COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

Center for Land Use Education & Research

CLEAR

Stormwater Runoff Reduction Plan - Branford, CT

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Summary

During the summer of 2021, a team of UConn students and Extension faculty performed an evaluation of potential stormwater enhancement opportunities in the Town of Branford, 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 benefits from each of the proposed installations. If all five projects identified in the report are implemented, 170,358.48 sq ft of impervious cover will be disconnected from the stormwater drainage system. This means that 3,492,342 gallons of untreated stormwater, 37.05 lbs of nitrogen, and 4.786 lbs of phosphorus will be prevented from entering local water bodies annually.

In This Report...

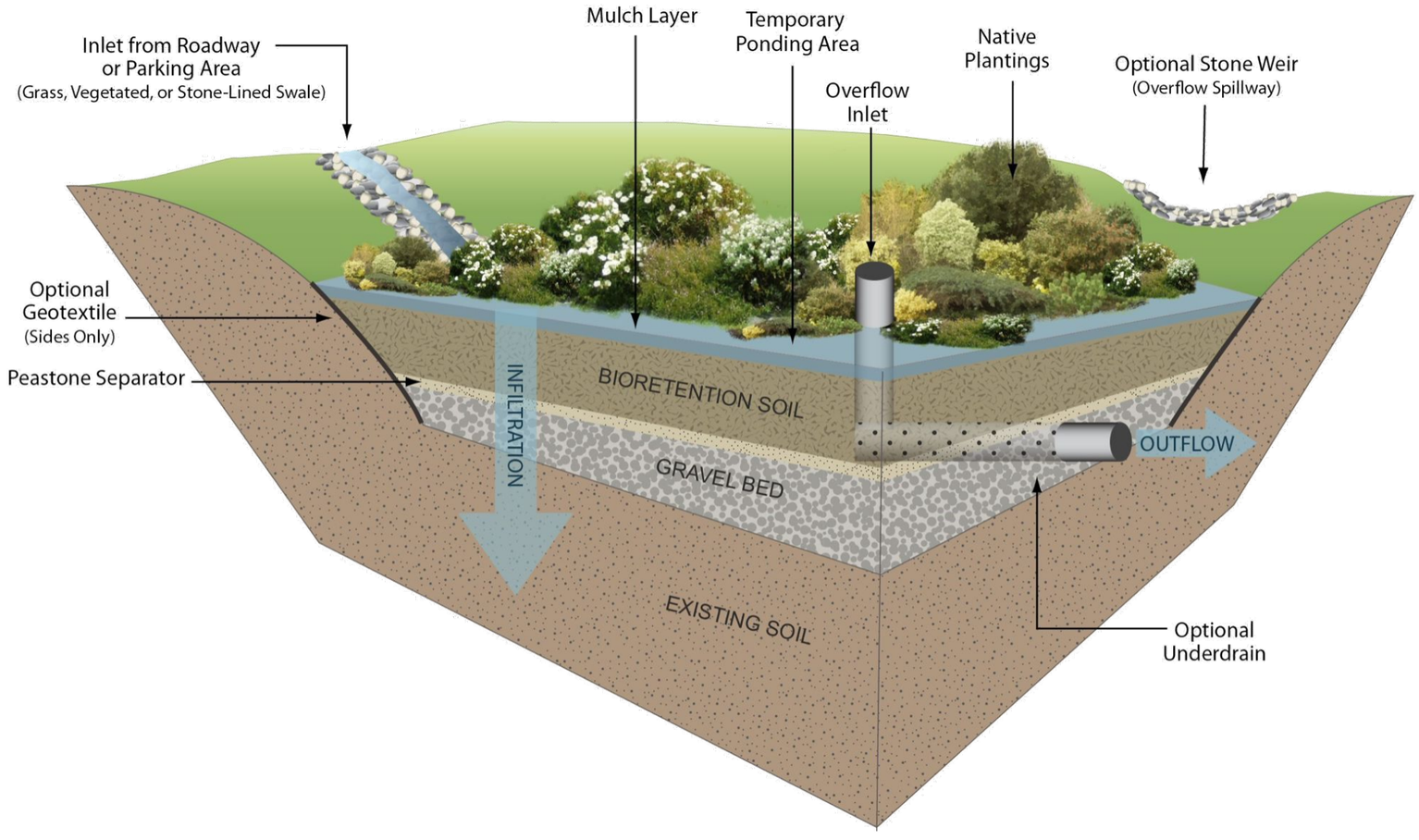
Included are recommendations for green stormwater infrastructure practices at five sites in the town of Branford. Each site is introduced with an aerial photo from Google Maps displaying the recommended green infrastructure and a map displaying all impervious cover in the area. The following report includes the address, total impervious area to be disconnected from the stormwater system, and the subregional watershed. Information about the nitrogen and phosphorus load reduction per year is included, as well as the size of the recommended installation, the gallons of runoff treated per year and its estimated cost. These estimations are calculated based on the drainage area, annual rainfall estimates specific to Connecticut, and literature export values. Sites that did not make it into the top five are also listed afterwards with some additional recommendations and notes, as well as some maintenance opportunities for the town of Branford.

Impervious Surfaces & Runoff

The expansion of developed land in Connecticut has vastly increased the area of imperious cover around the state. This includes roads, rooftops, parking lots, and other development, leading to increased runoff into stormwater management systems. This not only disrupts the local water cycle, but increases the amount of pollutants in waterways and causes erosion/flooding. The implementation of green infrastructure disconnects stormwater from local management systems and allows it to naturally infiltrate into the ground. Installations such as rain gardens, green roofs, tree box filters, and pervious pavements benefit the local water cycle and offer great educational opportunities to the surrounding area, as well as offering a more aesthetic alternative to more traditional stormwater management systems.

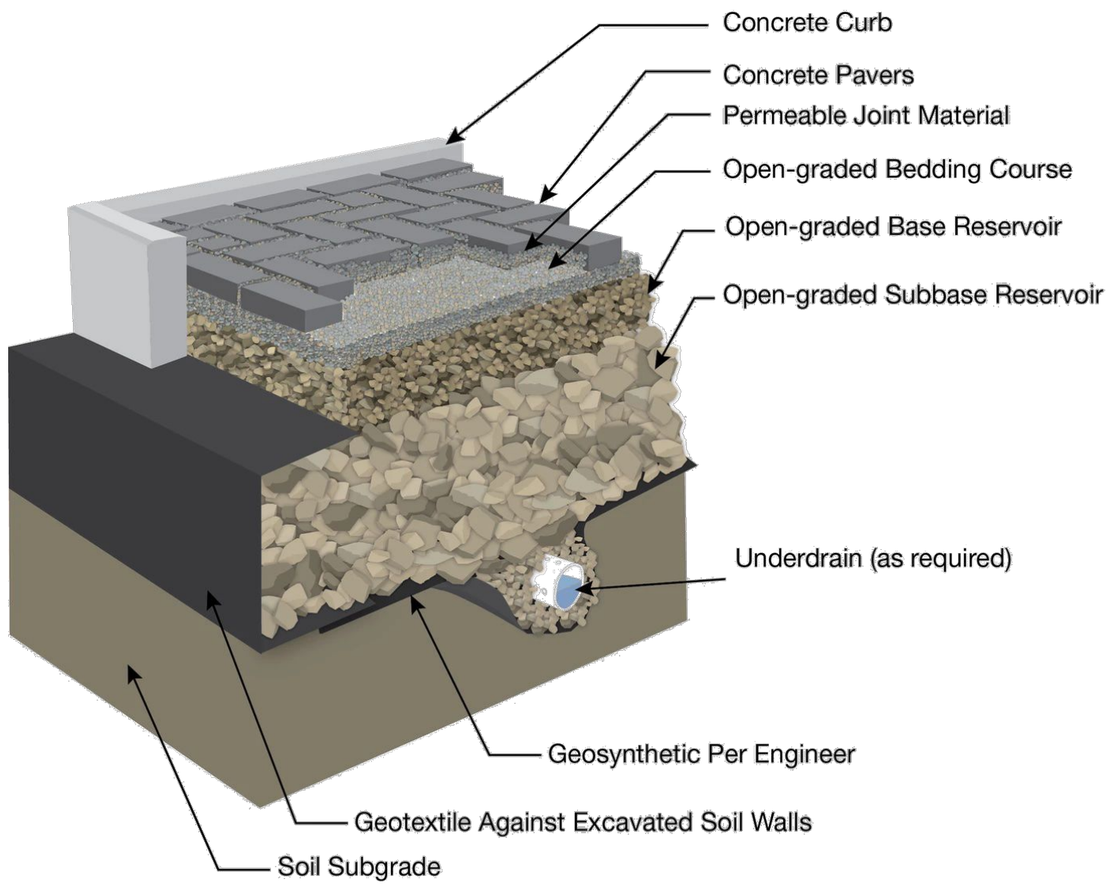
Rain Gardens and Bioretention

Rain gardens are a green infrastructure installation that captures stormwater from impervious surfaces or disconnected gutters. This practice allows the water to permeate into the ground to rejoin the local water cycle. Rain gardens consist of a depression at least 6 inches deep filled with native plants. The practice might involve curb cuts or gravel material as a buffer for erosion depending on the individual site. Rain gardens add to the aesthetic appeal and the biodiversity of urban areas.



Pervious Paving

Pervious paving is an alternative to traditional asphalt or concrete that allows for the infiltration of water. Ideal locations for pervious pavement 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 and is less susceptible to seasonal expansion and contraction which reduces the occurrence of frost heaves and cracking. Pervious pavements are also fairly costly and require maintenance such as pressure washing and vacuum sweeping to dislodge debris in the pores of the pavement. Without proper maintenance the stormwater is unable to infiltrate and the green infrastructure is ineffective. Pervious pavement requires less snow maintenance than its counterpart and decreases the need for salting. A variety of pavement types are available such as pervious asphalt, concrete, and a variety of permeable pavers.

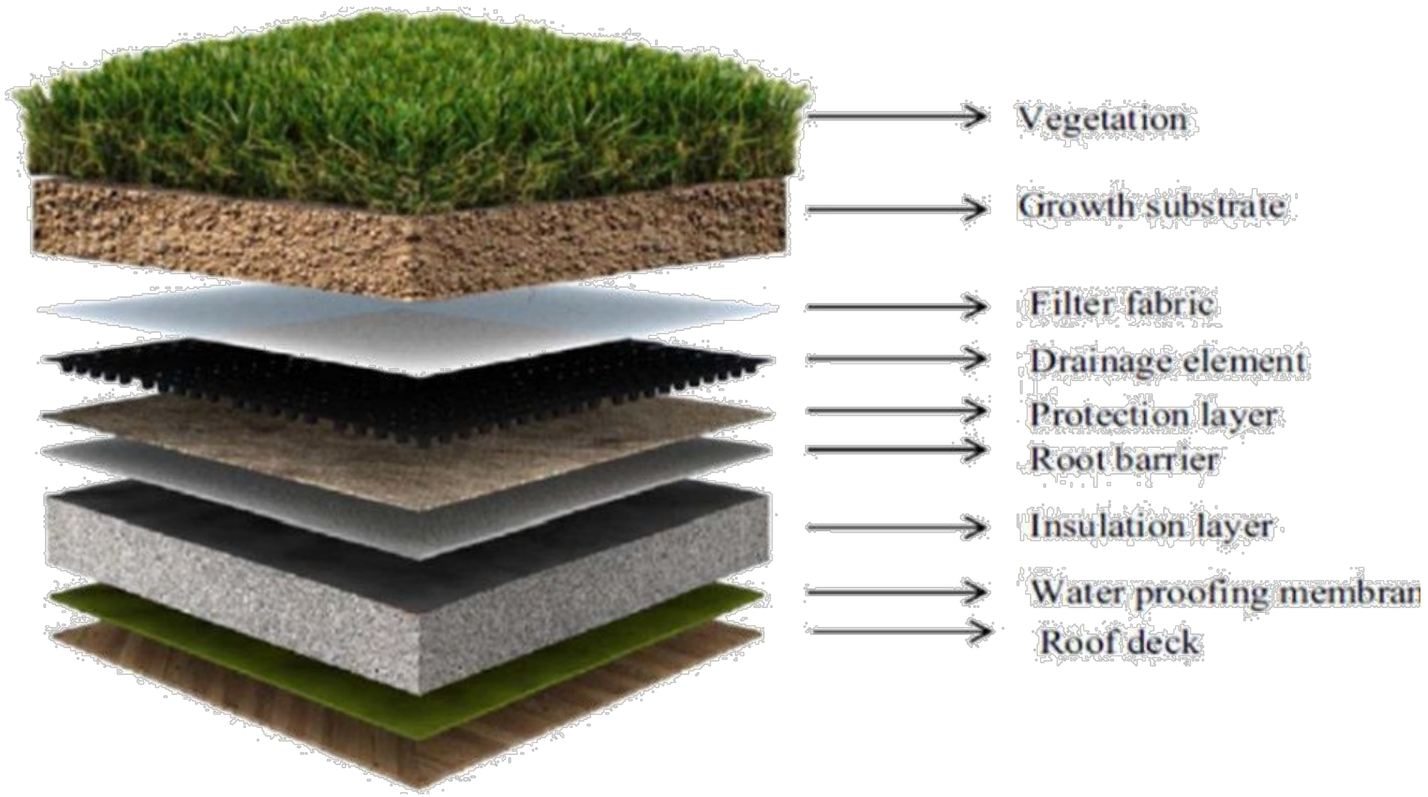


Tree Box Filters

Tree box filters are an aesthetically pleasing green infrastructure practice that filter runoff. Stormwater enters the installation through a grate, then infiltrates through the soil and root system, filtering out pollutants. Depending on the amount of stormwater present near the practice, an underdrain may be required to prevent flooding.

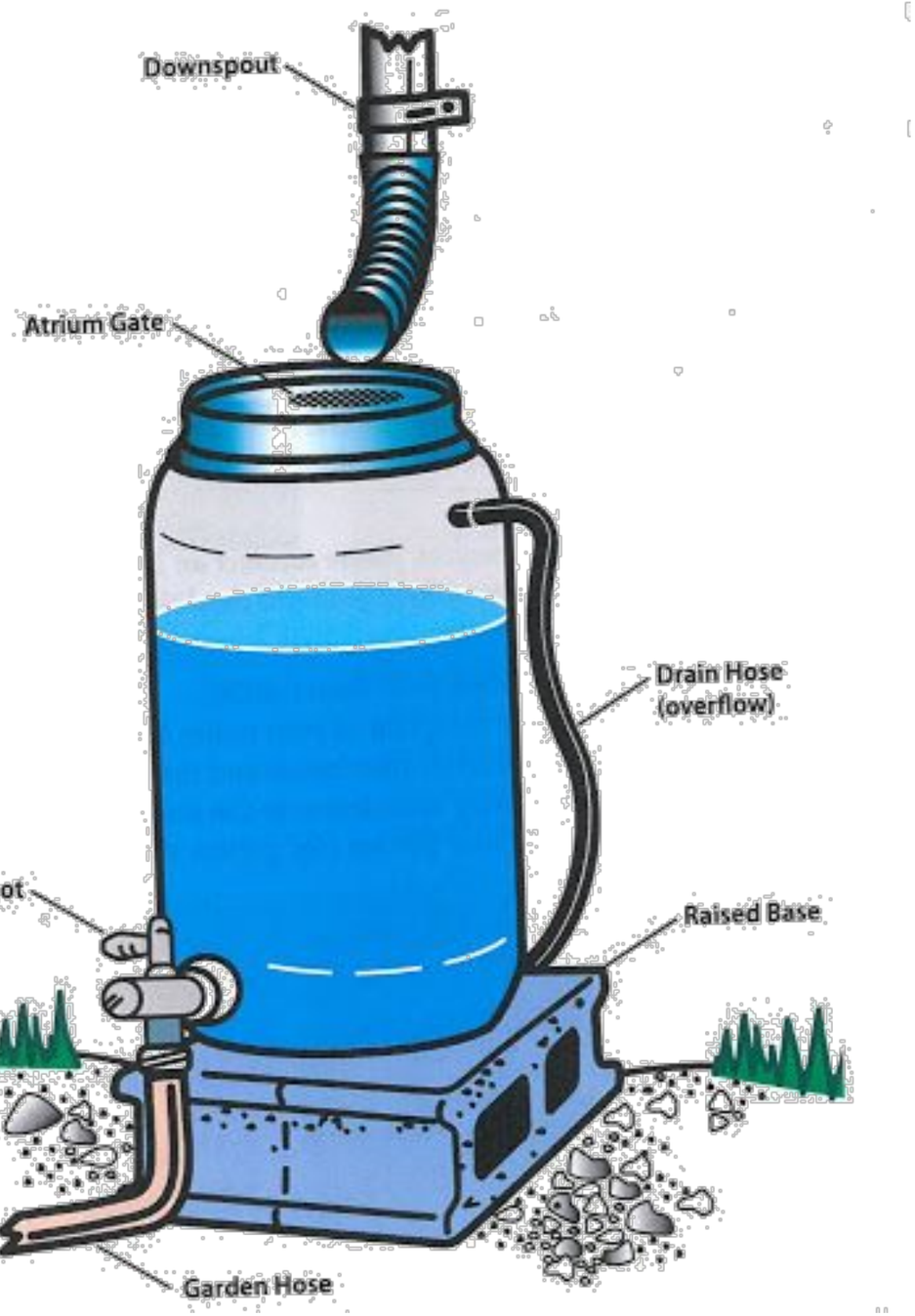
Green Roofs

A green roof is a form of green infrastructure that allows runoff, that would otherwise enter an internal piping or gutter system, to infiltrate substrate directly. This installation disconnects about 50% of the stormwater that sheds off any given building. It is the most expensive practice, but offers great educational opportunities for nearby communities and adds to the aesthetic of any location. Green roof trays may be a more affordable option. The implementation of a green roof depends on the structural support of the roof and proper roof access.



Rainwater Harvesting

Rainwater harvesting is the capture and reuse of water from gutters and downspouts which would otherwise end up in the municipal stormwater 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 uses. Not only does this reduce runoff, but it also reduces stress on private wells and municipal water supplies. The required size of the rain barrel depends on the collection area and materials can range from PVC to steel. Based on the needs at the location, a filter can be installed to remove pollutants. Cisterns require minimal maintenance; however, may need to be moved in the winter months to prevent freezing.

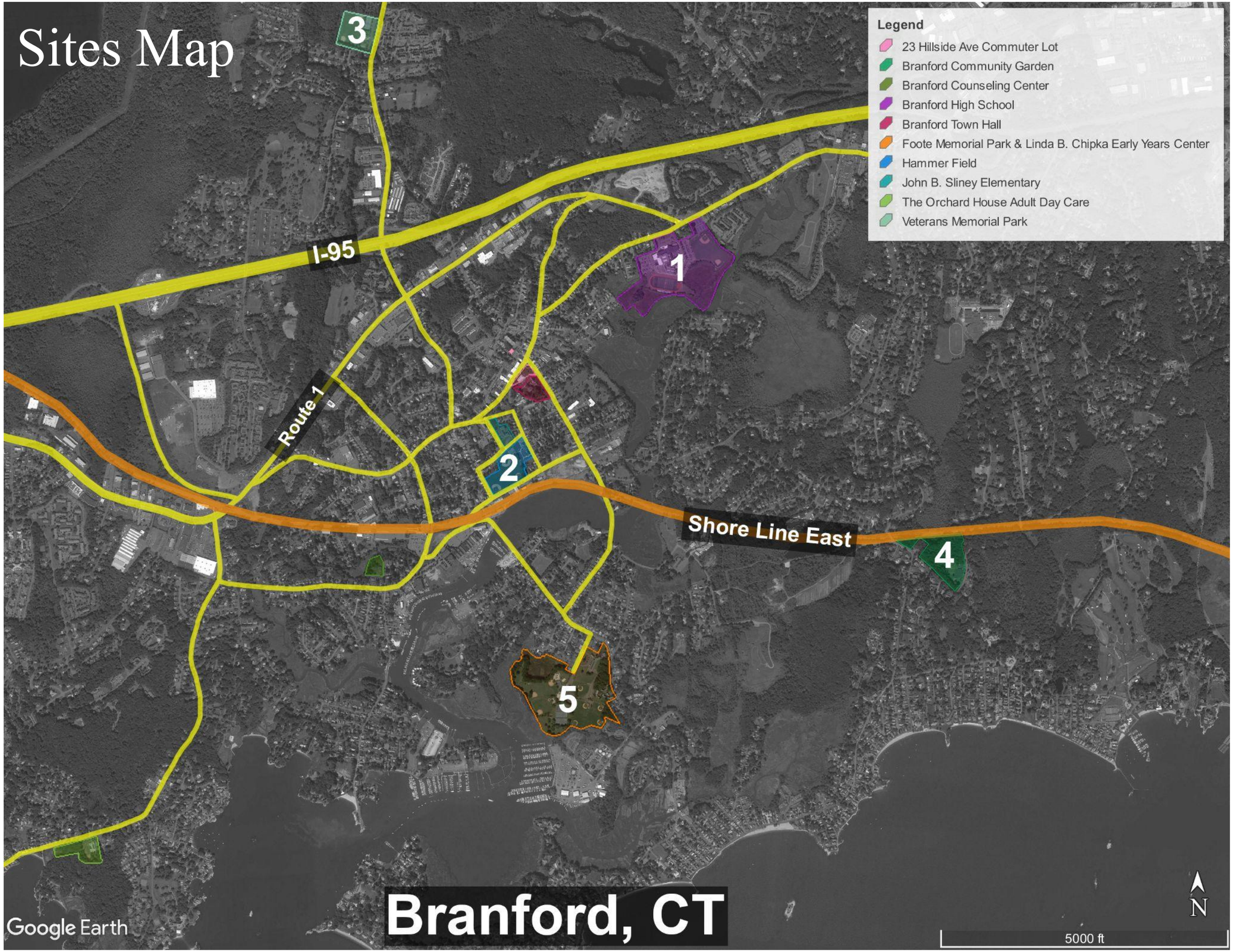


Site Selection & Approach

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 provide 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, locations 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


Legend
23 Hillside Ave Commuter Lot
Branford Community Garden
Branford Counseling Center
Branford High School
Branford Town Hall
Foote Memorial Park & Linda B. Chipka Early Years Center
Hammer Field
John B. Sliney Elementary
The Orchard House Adult Day Care
Veterans Memorial Park
3
1
I-95
Route 1
1
2
Shore Line East
4
5
Google Earth
Branford, CT
N
5000 ft

Branford HS

185 E Main St
Branford, CT

Notes:

-Multiple practices ideal for implementation; high educational value and visibility

-Close proximity to wetland ecosystem

-Opportunity to incorporate practices into curriculum

-Total Potential Disconnect:
32,669 sq. ft.

IMPERVIOUS COVER

Possible disconnect of 3,659 sq. ft. of impervious cover with use of tree box filter. This practice will add to the aesthetics of the entrance and provide great visibility for the project.

East Main St

Possible disconnect of 21,867 sq. ft. of impervious cover with use of rain garden. Excellent educational opportunity in student parking lot.

Possible disconnect of 7,143 sq. ft. of impervious cover with use of rain garden. Potential incorporation into community garden with opportunity for students to assist in maintenance.

Branford High School

Visitor Lot

Drainage Area

Storm Drain

Bioretention Opportunity

Drainage Area
- 3,659 sq. ft.

Suitable for various design options

Suggested Practice
Bioretention
- 12” Depth
- 304 sq. ft.
- $1,500 - $9,150

96,340 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .13 lb/year

7 N 14.007

Nitrogen Reduction 1 lb/year

Branford High School
East Lot

Drainage Area

Storm Drain

Rain Garden Opportunity

Drainage Area - 21,867 sq. ft.

Pedestrian Circulation

Suggested Practice
Rain Garden
- 8” Depth
- 2,700 sq. ft.
- $11,600 - $46,400

575,826 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .76 lb/year

7 N 14.007

Nitrogen Reduction 5.98 lb/year

Branford High School

West Lot Exit

Drainage Area

Storm Drain

Rain Garden Opportunity

Drainage Area
- 7,143 sq. ft.

Suggested Practice
Rain Garden
- 6” Depth
- 595 sq. ft.
- $2,380 - $9,520

188,094 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .25 lb/year

7 N 14.007

Nitrogen Reduction 1.95 lb/year

Hammer Field

46 Church Street
Branford, CT

Notes:

-Street front on SE corner suitable for rain garden
-Opportunity to improve swale on south end of parking area
-Opportunity to improve drainage in swale at north end of parking lot

-Total Potential Disconnect
5,793 sq. ft.

IMPERVIOUS COVER

Functioning swale at base of lot causing minor erosion and sedimentation issues.

Possible disconnect of 5793 square feet of impervious cover. Storm drain near the SE entrance to Hammer Field ideal for disconnect, with rain garden retrofit of grass street buffers and small parking area.

Functioning swale leading to storm drain causing erosion issues; storm drain should be raised.

Prospect St

Church St

Hopson Ave

Meadow St

Watershed

Storm Drain

Rain Garden Opportunity

Single parking spot between two grass buffers

SE entrance to Hammer Field

Watershed
-5793.48 sq. ft.

Church St

Meadow St

Hammer Field

Church & Meadow

Suggested Practice
Rain Garden
- 8" Depth
- 724 sq. ft.
- $2,896 - $11,584

152,560 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .216 lb/year

7 N 14.007

Nitrogen Reduction 1.58 lb/year

Foote Park & Linda B. Chipka Early Years Center

12 Melrose Ave
Branford, CT

Notes:

-Roadway at Early Years Center suitable for tree box filter
-Rear lot at Foote Park suitable for rain garden
-Functioning swale could be improved for greater efficency

-Total Potential Disconnect:
62,116 sq. ft.

IMPERVIOUS COVER

Possible disconnect of 15,507 sq. ft. of impervious cover with use of tree box filter. Great educational opportunity for kinder-garten students and parents. Excellent visibility and improvement to entrance.

Possible disconnect of 46,609 sq. ft. of impervious cover with use of rain garden. Storm drain at rear of lot prone to clogging causing ponding and erosion issues.

Swale along tennis courts could intercept additional parking lot runoff. Sedementation is an issue here; practices to promote better drainage could be employed

Linda B. Chipka Early Years Center

Melrose Ave

Drainage Area

Storm Drain

Tree Box Filter Opportunity

Drainage Area - 15,507 sq. ft.

Suggested Practice
Tree Box Filter
- 3' x 3'
- $14,000 - $36,000

408,357 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .54 lb/year

7 N 14.007

Nitrogen Reduction 4.24 lb/year

Foote Memorial Park

South Lot

Drainage Area

Storm Drain

Rain Garden Opportunity

Existing Grass Swale

X Curb Cut

Drainage Area 2 - 4,269 sq. ft.

Drainage Area 1 - 39,247 sq. ft.

Drainage Area 3 - 47,916 sq. ft.

xxx

xxx

Swale experiencing issues with ponding and sedimentation. Riprap may be employed along the tennis courts and in front of curb cut to reduce runoff velocity and sediment load. Planting the swale would also enhance aesthetics and recognition.

Suggested Practice

Rain Garden

- 1' Depth
- 3,270 sq. ft.
- $13,080 - $52,320

1,033,511 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction 1.36 lb/year

7 N 14.007

Nitrogen Reduction 10.73 lb/year

Branford Community Garden

16 Birch Rd
Branford, CT

Notes:

-Downspouts on north and south end of building ideal for rain harvesting barrels, with possible third location at entrance
-Building has potential for green roof if structural integrity allows

-Total Potential Disconnect:
11,020 sq. ft.

IMPERVIOUS COVER

Potential **disconnect of 11,020 sq. ft.** of impervious cover with use of **green roof**. If roof integrity allows, access may be provided allowing for greater visibility and educational opportunity.

Potential disconnect of 11,020 sq. ft. of impervious cover with the implementation of rain barrels. Excellent educational opportunity when used to water the community garden. If internal drainage allows, 3 total barrels could be retrofitted to the existing downspouts.

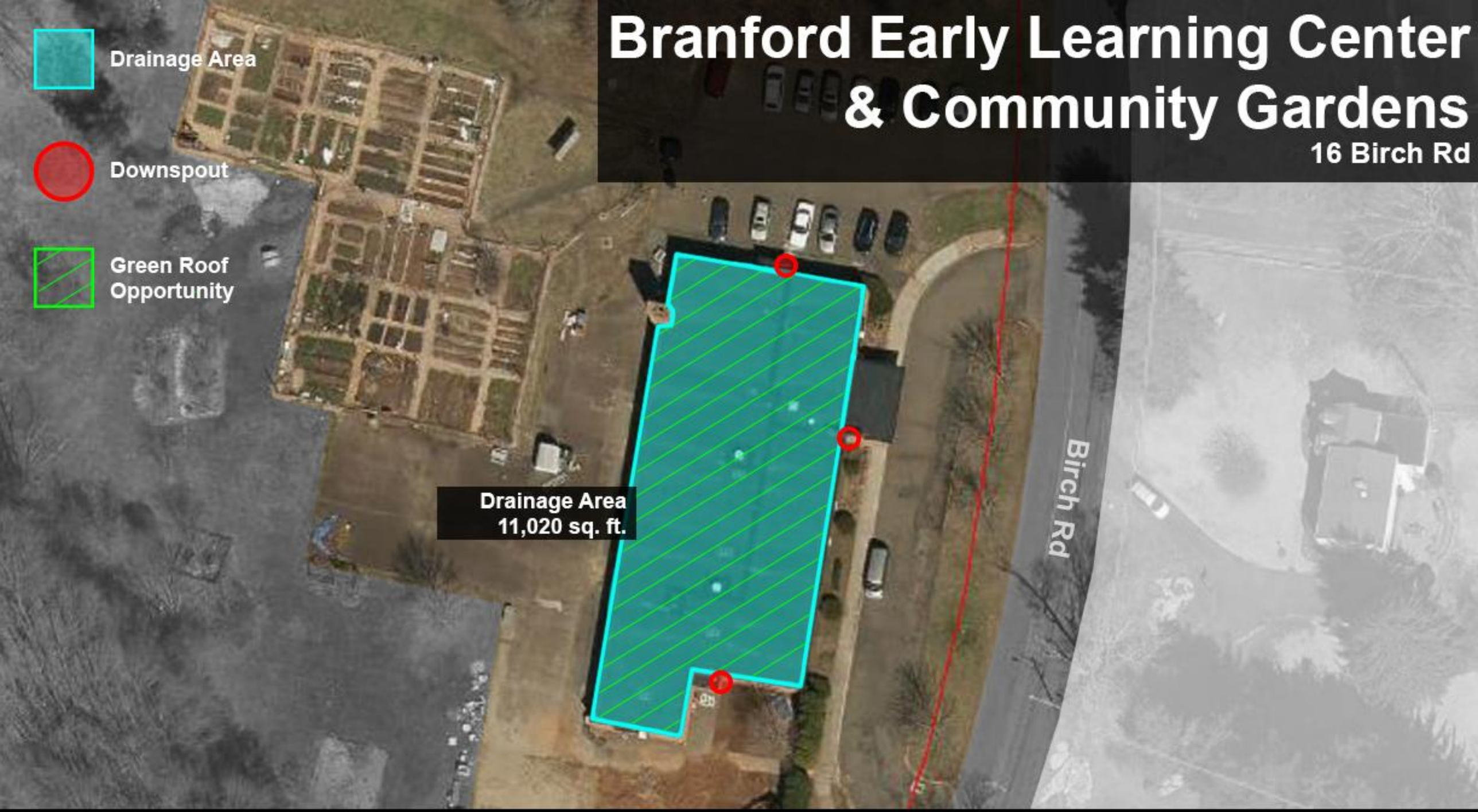
Branford Early Learning Center & Community Gardens

16 Birch Rd

Drainage Area

Downspout

Green Roof Opportunity



Suggested Practice
Green Roof
-$7 - $36/sq. ft.
-$77,144 - $396,744

164,891 gal. runoff treated per year

15 P 30.974
Phosphorus Reduction .38 lb/year

7 N 14.007
Nitrogen Reduction 3.01 lb/year

Branford Early Learning Center & Community Gardens

16 Birch Rd

Drainage Area

Downspout

Rain Barrel Opportunity

Drainage Area 1
5,183 sq. ft.

Drainage Area 2
4,530 sq. ft.

Birch Rd

Potential for third rain barrel, dependant on internal drainage

Drainage area determined through satellite imagery

Suggested Practice
Rain Barrel
- 2x 3,000 gal. cistern
- $1,500-$2,500

290,659 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .34 lb/year

7 N 14.007

Nitrogen Reduction 2.66 lb/year

Veteran's Memorial Park

120 Brushy Plains Rd

Notes:

-North and south parking areas ideal for permeable gravel pavement

-Central roundabout suitable for rain garden

-Various secondary options available for evolution of project

-Total Potential Disconnect:
33,147 sq. ft.

IMPERVIOUS COVER

Possible disconnect of 21,344 sq. ft. of impervious cover in north lot, 7,840 sq. ft. in south, with use of permeable gravel pavement. Great visibility in location for a less common GSI practice.

Possible disconnect of 3,693 sq. ft. of impervious cover in roundabout with implementation of rain garden in central grassed area. High profile location for both visibility and educational opportunity.

Veteran's Memorial Park

Parking Area

Drainage Area

Storm Drain

Gravel Grid Opportunity

Drainage Area 1
- 21,344 sq. ft.

Drainage Area 2
- 7,840 sq. ft.

Suggested Practice
Gravel Grid Pavers
- 7,361 sq. ft.
- $11,041- $42,325

768,434 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction 1.01 lb/year

7 N 14.007

Nitrogen Reduction 7.48 lb/year

Veteran's Memorial Park
Entrance

Drainage Area

Storm Drain

Rain Garden Opportunity

Curb Cut

Drainage Area - 3,963 sq. ft.

Preserve sign & flagpole

Suggested Practice
Rain Garden
- 6" Depth
- 658 sq. ft.
- $2,632 - $10,528

104,344 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .14 lb/year

7 N 14.007

Nitrogen Reduction 1.08 lb/year

Veterans Park

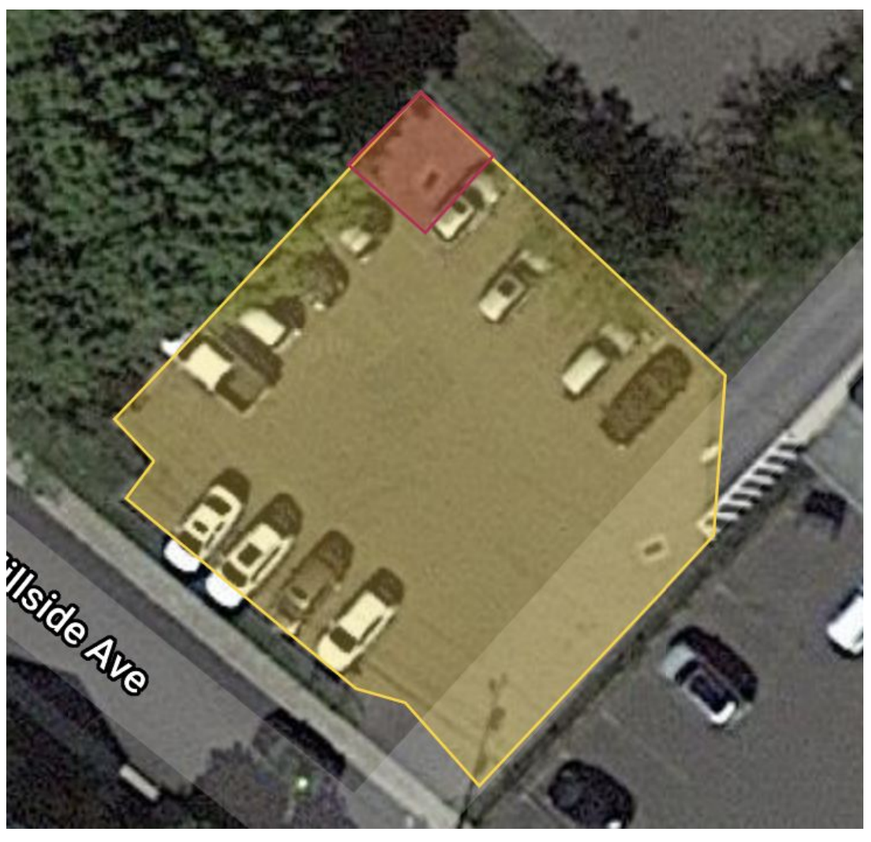
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
2918.52	Gravel Grids	76443	.80	.10	2918.52 (same as drainage area)	$4,377-16,781

This is another area of Veterans Park we can retrofit. Where the arrow is pointing there is a storm drain collecting water from the tennis court and pink highlighted area. There is not much visibility here but the gravel pavers would allow a better treatment of the water and stop what looks to be a lot erosion in the area.

Municipal Lot

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
6,229.08	Pervious Pavement	186,399	1.70	0.22	6,229.08	$21,801.78 - $49,832.64
6,054.84	Bioretention	159,443	1.66	0.21	261.36 @ 1’	$1,308.80 - $7,840.80

This location could be disconnected through either a curbed bioretention area or pervious pavement. This site is likely to be repaved soon which offers a lot of opportunities. The bioretention area would be placed in the corner of the site which would not decrease the parking area and the drain located there would be raised for overflow.



Site Recommendation Figures

		Total Disconnection (sq. ft)	Phosphorus Nutrient Reduction (lb P/yr)	Nitrogen Nutrient Reductions (lb N/yr)	Gallons Treated per Year	Estimated Cost
Branford High School	Visitor Lot	3,659	0.13	1.00	96,340	$1,500-9,150
	East Lot	21,867	0.76	5.98	575,826	$11,600-46,400
	West Lot Exit	7,143	0.25	1.95	188,094	$2,380-9,520
	Total for All	**32,669**	**1.14**	**8.93**	**860,260**	**$15,480-65,070**
Hammer Field	Church and Meadow Street	5,793	0.216	1.58	152,560	$2,896-11,584
	Total for All	**5,793**	**0.216**	**1.58**	**152,560**	**$2,896-11,584**
Foote Park & Linda B. Chipka Early Years Center	Melrose Ave	15,507	0.54	4.24	408,357	$14,000-36,000
	South Lot Rain Garden	39,247	1.36	10.72	1,033,511	$13,080-52,320
	South Lot Existing Grass Swale	52,185	1.81	14.27	1,374,217	-
	Total for All	**106,939**	**3.71**	**29.23**	**2,816,085**	**$27,080-88,320**
Branford Community Garden	Green Roof Opportunity	11,020	0.38	3.01	164,891	$77,144-396,744
	Rain Barrel Opportunity	9,715	0.34	2.66	290,659	$3,000-5,000
	Both of these drainage areas account for the same area so there is no need to total them					
Veterans Park	Parking Area	29,184	1.01	7.48	768,434	$11,041-42,325
	Entrance Area	3,963	0.14	1.08	104,344	$2,632-10,528
	North Walkway Path	2,918	0.10	0.80	76,443	$4,377-16,781
	Totals for above	**36,065**	**1.25**	**9.36**	**949,221**	**$18,050-69,634**
Municipal Lot	Pervious Pavement	6,299	0.22	1.70	186,399	$21,801-49,832
	Bioretention	6,054	0.21	1.66	159,443	$1,308-7,840
	Both of these drainage areas account for the same area so there is no need to total them					

Branford Town Hall and Green

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
2613.6	Rain Garden	68,815	.72	.10	433.8 @ 6”	$1,735.2-6,940.8

For this location we recommend implementing two rain gardens on each side of an already existing memorial/garden. Disconnecting the downspouts on the back of the Town Hall would treat a sizeable area, and the memorial would add to the rain garden’s visibility.

John B. Sliney Elementary

Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
6011.28	Tree Box Filter	158,274.6	1.64	.21	A 19.8 ft^2 area translates to a 3’x 6’ tree box filter	$7,000-18,000

Adding a practice in this area is recommended because the drainage area is quite large and there is a visibility and educational benefit of the practice. Young kids would be able to learn about a practice and it can be seen from Hammer Park.

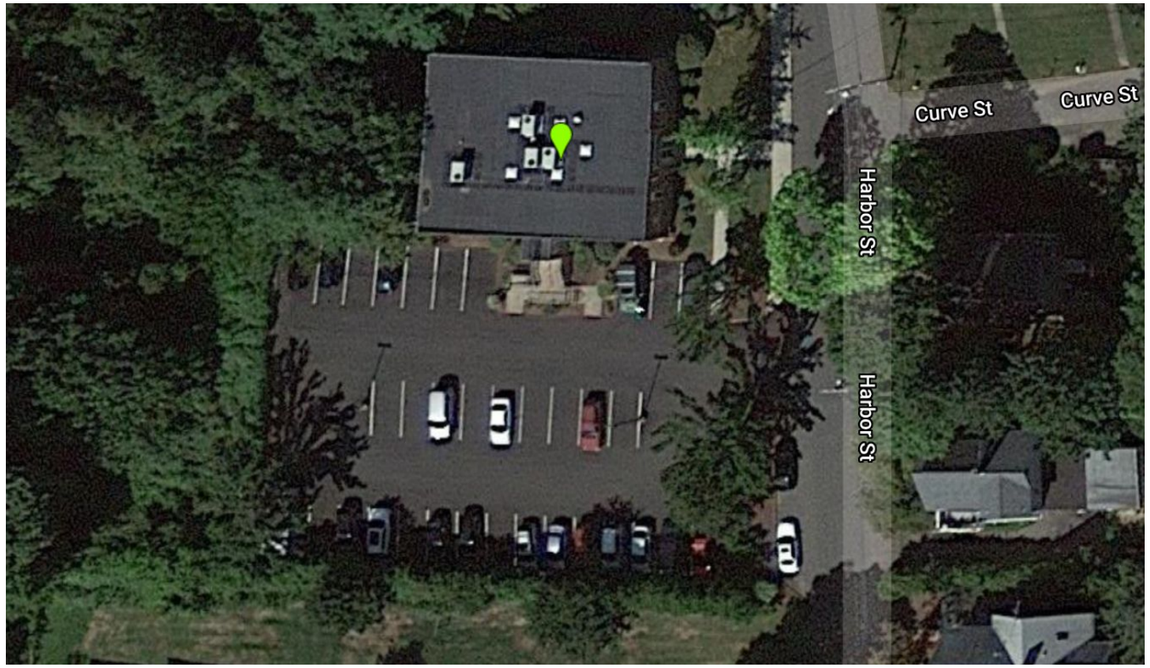
The Orchard House

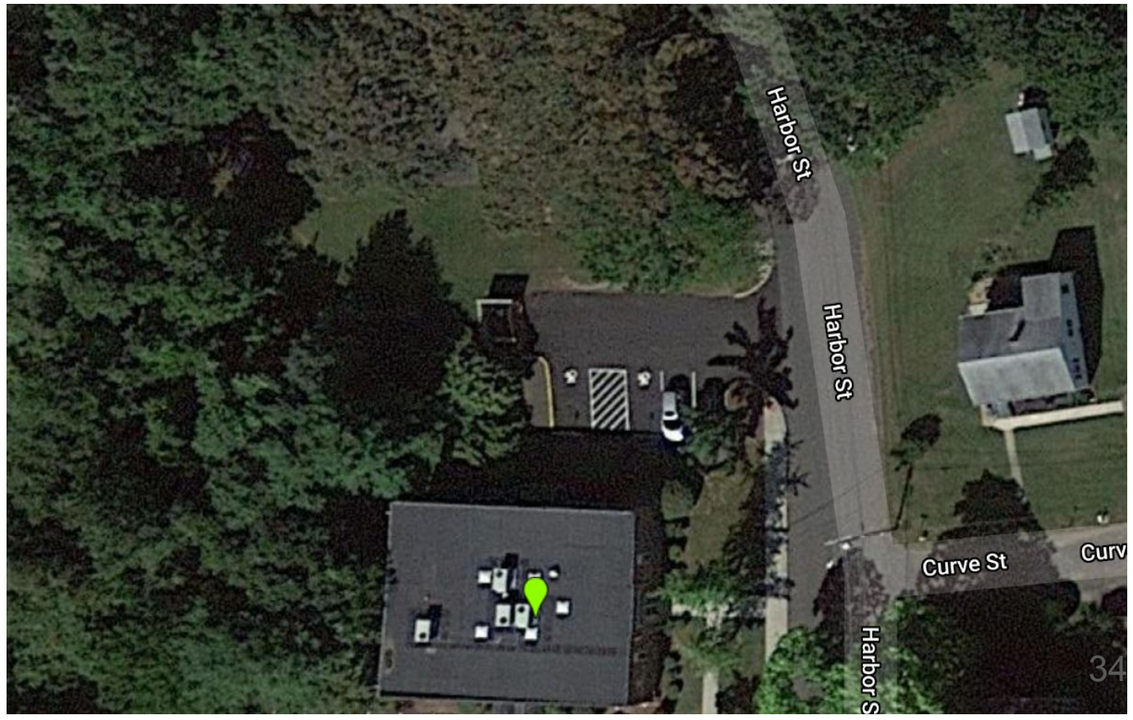
Drainage Area (sq ft)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
5270.76	Rain Garden	138,777	1.44	.18	437.5	$1,750-7,000

The Orchard House has a great opportunity for disconnection on the road side of the property. The best area for the practice is the front of building near the bus entrance. We can implement a rain garden in this area or potentially a tree box filter. There is not much foot traffic in this area but there is visibility from the road.

Branford Counseling Center

We choose not to implement a practice at this site because it would be impractical and costly. The drain for the main parking lot is in the middle of a parking spot which makes it very difficult to disconnect. The back parking lot where the dumpster is located seems to already be disconnected. The only thing we would recommend here is to address the erosion issue. We recommend considering an infiltration practice to prevent erosion.





Maintenance Opportunities

1. Police Department

- Existing rain garden behind Police Department in need of maintenance
- Curb cuts blocked by substrate
- Recommend lowering garden area
- Implementation of gravel buffers below curb cuts could be beneficial
- Additional rain garden could be implemented parallel to the back road for increased disconnection of lot

Police Department

Fire Headquarters

Foote Memorial Park

2. Fire Headquarters

- Rain garden behind Fire Department in need for maintenance
- Recommend additional weeding or implementation of lower maintenance plant matter

3. Foote Memorial Park

- Swale next to Tennis Courts in need of maintenance
- Signs of flooding present
- Recommend replacing grass bottom with gravel alternative and adding curb cuts in the parking lot with a gravel buffer to direct runoff
- Expansion of swale recommended if flooding persists
- The drain in this area is already raised for overflow

Contact & Partners

This project was funded by a grant form 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 Resource Program, and is adapted from a process developed by the latter.

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Green Stormwater Infrastructure (GSI) Practice Unit Pricing Table

Practice	Unit	Price Range		Notes	References
		Low	High		
Rain Garden	SF	$ 4.00	$ 16.00	Price varies with underdrain and vegetation	Houdeshel, 2011
Bioretention	SF	$ 5.00	$ 30.00	Price greatly varies with structures, underdrains, bank stabilization and depth	Brennan, 2011; MassDEP, 2018
Vegetated Swale	LF	$ 4.50	$ 20.00	Not Included: Structures, bank stabilization, clearing/grubbing, curbs, underdrain	PDEP, 2006
Extensive Green Roof	SF	$ 7.00	$ 36.00	Not Included: Irrigation system, structural improvements, > 6" medium depth	PDEP, 2006; Peck and Kuhn, 2001; Manso, 2021, LID Center, 2005
Gravel Grid	SF	$ 1.50	$ 5.75	Includes the cost of installation	LID Center Website, 2007
Porous Asphalt	SF	$ 3.50	$ 8.00	Not included: Underdrain, >12" aggregate depth	LID Center, 2005
Porous Concrete	SF	$ 5.00	$ 13.50	Not included: Underdrain, >12" aggregate depth	LID Center, 2005
Permeable Pavers	SF	$ 8.00	$ 17.00	Not included: Underdrain, >12" aggregate depth	LID Center, 2005
Tree Box Filter	EA	$ 7,000.00	$ 18,000.00	Unit sizes and treatment volumes vary	PVPC, 2015; MassDEP, 2018
Rain Barrel/Cistern	EA	$ 1,500.00	$ 2,500.00	Not included: Cost of installation	National Tank Outlet, 2021

These unit prices have been gathered from published literature, government websites/reports, and installation manuals. Unit prices have not been normalized to current market values. The cost ranges were selected to best represent recommendation typically made by the University of Connecticut Stormwater Corps course and are for informational purposes only. Prepared by Joshua Snarski, University of Connecticut, Department of Natural Resources and the Environment, 2021.

References for Cost and Sizing

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