DRAINAGE PLAN
AND
SUPPORTING CALCULATIONS

PROFESSIONAL
ENGINEERING
CONSULTANTS
PROFESSIONAL ASSOCIATION

FOR
TALLGRASS EAST 5TH ADDITION

PREPARED BY
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
ENGINEERS
WICHITA, KANSAS

FEBRUARY 22, 1991

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Project Tallgrass East 5th Addition

Item Drainage Plan - Introduction

Tallgrass East 5th Addition is a proposed single-family sub-division. This plat will replat Lots 1-9 Block 1, Lots 1-22 Block 2, and Lots 1-6 Block 3 Tallgrass East and will incorporate an unplatted tract that is approximately 6.7 acres in size. The Drainage Plan for Tallgrass East included storm sewer systems into the subject property. Due to the new plat geometrics, these systems will need to be re-evaluated.

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Project Tallgrass East 5th Addition

Item Drainage Plan SWS #1

SWS #1 = North System

I. HYDROLOGY Use Rational Method Q = CIA

Determine "c"

Node	Soil Type	Hydrologic Group	Land Use	C_2	C_{100}
105	Ma, Ia	20% B; 80% D	Res; 1/4 Ac.	0.49	0.73
110	Ia	D	Res; 1/4 Ac.	0.50	0.76
115	Ia	D	Res; 1/4 Ac.	0.50	0.76
120	Existing Curb Inlet (Connection Point)				

Determine "I"

Assume t_c = 15 minutes for each node.

∴ I_2 = 3.83 in/hr I_{100} = 7.37 in/hr.

Determine "A"

Node	Planimeter Units	Area (SF)	Area (Acre)
105	37.13	237,632	5.46
110	9.94	63,616	1.46
115	6.44	41,216	0.95
120	Existing Curb Inlet (Connection Point)		

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Item Drainage Plan SWS #1

Determine "Q_2"

Node	C_2	I_2	A	Q_2
105	0.49	3.83	5.46	10.2
110	0.50	3.83	1.46	2.8
115	0.50	3.83	0.95	1.8
120	Existing Curb Inlet (Connection Point)			

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
105	0.73	7.37	5.46	29.4
110	0.76	7.37	1.46	8.2
115	0.76	7.37	0.95	5.3
120	Existing Curb Inlet (Connection Point)			

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Item Drainage Plan SWS#1

II INLET SIZING / FLOOD ROUTING (2-YR)

Node	Inlet Condition	Q_2	Q_{max} (5' inlet)	Q_{max} (10' inlet)	≠ $Q_{intercept}$	Q_{bypass}	USE L=
105	Sump	10.2	11.0	22.0	10.2	0.0	5'
110	Sump	2.8	11.0	22.0	2.8	0.0	5'
115	Sump	1.8	N/A	N/A	1.8	0.0	Catch Basin
120	(Existing Curb Inlet) (Connection Point)						

≠ $Q_{intercept}$ = input data in "storm" program.

```
100 j,  213.6700  120    3    4    3
110 t,tallgrass east 5th addition
120 t,drainage plan
130 t,storm water sewer system no. 1 analysis
140 i,  105      0.49      5.46      0.00      0.00     10.20     15.00   220.40
150 i,  110      0.50      1.46      0.00      0.00      2.80     15.00   220.40
160 i,  115      0.50      0.95      0.00      0.00      1.80     15.00   216.50
170 m,  120   215.31
180 p,  105  110     40.00    18 0.013    0.00    0.00
190 p,  110  115     80.00    18 0.013   30.00    0.00
200 p,  115  120    140.00    18 0.013   90.00    0.00
210 e
```

Date: 02-19-1991
Time: 08:57:41

Input File: tall5-100

tallgrass east 5th addition
drainage plan
storm water sewer system no. 1 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)
105	110	0.49	5.46	0.00	0.0	15.00	4.06	10.20	15.00	4.06	10.20	10.20	18"	5.77	40.00	0.12	15.12
110	115	0.50	1.46	0.00	0.0	15.00	4.06	2.80	15.12	4.05	2.79	12.99	18"	7.35	80.00	0.18	15.30
115	120	0.50	0.95	0.00	0.0	15.00	4.06	1.80	15.30	4.03	1.79	14.78	18"	8.36	140.00	0.28	15.58

Date: 02-19-1991
Time: 08:57:41

Input File: tall5-100

tallgrass east 5th addition
drainage plan
storm water sewer system no. 1 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)
105	0.00943	0.3772	0.0000	0.0000	0.0000	0.0000	0.0000	0.3772	219.4999	220.4000	0.90
110	0.01530	1.2237	0.0000	0.0322	0.0000	0.0000	0.7069	1.9628	219.1227	220.4000	1.28
115	0.01979	2.7709	0.0000	0.0247	0.0000	0.1123	0.5821	3.4899	217.1599	216.5000	-0.66
120	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	213.6700	215.3100	1.64

starting HGL from Tallgrass East Drainage Plan (node 120)

top curb @ node 120

OK (catch basin)

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III STREET FLOW - 2yr.

Node	Q_2	Distribution	street slope	d	dmax	Comment
105	10.2	80% (W) = 8.2	0.75%	0.40'	0.55'	OK
		20% (N) = 2.0	0.40%	0.26'	0.55'	OK
110	2.8	60% (W) = 1.7	0.75%	0.22'	0.55'	OK
		40% (N) = 1.1	0.40%	0.21'	0.55'	OK

STREET FLOW - 100 yr.

$$Q_{street} = Q_{100} - Q_{pipe}$$

Location	Contributing Area	Q_{100}	Qpipe	Qstreet	street slope	Qmax ‡	Comment
Approaching Nodes 105 & 110 from W	80% 105 = 60% 110 =	23.5 4.9 28.4	0.0	28.4	0.75%	66.9	OK Std. Cb Wk. Gr. = 0.3'
Approaching Nodes 105 & 110 from N	20% 105 = 40% 110 =	5.9 3.3 9.2	0.0	9.2	0.40%	48.9	OK Std Cb. Wk Gr = 0.3'

‡ See Page No. 8

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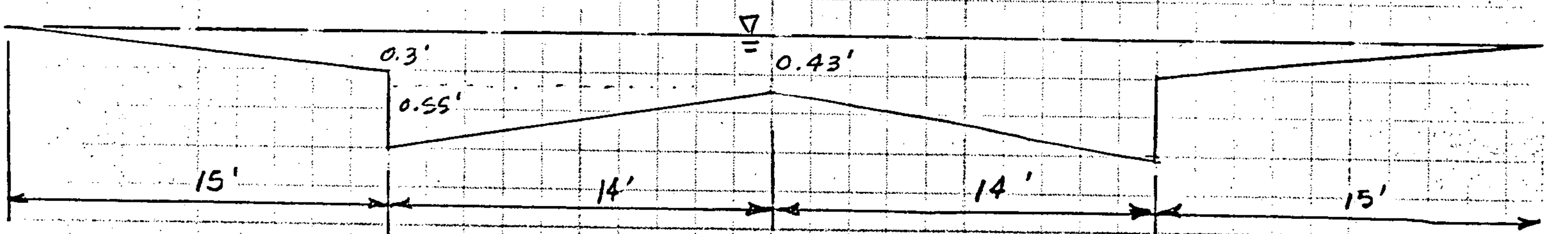
Item Drainage Plan SWS #1

Determine Capacities of Standard Curb Streets w/ Various Walk Grades for 100-year storm analysis (58' R-O-W)

0.3' WALK GRADE



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

$$= \frac{(0.87) + (0.0793) + (0.384)}{59.1} = \frac{1.3333}{59.1} = 0.0226$$

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

$$= (4.5) + (12.04) + (5.88)$$

$$= 22.42$$

$p = 59.1$

$R = A/p = 22.42/59.1 = 0.379357$ $\quad R^{2/3} = 0.52404$

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

$$Q = \frac{1.486}{0.0226} \times 22.42 \times 0.52404 \times S^{1/2}$$

$$Q = 772.5 \sqrt{S}$$

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Item Drainage Plan SWS#1

IV OVERFLOW CHANNEL

The original Drainage Plan for Tallgrass East was based on Q_2 in pipe with $Q_{100}-Q_2$ overland. Since the existing storm water sewer system was designed for only Q_2, overland flow of the major storm must still be accomplished

Between Nodes 110 & 115

$$Q_{overland} = Q_{100} - Q_2 = 37.6 - 13.0 = 23.6 \text{ cfs}$$

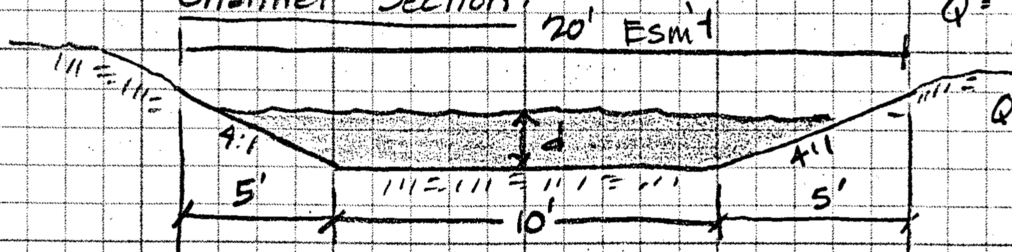
Use Manning's Eqn

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

$$Q = \frac{1.486}{0.03} AR^{2/3} (0.03)^{1/2}$$

$$Q = 8.5794\ AR^{2/3}$$

Channel Section:



d	A	P	R	$R^{2/3}$	$AR^{2/3}$	Q
0.3'	3.36	12.47	0.269	0.417	1.40	12.0
0.4'	4.64	13.30	0.349	0.496	2.29	19.7
0.5'	6.00	14.12	0.425	0.565	3.39	29.1

← Q=23.6

USE: d = 0.5' $V = Q/A = \frac{23.6}{6.0} = 3.9$ fps OK.

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Overflow Channel (Cont'd)

Between Nodes 115 & 120

$$Q_{overland} = Q_{100} - Q_2$$
$$= 42.9 - 14.8$$
$$= 28.1 \text{ cfs.}$$

Use same channel section

Use Manning's Eq'n $Q = \frac{1.486}{n} AR^{2/3} S^{1/2}$

$$Q = \frac{1.486}{0.03} AR^{2/3} (0.005)^{1/2}$$

$$Q = 3.503 \, AR^{2/3}$$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$	Q
0.6'	7.44	14.95	0.498	0.628	4.67	16.4
0.7'	8.96	15.77	0.568	0.686	6.15	21.5
0.8'	10.56	16.60	0.636	0.739	7.81	27.4

Use d = 0.8' $V = \frac{Q}{A} = \frac{28.1}{10.56} = 2.7$ fps OK

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Project Tallgrass East 5th Addition

Item Drainage Plan SWS #2

SWS #2 = South System.

I HYDROLOGY

Use Rational Method $Q = cIA$

Determine "c"

Node	Soil Type	Hydrologic Group	Land Use	C_2	C_{100}
200	I_a	D	Res; 1/4 Ac.	0.50	0.76
210	I_a	D	Res; 1/4 Ac.	0.50	0.76

Determine "I"

Assume t_c = 15 minutes ∴ $I_2 = 3.83$ $I_{100} = 7.37$

Determine "A"

Node	Planimeter Units	Area (SF)	Area (Ac)
200	28.45	182,400	4.19
210	30.20	193,280	4.44

Determine "Q_2"

Node	C_2	I_2	A	Q_2
200	0.50	3.83	4.19	8.0
210	0.50	3.83	4.44	8.5

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
200	0.76	7.37	4.19	23.5
210	0.76	7.37	4.44	24.9

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Item Drainage Plan SWS #2

II INLET SIZING / ROUTING 2-yr.

Node	Inlet Condition	Q_2	Q_{max} (5' inlet)	Q_{max} (10' inlet)	$Q_{intercept}$ ≠	Q_{bypass}	USE L =
200	Sump	8.0	11.0	22.0	8.0	0.0	5'
210	Sump	8.5	N/A	N/A	8.5	0.0	Catch Basin
230	(Existing Manhole = Connection Point)						

≠ $Q_{intercept}$ = input data in "Storm" program.

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```
100 j,  209.3000  230    3    3    2
110 t,tallgrass east 5th addition
120 t,drainage plan
130 t,storm water sewer system no. 2 analysis
140 i,  200     0.50     4.19     0.00     0.00     8.00     15.00   214.00
150 i,  210     0.50     0.44     0.00     0.00     8.50     15.00   211.50
160 m,  230   210.50
170 p,  200  210   260.00   18 0.013  45.00   0.00
180 p,  210  230   160.00   24 0.013   0.00   0.00
190 e
```

Date: 02-19-1991
Time: 13:34:09

Input File: tall5-200

tallgrass east 5th addition
drainage plan
storm water sewer system no. 2 analysis

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)
200 210	0.50	4.19	0.00	0.0	15.00	4.06	8.00	15.00	4.06	8.00	8.00	18"	4.53	260.00	0.96	15.96
210 230	0.50	0.44	0.00	0.0	15.00	4.06	8.50	15.96	3.96	8.30	16.30	24"	5.19	160.00	0.51	16.47

Date: 02-19-1991
Time: 13:34:09

Input File: tall5-200

tallgrass east 5th addition
drainage plan
storm water sewer system no. 2 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)
200	0.00580	1.5080	0.0000	0.0000	0.0000	0.0000	0.0000	1.5080	212.3578	214.0000	1.64
210	0.00519	0.8304	0.0000	0.0100	0.0000	0.0693	0.6401	1.5497	210.8497	211.5000	0.65
230	0.00000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	209.3000	210.5000	1.20

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Item Drainage Plan SWS #2

III STREET FLOW 2-yr.

Node	Q_2	Distribution	street slope	d	dmax	Comment
200	8.0	60% (W) = 4.8	1.00%	0.30'	0.55'	OK
		40% (E) = 3.2	1.00%	0.26'	0.55'	OK
210	8.5	(Catch Basin)				

STREET FLOW 100-yr

$$Q_{street} = Q_{100} - Q_{pipe}$$

Location	Contrib. Areas	Q_{100}	Q_{pipe}	Q_{street}	street slope	Q_{max} ‡	Comment
Approaching Node 200 from N	100% 200 =	23.5	0.0	23.5	1.00%	77.3	OK Std Cb. Wk. Gr. = +0.3'

‡ See page 7.

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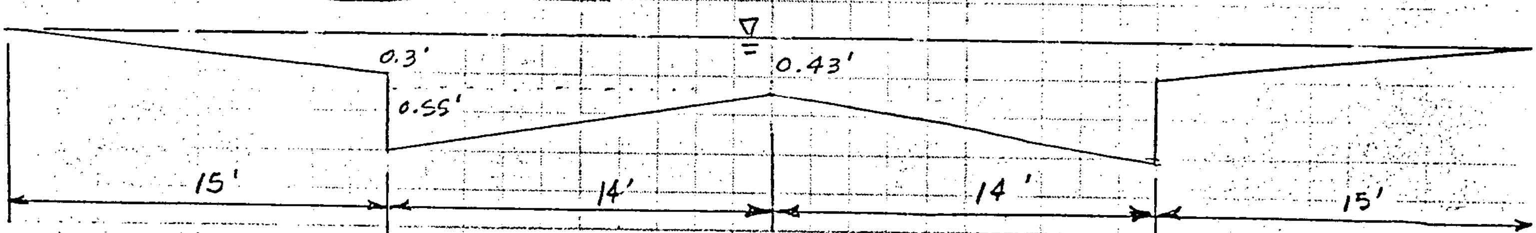
Item Drainage Plan SWS #2

Determine Capacities of Standard Curb Streets w/ Various Walk Grades for 100-year storm analysis (58' R-O-W)

<u>0.3' WALK GRADE</u>



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

$$= \frac{(0.87) + (0.0793) + (0.384)}{59.1} = \frac{1.3333}{59.1} = 0.0226$$

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

$$= (4.5) + (12.04) + (5.88)$$

$$= 22.42$$

$$p = 59.1$$

$$R = A/p = 22.42/59.1 = 0.379357 \qquad R^{2/3} = 0.52404$$

$$Q = \frac{1.486}{n} A R^{2/3} s^{1/2}$$

$$Q = \frac{1.486}{0.0226} \times 22.42 \times 0.52404 \times s^{1/2}$$

$$Q = 772.5 \sqrt{s}$$

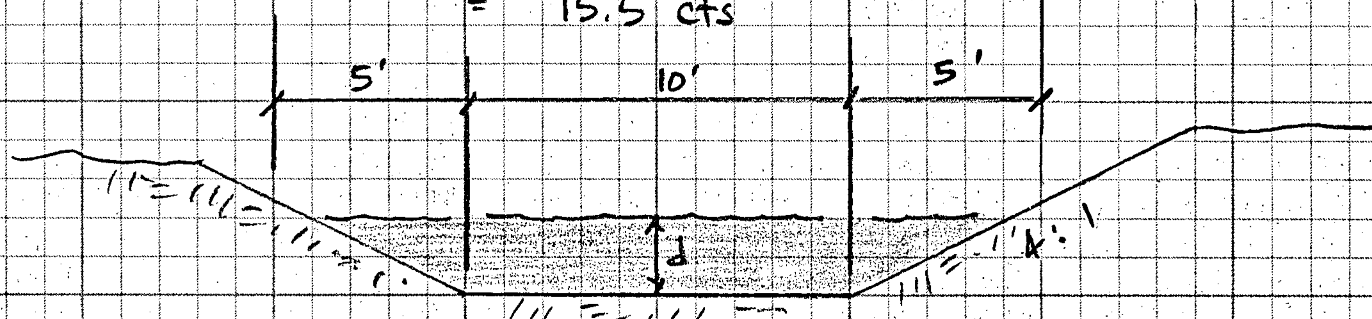
IV OVERFLOW CHANNEL

Between Nodes 200 & 210

Size for $Q_{100} - Q_2$

$= 23.5 - 8.0$

$= 15.5$ cfs



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

$Q = \frac{1.486}{0.03} A R^{2/3} (0.0125)^{1/2}$

$Q = 5.54 \; A R^{2/3}$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$	Q
0.4'	4.64	13.30	0.349	0.496	2.29	12.7
0.5'	6.00	14.12	0.425	0.565	3.39	18.8

USE d = 0.5' $V = Q/A = 15.5/6 = 2.6$ fps OK

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OVERFLOW CHANNEL (CONT'D)

Between Nodes 210 & 230

Q_{100} = 23.5 + 24.9 = 48.4 cfs

Q_2 = 8.0 + 8.5 = 16.5

$Q_{overland}$ = 48.4 − 16.5 = 31.9 cfs

Use same channel section

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

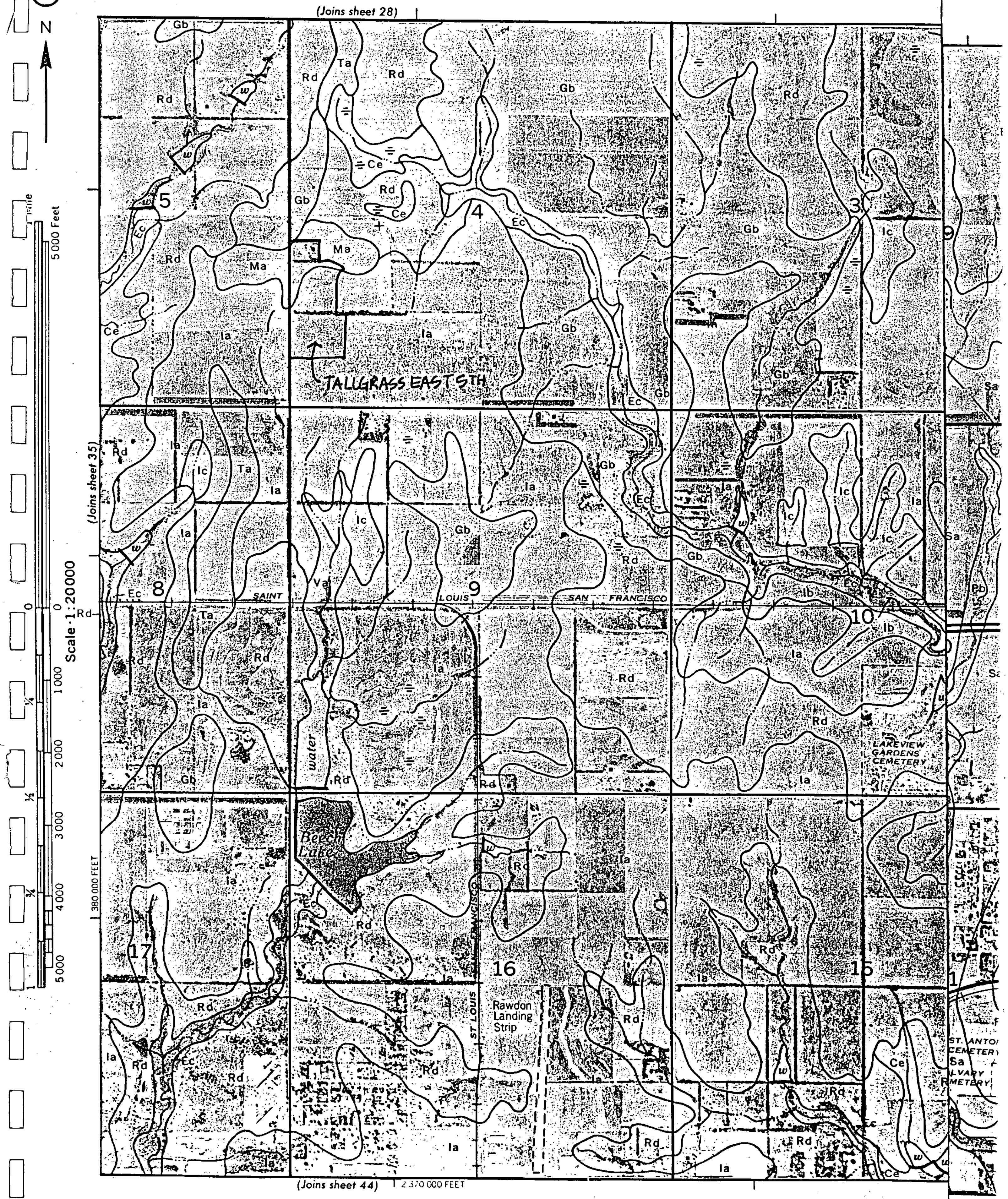
$$Q = \frac{1.486}{0.03} AR^{2/3} (0.67)^{1/2}$$

$$Q = 4.05\ AR^{2/3}$$

d	A	P	R	$R^{2/3}$	$AR^{2/3}$	Q
0.7'	8.96	15.77	0.568	0.686	6.15	24.9
0.8'	10.56	16.60	0.636	0.739	7.81	31.6

USE d = 0.8' $V = Q/A = 31.9/10.56 = 3.0$ fps

OK


N
(Joins sheet 28)
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2 370 000 FEET
380 000 FEET
Scale 1:20000
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
TALLGRASS EAST 5TH
SAINT LOUIS SAN FRANCISCO
ST LOUIS
Beech Lake
water
Rawdon Landing Strip
LAKEVIEW GARDENS CEMETERY
5
4
3
8
9
10
17
16
15

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

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

ATTACHMENT A CONTINUED
Page 2

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

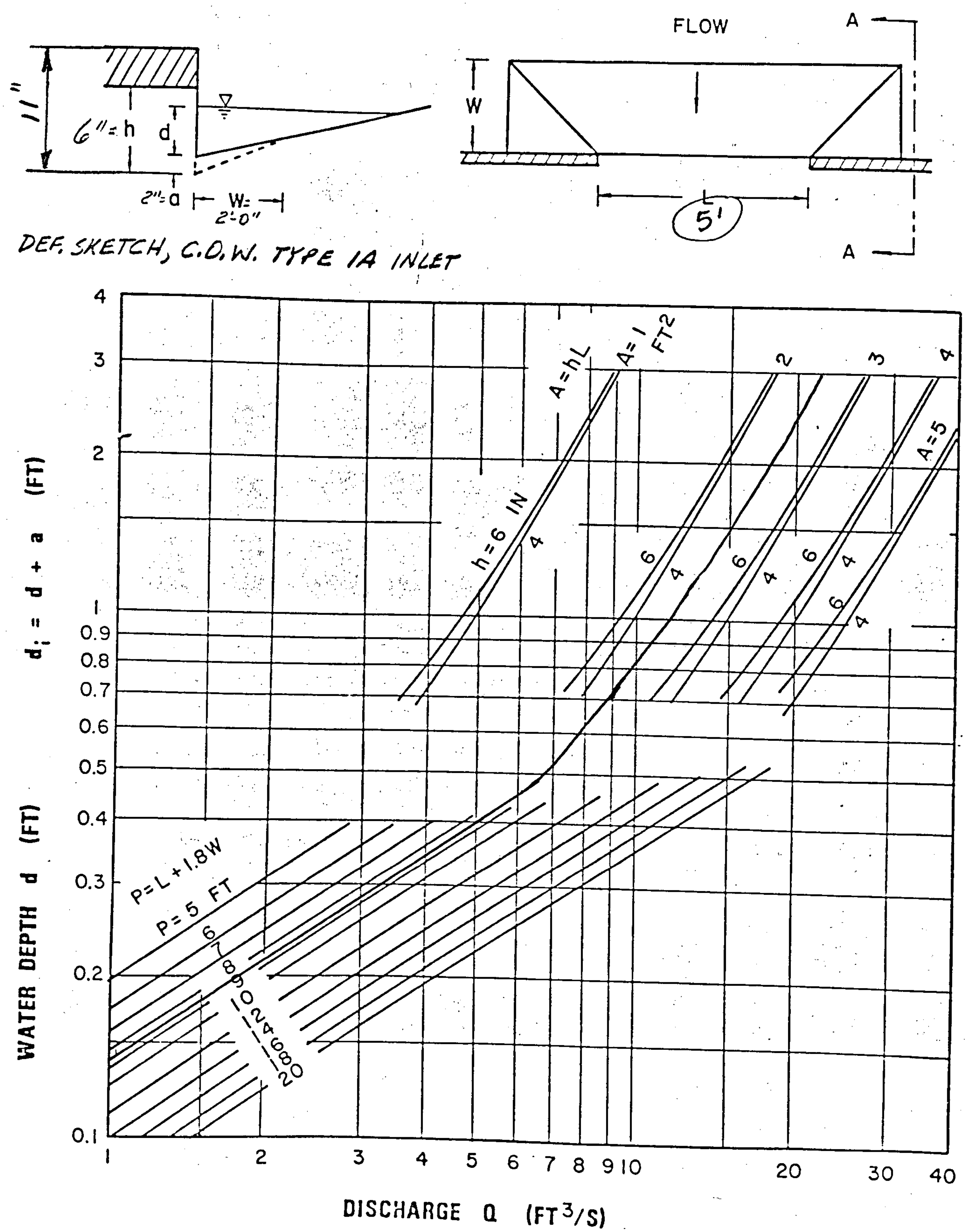
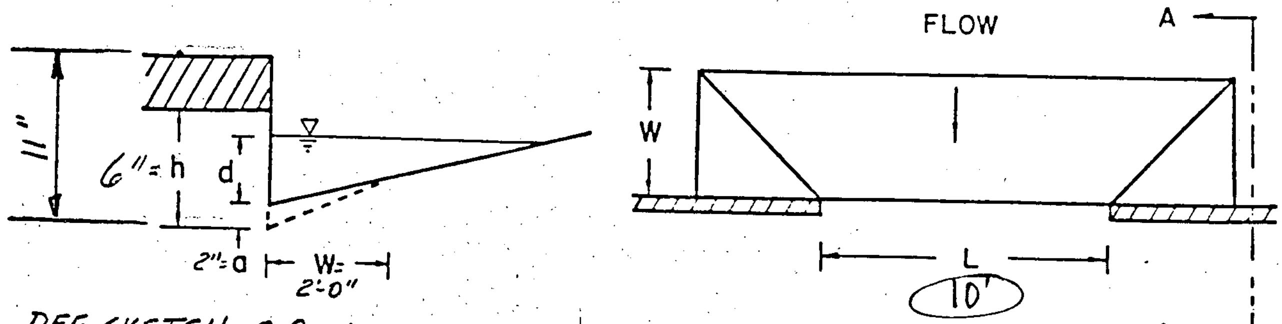


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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



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

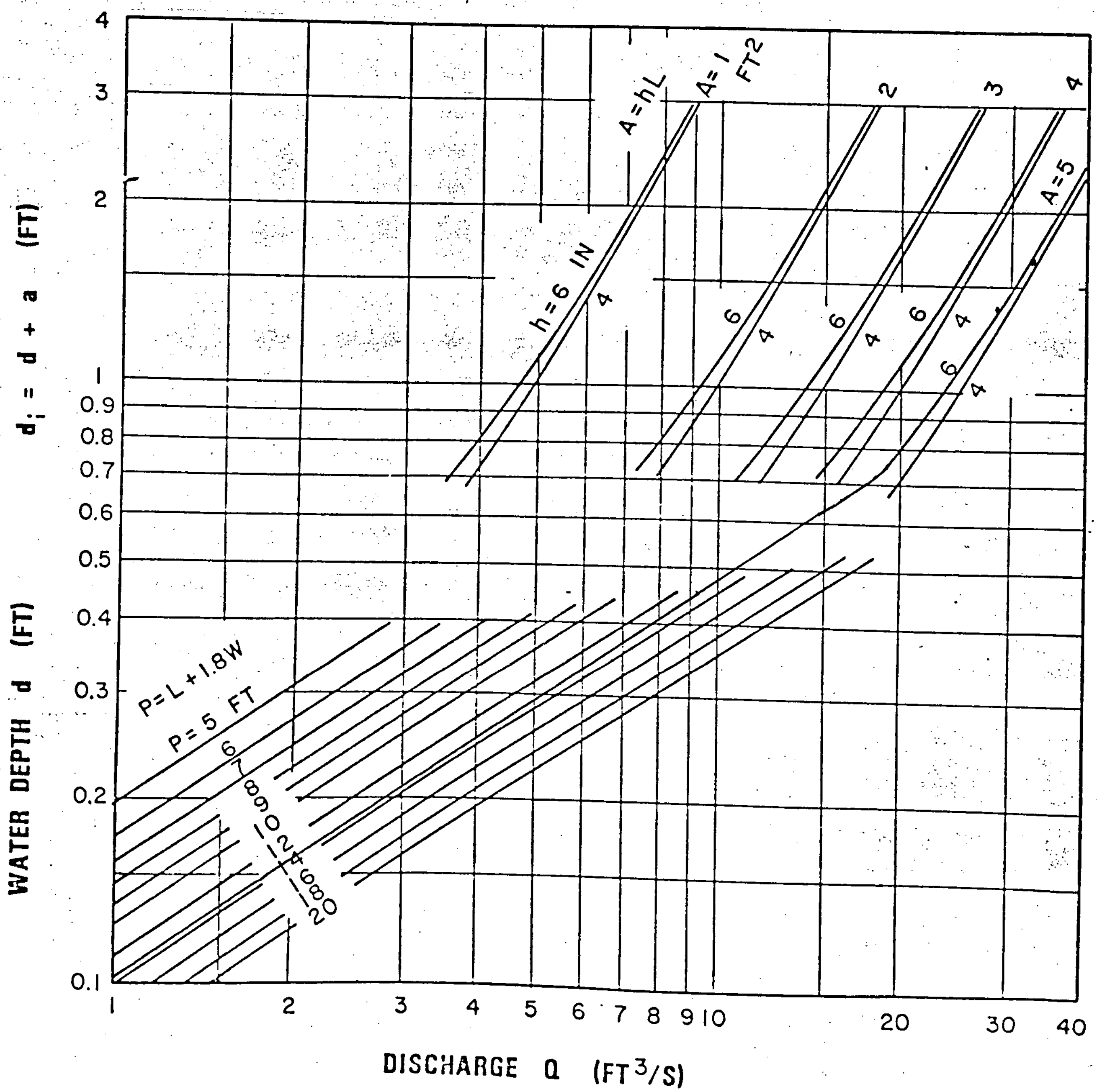
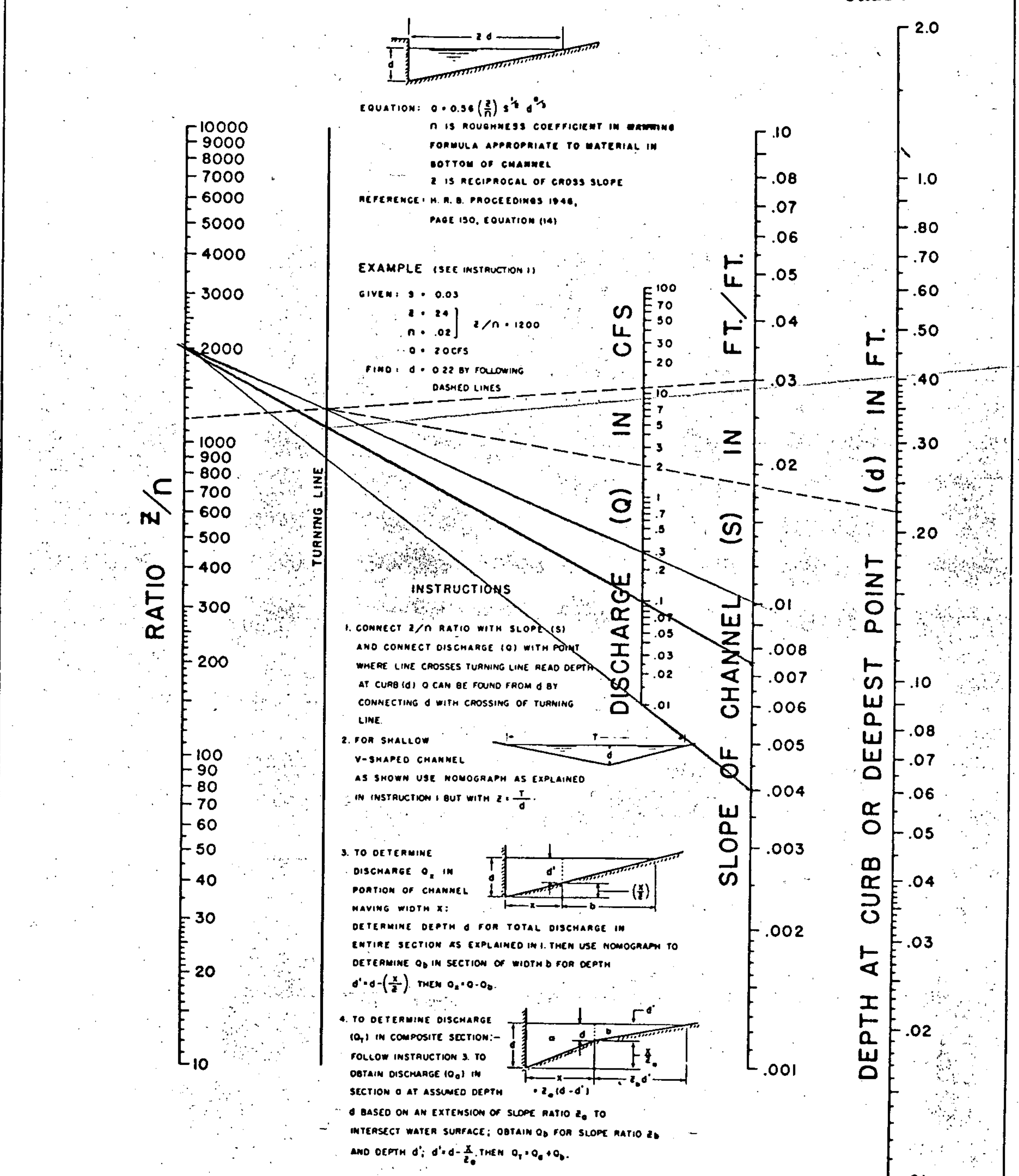


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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

Chart 1



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS