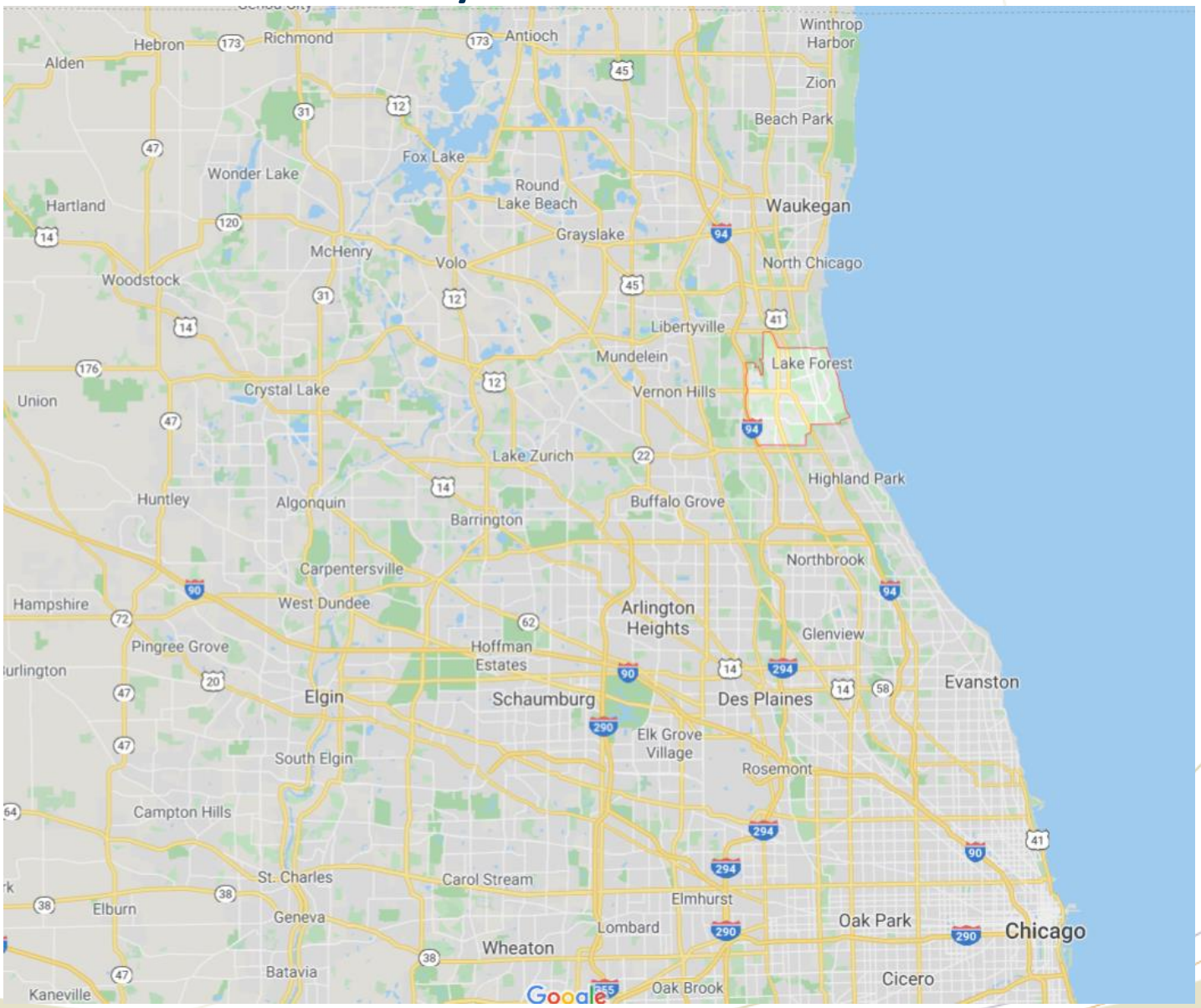
The City of Lake Forest

Bulletin 70 Stormwater Masterplan Updates – Lake Forest Case Study

Matt Moffitt, P.E., CFM, CPESC

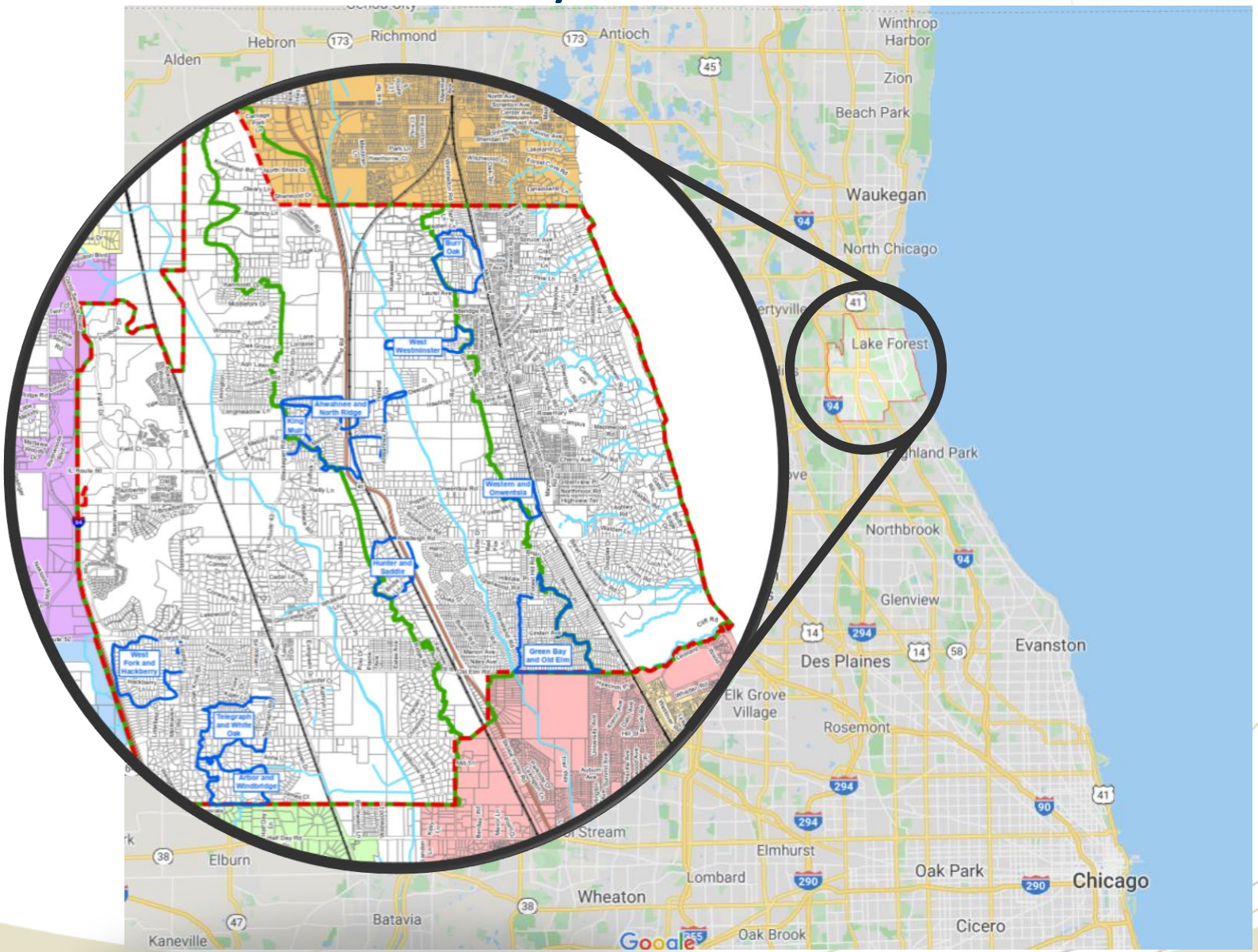
BAXTER & WOODMAN Consulting Engineers

The City of Lake Forest



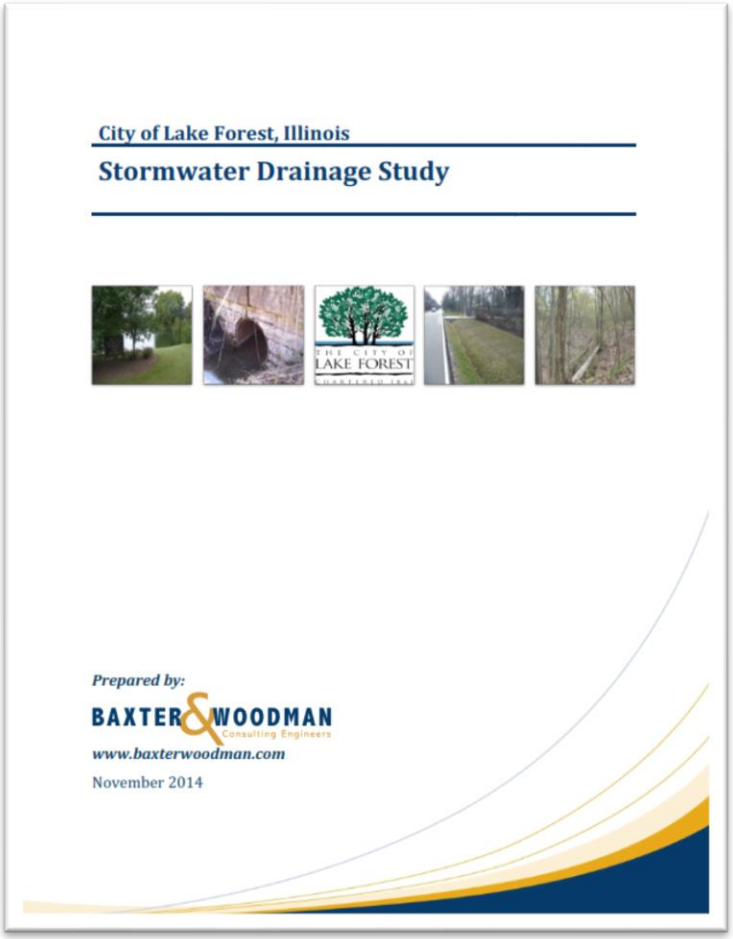
BAXTER & WOODMAN
Consulting Engineers

The City of Lake Forest



BAXTER & WOODMAN
Consulting Engineers

2013 Stormwater Masterplan



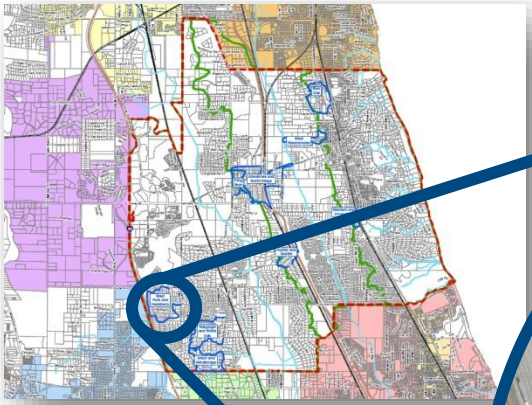
Criteria

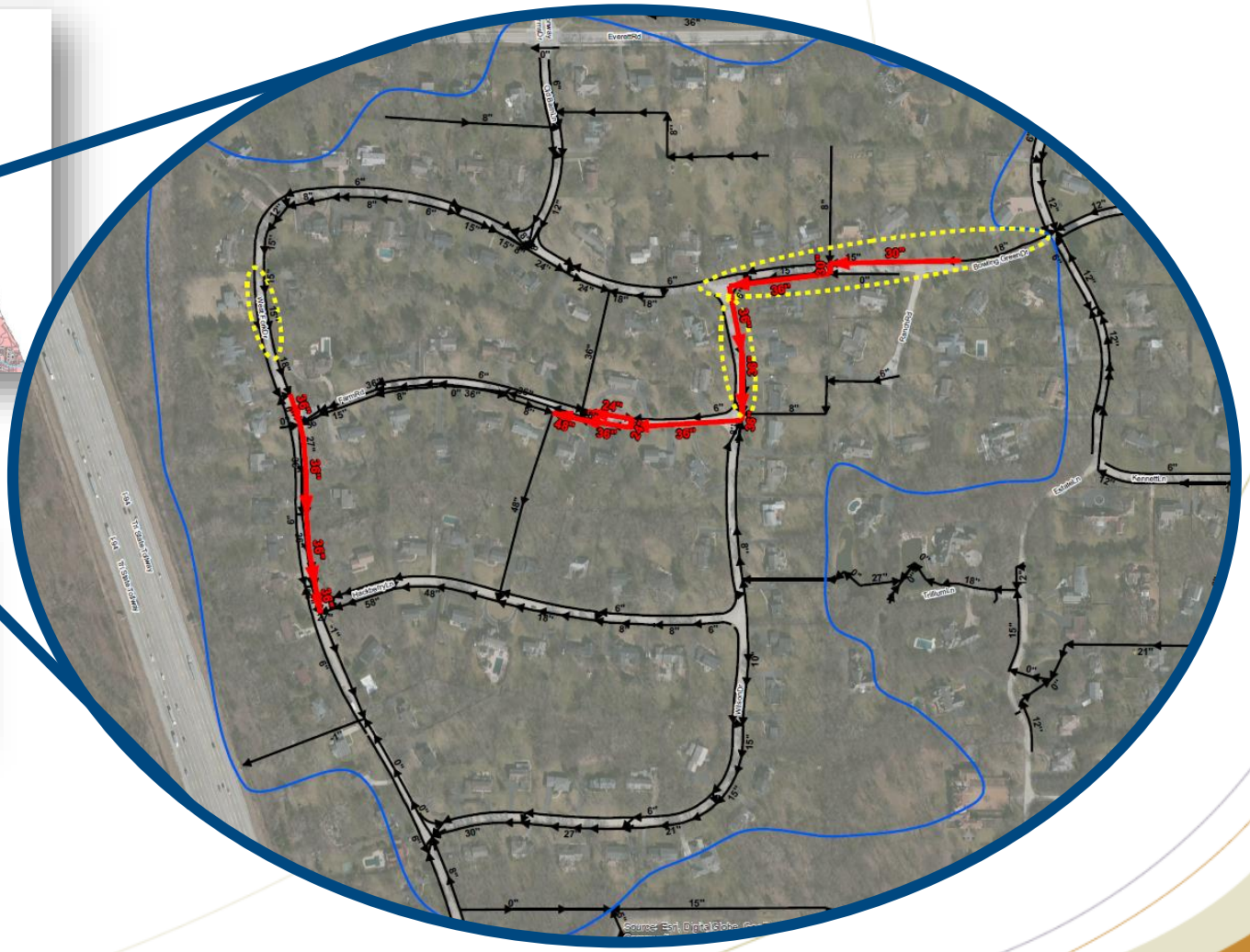
- New XPSWMM Model
- 15” Pipes and Larger
- 1’ Contours
- Tail-Water Sensitivity Analysis
- Critical Duration Analysis
- Calibration to experienced storm events:
  - May 13, 2010 (2.19”/6hrs)
  - April 17-18, 2013 (4.08”/24hrs)

Prioritized Storm Sewer Improvements

	Project Title	Structure Flooding*	Street Flooding*	Yard Flooding*	Other Factors	Probable Cost (2014 $)
	Arbor and Windridge Study Area - COMPLETE		14	4		-
1	West Fork and Hackberry Study Area	4	196	7	X	$1,450,000
2a	Telegraph and White Oak Study Area - Telegraph Road		58	7		$350,000
2b	Telegraph and White Oak Study Area - Wild Rose/White Oak		58	7		$910,000
3a	West Westminster Study Area – West End		87	4		$910,000
3b	West Westminster Study Area – East End		87	4		$940,000
4	Green Bay and Old Elm Study Area	2	10	4	X	$790,000
5a	Burr Oak Study Area - East of Western Avenue		36	3		$740,000
5b	Burr Oak Study Area - West of Western Avenue		36	3		$880,000
6a	Hunter and Saddle Study Area – Hunter and Saddle		25	4		$550,000
6b	Hunter and Saddle Study Area - Bridle		25	4		$170,000
7	Western and Onwentsia Study Area		100			$300,000
8	King Muir Study Area		16	3		$950,000
9a	Ahwahnee and North Ridge Study Area – Northeast		103	40		$1,450,000
9b	Ahwahnee and North Ridge Study Area – East		103	40		$1,760,000
9c	Ahwahnee and North Ridge Study Area - West		103	40		$2,740,000
*	Indicates an estimated number for the entire study area					$14,890,000

COMPLETED – West Fork and Hackberry

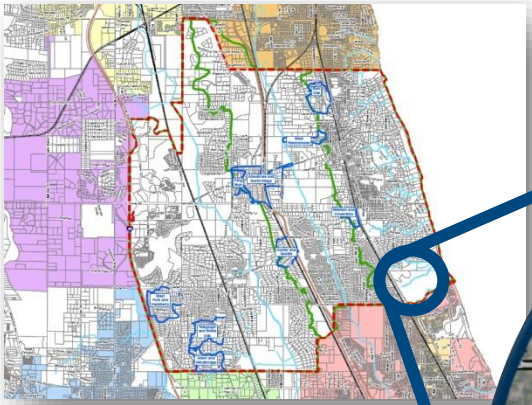


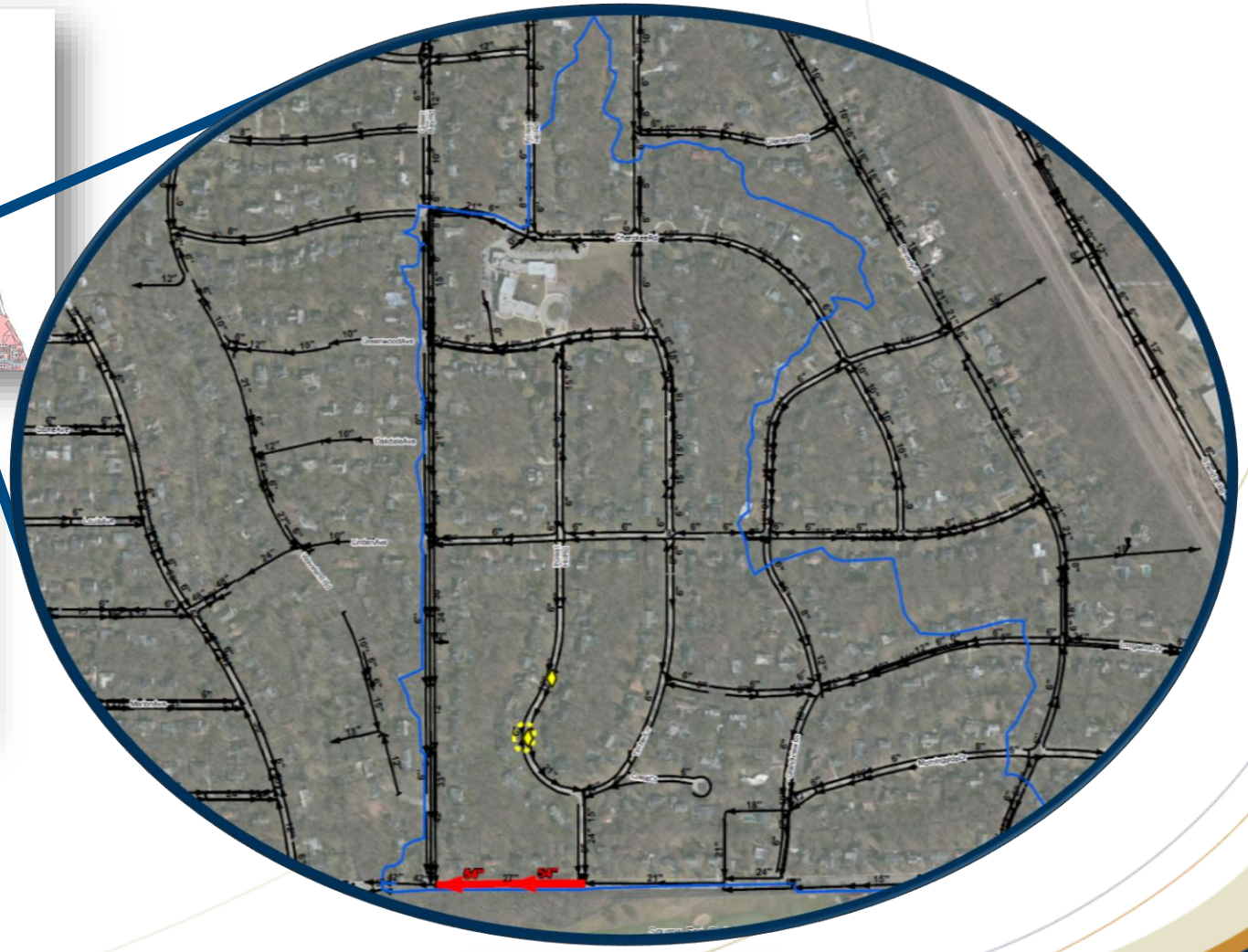


Projected Cost: $Projected Cost: $1,450,000

BAXTER & WOODMAN
Consulting Engineers

COMPLETED – Green Bay and Old Elm





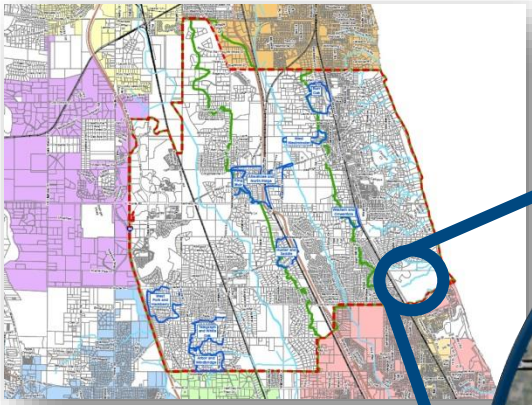
Legend

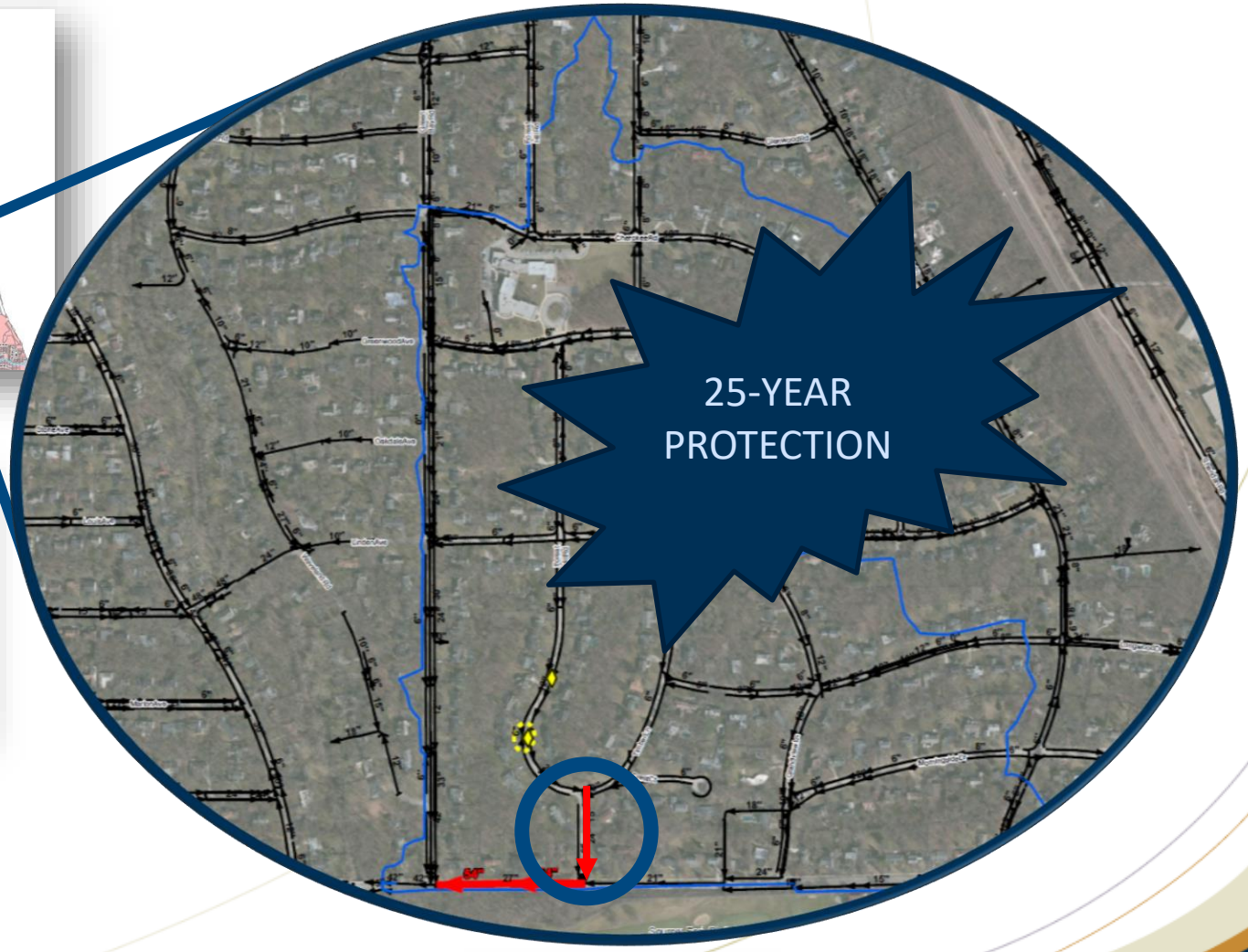
- Existing Problem Area
- Increase Inlet Capacity
- Storm Pipe - Existing
- Storm Pipe - Proposed

Projected Cost: $790,000

BAXTER & WOODMAN Consulting Engineers

COMPLETED – Green Bay and Old Elm





Legend

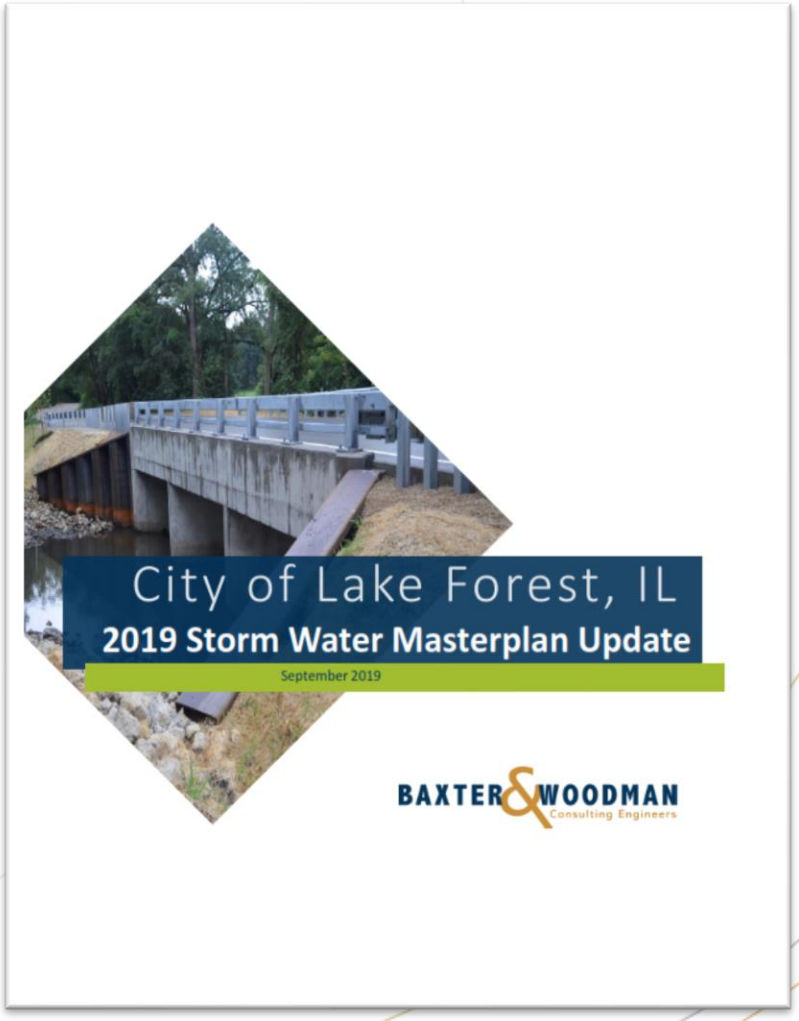
- Existing Problem Area
- Increase Inlet Capacity
- Storm Pipe - Existing
- Storm Pipe - Proposed

Projected Cost: $1,230,000

BAXTER & WOODMAN Consulting Engineers

2019 Stormwater Masterplan Update

- Quick Update ($10k NTE)
- Reassess each priority area
- Some “problem areas” changed, based on recent complaints (or lack of)
- Utilize Bulletin 70 (2019) rainfall data



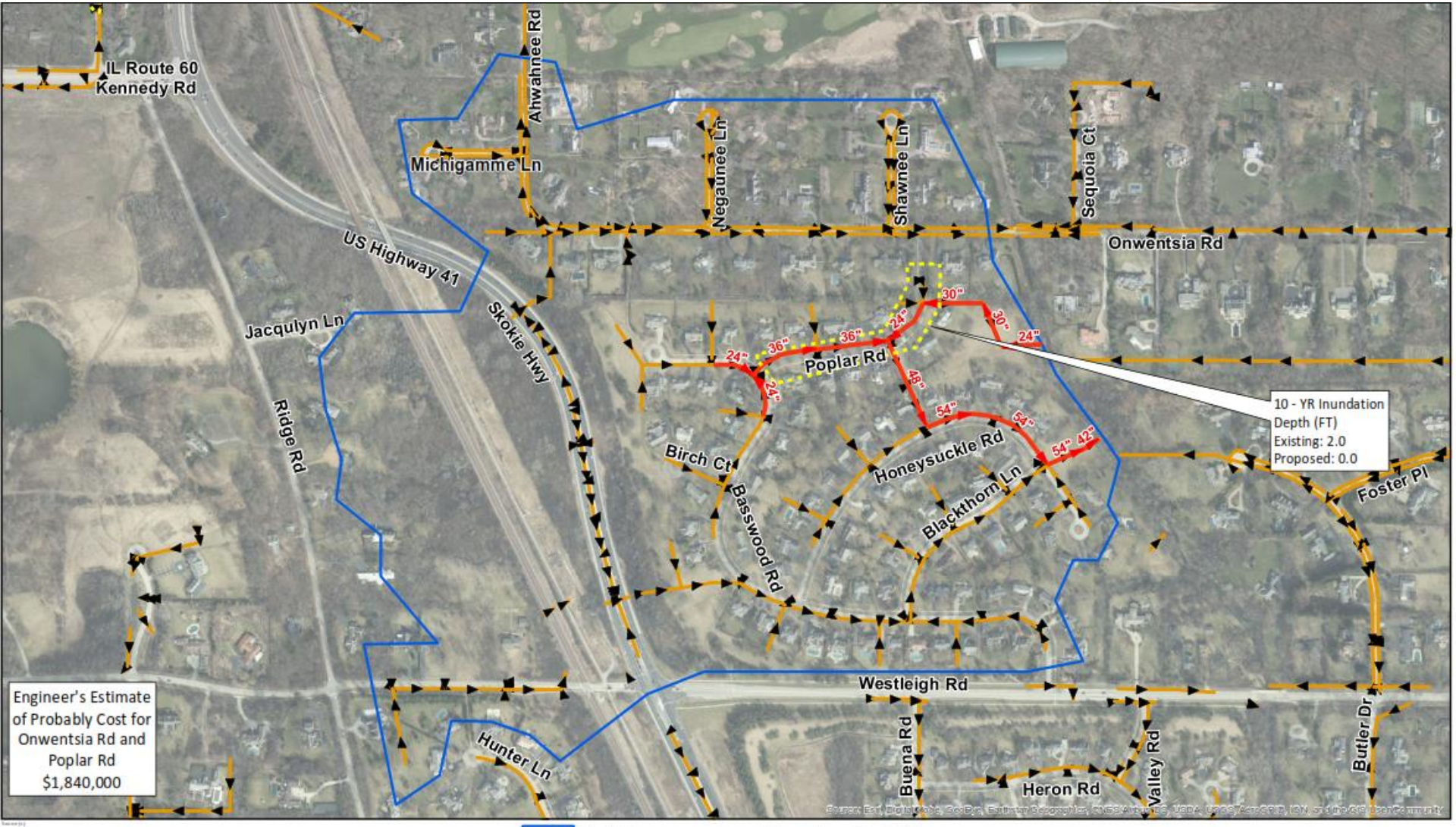
Recommendations – Prioritization Schedule

	Weighted Properties Benefitting	Project Cost (2019 dollars)	Cost per Properties Benefitting	Ranking
Burr Oak Road	71	$3,400,000	$47,887	**1**
Ahwahnee Road	40	$1,920,000	$48,000	**2**
Onwentsia Road & Poplar Road	24.4	$1,840,000	$75,410	**3**
Western Avenue & Onwentsia Road	5	$530,000	$106,000	**4**
Telegraph Road & White Oak Road	14.5	$2,060,000	$142,069	**5**
Gage Lane	15.5	$2,480,000	$160,000	**6**

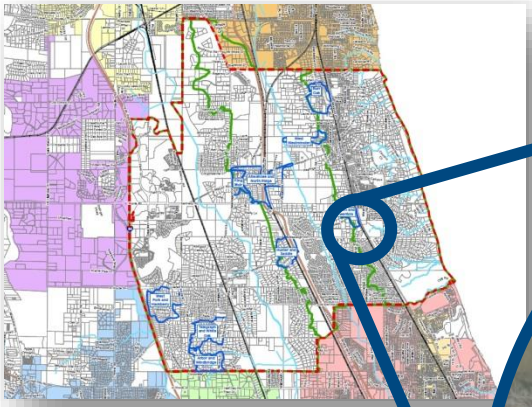
Recommendations – Prioritization Schedule

	Project Cost (2014 Dollars)	Project Cost (2019 Dollars)
Burr Oak Road	$1,620,000	$3,400,000
Ahwahnee Road	$1,760,000	$1,920,000
Onwentsia Road & Poplar Road	N/A	$1,840,000
Western Avenue & Onwentsia Road	$300,000	$530,000
Telegraph Road & White Oak Road	$1,260,000	$2,060,000
Gage Lane	N/A	$2,480,000

2019 Recommendation (NEW) – Onwentsia/Poplar



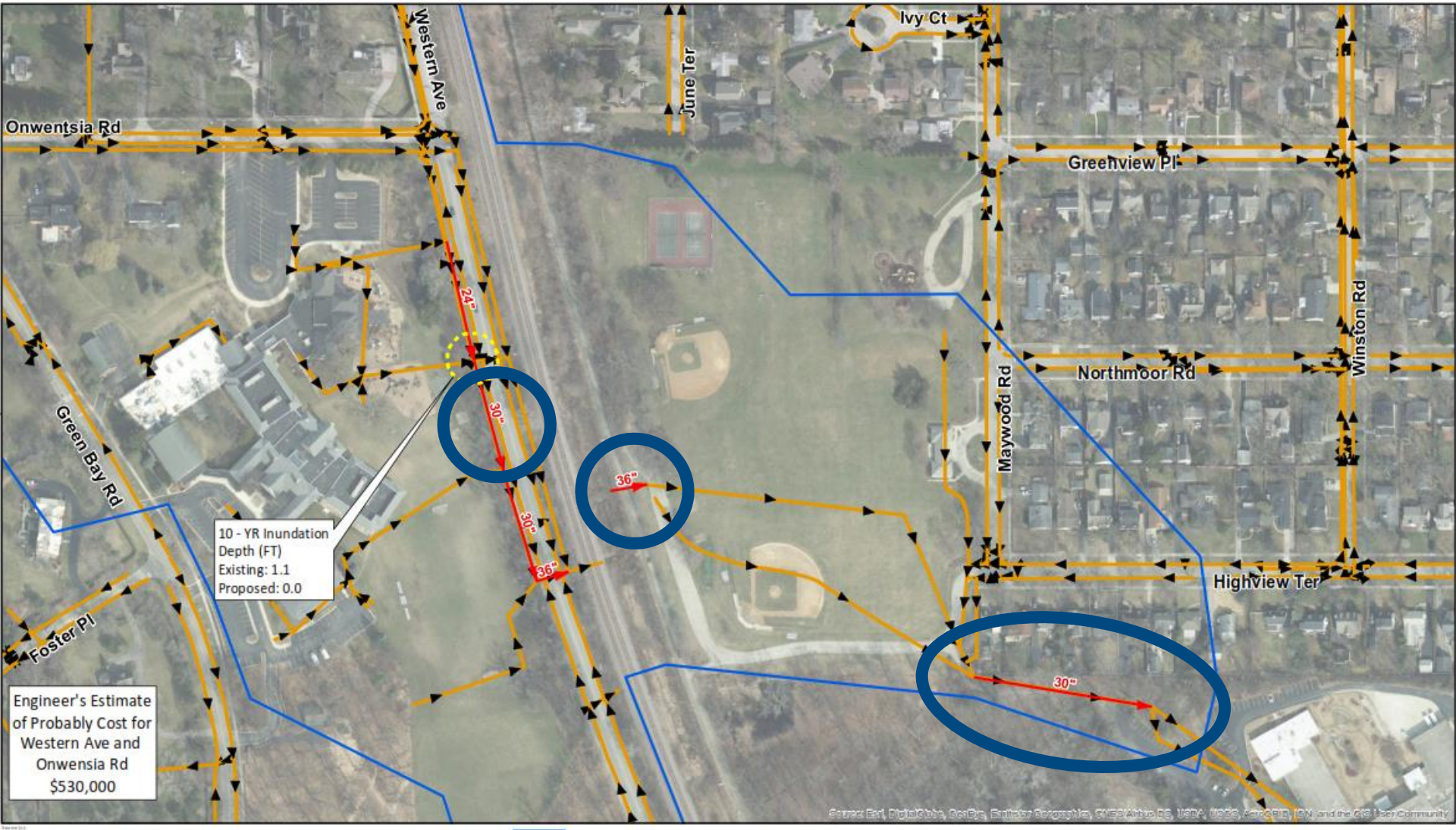
2014 Recommendation – Western & Onwentsia



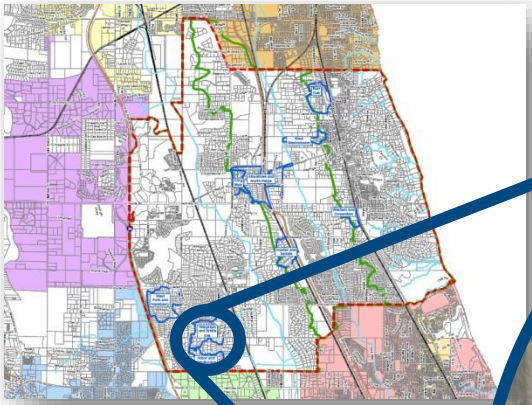
Western & Onwentsia Study Area: $300,000

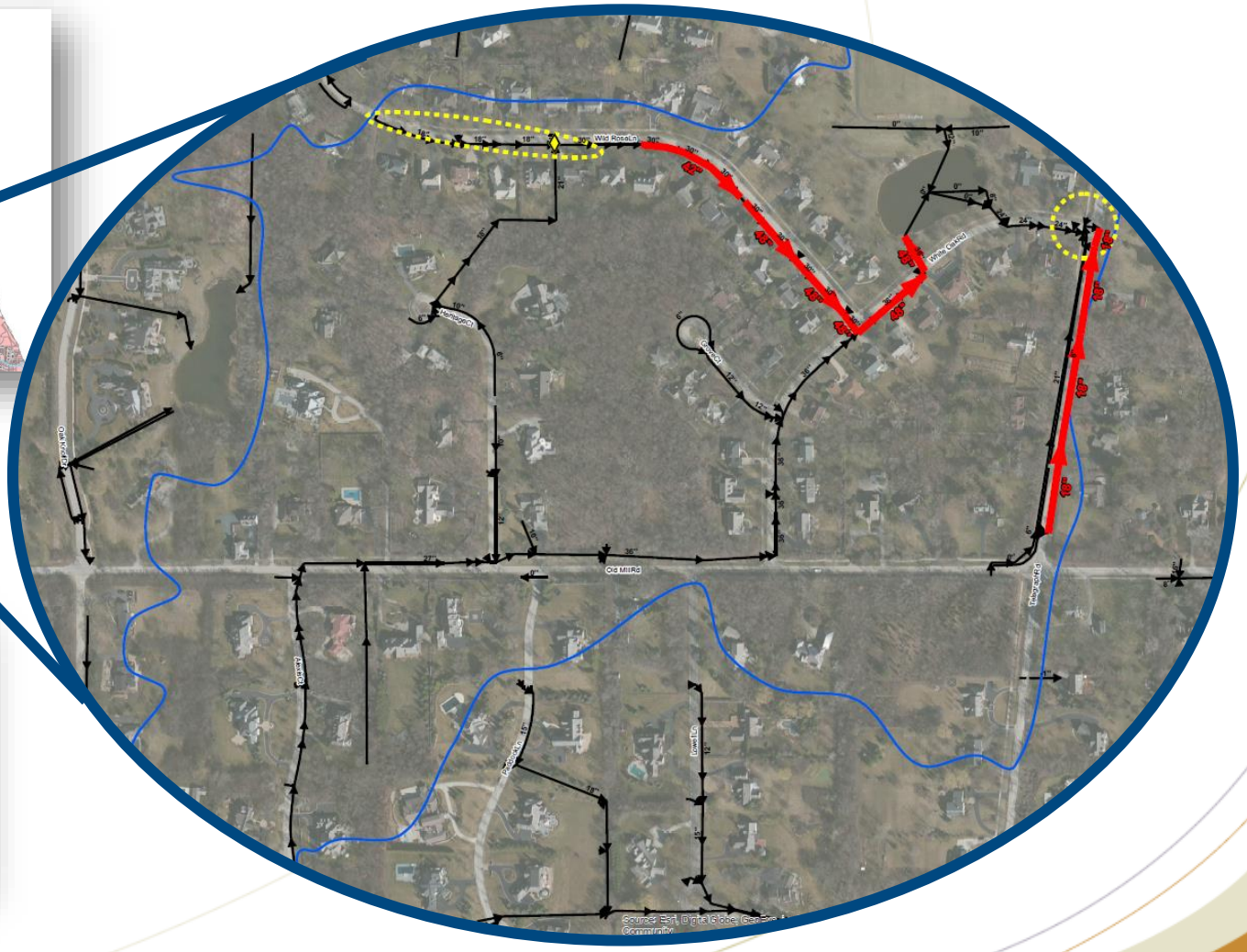
BAXTER & WOODMAN Consulting Engineers

2019 Recommendation – Western & Onwentsia



2014 Recommendation – Telegraph & White Oak

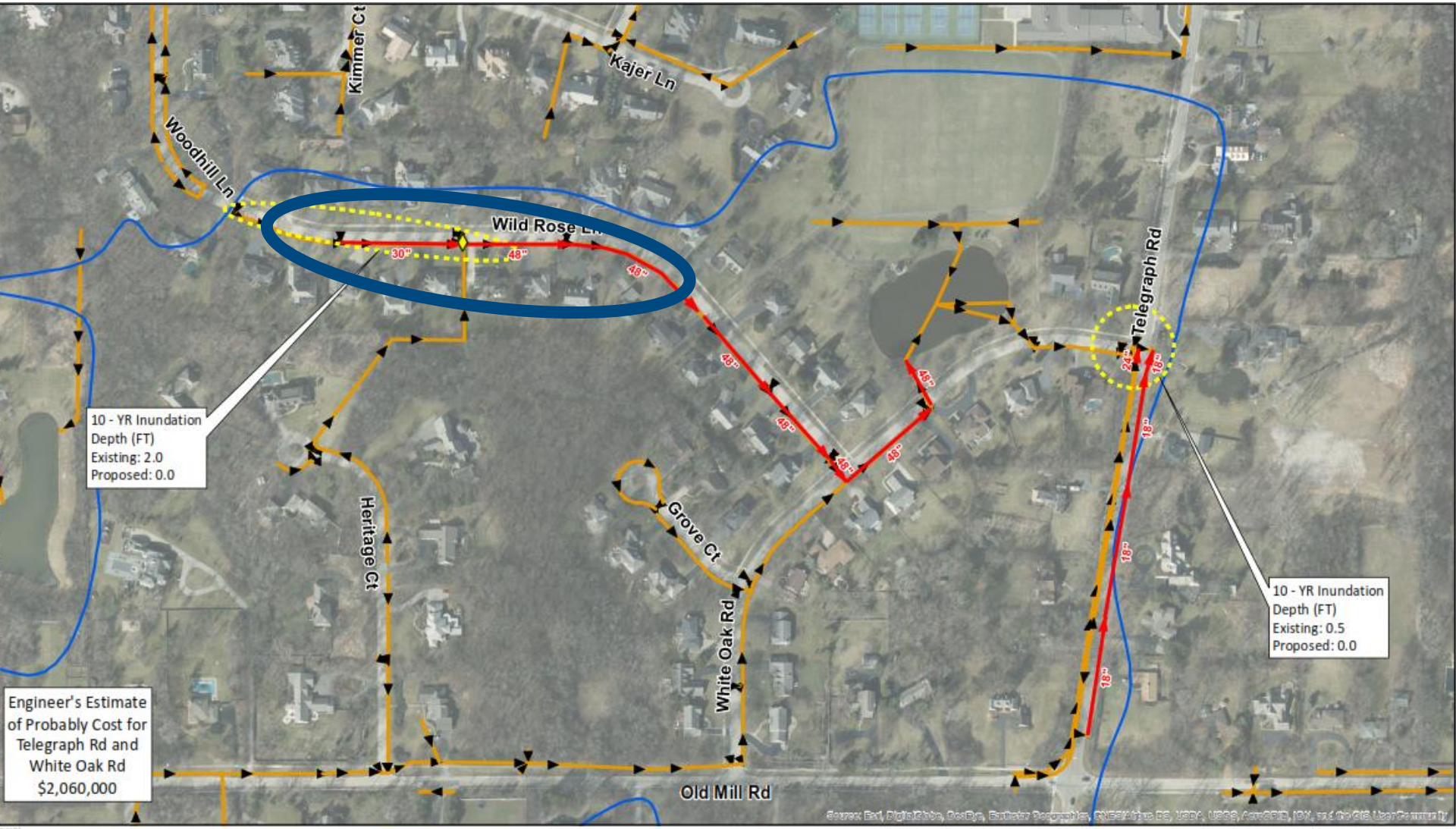




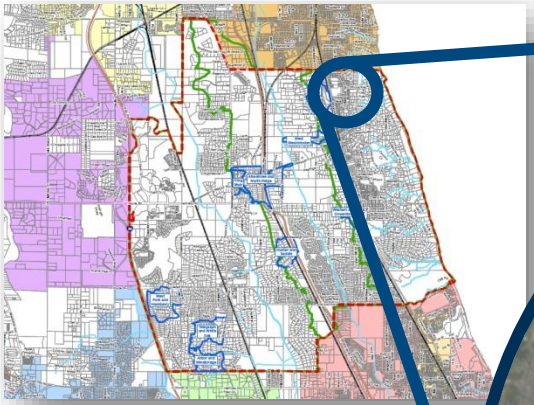
Telegraph & White Oak Study Area: $1,260,000

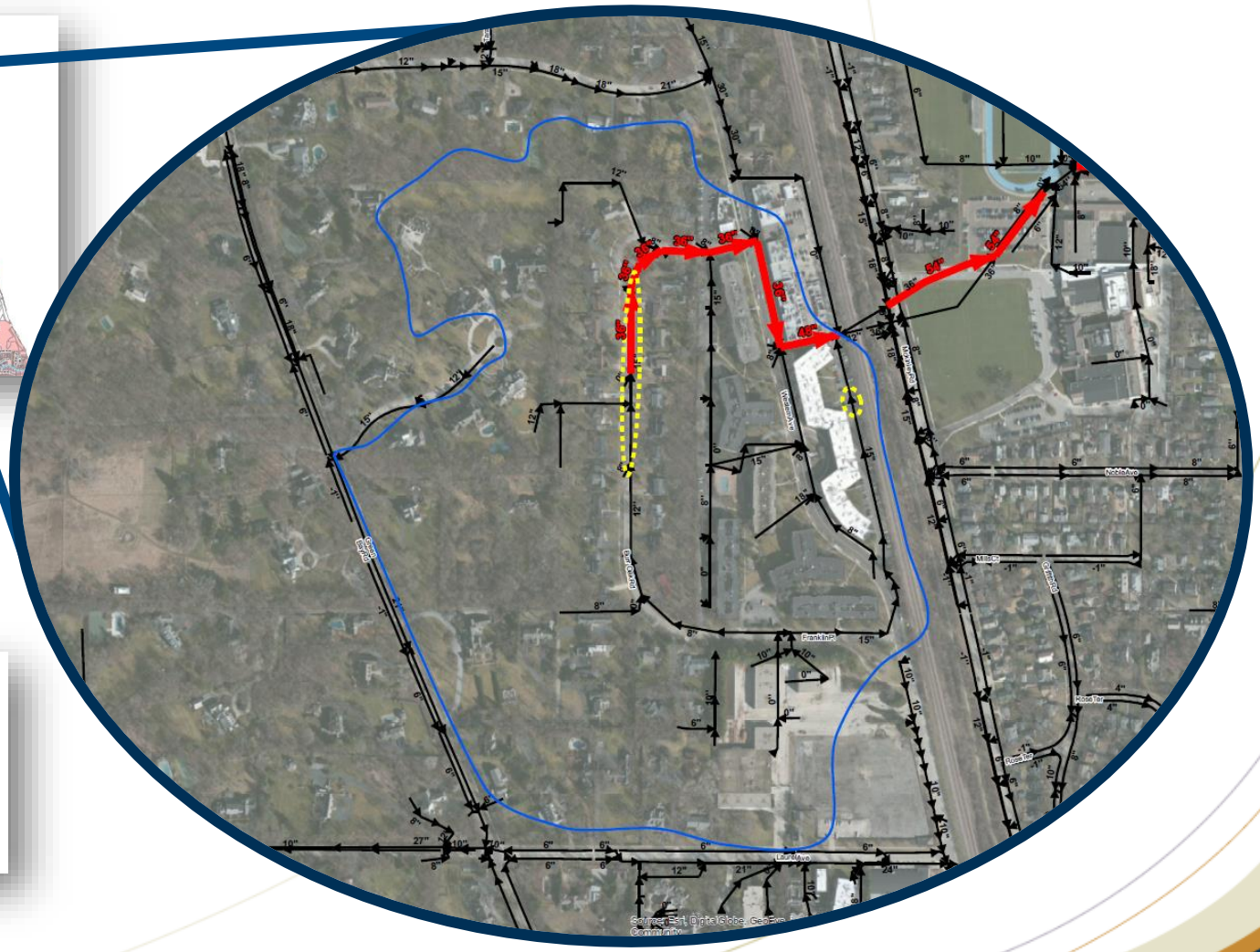
BAXTER & WOODMAN Consulting Engineers

2014 Recommendation – Telegraph & White Oak



2014 Recommendation - Burr Oak

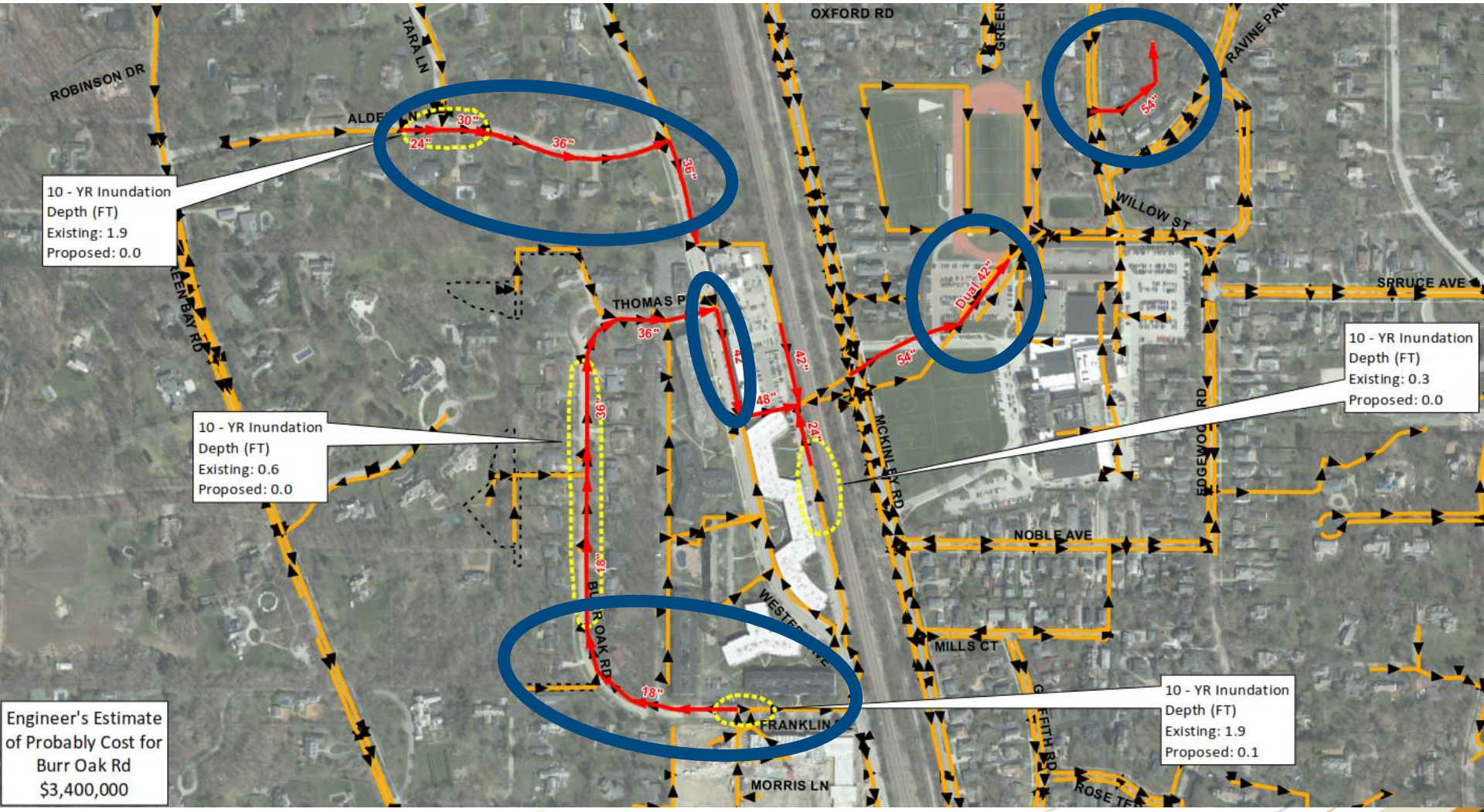




Burr Oak Study Area: $1,620,000

BAXTER & WOODMAN Consulting Engineers

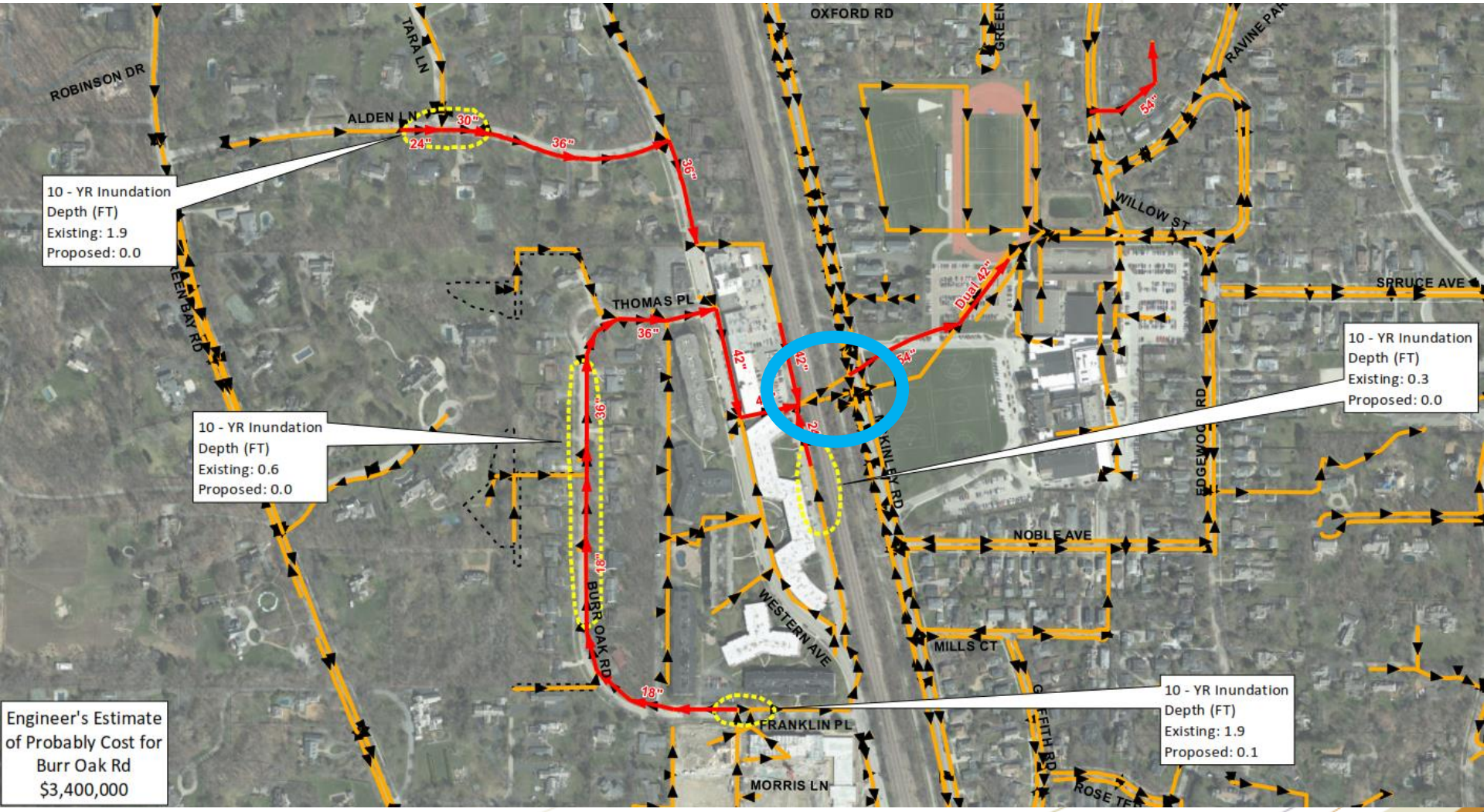
2019 Recommendation – Burr Oak



2019 Burr Oak Study Area: $3,400,000

BAXTER & WOODMAN
Consulting Engineers

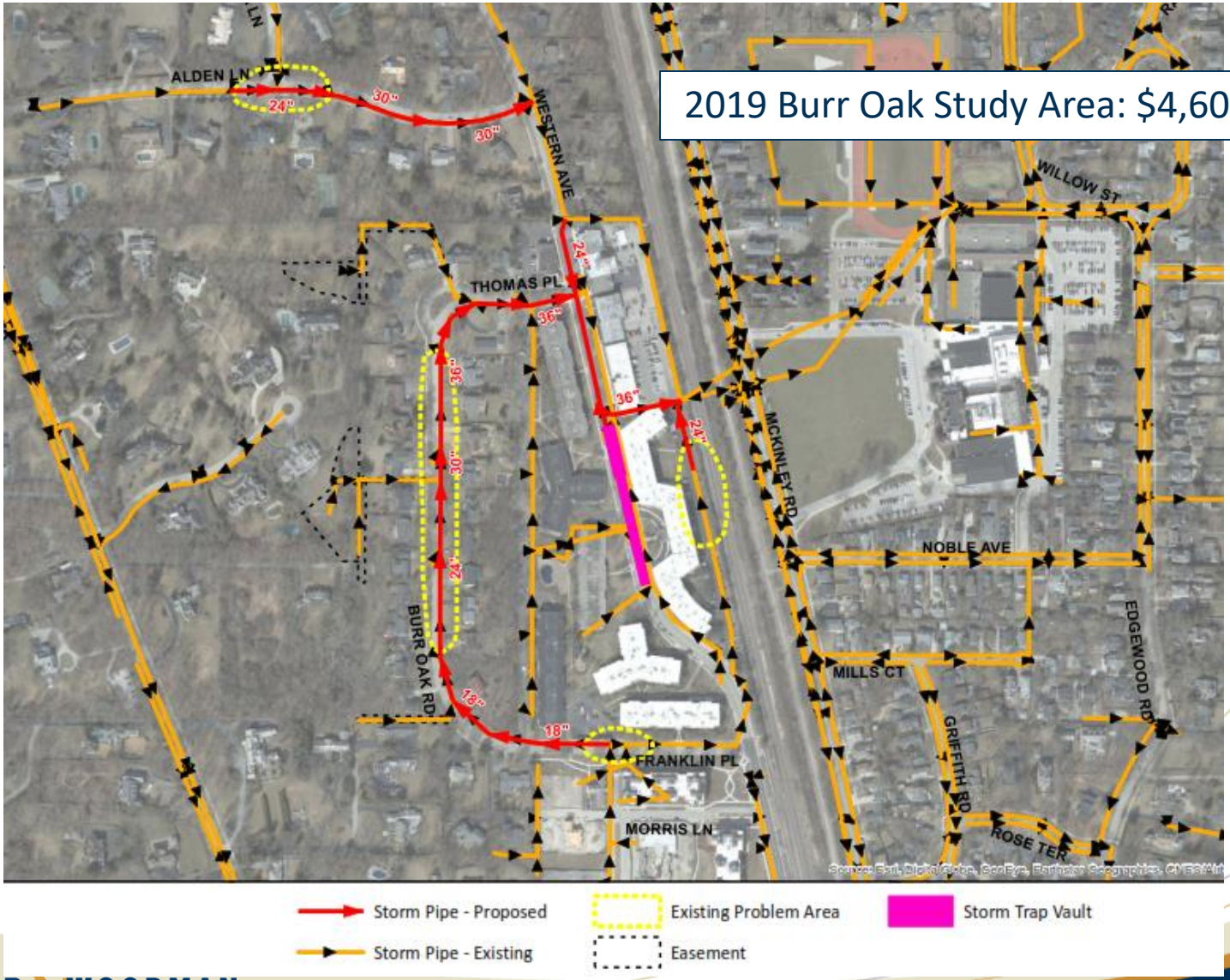
2019 Burr Oak Stormwater Improvements



2019 Burr Oak Study Area: $3,400,000

BAXTER & WOODMAN Consulting Engineers

2019 Redesign of Burr Oak

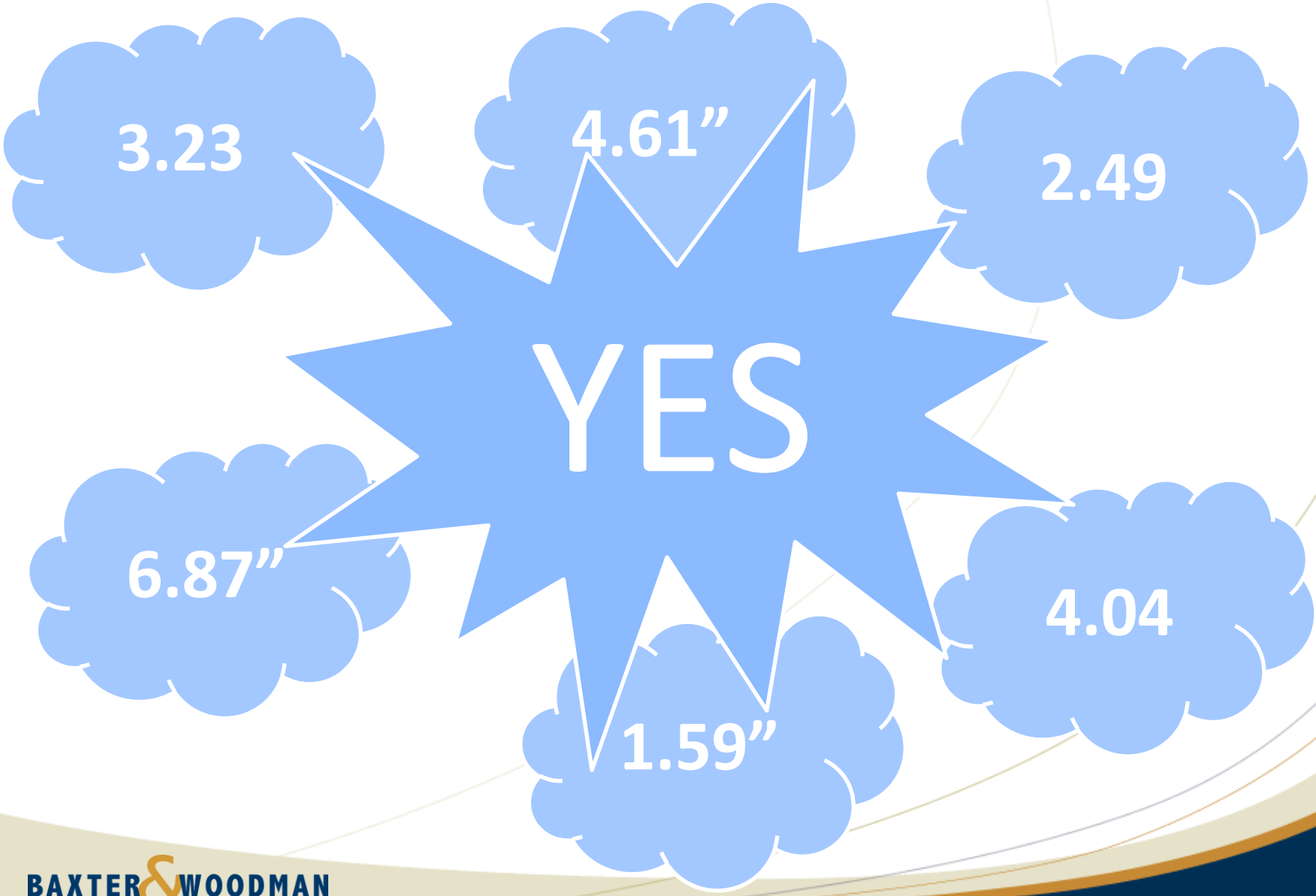


BAXTER & WOODMAN Consulting Engineers

Engaged City Council

BAXTER & WOODMAN Consulting Engineers

How Big is a “5-yr rain storm”?



BAXTER & WOODMAN Consulting Engineers

How Big is a “5-yr rain storm”?

Rainfalls are not measured by depth alone, but by RATE or depth over time.

How Big is a “5-yr rain storm”?

6 hr - 3.23

48 hr - 4.61”

2 hr- 2.49

240 hr - 6.87”

24 hr - 4.30

5 min - 0.52”

1.59”

What determines the “size” of a storm?

Rainstorms are defined in reference to a statistical analysis of real recorded rain events over many years.

The “Recurrence Rate” defines what depth of rainfall, has what chance of occurring over a specific duration, in a specific location, in a given year

- The 10% probable rate of recurrence is then understood as the “10-year” rain event
- The 1% probable rate of recurrence is then understood as the “100-year rain event

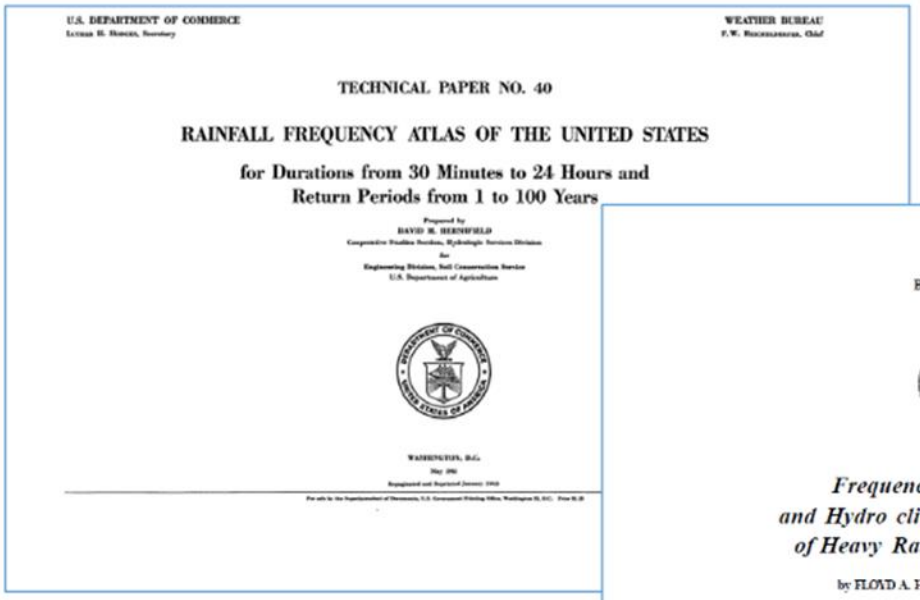
Rainfall (in) for given recurrence interval

Storm Duration	2-month	3-month	4-month	6-month	9-month	1-year	2-year	5-year	10-year	25-year	50-year	100-year	500-year
5 minutes	0.19	0.22	0.24	0.27	0.31	0.33	0.40	0.52	0.62	0.77	0.90	1.03	1.35
10 minutes	0.35	0.40	0.43	0.49	0.56	0.61	0.73	0.95	1.13	1.42	1.65	1.89	2.47
15 minutes	0.42	0.49	0.53	0.61	0.69	0.75	0.90	1.16	1.39	1.74	2.03	2.32	3.04
30 minutes	0.58	0.66	0.73	0.83	0.94	1.03	1.24	1.59	1.91	2.39	2.78	3.17	4.16
1 hour	0.74	0.84	0.93	1.05	1.20	1.30	1.57	2.02	2.42	3.03	3.53	4.03	5.28
2 hours	0.91	1.04	1.14	1.30	1.48	1.61	1.94	2.49	2.99	3.74	4.35	4.97	6.52
3 hours	1.00	1.15	1.26	1.44	1.63	1.77	2.14	2.75	3.30	4.13	4.80	5.49	7.20
6 hours	1.18	1.35	1.48	1.68	1.91	2.08	2.51	3.23	3.86	4.84	5.63	6.43	8.43
12 hours	1.37	1.56	1.71	1.95	2.21	2.41	2.91	3.74	4.48	5.61	6.53	7.46	9.78
18 hours	1.48	1.69	1.85	2.11	2.39	2.61	3.14	4.04	4.84	6.06	7.05	8.06	10.57
1 day	1.57	1.80	1.97	2.24	2.55	2.77	3.34	4.30	5.15	6.45	7.50	8.57	11.24
2 days	1.72	1.97	2.16	2.46	2.79	3.04	3.66	4.71	5.62	6.99	8.13	9.28	12.10
3 days	1.87	2.14	2.34	2.67	3.03	3.30	3.97	5.08	6.05	7.49	8.64	9.85	12.81
5 days	2.08	2.38	2.61	2.97	3.37	3.67	4.42	5.63	6.68	8.16	9.39	10.66	13.81
10 days	2.63	3.01	3.30	3.76	4.27	4.65	5.60	7.09	8.25	9.90	11.26	12.65	16.00

Northeast Illinois Section

Bulletin 70 (2019)

Rainfall Frequency Sources

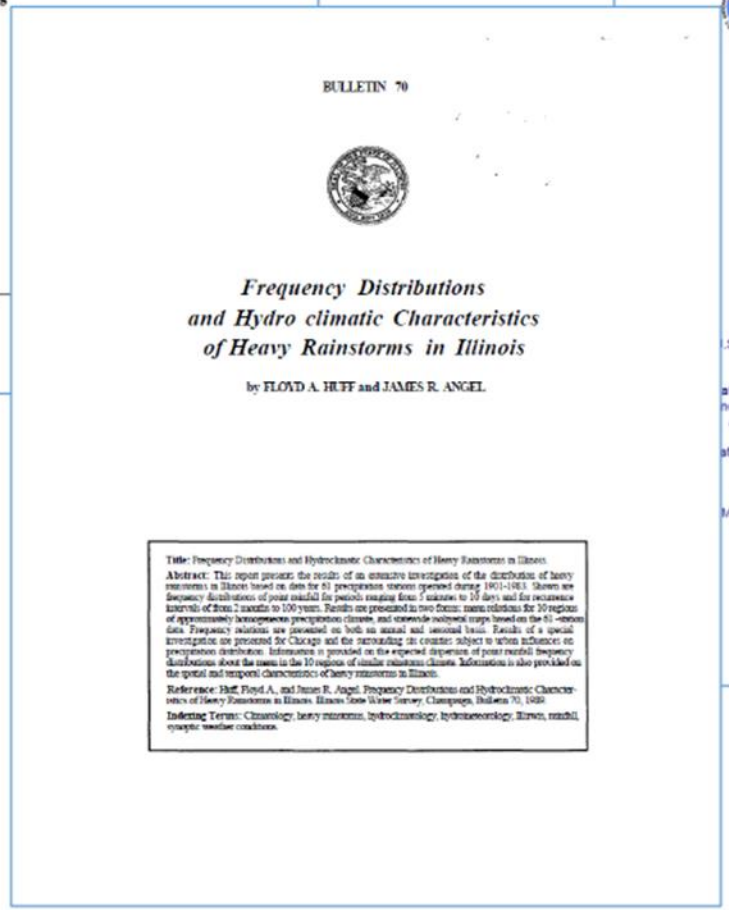

U.S. DEPARTMENT OF COMMERCE

WEATHER BUREAU

TECHNICAL PAPER NO. 40

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years


BULLETIN 70

Frequency Distributions and Hydro climatic Characteristics of Heavy Rainstorms in Illinois

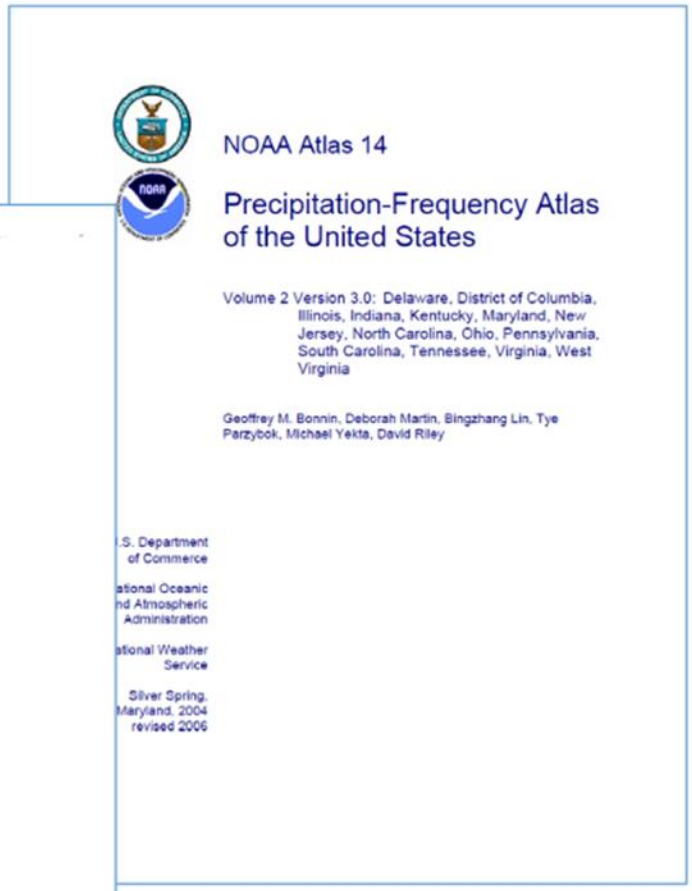
by FLOYD A. HUFF and JAMES R. ANGEL

Title: Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois

Abstract: This report presents the results of an extensive investigation of the distribution of heavy rainstorms in Illinois based on data for 81 precipitation stations operated during 1901-1963. Shown are frequency distributions of point rainfall for periods ranging from 5 minutes to 10 days and for recurrence intervals of from 2 months to 100 years. Results are presented in two forms: mean relations for 10 regions of approximately homogeneous precipitation climate, and statewide isopleth maps based on the 81 station data. Frequency relations are presented on both an annual and seasonal basis. Results of a special investigation are presented for Chicago and the surrounding six counties subject to urban influences on precipitation distribution. Information is provided on the expected dispersion of point rainfall frequency distributions about the mean in the 10 regions of similar relations climate. Information is also provided on the spatial and temporal characteristics of heavy rainstorms in Illinois.

Reference: Huff, Floyd A., and James R. Angel, Frequency Distributions and Hydroclimatic Characteristics of Heavy Rainstorms in Illinois, Illinois State Water Survey, Champaign, Bulletin 70, 1989.

Indexing Terms: Climatology, heavy rainstorms, hydroclimatology, hydrometeorology, Illinois, rainfall, synoptic weather conditions.


NOAA Atlas 14

Precipitation-Frequency Atlas of the United States

Volume 2 Version 3.0: Delaware, District of Columbia, Illinois, Indiana, Kentucky, Maryland, New Jersey, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, West Virginia

Geoffrey M. Bonnin, Deborah Martin, Bingzhang Lin, Tye Parzybok, Michael Yekta, David Riley

U.S. Department of Commerce

National Oceanic and Atmospheric Administration

National Weather Service

Silver Spring, Maryland, 2004 revised 2006

BAXTER & WOODMAN Consulting Engineers

Historical Precipitation for Illinois

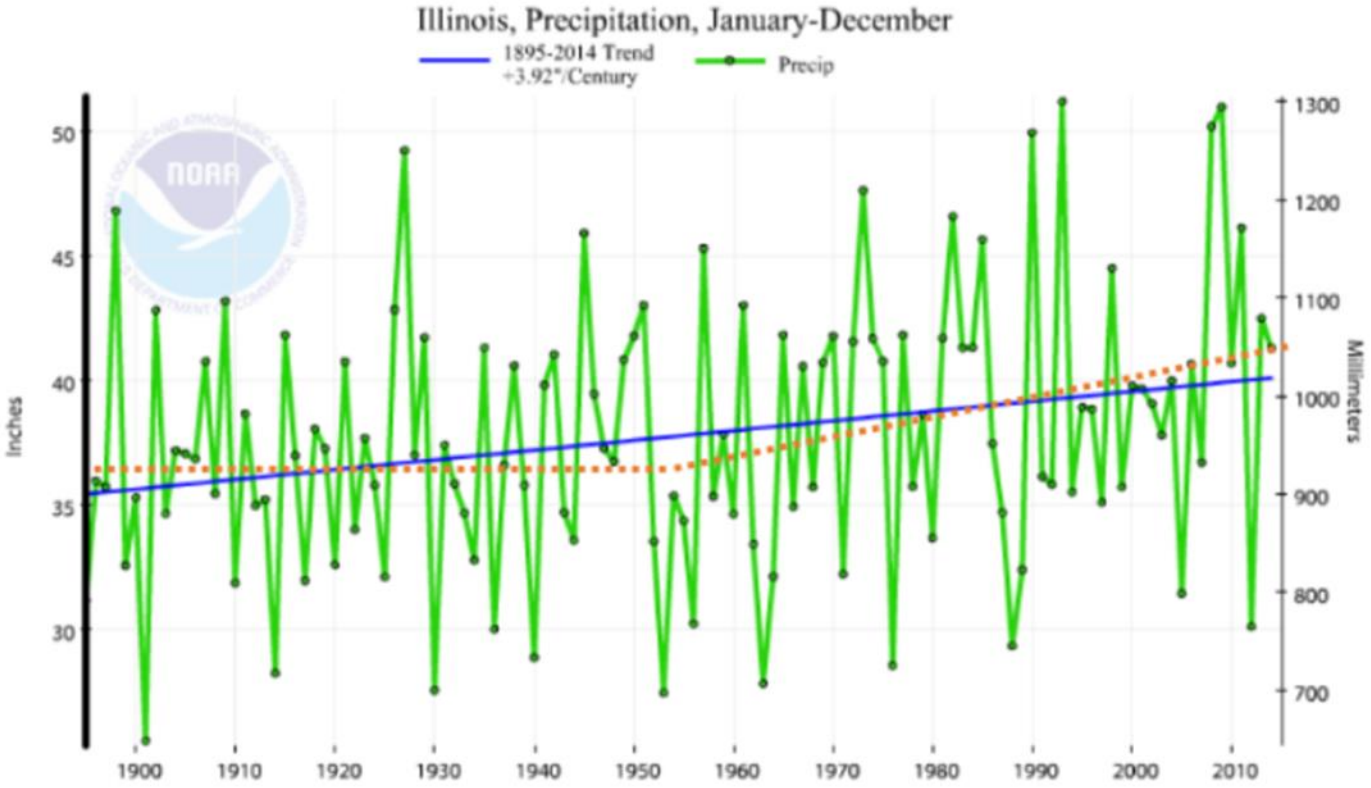
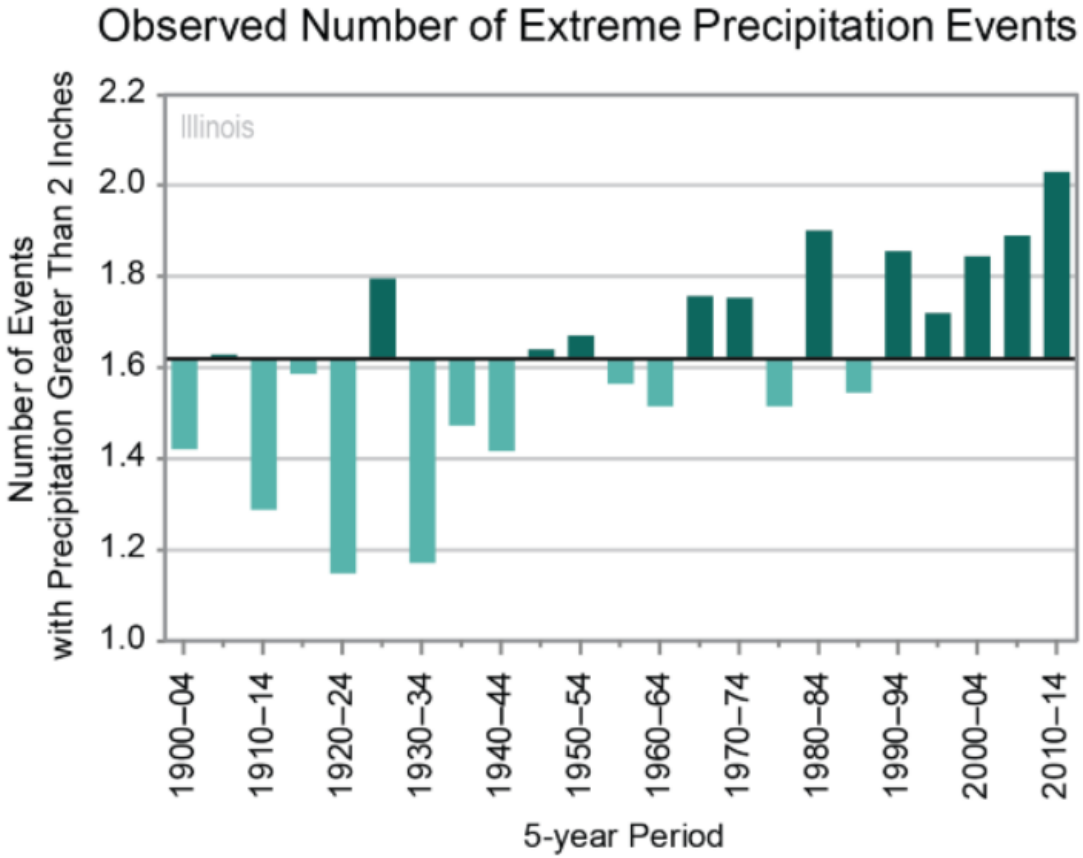


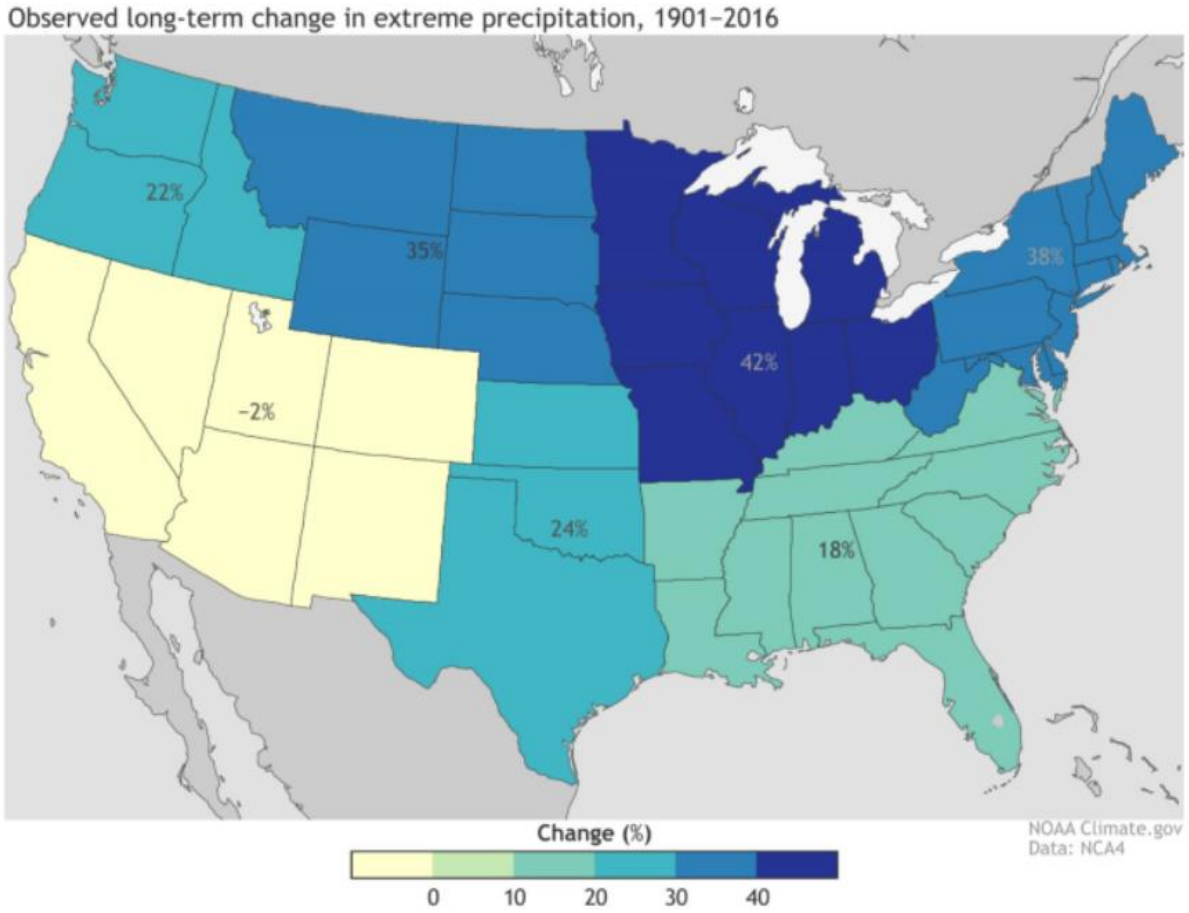
Figure 2.2: Statewide average annual precipitation for Illinois from 1895 to 2014. The green line represents the year to year variation. The blue line is the trend line. Source: National Center for Environmental Information (2015)

Extreme Precipitation Events Trending Up



BAXTER & WOODMAN Consulting Engineers

Change in the top 1% (99th percentile)



BAXTER & WOODMAN
Consulting Engineers

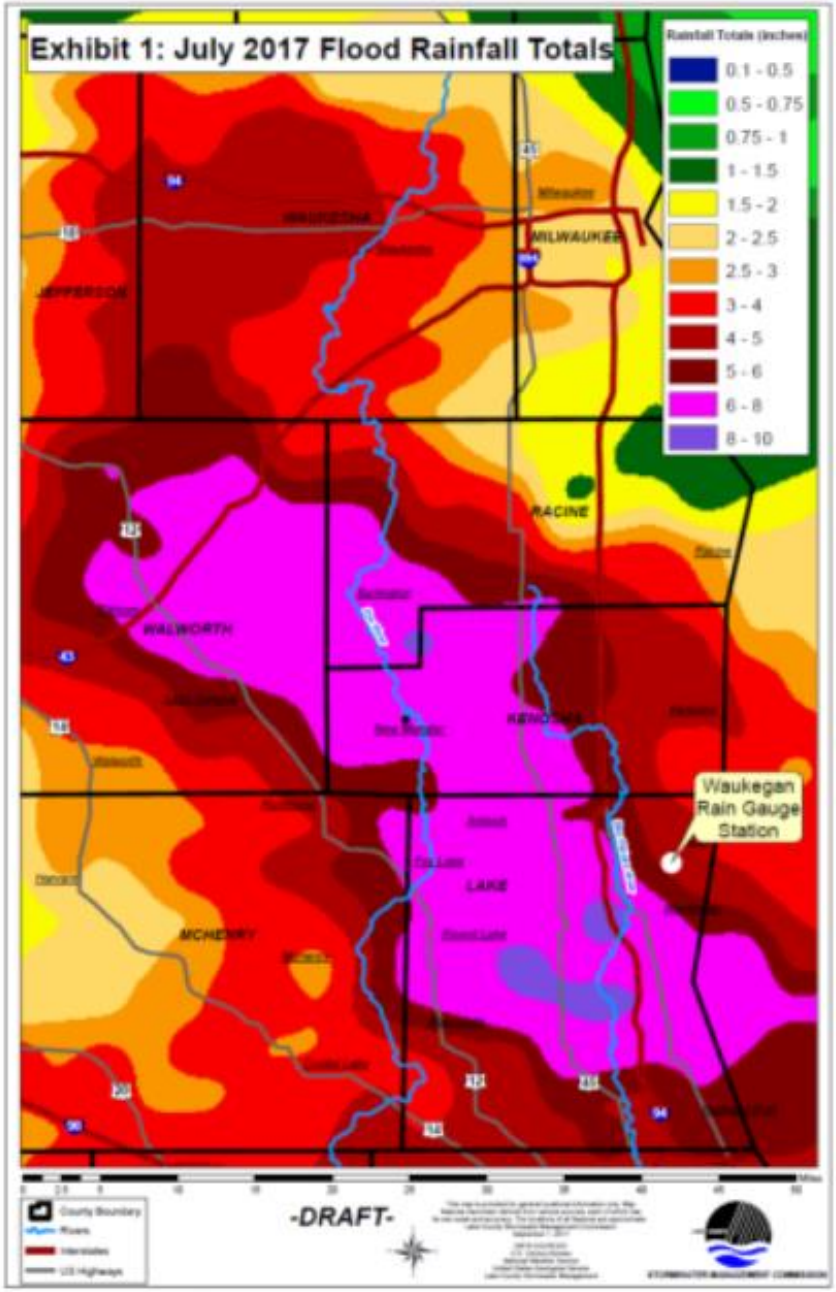
Lake Forest Rainfall

Record Event July 2017

(~500-year storm)

2019 – No events greater than

2-year recurrence



Courtesy of Kurt Wolford, LCSMC

BAXTER & WOODMAN Consulting Engineers

Update of Bulletin 70 Rainfall Depths

Storm Event	Duration	Bulletin 70 (1989) Depth [in]	Bulletin 70 (2019) Depth [in]	Percent Change	Updated Return Period for 1989 Depths
2-year	2-hour	1.79	1.94	8.40%	1.7-year
5-year	2-hour	2.24	2.49	11.20%	3.6-year
10-year	2-hour	2.64	2.99	13.30%	6.5-year
25-year	2-hour	3.25	3.74	15.10%	15.2-year
50-year	2-hour	3.82	4.35	13.90%	28.3-year
100-year	2-hour	4.47	4.97	11.20%	59.7-year

Burr Oak Stormwater Improvements

Current capacity for a 5-year rain event

Proposed conditions to mitigate flooding for a 10-year event (depth less than 3” in the road) ($3.4M)

Increase to 25-year protection ($5.3M) – DRAFT

-> Potential impacts

- Future expectations
- Costs
- Downstream capacity/impacts

Lake Forest Stormwater Masterplan Updates

The updates to the Stormwater Masterplan used the new, 2019, bulletin 70 data; and provided recommendations and costs as such

This is proactive!

Not many communities have updated their studies to even understand how the new data might affect the recommended projects

Questions?

Bulletin 70 Stormwater Masterplan Updates – Lake Forest Case Study

Matt Moffitt, P.E., CFM, CPESC