

CULVERT DESIGN ANALYSIS

for

Bellevue 160, Clay County, Texas

Prepared for: *American Land and Lakes*

August 20, 2026



Prepared by: Michael Pantell, P.E.

Introduction

Bellevue 160 is a subdivision in Clay County, Texas consisting of 16 approximately 10-acre lots. In total, there are 15 proposed driveways connecting to the existing roads. Lots 11 and 12 will share a driveway. Most of the driveways require a culvert to allow storm water pass. Driveways that are at crest of the road and do not require a culvert are identified in Table 3. This report sizes the culverts to pass the 100-year storm event using rational method to determine the flow and designs the culverts to pass the 100-year storm event without overtopping the driveway. The design of the culverts utilizes the TxDOT Hydraulic Manual design requirements. Due to lack of grading and survey data, the culvert parameters will be approximated. If field conditions differ greatly from these assumptions, Waterway Engineering should be contacted for verification.

Hydrology

Drainage Area

The existing drainage areas were delineated using a 1-meter resolution LiDAR (Light Detection and Ranging) obtained from the United States Geologic Survey (USGS). The drainage areas consist of small local flows with areas between 0.08 and 1.97 acres. The drainage areas for multiple culverts were combined for simplicity. The basins were named based on the lot number and the drainage areas shown on the design sheet provided in Appendix A.

Time of Concentration

The longest flow path was used to compute the time of concentration. The time of concentration was computed by dividing the longest flow path into overland flow, shallow concentrated flow, and channel flow depending on longest flow path characteristics. The time of concentration was computed for each flow type separately then summed to determine the total time of concentration. The time of concentration calculations are provided in Appendix B.

Runoff Coefficient

The composite runoff coefficient was determined using land use obtained from satellite imagery and field photographs. For areas within the road, gravel C value of 0.5 was used. For areas outside the road, pasture/range C value was 0.41. The composite runoff calculations for each drainage area are provided in Table 1.

Table 1 Composite C-Value Calculations

Composite C-Value Calculations									
Drainage Area	Area	Slope	Pasture/Range			Gravel Road			Composite
	(acres)	(%)	(acres)	(%)	C Value	(acres)	(%)	C Value	C Value
1-3	1.97	1.90%	1.71	86.95%	0.41	0.26	13.05%	0.50	0.42
4	0.08	0.70%	0.03	34.57%	0.41	0.05	65.43%	0.50	0.47
5-6	N/A – Driveway located at the crest								
7-12	1.15	3.30%	0.71	61.52%	0.41	0.44	38.48%	0.50	0.44
13	N/A – Driveway located at the crest								
14-15	1.96	2.70%	1.87	95.75%	0.41	0.08	4.25%	0.50	0.41
16	N/A – Driveway located at the crest								

Rainfall Data

The 5-, 10-, and 100-year 24-hour rainfall events were modeled for this study using precipitation depth acquired from NOAA Atlas 14 provided in Appendix C.

Flows

The 5-, 10-, and 100-year flows were calculated using the rational method. Where multiple culverts were combined into a single drainage basin, the flows were computed for the most downstream culvert and applied to each in the basin. This produces a conservative result for the culverts analyzed within each drainage basin. Table 2 provides the flows computed for each of the basins.

Table 2 Runoff Calculations

Runoff Calculations - Rational Method (Q=CIA)									
Drainage Areas	Area (acres)	Tc (min)	C	I (in/hr)			Q (cfs)		
				5-Year (in/hr)	10-Year (in/hr)	100-Year (in/hr)	5-Year (cfs)	10-Year (cfs)	100-Year (cfs)
1-3	1.97	8.60	0.42	5.79	6.72	9.85	4.8	5.6	8.2
4	0.08	2.60	0.47	7.38	8.50	12.45	0.3	0.3	0.5
5-6	N/A – Driveway located at the crest								
7-12	1.15	8.60	0.44	5.79	6.72	9.85	3.0	3.4	5.0
13	N/A – Driveway located at the crest								
14-15	1.96	3.00	0.41	7.27	8.38	12.28	5.9	6.8	9.9
16	N/A – Driveway located at the crest								

Culvert Design

The culverts were designed using Hydraflow Express that utilizes the Federal Highway Administration (FHA) publication Hydraulic Design of Highway Culverts (HDS-5). All culverts are analyzed as helical corrugated metal pipe, with no headwall for a 20' wide driveway and with a manning's n value of 0.016. The minimum culvert size should be 18" to reduce pipe clogging. All culverts, except 14 and 15, shall have minimum of one (1) foot of cover. Culverts 14 and 15 should have a minimum 18 inches (18") of cover. The property owner shall determine the actual amount of cover (above the minimum one foot utilized for the culvert calculations) required to carry the load of vehicles utilizing the driveway. Table 3 provides the culvert sizes for each culvert. For any culvert with entrance or exit velocities greater than 6 fps, it is the responsibility of the property owner to install appropriate erosion control measures. Appendix D provides the water surface profile for the design flow.

Table 3 Culvert Design

Lot	Type	Culvert Size	Number	Design Flow (cfs)
1	Corrugated Metal	18"	1	8.2
2	Corrugated Metal	18"	1	8.2
3	Corrugated Metal	18"	1	8.2
4	Corrugated Metal	18"	1	0.5
5	N/A – Driveway located at the crest			
6	N/A – Driveway located at the crest			
7	Corrugated Metal	18"	1	5.0
8	Corrugated Metal	18"	1	5.0
9	Corrugated Metal	18"	1	5.0
10	Corrugated Metal	18"	1	5.0
11/12	Corrugated Metal	18"	1	5.0
13	N/A – Driveway located at the crest			
14	Corrugated Metal	18"	1	9.9
15	Corrugated Metal	18"	1	9.9
16	N/A – Driveway located at the crest			

Appendix A

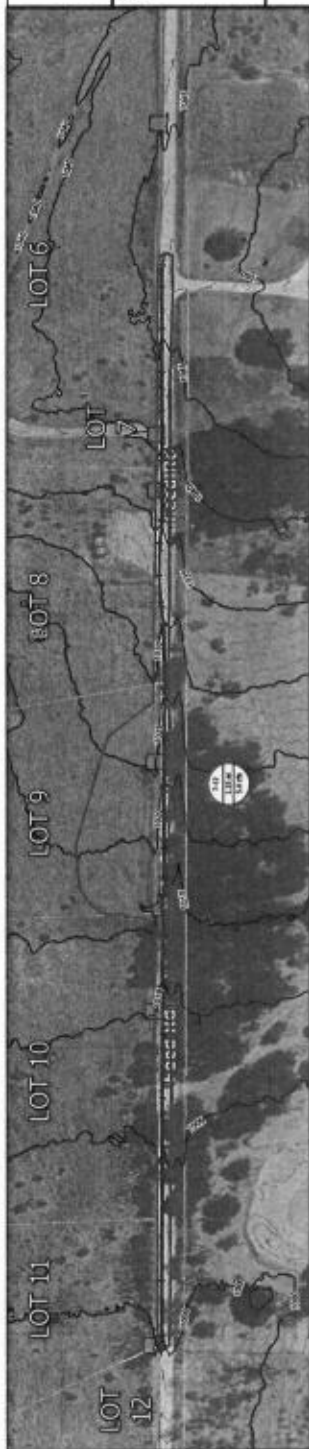
Drainage Area Map



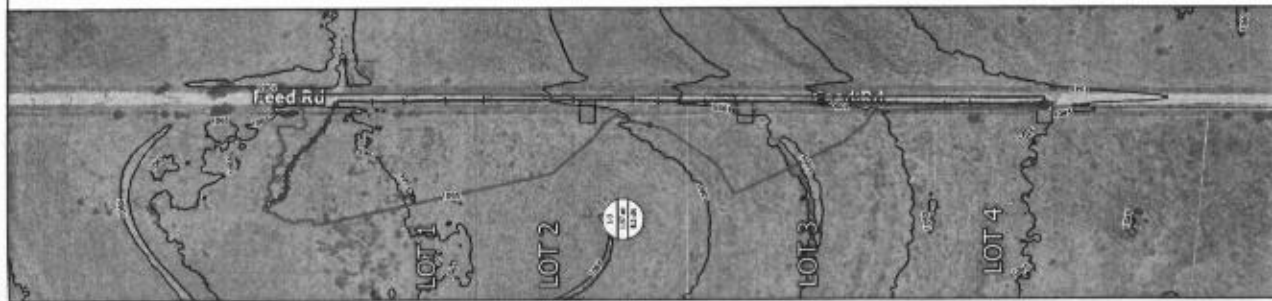
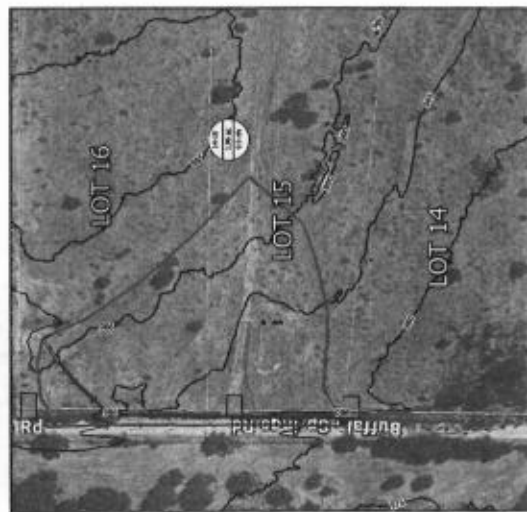
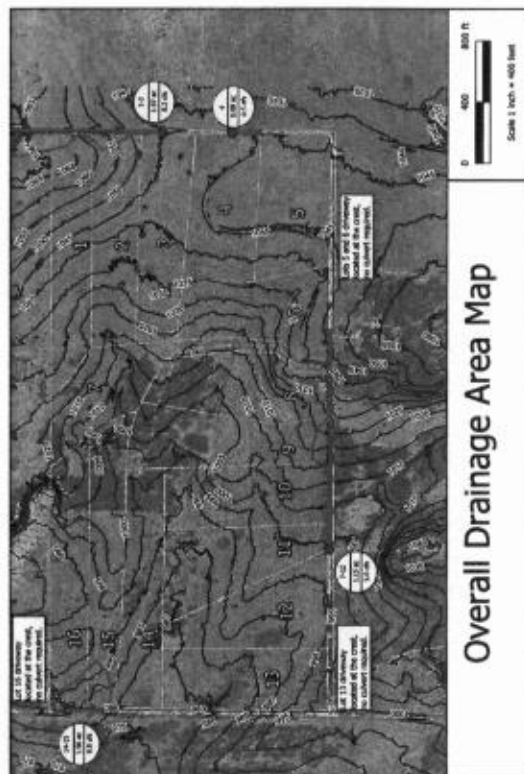
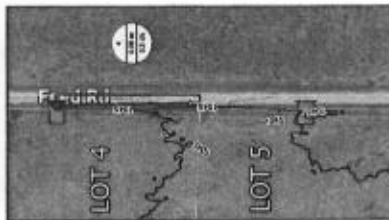
Drainage Area Map

- Legend**
- Drainage Points
 - Edgeline
 - Softswath
 - Overland
 - Shallow Concentrated
 - Bedrock Elevation
 - 1
 - 5
 - Drainage Piers
 - Drainage Piers
 - Drainage Piers
 - Drainage Piers

Sheet No.



Lot	Type	Conduit Size	Number	Design Flow (cfs)
1	Corrugated Metal	18"	1	0.2
2	Corrugated Metal	18"	1	0.2
3	Corrugated Metal	18"	1	0.2
4	Corrugated Metal	18"	1	0.5
5	N/A - Driveway located at the crest			
6	N/A - Driveway located at the crest			
7	Corrugated Metal	18"	1	0.0
8	Corrugated Metal	18"	1	5.0
9	Corrugated Metal	18"	1	5.0
10	Corrugated Metal	18"	1	5.0
11/12	Corrugated Metal	18"	1	5.0
13	N/A - Driveway located at the crest			
14	Corrugated Metal	18"	1	9.9
15	Corrugated Metal	18"	1	9.9
16	N/A - Driveway located at the crest			



Appendix B

Time of Concentration

Subbasin	Longest Flow Path (ft)	Overland Flow					Shallow Concentrated Flow							Results					
		Length (ft)	Land Use/ Surface Description	n value	U/S Elevation	D/S Elevation	2-Year 24 hour Precip (in)	Slope (%)	Tc Overland (min)	Length (ft)	U/S Elevation n	D/S Elevation	Slope 1 (%)	Factor	V1 (ft/s)	Ground Cover Type	Tc Shallow Concentrated (min)	Subbasin	Total Tc (min)
Pre-Project																			
1-3	1119	15	Gravel	0.011	1066.4	1066.00	3.5	3%	0.23	1104	1066.0	1045.3	1.9%	16.135	2.21	Unpaved	8.33	1-3	0.2
																			8.3
																			8.6
4	190	16	Gravel	0.011	1044.2	1044.10	3.5	1%	0.43	174	1044.1	1042.9	0.7%	16.135	1.34	Unpaved	2.16	4	0.4
																			2.2
																			2.6
7-12	1445	19	Gravel	0.011	1046.6	1046.50	3.5	1%	0.52	1426	1046.5	999.6	3.3%	16.135	2.93	Unpaved	8.12	7-12	0.5
																			8.1
																			8.6
14-15	446	38	Gravel	0.011	991.1	989.50	3.5	4%	0.40	408	989.5	978.6	2.7%	16.135	2.64	Unpaved	2.58	14-15	0.4
																			2.6
																			3.0

Appendix C

NOAA Atlas 14



NOAA Atlas 14, Volume 11, Version 2
Location name: Bellevue, Texas, USA*
Latitude: 33.5898°, Longitude: -98.136°
Elevation: 992 ft**

* source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.391 (0.296-0.517)	0.456 (0.349-0.598)	0.562 (0.428-0.739)	0.649 (0.487-0.864)	0.769 (0.557-1.05)	0.859 (0.606-1.20)	0.951 (0.656-1.36)	1.06 (0.710-1.54)	1.20 (0.781-1.81)	1.32 (0.836-2.03)
10-min	0.629 (0.476-0.830)	0.733 (0.560-0.961)	0.904 (0.689-1.19)	1.05 (0.785-1.39)	1.24 (0.900-1.69)	1.39 (0.980-1.93)	1.54 (1.06-2.20)	1.70 (1.14-2.48)	1.92 (1.24-2.89)	2.09 (1.32-3.22)
15-min	0.778 (0.589-1.03)	0.905 (0.692-1.19)	1.11 (0.849-1.46)	1.29 (0.965-1.71)	1.52 (1.10-2.07)	1.70 (1.20-2.36)	1.88 (1.30-2.69)	2.08 (1.40-3.04)	2.37 (1.54-3.57)	2.60 (1.65-4.00)
30-min	1.07 (0.810-1.41)	1.24 (0.951-1.63)	1.53 (1.16-2.01)	1.76 (1.32-2.34)	2.08 (1.50-2.82)	2.31 (1.63-3.22)	2.55 (1.76-3.65)	2.83 (1.90-4.14)	3.23 (2.10-4.88)	3.56 (2.26-5.48)
60-min	1.37 (1.04-1.82)	1.60 (1.22-2.10)	1.97 (1.50-2.60)	2.28 (1.71-3.04)	2.70 (1.96-3.67)	3.01 (2.13-4.20)	3.34 (2.30-4.78)	3.72 (2.50-5.44)	4.26 (2.77-6.43)	4.71 (2.98-7.26)
2-hr	1.66 (1.27-2.17)	1.96 (1.50-2.52)	2.43 (1.86-3.16)	2.83 (2.14-3.73)	3.40 (2.49-4.59)	3.85 (2.74-5.31)	4.32 (3.00-6.11)	4.86 (3.29-7.02)	5.62 (3.67-8.36)	6.24 (3.97-9.48)
3-hr	1.82 (1.40-2.37)	2.17 (1.67-2.76)	2.70 (2.06-3.49)	3.17 (2.42-4.15)	3.85 (2.84-5.16)	4.39 (3.15-6.04)	4.98 (3.47-6.99)	5.62 (3.82-8.06)	6.54 (4.29-9.66)	7.28 (4.65-11.0)
6-hr	2.13 (1.65-2.74)	2.56 (1.98-3.21)	3.21 (2.50-4.09)	3.80 (2.92-4.91)	4.65 (3.47-6.19)	5.36 (3.88-7.30)	6.14 (4.31-8.51)	6.97 (4.76-9.87)	8.15 (5.37-11.9)	9.10 (5.85-13.6)
12-hr	2.49 (1.95-3.16)	3.01 (2.34-3.72)	3.78 (2.96-4.76)	4.48 (3.48-5.74)	5.52 (4.15-7.27)	6.39 (4.67-8.60)	7.34 (5.19-10.1)	8.35 (5.75-11.7)	9.79 (6.50-14.1)	10.9 (7.07-16.1)
24-hr	2.90 (2.29-3.64)	3.50 (2.75-4.29)	4.41 (3.50-5.50)	5.24 (4.10-6.63)	6.44 (4.89-8.38)	7.45 (5.48-9.90)	8.55 (6.10-11.6)	9.73 (6.74-13.4)	11.4 (7.62-16.2)	12.8 (8.31-18.5)
2-day	3.36 (2.68-4.18)	4.05 (3.23-4.93)	5.10 (4.08-6.30)	6.03 (4.76-7.54)	7.36 (5.62-9.44)	8.45 (6.25-11.1)	9.62 (6.92-12.9)	10.9 (7.64-14.9)	12.8 (8.63-18.0)	14.4 (9.41-20.6)
3-day	3.68 (2.96-4.55)	4.42 (3.55-5.36)	5.56 (4.48-6.83)	6.56 (5.21-8.16)	7.98 (6.11-10.1)	9.11 (6.77-11.8)	10.3 (7.46-13.7)	11.7 (8.22-15.9)	13.7 (9.28-19.2)	15.4 (10.1-21.9)
4-day	3.93 (3.16-4.83)	4.70 (3.80-5.69)	5.92 (4.79-7.24)	6.98 (5.56-8.64)	8.48 (6.51-10.7)	9.66 (7.20-12.5)	10.9 (7.92-14.4)	12.4 (8.72-16.7)	14.5 (9.82-20.1)	16.2 (10.7-22.9)
7-day	4.47 (3.62-5.44)	5.34 (4.36-6.42)	6.73 (5.49-8.15)	7.92 (6.36-9.71)	9.60 (7.43-12.0)	10.9 (8.20-14.0)	12.3 (9.00-16.1)	13.9 (9.85-18.6)	16.2 (11.0-22.2)	18.1 (11.9-25.2)
10-day	4.91 (4.01-5.95)	5.86 (4.81-7.01)	7.38 (6.05-8.89)	8.67 (7.00-10.6)	10.5 (8.16-13.1)	11.9 (9.00-15.2)	13.5 (9.85-17.5)	15.1 (10.8-20.1)	17.6 (12.0-23.9)	19.5 (13.0-27.1)
20-day	6.24 (5.14-7.48)	7.39 (6.13-8.74)	9.22 (7.64-11.0)	10.8 (8.78-13.0)	13.0 (10.2-16.0)	14.7 (11.2-18.5)	16.5 (12.2-21.2)	18.5 (13.3-24.2)	21.4 (14.7-28.7)	23.7 (15.8-32.4)
30-day	7.34 (6.09-8.74)	8.65 (7.21-10.2)	10.7 (8.94-12.7)	12.5 (10.2-15.0)	15.0 (11.8-18.3)	16.9 (12.9-21.1)	19.0 (14.1-24.2)	21.3 (15.3-27.6)	24.5 (16.9-32.6)	27.0 (18.1-36.7)
45-day	8.93 (7.44-10.5)	10.5 (8.78-12.2)	12.9 (10.8-15.2)	15.0 (12.4-17.8)	17.9 (14.2-21.8)	20.2 (15.5-25.0)	22.6 (16.9-28.6)	25.2 (18.2-32.5)	28.9 (20.0-38.2)	31.8 (21.4-42.8)
60-day	10.3 (8.66-12.2)	12.1 (10.2-14.1)	14.9 (12.5-17.4)	17.2 (14.3-20.4)	20.6 (16.4-24.8)	23.2 (17.9-28.5)	25.9 (19.3-32.5)	28.8 (20.9-36.9)	32.9 (22.9-43.2)	36.1 (24.3-48.3)

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

Appendix D

Hydraflow Express Results

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Aug 20 2026

Culvert 1

Invert Elev Dn (ft) = 1058.34
Pipe Length (ft) = 24.00
Slope (%) = 3.25
Invert Elev Up (ft) = 1059.12
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.016
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Projecting
Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

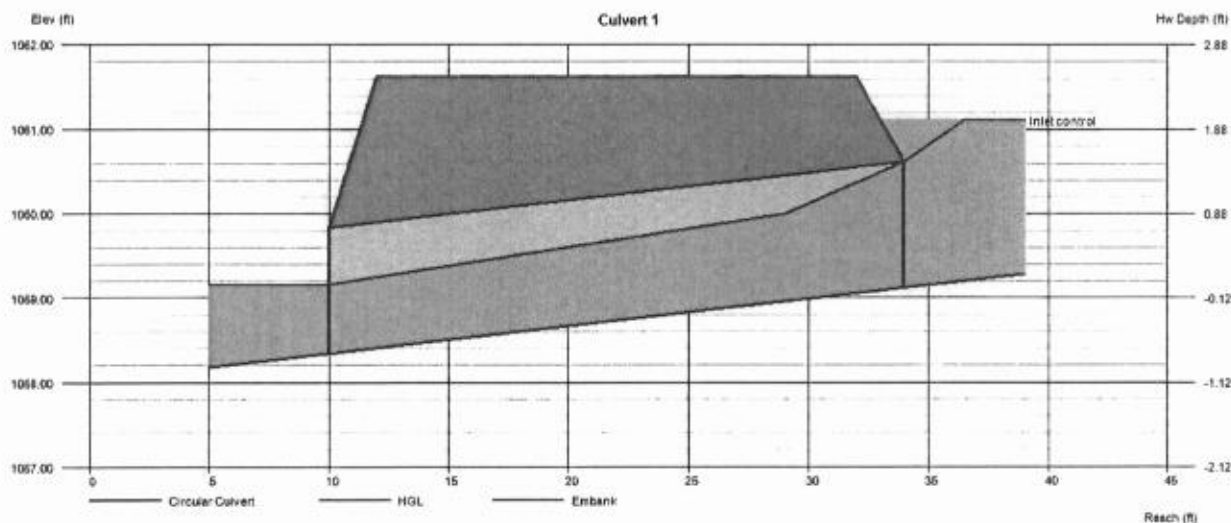
Top Elevation (ft) = 1061.62
Top Width (ft) = 20.00
Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 8.20
Qmax (cfs) = 8.20
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 8.20
Qpipe (cfs) = 8.20
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 8.29
Veloc Up (ft/s) = 5.86
HGL Dn (ft) = 1059.16
HGL Up (ft) = 1060.23
Hw Elev (ft) = 1061.11
Hw/D (ft) = 1.33
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Aug 20 2026

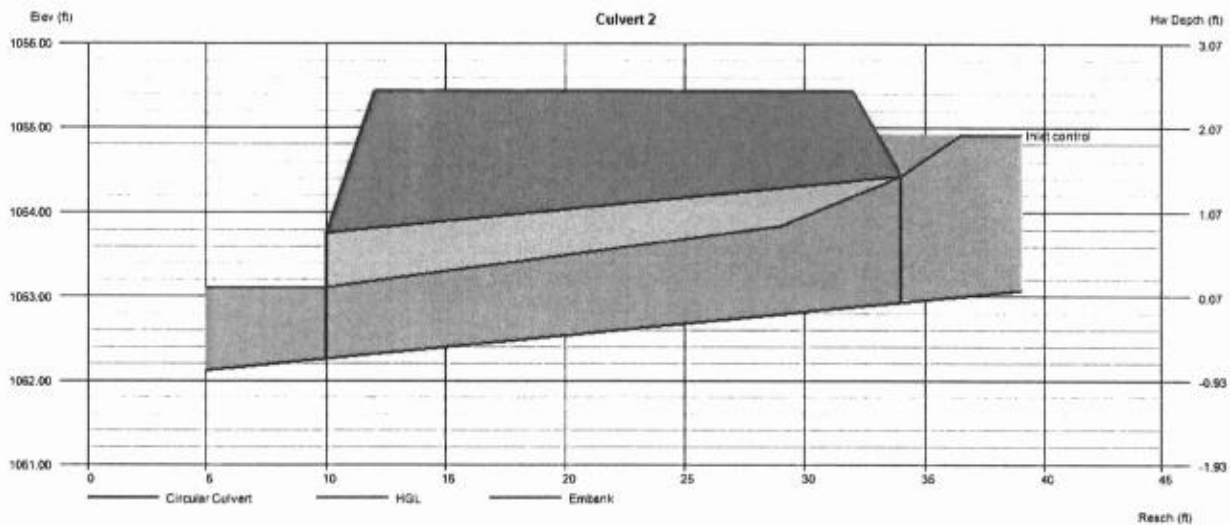
Culvert 2

Invert Elev Dn (ft)	= 1052.26
Pipe Length (ft)	= 24.00
Slope (%)	= 2.79
Invert Elev Up (ft)	= 1052.93
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.016
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Projecting
Coeff. K,M,c,Y,k	= 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment	
Top Elevation (ft)	= 1055.43
Top Width (ft)	= 20.00
Crest Width (ft)	= 24.00

Calculations	
Qmin (cfs)	= 8.18
Qmax (cfs)	= 8.18
Tailwater Elev (ft)	= Normal

Highlighted	
Qtotal (cfs)	= 8.18
Qpipe (cfs)	= 8.18
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.91
Veloc Up (ft/s)	= 5.85
HGL Dn (ft)	= 1053.11
HGL Up (ft)	= 1054.04
Hw Elev (ft)	= 1054.92
Hw/D (ft)	= 1.33
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Aug 20 2026

Culvert 3

Invert Elev Dn (ft) = 1045.30
Pipe Length (ft) = 24.00
Slope (%) = 1.00
Invert Elev Up (ft) = 1045.54
Rise (in) = 18.0
Shape = Circular
Span (in) = 18.0
No. Barrels = 1
n-Value = 0.016
Culvert Type = Circular Corrugate Metal Pipe
Culvert Entrance = Projecting
Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

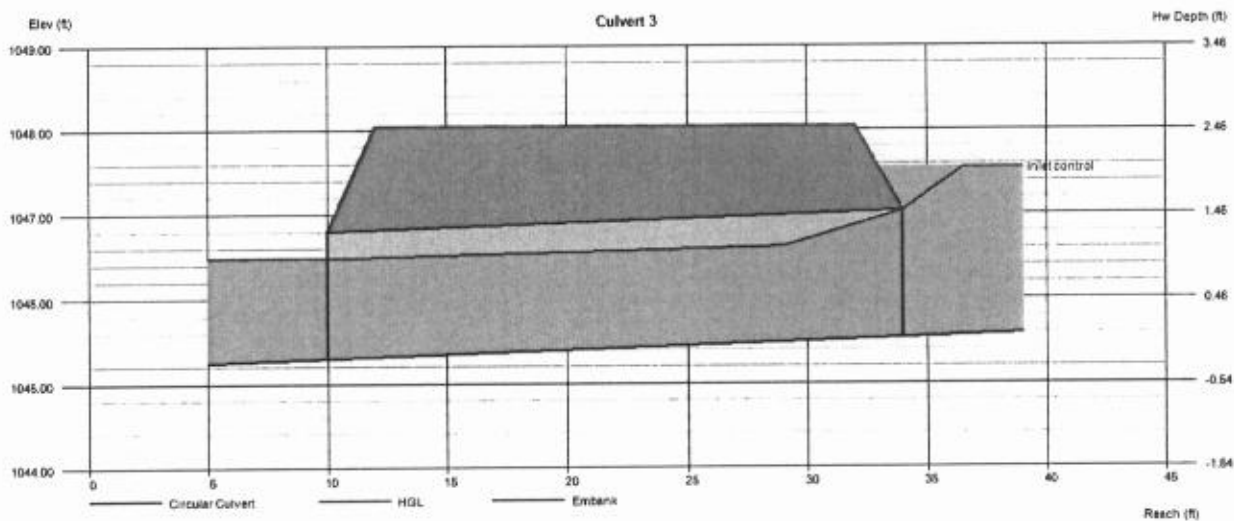
Embankment
Top Elevation (ft) = 1048.04
Top Width (ft) = 20.00
Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 8.18
Qmax (cfs) = 8.18
Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 8.18
Qpipe (cfs) = 8.18
Qovertop (cfs) = 0.00
Veloc Dn (ft/s) = 5.49
Veloc Up (ft/s) = 5.83
HGL Dn (ft) = 1046.48
HGL Up (ft) = 1046.65
Hw Elev (ft) = 1047.55
Hw/D (ft) = 1.34
Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Aug 20 2026

Culvert 4

Invert Elev Dn (ft)	= 1042.91
Pipe Length (ft)	= 24.00
Slope (%)	= 0.21
Invert Elev Up (ft)	= 1042.96
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.016
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Projecting
Coeff. K,M,c,Y,k	= 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

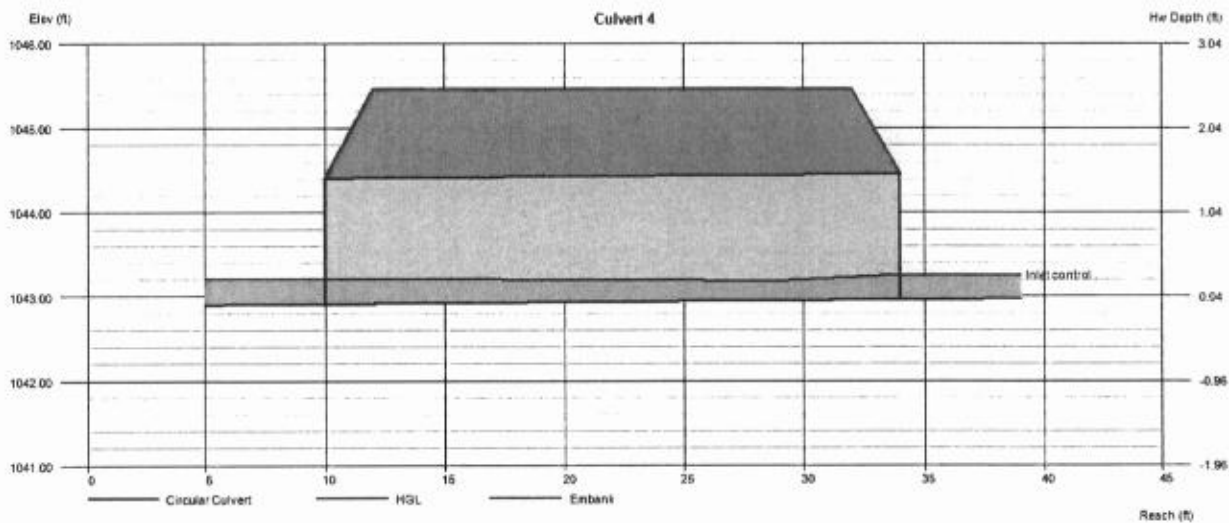
Top Elevation (ft)	= 1045.46
Top Width (ft)	= 20.00
Crest Width (ft)	= 24.00

Calculations

Qmin (cfs)	= 0.35
Qmax (cfs)	= 0.35
Tailwater Elev (ft)	= Normal

Highlighted

Qtotal (cfs)	= 0.35
Qpipe (cfs)	= 0.35
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 1.36
Veloc Up (ft/s)	= 2.20
HGL Dn (ft)	= 1043.22
HGL Up (ft)	= 1043.18
Hw Elev (ft)	= 1043.26
Hw/D (ft)	= 0.20
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Aug 20 2026

Culvert 7

Invert Elev Dn (ft) = 1040.37
 Pipe Length (ft) = 24.00
 Slope (%) = 4.46
 Invert Elev Up (ft) = 1041.44
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

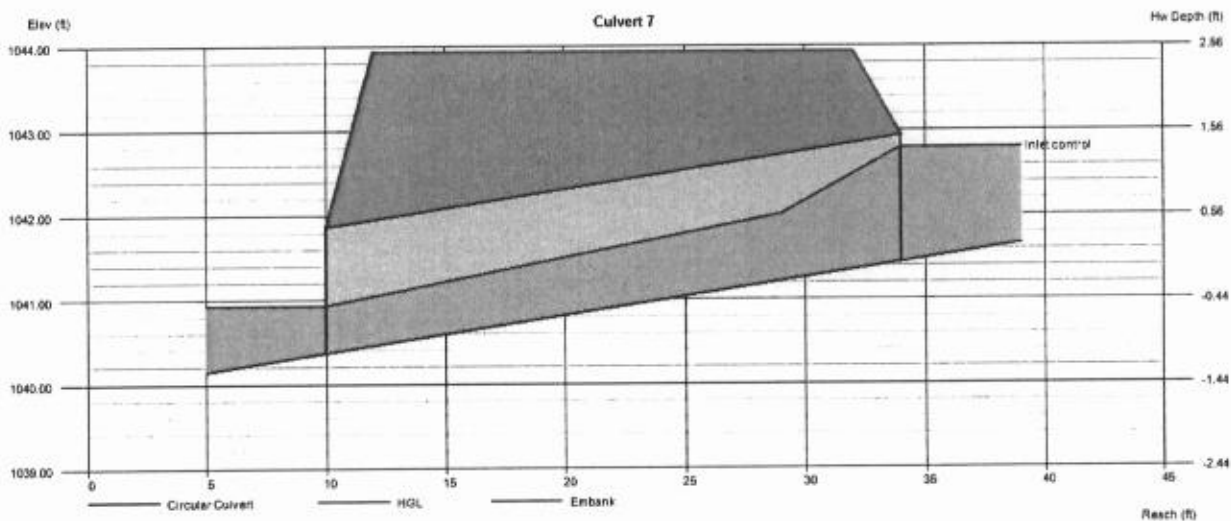
Embankment
 Top Elevation (ft) = 1043.94
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 5.02
 Qmax (cfs) = 5.02
 Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 5.02
 Qpipe (cfs) = 5.02
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 8.20
 Veloc Up (ft/s) = 4.78
 HGL Dn (ft) = 1040.94
 HGL Up (ft) = 1042.30
 Hw Elev (ft) = 1042.80
 Hw/D (ft) = 0.91
 Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

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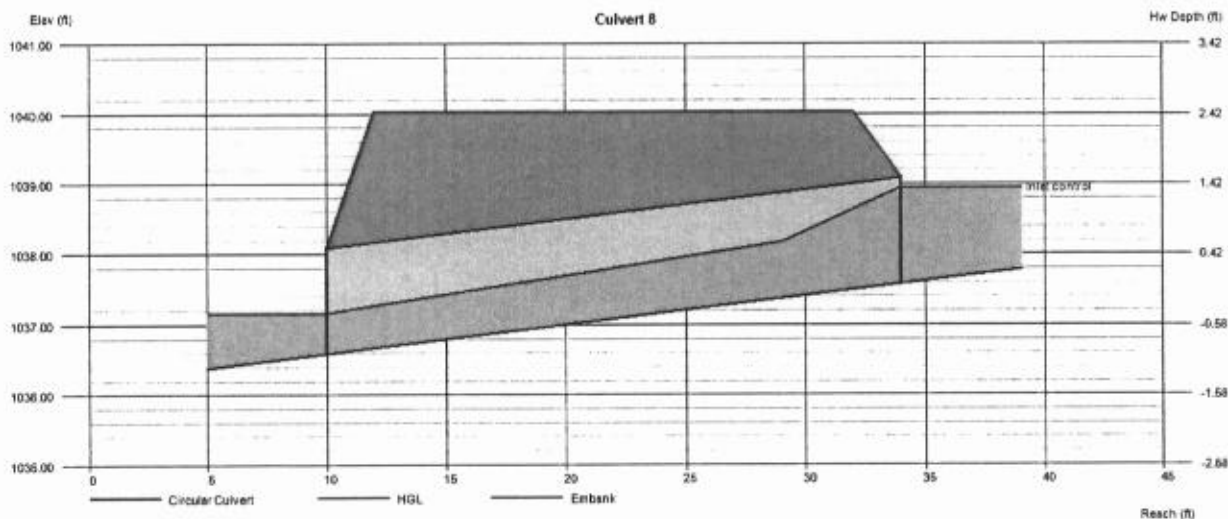
Culvert 8

Invert Elev Dn (ft) = 1036.59
 Pipe Length (ft) = 24.00
 Slope (%) = 4.12
 Invert Elev Up (ft) = 1037.58
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment
 Top Elevation (ft) = 1040.03
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations
 Qmin (cfs) = 5.02
 Qmax (cfs) = 5.02
 Tailwater Elev (ft) = Normal

Highlighted
 Qtotal (cfs) = 5.02
 Qpipe (cfs) = 5.02
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 7.99
 Veloc Up (ft/s) = 4.78
 HGL Dn (ft) = 1037.17
 HGL Up (ft) = 1038.44
 Hw Elev (ft) = 1038.95
 Hw/D (ft) = 0.91
 Flow Regime = Inlet Control



Culvert Report

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Culvert 9

Invert Elev Dn (ft) = 1020.68
 Pipe Length (ft) = 24.00
 Slope (%) = 4.12
 Invert Elev Up (ft) = 1021.67
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

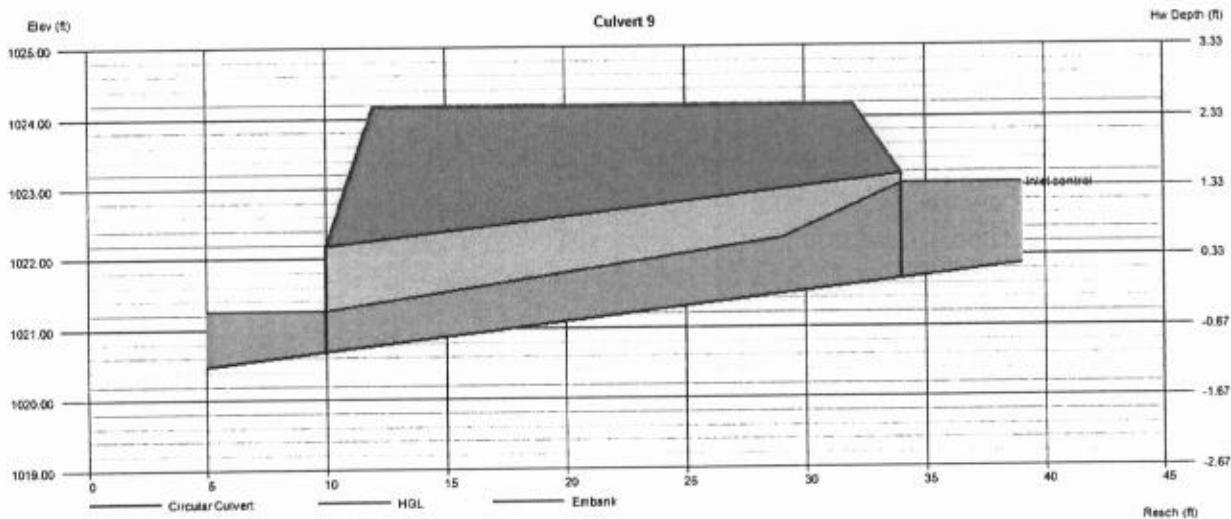
Embankment
 Top Elevation (ft) = 1024.17
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 5.02
 Qmax (cfs) = 5.02
 Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 5.02
 Qpipe (cfs) = 5.02
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 7.99
 Veloc Up (ft/s) = 4.78
 HGL Dn (ft) = 1021.26
 HGL Up (ft) = 1022.53
 Hw Elev (ft) = 1023.04
 Hw/D (ft) = 0.91
 Flow Regime = Inlet Control



Culvert Report

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Thursday, Aug 20 2026

Culvert 10

Invert Elev Dn (ft) = 1008.47
 Pipe Length (ft) = 24.00
 Slope (%) = 3.00
 Invert Elev Up (ft) = 1009.19
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

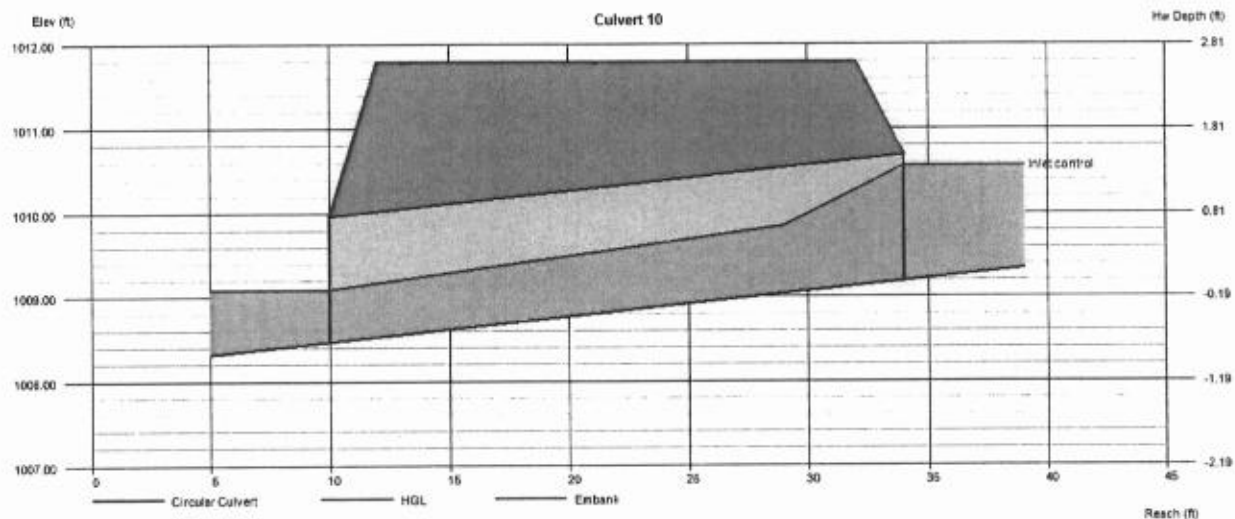
Embankment
 Top Elevation (ft) = 1011.79
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 5.02
 Qmax (cfs) = 5.02
 Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 5.02
 Qpipe (cfs) = 5.02
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 7.18
 Veloc Up (ft/s) = 4.78
 HGL Dn (ft) = 1009.10
 HGL Up (ft) = 1010.05
 Hw Elev (ft) = 1010.56
 Hw/D (ft) = 0.92
 Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Thursday, Aug 20 2026

Culvert 11/12

Invert Elev Dn (ft) = 999.21
 Pipe Length (ft) = 24.00
 Slope (%) = 1.96
 Invert Elev Up (ft) = 999.68
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

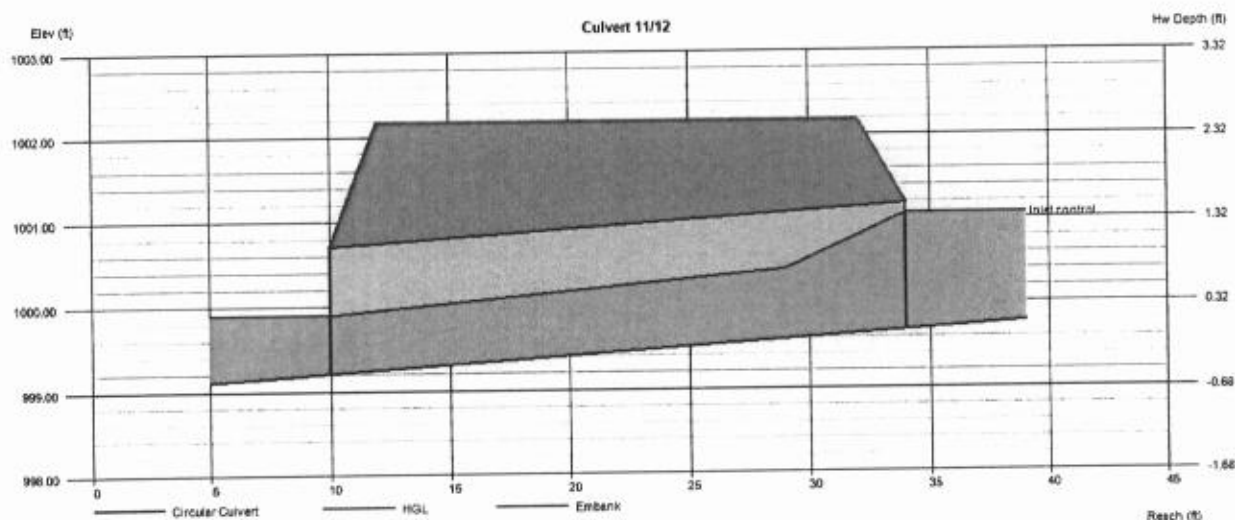
Embankment
 Top Elevation (ft) = 1002.18
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 5.02
 Qmax (cfs) = 5.02
 Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 5.02
 Qpipe (cfs) = 5.02
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 6.29
 Veloc Up (ft/s) = 4.78
 HGL Dn (ft) = 999.90
 HGL Up (ft) = 1000.54
 Hw Elev (ft) = 1001.06
 Hw/D (ft) = 0.92
 Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Aug 21 2026

Culvert 14

Invert Elev Dn (ft) = 978.56
 Pipe Length (ft) = 24.00
 Slope (%) = 1.17
 Invert Elev Up (ft) = 978.84
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

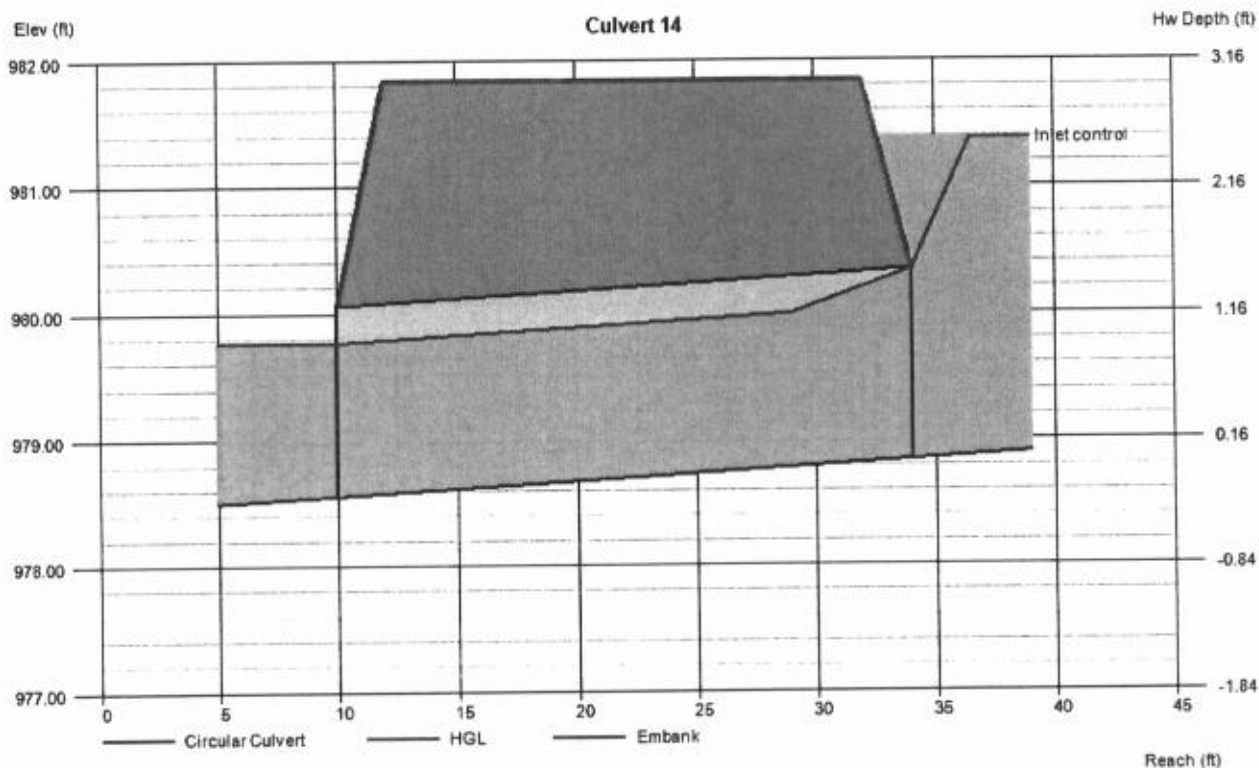
Top Elevation (ft) = 981.83
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 9.90
 Qmax (cfs) = 9.90
 Tailwater Elev (ft) = Critical

Highlighted

Qtotat (cfs) = 9.90
 Qpipe (cfs) = 9.90
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 6.47
 Veloc Up (ft/s) = 6.47
 HGL Dn (ft) = 979.77
 HGL Up (ft) = 980.05
 Hw Elev (ft) = 981.38
 Hw/D (ft) = 1.69
 Flow Regime = Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Aug 21 2026

Culvert 15

Invert Elev Dn (ft) = 980.93
 Pipe Length (ft) = 24.00
 Slope (%) = 0.83
 Invert Elev Up (ft) = 981.13
 Rise (in) = 18.0
 Shape = Circular
 Span (in) = 18.0
 No. Barrels = 1
 n-Value = 0.016
 Culvert Type = Circular Corrugate Metal Pipe
 Culvert Entrance = Projecting
 Coeff. K,M,c,Y,k = 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment
 Top Elevation (ft) = 984.13
 Top Width (ft) = 20.00
 Crest Width (ft) = 24.00

Calculations

Qmin (cfs) = 9.94
 Qmax (cfs) = 9.94
 Tailwater Elev (ft) = Normal

Highlighted

Qtotal (cfs) = 9.94
 Qpipe (cfs) = 9.94
 Qovertop (cfs) = 0.00
 Veloc Dn (ft/s) = 5.63
 Veloc Up (ft/s) = 5.62
 HGL Dn (ft) = 982.43
 HGL Up (ft) = 982.76
 Hw Elev (ft) = 983.68
 Hw/D (ft) = 1.70
 Flow Regime = Inlet Control

