Effectiveness of stormwater management practices in protecting stream channel stability

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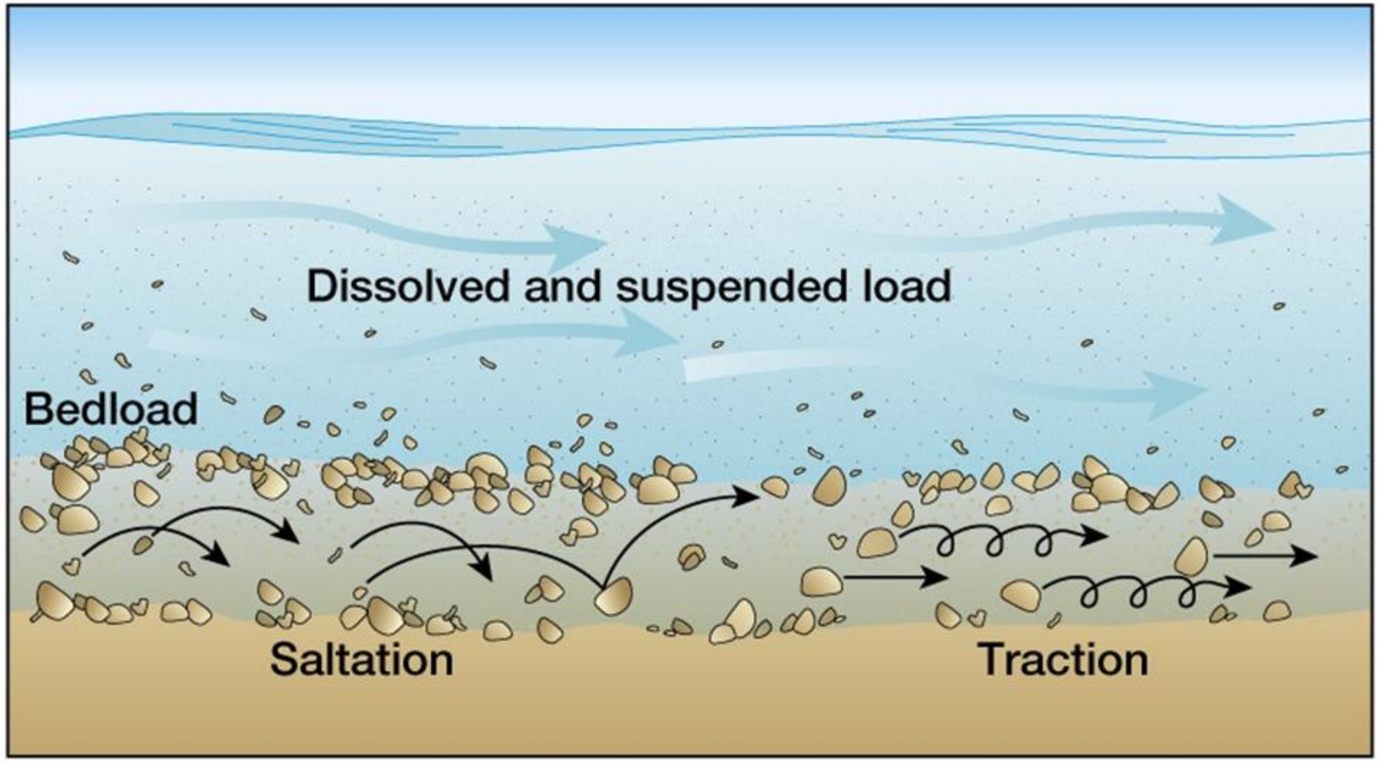
Before we talk research…

In this talk, “sediment” is not a four-lettered word.



- Coarse sediment is naturally transported in suspension and along the channel bed.
- Fine sediment does not play a major role in channel morphology.

Paying for good stormwater management now means you don't pay to fix things later.

In this talk, stream "stability" means the channel is not becoming deeper and/or wider.

All models are wrong, but some are useful

- George Box, British statistician

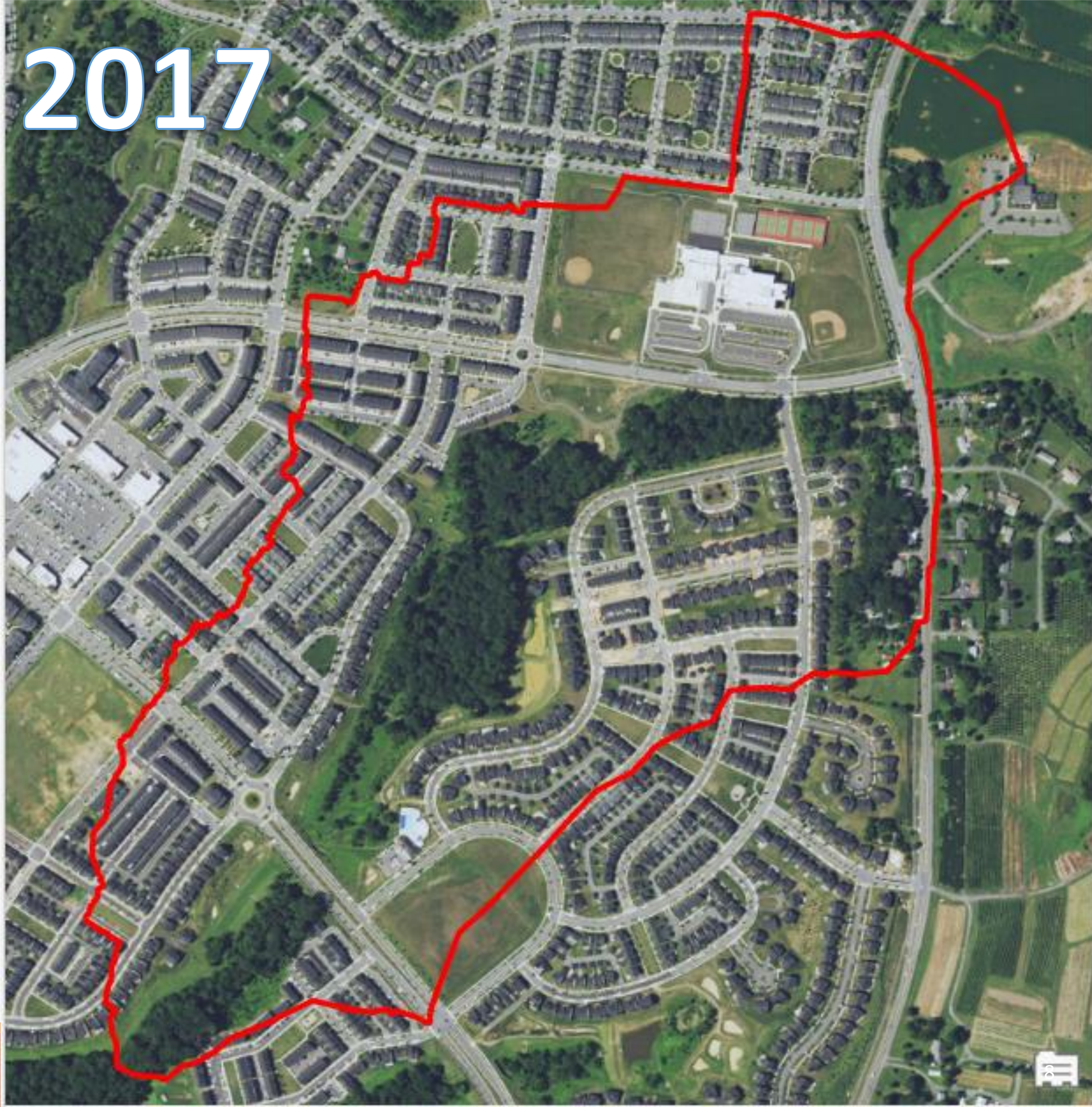
Adjust the model to match observed conditions.

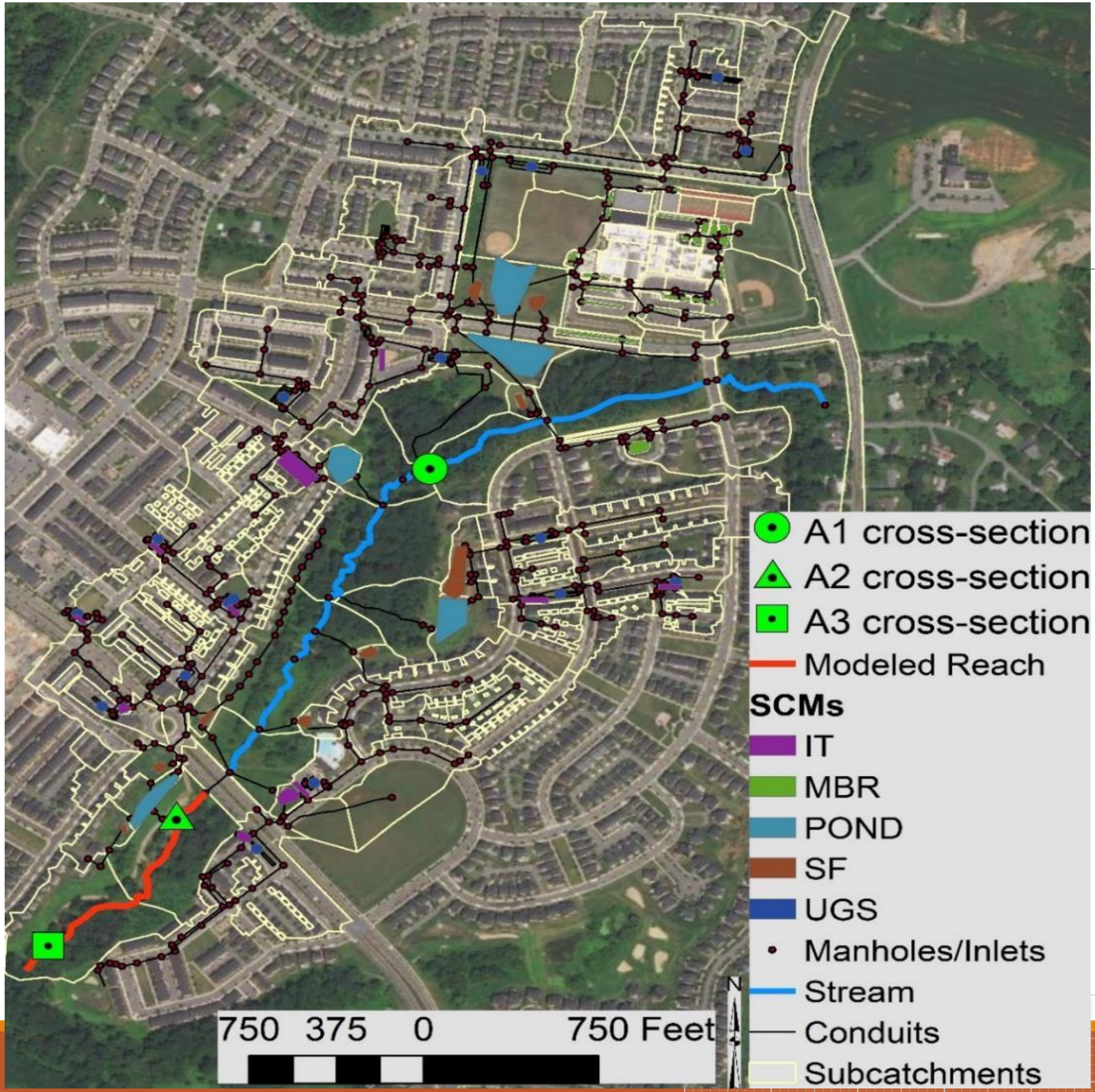
Apply common sense.

Ok, let's talk research…

Tributary 109 to Little Seneca Creek served as a case study

- 0.3 mi^2 drainage area, 44% TIA
- Developed 2006 - 2016
- USGS stream gage (2004)
- USGS rain gage
- Montgomery County data
  - Cross sections
  - Longitudinal profiles
  - Pebble counts
- Multiple lidar datasets

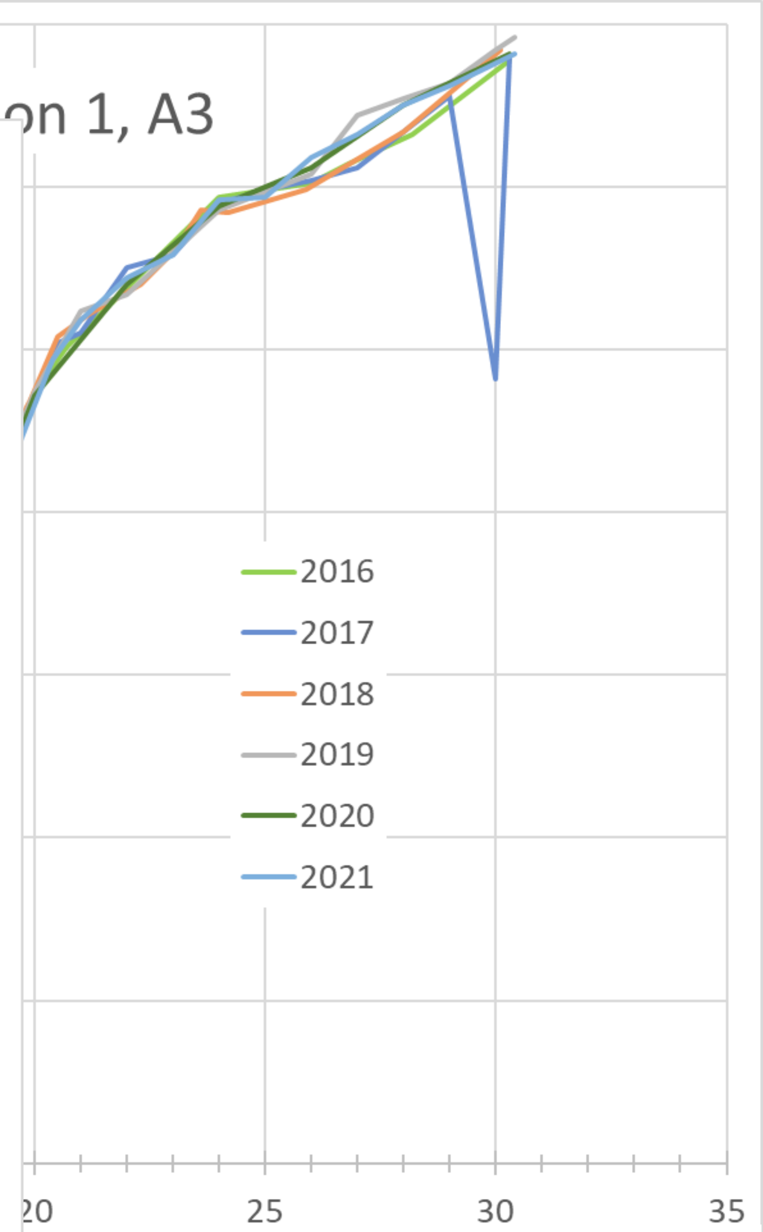




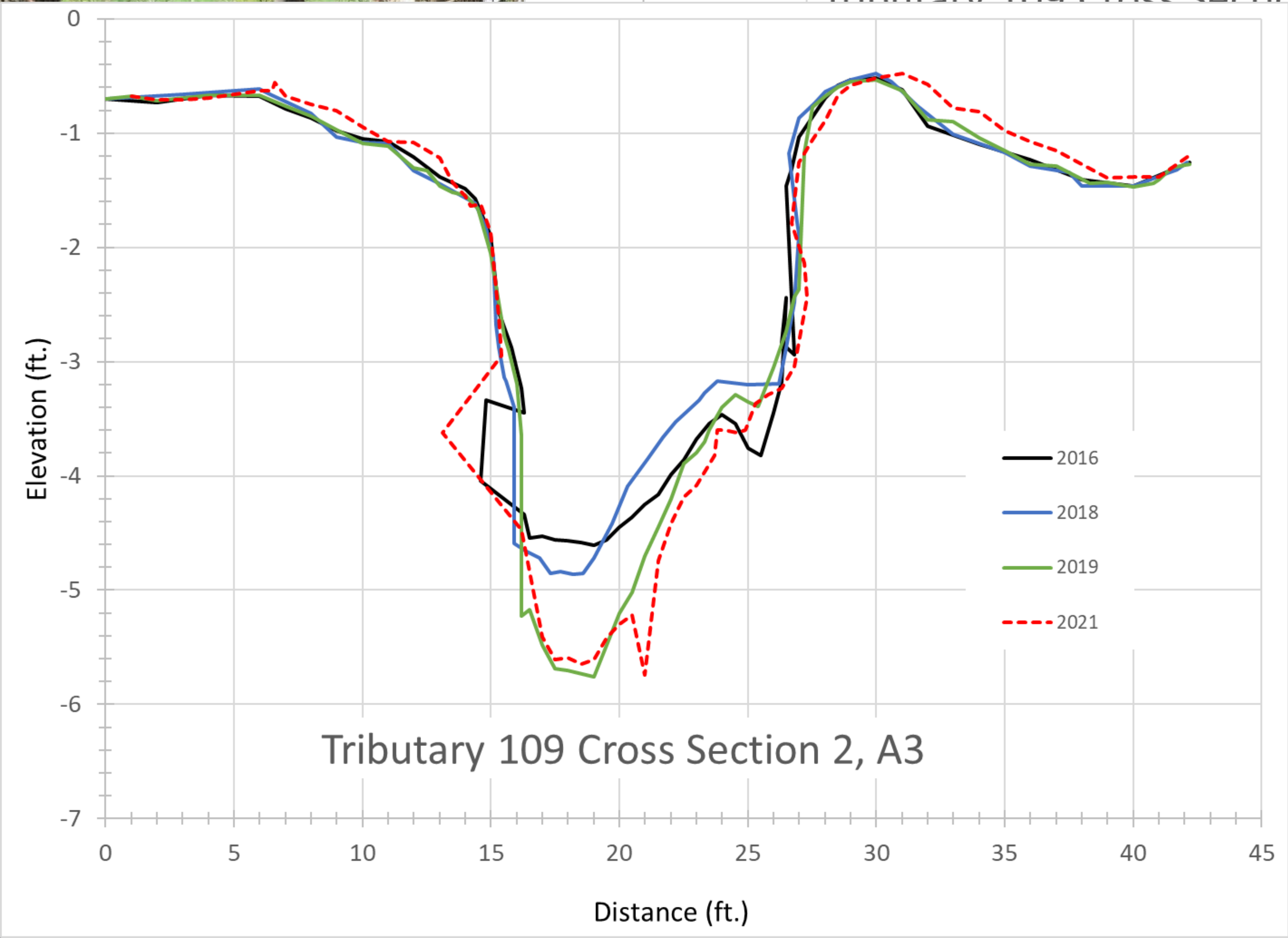
Stormwater system was designed to meet the 2000 USC requirements:

- 5 ponds
- 26 micro bioretention (MBR)
- 10 infiltration trenches (IT)
- 11 sand filters (SF)
- 18 underground storage facilities (UGS)

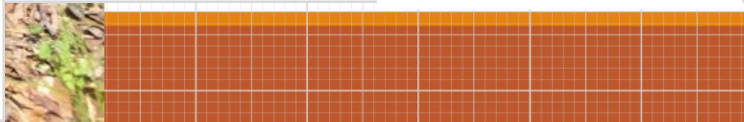
"Distributed" stormwater control practices



Tributary 109 Cross Section 1, A3
0
2016
2017
2018
2019
2020
2021
20
25
30
35



Tributary 109 Cross Section 2, A3
Elevation (ft.)
Distance (ft.)
0
-1
-2
-3
-4
-5
-6
-7
0
5
10
15
20
25
30
35
40
45
2016
2018
2019
2021



Channel stability is a two-part problem

Water

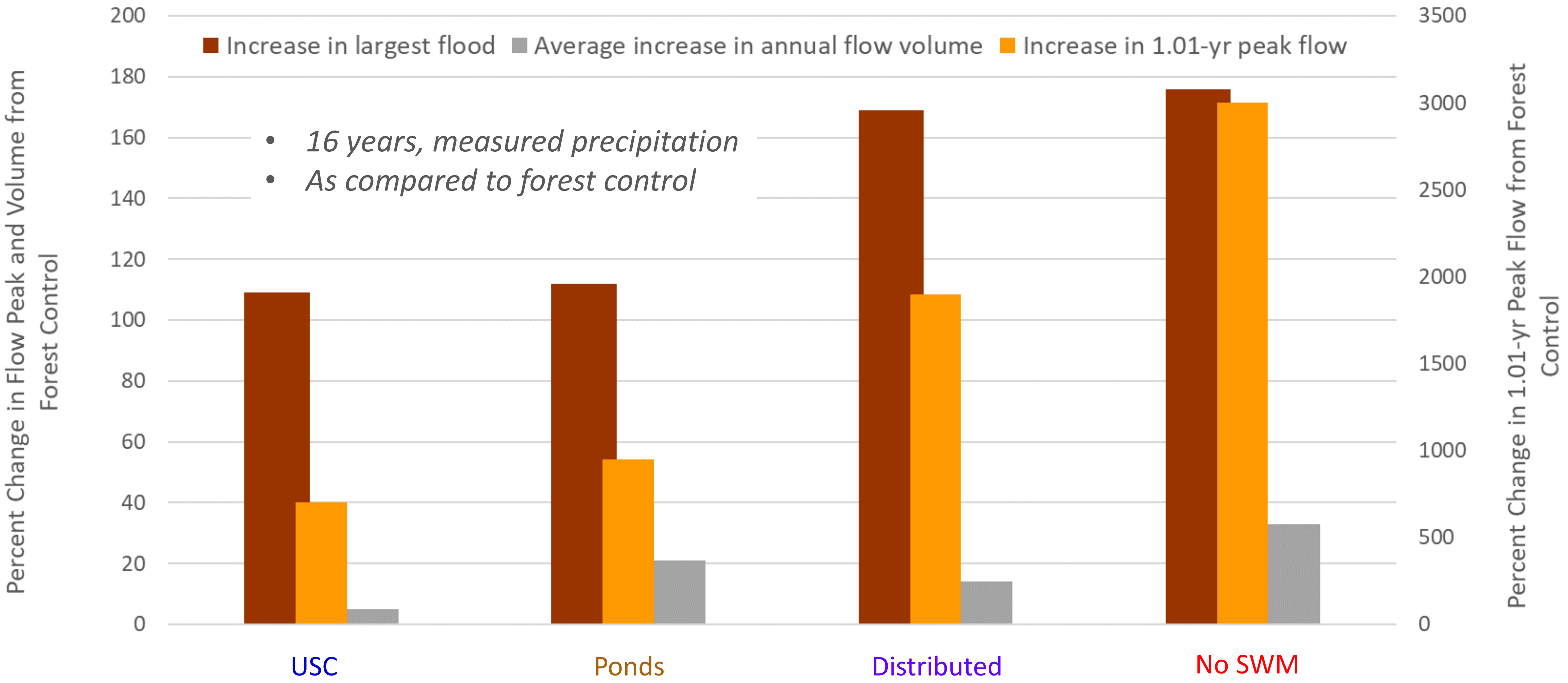
SWMM
Storm Water Management Model

Sediment

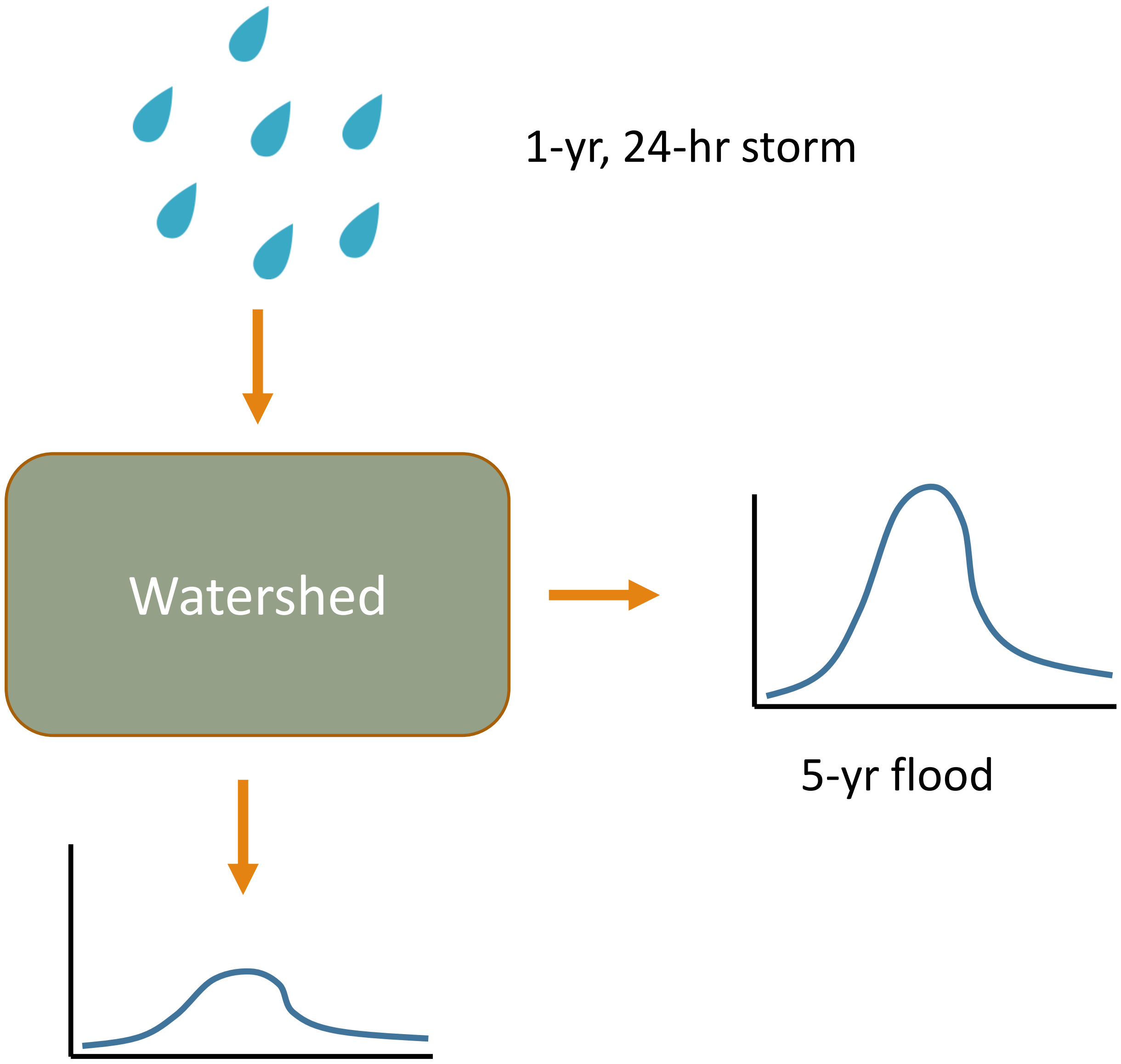
HEC-RAS 6.3

Results…

Both ponds (storage) and distributed SCMs are needed to minimize hydrologic impacts of development

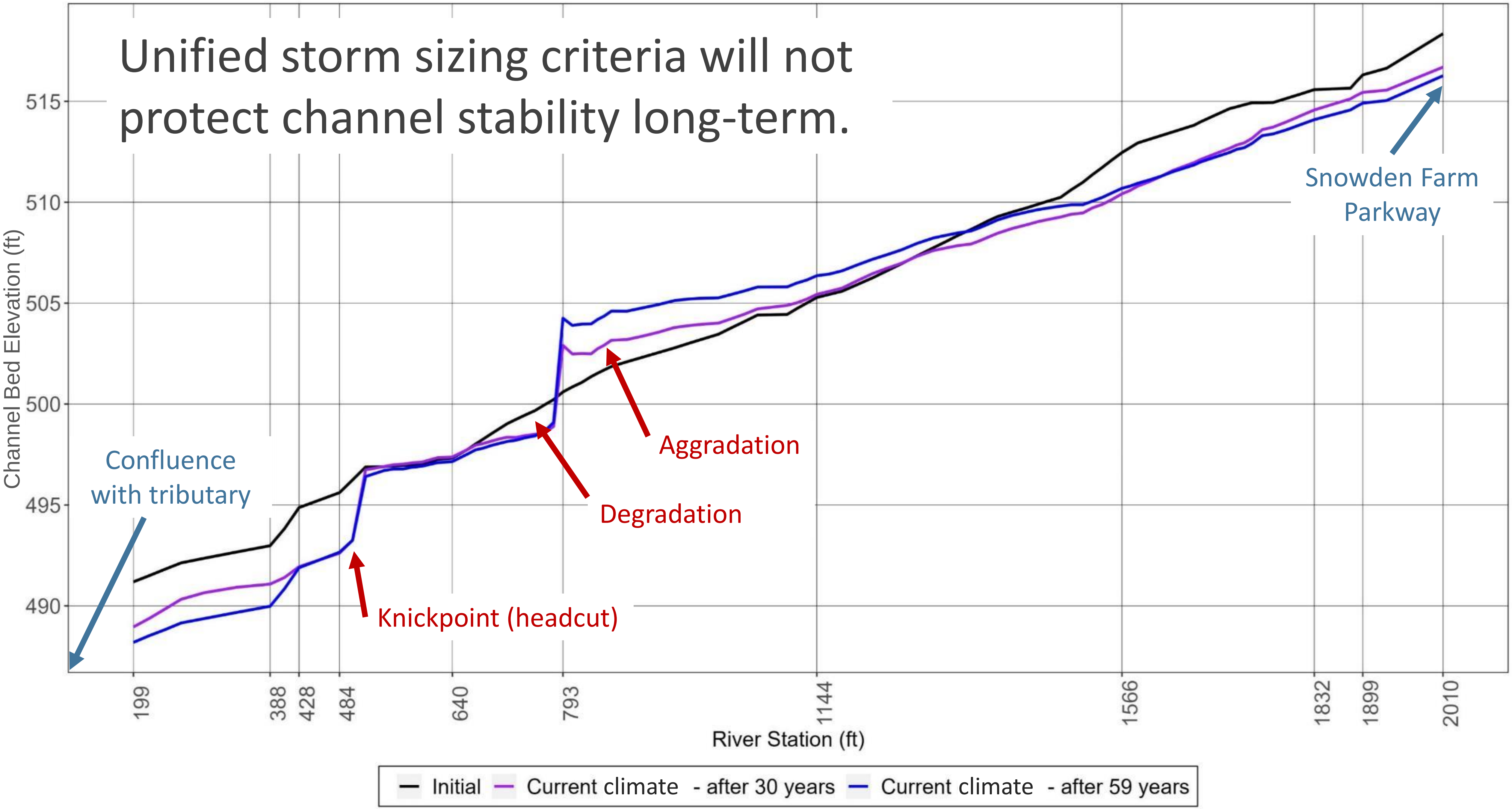


Stormwater
re… tio…
ass… 1-yr
sto…
pr… ces… 1-yr
flood.

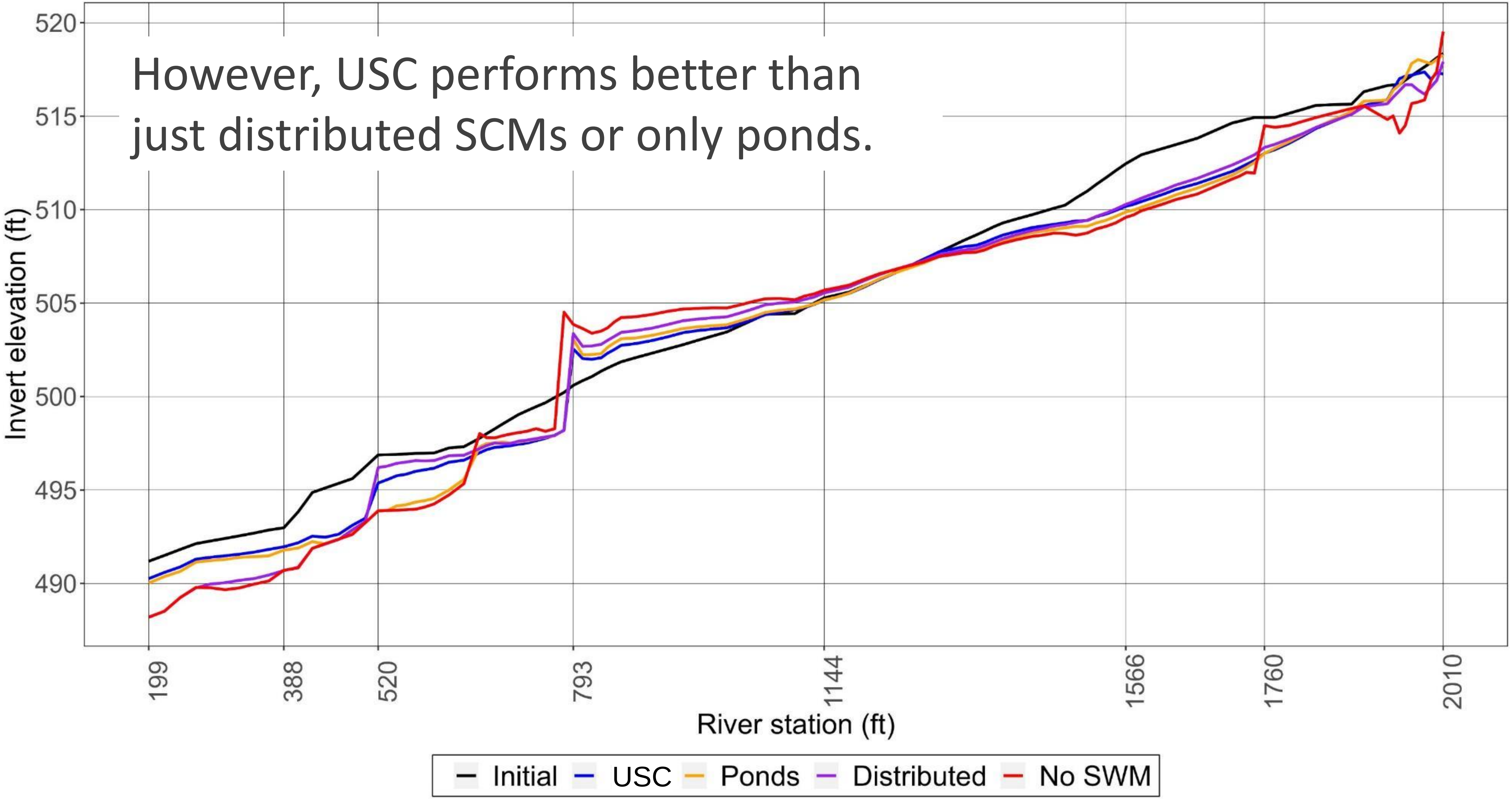


What does the change in hydrology mean for channel stability?

Unified storm sizing criteria will not protect channel stability long-term.



However, USC performs better than just distributed SCMs or only ponds.



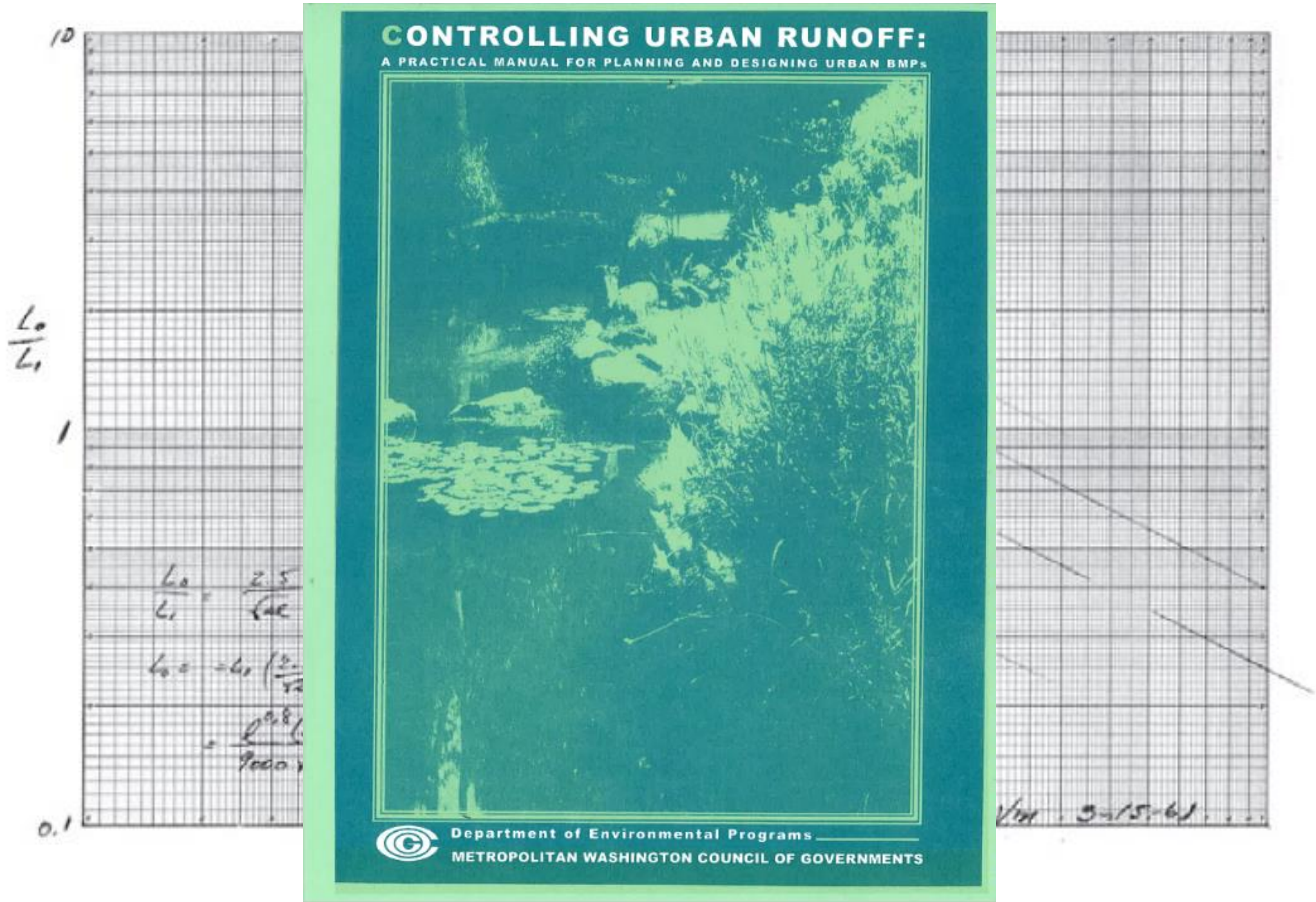
Where do we go from here?

geograph.org.uk

How can we design stormwater management to protect channel stability?

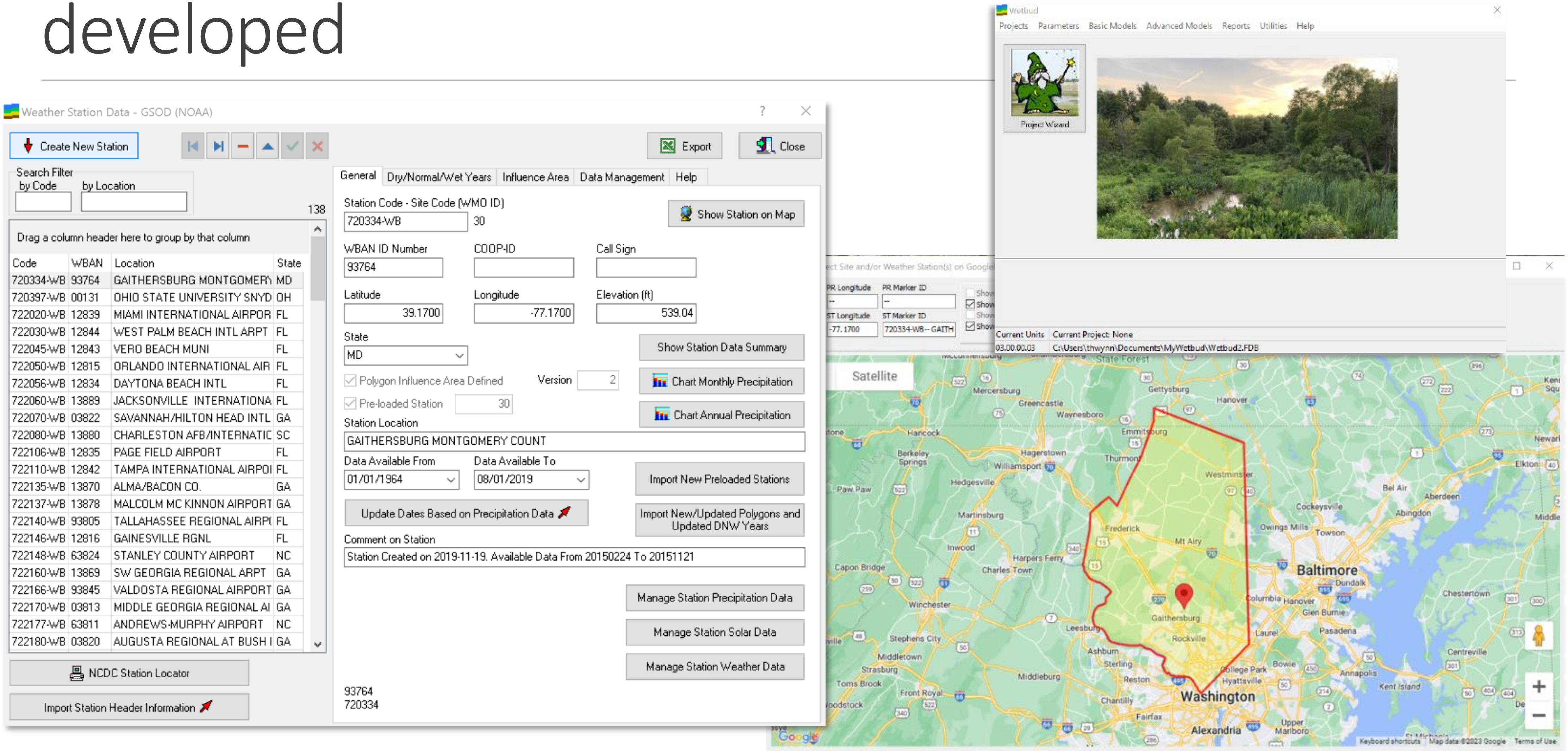
- Design/retrofit stormwater systems to match post-develop and pre-development sediment transport
  1. Erosion potential = 1
  2. Duration of critical flow
- Where the receiving stream is already incised, re-create floodplain connection to reduce sediment transport capacity
- Use design storms with durations <24 hours
- Use a watershed-scale model with continuous rainfall data to design SCMs

Some stormwater history



1984 computing power

Software with state-specific climate data could be developed



https://resourceprotectiongroup.org/wetbud/

Wetbud was developed for mitigation wetland design


Questions?