WINDEMERE FARMS

SECTIONS 4 & 5

DRAINAGE CALCULATIONS

A. DETERMINE WATERSHED AREA (A)

ESTIMATED WATERSHED AREA	200,300	(4.6 A.)
ESTIMATED HARD SURFACE	86,900	(2.0 A.)
ESTIMATED GRASS SURFACE	113,400	(2.6 A.)

B. DETERMINE TIME OF CONCENTRATION (t_c)

1.) OVERLAND FLOW

DISTANCE : 360'

SURFACE : SHORT GRASS, FEW WEEDS

MANNING, n : 0.025 (TABLE)

SLOPE : 2.77%

$t_{c\,(OVER)}$: 5.5 MIN (NOMOGRAPH)

2.) CHANNELIZED FLOW/PIPED

DISTANCE : 880'

SURFACE : CONCRETE & POLYETHELENE

MANNING, n : 0.015 (TABLE)

SLOPE : 2.55%

t_c (CHANNEL): 3.4 MIN. (NOMOGRAPH

3.) TOTAL $t_c = t_{c(\text{OVER})} + t_{c(\text{CHANNEL})}$

$t_c = 5.5 + 3.4 =$ 8.9 MIN, USE 10 MIN

C. RETURN PERIOD STORM EVENT

USE 25 YR. (PER DRAINAGE ORDINANCE)

D. DETERMINE INTENSITY (I)

INTENSITY-DURATION-FREQUENCY

TABLE 13.04.205C (EVANSVILLE)

t_c = 10 MIN I = 5.925 IN/HR

E. DETERMINE RUNOFF COEFFICIENT (C)

TURF TYPE LAWNS @ 2-5% SLOPE = 0.25

IMPERVIOUS-PAVEMENT, ROOFTOP @

2-5% SLOPE = 0.94

F. DETERMINE WEIGHTED "C"

$$C_w = \frac{C_1 A_1}{A} + \frac{C_2 A_2}{2}$$

$$C_w = \frac{0.25(2.6)}{4.6} + \frac{0.94(2.0)}{4.6}$$

$C_w = 0.141 + 0.41 = \underline{0.551}$

G. CALCULATE PEAK RUNOFF RATE (Q)

$Q = CIA$

$Q = 0.551(5.925)(4.6)$

$Q = \underline{15.0 \text{ CFS}}$

H. DETERMINE PIPE SIZE

- SLOPE OF PIPE = $6'/270' = 0.0222 = \underline{2.22\%}$

  MANNINGS, $n = 0.012$
- USE 18" ϕ HDPE SMOOTH WALL PIPE
- CAPACITY = $\underline{17 \text{ CFS}}$ (OK)

USING MANNINGS, $n = 0.010$

- CAPACITY = $\underline{20 \text{ CFS}}$ (OK)

(USE EITHER PIPE.)

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2) **Layout Your System:** This includes shaping topography to develop adequate drainage patterns to catch basins or drain inlets, dividing the watershed into subwatersheds, and strategically placing storm drainage pipe and structures where required.

3) **Determine Time of Concentration (t_c):** Time of concentration is defined as the measure of time it takes the entire watershed to contribute to runoff at the outlet. It is influenced by surface roughness and slope, channel slope and flow patterns. Time of concentration increases with increasing slopes and when flow patterns become more defined through urbanization.

Where local equations do not govern, use of the time of concentration nomograph given in Figure 1 is a convenient method of determining time of concentration for a drainage system. Overland flow is characterized as shallow sheet flow across a given area, while channelized flow allows for significant depth of flow to convey runoff off-site; this occurs in swales, ditches, natural and improved channels, and pipe systems.

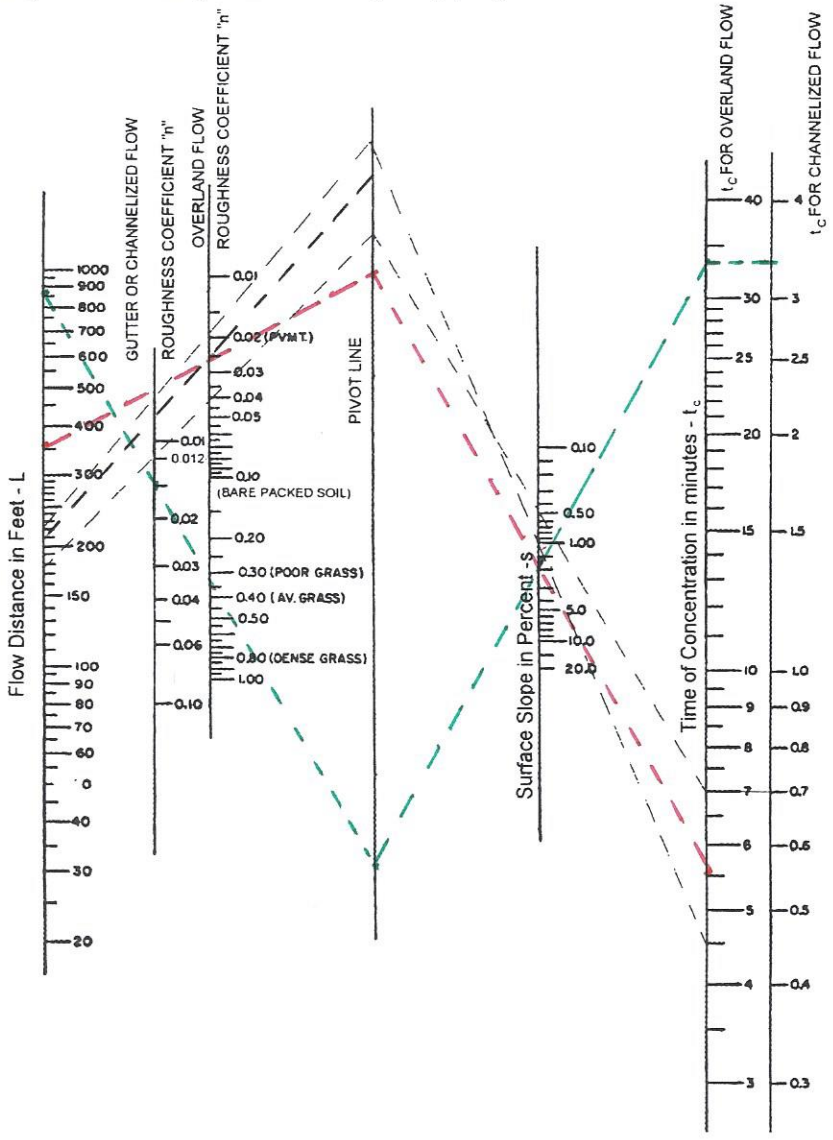
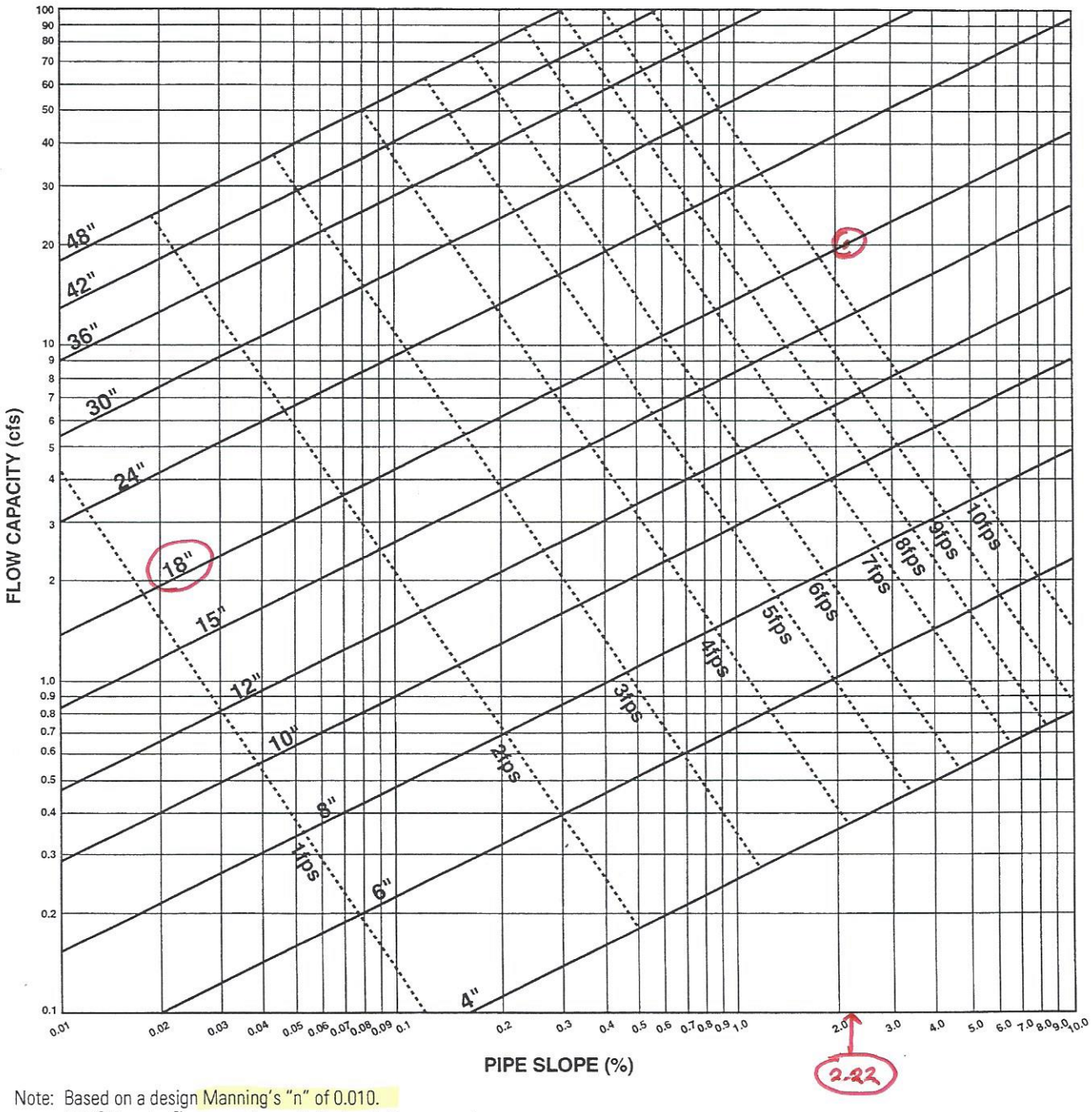


Figure 1: Time of concentration nomograph

Figure 3-1
Discharge Rates for Hancor Hi-Q® and Hi-Q® Sure-Lok™ Pipes



Note: Based on a design Manning's "n" of 0.010.
Hi-Q® Sure-Lok™ may not be available in all diameters shown.
Solid lines indicate pipe diameters. Dashed lines indicate approximate flow velocity.

TABLE 4

CIRCULAR PIPE FLOW CAPACITY
Full Flow (cubic feet per second)

Mannings "n"= 0.012

Dia. (in.)	*Conv. Factor	% Slope (feet per 100 feet)															
		0.02	0.05	0.10	0.20	0.35	0.50	0.75	1.00	1.25	1.50	1.75	2.0	2.5	5.0	10.0	20.0
		(c.f.s.)															
3	0.957	0.014	0.021	0.030	0.043	0.057	0.068	0.083	0.096	0.107	0.12	0.13	0.14	0.15	0.21	0.30	0.43
4	2.062	0.029	0.046	0.065	0.092	0.122	0.146	0.179	0.206	0.231	0.25	0.27	0.29	0.33	0.46	0.65	0.92
5	3.738	0.053	0.084	0.118	0.167	0.221	0.264	0.324	0.374	0.418	0.46	0.49	0.53	0.59	0.84	1.18	1.67
6	6.079	0.086	0.136	0.192	0.272	0.360	0.430	0.526	0.608	0.680	0.74	0.80	0.86	0.96	1.36	1.92	2.72
8	13.091	0.185	0.293	0.414	0.585	0.774	0.926	1.134	1.309	1.464	1.60	1.73	1.85	2.07	2.93	4.14	5.85
10	23.74	0.34	0.53	0.75	1.06	1.40	1.68	2.06	2.37	2.65	2.91	3.14	3.36	3.75	5.31	7.51	10.61
12	38.60	0.55	0.86	1.22	1.73	2.28	2.73	3.34	3.86	4.32	4.73	5.11	5.46	6.10	8.63	12.21	17.26
15	69.98	0.99	1.56	2.21	3.13	4.14	4.95	6.06	7.00	7.82	8.57	9.26	9.90	11.06	15.65	22.13	31.30
18	113.80	1.61	2.54	3.60	5.09	6.73	8.05	9.86	11.38	12.72	13.94	15.05	16.09	17.99	25.45	35.99	50.89
21	171.65	2.43	3.84	5.43	7.68	10.16	12.14	14.87	17.17	19.19	21.02	22.71	24.28	27.14	38.38	54.28	76.77
24	245.08	3.47	5.48	7.75	10.96	14.50	17.33	21.22	24.51	27.40	30.02	32.42	34.66	38.75	54.80	77.50	109.60
27	335.51	4.74	7.50	10.61	15.00	19.85	23.72	29.06	33.55	37.51	41.09	44.38	47.45	53.05	75.0	106.1	150.0
30	444.35	6.28	9.94	14.05	19.87	26.29	31.42	38.48	44.44	49.68	54.42	58.78	62.84	70.26	99.4	140.5	198.7
36	722.57	10.22	16.16	22.85	32.31	42.75	51.09	62.58	72.26	80.79	88.50	95.59	102.19	114.25	161.6	228.5	323.1
42	1089.9	15.41	24.37	34.47	48.74	64.5	77.1	94.4	109.0	121.9	133.5	144.2	154.1	172.3	243.7	344.7	487.4
48	1556.1	22.01	34.80	49.21	69.59	92.1	110.0	134.8	155.6	174.0	190.6	205.9	220.1	246.0	348.0	492.1	695.9

* Conveyance Factor = (1.486 x R2/3 x A) / n