

CHAPTER 1. RAINFALL

1.1 Rainfall Intensity-Duration-Frequency

A tabulation of rainfall intensities for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year recurrence intervals, and for durations ranging from 10 through 200 minutes, has been developed for Newark and is shown in Exhibit I-1 (page 1-2). This data supersedes the works of D.L. Yarnell and E.W. Steel (who developed the steel precipitation formulas). The data was developed from the latest precipitation-frequency data contained in the U.S. Department of Commerce Technical Memorandum NWS HYDRO-35 and Technical Paper No. 40. Intensities for durations not shown shall be calculated by the rainfall intensity equation given in Exhibit I-2 (page 1-4).

1.2 Example - Rainfall Intensity

Determine the 10- and 100-year rainfall intensities from a watershed having a time of concentration equal to 16 minutes.

Use Exhibit I-1 (page 1-2), locate a duration of 16.0 minutes, and read:

10-year rainfall intensity = 4.34 inches per hour
100-year rainfall intensity = 6.26 inches per hour

1.3 Rainfall Distribution by Time

Total rainfall amounts for Newark are presented in Table 1-1 for selected rainfall durations and recurrence intervals. The 24-hour rainfall amounts are to be used with the Soil Conservation Service, Technical Release No. 55 methods.

PLEASE SEE FOLLOWING PAGE 1-2

Table 1-1

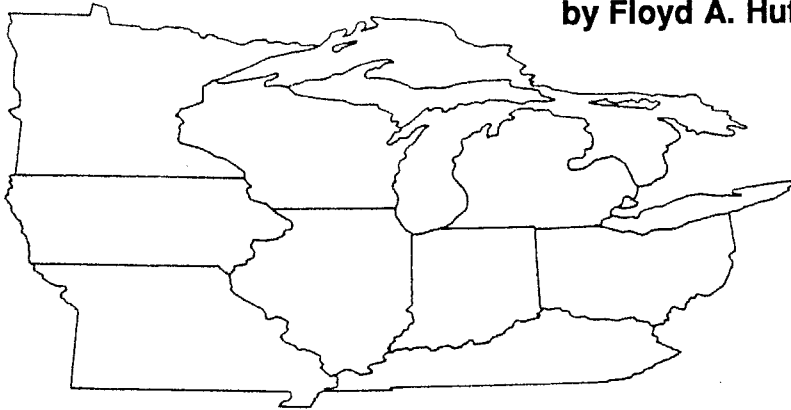
Revised Total Rainfall Amounts¹

<u>Recurrence Interval (Years)</u>	<u>Total Rainfall for Duration of:</u>			
	<u>1 Hour (Inches)</u>	<u>6 Hours (Inches)</u>	<u>12 Hours (Inches)</u>	<u>24 Hours (Inches)</u>
1	1.02	1.63	1.90	2.26
2	1.29	2.03	2.35	2.70
5	1.62	2.51	2.91	3.35
10	1.88	2.89	3.36	3.86
25	2.21	3.45	4.04	4.64
50	2.51	4.00	4.64	5.33
100	2.86	4.52	5.27	6.06

¹Incorporating Bulletin 71 data.

RAINFALL FREQUENCY ATLAS OF THE MIDWEST

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DESIGN RAINFALL INTENSITIES

DURATION (MINUTES)	RAINFALL INTENSITY (IN/HR) FOR RECURRENCE INTERVAL OF						
	1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
10.0	3.01	3.90	4.81	5.47	6.35	7.09	7.81
10.5	2.93	3.82	4.71	5.34	6.23	6.95	7.66
11.0	2.86	3.74	4.61	5.23	6.11	6.82	7.52
11.5	2.80	3.66	4.52	5.12	5.99	6.69	7.38
12.0	2.73	3.59	4.43	5.01	5.88	6.56	7.25
12.5	2.67	3.51	4.35	4.91	5.77	6.44	7.12
13.0	2.62	3.45	4.26	4.82	5.66	6.33	7.00
13.5	2.57	3.38	4.18	4.73	5.56	6.21	6.88
14.0	2.51	3.31	4.11	4.64	5.46	6.10	6.77
14.5	2.47	3.25	4.03	4.56	5.37	6.00	6.66
15.0	2.42	3.19	3.96	4.48	5.28	5.90	6.55
15.5	2.38	3.13	3.89	4.40	5.19	5.80	6.45
16.0	2.34	3.08	3.82	4.33	5.10	5.71	6.35
16.5	2.30	3.03	3.76	4.26	5.02	5.62	6.25
17.0	2.26	2.97	3.69	4.19	4.94	5.53	6.16
17.5	2.22	2.92	3.63	4.13	4.87	5.44	6.07
18.0	2.19	2.88	3.57	4.06	4.79	5.36	5.98
18.5	2.15	2.83	3.52	4.00	4.72	5.28	5.89
19.0	2.12	2.78	3.46	3.94	4.65	5.21	5.81
19.5	2.09	2.74	3.41	3.89	4.58	5.13	5.73
20.0	2.06	2.70	3.36	3.83	4.52	5.06	5.66
21.0	2.00	2.62	3.26	3.72	4.39	4.92	5.51
22.0	1.95	2.55	3.17	3.63	4.27	4.79	5.37
23.0	1.89	2.47	3.08	3.53	4.16	4.67	5.24
24.0	1.85	2.41	3.00	3.44	4.06	4.55	5.11
25.0	1.80	2.35	2.93	3.36	3.96	4.44	4.99
26.0	1.76	2.29	2.86	3.28	3.86	4.34	4.88
27.0	1.72	2.23	2.79	3.21	3.78	4.24	4.77
28.0	1.68	2.18	2.72	3.13	3.69	4.15	4.67
29.0	1.65	2.13	2.66	3.07	3.61	4.06	4.58
30.0	1.61	2.08	2.60	3.00	3.53	3.97	4.48
32.0	1.55	1.99	2.49	2.88	3.39	3.82	4.31
34.0	1.49	1.91	2.40	2.77	3.26	3.67	4.15

DESIGN RAINFALL INTENSITIES

DURATION (MINUTES)	RAINFALL INTENSITY (IN/HR) FOR RECURRENCE INTERVAL OF						
	1 YR	2 YR	5 YR	10 YR	25 YR	50 YR	100 YR
36.0	1.44	1.84	2.31	2.67	3.14	3.54	4.01
38.0	1.39	1.77	2.22	2.58	3.03	3.42	3.87
40.0	1.34	1.71	2.15	2.49	2.93	3.30	3.74
42.0	1.30	1.65	2.08	2.41	2.83	3.20	3.63
44.0	1.26	1.60	2.01	2.33	2.74	3.10	3.52
46.0	1.22	1.55	1.95	2.26	2.66	3.01	3.42
48.0	1.19	1.51	1.89	2.20	2.58	2.93	3.32
50.0	1.16	1.46	1.84	2.14	2.51	2.85	3.23
52.0	1.13	1.42	1.79	2.08	2.44	2.77	3.15
54.0	1.10	1.39	1.74	2.02	2.38	2.70	3.07
56.0	1.07	1.35	1.70	1.97	2.32	2.63	2.99
58.0	1.05	1.32	1.66	1.92	2.26	2.57	2.92
60.0	1.02	1.29	1.62	1.88	2.21	2.51	2.86
65.0	0.97	1.21	1.53	1.77	2.09	2.37	2.70
70.0	0.92	1.15	1.45	1.68	1.98	2.25	2.57
75.0	0.87	1.09	1.38	1.60	1.88	2.15	2.44
80.0	0.84	1.04	1.32	1.52	1.80	2.05	2.33
85.0	0.80	1.00	1.26	1.45	1.72	1.96	2.23
90.0	0.77	0.96	1.21	1.39	1.65	1.89	2.14
95.0	0.74	0.92	1.16	1.34	1.59	1.81	2.06
100.0	0.71	0.89	1.12	1.29	1.53	1.75	1.99
110.0	0.66	0.83	1.04	1.20	1.42	1.63	1.85
120.0	0.62	0.78	0.98	1.12	1.34	1.53	1.74
130.0	0.59	0.73	0.92	1.05	1.26	1.44	1.64
140.0	0.56	0.69	0.87	1.00	1.19	1.37	1.55
150.0	0.53	0.66	0.83	0.94	1.13	1.30	1.47
160.0	0.50	0.63	0.79	0.90	1.08	1.24	1.40
170.0	0.48	0.60	0.75	0.86	1.03	1.18	1.34
180.0	0.46	0.58	0.72	0.82	0.99	1.13	1.28
190.0	0.44	0.55	0.69	0.79	0.95	1.09	1.23
200.0	0.43	0.53	0.67	0.76	0.91	1.05	1.19

EXHIBIT I-2

Revised Rainfall Intensity Equations¹

<u>Frequency Years</u>	<u>Equation</u>
1	$I = e[+0.0219 - 0.6891 \ln T - 0.0416 (\ln T)^2 + 0.0077 (\ln T)^3 + 0.0012 (\ln T)^4 - 0.0006 (\ln T)^5]$
2	$I = e[+0.2510 - 0.7155 \ln T - 0.0194 (\ln T)^2 + 0.0106 (\ln T)^3 - 0.0041 (\ln T)^4 + 0.0003 (\ln T)^5]$
5	$I = e[+0.4818 - 0.7082 \ln T - 0.0274 (\ln T)^2 + 0.0054 (\ln T)^3 - 0.0042 (\ln T)^4 + 0.0010 (\ln T)^5]$
10	$I = e[+0.6299 - 0.7173 \ln T - 0.0485 (\ln T)^2 + 0.0141 (\ln T)^3 + 0.0007 (\ln T)^4 - 0.0007 (\ln T)^5]$
25	$I = e[+0.7932 - 0.7078 \ln T - 0.0350 (\ln T)^2 + 0.0129 (\ln T)^3 - 0.0025 (\ln T)^4 - 0.0000 (\ln T)^5]$
50	$I = e[+0.9206 - 0.6933 \ln T - 0.0357 (\ln T)^2 + 0.0105 (\ln T)^3 - 0.0025 (\ln T)^4 + 0.0002 (\ln T)^5]$
100	$I = e[+1.0494 - 0.6891 \ln T - 0.0467 (\ln T)^2 + 0.0119 (\ln T)^3 - 0.0012 (\ln T)^4 - 0.0001 (\ln T)^5]$

Where:

I = Rainfall Intensity in inches per hour

e = constant approximately equal 2.718282

ln = natural logarithm

T = time in hours

¹Incorporating Bulletin 71 data