Evolving Research for Stormwater Management

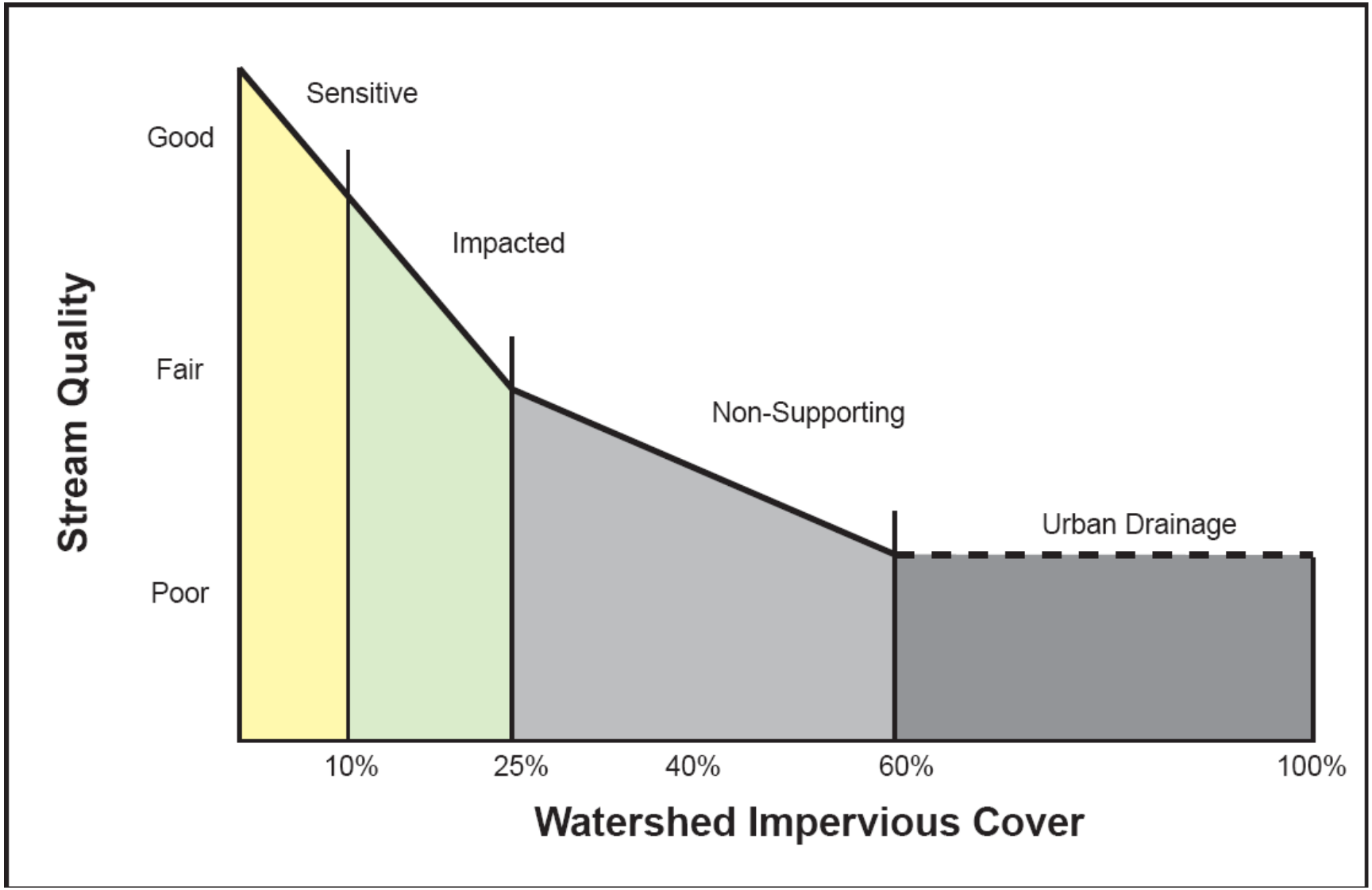
Sally Soule, NH DES
James Houle, UNH Stormwater Center

Providing Data to Protect Water Quality Since 2004

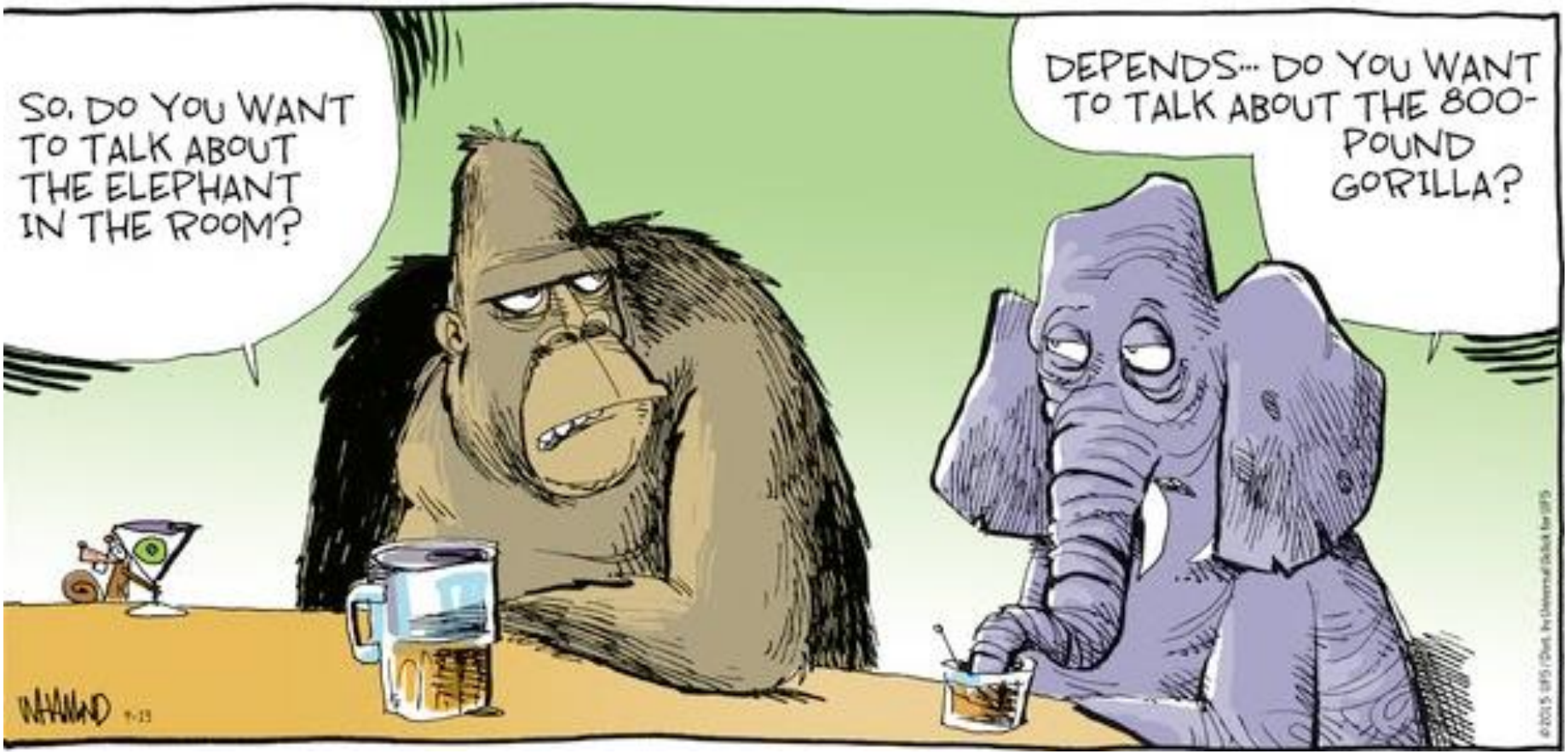
Contributors:

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

Impact of Impervious Cover



Yes, climate change gives us pause to think, but IC is the 800-pound gorilla



Hydrodynamic Separator

Isolator Row

Subsurface Infiltration

Filter Unit

Porous Asphalt

Pervious Concrete

Retention Pond

Stone Swale

Veg Swale

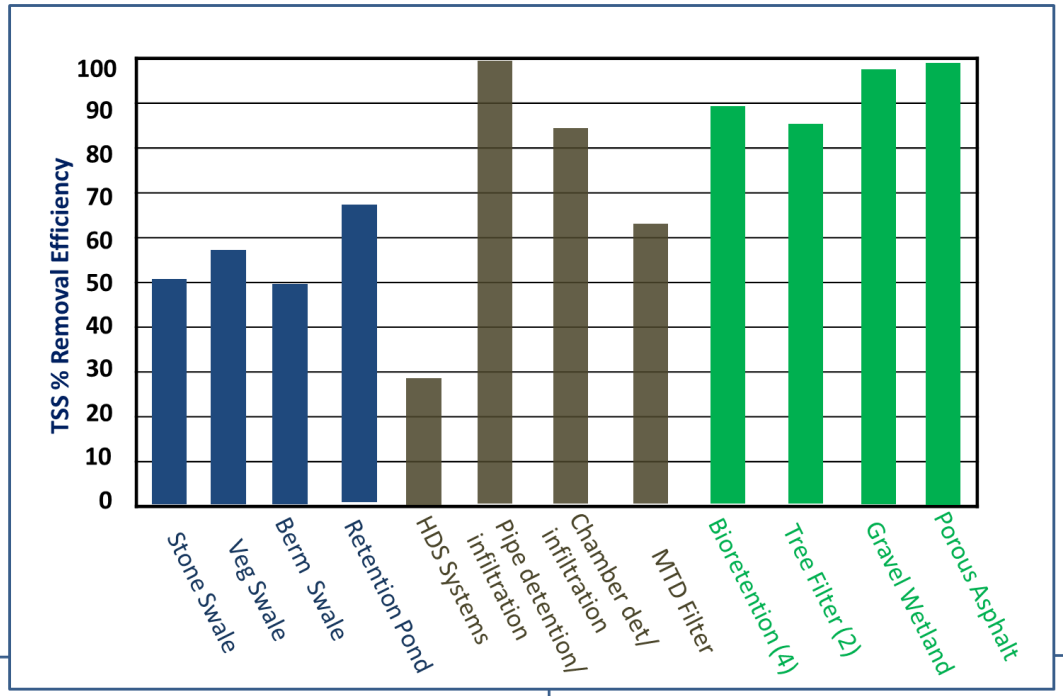
Gravel Wetland

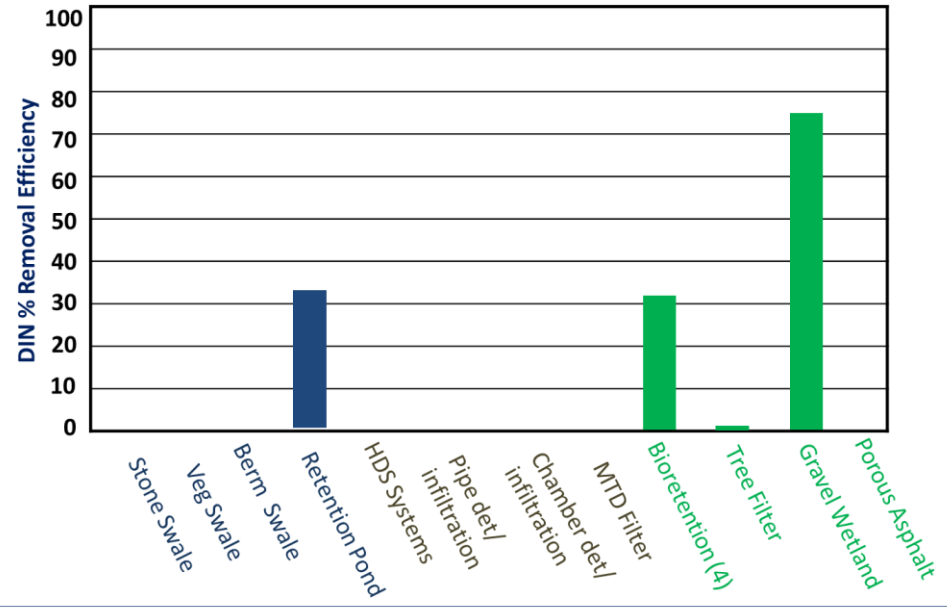
Sand Filter

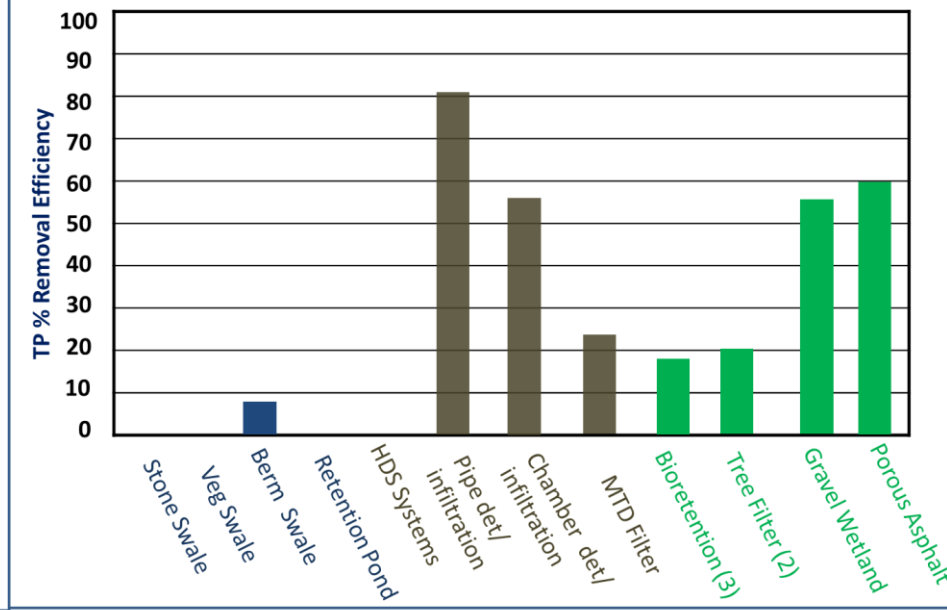
Bioretention Unit

Tree Filter

Common Pollutant RE's







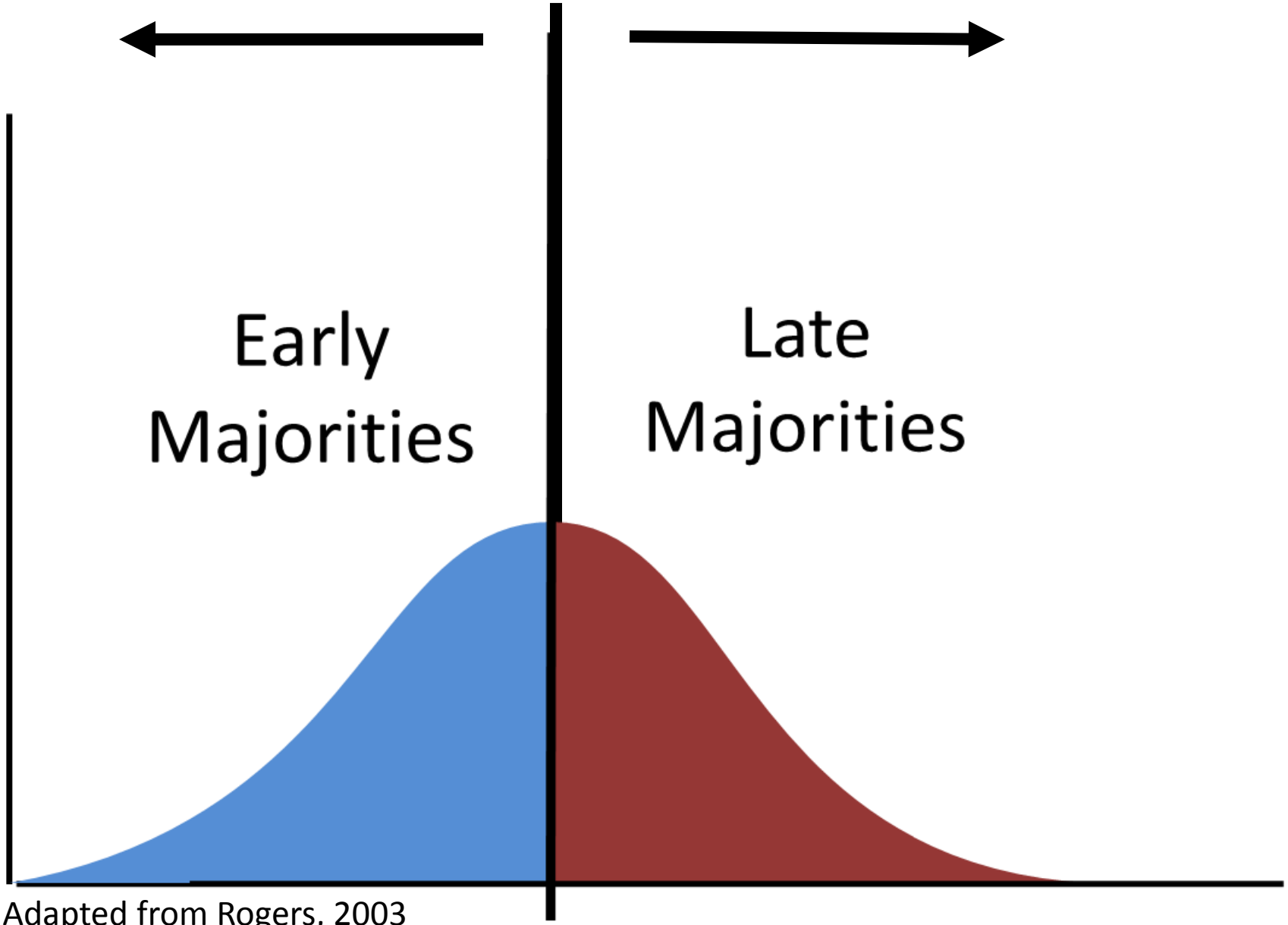
If we know what the problem is…
…and science informs potential…
…Then how are we doing on implementation?

In many cases implementation competence lags behind technical competence

How do innovations spread through populations?

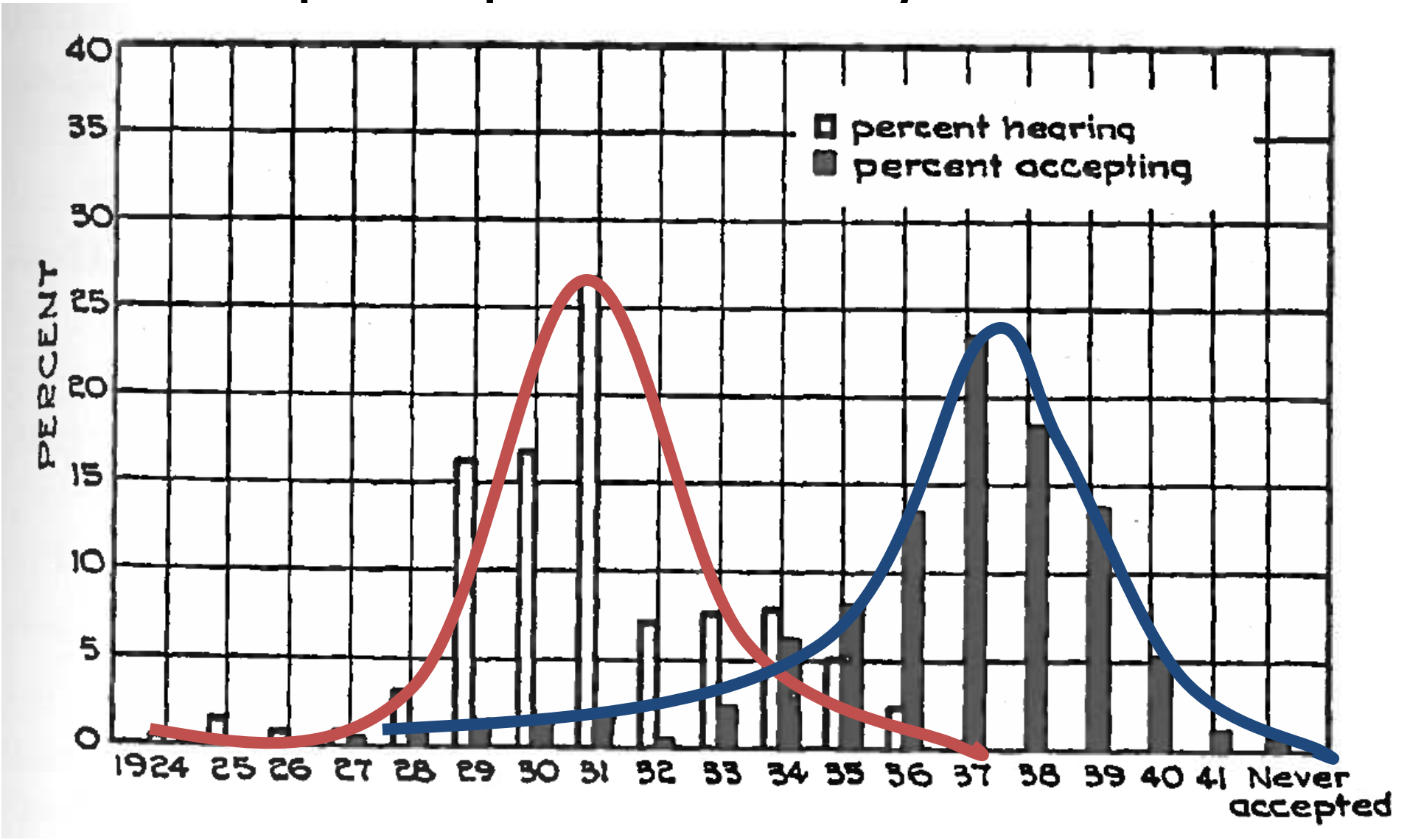
Diffusion of Innovation

- Diffusion of innovation is the process by which an **innovation** is communicated through certain channels over time among the members of a social system (Rogers, 2003)

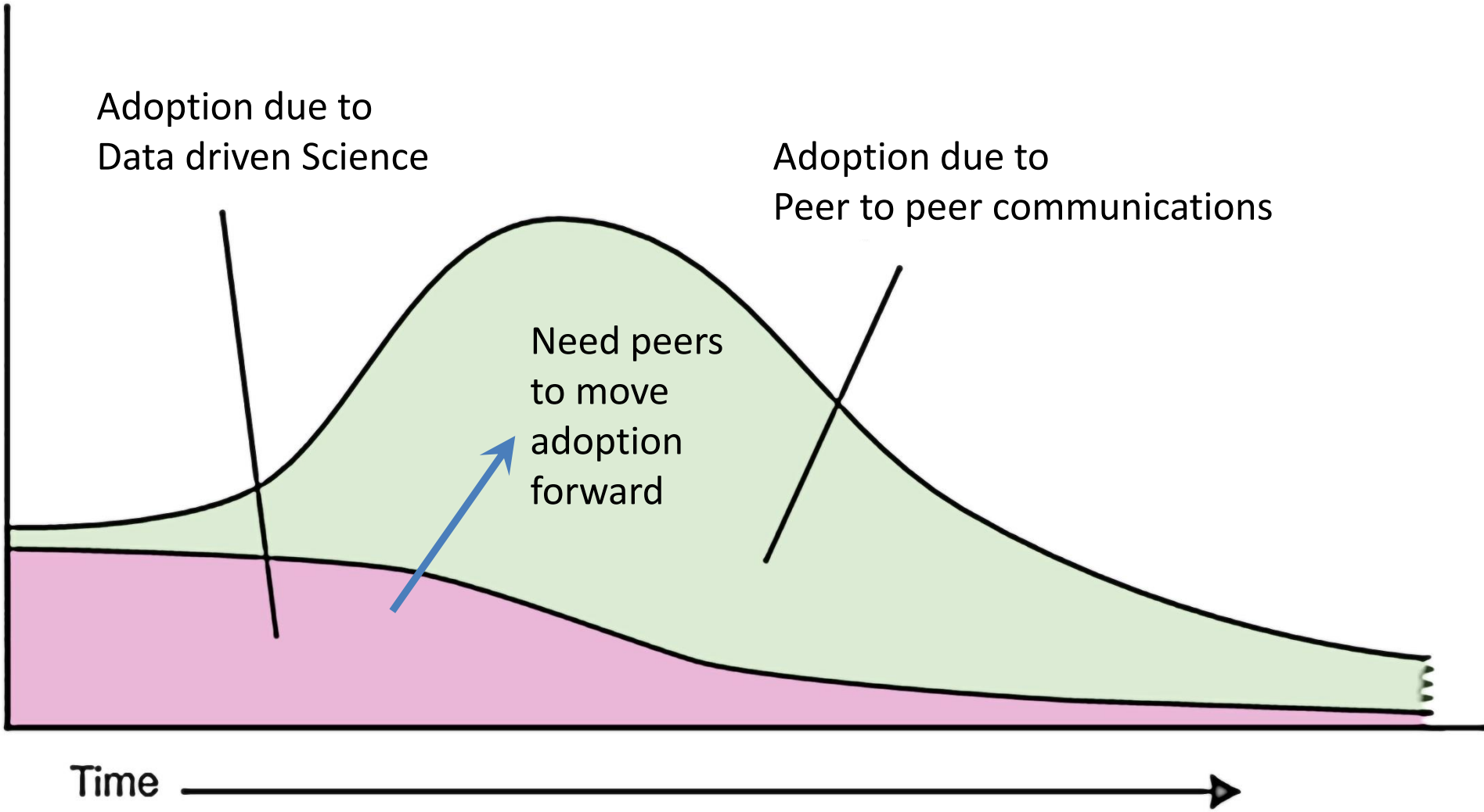


Adapted from Rogers, 2003

Results from Ryan and Gross on farmer adoption patterns of hybrid corn.



Source: Ryan & Gross (1943), "The Diffusion of Hybrid Seed Corn in Two Iowa Communities," *Rural Sociology 8* (March): 15.


Adoption due to
Data driven Science
Adoption due to
Peer to peer communications
Need peers
to move
adoption
forward
Time

The 3 things we fundamentally do wrong that ensures BAU – or – what we have learned through 15 years of implementation

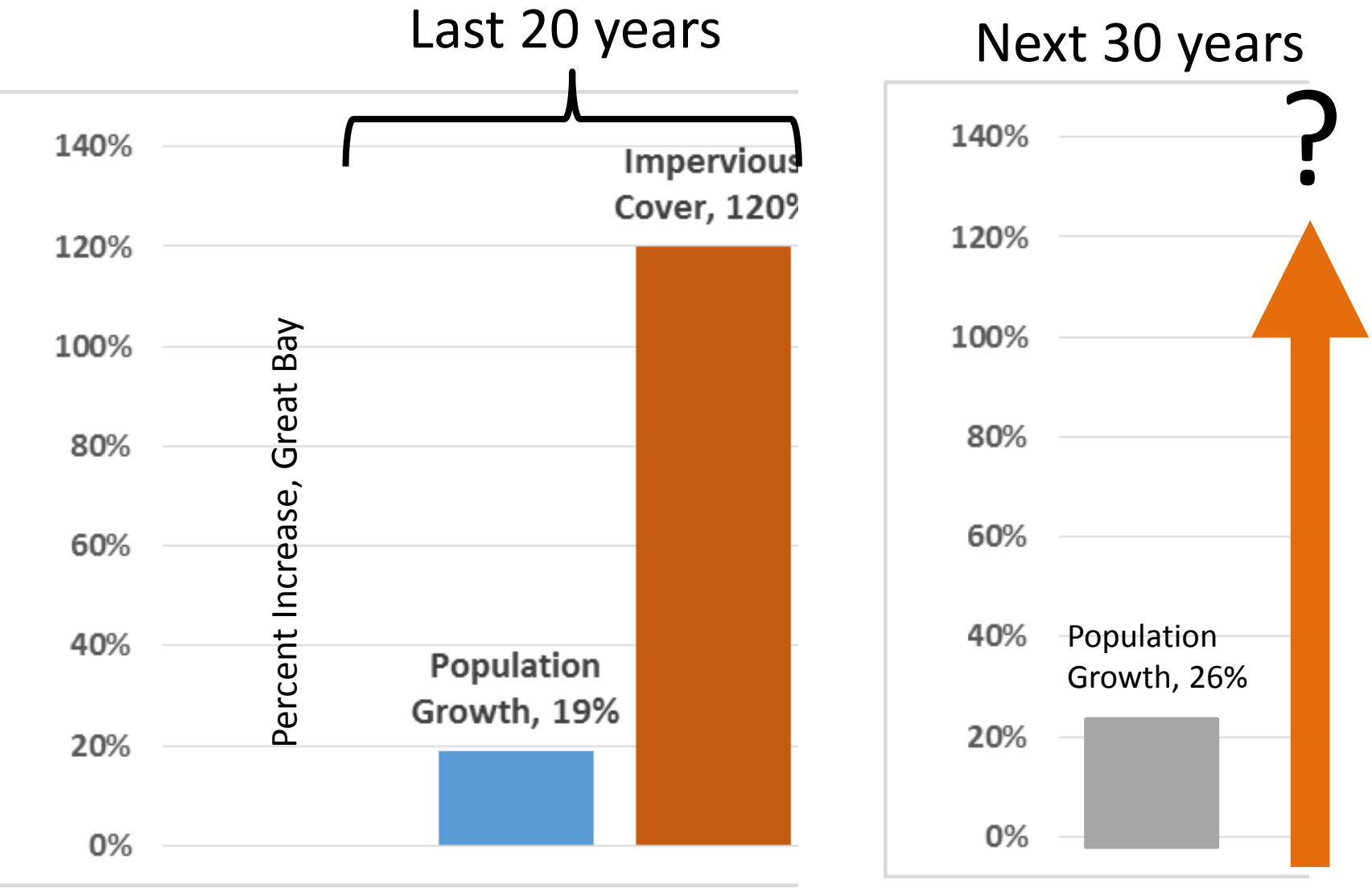
1.) We don’t sweat the small stuff

2.) We tend to target the finish line as opposed to the starting line.

3.) We hold on to relatively insignificant details that prevent transferring ownership.

The Small Stuff

Population Growth & Quality Problem



From 1990 to 2010 (Source: US Census; UNH earth systems research center; PREP; 2010-2040 Projections, UNHSC)

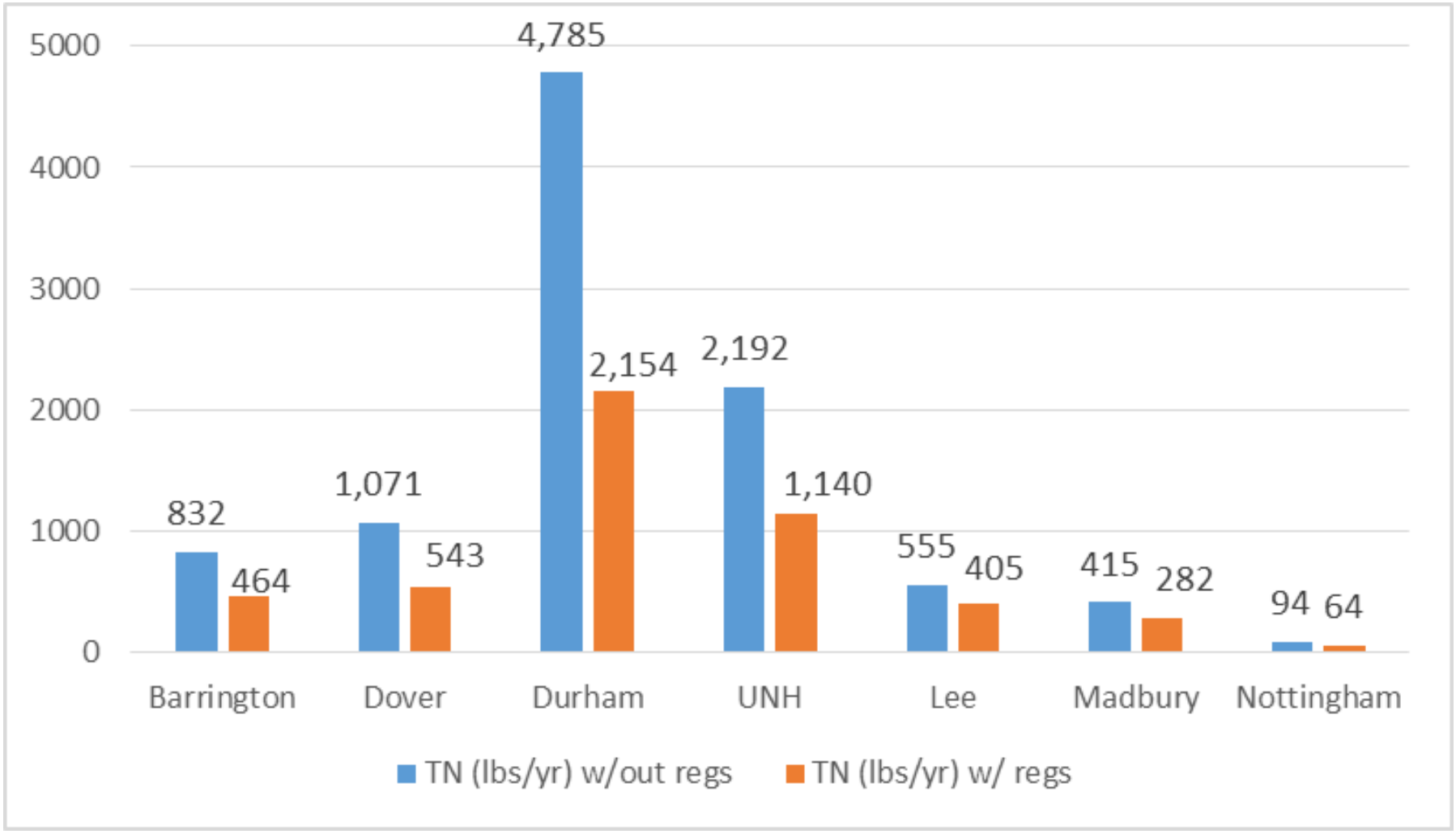
2017? Model Regulations

MODEL STORMWATER STANDARDS FOR COASTAL WATERSHED COMMUNITIES

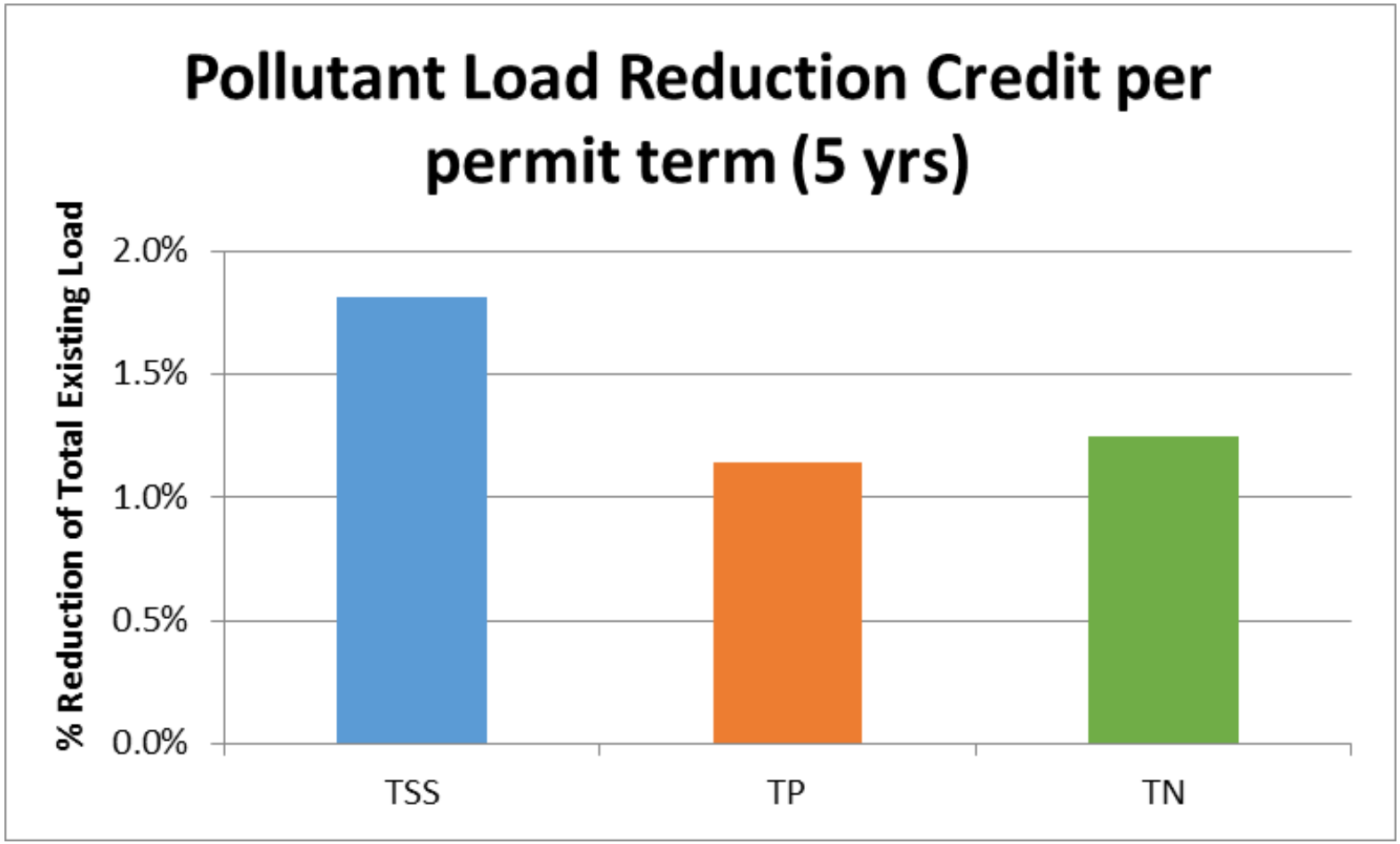
Prepared by the University of New Hampshire Stormwater Center and
The Rockingham Planning Commission
December 2012

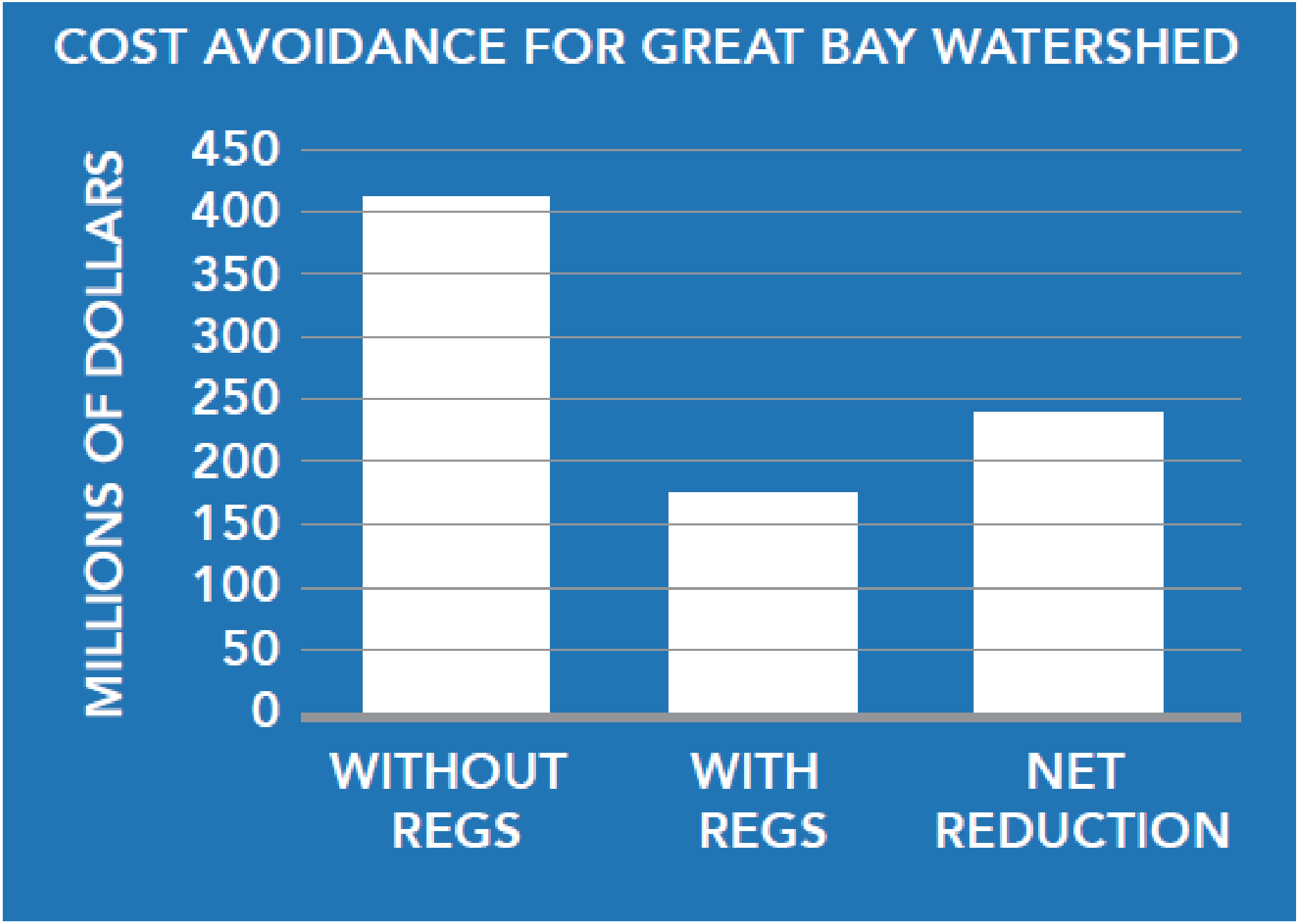
This project was funded under the Coastal Zone Management Act by NOAA's Office of Ocean and Coastal Resource Management in conjunction with the New Hampshire Coastal Program.

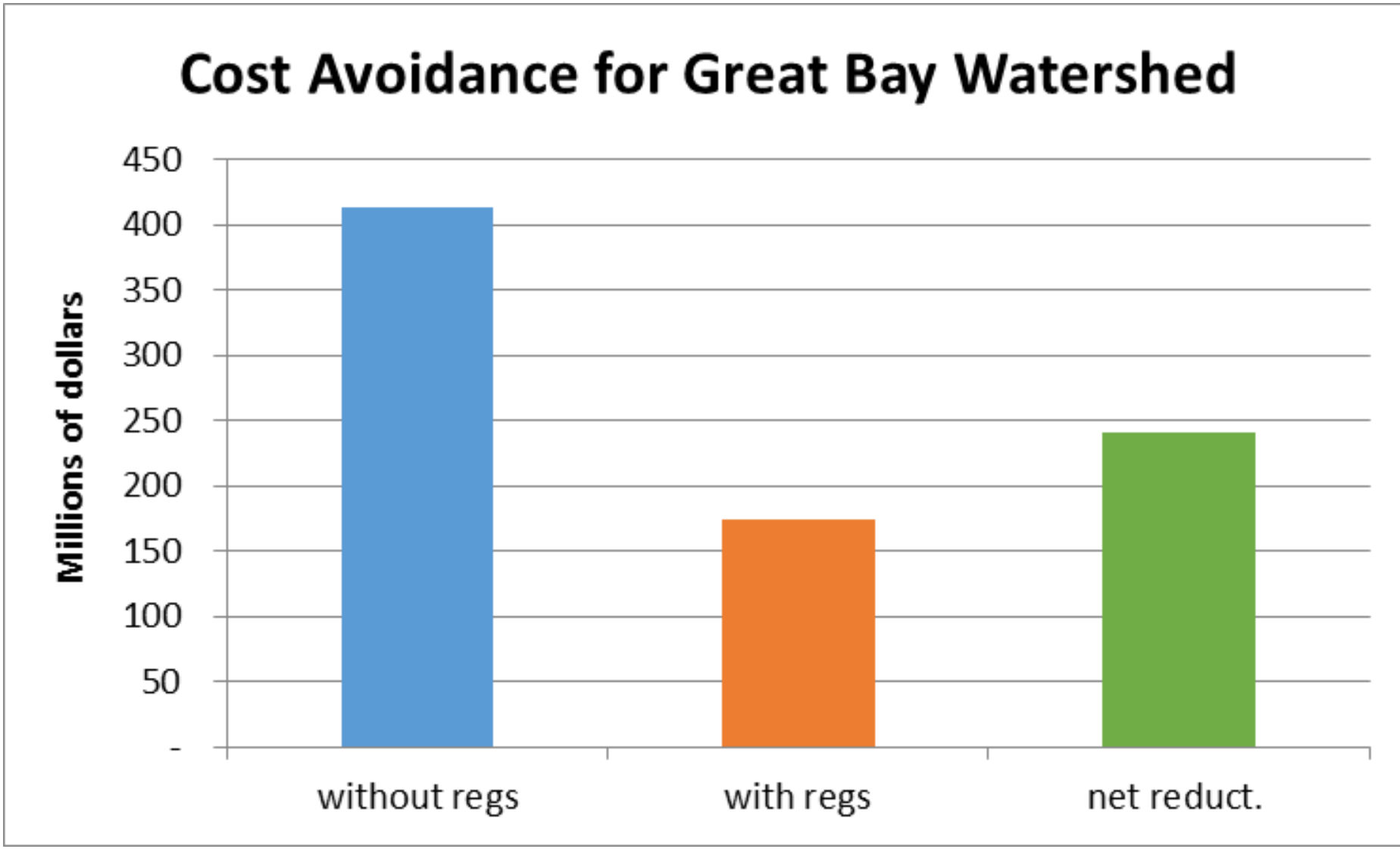
Estimated Effect on Future TN Load (lbs/yr) In Each Town Due to Stormwater Regulations



Potential Reduction Credits




COST AVOIDANCE FOR GREAT BAY WATERSHED
MILLIONS OF DOLLARS
450
400
350
300
250
200
150
100
50
0
WITHOUT REGS
WITH REGS
NET REDUCTION

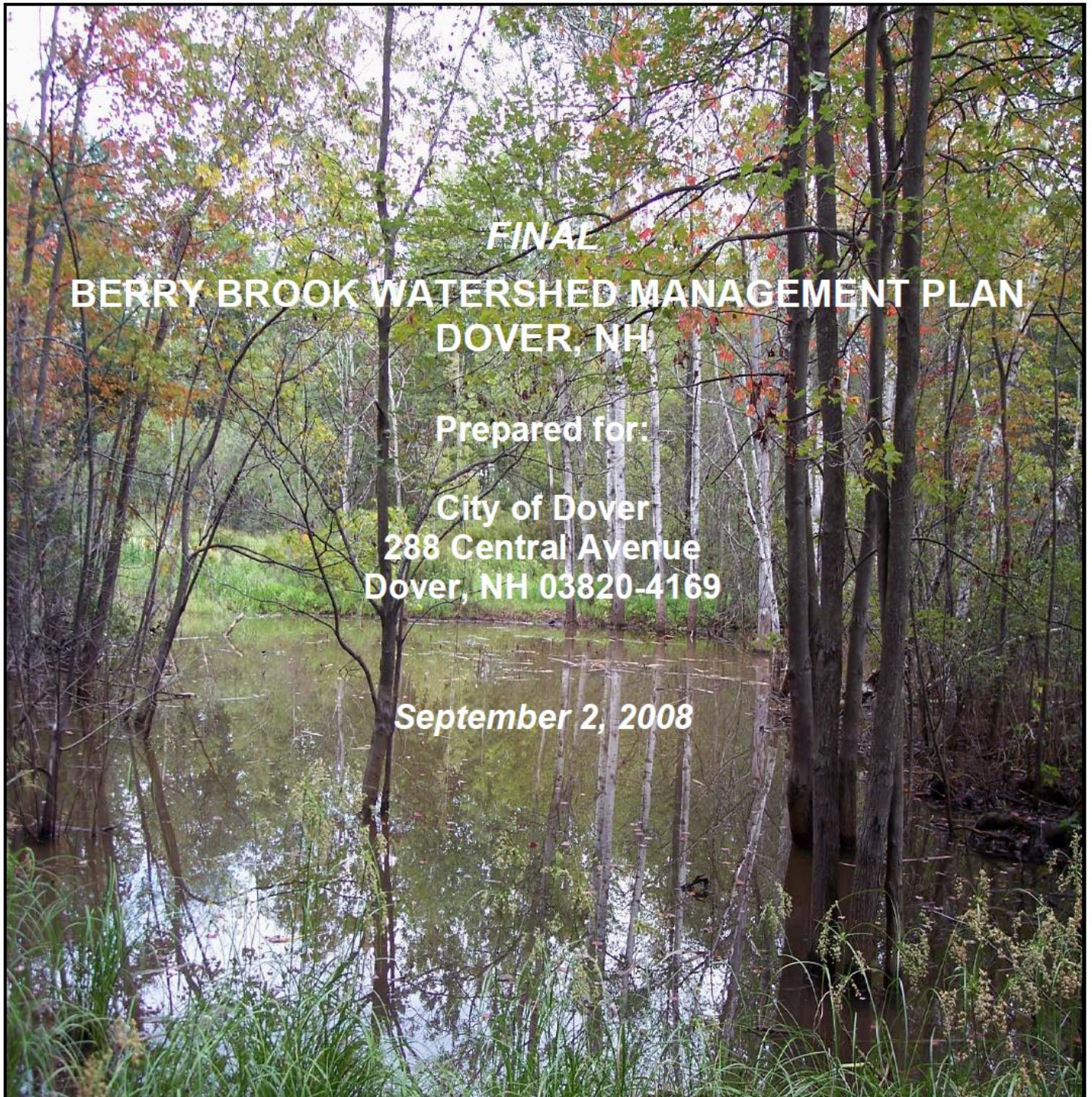


Assumes Oyster River Watershed Ratios are consistent throughout the GB

Are we at the Finish Line or the Starting Line?

Typical Project Approach

- Develop a watershed management plan (a-i)
- Optimize placement of BMPs for maximum gain
- Implement
- Model
- Outreach and education on project results
- Report



FINAL

BERRY BROOK WATERSHED MANAGEMENT PLAN
DOVER, NH

Prepared for:

City of Dover
288 Central Avenue
Dover, NH 03820-4169

September 2, 2008

Optimize Again…

- Need the first one…

2011 Watershed Restoration Grants for Impaired Waters

Section B: PRE-PROPOSAL APPLICATION FORM
Watershed Restoration Grants for Impaired Waters

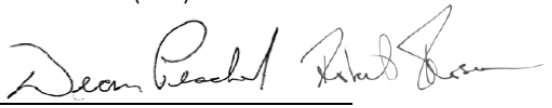
I. Proposal Title

Berry Brook Watershed Restoration through Low Impact Development Retrofits in an Urban Environment

II. Contact Information

Primary contact person:	Dean Peschel
Organization:	Environmental Project Manager, City of Dover DPW
Street address:	288 Central Avenue
City, State, ZIP:	Dover, NH, 03820-4169
Day phone: (603) 516-6094	Fax: ( ) Email: dean.peschel@ci.dover.nh.us

Secondary contact person:	Robert M. Roseen, Ph.D., D.WRE, P.E.
Organization:	Director, The UNH Stormwater Center
Street address:	35 Colovos Road
City, State, ZIP:	Durham, NH, 03824
Day phone: (603)862-4024	Fax: (603)862-3957 Email: robert.roseen@unh.edu

Signature of Applicant: 

Date of signature: 9/2/10

III. Project Summary

Berry Brook is a highly urbanized 1st order stream located in Dover, NH, that is classified as Class B waters. . The Brook is located in a built-out, 164-acre watershed with 25% impervious cover (IC) and includes medium-density housing with commercial and industrial uses. The stream has been placed on the NHDES 2006 Section 303(d) list and is impaired for primary recreation and for aquatic life. The source of this impairment includes urbanization resulting in an increase of pollutant mass and runoff volumes from stormwater.

And then you implement –
Inside a historic 40,000 sf slow sand filter

… and optimize Again…

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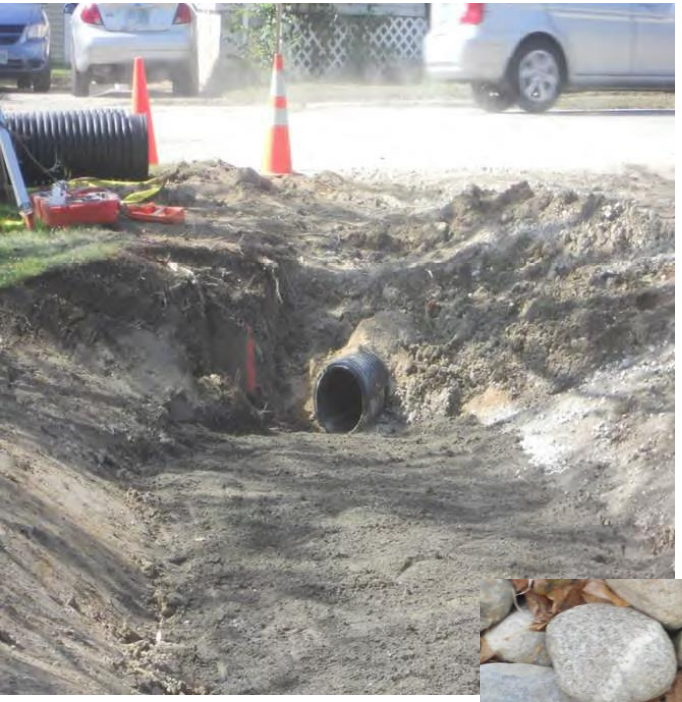
And more implementation…



… and optimize Again…

2013 Watershed Assistance Grants
PROPOSAL FORM

NEW HAMPSHIRE DEPARTMENT OF Environmental Services
CELEBRATING 25 YEARS 1987 2012

SUBMISSION DEADLINE
4:00pm
November 21, 2012

1. PROJECT TITLE

Getting to 10%: Watershed Restoration through Low Impact Development Retrofits in an Urban Environment

Berry Brook/Cocheco River Watershed Management Plan Implementation Phase III.

2. PROJECT LOCATION

A. Town(s): **Dover, NH**
Does project involve other states? **Yes** ☐ **No** ☒

B. What water body does it affect? **Berry Brook/Cocheco River/Great Bay**
12-digit hydrologic unit code (HUC): 010600030608

C. Attach a project location map showing the watershed and relevant project site locations (required).

HUC look-up: http://www2.des.nh.gov/SWQA/ or contact your DES project leader for assistance.

3. GRANT CATEGORY

Please check applicable water quality category:

a. High Quality Waters ☐

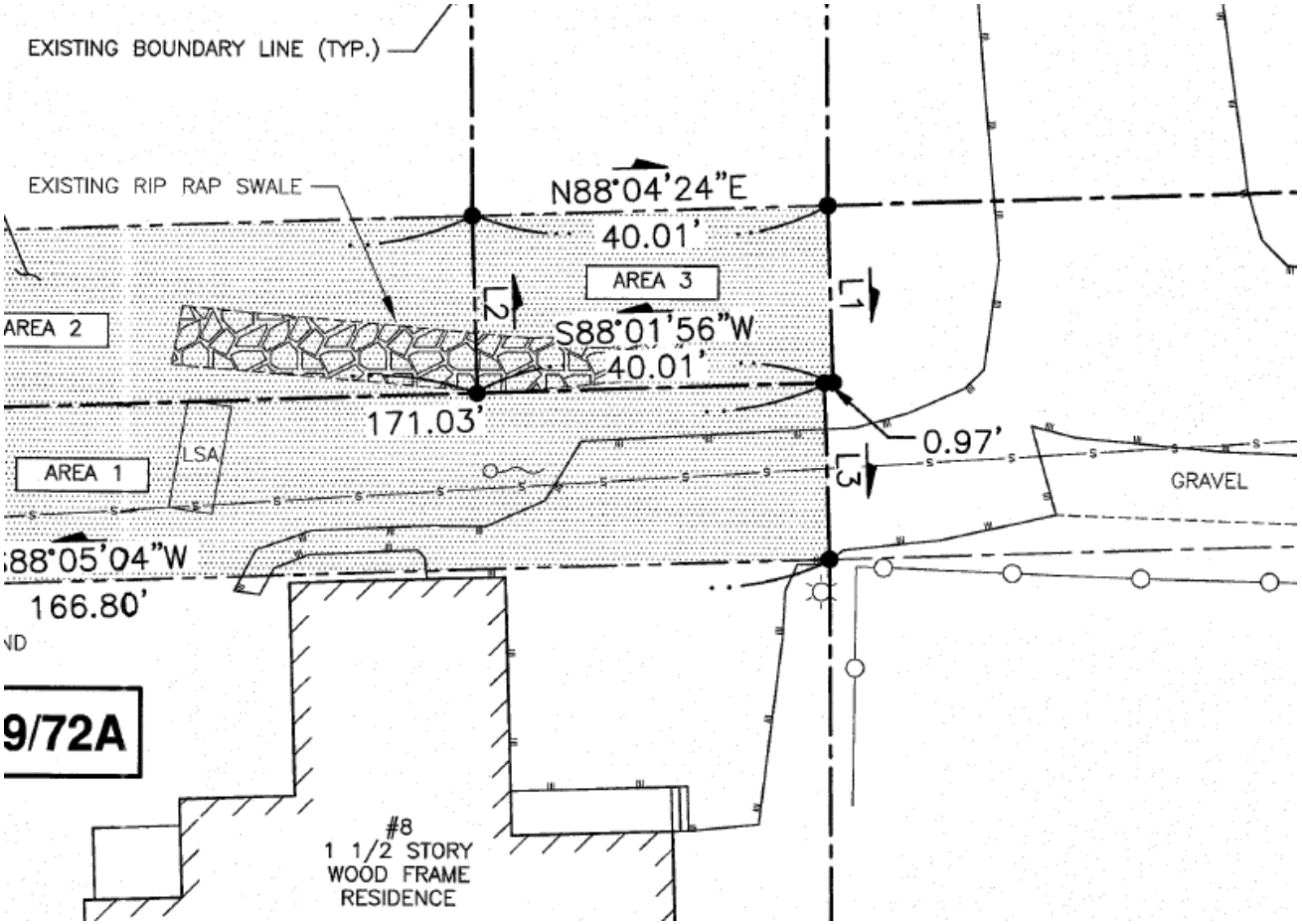
b. Impaired Waters ☒

Please list the designated uses that are impaired and the specific causes of impairments as identified on the *2010 305(b)/ 303(d) Surface Water Quality Assessment*. If the waterbody is not listed as impaired in the 2010 Surface Water Quality Assessment, then describe and attach documentation of the impairment.

***2010 Surface Water Quality Assessment*:** http://des.nh.gov/organization/divisions/water/wmb/swqa/2010/index.htm

Primary Contact Recreation (as a result of high bacteria concentrations) and for Aquatic Life Use due to an NHDES assessment of benthic macroinvertebrate monitoring.

And more implementation…



Results

- Not one single installation was installed as planned
- The entire project required flexibility in relation to all BMPs installed
- Overall goals of the project (disconnection of EIC) was considered paramount over actual implementation sites.

New Project Approach

- Desktop designs invariably change when in-depth site specific investigations begin.
- Better to quickly and coarsely develop a handful of candidate sites
- Conduct inexpensive site queries of local areas of concern to further develop a practical mitigation approach.
- Implement where and however much feasible
- municipal implementation efforts adapt or innovate “text book” research-based designs with what is practical for a public works department working in an urban setting leading to lower costs and more effective systems.

What's the Significance? – or – GI is as GI does…

Complete Community Approach

1. NPDES Phase II Regulated Community? Assumes that externally regulated communities are motivated by compliance.
2. LID Required? Low impact development requirements assume that the municipality is updating regulations in a timely and relevant manner.
3. Mimic Pre Development Hydrology Requirement? Increased measure of the extent of LID adoption. Assumes that the affirming municipality is attempting to manage water quantity and water quality.
4. Maximize On-Site Infiltration? Assumes that the affirming municipality is attempting to prioritize management of increased stormwater runoff volumes in addition to measures to address peak flow and water quality.
5. Surety Required From Developer? This largely assumes that the municipality has procedural requirements of occupancy and defendable oversight procedures for drainage installations.
6. Redevelopment Requirements? This depicts communities that recognize advanced concepts of integrated approaches, including appreciable gains from updating innovative stormwater requirements for redevelopment scenarios.
7. Dedicated Dollars for Stormwater in the Capital Improvements Program (CIP)? This indicates that the local governance body understands, and is committed to, the social, environmental, and economic benefits of advanced stormwater management.

Building Green Infrastructure Through a Complete Community Approach

The following measures outline a comprehensive strategy towards achieving the complete community approach:

- **Adopt ordinances and regulations for new development** that mandate the use of stormwater filtration to clean runoff, and infiltration practices to reduce runoff.
- **Require improved stormwater controls for reducing runoff** for redevelopment projects or other significant construction, and for site improvements such as repaving or building renovations.
- **Apply conservation strategies** such as protecting naturally vegetated areas near water bodies and wetlands, and limiting the size or percentage of allowable impervious cover in high value natural resource areas.
- **Reduce existing impervious cover** through targeted site improvements and stormwater management changes in high impact locations (i.e. locations that contribute high amounts of polluted runoff).


BIORETENTION SYSTEM


POROUS PAVEMENT

- **Make a long-term commitment to fund and maintain stormwater controls** along with an accounting mechanism to track long-term benefits of strategies. Consider innovative funding mechanisms such as impacts fees, exaction fees and stormwater utilities.

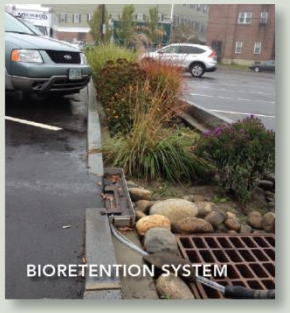

RAIN GARDEN SIGNAGE

- **Provide opportunities for outreach** by sharing plans and progress with citizens and business owners through community newsletters, cable access, and on-site signs that explain what steps are being taken to protect waterways or improve stormwater management.

FILTRATION SYSTEMS


TREE FILTERS

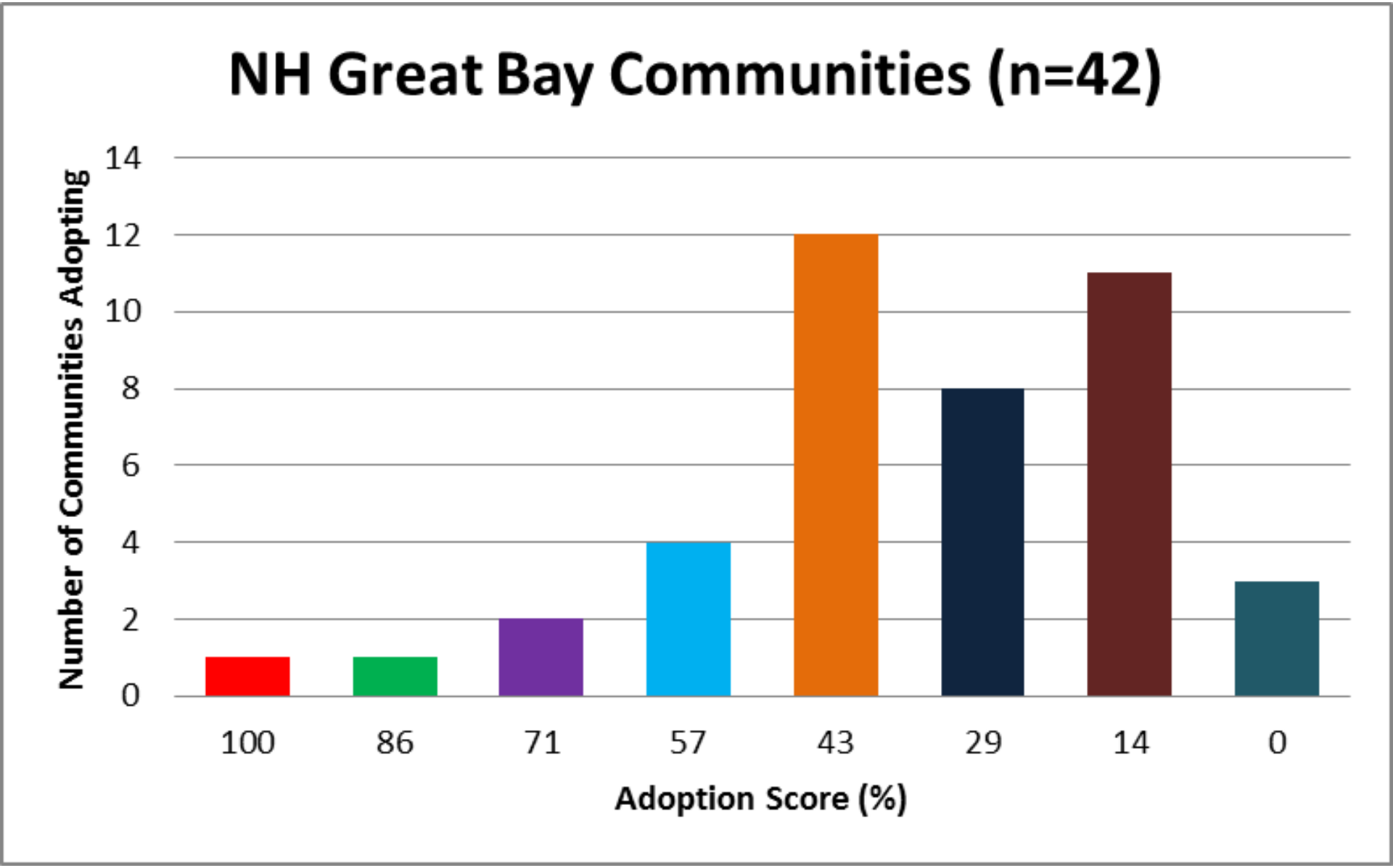

BIORETENTION SYSTEM


BIORETENTION SYSTEM

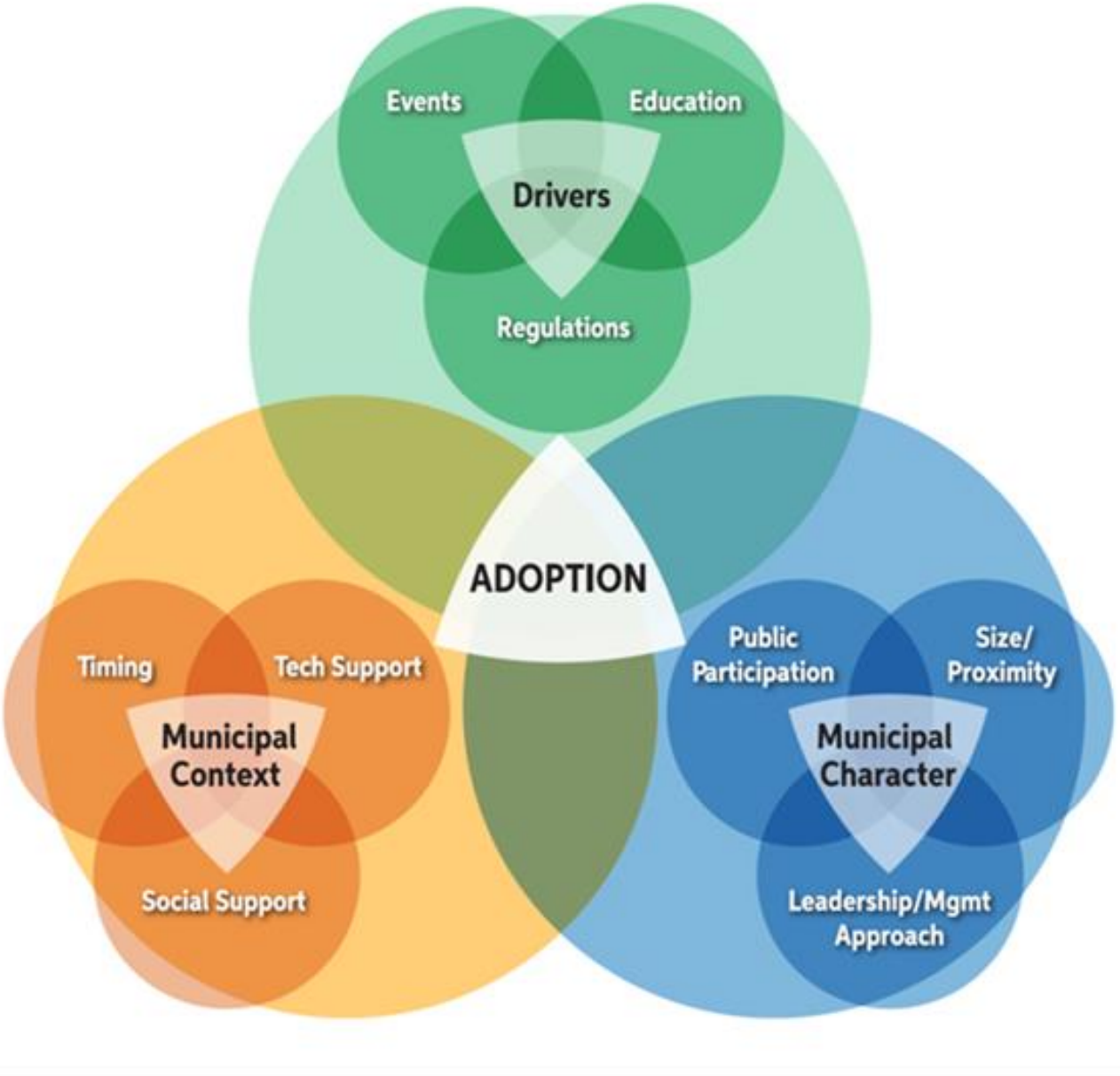
This project is funded by the **NERRs Science Collaborative** to a project team led by the **University of New Hampshire Stormwater Center** and the **Great Bay National Estuarine Research Reserve.**

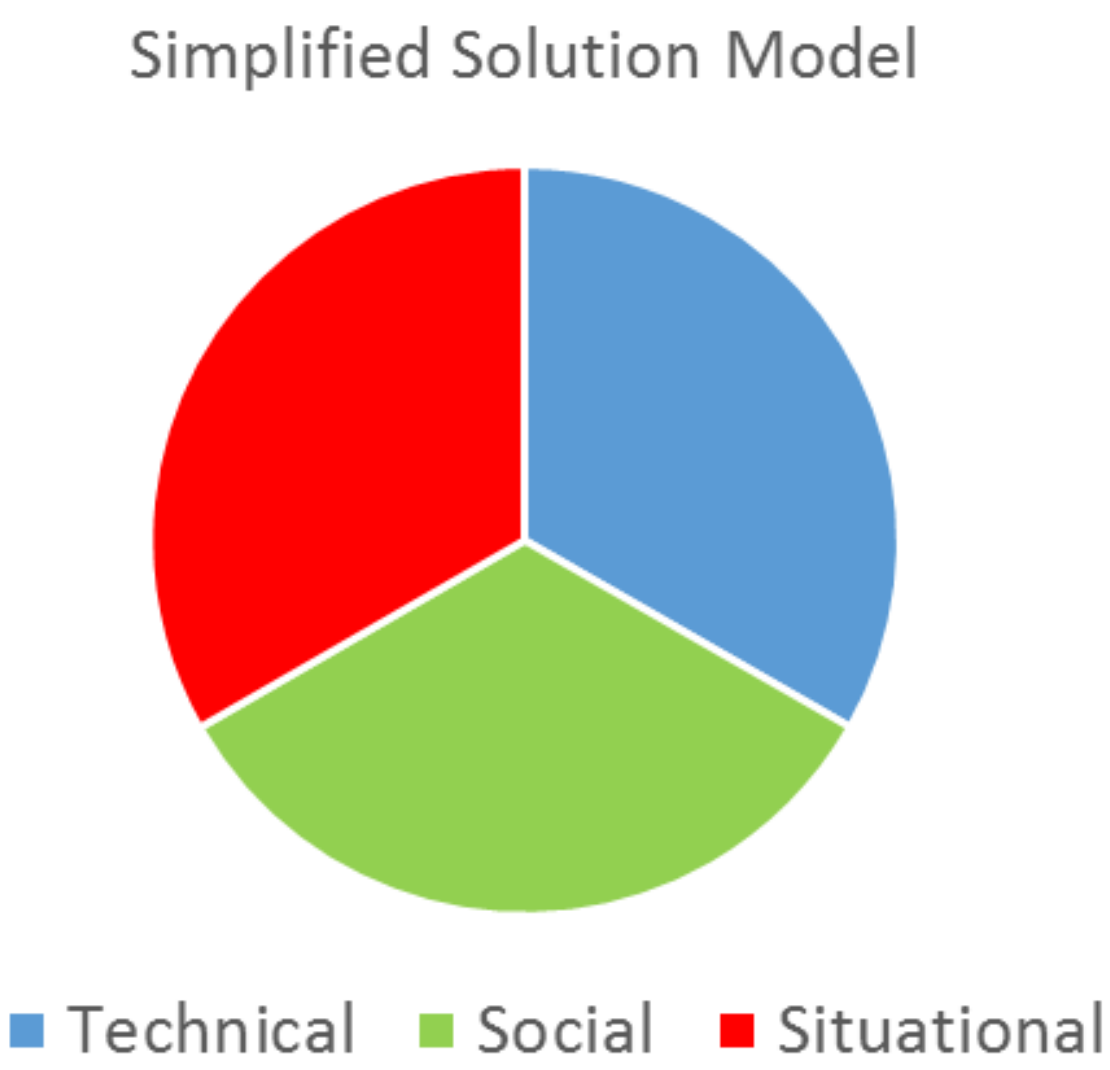
It supports Green Infrastructure implementation with local municipal, non-profit and private sector partners.

For more information please visit **southeastwatershedalliance.org/green-infrastructure**


NH Great Bay Communities (n=42)
Number of Communities Adopting
14
12
10
8
6
4
2
0
100
86
71
57
43
29
14
0
Adoption Score (%)

Conceptual Model Factors Influencing Adoption




Simplified Solution Model
Technical
Social
Situational

Technical: Elements pertaining to efforts that require technical expertise and understanding

Social: Elements pertaining to efforts that relate to public involvement and civic support for a cultural approach or common social responsibility.

Tale of two raingardens

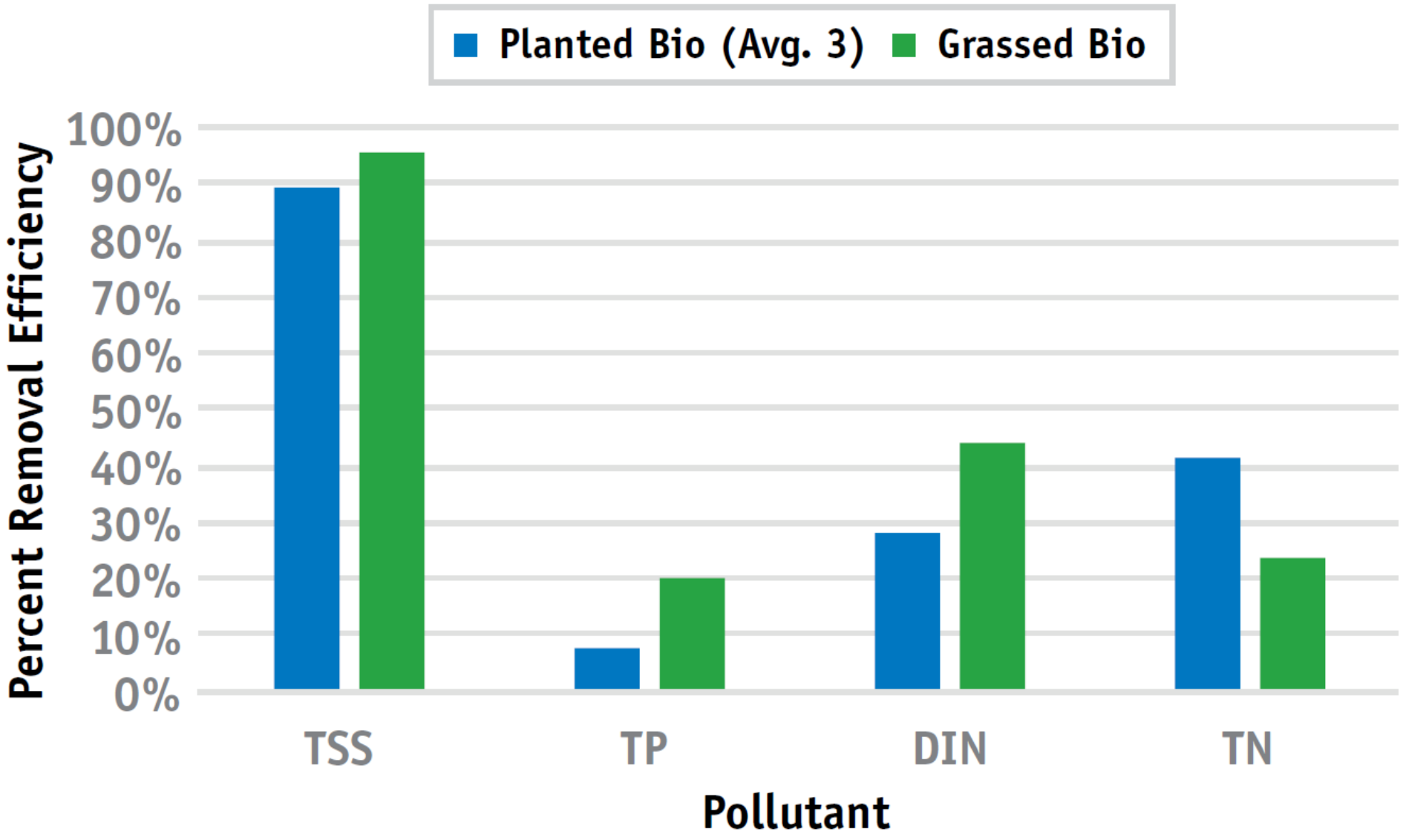
Tale of two raingardens

NDP!

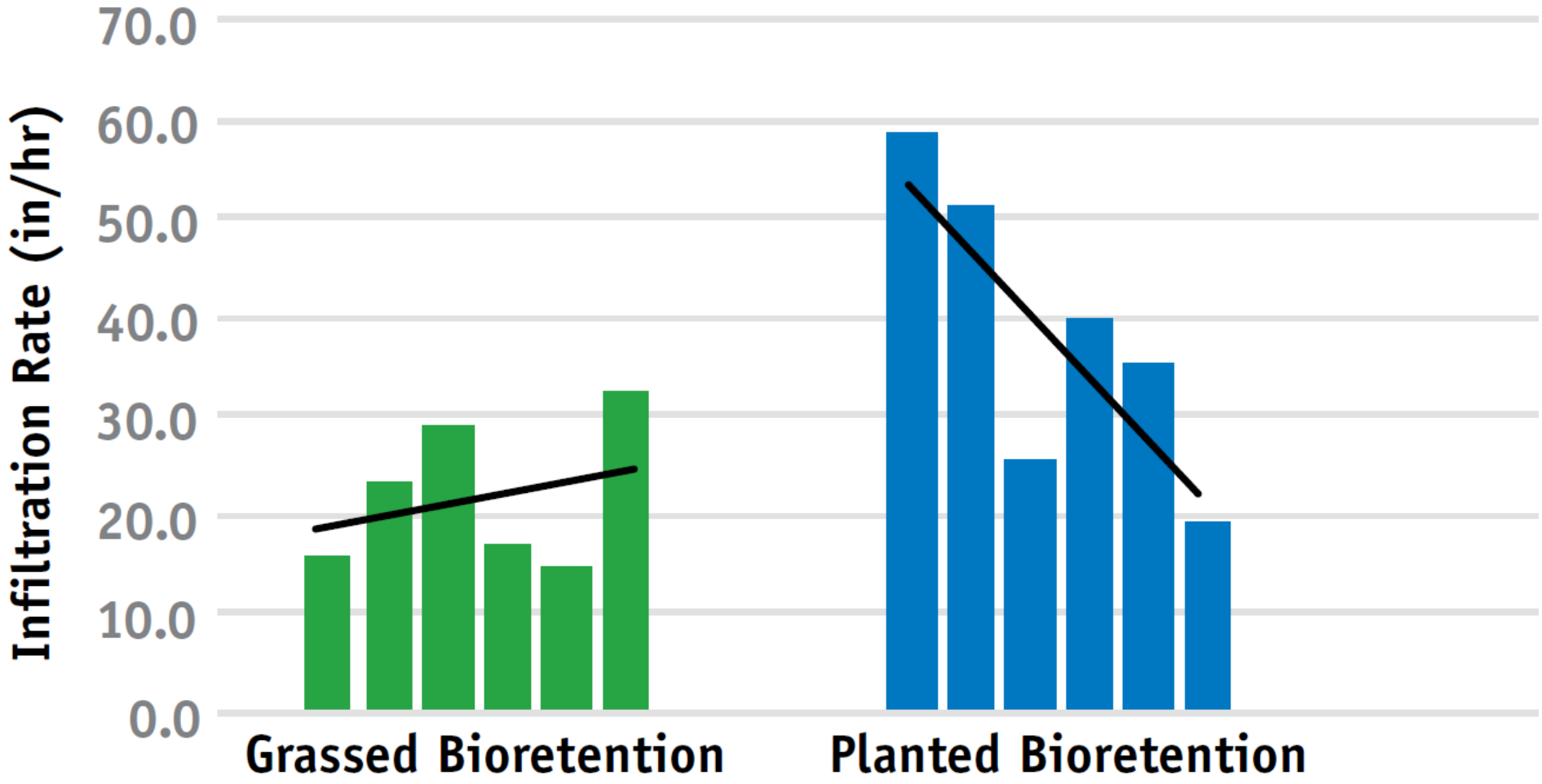
Maintenance Must be Included in the Design Process

- Not by the designers, but by the people who are expected to do it and pay for it

Comparison of Pollutant Removal Efficiency
Planted vs Grassed Bioretention



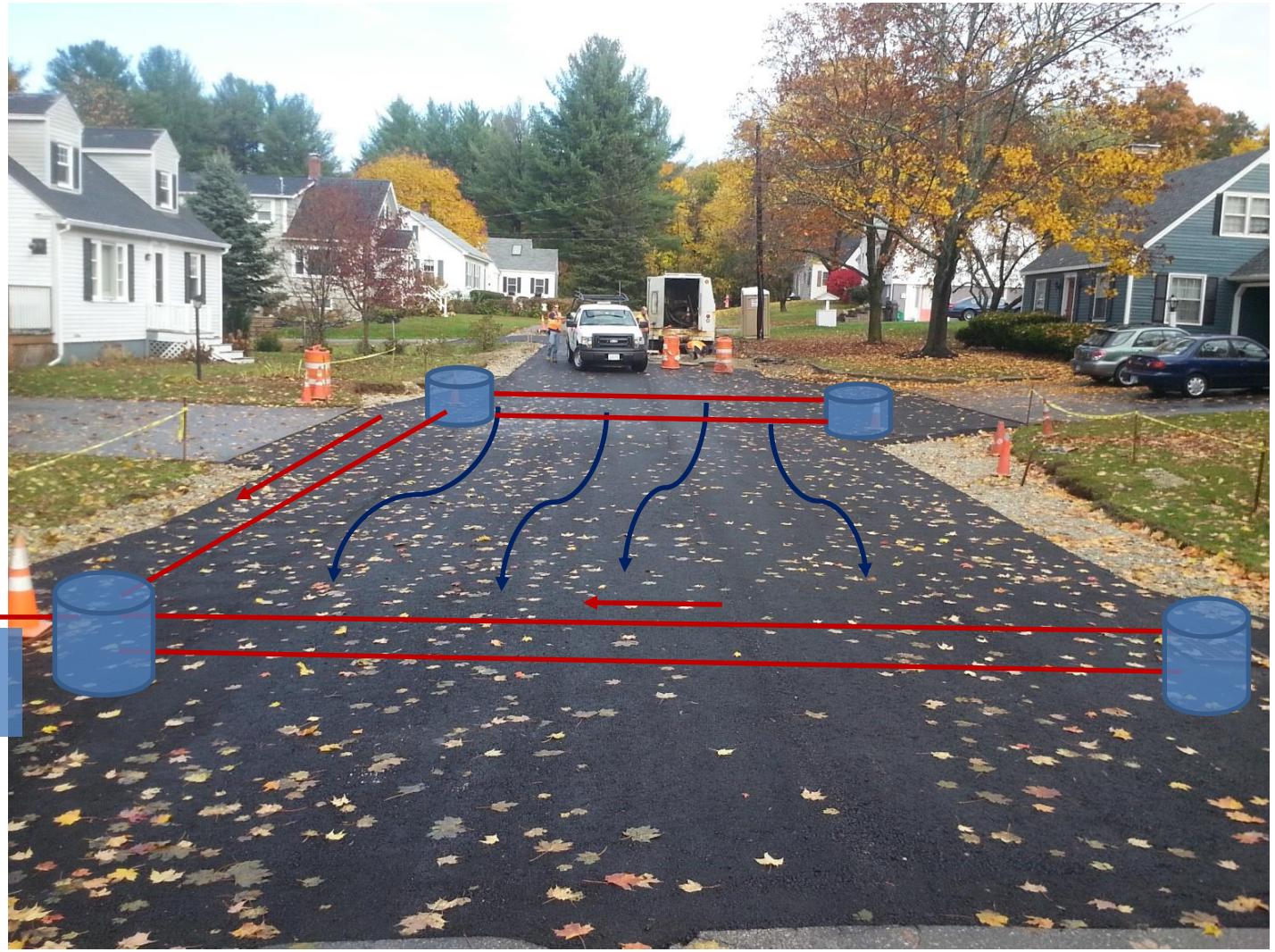
Average Infiltration Rates of a Planted (blue) versus Grassed (green) Bioretention Systems Over Time



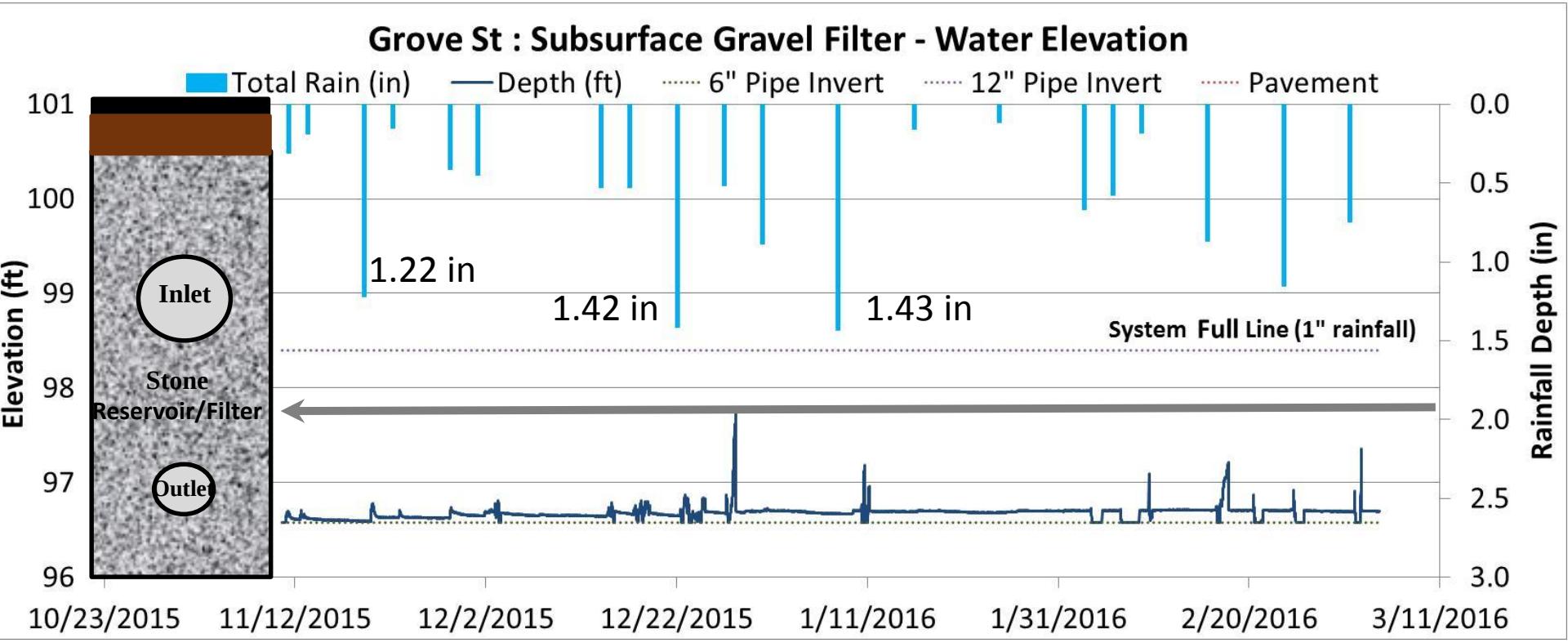
Permeable Pavement

OMDB!

GI: Subsurface Gravel Filter



Boulangenator Performance



GI Implementation Cost Comparisons

Costs per disconnected acre of IC			
	PA	NY	NH
Actual	$250,000.00	$320,000.00	$30,000.00

SGWS Costs

Site Characteristics and System Treatment Capacity						Annual Removals (lbs/yr)		
Project	Impervious Area (sf)	Impervious Area (acres)	Best Management Practice	Hydrologic Soil Group	Depth of Runoff Treated from Impervious Area (in)	Total Suspended Sediment	Total Phosphorus	Total Nitrogen
Hillcrest IT	39,640	0.91	Infiltration Trench	B	0.10	97	0.35	8.8

Water Quality Volume	Hillcrest IT
Drainage Area (ft^2)	39,640
% Impervious Cover	100%
Impervious Area (ft^2)	39,640
Conv WQV (ft^3) (@ P = 1.0in)	3,303
System Treatment	
System Area (ft^2)	10
Reservior Storage (ft^3)	400
System Storage (ft^3)	320
Rainfall Depth Treated (in)	0.10

Marginal Extra Materials	Marginal Cost Difference
700 cf stone	$10,000

Conclusions

1.) Let’s sweat the small stuff

2.) Let’s recognize the we are at the beginning stages of a long journey with many innovations yet to come

3.) Let’s facilitate transferring ownership and see what happens


Questions???