Longevity of bioretention depths

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(M.S. 2021)

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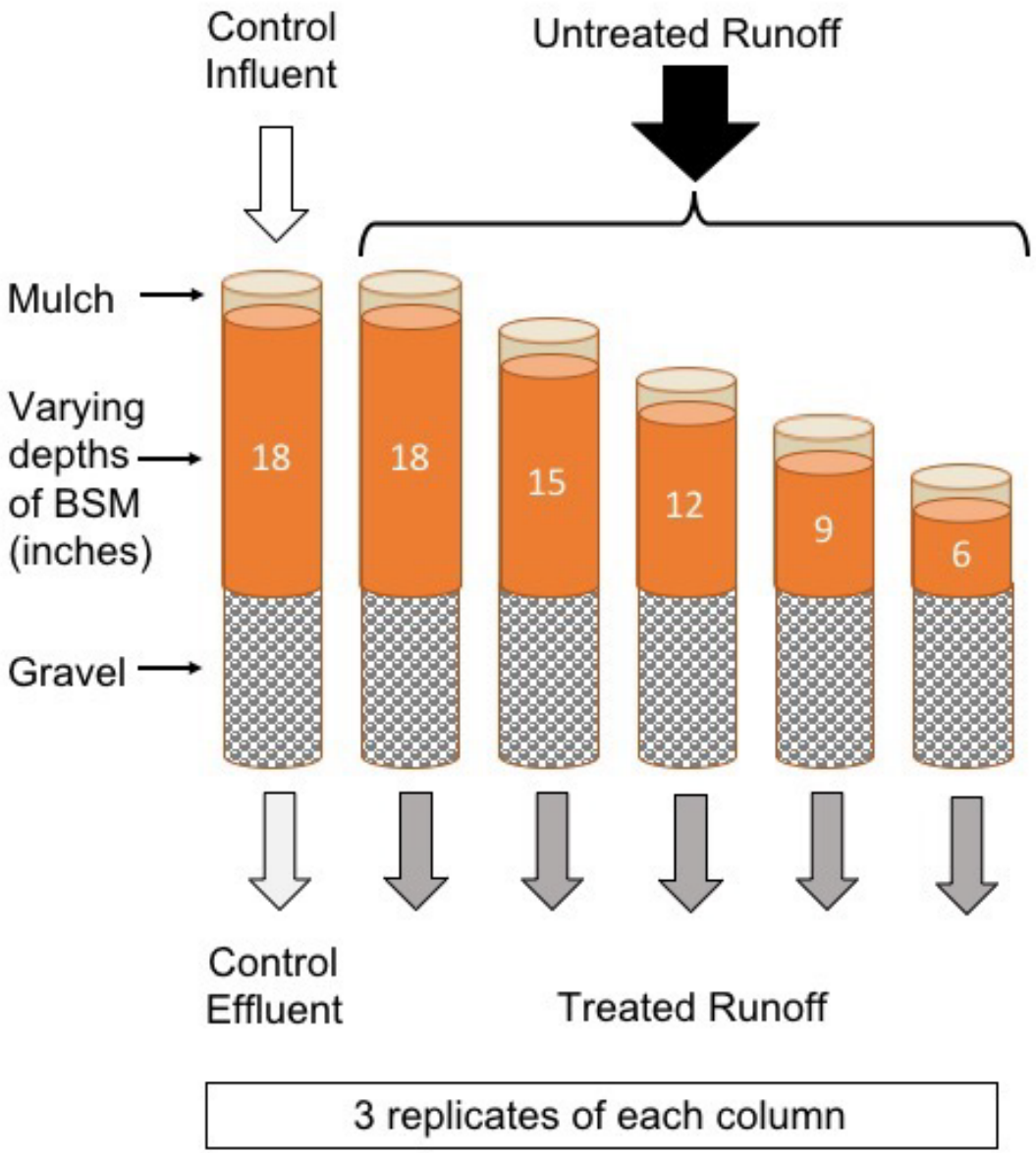
Longevity of bioretention depths



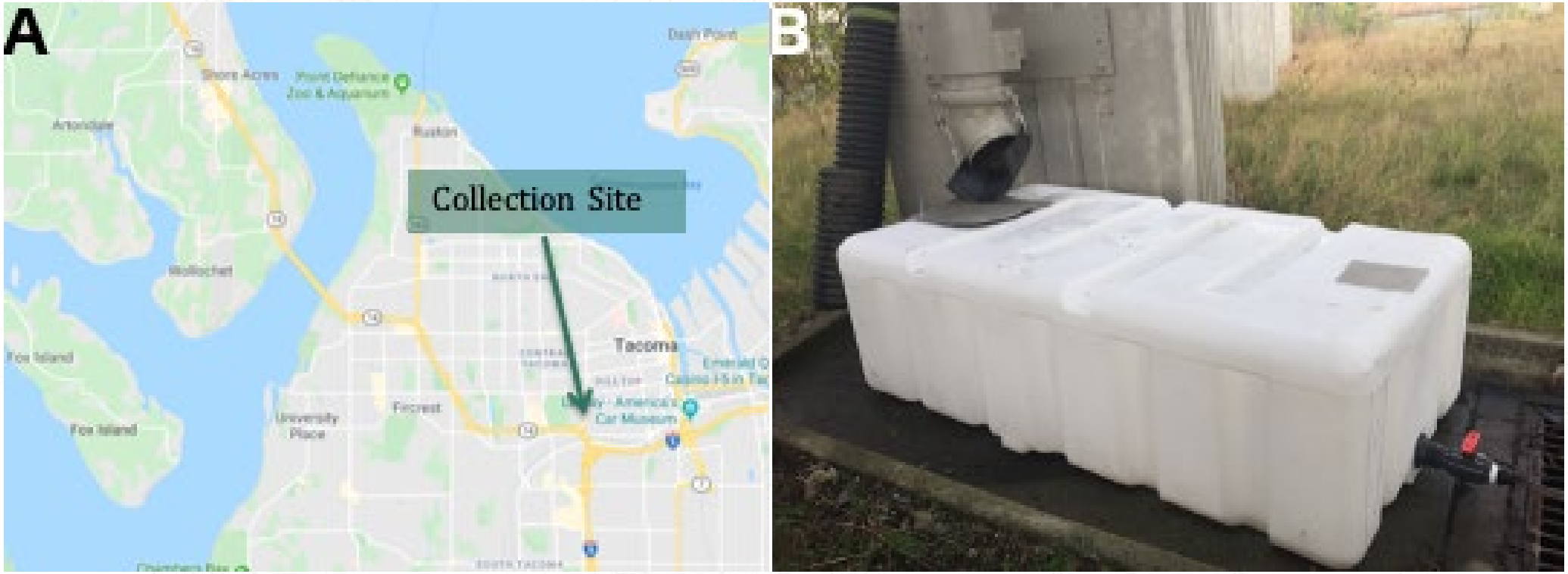
Research questions:

- What depths of bioretention are necessary to treat runoff?
- For how long are they effective?

Accelerated Aging:

- Dosing with collected runoff
- 10 water years across 2-yr study
- Assess chemical, physical, and biological performance at end of every water year

Roadway Runoff Collection

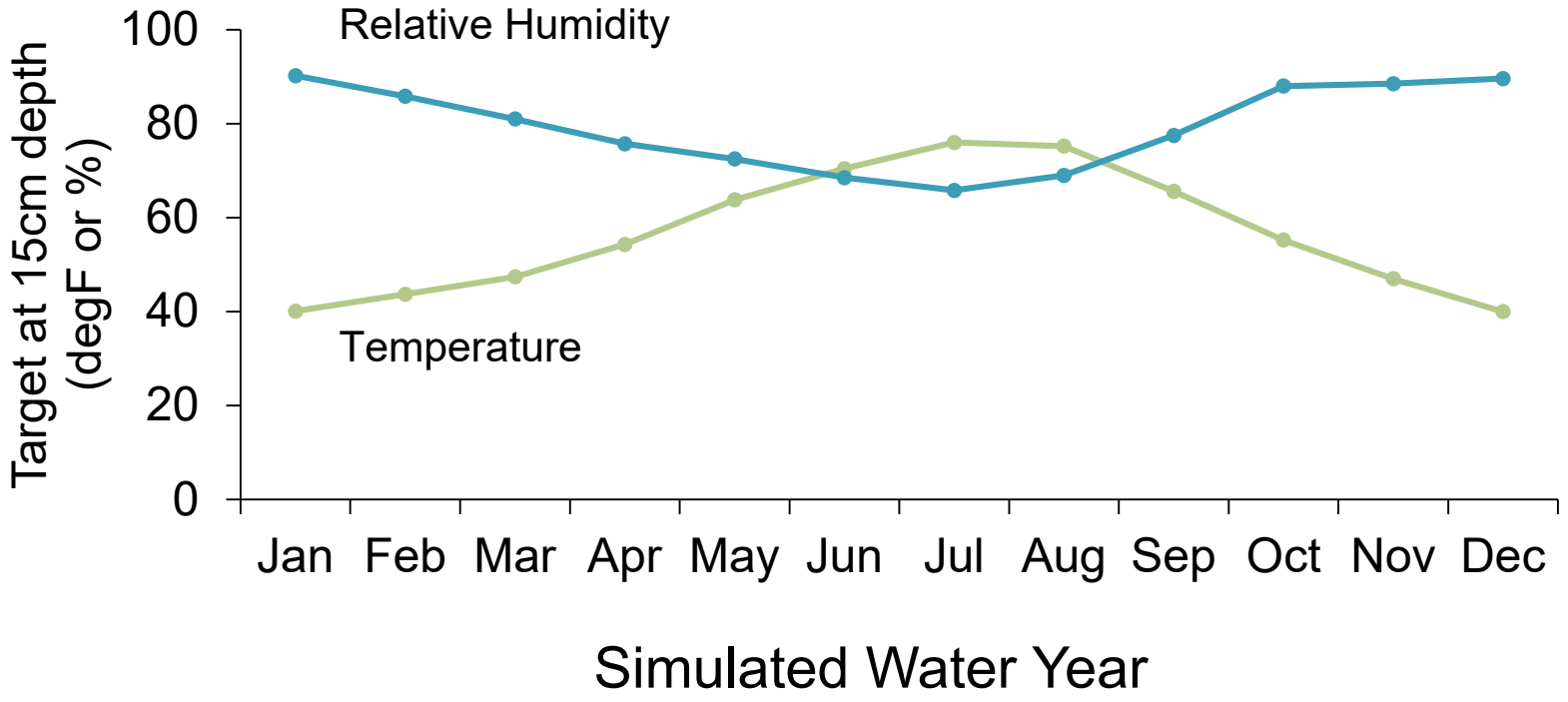


Roadway runoff collection in Tacoma, WA

Dosing in Environmental Chamber

Collected runoff transported to WSU-Puyallup

Simulated Water Years



End of Water Year	Event Number (Approximate)	Number of BSM Depths Tested	Analytical Chemistry	Zebrafish Assay	Coho Testing	Ksat
0	1	5	Yes	Yes	Yes	
1	6	5	Yes	Yes		Yes
2	12	5	Yes	Yes		Yes
3	18	3	Yes	Yes		Yes
4	24	3	Yes	Yes	Yes	Yes
5	30	3	Yes	Yes		Yes
6	36	3	Yes	Yes	Yes	Yes
7	42	3	Yes	Yes		Yes
8	48	3	Yes	Yes	Yes	Yes
9	54	3	Yes	Yes		Yes
10	60	3	Yes	Yes	Yes	Yes

Completed

Completed

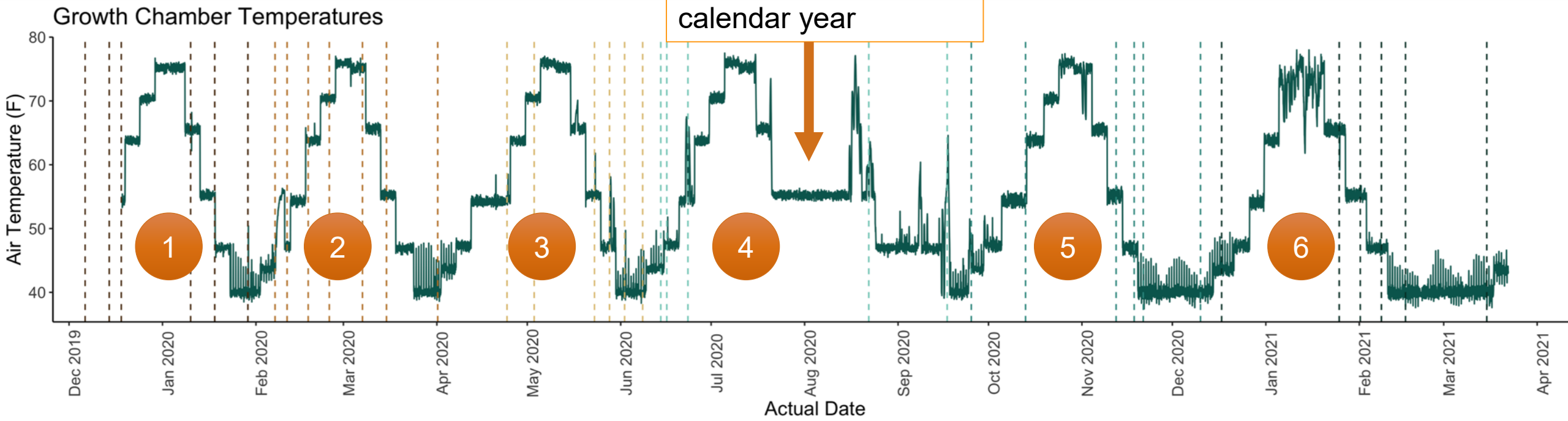
+ 6PPD-quinone

Molecular Assays

Simulated Water Years

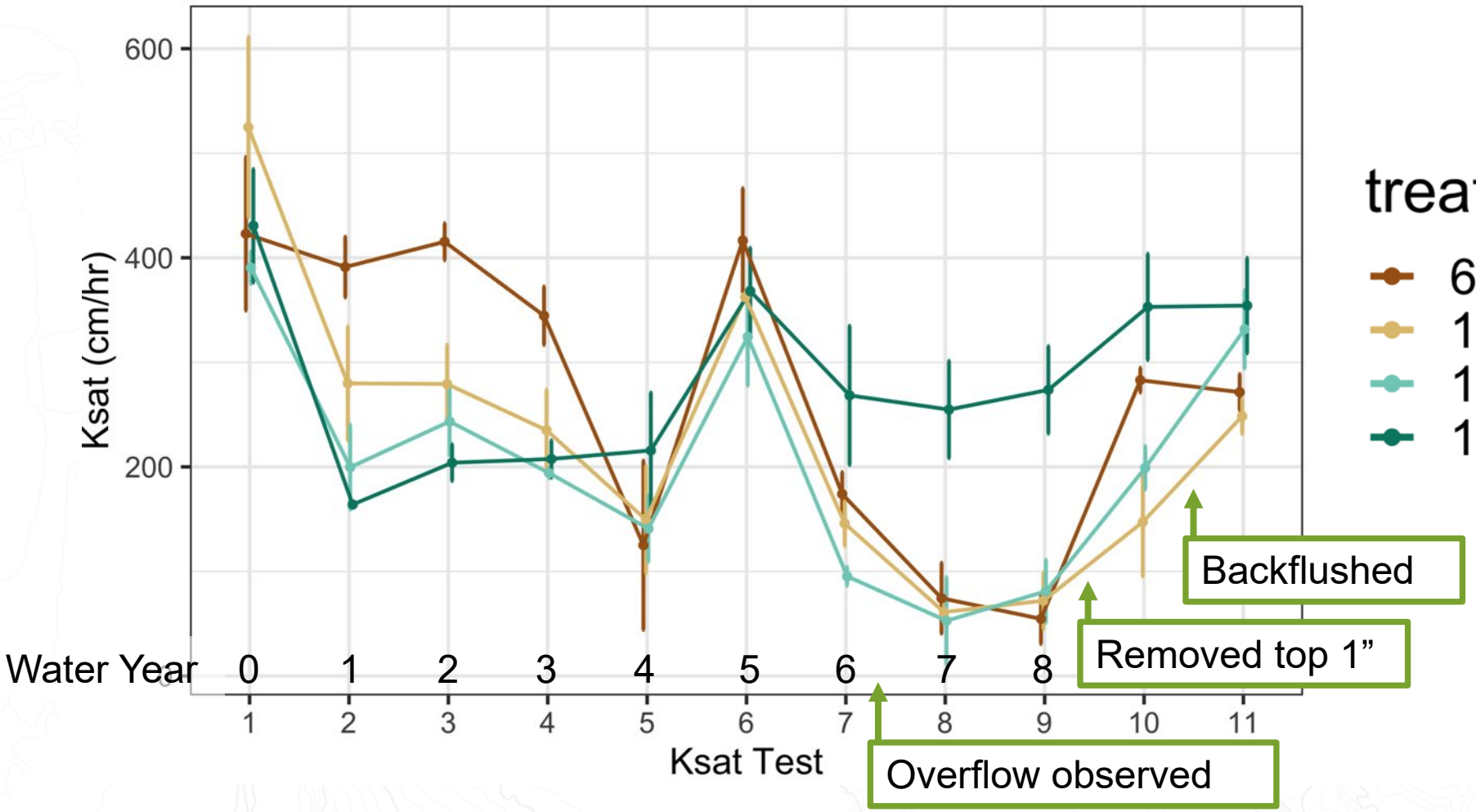
Longer simulated year when no rain during calendar year

9 WYs completed



Nearly 6 simulated water years over 16 months

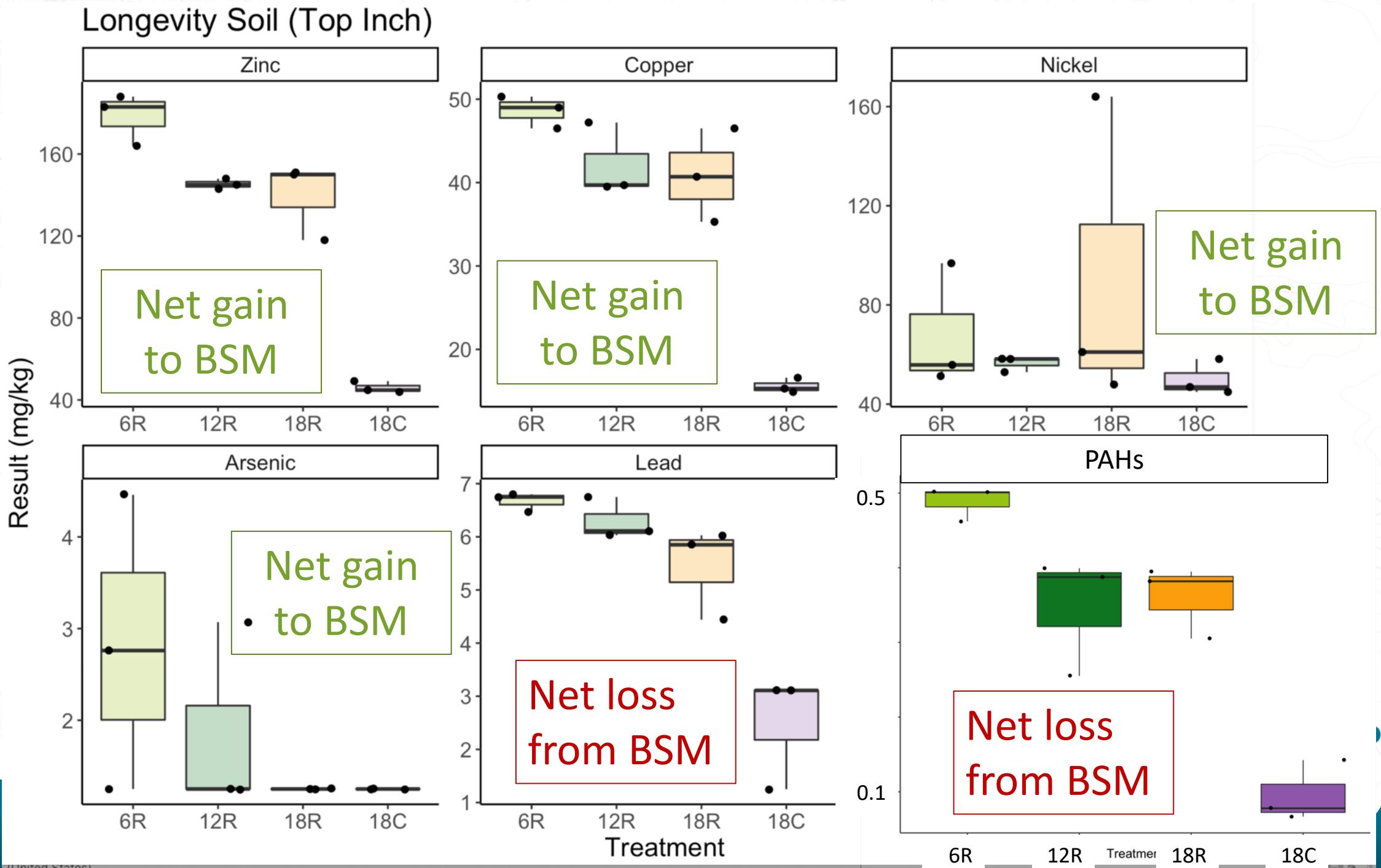
Saturated Hydraulic Conductivity

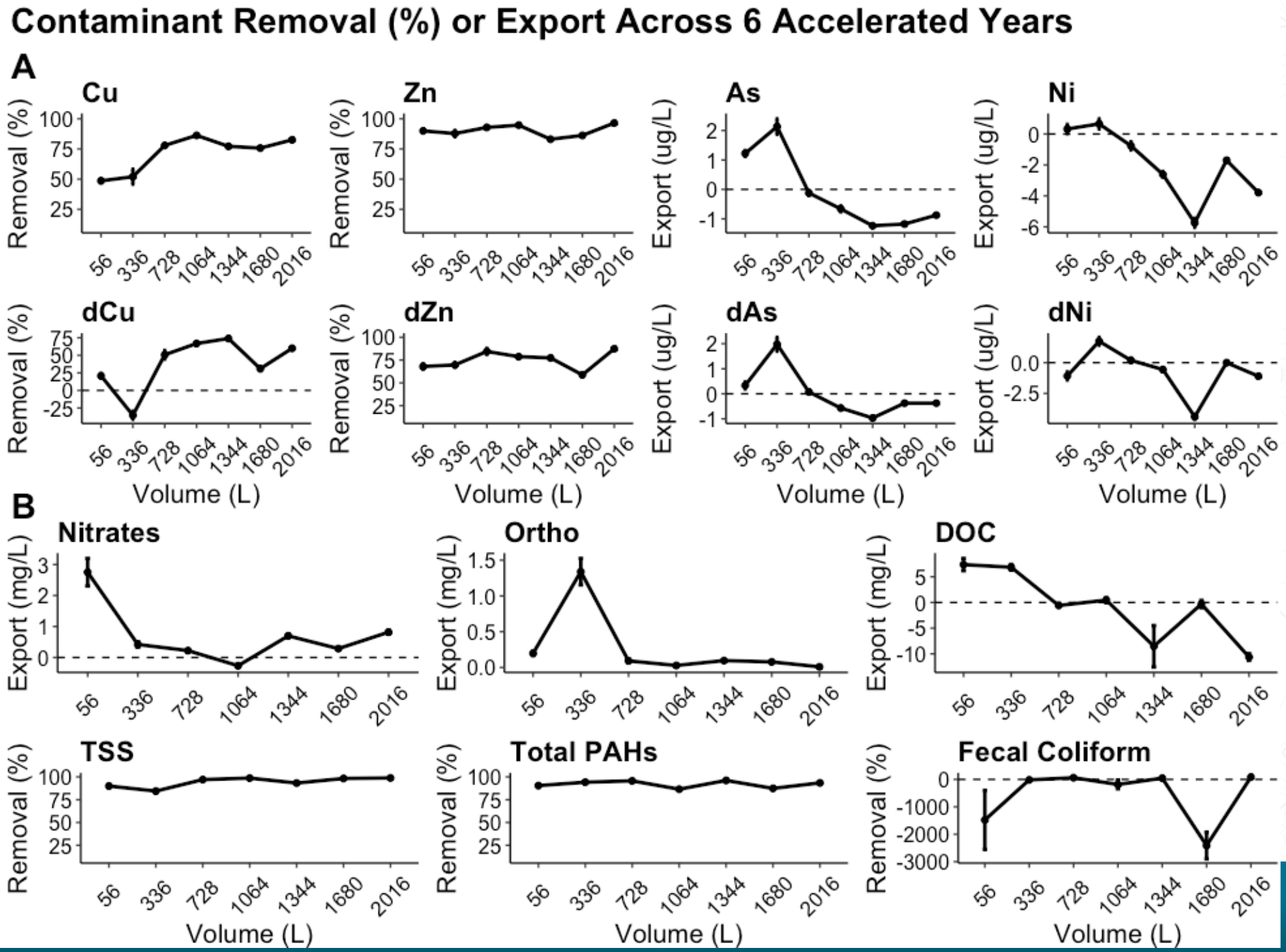


treatment
- 6R
- 12R
- 18R
- 18C

Overflow most common in 18R
Absent in 18C

Clogging of columns caused overflow starting in WY7; remedial actions pursued in WY9

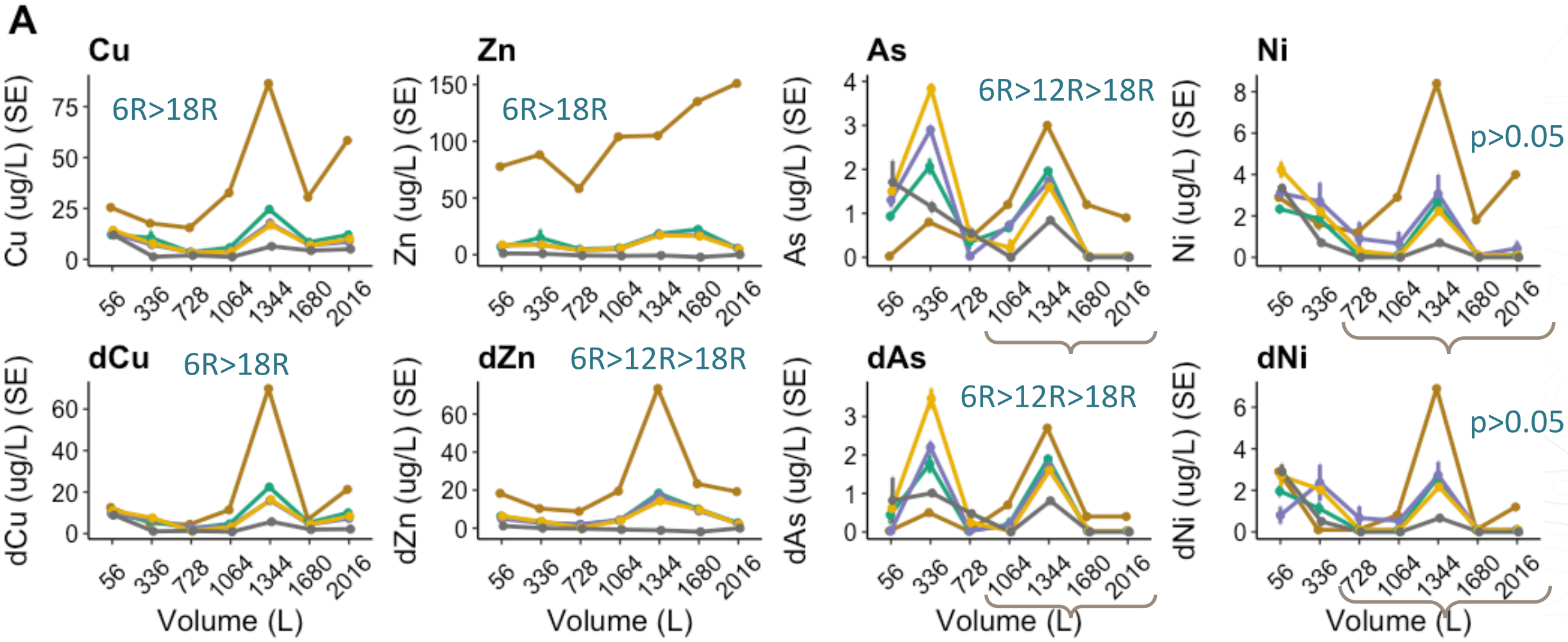

Longevity Soil (Top Inch)
Zinc
Copper
Nickel
Arsenic
Lead
PAHs
Result (mg/kg)
Treatment
6R
12R
18R
18C
Net gain to BSM
Net gain to BSM
Net gain to BSM
Net gain to BSM
Net loss from BSM
Net loss from BSM



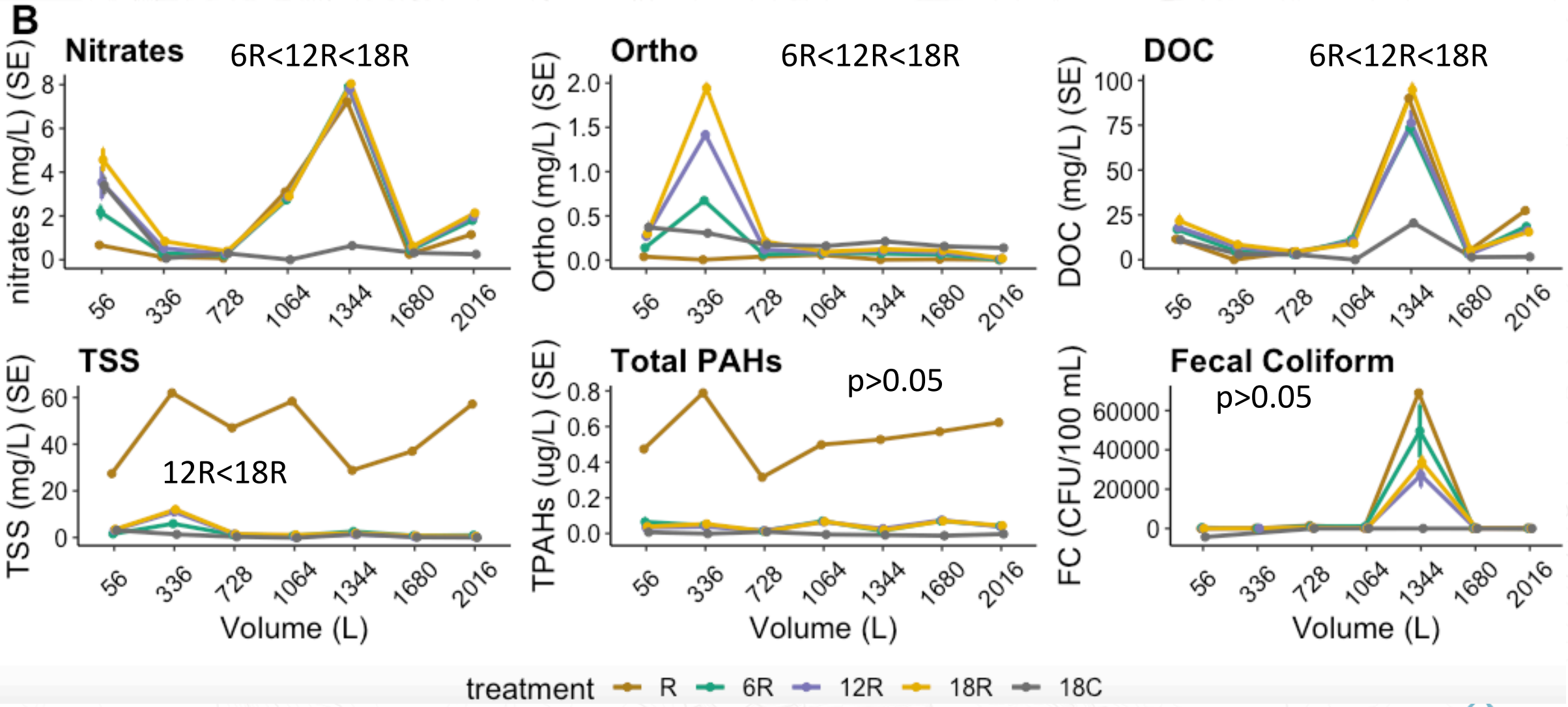
Contaminant Removal from Runoff

- Cu, Zn TSS in effluent are primarily from runoff
  - Good removal through WY6
- As, Ni, DOC, nutrients in effluent primarily from BSM
  - Initial export, net retention by WY2-3

Contaminant Effluent Concentrations Across 6 Accelerated Years

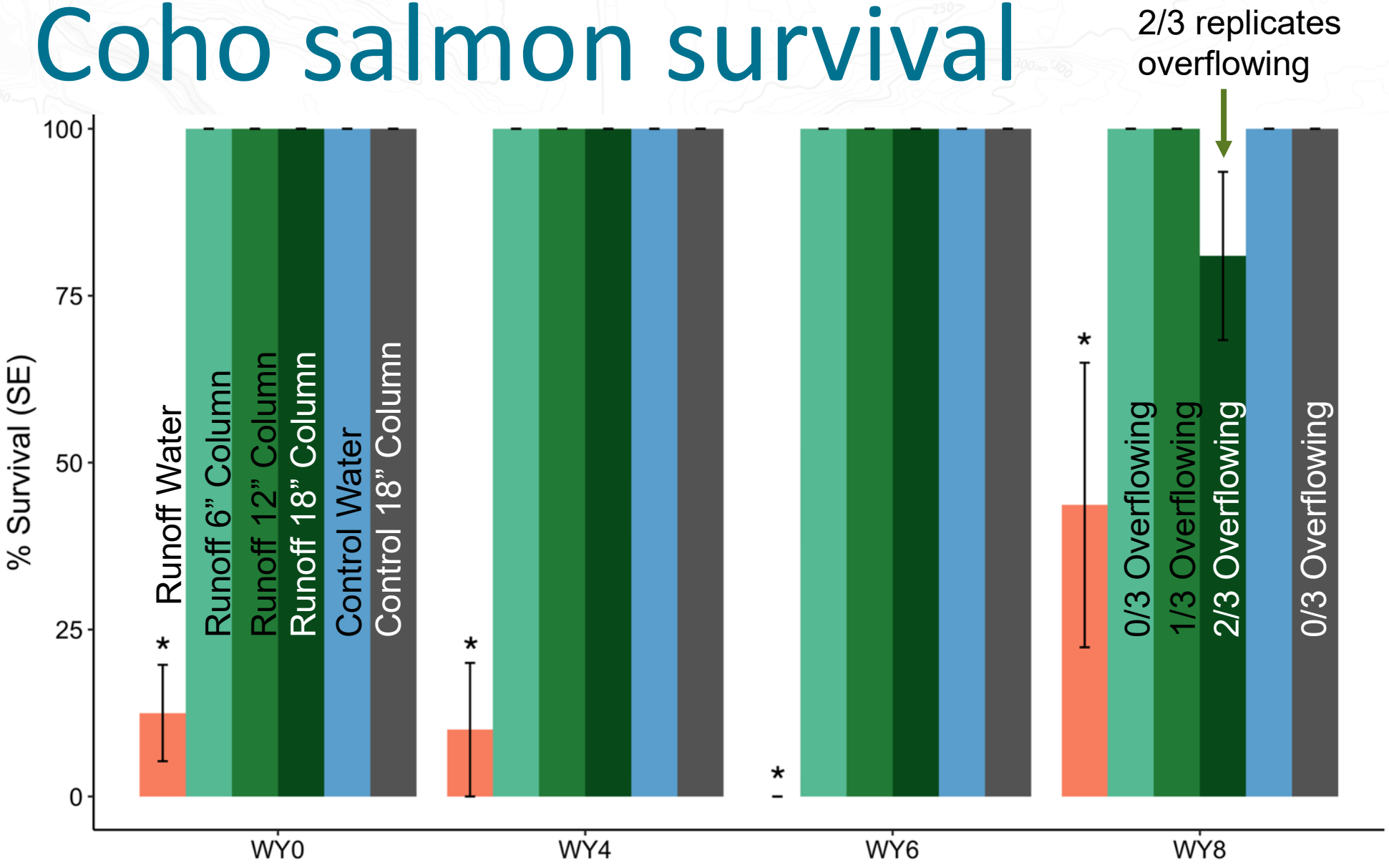


6” BSM generally allowed more influent pollution to pass through

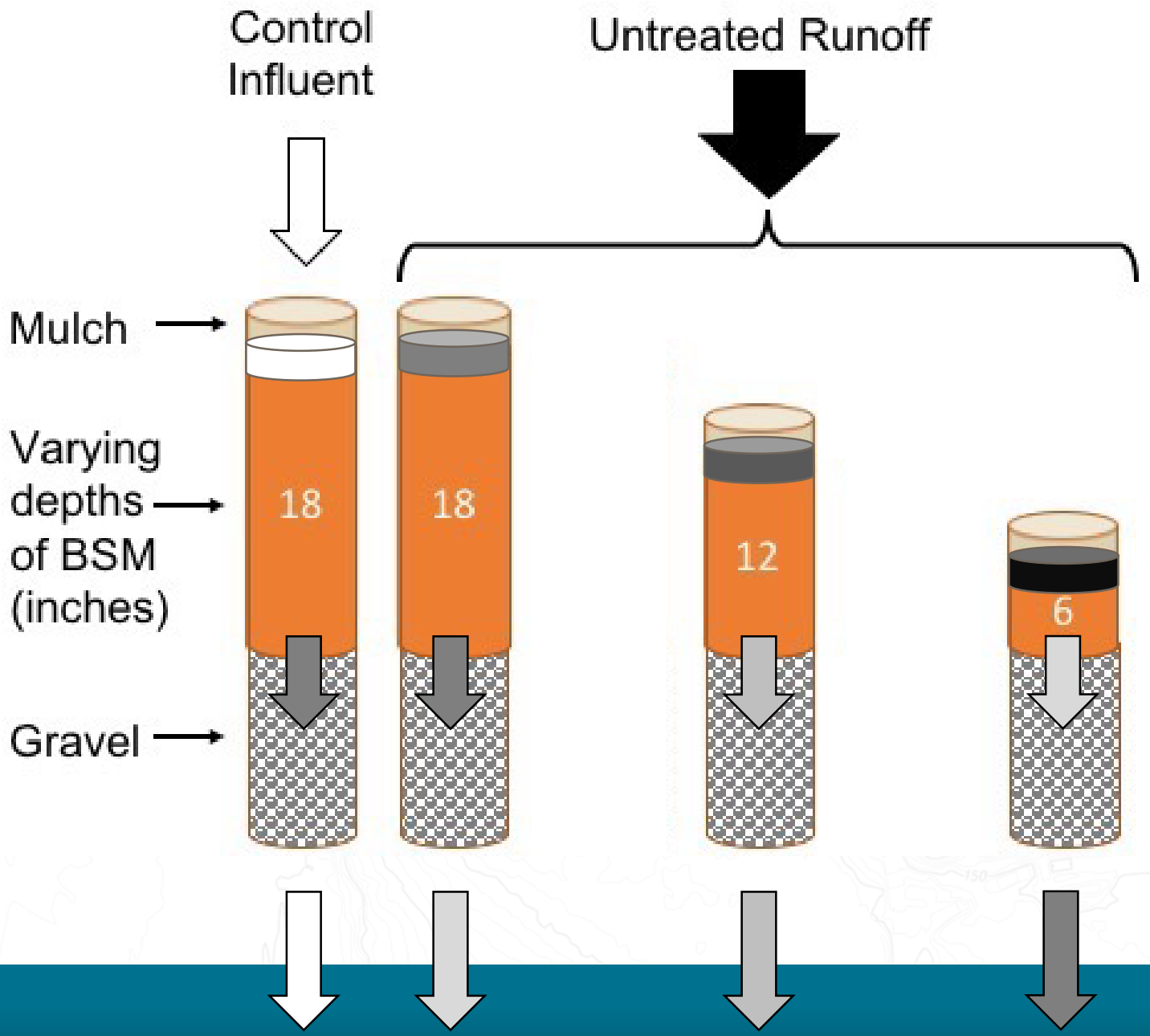


18” BSM generally released more nutrients, DOC, TSS

Coho salmon survival



Some mortality in effluent+overflow from 18R at the end of WY8



Take Home by WY6-9

- No loss of BSM chemical effectiveness by WY6
- 6” BSM generally captured less influent pollution than 18”
- More export of nutrients for 18”
- Slower loss of hydraulic conductivity for 6”
- Top layer of soil concentrated more pollutants in 6” than 18”