APPENDIX H

STORMWATER MANAGEMENT SOFTWARE

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SECTION 1: INTRODUCTION

Disclaimer*: The mention of software herein does not constitute endorsement, nor does it excuse the licensed professional from the exercise of appropriate judgment. The list of approved software may be modified by the City Engineer at his or her discretion.*

For the purposes of this manual, the approved list of software includes hydrologic and hydraulic software for modeling of major and minor systems.

Table 2.1 lists several widely used computer programs and modeling packages. Software use for stormwater management calculations is not limited to this list. However, if a different proprietary software program is to be used, it must be approved by the City Engineer during the technical plat review process. The design engineer shall include a description of the software used for analysis and design along with the formulas and methods that the software uses in its calculations for it to be considered for approval. The software must also be capable of producing an output report that provides information consistent with the requirements as listed in Chapter 6 of the Drainage Criteria Manual.

For the purposes of Table 2.1 below, major drainage systems are defined as those draining to FEMA-regulated streams, or lakes or reservoirs. Minor drainage systems are smaller natural and man-made systems that drain to the larger streams. Minor drainage systems can have both closed and open-channel components and can include, but are not limited to, neighborhood storm sewers, culverts, ditches, and tributaries.

SECTION 2: APPROVED SOFTWARE

Table 2.1. Stormwater Modeling Software Programs and Design Tools.				
Software	**Major System Modeling**	**Minor System Modeling**	**Hydrologic Features**	**Hydraulic Features**
HEC-HMS	X		X	
Hydraflow Hydrographs		X	X	
PondPack		X	X	X
Hydraflow Express		X	X	
HEC-RAS	X			X
CulvertMaster		X		X
FlowMaster		X		X
Hydraflow Storm Sewers		X	X	X
StormCad		X		

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	42.000	90.000	Curb	0.00	0.73	0.75	5.0	1283.00	1.57	1283.66	18	Cir	0.013	0.50	1290.02	
2	1	44.000	0.000	Curb	0.00	1.92	0.50	18.2	1283.72	1.00	1284.16	18	Cir	0.013	1.50	1290.02	
3	2	134.094	-90.359	Curb	0.00	0.70	0.50	17.5	1284.70	2.70	1288.32	18	Cir	0.013	1.00	1293.39	
4	2	68.000	90.000	Curb	0.00	0.48	0.50	16.2	1284.70	3.00	1286.74	18	Cir	0.013	1.00	1290.94	

Must match Drainage Area Inlet Map

Include Tc calculations when Min of 5 minutes is not used.

Provide Supporting Data for C calculations

All physical pipe and inlet data must match construction plans and details

Project File: Drainage Example.stm

Number of lines: 4

Date: 1/7/2013

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total	(C)	Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)				(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	42.000	0.73	3.83	0.75	0.55	2.10	5.0	18.7	4.9	11.79	13.16	4.21	18	1.57	1283.00	1283.66	1284.31	1284.77	1285.00	1290.02	
2	1	44.000	1.92	3.10	0.50	0.96	1.55	18.2	18.5	4.9	7.78	10.50	4.40	18	1.00	1283.72	1284.16	1286.09	1286.33	1290.02	1290.02	
3	2	134.094	0.70	0.70	0.50	0.35	0.35	17.5	17.5	5.0	1.75	17.25	2.17	18	2.70	1284.70	1288.32	1287.07	1288.83	1290.02	1293.39	
4	2	68.000	0.48	0.48	0.50	0.24	0.24	16.2	16.2	5.2	1.22	18.19	1.84	18	3.00	1284.70	1286.74	1287.08	1287.16	1290.02	1290.94	

Evaluate outlet velocity

Compare HGL and Rim Elevation - Minimum 6 inch clearance

Project File: Drainage Example.stm

Number of lines: 4

Run Date: 1/7/2013

NOTES: Intensity = 141.10 / (Inlet time + 19.90) ^ 0.92 ; Return period =Yrs. 10 ; Total flows limited to inlet captured flows. ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet Ht (in)	L (ft)	Grate Inlet Area (sqft)	L (ft)	W (ft)	Gutter So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Inlet Depth (ft)	Spread (ft)	Depr (in)	Byp Line No
1	Inlet A	4.02	0.00	4.02	0.00	Curb	2.0	6.00	0.00	0.00	0.00	Sag	1.00	0.020	0.020	0.000	0.37	1.76	0.70	1.76	4.0	Off
2	Inlet B	4.76	0.05	4.81	0.00	Curb	2.0	6.00	0.00	0.00	0.00	Sag	1.00	0.020	0.020	0.000	0.42	4.12	0.75	4.12	4.0	Off
3	Inlet C	1.77	0.00	1.75	0.01	Curb	2.0	11.00	0.00	0.00	0.00	0.052	1.00	0.020	0.020	0.013	0.12	6.11	0.36	1.19	4.0	2
4	Inlet D	1.25	0.00	1.22	0.04	Curb	2.0	7.50	0.00	0.00	0.00	0.032	1.00	0.020	0.020	0.013	0.12	5.86	0.34	0.97	4.0	2

Annotations:

- 20% Clogging Factor at Sag
- Max spread for pavement based on street classification
- Standard 4 inches
- Standard 6 inch curb with 4 inch depression
- Standard box with 1 extension
- Spread for Sag must be calculated separately based on drainage area and gutter slope on each side of inlet
- Max depth for parking lot is 6 inches
- If gutter spread is exceeded, add inlet upstream and recalculate drainage area
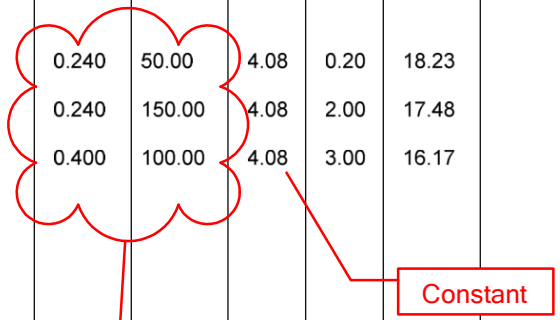
Project File: Drainage Example.stm

Number of lines: 4 Run Date: 1/7/2013

NOTES: Inlet N-Values = 0.016; Intensity = 141.10 / (Inlet time + 19.90) ^ 0.92; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc Method	Sheet Flow					Shallow Concentrated Flow					Channel Flow							Total
			n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	flow Length (ft)	Water Slope (%)	Surf Descr	Ave Vel (ft/s)	Travel Time (min)	X-sec Area (sqft)	Wetted Perim (ft)	Chan Slope (%)	n-Value	Vel	flow Length (ft)	Travel Time (min)	Travel Time (min)
1		User																		5.00
2		TR55	0.240	50.00	4.08	0.20	18.23													18.20
3		TR55	0.240	150.00	4.08	2.00	17.48													17.50
4		TR55	0.400	100.00	4.08	3.00	16.17													16.20

Constant

Show path and label on Drainage Area Inlet Map

Project File: Drainage Example.stm   Min. Tc used for intensity calculations = 5 min   Number of lines: 4   Date: 1/7/2013

Storm Sewers v10