Rational vs. Runoff: Sustainable Stormwater Design

Illinois Association of Floodplain and Stormwater Management

March 11, 2020

Adam Blumstein, PE, CFM, ENV SP
Madison Gibler, PE, ENV SP

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Today's Presentation

Key Points:

- How do we currently manage stormwater?
- What design calculations do we use?
- Are there ways that we can manage stormwater more sustainably?

Current Design Standards – Northeast IL

	MWRD	City of Chicago	DuPage County
Hydrology	Bulletin 70 (2019) Huff Distribution	City of Chicago IDF	Bulletin 70 (2019) Huff Distribution
Hydraulics – *Minor Systems	Rational Method 10-year LOS	Modified Rational Method 5-year LOS	Nomograph (<5 acres) 10-year LOS
Hydraulics – **Major Systems	Critical Duration 100-year LOS	100-year LOS	Critical Duration 100-year LOS
Detention/Retention	0.2-0.3 cfs/acre 100-year, 24-hour LOS	0.15-0.25 cfs/ local sewer capacity, 100-year LOS	0.10 cfs/acre 100-year LOS

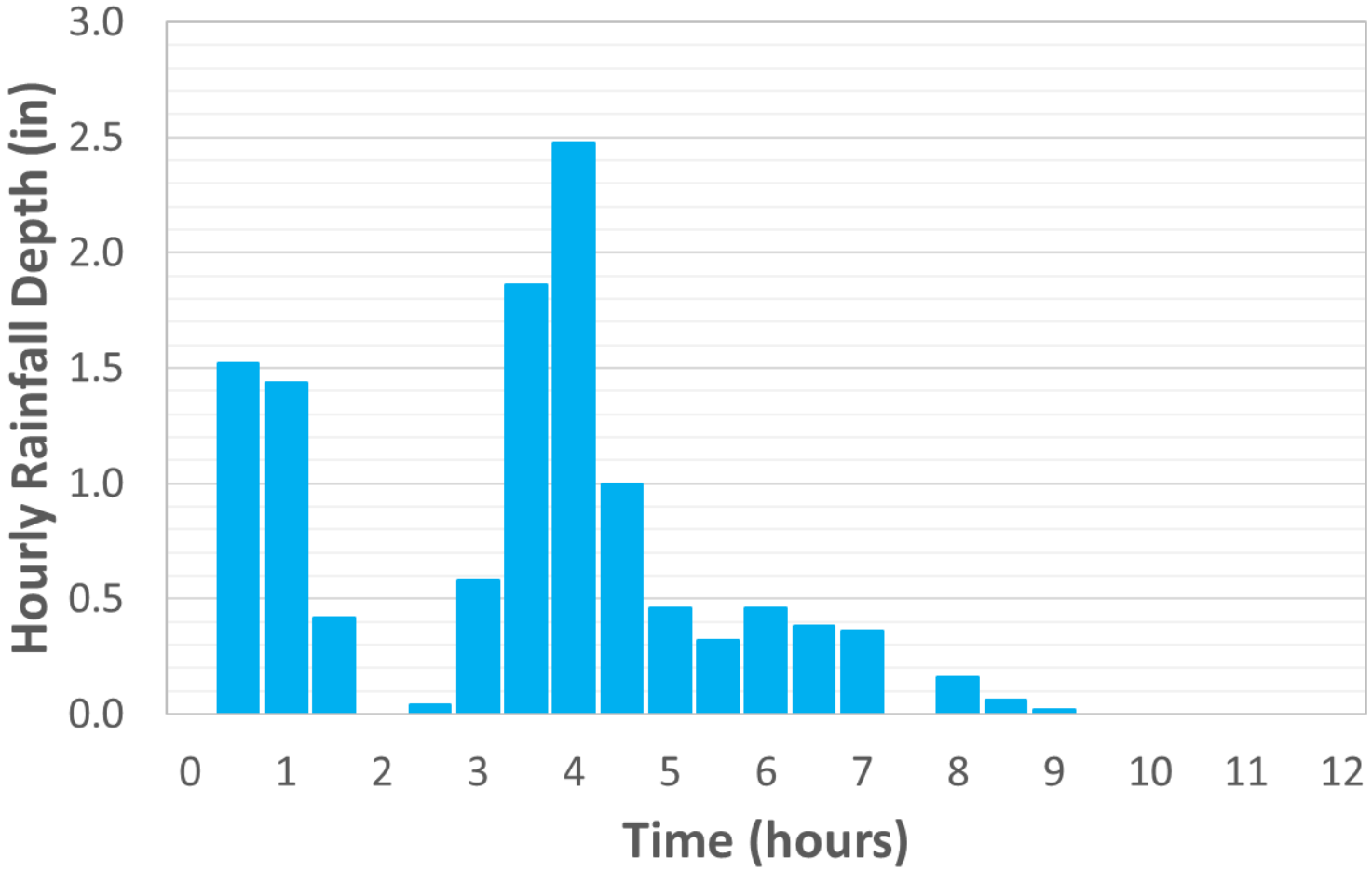
*Minor systems = storm sewers

**Major systems = open channel flow, overland flow

Changing our Modeling Methodology

Discrete Events

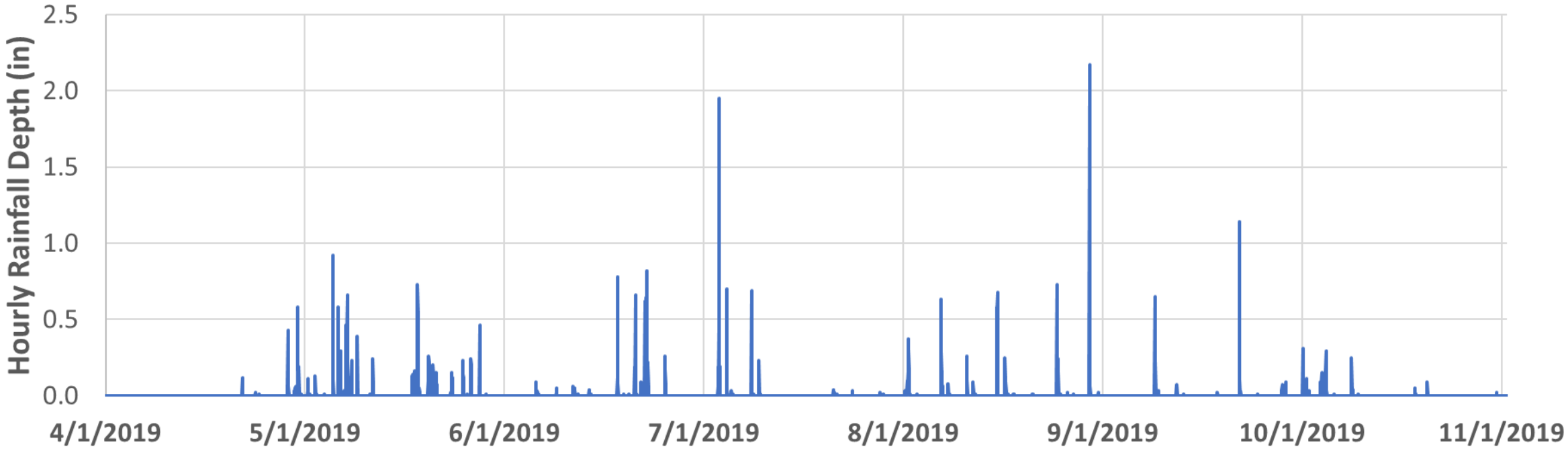
- Simpler
- Rational Method, SCS Curve Number
- Fundamental assumptions may be flawed



Changing our Modeling Methodology

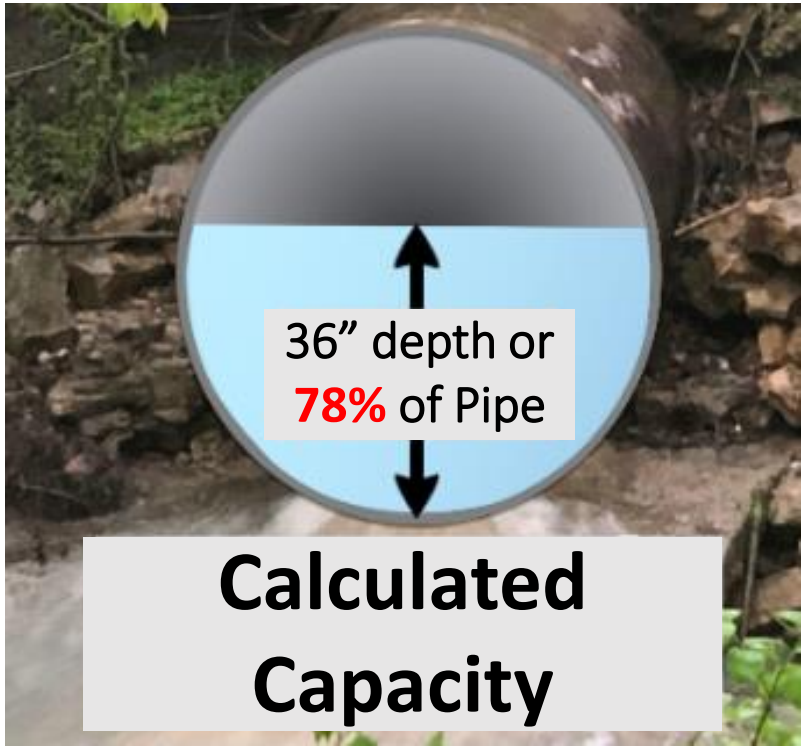
Continuous Simulation

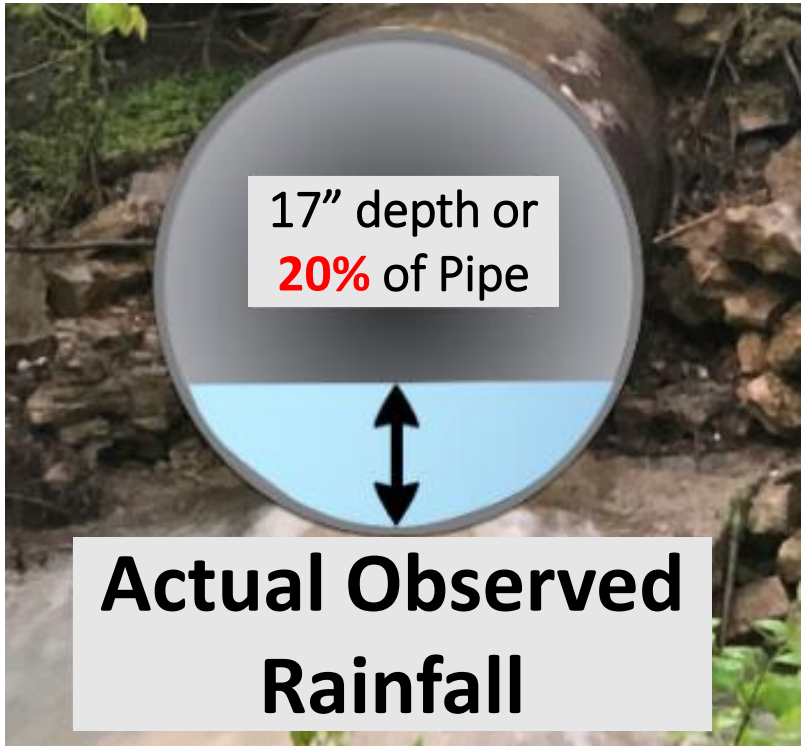
- More complex
- Using historical rainfall to predict future events



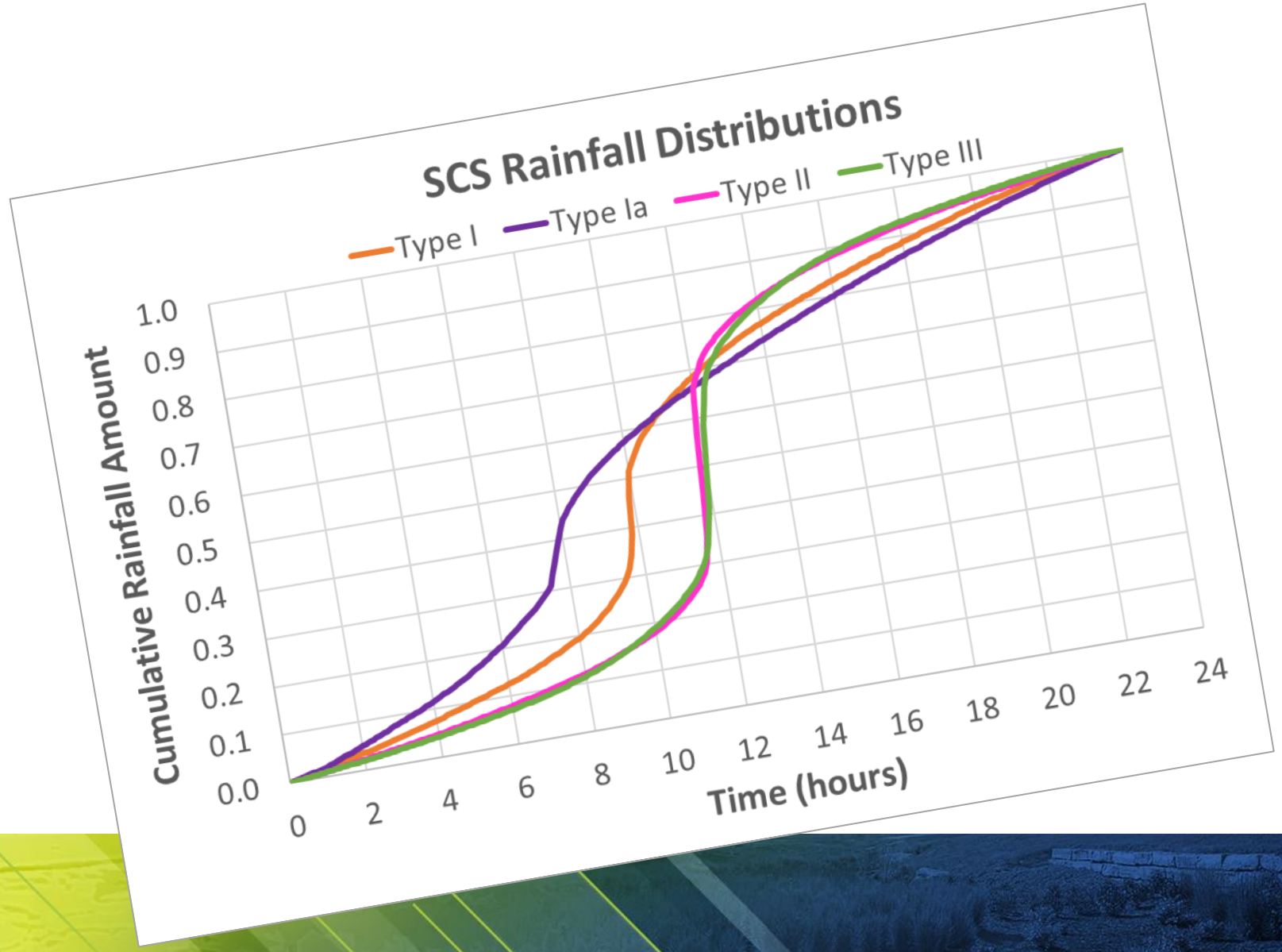
Impacts to Minor Systems

- Example site requires 49.1” pipe diameter, 54” diameter is selected
- How does this perform?





Can we predict the future?



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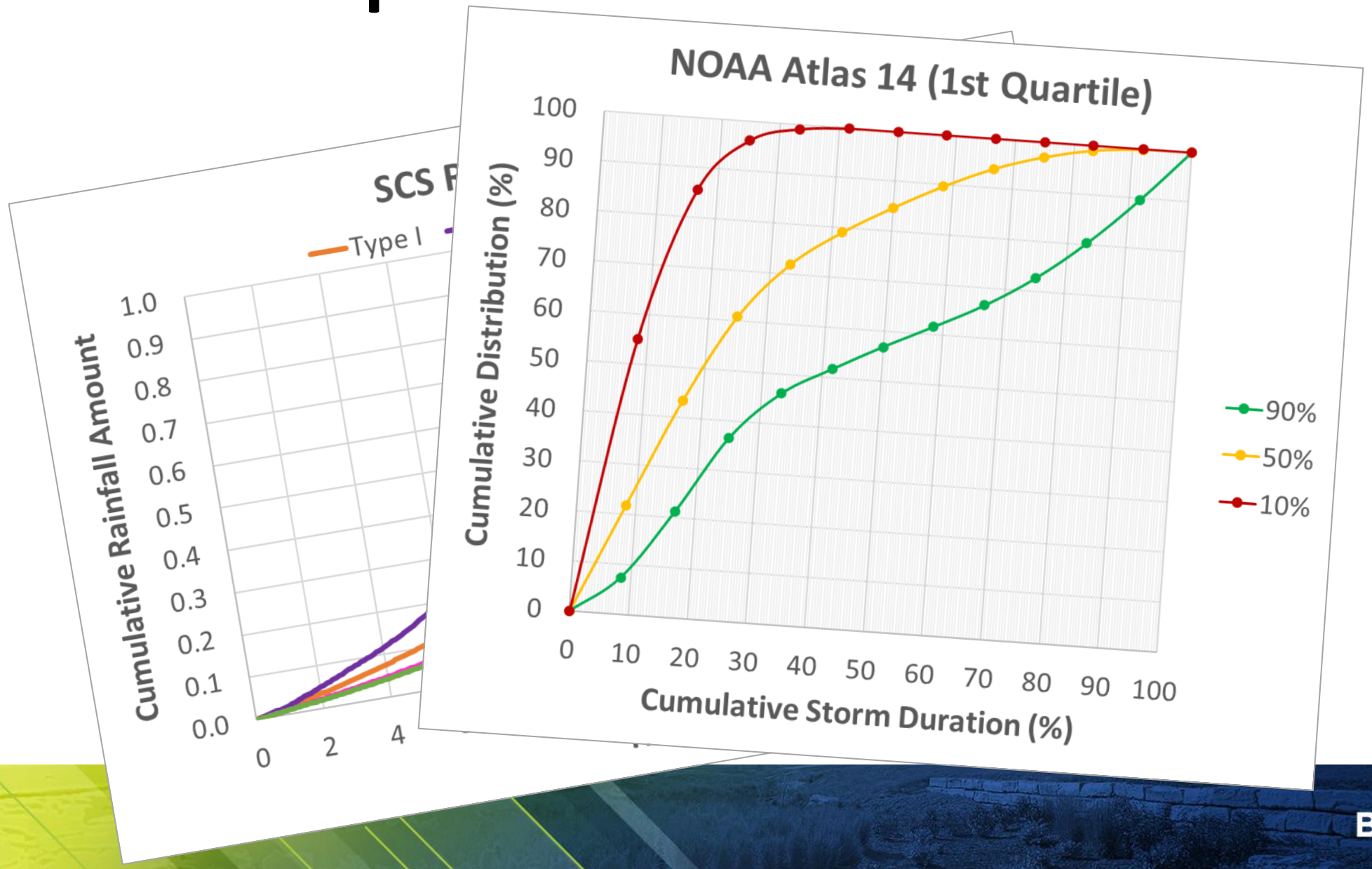

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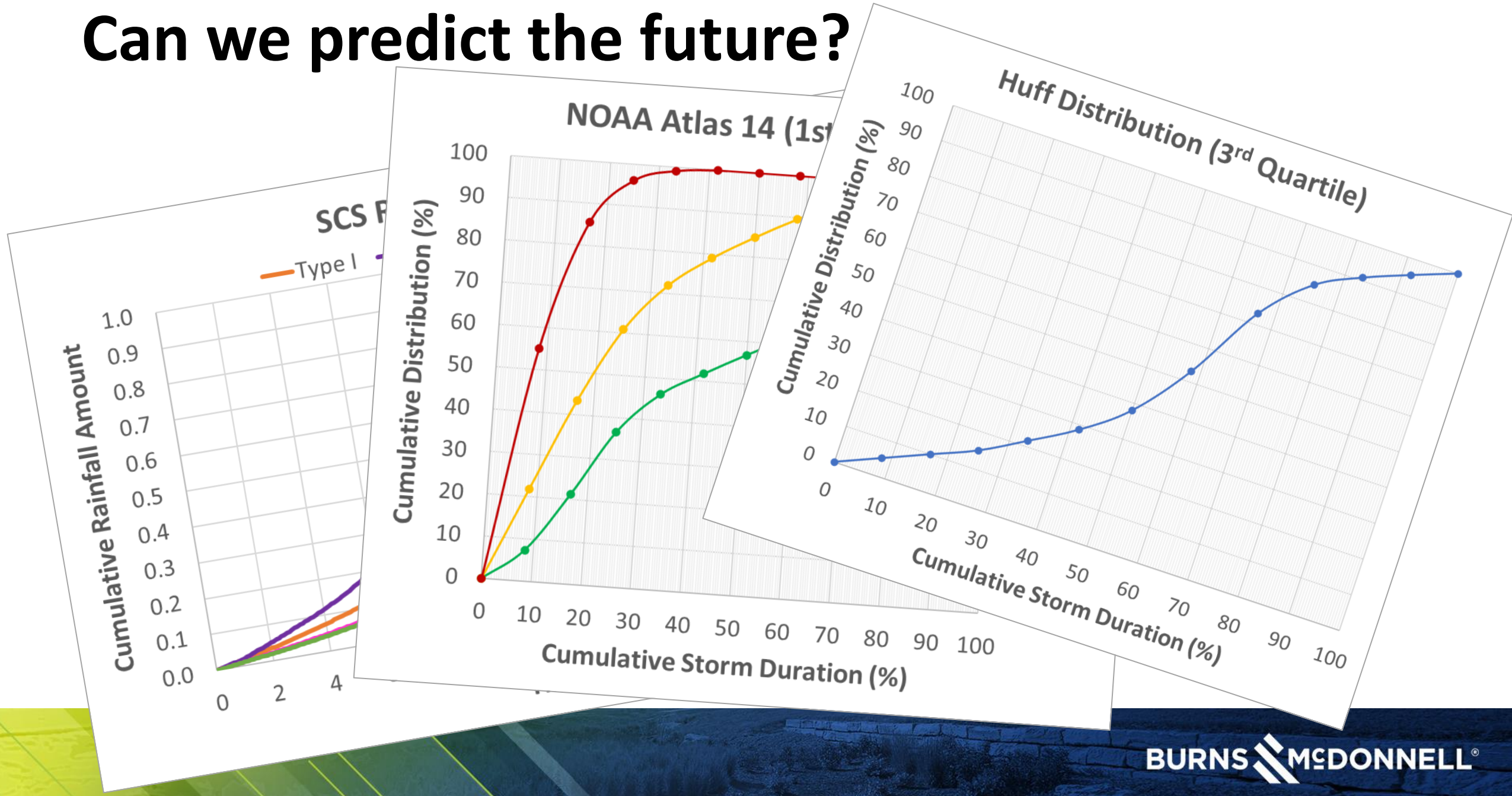

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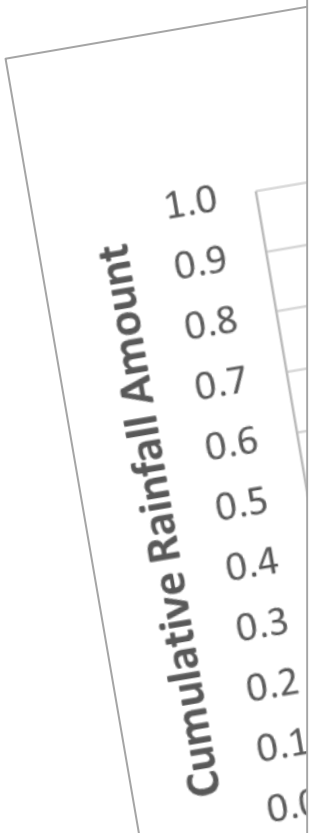

U.S. DEPARTMENT OF COMMERCE
LUTHER H. HODGES, Secretary

WEATHER BUREAU
F. W. REICHELDERFER, Chief

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

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

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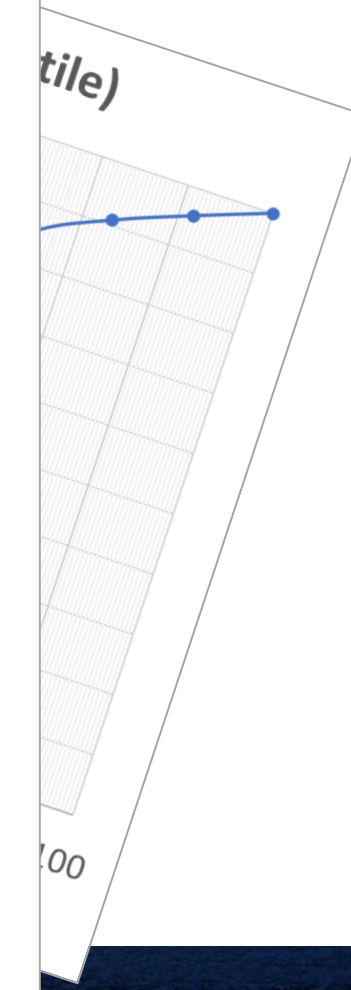

NOAA Atlas 14

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

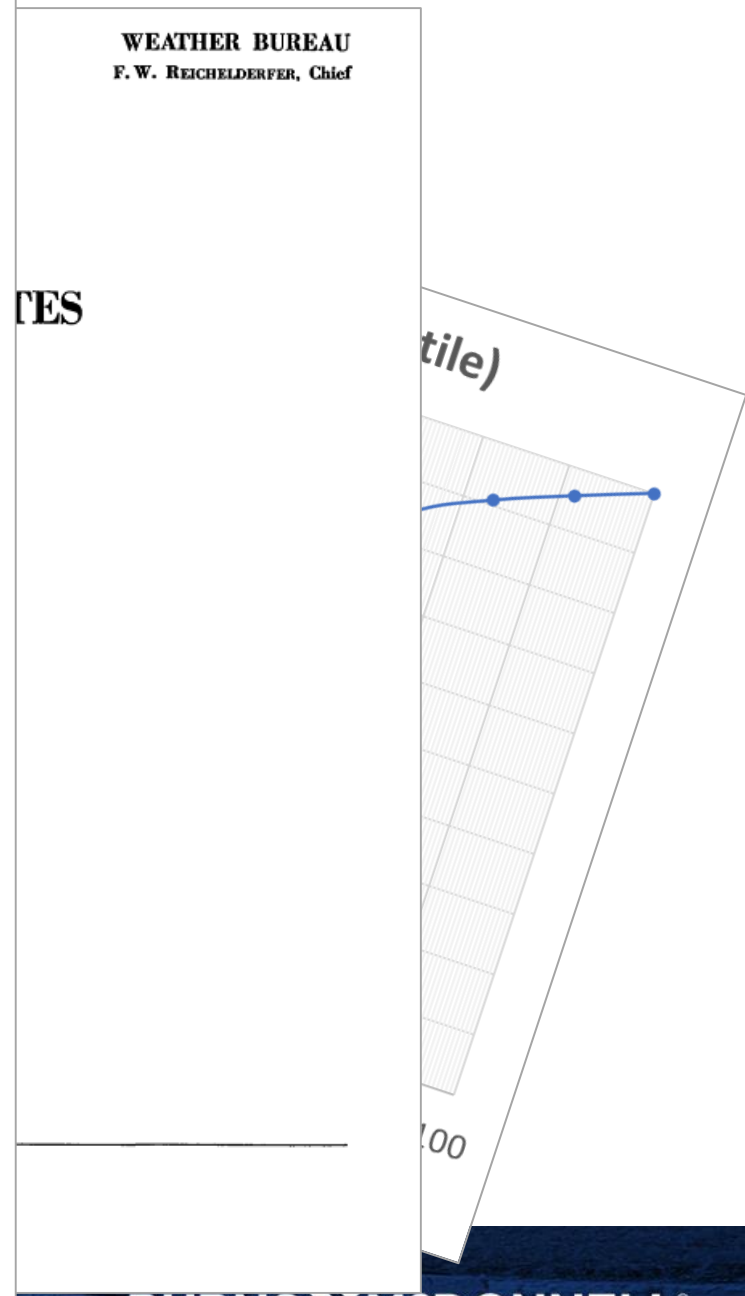

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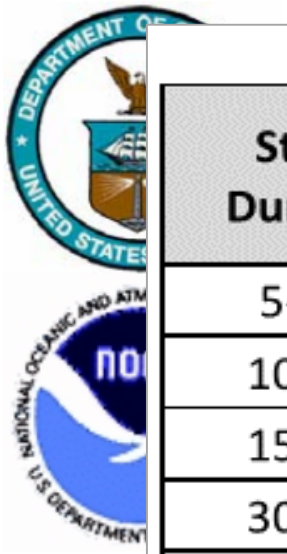
Table 5-6. Illinois State Water Survey Bulletin 70 Rainfall Depths for Northeast Sectional (inches)

Duration	Storm event Frequency						
	1-year	2-year	5-year	10-year	25-year	50-year	100-year
5 min	0.30	0.36	0.46	0.54	0.66	0.78	0.91
10 min	0.55	0.67	0.84	0.98	1.21	1.42	1.67
15 min	0.68	0.82	1.03	1.21	1.49	1.75	2.05
30 min	0.93	1.12	1.41	1.65	2.04	2.39	2.80
1 hour	1.18	1.43	1.79	2.10	2.59	3.04	3.56
2 hour	1.48	1.79	2.24	2.64	3.25	3.82	4.47
3 hour	1.60	1.94	2.43	2.86	3.53	4.14	4.85
6 hour	1.88	2.28	2.85	3.35	4.13	4.85	5.68
12 hour	2.18	2.64	3.31	3.89	4.79	5.62	6.59
18 hour	2.30	2.79	3.50	4.11	5.06	5.95	6.97
24 hour	2.51	3.04	3.80	4.47	5.51	6.46	7.58
48 hour	2.70	3.30	4.09	4.81	5.88	6.84	8.16
72 hour	2.93	3.55	4.44	5.18	6.32	7.41	8.78
120 hour	3.25	3.93	4.91	5.70	6.93	8.04	9.96
240 hour	4.12	4.95	6.04	6.89	8.18	9.38	11.14



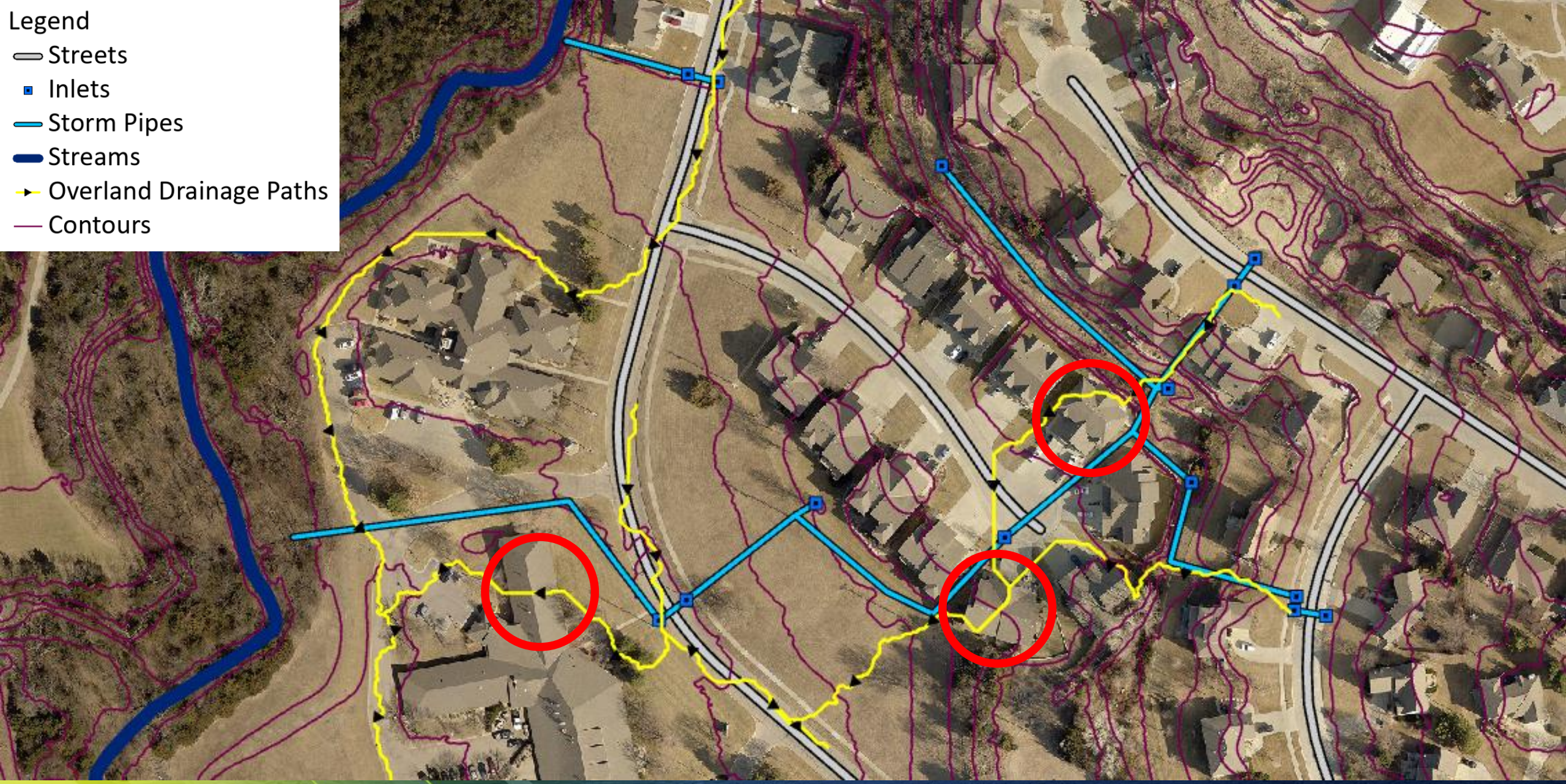
WEATHER BUREAU

TABLE 5.17 BULLETIN 70 (2019) NORTHEAST SECTIONAL RAINFALL DEPTH

Storm Duration	Rainfall Depth (in) per Storm Event Duration and Recurrence Interval					
	2-year	5-year	10-year	25-year	50-year	100-year
5-min	0.40	0.52	0.62	0.77	0.90	1.03
10-min	0.70	0.90	1.08	1.35	1.58	1.80
15-min	0.90	1.16	1.39	1.74	2.03	2.31
30-min	1.24	1.59	1.91	2.39	2.78	3.17
1-hour	1.57	2.02	2.42	3.03	3.53	4.03
2-hour	1.94	2.49	2.99	3.74	4.35	4.97
3-hour	2.14	2.75	3.30	4.13	4.80	5.49
6-hour	2.51	3.23	3.86	4.84	5.63	6.43
12-hour	2.91	3.74	4.48	5.61	6.53	7.46
18-hour	3.14	4.04	4.84	6.06	7.05	8.06
24-hour	3.34	4.30	5.15	6.45	7.50	8.57
48-hour	3.66	4.71	5.62	6.99	8.13	9.28
72-hour	3.97	5.08	6.05	7.49	8.64	9.85
120-hour	4.42	5.63	6.68	8.16	9.39	10.66
240-hour	5.60	7.09	8.25	9.90	11.26	12.65


Legend
Streets
Inlets
Storm Pipes
Streams


Legend
Streets
Inlets
Storm Pipes
Streams
Overland Drainage Paths
Contours


Legend
Streets
Inlets
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Contours

New Overland Drainage Paths?

- Urbanization
- Hydromodification

"alteration of the hydrologic characteristics of coastal and non-coastal waters, which in turn could cause degradation of water resources" –USEPA 1993

- Impact on Water Quality
- Impact on our major system, our natural open channels?

http://www.pittwateronlinenews.com/concernsoverbeebyreservenewcarparkflooding.php

Are we effectively managing stormwater?

- **Stream degradation**
  - **Property loss**
- Impacts to utilities and other infrastructure
- Development has viewed stormwater as a waste product
  - Out and away
- Are our stormwater standards sustainable?

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Are we effectively managing stormwater?

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  - Out and away
- **<u>Are our stormwater standards sustainable?</u>**

Sustainability – Stormwater Sustainability

- The ability to be maintained at a certain rate or level
- Meeting the needs of the present without compromising the ability of future generations to meet their needs
- Three Pillars of Sustainability
  - 1) Environmental (Planet)
  - 2) Social/Community (People)
  - 3) Economic (Cost)

Source: Sustainability 101. Towards sustainable cities and communities

How do we move forward?

- Need to start somewhere
  - Know your system
  - Identify the issues
  - Define your objectives and budget
- Stormwater issues are NOT going away
  - Aging Infrastructure/Failing Streams
  - Development/Redevelopment (Urban Growth)
  - Water Quality Regulations
  - Weather Extremes
- Evaluate new tools and approaches

Source: Sustainability 101. Towards sustainable cities and communities

Questions?

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