

Comparison of BMP Maintenance Cost, Labor Demands, and System Performance

**2014 Lamprey River Symposium
University of New Hampshire, Durham, NH**

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UNH Stormwater Center**

Acknowledgements

Funding for the University of New Hampshire Stormwater Research Center is provided by:

- Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET)
- National Estuarine Research Reserve System (NERRS) Science Collaborative
- New Hampshire Department of Environmental Services (NHDES)

UNH Stormwater Center



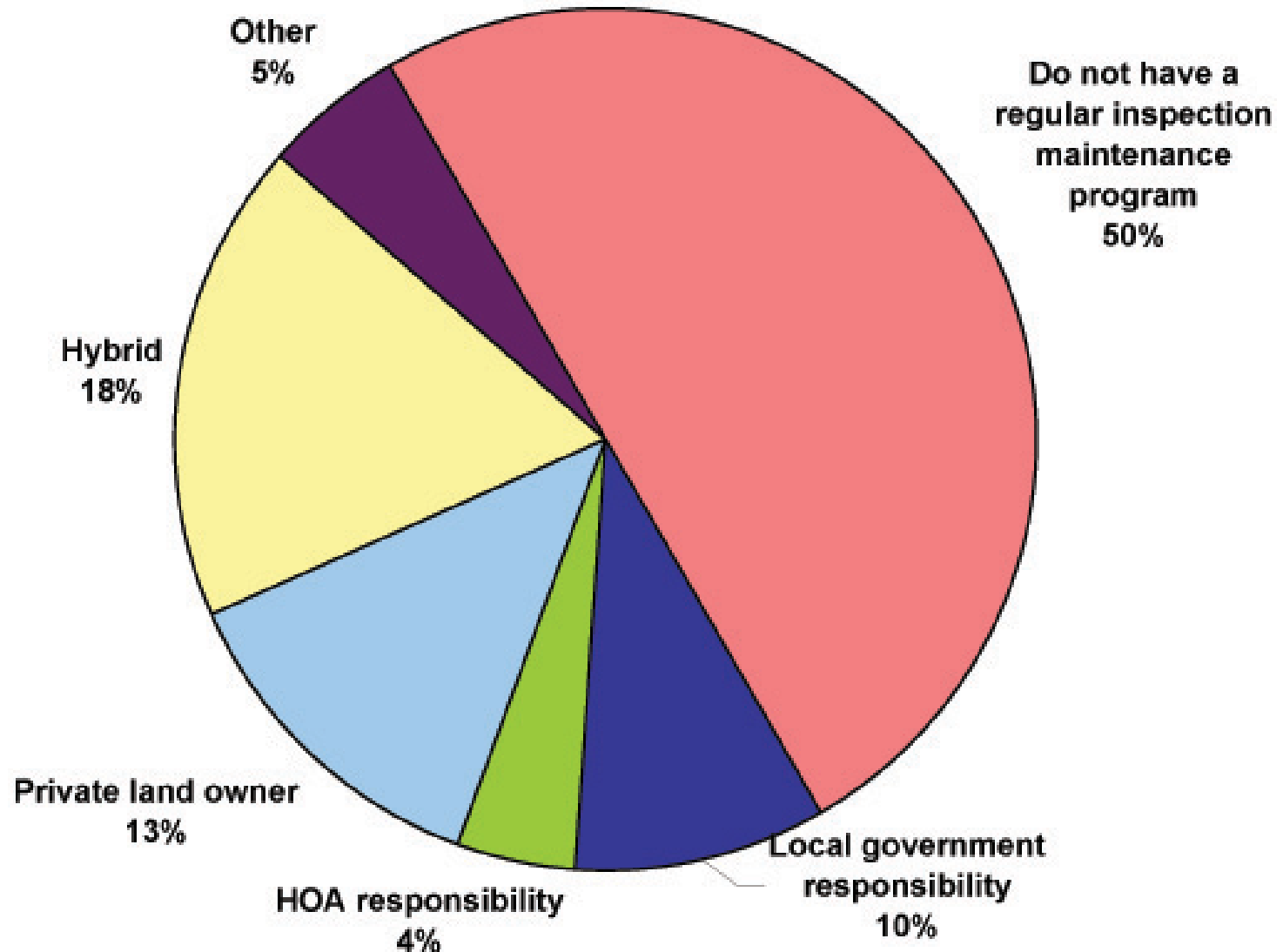
1,000 Pound Gorilla

Who has primary responsibility for maintenance?

- Local governments and public agencies
- States and the Federal Government
- Private property owners and home owner associations



Who is responsible for maintenance of post-construction stormwater facilities? (# of responses = 94)



What is Maintenance?

- Often Maintenance only occurs when there is failure
- There is a perception that LID systems require more maintenance
- Some claim LID systems fail and will require expensive repairs
- Our current practices have a high degree of failure and significant cost impacts—however we are familiar with it



Tools of the trade...



Tools of the trade...



Maintenance Data



Stormwater Systems Studied

Conventional Systems



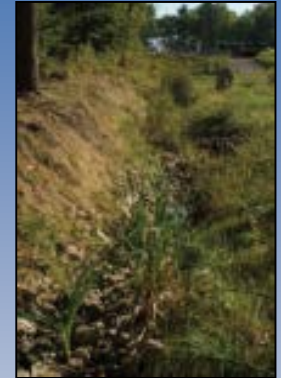
Detention Basin



Retention Pond



Stone Swale



Veg Swale

Low Impact Development Systems



Porous Asphalt



Gravel Wetland



Sand Filter



Bioretention Unit (3)

Maintenance Complexity is defined as:

Minimal	Simple
Stormwater Professional or Consultant is seldom needed ☐	Stormwater Professional or Consultant is occasionally needed
Moderate	Complicated
Stormwater Professional or Consultant is needed half the time	Stormwater Professional or Consultant is always needed

Reactive

Episodic maintenance,
cheap in short term,
expensive in the long
term

Periodic/Predictive

Science basis,
schedulable activities,
more cost effective

Proactive

Cost effective,
preventative operations

+

(\$)

-



Reactive Maintenance

- + Crack sealing
- + CB cleaning
- + Filling pot holes
- + Resetting curbs
- + Landscape maintenance beautification of streetscape
- + Culvert reinforcement/replacement/renewal
- + Pipe lining/repair

All of which can be reduced or replaced by green infrastructure

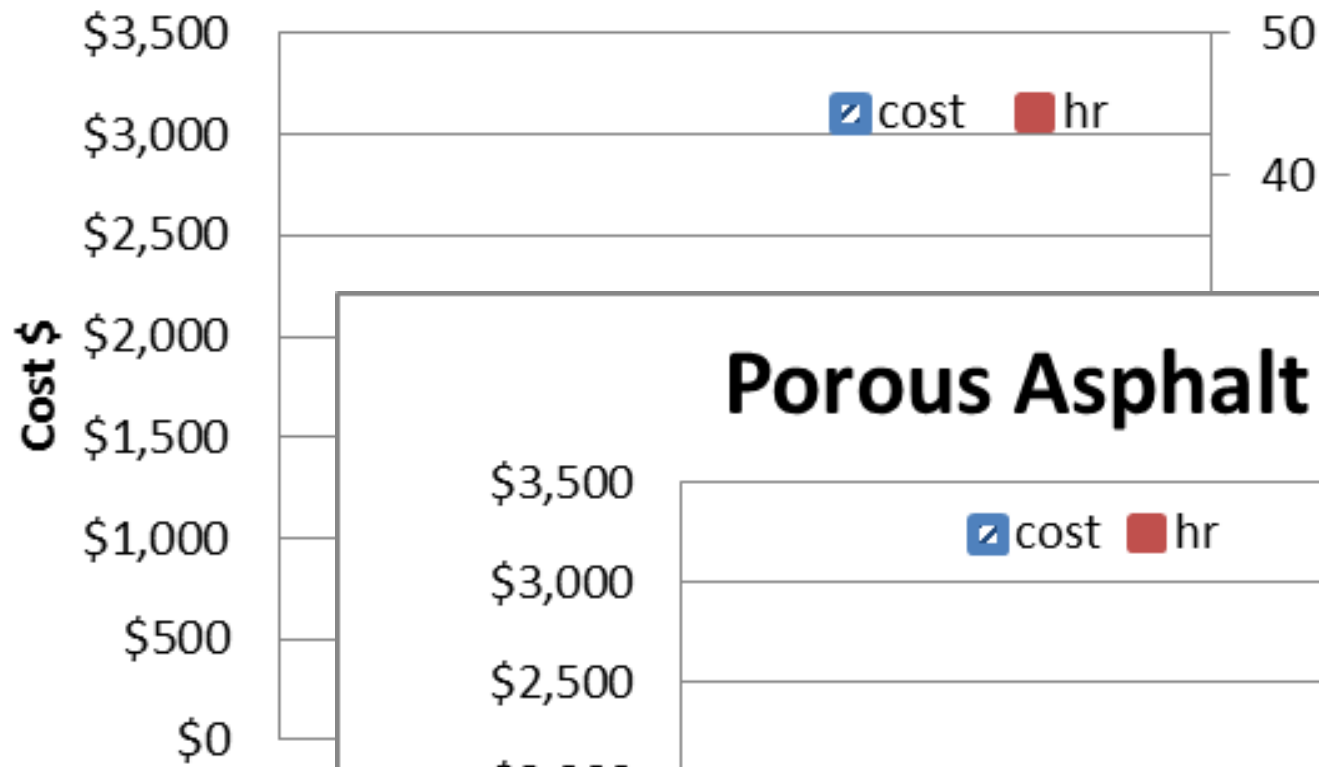
Assumptions

Category of Maintenance	Type of Maintenance	complexity	price (\$)
Reactive maintenance	Structural Repairs	complicated	135
	Partial Rehabilitation	complicated	135
	Rehabilitation	complicated	135
Periodic/Predictive maintenance	Solids and Debris Removal	moderate	115
	Inspection	simple	95
	Mowing	minimal	75
	Vegetation Management	minimal	75
Proactive maintenance	Pavement Vacuuming	moderate	115
	Erosion control & bank stabilization	simple	95

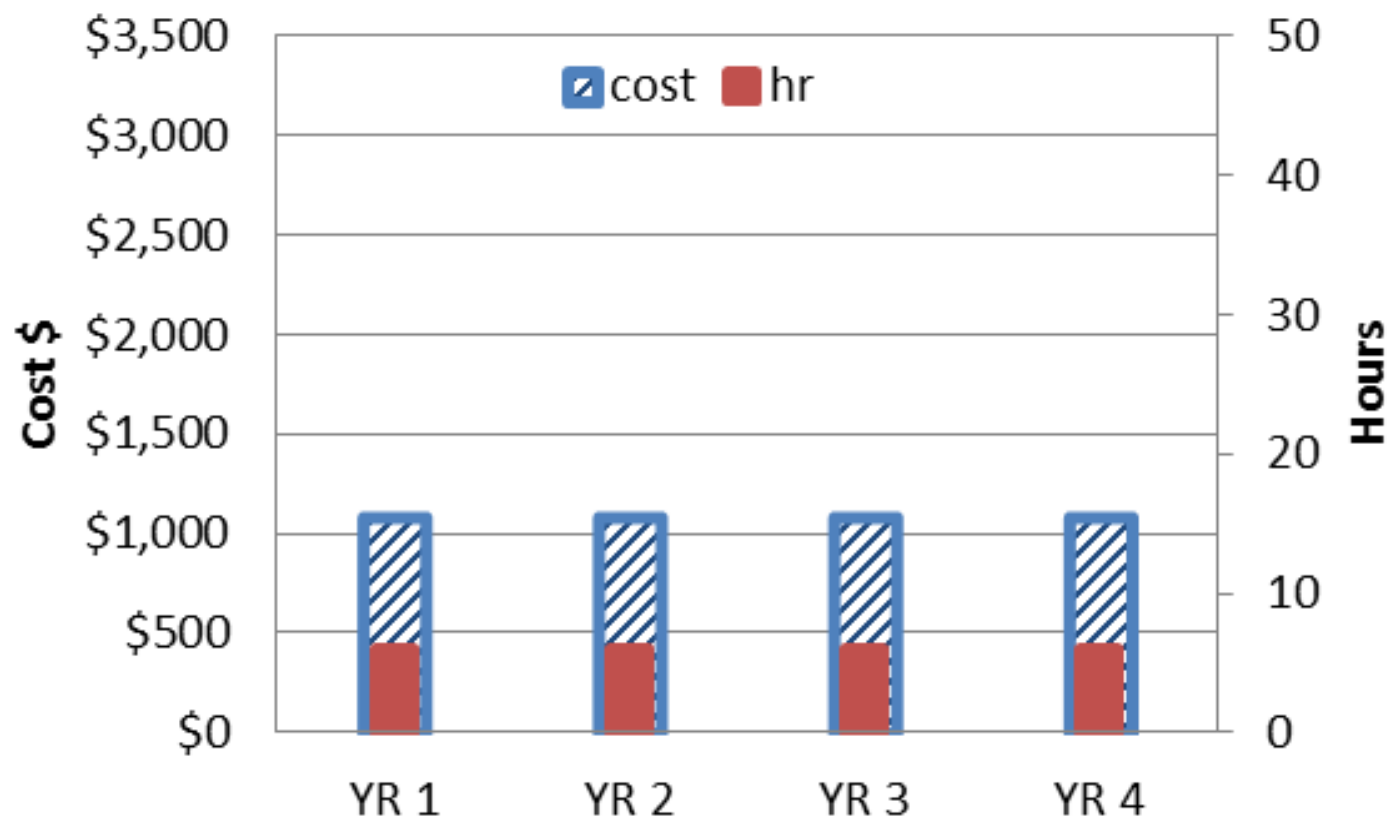
Tabular Data

Maintenance Year	BMP	Category of Maintenance	Type of Maintenance	Specific Maintenance	Complexity of Maintenance	Hours of Maintenance	Cost
2005	Unit D2: Bioretention Pond	Periodic maintenance	Mowing	side slope and perimeter mowing (Bi-Annualy 3 hrs each)	Minimal	3.0	\$225
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2005	Unit D2: Bioretention Pond	Proactive maintenance	Vegetation Management	erosion control, seeding, etc	Simple	3.0	\$285
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2008	Unit D2: Bioretention Pond	Periodic maintenance	Mowing	side slope and perimeter mowing (Bi-Annualy 3 hrs each)	Minimal	3.0	\$225
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2008	Unit D2: Bioretention Pond	Proactive maintenance	Vegetation Management	erosion control, seeding, etc	Simple	3.0	\$285
					TOTAL	64.0	\$5,600.0

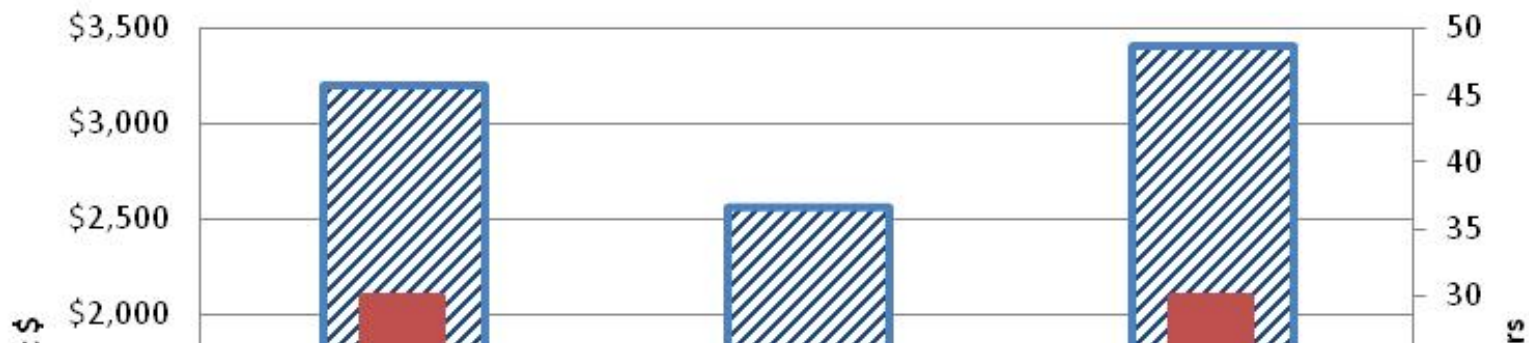
Bioretention



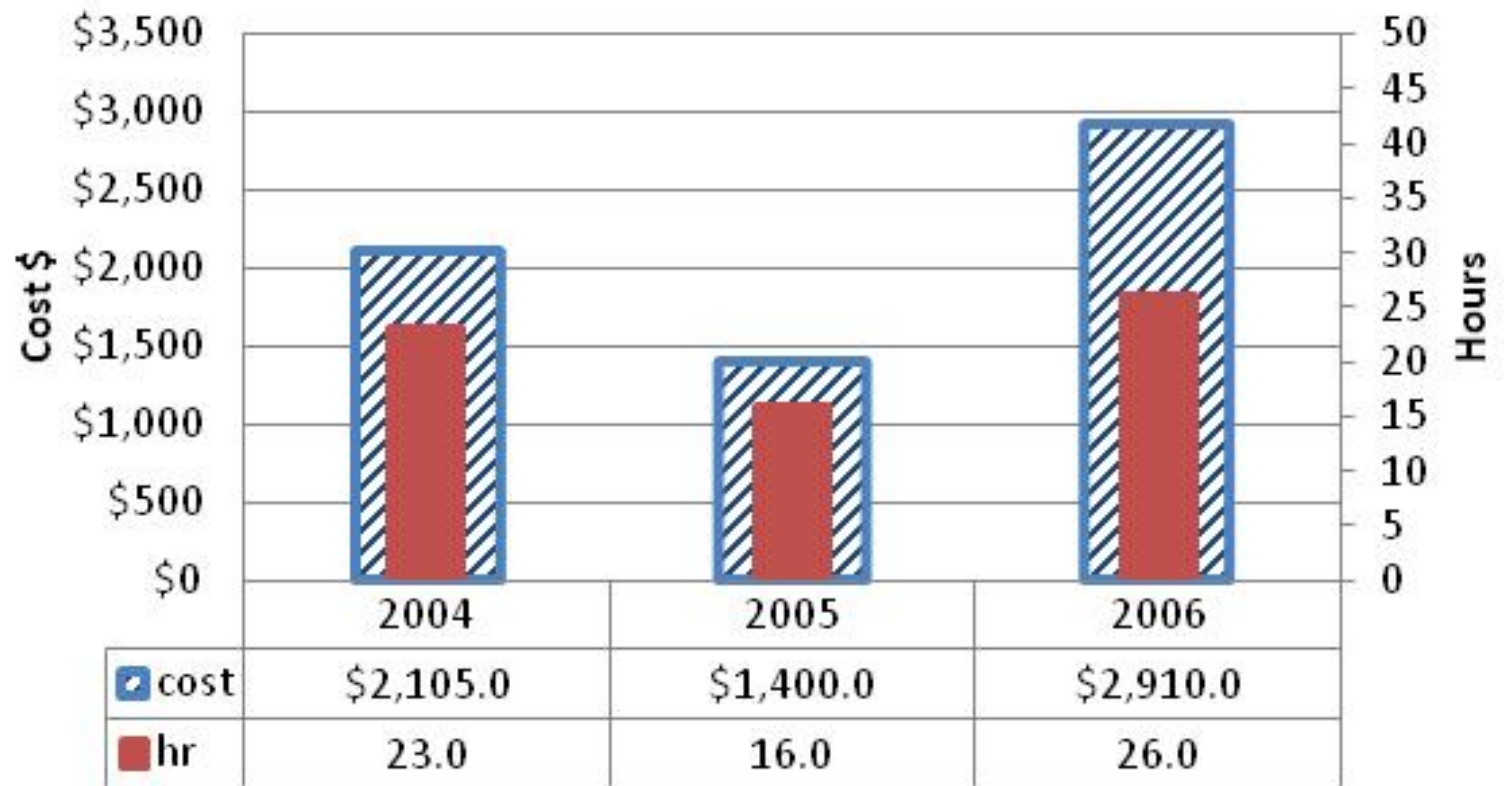
Porous Asphalt



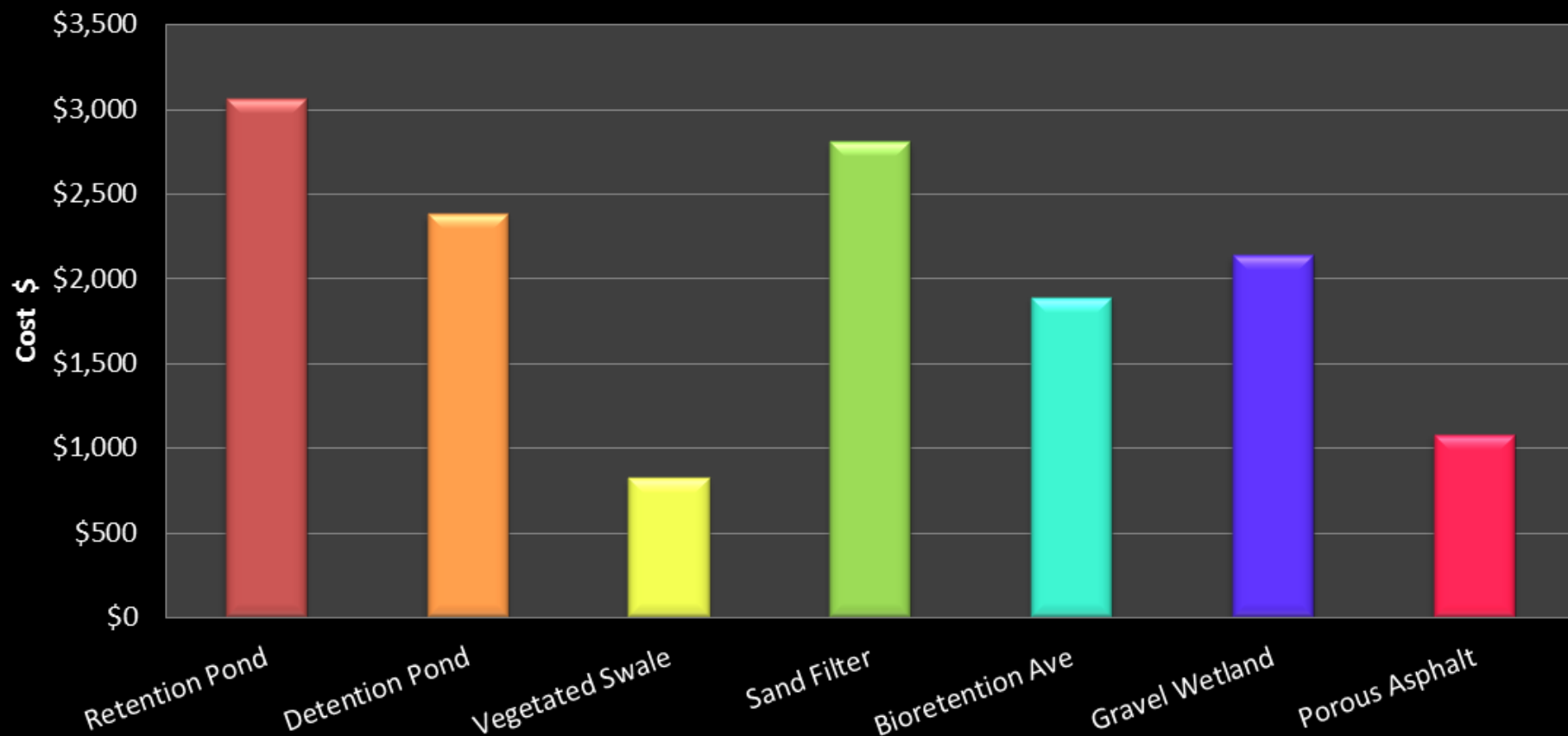
Retention Pond



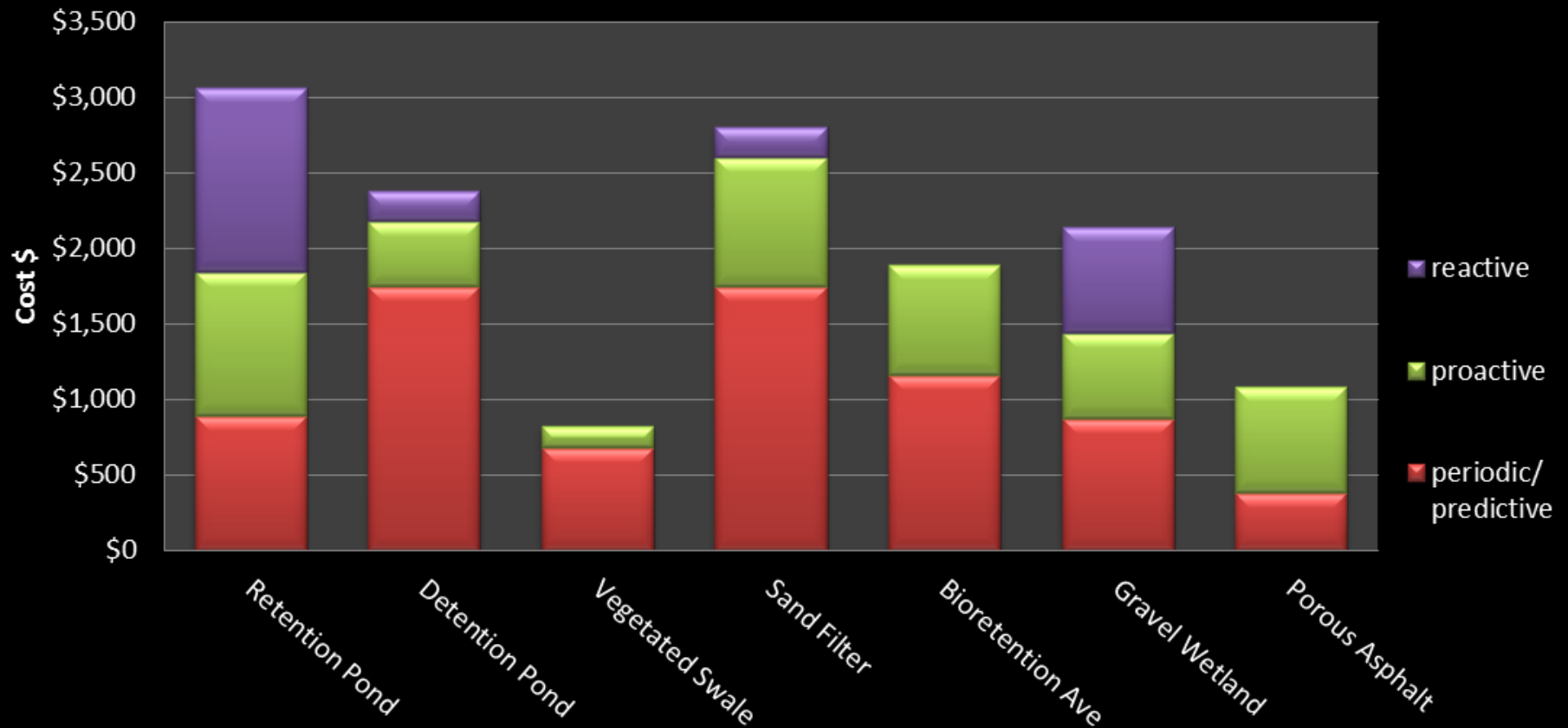
Gravel Wetland



Yearly BMP Maintenance (per acre treated)



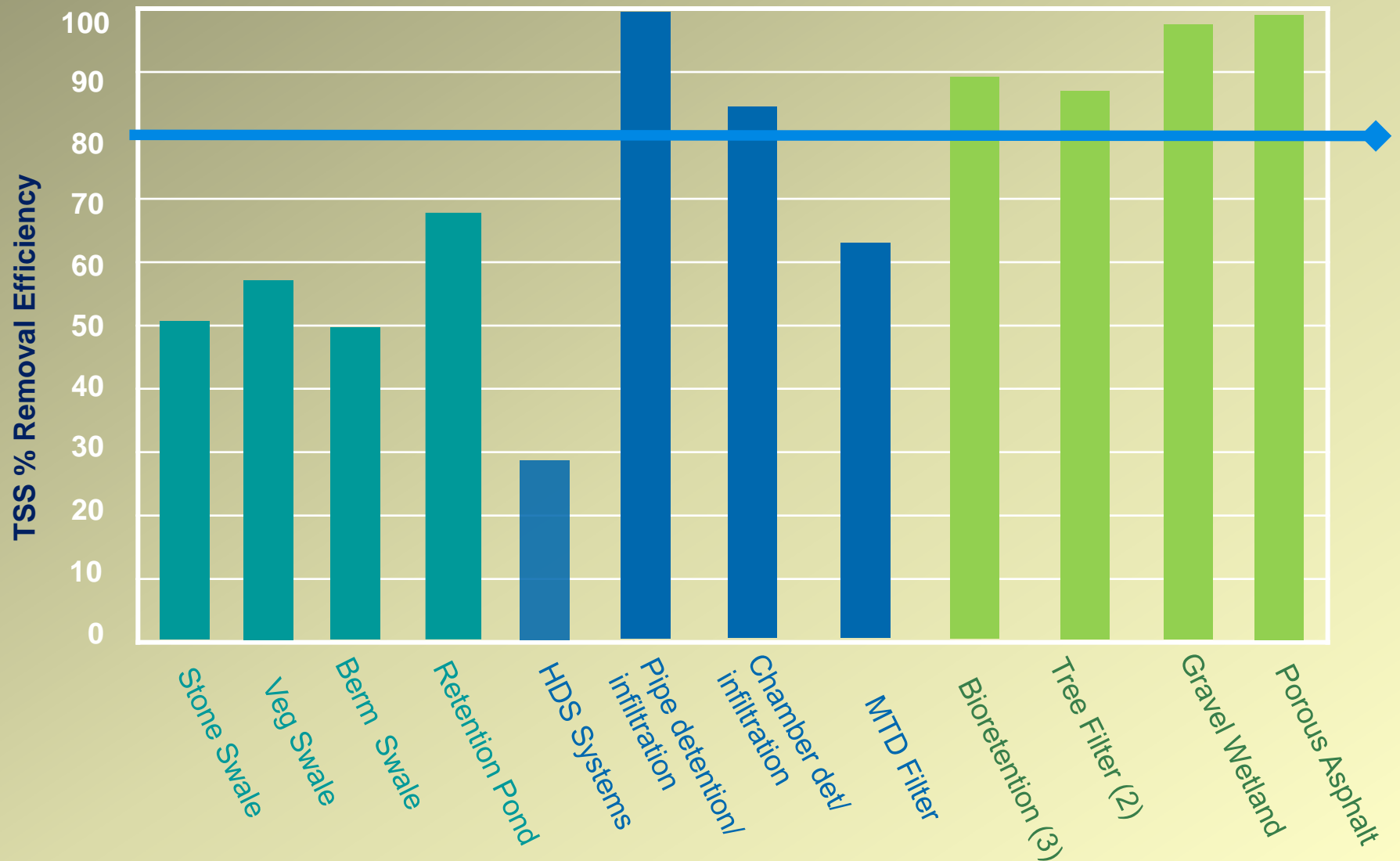
BMP Maintenance/acre/yr by Catagory



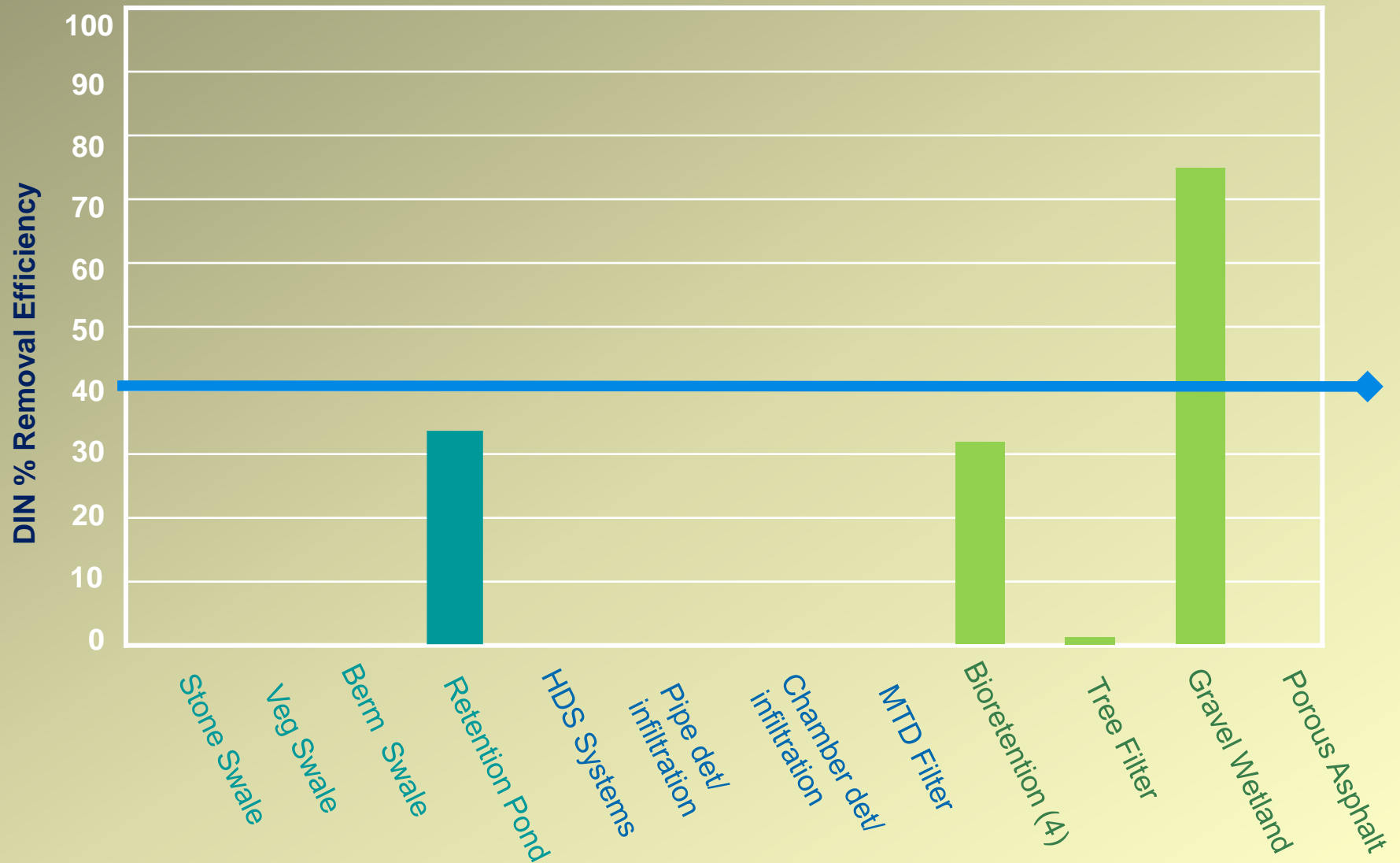
Economics of Installation vs Maintenance Costs, normalized by area

Parameter	Vegetated Swale	Wet Pond	Dry Pond	Sand Filter	Gravel Wetland	Bioretention	Porous Asphalt
Capital Cost (\$)	12,000	13,500	13,500	12,500	22,500	21,550	21,800
Inflated 2012 Capital Cost	14,600	16,500	16,500	15,200	27,400	25,600	26,600
Maintenance and Capital Cost Comparison	17.8	5.4	6.9	5.4	12.8	13.5	24.6
Personnel (hr/yr)	9.5	28.0	24.0	28.5	21.7	20.7	6.0
Personnel (\$/yr)	823	3,060	2,380	2,808	2,138	1,890	380
Subcontractor Cost (\$/yr)	0	0	0	0		0	700
Total Operational Cost (\$/yr)	823	3,060	2,380	2,808	2,138	1,890	1,080
Operation/Capital Cost (%)	6%	19%	14%	18%	8%	8%	4%

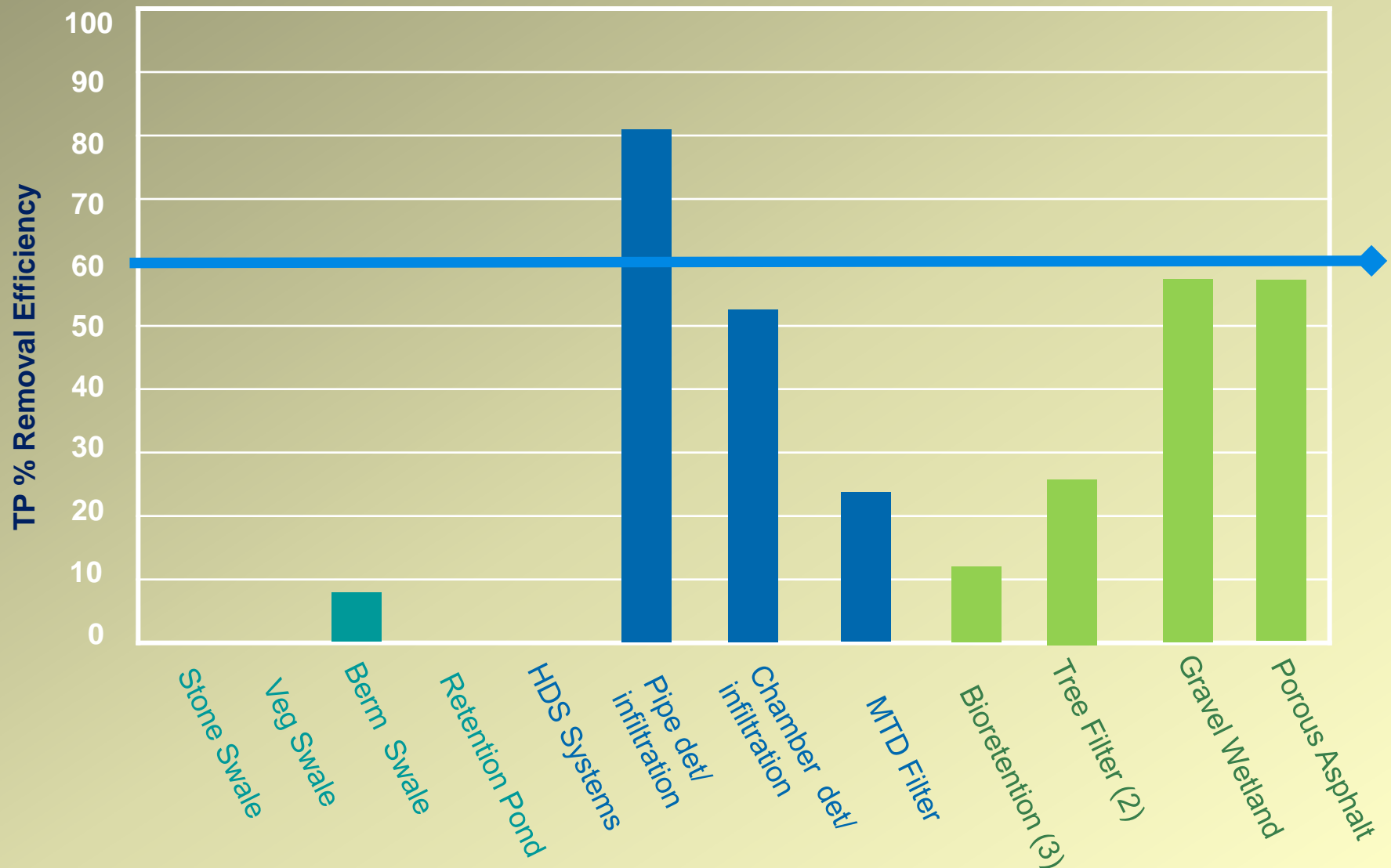
TSS Removal Efficiencies



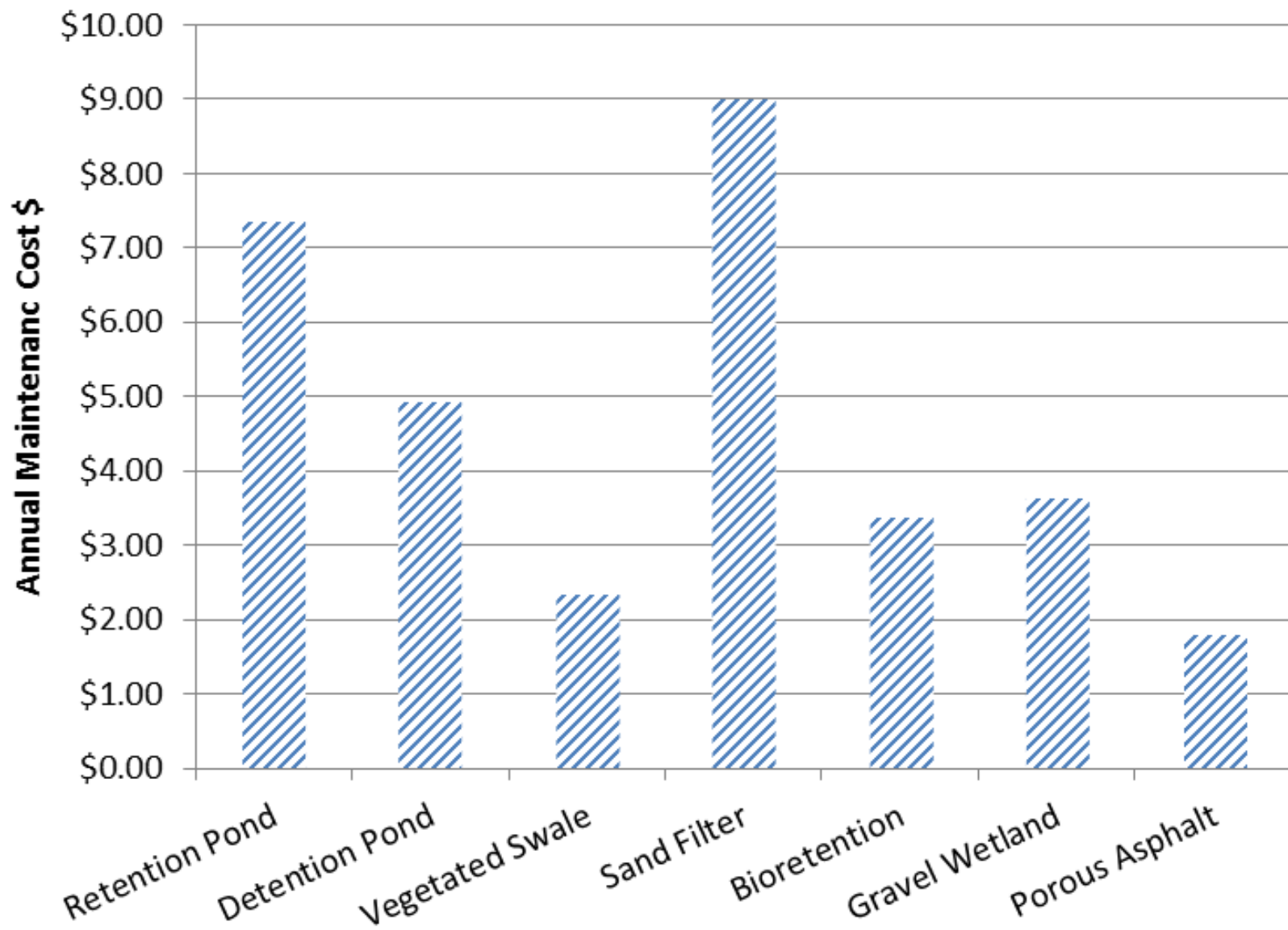
DIN Removal Efficiencies



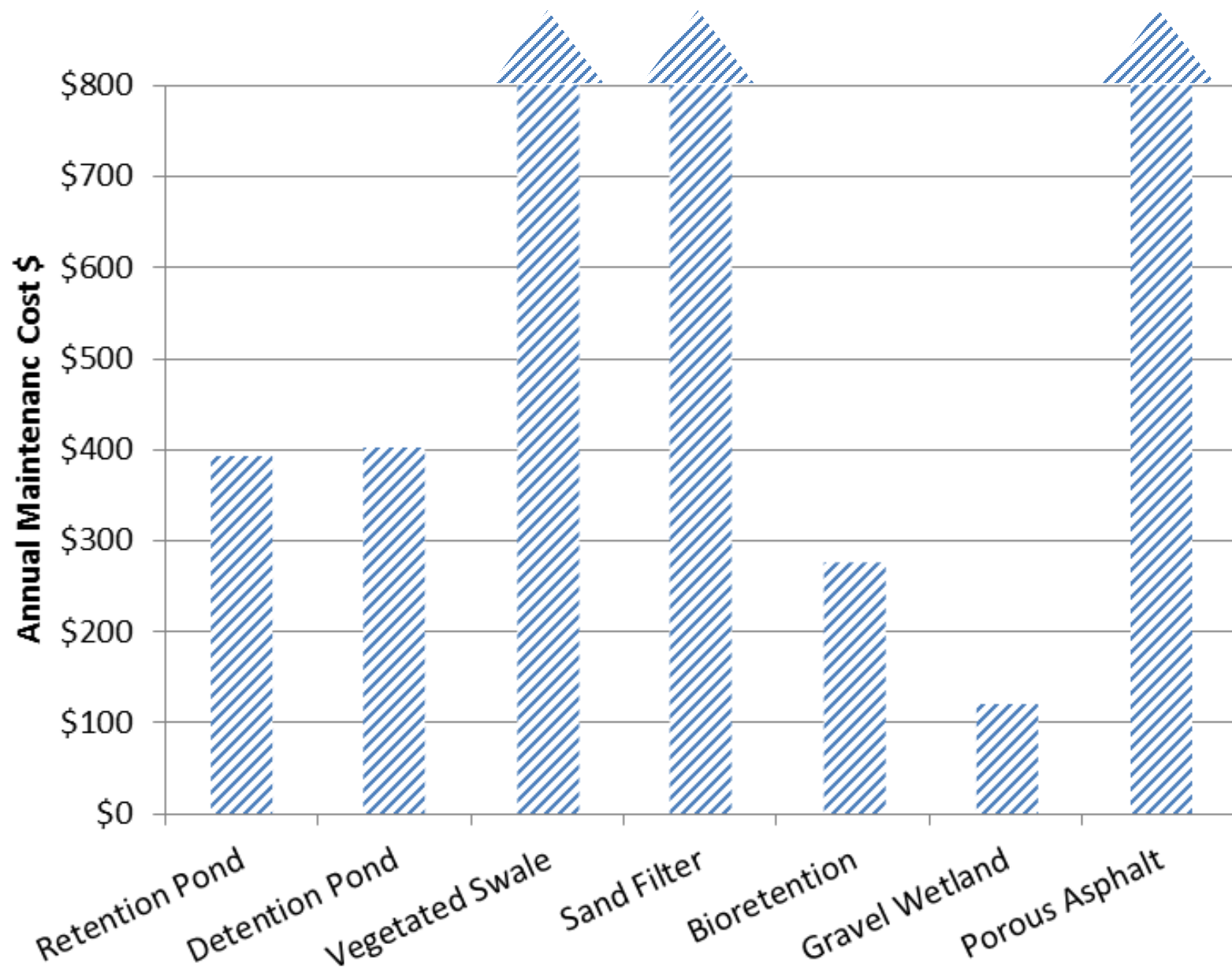
TP Removal Efficiencies



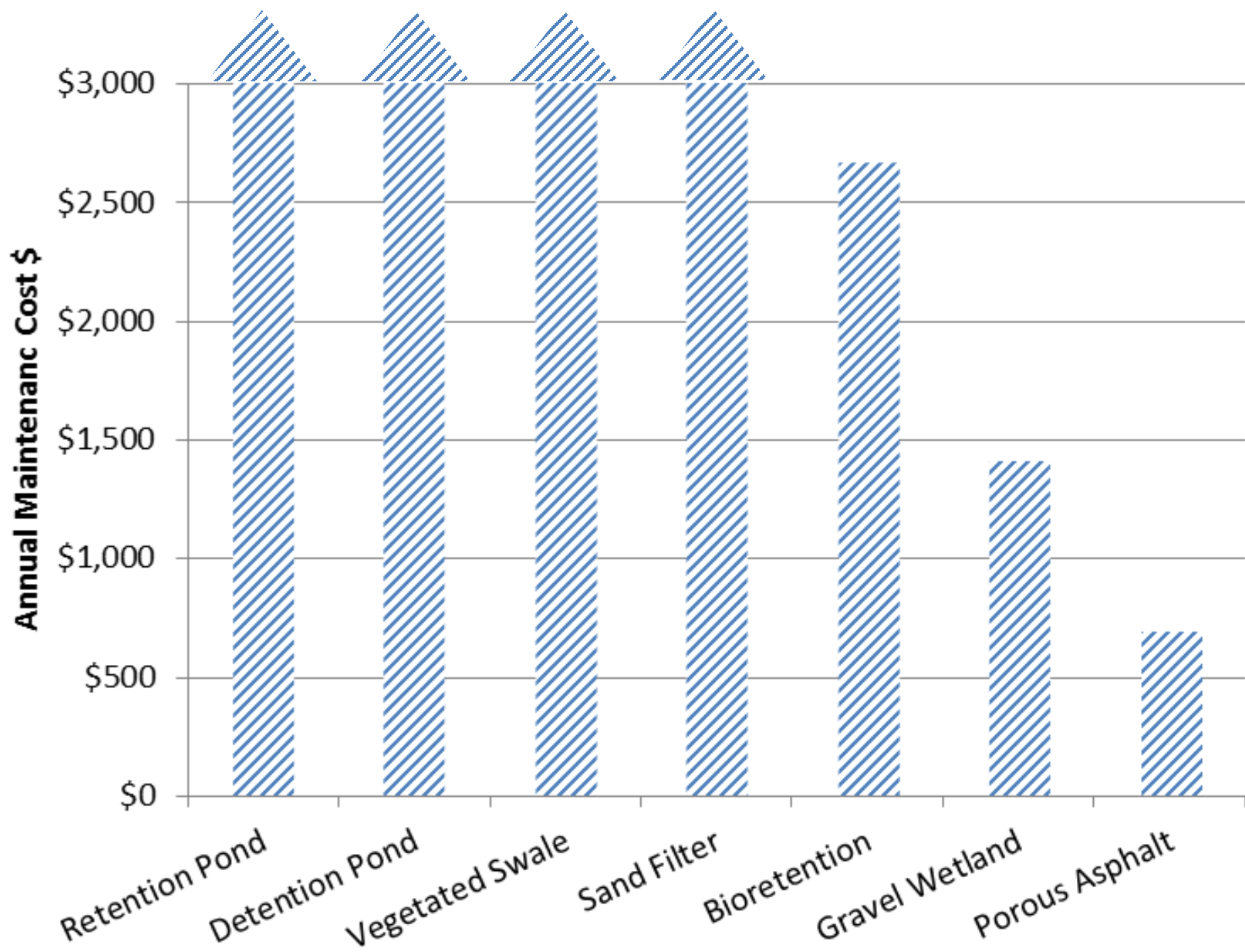
▨ Maintenance Cost/yr/acre/lb TSS



▨ Maintenance Cost/yr/acre/lb DIN as TN



▨ Maintenance Cost/yr/acre/lb TP



Conclusions

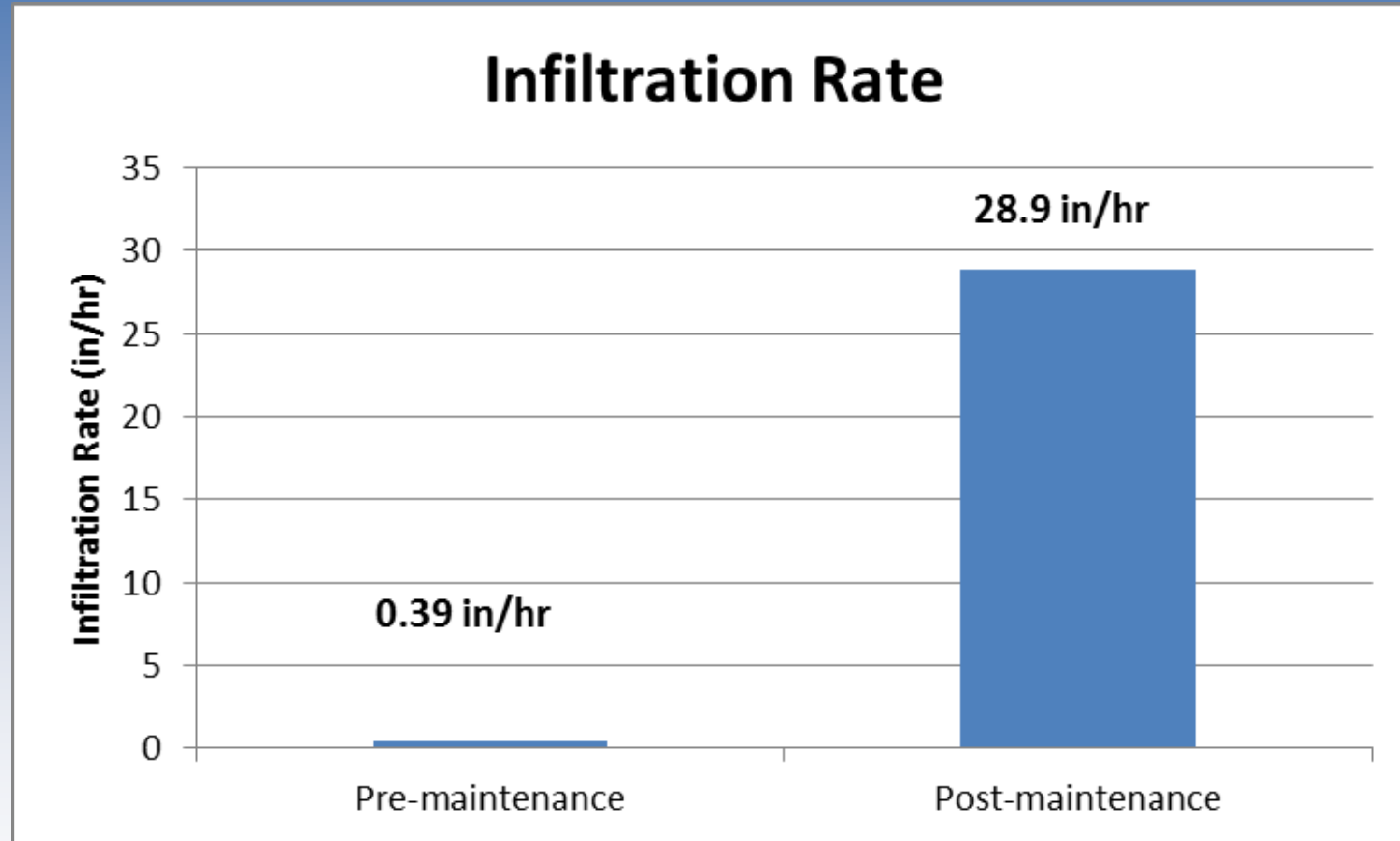
- All advanced stormwater systems require maintenance
- LID maintenance is often simple, low cost consistent with standard landscaping practices
- Estimations based on % of capital costs are not reliable
- Consider requiring permanent sureties
- Fine filter media systems may have reduced service life due to clogging—easily serviced—sand filters and bioretention
- Every site and system is different
- The more system maintenance can be standardized the lower the anticipated maintenance costs.



Questions???



Result of Maintenance



Bioretention Parking Lot Retrofit, Durham, NH



**Pollutant
(per year)**

Amount

TSS

179 lbs.

Cigarette Butts

4,392

Misc. Trash

752



Maintenance Activity	Minimum Frequency	Estimated Time Commitment	Number of Employees
Inspection	2 times per year	30 minutes taking time to fill out checklist in UNHSC document ¹	1
Clean Pretreatment Trash Screens and Pick Up Trash in system	1 time per month on average	30-60 minutes per visit	1
Spring Cleaning	1 time per year	4 hours	2

Total personnel hours per year: 16-21 hours
Estimated \$1,500 – \$2,000 (30,000 sf of IC Treated)