

### Rational Method Calculations

Project: Litchfield Hills CT KOA Campground  
 Location: Torrington, CT

By: ACD Date: 2/3/23  
 Checked: \_\_\_\_\_ Date: \_\_\_\_\_

	Ex. Culvert 1	Ex. Culvert 2	Ex. Culvert 3	Proposed Culvert 1	Proposed Culvert 2		
C	0.50	0.26	0.35	0.39	0.55		
I	7.50	7.50	7.50	7.50	7.50		
A	2.40	1.43	1.04	0.91	0.20		
Q	9.00	2.79	2.73	2.66	0.83		

Tc = 5 min, 10-Year storm

## Rational Method Individual Basin Calculations

Project: Litchfield Hills CT KOA Campground By: ACD Date: 2/6/22  
 Location: Torrington, CT Checked: \_\_\_\_\_ Date: \_\_\_\_\_

Basin Name	Impervious Area C=0.9 (sf)	Dirt Area C=0.6 (sf)	Grassed Area C=0.3 (sf)	Wooded Area C=0.2 (sf)	Total Area (sf)	Total Area (ac)	Weighted C	Tc (min)
Ex. Culvert 1	35744	0	60010	8798	104552	2.40	0.50	5.0
Ex. Culvert 2	2514	0	18262	41311	62087	1.43	0.26	5.0
Ex. Culvert 3	7696	0	14317	23076	45089	1.04	0.35	5.0
Proposed Culvert 1	8894	0	12072	18752	39718	0.91	0.39	5.0
Proposed Culvert 2	3600	0	4979	0	8579	0.20	0.55	5.0



**NOAA Atlas 14, Volume 10, Version 3**  
**Location name: Torrington, Connecticut, USA\***  
**Latitude: 41.8171°, Longitude: -73.1705°**  
**Elevation: 1115.11 ft\*\***  
 \* source: ESRI Maps  
 \*\* source: USGS



**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.26 (3.23-5.58)	5.08 (3.84-6.65)	6.41 (4.82-8.42)	7.50 (5.63-9.92)	9.01 (6.56-12.4)	10.2 (7.27-14.3)	11.3 (7.90-16.5)	12.6 (8.41-18.8)	14.3 (9.22-22.1)	15.6 (9.85-24.6)
10-min	3.02 (2.29-3.95)	3.59 (2.72-4.71)	4.54 (3.42-5.97)	5.31 (3.98-7.03)	6.38 (4.65-8.78)	7.20 (5.15-10.1)	8.03 (5.59-11.7)	8.91 (5.96-13.3)	10.1 (6.53-15.6)	11.0 (6.98-17.4)
15-min	2.37 (1.79-3.10)	2.82 (2.13-3.70)	3.56 (2.68-4.68)	4.16 (3.13-5.51)	5.00 (3.65-6.89)	5.65 (4.04-7.93)	6.30 (4.38-9.14)	6.99 (4.68-10.4)	7.92 (5.12-12.3)	8.65 (5.48-13.7)
30-min	1.62 (1.23-2.12)	1.93 (1.46-2.53)	2.43 (1.83-3.20)	2.85 (2.14-3.77)	3.42 (2.50-4.71)	3.86 (2.76-5.42)	4.31 (3.00-6.25)	4.78 (3.20-7.15)	5.42 (3.50-8.39)	5.92 (3.75-9.35)
60-min	1.03 (0.778-1.35)	1.22 (0.925-1.60)	1.54 (1.16-2.03)	1.81 (1.36-2.39)	2.17 (1.58-2.99)	2.45 (1.75-3.44)	2.74 (1.90-3.97)	3.03 (2.03-4.53)	3.44 (2.22-5.32)	3.76 (2.38-5.94)
2-hr	0.680 (0.518-0.885)	0.795 (0.604-1.04)	0.982 (0.746-1.28)	1.14 (0.858-1.50)	1.35 (0.992-1.85)	1.51 (1.09-2.12)	1.68 (1.18-2.44)	1.87 (1.25-2.78)	2.14 (1.39-3.30)	2.35 (1.49-3.71)
3-hr	0.525 (0.402-0.681)	0.613 (0.468-0.796)	0.757 (0.576-0.986)	0.876 (0.663-1.15)	1.04 (0.767-1.43)	1.16 (0.843-1.63)	1.29 (0.916-1.89)	1.45 (0.971-2.15)	1.67 (1.08-2.57)	1.85 (1.18-2.92)
6-hr	0.330 (0.253-0.425)	0.392 (0.301-0.505)	0.493 (0.377-0.637)	0.576 (0.439-0.750)	0.692 (0.514-0.947)	0.777 (0.568-1.09)	0.870 (0.624-1.27)	0.984 (0.663-1.46)	1.16 (0.756-1.79)	1.32 (0.839-2.06)
12-hr	0.198 (0.153-0.253)	0.243 (0.187-0.311)	0.317 (0.244-0.407)	0.378 (0.289-0.489)	0.463 (0.346-0.632)	0.524 (0.387-0.736)	0.593 (0.430-0.873)	0.681 (0.460-1.01)	0.820 (0.535-1.26)	0.943 (0.604-1.47)
24-hr	0.115 (0.089-0.146)	0.145 (0.113-0.185)	0.195 (0.151-0.250)	0.237 (0.182-0.304)	0.294 (0.222-0.402)	0.336 (0.250-0.471)	0.382 (0.280-0.565)	0.444 (0.301-0.654)	0.544 (0.356-0.832)	0.634 (0.407-0.988)
2-day	0.065 (0.051-0.082)	0.083 (0.065-0.105)	0.114 (0.088-0.144)	0.139 (0.107-0.177)	0.173 (0.132-0.236)	0.198 (0.149-0.278)	0.227 (0.168-0.336)	0.265 (0.180-0.390)	0.330 (0.216-0.503)	0.388 (0.250-0.602)
3-day	0.047 (0.037-0.059)	0.061 (0.048-0.077)	0.083 (0.065-0.105)	0.101 (0.079-0.129)	0.127 (0.097-0.172)	0.145 (0.109-0.203)	0.166 (0.123-0.245)	0.194 (0.132-0.285)	0.242 (0.159-0.368)	0.286 (0.184-0.443)
4-day	0.038 (0.030-0.048)	0.049 (0.038-0.062)	0.067 (0.052-0.084)	0.081 (0.063-0.103)	0.102 (0.078-0.138)	0.116 (0.088-0.162)	0.133 (0.099-0.196)	0.156 (0.106-0.228)	0.194 (0.128-0.295)	0.229 (0.148-0.355)
7-day	0.026 (0.021-0.032)	0.033 (0.026-0.041)	0.044 (0.035-0.056)	0.054 (0.042-0.068)	0.067 (0.051-0.090)	0.076 (0.058-0.106)	0.087 (0.065-0.128)	0.102 (0.070-0.148)	0.126 (0.083-0.190)	0.147 (0.095-0.228)
10-day	0.021 (0.017-0.026)	0.026 (0.021-0.033)	0.035 (0.028-0.044)	0.042 (0.033-0.053)	0.052 (0.040-0.069)	0.059 (0.044-0.081)	0.066 (0.049-0.097)	0.077 (0.053-0.112)	0.094 (0.062-0.142)	0.110 (0.071-0.169)
20-day	0.015 (0.012-0.019)	0.018 (0.014-0.022)	0.023 (0.018-0.028)	0.026 (0.021-0.033)	0.031 (0.024-0.041)	0.035 (0.026-0.047)	0.039 (0.029-0.056)	0.044 (0.030-0.064)	0.052 (0.035-0.079)	0.060 (0.039-0.092)
30-day	0.013 (0.010-0.016)	0.015 (0.012-0.018)	0.018 (0.014-0.022)	0.020 (0.016-0.025)	0.024 (0.018-0.031)	0.026 (0.020-0.035)	0.029 (0.021-0.041)	0.032 (0.022-0.046)	0.037 (0.025-0.056)	0.041 (0.027-0.063)
45-day	0.011 (0.009-0.013)	0.012 (0.010-0.015)	0.014 (0.011-0.017)	0.016 (0.013-0.020)	0.018 (0.014-0.024)	0.020 (0.015-0.026)	0.022 (0.016-0.030)	0.024 (0.017-0.034)	0.027 (0.018-0.040)	0.029 (0.019-0.044)
60-day	0.009 (0.008-0.012)	0.010 (0.008-0.013)	0.012 (0.010-0.015)	0.013 (0.011-0.017)	0.015 (0.012-0.020)	0.017 (0.012-0.022)	0.018 (0.013-0.025)	0.019 (0.013-0.028)	0.021 (0.014-0.032)	0.023 (0.015-0.035)

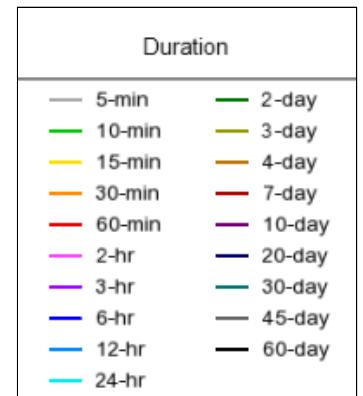
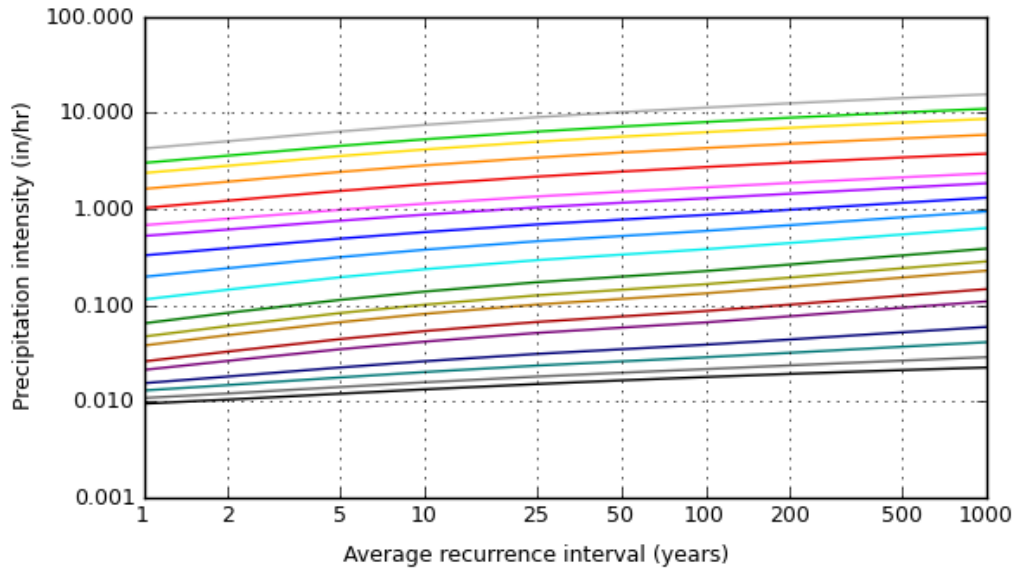
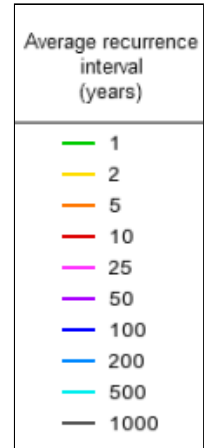
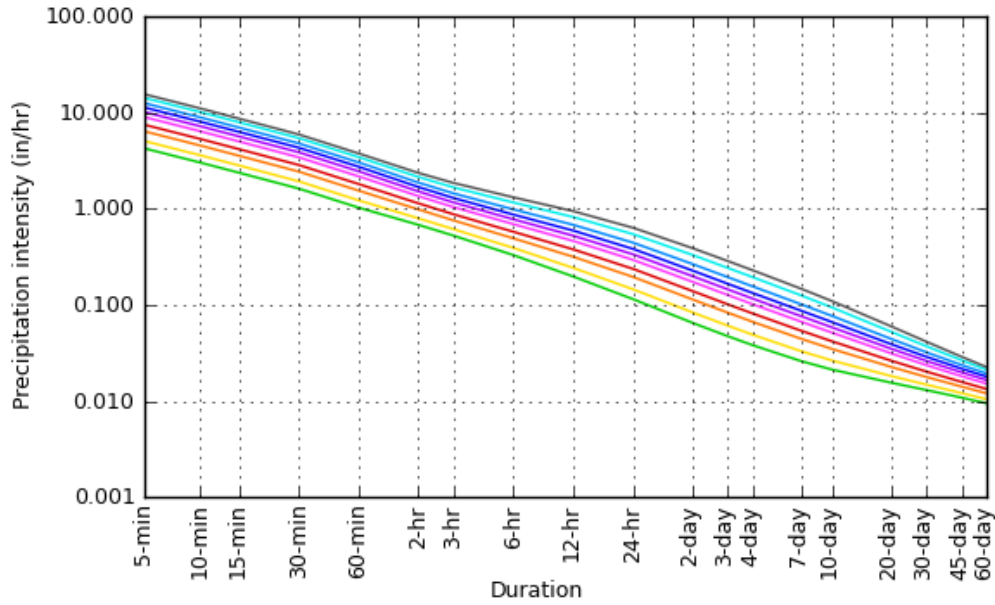
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration 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**

### PDS-based intensity-duration-frequency (IDF) curves

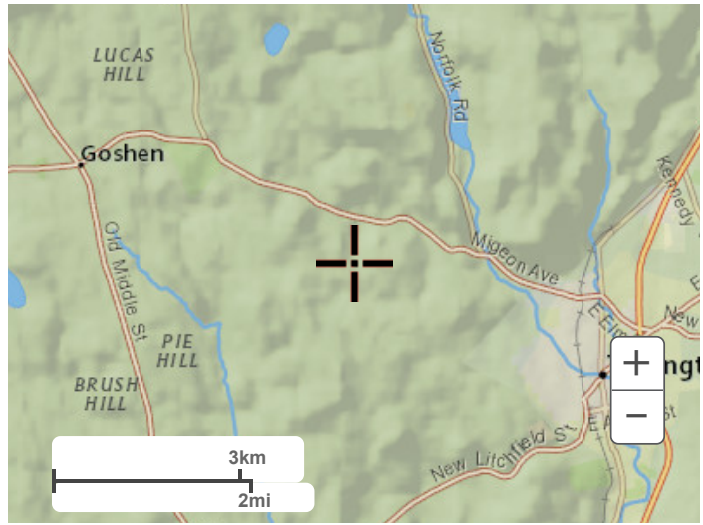
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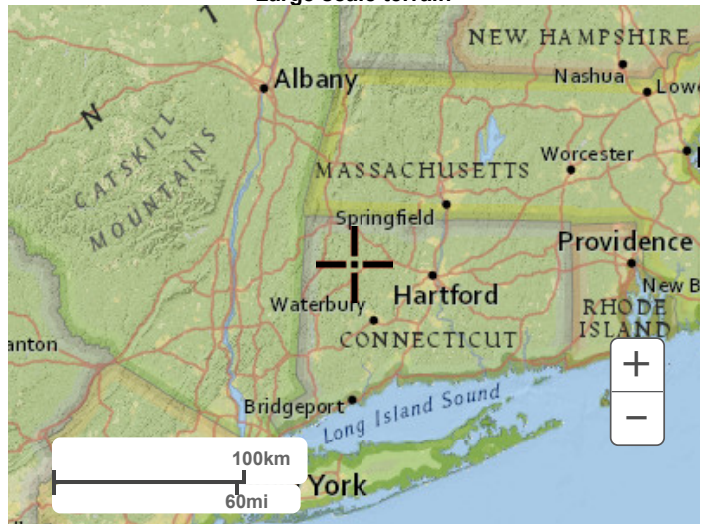
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### Maps & aerials

Small scale terrain



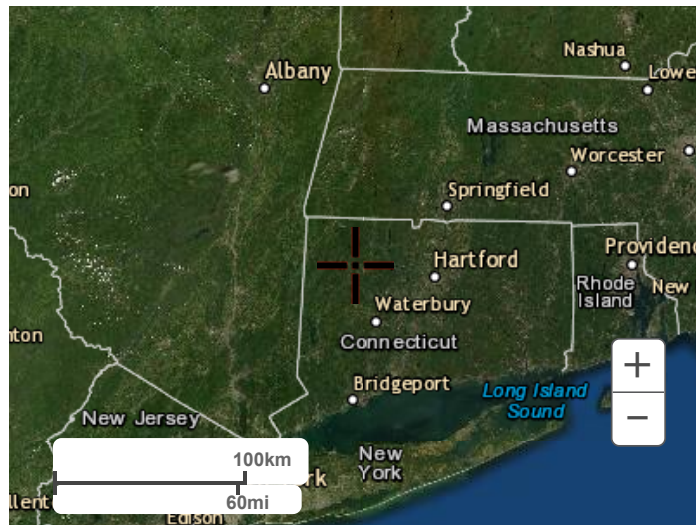
Large scale terrain



Large scale map



Large scale aerial



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[National Oceanic and Atmospheric Administration](#)  
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1325 East West Highway  
Silver Spring, MD 20910  
Questions?: [HDSC.Questions@noaa.gov](mailto:HDSC.Questions@noaa.gov)

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# Channel Report

## Ex. Culvert 1

### Circular

Diameter (ft) = 1.00

Invert Elev (ft) = 1146.50

Slope (%) = 2.72

N-Value = 0.012

### Calculations

Compute by: Q vs Depth

No. Increments = 10

### Highlighted

Depth (ft) = 0.90

Q (cfs) = 6.783

Area (sqft) = 0.74

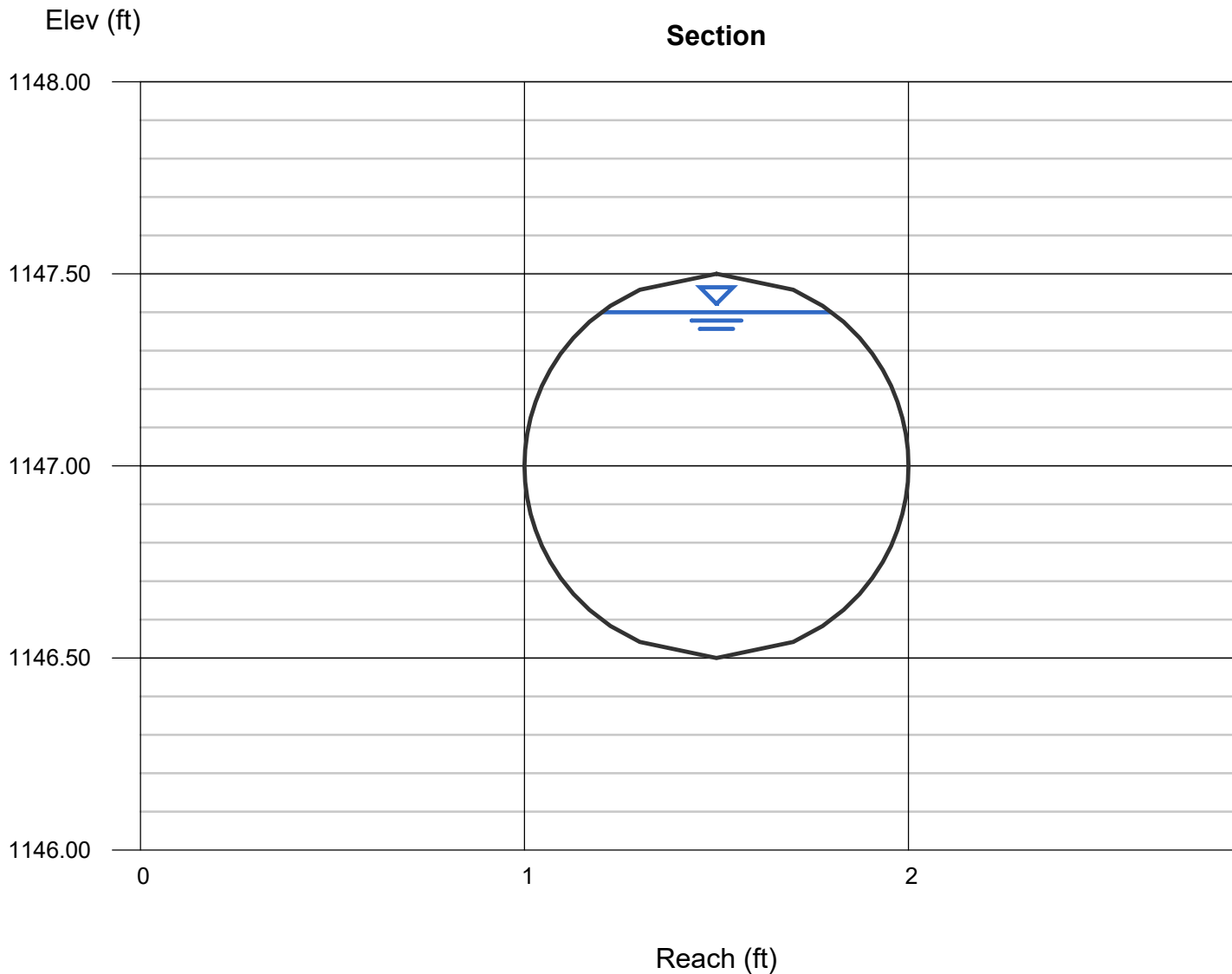
Velocity (ft/s) = 9.11

Wetted Perim (ft) = 2.50

Crit Depth,  $Y_c$  (ft) = 0.98

Top Width (ft) = 0.60

EGL (ft) = 2.19



# Channel Report

## Ex. Culvert 2

### Circular

Diameter (ft) = 1.00

Invert Elev (ft) = 1119.70

Slope (%) = 1.91

N-Value = 0.012

### Calculations

Compute by: Q vs Depth

No. Increments = 10

### Highlighted

Depth (ft) = 0.90

Q (cfs) = 5.684

Area (sqft) = 0.74

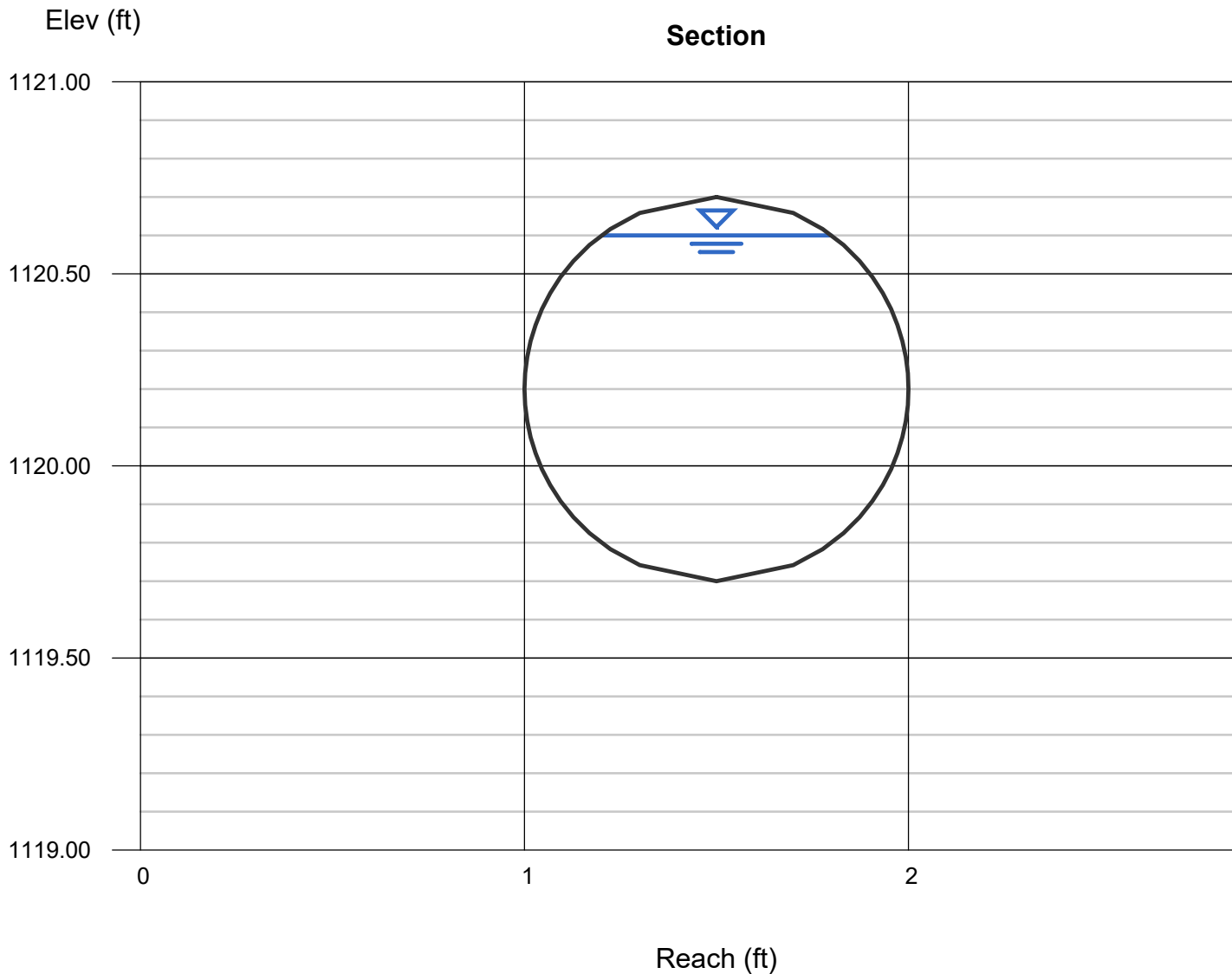
Velocity (ft/s) = 7.63

Wetted Perim (ft) = 2.50

Crit Depth,  $Y_c$  (ft) = 0.95

Top Width (ft) = 0.60

EGL (ft) = 1.81





# Channel Report

## Ex. Culvert 3

### Circular

Diameter (ft) = 1.00

Invert Elev (ft) = 1105.80

Slope (%) = 1.63

N-Value = 0.012

### Calculations

Compute by: Q vs Depth

No. Increments = 10

### Highlighted

Depth (ft) = 0.90

Q (cfs) = 5.251

Area (sqft) = 0.74

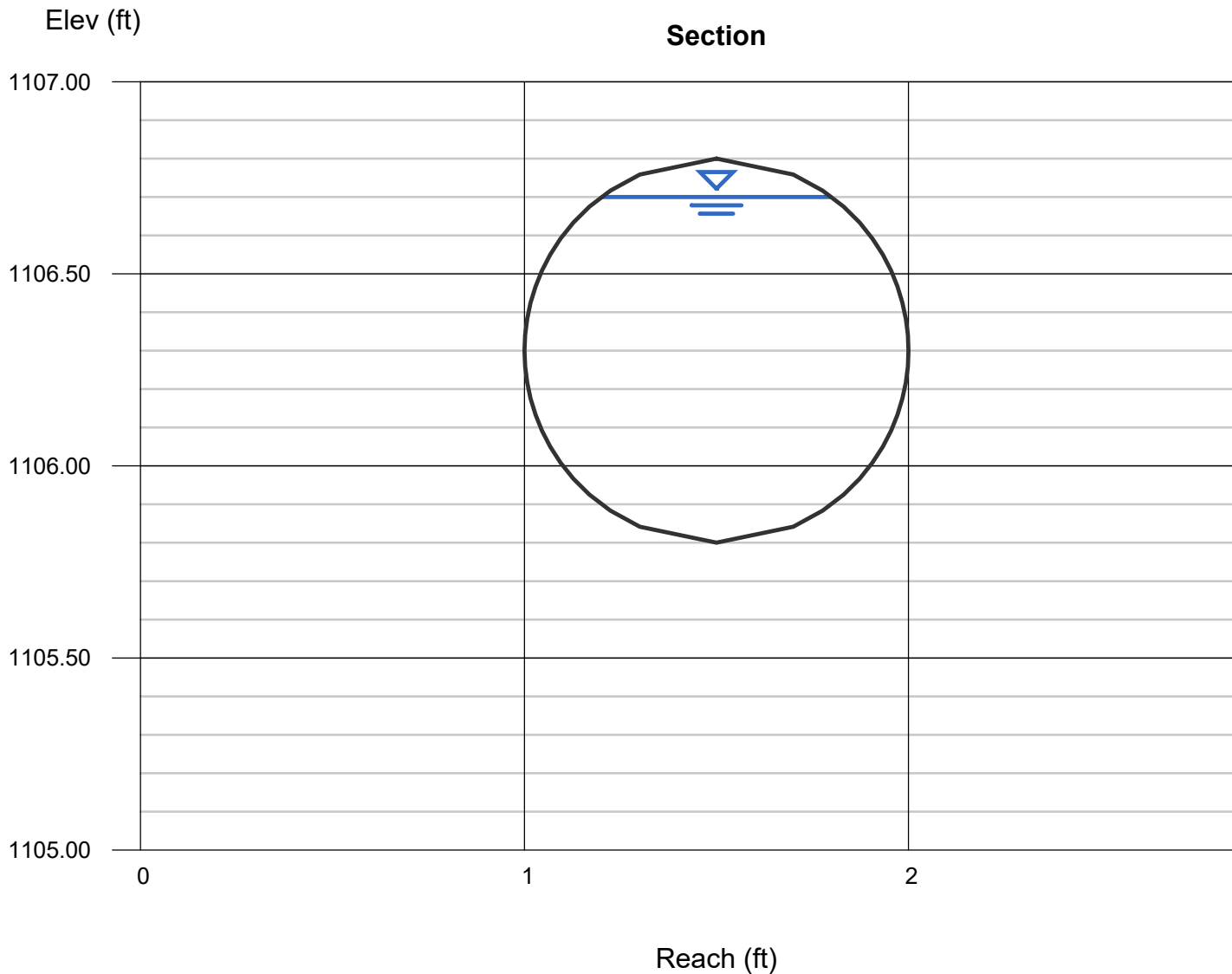
Velocity (ft/s) = 7.05

Wetted Perim (ft) = 2.50

Crit Depth, Yc (ft) = 0.93

Top Width (ft) = 0.60

EGL (ft) = 1.67



# Channel Report

## Proposed Culvert 1

### Circular

Diameter (ft) = 1.00

Invert Elev (ft) = 1087.80

Slope (%) = 2.82

N-Value = 0.012

### Calculations

Compute by: Q vs Depth

No. Increments = 10

### Highlighted

Depth (ft) = 0.90

Q (cfs) = 6.907

Area (sqft) = 0.74

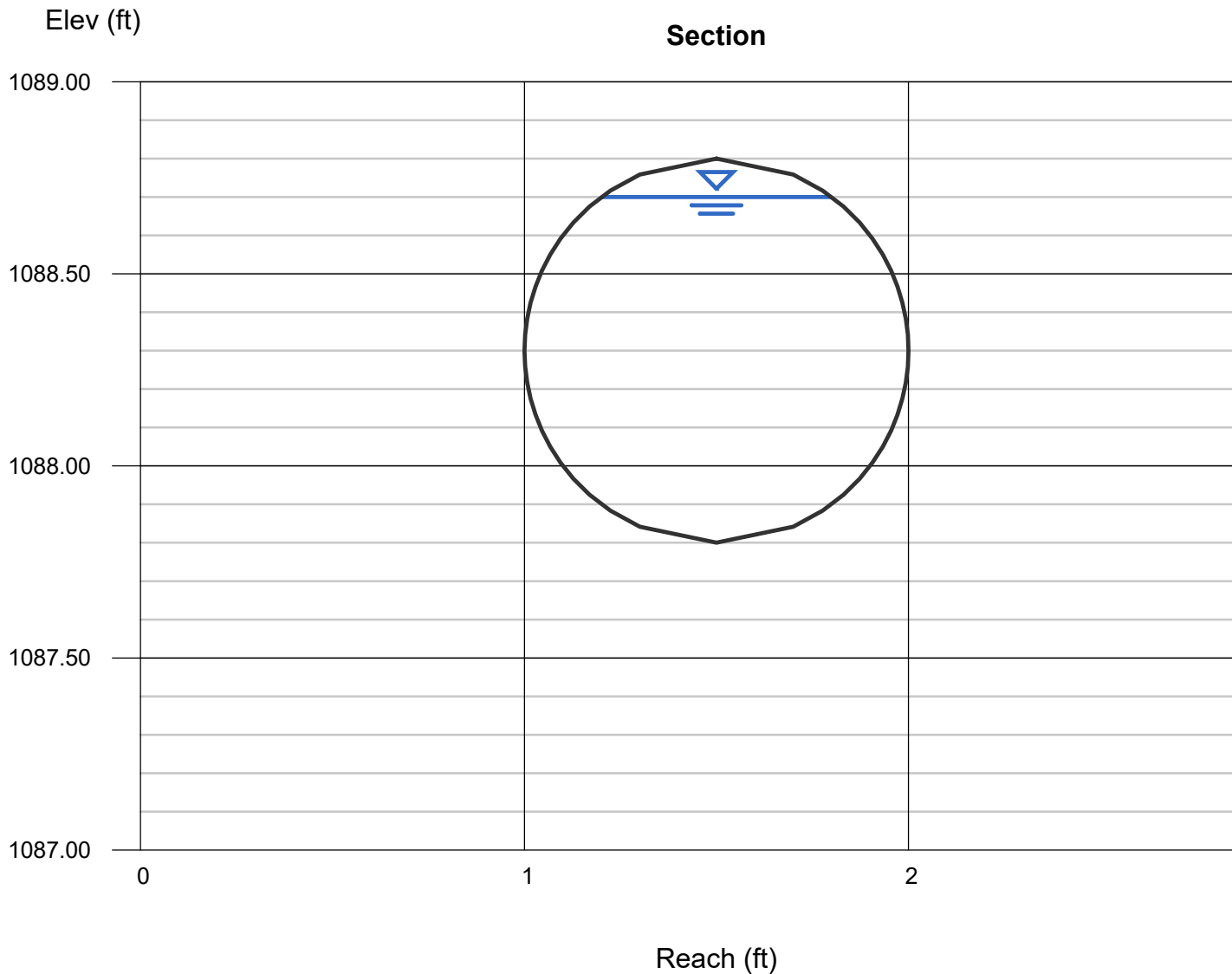
Velocity (ft/s) = 9.27

Wetted Perim (ft) = 2.50

Crit Depth,  $Y_c$  (ft) = 0.98

Top Width (ft) = 0.60

EGL (ft) = 2.24



# Channel Report

## Proposed Culvert 2

### Circular

Diameter (ft) = 1.00

Invert Elev (ft) = 1068.00

Slope (%) = 5.00

N-Value = 0.012

### Calculations

Compute by: Q vs Depth

No. Increments = 10

### Highlighted

Depth (ft) = 0.90

Q (cfs) = 9.197

Area (sqft) = 0.74

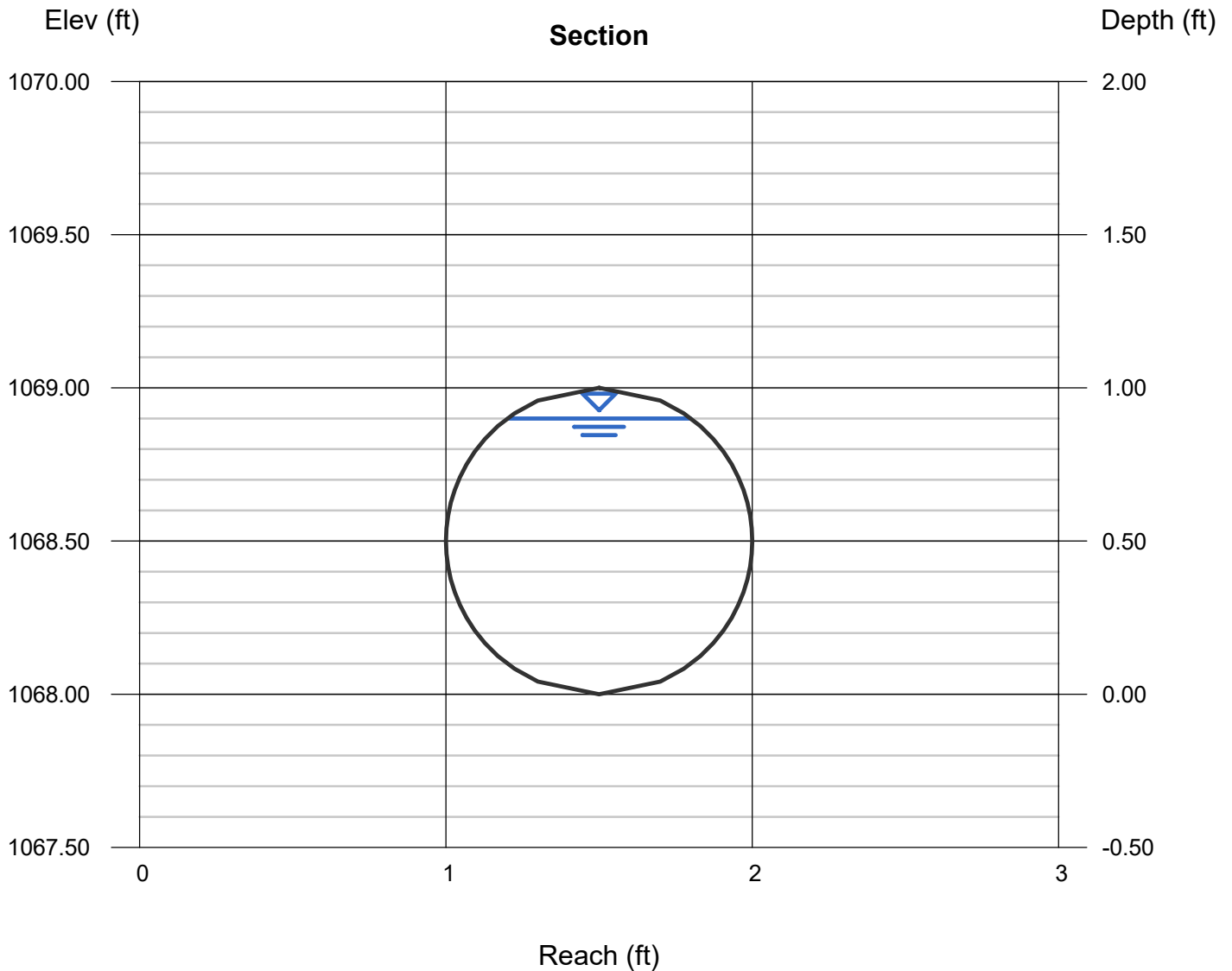
Velocity (ft/s) = 12.35

Wetted Perim (ft) = 2.50

Crit Depth, Yc (ft) = 1.00

Top Width (ft) = 0.60

EGL (ft) = 3.27



# Channel Report

## Riprap Channel

### Trapezoidal

Bottom Width (ft) = 2.00  
Side Slopes (z:1) = 2.00, 2.00  
Total Depth (ft) = 1.00  
Invert Elev (ft) = 1186.00  
Slope (%) = 11.80  
N-Value = 0.025

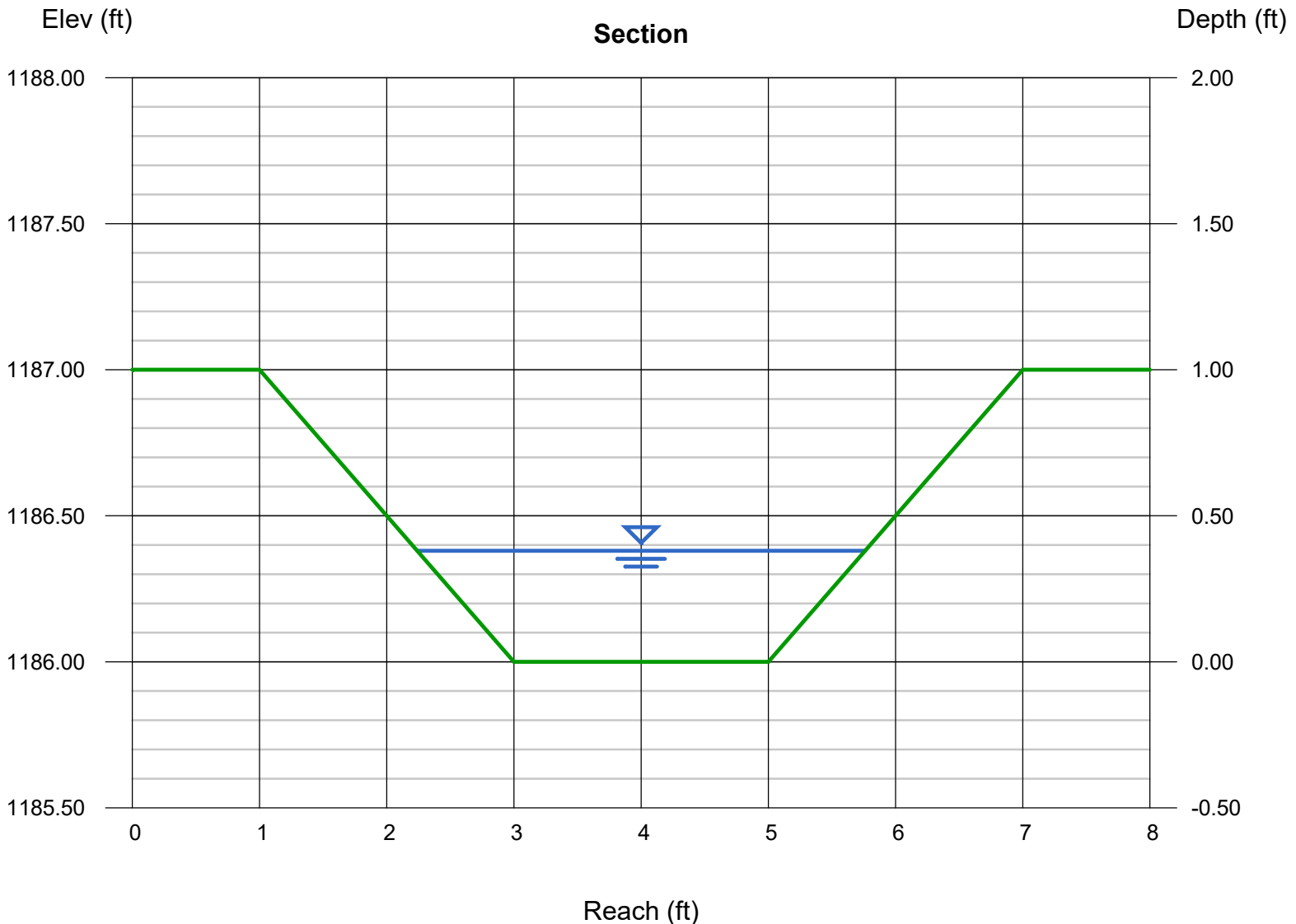
### Highlighted

Depth (ft) = 0.38  
Q (cfs) = 9.238  
Area (sqft) = 1.05  
Velocity (ft/s) = 8.81  
Wetted Perim (ft) = 3.70  
Crit Depth, Yc (ft) = 0.69  
Top Width (ft) = 3.52  
EGL (ft) = 1.59

### Calculations

Compute by: Q vs Depth  
No. Increments = 50




Velocity = 8.81 ft/s --> Intermediate Riprap

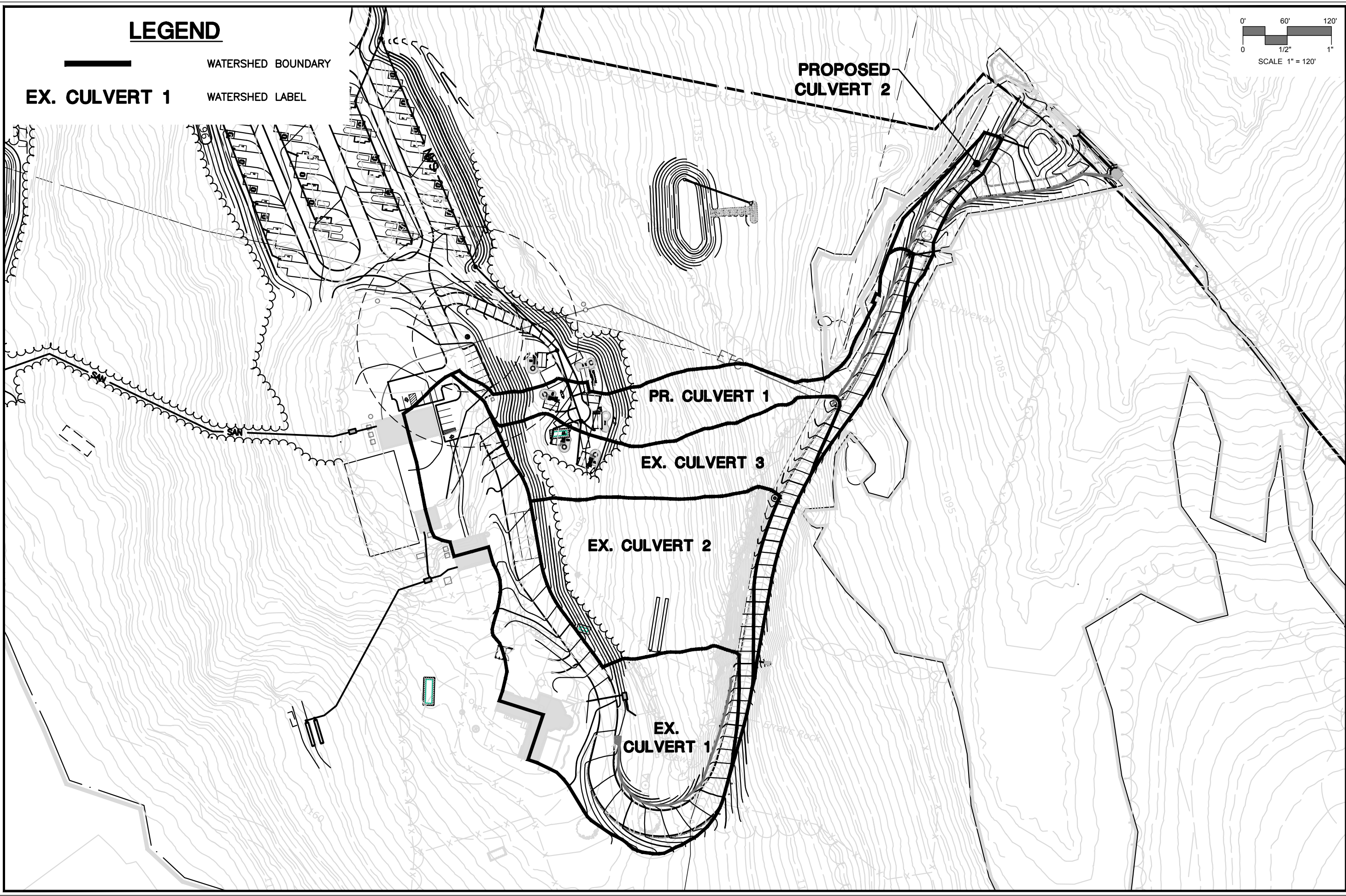
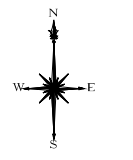
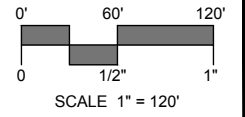




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# LEGEND

-  **EX. CULVERT 1**
-  **WATERSHED BOUNDARY**
-  **WATERSHED LABEL**



### REVISIONS


### CULVERT WATERSHED MAP - PROPOSED CONDITIONS

LITCHFIELD HILLS CT  
 KOA CAMPGROUND  
 232 KLUG HILL ROAD  
 TORRINGTON, CONNECTICUT

ACD DESIGNED	ACD DRAWN	RJM CHECKED
SCALE 1"=120'		
DATE FEBRUARY 6, 2023		
PROJECT NO. 20174.00002		

## C-WS

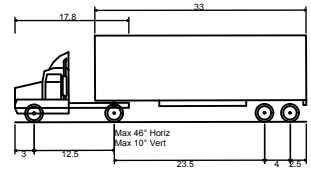
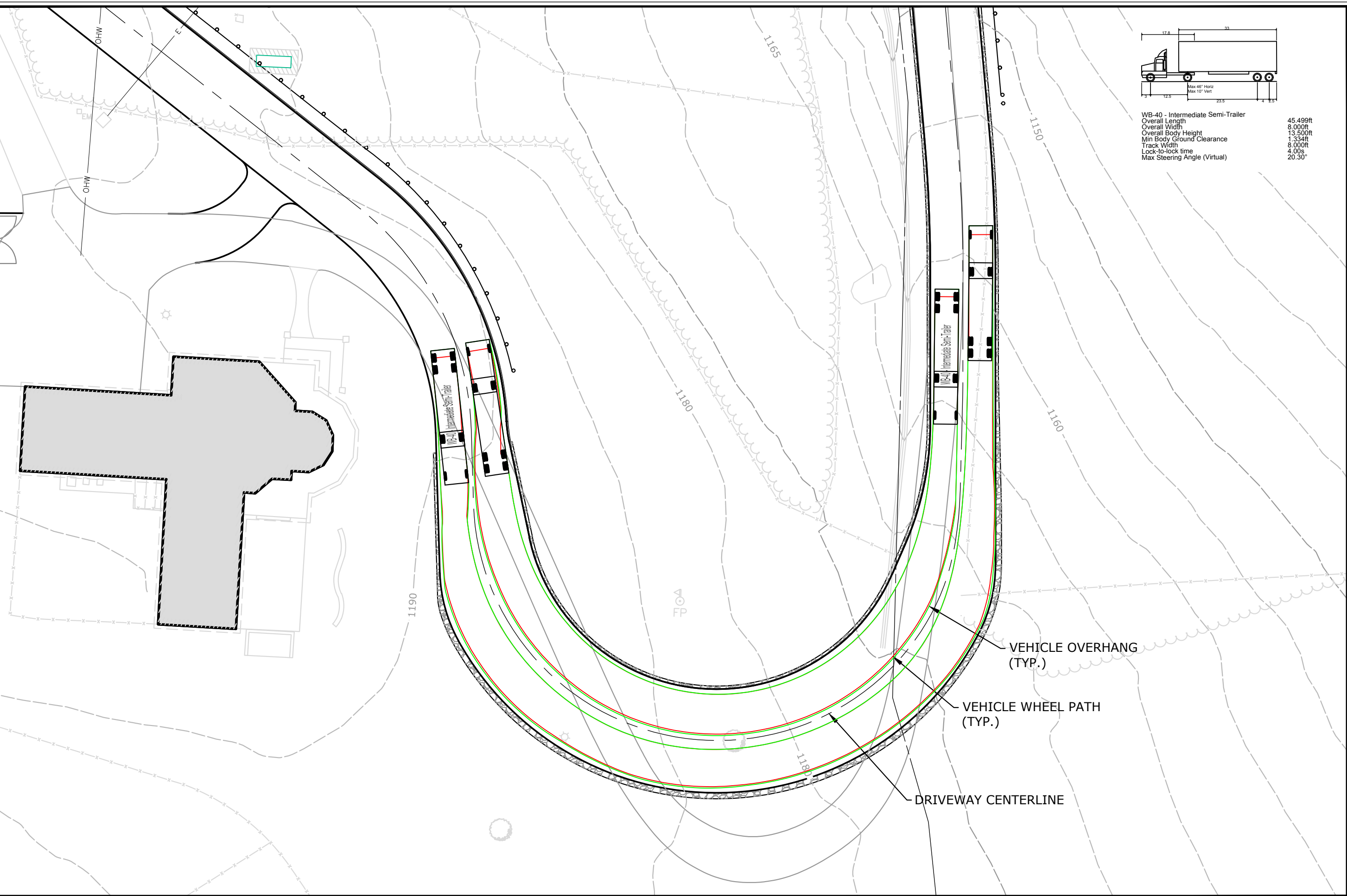
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Drawing: W:\CAD\DESIGN\20174.00002-DE\CAD\VEHICLE TRACKING\2023-02-03 VEHICLE TRACKING\DWG Layout Tab-WB-40  
 Plotted by: ADOMD On this date: Fri, 13 Feb 2023 11:46am



**WB-40 - Intermediate Semi-Trailer**  
 Overall Length 45.499ft  
 Overall Width 8.000ft  
 Overall Body Height 13.500ft  
 Min Body Ground Clearance 1.334ft  
 Track Width 8.000ft  
 Lock-to-lock time 4.00s  
 Max Steering Angle (Virtual) 20.30°



**SLR**  
 99 REALTY DRIVE  
 SUITE 100  
 TORRINGTON, CT 06410  
 203.271.1773  
 SLRCONSULTING.COM

REVISIONS	
02/01/2023	
02/03/2023	

**VEHICLE TRACKING - WB-40**  
 KLUG HILL RV PARK  
 KOA CAMPGROUND  
 232 KLUG HILL ROAD  
 TORRINGTON, CONNECTICUT

KJG DESIGNED  
 KJG DRAWN  
 RJM CHECKED  
 SCALE 1"=30'  
 DATE JANUARY 13, 2023  
 PROJECT NO. 20174.00002

**VT-1**  
SHEET NO.

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