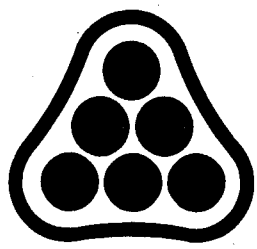

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DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

STONEBOROUGH

AN ADDITION TO WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

ENGINEERS

WICHITA, KANSAS

NOVEMBER 12, 1991

303 S. TOPEKA
WICHITA, KANSAS 67202
(316) 262-2691
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DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

STONEBOROUGH

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Project Stoneborough

Item Drainage Plan System 100

I HYDROLOGY

Use Rational Method $Q = CIA$

Determine "C"

Node	Soil Type	Hyd. Group	Land Use	C_2	C_{100}
103	C_L	D	Res; 1/8 Ac.	0.57	0.79
102	≈100% C_L	D	"	0.57	0.79
101	≈100% C_L	D	"	0.57	0.79
100	(Headwall)				

Determine "I"

Assume t_c = 15min all nodes ∴ $I_2 = 3.83$ $I_{100} = 7.37$

Determine "A"

Node	Planimeter Units	Area (SF)	Area (Ac)
103	15.7	157,000	3.60
102	21.9	219,000	5.03
101	23.6	236,000	5.41
100	(Headwall)		

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Project Stoneborough

Item Drainage Plan System 100

Determine "Q_2"

Node	C_2	I_2	A	Q_2
103	0.57	3.83	3.60	7.9
102	0.57	3.83	5.03	11.0
101	0.57	3.83	5.41	11.8
100	(Headwall)			

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
103	0.79	7.37	3.60	21.0
102	0.79	7.37	5.03	29.3
101	0.79	7.37	5.41	31.5
100	(Headwall)			

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Project Stoneborough

Item Drainage Plan System 100

II INLET SIZING - (100-YR)

Node	Inlet Condition	Q_{100}	Q_{max} 10'	Q_{max} 5'	USE:
103	Sump	21.0	26.0	13.0	1- 10' inlet
102	Sump	29.3	26.0	13.0	1-10' + 1-5' inlet
101	Sump	31.5	26.0	13.0	1-10' + 1-5' inlet

Note Q_{max} based on DWS_{100} @ TC +0.3'

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Project Stoneborough

Item Drainage Plan System 100

III STREET FLOW - 2 YR

Node	Q_2	Distribution		Street slope	d	d_{max}	comment
103	7.9	40% (E) =	3.2	0.60%	0.28'	0.30'	OK
		60% (N) =	4.7	0.32%	0.37'	0.55'	OK
102	11.0	40% (E) =	4.4	0.60%	0.31'	0.30'	OK
		60% (S) =	6.6	0.32%	0.43'	0.55'	OK
101	11.8	15% (N) =	1.8	0.32%	0.28'	0.55'	OK
		85% (S) =	10.0	0.32%	0.52'	0.55'	OK

IV STREET FLOW - 100-YR

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

Location	Contributing Area	Q_{100}	Q_{pipe}	Q_{street}	Street slope	Q_{max}	comment
Approaching 101 & 102 from so.	85% 101 60% 102	26.8 17.6 44.4	0.0	44.4	0.32%	49.9	OK Std Cb 0.3' WK Gr.
Approaching 101 & 103 from no.	15% 101 60% 103	4.7 12.6 17.3	0.0	17.3	0.32%	49.9	OK Std. Cb. 0.3' WK Gr.
Approaching 102 & 103 from e.	40% 102 40% 103	11.7 8.4 20.1	0.0	20.1	0.60%	31.2	OK Roll Cb 0.3' WK Gr

Date: 11-12-1991
Time: 15:03:09

Input File: STONE1.STM

STONEBOROUGH ADDITION
DRAINAGE PLAN
SYSTEM 100

Storm Frequency = 100-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)
103	102	.57	3.60	.00	.0	15.00	7.37	21.00	15.00	7.37	21.00	21.00	30"	4.28	70.00	.27	15.27
102	101	.57	5.03	.00	.0	15.00	7.37	29.30	15.27	7.32	29.09	50.09	42"	5.21	40.00	.13	15.40
101	100	.57	5.41	.00	.0	15.00	7.37	31.50	15.40	7.29	31.17	81.26	48"	6.47	140.00	.36	15.76

Date: 11-12-1991
Time: 15:03:09

Input File: STONE1.STM

STONEBOROUGH ADDITION
DRAINAGE PLAN
SYSTEM 100

Storm Frequency = 100-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)
103	.00262	.1835	.0000	.0000	.0000	.0000	.0000	.1835	1270.5260	1270.5000	-.0
102	.00248	.0992	.0000	.0137	.0000	.2007	.7449	1.0584	1270.3420	1270.2000	-.1
101	.00320	.4481	.0000	.0228	.0000	.0563	.7565	1.2838	1269.2840	1270.2000	.9
100	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1268.0000	1268.0000	.0

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Project Stoneborough

Item Drainage Plan System 200

I HYDROLOGY

Use Rational Method $Q = cIA$

Determine "c"

Node	Soil Type	Hydrologic Group	Land Use	C_2	C_{100}
211	≈100% C_A	B	Res; 1/8 Ac.	0.52	0.67
210	≈100% C_A	B	"	0.52	0.67
209	1/3 C_C 2/3 C_A	D B	"	0.54	0.70
208	(Manhole)				
207	≈100% C_C	D	"	0.57	0.79
206	100% C_C	D	"	0.57	0.79
205	(Manhole)				
204	C_C	D	"	0.57	0.79
203	C_C	D	"	0.57	0.79
202	C_C	D	"	0.57	0.79
201	C_C	D	"	0.57	0.79
200	(Headwall)				

Determine "I"

Assume t_c = 15 min. all nodes ∴ $I_2 = 3.83$ $I_{100} = 7.37$

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Project Stoneborough

Item Drainage Plan System 200

Determine "A"

Node	Planimeter Units	Area (SF)	Area (AC)
211	24.61	246,100	5.65
210	14.60	146,000	3.35
209	13.50	135,000	3.10
208	(Manhole)		
207	5.60	56,000	1.29
206	4.50	45,000	1.03
205	(Manhole)		
204	3.60	36,000	0.82
203	3.00	30,000	0.69
202	4.20	42,000	0.96
201	4.50	45,000	1.03
200	(Headwall)		

Determine "t"

Assume t_c = 15 min. all nodes

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Project Stoneborough

Item Drainage Plan System 200

Determine "Q_2"

Node	C_2	I_2	A	Q_2
211	0.52	3.83	5.65	11.3
210	0.52	3.83	3.35	6.7
209	0.54	3.83	3.10	6.4
208	(Manhole)			
207	0.57	3.83	1.29	2.8
206	0.57	3.83	1.03	2.2
205	(Manhole)			
204	0.57	3.83	0.82	1.8
203	0.57	3.83	0.69	1.5
202	0.57	3.83	0.96	2.1
201	0.57	3.83	1.03	2.2
200	(Headwall)			

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Project Stoneborough

Item Drainage Plan System 200

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
211	0.67	7.37	5.65	27.9
210	0.67	7.37	3.35	16.5
209	0.70	7.37	3.10	16.0
208	(Manhole)			
207	0.79	7.37	1.29	7.5
206	0.79	7.37	1.03	6.0
205	(Manhole)			
204	0.79	7.37	0.82	4.7
203	0.79	7.37	0.69	4.0
202	0.79	7.37	0.96	5.6
201	0.79	7.37	1.03	6.0
200	(Headwall)			

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Project Stoneborough

Item Drainage Plan System 200

II INLET SIZING (2-YR)

Node	Inlet Condition	Q_2	Qmax L=10'	Qmax L=5'	Use:
211	Sump	11.3	22 cfs	11 cfs	1 - 10' inlet
210	Sump	6.7	22	11	1 - 5' inlet
209	Sump	6.4	22	11	1 - 5' inlet
208	(Manhole)				
207	Sump	2.8	22	11	1 - 5' inlet
206	Sump	2.2	22	11	1 - 5' inlet
205	(Manhole)				
204	Sump	1.8	22	11	1 - 5' inlet
203	Sump	1.5	22	11	1 - 5' inlet
202	Sump	2.1	22	11	1 - 5' inlet
201	Sump	2.2	22	11	1 - 5' inlet
200	(Headwall)				

Note Q_{max} determined w/ DWS_2 = T.C.

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Project Stoneborough

Item Drainage Plan System 200

III STREET FLOW - 2YR

Node	Q_2	Distribution	st. slope	d	dmax	Comment
211	11.3	30% (E) = 3.4	0.32%	0.30'	0.55'	OK
		70% (N) = 7.9	0.32%	0.45'	0.55'	OK
210	6.7	≈100% (N) = 6.7	0.32%	0.40'	0.55'	OK
209	6.4	15% (W) = 1.0	0.32%	0.21'	0.55'	OK
		85% (E) = 5.4	0.80%	0.35'	0.55'	OK
208	(Manhole)					
207	2.8	50% (W) = 1.4	0.32%	0.25'	0.55'	OK
		50% (E) = 1.4	0.32%	0.25'	0.55'	OK
206	2.2	50% (W) = 1.1	0.32%	0.22'	0.55'	OK
		50% (E) = 1.1	0.32%	0.22'	0.55'	OK
205	(Manhole)					
204	1.8	50% (E) = 0.9	0.32%	0.20'	0.55'	OK
		50% (N) = 0.9	0.70%	0.18'	0.55'	OK
203	1.5	60% (E) = 0.9	0.32%	0.20'	0.55'	OK
		40% (S) = 0.6	0.32%	0.18'	0.55'	OK
202	2.1	≈100% (N) = 2.1	0.70%	0.24'	0.55'	OK
201	2.2	≈100% (S) = 2.2	0.32%	0.29'	0.55'	OK
200	(Headwall)					

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Project Stoneborough

Item Drainage Plan System 200

IV STREET FLOW - 100-YR

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

Location	Contrib. Area		Q_{100}	Q_{pipe}	Q_{street}	street slope	Q_{max}	comment
Approaching 210 + 209 (E)	100%	211	27.9					
	0%	210	0.0					
	85%	209	13.6					
			41.5	0.0	41.5	0.32%	50.2	OK Std Cb 0.3' WK Gr.
Approaching 207 + 206 (E)	100%	211	27.9	11.3				
	100%	210	16.5	6.7				
	100%	209	16.0	6.4				
	50%	207	3.8					
	50%	206	3.0					
			67.2	24.4	42.8	0.32%	50.2	OK Std. Cb. 0.3' WK Gr
Approaching 203 + 204 (E)	100%	211	27.9	11.3				
		210	16.5	6.7				
		209	16.0	6.4				
		207	7.5	2.8				
		206	6.0	2.2				
		204	4.7					
		203	4.0					
			82.6	29.4	53.2	0.32%	68.3	OK Std. Cb. 0.4' WK Gr

8/10

```
100 j, 1267.5000  200   3   12   11
110 t,STONEBOROUGH ADDITION
120 t,DRAINAGE PLAN
130 t,SYSTEM 200 ANALYSIS
140 i,  211    0.52    7.57    0.00    0.00   11.30   15.00  1271.50
150 i,  210    0.52    4.04    0.00    0.00    6.70   15.00  1271.50
160 i,  209    0.54    3.10    0.00    0.00    6.40   15.00  1271.50
170 m,  208  1272.00
180 i,  207    0.57    1.29    0.00    0.00    2.80   15.00  1270.70
190 i,  206    0.57    1.03    0.00    0.00    2.20   15.00  1270.70
200 m,  205  1271.20
210 i,  204    0.57    0.82    0.00    0.00    1.80   15.00  1270.20
220 i,  203    0.57    0.69    0.00    0.00    1.50   15.00  1270.20
230 i,  202    0.57    0.96    0.00    0.00    2.10   15.00  1270.20
240 i,  201    0.57    1.03    0.00    0.00    2.20   15.00  1270.20
250 m,  200  1267.50
260 p,  211  210   70.00  24 0.013  90.00   0.00
270 p,  210  209   40.00  27 0.013  90.00   0.00
280 p,  209  208  150.00  30 0.013  20.00   0.00
290 p,  208  206  140.00  30 0.013  20.00   0.00
300 p,  207  206   40.00  15 0.013  80.00   0.00
310 p,  206  205  180.00  36 0.013  30.00   0.00
320 p,  205  203  180.00  36 0.013   0.00   0.00
330 p,  204  203   40.00  15 0.013  90.00   0.00
340 p,  203  201   70.00  36 0.013   0.00   0.00
350 p,  202  201   40.00  15 0.013  90.00   0.00
360 p,  201  200  140.00  42 0.013   0.00   0.00
370 e
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Date: 11-13-1991
Time: 11:15:55

Input File: STONE2.STM

STONEBOROUGH ADDITION
DRAINAGE PLAN
SYSTEM 200 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)
211	210	.52	7.57	.00	.0	15.00	3.83	11.30	15.00	3.83	11.30	11.30	24"	3.60	70.00	.32	15.32
210	209	.52	4.04	.00	.0	15.00	3.83	6.70	15.32	3.79	6.64	17.94	27"	4.51	40.00	.15	15.47
209	208	.54	3.10	.00	.0	15.00	3.83	6.40	15.47	3.77	6.31	24.25	30"	4.94	150.00	.51	15.98
208	206	.00	.00	.00	.0	.00	.00	.00	15.98	3.72	.00	24.25	30"	4.94	140.00	.47	16.45
207	206	.57	1.29	.00	.0	15.00	3.83	2.80	15.00	3.83	2.80	2.80	15"	2.28	40.00	.29	15.29
206	205	.57	1.03	.00	.0	15.00	3.83	2.20	16.45	3.67	2.11	29.06	36"	4.11	180.00	.73	17.18
205	203	.00	.00	.00	.0	.00	.00	.00	17.18	3.59	.00	29.06	36"	4.11	180.00	.73	17.91
204	203	.57	.82	.00	.0	15.00	3.83	1.80	15.00	3.83	1.80	1.80	15"	1.47	40.00	.45	15.45
203	201	.57	.69	.00	.0	15.00	3.83	1.50	17.91	3.52	1.38	32.12	36"	4.54	70.00	.26	18.17
202	201	.57	.96	.00	.0	15.00	3.83	2.10	15.00	3.83	2.10	2.10	15"	1.71	40.00	.39	15.39
201	200	.57	1.03	.00	.0	15.00	3.83	2.20	18.17	3.50	2.01	36.07	42"	3.75	140.00	.62	18.79

Date: 11-13-199
Time: 11:15:55

Input File: STONE2.STM

STONEBOROUGH ADDITION
DRAINAGE PLAN
SYSTEM 200 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)
211	.00250	.1747	.0000	.0000	.0000	.0000	.0000	.1747	1271.0880	1271.5000	.4
210	.00335	.1341	.0000	.0115	.0000	.1004	.3666	.6127	1270.9140	1271.5000	.5
209	.00349	.5241	.0000	.0063	.0000	.1580	.2892	.9776	1270.3010	1271.5000	1.2
208	.00349	.4892	.0000	.0000	.0189	.0312	.0175	.5568	1269.3230	1272.0000	2.6
207	.00188	.0752	.0000	.0000	.0000	.0000	.0000	.0752	1268.8420	1270.7000	1.8
206	.00190	.3417	.0000	.0233	.0000	.0312	.0063	.4024	1268.7670	1270.7000	1.9
205	.00190	.3417	.0000	.0000	.0131	.0351	.0095	.3994	1268.3640	1271.2000	2.8
204	.00078	.0311	.0000	.0000	.0000	.0000	.0000	.0311	1267.9960	1270.2000	2.2
203	.00232	.1623	.0000	.0058	.0000	.0000	.1271	.2952	1267.9650	1270.2000	2.2
202	.00106	.0423	.0000	.0000	.0000	.0000	.0000	.0423	1267.7120	1270.2000	2.4
201	.00129	.1800	.0000	.0205	.0000	.0000	.0309	.1695	1267.6690	1270.2000	2.5
200	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1267.5000	1267.5000	.0

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Project Stoneborough

Item Drainage Plan System 300

I HYDROLOGY Use Rational Method Q = CIA

Determine "c"

Node	Soil Type	Hydrologic Group	Land Use	C_2	C_{100}
306	Ca	B	Res; 1/8 ac.	0.52	0.67
305	Ca	B	"	0.52	0.67
304	(Manhole)				
303	Cc	D	"	0.57	0.79
302	Cc	D	"	0.57	0.79
301	Cc	D	"	0.57	0.79
300	(Headwall)				

Determine "I" Assume t_c = 15 min I_2 = 3.83 I_{100} = 7.37

Determine "A"

Node	Plan. Units	Area SF	Area Ac
306	16.45	164,500	3.78
305	14.50	145,000	3.33
304	(Manhole)		
303	15.52	155,200	3.56
302	15.12	151,200	3.47
301	15.59	155,900	3.58
300	(Headwall)		

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Project Stoneborough

Item Drainage Plan System 300

Determine "Q_2"

Node	C_2	I_2	A	Q_2
306	0.52	3.83	3.78	7.5
305	0.52	3.83	3.33	6.6
304	(Manhole)			
303	0.57	3.83	3.56	7.8
302	0.57	3.83	3.47	7.6
301	0.57	3.83	3.58	7.8
300	(Headwall)			

Determine "Q_{100}"

Node	C_{100}	I_{100}	A	Q_{100}
306	0.67	7.37	3.78	19.1
305	0.67	7.37	3.33	16.5
304	(Manhole)			
303	0.79	7.37	3.56	20.7
302	0.79	7.37	3.47	20.2
301	0.79	7.37	3.58	20.8
300	(Headwall)			

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Project Stone borough

Item Drainage Plan System 300

II INLET SIZING

Nodes 306, 305, 303 - 2yr

" 302, 301 - 100yr.

Node	Inlet Condition	Q	Qmax L=10'	Qmax L=5	Use
306	Sump	7.5 (2yr)	22 *	11 *	1 - 5' inlet
305	Sump	6.6 (2yr)	22 *	11 *	1 - 5' inlet
304	(Manhole)				
303	Sump	7.8 (2yr)	22 *	11 *	1 - 5' inlet
302	Sump	20.2	26 ≠	13 ≠	
301	Sump	20.8			

303 overflow = $Q_{100} - Q_2$ = 12.9
305 overflow = $Q_{100} - Q_2$ = 9.9
306 overflow = $Q_{100} - Q_2$ = 11.6
} 75.4 cfs

Assume during 100 yr storm equal amounts to Nodes 302 & 301 = 37.7 cfs each.

Use 1-10' inlet + 1-5' inlet at each node

* Note : Qmax based on DWS_2 = T.C.

≠ Note : Qmax based on DWS_{100} = T.C. + 0.3'

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Project Stoneborough

Item Drainage Plan System 300

III STREET FLOW 2-YR

Node	Q_2	Distribution		street slope	d	d_{max}	Comment
306	7.5	∑ 100% (E) =	7.5	0.32%	0.42'	0.55'	OK
305	6.6	∑ 100% (E) =	6.6	0.32%	0.41'	0.55'	OK
304	(Manhole)						
303	7.8	∑ 100% (S) =	7.8	0.32%	0.43'	0.55'	OK
302	7.6	∑ 50% (S) =	3.8	0.32%	0.35'	0.55'	OK
		∑ 50% (E) =	3.8	0.32%	0.35'	0.55'	OK
301	7.8	40% (S) =	3.1	0.32%	0.33'	0.55'	OK
		60% (E) =	4.7	0.32%	0.37'	0.55'	OK

IV STREET FLOW - 100 YR

Location	Contrib. Area	Q_{100}	Q_{pipe}	Q_{street}	street slope	Q_{max}	Comment
Approaching 306 & 305 (E)	100% 306	19.1					
	100% 305	16.5					
		35.6	0.0	35.6	0.32%	49.9	OK Std. Cb 0.3' Wk Gr.
Approaching 302 & 301 (E)	100% 306	19.1	7.5				
	100% 305	16.5	6.6				
	50% 302	10.1					
	60% 301	12.5					
		58.2	14.1	44.8	0.32%	49.9	OK Std Cb 0.3' Wk. Gr
Approaching 302 & 301 (S)	100% 303	20.7	7.8				
	50% 302	10.1					
	40% 301	8.3					
		39.1	7.8	31.3	0.32%	49.9	OK Std Cb 0.3' Wk

Date: 11-13-199
Time: 14:27:47

Input File: STONE3.STM

STONEBOROUGH ADDITION
DRAINAGE PLAN
SYSTEM 300 ANALYSIS

Storm Frequency = 100-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)
306	305	.52	3.78	.00	.0	15.00	7.37	7.50	15.00	7.37	7.50	7.50	24"	2.39	40.00	.28	15.28
305	304	.52	3.33	.00	.0	15.00	7.37	6.60	15.28	7.31	6.55	14.05	27"	3.53	530.00	2.50	17.78
304	301	.00	.00	.00	.0	.00	.00	.00	17.78	6.87	.00	14.05	27"	3.53	200.00	.94	18.72
303	302	.57	3.56	.00	.0	15.00	7.37	7.80	15.00	7.37	7.80	7.80	24"	2.48	320.00	2.15	17.15
302	301	.79	3.47	.00	.0	15.00	7.37	37.70	15.00	7.37	37.70	44.52	48"	3.54	40.00	.19	15.19
301	300	.79	3.58	.00	.0	15.00	7.37	37.70	15.19	7.33	37.51	93.44	54"	5.87	155.00	.44	15.63

6/6

Date: 11-13-199
Time: 14:27:47

Input File: STONE3.STM

STONEBOROUGH ADDITION
DRAINAGE PLAN
SYSTEM 300 ANALYSIS

Storm Frequency = 100-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)
306	.00110	.0440	.0000	.0000	.0000	.0000	.0000	.0440	1271.6130	1271.6000	-.0
305	.00206	1.0911	.0000	.0105	.0000	.0442	.2855	1.4314	1271.5690	1271.6000	.0
304	.00206	.4117	.0000	.0000	.0097	.0422	.0103	.4739	1270.1380	1270.6000	.4
303	.00119	.3804	.0000	.0000	.0000	.0000	.0000	.3804	1270.6820	1271.0000	.3
302	.00096	.0384	.0000	.0099	.0000	.0354	.5535	.6373	1270.3010	1270.0000	-.3
301	.00226	.3499	.0000	.0341	.0000	.0000	.7799	1.1639	1269.6640	1270.0000	.3
300	.00000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	1268.5000	1268.5000	.0

OK For 100-Yr.

COUNTY, KANSAS — SHEET NUMBER 58

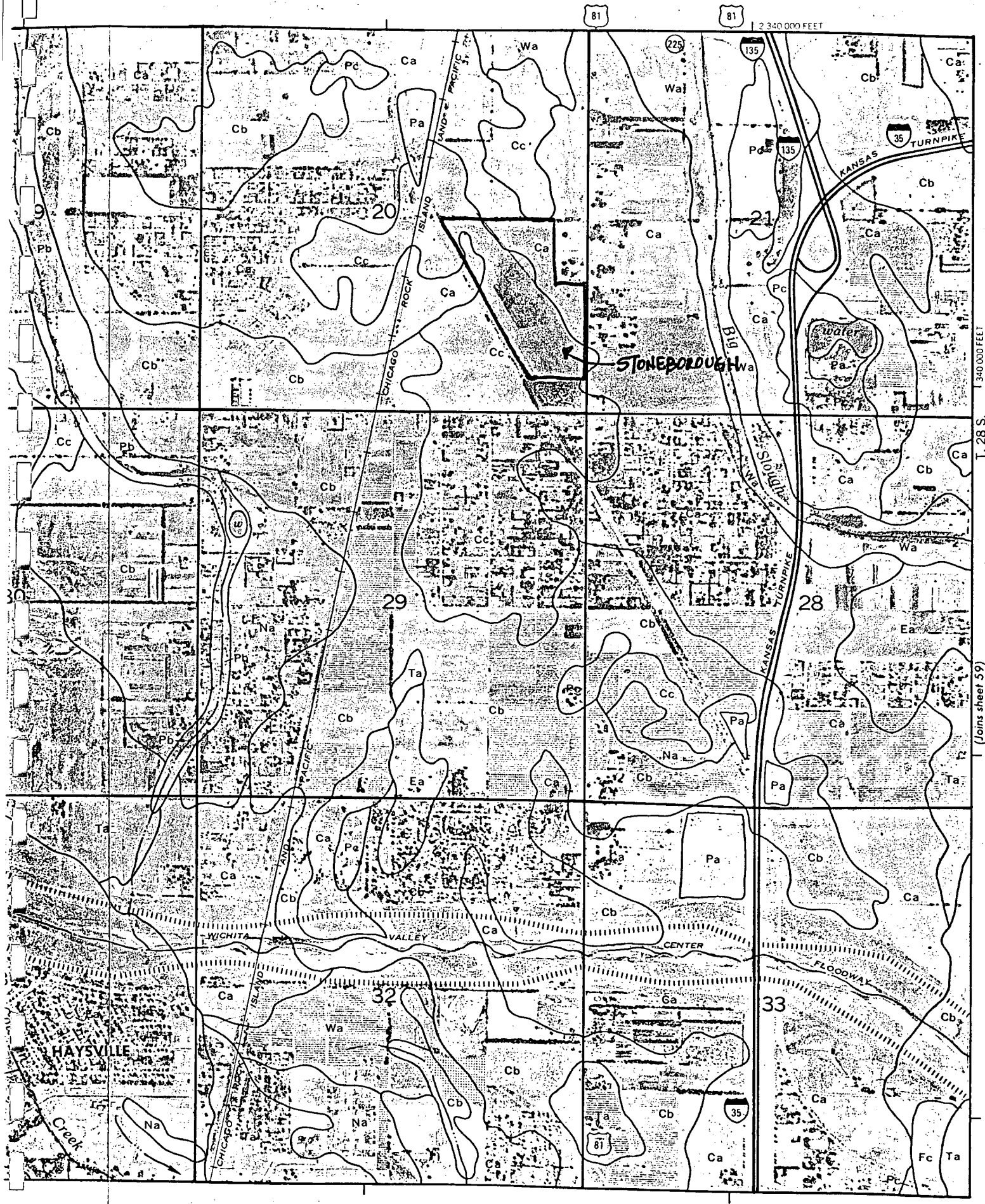


EXHIBIT NO. 1

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

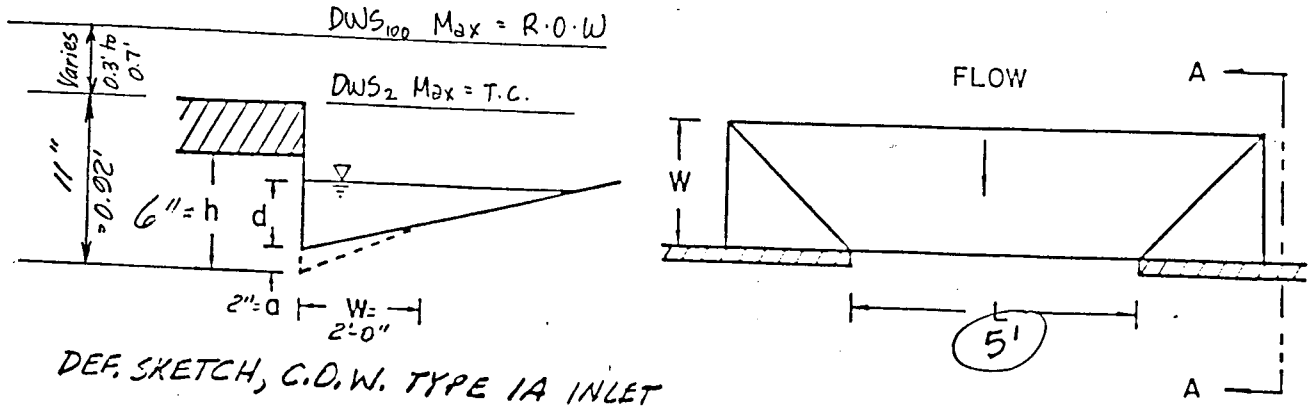
DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
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

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



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

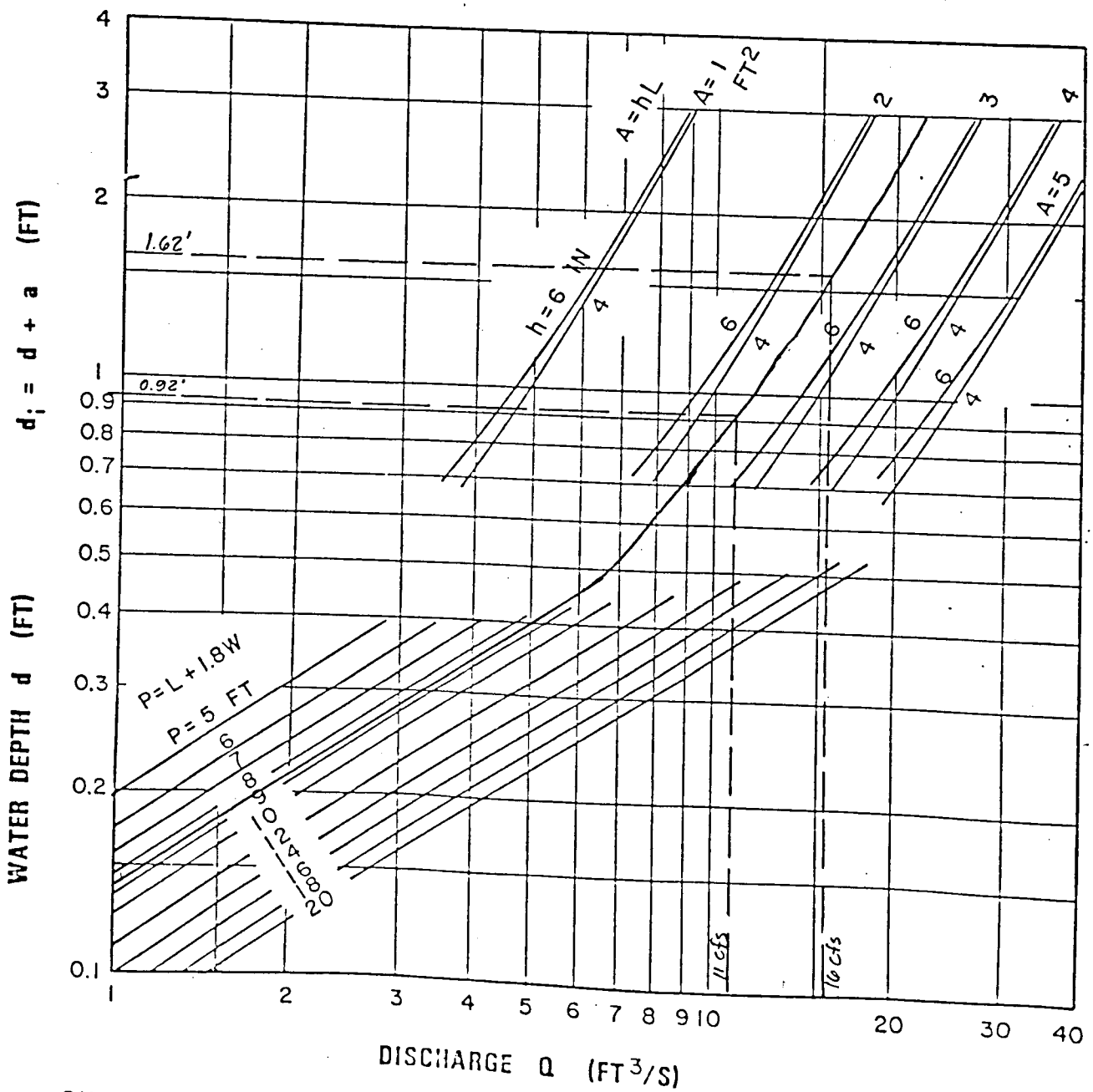
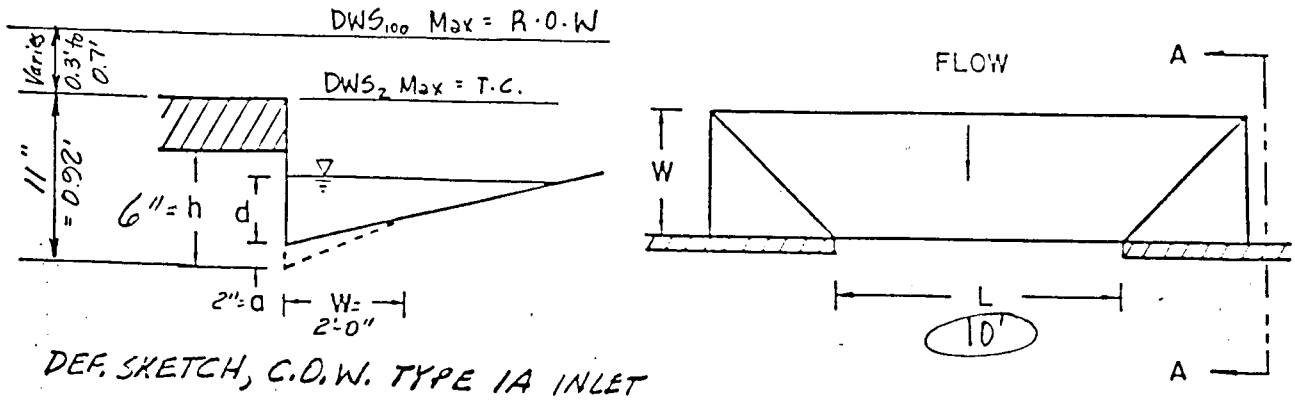


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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



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

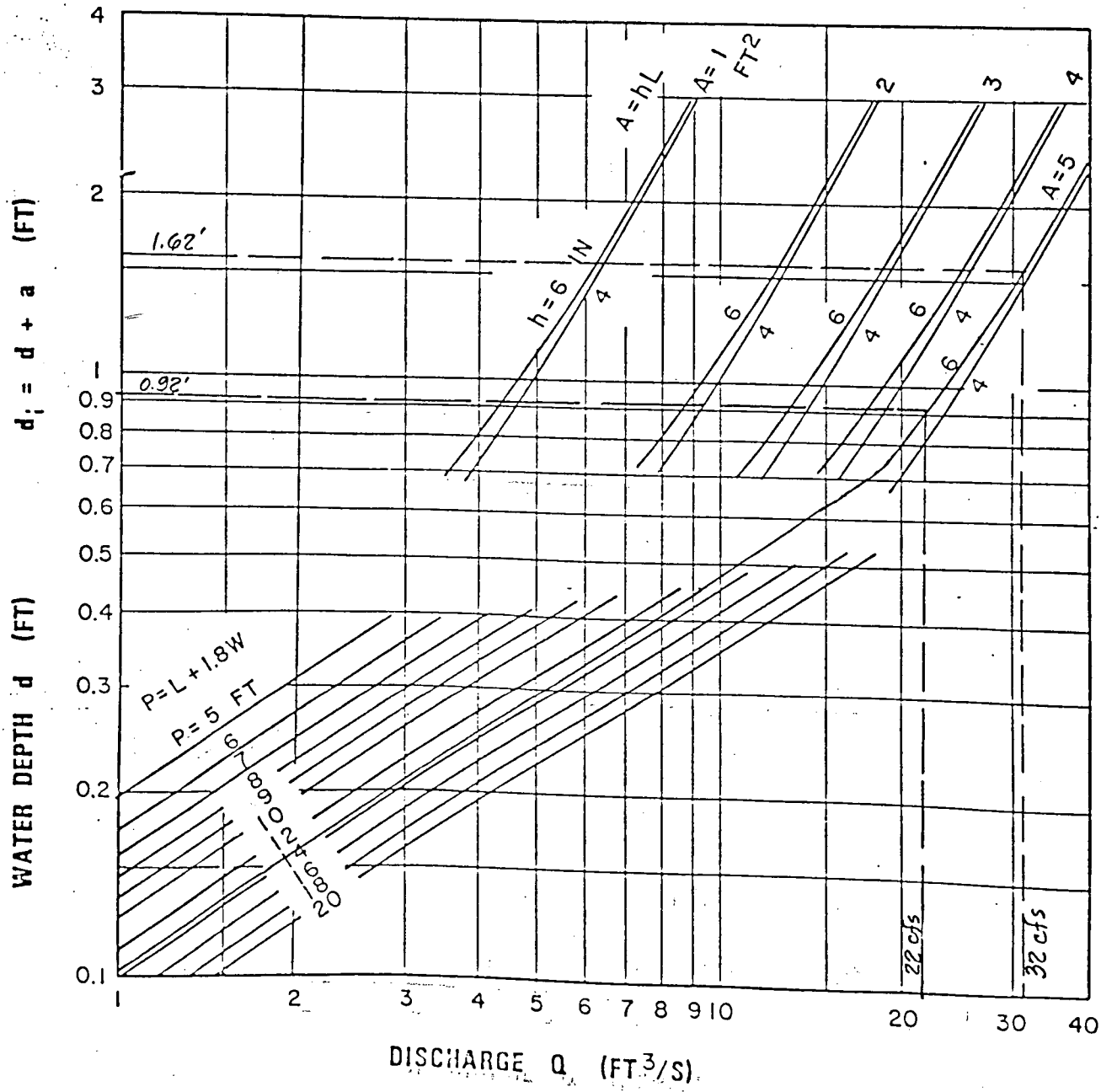


CHART 12. Depressed curb-opening inlet capacity in sump locations.

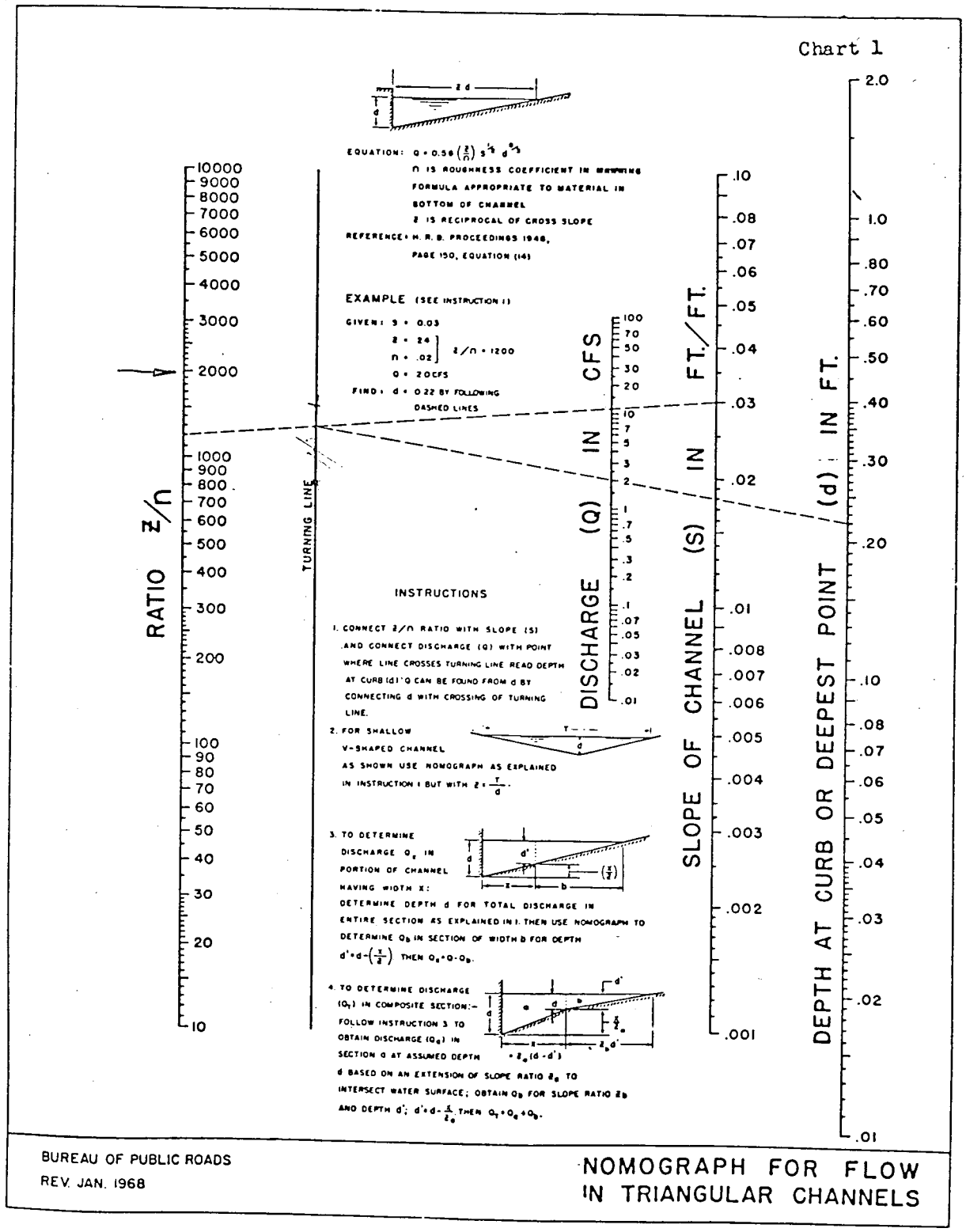
FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

x-slope = 3/8 "/Ft = 0.03125

Z = 1/x-slope = 1/0.03125 = 32

n = 0.016

Z/n = 32/0.016 = 2000



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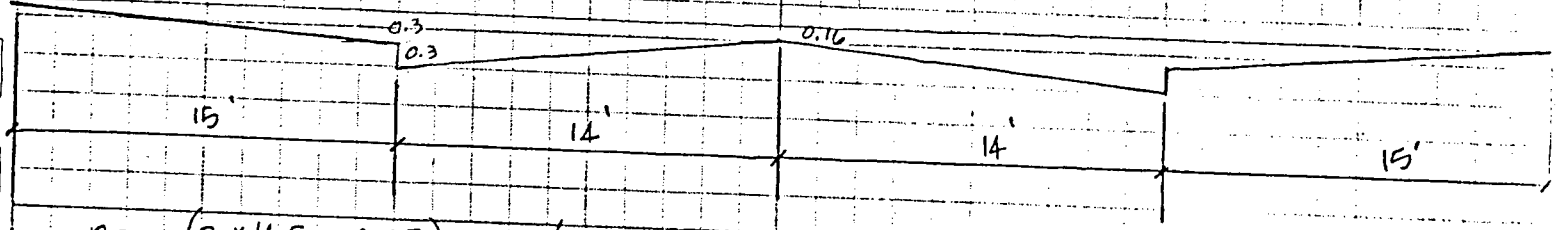
Item Drainage Plan

Determine capacities of Roll-curb streets w/ Various Walk Grades for 100-year storm analysis (58' R-O-W)

0.3' Walk Grade



$$n = \frac{(2 \times 14.5 \times 0.03) + (2 \times 2.8 \times 0.013) + (2 \times 12 \times 0.016)}{58.6}$$

$$= \frac{(0.87) + (0.0728) + (0.384)}{58.6} = \frac{1.3268}{58.6} = 0.0226$$

$$A = (2 \times \tfrac{1}{2} \times 15 \times 0.3) + (28 \times 0.16) + (2 \times \tfrac{1}{2} \times 14 \times 0.44)$$

$$= 4.5 + 4.48 + 6.16$$

$$= 15.14 \text{ SF}$$

$$P = 58.6$$

$$R = A/P = 15.14/58.6 = 0.258362 \qquad R^{2/3} = 0.40565$$

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

$$= \frac{1.486}{0.0226} \times 15.14 \times 0.40565 \times S^{1/2}$$

$$Q = 403.82 \sqrt{S}$$

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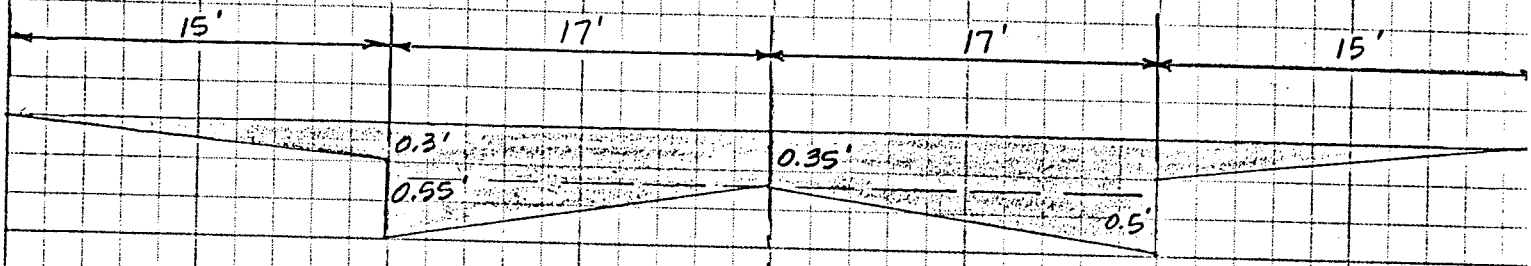
Item Drainage Plan -

Check . Street Flow 100-YR

(64' R-O-W)
(Walk Grade +0.3')
(Std. Curb)



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

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

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

$n = 1.4413 / 65.1 = 0.0221$

$A = 2(1/2 \times 15 \times 0.3) + (34 \times 0.35) + 2(1/2 \times 0.5 \times 17)$
$= 24.90$ 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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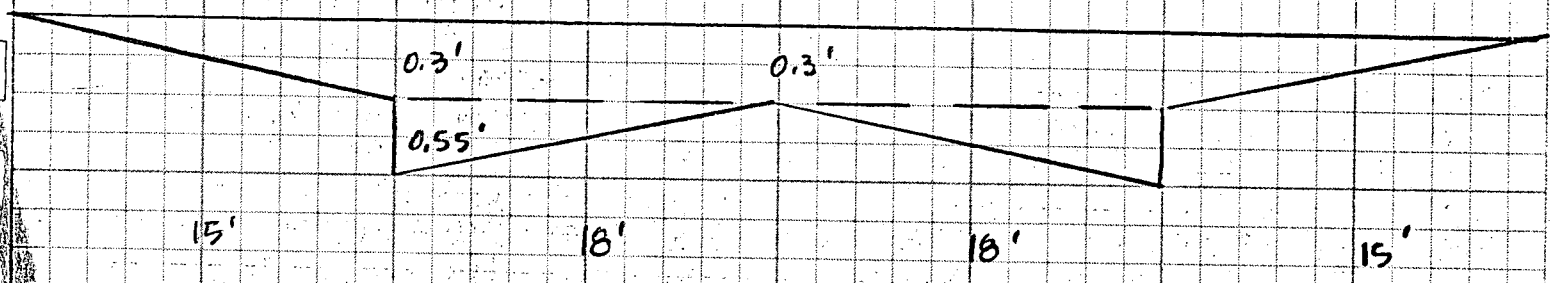
66' R-O-W
Std CB
WK Gr = TC +0.3'



$$n = \frac{2(14.5 \times 0.030) + 2(1.05' \times 0.013) + 2(18 \times 0.016)}{67.1}$$

$n = 0.02196$

$A = 2(1/2 \times 0.3 \times 15) + 2(1/2 \times 18 \times 0.55) + (0.3 \times 36)$

$A = 25.2$ SF

$P = (2 \times 15) + (2 \times 0.55) + (2 \times 18)$

$P = 67.1$

$R = A/P = 25.2/67.1 = 0.37556$

$R^{2/3} = 0.52054$

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

$Q = \frac{1.486}{0.02196} \times 25.2 \times 0.52054 \times S^{1/2}$

$Q = 887.6\sqrt{S}$

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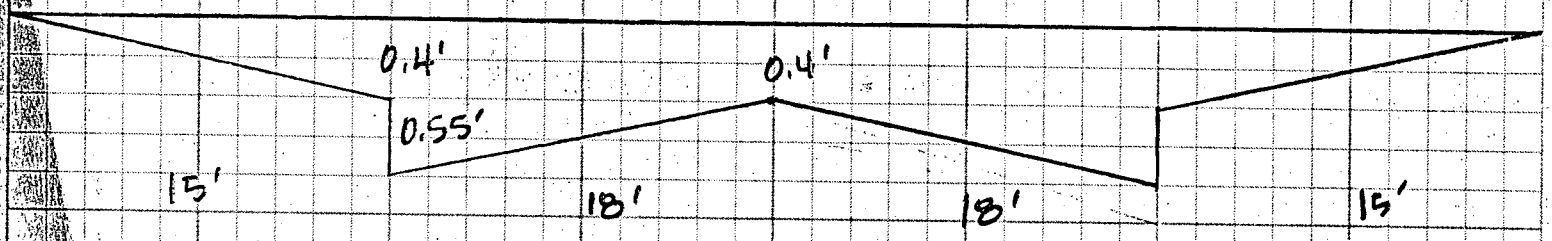
66' R-O-W
Std. Cb.
WK Gr. = TC + 0.4'



$n = 0.02196$

$A = 2(1/2 \times .4 \times 15) + 2(1/2 \times 18 \times .55) + (0.4 \times 36) = 30.3$

$P = 67.1$

$R = A/P = 30.3/67.1 = 0.45156$

$R^{2/3} = 0.58859$

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

$$Q = \frac{1.486}{0.02196} \times 30.3 \times 0.58859 \times S^{1/2}$$

$Q = 1,206.8\, S^{1/2}$