Recent Flash Flooding Events

AUGUST 20TH, 2018-PRESENT

Presentation Overview

- Review of Flash Flooding – What happened and why???
- Potential solutions in the University Ave corridor.
- How does Madison Plan to Proceed?
  - Moving Forward
  - New Policy
    - What types of solutions will we look at???
- Next Steps

August 20th Storm event – lets call it 10" in about 8 hours (this varied a lot …)

What happened and why as a result of the Aug 20th storm?

- The storm on Aug 20th was significant for a few reasons:
  - It caused historic flash flooding throughout the west side of Madison and Middleton – WHY??
  - The volume of runoff created by the event resulted in historically high lake levels within a few days – WHY?

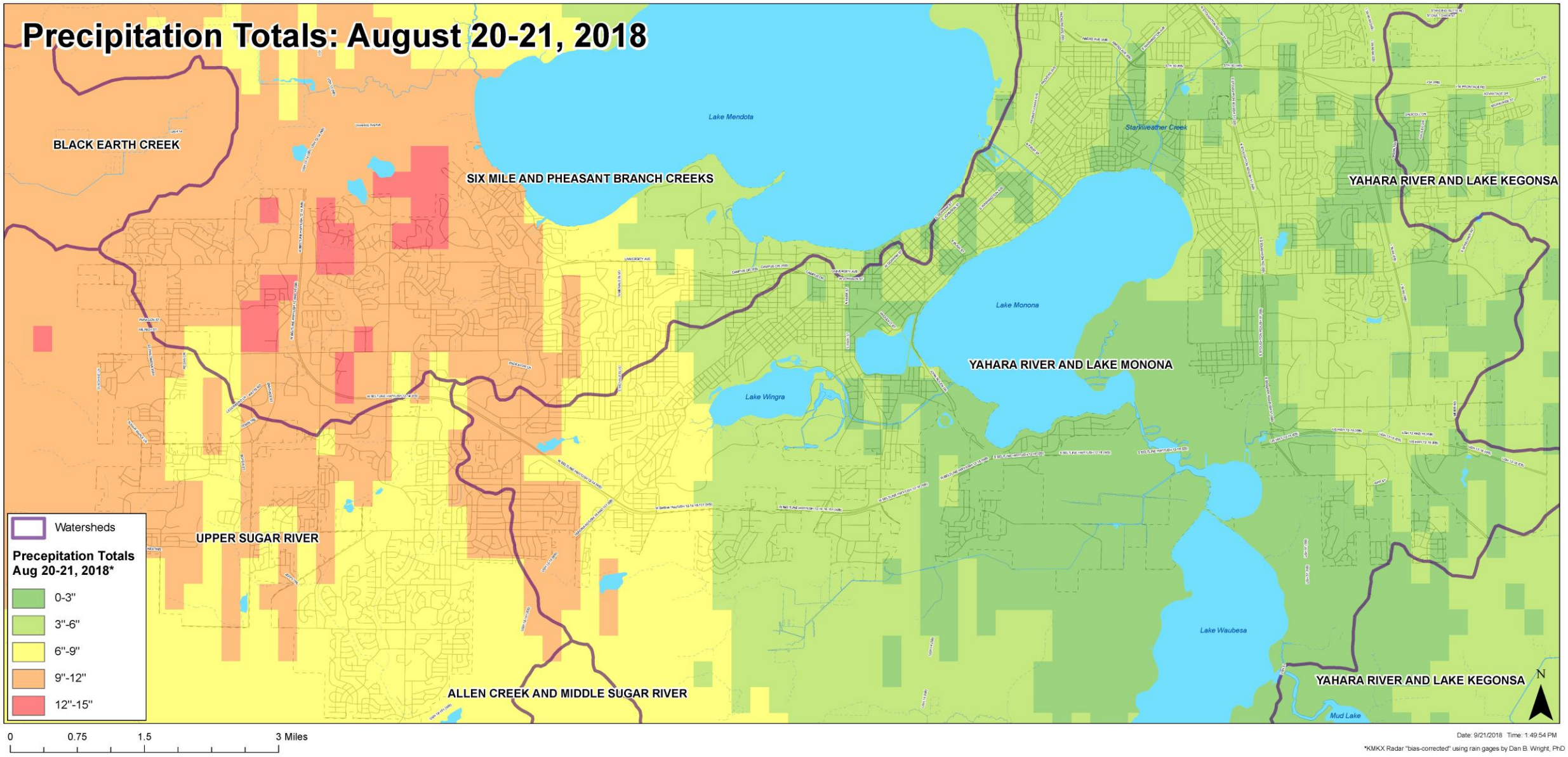
Flash Flooding – Why?

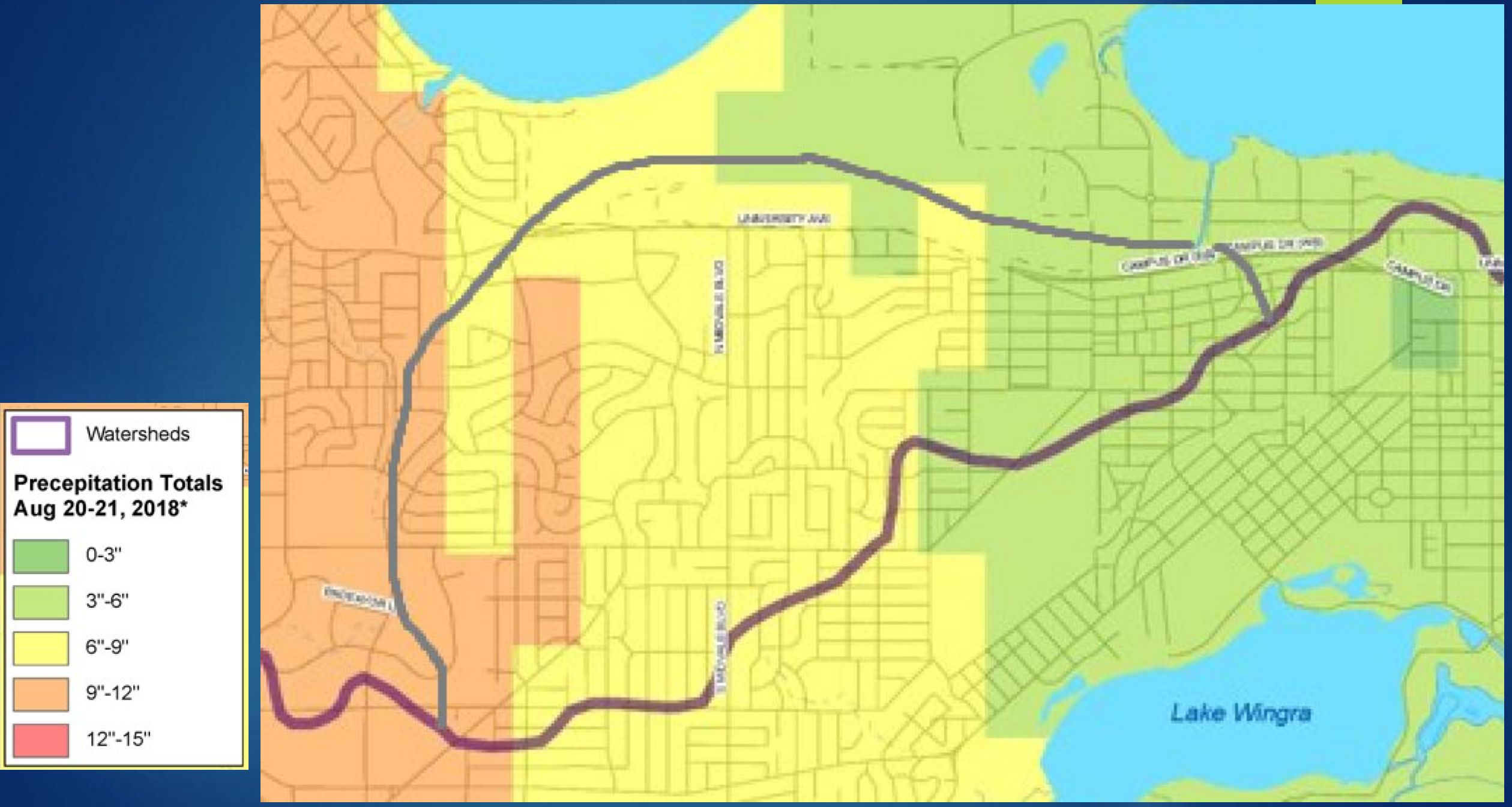
- Historic rain …. (what do I mean if I say 100-year event, 1000-year event)

  The term "100-year storm" is used to define a rainfall event that statistically has a 1% chance of occurring in any given year" In other words, over the course of 1 million years, these events would be expected to occur 10,000 times. But, just because it rained 10 inches in one day last year doesn't mean it can't rain 10 inches in one day again this year.

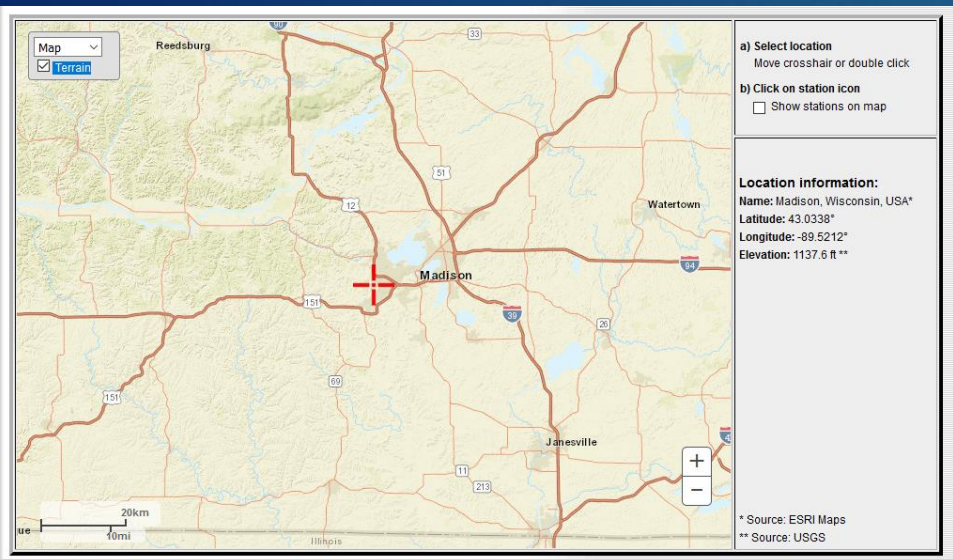
- What event was the Aug 20th rain ????? -
  - To define an event two terms are needed INTENSITY and DURATION.
  - There are multiple "100 – year" events. In our area for example:
    - 1 hour 3.09"
    - 2 hours 3.87"
    - 12 hours 5.96"
    - 24 hours 6.76"

Flash Flooding (approx. radar returns) DATA BY Dan Wright (NEXT)




Watersheds
Precepitation Totals
Aug 20-21, 2018*
0-3"
3"-6"
6"-9"
9"-12"
12"-15"
Lake Wingra

Most recent (Atlas 14) rainfalls from NOAA



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 8, Version 2

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.381** (0.327-0.447)	**0.437** (0.373-0.511)	**0.531** (0.453-0.623)	**0.613** (0.520-0.722)	**0.732** (0.605-0.889)	**0.829** (0.670-1.02)	**0.929** (0.728-1.16)	**1.04** (0.782-1.32)	**1.18** (0.861-1.54)	**1.30** (0.922-1.71)
10-min	**0.559** (0.478-0.654)	**0.639** (0.547-0.749)	**0.777** (0.663-0.912)	**0.898** (0.761-1.06)	**1.07** (0.886-1.30)	**1.21** (0.981-1.49)	**1.36** (1.07-1.70)	**1.52** (1.14-1.93)	**1.73** (1.26-2.25)	**1.90** (1.35-2.50)
15-min	**0.681** (0.583-0.798)	**0.780** (0.667-0.913)	**0.948** (0.808-1.11)	**1.10** (0.928-1.29)	**1.31** (1.08-1.59)	**1.48** (1.20-1.81)	**1.66** (1.30-2.07)	**1.85** (1.40-2.36)	**2.11** (1.54-2.75)	**2.32** (1.65-3.05)
30-min	**0.939** (0.804-1.10)	**1.08** (0.921-1.26)	**1.31** (1.12-1.54)	**1.52** (1.29-1.79)	**1.82** (1.50-2.20)	**2.06** (1.66-2.52)	**2.30** (1.81-2.88)	**2.57** (1.94-3.27)	**2.93** (2.13-3.81)	**3.21** (2.28-4.22)
60-min	**1.19** (1.02-1.40)	**1.38** (1.18-1.62)	**1.71** (1.46-2.01)	**1.99** (1.69-2.35)	**2.40** (1.99-2.92)	**2.74** (2.21-3.36)	**3.09** (2.42-3.85)	**3.45** (2.60-4.40)	**3.96** (2.88-5.15)	**4.36** (3.09-5.72)
2-hr	**1.45** (1.25-1.69)	**1.69** (1.46-1.97)	**2.11** (1.81-2.45)	**2.47** (2.11-2.88)	**2.99** (2.49-3.61)	**3.42** (2.78-4.17)	**3.87** (3.05-4.80)	**4.34** (3.30-5.49)	**4.99** (3.66-6.46)	**5.51** (3.94-7.18)
3-hr	**1.60** (1.39-1.86)	**1.88** (1.62-2.17)	**2.35** (2.03-2.73)	**2.77** (2.37-3.22)	**3.38** (2.83-4.07)	**3.88** (3.17-4.72)	**4.41** (3.49-5.46)	**4.97** (3.79-6.28)	**5.75** (4.24-7.42)	**6.37** (4.57-8.28)
6-hr	**1.89** (1.65-2.17)	**2.20** (1.91-2.53)	**2.75** (2.38-3.16)	**3.24** (2.79-3.74)	**3.98** (3.36-4.78)	**4.60** (3.79-5.56)	**5.26** (4.20-6.48)	**5.97** (4.60-7.51)	**6.98** (5.18-8.96)	**7.79** (5.62-10.1)
12-hr	**2.20** (1.93-2.51)	**2.52** (2.21-2.87)	**3.10** (2.71-3.54)	**3.64** (3.16-4.18)	**4.47** (3.82-5.36)	**5.19** (4.32-6.25)	**5.96** (4.81-7.31)	**6.81** (5.28-8.52)	**8.02** (6.01-10.3)	**9.02** (6.55-11.6)
24-hr	**2.51** (2.21-2.84)	**2.87** (2.53-3.25)	**3.53** (3.10-4.00)	**4.14** (3.62-4.71)	**5.08** (4.36-6.03)	**5.88** (4.93-7.03)	**6.76** (5.48-8.23)	**7.71** (6.02-9.58)	**9.08** (6.84-11.5)	**10.2** (7.46-13.0)

HYDROLOGY 101 - What causes urban flash floods??

- In URBAN areas – most flash flooding is a result of a very intense storm but often only a few hours long.
- Due to all the hard surface (impervious area) – the maximum runoff (water leaving a site – ie not infiltrating or "staying on the site) occurs during very intense short duration storms.
- An event that stresses the storm system, we need a long enough rain so that every part of a watershed (area draining to a point) contributes water to the point where the flow is being measured.
- Our modern development practices cause more runoff and it reaches the end (lake, pond, stream…) faster:
  - Stripping topsoil and regrading site
  - Compacting soil (when we put it back)
  - Smaller lots but bigger homes (+/-)
  - Better more efficient storm systems (+/-)

Design standards:

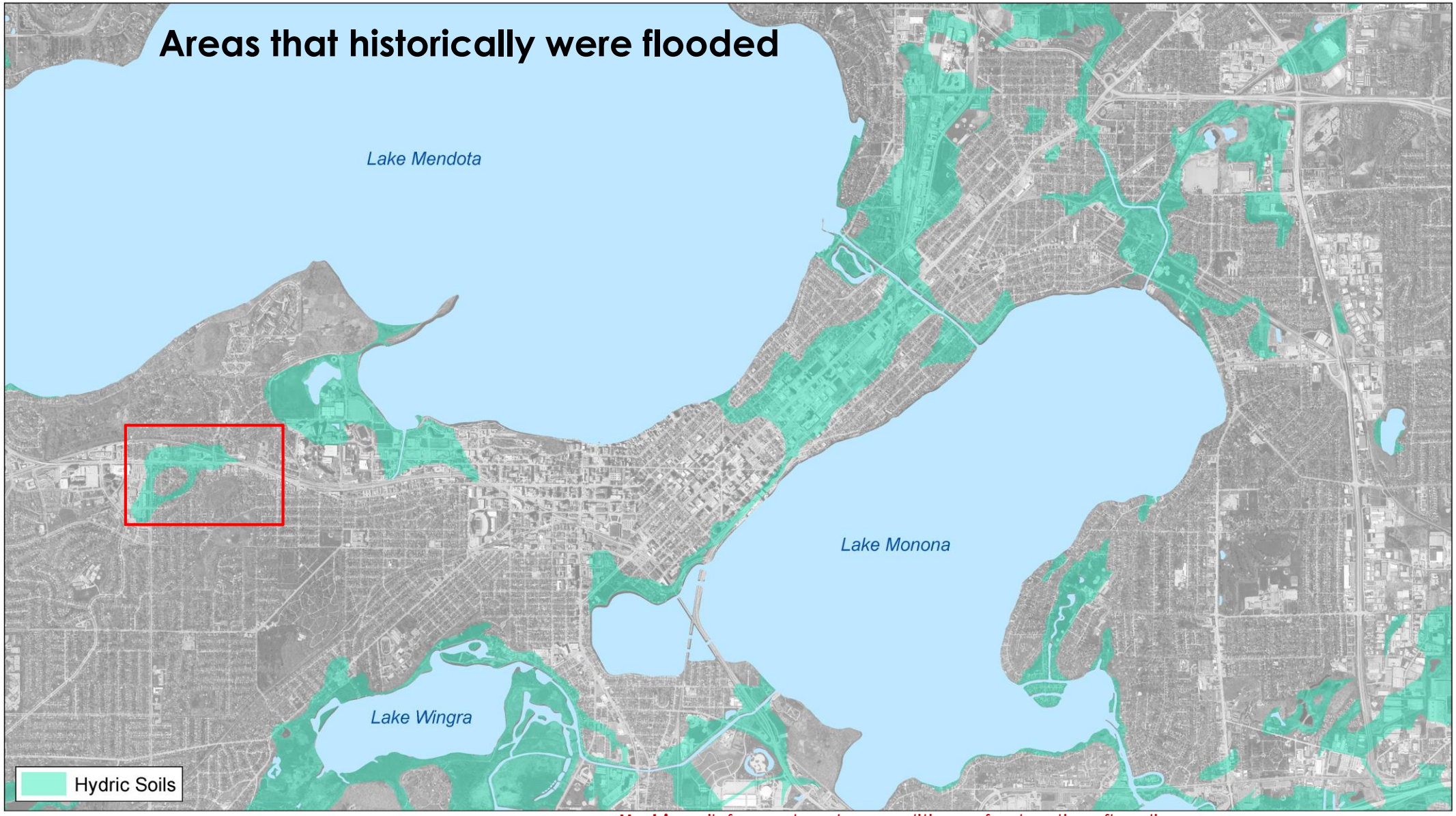
- Engineers talk in terms like 100-year 1000-year, intensity/duration, runoff curve numbers, impervious area??? Because of….

- Design standards – typically look at the cost to accommodate a specific event (say a 10-yr) and the consequences of failure (which might only be a small overtopping of the road with no damage) vs the cost to construt for a different more sever event (1000-yr).

- Engineering design standards –
  - pipes conveying water to a pond in a sub-division are often designed for a 10-year event
  - Culverts under a road are often designed for a 25 or 50-year event
  - Drainage of enclosed depressions (think bathtub) are often designed for a 25-year
  - Roads are expected to act as overflow during extreme events (100-year +)

- Why doesn't this always work?
  - Inlets clog and don't function as designed
  - Design standards change (what the pipe is designed for)
  - Design Storm change – old 100 year was 6.0" in 24 hours now it is 6.67 (and probably higher than that)
  - Roads can't work as overflows in enclosed depressions (bathtubs)

Areas that historically were flooded



City of Madison - Current Hydric Soils

Hydric *soil: formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.*

0 0.25 0.5 1 Miles

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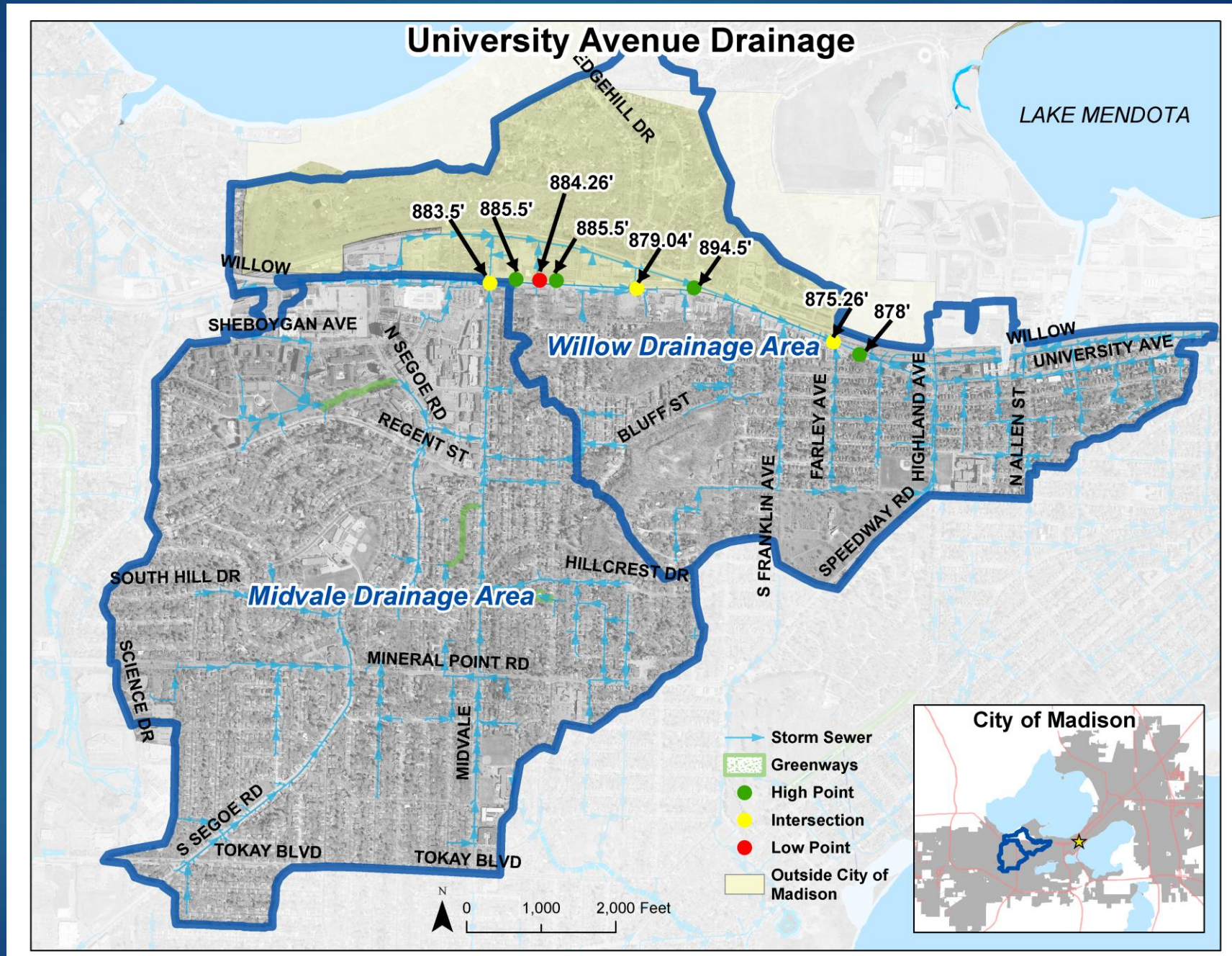
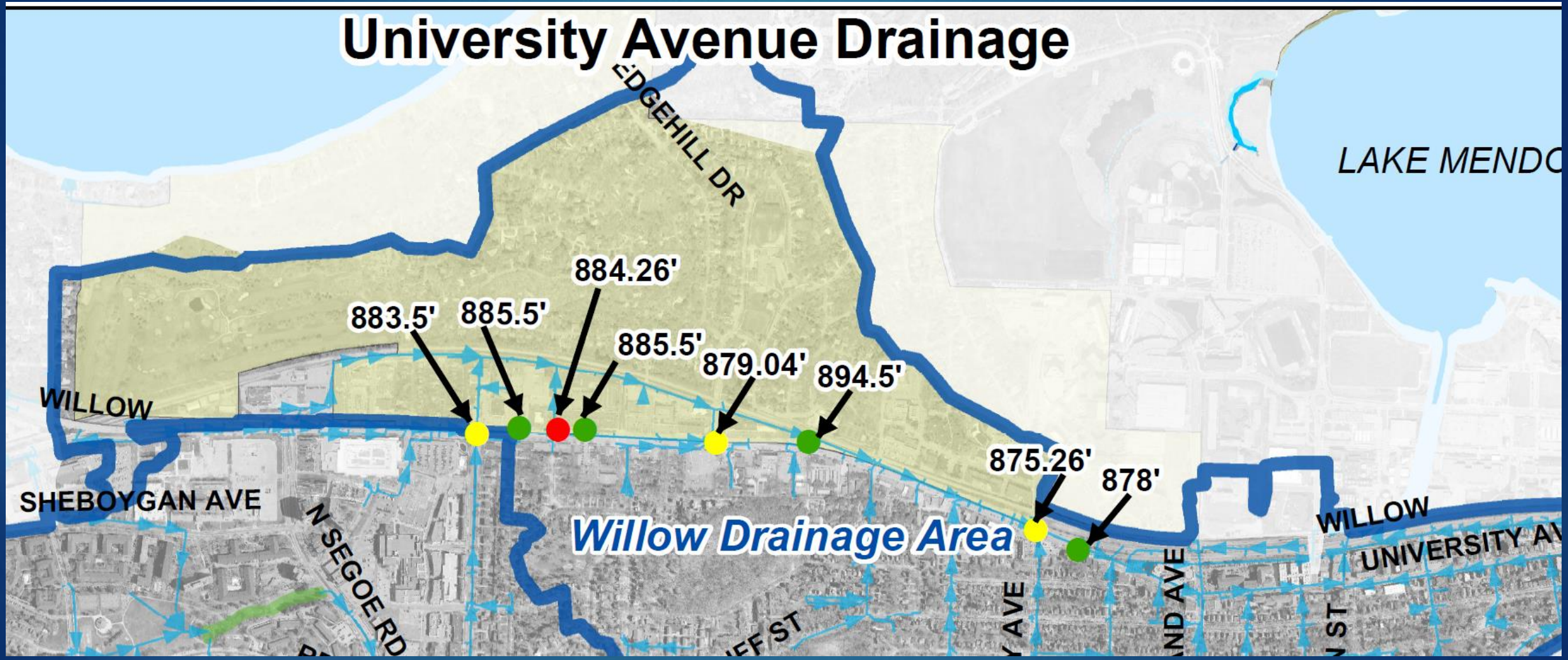

University Avenue Drainage
LAKE MENDOTA
EDGEHILL DR
883.5'
885.5'
884.26'
885.5'
879.04'
894.5'
875.26'
878'
WILLOW
SHEBOYGAN AVE
N SEGOE RD
REGENT ST
Willow Drainage Area
BLUFF ST
FARLEY AVE
HIGHLAND AVE
WILLOW
UNIVERSITY AVE
N ALLEN ST
S FRANKLIN AVE
SPEEDWAY RD
SOUTH HILL DR
HILLCREST DR
Midvale Drainage Area
SCIENCE DR
MINERAL POINT RD
MIDVALE
S SEGOE RD
TOKAY BLVD
TOKAY BLVD
N
0
1,000
2,000 Feet
Storm Sewer
Greenways
High Point
Intersection
Low Point
Outside City of Madison
City of Madison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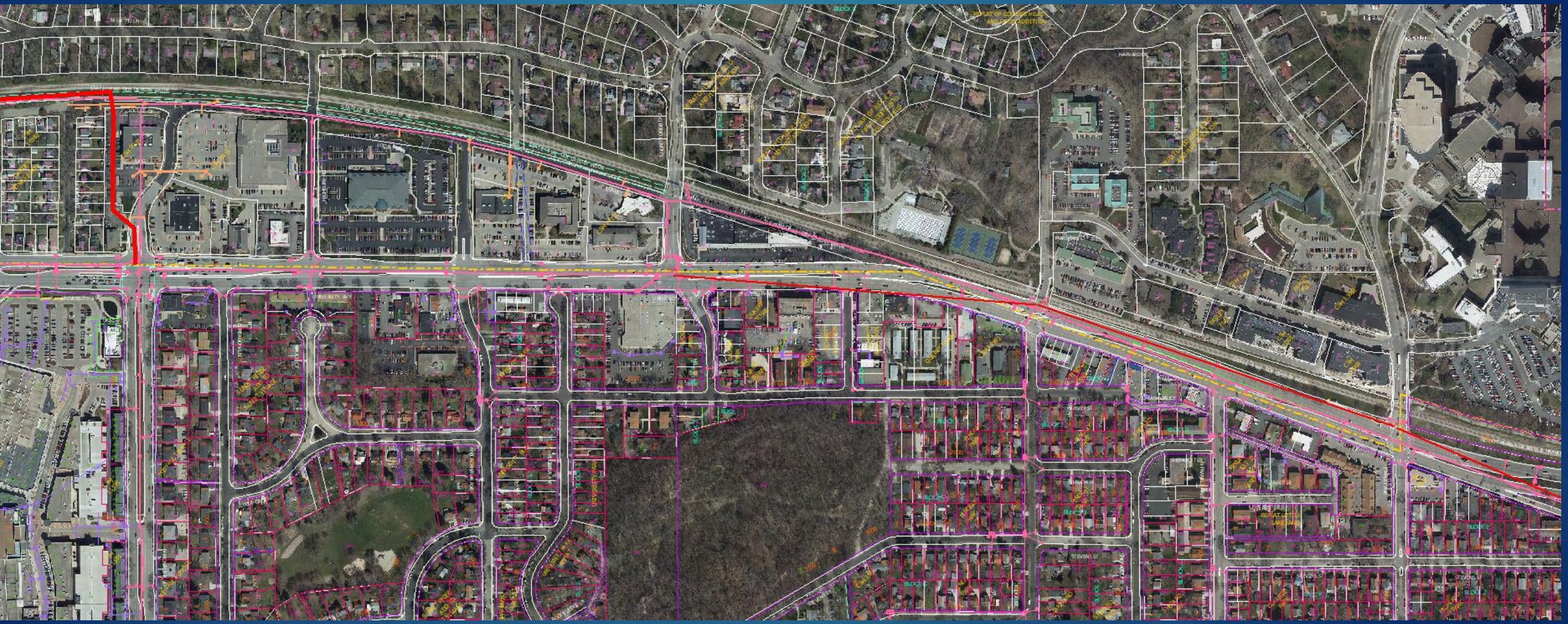
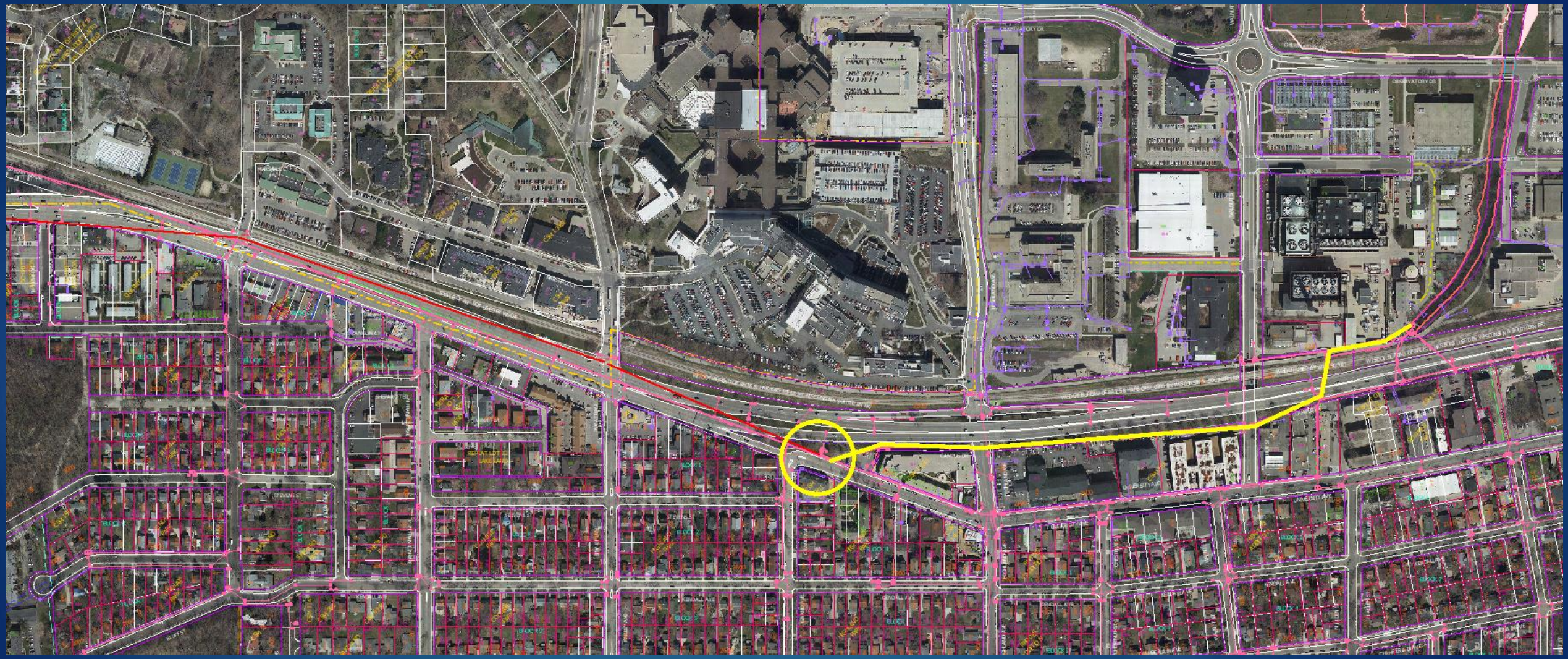
UNIVERSITY AV

University Avenue Corridor.






elev 860
50' deep
78'+ feet deep
2300'

OPTIONS:

- ***This is DRAFT model and the numbers I am going to give you are ESTIMATES.***
- ***The costs associated with these options are based on things we would not do - use them for comparison ONLY.***

Intersection	Scenario	Event			
		10 YR	25 YR	100 YR	August 20, 2018
University/Midvale OVERFLOW 885.5 LOW 883.5	Existing	887.56	887.98	888.48	888.62
	3 X 96" RCP from Midvale	883.80	886.60	887.40	887.01
	4 X 96" RCP from Midvale	-	883.90	887.02	886.48
	6 X 96" RCP from Midvale	-	-	884.07	883.95
University/Shorewood - WHOLE FOODS 882.12, LOW 879.04	Existing	882.19	882.53	883.10	883.34
	3 X 96" RCP from Midvale	880.76	881.28	882.30	881.73
	4 X 96" RCP from Midvale	-	881.24	881.88	881.49
	6 X 96" RCP from Midvale	-	-	881.72	881.47
University/Farley LOW 875.26	Existing	878.91	879.72	880.71	881.17
	3 X 96" RCP from Midvale	876.30	876.66	878.30	876.48
	4 X 96" RCP from Midvale	-	876.66	877.81	876.45
	6 X 96" RCP from Midvale	-	-	877.76	876.45

Intersection	Scenario	Event			
		10 YR	25 YR	100 YR	August 20, 2018
University/Midvale OVERFLOW 885.5 LOW 883.5	Existing	4.05	4.48	4.98	5.12
	3 X 96" RCP from Midvale	0.30	3.10	3.90	3.51
	4 X 96" RCP from Midvale	-	0.40	3.52	2.98
	6 X 96" RCP from Midvale	-	-	0.57	0.45
University/Shorewood - WHOLE FOODS 882.12, LOW 879.04	Existing	3.15	3.49	4.06	4.30
	3 X 96" RCP from Midvale	1.72	2.24	3.26	2.69
	4 X 96" RCP from Midvale	-	2.20	2.84	2.45
	6 X 96" RCP from Midvale	-	-	2.68	2.43
University/Farley LOW 875.26	Existing	3.65	4.46	5.45	5.91
	3 X 96" RCP from Midvale	1.04	1.40	3.04	1.22
	4 X 96" RCP from Midvale	-	1.40	2.55	1.19
	6 X 96" RCP from Midvale	-	-	2.50	1.19

COSTS??

- Tunneling = approximately 3400/LF/pipe
- Building a tunnel ???
- Open cutting a 96" at standard depth (10-15 feet) = 1000/LF
- Open cutting at the proposed depth = not possible

- Cost for 1 x 96" pipe = $8,000,000
- Cost to get to the location for the tunnel 1 x 96" = $1,300,000
- Ball park total cost for 1 x 96" pipe = $10,000,000
- Potential best value 3 x 96" pipes = 30,000,000

Potential best value???
3 x 96” pipes 30,000,000

- This would:
  - Protect Midvale to approximately a 15 year event - up from about a 2 year event
  - Protect Shorewood Blvd to a 100 year event – up from about a 10 year event
  - Protect Farley to approximately a 50 year event – up from about a 2 year event.

QUESTIONS ?