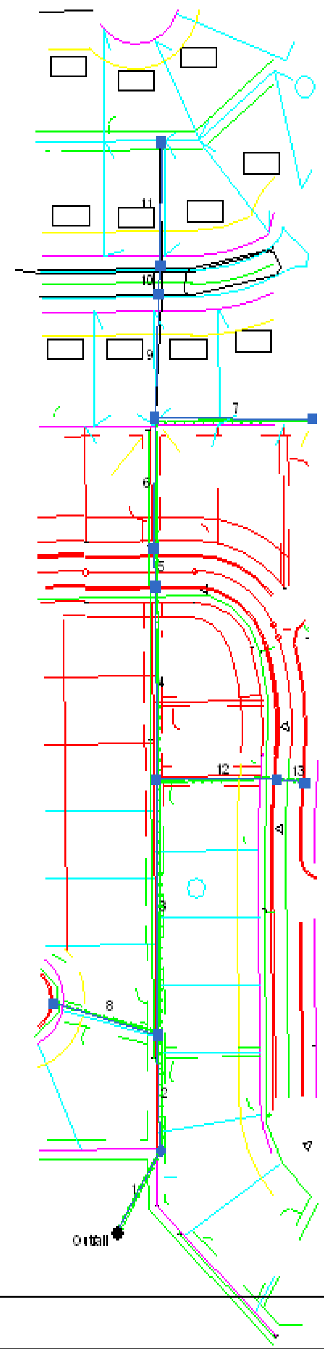
Hydraflow Plan View



Project File: sws_2.stm	No. Lines: 13	05-13-2008

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 type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
13	12	33.3	6.0	Curb	3.70	0.00	0.00	0.0	143.90	0.30	144.00	18	Cir	0.013	1.00	148.14	
12	3	138.5	90.5	Curb	3.70	0.00	0.00	0.0	141.00	2.02	143.80	24	Cir	0.013	0.50	148.14	
11	10	129.1	-2.6	DrGrt	0.00	0.70	0.65	15.0	143.28	0.44	143.85	18	Cir	0.013	1.00	147.30	
10	9	29.7	1.0	Curb	0.00	1.05	0.65	15.0	142.94	0.30	143.03	18	Cir	0.013	0.50	149.00	
9	6	129.2	1.6	Curb	0.00	1.05	0.65	15.0	142.30	0.30	142.69	18	Cir	0.013	0.50	147.00	
8	2	124.7	-72.9	Curb	2.80	0.00	0.00	0.0	141.25	3.41	145.50	15	Cir	0.013	1.00	148.55	
7	6	181.2	89.8	DrGrt	1.40	0.00	0.00	0.0	142.40	0.33	143.00	18	Cir	0.013	1.00	146.50	
6	5	136.1	3.2	DrGrt	1.30	0.00	0.00	0.0	141.80	0.37	142.30	18	Cir	0.013	1.50	147.00	
5	4	40.2	-2.5	Curb	1.60	0.00	0.00	0.0	141.50	0.50	141.70	18	Cir	0.013	0.50	149.50	
4	3	200.4	0.1	Curb	1.60	0.00	0.00	0.0	141.00	0.20	141.40	24	Cir	0.013	0.50	149.50	
3	2	267.0	1.3	DrGrt	2.20	0.00	0.00	0.0	139.60	0.15	140.00	36	Cir	0.013	1.50	145.60	
2	1	120.5	-32.2	DrGrt	4.80	0.00	0.00	0.0	139.30	0.17	139.50	36	Cir	0.013	1.45	145.90	
1	End	99.3	-59.4	MH	0.00	0.00	0.00	0.0	137.20	0.40	137.60	36	Cir	0.013	0.59	144.50	

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Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
13		3.70	18 c	33.3	143.90	144.00	0.300	145.27	145.30	0.08	145.38	12
12		7.40	24 c	138.5	141.00	143.80	2.022	143.87	144.76	n/a	145.27 i	3
11		2.38	18 c	129.1	143.28	143.85	0.441	150.74*	150.81*	0.03	150.84	10
10		5.69	18 c	29.7	142.94	143.03	0.303	150.44*	150.53*	0.08	150.61	9
9		9.07	18 c	129.2	142.30	142.69	0.302	149.02*	149.99*	0.20	150.19	6
8		2.80	15 c	124.7	141.25	145.50	3.408	143.25	146.17	n/a	146.54 i	2
7		1.40	18 c	181.2	142.40	143.00	0.331	149.42*	149.46*	0.01	149.47	6
6		11.67	18 c	136.1	141.80	142.30	0.367	146.06*	147.74*	1.02	148.75	5
5		13.19	18 c	40.2	141.50	141.70	0.498	144.80*	145.43*	0.43	145.87	4
4		14.77	24 c	200.4	141.00	141.40	0.200	143.77*	144.63*	0.17	144.80	3
3		24.22	36 c	267.0	139.60	140.00	0.150	143.15*	143.50*	0.27	143.77	2
2		31.55	36 c	120.5	139.30	139.50	0.166	142.30*	142.57*	0.45	143.02	1
1		31.46	36 c	99.3	137.20	137.60	0.403	139.13	139.53	n/a	140.30 i	End

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NOTES: c = cir; e = ellip; b = box; Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; i - Inlet control.

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q byp (cfs)	Junc type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp line No
							Ht (in)	L (ft)	area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
13		3.70*	0.00	3.70	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.36	6.04	0.47	6.04	2.00	12
12		3.70*	0.00	3.70	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.36	6.04	0.47	6.04	2.00	Off
11		2.38	0.00	2.38	0.00	DrGrt	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.16	8.53	0.16	8.53	0.00	10
10		3.56	0.00	3.56	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.35	5.89	0.46	5.89	2.00	9
9		3.56	0.00	3.56	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.35	5.89	0.46	5.89	2.00	6
8		2.80*	0.00	2.80	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.31	5.01	0.42	5.01	2.00	2
7		1.40*	0.00	1.40	0.00	DrGrt	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.11	6.59	0.11	6.59	0.00	6
6		1.30*	0.00	1.30	0.00	DrGrt	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.11	6.37	0.11	6.37	0.00	5
5		1.60*	0.00	1.60	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.23	3.45	0.34	3.45	2.00	4
4		1.60*	0.00	1.60	0.00	Curb	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.23	3.45	0.34	3.45	2.00	3
3		2.20*	0.00	2.20	0.00	DrGrt	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.16	8.20	0.16	8.20	0.00	2
2		4.80*	0.00	4.80	0.00	DrGrt	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.050	0.050	0.013	0.26	12.43	0.26	12.43	0.00	1
1		0.00	0.00	0.00	0.00	MH	6.0	6.00	2.50	4.00	2.00	Sag	2.00	0.080	0.050	0.013	0.00	0.00	0.00	0.00	0.00	Off

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NOTES: Inlet N-Values = 0.016 ; Intensity = 55.18 / (Inlet time + 11.10) ^ 0.72; Return period = 10 Yrs. ; * Indicates Known Q added

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
13	18	3.70	143.90	145.27	1.37	1.69	2.19	0.07	145.34	0.108	33.3	144.00	145.30	1.30	1.63	2.27	0.08	145.38	0.114	0.111	0.037	1.00	0.08
12	24	7.40	141.00	143.87	2.00	3.14	2.36	0.09	143.95	n/a	139	143.80	144.76 j	0.96**	1.50	4.94	0.38	145.14i	n/a	n/a	n/a	0.50	n/a
11	18	2.38	143.28	150.74	1.50	1.77	1.34	0.03	150.77	0.051	129	143.85	150.81	1.50	1.77	1.34	0.03	150.84	0.051	0.051	0.066	1.00	0.03
10	18	5.69	142.94	150.44	1.50	1.77	3.22	0.16	150.60	0.294	29.7	143.03	150.53	1.50	1.77	3.22	0.16	150.69	0.293	0.294	0.087	0.50	0.08
9	18	9.07	142.30	149.02	1.50	1.77	5.13	0.41	149.43	0.746	129	142.69	149.99	1.50	1.77	5.13	0.41	150.40	0.745	0.746	0.964	0.50	0.20
8	15	2.80	141.25	143.25	1.25	1.23	2.28	0.08	143.33	n/a	125	145.50	146.17 j	0.67**	0.67	4.18	0.27	146.44i	n/a	n/a	n/a	1.00	n/a
7	18	1.40	142.40	149.42	1.50	1.77	0.79	0.01	149.43	0.018	181	143.00	149.46	1.50	1.77	0.79	0.01	149.47	0.018	0.018	0.032	1.00	0.01
6	18	11.67	141.80	146.06	1.50	1.77	6.61	0.68	146.73	1.236	136	142.30	147.74	1.50	1.77	6.60	0.68	148.42	1.235	1.235	1.682	1.50	1.02
5	18	13.19	141.50	144.80	1.50	1.77	7.47	0.87	145.67	1.579	40.2	141.70	145.43	1.50	1.77	7.47	0.87	146.30	1.579	1.579	0.634	0.50	0.43
4	24	14.77	141.00	143.77	2.00	3.14	4.70	0.34	144.12	0.427	200	141.40	144.63	2.00	3.14	4.70	0.34	144.97	0.427	0.427	0.855	0.50	0.17
3	36	24.22	139.60	143.15	3.00	7.07	3.43	0.18	143.33	0.132	267	140.00	143.50	3.00	7.07	3.43	0.18	143.68	0.132	0.132	0.352	1.50	0.27
2	36	31.55	139.30	142.30	3.00*	7.07	4.46	0.31	142.61	0.224	120	139.50	142.57	3.00	7.07	4.46	0.31	142.88	0.224	0.224	0.270	1.45	0.45
1	36	31.46	137.20	139.13	1.93	4.80	6.56	0.67	139.80	n/a	99.3	137.60	139.53	1.93	4.80	6.56	0.67	140.20i	n/a	n/a	-0.269	0.59	n/a

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Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump.

Hydraflow HGL Computation Procedure

General Procedure: Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles. The computed HGL is checked against inlet control.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).