A Watershed Approach to Flooding

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As you all know…..

- Liquid water moves downwards, into the ground or downslope.
- If water moves more slowly than it is supplied, it ponds (floods).
- Downward moving water can be impeded by an impervious surface (such as a concrete parking lot, a compacted soil, or the water table) or by a channel or pipe that can’t fully convey it. (The rate that water moves in a channel or a pipe depends primarily on its size, slope, and internal roughness.)

Summary

- Flooding in Wisconson is increasing because of climate change (**increases in the magnitude and frequency of heavy rainfalls**) and land development (**impervious surfaces**).

- We urgently need to ensure that new development does not continue to increase flood risk.

- And we also need to retrofit stormwater management practices in existing developed areas.

Summary (cont'd)

- We need to make sure that stormwater mitigation practices are not inadvertently increasing flood risk, both locally and downstream.

- ***Soil enhancement*** and use of appropriate ***vegetation*** are two strategies that can be more effectively used to manage stormwater in Wisconsin.

Common Types of Flooding

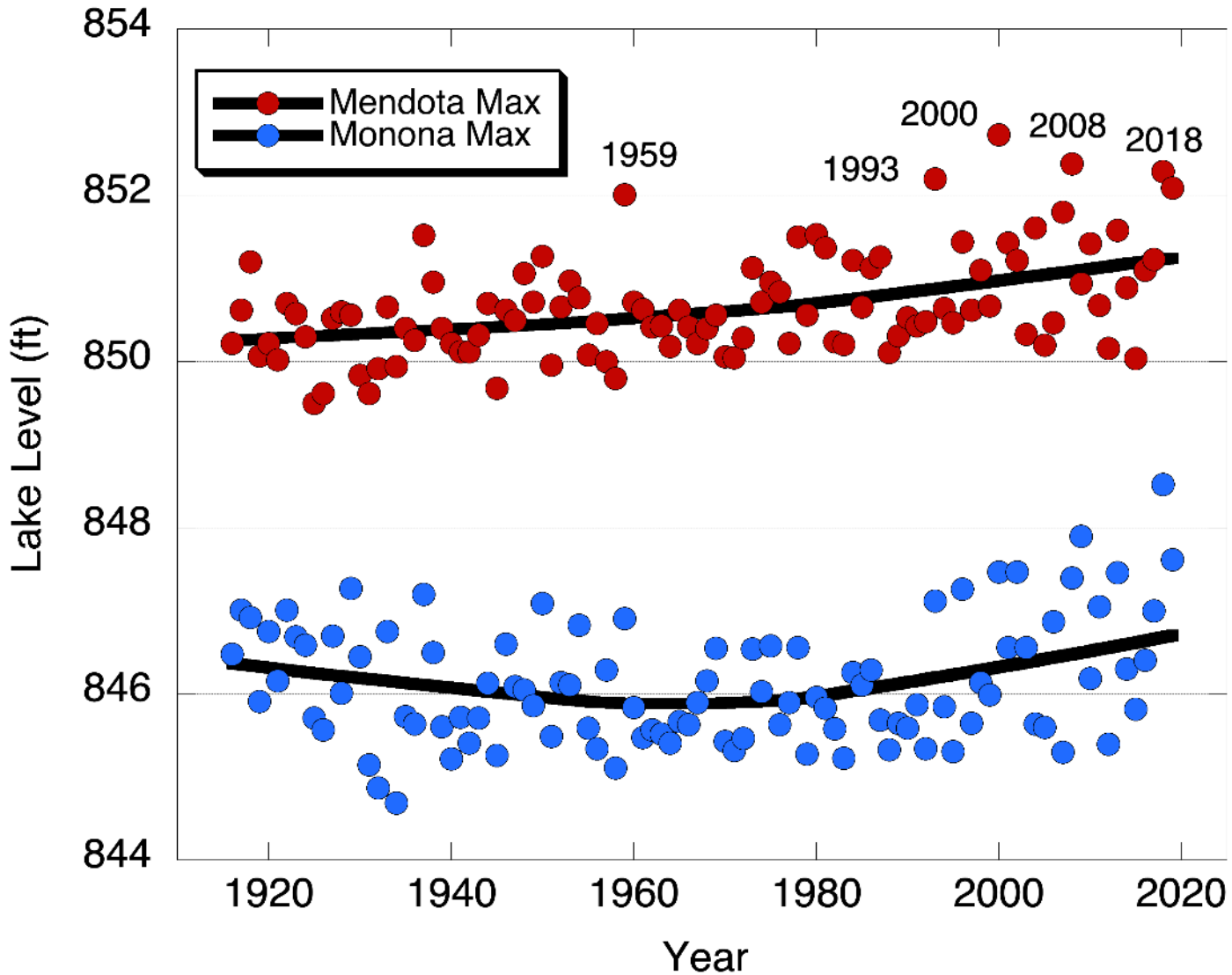
- Lake flooding
  - Many lakes drain slowly. So flooding is commonly due to the ***amount of runoff***, rather than the rate. **Is your lake vulnerable to the amount of runoff?**

- Stream flooding.
  - Due to both the peak rate and amount of runoff.

Common Types of Flooding

- Local flooding in developed areas caused by
  - extreme rainfall events that exceed the capacity of drainage systems (which may be reduced by high lake levels)
  - rising groundwater levels (an emerging problem)

Annual Maximum Levels- Lake Mendota and Lake Monona



Landuse Change

- Urbanization significantly increases runoff amounts and runoff rates, increasing the risk of lake and stream flooding.

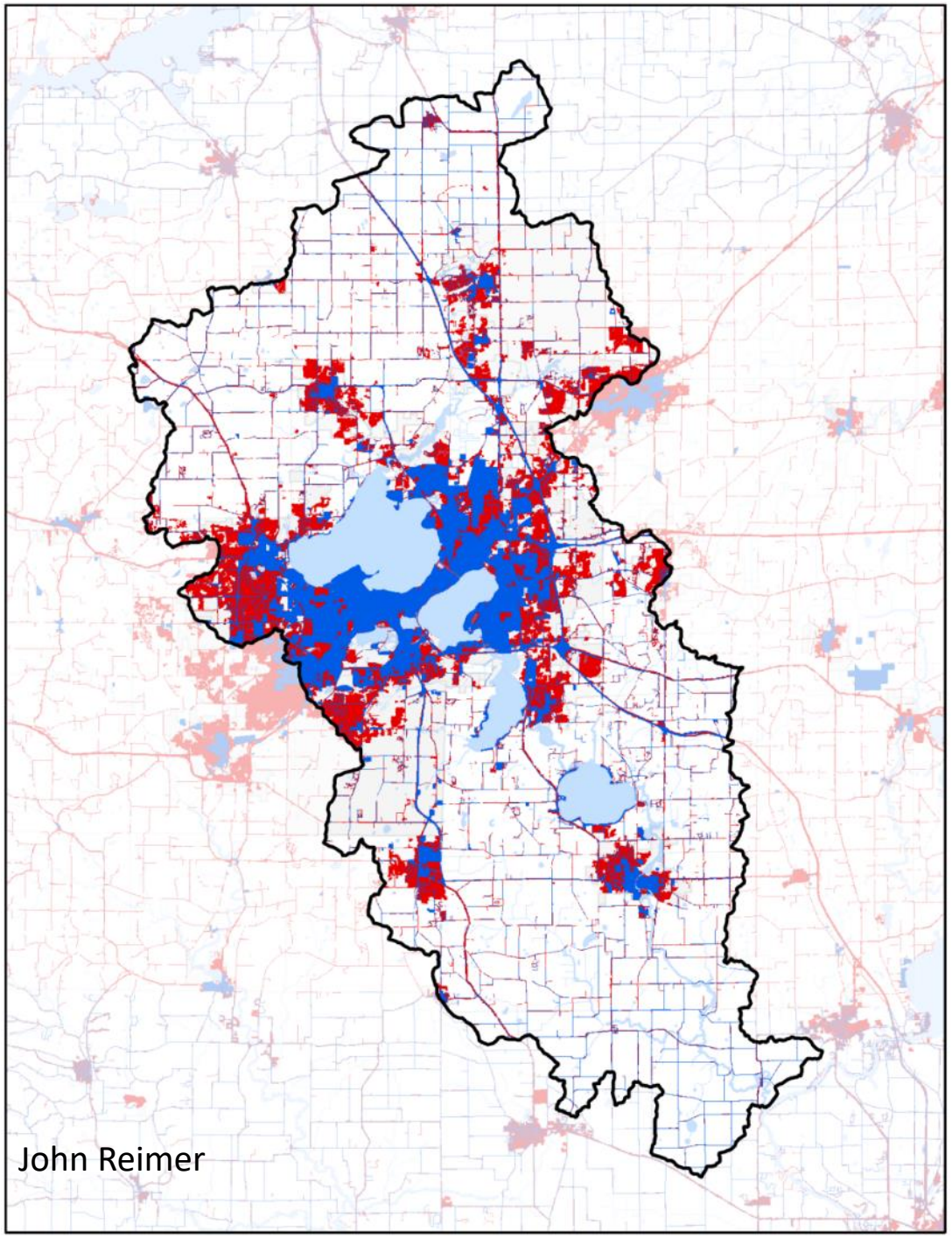
- The main factors are impervious surfaces, compacted soils, and expedited drainage.

Urban Development

Yahara Lakes Watershed

In **2017** (red & blue) there was about **twice** as much development as there was in **1970** (blue).

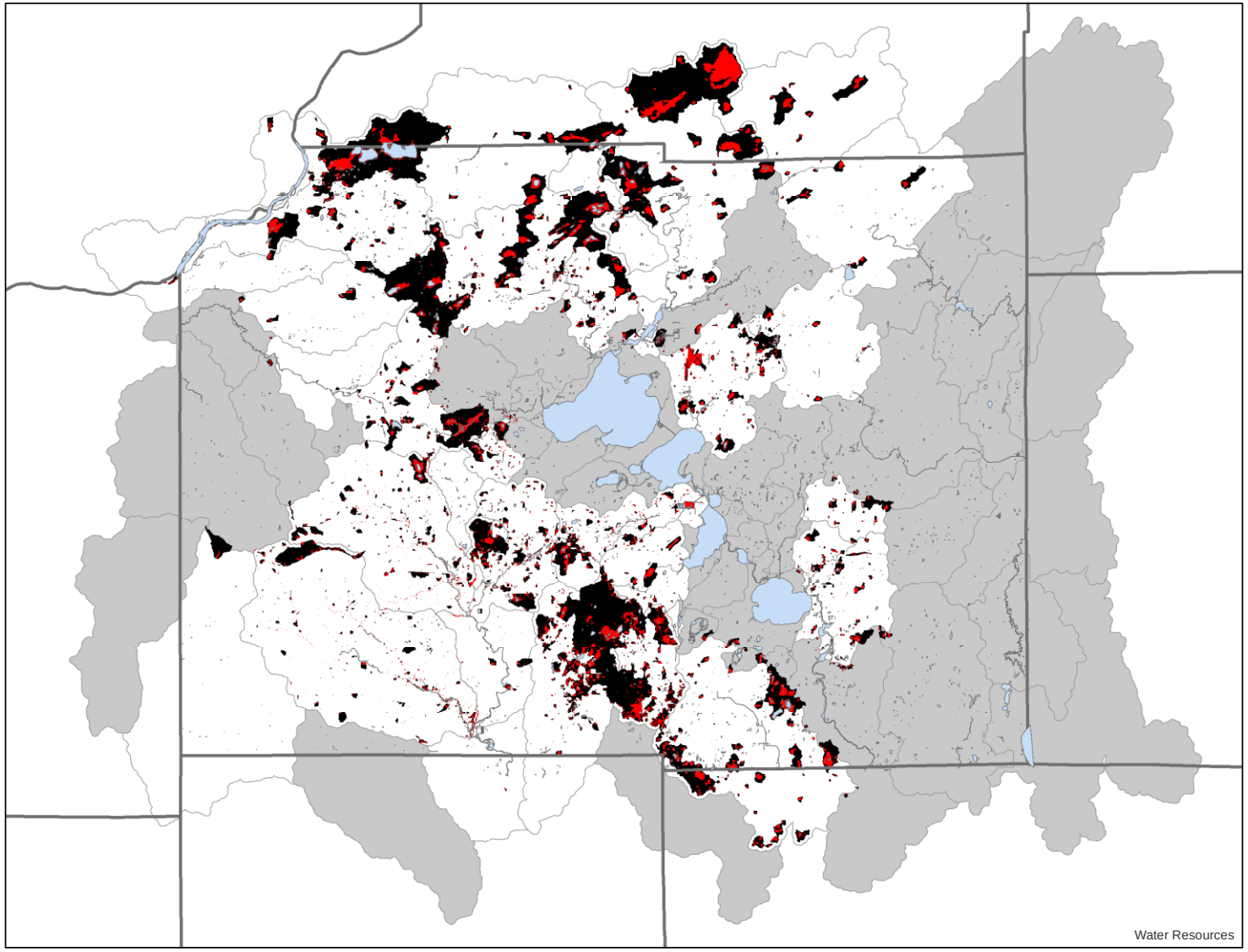
Note that **most** of the watershed is not yet developed!



Internally Drained Areas in Dane County

Internally drained areas do not naturally flow into streams, but instead lose water by evaporation and seepage.

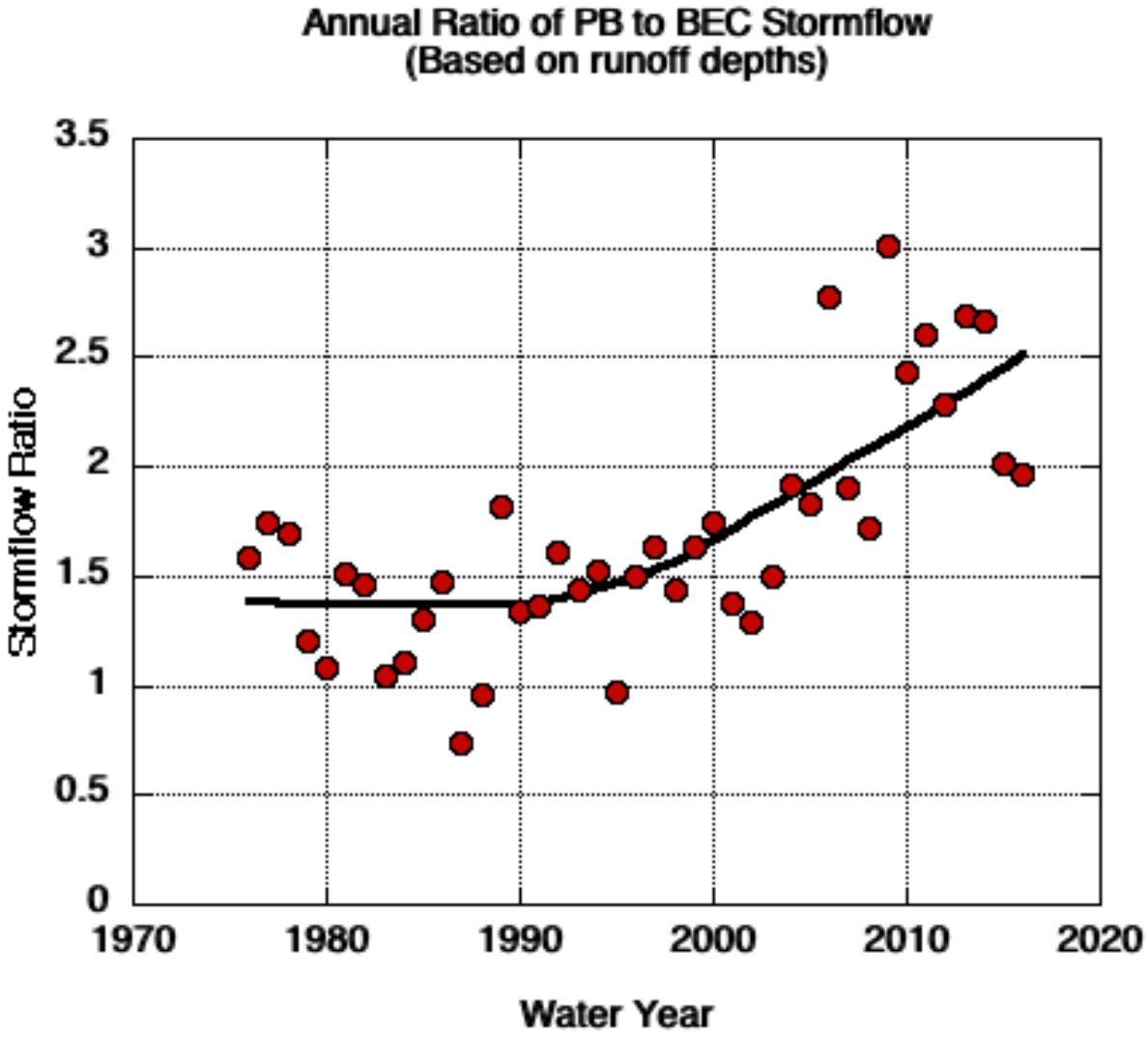
Depressions are red; black areas drain to the depressions.



Tony Vandermuss, Dane County Capitol Area Regional Planning Commission

Ratio of the *Annual Stormflow* of Pheasant Branch Creek to that of Black Earth Creek

Increase in flow of Pheasant Branch Creek is due to urbanization and drainage of a large internally drained area.



Runoff Volume Control Regulations

Runoff volume controls were established through Wisconsin in response to new ***WI DNR*** regulations in 2002.

The ***primary*** purpose of these regulations was to reduce ***channel erosion*****.**

Limitations of the Wisconsin Stormwater Ordinance

- The WDNR stayon requirement allows a 10% decrease in the water that does not runoff (“stayon”).

- Because pre-development stayon is typically large, this 10% decrease results in significant increases in the amount of runoff, and therefore increases the risk of lake flooding.

Limitations of the Wisconsin Stormwater Ordinance

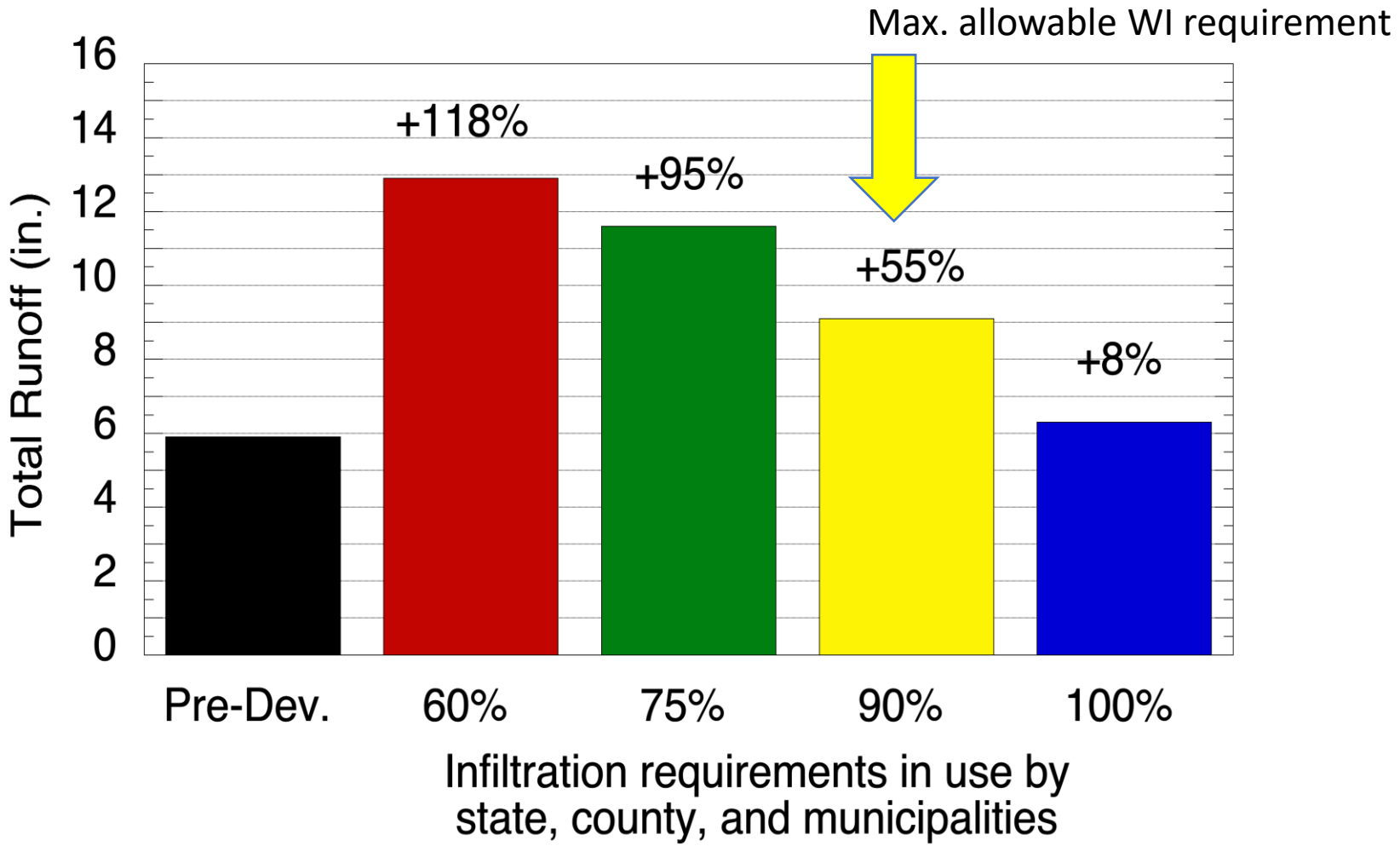
- A recent Dane County committee recommended 100% control of the ***pre-development*** stayon amount.

- However, the legislature subsequently prohibited any local government from increasing the stayon requirement above the DNR limit, ***even though the later was only intended to address stream erosion***.

Modelled Increase in Runoff for Various Levels of Control Based on Transposed 2008 Storm

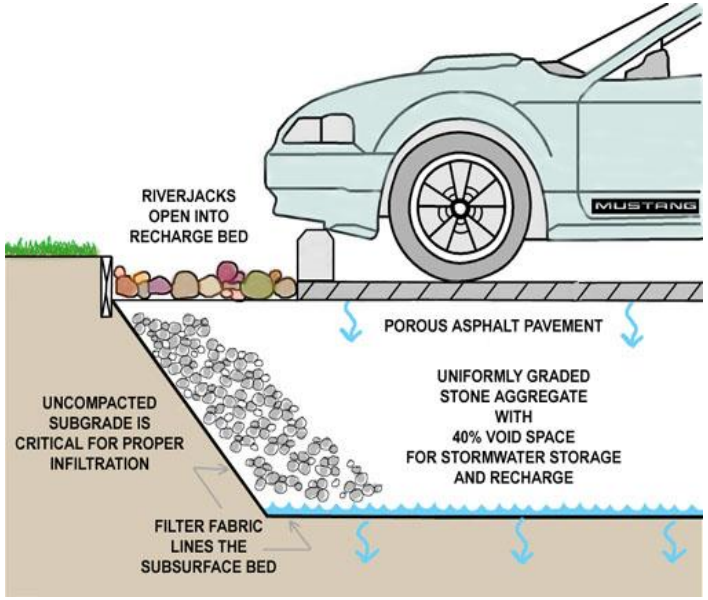
Assumes a B-soil and Upper Yahara rainfall.

The maximum allowable WI requirement is 90%.



Plot by Nick Hayden.

Common Volume Control Strategies



Subsoiling

- Runoff volumes can also be controlled by subsoiling, a method of restoring soil permeability by ***deep tilling chisel plowing***, and ***adding compost***

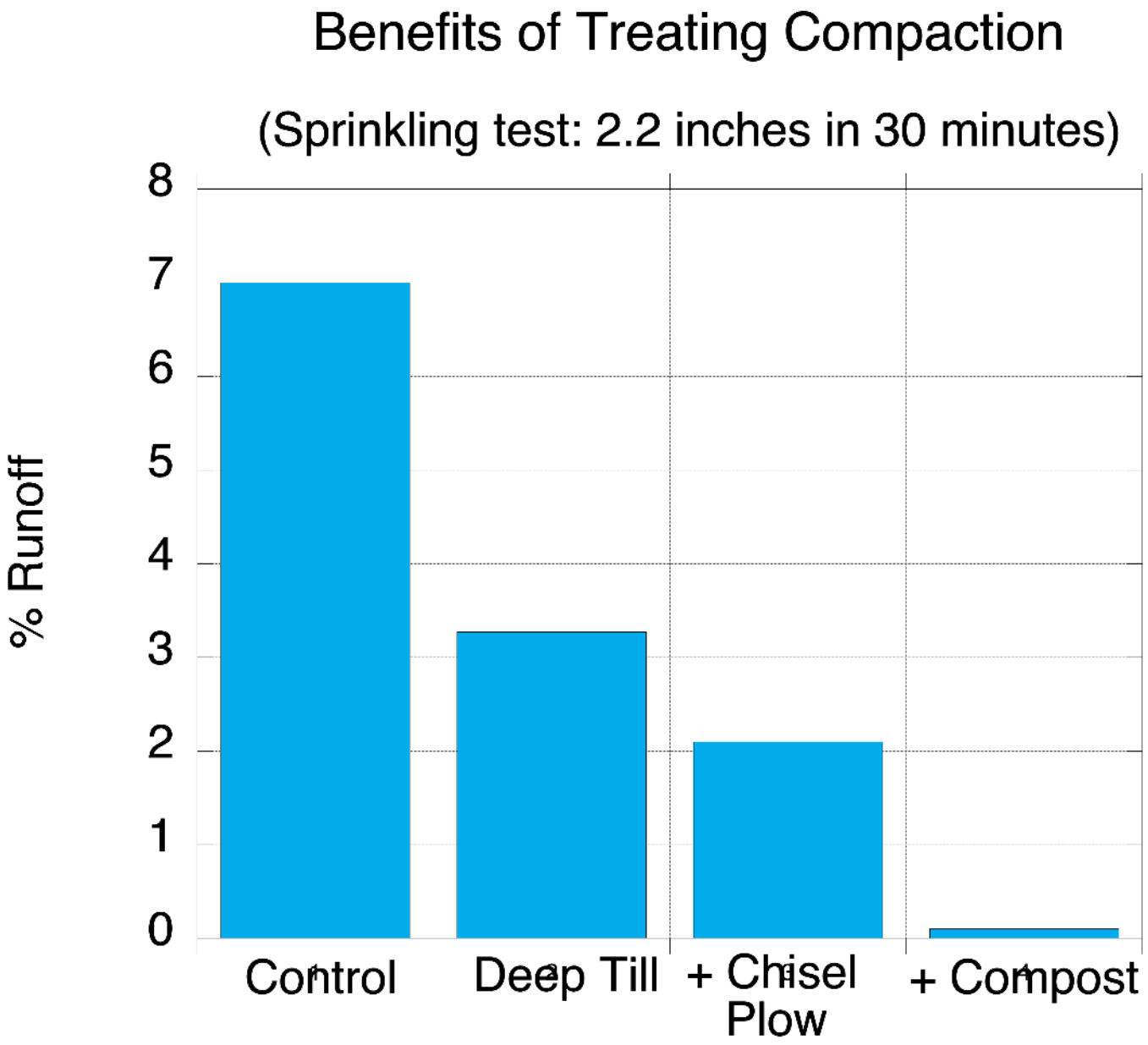
- It is most effective when used on flowpaths, such as a grassed swale or the path of water from a downspout to a street.

Balusek's Experimental Design

This plot shows the reduction in surface runoff from different approaches to treating compaction.

The control plot in this study was a sod lawn.

(Results obtained by Jeremy Balousek.)



Demonstration of Subsoiling in Maryland

Runoff Volume Trading

- To improve the efficiency of a 100% volume control ordinance, the stormwater committee recommended “runoff volume trading.”

- This would allow a new development to meet all or part of its volume control requirements by contributing financially to an efficient volume control practice elsewhere in the watershed.

Runoff Volume Trading

Analogous to existing "***pollution-trading***" systems-

- U.S. regulation of pollutants that cause ***acid deposition*** (e.g., sulfur and nitrogen oxides)
- ***Wetland*** "banking"
- WI regulation of ***Biological Oxygen Demand*** in the Wisconsin and Fox Rivers
- ***Phosphorus*** management under the ongoing adaptive management program in Dane Co.

Flooding Interrelationships

- High lake levels can cause flooding by raising water levels in adjacent groundwater.
- Fixing local flooding can increase flooding downstream. The water must go somewhere!
- The use of infiltration practices can potentially contribute to groundwater flooding in some locations.
- **Infiltration practices near volume-sensitive lakes likely provide no volume-control, although they do improve water quality.**

Groundwater Flooding

- Typically occurs in areas that are low compared to surrounding lands and have shallow impediments to the downward flow of water.

- Most common in internally drained areas; but can occur elsewhere.

Groundwater Flooding

- We typically discover these areas ***after*** a problem occurs.

- We need a program to identify where groundwater flooding is likely to occur in the future, so that we don’t promote infiltration there.

Vegetation for Stormwater Management

- In a heavily vegetated area in Wisconsin, about 2/3rds of annual precipitation evaporates or transpires.

- Most of the remaining water recharges groundwater. Only about 10% runs off the surface to lakes a and streams.

Vegetation for Stormwater Management

- In areas with high water tables, we need to aggressively use vegetation to prevent groundwater flooding.

- Tall deep-rooted plants with many small leaves generally transpose the most water. ***Willows*** and ***cottonwoods*** are a examples of trees with high ET rates and the ability to handle wet conditions.

Summary

- Climate and landuse change are increasing flood risk.
- Our current management practices are insufficient, and in some cases increase flood risk elsewhere (e.g., risk of groundwater flooding)
- We need to take a watershed approach to manage our flood risk and improve our understanding of local conditions.

Recommendations

- Repeal the legislative limit on volume control!
- Base design rainfall amounts on expected future increases in rainfall amounts for various recurrence intervals.

Recommendations

- Where groundwater flooding is a potential problem, emphasize the use of ***vegetation with high transpiration rates.***

- Better coordinate stormwater management across jurisdictions.

- Take a watershed approach!

Questions?