Storm Sewer Design

100 yr. Storm

Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
Revisions: MJL Date: 05/23/14
AS-Built 11-03-14

Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
1	2	0.97	98	10.00	0.97	98	10.00	118	891.29	890.43	0.73	15	0.015	4.78	0.41	5.54	4.78	0.25	0.25	895.37	892.93	2.44	895.52	891.71	3.81
2	4	0.77	98	10.00	1.74	98	10.45	118	889.89	889.22	0.57	24	0.015	3.73	0.53	9.26	14.77	0.25	0.25	895.52	891.71	3.81	894.88	891.42	3.46
3	5	0.24	98	10.00	0.24	98	10.00	156	891.14	889.62	0.98	12	0.015	3.23	0.80	1.35	3.05	0.25	0.25	894.65	891.61	3.04	893.66	890.84	2.82
9	5	0.00	0	0.00	0.00	0	0.00	185	893.22	889.91	1.79	12	0.015	0.00	0.00	0.00	4.13	0.25	0.25	897.22	893.22	4.00	893.66	890.84	2.82
4	5	0.56	98	10.00	2.30	98	11.00	118	889.22	888.60	0.53	24	0.015	3.88	0.51	12.17	14.24	0.25	0.25	894.88	891.42	3.46	893.66	890.84	2.82
5	7	0.78	98	10.00	3.32	98	11.56	96	888.60	888.19	0.43	24	0.015	5.97	0.27	17.42	12.80	0.25	0.25	893.66	890.84	2.82	892.84	885.96	6.88
6	7	0.44	98	10.00	0.44	98	10.00	40	885.70	885.40	0.75	12	0.015	3.96	0.17	2.50	2.67	0.25	0.25	889.51	886.53	2.98	892.84	885.96	6.88
7	8	0.49	98	10.00	4.25	98	11.87	124	883.80	883.19	0.49	30	0.015	5.10	0.41	22.16	24.91	0.25	0.25	892.84	885.96	6.88	893.38	885.36	8.02
8	15	0.18	98	10.00	4.43	98	12.30	107	883.19	882.45	0.69	30	0.015	4.86	0.37	22.57	29.59	0.25	0.25	893.38	885.36	8.02	892.48	884.86	7.62
15	16	0.49	98	10.00	4.92	98	12.69	122	882.45	881.95	0.41	30	0.015	5.35	0.38	24.78	22.77	0.25	0.25	892.48	884.86	7.62	890.63	884.05	6.58
16	25	0.00	0	0.00	4.92	98	13.10	197	881.95	880.93	0.52	30	0.015	6.17	0.53	24.61	25.55	0.25	0.25	890.63	884.05	6.58	888.23	881.21	7.02
17	18	0.50	98	10.00	0.50	98	10.00	60	886.66	885.82	1.40	15	0.015	3.79	0.26	2.85	6.62	0.25	0.25	890.67	887.26	3.41	889.85	886.72	3.13
19	21	0.00	0	0.00	0.00	0	0.00	53	890.38	888.96	2.68	12	0.015	0.00	0.00	0.00	5.05	0.25	0.25	894.01	890.38	3.63	892.94	889.54	3.40
22	20	0.54	98	10.00	0.54	98	10.00	149	891.22	889.73	1.00	12	0.015	4.69	0.53	3.05	3.09	0.25	0.25	896.83	892.09	4.74	893.74	890.41	3.33
20	21	0.00	0	0.00	0.54	98	10.55	39	889.73	888.96	1.99	12	0.015	5.83	0.11	3.04	4.35	0.25	0.25	893.74	890.41	3.33	892.94	889.54	3.40
21	18	0.00	0	0.00	0.54	98	10.67	105	888.96	886.15	2.67	12	0.015	6.53	0.27	3.02	5.04	0.25	0.25	892.94	889.54	3.40	889.85	886.72	3.13
18	25	0.24	98	10.00	1.28	98	10.96	50	885.82	884.27	3.08	15	0.015	8.14	0.10	7.11	9.83	0.25	0.25	889.85	886.72	3.13	888.23	881.21	7.02
25	26	0.64	98	10.00	6.84	98	13.68	212	879.86	875.24	2.18	36	0.015	8.24	0.43	34.17	85.37	0.25	0.25	888.23	881.21	7.02	881.34	877.30	4.04
26	27	0.22	98	10.00	7.06	98	14.13	115	875.24	874.36	0.76	36	0.015	7.14	0.27	35.08	50.54	0.25	0.25	881.34	877.30	4.04	880.40	876.24	4.16
27	38	0.13	98	10.00	7.19	98	14.42	180	874.36	872.64	0.96	36	0.015	8.03	0.37	35.59	56.58	0.25	0.25	880.40	876.24	4.16	878.90	871.10	7.80

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Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
28	29	0.73	98	10.00	0.73	98	10.00	59	874.27	873.68	1.00	15	0.015	4.30	0.23	4.15	5.59	0.25	0.25	878.38	875.17	3.21	878.38	874.62	3.76
29	30	0.29	98	10.00	1.02	98	10.24	59	873.59	873.12	0.80	18	0.015	4.75	0.21	5.76	8.13	0.25	0.25	878.38	874.62	3.76	878.44	874.01	4.43
30	31	0.57	98	10.00	1.59	98	10.47	58	872.71	872.25	0.79	24	0.015	3.70	0.26	8.77	17.42	0.25	0.25	878.44	874.01	4.43	878.44	873.85	4.59
31	32	0.30	98	10.00	1.89	98	10.76	54	872.25	872.02	0.43	24	0.015	3.89	0.23	10.22	12.78	0.25	0.25	878.44	873.85	4.59	878.38	873.55	4.83
32	33	0.66	98	10.00	2.55	98	11.03	56	872.02	871.53	0.88	24	0.015	5.68	0.16	13.65	18.41	0.25	0.25	878.38	873.55	4.83	878.38	872.99	5.39
33	34	0.41	98	10.00	2.96	98	11.21	117	871.21	870.59	0.53	30	0.015	3.82	0.51	15.64	25.89	0.25	0.25	878.38	872.99	5.39	878.38	872.70	5.68
34	36	1.05	98	10.00	4.01	98	11.75	39	870.59	870.41	0.46	30	0.015	4.94	0.13	20.68	24.12	0.25	0.25	878.38	872.70	5.68	879.39	872.33	7.06
35	36	0.02	98	10.00	0.02	98	10.00	61	875.32	874.88	0.72	12	0.015	1.66	0.61	0.11	2.62	0.25	0.25	879.00	875.46	3.54	879.39	872.33	7.06
36	37	0.08	98	10.00	4.11	98	11.89	70	870.41	869.95	0.66	30	0.015	5.32	0.22	21.07	28.88	0.25	0.25	879.39	872.33	7.06	879.06	871.83	7.23
37	38	0.15	98	10.00	4.26	98	12.13	95	869.95	869.41	0.57	30	0.015	5.94	0.27	21.61	26.84	0.25	0.25	879.06	871.83	7.23	878.90	871.10	7.80
38	45	0.16	98	10.00	11.61	98	14.84	216	868.36	867.08	0.59	42	0.015	7.66	0.47	57.57	67.11	0.25	0.25	878.90	871.10	7.80	877.16	868.77	8.39
50	51	0.00	0	0.00	0.00	0	0.00	64	875.66	875.34	0.50	12	0.015	0.00	0.00	0.00	2.18	0.25	0.25	880.25	875.66	4.59	880.14	875.34	4.80
51	52	0.00	0	0.00	0.00	0	0.00	60	875.34	875.04	0.50	12	0.015	0.00	0.00	0.00	2.18	0.25	0.25	880.14	875.34	4.80	880.14	875.04	5.10
52	40	0.00	0	0.00	0.00	0	0.00	108	875.04	874.13	0.84	12	0.015	0.00	0.00	0.00	2.83	0.25	0.25	880.14	875.04	5.10	878.49	874.71	3.78
40	47	0.53	98	10.00	0.53	98	10.00	68	874.13	872.15	2.91	12	0.015	6.69	0.17	3.04	5.27	0.25	0.25	878.49	874.71	3.78	878.18	867.49	10.69
45	46	0.40	98	10.00	12.01	98	15.35	50	865.37	864.91	0.91	42	0.015	6.19	0.14	58.90	83.38	0.25	0.25	877.16	868.77	8.39	877.82	868.27	9.55
46	47	0.07	98	10.00	12.08	98	15.52	63	864.91	864.74	0.27	42	0.015	6.64	0.16	59.14	45.37	0.25	0.25	877.82	868.27	9.55	878.18	867.49	10.69
47	49	0.11	98	10.00	12.72	98	15.72	97	864.74	864.00	0.76	42	0.015	8.21	0.20	61.59	76.12	0.25	0.25	878.18	867.49	10.69	878.89	866.38	12.51
48	249	0.75	98	10.00	0.75	98	10.00	33	875.88	875.41	1.41	12	0.015	5.61	0.10	4.28	3.66	0.25	0.25	877.68	877.18	0.50	878.94	865.62	13.32
49	249	0.07	98	10.00	12.79	98	16.02	48	864.00	863.30	1.47	42	0.015	10.07	0.08	62.24	105.85	0.25	0.25	878.89	866.38	12.51	878.94	865.62	13.32
55	56	0.15	98	10.00	0.15	98	10.00	42	875.69	875.22	1.11	12	0.015	3.08	0.23	0.84	3.25	0.25	0.25	879.10	876.06	3.04	879.02	875.61	3.41
56	60	0.13	98	10.00	0.28	98	10.26	21	875.22	874.46	3.58	12	0.015	5.88	0.06	1.55	5.85	0.25	0.25	879.02	875.61	3.41	879.58	874.82	4.76
57	58	0.15	98	10.00	0.15	98	10.00	89	875.64	874.91	0.82	18	0.015	1.26	1.18	0.83	8.24	0.25	0.25	879.36	875.96	3.40	879.26	875.81	3.45
58	59	1.04	98	10.00	1.19	98	11.33	7	874.91	874.63	4.00	18	0.015	7.23	0.02	6.64	18.21	0.25	0.25	879.26	875.81	3.45	879.50	875.43	4.07
59	63	0.16	98	10.00	1.35	98	11.36	29	874.16	873.94	0.75	24	0.015	3.50	0.14	7.37	17.02	0.25	0.25	879.50	875.43	4.07	879.43	875.31	4.12
62	63	0.07	98	10.00	0.07	98	10.00	7	875.29	874.92	5.69	12	0.015	4.18	0.03	0.41	7.37	0.25	0.25	879.26	875.47	3.79	879.43	875.31	4.12
63	65	0.00	0	0.00	1.42	98	11.53	66	873.94	873.75	0.29	24	0.015	3.49	0.32	7.58	10.51	0.25	0.25	879.43	875.31	4.12	879.29	875.03	4.26
64	65	0.11	98	10.00	0.11	98	10.00	7	875.31	874.72	9.08	12	0.015	5.88	0.02	0.64	9.30	0.25	0.25	879.17	875.51	3.66	879.29	875.03	4.26
65	60	0.00	0	0.00	1.53	98	11.88	34	873.75	873.53	0.66	24	0.015	3.83	0.15	8.12	15.89	0.25	0.25	879.29	875.03	4.26	879.58	874.82	4.76
60	61	0.00	0	0.00	1.81	98	12.05	114	873.53	872.92	0.53	24	0.015	4.84	0.39	9.59	14.32	0.25	0.25	879.58	874.82	4.76	878.96	874.07	4.89
61	247	0.63	98	10.00	2.44	98	12.49	122	872.92	871.32	1.32	24	0.015	7.02	0.29	12.50	22.50	0.25	0.25	878.96	874.07	4.89	879.44	866.54	12.90

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70	71	0.16	98	10.00	0.16	98	10.00	39	891.77	890.75	2.63	12	0.015	4.67	0.14	0.90	5.01	0.25	0.25	896.29	892.07	4.22	894.41	883.54	10.87
71	72	1.32	98	10.00	1.48	98	10.16	219	882.61	878.48	1.89	18	0.015	7.40	0.49	8.32	12.52	0.25	0.25	894.41	883.54	10.87	883.55	876.57	6.98
72	73	1.09	98	10.00	2.57	98	10.69	136	875.56	872.75	2.07	24	0.015	5.69	0.40	14.46	28.22	0.25	0.25	883.55	876.57	6.98	877.44	874.83	2.61
73	85	0.74	98	10.00	3.31	98	11.12	30	872.75	872.55	0.66	24	0.015	6.34	0.08	18.71	15.93	0.25	0.25	877.44	874.83	2.61	878.43	873.79	4.64
89	92	0.29	98	10.00	0.29	98	10.00	28	875.99	875.90	0.32	12	0.015	2.62	0.18	1.66	1.76	0.25	0.25	878.95	876.79	2.16	879.17	876.65	2.52
92	99	0.00	0	0.00	0.29	98	10.21	25	875.90	875.78	0.48	12	0.015	2.75	0.15	1.60	2.15	0.25	0.25	879.17	876.65	2.52	879.94	876.55	3.39
99	100	0.00	0	0.00	0.29	98	10.38	22	875.78	875.61	0.79	12	0.015	2.38	0.15	1.53	2.75	0.25	0.25	879.94	876.55	3.39	879.94	876.47	3.47
100	93	0.00	0	0.00	0.29	98	10.54	45	875.61	875.39	0.49	12	0.015	2.23	0.33	1.56	2.17	0.25	0.25	879.94	876.47	3.47	879.20	876.34	2.86
93	90	0.32	98	10.00	0.61	98	10.91	36	875.39	875.20	0.53	15	0.015	3.20	0.19	3.15	4.07	0.25	0.25	879.20	876.34	2.86	879.40	876.14	3.26
90	80	0.00	0	0.00	0.61	98	11.12	70	875.20	874.94	0.37	15	0.015	3.63	0.32	3.11	3.40	0.25	0.25	879.40	876.14	3.26	878.90	875.37	3.53
80	82	1.53	98	10.00	2.14	98	11.48	55	873.63	873.39	0.44	24	0.015	4.02	0.23	11.41	12.97	0.25	0.25	878.90	875.37	3.53	878.48	875.05	3.43
81	82	1.16	98	10.00	1.16	98	10.00	33	874.61	874.34	0.81	18	0.015	4.89	0.11	6.59	8.19	0.25	0.25	879.95	875.76	4.19	878.48	875.05	3.43
82	94	0.14	98	10.00	3.44	98	11.74	27	873.31	873.09	0.83	30	0.015	5.40	0.08	18.69	32.39	0.25	0.25	878.48	875.05	3.43	878.56	874.69	3.87
94	84	0.08	98	10.00	3.52	98	11.84	99	873.09	872.38	0.71	30	0.015	6.04	0.27	18.95	30.04	0.25	0.25	878.56	874.69	3.87	878.33	873.87	4.46
83	88	1.15	98	10.00	1.15	98	10.00	12	872.63	872.51	1.00	18	0.015	5.02	0.04	6.40	9.10	0.25	0.25	878.60	873.78	4.82	878.61	873.78	4.83
84	88	0.24	98	10.00	3.76	98	12.13	125	872.02	871.30	0.58	36	0.015	3.78	0.55	19.73	43.85	0.25	0.25	878.33	873.87	4.46	878.61	873.78	4.83
86	88	0.20	98	10.00	0.20	98	10.00	90	872.47	872.02	0.50	12	0.015	2.29	0.66	1.13	2.19	0.25	0.25	876.18	873.79	2.39	878.61	873.78	4.83
88	85	0.00	0	0.00	5.11	98	12.70	40	871.30	870.99	0.77	36	0.015	4.20	0.16	25.68	50.70	0.25	0.25	878.61	873.78	4.83	878.43	873.79	4.64
85	87	0.00	0	0.00	8.42	98	12.87	138	870.89	870.18	0.51	42	0.015	5.61	0.41	42.57	62.50	0.25	0.25	878.43	873.79	4.64	879.20	873.56	5.64
87	95	0.64	98	10.00	9.06	98	13.30	66	870.18	869.69	0.74	42	0.015	5.58	0.20	43.59	75.02	0.25	0.25	879.20	873.56	5.64	878.29	873.47	4.82
95	97	0.10	98	10.00	9.16	98	13.52	131	869.69	869.04	0.50	42	0.015	4.72	0.46	39.20	61.44	0.25	0.25	878.29	873.47	4.82	878.47	873.09	5.38
96	97	1.01	98	10.00	1.01	98	10.00	79	873.00	872.21	1.00	15	0.015	5.10	0.26	5.67	5.60	0.25	0.25	880.18	874.18	6.00	878.47	873.09	5.38
97	98	0.00	0	0.00	10.17	98	14.00	91	869.04	868.57	0.52	42	0.015	4.43	0.34	40.44	62.73	0.25	0.25	878.47	873.09	5.38	878.00	872.78	5.22
98	118	0.23	98	10.00	10.40	98	14.35	47	868.57	868.37	0.43	42	0.015	4.20	0.18	40.39	57.12	0.25	0.25	878.00	872.78	5.22	878.11	872.55	5.56
105	106	0.57	98	10.00	0.57	98	10.00	118	872.53	871.87	0.56	15	0.015	3.53	0.56	3.24	4.18	0.25	0.25	876.00	873.41	2.59	876.00	872.77	3.23
106	107	0.45	98	10.00	1.02	98	10.59	118	871.68	870.95	0.62	18	0.015	4.57	0.43	5.70	7.15	0.25	0.25	876.00	872.77	3.23	876.00	874.25	1.75
107	118	0.68	98	10.00	1.70	98	11.06	93	870.43	869.81	0.67	24	0.015	4.90	0.32	9.37	16.02	0.25	0.25	876.00	874.25	1.75	878.11	872.55	5.56
115	116	0.18	98	10.00	0.18	98	10.00	66	874.16	873.75	0.62	12	0.015	2.18	0.50	1.02	2.44	0.25	0.25	878.21	874.61	3.60	878.21	874.46	3.75
116	117	0.37	98	10.00	0.55	98	10.53	89	873.62	873.07	0.62	15	0.015	3.21	0.46	3.09	4.39	0.25	0.25	878.21	874.46	3.75	877.93	874.06	3.87
117	118	0.17	98	10.00	0.72	98	11.03	48	873.07	872.77	0.62	15	0.015	4.25	0.19	4.01	4.41	0.25	0.25	877.93	874.06	3.87	878.11	872.55	5.56
118	126	0.00	0	0.00	12.82	98	14.56	109	868.37	868.04	0.30	42	0.015	5.04	0.36	47.51	48.07	0.25	0.25	878.11	872.55	5.56	879.42	872.05	7.37
125	126	0.09	98	10.00	0.09	98	10.00	20	875.11	874.96	0.74	12	0.015	2.50	0.13	0.51	2.66	0.25	0.25	878.85	875.43	3.42	879.42	872.05	7.37
126	131	0.00	0	0.00	12.91	98	14.94	99	868.04	867.58	0.46	42	0.015	4.94	0.33	47.56	59.38	0.25	0.25	879.42	872.05	7.37	878.90	871.56	7.34

Storm Sewer Design

100 yr. Storm

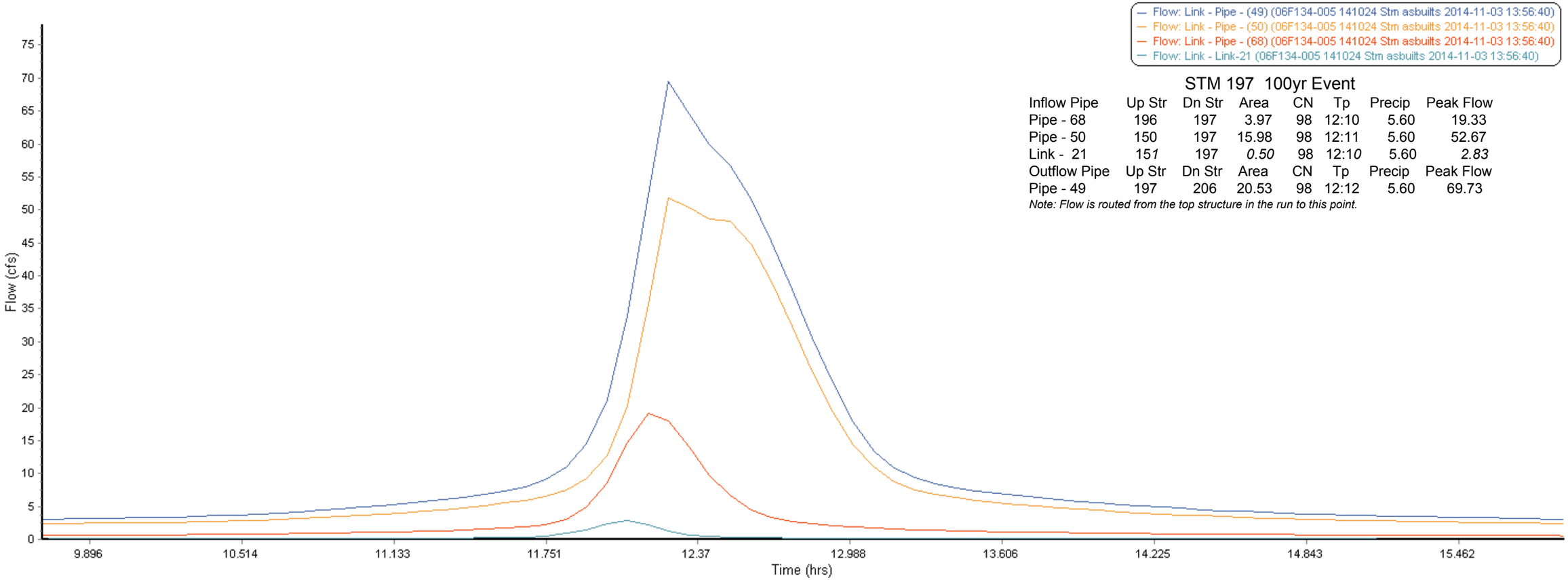
Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
Revisions: MJL Date: 05/23/14
AS-Built 11-03-14

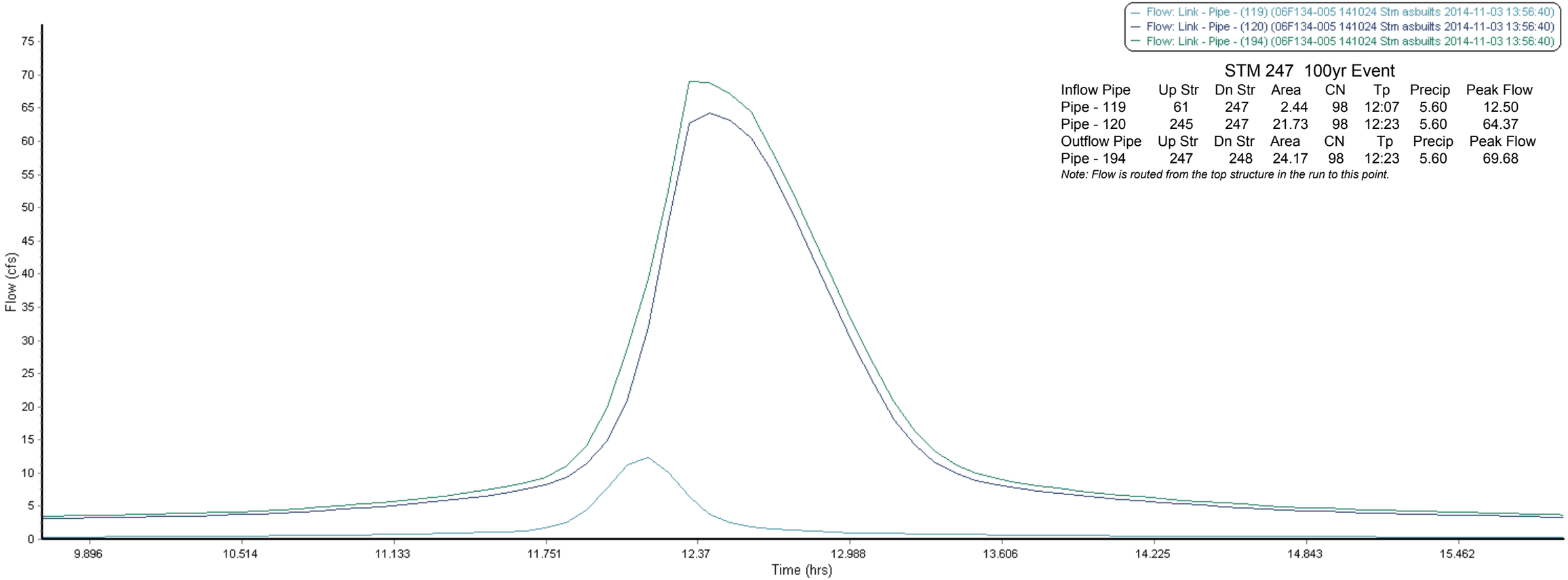
Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
127	128	1.05	98	10.00	1.05	98	10.00	53	875.60	875.33	0.50	18	0.015	3.55	0.25	5.92	6.44	0.25	0.25	879.41	876.99	2.42	878.90	876.71	2.19
128	129	0.07	98	10.00	1.12	98	10.27	56	875.33	875.05	0.50	18	0.015	3.77	0.25	6.25	6.44	0.25	0.25	878.90	876.71	2.19	878.23	876.34	1.89
129	131	0.20	98	10.00	1.32	98	10.53	45	875.05	874.75	0.67	18	0.015	4.95	0.15	7.28	7.43	0.25	0.25	878.23	876.34	1.89	878.90	871.56	7.34
130	131	0.17	98	10.00	0.17	98	10.00	15	875.13	875.02	0.72	12	0.015	2.96	0.09	0.98	2.63	0.25	0.25	878.72	875.60	3.12	878.90	871.56	7.34
131	132	0.00	0	0.00	14.40	98	15.31	74	867.58	867.22	0.49	42	0.015	5.59	0.22	53.74	60.90	0.25	0.25	878.90	871.56	7.34	878.76	871.06	7.70
132	135	0.08	98	10.00	14.48	98	15.56	47	867.22	867.13	0.19	42	0.015	5.61	0.14	53.98	38.99	0.25	0.25	878.76	871.06	7.70	878.76	870.66	8.10
139	133	0.30	98	10.00	0.30	98	10.00	28	875.74	875.41	1.20	12	0.015	5.53	0.08	1.75	3.38	0.25	0.25	879.37	876.29	3.08	879.37	875.72	3.65
133	134	0.00	0	0.00	0.30	98	10.10	29	875.41	873.30	7.40	12	0.015	5.19	0.09	1.75	8.40	0.25	0.25	879.37	875.72	3.65	879.37	873.90	5.47
134	135	0.00	0	0.00	0.30	98	10.20	29	873.30	873.03	0.92	12	0.015	3.71	0.13	1.72	2.97	0.25	0.25	879.37	873.90	5.47	878.76	870.66	8.10
140	136	0.18	98	10.00	0.18	98	10.00	11	874.76	874.61	1.36	12	0.015	3.66	0.05	1.02	3.61	0.25	0.25	878.76	875.17	3.59	878.88	870.28	8.60
135	136	0.05	98	10.00	14.83	98	15.73	35	867.13	867.08	0.14	42	0.015	5.90	0.10	55.11	38.99	0.25	0.25	878.76	870.66	8.10	878.88	870.28	8.60
136	138	0.23	98	10.00	15.24	98	15.84	62	867.08	866.58	0.81	42	0.015	6.29	0.16	55.56	78.30	0.25	0.25	878.88	870.28	8.60	879.38	869.90	9.48
137	138	0.14	98	10.00	0.14	98	10.00	27	874.61	874.32	1.08	12	0.015	3.25	0.14	0.80	3.21	0.25	0.25	878.57	874.97	3.60	879.38	869.90	9.48
138	145	0.00	0	0.00	15.38	98	16.02	43	866.58	866.17	0.95	42	0.015	6.08	0.12	54.58	85.14	0.25	0.25	879.38	869.90	9.48	879.14	869.57	9.57
145	148	0.14	98	10.00	15.52	98	16.15	38	866.17	865.86	0.81	42	0.015	5.90	0.11	53.56	78.45	0.25	0.25	879.14	869.57	9.57	879.12	869.31	9.81
147	148	0.34	98	10.00	0.34	98	10.00	28	875.10	874.91	0.68	12	0.015	3.61	0.13	1.92	2.55	0.25	0.25	878.76	875.80	2.96	879.12	869.31	9.81
148	150	0.00	0	0.00	15.86	98	16.27	56	865.86	865.47	0.70	42	0.015	5.80	0.16	53.27	72.96	0.25	0.25	879.12	869.31	9.81	879.16	868.98	10.18
149	150	0.12	98	10.00	0.12	98	10.00	9	875.29	875.08	2.33	12	0.015	3.95	0.04	0.69	4.72	0.25	0.25	878.75	875.59	3.16	879.16	868.98	10.18
150	197	0.00	0	0.00	15.98	98	16.44	84	865.47	864.95	0.62	42	0.015	5.59	0.25	52.67	68.81	0.25	0.25	879.16	868.98	10.18	878.57	868.54	10.03
151	197	0.50	98	10.00	0.50	98	10.00	29	874.47	873.87	2.07	18	0.015	5.55	0.09	2.83	13.11	0.25	0.25	879.23	875.00	4.23	878.57	868.54	10.03
152	194	0.79	98	10.00	0.79	98	10.00	44	873.47	873.25	0.50	15	0.015	4.26	0.17	4.44	3.96	0.25	0.25	879.23	874.60	4.63	878.74	871.53	7.21



STM 197 100yr Event

Inflow Pipe	Up Str	Dn Str	Area	CN	Tp	Precip	Peak Flow
Pipe - 68	196	197	3.97	98	12:10	5.60	19.33
Pipe - 50	150	197	15.98	98	12:11	5.60	52.67
Link - 21	151	197	0.50	98	12:10	5.60	2.83
Outflow Pipe	Up Str	Dn Str	Area	CN	Tp	Precip	Peak Flow
Pipe - 49	197	206	20.53	98	12:12	5.60	69.73

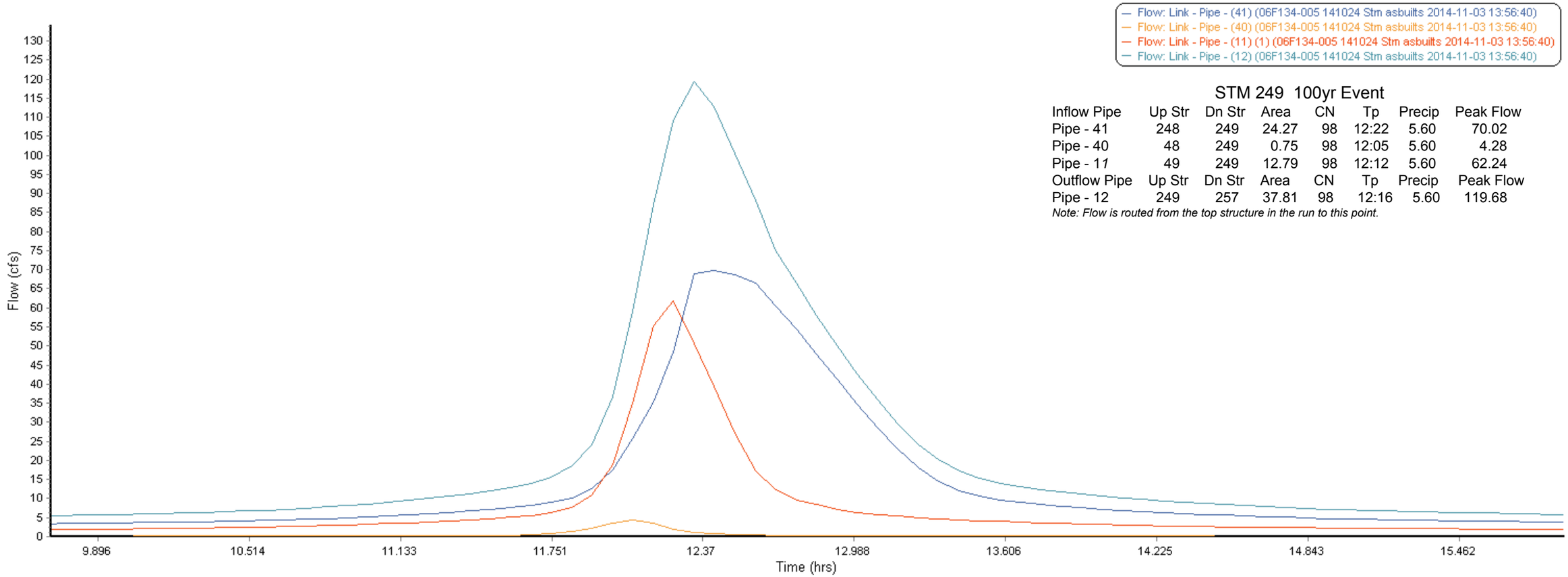
Note: Flow is routed from the top structure in the run to this point.



STM 247 100yr Event

Inflow Pipe	Up Str	Dn Str	Area	CN	Tp	Precip	Peak Flow
Pipe - 119	61	247	2.44	98	12:07	5.60	12.50
Pipe - 120	245	247	21.73	98	12:23	5.60	64.37
Outflow Pipe	Up Str	Dn Str	Area	CN	Tp	Precip	Peak Flow
Pipe - 194	247	248	24.17	98	12:23	5.60	69.68

Note: Flow is routed from the top structure in the run to this point.



STM 249 100yr Event

Inflow Pipe	Up Str	Dn Str	Area	CN	Tp	Precip	Peak Flow
Pipe - 41	248	249	24.27	98	12:22	5.60	70.02
Pipe - 40	48	249	0.75	98	12:05	5.60	4.28
Pipe - 11	49	249	12.79	98	12:12	5.60	62.24
Outflow Pipe	Up Str	Dn Str	Area	CN	Tp	Precip	Peak Flow
Pipe - 12	249	257	37.81	98	12:16	5.60	119.68

Note: Flow is routed from the top structure in the run to this point.

Storm Sewer Design

100 yr. Storm

Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
Revisions: MJL Date: 05/23/14
AS-Built 11-03-14

Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
165	171	0.60	98	10.00	0.60	98	10.00	139	874.87	874.21	0.48	15	0.015	3.74	0.62	3.42	3.86	0.25	0.25	877.84	875.84	2.00	878.25	875.11	3.14
169	171	0.26	98	10.00	0.26	98	10.00	57	874.97	874.21	1.33	12	0.015	3.48	0.27	1.49	3.56	0.25	0.25	878.54	875.42	3.12	878.25	875.11	3.14
171	175	0.00	0	0.00	0.86	98	10.67	20	873.98	873.60	1.88	18	0.015	3.06	0.11	4.56	12.49	0.25	0.25	878.25	875.11	3.14	877.92	875.08	2.84
175	176	0.32	98	10.00	1.18	98	10.80	29	873.60	873.51	0.31	18	0.015	3.76	0.13	6.09	5.11	0.25	0.25	877.92	875.08	2.84	878.00	874.86	3.14
176	177	0.09	98	10.00	1.27	98	10.93	90	873.51	872.85	0.73	18	0.015	3.76	0.40	6.47	7.80	0.25	0.25	878.00	874.86	3.14	878.00	874.38	3.62
177	178	0.37	98	10.00	1.64	98	11.35	35	872.71	872.60	0.31	21	0.015	3.59	0.16	8.29	7.68	0.25	0.25	878.00	874.38	3.62	878.00	874.15	3.85
182	183	0.00	0	0.00	0.00	0	0.00	40	875.08	874.78	0.75	12	0.015	0.00	0.00	0.00	2.67	0.25	0.25	878.58	875.08	3.50	878.58	874.78	3.80
183	184	0.00	0	0.00	0.00	0	0.00	27	874.78	874.58	0.75	12	0.015	0.00	0.00	0.00	2.66	0.25	0.25	878.58	874.78	3.80	878.78	874.58	4.20
184	178	0.00	0	0.00	0.00	0	0.00	27	874.58	874.31	1.00	12	0.015	0.00	0.00	0.00	3.09	0.25	0.25	878.78	874.58	4.20	878.00	874.15	3.85
178	179	0.21	98	10.00	1.85	98	11.53	89	872.60	872.29	0.35	21	0.015	4.70	0.32	9.29	8.11	0.25	0.25	878.00	874.15	3.85	878.00	873.34	4.66
179	181	0.60	98	10.00	2.45	98	11.88	61	871.96	871.32	1.05	24	0.015	5.11	0.20	12.41	20.05	0.25	0.25	878.00	873.34	4.66	878.15	872.88	5.27
180	181	0.13	98	10.00	0.13	98	10.00	15	873.58	873.28	1.99	12	0.015	3.91	0.06	0.76	4.35	0.25	0.25	877.88	873.89	3.99	878.15	872.88	5.27
181	191	0.00	0	0.00	2.58	98	12.09	52	871.32	870.79	1.01	24	0.015	4.68	0.19	12.90	19.74	0.25	0.25	878.15	872.88	5.27	878.73	872.56	6.17
188	189	0.00	0	0.00	0.00	0	0.00	38	875.78	875.40	1.00	12	0.015	0.00	0.00	0.00	3.08	0.25	0.25	879.28	875.78	3.50	879.42	875.42	4.00
189	190	0.00	0	0.00	0.00	0	0.00	26	875.40	875.14	1.00	12	0.015	0.11	3.91	0.01	3.09	0.25	0.25	879.42	875.42	4.00	878.79	875.42	3.37
190	191	0.12	98	10.00	0.12	98	10.00	38	875.14	874.38	2.00	12	0.015	3.91	0.16	0.68	4.37	0.25	0.25	878.79	875.42	3.37	878.73	872.56	6.17
191	193	0.04	98	10.00	2.74	98	12.30	90	870.79	870.36	0.48	24	0.015	4.96	0.30	13.61	13.58	0.25	0.25	878.73	872.56	6.17	878.73	871.86	6.87
192	193	0.19	98	10.00	0.19	98	10.00	38	875.29	874.53	2.00	12	0.015	4.44	0.14	1.09	4.37	0.25	0.25	878.79	875.65	3.14	878.73	871.86	6.87
193	194	0.07	98	10.00	3.00	98	12.61	88	870.19	869.75	0.50	30	0.015	4.13	0.36	14.88	25.09	0.25	0.25	878.73	871.86	6.87	878.74	871.53	7.21
194	196	0.06	98	10.00	3.85	98	12.99	10	869.75	869.51	2.50	30	0.015	5.02	0.03	18.79	56.21	0.25	0.25	878.74	871.53	7.21	878.98	871.31	7.67
195	196	0.12	98	10.00	0.12	98	10.00	18	875.18	874.67	2.83	12	0.015	4.36	0.07	0.69	5.20	0.25	0.25	878.72	875.45	3.27	878.98	871.31	7.67
196	197	0.00	0	0.00	3.97	98	13.03	46	869.51	869.30	0.46	30	0.015	5.67	0.13	19.33	24.15	0.25	0.25	878.98	871.31	7.67	878.57	868.54	10.03
197	206	0.08	98	10.00	20.53	98	16.70	46	864.67	864.35	0.70	48	0.015	6.03	0.13	69.73	104.40	0.25	0.25	878.57	868.54	10.03	879.08	868.28	10.80
205	206	0.07	98	10.00	0.07	98	10.00	13	875.28	875.03	2.00	12	0.015	3.29	0.06	0.40	4.37	0.25	0.25	878.74	875.50	3.24	879.08	868.28	10.80
206	208	0.00	0	0.00	20.60	98	16.84	86	864.35	863.81	0.63	48	0.015	5.69	0.25	67.50	98.53	0.25	0.25	879.08	868.28	10.80	878.75	867.91	10.84
207	208	0.05	98	10.00	0.05	98	10.00	22	874.84	874.69	0.68	12	0.015	2.13	0.17	0.29	2.54	0.25	0.25	878.76	875.08	3.68	878.75	867.91	10.84
208	209	0.50	98	10.00	21.15	98	17.11	92	863.81	863.50	0.34	48	0.015	5.54	0.28	66.53	72.34	0.25	0.25	878.75	867.91	10.84	878.39	867.49	10.90
209	234	0.42	98	10.00	21.57	98	17.41	31	863.50	863.30	0.65	48	0.015	5.45	0.09	64.69	100.64	0.25	0.25	878.39	867.49	10.90	878.86	867.22	11.64
234	245	0.00	0	0.00	21.57	98	17.51	50	863.30	863.02	0.57	48	0.015	5.29	0.16	63.75	93.63	0.25	0.25	878.86	867.22	11.64	879.23	866.91	12.32
245	247	0.16	98	10.00	21.73	98	17.67	65	863.02	862.67	0.54	48	0.015	5.56	0.19	64.37	91.49	0.25	0.25	879.23	866.91	12.32	879.44	866.54	12.90
247	248	0.00	0	0.00	24.17	98	17.87	38	862.67	862.37	0.79	48	0.015	6.07	0.10	69.68	110.32	0.25	0.25	879.44	866.54	12.90	878.80	866.16	12.64
248	249	0.10	98	10.00	24.27	98	17.99	62	862.37	862.23	0.22	48	0.015	7.16	0.15	70.02	59.01	0.25	0.25	878.80	866.16	12.64	878.94	865.62	13.32
249	257	0.00	0	0.00	37.81	98	18.15	93	861.14	860.63	0.55	60	0.015	6.49	0.24	119.68	166.97	0.25	0.25	878.94	865.62	13.32	877.78	865.06	12.72
256	257	0.63	98	10.00	0.63	98	10.00	134	873.45	872.11	1.00	15	0.015	4.72	0.47	3.59	5.60	0.25	0.25	877.78	874.21	3.57	877.78	865.06	12.72
257	258	0.56	98	10.00	39.00	98	18.43	92	860.66	860.20	0.50	60	0.015	6.70	0.23	120.68	159.49	0.25	0.25	877.78	865.06	12.72	877.84	864.43	13.41
258	259	0.24	98	10.00	39.24	98	18.68	36	860.20	860.02	0.50	60	0.015	7.17	0.08	120.78	159.21	0.25	0.25	877.84	864.43	13.41	879.01	863.81	15.20
259	260	0.00	0	0.00	39.24	98	18.77	21	860.02	859.92	0.50	60	0.015	8.36	0.04	121.08	159.61	0.25	0.25	879.01	863.81	15.20	867.00	862.71	4.29

Storm Sewer Design

100 yr. Storm

Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
Revisions: MJL Date: 05/23/14
AS-Built 11-03-14

Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
232	231	0.37	98	10.00	0.37	98	10.00	88	869.62	868.99	0.72	21	0.015	2.36	0.62	2.10	11.64	0.25	0.25	878.76	870.12	8.64	878.76	869.91	8.85
231	230	0.34	98	10.00	0.71	98	10.68	88	868.99	868.61	0.43	21	0.015	2.73	0.54	3.94	9.00	0.25	0.25	878.76	869.91	8.85	878.76	869.73	9.03
230	229	0.22	98	10.00	0.93	98	11.22	30	868.61	868.51	0.33	21	0.015	3.30	0.15	5.06	7.89	0.25	0.25	878.76	869.73	9.03	878.80	869.56	9.24
235	236	0.00	0	0.00	0.00	0	0.00	56	875.93	875.65	0.50	12	0.015	0.00	0.00	0.00	2.18	0.25	0.25	879.43	875.93	3.50	879.43	875.65	3.78
236	237	0.00	0	0.00	0.00	0	0.00	17	875.65	875.56	0.50	12	0.015	0.00	0.00	0.00	2.18	0.25	0.25	879.43	875.65	3.78	879.55	875.56	3.99
237	229	0.00	0	0.00	0.00	0	0.00	14	875.56	874.48	7.83	12	0.015	0.00	0.00	0.00	8.64	0.25	0.25	879.55	875.56	3.99	878.80	869.56	9.24
229	228	0.12	98	10.00	1.05	98	11.39	86	868.51	868.00	0.59	21	0.015	3.24	0.44	5.55	10.56	0.25	0.25	878.80	869.56	9.24	878.80	869.37	9.43
228	227	0.30	98	10.00	1.35	98	11.87	89	868.00	867.60	0.45	21	0.015	3.44	0.43	6.88	9.23	0.25	0.25	878.80	869.37	9.43	879.02	869.18	9.84
226	227	0.26	98	10.00	0.26	98	10.00	12	875.00	874.76	2.00	12	0.015	4.60	0.04	1.49	4.37	0.25	0.25	878.80	875.47	3.33	879.02	869.18	9.84
227	225	0.00	0	0.00	1.61	98	12.31	121	867.60	867.03	0.47	21	0.015	3.71	0.54	8.00	9.44	0.25	0.25	879.02	869.18	9.84	878.84	868.84	10.00
225	219	0.14	98	10.00	1.75	98	12.89	49	867.03	866.73	0.61	21	0.015	3.58	0.23	8.32	10.72	0.25	0.25	878.84	868.84	10.00	878.93	868.56	10.37
218	219	0.24	98	10.00	0.24	98	10.00	33	874.82	873.98	2.55	12	0.015	5.14	0.11	1.38	4.93	0.25	0.25	878.54	875.21	3.33	878.93	868.56	10.37
219	221	0.00	0	0.00	1.99	98	13.16	38	866.73	866.54	0.50	21	0.015	4.01	0.16	9.33	9.68	0.25	0.25	878.93	868.56	10.37	878.95	868.29	10.66
220	221	0.18	98	10.00	0.18	98	10.00	4	874.55	874.20	10.00	12	0.015	6.86	0.01	1.07	9.76	0.25	0.25	878.68	874.85	3.83	878.95	868.29	10.66
221	222	0.00	0	0.00	2.17	98	13.36	44	866.54	866.13	0.93	21	0.015	4.21	0.18	9.99	13.21	0.25	0.25	878.95	868.29	10.66	879.03	867.93	11.10
217	222	0.00	0	0.00	0.00	0	0.00	3	874.66	874.41	9.26	12	0.015	0.00	0.00	0.00	9.40	0.25	0.25	878.66	874.66	4.00	879.03	867.93	11.10
222	216	0.00	0	0.00	2.17	98	13.57	47	866.13	865.97	0.34	21	0.015	4.19	0.18	9.89	8.06	0.25	0.25	879.03	867.93	11.10	879.10	867.56	11.54
215	216	0.09	98	10.00	0.09	98	10.00	15	874.94	874.63	2.07	12	0.015	3.57	0.07	0.51	4.44	0.25	0.25	878.76	875.19	3.57	879.10	867.56	11.54
216	223	0.00	0	0.00	2.26	98	13.78	103	865.97	865.48	0.47	21	0.015	5.01	0.34	10.26	9.46	0.25	0.25	879.10	867.56	11.54	878.27	866.26	12.01
223	305	0.00	0	0.00	2.26	98	14.14	127	865.25	863.55	1.34	24	0.015	5.96	0.35	10.27	22.71	0.25	0.25	878.27	866.26	12.01	875.70	864.71	10.99
305	304	0.20	98	10.00	2.46	98	14.51	105	863.55	862.50	1.00	24	0.015	6.11	0.29	10.96	19.61	0.25	0.25	875.70	864.71	10.99	873.07	860.57	12.50
304	307	3.50	98	10.00	5.96	98	14.81	95	858.01	857.63	0.40	36	0.015	4.56	0.35	26.95	36.56	0.25	0.25	873.07	860.57	12.50	872.75	860.56	12.19
306	307	0.19	98	10.00	0.19	98	10.00	73	871.75	866.48	7.25	12	0.015	7.20	0.17	1.09	8.31	0.25	0.25	876.70	872.00	4.70	872.75	860.56	12.19
307	303	0.00	0	0.00	6.15	98	15.16	133	857.63	856.97	0.50	36	0.015	4.20	0.53	27.32	40.72	0.25	0.25	872.75	860.56	12.19	868.18	860.54	7.64
303	308	0.30	98	10.00	6.45	98	15.74	30	856.97	856.82	0.50	36	0.015	4.31	0.12	28.96	40.87	0.25	0.25	868.18	860.54	7.64	867.88	860.50	7.38
300	301	0.90	98	10.00	0.90	98	10.00	98	861.82	861.32	0.50	18	0.015	3.25	0.50	5.03	6.44	0.25	0.25	865.82	863.04	2.78	867.40	862.75	4.65
301	302	0.24	98	10.00	1.14	98	10.52	90	861.32	860.87	0.50	18	0.015	3.63	0.41	6.27	6.43	0.25	0.25	867.40	862.75	4.65	867.88	862.28	5.60
302	308	0.21	98	10.00	1.35	98	10.95	60	860.87	860.57	0.50	18	0.015	4.76	0.21	7.37	6.44	0.25	0.25	867.88	862.28	5.60	867.88	860.50	7.38
308	309	0.00	0	0.00	7.80	98	15.87	21	856.82	856.61	1.00	36	0.015	5.57	0.06	36.44	57.93	0.25	0.25	867.88	860.50	7.38	867.00	860.46	6.54
265	266	0.00	0	0.00	0.00	0	0.00	40	876.55	876.15	1.00	12	0.015	0.99	0.67	0.33	3.09	0.25	0.25	880.15	877.20	2.95	880.15	877.14	3.01
266	267	0.09	98	10.00	0.09	98	10.00	40	876.15	875.75	1.00	12	0.015	1.73	0.39	1.09	3.09	0.25	0.25	880.15	877.14	3.01	880.15	877.11	3.04
267	268	0.60	98	10.00	0.69	98	10.00	40	875.75	875.35	1.00	12	0.015	4.29	0.16	3.37	3.09	0.25	0.25	880.15	877.11	3.04	880.15	876.50	3.65
268	269	0.00	0	0.00	0.69	98	2.77	69	875.35	874.66	1.00	12	0.015	6.55	0.18	3.33	3.08	0.25	0.25	880.15	876.50	3.65	878.36	874.96	3.40
269	270	0.00	0	0.00	0.69	98	2.95	36	874.66	863.50	30.82	12	0.015	8.30	0.07	3.33	17.14	0.25	0.25	878.36	874.96	3.40	867.00	864.23	2.77

Storm Sewer Design

100 yr. Storm

Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
Revisions: MJL Date: 05/23/14
AS-Built 11-03-14

Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
280	287	1.24	98	10.00	1.24	98	10.00	76	864.57	863.81	1.00	15	0.015	5.77	0.22	7.08	5.60	0.25	0.25	867.60	867.52	0.08	867.60	866.05	1.55
287	281	0.00	0	0.00	1.24	98	10.29	28	863.81	863.53	1.00	15	0.015	5.77	0.08	7.09	5.58	0.25	0.25	867.60	866.05	1.55	868.29	865.42	2.87
281	282	0.00	0	0.00	1.24	98	10.40	3	863.53	863.50	1.00	15	0.015	5.78	0.01	7.10	5.60	0.25	0.25	868.29	865.42	2.87	867.00	865.37	1.63
283	284	0.98	98	10.00	0.98	98	10.00	60	867.60	867.00	1.00	15	0.015	4.72	0.21	5.54	5.60	0.25	0.25	871.10	868.82	2.28	871.10	868.12	2.98
284	285	0.00	0	0.00	0.98	98	10.22	60	867.00	866.40	1.00	15	0.015	5.04	0.20	5.46	5.60	0.25	0.25	871.10	868.12	2.98	871.10	866.53	4.57
285	286	0.00	0	0.00	0.98	98	10.43	4	866.15	863.50	66.25	18	0.015	7.70	0.01	5.66	74.10	0.25	0.25	871.10	866.53	4.57	867.00	864.49	2.51
290	291	0.00	0	0.00	0.00	0	0.00	41	874.00	863.50	25.51	12	0.015	0.00	0.00	0.00	15.60	0.25	0.25	879.81	874.00	5.81	867.00	863.50	3.50
292	293	0.00	0	0.00	0.00	0	0.00	17	852.34	852.26	0.50	12	0.015	5.99	0.05	4.71	2.19	0.25	0.25	855.33	855.33	0.00	856.47	856.03	0.44
293	294	0.00	0	0.00	0.00	0	0.05	8	852.25	852.21	0.50	12	0.015	6.00	0.02	4.71	2.18	0.25	0.25	856.47	856.03	0.44	856.47	856.47	0.00
320	321	75.71	74	24.00	75.71	74	24.00	21	851.00	850.66	1.60	72	0.015	12.71	0.03	182.47	464.61	0.25	0.25	858.33	854.54	3.79	869.81	852.64	17.17
321	323	0.00	0	0.00	75.71	74	24.04	38	849.46	848.42	2.77	72	0.015	15.13	0.04	185.62	610.43	0.25	0.25	869.81	852.64	17.17	867.99	850.22	17.77
322	323	0.00	0	0.00	0.00	0	0.00	19	849.98	849.69	1.49	72	0.015	4.62	0.07	4.08	463.97	0.25	0.25	857.33	850.45	6.88	867.99	850.22	17.77
323	324	0.00	0	0.00	75.71	74	24.12	139	846.84	846.04	0.57	96	0.015	10.92	0.21	189.61	599.25	0.25	0.25	867.99	850.22	17.77	866.18	848.72	17.46
324	325	0.00	0	0.00	75.71	74	24.45	120	846.04	843.59	2.04	96	0.015	14.77	0.14	190.74	1128.07	0.25	0.25	866.18	848.72	17.46	870.33	845.64	24.69
325	326	0.00	0	0.00	75.71	74	24.71	37	842.33	841.91	1.14	96	0.015	11.59	0.05	192.28	843.33	0.25	0.25	870.33	845.64	24.69	870.33	845.64	24.69
335	336	5.33	74	15.00	5.33	74	15.00	348	884.00	875.16	2.54	30	0.015	7.03	0.82	15.54	56.67	0.25	0.25	887.54	884.89	2.65	880.65	876.63	4.02
336	337	1.54	98	10.00	6.87	79	15.96	254	875.16	872.08	1.21	30	0.015	7.04	0.60	23.55	39.15	0.25	0.25	880.65	876.63	4.02	877.59	873.87	3.72
337	339	1.31	98	10.00	8.18	82	16.64	26	872.08	871.55	2.03	30	0.015	9.37	0.05	30.61	50.66	0.25	0.25	877.59	873.87	3.72	878.87	872.76	6.11
338	339	1.19	98	10.00	1.19	98	10.00	186	872.52	871.29	0.66	18	0.015	4.82	0.64	6.73	7.40	0.25	0.25	876.30	873.72	2.58	878.87	872.76	6.11
339	352	0.00	0	0.00	9.37	84	16.69	134	869.95	869.09	0.64	36	0.015	5.51	0.41	35.46	46.24	0.25	0.25	878.87	872.76	6.11	876.91	872.17	4.74
350	351	0.29	98	10.00	0.29	98	10.00	58	872.39	871.61	1.34	12	0.015	3.90	0.25	1.68	3.57	0.25	0.25	876.00	872.90	3.10	875.67	872.18	3.49
351	352	0.24	98	10.00	0.53	98	10.28	6	871.54	871.38	2.62	15	0.015	5.69	0.02	3.02	9.07	0.25	0.25	875.67	872.18	3.49	876.91	872.17	4.74
352	356	0.00	0	0.00	9.90	85	17.12	119	869.09	868.41	0.57	36	0.015	5.28	0.38	37.00	43.64	0.25	0.25	876.91	872.17	4.74	876.49	871.47	5.02
353	354	0.23	98	10.00	0.23	98	10.00	59	872.31	871.66	1.11	12	0.015	3.82	0.26	1.34	3.25	0.25	0.25	876.00	872.78	3.22	875.67	871.83	3.84
354	356	0.18	98	10.00	0.41	98	10.28	6	871.45	870.64	13.28	15	0.015	8.84	0.01	2.42	20.40	0.25	0.25	875.67	871.83	3.84	876.49	871.47	5.02
356	359	0.00	0	0.00	10.31	86	17.52	119	868.41	867.97	0.37	36	0.015	5.57	0.35	38.83	35.22	0.25	0.25	876.49	871.47	5.02	876.62	870.72	5.90
357	358	0.36	98	10.00	0.36	98	10.00	58	872.04	871.46	1.01	12	0.015	4.05	0.24	2.02	3.10	0.25	0.25	876.00	872.67	3.33	875.67	871.95	3.72
358	359	0.32	98	10.00	0.68	98	10.27	6	871.25	871.06	3.33	15	0.015	6.49	0.01	3.80	10.22	0.25	0.25	875.67	871.95	3.72	876.62	870.72	5.90
359	365	0.00	0	0.00	10.99	86	17.91	226	867.97	866.81	0.51	36	0.015	6.51	0.58	41.82	41.42	0.25	0.25	876.62	870.72	5.90	877.33	869.20	8.13
365	370	0.16	98	10.00	11.15	87	18.52	98	866.81	866.23	0.59	36	0.015	8.11	0.20	42.65	44.56	0.25	0.25	877.33	869.20	8.13	878.58	868.11	10.47

Storm Sewer Design

100 yr. Storm

Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
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AS-Built 11-03-14

Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
366	367	0.61	98	10.00	0.61	98	10.00	83	874.74	873.91	1.00	12	0.015	4.42	0.31	3.47	3.09	0.25	0.25	878.24	877.36	0.88	877.94	876.15	1.79
367	368	0.59	98	10.00	1.20	98	10.33	133	873.66	872.33	1.00	15	0.015	5.58	0.40	6.85	5.60	0.25	0.25	877.94	876.15	1.79	877.57	873.92	3.65
368	370	0.25	98	10.00	1.45	98	10.79	22	872.33	871.89	2.00	15	0.015	6.88	0.05	8.28	7.92	0.25	0.25	877.57	873.92	3.65	878.58	868.11	10.47
370	393	0.00	0	0.00	12.60	88	18.75	177	866.23	862.82	1.93	36	0.015	10.58	0.28	49.56	80.30	0.25	0.25	878.58	868.11	10.47	870.56	864.74	5.82
385	388	0.22	98	10.00	0.22	98	10.00	60	869.68	867.47	3.67	12	0.015	5.80	0.17	1.23	5.92	0.25	0.25	874.54	870.00	4.54	872.63	867.76	4.87
386	399	0.10	98	10.00	0.10	98	10.00	65	874.20	873.53	1.03	12	0.015	2.22	0.49	0.54	3.13	0.25	0.25	877.92	874.48	3.44	877.91	873.95	3.96
399	387	0.17	98	10.00	0.27	98	10.54	233	873.53	869.34	1.80	12	0.015	4.78	0.81	1.47	4.14	0.25	0.25	877.91	873.95	3.96	874.13	869.68	4.45
387	388	0.18	98	10.00	0.45	98	11.42	59	869.20	867.72	2.53	15	0.015	6.00	0.16	2.51	8.90	0.25	0.25	874.13	869.68	4.45	872.63	867.76	4.87
388	392	0.00	0	0.00	0.67	98	11.61	163	867.29	861.24	3.71	18	0.015	3.92	0.69	3.73	17.54	0.25	0.25	872.63	867.76	4.87	865.90	862.40	3.50
389	398	0.49	98	10.00	0.49	98	10.00	29	870.17	869.84	1.16	15	0.015	5.46	0.09	2.81	6.02	0.25	0.25	874.70	870.82	3.88	873.90	870.30	3.60
398	390	0.04	98	10.00	0.53	98	10.10	115	869.84	865.66	3.63	15	0.015	6.70	0.29	3.02	10.66	0.25	0.25	873.90	870.30	3.60	870.40	866.19	4.21
390	391	0.30	98	10.00	0.83	98	10.42	82	865.66	861.65	4.89	15	0.015	5.32	0.26	4.68	12.38	0.25	0.25	870.40	866.19	4.21	866.17	862.83	3.34
391	392	0.31	98	10.00	1.14	98	10.70	54	861.60	861.24	0.66	18	0.015	4.21	0.21	6.32	7.42	0.25	0.25	866.17	862.83	3.34	865.90	862.40	3.50
392	396	0.32	98	10.00	2.13	98	12.36	123	861.24	858.43	2.28	18	0.015	8.27	0.25	11.77	13.75	0.25	0.25	865.90	862.40	3.50	863.85	860.03	3.82
393	394	0.69	98	10.00	13.29	88	19.05	170	862.82	859.26	2.09	36	0.015	9.79	0.29	52.48	83.60	0.25	0.25	870.56	864.74	5.82	865.10	861.60	3.50
394	395	0.29	98	10.00	13.58	89	19.35	31	859.26	858.02	4.05	36	0.015	8.59	0.06	53.43	116.36	0.25	0.25	865.10	861.60	3.50	865.10	860.96	4.14
395	396	0.30	98	10.00	13.88	89	19.42	43	858.02	857.41	1.44	36	0.015	8.58	0.08	54.53	69.25	0.25	0.25	865.10	860.96	4.14	863.85	860.03	3.82
396	405	0.76	98	10.00	16.77	90	19.51	194	857.41	854.29	1.61	36	0.015	10.67	0.30	66.52	73.34	0.25	0.25	863.85	860.03	3.82	860.02	856.89	3.13
405	406	0.58	98	10.00	17.35	91	19.82	133	854.29	850.89	2.56	36	0.015	10.09	0.22	68.90	92.46	0.25	0.25	860.02	856.89	3.13	858.40	854.61	3.79
406	408	0.32	98	10.00	17.67	91	20.05	42	850.44	850.30	0.34	42	0.015	7.26	0.10	69.79	50.58	0.25	0.25	858.40	854.61	3.79	857.80	853.98	3.82
407	408	0.49	72	10.00	0.49	72	10.00	115	852.69	851.54	1.00	12	0.015	2.20	0.87	1.43	3.09	0.25	0.25	856.44	854.24	2.20	857.80	853.98	3.82
408	409	0.00	0	0.00	18.16	90	20.19	184	849.39	847.61	0.97	48	0.015	5.62	0.54	70.68	122.61	0.25	0.25	857.80	853.98	3.82	867.00	853.08	13.92
420	421	0.18	98	10.00	0.18	98	10.00	118	867.89	866.60	1.09	12	0.015	3.57	0.55	1.01	3.22	0.25	0.25	871.97	868.28	3.69	871.97	866.69	5.28
421	422	0.22	98	10.00	0.40	98	10.60	127	866.38	854.26	9.58	15	0.015	4.23	0.50	2.28	17.32	0.25	0.25	871.97	866.69	5.28	859.00	855.10	3.90
422	423	0.22	98	10.00	0.62	98	11.12	6	854.25	854.11	2.50	15	0.015	3.96	0.02	3.44	8.85	0.25	0.25	859.00	855.10	3.90	860.00	854.93	5.07
424	425	1.31	98	10.00	1.31	98	10.00	162	857.58	855.15	1.50	18	0.015	6.14	0.44	7.45	11.15	0.25	0.25	861.84	858.58	3.26	860.18	858.03	2.15
425	426	0.62	98	10.00	1.93	98	10.44	16	855.15	853.72	8.94	18	0.015	6.48	0.04	10.77	27.22	0.25	0.25	860.18	858.03	2.15	857.72	857.53	0.19
426	428	0.12	98	10.00	2.05	98	10.48	96	853.72	852.76	1.00	18	0.015	6.47	0.25	11.43	9.10	0.25	0.25	857.72	857.53	0.19	859.95	855.46	4.49
428	429	0.00	0	0.00	2.05	98	10.82	9	852.76	852.67	1.00	18	0.015	6.47	0.02	11.44	9.10	0.25	0.25	859.95	855.46	4.49	867.00	854.63	12.37

Storm Sewer Design

100 yr. Storm

Project: Liberty Center
Job No.: 06F135-005

Bayer Becker Engineers

Designed By: MJL Date: 10/21/13
Reviewed By: Date:
Revisions: MJL Date: 01/15/14
Revisions: MJL Date: 08/05/14

Revisions: MJL Date: 02/05/14
Revisions: MJL Date: 03/31/14
Revisions: MJL Date: 05/23/14
AS-Built 11-03-14

Up ID	Down ID	Area (Acres)	Cn	Tc Min	Cont Area (Acres)	Comp Cn	Cumul Tc Min	Length (ft)	Up Invert (ft)	Down Invert (ft)	Slope (%)	Pipe Diameter (inches)	Mannings N	Max Velocity (ft/sec)	Travel Time (min)	Peak Flow (cfs)	Design Capacity (cfs)	Ent Losses	Exit Losses	Up T/Gr (ft)	Up HGL (ft)	Up Freeboard (ft)	Down T/Gr (ft)	Down HGL (ft)	Down Freeboard (ft)
435	436	0.25	98	10.00	0.25	98	10.00	112	873.74	870.20	3.15	12	0.015	4.10	0.46	1.42	5.48	0.25	0.25	876.77	874.09	2.68	874.24	870.76	3.48
450	436	0.26	98	10.00	0.26	98	10.00	74	873.90	870.20	4.99	12	0.015	4.43	0.28	1.46	6.90	0.25	0.25	877.55	874.21	3.34	874.24	870.76	3.48
436	438	0.06	98	10.00	0.57	98	10.50	41	870.20	868.57	3.94	12	0.015	7.41	0.09	3.18	6.13	0.25	0.25	874.24	870.76	3.48	872.72	869.08	3.64
437	438	0.07	98	10.00	0.07	98	10.00	40	868.85	868.57	0.71	12	0.015	1.44	0.46	0.40	2.60	0.25	0.25	875.17	869.11	6.06	872.72	869.08	3.64
438	439	0.03	98	10.00	0.67	98	10.61	224	868.57	856.87	5.23	12	0.015	6.99	0.53	3.69	7.06	0.25	0.25	872.72	869.08	3.64	861.56	858.51	3.05
439	440	0.27	98	10.00	0.94	98	11.15	60	856.57	856.18	0.65	15	0.015	4.22	0.24	5.17	4.52	0.25	0.25	861.56	858.51	3.05	861.37	857.93	3.44
440	447	0.12	98	10.00	1.06	98	11.40	53	856.18	855.41	1.45	15	0.015	4.77	0.18	5.86	6.75	0.25	0.25	861.37	857.93	3.44	860.81	856.98	3.83
445	446	0.03	98	10.00	0.03	98	10.00	14	866.06	865.78	2.00	12	0.015	2.65	0.09	0.18	4.37	0.25	0.25	869.31	866.21	3.10	869.90	854.65	15.25
446	449	0.00	0	0.00	1.00	98	10.09	8	854.54	854.00	6.70	12	0.015	4.34	0.03	0.18	8.00	0.25	0.25	869.90	854.65	15.25	860.00	854.09	5.91
447	448	0.03	98	10.00	2.03	98	11.61	4	855.41	855.37	1.00	15	0.015	4.94	0.01	6.05	5.60	0.25	0.25	860.81	856.98	3.83	860.00	856.72	3.28
455	458	0.00	0	0.00	0.00	0	0.00	227	845.34	844.67	0.29	54	0.015	5.61	0.67	15.37	92.55	0.25	0.25	851.07	847.63	3.44	853.41	847.59	5.82
456	457	3.25	96	10.00	3.25	96	10.00	8	848.38	848.08	3.99	48	0.015	12.39	0.01	210.70	766.84	0.25	0.25	854.88	850.94	3.94	854.60	849.84	4.76
457	458	0.00	0	0.00	3.25	96	10.01	61	848.08	844.67	5.57	48	0.015	11.38	0.09	211.95	906.51	0.25	0.25	854.60	849.84	4.76	853.41	847.59	5.82
458	462	0.00	0	0.00	3.25	96	10.12	189	844.67	843.14	0.81	48	0.015	9.54	0.33	220.80	345.53	0.25	0.25	853.41	847.59	5.82	850.53	846.03	4.50
459	460	0.47	98	10.00	0.47	98	10.00	39	848.02	847.62	1.04	12	0.015	4.74	0.14	2.66	3.14	0.25	0.25	851.14	848.77	2.37	851.24	848.22	3.02
460	461	0.10	98	10.00	0.57	98	10.15	37	847.62	846.37	3.34	12	0.015	5.85	0.11	3.23	5.64	0.25	0.25	851.24	848.22	3.02	849.90	847.13	2.77
461	462	0.57	98	10.00	1.54	98	10.27	35	846.34	844.96	3.99	15	0.015	8.65	0.07	6.42	11.18	0.25	0.25	849.90	847.13	2.77	850.53	846.03	4.50
462	463	0.00	0	0.00	6.73	97	10.55	115	843.14	842.20	0.81	48	0.015	10.64	0.18	224.41	346.60	0.25	0.25	850.53	846.03	4.50	850.53	846.03	4.50
446	449	0.00	0	0.00	1.00	98	10.09	8	854.54	854.00	6.70	12	0.015	4.34	0.03	0.18	8.00	0.25	0.25	869.90	854.65	15.25	860.00	854.09	5.91
447	448	0.03	98	10.00	2.03	98	11.61	4	855.41	855.37	1.00	15	0.015	4.94	0.01	6.05	5.60	0.25	0.25	860.81	856.98	3.83	860.00	856.72	3.28
461	462	0.57	98	10.00	1.54	98	10.27	35	846.34	844.96	3.99	15	0.015	8.65	0.07	6.42	11.18	0.25	0.25	849.90	847.13	2.77	850.53	846.03	4.50
462	463	0.00	0	0.00	7.30	97	10.77	115	843.14	842.20	0.81	48	0.015	10.64	0.18	224.41	346.60	0.25	0.25	850.53	846.03	4.50	850.53	846.03	4.50
446	449	0.00	0	0.00	1.00	98	10.09	8	854.54	854.00	6.70	12	0.015	4.34	0.03	0.18	8.00	0.25	0.25	869.90	854.65	15.25	860.00	854.09	5.91
447	448	0.03	98	10.00	2.03	98	11.61	4	855.41	855.37	1.00	15	0.015	4.94	0.01	6.05	5.60	0.25	0.25	860.81	856.98	3.83	860.00	856.72	3.28