

3.1.2 Rainfall Estimation

The first step in any hydrologic analysis is an estimation of the rainfall that will fall on the site for a given time period. The amount of rainfall can be quantified with the following characteristics:

Duration (hours) – Length of time over which rainfall (storm event) occurs;

Depth (inches) – Total amount of rainfall occurring during the storm duration; and

Intensity (inches per hour) – Rate of rainfall or depth divided by the duration

The frequency of a rainfall event is the recurrence interval of storms having the same duration and volume (depth). This can be expressed either in terms of *exceedance probability* or *return period*.

Exceedance Probability – Probability that a storm event having the specified duration and volume will be exceeded in one given time period, typically 1-year.

Return Period – Average length of time between events that have the same duration and volume.

Thus, if a storm event with a specified duration and volume has a 1% chance of occurring in any given year, then it has an exceedance probability of 0.01 and a return period of 100-years. A design storm event over 24-hours with a 1% chance of occurring in any given year is often referred to as the 100-year, 24-hour storm. This design storm would be developed based on assumptions regarding intensity and distribution of the storm over the specified timeframe (24-hours for this scenario). Therefore, a design storm event is used to estimate actual storm events even though it would be very unlikely that an actual storm event would match up with all of the design storm event assumptions.

Rainfall intensities for Knox County are provided in Table 3-4 and should be used for all hydrologic analysis. The sources of the values in this table are the Weather Bureau Technical Papers TP-25 and TP-40 (Hershfield, 1961) and National Weather Service publication Hydro-35 (NOAA, 1977). The intensity values have been adjusted to produce smooth intensity-duration-frequency (IDF) curves and cumulative rainfall distributions. Table 3-5 shows the rainfall depths for hypothetical storm events.

Figure 3-1 shows the IDF curves for Knox County for the 1, 2, 5, 10, 25, and 100-year, 24-hour storms. These curves are plots of the tabular values. No values are given for times less than 5 minutes.

Table 3-4. Intensity-Duration-Frequency Curve Data

(Sources: Hershfield, 1961; NOAA, 1977)

ARI ¹ (years)		24-Hour Precipitation Frequency Estimates (inches/hour) by Return Periods					
Hours	Minutes	2-year	5-year	10-year	25-year	50-year	100-year
0.083	5	4.60	5.55	6.25	7.30	7.90	8.60
0.170	10	3.70	4.60	5.25	6.20	6.80	7.49
0.250	15	3.19	3.98	4.60	5.45	6.00	6.60
0.330	20	2.82	3.50	4.10	4.90	5.45	6.02
0.420	25	2.48	3.12	3.70	4.45	4.95	5.50
0.500	30	2.22	2.80	3.34	4.03	4.53	5.03
0.580	35	2.02	2.55	3.06	3.67	4.14	4.62
0.670	40	1.86	2.35	2.82	3.38	3.80	4.24
0.750	45	1.73	2.18	2.62	3.14	3.53	3.93
0.830	50	1.62	2.04	2.46	2.94	3.30	3.67



ARI ¹ (years)		24-Hour Precipitation Frequency Estimates (inches/hour) by Return Periods					
Hours	Minutes	2-year	5-year	10-year	25-year	50-year	100-year
0.920	55	1.53	1.92	2.32	2.77	3.10	3.45
1.000	60	1.45	1.82	2.20	2.62	2.93	3.26
1.500	90	1.06	1.36	1.64	1.95	2.18	2.45
2.000	120	0.86	1.09	1.31	1.55	1.71	1.95
3.000	180	0.66	0.80	0.97	1.13	1.23	1.38
6.000	360	0.41	0.50	0.58	0.66	0.75	0.83
12.000	720	0.24	0.30	0.34	0.39	0.43	0.48
24.000	1440	0.14	0.17	0.20	0.23	0.25	0.27

1 - ARI= Average Recurrence Interval

Table 3-5. Rainfall Depths for Hypothetical Storm Events

Rainfall Depths for Hypothetical Storm Events	
Storm Event	24-Hr Depth (in)
1-year	2.5
2-year	3.3
5-year	4.1
10-year	4.8
25-year	5.5
100-year	6.5

Figure 3-1. Intensity-Duration-Frequency-(IDF) Curves for Knox County 24-hour Storms
(Based upon partial duration-based point precipitation frequency estimates for average recurrence intervals (T))



