PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION

DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

BAY COUNTRY ESTATES

AN ADDITION TO WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
WICHITA, KANSAS

MAY 22, 1987

1440 EAST ENGLISH
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The Final Plat of Bay Country Estates is the southeasterly portion of the overall development plan as indicated on the Preliminary Plat.

Only 1 storm sewer system is proposed for this area.

DWS for the Calfskin Creek, upstream of Maple, is 1321.5 per FEMA Flood Insurance Study for the City of Wichita. (See sheet #1 of "Charts & Nomographs" section of this report for profile).

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I. HYDROLOGY

Use Rational Method $Q = CIA$

Determine "C"

Node	Soil Type	Lot Size	C_2	C_{100}
106	B	1/4 Ac. ±	0.44	0.61
105	B	1/4 Ac. ±	0.44	0.61
104	B	1/4 Ac ±	0.44	0.61
103	B	1/4 Ac ±	0.44	0.61
102	B	1/4 Ac ±	0.44	0.61
101	B	1/4 Ac. ±	0.44	0.61
100	(End Section)			

Determine "I"

Node	t_c	I_2	I_{100}
106	15	3.83	7.37
105	15	3.83	7.37
104	15	3.83	7.37
103	15	3.83	7.37
102	15	3.83	7.37
101	15	3.83	7.37
100	(End Section)		

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Determine "A"

Node	Units	Area S.F	Area Ac.
106	11.68	116,800	2.68
105	14.97	149,700	3.44
104	3.63	36,300	0.83
103	22.03	220,300	5.06
102	3.59	35,900	0.82
101	9.47	94,700	2.17
100	(End Section)		

Determine Runoff

2 Yr:	Node	C_2	I_2	A	Q_2
	106	0.44	3.83	2.68	4.5
	105	0.44	3.83	3.44	5.8
	104	0.44	3.83	0.83	1.4
	103	0.44	3.83	5.06	8.5
	102	0.44	3.83	0.82	1.4
	101	0.44	3.83	2.17	3.7
	100	(End Section)			

100 Yr:	Node	C_{100}	I_{100}	A	Q_{100}
	106	0.61	7.37	2.68	12.0
	105	0.61	7.37	3.44	15.5
	104	0.61	7.37	0.83	3.7
	103	0.61	7.37	5.06	22.7
	102	0.61	7.37	0.82	3.7
	101	0.61	7.37	2.17	9.8
	100	(End Section)			

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II INLET SIZING / FLOOD ROUTING

Node	Inlet Condition	L	$Q_{approach}$ *	$Q_{intercept}$ ‡	Q_{bypass}	to Node #
106	Sump	5'	4.5	4.5	0.0	-
105	Sump	5'	5.8	5.8	0.0	-
104	On Grade	5'	1.4	40% = 0.6	0.8	103
103	Sump	5'	8.5 + 0.8 = 9.3	9.3	0.0	-
102	On Grade	5'	1.4	40% = 0.6	0.8	101
101	Sump	5'	3.7 + 0.8 = 4.5	4.5	0.0	-

* $Q_{approach} = Q_Z$ + Bypass Q from other nodes.

‡ $Q_{intercept}$ = Q input into "Storm" Program

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III STREET FLOW - 2yr.

Node	$Q_{approach}$	Distribution	street slope	d	Comment
106	4.5	100% (E) = 4.5	0.8%	0.31'	OK
105	5.8	80% (E) = 4.6	0.8%	0.31'	OK
		20% (N) = 1.2	1.3%	0.17'	OK
104	1.4	100% (N) = 1.4	1.3%	0.19'	OK
103	8.5 + 0.8 = 9.3	50% (NW) = 4.7	1.5%	0.28'	OK
		50% (SE) = 4.6	1.3%	0.29'	OK
102	1.4	100% (E) = 1.4	1.3%	0.19'	OK
101	3.7 + 0.8 = 4.5	60% (N) = 2.7	0.32%	0.31	OK
		40% (S) = 1.8	0.32%	0.27	OK

7/15

```
100 j, 1317.5000  100    3    7    6
110 t,bay country estates
120 t,drainage plan
130 t,storm water system 100 analysis
140 i,  106     0.44     2.68     0.00     0.00     4.50    15.00  1329.20
150 i,  105     0.44     3.44     0.00     0.00     5.80    15.00  1329.20
160 i,  104     0.44     0.83     0.00     0.00     0.60    15.00  1328.50
170 i,  103     0.44     5.06     0.00     0.00     9.30    15.00  1324.50
180 i,  102     0.44     0.82     0.00     0.00     0.60    15.00  1324.20
190 i,  101     0.44     2.17     0.00     0.00     4.50    15.00  1323.50
200 m,  100  1317.50
210 p,  106  105    40.00   15 0.013  80.00   0.00
220 p,  105  104    90.00   18 0.013   5.00   0.00
230 p,  104  103   240.00   18 0.013  20.00   0.00
240 p,  103  102    70.00   24 0.013  20.00   0.00
250 p,  102  101   210.00   24 0.013  60.00   0.00
260 p,  101  100   240.00   30 0.013  90.00   0.00
270 e
```

IV HYDRAULICS

8/15

Date: 05-18-1987
Time: 19:01:24

Input File: bacnt100

bay country estates
drainage plan
storm water system 100 analysis

Storm Frequency = 2-Year

* * * HYDROLOGY * * *

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)
106	105	0.44	2.68	0.00	0.0	15.00	4.06	4.50	15.00	4.06	4.50	4.50	15"	3.67	40.00	0.18	15.18
105	104	0.44	3.44	0.00	0.0	15.00	4.06	5.80	15.18	4.04	5.77	10.27	18"	5.81	90.00	0.26	15.44
104	103	0.44	0.83	0.00	0.0	15.00	4.06	0.60	15.44	4.01	0.59	10.87	18"	6.15	240.00	0.65	16.09
103	102	0.44	5.06	0.00	0.0	15.00	4.06	9.30	16.09	3.95	9.05	19.92	24"	6.34	70.00	0.18	16.27
102	101	0.44	0.82	0.00	0.0	15.00	4.06	0.60	16.27	3.93	0.58	20.50	24"	6.52	210.00	0.54	16.81
101	100	0.44	2.17	0.00	0.0	15.00	4.06	4.50	16.81	3.88	4.30	24.80	30"	5.05	240.00	0.79	17.60

9/15

Date: 05-18-1987
Time: 19:01:24

Input File: bacnt100

bay country estates
drainage plan
storm water system 100 analysis

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)
106	0.00485	0.1941	0.0000	0.0000	0.0000	0.0000	0.0000	0.1941	1326.7544	1329.2000	2.45
105	0.00956	0.8608	0.0000	0.0316	0.0000	0.0906	0.9342	1.9172	1326.5603	1329.2000	2.64
104	0.01070	2.5681	0.0000	0.0062	0.0000	0.0082	0.1757	2.7583	1324.6432	1328.5000	3.86
103	0.00775	0.5425	0.0000	0.0037	0.0000	0.0483	0.7995	1.3940	1321.8849	1324.5000	2.62
102	0.00821	1.7238	0.0000	0.0037	0.0000	0.0513	0.1140	1.8928	1320.4910	1324.2000	3.71
101	0.00366	0.8774	0.0000	0.0529	0.0000	0.2032	-0.0354	1.0981	1318.5981	1323.5000	4.90
100	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1317.5000	1317.5000	0.00

V CHECK STREET FLOW - 100 YR

Check street flow approaching Nodes 106-105

Node	Q_{100}
106	12.0
105	15.5

$\Sigma = 27.5$ cfs

$Q_{street} = Q_{100} - Q_2(\text{pipe})$

$= 27.5 - 0.0$

$= 27.5$ cfs

w/ street slope of 0.8%

$Q_{max} = 882.3\sqrt{s}$ (see page 13)

$= 882.3\sqrt{0.008}$

$= 78.9$ cfs

street flow < 78.9 street flow OK

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Item Drainage Plan

Check Street Flow approaching Nodes 103 - 102

Node	Q_{100}
106	12.0
105	15.5
104	3.7
103	22.7
102	3.7
Σ	57.6 cfs

$Q_{street} = Q_{100} - Q_2 (pipe)_{nodes\ 104-103}$

$= 57.6 - 10.9 = 46.7$ cfs

w/ street slope @ 1.3%

$Q_{max} = 882.3\sqrt{S}$ (see page 13)

$= 882.3\sqrt{0.013}$

$= 100.6$ cfs

street flow < 100.6 cfs street flow OK

Check Street Flow Approaching Node 101

Node	Q_{100}
106	12.0
105	15.5
104	3.7
103	22.7
102	3.7
101	9.8

$\Sigma = 67.4$ cfs

$Q_{street} = Q_{100} - Q_2(pipe)_{102-101}$

$= 67.4 - 20.5$

$= 46.9$ cfs

w/ street slope @ 0.32%,

$Q_{max} = 773.89\sqrt{S}$ (see page 14) (walk gr. = 0.3')

$= 773.89\sqrt{0.0032}$

$= 43.76$ cfs

street flow > Q_{max}

Use Walk grade 0.4'

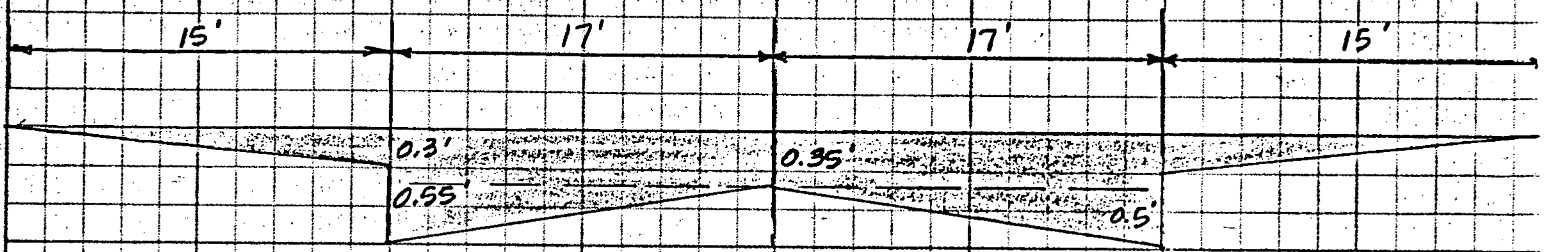
(w S = 0.32%)

Date May 19, 1987 Page 13 of 15

Project Bay Country Estates

Item Drainage Plan - System 100

Check Street Flow 100-YR (Walk Grade +0.3')



Determine Q_{max} in Street R-O-W

Use Mannings Eq'n $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

$$n = \frac{2(14.5 \times 0.030) + 2(1.05' \times 0.013) + 2(17 \times 0.016)}{65.1}$$

$$n = 1.4413/65.1 = 0.0221$$

$$A = 2(1/2 \times 15 \times 0.3) + (34 \times 0.35) + 2(1/2 \times 0.5 \times 17)$$
$$= 24.90 \text{ SF}$$

$$P = (2 \times 15) + (2 \times 17) + (2 \times 0.55)$$
$$= 65.1'$$

$$R = A/P = 24.9/65.1 = 0.38249$$

$$R^{2/3} = 0.527$$

$$Q = \frac{1.486}{0.0221} \times 24.90 \times 0.527 \times S^{1/2}$$

$$Q = 882.3 \times S^{1/2}$$

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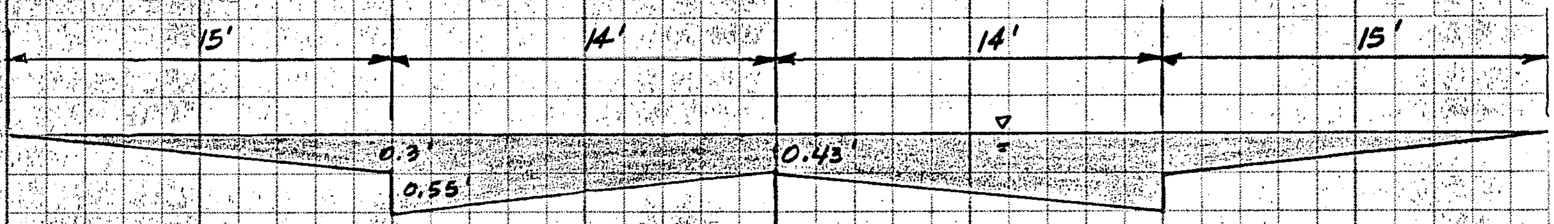
Item Drainage Plan - System 100



Determine Q_{max} in street R-O-W

Use Manning's Equation $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

$$n = \frac{2(14.5 \times 0.03) + 2(3.05 \times 0.013) + 2(12 \times 0.016)}{59.1}$$

$n = 0.02256$

$$A = 2(\tfrac{1}{2} \times 15 \times 0.3) + (28 \times 0.43) + 2(\tfrac{1}{2} \times 14 \times 0.42)$$

$A = 22.42$ SF

$R = A/p = 22.42/59.1 = 0.379357$

$R^{2/3} = 0.524041$

$$Q = \frac{1.486}{0.02256} \times 22.42 \times 0.524041 \times S^{1/2}$$

$Q = 773.89 \sqrt{S}$

Date May 19, 1987
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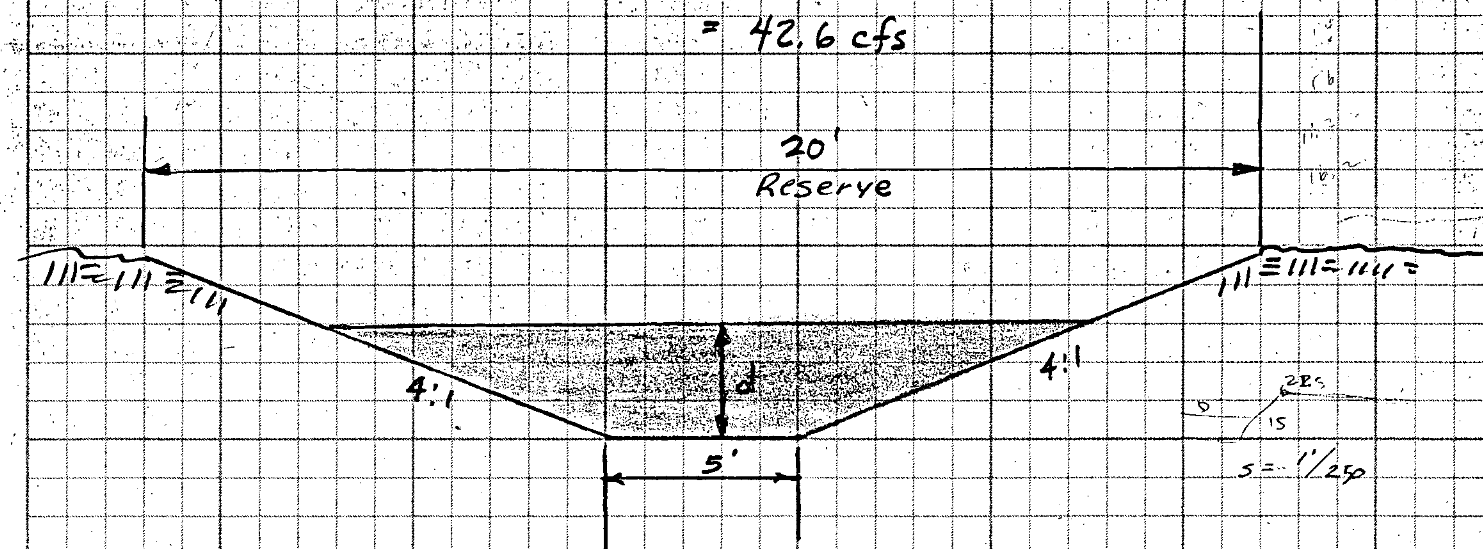
Item Drainage Plan

VI Size Overflow Channel

$Q_{overflow\ channel} = Q_{100} - Q_{2\ pipe}$

$= 67.4 - 24.8$

$= 42.6$ cfs



Use Manning's Equation $Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$

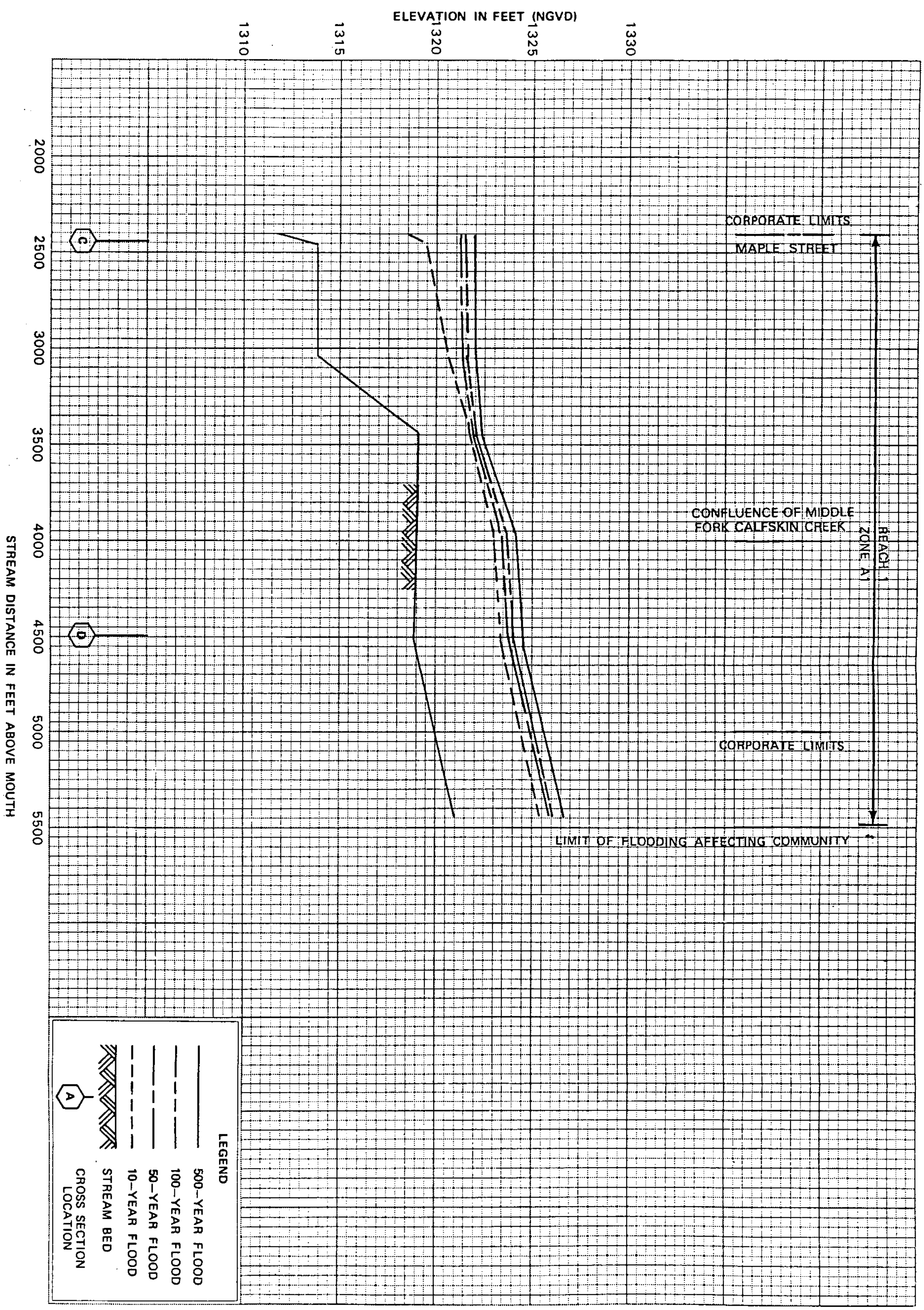
$AR^{2/3} = \frac{Q \times n}{1.486 \times S^{1/2}}$

$AR^{2/3} = \frac{42.6 \times 0.030}{1.486 \times 0.004^{1/2}} = \frac{1.27}{0.09398}$

$AR^{2/3} = 13.51$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$
1'	9.0	13.25	0.679	0.772	6.96
1.1'	10.34	14.07	0.735	0.814	8.42
1.2'	11.76	14.90	0.789	0.854	10.04
1.3	13.26	15.72	0.843	0.892	11.83
1.4	14.84	16.54	0.897	0.930	13.80 ←

$V = Q/A = \frac{42.6}{14.84} = 2.9$ OK



35P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF WICHITA, KS (SEDGWICK CO.)	FLOOD PROFILES NORTH FORK CALFSKIN CREEK

AS — SHEET NUMBER 40

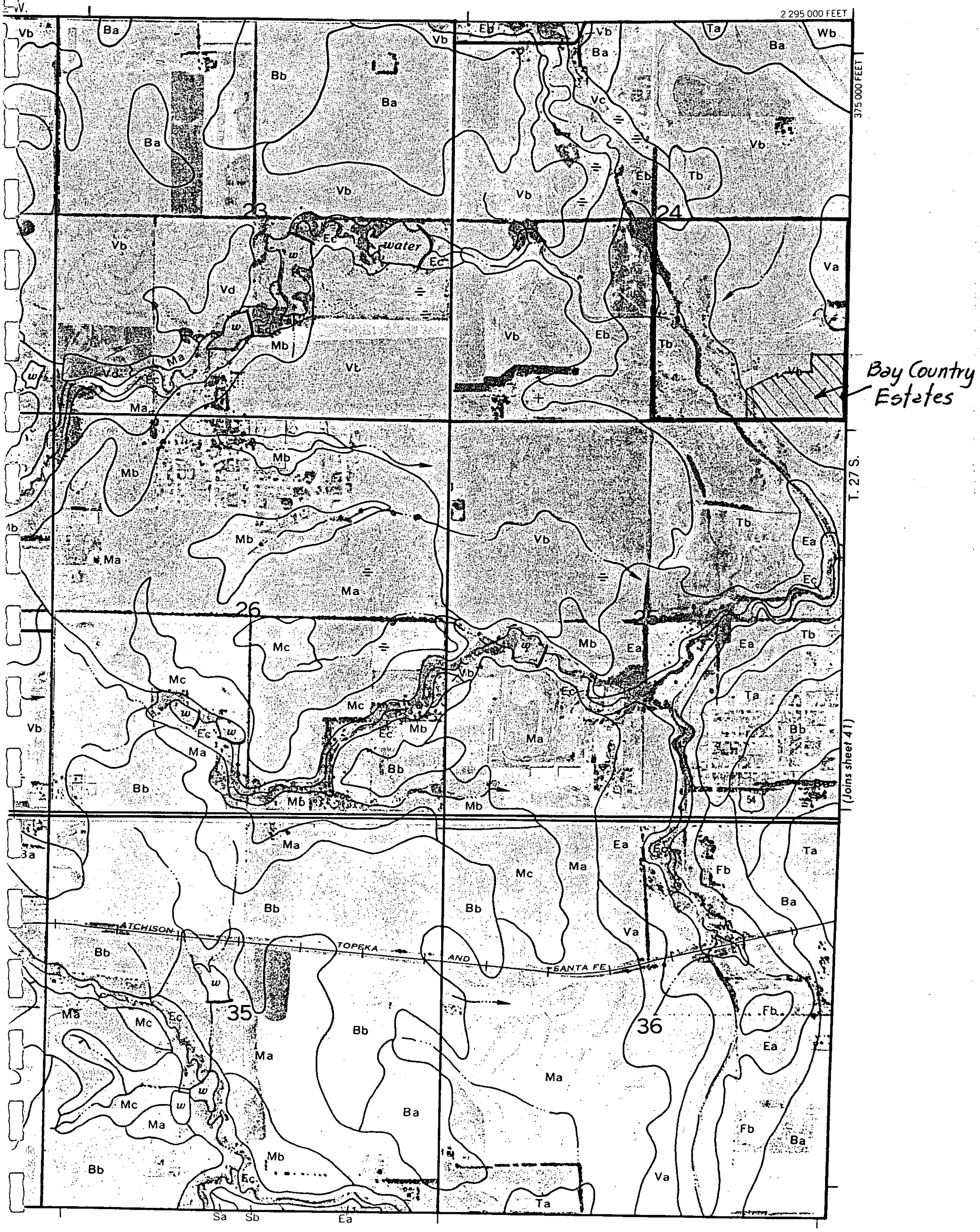


EXHIBIT NO. 1

SOIL LEGEND

SYMBOL	HYDROLOGIC GROUP	NAME
Aa	B	Albion-Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loans, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loan, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loan
Cb	B	Canadian-Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark-Ost clay loams, 1 to 4 percent slopes
Ce	C	Clime silty clay, 3 to 6 percent slopes
Ea	B	Elandco silt loam
Eb	B	Elandco silt loam, occasionally flooded
Ec	B	Elandco silt loam, frequently flooded
Fa	B	Farnum loam, 0 to 1 percent slopes
Fb	B	Farnum loam, 1 to 3 percent slopes
Fc	B	Farnum loam, sandy substratum, 0 to 1 percent slopes
Ga	D	Goessel silty clay, 0 to 1 percent slopes
Gb	D	Goessel silty clay, 1 to 2 percent slopes
Ia	D	Irwin silty clay loam, 1 to 3 percent slopes
Ib	D	Irwin silty clay loam, 3 to 6 percent slopes
Ic	D	Irwin silty clay loam, 2 to 6 percent slopes, eroded
La	C	Lesho loam
Lb	A	Lincoln soils
Ma	B	Milan loam, 1 to 3 percent slopes
Mb	B	Milan form, 3 to 6 percent slopes
Mc	B	Milan clay loam, 2 to 6 percent slopes, eroded
Na	B	Naron fine sandy loam
Oc	D	Owens clay loam, 1 to 3 percent slopes
Od	D	Owens-Rock outcrop complex, 3 to 10 percent slopes
Pa		Pits
Pb	D	Plevna fine sandy loam
Pc	A	Pratt loamy fine sand, undulating
Pd	A	Pratt-Tivoli complex, rolling
Ra	D	Renfrow silty clay loam, 1 to 3 percent slopes
Rb	D	Renfrow silty clay loam, 3 to 6 percent slopes
Rc	D	Renfrow-Owens clay loams, 1 to 4 percent slopes
Rd	D	Rosehill silty clay, 1 to 3 percent slopes
Sa	B	Shellabarger sandy loam, 1 to 3 percent slopes
Sb	B	Shellabarger sandy loam, 3 to 6 percent slopes
Sc	B	Shellabarger sandy loam, 3 to 6 percent slopes, eroded
Ta	D	Tabler silty clay loam
Tb	D	Tabler-Drummond complex
Ua	B	Urban land-Canadian complex
Ub	B	Urban land-Elandco complex
Uc	B	Urban land-Farnum complex, 0 to 3 percent slopes
Ud	D	Urban land-Irwin complex, 1 to 3 percent slopes
Ue	D	Urban land-Tabler complex
Va	B	Vanoss silt loam, 0 to 1 percent slopes
Vb	B	Vanoss silt loam, 1 to 3 percent slopes
Vc	B	Vanoss silt loam, 3 to 6 percent slopes
Vd	B	Vanoss silt loam, 3 to 6 percent slopes, eroded
Ve	D	Vernon sandy loam, 1 to 3 percent slopes
Vf	D	Vernon sandy loam, 3 to 6 percent lopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam

(3 pages)

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

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
7. Undeveloped Urban Areas:					
Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:	96	0.87	0.87	0.88	0.89
10. Roofs:	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for basins 320 acres or larger.

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

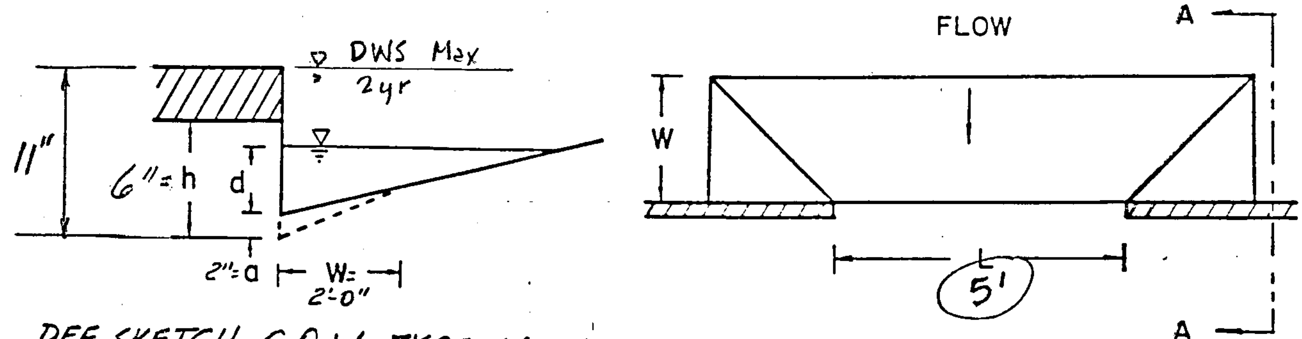
The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
46	1.70	2.05	2.54	2.97	3.48	3.93	4.33
47	1.67	2.02	2.50	2.93	3.44	3.88	4.28
48	1.66	2.00	2.47	2.90	3.39	3.84	4.23
49	1.64	1.97	2.44	2.86	3.35	3.79	4.18
50	1.61	1.95	2.41	2.83	3.32	3.75	4.13
51	1.59	1.92	2.38	2.79	3.28	3.71	4.09
52	1.56	1.89	2.35	2.76	3.24	3.67	4.05
53	1.54	1.86	2.33	2.73	3.20	3.63	4.00
54	1.52	1.84	2.30	2.70	3.17	3.59	3.96
55	1.50	1.81	2.27	2.67	3.14	3.55	3.92
56	1.47	1.79	2.25	2.64	3.10	3.51	3.88
57	1.45	1.76	2.22	2.61	3.07	3.48	3.84
58	1.43	1.74	2.20	2.59	3.04	3.44	3.81
59	1.42	1.72	2.18	2.56	3.01	3.41	3.77
60	1.40	1.69	2.15	2.53	2.98	3.37	3.73
61	1.38	1.67	2.13	2.51	2.95	3.34	3.70
62	1.36	1.65	2.11	2.48	2.92	3.31	3.67
63	1.34	1.63	2.09	2.46	2.89	3.28	3.63
64	1.33	1.61	2.07	2.44	2.86	3.25	3.60
65	1.31	1.59	2.05	2.41	2.84	3.22	3.57
66	1.30	1.57	2.03	2.39	2.81	3.19	3.54
67	1.28	1.56	2.01	2.37	2.79	3.16	3.51
68	1.26	1.54	1.99	2.35	2.76	3.13	3.48
69	1.25	1.52	1.97	2.33	2.74	3.10	3.45
70	1.24	1.50	1.95	2.31	2.71	3.08	3.42
71	1.22	1.49	1.93	2.28	2.69	3.05	3.39
72	1.21	1.47	1.92	2.26	2.67	3.02	3.36
73	1.20	1.46	1.90	2.25	2.64	3.00	3.34
74	1.18	1.44	1.88	2.23	2.63	2.98	3.31
75	1.17	1.43	1.86	2.21	2.61	2.95	3.29
76	1.16	1.41	1.85	2.19	2.58	2.93	3.26
77	1.15	1.40	1.83	2.17	2.55	2.90	3.24
78	1.13	1.38	1.82	2.15	2.53	2.88	3.22
79	1.12	1.37	1.80	2.14	2.50	2.86	3.19
80	1.11	1.36	1.79	2.12	2.48	2.84	3.16
81	1.10	1.34	1.77	2.10	2.46	2.82	3.13
82	1.09	1.33	1.76	2.08	2.43	2.79	3.10
83	1.08	1.32	1.74	2.06	2.41	2.76	3.07
84	1.07	1.31	1.73	2.04	2.39	2.74	3.04
85	1.06	1.30	1.72	2.02	2.37	2.71	3.01
86	1.05	1.28	1.70	2.00	2.34	2.69	2.99
87	1.04	1.27	1.69	1.99	2.32	2.66	2.96
88	1.03	1.26	1.68	1.97	2.30	2.64	2.93
89	1.02	1.25	1.68	1.95	2.28	2.62	2.91
90	1.01	1.24	1.66	1.93	2.26	2.59	2.88

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
91	1.00	1.23	1.65	1.92	2.24	2.57	2.86
92	1.00	1.22	1.63	1.90	2.22	2.55	2.83
93	0.99	1.21	1.62	1.89	2.20	2.53	2.81
94	0.98	1.20	1.61	1.87	2.19	2.51	2.79
95	0.97	1.19	1.59	1.85	2.17	2.49	2.76
96	0.96	1.18	1.58	1.84	2.15	2.46	2.74
97	0.96	1.17	1.57	1.82	2.13	2.44	2.72
98	0.95	1.16	1.56	1.81	2.12	2.42	2.70
99	0.94	1.15	1.54	1.80	2.10	2.41	2.67
100	0.93	1.14	1.53	1.78	2.08	2.39	2.65
101	0.93	1.13	1.52	1.77	2.07	2.39	2.65
102	0.92	1.13	1.51	1.75	2.05	2.35	2.61
103	0.91	1.12	1.50	1.74	2.04	2.33	2.59
104	0.90	1.11	1.49	1.73	2.02	2.31	2.57
105	0.90	1.10	1.47	1.72	2.01	2.30	2.55
106	0.89	1.09	1.46	1.70	1.99	2.28	2.54
107	0.88	1.09	1.45	1.69	1.98	2.26	2.52
108	0.88	1.08	1.44	1.68	1.96	2.25	2.50
109	0.87	1.07	1.43	1.67	1.95	2.23	2.48
110	0.87	1.06	1.42	1.65	1.93	2.21	2.46
111	0.86	1.06	1.41	1.64	1.92	2.20	2.45
112	0.85	1.05	1.40	1.63	1.91	2.18	2.43
113	0.85	1.04	1.39	1.62	1.89	2.17	2.41
114	0.84	1.03	1.38	1.61	1.88	2.15	2.40
115	0.84	1.03	1.37	1.60	1.87	2.14	2.38
116	0.83	1.02	1.36	1.59	1.86	2.12	2.36
117	0.82	1.01	1.36	1.58	1.84	2.11	2.35
118	0.82	1.01	1.35	1.57	1.83	2.09	2.33
119	0.81	1.00	1.34	1.56	1.82	2.08	2.32
120	0.81	0.99	1.33	1.55	1.81	2.07	2.30

DURATION IN HOURS	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
2	0.81	0.99	1.33	1.55	1.81	2.07	2.30
3	0.59	0.72	0.97	1.13	1.32	1.51	1.68
4	0.47	0.58	0.78	0.91	1.06	1.21	1.35
5	0.40	0.49	0.66	0.77	0.89	1.02	1.14
6	0.35	0.42	0.57	0.67	0.78	0.89	0.99
8	0.28	0.34	0.46	0.53	0.62	0.71	0.79
10	0.23	0.29	0.39	0.45	0.52	0.60	0.67
12	0.20	0.25	0.33	0.39	0.45	0.52	0.58
18	0.15	0.18	0.24	0.28	0.33	0.38	0.42
24	0.12	0.15	0.20	0.23	0.27	0.31	0.34



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

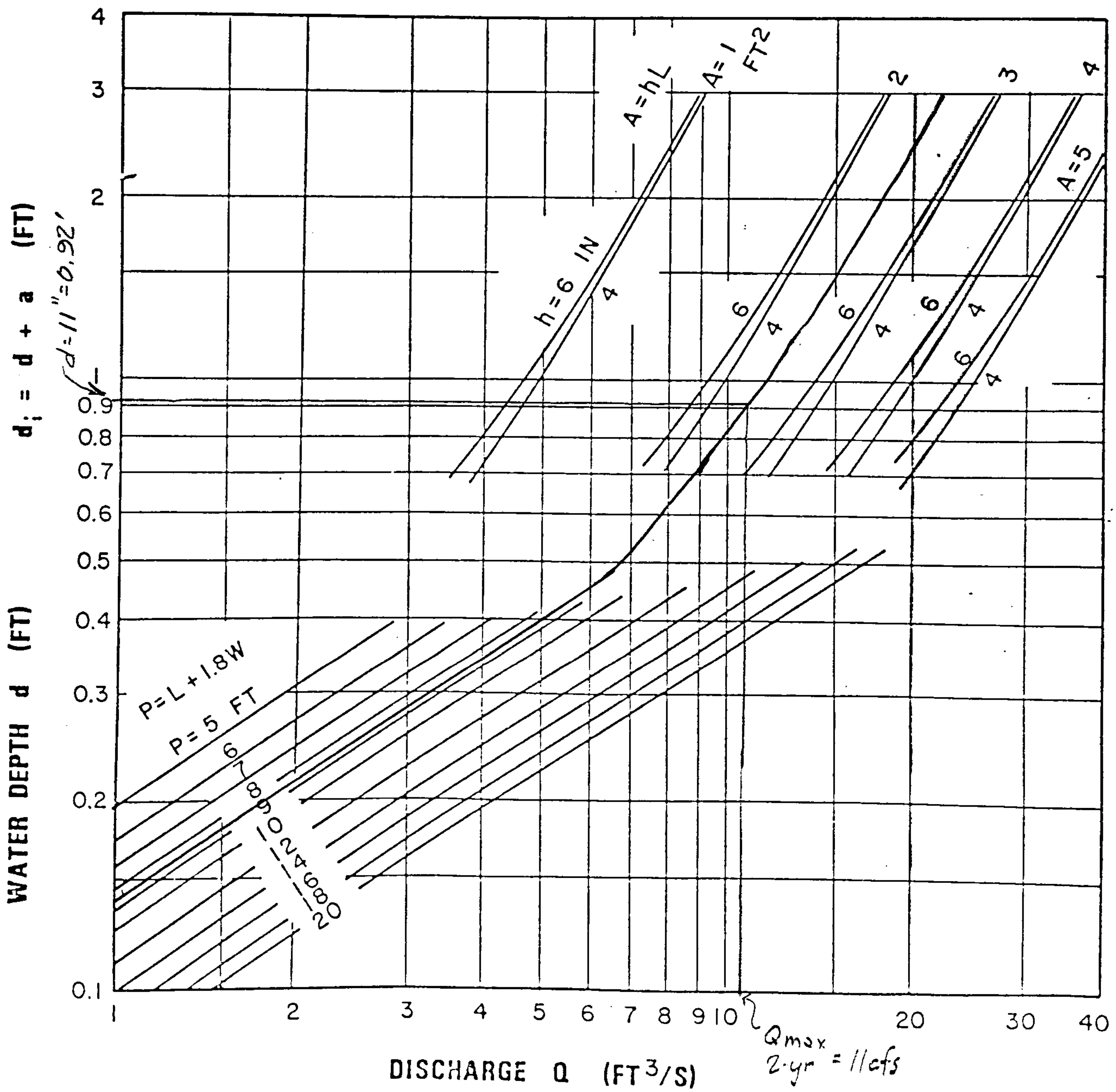


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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

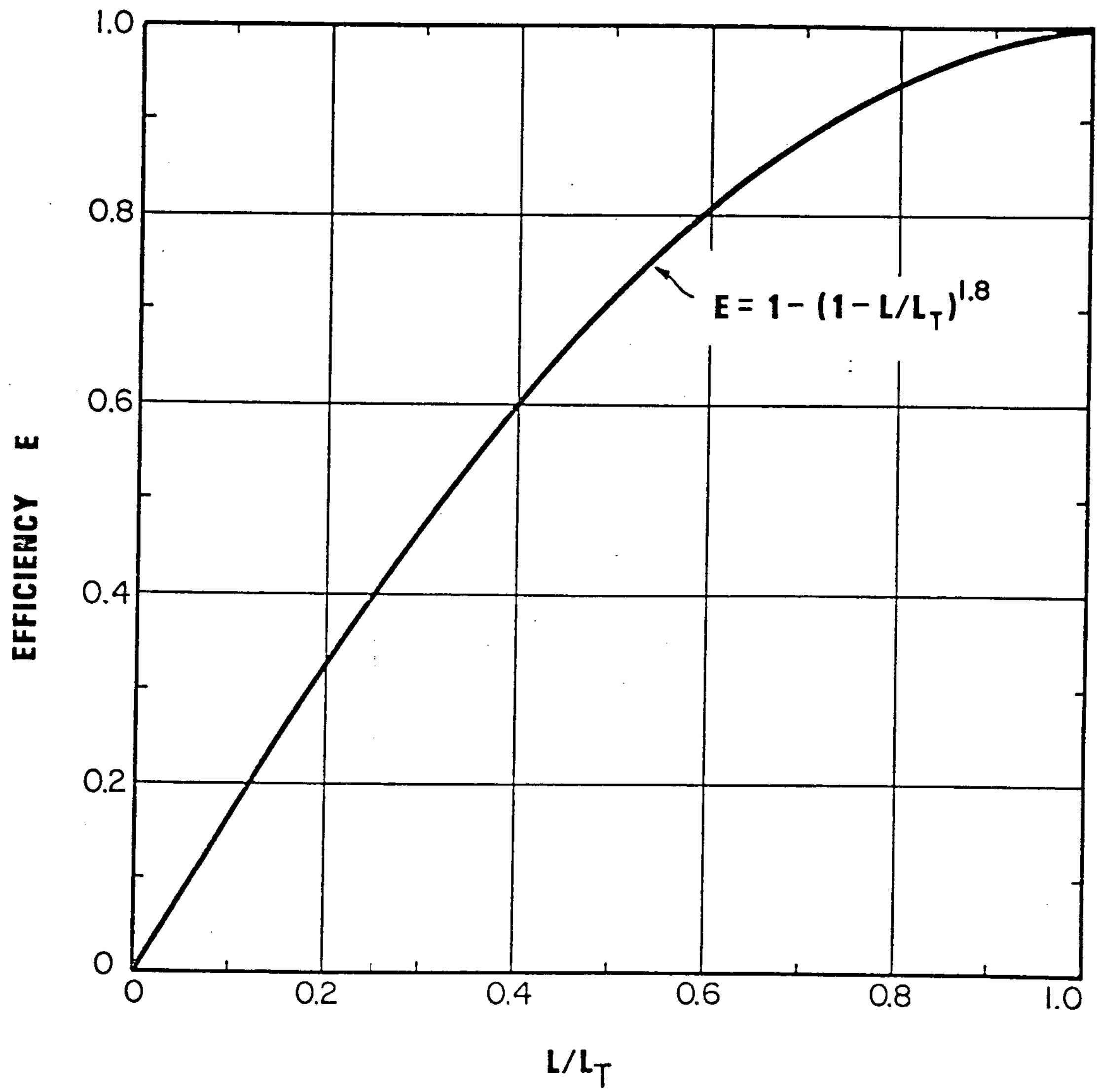


CHART 10. Curb–opening and slotted drain inlet interception efficiency.

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

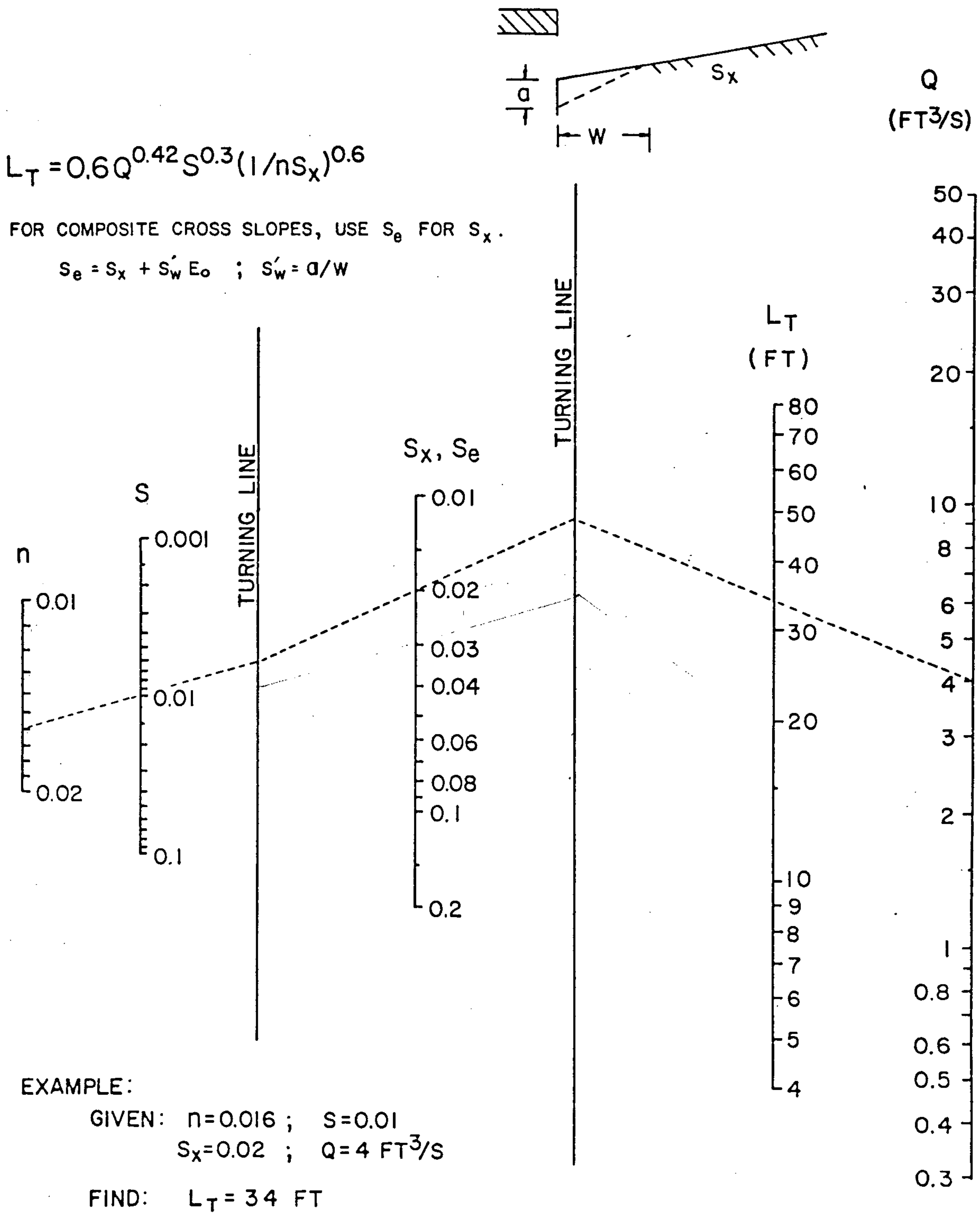


CHART 9. Curb-opening and slotted drain inlet length for total interception.

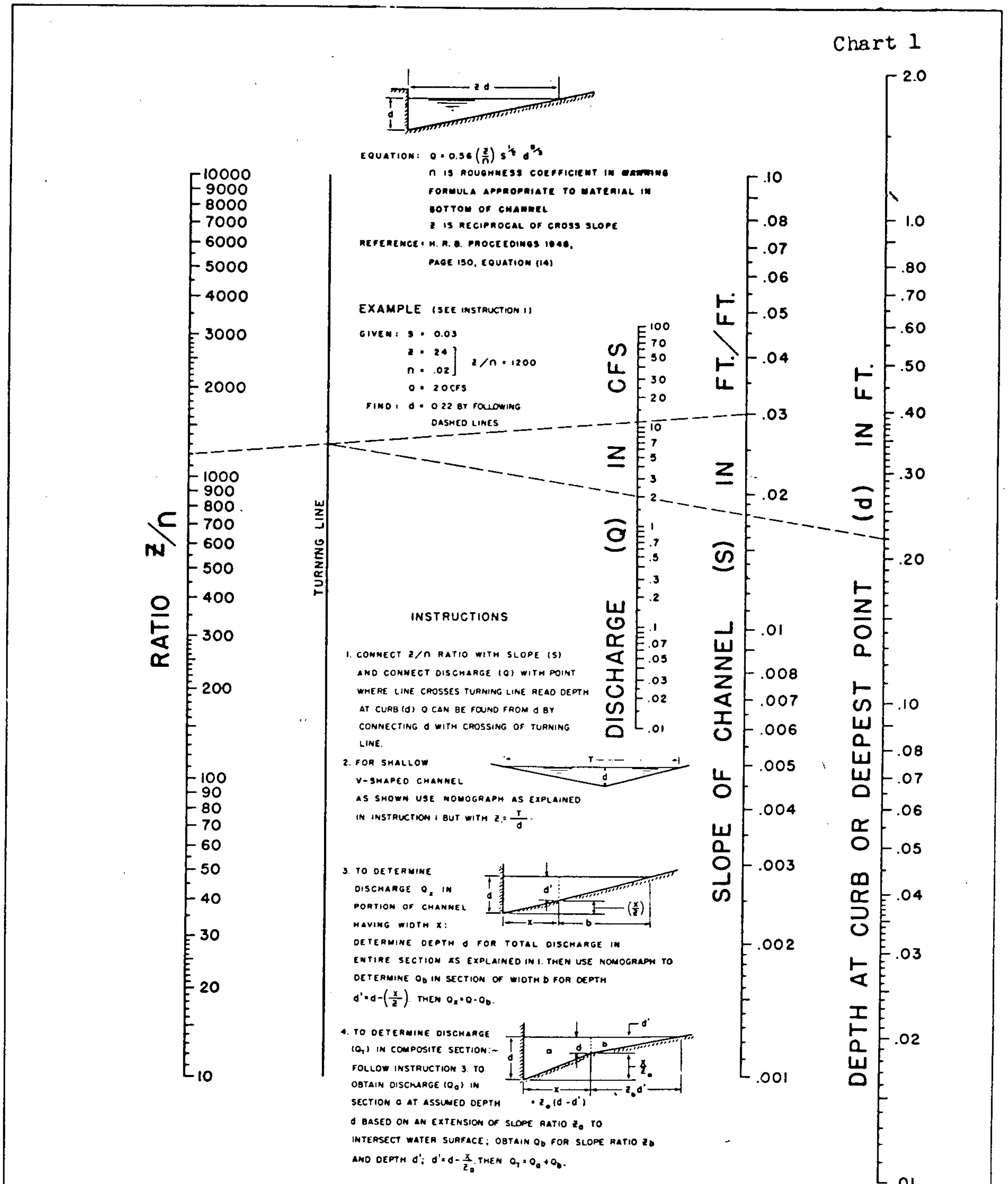
From: HEC-12, Drainage of Highway Pavements, F.H.W.A., Mar. 1984.

Bay Country Estates

$Z = 1 / 3/8''/1 = 32$

$n = 0.016$

$Z/n = 2000$



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS