

**PRELIMINARY
STORMWATER MANAGEMENT
CALCULATIONS**

FOR

**NEW POLICE STATION
ARLINGTON HEIGHTS, ILLINOIS**

Prepared By:



Mackie Consultants, LLC
9575 W. Higgins Road, Suite 500
Rosemont, IL 60018
(847)696-1400
www.mackieconsult.com



Dated: December 29, 2016
Revised: January 27, 2017

Runoff Curve Number

Project: Arlington Heights Police Station By: SMM Date: 1/27/2017
 Location: Arlington Heights Checked: _____ Date: _____
 File: _____

Circle One: Present Developed Description: _____

Soil Name and Hydrologic Group (Appendix A)	Cover Description (cover type, treatment, and hydrologic condition; percent impervious; unconnected/connected impervious area ratio)	Curve Number	Area <input checked="" type="checkbox"/> acres <input type="checkbox"/> sq. mi. <input type="checkbox"/> %	Product of Curve Number and Area
D	Impervious Area - Building and Asphalt Pave	98	1.90	186.2
D	Landscaping and Green Space	77	0.10	7.7
Totals =			2.00	193.9

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{193.9}{2} = \underline{96.95}$$

Use CN = 97

Time of Concentration (T_c) or Travel Time (T_t)

Project: Arlington Heights Police Station
 Location: Arlington Heights
 File: _____

By: SMM Date: 1/27/2017
 Checked: _____ Date: _____

Present / Developed
 Tc through subarea _____

SHEET FLOW

Segment ID	AB				
Surface Description (table 3-1)	Smooth Surface (Paved)				
Manning's roughness coeff., n	0.011				
Flow Length, L (total L ≤ 100') (ft)	100				
Two-yr 24-hr rainfall, P ₂ (in)	3.04				
Land slope, s (ft/ft)	0.005				
$T_t = (0.007(nL)^{0.8}) / (P_2^{0.5} s^{0.4})$ (hr)	0.04	+			= 0.04 hr

SHALLOW CONCENTRATED FLOW

Segment ID	BC				
Surface Description (paved or unpaved)	Paved				
Flow Length, L (ft)	150				
Watercourse slope, s (ft/ft)	0.005				
Average velocity, V (ft/s)	1.44				
$T_t = L / 3600 V$ (hr)	0.03	+			= 0.03 hr

CHANNEL FLOW

Segment ID	CD		
Cross-sectional flow area, a (ft ²)	0.785		
Wetted perimeter, Pw (ft)	3.14		
Hydraulic radius, r = a/Pw (ft)	0.25		
Channel slope, s (ft/ft)	0.005		
Manning's roughness coeff., n	0.012		
$V = (1.49 r^{0.667} s^{0.5}) / n$ (ft/s)	3.48		
Flow length, L (ft)	1000		
$T_t = L / 3600 V$ (hr)	0.08	+	

Watershed or subarea T_c or T_t = 0.15 hr

PROPOSED CONDITIONS

ORIFICE/WEIR STRUCTURE RATING ANALYSIS

PROJECT NAME: Arlington Heights Police Station
PROJ. NO.: 2930
DESCRIPTION: Detention Vault
FILENAME: Orifice.xlsx
DATE: 27-Jan-17

OUTLET: ORIFICE: 2.25 IN. DIA. @ ELEV 671.3
 WEIR: 6 FEET WIDE @ ELEV 681

ORIFICE FLOW EQUATION: $Q = C_d A (2gH)^{0.5}$

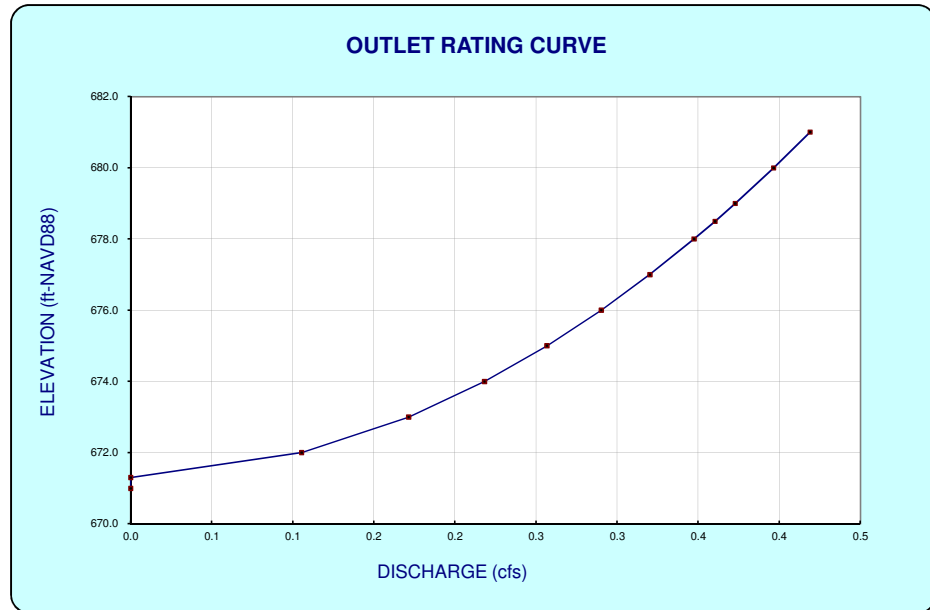
WEIR FLOW EQUATION: $Q = 3.0L(H)^{1.5}$

HYDRAULIC DIMENSIONS

	# 1
ORIFICE AREA (ft ²)	0.0276
ORIFICE DIAMETER (in)	2.25
ORIFICE DISCHARGE COEFFICIENT	0.61
ORIFICE ELEV. (ft-NAVD88)	671.30
TAILWATER OR CENTROID (ft-NAVD88)	671.394
WEIR LENGTH (ft)	6.00
WEIR COEFFICIENT	3.0
WEIR ELEV. (ft-NAVD88)	681.0

ELEVATION-DISCHARGE RELATIONSHIP

Elevation (feet)	Q-Orifice (cfs)	Q-Weir (cfs)	Q-Total (cfs)
671.0	0.00	0.00	0.00
671.3	0.00	0.00	0.00
672.0	0.11	0.00	0.11
673.0	0.17	0.00	0.17
674.0	0.22	0.00	0.22
675.0	0.26	0.00	0.26
676.0	0.29	0.00	0.29
677.0	0.32	0.00	0.32
678.0	0.35	0.00	0.35
678.5	0.36	0.00	0.36
679.0	0.37	0.00	0.37
680.0	0.40	0.00	0.40
681.0	0.42	0.00	0.42
682.0	0.44	18.00	18.44
683.0	0.46	50.91	51.37
684.0	0.48	93.53	94.01
685.0	0.50	144.00	144.50



*****80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY*****

JOB TR-20	SUMMARY NOPLOTS				
TITLE	MCI#2820	ARLINGTON HEIGHTS POLICE STATION	THEORET.DAT		
5 RAINFL 6		0.05			
8	0.00	0.16	0.33	0.43	0.52
8	0.60	0.66	0.71	0.75	0.79
8	0.82	0.84	0.86	0.88	0.90
8	0.92	0.94	0.96	0.97	0.98
8	1.00	1.00	1.00	1.00	1.00
9 ENDTBL					
5 RAINFL 7		0.05			
8	0.00	0.03	0.08	0.12	0.16
8	0.22	0.29	0.39	0.51	0.62
8	0.70	0.76	0.81	0.85	0.88
8	0.91	0.93	0.95	0.97	0.98
8	1.00	1.00	1.00	1.00	1.00
9 ENDTBL					
5 RAINFL 8		0.05			
8	0.00	0.03	0.06	0.09	0.12
8	0.15	0.19	0.23	0.27	0.32
8	0.38	0.45	0.57	0.70	0.79
8	0.85	0.89	0.92	0.95	0.97
8	1.00	1.00	1.00	1.00	1.00
9 ENDTBL					
5 RAINFL 9		0.05			
8	0.00	0.02	0.05	0.08	0.10
8	0.13	0.16	0.19	0.22	0.25
8	0.28	0.32	0.35	0.39	0.45
8	0.51	0.59	0.72	0.84	0.92
8	1.00	1.00	1.00	1.00	1.00
9 ENDTBL					
3 STRUCT 01					
8		671.3	0.01	0.000	
8		672.0	0.11	0.000	
8		673.0	0.17	0.000	
8		674.0	0.22	0.000	
8		675.0	0.26	0.170	
8		676.0	0.29	0.340	
8		677.0	0.32	0.520	
8		678.0	0.35	0.690	

PRELIMINARY STORMWATER MANAGEMENT CALCULATIONS

OUTLET CONTROL STRUCTURE INVERT
=671.30

DETENTION VAULT OUTLET PIPE
= 674.00

DETENTION VOLUME REQUIRED
= 0.69

DETENTION VOLUME PROVIDED
= 0.77

HIGH WATER ELEVATION
= 677.86

TOP OF DETENTION VAULT
= 678.46

8		678.5	0.36	0.770					
8		679.0	0.37	0.770					
8		680.0	0.40	0.770					
8		681.0	0.42	0.770					
8		682.0	0.42	18.44					

9 ENDTBL
6 RUNOFF 1 001 1 0.00313 97.0 0.17 0 0 0 0 0 0

*****80-80 LIST OF INPUT DATA (CONTINUED)*****

6 RESVOR 2 01 1 2 0.00 0 0 0 0 0 0
ENDATA
7 INCREM 6 0.10
7 COMPUT 7 001 01 0.0 3.04 24.0 8 2 02 24
ENDCMP 1
7 COMPUT 7 001 01 0.0 7.58 24.0 8 2 99 24
ENDCMP 1
ENDJOB 2

0*****END OF 80-80 LIST*****

EXECUTIVE CONTROL OPERATION INCREM RECORD ID
+ MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID
+ FROM XSECTION 1
+ TO STRUCTURE 1
STARTING TIME = .00 RAIN DEPTH = 3.04 RAIN DURATION= 24.00 RAIN TABLE NO.= 8 ANT. MOIST. COND= 2
ALTERNATE NO.= 2 STORM NO.=24 MAIN TIME INCREMENT = .10 HOURS

*** WARNING-NO PEAK FOUND, MAXIMUM DISCHARGE = .15 CFS.
*** WARNING - STRUCTURE 1 DELTA T IS TOO LARGE. 0 /2 > S /DELTA T OCCURED 9 TIMES STARTING WITH POINT284

*** WARNING-NO PEAK FOUND, MAXIMUM DISCHARGE = .06 CFS.

EXECUTIVE CONTROL OPERATION ENDCMP RECORD ID
+ COMPUTATIONS COMPLETED FOR PASS 1

+														
XSECTION	1	RUNOFF	.00	8	2	.10	.0	7.58	24.00	7.21	---	15.50	1.65	527.7
STRUCTURE	1	RESVOR	.00	8	2	.10	.0	7.58	24.00	4.20	677.86	21.70	.35	110.5

TR20 XEQ 01-27-17 12:06
REV PC 09/83(.2)

MCI#2820 ARLINGTON HEIGHTS POLICE STATION THEORET.DAT

JOB 1 SUMMARY
PAGE 2

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS..... 24
0 STRUCTURE 1	.00	
+		
ALTERNATE 2		.25
ALTERNATE 99		.35
0 XSECTION 1	.00	
+		
ALTERNATE 2		.65
ALTERNATE 99		1.65

1END OF 1 JOBS IN THIS RUN

STORMWATER DETENTION VOLUMES
UNDERGROUND VAULT

ARLINGTON HEIGHTS POLICE DEPARTMENT
JANUARY 27, 2017

VOLUME CONTROL (AGGREGATE VOIDS) (33%)

Elevation (FT)	Area (SF)	Depth (FT)	Volume (CF)	Volume (CF)	Volume (AC-FT)
672.80	7480				
		1.00	2468.40	2468.40	0.06
671.80	7480				

VOLUME CONTROL (VAULT) (50%)

Elevation (FT)	Area (SF)	Depth (FT)	Volume (CF)	Volume (CF)	Volume (AC-FT)
674.00	7480				
		1.20	4488.00	4488.00	0.10
672.80	7480				

TOTAL PROVIDED 0.16 AC-FT
TOTAL REQUIRED 0.16 AC-FT

STORMWATER DETENTION (VAULT)

Elevation (FT)	Area (SF)	Depth (FT)	Volume (CF)	Volume (CF)	Volume (AC-FT)
678.46	7480				
		0.46	3440.80	33360.80	0.77
678.00	7480				
		0.14	1047.20	29920.00	0.69
677.86	7480				
		0.86	6432.80	28872.80	0.66
677.00	7480				
		1.00	7480.00	22440.00	0.52
676.00	7480				
		1.00	7480.00	14960.00	0.34
675.00	7480				
		1.00	7480.00	7480.00	0.17
674.00	7480				

HWL

TOTAL PROVIDED 0.77 AC-FT
TOTAL REQUIRED 0.69 AC-FT