DRAINAGE CALCULATIONS

SYCAMORE HILLS IV

DEVELOPER : GARY WILLIAMS

SUBMITTED BY : BILLY T. NICHOLSON, P.E.

BILLY T. NICHOLSON, P.E.

DATE 10/20/95

VEACH NICHOLSON ASSOC.

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INTRODUCTION

SYCAMORE HILLS IV IS AN 8 LOT SUBDIVISION WHICH INCLUDES THREE UNRECORDED LOTS IN THE SYCAMORE HILLS PRIMARY PLAT. THE PROJECT IS LOCATED SOUTH OF SCHLENSKER ROAD AND WEST OF CASTLE BROOK ROAD. LOTS RANGE IN SIZE FROM 3.28 ACRES TO 8.0 ACRES WITH THE TOTAL SUBDIVISION BEING 43.194 ACRES. THERE WILL BE APPROXIMATELY 1200 LINEAR FEET OF PRIVATELY MAINTAINED ROCK ROAD WITH A PRIVATE BRIDGE OVER SCHLENSKER DITCH.

EXISTING CONDITIONS

THE SITE IS HILLY, WITH THE NORTHERN PART OF THE SUB. HAVING SLOPES AROUND 10% WHICH GRADUALLY FLATTEN TO SLOPES OF 2 TO 5% NEAR THE SOUTHERN PART. GROUND COVER HAD BEEN CROPS AND IS NOW ROUGH GRASS PASTURE. THERE IS A 4.0 ACRE LAKE (INDIAN LAKE) JUST EAST OF THE SUB. THAT IS NOT PART OF THE PLAT BUT WAS BUILT BY THE DEVELOPER. A PORTION OF INDIAN LAKE DRIVE ALONG LOTS 20 & 21 HAS BEEN BUILT. SCHLENSKER DITCH CROSSES THE PROPOSED SUB. BETWEEN LOTS 26 AND 27.

RUNOFF FROM ABOUT 24 ACRES OF THE SITE FLOWS DIRECTLY TO SCHLENSKER DITCH. MOST OF THE REMAINING AREA (LOTS 20 & 21) FLOWS INTO INDIAN LAKE, THEN TO SCHLENSKER DITCH. INDIAN LAKE IS ABOUT 4.0 ACRES IN SURFACE AREA AND CAN HOLD ABOUT 4.3 ACRE-FEET IN STORAGE VOLUME.

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METHOD OF CALCULATION

THE RATIONAL METHOD, HERPIC MANUAL, AND THE VANDERBURGH COUNTY DRAINAGE ORDINANCE WERE USED FOR THESE CALCULATIONS. CULVERT, DITCHES, AND BASIN INFLOW ARE SIZED BASED ON A 25 YEAR RETURN PERIOD; BASIN RELEASE IS A 10 YEAR RETURN PERIOD. RUNOFF COEFFICIENTS, AND RAINFALL INTENSITIES WERE FROM THE VAND. CO. DRAINAGE ORDINANCE. TIME OF CONCENTRATION IS BASED ON KERBY'S EQUATION AND ESTIMATED VELOCITY FOR SWALE FLOW

CONCLUSIONS

THE BASIN WAS SIZED TO ACCOMADATE RUNOFF FROM JUST THE PORTION OF THE SITE TO BE DEVELOPED AREAS A1 AND A2 ON THE DRAINAGE PLAN OR 7.0 ACRES. BECAUSE OF THE LARGE LOT SIZE, LITTLE CHANGE IN RUNOFF VOLUME AND TIME TO PEAK COULD BE EXPECTED IN AREAS NOT DEVELOPED - THE BACK OR WEST SIDE OF THE LOTS. RUNOFF FROM THE HOUSES, DRIVES, FRONT LAWNS, AND STREET WILL GO INTO SIDE DITCHES OF THE ROAD, THEN SOUTH TO THE DETENTION BASIN.

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EXISTING FLOW

EXISTING FLOW FROM AREA THAT WILL BE DEVELOPED - HOUSES, DRIVEWAYS, AND STREET - AREA A1, A2 ON PLAN

A = 7.0 AC

C: 0.24 ROUGH PASTURE 2 TO 5%

t_c:

OVERLAND FLOW:

$$0.827\left[\frac{0.2(1000)}{\sqrt{0.05}}\right]^{0.467} \approx 20 \text{ MIN}$$

10 YEAR INTENSITY

$I_{15} = 4.515$
$I_{20} = 4.085$
$I_{30} = 3.226$

$Q_{10} = 0.24(4.085)\,7.0 = 6.9$ cfs

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DEVELOPED FLOW

FLOW TO SIDE DITCH OF ROAD - WEST SIDE
AREA A1
A = 5.2 AC.

C:

5 LOTS 6000 ft²/EA. @ C=0.94 = 0.69 AC.
900 LINEAR FEET STREET @ C=0.94 = 0.25 AC.
LAWN 2 TO 5% @ C=0.25 = 4.26 AC.

$$C = \frac{0.69(0.94) + 0.25(0.94) + 4.26(0.25)}{5.2} = 0.37$$

t_c: OVERLAND FLOW:

$$0.827\left[\frac{0.4\,(350)}{\sqrt{0.02}}\right]^{0.467} \approx 21 \text{ MIN.}$$

DITCH FLOW:
L = 700 ft V = 3.0 ft/s

$$t = \frac{700}{3.0} \times \frac{1 \text{ MIN}}{60 \text{ s}} \approx 4 \text{ MIN.}$$

t_c = 21 + 4 = 25 MIN.

25 YR. INTENSITY

I_{15} = 5.033
I_{25} = 4.108 IN/HR.
I_{30} = 3.646

Q_{25} = 0.37 (4.108) 5.2 = 7.9 CFS

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FLOW TO SIDE DITCH OF ROAD - EAST SIDE
& FLOW TO CULVERT AREA A2
A = 1.8 AC.

C:

900 LFT STREET @ c = 0.94 = 0.25 AC.
LAWN 2 TO 5% @ C = 0.25 = 1.55 AC

$$C = \frac{0.25(0.94) + 1.55(0.25)}{1.8} = 0.35$$

t_c

OVERLAND FLOW

$$0.827 \left[\frac{0.4\ 150}{\sqrt{0.02}}\right]^{0.467} \approx 14 \text{ MIN.}$$

DITCH FLOW
L = 700 ft V = 3.0 ft/s

$$t = \frac{700}{3.0} \times \frac{1 \text{ MIN}}{60 \text{ S.}} \approx 4 \text{ MIN.}$$

t_c = 14 + 4 = 18 MIN.

25 YR. INTENSITY
I_{15} = 5.033
I_{18} = 4.756
I_{30} = 3.646

$Q_{25} = 0.35\ (4.756)\ 1.8 = 3.0$ CFS

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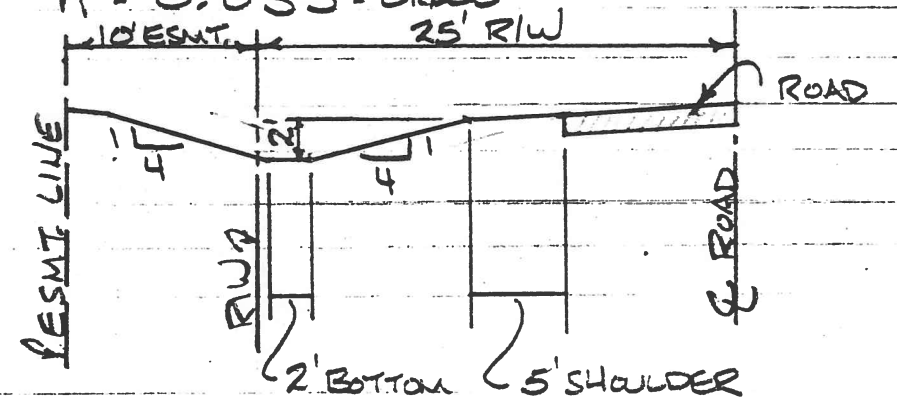
SIDE DITCH DESIGN

WEST SIDE OF ROAD

REQUIRED 25 YR. FLOW Q = 7.9 CFS
SLOPE (FROM ROAD PROFILE) S = 4.25%
n = 0.035 - GRASS



$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

ASSUME DEPTH = 1.0' FLOW W/ 1.0' OF FREEBOARD/HEAD FOR DRIVEWAY CULVERTS

$$A = 2(1) + 1^2(4) = 6\ ft^2$$

$$P_W = 2 + 2\left(\sqrt{1^2+4^2}\right) = 10.2\ ft$$

$$R = \frac{6\ ft^2}{10.2\ ft} = 0.588$$

$$Q = \frac{1.49}{0.035}(6)(0.588)^{2/3}(0.0425)^{1/2} = 37.0\ CFS$$

37.0 CFS > 7.9 CFS
PROVIDED REQUIRED

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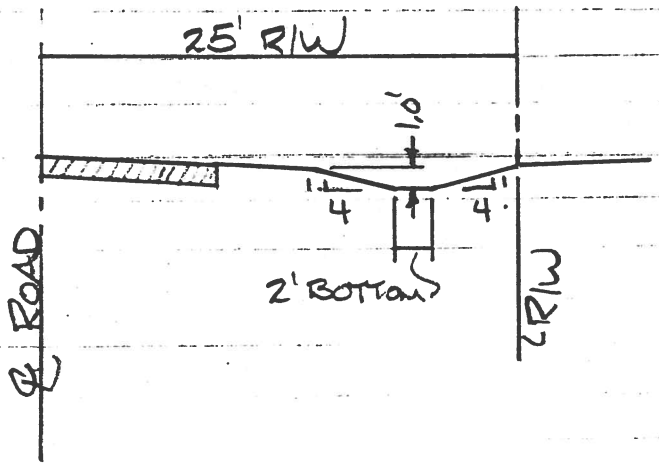
EAST SIDE OF DITCH

REQUIRED 25 YR. FLOW Q = 3.0 CFS
SLOPE (FROM ROAD PROFILE) S = 4.25%
n = 0.035 - GRASS



ASSUME DEPTH OF FLOW = 1.0 FT., FLOW CAPACITY = 37.0 CFS (FROM PRECEEDING PAGE) NO FREEBOARD IS REQUIRED BECAUSE OF THE MUCH HIGHER CAPACITY OF DITCH (37.0 CFS) OVER REQUIRED FLOW (3.0 CFS) AND NO DRIVEWAYS & CULVERTS WILL BE REQUIRED EAST OF ROAD

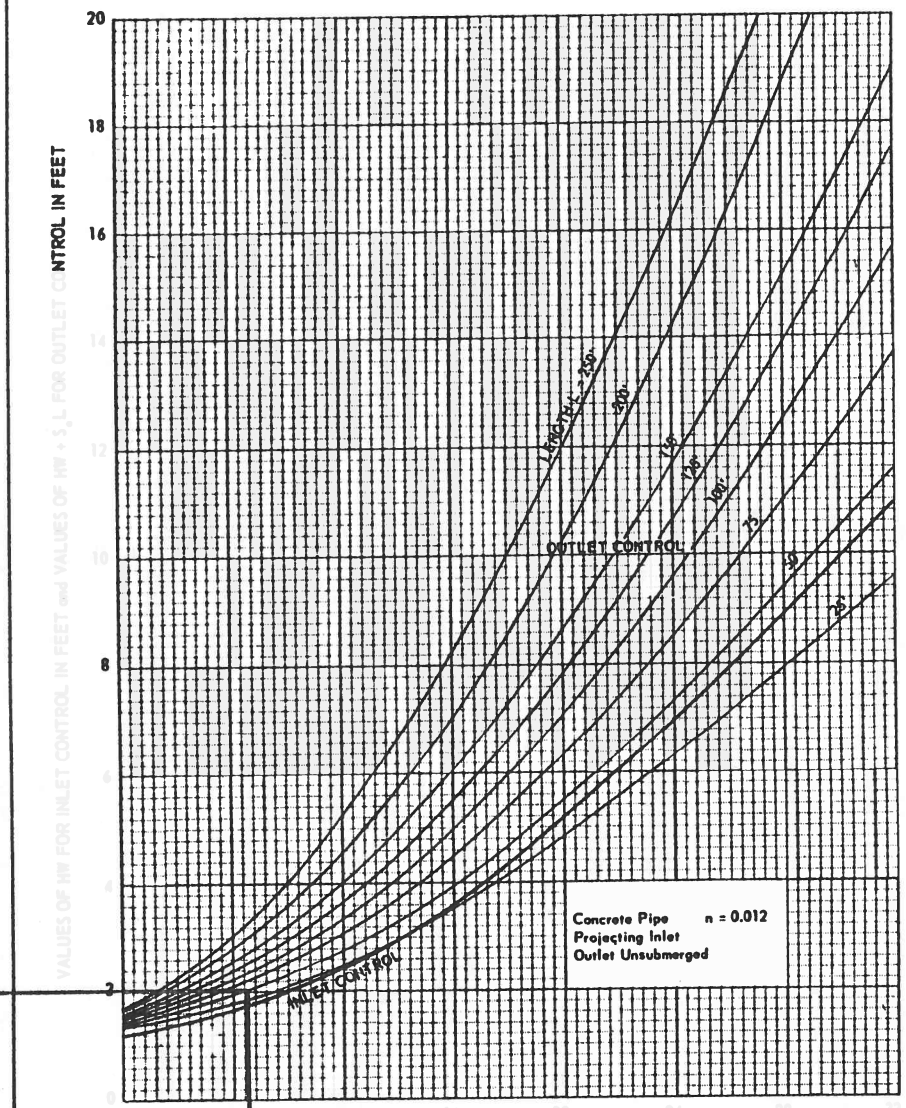
CULVERT SIZING

CULVERT UNDER ROAD AT STA.

FLOW = 7.9 CFS

USE 18" R.C.P. WITH 2.0 FOOT HEAD @ 1.0%
SEE NEXT PAGE

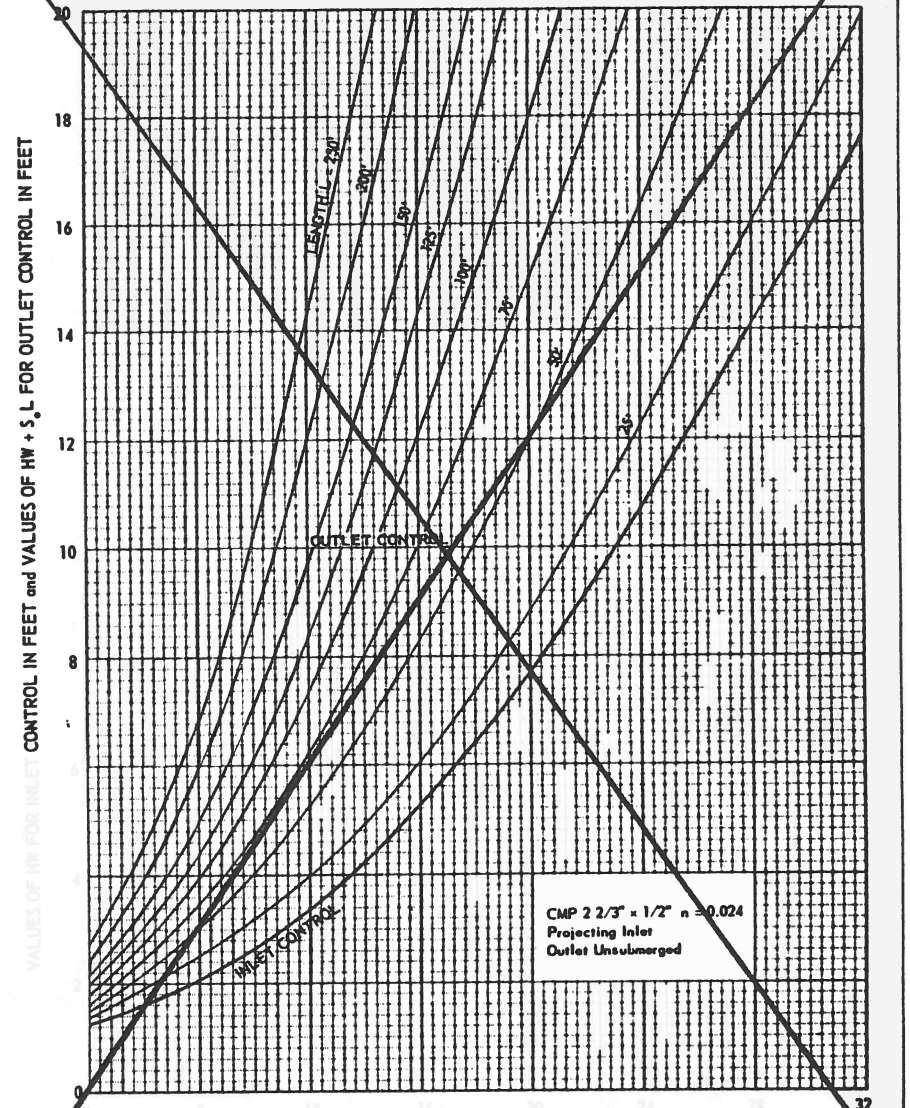
FIGURE 8: 18-Inch Diameter Concrete Pipe



HEAD = 20 FT.

Q = 8.4 cfs

FIGURE 9: 18-Inch Diameter Corrugated Metal Pipe



Interpolate for intermediate culvert lengths

design data 8

FORM 800

This form must be completed and submitted with all drainage plans

Project SYCAMORE HILLS Detention Facility Design Return Period 25 yrs.

Designer _____ Release Rate Return Period 10 yrs.

Watershed Area 7.0 acres

Time of Concentration (undeveloped watershed) 20 minutes

Rainfall Intensity (i_U) 4.085 inches/hr

Undeveloped Runoff Coefficient (C_U) _____

Undeveloped Runoff Coefficient ($O = C_U i_U A_U$) 6.9 cfs

Developed Runoff Coefficient (C_D) 0.37

Storm Duration t_d (hrs.)	Rainfall Intensity i_d (inches/hr)	Inflow Rate $I(t_d)$ $(C_D i_d A_D)$ (cfs)	Outflow Rate O $(C_U i_U A_U)$ (cfs)	Storage Rate $I(t_d)-O$ (cfs)	Required Storage $I(t_d)-O \frac{t_d}{12}$ (acre-ft)
0.17	5.925	15.3	6.9	8.4	0.119
0.33	4.571	11.8	6.9	4.9	0.135 ←
0.50	3.646	9.4	6.9	2.5	0.104
0.67	3.123	8.1	6.9	1.2	0.067
0.83	2.601	6.7	6.9	–	–
1.00	2.078				
1.50	1.739				
2.00	1.400				

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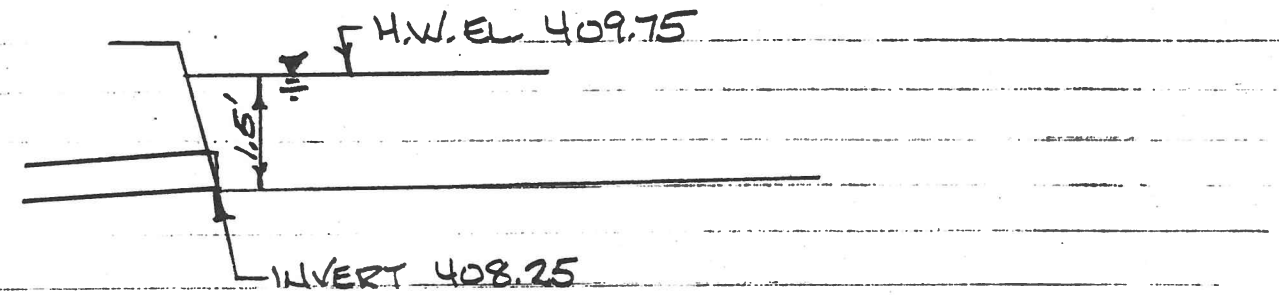
BASIN OUTLET



REQUIRED BASIN OUTFLOW Q = 6.9 cfs

TRY 15" R.C.P.

USE HEAD AT TOP OF PIPE AND MANNINGS EQUATION TO SOLVE FOR SLOPE

$$6.9 = \frac{1.49}{0.013}(1.23)(0.307)^{2/3} S^{1/2}$$

$$S = 1.16\%$$

USE 30 L.F. 15" R.C.P. @ 1.16%