

# TRIECA | 2017 CONFERENCE

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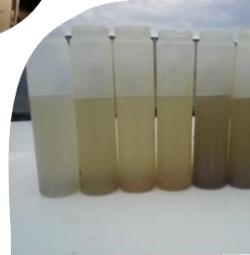


# The Many Faces of Bioretention:

*What monitoring and research in Ontario is telling us about design and performance*

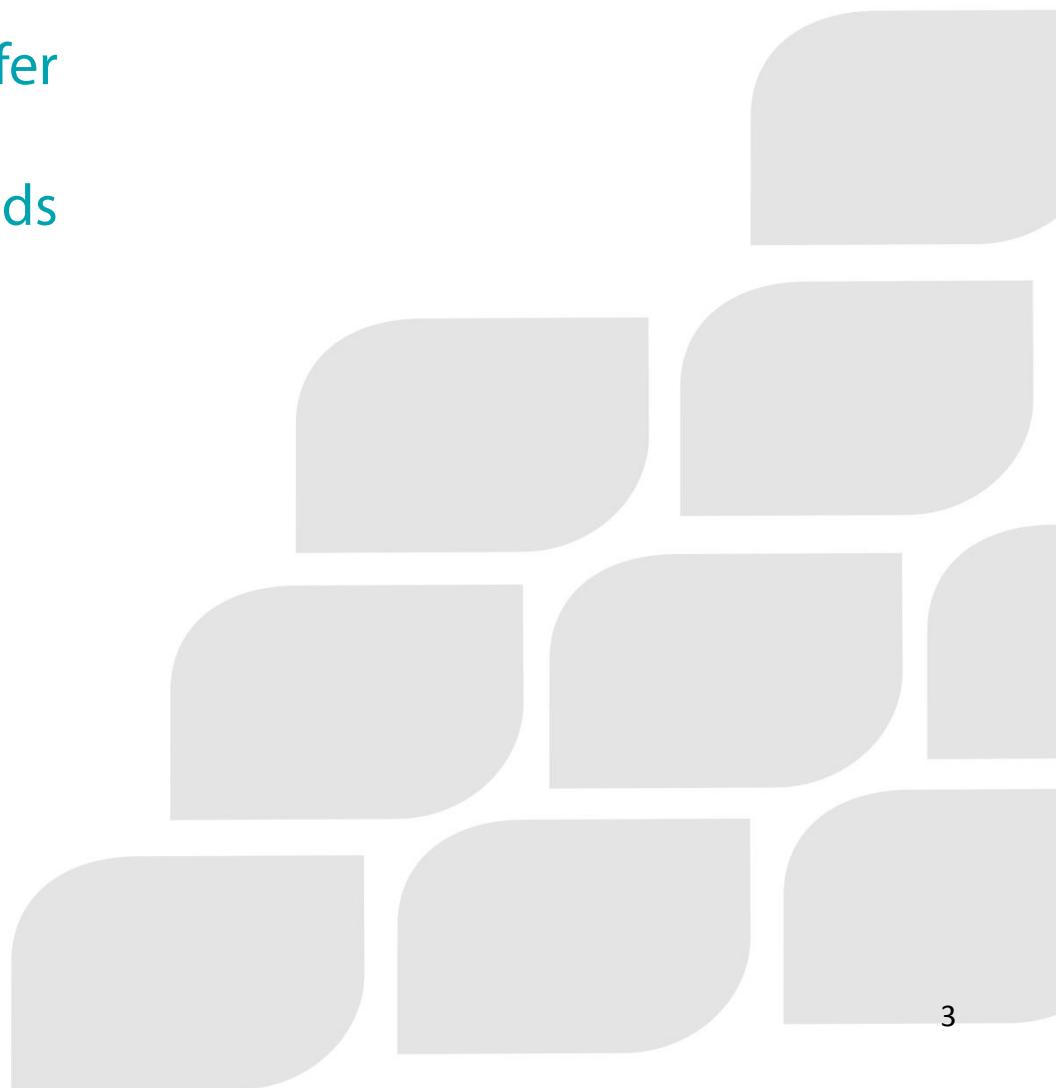
Tim Van Seters, TRCA  
TRIECA 2017

**STEP Water** is a partnership between:



# Presentation Overview

- What bioretention has to offer
- Monitoring sites and methods
- Compare with respect to:
  - Water quality
  - Hydrology
  - Winter Performance
  - Plant survivability
  - Maintenance
- Design considerations



# What bioretention has to offer: The marketing pitch

- Flexible, adaptable
- Multi-functional
- Attractive and Alive
- Reduces urban heat island; VOC emissions
- Incorporates several treatment processes
- Resists clogging, long lasting



# Monitored Sites



CREDIT VALLEY  
CONSERVATION



Toronto and Region  
**Conservation**  
*for The Living City®*

# Bioretention, Living City Campus

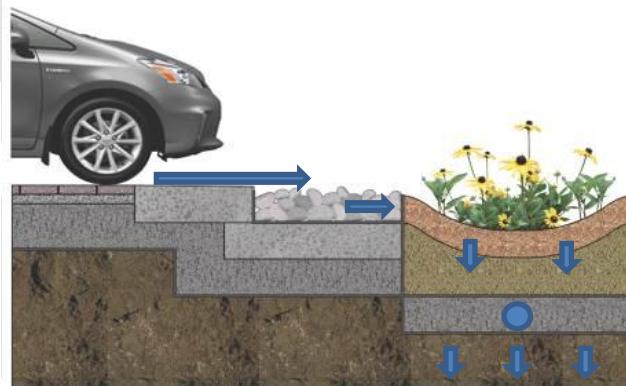


Brand name

*Pocket  
Flow  
Filter*

## Site Characteristics

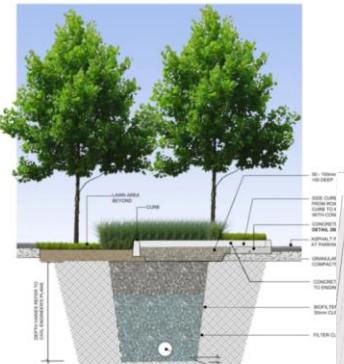
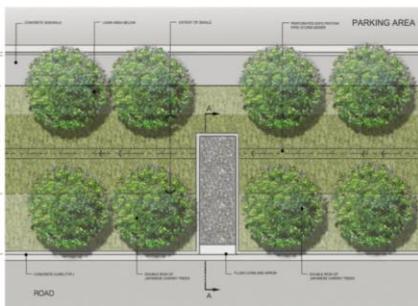
Drainage Area	Parking Lot
I:P Ratio	9:1
Cover	Plants/Mulch
Native Soils	Silty Clay
Filter Media	60% Sand



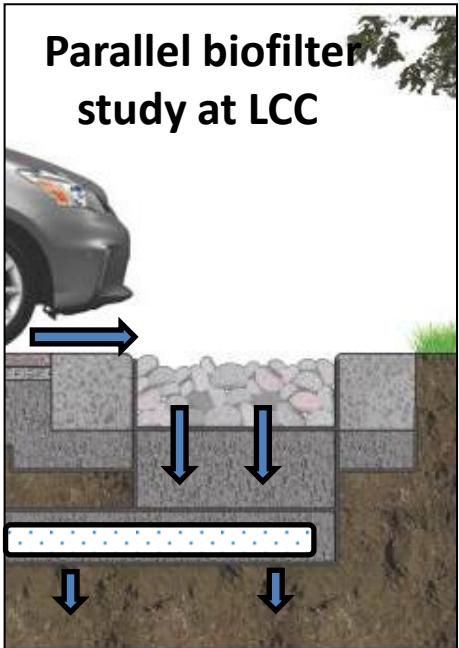
# Honda Canada Biofilter

Biofiltration System

BIOFILTER IN TRAFFIC ISLAND

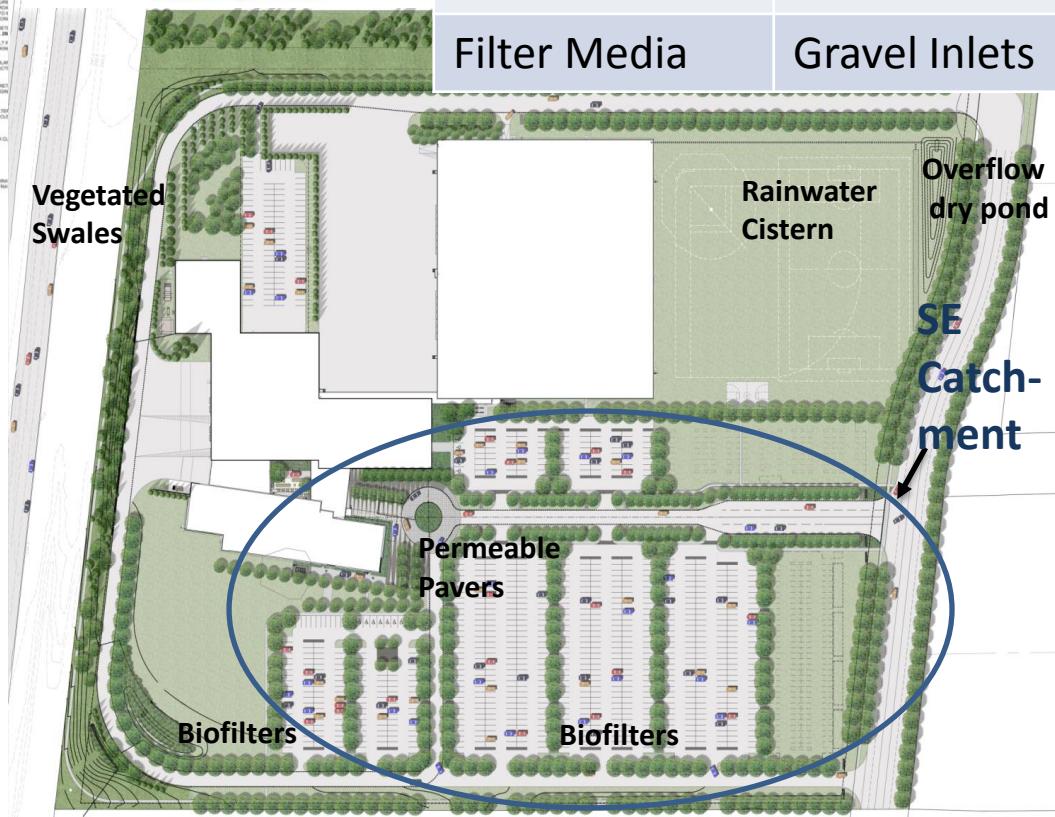


Parallel biofilter study at LCC



## Brand name

**Flood Filter-  
Buster**



Courtesy: Schollen & Co.

## Site Characteristics

Drainage Area	Parking Lot
I:P Ratio	8 to 10:1
Cover	Trees/shrubs cobble inlets
Native Soils	Silty Clay
Filter Media	Gravel Inlets

# North Bioretention, LCC



Brand name  
**Nutrient  
Nixer**



## Site Characteristics

Drainage Area	Parking Lot
I:P Ratio	10:1
Cover	Plants/mulch
Native Soils	Silty Clay
Filter Media	>80% sand

# Earth Rangers Bioretention at LCC



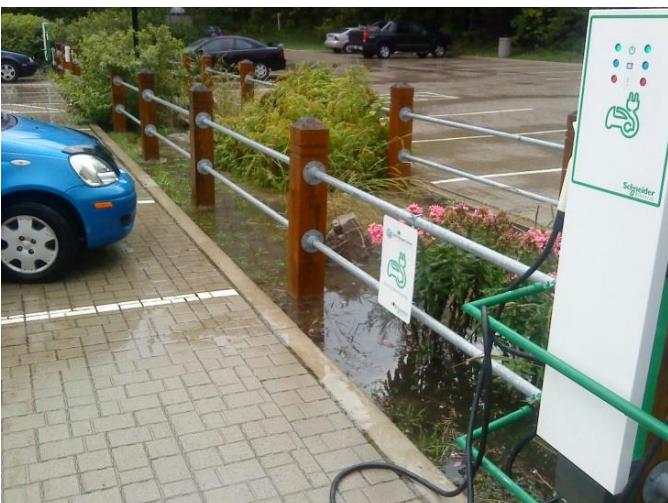
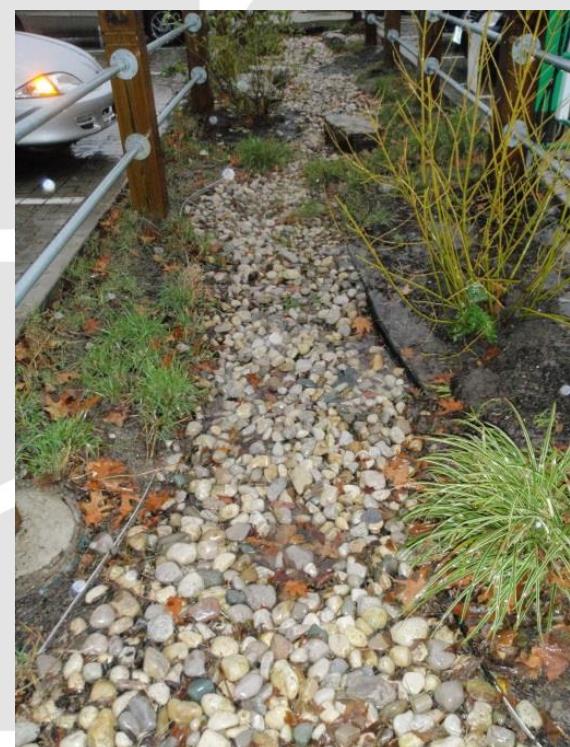
Brand name

*River  
Rocker*



## Site Characteristics

Drainage Area	Parking Lot
I:P Ratio	11 to 13:1
Cover	Plants/Stone
Native Soils	Silty Clay
Filter Media	10–30% sand!



# County Court Filter Swale



**Brand name**  
**Lake Saver**  
**Swale**

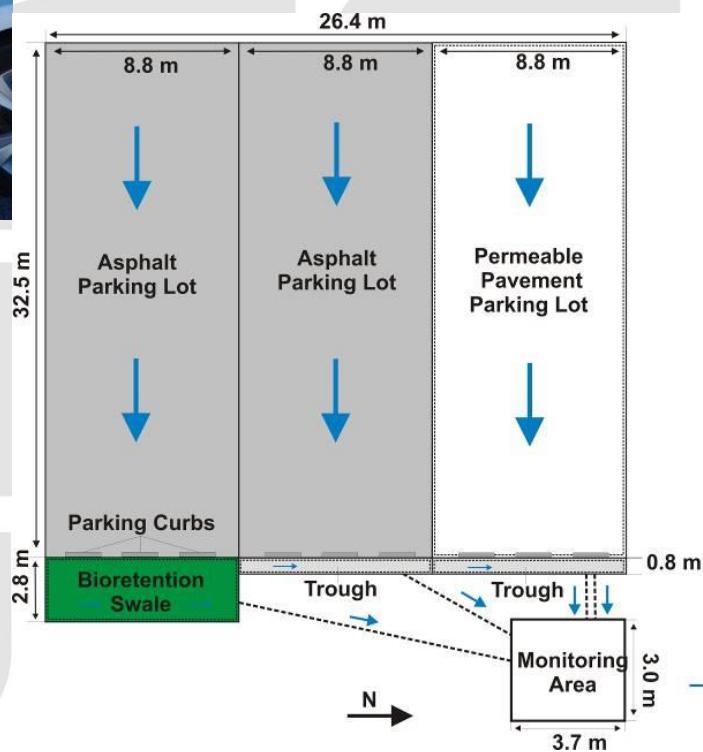
# Seneca College Bioretention



Brand name  
**ORGANIC  
OASIS**

## Site Characteristics

Drainage Area	Parking Lot
I:P Ratio	10:1
Cover	Plants/Mulch
Native Soils	Silty Clay
Filter Media	Garden loam



# Lakeview, Mississauga (CVC)



Vegetated bio-swales

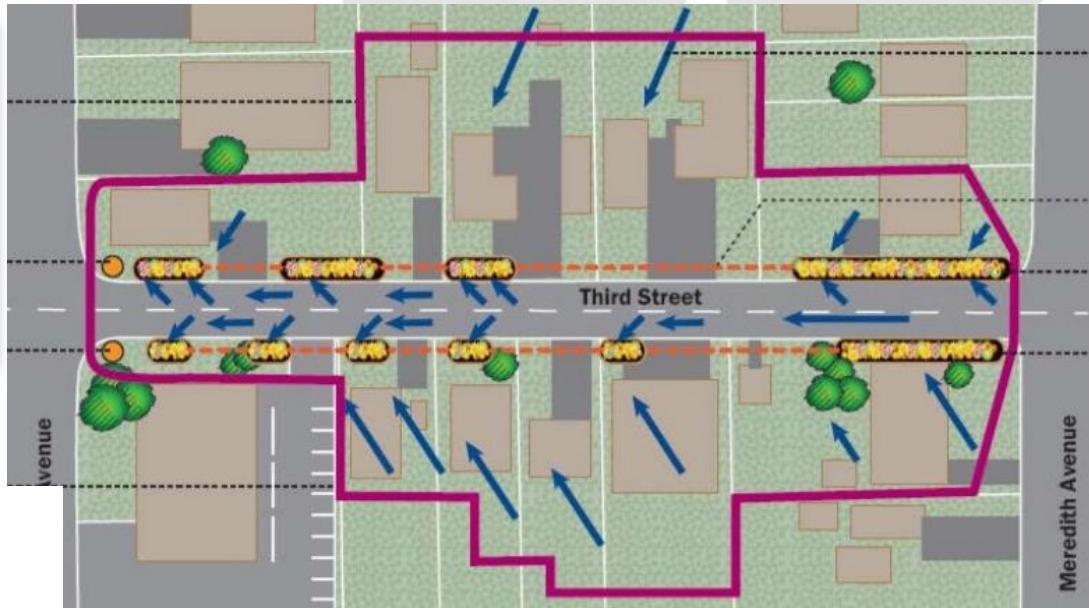


Gardens with curb cuts



Grass swales

Brand name  
**Sunken Soakers**



## Site Characteristics

Drainage Area	Road/Lawn/Roof
I:P Ratio	Approx: 10:1
Cover	Plants/mulch
Native Soils	Silty Clay
Filter Media	Sandy

# Elm Drive Planter Boxes and Permeable Lay-bys (CVC)

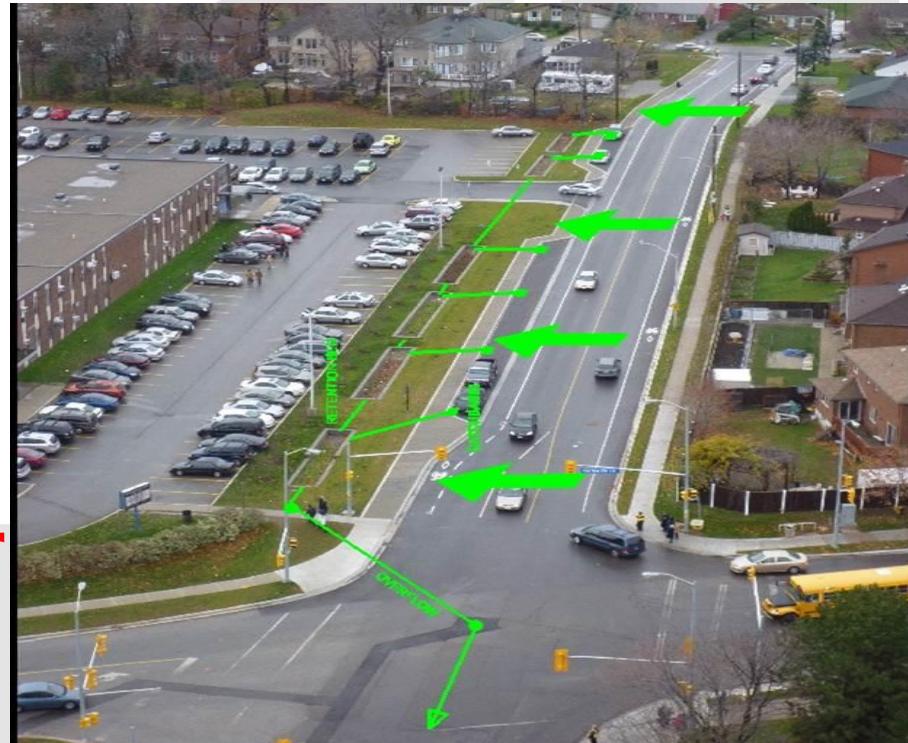


## Site Characteristics

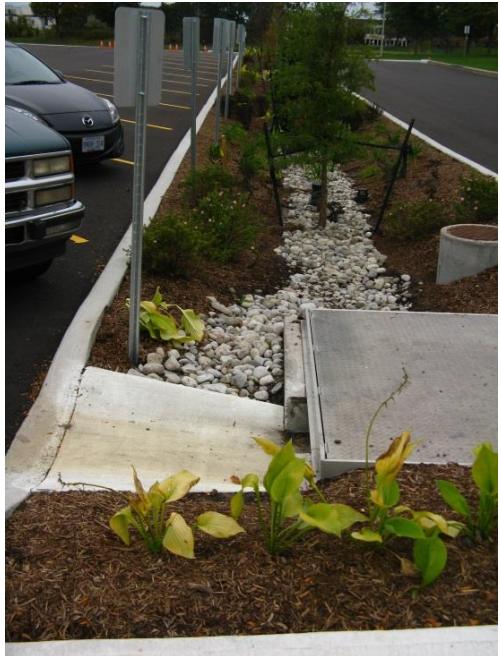
Drainage Area	Road/Lawn
I:P Ratio	Approx: 6:1
Cover	Plants/Mulch
Native Soils	Clayey silt on silt till
Filter Media	Sandy



Brand name  
**Runoff  
Redeemer**



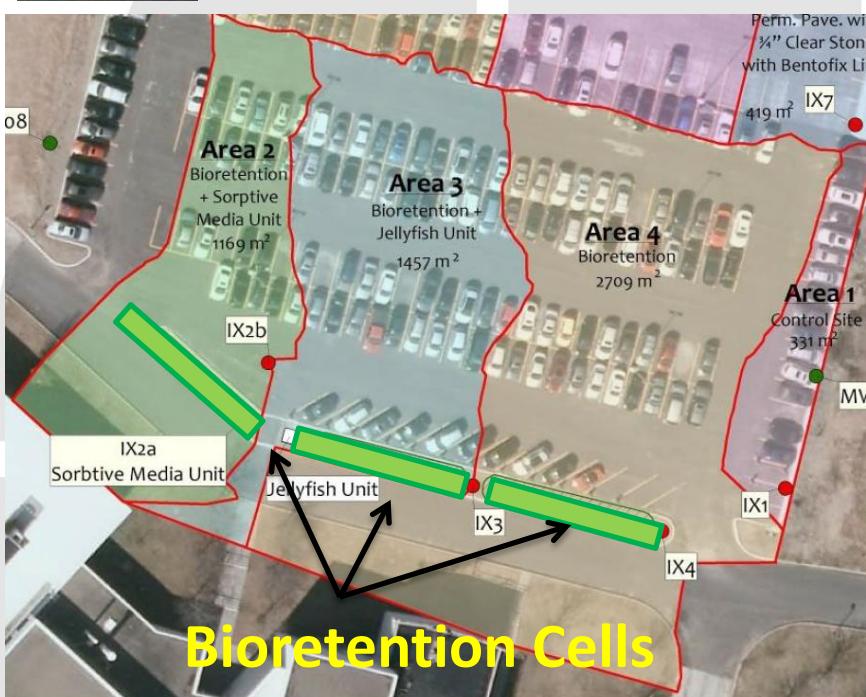
# Imax Bioretention (CVC)



## Brand name

# Treatment Trainer

Site Characteristics	
Drainage Area	Parking Lot
I:P Ratio	22 - 30:1
Cover	Trees/shrubs /plants
Native Soils	Silty Clay fill over clay till
Filter Media	Sandy



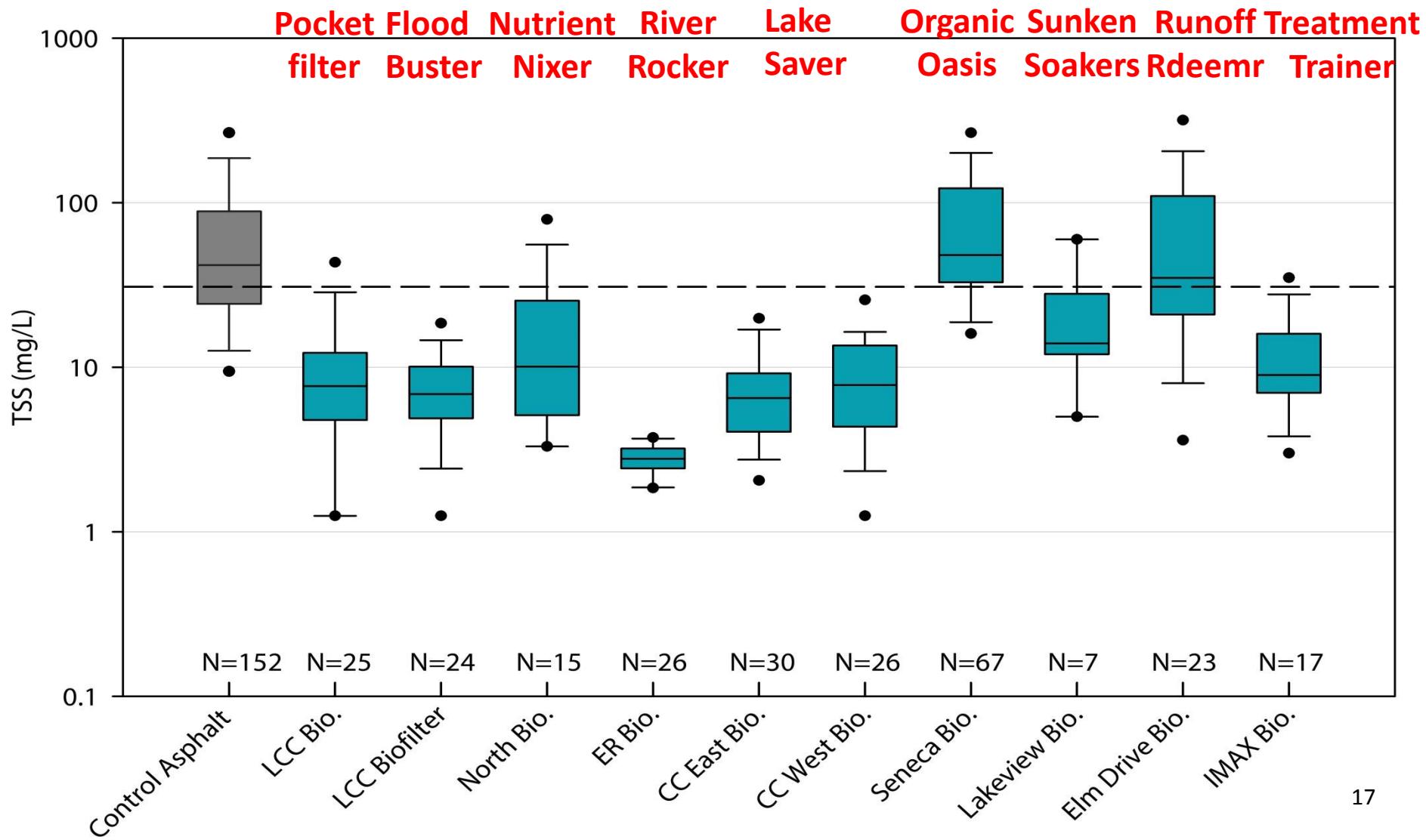
# Monitoring Methods

- Continuous, long term monitoring
- Flow weighted water quality sampling
- Certified analytical laboratories
- Robust QA/QC field testing protocols
- Reference site controls where possible
- Parameters include: Water quality, quantity, temperature, surface ponding/infiltration, subsurface infiltration, plant survivability, O&M, Cost.

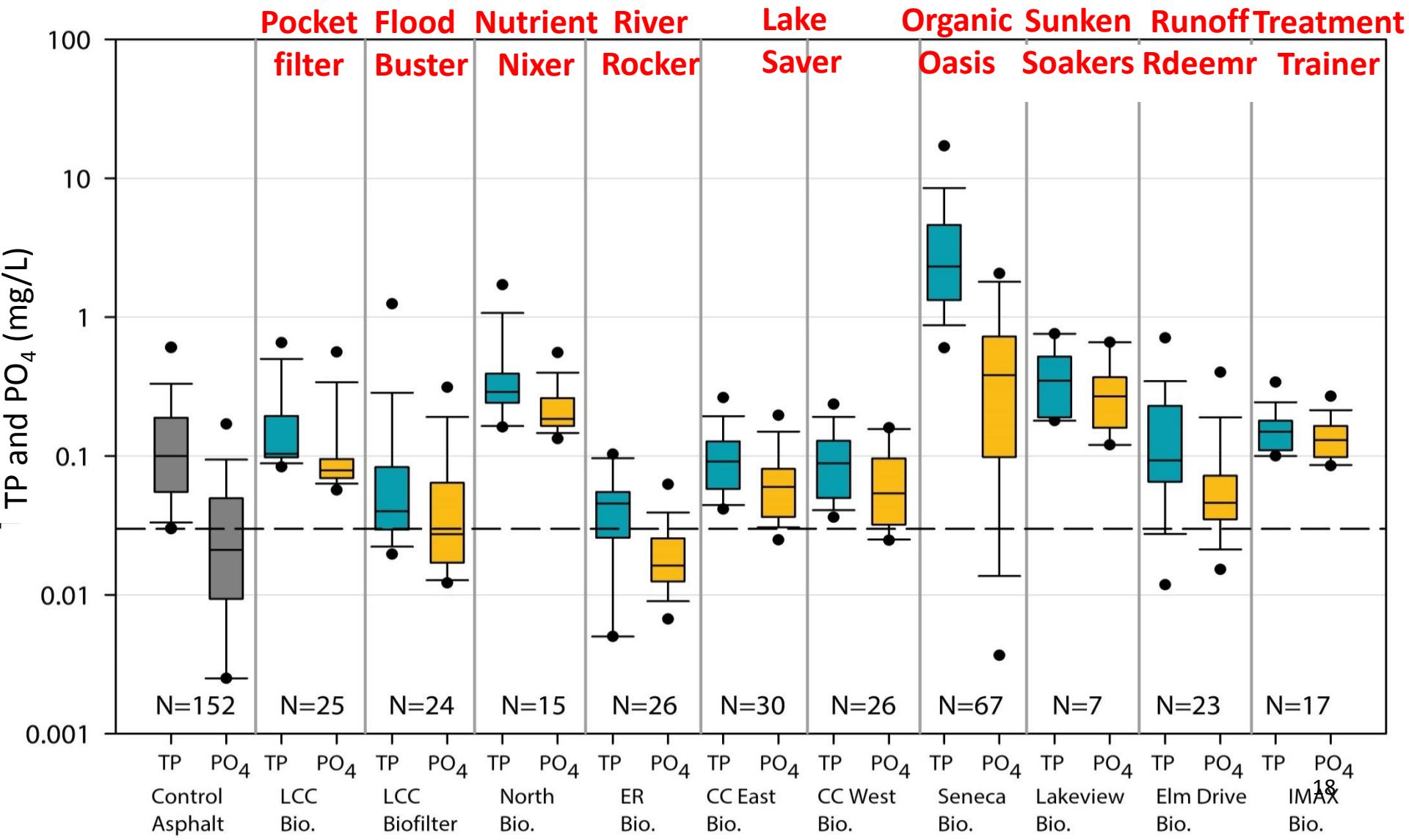


# Performance Results

# Total Suspended Solids Effluent Concentrations



# TP and PO<sub>4</sub> Effluent Concentrations

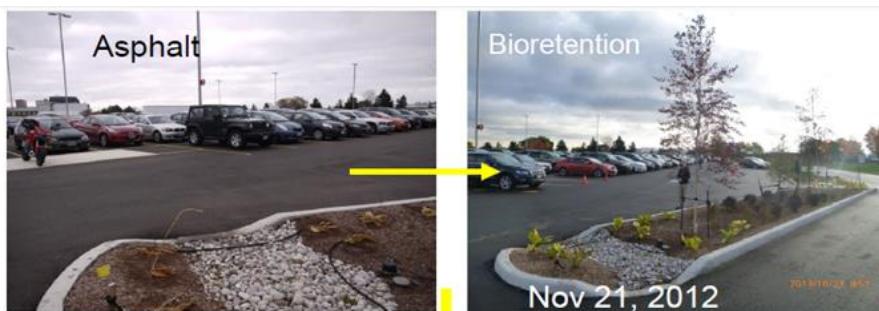


# Phosphorus Reactive Media Trials

## North Bio @ LCC



## IMAX Bio



## Imbrium Sorbive Media™



## Red sand



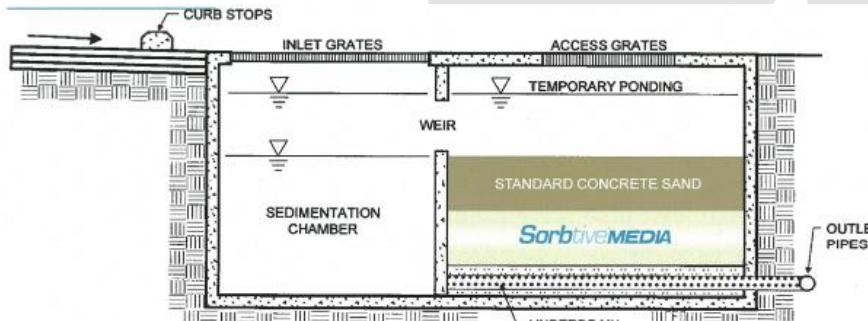
Asphalt to  
Bioretention to  
Sorbive Media  
Vault

Bioretention  
-Primary treatment



Sorbive Media  
Vault  
- Dissolved nutrient  
removal

Overflow by-passes  
Sorbive Media  
Vault



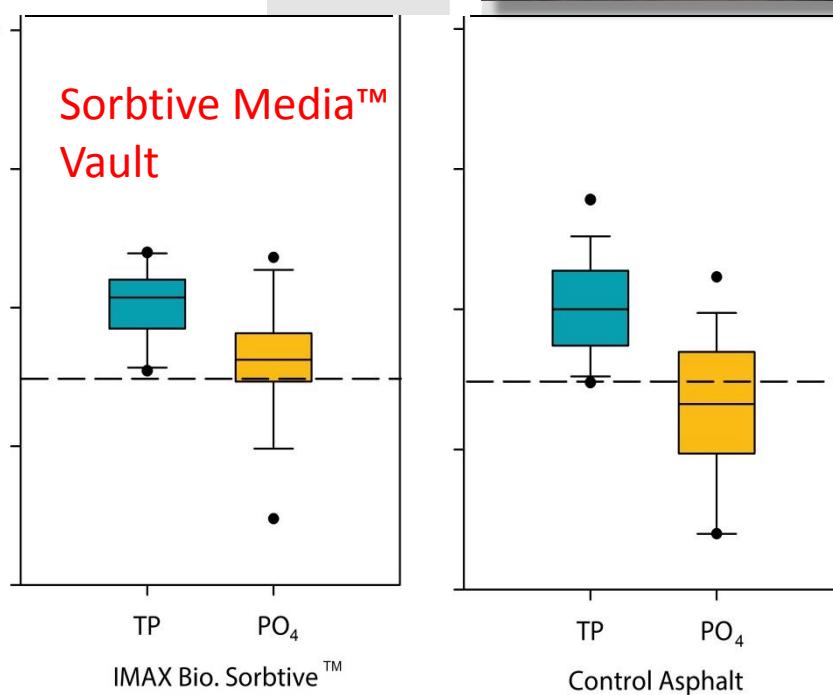
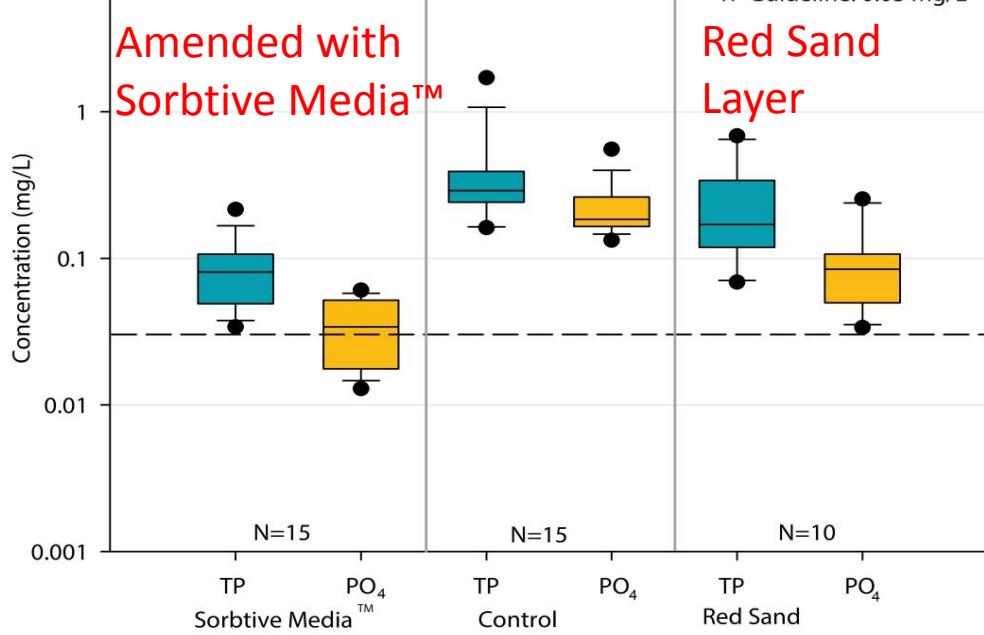
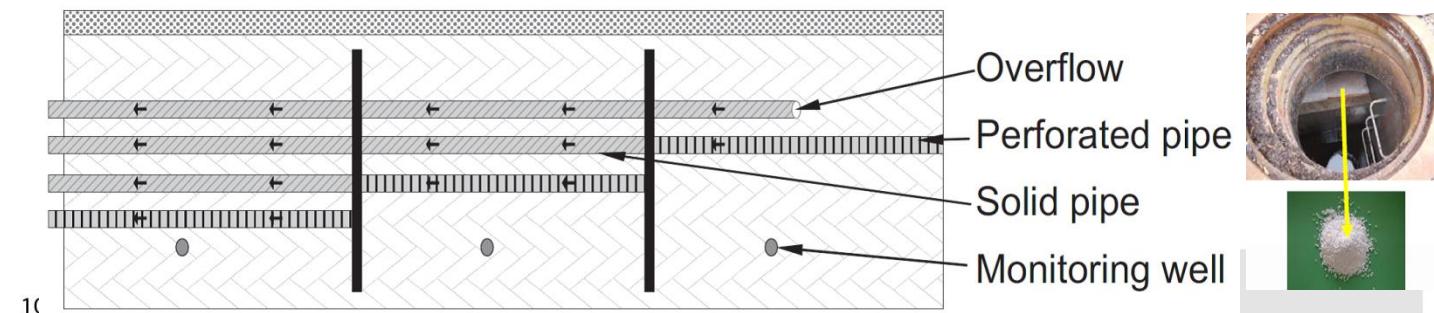
# Phosphorus Reactive Media Trials

# Imbrium Sorbtive Media™

# North Bio @ LCC (aka Nutrient Nixer)

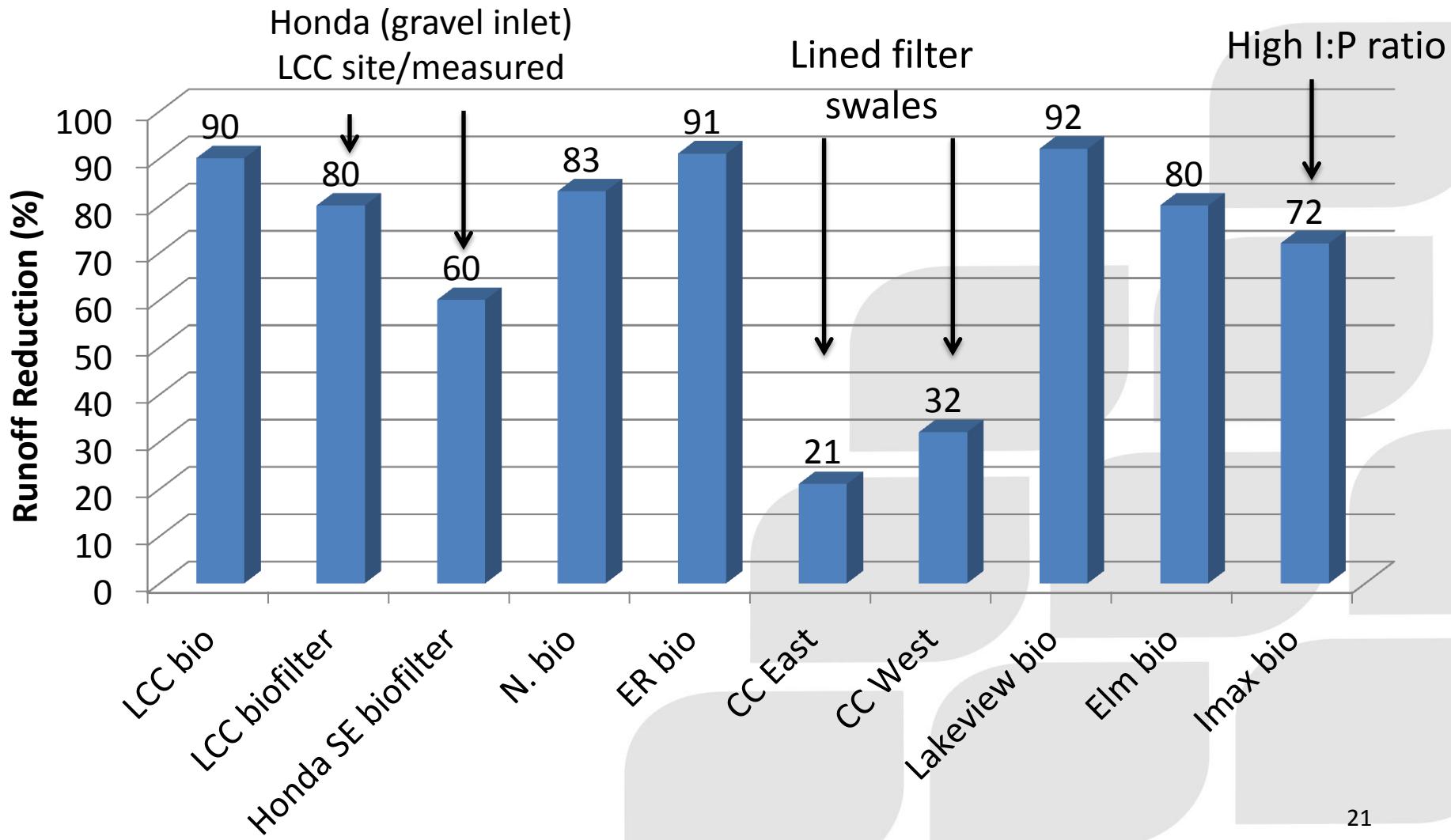
# IMAX Bio(aka Treatment Trainer)

## Asphalt (n= 152)

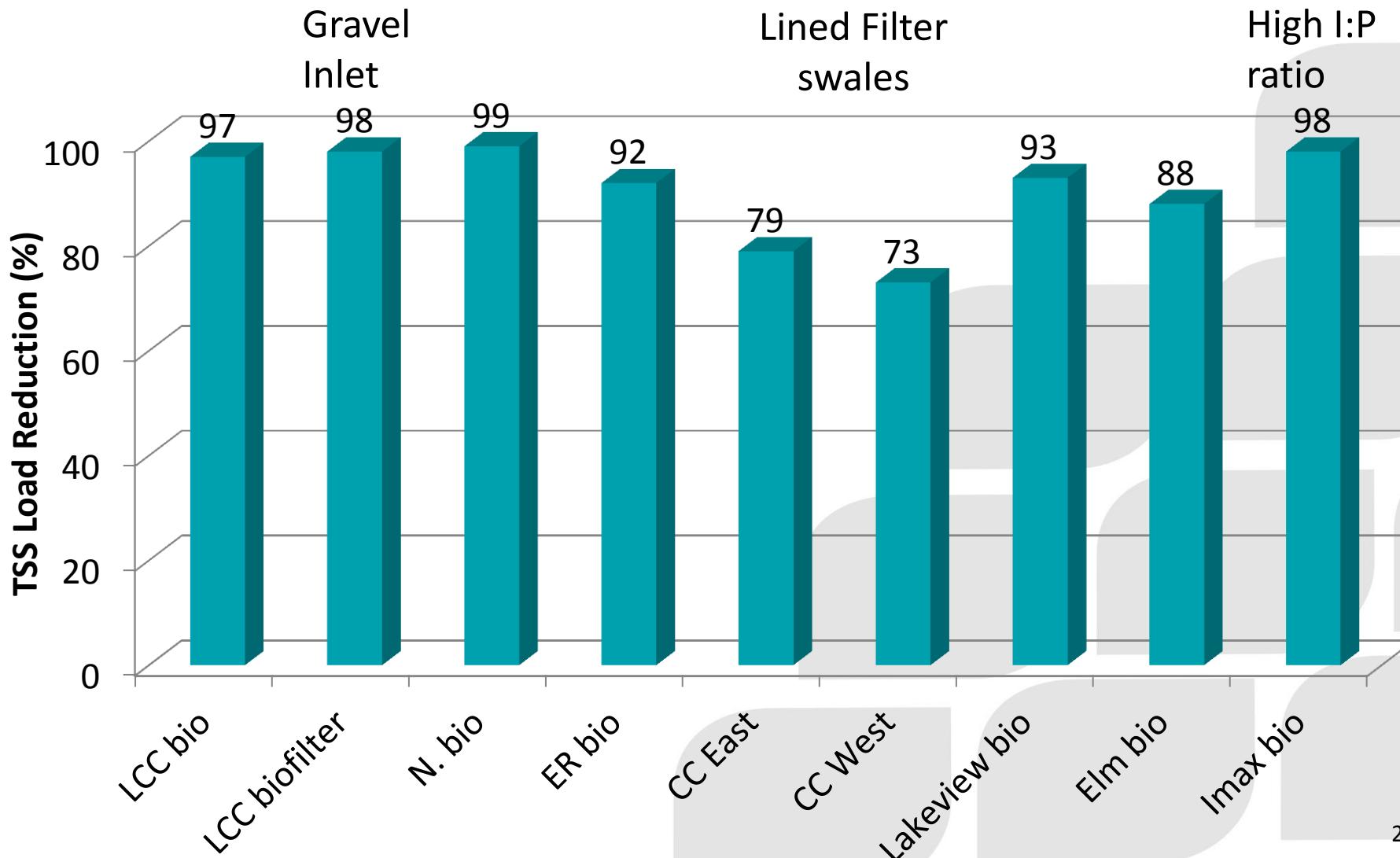


## Preliminary data

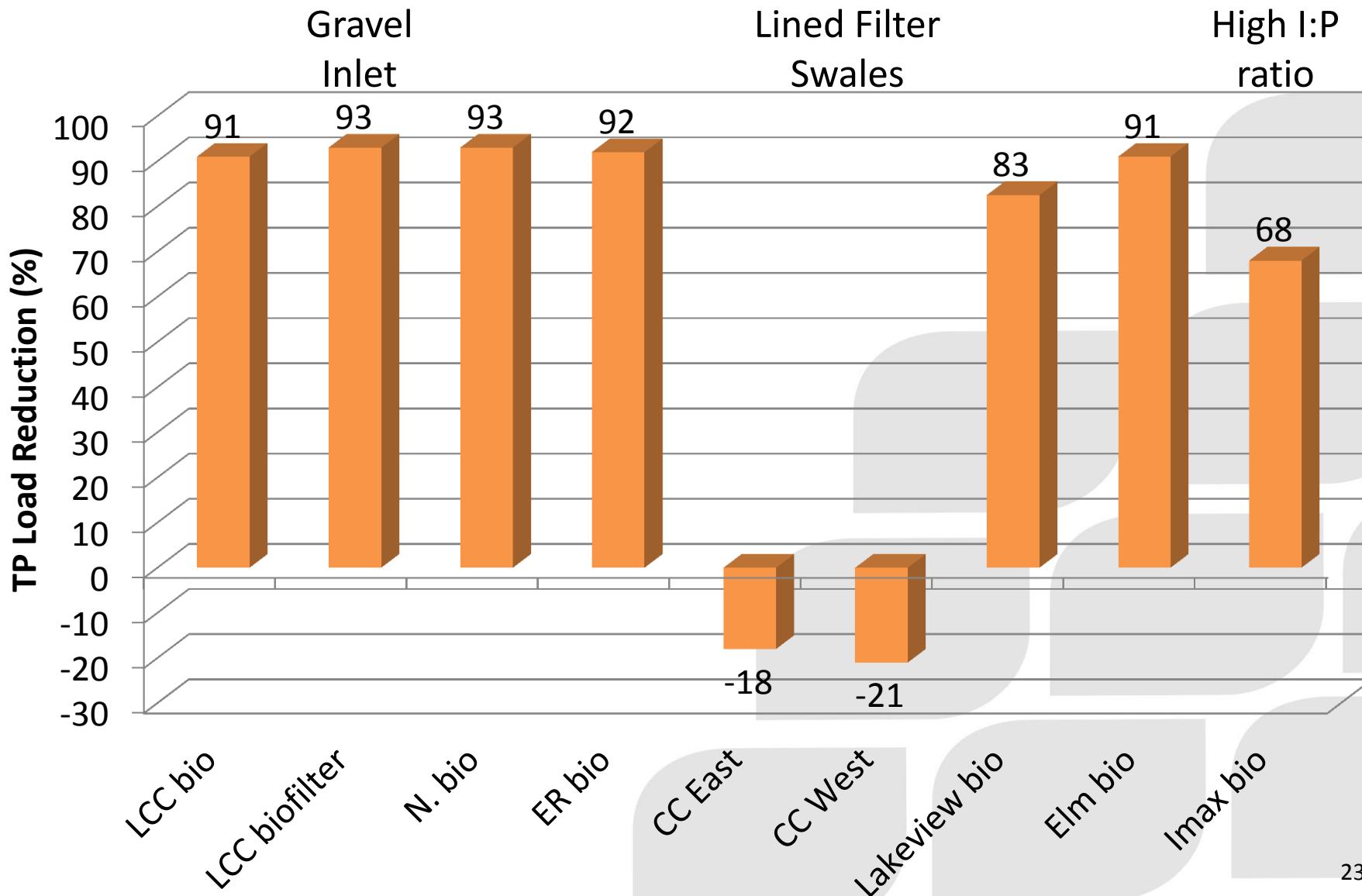
# Runoff Volume Reduction



# TSS Load Reductions



# TP Load Reductions



# Winter Performance

- Performance at least as good during the winter (96% runoff reduction at ER bio)
- Longer duration ponding can occur (up to 38 hours observed).
- Infiltration occurs throughout the winter; infrequent surface overflows
- Temperatures above zero at 50 cm depth
- Vegetation survives salt loading

ER Bio (River Rocker)

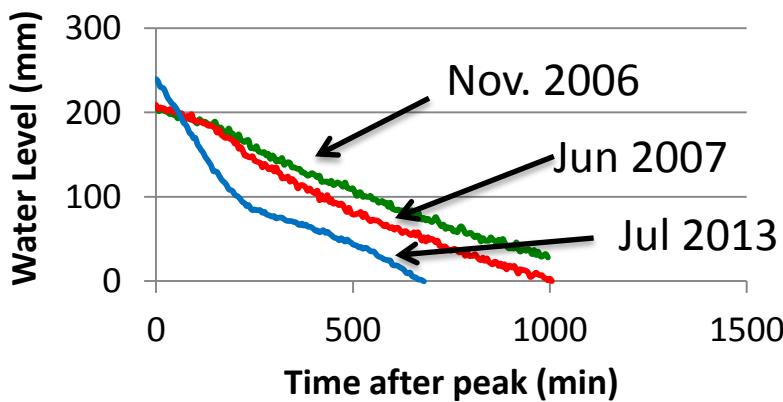


Seneca Bio (Organic Oasis)



# Surface Infiltration over Time

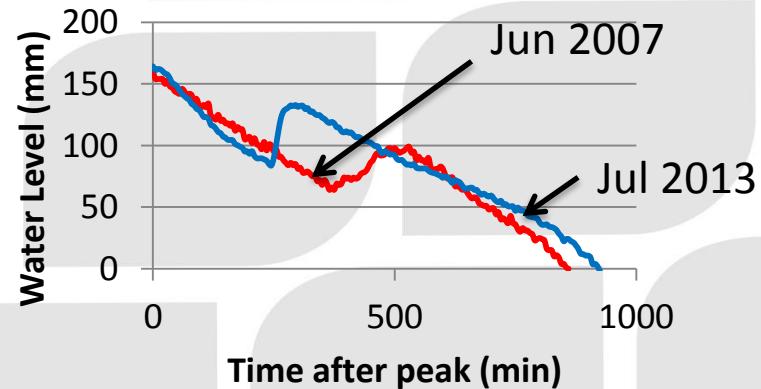
- No soil maintenance over seven years; limited veg. maintenance
- Drawdown of surface ponding levels after rain events in 2013 roughly the same as in 2006 and 2007



2007



2013



# Upkeep and Maintenance

- Irrigation and replanting often necessary during establishment
- Top-ups of soil and mulch needed if settling occurs post construction
- Inspect and clean curb inlets, trash
- No need to replace media within at least first 10 years; low contaminant buildup in soils
- Occasional replanting, weeding...



# The Takeaways

- Effluent concentrations not sensitive to influent concentrations; practice design more important
- Gravel and soil filter media perform similarly
- Substantial runoff reduction on tight soils
- Observed volume reduction differences relate to I:P ratio, liners and presence/absence of Et
- Winter performance as good as summer
- Plants/roots and microbes help maintain soil infiltration
- Be prepared to weed – gardens are not maintenance free!



## More Takeaways... on Design

- Recommended I:P ratio up to 15:1 still considered reasonable; further increase to 20:1 may be justified
- Flood flow biofilter designs feasible – more examples needed
- Low infiltration or lined units can benefit from reactive media amendments to improve nutrient removal
- Filter media selection critical to success; need to better understand controlling factors on P retention
- Convey overflows through separate pipe, rather than through underdrain... and cover to prevent mulch from entering
- Install a standpipe for monitoring to facilitate inspections

# THANK YOU

**For study reports and  
guideline documents, visit:**  
[www.sustainabletechnologies.ca](http://www.sustainabletechnologies.ca)

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