HY-8 Culvert Analysis Report

PULASKI - STH 22
STH 32
OCONTO COUNTY

9190-26(27)-00

Note:

1. Headwater elevations at Crossings 6, 7, and 8 were investigated per FDM 13-15-1.1 and discussed with Project Manager Paul Zoellner on 3-21-18. There is no history of flooding and no evidence of erosion of embankment at these locations, and design and maximum flow headwater does not reach roadway subgrade. Further, increased flow rate associated with upsizing these pipes increases the likelihood of flooding downstream, including the property at STA 582+50 RT adjacent to Crossings 6 and 7.

2. The calculated headwater elevation at Crossing 3 exceeds the assumed bottom of subgrade by 2.6". No erosion or other issues were noted during a field review. Therefore, existing pipe size will be maintained, while slope will be increased from 0.09% to 0.30%, which is an improvement from existing conditions.

FDM 13-15-1 Economic Analysis

August 8, 1997

1.1 Introduction

It is desired practice to keep headwater at a minimum. However, economic design in many instances requires that the pipe flow at least full or with some headwater. Full-flow structures or structures designed to flow full under certain conditions are subject to close study. Full-flow culverts that are so designed to increase headwater and reduce the size of the culvert, and therefore reduce the cost, result in a savings for the conduit itself; but many effects that cannot be accurately determined enter into the economic design of culverts with headwater. Each individual location should be analyzed to determine the allowable headwater for a specific design frequency.

The economic design of culverts with headwater for a specific design frequency requires that consideration be given to the following effects:

1. Hydraulic uplift or buoyancy, which is especially significant for large pipes in permeable soils and/or pipes with no headwalls. This danger is augmented when the culvert entrance becomes blocked with debris.
2. Accuracy of the estimate of design discharge. When determining allowable headwater depth, the designer should keep in mind that the estimate of design discharge is an approximation.
3. Exfiltration from pipes due to pressure.
4. Erosion of the embankment due to receding headwater.
5. Danger of transverse seepage through fills, especially in side hill locations.
6. Debris protection.
7. Maintenance.
8. Damage to property.
9. Hazards to life.
10. Public image.
11. Flooding of land affected by headwater. It must be understood that raising headwater over the levels of former flooding is to be avoided.
12. The installation cost includes the pipe, structure excavation, backfill, and other special features, and occasionally maintenance costs that occur on a regular, predictable basis, or specific material features that offer additional resistance to such things as silting, sliding, rupture, or corrosion.

FDM 13-15-5 Design Criteria

August 8, 1997

5.1 Introduction

In this procedure the criteria for the hydraulic design of culverts are discussed under two broad headings--Culvert Location, and Structure Size Selection. When designing culverts, the hydraulic design engineer should employ these criteria along with FDM 13-15-10, "Culvert Hydraulics," of this manual.

A Structure Survey Report containing the site data information should be submitted to the Structures Design Section in the Bureau of Highway Development for the design of all cast-in-place culverts (refer to Chapter 6 of the Bridge Manual for reporting procedures). In addition, each cast-in-place culvert requires a Hydraulic Report as described in Chapter 8 of the Bridge Manual.

5.2 Culvert Location

The culvert location should be selected so the culvert passes the expected discharge with as little interruption as practical. Where water is confined in a channel, the culvert should be located at or near the point where the channel reaches the project and as much in line with the channel as possible. Where other considerations indicate a less desirable location, the roadbed and special ditch must be protected against turbulence generated by the change in direction of flow.

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 14 cfs

Maximum Flow: 17 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing 1

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
802.65	0.00	0.00	0.00	1
803.33	1.70	1.70	0.00	1
803.63	3.40	3.40	0.00	1
803.87	5.10	5.10	0.00	1
804.09	6.80	6.80	0.00	1
804.28	8.50	8.50	0.00	1
804.47	10.20	10.20	0.00	1
804.65	11.90	11.90	0.00	1
804.83	13.60	13.60	0.00	1
804.87	14.00	14.00	0.00	1
805.20	17.00	17.00	0.00	1
808.50	33.48	33.48	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 1

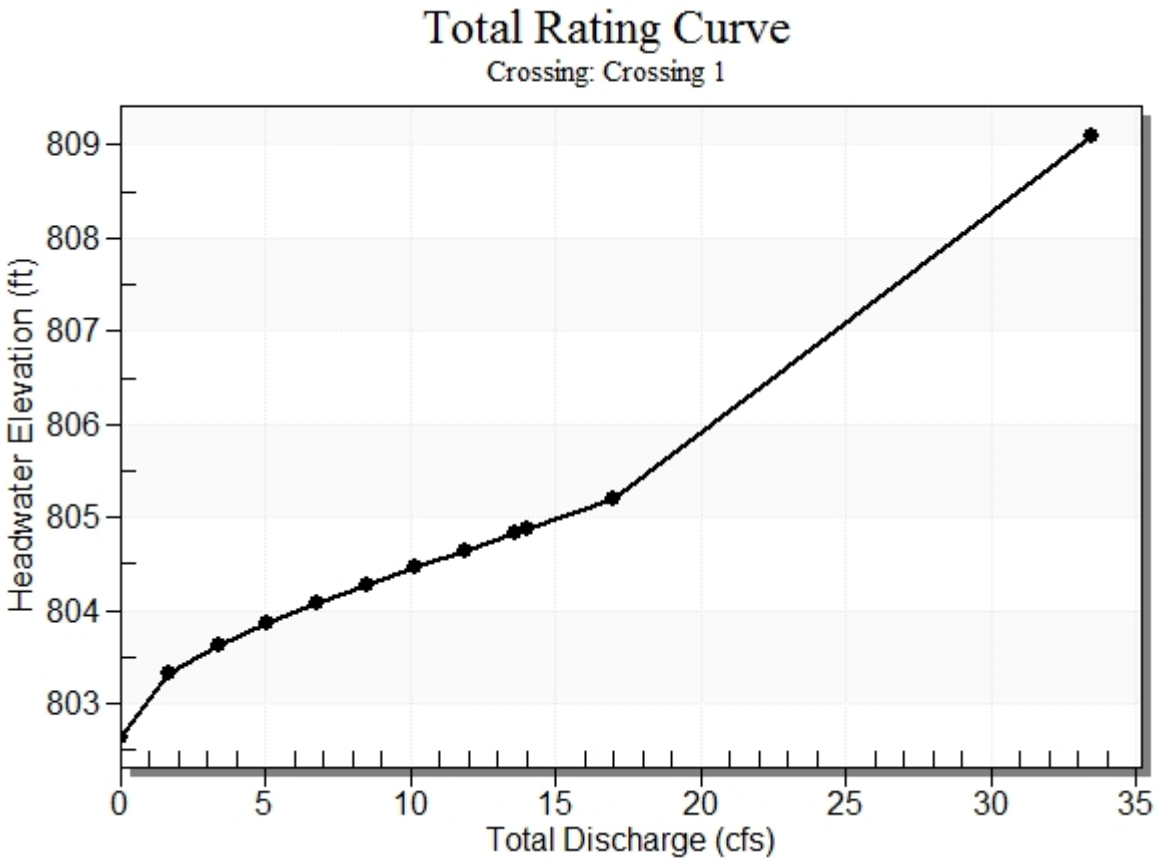

Table 2 - Culvert Summary Table: Outfall 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	802.65	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.70	1.70	803.33	0.613	0.682	2-M2c	0.474	0.449	0.449	0.052	3.224	4.075
3.40	3.40	803.63	0.886	0.983	2-M2c	0.685	0.643	0.643	0.079	3.902	5.361
5.10	5.10	803.87	1.124	1.224	2-M2c	0.855	0.792	0.792	0.101	4.407	6.294
6.80	6.80	804.09	1.344	1.436	2-M2c	1.009	0.925	0.925	0.121	4.787	7.046
8.50	8.50	804.28	1.541	1.632	2-M2c	1.159	1.038	1.038	0.138	5.160	7.687
10.20	10.20	804.47	1.725	1.818	2-M2c	1.310	1.141	1.141	0.154	5.508	8.261
11.90	11.90	804.65	1.906	1.999	2-M2c	1.472	1.234	1.234	0.170	5.850	8.769
13.60	13.60	804.83	2.093	2.179	7-M2c	1.685	1.325	1.325	0.184	6.159	9.242
14.00	14.00	804.87	2.139	2.221	7-M2c	1.761	1.344	1.344	0.187	6.235	9.346
17.00	17.00	805.20	2.508	2.551	7-M2c	2.000	1.484	1.484	0.211	6.799	10.075

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Straight Culvert

Inlet Elevation (invert): 802.65 ft, Outlet Elevation (invert): 802.49 ft

Culvert Length: 54.00 ft, Culvert Slope: 0.0030

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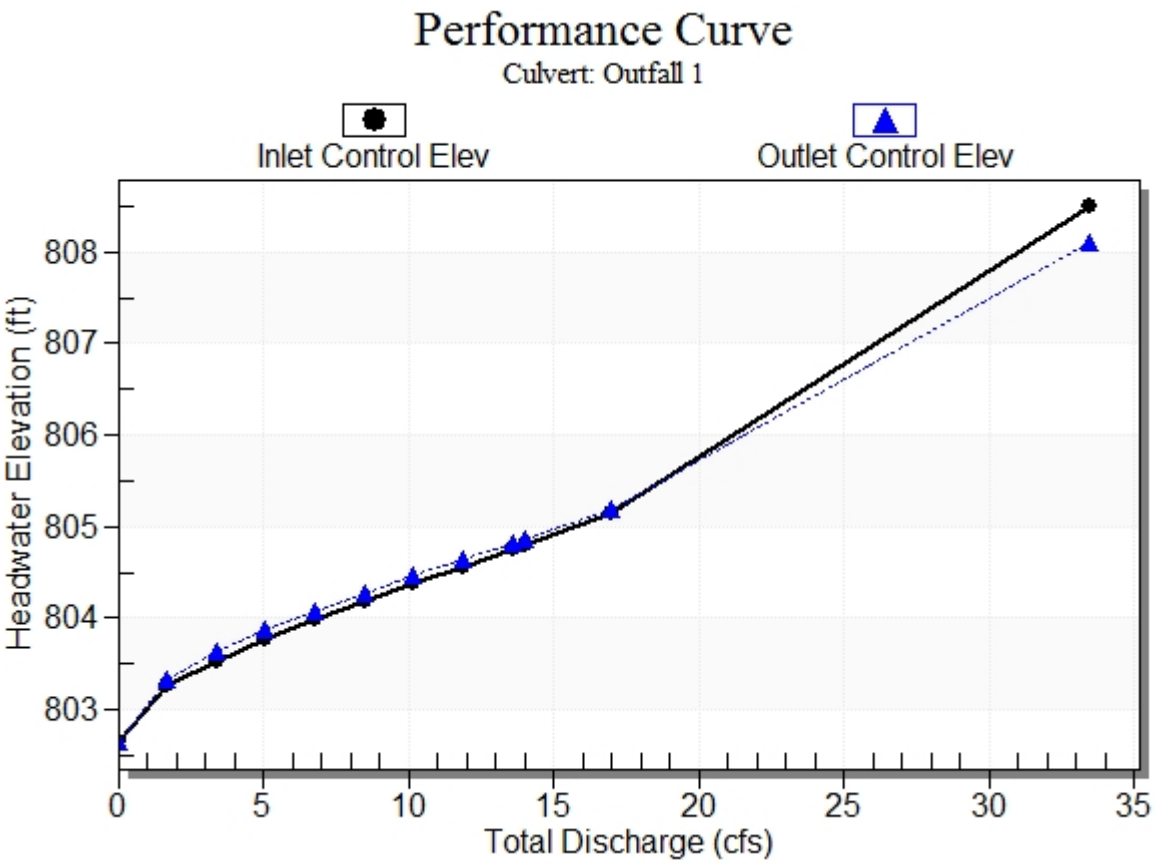
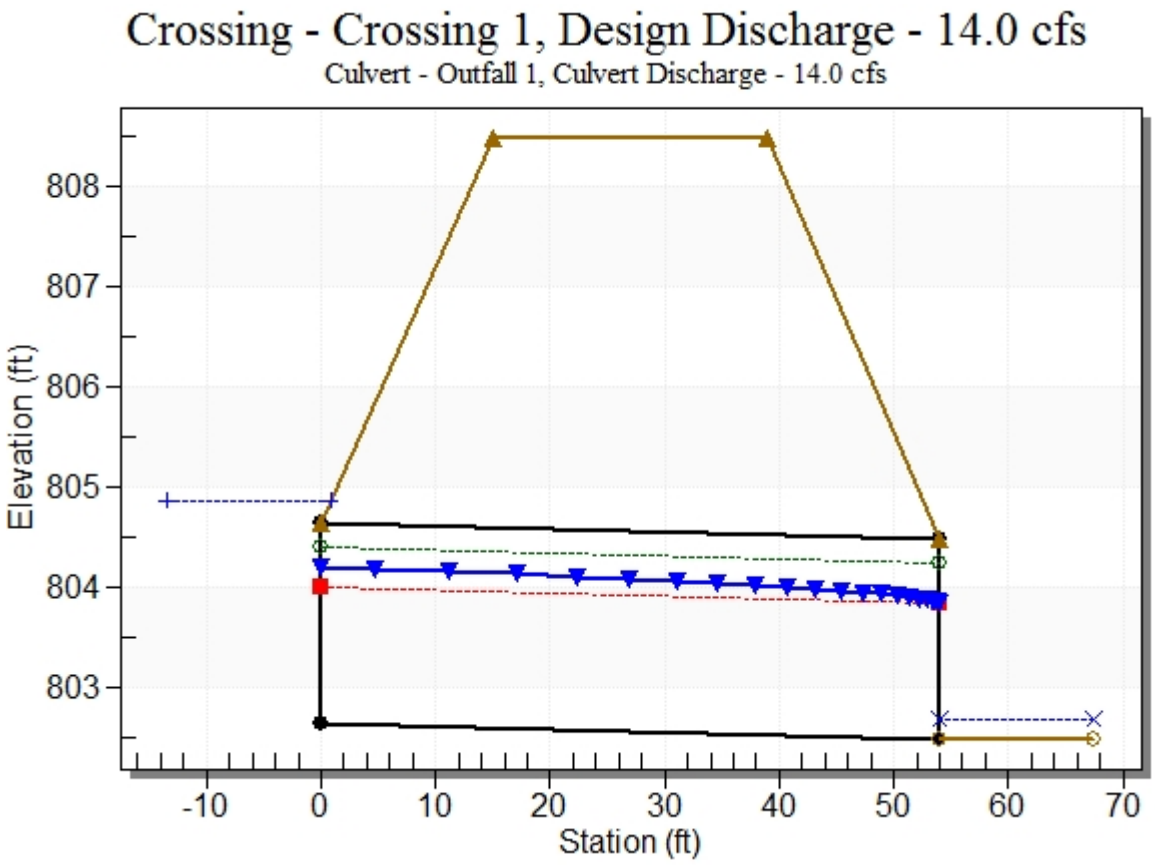
Culvert Performance Curve Plot: Outfall 1



Water Surface Profile Plot for Culvert: Outfall 1



Site Data - Outfall 1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 802.65 ft

Outlet Station: 54.00 ft

Outlet Elevation: 802.49 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 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

Table 3 - Downstream Channel Rating Curve (Crossing: Crossing 1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	802.49	0.00	0.00	0.00	0.00
1.70	802.54	0.05	4.08	1.07	3.14
3.40	802.57	0.08	5.36	1.63	3.36
5.10	802.59	0.10	6.29	2.09	3.48
6.80	802.61	0.12	7.05	2.48	3.58
8.50	802.63	0.14	7.69	2.85	3.64
10.20	802.64	0.15	8.26	3.18	3.71
11.90	802.66	0.17	8.77	3.49	3.75
13.60	802.67	0.18	9.24	3.79	3.80
14.00	802.68	0.19	9.35	3.86	3.81
17.00	802.70	0.21	10.07	4.34	3.87

Tailwater Channel Data - Crossing 1

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 802.49 ft

Roadway Data for Crossing: Crossing 1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 54.00 ft

Crest Elevation: 808.50 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 20 cfs

Maximum Flow: 26 cfs

Table 4 - Summary of Culvert Flows at Crossing: Crossing 2

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
801.53	0.00	0.00	0.00	1
802.26	2.60	2.60	0.00	1
802.59	5.20	5.20	0.00	1
802.89	7.80	7.80	0.00	1
803.15	10.40	10.40	0.00	1
803.39	13.00	13.00	0.00	1
803.62	15.60	15.60	0.00	1
803.86	18.20	18.20	0.00	1
804.04	20.00	20.00	0.00	1
804.40	23.40	23.40	0.00	1
804.71	26.00	26.00	0.00	1
806.00	34.56	34.56	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 2

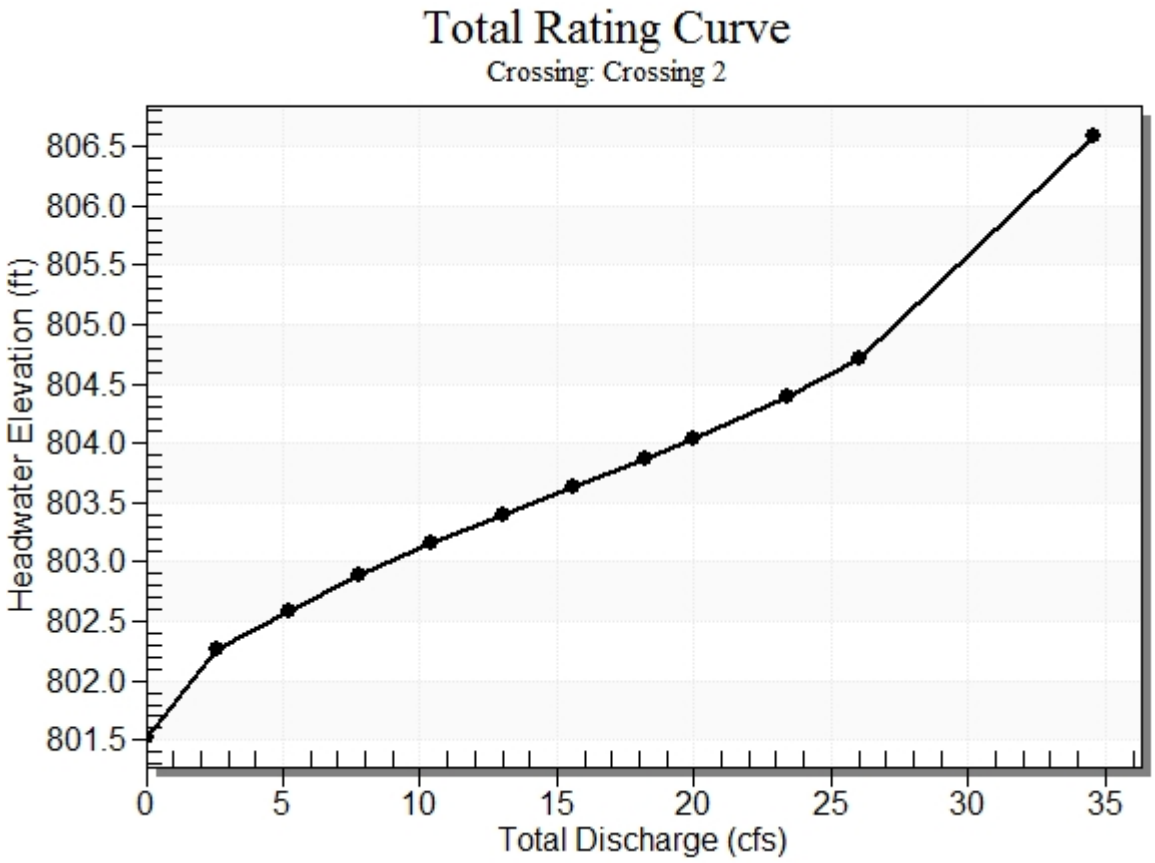


Table 5 - Culvert Summary Table: Outfall 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	801.53	0.000	0.000	0-NF	0.000	0.000	0.400	0.000	0.000	0.000
2.60	2.60	802.26	0.730	0.0*	1-S2n	0.359	0.541	0.373	0.067	5.940	4.818
5.20	5.20	802.59	1.056	0.0*	1-S2n	0.511	0.771	0.534	0.103	7.133	6.339
7.80	7.80	802.89	1.356	0.135	1-S2n	0.636	0.956	0.666	0.131	7.901	7.434
10.40	10.40	803.15	1.621	0.385	1-S2n	0.736	1.114	0.781	0.156	8.460	8.325
13.00	13.00	803.39	1.862	0.637	1-S2n	0.833	1.247	0.888	0.179	8.898	9.077
15.60	15.60	803.62	2.095	0.906	1-S2n	0.918	1.372	0.988	0.200	9.278	9.747
18.20	18.20	803.86	2.333	1.194	5-S2n	1.003	1.488	1.084	0.220	9.602	10.350
20.00	20.00	804.04	2.508	1.401	5-S2n	1.059	1.560	1.149	0.233	9.796	10.731
23.40	23.40	804.40	2.870	2.098	5-S2n	1.160	1.691	1.265	0.256	10.167	11.405
26.00	26.00	804.71	3.183	2.393	5-S2n	1.238	1.778	1.350	0.274	10.448	11.875

* Full Flow Headwater elevation is below inlet invert.

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Straight Culvert

Inlet Elevation (invert): 801.53 ft, Outlet Elevation (invert): 800.59 ft

Culvert Length: 54.01 ft, Culvert Slope: 0.0174

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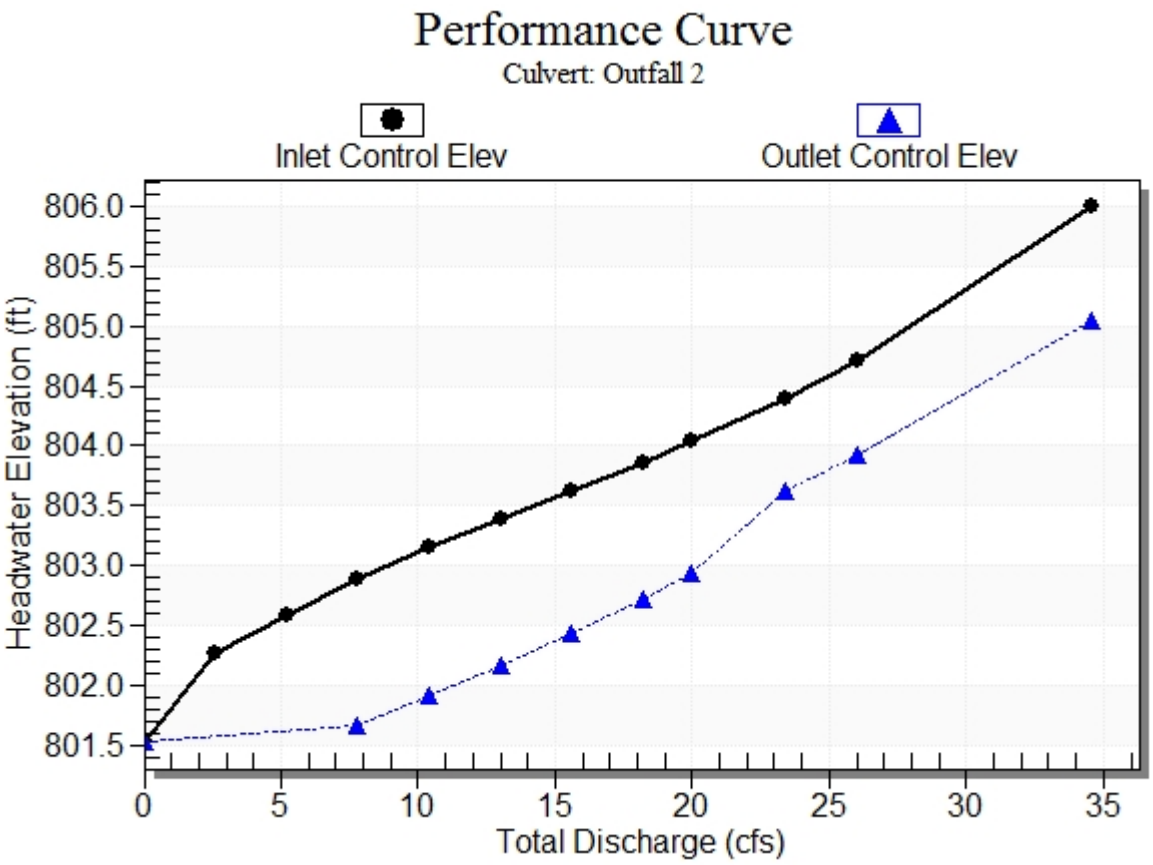
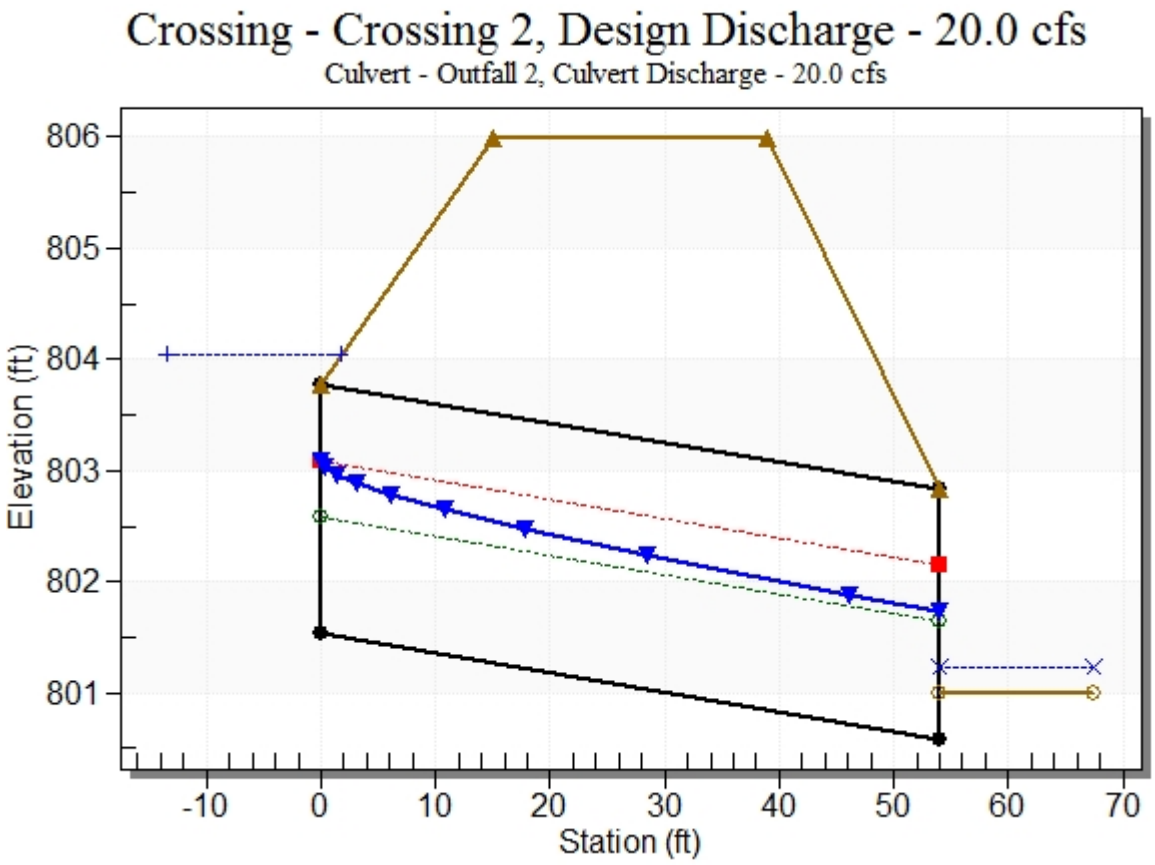
Culvert Performance Curve Plot: Outfall 2



Water Surface Profile Plot for Culvert: Outfall 2



Site Data - Outfall 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 801.53 ft

Outlet Station: 54.00 ft

Outlet Elevation: 800.59 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 2

Barrel Shape: Circular

Barrel Diameter: 2.25 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

Table 6 - Downstream Channel Rating Curve (Crossing: Crossing 2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	800.99	0.00	0.00	0.00	0.00
2.60	801.06	0.07	4.82	1.39	3.27
5.20	801.09	0.10	6.34	2.11	3.49
7.80	801.12	0.13	7.43	2.70	3.62
10.40	801.15	0.16	8.33	3.22	3.71
13.00	801.17	0.18	9.08	3.69	3.78
15.60	801.19	0.20	9.75	4.12	3.84
18.20	801.21	0.22	10.35	4.53	3.89
20.00	801.22	0.23	10.73	4.80	3.92
23.40	801.25	0.26	11.40	5.28	3.97
26.00	801.26	0.27	11.88	5.64	4.00

Tailwater Channel Data - Crossing 2

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 800.99 ft

Roadway Data for Crossing: Crossing 2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 50.00 ft

Crest Elevation: 806.00 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 15 cfs

Maximum Flow: 19 cfs

Table 7 - Summary of Culvert Flows at Crossing: Crossing 3

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
798.50	0.00	0.00	0.00	1
799.18	1.90	1.90	0.00	1
799.47	3.80	3.80	0.00	1
799.71	5.70	5.70	0.00	1
799.91	7.60	7.60	0.00	1
800.09	9.50	9.50	0.00	1
800.26	11.40	11.40	0.00	1
800.42	13.30	13.30	0.00	1
800.56	15.00	15.00	0.00	1
800.72	17.10	17.10	0.00	1
800.86	19.00	19.00	0.00	1
801.75	30.69	30.69	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 3

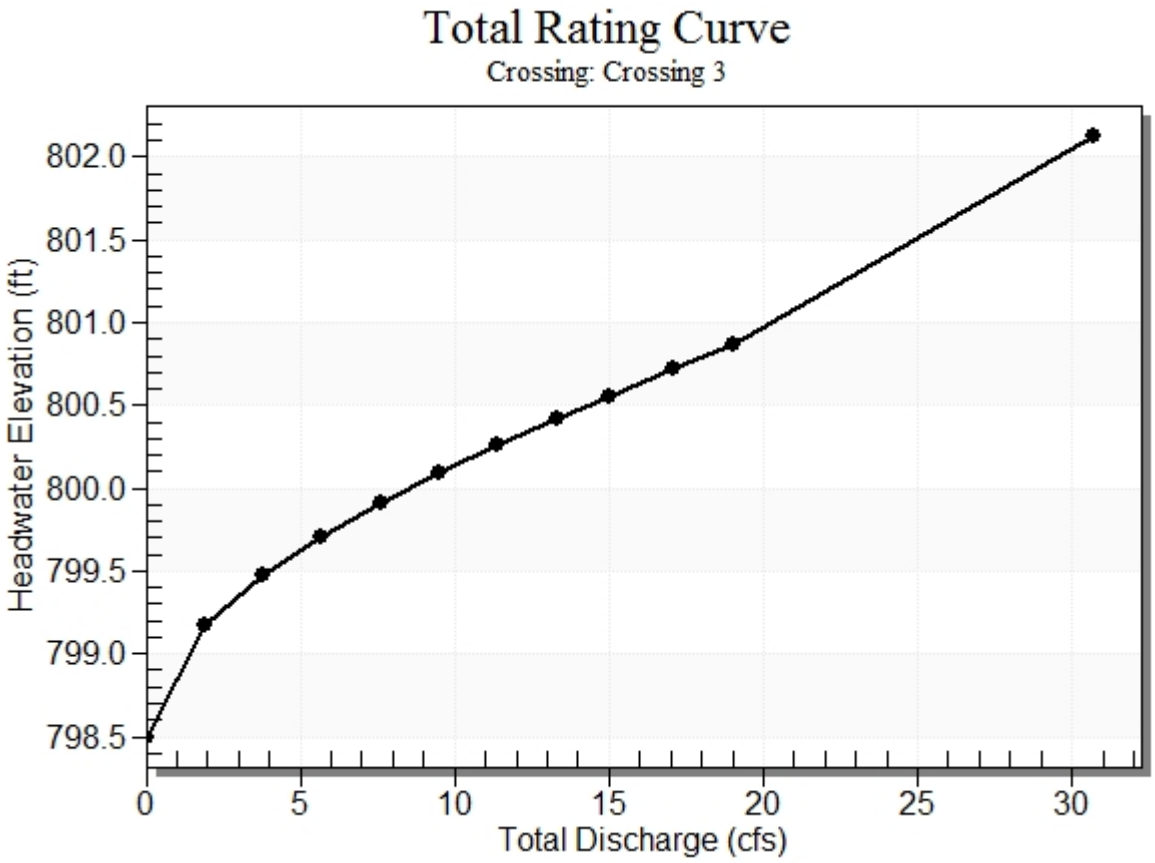


Table 8 - Culvert Summary Table: Outfall 3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	798.50	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
1.90	1.90	799.18	0.610	0.676	2-M2c	0.468	0.444	0.444	0.056	3.223	4.260
3.80	3.80	799.47	0.874	0.973	2-M2c	0.662	0.638	0.638	0.085	3.846	5.605
5.70	5.70	799.71	1.083	1.208	2-M2c	0.814	0.786	0.786	0.108	4.314	6.569
7.60	7.60	799.91	1.269	1.409	2-M2c	0.953	0.912	0.912	0.129	4.692	7.363
9.50	9.50	800.09	1.462	1.591	2-M2c	1.077	1.025	1.025	0.148	5.013	8.036
11.40	11.40	800.26	1.638	1.759	2-M2c	1.196	1.131	1.131	0.165	5.284	8.626
13.30	13.30	800.42	1.800	1.918	2-M2c	1.311	1.226	1.226	0.181	5.552	9.161
15.00	15.00	800.56	1.938	2.055	2-M2c	1.413	1.304	1.304	0.195	5.790	9.601
17.10	17.10	800.72	2.101	2.219	2-M2c	1.538	1.393	1.393	0.212	6.083	10.103
19.00	19.00	800.86	2.246	2.363	2-M2c	1.655	1.474	1.474	0.226	6.311	10.522

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Straight Culvert

Inlet Elevation (invert): 798.50 ft, Outlet Elevation (invert): 798.33 ft

Culvert Length: 56.00 ft, Culvert Slope: 0.0030

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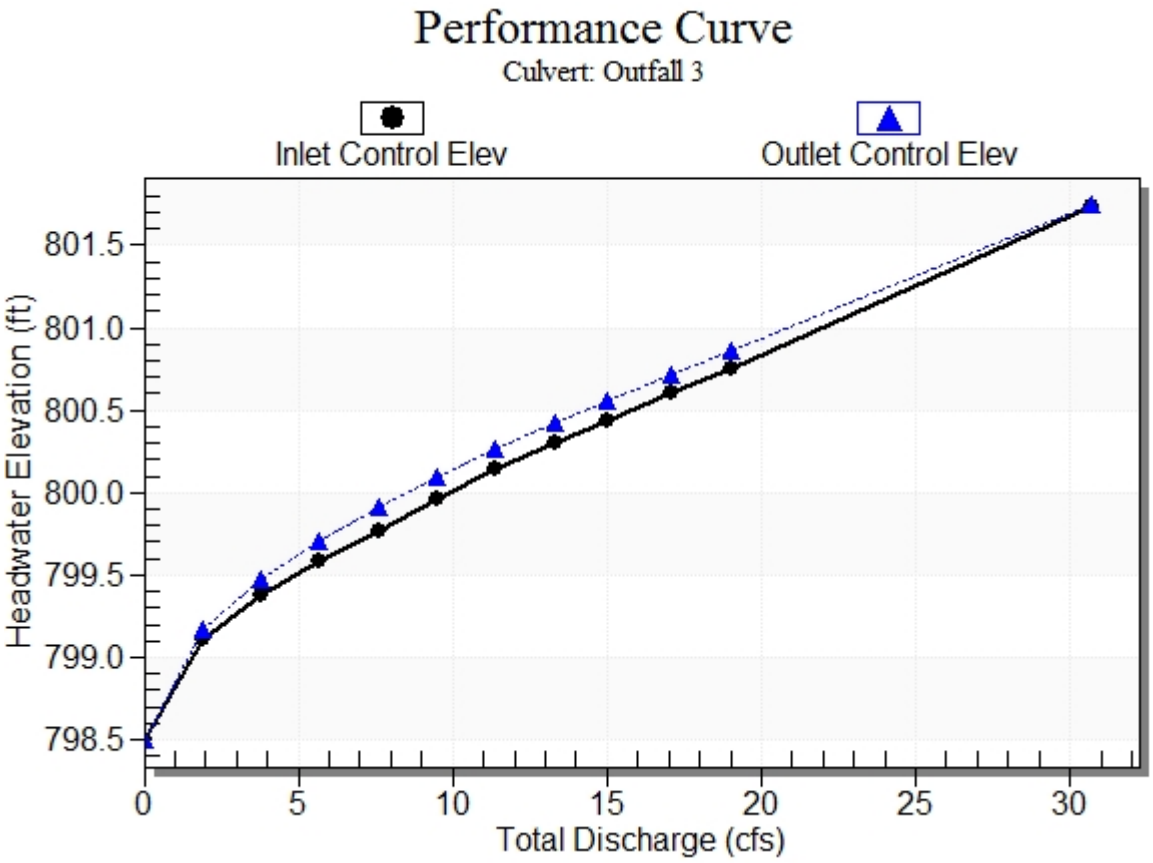
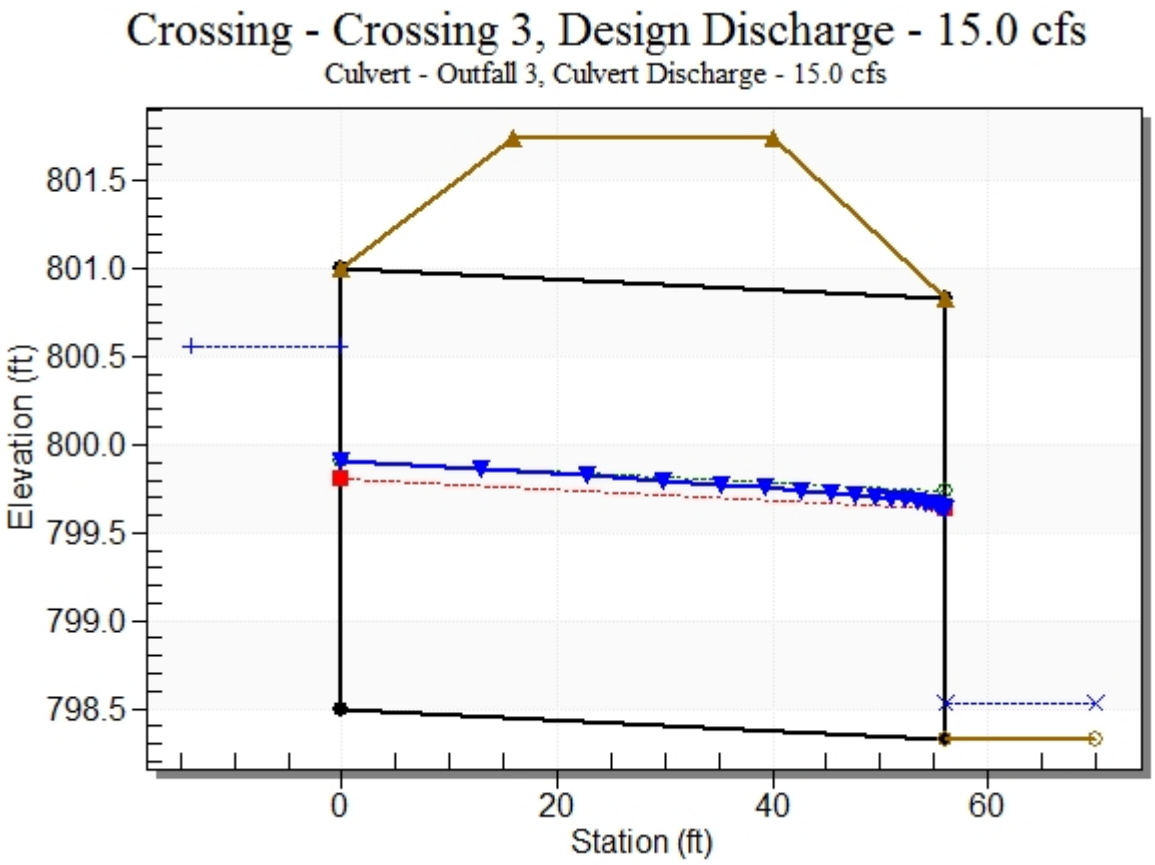
Culvert Performance Curve Plot: Outfall 3



Water Surface Profile Plot for Culvert: Outfall 3



Site Data - Outfall 3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 798.50 ft

Outlet Station: 56.00 ft

Outlet Elevation: 798.33 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 3

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

Inlet Depression: NONE

Table 9 - Downstream Channel Rating Curve (Crossing: Crossing 3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	798.33	0.00	0.00	0.00	0.00
1.90	798.39	0.06	4.26	1.15	3.18
3.80	798.41	0.08	5.61	1.75	3.39
5.70	798.44	0.11	6.57	2.23	3.52
7.60	798.46	0.13	7.36	2.66	3.61
9.50	798.48	0.15	8.04	3.04	3.68
11.40	798.50	0.17	8.63	3.40	3.74
13.30	798.51	0.18	9.16	3.74	3.79
15.00	798.53	0.20	9.60	4.02	3.83
17.10	798.54	0.21	10.10	4.36	3.87
19.00	798.56	0.23	10.52	4.65	3.90

Tailwater Channel Data - Crossing 3

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 798.33 ft

Roadway Data for Crossing: Crossing 3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 56.00 ft

Crest Elevation: 801.75 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 21 cfs

Maximum Flow: 26 cfs

Table 10 - Summary of Culvert Flows at Crossing: Crossing 4

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 4 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
797.86	0.00	0.00	0.00	1
798.66	2.60	2.60	0.00	1
799.01	5.20	5.20	0.00	1
799.29	7.80	7.80	0.00	1
799.53	10.40	10.40	0.00	1
799.75	13.00	13.00	0.00	1
799.96	15.60	15.60	0.00	1
800.16	18.20	18.20	0.00	1
800.36	20.80	20.80	0.00	1
800.37	21.00	21.00	0.00	1
800.75	26.00	26.00	0.00	1
802.00	38.28	38.28	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 4

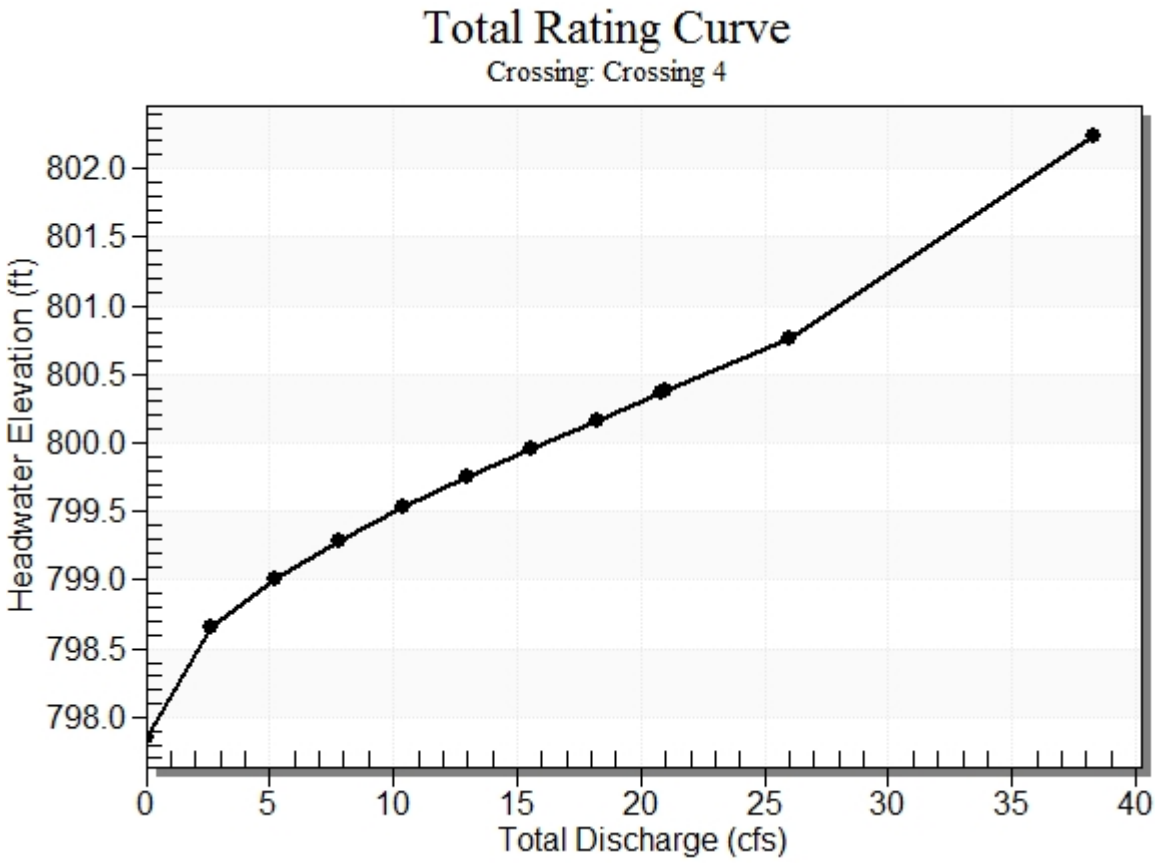


Table 11 - Culvert Summary Table: Outfall 4

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	797.86	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
2.60	2.60	798.66	0.715	0.799	2-M2c	0.540	0.524	0.524	0.067	3.484	4.818
5.20	5.20	799.01	1.032	1.150	2-M2c	0.776	0.749	0.749	0.103	4.208	6.339
7.80	7.80	799.29	1.290	1.428	2-M2c	0.967	0.925	0.925	0.131	4.726	7.434
10.40	10.40	799.53	1.547	1.671	2-M2c	1.138	1.077	1.077	0.156	5.142	8.325
13.00	13.00	799.75	1.775	1.893	2-M2c	1.295	1.212	1.212	0.179	5.510	9.077
15.60	15.60	799.96	1.985	2.101	2-M2c	1.451	1.331	1.331	0.200	5.874	9.747
18.20	18.20	800.16	2.185	2.302	2-M2c	1.607	1.442	1.442	0.220	6.208	10.350
20.80	20.80	800.36	2.384	2.498	2-M2c	1.773	1.547	1.547	0.239	6.522	10.899
21.00	21.00	800.37	2.399	2.513	7-M2c	1.786	1.554	1.554	0.240	6.546	10.936
26.00	26.00	800.75	2.802	2.894	7-M2c	2.249	1.733	1.733	0.274	7.161	11.875

****

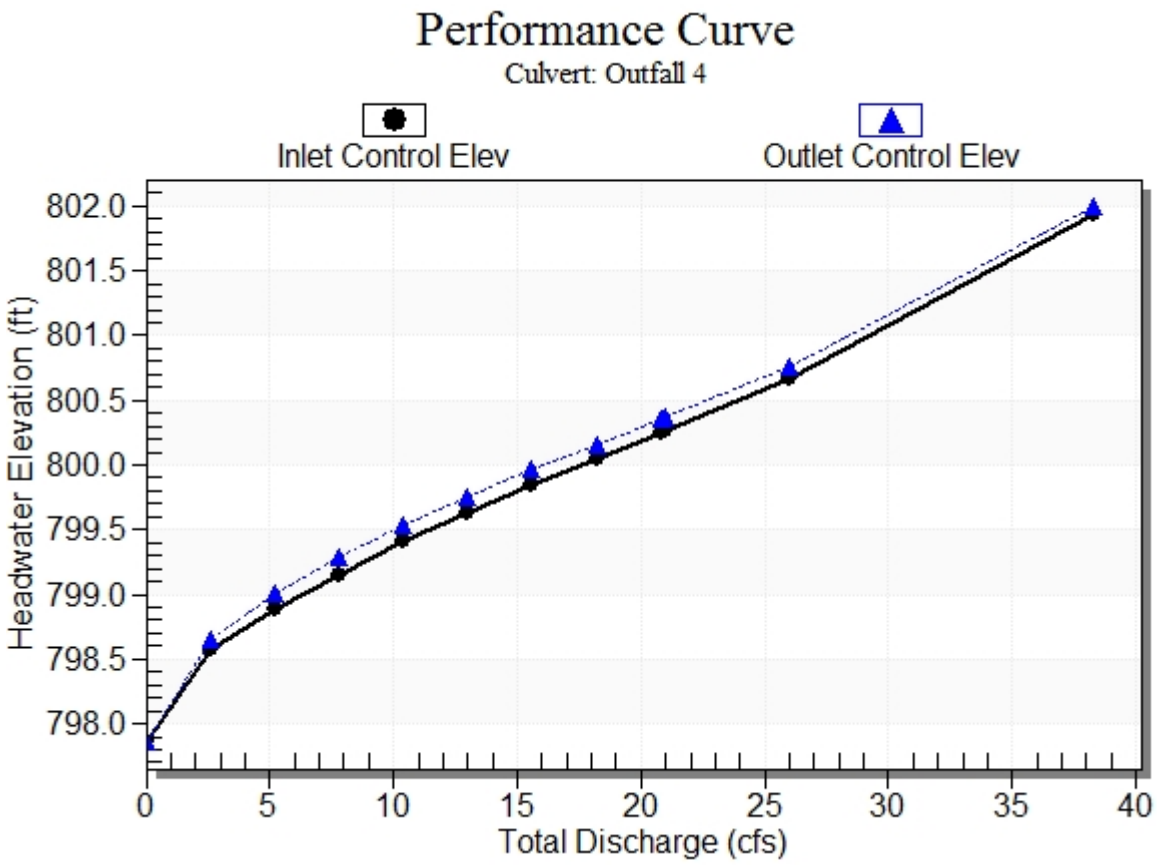
Straight Culvert

Inlet Elevation (invert): 797.86 ft, Outlet Elevation (invert): 797.57 ft

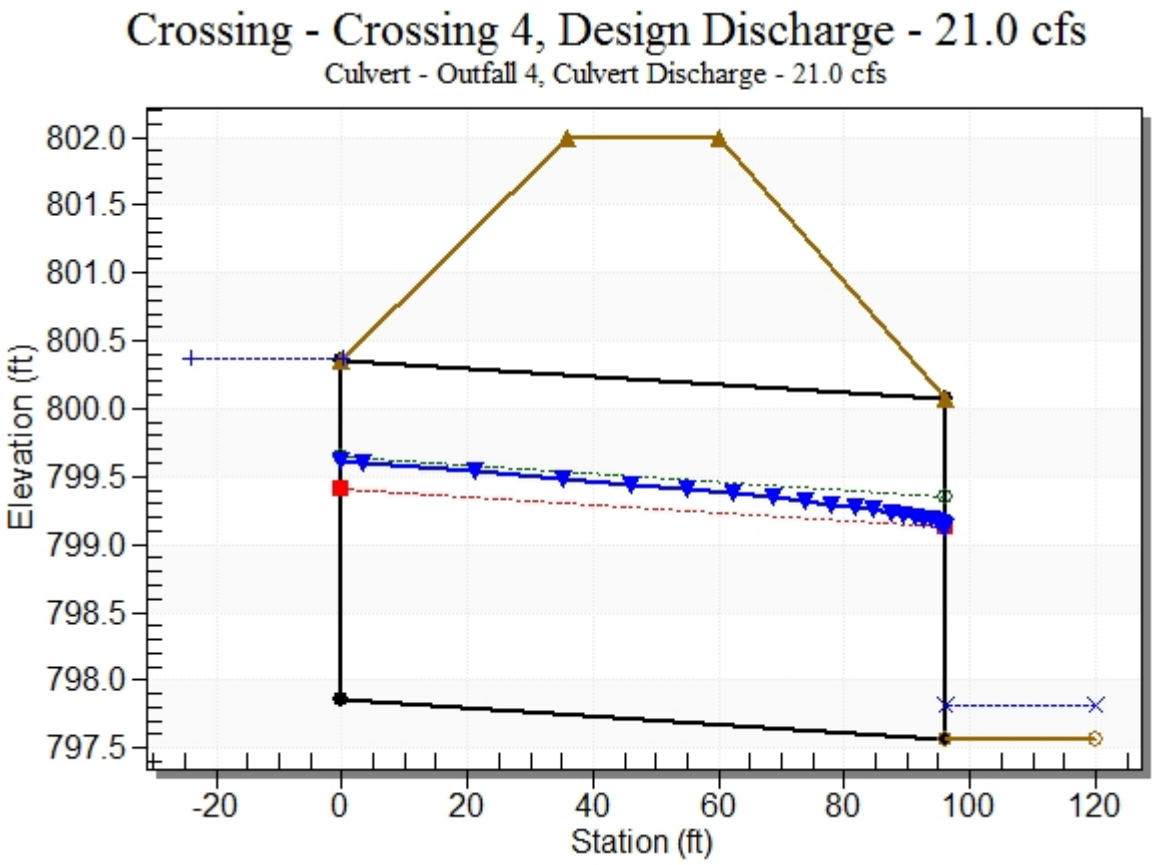
Culvert Length: 96.00 ft, Culvert Slope: 0.0030

****

Culvert Performance Curve Plot: Outfall 4



Water Surface Profile Plot for Culvert: Outfall 4



Site Data - Outfall 4

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 797.86 ft

Outlet Station: 96.00 ft

Outlet Elevation: 797.57 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 4

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

Inlet Depression: NONE

Table 12 - Downstream Channel Rating Curve (Crossing: Crossing 4)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	797.57	0.00	0.00	0.00	0.00
2.60	797.64	0.07	4.82	1.39	3.27
5.20	797.67	0.10	6.34	2.11	3.49
7.80	797.70	0.13	7.43	2.70	3.62
10.40	797.73	0.16	8.33	3.22	3.71
13.00	797.75	0.18	9.08	3.69	3.78
15.60	797.77	0.20	9.75	4.12	3.84
18.20	797.79	0.22	10.35	4.53	3.89
20.80	797.81	0.24	10.90	4.91	3.93
21.00	797.81	0.24	10.94	4.94	3.93
26.00	797.84	0.27	11.88	5.64	4.00

Tailwater Channel Data - Crossing 4

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 797.57 ft

Roadway Data for Crossing: Crossing 4

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 96.00 ft

Crest Elevation: 802.00 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 42 cfs

Maximum Flow: 52 cfs

Table 13 - Summary of Culvert Flows at Crossing: Crossing 5

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 5 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
788.76	0.00	0.00	0.00	1
789.73	5.20	5.20	0.00	1
790.16	10.40	10.40	0.00	1
790.55	15.60	15.60	0.00	1
790.90	20.80	20.80	0.00	1
791.22	26.00	26.00	0.00	1
791.52	31.20	31.20	0.00	1
791.83	36.40	36.40	0.00	1
792.15	41.60	41.60	0.00	1
792.18	42.00	42.00	0.00	1
792.91	52.00	52.00	0.00	1
795.00	73.26	73.26	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 5

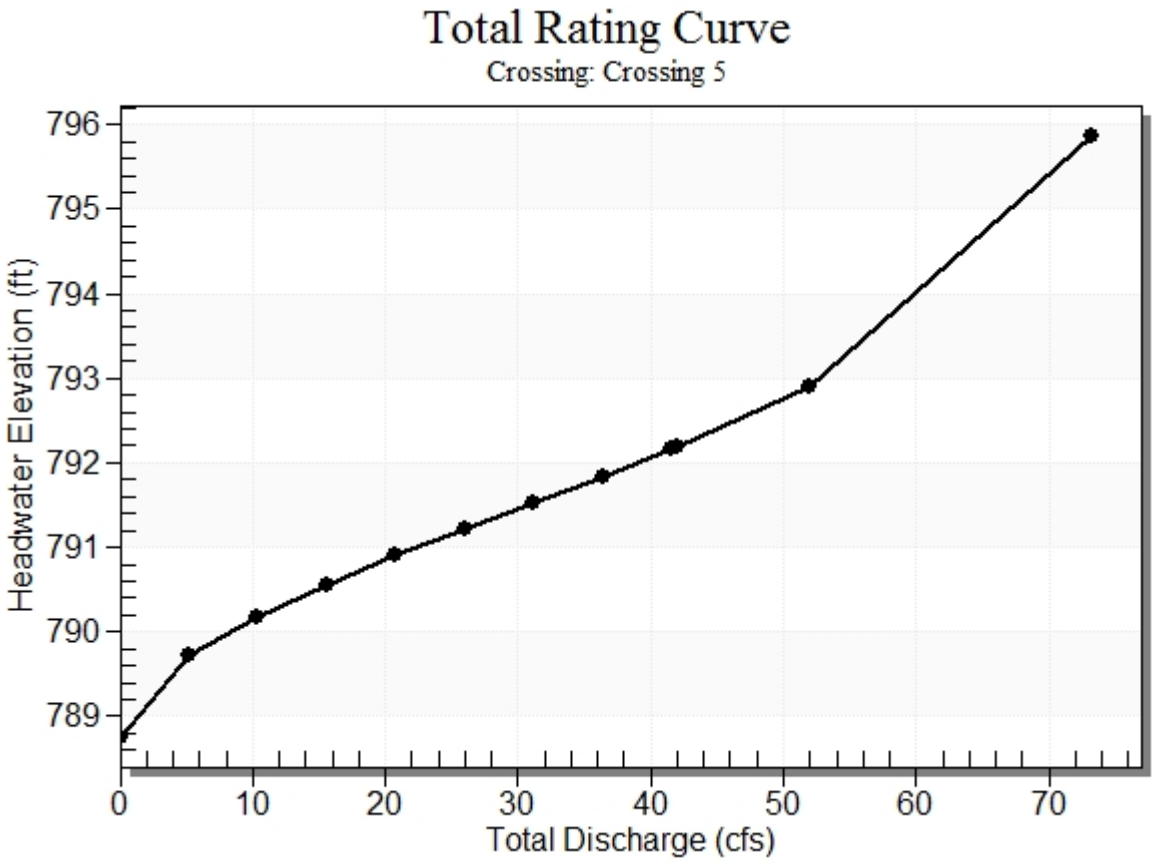


Table 14 - Culvert Summary Table: Outfall 5

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	788.76	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
5.20	5.20	789.73	0.967	0.227	1-S2n	0.569	0.711	0.579	0.103	5.499	6.339
10.40	10.40	790.16	1.400	0.581	1-S2n	0.810	1.018	0.827	0.156	6.563	8.325
15.60	15.60	790.55	1.792	0.900	1-S2n	0.994	1.257	1.029	0.200	7.256	9.747
20.80	20.80	790.90	2.141	1.218	1-S2n	1.163	1.465	1.207	0.239	7.807	10.899
26.00	26.00	791.22	2.456	1.536	1-S2n	1.317	1.641	1.370	0.274	8.267	11.875
31.20	31.20	791.52	2.759	1.877	1-S2n	1.463	1.809	1.524	0.306	8.653	12.736
36.40	36.40	791.83	3.067	2.232	5-S2n	1.604	1.958	1.671	0.337	8.998	13.507
41.60	41.60	792.15	3.393	2.609	5-S2n	1.745	2.098	1.813	0.366	9.323	14.209
42.00	42.00	792.18	3.420	2.639	5-S2n	1.756	2.109	1.823	0.368	9.346	14.257
52.00	52.00	792.91	4.146	3.751	5-S2n	2.033	2.342	2.092	0.421	9.894	15.455

****

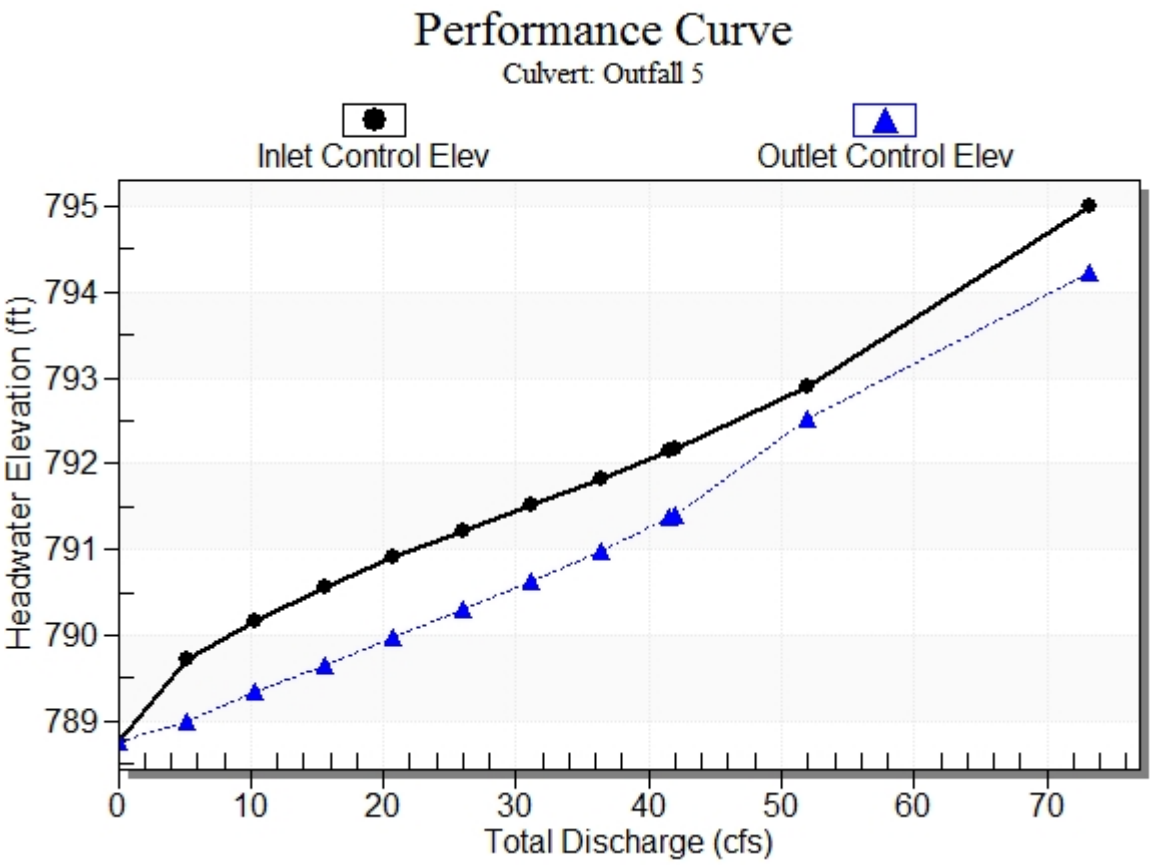
Straight Culvert

Inlet Elevation (invert): 788.76 ft, Outlet Elevation (invert): 788.26 ft

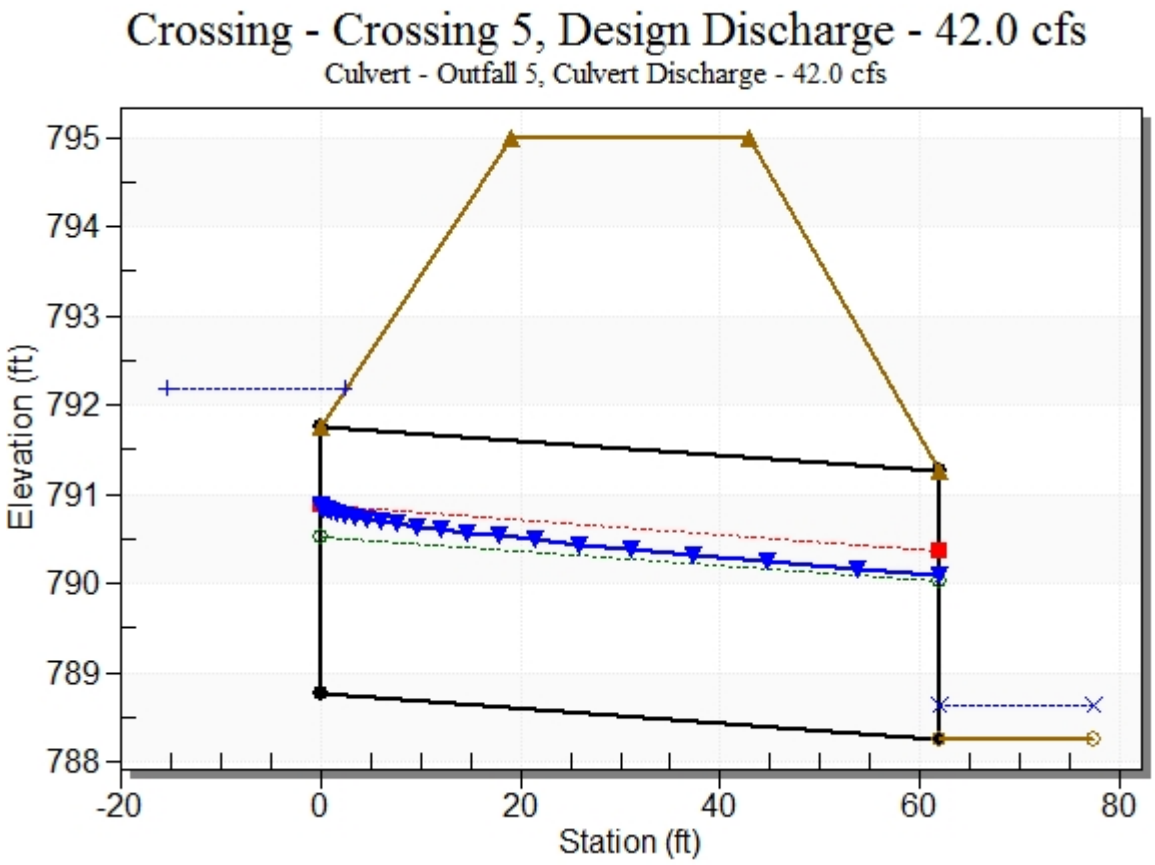
Culvert Length: 62.00 ft, Culvert Slope: 0.0081

****

Culvert Performance Curve Plot: Outfall 5



Water Surface Profile Plot for Culvert: Outfall 5



Site Data - Outfall 5

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 788.76 ft

Outlet Station: 62.00 ft

Outlet Elevation: 788.26 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 5

Barrel Shape: Circular

Barrel Diameter: 3.00 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

Table 15 - Downstream Channel Rating Curve (Crossing: Crossing 5)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	788.26	0.00	0.00	0.00	0.00
5.20	788.36	0.10	6.34	2.11	3.49
10.40	788.42	0.16	8.33	3.22	3.71
15.60	788.46	0.20	9.75	4.12	3.84
20.80	788.50	0.24	10.90	4.91	3.93
26.00	788.53	0.27	11.88	5.64	4.00
31.20	788.57	0.31	12.74	6.31	4.06
36.40	788.60	0.34	13.51	6.94	4.10
41.60	788.63	0.37	14.21	7.54	4.14
42.00	788.63	0.37	14.26	7.58	4.14
52.00	788.68	0.42	15.45	8.66	4.20

Tailwater Channel Data - Crossing 5

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 788.26 ft

Roadway Data for Crossing: Crossing 5

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 62.00 ft

Crest Elevation: 795.00 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 25 cfs

Maximum Flow: 31 cfs

Table 16 - Summary of Culvert Flows at Crossing: Crossing 6

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
789.62	0.00	0.00	0.00	1
790.45	3.10	3.10	0.00	1
790.88	6.20	6.20	0.00	1
791.24	9.30	9.30	0.00	1
791.57	12.40	12.40	0.00	1
791.92	15.50	15.50	0.00	1
792.34	18.60	18.60	0.00	1
792.83	21.70	21.70	0.00	1
793.40	24.80	24.80	0.00	1
793.44	25.00	25.00	0.00	1
794.81	31.00	31.00	0.00	1
798.25	42.10	42.10	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 6

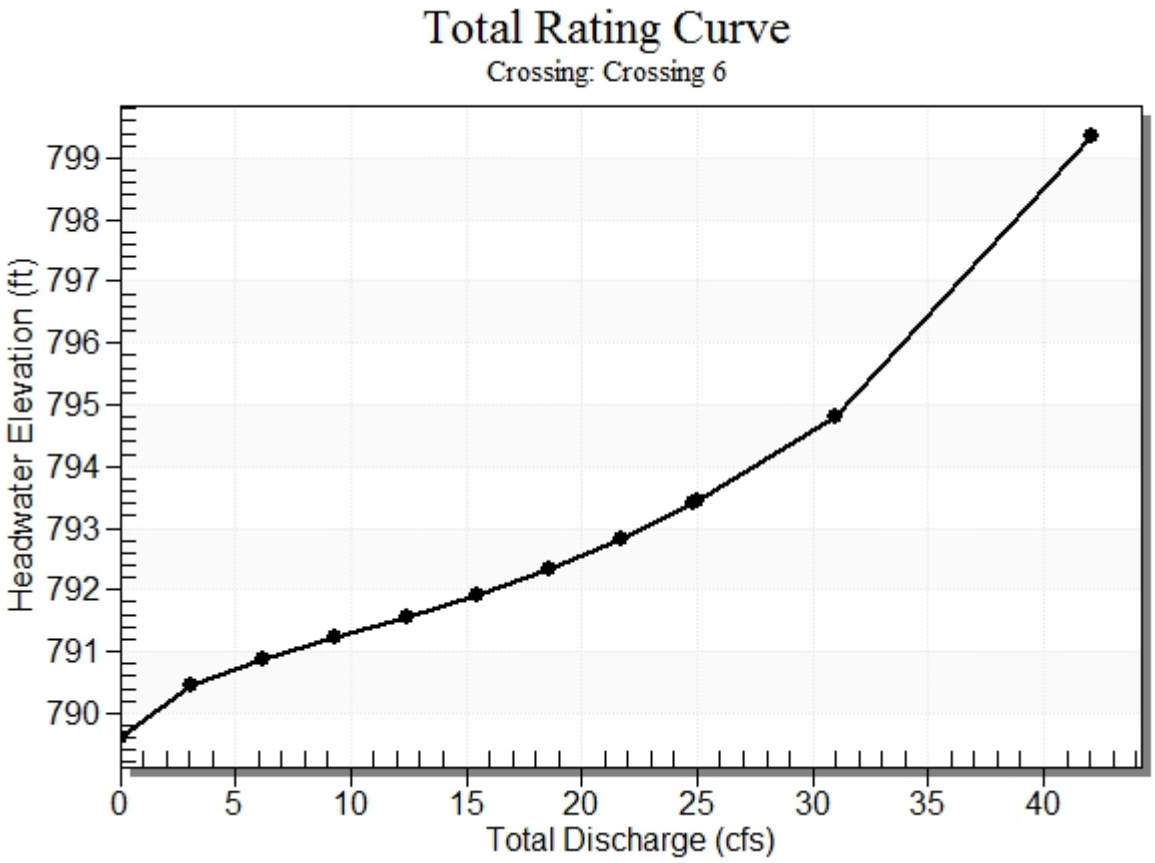


Table 17 - Culvert Summary Table: Outfall 6

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	789.62	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
3.10	3.10	790.45	0.835	0.0*	1-S2n	0.425	0.612	0.437	0.075	6.048	5.172
6.20	6.20	790.88	1.258	0.0*	1-S2n	0.610	0.880	0.619	0.114	7.464	6.795
9.30	9.30	791.24	1.616	0.0*	1-S2n	0.760	1.086	0.772	0.146	8.339	7.965
12.40	12.40	791.57	1.948	0.321	1-S2n	0.892	1.264	0.910	0.174	8.912	8.912
15.50	15.50	791.92	2.304	0.825	5-S2n	1.015	1.415	1.037	0.199	9.421	9.724
18.60	18.60	792.34	2.718	1.617	5-S2n	1.136	1.551	1.163	0.223	9.819	10.437
21.70	21.70	792.83	3.207	2.184	5-S2n	1.256	1.664	1.286	0.245	10.161	11.073
24.80	24.80	793.40	3.782	2.819	5-S2n	1.383	1.756	1.413	0.266	10.460	11.661
25.00	25.00	793.44	3.823	2.862	5-S2n	1.392	1.761	1.422	0.267	10.477	11.697
31.00	31.00	794.81	5.187	4.290	5-S2n	1.710	1.875	1.716	0.305	10.841	12.703

* Full Flow Headwater elevation is below inlet invert.

****

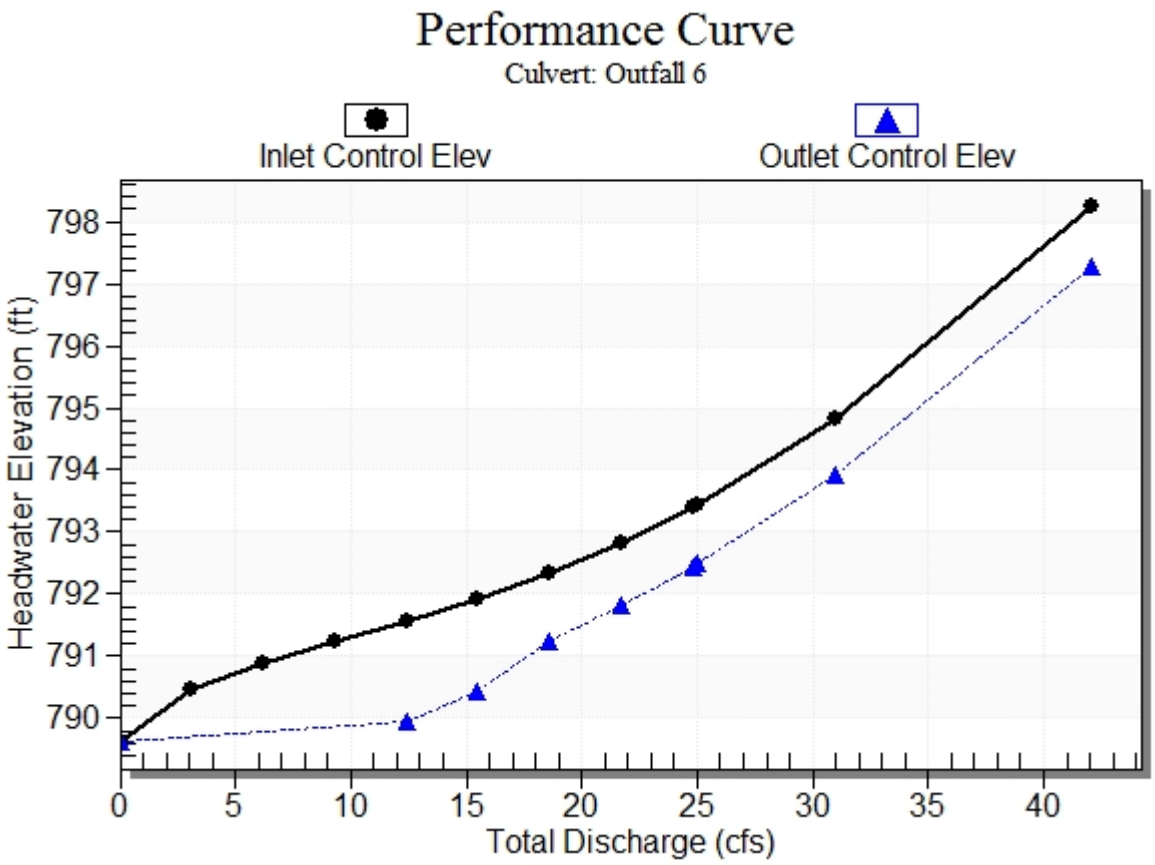
Straight Culvert

Inlet Elevation (invert): 789.62 ft, Outlet Elevation (invert): 788.05 ft

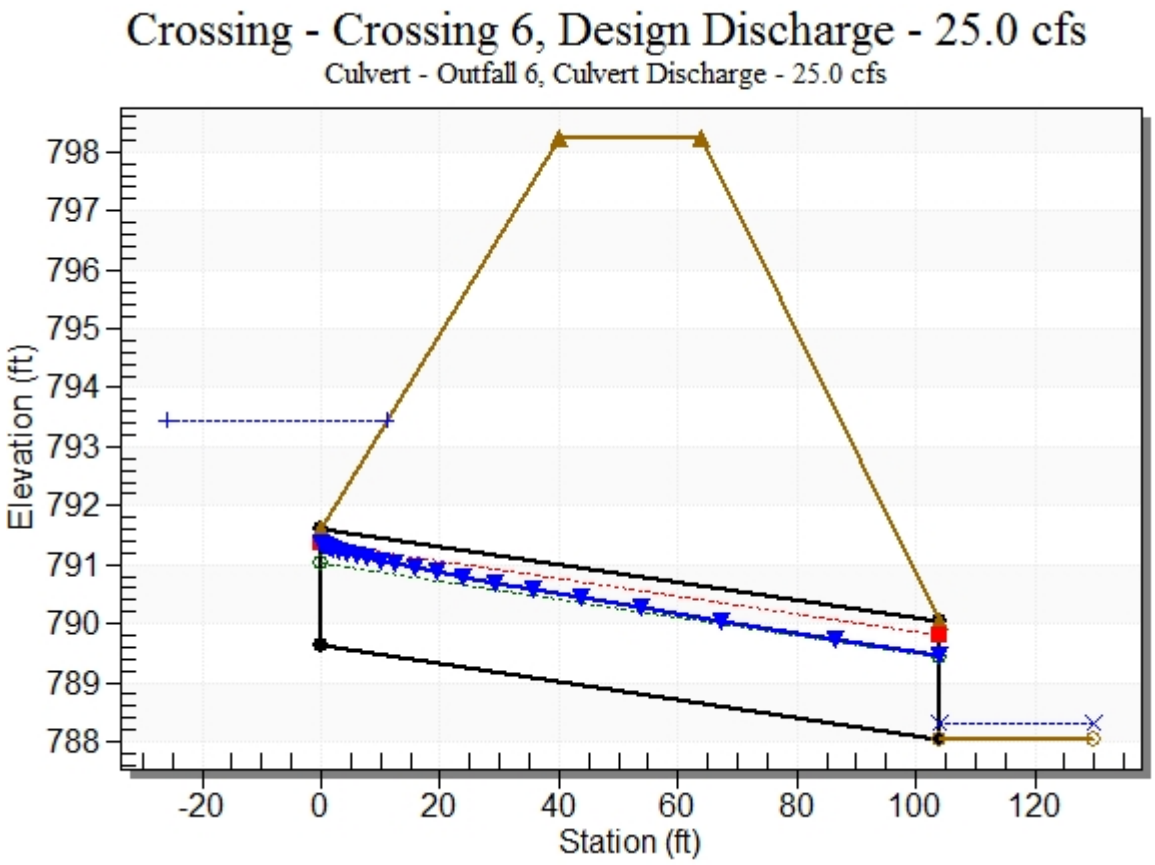
Culvert Length: 104.01 ft, Culvert Slope: 0.0151

****

Culvert Performance Curve Plot: Outfall 6



Water Surface Profile Plot for Culvert: Outfall 6



Site Data - Outfall 6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 789.62 ft

Outlet Station: 104.00 ft

Outlet Elevation: 788.05 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 6

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

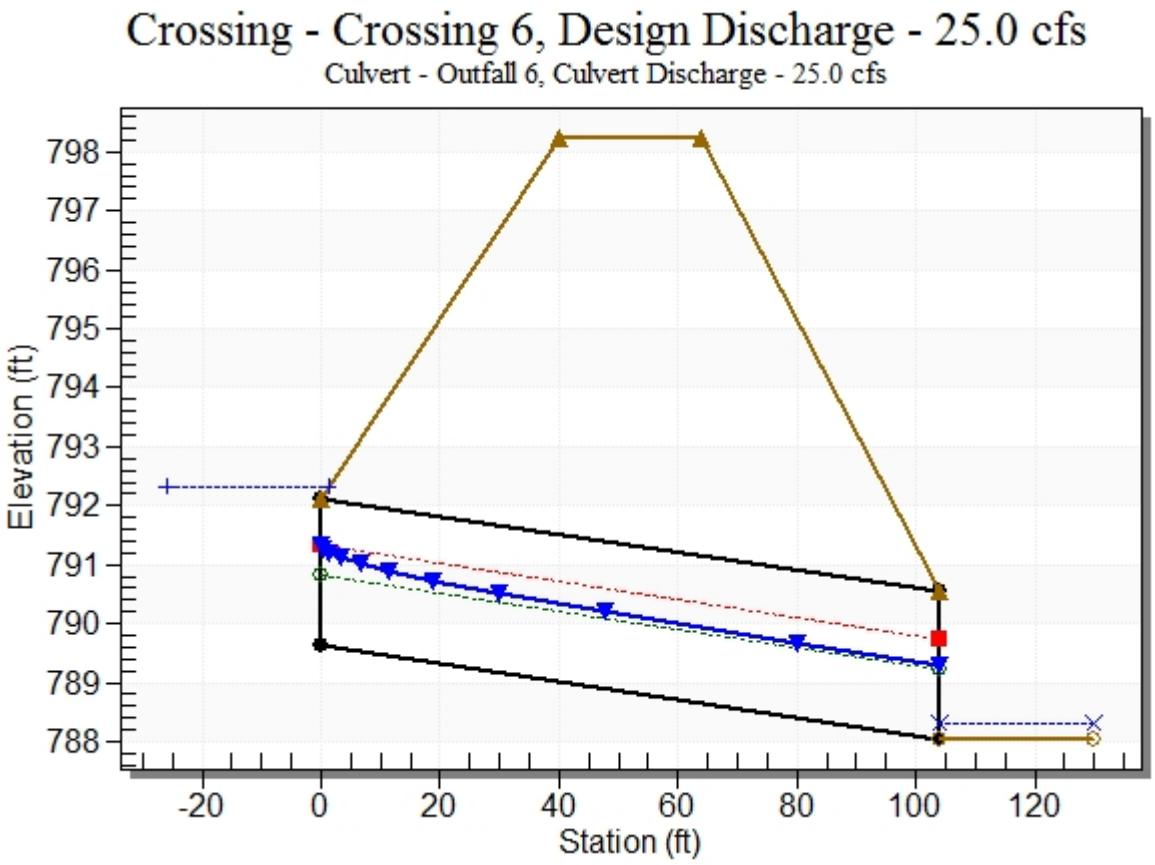
Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Water Surface Profile Plot for Culvert: Outfall 6 - 30in diameter ALT



Site Data - Outfall 6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 789.62 ft

Outlet Station: 104.00 ft

Outlet Elevation: 788.05 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 6

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

Inlet Depression: NONE

Table 18 - Downstream Channel Rating Curve (Crossing: Crossing 6)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	788.05	0.00	0.00	0.00	0.00
3.10	788.12	0.07	5.17	1.54	3.33
6.20	788.16	0.11	6.80	2.35	3.55
9.30	788.20	0.15	7.96	3.01	3.67
12.40	788.22	0.17	8.91	3.58	3.77
15.50	788.25	0.20	9.72	4.10	3.84
18.60	788.27	0.22	10.44	4.59	3.90
21.70	788.29	0.24	11.07	5.04	3.94
24.80	788.32	0.27	11.66	5.47	3.99
25.00	788.32	0.27	11.70	5.50	3.99
31.00	788.36	0.31	12.70	6.28	4.05

Tailwater Channel Data - Crossing 6

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 788.05 ft

Roadway Data for Crossing: Crossing 6

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 104.00 ft

Crest Elevation: 798.25 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 25 cfs

Maximum Flow: 31 cfs

Table 19 - Summary of Culvert Flows at Crossing: Crossing 7

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 7 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
784.24	0.00	0.00	0.00	1
785.06	3.10	3.10	0.00	1
785.48	6.20	6.20	0.00	1
785.84	9.30	9.30	0.00	1
786.17	12.40	12.40	0.00	1
786.53	15.50	15.50	0.00	1
786.94	18.60	18.60	0.00	1
787.43	21.70	21.70	0.00	1
788.01	24.80	24.80	0.00	1
788.05	25.00	25.00	0.00	1
789.41	31.00	31.00	0.00	1
791.50	38.19	38.19	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 7

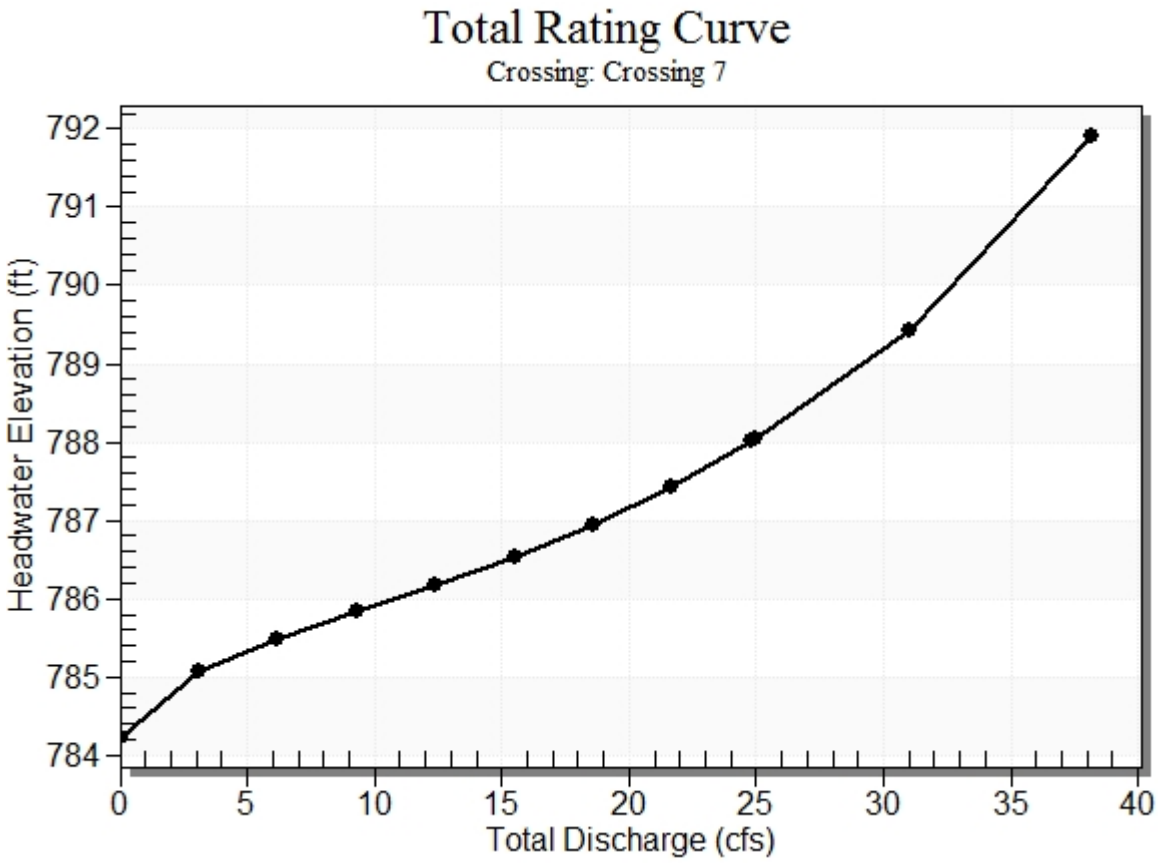


Table 20 - Culvert Summary Table: Outfall 7

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	784.24	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
3.10	3.10	785.06	0.825	0.0*	1-S2n	0.366	0.612	0.366	0.075	7.891	5.172
6.20	6.20	785.48	1.243	0.0*	1-S2n	0.513	0.880	0.513	0.114	9.701	6.795
9.30	9.30	785.84	1.601	0.0*	1-S2n	0.632	1.086	0.653	0.146	10.391	7.965
12.40	12.40	786.17	1.934	0.0*	1-S2n	0.740	1.264	0.740	0.174	11.741	8.912
15.50	15.50	786.53	2.290	0.0*	5-S2n	0.834	1.415	0.865	0.199	11.904	9.724
18.60	18.60	786.94	2.703	0.233	5-S2n	0.927	1.551	0.971	0.223	12.290	10.437
21.70	21.70	787.43	3.193	0.788	5-S2n	1.013	1.664	1.063	0.245	12.790	11.073
24.80	24.80	788.01	3.768	1.408	5-S2n	1.099	1.756	1.156	0.266	13.189	11.661
25.00	25.00	788.05	3.808	1.450	5-S2n	1.105	1.761	1.162	0.267	13.213	11.697
31.00	31.00	789.41	5.173	2.845	5-S2n	1.270	1.875	1.345	0.305	13.818	12.703

* Full Flow Headwater elevation is below inlet invert.

****

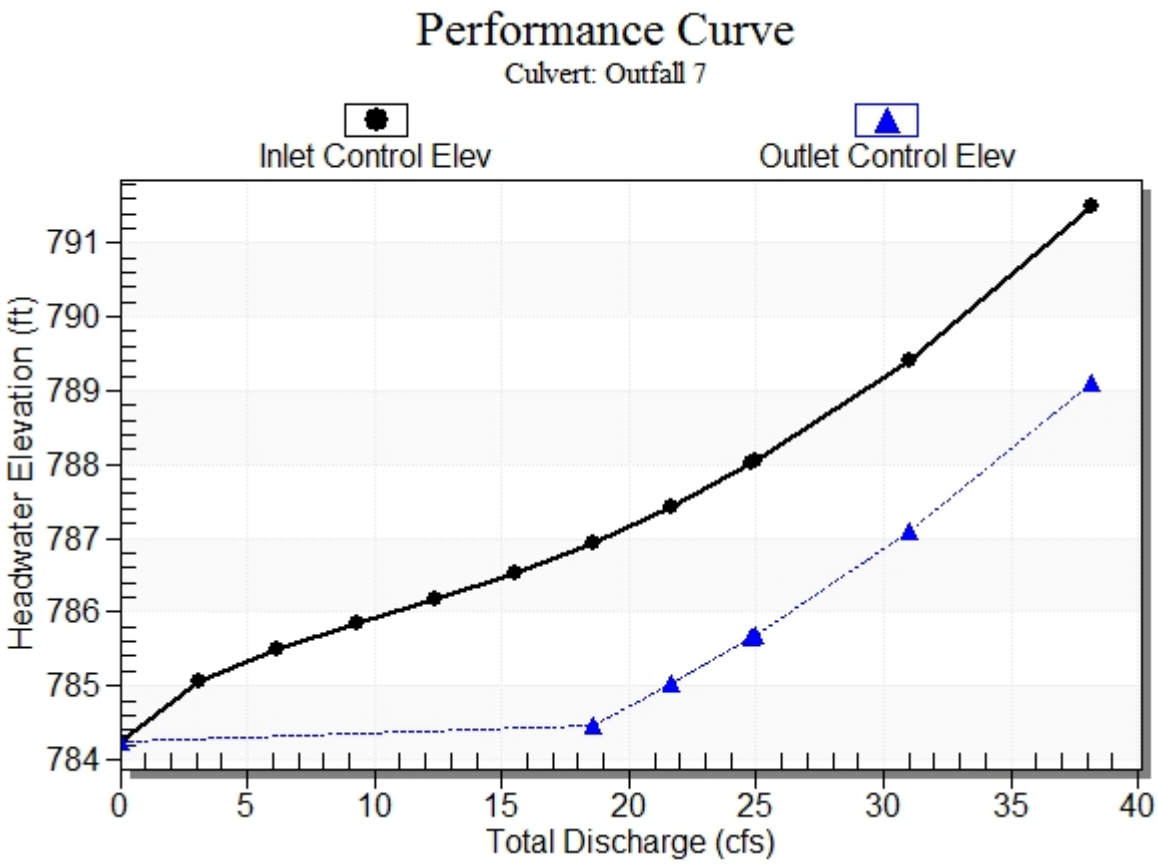
Straight Culvert

Inlet Elevation (invert): 784.24 ft, Outlet Elevation (invert): 781.32 ft

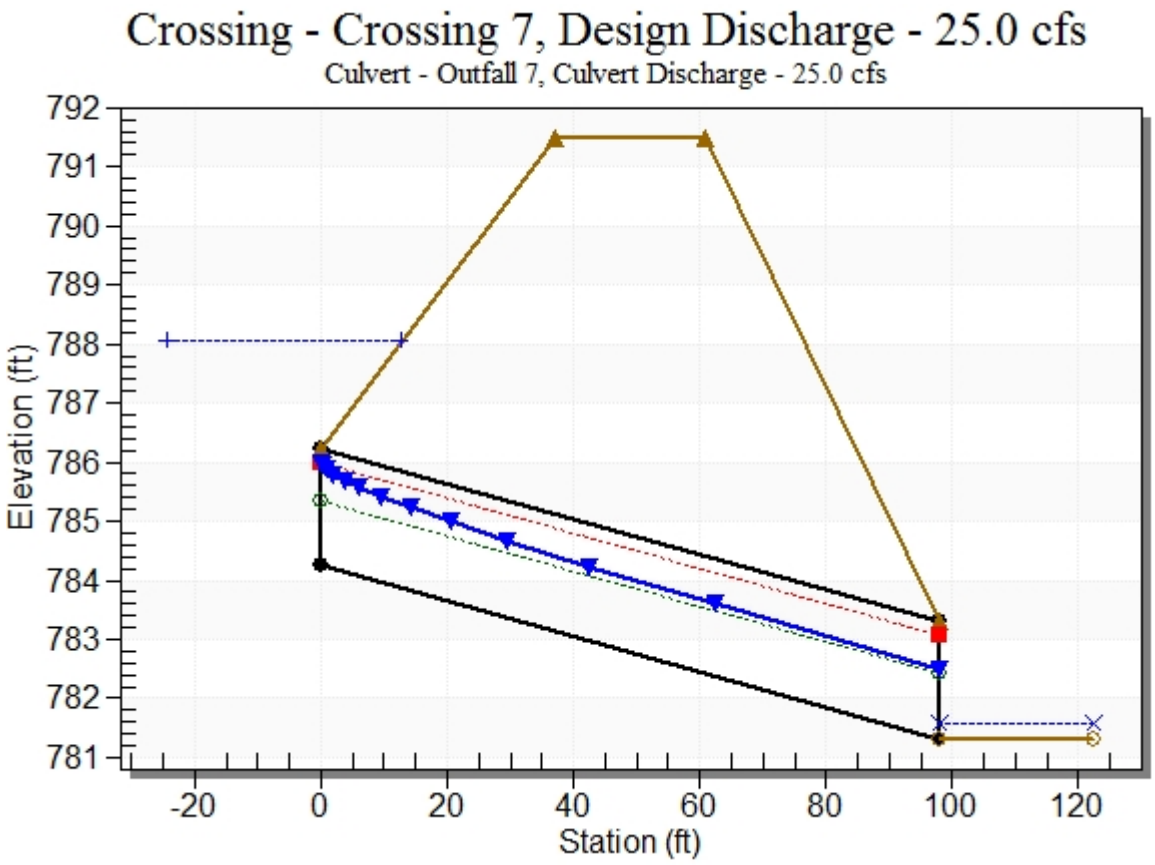
Culvert Length: 98.04 ft, Culvert Slope: 0.0298

****

Culvert Performance Curve Plot: Outfall 7



Water Surface Profile Plot for Culvert: Outfall 7



Site Data - Outfall 7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 784.24 ft

Outlet Station: 98.00 ft

Outlet Elevation: 781.32 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 7

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

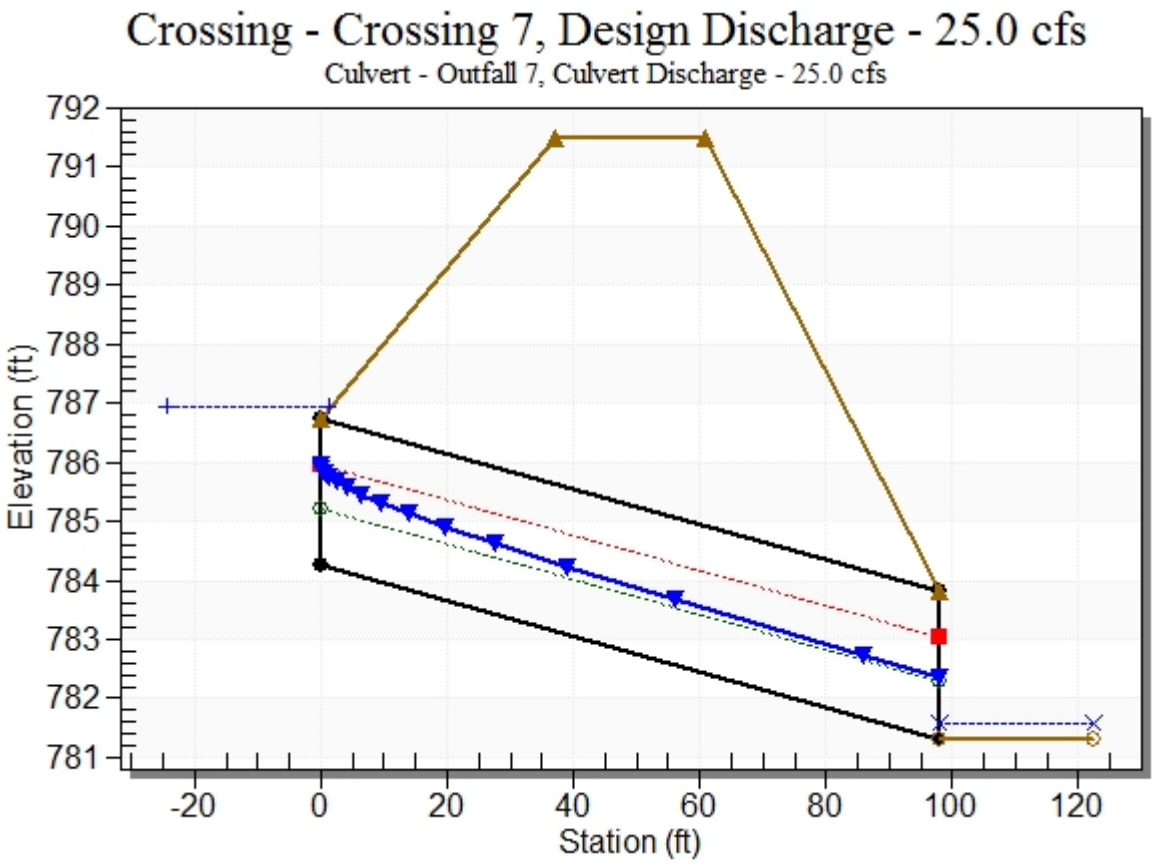
Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Water Surface Profile Plot for Culvert: Outfall 7 - 30in diameter ALT



Site Data - Outfall 7

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 784.24 ft

Outlet Station: 98.00 ft

Outlet Elevation: 781.32 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 7

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

Inlet Depression: NONE

Table 21 - Downstream Channel Rating Curve (Crossing: Crossing 7)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	781.32	0.00	0.00	0.00	0.00
3.10	781.39	0.07	5.17	1.54	3.33
6.20	781.43	0.11	6.80	2.35	3.55
9.30	781.47	0.15	7.96	3.01	3.67
12.40	781.49	0.17	8.91	3.58	3.77
15.50	781.52	0.20	9.72	4.10	3.84
18.60	781.54	0.22	10.44	4.59	3.90
21.70	781.56	0.24	11.07	5.04	3.94
24.80	781.59	0.27	11.66	5.47	3.99
25.00	781.59	0.27	11.70	5.50	3.99
31.00	781.63	0.31	12.70	6.28	4.05

Tailwater Channel Data - Crossing 7

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 781.32 ft

Roadway Data for Crossing: Crossing 7

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 98.00 ft

Crest Elevation: 791.50 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 25 cfs

Maximum Flow: 31 cfs

Table 22 - Summary of Culvert Flows at Crossing: Crossing 8

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 8 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
786.27	0.00	0.00	0.00	1
787.11	3.10	3.10	0.00	1
787.53	6.20	6.20	0.00	1
787.89	9.30	9.30	0.00	1
788.22	12.40	12.40	0.00	1
788.58	15.50	15.50	0.00	1
788.99	18.60	18.60	0.00	1
789.48	21.70	21.70	0.00	1
790.06	24.80	24.80	0.00	1
790.10	25.00	25.00	0.00	1
791.46	31.00	31.00	0.00	1
792.00	33.06	33.06	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 8

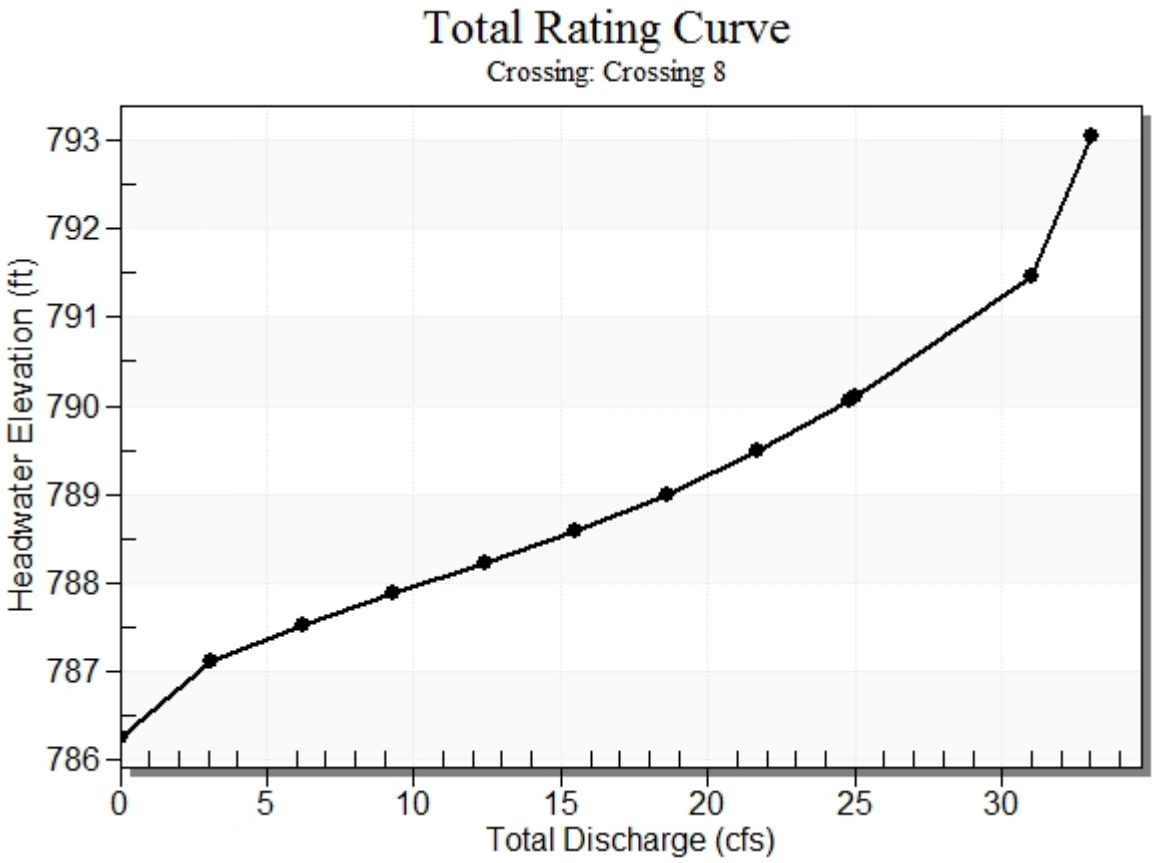


Table 23 - Culvert Summary Table: Outfall 8

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	786.27	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
3.10	3.10	787.11	0.838	0.025	1-S2n	0.472	0.612	0.483	0.075	5.251	5.172
6.20	6.20	787.53	1.263	0.391	1-S2n	0.682	0.880	0.695	0.114	6.372	6.795
9.30	9.30	787.89	1.621	0.759	1-S2n	0.851	1.086	0.871	0.146	7.075	7.965
12.40	12.40	788.22	1.953	1.164	1-S2n	1.005	1.264	1.030	0.174	7.603	8.912
15.50	15.50	788.58	2.309	1.608	5-S2n	1.153	1.415	1.181	0.199	8.034	9.724
18.60	18.60	788.99	2.723	2.327	5-S2n	1.303	1.551	1.330	0.223	8.392	10.437
21.70	21.70	789.48	3.212	2.807	5-S2n	1.462	1.664	1.484	0.245	8.669	11.073
24.80	24.80	790.06	3.788	3.341	5-S2n	1.666	1.756	1.667	0.266	8.846	11.661
25.00	25.00	790.10	3.828	3.377	5-S2n	1.686	1.761	1.686	0.267	8.866	11.697
31.00	31.00	791.46	5.193	4.578	7-M2c	2.000	1.875	1.875	0.305	10.130	12.703

****

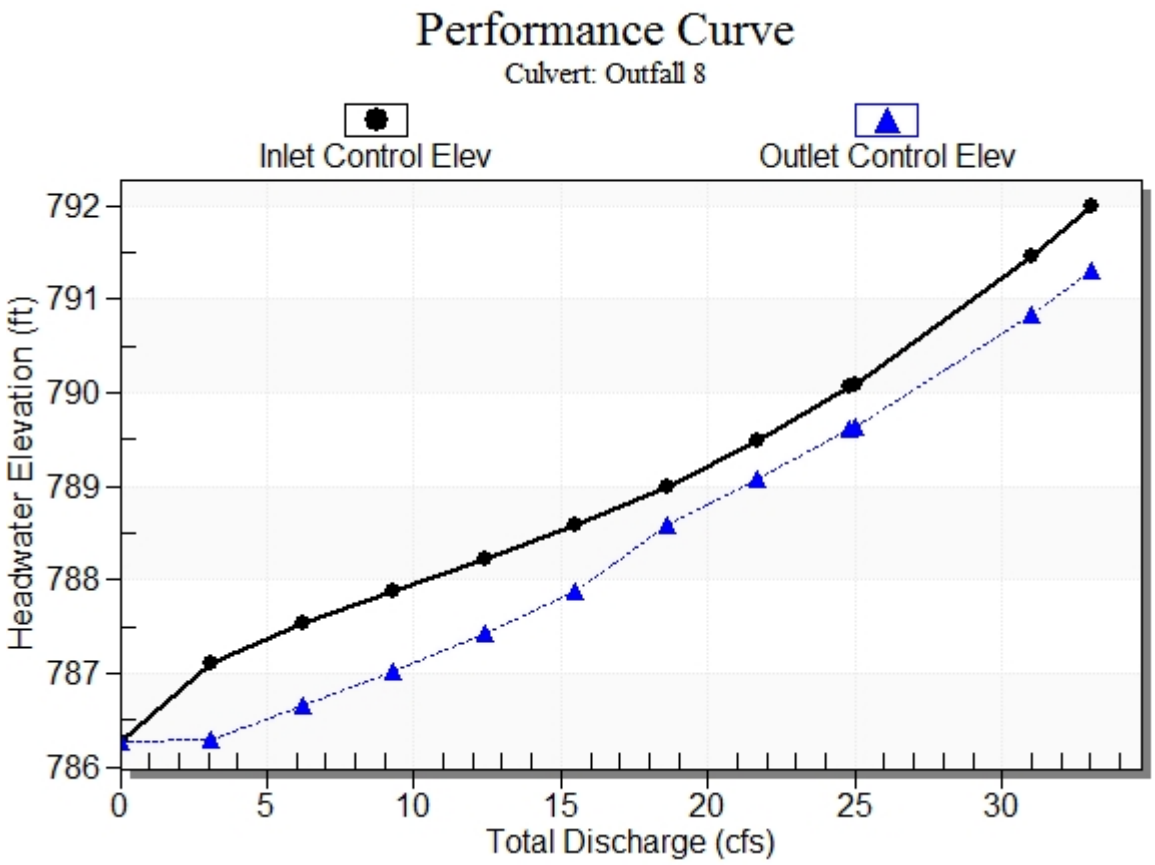
Straight Culvert

Inlet Elevation (invert): 786.27 ft, Outlet Elevation (invert): 785.65 ft

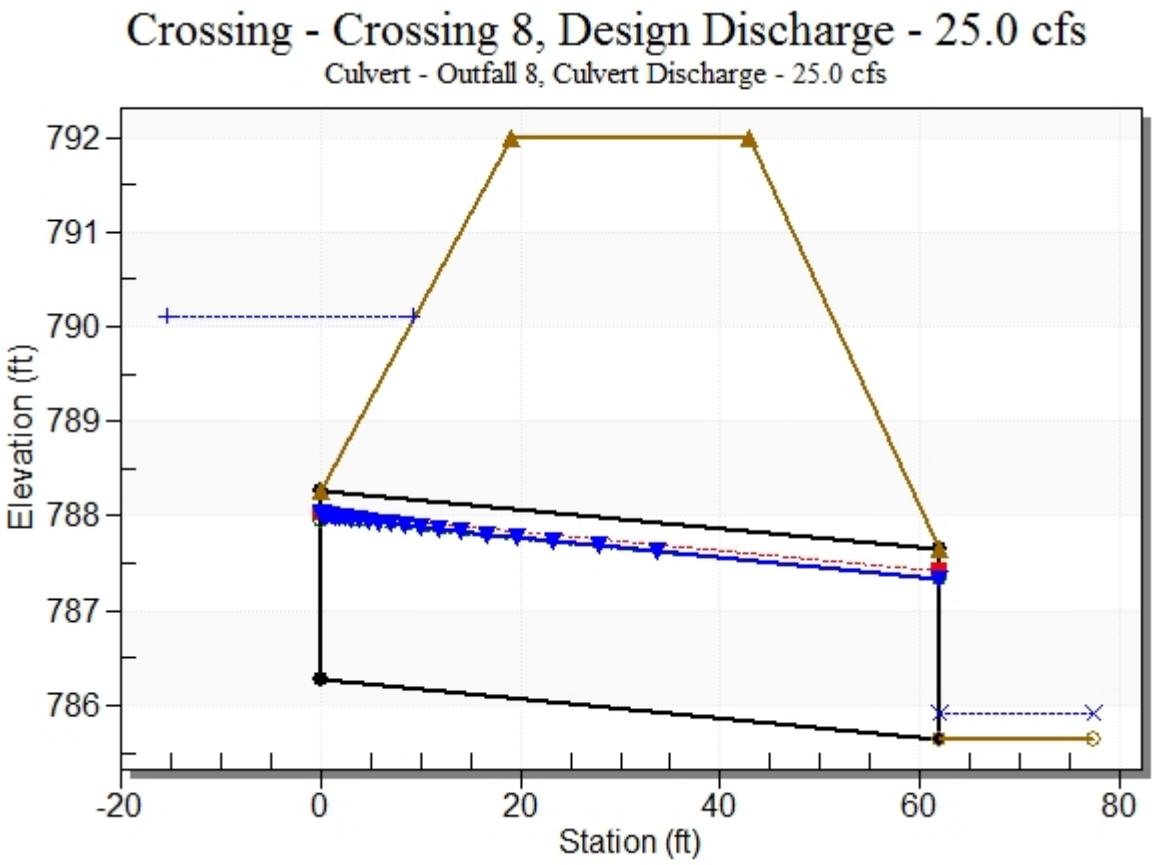
Culvert Length: 62.00 ft, Culvert Slope: 0.0100

****

Culvert Performance Curve Plot: Outfall 8



Water Surface Profile Plot for Culvert: Outfall 8



Site Data - Outfall 8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 786.27 ft

Outlet Station: 62.00 ft

Outlet Elevation: 785.65 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 8

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

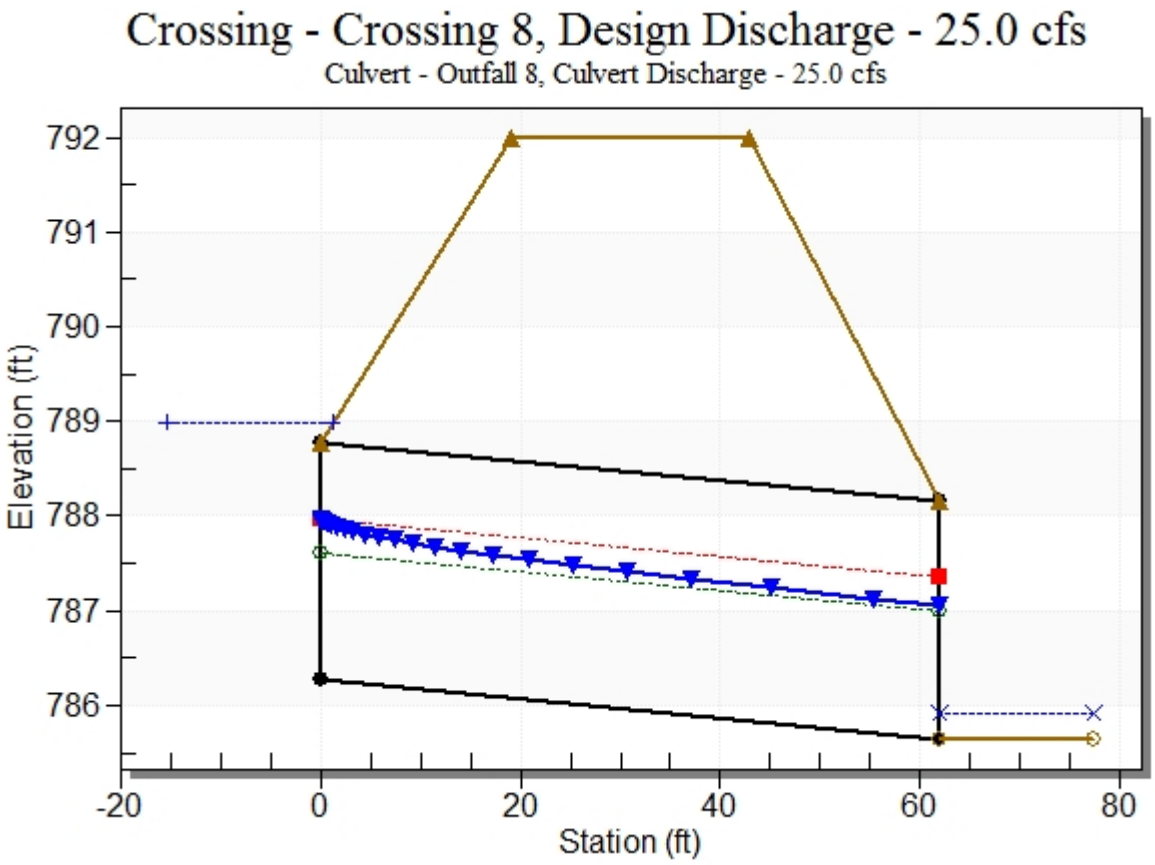
Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: NONE

Water Surface Profile Plot for Culvert: Outfall 8 - 30in dimater ALT



Site Data - Outfall 8

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 786.27 ft

Outlet Station: 62.00 ft

Outlet Elevation: 785.65 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 8

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

Inlet Depression: NONE

Table 24 - Downstream Channel Rating Curve (Crossing: Crossing 8)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	785.65	0.00	0.00	0.00	0.00
3.10	785.72	0.07	5.17	1.54	3.33
6.20	785.76	0.11	6.80	2.35	3.55
9.30	785.80	0.15	7.96	3.01	3.67
12.40	785.82	0.17	8.91	3.58	3.77
15.50	785.85	0.20	9.72	4.10	3.84
18.60	785.87	0.22	10.44	4.59	3.90
21.70	785.89	0.24	11.07	5.04	3.94
24.80	785.92	0.27	11.66	5.47	3.99
25.00	785.92	0.27	11.70	5.50	3.99
31.00	785.96	0.31	12.70	6.28	4.05

Tailwater Channel Data - Crossing 8

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 785.65 ft

Roadway Data for Crossing: Crossing 8

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 62.00 ft

Crest Elevation: 792.00 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 17 cfs

Maximum Flow: 22 cfs

Table 25 - Summary of Culvert Flows at Crossing: Crossing 9

Headwater Elevation (ft)	Total Discharge (cfs)	Outfall 9 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
796.27	0.00	0.00	0.00	1
797.00	2.20	2.20	0.00	1
797.32	4.40	4.40	0.00	1
797.57	6.60	6.60	0.00	1
797.79	8.80	8.80	0.00	1
797.99	11.00	11.00	0.00	1
798.18	13.20	13.20	0.00	1
798.35	15.40	15.40	0.00	1
798.48	17.00	17.00	0.00	1
798.69	19.80	19.80	0.00	1
798.86	22.00	22.00	0.00	1
802.30	51.49	51.49	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing 9

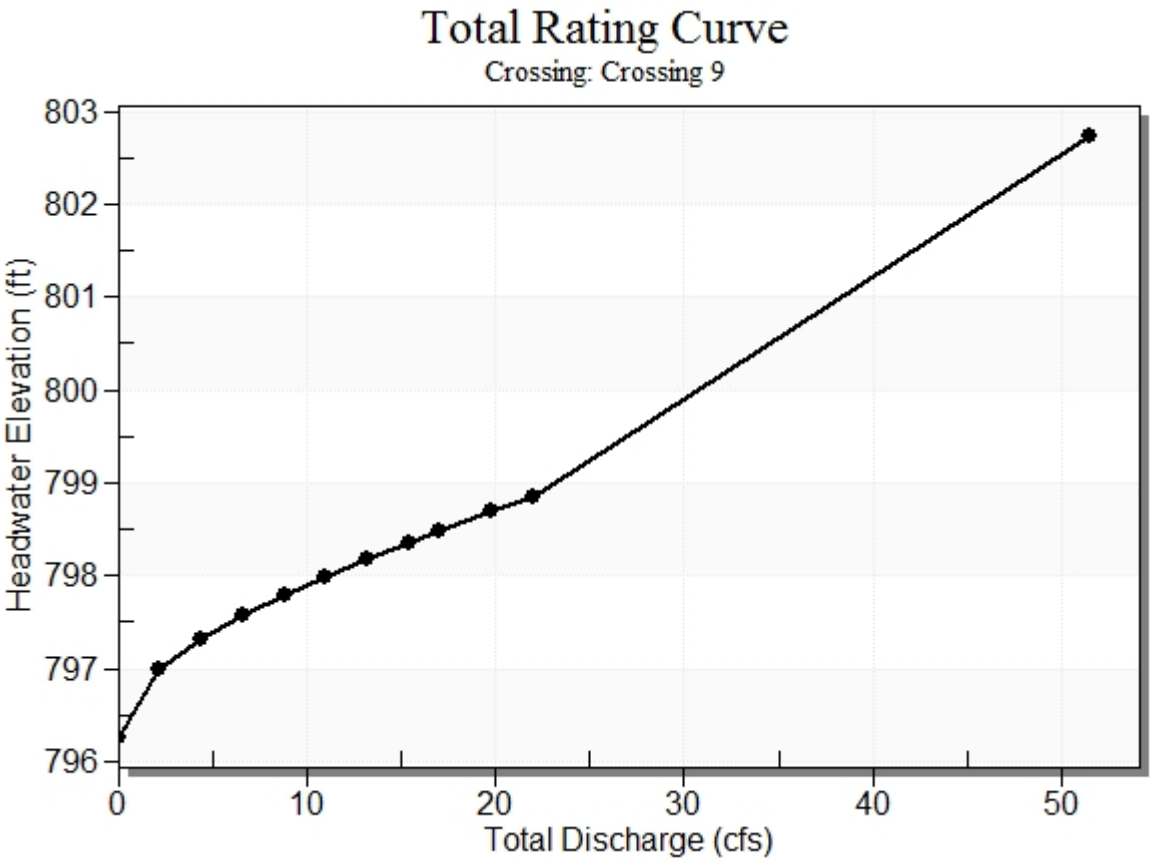


Table 26 - Culvert Summary Table: Outfall 9

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	796.27	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
2.20	2.20	797.00	0.663	0.730	2-M2c	0.505	0.480	0.480	0.061	3.341	4.510
4.40	4.40	797.32	0.947	1.049	2-M2c	0.723	0.685	0.685	0.093	4.028	5.933
6.60	6.60	797.57	1.172	1.302	2-M2c	0.897	0.849	0.849	0.118	4.492	6.962
8.80	8.80	797.79	1.394	1.522	2-M2c	1.047	0.983	0.983	0.141	4.912	7.800
11.00	11.00	797.99	1.602	1.721	2-M2c	1.190	1.110	1.110	0.162	5.227	8.510
13.20	13.20	798.18	1.792	1.907	2-M2c	1.326	1.222	1.222	0.181	5.538	9.133
15.40	15.40	798.35	1.969	2.085	2-M2c	1.461	1.322	1.322	0.198	5.846	9.702
17.00	17.00	798.48	2.093	2.209	2-M2c	1.559	1.389	1.389	0.211	6.069	10.075
19.80	19.80	798.69	2.307	2.423	2-M2c	1.740	1.505	1.505	0.231	6.414	10.692
22.00	22.00	798.86	2.477	2.588	7-M2c	1.898	1.592	1.592	0.247	6.670	11.136

****

Straight Culvert

Inlet Elevation (invert): 796.27 ft, Outlet Elevation (invert): 796.08 ft

Culvert Length: 66.00 ft, Culvert Slope: 0.0029

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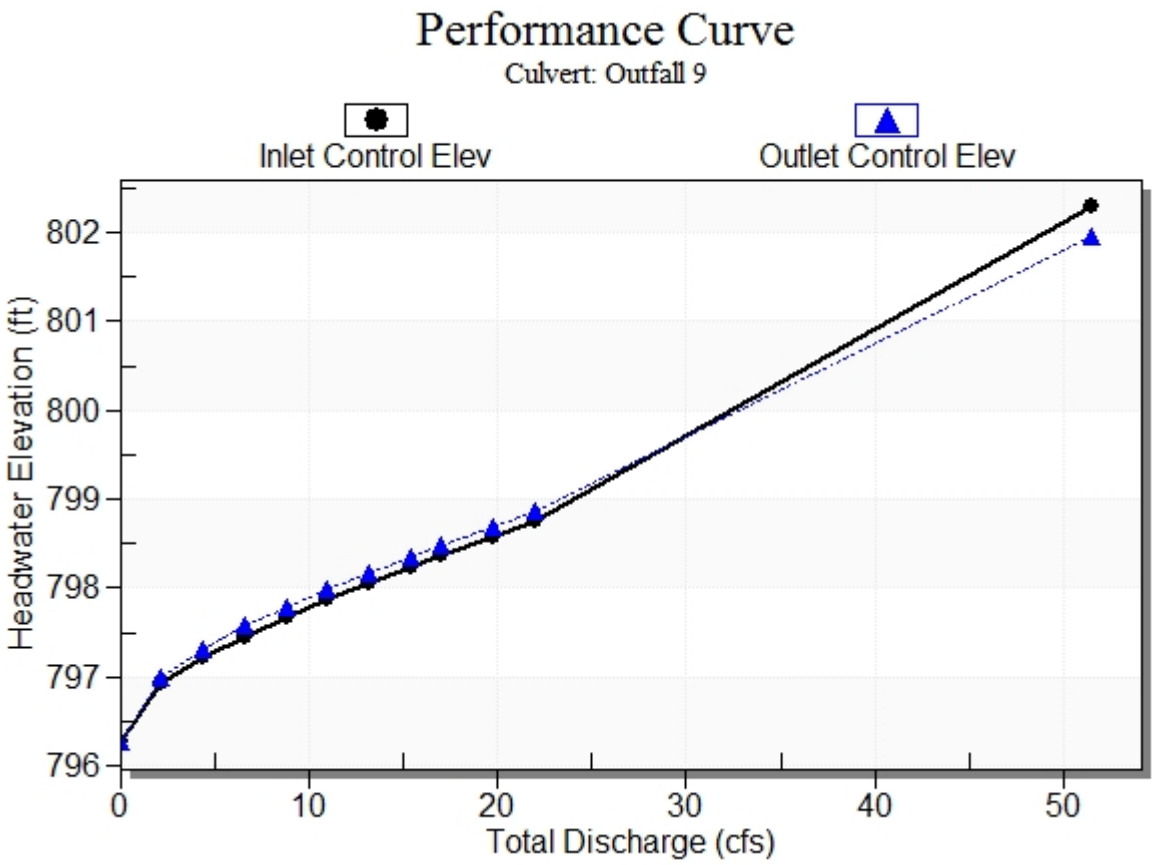
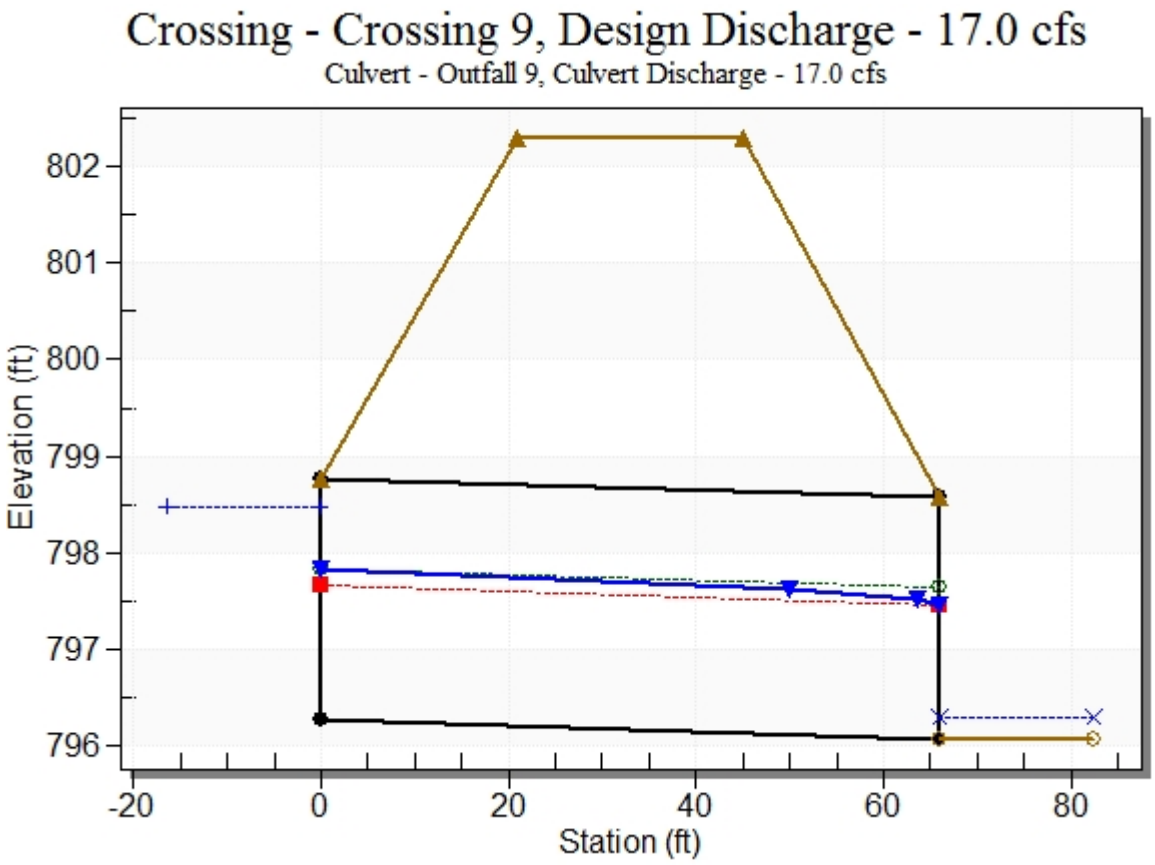
Culvert Performance Curve Plot: Outfall 9



Water Surface Profile Plot for Culvert: Outfall 9



Site Data - Outfall 9

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 796.27 ft

Outlet Station: 66.00 ft

Outlet Elevation: 796.08 ft

Number of Barrels: 1

Culvert Data Summary - Outfall 9

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

Inlet Depression: NONE

Table 27 - Downstream Channel Rating Curve (Crossing: Crossing 9)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	796.08	0.00	0.00	0.00	0.00
2.20	796.14	0.06	4.51	1.26	3.22
4.40	796.17	0.09	5.93	1.91	3.43
6.60	796.20	0.12	6.96	2.44	3.56
8.80	796.22	0.14	7.80	2.90	3.66
11.00	796.24	0.16	8.51	3.33	3.73
13.20	796.26	0.18	9.13	3.72	3.79
15.40	796.28	0.20	9.70	4.09	3.84
17.00	796.29	0.21	10.07	4.34	3.87
19.80	796.31	0.23	10.69	4.77	3.92
22.00	796.33	0.25	11.14	5.08	3.95

Tailwater Channel Data - Crossing 9

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.3300

Channel Manning's n: 0.0290

Channel Invert Elevation: 796.08 ft

Roadway Data for Crossing: Crossing 9

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 66.00 ft

Crest Elevation: 802.30 ft

Roadway Surface: Paved

Roadway Top Width: 24.00 ft