Watershed Studies 2019

By City of Madison Engineering Division

Evening Overview

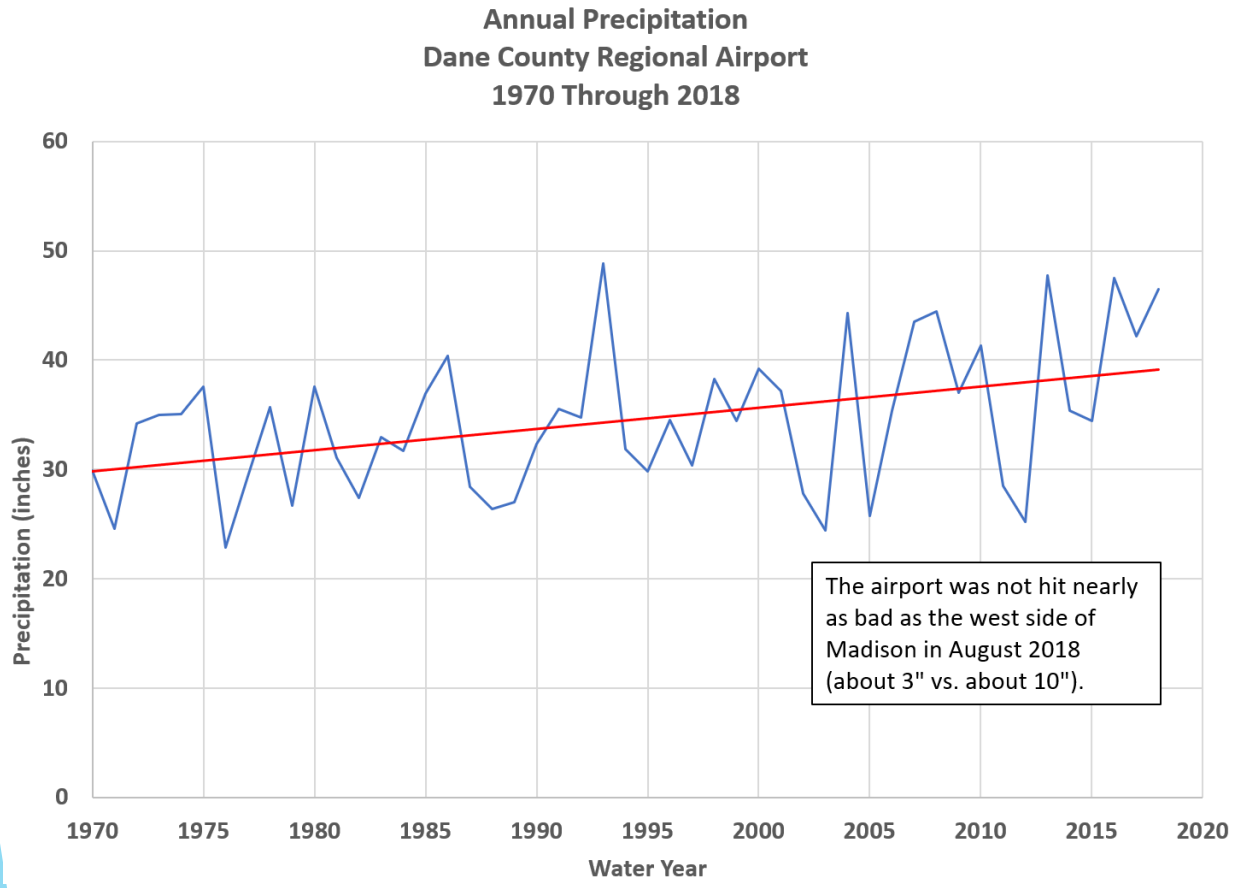
- Welcome (Hannah Mohelnitzky, City of Madison)
- Presentation (Jim Bachhuber, Brown and Caldwell)
- Q&A (facilitated by Hannah Mohelnitzky, City of Madison)
- Wrap Up (Hannah Mohelnitzky, City of Madison)
- Breakout to Small Groups (City of Madison and Brown and Caldwell Staff)

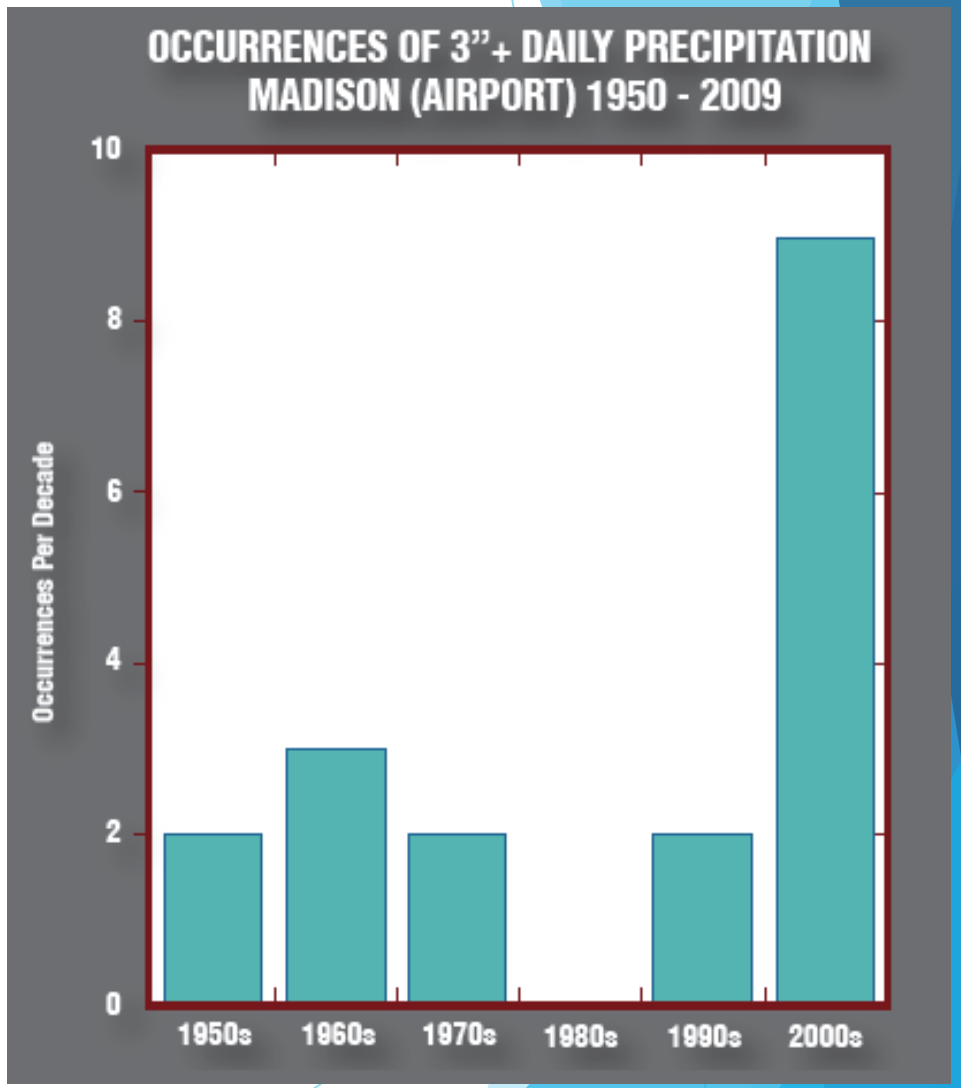
Presentation Overview

1. Why We Are Here
2. 100-Yr Storm Definition
3. Where the Water Goes
4. Reasons for Flooding Issues
5. Watershed Study Goals
6. Next Steps
7. Property Owner Responsibilities
8. How to Stay Involved

Why We Are Here: Historic Events

- More rain
- More rain events greater than 3”





Wisconsin's Changing Climate: Impacts and Adaptation. 2011. Wisconsin Initiative on Climate Change Impacts. Nelson Institute for Environmental Studies, University of Wisconsin-Madison and the Wisconsin Department of Natural Resources, Madison, Wisconsin.

Why We Are Here: Historic Rain Events

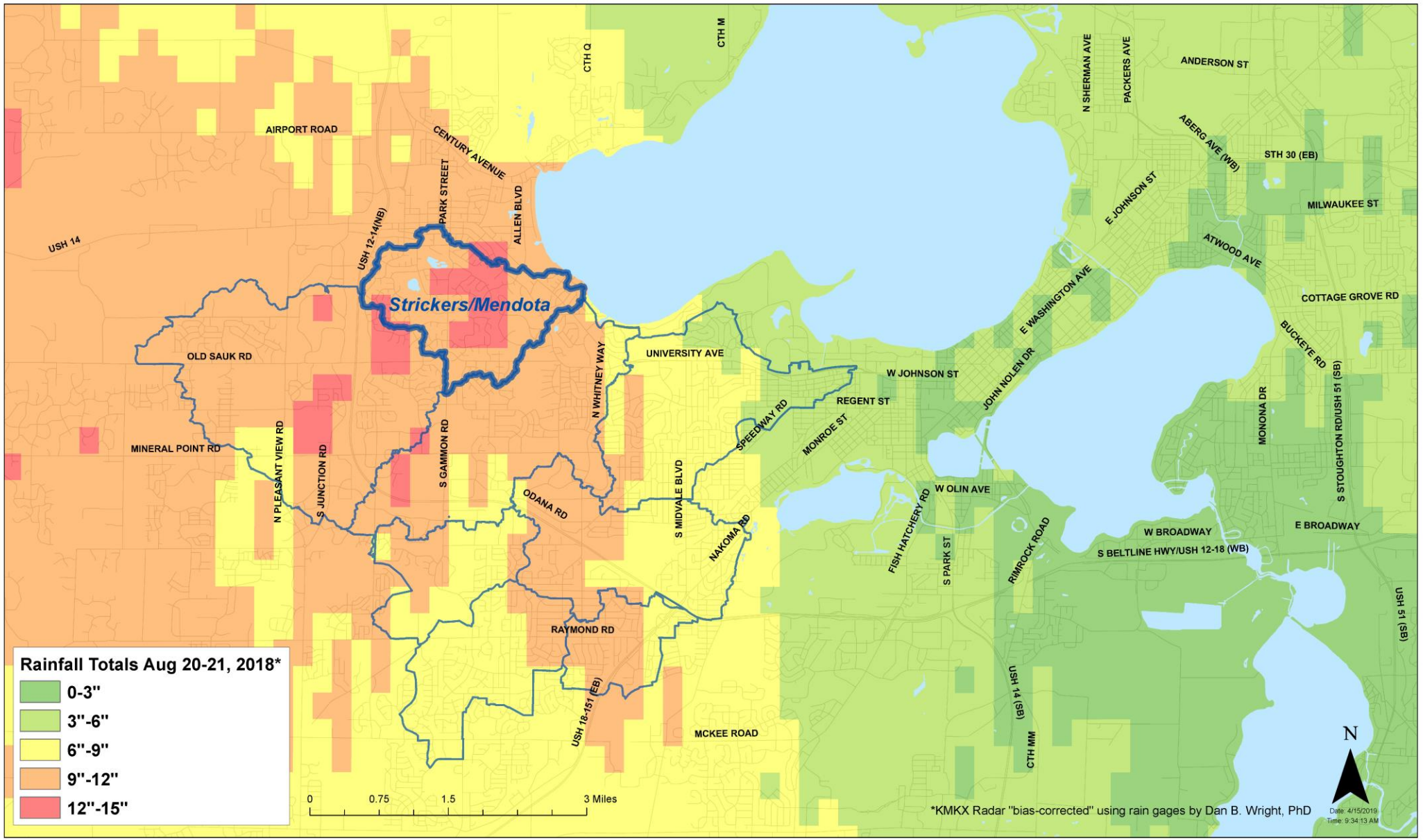
Recent Rain Events

- July 21, 2016: 2.41” in 2 hours
- June 16, 2018: 1.54” in 2 hours
- August 20, 2018: 6.72” in 14 hours

E Johnson Street, Madison, WI

All rainfall totals taken from the Weather Underground Camelot Dr station (KWIMADIS87) in Madison, WI.

Rainfall Totals August 20-21, 2018



KMKX Radar that was "bias corrected" using rain gauges by UW Professor Dan Wright

Why We Are Here: Historic Rain Events

- Recent storms have amplified known inadequacies
- Recent storms have revealed new storm sewer deficiencies
- ⇨ Result: flood damage

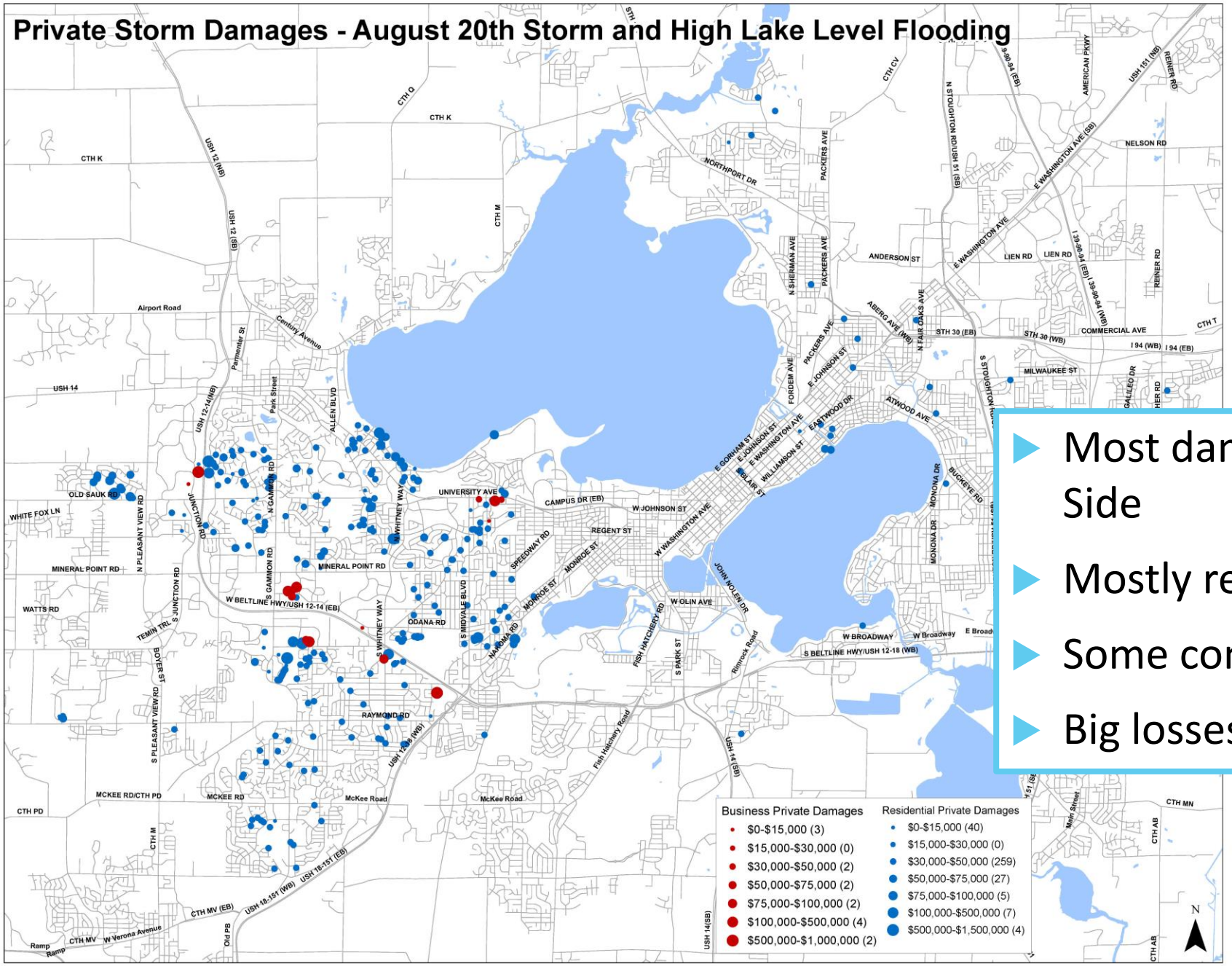
- City's plan
  - Complete watershed studies of impacted areas
  - Develop solutions from watershed studies

Deming Way, Madison, WI

Why We Are Here: Historic Rain Events

- August 20th event: substantial damage
  - Public infrastructure: $4 million
  - Private property: reported $17.5 million, estimated $30 million

Odana Road (above), Glenwood Children's Park (right), Madison, WI



- Most damage on the West Side
- Mostly residential damage
- Some commercial damages
- Big losses!

100-Year Storm Definition

The “100-Year” Storm

- Annual exceedance probability (AEP): chance that a rainfall event will occur in one year.
- 100-yr storm = 1/100 (1%) AEP
  - Does **NOT** mean that a storm will only occur once in 100 years.
  - During a 30-year mortgage, there’s a 26% chance of experiencing a 100-year (1%) event.

Annual Exceedance Probability (AEP)	Chance of occurring in 1 Year	Return Period or Average Recurrence Interval (ARI)
100%	1 in 1	1-year
50%	1 in 2	2-year
10%	1 in 10	10-year
4%	1 in 25	25-year
1%	1 in 100	100-year
0.10%	1 in 1000	1000-year

Historic Rain Events: In Context

Recent Rain Events

- July 21, 2016: 2.41” in 2 hours
  - 10% chance of occurring each year
- June 16, 2018: 1.54” in 2 hours
  - 50-100% chance of occurring each year
- August 20, 2018: 6.72” in 14 hours
  - 0.5-1.0% chance of occurring each year

All rainfall totals taken from the Weather Underground Camelot Dr station (KWIMADIS87) in Madison, WI.

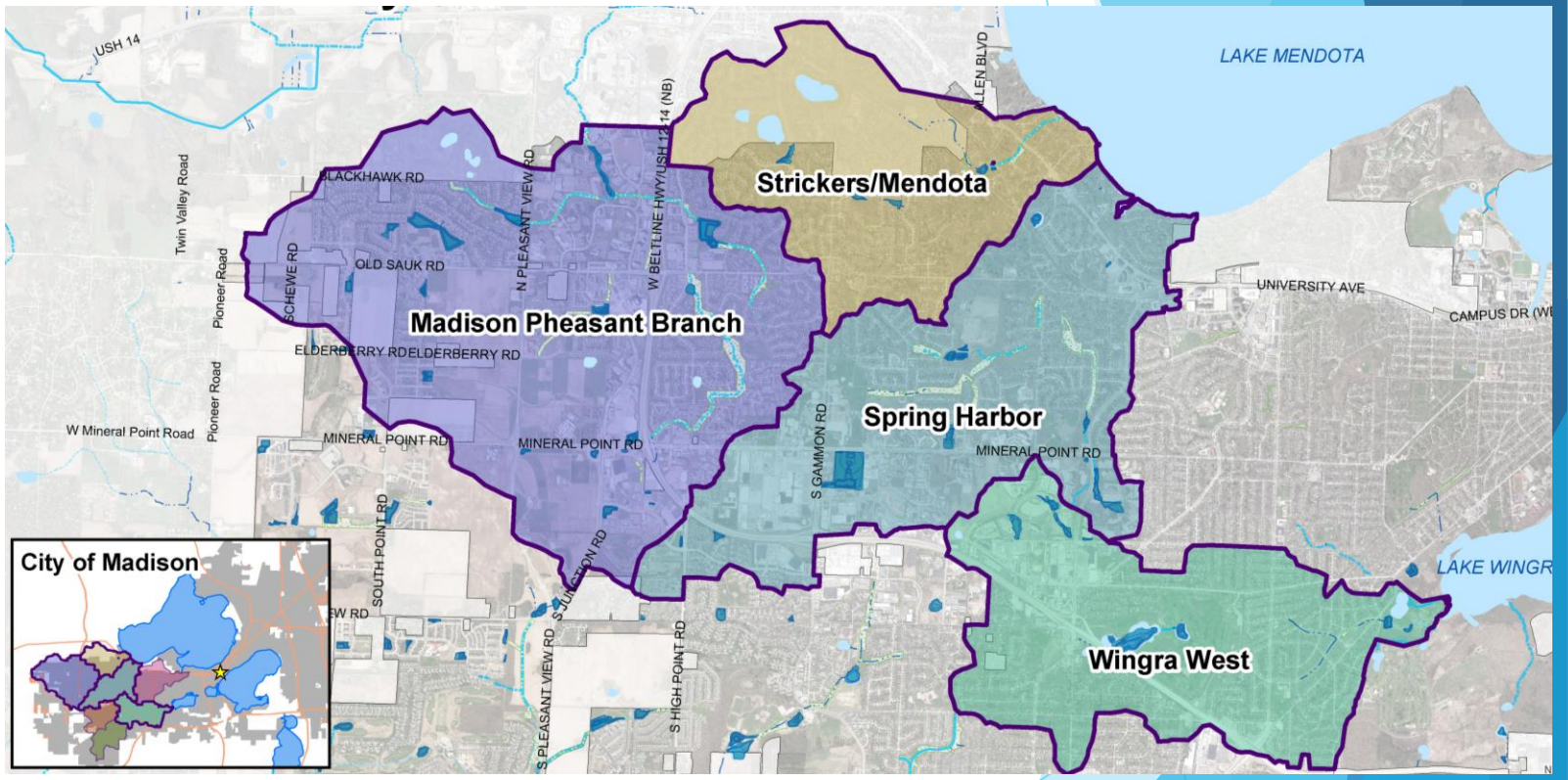
E Johnson Street, Madison, WI

Where the Water Goes

What's a watershed?

- A watershed is the area of land that drains precipitation (rain, snow, etc.) to a common low point, such as an inlet, stream, or lake.

- Determined by surface terrain and underground pipe system.



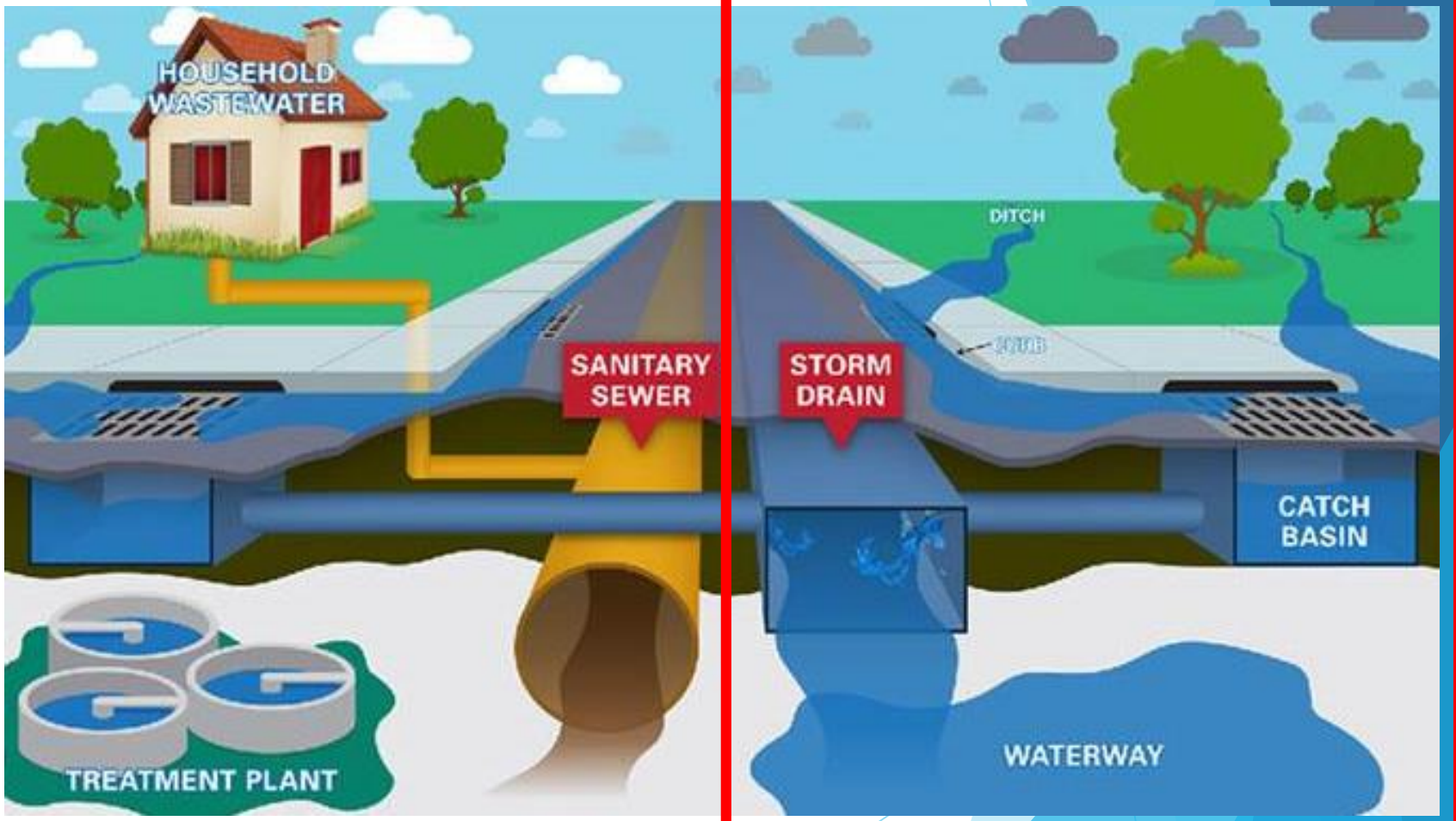
Where the Water Goes: Sewer Systems

- Madison has separate storm and sanitary sewers
- Storm sewer system is NOT the same as the sanitary sewer system

https://www.azstorm.org/stormwater-101/storm-vs-sanitary-sewer

Where the Water Goes: Storm Sewer

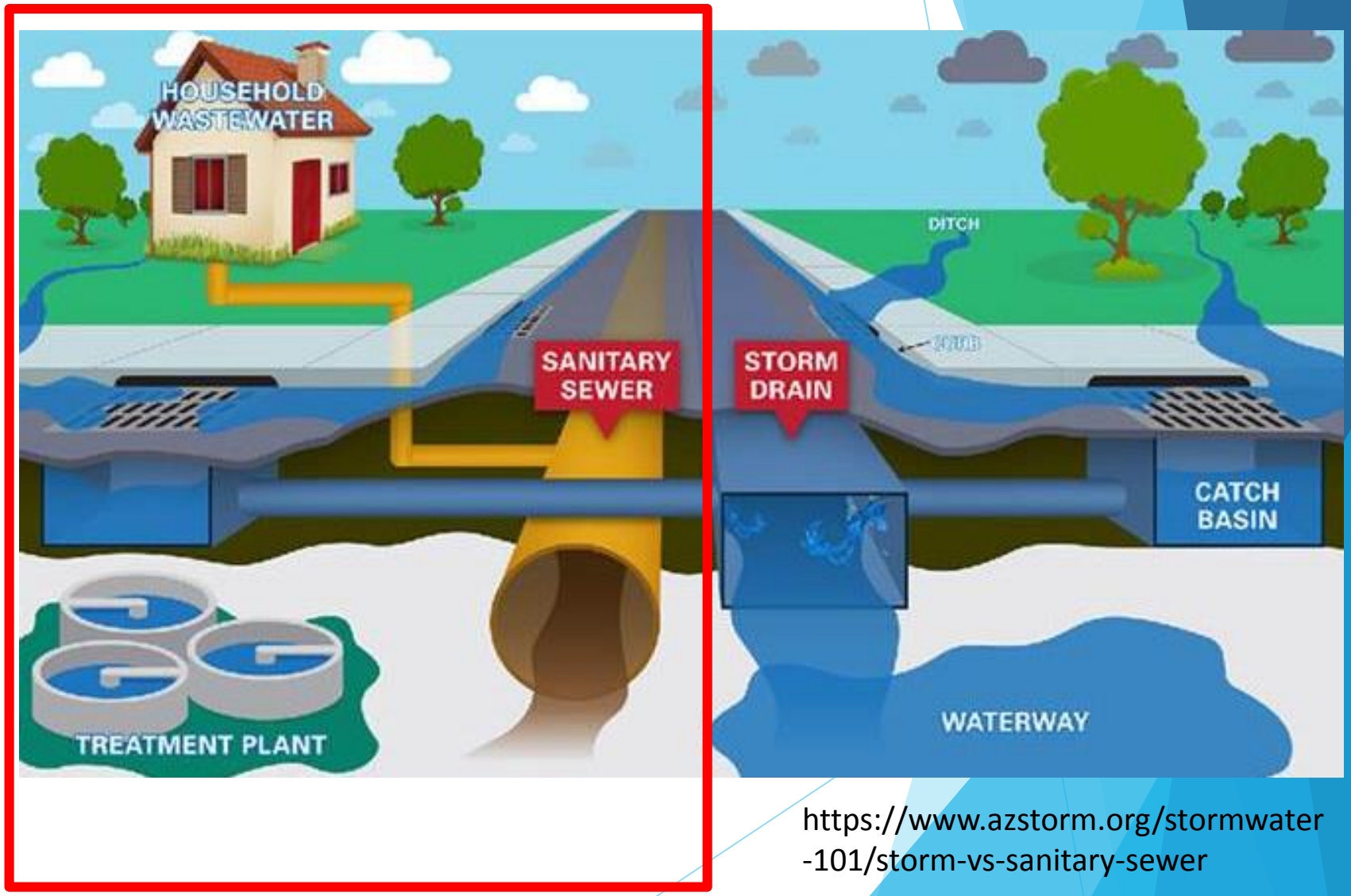
- Our stormwater drains to local surface waters
- We try to treat for nutrients and sediment
- Storm infrastructure includes:
  - Curbs and gutters
  - Inlets
  - Pipes
  - Channels (greenways)
  - Ponds



https://www.azstorm.org/stormwater-101/storm-vs-sanitary-sewer

Where the Water Goes: Sanitary Sewer

- Sanitary sewer drains residential (toilets, showers, kitchen sinks, etc.), commercial and industrial wastewater streams
- Sanitary sewer transports wastewater to Madison Metropolitan Sewerage District (MMSD) treatment plant
- Sanitary infrastructure includes:
  - Manholes
  - Household lateral pipes
  - Main collector pipes



https://www.azstorm.org/stormwater-101/storm-vs-sanitary-sewer

Reasons for Flooding Issues

- Flash flooding: when storm sewer system cannot handle high amounts of rain
- Comparative example: a traffic jam
  - Too many cars of the Beltline during rush hour → backups happen
- During a storm, more water tries to move through the storm sewer system → backups happen

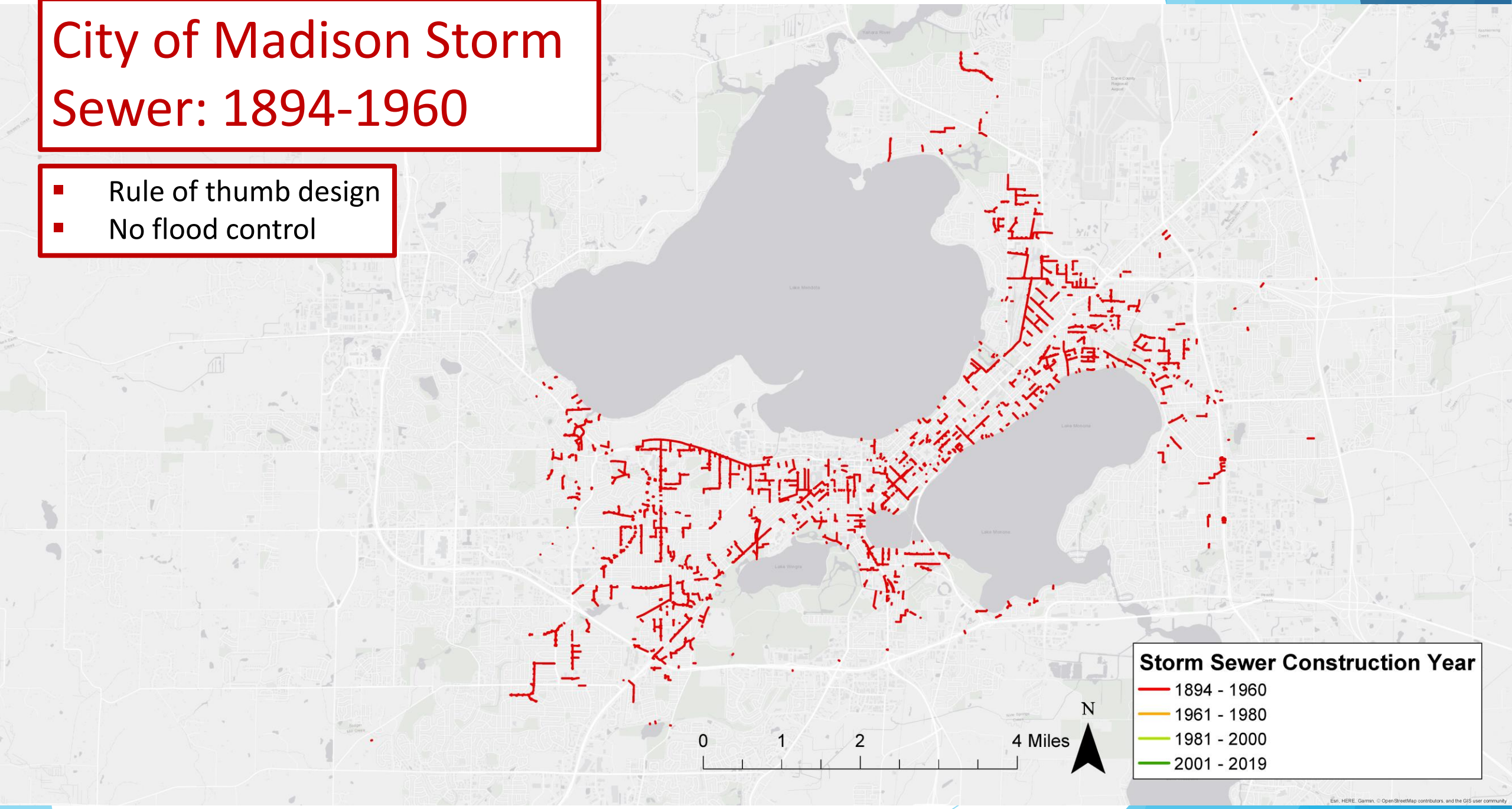
Beltline, looking west from Park Street, WisDOT

Reasons for Flooding Issues: Changing Design Standards

- Changing public design standards and past limited private design standards have led to flash flooding.
- Lax historical building requirements created hard-to-solve flooding problems on private property which cannot be easily corrected.

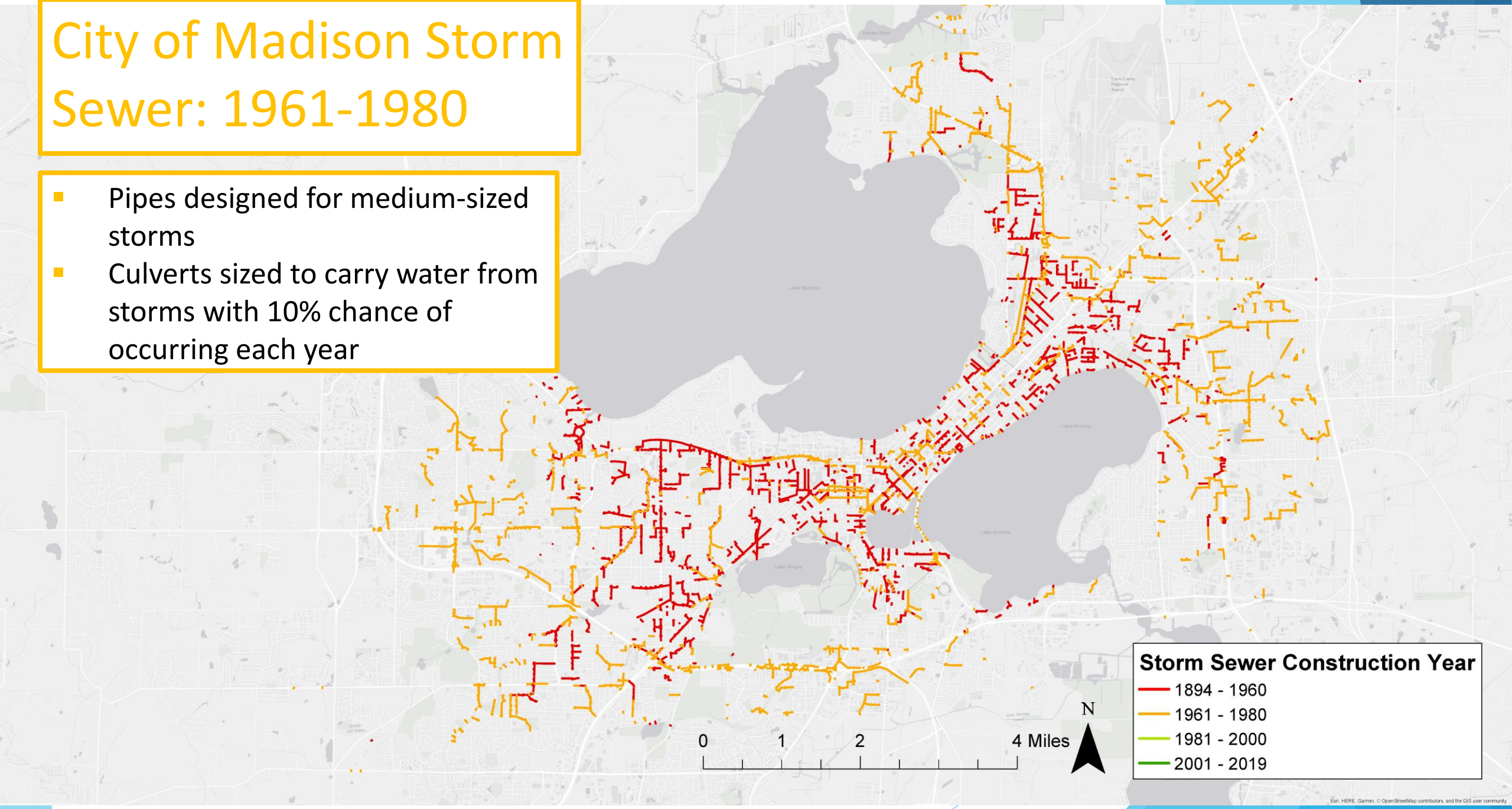
City of Madison Storm Sewer: 1894-1960

- Rule of thumb design
- No flood control



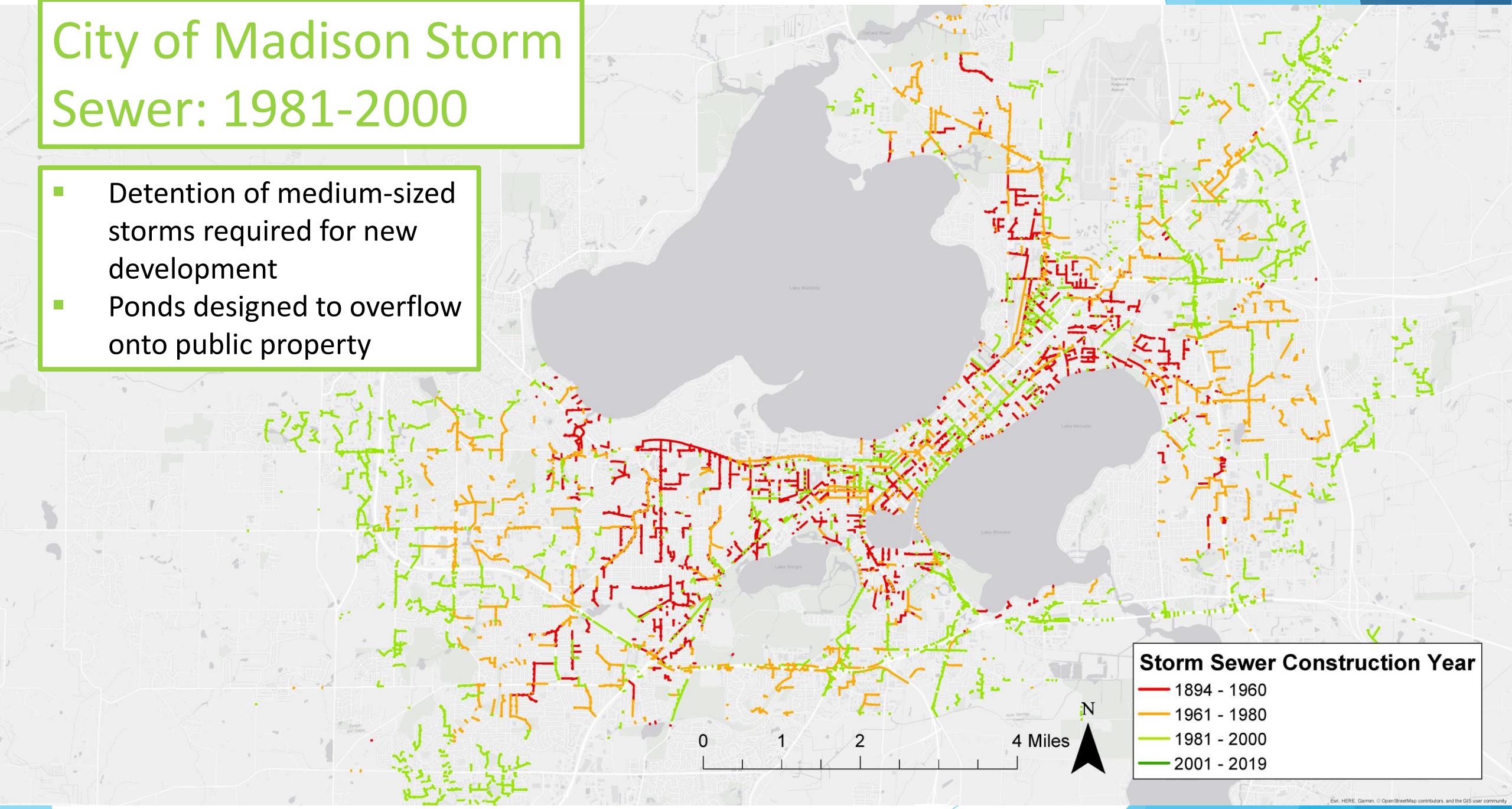
City of Madison Storm Sewer: 1961-1980

- Pipes designed for medium-sized storms
- Culverts sized to carry water from storms with 10% chance of occurring each year



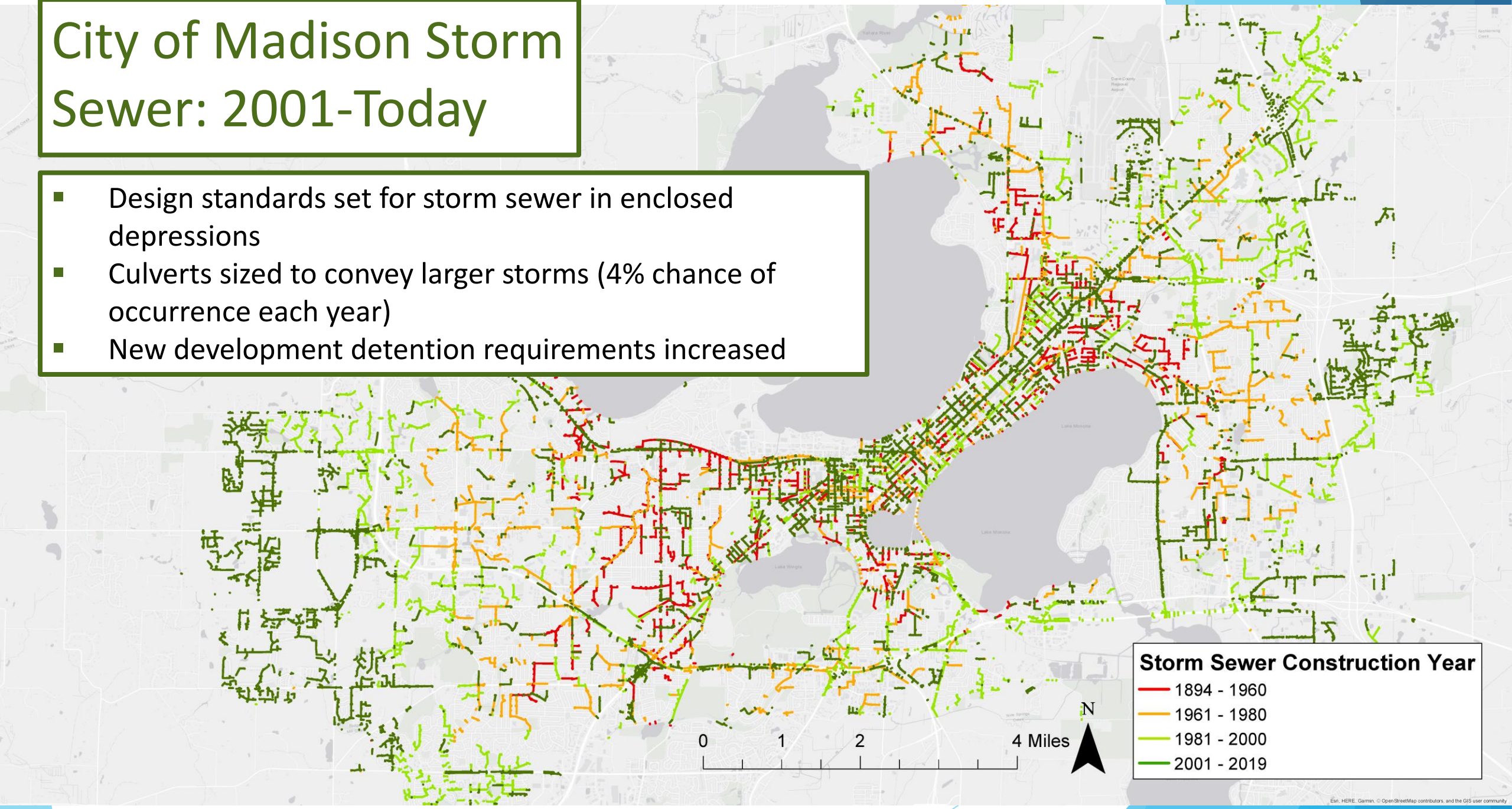
City of Madison Storm Sewer: 1981-2000

- Detention of medium-sized storms required for new development
- Ponds designed to overflow onto public property



City of Madison Storm Sewer: 2001-Today

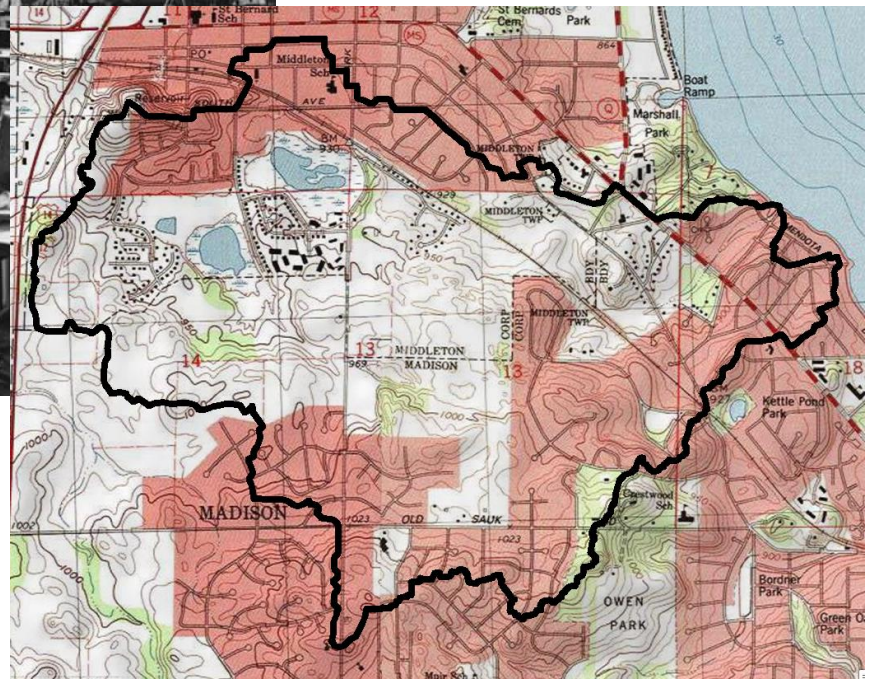
- Design standards set for storm sewer in enclosed depressions
- Culverts sized to convey larger storms (4% chance of occurrence each year)
- New development detention requirements increased



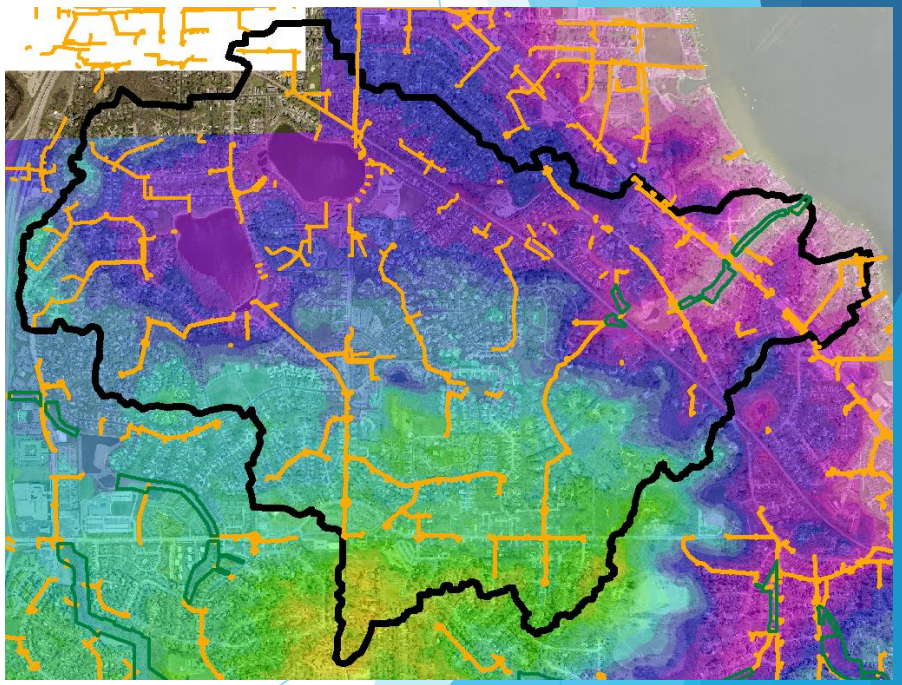
Reasons for Flooding Issues

- Tools have changed in the last five decades.
- Old tools made data gathering and stormwater modeling difficult.

Photo above:
https://www.vintag.es/2018/08/life-before-autocad.html



VS.



Why Replacement Takes Time

- Road reconstruction, storm sewer is expensive but long-lasting
  - Road reconstruction cost = approximately $500-$2,000/ft
  - 2% City infrastructure is upgraded annually
  - Average life:
    - Street=30-50 years
    - Pipes=50-100 years
- Storm Water Utility bill
  - 2018 increased 2.3% (avg. residential increase of $2.15/year)
  - 2019 increased 10.1% (avg. residential increase of $9.60/year)

96” pipe tunneling on University Ave, Madison, WI (2013)

Watershed Study Goals

- Find out why flooding happens in certain locations.
- See how existing storm sewer would perform in design storms.
- Test solutions.

Example output from watershed modeling

Watershed Study Goals

- Find out why flooding happens in certain locations
- System goals
  - Eliminate flooding from storm sewer during storms with a 10% chance of occurring each year (4” in a day)

N. High Point Road at Old Sauk Road, Madison, WI

Watershed Study Goals

- Find out why flooding happens in certain locations
- System goals
  - Eliminate flooding from storm sewer during storms with a 10% chance of occurring each year (4” of rain in a day)
  - Cars can pass down the middle (highest) part of the street during a storm with a 4% chance of occurring each year (~5” of rain in a day)

Winding Way, Madison, WI

Watershed Study Goals

- Find out why flooding happens in certain locations
- System goals
  - Eliminate flooding from storm sewer during storms with a 10% chance of occurring each year (4” of rain in a day)
  - Cars can pass down the middle (highest) part of the street during a storm with a 4% chance of occurring each year (~5” of rain in a day)
  - Structure and major roadway damage is eliminated for storms with a 1% chance of occurring each year (6.5” of rain in a day)

Regent St at Kenosha Ave, Madison, WI

Watershed Study Goals

- Find out why flooding happens in certain locations
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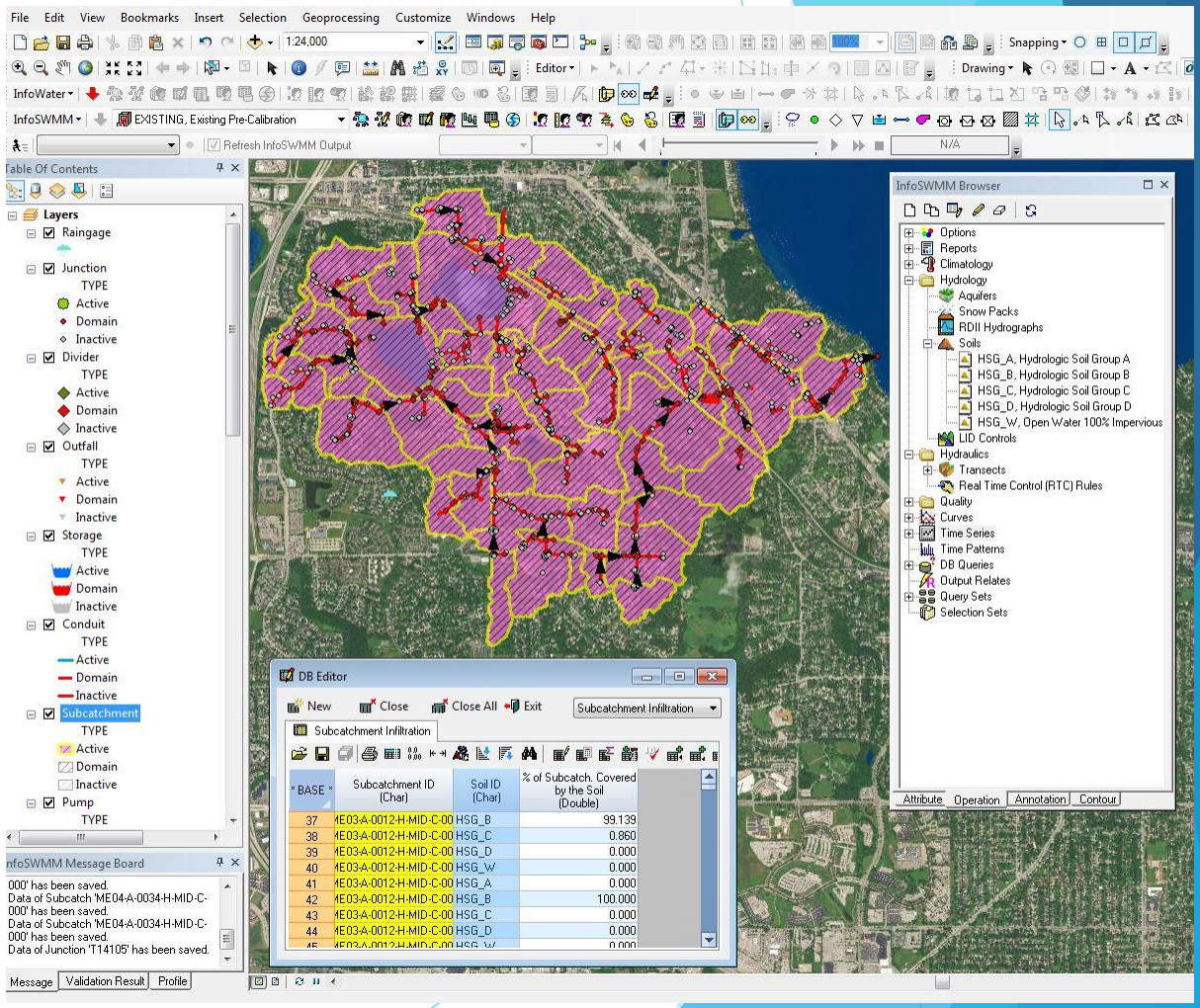
  - Eliminate flooding from storm sewer during storms with a 10% chance of occurring each year (4” of rain in a day)
  - Cars can pass down the middle (highest) part of the street during a storm with a 4% chance of occurring each year (~5” of rain in a day)
  - Structure and major roadway damage is eliminated for storms with a 1% chance of occurring each year (6.5” of rain in a day)
  - Flooding extents known during storms with a 0.2% chance of occurring each year (8.96” of rain in a day)

Tenney Park, Madison, WI

Watershed Study Goals

- Find out why flooding happens in certain locations
- System goals
- Test solutions
  - Lots more detail gets added in final design
  - Will help prioritize and budget future projects



Example of a stormwater modeling program

Watershed Study Limitations

- Retrofitting infrastructure takes time and money
- Repairs are not always easy, popular, or cheap
- Not always a good solution
- Property owners will need to create solutions too
- Solutions will need broad community cooperation

Next Steps

Model Existing Conditions & Predict Future Flood Risk

Analyze Solutions on Watershed Scale, Rank & Budget

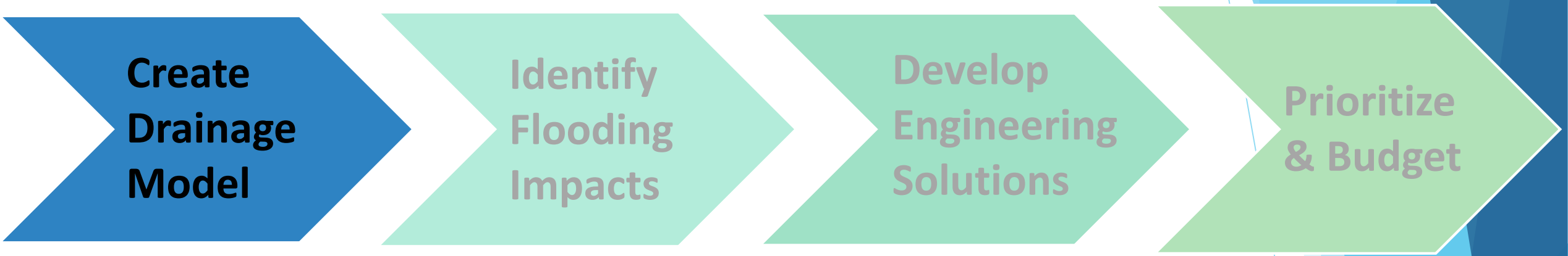
Create Drainage Model

Identify Flooding Impacts

Develop Engineering Solutions

Prioritize & Budget

Next Steps



- Gather model input data
- Install equipment and measure rainfall and channel flow
- Build computer models to represent rainfall-runoff-routing
- Compare model to data
- Determine extent of past flooding

Next Steps

Create Drainage Model

- What does modeling Stricker's Pond / Mendota watershed involve?
  - Watershed area: 855 acres (Madison), 589 acres (Middleton)
  - 12.8 miles of storm sewer
  - 3,800 feet of open channel
  - 5 stormwater detention basins / ponds
  - 16 commercial lots, ~2500 residential lots
  - ~ 670 inlets

Next Steps

Create Drainage Model

- What you might see in the watershed

USGS station (left) and stage gauge (above). Photos courtesy of Bill Selbig (USGS).

Above: surveyor in the field. Photo courtesy of Amber Lefers (AE2S).

Next Steps

Create Drainage Model → **Identify Flooding Impacts** → Develop Engineering Solutions → Prioritize & Budget

- See how well existing storm sewer system meets goals

Commerce Drive near Plaza Drive, Madison, WI

Next Steps

- Must be holistic
- Not “move the problem elsewhere”
- Account for climate change
  - Look at **trending increases** in storm frequency and intensity
- Consider long term maintenance needs
- Provide benefits relative to cost

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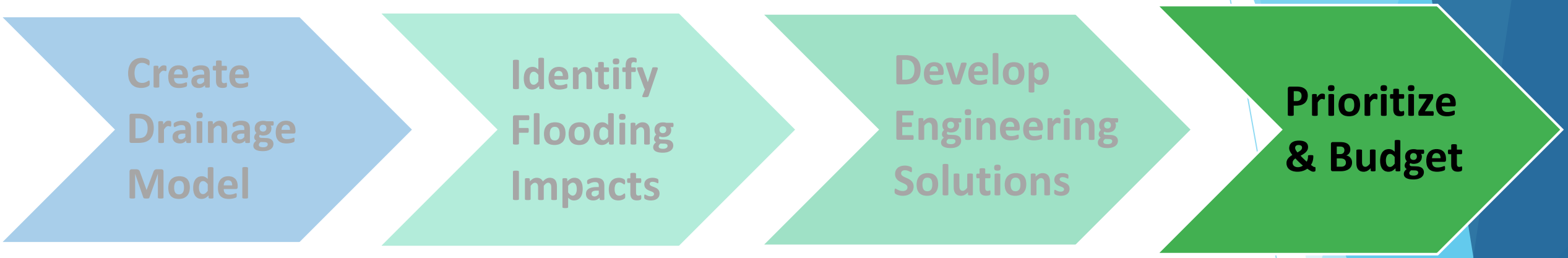
Next Steps

Create Drainage Model → Identify Flooding Impacts → **Develop Engineering Solutions** → Prioritize & Budget

What are some general options?

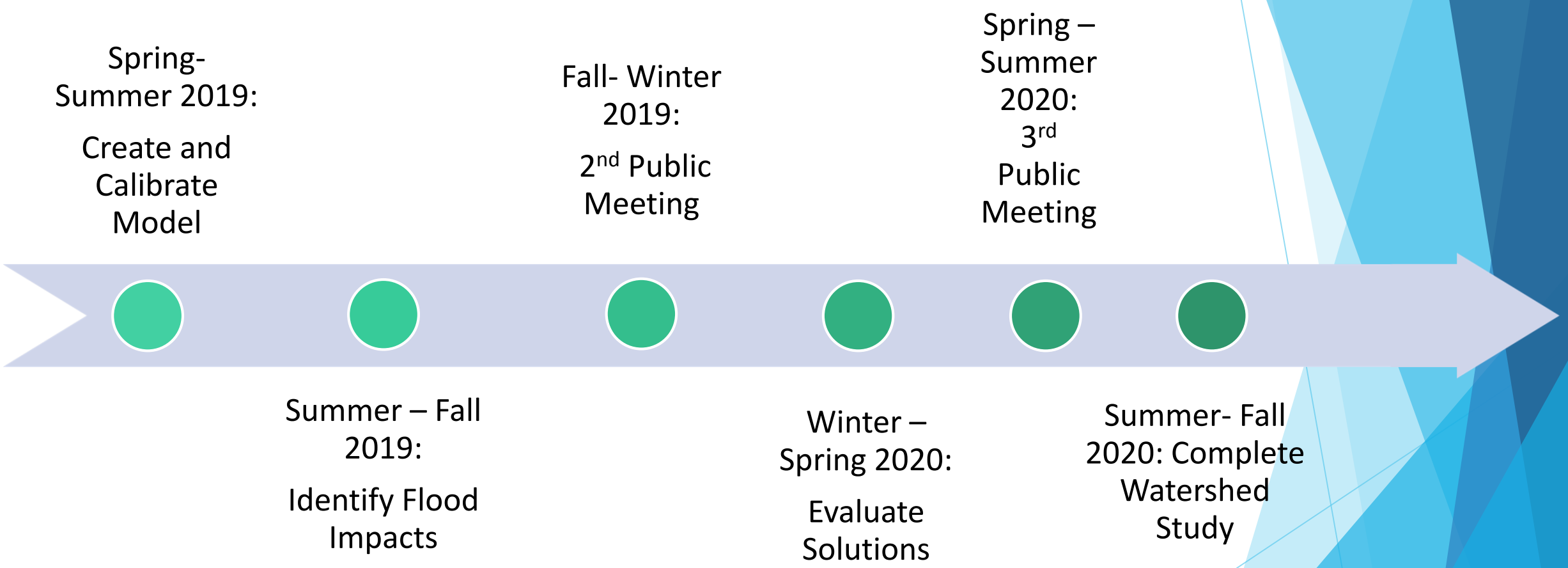
- Improve pipe and/or inlet capacity
- Safe overflow paths
- Reroute flow
- Increase storage / detention
- Flood-proof buildings
- Local landscaping / grading
- Solutions on private property to structures or land

Next Steps



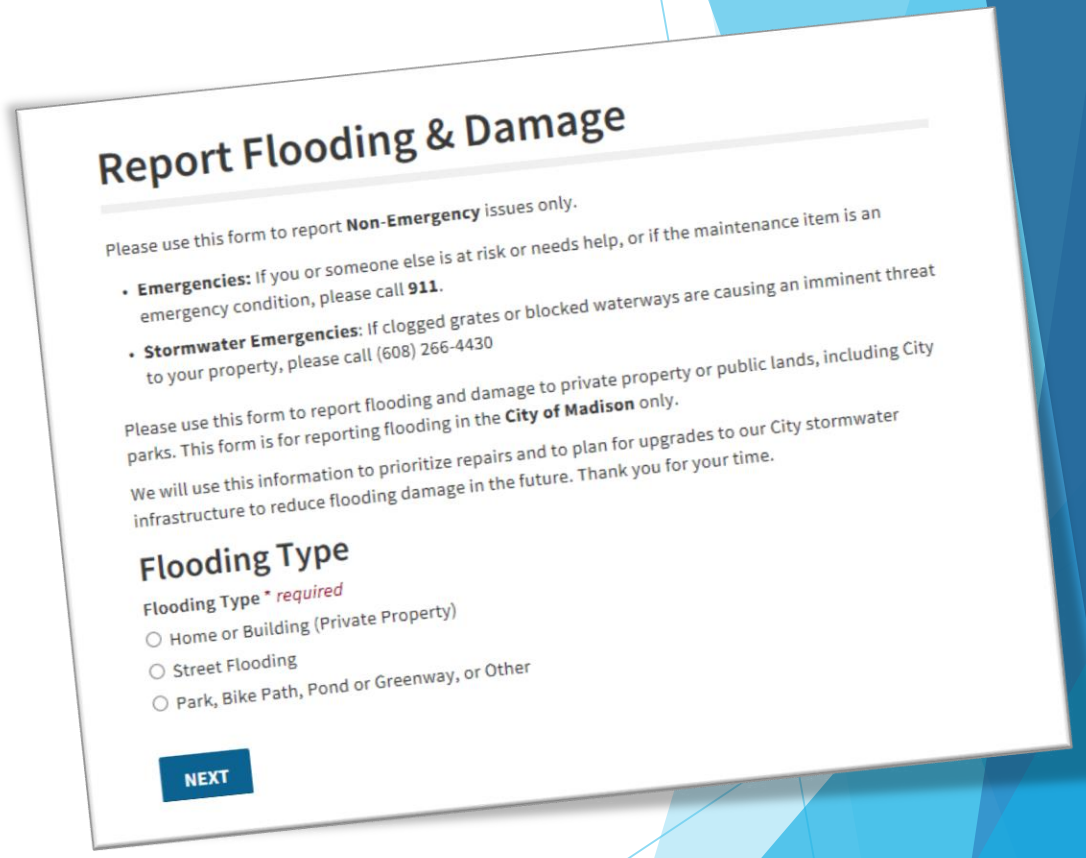
- Improvements require time and money
  - Some solutions are long-term, sustained community efforts (green infrastructure)
  - Some solutions are discrete, high capital-cost projects (box culverts, pond, etc.)
- Solutions prioritized based on:
  - Frequency, severity and damage (cost-benefit)
  - Emergency response routes
  - Areas with other projects scheduled (road repair, etc.)
  - Within a Neighborhood Resource Team area

Next Steps


Spring- Summer 2019:
Create and Calibrate Model
Summer – Fall 2019:
Identify Flood Impacts
Fall- Winter 2019:
2nd Public Meeting
Winter – Spring 2020:
Evaluate Solutions
Spring – Summer 2020:
3rd Public Meeting
Summer- Fall 2020: Complete Watershed Study

Property Owner Responsibilities

- Self-report Online Survey: document and share data during rain events
  - www.cityofmadison.com/flooding
- Understand local drainage and how to protect your property
- Install backflow preventers and sump pumps
- Consider supplemental insurance
- Focus group participation



Report Flooding & Damage

Please use this form to report **Non-Emergency** issues only.

- **Emergencies:** If you or someone else is at risk or needs help, or if the maintenance item is an emergency condition, please call **911**.
- **Stormwater Emergencies**: If clogged grates or blocked waterways are causing an imminent threat to your property, please call (608) 266-4430

Please use this form to report flooding and damage to private property or public lands, including City parks. This form is for reporting flooding in the **City of Madison** only.

We will use this information to prioritize repairs and to plan for upgrades to our City stormwater infrastructure to reduce flooding damage in the future. Thank you for your time.

Flooding Type

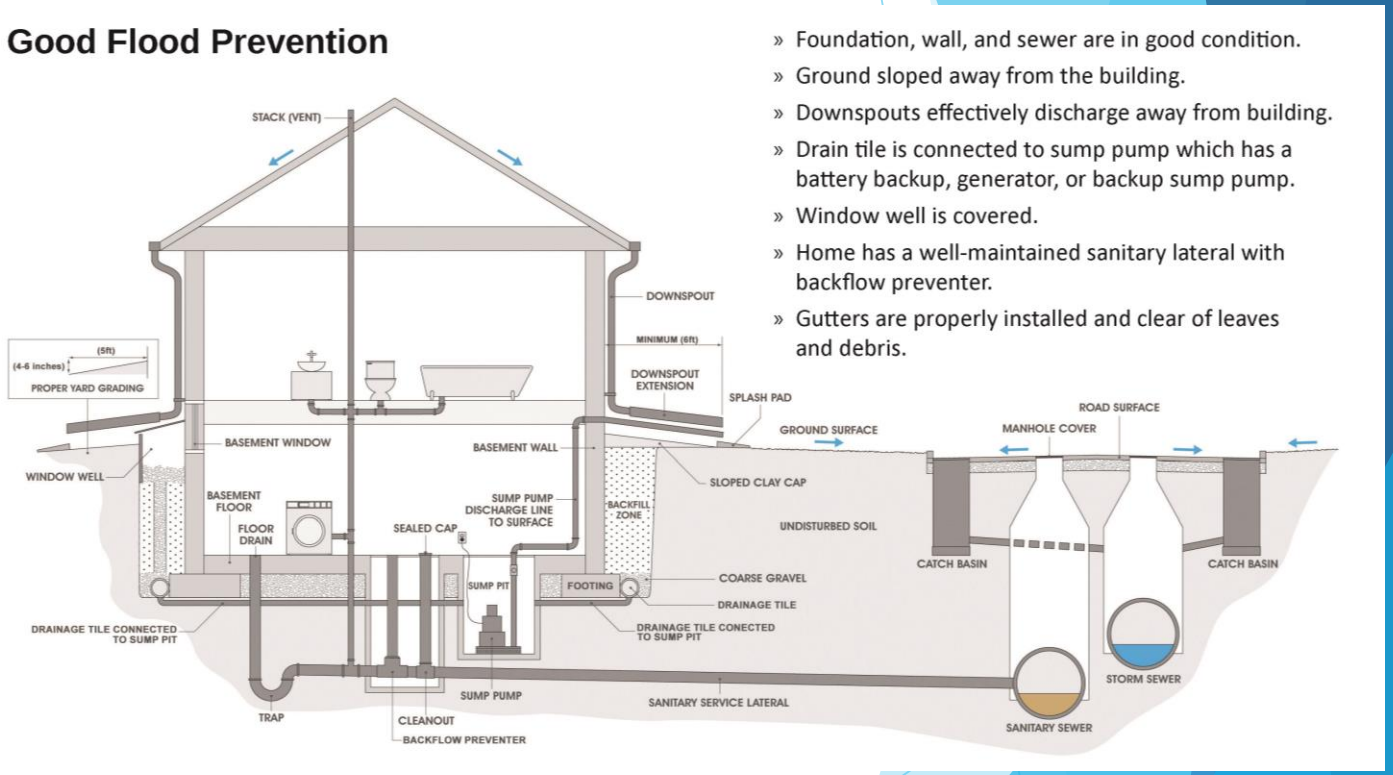
Flooding Type * *required*

- ○ Home or Building (Private Property)
- ○ Street Flooding
- ○ Park, Bike Path, Pond or Greenway, or Other

NEXT

Property Owner Responsibilities

- Self-report Online Survey
- Understand local drainage and how to protect your property
- Install backflow preventers and sump pumps
- Consider supplemental insurance
- Focus group participation



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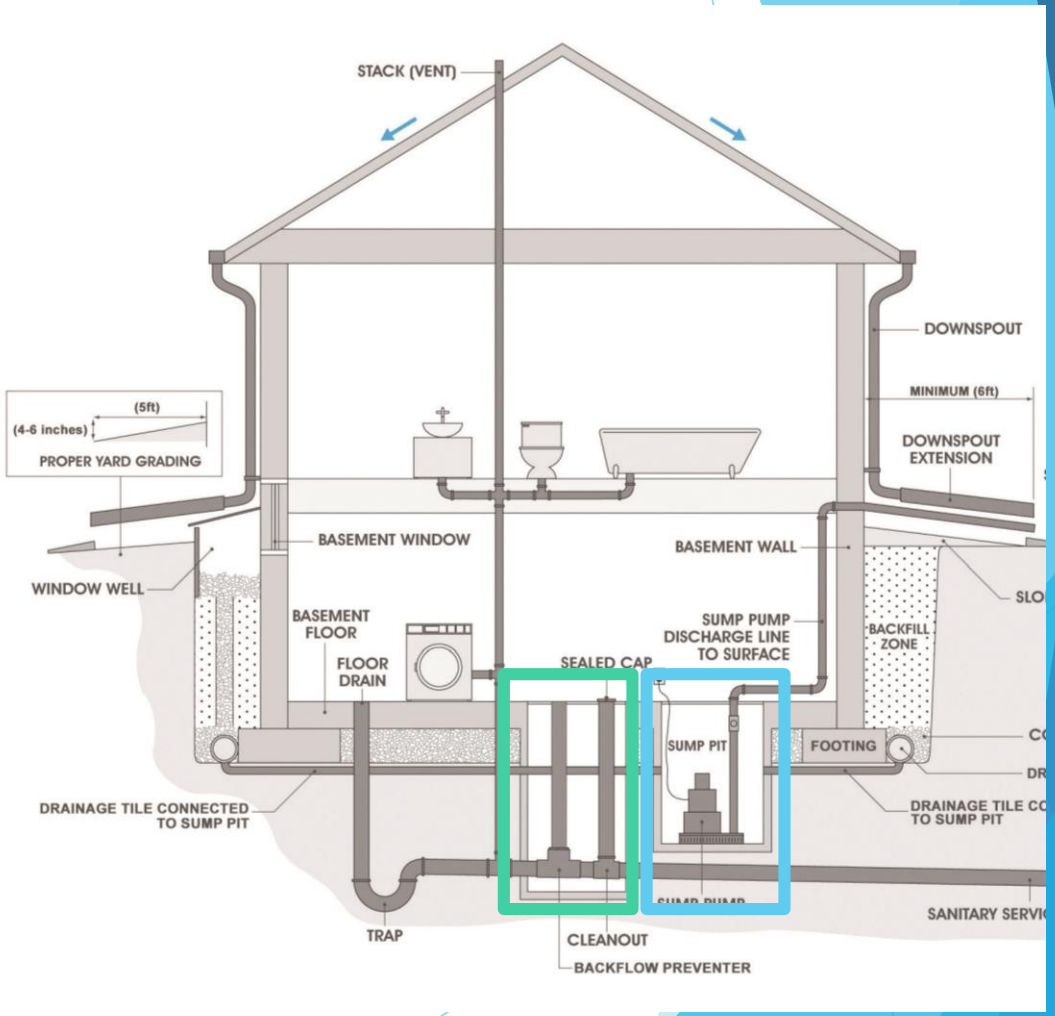


Property Owner Responsibilities

- Self-report Online Survey
- Understand local drainage and how to protect your property
- Install backflow preventers and sump pumps
- Consider supplemental insurance – **contact your private insurance agent for more information**
- Focus group participation

Property Owner Responsibilities

- Self-report Online Survey
- Understand local drainage and how to protect your property
- Install backflow preventers and sump pumps
- Consider supplemental insurance
- Focus group participation: for regional issues that affect more than one person

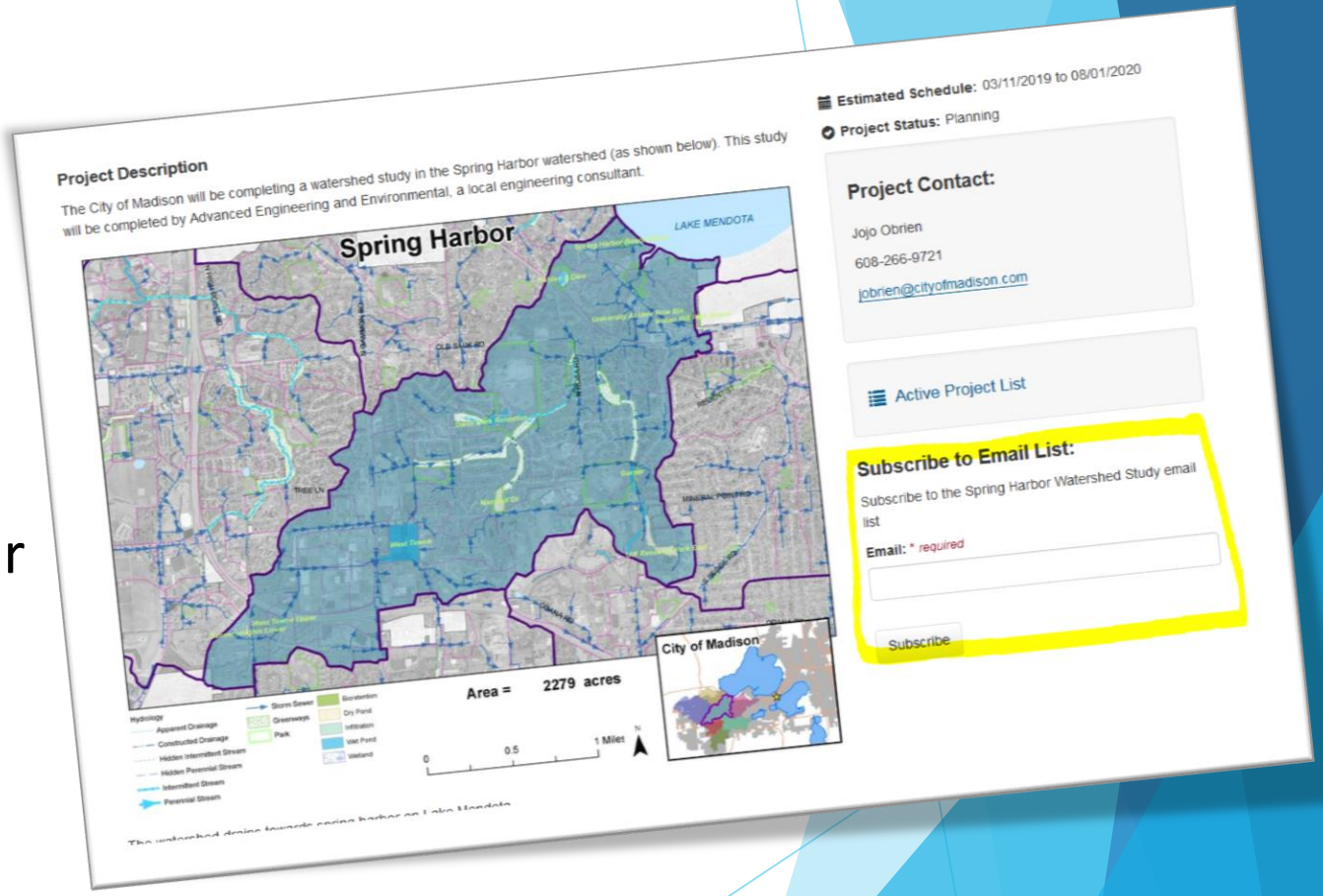
Property Owner Responsibilities

- **Be a good neighbor!** Understand how your water could have negative impacts on your neighbor's property.
- Install rain gardens and/or rain barrels etc.
- **Have a plan** to protect yourself during a flash flood warning.
- Become a better steward of your watershed.
  - Adopt an Inlet
  - Remove leaves from the street
  - http://www.ripple-effects.com/

Questions and Answers

How to Stay Involved

- www.cityofmadison.com/flooding
  - Report Flooding Survey
  - Individual Watershed Studies Pages
    - Sign up for updates!
  - How you can prevent flooding at your home



Project Recovery

- A community-based program providing outreach, crisis counseling, and support to communities impacted by severe storms, flooding, land-slides, straight-line winds, and tornadoes in the summer of 2018.
- Contact Project Recovery
  - By phone: 1-844-260-7029 (toll free)
  - By email: ProjectRecovery@couleecap.org

PROJECT RECOVERY

A Resource for Wisconsin Flood and Severe Storm Victims

Next PIM

- Fall – Winter of 2019
  - Present stormwater and flood model findings
  - Specific to the watershed
  - Refine data and model
  - Use as a ‘fact check’ with residents

Small Group Discussions and Feedback

City Contact Info:

- Lauren Striegl: Lstriegl@cityofmadison.com
  (608) 266-4094