DRAINAGE REPORT

WAREHOUSE 38

PREPARED FOR

JS ADVISORS

PREPARED BY

DUTTON ASSOCIATES, LLC
67 EASTERN BOULEVARD
GLASTONBURY, CT 06033

08/08/2021

REVISED 08-25-2021

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INTRODUCTION AND SUMMARY

EXISTING CONDITIONS

The subject property is located on the south side of Hubbard Street across from the Town Green Cemetery. The property contains 1.2093 acres. The site was developed many years ago and contains for industrial use. The parcel is gently sloped with grades ranging from (1% to 5%). The northerly portion of the site drains northwest toward Hubbard St., west along Hubbard St. then southerly along Main St. and ultimately to Wickham Brook. The southerly portion of the site drains to the southwest crossing Clark Field to a man-made swale leading to Wickham brook. Soils in the area are udorthents. Deep test pits were dug and the results are shown on the site plans.

PROPOSED CONDITIONS

This report discusses the drainage associated with the construction of a new parking lot and modifications to the existing structure. Rainfall from the existing building rooftop drains to two rain gardens sized to hold the entire water quality volume. Flow from larger frequency storms from the roof will be collected in a storm sewer system which ultimately leads to the man-made swale referenced above. Runoff from the paved parking area is collected in two catch basins, the last of which is a standard Town of Glastonbury Sedimentation Structure. The water quality volume is collected from the sediment structure and is directed to two cultic infiltration systems. The entire water quality volume (not 50% as allowed by DEEP) is directed to rain gardens or the cultic systems.

ANALYSIS METHOD

The proposed storm drains are designed convey a 10-year design storm without significant surcharge to the system. Peak rates of runoff were calculated using the Rational Method using CT DOT rainfall intensities. Pipe design and headwater analysis were made using the Hydraflow Storm Sewers Ver. 2005 program. Mitigation of peak flow increases (detention systems) is not required for this site per the Town of Glastonbury Master Drainage Study.

CONCLUSION

This proposal will not adversely impact downstream properties and provides significant recharge to the groundwater and is in compliance with the Connecticut DEEP requirements.

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Water Quality Volume Calculation

CB-1

$$WQV = \frac{(1")(R)(A)}{12}$$

R = 0.05 + 0.009(I) = 0.05 + 0.009(86.6) = 0.829

I = 0.351 ac = 86.6%
A = 0.406 ac

$$WQV = \frac{(1")(0.829)(0.406ac)}{12}$$

= 0.028 ac-ft = **1222 ft³**

SS-1

R = 0.05 + 0.009(I) = 0.05 + 0.009(93.3) = 0.889

I = 0.124 ac = 93.3%
A = 0.132 ac

$$WQV = \frac{(1")(0.889)(0.132ac)}{12}$$

= 0.0098 ac-ft = **426 ft³**

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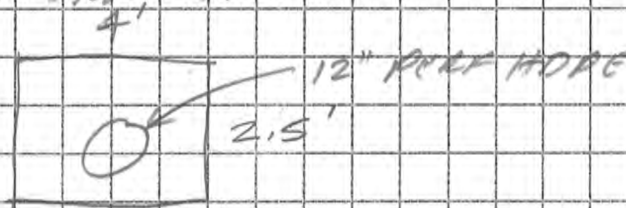
WQV STORAGE - CB1

INFILTRATION TRENCH



TOTAL LENGTH = 118'

VOL =

12" HDPE O.D. STONE VOIDS

STONE 4 x 2.5 ((1.2083/2)² x π)) x 0.35 x 1 = 3.10 FT³/LF

PIPE 0.5² x π x 1 = 0.79 FT³/LF

TOTAL / LF = .79 + 3.10 = 3.89 FT³/LF

TOTAL = 3.89 x 118 = 459 FT³

TOTAL WQV REQ = 1222 FT³

NEEDED FOR GALLERIES 1222 - 459 = 763 FT³

GALLERY STORAGE

CULTEC 150 XLHD (SEE APPENDIX)

USE 6" STONE FOUNDATION DEPTH

VOL / CHAMBER = 50.17 FT³

REQ'D = 763 / 50.17 = 15.2 USE <u>16</u>

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WQV STORAGE SS 1

VOL. REQ'D = 426 FT^3

CULTEC 150 XLHD (SEE APPENDIX)
6" STONE FOUNDATION DEPTH

VOL / CHAMBER = 50.17 FT^3

CHAMBERS REQ'D = 426/50.17 = 8.49

USE 9

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R

RAINGARDEN #1

$$WQV = \frac{(1")(R)(A)}{12}$$

A = 0.202 ac

I = 0.169 ac = 83.7%

R = 0.05 + 0.009(I) = 0.05 + 0.009(83.7) = 0.803

$$WQV = \frac{(1")(0.803)(0.202)}{12}$$

WQV = 0.0135 ac-ft = 588 ft^3

RAINGARDEN #2

A = 0.370 ac
I = 0.169 ac = 45.7%

R = 0.05 + 0.009(45.7) = 0.461

$$WQV = \frac{(1")(0.461)(0.370)}{12}$$

WQV = 0.0142 ac-ft = 619 ft^3

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RAIN GARDEN #1 (RG #1)

VOLUME

EL	AREA	VOL.
32	159.5	
		280.9 FT^3
33	402.3	
		339.2
33.7	566.8	

TOTAL 620.1 ft^3 (588 FT^3 REQUIRED)

RAIN GARDEN #2 (RG #2)

VOLUME

EL	AREA	VOL
32	188.6	
		554.9
33	921.3	
		1459.0
34.	1996.61	

TOTAL 2013.9 REQ = 619

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AREA TO INLET, TC, R

RATIONAL METHOD

Q = AIR

A = AREA

I = RAINFALL (CT DOT)

R = RUNOFF COEFFICIENT

USE R = 0.9 PAVED

R = 0.3 GRASS

IMPACTS FROM THE RAIN GARDENS ARE NOT CONSIDERED (WILL PROVIDE A SLIGHTLY CONSERVATIVE DESIGN)

CB #1

TOTAL AREA = 17,689 SF = 0.406 AC

PAVED = 15,311 SF = 0.351 AC @0.9 = 0.316

GRASS = 2378 SF = 0.055 AC @0.3 = 0.017

Σ 0.333

USE TC = 5 MIN (86% PAVED) AVG R = 0.820

Q_{10} = .820 × 6.0 = 2.0 CFS

SS-1

TOTAL AREA = 5773 SF = 0.133 AC

PAVED = 5391 SF = 0.124 AC @0.9 = 0.112

GRASS = 382 SF = 0.009 AC @0.3 = 0.003

Σ 0.115

USE TC = 5 MIN (93% PAVED) AVG R = 0.865

Q_{10} = 0.133 × 0.865 × 6.0 = 0.69 CFS

RG #1

TOTAL AREA = 8814 SF = 0.202 AC

PAVED = 7375 SF = 0.169 AC @0.9 = 0.152

GRASS = 1439 SF = 0.033 AC @0.3 = 0.010

0.99 CFS Q_{10} = 0.202 × 0.802 × 6 AVG R = 0.802 Σ 0.162

USE TC = 5 MIN (84% PAVED)

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RG #2

TOTAL AREA = 16103 SF = 0.370 AC

PAVED = 7345 SF = 0.169 AC @0.9 = 0.152

GRASS = 8758 SF = 0.201 AC @0.3 = 0.060

Σ 0.212

USE TC = 10 MIN (46% PAVED)

AVG R = 0.573

Q_{10} = 0.370 × 0.573 × 4.8 = 1.02 CFS

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DEPTH ABOVE GRATE

BOTH CB 1 & SS1 (TYPE C INLET) ARE AT LOW POINTS
SEE DOT DRAINAGE MANUAL 11.9.10, DOT TABLE B-2.1

GRATE AREA = 3.13 FT² (A)
PERIMETER = 5.02 FT (P)

Q_{10} CB #1

TOTAL AI = (.351 X 0.9) + (0.055 X 0.3) = 0.332
I = 6.0
Q_{10} = 6.0 X .332 = 1.99 CFS

AS A WEIR:

$$Q = \frac{CPd^{1.3}}{C_{FS}} = Q = \frac{1.66(5.02)^{1.3}}{2}$$

C = 1.66
C_{FS} = 2

= 6.76 CFS - OK

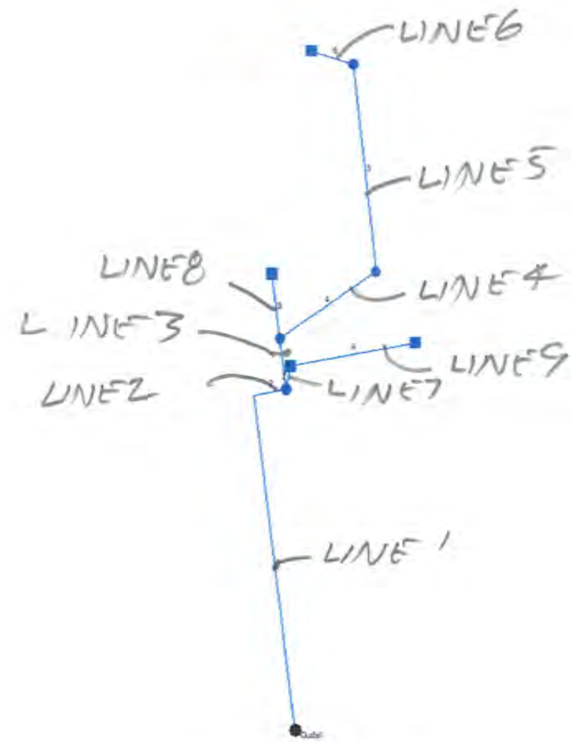
$$DEPTH = \left(\frac{Q\,C_{FS}}{CP}\right)^{2/3} = \left(\frac{0.332 \times 2}{1.66 \times 5.02}\right)^{2/3}$$

$$= \left(\frac{0.664}{8.33}\right)^{0.666}$$

= 0.18' OK

THE WATERSHED TO SS 1 IS 0.133 AC (40% OF THAT TO CB#1) AND PAVEMENT GRADES ARE THE SAME, IF CB 1 IS OK SS 1 IS ALSO. DEPTH ABOVE GRATE NOT COMPUTED

Hydraflow Plan View



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Project File: 21050.stm	No. Lines: 9	08-07-2021

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns line No.
1	OUT TO DMH1	4.68	15 c	322.0	22.00	23.61	0.500	23.13	24.54	0.35	24.90	End
2	DMH1 TO DMH2	4.68	15 c	34.4	23.61	25.27	4.824	25.02	26.14	n/a	26.78 i	1
3	DMH2 TO DMH3	1.99	12 c	48.7	25.52	26.49	1.994	26.78	27.09	n/a	27.46 i	2
4	DMH3 TO DMH4	1.02	12 c	118.6	26.49	27.91	1.198	27.46	28.34	n/a	28.53 i	3
5	DMH4 TO MH1	1.02	12 c	198.6	27.91	30.29	1.198	28.53	30.72	n/a	30.91 i	4
6	MH1 TO YD2	1.02	12 c	40.0	30.20	30.68	1.200	30.91	31.11	n/a	31.30 i	5
7	MH2 TO SS1	2.69	15 c	22.1	27.44	27.86	1.904	27.89	28.68	0.22	28.90	2
8	DMH3 TO YD1	0.97	12 c	62.7	26.49	30.70	6.714	27.46	31.12	n/a	31.30 i	3
9	CB1 to SS1	2.00	12 c	124.4	28.54	29.16	0.498	29.18	29.80	n/a	30.06 i	7

Project File: 221050 BACK-UP.stm	Number of lines: 9	Run Date: 08-25-2021

NOTES: c = cir; e = ellip; b = box; Return period = 10 Yrs. ; i - Inlet control.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	322.0	0.00	0.00	0.00	0.00	0.00	0.0	12.8	0.0	4.68	4.95	4.39	15	0.50	23.61	22.00	24.54	23.13	31.80	23.00	OUT TO DMH1
2	1	34.4	0.00	0.00	0.00	0.00	0.00	0.0	12.7	0.0	4.68	15.36	4.49	15	4.82	25.27	23.61	26.14	25.02	32.30	31.80	DMH1 TO DMH2
3	2	48.7	0.00	0.00	0.00	0.00	0.00	0.0	12.4	0.0	1.99	5.45	3.30	12	1.99	26.49	25.52	27.09	26.78	33.50	32.30	DMH2 TO DMH3
4	3	118.6	0.00	0.00	0.00	0.00	0.00	0.0	11.6	0.0	1.02	4.22	2.24	12	1.20	27.91	26.49	28.34	27.46	34.67	33.50	DMH3 TO DMH4
5	4	198.6	0.00	0.00	0.00	0.00	0.00	0.0	10.3	0.0	1.02	4.22	2.58	12	1.20	30.29	27.91	30.72	28.53	37.30	34.67	DMH4 TO MH1
6	5	40.0	0.00	0.00	0.00	0.00	0.00	10.0	10.0	0.0	1.02	4.23	2.44	12	1.20	30.68	30.20	31.11	30.91	34.00	37.30	MH1 TO YD2
7	2	22.1	0.00	0.00	0.00	0.00	0.00	5.0	5.5	0.0	2.69	9.65	4.95	15	1.90	27.86	27.44	28.68	27.89	33.00	32.30	MH2 TO SS1
8	3	62.7	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	0.97	10.00	2.18	12	6.71	30.70	26.49	31.12	27.46	34.50	33.50	DMH3 TO YD1
9	7	124.4	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	2.00	2.72	3.79	12	0.50	29.16	28.54	29.80	29.18	32.70	33.00	CB1 to SS1

Project File: 221050 BACK-UP.stm | Number of lines: 9 | Run Date: 08-25-2021

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80; Return period = 10 Yrs.

MyCustom

Line No.	Line ID	Storage (cft)	Invert Dn (ft)	Drng Area (ac)	Runoff Coeff (C)	Total CxA	Tc (min)	i Sys (in/hr)	Flow Rate (cfs)	Capac Full (cfs)	Line Size (in)	Line Slope (%)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	HGL Up (ft)	HGL Dn (ft)	Gnd/Rim El Up (ft)	n-val Pipe
1	OUT TO DMH1	347.40	22.00	0.00	0.00	0.00	12.8	0.00	4.68	4.95	15	0.50	4.39	23.61	22.00	24.54	23.13	31.80	0.012
2	DMH1 TO DMH2	39.17	23.61	0.00	0.00	0.00	12.7	0.00	4.68	15.36	15	4.82	4.49	25.27	23.61	26.14 j	25.02	32.30	0.012
3	DMH2 TO DMH3	35.02	25.52	0.00	0.00	0.00	12.4	0.00	1.99	5.45	12	1.99	3.30	26.49	25.52	27.09 j	26.78	33.50	0.012
4	DMH3 TO DMH4	67.89	26.49	0.00	0.00	0.00	11.6	0.00	1.02	4.22	12	1.20	2.24	27.91	26.49	28.34 j	27.46	34.67	0.012
5	DMH4 TO MH1	82.94	27.91	0.00	0.00	0.00	10.3	0.00	1.02	4.22	12	1.20	2.58	30.29	27.91	30.72 j	28.53	37.30	0.012
6	MH1 TO YD2	18.46	30.20	0.00	0.00	0.00	10.0	0.00	1.02	4.23	12	1.20	2.44	30.68	30.20	31.11 j	30.91	34.00	0.012
7	MH2 TO SS1	13.81	27.44	0.00	0.00	0.00	5.5	0.00	2.69	9.65	15	1.90	4.95	27.86	27.44	28.68	27.89	33.00	0.012
8	DMH3 TO YD1	35.58	26.49	0.00	0.00	0.00	5.0	0.00	0.97	10.00	12	6.71	2.18	30.70	26.49	31.12 j	27.46	34.50	0.012
9	CB1 to SS1	65.62	28.54	0.00	0.00	0.00	5.0	0.00	2.00	2.72	12	0.50	3.79	29.16	28.54	29.80	29.18	32.70	0.012

Project File: 221050 BACK-UP.stm | Number of lines: 9 | Date: 08-25-2021

NOTES: Intensity = 54.74 / (Inlet time + 10.80) ^ 0.80 -- Return period = 10 Yrs. ; i Inlet control; ** Critical depth

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr line No.	Line length (ft)	Defl angle (deg)	Junc type	Known Q (cfs)	Drng area (ac)	Runoff coeff (C)	Inlet time (min)	Invert El Dn (ft)	Line slope (%)	Invert El Up (ft)	Line size (in)	Line type	N value (n)	J-loss coeff (K)	Inlet/ Rim El (ft)	
1	End	322.0	-98.1	None	0.00	0.00	0.00	0.0	22.00	0.50	23.61	15	Cir	0.012	1.00	31.80	OUT TO DMH1
2	1	34.4	87.8	MH	0.00	0.00	0.00	0.0	23.61	4.82	25.27	15	Cir	0.012	1.00	32.30	DMH1 TO DMH2
3	2	48.7	-88.0	MH	0.00	0.00	0.00	0.0	25.52	1.99	26.49	12	Cir	0.012	0.93	33.50	DMH2 TO DMH3
4	3	118.6	65.4	MH	0.00	0.00	0.00	0.0	26.49	1.20	27.91	12	Cir	0.012	0.92	34.67	DMH3 TO DMH4
5	4	198.6	-64.2	MH	0.00	0.00	0.00	0.0	27.91	1.20	30.29	12	Cir	0.012	0.93	37.30	DMH4 TO MH1
6	5	40.0	-66.7	Grate	1.02	0.00	0.00	10.0	30.20	1.20	30.68	12	Cir	0.012	1.00	34.00	MH1 TO YD2
7	2	22.1	-69.7	Curb	0.69	0.00	0.00	5.0	27.44	1.90	27.86	15	Cir	0.012	1.42	33.00	MH2 TO SS1
8	3	62.7	0.0	Grate	0.97	0.00	0.00	5.0	26.49	6.71	30.70	12	Cir	0.012	1.00	34.50	DMH3 TO YD1
9	7	124.4	69.7	Curb	2.00	0.00	0.00	5.0	28.54	0.50	29.16	12	Cir	0.012	1.00	32.70	CB1 to SS1

13A

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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)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	15	4.68	22.00	23.13	1.13	1.17	4.01	0.25	23.38	0.393	322	23.61	24.54	0.93	0.98	4.78	0.35	24.90	0.548	0.470	1.514	1.00	0.35
2	15	4.68	23.61	25.02	1.25	1.23	3.81	0.23	25.25	n/a	34.4	25.27	26.14 j	0.87**	0.91	5.16	0.41	26.55i	n/a	n/a	n/a	1.00	n/a
3	12	1.99	25.52	26.78	1.00	0.79	2.53	0.10	26.88	n/a	48.7	26.49	27.09 j	0.60**	0.49	4.06	0.26	27.34i	n/a	n/a	n/a	0.93	n/a
4	12	1.02	26.49	27.46	0.97	0.78	1.31	0.03	27.48	n/a	119	27.91	28.34 j	0.43**	0.32	3.17	0.16	28.50i	n/a	n/a	n/a	0.92	n/a
5	12	1.02	27.91	28.53	0.62	0.51	1.99	0.06	28.59	n/a	199	30.29	30.72 j	0.43**	0.32	3.17	0.16	30.88i	n/a	n/a	n/a	0.93	n/a
6	12	1.02	30.20	30.91	0.71	0.60	1.71	0.05	30.96	n/a	40.0	30.68	31.11 j	0.43**	0.32	3.17	0.16	31.27i	n/a	n/a	n/a	1.00	n/a
7	15	2.69	27.44	27.89	0.45*	0.40	6.73	0.70	28.60	1.900	22.1	27.86	28.68	0.82	0.85	3.16	0.16	28.83	0.253	1.077	0.237	1.42	0.22
8	12	0.97	26.49	27.46	0.97	0.78	1.25	0.02	27.48	n/a	62.7	30.70	31.12 j	0.42**	0.31	3.12	0.15	31.27i	n/a	n/a	n/a	1.00	n/a
9	12	2.00	28.54	29.18	0.64*	0.53	3.79	0.22	29.40	n/a	124	29.16	29.80	0.64	0.53	3.79	0.22	30.02i	n/a	n/a	0.396	1.00	n/a

Project File: 221050 BACK-UP.stm | Number of lines: 9 | Run Date: 08-25-2021

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

Hydraflow HGL Computation Procedure

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

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

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

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

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

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

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

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

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

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

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

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

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

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

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

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

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

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

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

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

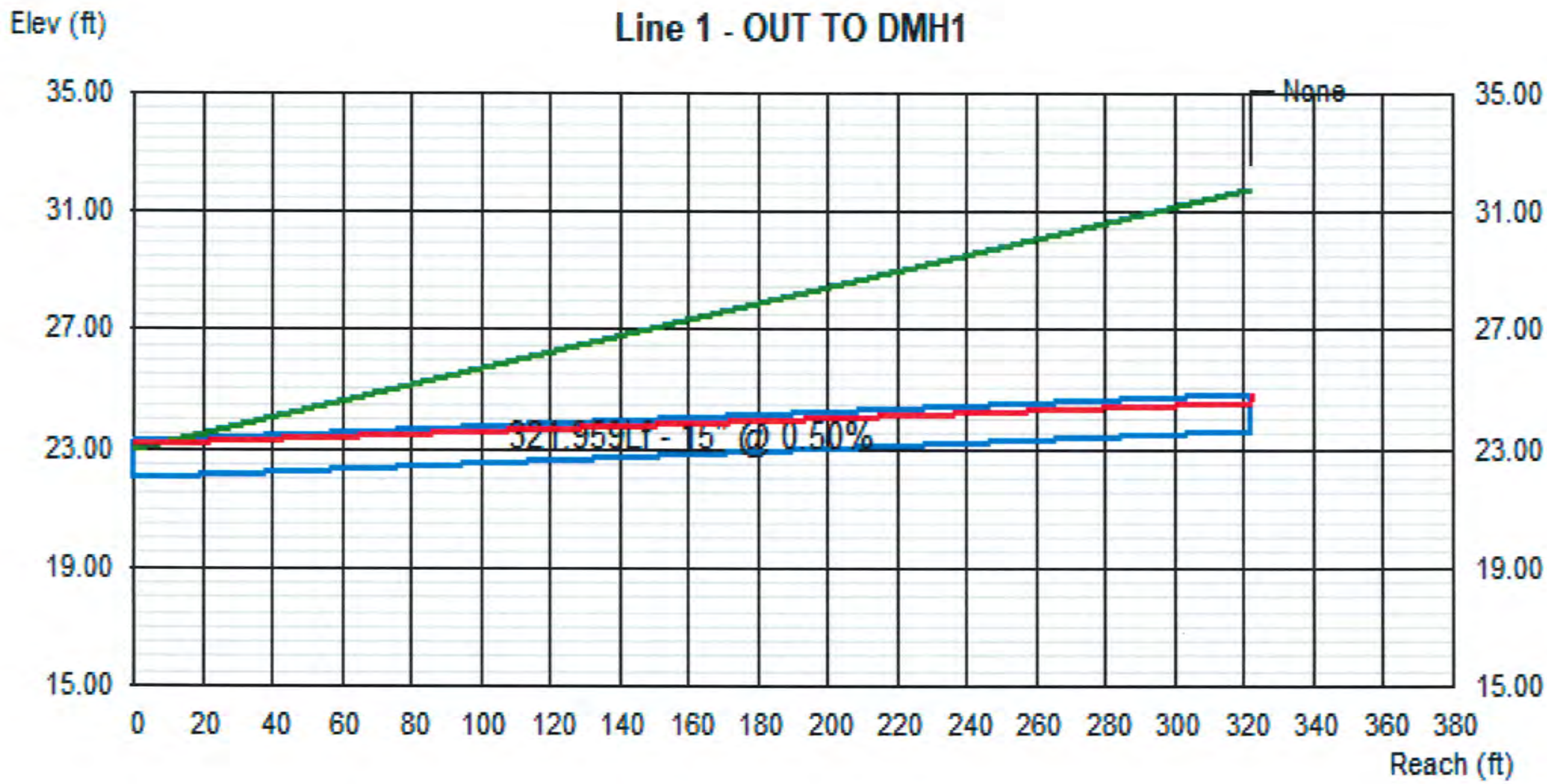
Col. 22 Energy loss. Average Sf/100 x Line Length (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

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

15

Line Profile (Line 1) - OUT TO DMH1

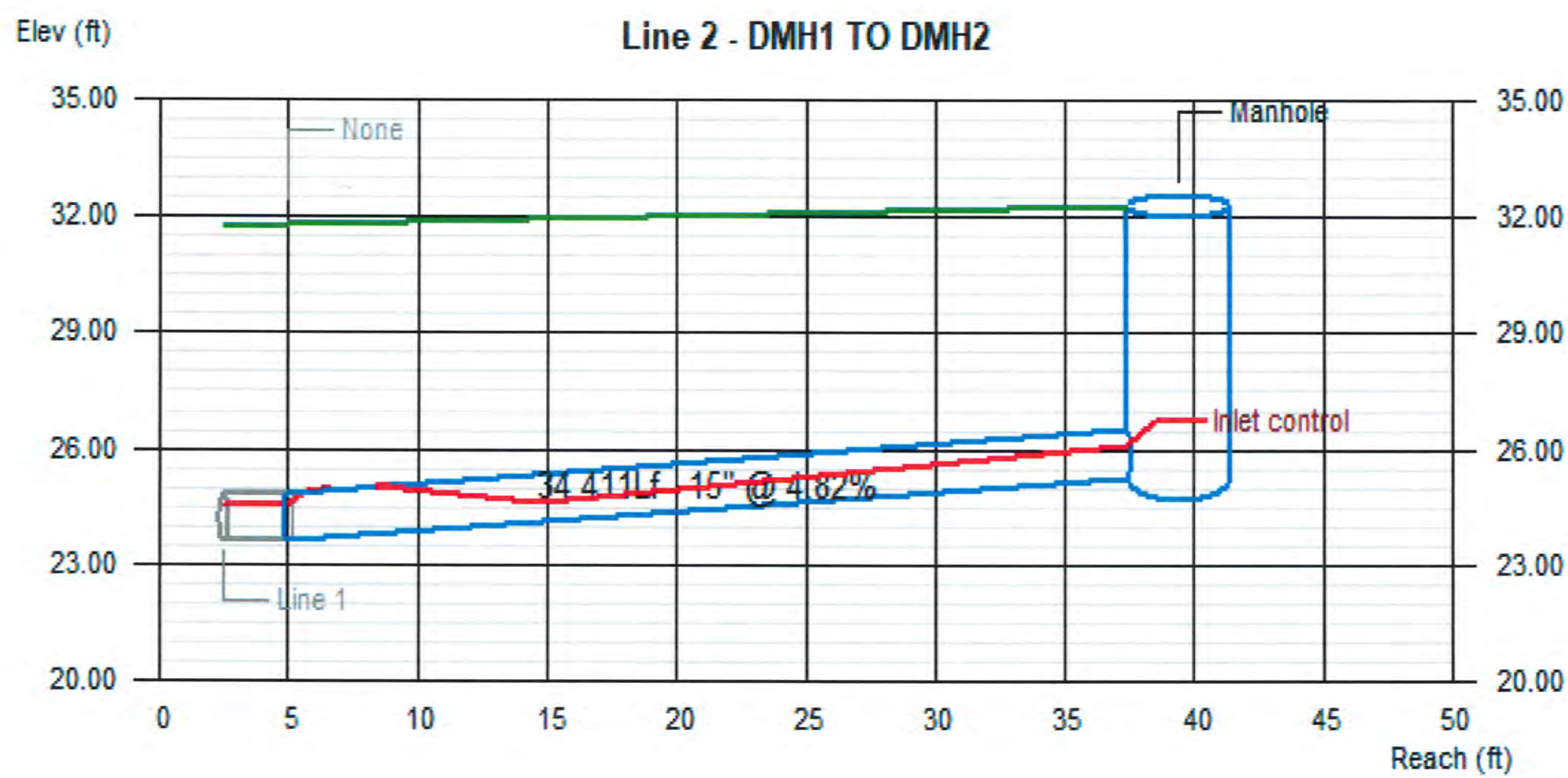


Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
1	4.68	22.00	23.61	1.13	0.93	1.29	23.13	24.54	24.90	4.01	4.78	-0.25	6.94

Project File: | No. Lines: 9 | Run Date: 08-25-2021

16

Line Profile (Line 2) - DMH1 TO DMH2



Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
2	4.68	23.61	25.27	1.25	0.87	1.51	25.02	26.14 j	26.78 i	3.81	5.16	6.94	5.78

Project File: | No. Lines: 9 | Run Date: 08-25-2021

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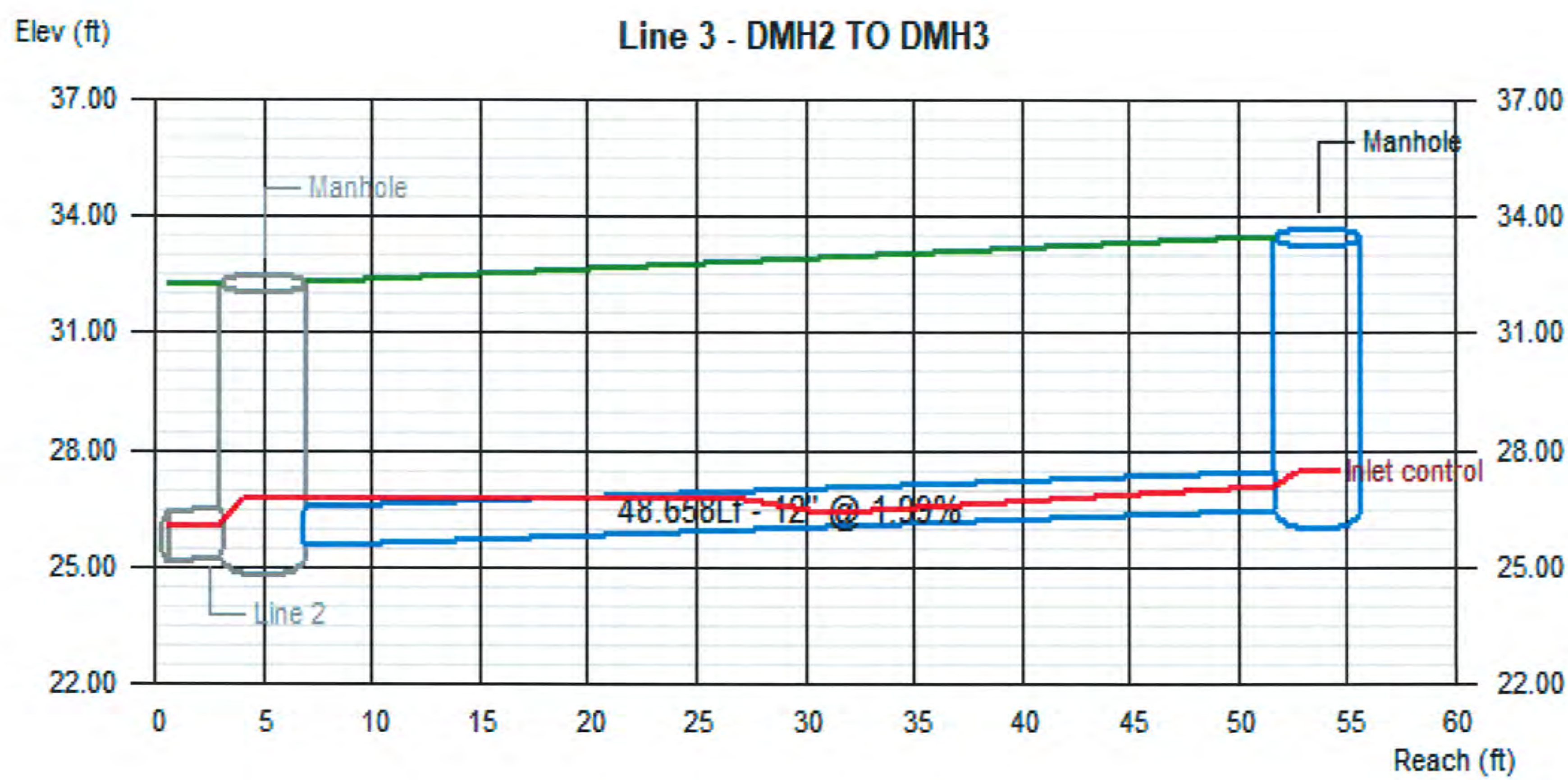
Line Profile (Line 3) - DMH2 TO DMH3



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
3	1.99	25.52	26.49	1.00	0.60	0.97	26.78	27.09 j	27.46 i	2.53	4.06	5.78	6.01

Project File: | No. Lines: 9 | Run Date: 08-25-2021

Hydraflow Storm Sewers 2005

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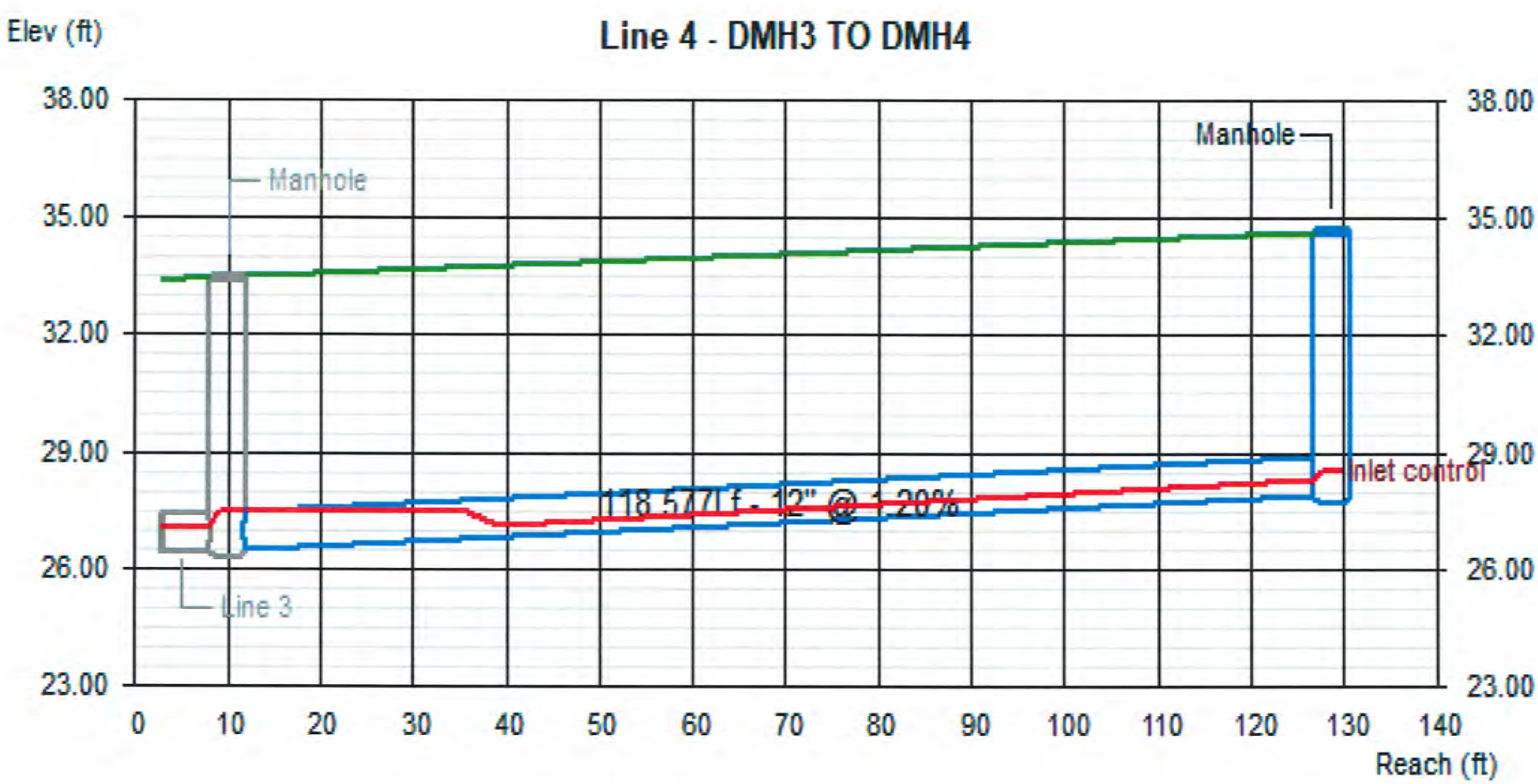
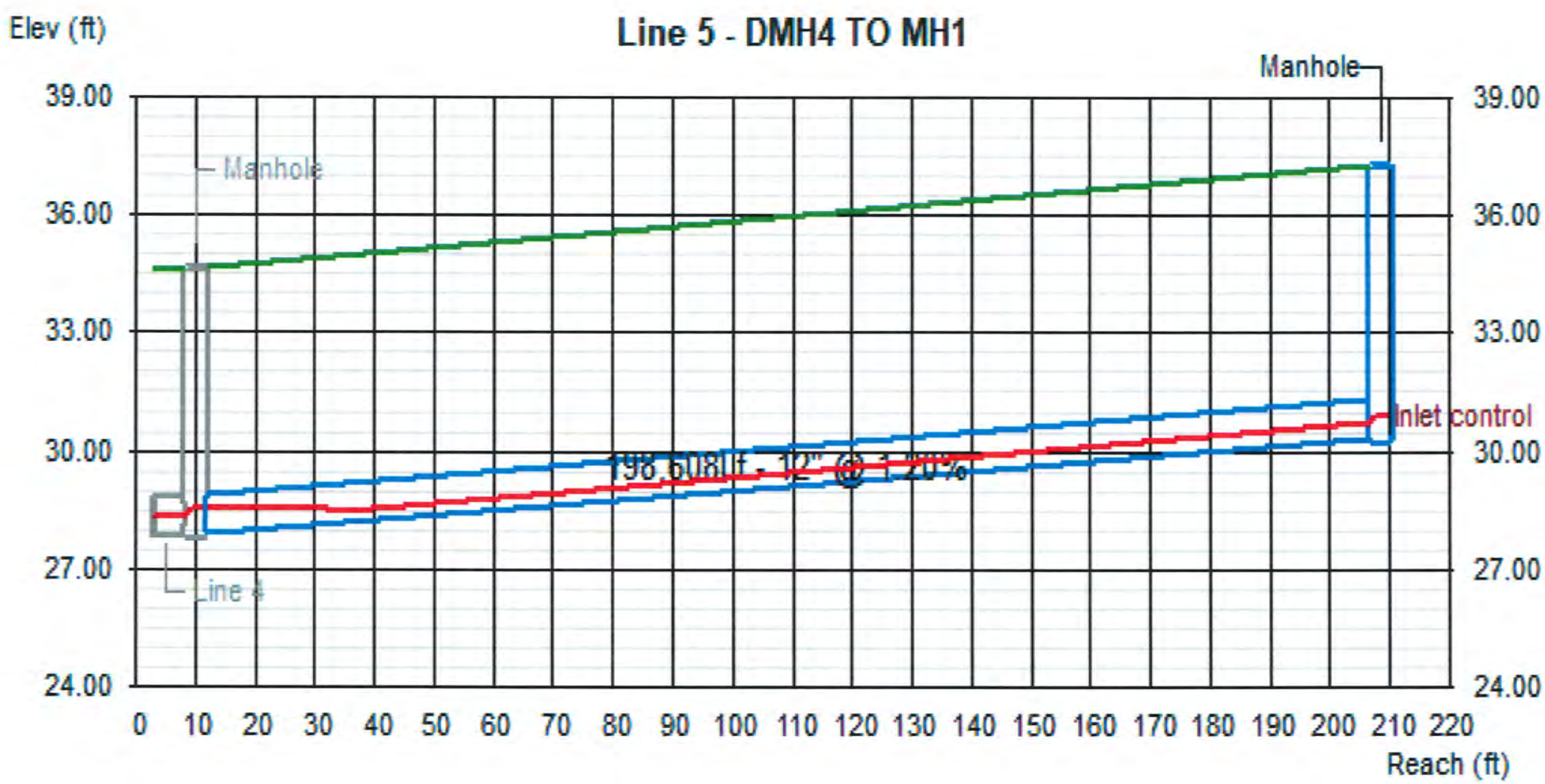
Line Profile (Line 4) - DMH3 TO DMH4



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
4	1.02	26.49	27.91	0.97	0.43	0.62	27.46	28.34 j	28.53 i	1.31	3.17	6.01	5.76

Project File:	No. Lines: 9	Run Date: 08-25-2021

Line Profile (Line 5) - DMH4 TO MH1



Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
5	1.02	27.91	30.29	0.62	0.43	0.62	28.53	30.72 j	30.91 i	1.99	3.17	5.76	6.01

Project File:	No. Lines: 9	Run Date: 08-25-2021

Hydraflow Storm Sewers 2005

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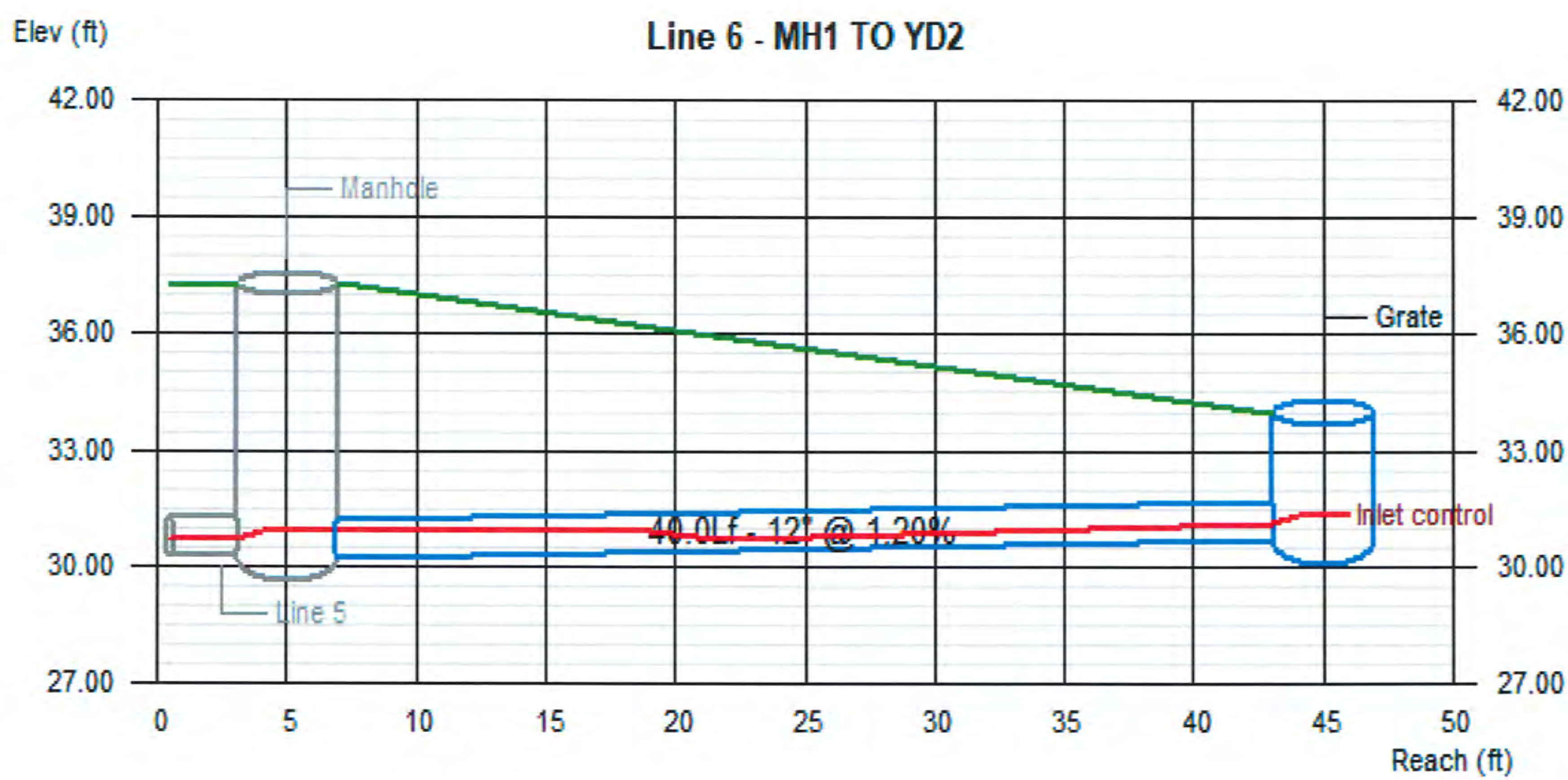
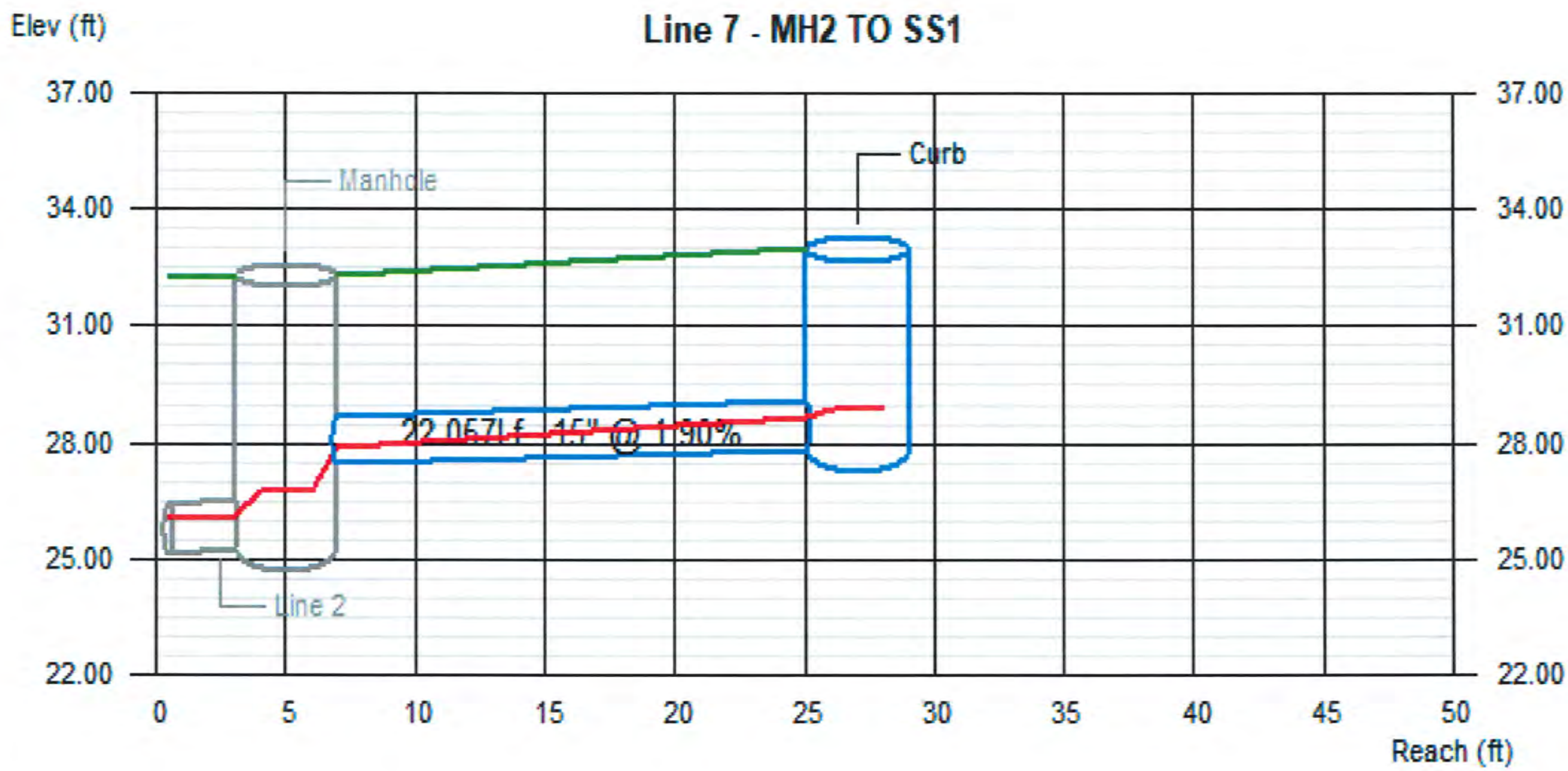
Line Profile (Line 6) - MH1 TO YD2



Line #	Q (cfs)	Invert Elevation Dn (ft)	Invert Elevation Up (ft)	Depth of Flow Dn (ft)	Depth of Flow Up (ft)	Depth of Flow Hw (ft)	Hydraulic Grade Line Dn (ft)	Hydraulic Grade Line Up (ft)	Hydraulic Grade Line Jnct (ft)	Velocity Dn (ft/s)	Velocity Up (ft/s)	Cover Dn (ft)	Cover Up (ft)
6	1.02	30.20	30.68	0.71	0.43	0.62	30.91	31.11 j	31.30 i	1.71	3.17	6.10	2.32

Project File: | No. Lines: 9 | Run Date: 08-25-2021

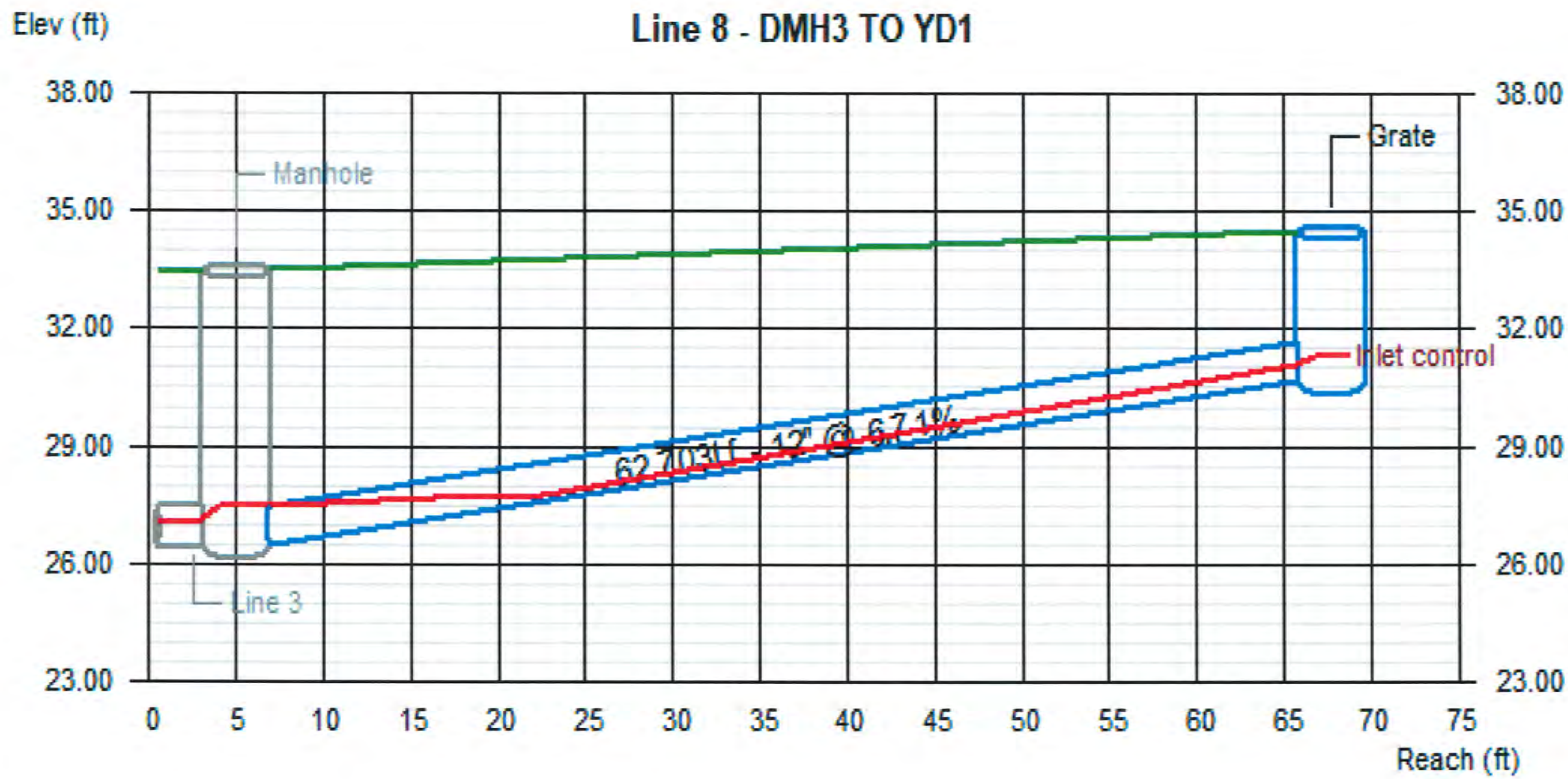
Line Profile (Line 7) - MH2 TO SS1



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
7	2.69	27.44	27.86	0.45	0.82	1.04	27.89	28.68	28.90	6.73	3.16	3.61	3.89

Project File:	No. Lines: 9	Run Date: 08-25-2021

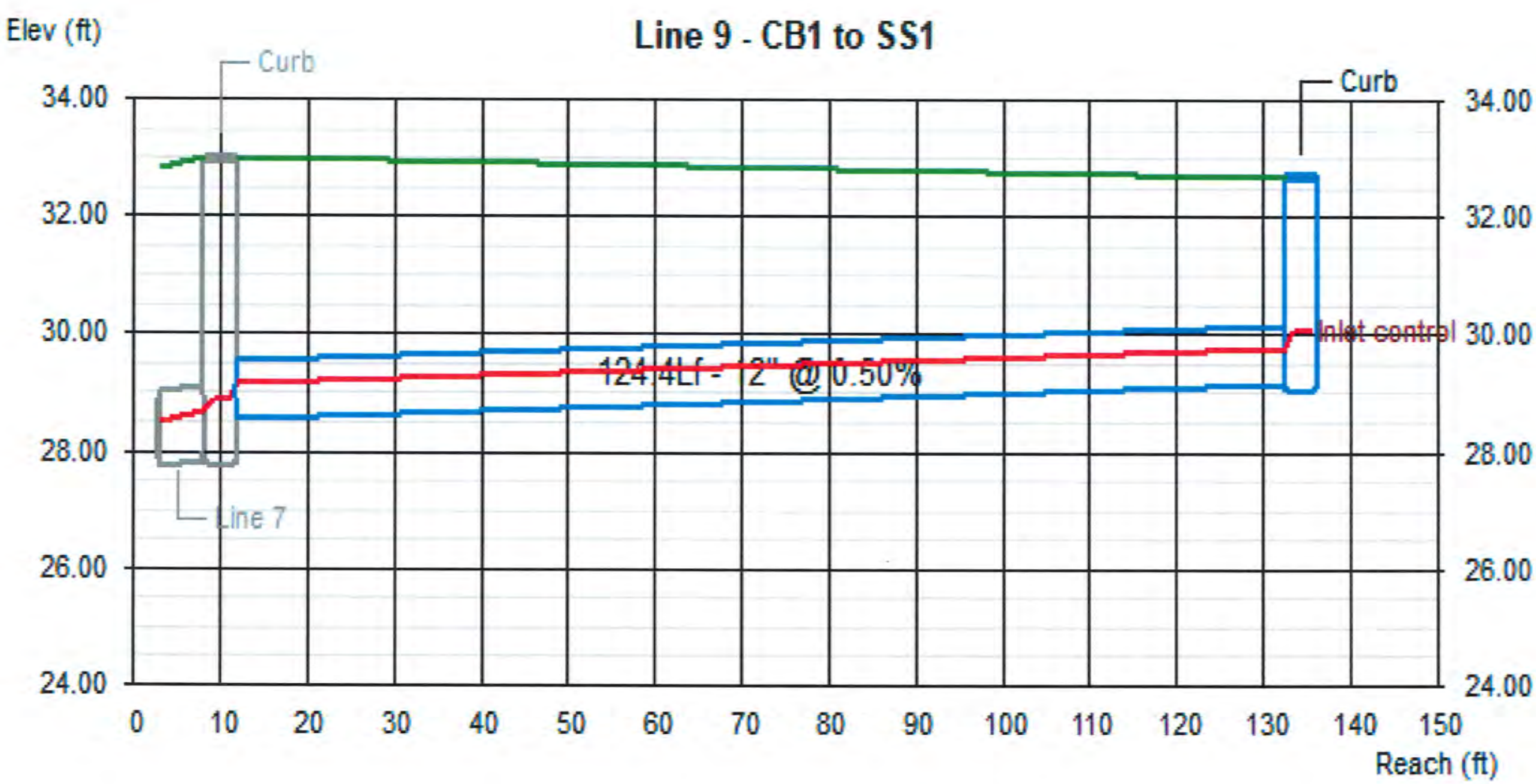
Line Profile (Line 8) - DMH3 TO YD1



Line #	Q (cfs)	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
		Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
8	0.97	26.49	30.70	0.97	0.42	0.60	27.46	31.12 j	31.30 i	1.25	3.12	6.01	2.80

Project File: | No. Lines: 9 | Run Date: 08-25-2021

Line Profile (Line 9) - CB1 to SS1



Line #	Q	Invert Elevation		Depth of Flow			Hydraulic Grade Line			Velocity		Cover	
	(cfs)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Hw (ft)	Dn (ft)	Up (ft)	Jnct (ft)	Dn (ft/s)	Up (ft/s)	Dn (ft)	Up (ft)
9	2.00	28.54	29.16	0.64	0.64	0.90	29.18	29.80	30.06 i	3.79	3.79	3.46	2.54

Project File: | No. Lines: 9 | Run Date: 08-25-2021

Hydraflow Storm Sewers 2005

CULTEC Recharger® 150XLHD Stormwater Chamber

APPENDIX A

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The Recharger® 150XLHD is an 18.5" (470 mm) tall, lower profile chamber and is typically used for installations with depth restrictions or when a larger infiltrative area is required. The Recharger® 150XLHD has the side portal internal manifold feature. HVLV® FC-24 Feed Connectors are inserted into the side portals to create the internal manifold.

Size (L x W x H)	11' x 33" x 18.5"
	3.35 m x 838 mm x 470 mm
Installed Length	10.25'
	3.12 m
Length Adjustment per Run	0.75'
	0.23 m
Chamber Storage	2.65 ft^3/ft
	0.25 m^3/m
	27.16 ft^3/unit
	0.77 m^3/unit
Min. Installed Storage	4.89 ft^3/ft
	0.45 m^3/m
	50.17 ft^3/unit
	1.42 m^3/unit
Min. Area Required	33.31 ft^2
	3.09 m^2
Min. Center-to-Center Spacing	3.25'
	0.99 m
Max. Allowable Cover	12'
	3.66 m
Max. Inlet Opening in End Wall	12"
	300 mm
Max. Allowable O.D. in Side Portal	10.25"
	260 mm
Compatible Feed Connector	HVLV FC-24 Feed Connector

	Stone Foundation Depth		
	6"	12"	18"
	152 mm	305 mm	457 mm
Chamber and Stone Storage Per Chamber	50.17 ft^3	56.83 ft^3	63.49 ft^3
	1.42 m^3	1.61 m^3	1.80 m^3
Min. Effective Depth	2.54'	3.04'	3.54'
	0.77 m	0.93 m	1.08 m
Stone Required Per Chamber	2.13 yd^3	2.75 yd^3	3.36 yd^3
	1.63 m^3	2.10 m^3	2.57 m^3

Calculations are based on installed chamber length.
Includes 6" (152 mm) stone above crown of chamber and typical stone surround.
Stone void calculated at 40%.

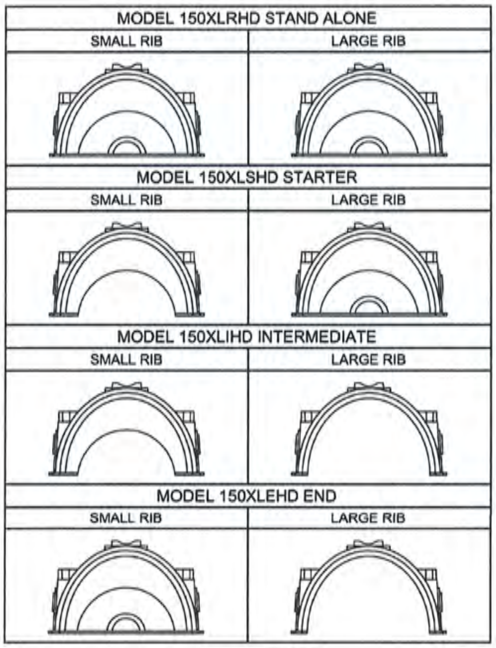
Recharger® 150XLHD Bare Chamber Storage Volumes

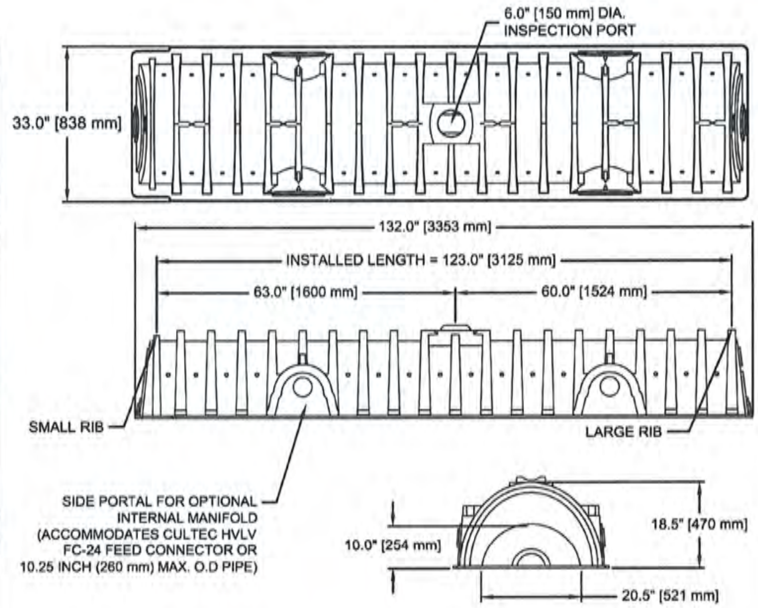
Elevation		Incremental Storage Volume				Cumulative Storage	
in.	mm	ft^3/ft	m^3/m	ft^3	m^3	ft^3	m^3
18.5	470	0.006	0.001	0.062	0.002	27.193	0.770
18	457	0.010	0.001	0.103	0.003	27.132	0.768
17	432	0.032	0.003	0.328	0.009	27.029	0.765
16	406	0.077	0.007	0.789	0.022	26.701	0.756
15	381	0.102	0.009	1.046	0.030	25.912	0.734
14	356	0.119	0.009	1.220	0.035	24.867	0.704
13	330	0.134	0.011	1.374	0.039	23.647	0.670
12	305	0.146	0.012	1.497	0.042	22.273	0.631
11	279	0.156	0.014	1.599	0.045	20.777	0.588
10	254	0.165	0.015	1.691	0.048	19.178	0.543
9	229	0.172	0.016	1.763	0.050	17.487	0.495
8	203	0.179	0.017	1.835	0.052	15.724	0.445
7	178	0.184	0.017	1.886	0.053	13.889	0.393
6	152	0.188	0.017	1.927	0.055	12.003	0.340
5	127	0.191	0.018	1.958	0.055	10.076	0.285
4	102	0.193	0.018	1.978	0.056	8.118	0.230
3	76	0.195	0.018	1.999	0.057	6.140	0.174
2	51	0.197	0.018	2.019	0.057	4.141	0.117
1	25	0.207	0.019	2.122	0.060	2.122	0.060
Total		**2.650**	**0.246**	**27.193**	**0.770**	**27.193**	**0.770**

Calculations are based on installed chamber length.

Visit www.cultec.com/downloads.html for Product Downloads and CAD details.

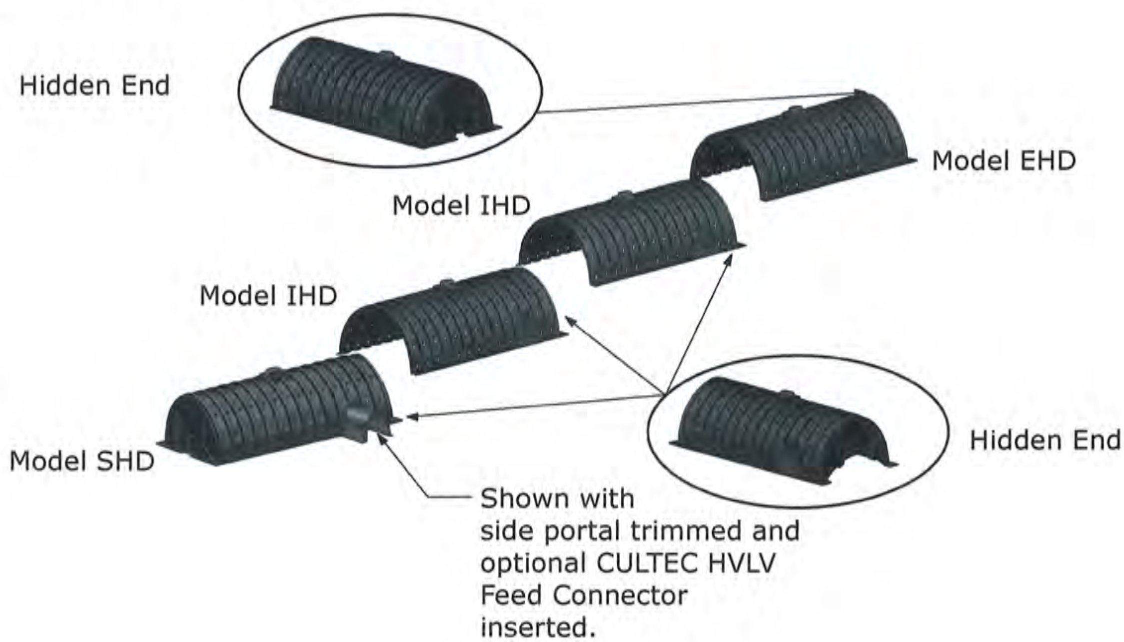
Three View Drawing





CULTEC RECHARGER 150XLHD CHAMBER STORAGE = 2.65 CF/FT [0.245 m³/m]
INSTALLED LENGTH ADJUSTMENT = 0.75' [0.23 m]
ALL RECHARGER 150XLHD HEAVY-DUTY UNITS ARE MARKED WITH A COLORED STRIPE FORMED INTO THE PART ALONG THE LENGTH OF THE CHAMBER.
SIDE PORTAL ACCEPTS CULTEC HVLV FC-24 FEED CONNECTOR.

Typical Interlock Installation



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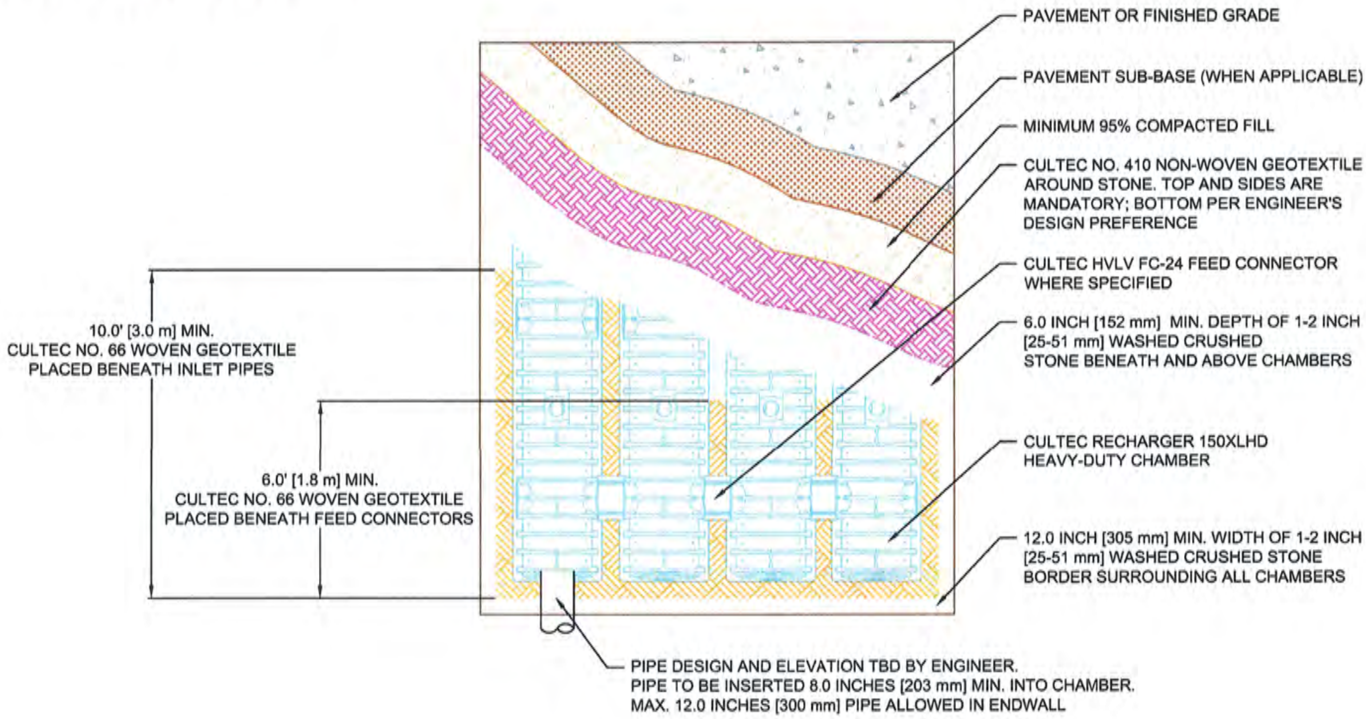
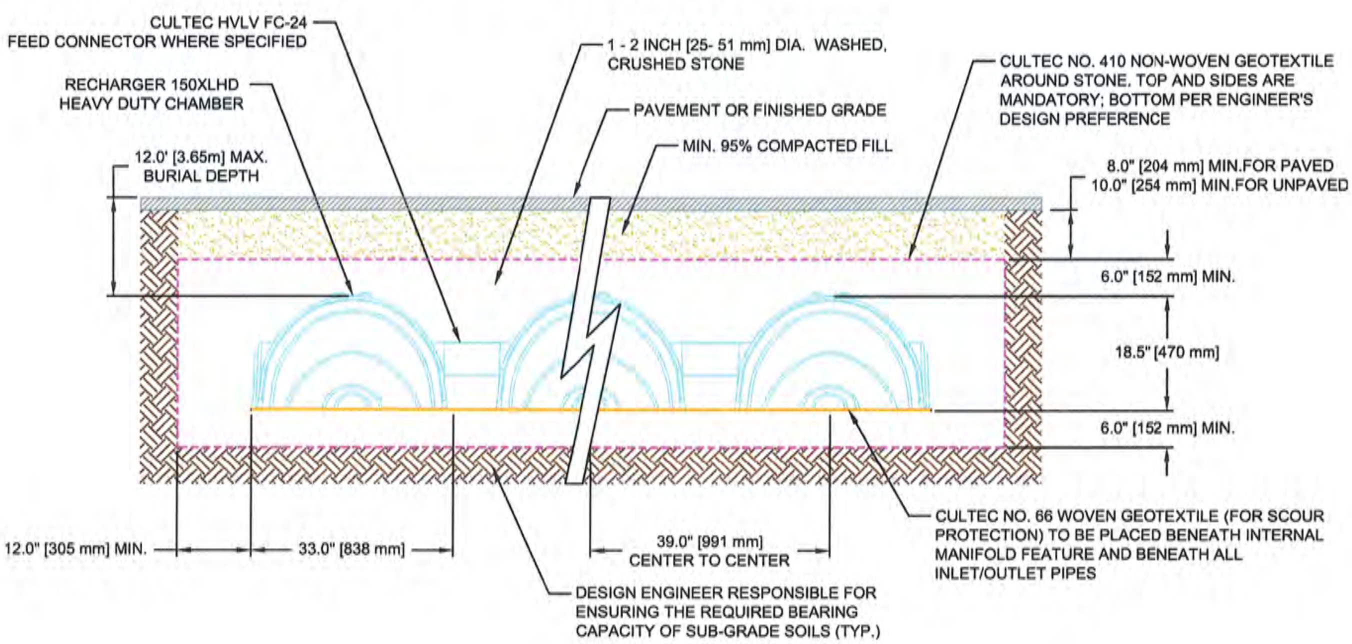
Plan View Drawing



Typical Cross Section for Traffic Application



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CULTEC Recharger® 150XLHD Specifications

GENERAL

CULTEC Recharger® 150XLHD chambers are designed for underground stormwater management. The chambers may be used for retention, recharging, detention or controlling the flow of on-site stormwater runoff.

CHAMBER PARAMETERS

1. The chambers shall be manufactured in the U.S.A. by CULTEC, Inc. of Brookfield, CT (cultec.com, 203-775-4416).
2. The chamber shall be vacuum thermoformed of black polyethylene.
3. The chamber shall be arched in shape.
4. The chamber shall be open-bottomed.
5. The chamber shall be joined using an interlocking overlapping rib method. Connections must be fully shouldered overlapping ribs, having no separate couplings or separate end walls.
6. The nominal chamber dimensions of the CULTEC Recharger® 150XLHD shall be 18.5 inches (470 mm) tall, 33 inches (838 mm) wide and 11 feet (3.35 m) long. The installed length of a joined Recharger® 150XLHD shall be 10.25 feet (3.12 m).
7. Maximum inlet opening on the chamber end wall is 12 inches (300 mm).
8. The chamber shall have two side portals to accept CULTEC HVLV® FC-24 Feed Connectors to create an internal manifold. The nominal I.D. dimensions of each side portal shall be 8.5 inches (216 mm) high by 12 inches (304 mm) wide. Maximum allowable O.D. in the side portal is 10.25 inches (260 mm).
9. The nominal chamber dimensions of the CULTEC HVLV® FC-24 Feed Connector shall be 12 inches (305 mm) tall, 16 inches (406 mm) wide and 24.2 inches (615 mm) long.
10. The nominal storage volume of the Recharger® 150XLHD chamber shall be 2.650 ft^3 / ft (0.246 m^3 / m) - without stone. The nominal storage volume of a single Recharger 150XLRHD Stand Alone unit shall be 29.15 ft^3 (0.83 m^3) - without stone. The nominal storage volume of a joined Recharger® 150XLIHD Intermediate unit shall be 27.16 ft^3 (0.77 m^3) - without stone. The nominal storage volume of the length adjustment amount per run shall be 1.99 ft^3 (0.18 m^3) - without stone.
11. The nominal storage volume of the HVLV® FC-24 Feed Connector shall be 0.913 ft^3 / ft (0.085 m^3 / m) - without stone.
12. The Recharger® 150XLHD chamber shall have thirty discharge holes bored into the sidewalls of the unit's core to promote lateral conveyance of water.
13. The Recharger® 150XLHD chamber shall have 20 corrugations.
14. The end wall of the chamber, when present, shall be an integral part of the continuously formed unit. Separate end plates cannot be used with this unit.
15. The Recharger® 150XLRHD Stand Alone unit must be formed as a whole chamber having two fully formed integral end walls and having no separate end plates or separate end walls.
16. The Recharger® 150XLSHD Starter unit must be formed as a whole chamber having one fully formed integral end wall and one partially formed integral end wall with a lower transfer opening of 10 inches (254 mm) high x 20.5 inches (521 mm) wide.
17. The Recharger® 150XLIHD Intermediate unit must be formed as a whole chamber having one fully open end wall and one partially formed integral end wall with a lower transfer opening of 10 inches (254 mm) high x 20.5 inches (521 mm) wide.
18. The Recharger® 150XLEHD End unit must be formed as a whole chamber having one fully formed integral end wall and one fully open end wall and having no separate end plates or end walls.
19. The HVLV® FC-24 Feed Connector must be formed as a whole chamber having two open end walls and having no separate end plates or separate end walls. The unit shall fit into the side portals of the Recharger® 150XLHD and act as cross feed connections.
20. Chambers must have horizontal stiffening flex reduction steps between the ribs.
21. Heavy duty units are designated by a colored stripe formed into the part along the length of the chamber.
22. The chamber shall have a raised integral cap at the top of the arch in the center of each unit to be used as an optional inspection port or clean-out.
23. The units may be trimmed to custom lengths by cutting back to any corrugation on the large rib end.
24. The chamber shall be manufactured in an ISO 9001:2008 certified facility.
25. Maximum allowable cover over the top of the chamber shall be 12' (3.66 m).
26. The chamber shall be designed to withstand traffic loads when installed according to CULTEC's recommended installation instructions.

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		RAINFALL INTENSITY (in/hr)					
DURATION (min)	**DURATION (hr)**	**2 Yr**	**5 Yr**	**10 Yr**	**25 Yr**	**50 Yr**	**100 Yr**
5	0.08	4.6	5.5	6.0	6.7	7.3	7.8
6	0.10	4.4	5.2	5.8	6.5	7.0	7.5
7	0.12	4.2	5.0	5.5	6.2	6.8	7.2
8	0.13	4.0	4.8	5.3	6.0	6.5	7.0
9	0.15	3.8	4.6	5.1	5.7	6.2	6.7
10	0.17	3.6	4.3	4.8	5.5	6.0	6.5
11	0.18	3.4	4.2	4.7	5.3	5.8	6.3
12	0.20	3.3	4.0	4.5	5.1	5.6	6.1
13	0.22	3.1	3.8	4.3	5.0	5.4	5.9
14	0.23	3.0	3.7	4.2	4.8	5.3	5.7
15	0.25	2.8	3.5	4.0	4.6	5.1	5.5
16	0.27	2.8	3.5	3.9	4.5	5.0	5.4
17	0.28	2.7	3.4	3.8	4.4	4.9	5.4
18	0.30	2.7	3.3	3.8	4.4	4.8	5.3
19	0.32	2.6	3.2	3.7	4.3	4.7	5.2
20	0.33	2.5	3.2	3.6	4.2	4.6	5.1
21	0.35	2.5	3.1	3.5	4.1	4.5	5.0
22	0.37	2.4	3.0	3.4	4.0	4.4	4.9
23	0.38	2.3	2.9	3.4	3.9	4.3	4.8
24	0.40	2.3	2.9	3.3	3.8	4.2	4.7
25	0.42	2.2	2.8	3.2	3.7	4.2	4.6
26	0.43	2.2	2.7	3.1	3.7	4.1	4.5
27	0.45	2.1	2.7	3.0	3.6	4.0	4.4
28	0.47	2.0	2.6	3.0	3.5	3.9	4.3
29	0.48	2.0	2.5	2.9	3.4	3.8	4.2
30	0.50	1.9	2.4	2.8	3.3	3.7	4.1

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1

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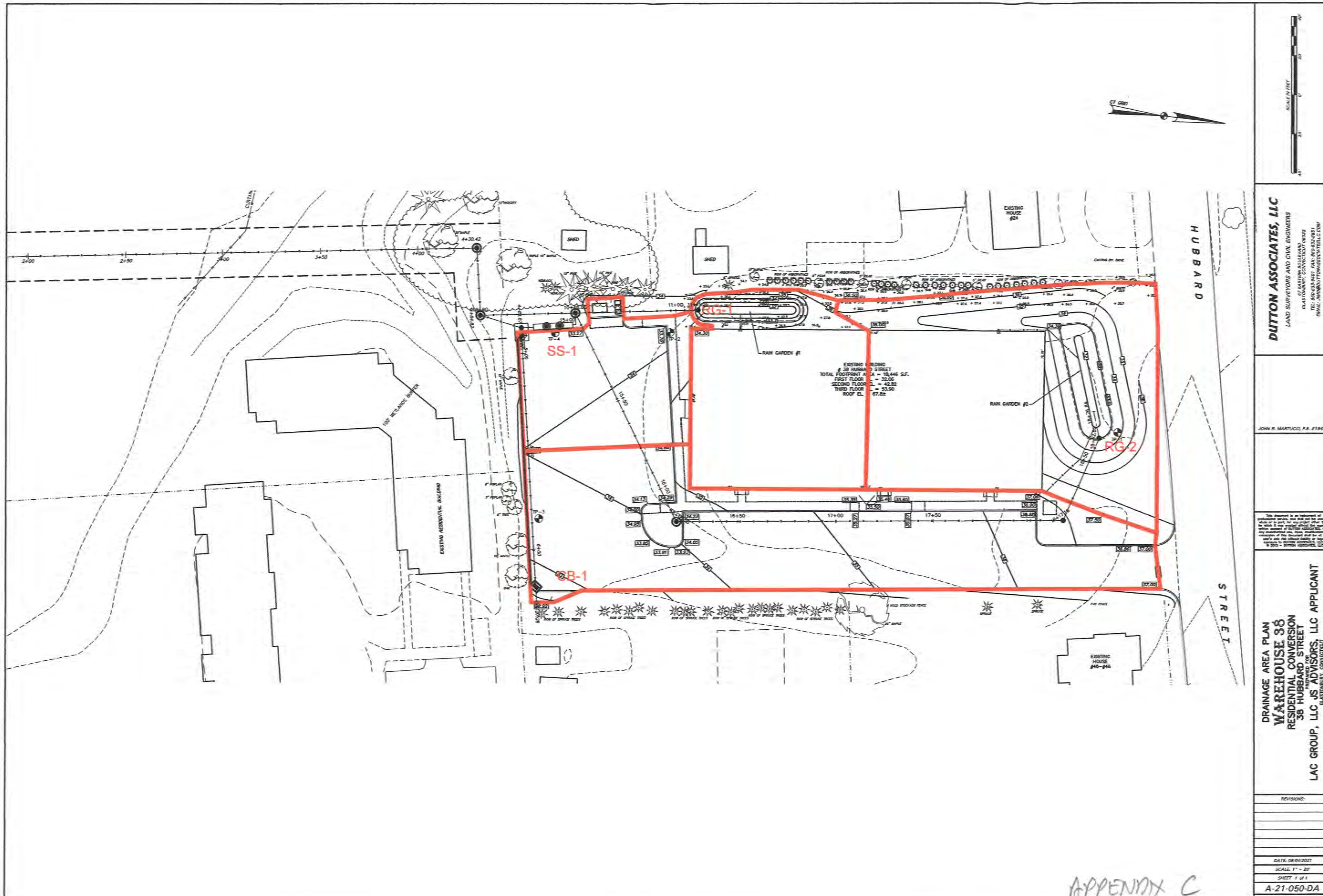
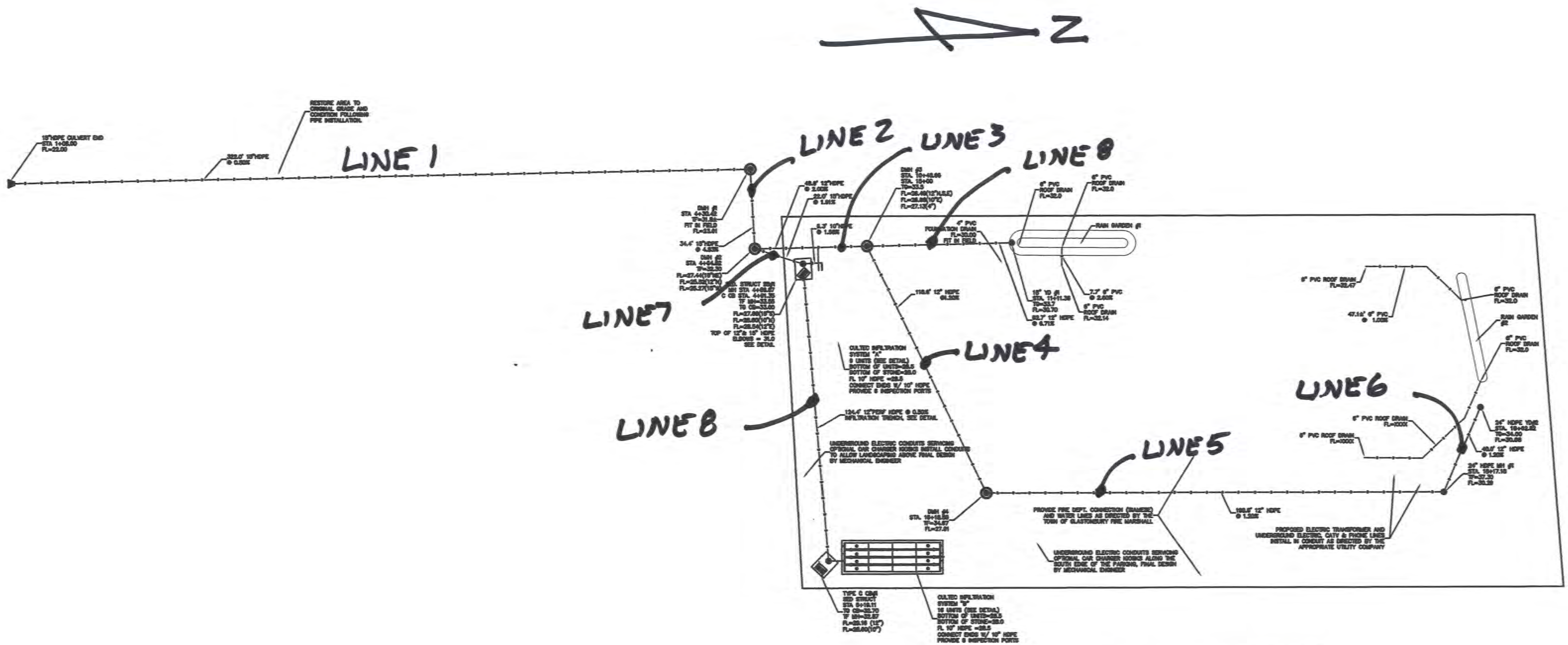
		RAINFALL INTENSITY (in/hr)					
DURATION	DURATION	2 Yr	5 Yr	10 Yr	25 Yr	50 Yr	100 Yr
31	0.52	1.9	2.4	2.8	3.3	3.6	4.0
32	0.53	1.9	2.4	2.7	3.2	3.6	4.0
33	0.55	1.8	2.4	2.7	3.2	3.6	3.9
34	0.57	1.8	2.3	2.7	3.2	3.5	3.9
35	0.58	1.8	2.3	2.6	3.1	3.5	3.8
36	0.60	1.8	2.3	2.6	3.1	3.4	3.8
37	0.62	1.7	2.2	2.6	3.0	3.4	3.7
38	0.63	1.7	2.2	2.5	3.0	3.4	3.7
39	0.65	1.7	2.2	2.5	3.0	3.3	3.7
40	0.67	1.7	2.1	2.5	2.9	3.3	3.6
41	0.68	1.6	2.1	2.4	2.9	3.2	3.6
42	0.70	1.6	2.1	2.4	2.8	3.2	3.5
43	0.72	1.6	2.1	2.4	2.8	3.1	3.5
44	0.73	1.6	2.0	2.3	2.8	3.1	3.4
45	0.75	1.5	2.0	2.3	2.7	3.1	3.4
46	0.77	1.5	2.0	2.3	2.7	3.0	3.3
47	0.78	1.5	1.9	2.2	2.6	3.0	3.3
48	0.80	1.5	1.9	2.2	2.6	2.9	3.2
49	0.82	1.5	1.9	2.2	2.6	2.9	3.2
50	0.83	1.4	1.8	2.1	2.5	2.8	3.2
51	0.85	1.4	1.8	2.1	2.5	2.8	3.1
52	0.87	1.4	1.8	2.1	2.5	2.8	3.1
53	0.88	1.4	1.8	2.0	2.4	2.7	3.0
54	0.90	1.3	1.7	2.0	2.4	2.7	3.0
55	0.92	1.3	1.7	2.0	2.3	2.6	2.9
56	0.93	1.3	1.7	1.9	2.3	2.6	2.9
57	0.95	1.3	1.6	1.9	2.3	2.5	2.8
58	0.97	1.2	1.6	1.9	2.2	2.5	2.8
59	0.98	1.2	1.6	1.8	2.2	2.5	2.7
60	1.00	1.2	1.5	1.8	2.1	2.4	2.7

Rainfall Intensity/Duration/Frequency Relationship for Connecticut (English Units)
Table B-2.1 continued


31
CT GRID
HUBBARD STREET
RAIN GARDEN #1
RAIN GARDEN #2
RG-1
RG-2
SS-1
CB-1
EXISTING BUILDING
38 HUBBARD STREET
TOTAL FOOTPRINT AREA = 18,446 S.F.
FIRST FLOOR = 32.05
SECOND FLOOR = 42.82
THIRD FLOOR = 53.90
ROOF EL. 67.8±
EXISTING RESIDENTIAL BUILDING
EXISTING HOUSE #24
EXISTING HOUSE #46-#48
SHED
100' WETLANDS BUFFER
DUTTON ASSOCIATES, LLC
LAND SURVEYORS AND CIVIL ENGINEERS
JOHN R. MARTUCCI, P.E. #19494
DRAINAGE AREA PLAN
WAREHOUSE 38
RESIDENTIAL CONVERSION
38 HUBBARD STREET
PREPARED FOR
LAC GROUP, LLC JS ADVISORS, LLC APPLICANT
GLASTONBURY, CONNECTICUT
REVISIONS:
DATE: 08/04/2021
SCALE: 1" = 20'
SHEET 1 of 1
A-21-050-DA
FILE: 21050.DWG
APPENDIX C



NOT TO SCALE
8/25/2021