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GOLDEN HILLS ADDITION

DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS

JUNE 7, 1985

OWNER: SUNRISE ENTERPRISES, LTD.
P.O. BOX 131
GODDARD, KANSAS 67052

ENGINEER: PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
1440 EAST ENGLISH
WICHITA, KANSAS 67211

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WICHITA, KANSAS 67211
(316) 262-2691

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MEMO

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PROFESSIONAL ASSOCIATION
1440 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

TO: File

ATTN:

PROJECT NO. 36-85032-

PROJECT: Golden Hills Drainage Plan

DATE: 6/4/85

COPIES TO:

M.E. Lindebak, P.E.,

Attn: C. Breitenstein, P.E.

FROM: Michael W. Berry, P.E.

REFERENCE: Drainage Plan Computations

PLEASE ADVISE IMMEDIATELY OF ANY MISCONCEPTIONS OR OMISSIONS YOU BELIEVE TO BE CONTAINED HEREIN.

Attached hereto are the computations for the referenced drainage plan.

The publication "Interim Drainage and Storm Sewer Policy for Design Criteria and Documentation, City of Wichita," noted "Tentative" and dated 5/2/85, as provided by D.E. Schneider of the MAPD, Division of Design, was used as a guide for the hydrologic and hydraulic computations. This publication is hereinafter referred to as the "Policy Manual." This "Policy Manual" was used for this project as a test of the procedures given therein.

Manual #1, as referenced herein, refers to "Design of Urban Highway Drainage - The State of the Art," by Reitz & Jens, Inc., April, 1980. Manual #2 refers to "Drainage of Highway Pavements, Hydraulic Engineering Circular #12," by Tye Engineering, Inc., March, 1984.

HYDROLOGY METHODS

The rational method was used for hydrologic analysis. Runoff coefficients were based on the table provided in Attachment D, of the "Policy Manual." The average lot in this development is 1/6 Ac; thus, the average of the 1/8 and 1/4-Ac values was used for C.

The time of concentration for overland flow was determined by either the velocities given in Attachment E, of the "Policy Manual" or by the Kinematic Wave Theory, as presented in Section 4.1.3, of Manual #2. Time of travel in street gutters was determined by the method used in Section 4.1.3, of Manual #2. The minimum time of concentration for design purposes was taken to be ten minutes for single family areas and five minutes for commercial and/or multi-family areas.

The two-year design storm was used for basins which do not discharge onto arterial streets. The five-year design storm was used for basins discharging onto arterial streets. In all cases, a check was made that the 100-year runoff was confined to the right-of-way.

HYDRAULIC DESIGN

For each inlet, street flooding and inlet capacity was checked for the minor storm. Conveyance in the street was based on the modified Manning Eq:

$$Q = 0.56/n(S_x)^{5/3}(T)^{8/3}\sqrt{S} \qquad \text{(Eq. 4, Manual \#2)}$$

It was assumed that t_c, for street flow, was equal to t_c, for pipe flow. This should be a conservative assumption.

For local streets, curb-deep flow is tolerable for the minor storm. For collectors, a single eight-foot center lane should remain unflooded for the minor storm. For arterials, one eight-foot lane in each direction should remain unflooded for the five-year storm.

Inlet capacities were determined by the methods presented in Manual #2, using charts 9, 10, and 12. Carryover flows were added to the next inlet downstream.

In this analysis, City of Wichita Type 1A Inlets, 3/8 in/ft street cross-slope, and 6-5/8 Std. curb and gutter were assumed to be utilized.

Pipe systems were designed using the calculated capacity of each inlet. System 450 and System 300 were designed for a five-year minor storm because they adjoin arterial streets. All other systems were designed on the basis of a two-year minor storm.

Preliminary pipe sizes were estimated and tabulated on the "Hydrology Data Sheets." Fine tuning of the pipe design was performed using PEC's Storm Program. This program uses Manning's Equation to calculate friction losses in pipes flowing full. Minor losses are accounted for using conservation of momentum principles. It is desirable to keep the hydraulic grade line approximately one-foot below the top of curb elevations. Several trials were made; only the computations for the best system are printed herein.

MAJOR STORM OVERFLOW

For each subarea, a check was made for conveyance capacity of the major storm. To simplify analysis, the following assumptions were made:

1. The time of concentration is identical for both the major and minor storm. Thus, a ratio of rainfall intensities is used to determine Q_{100} @ each point.

2. The pipe system capacity during the major storm is assumed to be the same as during the minor storm. This is a conservative assumption, because increased ponding depths during the major storm event will increase the available head on the inlet/pipe system, thus increasing the capacity.

3. Street conveyance was analyzed using only the street width. Depths above the curb up to the walk grade were used, but the conveyance of the parking was neglected. In general, the parking area conveyance is quite small, due to the relatively higher n factor. Again, Eq. 4, of Manual #2, was used.

In general, the minimum grade at the right-of-way line is 0.3' above the top of the curb. Where walk grades higher than minimum are required to confine the major storm overflow, walk elevations are shown on the drainage plan.

GENERAL SUMMARY OF SYSTEMS

For systems 100, 700 and 800, the minor storm is conveyed through pipe systems and the major storm is conveyed through the streets to Reserves B or C. Rear lot drainage around the perimeter of the plat is assumed to drain out across the plat boundary.

For systems 300 and 450, the minor storm (five-year) discharge is conveyed through pipes and the major storm (100-year) discharge is conveyed through street rights-of-way to either Central Ave. or 119th Street West. It is presumed that the 100-foot arterial street rights-of-wqy will convey the major storm overflow.

For system 500, the minor storm (two-year) is conveyed in a pipe system with an outfall on the east side of 119th Street West. No accounting of 119th Street drainage or any areas west of 119th Street West was made for the design of this ourfall. Separate analysis and design will be required for this area. It might be advantageous for the City/County officials to fund this analysis and design, and to upsize the proposed 42" conduit to handle the area lying outside of the Golden Hills plat. The outfall will daylight in the east ditch of 119th Street West and will be conveyed to Cowskin Creek.

The major storm overflow is routed at Hickory and at Bekemeyer (through a fhune) to 119th Street West right-of-way. The right-of-way is presumed to have capacity to convey this flow.

FEMA FLOODPLAIN REQUIREMENTS

Portions of Blks 10 and 12 lie within the regulatory floodplain of Cowskin Creek. The minimum pad elevation for these lots shall be one-foot above the 100-year design water surface and are as follows:

Blk. 10, Lots 20 thru 52	1332.30 M.S.L.	144.8
Blk. 10, Lots 53 thru 61	1331.60 M.S.L.	144.2
Blk. 12, Lots 16 thru 24	1331.60 M.S.L.	144.2

MWB/mkm

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Project Golden Hills Drainage Plan

Item System 100 – Shefford

RECURRENCE INTERVAL, YEARS (2) 5 10 25 50 100

Area	OVERLAND FLOW L ft	OVERLAND FLOW S_o ft/ft	OVERLAND FLOW V ft/sec	OVERLAND FLOW t_o min	Street	GUTTER FLOW T_1/T_2	GUTTER FLOW T_a/T_z	GUTTER FLOW L ft	GUTTER FLOW S_x in/ft	GUTTER FLOW S_o %	GUTTER FLOW V ft/s	GUTTER FLOW t_g min	GUTTER FLOW $t_c = t_o + t_g$ min	GUTTER FLOW T ft	HYDROLOGY C	HYDROLOGY i in/hr	HYDROLOGY A Ac	HYDROLOGY Q cfs
110	125	0.01	0.7	3	Delano	0	0.65	780	3/8	1.19	2.5	5.3	8.3	11				
					Shefford	11/13	0.95	500	3/8	0.43	2.3	2.2	10.5	13	0.48	4.66	2.8	6.3
120	125	0.01	0.7	3	Golden Hills	0	0.65	230	3/8	0.86	1.63	2.4	5.4	4				
					Delano	0.3	0.70	780	3/8	1.19	2.7	4.8	10.2	12½				
					Shefford	0.9	0.95	300	3/8	0.43	2.3	2.2	12.4	13	0.48	4.35	5.8	12.1
130	125	0.01	0.7	3	Golden Hills	0	0.65	110	3/8	0.32	0.5	3.4	6.4	3				
					Cindy	0.5	0.77	330	3/8	0.32	1.0	5.5	11.9	6				
					Cindy	1	1.0	670	3/8	1.83	3.1	3.6	15.5	6				
					Shefford	0.4	0.74	250	3/8	0.43	2.0	2.1	17.6	14				
					Shefford	1	1.0	120	3/8	3.00	5.2	0.4	18.0	9	0.52	3.78	5.5	10.8
140	125	0.01	0.7	3	Bekemeyer	0	0.65	150	3/8	0.80	2.1	1.2	4.2	6				
					Bekemeyer	6/6	1.0	350	3/8	3.37	4.2	1.4	5.6	6				
					Bekemeyer	6/8	0.88	240	3/8	2.83	4.7	0.9	6.5	8				
					Shefford	8/14	0.81	320	3/8	0.32	1.9	2.9	10	14	0.52	4.75	3.5	8.6
150 3 soil	100	0.01	0.7	2.4	Shefford	0	0.65	250	3/8	0.43	1.1	3.8	6.2	7				
					Shefford	1	1.0	175	3/8	3.00	4.2	0.7	6.9	6.5				
					Shefford	0.6	0.82	280	3/8	0.32	1.6	2.9	10	11	0.48	4.75	1.74	4.0
160 3 soil		USE	10 min	T_c									10		0.48	4.75	0.5	1.1
190 3 soil		USE	10 min	T_c									10		0.48	4.75	0.6	1.4

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Project GOLDEN HILLS DRAINAGE PLAN

Item SYSTEM 100 CON'T.

RECURRENCE INTERVAL, YEARS (2) 5 10 25 50 100

Section	Quantity	Area 170 S.W.1	Area 180 S.W.1
HYDROLOGY	Q cfs	7.3	5.5
HYDROLOGY	A Ac	3.2	2.4
HYDROLOGY	i in/hr	4.75	4.75
HYDROLOGY	C	0.48	0.48
GUTTER FLOW	T ft	8 14	8 14
GUTTER FLOW	$t_c = t_o + t_g$ min	5.3 10	5.3 10
GUTTER FLOW	t_g min	2.3 3.1	2.3 3.1
GUTTER FLOW	V ft/s	3.6 1.9	3.6 1.9
GUTTER FLOW	S_o	4.0 0.32	4.0 0.32
GUTTER FLOW	S_x	3/8 3/8	3/8 3/8
GUTTER FLOW	L ft	500 350	500 350
GUTTER FLOW	T_a/T_2	0.65 0.82	0.65 0.82
GUTTER FLOW	T_1/T_2	0 0.6	0 0.6
OVERLAND FLOW	t_o min	3	3
OVERLAND FLOW	V ft/sec	0.7	0.7
OVERLAND FLOW	S_o ft/ft	0.01	0.01
OVERLAND FLOW	L ft	125	125

Date	5/29/85
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Project	GOLDEN HILLS DRAINAGE PLAN
Item	SYSTEM 300 CENTRAL AVE.

RECURRENCE INTERVAL, YEARS 2 (5) 10 25 50 100

	OVERLAND FLOW				GUTTER FLOW									HYDROLOGY			
Area	L ft	S_o ft/ft	V ft/sec	t_o min	T_1/T_2	T_a/T_2	L ft	S_x	S_o	V ft/s	t_g min	$t_c = t_o + t_g$ min	T ft	C	i in/hr	A Ac.	Q cfs
310	140	0.01	0.7	3.3	0	0.65	575	3/8"	1.10	1.9	5.0	10	8	0.57	6.11	1.4	4.9
320	140	0.01	0.7	3.3	0 / 0.84	0.65 / 0.9	600 / 350	" / "	0.86 / 1.10	1.95 / 3.7	5.1 / 1.6	~~8.4~~ 10	11 / 13	0.57	6.11	2.9	10.1
325 / 34 K.W.	800 / "	0.01 / "	2.0 / "	6.7 / 9.0	0	0.65	850 + Tc's not additive	"	0.4	1.9	7.4	9.0	17	0.73	6.36	4.7	21.8
330	75	0.01	0.7	1.8	0	0.65	850	"	0.4	1.5	9.3	11.1	12	0.54	5.87	2.4	7.6
350	90	0.01	0.7	2.2	0	0.65	500	"	0.32	2.1	6.2	10	12	0.57	6.11	1.6	5.6
360	USE	Tc = 10 min												0.57	6.11	1.1	3.8
380	USE	Tc = 10 min												0.57	6.11	0.6	2.1
370	USE	Tc = 10 min												0.54	6.11	1.6	5.6
400	150	0.01	0.7	3.6	0	0.65	900	3/8"	0.32	1.5	10	13.6	14	0.57	5.41	3.6	11.1
410	75	0.01	0.7	1.8	0	0.65	900	"	0.32	1.5	10	11.8	14	0.57	5.73	2.9	9.5

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PROFESSIONAL ASSOCIATION
1440 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

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Project ____________

Item ____________

Recurrence Interval, Years (2) 5 10 25 50 100

Estimated

	OVERLAND FLOW				GUTTER FLOW									HYDROLOGY			
Area	L ft	S_o ft/ft	V ft/sec	t_o min	T_1/T_2	T_a/T_2	L ft	S_x in/ft	S_o	V ft/s	t_g min	$t_c=t_o+t_g$ min	T ft	C	i in/hr	A Ac	Q cfs
505 : SOIL	125'	0.01	0.7	3	0	0.65	1320	3/8	0.32	1.26	17.5	20.5	11	0.52	3.60	~~13.0~~ 6.1	11.4
Parkridge/Cindy ~~Pine Grove~~					~~11/14~~	~~0.90~~	~~225~~	"	~~0.36~~	~~2.1~~	~~1.8~~	~~22.3~~	14	~~0.52~~	~~3.49~~	~~13.0~~	~~23.6~~
520 C	125	0.01	0.7 North South	3	0	0.65	550	"	0.50	0.9	10.2	13.2	5	0.52	4.29	1.2 / 1.2	2.7
530 C	125	0.01	0.7 Murdock	3	0 6/12	0.65 0.77	750 300	" "	0.36 0.50	1.4 2.6	9.1 1.9	12.1 14	6 12	0.52	4.17	9.1	19.7
560 B	125	0.01	0.7	3	0	0.65	550	"	0.32	1.3	7.1	10.1	6	0.48	4.75	2.8	6.4
570 B	125	0.01	0.7	3	0	0.65	250	"	0.32	1.0	4.2	10	4	0.48	4.75	0.7	1.6
580 B	125	0.01	0.7	3	0	0.65	550	"	0.32	1.3	7.1	10.1	6	0.48	4.75	1.6	3.6
590 B	125	0.01	0.7	3	0	0.65	550	"	0.32	1.3	7.1	10.1	6	0.48	4.75	2.5	5.6
510 C	125	0.01	0.7	3	0	0.65	1330	3/8	0.32	1.26	17.5	20.5	11	0.52	3.60	6.9	12.9

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Project GOLDEN HILLS DRAINAGE PLAN

Item SYSTEM 700

RECURRENCE INTERVAL, YEARS (2) 5 10 25 50 100

	OVERLAND FLOW				GUTTER FLOW									HYDROLOGY			
Area	L ft	S_o ft/ft	V ft/sec	t_o min	T_1/T_2	T_a/T_2	L ft	S_x	S_o	V ft/s	t_g min	$t_c = t_o + t_g$ min	T ft	C	i in/hr	A Ac	Q cfs
700 C Soil	125	0.01	0.7	3	0	0.65	520	3/8"/'	0.32%	1.5	5.8	10	14	0.52	4.75	3.8	9.4
705 C Soil	125	0.01	0.7	3													
		BEKEMEYER			0	0.65	350	"	1.26%	1.7	3.4	6.4	6				
		GOLDEN HILLS			6/14	0.74	530	"	0.80%	2.7	3.3	10	14	0.52	4.75	4.9	12.1
710 C Soil	160	0.01	0.7	3.8	0	0.65	330	"	0.86%	1.7	3.3	10	8	0.52	4.75	2.3	5.7
720 B Soil	125	0.01	0.7	3													
			0.36%		0	0.65	500	"	0.36%	1.4	6.0	9	11				
			1.75%		0.78	0.90	150	"	1.75%	4.8	0.5	10	14	0.48	4.75	4.9	11.2
730 B Soil	125	0.01	0.7	3													
			0.86%		0	0.65	300	"	0.86%	1.4	3.7	6.7	6				
			0.43%		0.42	0.74	410	"	0.43%	1.6	4.4	11.1	10				
			1.75%		1.00	1.0	200	"	1.75%	4.3	0.8	11.9	10	0.48	4.40	3.4	7.2
740 B Soil	80	0.01	0.7	1.9													
			0.36%		0	0.65	500	"	0.36%	1.4	3.7	5.6	6				
			1.75%		0.67	0.85	350	"	1.75%	3.4	1.7	10	9	0.48	4.75	2.5	5.7

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Project GOLDEN HILLS DRAINAGE PLAN

Item MISC AREAS

RECURRENCE INTERVAL, YEARS   2 (5) 10 25 50 100

Area	Overland Flow L ft	Overland Flow So ft/ft	Overland Flow V ft/sec	Overland Flow to min	Gutter Flow T1/T2	Gutter Flow Ta/T2	Gutter Flow L ft	Gutter Flow Sx 1/1	Gutter Flow So %	Gutter Flow V ft/s	Gutter Flow tg min	tc = to + tg min	T ft	Hydrology C	Hydrology i in/hr	Hydrology A Ac	Hydrology Q cfs
450	130	0.01	0.7	3.1	0	0.65	880	3/8	0.4	1.7	8.8	11.9	14	0.55	5.71	2.5	7.9
460	140	0.01	0.7	4.5	0	0.65	1500	3/8	0.4	1.7	14.7	19.2	14	0.55	4.74	6.0	15.6
900	300	0.01		2.5	6	0.74	600	3/8	0.7	2.7	3.7	10	15	0.69	6.11	3.3	13.9
910	160	0.01	2.0	1.3	0	0.65	200	3/8	0.32	1.3	3.9	10	6	0.69	6.11	0.5	2.1
920	140	0.01	2.0	1.2	0	0.65	775	3/8	0.32	1.5	8.6	10	14	0.52	6.11	2.0	6.4
800 (← 2-YR DESIGN →)	150	0.01	0.7	3.6	0	0.65	275	3/8	2.88	3.1	1.5	10	6	0.48	4.75	1.1	2.5
810	150	0.01	0.7	3.6	0	0.65	275	3/8	2.88	3.1	1.5	10	8	0.48	4.75	1.8	4.1

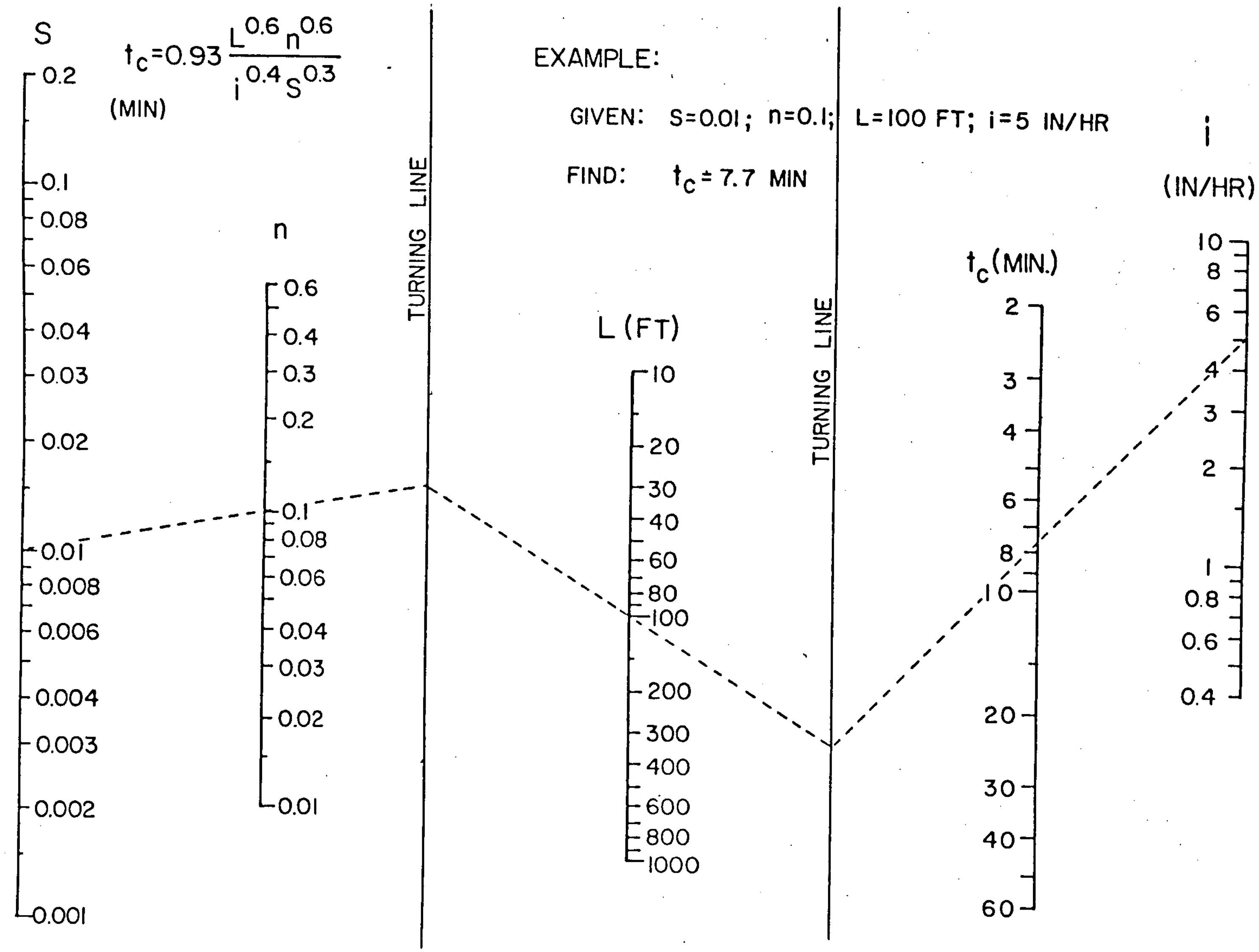

CHART 1. Kinematic wave formulation for determining time of concentration.

From: HEC-12, Drainage of Highway Pavements, FHWA, Mar. 1984

Table 3. Spread at average velocity in a reach of triangular gutter.

T_1/T_2	Ø	Ø.1	Ø.2	Ø.3	Ø.4	Ø.5	Ø.6	Ø.7	Ø.8
T_a/T_2	Ø.65	Ø.66	Ø.68	Ø.7Ø	Ø.74	Ø.77	Ø.82	Ø.86	Ø.9Ø

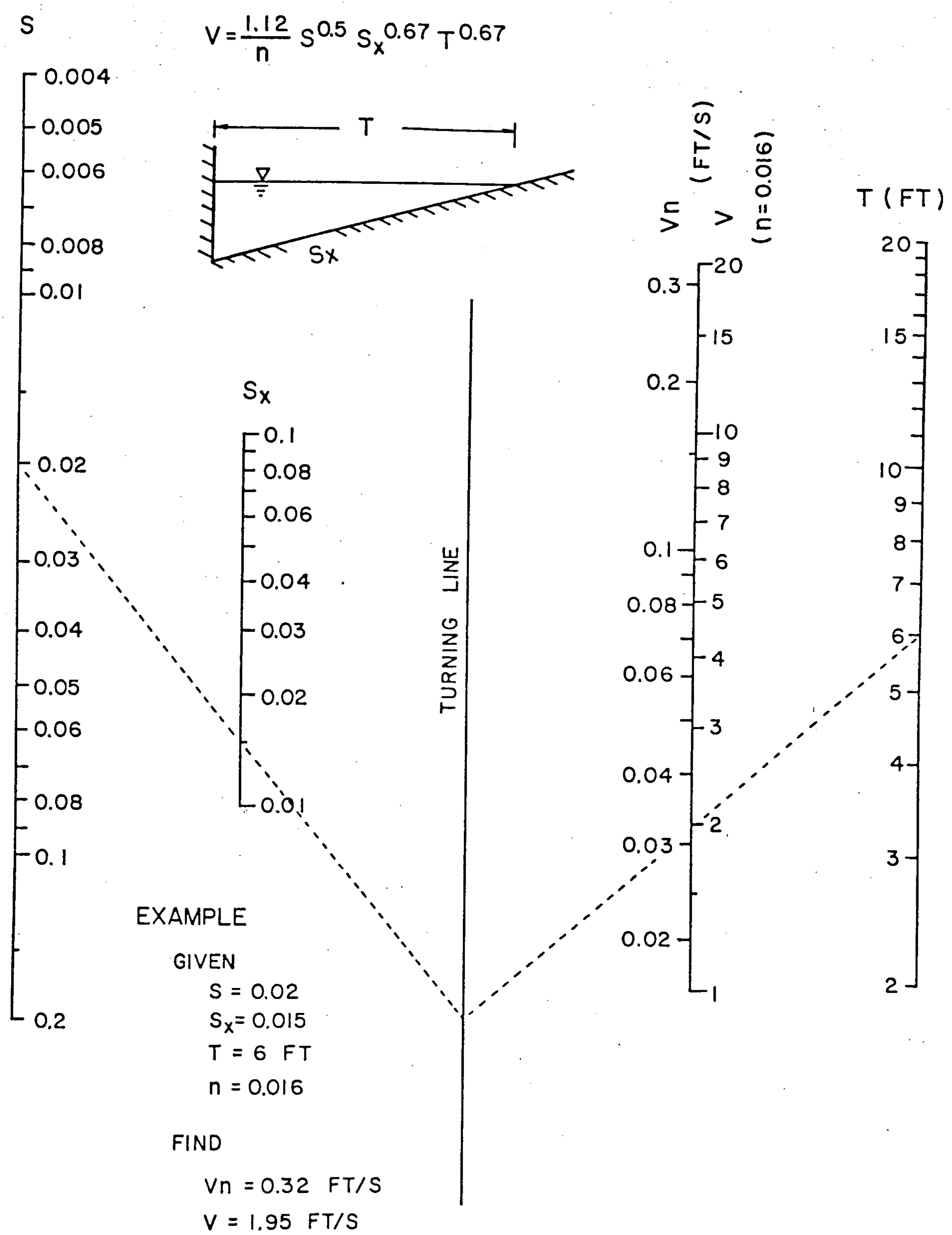

CHART 2. Velocity in triangular gutter sections.

From HEC-12: Drainage of Highway Pavements, F.H.W.A., Mar. 1984

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40.

DURATION IN MINUTES	RETURN PERIODS OF						
	1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.67	6.23	8.00	9.34	10.67	12.23	13.79
6	4.35	5.80	7.45	8.70	9.94	11.39	12.84
7	4.09	5.46	7.02	8.19	9.36	10.72	12.09
8	3.88	5.18	6.66	7.77	8.89	10.18	11.48
9	3.71	4.95	6.36	7.43	8.49	9.72	10.96
10	3.56	4.75	6.11	7.13	8.15	9.33	10.52
11	3.43	4.58	5.89	6.87	7.85	8.99	10.14
12	3.32	4.40	5.69	6.64	7.59	8.69	9.80
13	3.21	4.29	5.51	6.43	7.35	8.42	9.50
14	3.12	4.17	5.36	6.25	7.14	8.18	9.23
15	3.04	4.06	5.21	6.08	6.95	7.97	8.98
16	2.96	3.96	5.09	5.93	6.78	7.77	8.76
17	2.90	3.86	4.97	5.79	6.62	7.59	8.55
18	2.83	3.78	4.86	5.67	6.48	7.42	8.37
19	2.77	3.70	4.76	5.55	6.34	7.27	8.19
20	2.72	3.63	4.66	5.44	6.22	7.12	8.03
21	2.67	3.56	4.57	5.34	6.10	6.99	7.88
22	2.62	3.49	4.49	5.24	5.99	6.86	7.74
23	2.57	3.43	4.41	5.15	5.89	6.74	7.60
24	2.53	3.38	4.34	5.07	5.79	6.63	7.48
25	2.49	3.32	4.27	4.99	5.70	6.53	7.36
26	2.45	3.23	4.21	4.91	5.61	6.43	7.25
27	2.42	3.18	4.15	4.84	5.53	6.33	7.14
28	2.38	3.05	4.09	4.77	5.45	6.25	7.04
29	2.35	2.97	4.02	4.68	5.38	6.16	6.95
30	2.32	2.89	3.92	4.56	5.31	6.08	6.79
31	2.29	2.82	3.82	4.44	5.19	6.00	6.62
32	2.26	2.75	3.73	4.33	5.07	5.87	6.45
33	2.24	2.68	3.64	4.23	4.95	5.73	6.30
34	2.19	2.62	3.55	4.13	4.83	5.60	6.16
35	2.14	2.57	3.47	4.04	4.73	5.47	6.02
36	2.09	2.51	3.40	3.95	4.62	5.35	5.89
37	2.05	2.46	3.33	3.87	4.52	5.23	5.76
38	2.00	2.41	3.26	3.79	4.43	5.13	5.64
39	1.96	2.36	3.19	3.71	4.34	5.02	5.53
40	1.92	2.32	3.13	3.64	4.26	4.92	5.42
41	1.89	2.27	3.07	3.57	4.18	4.83	5.32
42	1.85	2.23	3.01	3.51	4.10	4.74	5.22
43	1.82	2.19	2.96	3.44	4.02	4.65	5.13
44	1.78	2.15	2.91	3.38	3.95	4.56	5.03
45	1.75	2.11	2.86	3.32	3.88	4.48	4.95

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

Land Use or Surface Characteristics	Percent Impervious	Frequency			
		2	5	10	100
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
Single Family (Soil Group D)					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
Multi-Family (Soil Group D)					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
Single Family (Soil Group C)					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
Multi-Family (Soil Group C)					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
Single-Family (Soil Group B)					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
Multi-Family (Soil Group B)					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

ATTACHMENT E

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

AVERAGE OVERLAND FLOW VELOCITY FOR USE WITH URBANIZED AREAS

Surface Type	VELOCITY IN FEET/SECOND FOR SLOPES IN PERCENT SHOWN																			
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	20.0
Forrest with Heavy Ground Litter or Meadow	0.08	0.11	0.14	0.16	0.18	0.19	0.20	0.22	0.23	0.25	0.35	0.42	0.50	0.55	0.60	0.66	0.70	0.75	0.80	1.10
Fallow or Minimum Tillage Cultivation	0.15	0.21	0.26	0.29	0.33	0.35	0.39	0.41	0.44	0.46	0.65	0.80	0.92	1.10	1.20	1.30	1.40	1.50	1.60	2.10
Short Grass Pasture or Lawns	0.23	0.32	0.38	0.44	0.50	0.53	0.58	0.62	0.66	0.70	1.00	1.20	1.40	1.60	1.80	1.90	2.00	2.10	2.20	3.20
Almost Bare Ground	0.32	0.44	0.53	0.62	0.69	0.75	0.82	0.87	0.92	0.98	1.40	1.70	1.90	2.10	2.30	2.50	2.70	2.90	3.10	4.40
Grassed Waterway	0.50	0.68	0.83	0.95	1.10	1.20	1.30	1.40	1.50	1.60	2.20	2.60	3.00	3.40	3.70	4.00	4.30	4.60	4.80	7.00
Paved Areas (Sheet Flow) or Shallow Gutter Flow	0.63	0.89	1.10	1.30	1.50	1.60	1.70	1.80	1.90	2.00	2.80	3.40	4.00	4.50	4.90	5.30	5.70	6.00	6.20	9.00

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PROFESSIONAL ASSOCIATION
1440 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

z/n : 2000

(2) 5 10 25 50 100-YR

Assume T_t in gutter = T_t in pipe. This will be conservative, for pipe velocities are in 5 ft/s range, whereas gutter velocities are in 1.5 - 4 ft/sec. Thus calculated Q will be higher than actual.

SYSTEM 100 SHEFFORD

NODE NO	HYDROLOGY Q_o cfs	HYDROLOGY Q_o+Q_b cfs	APPROACHING FLOW S_o %	APPROACHING FLOW S_x in/ft	APPROACHING FLOW d ft	APPROACHING FLOW T ft	INLET Type	INLET L	ON-GRADE COMP L_T ft	ON-GRADE COMP L/L_T	ON-GRADE COMP E	SUMP COMP. d_i ft	SUMP COMP. d ft	SUMP COMP. T ft	Q_i cfs	Q_b cfs	
110	5.8	5.8	0.43	3/8	0.39	12.5	1A	5	24	0.21	0.33				1.9	3.9	
150	3.9	7.8	0.32	3/8	0.46	14	1A	5				0.58	0.41	13.1	7.8	-0-	Spill Over Crown 0.05'
120	11.9	11.9															
W.	5.9		1.83	3/8	0.30	9.6											
S.	6.0		0.43	3/8	0.42	13.4	1A	10				0.52	0.35	11.2	11.9	-0-	
130	10.8	10.8															
W	5.4		2.83	3/8	0.28	9											
S	5.4		3.00	3/8	0.25	8	1A	10				0.50	0.33	10.6	10.8	-0-	
140	6.7	6.7	0.32	3/8	0.43	14	1A	5				0.50	0.33	10.6	6.7	-0-	
170	7.3	7.3	0.32	3/8	0.45	14	1A	5				0.55	0.42	13.4	7.3	-0-	SPILL 0.02' OVER CROWN
180	5.5	5.5	0.32	3/8	0.40	12.8	1A	5				0.42	0.25	8	5.5	-0-	
160	0.9	0.9	0.32	3/8	0.21	6.7	1A	5				—	—	—	0.9	-0-	
190	1.4	1.4	0.32	3/8	0.24	7.7	1A	5				0.13	-0-	—	1.4	-0-	

PROFESSIONAL ENGINEERING CONSULTANTS
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1440 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

Date ______ Page ______ of ______

Project ______

Item ______

2/n = 2000

5-YR

Assume T_t in gutter = T_t in pipe. This will be conservative, for pipe velocities are in 5 ft/s range, whereas gutter velocities are in 1.5 – 4 ft/sec. Thus calculated Q will be higher than actual.

NODE NO	HYDROLOGY Q_o cfs	HYDROLOGY Q_o+Q_b cfs	APPROACHING FLOW S_o %	APPROACHING FLOW S_x in/ft	APPROACHING FLOW d ft	APPROACHING FLOW T ft	INLET Type	INLET L	ON-GRADE COMP L_T ft	ON-GRADE COMP L/L_T	ON-GRADE COMP E	SUMP COMP. d_i ft	SUMP COMP. d ft	SUMP COMP. T ft	Q_i cfs	Q_b cfs	
310	4.9	4.9	1.10	3/8	0.31	9.9	1A	10	33	0.30	0.48				2.4	2.5	
Check Qb on Central			0.45	3/8	0.28	9.0	- OK -										
350	5.6	8.1															
N-	5.6		0.32	3/8	0.40	12.8											
W	See above						1A	5				0.61	0.44	14.1	8.1	-0-	
360	3.8	3.8	0.32	3/8	0.34	10.9	1A	5	18	0.28	0.45				1.7	2.1	
380	2.1	4.2	0.45	3/8	0.34	10.9	1A	5	22	0.22	0.35				1.5	2.7	
400	11.1		0.32	3/8	0.52	14	← from N on Covington										
	2.7		0.45	3/8	0.29	9.3	← from W on Central										0.09' over crown
		13.8					1A	10				0.58	0.41	13.1	13.1	-0-	
410	3.9	8.9	0.32	3/8	0.47	14	1A	10	28	0.36	0.55				4.9	4.0	0.04' over crown
320	31 (10)		0.32	3/8	0.50	14	1A	10				0.62	0.45	14.4	15.5	-0-	0.07' over crown
325	(21)		0.41	3/8	0.63	20	1A	10#				0.62	0.45	14.4	15.5	-0-	Put system req'd ?
330	7.1	7.1	0.41	3/8	0.42	13.4	1A	10	22	0.45	0.7				5.0	2.1	
370	4.9	7.0	0.45	3/8	0.42	13.4	1A	10	22	0.45	0.7				4.9	2.1	

\# As shown on B.F.A. plans

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Date ________ Page ______ of ______

z/n = 2000
2-YR

Assume T_t in gutter = T_t in pipe. This will be conservative, for pipe velocities are in 5 ft/s range, whereas gutter velocities are in 1.5 - 4 ft/sec. Thus calculated Q will be higher than actual.

NODE NO	HYDROLOGY Q_o cfs	Q_o+Q_b cfs	APPROACHING FLOW S_o %	S_x in/ft	d ft	T ft	INLET Type	L	ON-GRADE COMP L_T ft	L/L_T	E	SUMP COMP. d_i ft	d ft	T ft	Q_i cfs	Q_b cfs	
505	11.4	11.4	0.32	3/8	0.49	14	1A	10				0.47	0.3	9.6	11.4	-0-	0.06 over crown
510	12.7	12.7					1A	10				0.57	0.4	12.8	12.7	-0-	CURB DEEP
S-Pir	Grove	6.4	0.32	3/8	0.42	13.4											
E-Bek	meyer	6.3	0.40	3/8	0.42	13.4											
530	19.7	19.7										0.75	0.58	14	19.7	-0-	SPILL OVER CROWN
N-Pir	Grove	12.0	0.50	3/8	0.50	14	1A	10									0.07 OVER CROWN
E-Bek	meyer	7.7	0.40	3/8	0.43	14											
520	2.2	2.2	OK BY INSPECTION (EXCESS	CAPACITY FROM E.	FOR SPILLOVER SIDE)		1A	5				0.22	0.05	0.7	2.2	-0-	
560	6.4	6.4	0.32	3/8	0.42	13.4	1A	5				0.51	0.34	10.9	6.4	-0-	
570	1.6	1.6	0.32	3/8	0.25	8.0	1A	5				0.17	0	0	1.6	-0-	
580	5.7	5.7	0.32	3/8	0.41	13.1	1A	5				0.44	0.27	8.6	5.7	-0-	
590	3.6	3.6	0.32	3/8	0.33	10.7	1A	5				0.32	0.15	4.8	3.6	-0-	

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Date ____ Page ____ of ____

z/n = 2000
2-YR

Assume T_t in gutter = T_t in pipe. This will be conservative, for pipe velocities are in 5 ft/s range, whereas gutter velocities are in 1.5 – 4 ft/sec. Thus calculated Q will be higher than actual.

NODE NO	HYDROLOGY Q_o cfs	HYDROLOGY Q_o+Q_b cfs	APPROACHING FLOW S_o %	APPROACHING FLOW S_x in/ft	APPROACHING FLOW d ft	APPROACHING FLOW T ft	INLET Type	INLET L	ON-GRADE COMP L_T ft	ON-GRADE COMP L/L_T	ON-GRADE COMP E	SUMP COMP. d_i ft	SUMP COMP. d ft	SUMP COMP. T ft	Q_i cfs	Q_b cfs	
700	9.4	9.4					1A	10				0.45	0.28	9.0	9.4	-0-	0.10' OVER CROWN
North		7.0	0.32	3/8	0.44	14.1											
South		2.4	0.80	3/8	0.26	8.3											
705	12.0	12.0	0.80	3/8	0.45	14.4	1A	10	39	0.26	0.45				5.4	6.6	
710	5.5	12.1					1A	10				0.52	0.35	11.2	12.1	-0-	
W.	8.4		0.32	3/8	0.47	14											0.04 OVER CROWN
E.	3.7		0.86	3/8	0.28	9											
720	10.3	10.3					1A	10				0.48	0.31	9.9	10.3	-0-	
W.	3.3		1.75	3/8	0.26	8.3											
So.	7.0		0.43	3/8	0.41	13.1											
730	7.1	7.1	1.75	OK BY INSPECTION			1A	5				0.53	0.36	11.5	7.1	-0-	
740	5.2	5.2	1.75	OK BY INSPECTION			1A	5				0.40	0.23	7.4	5.2	-0-	

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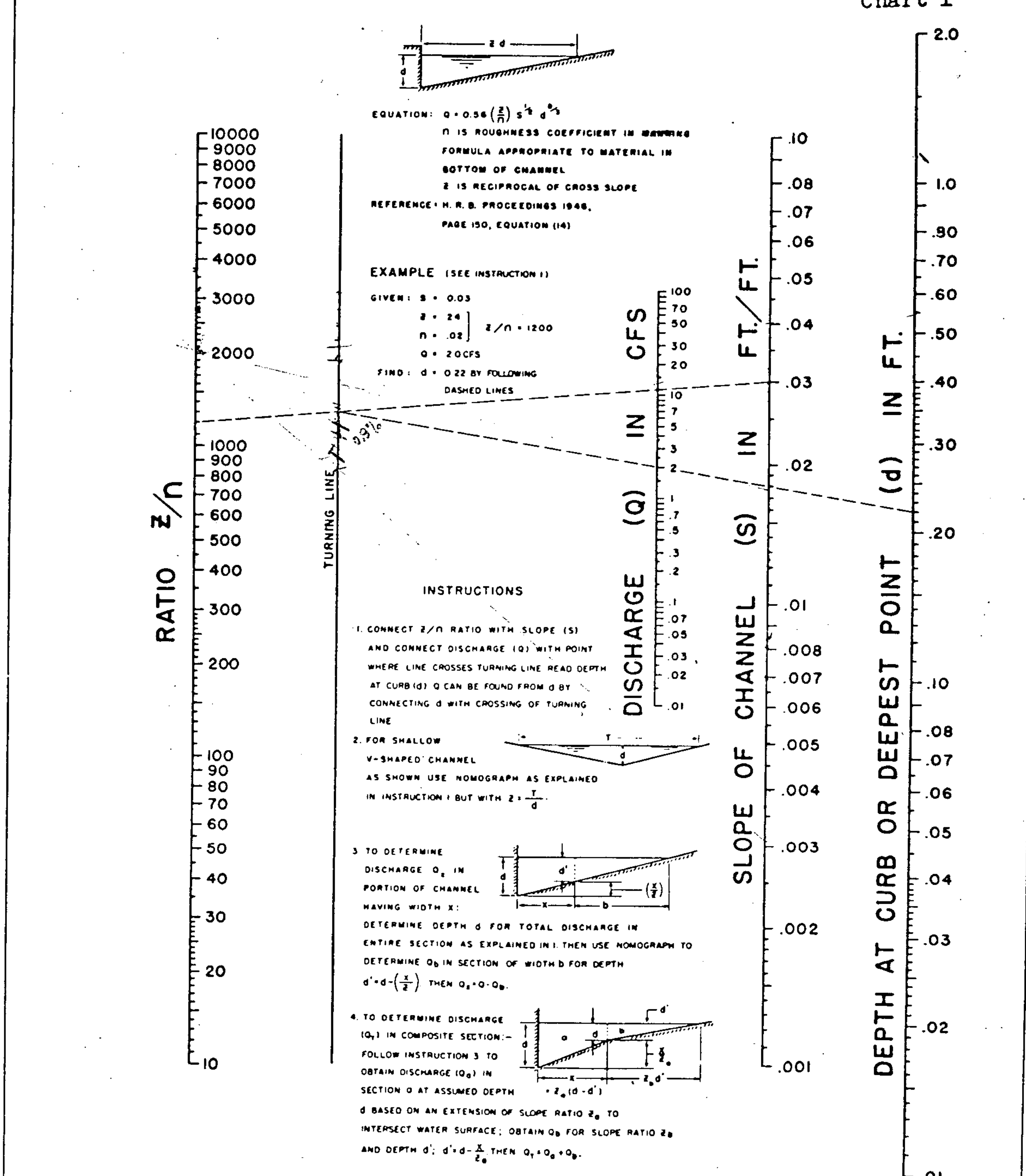
ZIP CODE / 67211

z/n = 2000
2-YR 800 & 810
5-YR 450's & 900's

Assume T_t in gutter = T_t in pipe. This will be conservative, for pipe velocities are in 5 ft/s range, whereas gutter velocities are in 1.5 - 4 ft/sec. Thus calculated Q will be higher than actual.

NODE NO	HYDROLOGY Q_o cfs	Q_o+Q_b cfs	APPROACHING FLOW S_o %	S_x in/ft	d ft	T ft	INLET Type	L	ON-GRADE COMP L_T ft	L/L_T	E	SUMP COMP. d_i ft	d ft	T ft	Q_i cfs	Q_b cfs	
450	7.9	7.9	0.40	3/8	0.42	13.4	1A	5				0.59	0.42	13.4	7.9	-0-	0.01' over crown
460	15.6	15.6	0.40	3/8	0.55	14	1A	10				0.62	0.45	14.4	15.6	-0-	↑ 5-YR CURB DEEP
920	6.4	6.4	0.32	3/8	0.42	13.7	V.G. →										
910	2.1	8.5	0.70	3/8	0.41	13.4	To be	designed	w/ Central			Ave	project				
900	13.9	22.4	0.70	3/8	0.57	18.2	—	Exceeds Use	T.C. - flume	Do not let to back of		Area 900 inlet	drain out and/or pvt.	into street, system.			
↑ 5-YR DESIGN ↑ ↓ 2-YR DESIGN ↓																	
810	4.1	4.1	0.32	OK BY	INSPECTION		1A	5				0.35	0.18	5.8	4.1	-0-	
800	2.5	2.5	0.32	OK BY	INSPECTION		1A	5				0.25	0.08	2.6	2.5	-0-	

Chart 1



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS

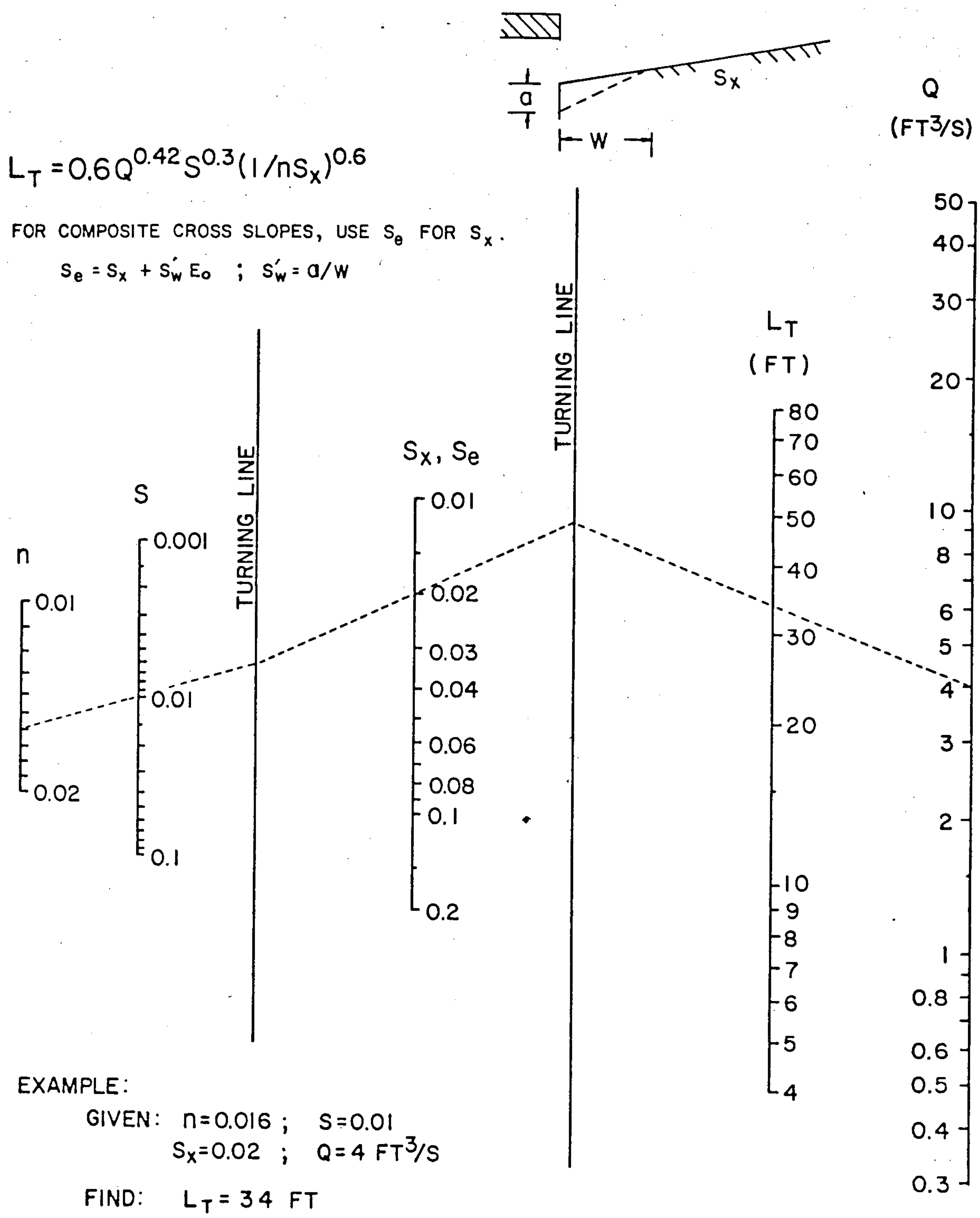


CHART 9. Curb-opening and slotted drain inlet length for total interception.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR. 1984.

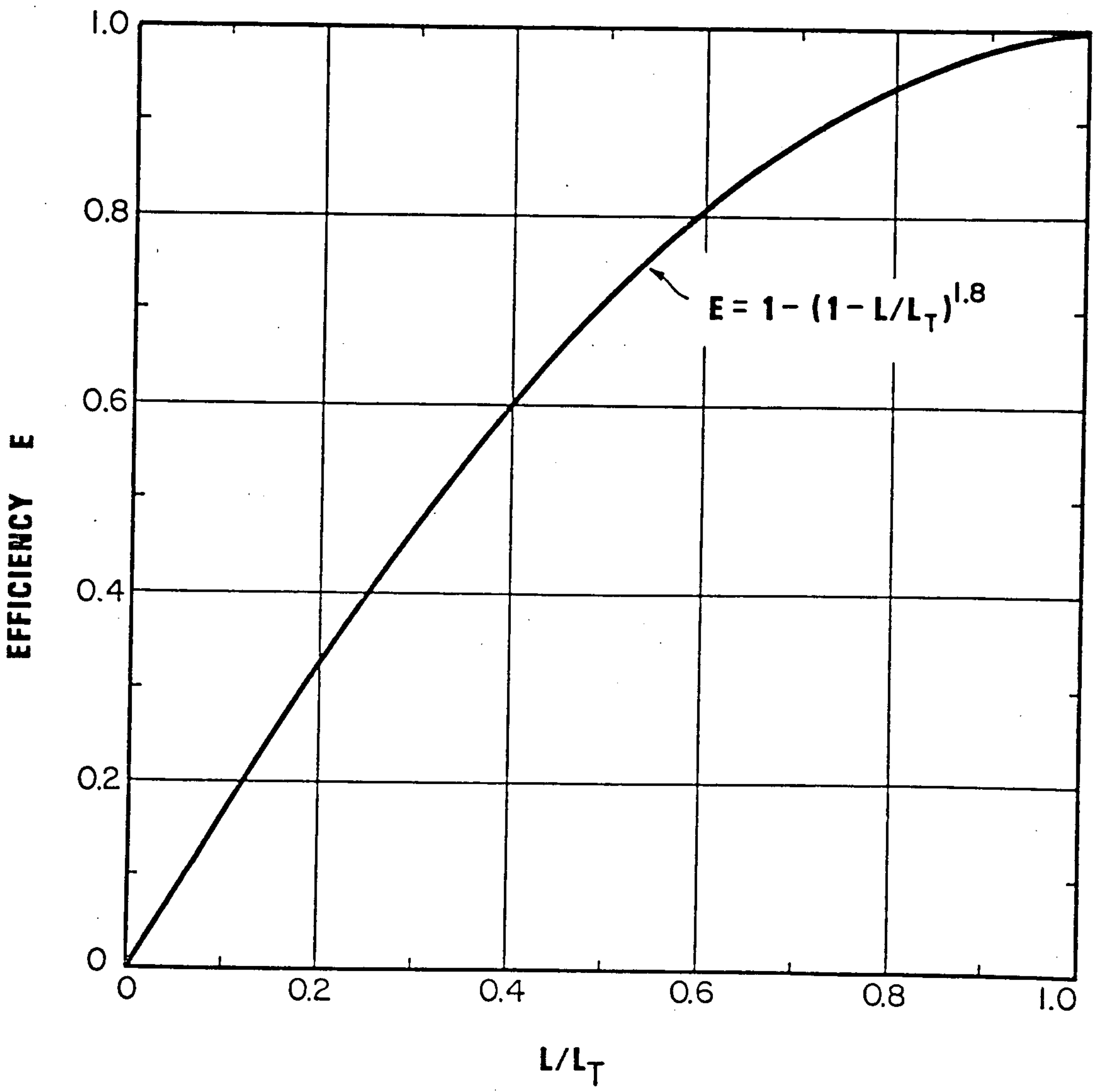
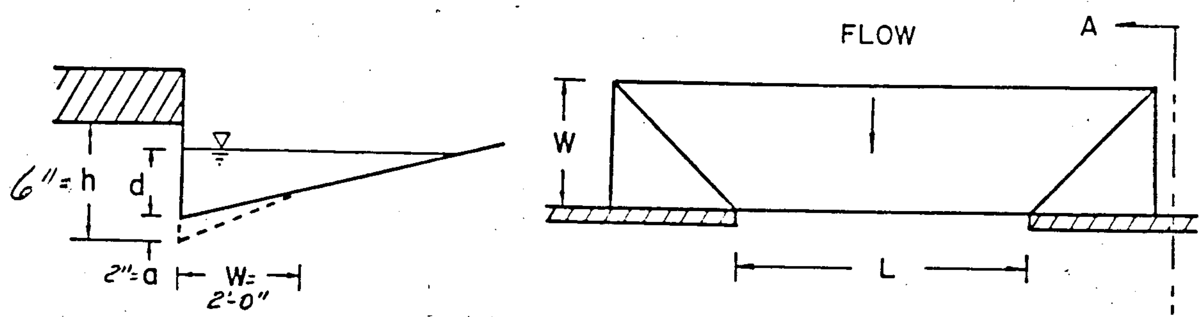


CHART 10. Curb–opening and slotted drain inlet interception efficiency.

From: HEC-12, Drainage of Highway Pavements, F.H.W.A., Mar. 1984



DEF. SKETCH, C.O.W. TYPE 1A INLET

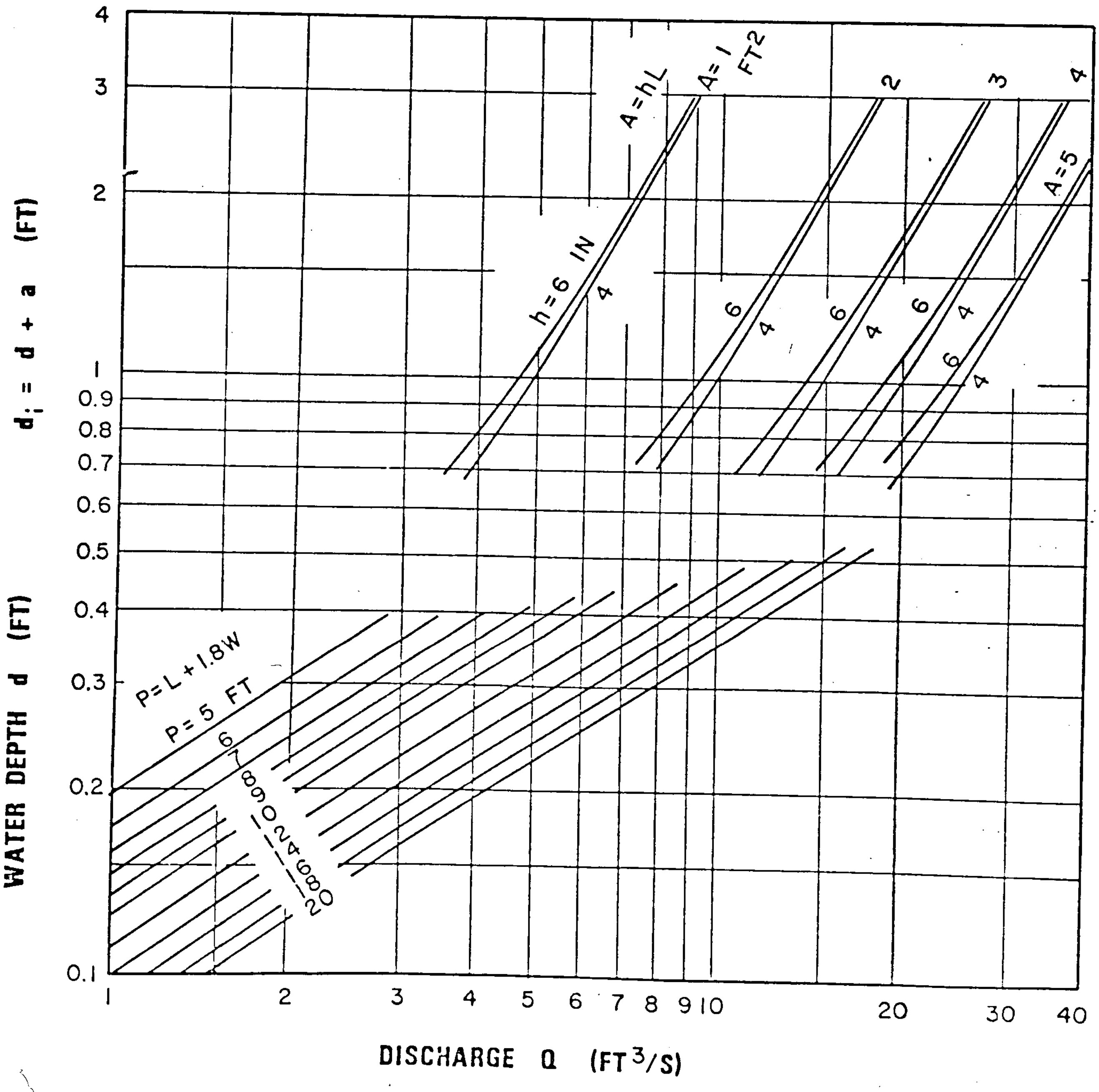


CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

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(316) 262-2691

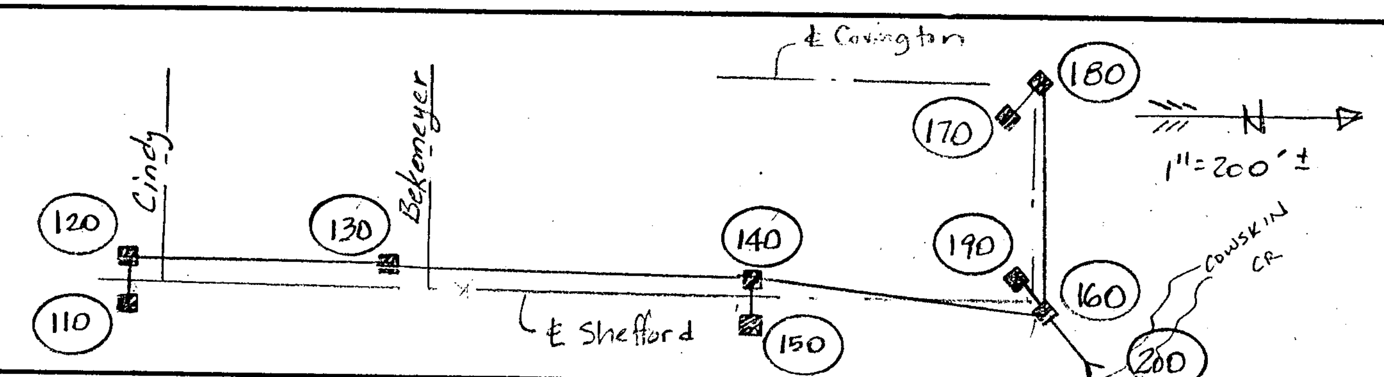
HYDROLOGY DATA SHEET

PROJECT: GOLDEN HILLS DRAINAGE PLAN PROJECT NO. ______

ITEM: SYSTEM 110 / SHEFFORD DATE: 5/28/85

RETURN PERIOD: 2-YR COMPUTATIONS BY: MWB REVISIONS BY: ______

SCHEMATIC DIAGRAM:



TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_o} (minutes) (6)	I_o in./hr. (7)	Q_o (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
110	0.48	2.8	—	—	13	4.66	6.3	13	4.66	6.3	6.3	15	0.95	5.1	30	0.1	15.1
120	0.48	5.8	—	—	12.4	4.35	12.1	13	4.29	11.9	18.2	18	1.05	10.3	270	0.4	13.4
								18	3.78	16.0							
130	0.52	5.5	—	—	18.0	3.78	10.8	18	3.78	10.8	26.8	30	0.43	5.5	380	1.2	19.2
150	0.48	1.7	—	—	10	4.75	4.0	10	4.75	4.0	4.0	15	0.38	3.3	30	0.2	10.2
								19.2	3.69	3.1	3.1						
140	0.52	3.5	—	—	10	4.75	8.6	19.2	3.69	6.7	36.6	36	0.30	5.2	300	1.0	20.2
170	0.48	3.2	—	—	10	4.75	7.3	10	4.75	7.3	7.3	18	0.48	4.1	30	0.1	10.1
180	0.48	2.4	—	—	10	4.75	5.5	10.1	4.74	5.5	12.8	24	0.32	4.1	260	1.1	11.2
								20.2	3.62	9.8							

T.C. Inv.
2.3
2.1
7.0
4.6
4.6
5.0
5.0

HYDROLOGY DATA SHEET

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WICHITA, KANSAS 67211
(316) 262-2691

PAGE 2 OF 2

PROJECT: GOLDEN HILLS DRAINAGE PLAN PROJECT NO. ______

ITEM: SYSTEM 100/SHEFFORD DATE: 5/29/85

RETURN PERIOD: 2-YR COMPUTATIONS BY: MWB REVISIONS BY: ______

SCHEMATIC DIAGRAM:

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{co} (minutes) (6)	I_o in./hr. (7)	Q_o (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
190	0.48	0.6			.10	4.75	1.4	10	4.75	1.4	1.4	15"	0.05	1.14	30	0.4	10.4
								20.2	3.62	1.1							
160	0.48	0.5			10	4.75	1.1	20.2	3.62	0.8							
200						36.6 + 1.1 + 9.3 + 0.8 =					48.3	36	0.53	6.83	50	0.1	20.3

Professional Engineering Consultants
Professional Association

1440 East English
Wichita, Kansas 67211
(316) 262-2691

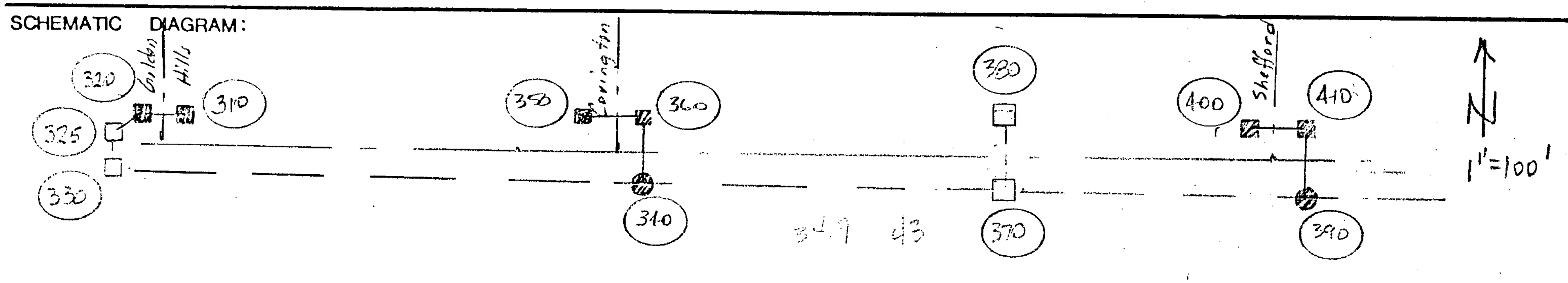
HYDROLOGY DATA SHEET

PROJECT: Golden Hills Drainage Plan PROJECT NO. ____

ITEM: System 300 Central DATE: 5/29/85

RETURN PERIOD: 5-YR COMPUTATIONS BY: MWB REVISIONS BY: ____

SCHEMATIC DIAGRAM:



TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in/hr. (7)	Q_0 (cfs) (8)	T_c (minutes) (9)	I In./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
310	0.57	1.4			.10	6.11	4.9	10	6.11	4.9	4.9	15	0.57	2.9	30	0.2	10.2
320	0.57	2.9			10	6.11	10.1	10.2	6.09	10.1	15.0	24	0.44	4.8	30	0.1	10.3
325	0.73	4.7			9	6.36	21.8	10.3	6.07	20.8	35.8	36	0.29	5.1	50	0.2	10.5
330	0.54	2.4			11.1	5.87	7.6	10.5	6.00	7.2	43.0	36	0.42	6.1	340	0.9	11.4
350	0.57	1.6			10	6.11	5.6	10	6.11	5.6	5.6	18	0.28	3.2	30	0.2	10.2
360	0.57	1.1			10	6.11	3.8	10.2	6.07	3.8	9.4	21	0.35	3.9	75	0.3	10.5
								11.4	5.81	9.1							
340	—	—						11.4	5.81	52.1	52.1	42	0.27	5.41	250	0.8	12.2

HYDROLOGY DATA SHEET

Professional Engineering Consultants
Professional Association
1440 East English
Wichita, Kansas 67211
(316) 262-2691

PROJECT: Golden Hills Data Sheet PROJECT NO. ____

ITEM: System 300 Central Ave DATE: 5/29/85

RETURN PERIOD: 5-YR COMPUTATIONS BY: MWB REVISIONS BY: ____

SCHEMATIC DIAGRAM:

See Sh 1 of 2 for sketch

76

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
380	0.57	0.6			10	6.11	2.1	10	6.11	2.1	2.1	15	0.11	1.7	50	0.5	10.5
370	0.54	1.6			10	6.11	5.6				5.2 +52.1						
								12.2	5.66	5.2	57.3	42	0.32	5.95	200	0.6	12.8
400	0.57	3.6			13.6	5.41	11.1	13.6	5.41	11.1	11.1	21	0.49	4.6	30	0.1	13.7
410	0.57	2.9			11.8	5.73	9.5	13.7	5.39	8.9	20	30	0.24	4.1	75	0.3	14.0
								12.8	5.54	(18.7)							
390																	
										76	76	42	0.57	7.9	520		
430																	

46.6 = H.G.L. Start

PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION
1440 EAST ENGLISH
WICHITA, KANSAS 67211
(316) 262-2691

HYDROLOGY DATA SHEET

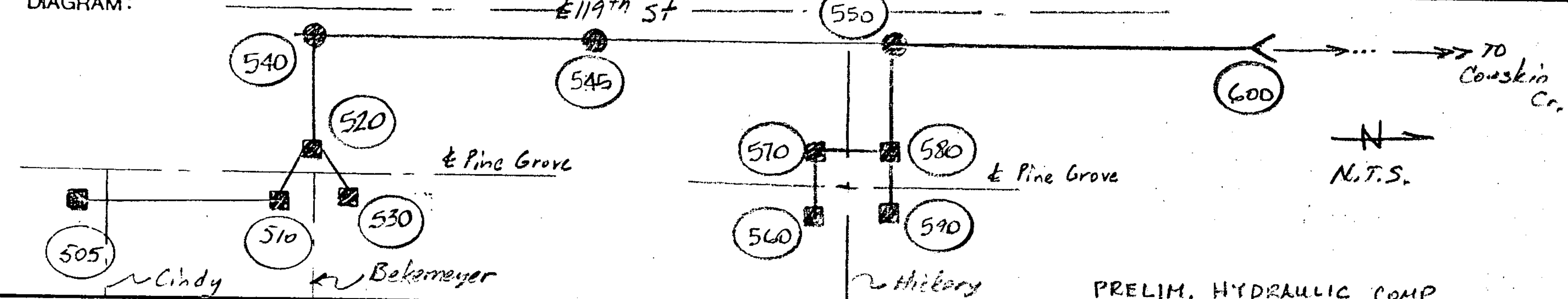
PAGE ____ OF ____

PROJECT: Golden Hills Drainage Plan PROJECT NO. 36-

ITEM: ____ DATE: 5-24-85

RETURN PERIOD: 2 COMPUTATIONS BY: MWB REVISIONS BY: ____

SCHEMATIC DIAGRAM:



PRELIM. HYDRAULIC COMP.

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in/hr. (7)	Q_0 (cfs) (8)	T_c (minutes) (9)	I In./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
505	0.52	6.1			20.5	3.60	11.4	20.5	3.60	11.4	11.40	24"	0.25	3.6	260	1.1	21.6
510	0.52	6.9			20.5	3.60	12.9	21.6	3.52	12.6	24.01	30"	0.34	4.9	50	—	21.6
530	0.52	9.1			14	4.17	19.7	14	4.17	19.7	19.7	24"	0.76	6.3	50	—	14
					Route to 520			21.6	3.52	16.6	16.6						
520	0.52	1.2			13.2	4.29	2.7	21.6	3.52	2.2	42.8	36"	0.41	6.1	160	0.4	22
540	—	—	—	—	—	—	—	22			42.8	36"	"	"	440	1.2	23.2
545	—	—	—	—	—	—	—	23.2			42.8	36"	"	"	440	1.2	25.4

PROFESSIONAL ENGINEERING CONSULTANTS
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HYDROLOGY DATA SHEET

PAGE ____ OF ____

PROJECT: Golden Hills Drainage Plan PROJECT NO. 36 -

ITEM: ____ DATE: 5-24-85

RETURN PERIOD: 2 COMPUTATIONS BY: MWB REVISIONS BY: ____

SCHEMATIC DIAGRAM:

See Previous Sheet for Sketch

PRELIM HYDR. COMP.

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
560	0.48	2.8			10.1	4.75	6.4	10.1	4.75	6.4	6.4	18"	0.37	3.6	80	0.4	10.5
570	0.48	0.7			10	4.75	1.6	10.5	4.67	1.6	8.0	21"	0.26	3.3	35	0.1	10.6
590	0.48	2.5			10.1	4.75	5.6	10.1	4.75	5.6	5.6	18"	0.28	3.2	80	0.4	10.5
580	0.48	1.6			10.1	4.75	3.6	10.5	4.67	3.5	17.1	30"	0.20	3.5	160	0.8	11.3
					Route to	550 @	25.4 min	25.4	3.28	12.0	~~12.0~~						
	1																
550	—	—	—	—	—	—	—	25.4	3.28		54.8	42"	0.30	5.7	400	1.2	26.6

PROFESSIONAL ENGINEERING CONSULTANTS
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(316) 262 2691

HYDROLOGY DATA SHEET

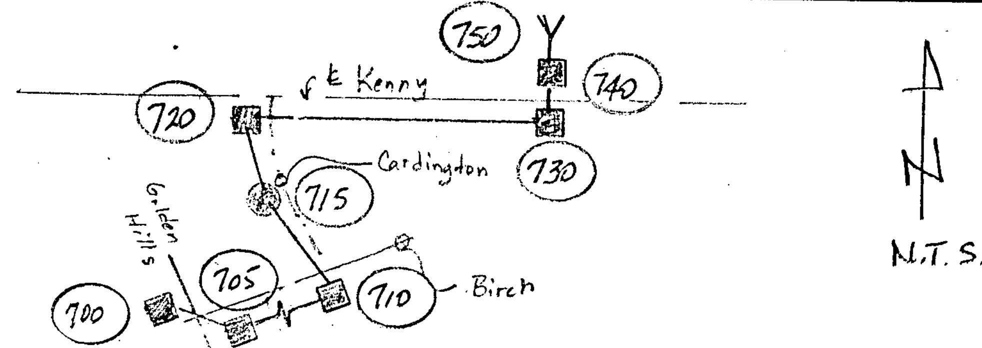
PAGE ____ OF ____

PROJECT: Golden Hills Drainage Plan PROJECT NO. ____

ITEM: System 700 DATE: 5-28-85

RETURN PERIOD: 2-YR COMPUTATIONS BY: MWB REVISIONS BY: ____

SCHEMATIC DIAGRAM:



	TRIBUTARY AREA							HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_o} (minutes) (6)	I_o in./hr. (7)	Q_o (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
700	0.52	3.8	–	–	10	4.75	9.4	10	4.75	9.4	9.4	18	0.8	5.3	65	0.2	10.2
705	0.52	4.9	–	–	10	4.75	12.1	10.2	4.71	12.0	21.4	24	0.9	6.8	230	0.6	10.8
710	0.52	2.3	–	–	10	4.75	5.7	10.8	4.61	5.5	26.9	30	0.43	5.5	300	0.9	11.7
715	–	–	–	–	–	–	–	11.7			26.9	30	0.43	5.5	180	0.5	12.2
720	0.48	4.9	–	–	10	4.75	11.2	12.2	4.38	10.3	37.2	30	0.82	7.6	225	0.5	12.7
730	0.48	3.4	–	–	11.9	4.40	7.2	12.7	4.31	7.1	44.3	30	1.16	9.1	30	0.1	12.8
740	0.48	2.5	–	–	10.	4.75	5.7	12.8	4.30	5.2	49.5	30	1.46	10.1	20	–	12.8

Professional Engineering Consultants
PROFESSIONAL ASSOCIATION

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WICHITA, KANSAS 67211
(316) 262-2691

HYDROLOGY DATA SHEET

PROJECT: GOLDEN HILLS DRAINAGE PLAN PROJECT NO. ________

ITEM: MISC SYSTEMS 450 & 800 DATE: 5/29/85

RETURN PERIOD: 5 & 2 COMPUTATIONS BY: MWB REVISIONS BY: ________

SCHEMATIC DIAGRAM:

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_0} (minutes) (6)	I_0 in./hr. (7)	Q_0 (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	Σ Q (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
D-1R: 460	0.55	6.0			19.2	4.74	15.6	19.2	4.74	15.6	15.6	21"	0.97	6.5	30	0.1	19.3
450	0.55	2.5			11.9	5.71	7.9	19.3	4.73	6.5	22.1	24"	0.96	7.0	50	0.1	19.4
C-1R: 800	0.48	1.1			10	4.75	2.5	10	4.75	2.5	2.5	15"	0.15	2.0	30	0.2	10.2
810	0.48	1.8			10	4.75	4.1	10.2	4.71	4.1	6.6	15"	1.04	5.4	50	0.2	10.4

FINAL

```
100 J,  141.0000  200     3     9     9
110 t,GOLDEN HILLS DRAINAGE PLAN
120 t,SYSTEM 100      SHEFFORD
130 t,MWB 5/29/85
140 i,  110      0.48      2.80      0.00      0.00      1.90     13.00    152.10
150 i,  120      0.48      5.80      0.00      0.00      0.00     12.40    152.10
160 i,  130      0.52      5.50      0.00      0.00      0.00     18.00    147.00
170 i,  150      0.48      1.70      0.00      0.00      7.80     10.00    144.60
180 i,  140      0.52      3.50      0.00      0.00      0.00     10.00    144.60
185 i,  170      0.48      3.20      0.00      0.00      0.00     10.00    145.00
190 i,  180      0.48      2.40      0.00      0.00      0.00     10.00    145.00
200 i,  190      0.48      0.60      0.00      0.00      0.00     10.00    144.50
210 i,  160      0.48      0.50      0.00      0.00      0.00     10.00    144.50
220 m,  200    142.00
230 P,  110  120     30.00    15 0.013  90.00    0.00
240 P,  120  130    270.00    21 0.013   0.00    0.00
250 P,  130  140    380.00    30 0.013   5.00    0.00
260 P,  150  140     30.00    18 0.013  90.00    0.00
270 P,  140  160    300.00    36 0.013  40.00    0.00
280 P,  170  180     30.00    18 0.013 135.00    0.00
290 P,  180  160    260.00    24 0.013  45.00    0.00
300 P,  160  200     50.00    36 0.013   0.00    0.00
310 P,  190  160     30.00    15 0.013   0.00    0.00
320 e
```

Date: 05-30-1985
Time: 16:12:52

Input File: sys100

FINAL

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 100 SHEFFORD
MWB 5/29/85

Storm Frequency = 2-Year

* * * H Y D R O L O G Y * * *

Tributary Area									Hydrology Summation				Conduit Data				
Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(0) (Min)	I(0) (In/Hr)	Q(0) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
110	120	0.48	2.80	0.00	0.0	13.00	4.29	1.90	13.00	4.29	1.90	1.90	15"	1.55	30.00	0.32	13.32
120	130	0.48	5.80	0.00	0.0	12.40	4.37	12.17	12.40	4.37	12.17	13.94	21"	5.80	270.00	0.78	13.18
130	140	0.52	5.50	0.00	0.0	18.00	3.78	10.81	18.00	3.78	10.81	23.15	30"	4.72	380.00	1.34	19.34
150	140	0.48	1.70	0.00	0.0	10.00	4.75	7.80	10.00	4.75	7.80	7.80	18"	4.41	30.00	0.11	10.11
140	160	0.52	3.50	0.00	0.0	10.00	4.75	8.65	19.34	3.68	6.69	35.90	36"	5.08	300.00	0.98	20.33
170	180	0.48	3.20	0.00	0.0	10.00	4.75	7.30	10.00	4.75	7.30	7.30	18"	4.13	30.00	0.12	10.12
180	160	0.48	2.40	0.00	0.0	10.00	4.75	5.48	10.12	4.73	5.45	12.75	24"	4.06	260.00	1.07	11.19
160	200	0.48	0.50	0.00	0.0	10.00	4.75	1.14	20.33	3.61	0.87	47.93	36"	6.78	50.00	0.12	20.45
190	160	0.48	0.60	0.00	0.0	10.00	4.75	1.37	10.00	4.75	1.37	1.37	15"	1.12	30.00	0.45	10.45

Date: 05-30-1985
Time: 16:12:52

Input File: sys100

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 100 SHEFFORD
MWB 5/29/85

Storm Frequency = 2-Year

*** HYDRAULICS ***

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
110	0.00087	0.0260	0.0000	0.0000	0.0000	0.0000	0.0000	0.0260	148.1728	152.1000	3.93
120	0.00774	2.0894	0.0000	0.0484	0.0000	0.0186	1.3548	3.5113	148.1469	152.1000	3.95
130	0.00319	1.2108	0.0000	0.0352	0.0000	0.0000	0.2693	1.5153	144.6356	147.0000	2.36
150	0.00551	0.1654	0.0000	0.0000	0.0000	0.0000	0.0000	0.1654	143.2857	144.6000	1.31
140	0.00290	0.8691	0.0000	0.0055	0.0000	0.0054	0.3951	1.2751	143.1203	144.6000	1.48
170	0.00483	0.1450	0.0000	0.0000	0.0000	0.0000	0.0000	0.1450	143.3278	145.0000	1.67
180	0.00318	0.8263	0.0000	0.0019	0.0000	0.2157	0.2938	1.3377	143.1828	145.0000	1.82
190	0.00045	0.0135	0.0000	0.0000	0.0000	0.0000	0.0000	0.0135	141.8586	144.5000	2.64
160	0.00516	0.2582	0.0000	0.0313	0.0000	0.0757	0.4800	0.8452	141.8452	144.5000	2.65
200	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	141.0000	142.0000	1.00

Final

```
100 j,  146.6000  430    3   13   12
110 t,GOLDEN HILLS DRAINAGE PLAN
120 t,SYSTEM 300   CENTRAL AVE   5-YR PIPE DESIGN
130 t,MWB    5/29/85
140 i,  310       0.57      1.40      0.00      0.00      2.40     10.00    158.60
150 i,  320       0.57      2.90      0.00      0.00      0.00     10.00    158.60
160 i,  325       0.73      4.70      0.00      0.00      0.00      9.00    156.70
170 i,  330       0.54      2.40      0.00      0.00      5.00     11.10    156.70
180 i,  350       0.57      1.60      0.00      0.00      8.10     10.00    156.10
190 i,  360       0.57      1.10      0.00      0.00      1.70     10.00    156.10
200 m,  340    154.90
210 i,  380       0.57      0.60      0.00      0.00      1.50     10.00    153.80
220 i,  370       0.54      1.60      0.00      0.00      4.90     10.00    153.80
230 i,  400       0.57      3.60      0.00      0.00     13.10     13.60    153.80
240 i,  410       0.57      2.90      0.00      0.00      4.90     11.80    153.80
250 m,  390    152.90
260 m,  430    150.40
270 p,  310  320     30.00     15 0.013   45.00    0.00
280 p,  320  325     30.00     21 0.013   45.00    0.00
290 p,  325  330     50.00     36 0.013   90.00    0.00
300 p,  330  340    340.00     36 0.013    0.00    0.00
310 p,  350  360     30.00     15 0.013   90.00    0.00
320 p,  360  340     75.00     18 0.013   90.00    0.00
330 p,  340  370    250.00     36 0.013    0.00    0.00
340 p,  380  370     50.00     15 0.013   90.00    0.00
350 p,  370  390    200.00     36 0.013    0.00    0.00
360 p,  400  410     30.00     18 0.013   90.00    0.00
370 p,  410  390     75.00     21 0.013   90.00    0.00
380 p,  390  430    520.00     42 0.013    0.00    0.00
390 e
```

Date: 06-03-1985
Time: 12:58:38

Input File: sys300

FINAL

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 300 CENTRAL AVE 5-YR PIPE DESIGN
MWB 5/29/85

Storm Frequency = 5-Year

* * * H Y D R O L O G Y * * *

Tributary Area									Hydrology Summation				Conduit Data				
Node to	Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
310	320	0.57	1.40	0.00	0.0	10.00	6.11	2.40	10.00	6.11	2.40	2.40	15"	1.96	30.00	0.26	10.26
320	325	0.57	2.90	0.00	0.0	10.00	6.11	10.10	10.00	6.11	10.10	12.44	21"	5.17	30.00	0.10	10.10
325	330	0.73	4.70	0.00	0.0	9.00	6.37	21.85	10.10	6.09	20.89	33.33	36"	4.72	50.00	0.18	10.27
330	340	0.54	2.40	0.00	0.0	11.10	5.87	5.00	10.27	6.05	4.63	37.96	36"	5.37	340.00	1.06	11.33
350	360	0.57	1.60	0.00	0.0	10.00	6.11	8.10	10.00	6.11	8.10	8.10	15"	6.60	30.00	0.08	10.08
360	340	0.57	1.10	0.00	0.0	10.00	6.11	1.70	10.08	6.09	1.70	9.80	18"	5.54	75.00	0.23	10.30
340	370	0.00	0.00	0.00	0.0	0.00	0.00	0.00	11.33	5.82	0.00	47.39	36"	6.70	250.00	0.62	11.95
380	370	0.57	0.60	0.00	0.0	10.00	6.11	1.50	10.00	6.11	1.50	1.50	15"	1.22	50.00	0.68	10.68
370	390	0.54	1.60	0.00	0.0	10.00	6.11	4.90	11.95	5.70	4.57	53.40	36"	7.55	200.00	0.44	12.39
400	410	0.57	3.60	0.00	0.0	13.60	5.42	13.10	13.60	5.42	13.10	13.10	18"	7.41	30.00	0.07	13.67
410	390	0.57	2.90	0.00	0.0	11.80	5.73	4.90	13.67	5.41	4.63	17.73	21"	7.37	75.00	0.17	13.84
390	430	0.00	0.00	0.00	0.0	0.00	0.00	0.00	12.39	5.62	0.00	69.28	42"	7.20	520.00	1.20	13.59

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 300 CENTRAL AVE 5-YR PIPE DESIGN
MWB 5/29/85

Input File: sys300

Date: 06-03-1985
Time: 12:58:38

Storm Frequency = 5-Year

* * * H Y D R A U L I C S * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
310	0.00138	0.0414	0.0000	0.0000	0.0000	0.0000	0.0000	0.0414	156.6614	158.6000	1.94
320	0.00617	0.1850	0.0000	0.0356	0.0000	0.0129	1.0408	1.2743	156.6199	158.6000	1.98
325	0.00250	0.1248	0.0000	0.0140	0.0000	0.0904	0.6311	0.8604	155.3457	156.7000	1.35
330	0.00324	1.1011	0.0000	0.0103	0.0000	0.1726	0.2198	1.5037	154.4852	156.7000	2.21
350	0.01572	0.4717	0.0000	0.0000	0.0000	0.0000	0.0000	0.4717	154.5618	156.1000	1.54
360	0.00870	0.6521	0.0000	0.0399	0.0000	0.3382	0.0784	1.1086	154.0901	156.1000	2.01
340	0.00505	1.2623	0.0000	0.0250	0.0000	0.0000	0.5224	1.8097	152.9815	154.9000	1.92
380	0.00054	0.0270	0.0000	0.0000	0.0000	0.0000	0.0000	0.0270	151.1988	153.8000	2.60
370	0.00641	1.2821	0.0000	0.0188	0.0000	0.0000	0.4057	1.7066	151.1718	153.8000	2.63
400	0.01555	0.4666	0.0000	0.0000	0.0000	0.0000	0.0000	0.4666	151.8697	153.8000	1.93
410	0.01252	0.9388	0.0000	0.0020	0.0000	0.4267	0.5705	1.9378	151.4031	153.8000	2.40
390	0.00474	2.4654	0.0000	0.0162	0.0000	0.0000	0.3835	2.8652	149.4652	152.9000	3.43
430	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	146.6000	150.4000	3.80

```
100 j,  151.0000  600    2   12   11
110 t,GOLDEN HILLS DRAINAGE PLAN
120 t,SYSTEM 500-PINE GROVE          MWB      5/24/85
130 i,  505      0.52      6.10     0.00      0.00      0.00     20.50    158.50
140 i,  510      0.52      6.90     0.00      0.00      0.00     20.50    157.40
150 i,  530      0.52      9.10     0.00      0.00      0.00     14.00    157.40
160 i,  520      0.52      1.20     0.00      0.00      0.00     13.20    157.40
170 m,  540    157.10
180 m,  545    158.50
190 i,  560      0.48      2.80     0.00      0.00      0.00     10.10    159.10
200 i,  570      0.48      0.70     0.00      0.00      0.00     10.00    159.10
210 i,  590      0.48      2.50     0.00      0.00      0.00     10.10    159.10
220 i,  580      0.48      1.60     0.00      0.00      0.00     10.10    159.10
230 m,  550    158.80
240 m,  600    153.00
250 p,  505  510   260.00   21 0.013  45.00   0.00
260 p,  510  520    50.00   30 0.013  45.00   0.00
270 p,  530  520    50.00   24 0.013  45.00   0.00
280 p,  520  540   160.00   42 0.013  90.00   0.00
290 p,  540  545   440.00   42 0.013   0.00   0.00
300 p,  545  550   440.00   42 0.013   0.00   0.00
310 p,  560  570    80.00   15 0.013  90.00   0.00
320 p,  570  580    35.00   18 0.013  90.00   0.00
330 p,  590  580    80.00   15 0.013   0.00   0.00
340 p,  580  550   160.00   21 0.013  90.00   0.00
350 p,  550  600   400.00   42 0.013   0.00   0.00
360 e
```

TRIAL # 5
SYSTEM 500
USE

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 500-PINE GROVE MWB 5/24/85

Input File: sys500

Date: 05-24-1985
Time: 16:55:28
USE

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
Tributary Area									Hydrology Summation				Conduit Data				
505	510	0.52	6.10	0.00	0.0	20.50	3.59	11.40	20.50	3.59	11.40	11.40	21"	4.74	260.00	0.91	21.41
510	520	0.52	6.90	0.00	0.0	20.50	3.59	12.89	21.41	3.53	12.67	24.07	30"	4.90	50.00	0.17	21.58
530	520	0.52	9.10	0.00	0.0	14.00	4.17	19.73	14.00	4.17	19.73	19.73	24"	6.28	50.00	0.13	14.13
520	540	0.52	1.20	0.00	0.0	13.20	4.27	2.66	21.58	3.52	2.20	43.00	42"	4.47	160.00	0.60	22.18
540	545	0.00	0.00	0.00	0.0	0.00	0.00	0.00	22.18	3.48	0.00	43.00	42"	4.47	440.00	1.64	23.82
545	550	0.00	0.00	0.00	0.0	0.00	0.00	0.00	23.82	3.39	0.00	43.00	42"	4.47	440.00	1.64	25.46
560	570	0.48	2.80	0.00	0.0	10.10	4.74	6.36	10.10	4.74	6.36	6.36	15"	5.19	80.00	0.26	10.36
570	580	0.48	0.70	0.00	0.0	10.00	4.75	1.60	10.36	4.69	1.58	7.94	18"	4.49	35.00	0.13	10.49
590	580	0.48	2.50	0.00	0.0	10.10	4.74	5.68	10.10	4.74	5.68	5.68	15"	4.63	80.00	0.29	10.39
580	550	0.48	1.60	0.00	0.0	10.10	4.74	3.64	10.49	4.67	3.58	17.19	21"	7.15	160.00	0.37	10.86
550	600	0.00	0.00	0.00	0.0	0.00	0.00	0.00	25.46	3.30	0.00	55.32	42"	5.75	400.00	1.16	26.62

Input File: sys500

Date: 05-24-1985
Time: 16:55:28

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 500-PINE GROVE MWB 5/24/85

Storm Frequency = 2-Year

* * * H Y D R A U L I C S * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
505	0.00517	1.3453	0.0000	0.0000	0.0000	0.0000	0.0000	1.3453	156.9647	158.5000	1.54
510	0.00344	0.1722	0.0000	0.0025	0.0000	0.0759	0.5664	0.8170	155.6194	157.4000	1.78
530	0.00761	0.3803	0.0000	0.0000	0.0000	0.0000	0.0000	0.3803	155.1827	157.4000	2.22
520	0.00183	0.2922	0.0000	0.0127	0.0000	0.0813	-0.0447	0.3415	154.8024	157.4000	2.60
540	0.00183	0.8036	0.0000	0.0000	0.0155	0.1551	0.0091	0.9833	154.4609	157.1000	2.64
545	0.00183	0.8036	0.0000	0.0000	0.0155	0.0000	0.0091	0.8283	153.4776	158.5000	5.02
560	0.00971	0.7766	0.0000	0.0000	0.0000	0.0000	0.0000	0.7766	156.9873	159.1000	2.11
570	0.00571	0.2000	0.0000	0.0208	0.0000	0.2088	0.0941	0.5238	156.2107	159.1000	2.89
590	0.00774	0.6191	0.0000	0.0000	0.0000	0.0000	0.0000	0.6191	156.3061	159.1000	2.79
580	0.01176	1.8824	0.0000	0.0479	0.0000	0.1568	0.9506	3.0376	155.6869	159.1000	3.41
550	0.00302	1.2095	0.0000	0.0203	0.0000	0.0000	0.4195	1.6493	152.6493	158.8000	6.15
600	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	151.0000	153.0000	2.00

```
100 j,  147.5000  750    3   8    7
110 t,GOLDEN HILLS DRAINAGE PLAN
120 t,SYSTEM 700    MWB  6-02-85
130 t,GOLDEN HILLS/BIRCH/CARDINGTON/KENNY
140 i,  700       0.52      3.80      0.00      0.00      0.00     10.00    159.50
150 i,  705       0.52      4.90      0.00      0.00      5.40     10.00    159.00
160 i,  710       0.52      2.30      0.00      0.00     12.10     10.00    158.20
180 m,  715     156.80
190 i,  720       0.48      4.90      0.00      0.00      0.00     10.00    155.80
200 i,  730       0.48      3.40      0.00      0.00      0.00     11.90    152.00
210 i,  740       0.48      2.50      0.00      0.00      0.00     10.00    152.00
220 m,  750     147.50
230 p,  700  705     65.00    18 0.013  30.00   0.00
240 p,  705  710    230.00    24 0.013  90.00   0.00
250 p,  710  715    300.00    30 0.013  15.00   0.00
260 p,  715  720    180.00    30 0.013  95.00   0.00
270 p,  720  730    225.00    30 0.013  90.00   0.00
280 p,  730  740     30.00    36 0.013   0.00   0.00
290 p,  740  750     20.00    36 0.013   0.00   0.00
300 e
```

REFINED

Date: 06-03-1985
Time: 13:22:40

Input File: sys700

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 700 MWB 6-02-85
GOLDEN HILLS/BIRCH/CARDINGTON/KENNY

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

Tributary Area									Hydrology Summation				Conduit Data				
Node	to Node	C	Area (Ac)	Slope (%)	Length (Ft)	TC(O) (Min)	I(O) (In/Hr)	Q(O) (CFS)	TC (Min)	I (In/Hr)	Q (CFS)	Sum Q (CFS)	Size	Velocity (Ft/Sec)	Length (Ft)	TT (Min)	TT+TC (Min)
700	705	0.52	3.80	0.00	0.0	10.00	4.75	9.39	10.00	4.75	9.39	9.39	18"	5.32	65.00	0.20	10.20
705	710	0.52	4.90	0.00	0.0	10.00	4.75	5.40	10.20	4.72	5.36	14.75	24"	4.70	230.00	0.82	11.02
710	715	0.52	2.30	0.00	0.0	10.00	4.75	12.10	11.02	4.58	11.65	26.40	30"	5.38	300.00	0.93	11.95
715	720	0.00	0.00	0.00	0.0	0.00	0.00	0.00	11.95	4.44	0.00	26.40	30"	5.38	180.00	0.56	12.51
720	730	0.48	4.90	0.00	0.0	10.00	4.75	11.18	12.51	4.36	10.25	36.65	30"	7.47	225.00	0.50	13.01
730	740	0.48	3.40	0.00	0.0	11.90	4.44	7.25	13.01	4.29	7.00	43.65	36"	6.18	30.00	0.08	13.09
740	750	0.48	2.50	0.00	0.0	10.00	4.75	5.70	13.09	4.28	5.14	48.79	36"	6.90	20.00	0.05	13.14

Date: 06-03-1985
Time: 13:22:40

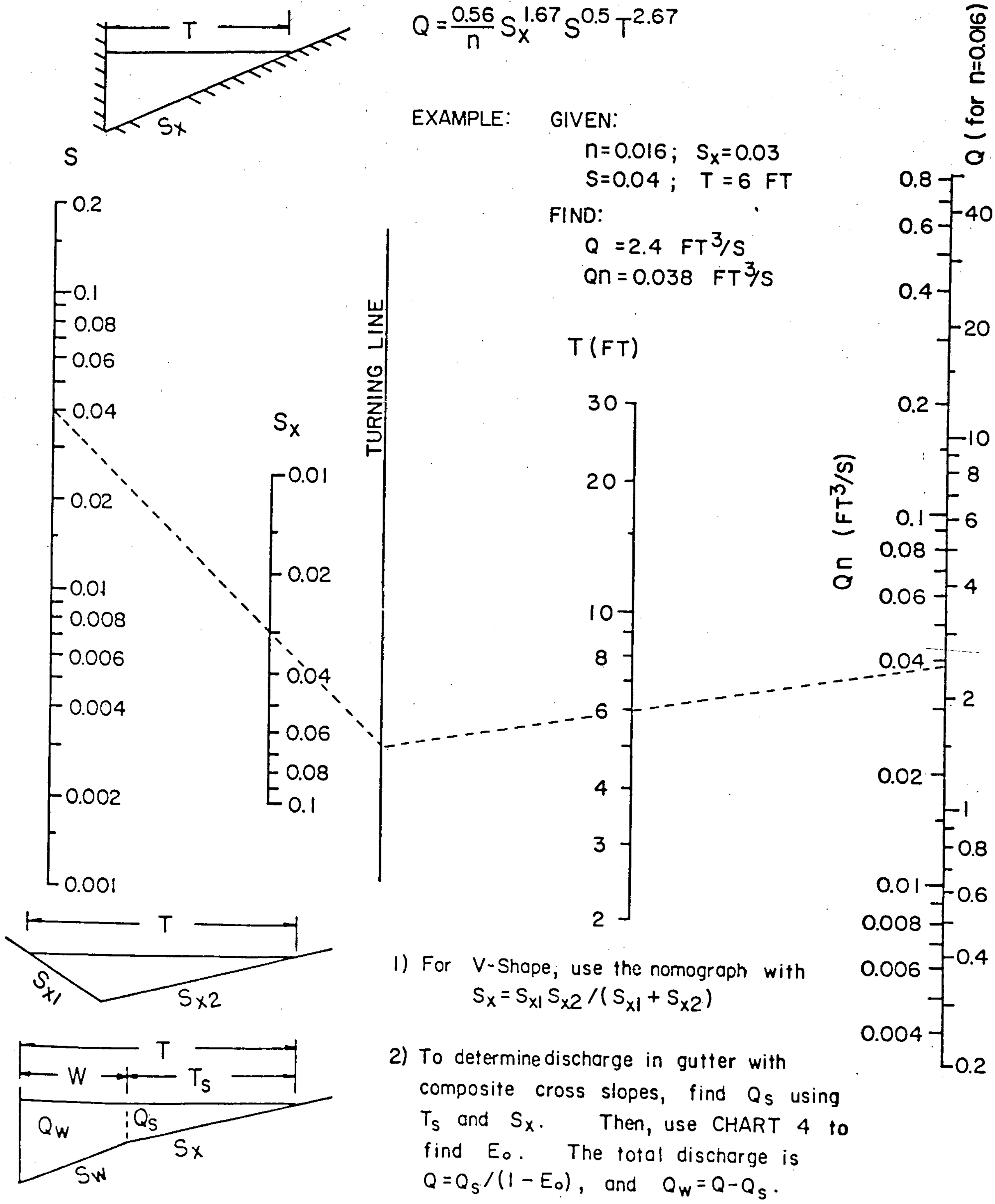
Input File: sys700

GOLDEN HILLS DRAINAGE PLAN
SYSTEM 700 MWB 6-02-85
GOLDEN HILLS/BIRCH/CARDINGTON/KENNY

Storm Frequency = 2-Year

* * * H Y D R A U L I C S * * *

Node	Hyd-Slope (Ft/Ft)	Friction (Ft)	Bend (Ft)	Transition (Ft)	Manhole (Ft)	Deflection (Ft)	Junction (Ft)	Total (Ft)	Hyd-Gl Elevation	Desired Elevation	Diff. (Ft)
700	0.00800	0.5199	0.0000	0.0000	0.0000	0.0000	0.0000	0.5199	156.1841	159.5000	3.32
705	0.00425	0.9780	0.0000	0.0193	0.0000	0.0587	0.2757	1.3317	155.6642	159.0000	3.34
710	0.00414	1.2430	0.0000	0.0107	0.0000	0.1712	0.5832	2.0081	154.3325	158.2000	3.87
715	0.00414	0.7458	0.0000	0.0000	0.0225	0.0262	0.0208	0.8152	152.3245	156.8000	4.48
720	0.00798	1.7963	0.0000	0.0416	0.0000	0.2397	0.8646	2.9422	151.5093	155.8000	4.29
730	0.00428	0.1285	0.0000	0.0547	0.0000	0.4328	0.0096	0.6256	148.5671	152.0000	3.43
740	0.00535	0.1070	0.0000	0.0148	0.0000	0.0000	0.3198	0.4415	147.9415	152.0000	4.06
750	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	147.5000	147.5000	0.00



$$Q = \frac{0.56}{n} S_x^{1.67} S^{0.5} T^{2.67}$$

EXAMPLE: GIVEN:
$n = 0.016$; $S_x = 0.03$
$S = 0.04$; $T = 6$ FT

FIND:
$Q = 2.4$ FT³/S
$Qn = 0.038$ FT³/S

1) For V-Shape, use the nomograph with $S_x = S_{x1} S_{x2} / (S_{x1} + S_{x2})$

2) To determine discharge in gutter with composite cross slopes, find Q_s using T_s and S_x. Then, use CHART 4 to find E_o. The total discharge is $Q = Q_s / (1 - E_o)$, and $Q_w = Q - Q_s$.

CHART 3. Flow in triangular gutter sections.

From: HEC-12: Drainage of Highway Pavements, FHWA, Mar. 1984

$Q = CLH^{1.5}$

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Date 5/30/85 MWB Page ____ of ____

Project GOLDEN HILLS DRAINAGE PLAN

Item SYSTEM 100/300

Q_{100} CHECK

† Approx. for mini-sump

NODE	Tc Min	i_{100}/i_2	Q_2 cfs	Q_{100} cfs	ΣQ cfs	Q_{pipe} cfs	$Q_{100}-Q_p$ cfs	S_o %	Bk-Bk Street Width	MAX DISCHARGE (cfs) @ d = T.C.	T.C. +0.3'	T.C. +0.41'	T.C. +0.52	T.C. +0.63'	
110	13	2.21	5.8	12.8	10.9	1.9	10.9	0.43	29'	14.6					
120	13	2.21	11.9	26.3	14.4	11.9	14.4	0.43	"	14.6					
130	18	2.21	10.8	23.9	27.5	10.8	13.1	3.00	"	38.6					
140	19	2.21	6.7	14.8	35.6	6.7	8.1	0.32	"		34.8	SPILL	0.8 TO	E SIDE	
150	10	2.21	3.9	8.6	12.5	7.8	0.8	0.32	"	12.6					
		0.8+0.8+10.9 = → (12.5)													
190	10	2.21	1.37	3.0	37.2	1.4	1.6	0.27†	"		32	Spill 5.2	cfs to E.	side	

Ignore Q_{100} overflow from 170/180. Will overtop curb & enter creek

System 300: Check side streets only. Assume conveyance in Central Ave 100' R.O.W. is adequate.

NODE	Tc Min	i_{100}/i_2	Q_2 cfs	Q_{100} cfs	ΣQ cfs	Q_{pipe} cfs	$Q_{100}-Q_p$ cfs	S_o %	Bk-Bk Street Width	T.C.	T.C. +0.3'	T.C. +0.41'	T.C. +0.52	T.C. +0.63'	
310	10	2.21	4.9	10.8				1.1	35'	23.8					OK
320	10	2.21	6.1	13.5				1.1	"	23.8					OK
350	10	2.21	5.6	12.4				0.32	29'	12.6					ok
360	10	2.21	3.8	8.4				0.32	"	12.6					OK
400	13.6	2.21	11.1	24.6				0.32	"	12.6	34.8				
410	13.7	2.21	8.9	19.7				0.32	"	12.6	34.8				

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Date 5/30/85 MWB   Page ____ of ____

Project GOLDEN HILLS DRAINAGE PLAN

Item SYSTEM 500

Q_{100} CHECK

NODE	Tc Min	i_{100}/i_2	Q_2 cfs	Q_{100} cfs	ΣQ cfs	Q_{pipe} cfs	$Q_{100}-Q_p$ cfs	S_o %	Bk-Bk Street Width	MAX DISCHARGE (cfs) @ d = T.C.	T.C. +0.3'	T.C. +0.41'	T.C. +0.52	T.C. +0.63'
505	20.5	2.21	11.4	25.2	13.8	11.4	13.8	0.32	29'	12.6	34.8			
510	21.4	2.21	12.7	28.1		12.7	15.4							
			from	So.	21.5			0.32	"	12.6	34.8			
530	14	2.21	19.7	43.6		19.7	23.9							
			from	No.	29			0.50		15.8	43.5			
520	22	2.21	2.2	4.8	2.2	2.2	2.2	OK BY INSPECTION						

ΣQ_{100} arriving @ Bekemeyer & Pine Grove = 13.8 + 28.1 + 43.6 = 85.5 cfs

ΣQ_2 @ 520, 530, 510 = 12.7 + 19.7 + 2.2 = 34.6

Design Flume for 85.5 − 34.6 = 50.9 cfs

For b = 18', Q = 51 cfs, n = 0.016, d = 0.5' = S_{min} = 0.008 ft/ft

NODE	Tc Min	i_{100}/i_2	Q_2 cfs	Q_{100} cfs	ΣQ cfs	Q_{pipe} cfs	$Q_{100}-Q_p$ cfs	S_o %	Bk-Bk Street Width	T.C.	T.C. +0.3'	T.C. +0.41'	T.C. +0.52	T.C. +0.63'
560	10.1	2.21	6.4	14.2		6.4	7.8	0.32	35	12.6	34.8			
570	10.4	2.21	1.6	3.5		1.6	1.9	0.32	35	12.6				
580	10.1	2.21	5.7	12.6		5.7	6.9	0.32	35	12.6				
590	10.5	2.21	3.6	8.0		3.6	4.4	0.32	35	12.6				

@ Pine Grove & Hickory:

ΣQ_{100} = 38.3 cfs Q_{PIPE} = 17.3 cfs Overflow = 21 cfs

$S_o = \frac{0.4}{175} = 0.23\%$ 0.23 35 10.9

= 21.0 for full width

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Date 5/30/85 MWB Page ______ of ______

Project GOLDEN HILLS DRAINAGE PLAN

Item SYSTEM 700 / 800 / MISC.

Q100 CHECK

NODE	Tc Min	i100/i2	Q2 cfs	Q100 cfs	ΣQ cfs	Qpipe cfs	Q100-Qp cfs	So %	Bk-Bk Street Width	MAX DISCHARGE (cfs) @ d = T.C.	T.C. +0.3'	T.C. +0.41'	T.C. +0.52	T.C. +0.63'
700	10	2.21	9.4	20.8	11.4	9.4	11.4	0.32	35	12.9	37.9			
705	10.2	2.21	12.0	26.5	32.5	5.4	21.1	0.80	35	20.3	60			
710	10.6	2.21	5.5	12.2	32.6	12.1	0.1	0.32	29	12.6	34.6			
720	12.2	2.21	10.3	22.8	45.1	10.3	12.5	0.43	29	14.9	44	spill over crown 1.1 cfs		
730								1.75						
		OK BY INSPECTION												
740								1.75						
		OVERFLOW AT 740 TOPS CURB & INTO RESERVE C												
800	10	2.21	2.5	5.5		2.5	3.0	2.88	29	OK BY INSPECTION				
810	10	2.21	4.1	9.1		4.1	5.0	2.88	29	OK BY INSPECTION				
		OVERFLOW TOP CURB & FLOWS DIRECTLY TO COWSKIN CR												
450	11.9	2.21	7.9	17.5		7.9	9.6	0.40	29	14.1	38.9			
460	19.2	2.21	15.6	34.5		15.6	18.9	0.40	29	14.1	38.9			
910	10	2.21	2.1	4.6		2.1	2.5	0.32	29	12.6	34.8			
920	10	2.21	6.4	14.2		6.4	7.8	0.32	29	12.6	34.8			

PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION
1440 EAST ENGLISH
WICHITA, KANSAS
ZIP CODE / 67211

Date 6-5-85 MWB Page ____ of ____

Project GOLDEN HILLS DRAINAGE PLAN

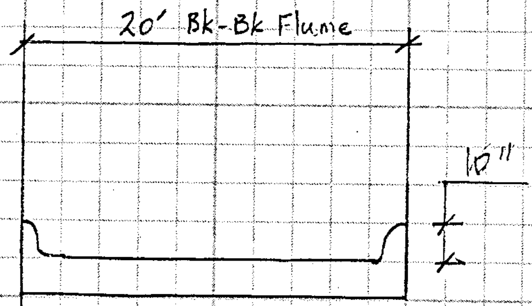
Item BEKEMEYER FLUME

$\Sigma Q_{100} = 13.8 + 28.1 + 43.6 = 85.5$ cfs (Added peak on peak)

$\Sigma Q_{PIPE} = 12.7 + 19.7 + 2.2 = 34.6$ cfs (Assume capacity = 2-yr discharge)

Design flume for $85.5 - 34.6 = 50.9$ cfs

Proposed section



$S = 0.002$ ft/ft
$n = 0.016$
$B = 19'$
$d_{max} = 0.83'$
$Q = 51$ cfs
$Qn = 0.82$
$z = 0$

Using Chart 16, p. 94, HEC-12

$\frac{d}{B} = 0.041$

$d = 0.041(19) = 0.78'$ OK

$V = \frac{Q}{A} = \frac{51}{(0.78)(19)} = 3.4$ ft/sec

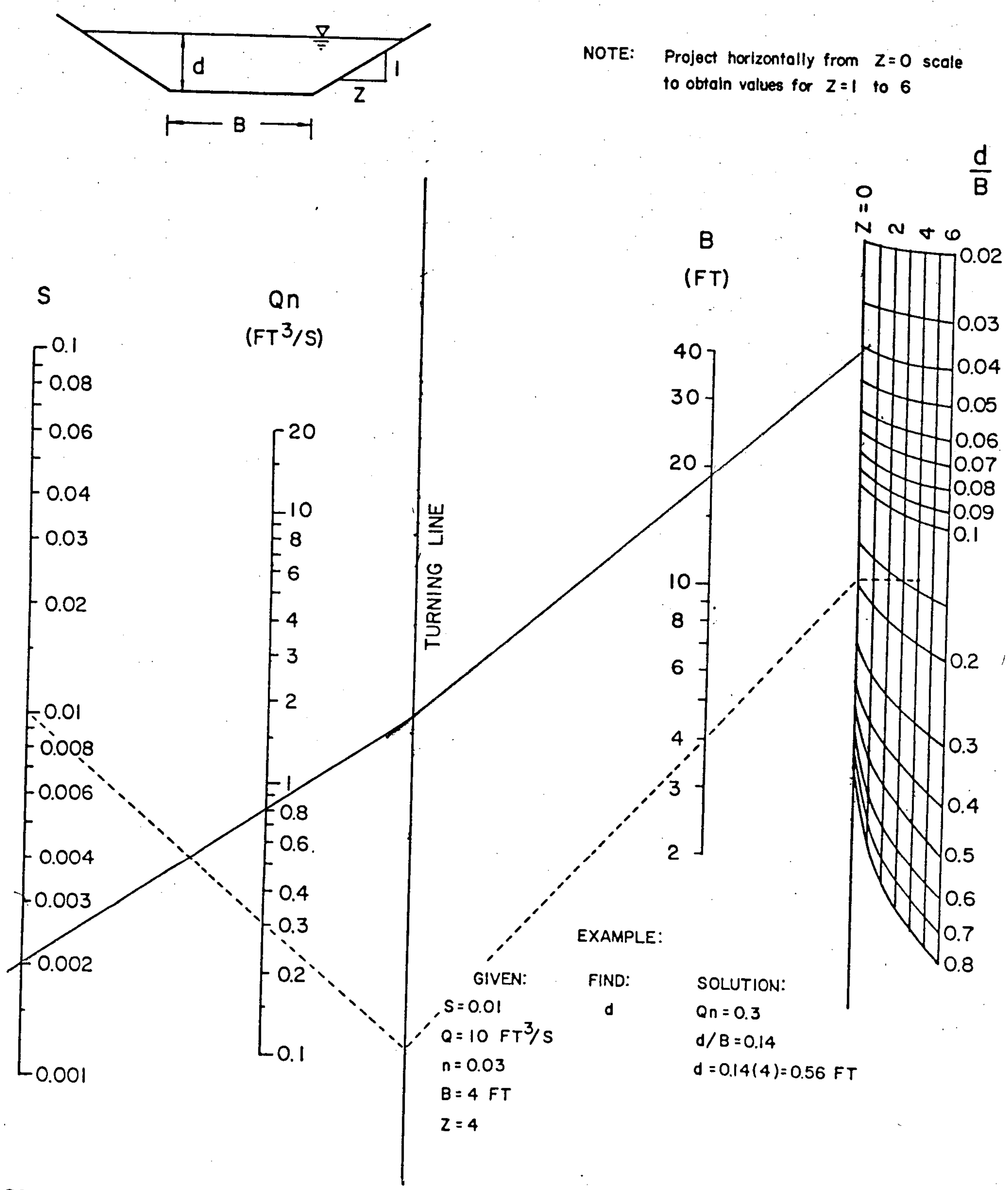
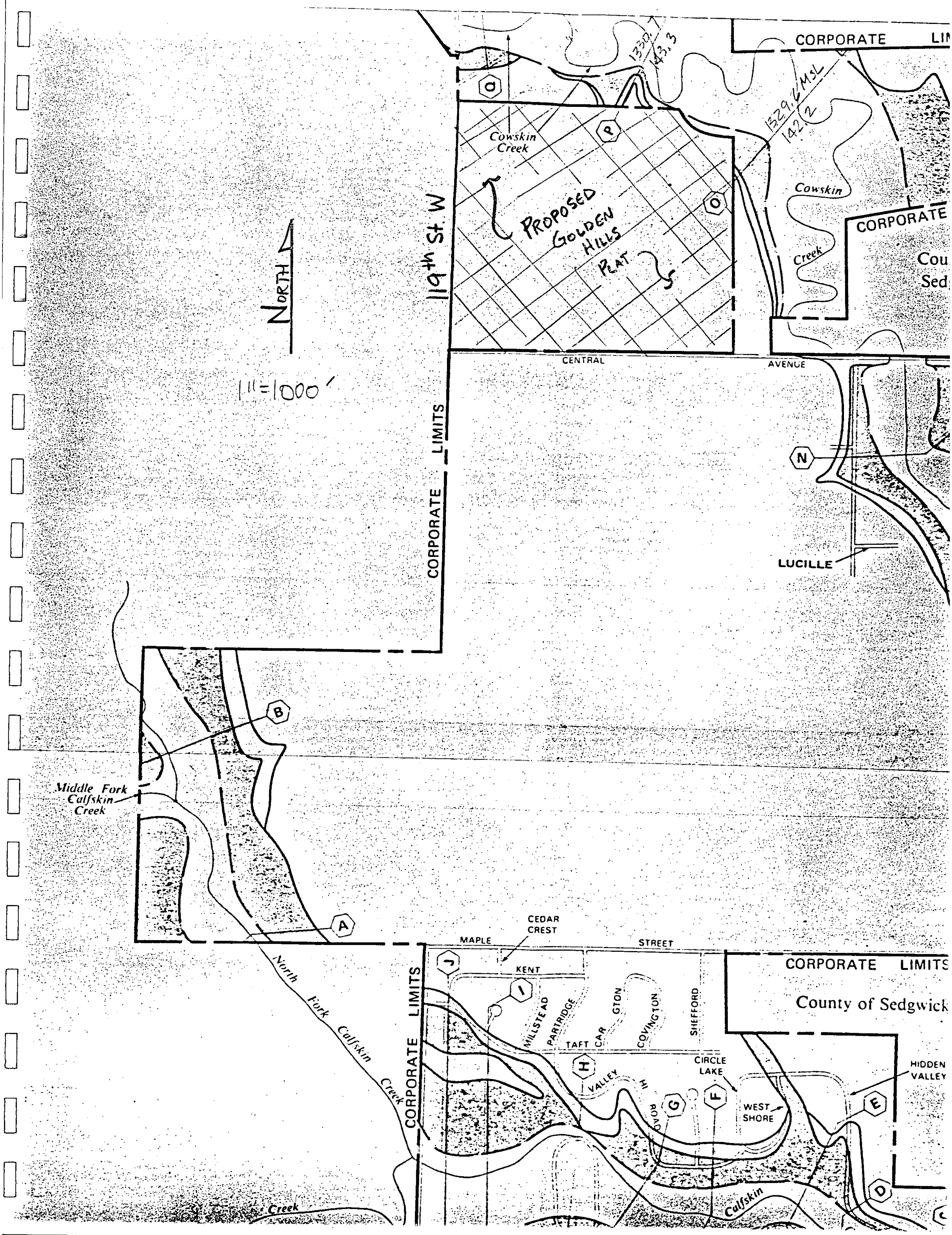
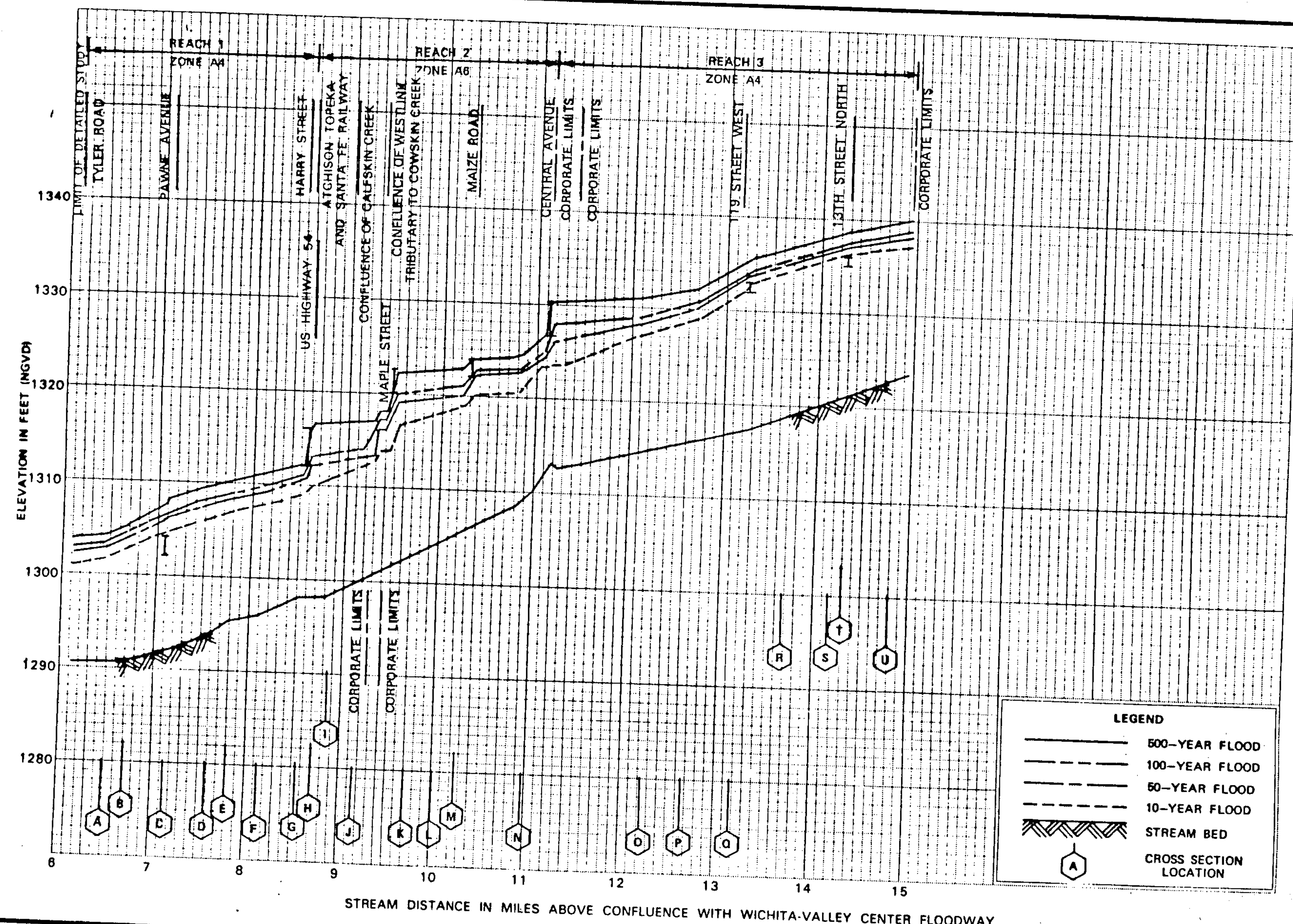


CHART 18. Solution of Manning's equation for channels of various side slopes.



CORPORATE LIMITS
1330.7
143.3
1329.6 MSL
142.2
Cowskin Creek
PROPOSED GOLDEN HILLS PLAT
Cowskin Creek
CORPORATE
County of Sedgwick
119th St. W
NORTH
1"=1000'
CENTRAL AVENUE
CORPORATE LIMITS
LUCILLE
Middle Fork Calfskin Creek
North Fork Calfskin Creek
CEDAR CREST
MAPLE STREET
KENT
MILLSTEAD
PARTRIDGE
TAFT
CARLTON
COVINGTON
SHEFFORD
VALLEY HI ROAD
CIRCLE LAKE
WEST SHORE
HIDDEN VALLEY
CORPORATE LIMITS
County of Sedgwick
CORPORATE LIMITS
Calfskin
Creek
A
B
D
E
F
G
H
I
J
N
O
P
Q



FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WICHITA, KS
(SEDGWICK CO.)

FLOOD PROFILES

COWSKIN CREEK