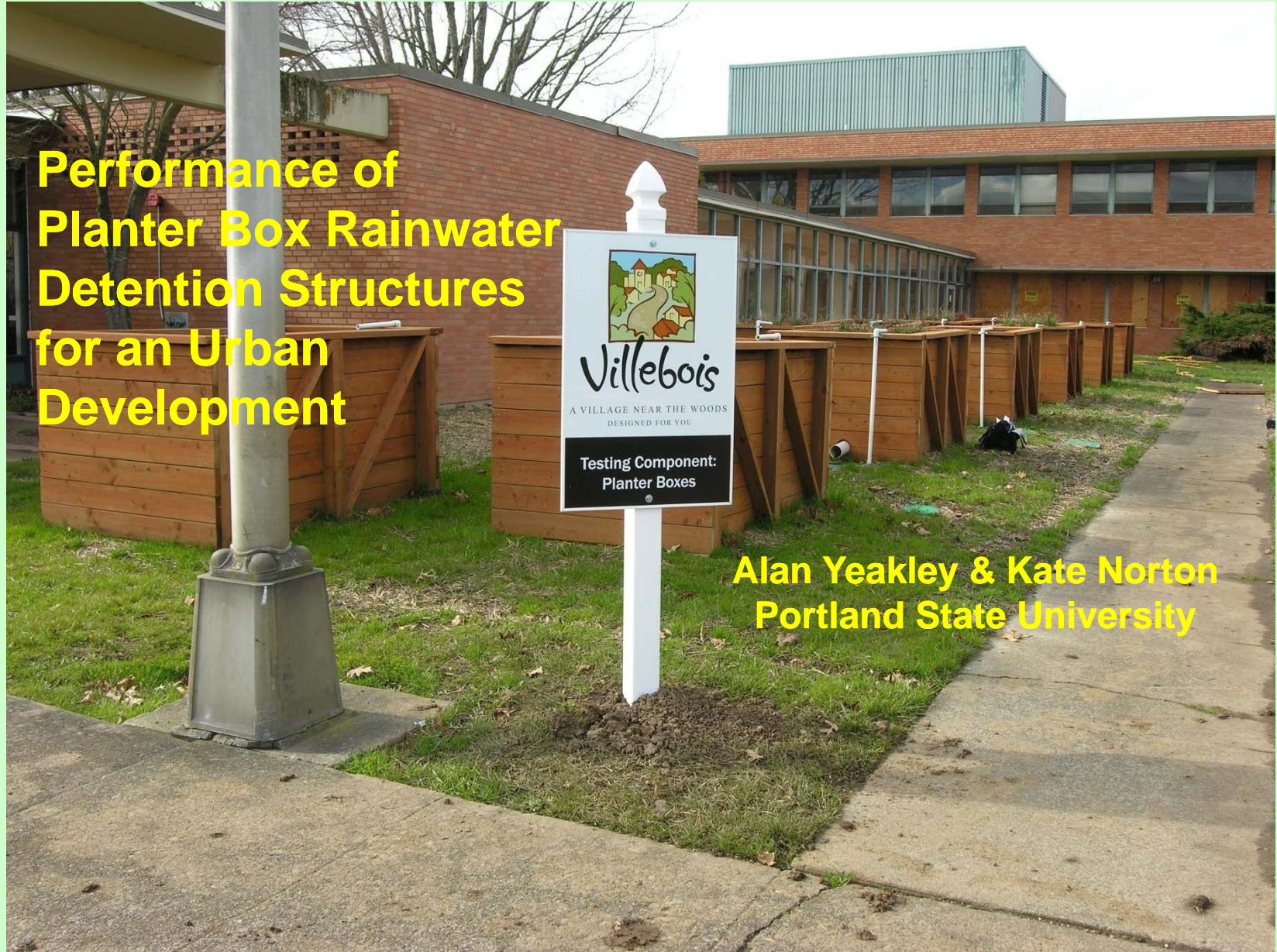


**Performance of
Planter Box Rainwater
Detention Structures
for an Urban
Development**



**Alan Yeakley & Kate Norton
Portland State University**

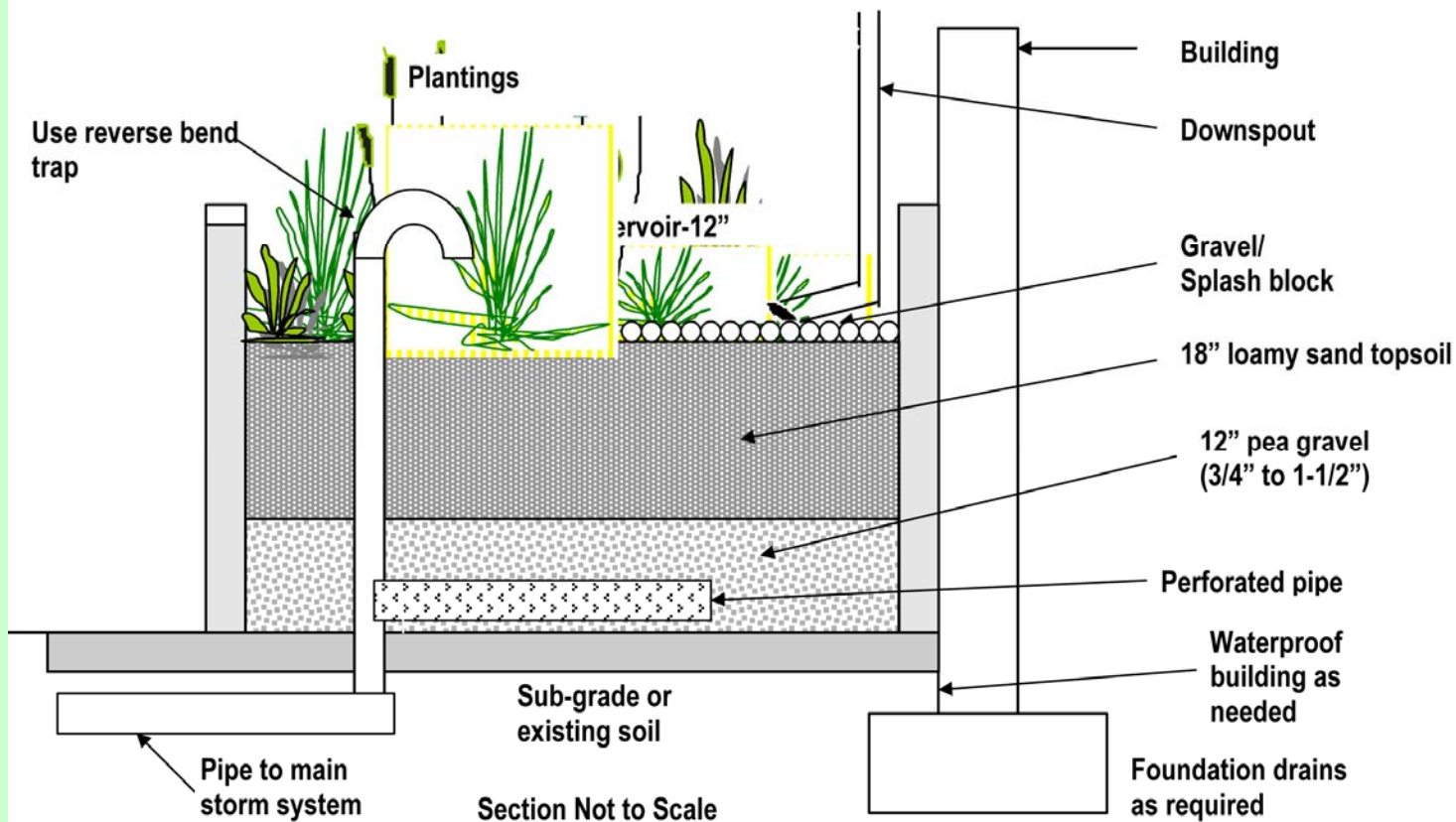


Research Questions

- How effective are planter boxes at retaining stormwater?
 - Volume
 - Time delay
- Do planter box characteristics affect retention efficiency?
 - Soil texture
 - Soil depth
 - Filter liner

2.3 Stormwater Planter

Figure 2. Stormwater Planter



Source: City of Seattle



Experimental Set-up

- 2 soil mixes (A - fine, B - coarse)
- 2 depths (23cm - shallow, 39cm - deep)
- 2 filter conditions (yes, no)

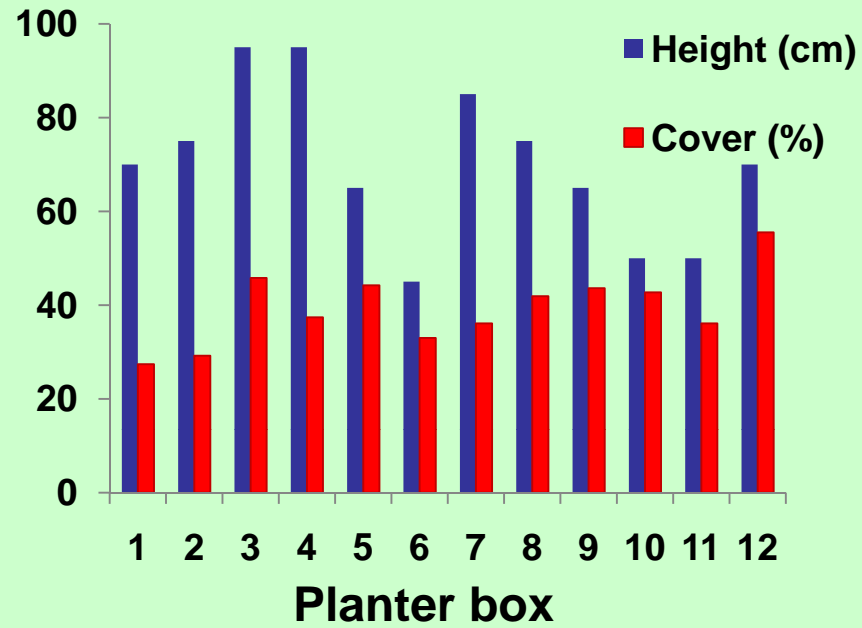
- 2 replicates for each configuration
- Similar vegetation for all boxes

- Storms to span dry and wet seasons (n=6)
- Storm target: 1 cm/24 hr (0.5 in/day)

Vegetation



Slough sedge



Fringecup

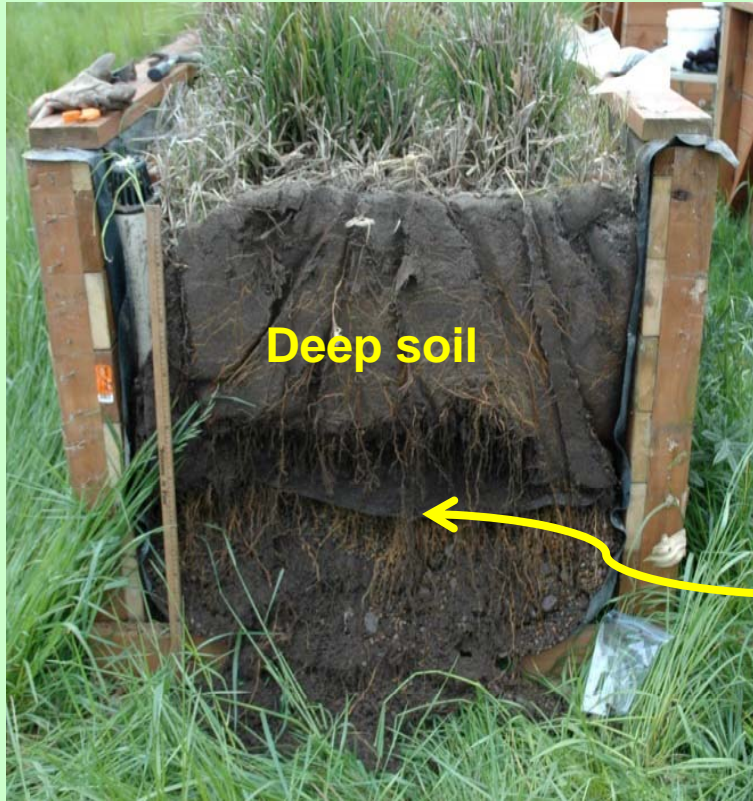


Evergreen huckleberry



Common spike-rush

Physical Characteristics



Deep soil

Fabric
liner

Fine soil texture



Shallow soil

Coarse soil texture

Water Flux

Input



Perforated
drainpipe

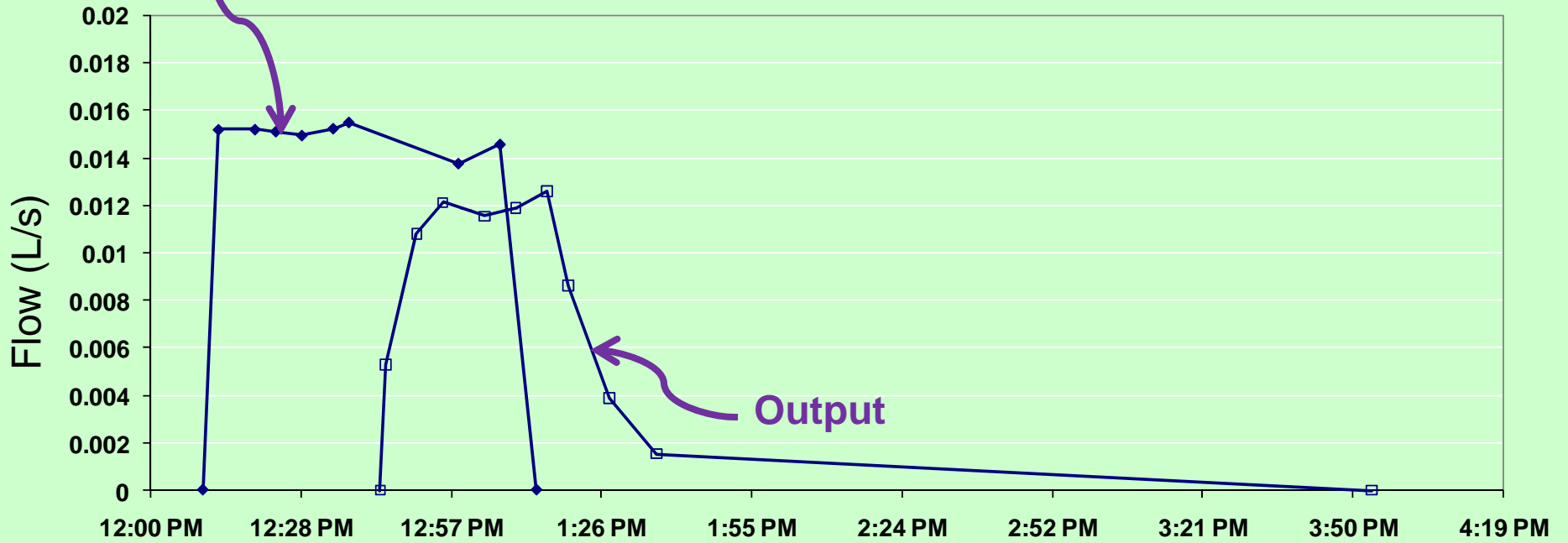


Output

An example storm

Input

Planter Box 3 on September 21, 2007

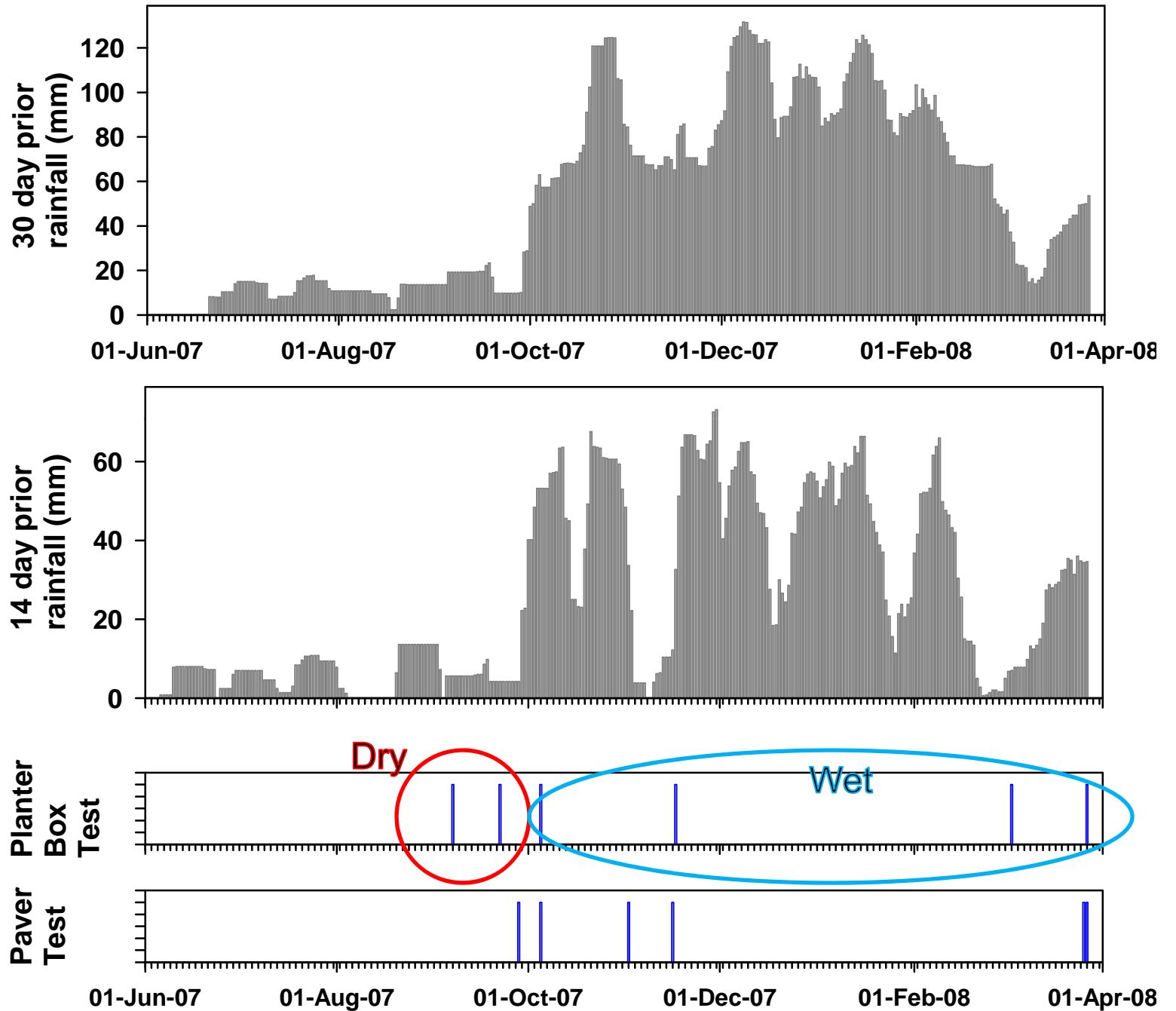


Time lag

$$\text{Retention \%} = 100 * [\Sigma(\text{Input}) - \Sigma(\text{Output})] / \Sigma(\text{Input})$$

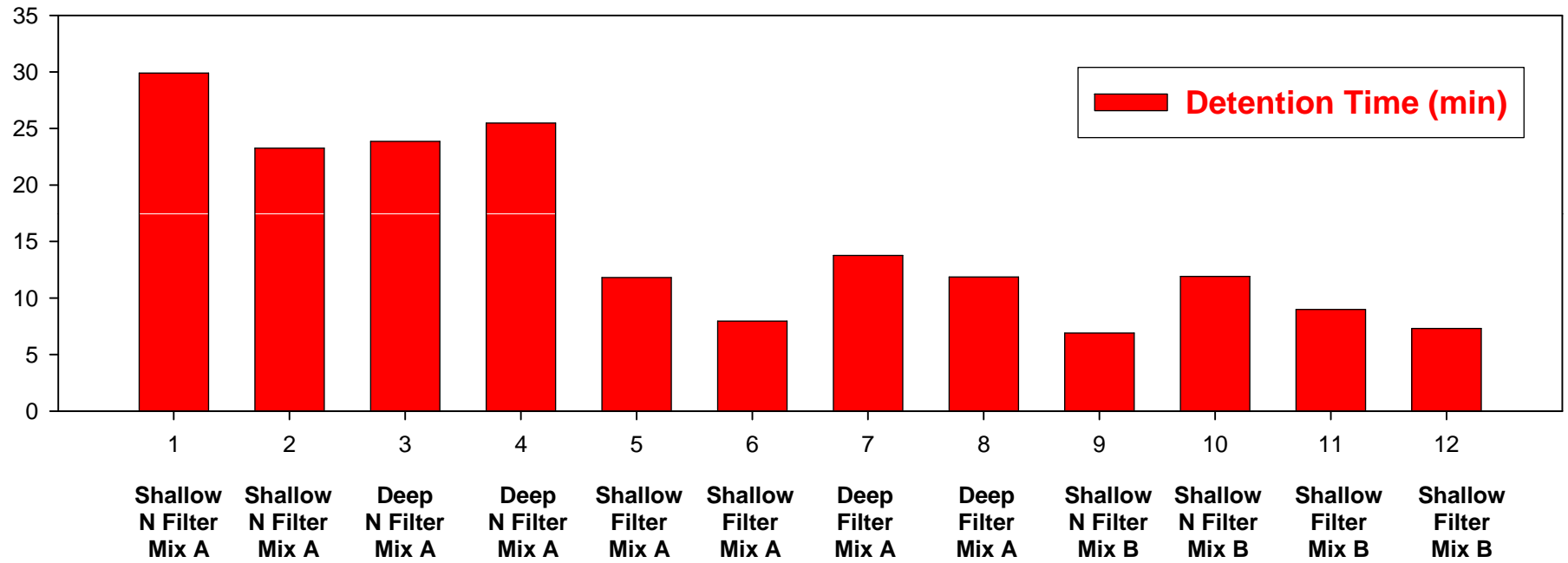
Seasonal span

Seasonal span



Detention times

Simulated Storm 7 Sep 07 (dry API)

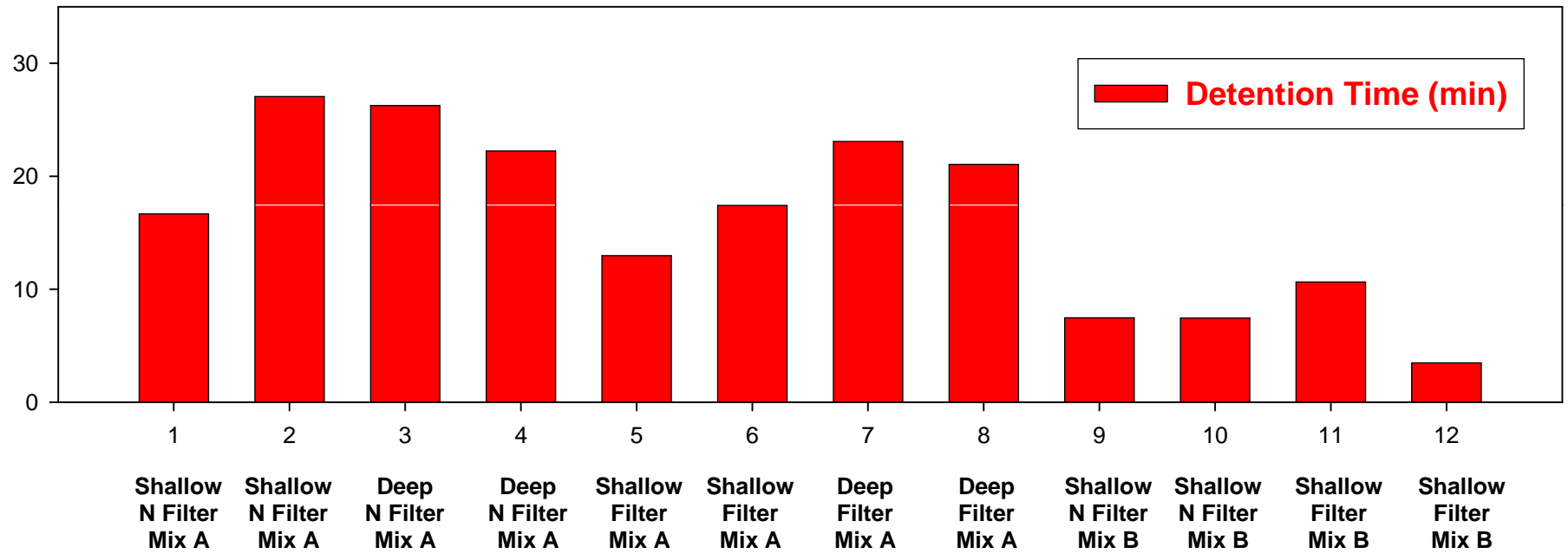


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 21 Sep 07 (dry API)

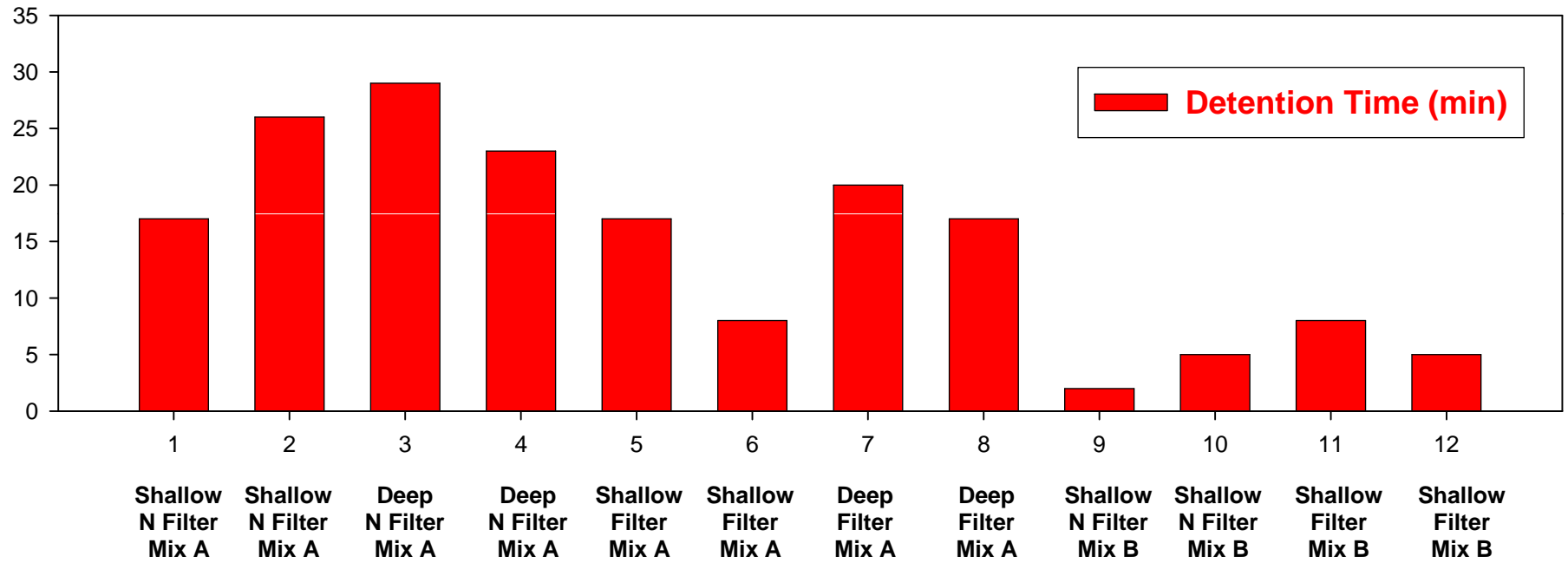


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 5 Oct 07 (wet API)

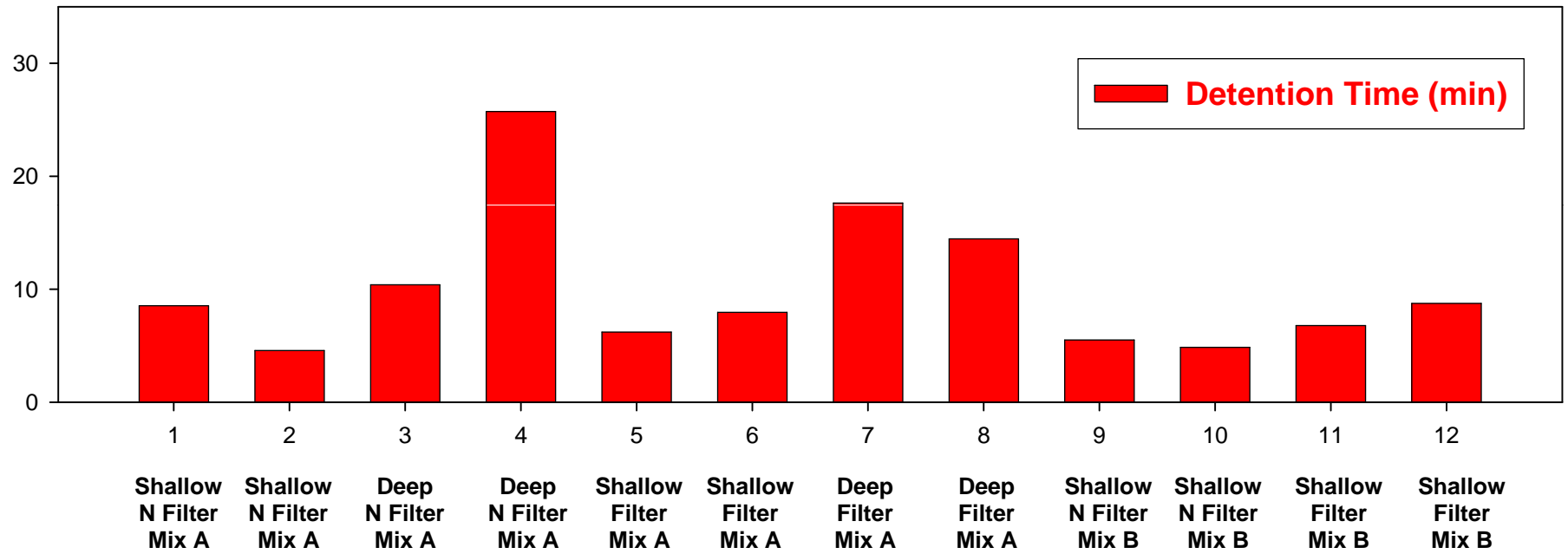


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 17 Nov 07 (moderate API)

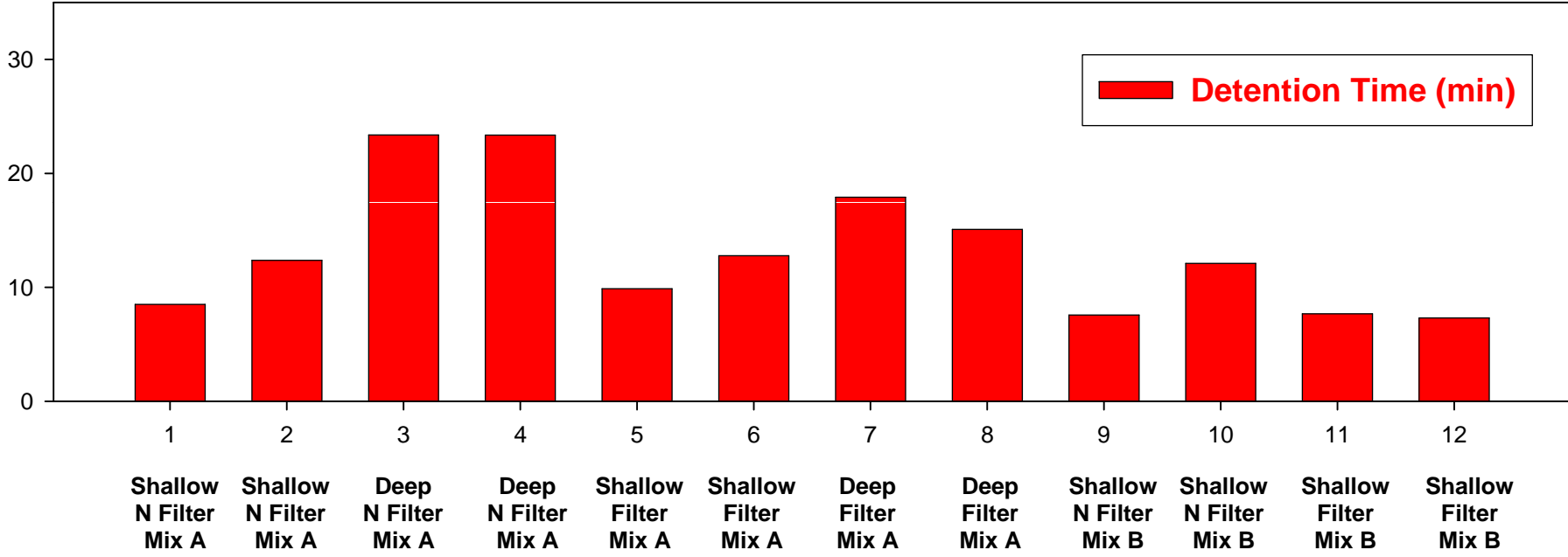


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 1 Mar 08 (moderate API)

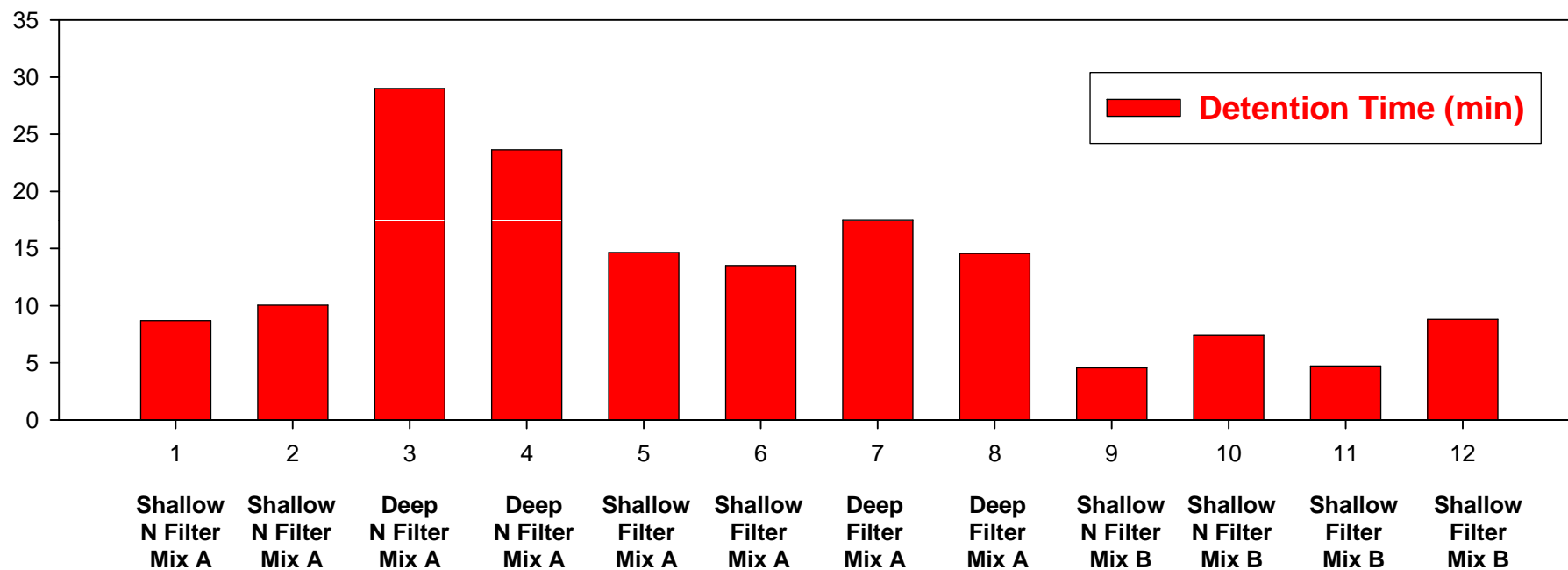


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 27 Mar 08 (wet API)



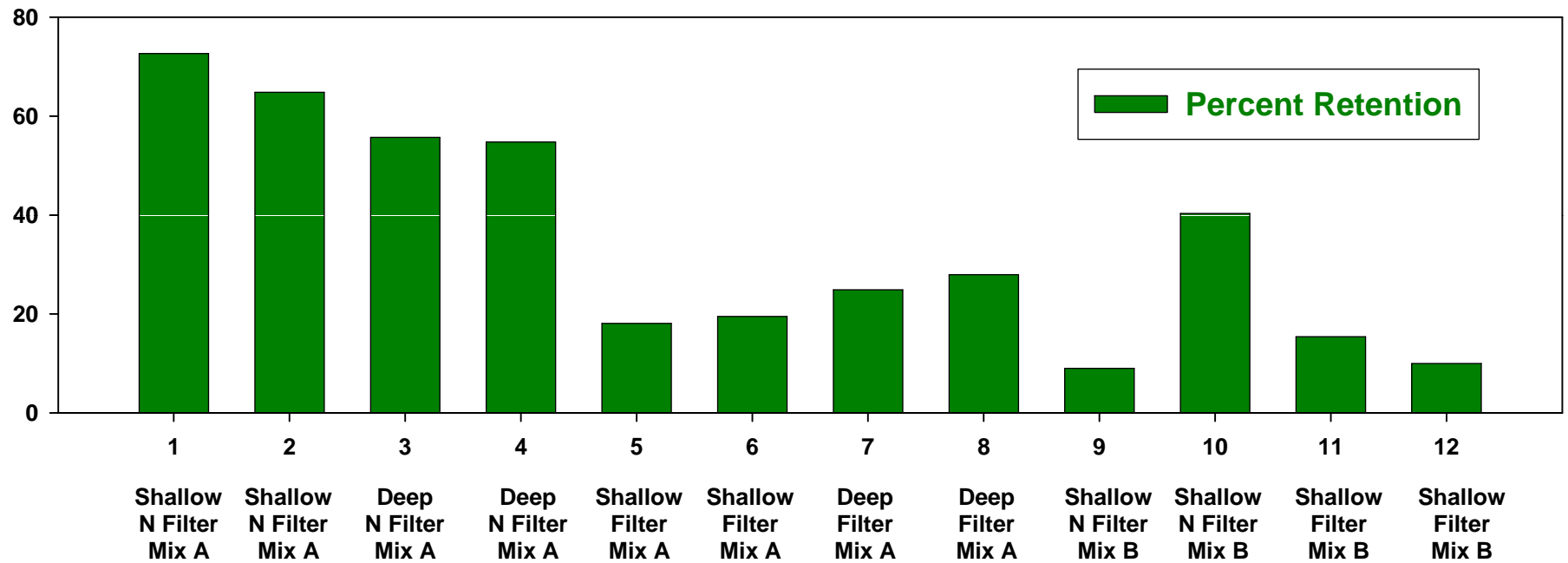
← Fine texture soil →

← Filter →

← Filter →

Detention efficiencies

Simulated Storm #1, 7 Sep 07 (dry API)

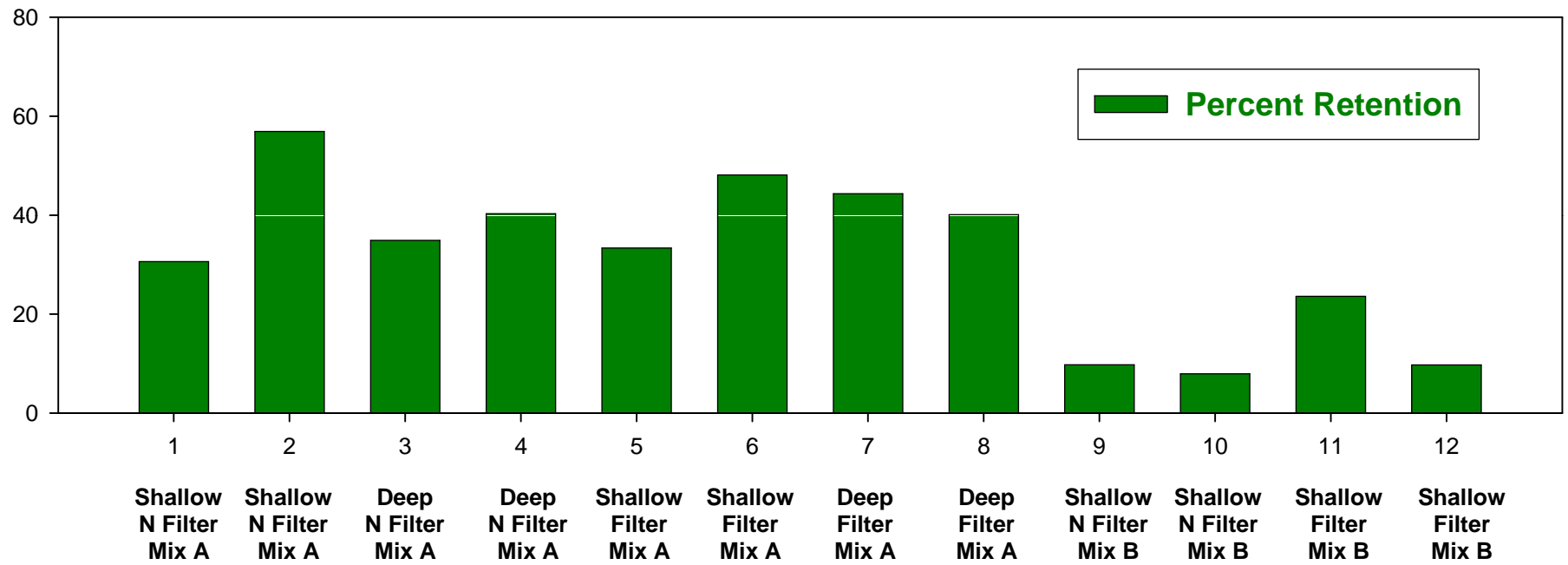


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 21 Sep 07 (dry API)

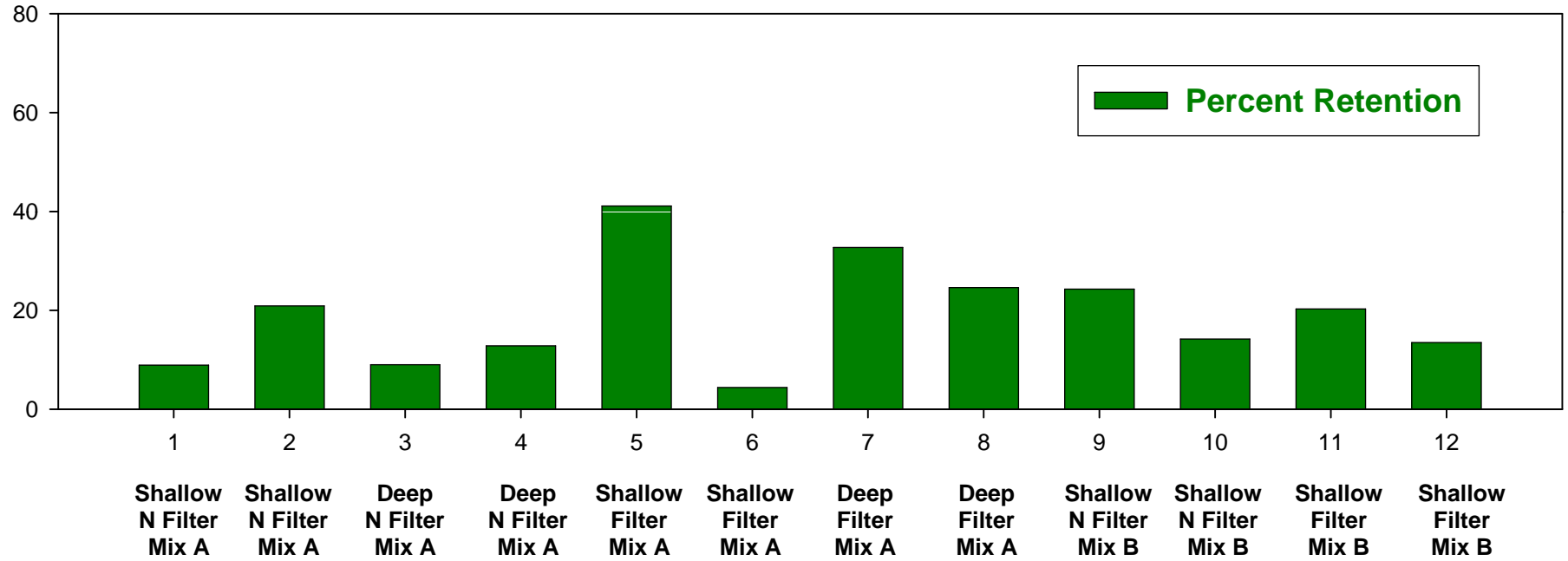


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 5 Oct 07 (wet API)

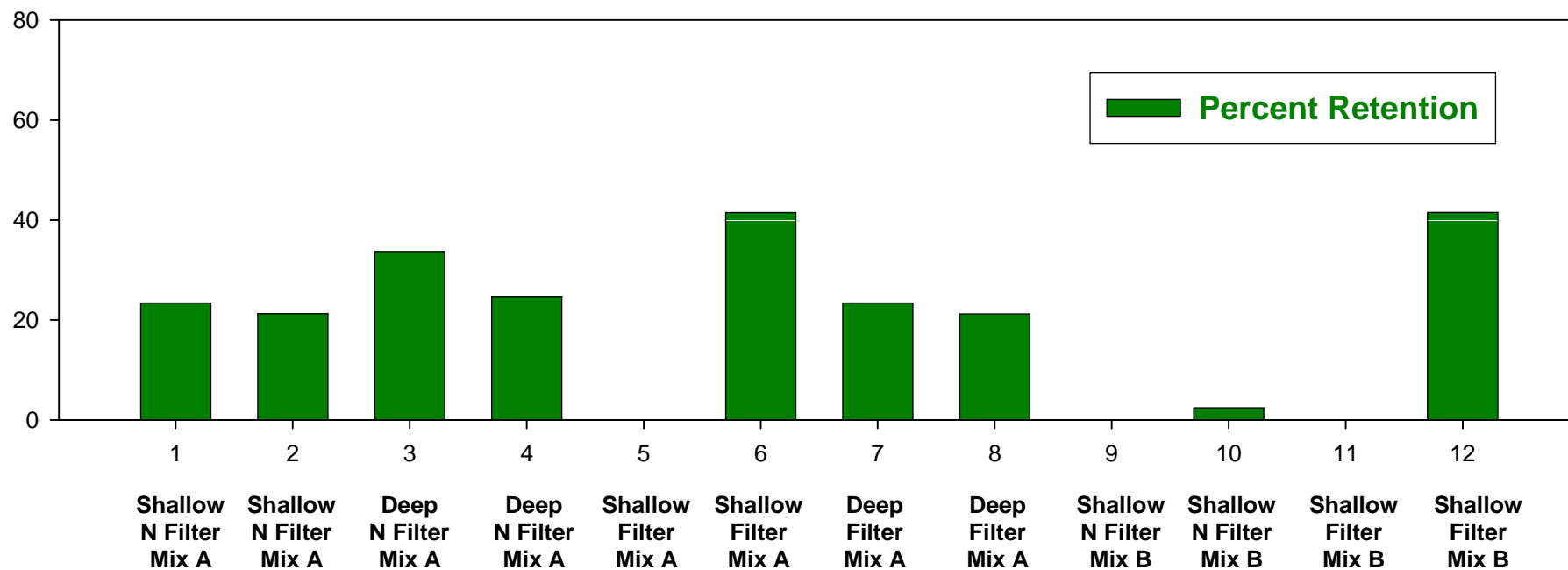


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 17 Nov 07 (moderate API)

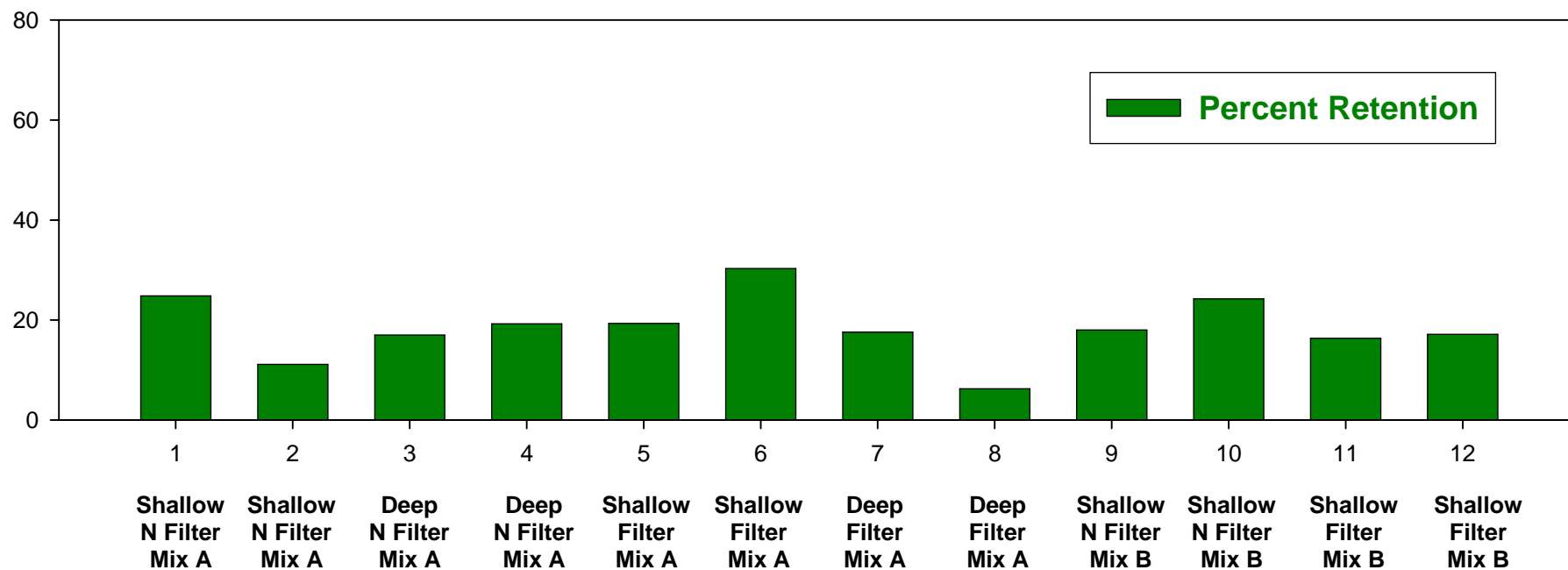


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 1 Mar 08 (moderate API)

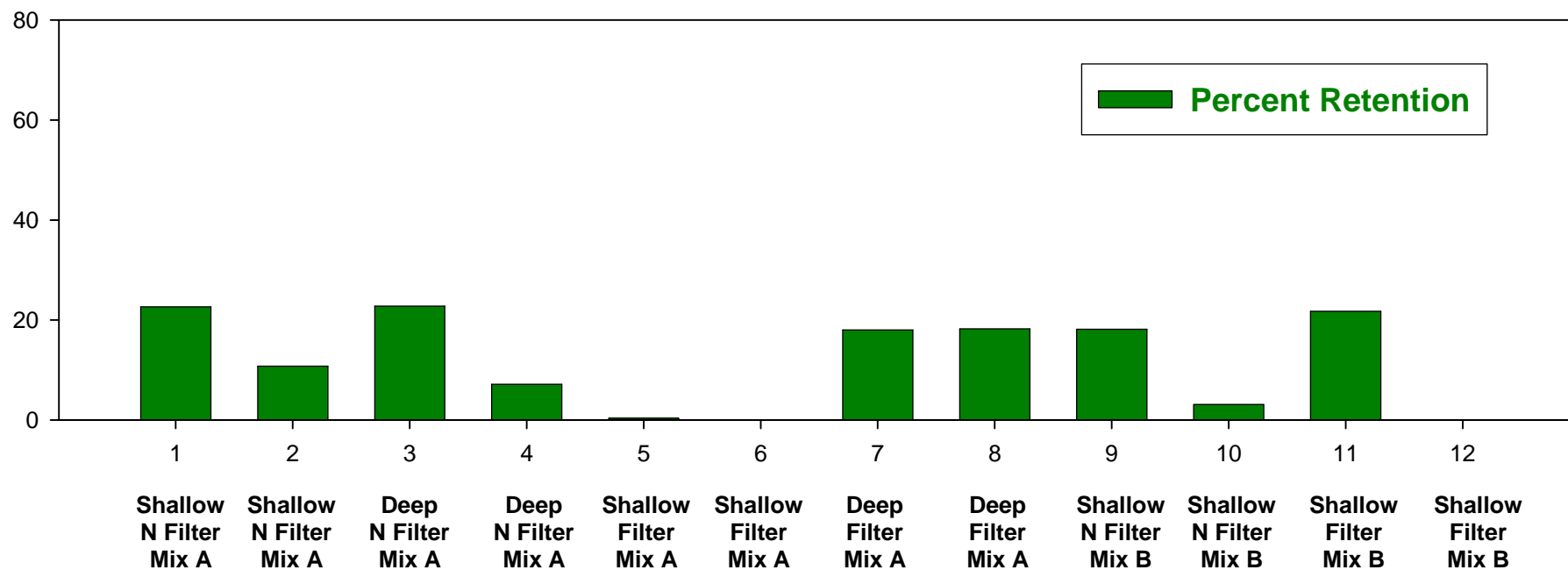


← Fine texture soil →

← Filter →

← Filter →

Simulated Storm 27 Mar 08 (wet API)



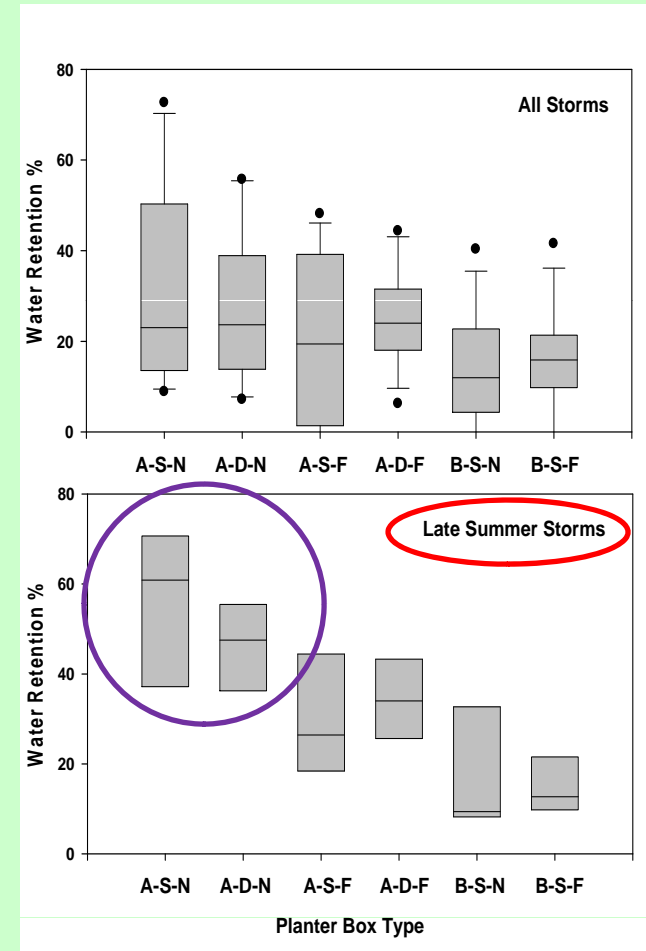
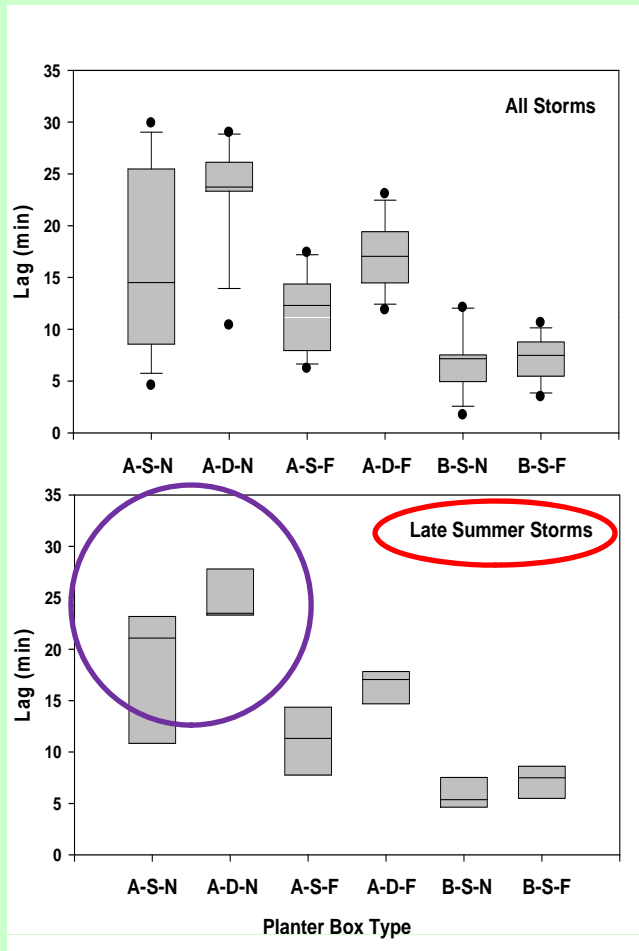
← Fine texture soil →

← Filter →

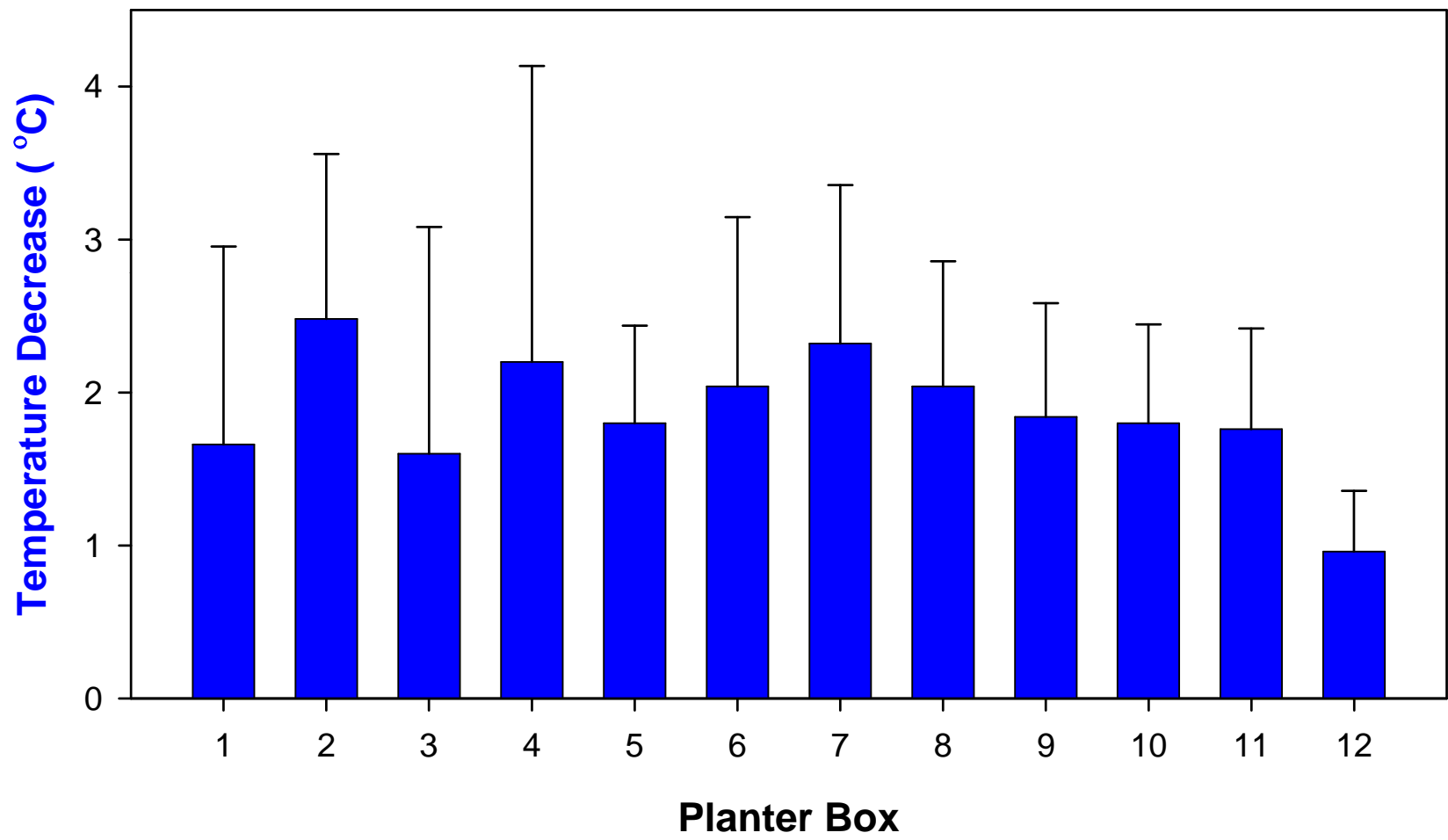
← Filter →

Statistical Summary

Overall results



Effect on water temperature



Conclusions - physical characteristics

- Filter liner decreased retention
- Soil depth had less effect than expected
- Soil texture showed the largest difference, with finer soil texture resulting in the greatest water retention

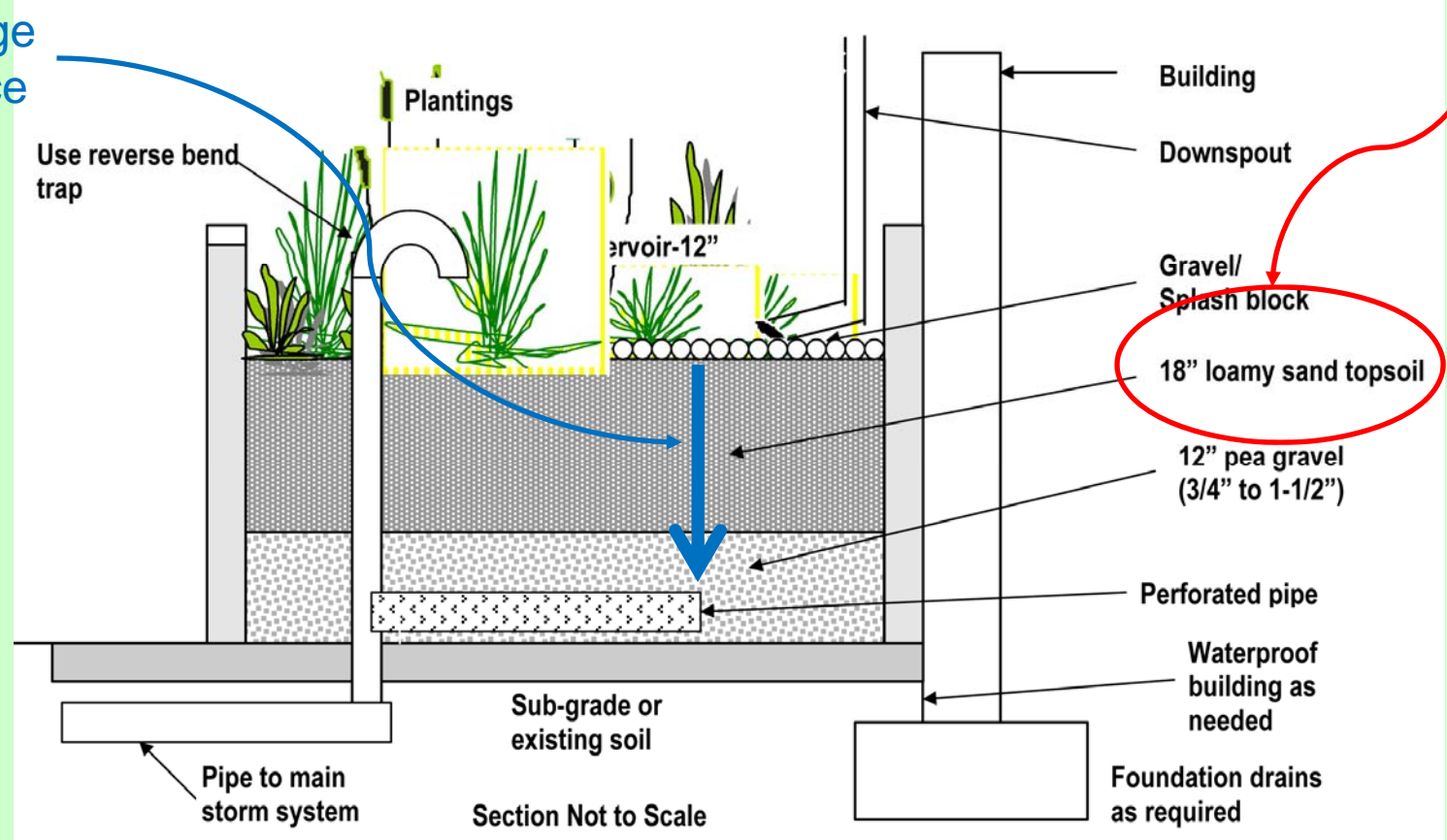
But ...

- Differences largely disappeared during winter

2.3 Stormwater Planter

Figure 2. Stormwater Planter

Drainage
Distance



Soil Texture

Source: City of Seattle

Input



**Perforated
drainpipe**

**Point of
Water
Entry**



Output

General conclusions

Planter boxes

- retained 20% of input water
- caused a 13 min time lag
- decreased water temperature by ~2 °C

Positives: low cost, no effect on basements

Take home message

- No magic bullet for stormwater management, yet planter boxes do contribute to stormwater reduction and might be particularly useful for areas with shallow water tables and/or dense building footprints

Particular thanks to

- Christina Skellenger (Costa Pacific Communities)
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- Joel Salter (EPA)
- Patrick Norton, Kelly Cole, Heather Spalding (PSU)

