Stormwater Runoff Reduction Plan

Fairfield, CT

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Summary

In the summer of 2024, UConn students and faculty conducted a stormwater retrofit assessment in the town of Fairfield, CT. A discussion with the town, a desktop analysis, and field site visits were conducted to determine where potential green stormwater infrastructure may be installed.

A total of **16 potential projects** were identified. If all projects are installed, **43,800 ft^2** of impervious cover will be disconnected.

Impervious Surfaces and Stormwater Runoff

Increased development in the state of Connecticut has ultimately caused an immense increase in the amount of impervious cover throughout the state. Impervious surfaces, such as rooftops, parking lots, roads, and more, increase the amount of stormwater runoff that flows into waterways. Traditional stormwater infrastructure disrupts the water cycle, increases the number of pollutants in our waterways, and increases flooding and erosion. By installing green stormwater infrastructure, impervious surfaces are disconnected from stormwater management systems and stormwater can naturally infiltrate into the ground.

MS4 Requirements

As part of the **Federal Clean Water Act**, the Connecticut Department of Energy and Environment Protection **(DEEP)** requires Municipalities to regulate stormwater discharges into water bodies.

- **Nonpoint Source Pollution:** stormwater runs across impervious surfaces, collecting pollutants before it flows into storm drains and eventually waterways
- **The MS4 General Permit** and other stormwater permitting programs prefer the use of Low Impact Development **(LID)** practices, including green stormwater infrastructure, wherever possible to mitigate pollution in waterways.
- **LID practices** aim to preserve pre-development hydrology, with an emphasis on treatment and retention of stormwater onsite.
- MS4 Towns are required to develop and work to implement a **plan to disconnect 1% of their impervious surfaces** from draining into the stormwater system.

What does MS4 stand for?

Municipal Separate Storm Sewer Systems Permitting Program

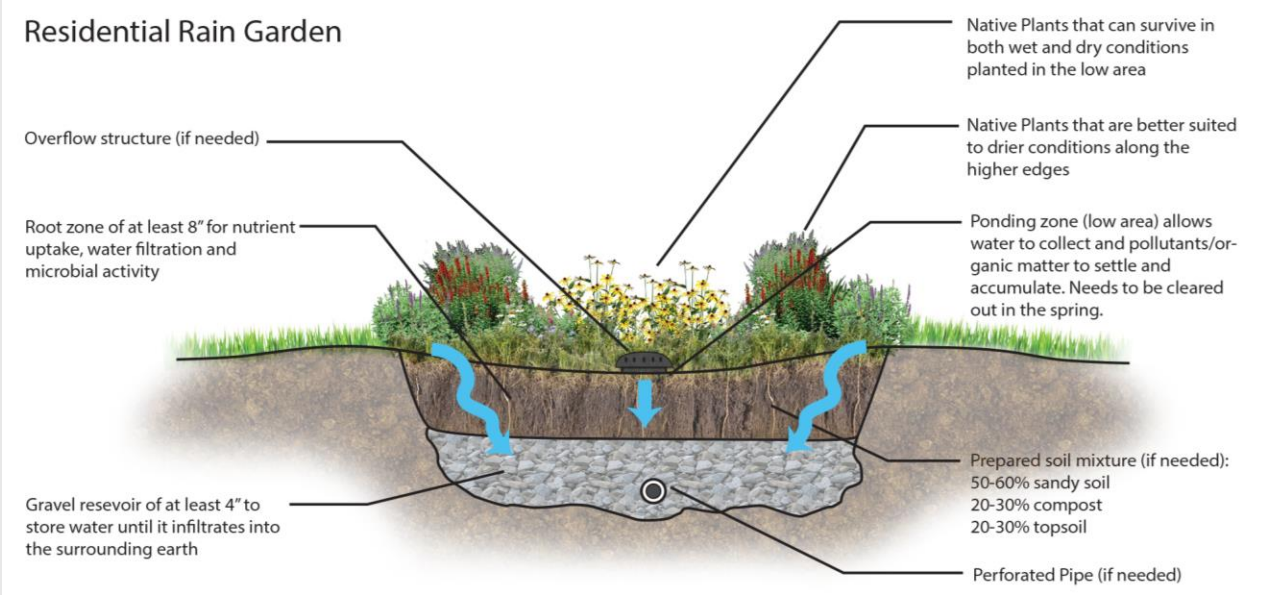
Green Stormwater Infrastructure Practices

Green stormwater infrastructure disconnects impervious cover from stormwater management systems, which allows stormwater to infiltrate naturally into the ground.

Types of green stormwater infrastructure include: **rain gardens, bioretention basins, pervious pavement, tree box filters, green roofs,** and **rainwater harvesting**.

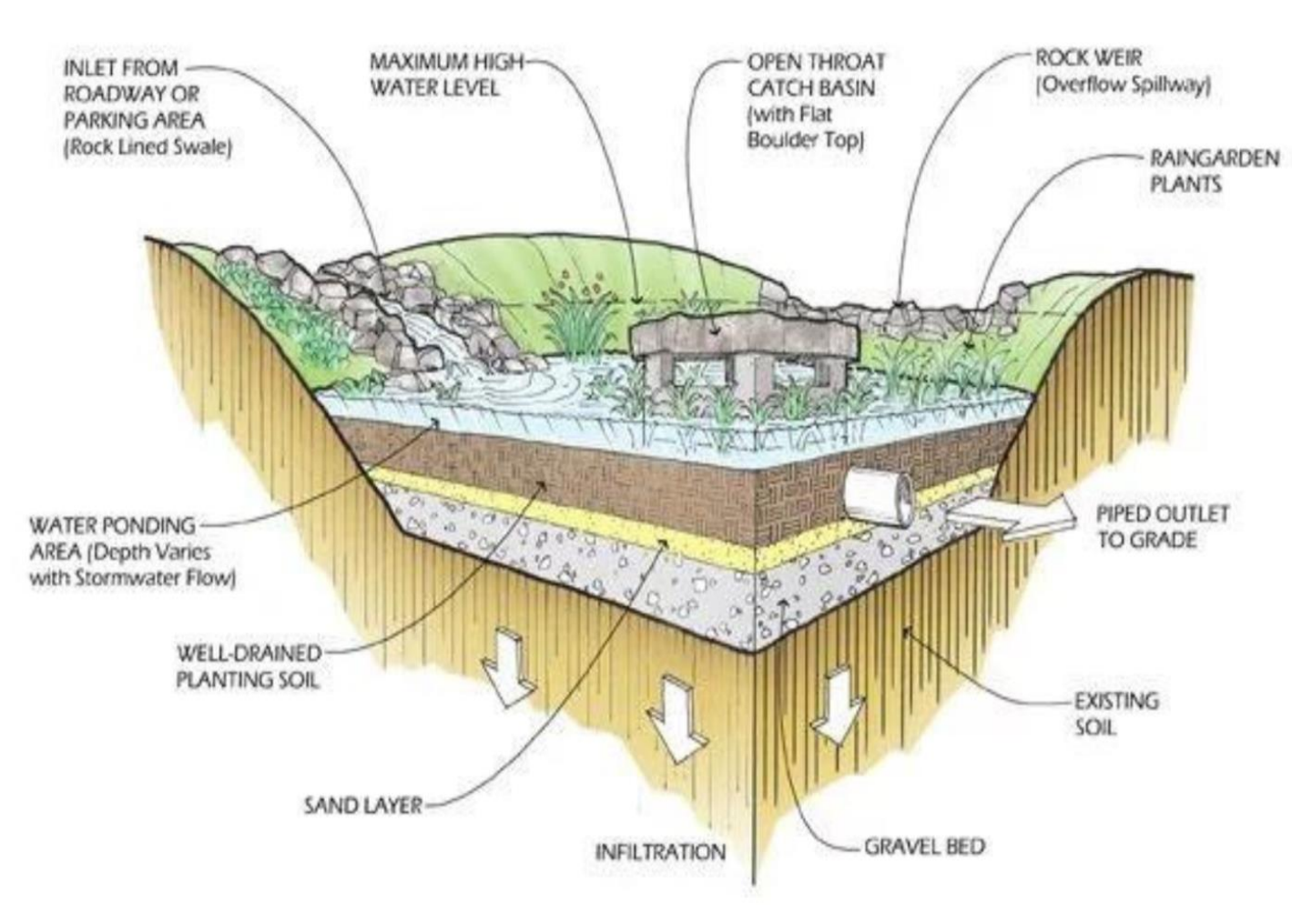
Rain Gardens

- Collects stormwater runoff from roofs via disconnected gutters or from impervious surfaces and infiltrates runoff into the ground naturally
- Involves a **6+ inch** depression, often with grass, native plants, or stone
- May include curb cuts, gravel, or stone to prevent erosion
- Aesthetically pleasing and provides greater biodiversity
  - Pollinator pathways
- **Less costly** than other types of green stormwater infrastructure
- Maintenance includes weed/invasive removal and flow path inspections
- Avoid creating mowing islands and building too close to the tree roots
- Rain gardens drain within **12-24 hours**
  - If drained in this timeframe, they would ***not*** be breeding ground for mosquitoes and other bugs



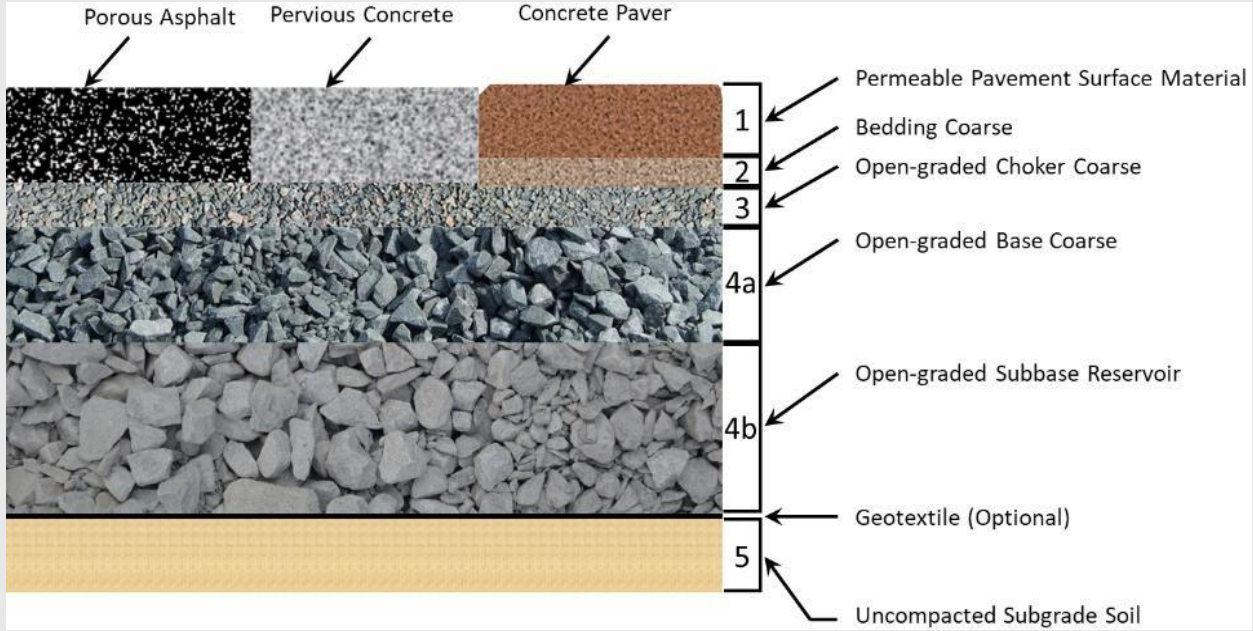
Bioretention Basins

- Serve the same function as rain gardens
- Key differences include: **special soil media, overflow structures, and underdrains**
- Essentially involve more engineering than rain gardens and are typically done in either **more developed areas or areas where the soil conditions require it**



Pervious Pavement

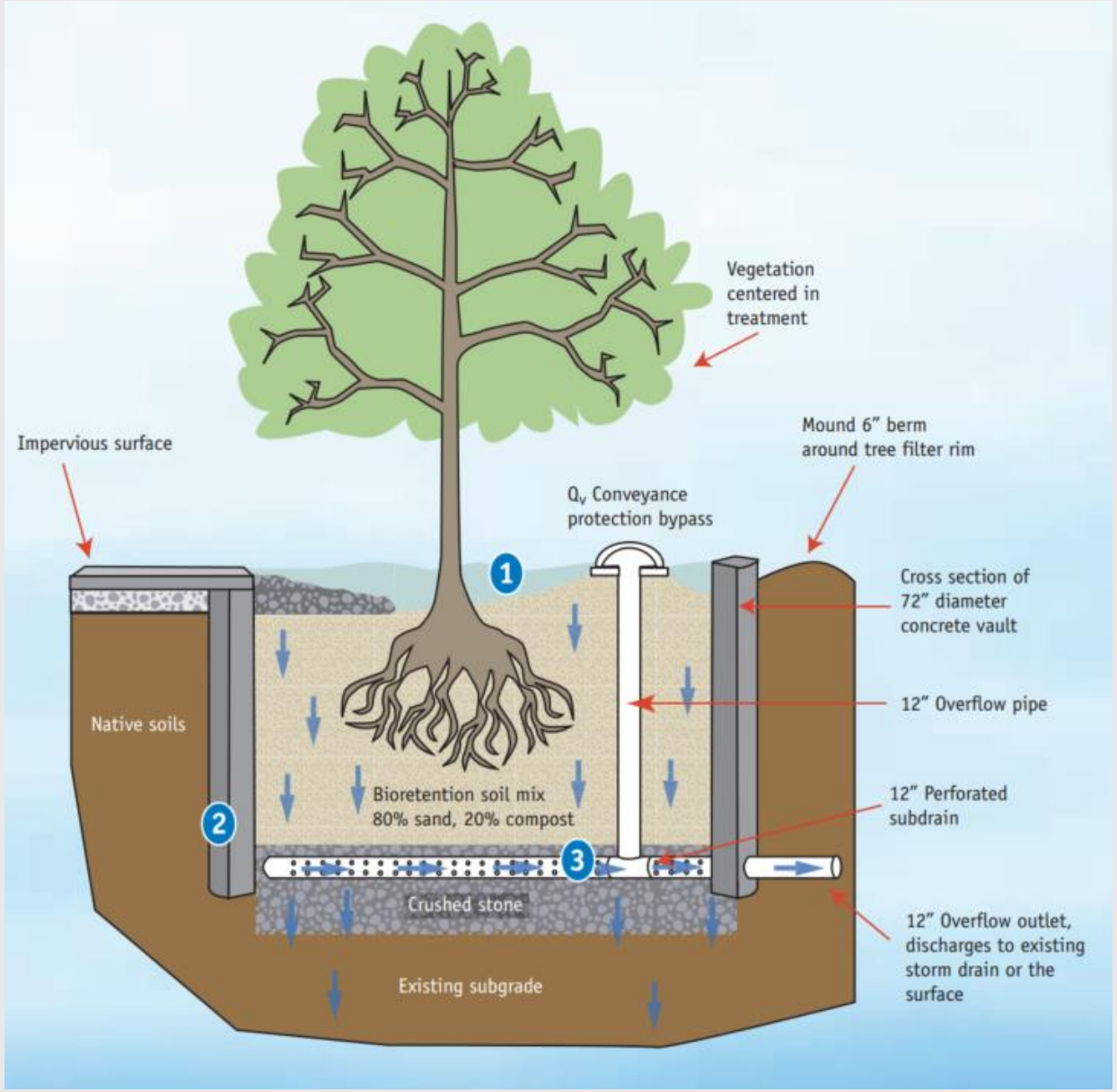
- Serve as an alternative to traditional pavement by allowing water to infiltrate into the ground instead of running off
  - Typically installed in areas that are **already being repaved** to avoid excess construction
  - **Cost competitive** with typical pavement
- Ideally installed somewhere relatively flat and already deals with large amounts of runoff



- Needs to be maintained effectively (pressure washing and vacuum sweeping) to make sure that stormwater can still infiltrate well
- Requires **less snow maintenance** than traditional pavement
- Needs to be **replaced less frequently** than traditional pavement because it doesn't contract and expand as much with the changing seasons and temperatures

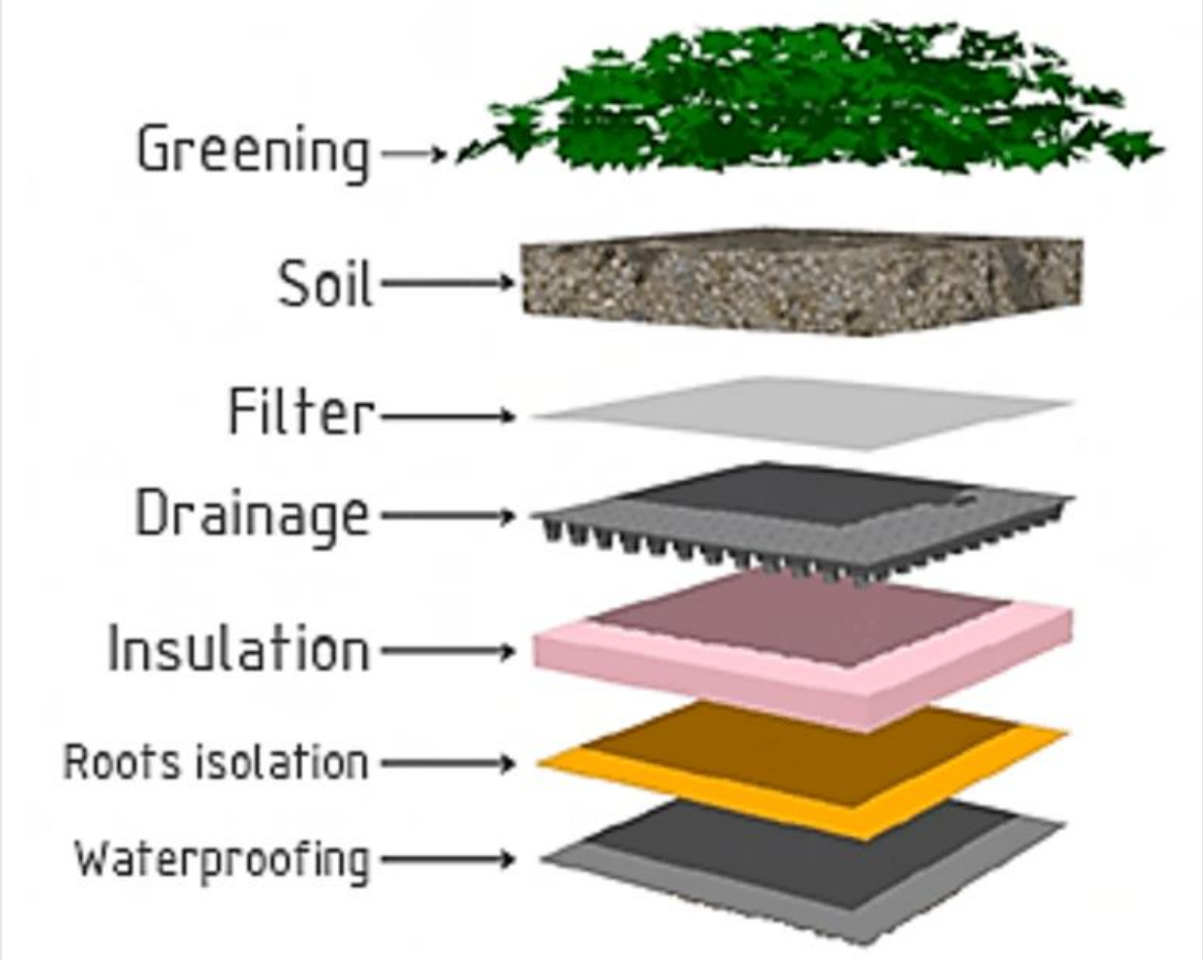
Tree Box Filters

- Aesthetically pleasing practice that filters runoff through tree roots
  - Stormwater enters the installation through a grate, then infiltrates through the soil and root system of the tree, filtering out pollutants in the process
- In the case of extreme amounts of stormwater present near the filter, an underdrain may be required to prevent flooding



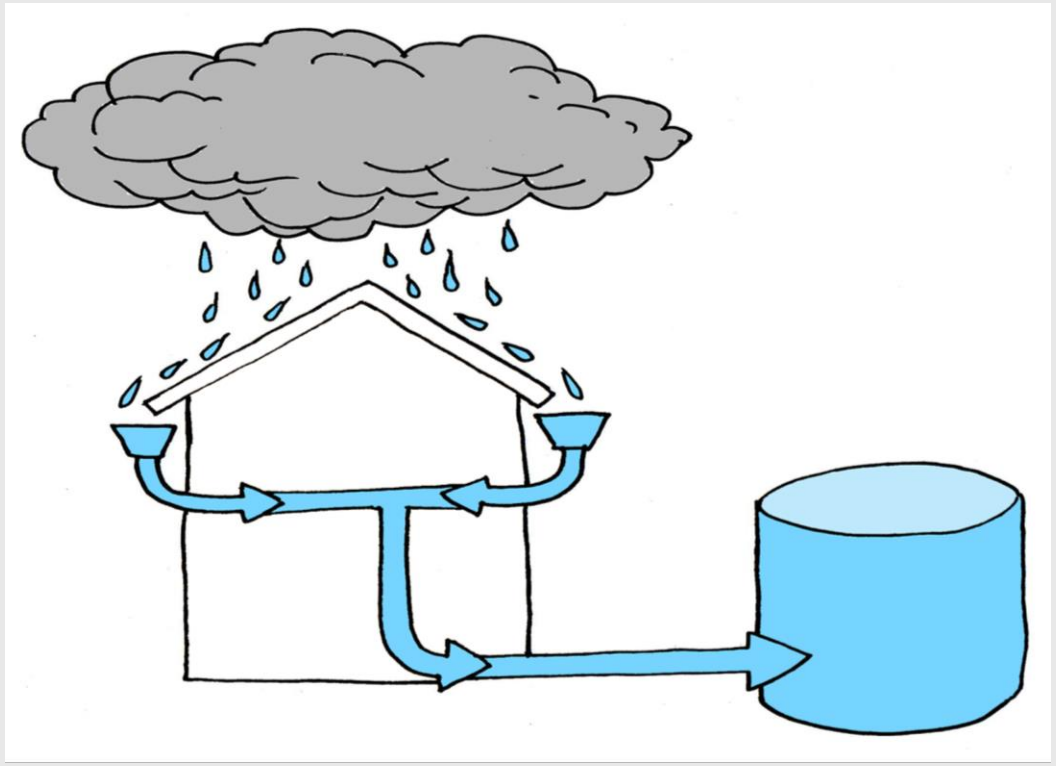
Green Roofs

- Allows runoff to infiltrate substrate directly
- Disconnects about **50%** of the stormwater from roof
- Most expensive practice, but offers great educational opportunities for nearby communities and adds to the aesthetic
- **Green roof trays** may be a more affordable option and will give many of the same benefits
- 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 rainwater from gutters and downspouts
- Roof runoff is fed into large cisterns which retain the water until it can be repurposed
  - Cisterns require minimal maintenance
    - May need to be moved in the winter months to prevent freezing.
- Reduces stress on private wells and municipal water supplies
- The required size of the rain barrel depends on the collection area
- Materials can range from PVC to steel
- Filters can be installed to remove pollutants if needed



Site Selection and Approach

Before visiting sites, team members used aerial imagery tools to view different locations to determine possible sites suitable for green infrastructure practices. This work included using the statewide **high-resolution impervious surface maps** to get an overall feel for the site, following **contour lines provided by ArcGIS** to estimate drainage patterns, and examining **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. Criteria used include:

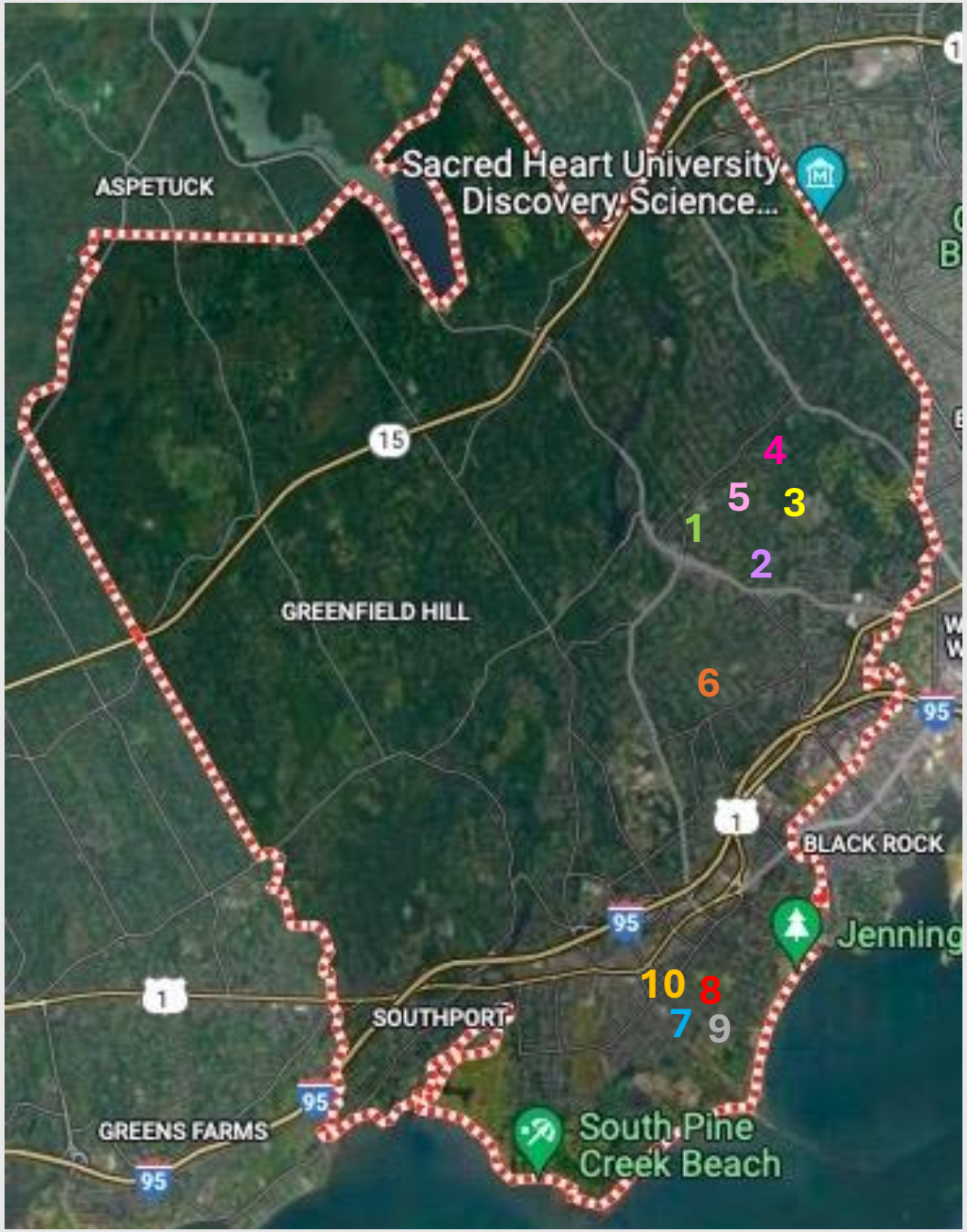
- **Slope** of surrounding land
- **Land available** for use
- Locations of existing **storm drains or other overflow opportunities**
- Above ground and underground **obstructions** (large trees, pipes, utilities, etc.)
- Pre-existing **green infrastructure practices**
- **Maintenance** concerns
- **Educational** value
- Visibility
- Safety
- Volunteer opportunities
- **Size** of disconnect/impact

Explanation of calculations

- **Drainage Area:** The potential watershed area for each retrofit was estimated using topographic tools and confirmed during site visits.
- **Rain Garden Size:** Rain garden area and depth is heavily dependent on the estimated drainage area and amount of rainfall expected. All rain gardens in this presentation are sized to handle a **1.3 inch rainstorm event**. Rain gardens should be able to hold the same volume so the area and depth is altered accordingly. Rain gardens deeper than 12 inches are avoided for safety reasons.
- **Nutrient Reductions:** The area of land treated and estimated concentrations of nutrients that runoff into that area is equal to the amount of nutrients that can be directed away from that watershed, as calculated by **Charles Frink** in a paper discussing nutrient concentrations in Connecticut by major type of land cover**.** *Point source pollution was not taken into consideration in these calculations as it varies depending on the site.*
- **Gallons Treated:** The volume of stormwater treated was determined with the assumption that Connecticut experiences around 48 inches of rain annually.

Location Overview

1. Fairfield Woods Middle School
2. McKinley Elementary School
3. Warde High School
4. Stratfield Elementary School
5. Jennings Elementary School
6. Mill Hill Elementary School
7. Independence Hall
8. Fairfield Burr Homestead
9. Old Town Hall
10. Fairfield Center



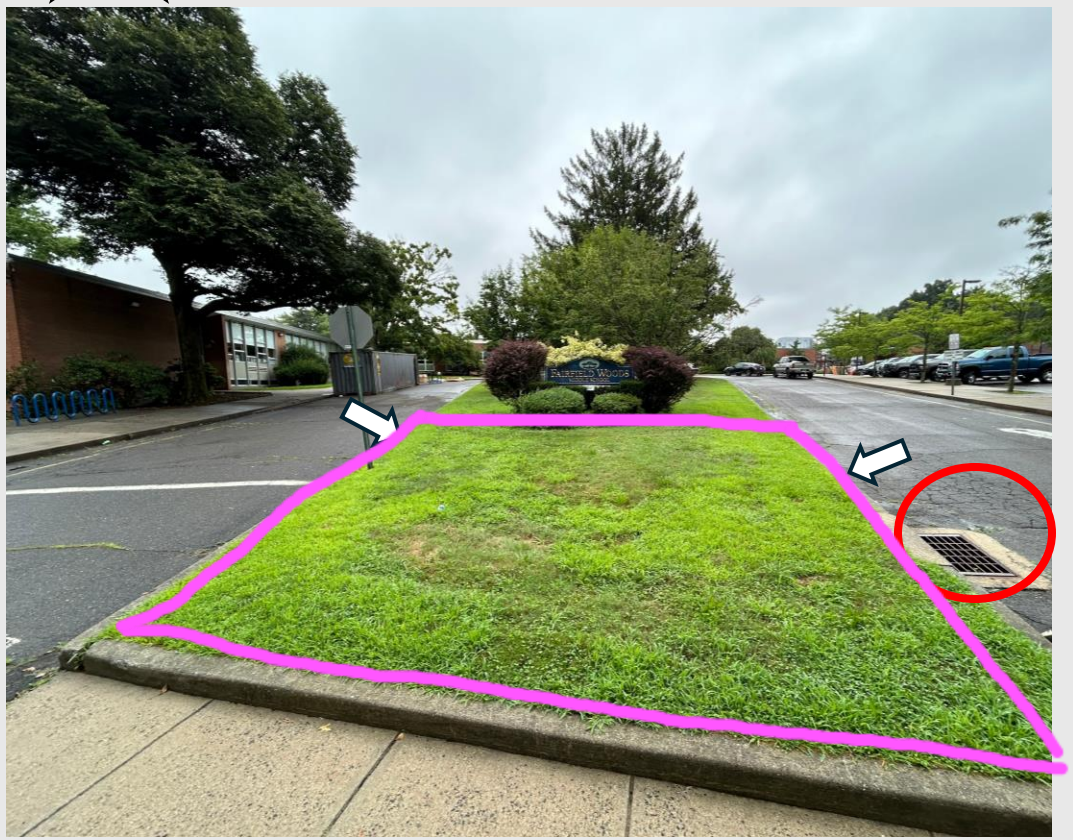
Fairfield Woods Middle School

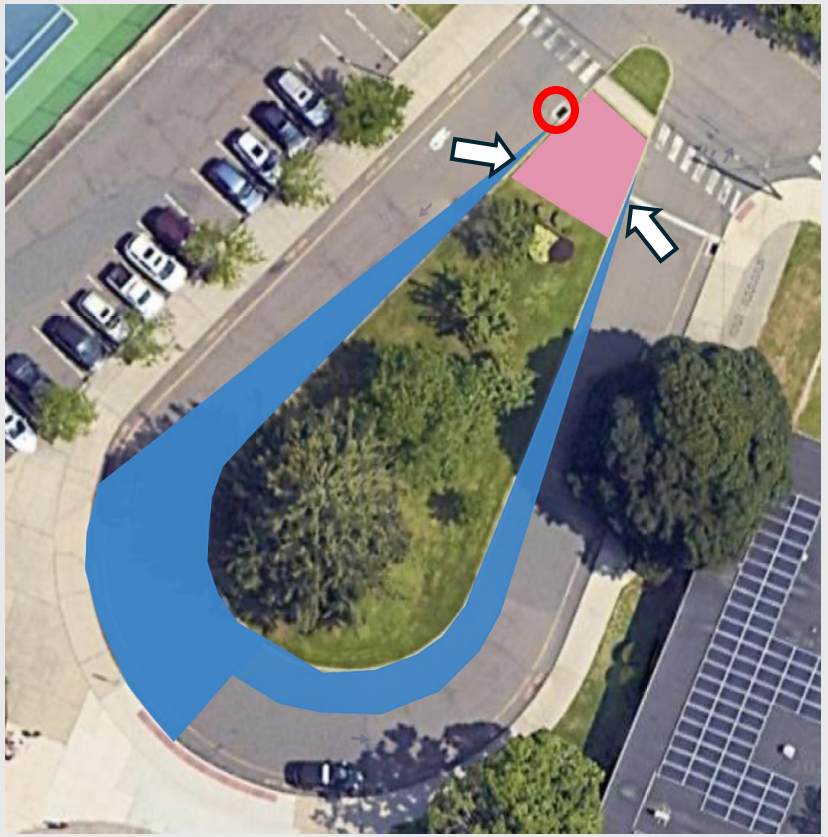
1115 Fairfield Woods Road

At this site, we recommend the installation of a rain garden near the front of the school that will enhance the overall aesthetic of the area and provide a great visible educational opportunity. This site will not interfere with the current construction at the school.

Possible **disconnection of 3,920 feet^2** of impervious cover.

Fairfield Woods Middle School Site 1





Site Notes:

- High visibility near front of school
- High disconnection
- High educational value
- Can incorporate into existing landscaping

Key:

Curb cuts = ⇧

Drain = ○

Drainage area

Rain garden

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
3,920	Rain garden	103,236	0.86	0.11	637 (8-inch depth)

McKinley Elementary School

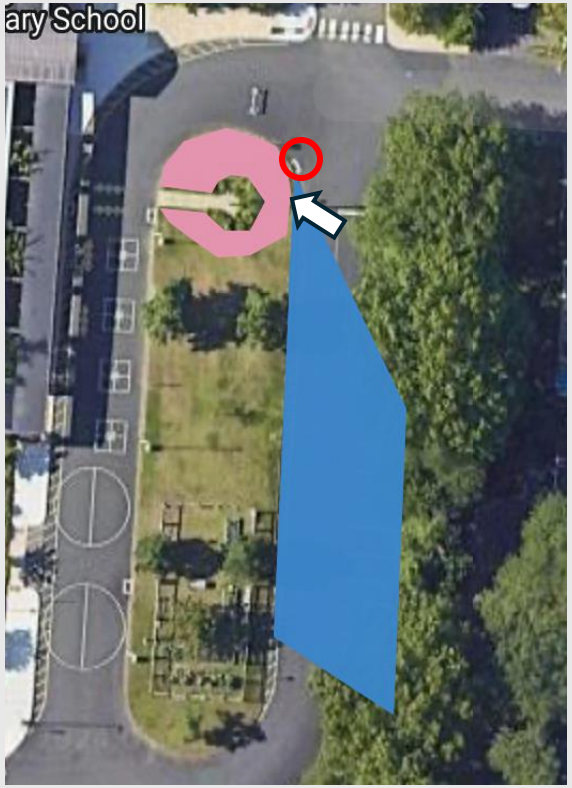
60 Thompson Street

At this site, we recommend the installation of a rain garden near the front of the school. This project would disconnect a major portion of the paved loop and help add to the aesthetics of this underused area. Additionally, there doesn't seem to be major foot traffic here, making this site an ideal location for this project.

Possible **disconnection of 5,358 feet^2** of impervious cover.

McKinley Elementary School Site 1

Key:
Curb cuts = ⇧
Drain = ○
Drainage area
Rain garden



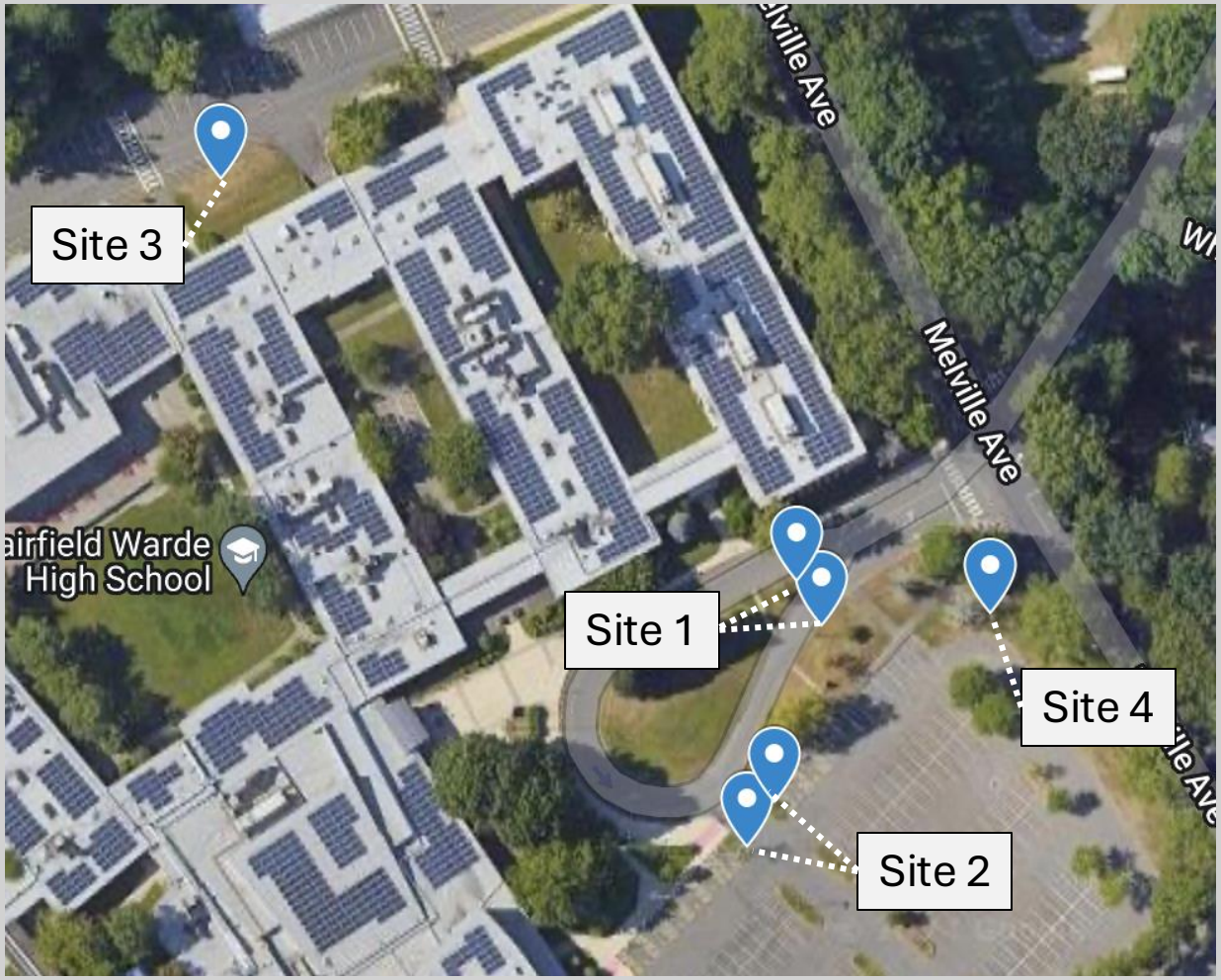
Site Notes:
- High visibility near front of school
- High disconnection
- Avoid crown of trees
- Would need to remove remains of old sign post
- High educational value
  - Opportunity for the sign to promote rain gardens and their benefits

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
5,358	Rain garden	141,090	1.17	0.15	1,161 (6-inch depth)

Warde High School

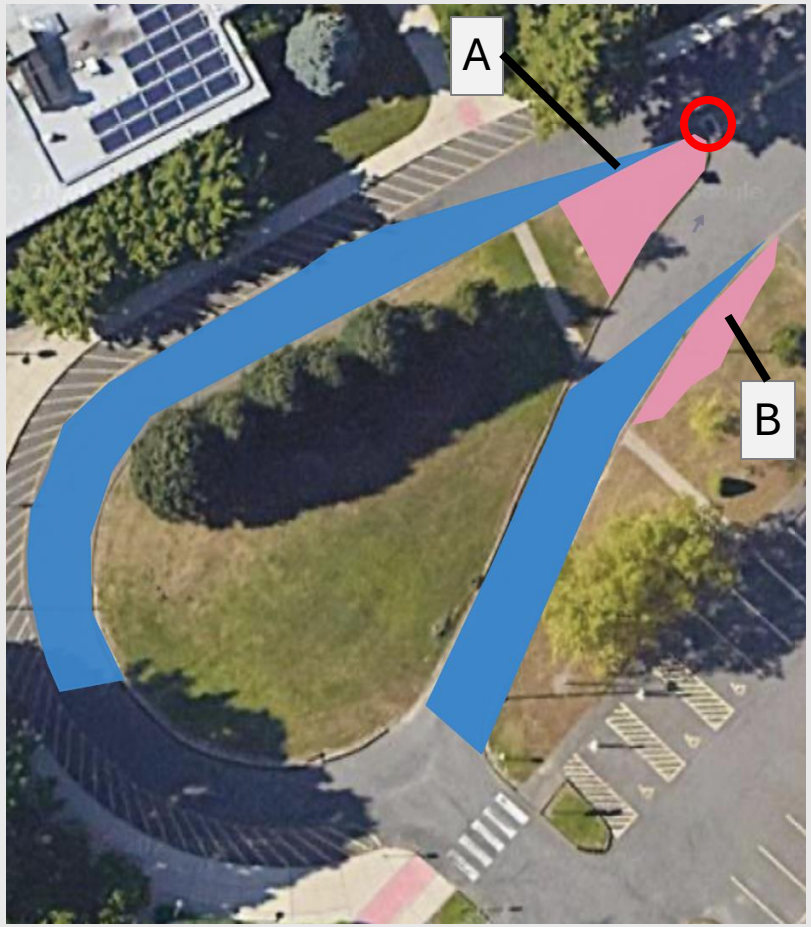
755 Melville Avenue

At this site, we recommend we recommend the installation of four different green stormwater practices. These practices all offer high disconnections and high education values for the students. These gardens could also provide volunteering opportunities for students as well.



Possible **disconnection of 13,242 feet^2** of impervious cover.

Warde High School Site 1



Site notes:

- Together, these rain gardens disconnect a great area
- They are highly visible and provide a great educational value as they are near the front of the school
- Use lower shrubs to not impede driver's views
- They would help add to the aesthetics of this area

Key:

Curb cuts = ⇧

Drains = ○

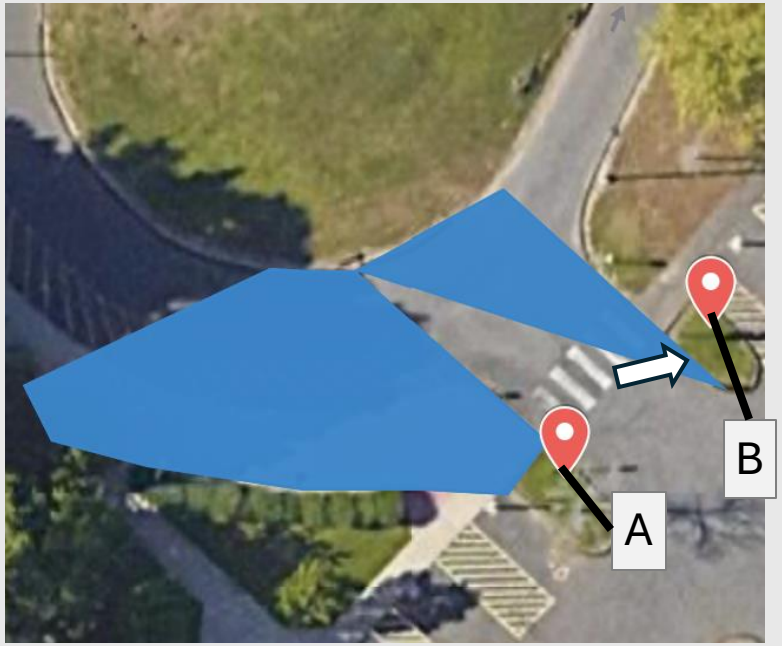
Drainage areas

Rain gardens

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
A: 2,134 B: 1,394	Rain gardens	A: 56,206 B: 36,706	A: 0.47 B: 0.30	A: 0.06 B: 0.04	A: 462 B: 302

Key:
Curb cuts = ⇧
Tree box filters =
Drains = ○
Drainage areas

Warde High School Site 2

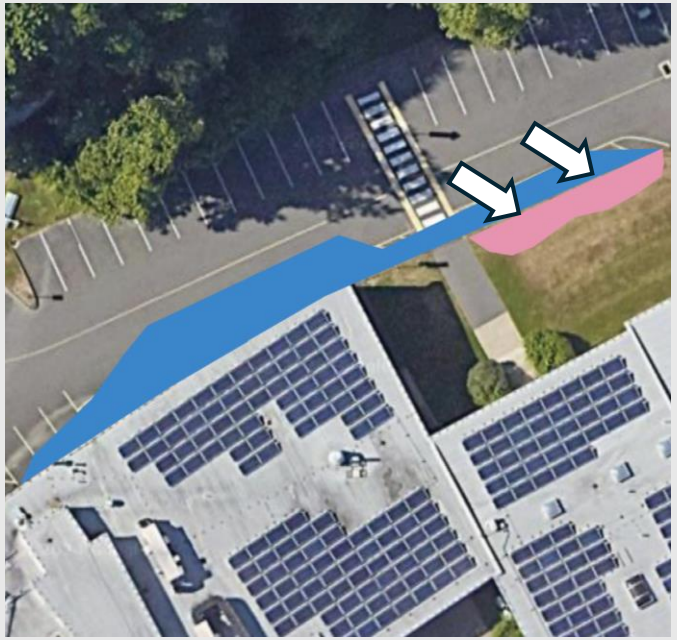


Site notes:
- There is an opportunity to have tree box filters in any of the green islands in the back lot
- These two spots are examples of where tree box filters can be implemented
- The tree boxes would also help to provide shade for the students in the lot
- Tree box filters are on the more expensive side
- Possibility for high disconnection

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
A: 1,917 B: 566	Tree box filters	A: 50,481 B: 14,905	A: 0.42 B: 0.12	A: 0.05 B: 0.02

Warde High School Site 3

Key:
Curb cuts = ⇧
Drains = ○
Drainage area
Rain garden



Site notes:
- Low visibility as it is near the back of the school
- High disconnection
- Would help add to the aesthetics of this otherwise underused area
- The speed bump helps to direct the water toward the rain garden
- There is lots of green space to work with

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
2,134	Rain garden	56,206	0.47	0.06	462 (6-inch depth)

Key:
Curb cuts = ⇧
Drains = ○
Drainage area
Rain garden

Warde High School Site 4

Site notes:

- High visibility as it is near the front of the school
- High disconnection
- Would help add to the aesthetics of this otherwise underused area
- There is a ponding problem here
  - The rain garden would help to prevent this during rainstorms
- Note electrical pole
- Avoid crown of tree

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
5,097	Rain garden	134,220	1.11	0.14	1,104 (6 inch depth)

Stratfield Elementary School

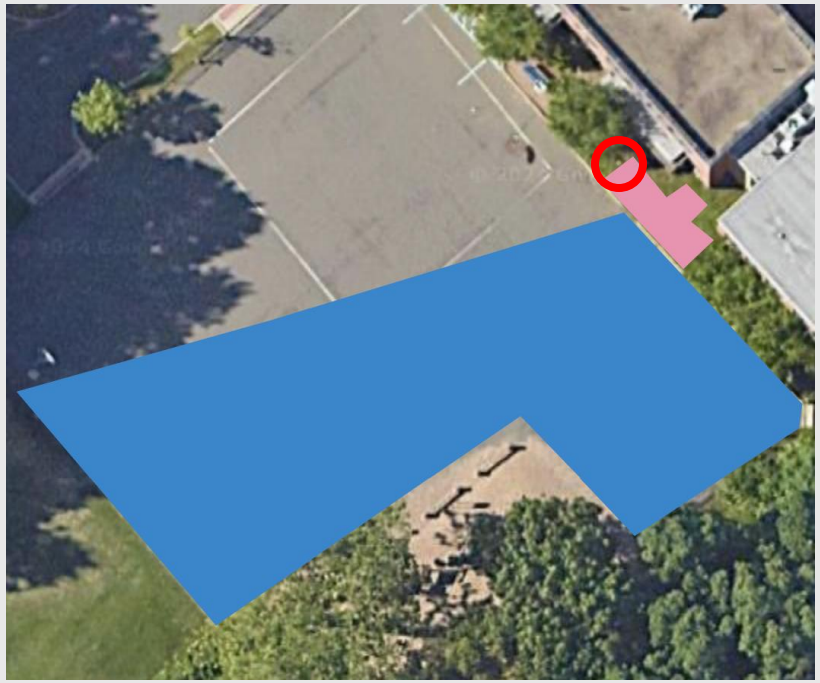
1407 Melville Avenue

At this site, we recommend the installation of two green stormwater infrastructure practices. These practices are highly visible and provide a lot of education value. These practices will also help to add to the aesthetic value of the school if implemented.

Possible **disconnection of 2,852 feet^2** of impervious cover.

Stratfield Elementary School Site 1

Key:
Drain = ○
Drainage area
Rain garden



Site notes:
- Would need to be at least ten feet from the building
- Avoid crown of trees
- Existing curb cut and depression/swale make this project relatively low cost
- Woody shrubs would add the landscaping aesthetics, provide pollinator pathway habitat
- High educational value

Based on the available greenspace, this rain garden will only disconnect about *2,111 ft^2 of the area draining toward it*. The rest will flow into the existing storm drain, acting as an overflow

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
9,418	Rain garden	55,589	0.46	0.06	305 (9-inch depth)

Key:

Green roof

Stratfield Elementary School Site 2

Site notes:

- Would need to ensure there is proper roof access
- Make sure roof is strong enough
- High educational value
- High visibility as it is near the front entrance
- A little more expensive than other GSI
    - Green roof trays provide a less expensive alternative that provide many of the same functions

Suggested Green Infrastructure	Suggested Practice Size (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
Green roof	741	11,080	0.16	0.02

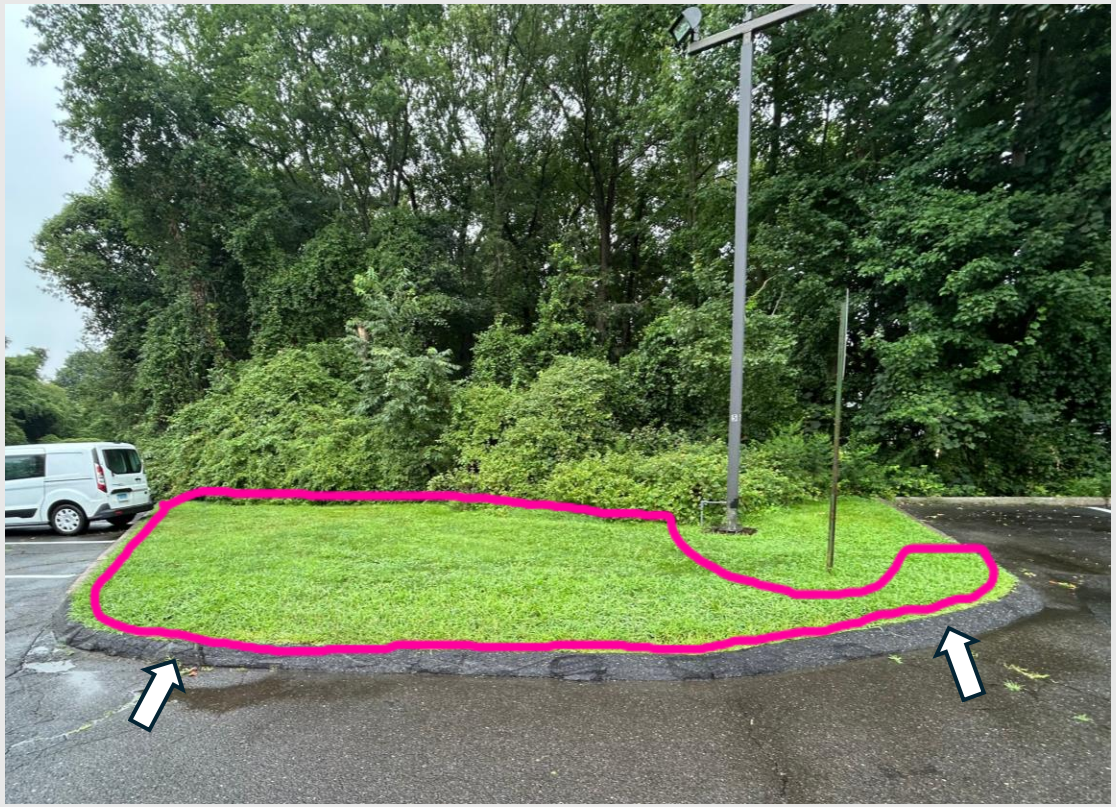
Jennings Elementary School

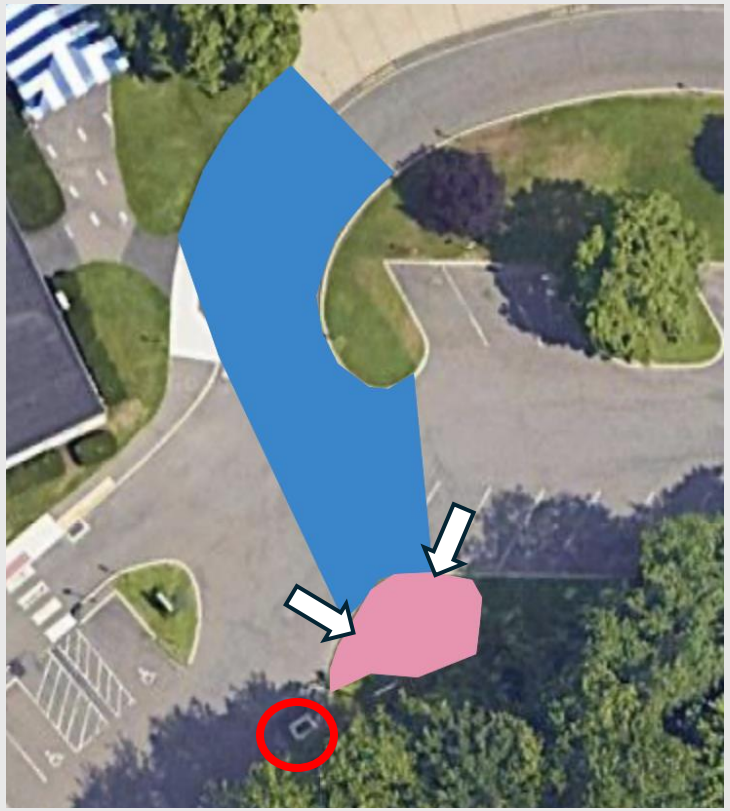
31 Palm Drive

At this site, we recommend the installation of two rain gardens and two tree box filters. These sites will help to add to the aesthetic value of the school. Additionally, these practices will help to reduce the stress on the storm drains and prevent any ponding during storms

Possible **disconnection of 6,967 feet^2** of impervious cover.

Jennings Elementary School Site 1





Site Notes:

- High visibility and educational value
- May need more depth to avoid electrical

Key:

Curb cuts = ⇧

Drains = ○

Drainage area

Rain garden

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
2,483	Rain Garden	65,383	0.54	0.07	461 (7-inch depth)

Jennings Elementary School Site 2

Site Notes:

- Would provide shade to students
- Disconnect majority of playground
- Help mitigate the amount of mulch displaced from rain events

Key:

Drainage area

Tree box filter

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
2,178	Tree Box filters	57,354	0.47	0.06

Jennings Elementary School Site 3

Site Notes:

- Existing drain can act as overflow for the rain garden
- Lay boulders on side shared with playground to limit access to rain garden

Key:

Drains =

Drainage area

Rain garden

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
2,309	Rain Garden	60,795	0.51	0.06	500 (6-inch depth)

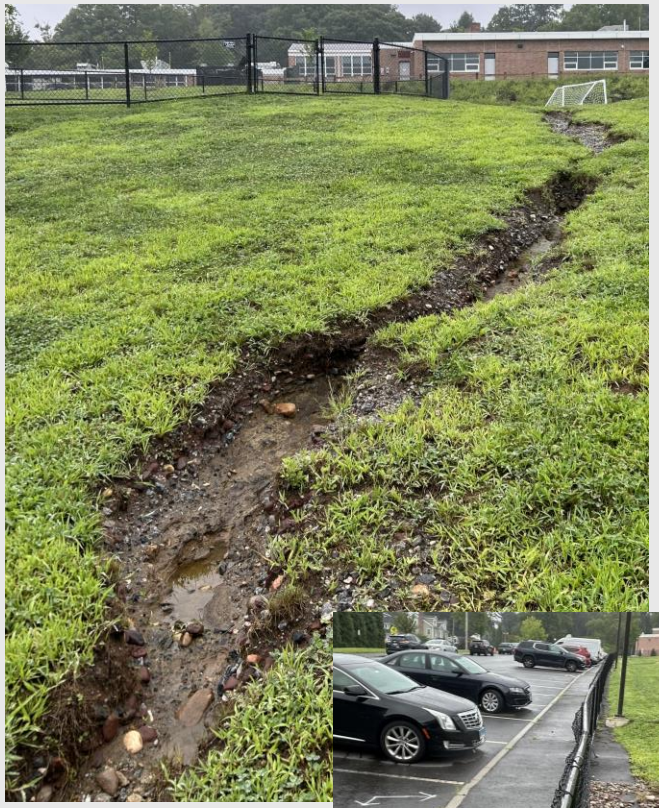
Mill Hill Elementary School

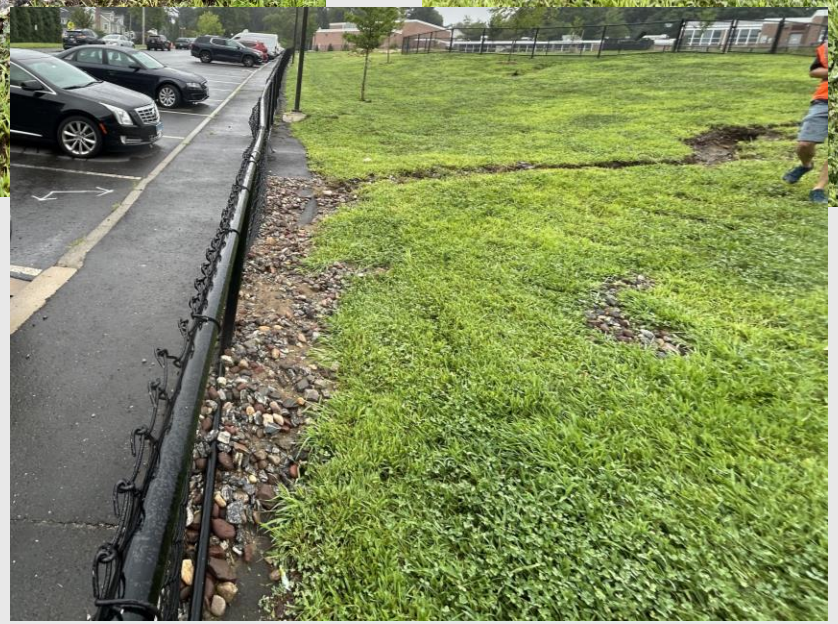
635 Mill Hill Terrace

At this site, we recommend we recommend the installation of two different green stormwater infrastructure practices. Although these practices aren't highly visible, they are targeting an erosion problem near the back of the school.

Possible **disconnection of 2,701 feet^2** of impervious cover.

Mill Hill Elementary School Site 1



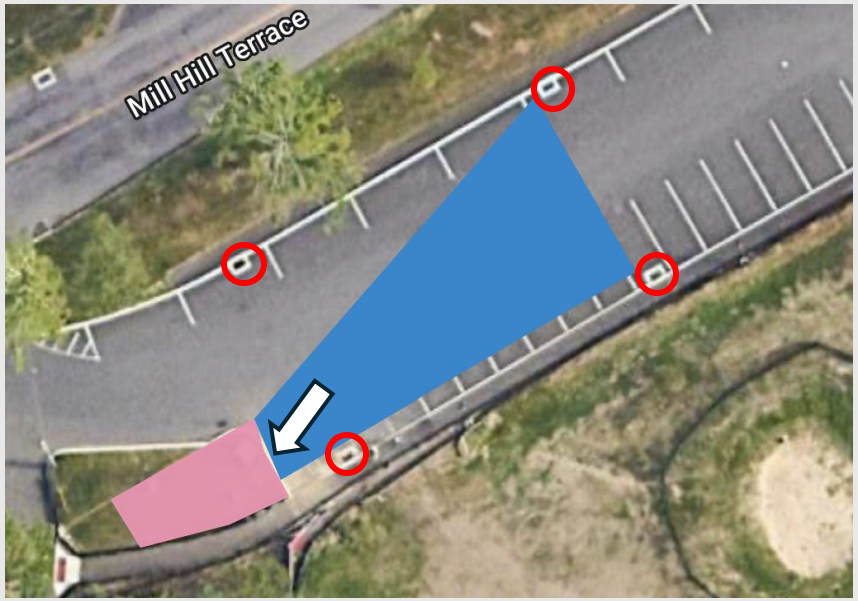


Mill Hill Elementary School Site 1

Site notes:

- Deep erosion marks
  - It is difficult to tell exactly how much water is draining to this area
- A lot of sediment is being carried down the hill during rainstorms
- There is an existing vegetative swale
  - Integrate run off into this existing vegetative swale
  - Add woody shrubs or gravel to reduce run off and prevent further erosion of the hill
- If this erosion continues to worsen, it could create a safety concern since kids are playing and the erosion already runs pretty deep
- Make sure not to interfere with the playground and the min turf soccer field

Mill Hill Elementary School Site 2



Key:
Curb cuts = ⇧
Drains = ○
Drainage area
Rain garden

Site notes:
- This site would disconnect a major portion of the parking lot and help reduce stress on existing drains
- Although it is not highly visible, it provides *another* example of green stormwater infrastructure
  - Good educational opportunity, signs can be placed at other sites to direct people to this site
  - There seems to be some practices at this school already

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
2,701	Rain garden	71,118	0.59	0.07	585 (6-inch depth)

Independence Hall

725 Old Post Road

At this site, we recommend the installation of a grass swale to mitigate flooding issues. This swale could help to prevent ponding and reduce the stress on the existing drain in the lot.

Possible **disconnection of 4,922 feet^2** of impervious cover.

Independence Hall Site 1

Site Notes:

- To avoid this parking lot from flooding adding a grass swale next to the area could mitigate the amount of pooling
- Installing a fence around swale to not pose hazard during community use of field

Key:

Drains =

Drainage area

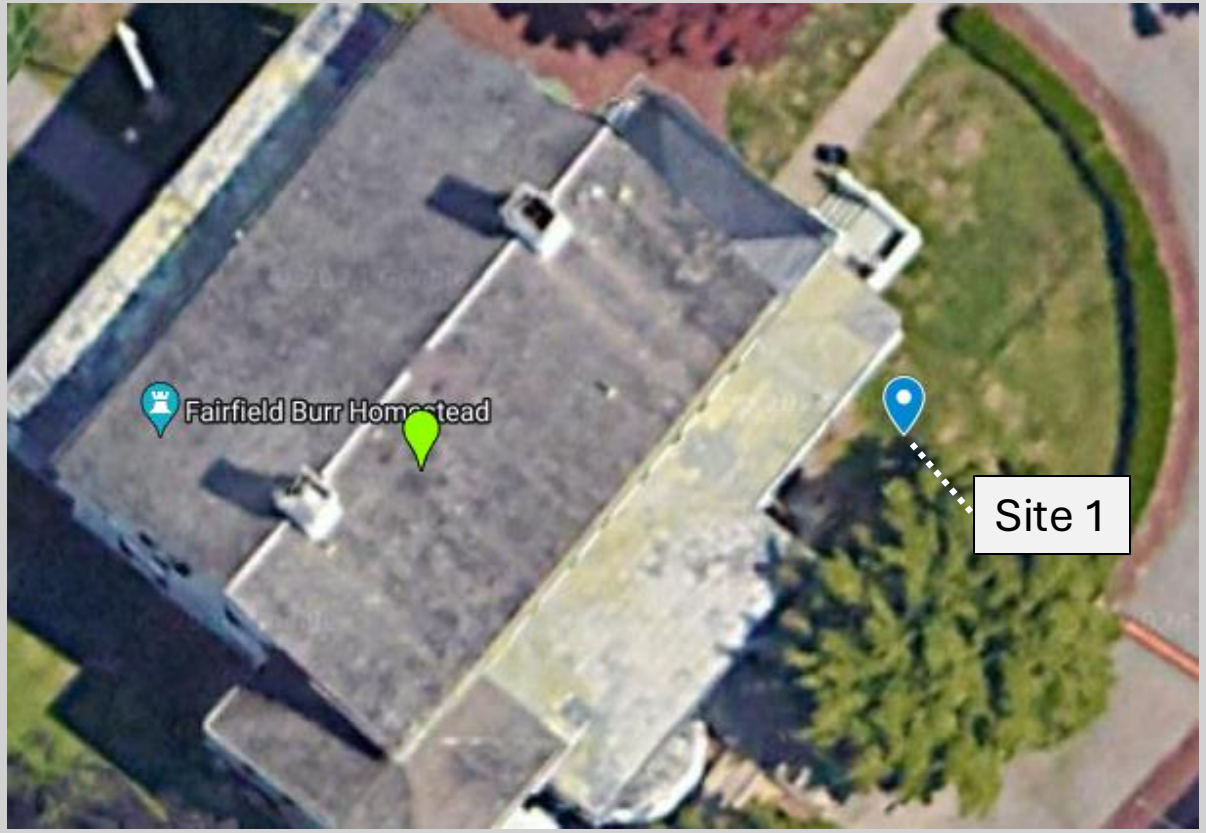
Vegetative Swale

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
4,922	Vegetative swale	129,619	1.08	0.14	640 (10-inch depth)

Fairfield Burr Homestead

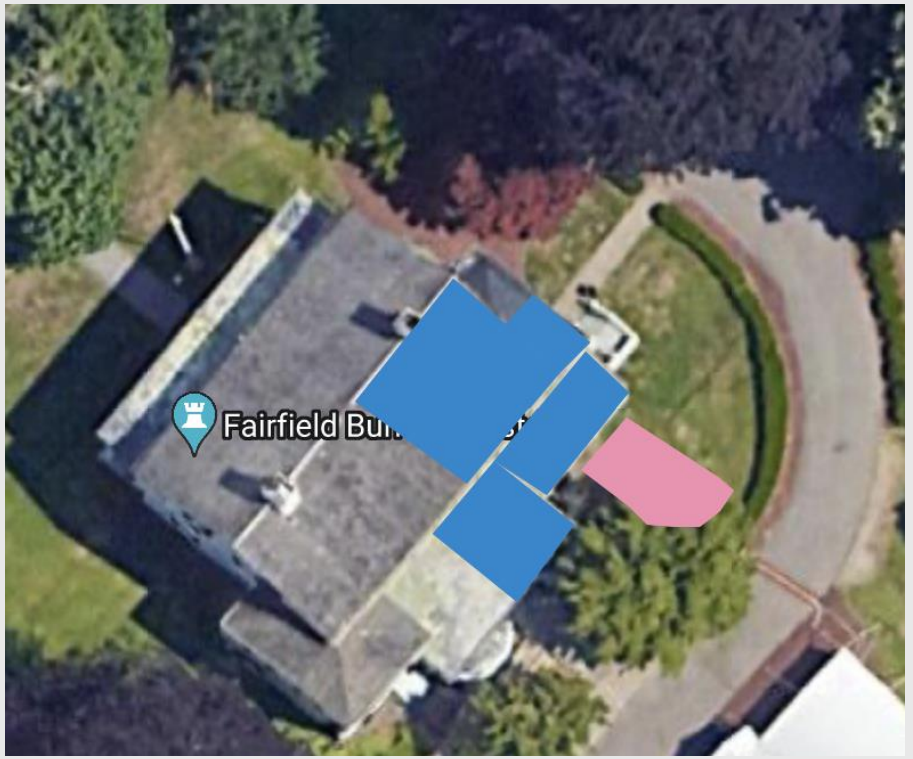
739 Old Post Road

At this site, we recommend the disconnection of two downspouts to be directed into a rain garden to further beautify this already well-manicured area.



Possible **disconnection of 1,133 feet^2** of impervious cover.

Fairfield Burr Homestead Site 1



Site Notes:

- High visibility
- Could be incorporated into existing landscaping
- High educational value

Key:

Downspouts =

Drainage area

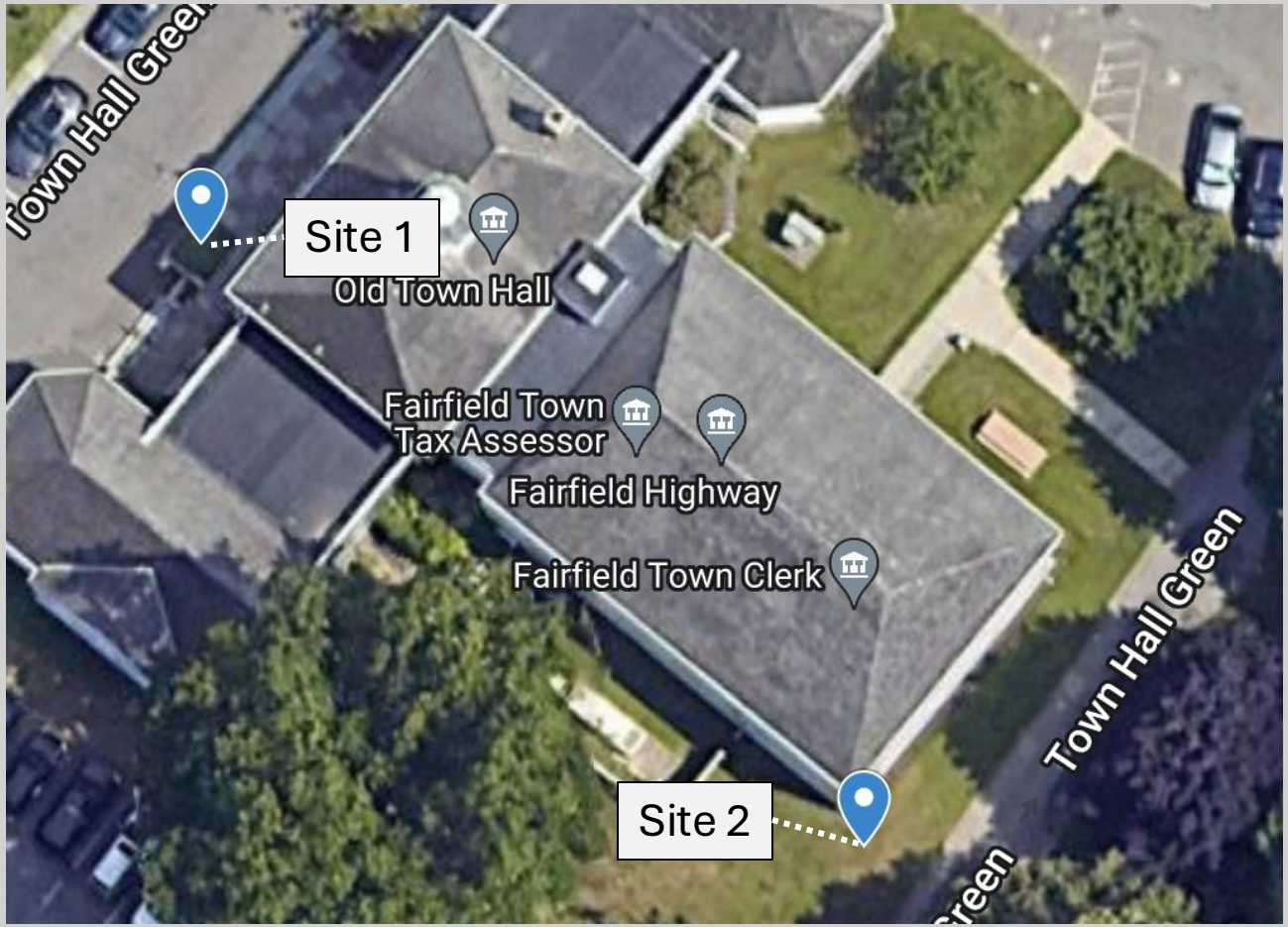
Rain garden

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
1,133	Rain Garden	29,824	0.25	0.03	245 (6-inch depth)

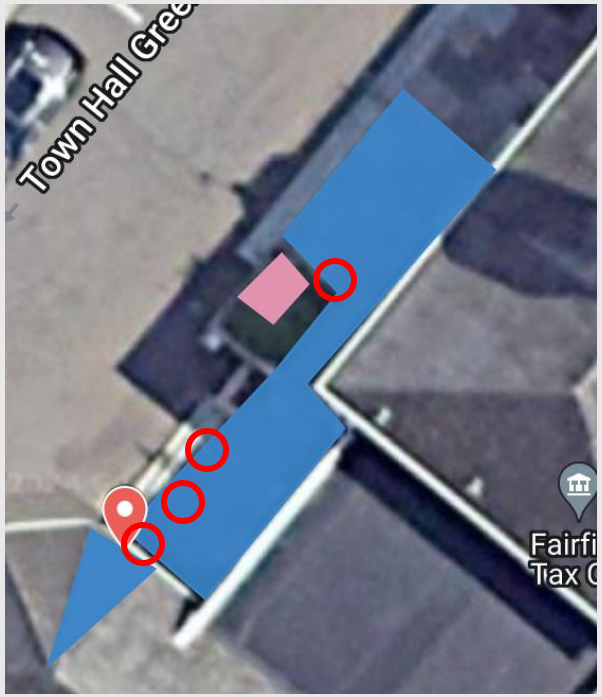
Old Town Hall

611 Old Post Road

At this site, we recommend the installation of two rain gardens. Although ***these sites would not count toward the town's MS4 goals***, they are highly visible, and they provide a good educational opportunity for the public. These practices also provide a good opportunity to add to the existing aesthetics of the already manicured area.



Old Town Hall Site 1



Drainage Area (ft^2)	Suggested Green Infrastructure	Suggested Practice Size (ft^2)
436	Rain garden/Rain barrel	71 (8-inch depth)

During the warmer months, 44 ft^2 of this drainage area would drain to the rain barrel and would drain to the rain garden

Key:

Rain barrel =

Downspouts =

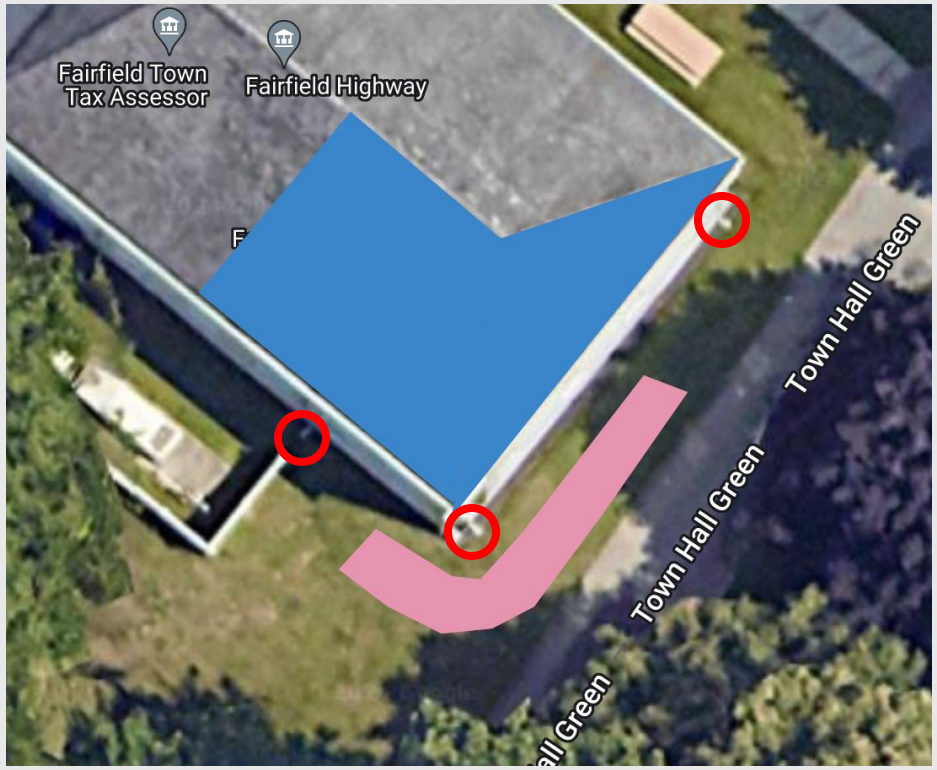
Drainage area

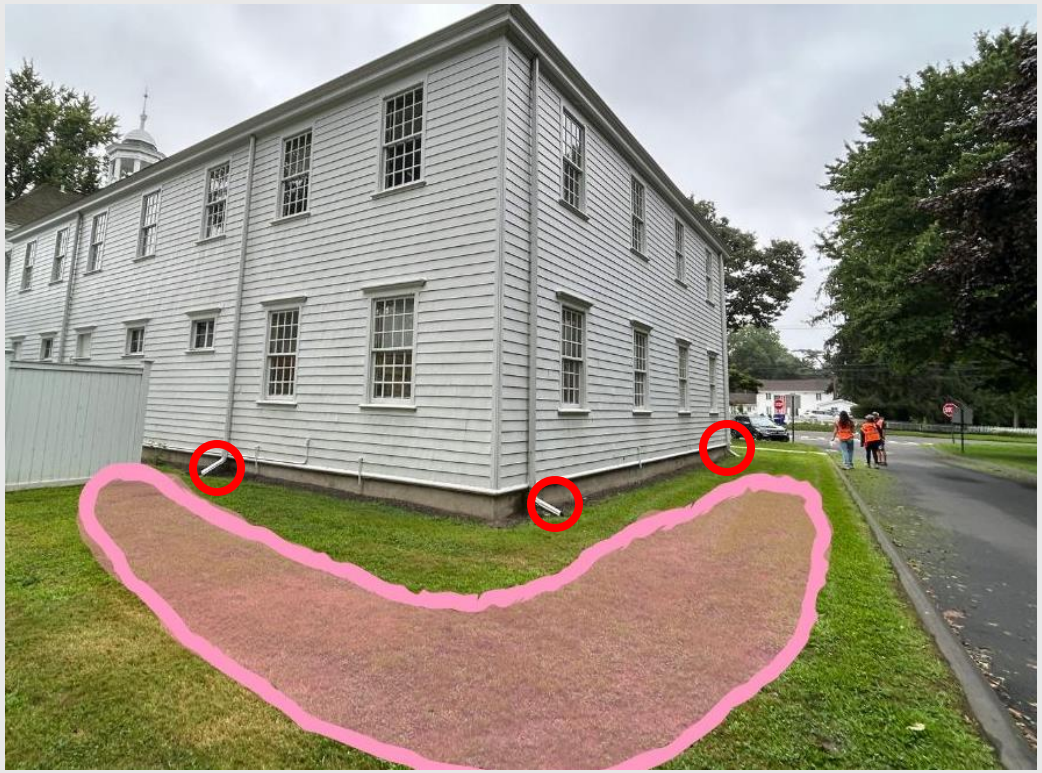
Rain garden

Site notes:

- Three downspouts redirected to the rain garden
- Would need to be at least 10 feet from the building
- Note electrical
- A fourth downspout directed into a rain barrel during the warmer months
  - This water can be used to water the plants in this area instead of a hose
  - In the colder months, the downspout would be directed into rain garden

Old Town Hall Site 2





Key:

Downspouts =

Drainage area

Rain garden

Drainage Area (ft^2)	Suggested Green Infrastructure	Suggested Practice Size (ft^2)
1,133	Rain garden	245 (6-inch depth)

Site notes:

- Three downspouts would be redirected to the rain garden
- This spot is not highly visible
- Good educational opportunity
- Would need to be at least 10 feet from the building

Fairfield Center

In downtown Fairfield, we did not come up with specific green stormwater practices. We were able to come up with two suggestions for the town based on preferences and goals. Our two suggestions are streetside bioswales or tree box filters. Both have been successfully implemented in other Connecticut towns. We provided some examples (left) of specific locations where these types of practices would be ideal.

Fairfield Center

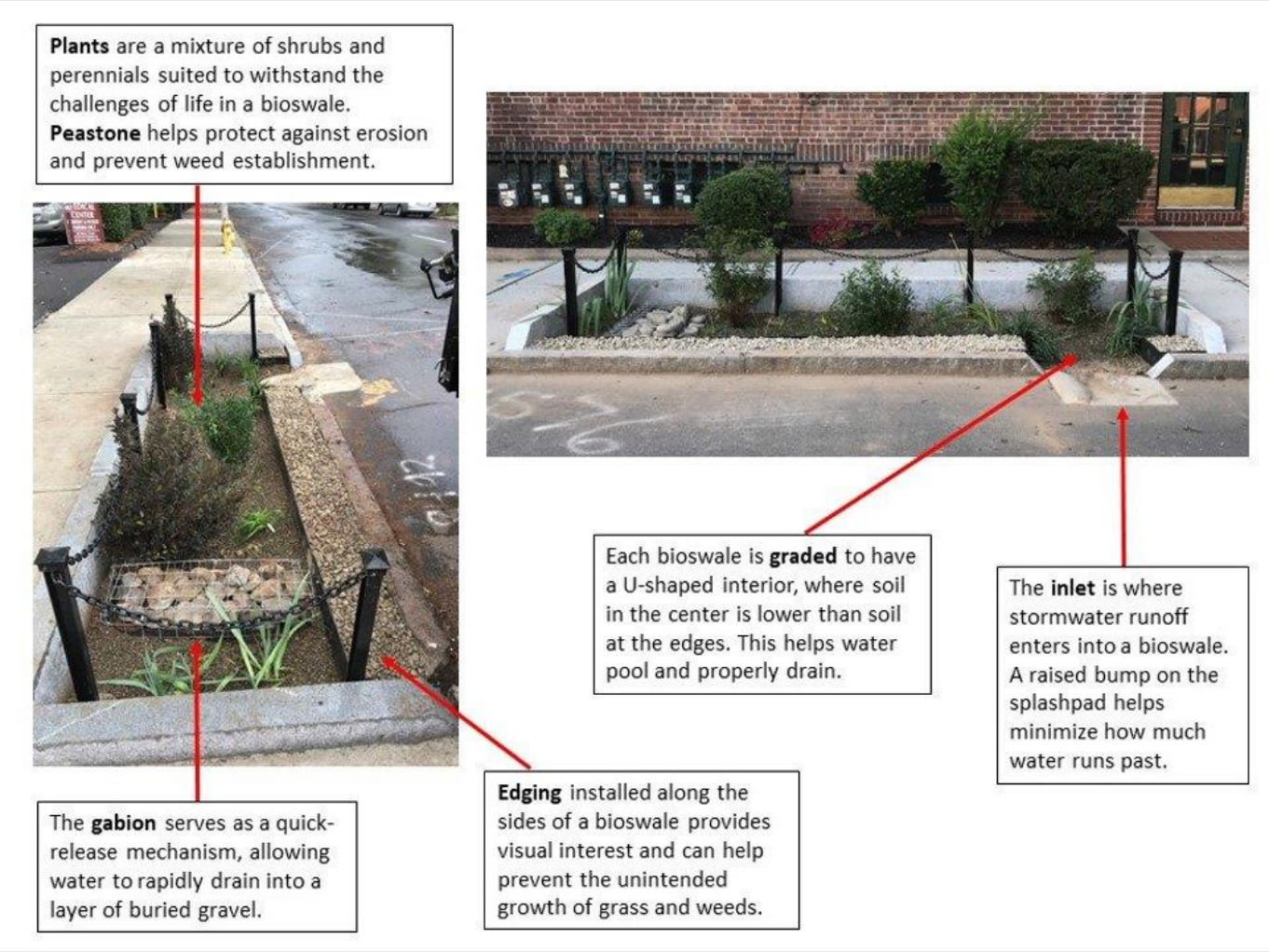


Photo courtesy of Yale's Urban Resources Initiative

Our first suggestion is to implement **<u>streetside bioswales</u>** as New Haven has done (see photo example). These take in runoff from the street and overflow into the stormwater system

Markeshia Ricks Photo

Fairfield Center

Our second suggestion is to implement **tree box filters** as East Lyme has done (see photo example). These are similar to other street trees in the area, but they are designed to take in runoff from the street and overflow into the stormwater system. They also can help to reduce heat island effects when fully grown and used in a large area.

Tree filters in downtown Niantic, CT

Calculation Totals

Site	Disconnected Area (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
Fairfield Woods Middle School Site 1	3,920	103,236	0.86	0.11
McKinley Elementary School Site 1	5,358	141,090	1.17	0.15
Warde High School Site 1A	2,134	56,206	0.47	0.06
Warde High School Site 1B	1,394	36,706	0.30	0.04
Warde High School Site 2A	1,917	50,481	0.42	0.05
Warde High School Site 2B	566	14,905	0.12	0.02
Warde High School Site 3	2,134	56,206	0.47	0.06
Warde High School Site 4	5,097	134,220	1.11	0.14
Stratfield Elementary School Site 1	2,111	55,589	0.46	0.06
Stratfield Elementary School Site 2	741	11,080	0.16	0.02

Calculation Totals

Site	Disconnected Area (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
Jennings Elementary School Site 1	2,483	65,383	0.54	0.07
Jennings Elementary School Site 2	2,178	57,354	0.47	0.06
Jennings Elementary School Site 3	2,309	60,795	0.51	0.06
Mill Hill Elementary School Site 2	2,701	71,118	0.59	0.07
Independence Hall Site 1	4,922	129,619	1.08	0.14
Fairfield Burr Homestead Site 1	1,133	29,824	0.25	0.03
TOTAL	**43,800**	**1,073,812**	**8.98**	**1.14**

Top 5 Recommendations

1. Fairfield Woods Middle School Site 1
   - High educational value and high visibility
   - High disconnection
2. Warde High School Site 1
   - High disconnection
   - Will add to the existing aesthetics
   - High visibility
3. McKinley Elementary School Site 1
   - Minimal maintenance disruptions
   - High visibility
4. Warde High School Site 2
   - High educational value
   - Provide students with shade
   - High visibility
5. Stratfield Elementary School Site 2
   - High disconnection
   - Low cost

Sites not visited/not selected

- Roger Sherman Elementary School
  - No visible downspouts, flat roofs, minimal greenspace
- Fairfield Woods Branch Library
  - Minimal greenspace, flat roofs
- Ludlowe High School
  - No visible downspouts, flat roofs, minimal greenspace
- Roger Ludlowe Middle School
  - No visible downspouts, flat roofs, minimal greenspace
- Burr Elementary School
  - Flat roofs, minimal greenspace
- Riverfield Elementary School
  - Minimal greenspace
- North Stratfield Elementary School
  - Minimal greenspace, no visible downspouts
- Holland Hill Elementary School
  - Construction
- Osborn Hill Elementary School
  - Construction
- Tomlinson Middle School
  - Summer Program
- Dwight Elementary School
  - Possible reconstruction
- Bigelow Senior Center
  - Not a lot of greenspace, no downspouts to disconnect

Questions/Discussion

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