EASTSIDE COMMUNITY CHURCH ADDITION

(Southeast corner of 21st St. N. and Greenwich Rd.)

Stormwater Drainage Study

Tributary Basin to the
West Branch of Four Mile Creek

Y&A Project No. 97-041-115

September, 1997

Prepared by:

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EASTSIDE COMMUNITY CHURCH ADDITION
Sedgwick County, Kansas

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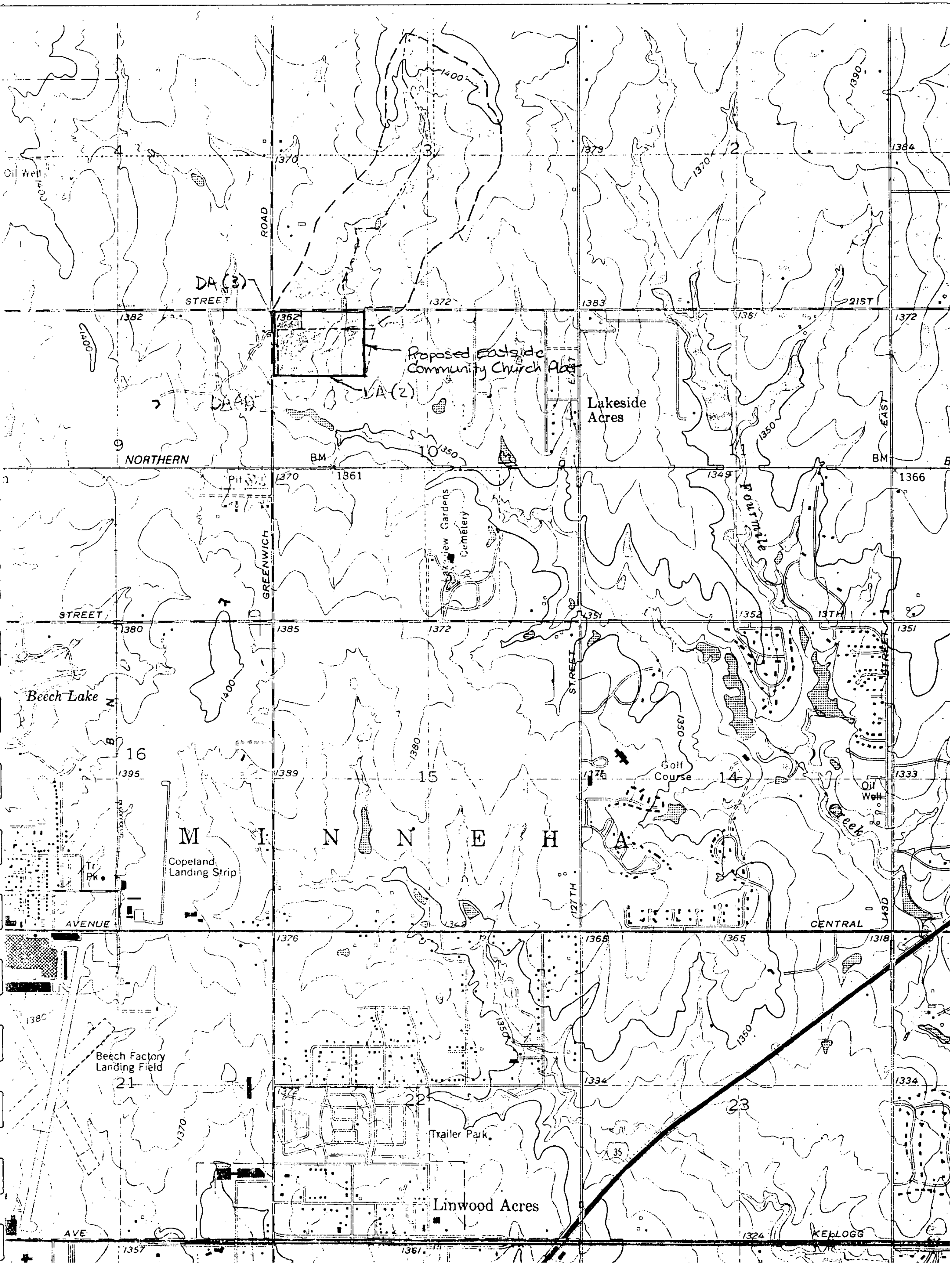
EASTSIDE COMMUNITY CHURCH ADDITION
Sedgwick County, Kansas

1. Drainage Basin Characteristics


DA(3)
Proposed Eastside Community Church Plat
DA(2)
Oil Well
ROAD
STREET
21ST
Lakeside Acres
NORTHERN
BM
Pit
GREENWICH
Lakeview Gardens Cemetery
Fourmile
STREET
13TH
EAST
Beech Lake
Golf Course
Oil Well
Creek
M I N N E H A
Tr Pk
Copeland Landing Strip
127TH
143D
AVENUE
CENTRAL
Beech Factory Landing Field
Trailer Park
35
Linwood Acres
AVE
KELLOGG
1400
1370
1373
1390
1384
1372
1382
1362
1383
1351
1350
1361
1349
1366
1380
1385
1352
1395
1389
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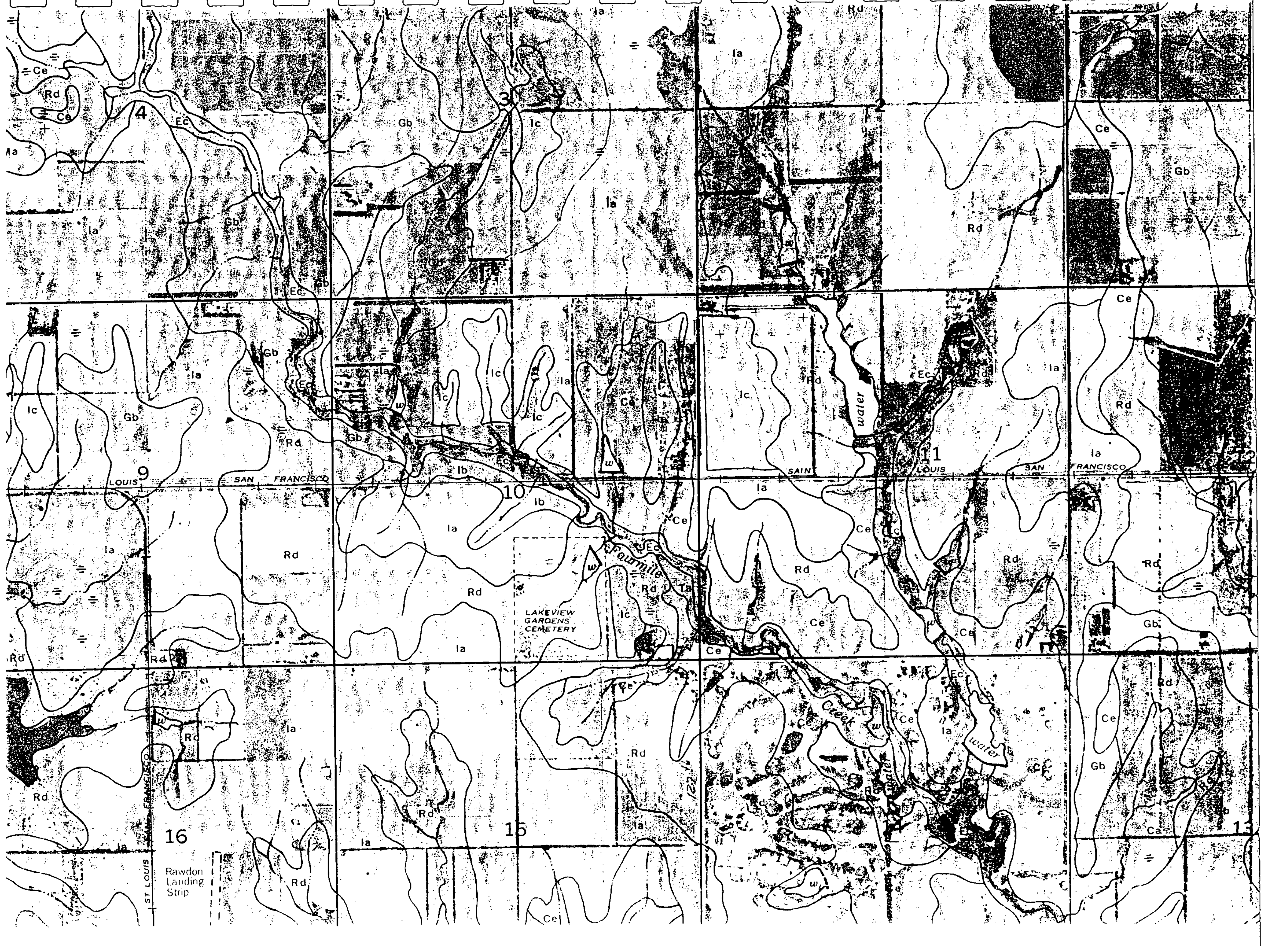
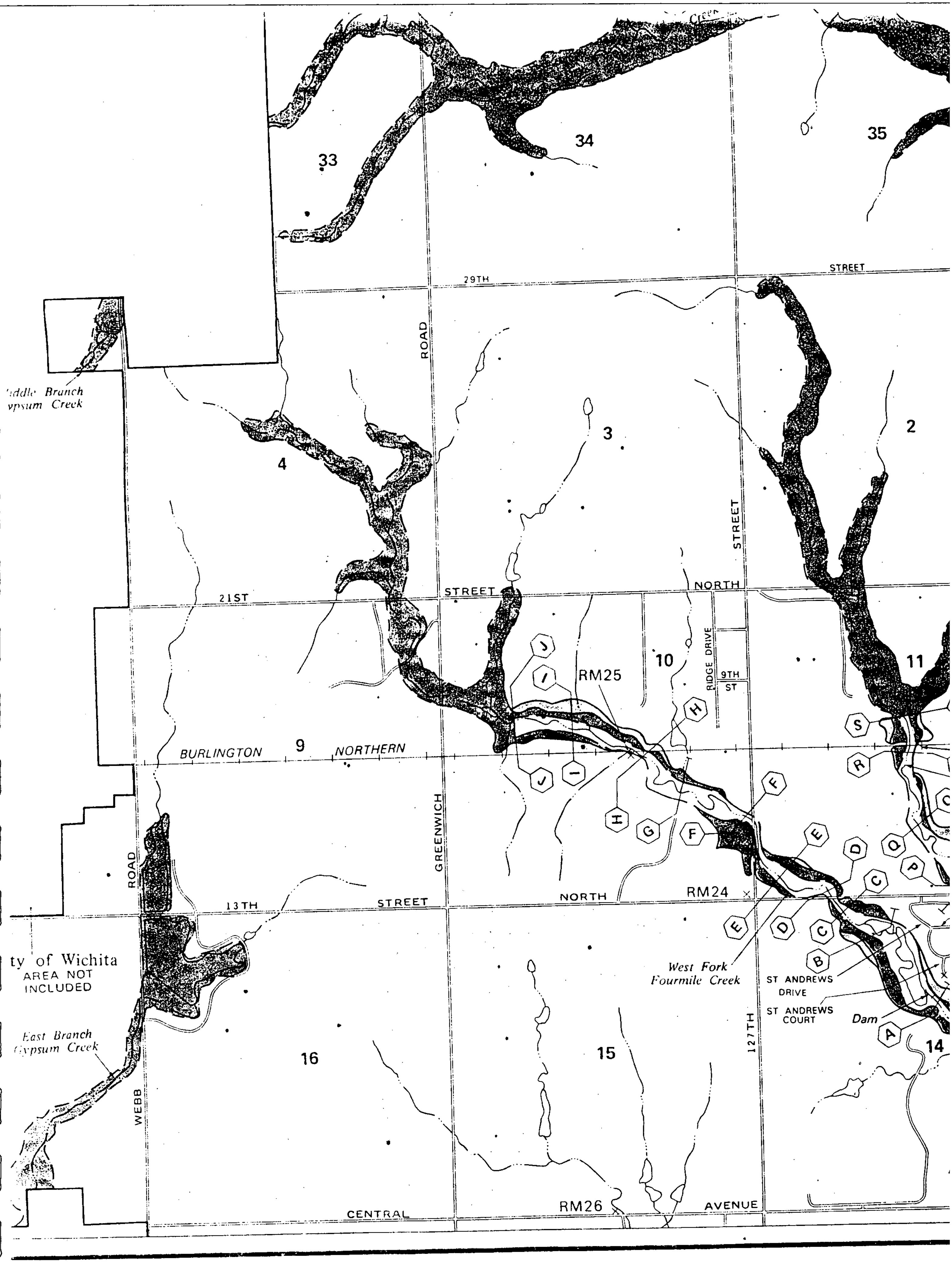


Fourmile
Creek
water
LAKEVIEW GARDENS CEMETERY
Rawdon Landing Strip
SAN FRANCISCO
ST LOUIS
2
3
4
9
10
11
12
13
15
16



33
34
35
29TH
STREET
ROAD
2
3
4
iddle Branch
ypsum Creek
STREET
21ST
STREET
NORTH
RIDGE DRIVE
9TH
ST
10
11
RM25
BURLINGTON
9
NORTHERN
GREENWICH
ROAD
13TH
STREET
NORTH
RM24
West Fork
Fourmile Creek
ST ANDREWS
DRIVE
ST ANDREWS
COURT
Dam
127TH
ty of Wichita
AREA NOT
INCLUDED
East Branch
Gypsum Creek
WEBB
16
15
14
CENTRAL
RM26
AVENUE

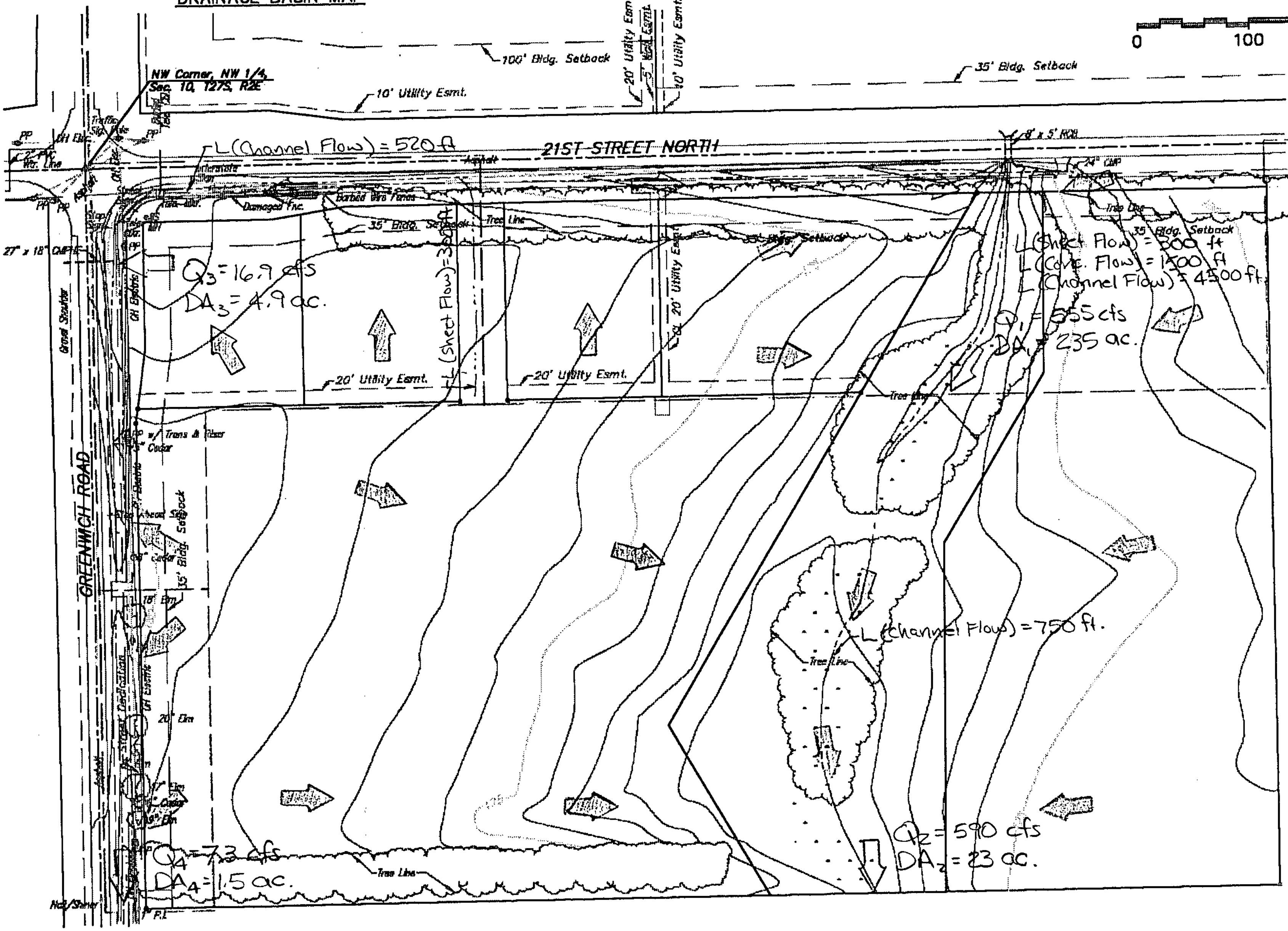
EASTSIDE COMMUNITY CHURCH ADDITION
Sedgwick County, Kansas

2. Discharge Computations

EASTSIDE COMMUNITY CHURCH ADDITION

TO SEDGWICK COUNTY, KANSAS

DRAINAGE BASIN MAP



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FILE: 041/CONTOURS.dwg PLOT: 8-25-97 ACADWIN r.14

Eastside Community Church
Drainage Computations
6-5-97

1. Design Criteria:

1.1 For drainage areas larger than 100 acres, use TR-55 "Graphical Peak Discharge" method

$q_p = q_u A_m Q$

For small drainage areas use Rational Method

$Q = ciA$

1.2 Refer to attached USGS map for drainage area limits, and general basin characteristics. Soil types per SCS data for Sedgwick Co., KS.

1.3 Discharge computations are included for two locations along the proposed drainage reserve. Additional discharge is computed at the NW and SW corners of the proposed plat

2. Discharge Computations:

2.1 Drainage Area (1), refer to attached "Drainage Basin Map", USGS map, and TR-55 "Graphical Peak Discharge" worksheets,

Worksheet #2, CN = 85
Q = 6.02 in

Worksheet #3, T_c = 1.25 hrs

Worksheet #4, Q_{100} = 555 cfs

2.2 Drainage Area (2)

Worksheet #2, CN = 85
Q = 6.02 in

Worksheet #3, T_c = 1.35 hrs

Worksheet #4, Q_{100} = 590 cfs

2.3 Drainage Area (3), using Rational Method

DA = 4.9 ac.

T_c, sheet flow $n = 0.15$
$L = 300'$
$P_2 = 3.6$
$S = 1.0\%$
$\Rightarrow T_t = 0.49$ hrs

Channel flow $V = 2.0$ fps
$L = 520'$
$\Rightarrow T_t = 0.07$ hrs

$T_c = 0.56$ hrs (34 min)

$i_{100} = 5.07$ in/hr

$C = 0.68$ (Undefined Urban land use)

$Q_{100} = 0.68 \times 5.07 \times 4.9 = 16.9$ cfs

2.4 Drainage Area (4), using Rational Method

DA = 1.5 ac.

T_c, sheet flow $n = 0.15$
$L = 150'$
$P_2 = 3.6$
$S = 2.0\%$
$T_t = 0.21$ hrs

channel flow $V = 2.0$ fps
$L = 430'$
$T_t = 0.06$ hrs.

$T_c = 0.27$ hrs (16 min)

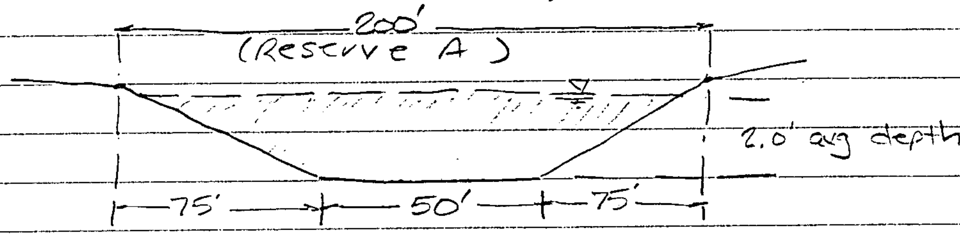
$i_{100} = 7.18$ in/hr

$C = 0.68$

$Q_{100} = 0.68 \times 7.18 \times 1.5 = 7.3$ cfs

3. Hydraulic Design

3.1 Drainage Area (1), Check typical Channel Section,



Cross-Sectional Area, $A = 250$ ft^2

$P_w = 200$ ft

$R_h = 1.25$ ft

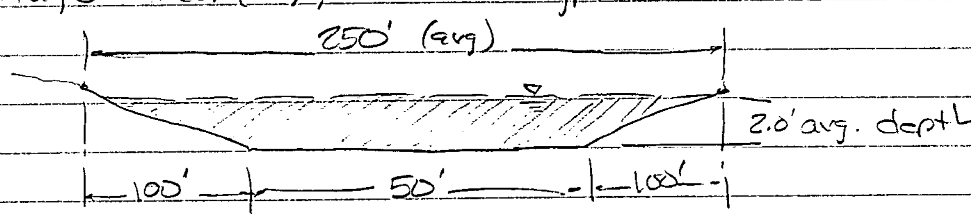
$S_{avg} = 0.25$ %

$n = 0.035$

$Q = 1.49(250)(1.25)^{2/3}(0.0025)^{1/2} / 0.035 = 617$ cfs

> 555 cfs OK

3.2 Drainage Area (2), Check typical Channel Section,



Cross-Sectional Area, $A = 300$ ft^2

$P_w = 250$ ft

$R_h = 1.20$ ft

$$Q = 1.49(300)(1.20)^{2/3}(0.0025)^{1/2}/0.035 = 721 \text{ cfs}$$

> 590 cfs ok

3.3 Drainage Area (3), check existing 29" x 18" CMPHE using Design Data 18 "ACPA"

For $Q = 16.9$ cfs, $L = 75'$

Inlet Control Curve, $HW = 2.65'$

Outlet Control Curve, $HW + S_o L = 4.2'$

where $S_o = 0.75\%$ (est.)

$L = 75'$

$$HW = 4.2 - (0.0075 \times 75) = 3.6'$$

ok

∴ Outlet Control

Check, $Q = 1.49\, A R_h^{2/3} S^{1/2} / n$

$A = 2.90$ ft²

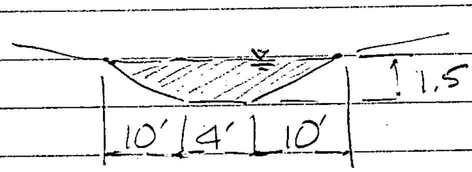
$P_w = 6.2832$ ft.

$R_h = 0.4615$ ft

$n = 0.013$

$Q = 17.2$ cfs ok

3.4 Drainage Area (4), Check typical channel section



Cross-Sectional Area, $A = 21$ ft²

$P_w = 24.2237$ ft

$R_h = 0.8669$ ft

$S = 0.50\%$

$n = 0.035$

$$Q = 1.49(21)(0.8669)^{2/3}(0.005)^{1/2}/0.035 = 57 \text{ cfs}$$

ok

Worksheet 2: Runoff curve number and runoff

Project Eastside Community Church By CRY Date 6-5-97.

Location DA (1) reference Drainage Map Checked ____ Date ____

Circle one: Present (Developed) ____________

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN [1] Table 2-2	CN [1] Fig. 2-3	CN [1] Fig. 2-4	Area ☑ acres ☐ mi² ☐ %	Product of CN x area
D	Cemeteries	84			40	3360
D	Pastures, grassland.	84			175	14,700
D	Urban Commercial	95			20	1,900
				Totals =	235	19,960

[1] Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = ____; Use CN = 85

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	100		
Rainfall, P (24-hour)	in	7.8		
Runoff, Q .... (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	in	6.02		

Worksheet 2: Runoff curve number and runoff

Project Eastside Community Church By CKY Date 6-5-97

Location DA (2) reference attached map Checked ____ Date ____

Circle one: Present (Developed) ____

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	CN 1/			Area ☑ acres ☐ mi² ☐ %	Product of CN x area
		Table 2-2	Fig. 2-3	Fig. 2-4		
D	Urban Commercial	95			25	2,375
D	Open Space	80			12	960
D	Residential (1/4 ac. lots)	87			6	522
D	Cemeteries	84			40	3,360
D	Pastures, grassland	84			175	14,700

1/ Use only one CN source per line.

Totals = 258 | 21,917

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = ____ = ____; Use CN = 85

2. Runoff

	Storm #1	Storm #2	Storm #3
Frequency .... yr	100		
Rainfall, P (24-hour) .... in	7.8		
Runoff, Q .... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)	6.02		

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Eastside Community Church By CRY Date 6-5-97

Location DA(1) reference attached map Checked ____ Date ____

Circle one: Present (Developed)

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID	(1)		
1. Surface description (table 3-1)			Grass		
2. Manning's roughness coeff., n (table 3-1) ..			0.15		
3. Flow length, L (total L ≤ 300 ft)	ft		300		
4. Two-yr 24-hr rainfall, P_2	in		3.5		
5. Land slope, s	ft/ft		0.015		
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		0.42	+	=

Shallow concentrated flow		Segment ID	(1)		
7. Surface description (paved or unpaved)			unpaved		
8. Flow length, L	ft		1500		
9. Watercourse slope, s	ft/ft		0.015		
10. Average velocity, V (figure 3-1)	ft/s		2.0		
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.21	+	=

Channel flow		Segment ID	(1)		
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s		2.0		
18. Flow length, L	ft		4500		
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		0.62	+	=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				1.25

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project Eastside Community Church By CEY Date 6-5-97

Location DA (2) reference attached map Checked _____ Date _____

Circle one: Present (Developed) _______________

Circle one: T_c T_t through subarea _______________

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Unit	Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1)					
3. Flow length, L (total L ≤ 300 ft)	ft				
4. Two-yr 24-hr rainfall, P_2	in				
5. Land slope, s	ft/ft				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr		+		=

Shallow concentrated flow	Unit	Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft				
9. Watercourse slope, s	ft/ft				
10. Average velocity, V (figure 3-1)	ft/s				
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=

Channel flow	Unit	Segment ID (1)		(2)	
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s			2.0	
18. Flow length, L	ft			750	
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	1.25	+	0.10	=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				1.35

Worksheet 4: Graphical Peak Discharge method

Project Eastside Community Church By CRY Date 6-5-97

Location DA(1) reference attached map Checked _____ Date _____

Circle one: Present (Developed) ______________________

1. Data:

Drainage area .... A_m = 0.3672 mi^2 (acres/640)

Runoff curve number .... CN = 85 (From worksheet 2)

Time of concentration .. T_c = 1.25 hr (From worksheet 3)

Rainfall distribution type = II (I, IA, II, III)

Pond and swamp areas spread throughout watershed ...... = 2% percent of A_m (5 (acres) or mi^2 covered)

			Storm #1	Storm #2	Storm #3
2.	Frequency	yr	100		
3.	Rainfall, P (24-hour)	in	7.8		
4.	Initial abstraction, I_a .... (Use CN with table 4-1.)	in	0.353		
5.	Compute I_a/P		0.0453		
6.	Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4- II)	csm/in	310		
7.	Runoff, Q .... (From worksheet 2).	in	6.02		
8.	Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.81		
9.	Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	555		

(685 cfs w/o pond adjustment)

Worksheet 4: Graphical Peak Discharge method

Project Eastside Community Church By CRY Date 6-5-97

Location DA(2) reference attached map Checked ____ Date ____

Circle one: Present (Developed) ________________

1. Data:

   Drainage area .... A_m = 0.4030 mi^2 (acres/640)

   Runoff curve number .... CN = 85 (From worksheet 2)

   Time of concentration .. T_c = 1.35 hr (From worksheet 3)

   Rainfall distribution type = II (I, IA, II, III)

   Pond and swamp areas spread throughout watershed ...... = 2% percent of A_m (5 (acres) or mi^2 covered)

		Storm #1	Storm #2	Storm #3
2. Frequency	yr	100		
3. Rainfall, P (24-hour)	in	7.8		
4. Initial abstraction, I_a .... (Use CN with table 4-1.)	in	0.353		
5. Compute I_a/P		0.0453		
6. Unit peak discharge, q_u .... (Use T_c and I_a/P with exhibit 4-II)	csm/in	300		
7. Runoff, Q .... (From worksheet 2).	in	6.02		
8. Pond and swamp adjustment factor, F_p .... (Use percent pond and swamp area with table 4-2. Factor is 1.0 for zero percent pond and swamp area.)		0.81		
9. Peak discharge, q_p .... (Where $q_p = q_u A_m Q F_p$)	cfs	590.		

(728 cfs w/o pond adjustment)

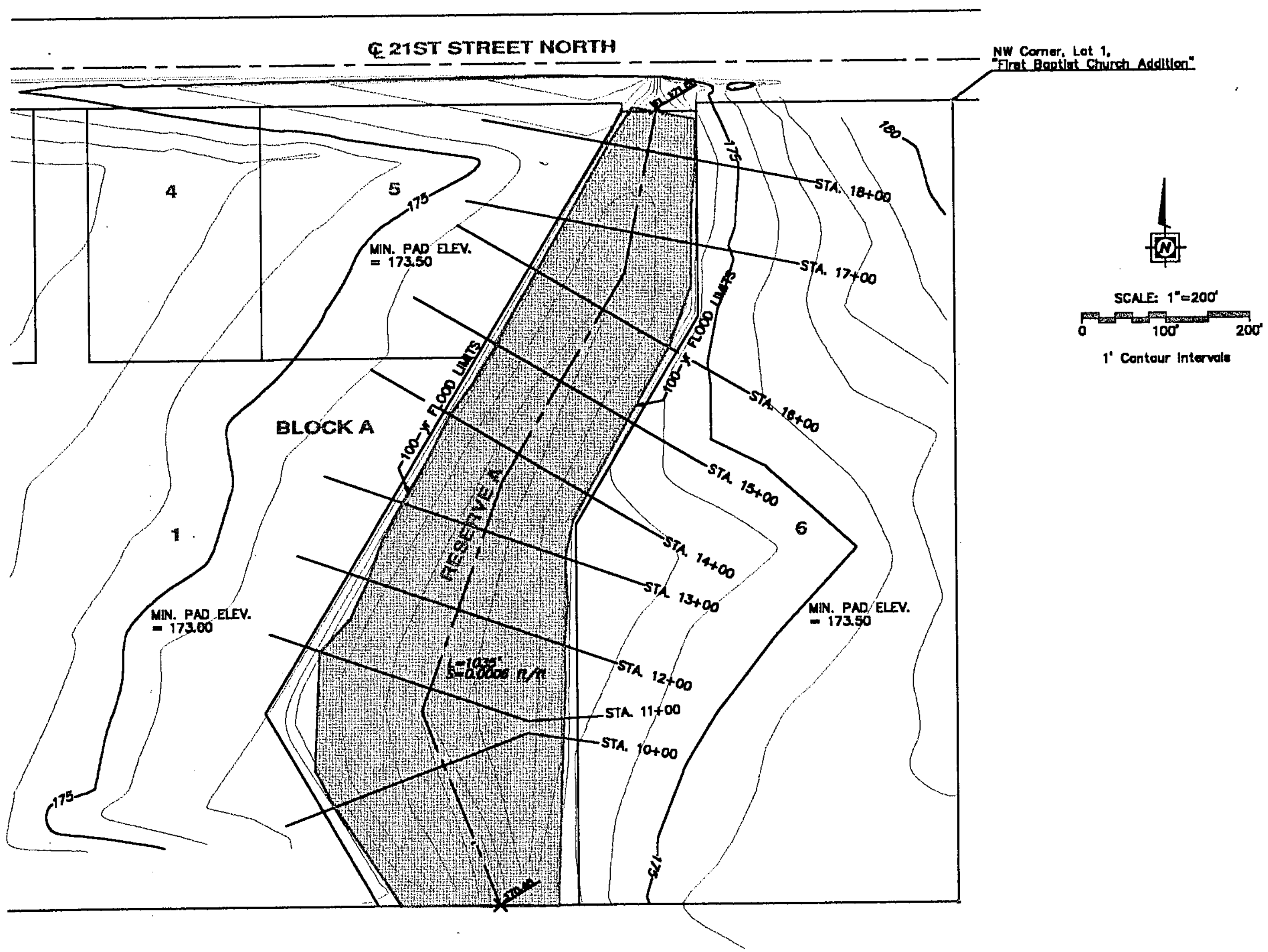
EASTSIDE COMMUNITY CHURCH ADDITION
Sedgwick County, Kansas

3. HEC2 Computer Analysis

(AutoCivil v.7.0)

EASTSIDE COMMUNITY CHURCH ADDITION
TO SEDGWICK COUNTY, KANSAS

FLOODWAY ANALYSIS



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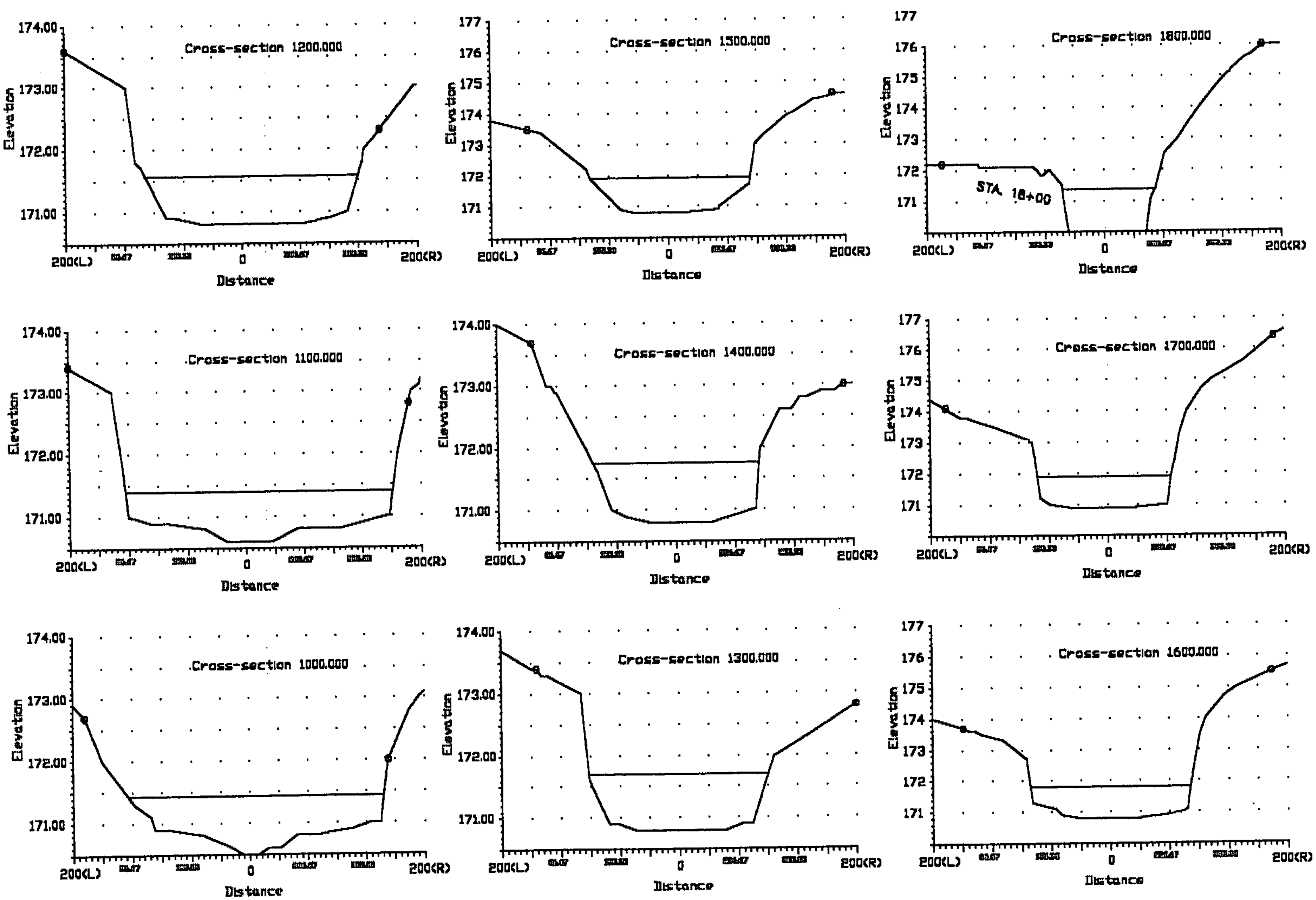
July 12, 1997

FILE: 041/HEC2DATA.dwg PLOT: 7-12-97 ACADWIN r.12

EASTSIDE COMMUNITY CHURCH ADDITION
TO SEDGWICK COUNTY, KANSAS

CHANNEL CROSS-SECTIONS



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July 12, 1997

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1********************************************
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 * HEC-2 WATER SURFACE PROFILES          *                                     * U.S. ARMY
CORPS OF ENGINEERS     *
 *                         *                            * HYDROLOGIC ENGINEERING
CENTER     *
 * Version  4.6.2;  May 1991            *                            * 609 SECOND STREET,
SUITE D       *
 *                         *                            * DAVIS, CALIFORNIA 95616-4687
*
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 Version  4.6.2;  May 1991
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T2 97-041-118
T3 FMC TRIBUTARY   PROFILE 1: FLOW 800

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ELEV
   Q     QLOB    QCH    QROB    ALOB    ACH    AROB    VOL    TWA    R-BANK
ELEV
   TIME   VLOB   VCH   VROB   XNL    XNCH   XNR    WTN    ELMIN   SSTA
   SLOPE  XLOBL  XLCH  XLOBR  ITRIAL  IDC   ICONT  CORAR  TOPWID
ENDST


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0

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     .00    .00    4.49    .00    .000    .035    .000    .000   170.50    82.44
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ELEV
  TIME    VLOB    VCH     VROB    XNL     XNCH   XNR    WTN    ELMIN  SSTA
  SLOPE   XLOBL   XLCH    XLOBR   ITRIAL  IDC    ICONT  CORAR  TOPWID
ENDST


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3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
 1300.000     .90  171.70  171.70     .00  172.10    .39    1.00    .42  173.40
   800.0      .0   800.0      .0      .0   158.7     .0     1.2    1.9  172.80
     .02     .00    5.04     .00    .000    .035   .000    .000  170.80  117.82
  .019560     62.     50.     61.     20       8      0     .00  202.78  320.60


*SECNO 1350.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
 1350.000     .91  171.71  171.71     .00  172.12    .42     .97    .40  173.40
   800.0      .0   800.0      .0      .0   154.7     .0     1.4    2.1  173.00
     .02     .00    5.17     .00    .000    .035   .000    .000  170.80  127.58
  .019157     50.     50.     50.     20       5      0     .00  187.15  314.72


*SECNO 1400.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
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3693 PROBABLE MINIMUM SPECIFIC ENERGY
1
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  SECNO   DEPTH   CWSEL   CRIWS   WSELK   EG     HV     HL     OLOSS   L-BANK
ELEV
  Q      QLOB    QCH     QROB    ALOB    ACH     AROB    VOL     TWA     R-BANK
ELEV
  TIME    VLOB    VCH     VROB    XNL     XNCH    XNR     WTN     ELMIN   SSTA
  SLOPE   XLOBL   XLCH    XLOBR   ITRIAL  IDC     ICONT   CORAR   TOPWID
ENDST


 3720 CRITICAL DEPTH ASSUMED
 1400.000    .95   171.75   171.75    .00   172.17    .42    .96    .39   173.70
   800.0     .0   800.0      .0     .0   154.2      .0     1.6    2.3   173.00
    .02     .00    5.19     .00    .000    .035    .000    .000  170.80   127.12
  .019313    81.     50.     13.     20       8       0     .00  186.99   314.11


 *SECNO 1450.000
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
 1450.000    .93   171.73   171.73    .00   172.16    .43    .97    .40   173.80
   800.0     .0   800.0      .0     .0   152.0      .0     1.7    2.5   173.80
    .03     .00    5.26     .00    .000    .035    .000    .000  170.80   131.71
  .019447    59.     50.     50.     20       5       0     .00  181.38   313.10


 *SECNO 1500.000
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
 1500.000   1.09   171.89   171.89    .00   172.31    .42    .96    .44   173.50
   800.0     .0   800.0      .0     .0   153.0      .0     1.9    2.7   174.60
    .03     .00    5.23     .00    .000    .035    .000    .000  170.80   132.14
  .018860    60.     50.     50.     20       8       0     .00  180.07   312.21


 *SECNO 1550.000
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
 1550.000   1.02   171.82   171.82    .00   172.25    .43    .95    .46   173.60
   800.0     .0   800.0      .0     .0   152.7      .0     2.1    2.9   175.00
    .03     .00    5.24     .00    .000    .035    .000    .000  170.80   129.39
  .019232    52.     50.     51.     20      11       0     .00  181.83   311.21


 *SECNO 1600.000
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
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3720 CRITICAL DEPTH ASSUMED
 1600.000    .98  171.78  171.78    .00  172.20    .42    .95    .42  173.70
   800.0     .0   800.0     .0     .0   153.2     .0    2.3    3.1  175.50
     .03    .00    5.22    .00   .000    .035   .000   .000  170.80  129.45
 .018877    50.     50.    50.     20       8      0    .00  180.83  310.28
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   SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG     HV     HL     OLOSS   L-BANK
ELEV
   Q      QLOB     QCH     QROB    ALOB    ACH     AROB    VOL     TWA     R-BANK
ELEV
   TIME    VLOB    VCH    VROB    XNL    XNCH    XNR    WTN    ELMIN    SSTA
   SLOPE   XLOBL   XLCH   XLOBR   ITRIAL  IDC    ICONT   CORAR   TOPWID
ENDST


*SECNO 1650.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
 1650.000   1.05  171.85  171.85    .00  172.29    .43    .95    .39  173.80
   800.0     .0   800.0     .0     .0   151.4     .0    2.4    3.3  176.00
     .04    .00    5.28    .00   .000    .035   .000   .000  170.80  123.08
 .019130    19.     50.   107.     20       8      0    .00  177.36  300.44


*SECNO 1700.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
 1700.000   1.02  171.92  171.92    .00  172.40    .48    .93    .38  174.10
   800.0     .0   800.0     .0     .0   144.2     .0    2.6    3.5  176.40
     .04    .00    5.55    .00   .000    .035   .000   .000  170.90  139.74
 .018231    51.     50.    57.     20       8      0    .00  151.35  291.09


*SECNO 1750.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
 1750.000   1.15  172.05  172.05    .00  172.59    .54    .90    .37  175.00
   800.0     .0   800.0     .0     .0   135.8     .0    2.8    3.7  176.30
     .04    .00    5.89    .00   .000    .035   .000   .000  170.90  155.78
 .017582    50.     50.    51.     20       8      0    .00  126.57  282.35


*SECNO 1800.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
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 1800.000    1.34   172.34   172.34    .00   172.95    .61    .86    .36   173.20
  800.0       .0    800.0      .0       .0   127.6      .0    2.9    3.8   177.00
   .04       .00     6.27     .00     .000    .035    .000   .000  171.00  172.51
 .016790     50.      50.     50.      20       8       0    .00  104.64  277.15


*SECNO 1849.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
1
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  SECNO   DEPTH   CWSEL   CRIWS   WSELK   EG     HV     HL    OLOSS  L-BANK
ELEV
  Q     QLOB    QCH    QROB    ALOB    ACH    AROB    VOL    TWA    R-BANK
ELEV
  TIME   VLOB    VCH    VROB    XNL    XNCH    XNR    WTN    ELMIN   SSTA
  SLOPE  XLOBL   XLCH   XLOBR  ITRIAL  IDC    ICONT  CORAR  TOPWID
ENDST


3720 CRITICAL DEPTH ASSUMED
 1849.000    1.77   172.77   172.77    .00   173.54    .77    .81    .39   174.00
  800.0       .0    800.0      .0       .0   113.4      .0    3.0    3.9   177.00
   .05       .00     7.05     .00     .000    .035    .000   .000  171.00  191.75
 .015779     50.      50.     50.      20      11       0    .00   74.29  266.04


1
PROFILE FOR STREAM  FMC TRIBUTARY



PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL
W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA



ELEVATION  171.    171.    171.    172.    172.    172.    172.    172.    173.    173.
   SECNO   CUMDIS

1
PROFILE FOR STREAM  FMC TRIBUTARY



PLOTTED POINTS (BY PRIORITY) E-ENERGY,W-WATER SURFACE,I-INVERT,C-CRITICAL
W.S.,L-LEFT BANK,R-RIGHT BANK,M-LOWER END STA



ELEVATION   0.     0.     0.     1.     1.     1.     1.     1.     2.     2.
   SECNO   CUMDIS
```

4. Appendix

Table 2-2a.—Runoff curve numbers for urban areas[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area[2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.)[3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)[4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

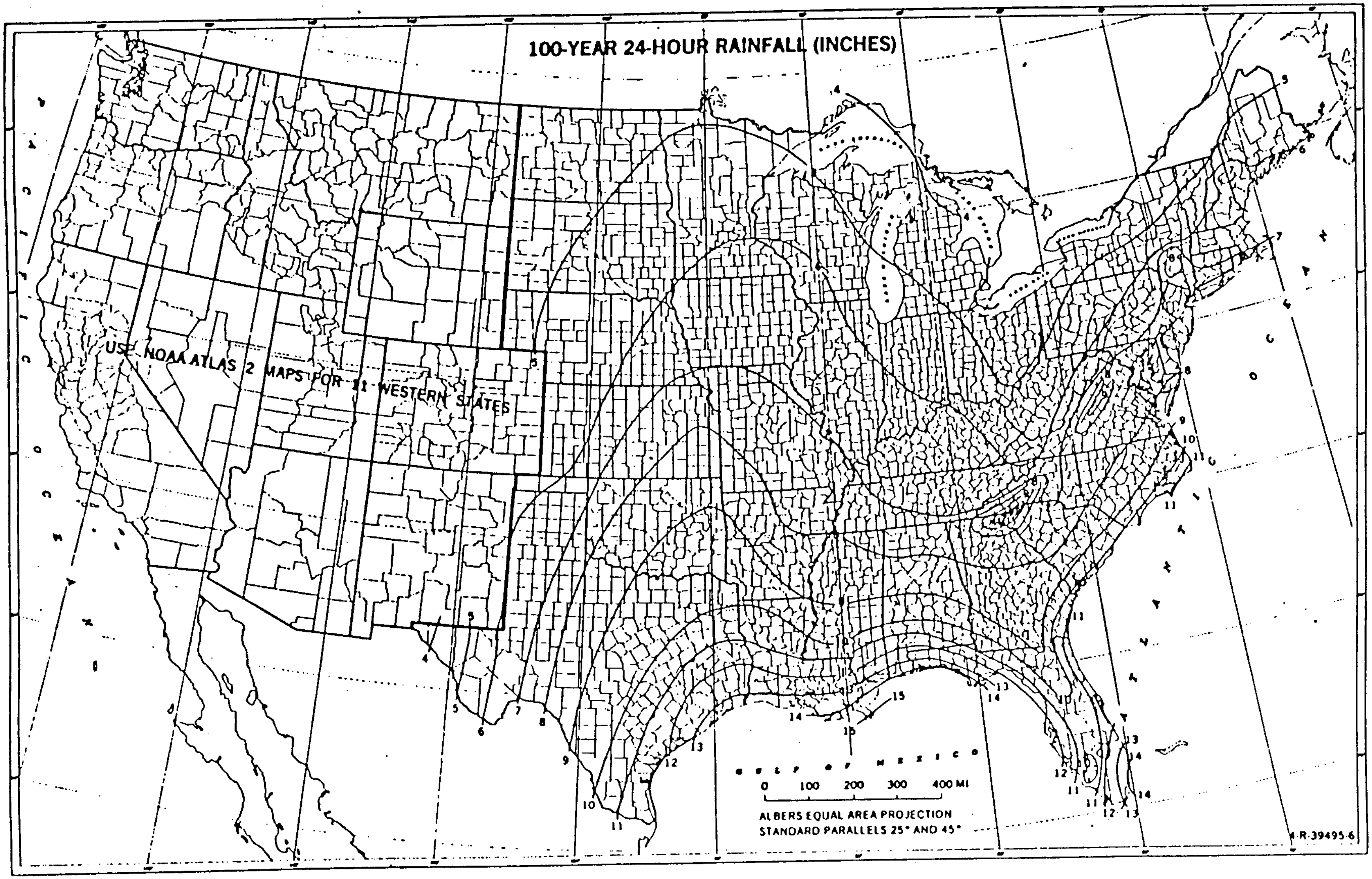

Figure B-8.—One-hundred-year, 24-hour rainfall.

texture is given in appendix A for determining the HSG classification for disturbed soils.

Cover type

Table 2-2 addresses most cover types, such as vegetation, bare soil, and impervious surfaces. There are a number of methods for determining cover type. The most common are field reconnaissance, aerial photographs, and land use maps.

Treatment

Treatment is a cover type modifier (used only in table 2-2b) to describe the management of cultivated agricultural lands. It includes mechanical practices, such as contouring and terracing, and management practices, such as crop rotations and reduced or no tillage.

Hydrologic condition

Hydrologic condition indicates the effects of cover type and treatment on infiltration and runoff and is generally estimated from density of plant and residue cover on sample areas. *Good* hydrologic condition indicates that the soil usually has a low runoff potential for that specific hydrologic soil group, cover type, and treatment. Some factors to consider in estimating the effect of cover on infiltration and runoff are (a) canopy or density of lawns, crops, or other vegetative areas; (b) amount of year-round cover; (c) amount of grass or close-seeded legumes in rotations; (d) percent of residue cover; and (e) degree of surface roughness.

Table 2-1.—Runoff depth for selected CN's and rainfall amounts[1]

	Runoff depth for curve number of—												
Rainfall	40	45	50	55	60	65	70	75	80	85	90	95	98
	inches												
1.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.08	0.17	0.32	0.56	0.79
1.2	.00	.00	.00	.00	.00	.00	.03	.07	.15	.27	.46	.74	.99
1.4	.00	.00	.00	.00	.00	.02	.06	.13	.24	.39	.61	.92	1.18
1.6	.00	.00	.00	.00	.01	.05	.11	.20	.34	.52	.76	1.11	1.38
1.8	.00	.00	.00	.00	.03	.09	.17	.29	.44	.65	.93	1.29	1.58
2.0	.00	.00	.00	.02	.06	.14	.24	.38	.56	.80	1.09	1.48	1.77
2.5	.00	.00	.02	.08	.17	.30	.46	.65	.89	1.18	1.53	1.96	2.27
3.0	.00	.02	.09	.19	.33	.51	.71	.96	1.25	1.59	1.98	2.45	2.77
3.5	.02	.08	.20	.35	.53	.75	1.01	1.30	1.64	2.02	2.45	2.94	3.27
4.0	.06	.18	.33	.53	.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
4.5	.14	.30	.50	.74	1.02	1.33	1.67	2.05	2.46	2.91	3.40	3.92	4.26
5.0	.24	.44	.69	.98	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	.50	.80	1.14	1.52	1.92	2.35	2.81	3.28	3.78	4.30	4.85	5.41	5.76
7.0	.84	1.24	1.68	2.12	2.60	3.10	3.62	4.15	4.69	5.25	5.82	6.41	6.76
8.0	1.25	1.74	2.25	2.78	3.33	3.89	4.46	5.04	5.63	6.21	6.81	7.40	7.76
9.0	1.71	2.29	2.88	3.49	4.10	4.72	5.33	5.95	6.57	7.18	7.79	8.40	8.76
10.0	2.23	2.89	3.56	4.23	4.90	5.56	6.22	6.88	7.52	8.16	8.78	9.40	9.76
11.0	2.78	3.52	4.26	5.00	5.72	6.43	7.13	7.81	8.48	9.13	9.77	10.39	10.76
12.0	3.38	4.19	5.00	5.79	6.56	7.32	8.05	8.76	9.45	10.11	10.76	11.39	11.76
13.0	4.00	4.89	5.76	6.61	7.42	8.21	8.98	9.71	10.42	11.10	11.76	12.39	12.76
14.0	4.65	5.62	6.55	7.44	8.30	9.12	9.91	10.67	11.39	12.08	12.75	13.39	13.76
15.0	5.33	6.36	7.35	8.29	9.19	10.04	10.85	11.63	12.37	13.07	13.74	14.39	14.76

[1]Interpolate the values shown to obtain runoff depths for CN's or rainfall amounts not shown.

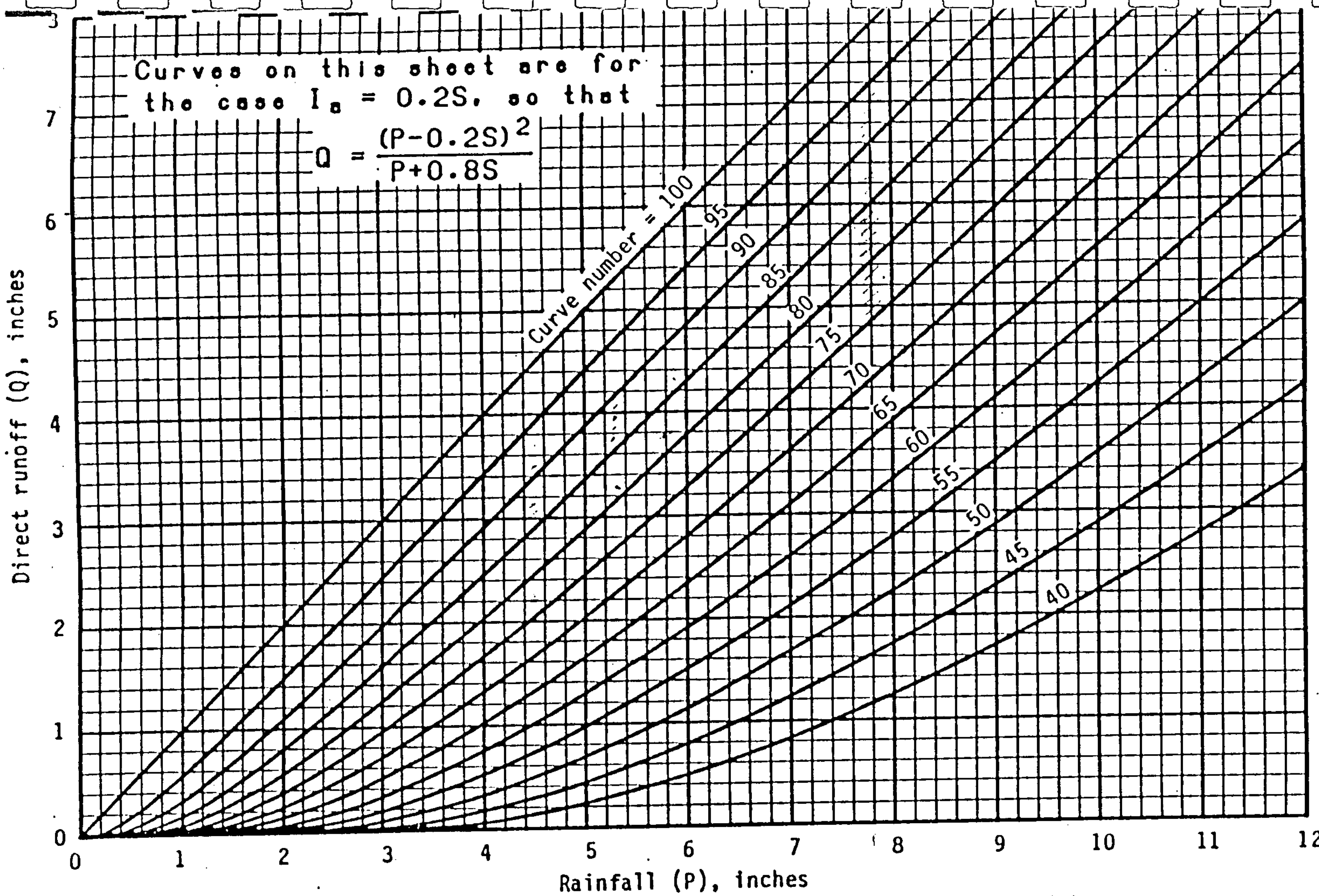

Figure 2-1.—Solution of runoff equation.

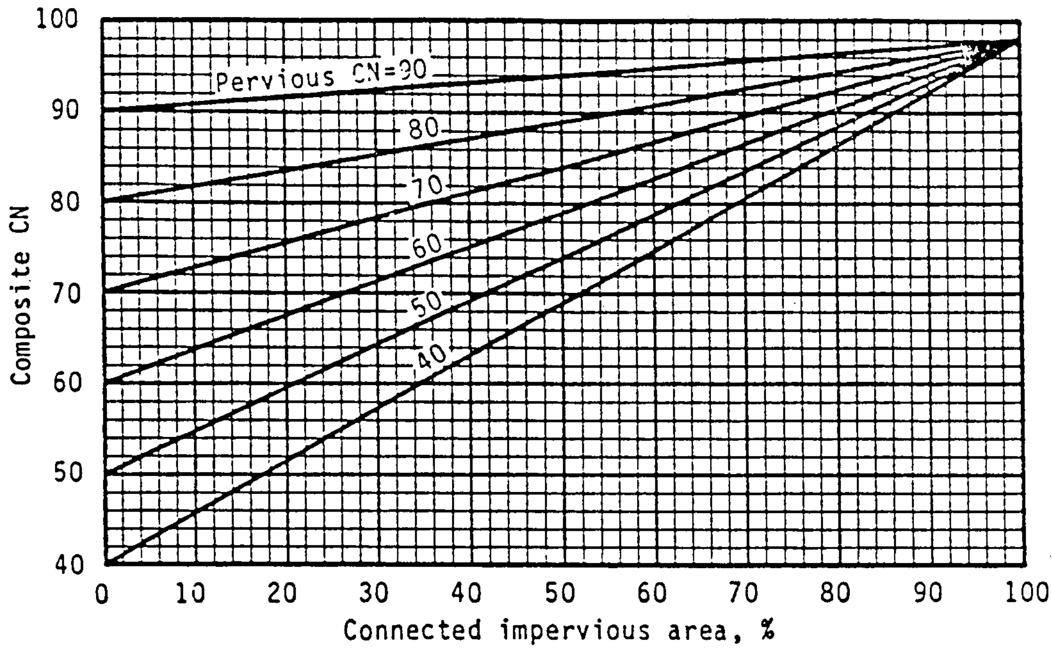

Figure 2-3.—Composite CN with connected impervious area.

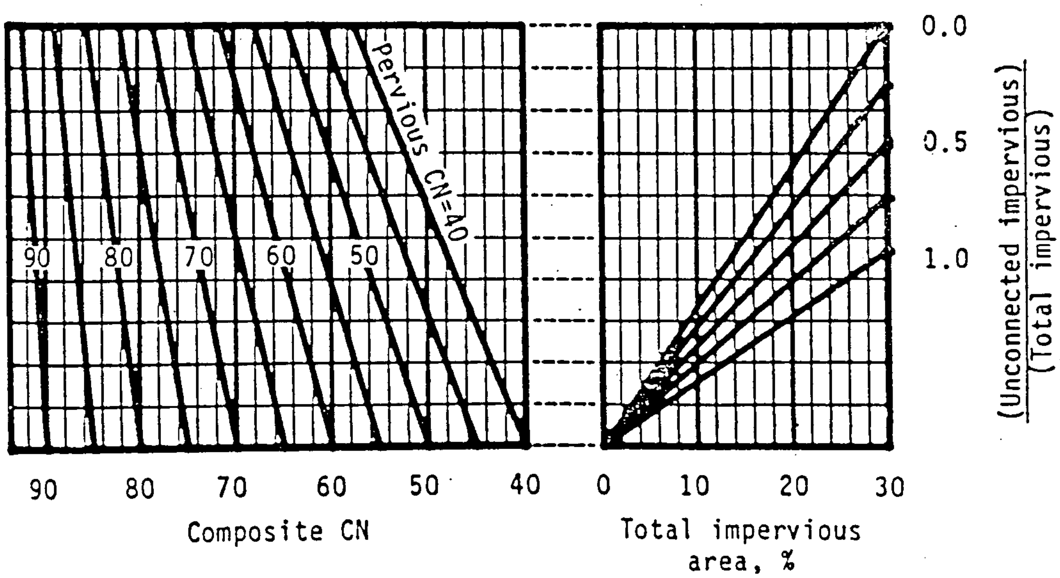

Figure 2-4.—Composite CN with unconnected impervious areas and total impervious area less than 30%.

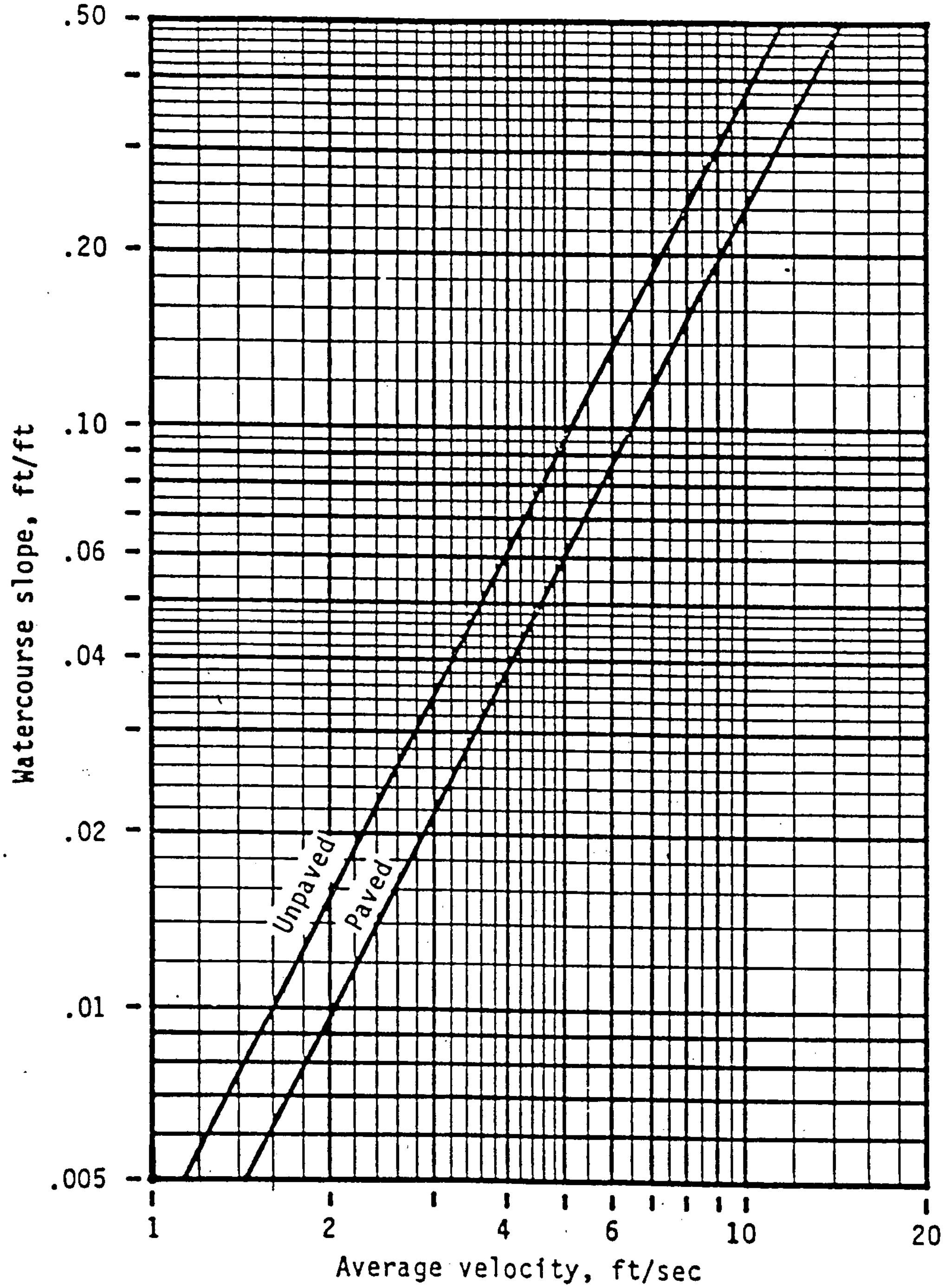

Figure 3-1.—Average velocities for estimating travel time for shallow concentrated flow.

Exhibit 4-II: Unit peak discharge (q_u) for SCS type II rainfall distribution