MIDDLETOWN,CT

Stormwater Runoff Reduction Plan

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Summary

In the fall of 2024, UConn students and faculty conducted a stormwater retrofit assessment in the town of Middletown, 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, **55,618 ft²** 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

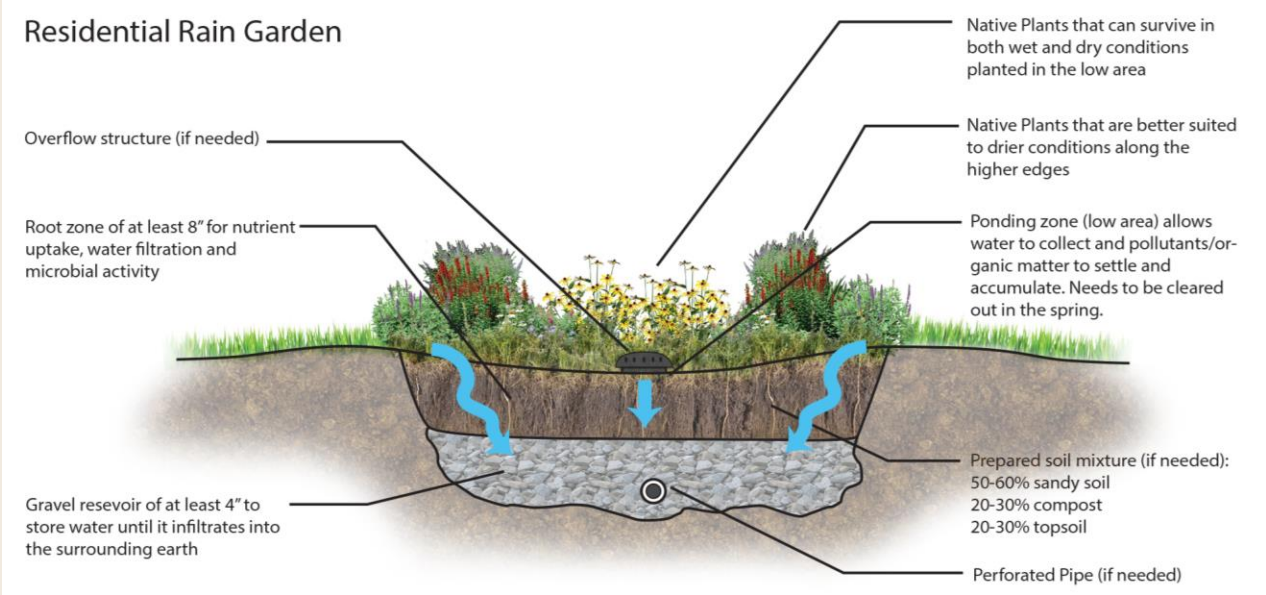
Green Stormwater Infrastructure Practices

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

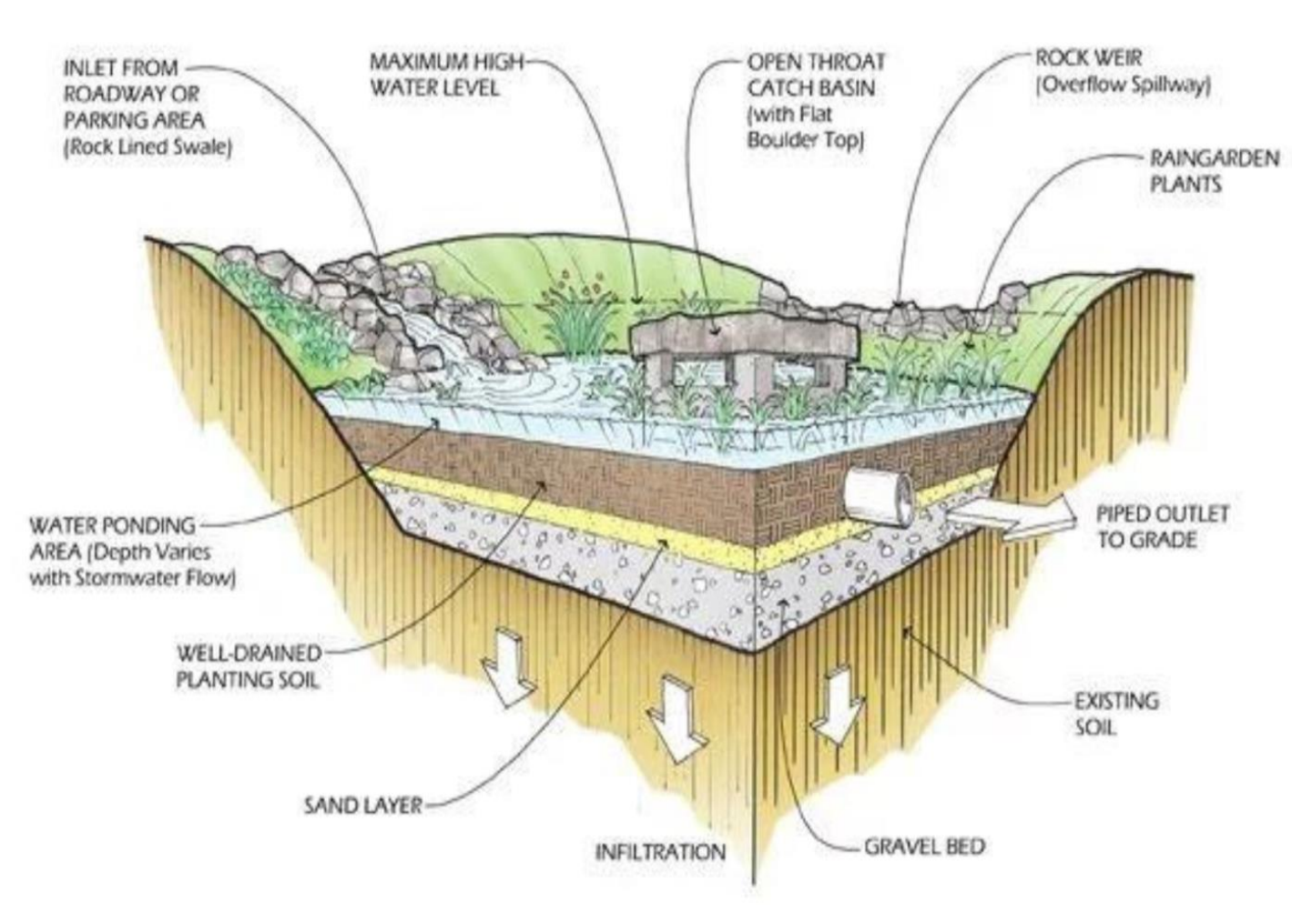
- Collects stormwater runoff from roofs via disconnected gutters or from impervious surfaces and infiltrates runoff into the ground naturally
- Involves a **6+ inch** depression, often with grass, native plants, or stone
- May include curb cuts, gravel, or stone to prevent erosion
- Aesthetically pleasing 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

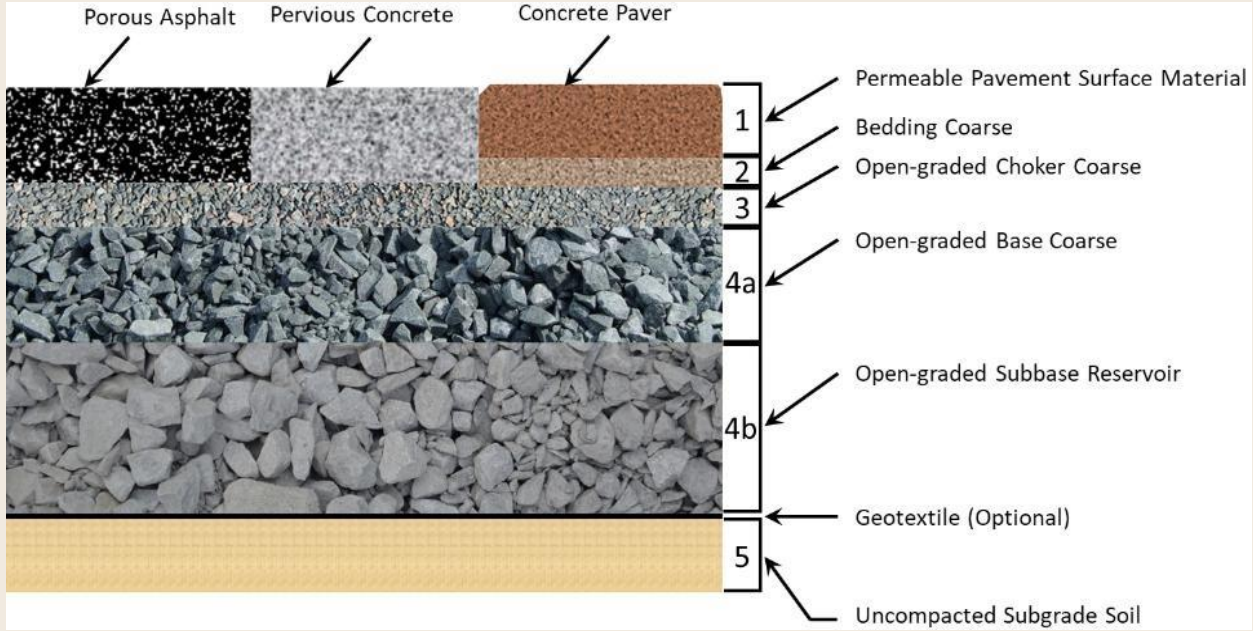
Bioretention Basins

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

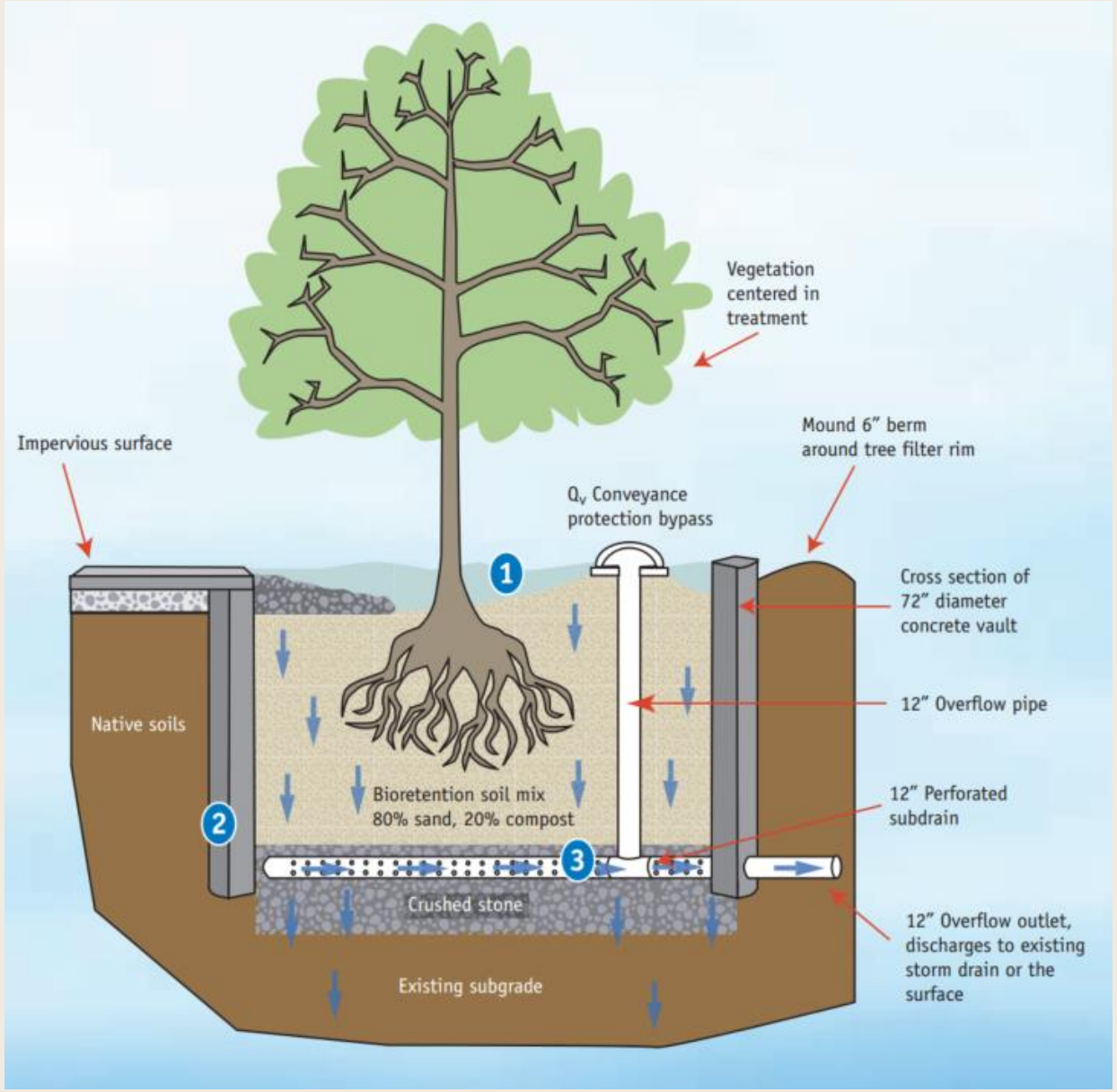
- Serve as an alternative to traditional pavement by allowing water to infiltrate into the ground instead of running off
- Typically installed in areas that are **already being repaved** to avoid excess construction
- **Cost competitive** with typical pavement
- Ideally installed somewhere relatively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

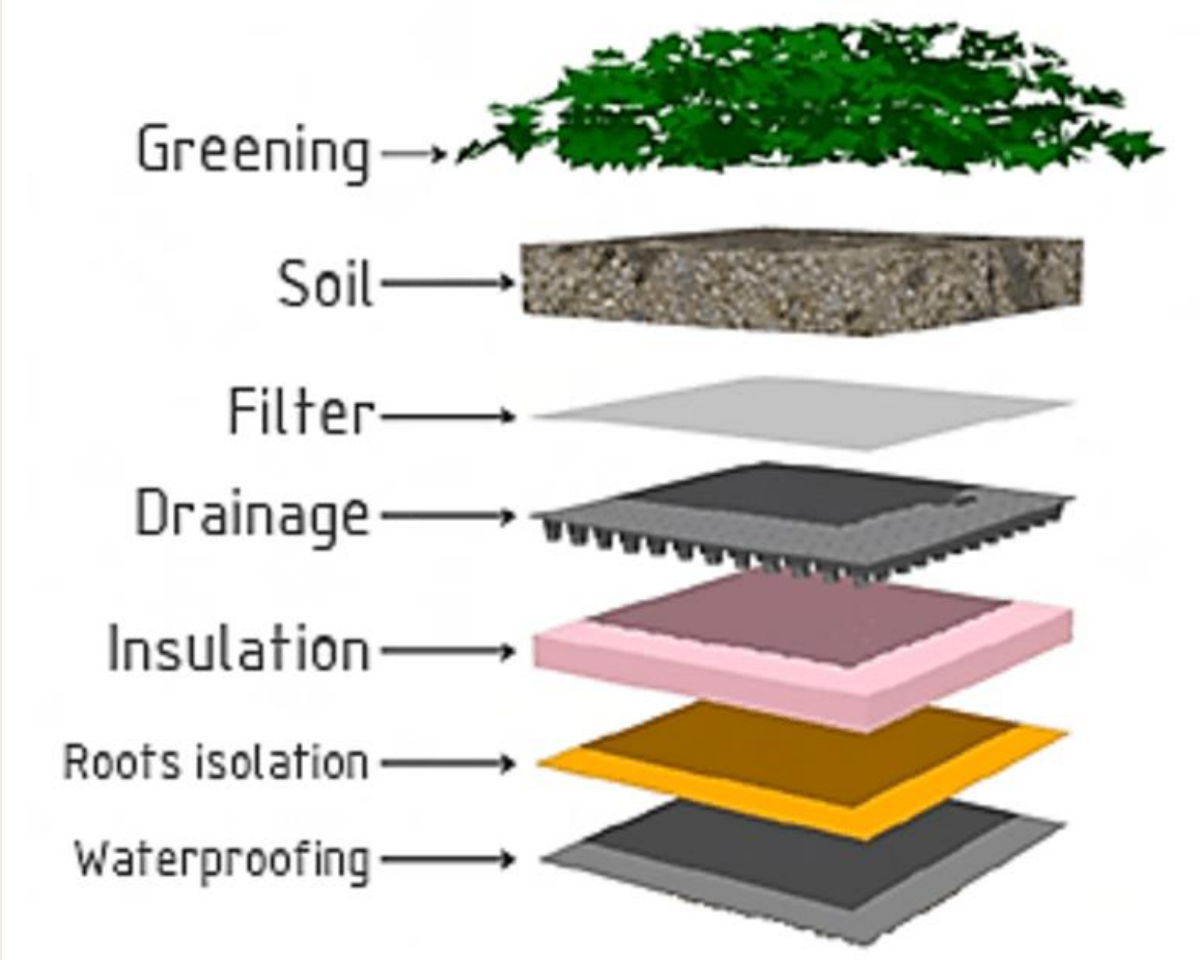
Tree Box Filters

- 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



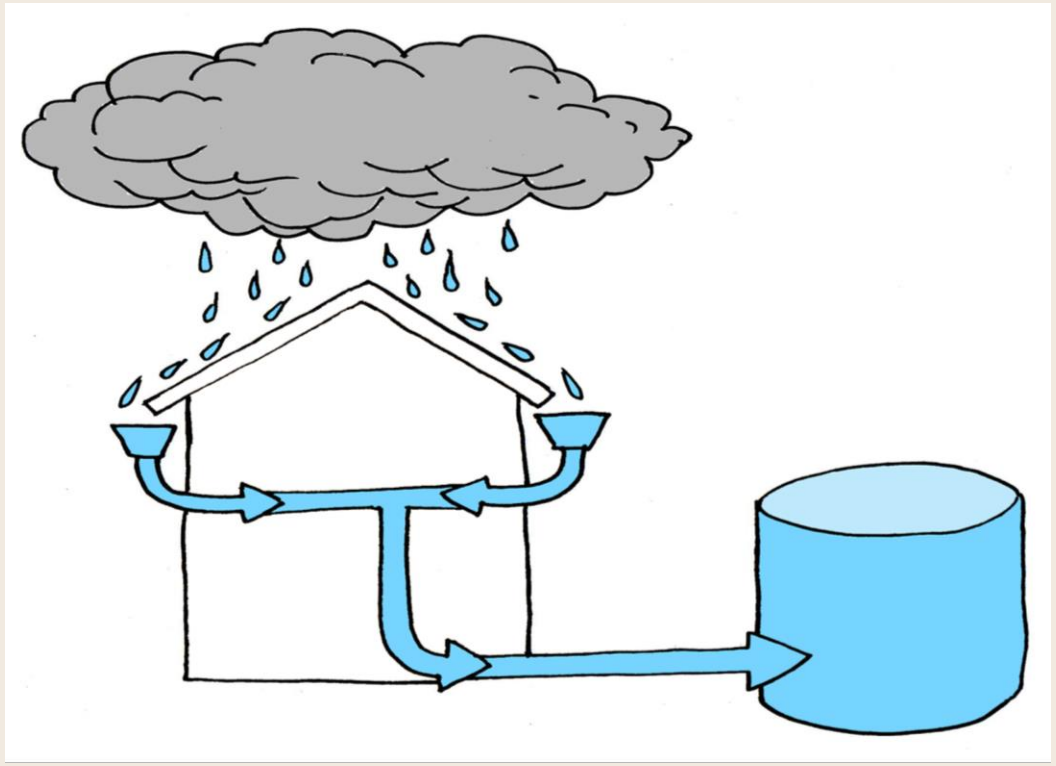
Green Roofs

- 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

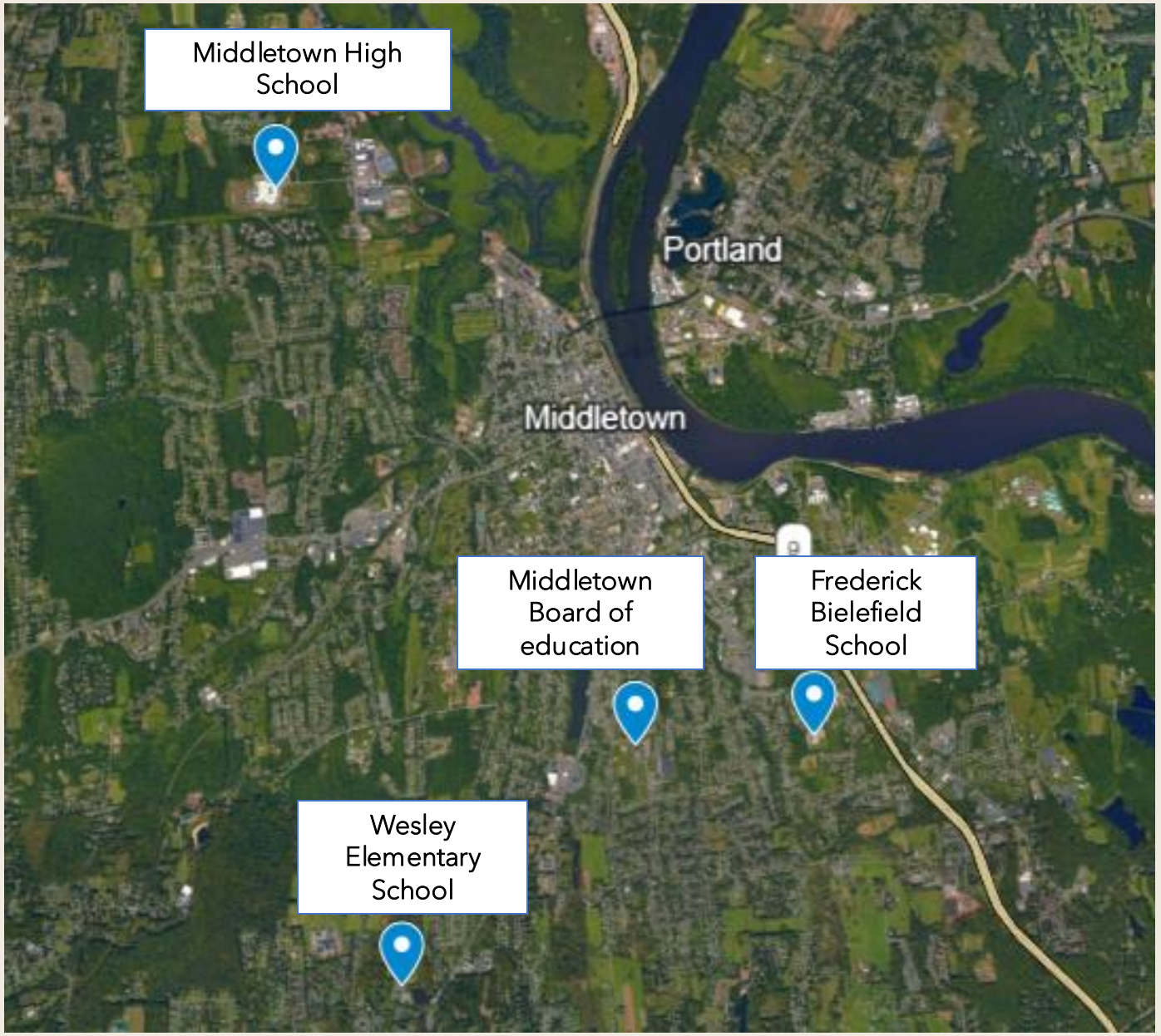
- **Drainage Area:** The potential watershed area for each retrofit was estimated using topographic tools and confirmed during site visits.
- **Rain Garden Size:** Rain garden area and depth is heavily dependent on the estimated drainage area and amount of rainfall expected. All rain gardens in this presentation are sized to handle a **1.3 inch rain 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

The locations selected were Middletown High School, Frederick Bielefield School, Wesley Elementary School, and the Middletown Board of education.

These sites offer opportunities for education for those that attend these schools.

Additionally, maintenance required for an existing bioretention site was observed at the Middletown Recreation Center.



Middletown Board Of Education

311 Hunting Hill Ave

At this site, we recommend the installation of 2 rain gardens.

Possible **disconnection of 9,749 feet²** of impervious cover with the implementation of these green stormwater practices.

Middletown Board Of Education

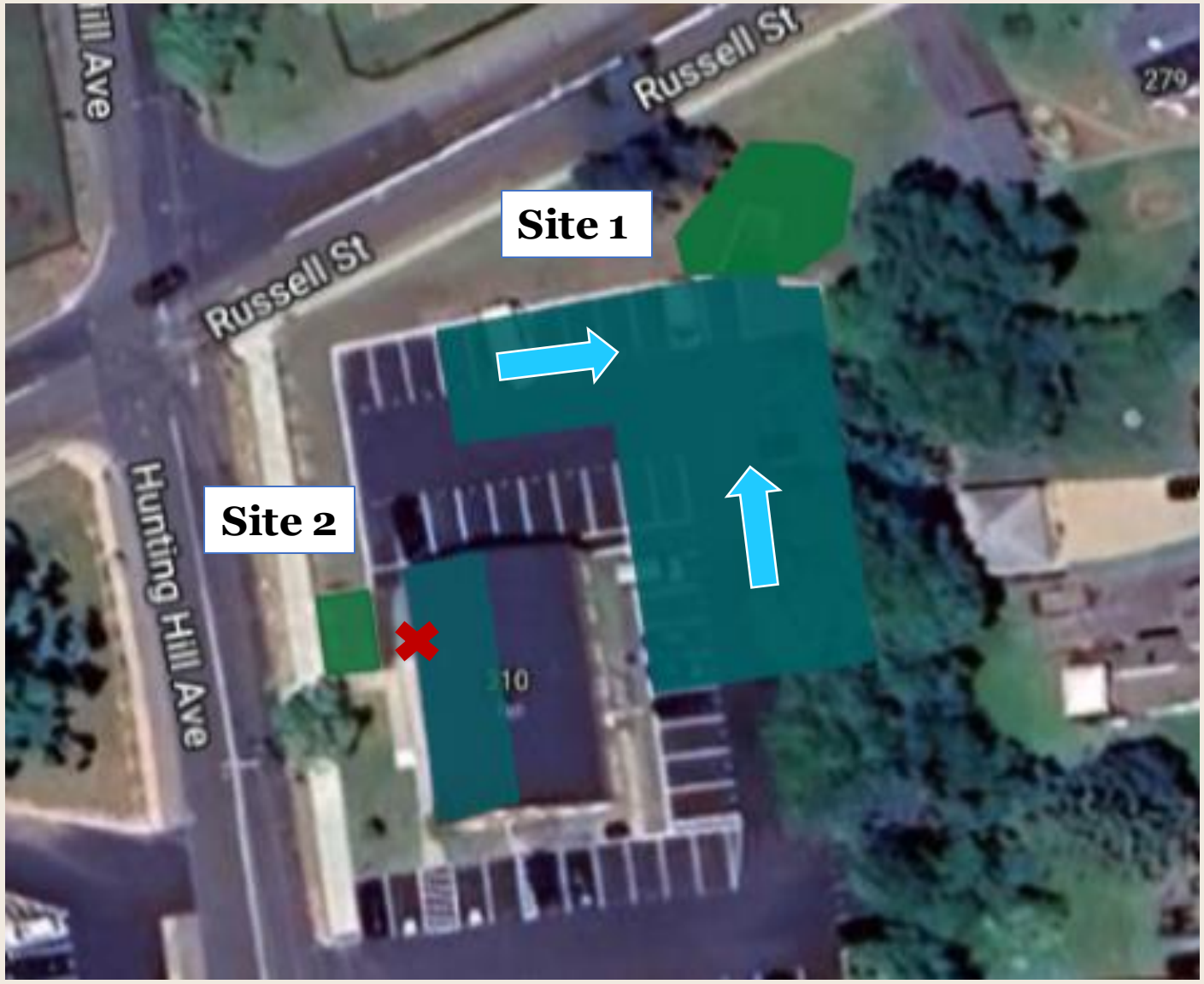
311 Hunting Hill Ave

Disconnected area

Suggested practice

Existing downspout

Water direction



Middletown Board Of Education

Site 1

Recommendation:

Installation of a rain garden disconnecting much of the parking lot.

Notes:

- Removal of pavement required
- Current drain turned into overflow system by being raised to allow for infiltration.

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)
8,224	Rain Garden	216,564	1.80	0.23	1,782 6inch depth

Middletown Board Of Education

Site 1

Before

Potential After

Middletown Board Of Education

Site 2

Recommendation:
Disconnection of half of the roof.

Notes:
- High visibility
- Sidewalk will need to be altered to pipe storm water to rain garden

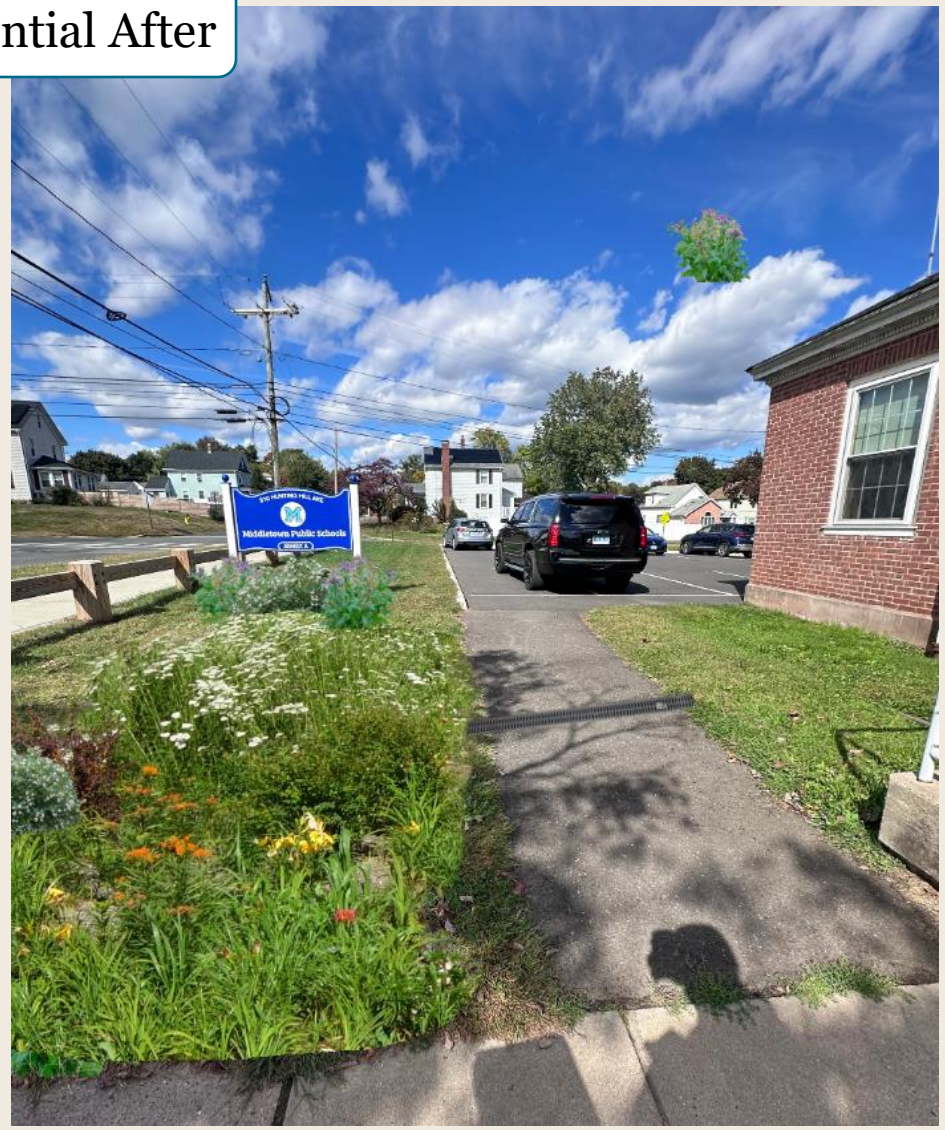
Drainage Area (ft^2)	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)	Suggested Practice Size (ft^2)
1525	Rain Garden	40,147	0.33	0.04	283 7inch depth

Middletown Board Of Education

Site 2

Before

Potential After



Middletown High School

200 La Rosa Ln

At this site, we recommend the installation of 2 rain gardens.

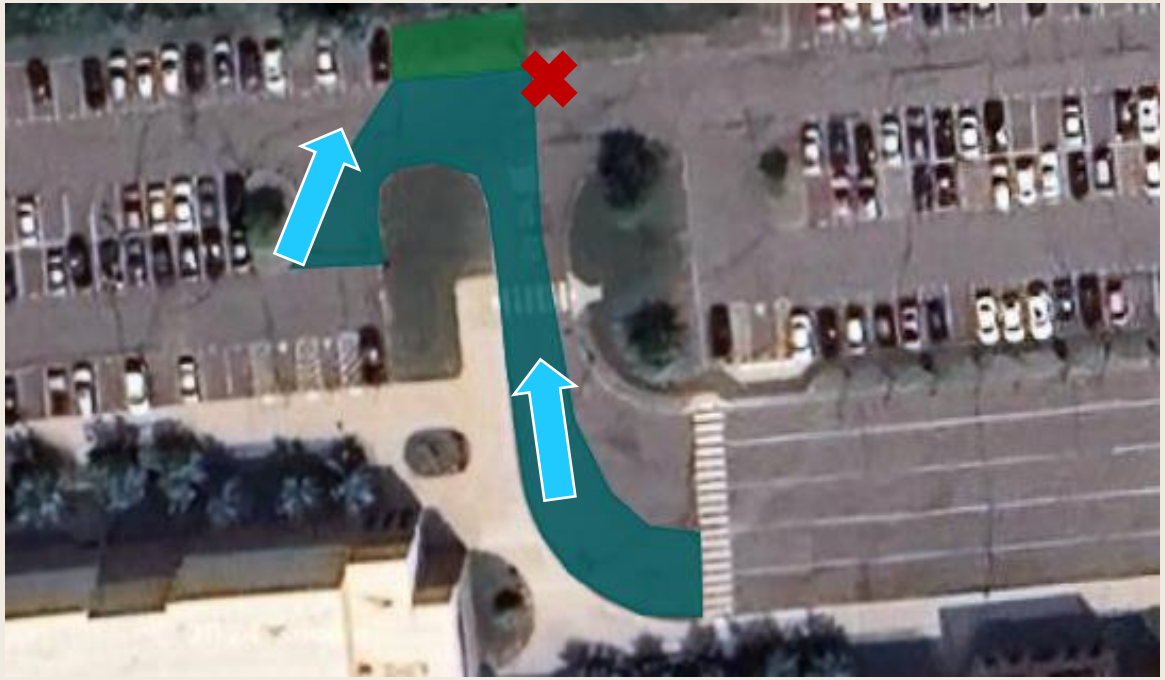
Possible **disconnection of 21,388 feet²** of impervious cover with the implementation of these green stormwater practices.

Disconnected area

Suggested practice

Existing drain

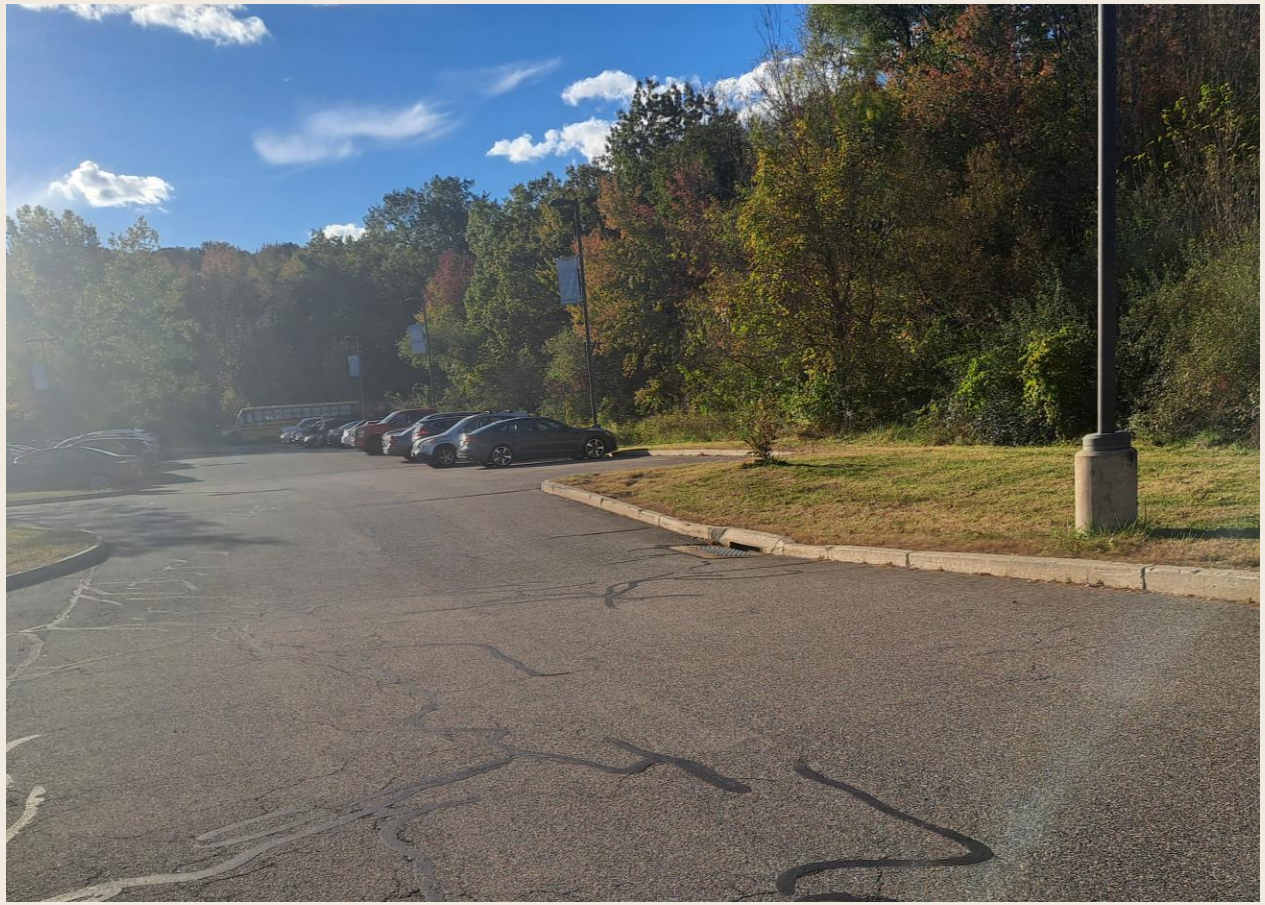
Water direction



Middletown High School Site 1

Recommendation:
Disconnect portion of parking lot by installing rain garden or Bio swale.

Notes:
- Low visibility
- Note electrical to avoid



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)
6,752	Rain Garden	177,796	1.48	0.19	878 10-inch depth

Middletown High School Site 2

Recommendation:
Redesign bioswale to be completely disconnected from drain

Notes:
- Low visibility
- High disconnection

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)
14,636	Bioswale	385,416	3.20	0.41	1,586 12 inch depth

Middletown Recreation Center

140 Wilderman's Way

At this site, we recommend the installation of Restoration and maintenance of existing bioretention site

Possible **disconnection of 13,748 feet²** of impervious cover with the implementation of these green stormwater practices.

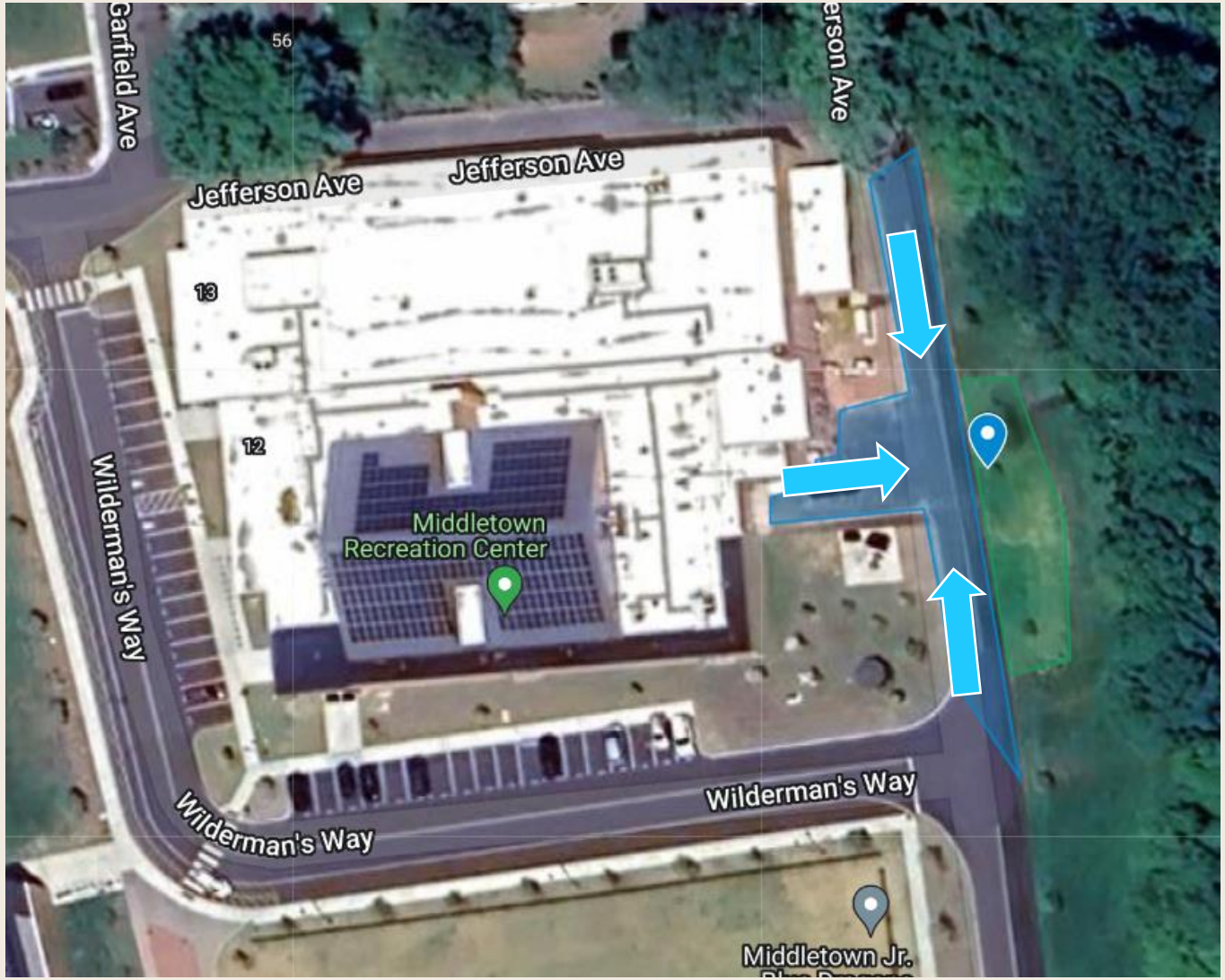
Middletown Recreation Center

Disconnected area

Suggested practice

Existing downspout

Water direction



Middletown Recreation Center

Recommendation:
Restoration and maintenance of existing bioretention site

Notes:
- This site will not count towards the 1% disconnection goal required via MS4
- Previously placed plants were mostly dead,
- Site is currently visually unattractive

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)
13,748	Maintenance	362,028	3.01	0.38	Existing is 4,361

Middletown Recreation Center

Plant Recommendation:
The best plants for the bioretention area are those that are native to this area, and can handle both wet and dry soil conditions. Some possible plants may be:

- Blue Flag iris
- Sensitive Fern
- Joe-Pye Weed

Frederick Bielefield School

70 Maynard St

At this site, we recommend the installation of 2 rain gardens at selected sites around the school.

Possible **disconnection of 2,268 feet²** of impervious cover with the implementation of these green stormwater practices.

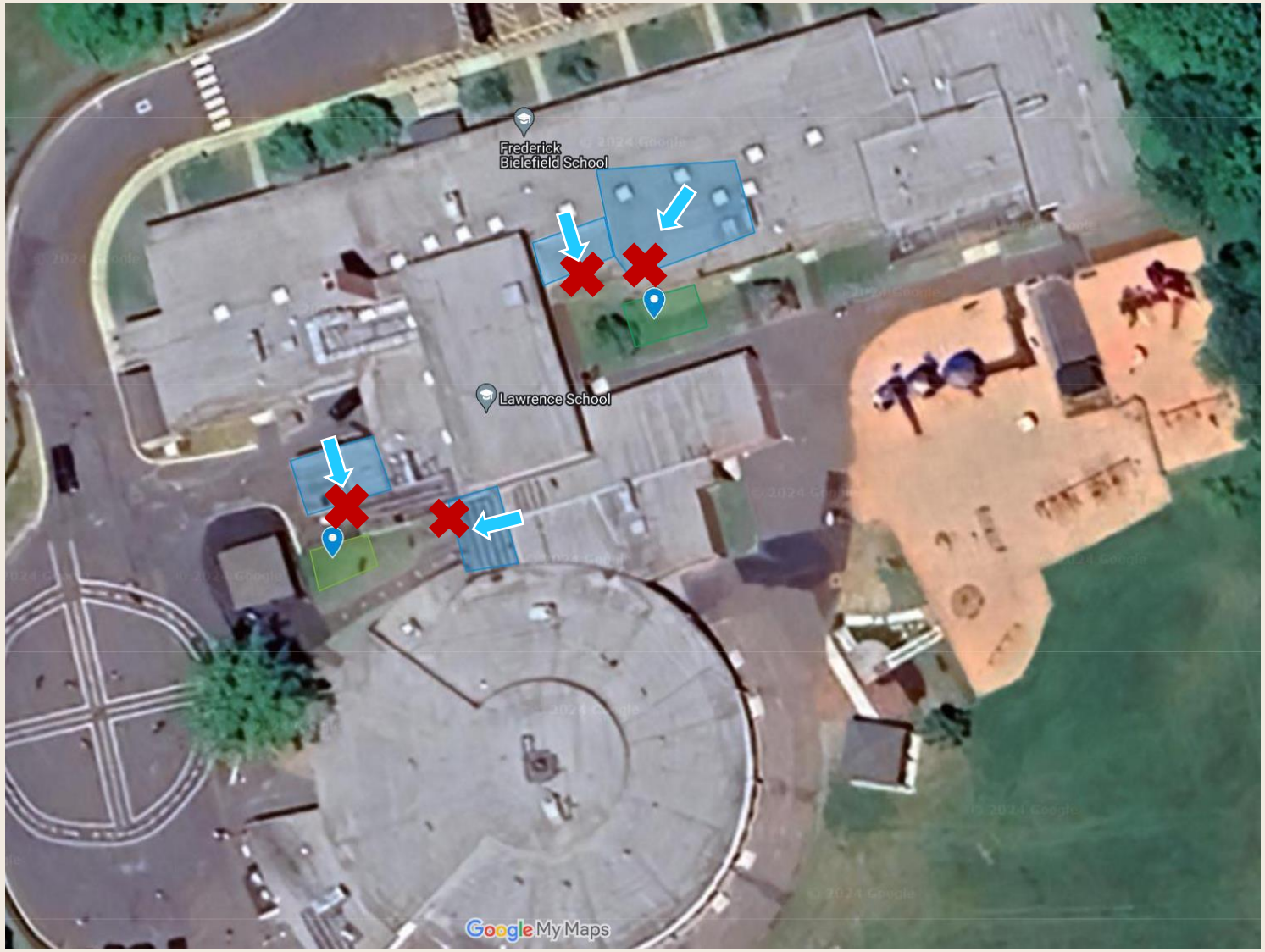
Frederick Bielefield School

Disconnected area

Suggested practice

Existing downspout

Water direction



Frederick Bielefield School

Recommendation:
Disconnect downspouts and install a rain garden

Notes:

- Project would be most effective if existing downspout became gutter that directed water to the garden
- Very visible

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)
769	Rain Garden	20,229	0.17	0.02	100 10in depth

Frederick Bielefield School

Before

Potential After

Frederick Bielefield School

Recommendation:
Disconnect downspouts and install a rain garden

Notes:
- Needs to be relatively long and thin to avoid being too near the building
- Low Visibility

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)
1500	Rain Garden	39,500	0.33	0.04	325 6in depth

Frederick Bielefield School

Before

Potential After

Wesley Elementary School

10 Wesleyan Hills Rd

At this site, we recommend the installation of

Possible **disconnection of 1,365 feet²** of impervious cover with the implementation of these green stormwater practices.

Disconnected area

Suggested practice

Existing downspout

Water direction

Recommendation:
Disconnect downspout and channel water into wooded area

Notes:

- Area already has dense vegetation present, just channel the downspout away from the building
- Low visibility

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)
707.48	Disconnection and overflow drain	18,630	0.15	0.3	N/A

Recommendation:
Disconnect downspout and install a rain garden

Notes:

- Pre-existing storm drain make an overflow drain installation easier
- Very visible

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)
657.11	Rain Garden	17,304	0.14	0.02	142 6in depth

Calculation Totals

Site	Disconnected Area (ft^2)	Annual Gallons Treated	Annual Nitrogen Reduction (lb N / yr)	Annual Phosphorus Reduction (lb P / yr)
Middletown Board of Education	9,749	256,711	2.13	0.27
Middletown High School	28,488	563,212	4.68	0.6
Middletown Recreation Center	0	362,028	3.01	0.38
Friedrick Bielefield School	2,269	59,729	0.4	0.06
Wesley Elementary School	1,365	35,934	0.29	0.32
Total	**41,870**	**1,227,614**	**10.51**	**1.63**

Questions/Discussion

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