Construction and Post Construction Stormwater Management Research Approaches

James Houle, PhD University of New Hampshire Stormwater Center

Providing Data to Protect Water Quality Since 2004

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Breaking Through

Nearly two decades of stormwater research

2023 SEC Seminar Omaha, NE

02 February 2023

University of New Hampshire

Taking Root

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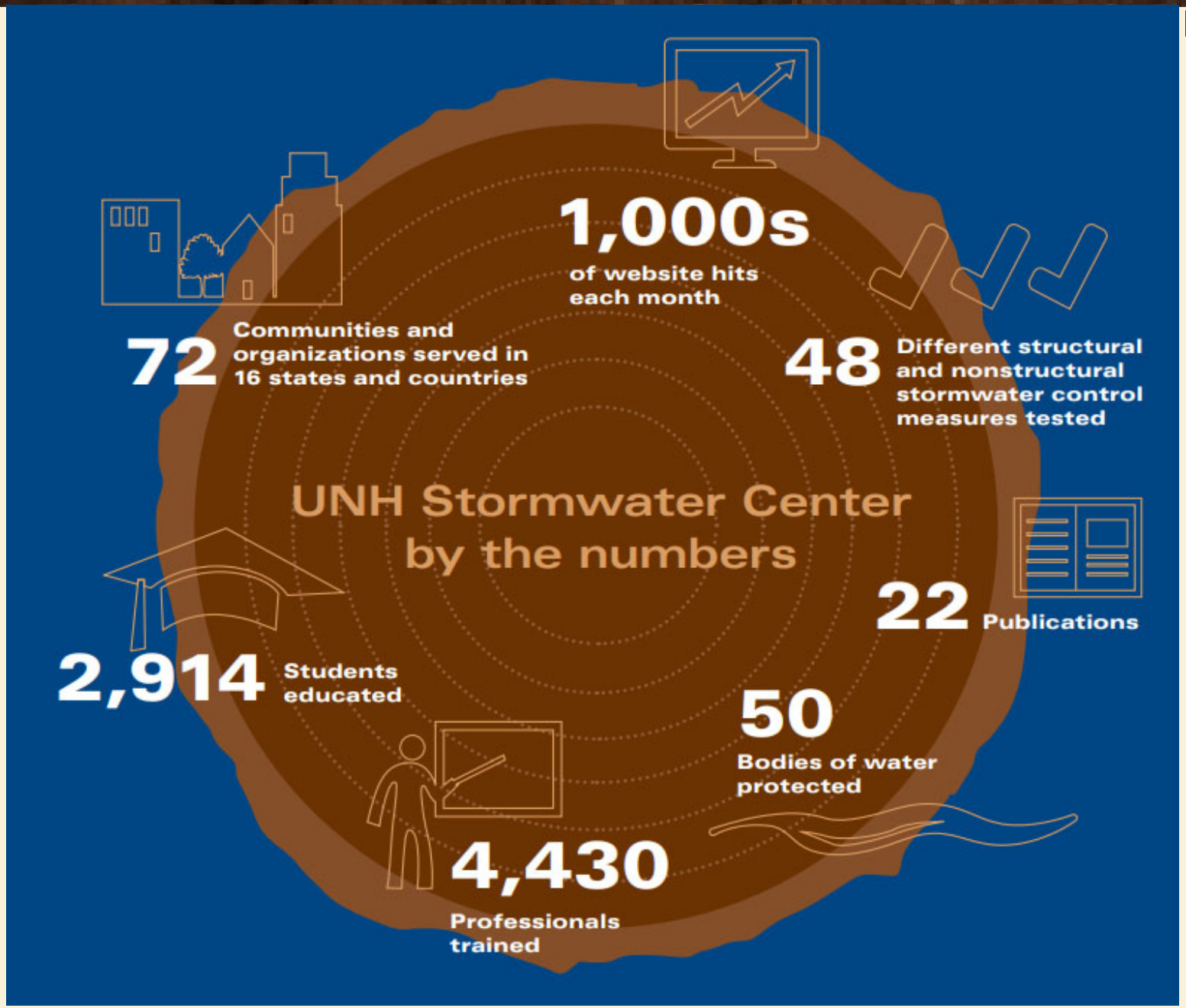

BMP Performance Monitoring

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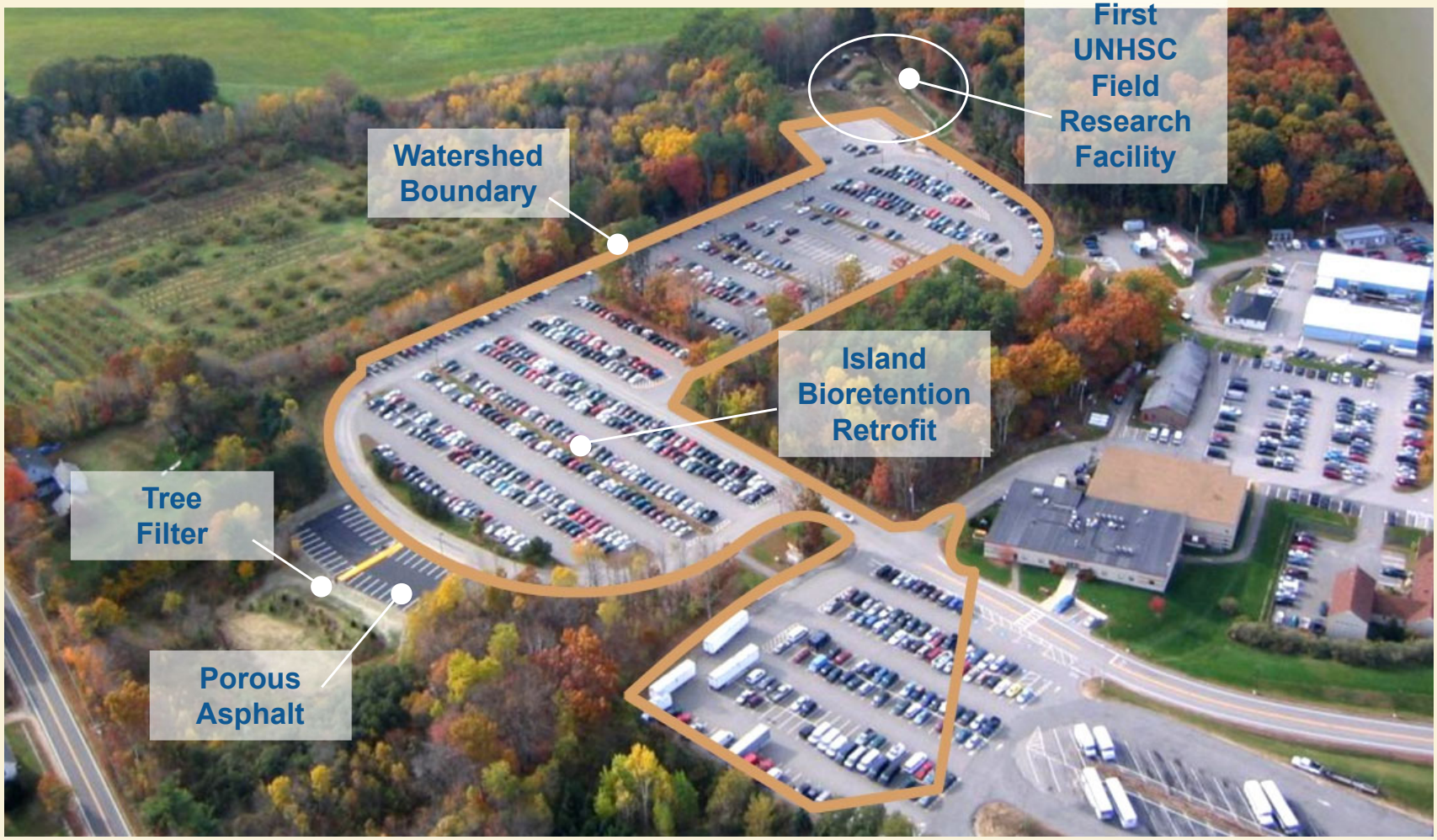
Research Field Facility at UNH

Tc ~ 19 minutes



BMP Performance Monitoring

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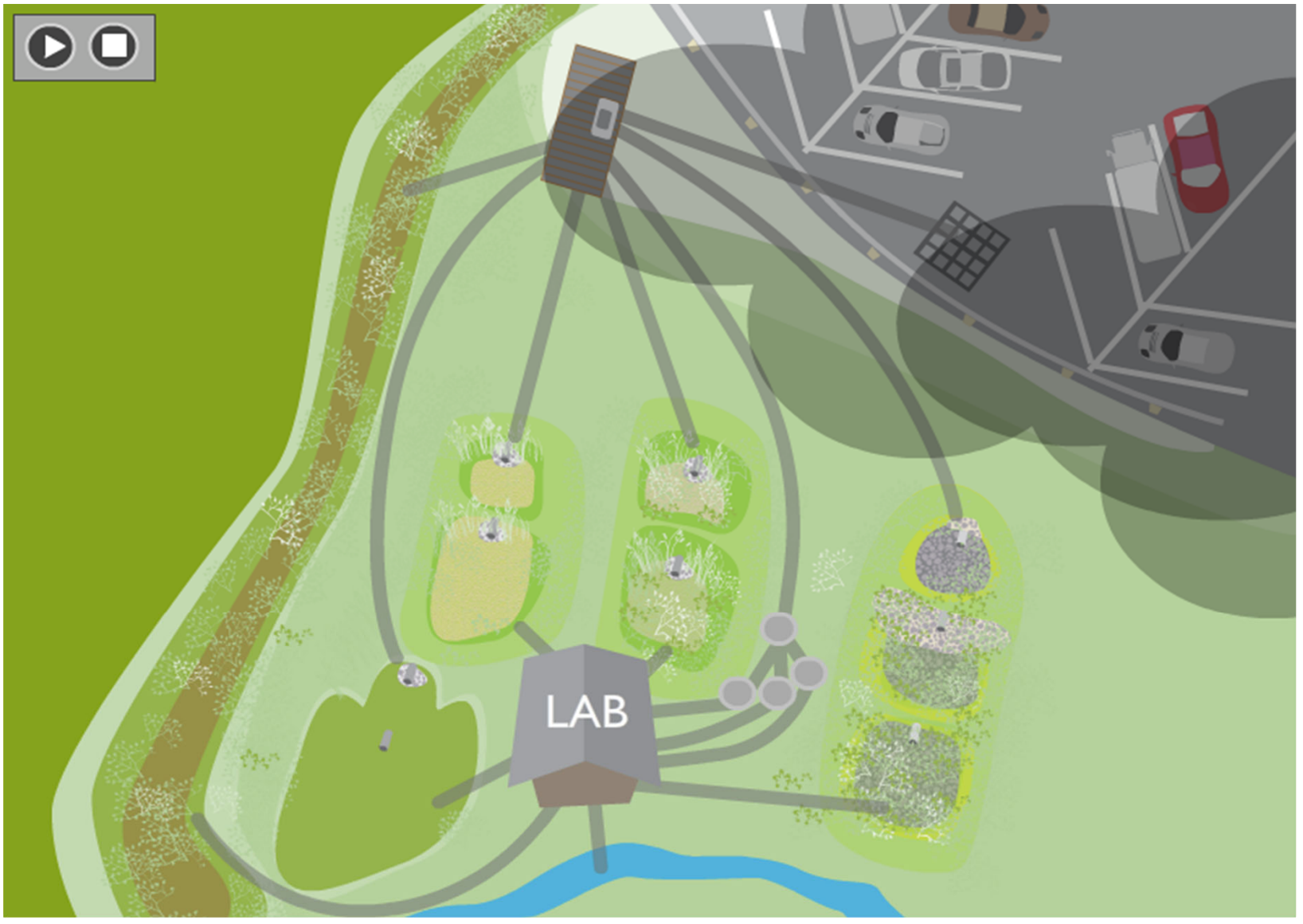

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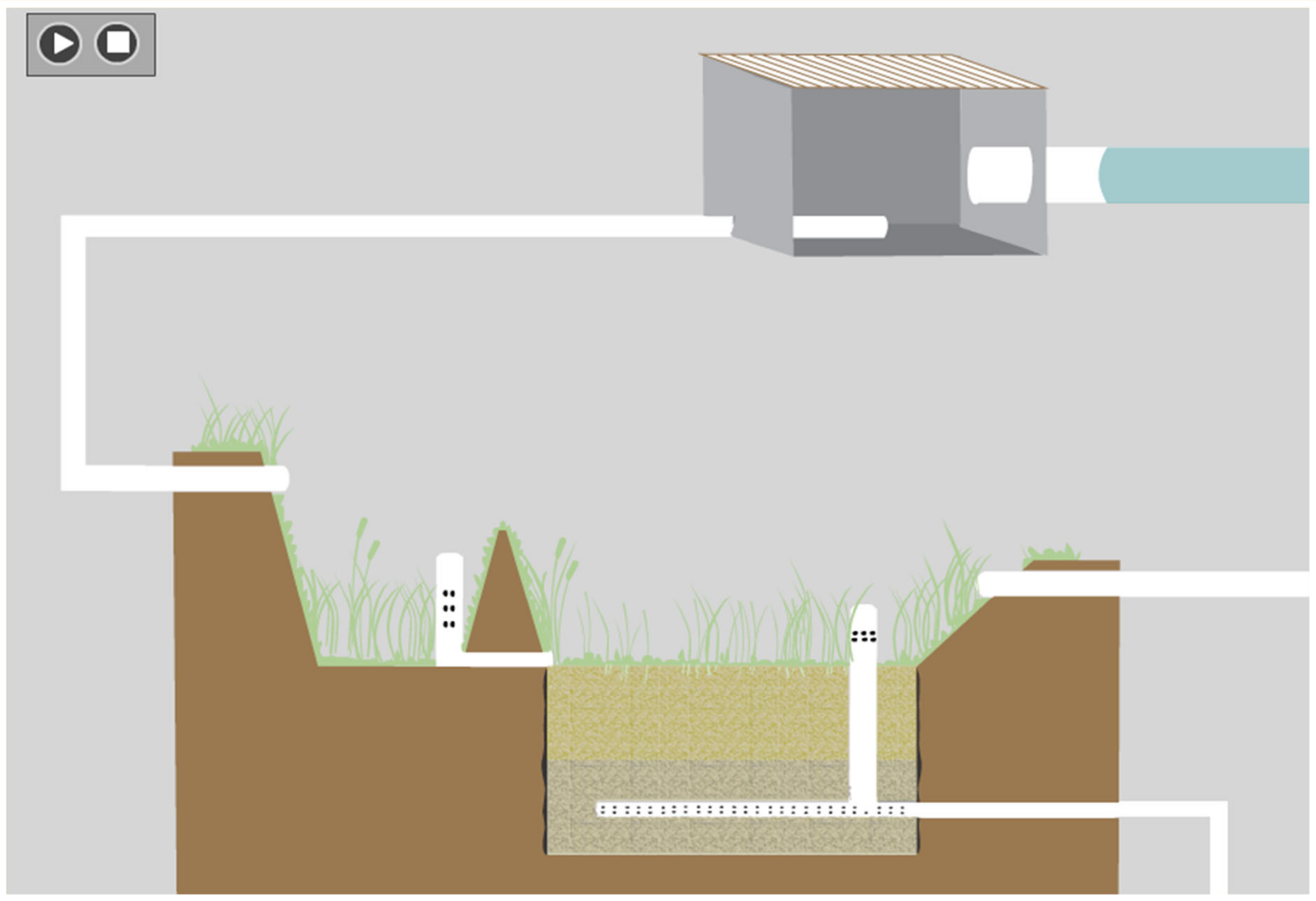
How We Evaluate Systems



BMP Performance Monitoring

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What We Look For

- Hydrology
- Hydraulics
- Maintenance
- Sediment
- Petroleum
- Metals
- Nutrients
- Microorganisms

Hydrodynamic Separator

Isolator Row

Subsurface Infiltration

Filter Unit

Porous Asphalt

Pervious Concrete

Retention Pond

Stone Swale

Veg Swale

Gravel Wetland

Sand Filter

Bioretention Unit

Tree Filter

TSS Removal Efficiencies

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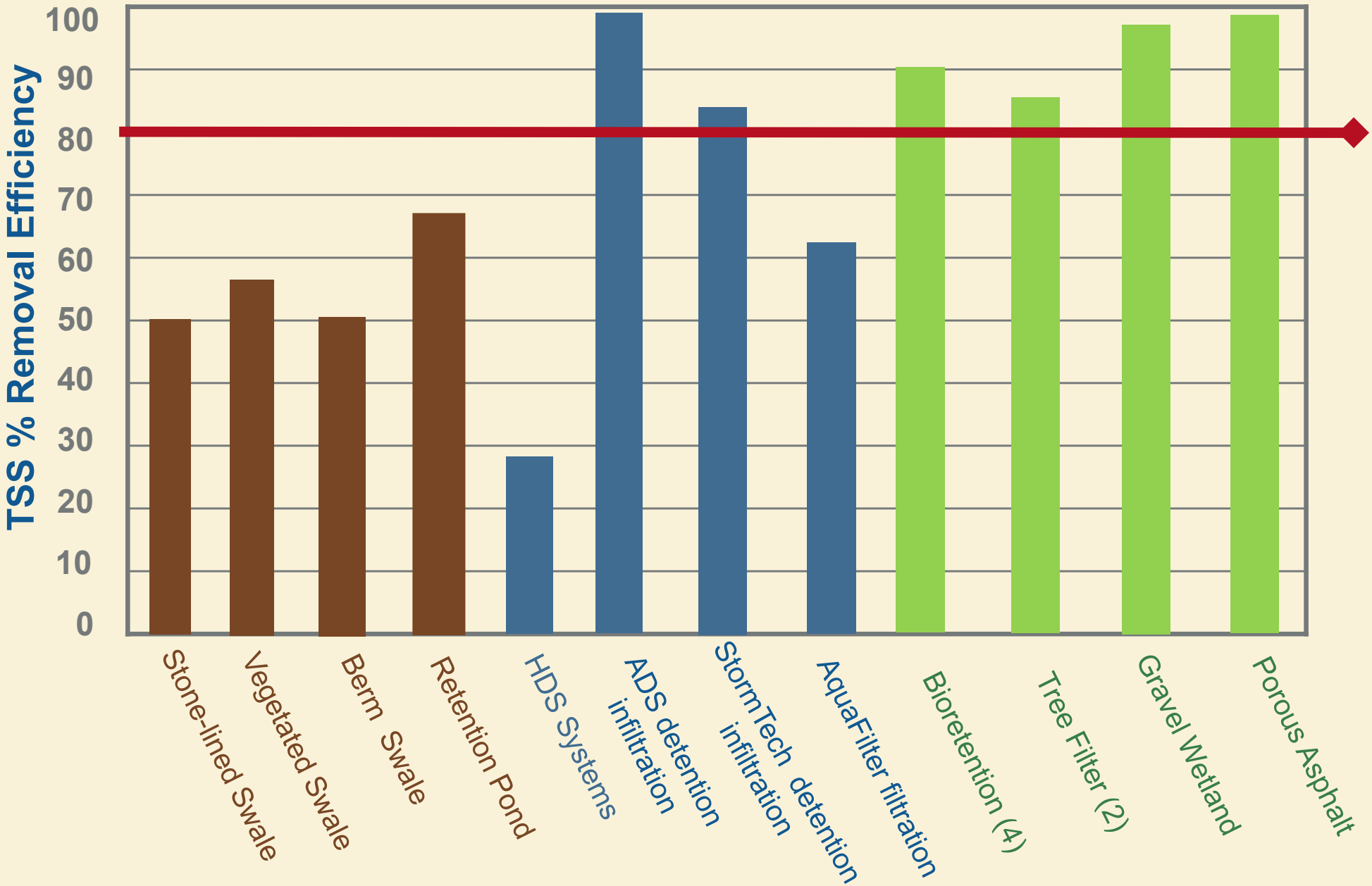

DIN Removal Efficiencies

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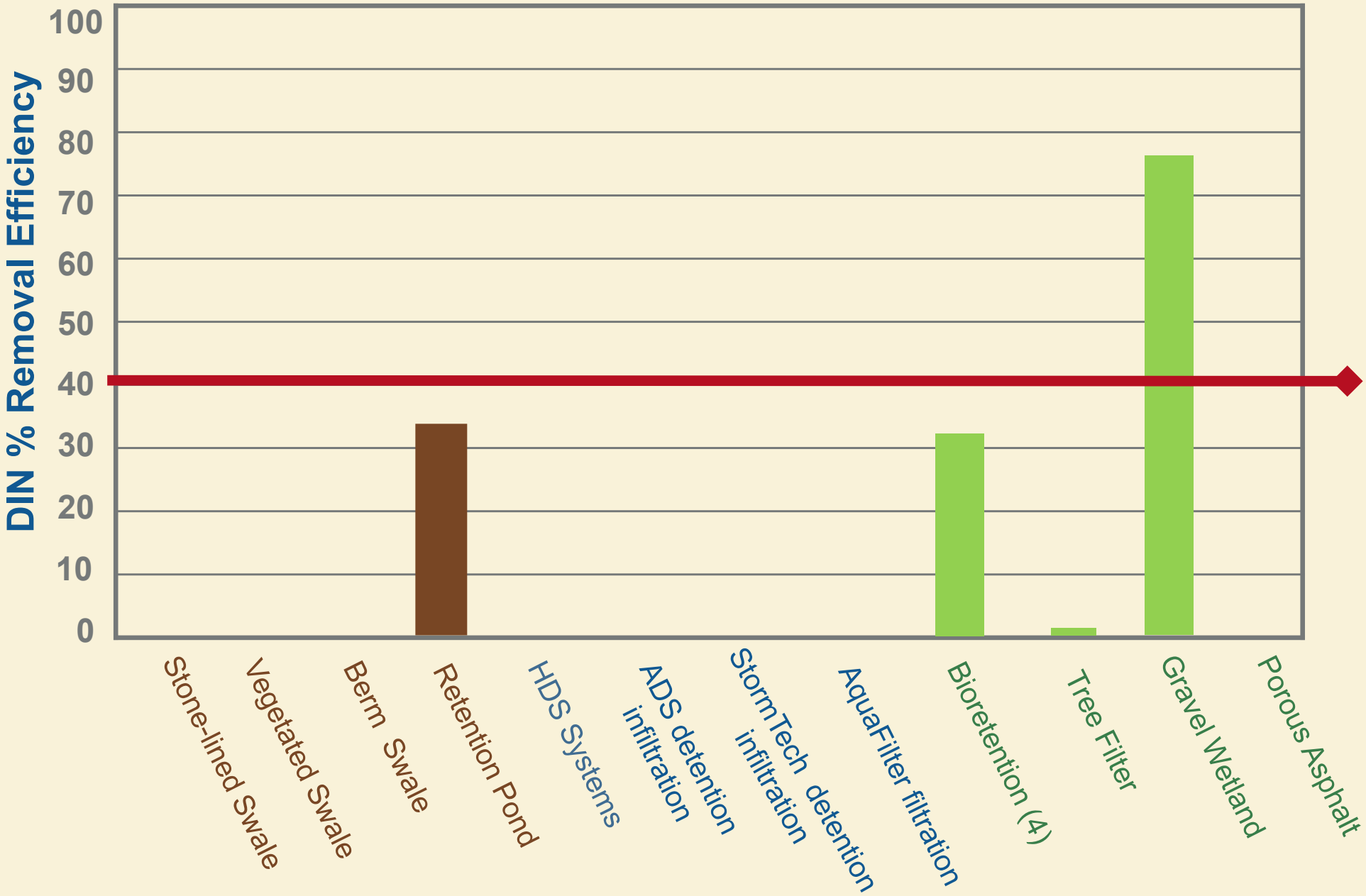

TP Removal Efficiencies

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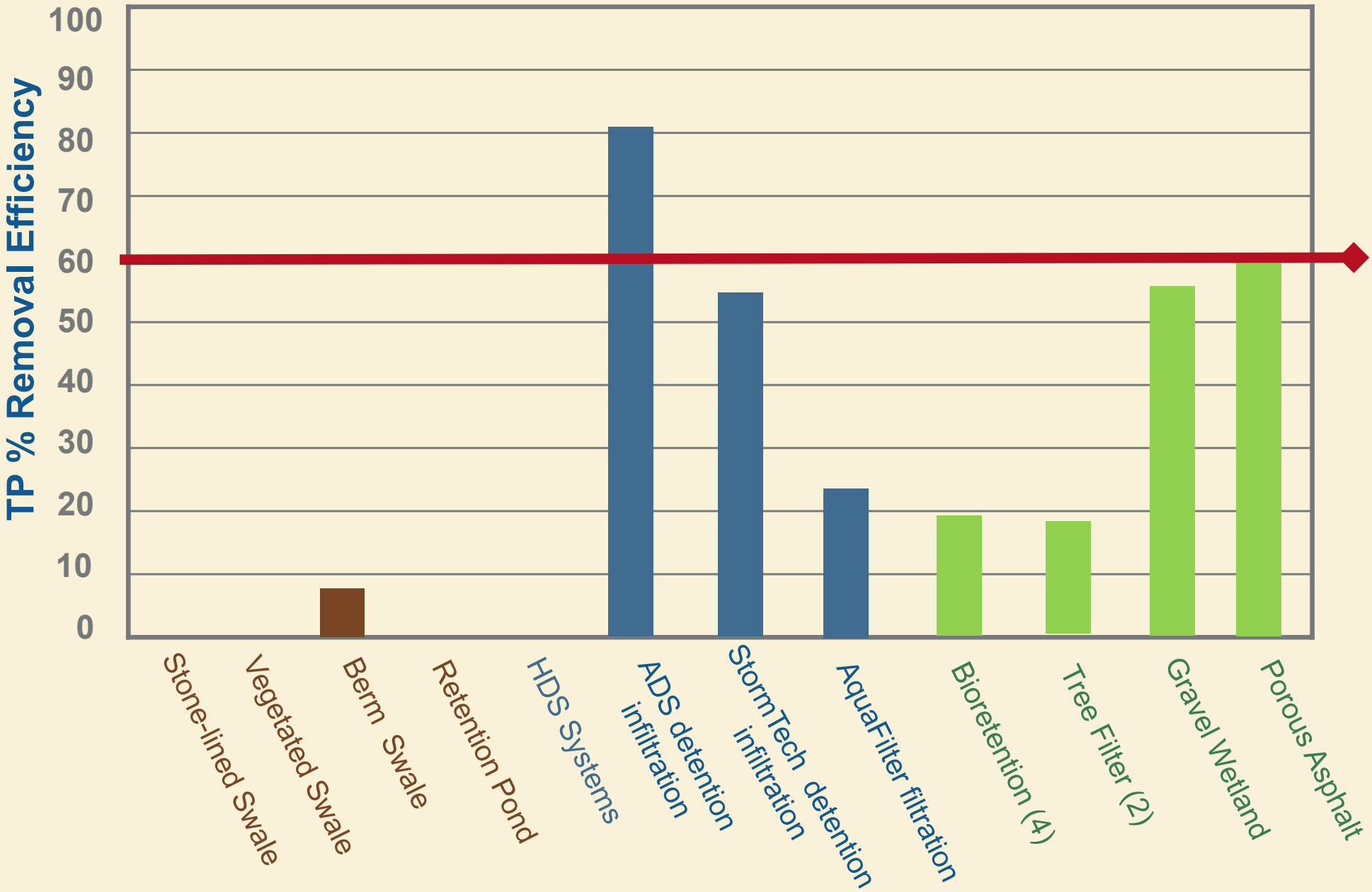

Decadal Reflections

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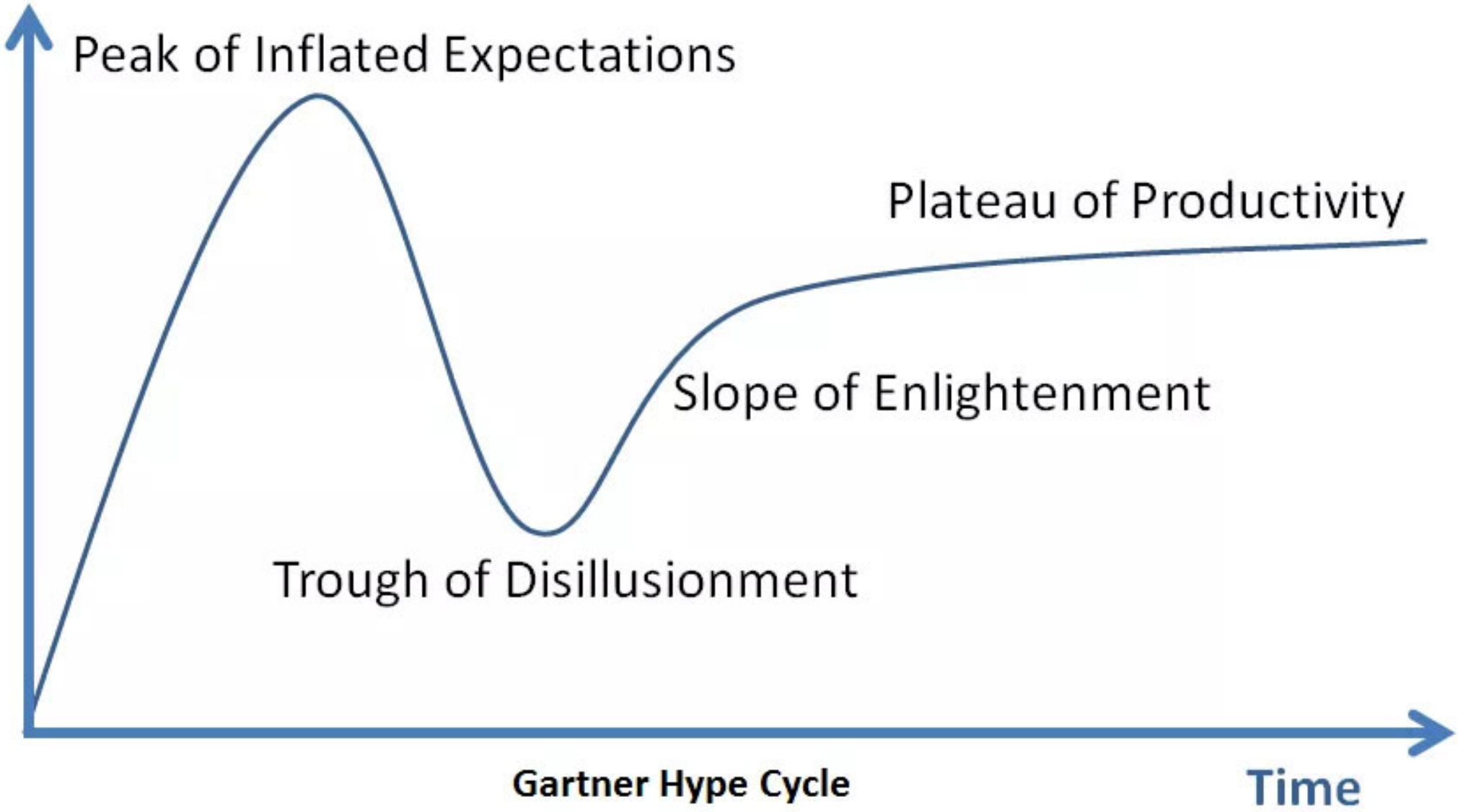

Cart Before the Horse?

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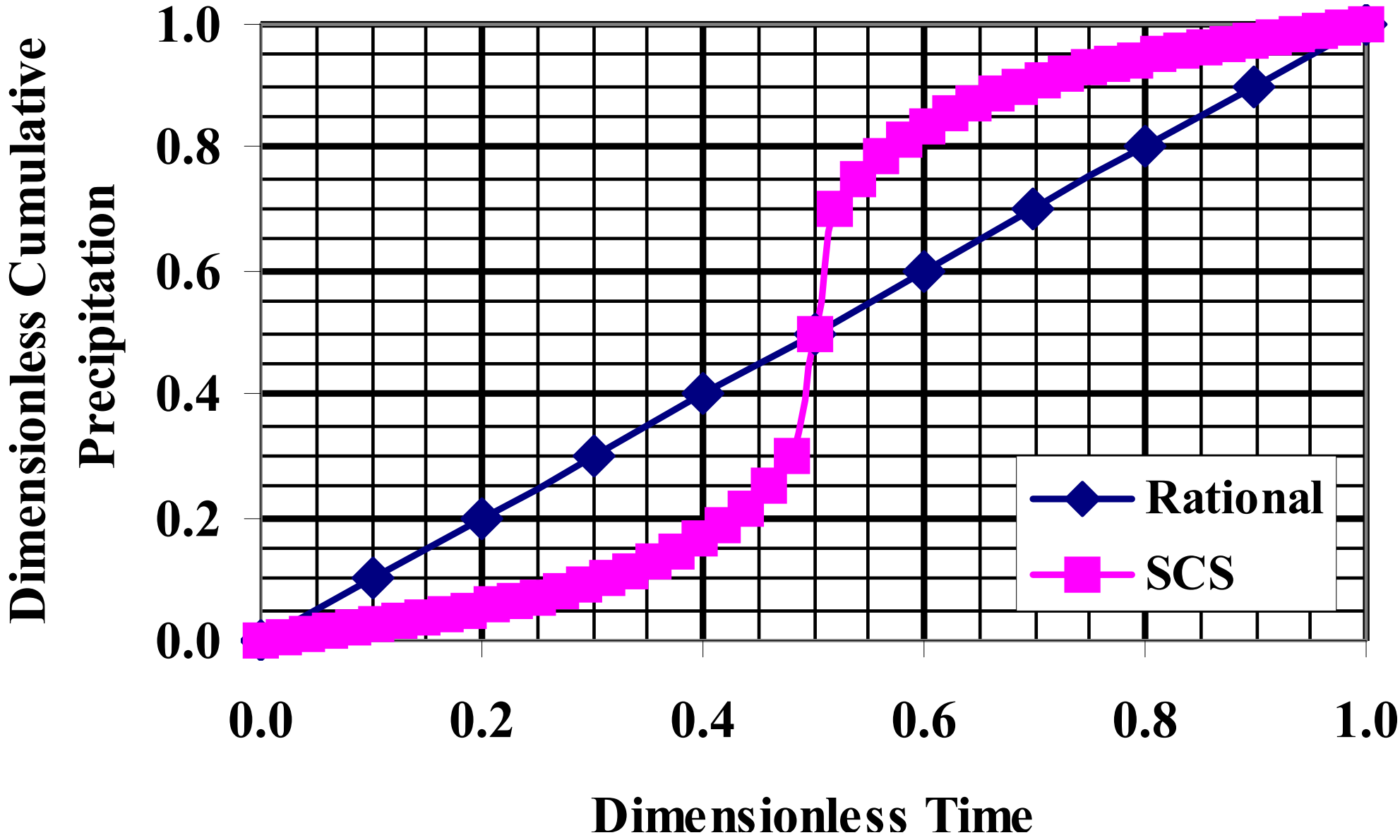
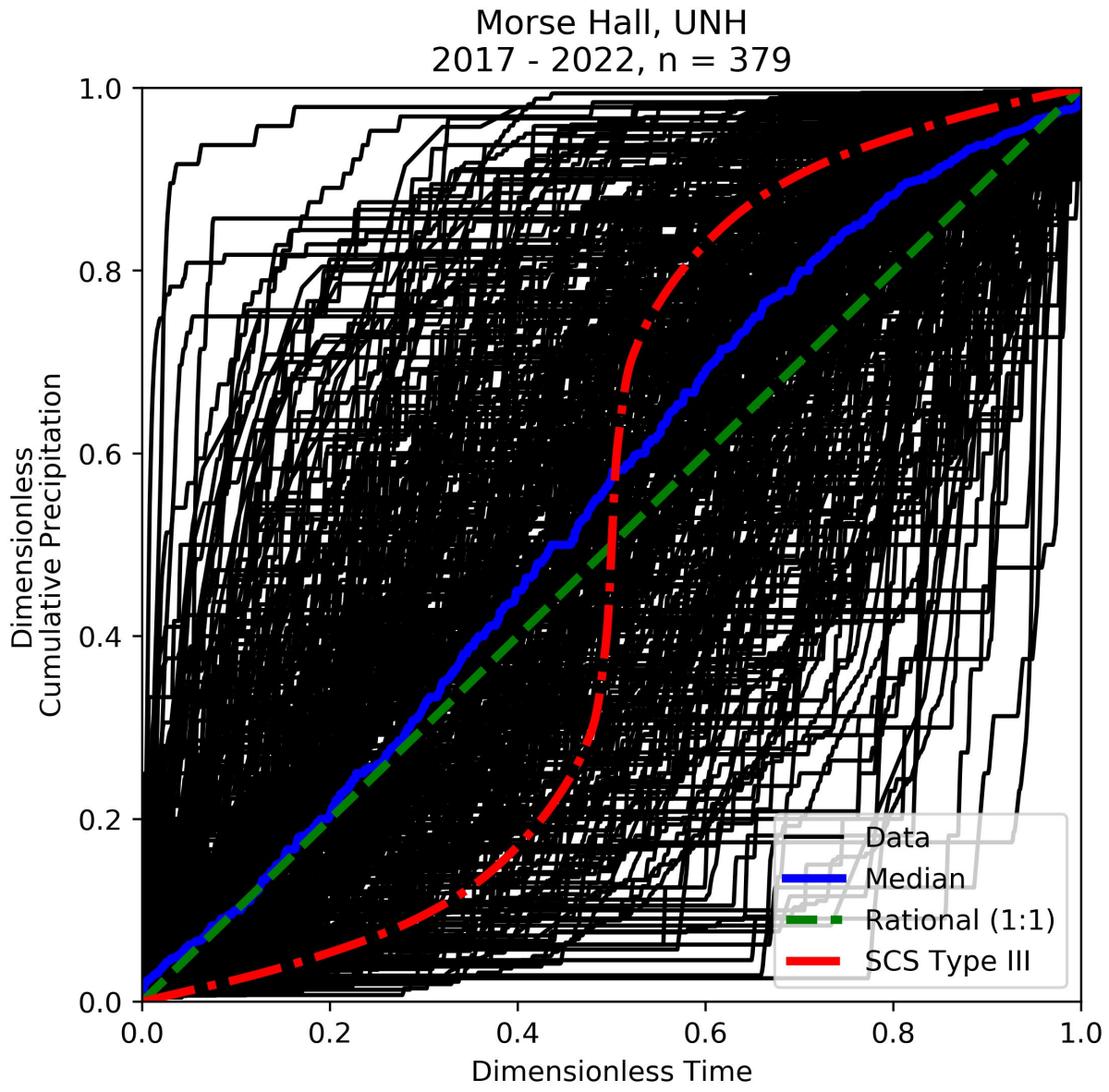
Stormwater Modeling

Do we know what we are doing?

Design Dimensionless Hyetographs



Sampling of Observed Hyetographs
Durham, NH NOAA Gage



System Construction

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Field Measured Infiltration Results

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Location	Double Ring (in/hr)
1	0.03
2	0.29*
3	0.08*
4	0.46*

DRI Median = 0.215 in/hr

Results

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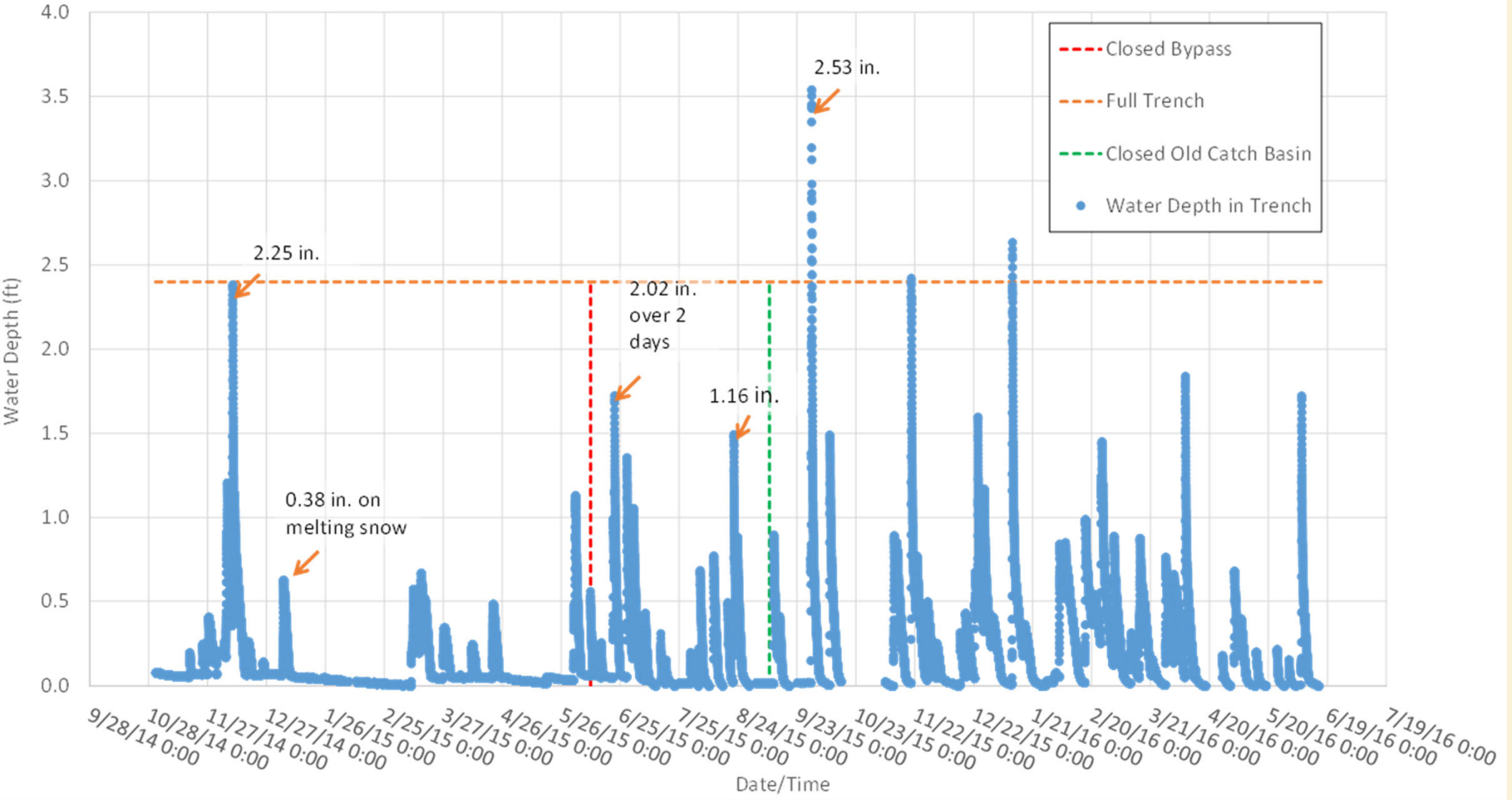

Infiltrated Volume

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For the 366 day period

- 41.47 in. precip.
- Precip. Volume = 87,300 ft^3
- Runoff volume from asphalt (C = 0.92) = 80,330 ft^3
- Infiltrated volume = 64,583 ft^3 (estimated from water depth)
- Volume reduction = 80% (20% not infiltrated occurred in just 2 storms)

Empirical vs Model Results

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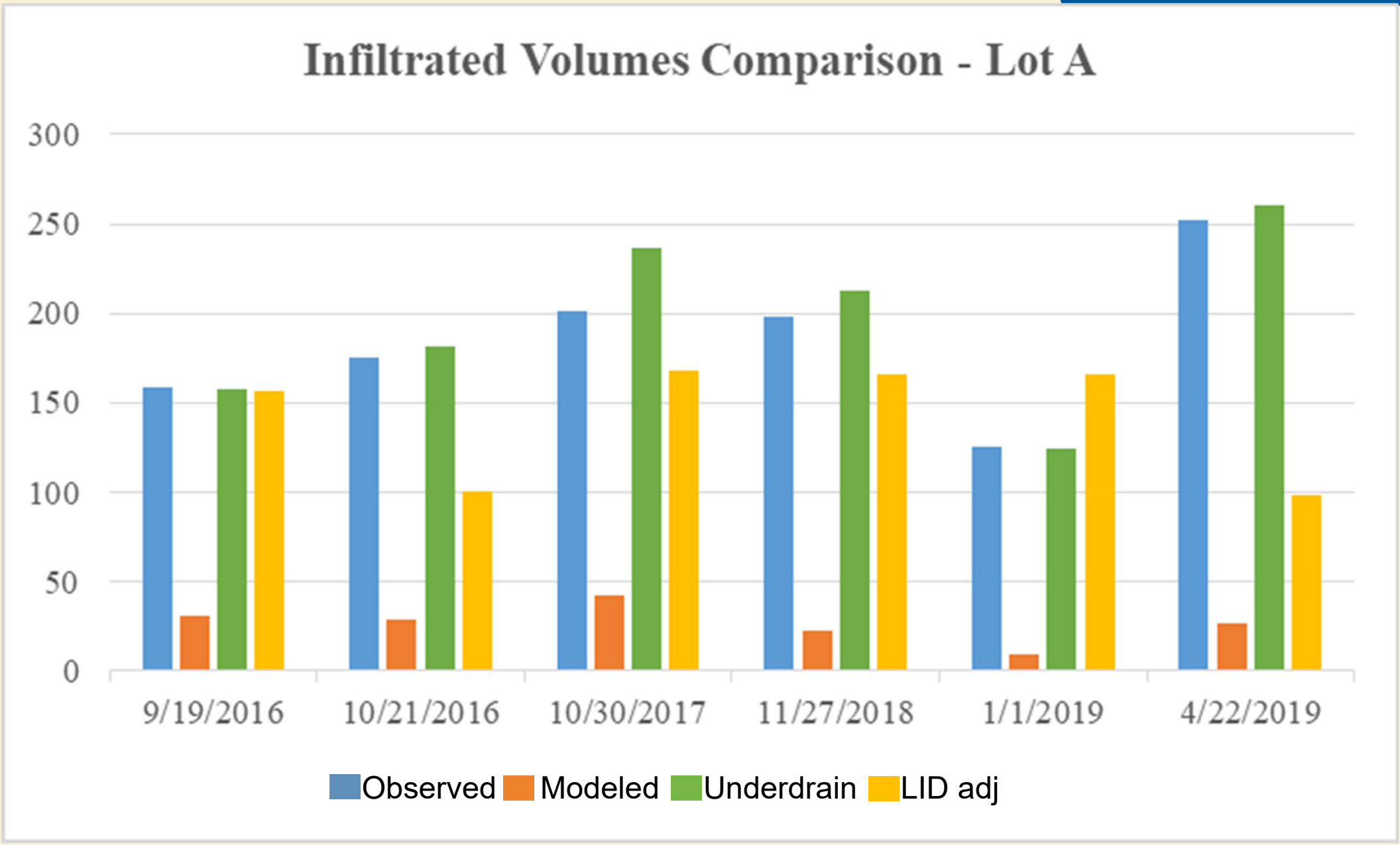

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Stormwater System Sizing

Performance analysis of two relatively small capacity urban retrofit stormwater controls

Sizing Details

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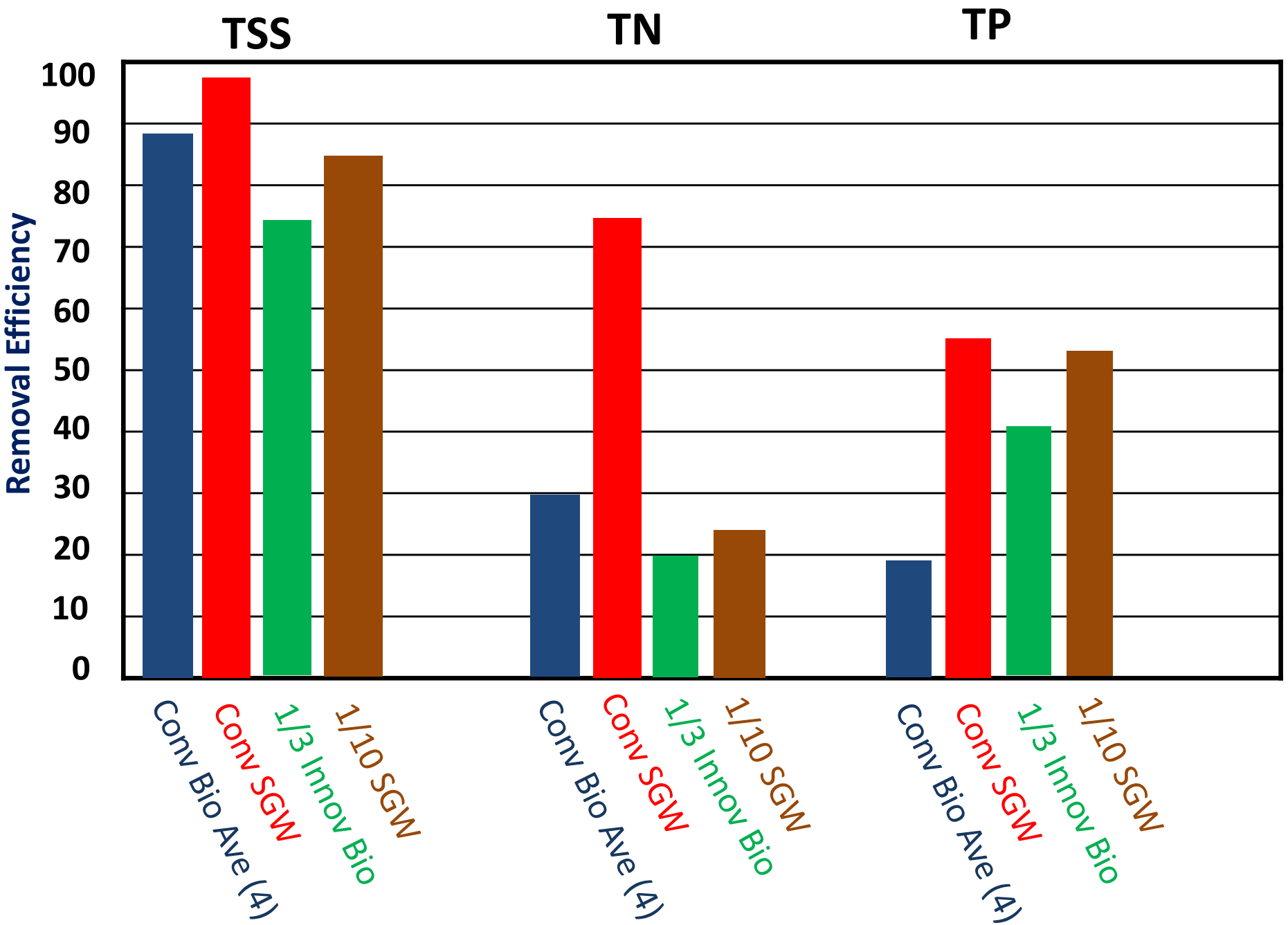
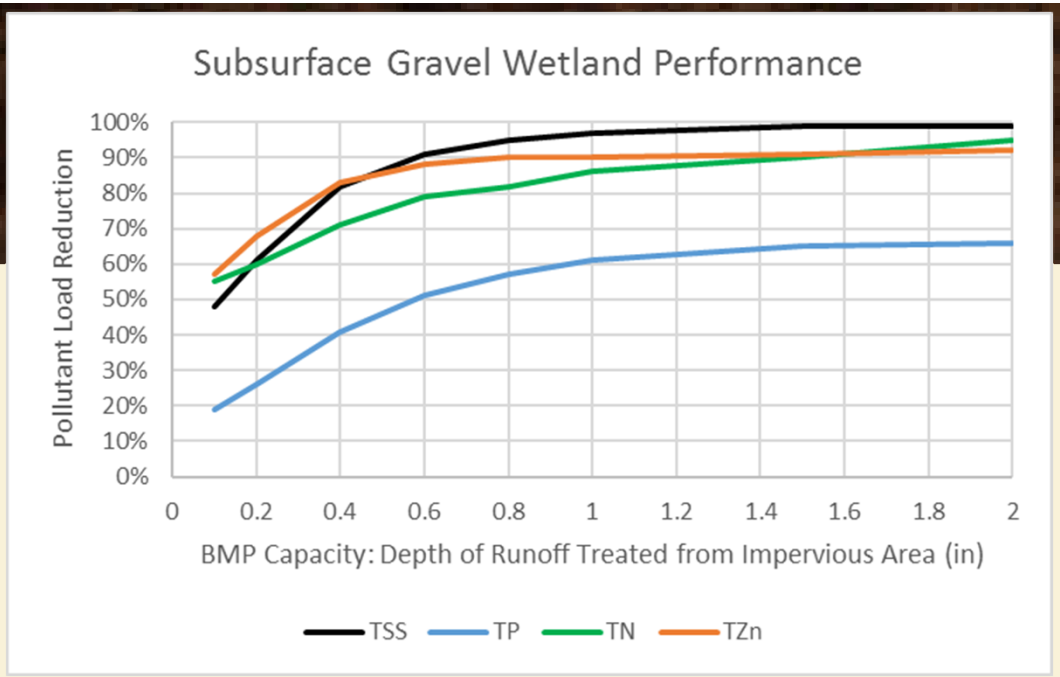
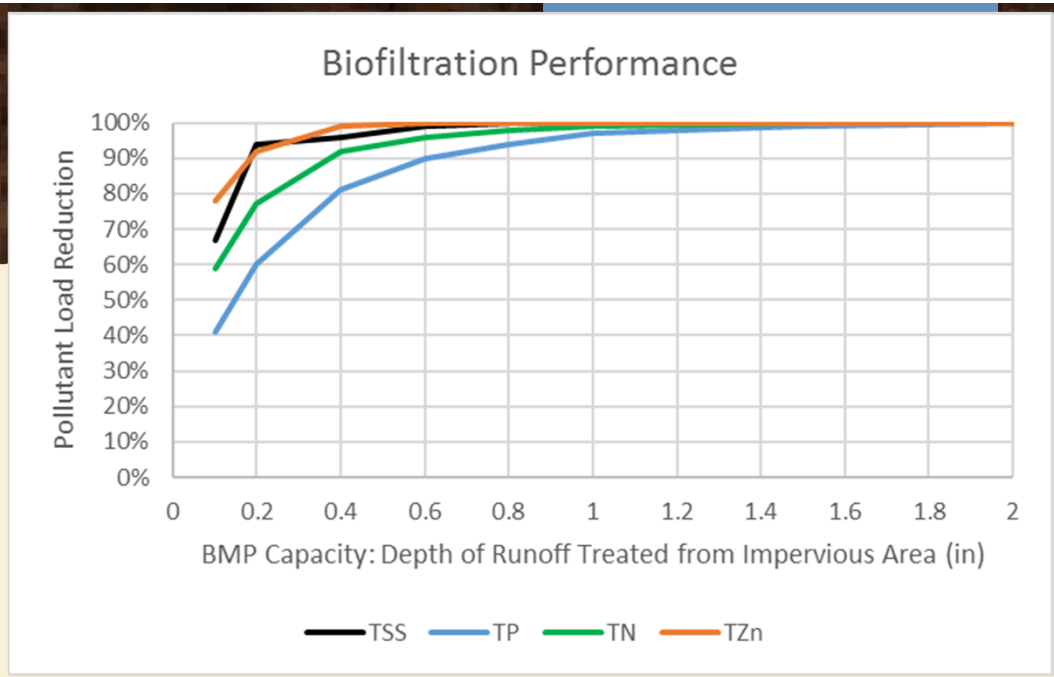
System	WQV ft^3 (m^3)	Actual WQV ft^3 (m^3)	% of normal design	Rain Event in (mm)	Sizing Method
SGWSC	7,577 (214.6)	720 (20.4)	10%	0.10 (2.5)	Static
IBSCS	1,336 (37.8)	310 (8.8)	23%	0. 23 (5.8)	Dynamic

Comparative Removal Efficiencies



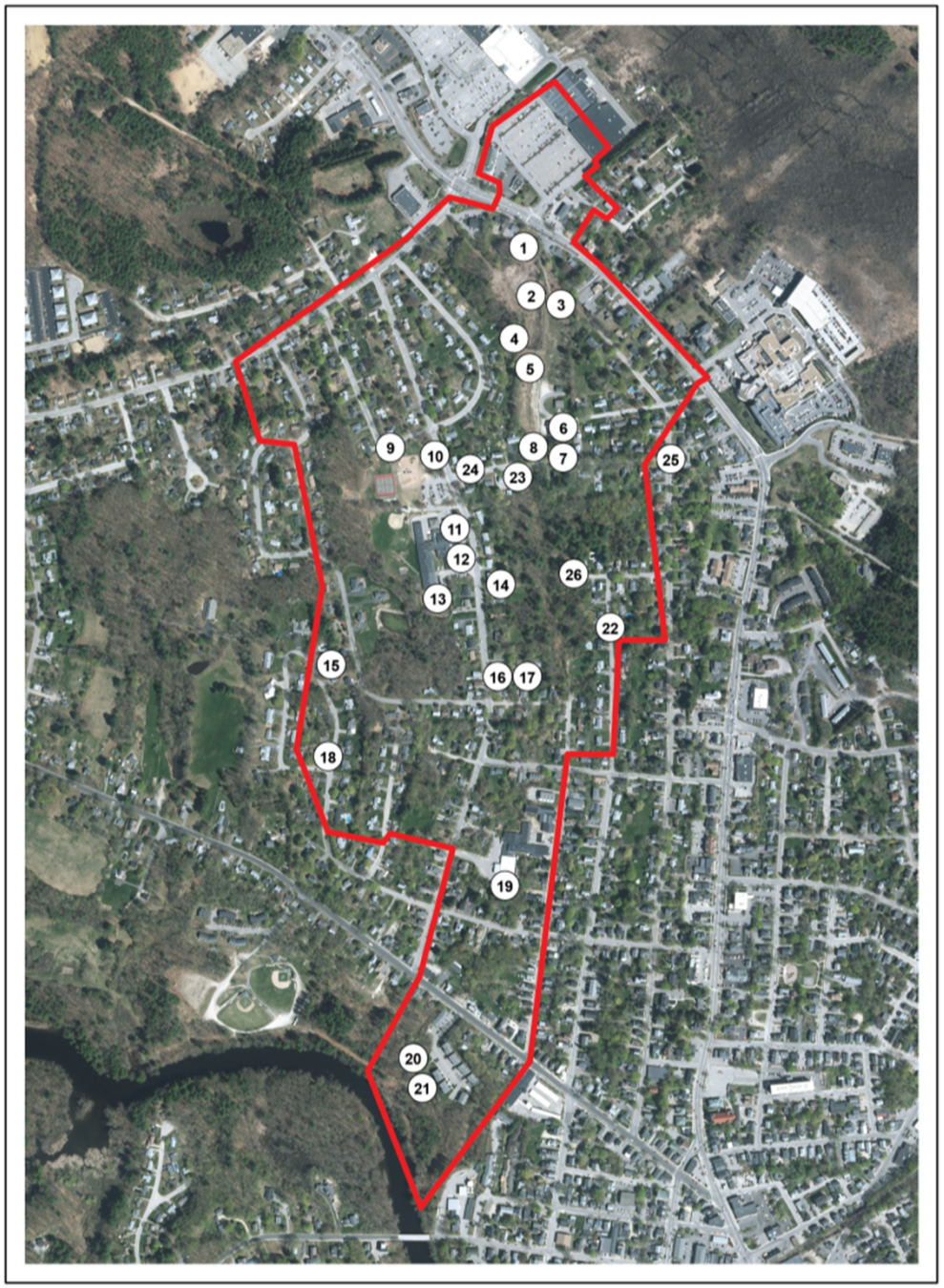




Design Storage Volume (DSV) - runoff depth from IA (in)

Analyte	Depth txt	Modeled RE	Measured RE
TSS	0.1	48	75
TZn	0.1	57	75
TN	0.1	55	23
TP	0.1	19	53

Analyte	Depth txt	Modeled RE	Measured RE
TSS	0.23	70	81
TZn	0.23	88	86
TN	0.23	60	27
TP	0.23	35	45



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Berry Brook BMPS

0 0.0450.09 0.18 0.27 0.36 Miles

Legend

New BMPs

BB_Watershed

2015 1-foot Orthophotography

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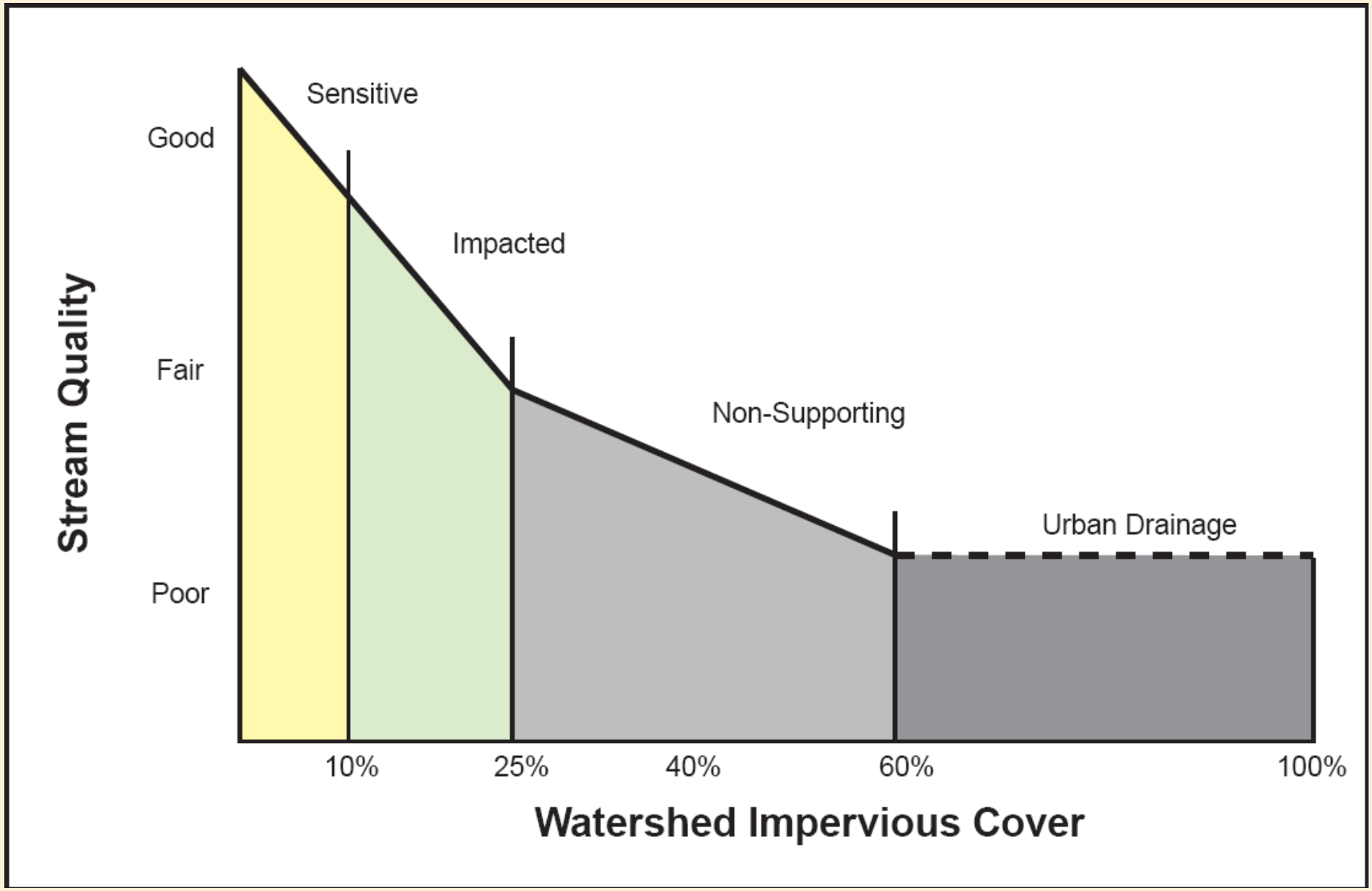
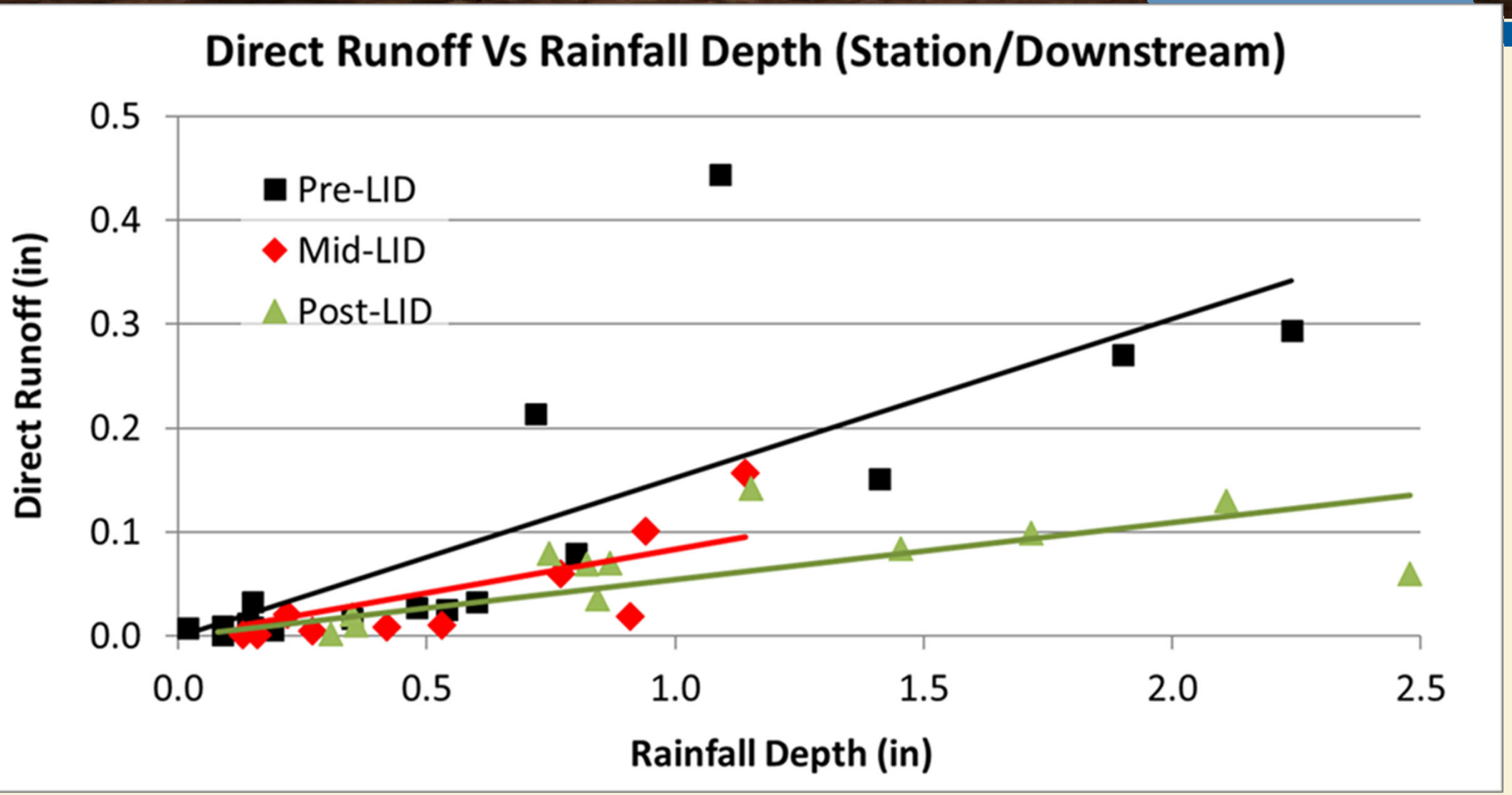
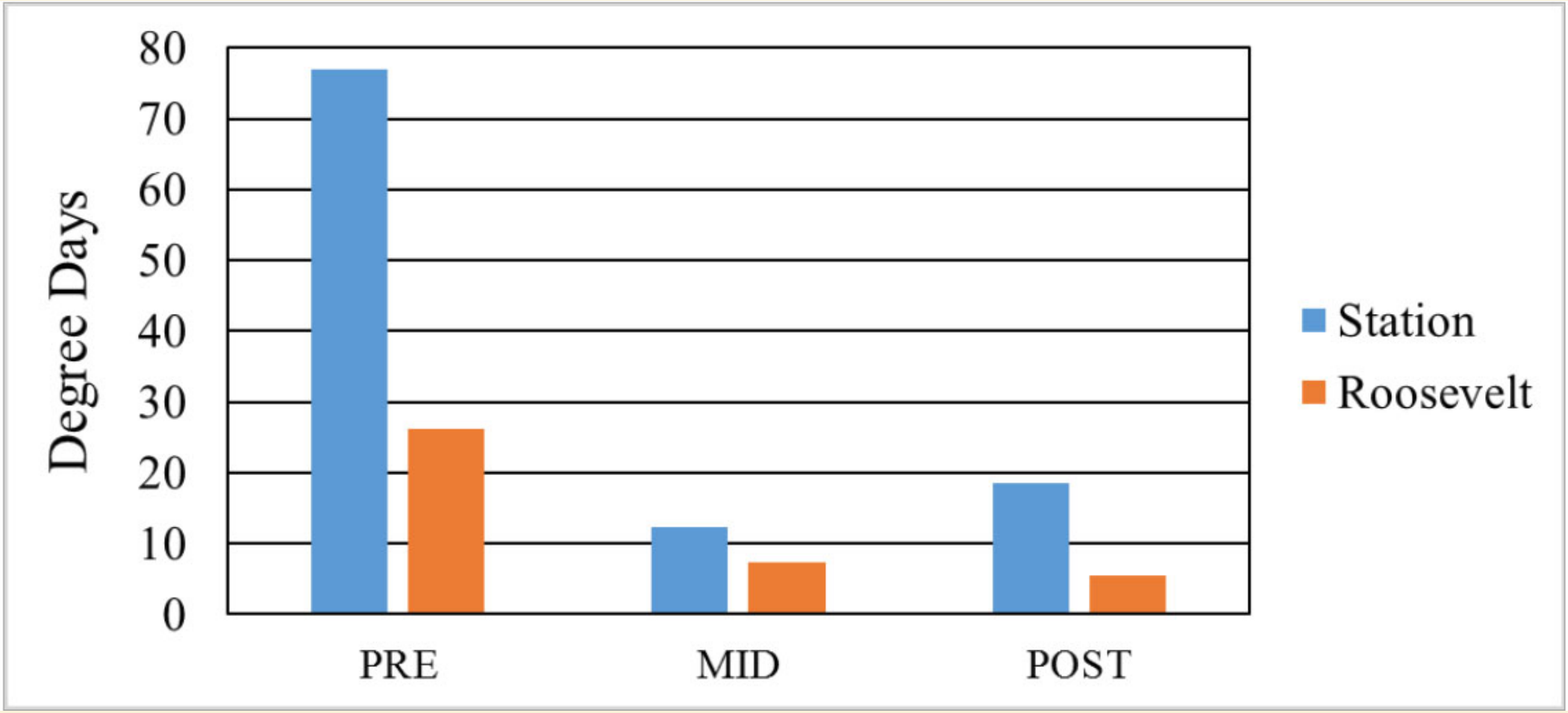
Impact of Impervious Cover





Empirically derived trendlines of direct runoff vs. rainfall depths for berry brook at station drive (downstream end) between project periods. Berry Brook project, Dover, NH.



SUMMER PERIOD CUMULATIVE DEGREE DAYS OVER 65 F THRESHOLD THROUGHOUT THE PROJECT PERIOD.

Results

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Not one single installation was installed as originally planned

The entire project required flexibility in relation to all BMPs installed

Overall goals of the project (disconnection of EIC) was considered paramount objective over actual implementation sites.

NE Retrofit Manual

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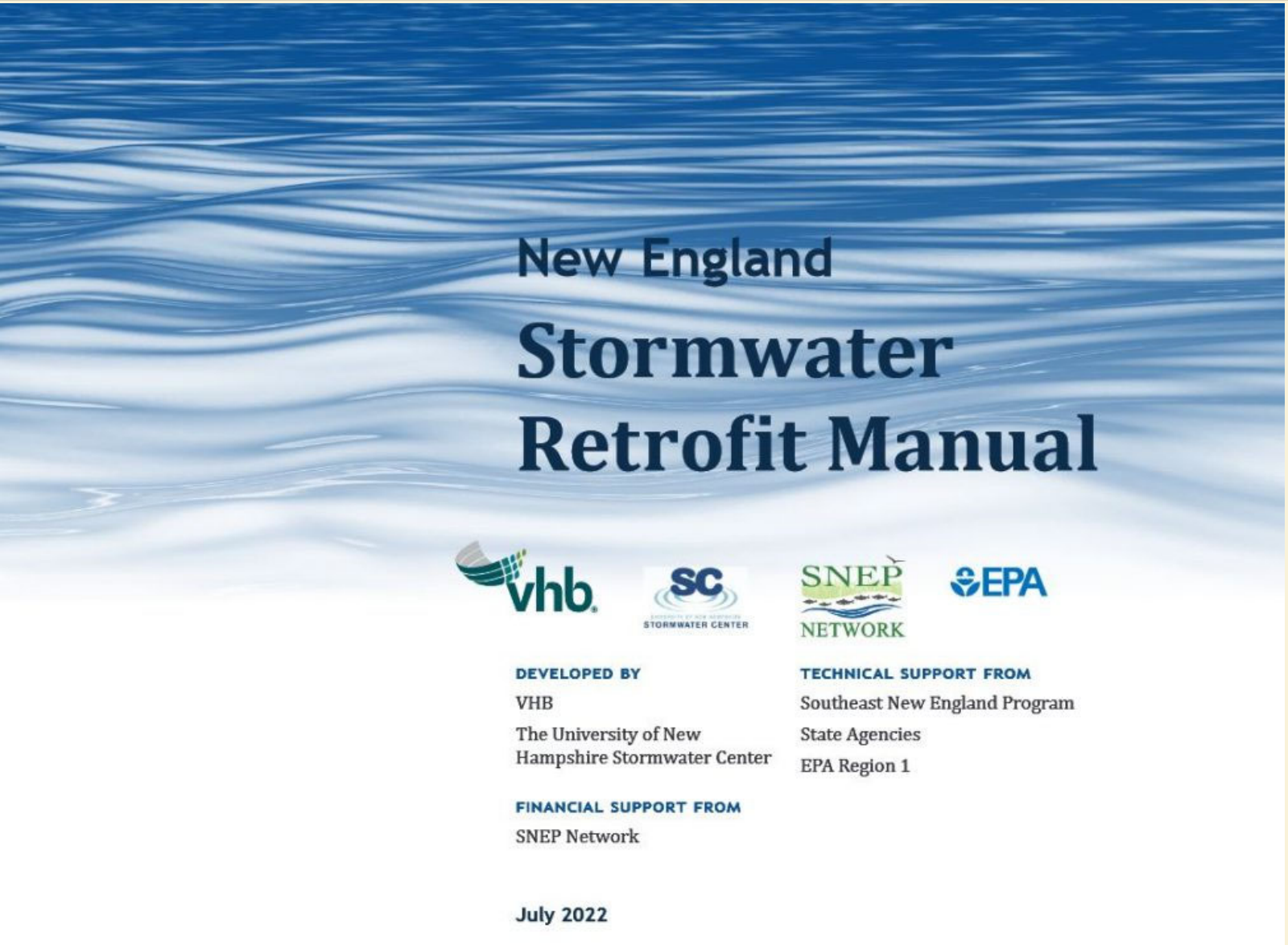

https://snepnetwork.org/stormwater-retrofit-manual/

Cart Before the Horse?

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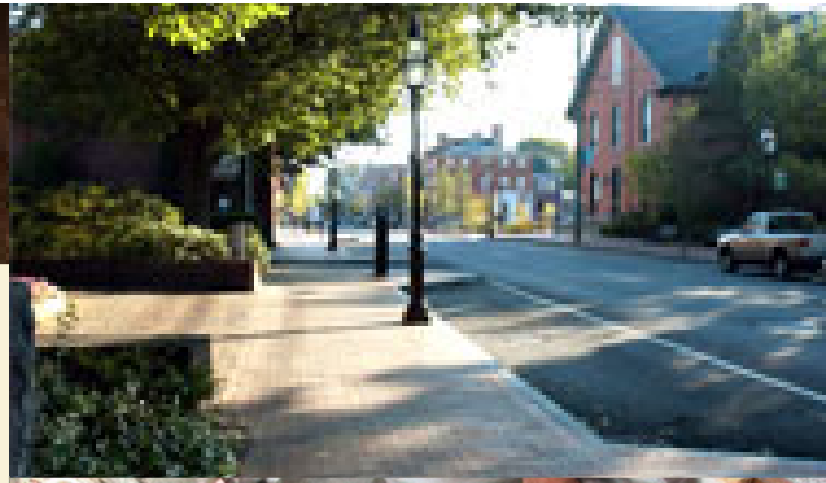
Maintenance

Outstanding Civil Engineering Achievement Award, 2010



American Society of Civil Engineers, NH Section

Transformation of State Street, Portsmouth, NH. Complete reconstruction of utilities, including wastewater/stormwater separation and stormwater treatment, with construction of pedestrian- and business-friendly streetscape.

What is the impact seven years later?

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Drainage Area	Area (sf)	Area (ac)	IC (ac)	%IC
State Street	682,531	15.7	13.4	85%
Daniel Street	106,374	2.4	1.8	74%

Maintenance Basics

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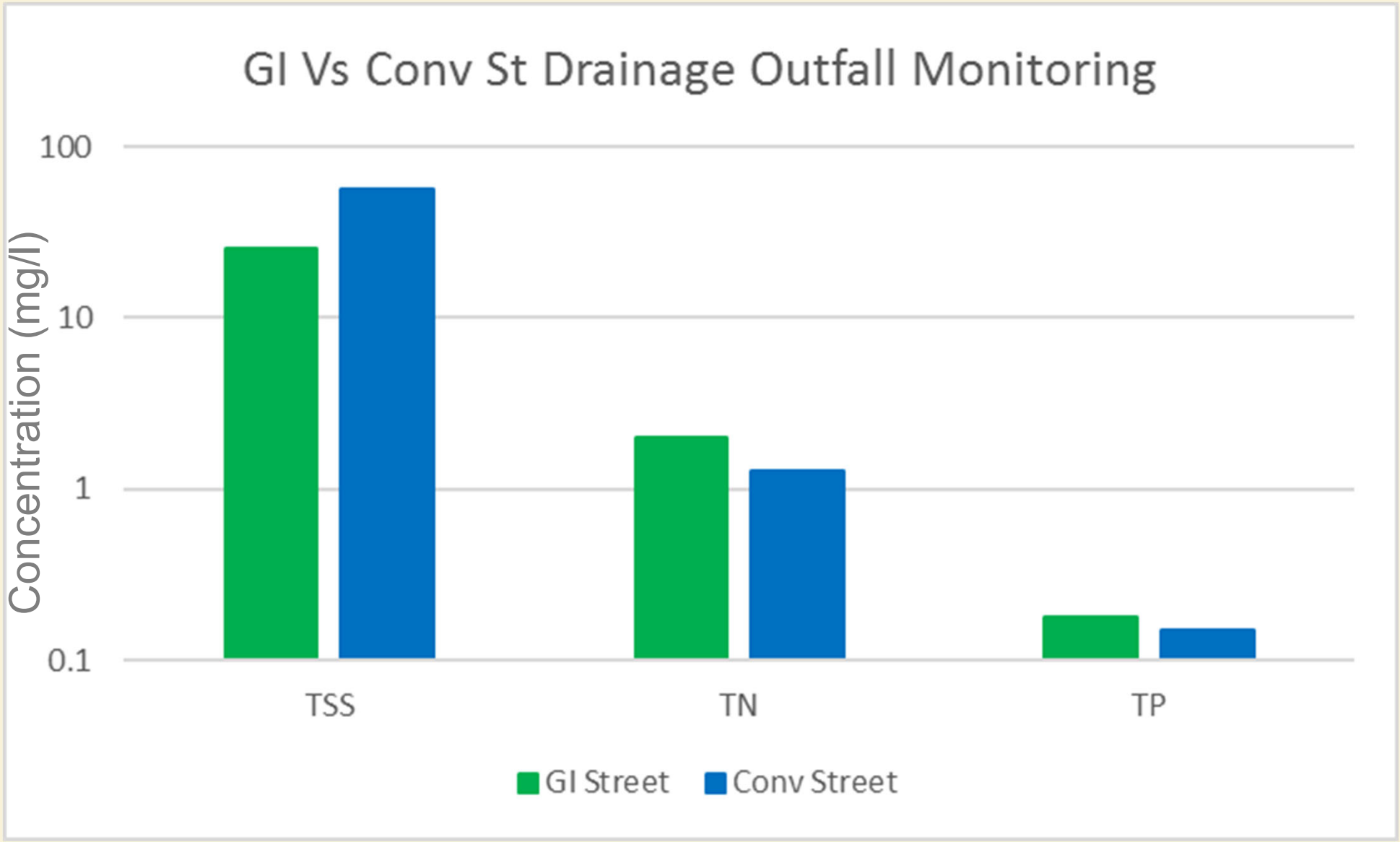

Are we at the Finish Line or the Starting Line?

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Brian

Questions?

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