Metropolitan Water Reclamation District of Greater Chicago

Welcome to the September Edition of the 2025 M&R Seminar Series

NOTES FOR SEMINAR ATTENDEES

- Remote attendees' microphones are muted at entry to minimize background noise. For attendees in the auditorium, please silence your phones.
- A question and answer (Q/A) session will follow the presentation.
- For remote attendees, please use "**Chat**" only to type questions for the presenter. For other issues, please send emails to MnRseminars@mwrd.org.
  For attendees in the auditorium, please raise your hand and wait for the microphone to ask a verbal question during the Q/A session.
- The presentation slides will be posted on the MWRD website after the seminar.
- This seminar has been approved by the Engineering Society of Illinois (ESI) for one PDH and is pending approval by the IEPA for one TCH. Certificates will be issued only to participants who attend the entire presentation. For PDH certificate seekers, **completing a brief course evaluation and submitting it are required**.

Scott Lincoln, GISP

Senior Service Hydrologist/Cartographer
National Weather Service
Chicago, Illinois

Scott Lincoln is the senior service hydrologist and cartographer at the National Weather Service Chicago, Illinois, forecast office which covers portions of northeastern Illinois, northwestern Indiana, and Lake Michigan. Scott has a masters degree in environmental science and is a certified GIS professional. His duties include operational forecasting during times of significant rainfall or snowmelt, training the forecast staff on hydrology-related products and services, participating in hydrology-related outreach, and being the office's subject matter expert on hydrology topics including river flooding, flash flooding, extreme rainfall, and drought. Scott's areas of expertise also include post-event rainfall analysis, computer programming, and historical weather event research. He previously worked as a river forecaster at the Lower Mississippi River Forecast Center in Slidell, Louisiana. Scott serves as a member of the American Meteorological Society's Committee on Hydrology.

A History of Extreme Rain Events Impacting Chicago

Presented to MWRDGC Monitoring & Research Seminar Program
September 26, 2025

W. Scott Lincoln, GISP
Senior Service Hydrologist

A History of Extreme Rain Events Impacting Chicago

Summary

- What is an “extreme” event?
- Why research and review past extreme rainfall events?
- Difficulties comparing modern events to past events
- Data availability for past events
- Summary of extreme rainfall events impacting Chicago area
- Changes in frequency of extreme rainfall events

What is an “extreme” event?

A History of Extreme Rain Events Impacting Chicago

What is extreme?

Multiple definitions of “extreme” which can vary by context or discipline.

AMS American Meteorological Society

“In climatology, the highest and, in some cases, the lowest value of a climatic element observed during a given time interval or during a given month or season of that period.”

-American Meteorological Society’s Glossary of Meteorology

U.S. Global Change Research Program

“A weather event that is rare at a particular place and time of year…Definitions of “rare” vary, but an extreme weather event would normally be as rare as or rarer than the 10% of 90% probability density function estimated from observations.”

-US Global Change Research Program’s Fifth National Climate Assessment Glossary of Terms

A History of Extreme Rain Events Impacting Chicago

What is extreme?

Multiple definitions of "extreme" which can vary by context or discipline.

ipcc

"An extreme/heavy precipitation event is an event that is of very high magnitude with a very rare occurrence at a particular place…The intensity of such events may be defined with block maxima approach such as annual maxima or with peak over threshold approach, such as rainfall above 95th or 99th percentile at a particular space."

-Intergovernmental Panel on Climate Change's Sixth Assessment Report Glossary

EPA United States Environmental Protection Agency

U.S. Global Change Research Program

"Extreme precipitation is defined as precipitation equal to or greater than the top 1% of heavy precipitation events…"

-US EPA, based upon information from US Global Change Research Program's Fifth National Climate Assessment

A History of Extreme Rain Events Impacting Chicago

What is extreme?

For the purposes of the research discussed in this presentation, an extreme event was defined as:

- Storm total rainfall (over 1-2 days) of at least 7.5 inches*
- Sub-daily (1-hr through 12-hr) rainfall amounts exceeding the 1% annual exceedance probability according to NOAA Atlas 14

Duration	1 hour	2 hour	3 hour	6 hour	12 hour
Rainfall	3.1	3.8	4.2	5.5	6.1

**Approximately equal to the 1-day rain event with a 1% chance of occurring each year in the Chicago area, according to NOAA Atlas 14.*

Why review past extreme rainfall events?

A History of Extreme Rain Events Impacting Chicago

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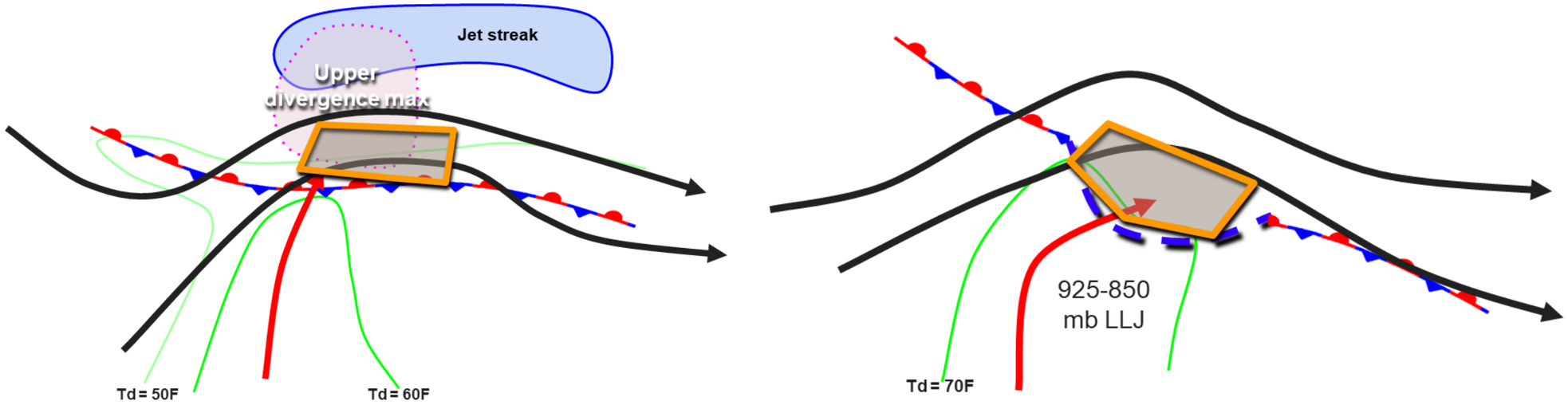
Why review past extreme rainfall events?

- Details about weather patterns that are common between all events can be used for assessment of future possible events.



A History of Extreme Rain Events Impacting Chicago

Why review past extreme rainfall events?

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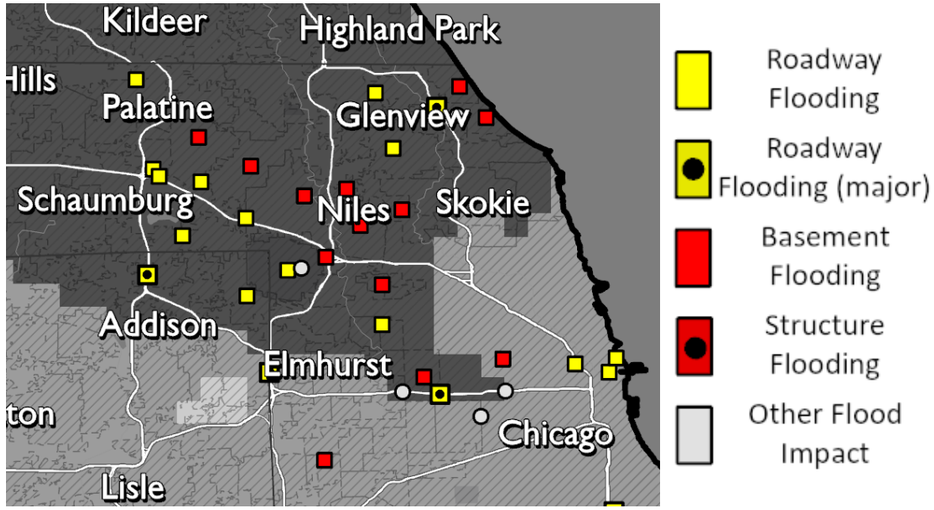
- Details about impacts from such events, including how impacts differ over space and time, can inform potential flood mitigation projects.



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Why review past extreme rainfall events?

- Details about weather patterns that are common between all events can be used for assessment of future possible events.

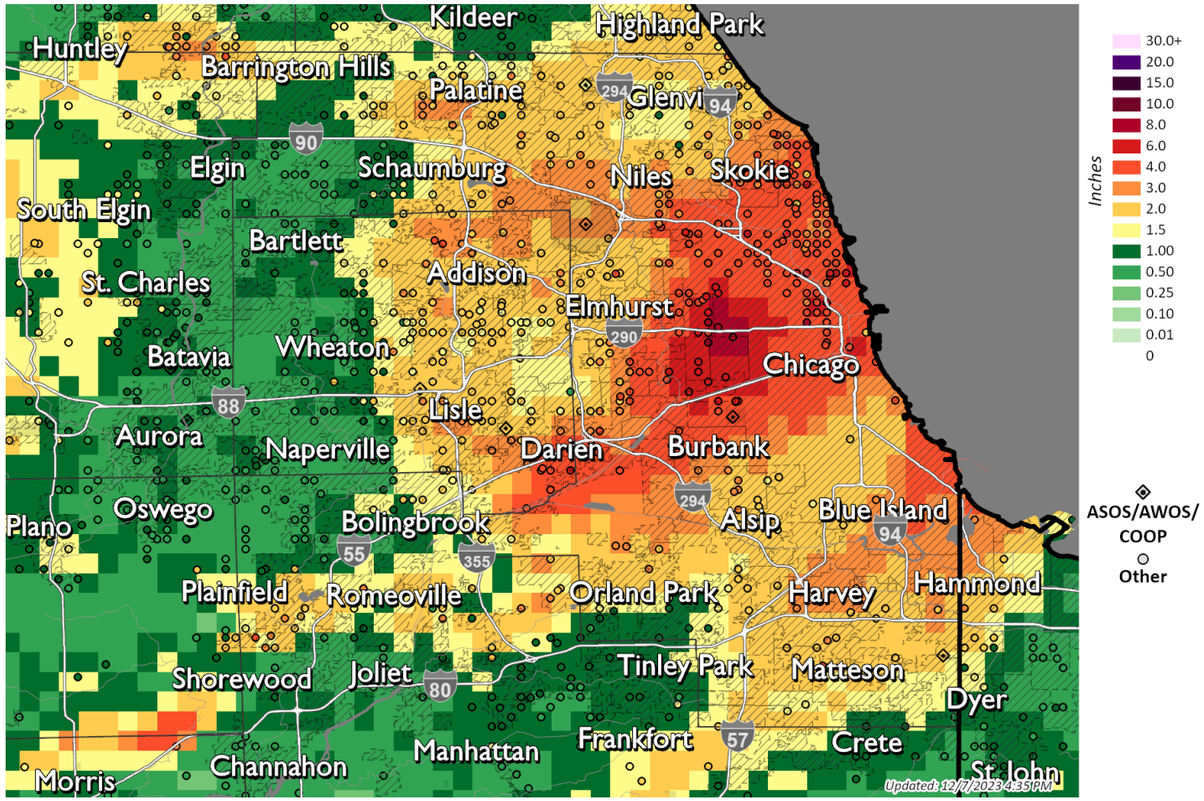
- Details about impacts from such events, including how impacts differ over space and time, can inform potential flood mitigation projects.

- Learn what is possible in given area… <u>what's happened before can (and often does) happen again!</u>

A History of Extreme Rain Events Impacting Chicago

Why review past extreme rainfall events?

After big rain event on July 2, 2023, people asked… how common are these events? Are they unprecedented? Was July 2023 the “record” event?



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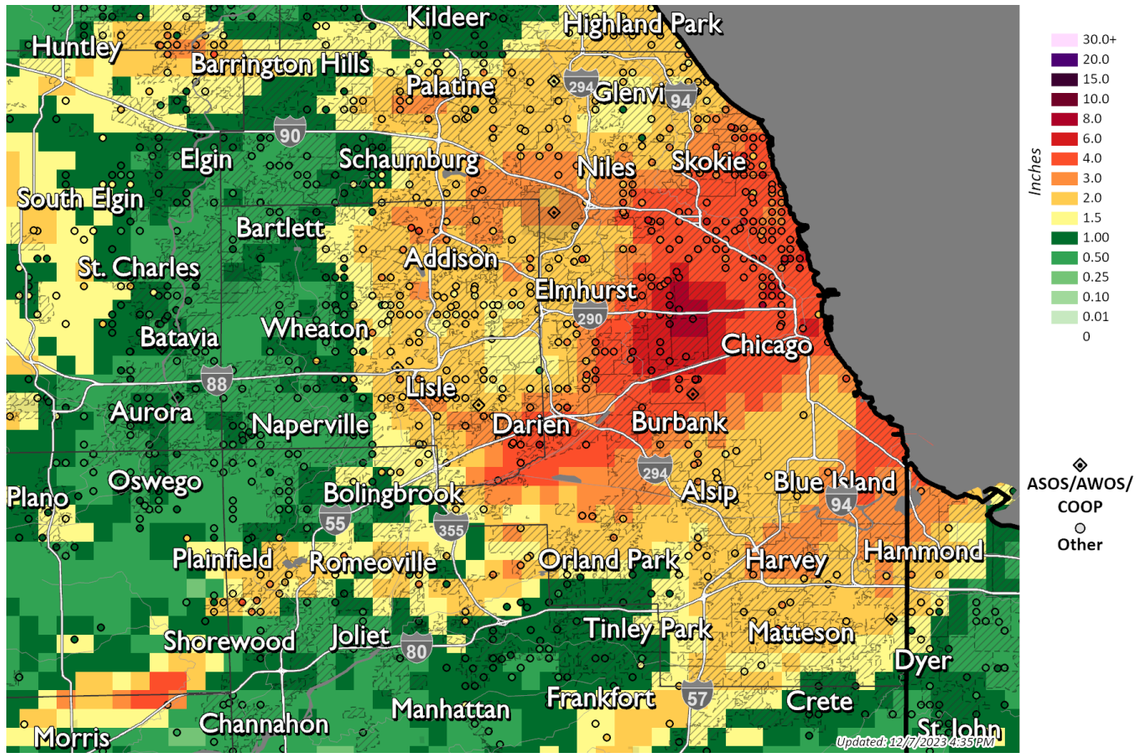

- Little detailed analysis had been done on specifics of extreme events, such as rainfall patterns, weather patterns, & flood impacts.
- Similar studies completed in 1970s/1980s focused on rainfall patterns only.
- Question couldn’t be answered without more study.

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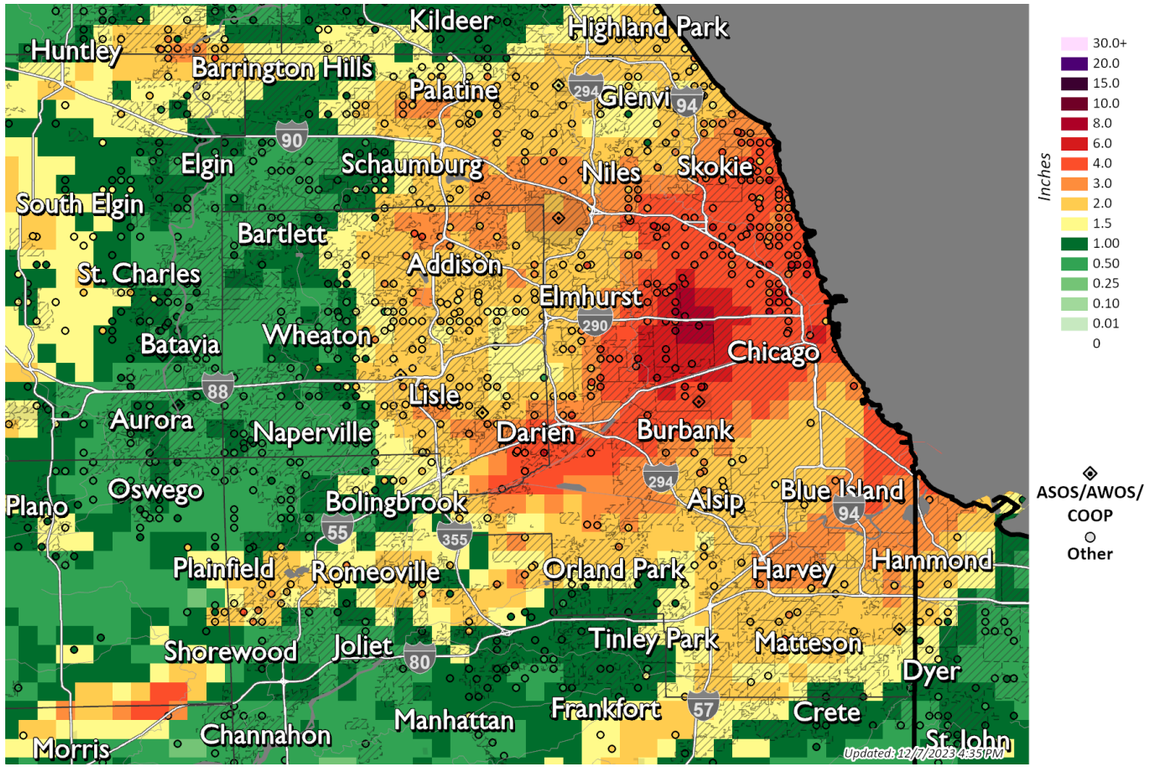
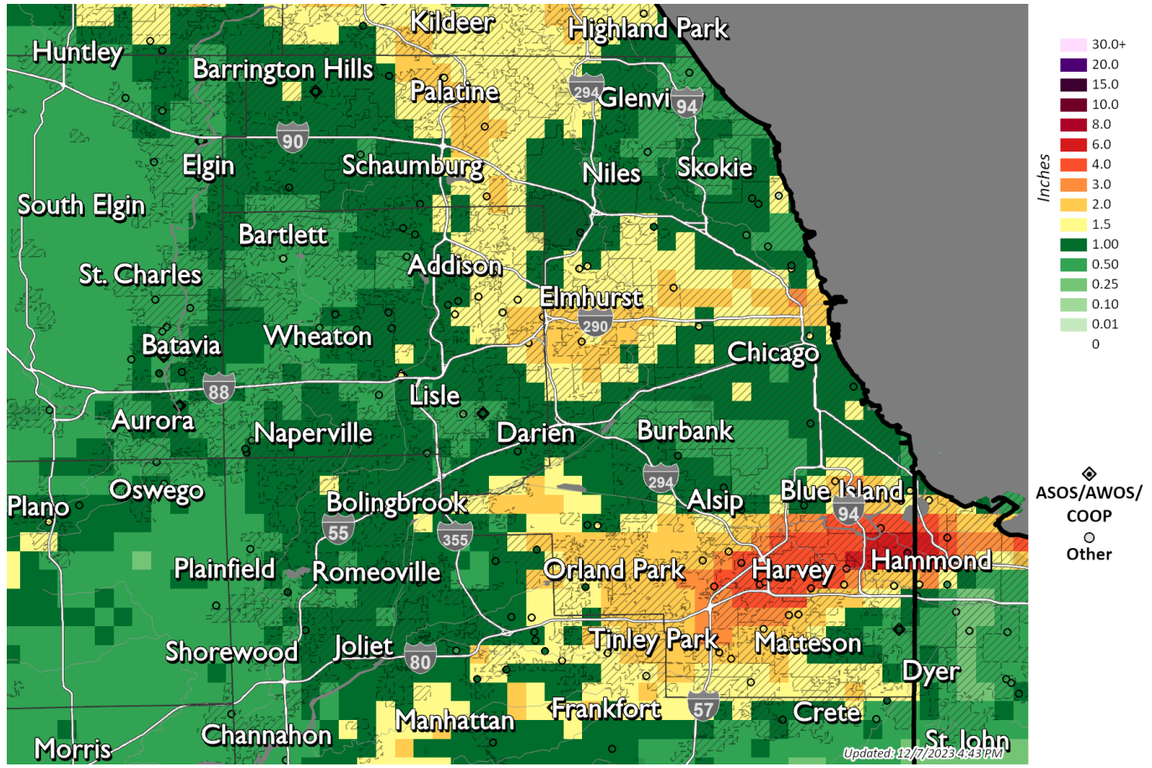
Why review past extreme rainfall events?

While conducting detailed research to answer these questions, another extreme rainfall event occurred in the vicinity of Chicago.

July 2023

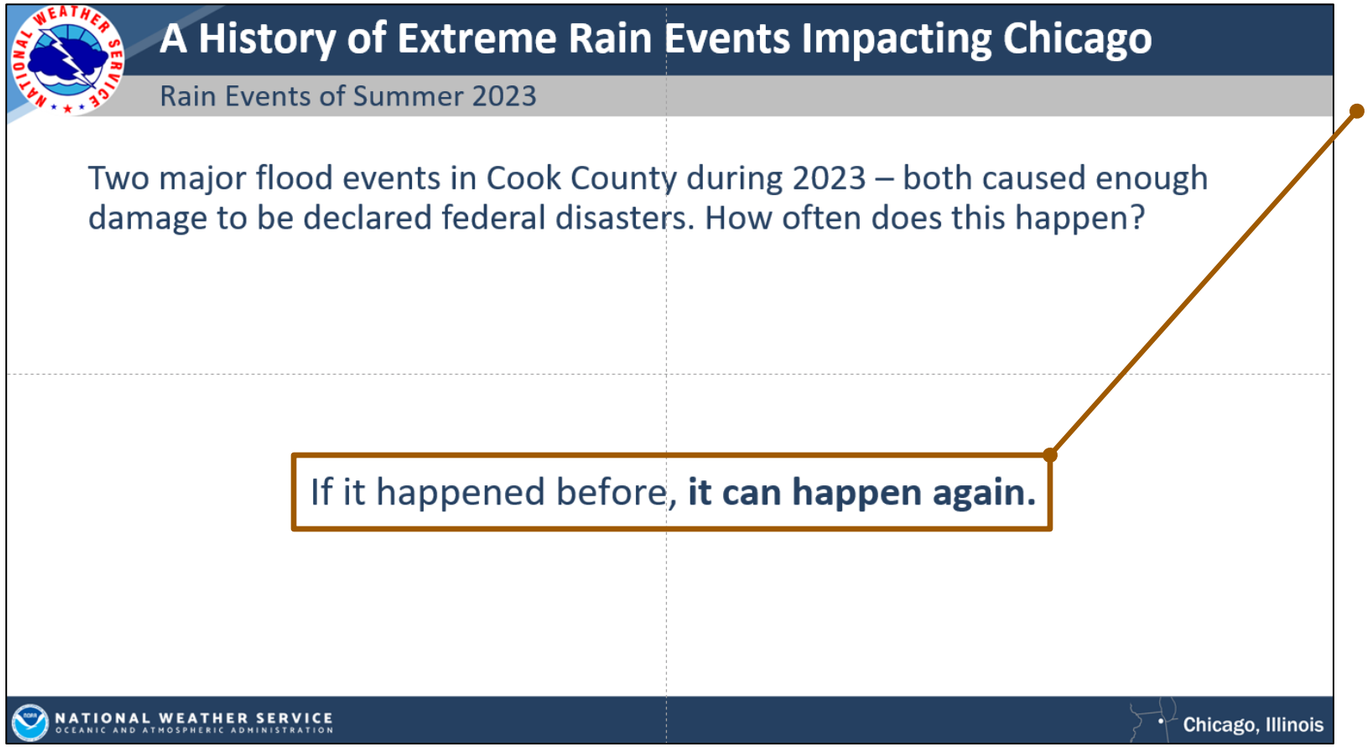


September 2023



A History of Extreme Rain Events Impacting Chicago

Why review past extreme rainfall events?

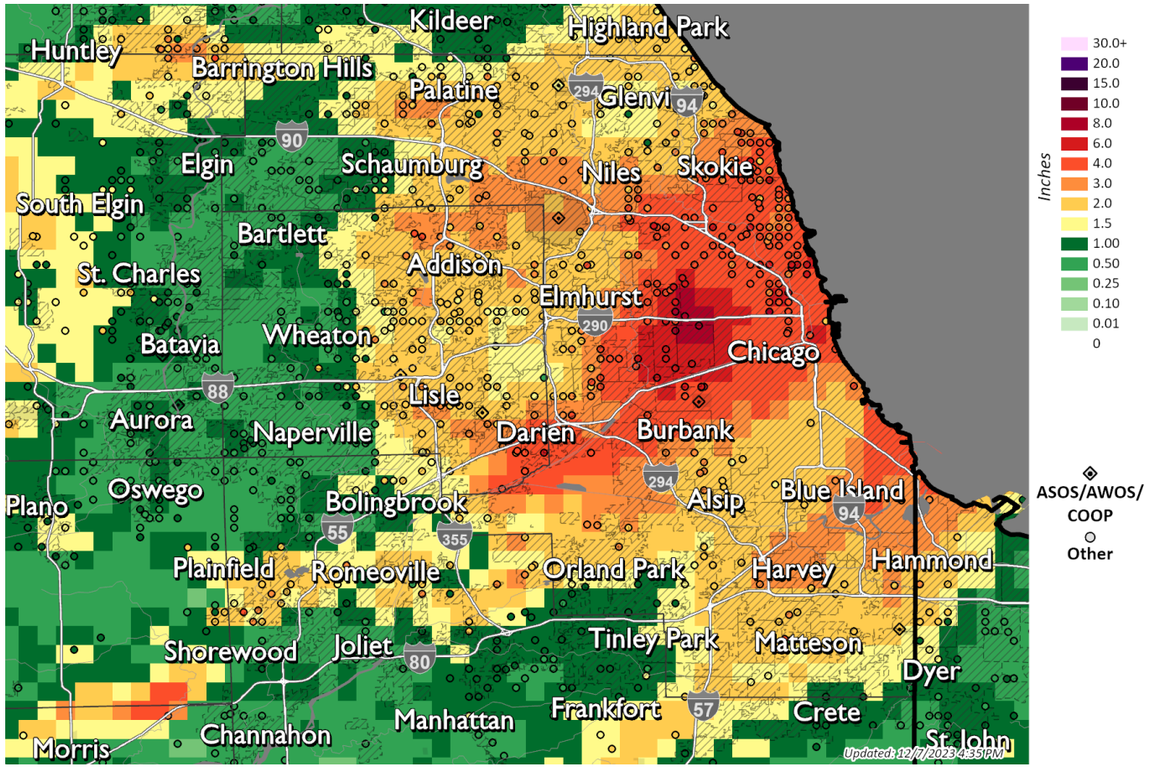


Original presentation on this topic…
early 2024 through early 2025

A History of Extreme Rain Events Impacting Chicago

Why review past extreme rainfall events?

July 2023



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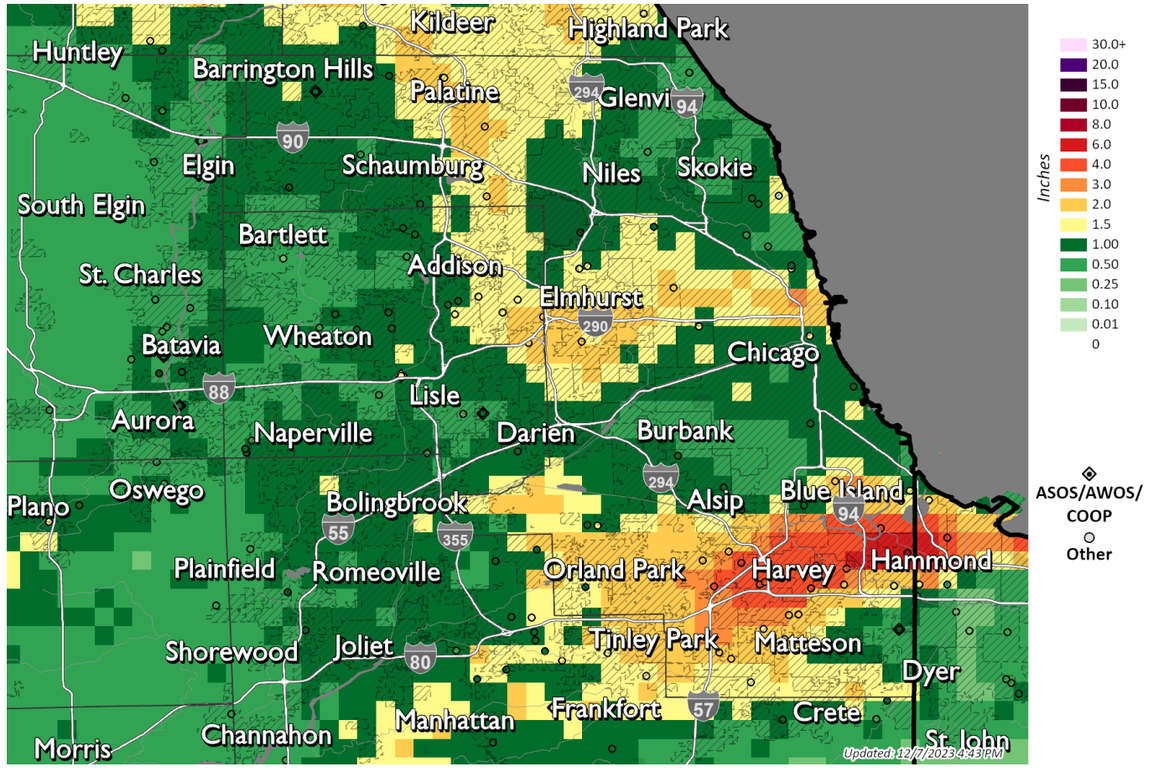

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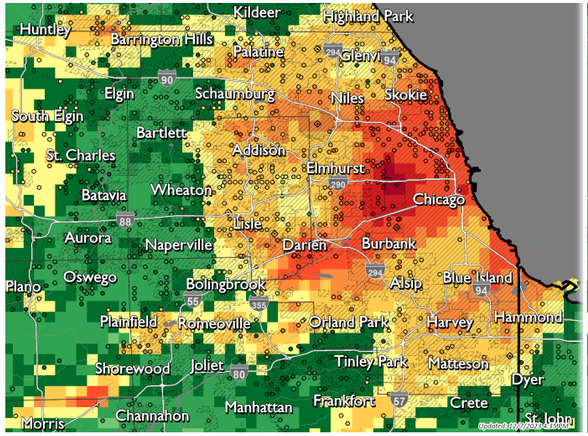

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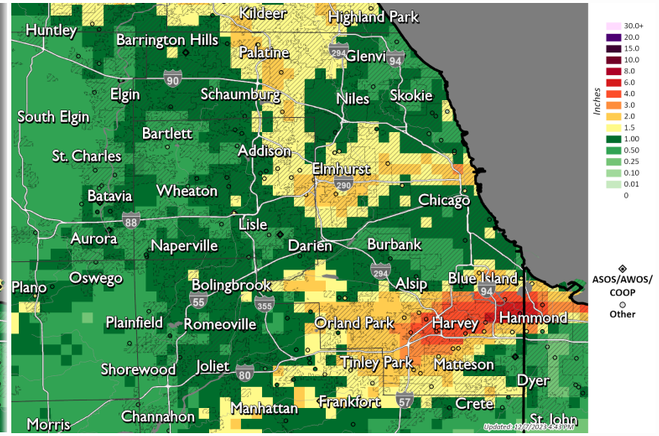
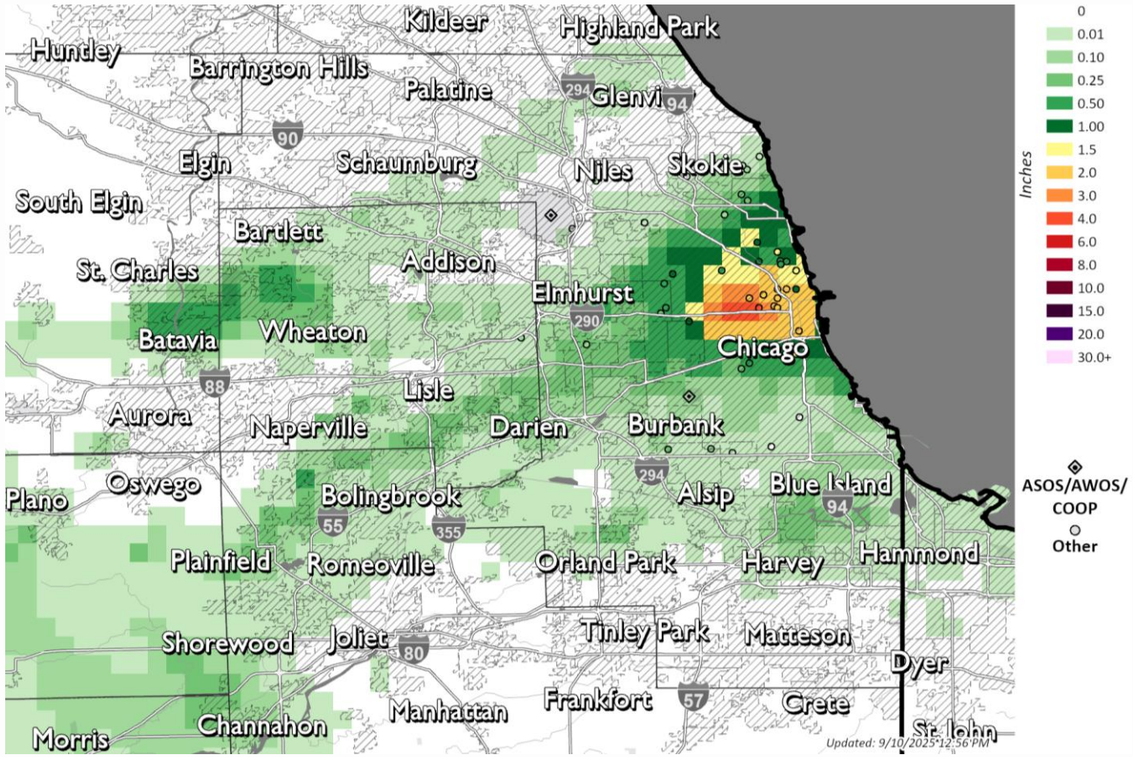


July 8 2025



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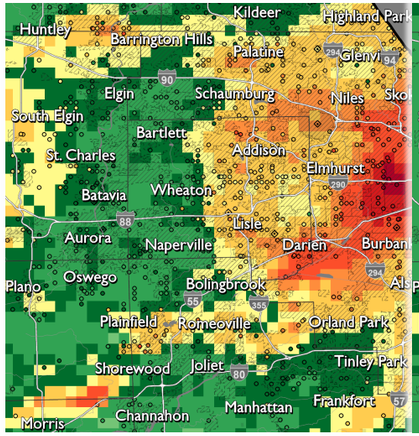
Why review past extreme rainfall events?

Two more extreme rainfall events, in just a single month, in summer 2025

July 2023



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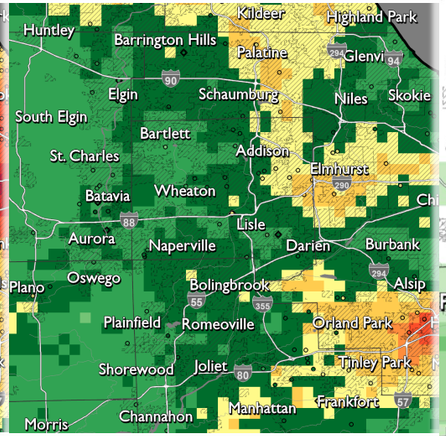

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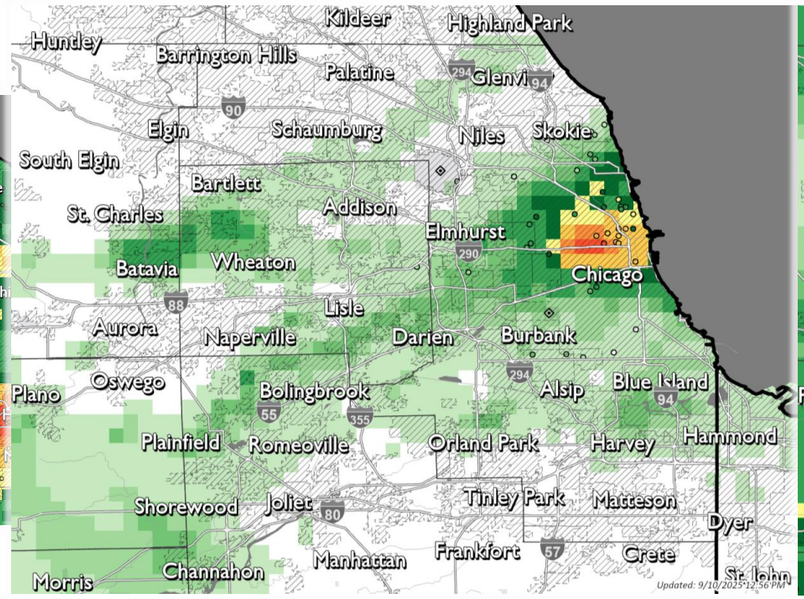
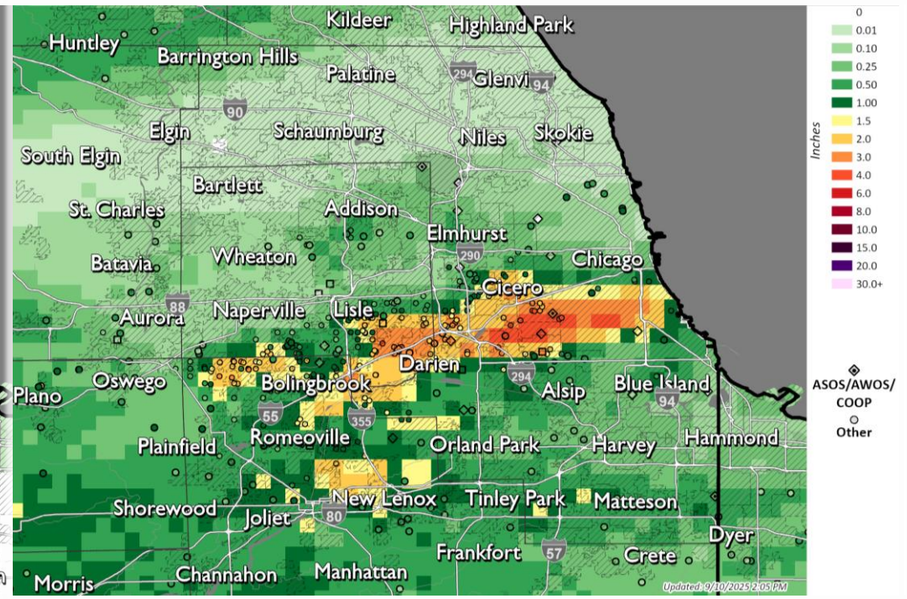


July 25 2025



Difficulties comparing modern events to past events

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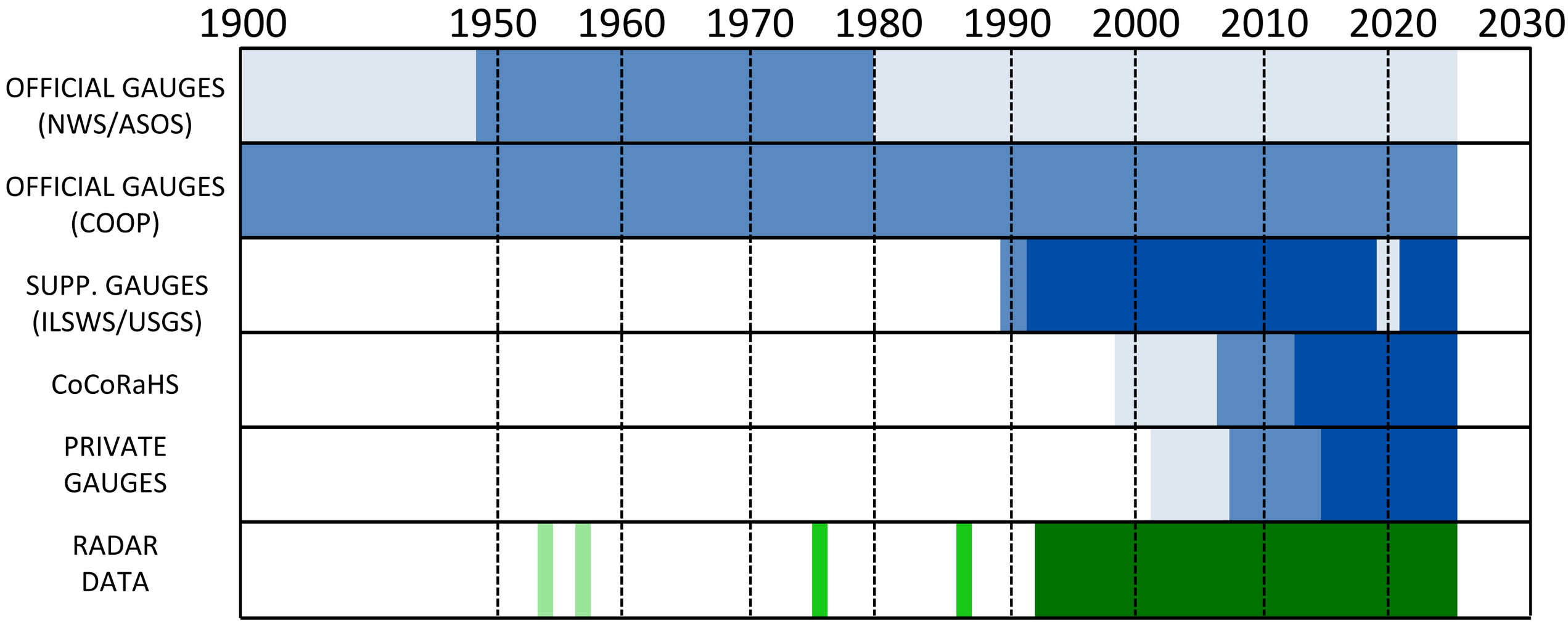
Data Availability for Chicago Area



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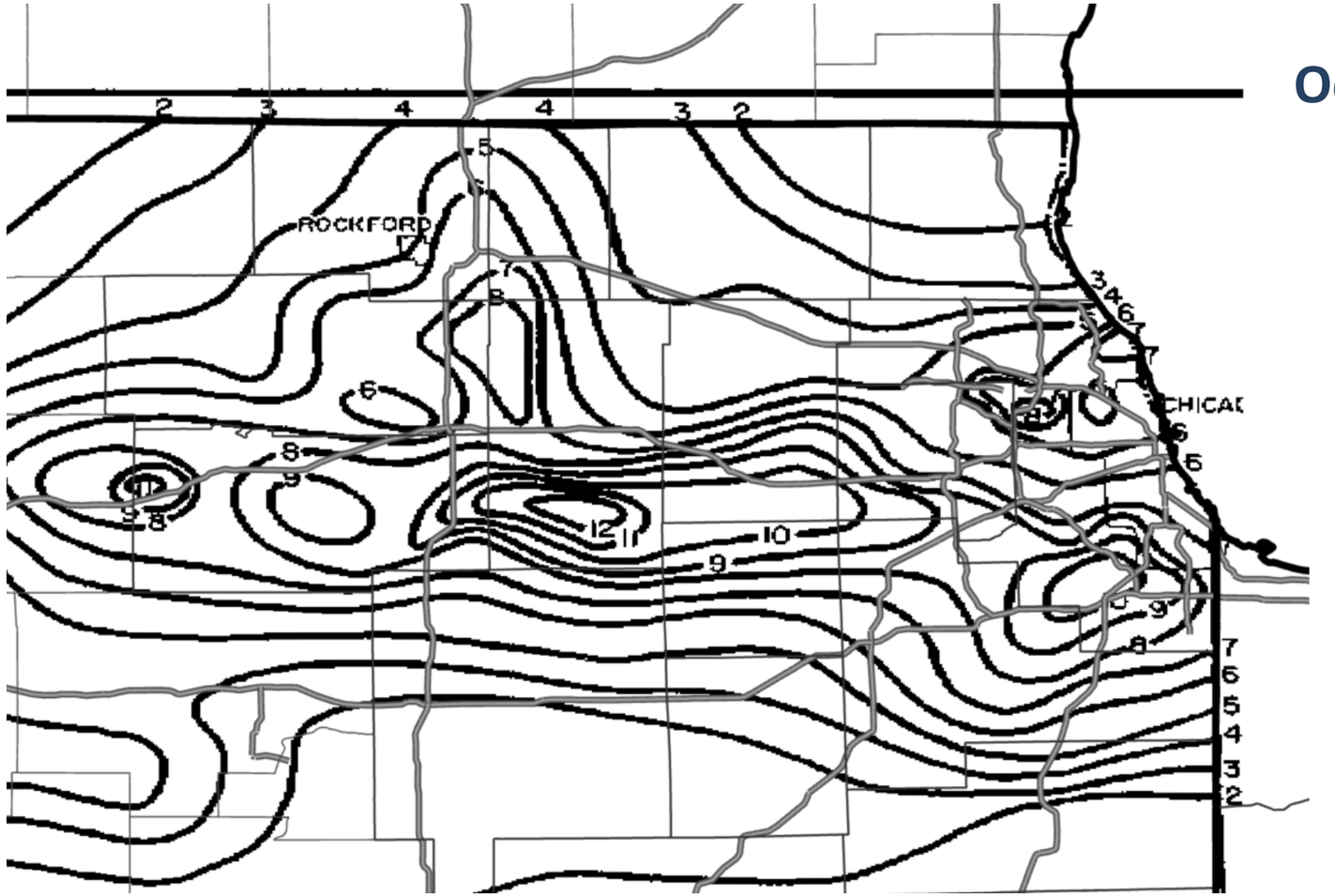
Difficulties comparing modern events to past events

How do we directly compare rain events occurring across multiple decades?

- Digitize old maps, trace rainfall contours
- Interpolate contours to a similar grid
- Display data with common color tables
- Improve earlier rainfall estimates using:
  - Rain gauge observations from multiple networks
  - Archived radar data, when available
  - Anecdotal reports in newspapers, when available

A History of Extreme Rain Events Impacting Chicago

Digitizing Archived Rainfall Maps

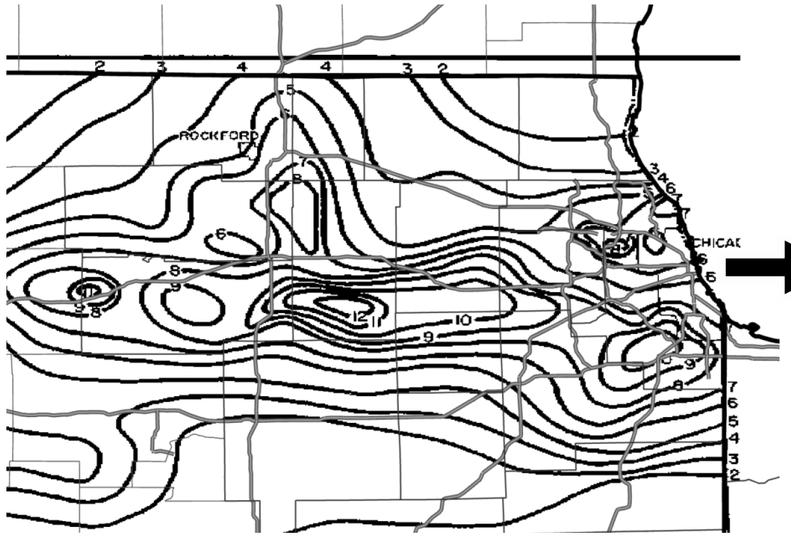


October 1954 rainfall

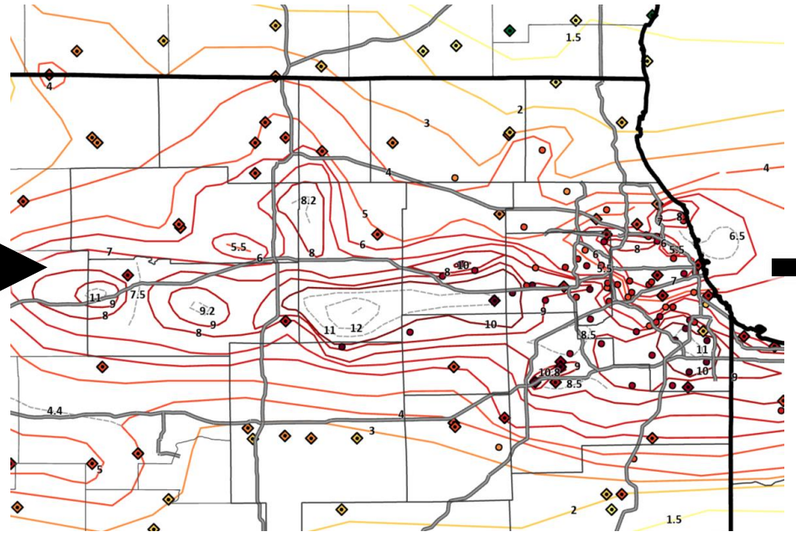
Source: Huff et al. 1955, Illinois State Water Survey Report of Investigation 27

A History of Extreme Rain Events Impacting Chicago

Digitizing Archived Rainfall Maps

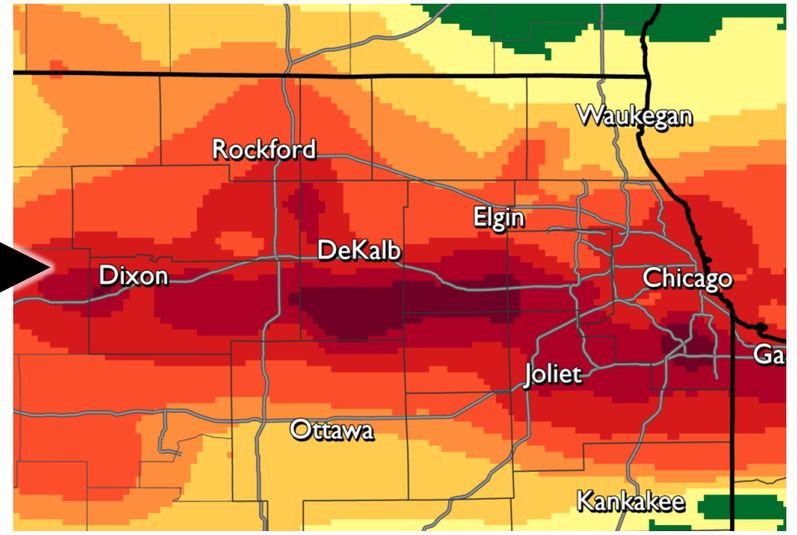


Original Contoured Rainfall



Digitized Contours

Minor Adjustments to Rain Gauges and Radar (when available)



Final Rainfall Estimate

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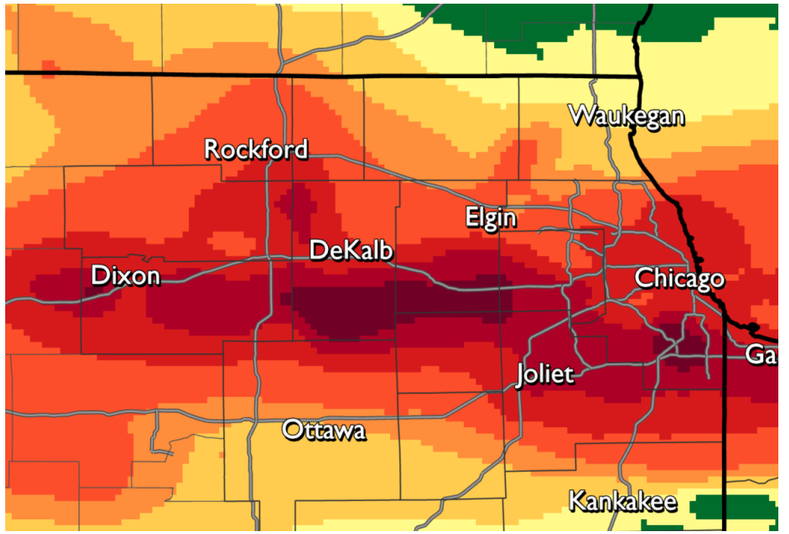
Differences in Available Historical Data



A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

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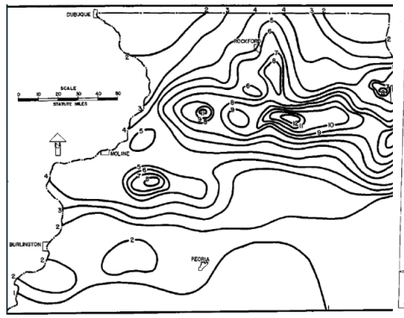
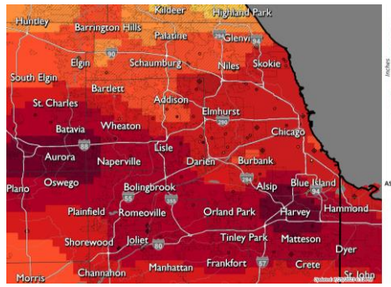
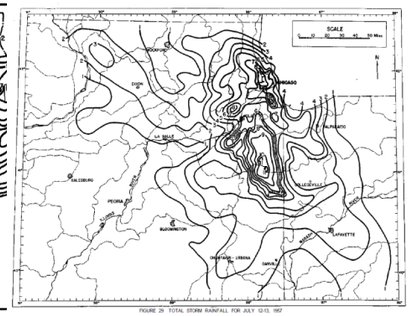
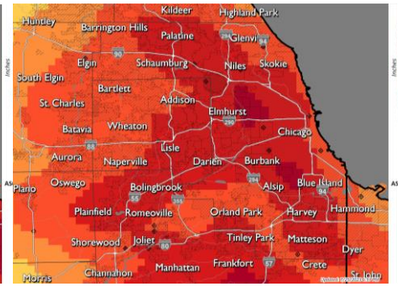




Source: Huff et al. 1955, Illinois State Water Survey Report of Investigation 27

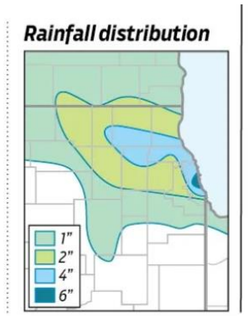
July 1957

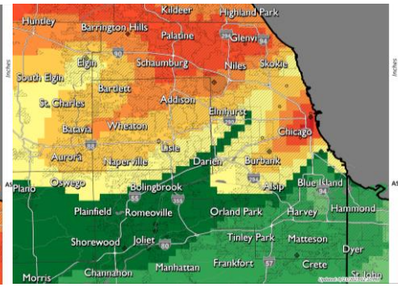




Source: Huff et al. 1958, Illinois State Water Survey Report of Investigation 35

June 1967





Source: WGN-TV, Kahn & Kohnke

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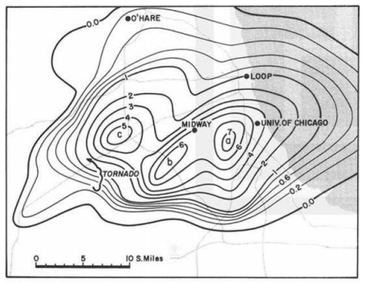
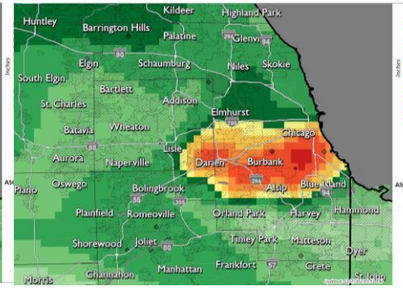
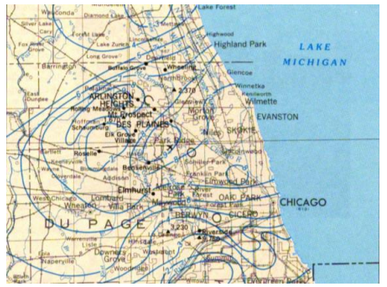


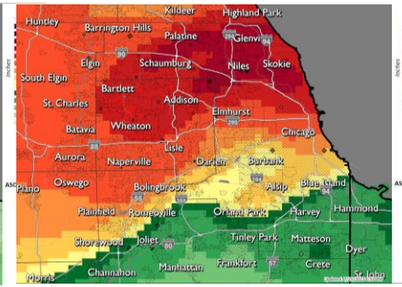
Fig. 1. Isohyets of the 5-hour period of Chicago rainstorm between 2030Z and 0130Z.



Source: Fujita et al. 1977, AMS 10th Conference on Severe and Local Storms

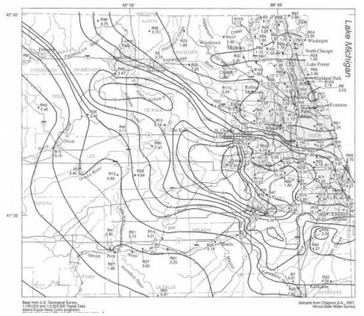
August 1987

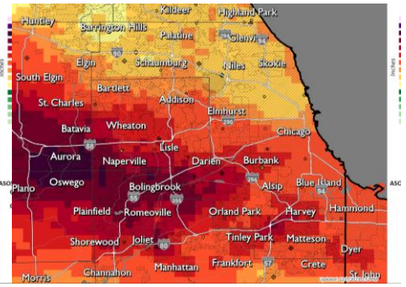




Source: Curtis 1987, USGS Water Supply Paper 2350

July 1996



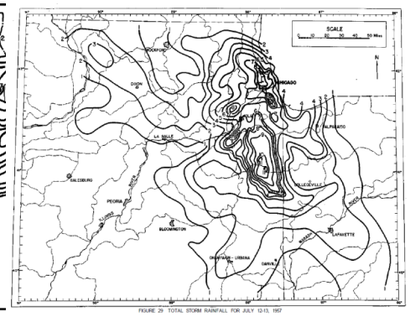


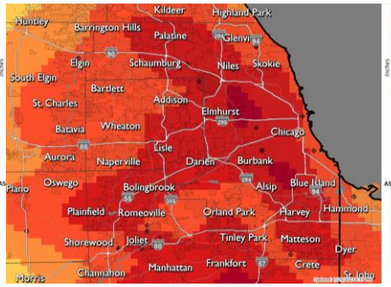
Source: Holmes and Kupka 1997, USGS technical paper

A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

July 1957





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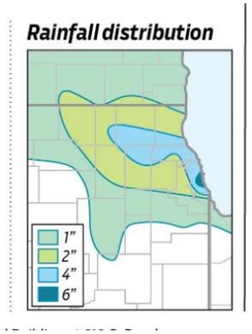

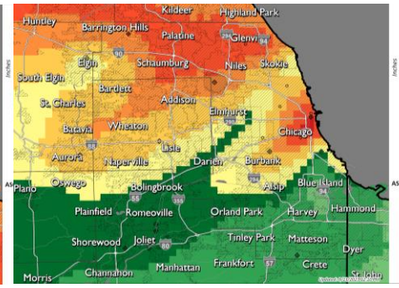

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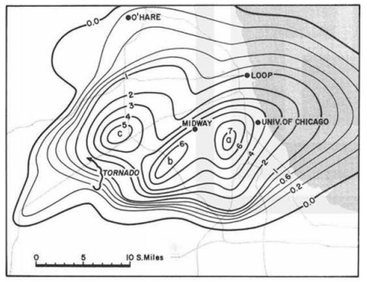

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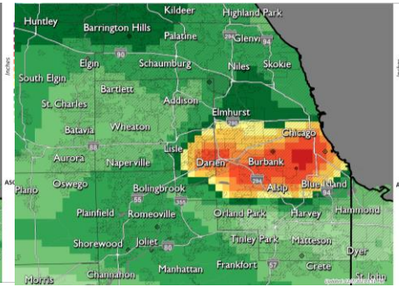

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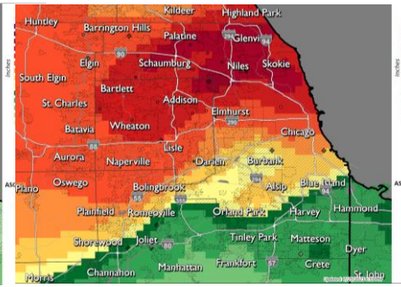

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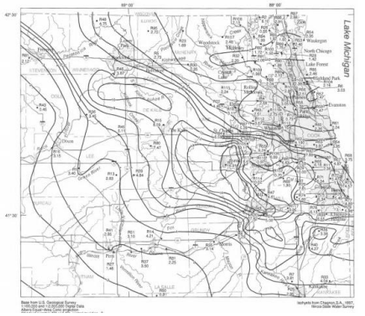

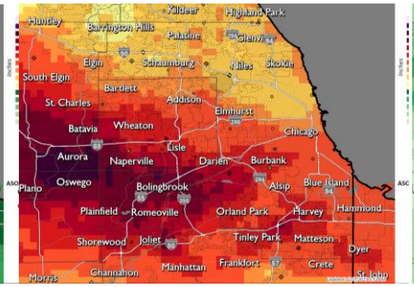

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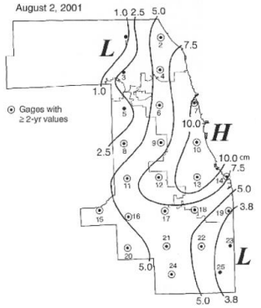
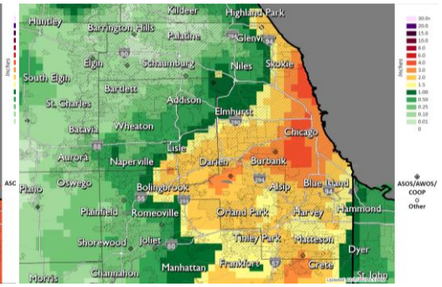
August 2001



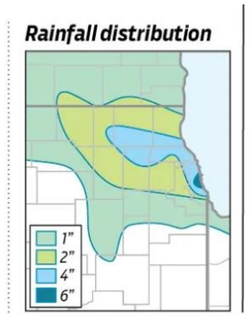


Source: Changnon and Westcott 2002, Illinois State Academy of Science

A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

June 1967



June 1976

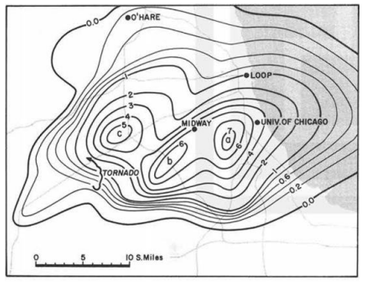
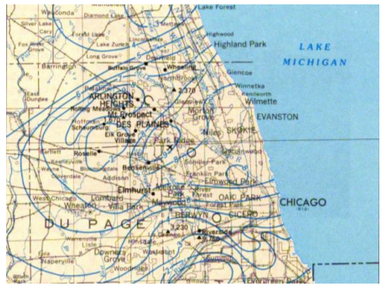
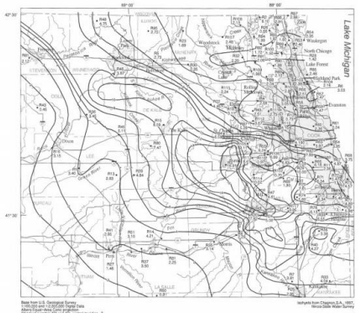


Fig. 1. Isohyets of the 5-hour period of Chicago rainstorm between 2030Z and 0130Z.

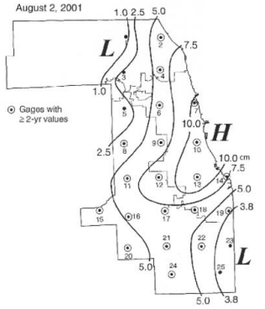
August 1987



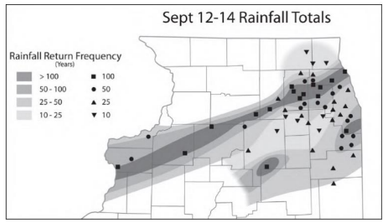
July 1996

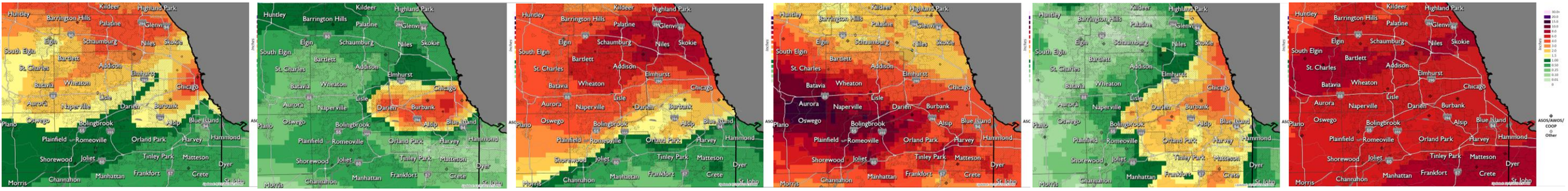


August 2001



Sep. 2008





Source: WGN-TV, Kahn & Kohnke

Source: Fujita et al. 1977, AMS 10th Conference on Severe and Local Storms

Source: Curtis 1987, USGS Water Supply Paper 2350

Source: Holmes and Kupka 1997, USGS technical paper

Source: Changnon and Westcott 2002, Illinois State Academy of Science

Source: Gensini et al 2011, Illinois State Academy of Science

A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

June 1976

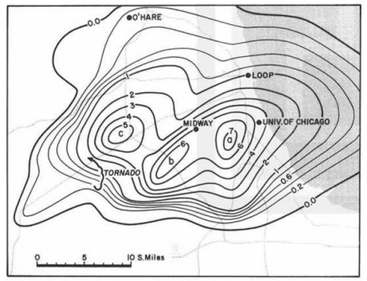
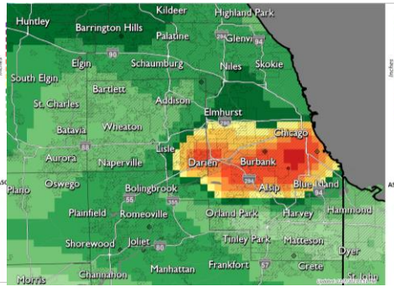
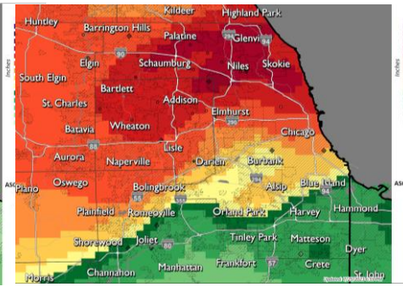


Fig. 1. Isohyets of the 5-hour period of Chicago rainstorm between 2030Z and 0130Z.



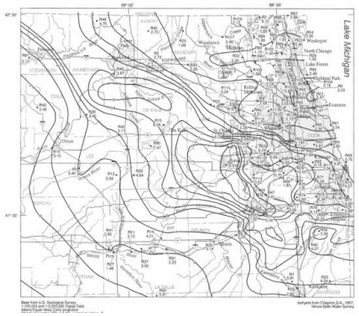
Source: Fujita et al. 1977, AMS 10th Conference on Severe and Local Storms

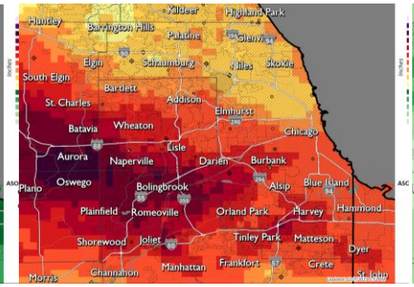
August 1987



Source: Curtis 1987, USGS Water Supply Paper 2350

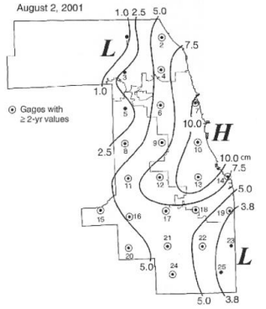
July 1996

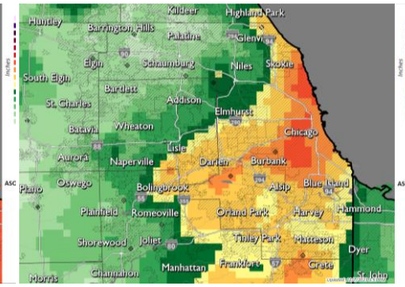




Source: Holmes and Kupka 1997, USGS technical paper

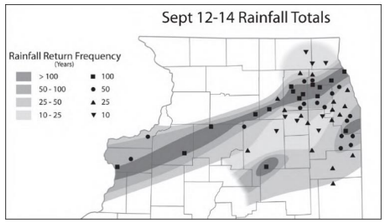
August 2001

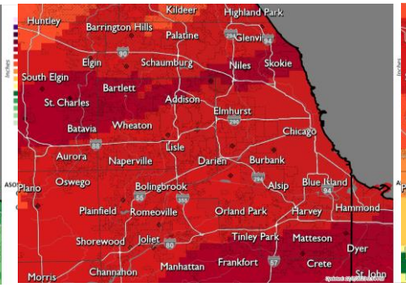




Source: Changnon and Westcott 2002, Illinois State Academy of Science

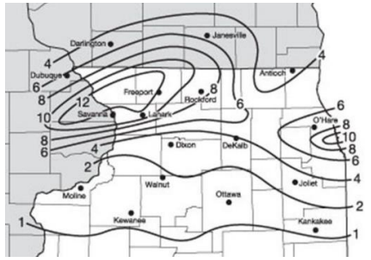
Sep. 2008

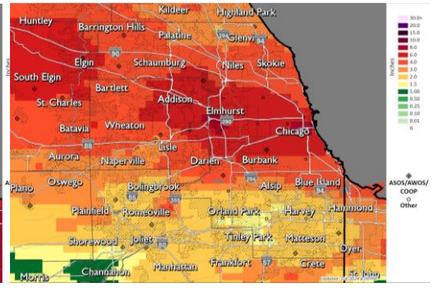




Source: Gensini et al 2011, Illinois State Academy of Science

July 2010





Source: Changnon 2011, Illinois State Academy of Science

A History of Extreme Rain Events Impacting Chicago

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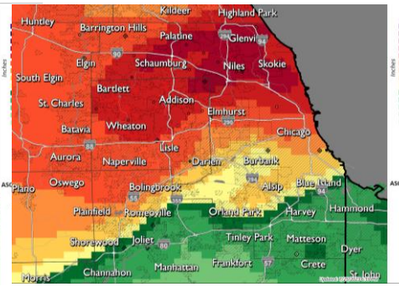
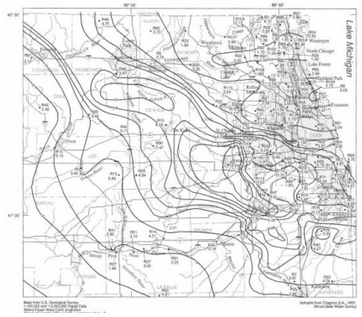
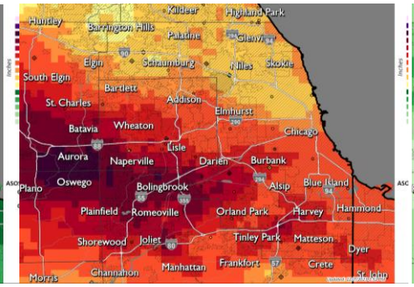
August 1987



Source: Curtis 1987, USGS Water Supply Paper 2350

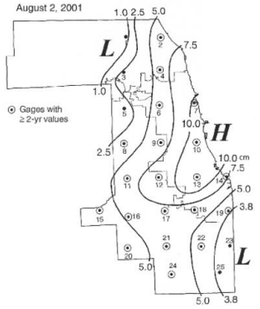
July 1996

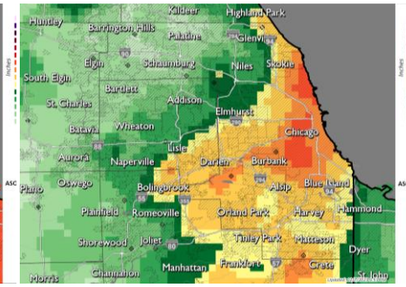




Source: Holmes and Kupka 1997, USGS technical paper

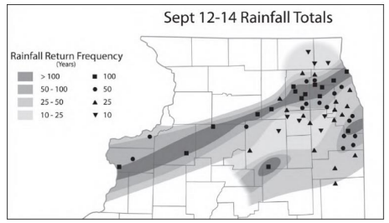
August 2001

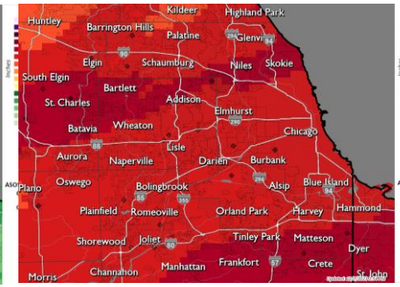




Source: Changnon and Westcott 2002, Illinois State Academy of Science

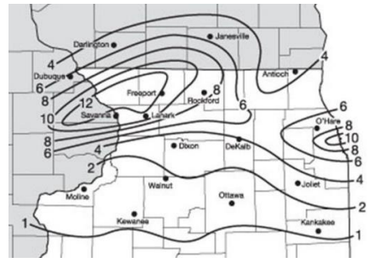
Sep. 2008

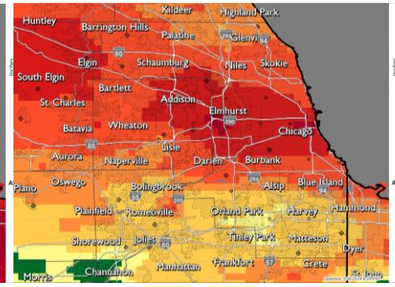




Source: Gensini et al 2011, Illinois State Academy of Science

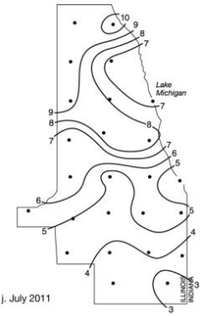
July 2010

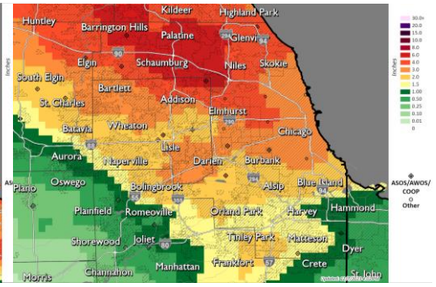




Source: Changnon 2011, Illinois State Academy of Science

July 2011





Source: Changnon 2011, Illinois State Academy of Science

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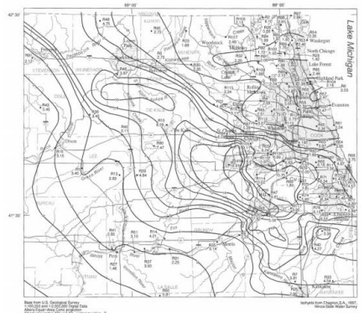
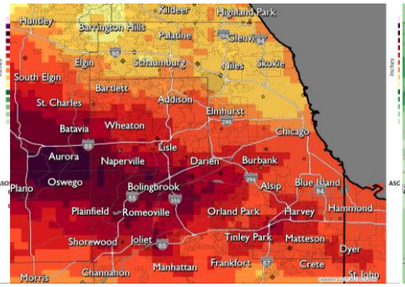
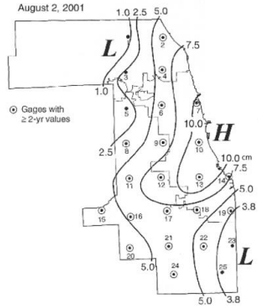
July 1996

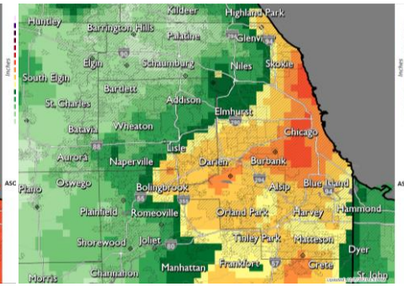




Source: Holmes and Kupka 1997, USGS technical paper

August 2001





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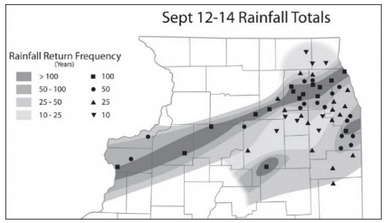
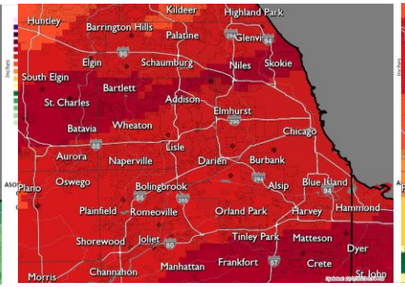
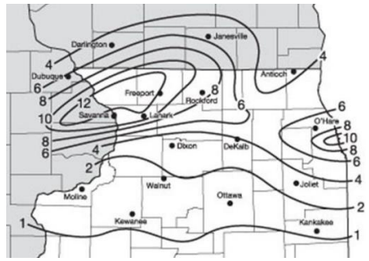
Sep. 2008

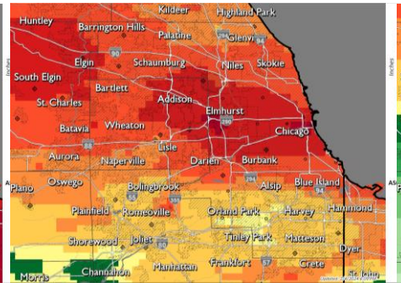




Source: Gensini et al 2011, Illinois State Academy of Science

July 2010





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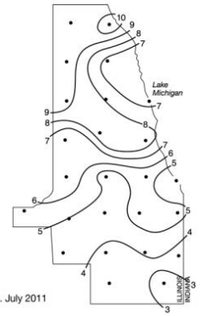
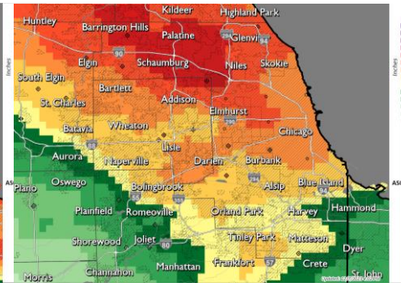
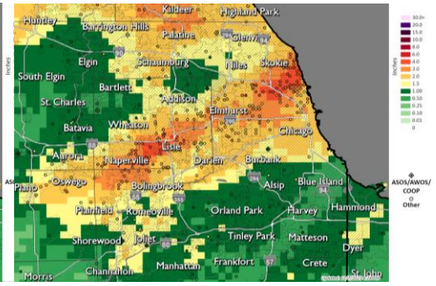
July 2011





Source: Changnon 2011, Illinois State Academy of Science

Sep. 2022



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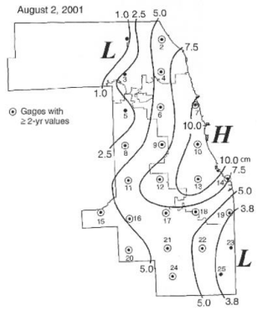
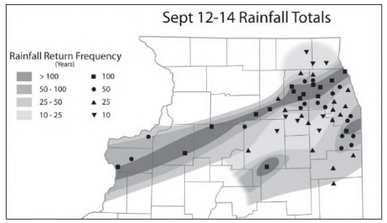
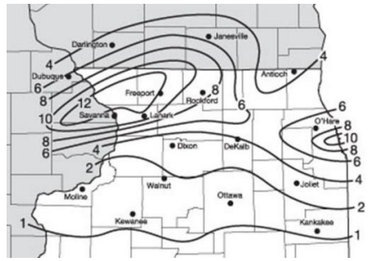


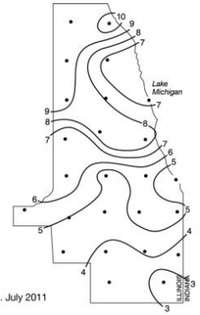
Sep. 2008



July 2010

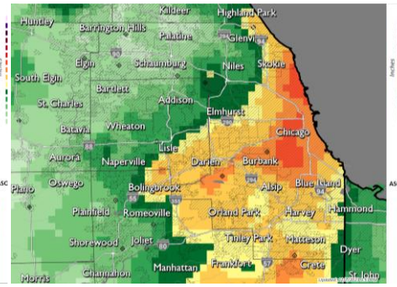


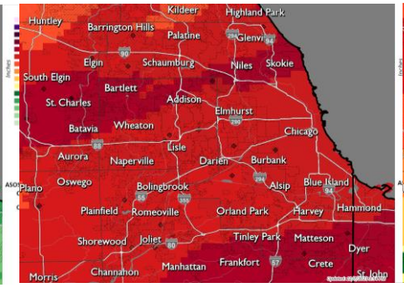
July 2011

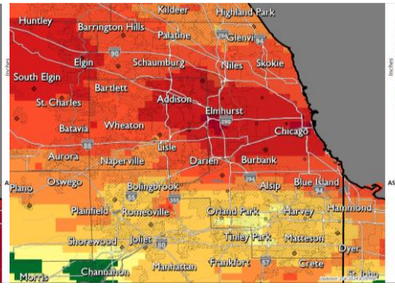


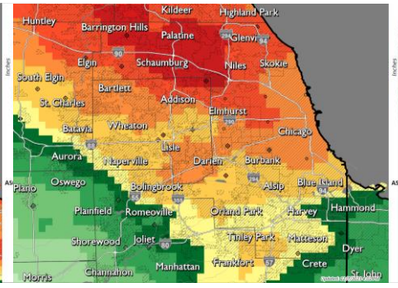
Sep. 2022

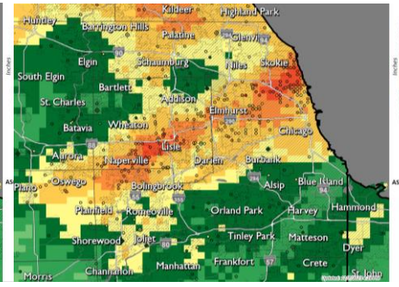
July 2023

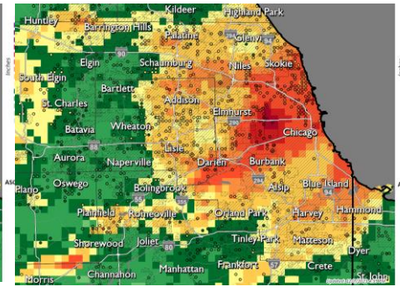












Source: Changnon and Westcott 2002, Illinois State Academy of Science

Source: Gensini et al 2011, Illinois State Academy of Science

Source: Changnon 2011, Illinois State Academy of Science

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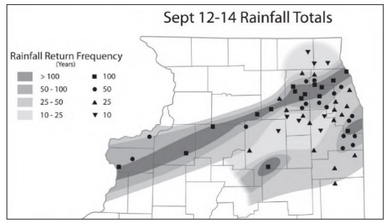
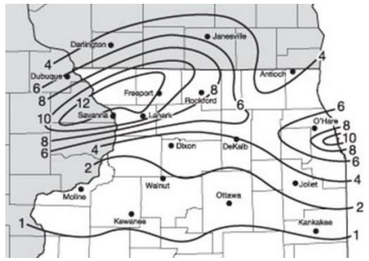


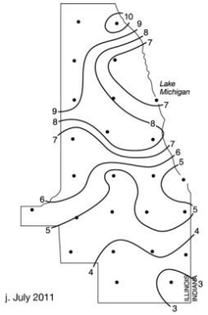
Source: Gensini et al 2011, Illinois State Academy of Science

July 2010



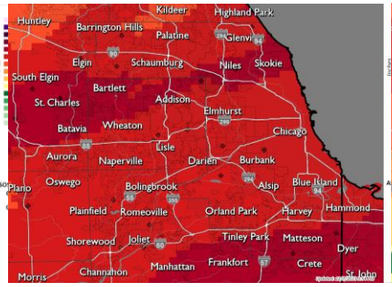
Source: Changnon 2011, Illinois State Academy of Science

July 2011

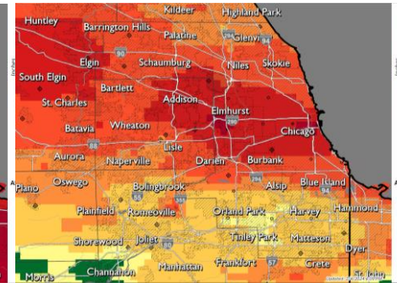


Source: Changnon 2011, Illinois State Academy of Science

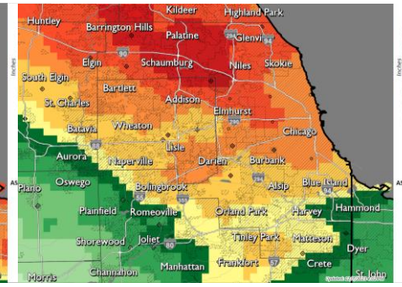
Sep. 2022

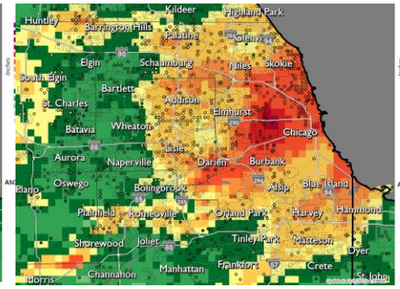


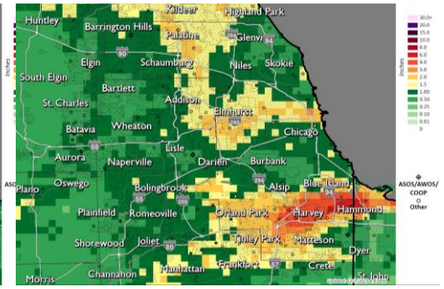
July 2023



Sep. 2023



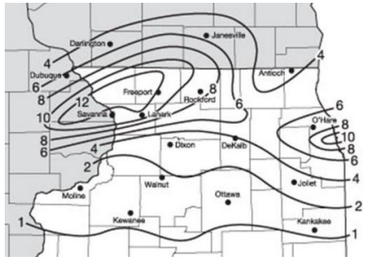




A History of Extreme Rain Events Impacting Chicago

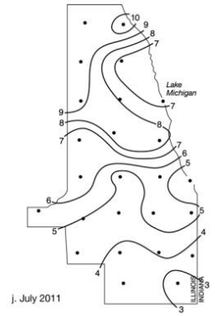
Differences in Available Historical Data

July 2010



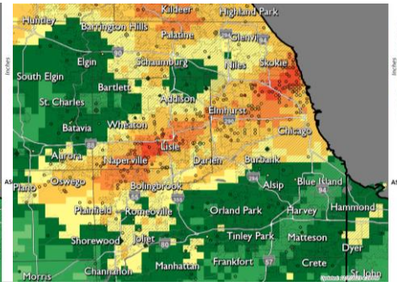
Source: Changnon 2011, Illinois State Academy of Science

July 2011

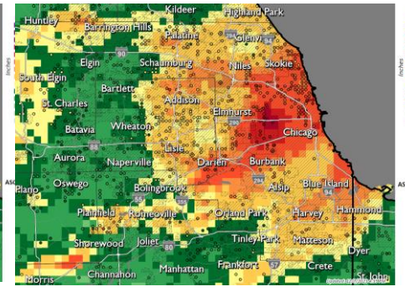


Source: Changnon 2011, Illinois State Academy of Science

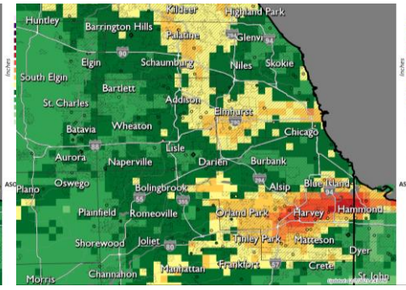
Sep. 2022



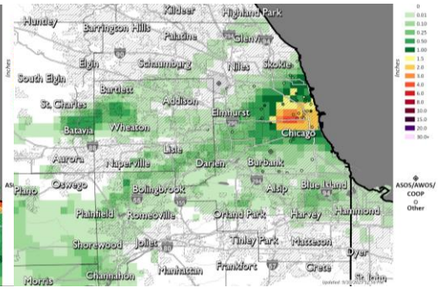
July 2023



Sep. 2023



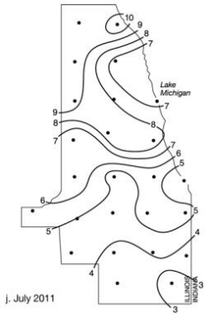
July 8 2025



A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

July 2011



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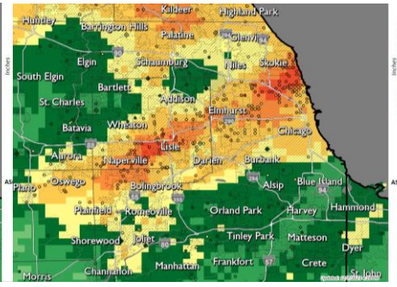

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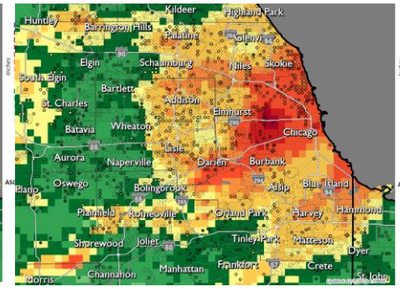
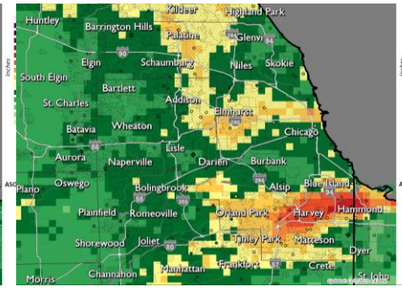
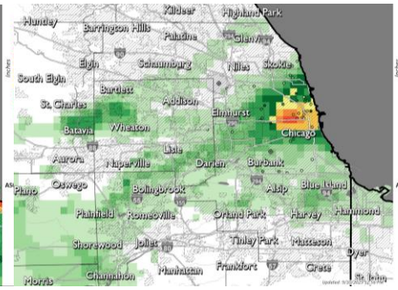


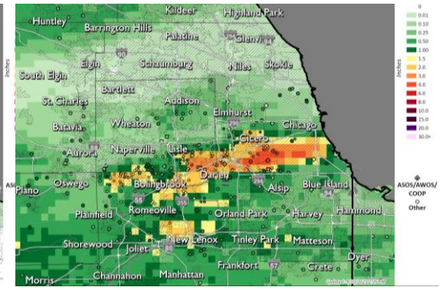
Sep. 2023



July 8 2025



July 25 2025

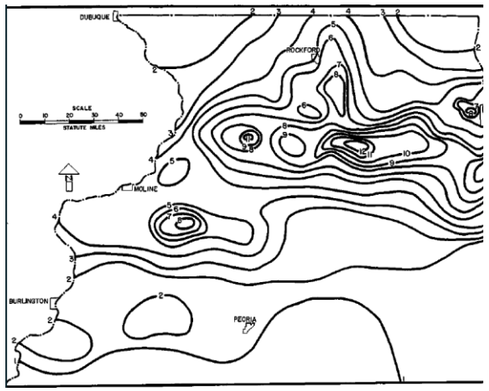


Source: Changnon 2011, Illinois State Academy of Science

A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

Original analyses



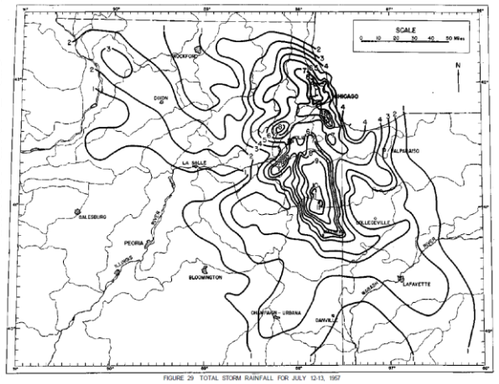
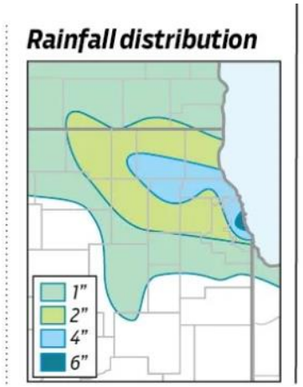


FIGURE 29 TOTAL STORM RAINFALL FOR JULY 12-13, 1957



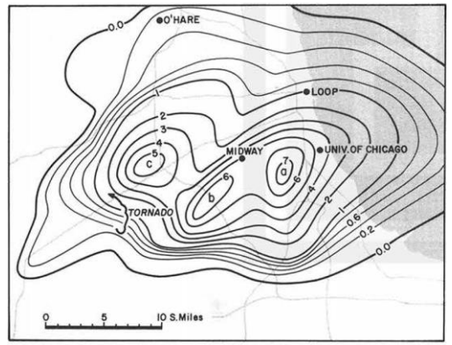
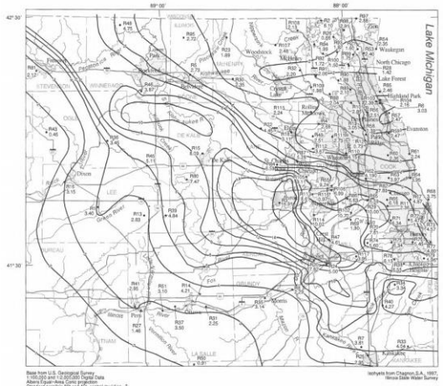
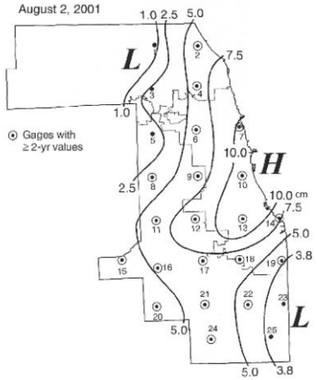
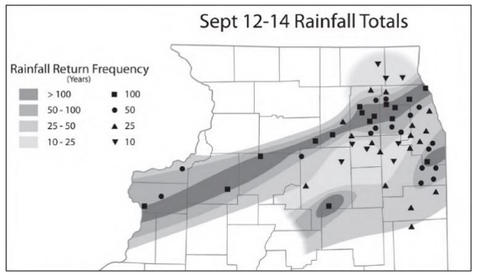
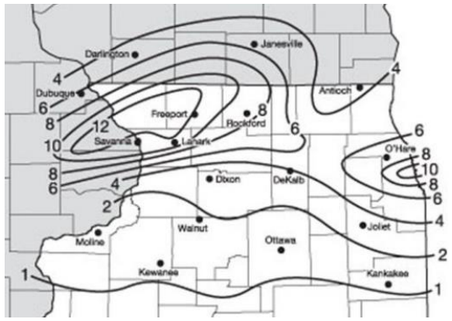


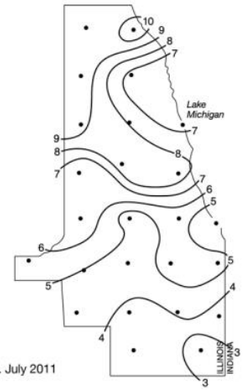
Fig. 1. Isohyets of the 5-hour period of Chicago rainstorm between 2030Z and 0130Z.











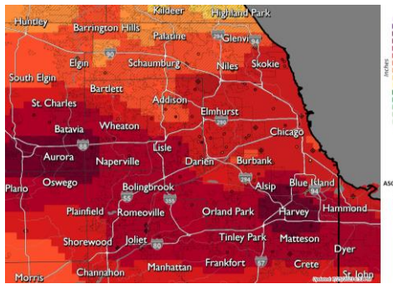
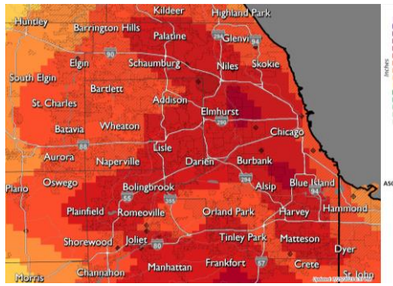
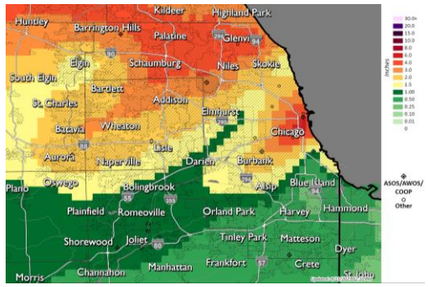
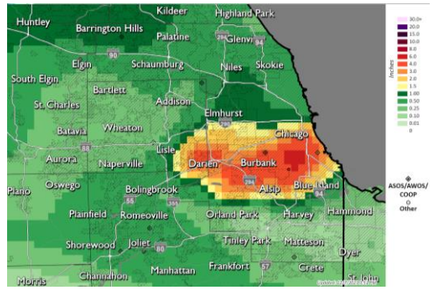
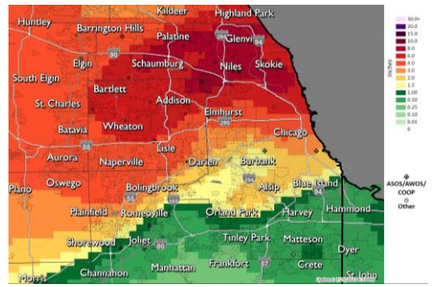
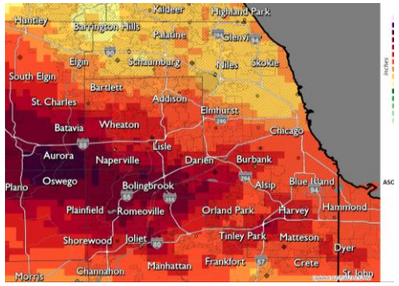
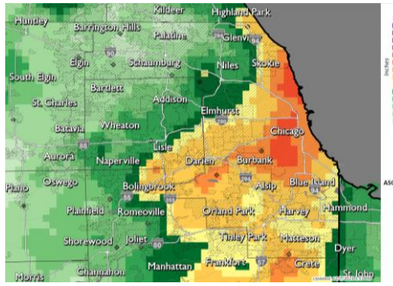
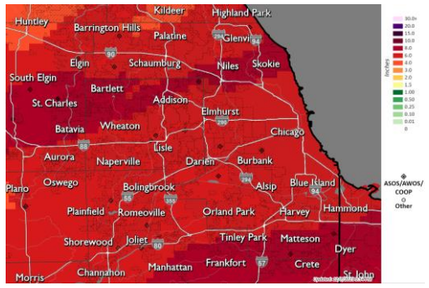
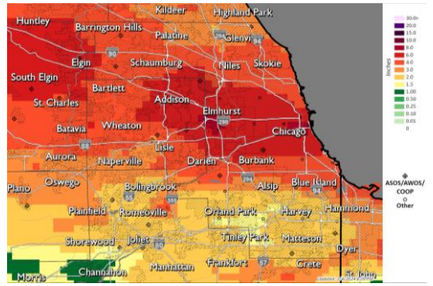
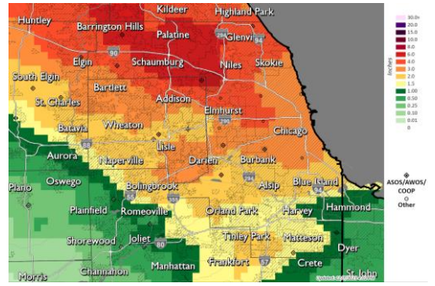
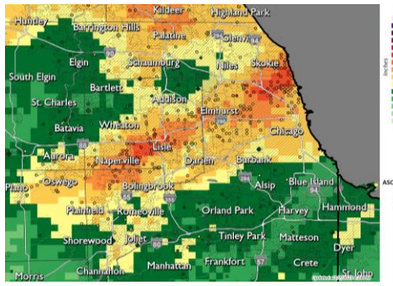
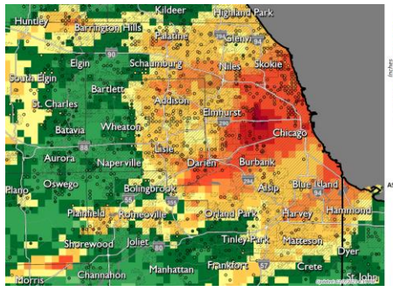
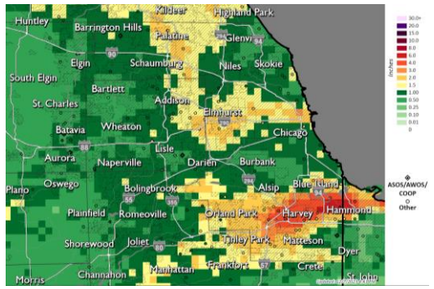
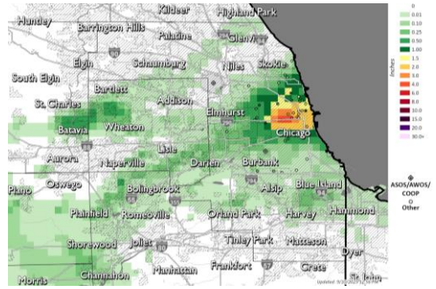
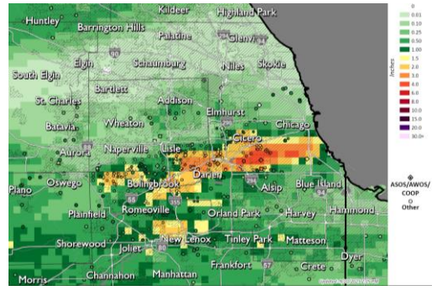
Original analyses

- Different data sources and authors
- Different analysis methods
- Different contouring, mapping, and display methods
- Different color and symbology choices

A History of Extreme Rain Events Impacting Chicago

Differences in Available Historical Data

Updated analyses

Updated analyses

- Consistent analysis method for all events
- Consistent color table and symbology across events
- Consistent map extent (zoom/pan) across events

Summary of Extreme Rainfall Events

A History of Extreme Rain Events Impacting Chicago

Summary of Extreme Rainfall Events

Since 1950….

- 15 extreme rainfall events*
- 1-5 events per decade (average 1.9/decade)
- 0-11 years between events (average 5.1 years)

**Extreme events defined as storm total rainfall (over 1-2 days) of at least 7.5 inches or sub-daily rainfall amounts exceeding the 1% AEP*

A History of Extreme Rain Events Impacting Chicago

Summary of Extreme Rainfall Events

Rain Event	Peak Storm Total Rainfall (in)	Average Rainfall (in)	Duration (hrs)	Peak Average Rainfall Rate (in/hr)	Average Rainfall Rate (in/hr)
October 9-11, 1954	**11.1**	**7.4**	48	0.23	0.15
July 12-13, 1957	8.6	6.9	18	0.48	0.38
June 10, 1967	6.7	2.1	11	0.61	0.19
June 13, 1976	7.0	2.2	5	1.40	0.44
August 13-14, 1987	9.2	4.1	18	0.51	0.23
July 17-18, 1996	10.0	4.8	24	0.42	0.20
August 2, 2001	4.8	2.6	5	0.96	0.52
September 13-15, 2008	8.3	7.1	60	0.14	0.12
July 23-24, 2010	8.6	5.6	16	0.54	0.35
July 22-23, 2011	6.4	3.4	4	1.60	**0.85**
September 11, 2022	5.9	2.2	4	1.48	0.55
July 2, 2023	9.1	4.0	12	0.76	0.33
September 17, 2023	8.9	1.7	12	0.74	0.14
July 8, 2025	5.5	0.4	3	1.83	0.13
July 25, 2025	6.3	0.9	3	**2.10**	0.30

NOTES: "Peak storm total" and "average rainfall" determined by bounds of Central Cook County. Highest values for a particular category are bolded.
"Peak average rainfall rate" is not based upon instantaneous point values but is the peak storm total rainfall divided by the event duration.

A History of Extreme Rain Events Impacting Chicago

Summary of Extreme Rainfall Events

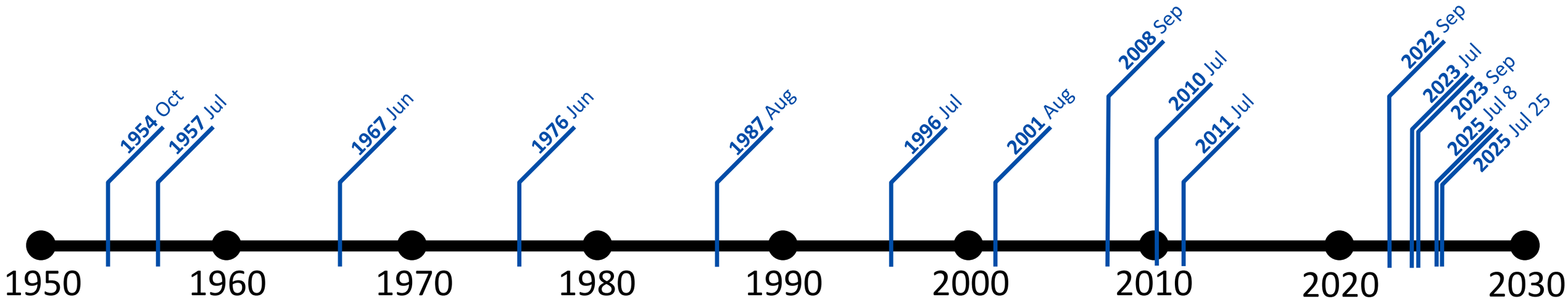
Rain Event	# Rain Gauges in Analysis	# Official Rain Gauges	# Private Rain Gauges	Source of Peak Observation	Extreme Rain Event With Official Gauges Only?
October 9-11, 1954	39	6	33	Private (Bucket Survey)	Yes
July 12-13, 1957	19	18	1*	Private (Bucket Survey)	Yes
June 10, 1967	15	5	10	Official (NWS)	Yes
June 13, 1976	6	4	2	Published Contour Analysis	Yes
August 13-14, 1987	10	6	4	Official (ASOS)	Yes
July 17-18, 1996	22	22	0	Official (NWS COOP)	Yes
August 2, 2001	6	6	0	Official (ILSWS)	Yes
September 13-15, 2008	6	6	0	Official (ASOS)	Yes
July 23-24, 2010	21	21	0	Official (ASOS)	Yes
July 22-23, 2011	19	19	0	Official (ASOS)	Yes
September 11, 2022	148	40	108	Private (WU)	No*
July 2, 2023	258	42	216	Private (WU)	Yes
September 17, 2023	43	37	6	Private (Bucket Survey)	Yes
July 8, 2025	51	31	20	Private (WU)	No
July 25, 2025	126	53	73	Radar Bias Correction	Yes

NOTES: Count of rain gauges applies to central Cook County, including O'hare. Gauge count for 1957 is a minimum. Peak official gauge observation for the 2022 event was approximately 0.1 inches below criteria to be called extreme event.

A History of Extreme Rain Events Impacting Chicago

Summary of Extreme Rainfall Events

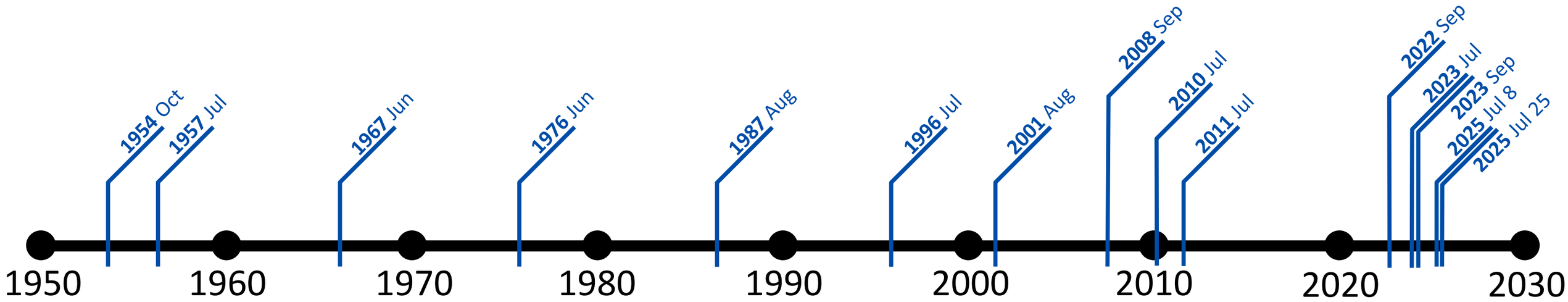
- At least 15 extreme rainfall events in 75 years
- At least $1.6 billion in flood damages in (2025 dollars)



A History of Extreme Rain Events Impacting Chicago

Summary of Extreme Rainfall Events

- Over half of flood damages from July 2023 and July 2010 alone, which also may be the top 2 most expensive weather disasters in Chicago history
- For comparison, costliest non-flood disaster was March 1961 tornado (2025 dollars)

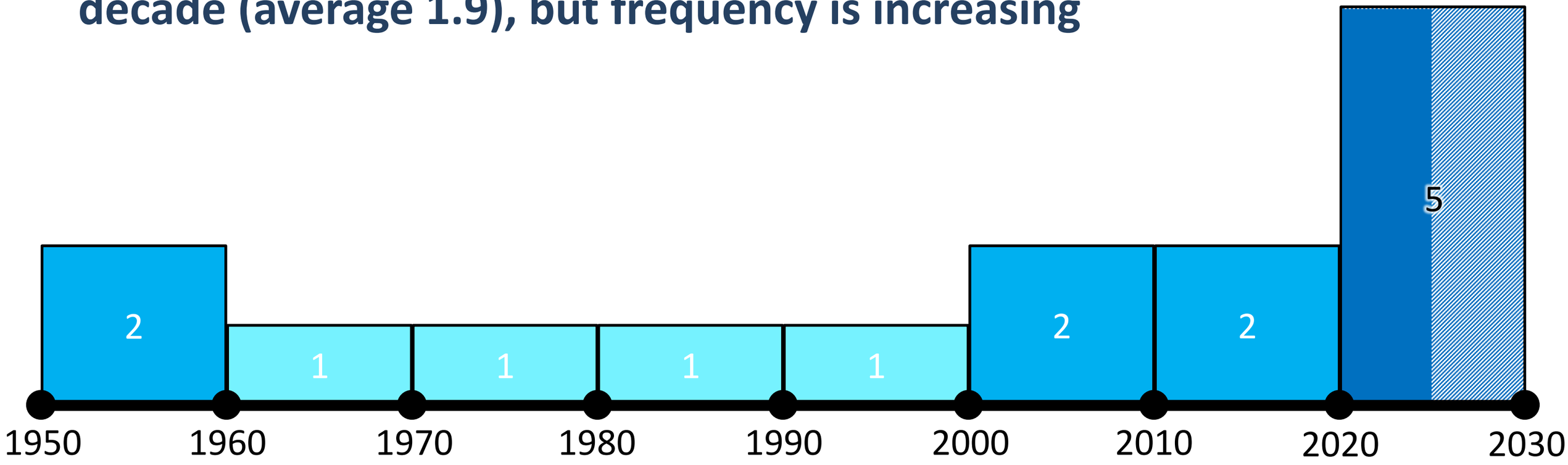


Changes in Frequency and Magnitude of Extreme Rainfall Events

A History of Extreme Rain Events Impacting Chicago

Extreme Event Frequency

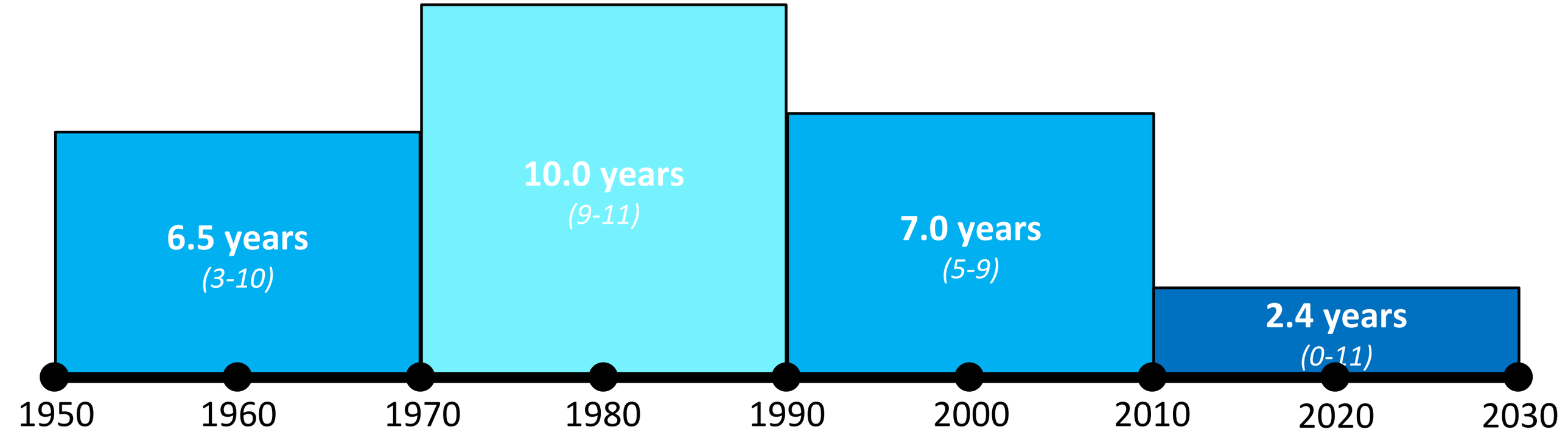
Extreme events occur in the vicinity of Chicago 1-5 times per decade (average 1.9), but frequency is increasing



A History of Extreme Rain Events Impacting Chicago

Interval Between Events

Average interval between events is decreasing



A History of Extreme Rain Events Impacting Chicago

Changes in Heavy Rainfall Amounts

How have rainfall events at the official Chicago observation station changed over time?

Official observations in/near Chicago have a relatively long period of record – continuous back to 1871, and periodic back to 1840s – which can be used to explore this question!

A History of Extreme Rain Events Impacting Chicago

Changes in Heavy Rainfall Amounts

Climate of Chicago

Henry Hazen, 1893

HEAVY PRECIPITATION.

In order to obtain an idea of the number of heavy rains that have fallen, Table XXXV has been prepared, which gives the dates on which a precipitation of .75 inch or more occurred in 8, or, since July, 1888, in 12 hours. There are 167 cases in the 20 years, or about 8 per year. The distribution by months is as follows:

0.75 inches in 12 hours was considered a "heavy rain" in Chicago's early history

>=0.75 inches per 1 day

- 16.9 per year… late 1800s
- 16.4 per year… early 1900s
- 17.4 per year… late 1900s
- 18.7 per year… last 30 years

A History of Extreme Rain Events Impacting Chicago

Changes in Heavy Rainfall Amounts

The Weather and Climate of Chicago

Henry Cox & John Armington, 1914

EXCESSIVE PRECIPITATION

In many kinds of building, street, sewer, and dredging work information as to the greatest amounts of precipitation that have occurred in short spaces of time is of prime importance. Tables containing such data for Chicago have been prepared so far as possible. The records of excessive precipitation in earlier years, however, are in many cases either fragmentary or wanting altogether, and it was not until after the installation of the automatic recorders in 1897 that more complete data became available. Excessive precipitation is distinguished in several different ways, and the various classes are discussed in the following paragraphs.

Top 1-hour Rainfalls

- 2.13 1871/06/23
- 1.93 1871/06/19 (30 min)
- 1.60 1892/06/23 (23 min)
- 1.55 1889/07/18 (35 min)
- 1.24 1896/05/25 (15 min)
- 1.18 1889/07/27 (54 min)

Top 24-hour Rainfalls

- 6.19 1885/08/03
- 4.34 1908/08/12
- 4.14 1878/07/26
- 4.02 1889/07/27 (3.5 hrs)
- 3.52 1909/08/15
- 3.44 1885/06/03

No known rain events from Chicago's early history would count as extreme using today's criteria.

A History of Extreme Rain Events Impacting Chicago

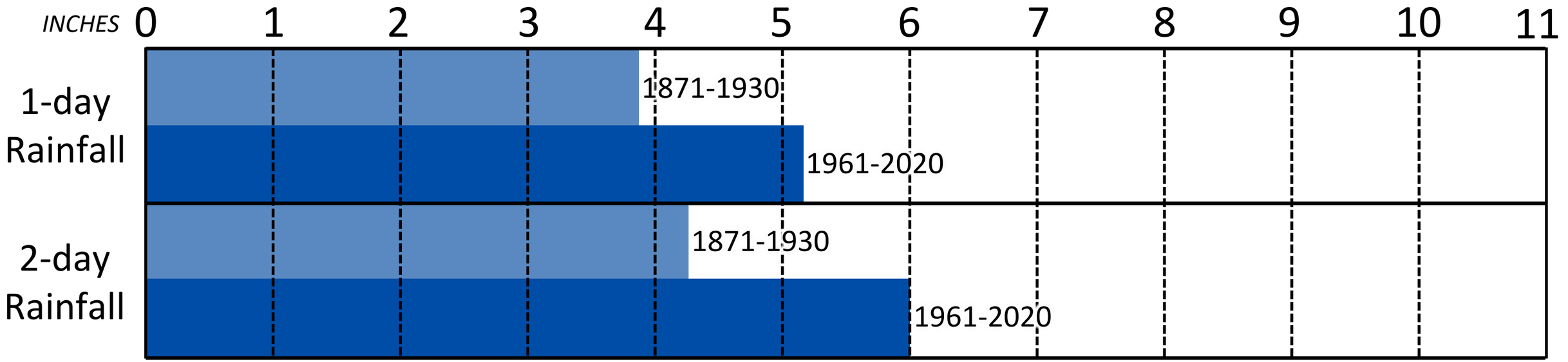
Changes in Heavy Rainfall Amounts

How has 1-day rainfall changed over Chicago's history?

10% (1-in-10 annual chance)

Somewhat unusual, generally experienced about once per decade.

Note: These values are estimated using a simple extreme value distribution fit to daily precipitation values. This analysis is not as robust as what would be found in published rainfall frequency studies.



A History of Extreme Rain Events Impacting Chicago

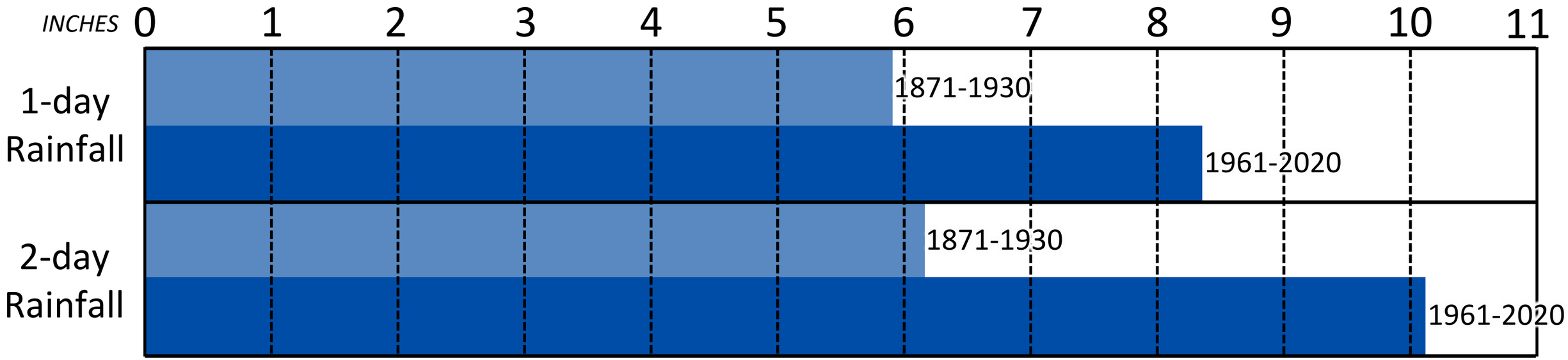
Changes in Heavy Rainfall Amounts

How has rainfall changed over Chicago's history?

1% (1-in-100 annual chance)

Generally referred to as "extreme," may only be experienced once in a lifetime.

Note: These values are estimated using a simple extreme value distribution fit to daily precipitation values. This analysis is not as robust as what would be found in published rainfall frequency studies.

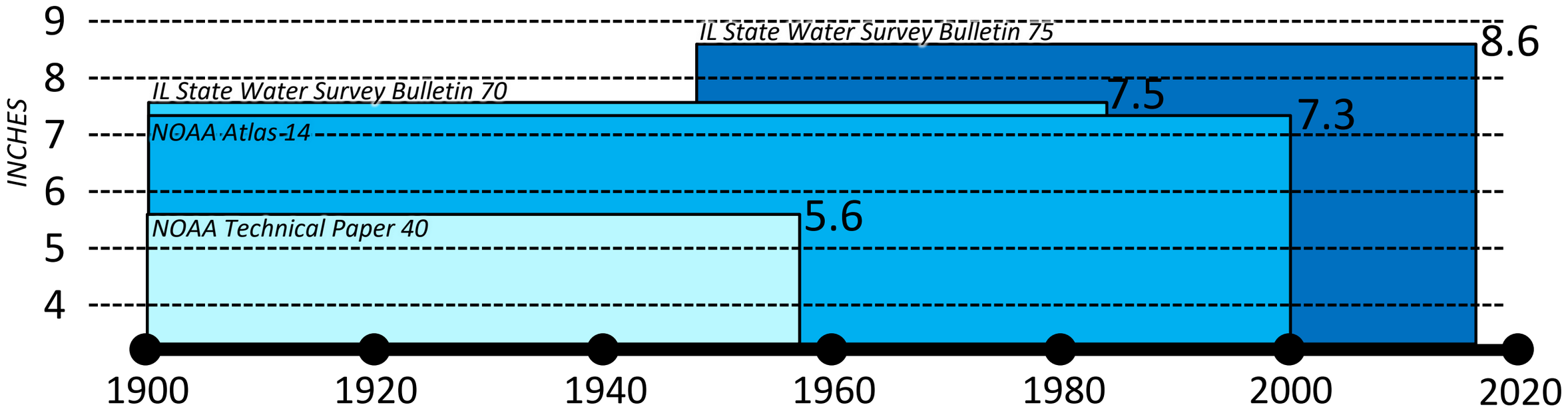


A History of Extreme Rain Events Impacting Chicago

Changes in Heavy Rainfall Amounts

How has 1-day rainfall changed over Chicago's history?

Numerous rainfall frequency studies show changing 1-day extreme rainfall (1% AEP) values, supporting the general conclusions of the simpler analysis.



A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

What implications do these changes have for stormwater and flooding?

- Increased chance of Chicago River flooding
- Increased chance of neighborhood-level flooding of streets and basements
- Increased chance of combined-sewer water contamination of Chicago River and Lake Michigan
- Reduced effectiveness of stormwater infrastructure, such as local sewers, deep tunnels, and reservoirs

A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

Why have we still had flooding in recent years, even with the tunnel and reservoir system?

- Capacity and/or conveyance limitations in a stormwater system may lead to flooding even when storage is not full.

- Flooding would have been even worse *without* stormwater storage!

A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

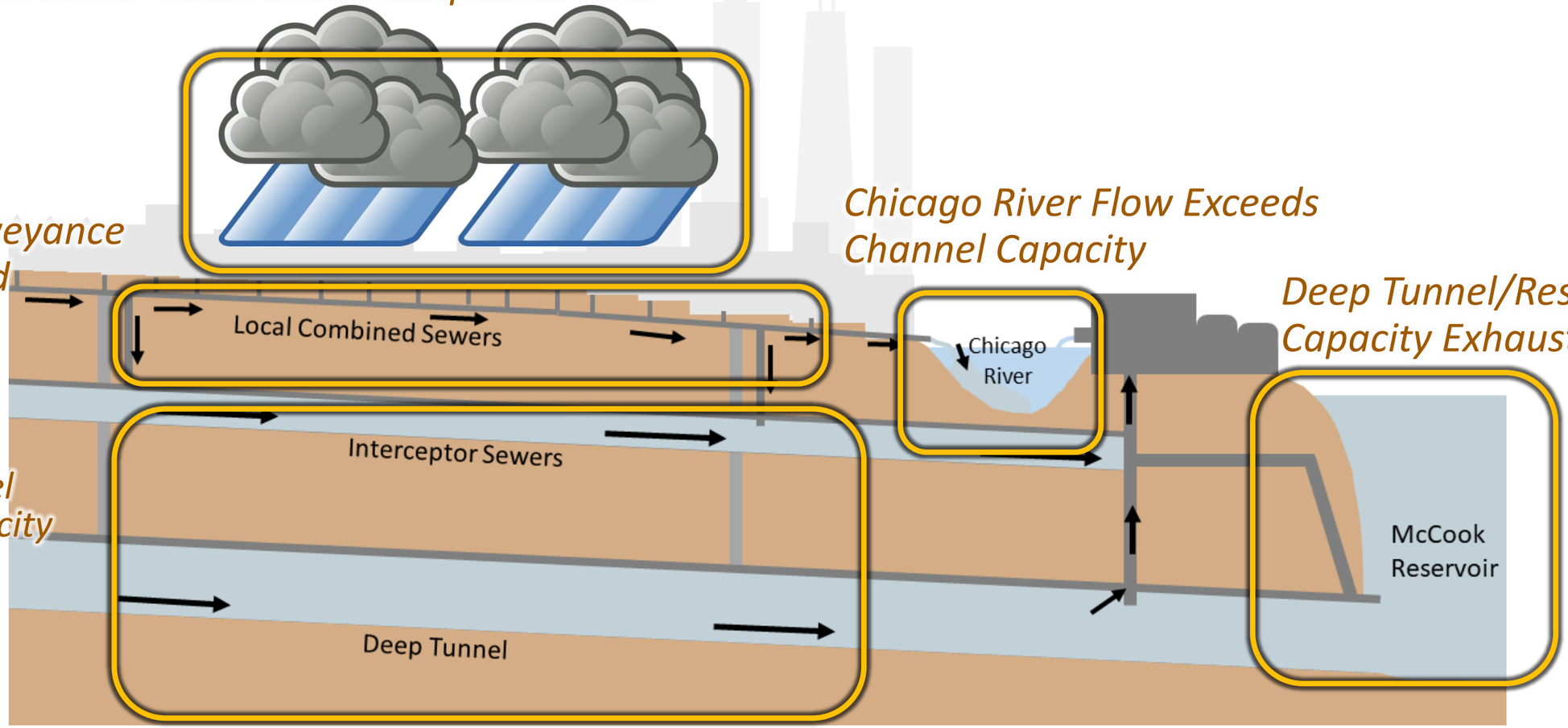
Rainfall Intensity Exceeds Storm Sewer Catch Basin Acceptance Rate

Storm Sewer Conveyance Capacity Exceeded

Chicago River Flow Exceeds Channel Capacity

Deep Tunnel/Reservoir Capacity Exhausted

Interceptor/Tunnel Conveyance Capacity Exceeded



A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

How has service level of storm sewers changed over time?

*Assuming 10% AEP/10-year ARI level used for design.**

Storm Sewers Designed in…	10% AEP Point Rainfall	Service Level 1940s	Service Level 1960s	Service Level 1980s	Service Level 2000s	Service Level 2020s
1940s	3.3 inches	10%	13%	20%	28%	33%
1960s	3.5 inches		10%	16%	22%	27%
1980s	3.9 inches			10%	14%	18%
2000s	4.3 inches				10%	13%
2020s	4.6 inches					10%

**Design standards can vary by community or even by specific project based upon available funding, but roughly average the 10% AEP based upon a survey conducted by Illinois DNR in 2015 as part of the Urban Flood Awareness Act.*

A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

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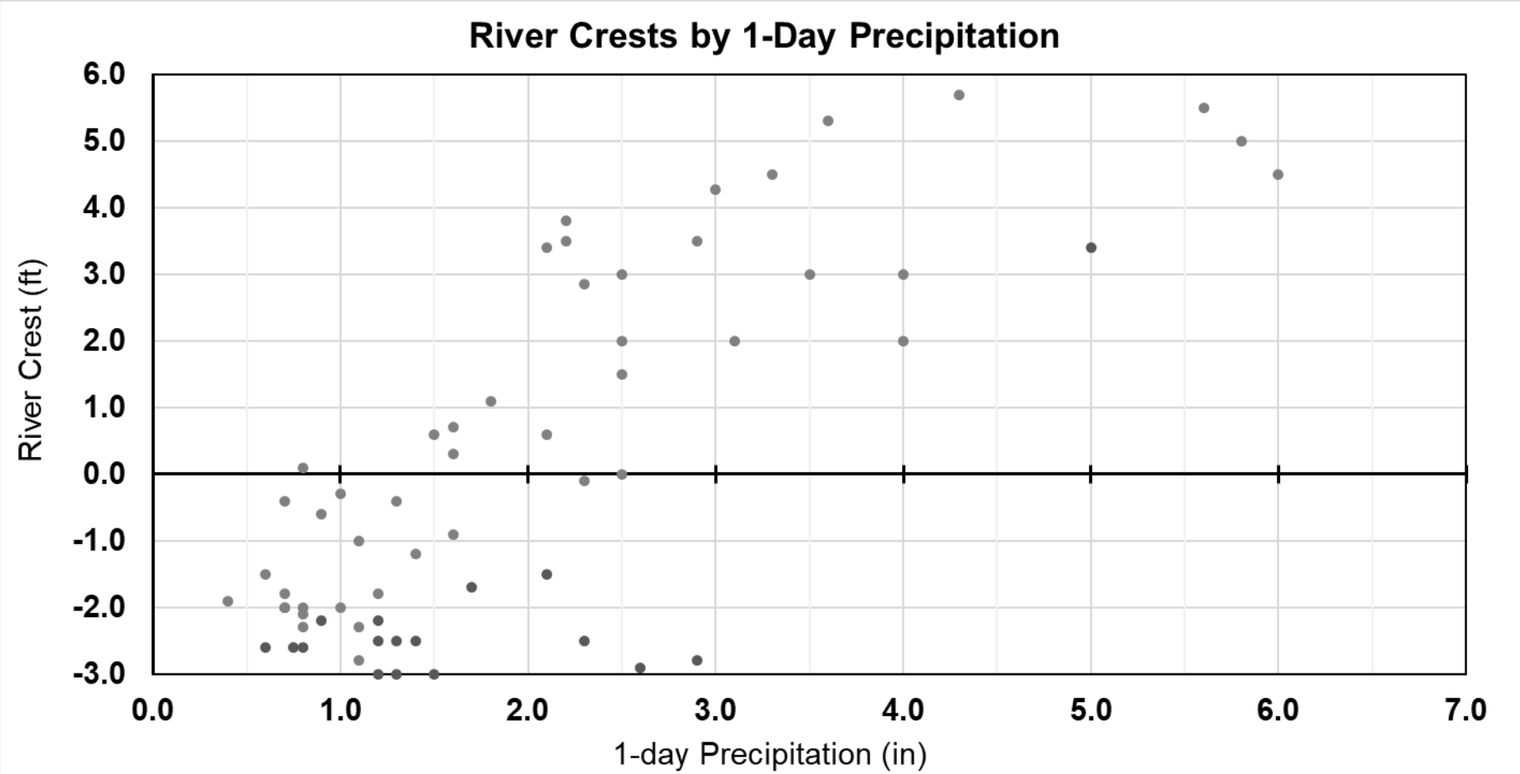

Recent rainfall events and Chicago River crests.

A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

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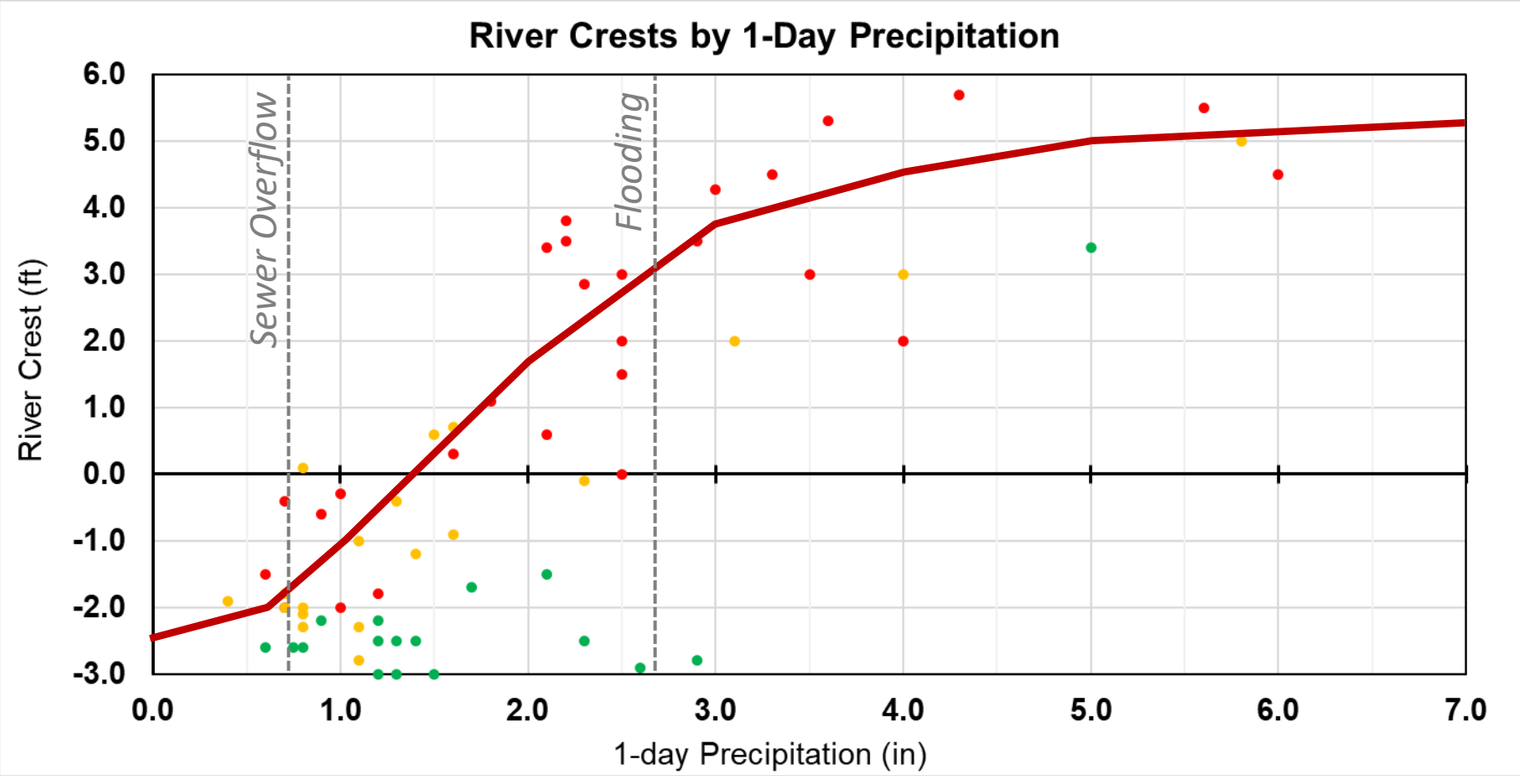

No tunnel or reservoir storage (pre-TARP)

Deep tunnel storage available

Deep tunnel and McCook Reservoir storage available

A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

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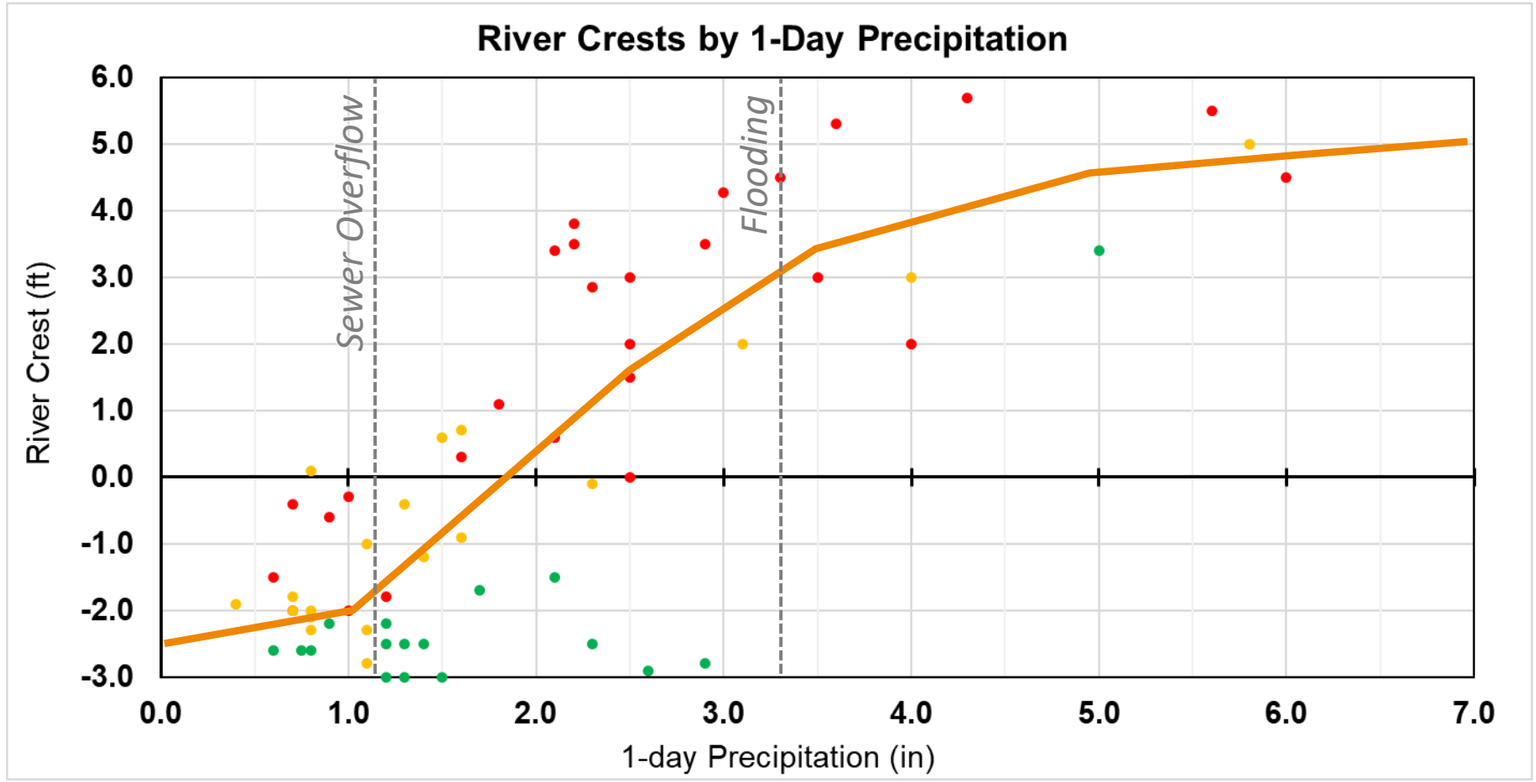

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A History of Extreme Rain Events Impacting Chicago

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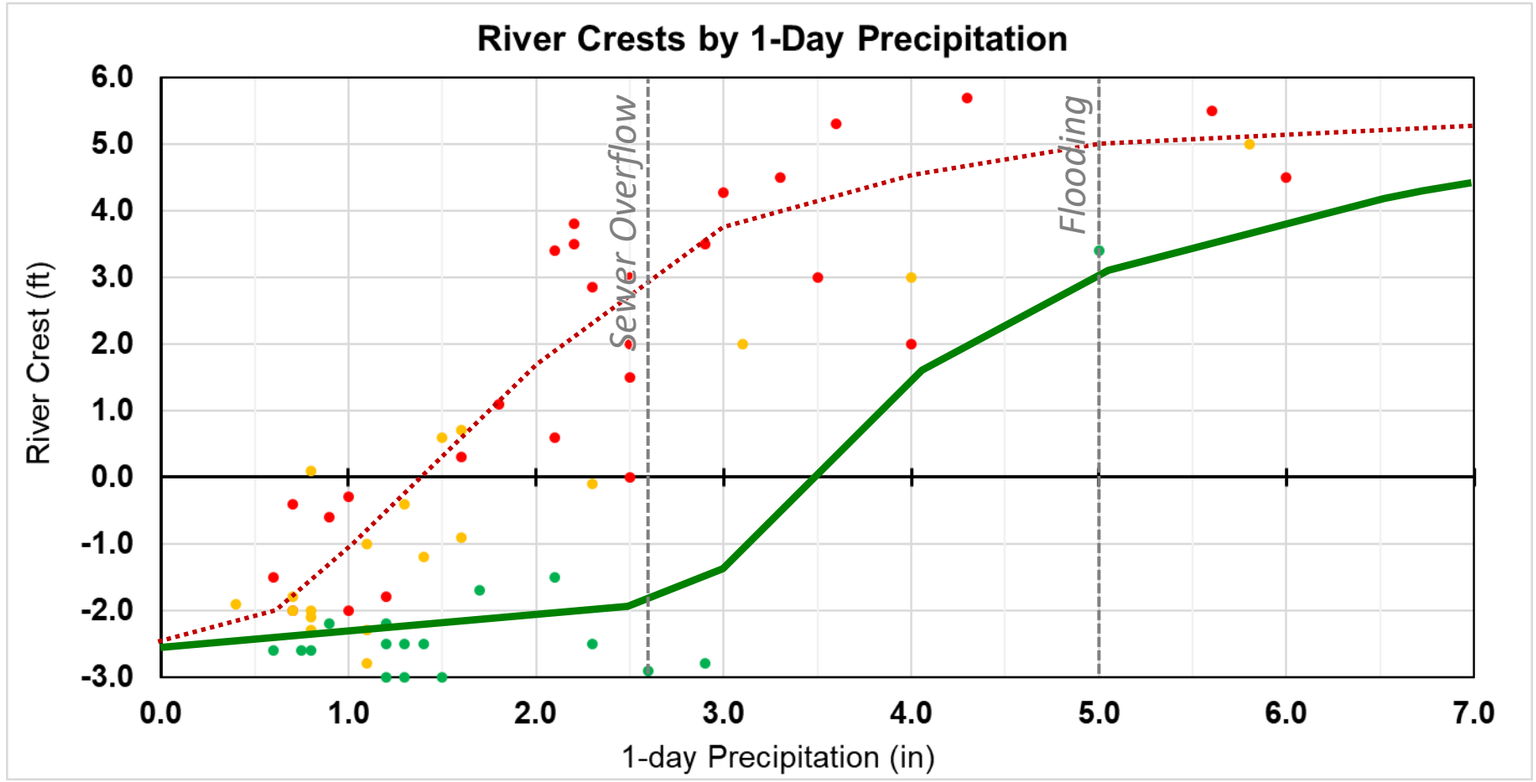

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A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

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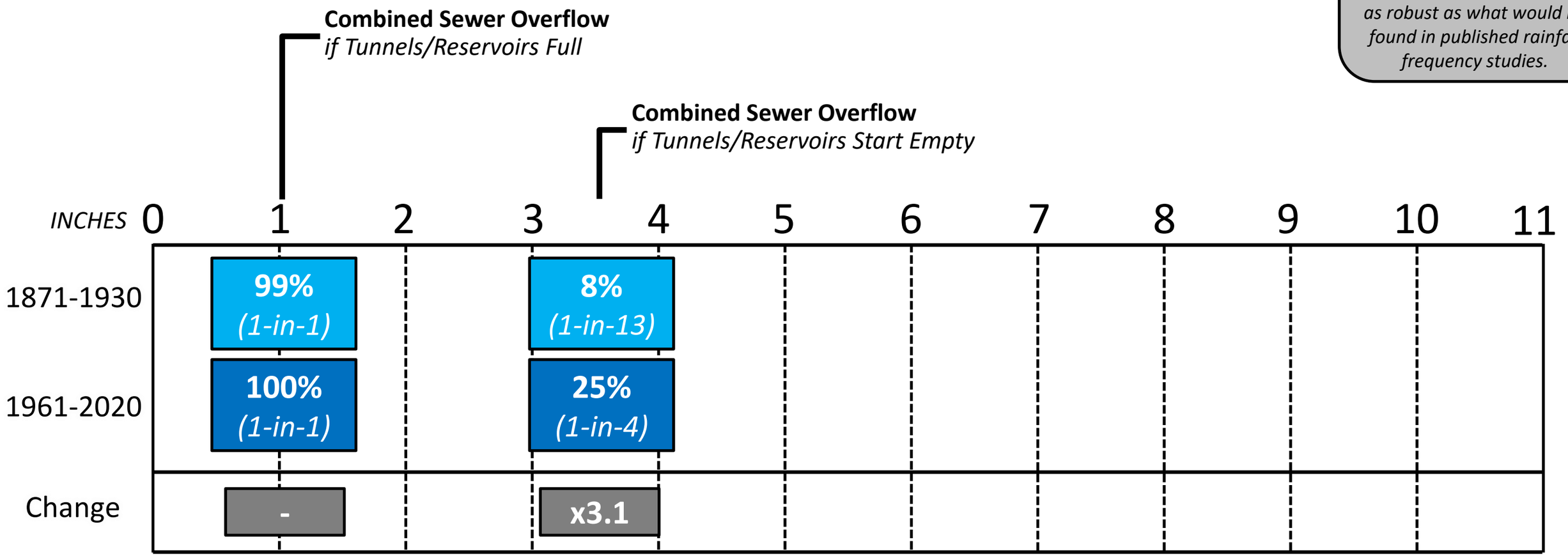
1-day Rainfall Probability

(approximate, averaged across city)



A History of Extreme Rain Events Impacting Chicago

Implications of Rainfall Changes

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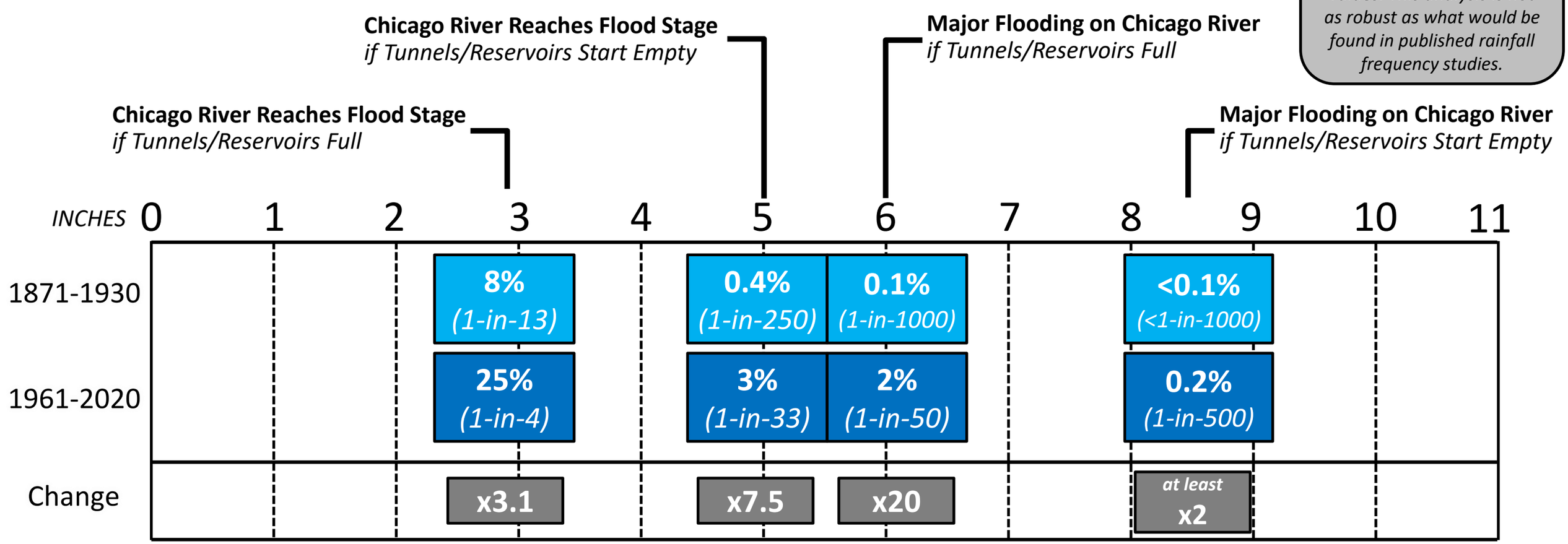
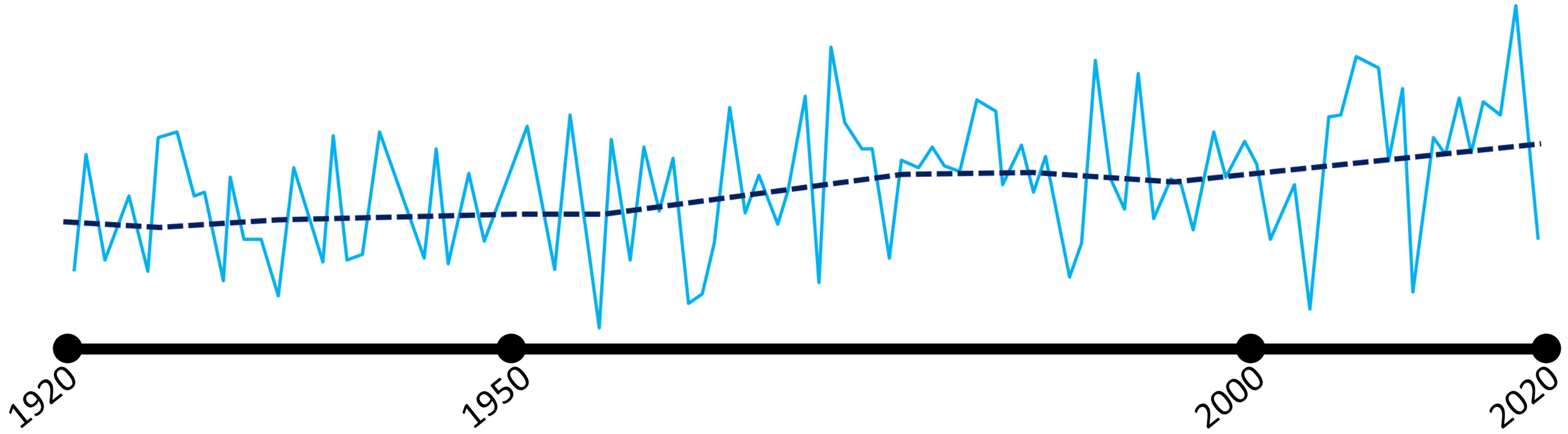


A History of Extreme Rain Events Impacting Chicago

Rainfall Frequency Analysis Assumptions

What does this mean for the future?



A History of Extreme Rain Events Impacting Chicago

Rainfall Frequency Analysis Assumptions

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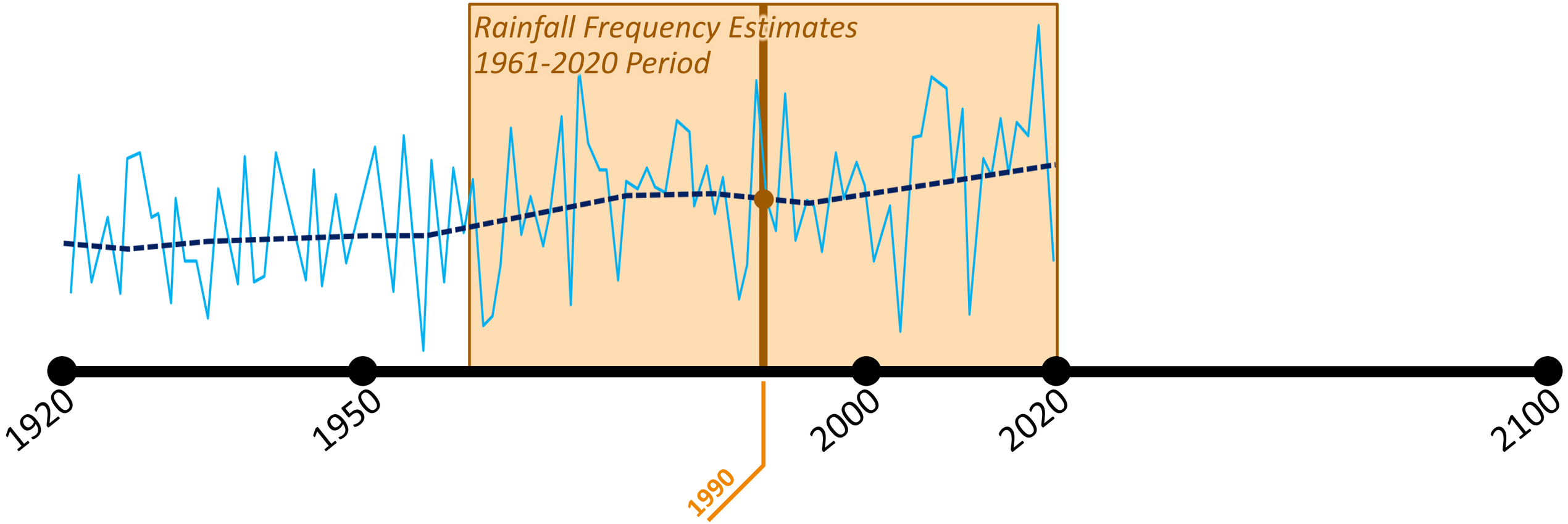

Rainfall frequency estimates in use today are based upon past observations, and assume trends have not changed.

A History of Extreme Rain Events Impacting Chicago

Rainfall Frequency Analysis Assumptions

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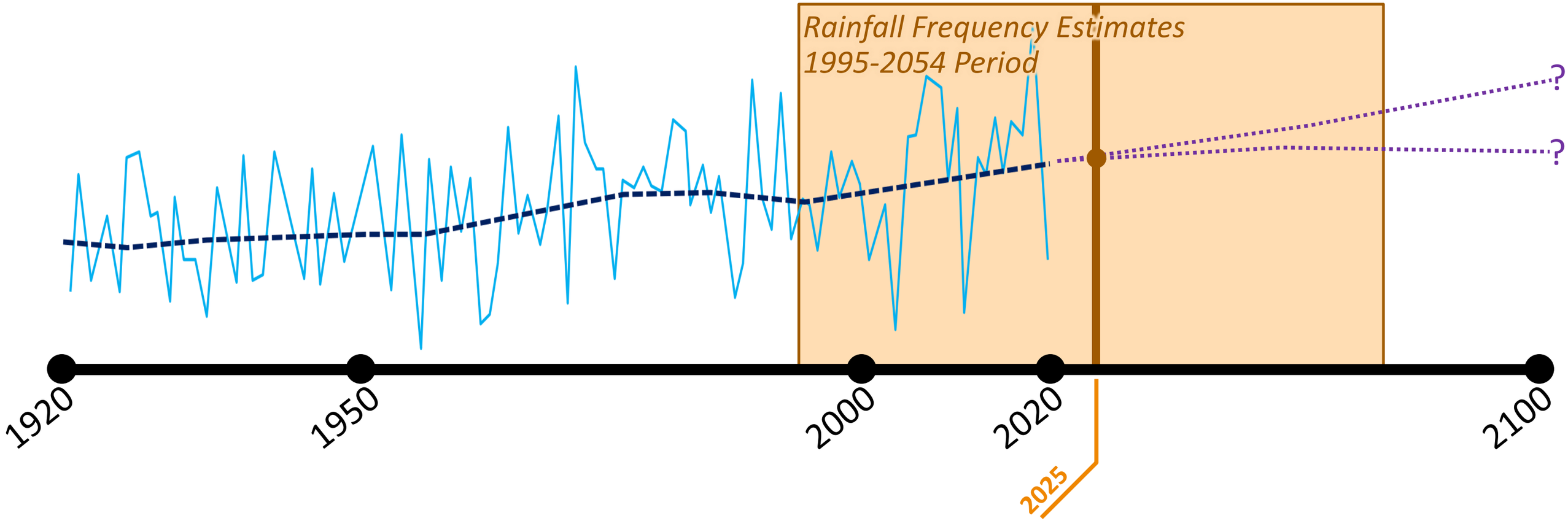
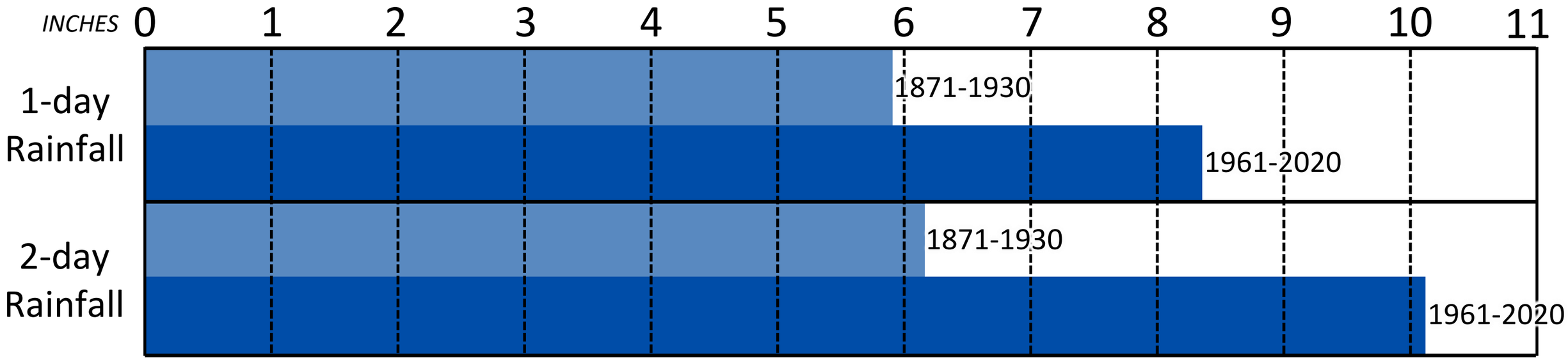


Rainfall frequency estimates centered on today <u>can't be calculated yet.</u>

A History of Extreme Rain Events Impacting Chicago

Rainfall Frequency Analysis Assumptions

Even if the weather patterns of today remain stable into the coming decades, the large changes in extreme rainfall shown here are <u>already outdated.</u>



A History of Extreme Rain Events Impacting Chicago

More information

Detailed report on history of Chicago extreme rainfall events

Technical Service Publication 21

Lincoln, W.S., and Ford, T., 2024: An Analysis of Extreme Rainfall Events in Chicago Since 1950. *NWS Technical Report TSP-21*.
https://www.weather.gov/media/crh/publications/TSP/TSP-21.pdf

Detailed report on summer 2025 extreme rainfall events

Lincoln, W.S., 2025: The Summer 2025 Flash Flood Events in Northern Illinois and Northwestern Indiana. *NWS Technical Report, in review*.

A History of Extreme Rain Events Impacting Chicago

Conclusions

- Numerous extreme rainfall events have occurred throughout Chicago's history, with at least 15 events since 1950.

- An extreme rainfall event occurs in central Cook County approximately 1-5 (average 1.9) times per decade, but frequency is increasing.

- Continued changes in the distribution of extreme rainfall events will have implications for future flooding and stormwater infrastructure design.

W. Scott Lincoln, GISP

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NWS Chicago/Rockford

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Chicago, Illinois

For PDH Certificate seekers,

The link to the new on-line course evaluation form has been posted in the Chat. The link is also available on the District website. The form will only be available online until the start of next month's seminar. Please be sure to fill it out and submit promptly.