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PROJECT # W11531 BY MRG
DATE _____ CHECKED TJS 2-20-17

#8

LOCATION: 'B'-LINE, STA. 321+60
DESCRIPTION: CROSS DRAIN UNDER CTH C
TYPE: ANY

AREA = 102.8 ACRES
LENGTH = 3,350 FT
$\Delta H = 869.555' - 853.22' = 16.34'$
$T_c = 35$ min.
$i = 3.4$ in/hr.

HYDROLOGIC SOIL GROUP = B
LAND USE = 25% EXPRESSWAY, 75% Agricultural
SLOPE = 0.5%
$C = (0.25 \times 0.71) + (0.75 \times 0.16) = 0.30$

$Q = ciA$
$Q = 0.30\ (3.4\ in/hr)(102.8\ ACRES)$
$Q = 105$ CFS
$S_{LOPE_{CULVERT}} = \cancel{0.4\%}$ 0.92%

SIZE = 60-INCH CPRC OR ~~72~~ 60-INCH CPCS

SHEET _____ OF _____

Flood Design Frequency Selection Chart

Design Frequency - Years					Drainage Structures
Rural Class			Urban Class		
STH/CTH (1) T1,T2,T3,T4,T5,T6	**STH/CTH (2) T7**	**STH (3)**	**Urban Streets 1, 2, 3, 4, 5,**	**Urban Expressways & Freeways 1, 2, 3**	
See FDM 13-10-1, discussion of Major Drainage Structures					Bridges & Box Culverts
50	50	50	50	50	Underpass Storm Sewers
25	50	50	50	50	Main or Primary Channels
25	25	50	50	50	Cross Drain Pipe Culverts
25	25	25	25	25	Side Drain Pipe Culverts
25	25	25	25	25	Side Ditches and Channels
X	X	25	X	25	Median Ditches and Channels
X	X	X	10 **(4)** Check 25 Yr.	25	Urban Gutters, Inlets and Storm Sewers

(1) All state trunk highways with design ADT under 1500 and all county trunk highways with design ADT under 4000.

(2) All state trunk highways with design ADT of 1500-7000 and all county trunk highways with design ADT over 4000.

(3) All state trunk highways with design ADT of over 7000.

(4) See FDM 13-25-20

Detail A - Runoff Coefficients (C), Rational Formula

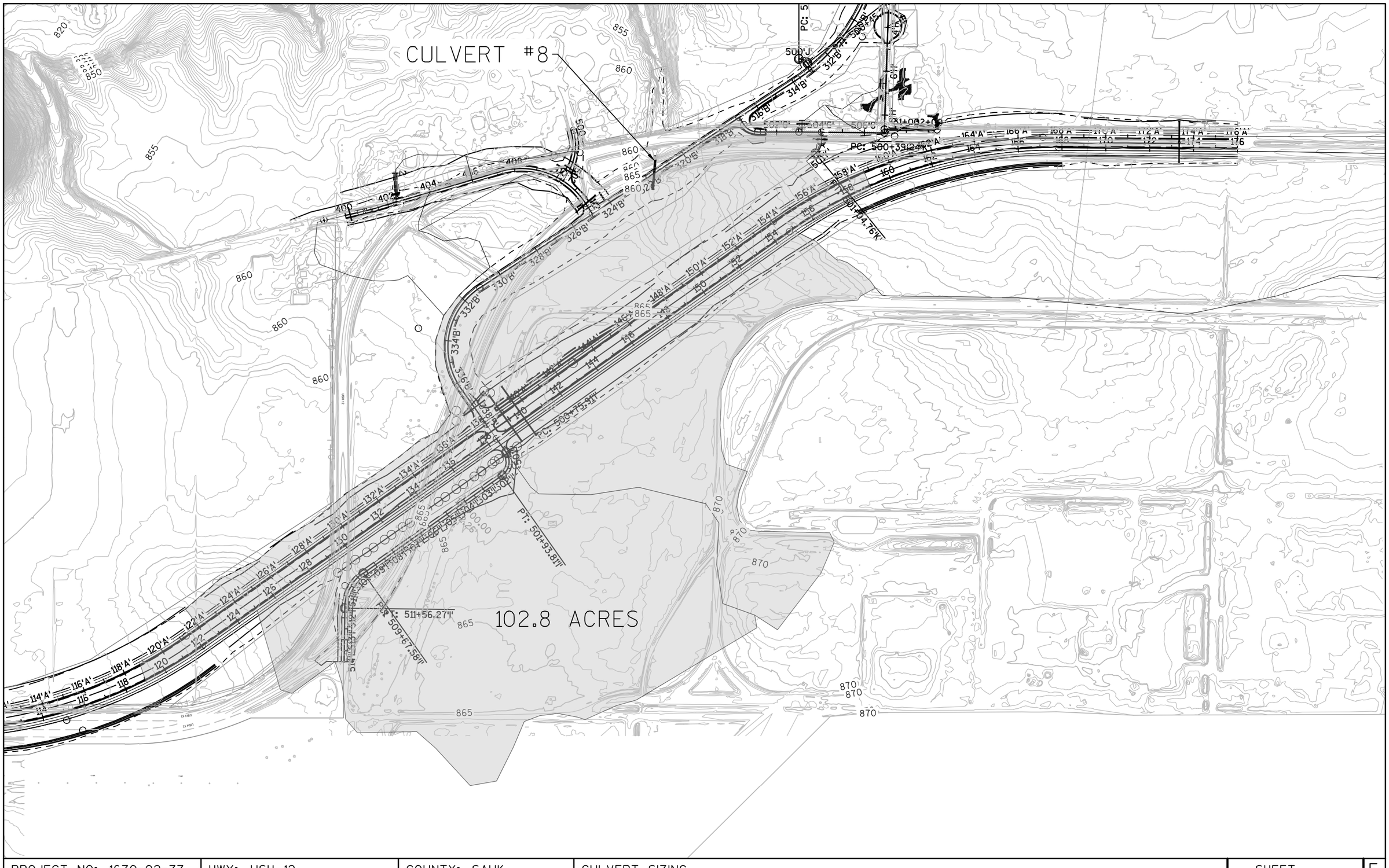
Land Use	Percent Impervious Area	Hydrologic Soil Group											
		A			B			C			D		
		Slope Range Percent			Slope Range Percent			Slope Range Percent			Slope Range Percent		
		0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over
Industrial	90	0.67 0.85	0.68 0.85	0.68 0.86	0.68 0.85	0.68 0.86	0.69 0.86	0.68 0.86	0.69 0.86	0.69 0.87	0.69 0.86	0.69 0.86	0.70 0.88
Commercial	95	0.71 0.88	0.71 0.89	0.72 0.89	0.71 0.89	0.72 0.89	0.72 0.89	0.72 0.89	0.72 0.89	0.72 0.90	0.72 0.89	0.72 0.89	0.72 0.90
High Density Residential	60	0.47 0.58	0.49 0.60	0.50 0.61	0.48 0.59	0.50 0.61	0.52 0.64	0.49 0.60	0.51 0.62	0.54 0.66	0.51 0.62	0.53 0.64	0.56 0.69
Med. Density Residential	30	0.25 0.33	0.28 0.37	0.31 0.40	0.27 0.35	0.30 0.39	0.35 0.44	0.30 0.38	0.33 0.42	0.38 0.49	0.33 0.41	0.36 0.45	0.42 0.54
Low Density Residential	15	0.14 0.22	0.19 0.26	0.22 0.29	0.17 0.24	0.21 0.28	0.26 0.34	0.20 0.28	0.25 0.32	0.31 0.40	0.24 0.31	0.28 0.35	0.35 0.46
Agriculture	5	0.08 0.14	0.13 0.18	0.16 0.22	0.11 0.16	0.15 0.21	0.21 0.28	0.14 0.20	0.19 0.25	0.26 0.34	0.18 0.24	0.23 0.29	0.31 0.41
Open Space	2	0.05 0.11	0.10 0.16	0.14 0.20	0.08 0.14	0.13 0.19	0.19 0.26	0.12 0.18	0.17 0.23	0.24 0.32	0.16 0.22	0.21 0.27	0.28 0.39
Freeways & Expressways	70	0.57 0.70	0.59 0.71	0.60 0.72	0.58 0.71	0.60 0.72	0.61 0.74	0.59 0.72	0.61 0.73	0.63 0.76	0.60 0.73	0.62 0.75	0.64 0.78

Detail B - Runoff Coefficients for Specific Land Use

Land Use	Hydrologic Soil Group											
	A			B			C			D		
	Slope Range Percent			Slope Range Percent			Slope Range Percent			Slope Range Percent		
	0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over	0-2	2-6	6 & over
Row Crops	.08 .22	.16 .30	.22 .38	.12 .26	.20 .34	.27 .44	.15 .30	.24 .37	.33 .50	.19 .34	.28 .41	.38 .56
Median Stripturf	.19 .24	.20 .26	.24 .30	.19 .25	.22 .28	.26 .33	.20 .26	.23 .30	.30 .37	.20 .27	.25 .32	.30 .40
Side Slopeturf			.25 .32			.27 .34			.28 .36			.30 .38
PAVEMENT												
Asphalt	.70 - .95											
Concrete	.80 - .95											
Brick	.70 - .80											
Drives, Walks	.75 - .85											
Roofs	.75 - .95											
Gravel Roads Shoulders	.40 - .60											

NOTE: The lower C values in each range should be used with the relatively low intensities associated with 2 to 10 year design recurrence intervals whereas the higher C values should be used for intensities associated with the longer 25 to 100 year deign recurrence intervals.

Need: Soil Group (use Web Soil Survey)



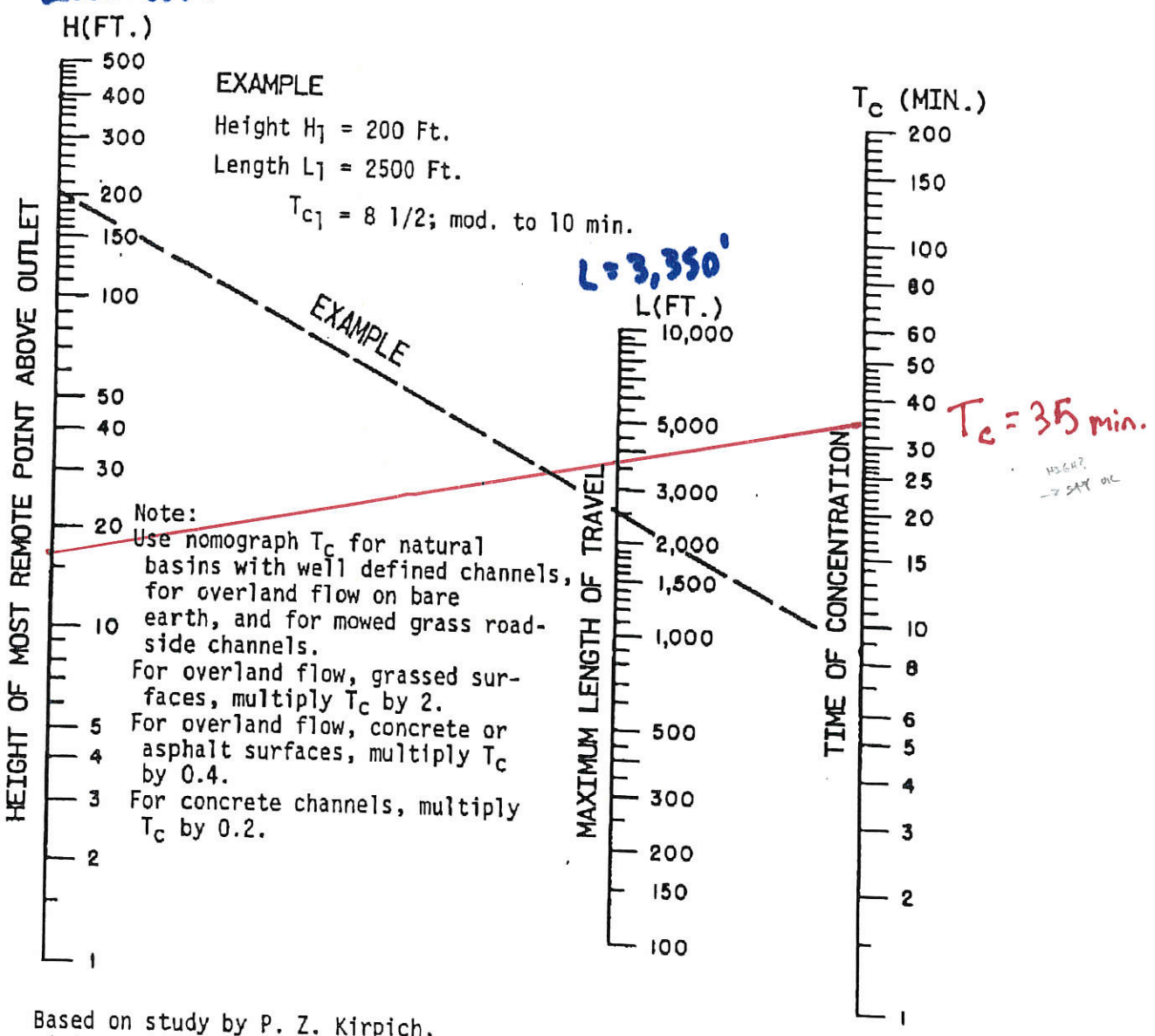
PROJECT NO: 1670-02-77	HWY: USH 12	COUNTY: SAUK	CULVERT SIZING	SHEET _____	E

FILE NAME : S:\Projects\W11531 USH 12 Sauk County\Design\Culvert Sizing\Drainage Areas.dwg PLOT DATE : 10/18/2017 2:17 PM PLOT BY : STEPHANIE POTTER PLOT SCALE : 1" = 1'

JRB 2-20-17

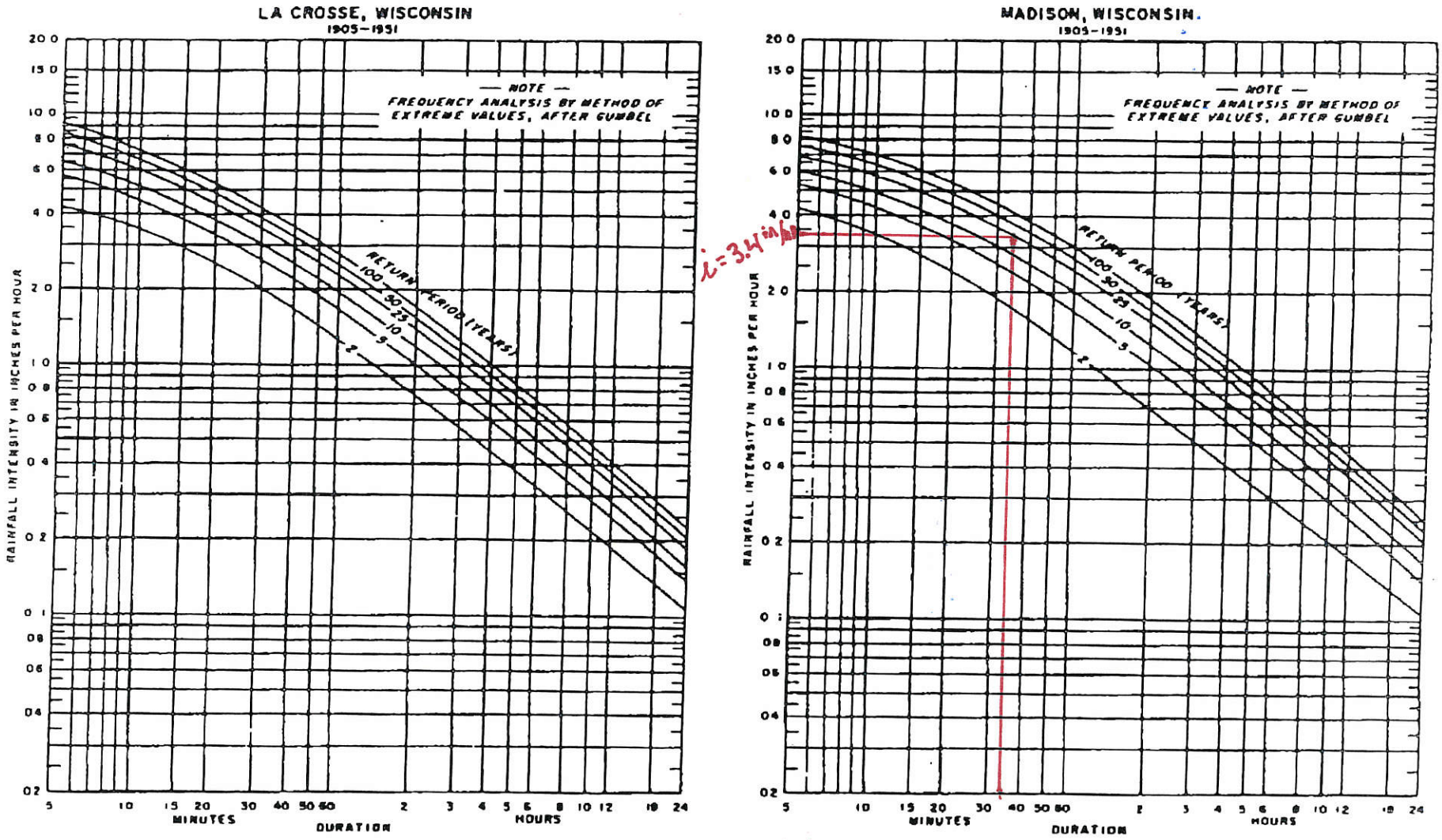
TIME OF CONCENTRATION OF SMALL T_c DRAINAGE BASINS.

ΔH = 16.34'



Based on study by P. Z. Kirpich,
Civil Engineering, Vol. 10, No. 6, June 1940, p.362

Need: Height of furthest point, length of path from top of water
(use Terrain Program)



$i = 3.4$ in/hr

$T_c = 35$ min.

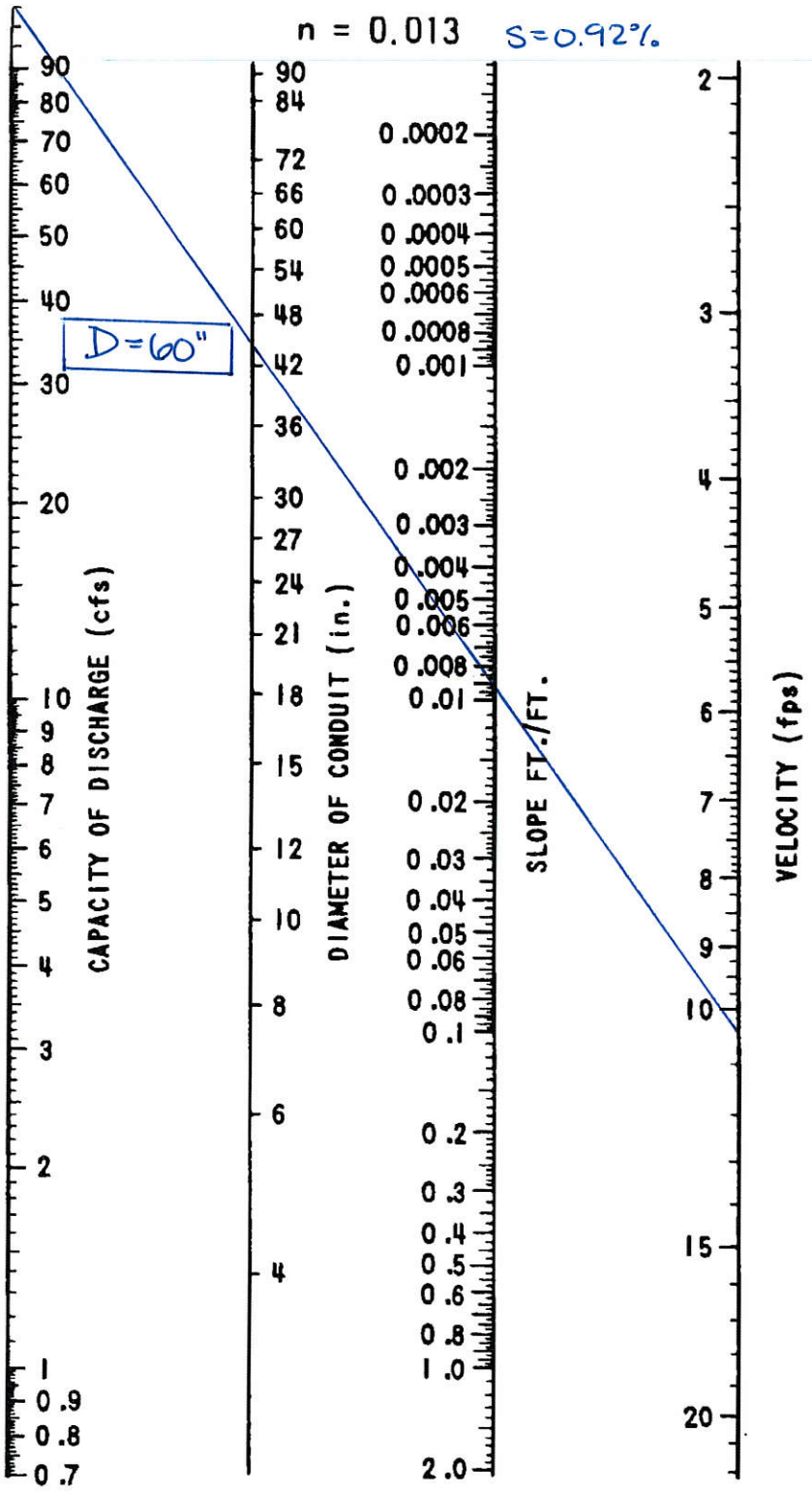
RAINFALL INTENSITY – DURATION – FREQUENCY CURVES

Need: Design Frequency, Time of Conc. (T_c), Location (Map, Have Diff Maps in FDM)

Capacity and Velocity Diagram

For Circular Concrete Pipe Flowing Full

Q = 105 cfs

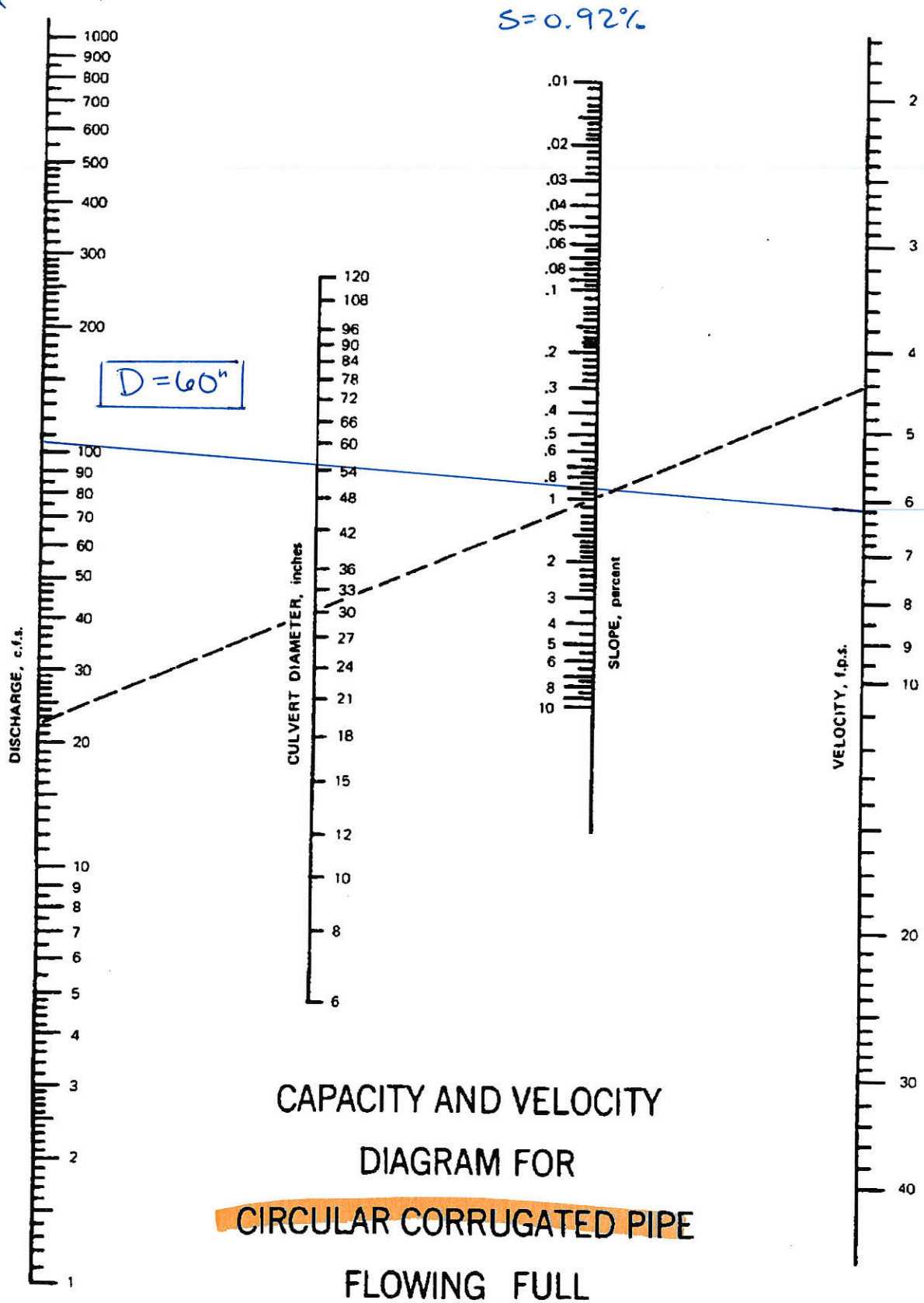


48" RCCP IS ACCEPTABLE. HOWEVER, 60" RCCP IS PRESENT TODAY. MATCH EXISTING.

Nomograph based on Manning's formula for circular pipes flowing full in which n=0.013

Q = 105 cfs

S = 0.92%



CAPACITY AND VELOCITY DIAGRAM FOR CIRCULAR CORRUGATED PIPE FLOWING FULL

n = 0.024