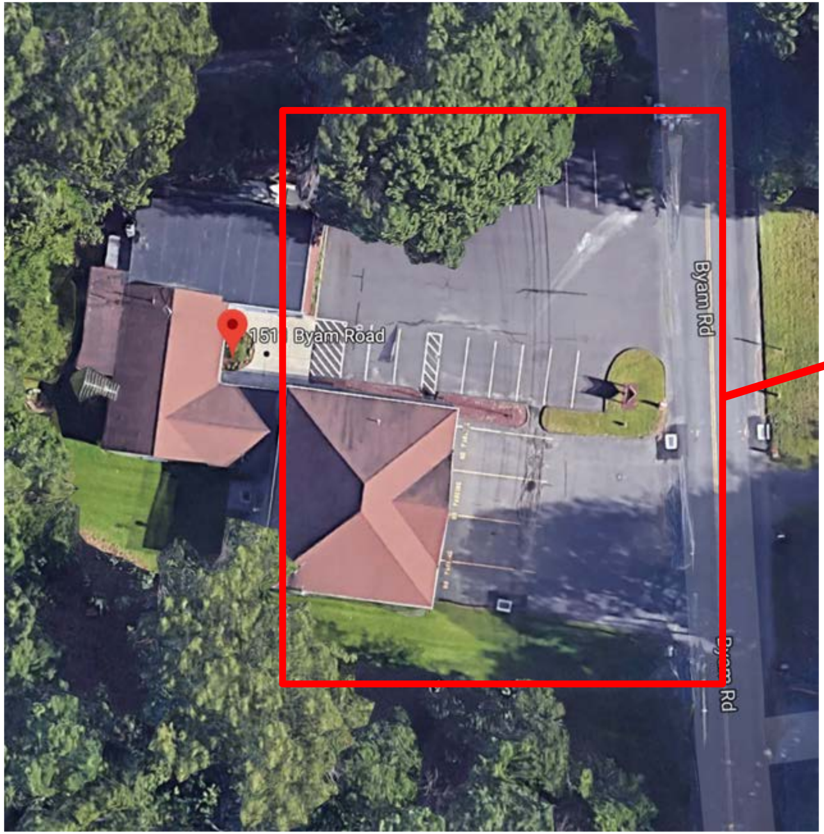
Beaver Pond Brook; 6913

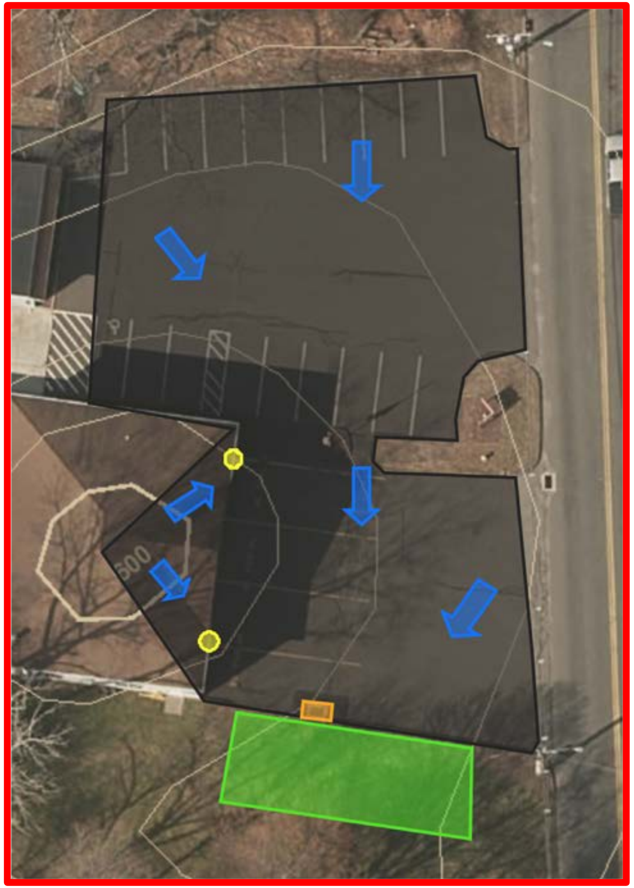



500
600
Rain Garden/Bioretention Area
Drainage Area
Location of Downspout
Direction of Water Flow
Location of Existing Storm Drains


Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious

Company 3 Fire Station
Option 1: 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)
12,170	Rain Garden	309,510	2.11	0.15	1010 sq ft at 12 inches deep

For this location we recommend implementing a rain garden and bypassing the storm drain at the southern end of the parking lot. While the parking lot is fairly large, the patch of grass on which a rain garden would be built is sizable enough to compensate for this. It is also valuable to know that the fire trucks are likely washed in front of the building so it would receive this water as well. The visibility is decent as it would be fully visible from the road.

Site 2: DARCEY SCHOOL

LOCATION:

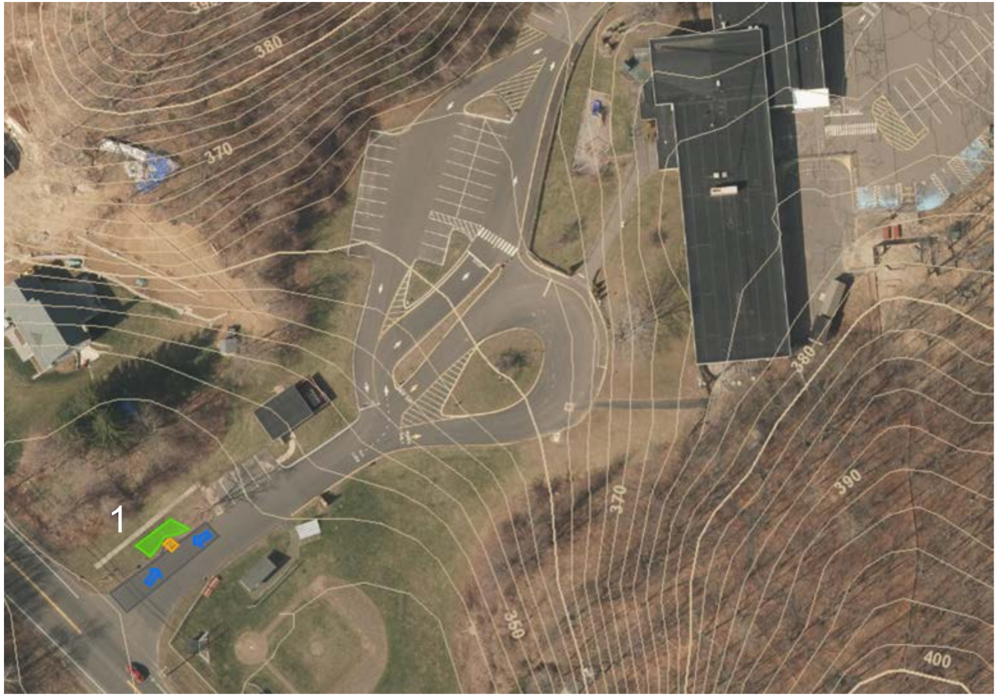
1686 Waterbury Rd, Cheshire, CT

IMPERVIOUS AREA:

1,237 sq ft

SUBREGIONAL WATERSHED:

Tenmile River; 5205



Rain Garden/Bioretention Area

Direction of Water Flow

Drainage Area

Location of Existing Storm Drains

Buildings

Parcel Boundaries

Roads

Other Impervious

Not Impervious

Darcey School
Option 1: Southern Part of 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)
1,237	Rain Garden	31,459	0.214	0.0152	206

For this location we recommend implementing a rain garden along the curb at the end of the driveway. It wouldn't have the potential to handle a huge amount of water but it would have fantastic visibility. The curb here is already cut so it would make it easier to start the project of building a rain garden. As this is an elementary school, it would be an excellent learning opportunity.

Site 3: DOOLITTLE ELEMENTARY SCHOOL

LOCATION:

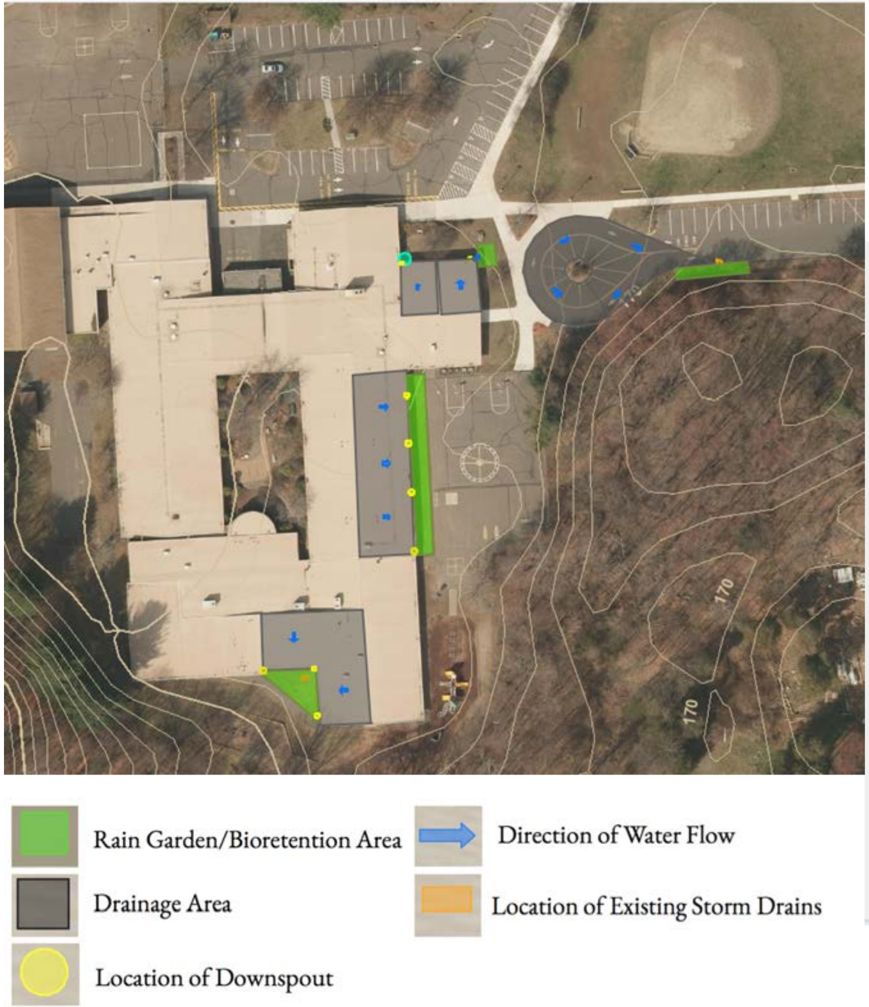
735 Cornwall Avenue, Cheshire, CT

IMPERVIOUS AREA:

18,392 sq ft

SUBREGIONAL WATERSHED:

Willow Brook; 5301


170
170
Rain Garden/Bioretention Area
Drainage Area
Location of Downspout
Direction of Water Flow
Location of Existing Storm Drains

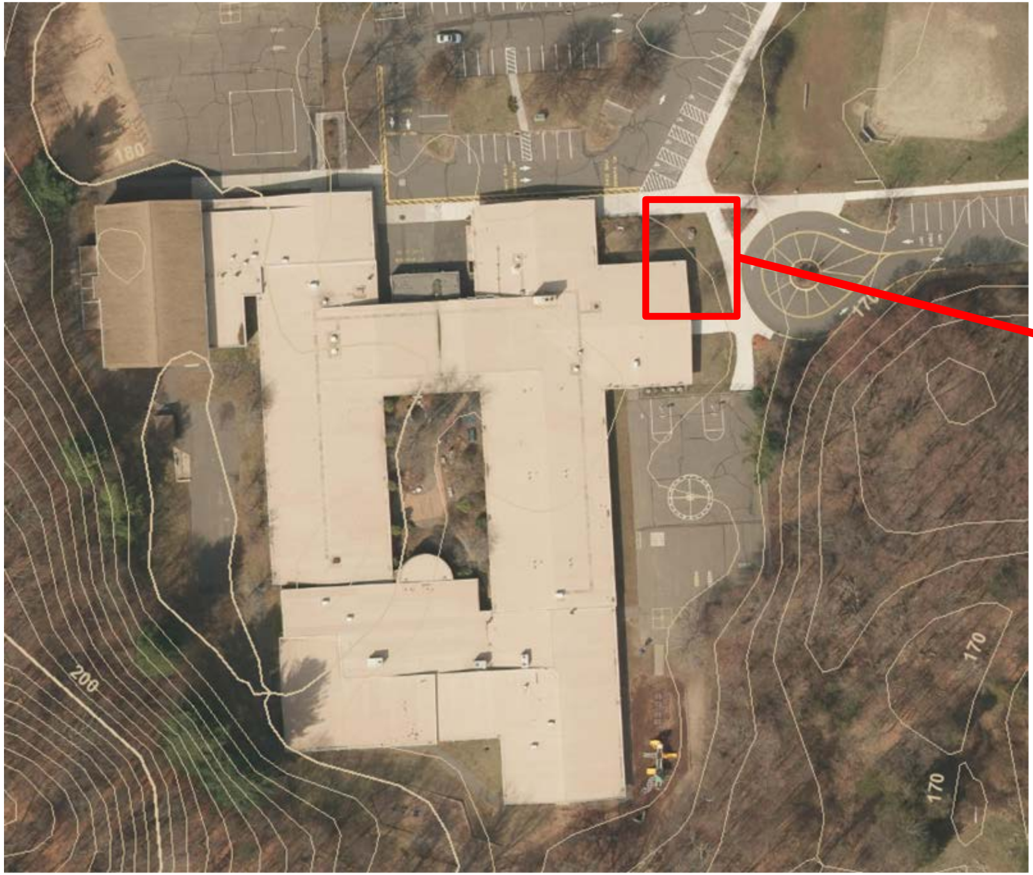

Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious

Doolittle School
Option 1: Bus Drop off Location

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)
6,128	Rain Garden	162,952	1.06	0.075	1,021

For this location we recommend installing a rain garden along the patch of grass adjacent to the storm drain. We recommend making multiple curb cuts to maximize the amount of water caught by the garden. This location offers fantastic visibility as it is where the busses drop kids off every day.

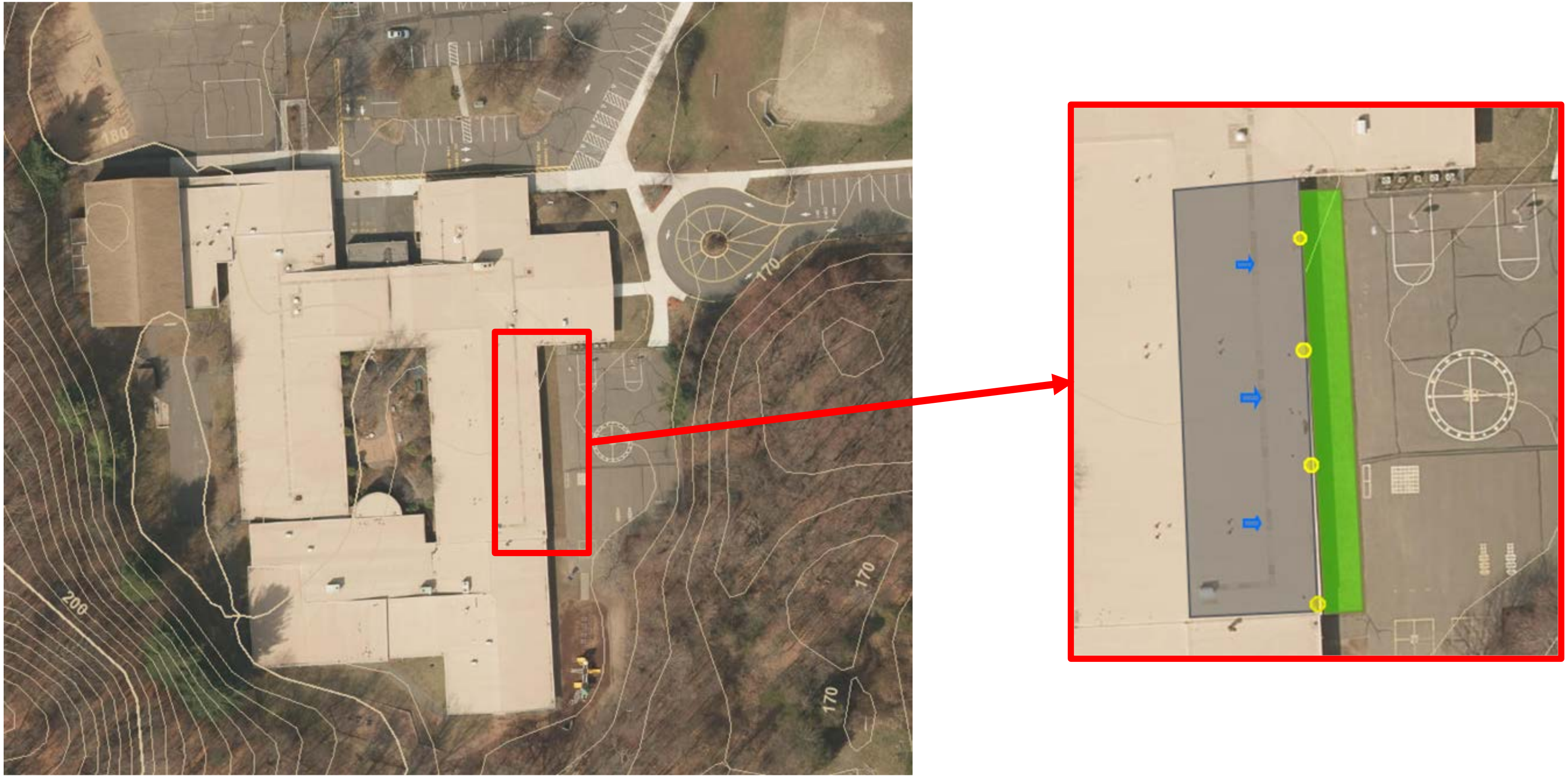
Doolittle School
Option 2: Area in Front of Remembrance Garden



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)
1,098	Rain Garden	29,197	0.190	0.013	183

For this location we recommend extending the remembrance garden located in the front of the school. To avoid any water lines or electrics we suggest building the rain garden on the eastern side of the school rather than on the north side. Not only would this garden have great visibility, it would serve as a fantastic educational opportunity for the kids at the school.

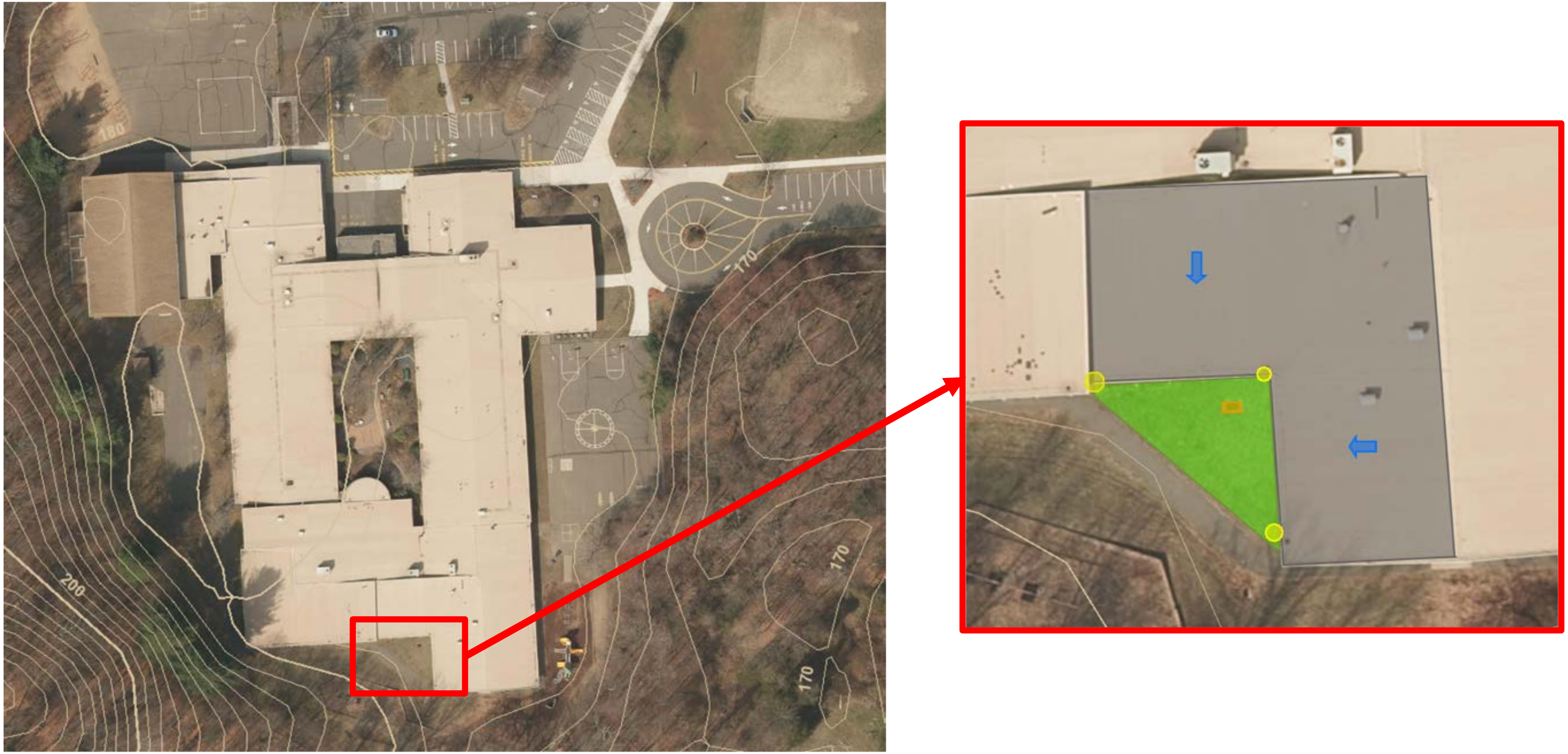
Doolittle School
Option 3: Patch of Grass Adjacent to Blacktop



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)
5,330	Rain Garden	141,732	0.922	0.065	888

For this area we suggest to build a rain garden along this strip of grass. There is enough room to compensate for the drainage area. If the space is too large to work with, less drainage spouts could be disconnected. This would offer great visibility as well as a good learning opportunity as it would be seen by kids every day. As this is where kids play, we also recommend building a fence around the garden if it is built.

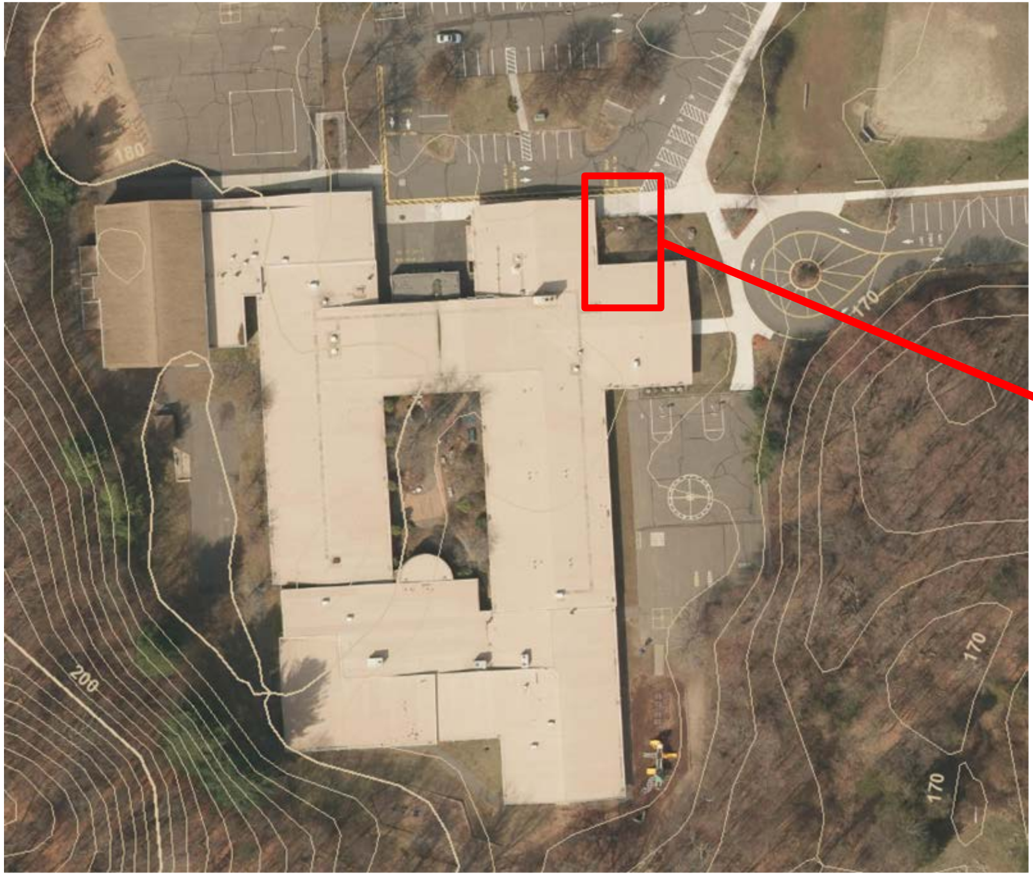
Doolittle School
Option 4: Patch of Grass Adjacent to Southern part of School



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)
4,764	Rain Garden	126,681	0.824	0.058	794

At this location, we recommend disconnecting the downspouts and building a rain garden on this patch of grass. This spot includes a storm drain already present which could be raised and used as an overflow. This is not a top priority however as it does not offer great visibility.

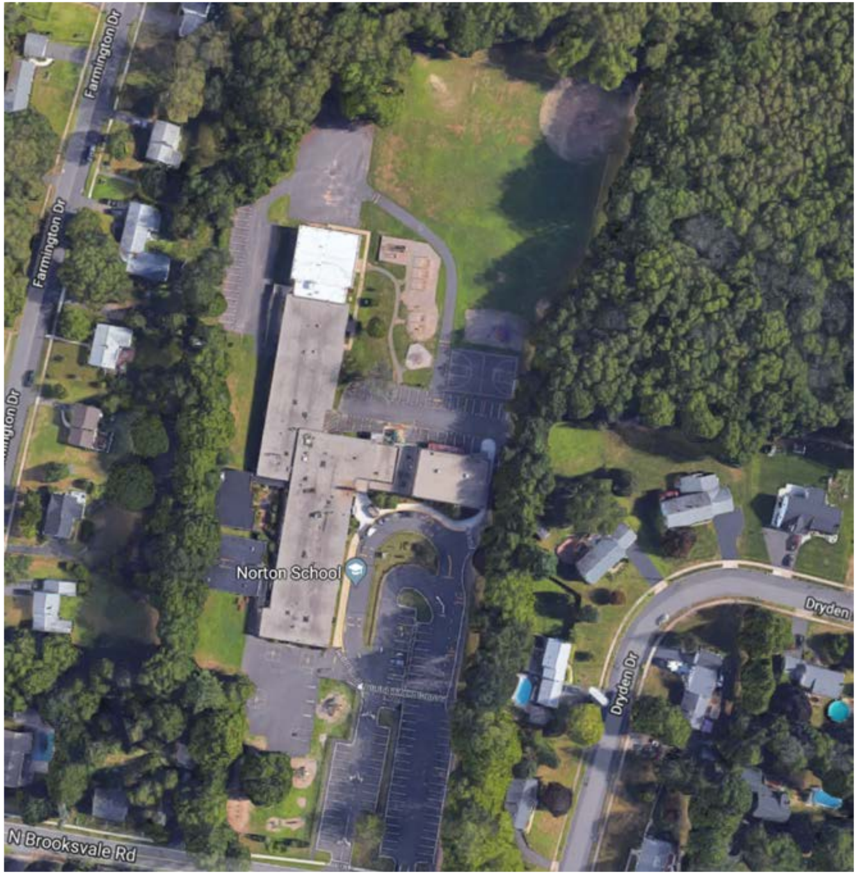
Doolittle School
Option 5: Downspout near School Entrance



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)
1,072	Rain Barrel	28,506	0.185	0.013	NA

At this location we recommend implementing a rain barrel at the downspout towards the back of the garden. In this area the soil was moist and we saw hoses which suggests that this flower garden is watered fairly regularly. A rain barrel would not only help disconnect a downspout but it would help with water conservation. This would be a great learning opportunity for the kids at this school.

Site 4: NORTON SCHOOL



LOCATION:

414 N Brooksvale Rd, Cheshire, CT

IMPERVIOUS AREA:

2,659 sq ft

SUBREGIONAL WATERSHED:

Willow Brook; 5301


170
180
Rain Garden/Bioretention Area
Direction of Water Flow
Drainage Area
Location of Existing Storm Drains


Buildings
Roads
Parcel Boundaries
Other Impervious
Not Impervious

Norton School
Option 1: Front Entrance 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)
2,659	Rain Garden	67,634	0.46	0.03	443

Here, we recommend installing a rain garden in the grassy area of the bus loop. Curb cuts would allow the water to enter the rain garden from multiple angles. The rain garden would prevent the water running off the pavement from entering directly into the storm drain.
The location is also ideal since because it is located in a high traffic area and could be an educational opportunity for the students to learn about green infrastructure.

Site 5: CHESHIRE STATION 3

LOCATION:

1125 South Main Street, Cheshire, CT

IMPERVIOUS AREA:

4,171 sq ft

SUBREGIONAL WATERSHED:

Mill River; 5302

Rain Garden/Bioretention Area

Drainage Area

Direction of Water Flow

Location of Existing Storm Drains

Buildings

Parcel Boundaries

Roads

Other Impervious

Not Impervious

Cheshire Fire Station 3
Option 1: Front East 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)
4,171	Rain Garden	106,077	0.72	0.05	695

At this location, a rain garden would prevent the runoff from entering directly into the storm water system. The water would be directed to the rain garden using curb cuts on all sides of the grass median allowing the water to flow to the area. The existing drain would be used as an overflow for intense rain events.
The rain garden would be placed in a highly visible area since its adjacent to a main road. This would enhance the aesthetic appeal of the Fire Station.

Site 6: BARTLEM RECREATIONAL AREA

LOCATION:

520 South Main Street, Cheshire, CT

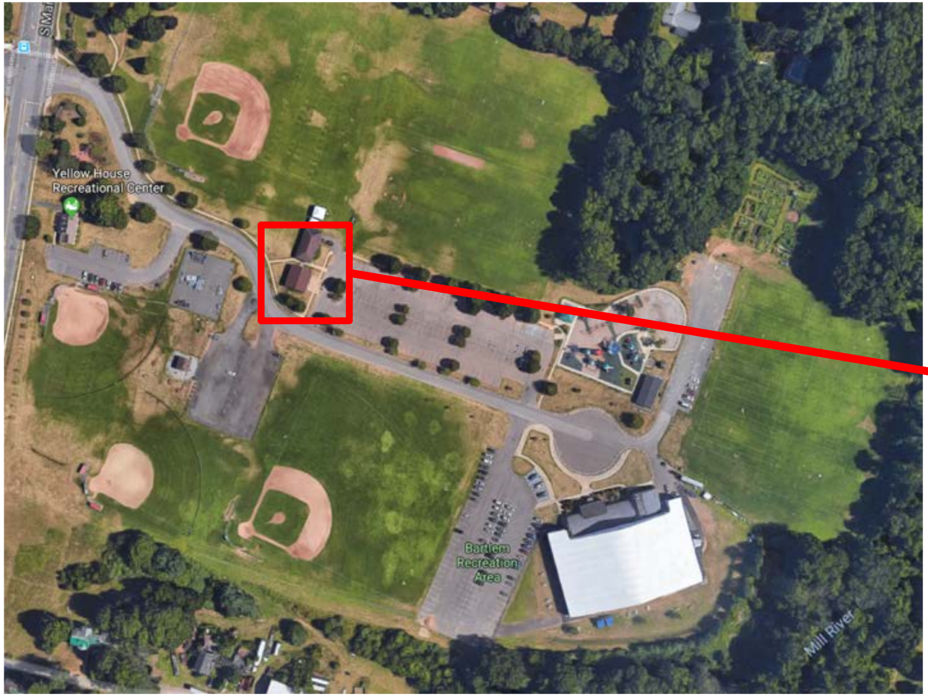
IMPERVIOUS AREA:

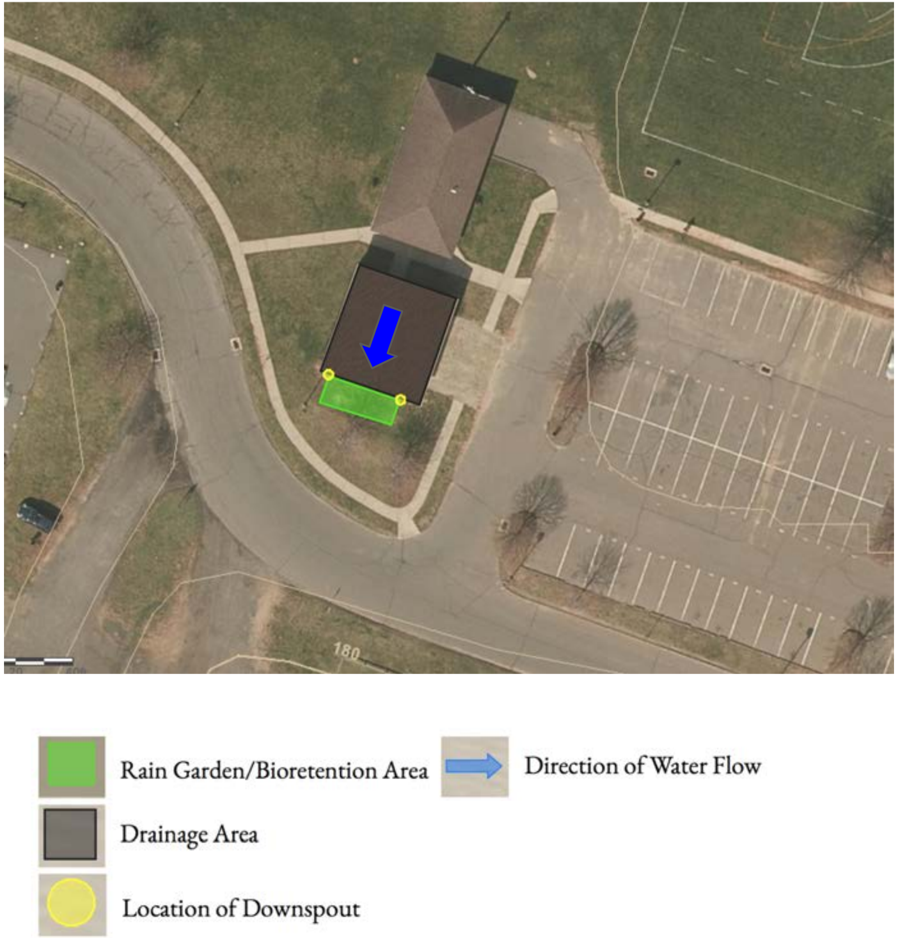
1,141 sq ft

SUBREGIONAL WATERSHED:

Willow Brook 5301

Bartlem Recreational Area
Option 1: South Side of Restroom





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

Buildings
Roads
Parcel Boundaries
Other Impervious
Not Impervious

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)
1,414	Rain Garden	35,960	0.24	.017	235

The two downspouts located on the South side of this building are connected to a stormwater system. We recommend that they be disconnected and fed into a small, simple rain garden beside the building.

Site 7: CHESHIRE TOWN HALL

LOCATION:

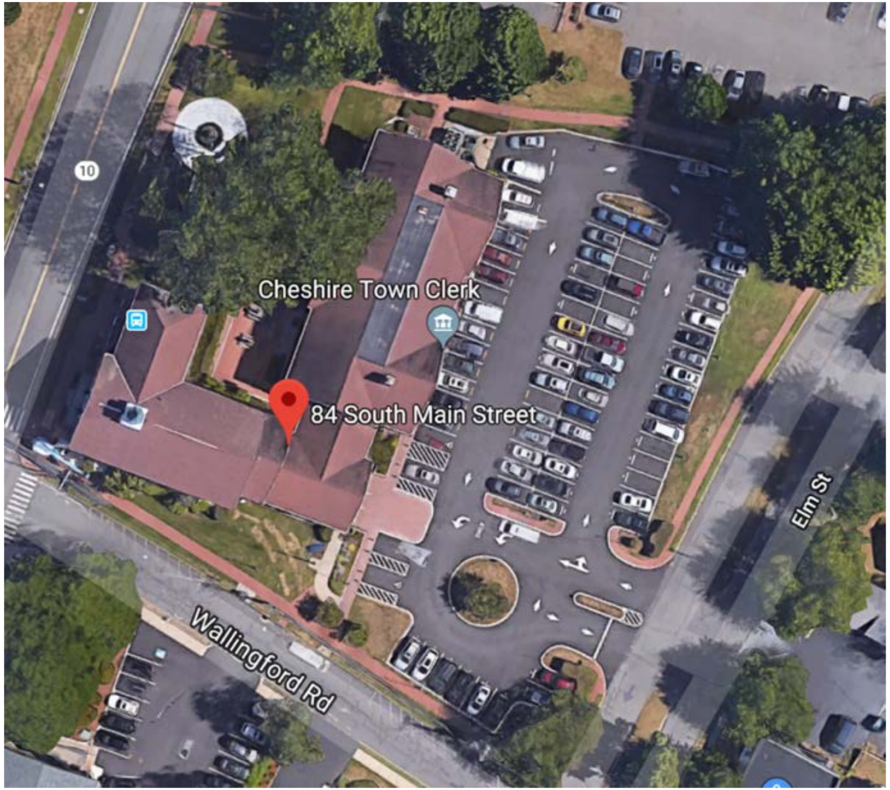
84 South Main Street, Cheshire, CT

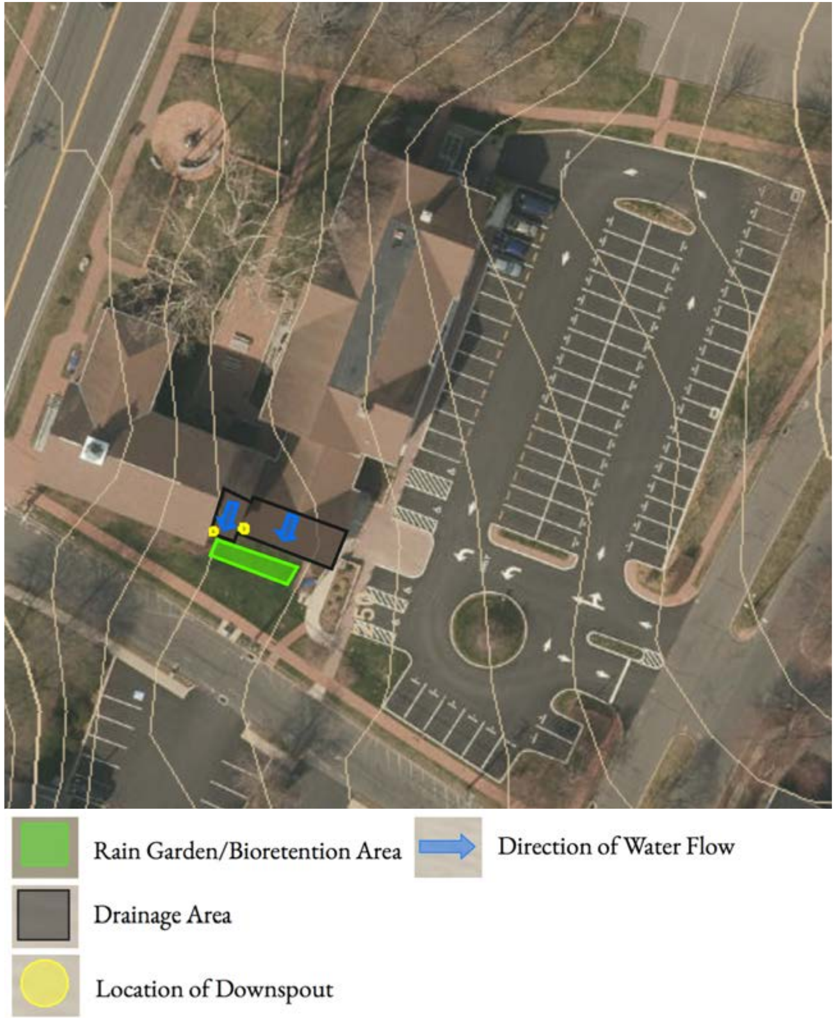
IMPERVIOUS AREA:

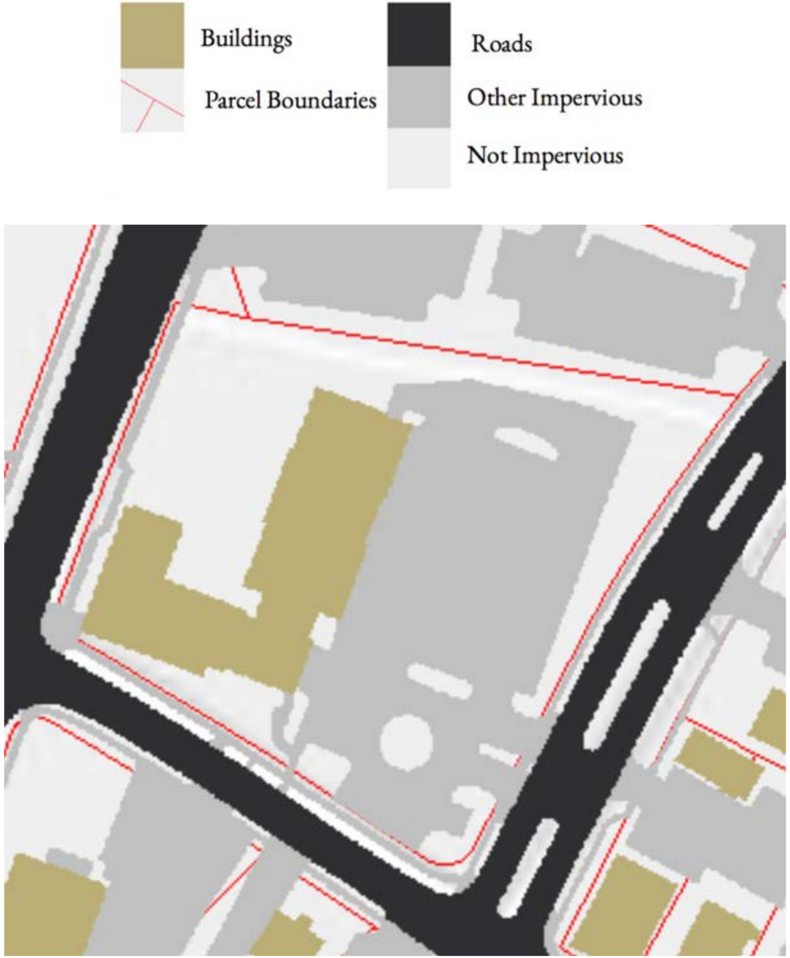
944 sq ft

SUBREGIONAL WATERSHED:

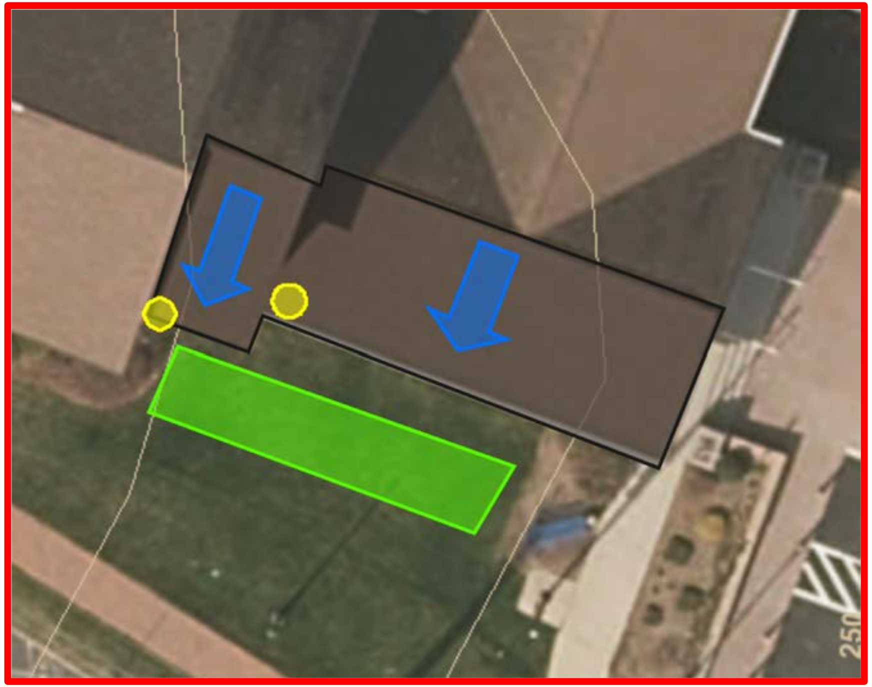
Mill River; 5302




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


Buildings
Roads
Parcel Boundaries
Other Impervious
Not Impervious

Cheshire Town Hall
Option 1: Southeast Side of Town Hall



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)
944	Rain Garden	24,015	0.163	0.012	157

At this location, we recommend installing a rain garden to disconnect the two downspouts in the corner of the building. The water from the two downspouts would redirect the water, using a gravel pathway, into the rain garden. This site it ideal because it is located on a main street and near an entrance to the town hall.

Site 8: CHESHIRE PUBLIC SCHOOLS OFFICES

LOCATION:

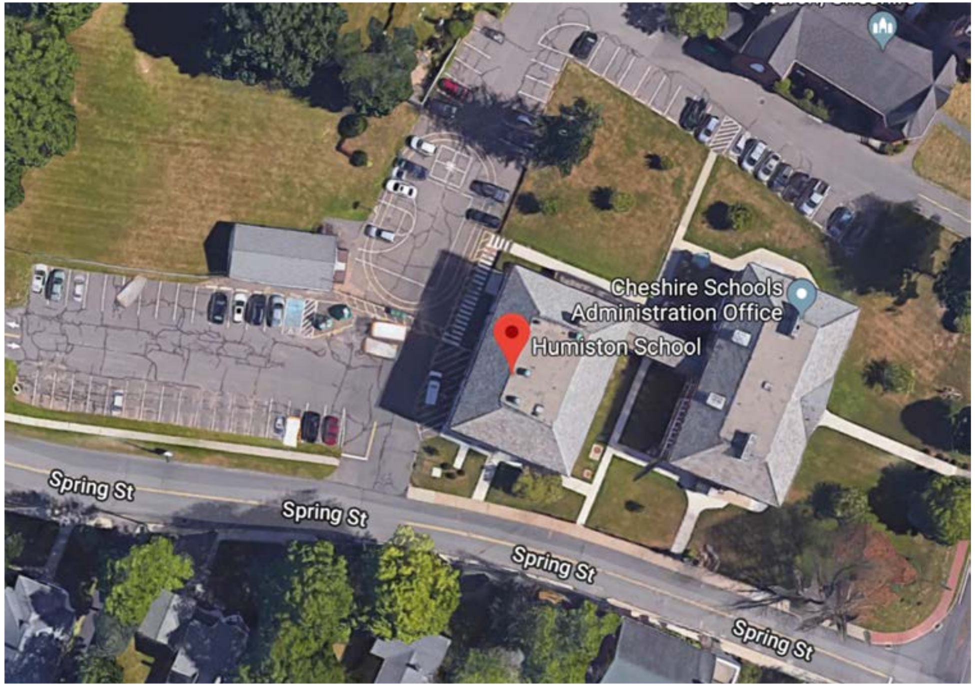
29 Main St, Cheshire, CT

IMPERVIOUS AREA:

1,585 sq ft

SUBREGIONAL WATERSHED:

Mill River; 5302



Rain Garden/Bioretention Area

Direction of Water Flow

Drainage Area

Location of Downspout

Buildings

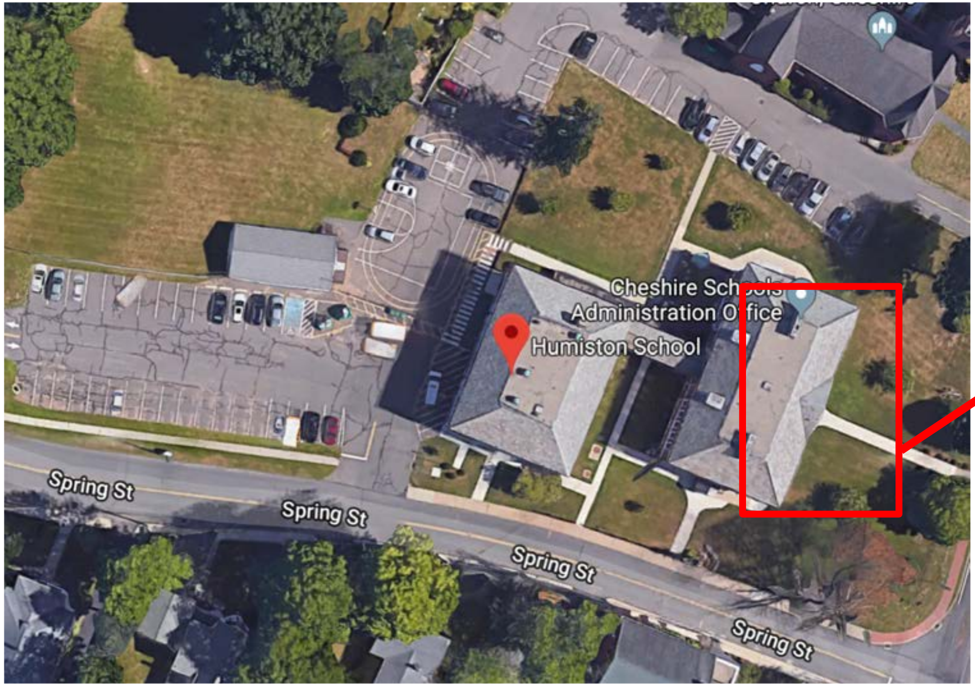
Parcel Boundaries

Roads

Other Impervious

Not Impervious

Cheshire Public Schools Office
Option 1: Eastern Sidewalk



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)
1,585	Rain Garden	40,310	0.27	0.02	264

The two downspouts on the front of this building currently feed roof runoff directly into the storm drain system. They can be disconnected and retrofitted to feed the water underneath the existing sidewalk and discharged into two small rain gardens (approximately 132 sq ft each) on either side of the center pathway.

Site 9: HIGHLAND SCHOOL

LOCATION:

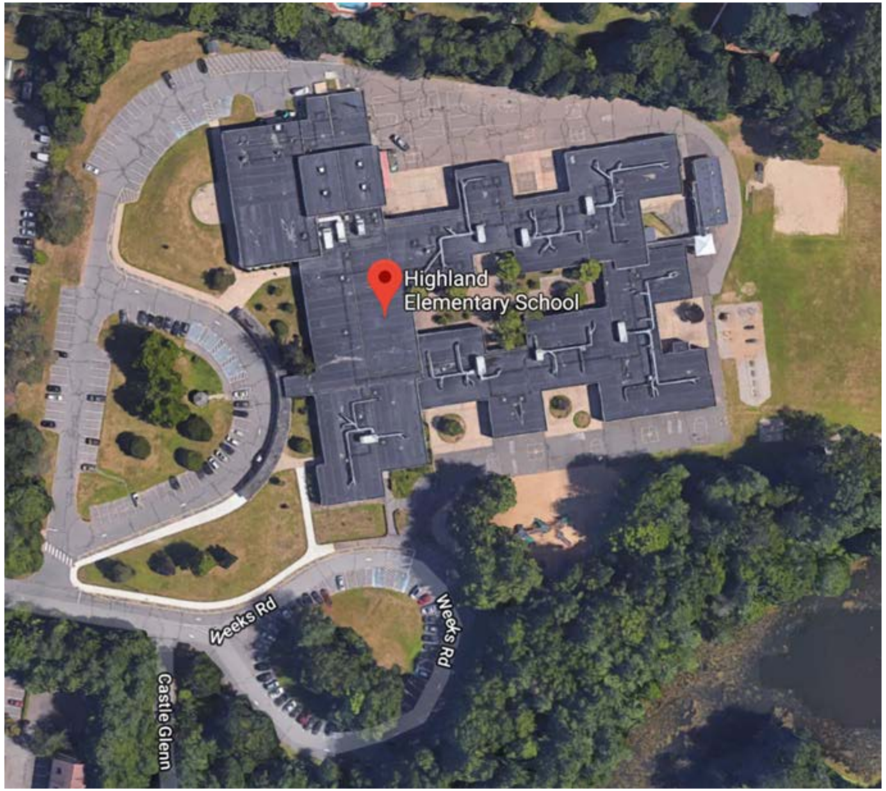
490 Highland Avenue, Cheshire CT 06410

IMPERVIOUS AREA:

16,315 sq ft

SUBREGIONAL WATERSHED:

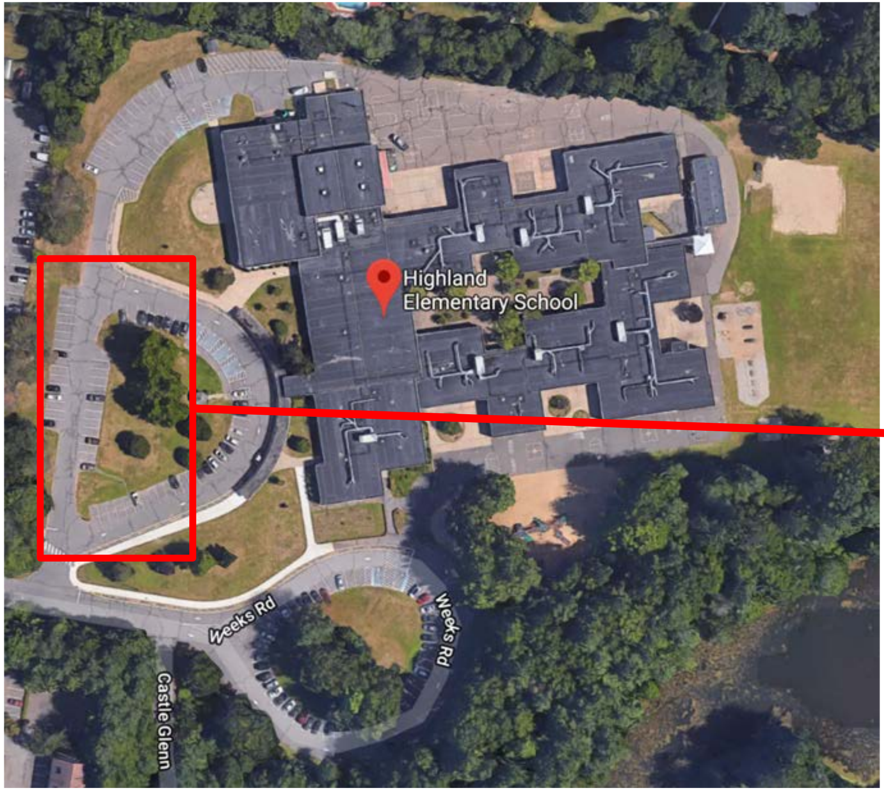
Quinnipiac River; 5200




200
200
Rain Garden/Bioretention Area
Drainage Area
Direction of Water Flow
Location of Existing Storm Drains


Buildings
Parcel Boundaries
Roads
Other Impervious
Not Impervious
WEEKS RD

Highland School
Option 1: 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)
16,315	Rain Garden	414,923	2.82	0.20	2,719

At this location, we recommend implementing a bioretention system. This would prevent the water from directly flowing off the parking lot and into the existing storm drain. The bioretention system would allow the water to naturally drain into the soils and the drain would be used as an overflow. This site is ideal because it is in a highly visible location and could be an educational opportunity for the students to learn about green infrastructure practices.

CONTACT & PARTNERS

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