DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

BAREFOOT BAY ADDITION
TO WICHITA, SEDGWICK COUNTY, KANSAS

PREPARED BY

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.
ENGINEERS

WICHITA, KANSAS

NOVEMBER 22, 1993

MEMO

PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION
303 S. TOPEKA
WICHITA, KANSAS
ZIP CODE / 67202

TO: Michael E. Lindebak, P.E.
455 N. Main - 7th Floor
Wichita, KS 67220
ATTN: Ms. Vicky Huang, P.E.

PROJECT NO. 36-93444-2051
PROJECT: Barefoot Bay
Drainage Plan
DATE: November 22, 1993

COPIES TO:
Jack Ritchie

FROM: Darwin R. Cronk, E.I.T.
REFERENCE: Drainage Plan Computations

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

Attached hereto are the computation s for the referenced project.

The publication Interim Drainage and Storm Sewer policy for Design Criteria and Documentation, City of Wichita, as revised 7/1/87, was used as the guideline for the hydrologic and hydraulic computations. This publication is hereinafter referred to as the "Design Manual".

Manual #1 refers to Drainage of Highway Pavements, Hydraulic Engineering Circular #12, by Tye Engineering, Inc., March 1984.

The analysis made herein is based on the available site data which includes a February 25, 1986, aerial photogrammetry map, and the Drainage Plan for Barefoot Bay Addition.

HYDROLOGIC ANALYSIS FOR STORM WATER SEWERS

For storm sewer design, the Rational Method was used for hydrologic analysis in accordance with the Design Manual. Runoff coefficients were based on the table provided in Attachment D of the Design Manual. The Rational Method assumes uniformly distributed rainfall, both temporally and spatially.

For this development, a uniform assumption of the minimum time of concentration value of 15 minutes was appropriate.

HYDRAULIC ANALYSIS FOR STORM WATER SEWERS

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

$$Q = 0.56\,(S_x)^{5/3}(T)^{8/3}\,S\,/n \text{ (Eq. 4, Manual \#1)}$$

It was assumed that t_c for street flow was equal to t_c for pipe flow. This is a conservative assumption, as pipe velocities generally exceed gutter velocities.

For local streets, walk-grade-deep flow is tolerable for the design storm.

Inlet capacities were determined by the methods presented in Manual #1, using Chart No. 12.

In this analysis, City of Wichita Type 1A inlets and 3/8 in./ft. street cross-slope were assumed to be utilized. Minimum walk grade was assumed as 0.3 feet above the top of curb. Local streets are assumed to have standard curb and gutter.

All storm water sewers drain to the adjacent lake either between or next to residential lots. Therefore, in order to avoid frequently flooding lots, the design storm has a recurrence interval of one hundred years. All systems are designed to carry the design storm with street flows contained within the street rights-of-way.

To simplify analysis, the following assumption was made:

1. The street conveyance was analyzed using only the street with. 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 #1 was used.

Pipe sizes for the systems were chosen using Fig. 5 of the Concrete Pipe Design Manual, by the American Concrete Pipe Association, June 1980. From the Figure, a friction slope corresponding to the chosen pipe size is used to approximate the hydraulic grade line elevation at inlets. Minor losses have been ignored and are considered insignificant as the hydraulic grade line elevation is greater than 0.5' below the top of curb elevation at all inlets for the design storm. It is desirable to keep the hydraulic grade line at or below the top of curb for a one hundred year storm. All pipes are assumed to be reinforced concrete with a Manning's "n" factor of 0.013.

DRAINAGE MAP

A 1" = 100' scale drainage map is included in a map packet at the back of the report.

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Project BAREFOOT BAY

Item DRAINAGE PLAN

I. HYDROLOGY

A. Determine "C" factor

Basin	Hyd. Group	Land Use	C_{100}
1A	B	Res. (3/4 Ac.)	0.52
1B	B	"	0.52
2A	B	"	0.52
2B	B	"	0.52
3A	B	"	0.52
3B	B	"	0.52
3C	B	"	0.52
4A	B	"	0.52
4B	B	"	0.52

B. Determine "I"

Assume all T_c = 15 min.

I_{100} = 7.37 in/hr for all basins

C. Basin Areas

1A	-	3.18 Ac
1B	-	2.11 Ac
2A	-	3.09 Ac
2B	-	3.23 Ac
3A	-	3.00 Ac
3B	-	1.24 Ac
3C	-	3.95 Ac
4A	-	1.97 Ac
4B	-	2.70 Ac

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Item DRAINAGE PLAN

D. SUBBASIN RUNOFF FLOWS

1A

$Q_{100} = CIA$
$= (0.52)(7.37\ in/hr)(3.18\ Ac)$
$= \underline{12.2\ cfs}$

1B

$Q_{100} = (0.52)(7.37)(2.11)$
$= \underline{8.10\ cfs}$

2A.

$Q_{100} = (0.52)(7.37)(3.09)$
$= \underline{11.8\ cfs}$

2B

$Q_{100} = (0.52)(7.37)(3.23)$
$= \underline{12.4\ cfs}$

3A

$Q_{100} = (0.52)(7.37)(3.00)$
$= \underline{11.5\ cfs}$

3B

$Q_{100} = (0.52)(7.37)(1.24)$
$= \underline{4.8\ cfs}$

3C

$Q_{100} = (0.52)(7.37)(3.95)$
$= \underline{15.1\ cfs}$

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Item DRAINAGE PLAN

4A

$Q_{100} = (0.52)(7.37)(1.97)$
$= 7.54$ cfs

4B

$Q_{100} = (0.52)(7.37)(2.70)$
$= 10.3$ cfs

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II. Pipe Sizing for 100-year Storm

A. System 1

Starting HGL = 1322.0
Inlet Elev. = 1326.0

Total Q at inlet = 12.2 + 8.1
= 20.3 cfs

Use 24" Pipe or larger

Fric. slope = 0.80 %

HGL @ inlet = 1322 + 220(.008) = 1323.76 OK

Diff. = 2.24'

B. System 2

Starting HGL = 1322.0
Inlet Elev. = 1326.0

Total Q at inlet = 11.8 + 12.4
= 24.2 cfs

Use 24" Pipe or larger

Fric. Slope = 1.1 %

HGL @ inlet = 1322 + .011(240) = 1324.64 OK

Diff. = 1.36'

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c. System 3

Node 301 to 300

Starting HGL = 1322.0
Inlet Elev = 1326.5 @ Node 301

Total Q @ inlet = 11.5 + 4.8 + 15.1
= 31.4 cfs

Use 27" Pipe or Larger

Fric slope = 1.0%

HGL @ Inlet node #301 = 1322 + (.010)(230) = 1324.30 OK

Diff: 2.20'

Node 302 to 301

Starting HGL = 1324.30 @ Node 301
Inlet Elev. = 1326.50 @ Node 302

Total Q @ Inlet node # 302 = 11.5 + 4.8
= 16.3 cfs

Use 18" pipe or Larger

Fric. Slope = 2.4%

HGL @ Inlet node #302 = 1324.30 + (.024)(70) =
1325.98

Diff. = 0.52'
OK

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D. System 4

Starting HGL = 1322.0
Inlet Elev. = 1326.0

Total Q @ inlet = 7.5 + 10.3
= 17.8 cfs

Use 24" Pipe or larger

Fric. Slope = 0.65 %
HGL @ Inlet = 1322.0 + (0.0065)(280')
= 1323.82 ok

Diff. = 2.18'

III. Street Flow - 100 YR

Basin 1A

$S = 0.57\%$
$Q_{100} = 12.2$ cfs
$z = 32$ $n = 0.016$ $z/n = 2000$

$d_{100} = 0.46'$ $d_{max} = 0.55'$ OK

BASIN 1B

$S = 0.57\%$
$Q_{100} = 8.10$ cfs
$z = 32$ $n = 0.016$ $z/n = 2000$

By inspection $d_{100} < d_{max}$ OK
(See BASIN 1A)

BASIN 2A

$S = 0.5\%$
$Q_{100} = 11.8$ cfs
$z = 32$ $n = 0.016$ $z/n = 2000$

$d_{100} = 0.48'$ $d_{max} = 0.55'$ OK

BASIN 2B

$S = 0.5\%$
$Q_{100} = 12.4$ cfs
$z = 32$ $n = 0.016$ $z/n = 2000$

$d_{100} = 0.49'$ $d_{max} = 0.55'$ OK

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Item DRAINAGE PLAN

BASIN 3A

S = 0.4%
Q_{100} = 11.5 cfs
z = 32 n = 0.016 z/n = 2000

d_{100} = 0.49' dmax = 0.55' OK

BASIN 3B

S = 0.4%
Q_{100} = 4.8 cfs
Z = 32 n = 0.016 z/n = 2000

By inspection d_{100} < dmax ∴ OK
(See Basin 3A)

BASIN 3C

S = 0.4%
Q_{100} = 15.1
z = 32 n = 0.016 z/n = 2000

d_{100} = 0.55' dmax = 0.55' OK

BASIN 4A

S = 0.8%
Q_{100} = 7.5 cfs
z = 32 n = 0.016 z/n = 2000

d_{100} = 0.38' dmax = 0.55' OK

BASIN 4B

S = 0.8%
Q_{100} = 10.3 cfs

d_{100} = 0.42'
dmax = 0.55' OK

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Item DRAINAGE PLAN

IV. Inlet Sizing (100-YR)

NODE	SIZE & TYPE	Q CFS	PONDING DEPTH, ft.	Remarks
101	10', 1A	20.3	0.63'	OK
201	10', 1A	24.2	0.85'	OK
301	10', 1A	15.1	0.46'	OK
302	10', 1A	16.3	0.48'	OK
401	10', 1A	17.8	0.53	OK

, KANSAS — SHEET NUMBER 33

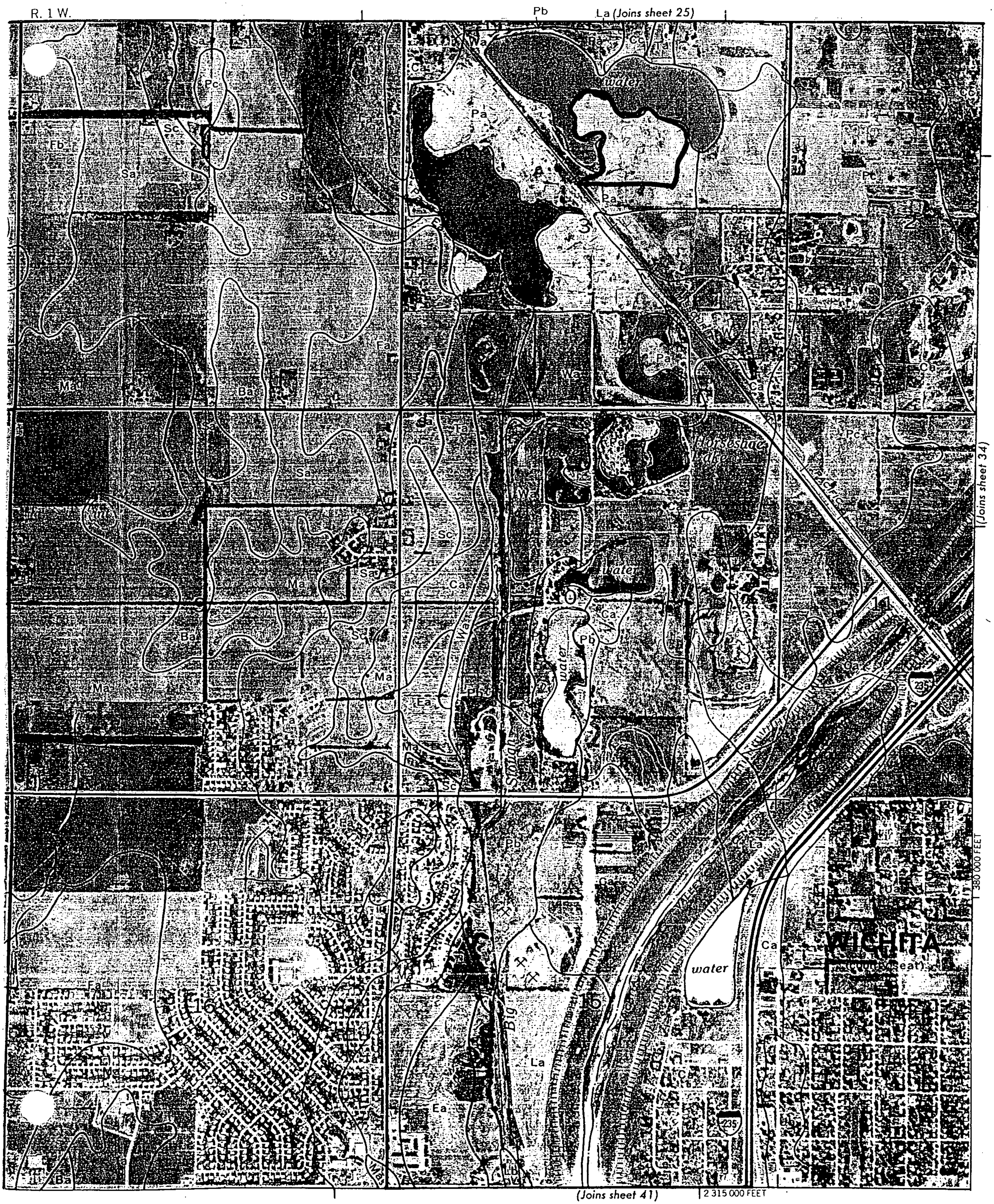


EXHIBIT NO. 1

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 ~~face~~ 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
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 ~face 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

FIGURE 3

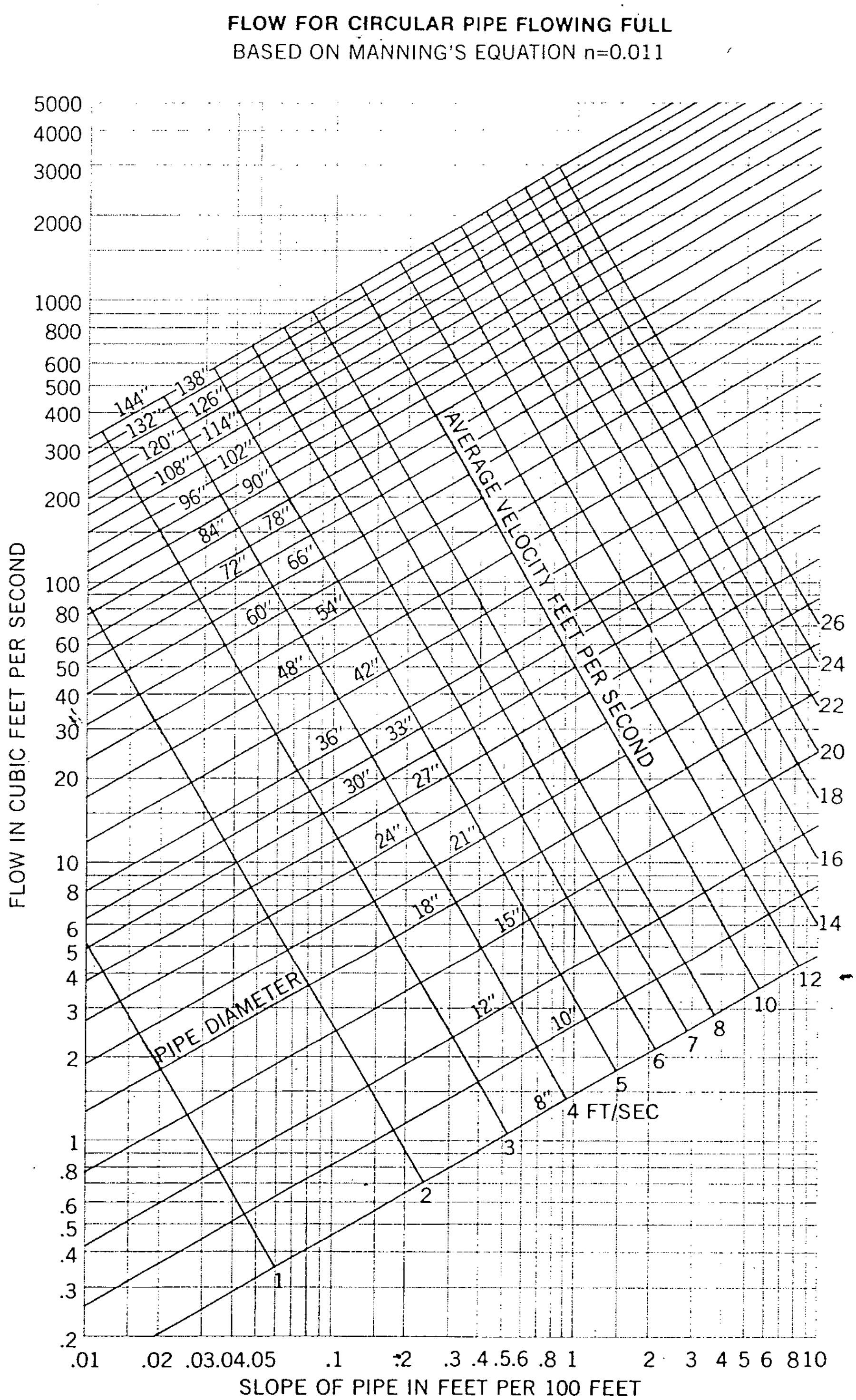
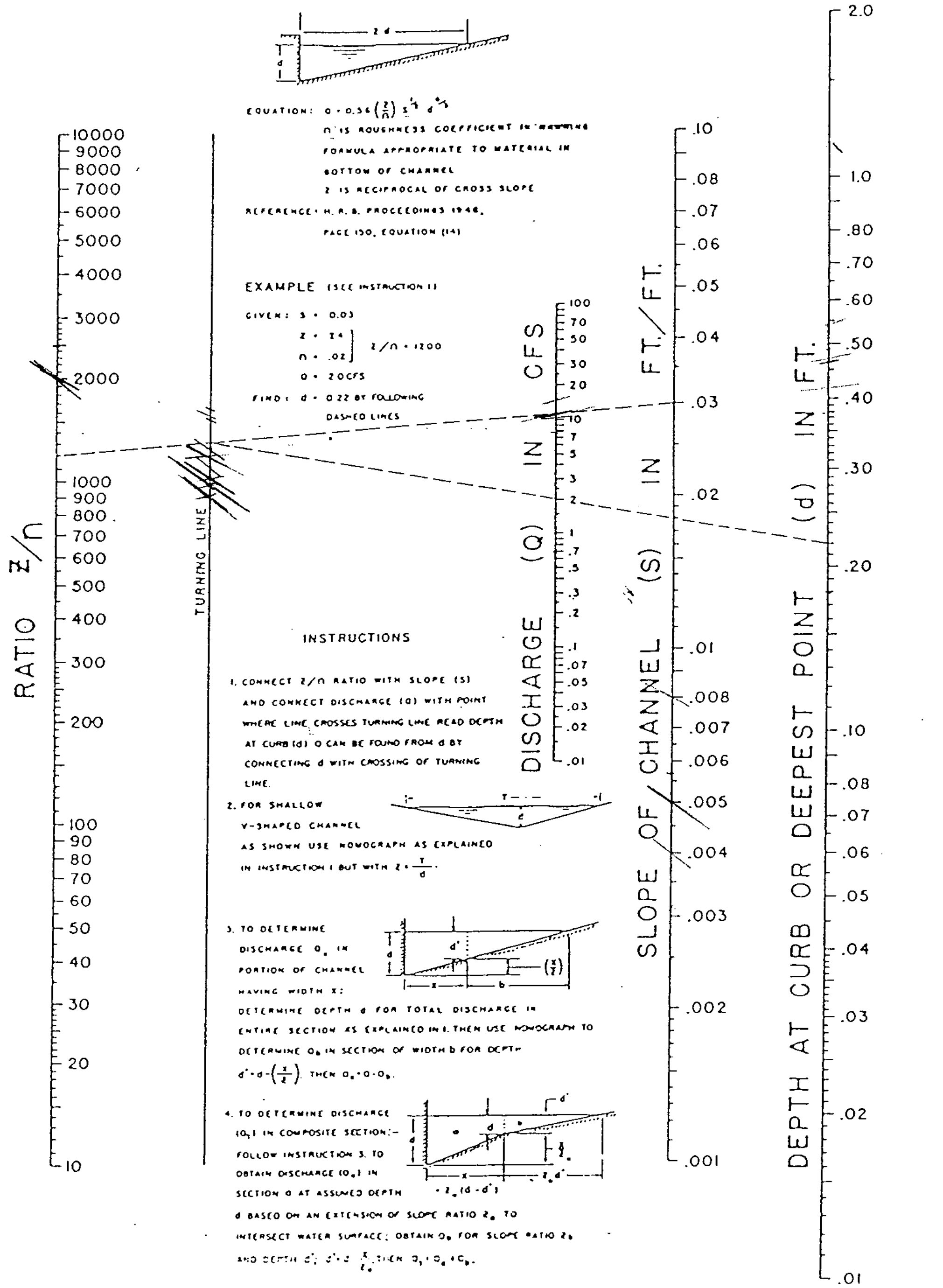
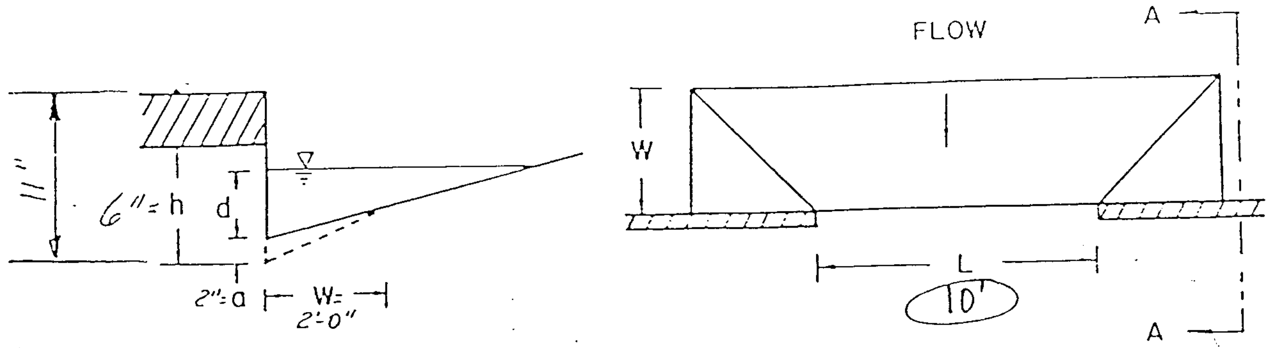

FLOW FOR CIRCULAR PIPE FLOWING FULL
BASED ON MANNING'S EQUATION n=0.011
FLOW IN CUBIC FEET PER SECOND
SLOPE OF PIPE IN FEET PER 100 FEET
PIPE DIAMETER
AVERAGE VELOCITY FEET PER SECOND
4 FT/SEC
144″ 138″ 132″ 126″ 120″ 114″ 108″ 102″ 96″ 90″ 84″ 78″ 72″ 66″ 60″ 54″ 48″ 42″ 36″ 33″ 30″ 27″ 24″ 21″ 18″ 15″ 12″ 10″ 8″
1 2 3 5 6 7 8 10 12 14 16 18 20 22 24 26
5000 4000 3000 2000 1000 800 600 500 400 300 200 100 80 60 50 40 30 20 10 8 6 5 4 3 2 1 .8 .6 .5 .4 .3 .2
.01 .02 .03 .04 .05 .1 .2 .3 .4 .5 .6 .8 1 2 3 4 5 6 8 10

Chart 1



BUREAU OF PUBLIC ROADS
REV. JAN. 1968

NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS



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

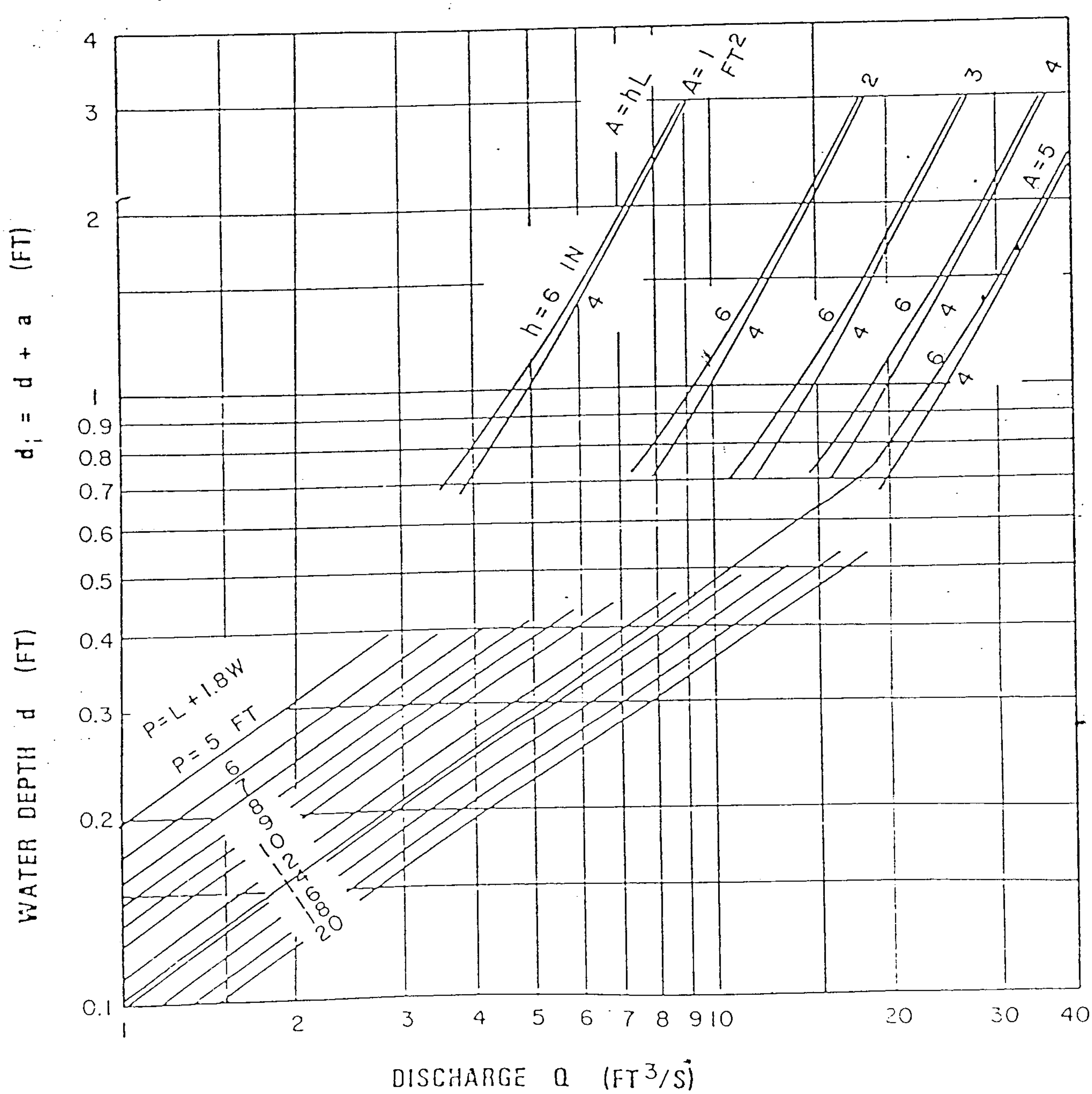
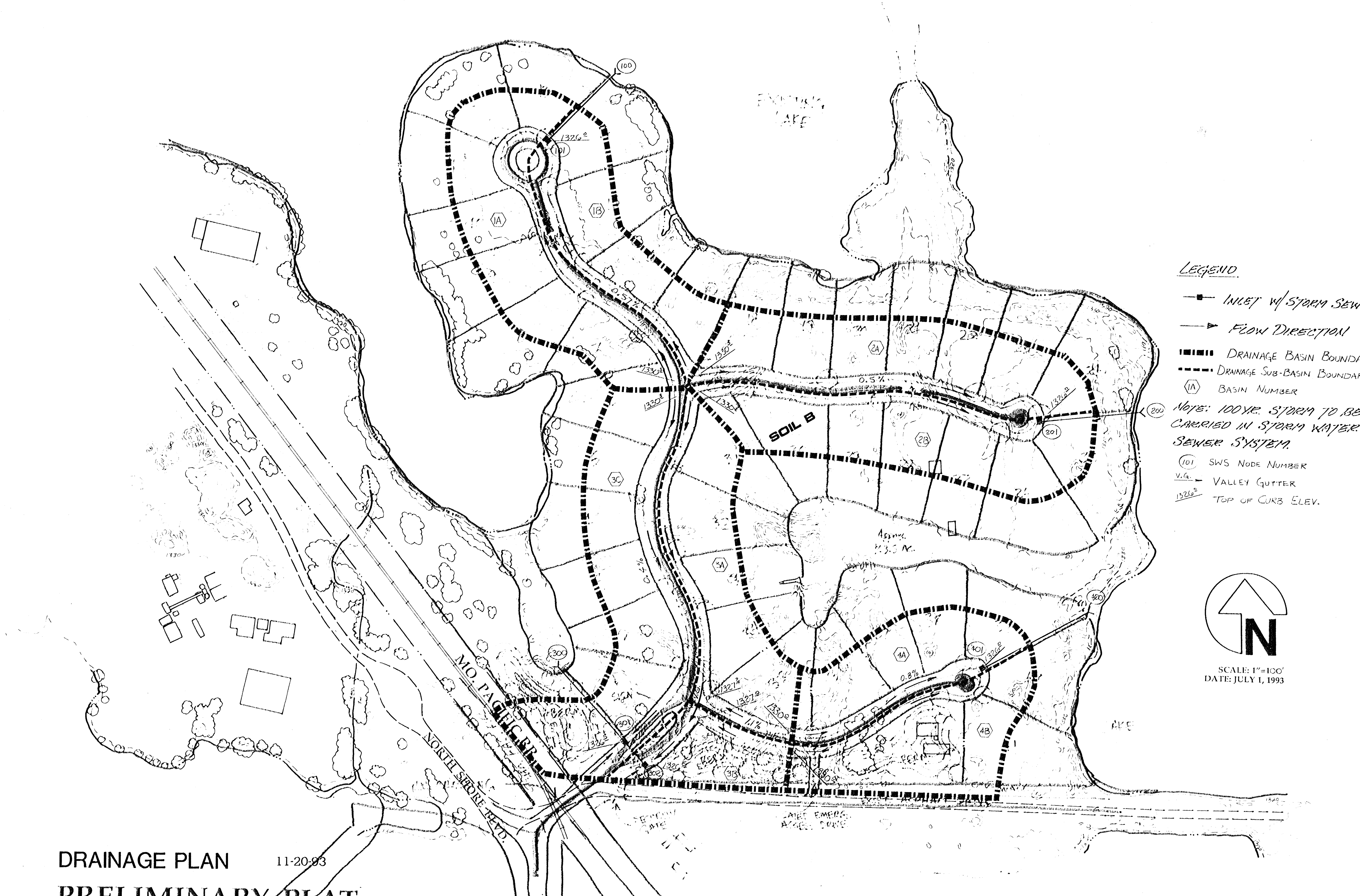


CHART 12. Depressed curb-opening inlet capacity in sump locations.

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



DRAINAGE PLAN 11-20-93

PRELIMINARY PLAT

BAREFOOT BAY

OWNER: RITCHIE & ASSOCIATES 8100 E. 22ND N. BLDG. 1000 WICHITA, KS. 67226 PH. (316) 683-7400

Professional Engineering Consultants
303 S. Topeka
Wichita, KS 67202

BILL G. YUNG DESIGN
4912 E 29TH STREET NORTH WICHITA, KS 67220
316-683-5567 FAX 316-683-9296

DATE
REV.

SHEET TITLE

PROJECT

SHEET
OF 233