NOTE:

THE RAINFALL INTENSITIES FOR THE ONE YEAR STORM WERE COMPILED USING THE RAINFALL FREQUENCY ATLAS OF THE MIDWEST (HUFF AND ANGEL, 1992). THE INTENSITIES SHOWN ARE FOR ZONE 9, SOUTHEAST MINNESOTA. THIS ZONE IS THE MOST CONSERVATIVE OF THE FOUR ZONES WHICH REPRESENT THE METRO AREA.

THE RAINFALL INTENSITIES FOR ALL OTHER STORM FREQUENCIES WERE COMPILED USING THE NWS TECHNICAL MEMORANDUM HYDRO-35 (FREDERICK, ET AL. 1977) FOR ZONE 1, SOUTHERN MINNESOTA. THIS WAS DONE BY LISA SAYLER OF THE MNDOT CENTRAL OFFICE HYDRAULIC SECTION.

TOTAL TIME OF CONCENTRATION

$t_c = t_o + t_t$

t_c = TOTAL TIME OF CONCENTRATION

t_o = OVERLAND FLOW TIME

$$t_t = \frac{L}{3600 \times \frac{1.49}{n} \times Rh^{2/3} \times S^{1/2}}$$

t_t = TRAVEL TIME (MIN.)

SHALLOW CONCENTRATED FLOW
OR GUTTER FLOW

Rh = AREA / PERIMETER (HYDRAULIC RADIUS)
S = SLOPE FT./FT.
L = LENGTH WHICH RUNOFF MUST TRAVEL (FT.)
V = ESTIMATED OR CALCULATED VELOCITY (FT./S)

RATIONAL METHOD

$Q = CIA = (\Sigma CA)I$

Q = DISCHARGE (CFS)
C = RUNOFF COEFFICIENT REPRESENTING A RATIO OF RUNOFF TO RAINFALL
I = RAINFALL INTENSITY (IN/HR)
A = DRAINAGE AREA (ACRES)

USE A 10 YEAR RAIN EVENT FOR ALL PIPE DESIGN

SHEET FLOW OR OVERLAND FLOW

$t_t = .007 \times (nxL)^{0.8} / (P2^{0.5}(S^{0.4}))$

n = MANNING'S ROUGHNESS COEFFICIENT

P2 = (INCHES) TWO-YEAR FREQUENCY, 24 HOUR RAINFALL

P2 = 2.75"

S = SLOPE FT./FT.

L = LENGTH WHICH RUNOFF MUST TRAVEL (FT.)

MINNEAPOLIS STORM DRAIN DESIGN STANDARDS
S.C.S. TR-55, REVISED 1986

2 YEAR,	24 HOUR RAINFALL (INCHES)	2.75
5 YEAR,	24 HOUR RAINFALL (INCHES)	3.50
10 YEAR,	24 HOUR RAINFALL (INCHES)	4.20
10 YEAR,	1 HOUR RAINFALL (INCHES)*	2.30
25 YEAR,	24 HOUR RAINFALL (INCHES)	4.80
50 YEAR,	24 HOUR RAINFALL (INCHES)	5.30
100 YEAR,	24 HOUR RAINFALL (INCHES)	5.90

* 10 YEAR, 1 HOUR RAINFALL (INCHES), USED IN 1997 FLOOD REPORT

MINNESOTA RAINFALL DATUM
MINNEAPOLIS DESIGN REFERENCE

Minneapolis Public Works

DRW: DCD	DATE: 5/03	RAINFALL DATA	STANDARD PLATE NO. SEWR-6012
APP: HRS	DATE: 2/09		