Stormwater Runoff Reduction Plan

Westport, CT

Created by: *UConn Undergraduate Students*

Indigo Irwin, December 2024, *Anthropology and Political Science*

Emily Markelon, December 2024, *Environmental Studies and Journalism*

Sophia Steen, May 2025, *Environmental Studies*

Advisors:

UConn Extension Faculty

Michael Dietz

David Dickson

UConn Graduate Student

Chloé Zampetti

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Summary

In the summer of 2024, UConn students and faculty conducted a stormwater retrofit assessment in the town of Westport, 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 **10 potential projects** were identified. If all projects are installed, **18,496 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

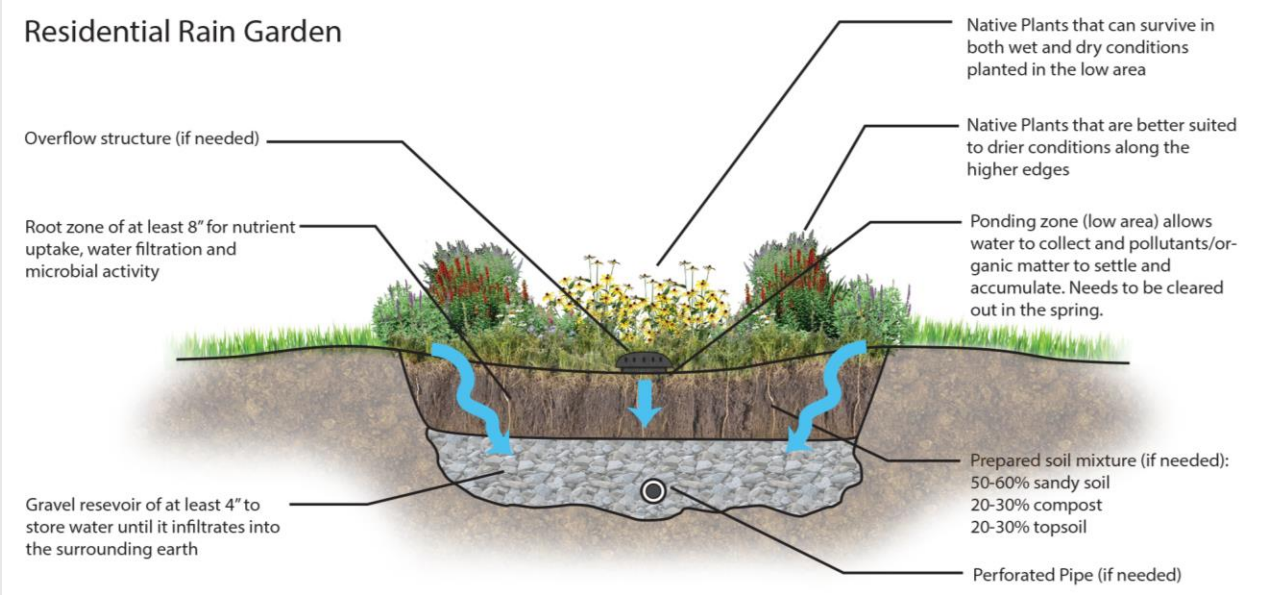
Green Stormwater Infrastructure Practices

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**.

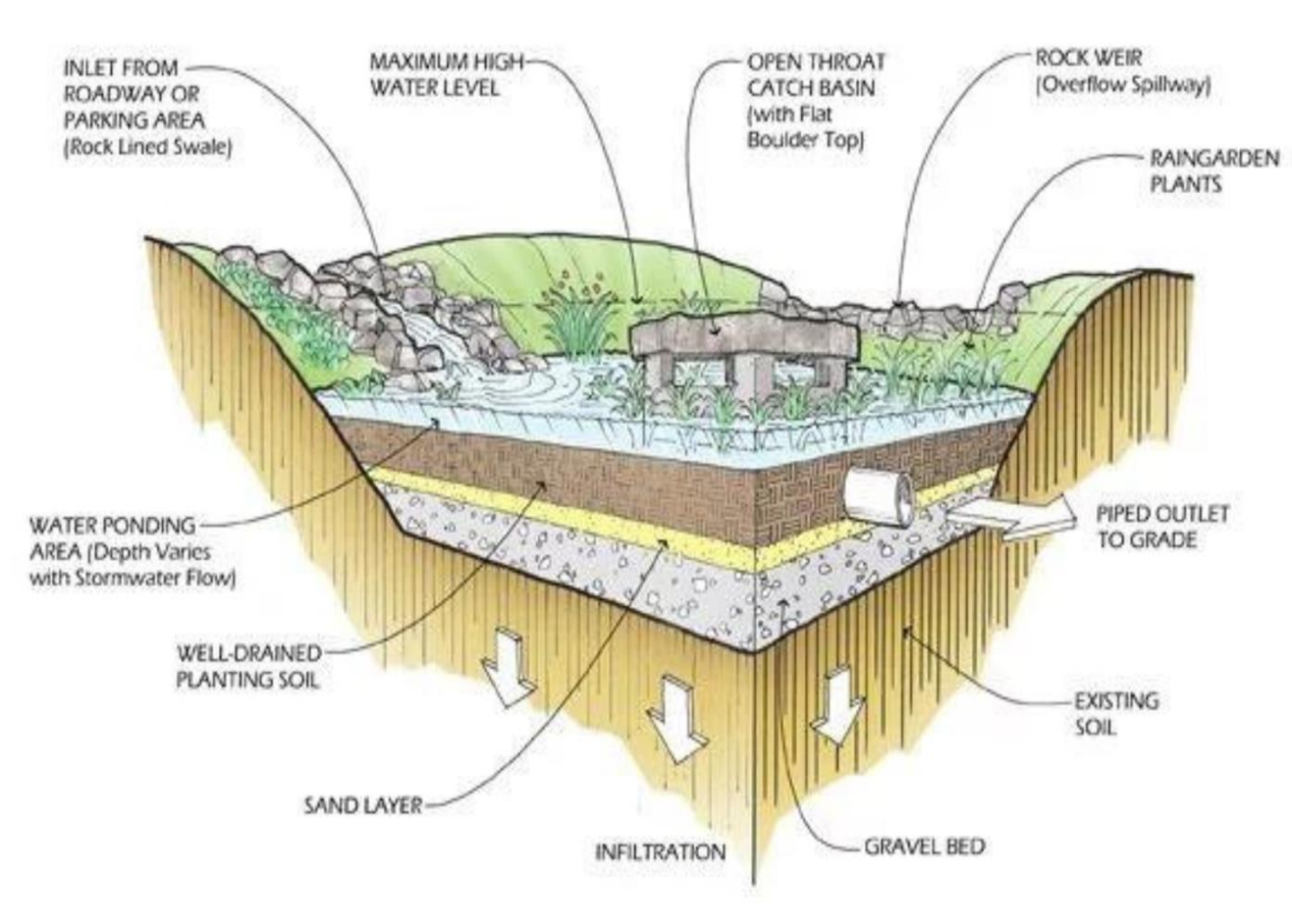
Rain Gardens

- 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



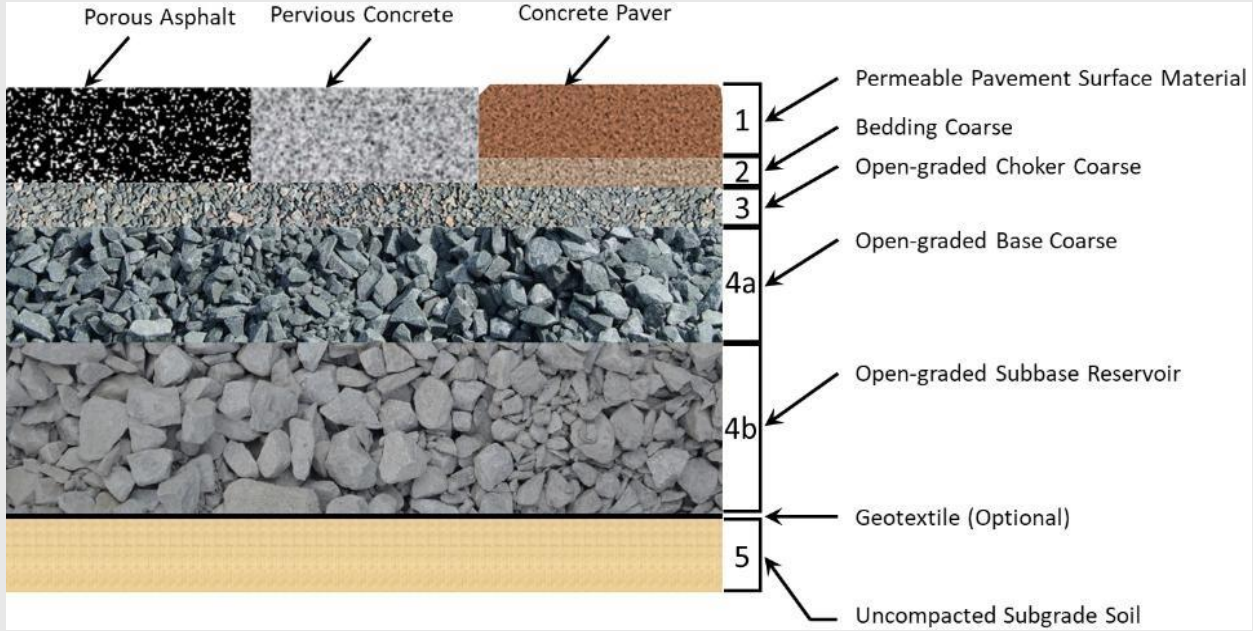
Bioretention Basins

- 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

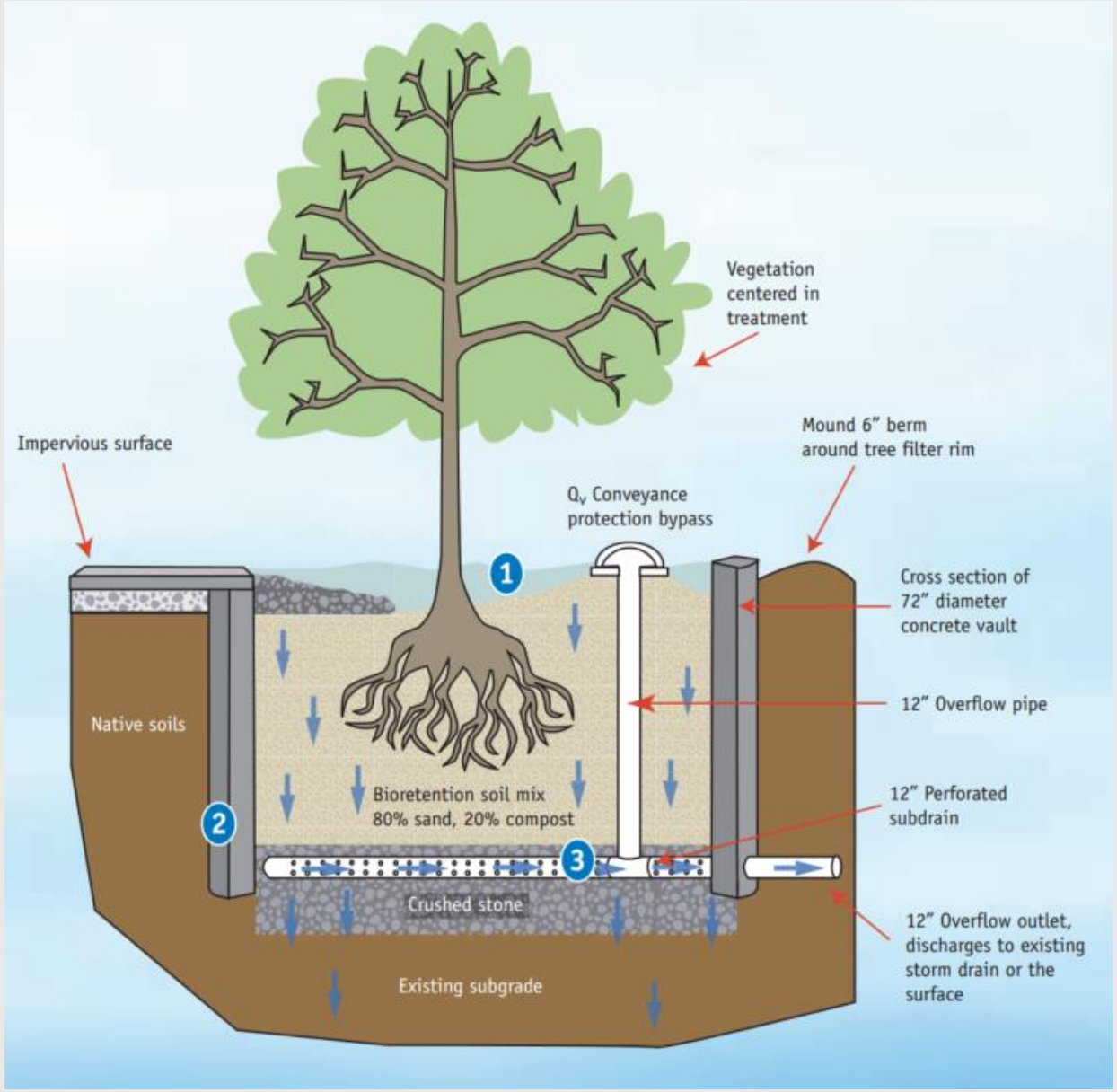
- Serve as an alternative to traditional pavement by allowing water to infiltrate into the ground instead of running off
  - Typically installed in areas that are **already being repaved** to avoid excess construction
  - **Cost competitive** with typical pavement
- Ideally installed somewhere relatively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

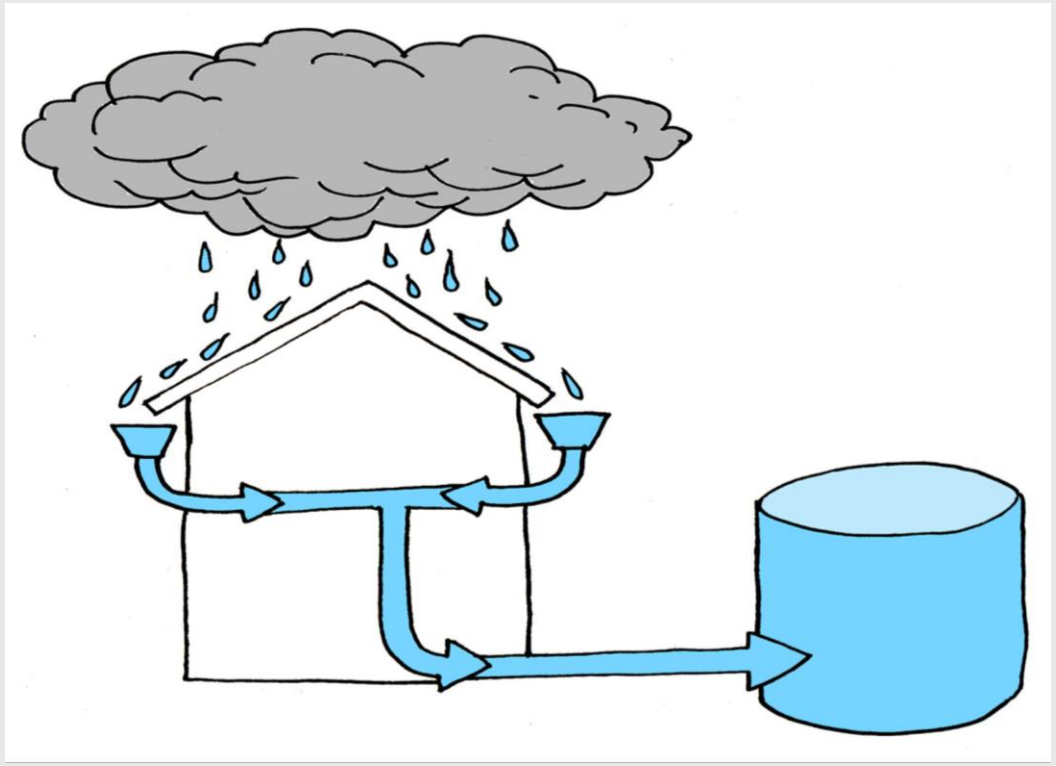
Tree Box Filters

- 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



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:

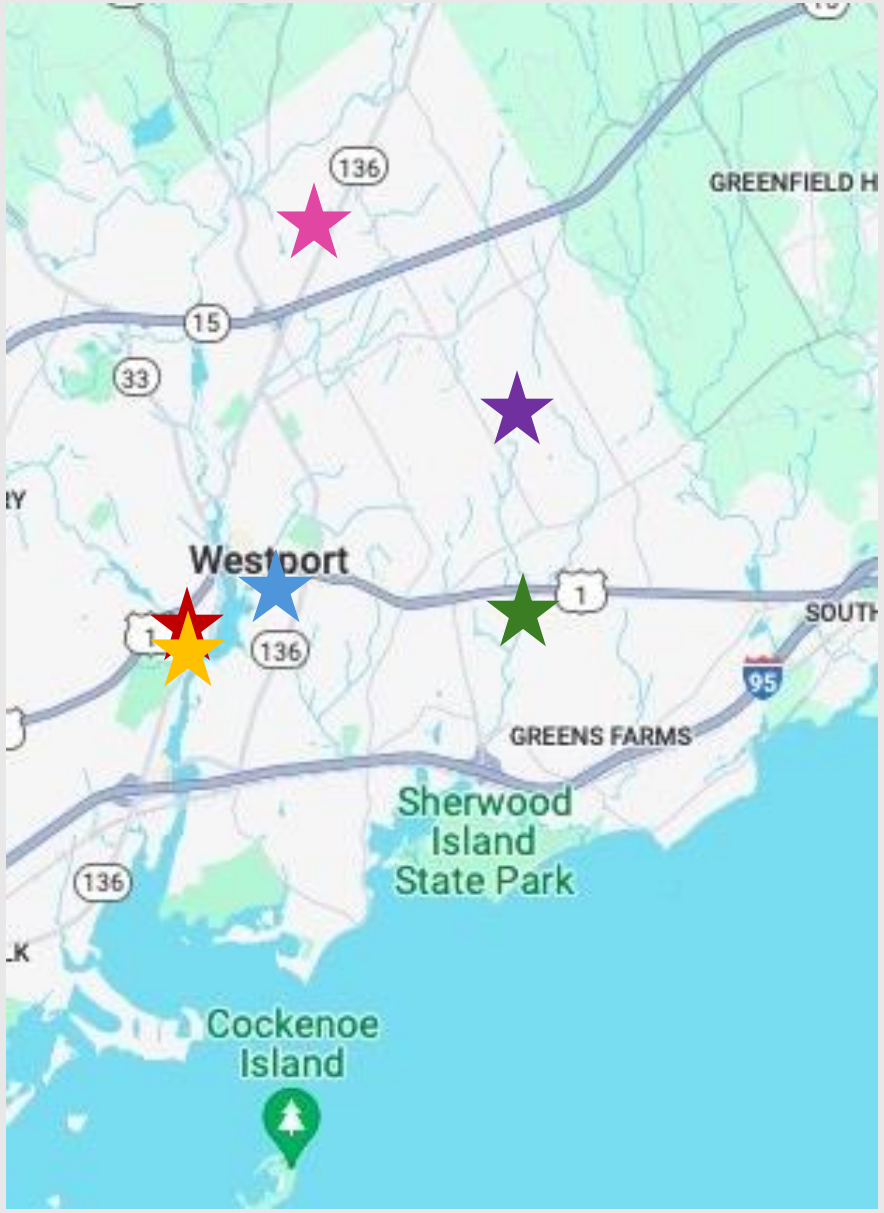
- **Slope** of surrounding land
- **Land available** for use
- Locations of existing **storm drains or other overflow opportunities**
- Above ground and underground **obstructions** (large trees, pipes, utilities, etc.)
- Pre-existing **green infrastructure practices**
- **Maintenance** concerns
- **Educational**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

Site Overview

- Kings Highway Elementary School
- Senior Center
- Coleytown Elementary School
- Greens Farms Elementary School
- Staples High School
- Saugatuck Elementary School

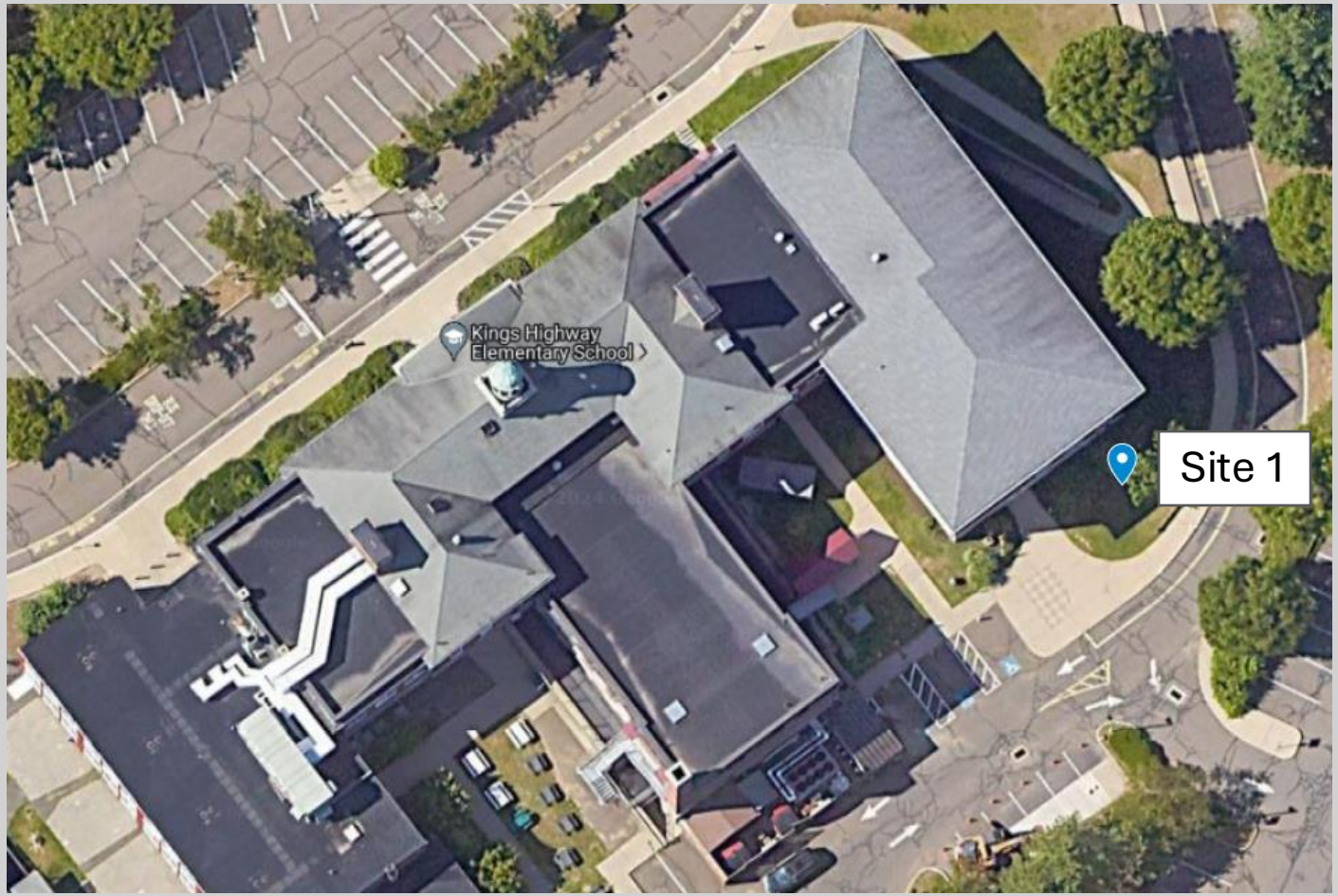


Kings Highway Elementary School

125 Post Road West

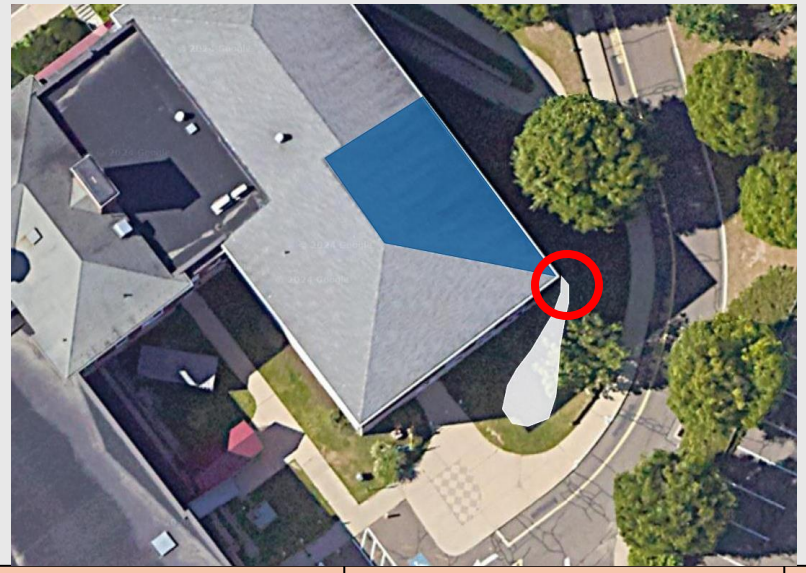
At this site, we recommend the installation of a grass swale to disconnect the portion of the roof.

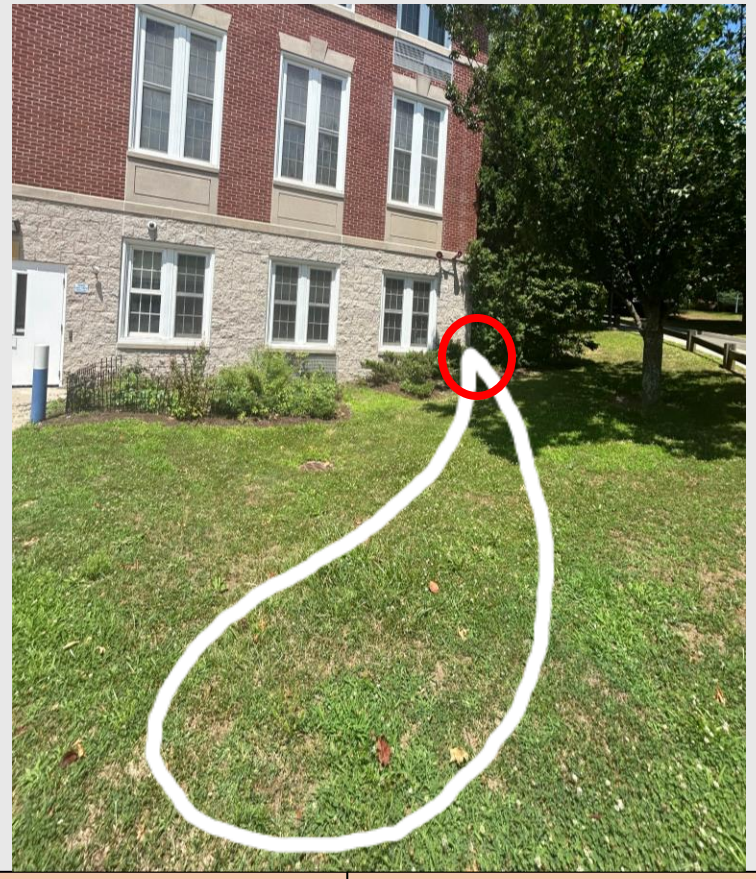
Possible **disconnection of 1,263 feet^2** of impervious cover with the implementation of these green stormwater practices.



Kings Highway Elementary School Site 1

Key:
Downspouts =
Drainage area
Rain garden





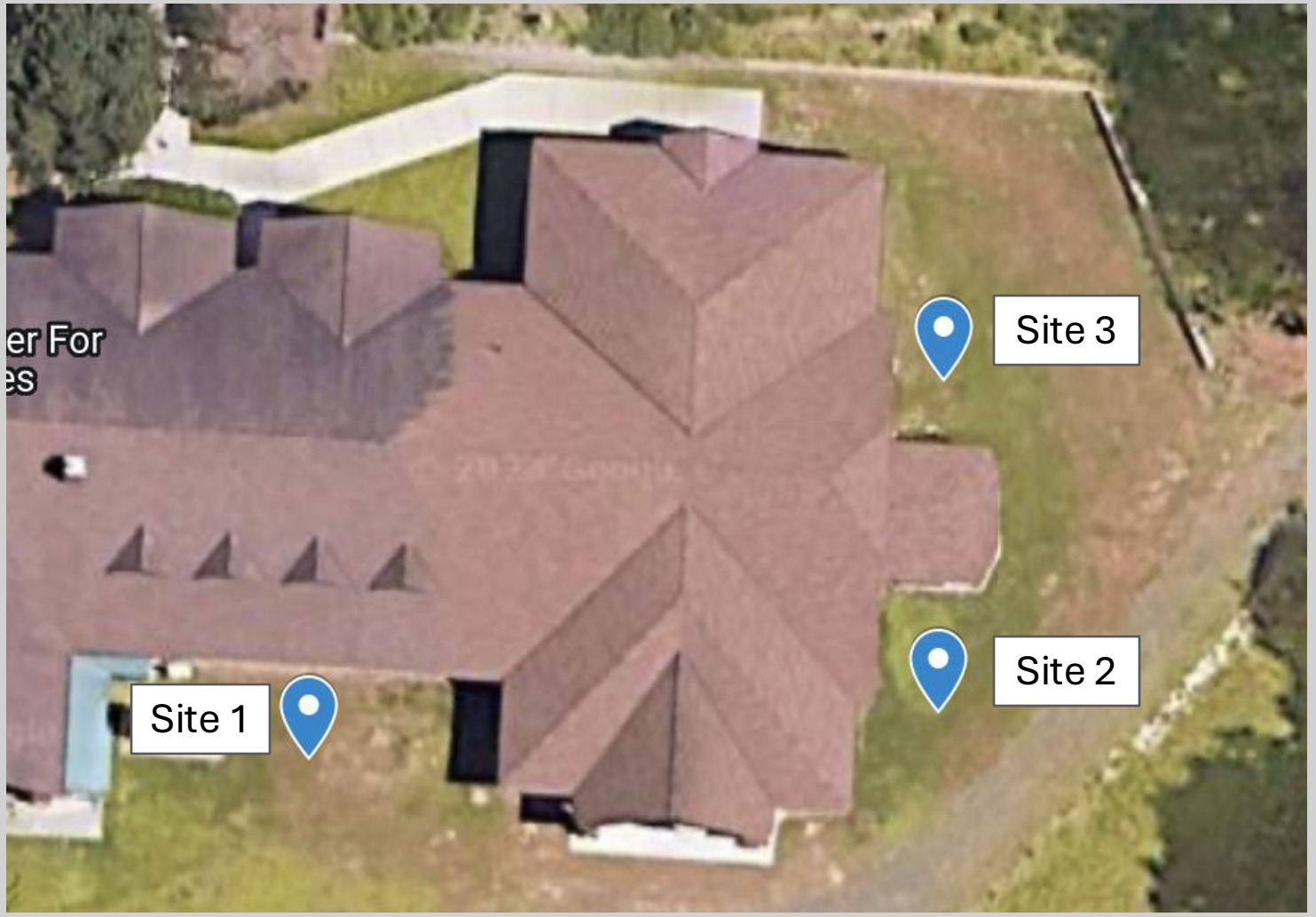
Site Notes:
- Lower visibility since it is located near the back of the building
- Low maintenance
- High disconnection
- High educational value

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)
1,263	Rain garden or grass swale	33,259	0.28	0.04	274

Senior Center

21 Imperial Avenue

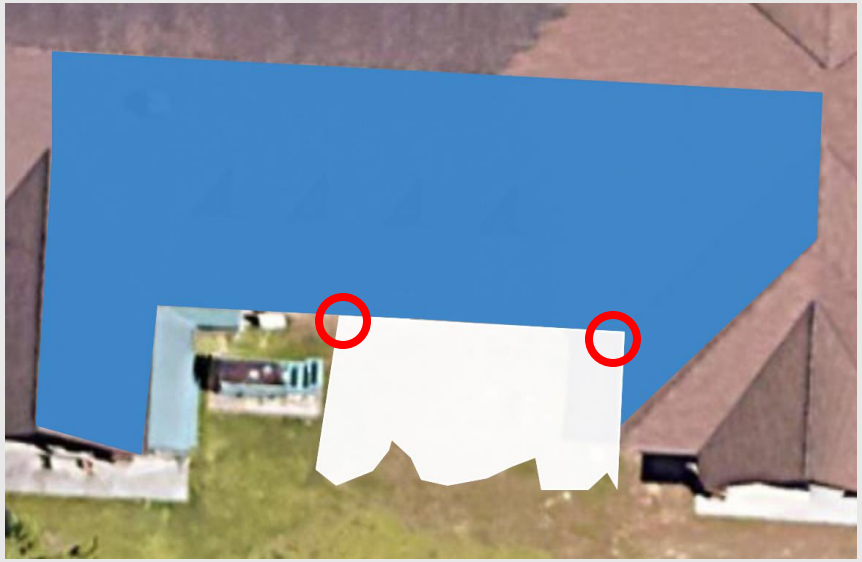
At the Senior Center, we recommend 3 potential sites for rain garden installations. Although these gardens have low visibility, they have high educational value as the garden club at the senior center may be able to help care for them.



Possible **disconnection of 5,271 feet^2** of impervious cover with the implementation of these green stormwater practices.

Key:
Downspouts =
Drainage area
Rain garden

Senior Center Site 1



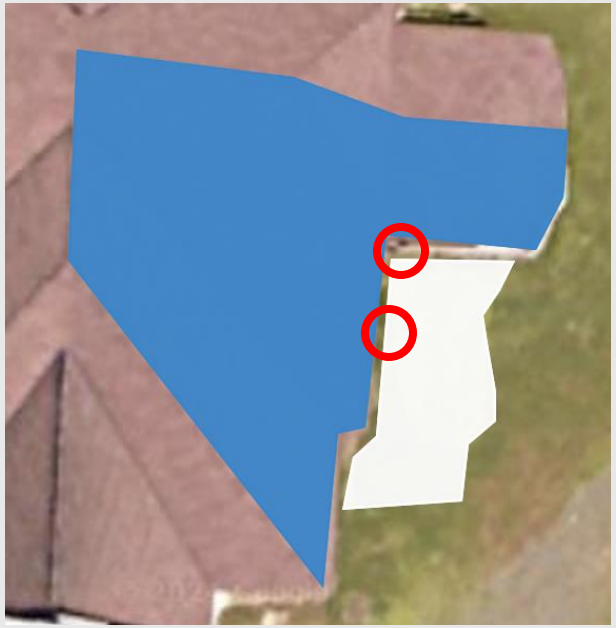
Site Notes:

- Large disconnection
- Lower visibility since it is located near the back of the building
- Can be connected to existing gardens to minimize mowing maintenance
- Note existing electrical
- Will add to aesthetics of the area

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)
3,267	Rain garden	86,030	0.71	0.09	708 (6 inch depth)

Senior Center Site 2

Key:
Downspouts =
Drainage area
Rain garden

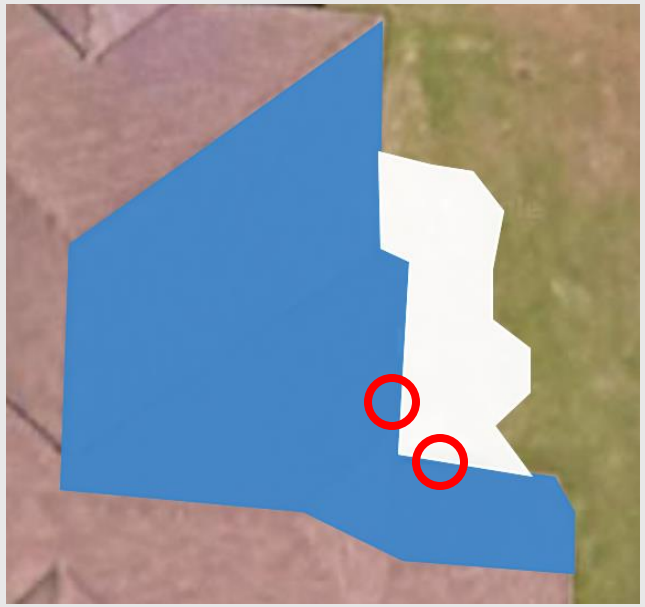


Site Notes:
- Small disconnection
- Low visibility since located at back of building and few windows nearby
- Minimal mowing maintenance disruptions
- Will add aesthetics to the area

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)
1,002	Rain garden	26,383	0.22	0.03	217 (6 inch depth)

Key:
Downspouts =
Existing drain =
Drainage area
Rain garden

Senior Center Site 3



Site Notes:
- Small disconnection
- Low visibility since located at back of building and few windows nearby
- Minimal mowing maintenance disruptions
- Will add aesthetics to the area

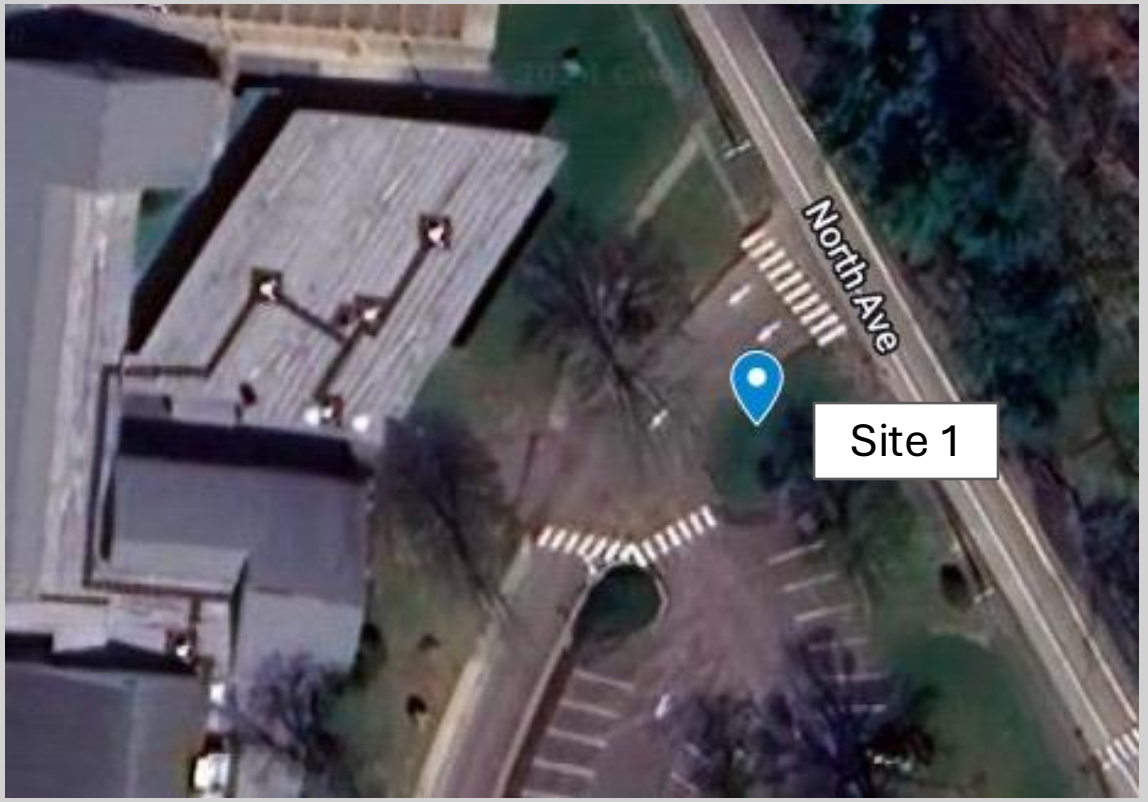
Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
1,002	Rain garden	26,383	0.22	0.03	217 (6 inch depth)

Coleytown Elementary School

65 Easton Road

At this site, we recommend the installation of a rain garden/grass swale near the entrance of the parking lot.

Possible **disconnection of 4,449 feet^2** of impervious cover with the implementation of these green stormwater practices.



Coleytown Elementary School Site 1

Key:

Drainage area

Curb cuts =

Rain garden

Coleytown Elementary School Site 1

Site Notes
- High visibility
- High educational value
- Very significant disconnection area
- Unlikely to impede students or staff
- Low maintenance options (grass 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)
4,449	Rain garden/ grass swale	117,156	0.97	0.12	964 (6 inch depth)

Green Farms Elementary School

17 Morningside Drive South

At this site, we recommend 2 potential rain barrel sites and 1 potential rain garden site. These practices would fit in wonderfully with the current practices at this location. Although the disconnection area is relatively small, these sites have both high visibility and a high educational value.

Possible **disconnection of 1,496 feet^2** of impervious cover with the implementation of these green stormwater practices.

Greens Farms Elementary School Site 1

Key:

Downspouts =

Rain barrel =

Drainage area

Site Notes:

- High educational value
- Can supply water to the surroundings gardens
- The disconnection is very minimal

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)
683	Rain barrel	---	---	---	---

Greens Farms Elementary School Site 2

Key:

Downspouts =

Rain barrel =

Drainage area

Site Notes:

- High educational value
- Can supply water to the surroundings gardens
- The disconnection is very minimal

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)
393	Rain barrel	---	---	---	---

Greens Farms Elementary School Site 3

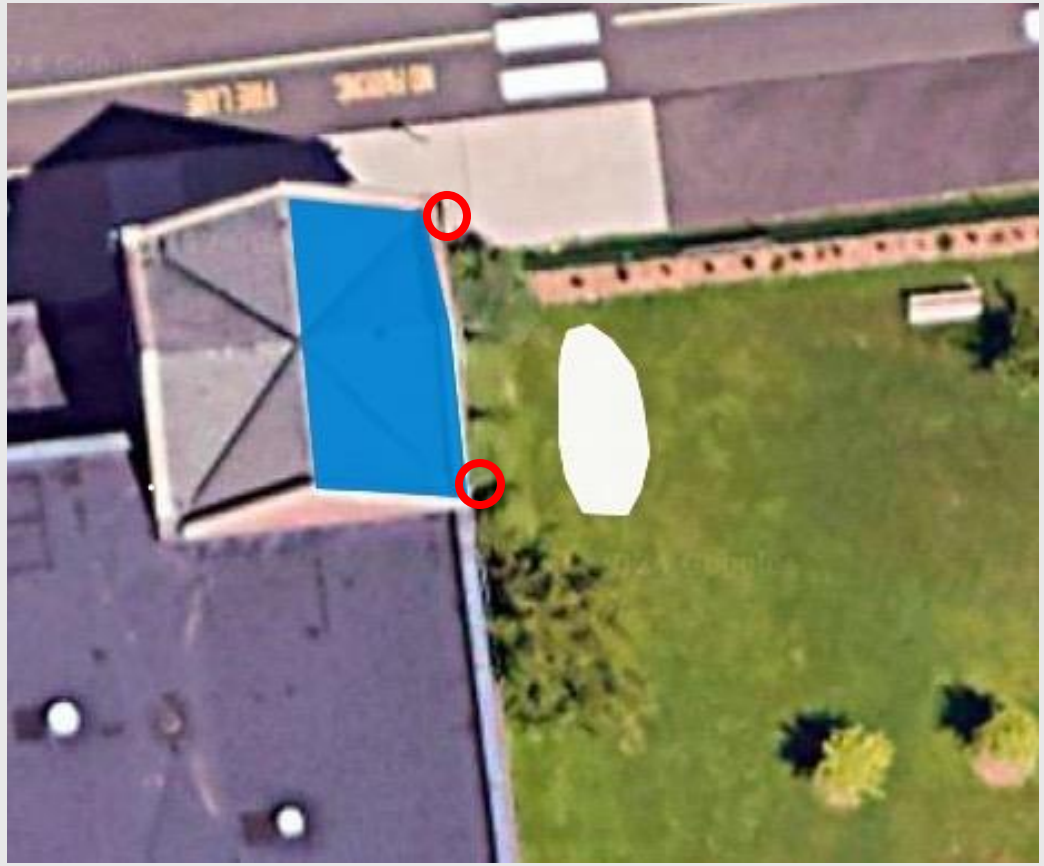
Key:

Downspouts =

Water flow =

Drainage area

Rain garden



Greens Farms Elementary School Site 3

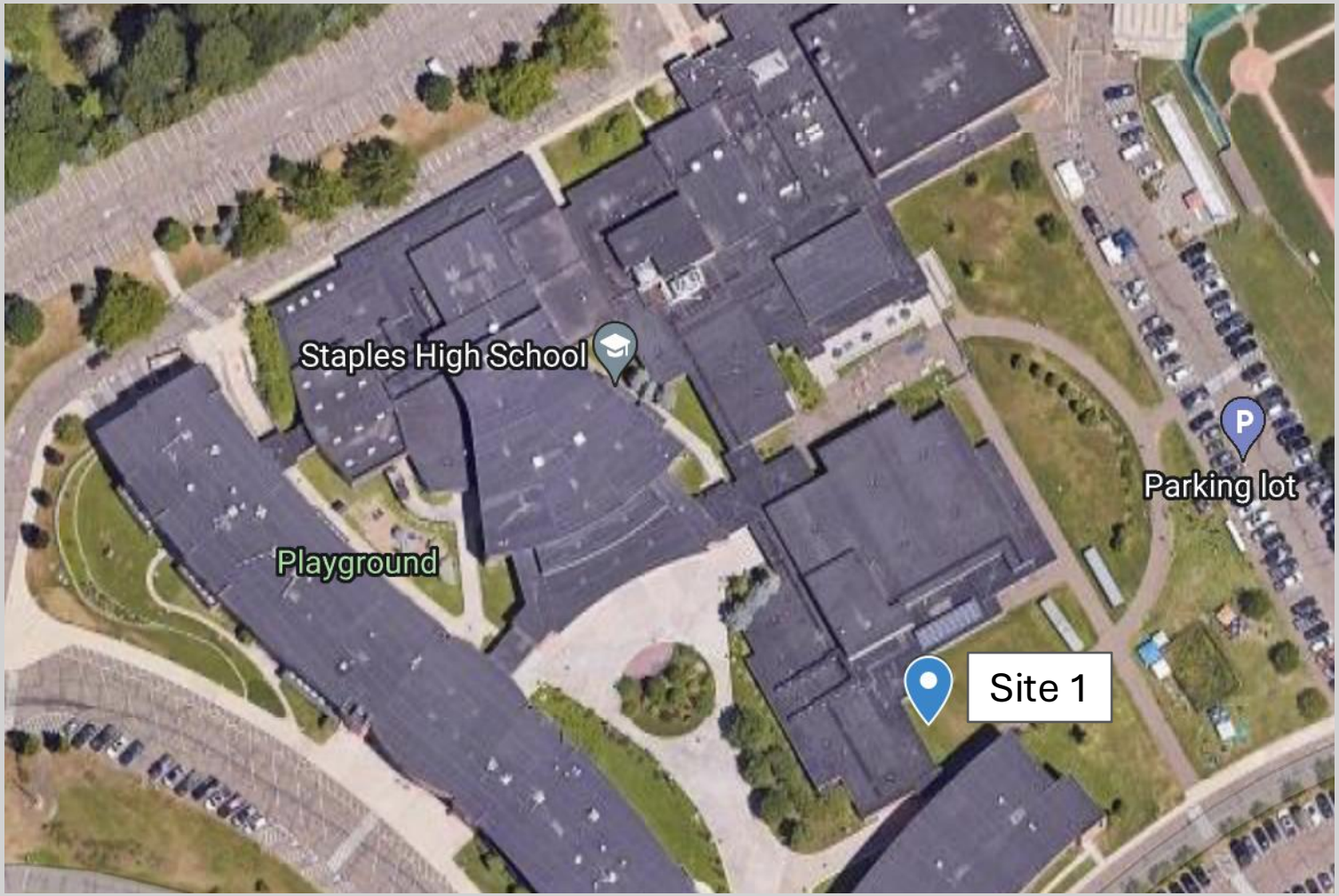
Site Notes:
- High educational value
- High visibility
- Be aware of student proximity
- Ability for an overflow drain

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)
420	Rain garden	11,060	0.09	0.01	91 (6 inch depth)

Staples Highschool
70 North Avenue

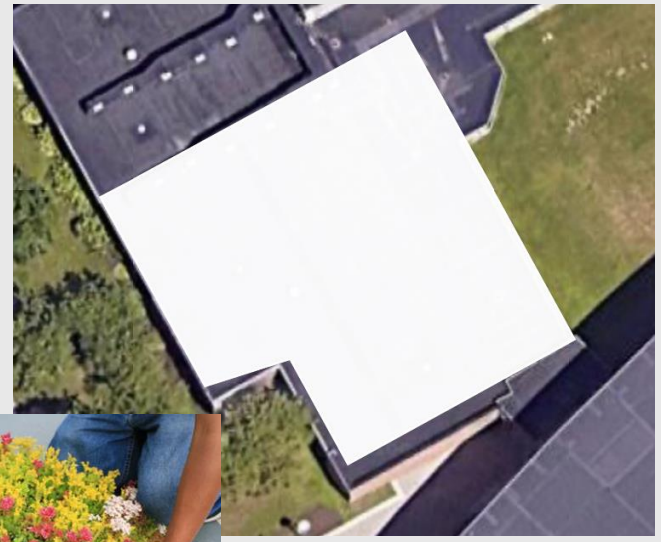
At Staples Highschool, we recommend a green roof. The green roof will be located on a roof that is overlooked by existing windows which will enhance the education value. The green roof will not impact *existing* maintenance practices but will require *some* maintenance.

Partial **disconnection of 5,271 feet^2 of** impervious cover with the implementation of the green roof.



Staples Highschool Site 1

Site Notes:
- High visibility
- High educational value
- No maintenance impact on existing green areas
- Cost is higher than other GSI
- Recommend to have a structural engineer evaluate roof
- Will need proper roof access to maintain the plants



In regard to cost of green roof installation, the typical rate is $20/ft^2 plus delivery fees.

For more information about green roof costs visit:
https://liveroof.com/contact/representatives/liveroof-northeast/

Key:
Green roof

Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
5,271	Green roof	78,861	----	----

Saugatuck Elementary School

170 Riverside Road

At this site, we recommend the installation of a rain garden in the front of the school to help disconnect a portion of the entrance parking lot.

Possible **disconnection of 696 feet^2** of impervious cover with the implementation of these green stormwater practices.

Saugatuck Elementary School Site 1

Site Notes:
- High visibility
- Adds aesthetic value
- 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)
696	Rain garden	18,328	0.15	.02	151

Calculation Totals

Site	Disconnected Area (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
Kings Highway Elementary School Site 1	1,263	33,259	0.28	0.04
Senior Center Site 1	3,267	86,030	0.71	0.09
Senior Center Site 2	1,002	26,383	0.22	0.03
Senior Center Site 3	1,002	26,383	0.22	0.03
Coleytown Elementary School Site 1	4,449	117,156	0.97	0.12
Greens Farms Elementary School Site 1	683	----	----	----
Greens Farms Elementary School Site 2	393	----	----	----
Greens Farms Elementary School Site 3	420	11,060	0.09	0.01
Staples Highschool Site 1	5,271	78,861	----	----
Saugatuck Elementary School Site 1	696	18,328	0.15	0.02
Total	**18,496**	**397,460**	**2.64**	**0.34**

Top 5 Recommendations

1) **Kings Highway Elementary School Site 1**
    1) High disconnection
    2) Low maintenance
2) **Senior Center Site 1**
    1) High disconnection
    2) Garden club can aid in maintenance
    3) Will add to existing aesthetics of the area
3) **Coleytown Elementary School Site 1**
    1) High disconnection
    2) High visibility
    3) High educational value
4) **Green Farms Elementary School Site 3**
    1) High educational value
    2) Matches the purpose of the area well
5) **Staples Highschool Site 1**
    1) High visibility
    2) High disconnection
    3) No change in maintenance of existing greenspace

Sites not visited/not selected

1) **Town Hall**
    1) Highly developed
        1) Minimal greenspaces
    2) Basement
    3) Large trees nearby
2) **Bedford Middle School**
    1) Highly developed
        1) Minimal greenspaces
    2) Flat roofs
3) **Stepping Stones Preschool**
    1) Highly developed
        1) Minimal green space
    2) Minimal sloped roofs to potentially disconnect

Questions/Discussion

Contact information

- **Mike Dietz**, Extension Educator & CT Institute of Water Resources Director, 860-486-2436, michael.dietz@uconn.edu
- **Dave Dickson**, 860-345-4511, Extension Educator & CLEAR Director, david.dickson@uconn.edu

- **Courtney Gilligan**, Natural Resource Specialist, cgilligan@conservect.org
- **Jaime Veins**, Water Conservation Specialist, jviens@conservect.org