
TECHNICAL MEMORANDUM

TO: A.J. Alevisos, The Alevizos Group

FROM: Todd P. Morey, P.E., Principal

SUBJECT: Peer Review Comment SW21
444 East Central Street, Franklin, MA

DATE: October 16, 2025

Comment SW21: *The HydroCAD model has been updated, and an HY-8 model has been provided to analyze the capacities for the existing culverts. HY-8 should also be used to model the proposed conditions to demonstrate there will be no adverse impacts to flood levels following construction.*

Response: Our office has updated the HY-8 model by adding the proposed culverts into the data. The culverts consist of six (6) 36-inch diameter concrete culverts at each of the northerly and southerly crossings that were previously analyzed. It is assumed that the existing culverts will remain in place, and the new culverts will be installed above them. Since we did not have the design profiles at our disposal during the modeling, we assumed a roadway overtopping elevation based on the proposed plans. As is demonstrated below and in the attached calculations, this assumption turns out to be irrelevant since the water levels did not approach the overtopping elevations.

The Northern Spy Road culverts were not altered in the updated model. The original results from the analysis at that point remain for this updated analysis. As was previously noted, the results at Northern Spy Road indicate that the roadway overtops between the 2- and 5-year events with the water level continuing to rise throughout the various storms.

Northern Spy Road Analysis		
Storm Event (year)	Total Discharge (cfs)	Headwater Elevation (ft)
2	48	268.87
5	80.3	270.51
10	106	270.74
25	144	270.93
50	176	271.06
100	210	271.17
200	246	271.27
500	299	271.40

The HY-8 program was used for the next culvert upstream with the following results:

Southerly Culvert Analysis				
Storm Event (year)	Total Discharge (cfs)	Tailwater Elevation (ft)	Original Headwater Elevation (ft)	Proposed Design Headwater Elevation (ft)
2	12.8	268.87	269.03	269.03
5	21.9	270.51	270.92	270.97
10	29.3	270.74	271.21	271.23
25	40.3	270.93	271.41	271.47
50	49.6	271.06	271.50	271.64
100	59.6	271.17	271.58	271.79
200	70.6	271.27	271.65	271.93
500	86.6	271.40	271.74	272.19

Once again, the headwater for this culvert becomes the tailwater for the next upstream culvert and the analysis is run again at that point.

Northerly Culvert Analysis					
Storm Event (year)	Total Discharge (cfs)	Original Tailwater Elevation (ft)	Proposed Design Tailwater Elevation (ft)	Original Headwater Elevation (ft)	Proposed Design Headwater Elevation (ft)
2	11.7	269.03	269.03	269.25	269.18
5	20.1	270.92	270.97	270.93	270.97
10	26.9	271.21	271.23	271.22	271.24
25	37.0	271.41	271.47	271.42	271.49
50	45.5	271.50	271.64	271.51	271.66
100	54.7	271.58	271.79	271.59	271.82
200	64.9	271.65	271.93	271.66	271.98
500	79.6	271.74	272.19	271.76	272.19

The results show that the water elevations will rise by about two to three inches during higher storm events. This does not indicate that there will be any adverse impacts to flood elevations across all storm events modeled.

HY-8 Culvert Analysis Report

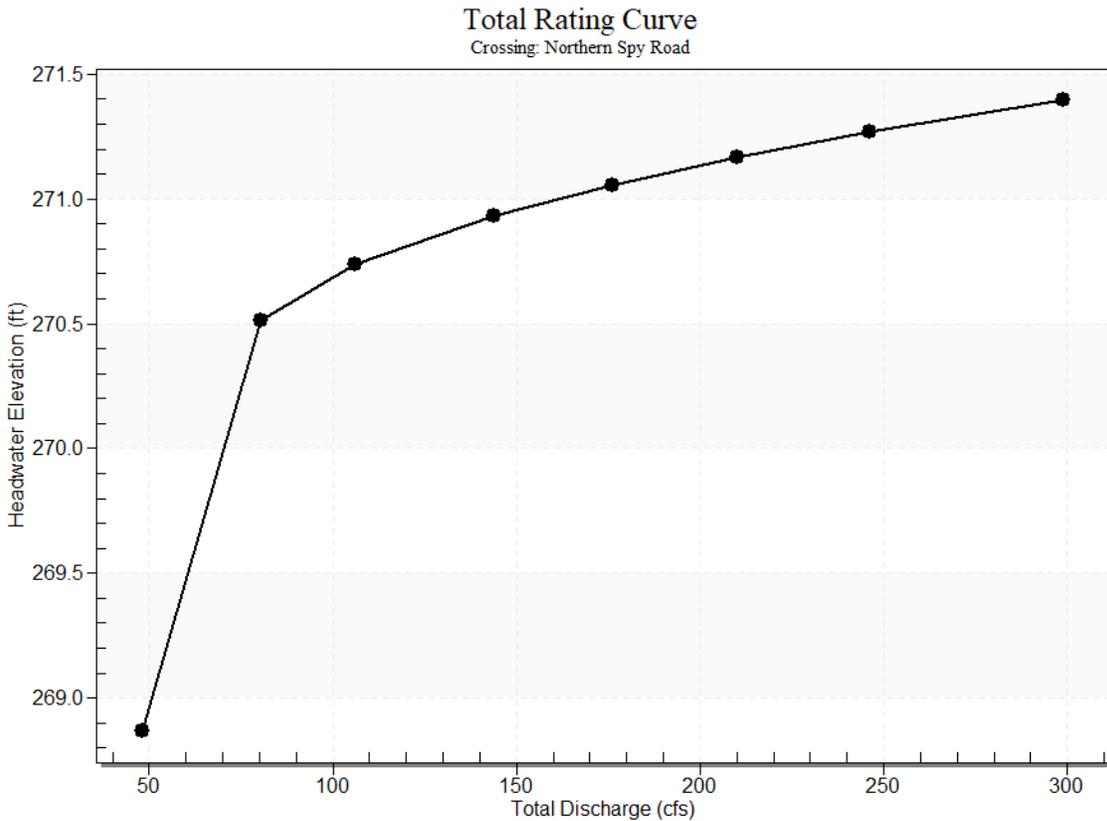
Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 1 - Summary of Culvert Flows at Crossing: Northern Spy Road

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
268.87	2 year	48.00	48.00	0.00	1
270.51	5 year	80.30	77.77	2.44	15
270.74	10 year	106.00	80.86	24.94	9
270.93	25 year	144.00	83.51	60.28	7
271.06	50 year	176.00	85.14	90.55	5
271.17	100 year	210.00	86.56	123.34	5
271.27	200 year	246.00	87.83	157.97	4
271.40	500 year	299.00	89.44	209.51	4
270.40	Overtopping	76.11	76.11	0.00	Overtopping

Rating Curve Plot for Crossing: Northern Spy Road



Culvert Data: Culvert 1

Table 2 - Culvert Summary Table: Culvert 1

Disc harg e Nam es	Total Disc harg e (cfs)	Culv ert Disc harg e (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl o w Ty pe	Nor mal Dep th (ft)	Crit ical De pth (ft)	Ou tle t De pth (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2 year	48.00 cfs	48.00 cfs	268.8 7	2.37	1.71 6	6- FF c	1.10	1.4 4	1.4 4	0.67	6.60	6.30
5 year	80.30 cfs	77.77 cfs	270.5 1	4.01	3.42 3	6- FF c	1.55	1.7 8	1.7 8	0.91	8.76	7.51
10 year	106.0 0 cfs	80.86 cfs	270.7 4	4.24	3.59 9	6- FF c	1.61	1.8 1	1.8 1	1.06	9.03	8.23
25 year	144.0 0 cfs	83.51 cfs	270.9 3	4.43	3.75 5	6- FF c	1.67	1.8 3	1.8 3	1.27	9.26	9.08
50 year	176.0 0 cfs	85.14 cfs	271.0 6	4.56	3.85 2	6- FF c	1.71	1.8 4	1.8 4	1.42	9.40	9.68
100 year	210.0 0 cfs	86.56 cfs	271.1 7	4.67	3.93 8	6- FF c	1.75	1.8 4	1.8 4	1.56	9.53	10.22
200 year	246.0 0 cfs	87.83 cfs	271.2 7	4.77	4.01 6	6- FF c	2.00	1.8 5	1.8 5	1.71	9.65	10.73
500 year	299.0 0 cfs	89.44 cfs	271.4 0	4.90	4.09 0	6- FF t	2.00	1.8 6	1.9 0	1.90	9.66	11.38

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 266.50 ft,

Outlet Elevation (invert): 266.00 ft

Culvert Length: 40.00 ft,

Culvert Slope: 0.0125

Site Data - Culvert 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 266.50 ft

Outlet Station: 40.00 ft

Outlet Elevation: 266.00 ft

Number of Barrels: 3

Culvert Data Summary - Culvert 1

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Tailwater Data for Crossing: Northern Spy Road

Table 3 - Downstream Channel Rating Curve (Crossing: Northern Spy Road)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
48.00	266.67	0.67	6.30	1.88	1.43
80.30	266.91	0.91	7.51	2.54	1.49
106.00	267.06	1.06	8.23	2.98	1.53
144.00	267.27	1.27	9.08	3.55	1.56
176.00	267.42	1.42	9.68	3.98	1.58
210.00	267.56	1.56	10.22	4.39	1.60
246.00	267.71	1.71	10.73	4.80	1.62
299.00	267.90	1.90	11.38	5.35	1.64

Tailwater Channel Data - Northern Spy Road

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 10.00 ft

Side Slope (H:V): 2.00 (:1)

Channel Slope: 0.0450

Channel Manning's n: 0.0350

Channel Invert Elevation: 266.00 ft

Roadway Data for Crossing: Northern Spy Road

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	272.00
1	68.00	271.00
2	75.00	270.50
3	100.00	270.40
4	125.00	270.50
5	155.00	271.00
6	200.00	272.00

Roadway Surface: Paved

Roadway Top Width: 40.00 ft

Crossing Discharge Data

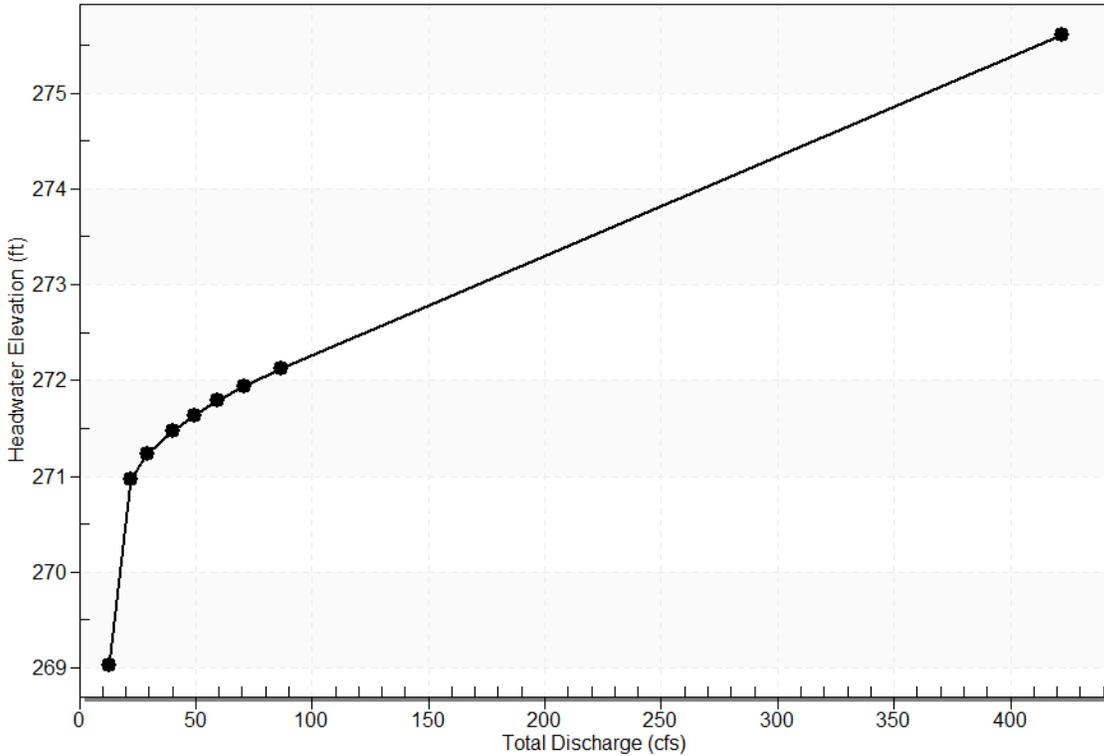
Discharge Selection Method: Recurrence

Table 4 - Summary of Culvert Flows at Crossing: Southern Site Culvert

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing Discharge (cfs)	Oct 2025 Proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
269.03	2 year	12.80	12.86	0.00	0.00	37
270.97	5 year	21.90	19.85	2.06	0.00	3
271.23	10 year	29.30	20.55	8.73	0.00	6
271.47	25 year	40.30	21.58	18.68	0.00	5
271.64	50 year	49.60	22.19	27.33	0.00	4
271.79	100 year	59.60	22.97	36.61	0.00	4
271.93	200 year	70.60	23.80	46.79	0.00	4
272.12	500 year	86.60	24.87	61.80	0.00	3
276.00	Overtopping	449.28	62.75	386.52	0.00	Overtopping

Rating Curve Plot for Crossing: Southern Site Culvert

Total Rating Curve
Crossing: Southern Site Culvert



Culvert Data: Existing

Table 5 - Culvert Summary Table: Existing

Disc harg e Nam es	Total Disc harg (cfs)	Culv ert Disc harg (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical Dep th (ft)	Ou tle t Dep th (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2 year	12.80 cfs	12.86 cfs	269.0 3	1.77	2.66 0	7- H2 f	- 1.00	1.2 0	2.5 0	3.87	2.62	0.00
5 year	21.90 cfs	19.85 cfs	270.9 7	2.31	4.60 0	4- FF f	- 1.00	1.5 1	2.5 0	5.51	4.04	0.00
10 year	29.30 cfs	20.55 cfs	271.2 3	2.37	4.86 3	4- FF f	- 1.00	1.5 4	2.5 0	5.74	4.19	0.00
25 year	40.30 cfs	21.58 cfs	271.4 7	2.45	5.10 4	4- FF f	- 1.00	1.5 8	2.5 0	5.93	4.40	0.00

50 year	49.60 cfs	22.19 cfs	271.6 4	2.50	5.26 5	4- FF f	- 1.00	1.6 0	2.5 0	6.06	4.52	0.00
100 year	59.60 cfs	22.97 cfs	271.7 9	2.56	5.41 6	4- FF f	- 1.00	1.6 3	2.5 0	6.17	4.68	0.00
200 year	70.60 cfs	23.80 cfs	271.9 3	2.62	5.56 2	4- FF f	- 1.00	1.6 6	2.5 0	6.27	4.85	0.00
500 year	86.60 cfs	24.87 cfs	272.1 2	2.71	5.75 3	4- FF f	- 1.00	1.7 0	2.5 0	6.40	5.07	0.00

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert

Inlet Elevation (invert): 266.37 ft,

Outlet Elevation (invert): 266.37 ft

Culvert Length: 40.00 ft,

Culvert Slope: 0.0000

Site Data - Existing

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 266.37 ft

Outlet Station: 40.00 ft

Outlet Elevation: 266.37 ft

Number of Barrels: 1

Culvert Data Summary - Existing

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Culvert Data: Oct 2025 Proposed

Table 6 - Culvert Summary Table: Oct 2025 Proposed

Disc harg e Nam es	Total Disc harg e (cfs)	Culv ert Disc harg e (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical Dep th (ft)	Ou tle t Dep th (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2 year	12.80 cfs	0.00 cfs	269.0 3	0.00	0.00 0	0- NF	0.00	0.0 0	0.0 0	3.87	0.00	0.00
5 year	21.90 cfs	2.06 cfs	270.9 7	0.24	0.0* 0	6- FF c	0.15	0.1 8	0.1 8	5.51	1.95	0.00
10 year	29.30 cfs	8.73 cfs	271.2 3	0.50	0.13 4	6- FF c	0.30	0.3 7	0.3 7	5.74	2.87	0.00
25 year	40.30 cfs	18.68 cfs	271.4 7	0.74	0.31 4	6- FF c	0.43	0.5 5	0.5 5	5.93	3.51	0.00
50 year	49.60 cfs	27.33 cfs	271.6 4	0.91	0.43 8	6- FF c	0.51	0.6 7	0.6 7	6.06	3.89	0.00
100 year	59.60 cfs	36.61 cfs	271.7 9	1.06	0.55 4	6- FF c	0.59	0.7 8	0.7 8	6.17	4.21	0.00
200 year	70.60 cfs	46.79 cfs	271.9 3	1.20	0.67 1	6- FF c	0.67	0.8 8	0.8 8	6.27	4.51	0.00
500 year	86.60 cfs	61.80 cfs	272.1 2	1.39	0.83 0	6- FF c	0.77	1.0 2	1.0 2	6.40	4.89	0.00

* Full Flow Headwater elevation is below inlet invert.

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 270.73 ft,

Outlet Elevation (invert): 270.49 ft

Culvert Length: 25.00 ft,

Culvert Slope: 0.0096

Site Data - Oct 2025 Proposed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 270.73 ft

Outlet Station: 25.00 ft

Outlet Elevation: 270.49 ft

Number of Barrels: 6

Culvert Data Summary - Oct 2025 Proposed

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Tailwater Data for Crossing: Southern Site Culvert

Table 7 - Downstream Channel Rating Curve (Crossing: Southern Site Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
12.80	268.87	3.87	0.00
21.90	270.51	5.51	0.00
29.30	270.74	5.74	0.00
40.30	270.93	5.93	0.00
49.60	271.06	6.06	0.00
59.60	271.17	6.17	0.00
70.60	271.27	6.27	0.00
86.60	271.40	6.40	0.00

Tailwater Channel Data - Southern Site Culvert

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: Enter Rating Curve

Roadway Data for Crossing: Southern Site Culvert

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	276.00
1	29.00	276.00
2	47.00	276.00
3	48.00	276.00
4	53.00	276.00
5	64.00	276.00
6	98.00	276.00
7	98.10	276.00

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

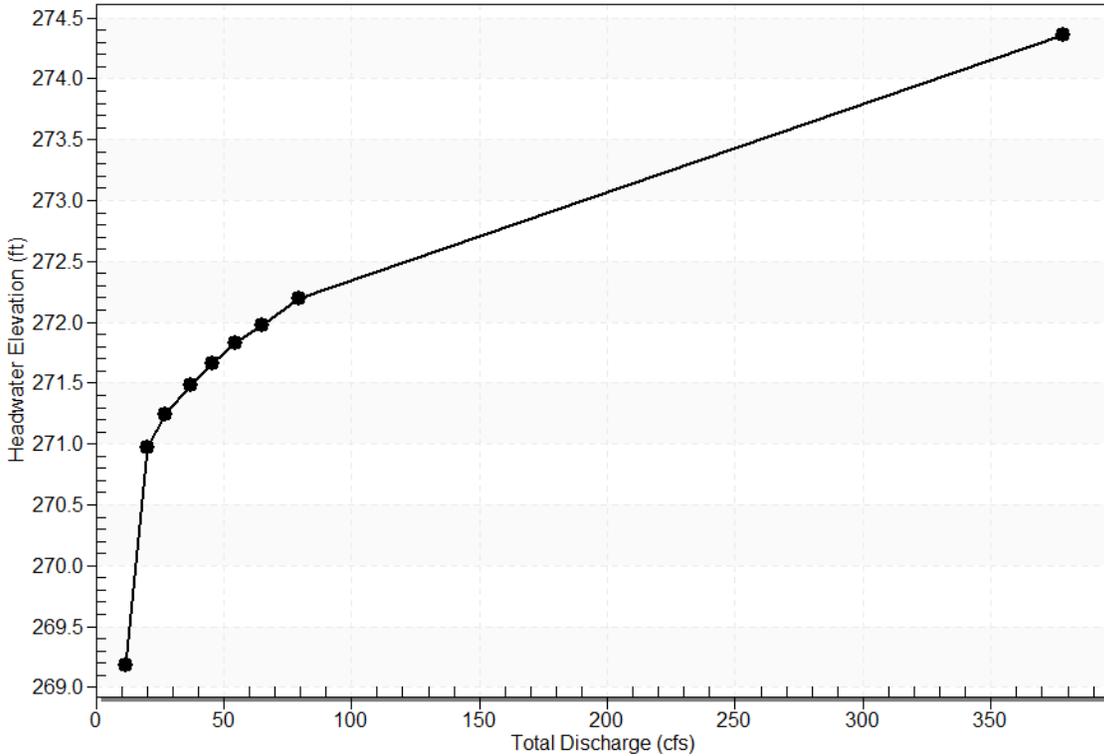
Discharge Selection Method: Recurrence

Table 8 - Summary of Culvert Flows at Crossing: North Site Culvert

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Existing Discharge (cfs)	Oct 2025 Proposed Discharge (cfs)	Roadway Discharge (cfs)	Iterations
269.18	2 year	11.70	11.77	0.00	0.00	39
270.97	5 year	20.10	2.04	18.18	0.00	3
271.24	10 year	26.90	2.88	24.34	0.00	9
271.49	25 year	37.00	4.17	33.12	0.00	8
271.66	50 year	45.50	5.16	40.43	0.00	9
271.82	100 year	54.70	6.27	48.69	0.00	9
271.98	200 year	64.90	7.48	57.93	0.00	8
272.19	500 year	79.60	9.20	70.80	0.00	6
274.80	Overtopping	412.85	56.54	356.32	0.00	Overtopping

Rating Curve Plot for Crossing: North Site Culvert

Total Rating Curve
Crossing: North Site Culvert



Culvert Data: Existing

Table 9 - Culvert Summary Table: Existing

Disc harg e Nam es	Total Disc harg (cfs)	Culv ert Disc harg (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical Dep th (ft)	Ou tle t Dep th (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2 year	11.70 cfs	11.77 cfs	269.1 8	1.23	1.70 4	7- H2 t	- 1.00	0.8 6	1.5 5	7.03	2.25	0.00
5 year	20.10 cfs	2.04 cfs	270.9 7	0.47	3.49 3	4- FF f	- 1.00	0.3 5	2.0 0	8.97	0.32	0.00
10 year	26.90 cfs	2.88 cfs	271.2 4	0.57	3.75 7	4- FF f	- 1.00	0.4 1	2.0 0	9.23	0.46	0.00
25 year	37.00 cfs	4.17 cfs	271.4 9	0.69	4.00 5	4- FF f	- 1.00	0.5 0	2.0 0	9.47	0.66	0.00

50 year	45.50 cfs	5.16 cfs	271.6 6	0.77	4.18 2	4- FF f	- 1.00	0.5 6	2.0 0	9.64	0.82	0.00
100 year	54.70 cfs	6.27 cfs	271.8 2	0.85	4.34 3	4- FF f	- 1.00	0.6 2	2.0 0	9.79	1.00	0.00
200 year	64.90 cfs	7.48 cfs	271.9 8	0.94	4.49 7	4- FF f	- 1.00	0.6 8	2.0 0	9.93	1.19	0.00
500 year	79.60 cfs	9.20 cfs	272.1 9	1.06	4.71 1	4- FF f	- 1.00	0.7 5	2.0 0	10.12	1.46	0.00

Culvert Barrel Data

Culvert Barrel Type: Straight Culvert

Inlet Elevation (invert): 267.48 ft,

Outlet Elevation (invert): 267.48 ft

Culvert Length: 60.00 ft,

Culvert Slope: 0.0000

Site Data - Existing

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 267.48 ft

Outlet Station: 60.00 ft

Outlet Elevation: 267.48 ft

Number of Barrels: 2

Culvert Data Summary - Existing

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Culvert Data: Oct 2025 Proposed

Table 10 - Culvert Summary Table: Oct 2025 Proposed

Disc harg e Nam es	Total Disc harg e (cfs)	Culv ert Disc harg e (cfs)	Head water Eleva tion (ft)	Inle t Con trol Dep th (ft)	Out let Con trol Dep th (ft)	Fl ow Ty pe	Nor mal Dep th (ft)	Crit ical Dep th (ft)	Ou tle t Dep th (ft)	Tail water r Dept h (ft)	Outl et Vel ocit y (ft/ s)	Tail water r Velo city (ft/s)
2 year	11.70 cfs	0.00 cfs	269.1 8	0.00	0.00 0	0- NF	0.00	0.0 0	0.0 0	7.03	0.00	0.00
5 year	20.10 cfs	18.18 cfs	270.9 7	0.73	0.95 5	6- FF t	0.42	0.5 4	1.2 4	8.97	1.10	0.00
10 year	26.90 cfs	24.34 cfs	271.2 4	0.85	1.21 9	6- FF t	0.48	0.6 3	1.5 0	9.23	1.15	0.00
25 year	37.00 cfs	33.12 cfs	271.4 9	1.00	1.46 6	6- FF t	0.56	0.7 4	1.7 4	9.47	1.30	0.00
50 year	45.50 cfs	40.43 cfs	271.6 6	1.11	1.64 4	6- FF t	0.62	0.8 2	1.9 1	9.64	1.42	0.00
100 year	54.70 cfs	48.69 cfs	271.8 2	1.23	1.80 4	6- FF t	0.68	0.9 0	2.0 6	9.79	1.57	0.00
200 year	64.90 cfs	57.93 cfs	271.9 8	1.34	1.95 9	6- FF t	0.74	0.9 8	2.2 0	9.93	1.74	0.00
500 year	79.60 cfs	70.80 cfs	272.1 9	1.50	2.17 3	6- FF t	0.82	1.0 9	2.3 9	10.12	1.95	0.00

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 270.02 ft,

Outlet Elevation (invert): 269.73 ft

Culvert Length: 29.00 ft,

Culvert Slope: 0.0100

Site Data - Oct 2025 Proposed

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 270.02 ft

Outlet Station: 29.00 ft

Outlet Elevation: 269.73 ft

Number of Barrels: 6

Culvert Data Summary - Oct 2025 Proposed

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall (Ke=0.5)

Inlet Depression: None

Tailwater Data for Crossing: North Site Culvert

Table 11 - Downstream Channel Rating Curve (Crossing: North Site Culvert)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)
11.70	269.03	7.03	0.00
20.10	270.97	8.97	0.00
26.90	271.23	9.23	0.00
37.00	271.47	9.47	0.00
45.50	271.64	9.64	0.00
54.70	271.79	9.79	0.00
64.90	271.93	9.93	0.00
79.60	272.12	10.12	0.00

Tailwater Channel Data - North Site Culvert

Tailwater Channel Option: Enter Rating Curve

Channel Invert Elevation: Enter Rating Curve

Roadway Data for Crossing: North Site Culvert

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	0.00	274.80
1	25.00	274.80
2	50.00	274.80
3	100.00	274.80
4	125.00	274.80
5	150.00	274.80

Roadway Surface: Paved

Roadway Top Width: 24.00 ft