CHAPTER 6 - HYDROGRAPH DEVELOPMENT

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CHAPTER 6 - HYDROGRAPH DEVELOPMENT

Introduction

This chapter deals with the development of a hydrograph, whether it is by using available computer programs or by tabular methods which are appropriate for preliminary designs and quick approximations when they are needed. The hydrographs used by the Soil Conservation Service are synthetic hydrographs which are obtained by using watershed parameters and storm characteristics to simulate a natural runoff occurrence. The hydrograph families are vertical lines of equal duration of excess rainfall (T_c) on Figure 6-1. The hydrograph families 1, 1.5, 2, 2.5, 3 and 3.5 are durations of excess rainfall of 19.0, 16.5, 15.5, 15.0, 14.5 and 14.25 hours respectively. The synthetic hydrographs are developed based on a unit hydrograph procedure which is explained in Chapter 16, "Hydrographs", National Engineering Handbook, Section 4.

Hydrograph Development by Electronic Computer Programs

The DAMS-2 and TR-20 computer programs can be used to develop the Soil Conservation Service standard hydrographs and also variations of the standard hydrograph depending upon the cumulative rainfall table used. The description of the use of these programs is Technical Release No. 48 for the DAMS-2 program and Technical Release No. 20 for the TR-20 program.

This chapter includes four cumulative rainfall tables to be used with the above programs. These tables define the rainfall distribution used and are available from the SCS state office by the appropriate form number.

Table 6-2 is used with the DAMS-2 program when designing a pond where a 24-hour duration Type I distribution storm is used. Tables 6-3 through 6-5 are used with the TR-20 program for hydrologic processes in project formulation. The cumulative rainfall table used should correspond with the type of rainfall distribution desired in the analysis.

Tabular Hydrograph Development

This chapter presents a tabular method of computing a hydrograph based upon a 24-hour duration Type I distribution storm. This tabulation was developed from a TR-20 computer program analysis. The method is an approximation of the hydrograph because the time of concentration and the hydrograph family must be adjusted to one of the tabulated values. When adjusting the T_c and the hydrograph family, both should be adjusted downward to the next tabulated value. This will produce a more conservative hydrograph than the actual time of concentration and hydrograph family.

It is possible to interpolate between the tabulated combinations but quite impractical when the available computer programs can develop and route the exact hydrograph for the given conditions.

The tabulated hydrograph procedure can be used to develop a composite hydrograph or peak flow for a non-homogeneous watershed which must be divided into two or more subwatersheds.

Example No. 1 -- Develop a tabulated hydrograph for a 2300 acre watershed.

Given: Drainage area = $\frac{2300}{640}$ acres = 3.6 sq. mi.

P = 5" (24-hour duration)
Runoff Curve Number 72
T_c = 3.5 hours

1. Read hydrograph family 1.4 from Figure 5-1. Both the hydrograph family and T_c are adjusted downward to select an appropriate tabulated hydrograph from Table 6-6 1/. Use hydrograph family 1 and T_c of 3.0.
2. Q = 2.19 inches (Table 3-5).
3. Set up a table and compute the hydrograph. The peak of the hydrograph occurs at time 11.8 hours and is:
   q = 95.3 CSM/in. x 3.6 sq. mi. x 2.19"
   = 751 cfs.
   (See Table 6-1 for complete hydrograph tabulation, Columns 1 and 2.)

Example No. 2 -- Determine a hydrograph 2 miles downstream of the hydrograph developed in example problem No. 1. The average bank full velocity is 2.1 feet per second and the data is for preliminary design purposes. Add in the hydrograph for the intervening area representing the drainage area along the 2 mile reach.

Given: The stream reach is 2 miles long. The average bank full velocity is 2.1 feet per second. The intervening drainage area is 1000 acres with a runoff curve number of 68 and a T_c = 1.6 hour.

1. Tabulate the hydrograph from Example No. 1 in the form of an operations table. (See Table 6-1.)
2. Perform the stream routing by the Wilson tabular method. See appendix B for a derivation of the equations for the Wilson tabular method. The working equations for the Wilson tabular method are as follows:

$$Q_2 = \frac{I_1 + I_2 + O_1 (C-1)}{C + 1}; \quad C = \frac{2\ T_w}{\Delta T}; \quad T_w = \frac{T_t}{R} = \frac{T_t}{1.3}$$

O_1 and O_2 are outflows at points 1 and 2 respectfully.

I_1 and I_2 are inflows at points 1 and 2 respectfully.

T_t is the travel time of the reach based upon the bank full velocity or a velocity associated with a given frequency flow.

T_w is the travel time of the reach based upon the flood wave velocity.

C is a routing coefficient.

1/ Table 6-6 is based upon a 0.25 hour time increment in the rainfall distribution table.

R is the ratio between T_t and T_w. Use R equal to 1.3.

ΔT is the time increment used in the hydrograph. ΔT should be between 0.5 T_w and 1.0 T_w.

3. Prepare the working equation:

$$T_t = \frac{2 \times 5280}{2.1 \text{ ft/sec.}} = 5029 \text{ sec.} \times \frac{1}{3600 \text{ sec/hr.}} = 1.40 \text{ Hours.}$$

$$T_w = \frac{T_t}{R} = \frac{1.40}{1.3} = 1.07$$

Set ΔT = 1.0 Hour $\qquad (0.5\ T_w < \Delta T < 1.0\ T_w)$

$$C = \frac{2\ T_w}{\Delta T} = \frac{2 \times 1.07}{1}$$

$$C = 2.14$$

$$O_2 = \frac{I_1 + I_2 + O_1\ (C-1)}{C + 1}$$

Therefore the working equation is:

$$O_2 = \frac{I_1 + I_2 + 1.14\ O_1}{3.14}$$

Example at time 15 hours.

$$O_{15} = \frac{462 + 366 + 1.14\ (572)}{3.14}$$

O_{15} - 471 cfs.

Complete Column 3 of Table 6-1.

4. Develop the hydrograph for the intervening area along the 2 mile reach and add it to the routed hydrograph.

$$\text{Drainage area} = \frac{1000}{640} = 1.56 \text{ sq. mi.}$$

RCN = 68 $\qquad T_c = 1.6$

Q = 1.88 inches (Table 3-5)

Read 1.6 Hydrograph family from Figure 5-1.

Using hydrograph family 1.5 and T_c of 1.0, find the tabulated hydrograph coordinates in Table 6-6.

Compute the hydrograph and record values in Column 4 of Table 6-1. The peak of the hydrograph occurs at time 10.6 hours and is:

$$q = 167.1 \text{ CSM/in.} \times 1.56 \text{ sq. mi.} \times 1.88''$$
$$= 490 \text{ cfs.}$$

The hydrograph for the intervening area does not start until 7.7 hours (page 6-18) because with a lower curve number, the runoff begins at a later time than it did for the first hydrograph. The lower curve number causes the period of excess rainfall to start at a later time. See Figure 6-1.

5. Add columns 3 and 4 to obtain the complete hydrograph at the lower end of the two mile reach.

TABLE 6-1

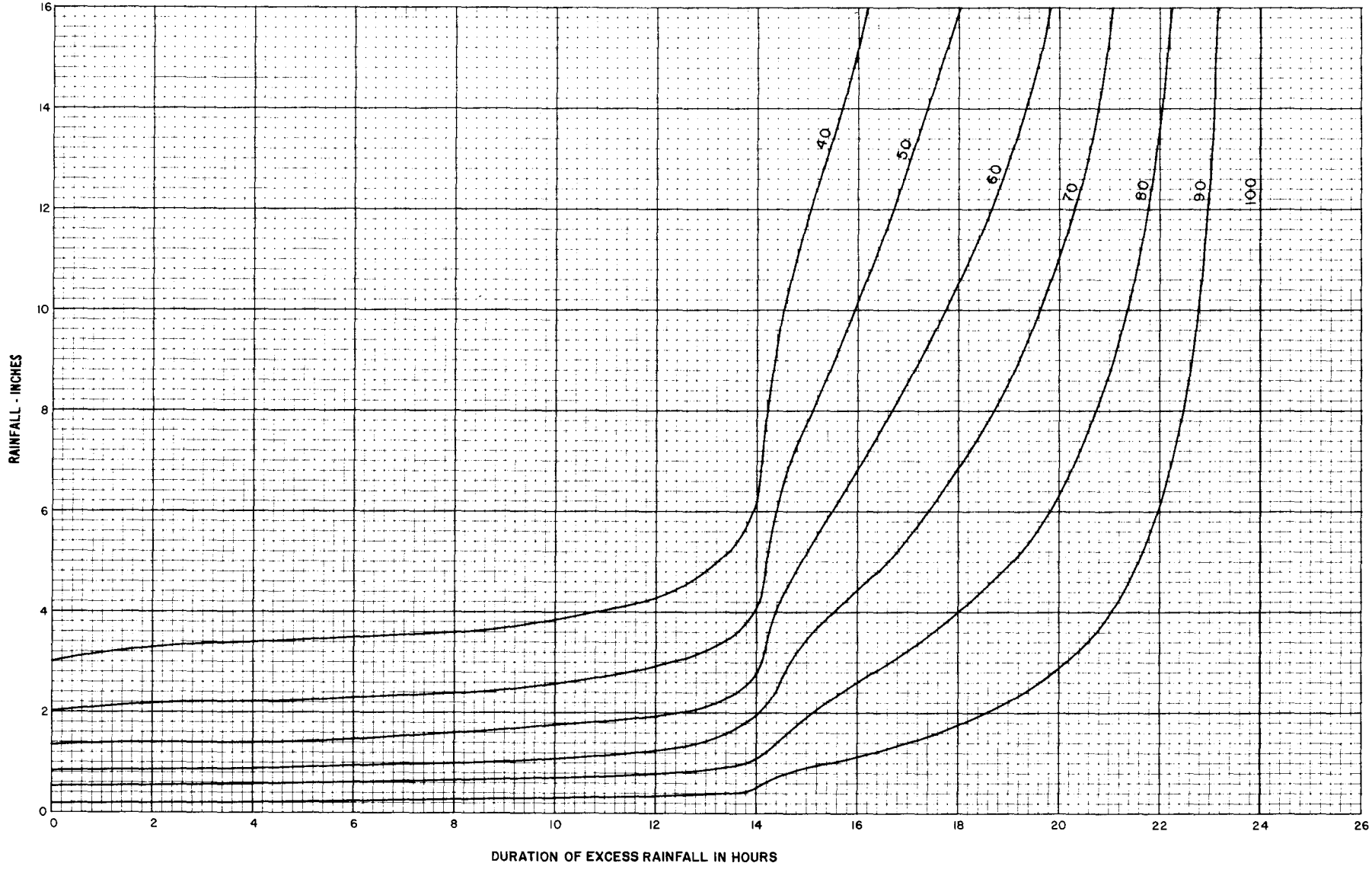
OPERATIONS TABLE, EXAMPLE NO. 2

Time (hrs)	Inflow, I (cfs)	Outflow, O (cfs)	Intervening Hydrograph (cfs)	Composite Hydrograph (cfs)
(1)	(2)	(3)	(4)	(5)
5	0	0	0	0
6	1	0.3	0	0.3
7	7	3	0	3
8	24	11	0.3	11.3
9	60	31	17	48
10	180	88	187	275
10.6		192 1/	490 (peak)	682
11	538	261	382	643
11.8	751 (peak)			
12	751	505	189	694
13	626	622	141	763
14	462	572	125	697
15	366	471	107	578
16	301	383	99	482
17	257	317	90	407
18	227	269	83	352
19	204	235	77	312
20	186	210	73	283
21	173	190	69	259
22	161	175	65	240
23	152	163	64	227
24	144	153	60	213
25	121	140	15	155
26	76	114	1	115
27	35	77	0	77
28	16	44	0	44
29	7	23	0	23
30	3	12	0	12
31	2	6	0	6
32	1	3	0	3
33	0	1	0	1

1/ interpolated

FIGURE 6–1

DURATION OF EXCESS RAINFALL FOR RUNOFF CURVE NUMBERS 40 TO 100
24-HOUR DURATION-TYPE 1 DISTRIBUTION STORMS



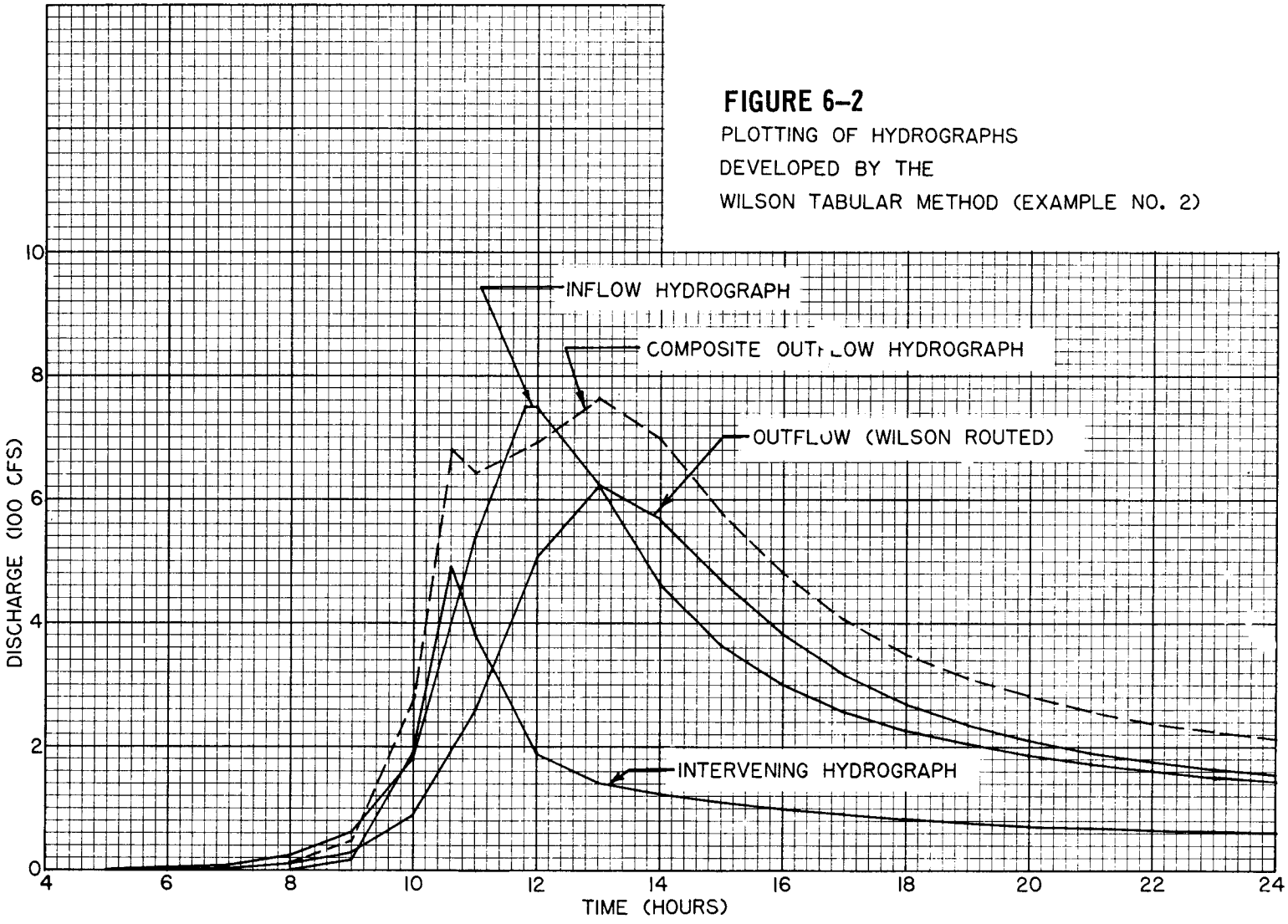


FIGURE 6–2

PLOTTING OF HYDROGRAPHS DEVELOPED BY THE WILSON TABULAR METHOD (EXAMPLE NO. 2)

SCS-ENG-13
2-71
(With Type I Rainfall
District Added)

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FIGURE 6-2

CUMULATIVE RAINFALL TABLE FOR 24 HOUR DURATION STORM

TYPE I RAINFALL DISTRIBUTION

(FOR DAMS 2)

WATERSHED _____ TECHNICIAN _____ DATE _____

Control Word	TABLE ID NAME		Duration, Hours	Any Alphameric Label				Card Ident.
RAINTABLE	24.1		24.0	24 HR RAINFALL DISTRIBUTION, TYPE I				
			Enter successive entries left to right with initial entry for time = 0.					
			.000	.008	.017	.026	.035	
			.045	.055	.065	.076	.087	
			.099	.112	.125	.140	.156	
			.174	.194	.219	.254	.303	
			.515	.583	.624	.654	.682	
			.705	.727	.748	.767	.784	
			.800	.816	.830	.844	.857	
			.870	.882	.893	.905	.916	
			.926	.936	.946	.955	.965	
			.974	.983	.992	1.000	1.000	
END TABLE								

Key Punch Operator: This Form Set Up For 10-Column Skip
Left Justify Data In Open Fields.

FIGURE 6-3

CUMULATIVE RAINFALL TABLE, FOR ONE-DAY WATERSHED EVALUATION STORMS

Type I Rainfall Distribution (For TR-20)

SCS-272 (a)
Rev. 6-65

Watershed _____ Hydrologist _____ Date _____

DATA CODE	TABLE ID NAME	TABLE ID NO.	DATA FIELD #1	DATA FIELD #2	DATA FIELD #3	DATA FIELD #4	DATA FIELD #5	CARD NO. / IDENTIFICATION
			IMPORTANT: Line out unused cards. Data fields require decimal points. KEYPUNCHER: Left justify data fields.					
		TABLE NO		TIME INCREMENT*				
5	RAINFL	1		0.5				
			Enter successive entries left to right with first entry for time = 0. Fill last row or data with last entry of table.					
8			.000	.008	.017	.026	.035	
8			.045	.055	.065	.076	.087	
8			.099	.112	.125	.140	.156	
8			.174	.194	.219	.254	.303	
8			.515	.583	.624	.654	.682	
8			.705	.727	.748	.767	.784	
8			.800	.816	.830	.844	.857	
8			.870	.882	.893	.905	.916	
8			.926	.936	.946	.955	.965	
8			.974	.983	.992	1.000	1.000	
9	ENDTBL		NOTE: This card must be the last card of this table.					

Watershed Program, Soil Conservation Service, Sept. 30, 1963

* Time increment is 0.5 hour. On "Executive Control for Watershed" (SCS-274) form set DATA FIELD # 2 to actual rainfall depth and DATA FIELD # 3 to 1.0.

SCS-ENG-271
REV. 7-72

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TABLE 6-4

CUMULATIVE RAINFALL TABLE, FOR PRINCIPAL SPILLWAY HYDROGRAPH (Q_1/Q_{10} = 0.5)

Watershed _____ Hydrologist _____ Date _____

DATA CODE	TABLE ID NAME	TABLE ID NO.	DATA FIELD #1	DATA FIELD #2	DATA FIELD #3	DATA FIELD #4	DATA FIELD #5	CARD NO. / IDENTIFICATION
			IMPORTANT: Line out unused cards. Data fields require decimal points. KEYPUNCHER: Left justify data fields.					
		TABLE NO.	TIME INCREMENT					
5	RAINFL	5		2.4				
			Enter successive entries left to right with first entry for time = 0. Fill last row of data with last entry of table.					
8			0.0	0.0030	0.0061	0.0093	0.0124	
8			0.0157	0.0189	0.0223	0.0257	0.0291	
8			0.0326	0.0362	0.0398	0.0435	0.0473	
8			0.0511	0.0550	0.0590	0.0631	0.0673	
8			0.0716	0.0759	0.0805	0.0851	0.0898	
8			0.0946	0.0996	0.1048	0.1101	0.1155	
8			0.1212	0.1271	0.1332	0.1395	0.1461	
8			0.1530	0.1602	0.1679	0.1759	0.1844	
8			0.1936	0.2033	0.2140	0.2256	0.2384	
8			0.2530	0.2699	0.2902	0.3166	0.3566	
8			0.6066	0.6646	0.6961	0.7190	0.7374	
8			0.7530	0.7667	0.7789	0.7899	0.8001	
8			0.8096	0.8184	0.8267	0.8345	0.8419	
8			0.8490	0.8557	0.8622	0.8684	0.8744	
8			0.8801	0.8857	0.8911	0.8963	0.9014	
8			0.9063	0.9111	0.9157	0.9203	0.9247	
8			0.9291	0.9333	0.9374	0.9415	0.9454	
8			0.9493	0.9531	0.9568	0.9605	0.9641	
8			0.9676	0.9711	0.9745	0.9779	0.9812	
8			0.9844	0.9876	0.9908	0.9939	0.9970	
9	ENDTBL		NOTE: This card must be the last card of this table.					

TABLE 6-5

CUMULATIVE RAINFALL TABLE, FOR EMERGENCY SPILLWAY OR FREEBOARD HYDROGRAPHS (FOR TR-20)

SCS-272 (b)
Rev. 6-65 Watershed _____ Hydrologist _____ Date _____

DATA CODE	TABLE ID NAME	TABLE ID NO.	DATA FIELD #1	DATA FIELD #2	DATA FIELD #3	DATA FIELD #4	DATA FIELD #5	CARD NO. / IDENTIFICATION
			IMPORTANT: Line out unused cards. Data fields require decimal points. KEYPUNCHER: Left justify data fields.					
		TABLE NO.		TIME INCREMENT*				
5	RAINFL	2		0.02				
			Enter successive entries left to right with first entry for time = 0. Fill last row of data with last entry of table.					
8			.00	.01	.02	.02	.03	
8			.04	.05	.06	.07	.08	
8			.10	.11	.13	.14	.17	
8			.19	.22	.27	.35	.44	
8			.52	.60	.63	.66	.68	
8			.70	.72	.74	.76	.77	
8			.79	.80	.82	.83	.84	
8			.85	.87	.88	.89	.90	
8			.91	.92	.93	.94	.95	
8			.9567	.9633	.97	.98	.99	
8			1.00	1.00	1.00	1.00	1.00	

Watershed Program, Soil Conservation Service, Sept. 30, 1963

9	ENTBDL	NOTE: This card must be the last card of this table.	

* Time increment is 0.02 of unit duration, hence storm duration and rainfall depth need to be shown in DATA FIELDS #3 and #2 respectively on " Executive Control for Watershed" (SCS-274) form

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1

T_c = 0.10				T_c = 0.25			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
5.0	0.0	14.5	29.8	5.0	0.0	14.5	30.2
5.5	1.0	15.0	29.6	5.5	0.7	15.0	29.6
6.0	2.3	15.5	29.5	6.0	2.0	15.5	29.4
6.5	4.2	16.0	26.3	6.5	3.9	16.0	26.1
7.0	6.5	16.5	26.2	7.0	6.1	16.5	26.1
7.5	9.4	17.0	23.0	7.5	8.8	17.0	23.5
8.0	12.7	17.5	22.8	8.0	12.0	17.5	23.5
8.5	18.2	18.0	22.8	8.5	17.7	18.0	22.7
8.6	23.4	18.5	22.7	8.6	19.2	18.5	22.7
8.7	25.8	19.0	19.4	8.7	22.3	19.0	20.1
8.8	28.3	19.5	19.3	8.8	24.9	19.5	20.0
8.9	32.7	20.0	19.2	8.9	28.1	20.0	19.2
9.0	34.3	20.5	19.2	9.0	31.3	20.5	19.2
9.1	38.3	21.0	19.2	9.1	34.0	21.0	19.2
9.2	40.6	21.5	19.1	9.2	37.1	21.5	19.1
9.3	45.8	22.0	15.7	9.3	40.1	22.0	16.5
9.4	56.9	22.5	15.7	9.4	46.6	22.5	16.5
9.5	60.4	23.0	15.7	9.5	54.1	23.0	16.5
9.6	116.9	23.5	15.6	9.6	70.4	23.5	16.5
9.7	141.5	24.0	15.5	9.7	104.4	24.0	15.6
9.8	216.1	24.3	0.0	9.8	142.3	24.5	0.4
9.9	400.1			9.9	238.3	24.8	0.0
10.0	449.9			10.0	348.7		
10.1	216.1			10.1	356.3		
10.2	135.8			10.2	251.2		
10.3	119.5			10.3	174.2		
10.4	94.7			10.4	133.0		
10.5	92.6			10.5	108.1		
10.6	81.0			10.6	95.5		
10.7	77.4			10.7	85.1		
10.8	73.0			10.8	79.0		
10.9	62.3			10.9	71.9		
11.0	61.3			11.0	65.3		
11.1	56.5			11.1	61.5		
11.2	55.1			11.2	57.9		
11.3	53.3			11.3	55.5		
11.4	49.3			11.4	52.7		
11.5	48.9			11.5	50.1		
12.0	48.6			12.0	48.8		
12.5	39.6			12.5	40.0		
13.0	39.2			13.0	39.3		
13.5	36.3			13.5	37.0		
14.0	33.0			14.0	33.7		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1

T_c = 0.50				T_c = 1.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
5.0	0.0	14.5	32.2	5.0	0.0	14.5	34.7
5.5	0.3	15.0	29.7	5.5	0.1	15.0	31.6
6.0	1.6	15.5	29.5	6.0	0.8	15.5	30.1
6.5	3.3	16.0	27.0	6.5	2.1	16.0	28.8
7.0	5.3	16.5	26.2	7.0	3.8	16.5	27.0
7.5	7.8	17.0	25.2	7.5	5.9	17.0	26.2
8.0	10.9	17.5	24.6	8.0	8.5	17.5	25.1
8.5	16.2	18.0	22.9	8.5	12.4	18.0	23.9
9.0	25.6	18.5	22.1	9.0	18.6	18.5	22.8
9.1	28.4	19.0	21.7	9.1	20.4	19.0	21.9
9.2	31.3	20.0	19.4	9.2	22.5	20.0	20.7
9.3	34.3	21.0	19.2	9.3	24.8	21.0	19.3
9.4	38.0	22.0	18.6	9.4	27.4	22.0	18.3
9.5	43.0	23.0	17.6	9.5	30.8	23.0	17.9
9.6	51.0	24.0	15.8	9.6	34.7	24.0	16.8
9.7	65.7	25.0	0.4	9.7	41.6	25.0	4.1
9.8	90.5	25.7	0.0	9.8	51.0	26.0	0.4
9.9	131.9			9.9	66.4	27.0	0.0
10.0	192.4			10.0	87.0		
10.1	251.0			10.1	111.5		
10.2	277.2			10.2	138.0		
10.3	256.5			10.3	163.1		
10.4	216.0			10.4	177.7		
10.5	175.9			10.5	185.7		
10.6	145.4			10.6	184.9		
10.7	123.4			10.7	176.8		
10.8	106.8			10.8	165.8		
10.9	94.7			10.9	150.4		
11.0	84.7			11.0	135.7		
11.1	76.5			11.1	122.6		
11.2	69.9			11.2	111.2		
11.3	64.6			11.3	101.1		
11.4	60.4			11.4	92.8		
11.5	56.7			11.5	85.0		
11.6	53.8			11.6	78.7		
11.7	51.7			11.7	73.0		
11.8	50.5			11.8	68.2		
11.9	49.7			11.9	64.4		
12.0	49.3			12.0	60.9		
12.5	43.1			12.5	50.6		
13.0	39.5			13.0	43.3		
13.5	38.5			13.5	40.1		
14.0	35.5			14.0	37.7		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1

T_c = 2.0				T_c = 3.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
5.0	0.0	24.0	17.7	5.0	0.0	24.0	18.3
6.0	0.2	25.0	12.3	6.0	0.1	25.0	15.4
7.0	1.8	26.0	4.3	7.0	0.9	26.0	9.6
8.0	5.2	27.0	1.3	8.0	3.1	27.0	4.5
8.2	6.1	28.0	0.4	8.2	3.7	28.0	2.0
8.4	7.1	29.0	0.1	8.4	4.5	29.0	0.9
8.6	8.3	30.0	0.0	8.6	5.4	30.0	0.4
8.8	9.8			8.8	6.3	31.0	0.2
9.0	11.5			9.0	7.6	32.0	0.1
9.2	13.5			9.2	8.8	33.0	0.0
9.4	16.5			9.4	11.0		
9.6	19.8			9.6	13.6		
9.8	28.5			9.8	16.6		
10.0	39.3			10.0	22.9		
10.2	55.4			10.2	29.2		
10.4	73.9			10.4	37.7		
10.6	94.0			10.6	47.8		
10.8	108.0			10.8	57.9		
11.0	119.4			11.0	68.2		
11.2	121.5			11.2	78.4		
11.4	120.2			11.4	86.2		
11.6	114.3			11.6	90.8		
11.8	105.5			11.8	95.3		
12.0	95.6			12.0	95.2		
12.2	86.9			12.2	94.3		
12.4	78.8			12.4	92.5		
12.6	72.4			12.6	88.4		
12.8	66.8			12.8	84.3		
13.0	61.7			13.0	79.4		
13.2	57.7			13.2	74.2		
13.4	53.9			13.4	69.3		
13.6	51.0			13.6	65.5		
13.8	48.3			13.8	61.8		
14.0	46.1			14.0	58.6		
15.0	37.7			15.0	46.4		
16.0	32.1			16.0	38.2		
17.0	28.4			17.0	32.6		
18.0	25.8			18.0	28.8		
19.0	23.6			19.0	25.9		
20.0	22.1			20.0	23.6		
21.0	20.4			21.0	21.9		
22.0	19.3			22.0	20.4		
23.0	18.5			23.0	19.3		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1

T_c = 4.0				T_c = 5.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
4.8	0.0	24.0	19.3	5.0	0.0	24.0	20.7
6.0	0.1	25.0	17.2	6.0	0.1	25.0	18.8
7.0	0.6	26.0	13.1	7.0	0.4	26.0	15.6
8.0	2.0	27.0	8.3	8.0	1.4	27.0	11.5
9.0	5.1	28.0	4.5	9.0	3.7	28.0	7.6
10.0	15.7	29.0	2.5	10.0	11.5	29.0	4.7
10.2	19.2	30.0	1.4	10.2	13.7	30.0	2.8
10.4	24.2	31.0	0.7	10.4	17.0	31.0	1.8
10.6	30.4	32.0	0.4	10.6	21.2	32.0	1.1
10.8	36.5	33.0	0.2	10.8	25.4	33.0	0.7
11.0	42.8	34.0	0.1	11.0	29.6	34.0	0.4
11.2	49.9	35.0	0.0	11.2	34.1	35.0	0.2
11.4	56.9			11.4	39.2	36.0	0.1
11.6	64.0			11.6	44.3	37.0	0.1
11.8	68.6			11.8	49.5	38.0	0.0
12.0	72.3			12.0	54.6		
12.2	76.0			12.2	57.5		
12.4	78.7			12.4	60.5		
12.6	78.8			12.6	63.4		
12.8	79.0			12.8	66.3		
13.0	79.1			13.0	67.5		
13.2	77.4			13.2	68.0		
13.4	75.3			13.4	68.4		
13.6	73.2			13.6	68.9		
13.8	70.7			13.8	68.6		
14.0	67.5			14.0	67.4		
14.2	64.4			14.2	66.2		
14.4	61.2			14.4	65.0		
14.6	58.8			14.6	63.6		
14.8	56.5			14.8	61.5		
15.0	54.1			15.0	59.4		
15.2	52.0			15.2	57.2		
15.4	50.2			15.4	55.1		
15.6	48.3			15.6	53.4		
15.8	46.5			15.8	51.7		
16.0	45.0			16.0	50.0		
17.0	38.0			17.0	42.9		
18.0	32.9			18.0	37.1		
19.0	29.1			19.0	32.7		
20.0	26.2			20.0	29.1		
21.0	23.9			21.0	26.3		
22.0	22.0			22.0	24.0		
23.0	20.5			23.0	22.2		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1

T_c = 6.0				T_c = 8.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
5.0	0.0	24.0	22.2	5.0	0.0	24.0	26.1
6.0	0.1	25.0	20.2	6.0	0.1	25.0	23.8
7.0	0.3	26.0	17.6	7.0	0.2	26.0	21.4
8.0	1.0	27.0	14.3	8.0	0.6	27.0	18.6
9.0	2.7	28.0	10.7	9.0	1.8	28.0	15.6
10.0	8.9	29.0	7.4	10.0	5.0	29.0	12.6
11.0	22.0	30.0	4.9	11.0	10.9	30.0	9.7
12.0	40.1	31.0	3.3	12.0	21.4	31.0	7.4
12.2	43.9	32.0	2.2	13.0	33.0	32.0	5.5
12.4	47.4	33.0	1.5	14.0	43.6	33.0	4.0
12.6	49.7	34.0	1.0	14.2	44.9	34.0	3.0
12.8	52.1	35.0	0.6	14.4	46.2	35.0	2.2
13.0	54.6	36.0	0.4	14.6	47.5	36.0	1.6
13.2	56.8	37.0	0.3	14.8	48.9	37.0	1.1
13.4	58.9	38.0	0.2	15.0	50.2	38.0	0.8
13.6	59.4	39.0	0.1	15.2	50.9	39.0	0.6
13.8	60.0	40.0	0.0	15.4	51.0	40.0	0.4
14.0	60.5			15.6	51.2	41.0	0.3
14.2	61.0			15.8	51.4	42.0	0.2
14.4	61.5			16.0	51.5	43.0	0.2
14.6	60.8			16.2	51.7	44.0	0.1
14.8	60.0			16.4	51.9	45.0	0.1
15.0	59.3			16.6	51.5	46.0	0.0
15.2	58.5			16.8	50.9		
15.4	57.7			17.0	50.3		
15.6	56.3			17.2	49.7		
15.8	54.8			17.4	49.0		
16.0	53.3			17.6	48.4		
16.2	51.8			17.8	47.8		
16.4	50.2			18.0	46.9		
16.6	48.9			18.2	45.9		
16.8	47.7			18.4	44.9		
17.0	46.4			18.6	43.9		
17.2	45.2			18.8	42.9		
17.4	43.9			19.0	41.9		
17.6	42.8			19.2	40.9		
17.8	41.8			19.4	40.1		
18.0	40.8			19.6	39.4		
19.0	36.1			19.8	38.6		
20.0	32.2			20.0	37.8		
21.0	29.0			21.0	34.2		
22.0	26.3			22.0	31.2		
23.0	24.1			23.0	28.5		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1

T_c = 10.0				T_c = 12.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
5.0	0.0	26.0	24.5	4.2	0.0	27.0	24.7
6.0	0.1	27.0	22.1	7.0	0.1	28.0	22.4
7.0	0.1	28.0	19.5	8.0	0.3	29.0	20.1
8.0	0.4	29.0	16.7	9.0	1.7	30.0	17.6
9.0	1.7	30.0	14.0	10.0	3.4	31.0	15.2
10.0	4.3	31.0	11.5	11.0	7.0	32.0	13.0
11.0	9.4	32.0	9.3	12.0	11.3	33.0	10.8
12.0	15.5	33.0	7.3	13.0	17.0	34.0	9.1
13.0	24.0	34.0	5.7	14.0	23.2	35.0	7.4
13.2	25.7	35.0	4.5	15.0	28.6	36.0	6.1
13.4	27.4	36.0	3.5	15.2	29.5	37.0	4.9
13.6	29.1	37.0	2.8	15.4	30.5	38.0	4.1
13.8	30.6	38.0	2.2	15.6	31.4	39.0	3.3
14.0	31.9	39.0	1.8	15.8	32.4	40.0	2.8
14.2	33.1	40.0	1.4	16.0	33.3	41.0	2.2
14.4	34.3	41.0	1.1	16.2	34.2	42.0	1.9
14.6	35.5	42.0	0.8	16.4	35.2	43.0	1.5
14.8	36.7	43.0	0.6	16.6	35.7	44.0	1.3
15.0	37.9	44.0	0.5	16.8	36.1	45.0	1.0
15.2	39.1	45.0	0.4	17.0	36.5	46.0	0.8
15.4	40.4	46.0	0.3	17.2	36.8	47.0	0.7
15.6	40.9	47.0	0.2	17.4	37.2	48.0	0.5
15.8	41.4	48.0	0.2	17.6	37.6	49.0	0.4
16.0	41.8	49.0	0.1	17.8	38.0	50.0	0.3
16.2	42.2	50.0	0.1	18.0	38.4	51.0	0.3
16.4	42.7	51.0	0.1	18.2	38.7	52.0	0.2
16.6	43.1	52.0	0.0	18.4	39.1	53.0	0.2
16.8	43.6			18.6	39.3	54.0	0.1
17.0	44.0			18.8	39.2	55.0	0.1
17.2	44.3			19.0	39.1	56.0	0.1
17.4	44.1			19.2	39.0	57.0	0.1
17.6	43.9			19.4	38.9	58.0	0.0
17.8	43.7			19.6	38.8		
18.0	43.5			19.8	38.7		
18.2	43.3			20.0	38.6		
18.4	43.1			20.2	38.5		
18.6	43.0			20.4	38.4		
18.8	42.8			20.6	38.2		
19.0	42.3			20.8	37.8		
20.0	39.3			21.0	37.4		
21.0	36.4			22.0	35.3		
22.0	33.7			23.0	33.1		
23.0	31.3			24.0	31.0		
24.0	29.0			25.0	28.9		
25.0	26.8			26.0	26.8		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1.5

T_c = 0.10				T_c = 0.25			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
7.6	0.0	17.0	27.5	7.6	0.0	17.0	28.0
8.0	1.7	17.5	27.1	8.0	1.1	17.5	27.9
8.5	6.1	18.0	27.0	8.5	5.2	18.0	27.3
8.6	8.6	18.5	26.8	8.6	6.3	18.5	27.1
8.7	10.4	19.0	23.6	8.7	8.2	19.0	24.2
8.8	12.3	19.5	23.4	8.8	10.0	19.5	23.9
8.9	15.4	20.0	23.3	8.9	12.3	20.0	23.5
9.0	17.3	20.5	23.2	9.0	14.7	20.5	23.4
9.1	20.5	21.0	23.1	9.1	17.1	21.0	23.2
9.2	23.0	21.5	22.8	9.2	19.8	21.5	23.1
9.3	27.3	22.0	19.2	9.3	22.7	22.0	20.3
9.4	35.8	22.5	19.1	9.4	27.9	22.5	20.2
9.5	39.8	23.0	19.1	9.5	34.1	23.0	20.2
9.6	82.0	23.5	19.0	9.6	47.1	23.5	20.0
9.7	105.9	24.0	18.8	9.7	74.3	24.0	19.2
9.8	173.8	24.3	0.0	9.8	108.3	24.5	0.4
9.9	349.9			9.9	196.8	24.8	0.0
10.0	423.7			10.0	309.2		
10.1	211.4			10.1	331.9		
10.2	136.2			10.2	241.1		
10.3	121.5			10.3	171.5		
10.4	97.3			10.4	133.7		
10.5	95.9			10.5	110.4		
10.6	84.4			10.6	98.9		
10.7	81.3			10.7	89.0		
10.8	77.1			10.8	83.1		
10.9	66.1			10.9	76.1		
11.0	65.3			11.0	69.6		
11.1	60.5			11.1	65.8		
11.2	59.1			11.2	62.2		
11.3	57.4			11.3	59.9		
11.4	54.2			11.4	57.0		
11.5	52.9			11.5	54.4		
12.0	52.7			12.0	53.9		
12.5	44.5			12.5	44.6		
13.0	43.6			13.0	44.3		
13.5	41.2			13.5	42.1		
14.0	37.7			14.0	38.6		
14.5	34.7			14.5	34.9		
15.0	34.3			15.0	34.6		
15.5	33.9			15.5	34.2		
16.0	30.9			16.0	30.8		
16.5	30.6			16.5	30.7		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1.5

T_c = 0.50				T_c = 1.00			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
7.6	0.0	17.0	29.6	7.7	0.0	17.0	30.8
8.0	0.4	17.5	29.0	8.0	0.1	17.5	29.7
8.5	3.6	18.0	27.1	8.5	1.6	18.0	28.4
9.0	10.5	18.5	26.3	9.0	5.7	18.5	27.2
9.1	12.6	19.0	26.0	9.1	7.0	19.0	26.6
9.2	14.9	19.5	25.8	9.2	8.6	19.5	26.2
9.3	17.5	20.0	23.3	9.3	10.3	20.0	25.0
9.4	20.6	20.5	23.1	9.4	12.3	20.5	23.7
9.5	24.7	21.0	23.1	9.5	15.0	21.0	23.4
9.6	31.1	21.5	22.5	9.6	18.1	21.5	23.1
9.7	43.0	22.0	22.2	9.7	23.8	22.0	22.7
9.8	63.7	22.5	22.0	9.8	31.7	22.5	22.2
9.9	100.4	23.0	21.4	9.9	45.2	23.0	21.9
10.0	157.3	23.5	21.4	10.0	63.9	23.5	21.6
10.1	216.2	24.0	19.3	10.1	86.7	24.0	20.6
10.2	247.7	24.5	4.9	10.2	112.6	24.5	14.5
10.3	235.4	25.0	0.4	10.3	137.7	25.0	5.1
10.4	202.7	25.5	0.0	10.4	154.2	25.5	1.5
10.5	168.3			10.5	164.7	26.0	0.4
10.6	141.7			10.6	167.1	26.5	0.1
10.7	122.3			10.7	162.5	27.0	0.0
10.8	107.5			10.8	154.9		
10.9	96.5			10.9	142.5		
11.0	87.2			11.0	130.4		
11.1	79.5			11.1	119.3		
11.2	73.2			11.2	109.5		
11.3	68.2			11.3	100.7		
11.4	64.1			11.4	93.3		
11.5	60.5			11.5	86.4		
11.6	57.7			11.6	80.7		
11.7	55.7			11.7	75.5		
11.8	54.5			11.8	71.1		
11.9	53.9			11.9	67.6		
12.0	53.7			12.0	64.5		
12.5	47.5			12.5	55.0		
13.0	44.1			13.0	48.0		
13.5	43.4			13.5	45.1		
14.0	40.3			14.0	42.8		
14.5	36.8			14.5	39.7		
15.0	34.2			15.0	36.4		
15.5	34.2			15.5	34.9		
16.0	31.4			16.0	33.6		
16.5	30.6			16.5	31.7		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1.5

T_c = 2.0				T_c = 3.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
7.6	0.0	24.0	21.5	7.6	0.0	24.0	22.3
8.0	0.1	25.0	15.0	8.0	0.1	25.0	18.8
8.2	0.1	26.0	5.2	9.0	1.1	26.0	11.7
8.4	0.3	27.0	1.6	10.0	11.8	27.0	5.6
8.6	0.6	28.0	0.5	10.2	17.1	28.0	2.5
8.8	1.2	29.0	0.1	10.4	24.7	29.0	1.1
9.0	2.0	30.0	0.0	10.6	34.0	30.0	0.5
9.2	3.2			10.8	43.4	31.0	0.2
9.4	5.1			11.0	53.9	32.0	0.1
9.6	7.4			11.2	64.3	33.0	0.0
9.8	14.5			11.4	72.7		
10.0	23.7			11.6	78.4		
10.2	38.2			11.8	84.1		
10.4	55.5			12.0	85.4		
10.6	74.8			12.2	86.1		
10.8	89.7			12.4	85.8		
11.0	102.4			12.6	83.1		
11.2	107.0			12.8	80.5		
11.4	108.3			13.0	76.8		
11.6	105.3			13.2	72.8		
11.8	99.0			13.4	68.8		
12.0	91.5			13.6	65.8		
12.2	84.4			13.8	62.8		
12.4	77.9			14.0	60.2		
12.6	72.5			14.2	57.9		
12.8	67.8			14.4	55.6		
13.0	63.5			14.6	53.6		
13.2	60.0			14.8	51.7		
13.4	56.7			15.0	49.8		
13.6	54.2			15.2	48.2		
13.8	51.9			15.4	46.6		
14.0	49.9			15.6	45.1		
15.0	42.1			15.8	43.7		
16.0	36.6			16.0	42.4		
17.0	32.9			17.0	37.1		
18.0	30.2			18.0	33.4		
19.0	27.8			19.0	30.4		
20.0	26.3			20.0	28.1		
21.0	24.4			21.0	26.2		
22.0	23.2			22.0	24.6		
23.0	22.4			23.0	23.4		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1.5

T_c = 4.0				T_c = 5.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
7.4	0.0	27.0	10.1	7.6	0.0	28.0	9.3
8.0	0.1	28.0	5.5	8.0	0.1	29.0	5.7
9.0	0.7	29.0	3.0	9.0	0.5	30.0	3.5
10.0	7.6	30.0	1.7	10.0	5.5	31.0	2.2
10.2	10.3	31.0	0.9	10.2	7.1	32.0	1.3
10.4	14.6	32.0	0.5	10.4	9.9	33.0	0.8
10.6	20.1	33.0	0.3	10.6	13.5	34.0	0.5
10.8	25.6	34.0	0.1	10.8	17.1	35.0	0.3
11.0	31.3	35.0	0.1	11.0	20.7	36.0	0.2
11.2	38.2	36.0	0.0	11.2	24.7	37.0	0.1
11.4	45.2			11.4	29.7	38.0	0.1
11.6	52.2			11.6	34.6	39.0	0.0
11.8	57.3			11.8	39.5		
12.0	61.6			12.0	44.5		
12.2	65.9			12.2	47.8		
12.4	69.3			12.4	51.1		
12.6	70.4			12.6	54.4		
12.8	71.6			12.8	57.7		
13.0	72.7			13.0	59.5		
13.2	71.9			13.2	60.7		
13.4	70.8			13.4	61.8		
13.6	69.7			13.6	63.0		
13.8	68.1			13.8	63.4		
14.0	65.8			14.0	62.9		
14.2	63.4			14.2	62.4		
14.4	61.1			14.4	61.9		
14.6	59.2			14.6	61.3		
14.8	57.3			14.8	59.8		
15.0	55.4			15.0	58.2		
15.2	53.7			15.2	56.7		
15.4	52.2			15.4	55.2		
15.6	50.7			15.6	53.9		
15.8	49.2			15.8	52.5		
16.0	47.9			16.0	51.2		
17.0	41.8			17.0	45.5		
18.0	37.1			18.0	40.6		
19.0	33.4			19.0	36.5		
20.0	30.5			20.0	33.2		
21.0	28.3			21.0	30.5		
22.0	26.3			22.0	28.2		
23.0	24.7			23.0	26.3		
24.0	23.4			24.0	24.8		
25.0	20.9			25.0	22.7		
26.0	16.0			26.0	19.0		
				27.0	14.0		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1.5

T_c = 6.0				T_c = 8.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
7.2	0.0	27.0	17.2	7.0	0.0	27.0	21.8
8.0	0.1	28.0	12.9	8.0	0.1	28.0	18.4
9.0	0.4	29.0	9.0	9.0	0.4	29.0	14.9
10.0	4.4	30.0	6.0	10.0	2.4	30.0	11.5
11.0	15.1	31.0	4.0	11.0	6.7	31.0	8.8
11.2	17.7	32.0	2.7	12.0	15.8	32.0	6.5
11.4	20.7	33.0	1.8	13.0	26.8	33.0	4.7
11.6	24.4	34.0	1.2	13.2	29.2	34.0	3.6
11.8	28.0	35.0	0.8	13.4	31.6	35.0	2.7
12.0	31.7	36.0	0.5	13.6	34.0	36.0	1.9
12.2	35.3	37.0	0.3	13.8	36.0	37.0	1.4
12.4	38.7	38.0	0.2	14.0	37.6	38.0	1.0
12.6	41.3	39.0	0.1	14.2	39.1	39.0	0.7
12.8	43.9	40.0	0.1	14.4	40.7	40.0	0.5
13.0	46.5	41.0	0.0	14.6	42.2	41.0	0.4
13.2	49.1			14.8	43.8	42.0	0.3
13.4	51.5			15.0	45.3	43.0	0.2
13.6	52.6			15.2	46.3	44.0	0.1
13.8	53.6			15.4	46.8	45.0	0.1
14.0	54.7			15.6	47.3	46.0	0.1
14.2	55.7			15.8	47.8	47.0	0.0
14.4	56.8			16.0	48.4		
14.6	56.6			16.2	48.9		
14.8	56.4			16.4	49.4		
15.0	56.2			16.6	49.3		
15.2	56.0			16.8	49.1		
15.4	55.8			17.0	48.8		
15.6	54.8			17.2	48.5		
15.8	53.8			17.4	48.3		
16.0	52.7			17.6	48.0		
16.2	51.7			17.8	47.7		
16.4	50.6			18.0	47.0		
16.6	49.6			18.2	46.3		
16.8	48.7			18.4	45.5		
17.0	47.7			18.6	44.8		
18.0	43.2			18.8	44.0		
19.0	39.2			19.0	43.3		
20.0	35.8			20.0	40.0		
21.0	32.8			21.0	37.0		
22.0	30.3			22.0	34.3		
23.0	28.1			23.0	32.0		
24.0	26.2			24.0	29.7		
25.0	24.1			25.0	27.4		
26.0	21.1			26.0	24.9		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 1.5

T_c = 10.0				T_c = 12.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
6.8	0.0	26.0	27.7	6.6	0.0	27.0	27.5
8.0	0.1	27.0	25.2	9.0	0.9	28.0	25.1
9.0	0.8	28.0	22.4	10.0	2.2	29.0	22.7
10.0	2.6	29.0	19.3	11.0	5.0	30.0	20.0
11.0	6.6	30.0	16.3	12.0	8.5	31.0	17.4
12.0	11.5	31.0	13.3	13.0	13.5	32.0	14.9
13.0	19.3	32.0	10.8	14.0	19.2	33.0	12.4
14.0	28.2	33.0	8.5	15.0	24.5	34.0	10.4
15.0	33.2	34.0	6.6	16.0	29.4	35.0	8.4
16.0	37.8	35.0	5.3	17.0	33.2	36.0	7.0
16.2	38.5	36.0	4.1	18.0	35.8	37.0	5.6
16.4	39.1	37.0	3.3	18.2	36.4	38.0	4.7
16.6	39.8	38.0	2.6	18.4	36.9	39.0	3.8
16.8	40.4	39.0	2.0	18.6	37.3	40.0	3.2
17.0	41.1	40.0	1.6	18.8	37.4	41.0	2.6
17.2	41.6	41.0	1.2	19.0	37.4	42.0	2.1
17.4	41.7	42.0	1.0	19.2	37.5	43.0	1.7
17.6	41.7	43.0	0.7	19.4	37.6	44.0	1.4
17.8	41.8	44.0	0.6	19.6	37.7	45.0	1.2
18.0	41.9	45.0	0.4	19.8	37.8	46.0	1.0
18.2	41.9	46.0	0.3	20.0	37.9	47.0	0.8
18.4	42.0	47.0	0.3	20.2	38.0	48.0	0.6
18.6	42.1	48.0	0.2	20.4	38.1	49.0	0.5
18.8	42.2	49.0	0.1	20.6	38.1	50.0	0.4
19.0	41.9	50.0	0.1	20.8	37.8	51.0	0.3
19.2	41.5	51.0	0.1	21.0	37.6	52.0	0.2
19.4	41.1	52.0	0.1	21.2	37.3	53.0	0.2
19.6	40.8	53.0	0.0	21.4	37.1	54.0	0.1
19.8	40.4			21.6	36.8	55.0	0.1
20.0	40.0			21.8	36.5	56.0	0.1
20.2	39.6			22.0	36.3	57.0	0.1
20.4	39.3			22.2	36.0	58.0	0.0
20.6	38.9			22.4	35.8		
20.8	38.4			22.6	35.5		
21.0	38.0			22.8	35.2		
21.2	37.6			23.0	34.8		
21.4	37.2			23.2	34.5		
21.6	36.7			23.4	34.2		
21.8	36.3			23.6	33.8		
22.0	35.9			23.8	33.5		
23.0	33.9			24.0	33.2		
24.0	31.9			25.0	31.4		
25.0	29.9			26.0	29.5		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 2

T_c = 0.10				T_c = 0.25			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
8.5	0.0	18.5	28.9	8.5	0.0	18.5	29.2
8.6	0.2	19.0	25.9	8.6	0.1	19.0	26.2
8.7	1.4	19.5	25.6	8.7	0.4	19.5	25.8
8.8	3.0	20.0	25.5	8.8	1.4	20.0	25.6
8.9	5.2	20.5	25.3	8.9	2.9	20.5	25.4
9.0	7.2	21.0	25.2	9.0	4.8	21.0	25.2
9.1	10.0	21.5	24.8	9.1	6.9	21.5	25.1
9.2	12.5	22.0	21.2	9.2	9.4	22.0	22.2
9.3	16.2	22.5	21.1	9.3	12.1	22.5	22.1
9.4	23.0	23.0	21.0	9.4	16.4	23.0	22.0
9.5	27.3	23.5	20.9	9.5	21.7	23.5	21.8
9.6	60.4	24.0	20.7	9.6	32.4	24.0	21.0
9.7	83.5	24.3	0.0	9.7	55.0	24.5	0.5
9.8	146.3			9.8	85.7	24.8	0.0
9.9	314.7			9.9	167.3		
10.0	401.4			10.0	277.8		
10.1	205.1			10.1	308.7		
10.2	134.2			10.2	228.8		
10.3	120.8			10.3	165.3		
10.4	97.3			10.4	130.6		
10.5	96.3			10.5	109.0		
10.6	85.2			10.6	98.3		
10.7	82.3			10.7	88.9		
10.8	78.3			10.8	83.5		
10.9	67.3			10.9	76.7		
11.0	66.8			11.0	70.3		
11.1	61.9			11.1	66.6		
11.2	60.7			11.2	63.2		
11.3	59.0			11.3	61.0		
11.4	56.4			11.4	58.2		
11.5	54.5			11.5	55.6		
12.0	54.4			12.0	55.5		
12.5	46.8			12.5	46.3		
13.0	45.7			13.0	46.2		
13.5	43.6			13.5	44.1		
14.0	40.0			14.0	40.7		
14.5	37.2			14.5	36.9		
15.0	36.7			15.0	36.8		
15.5	36.2			15.5	36.3		
16.0	33.3			16.0	33.0		
16.5	33.0			16.5	32.7		
17.0	29.9			17.0	30.1		
17.5	29.4			17.5	29.9		
18.0	29.2			18.0	29.5		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 2

T_c = 0.50				T_c = 1.00			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
8.5	0.0	18.0	29.3	8.5	0.0	18.0	30.5
9.0	2.2	18.5	28.6	9.0	0.7	18.5	29.3
9.1	3.7	19.0	28.4	9.1	1.2	19.0	28.7
9.2	5.5	19.5	28.0	9.2	2.0	19.5	28.2
9.3	7.6	20.0	25.4	9.3	3.0	20.0	27.0
9.4	10.3	20.5	25.3	9.4	4.3	20.5	25.7
9.5	13.8	21.0	25.2	9.5	6.4	21.0	25.4
9.6	19.3	21.5	24.7	9.6	8.7	21.5	25.1
9.7	29.3	22.0	24.3	9.7	13.5	22.0	24.7
9.8	47.3	22.5	24.1	9.8	20.2	22.5	24.2
9.9	80.7	23.0	23.6	9.9	32.1	23.0	23.9
10.0	134.4	23.5	23.6	10.0	49.2	23.5	23.6
10.1	192.6	24.0	21.3	10.1	70.2	24.0	22.5
10.2	226.7	24.5	5.5	10.2	95.0	24.5	15.9
10.3	219.4	25.0	0.5	10.3	119.3	25.0	5.6
10.4	191.8	25.5	0.0	10.4	136.5	25.5	1.7
10.5	161.4			10.5	148.1	26.0	0.5
10.6	137.4			10.6	152.4	26.5	0.1
10.7	119.8			10.7	149.9	27.0	0.0
10.8	106.3			10.8	144.6		
10.9	96.1			10.9	134.2		
11.0	87.5			11.0	124.0		
11.1	80.2			11.1	114.3		
11.2	74.2			11.2	105.7		
11.3	69.4			11.3	97.9		
11.4	65.4			11.4	91.3		
11.5	62.0			11.5	85.0		
11.6	59.2			11.6	79.8		
11.7	57.3			11.7	75.1		
11.8	56.2			11.8	71.1		
11.9	55.7			11.9	67.9		
12.0	55.6			12.0	65.0		
12.5	49.5			12.5	56.4		
13.0	46.2			13.0	49.7		
13.5	45.8			13.5	47.0		
14.0	42.7			14.0	44.8		
14.5	39.1			14.5	41.8		
15.0	36.6			15.0	38.5		
15.5	36.5			15.5	37.0		
16.0	33.7			16.0	35.7		
16.5	33.0			16.5	33.8		
17.0	32.0			17.0	33.0		
17.5	31.4			17.5	31.8		

TABLE 6-6

HYDROGRAPH COORDINATES
24 HOUR DURATION - TYPE I DISTRIBUTION STORM
HYDROGRAPH FAMILY 2

T_c = 2.0				T_c = 3.0			
Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.	Time (HR)	CSM/ IN.
8.4	0.0	28.0	0.5	8.2	0.0	28.0	2.7
9.0	0.2	29.0	0.1	9.0	0.2	29.0	1.2
9.2	0.5	30.0	0.0	9.2	0.3	30.0	0.5
9.4	1.5			9.4	1.0	31.0	0.2
9.6	2.7			9.6	1.9	32.0	0.1
9.8	8.3			9.8	3.3	33.0	0.0
10.0	16.1			10.0	7.6		
10.2	29.0			10.2	11.9		
10.4	45.0			10.4	18.5		
10.6	63.3			10.6	27.0		
10.8	78.3			10.8	35.4		
11.0	91.6			11.0	45.5		
11.2	97.4			11.2	55.6		
11.4	100.2			11.4	64.0		
11.6	98.7			11.6	70.0		
11.8	94.0			11.8	76.1		
12.0	88.0			12.0	78.2		
12.2	82.0			12.2	79.6		
12.4	76.3			12.4	80.1		
12.6	71.7			12.6	78.4		
12.8	67.5			12.8	76.6		
13.0	63.7			13.0	73.7		
13.2	60.6			13.2	70.3		
13.4	57.7			13.4	67.1		
13.6	55.4			13.6	64.5		
13.8	53.3			13.8	61.9		
14.0	51.5			14.0	59.7		
14.2	49.9			14.2	57.8		
14.4	48.4			14.4	55.8		
14.6	47.0			14.6	54.1		
14.8	45.6			14.8	52.4		
15.0	44.2			15.0	50.8		
16.0	38.9			16.0	44.0		
17.0	35.2			17.0	39.0		
18.0	32.6			18.0	35.4		
19.0	30.1			19.0	32.5		
20.0	28.6			20.0	30.2		
21.0	26.6			21.0	28.2		
22.0	25.4			22.0	26.6		
23.0	24.6			23.0	25.4		
24.0	23.6			24.0	24.3		
25.0	16.5			25.0	20.6		
26.0	5.8			26.0	12.8		
27.0	1.7			27.0	6.1		