Storm Drainage Calculations

Broadmoor Clubhouse Amenity

Town of Rolesville

Pulte Home Company, LLC

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WithersRavenel Project No. 23-0045

May 1, 2025

PRELIMINARY

Drew Plato, PE
Amber Mason, PE

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Appendices

Storm Drainage Narrative

The overall Broadmoor development is located at 1321 Rolesville Road in Rolesville, NC. The site in its existing conditions is undeveloped, mostly wooded with HSG 'B', 'C' & 'D' soils. The proposed development consists of 253 lots and associated roads and infrastructure. This project is for the Clubhouse Amenity site, located within the development near the intersection of Picasso Drive and Bearden Street. The proposed storm system is made up of 3 structures, which will capture the proposed parking lot and adjacent sidewalk. A 10-yr HGL analysis and 4"/hr gutter spread analysis have been performed for all the storm drainage associated with the project. These calculations are included within this report.

1. Rainfall Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Wake Forest, North Carolina, USA*
Latitude: 35.8944°, Longitude: -78.4449°
Elevation: 375 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.84** (4.43-5.30)	**5.62** (5.16-6.14)	**6.41** (5.87-6.98)	**7.20** (6.59-7.85)	**7.99** (7.27-8.71)	**8.63** (7.82-9.41)	**9.19** (8.29-10.0)	**9.70** (8.69-10.6)	**10.3** (9.12-11.2)	**10.8** (9.49-11.8)
10-min	**3.86** (3.54-4.24)	**4.49** (4.12-4.91)	**5.13** (4.70-5.60)	**5.76** (5.26-6.28)	**6.37** (5.80-6.94)	**6.88** (6.23-7.49)	**7.31** (6.59-7.96)	**7.69** (6.89-8.39)	**8.12** (7.21-8.86)	**8.48** (7.47-9.28)
15-min	**3.22** (2.95-3.53)	**3.77** (3.46-4.12)	**4.32** (3.96-4.72)	**4.86** (4.44-5.30)	**5.38** (4.90-5.87)	**5.80** (5.26-6.32)	**6.16** (5.55-6.71)	**6.47** (5.80-7.06)	**6.81** (6.05-7.44)	**7.10** (6.25-7.77)
30-min	**2.21** (2.02-2.42)	**2.60** (2.39-2.84)	**3.07** (2.81-3.35)	**3.52** (3.22-3.84)	**3.99** (3.63-4.35)	**4.37** (3.96-4.76)	**4.71** (4.25-5.14)	**5.03** (4.51-5.49)	**5.42** (4.81-5.92)	**5.75** (5.06-6.29)
60-min	**1.38** (1.26-1.51)	**1.63** (1.50-1.78)	**1.97** (1.80-2.15)	**2.29** (2.09-2.50)	**2.65** (2.42-2.89)	**2.96** (2.68-3.23)	**3.25** (2.93-3.54)	**3.53** (3.16-3.85)	**3.89** (3.45-4.24)	**4.19** (3.70-4.59)
2-hr	**0.805** (0.731-0.889)	**0.957** (0.874-1.05)	**1.17** (1.06-1.28)	**1.37** (1.25-1.51)	**1.62** (1.46-1.77)	**1.83** (1.64-2.00)	**2.04** (1.82-2.23)	**2.25** (1.99-2.46)	**2.53** (2.22-2.76)	**2.77** (2.41-3.04)
3-hr	**0.568** (0.516-0.630)	**0.676** (0.617-0.746)	**0.827** (0.753-0.913)	**0.981** (0.889-1.08)	**1.16** (1.05-1.28)	**1.33** (1.19-1.46)	**1.50** (1.33-1.64)	**1.67** (1.47-1.83)	**1.90** (1.66-2.08)	**2.11** (1.82-2.32)
6-hr	**0.341** (0.311-0.377)	**0.406** (0.372-0.448)	**0.498** (0.454-0.548)	**0.591** (0.537-0.648)	**0.705** (0.637-0.772)	**0.809** (0.727-0.885)	**0.913** (0.813-0.998)	**1.02** (0.902-1.12)	**1.17** (1.02-1.28)	**1.31** (1.13-1.43)
12-hr	**0.200** (0.183-0.220)	**0.238** (0.218-0.261)	**0.293** (0.268-0.321)	**0.349** (0.319-0.383)	**0.420** (0.381-0.459)	**0.486** (0.436-0.528)	**0.552** (0.490-0.600)	**0.623** (0.548-0.676)	**0.721** (0.624-0.783)	**0.813** (0.693-0.884)
24-hr	**0.119** (0.110-0.128)	**0.144** (0.134-0.155)	**0.181** (0.168-0.195)	**0.210** (0.195-0.227)	**0.251** (0.232-0.271)	**0.284** (0.261-0.306)	**0.317** (0.291-0.342)	**0.352** (0.322-0.380)	**0.401** (0.364-0.433)	**0.440** (0.398-0.476)
2-day	**0.069** (0.064-0.074)	**0.083** (0.077-0.089)	**0.103** (0.096-0.111)	**0.120** (0.111-0.129)	**0.142** (0.131-0.153)	**0.160** (0.147-0.172)	**0.178** (0.164-0.192)	**0.198** (0.181-0.213)	**0.224** (0.203-0.242)	**0.245** (0.221-0.265)
3-day	**0.048** (0.045-0.052)	**0.058** (0.054-0.063)	**0.072** (0.067-0.078)	**0.084** (0.078-0.090)	**0.099** (0.092-0.106)	**0.112** (0.103-0.120)	**0.124** (0.114-0.134)	**0.137** (0.126-0.148)	**0.156** (0.142-0.168)	**0.170** (0.154-0.184)
4-day	**0.038** (0.036-0.041)	**0.046** (0.043-0.049)	**0.057** (0.053-0.061)	**0.066** (0.061-0.070)	**0.078** (0.072-0.083)	**0.087** (0.081-0.093)	**0.097** (0.090-0.104)	**0.107** (0.099-0.115)	**0.122** (0.111-0.131)	**0.133** (0.120-0.143)
7-day	**0.025** (0.024-0.027)	**0.030** (0.028-0.032)	**0.037** (0.035-0.039)	**0.042** (0.040-0.045)	**0.050** (0.046-0.053)	**0.056** (0.052-0.060)	**0.062** (0.057-0.066)	**0.068** (0.063-0.073)	**0.077** (0.070-0.082)	**0.084** (0.076-0.090)
10-day	**0.020** (0.019-0.021)	**0.024** (0.022-0.025)	**0.029** (0.027-0.031)	**0.033** (0.031-0.035)	**0.038** (0.036-0.041)	**0.042** (0.039-0.045)	**0.047** (0.043-0.050)	**0.051** (0.047-0.055)	**0.057** (0.052-0.061)	**0.062** (0.056-0.066)
20-day	**0.013** (0.012-0.014)	**0.016** (0.015-0.017)	**0.019** (0.018-0.020)	**0.021** (0.020-0.022)	**0.024** (0.023-0.026)	**0.027** (0.025-0.029)	**0.029** (0.027-0.031)	**0.032** (0.030-0.034)	**0.036** (0.033-0.038)	**0.038** (0.035-0.041)
30-day	**0.011** (0.010-0.012)	**0.013** (0.012-0.014)	**0.015** (0.014-0.016)	**0.017** (0.016-0.018)	**0.019** (0.018-0.020)	**0.021** (0.019-0.022)	**0.023** (0.021-0.024)	**0.024** (0.023-0.026)	**0.027** (0.025-0.029)	**0.028** (0.026-0.031)
45-day	**0.009** (0.009-0.010)	**0.011** (0.010-0.011)	**0.012** (0.012-0.013)	**0.014** (0.013-0.015)	**0.015** (0.015-0.016)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.019** (0.018-0.020)	**0.021** (0.019-0.022)	**0.022** (0.021-0.023)
60-day	**0.008** (0.008-0.009)	**0.010** (0.009-0.010)	**0.011** (0.010-0.012)	**0.012** (0.011-0.013)	**0.013** (0.013-0.014)	**0.014** (0.014-0.015)	**0.015** (0.015-0.016)	**0.016** (0.015-0.017)	**0.018** (0.017-0.019)	**0.019** (0.017-0.020)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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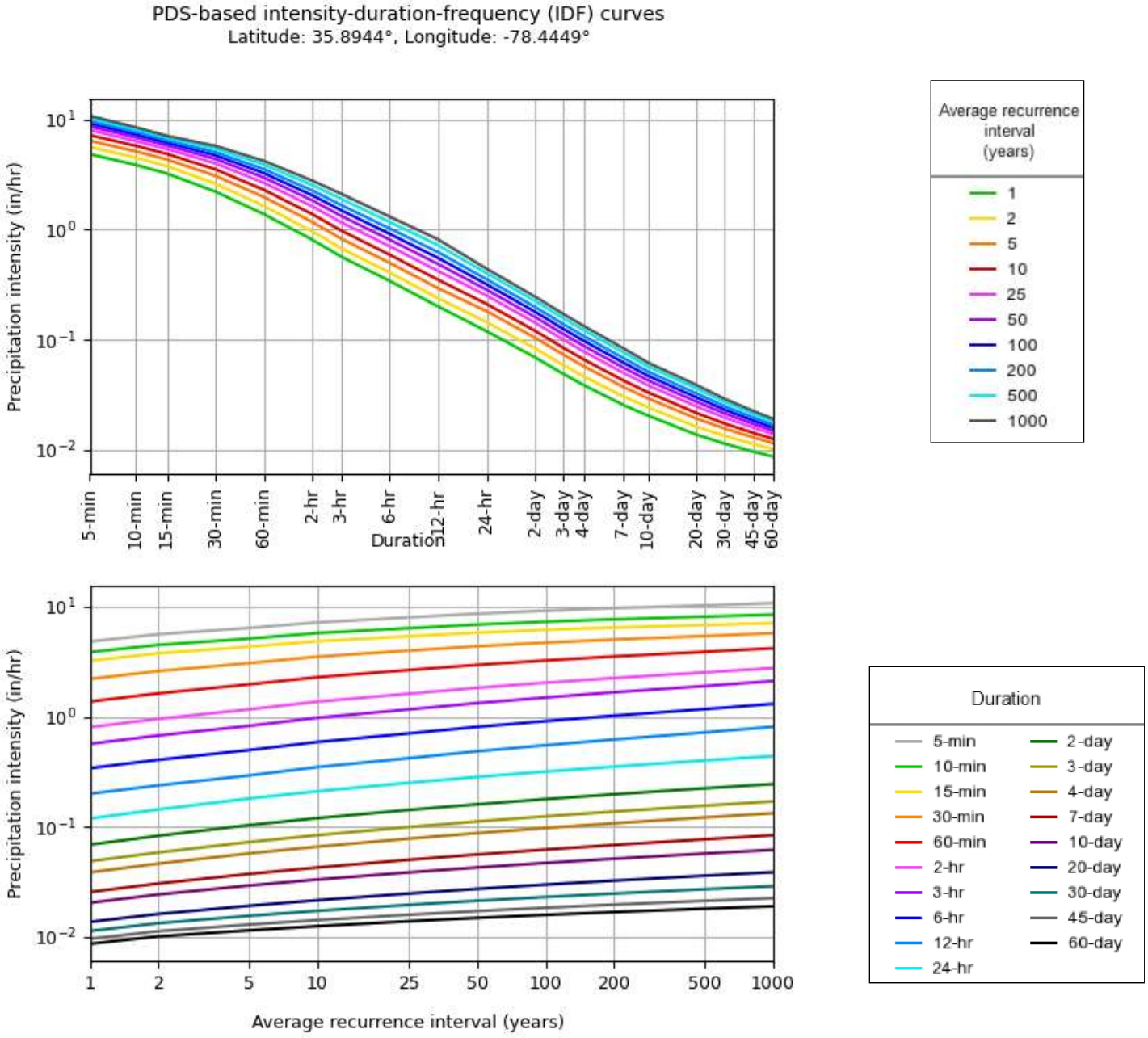
PF graphical



NOAA Atlas 14, Volume 2, Version 3

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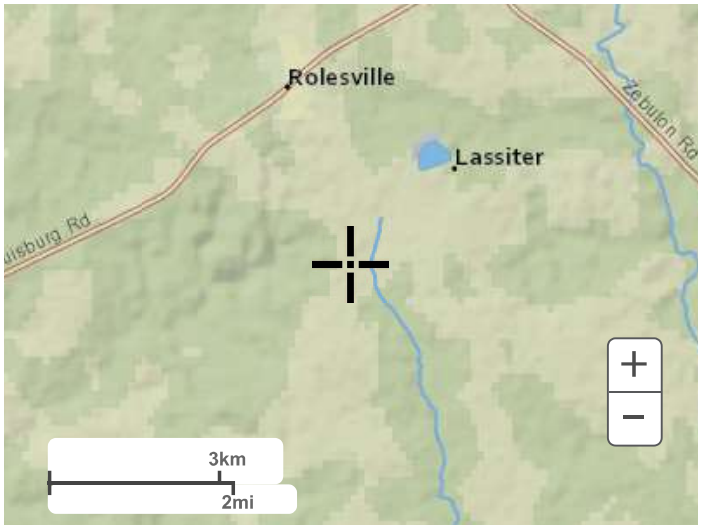
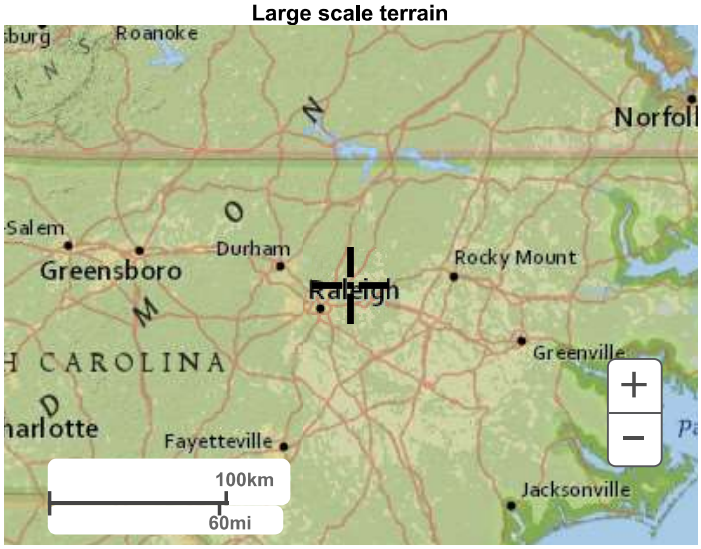
Maps & aerials

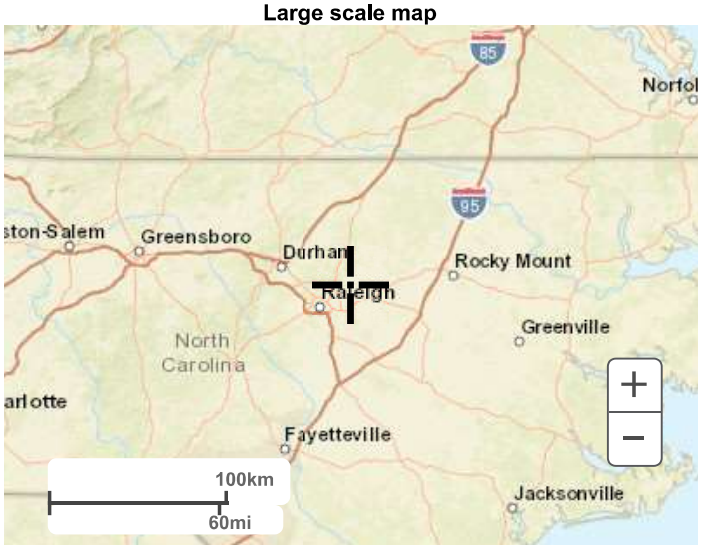
Small scale terrain



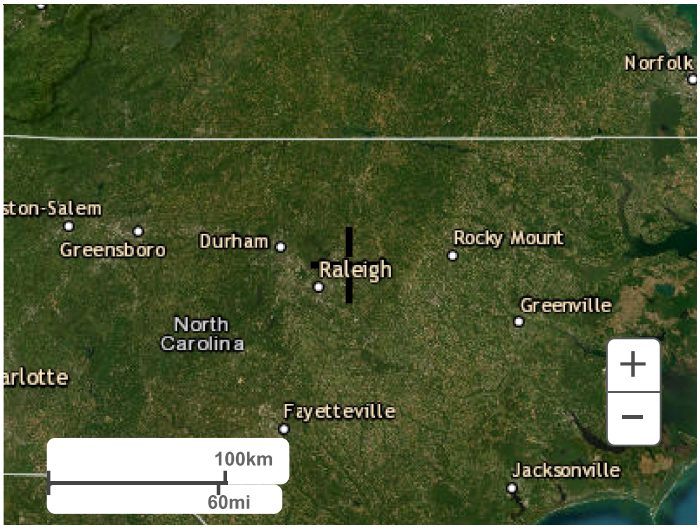
Large scale terrain



Large scale map



Large scale aerial



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National Weather Service
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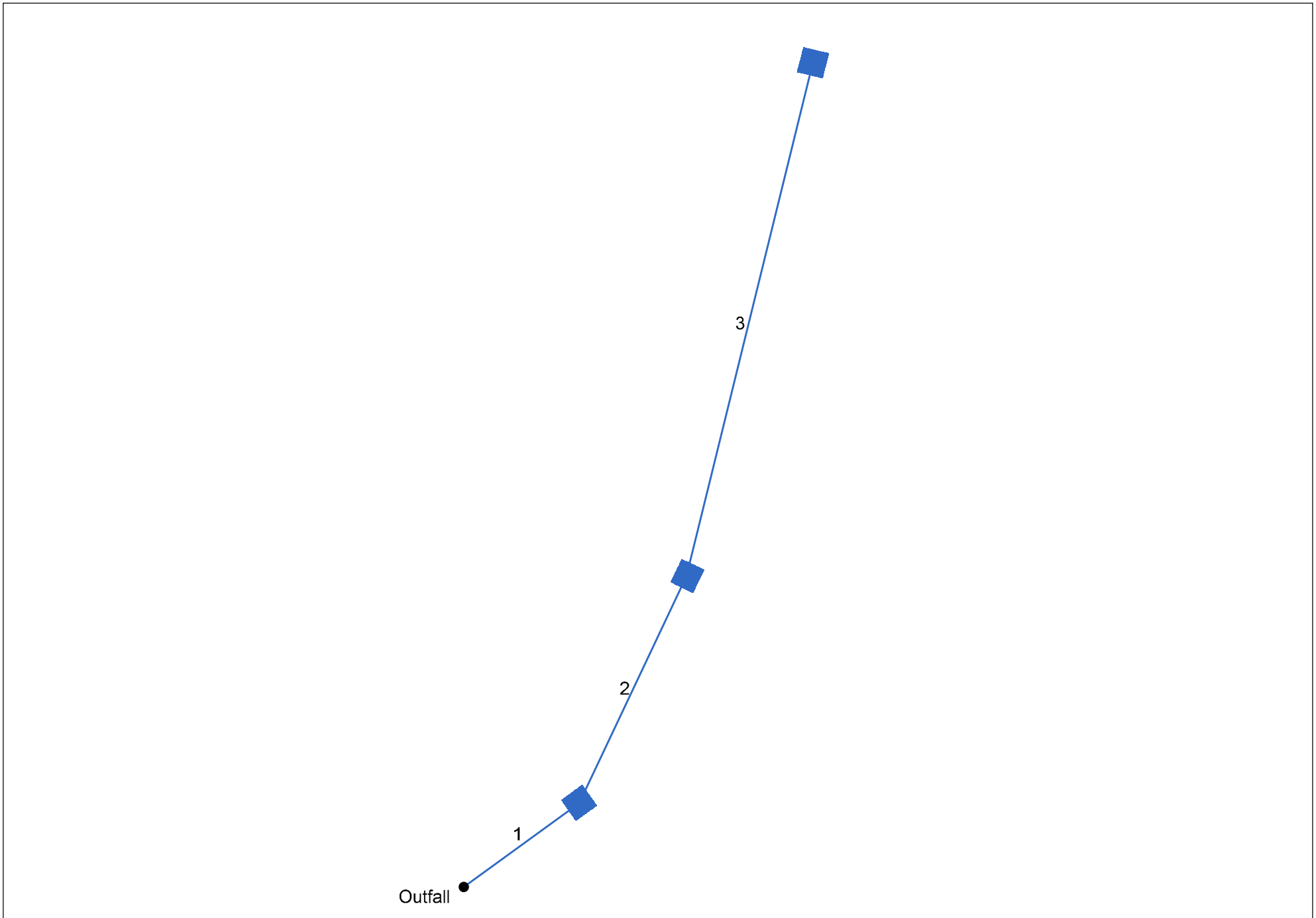
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

2. 10-YR Storm Drainage Chart

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: Amenity.stm	Number of lines: 3	Date: 5/1/2025

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	22.645	-36.038	Comb	0.00	0.07	0.85	5.0	365.95	1.99	366.40	15	Cir	0.013	0.80	372.27	453-4531
2	1	39.845	-28.721	Comb	0.00	0.19	0.85	5.0	366.50	2.01	367.30	15	Cir	0.013	0.50	372.79	4531-4532
3	2	84.023	-11.410	Comb	0.00	0.16	0.85	5.0	367.40	2.02	369.10	15	Cir	0.013	1.00	373.63	4532-4533

Project File: Amenity.stm | Number of lines: 3 | Date: 5/1/2025

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	453-4531	2.38	15	Cir	22.645	365.95	366.40	1.987	366.39	367.02	n/a	367.02	End	Combination
2	4531-4532	2.01	15	Cir	39.845	366.50	367.30	2.008	367.02	367.87	0.11	367.87	1	Combination
3	4532-4533	0.99	15	Cir	84.023	367.40	369.10	2.023	367.87	369.49	n/a	369.49 j	2	Combination

Project File: Amenity.stm | Number of lines: 3 | Run Date: 5/1/2025

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

3. 10-YR HGL Calculations and Profiles

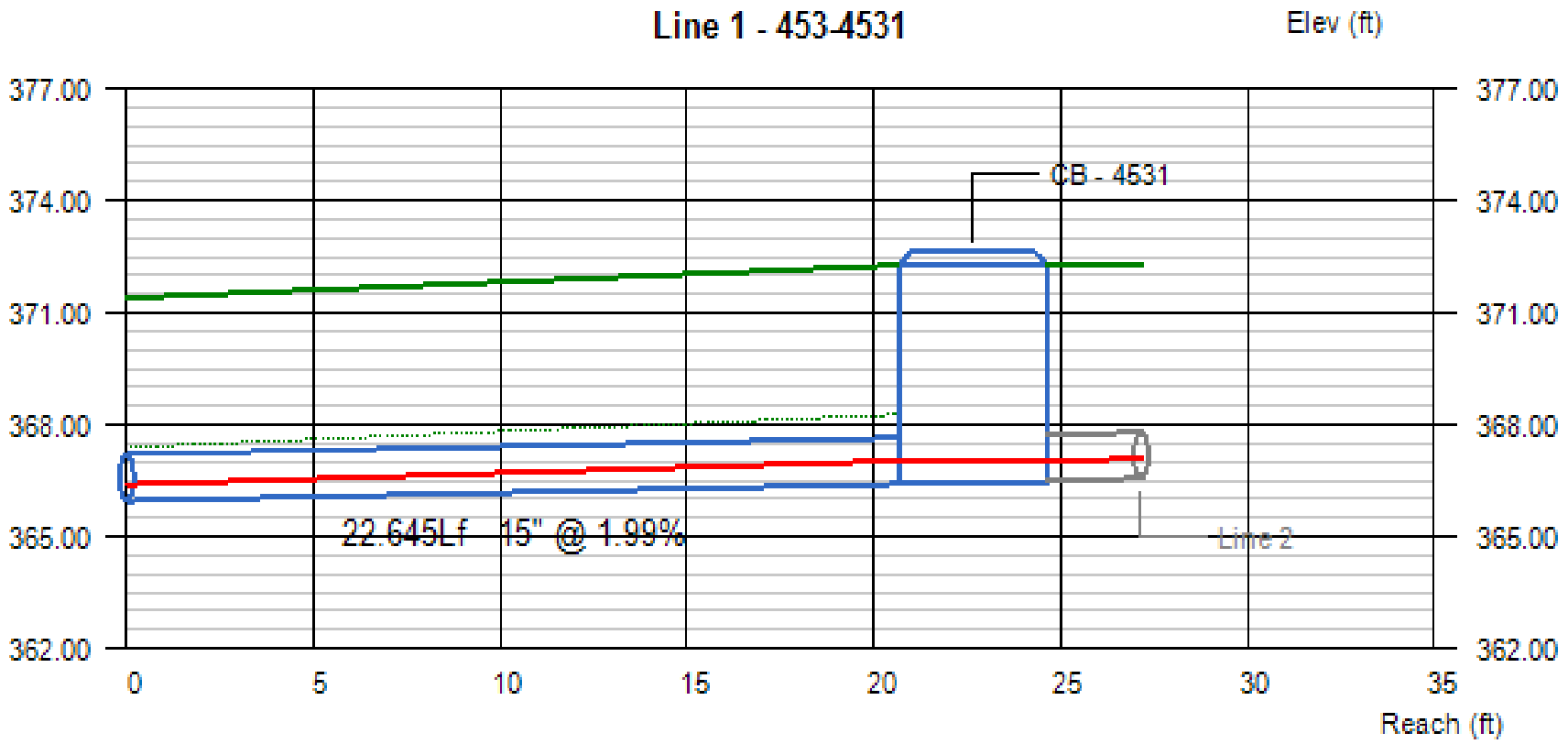
Hydraulic Grade Line Computations

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	2.38	365.95	366.39	0.44	0.38	6.24	0.24	366.63	0.000	22.645	366.40	367.02	0.62**	0.60	3.95	0.24	367.26	0.000	0.000	n/a	0.80	n/a
2	15	2.01	366.50	367.02	0.52	0.48	4.20	0.22	367.23	0.000	39.845	367.30	367.87	0.57**	0.54	3.74	0.22	368.08	0.000	0.000	n/a	0.50	0.11
3	15	0.99	367.40	367.87	0.47	0.33	2.37	0.14	368.01	0.000	84.023	369.10	369.49 j	0.39**	0.33	3.02	0.14	369.63	0.000	0.000	n/a	1.00	0.14

Project File: Amenity.stm | Number of lines: 3 | Run Date: 5/1/2025

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

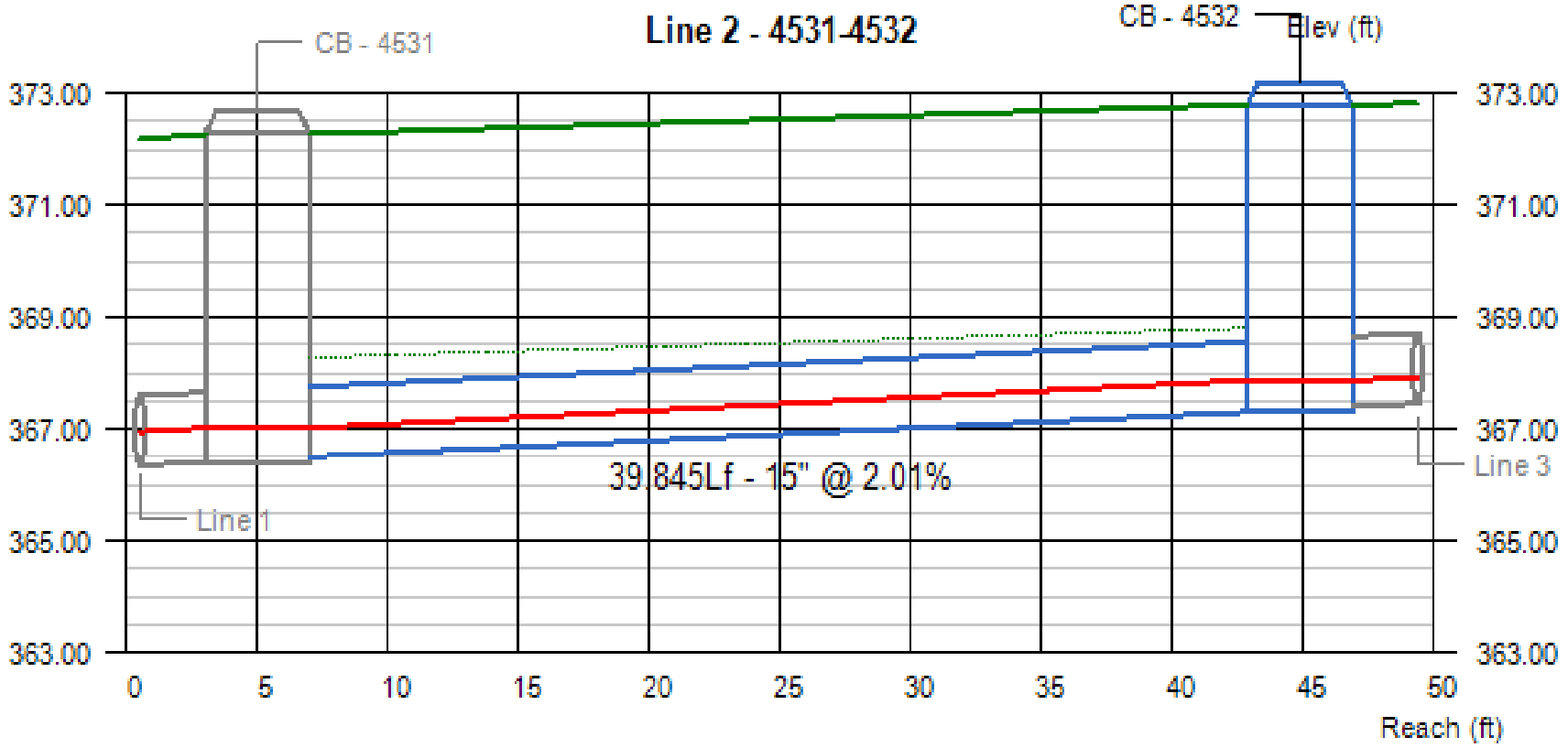
Line Profile (Line 1) - 453-4531



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	2.38	365.95	366.40	0.44	0.62	0.62	366.39	367.02	367.02	6.24	3.95	4.20	4.62

Project File: | No. Lines: 3 | Run Date: 5/1/2025

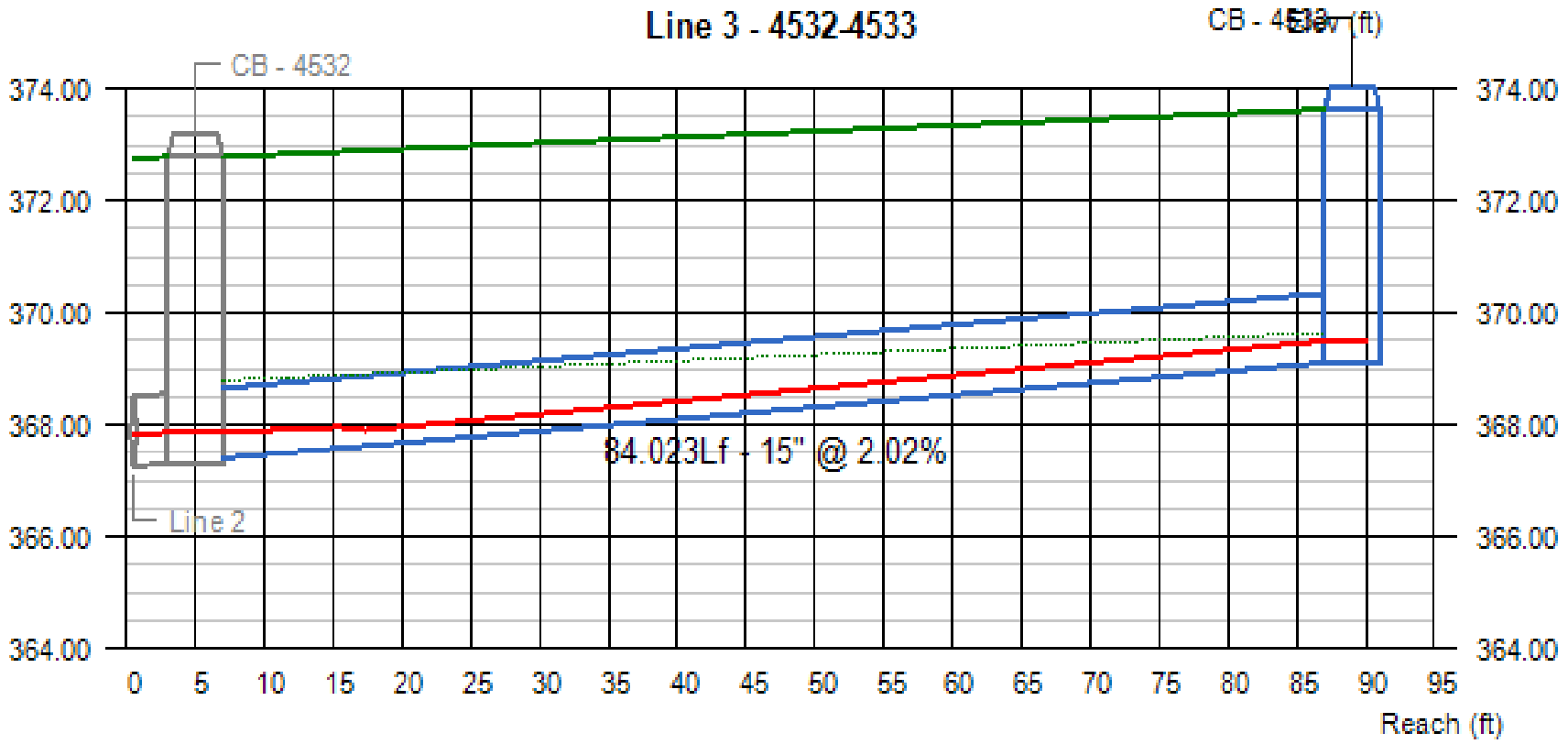
Line Profile (Line 2) - 4531-4532



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)
2	2.01	366.50	367.30	0.52	0.57	0.57	367.02	367.87	367.87	4.20	3.74	4.52	4.24

Project File:	No. Lines: 3	Run Date: 5/1/2025

Line Profile (Line 3) - 4532-4533



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	0.99	367.40	369.10	0.47	0.39	0.39	367.87	369.49 j	369.49	2.37	3.02	4.14	3.28

Project File: | No. Lines: 3 | Run Date: 5/1/2025

4. 4”/Hour Gutter Spread Chart

Inlet Report

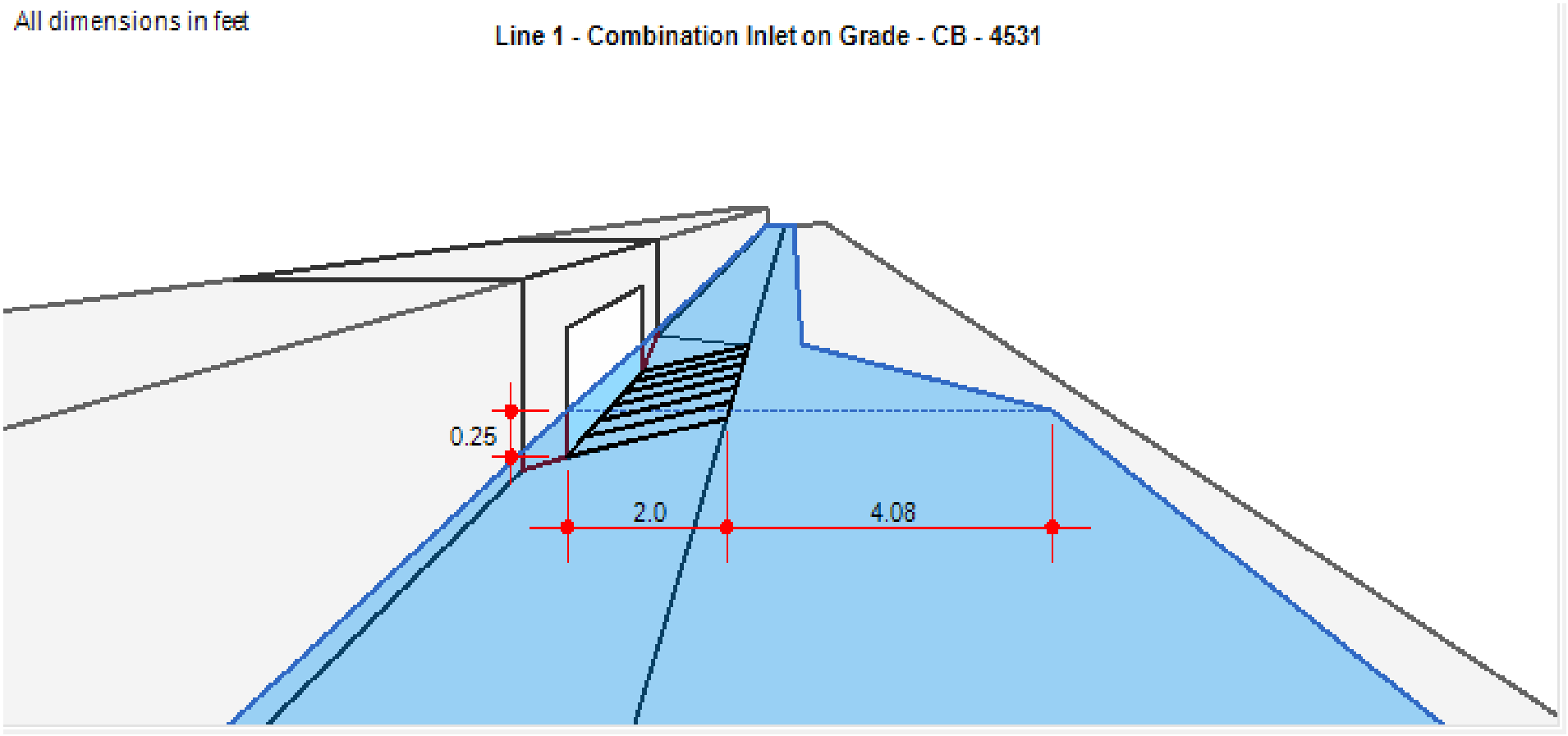
Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CB - 4531	0.43	0.00	0.33	0.10	Comb	4.0	3.00	0.00	3.00	2.00	0.020	2.00	0.020	0.010	0.013	0.08	6.08	0.22	2.89	2.0	Off
2	CB - 4532	1.17	0.00	1.17	0.00	Comb	4.0	3.00	6.00	3.00	2.00	Sag	2.00	0.020	0.010	0.013	0.08	6.27	0.25	6.27	2.0	Off
3	CB - 4533	0.99	0.00	0.99	0.00	Comb	4.0	3.00	6.00	3.00	2.00	Sag	2.00	0.020	0.010	0.013	0.07	4.69	0.23	4.69	2.0	Off

Project File: Amenity.stm | Number of lines: 3 | Run Date: 5/1/2025

NOTES: Inlet N-Values = 0.016; Intensity = 86.72 / (Inlet time + 15.30) ^ 0.82; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Inlet Section (Line 1 - Combination Inlet) - CB - 4531

All dimensions in feet

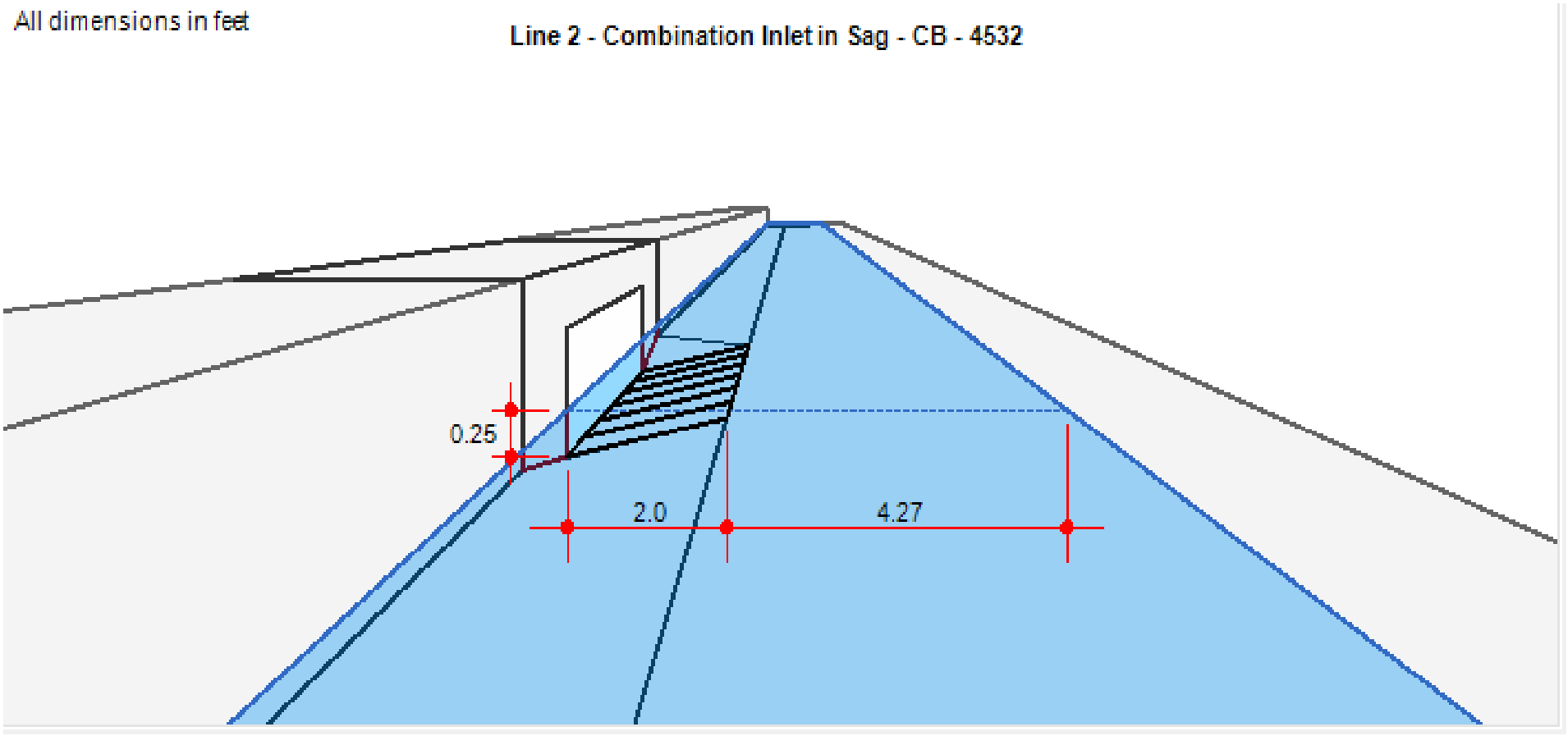


Line #	Q				Inlet			Gutter				Depth		Spread		Byp
	Catch (cfs)	Carry (cfs)	Capt (cfs)	Byp (cfs)	Length (ft)	Depr (in)	Throat (in)	Width (ft)	Slope (ft/ft)	Sw (ft/ft)	Sx (ft/ft)	Gutter (ft)	Inlet (ft)	Gutter (ft)	Inlet (ft)	Line (ft)
1	0.43	0.00	0.33	0.10	3.00	2.0	4.0	2.00	0.020	0.020	0.010	0.08	6.08	0.05	2.89	Offsite

Project File: | No. Lines: 3 | Run Date: 5/1/2025

Inlet Section (Line 2 - Combination Inlet) - CB - 4532

All dimensions in feet

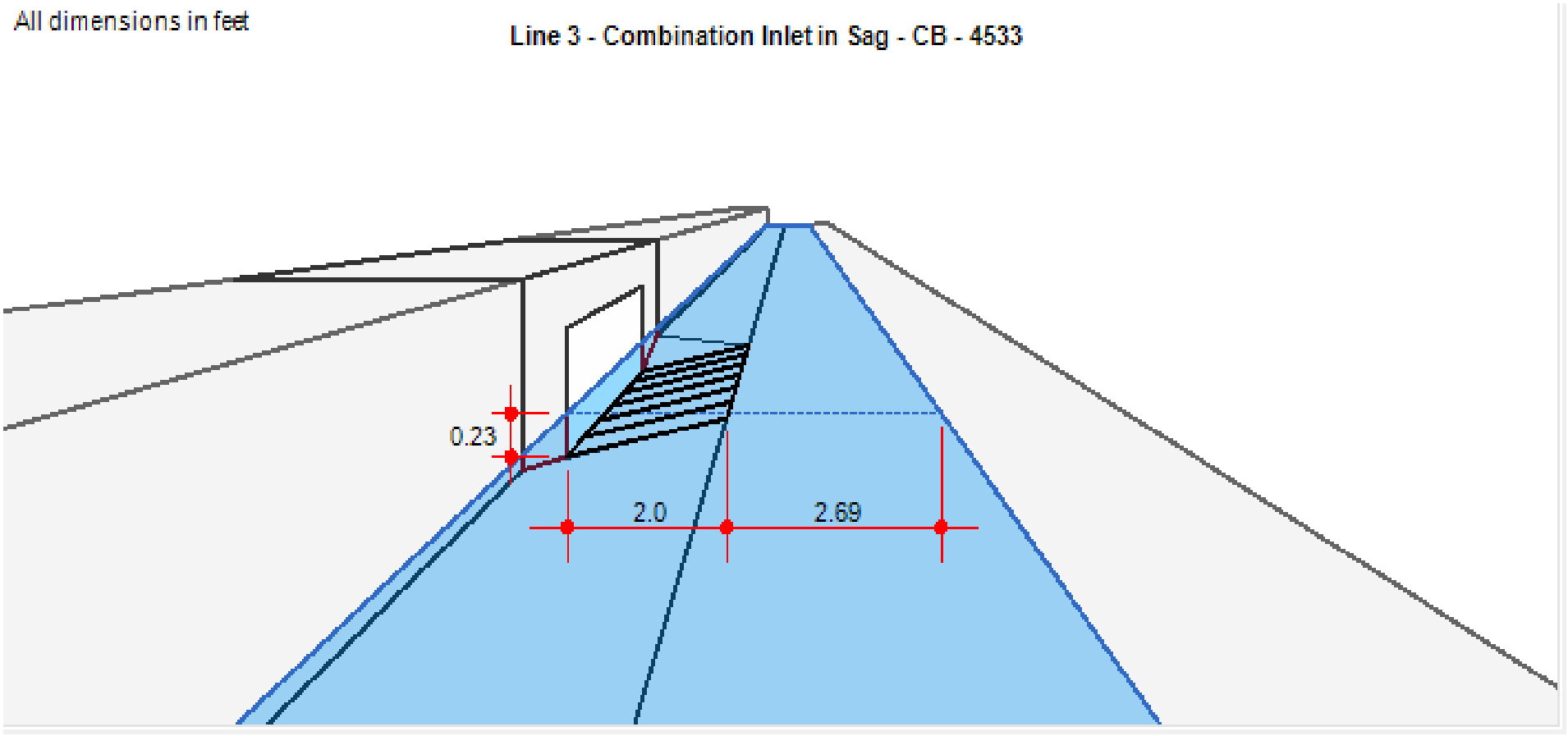


Line #	Q				Inlet			Gutter				Depth		Spread		Byp
	Catch (cfs)	Carry (cfs)	Capt (cfs)	Byp (cfs)	Length (ft)	Depr (in)	Throat (in)	Width (ft)	Slope (ft/ft)	Sw (ft/ft)	Sx (ft/ft)	Gutter (ft)	Inlet (ft)	Gutter (ft)	Inlet (ft)	Line (ft)
2	1.17	0.00	1.17	0.00	3.00	2.0	4.0	2.00	Sag	0.020	0.010	0.08	6.27	n/a	n/a	Sag

Project File: | No. Lines: 3 | Run Date: 5/1/2025

Inlet Section (Line 3 - Combination Inlet) - CB - 4533

All dimensions in feet



Line #	Q				Inlet			Gutter				Depth		Spread		Byp
	Catch (cfs)	Carry (cfs)	Capt (cfs)	Byp (cfs)	Length (ft)	Depr (in)	Throat (in)	Width (ft)	Slope (ft/ft)	Sw (ft/ft)	Sx (ft/ft)	Gutter (ft)	Inlet (ft)	Gutter (ft)	Inlet (ft)	Line (ft)
3	0.99	0.00	0.99	0.00	3.00	2.0	4.0	2.00	Sag	0.020	0.010	0.07	4.69	n/a	n/a	Sag

Project File: | No. Lines: 3 | Run Date: 5/1/2025