

Stormwater Runoff Reduction Plan

Hamden, Connecticut



Created by: Emma Saavedra, James Sheridan, Katherine Nee, and RosaLinda Sibilio -UConn undergraduate students.
Mike Dietz, David Dickson, Chester Arnold, and Amanda Ryan - UConn Center for Land Use Education and Research.

PROJECT TEAM

UConn Students: Emma Saavedra, James Sheridan, Katherine Nee, and RosaLinda Sibilio

UConn Extension: Mike Dietz, David Dickson, Chester Arnold, Amanda Ryan

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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 Hamden, 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, 133,291 sq ft of impervious cover would be disconnected from the stormwater drainage system. This means that an estimated 3,389,849 gallons of untreated stormwater, 23.06 pounds of nitrogen, and 1.64 pounds of phosphorus would be prevented from entering local streams annually.

IN THIS REPORT...

Included are recommendations for green stormwater infrastructure practices at 12 sites in the town of Hamden. 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 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



Tree Box Filters



Pervious Pavement



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.

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.

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.

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.

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.

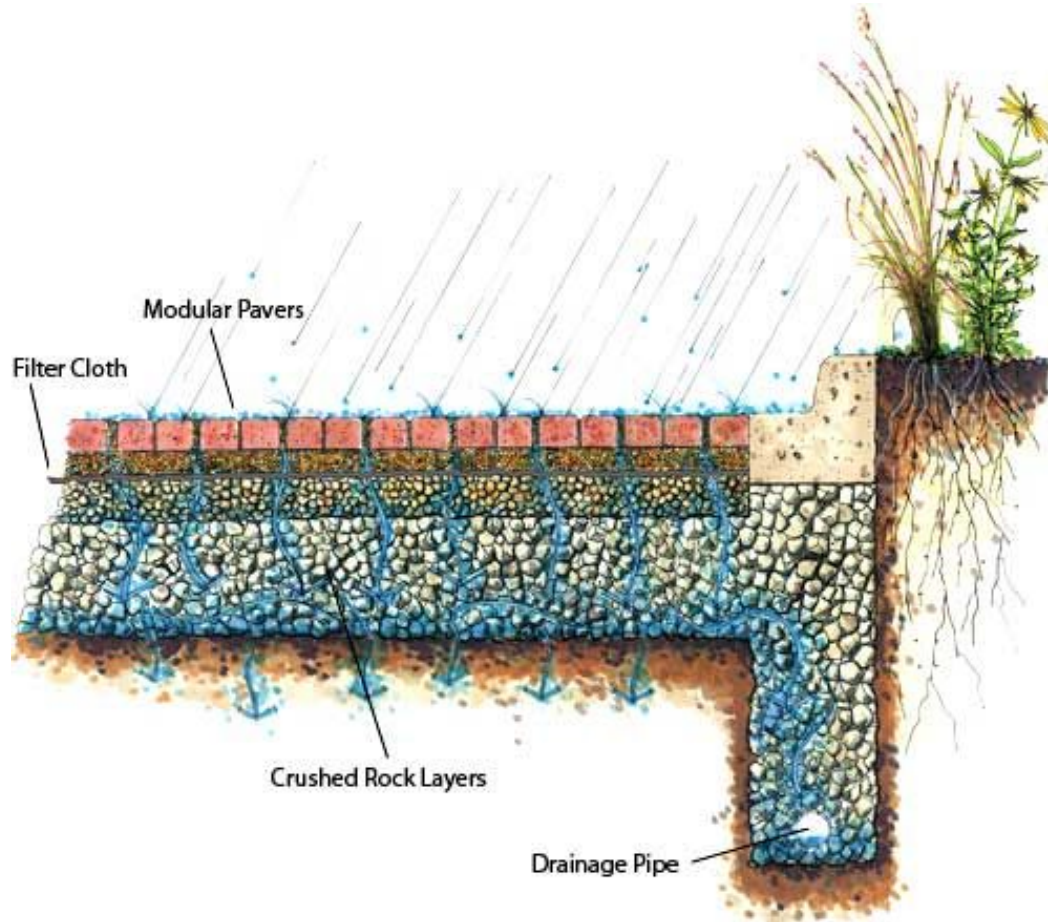
ORGANIC MATTER

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.

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.

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 releivies local aquatic ecosystems as well.

TREE BOX FILTERS

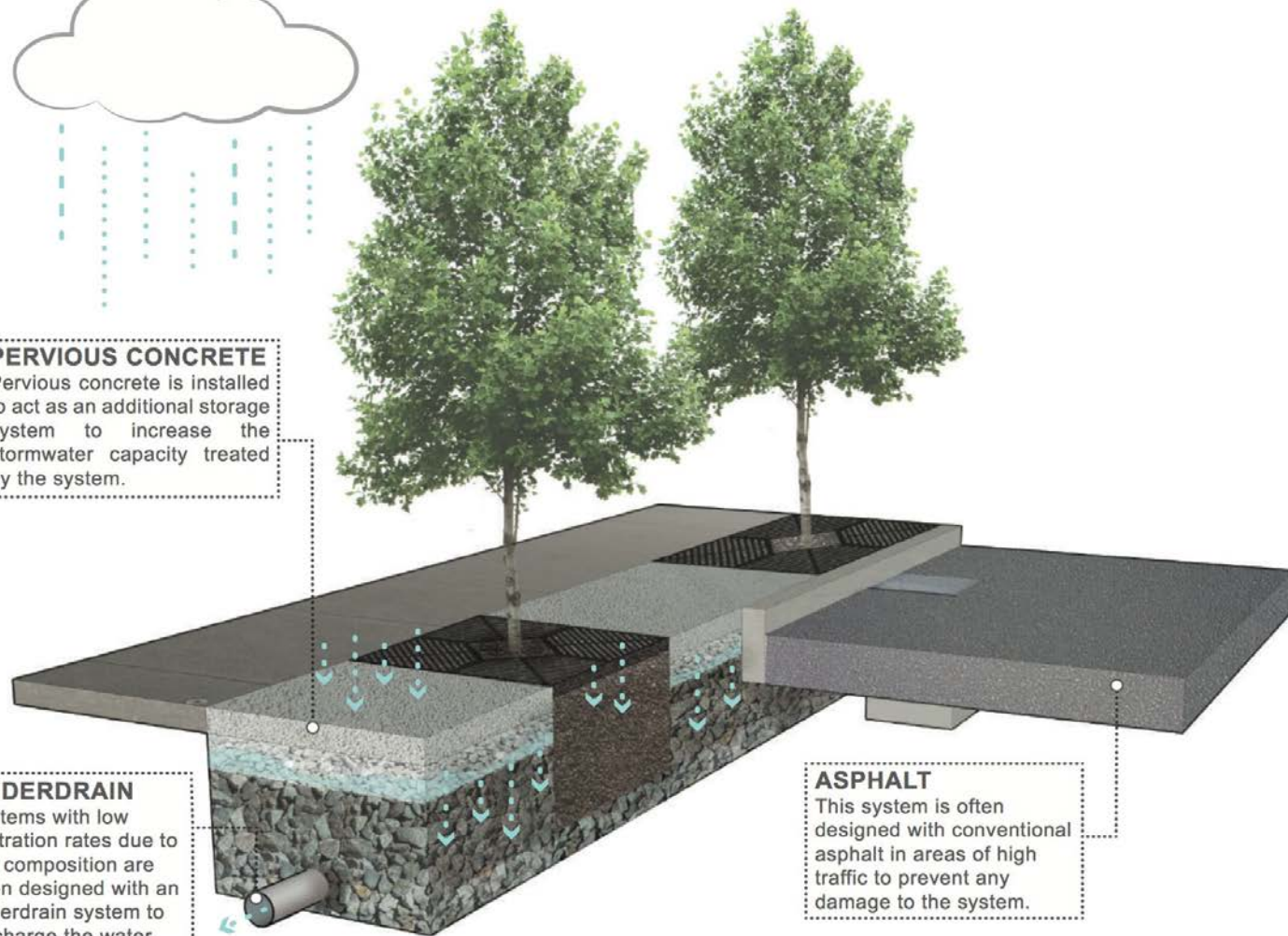


Tree box filters are an aesthetically pleasing green infrastructure practice that directs stormwater runoff through soil and other substrates with excellent filtration qualities before allowing it to enter municipal stormwater systems. Stormwater runoff flowing over impervious sidewalks and roads enters 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.



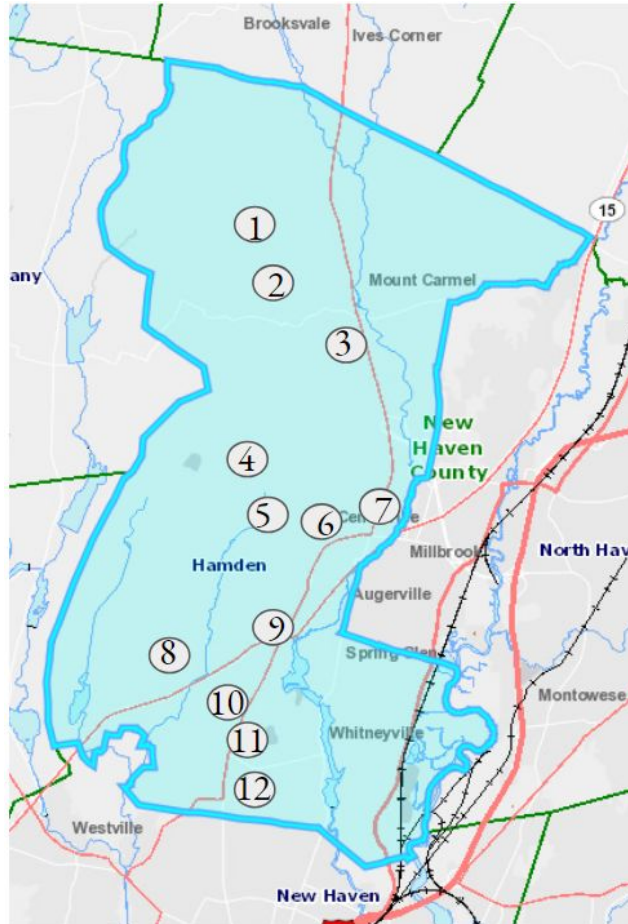
Both the amount of water needed as well as the area of impermeable surface are important to pay attention to when deciding how large a cistern to install. The size of the cistern also dictates what material it should be made of. For small drainage areas, PVC is appropriate, but as the size increases 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. 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. West Woods Elementary School
2. Alice Peck Learning Center
3. Farmington Canal Heritage Trail Parking Lot
4. Bear Path Elementary School
5. Shepherd Glen Elementary school
6. Hamden Middle School
7. Town Center Park
8. Dunbar Hill School
9. Hamden High School
10. Church Street School
11. Community Branch Library
12. ML Keefe Community Center

TOP FIVE SITES FOR HAMDEN

The top five sites for Hamden 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. Alice Peck Learning Center
2. Bear Path Elementary School
3. Hamden Middle School
4. Town Center Park
5. Community Branch Library

If all top five site projects were implemented, 27,497 sq ft of impervious cover will be disconnected from the stormwater drainage system. This means that 732,340 gallons of untreated stormwater, 4.76 pounds of nitrogen, and 0.34 pounds of phosphorus will be prevented from entering local water bodies annually.

Site 1: WEST WOODS ELEMENTARY SCHOOL

LOCATION:

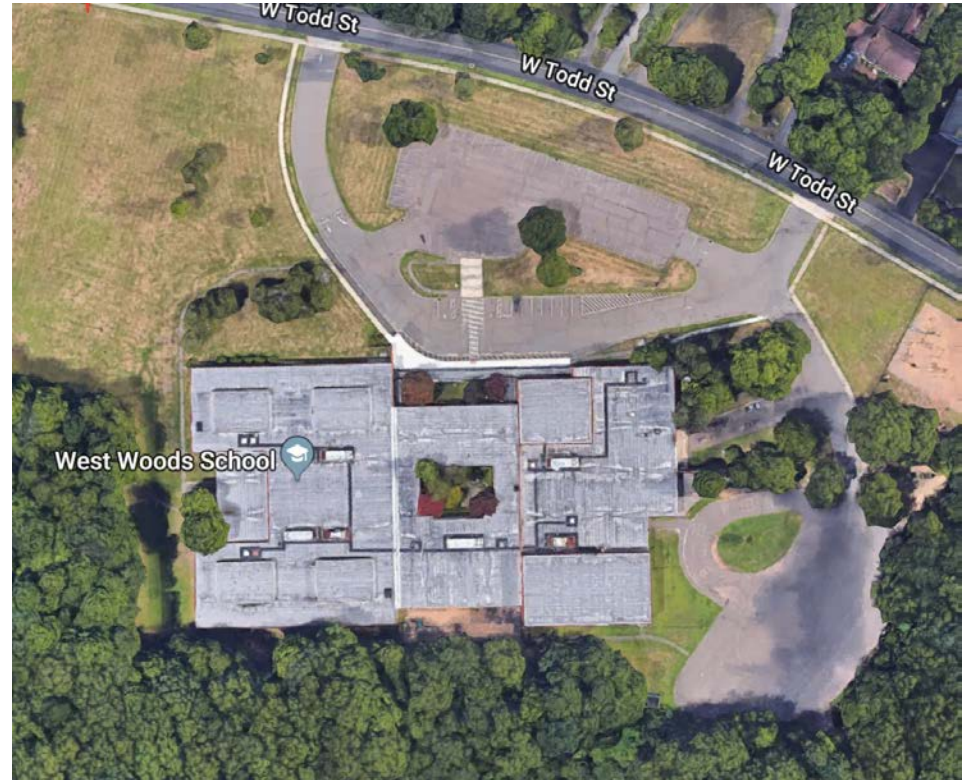
350 West Todd Street, Hamden, CT

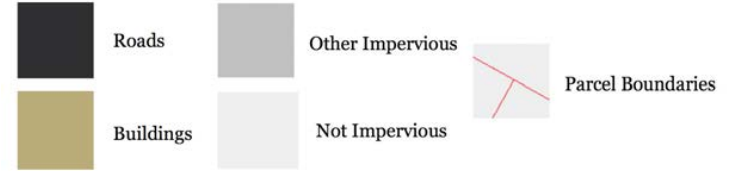
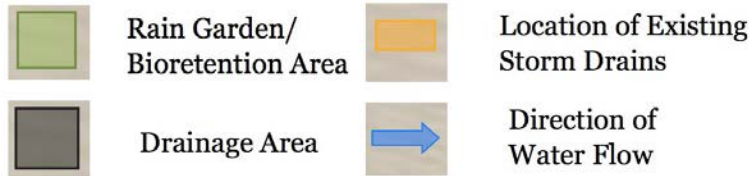
IMPERVIOUS AREA:

34,750 sq feet

SUBREGIONAL WATERSHED:

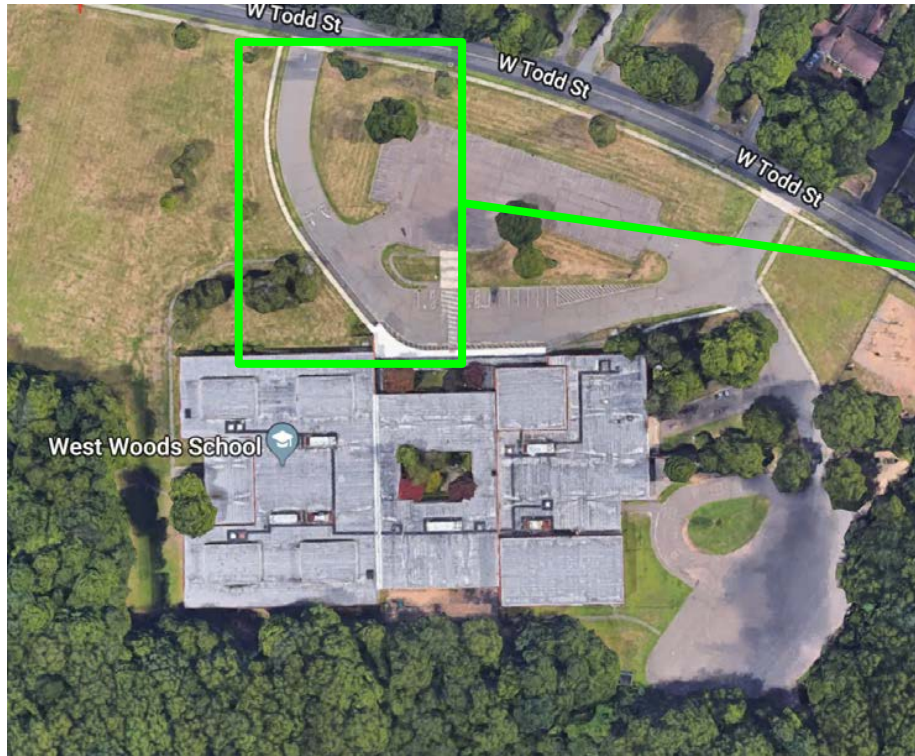
Willow Brook; 5301





WEST WOODS ELEMENTARY

Option 1: Parking Lot on Southwest 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)
10,975	Rain Garden	279,116	1.90	0.135	609



Here, we suggest implementing a rain garden in the middle section of the island. Water from the bus loop drains to this area naturally. The rain garden would collect the discharge using curb cuts that would direct flow underneath the sidewalk to prevent the sidewalk from freezing in the winter. This would also be a great spot to enhance the aesthetic appeal of the school and serve as an educational opportunity for the students to understand green infrastructure practices.

WEST WOODS ELEMENTARY

Option 2: Parking Lot on Northeast 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)
23,775	Rain Garden	604,646	4.10	0.29	1,321



On this side of the parking lot there is another great location for a rain garden. The water from this entrance and the rest of the parking lot flows to this grass area. Curb cuts on all sides would allow the water to infiltrate instead of being connected to the stormwater system. This location is also in front of the school and would add to the aesthetic appeal. In addition, the rain garden would deter people from parking on the grass.

Site 2: ALICE PECK LEARNING CENTER

LOCATION:

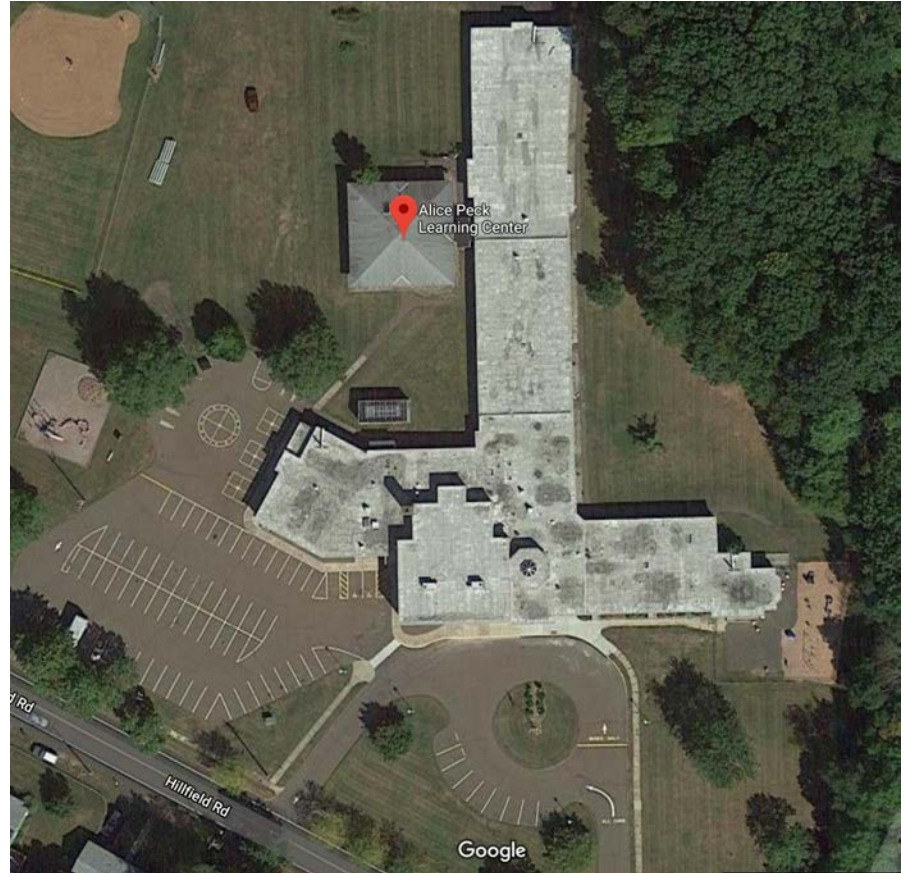
35 Hillfield Rd, Hamden, CT

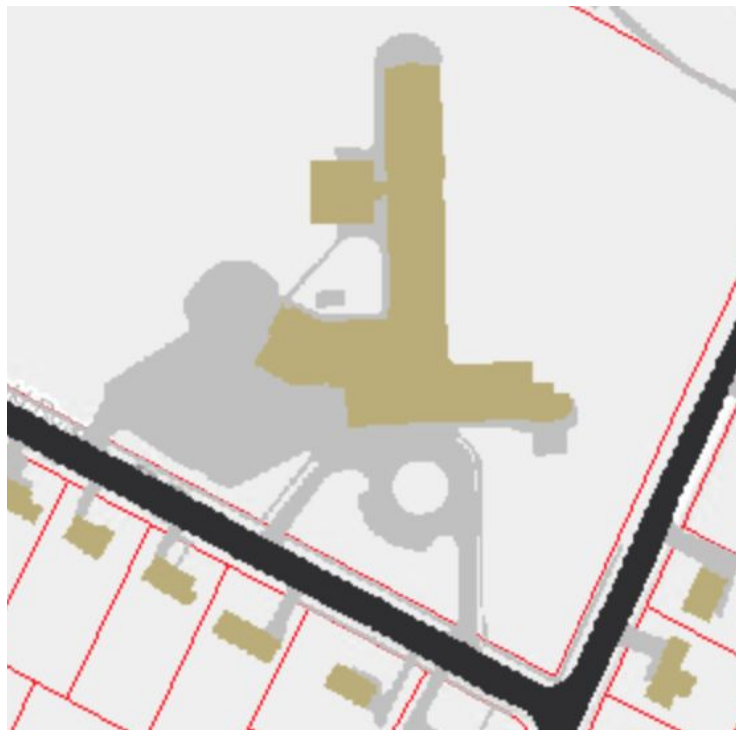
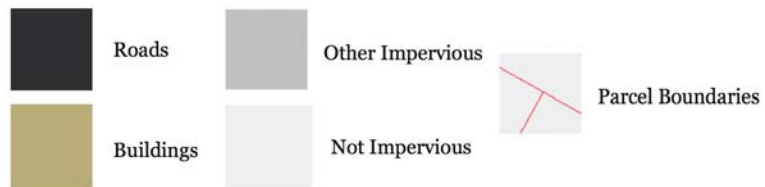
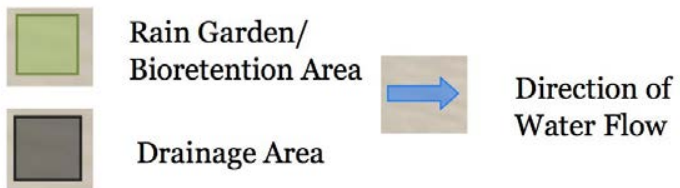
IMPERVIOUS AREA:

7,956 sq feet

SUBREGIONAL WATERSHED:

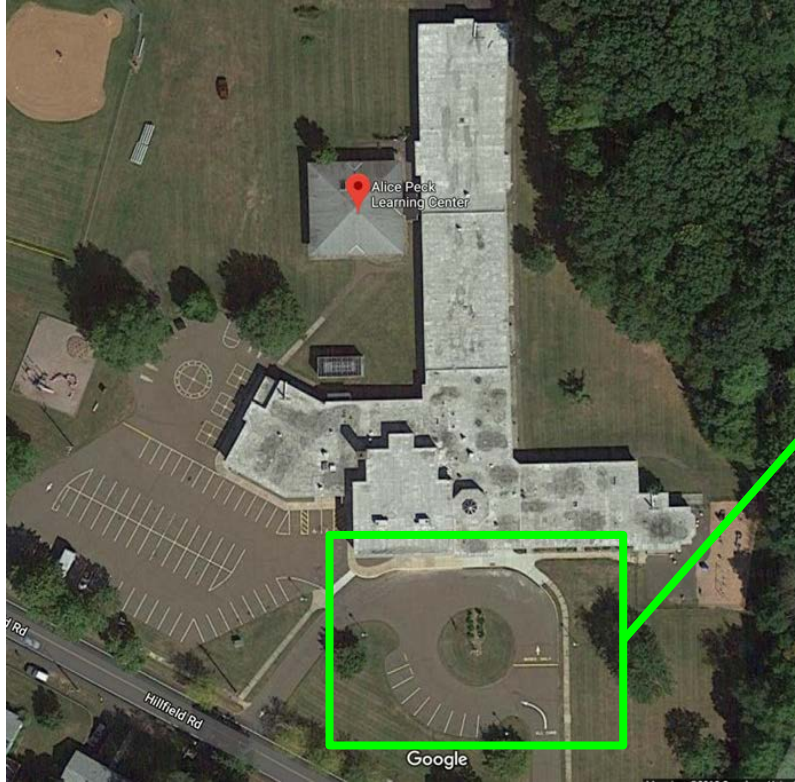
Mill River; 5302





ALICE PECK LEARNING CENTER

Option 1: Front Entrance 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)
7,956	Rain garden	202,337	1.38	0.098	1,320



The shallow depression in front of the flagpole, on the center island, would be an excellent location for a rain garden. Not only would it drain a large portion of impervious surface and disconnect a large quantity of runoff from the stormwater system, but it would also add aesthetic appeal to the front of the school.

Site 3: FARMINGTON CANAL HERITAGE TRAIL PARKING

LOCATION:

4340 Farmington Canal Heritage Trail,
Hamden, CT

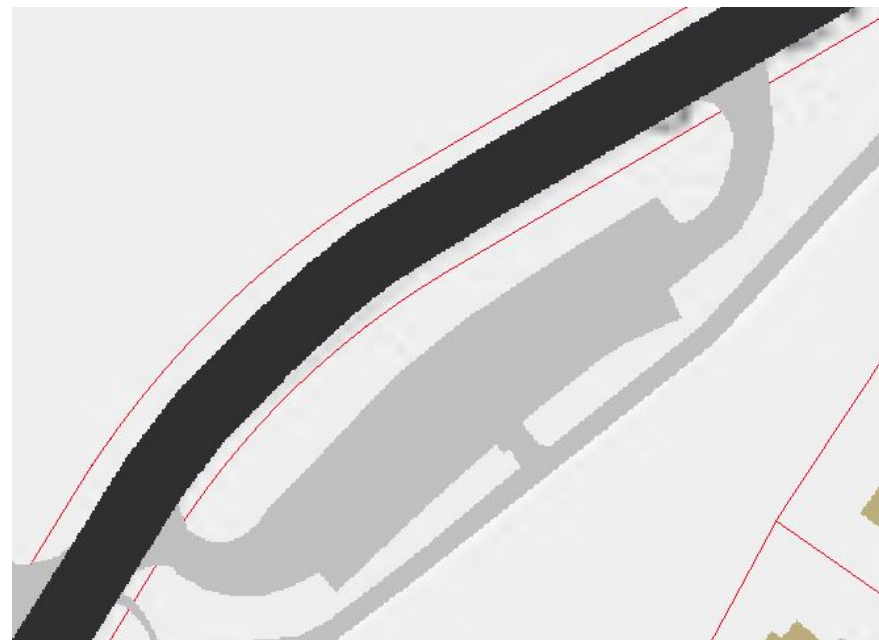
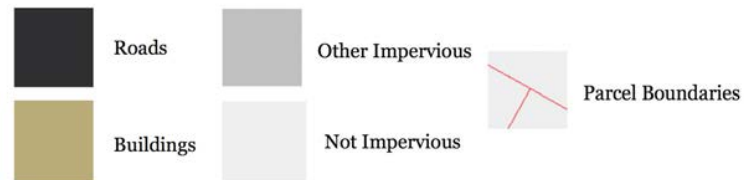
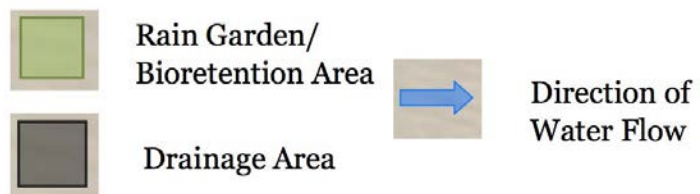
IMPERVIOUS AREA:

9, 323 sq feet

SUBREGIONAL WATERSHED:

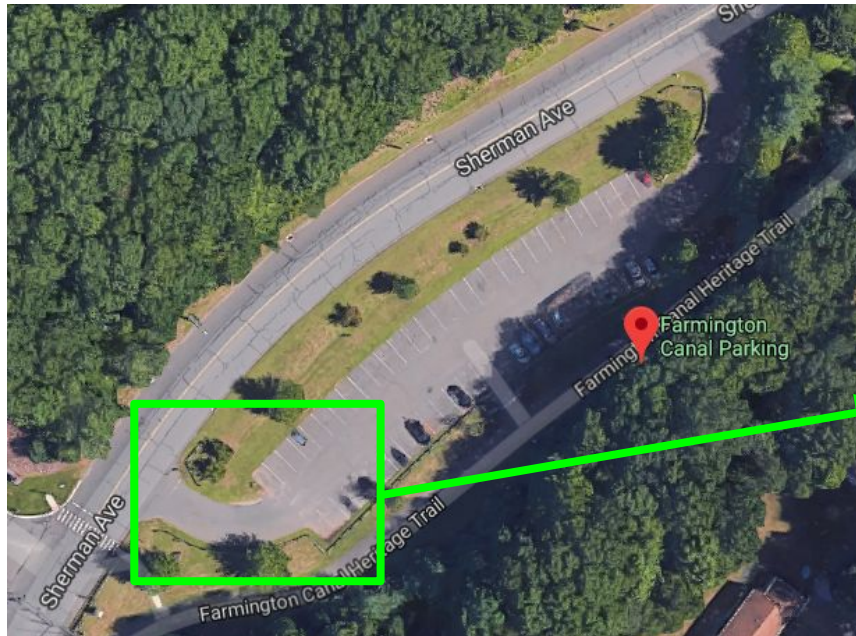
Mill River; 5302





FARMINGTON CANAL HERITAGE TRAIL PARKING

Option 1: West Side of Parking Lot



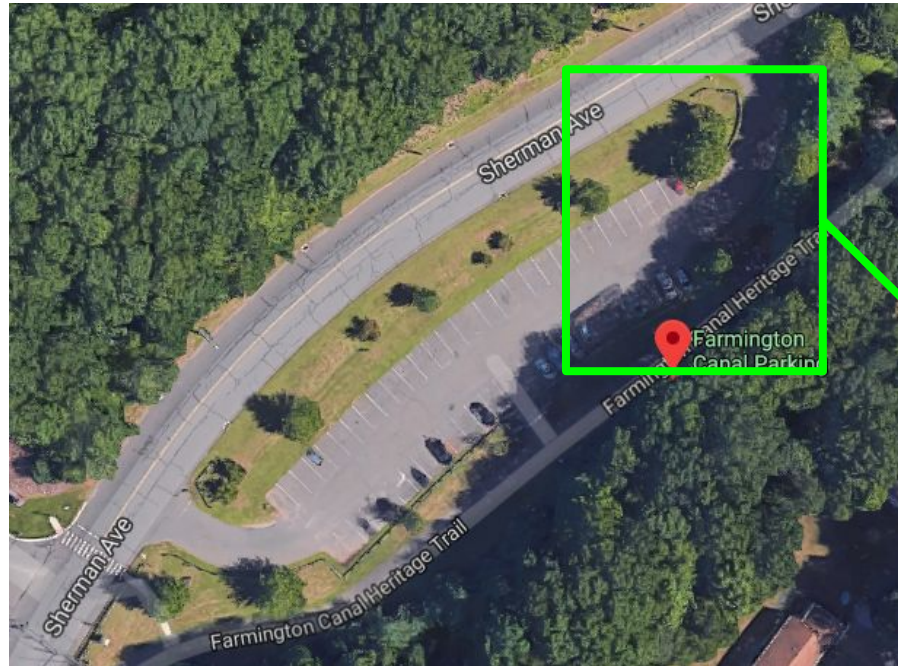
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
2,528	Rain garden	64,292	0.437	0.031	420



This site recommendation involves creating a rain garden that would help prevent flooding in the parking lot. The water pools at the bottom of the right entrance. If this water were to be directed into a rain garden, on the other side of the fence, it will be absorbed slowly and would lessen the flooding and sediment accumulation in the parking lot. This area is already disconnected from the stormwater system, but would serve as a great opportunity for implementing green infrastructure practices.

FARMINGTON CANAL HERITAGE TRAIL PARKING

Option 2: East Side 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)
6,795	Bioretention/Rain Garden	172,810	1.176	0.083	1,113

The practice suggestion here is a rain garden in front of the parking spots. Near the left entrance there is a large drainage area that pools the water in the dirt area before the grass patch. This water could be used to feed a rain garden instead of sitting on the pavement and dirt area. This area is already disconnected from the stormwater system, but would serve as a great opportunity for implementing green infrastructure practices.



Site 4: BEAR PATH ELEMENTARY

LOCATION:

10 Kirk Rd, Hamden, CT

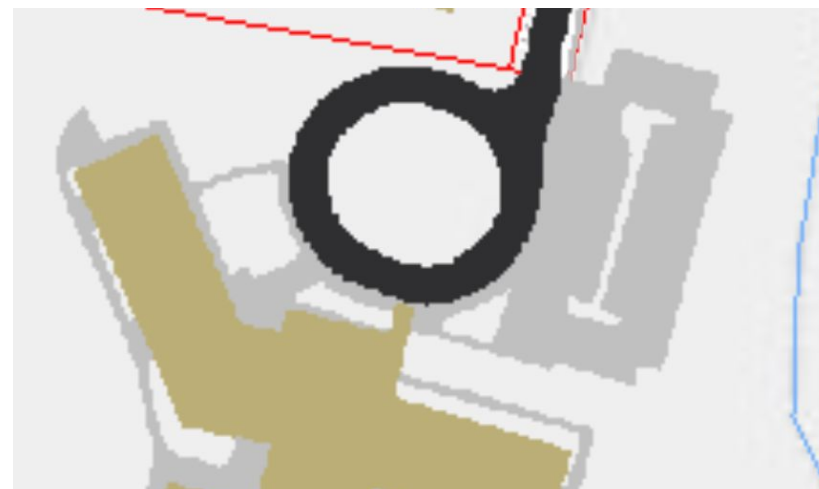
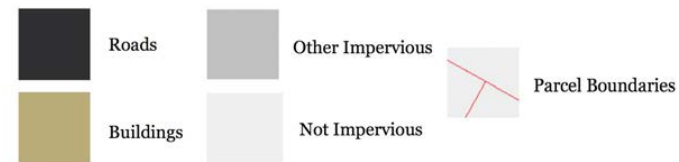
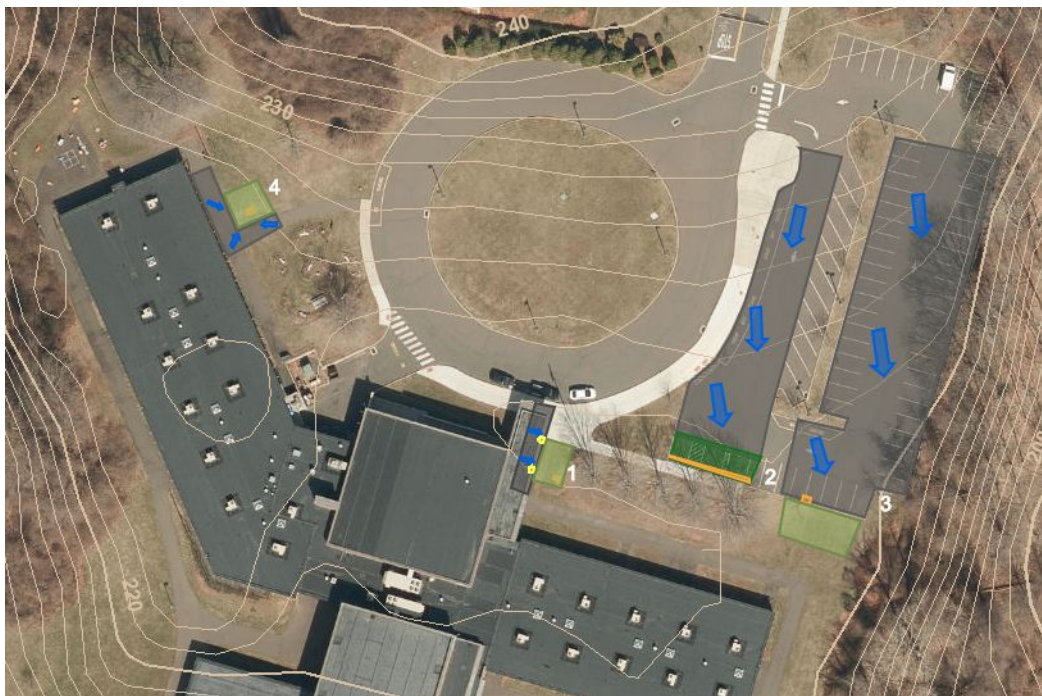
IMPERVIOUS AREA:

21,365 sq feet

SUBREGIONAL WATERSHED:

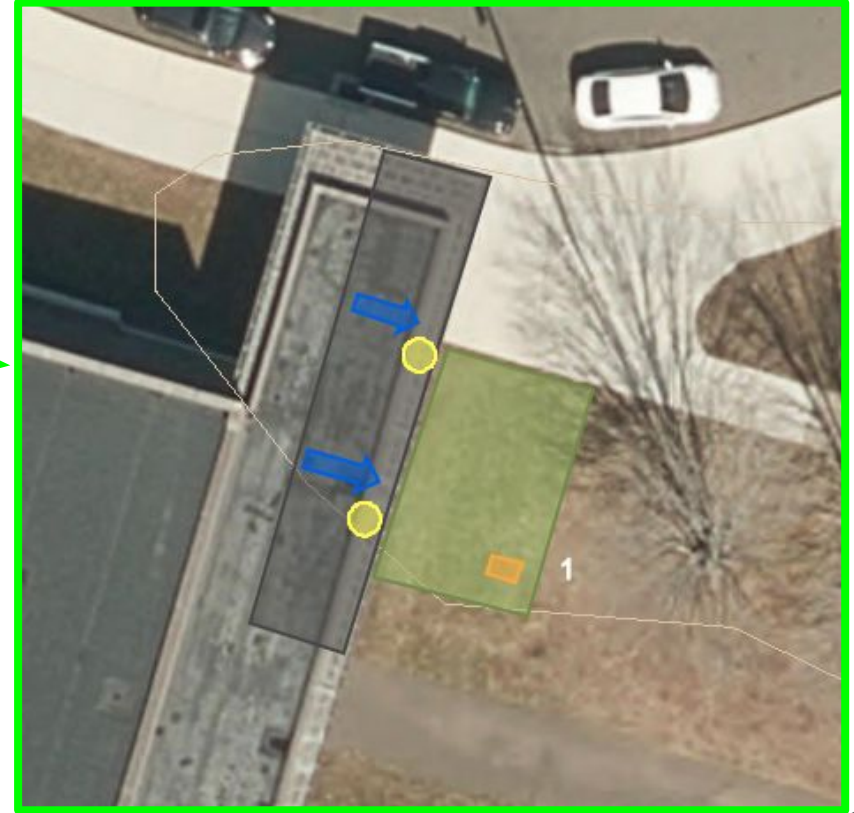
Mill River; 5302





BEAR PATH ELEMENTARY SCHOOL

Option 1: Area Adjacent to Terrace at School Entrance

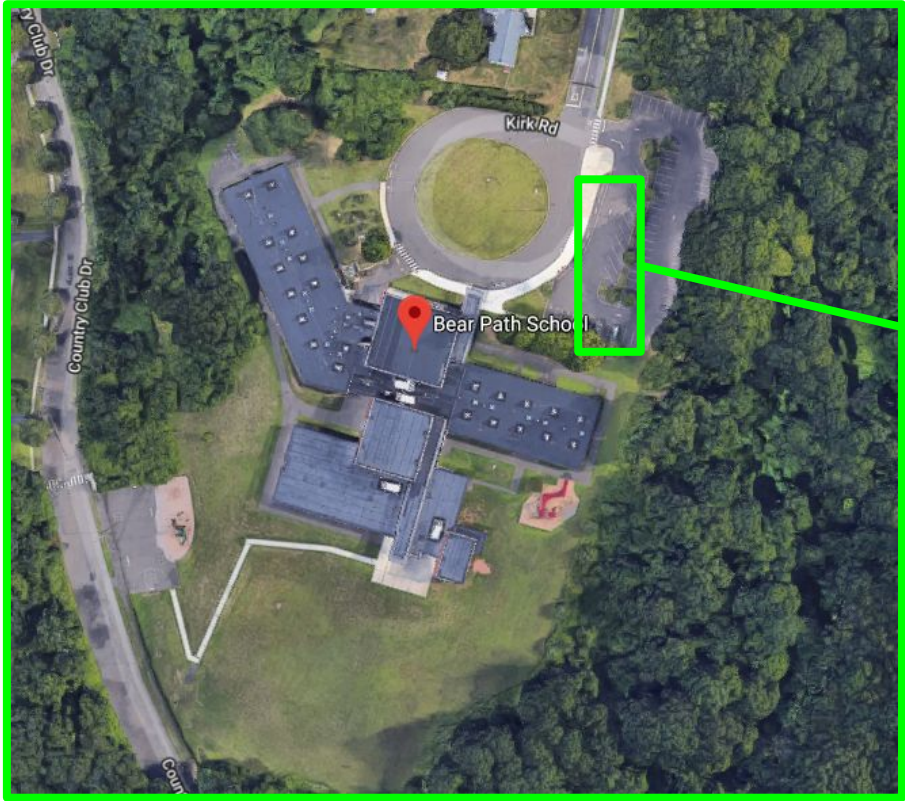


Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
516	Bioretention	13,123	0.089	0.006	86



This would be an ideal location to implement a bioretention area. While the location does not receive a significant amount of runoff, it would have excellent visibility. There is also a storm drain which is already present in the area which could be utilized as an overflow. It is difficult to say how much water from the sidewalks would enter the bioretention area; but it is likely some of it would.

BEAR PATH ELEMENTARY SCHOOL
Option 2: Parking lot North of Trench Drain



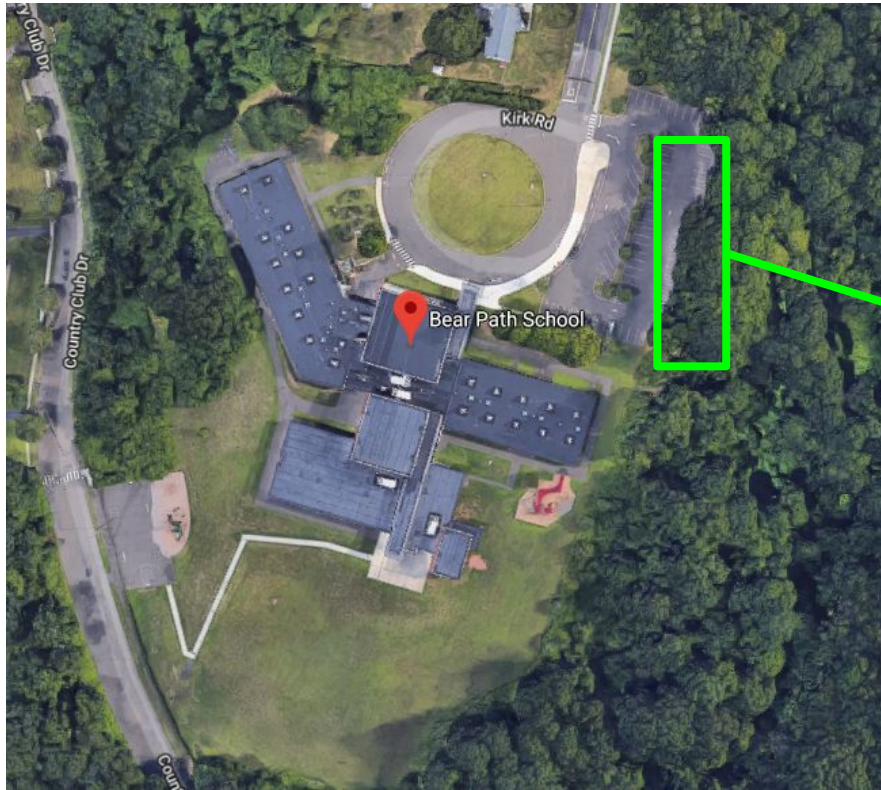
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
6,387	Permeable Pavement	162,434	1.105	0.078	1,065



Our recommendation for this location would be to implement permeable pavement along the southern part of this parking lot. Without this, all of the water is running directly into a trench drain and into the storm drain system. Permeable pavement wouldn't totally mitigate this, but it would catch a decent amount because of how flat this section of the parking lot is.

BEAR PATH ELEMENTARY SCHOOL

Option 3: Eastern Side of Parking Lot



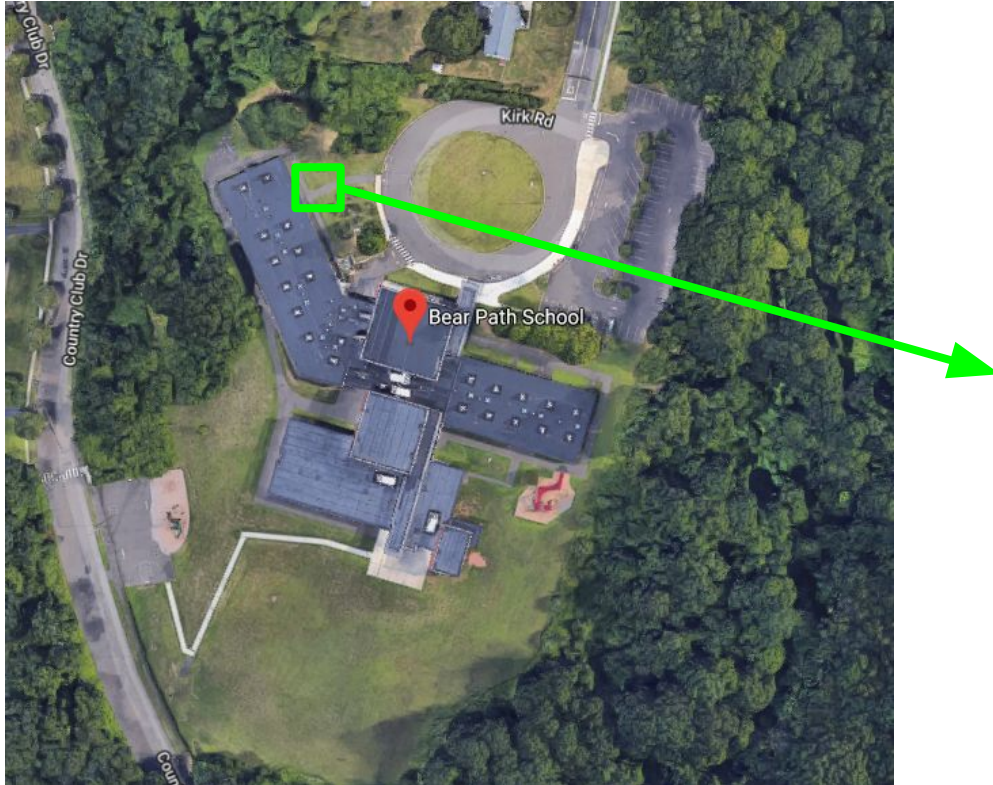
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
13,767	Bioretention	350,122	2.382	0.169	2,295



This would be a fantastic spot to implement a bioretention area. It receives a very large amount of runoff from the parking lot directly north of it. To compensate for this, the area of interest has a lot of workable soil to build a large bioretention area. It is located directly next to a wetland nature trail which could allow this site to be a great educational opportunity.

BEAR PATH ELEMENTARY SCHOOL

Option 4: Area North of Flower 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)
695	Bioretention	17,675	0.120	0.009	116



This is great location for an educational opportunity. A few meters south of this location is an educational flower garden the school built. This location wouldn't receive a significant amount of water from the surrounding sidewalk and as a result of this would be relatively small.

Site 5: SHEPHERD GLEN ELEMENTARY SCHOOL

LOCATION:

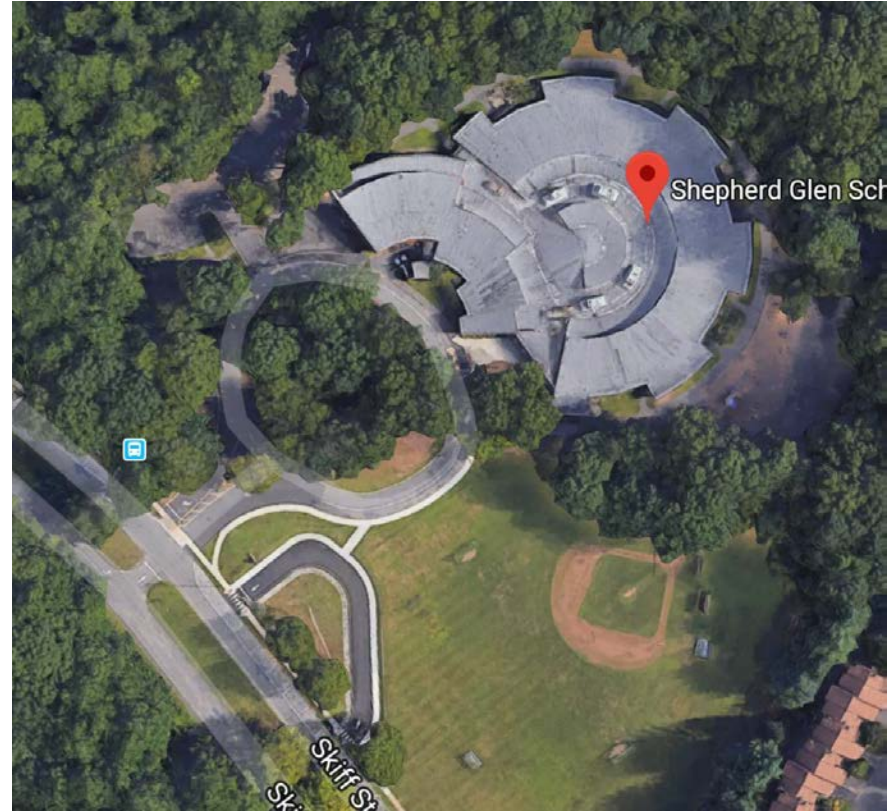
1 Skeff Street Ext., Hamden, CT

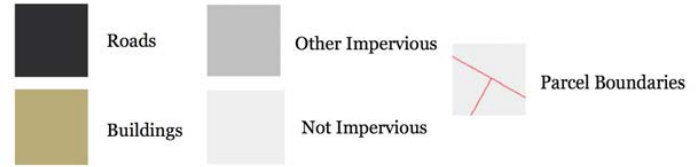
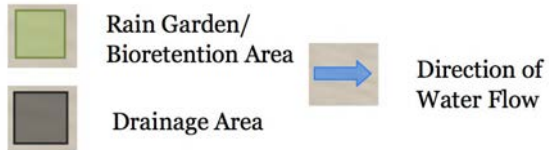
IMPERVIOUS AREA:

1,699 sq feet

SUBREGIONAL WATERSHED:

Mill River; 5302





SHEPHERD GLEN ELEMENTARY SCHOOL

Option 1: Front Entrance 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)
1,699	Rain garden	43,199	0.294	0.021	283



In this location we recommend implementing a rain garden. The water flows naturally to this location and the water could be collected using curb cuts to direct the water into the medium. This is an ideal spot for a rain garden because it is in the front of the school with high visibility. In addition, it would also serve as an educational opportunity for the students to learn about green infrastructure practices.

Site 6: HAMDEN MIDDLE SCHOOL

LOCATION:

2623 Dixwell Avenue, Hamden, CT

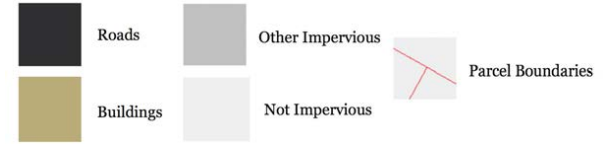
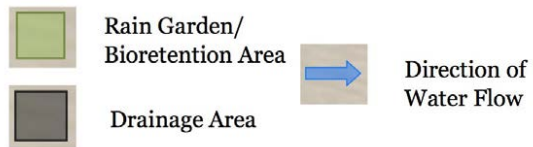
IMPERVIOUS AREA:

30,463 sq feet

SUBREGIONAL WATERSHED:

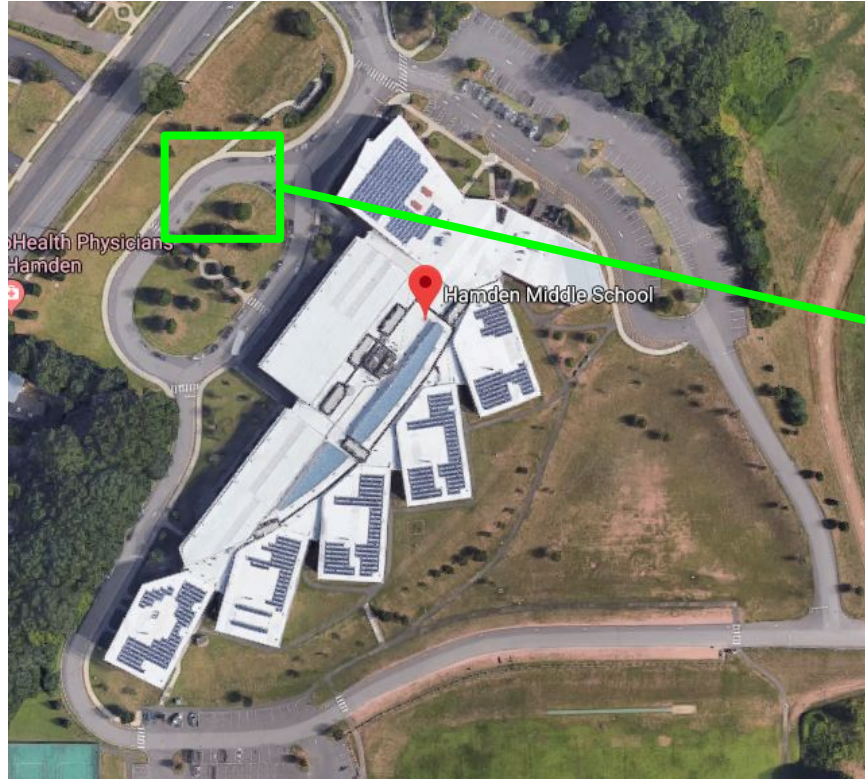
Mill River; 5302





HAMDEN MIDDLE SCHOOL

Option 1: First Front Circle



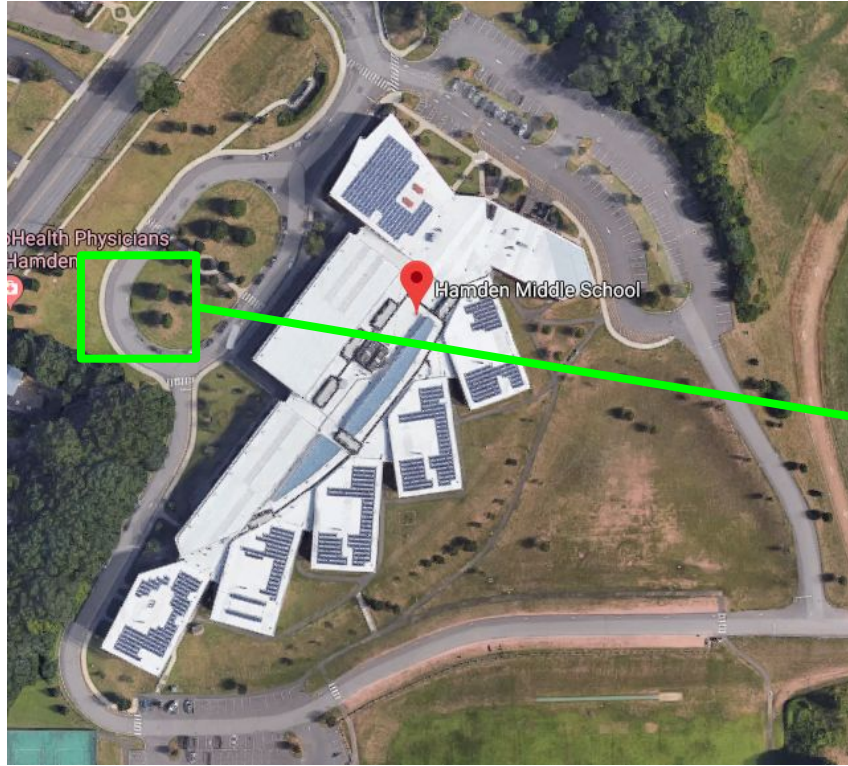
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
5,080	Rain garden	129,195	0.879	0.062	847



This option involves constructing a rain garden in the front of the bus loop facing the school. If the curb is cut to the left and to the right of the storm drain, it could be intercepted from the stormwater storage system and directed into a rain garden.

HAMDEN MIDDLE SCHOOL

Option 2: Second Front Circle



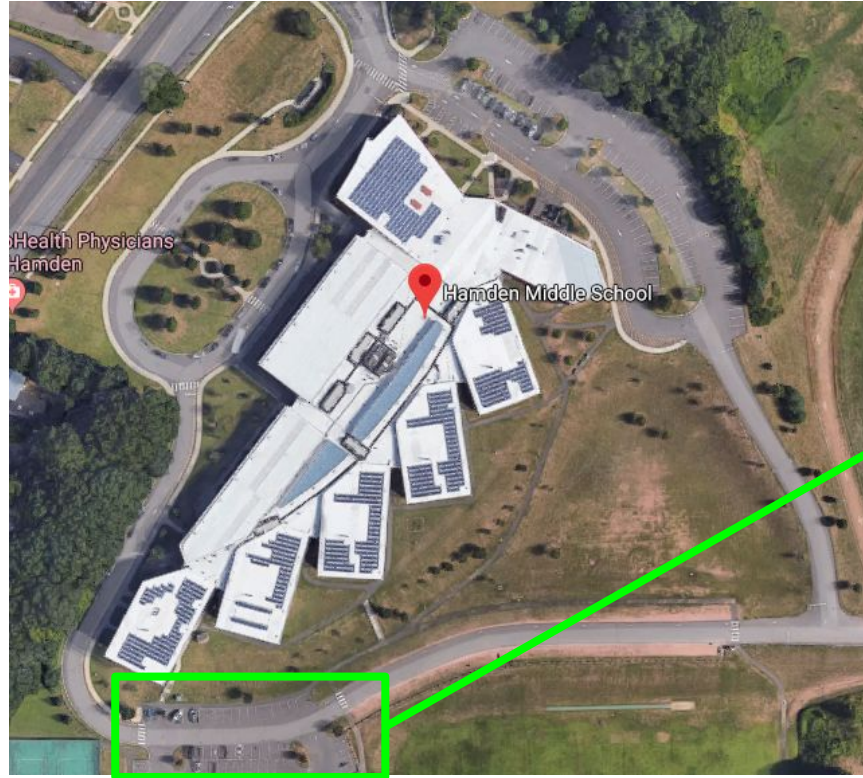
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
4,681	Rain garden	119,047	0.810	0.057	780



This option involves constructing a rain garden on the other side of the bus loop facing the school. If the curb is cut to the left or to the right of the storm drainage the water would be diverted from the stormwater storage system. The water could feed a rain garden where it is infiltrated slowly and absorbed back into the ground.

HAMDEN MIDDLE SCHOOL

Option 3: Southern 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)
19,030	Rain garden	483,971	3.292	0.233	1,585



The recommendation for this area is to build a rain garden along the end of the parking lot in the already depressed area before the fence. With multiple curb cuts the entire parking lot runoff could be used to feed a rain garden and filter directly back into the ground. This rain garden would significantly decrease the amount of water entering the stormwater system and would enhance the schools aesthetic appeal.

HAMDEN MIDDLE SCHOOL

Option 4: Eastern Field 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 (sq ft)
1,672	Rain Garden	42,522	0.289	0.021	279

This location would be ideal for a rain garden. The slope of the road leads all of the stormwater into a drain at the bottom of the driveway. If the curb is cut before it reaches the drainage, the water would be directed into the rain garden, disconnecting it from the system. There is already a drain in the grass area, so if it is elevated it will be useful as a overflow for the garden.



Site 7: TOWN CENTER PARK

LOCATION:

2761 Dixwell Ave, Hamden, CT

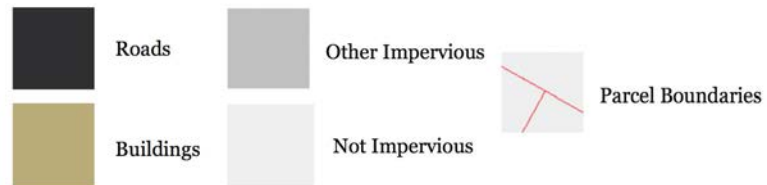
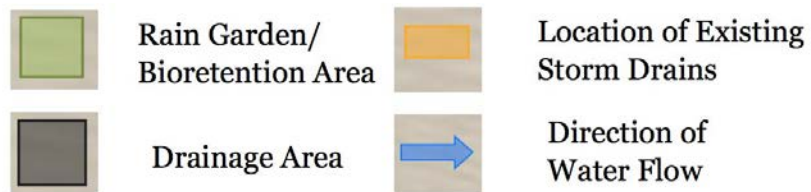
IMPERVIOUS AREA:

7,361 sq feet

SUBREGIONAL WATERSHED:

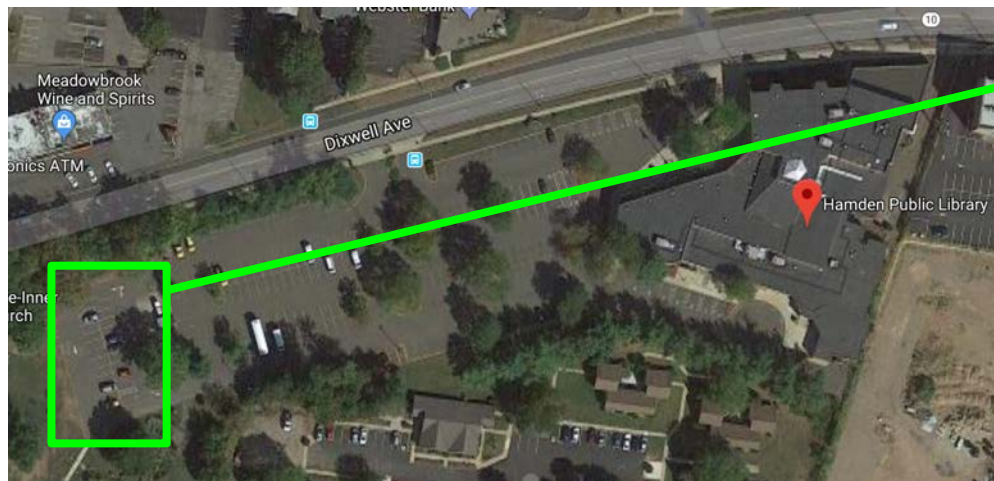
Mill River; 5302





TOWN CENTER PARK

Option 1: Parking Lot near Community 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)
7,361	Rain Garden	220,241	1.274	0.090	1,230



Storm water from almost all of the adjacent parking lot in this location flows into a single storm drain across from the community garden. We suggest that a rain garden be constructed to receive a large portion of this water before it flows into the stormwater system.

Site 8: DUNBAR HILL SCHOOL

LOCATION:

315 Lane St, Hamden, CT

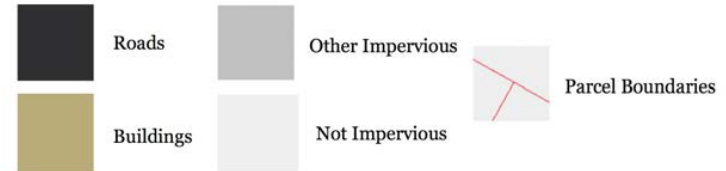
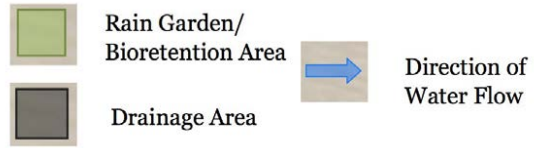
IMPERVIOUS AREA:

2,321 sq feet

SUBREGIONAL WATERSHED:

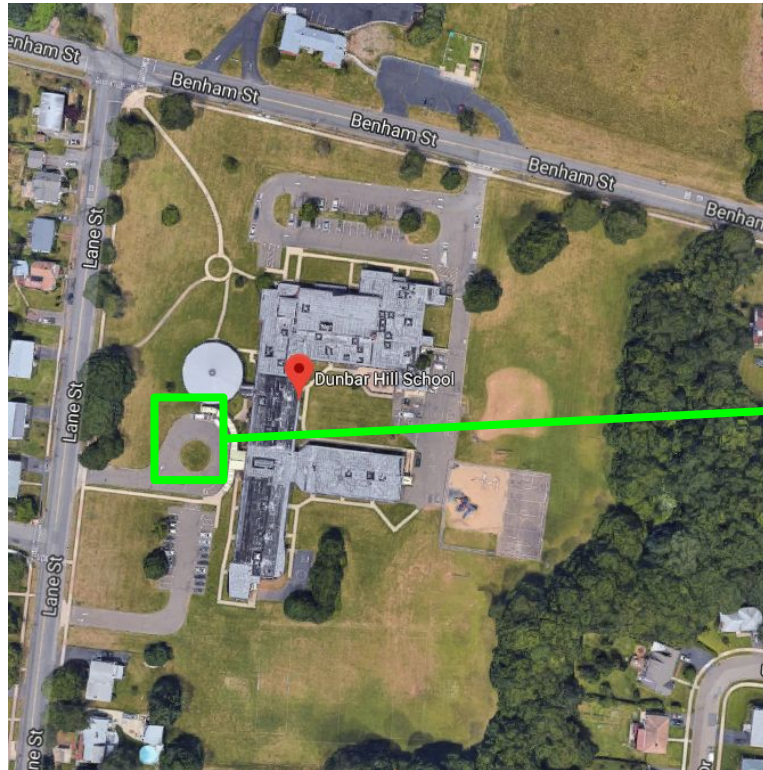
Mill River; 5302





DUNBAR HILL SCHOOL

Option 1: West Side 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)
2,321	Bioretention	59,036	0.401	0.028	387



Our recommendation for this location is to cut the curb along the western side of the bus drop off. The water would be led into a rain garden in the wide stretch of grass between the parking lot and the road. While this wouldn't offer a very large drainage area it would be visible to students, parents, and faculty; posing a great learning opportunity.

Site 9: HAMDEN HIGH SCHOOL

LOCATION:

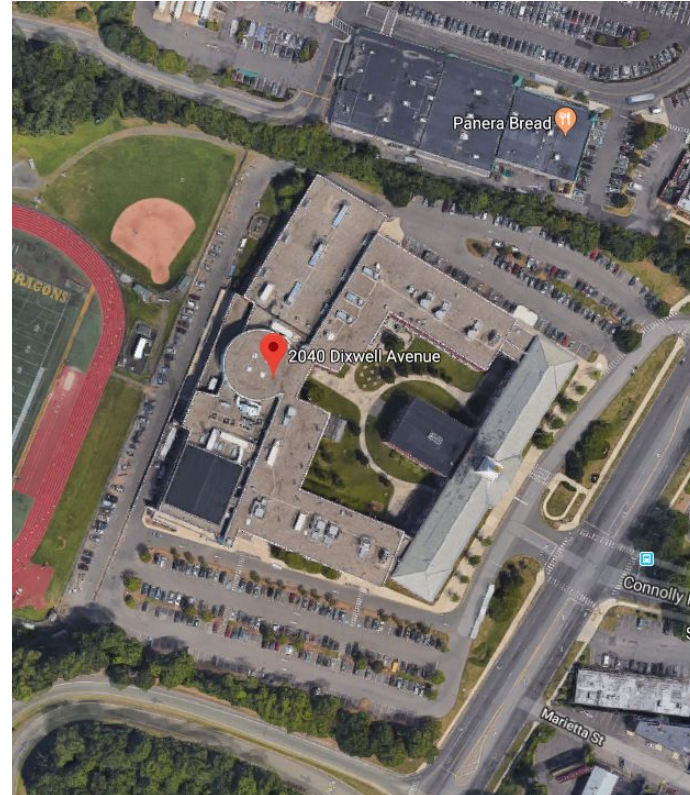
2040 Dixwell Ave, Hamden, CT

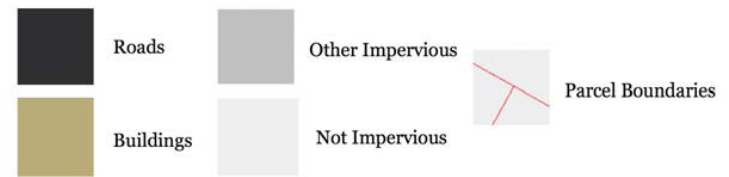
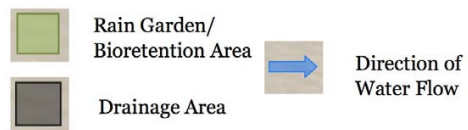
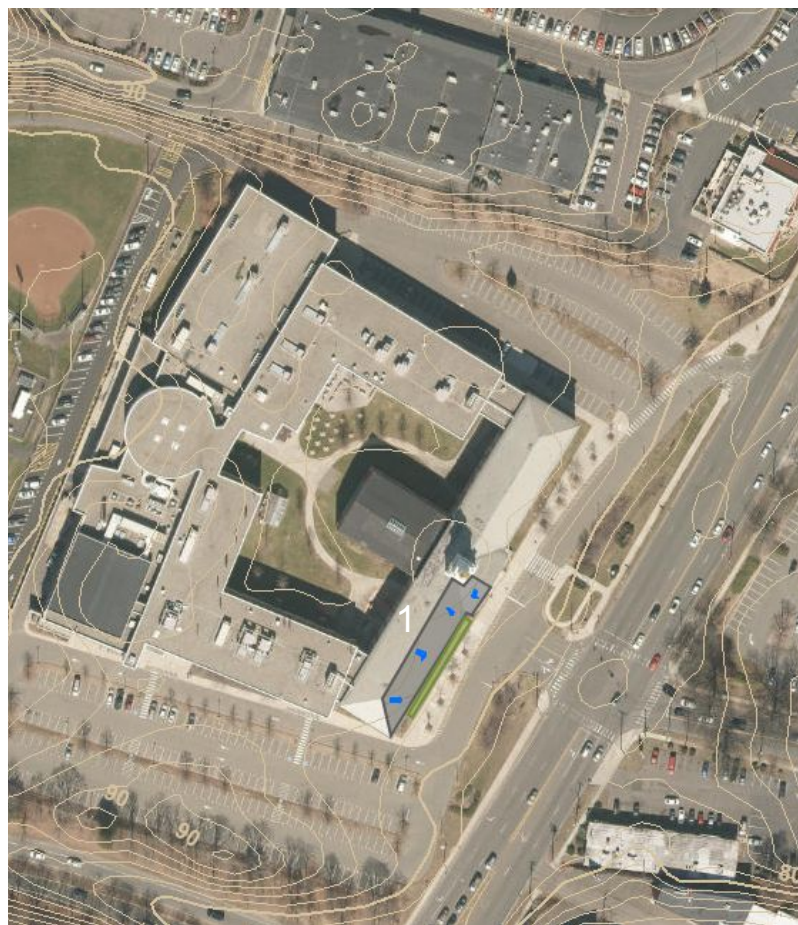
IMPERVIOUS AREA:

5,209 sq feet

SUBREGIONAL WATERSHED:

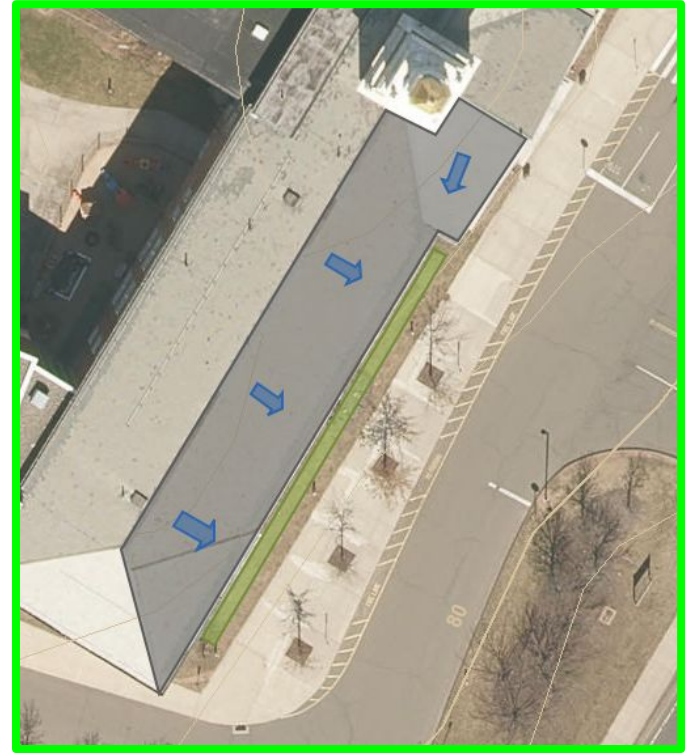
Mill River; 5302





HAMDEN HIGH SCHOOL

Option 1: Southern 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)
5,209	Bioretention	132,493	0.911	0.064	868



The front of Hamden High School would be an ideal spot to implement a rain garden. The area is a large stretch of grass which is a large enough area to collect and filter the water that would run off of the roof of the high school. As it is located by where the busses drop off students and close to a major road; visibility would be exceptional.

Site 10: CHURCH STREET SCHOOL

LOCATION:

95 Church St, Hamden, CT

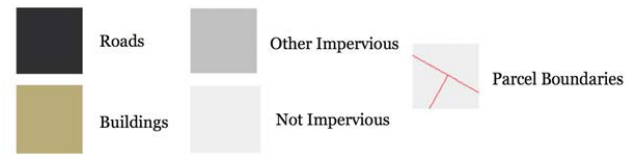
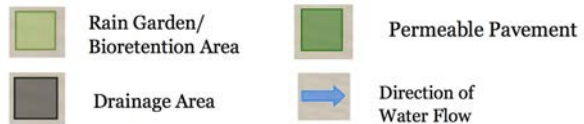
IMPERVIOUS AREA:

1,525 sq feet

SUBREGIONAL WATERSHED:

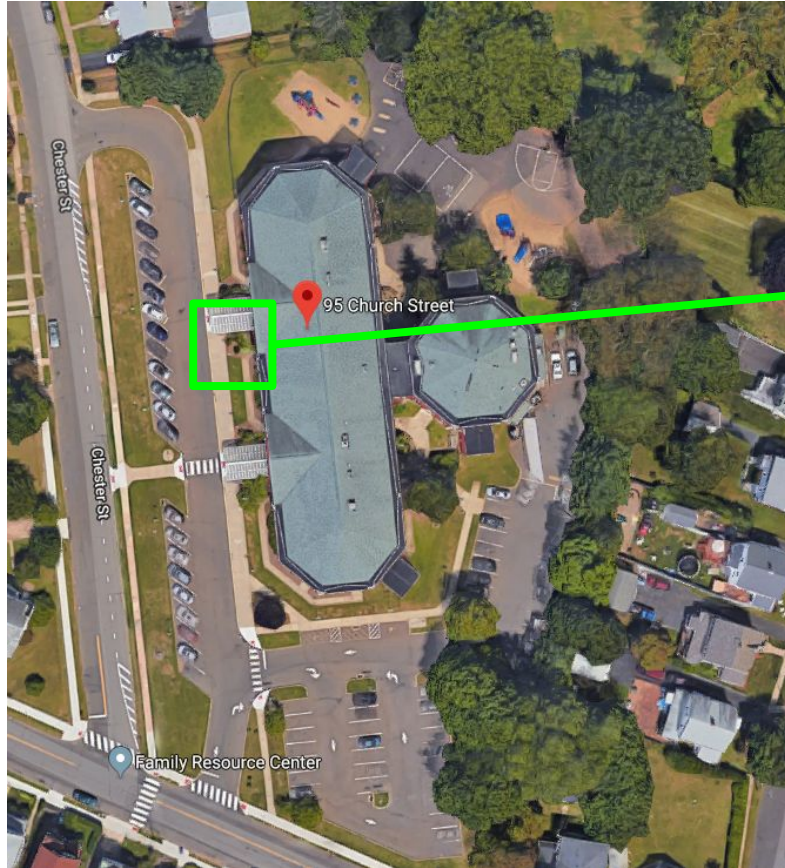
Wintergreen Brook; 5304





CHURCH STREET SCHOOL

Options 1: South Facing Roof Drainage Area



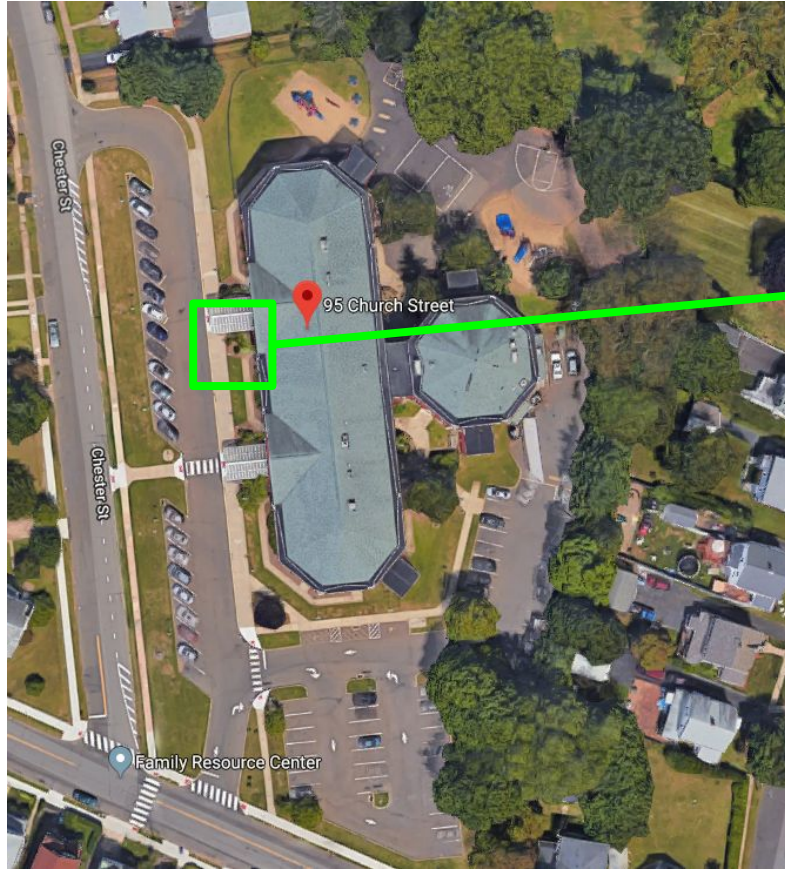
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
282	Rain Garden	7,172	0.049	0.003	47



School faculty raised concerns about the current erosion and flooding problems in this area. We recommend constructing a rain garden down slope where rain water falls off the awning and pools below the entrance of the school. This may require existing trees, shrubs, and other plants to be removed.

CHURCH STREET SCHOOL

Options 2: Entrance Sidewalk



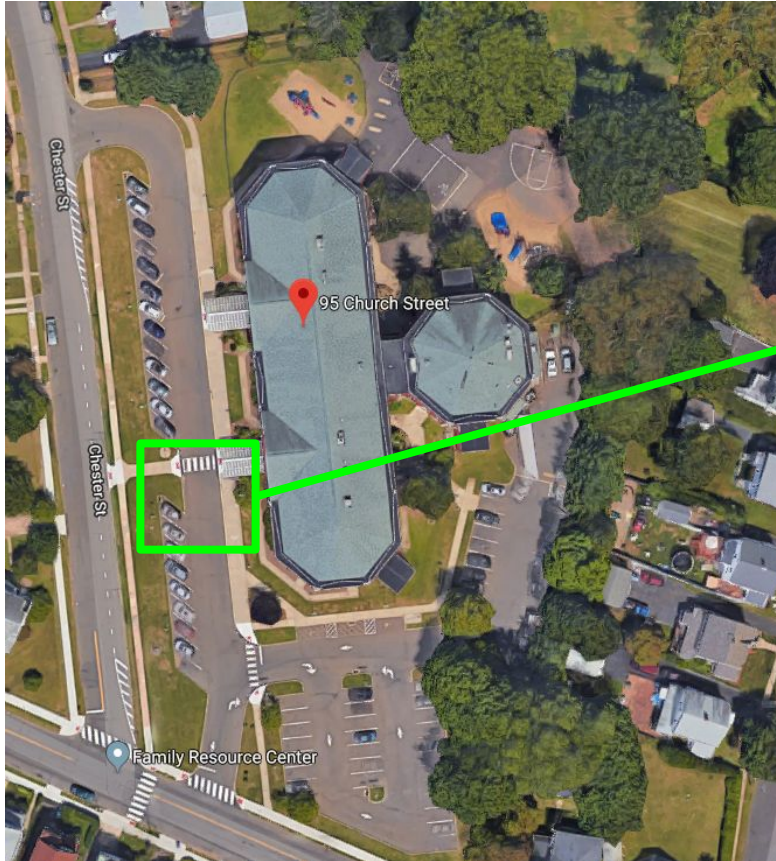
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
170	Permeable Surface	4,323	0.029	0.002	170



We also recommend replacing the flood prone sidewalk areas with a pervious surface such as pervious concrete, pavement, or pavers. The substrate below would need to have enough water storage and well drained soils to allow for maximum infiltration.

CHURCH STREET SCHOOL

Option 3: Southwest Entrance 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)
418	Rain Garden	10,631	0.072	0.005	70



Although a rain garden in this corner may not disconnect a significant portion of runoff from the stormwater system, the location in front of the school is ideal for visibility, aesthetic value, and educational purposes.

CHURCH STREET SCHOOL

Option 4: Southeast Square



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)
655	Permeable Surface	16,658	0.113	0.008	655



This patio area could be resurfaced with pervious pavers to keep storm water from entering the nearest storm drain and to increase the aesthetic value of this space.

Site 11: COMMUNITY BRANCH LIBRARY

LOCATION:

91 Circular Ave, Hamden, CT

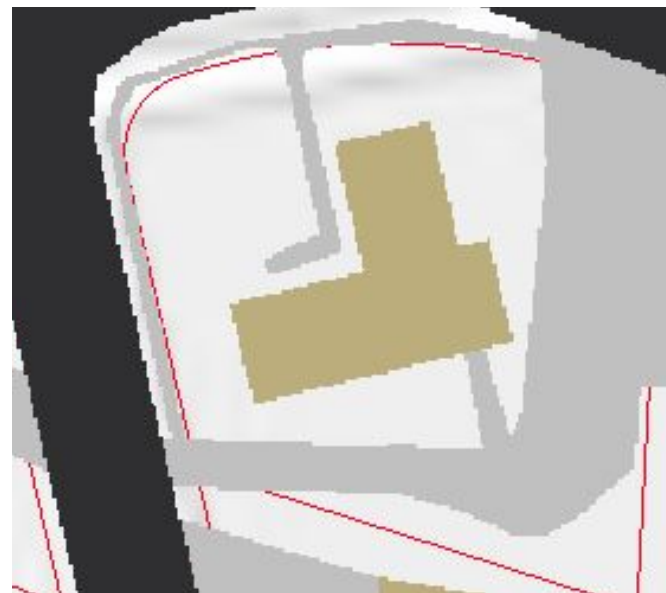
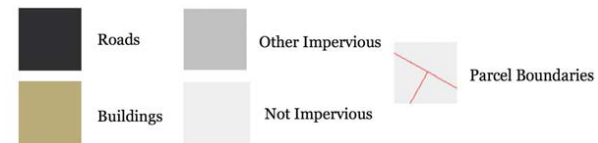
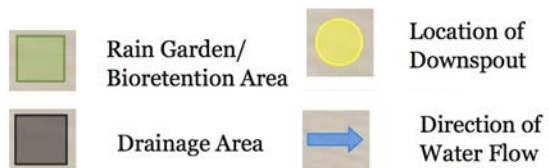
IMPERVIOUS AREA:

1,138 sq feet

SUBREGIONAL WATERSHED:

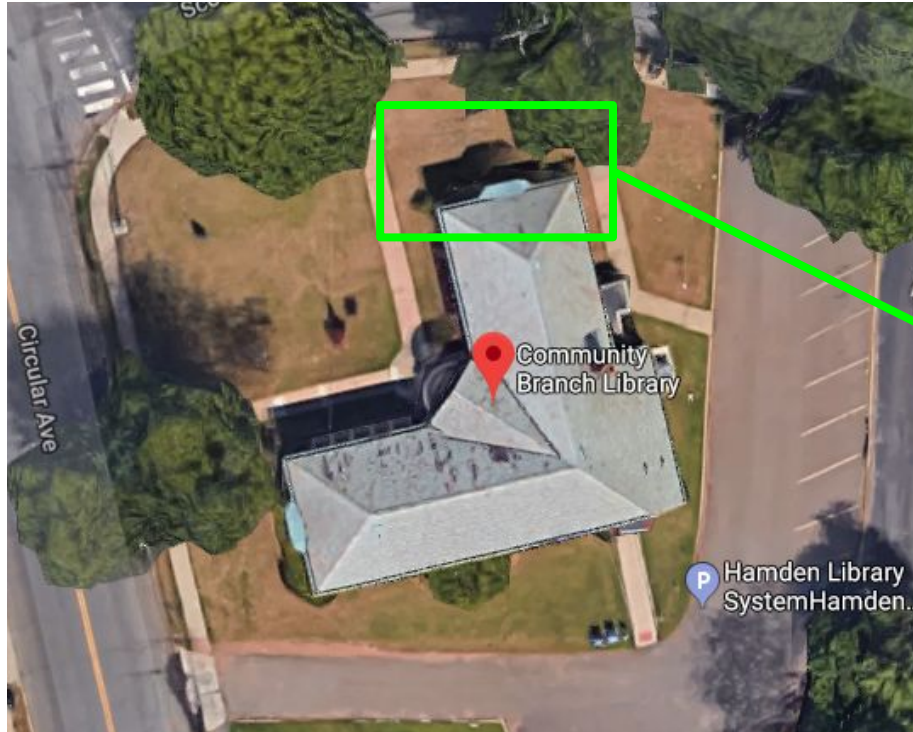
Wintergreen Brook; 5304





COMMUNITY BRANCH LIBRARY

Option 1: Northern Side



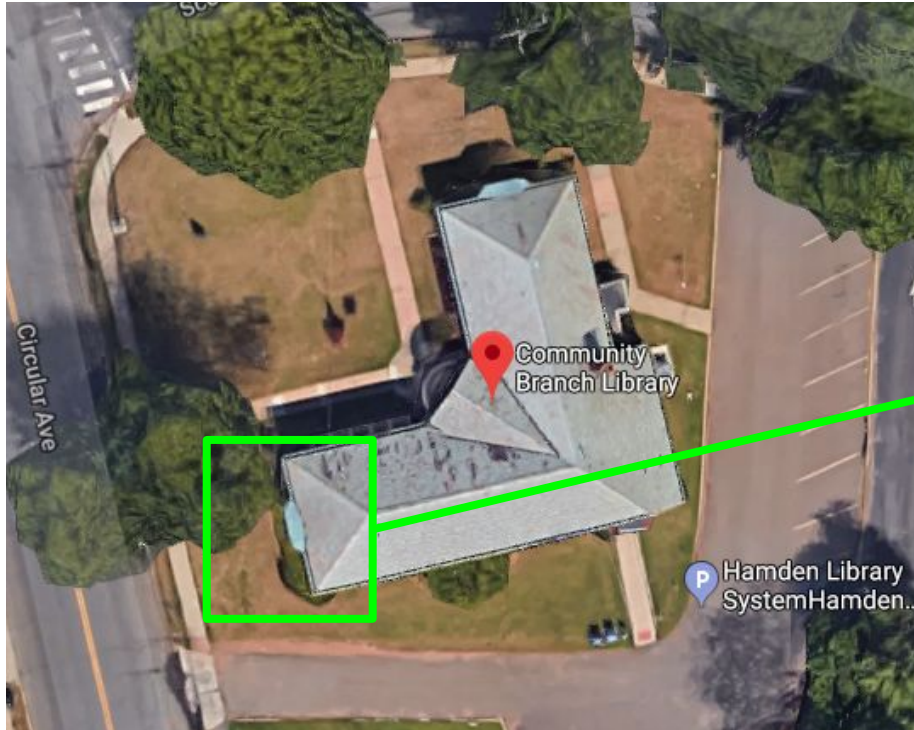
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
214	Rain garden	5,442	0.037	0.003	36



Here, implementing a rain garden would disconnect the two downspouts on the side of the building. The downspouts would lead to the rain garden and would prevent the roof runoff from discharging into the stormwater system.

COMMUNITY BRANCH LIBRARY

Option 2: Western Side



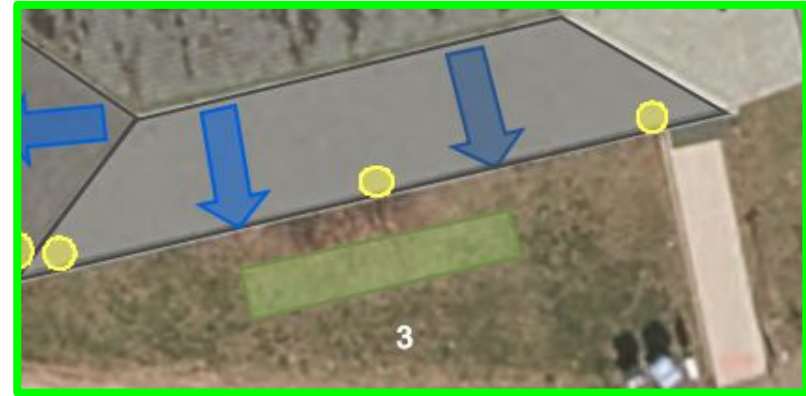
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N/yr)	Annual Phosphorus Reduction (lb P/yr)	Suggested Practice Size (sq ft)
211	Rain garden	5,366	0.037	0.003	35



The proposal for this option is to use the two downspouts catching the runoff from the roof to feed a rain garden. Currently the water falls into the stormwater system, but could be used to water the garden and permeate slowly back into the natural groundwater storage. This location is in the front of the library and alongside the road, so would provide an educational opportunity and public outreach.

COMMUNITY BRANCH LIBRARY

Option 3: Southern 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)
713	Rain garden	18,133	0.123	0.009	119



Currently there are 3 downspouts connected to the stormwater system on this side of the building. If these are disconnected and redirected into a rain garden, the water will be slowly infiltrated back into the ground rather than moved into the stormwater system. This would also add to the aesthetics and educational aspect of the library.

Site 12: ML KEEFE COMMUNITY CENTER

LOCATION:

11 Pine St, Hamden, CT

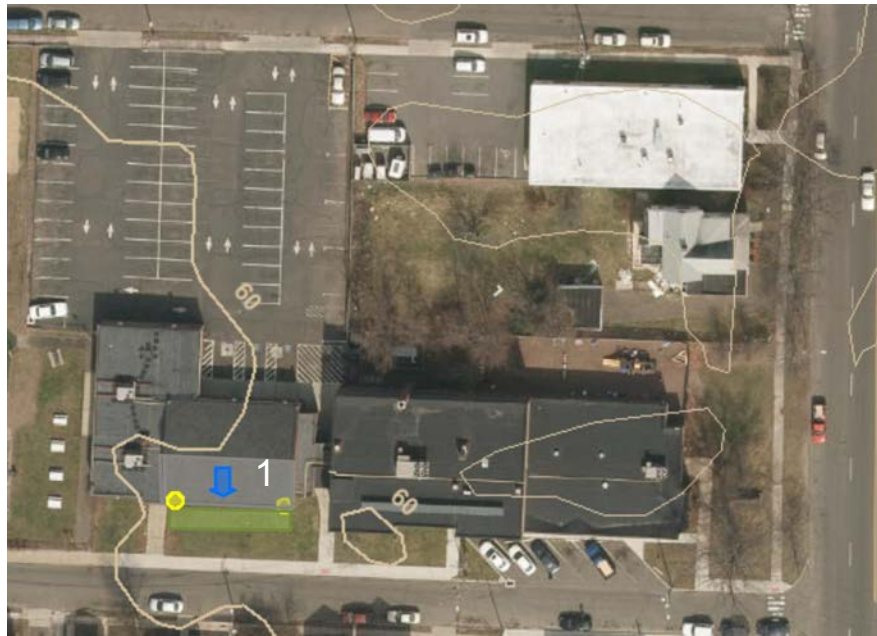
IMPERVIOUS AREA:

1,343 sq feet

SUBREGIONAL WATERSHED:

Mill River; 5302





Rain Garden/
Bioretention Area



Location of
Downspout



Drainage Area



Direction of
Water Flow



Roads



Other Impervious



Parcel Boundaries



Buildings

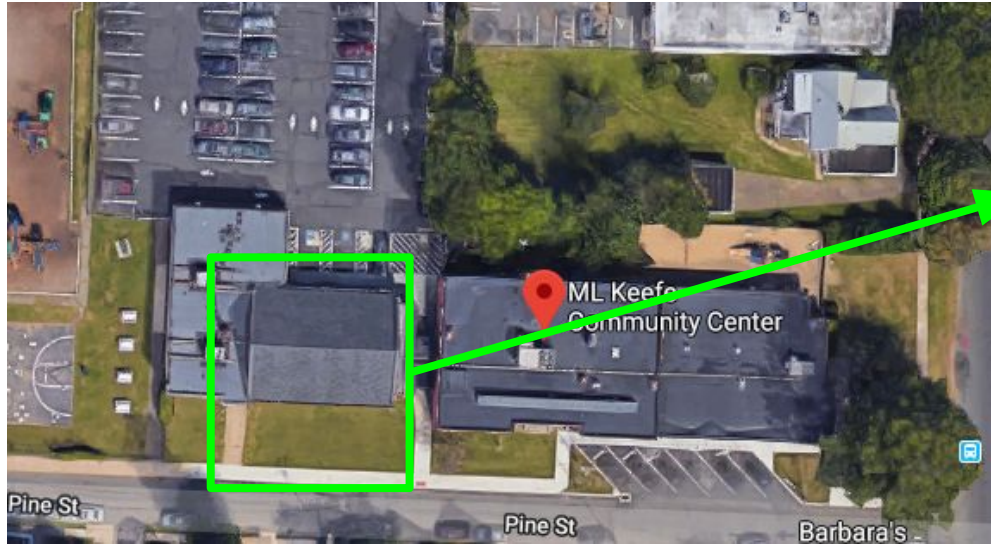


Not Impervious



ML KEEFE COMMUNITY CENTER

Option 1: 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)
1,343	Rain Garden	34,147.5	0.232	0.016	223.8



At this location, a rain garden is recommended in the front of the building to disconnect the two downspouts from the stormwater system. In addition, to disconnecting the downspouts the rain garden would be a good educational opportunity for the students to learn about green infrastructure practices.

CONTACT & PARTNERS

This project was funded by a grant from the Long Island Sound Futures Fund of the [National Fish and Wildlife Foundation](#). It is a partnership of the [University of Connecticut Center for Land Use Education and Research \(CLEAR\)](#) and [Rutgers University Water Resources Program](#), and is adapted from a process developed by the latter.

Contacts:

Mike Dietz, UConn CLEAR, michael.dietz@uconn.edu, 860-486-2436

Dave Dickson, UConn CLEAR, david.dickson@uconn.edu, 860-345-5228

