Climate Change Exacerbates Rain-Related Disease Risk

Michael Timm

Science Communication Specialist

Center for Water Policy

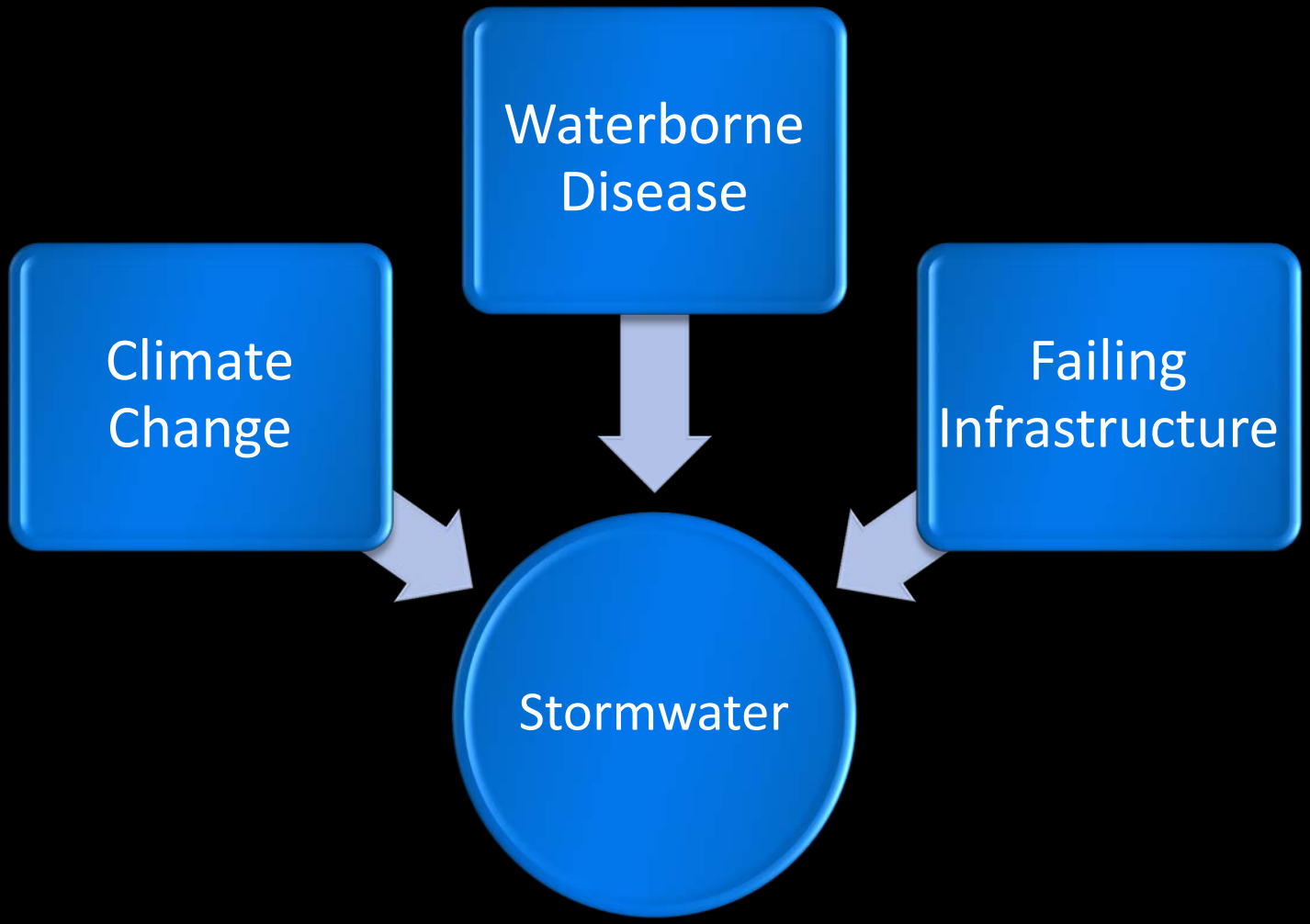
School of Freshwater Sciences

University of Wisconsin-Milwaukee

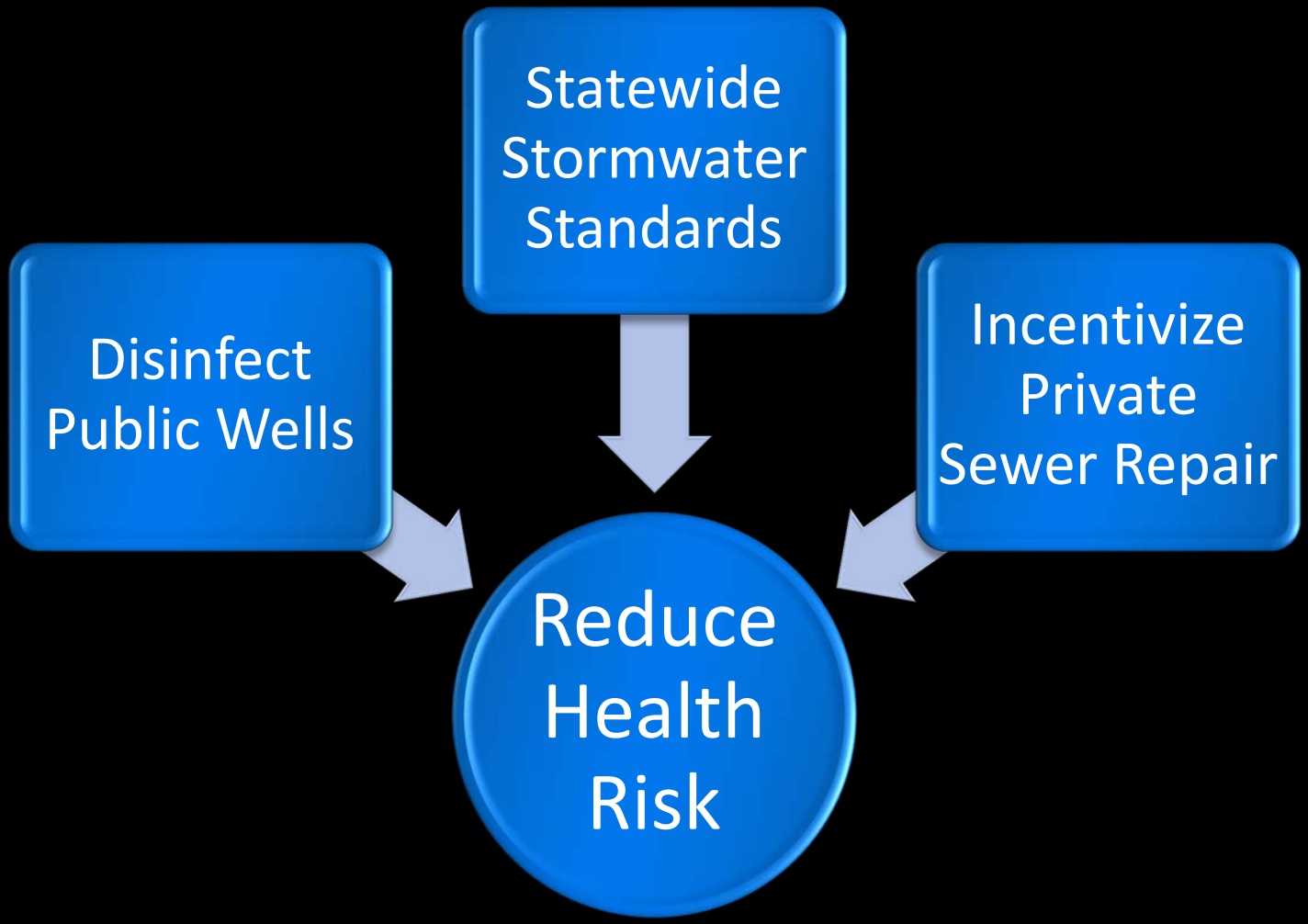
matimm@uwm.edu

c. 414.378.0945

The Problem:
Rain-related Disease Risk

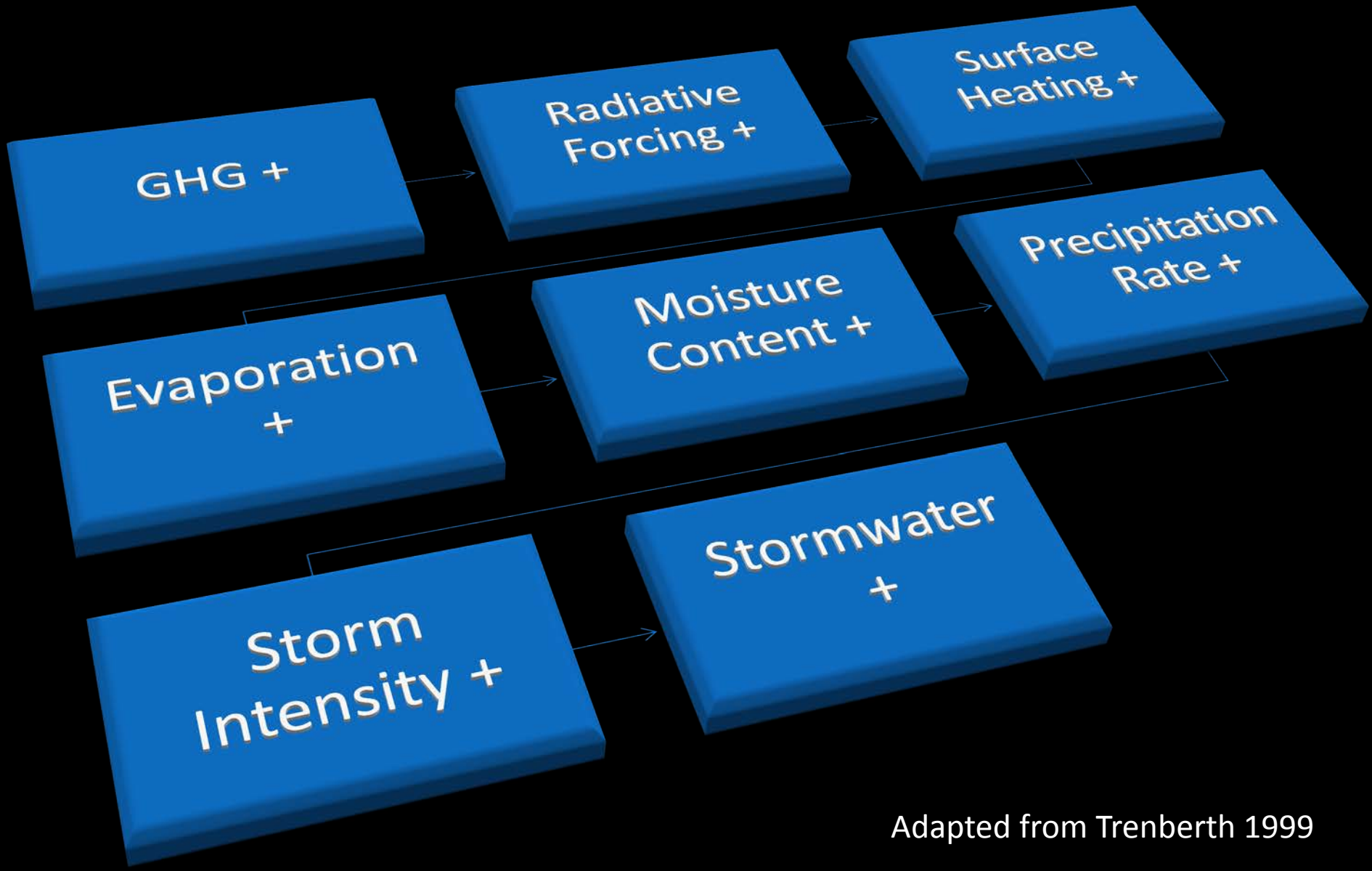


Policy Solutions: Rain-related Disease Risk



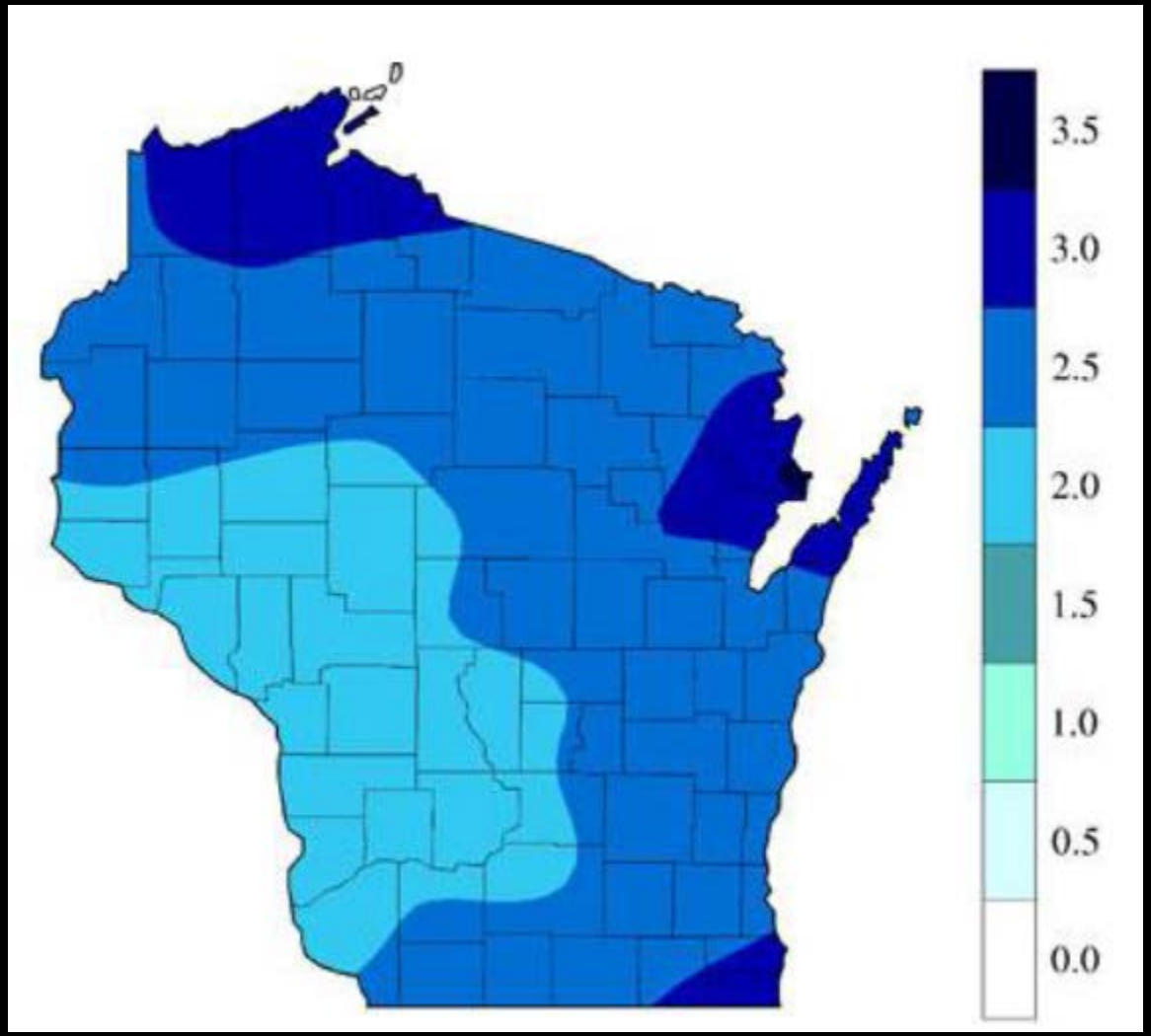
I. Climate Change

Energizing storms & loading the dice



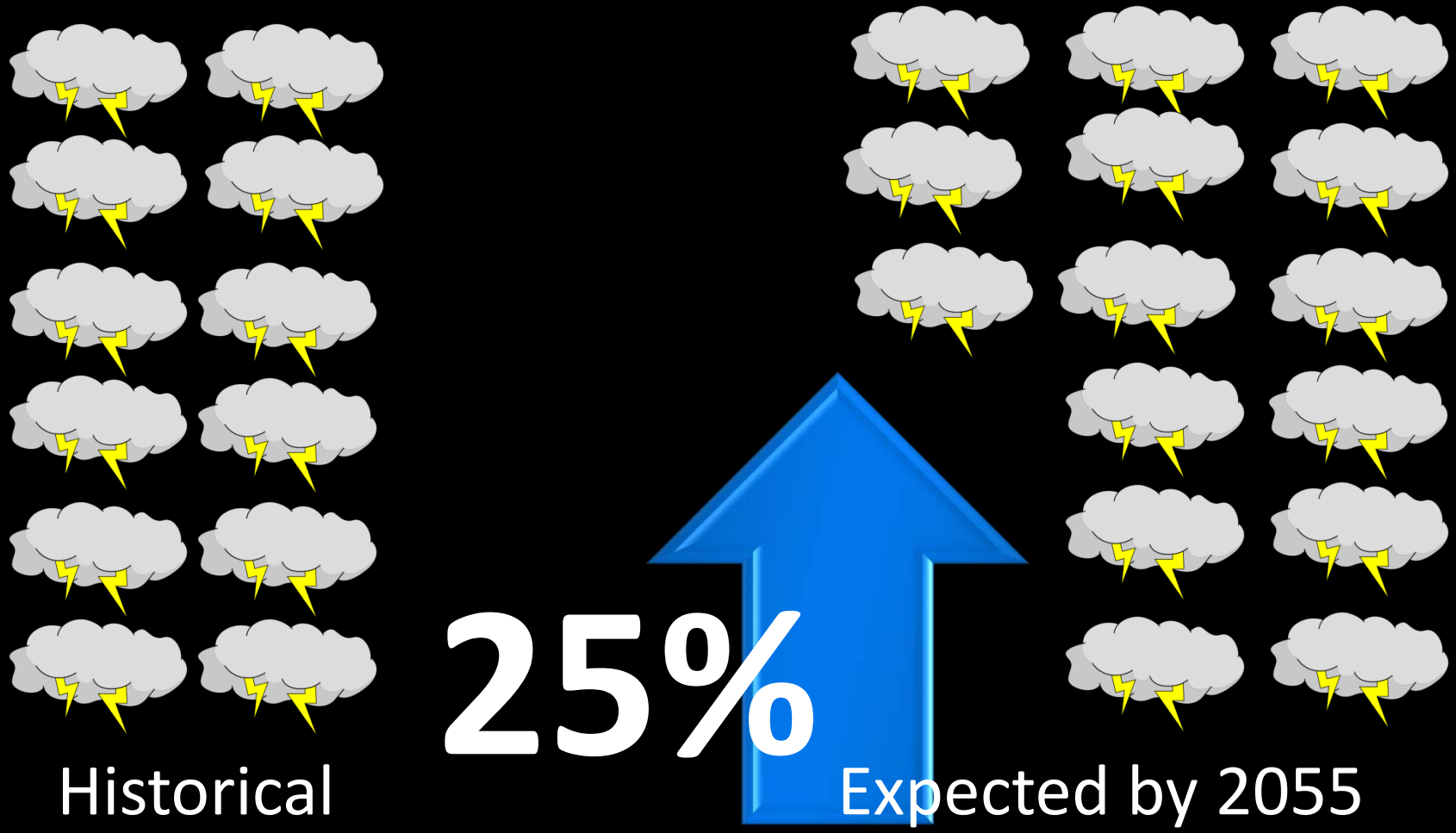
Adapted from Trenberth 1999

Downscaled models by WICCI



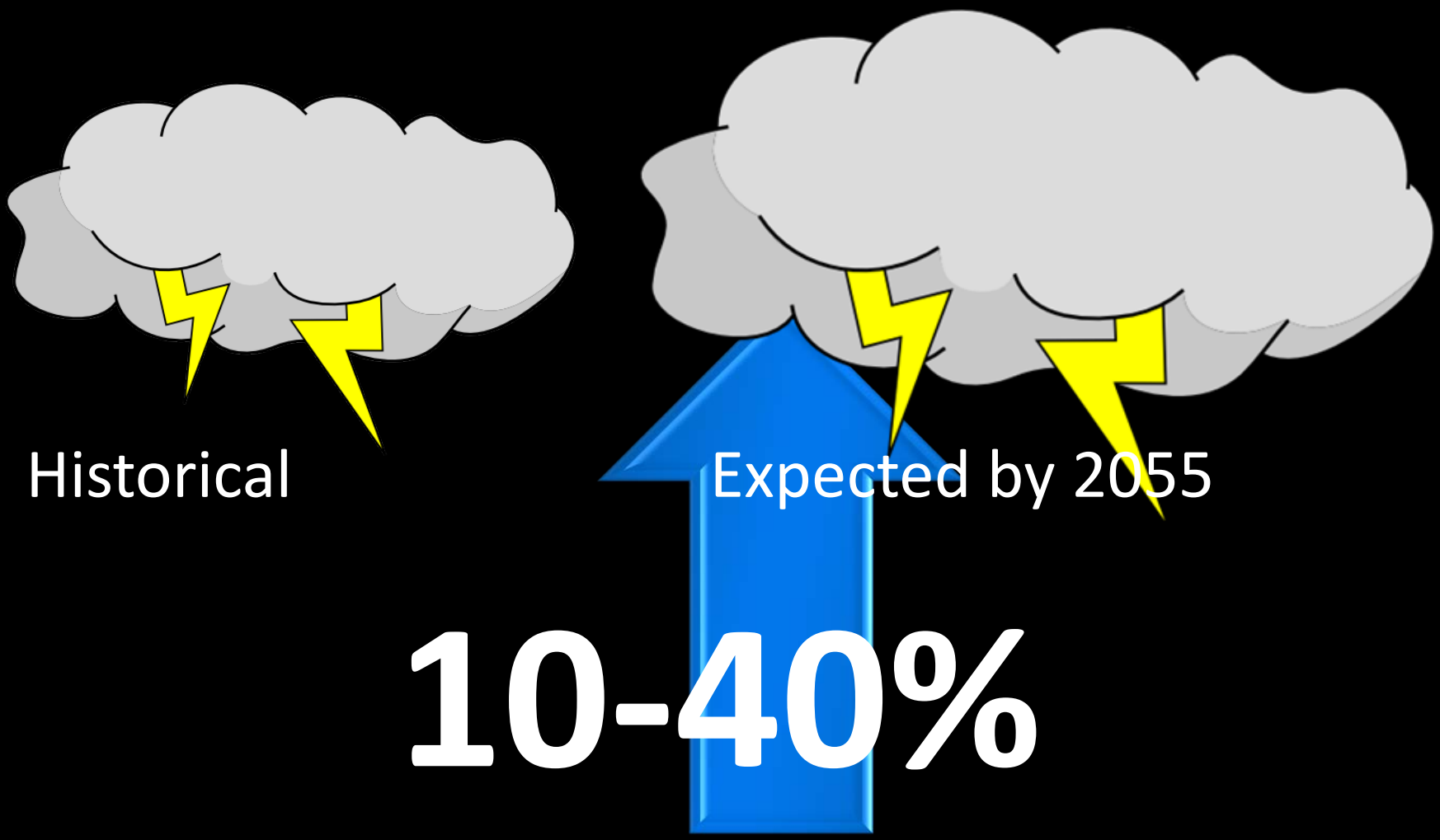
Significant increase in intense storm frequency by 2055

WICCI 2011



increase in intense storm **frequency**

WICCI 2011

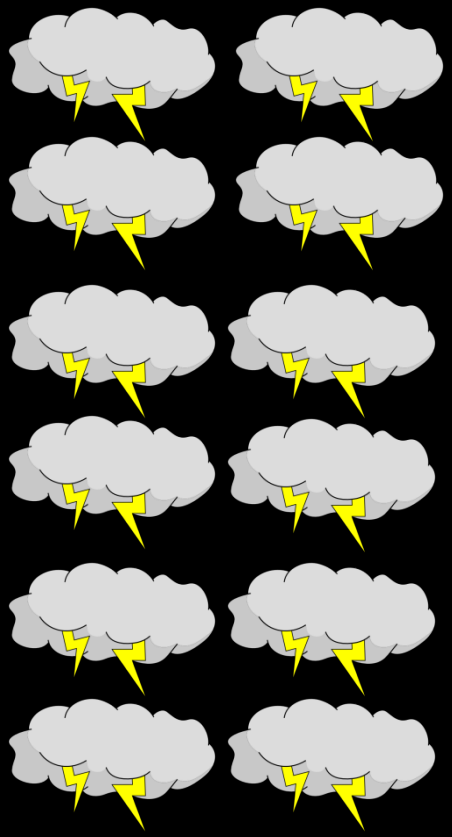


10-40%

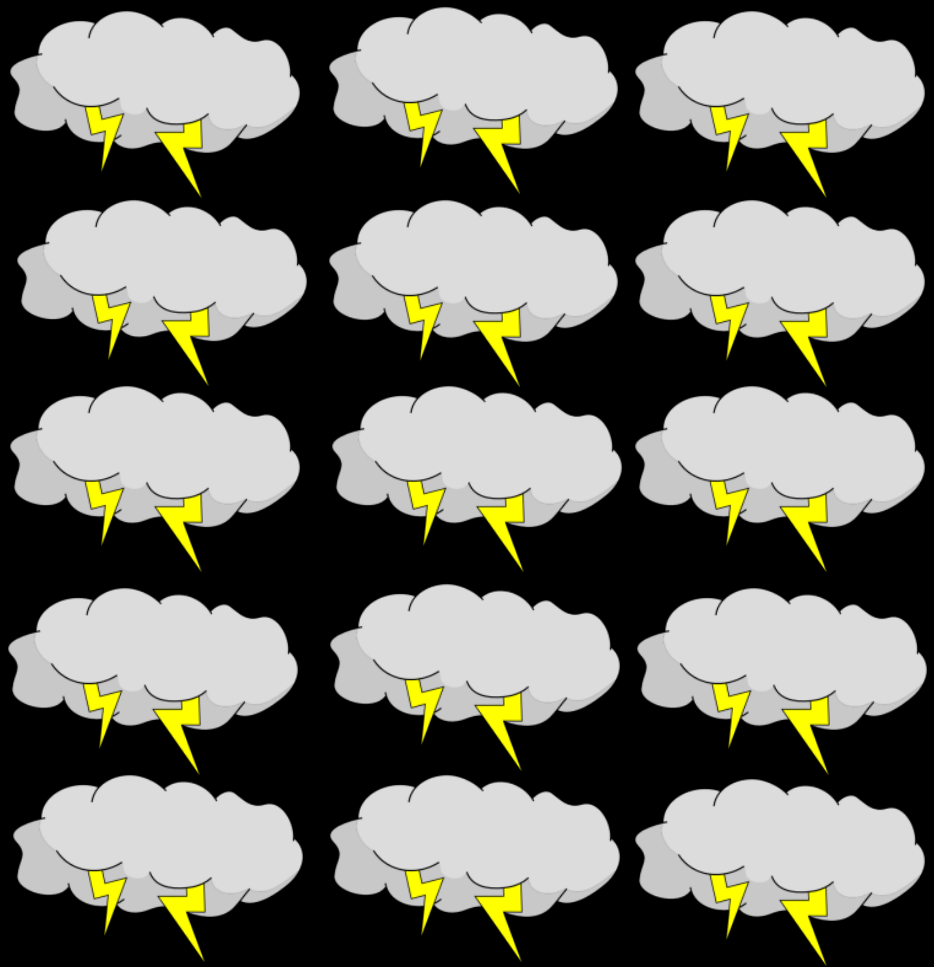
increase in storm **intensity**

WICCI 2011

More storms for warmer Wisconsin

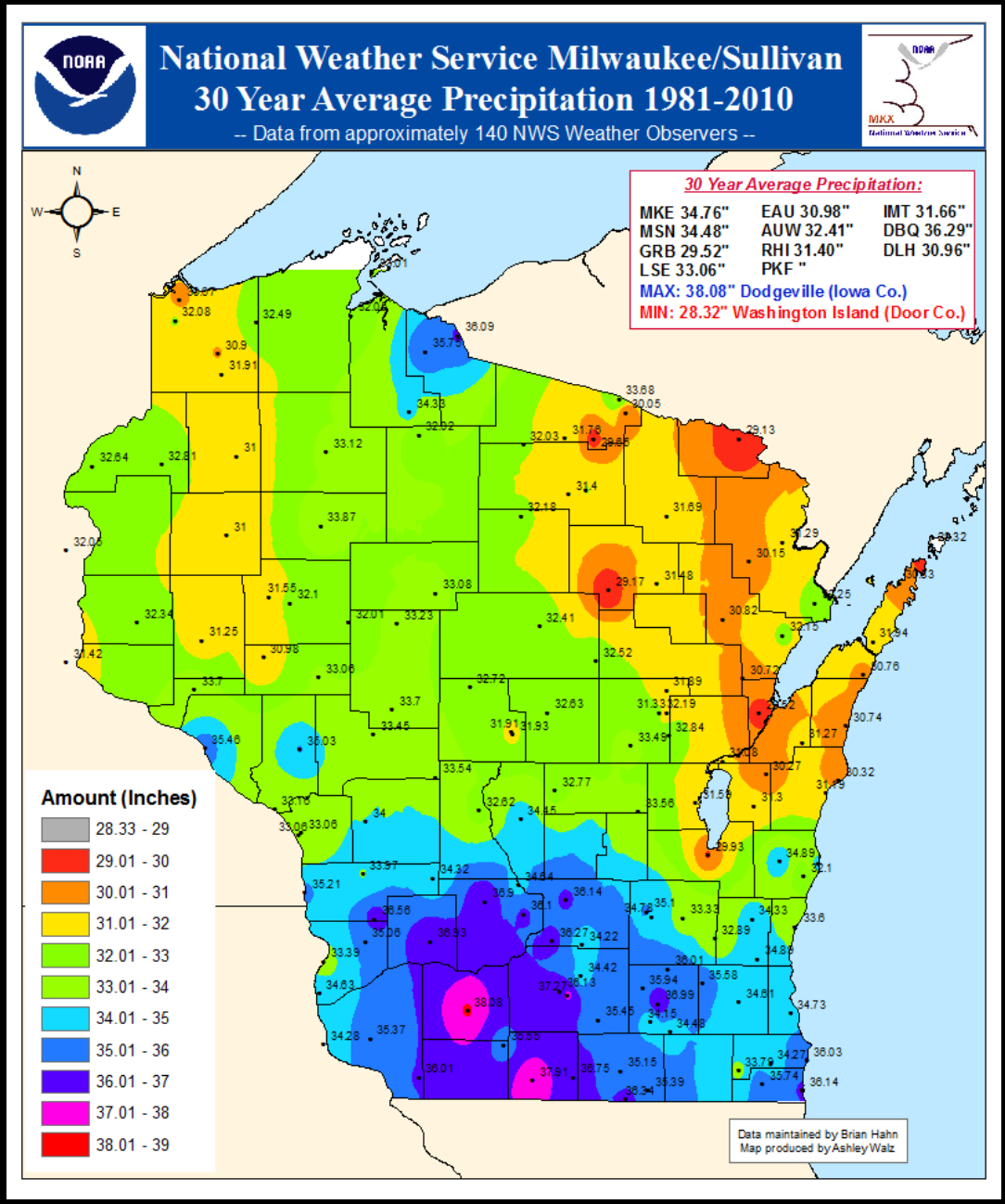


Historical



Expected by 2055

Historically, Wisconsin is wetter in some areas and drier in others. Drier areas may face added stormwater burden.

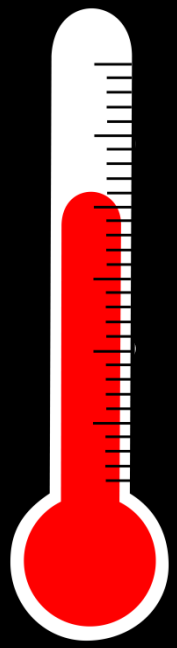


NOAA

Historically we've already been getting warmer and wetter

Data from 1950 to 2006:

- Nighttime lows temps up ~1-4°F
- Average annual daytime highs up ~0.5-1°F
- Southern precipitation increased by ~2-4"
- Northern precipitation decreased by ~1-2"



Rainfall over S. Wis.

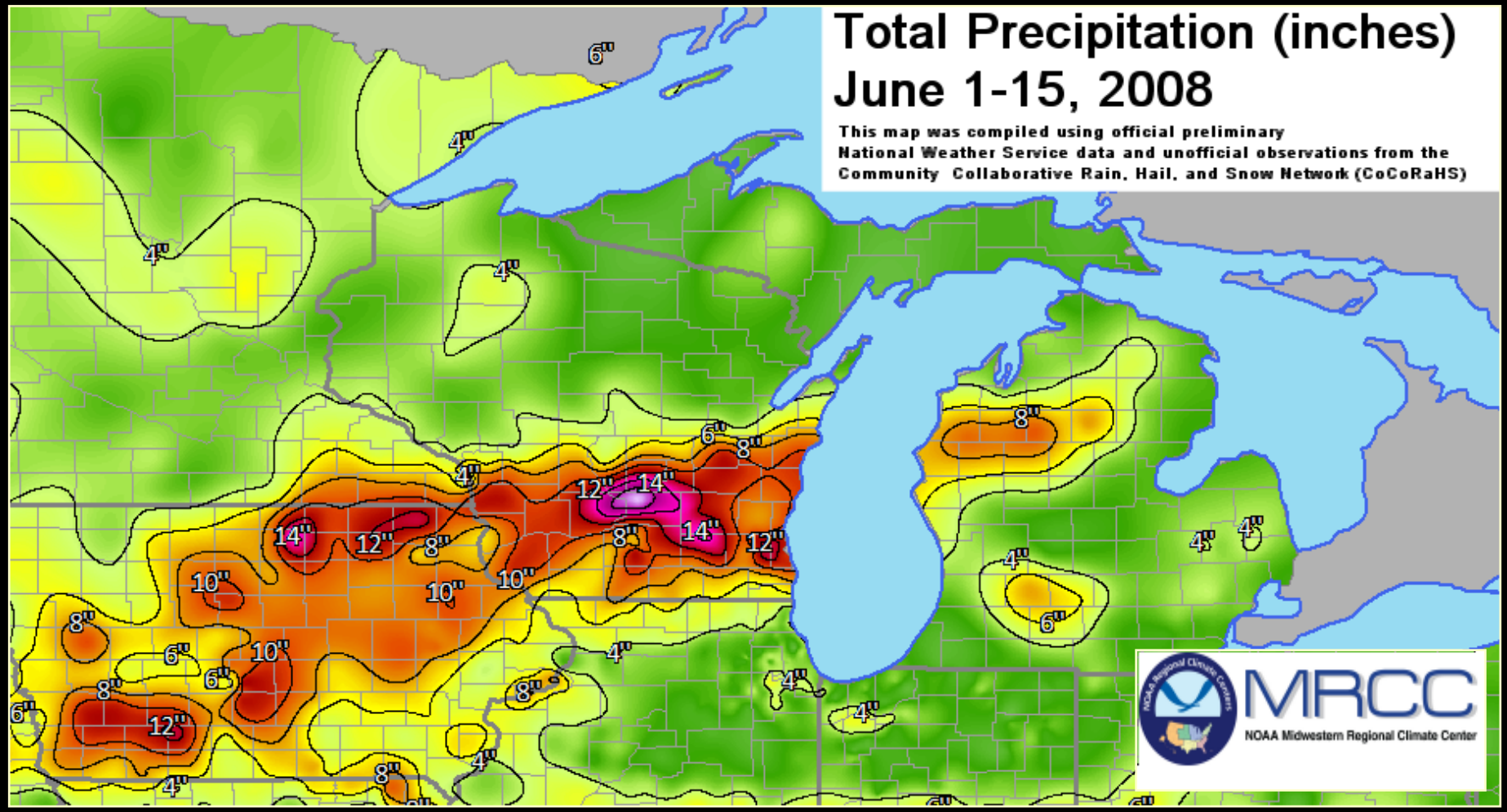
10-15%

Kucharik et al. 2010

The past is no longer an adequate guide

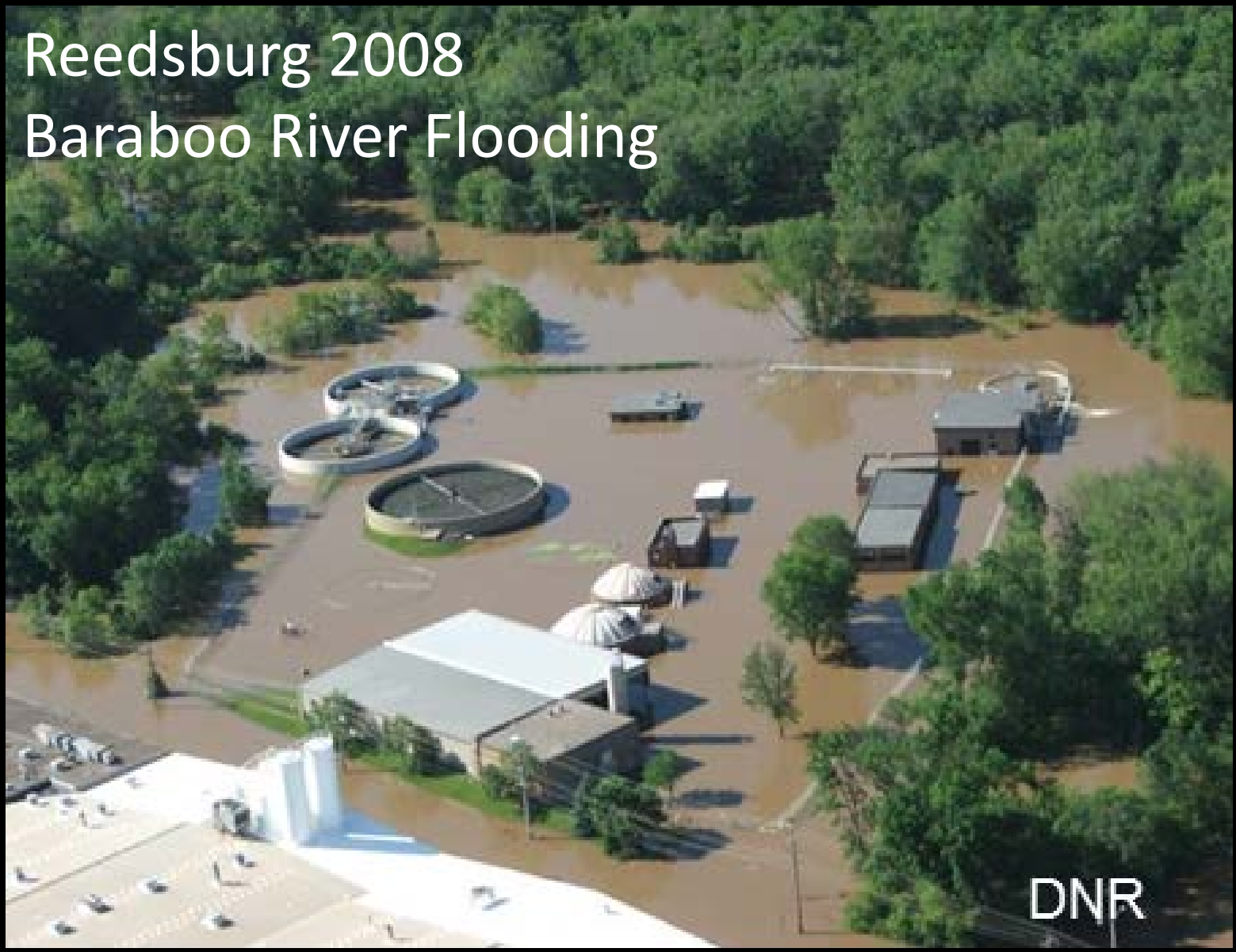
1950 ≠ 2006

Shifting trends mean our pipes were not designed or constructed to convey actual or expected flows



- 90 million gallons of sewage overflows at 61 communities
- 700 drinking water wells contaminated
- $34 million in damage claims paid

Slide courtesy of David Liebl, WICCI



Credit: WICCI; UW-Extension - David S. Liebl and Bill Bland

II. Waterborne Disease

Waterborne Disease in U.S.

- More than half of U.S. waterborne disease outbreaks followed heavy storms
- Contaminated water is responsible for between 6% and 40% of diarrhea-related illness
- Remember *Crypto*?
  - 403,000 sick
  - 69 dead
  - $96 million costs to society
  - $406 million in public investment as cure

Curriero et al. 2001; Gaffield et al. 2003; Corso et al. 2003

Acute Diarrhea (AGI)

- **10%** of U.S. hospital admissions
- **300** U.S. kids' deaths per year
- **$1 billion** in annual costs to U.S. society

- Biggest concern is for kids age 5 and under
  - Less immunity
  - Smaller body size
  - More complications

Elliot 2007

Relationship between rain & diarrhea

- **11%** increase in AGI ER visits for kids four days after rainfall (2002-2007 Children's Hospital)
- Associated with rain, not overflows
- Probably underestimates disease incidence
- These kids were primarily served by surface waters, but highlights role of rain in transporting pathogens
- Pathway/s not identified in this study

Drayna et al. 2010

Kids seem to be getting more sick from well water than surface water

- Another Children's Hospital study
- Top 3 illness risk factors in order of odds ratios:
  - Ill contacts in the home (2.52)
  - Well water (1.38)
  - Primarily bottled water (1.27)

Gorelick et al. 2011

Viruses in Wisconsin groundwater

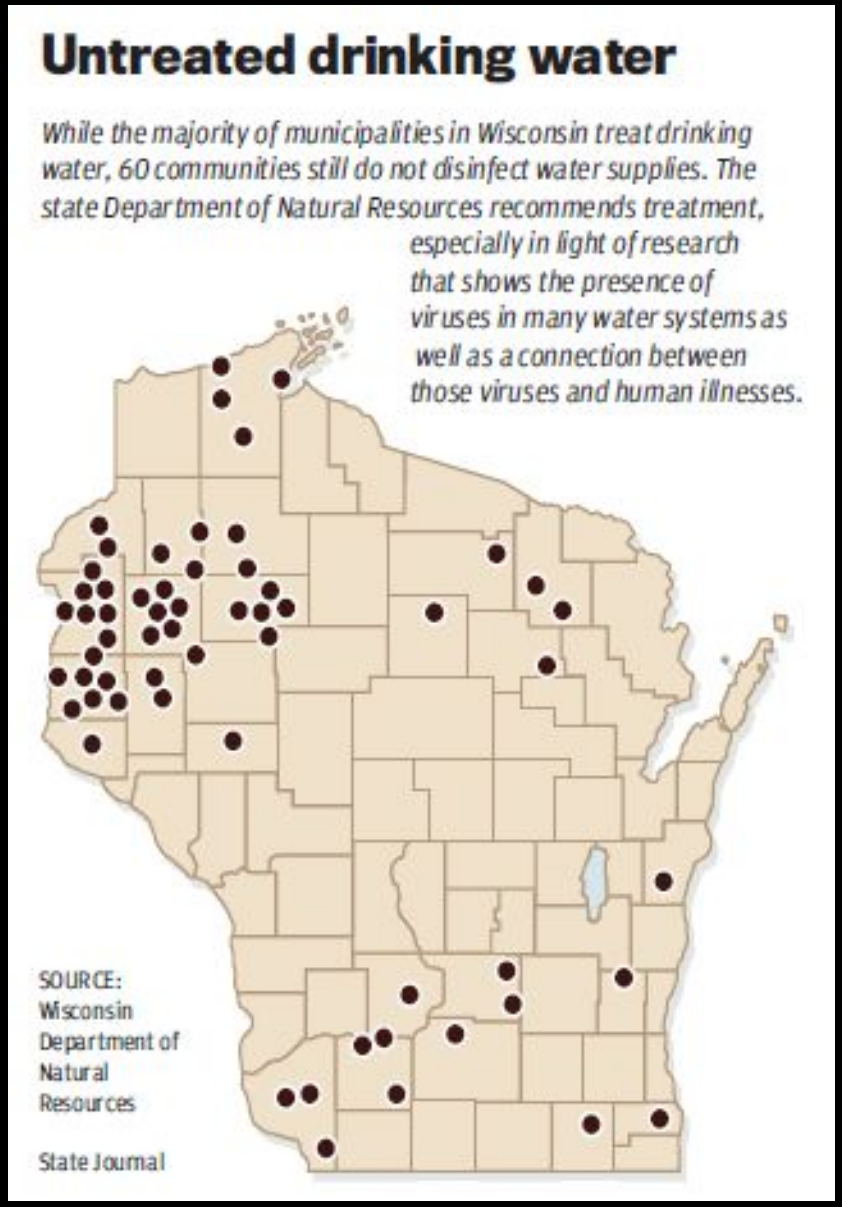
- Diarrhea linked with septic tank proximity in central Wisconsin (Marshfield)
  - Risk for viral diarrhea increased 8% per additional holding tank per section
- Viruses in pre-treated drinking water from groundwater, with sources both from river and elsewhere (La Crosse)
- Tap water from **14 of 14** non-disinfecting communities tested positive for viruses

Borchardt et al. 2003; Borchardt et al. 2004; Borchardt et al. 2012

2011 Wis. Act 19 leaves some 60 communities vulnerable by not requiring municipal well disinfection.

~65,000 people (1.1% of Wis. pop) and about 4,000 kids under age 5

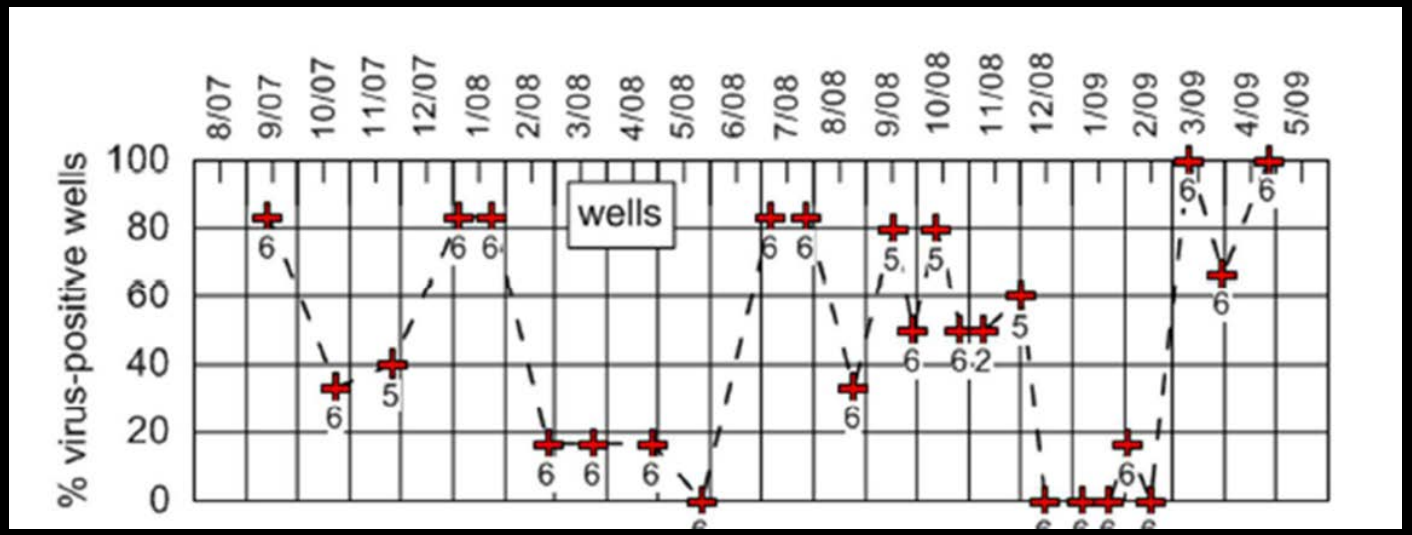
U.S. Census Bureau



Seeley in Wisconsin State Journal, 2012

Viruses in deep Madison groundwater

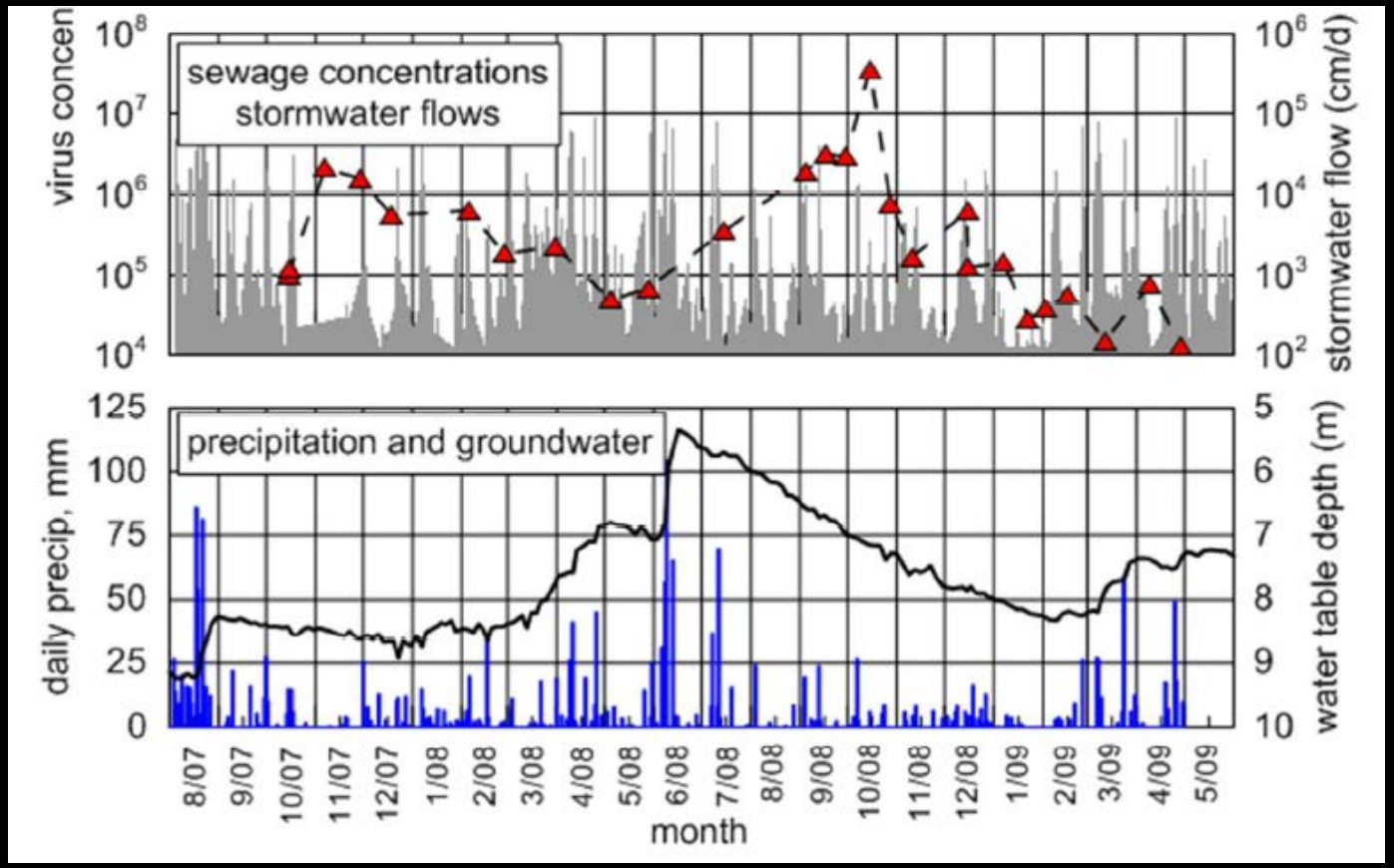
Data from six wells from 2007 to 2009



Bradbury et al. 2013

How are they getting there?

- Leaky sanitary sewer pipes implicated, transported by recharge from heavy rains



Bradbury et al. 2013

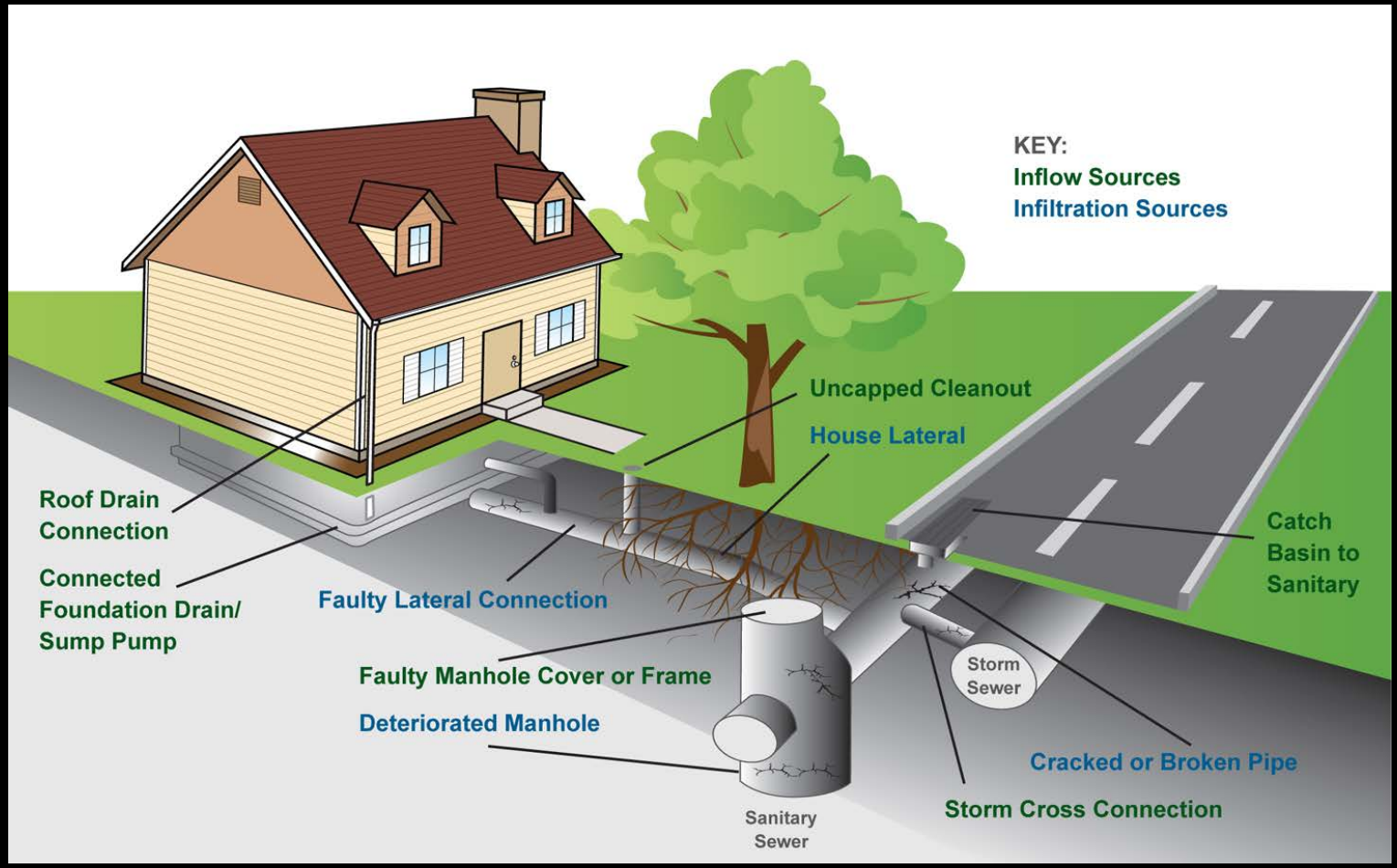
III. Failing Infrastructure

Leaky pipes

- **13,000,000,000** feet of pipe under America
  That's 10x distance between Earth and Moon
- Old sewer pipes leak, pathogens get out, especially when hydrology is conducive, i.e. when stormwater changes the game
- Old water mains break (1 per 10 miles per year), allowing viruses to seep into municipal distribution systems

American Water Works Association 2012; Folkman 2012

Then there are leaky laterals…



Milwaukee Metropolitan Sewerage District

Wisconsin's estimated 20-yr needs

- $2.5 billion for treatment upgrades
- $3.5 billion for distribution upgrades

U.S. EPA 2007

Wisconsin budget priorities

- **$94 million** in low-interest loans for drinking water infrastructure (short of projected 20-yr need by a lot)
- State highways get **$3.6 billion** over 2 years

Wis 2013 Act 20

Systemic Vulnerability

- Even with best treatment, if the distribution system is vulnerable, then we remain at risk
- Proximity of water and sanitary pipes: WI: 8ft; other states, 10ft; in reality there is likely communication when groundwater tables rise under heavy recharge
- Remember those 14 non-disinfected communities? The distribution system was implicated as the entry point for viruses from sewage.

Lambertini et al. 2012

IV. Policy Recommendations

First, acknowledge the scope of the problem

1. Disinfect public water supplies
2. Research local sewer and water vulnerabilities
3. Invest in underground infrastructure
4. Establish statewide stormwater standards that account for climate change expectations
5. Offer incentives to replace sewer laterals

Where's Our Water?
Out of sight, but not out of mind

Where's My Water's lovable alligator, Swampy, knows a thing or two about failing pipes