



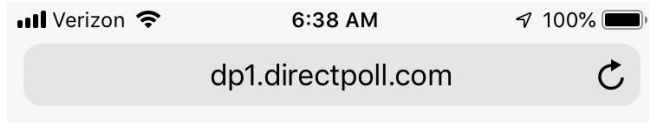
When and How to Modify Stormwater Design Standards for Climate Resiliency

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October 30, 2018

Voting Instructions

<http://etc.ch/DFVo>



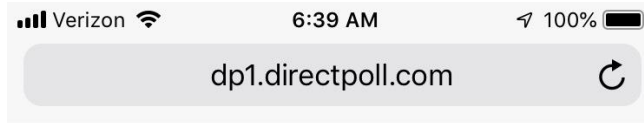
DirectPoll 

Does your community use stormwater design standards that account for climate change?

☐ Yes

☐ No

VOTE



DirectPoll 

Your votes have been registered!

Thank you for participating!

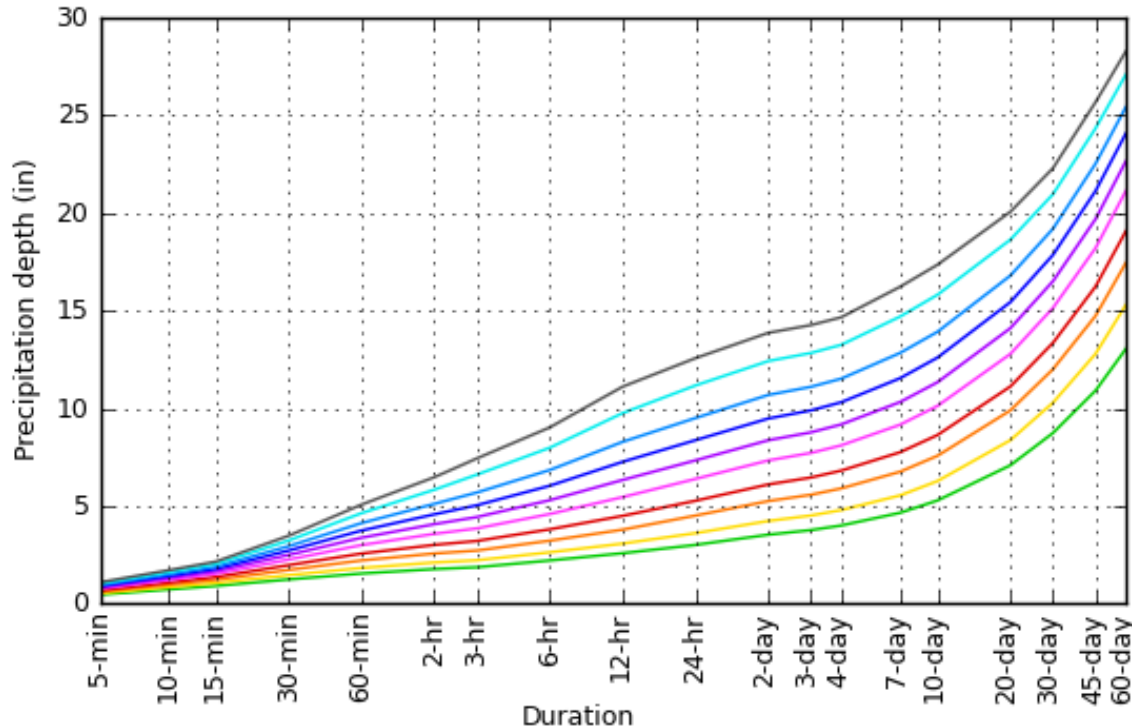
Create your own, free poll anytime with us!

DirectPoll.com



Design Storm Background

PDS-based depth-duration-frequency (DDF) curves
Latitude: 33.9833°, Longitude: -81.0167°



Used for:

- Peak flow estimates
- Runoff volume estimates
- Synthetic hydrographs
- Runoff routing

NOAA Atlas 14, Volume 2, Version 3

Stormwater Conveyance Design Implications

- Pipe sizing
- Size, location, and number of storm inlets
- Prevalence of surcharged / deficient infrastructure

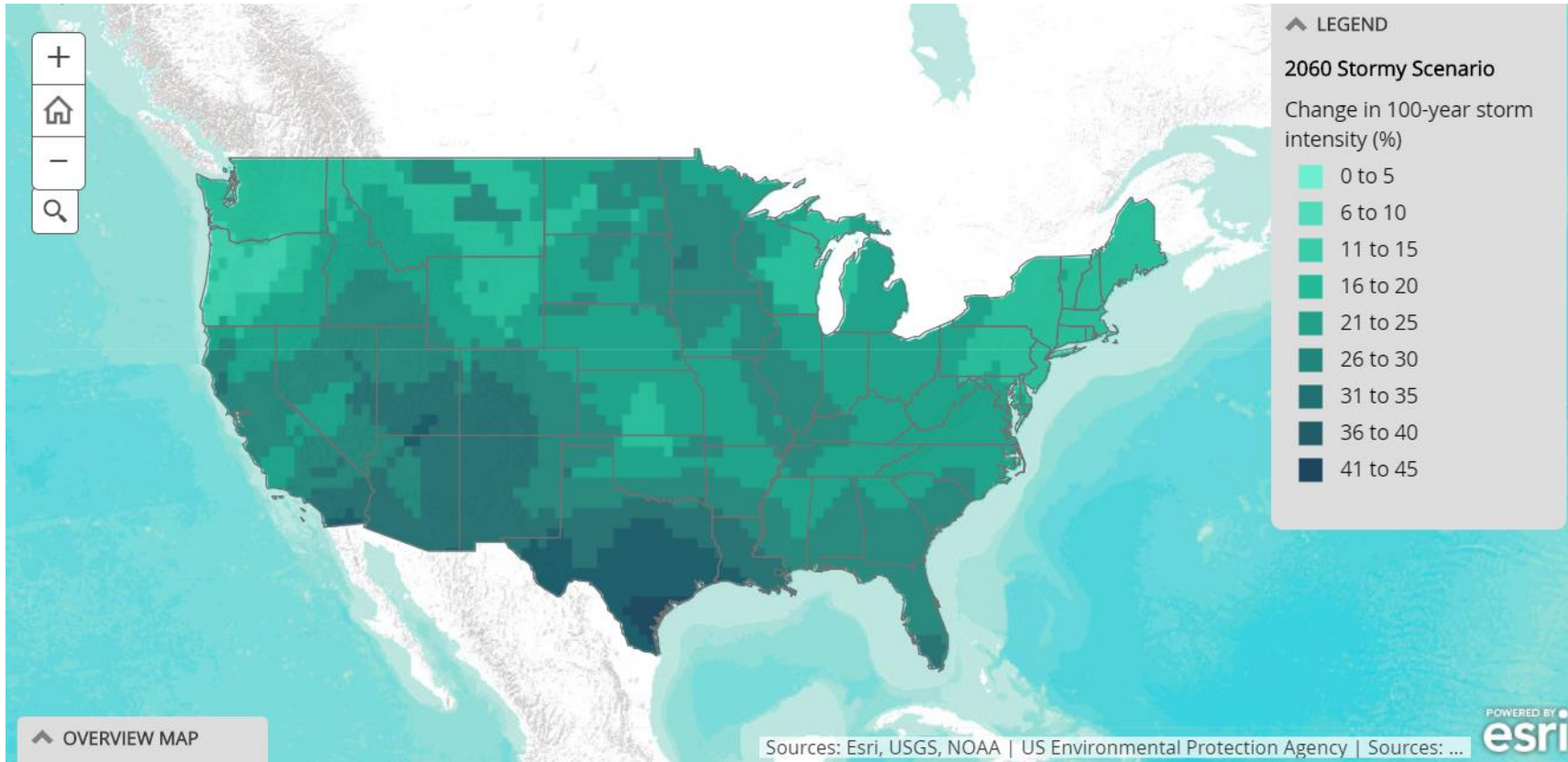


Stormwater Control Design Implications

- BMP storage volume
- Outlet structure design
- Prevalence of undersized BMPs
- Modified drawdown and siting criteria

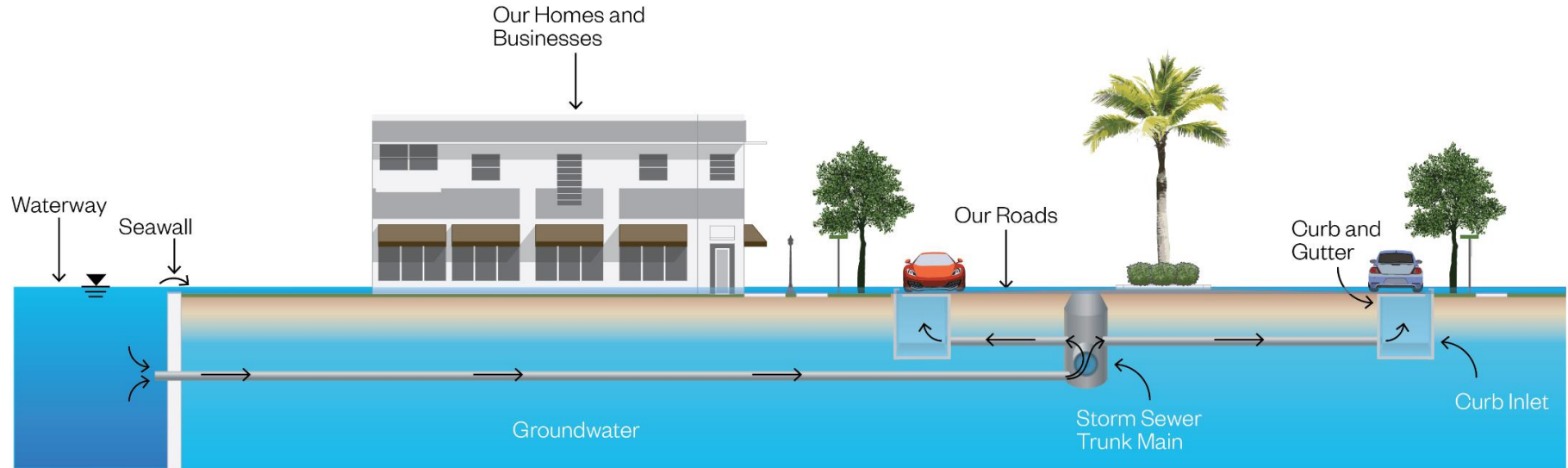


Accounting for Climate Change in Design Storms



EPA CREAT Climate Scenarios Projection Map

Accounting for Sea Level in Boundary Conditions



Poll Question

What is the level of interest in design standard changes in your community?

- Coastal - high interest
- Coastal - low interest
- Non-coastal - high interest
- Non-coastal - low interest



Poll Question

Does your community use stormwater design standards that account for climate change?

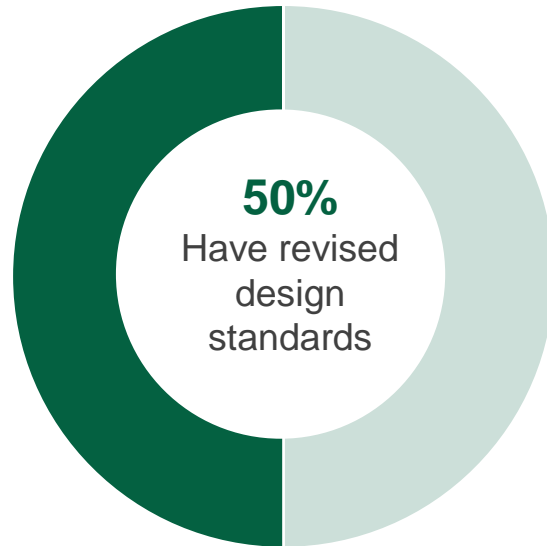
- Coastal - Yes
- Coastal – No
- Non-Coastal – Yes
- Non-Coastal - No



Storm Depths | Storm Intensities | Sea Level Rise

What are other communities doing?

Innovative & Integrated Stormwater Management Report Results



Approaches to Design Storm Adjustments



Different recurrence interval



Change in depth / intensity
based on historical analysis



Change in depth / intensity
based on climate forecasts

Different Recurrence Interval

Approaches to Design Storm Adjustments

Familiar adjustment

More protective than no adjustment

Doesn't directly correlate with climate change forecasts

Incremental increase could be large

Columbia, SC Example

Recurrence Interval	24-hr Depth	% Increase from 5-yr
5-yr	4.52"	0%
10-yr	5.28"	17%
25-yr	6.39"	41%
50-yr	7.33"	62%

Change Based on Revised Historical Analysis

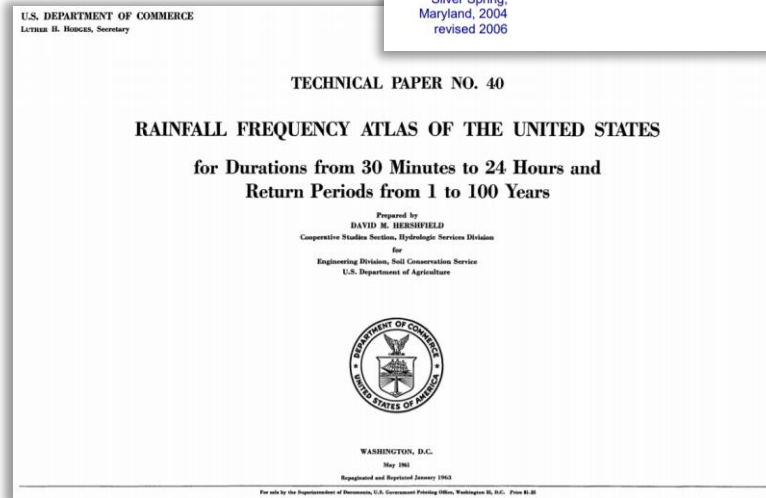
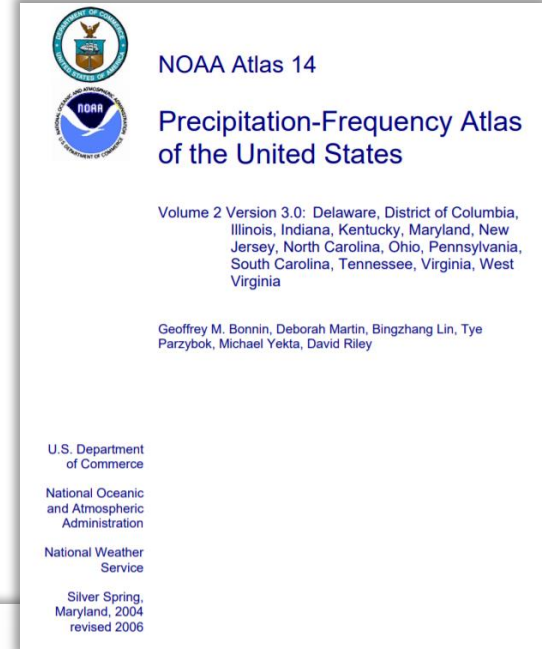
Approaches to Design Storm Adjustments

Use of more recent data

Limited uncertainty

Possibly less stakeholder resistance to change

Doesn't account for future conditions



Change based on climate forecasts

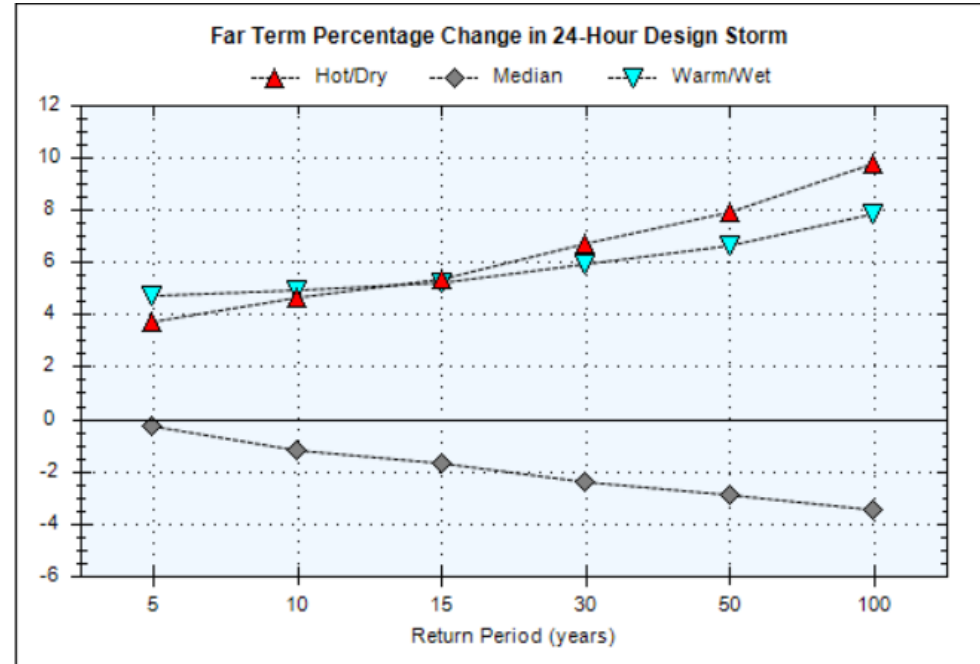
Approaches to Design Storm Adjustments

Potentially most representative of future needs

Aspects of uncertainty

Decisions regarding time period, scenario, methodology

Variable adjustment increment



Poll Question

What approach is preferred for design storm adjustments?

- Different recurrence interval
- Change in depth/intensity based upon historical analysis
- Change in depth/intensity using climate forecasts
- No change needed



Design Storm Changes

SWMM-CAT - 2045-2074 Projections

	10-yr Design Storm Depth			100-yr Design Storm Depth		
	Hot/Dry	Median	Warm/Wet	Hot/Dry	Median	Warm/Wet
Myrtle Beach	3.9%	-0.9%	5.3%	9.9%	-1.9%	9.0%
Charleston	4.0%	-1.4%	4.8%	9.6%	-1.9%	8.8%
Hilton Head	4.3%	-1.8%	4.4%	9.9%	-2.4%	8.5%
Aiken	4.8%	-1.2%	4.3%	10.0%	-3.9%	6.9%
Columbia	4.6%	-1.2%	4.9%	9.7%	-3.5%	7.8%
Florence	4.4%	-0.7%	5.5%	9.4%	-2.7%	8.8%
Greenville	5.8%	-0.2%	4.8%	10.1%	-4.3%	5.6%
Anderson	6.0%	1.6%	4.5%	10.5%	2.2%	4.8%
Rock Hill	5.3%	-0.3%	5.3%	9.8%	-3.6%	7.1%

Design Storm Changes

Differences in Scenario Grouping

	SWMM-CAT 100-yr Design Storm Depth			EPA CREAT 100-yr Design Storm Depth	
City	Hot/Dry	Median	Warm/Wet	Stormy	Not as Stormy
Myrtle Beach	9.9%	-1.9%	9.0%	27.1%	6.6%
Charleston	9.6%	-1.9%	8.8%	28.4%	6.5%
Hilton Head	9.9%	-2.4%	8.5%	28.5%	6.7%
Aiken	10.0%	-3.9%	6.9%	25.7%	7.8%
Columbia	9.7%	-3.5%	7.8%	25.8%	7.6%
Florence	9.4%	-2.7%	8.8%	25.8%	7.0%
Greenville	10.1%	-4.3%	5.6%	23.3%	3.8%
Anderson	10.5%	2.2%	4.8%	23.4%	3.4%
Rock Hill	9.8%	-3.6%	7.1%	24.7%	8.4%

Challenges with Design Standard Modifications



Cost



Uncertainty

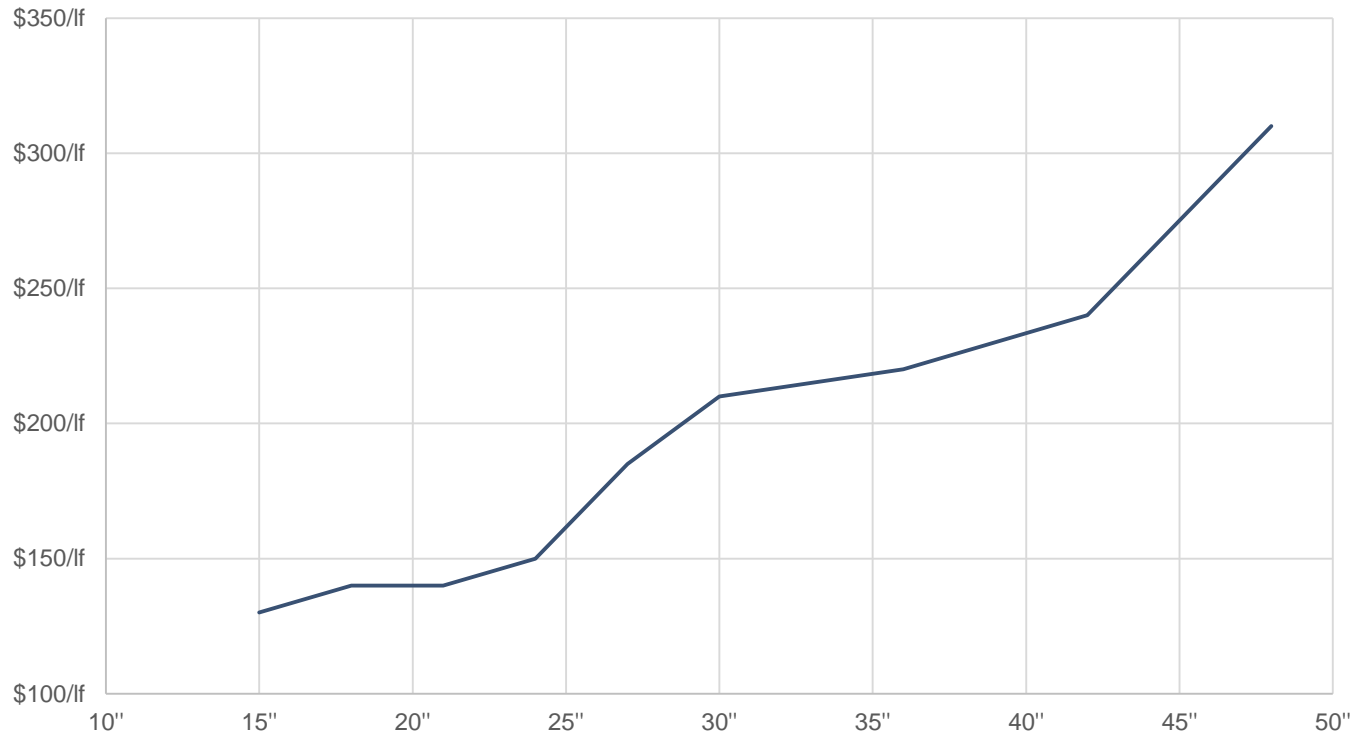


Stakeholders

Cost Implications of Pipe Size Change

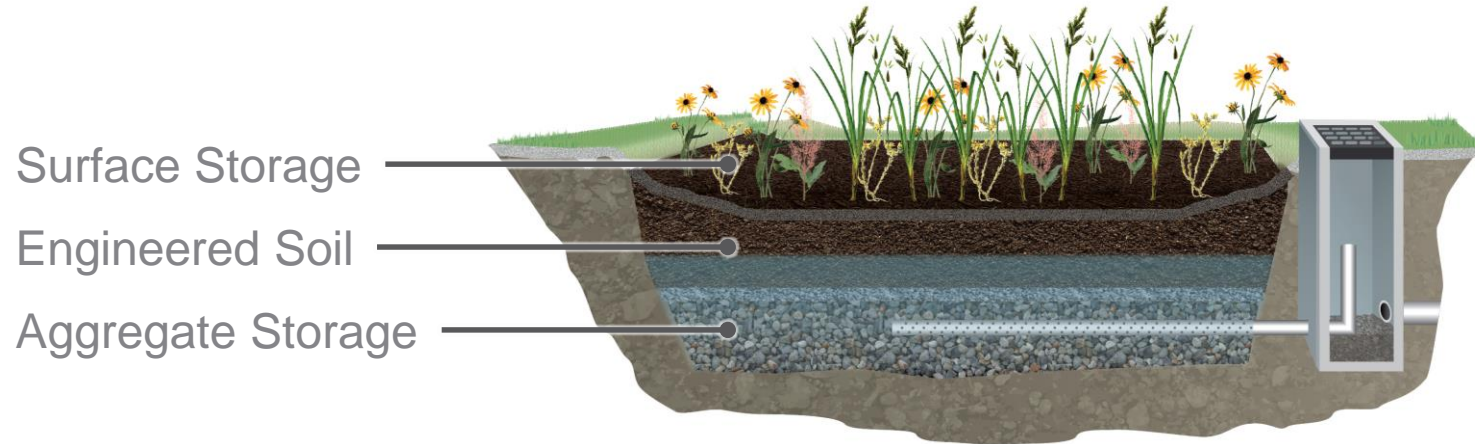
Challenges with Design Standard Modifications

Example Storm Conveyance Pipe Costs

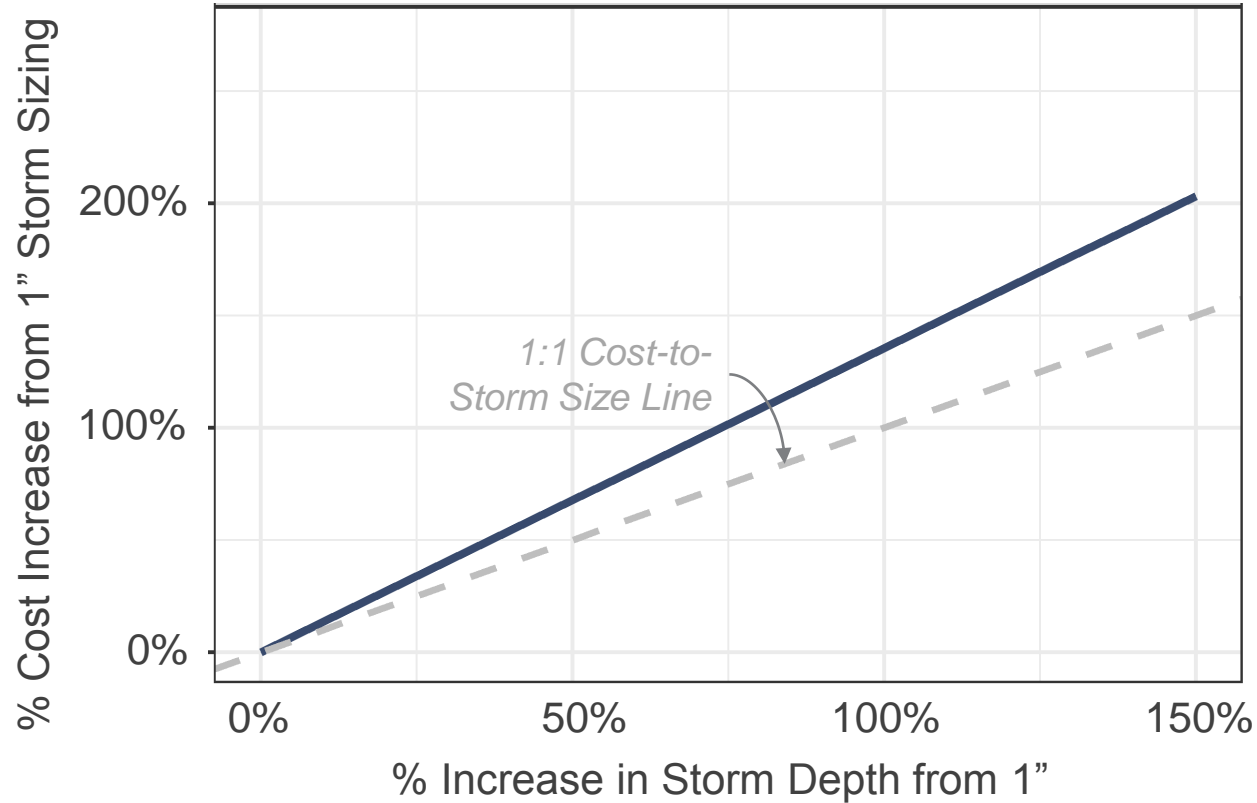


Cost Implications of WQ BMP Sizing

Challenges with Design Standard Modifications




Cost Implications of WQ BMP Sizing



Stormwater Detention Control Design Example

Parameter	Current 10-yr, 24-hr	Warm / Wet 2060 10-yr, 24-hr
Storm Depth	5.7 in	6.0 in
Pre-Dev Runoff	9.3 cfs	10.1 cfs
Post-Dev Runoff	14.2 cfs	15.0 cfs
Storage Volume	10,600 ft ³	10,970 ft ³
Peak WSE	2.4 ft	2.5 ft



5% Increase

Marginal increase in peak WSE and storage volume
No design changes required in this instance

Poll Question

What is the most significant hurdle to revising design standards?

- Lacking guidance
- Cost / developer opposition
- Difference from neighboring communities



Poll Question

What could be done to best facilitate changes?

- Outreach on costs & benefits
- Tools to inform need for change
- Regional / collaborative guidance



What are benefits of making changes now?



Greater level of protection

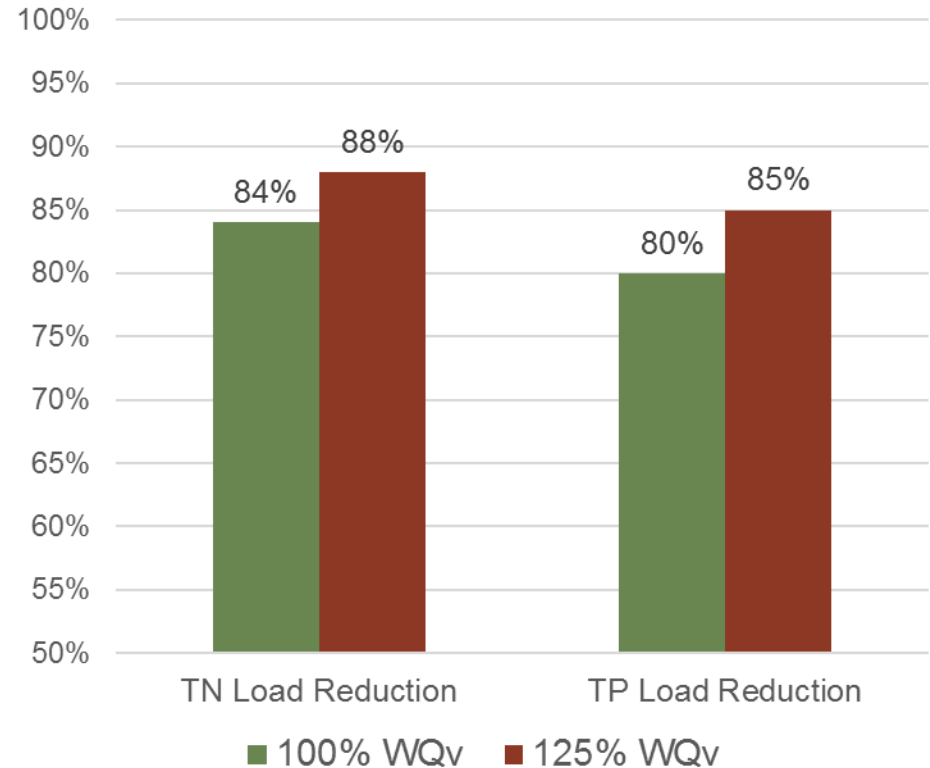
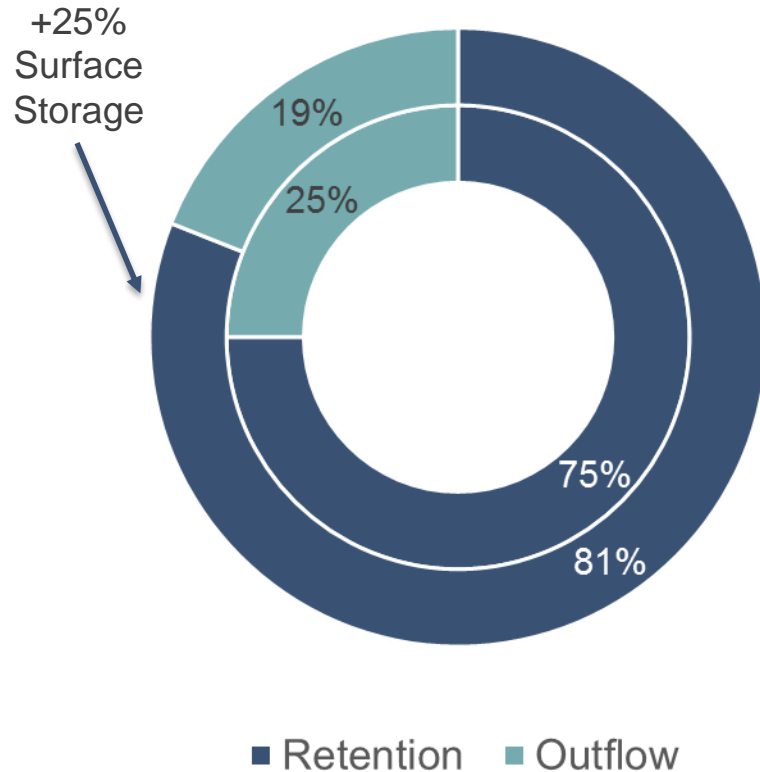


Reduced need for future retrofits



Improved performance

Implications of 25% Increase in Bioretention Surface Storage





Questions?

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