Berry Brook – Getting to 10%

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STORMWATER CENTER

Project Partners

- City of Dover Staff
- UNH Stormwater Center
- NH Department of Environmental Services
- Environmental Protection Agency

Berry Brook Watershed Management Plan –Implementation Projects Phase III

Final Report to
The New Hampshire Department of Environmental Services
Submitted by

The City of Dover and the UNH Stormwater Center
December, 2017

https://www.unh.edu/unhsc/berry-brook-project

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Funding and Results

Funding: 3 watershed assistance grants and 1 aquatic resource mitigation grant with match from the city.

Berry Brook Project: Getting to 10%	
Cost	$1,322,000
Grant Funds	$793,000
Match (min estimate)	529,000
BMPs	26
DCIA Reduced	37 acres
TSS Reductions (lb./yr.)	57,223
TP Reductions (lb./yr.)	201
TN Reductions (lb./yr.)	1,127

BMPs

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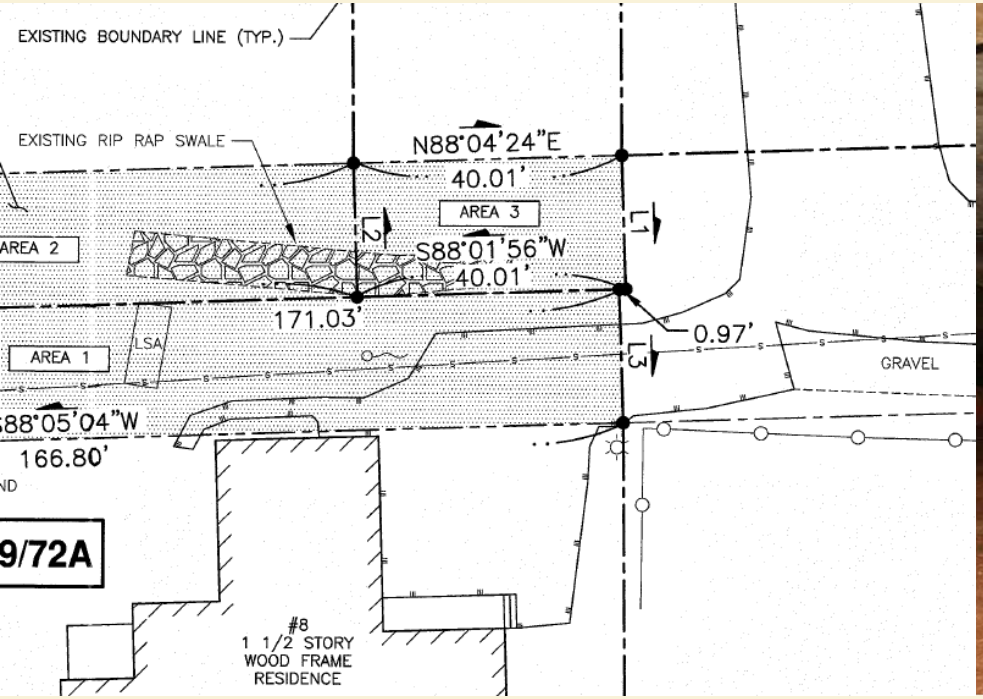
Installations include:

- 12 bioretention systems,
- a tree filter,
- a subsurface gravel wetland,
- one acre of new wetland,
- daylighted and restored 1,100 linear feet of stream at the headwaters and restored 500 linear feet of stream at the confluence including two new geomorphically-designed stream crossings
- 3 grass-lined swales
- 2 subsurface gravel filters
- an infiltration trench system
- 3 innovative filtering catch basin designs

Out of space


EXISTING BOUNDARY LINE (TYP.)
EXISTING RIP RAP SWALE
N88°04'24"E
40.01'
AREA 3
L2
L1
AREA 2
S88°01'56"W
40.01'
171.03'
0.97'
AREA 1
LSA
L3
GRAVEL
88°05'04"W
166.80'
ND
9/72A
#8
1 1/2 STORY
WOOD FRAME
RESIDENCE

Need for Innovation

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- "Boulanginator" (subsurface gravel filter) mimics performance of PA with regular pavement.
- The hydraulic inlet and outlets are controlled through perforated pipes and underdrains.
- treat runoff from 1.96 acres and 0.61 acres DCIA

Need for Innovation

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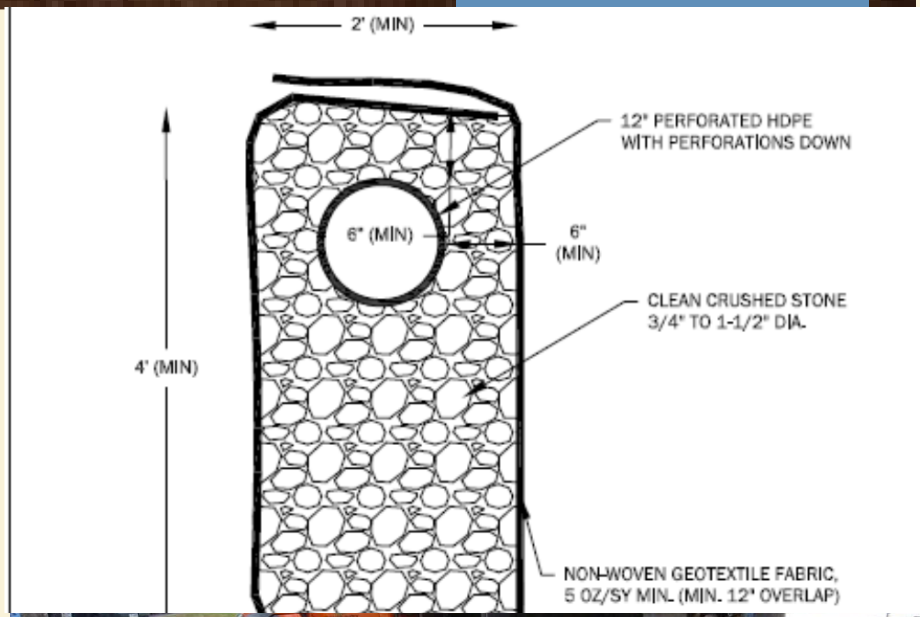
- In HSG A installed an infiltration trench between two conv CBs
- A simple but effective adaptation instead of solid pipe.
- Treats runoff from 3.36 acres and 1.04 acres DCIA



Need for Innovation

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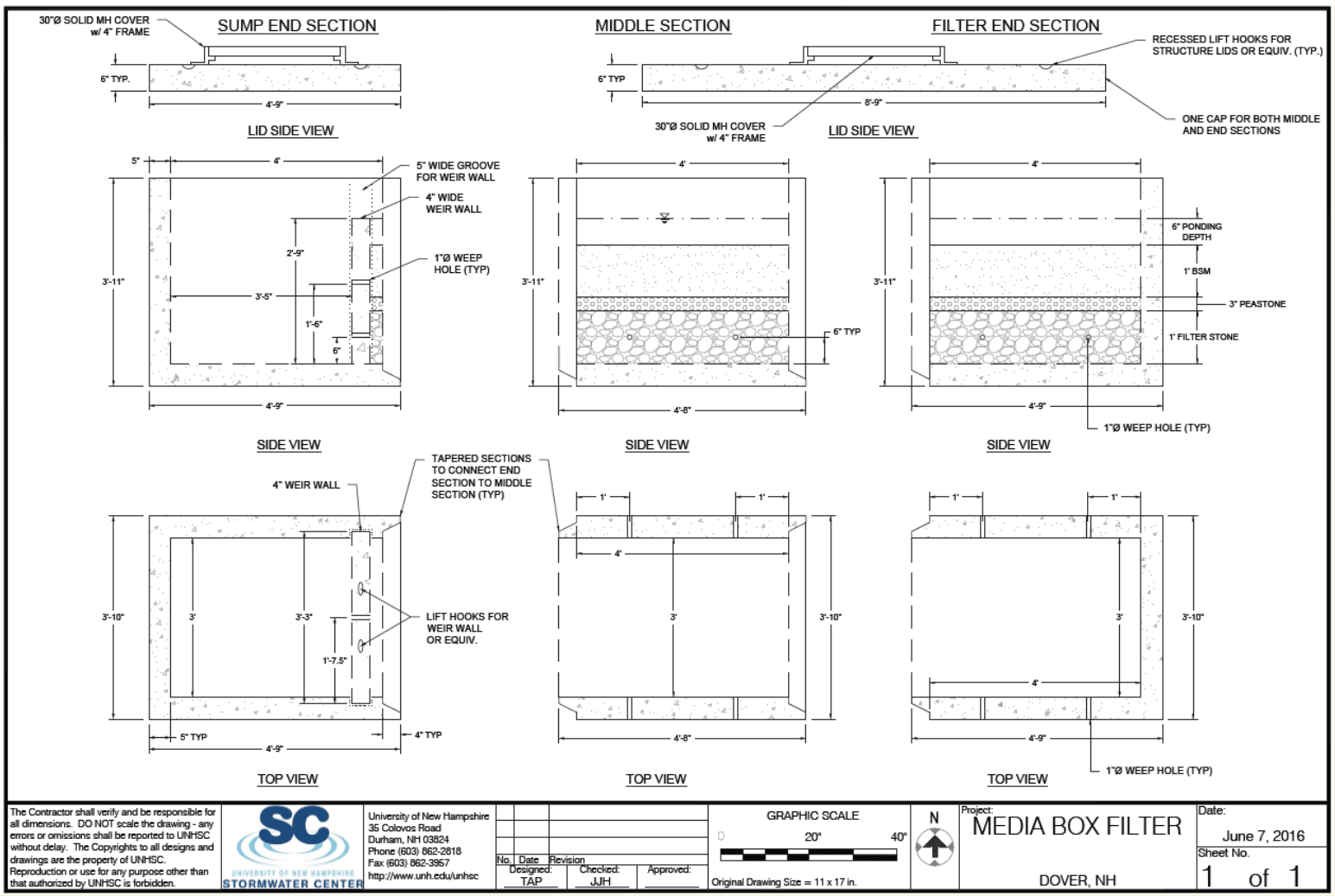
Sectional Media Box Filter Design – version 3



August 2017

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- Filtering Catch Basin Designed to replace conv DSCB where applicable
- This system was the third iteration
- The City has purchased four additional filtering catch basins and will install them in other areas throughout the city.
- The system is designed to treat 0.5 acres (0.25 acres/section) of IC per section and costs 2,400 per

In Operation

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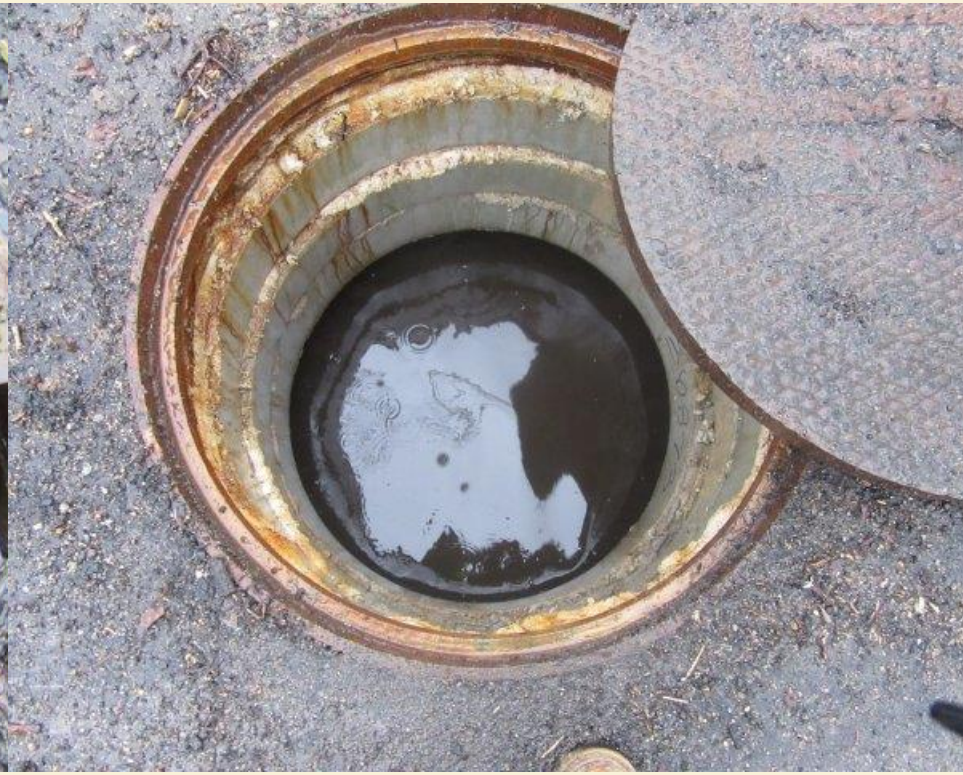

Part of the Solution – Watershed approach all communities can access

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Awards

2016 EPA Environmental Merit Award

The 2017 New England Stormy Award:

City of Dover, NH for "Stormwater Green Infrastructure Innovations and Programmatic Efficiency”

Berry Brook

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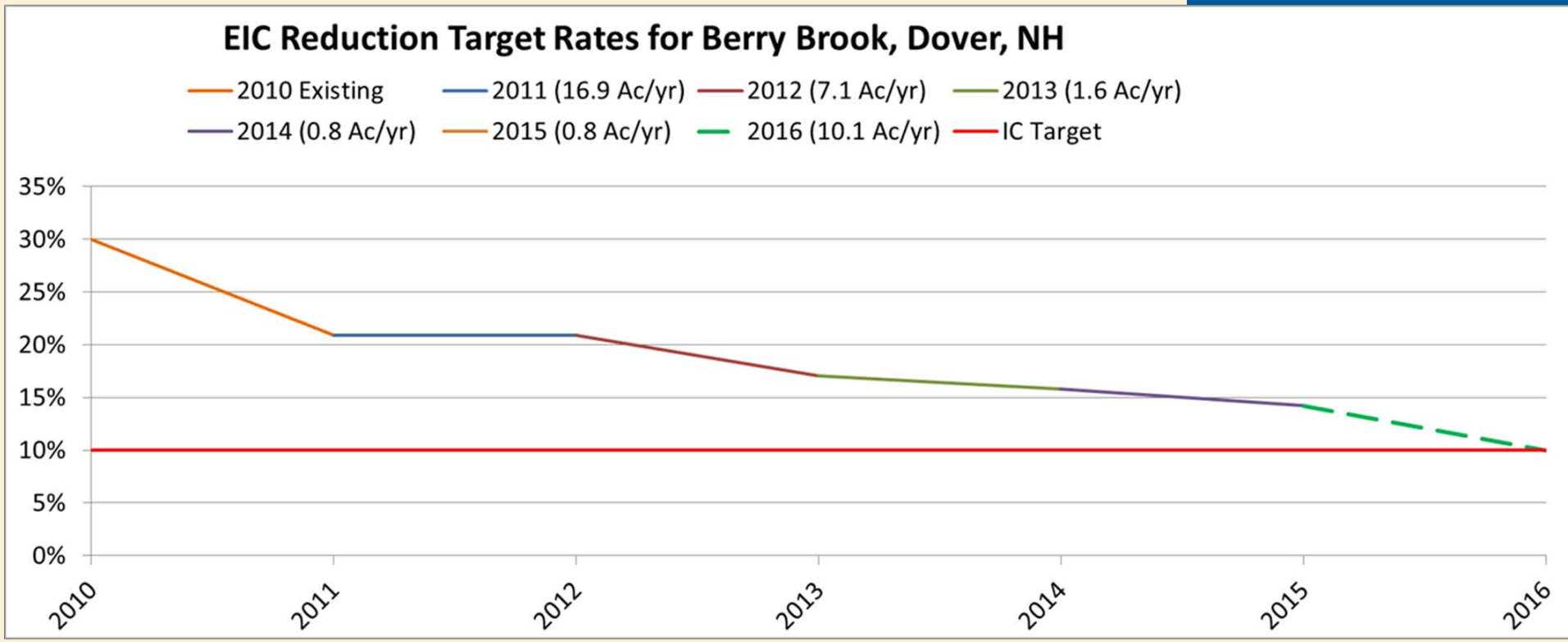
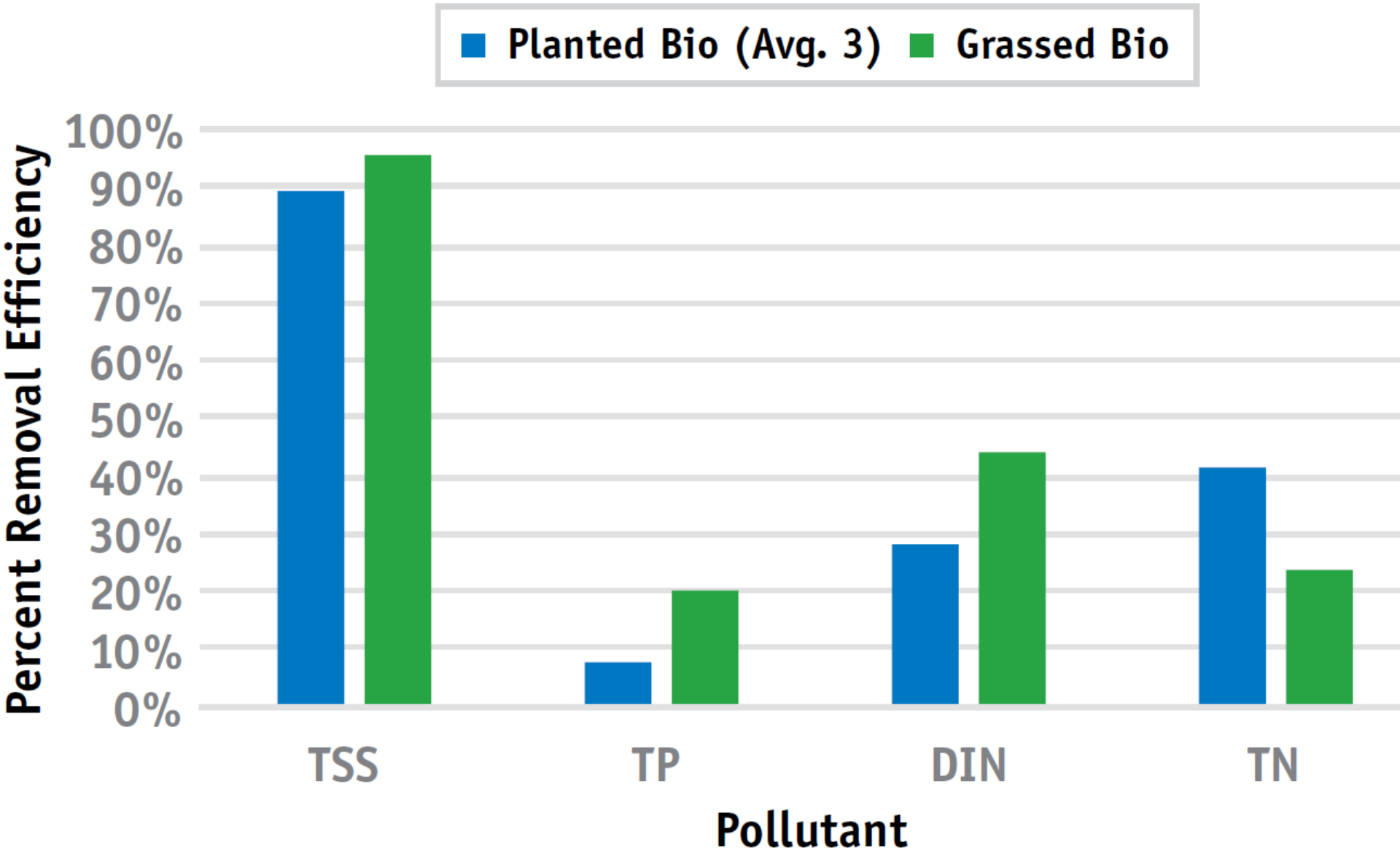


Comparison of Pollutant Removal Efficiency
Planted vs Grassed Bioretention



Grassed vs Planted Surface IR

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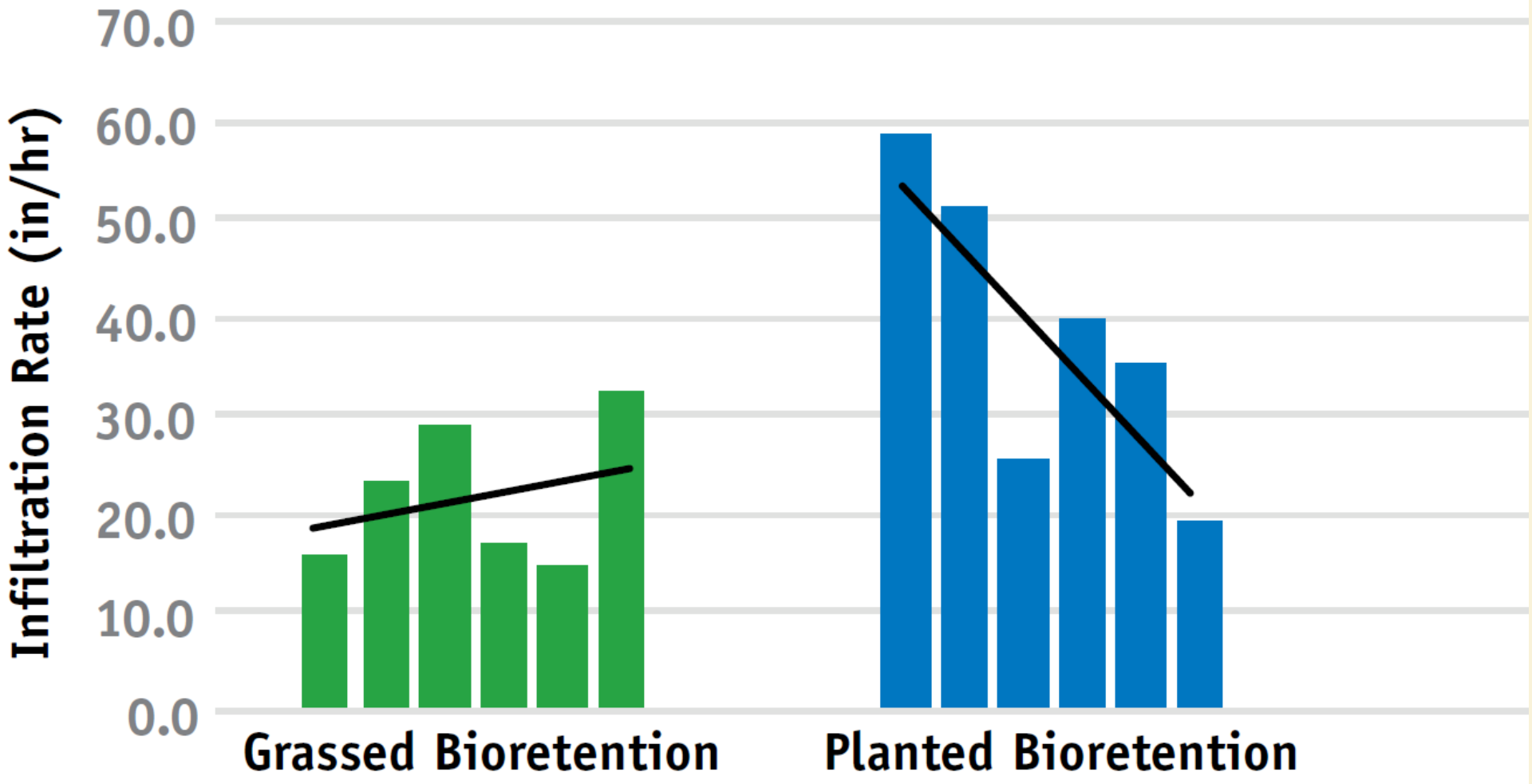
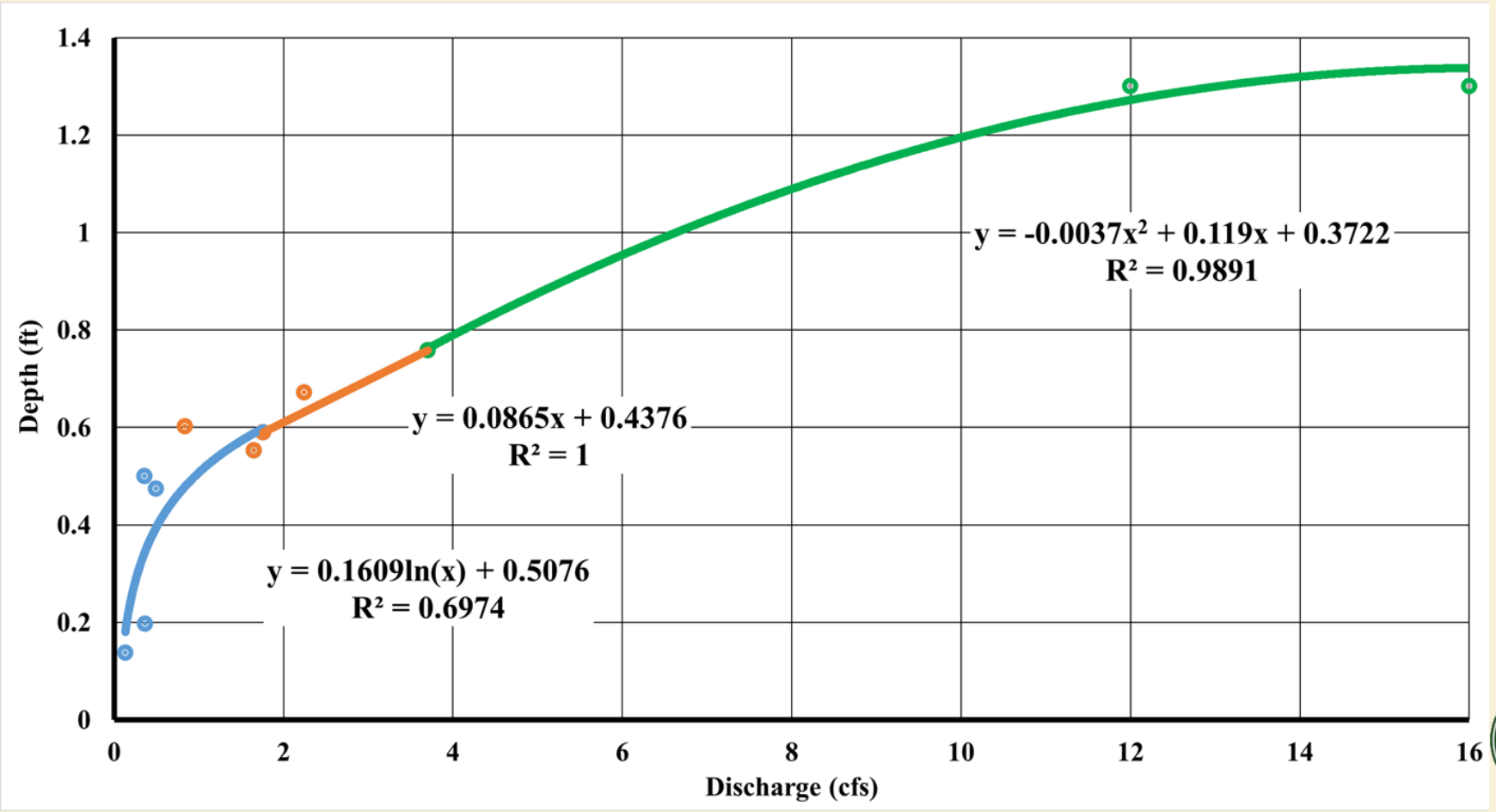
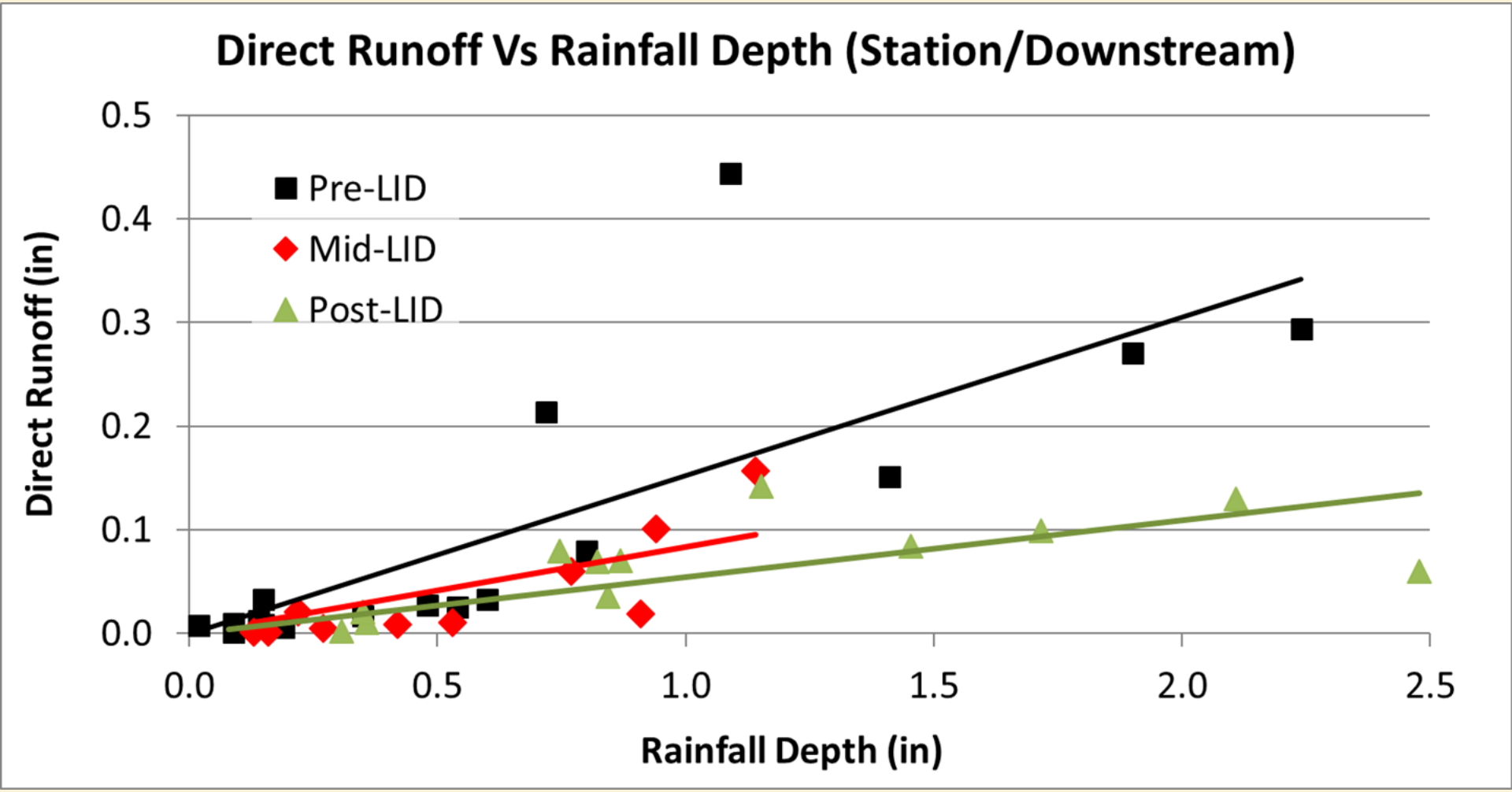
Average Infiltration Rates of a Planted (blue) versus Grassed (green) Bioretention Systems Over Time



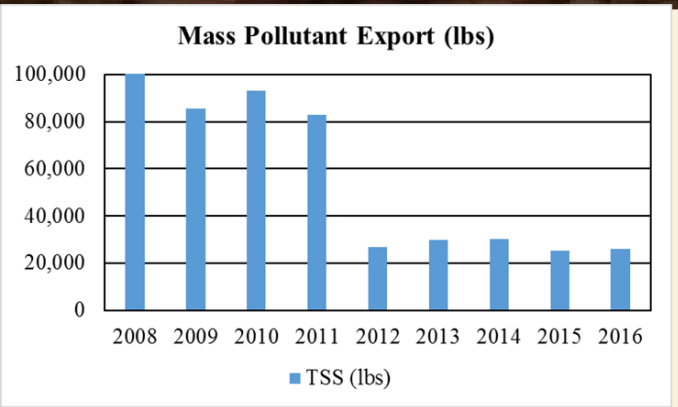
Hydrology

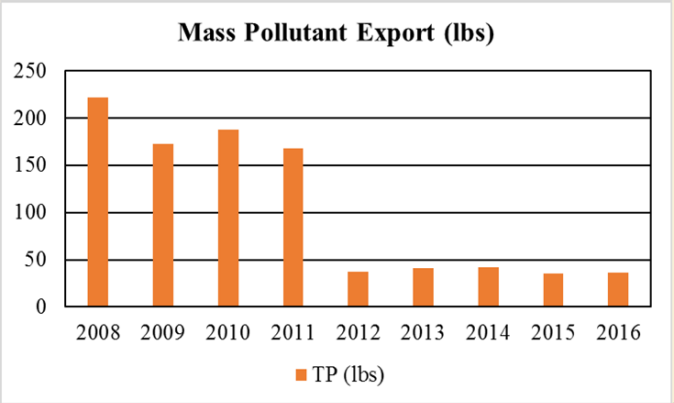

1.4
1.2
1
0.8
0.6
0.4
0.2
0
Depth (ft)
0
2
4
6
8
10
12
14
16
Discharge (cfs)
y = -0.0037x² + 0.119x + 0.3722
R² = 0.9891
y = 0.0865x + 0.4376
R² = 1
y = 0.1609ln(x) + 0.5076
R² = 0.6974

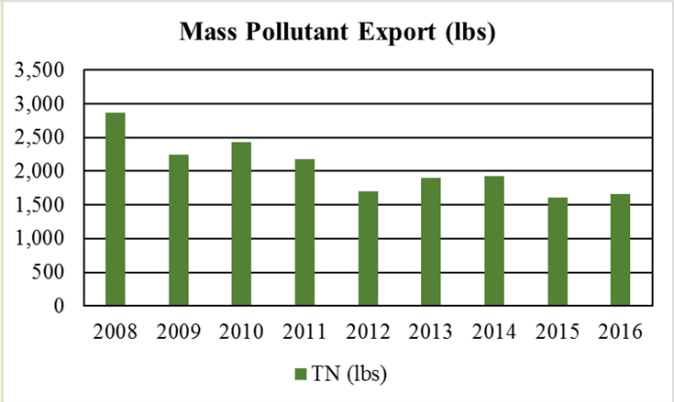
Hydrology


Direct Runoff Vs Rainfall Depth (Station/Downstream)
Direct Runoff (in)
0.5
0.4
0.3
0.2
0.1
0.0
Pre-LID
Mid-LID
Post-LID
0.0
0.5
1.0
1.5
2.0
2.5
Rainfall Depth (in)

Modeled Water Quality







Results for Berry Brook at Station Drive

1-Inch Storm, Ia = 0.05 S[1]

Year	% IC	P (in)	Q (in)	S (in)	CN	Q Reduction
2011	30	1.00	0.153	3.59	74	
2012	20	1.00	0.084	5.54	64	45.3%
2015	14	1.00	0.055	7.02	59	64.0%

[1]*Hawkins, R.H.; Jiang, R.; Woodward, D.E.; Hjelmfelt, A.T.; Van Mullem, J.A. (2002). "Runoff Curve Number Method: Examination of the Initial Abstraction Ratio".*

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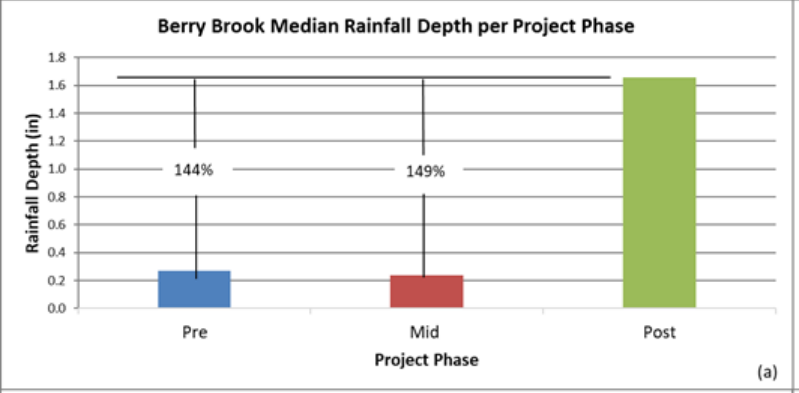
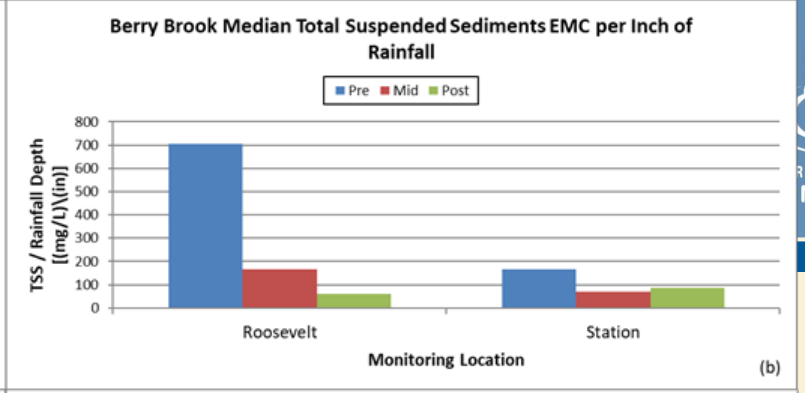
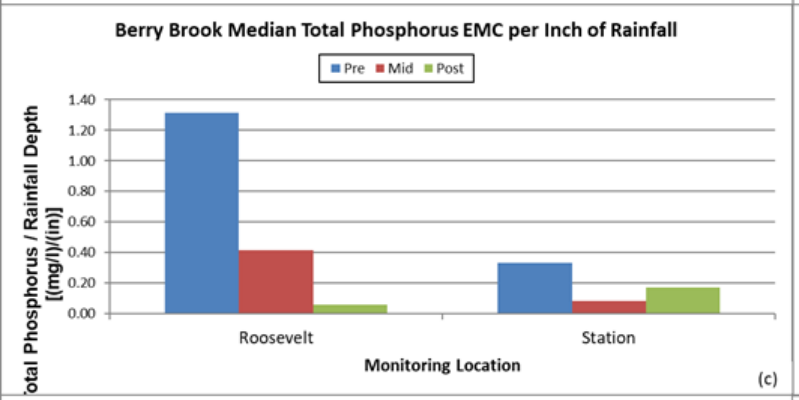
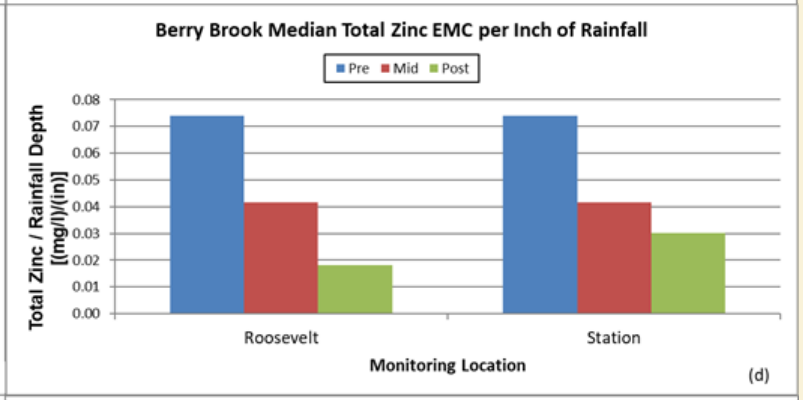
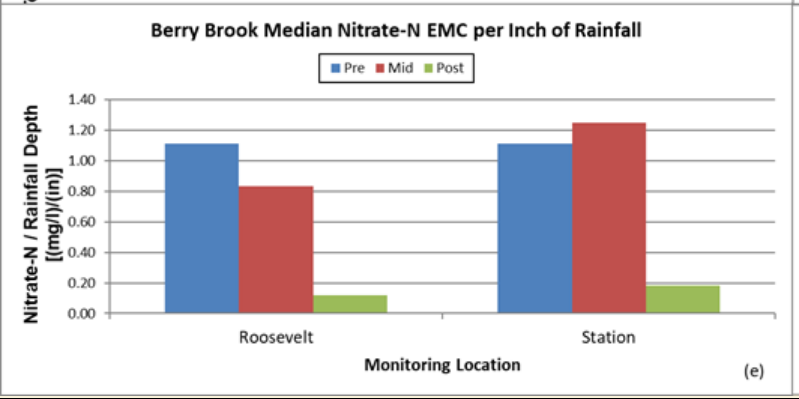
Year	A	P	CN	TSS (lbs)	TP (lbs)	TN (lbs)
2008-20011	185	56.14	74	92,719	188	2,428
20012-2016	185	42.20	62	27,575	38	1,762
Annual Reductions (lb./yr.)				65,144	149	667
Simple Method (lb./yr.)				57,223	201	1,127

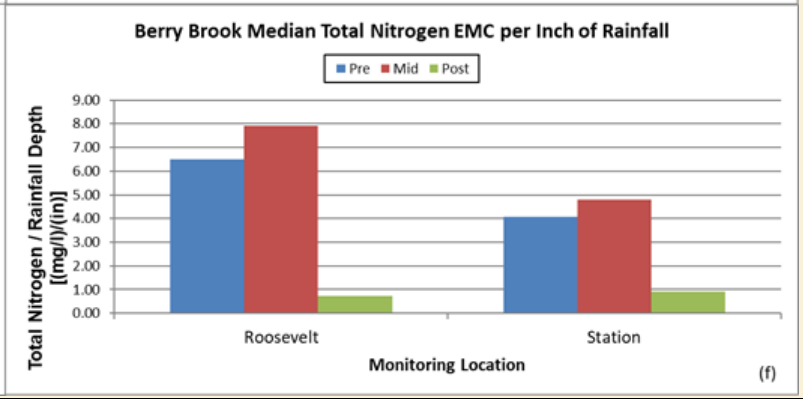








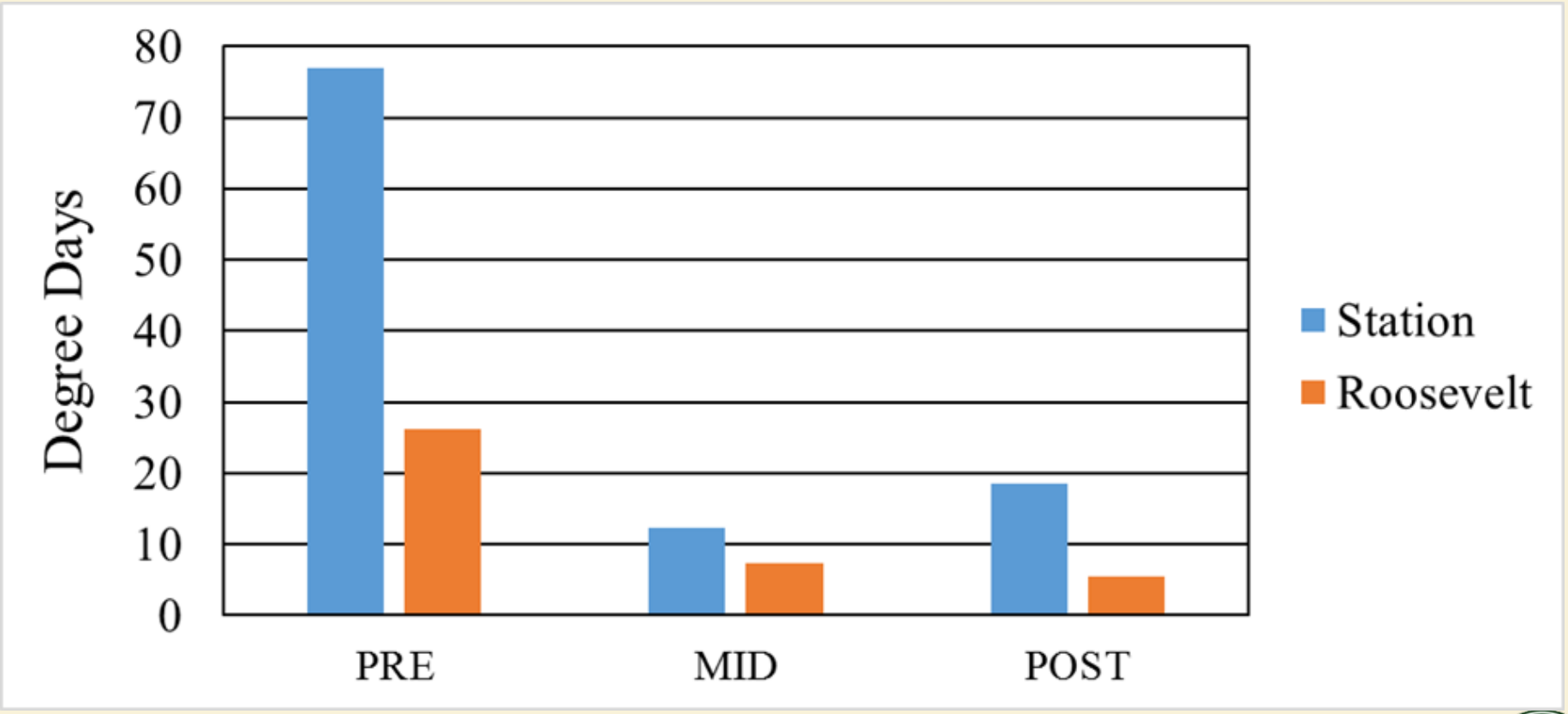




Measured Water Quality mg/L/yr/in

		TSS (mg/l) / (in)			Zinc (mg/l) / (in)			Nitrate-N (mg/l) / (in)			Total Nitrogen (mg/l) / (in)			Total Phosphorus (mg/l) / (in)		
		Pre	Mid	Post	Pre	Mid	Post	Pre	Mid	Post	Pre	Mid	Post	Pre	Mid	Post
Roosevelt	Weighted EMC	704	167	60	0.07	0.04	0.02	1.1	0.8	0.1	6.5	7.9	0.7	1.31	0.42	0.06
	% Difference		123%	168%		56%	121%		29%	161%		-20%	160%		104%	182%
Station	Weighted EMC	167	69	85	0.07	0.04	0.03	1.1	1.3	0.2	4.1	4.8	0.9	0.33	0.08	0.17
	% Difference		83%	65%		56%	84%		-12%	144%		-16%	127%		120%	65%
Average	%Difference		103%	117%		56%	103%		8%	152%		-18%	144%		112%	124%

Temperature Data



One degree day is a day when the average stream temperature is one degree Fahrenheit above 65 degrees F. This is important as the temperature that a Brook Trout begins to feel heat stress is 65 °F. Therefore a day with an average daily stream temperature of 71 degrees would represent 6 degree days.

Conclusions

- Green infrastructure implementation was effective at reducing EIC with respect to hydrologic, water quality at the watershed scale.
- Modeling, stream gauging and water quality sampling results indicate that storm event hydrology and water quality parameters have improved in Berry Brook
- Having the community involved with decisions/design transferred ownership which led to innovations that decreased costs and improved system maintainability.
- Berry Brook project should help both regulators and municipalities adapt their mitigation and restoration efforts toward opportunistic implementation and resiliency planning.