COLLEGE OF AGRICULTURE, HEALTH AND NATURAL RESOURCES

Center for Land Use Education & Research

CLEAR

Stormwater Runoff Reduction Plan - Madison, CT

Created by: Ben Zaccara, Fiona Casey, and Rachael Ruggiero - UConn Undergraduate Students

Mike Deitz , David Dickson, Chet Arnold and Josh Snarski - UConn Center for Land Use Education & Research

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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 Madison, 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 top five projects identified in the report are implemented, 113,101 sq ft of impervious cover will be disconnected from the stormwater drainage system, and 2,814,616 gallons of untreated stormwater, 29.24 lbs of nitrogen, and 3.70 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 Madison. 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 the top five are also listed afterwards with some additional recommendations and notes, as well as some maintenance opportunities for the town of Madison.

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 and 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.

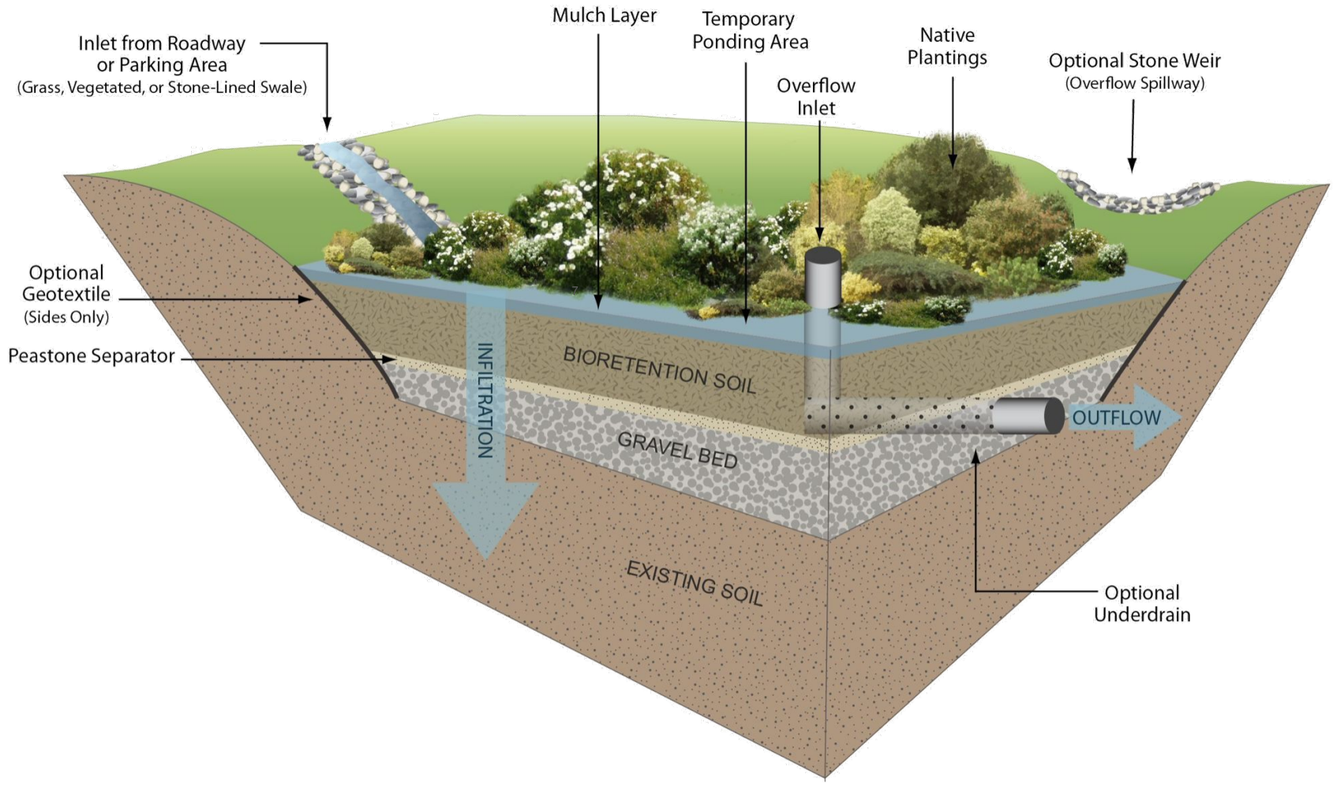
MS4 Requirements- Municipal Separate Storm Sewer Systems Permitting Program

- 2004- DEEP recognizes need for regulation of stormwater runoff
  - ***Nonpoint Source Pollution***: stormwater runs across impervious surfaces, collecting pollutants as it flows into storm drains.
  - Permitting program encourages use of ***Low Impact Development*** practices to mitigate pollution in waterways. These practices are designed to maintain or recreate ***pre-development hydrology***, with an emphasis on ***treatment of stormwater onsite***.

- 2016- DEEP issues additional MS4 requirements
  - As part of the development of stormwater management plans, along with subsequent monitoring and reporting, municipalities are required to ***disconnect 2% of directly connected impervious cover***.
  - ***Directly connected impervious cover*** is any impervious surface which conducts stormwater into the city sewer system, and which eventually flows into lakes, streams, and the ocean.

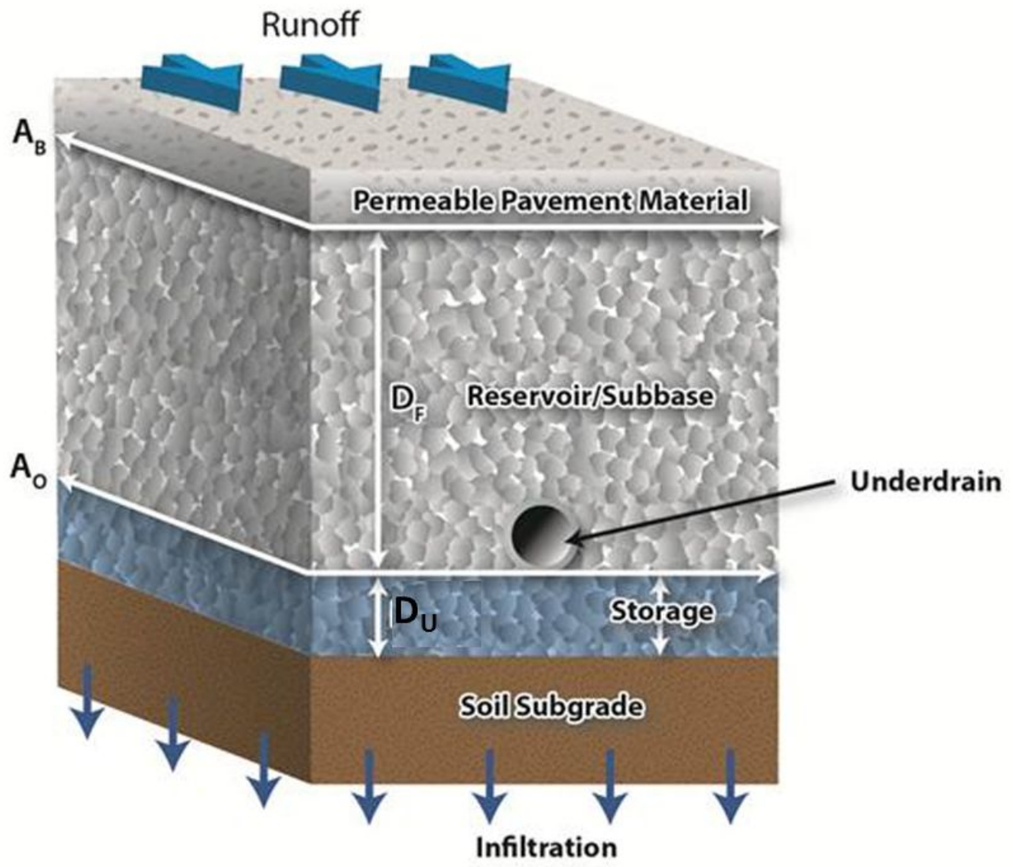
Rain Gardens and Bioretention

Rain gardens are a green infrastructure installation that capture stormwater from impervious surfaces or disconnected gutters. This practice allows the runoff to infiltrate into the soil and recharge groundwater. 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.

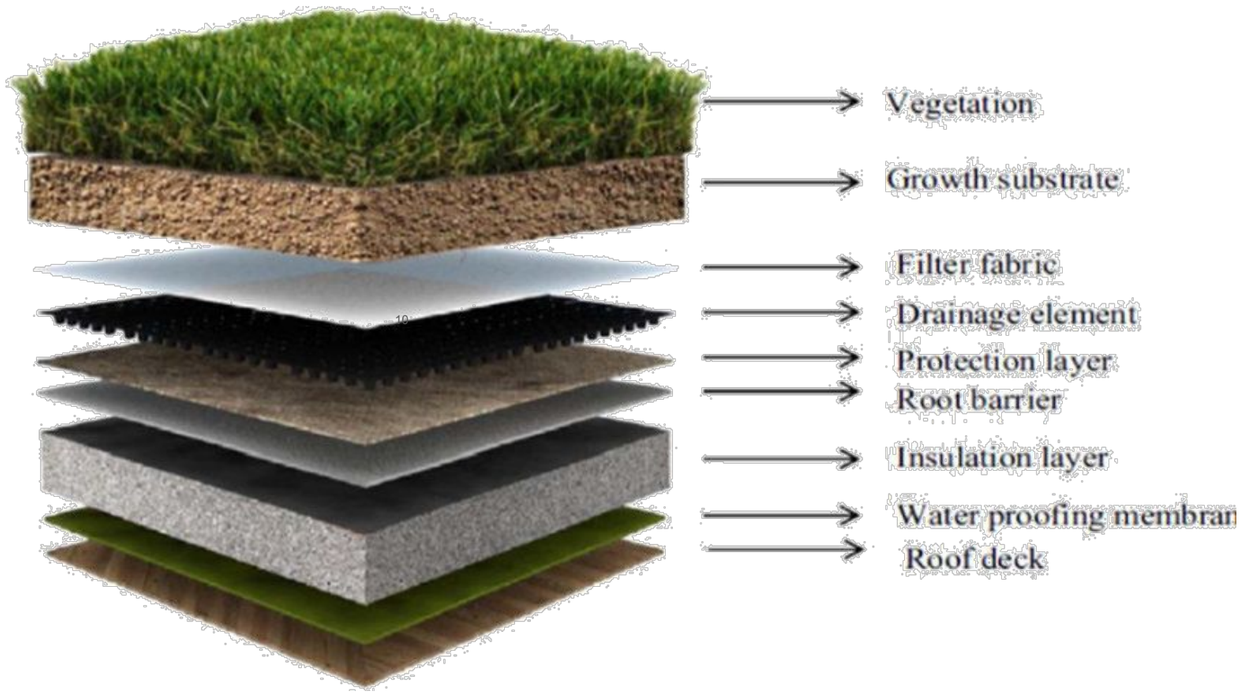


Tree Box Filters

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.

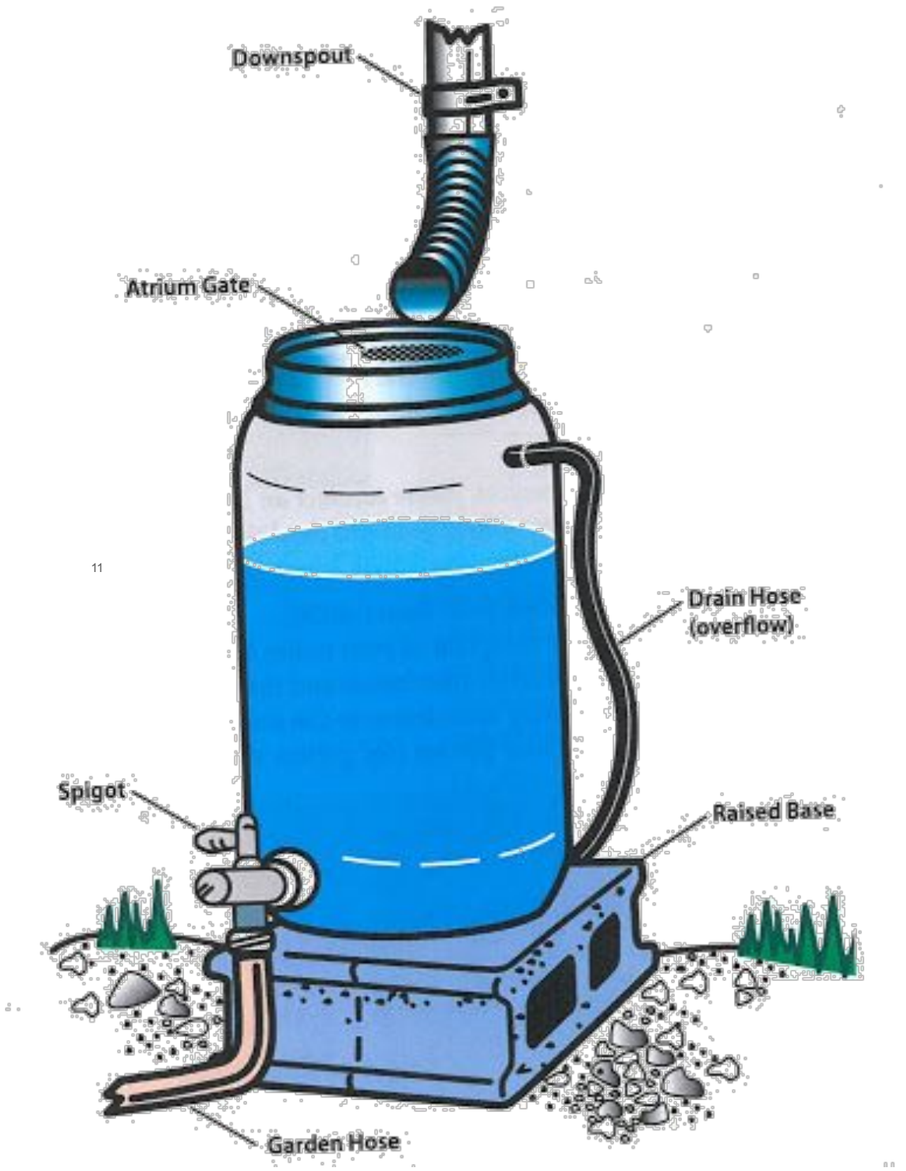
Green Roofs

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.

Educational value, visibility, and volunteer opportunities were also considered when determining the most beneficial locations and practices.

Madison, CT

4 – Ryerson Elementary
982 Durham Rd

Walter C Polson Middle School – 1
302 Green Hill Rd

J Milton Jeffrey Elementary
331 Copse Rd

Bauer Park
323 Copse Rd

Madison Town Campus
& Campus Dr

I-95

Shore Line East

DPW Garage – 5
16 Fort Path Rd

3 – Madison Senior Center
29 Bradley Rd

Surf Club Park – 2
64 Surf Club Rd

Google Earth
© 2021 Google

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1 mi

Polson Middle School

302 Green Hill Rd

Notes:

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

-North and West lots suitable for rain gardens

-Various design options available

-Total Potential Disconnect:
52,750 sq. ft.

IMPERVIOUS COVER

Green Hill Rd

Copse Rd

Possible disconnect of 4,573 sq. ft. of impervious cover with use of tree box filter

Possible disconnect of 37,287 sq. ft. of impervious cover with use of rain gardens. Two ideal locations within the grass island, with multiple design options. Area is ideal for aesthetic improvement and provides great visibility and educational opportunities for the projcet. Can be implemented with tree box filter to north to offset total runoff.

Possible disconnect of 10,890 sq. ft. of impervious cover with use of rain garden.

Walter C. Polson Middle School

North Lot

4,574 sq. ft. offset of D.A. 1 with use of tree box filter

Drainage Area 1
25,482 sq. ft.

Tree Box Filter Opportunity ($3-$18k)

Rain Garden Opportunity

Storm Drain

CT DEEP, USGS | CT DEEP | USGS, CT DEEP | USDA - NRCS | USDA NRCS | USACE, CT DESPP, CT DEEP | USAC

Suggested Practice
Rain Garden
- 12” Depth
- 1,717 sq. ft. total
- $8,460 - $33,840

670,930 gal. runoff treated per year

15 P 30.974

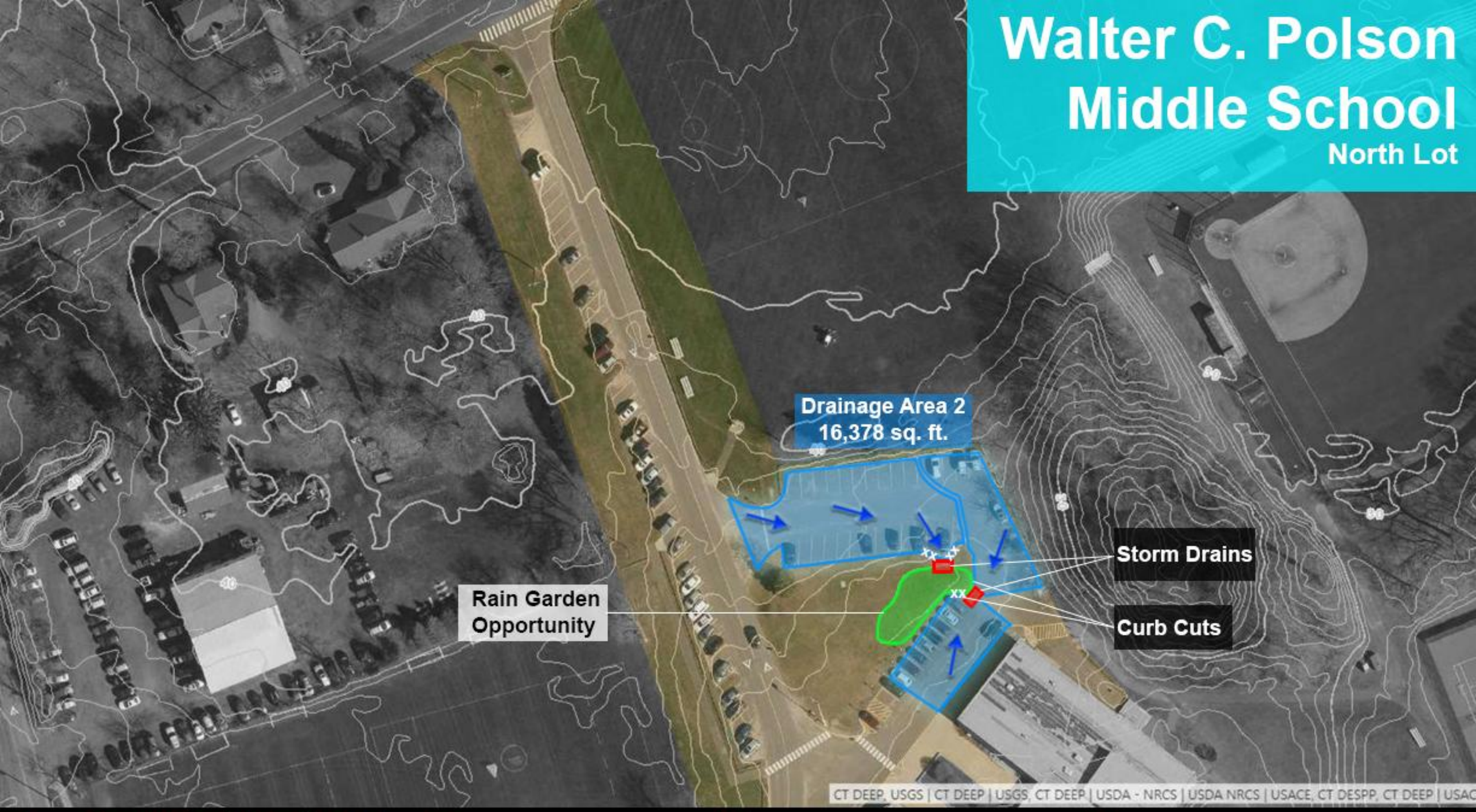
Phosphorus Reduction .88 lb/year

7 N 14.007

Nitrogen Reduction 6.97 lb/year

Walter C. Polson Middle School

North Lot



Suggested Practice

Rain Garden

- 12” Depth
- 1,355 sq. ft. total
- $5,240 - $21,680

431,227 gal. runoff treated per year

15 P 30.974

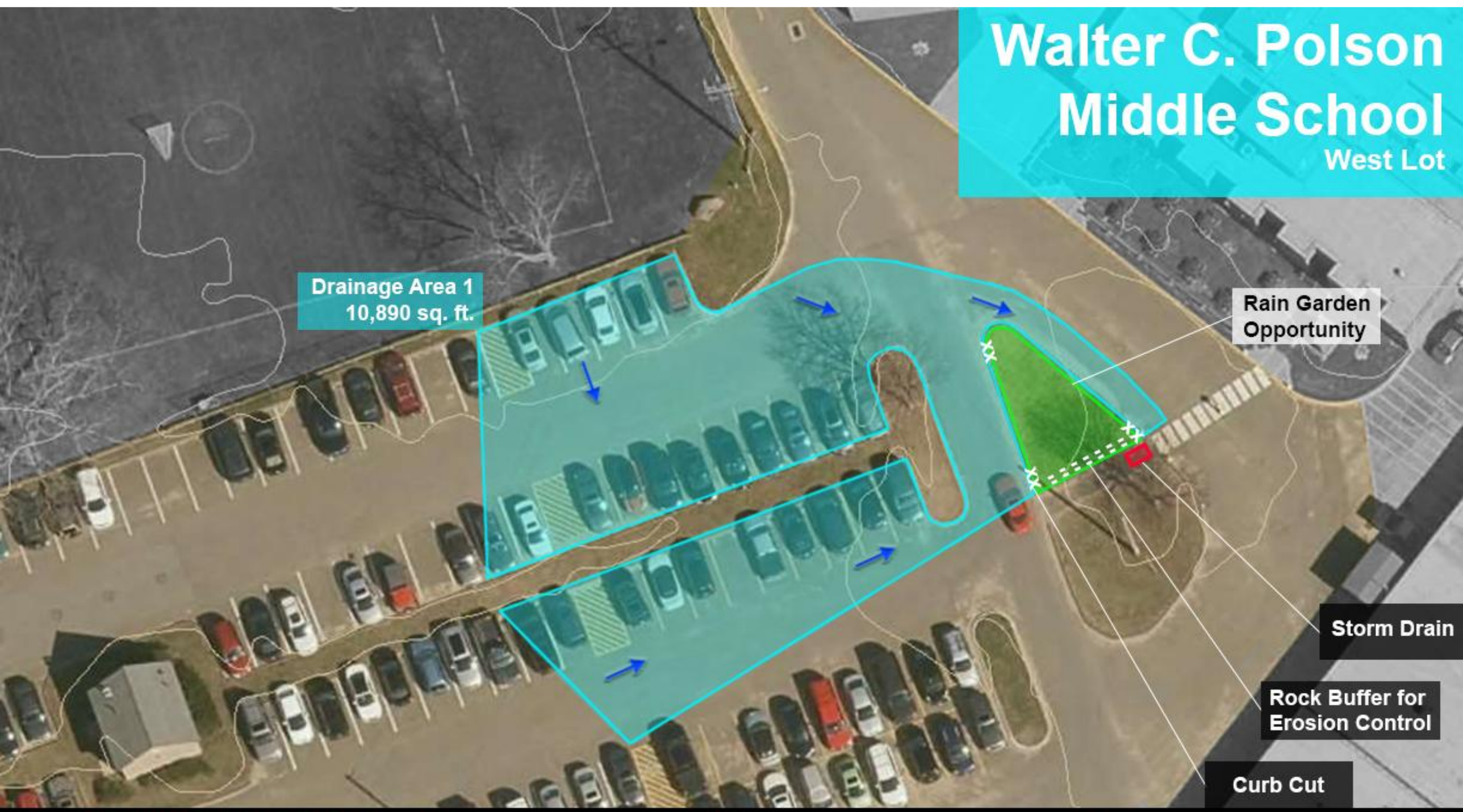
Phosphorus Reduction .56 lb/year

7 N 14.007

Nitrogen Reduction 4.48 lb/year

Walter C. Polson Middle School

West Lot



Suggested Practice

Rain Garden

- 12” Depth
- 900 sq. ft. total
- $3,400 - $14,400

286,730 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .38 lb/year

7 N 14.007

Nitrogen Reduction 2.98 lb/year

Surf Club Park

64 Surf Club Rd
Madison, CT

Notes:

-Large areas of impervious cover ideal for disconnect
-Excellent visibility and educational opportunity
-Perfect location for GSI with proximity to LI Sound

-Total Potential Disconnect:
16,116 sq. ft.

IMPERVIOUS COVER

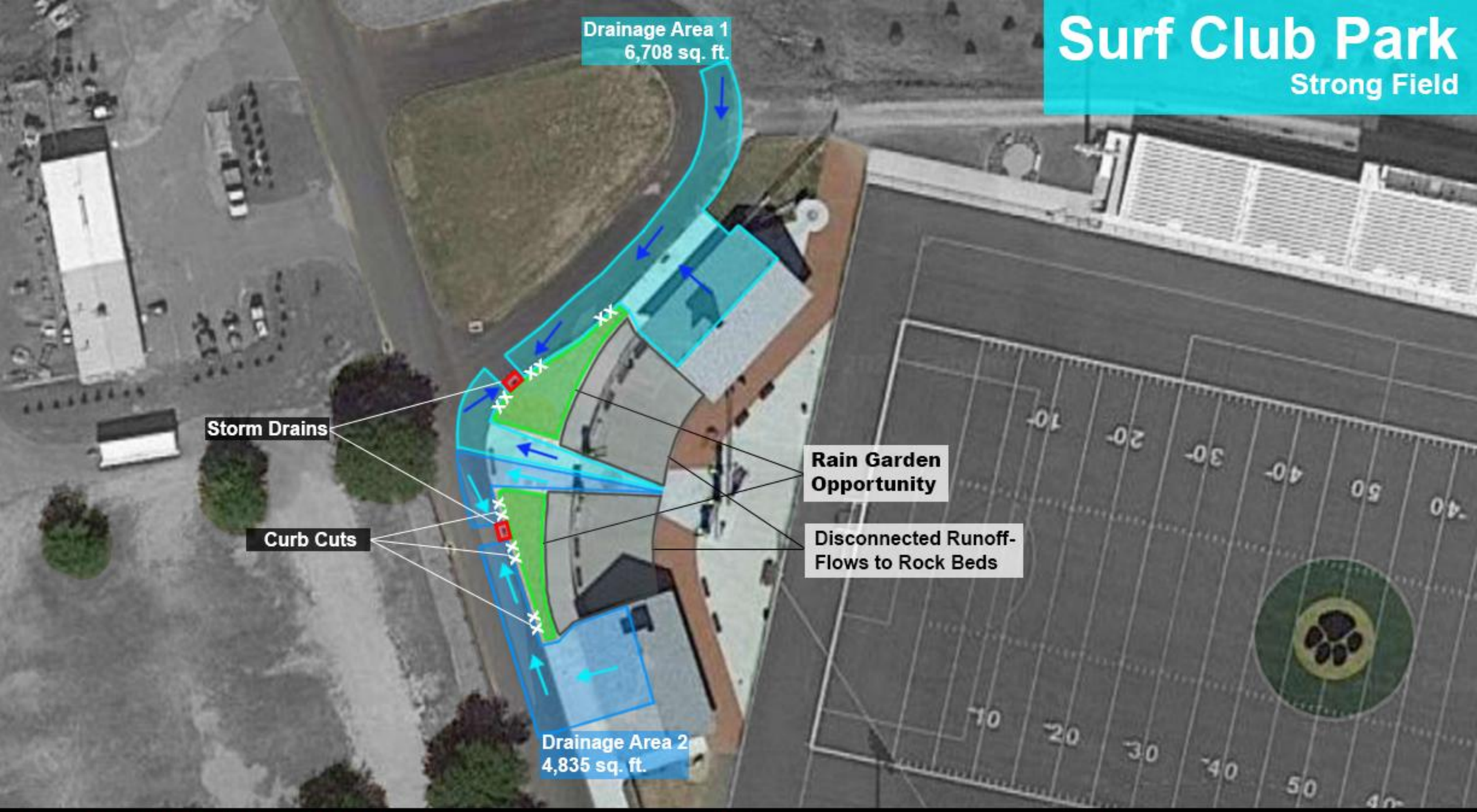
Possible disconnect of 11,543 sq. ft. of impervious cover with retrofit of existing rock beds to accommodate runoff from roadway. Various design options available: rain garden or simple stone infiltration basin.

Possible disconnect of 2,134 sq. ft. of impervious cover with use of tree box. Run-off to be conducted via swale beneath existing fence. High visibility and educational opportunity near entrance to Strong Field and children's play area.

Possible disconnect of 2,439 sq. ft. of impervious cover with use of tree box filter.

Surf Club Park

Strong Field



Suggested Practice

Rain Garden

- 8” & 10” Depths
- 1,351 sq. ft.
- $5,401 - $21,606

152,560 gal. runoff treated per year

15 P 30.974

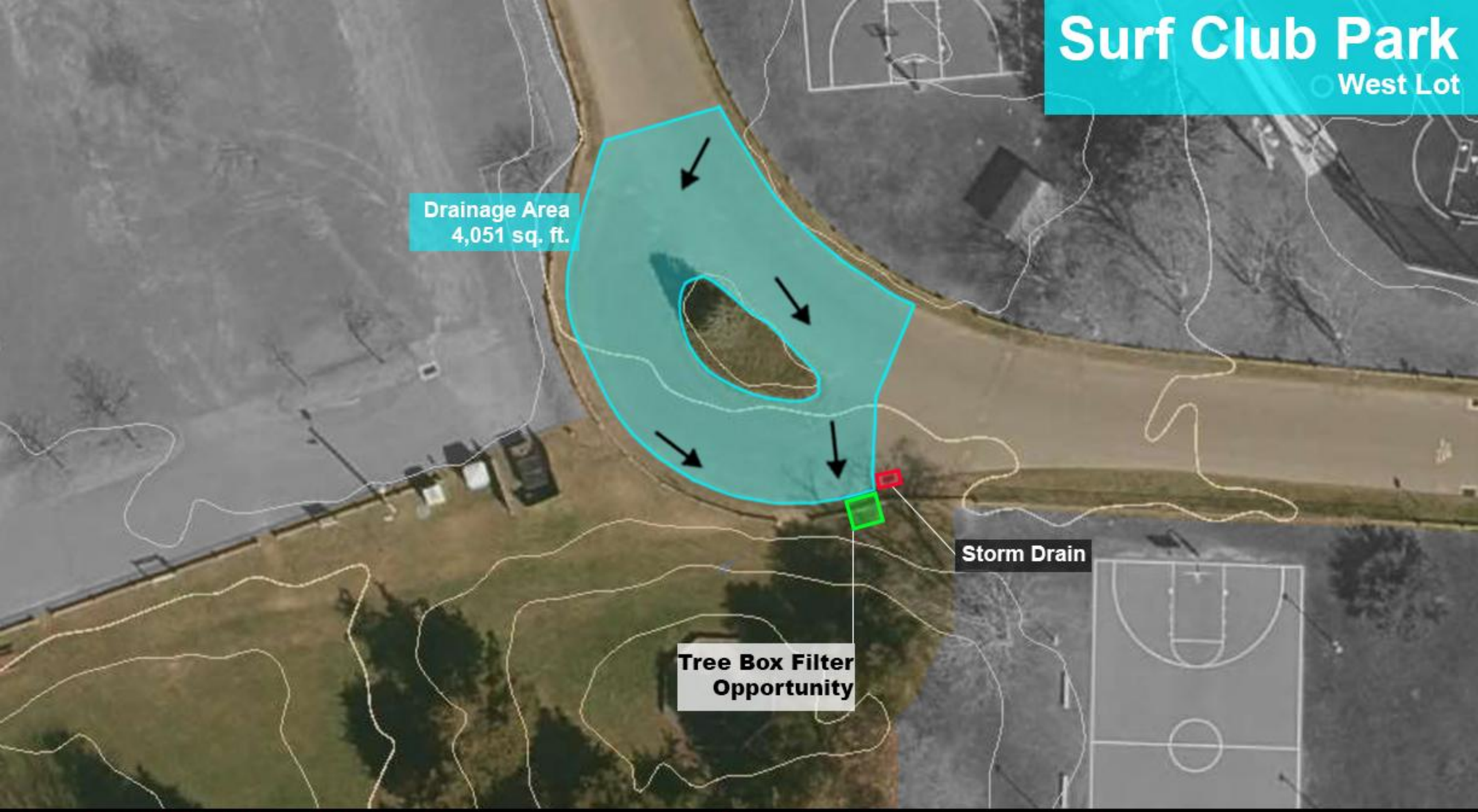
Phosphorus Reduction .20 lb/year

7 N 14.007

Nitrogen Reduction 1.58 lb/year

Surf Club Park

West Lot



Suggested Practice
Tree Box Filter
- 3'x3'
- $7,000 - $14,000

106,678 gal. runoff treated per year

15 P 30.974

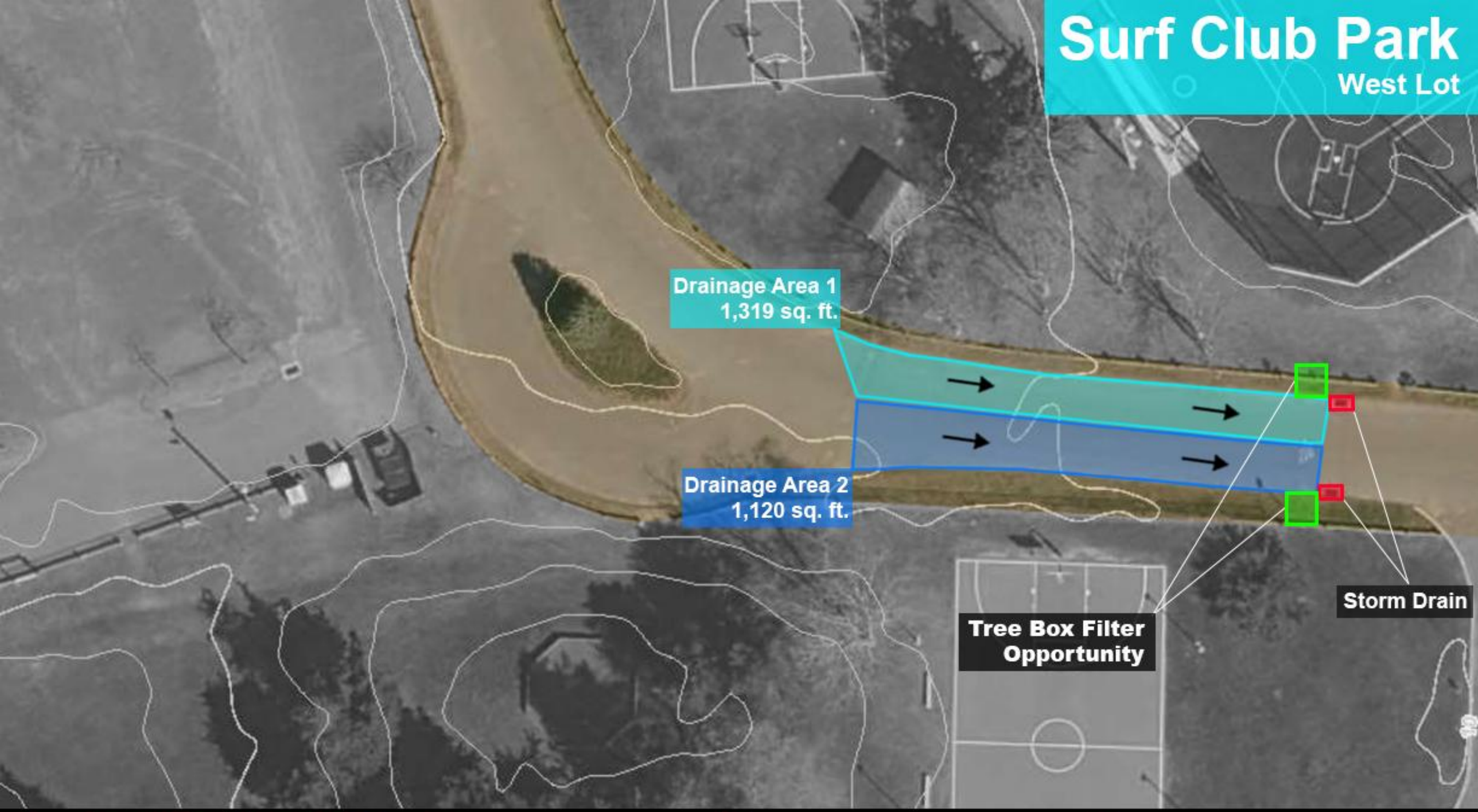
Phosphorus Reduction .14 lb/year

7 N 14.007

Nitrogen Reduction 1.12 lb/year

Surf Club Park

West Lot



Suggested Practice
Tree Box Filter
- 2 @ 3'x3'

- $14,000 - $36,000

64,236 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .08 lb/year

7 N 14.007

Nitrogen Reduction .67 lb/year

Madison Senior Center

29 Bradley Rd

Notes:

-Good visibility and educational value
-Large areas of impervious cover ideal for disconnect with rain gardens.
-Some site runoff being conducted into sensitive wetland ecosystem

-Total Potential Disconnect:
15,725 sq. ft.

IMPERVIOUS COVER

Opportunity for rain barrel at central downspout. Ideal for integration into existing vegetable and flower gardening area.

Possible disconnect of 1,742 sq. ft. of impervious cover with use of rain gardens. Run-off from roof conducted into nearby wetland.

Possible disconnect of 13,983 sq. ft. of impervious cover with use of rain gardens. Various design options available dependent upon ownership of neighboring parcels.

Bradley Rd

Madison Senior Center

29 Bradley Rd

Suggested Practice

Rain Garden

- 9” Depths
- 1,548 sq. ft.
- $6,192 - $24,768

368,210 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .49 lb/year

7 N 14.007

Nitrogen Reduction 3.82 lb/year

Madison Senior Center

Front of Building

Suggested Practice

Rain Garden

- 6” Depth
- 289 sq. ft.
- $1,156 - $4,642

45,888 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .06 lb/year

7 N 14.007

Nitrogen Reduction .48 lb/year

Ryerson Elementary

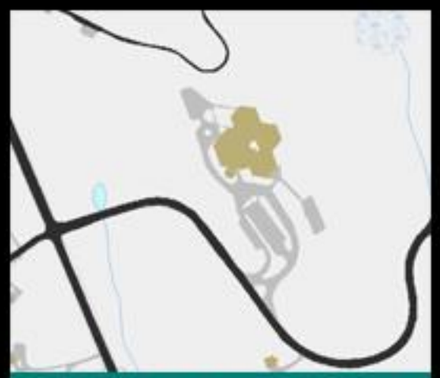
982 Durham Rd

Notes:

-Roadway outside visitor lot ideal for "gateway" rain gardens

-Runoff from site enters small stream leading to LI Sound, treatment here is of great ecological importance

-Total Potential Disconnect:
7,970 sq. ft.



IMPERVIOUS COVER

Lyle Dr

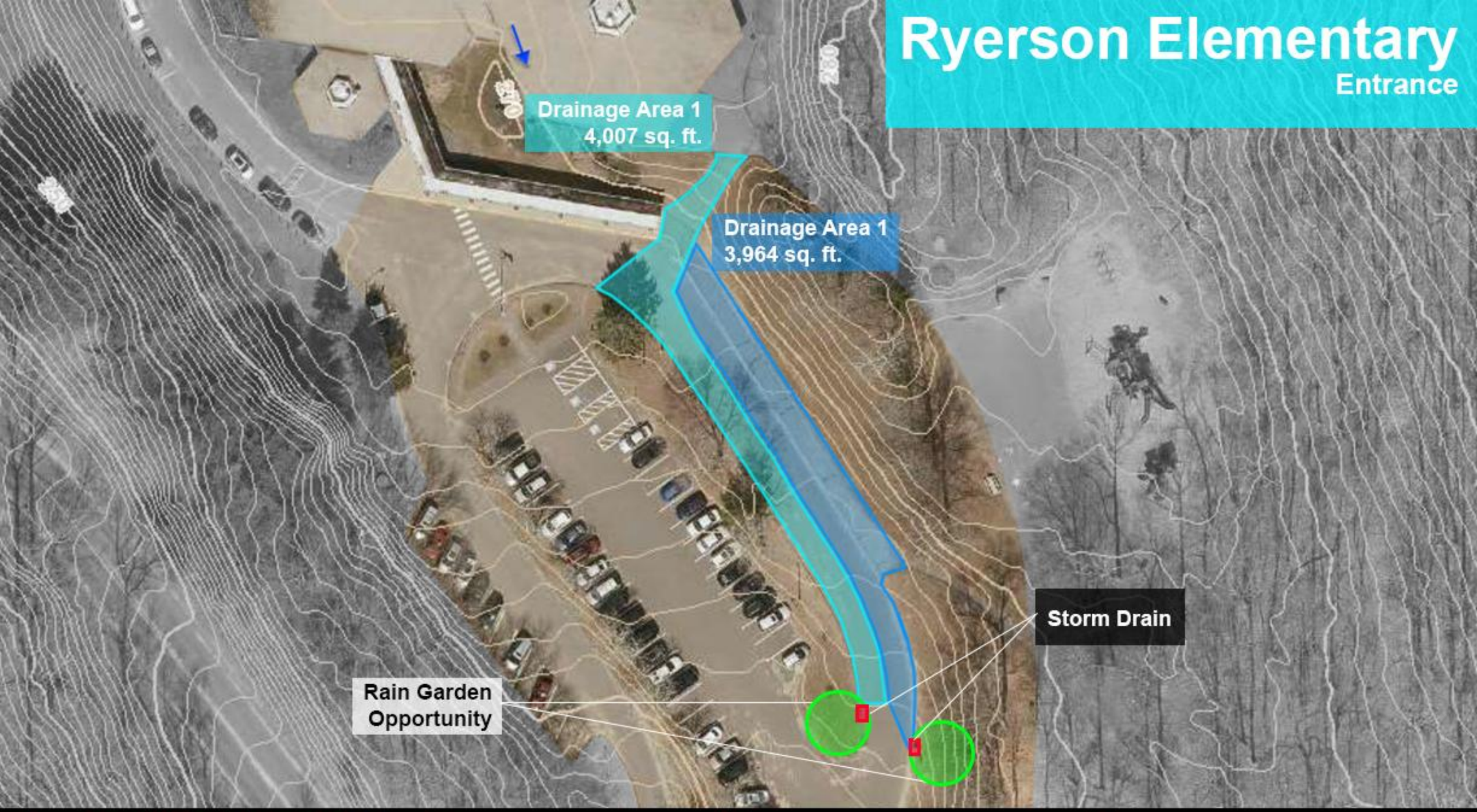
Durham Rd

Possible disconnect of 7,970 sq. ft. of impervious cover with use of rain gardens. Location at entrance to school provides excellent visibility and educational opportunities. Two practices on opposite sides of the street can serve as the "front gate".

Google

Ryerson Elementary

Entrance



Suggested Practice

Rain Garden

- 6” Depth
- 662 sq. ft. total
- $2,648 - $10,592

209,847 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .28 lb/year

7 N 14.007

Nitrogen Reduction 2.18 lb/year

DPW Garage

16 Fort Path Rd
Madison, CT

Notes:

-Street front island and rear of parking area suitable for rain gardens
-DPW location encourages use of sustainable practices
-Practice would greatly improve aesthetics of site

-Total Potential Disconnect:
28,444 sq. ft.

IMPERVIOUS COVER

Shore Line East

Fort Path Rd

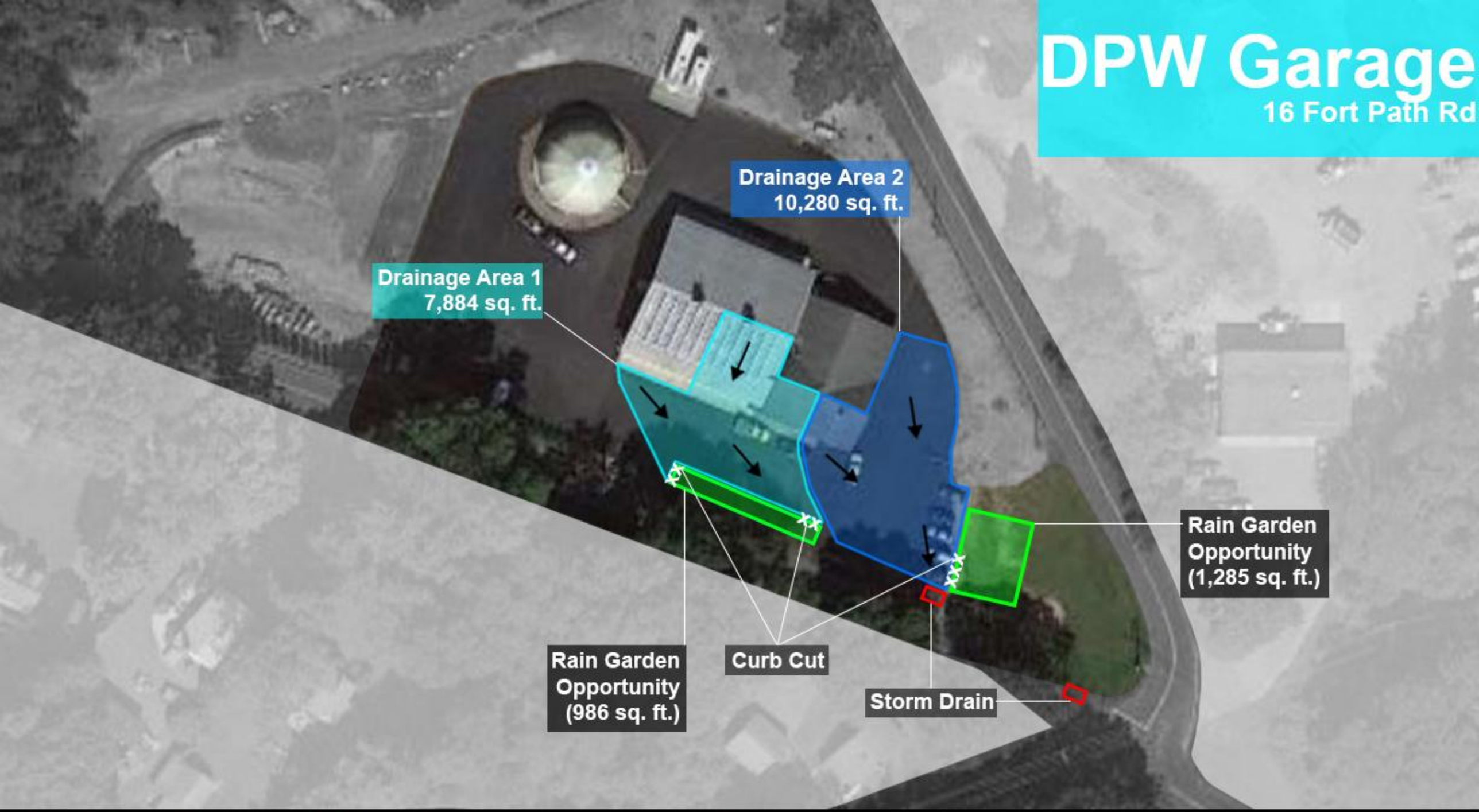
Copse Rd

Possible disconnect of 7,884 sq. ft. of impervious cover with use of rain garden. Great street front visibility and educational opportunity.

Possible disconnect of 10,280 sq. ft. of impervious cover with use of rain garden. Great visibility and opportunity to treat surface pollutants from parking area.

DPW Garage

16 Fort Path Rd



Suggested Practice

Rain Garden

- 8” Depth
- 2,270 sq. ft.
- $11,600 - $46,400

478,315 gal. runoff treated per year

15 P 30.974

Phosphorus Reduction .63 lb/year

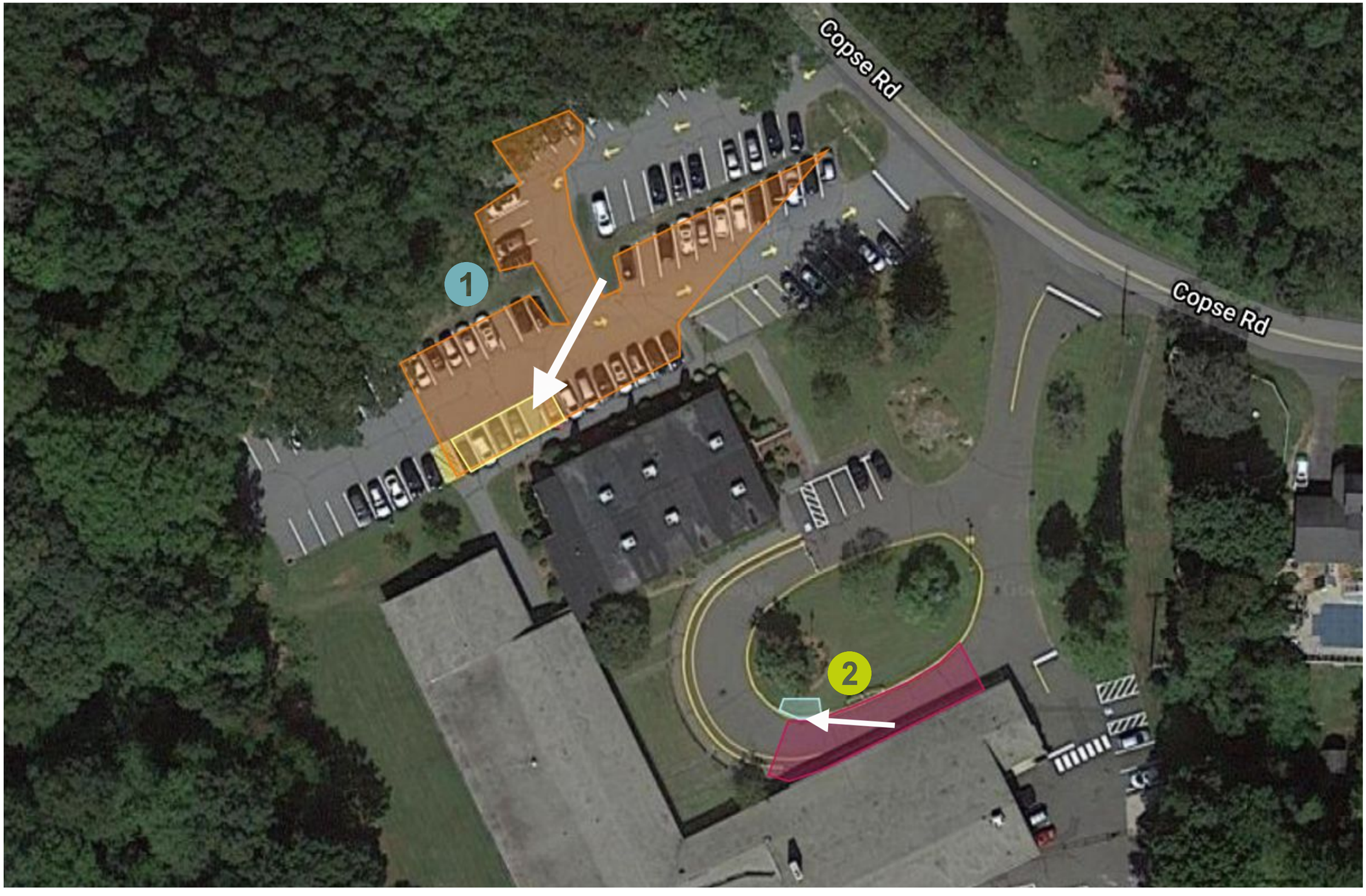
7 N 14.007

Nitrogen Reduction 4.97 lb/year

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
Walter C. Polson Middle School	North Lot Entrance Road	25,482	0.88	6.97	670,930	$6,868-27,472
	North Lot Parking Area	16,378	0.56	4.48	431,227	$5,420-21,680
	West Lot Parking Area	10,890	0.38	2.98	286,730	$3,400-14,400
	Total for all	**52,750**	**1.82**	**14.43**	**1,388,887**	**$15,688-63,552**
Surf Club Park	Strong Field	11,543	0.20	1.58	152,560	$5,401-21,606
	West Lot Parking Area	4,051	0.14	1.11	106,678	$3,000-18,000
	West Lot Road	2,419	0.08	0.67	64,236	$14,000-36,000
	Total for all	**17,839**	**0.42**	**3.36**	**323,474**	**$22,401-75,606**
Madison Senior Center	Front Parking Area	13,982	0.49	3.82	368,210	$6,190-24,760
	Front Building Rain Garden	1,742	0.06	0.48	45,883	$1,567-4,630
	Northeast Drain Rain Barrel	653	-	-	400 gal/week	$500-1,000
	Total for all	**16,377**	**0.55**	**4.30**	**414,093**	**$8,257-30,390**
Ryerson Elementary	Lane on the Inside	4,007	0.14	1.10	105,503	$1,332-5,328
	Lane on the Outside	3,964	0.14	1.08	104,344	$1,316-5,264
	Total for all	**7,971**	**0.28**	**2.18**	**209,847**	**$2,648-10,592**
DPW Garage	Front Entrance	7,884	0.27	2.16	207,610	$3,944-15,744
	Side Parking Area	10,280	0.36	2.81	270,704	$5,140-20560
	Total for all	**18,164**	**0.63**	**4.97**	**478,315**	**$11,600-46,400**

Additional Site: J. Milton Jeffery Elementary



1

Drainage Area	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
11543.4	Rain Garden	~303,922	3.16	.40	~958	$3,832-15,328

This parking lot has a sizable drainage area, a rain garden could be used but about 6 parking spaces would be have to be taken out for the practice. This is the bigger of the two possible retrofits for this school which is why we recommend it.

2

Drainage Area	Suggested Green Infrastructure	Annual Gallons Treated	Annual Nitrogen reduction (lb N/yr)	Annual Phosphorus reduction (lb N/yr)	Suggested practice size (sq ft)	Cost
2221.56	Rain Garden	~58,504	.61	.08	~184	$736-2,944

The roundabout area has some storm drains placed in the middle of the road which limits the watershed of the possible practices. We can still catch a sizable drainage area with the added benefit of the practice being visible by the whole school. This is a good educational opportunity for the kids as well.

Additional Site: Bauer Park (245-323 Copse Rd)

Although there is no impervious cover to disconnect at this location, it could offer an educational opportunity to the community. We recommend placing a small rain garden near the outdoor classroom as a model for students as well as a sample green roof.

Rain Garden (6’x6’) = $144 - $576

Green Roof (2’x6’) = $0 - $432

*Free green roof tray samples may be available

Maintenance Opportunity: Dr Robert H. Brown Intermediate School (980 Durham Rd)

Although we couldn’t find any viable opportunities to implement a new green practice in this area, we did find some opportunities for maintenance. We would recommend adding a rip-rap zone for the small swale located off the corner of the upper parking lot to help with erosion.

Sites Not Chosen for Stormwater Retrofits

1. Probate Court/Academy St School: Although there were some possible opportunities for LID retrofits in this area, we chose not to include it in this report due to the condition of the site. The abandoned school and back parking lot are in need of renovation and currently not in use. The addition of a practice here might become problematic in future construction and the future ownership of the school property is unclear.
2. Madison Town Campus: This site was not included because parts were already disconnected, storm drains were in areas which made nearby LID practices ineffective, and educational opportunities/visibility was not as prominent.
3. Salt Meadow Park: This site had great educational value; however, the area was already disconnected so we didn't see the need for a practice at this location.
4. Daniel Hand High school: There appeared to be a lot of opportunities available around this location; however, it was determined that the catch basins most likely diverted the water into a nearby constructed wetland. This means the water is already disconnected and being treated. An additional practice wouldn't be necessary at this site.

Contact & Partners

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

Contacts:
Mike Dietz, UConn CLEAR, michael.dietz.@uconn.edu, 860-486-2436
Dave Dickson, UConn CLEAR, david.dickson@uconn.edu, 860-345-5228

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,
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	$ 500.00	$ 1,000.00	Additions can cause the rain barrel to be on the higher cost end	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.

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