OK JW 8/5/14

STORM WATER CALCULATIONS
for
WOODBURY PLACE PHASE 2
O'FALLON, MISSOURI

Prepared for

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STORM WATER CALCULATIONS
WOODBURY PLACE

The site is in O'Fallon, St. Charles County, Missouri and is described as Lots 1 and 2 Woodbury Place, a part of the NW quarter of Section 29, T47N, R3E. The site is 8.32 acres of partially developed land that is bounded to the north by the Liberty Christian Church and a residential home, to the east by Woodlawn Avenue, to the south by a mix of commercial and residential, and to the west by residential. Phase 1 is 4.75 acres, was built in 2010 and consists of seven (7) six plex buildings, a community center, an accessory building, and a picnic pavilion. Phase 2 is 3.57 acres and will consist of seven (7) six plex units. The site is served by an underground detention basin.

Post development flows must be less than or equal to predevelopment flows for the 2, 15, 25, and 100-year storms. The existing detention basin was built for Phase 1 and will be made larger to accommodate the additional flow from Phase 2. Phase 1 has 4.32 acres flowing to the detention basin, 0.47 acres of bypass, and 0.41 acres of offsite water. Phase 2 has 3.36 acres flowing to the detention basin, 0.21 acres of bypass, and 1.13 acres of offsite water. The total site has 7.68 acres flowing to detention, 0.68 acres of bypass, and 1.54 acres of offsite water.

The Rational method for a 20 minute storm was used to determine pipe sizes. The runoff factors for the 15, 25, and 100-year storms came from city ordinance. The runoff factor for the 2-year storm is based on the IDF curve for MoDOT District 6 (St. Louis). The SCS method for a 24 hour storm was used to design the detention basin and control structures. The 24 hour storm event was calculated from MoDOT District 6 IDF curves for the 2-, 25-, and 100-year storms. The 15-year storm was extrapolated from MSD IDF Curve Figure 4-1. Detention basin inflow and outflow hydrographs were used to determine the size of the basin and to size the control structures.

The detention basin built will be increased so that it will treat the entire site. The existing basin consists of an Inflow Control Structure (ICS 2), a 30" header pipe, five (5) rows of StormTech MC-3500 chambers, and a Outflow Control Structure (OCS 1). Each row currently consists of about 33 chambers, and 16 chambers will be added to each row. The chambers are 3.75 high by 6.42 feet wide. Stormwater currently enters the detention basin at ICS 2 that is a 5 foot diameter manhole that has a weir that forces the low flow storms into the first row of chambers. A manhole and manifold will be added to the detention basin addition for the Phase 2 flows. The manifold will direct the first flush of stormwater into the isolator row. The isolator row is designed to have a TSS removal of 84% of an average particle size of 45 microns. OCS 1 is a 5 foot diameter manhole that has a series of weirs that control the flow from the detention basin. The discharge from the detention basin is designed to be less than the 2, 15, 25, and 100-year, predevelopment flows for the site.

OCS 1 is designed to handle the 100-year flow. The discharge pipe from the control structure is also sized to allow full discharge of the 100-year emergency flow. The roof of the control structure is set at least 1' above the 100-year flow elevation in the basin. The entire site runoff is summarized in the table below:

Table 1: Stormwater Runoff for Entire Site (Phases 1 & 2)

Design Storm	Predeveloped Runoff (cfs)	Post Developed Runoff (cfs)	Elevation in Detention Basin (feet)
2-year	11.1	10.3	586.0
15-year	28.5	28.1	587.1
25-year	34.6	33.6	587.4
100-year	61.7	54.0	589.8

The basin required sediment storage volume is:

(180 cf/yr x 3.36 acres + 250 cf/yr x 1.91 acres) x 2 years = 2,165 cf.

The basin has a total storage volume of 49,459 cf., of which 47,228 cf. is used during the 100-year storm, leaving 2,231 cf for sediment. Therefore the basin has adequate sediment storage.

Post construction water quality treatment shall be by the isolator row of the StormTech detention basin. The water quality volume (WQv) for the site is

WQv = [(1.14")(0.05 + 0.009 * 54.2%)(8.32 Acres)]/12 = 0.43 Ac-ft
WQv = 0.43 Ac-ft * 43,560 cf/Ac = 18,516 cf.

This is equivalent to 6.7 cfs (3,025 gpm) flow to the detention basin (See calculations in Appendix). According to the New Jersey Corporation for Advanced Technology report dated August 15, 2007, an isolator row sized at a treatment rate of no more than 2.5 gpm/sf of bottom area, using 2 layers of woven geotextile fabric under the base and one layer of nonwoven fabric wrapped over the system and a mean effluent concentration of 318 mg/L has been shown to have a TSS removal efficiency of 84% for an average particle size of 45 microns. The isolator row is 308.2 feet long and 6.42' wide. The isolator row treatment area is

Treatment area = 308.2 * 4 * 6.42 = 1,978 sf

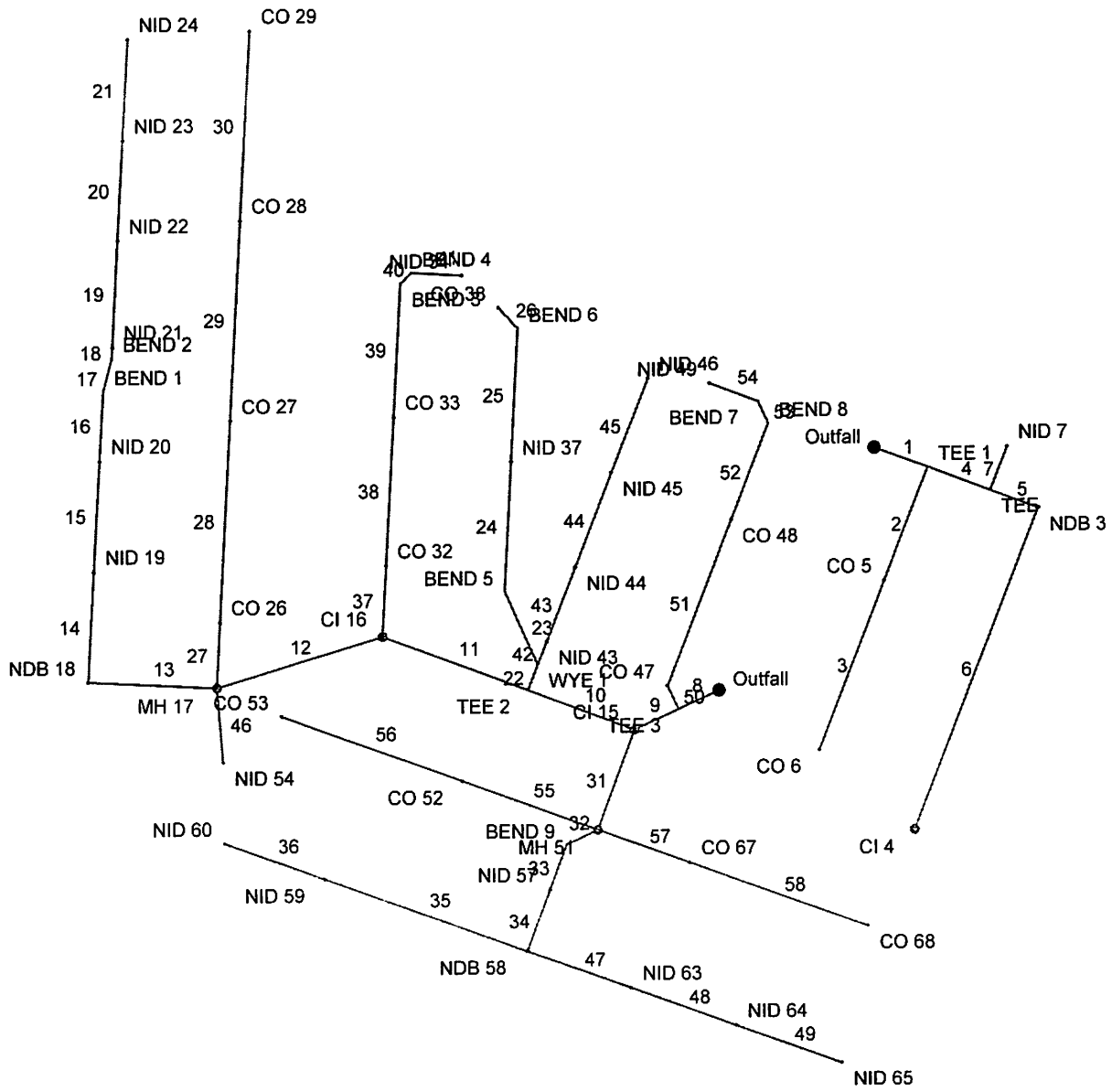
Treatment rate = 3,025 gpm/1,978 sf = 1.5 gpm/sf.

This treatment rate is well below the tested treatment rate which may indicate the isolator row may have a higher removal efficiency rate or may be able to treat higher concentrations of effluent.

The StormTech units may also provide some infiltration into the soils below the detention basin. The units are placed on a minimum of 9" of gravel that have 40% porosity. The footprint of the detention basin is 14,000 sf which provides a good area for infiltration. However, the soils on this site are clay (CH) and silty clay (CL) which are not expected to have very high infiltration rates.

APPENDIX A
STORM PIPE CALCULATIONS
15-YEAR STORM

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2013 Plan



Phase 2

Project File: 12660 Storm Sewers 15-YR.stm	Number of lines: 58	Date: 7/17/2014

Storm Sewers v10.00

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
1		1.15	15	Cir	28.000	584.31	584.57	0.929	587.10*	587.11*	0.01	587.12	End	None
2		0.23	8	Cir	60.000	584.80	586.28	2.467	587.12*	587.14*	0.00	587.14	1	Manhole
3		0.23	8	Cir	90.000	586.28	588.50	2.467	587.14	588.72	n/a	588.72 j	2	Manhole
4		0.92	15	Cir	32.761	584.56	584.87	0.946	587.12*	587.13*	0.01	587.14	1	None
5		0.79	15	Cir	25.000	584.87	585.10	0.920	587.14*	587.14*	0.01	587.15	4	DropGrate
6		0.52	12	Cir	170.253	585.30	586.40	0.646	587.15	587.18	0.01	587.19	5	Manhole
7		0.13	12	Cir	23.000	584.93	588.50	15.522	587.14	588.65	n/a	588.65 j	4	DropGrate
8		9.21	24	Cir	21.985	584.80	585.14	1.547	587.10	587.13	0.13	587.26	End	None
9		8.96	24	Cir	23.844	585.14	585.50	1.510	587.26	587.28	0.11	587.38	8	Manhole
10		5.46	18	Cir	55.878	586.00	586.42	0.752	587.38	587.32	n/a	587.32	9	None
11		4.44	18	Cir	76.347	586.42	587.00	0.760	587.32	587.81	n/a	587.81 j	10	Manhole
12		3.21	15	Cir	85.246	587.20	588.00	0.938	587.81	588.72	n/a	588.72	11	Manhole
13		2.15	12	Cir	63.169	588.30	589.00	1.108	588.82	589.63	0.40	589.63	12	DropGrate
14		1.98	12	Cir	55.000	589.00	589.71	1.291	589.63	590.31	n/a	590.31 j	13	DropGrate
15		1.75	12	Cir	55.000	589.71	590.43	1.309	590.31	590.99	n/a	590.99 j	14	DropGrate
16		1.47	12	Cir	34.927	590.43	590.88	1.288	590.99	591.39	n/a	591.39 j	15	None
17		1.47	12	Cir	16.948	590.88	591.10	1.298	591.39	591.61	0.05	591.61	16	None
18		1.47	12	Cir	5.353	591.10	591.17	1.308	591.61	591.68	0.10	591.68	17	DropGrate
19		1.15	12	Cir	53.000	591.17	591.86	1.302	591.68	592.31	n/a	592.31 j	18	DropGrate
20		0.81	12	Cir	50.000	591.86	592.51	1.300	592.31	592.89	n/a	592.89 j	19	DropGrate
21		0.40	12	Cir	50.000	592.51	593.16	1.300	592.89	593.42	n/a	593.42 j	20	DropGrate
22		1.02	12	Cir	13.626	586.47	586.73	1.908	587.32	587.15	n/a	587.15	10	None

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NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
23		0.32	8	Cir	39.778	587.00	588.25	3.142	587.17	588.51	0.05	588.51	22	None
24		0.32	8	Cir	64.178	588.25	590.26	3.132	588.51	590.52	0.05	590.52	23	DropGrate
25		0.27	8	Cir	66.638	590.26	592.36	3.151	590.52	592.60	n/a	592.60 j	24	None
26		0.27	8	Cir	14.160	592.36	592.80	3.107	592.60	593.04	0.09	593.04	25	Manhole
27		0.46	8	Cir	32.848	588.60	588.80	0.609	588.91	589.12	0.02	589.12	12	Manhole
28		0.46	8	Cir	100.000	588.80	589.50	0.700	589.12	589.82	0.02	589.82	27	Manhole
29		0.46	8	Cir	100.000	589.50	590.10	0.600	589.82	590.42	0.02	590.42	28	Manhole
30		0.23	8	Cir	94.078	590.10	590.70	0.638	590.42	590.92	n/a	590.92 j	29	Manhole
31		2.47	18	Cir	52.667	586.00	586.50	0.949	587.38	587.09	0.22	587.09	9	Manhole
32		2.01	12	Cir	17.101	586.70	586.87	0.994	587.21	587.47	n/a	587.47	31	None
33		2.01	12	Cir	23.589	586.87	587.10	0.975	587.47	587.70	n/a	587.70	32	DropGrate
34		1.97	12	Cir	32.755	587.10	587.50	1.221	587.70	588.10	n/a	588.10 j	33	DropGrate
35		0.61	12	Cir	106.000	587.50	589.51	1.896	588.10	589.83	n/a	589.83 j	34	DropGrate
36		0.27	12	Cir	52.000	589.51	590.50	1.904	589.83	590.71	n/a	590.71 j	35	DropGrate
37		0.27	8	Cir	35.000	587.40	587.80	1.143	587.81	588.04	n/a	588.04 j	11	Manhole
38		0.27	8	Cir	74.000	587.80	588.70	1.216	588.04	588.94	0.01	588.94	37	Manhole
39		0.27	8	Cir	66.535	588.70	589.58	1.323	588.94	589.82	0.06	589.82	38	None
40		0.27	8	Cir	7.416	589.57	589.67	1.348	589.82	589.91	n/a	589.91 j	39	None
41		0.27	8	Cir	25.025	589.67	590.00	1.319	589.91	590.24	0.09	590.24	40	DropGrate
42		0.70	12	Cir	12.374	586.73	587.05	2.586	587.15	587.40	n/a	587.40 j	22	DropGrate
43		0.62	12	Cir	39.400	587.05	588.00	2.411	587.40	588.33	n/a	588.33 j	42	DropGrate
44		0.39	12	Cir	50.000	588.00	589.20	2.400	588.33	589.46	n/a	589.46 j	43	DropGrate

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Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
45		0.19	12	Cir	50.000	589.20	590.40	2.400	589.46	590.58	n/a	590.58 j	44	DropGrate
46		0.60	12	Cir	36.907	588.90	589.30	1.084	589.16	589.62	n/a	589.62	12	DropGrate
47		0.72	12	Cir	53.935	587.50	588.12	1.150	588.10	588.47	n/a	588.47 j	34	DropGrate
48		0.38	12	Cir	55.000	588.12	588.76	1.164	588.47	589.01	n/a	589.01 j	47	DropGrate
49		0.15	12	Cir	55.000	588.76	589.40	1.164	589.01	589.56	n/a	589.56 j	48	DropGrate
50		0.25	8	Cir	12.811	585.80	585.99	1.483	587.26*	587.27*	0.01	587.27	8	Manhole
51		0.25	8	Cir	88.042	585.99	587.29	1.477	587.27	587.52	n/a	587.52 j	50	Manhole
52		0.25	8	Cir	51.124	587.29	588.05	1.487	587.52	588.28	0.06	588.28	51	None
53		0.25	8	Cir	12.126	588.04	588.22	1.484	588.28	588.45	n/a	588.45 j	52	None
54		0.25	8	Cir	25.425	588.22	588.60	1.495	588.45	588.83	0.08	588.83	53	DropGrate
55		0.23	8	Cir	70.794	587.00	587.73	1.031	587.19	587.95	0.01	587.95	31	Manhole
56		0.23	8	Cir	94.503	587.73	588.70	1.026	587.95	588.92	0.08	588.92	55	Manhole
57		0.23	8	Cir	47.836	587.00	587.54	1.129	587.18	587.76	0.01	587.76	31	Manhole
58		0.23	8	Cir	93.072	587.54	588.60	1.139	587.76	588.82	0.08	588.82	57	Manhole

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Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		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)		
	(in)	(cfs)									(ft)											(K)	(ft)
1	15	1.15	584.31	587.10	1.25	1.23	0.94	0.01	587.11	0.027	28.000	584.57	587.11	1.25	1.23	0.94	0.01	587.12	0.027	0.027	0.008	1.00	0.01
2	8	0.23	584.80	587.12	0.67	0.35	0.66	0.01	587.13	0.031	60.000	586.28	587.14	0.67	0.35	0.66	0.01	587.15	0.031	0.031	0.019	0.15	0.00
3	8	0.23	586.28	587.14	0.67	0.10	0.66	0.01	587.15	0.031	90.000	588.50	588.72 j	0.22**	0.10	2.28	0.08	588.80	0.551	0.291	n/a	1.00	0.08
4	15	0.92	584.56	587.12	1.25	1.23	0.75	0.01	587.13	0.017	32.761	584.87	587.13	1.25	1.23	0.75	0.01	587.14	0.017	0.017	0.006	1.00	0.01
5	15	0.79	584.87	587.14	1.25	1.23	0.64	0.01	587.14	0.013	25.000	585.10	587.14	1.25	1.23	0.64	0.01	587.15	0.013	0.013	0.003	1.50	0.01
6	12	0.52	585.30	587.15	1.00	0.79	0.66	0.01	587.16	0.018	170.253	586.40	587.18	0.78	0.66	0.79	0.01	587.19	0.020	0.019	0.033	1.00	0.01
7	12	0.13	584.93	587.14	1.00	0.07	0.17	0.00	587.14	0.001	23.000	588.50	588.65 j	0.15**	0.07	1.81	0.05	588.70	0.520	0.261	n/a	1.00	0.05
8	24	9.21	584.80	587.10	2.00	3.14	2.93	0.13	587.23	0.141	21.985	585.14	587.13	1.99	3.14	2.93	0.13	587.26	0.133	0.137	0.030	1.00	0.13
9	24	8.96	585.14	587.26	2.00	3.14	2.85	0.13	587.39	0.134	23.844	585.50	587.28	1.78	2.95	3.04	0.14	587.42	0.119	0.126	0.030	0.76	0.11
10	18	5.46	586.00	587.38	1.38	1.11	3.20	0.38	587.76	0.000	55.878	586.42	587.32	0.90**	1.11	4.93	0.38	587.70	0.000	0.000	n/a	1.00	n/a
11	18	4.44	586.42	587.32	0.90	0.97	4.01	0.33	587.65	0.000	76.347	587.00	587.81 j	0.81**	0.97	4.58	0.33	588.13	0.000	0.000	n/a	0.96	n/a
12	15	3.21	587.20	587.81	0.61	0.59	5.42	0.30	588.11	0.000	85.246	588.00	588.72	0.72**	0.73	4.38	0.30	589.02	0.000	0.000	n/a	1.00	n/a
13	12	2.15	588.30	588.82	0.52*	0.41	5.24	0.27	589.09	0.000	63.169	589.00	589.63	0.63**	0.52	4.16	0.27	589.89	0.000	0.000	n/a	1.50	0.40
14	12	1.98	589.00	589.63	0.63	0.49	3.83	0.25	589.88	0.000	55.000	589.71	590.31 j	0.60**	0.49	4.03	0.25	590.56	0.000	0.000	n/a	0.50	0.13
15	12	1.75	589.71	590.31	0.60	0.45	3.56	0.23	590.54	0.000	55.000	590.43	590.99 j	0.56**	0.45	3.85	0.23	591.22	0.000	0.000	n/a	0.50	0.12
16	12	1.47	590.43	590.99	0.56	0.41	3.23	0.20	591.20	0.000	34.927	590.88	591.39 j	0.51**	0.41	3.62	0.20	591.60	0.000	0.000	n/a	0.23	0.05
17	12	1.47	590.88	591.39	0.51*	0.41	3.62	0.20	591.60	0.000	16.948	591.10	591.61	0.51**	0.41	3.62	0.20	591.82	0.000	0.000	n/a	0.23	0.05
18	12	1.47	591.10	591.61	0.51*	0.41	3.62	0.20	591.82	0.000	5.353	591.17	591.68	0.51**	0.41	3.62	0.20	591.89	0.000	0.000	n/a	0.50	0.10
19	12	1.15	591.17	591.68	0.51	0.34	2.83	0.17	591.86	0.000	53.000	591.86	592.31 j	0.45**	0.34	3.34	0.17	592.49	0.000	0.000	n/a	0.50	n/a
20	12	0.81	591.86	592.31	0.45	0.27	2.35	0.14	592.45	0.000	50.000	592.51	592.89 j	0.38**	0.27	3.00	0.14	593.03	0.000	0.000	n/a	0.50	0.07
21	12	0.40	592.51	592.89	0.38	0.16	1.48	0.09	592.98	0.000	50.000	593.16	593.42 j	0.26**	0.16	2.45	0.09	593.51	0.000	0.000	n/a	1.00	n/a

Project File: 12660 Storm Sewers 15-YR.stm | Number of lines: 58 | Run Date: 7/17/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

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)
22	12	1.02	586.47	587.32	0.85	0.32	1.43	0.16	587.48	0.000	13.626	586.73	587.15	0.42**	0.32	3.22	0.16	587.31	0.000	0.000	n/a	0.75	n/a
23	8	0.32	587.00	587.17	0.17*	0.07	4.66	0.10	587.27	0.000	39.778	588.25	588.51	0.26**	0.13	2.51	0.10	588.61	0.000	0.000	n/a	0.51	0.05
24	8	0.32	588.25	588.51	0.26*	0.13	2.51	0.10	588.61	0.000	64.178	590.26	590.52	0.26**	0.13	2.51	0.10	590.62	0.000	0.000	n/a	0.50	0.05
25	8	0.27	590.26	590.52	0.26	0.11	2.12	0.09	590.61	0.000	66.638	592.36	592.60 j	0.24**	0.11	2.39	0.09	592.69	0.000	0.000	n/a	0.75	0.07
26	8	0.27	592.36	592.60	0.24*	0.11	2.39	0.09	592.69	0.000	14.160	592.80	593.04	0.24**	0.11	2.39	0.09	593.13	0.000	0.000	n/a	1.00	0.09
27	8	0.46	588.60	588.91	0.31*	0.16	2.85	0.12	589.04	0.000	32.848	588.80	589.12	0.32**	0.16	2.82	0.12	589.24	0.000	0.000	n/a	0.15	0.02
28	8	0.46	588.80	589.12	0.32*	0.16	2.82	0.12	589.24	0.000	100.000	589.50	589.82	0.32**	0.16	2.82	0.12	589.94	0.000	0.000	n/a	0.15	0.02
29	8	0.46	589.50	589.82	0.32*	0.16	2.82	0.12	589.94	0.000	100.000	590.10	590.42	0.32**	0.16	2.82	0.12	590.54	0.000	0.000	n/a	0.15	0.02
30	8	0.23	590.10	590.42	0.32	0.10	1.41	0.08	590.50	0.000	94.078	590.70	590.92 j	0.22**	0.10	2.28	0.08	591.00	0.000	0.000	n/a	1.00	0.08
31	18	2.47	586.00	587.38	1.38	0.65	1.45	0.22	587.61	0.000	52.667	586.50	587.09	0.59**	0.65	3.79	0.22	587.32	0.000	0.000	n/a	1.00	0.22
32	12	2.01	586.70	587.21	0.51*	0.41	4.95	0.25	587.47	0.000	17.101	586.87	587.47	0.60**	0.50	4.05	0.25	587.73	0.000	0.000	n/a	0.75	n/a
33	12	2.01	586.87	587.47	0.60*	0.50	4.05	0.25	587.73	0.000	23.589	587.10	587.70	0.60**	0.50	4.05	0.25	587.96	0.000	0.000	n/a	0.50	n/a
34	12	1.97	587.10	587.70	0.60	0.49	3.97	0.25	587.96	0.000	32.755	587.50	588.10 j	0.60**	0.49	4.02	0.25	588.35	0.000	0.000	n/a	2.25	0.56
35	12	0.61	587.50	588.10	0.60	0.22	1.24	0.12	588.22	0.000	106.000	589.51	589.83 j	0.32**	0.22	2.76	0.12	589.95	0.000	0.000	n/a	0.50	n/a
36	12	0.27	589.51	589.83	0.32	0.12	1.22	0.08	589.91	0.000	52.000	590.50	590.71 j	0.21**	0.12	2.20	0.08	590.79	0.000	0.000	n/a	1.00	0.08
37	8	0.27	587.40	587.81	0.41	0.11	1.21	0.09	587.90	0.000	35.000	587.80	588.04 j	0.24**	0.11	2.39	0.09	588.13	0.000	0.000	n/a	0.15	0.01
38	8	0.27	587.80	588.04	0.24*	0.11	2.39	0.09	588.13	0.000	74.000	588.70	588.94	0.24**	0.11	2.39	0.09	589.03	0.000	0.000	n/a	0.15	0.01
39	8	0.27	588.70	588.94	0.24*	0.11	2.39	0.09	589.03	0.000	66.535	589.58	589.82	0.24**	0.11	2.39	0.09	589.91	0.000	0.000	n/a	0.72	0.06
40	8	0.27	589.57	589.82	0.25	0.11	2.26	0.09	589.91	0.000	7.416	589.67	589.91 j	0.24**	0.11	2.39	0.09	590.00	0.000	0.000	n/a	0.78	0.07
41	8	0.27	589.67	589.91	0.24*	0.11	2.39	0.09	590.00	0.000	25.025	590.00	590.24	0.24**	0.11	2.39	0.09	590.33	0.000	0.000	n/a	1.00	0.09
42	12	0.70	586.73	587.15	0.42	0.24	2.21	0.13	587.28	0.000	12.374	587.05	587.40 j	0.35**	0.24	2.87	0.13	587.53	0.000	0.000	n/a	0.50	n/a

Project File: 12660 Storm Sewers 15-YR.stm | Number of lines: 58 | Run Date: 7/17/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

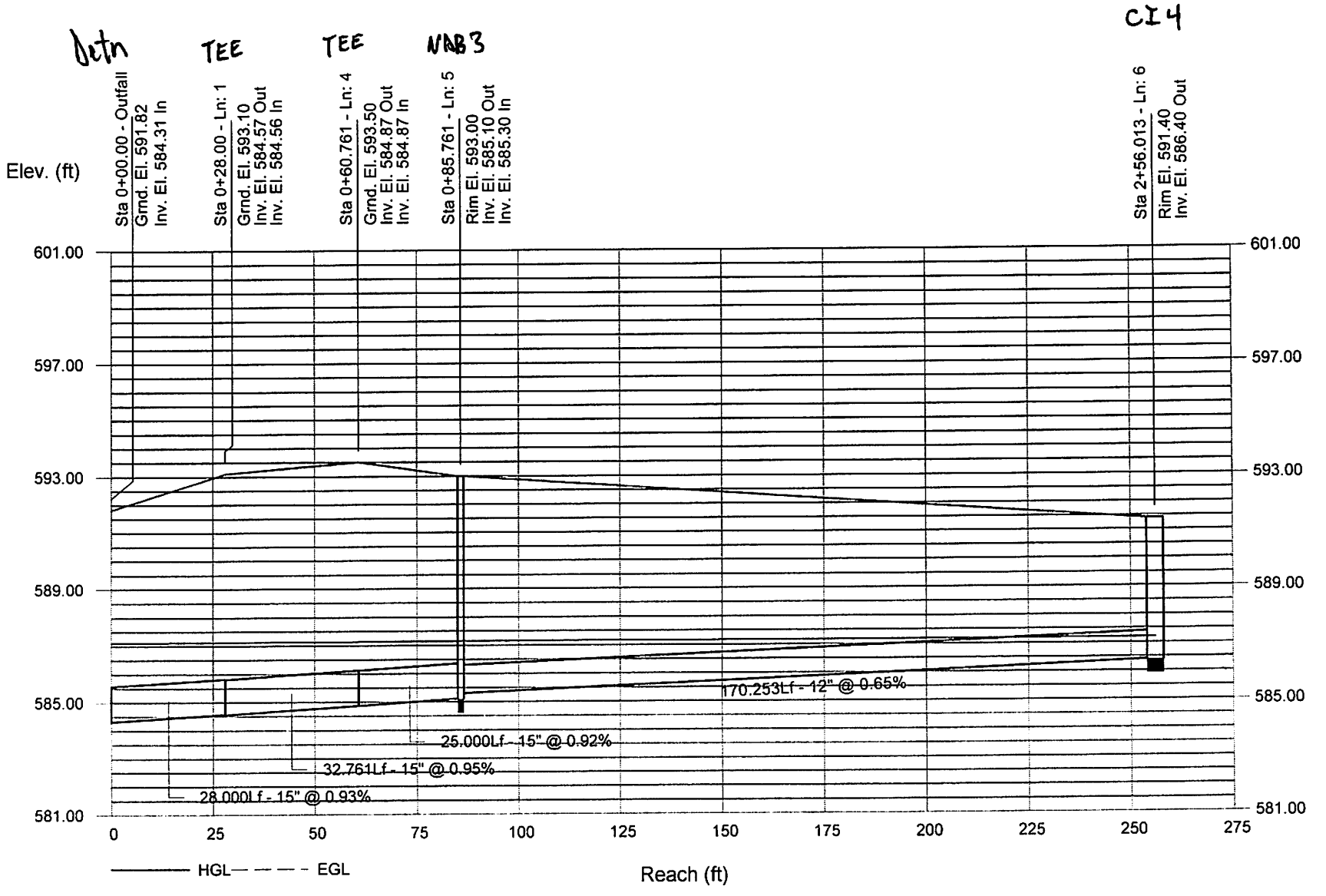
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
43	12	0.62	587.05	587.40	0.35	0.22	2.55	0.12	587.52	0.000	39.400	588.00	588.33 j	0.33**	0.22	2.77	0.12	588.45	0.000	0.000	n/a	0.50	n/a
44	12	0.39	588.00	588.33	0.33	0.16	1.74	0.09	588.42	0.000	50.000	589.20	589.46 j	0.26**	0.16	2.43	0.09	589.55	0.000	0.000	n/a	0.50	n/a
45	12	0.19	589.20	589.46	0.26	0.10	1.19	0.06	589.52	0.000	50.000	590.40	590.58 j	0.18**	0.10	2.00	0.06	590.64	0.000	0.000	n/a	1.00	n/a
46	12	0.60	588.90	589.16	0.26*	0.16	3.67	0.12	589.28	0.000	36.907	589.30	589.62	0.32**	0.22	2.75	0.12	589.74	0.000	0.000	n/a	1.00	n/a
47	12	0.72	587.50	588.10	0.60	0.25	1.47	0.13	588.23	0.000	53.935	588.12	588.47 j	0.35**	0.25	2.90	0.13	588.60	0.000	0.000	n/a	0.50	n/a
48	12	0.38	588.12	588.47	0.35	0.16	1.53	0.09	588.56	0.000	55.000	588.76	589.01 j	0.25**	0.16	2.41	0.09	589.11	0.000	0.000	n/a	0.50	n/a
49	12	0.15	588.76	589.01	0.25	0.08	0.95	0.05	589.07	0.000	55.000	589.40	589.56 j	0.16**	0.08	1.88	0.05	589.61	0.000	0.000	n/a	1.00	n/a
50	8	0.25	585.80	587.26	0.67	0.35	0.72	0.01	587.27	0.037	12.811	585.99	587.27	0.67	0.35	0.72	0.01	587.28	0.037	0.037	0.005	0.76	0.01
51	8	0.25	585.99	587.27	0.67	0.11	0.72	0.01	587.28	0.037	88.042	587.29	587.52 j	0.23**	0.11	2.34	0.08	587.61	0.554	0.295	n/a	0.15	0.01
52	8	0.25	587.29	587.52	0.23*	0.11	2.34	0.08	587.61	0.000	51.124	588.05	588.28	0.23**	0.11	2.34	0.08	588.37	0.000	0.000	n/a	0.75	0.06
53	8	0.25	588.04	588.28	0.24	0.11	2.20	0.08	588.37	0.000	12.126	588.22	588.45 j	0.23**	0.11	2.34	0.08	588.54	0.000	0.000	n/a	0.75	0.06
54	8	0.25	588.22	588.45	0.23*	0.11	2.34	0.08	588.54	0.000	25.425	588.60	588.83	0.23**	0.11	2.34	0.08	588.92	0.000	0.000	n/a	1.00	0.08
55	8	0.23	587.00	587.19	0.19*	0.08	2.85	0.08	587.27	0.000	70.794	587.73	587.95	0.22**	0.10	2.28	0.08	588.03	0.000	0.000	n/a	0.15	0.01
56	8	0.23	587.73	587.95	0.22*	0.10	2.28	0.08	588.03	0.000	94.503	588.70	588.92	0.22**	0.10	2.28	0.08	589.00	0.000	0.000	n/a	1.00	0.08
57	8	0.23	587.00	587.18	0.18*	0.08	2.94	0.08	587.26	0.000	47.836	587.54	587.76	0.22**	0.10	2.28	0.08	587.84	0.000	0.000	n/a	0.15	0.01
58	8	0.23	587.54	587.76	0.22*	0.10	2.28	0.08	587.84	0.000	93.072	588.60	588.82	0.22**	0.10	2.28	0.08	588.90	0.000	0.000	n/a	1.00	0.08

Project File: 12660 Storm Sewers 15-YR.stm | Number of lines: 58 | Run Date: 7/17/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

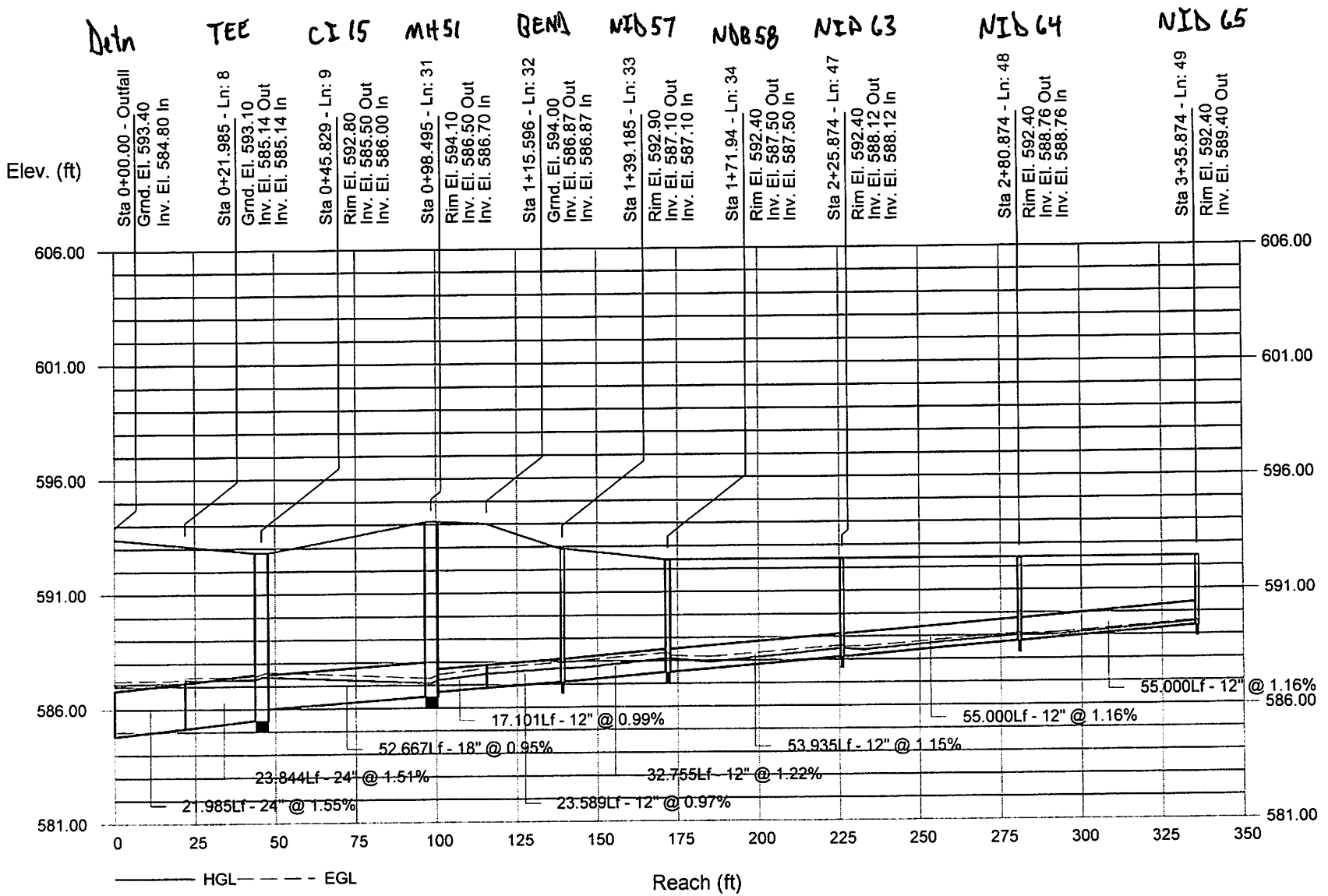
Storm Sewer Profile

Proj. file: 12660 Storm Sewers 15-YR.stm



Storm Sewer Profile

Proj. file: 12660 Storm Sewers 15-YR.stm



Storm Sewer Profile

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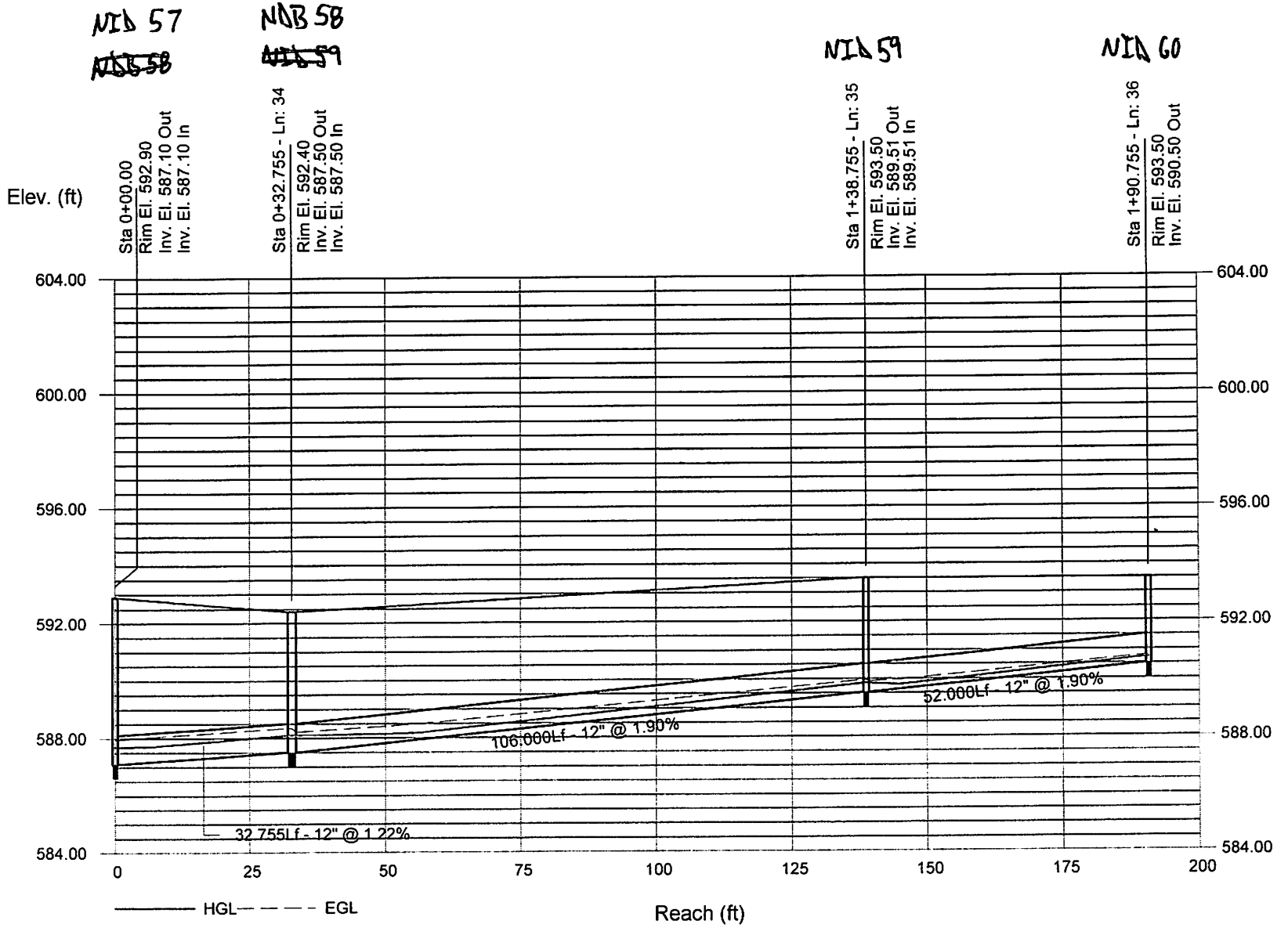
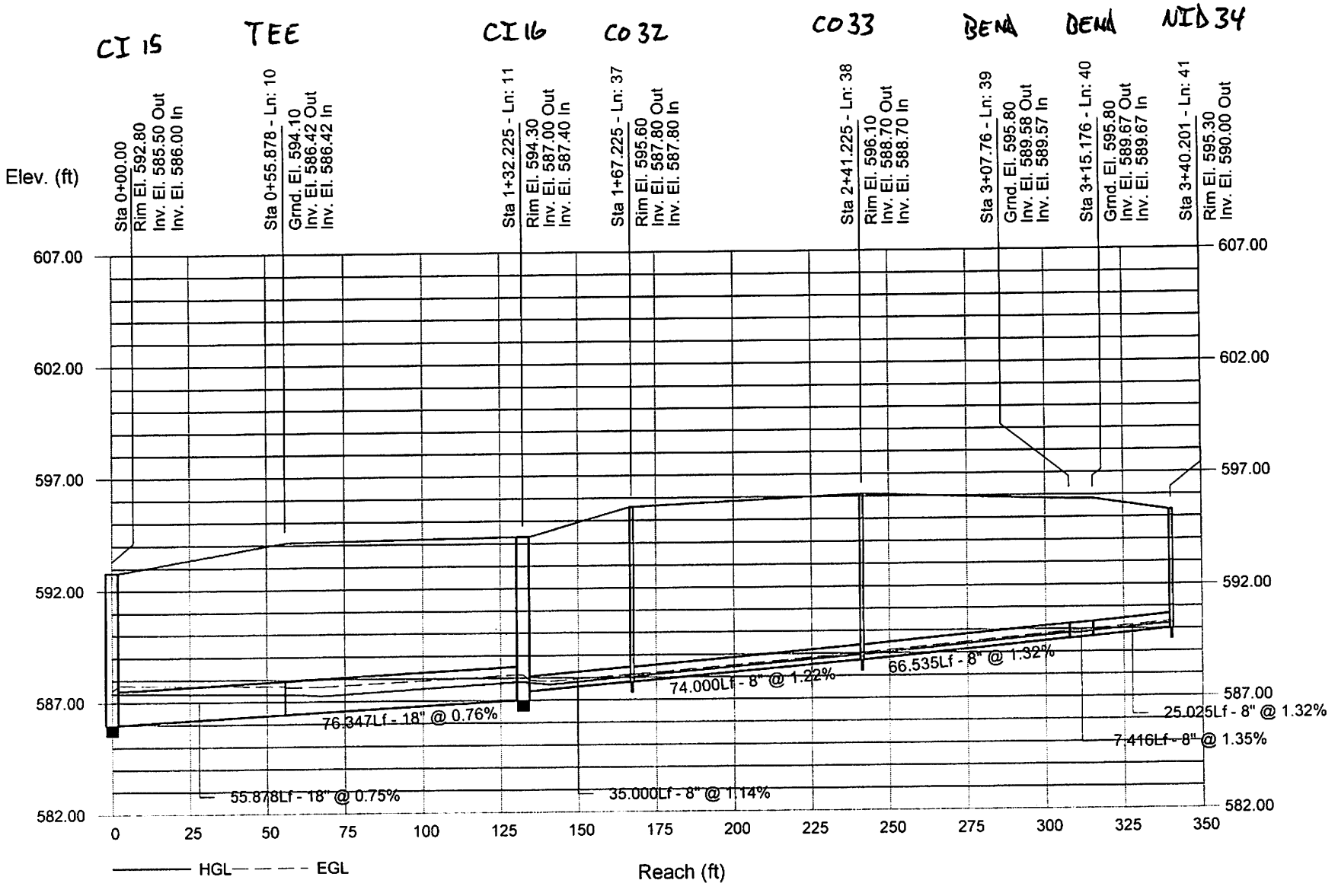


Storm Sewer Profile

Proj. file: 12660 Storm Sewers 15-YR.stm



Storm Sewer Profile

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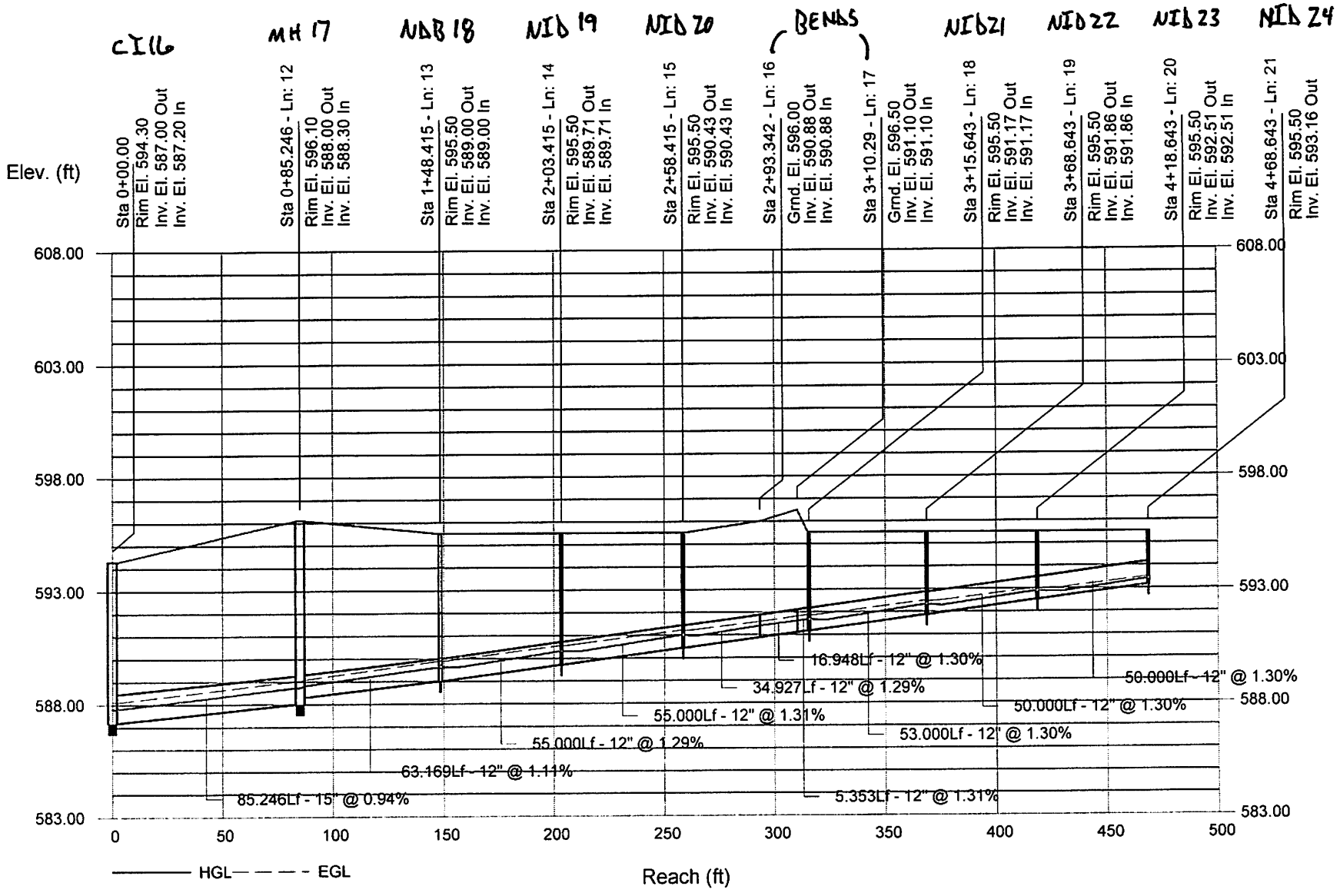

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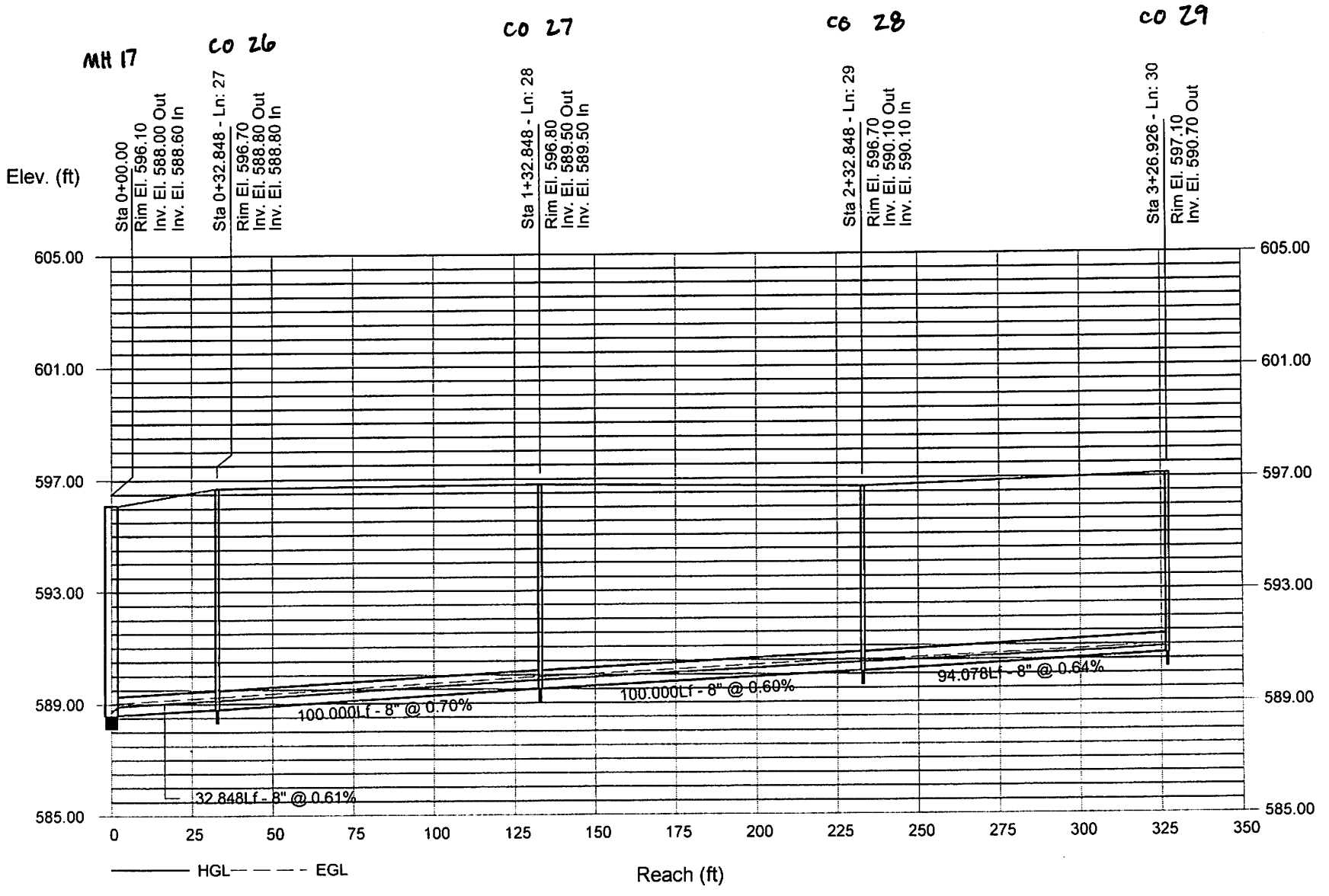

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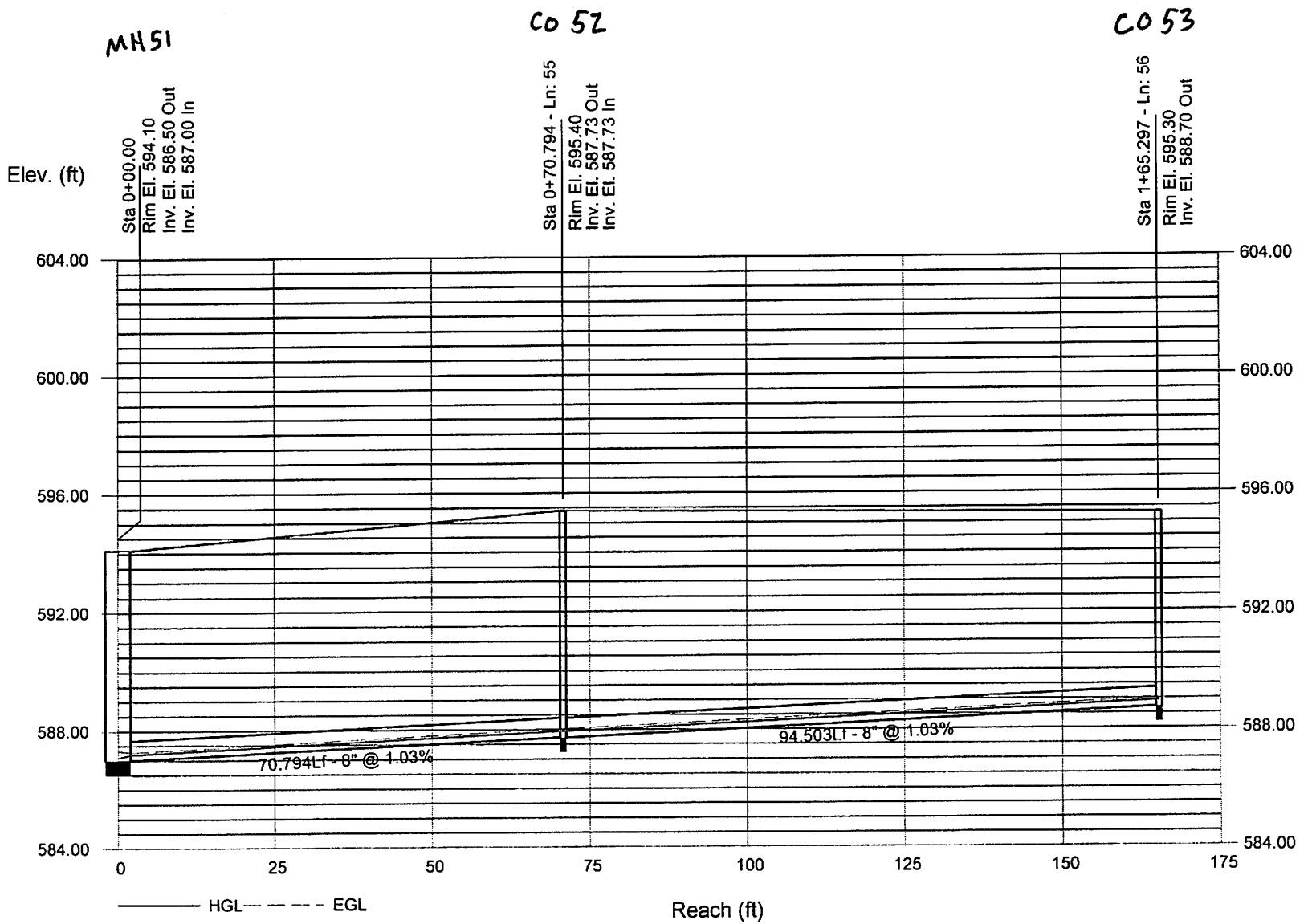

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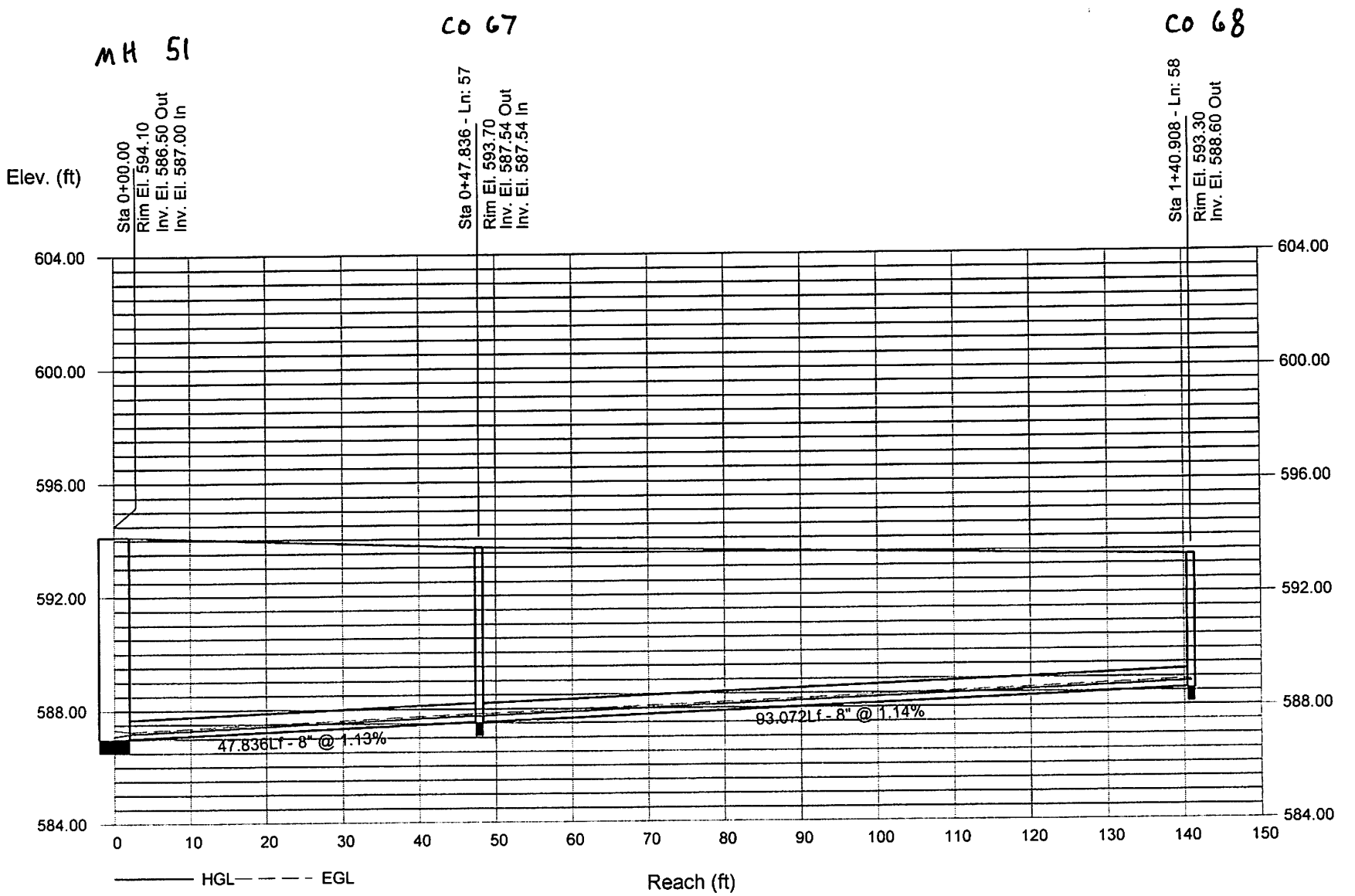

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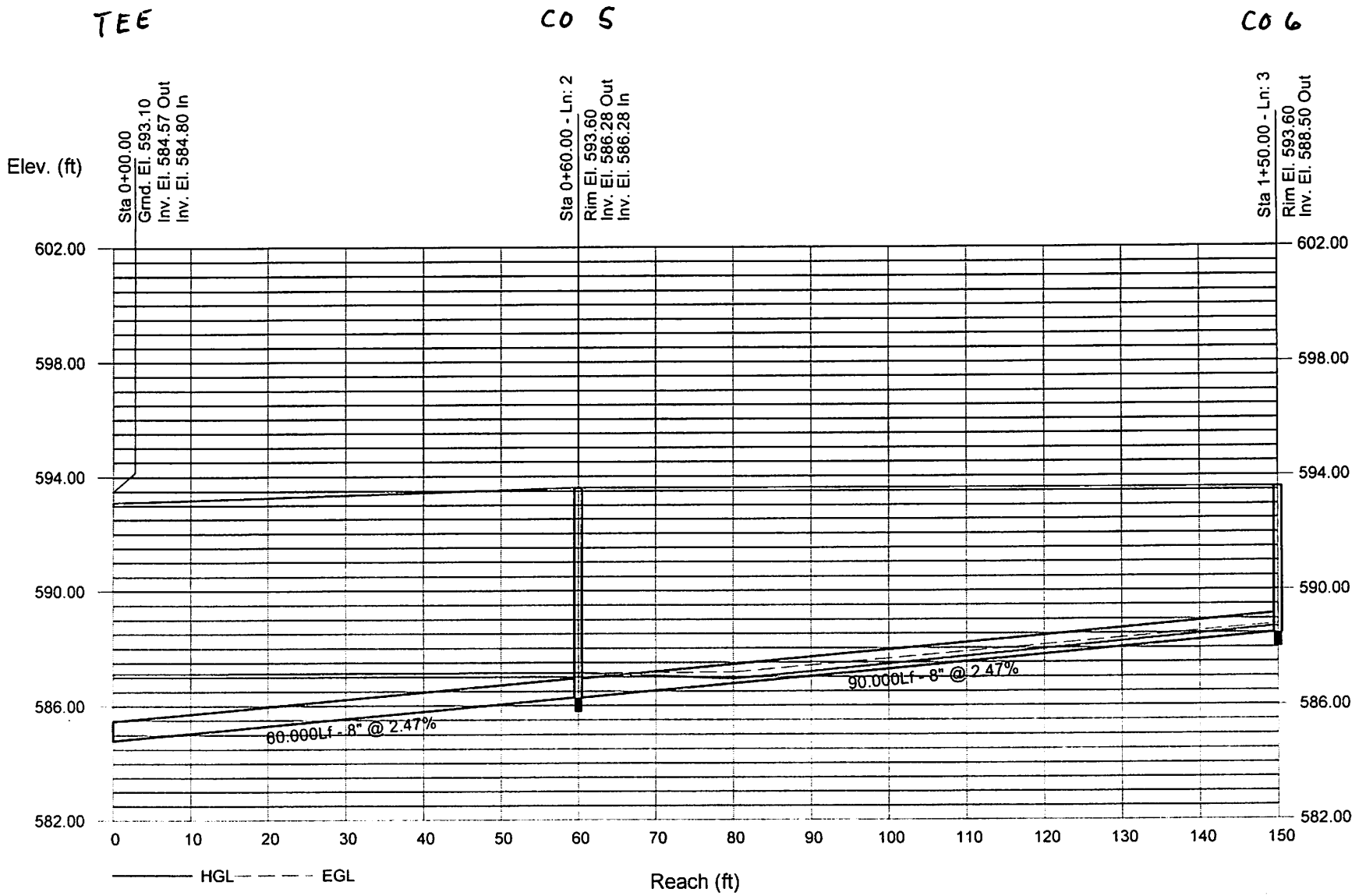

Storm Sewer Profile

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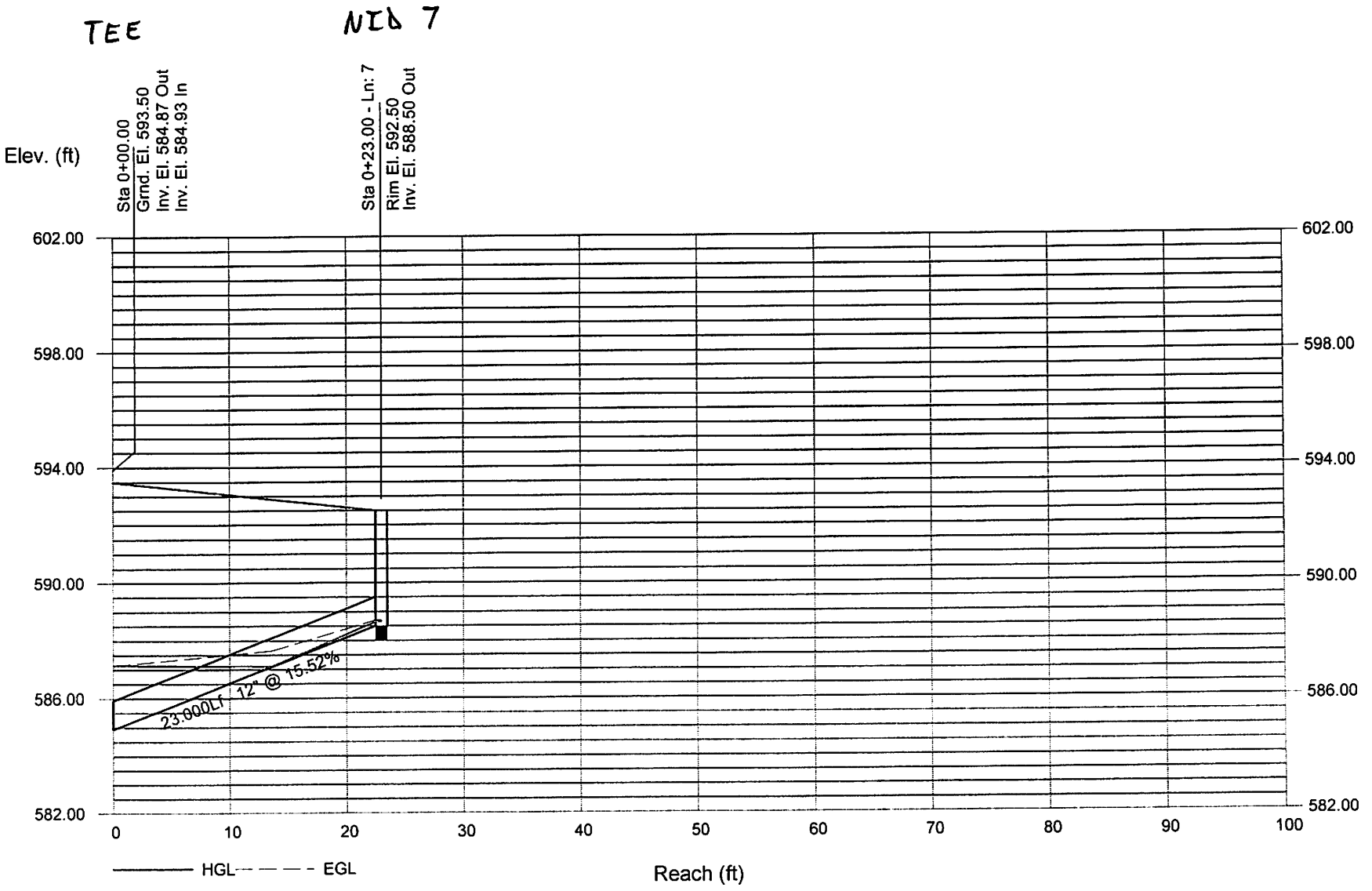

Storm Sewer Profile

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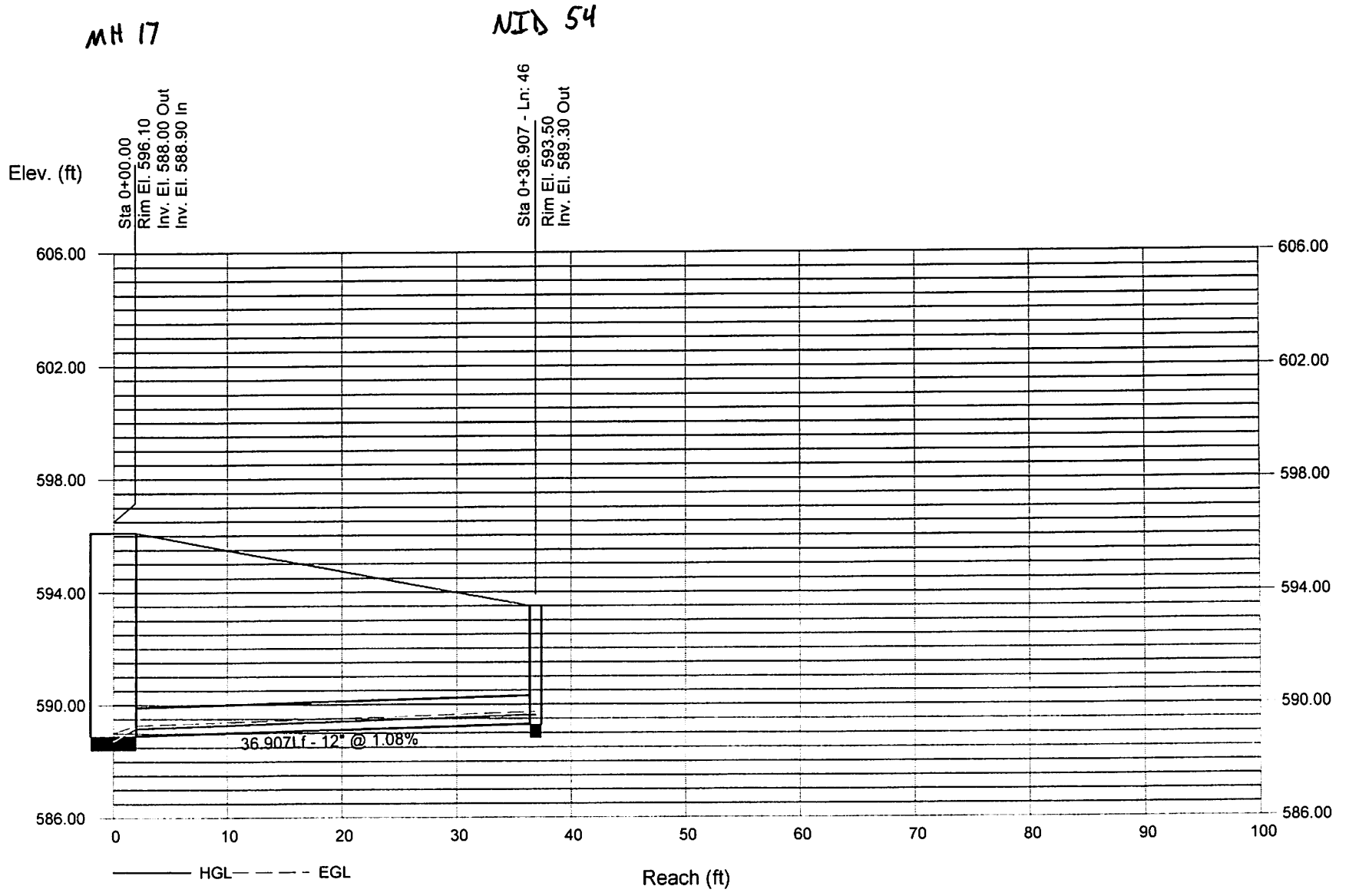

Storm Sewer Profile

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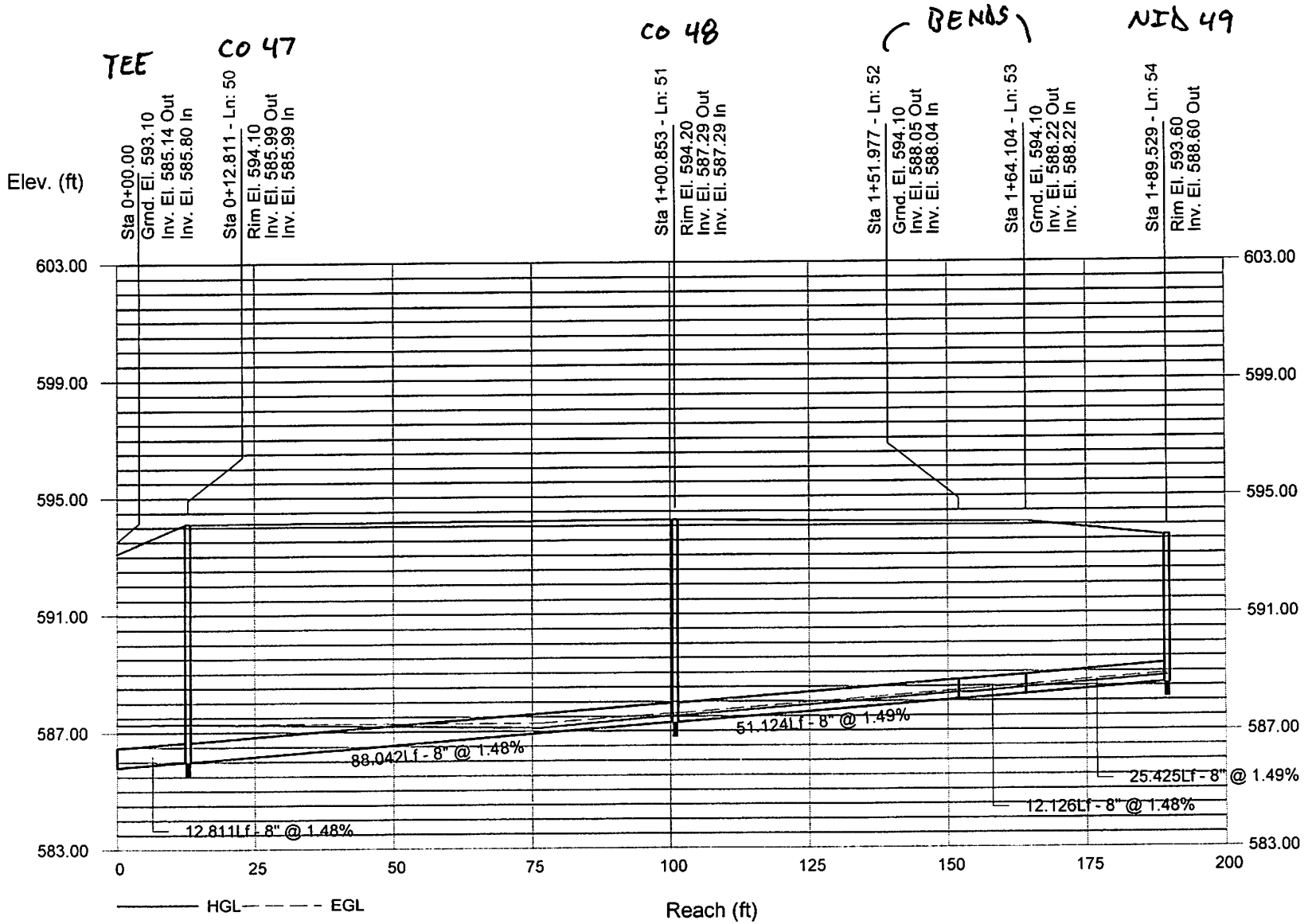

Storm Sewer Profile

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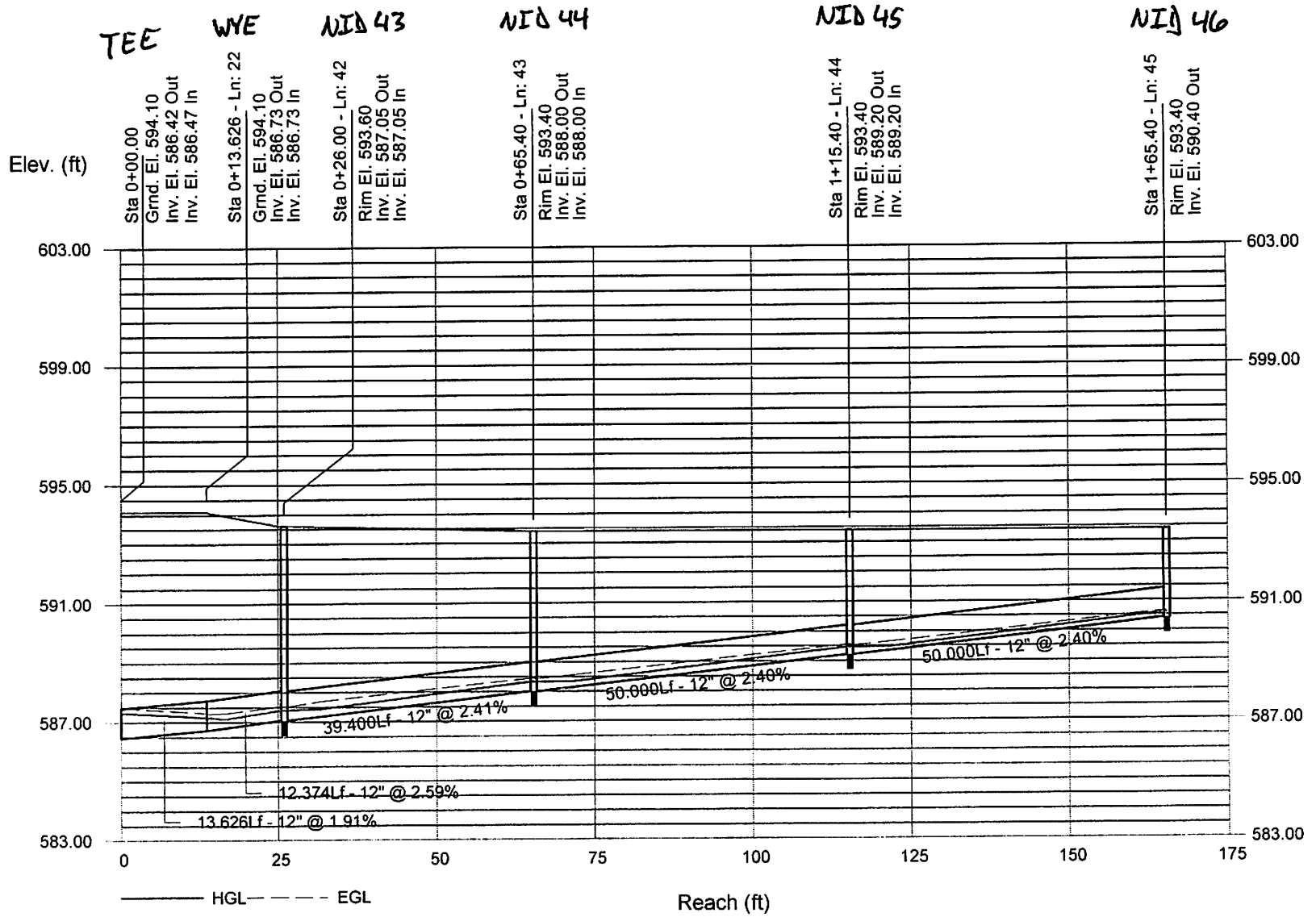

Storm Sewer Profile

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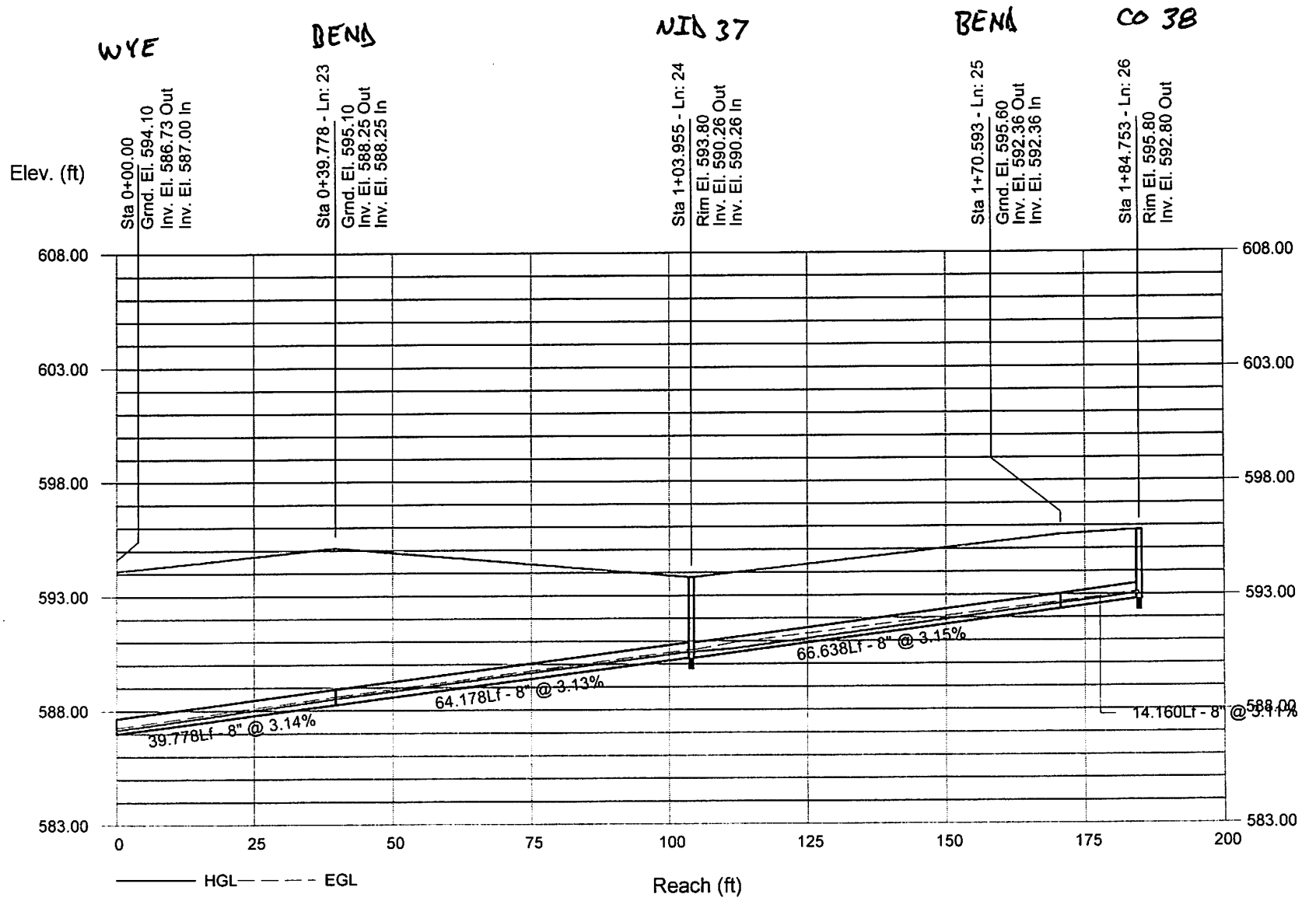
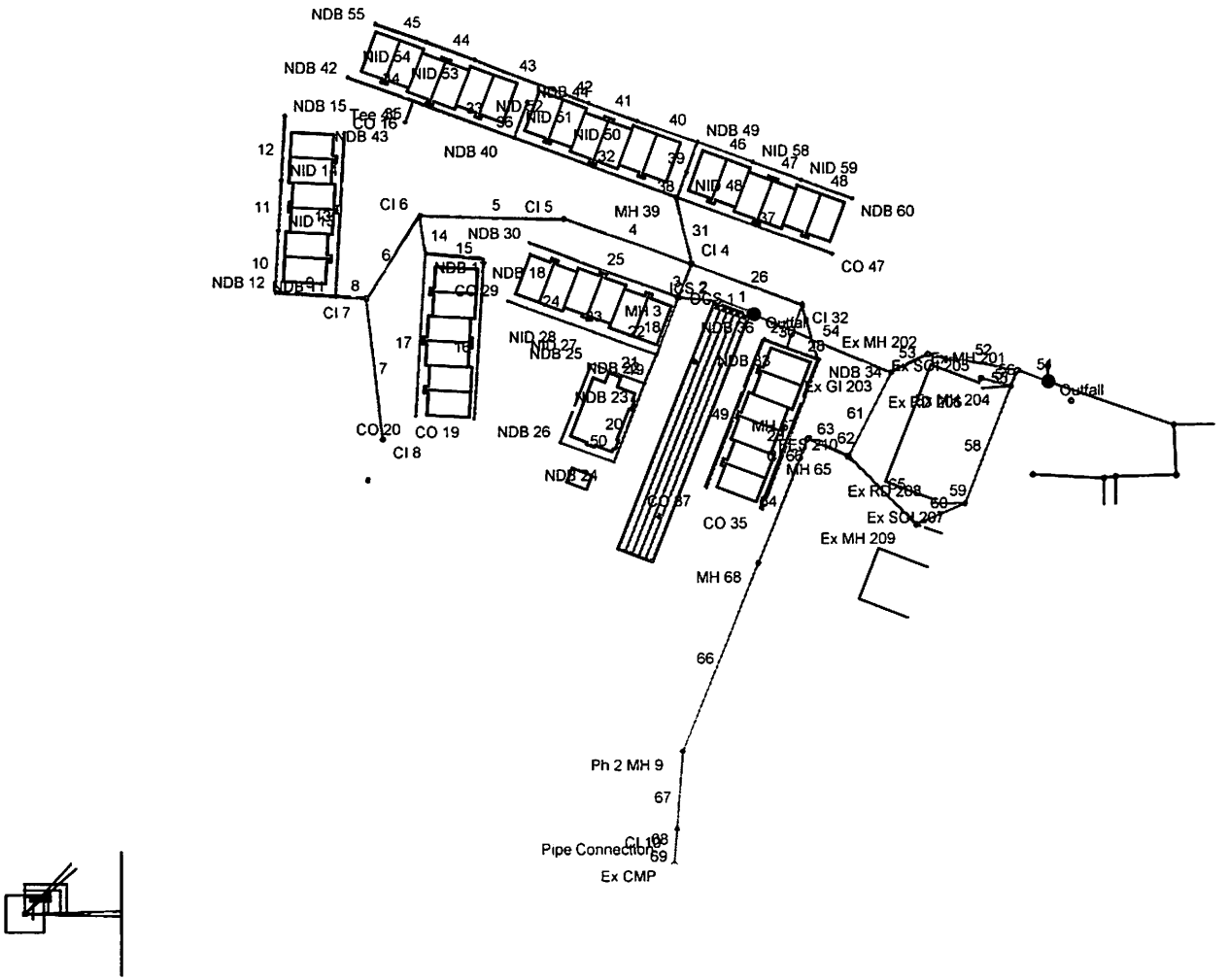


Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2013 Plan



Phase 1

Project File: 11354 Storm 15-yr.stm	Number of lines: 69	Date: 5/16/2014

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
1	ICS 2 to Detn	12.81	30	Cir	35.700	584.40	584.50	0.280	587.10*	587.13*	0.03	587.16	End	Manhole
2	MH 3 to ICS 2	12.81	30	Cir	39.398	584.50	584.80	0.761	587.16	587.19	0.11	587.30	1	Manhole
3	CI 4 to MH 3	11.08	30	Cir	34.971	585.00	585.30	0.858	587.30	586.41	1.28	586.41	2	Combination
4	CI 5 to CI 4	6.21	24	Cir	129.142	585.80	586.80	0.774	586.78	587.68	n/a	587.68 j	3	Combination
5	CI 6 to CI 5	4.74	18	Cir	138.755	587.30	588.40	0.793	588.02	589.24	n/a	589.24	4	Combination
6	CI 7 to CI 6	3.74	18	Cir	94.555	588.60	589.40	0.846	589.51	590.14	n/a	590.14 j	5	Combination
7	CI 8 to CI 7	1.17	15	Cir	137.207	589.60	590.70	0.802	590.41	591.13	n/a	591.13 j	6	Combination
8	NDB 11 to CI 7	1.80	12	Cir	29.648	589.50	589.80	1.012	590.35	590.37	n/a	590.37 j	6	Manhole
9	NDB 12 to NDB 11	1.50	12	Cir	57.690	590.00	590.60	1.040	590.55	591.12	n/a	591.12 j	8	DropGrate
10	NID 13 to NDB 12	1.20	12	Cir	59.339	590.80	591.42	1.045	591.29	591.88	n/a	591.88 j	9	DropGrate
11	NID 14 to NID 13	0.50	12	Cir	49.035	591.42	591.95	1.081	592.05	592.24	n/a	592.24 j	10	DropGrate
12	NDB 15 to NID 14	0.15	12	Cir	62.081	591.95	592.59	1.031	592.35	592.75	n/a	592.75 j	11	DropGrate
13	CO 16 to NDB 11	0.30	10	Cir	157.866	590.80	592.40	1.014	591.01	592.64	n/a	592.64	8	Manhole
14	NDB 17 to CI 6	0.58	10	Cir	36.950	588.80	589.20	1.083	589.56	589.53	n/a	589.53 j	5	Manhole
15	NDB 18 to NDB 17	0.28	10	Cir	55.847	589.40	590.00	1.074	589.66	590.23	n/a	590.23 j	14	Manhole
16	CO 19 to NDB 18	0.28	10	Cir	155.417	590.20	591.90	1.094	590.39	592.13	n/a	592.13	15	Manhole
17	CO 20 to NDB 17	0.30	10	Cir	157.586	589.70	591.30	1.015	589.90	591.54	n/a	591.54	14	Manhole
18	NDB 22 to MH 3	1.43	12	Cir	59.638	585.80	586.40	1.006	587.36	587.40	0.08	587.48	2	DropGrate
19	NDB 23 to NDB 22	0.73	12	Cir	30.358	586.60	587.00	1.318	587.48	587.36	n/a	587.36	18	DropGrate
20	NDB 24 to NDB 23	0.45	10	Cir	81.312	587.20	588.20	1.230	587.48	588.49	n/a	588.49	19	DropGrate
21	NDB 25 to NDB 23	0.24	10	Cir	53.362	587.20	587.80	1.124	587.48	588.01	n/a	588.01 j	19	DropGrate
22	NID 27 to NDB 22	0.67	10	Cir	64.445	586.60	587.30	1.086	587.51	587.66	n/a	587.66 j	18	DropGrate

Project File: 11354 Storm 15-yr.stm | Number of lines: 69 | Run Date: 5/16/2014

NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
23	NID 28 to NID 27	0.32	10	Cir	22.214	587.30	587.60	1.350	587.79	587.85	n/a	587.85 j	22	DropGrate
24	CO 29 to NID 28	0.09	10	Cir	65.070	587.60	588.40	1.230	587.93	588.53	n/a	588.53 j	23	DropGrate
25	NDB 30 to MH 3	0.30	10	Cir	150.615	586.10	587.90	1.195	587.40	588.14	n/a	588.14 j	2	Manhole
26	CI 32 to CI 4	1.08	12	Cir	113.359	586.80	587.60	0.706	587.20	588.04	0.25	588.04	3	Combination
27	NDB 33 to CI 32	0.58	12	Cir	44.400	587.80	588.20	0.901	588.20	588.52	n/a	588.52 j	26	Manhole
28	NDB 34 to NDB 33	0.28	12	Cir	33.100	588.40	588.70	0.906	588.63	588.92	n/a	588.92 j	27	Manhole
29	CO 35 to NDB 34	0.28	10	Cir	155.500	588.90	590.45	0.997	589.09	590.68	n/a	590.68	28	Manhole
30	NDB 36 to NDB 33	0.30	10	Cir	23.200	588.60	589.20	2.586	588.76	589.44	n/a	589.44	27	Manhole
31	MH 39 to CI 4	2.82	15	Cir	65.436	586.30	587.00	1.070	586.84	587.67	0.27	587.67	3	Manhole
32	NDB 40 to NDB 39	1.20	12	Cir	166.655	587.20	588.90	1.020	587.91	589.36	n/a	589.36 j	31	Manhole
33	Tee 41 to NDB 40	0.80	12	Cir	103.598	589.10	590.20	1.062	589.52	590.57	n/a	590.57 j	32	None
34	NDB 42 to Tee 41	0.53	12	Cir	66.042	590.20	590.90	1.060	590.71	591.20	n/a	591.20 j	33	DropGrate
35	NDB 43 to Tee 41	0.06	10	Cir	22.181	590.20	591.40	5.410	590.71	591.50	n/a	591.50 j	33	DropGrate
36	NDB 44 to NDB 40	0.10	10	Cir	36.239	588.90	589.30	1.104	589.52	589.44	n/a	589.44	32	DropGrate
37	CO 47 to MH 39	0.30	10	Cir	158.171	587.40	589.00	1.012	587.94	589.24	n/a	589.24 j	31	Manhole
38	NID 48 to MH 39	1.32	12	Cir	25.546	587.10	587.41	1.213	587.90	587.90	n/a	587.90 j	31	DropGrate
39	NDB 49 to NID 48	1.26	12	Cir	31.582	587.41	587.80	1.235	588.04	588.27	n/a	588.27 j	38	DropGrate
40	NID 50 to NDB 49	0.78	10	Cir	61.377	588.00	588.62	1.010	588.43	589.01	n/a	589.01 j	39	DropGrate
41	NID 51 to NID 50	0.57	10	Cir	49.071	588.62	589.11	0.999	589.14	589.44	n/a	589.44 j	40	DropGrate
42	NID 52 to NID 51	0.54	10	Cir	30.562	589.11	589.42	1.014	589.55	589.74	n/a	589.74 j	41	DropGrate
43	NID 53 to NID 52	0.44	10	Cir	87.409	589.42	590.29	0.995	589.85	590.58	n/a	590.58 j	42	DropGrate
44	NID 54 to NID 53	0.32	10	Cir	48.744	590.29	590.78	1.005	590.68	591.03	n/a	591.03 j	43	DropGrate

Project File: 11354 Storm 15-yr.stm | Number of lines: 69 | Run Date: 5/16/2014

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Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
45	NDB 55 to NID 54	0.21	10	Cir	52.072	590.78	591.30	0.999	591.11	591.50	n/a	591.50 j	44	DropGrate
46	NID 58 to NDB 49	0.38	10	Cir	56.871	588.00	588.36	0.633	588.45	588.63	n/a	588.63 j	39	DropGrate
47	NID 59 to NID 58	0.25	10	Cir	48.912	588.36	588.67	0.634	588.72	588.89	n/a	588.89 j	46	DropGrate
48	NDB 60 to NID 59	0.14	10	Cir	52.105	588.67	589.00	0.633	588.96	589.16	n/a	589.16 j	47	DropGrate
49	CO 37 to NDB 36	0.30	10	Cir	154.700	589.40	591.00	1.034	589.60	591.24	n/a	591.24	30	Manhole
50	NDB 26 to NDB 24	0.41	10	Cir	55.142	588.40	589.00	1.088	588.63	589.28	n/a	589.28	20	DropGrate
51	MH 201 to MH 200	28.66	30	Cir	31.116	572.30	573.06	2.443	574.14	574.88	n/a	575.75 j	End	Manhole
52	MH 202 to MH 201	27.14	30	Cir	86.489	573.31	577.61	4.972	575.28	579.38	n/a	579.38 j	51	Manhole
53	GI 203 to MH 202	27.14	30	Cir	39.900	577.83	582.40	11.454	579.73	584.17	n/a	585.38 j	52	DropGrate
54	OCS1 to Ex GI 203	17.80	30	Cir	150.528	582.60	583.75	0.764	584.79	585.18	n/a	585.18 j	53	Manhole
55	MH 204 to MH 201	1.52	15	Cir	16.963	573.36	573.40	0.236	576.59*	576.60*	0.02	576.63	51	Manhole
56	SOI 205 to MH 204	0.26	12	Cir	29.257	573.62	575.01	4.751	576.65*	576.65*	0.00	576.65	55	DropCurb
57	RD 206 to MH 204	0.27	6	Cir	27.361	574.18	574.48	1.096	576.63*	576.67*	0.03	576.70	55	None
58	SOI 207 to MH 204	0.99	15	Cir	121.371	573.42	574.63	0.997	576.64*	576.67*	0.02	576.69	55	DropCurb
59	RD 208 to SOI 207	0.27	6	Cir	30.590	575.30	575.64	1.112	576.69*	576.74*	0.03	576.77	58	None
60	MH 209 to SOI 207	0.01	15	Cir	51.238	575.23	576.34	2.166	576.70	576.70	0.00	576.70	58	Manhole
61	MH 65 to MH 203	9.34	24	Cir	90.402	583.00	583.43	0.476	585.86*	586.02*	0.14	586.15	53	Manhole
62	CI 66 to MH 65	7.14	24	Cir	30.800	583.60	583.76	0.520	586.21*	586.24*	0.04	586.28	61	Curb-Horiz
63	MH 67 to CI 66	6.09	24	Cir	11.000	583.81	584.23	3.818	586.30*	586.31*	0.06	586.37	62	Manhole
64	MH 68 to MH 67	6.09	24	Cir	130.100	584.32	585.33	0.776	586.37	586.43	0.03	586.46	63	Manhole
65	Ex FES 210 to Ex MH 209	0.01	15	Cir	91.300	576.50	585.31	9.650	576.70	585.35	n/a	585.35 j	60	OpenHeadwall
66	Ph 2 MH9 to MH68	1.09	15	Cir	195.000	586.10	587.80	0.872	586.63	588.21	n/a	588.21 j	64	Manhole

Project File: 11354 Storm 15-yr.stm | Number of lines: 69 | Run Date: 5/16/2014

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Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
67	Ph2 CI10 to MH9	1.09	15	Cir	75.640	588.00	588.60	0.793	588.37	589.01	0.08	589.01	66	Curb-Horiz
68	Pipe Connection	0.92	12	Cir	6.430	590.70	590.85	2.332	590.98	591.25	n/a	591.27	67	None
69	Ex CMP	0.92	12	Cir	26.000	590.85	591.27	1.616	591.40	591.67	n/a	591.82 j	68	OpenHeadwall

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NOTES: Return period = 10 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	30	12.81	584.40	587.10	2.50	4.91	2.61	0.11	587.21	0.083	35.700	584.50	587.13	2.50	4.91	2.61	0.11	587.24	0.083	0.083	0.030	0.31	0.03
2	30	12.81	584.50	587.16	2.50	4.91	2.61	0.11	587.27	0.083	39.398	584.80	587.19	2.39	4.83	2.65	0.11	587.30	0.072	0.078	0.031	1.00	0.11
3	30	11.08	585.00	587.30	2.30	2.11	2.35	0.43	587.73	0.000	34.971	585.30	586.41	1.11**	2.11	5.24	0.43	586.84	0.000	0.000	n/a	2.99	1.28
4	24	6.21	585.80	586.78	0.98	1.33	4.06	0.34	587.12	0.000	129.142	586.80	587.68 j	0.88**	1.33	4.66	0.34	588.02	0.000	0.000	n/a	0.55	0.19
5	18	4.74	587.30	588.02	0.72*	0.84	5.64	0.34	588.36	0.000	138.755	588.40	589.24	0.84**	1.01	4.68	0.34	589.58	0.000	0.000	n/a	1.50	n/a
6	18	3.74	588.60	589.51	0.91	0.87	3.35	0.29	589.80	0.000	94.555	589.40	590.14 j	0.74**	0.87	4.32	0.29	590.43	0.000	0.000	n/a	1.35	0.39
7	15	1.17	589.60	590.41	0.81	0.37	1.38	0.16	590.57	0.000	137.207	590.70	591.13 j	0.43**	0.37	3.17	0.16	591.28	0.000	0.000	n/a	1.00	n/a
8	12	1.80	589.50	590.35	0.85	0.46	2.54	0.23	590.58	0.000	29.648	589.80	590.37 j	0.57**	0.46	3.89	0.23	590.61	0.000	0.000	n/a	1.00	0.23
9	12	1.50	590.00	590.55	0.55	0.41	3.40	0.21	590.76	0.000	57.690	590.60	591.12 j	0.52**	0.41	3.65	0.21	591.33	0.000	0.000	n/a	1.50	n/a
10	12	1.20	590.80	591.29	0.49	0.35	3.14	0.18	591.47	0.000	59.339	591.42	591.88 j	0.46**	0.35	3.39	0.18	592.06	0.000	0.000	n/a	0.50	n/a
11	12	0.50	591.42	592.05	0.63	0.19	0.95	0.11	592.16	0.000	49.035	591.95	592.24 j	0.29**	0.19	2.61	0.11	592.35	0.000	0.000	n/a	0.50	0.05
12	12	0.15	591.95	592.35	0.40	0.08	0.51	0.05	592.40	0.000	62.081	592.59	592.75 j	0.16**	0.08	1.88	0.05	592.80	0.000	0.000	n/a	1.00	n/a
13	10	0.30	590.80	591.01	0.21*	0.11	2.83	0.09	591.09	0.000	157.866	592.40	592.64	0.24**	0.13	2.34	0.09	592.72	0.000	0.000	n/a	1.00	n/a
14	10	0.58	588.80	589.56	0.76	0.20	1.11	0.13	589.68	0.000	36.950	589.20	589.53 j	0.33**	0.20	2.84	0.13	589.66	0.000	0.000	n/a	0.98	0.12
15	10	0.28	589.40	589.66	0.26	0.12	1.98	0.08	589.74	0.000	55.847	590.00	590.23 j	0.23**	0.12	2.30	0.08	590.31	0.000	0.000	n/a	1.00	n/a
16	10	0.28	590.20	590.39	0.19*	0.09	3.01	0.08	590.47	0.000	155.417	591.90	592.13	0.23**	0.12	2.30	0.08	592.21	0.000	0.000	n/a	1.00	n/a
17	10	0.30	589.70	589.90	0.20*	0.10	2.99	0.09	589.98	0.000	157.586	591.30	591.54	0.24**	0.13	2.34	0.09	591.62	0.000	0.000	n/a	1.00	n/a
18	12	1.43	585.80	587.36	1.00	0.79	1.82	0.05	587.41	0.137	59.638	586.40	587.40	1.00	0.79	1.82	0.05	587.45	0.136	0.137	0.081	1.50	0.08
19	12	0.73	586.60	587.48	0.88	0.25	1.00	0.13	587.61	0.000	30.358	587.00	587.36	0.36**	0.25	2.91	0.13	587.49	0.000	0.000	n/a	1.50	n/a
20	10	0.45	587.20	587.48	0.28	0.16	2.84	0.11	587.59	0.000	81.312	588.20	588.49	0.29**	0.17	2.63	0.11	588.60	0.000	0.000	n/a	1.50	n/a
21	10	0.24	587.20	587.48	0.28	0.11	1.46	0.08	587.56	0.000	53.362	587.80	588.01 j	0.21**	0.11	2.20	0.08	588.09	0.000	0.000	n/a	1.00	0.08

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Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
22	10	0.67	586.60	587.51	0.83	0.23	1.23	0.02	587.53	0.080	64.445	587.30	587.66 j	0.36**	0.23	2.97	0.14	587.80	0.532	0.306	n/a	0.50	0.07
23	10	0.32	587.30	587.79	0.49	0.13	0.96	0.09	587.88	0.000	22.214	587.60	587.85 j	0.25**	0.13	2.39	0.09	587.93	0.000	0.000	n/a	0.50	n/a
24	10	0.09	587.60	587.93	0.33	0.05	0.44	0.04	587.98	0.000	65.070	588.40	588.53 j	0.13**	0.05	1.69	0.04	588.57	0.000	0.000	n/a	1.00	n/a
25	10	0.30	586.10	587.40	0.83	0.13	0.55	0.00	587.41	0.019	150.615	587.90	588.14 j	0.24**	0.13	2.34	0.09	588.22	0.599	0.309	n/a	1.00	n/a
26	12	1.08	586.80	587.20	0.40*	0.29	3.71	0.17	587.36	0.000	113.359	587.60	588.04	0.44**	0.33	3.28	0.17	588.20	0.000	0.000	n/a	1.50	0.25
27	12	0.58	587.80	588.20	0.40	0.21	2.01	0.12	588.31	0.000	44.400	588.20	588.52 j	0.32**	0.21	2.72	0.12	588.63	0.000	0.000	n/a	1.00	0.12
28	12	0.28	588.40	588.63	0.23	0.13	2.06	0.08	588.71	0.000	33.100	588.70	588.92 j	0.22**	0.13	2.22	0.08	588.99	0.000	0.000	n/a	1.00	0.08
29	10	0.28	588.90	589.09	0.19*	0.10	2.91	0.08	589.18	0.000	155.500	590.45	590.68	0.23**	0.12	2.30	0.08	590.76	0.000	0.000	n/a	1.00	n/a
30	10	0.30	588.60	588.76	0.16*	0.07	4.17	0.09	588.84	0.000	23.200	589.20	589.44	0.24**	0.13	2.34	0.09	589.52	0.000	0.000	n/a	1.00	n/a
31	15	2.82	586.30	586.84	0.54*	0.51	5.53	0.27	587.11	0.000	65.436	587.00	587.67	0.67**	0.67	4.18	0.27	587.95	0.000	0.000	n/a	1.00	0.27
32	12	1.20	587.20	587.91	0.71	0.35	2.01	0.18	588.09	0.000	166.655	588.90	589.36 j	0.46**	0.35	3.39	0.18	589.54	0.000	0.000	n/a	1.00	n/a
33	12	0.80	589.10	589.52	0.42	0.27	2.53	0.14	589.66	0.000	103.598	590.20	590.57 j	0.37**	0.27	2.99	0.14	590.71	0.000	0.000	n/a	1.00	n/a
34	12	0.53	590.20	590.71	0.51	0.20	1.33	0.11	590.81	0.000	66.042	590.90	591.20 j	0.30**	0.20	2.65	0.11	591.31	0.000	0.000	n/a	1.00	0.11
35	10	0.06	590.20	590.71	0.51	0.04	0.17	0.04	590.75	0.000	22.181	591.40	591.50 j	0.10**	0.04	1.52	0.04	591.54	0.000	0.000	n/a	1.00	n/a
36	10	0.10	588.90	589.52	0.62	0.06	0.23	0.05	589.57	0.000	36.239	589.30	589.44	0.14**	0.06	1.74	0.05	589.48	0.000	0.000	n/a	1.00	n/a
37	10	0.30	587.40	587.94	0.54	0.13	0.80	0.09	588.03	0.000	158.171	589.00	589.24 j	0.24**	0.13	2.34	0.09	589.32	0.000	0.000	n/a	1.00	n/a
38	12	1.32	587.10	587.90	0.80	0.38	1.96	0.19	588.09	0.000	25.546	587.41	587.90 j	0.49**	0.38	3.49	0.19	588.08	0.000	0.000	n/a	0.50	0.09
39	12	1.26	587.41	588.04	0.63	0.37	2.40	0.18	588.23	0.000	31.582	587.80	588.27 j	0.47**	0.37	3.44	0.18	588.46	0.000	0.000	n/a	2.25	n/a
40	10	0.78	588.00	588.43	0.43	0.25	2.78	0.15	588.58	0.000	61.377	588.62	589.01 j	0.39**	0.25	3.12	0.15	589.16	0.000	0.000	n/a	0.50	0.08
41	10	0.57	588.62	589.14	0.52	0.20	1.58	0.12	589.27	0.000	49.071	589.11	589.44 j	0.33**	0.20	2.82	0.12	589.57	0.000	0.000	n/a	0.50	0.06
42	10	0.54	589.11	589.55	0.44	0.19	1.85	0.12	589.67	0.000	30.562	589.42	589.74 j	0.32**	0.19	2.78	0.12	589.86	0.000	0.000	n/a	0.50	0.06

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Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
43	10	0.44	589.42	589.85	0.43	0.17	1.54	0.11	589.96	0.000	87.409	590.29	590.58 j	0.29**	0.17	2.62	0.11	590.69	0.000	0.000	n/a	0.50	0.05
44	10	0.32	590.29	590.68	0.39	0.13	1.28	0.09	590.77	0.000	48.744	590.78	591.03 j	0.25**	0.13	2.39	0.09	591.11	0.000	0.000	n/a	0.50	n/a
45	10	0.21	590.78	591.11	0.33	0.10	1.04	0.07	591.18	0.000	52.072	591.30	591.50 j	0.20**	0.10	2.12	0.07	591.57	0.000	0.000	n/a	1.00	n/a
46	10	0.38	588.00	588.45	0.45	0.15	1.26	0.10	588.55	0.000	56.871	588.36	588.63 j	0.27**	0.15	2.51	0.10	588.73	0.000	0.000	n/a	0.50	n/a
47	10	0.25	588.36	588.72	0.36	0.11	1.10	0.08	588.80	0.000	48.912	588.67	588.89 j	0.22**	0.11	2.23	0.08	588.96	0.000	0.000	n/a	0.50	n/a
48	10	0.14	588.67	588.96	0.29	0.07	0.82	0.06	589.02	0.000	52.105	589.00	589.16 j	0.16**	0.07	1.90	0.06	589.22	0.000	0.000	n/a	1.00	0.06
49	10	0.30	589.40	589.60	0.20*	0.10	3.01	0.09	589.68	0.000	154.700	591.00	591.24	0.24**	0.13	2.34	0.09	591.32	0.000	0.000	n/a	1.00	n/a
50	10	0.41	588.40	588.63	0.23*	0.12	3.36	0.10	588.73	0.000	55.142	589.00	589.28	0.28**	0.16	2.56	0.10	589.38	0.000	0.000	n/a	1.00	n/a
51	30	28.66	572.30	574.14	1.84	3.84	7.40	0.87	575.01	0.000	31.116	573.06	574.88 j	1.82**	3.84	7.47	0.87	575.75	0.000	0.000	n/a	1.00	n/a
52	30	27.14	573.31	575.28	1.97	3.73	6.55	0.82	576.10	0.000	86.489	577.61	579.38 j	1.77**	3.73	7.28	0.82	580.21	0.000	0.000	n/a	0.65	n/a
53	30	27.14	577.83	579.73	1.90	3.73	6.77	0.82	580.56	0.000	39.900	582.40	584.17 j	1.77**	3.73	7.28	0.82	585.00	0.000	0.000	n/a	1.46	n/a
54	30	17.80	582.60	584.79	2.19	2.90	3.90	0.59	585.38	0.000	150.528	583.75	585.18 j	1.43**	2.90	6.15	0.59	585.76	0.000	0.000	n/a	1.00	0.59
55	15	1.52	573.36	576.59	1.25	1.23	1.24	0.02	576.62	0.055	16.963	573.40	576.60	1.25	1.23	1.24	0.02	576.63	0.055	0.055	0.009	0.99	0.02
56	12	0.26	573.62	576.65	1.00	0.79	0.33	0.00	576.65	0.005	29.257	575.01	576.65	1.00	0.79	0.33	0.00	576.65	0.005	0.005	0.002	1.00	0.00
57	6	0.27	574.18	576.63	0.50	0.20	1.38	0.03	576.66	0.166	27.361	574.48	576.67	0.50	0.20	1.38	0.03	576.70	0.166	0.166	0.045	1.00	0.03
58	15	0.99	573.42	576.64	1.25	1.23	0.81	0.01	576.65	0.024	121.371	574.63	576.67	1.25	1.23	0.81	0.01	576.68	0.024	0.024	0.029	1.70	0.02
59	6	0.27	575.30	576.69	0.50	0.20	1.38	0.03	576.72	0.166	30.590	575.64	576.74	0.50	0.20	1.38	0.03	576.77	0.166	0.166	0.051	1.00	0.03
60	15	0.01	575.23	576.70	1.25	1.23	0.01	0.00	576.70	0.000	51.238	576.34	576.70	0.36	0.29	0.03	0.00	576.70	0.000	0.000	0.000	0.95	0.00
61	24	9.34	583.00	585.86	2.00	3.14	2.97	0.14	586.00	0.171	90.402	583.43	586.02	2.00	3.14	2.97	0.14	586.15	0.171	0.171	0.154	1.00	0.14
62	24	7.14	583.60	586.21	2.00	3.14	2.27	0.08	586.29	0.100	30.800	583.76	586.24	2.00	3.14	2.27	0.08	586.32	0.100	0.100	0.031	0.50	0.04
63	24	6.09	583.81	586.30	2.00	3.14	1.94	0.06	586.36	0.073	11.000	584.23	586.31	2.00	3.14	1.94	0.06	586.37	0.073	0.073	0.008	1.00	0.06

Project File: 11354 Storm 15-yr.stm | Number of lines: 69 | Run Date: 5/16/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

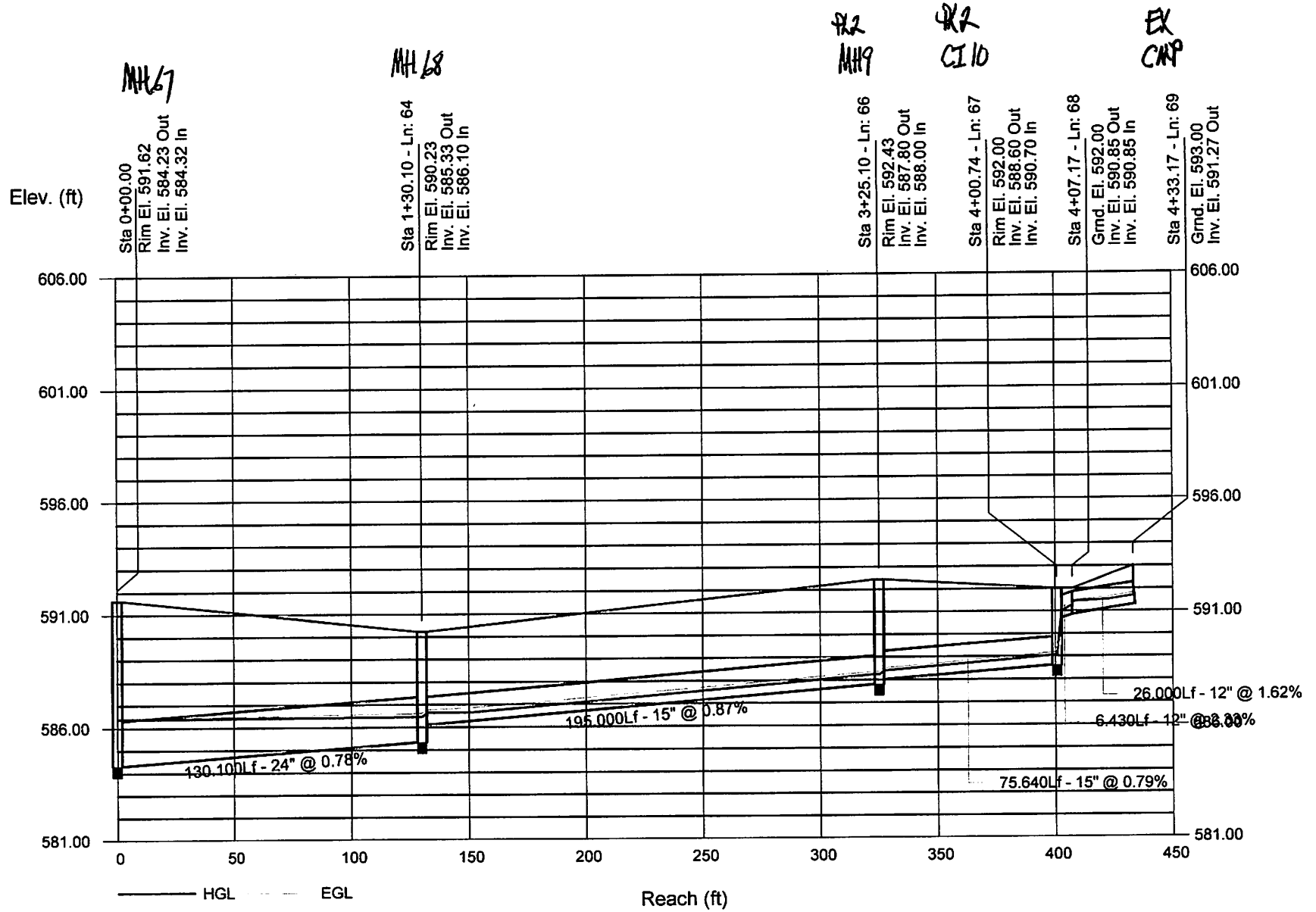
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
	(in)	(cfs)									(ft)											(K)	(ft)
64	24	6.09	584.32	586.37	2.00	3.14	1.94	0.06	586.43	0.073	130.100	585.33	586.43	1.10	1.77	3.43	0.18	586.61	0.210	0.141	0.184	0.15	0.03
65	15	0.01	576.50	576.70	0.20	0.01	0.08	0.01	576.71	0.000	91.300	585.31	585.35 j	0.04**	0.01	0.91	0.01	585.36	0.000	0.000	n/a	1.00	n/a
66	15	1.09	586.10	586.63	0.53	0.35	2.20	0.15	586.78	0.000	195.000	587.80	588.21 j	0.41**	0.35	3.11	0.15	588.36	0.000	0.000	n/a	0.35	0.05
67	15	1.09	588.00	588.37	0.37*	0.30	3.60	0.15	588.52	0.000	75.640	588.60	589.01	0.41**	0.35	3.11	0.15	589.16	0.000	0.000	n/a	0.50	0.08
68	12	0.92	590.70	590.98	0.28*	0.18	5.15	0.15	591.13	0.000	6.430	590.85	591.25	0.40**	0.30	3.12	0.15	591.40	0.000	0.000	n/a	0.15	n/a
69	12	0.92	590.85	591.40	0.55	0.30	2.06	0.07	591.47	0.647	26.000	591.27	591.67 j	0.40**	0.30	3.09	0.15	591.82	1.928	1.288	0.335	1.00	0.15

Project File: 11354 Storm 15-yr.stm | Number of lines: 69 | Run Date: 5/16/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

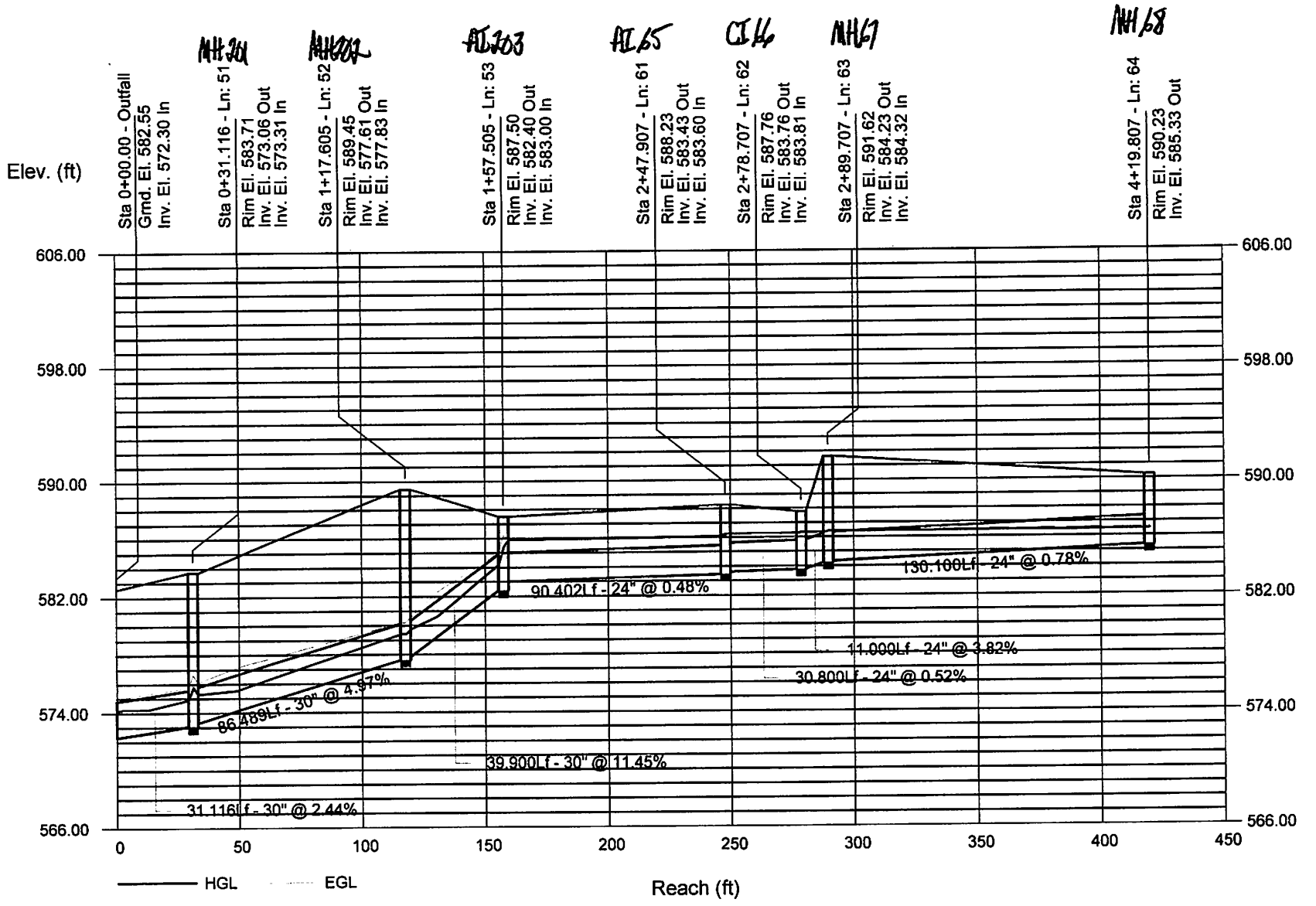
Storm Sewer Profile

Proj. file: 11354 Storm 15-yr.stm



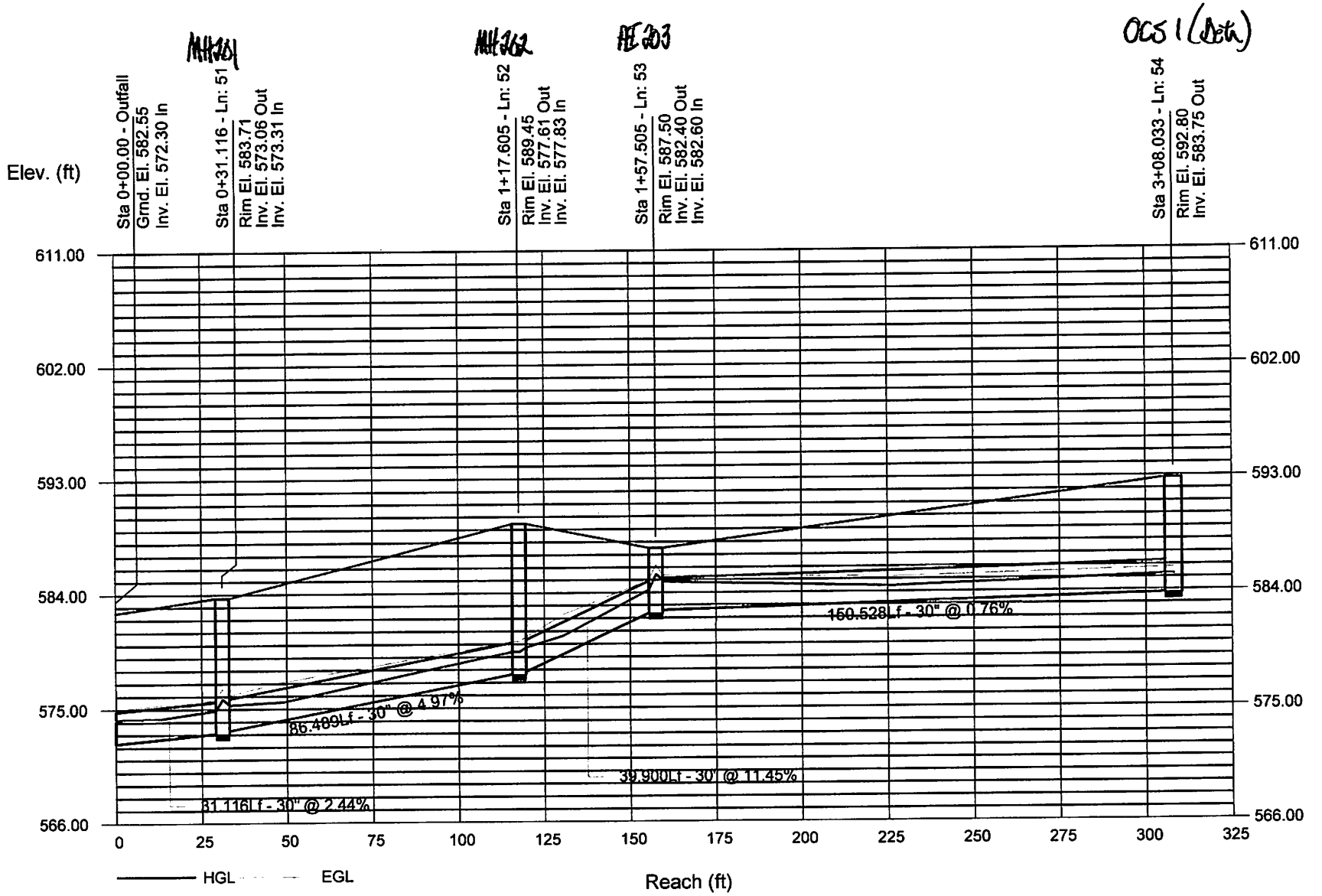
Storm Sewer Profile

Proj. file: 11354 Storm 15-yr.stm



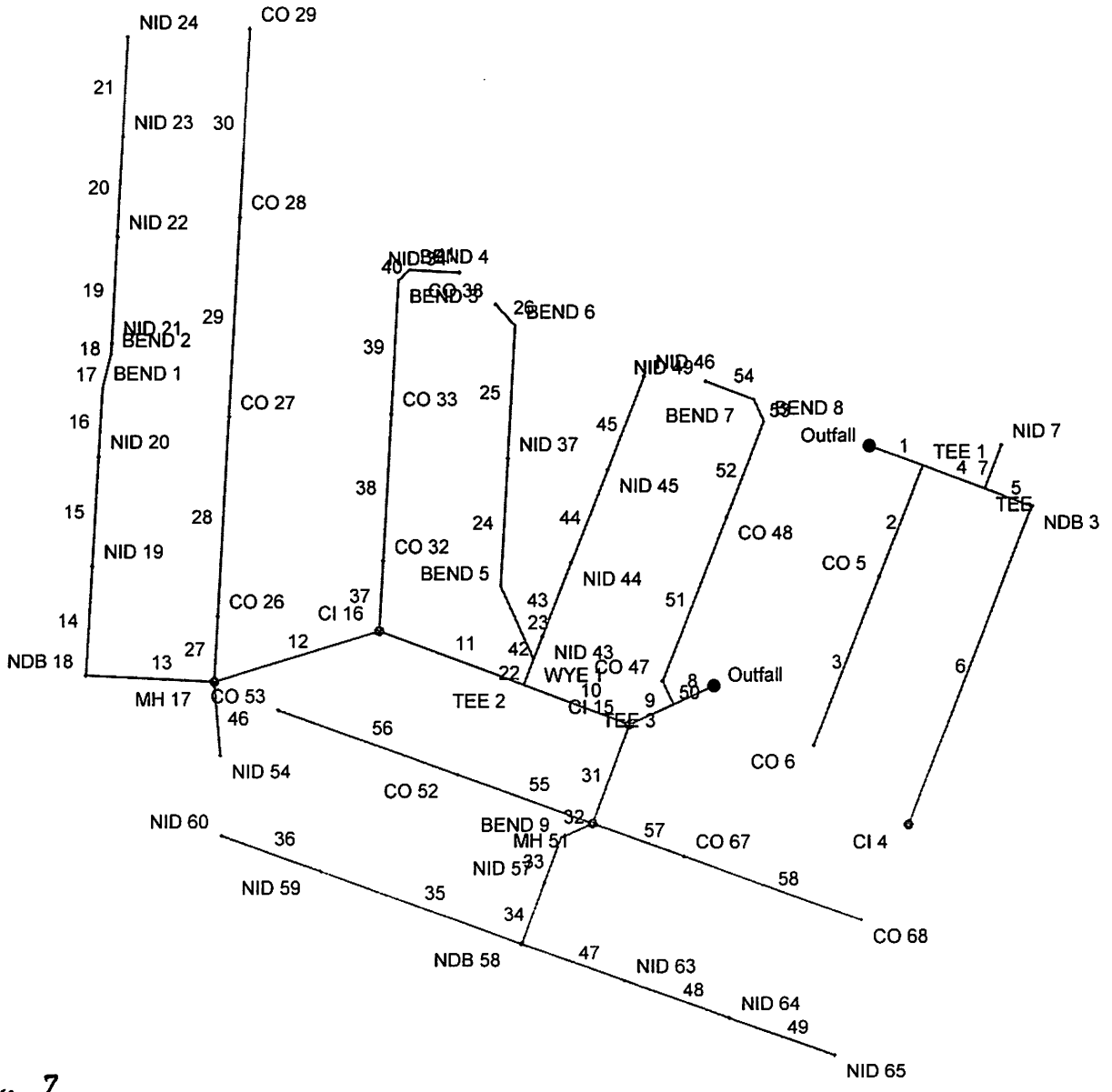
Storm Sewer Profile

Proj. file: 11354 Storm 15-yr.stm



APPENDIX B
STORM PIPE CALCULATIONS
100-YEAR STORM

Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2013 Plan



Phase 2

Project File: 12660 Storm Sewers 100-YR.stm	Number of lines: 58	Date: 7/18/2014

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
1		2.14	15	Cir	28.000	584.31	584.57	0.929	589.80*	589.83*	0.05	589.87	End	None
2		0.36	8	Cir	60.000	584.80	586.28	2.467	589.87*	589.92*	0.00	589.92	1	Manhole
3		0.36	8	Cir	90.000	586.28	588.50	2.467	589.92*	589.99*	0.02	590.01	2	Manhole
4		1.78	15	Cir	32.761	584.56	584.87	0.946	589.87*	589.89*	0.03	589.93	1	None
5		1.52	15	Cir	25.000	584.87	585.10	0.920	589.93*	589.94*	0.04	589.98	4	DropGrate
6		1.25	12	Cir	170.253	585.30	586.40	0.646	589.98*	590.15*	0.04	590.19	5	Manhole
7		0.26	12	Cir	23.000	584.93	588.50	15.522	589.93*	589.93*	0.00	589.93	4	DropGrate
8		14.21	24	Cir	21.985	584.80	585.14	1.547	589.80*	589.87*	0.32	590.19	End	None
9		13.82	24	Cir	23.844	585.14	585.50	1.510	590.19*	590.27*	0.23	590.50	8	Manhole
10		8.76	18	Cir	55.878	586.00	586.42	0.752	590.50*	590.83*	0.38	591.21	9	None
11		6.92	18	Cir	76.347	586.42	587.00	0.760	591.21*	591.49*	0.23	591.72	10	Manhole
12		4.99	15	Cir	85.246	587.20	588.00	0.938	591.72*	592.16*	0.26	592.41	11	Manhole
13		3.32	12	Cir	63.169	588.30	589.00	1.108	592.41*	592.88*	0.42	593.30	12	DropGrate
14		3.05	12	Cir	55.000	589.00	589.71	1.291	593.30*	593.64*	0.12	593.76	13	DropGrate
15		2.69	12	Cir	55.000	589.71	590.43	1.309	593.76*	594.03*	0.09	594.12	14	DropGrate
16		2.31	12	Cir	34.927	590.43	590.88	1.288	594.12*	594.24*	0.03	594.27	15	None
17		2.31	12	Cir	16.948	590.88	591.10	1.298	594.27*	594.33*	0.03	594.37	16	None
18		2.31	12	Cir	5.353	591.10	591.17	1.308	594.37*	594.38*	0.07	594.45	17	DropGrate
19		1.81	12	Cir	53.000	591.17	591.86	1.302	594.45*	594.57*	0.04	594.61	18	DropGrate
20		1.27	12	Cir	50.000	591.86	592.51	1.300	594.61*	594.66*	0.02	594.68	19	DropGrate
21		0.62	12	Cir	50.000	592.51	593.16	1.300	594.68*	594.70*	0.01	594.71	20	DropGrate
22		1.84	12	Cir	13.626	586.47	586.73	1.908	591.21*	591.24*	0.06	591.31	10	None

Project File: 12660 Storm Sewers 100-YR.stm

Number of lines: 58

Run Date: 7/18/2014

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
23		0.53	8	Cir	39.778	587.00	588.25	3.142	591.31*	591.37*	0.02	591.39	22	None
24		0.53	8	Cir	64.178	588.25	590.26	3.132	591.39*	591.49*	0.02	591.51	23	DropGrate
25		0.43	8	Cir	66.638	590.26	592.36	3.151	591.51	592.67	n/a	592.67 j	24	None
26		0.43	8	Cir	14.160	592.36	592.80	3.107	592.67	593.11	0.12	593.11	25	Manhole
27		0.72	8	Cir	32.848	588.60	588.80	0.609	592.41*	592.51*	0.01	592.52	12	Manhole
28		0.72	8	Cir	100.000	588.80	589.50	0.700	592.52*	592.83*	0.01	592.84	27	Manhole
29		0.72	8	Cir	100.000	589.50	590.10	0.600	592.84*	593.14*	0.01	593.15	28	Manhole
30		0.36	8	Cir	94.078	590.10	590.70	0.638	593.15*	593.22*	0.02	593.24	29	Manhole
31		3.90	18	Cir	52.667	586.00	586.50	0.949	590.50*	590.56*	0.08	590.63	9	Manhole
32		3.18	12	Cir	17.101	586.70	586.87	0.994	590.63*	590.75*	0.19	590.94	31	None
33		3.18	12	Cir	23.589	586.87	587.10	0.975	590.94*	591.10*	0.13	591.23	32	DropGrate
34		3.12	12	Cir	32.755	587.10	587.50	1.221	591.23*	591.44*	0.55	592.00	33	DropGrate
35		0.96	12	Cir	106.000	587.50	589.51	1.896	592.00*	592.06*	0.01	592.07	34	DropGrate
36		0.42	12	Cir	52.000	589.51	590.50	1.904	592.07*	592.08*	0.00	592.08	35	DropGrate
37		0.42	8	Cir	35.000	587.40	587.80	1.143	591.72*	591.76*	0.00	591.76	11	Manhole
38		0.42	8	Cir	74.000	587.80	588.70	1.216	591.76*	591.84*	0.00	591.84	37	Manhole
39		0.42	8	Cir	66.535	588.70	589.58	1.323	591.84*	591.91*	0.02	591.93	38	None
40		0.42	8	Cir	7.416	589.57	589.67	1.348	591.93*	591.93*	0.02	591.95	39	None
41		0.42	8	Cir	25.025	589.67	590.00	1.319	591.95*	591.98*	0.02	592.00	40	DropGrate
42		1.31	12	Cir	12.374	586.73	587.05	2.586	591.31*	591.32*	0.02	591.34	22	DropGrate
43		1.23	12	Cir	39.400	587.05	588.00	2.411	591.34*	591.38*	0.02	591.40	42	DropGrate
44		0.69	12	Cir	50.000	588.00	589.20	2.400	591.40*	591.42*	0.01	591.42	43	DropGrate

Project File: 12660 Storm Sewers 100-YR.stm | Number of lines: 58 | Run Date: 7/18/2014

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
45		0.30	12	Cir	50.000	589.20	590.40	2.400	591.42*	591.43*	0.00	591.43	44	DropGrate
46		0.95	12	Cir	36.907	588.90	589.30	1.084	592.41*	592.44*	0.02	592.46	12	DropGrate
47		1.14	12	Cir	53.935	587.50	588.12	1.150	592.00*	592.04*	0.02	592.06	34	DropGrate
48		0.60	12	Cir	55.000	588.12	588.76	1.164	592.06*	592.07*	0.00	592.08	47	DropGrate
49		0.24	12	Cir	55.000	588.76	589.40	1.164	592.08*	592.08*	0.00	592.08	48	DropGrate
50		0.39	8	Cir	12.811	585.80	585.99	1.483	590.19*	590.20*	0.01	590.22	8	Manhole
51		0.39	8	Cir	88.042	585.99	587.29	1.477	590.22*	590.30*	0.00	590.30	50	Manhole
52		0.39	8	Cir	51.124	587.29	588.05	1.487	590.30*	590.34*	0.01	590.36	51	None
53		0.39	8	Cir	12.126	588.04	588.22	1.484	590.36*	590.37*	0.01	590.38	52	None
54		0.39	8	Cir	25.425	588.22	588.60	1.495	590.38*	590.41*	0.02	590.43	53	DropGrate
55		0.36	8	Cir	70.794	587.00	587.73	1.031	590.63*	590.69*	0.00	590.69	31	Manhole
56		0.36	8	Cir	94.503	587.73	588.70	1.026	590.69*	590.76*	0.02	590.78	55	Manhole
57		0.36	8	Cir	47.836	587.00	587.54	1.129	590.63*	590.67*	0.00	590.67	31	Manhole
58		0.36	8	Cir	93.072	587.54	588.60	1.139	590.67*	590.74*	0.02	590.76	57	Manhole

Project File: 12660 Storm Sewers 100-YR.stm | Number of lines: 58 | Run Date: 7/18/2014

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	15	2.14	584.31	589.80	1.25	1.23	1.74	0.05	589.85	0.094	28.000	584.57	589.83	1.25	1.23	1.74	0.05	589.87	0.094	0.094	0.026	1.00	0.05
2	8	0.36	584.80	589.87	0.67	0.35	1.03	0.02	589.89	0.076	60.000	586.28	589.92	0.67	0.35	1.03	0.02	589.94	0.076	0.076	0.045	0.15	0.00
3	8	0.36	586.28	589.92	0.67	0.35	1.03	0.02	589.94	0.076	90.000	588.50	589.99	0.67	0.35	1.03	0.02	590.01	0.076	0.076	0.068	1.00	0.02
4	15	1.78	584.56	589.87	1.25	1.23	1.45	0.03	589.91	0.065	32.761	584.87	589.89	1.25	1.23	1.45	0.03	589.93	0.065	0.065	0.021	1.00	0.03
5	15	1.52	584.87	589.93	1.25	1.23	1.24	0.02	589.95	0.047	25.000	585.10	589.94	1.25	1.23	1.24	0.02	589.96	0.047	0.047	0.012	1.50	0.04
6	12	1.25	585.30	589.98	1.00	0.79	1.59	0.04	590.01	0.105	170.25	586.40	590.15	1.00	0.79	1.59	0.04	590.19	0.105	0.105	0.179	1.00	0.04
7	12	0.26	584.93	589.93	1.00	0.79	0.33	0.00	589.93	0.005	23.000	588.50	589.93	1.00	0.79	0.33	0.00	589.93	0.005	0.005	0.001	1.00	0.00
8	24	14.21	584.80	589.80	2.00	3.14	4.52	0.32	590.12	0.336	21.985	585.14	589.87	2.00	3.14	4.52	0.32	590.19	0.336	0.336	0.074	1.00	0.32
9	24	13.82	585.14	590.19	2.00	3.14	4.40	0.30	590.49	0.318	23.844	585.50	590.27	2.00	3.14	4.40	0.30	590.57	0.318	0.318	0.076	0.76	0.23
10	18	8.76	586.00	590.50	1.50	1.77	4.96	0.38	590.88	0.593	55.878	586.42	590.83	1.50	1.77	4.96	0.38	591.21	0.593	0.593	0.331	1.00	0.38
11	18	6.92	586.42	591.21	1.50	1.77	3.92	0.24	591.45	0.370	76.347	587.00	591.49	1.50	1.77	3.92	0.24	591.73	0.370	0.370	0.283	0.96	0.23
12	15	4.99	587.20	591.72	1.25	1.23	4.07	0.26	591.98	0.509	85.246	588.00	592.16	1.25	1.23	4.07	0.26	592.41	0.509	0.509	0.434	1.00	0.26
13	12	3.32	588.30	592.41	1.00	0.79	4.23	0.28	592.69	0.741	63.169	589.00	592.88	1.00	0.79	4.23	0.28	593.16	0.741	0.741	0.468	1.50	0.42
14	12	3.05	589.00	593.30	1.00	0.79	3.88	0.23	593.53	0.625	55.000	589.71	593.64	1.00	0.79	3.88	0.23	593.88	0.625	0.625	0.344	0.50	0.12
15	12	2.69	589.71	593.76	1.00	0.79	3.43	0.18	593.94	0.486	55.000	590.43	594.03	1.00	0.79	3.43	0.18	594.21	0.486	0.486	0.267	0.50	0.09
16	12	2.31	590.43	594.12	1.00	0.79	2.94	0.13	594.25	0.359	34.927	590.88	594.24	1.00	0.79	2.94	0.13	594.38	0.359	0.359	0.125	0.23	0.03
17	12	2.31	590.88	594.27	1.00	0.79	2.94	0.13	594.41	0.359	16.948	591.10	594.33	1.00	0.79	2.94	0.13	594.47	0.359	0.359	0.061	0.23	0.03
18	12	2.31	591.10	594.37	1.00	0.79	2.94	0.13	594.50	0.359	5.353	591.17	594.38	1.00	0.79	2.94	0.13	594.52	0.359	0.359	0.019	0.50	0.07
19	12	1.81	591.17	594.45	1.00	0.79	2.30	0.08	594.53	0.220	53.000	591.86	594.57	1.00	0.79	2.30	0.08	594.65	0.220	0.220	0.117	0.50	0.04
20	12	1.27	591.86	594.61	1.00	0.79	1.62	0.04	594.65	0.108	50.000	592.51	594.66	1.00	0.79	1.62	0.04	594.70	0.108	0.108	0.054	0.50	0.02
21	12	0.62	592.51	594.68	1.00	0.79	0.79	0.01	594.69	0.026	50.000	593.16	594.70	1.00	0.79	0.79	0.01	594.71	0.026	0.026	0.013	1.00	0.01

Project File: 12660 Storm Sewers 100-YR.stm | Number of lines: 58 | Run Date: 7/18/2014

; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
22	12	1.84	586.47	591.21	1.00	0.79	2.34	0.09	591.30	0.228	13.626	586.73	591.24	1.00	0.79	2.34	0.09	591.33	0.227	0.228	0.031	0.75	0.06
23	8	0.53	587.00	591.31	0.67	0.35	1.52	0.04	591.34	0.164	39.778	588.25	591.37	0.67	0.35	1.52	0.04	591.41	0.164	0.164	0.065	0.51	0.02
24	8	0.53	588.25	591.39	0.67	0.35	1.52	0.04	591.42	0.164	64.178	590.26	591.49	0.67	0.35	1.52	0.04	591.53	0.164	0.164	0.105	0.50	0.02
25	8	0.43	590.26	591.51	0.67	0.16	1.23	0.02	591.54	0.108	66.638	592.36	592.67 j	0.31**	0.16	2.76	0.12	592.78	0.583	0.346	n/a	0.75	0.09
26	8	0.43	592.36	592.67	0.31*	0.16	2.76	0.12	592.78	0.000	14.160	592.80	593.11	0.31**	0.16	2.76	0.12	593.22	0.000	0.000	n/a	1.00	0.12
27	8	0.72	588.60	592.41	0.67	0.35	2.06	0.07	592.48	0.303	32.848	588.80	592.51	0.67	0.35	2.06	0.07	592.58	0.303	0.303	0.099	0.15	0.01
28	8	0.72	588.80	592.52	0.67	0.35	2.06	0.07	592.59	0.303	100.000	589.50	592.83	0.67	0.35	2.06	0.07	592.89	0.303	0.303	0.303	0.15	0.01
29	8	0.72	589.50	592.84	0.67	0.35	2.06	0.07	592.90	0.303	100.000	590.10	593.14	0.67	0.35	2.06	0.07	593.20	0.303	0.303	0.303	0.15	0.01
30	8	0.36	590.10	593.15	0.67	0.35	1.03	0.02	593.16	0.076	94.078	590.70	593.22	0.67	0.35	1.03	0.02	593.24	0.076	0.076	0.071	1.00	0.02
31	18	3.90	586.00	590.50	1.50	1.77	2.21	0.08	590.57	0.118	52.667	586.50	590.56	1.50	1.77	2.21	0.08	590.63	0.118	0.118	0.062	1.00	0.08
32	12	3.18	586.70	590.63	1.00	0.79	4.05	0.25	590.89	0.680	17.101	586.87	590.75	1.00	0.79	4.05	0.25	591.01	0.679	0.680	0.116	0.75	0.19
33	12	3.18	586.87	590.94	1.00	0.79	4.05	0.25	591.20	0.680	23.589	587.10	591.10	1.00	0.79	4.05	0.25	591.36	0.679	0.680	0.160	0.50	0.13
34	12	3.12	587.10	591.23	1.00	0.79	3.97	0.25	591.48	0.654	32.755	587.50	591.44	1.00	0.79	3.97	0.25	591.69	0.654	0.654	0.214	2.25	0.55
35	12	0.96	587.50	592.00	1.00	0.79	1.22	0.02	592.02	0.062	106.000	589.51	592.06	1.00	0.79	1.22	0.02	592.09	0.062	0.062	0.066	0.50	0.01
36	12	0.42	589.51	592.07	1.00	0.79	0.53	0.00	592.08	0.012	52.000	590.50	592.08	1.00	0.79	0.53	0.00	592.08	0.012	0.012	0.006	1.00	0.00
37	8	0.42	587.40	591.72	0.67	0.35	1.20	0.02	591.74	0.103	35.000	587.80	591.76	0.67	0.35	1.20	0.02	591.78	0.103	0.103	0.036	0.15	0.00
38	8	0.42	587.80	591.76	0.67	0.35	1.20	0.02	591.78	0.103	74.000	588.70	591.84	0.67	0.35	1.20	0.02	591.86	0.103	0.103	0.076	0.15	0.00
39	8	0.42	588.70	591.84	0.67	0.35	1.20	0.02	591.86	0.103	66.535	589.58	591.91	0.67	0.35	1.20	0.02	591.93	0.103	0.103	0.069	0.72	0.02
40	8	0.42	589.57	591.93	0.67	0.35	1.20	0.02	591.95	0.103	7.416	589.67	591.93	0.67	0.35	1.20	0.02	591.96	0.103	0.103	0.008	0.78	0.02
41	8	0.42	589.67	591.95	0.67	0.35	1.20	0.02	591.97	0.103	25.025	590.00	591.98	0.67	0.35	1.20	0.02	592.00	0.103	0.103	0.026	1.00	0.02
42	12	1.31	586.73	591.31	1.00	0.79	1.67	0.04	591.35	0.115	12.374	587.05	591.32	1.00	0.79	1.67	0.04	591.36	0.115	0.115	0.014	0.50	0.02

Project File: 12660 Storm Sewers 100-YR.stm | Number of lines: 58 | Run Date: 7/18/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

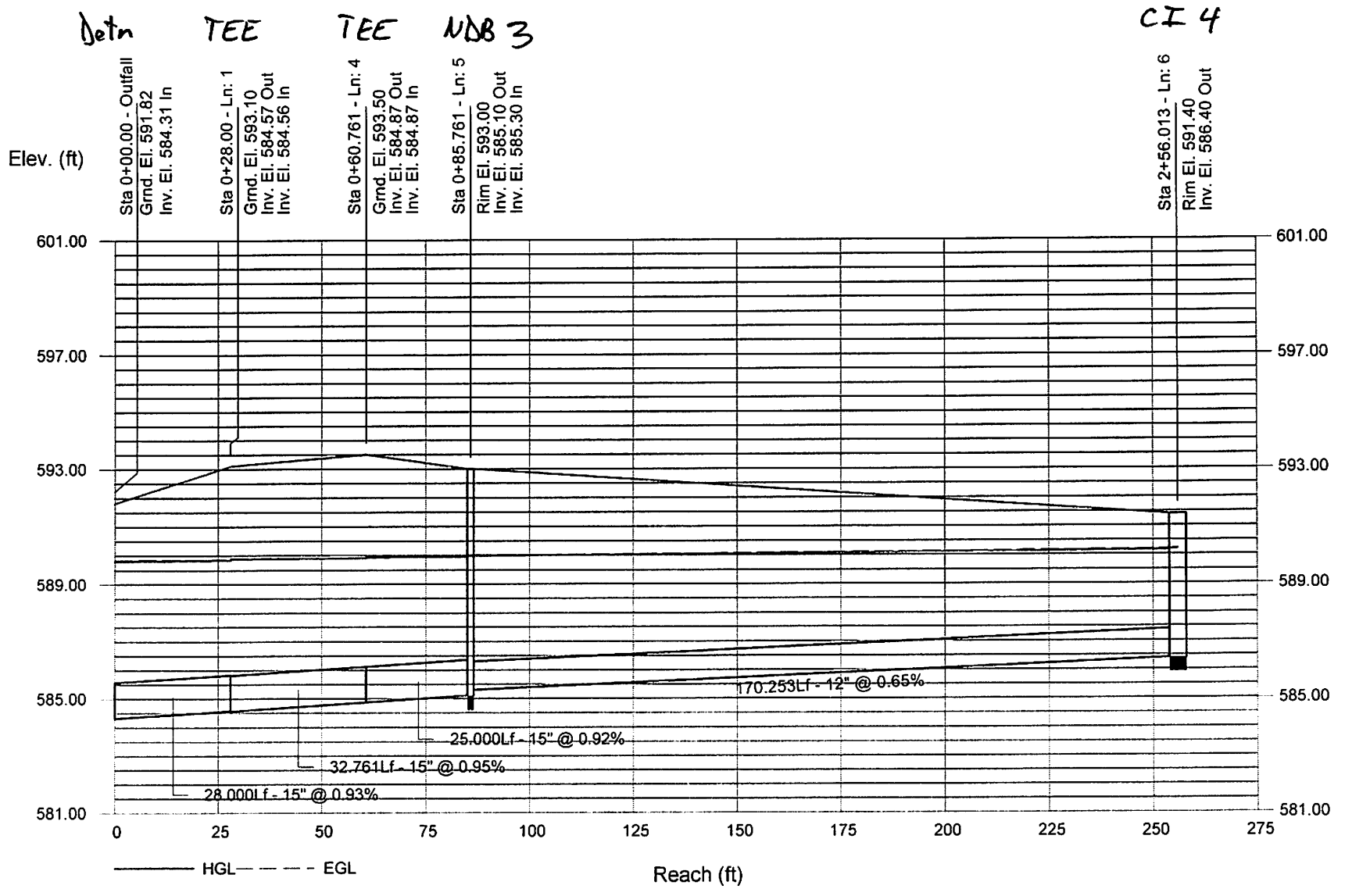
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
	(in)	(cfs)									(ft)											(K)	(ft)
43	12	1.23	587.05	591.34	1.00	0.79	1.57	0.04	591.38	0.102	39.400	588.00	591.38	1.00	0.79	1.57	0.04	591.42	0.102	0.102	0.040	0.50	0.02
44	12	0.69	588.00	591.40	1.00	0.79	0.88	0.01	591.41	0.032	50.000	589.20	591.42	1.00	0.79	0.88	0.01	591.43	0.032	0.032	0.016	0.50	0.01
45	12	0.30	589.20	591.42	1.00	0.79	0.38	0.00	591.42	0.006	50.000	590.40	591.43	1.00	0.79	0.38	0.00	591.43	0.006	0.006	0.003	1.00	0.00
46	12	0.95	588.90	592.41	1.00	0.79	1.21	0.02	592.44	0.061	36.907	589.30	592.44	1.00	0.79	1.21	0.02	592.46	0.061	0.061	0.022	1.00	0.02
47	12	1.14	587.50	592.00	1.00	0.79	1.45	0.03	592.03	0.087	53.935	588.12	592.04	1.00	0.79	1.45	0.03	592.08	0.087	0.087	0.047	0.50	0.02
48	12	0.60	588.12	592.06	1.00	0.79	0.76	0.01	592.07	0.024	55.000	588.76	592.07	1.00	0.79	0.76	0.01	592.08	0.024	0.024	0.013	0.50	0.00
49	12	0.24	588.76	592.08	1.00	0.79	0.31	0.00	592.08	0.004	55.000	589.40	592.08	1.00	0.79	0.31	0.00	592.08	0.004	0.004	0.002	1.00	0.00
50	8	0.39	585.80	590.19	0.67	0.35	1.12	0.02	590.21	0.089	12.811	585.99	590.20	0.67	0.35	1.12	0.02	590.22	0.089	0.089	0.011	0.76	0.01
51	8	0.39	585.99	590.22	0.67	0.35	1.12	0.02	590.24	0.089	88.042	587.29	590.30	0.67	0.35	1.12	0.02	590.32	0.089	0.089	0.078	0.15	0.00
52	8	0.39	587.29	590.30	0.67	0.35	1.12	0.02	590.32	0.089	51.124	588.05	590.34	0.67	0.35	1.12	0.02	590.36	0.089	0.089	0.045	0.75	0.01
53	8	0.39	588.04	590.36	0.67	0.35	1.12	0.02	590.38	0.089	12.126	588.22	590.37	0.67	0.35	1.12	0.02	590.39	0.089	0.089	0.011	0.75	0.01
54	8	0.39	588.22	590.38	0.67	0.35	1.12	0.02	590.40	0.089	25.425	588.60	590.41	0.67	0.35	1.12	0.02	590.43	0.089	0.089	0.023	1.00	0.02
55	8	0.36	587.00	590.63	0.67	0.35	1.03	0.02	590.65	0.076	70.794	587.73	590.69	0.67	0.35	1.03	0.02	590.70	0.076	0.076	0.054	0.15	0.00
56	8	0.36	587.73	590.69	0.67	0.35	1.03	0.02	590.71	0.076	94.503	588.70	590.76	0.67	0.35	1.03	0.02	590.78	0.076	0.076	0.072	1.00	0.02
57	8	0.36	587.00	590.63	0.67	0.35	1.03	0.02	590.65	0.076	47.836	587.54	590.67	0.67	0.35	1.03	0.02	590.69	0.076	0.076	0.036	0.15	0.00
58	8	0.36	587.54	590.67	0.67	0.35	1.03	0.02	590.69	0.076	93.072	588.60	590.74	0.67	0.35	1.03	0.02	590.76	0.076	0.076	0.070	1.00	0.02

Project File: 12660 Storm Sewers 100-YR.stm | Number of lines: 58 | Run Date: 7/18/2014

Notes: * Normal depth assumed.; ** Critical depth.; j-Line contains hyd. jump. ; c = cir e = ellip b = box

Storm Sewer Profile

Proj. file: 12660 Storm Sewers 100-YR.stm



Storm Sewer Profile

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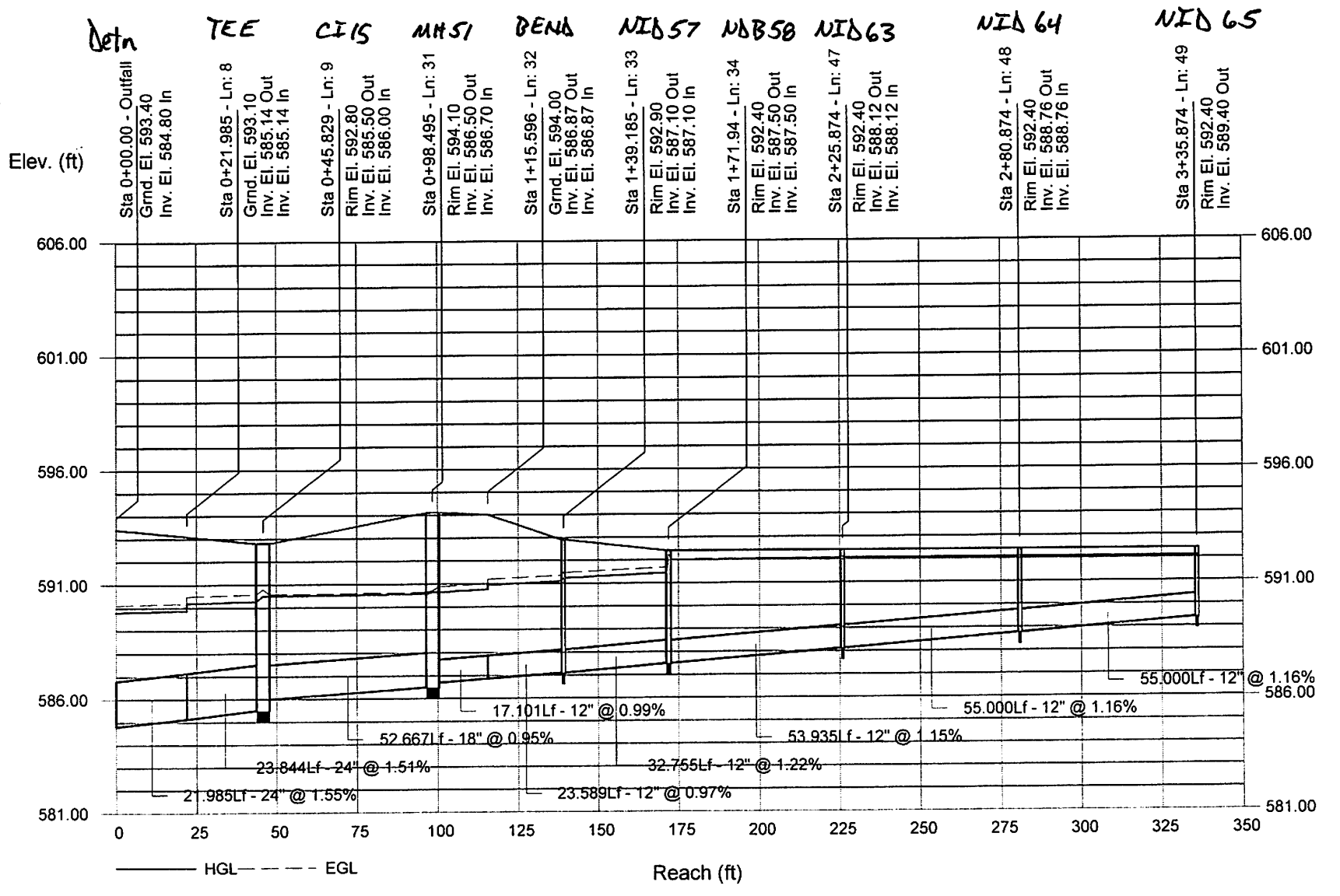

Storm Sewer Profile

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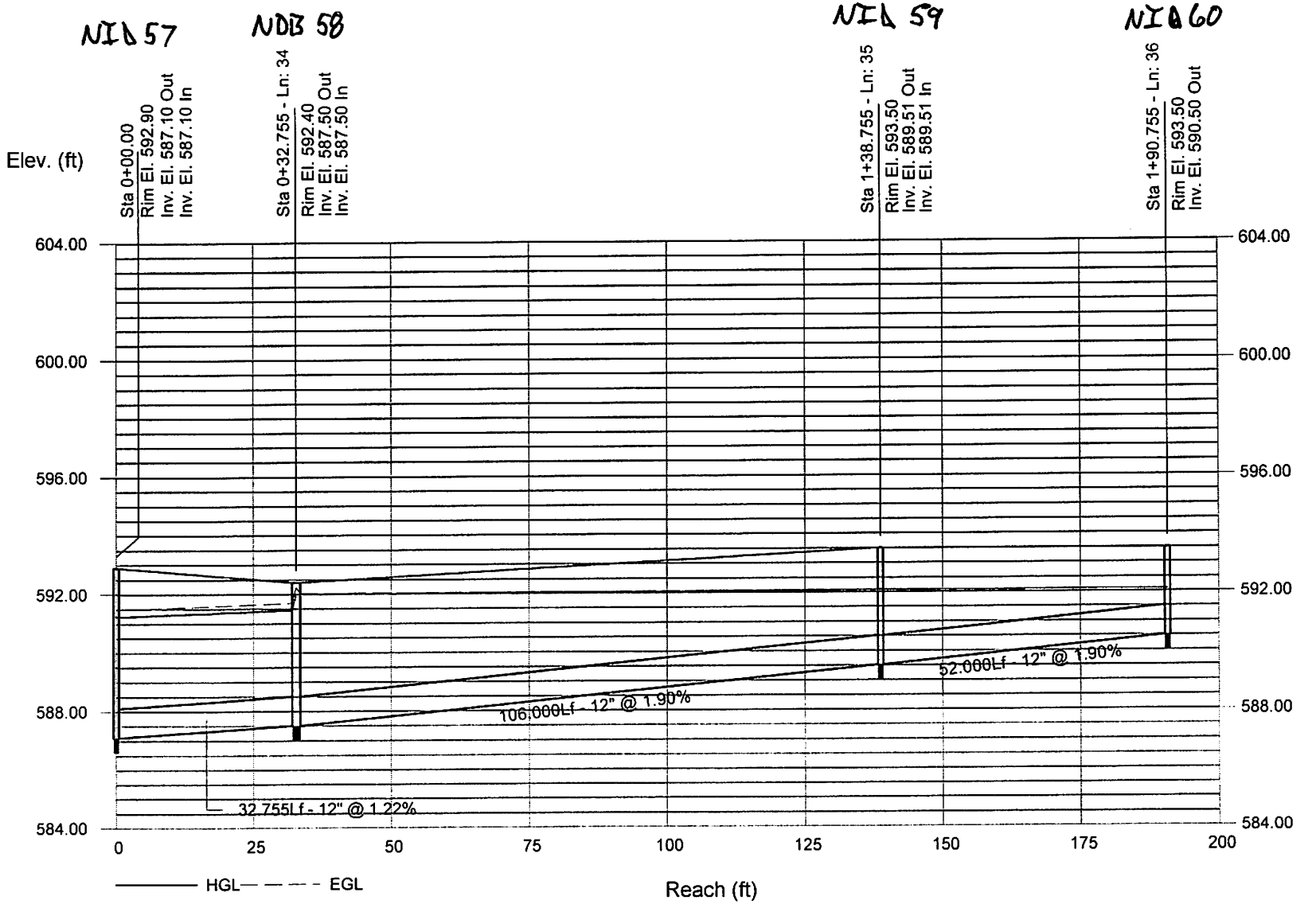

Storm Sewer Profile

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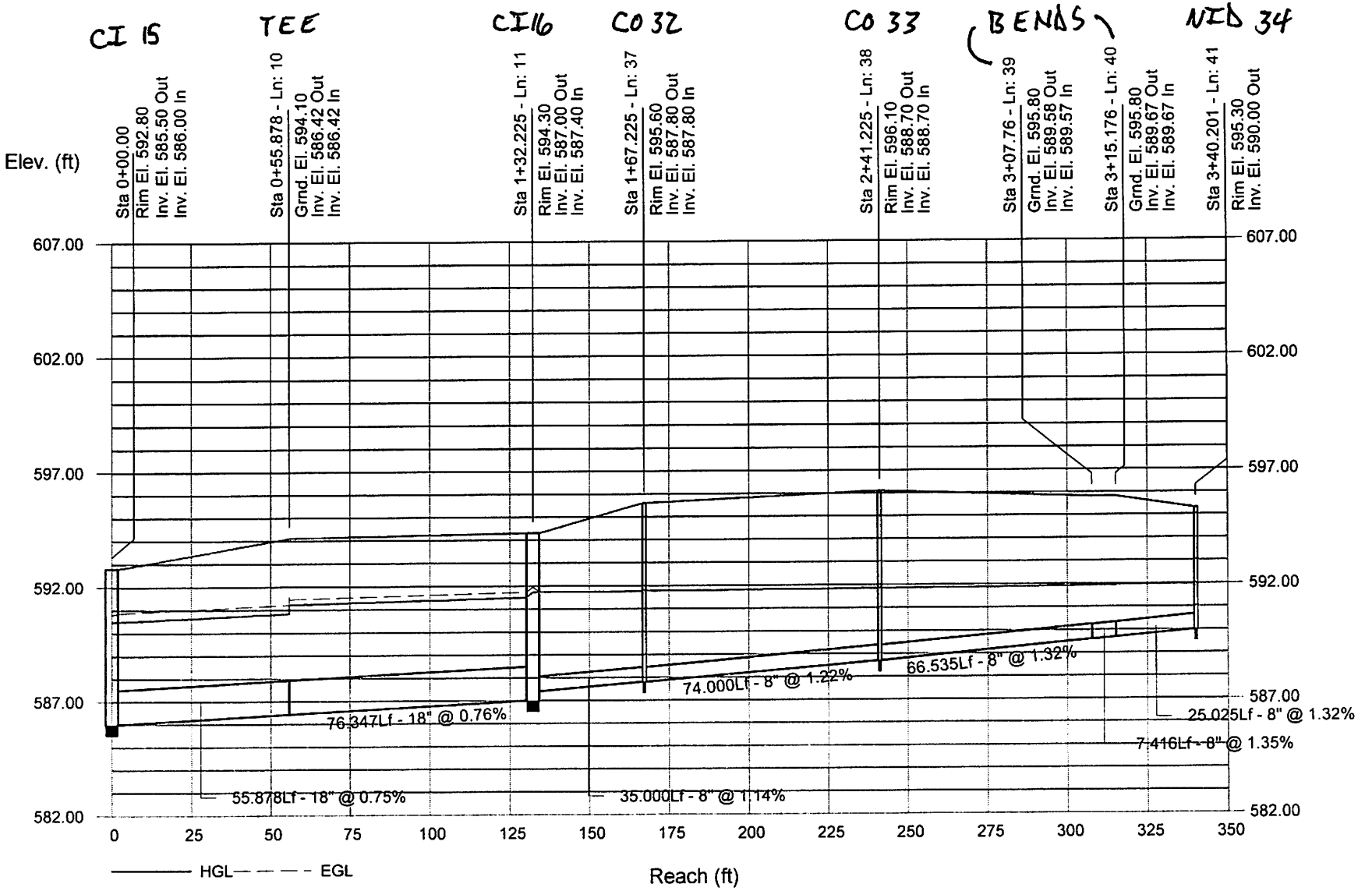

Storm Sewer Profile

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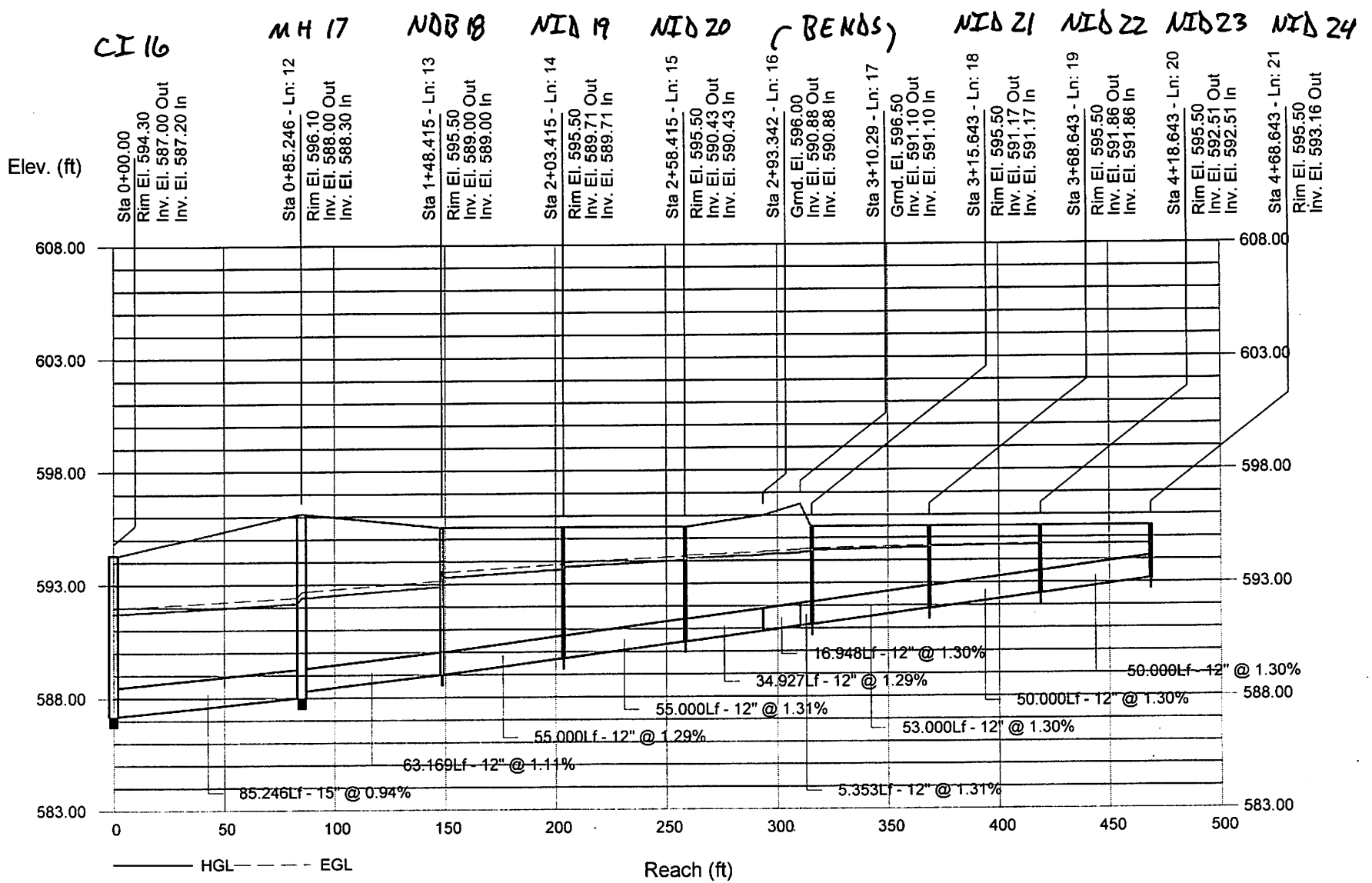

Storm Sewer Profile

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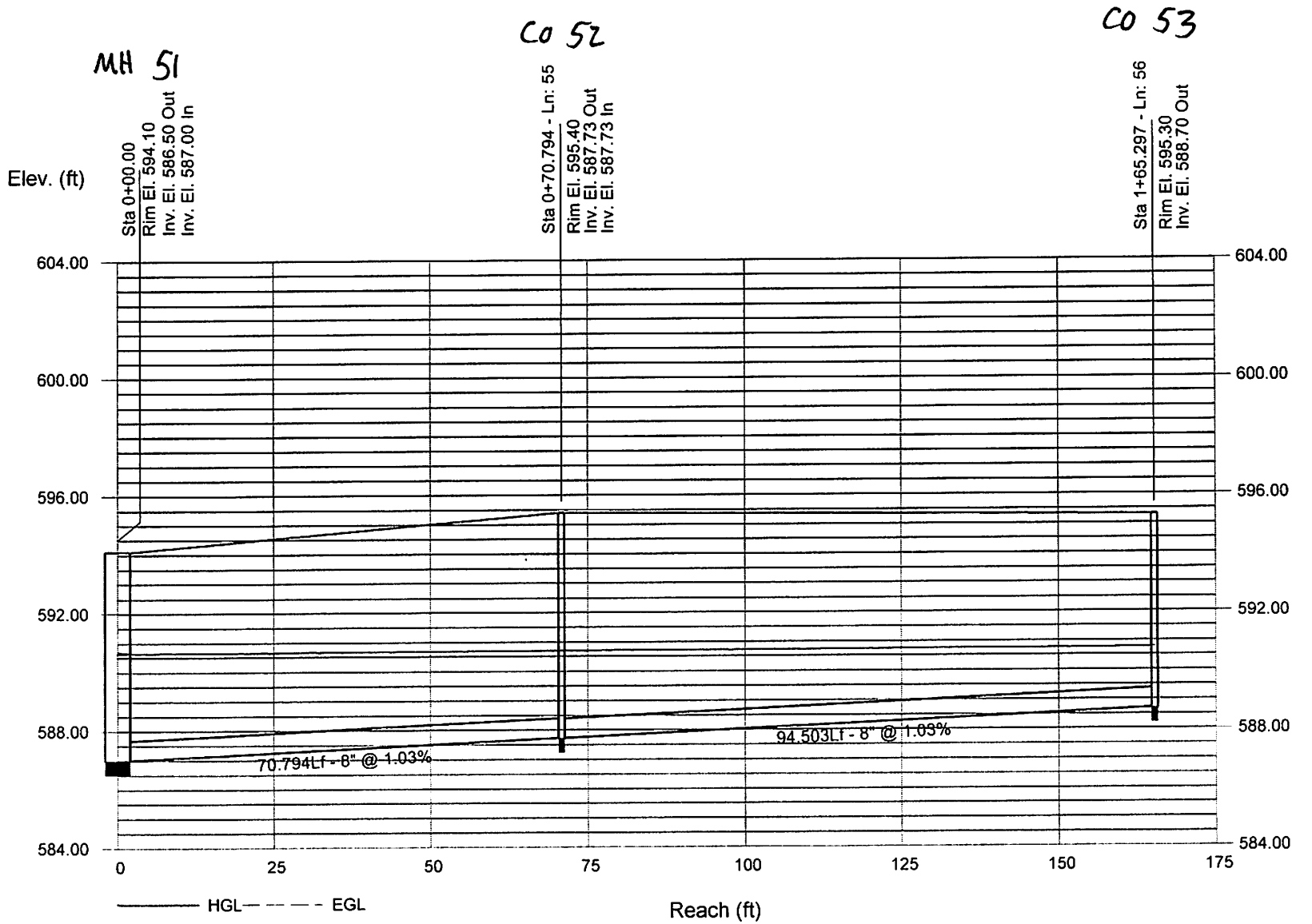

Storm Sewer Profile

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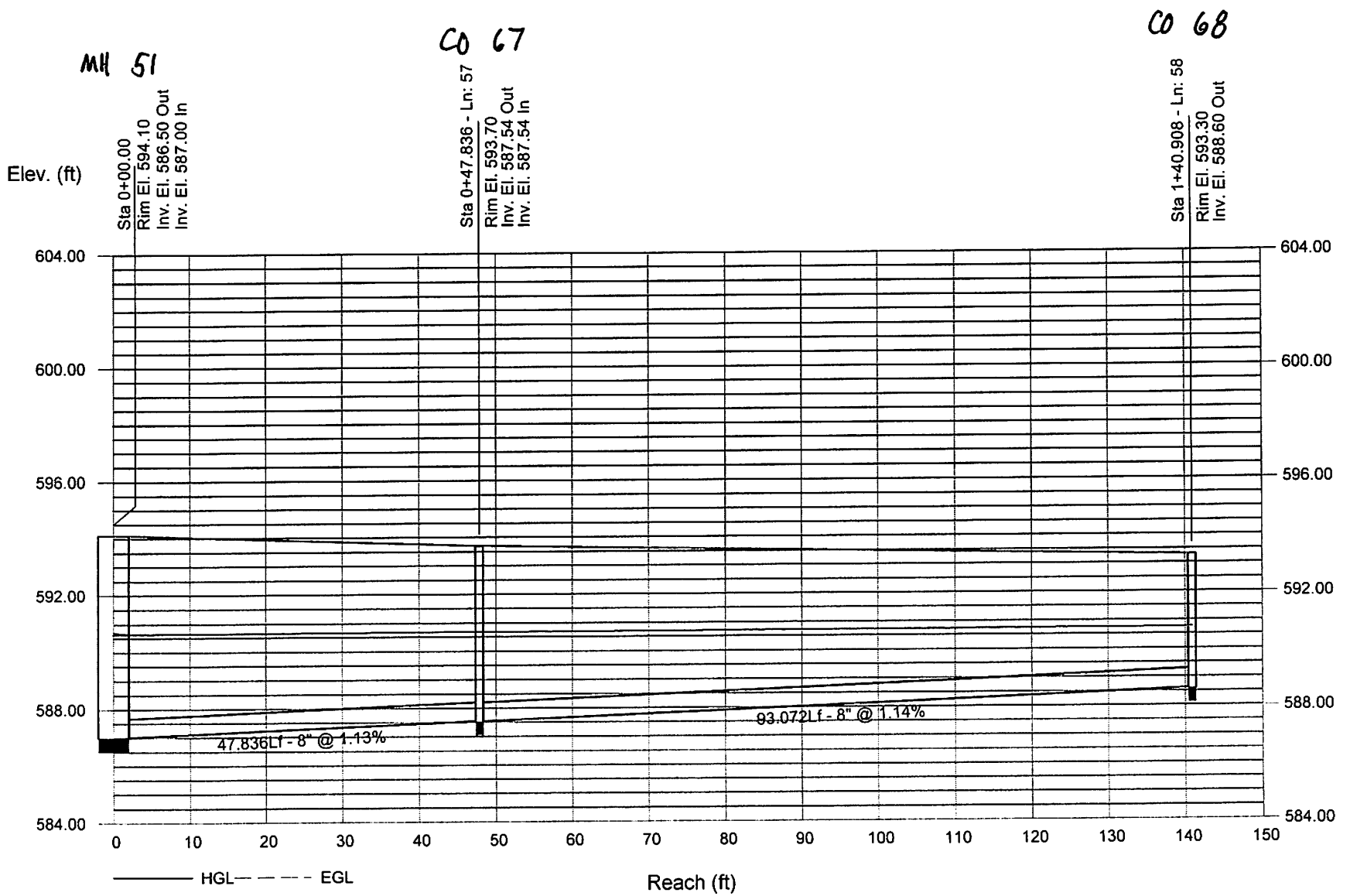

Storm Sewer Profile

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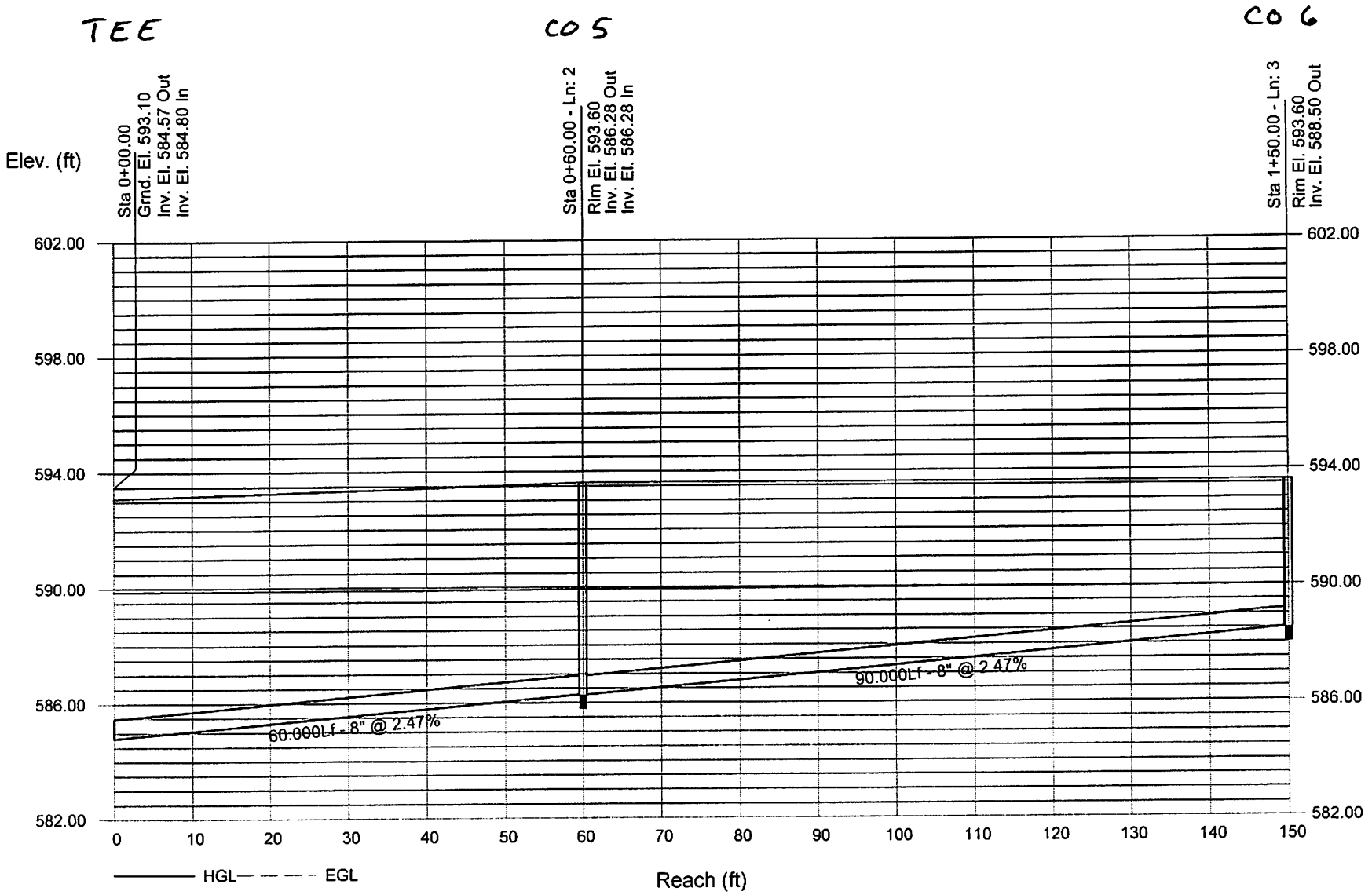

Storm Sewer Profile

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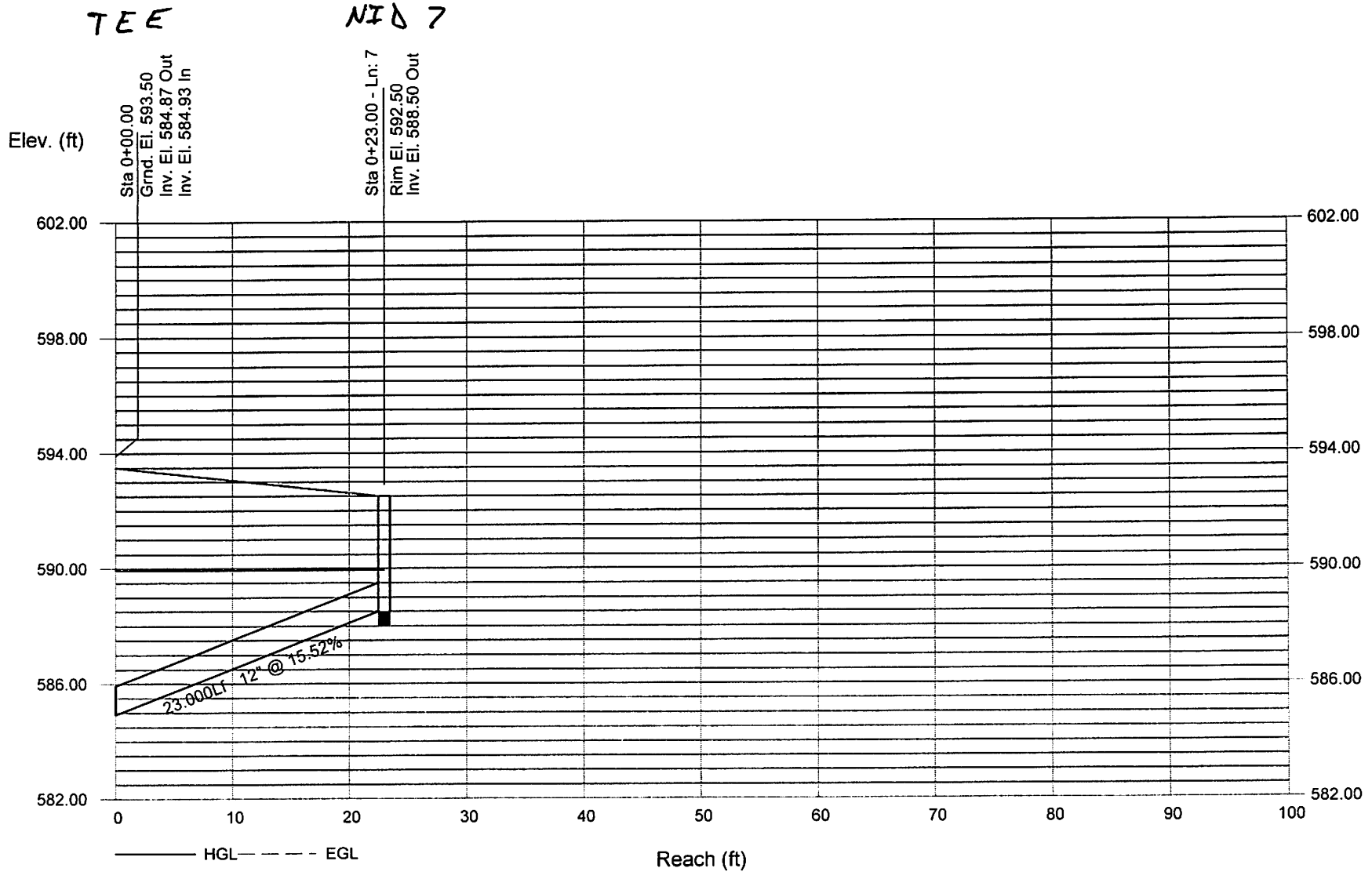

Storm Sewer Profile

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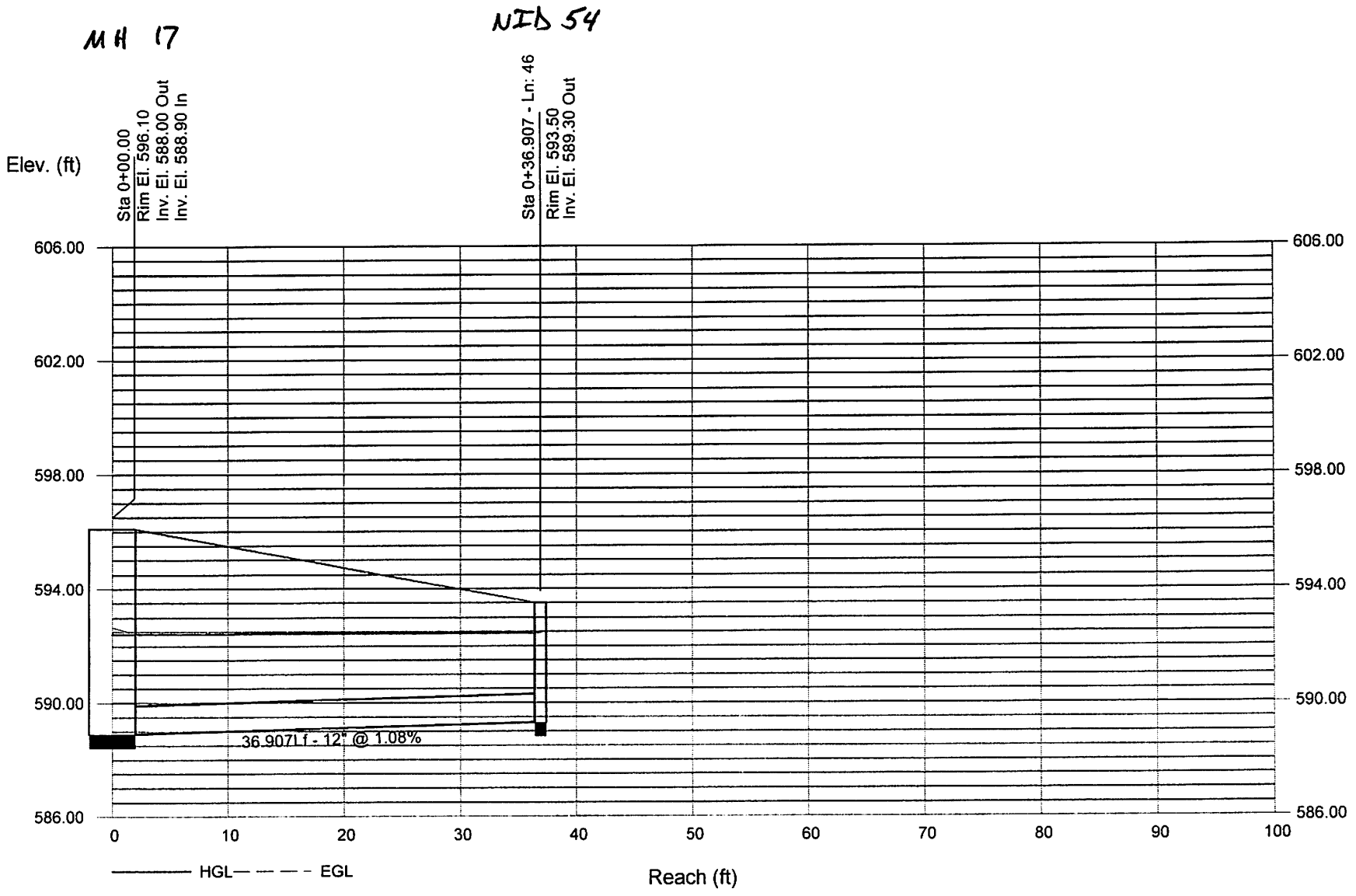

Storm Sewer Profile

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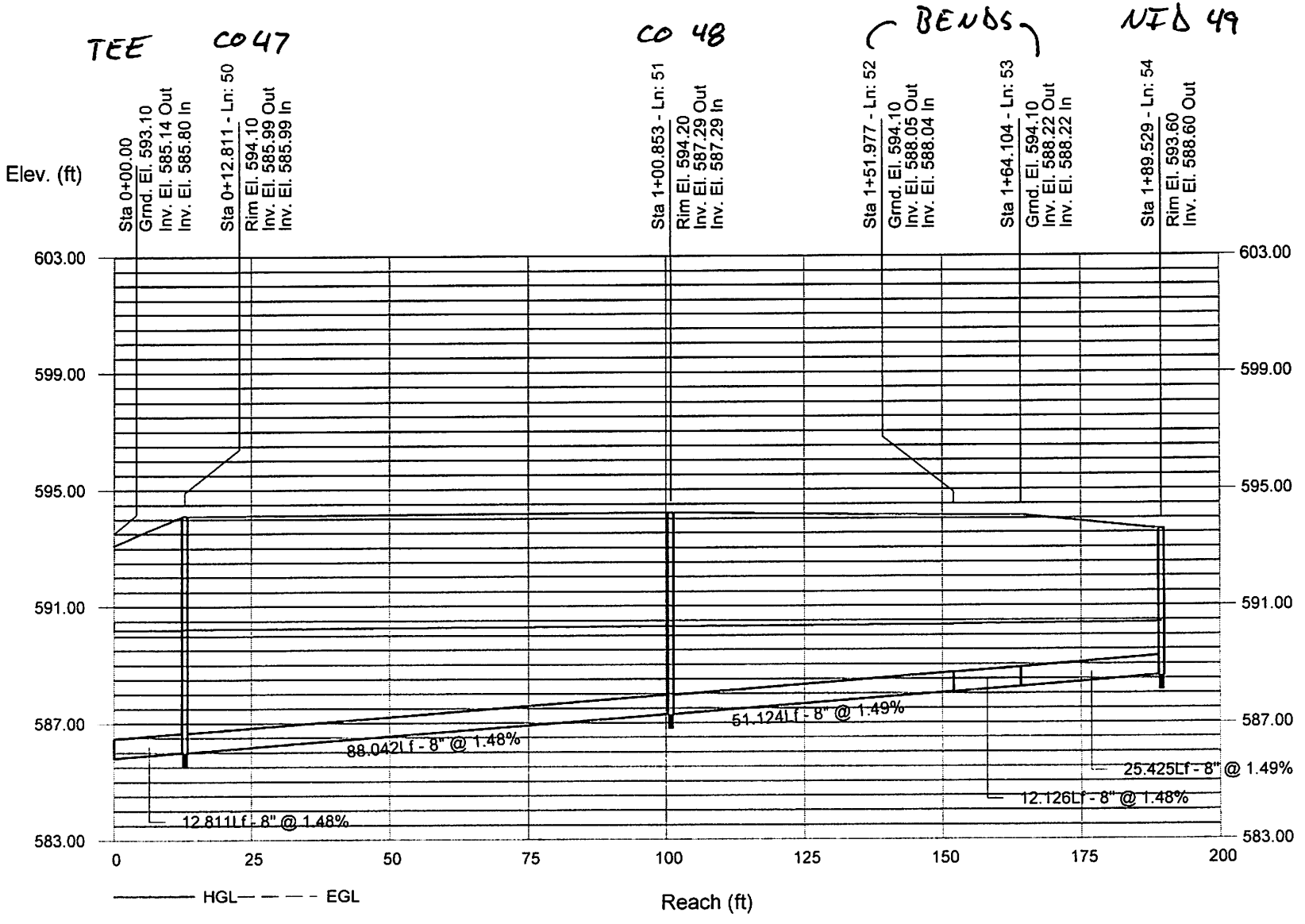

Storm Sewer Profile

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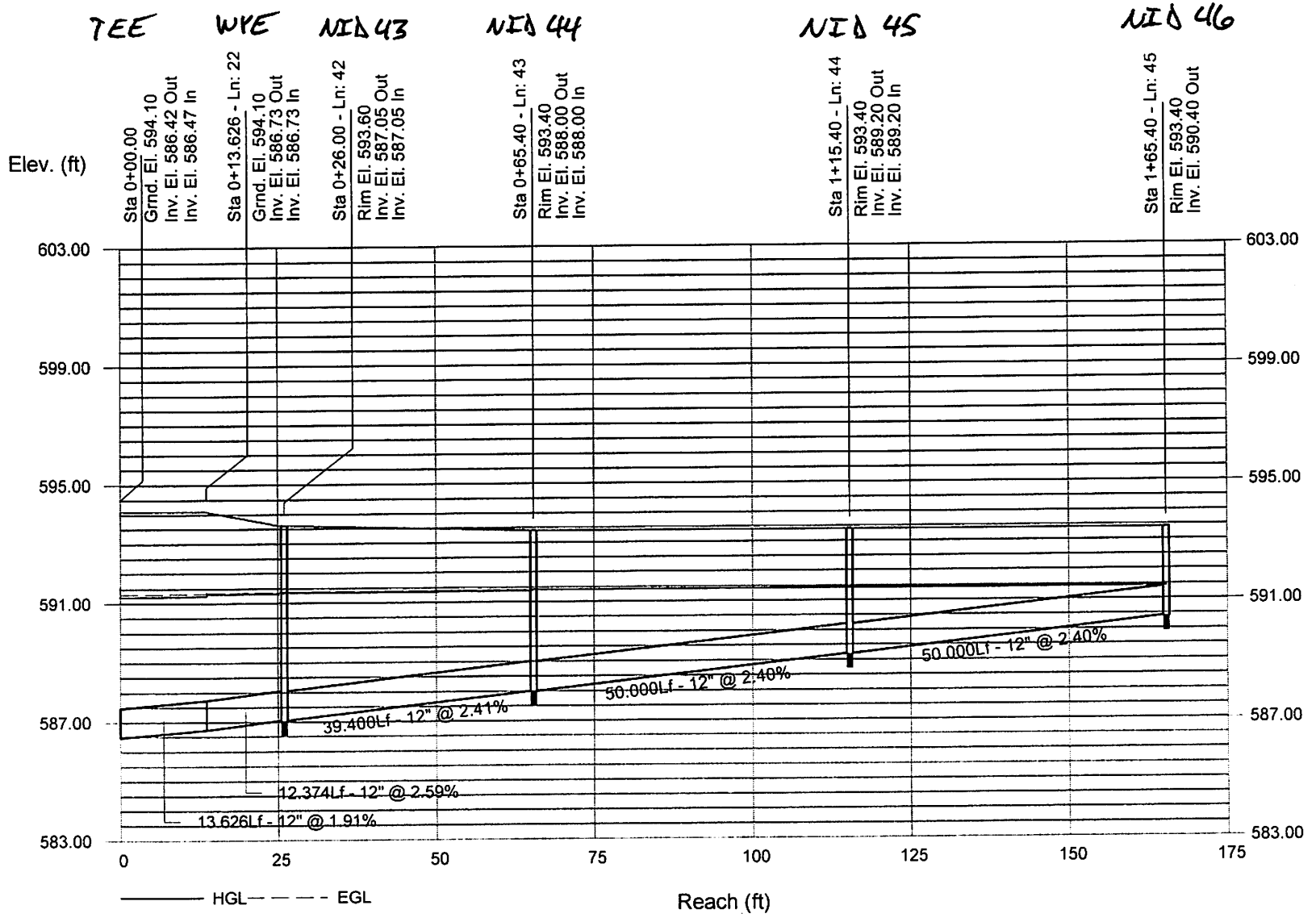

Storm Sewer Profile

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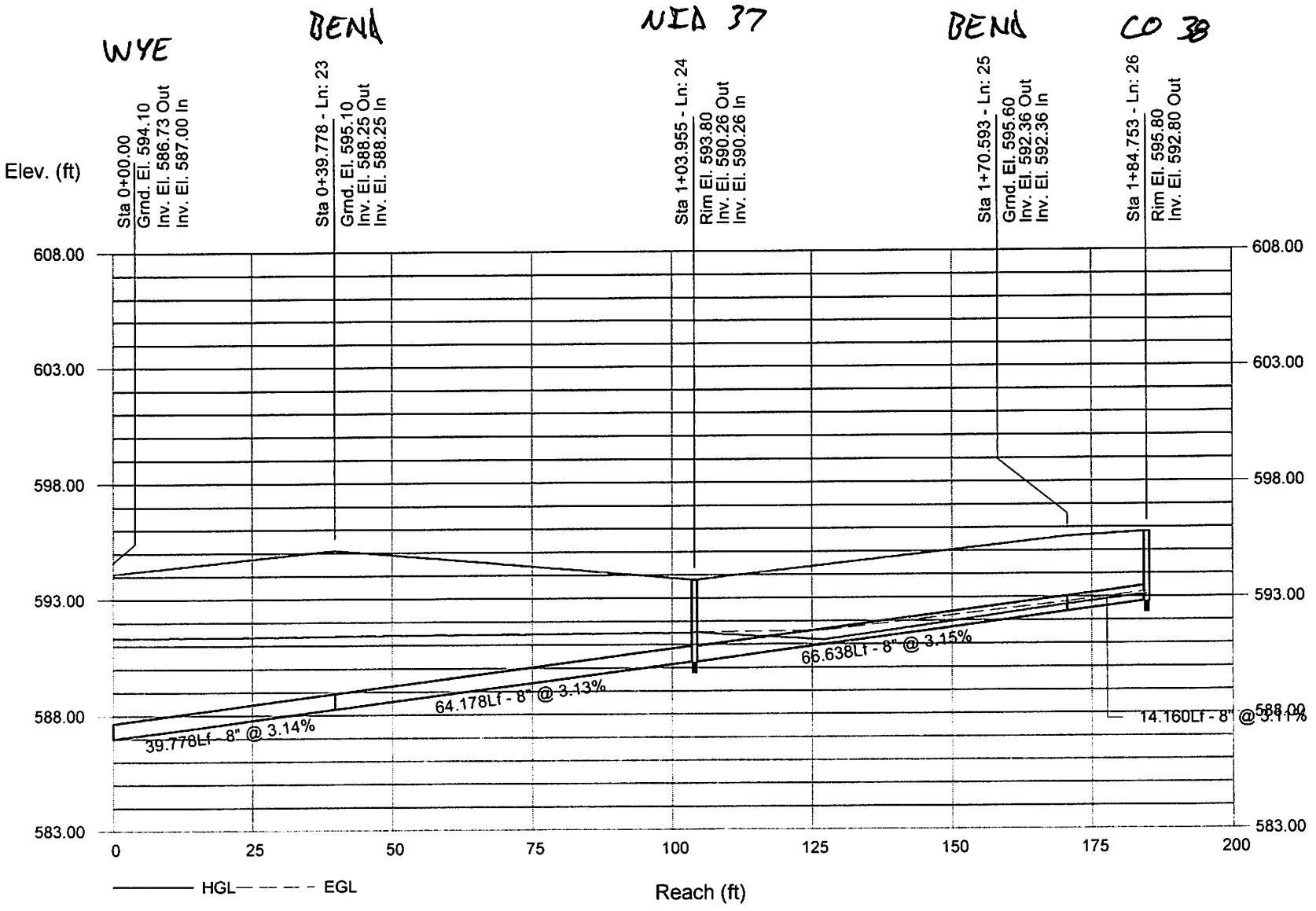

Storm Sewer Profile

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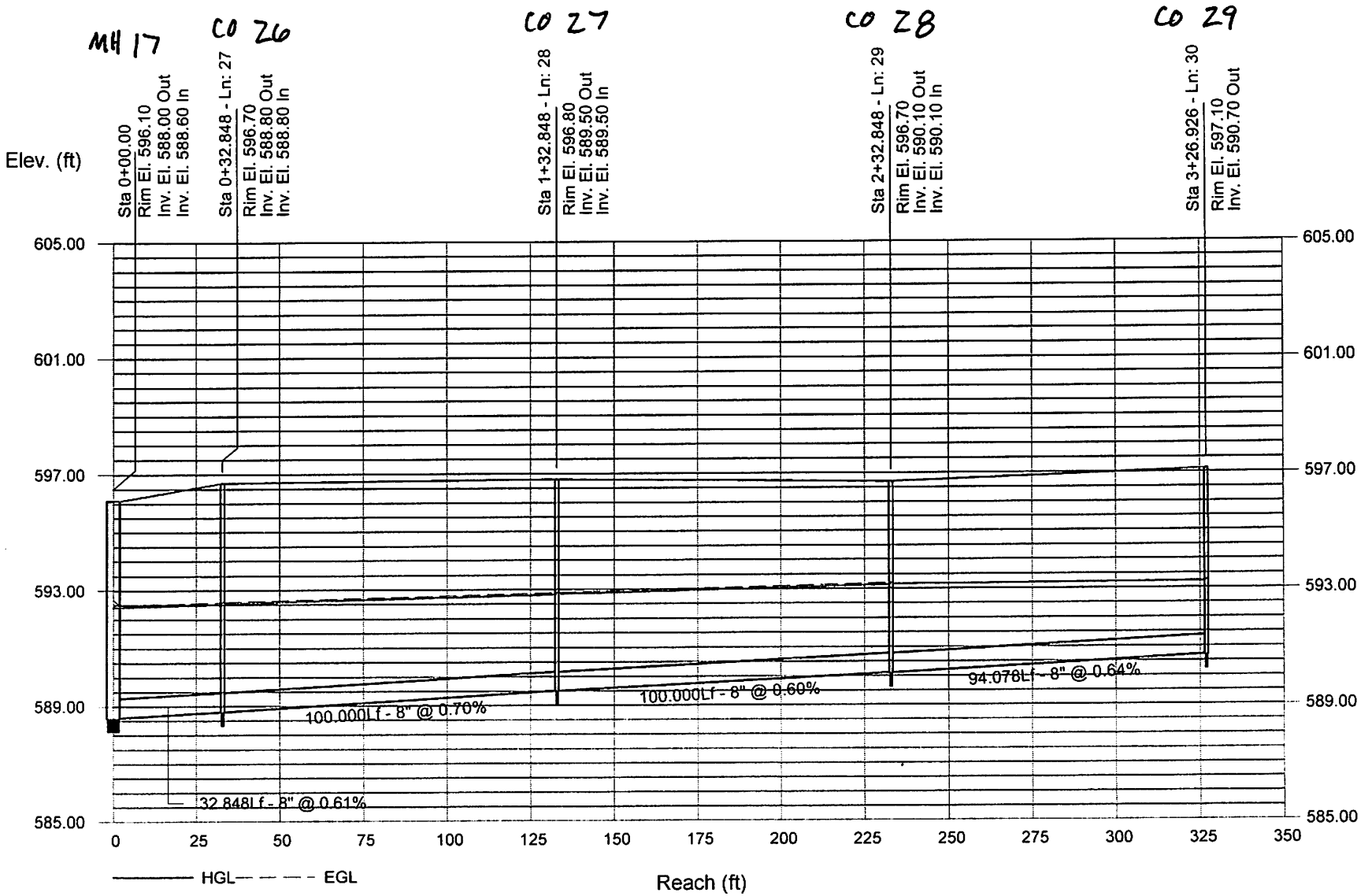
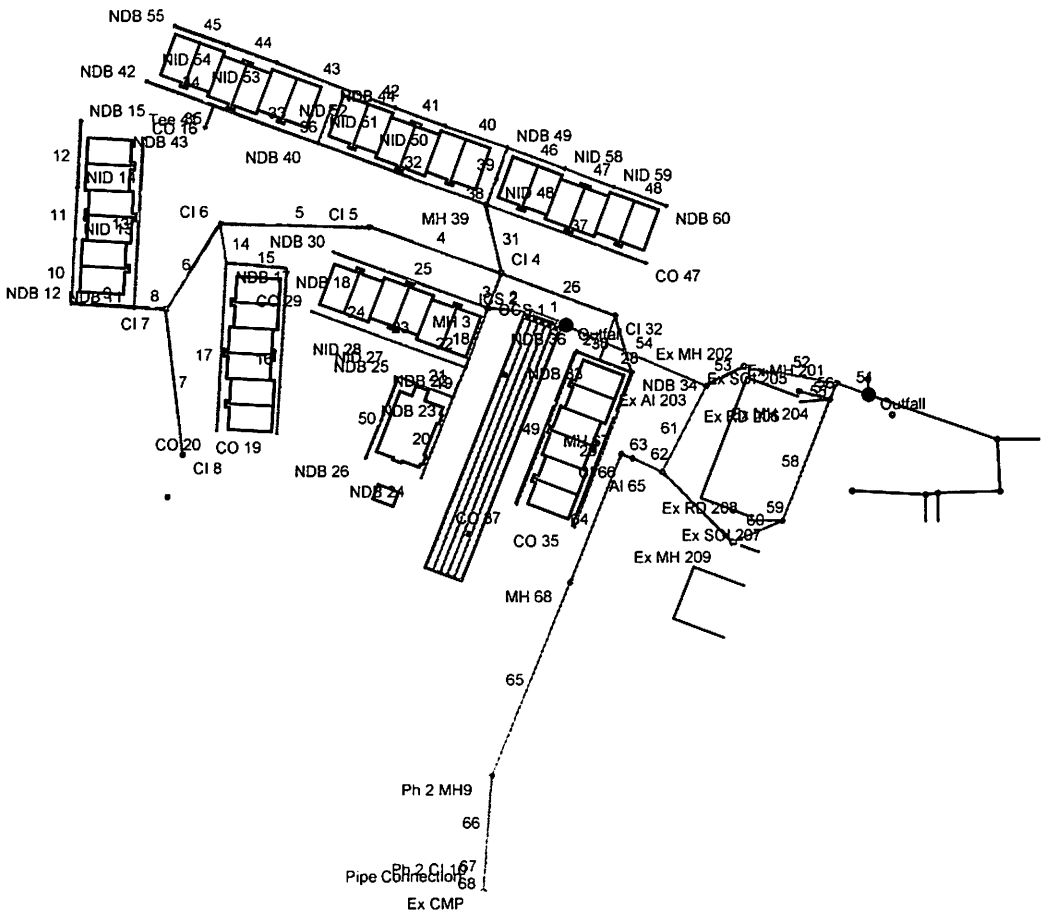


Hydraflow Storm Sewers Extension for AutoCAD® Civil 3D® 2013 Plan



Phase 1

Project File: 11354 Storm 100-yr.stm	Number of lines: 68	Date: 5/16/2014

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
1	ICS 2 to Detn	20.30	30	Cir	35.700	584.40	584.50	0.280	589.80*	589.87*	0.08	589.96	End	Manhole
2	MH 3 to ICS 2	20.30	30	Cir	39.398	584.50	584.80	0.761	589.96*	590.04*	0.27	590.31	1	Manhole
3	CI 4 to MH 3	17.47	30	Cir	34.971	585.00	585.30	0.858	590.37*	590.43*	0.59	591.02	2	Combination
4	CI 5 to CI 4	9.79	24	Cir	129.142	585.80	586.80	0.774	591.06*	591.27*	0.08	591.35	3	Combination
5	CI 6 to CI 5	7.47	18	Cir	138.755	587.30	588.40	0.793	591.35*	591.95*	0.42	592.37	4	Combination
6	CI 7 to CI 6	5.90	18	Cir	94.555	588.60	589.40	0.846	592.47*	592.73*	0.23	592.96	5	Combination
7	CI 8 to CI 7	1.84	15	Cir	137.207	589.60	590.70	0.802	593.10*	593.19*	0.03	593.23	6	Combination
8	NDB 11 to CI 7	2.85	12	Cir	29.648	589.50	589.80	1.012	592.96*	593.12*	0.20	593.33	6	Manhole
9	NDB 12 to NDB 11	2.38	12	Cir	57.690	590.00	590.60	1.040	593.39*	593.61*	0.21	593.82	8	DropGrate
10	NID 13 to NDB 12	1.90	12	Cir	59.339	590.80	591.42	1.045	593.87*	594.02*	0.05	594.06	9	DropGrate
11	NID 14 to NID 13	0.79	12	Cir	49.035	591.42	591.95	1.081	594.14*	594.16*	0.01	594.17	10	DropGrate
12	NDB 15 to NID 14	0.24	12	Cir	62.081	591.95	592.59	1.031	594.18*	594.18*	0.00	594.19	11	DropGrate
13	CO 16 to NDB 11	0.47	10	Cir	157.866	590.80	592.40	1.014	593.52*	593.59*	0.01	593.60	8	Manhole
14	NDB 17 to CI 6	0.91	10	Cir	36.950	588.80	589.20	1.083	592.60*	592.66*	0.04	592.70	5	Manhole
15	NDB 18 to NDB 17	0.44	10	Cir	55.847	589.40	590.00	1.074	592.73*	592.75*	0.01	592.76	14	Manhole
16	CO 19 to NDB 18	0.44	10	Cir	155.417	590.20	591.90	1.094	592.76*	592.81*	0.01	592.83	15	Manhole
17	CO 20 to NDB 17	0.47	10	Cir	157.586	589.70	591.30	1.015	592.73*	592.79*	0.01	592.80	14	Manhole
18	NDB 22 to MH 3	2.36	12	Cir	59.638	585.80	586.40	1.006	590.43*	590.65*	0.21	590.86	2	DropGrate
19	NDB 23 to NDB 22	1.26	12	Cir	30.358	586.60	587.00	1.318	590.96*	591.00*	0.06	591.06	18	DropGrate
20	NDB 24 to NDB 23	0.30	10	Cir	81.312	587.20	588.20	1.230	591.09*	591.11*	0.00	591.11	19	DropGrate
21	NDB 25 to NDB 23	0.90	10	Cir	53.362	587.20	587.80	1.124	591.06*	591.13*	0.06	591.20	19	DropGrate
22	NID 27 to NDB 22	1.05	10	Cir	64.445	586.60	587.30	1.086	590.95*	591.07*	0.03	591.10	18	DropGrate

Project File: 11354 Storm 100-yr.stm | Number of lines: 68 | Run Date: 5/16/2014

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
23	NID 28 to NID 27	0.50	10	Cir	22.214	587.30	587.60	1.350	591.15*	591.16*	0.01	591.16	22	DropGrate
24	CO 29 to NID 28	0.14	10	Cir	65.070	587.60	588.40	1.230	591.18*	591.18*	0.00	591.18	23	DropGrate
25	NDB 30 to MH 3	0.47	10	Cir	150.615	586.10	587.90	1.195	590.56*	590.63*	0.01	590.64	2	Manhole
26	CI 32 to CI 4	1.70	12	Cir	113.359	586.80	587.60	0.706	591.14*	591.36*	0.11	591.47	3	Combination
27	NDB 33 to CI 32	0.91	12	Cir	44.400	587.80	588.20	0.901	591.52*	591.55*	0.02	591.57	26	Manhole
28	NDB 34 to NDB 33	0.44	12	Cir	33.100	588.40	588.70	0.906	591.58*	591.59*	0.00	591.59	27	Manhole
29	CO 35 to NDB 34	0.44	10	Cir	155.500	588.90	590.45	0.997	591.59*	591.65*	0.01	591.66	28	Manhole
30	NDB 36 to NDB 33	0.47	10	Cir	23.200	588.60	589.20	2.586	591.58*	591.59*	0.01	591.60	27	Manhole
31	MH 39 to CI 4	4.45	15	Cir	65.436	586.30	587.00	1.070	591.02*	591.28*	0.20	591.49	3	Manhole
32	NDB 40 to NDB 39	1.89	12	Cir	166.655	587.20	588.90	1.020	591.60*	592.00*	0.09	592.09	31	Manhole
33	Tee 41 to NDB 40	1.26	12	Cir	103.598	589.10	590.20	1.062	592.14*	592.27*	0.04	592.31	32	None
34	NDB 42 to Tee 41	0.84	12	Cir	66.042	590.20	590.90	1.060	592.33*	592.37*	0.02	592.39	33	DropGrate
35	NDB 43 to Tee 41	0.09	10	Cir	22.181	590.20	591.40	5.410	592.35*	592.35*	0.00	592.35	33	DropGrate
36	NDB 44 to NDB 40	0.16	10	Cir	36.239	588.90	589.30	1.104	592.18*	592.18*	0.00	592.18	32	DropGrate
37	CO 47 to MH 39	0.47	10	Cir	158.171	587.40	589.00	1.012	591.68*	591.74*	0.01	591.75	31	Manhole
38	NID 48 to MH 39	2.09	12	Cir	25.546	587.10	587.41	1.213	591.58*	591.66*	0.06	591.71	31	DropGrate
39	NDB 49 to NID 48	2.00	12	Cir	31.582	587.41	587.80	1.235	591.72*	591.82*	0.23	592.05	38	DropGrate
40	NID 50 to NDB 49	1.23	10	Cir	61.377	588.00	588.62	1.010	592.07*	592.23*	0.04	592.27	39	DropGrate
41	NID 51 to NID 50	0.90	10	Cir	49.071	588.62	589.11	0.999	592.31*	592.38*	0.02	592.40	40	DropGrate
42	NID 52 to NID 51	0.85	10	Cir	30.562	589.11	589.42	1.014	592.41*	592.45*	0.02	592.46	41	DropGrate
43	NID 53 to NID 52	0.69	10	Cir	87.409	589.42	590.29	0.995	592.48*	592.55*	0.01	592.56	42	DropGrate
44	NID 54 to NID 53	0.50	10	Cir	48.744	590.29	590.78	1.005	592.58*	592.60*	0.01	592.60	43	DropGrate

Project File: 11354 Storm 100-yr.stm

Number of lines: 68

Run Date: 5/16/2014

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Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
45	NDB 55 to NID 54	0.33	10	Cir	52.072	590.78	591.30	0.999	592.61*	592.62*	0.01	592.63	44	DropGrate
46	NID 58 to NDB 49	0.60	10	Cir	56.871	588.00	588.36	0.633	592.13*	592.17*	0.01	592.17	39	DropGrate
47	NID 59 to NID 58	0.39	10	Cir	48.912	588.36	588.67	0.634	592.19*	592.20*	0.00	592.20	46	DropGrate
48	NDB 60 to NID 59	0.22	10	Cir	52.105	588.67	589.00	0.633	592.21*	592.21*	0.00	592.21	47	DropGrate
49	CO 37 to NDB 36	0.47	10	Cir	154.700	589.40	591.00	1.034	591.60	591.66	0.02	591.67	30	Manhole
50	NDB 26 to NDB 25	0.65	10	Cir	81.358	588.00	588.90	1.106	591.22*	591.28*	0.02	591.30	21	DropGrate
51	MH 201 to MH 200	55.38	30	Cir	31.116	572.30	573.06	2.443	574.74	575.42	2.07	577.49	End	Manhole
52	MH 202 to MH 201	52.86	30	Cir	86.489	573.31	577.61	4.972	575.69	579.94	n/a	579.94	51	Manhole
53	AI 203 to MH 202	52.86	30	Cir	40.668	577.83	582.40	11.237	580.05	584.73	n/a	587.52	52	DropGrate
54	OCS1 to Ex AI 203	28.10	30	Cir	150.528	582.60	583.75	0.764	588.89*	589.60*	0.51	590.11	53	Manhole
55	MH 204 to MH 201	2.52	15	Cir	16.963	573.36	573.40	0.236	579.50*	579.52*	0.06	579.59	51	Manhole
56	SOI 205 to MH 204	0.41	12	Cir	29.257	573.62	575.01	4.751	579.65*	579.65*	0.00	579.66	55	DropCurb
57	RD 206 to MH 204	0.42	6	Cir	27.361	574.18	574.48	1.096	579.59*	579.70*	0.07	579.77	55	None
58	SOI 207 to MH 204	1.69	15	Cir	121.371	573.42	574.63	0.997	579.62*	579.71*	0.05	579.76	55	DropCurb
59	RD 208 to SOI 207	0.42	6	Cir	30.590	575.30	575.64	1.112	579.76*	579.88*	0.07	579.95	58	None
60	MH 209 to SOI 207	0.16	15	Cir	51.238	575.23	576.50	2.479	579.79*	579.79*	0.00	579.79	58	Manhole
61	AI 65 to MH 203	24.76	24	Cir	90.402	582.90	583.40	0.553	588.47*	589.55*	1.45	591.00	53	DropCurb
62	CI 66 to AI 65	21.28	24	Cir	30.800	583.60	583.80	0.649	591.25*	591.53*	0.36	591.88	61	Curb-Horiz
63	MH 67 to CI 66	19.63	24	Cir	11.000	584.00	584.10	0.909	591.99*	592.07*	0.61	592.68	62	Manhole
64	MH 68 to MH 67	19.63	24	Cir	130.100	584.32	585.33	0.776	592.68*	593.66*	0.09	593.75	63	Manhole
65	Ph 2 MH9 to MH 68	1.73	15	Cir	195.000	586.10	587.80	0.872	594.33*	594.47*	0.01	594.48	64	Manhole
66	Ph2 CI10 to MH9	1.73	15	Cir	75.640	588.00	588.60	0.793	594.48*	594.53*	0.02	594.55	65	Curb-Horiz

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Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	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.	Junction Type
67	Pipe Connection	1.73	12	Cir	6.430	590.70	590.85	2.332	594.55*	594.56*	0.01	594.58	66	None
68	Ex CMP to CI10	1.46	12	Cir	26.000	590.85	591.27	1.616	594.60*	594.75*	0.05	594.80	67	OpenHeadwall

Project File: 11354 Storm 100-yr.stm | Number of lines: 68 | Run Date: 5/16/2014

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown).

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	30	20.30	584.40	589.80	2.50	4.91	4.14	0.27	590.07	0.209	35.700	584.50	589.87	2.50	4.91	4.14	0.27	590.14	0.209	0.209	0.075	0.31	0.08
2	30	20.30	584.50	589.96	2.50	4.91	4.14	0.27	590.22	0.209	39.398	584.80	590.04	2.50	4.91	4.14	0.27	590.31	0.209	0.209	0.082	1.00	0.27
3	30	17.47	585.00	590.37	2.50	4.91	3.56	0.20	590.57	0.155	34.971	585.30	590.43	2.50	4.91	3.56	0.20	590.63	0.155	0.155	0.054	2.99	0.59
4	24	9.79	585.80	591.06	2.00	3.14	3.12	0.15	591.21	0.160	129.142	586.80	591.27	2.00	3.14	3.12	0.15	591.42	0.160	0.160	0.206	0.55	0.08
5	18	7.47	587.30	591.35	1.50	1.77	4.23	0.28	591.63	0.431	138.755	588.40	591.95	1.50	1.77	4.23	0.28	592.23	0.431	0.431	0.598	1.50	0.42
6	18	5.90	588.60	592.47	1.50	1.77	3.34	0.17	592.65	0.269	94.555	589.40	592.73	1.50	1.77	3.34	0.17	592.90	0.269	0.269	0.254	1.35	0.23
7	15	1.84	589.60	593.10	1.25	1.23	1.50	0.03	593.13	0.069	137.207	590.70	593.19	1.25	1.23	1.50	0.03	593.23	0.069	0.069	0.095	1.00	0.03
8	12	2.85	589.50	592.96	1.00	0.79	3.63	0.20	593.17	0.546	29.648	589.80	593.12	1.00	0.79	3.63	0.20	593.33	0.546	0.546	0.162	1.00	0.20
9	12	2.38	590.00	593.39	1.00	0.79	3.03	0.14	593.53	0.381	57.690	590.60	593.61	1.00	0.79	3.03	0.14	593.75	0.381	0.381	0.220	1.50	0.21
10	12	1.90	590.80	593.87	1.00	0.79	2.42	0.09	593.97	0.243	59.339	591.42	594.02	1.00	0.79	2.42	0.09	594.11	0.243	0.243	0.144	0.50	0.05
11	12	0.79	591.42	594.14	1.00	0.79	1.01	0.02	594.15	0.042	49.035	591.95	594.16	1.00	0.79	1.01	0.02	594.18	0.042	0.042	0.021	0.50	0.01
12	12	0.24	591.95	594.18	1.00	0.79	0.31	0.00	594.18	0.004	62.081	592.59	594.18	1.00	0.79	0.31	0.00	594.19	0.004	0.004	0.002	1.00	0.00
13	10	0.47	590.80	593.52	0.83	0.55	0.86	0.01	593.53	0.046	157.866	592.40	593.59	0.83	0.55	0.86	0.01	593.60	0.046	0.046	0.073	1.00	0.01
14	10	0.91	588.80	592.60	0.83	0.55	1.67	0.04	592.65	0.147	36.950	589.20	592.66	0.83	0.55	1.67	0.04	592.70	0.147	0.147	0.054	0.98	0.04
15	10	0.44	589.40	592.73	0.83	0.55	0.81	0.01	592.74	0.034	55.847	590.00	592.75	0.83	0.55	0.81	0.01	592.76	0.034	0.034	0.019	1.00	0.01
16	10	0.44	590.20	592.76	0.83	0.55	0.81	0.01	592.77	0.034	155.417	591.90	592.81	0.83	0.55	0.81	0.01	592.83	0.034	0.034	0.053	1.00	0.01
17	10	0.47	589.70	592.73	0.83	0.55	0.86	0.01	592.74	0.039	157.586	591.30	592.79	0.83	0.55	0.86	0.01	592.80	0.039	0.039	0.062	1.00	0.01
18	12	2.36	585.80	590.43	1.00	0.79	3.01	0.14	590.57	0.374	59.638	586.40	590.65	1.00	0.79	3.00	0.14	590.79	0.374	0.374	0.223	1.50	0.21
19	12	1.26	586.60	590.96	1.00	0.79	1.60	0.04	591.00	0.107	30.358	587.00	591.00	1.00	0.79	1.60	0.04	591.04	0.107	0.107	0.032	1.50	0.06
20	10	0.30	587.20	591.09	0.83	0.55	0.55	0.00	591.10	0.016	81.312	588.20	591.11	0.83	0.55	0.55	0.00	591.11	0.016	0.016	0.013	1.00	0.00
21	10	0.90	587.20	591.06	0.83	0.55	1.65	0.04	591.10	0.144	53.362	587.80	591.13	0.83	0.55	1.65	0.04	591.18	0.144	0.144	0.077	1.50	0.06

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Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
22	10	1.05	586.60	590.95	0.83	0.55	1.93	0.06	591.00	0.196	64.445	587.30	591.07	0.83	0.55	1.93	0.06	591.13	0.196	0.196	0.126	0.50	0.03
23	10	0.50	587.30	591.15	0.83	0.55	0.92	0.01	591.16	0.044	22.214	587.60	591.16	0.83	0.55	0.92	0.01	591.17	0.044	0.044	0.010	0.50	0.01
24	10	0.14	587.60	591.18	0.83	0.55	0.26	0.00	591.18	0.004	65.070	588.40	591.18	0.83	0.55	0.26	0.00	591.18	0.004	0.004	0.003	1.00	0.00
25	10	0.47	586.10	590.56	0.83	0.55	0.86	0.01	590.57	0.046	150.615	587.90	590.63	0.83	0.55	0.86	0.01	590.64	0.046	0.046	0.069	1.00	0.01
26	12	1.70	586.80	591.14	1.00	0.79	2.16	0.07	591.21	0.194	113.359	587.60	591.36	1.00	0.79	2.16	0.07	591.43	0.194	0.194	0.220	1.50	0.11
27	12	0.91	587.80	591.52	1.00	0.79	1.16	0.02	591.54	0.056	44.400	588.20	591.55	1.00	0.79	1.16	0.02	591.57	0.056	0.056	0.025	1.00	0.02
28	12	0.44	588.40	591.58	1.00	0.79	0.56	0.00	591.59	0.013	33.100	588.70	591.59	1.00	0.79	0.56	0.00	591.59	0.013	0.013	0.004	1.00	0.00
29	10	0.44	588.90	591.59	0.83	0.55	0.81	0.01	591.60	0.034	155.500	590.45	591.65	0.83	0.55	0.81	0.01	591.66	0.034	0.034	0.054	1.00	0.01
30	10	0.47	588.60	591.58	0.83	0.55	0.86	0.01	591.59	0.039	23.200	589.20	591.59	0.83	0.55	0.86	0.01	591.60	0.039	0.039	0.009	1.00	0.01
31	15	4.45	586.30	591.02	1.25	1.23	3.63	0.20	591.22	0.405	65.436	587.00	591.28	1.25	1.23	3.63	0.20	591.49	0.405	0.405	0.265	1.00	0.20
32	12	1.89	587.20	591.60	1.00	0.79	2.41	0.09	591.69	0.240	166.655	588.90	592.00	1.00	0.79	2.41	0.09	592.09	0.240	0.240	0.400	1.00	0.09
33	12	1.26	589.10	592.14	1.00	0.79	1.60	0.04	592.18	0.125	103.598	590.20	592.27	1.00	0.79	1.60	0.04	592.31	0.125	0.125	0.130	1.00	0.04
34	12	0.84	590.20	592.33	1.00	0.79	1.07	0.02	592.35	0.056	66.042	590.90	592.37	1.00	0.79	1.07	0.02	592.39	0.056	0.056	0.037	1.00	0.02
35	10	0.09	590.20	592.35	0.83	0.55	0.17	0.00	592.35	0.001	22.181	591.40	592.35	0.83	0.55	0.17	0.00	592.35	0.001	0.001	0.000	1.00	0.00
36	10	0.16	588.90	592.18	0.83	0.55	0.29	0.00	592.18	0.005	36.239	589.30	592.18	0.83	0.55	0.29	0.00	592.18	0.005	0.005	0.002	1.00	0.00
37	10	0.47	587.40	591.68	0.83	0.55	0.86	0.01	591.69	0.039	158.171	589.00	591.74	0.83	0.55	0.86	0.01	591.75	0.039	0.039	0.062	1.00	0.01
38	12	2.09	587.10	591.58	1.00	0.79	2.66	0.11	591.69	0.294	25.546	587.41	591.66	1.00	0.79	2.66	0.11	591.77	0.293	0.294	0.075	0.50	0.06
39	12	2.00	587.41	591.72	1.00	0.79	2.55	0.10	591.82	0.316	31.582	587.80	591.82	1.00	0.79	2.55	0.10	591.92	0.315	0.315	0.100	2.25	0.23
40	10	1.23	588.00	592.07	0.83	0.55	2.26	0.08	592.15	0.269	61.377	588.62	592.23	0.83	0.55	2.26	0.08	592.31	0.269	0.269	0.165	0.50	0.04
41	10	0.90	588.62	592.31	0.83	0.55	1.65	0.04	592.35	0.144	49.071	589.11	592.38	0.83	0.55	1.65	0.04	592.42	0.144	0.144	0.071	0.50	0.02
42	10	0.85	589.11	592.41	0.83	0.55	1.56	0.04	592.44	0.128	30.562	589.42	592.45	0.83	0.55	1.56	0.04	592.48	0.128	0.128	0.039	0.50	0.02

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Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Engy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
43	10	0.69	589.42	592.48	0.83	0.55	1.27	0.02	592.50	0.085	87.409	590.29	592.55	0.83	0.55	1.27	0.02	592.58	0.085	0.085	0.074	0.50	0.01
44	10	0.50	590.29	592.58	0.83	0.55	0.92	0.01	592.59	0.044	48.744	590.78	592.60	0.83	0.55	0.92	0.01	592.61	0.044	0.044	0.022	0.50	0.01
45	10	0.33	590.78	592.61	0.83	0.55	0.61	0.01	592.62	0.019	52.072	591.30	592.62	0.83	0.55	0.61	0.01	592.63	0.019	0.019	0.010	1.00	0.01
46	10	0.60	588.00	592.13	0.83	0.55	1.10	0.02	592.15	0.064	56.871	588.36	592.17	0.83	0.55	1.10	0.02	592.18	0.064	0.064	0.036	0.50	0.01
47	10	0.39	588.36	592.19	0.83	0.55	0.72	0.01	592.19	0.027	48.912	588.67	592.20	0.83	0.55	0.72	0.01	592.21	0.027	0.027	0.013	0.50	0.00
48	10	0.22	588.67	592.21	0.83	0.55	0.40	0.00	592.21	0.009	52.105	589.00	592.21	0.83	0.55	0.40	0.00	592.21	0.009	0.009	0.004	1.00	0.00
49	10	0.47	589.40	591.60	0.83	0.55	0.86	0.01	591.61	0.039	154.700	591.00	591.66	0.66	0.46	1.02	0.02	591.67	0.042	0.041	0.063	1.00	0.02
50	10	0.65	588.00	591.22	0.83	0.55	1.19	0.02	591.24	0.075	81.358	588.90	591.28	0.83	0.55	1.19	0.02	591.30	0.075	0.075	0.061	1.00	0.02
51	30	55.38	572.30	574.74	2.44	4.80	11.35	2.07	576.81	0.000	31.116	573.06	575.42	2.36**	4.80	11.55	2.07	577.49	0.000	0.000	n/a	1.00	2.07
52	30	52.86	573.31	575.69	2.38	4.77	10.97	1.91	577.60	0.000	86.489	577.61	579.94	2.33**	4.77	11.09	1.91	581.85	0.000	0.000	n/a	0.65	n/a
53	30	52.86	577.83	580.05	2.22	4.61	11.47	1.91	581.96	0.000	40.668	582.40	584.73	2.33**	4.77	11.09	1.91	586.64	0.000	0.000	n/a	1.46	n/a
54	30	28.10	582.60	588.89	2.50	4.91	5.73	0.51	589.40	0.470	150.523	583.75	589.60	2.50	4.91	5.72	0.51	590.11	0.469	0.470	0.707	1.00	0.51
55	15	2.52	573.36	579.50	1.25	1.23	2.05	0.07	579.56	0.152	16.963	573.40	579.52	1.25	1.23	2.05	0.07	579.59	0.152	0.152	0.026	0.99	0.06
56	12	0.41	573.62	579.65	1.00	0.79	0.52	0.00	579.65	0.013	29.257	575.01	579.65	1.00	0.79	0.52	0.00	579.66	0.013	0.013	0.004	1.00	0.00
57	6	0.42	574.18	579.59	0.50	0.20	2.14	0.07	579.66	0.402	27.361	574.48	579.70	0.50	0.20	2.14	0.07	579.77	0.402	0.402	0.110	1.00	0.07
58	15	1.69	573.42	579.62	1.25	1.23	1.38	0.03	579.65	0.069	121.371	574.63	579.71	1.25	1.23	1.38	0.03	579.74	0.068	0.069	0.083	1.70	0.05
59	6	0.42	575.30	579.76	0.50	0.20	2.14	0.07	579.83	0.402	30.590	575.64	579.88	0.50	0.20	2.14	0.07	579.95	0.402	0.402	0.123	1.00	0.07
60	15	0.16	575.23	579.79	1.25	1.23	0.13	0.00	579.79	0.001	51.238	576.50	579.79	1.25	1.23	0.13	0.00	579.79	0.001	0.001	0.000	1.00	0.00
61	24	24.76	582.90	588.47	2.00	3.14	7.88	0.97	589.44	1.199	90.402	583.40	589.55	2.00	3.14	7.88	0.97	590.52	1.198	1.199	1.084	1.50	1.45
62	24	21.28	583.60	591.25	2.00	3.14	6.77	0.71	591.97	0.886	30.800	583.80	591.53	2.00	3.14	6.77	0.71	592.24	0.885	0.885	0.273	0.50	0.36
63	24	19.63	584.00	591.99	2.00	3.14	6.25	0.61	592.60	0.754	11.000	584.10	592.07	2.00	3.14	6.25	0.61	592.68	0.753	0.753	0.083	1.00	0.61

Project File: 11354 Storm 100-yr.stm | Number of lines: 68 | Run Date: 5/16/2014

Notes: ; ** Critical depth. ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

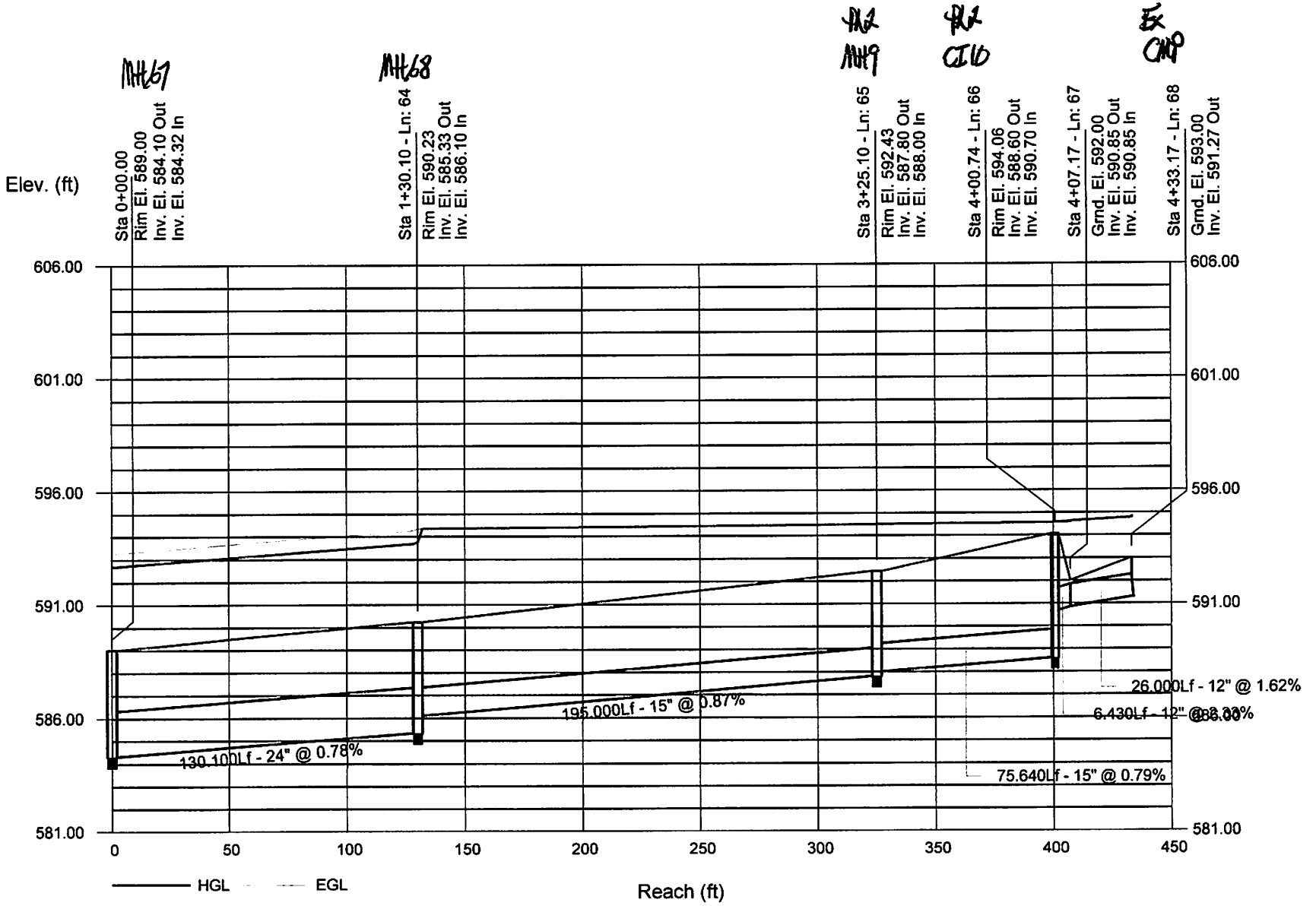
Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
64	24	19.63	584.32	592.68	2.00	3.14	6.25	0.61	593.29	0.754	130.10	585.33	593.66	2.00	3.14	6.25	0.61	594.27	0.753	0.753	0.980	0.15	0.09
65	15	1.73	586.10	594.33	1.25	1.23	1.41	0.03	594.36	0.072	195.00	587.80	594.47	1.25	1.23	1.41	0.03	594.50	0.072	0.072	0.140	0.35	0.01
66	15	1.73	588.00	594.48	1.25	1.23	1.41	0.03	594.51	0.072	75.640	588.60	594.53	1.25	1.23	1.41	0.03	594.56	0.072	0.072	0.054	0.50	0.02
67	12	1.73	590.70	594.55	1.00	0.79	2.20	0.08	594.62	0.236	6.430	590.85	594.56	1.00	0.79	2.20	0.08	594.64	0.236	0.236	0.015	0.15	0.01
68	12	1.46	590.85	594.60	1.00	0.79	1.86	0.05	594.65	0.573	26.000	591.27	594.75	1.00	0.79	1.86	0.05	594.80	0.573	0.573	0.149	1.00	0.05

Project File: 11354 Storm 100-yr.stm | Number of lines: 68 | Run Date: 5/16/2014

Notes: ; ** Critical depth. ; c = cir e = ellip b = box

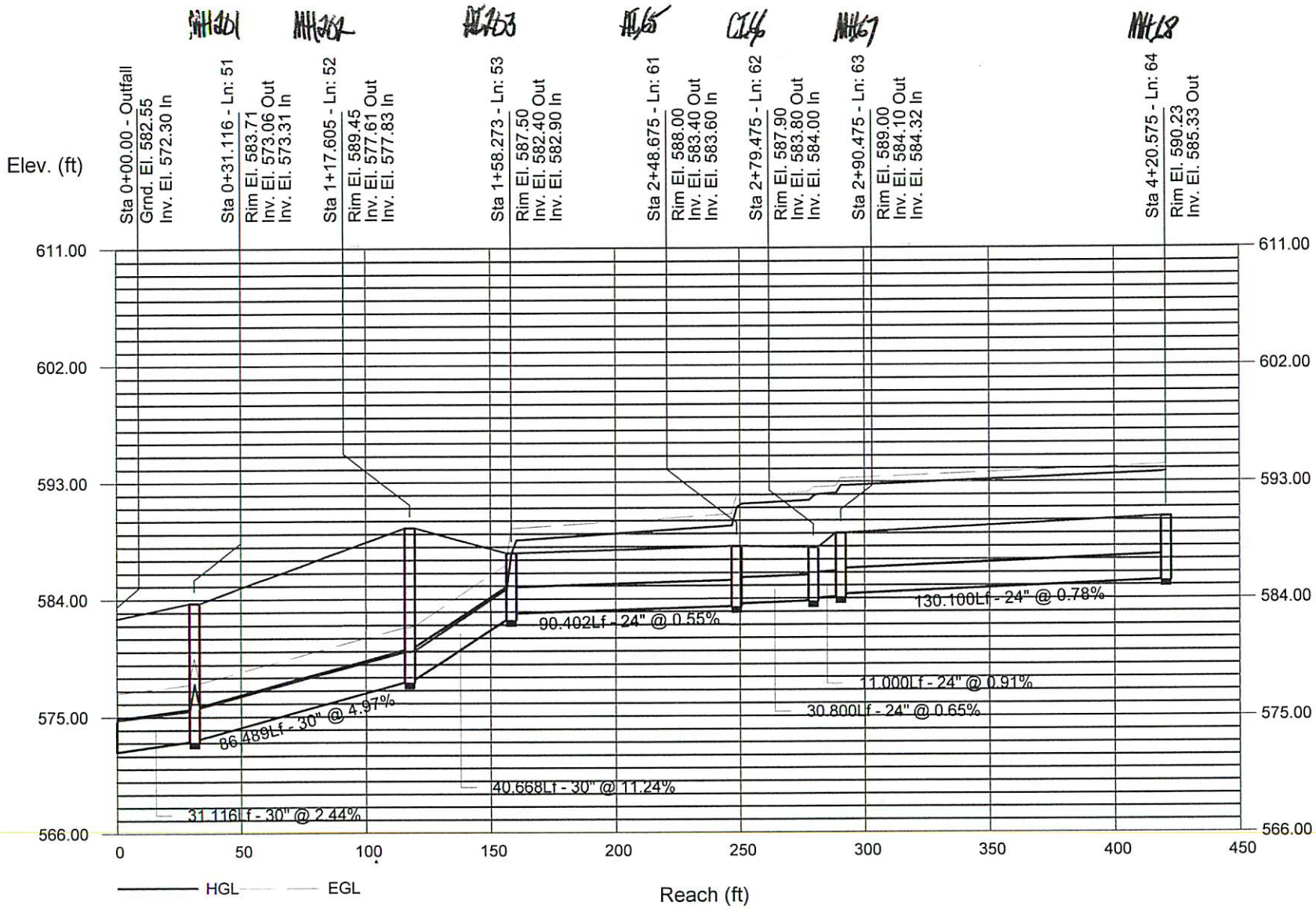
Storm Sewer Profile

Proj. file: 11354 Storm 100-yr.stm



Storm Sewer Profile

Proj. file: 11354 Storm 100-yr.stm



Storm Sewer Profile

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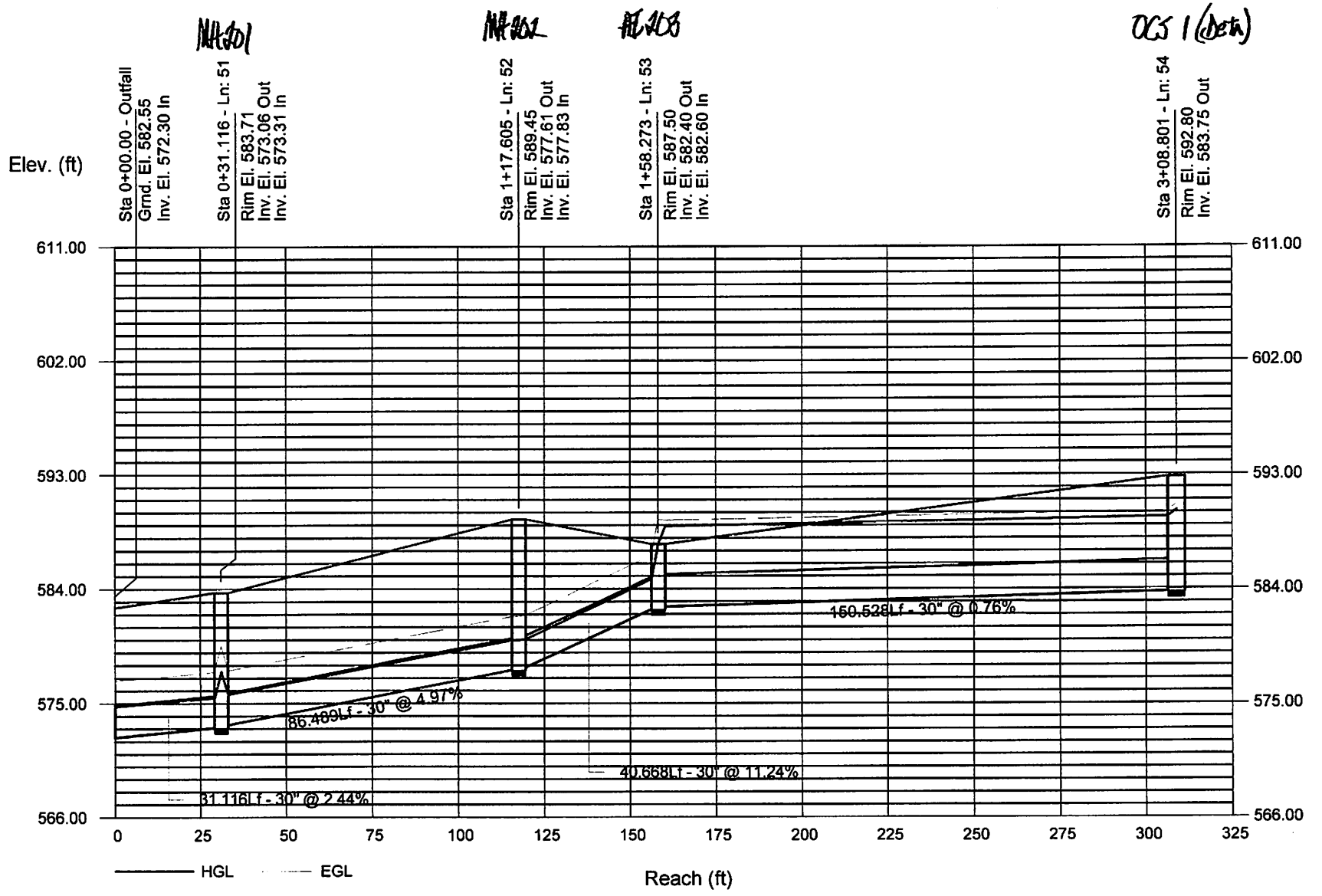
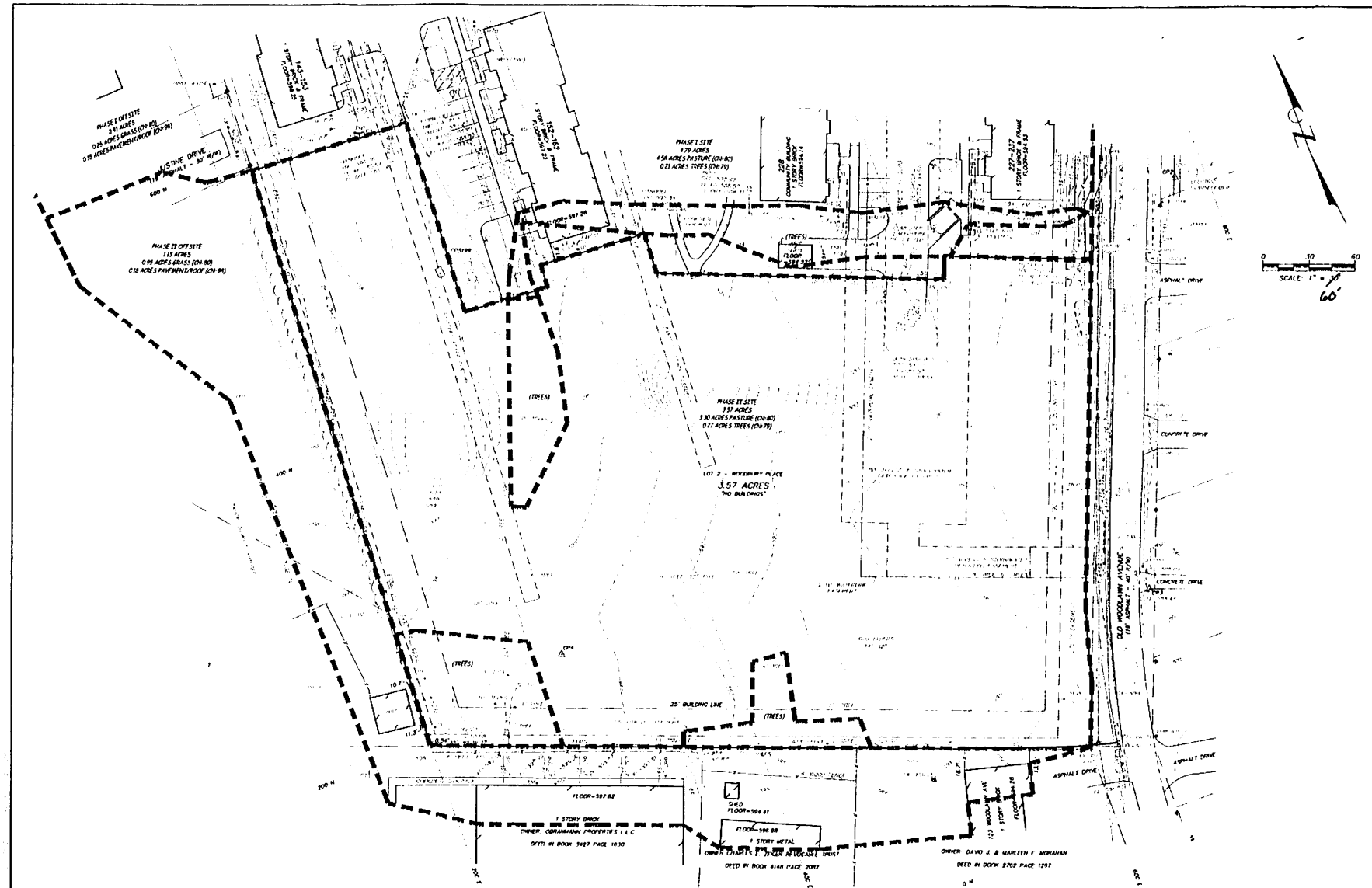


APPENDIX C
DETENTION POND CALCULATIONS
PHASE 1 & 2



PLANNING & DEVELOPMENT #1804.04 APPROVED MAY 1, 2014

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WOODBURY PLACE II

721 WOODLAWN AVENUE

O'FALLON, ST. CHARLES COUNTY, MISSOURI

STATE OF MISSOURI
MATTHEW A. MINUTE
2007003611
PROFESSIONAL ENGINEER

5-23-14

MATTHEW A. MINUTE
PROFESSIONAL ENGINEER
PE 2007003611

Date
MAY 23, 2014

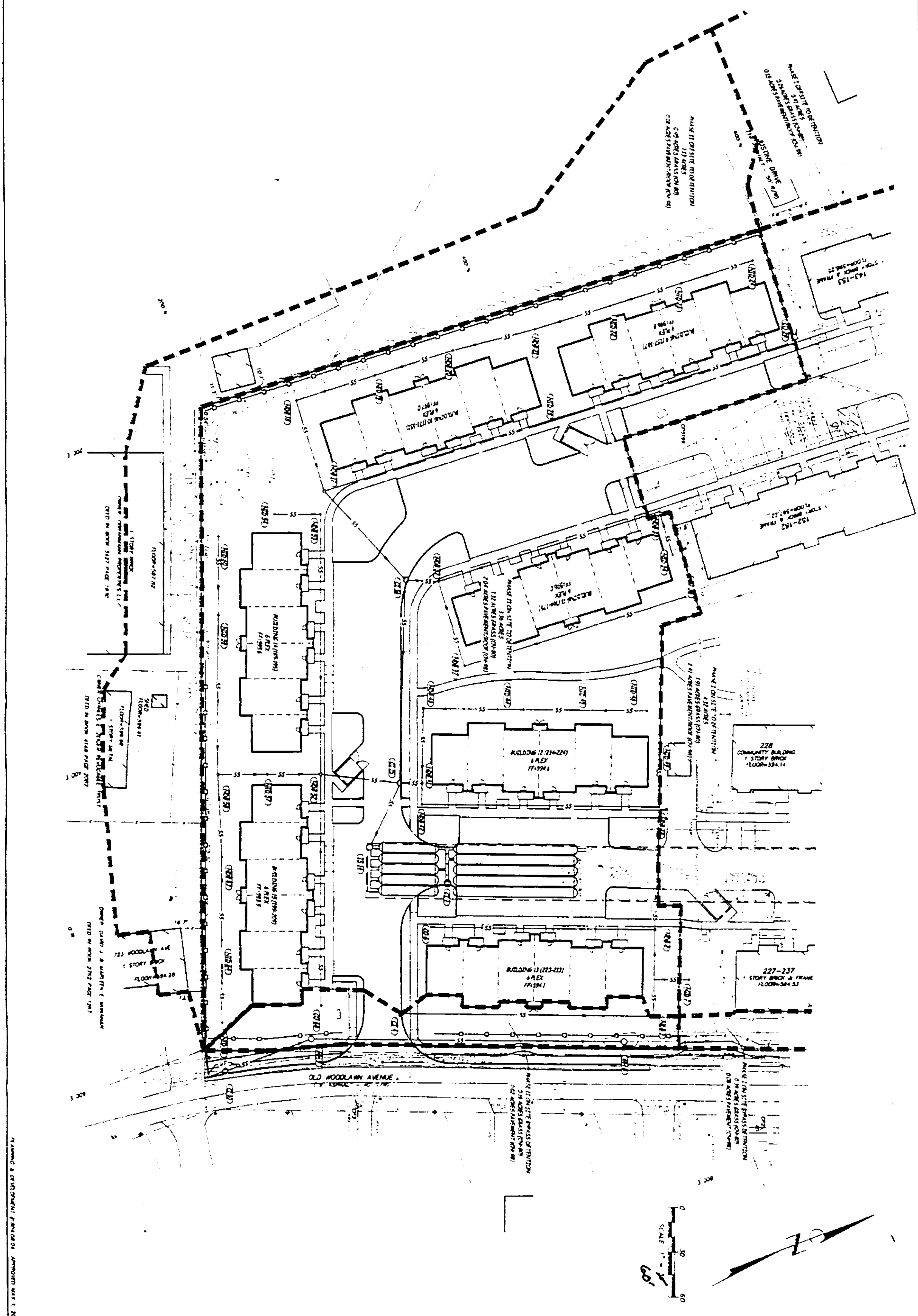
Revised

Design: TDC Drawn: BR

PRE DEVELOPMENT DRAINAGE AREA MAP

Sheet
C13.01

FS&S PROJECT NO. 13648



WOODBURY PLACE II

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POST DEVELOPMENT DRAINAGE AREA MAP

Sheet C13.02

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