



# DRAINAGE ASSESSMENT

PRE-SR725-13.60

**2LMN**

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# Drainage Narrative:

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## Project Description

2LMN, Inc. has been retained to prepare plans to remove the existing guardrail, improve roadside ditches, and provide the necessary design to replace the existing two culverts, CFN 1982079 (PRE-725-1383) and SFN 6804403 (PRE-725-1394), on S.R. 725. With the above improvements, 2LMN has conducted a drainage assessment on the existing and proposed culverts, roadway ditches, drive culverts, and water quality within the project limits using the latest ODOT Location and Design Volume 2.

## Design Criteria and Headwater Control

The drainage design criteria for this project follow the design standards found within the ODOT Location and Design Manual: Volume 2 dated July 19, 2024.

### ODOT Culvert Design Requirements:

1. Culvert headwater controls
  - 1- ft below low edge of pavement for drainage area less than 1000 acres.
  - 2-ft above inlet crown elevation or tailwater elevation.
2. Check Storm Controls
  - 2-ft below lowest ground elevation of adjacent building.
  - Twice the diameter/rise of the culvert.
  - Size a replacement structure to prevent overtopping by the 100-year storm where overtopping would not occur with the existing structure.
  - Size a replacement structure so that flooding of upstream land is not increased for the 100-year storm when compared to the existing structure. Before implementing this criterion consider the type of upstream property and land use.

## Hydrology

USGS StreamStats, a web-based GIS platform was used to determine contributing drainage area of the existing culverts. The existing culvert located at station 735+16.10 conveys water from a total contributing drainage area of 160.0 acres, while the second is located at sta. 744+20.18 conveys water from a total contributing drainage area of 108.80 acres. The peak flows obtained from the StreamStats report are listed in Table 1.

See [Appendix 1](#) for the StreamStats report for the Culverts. The drainage area for the ditches and drive pipes was determined using the Lidar and survey data. The time of concentration was calculated using the ODOT Location and Design Volume 2 with a minimum time of concentration 15 minutes.

See [Appendix 2](#) and 3 for the ditch map area.

See [Appendix 3](#) for the ditch time of concentration calculations.

Table 1 Calculated flows

Culvert	DA, ac	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
43" x 64" PRE-725-1383	160.0	64.80	115	156	216	265	319
44" x 72" PRE-725-1394	108.80	48	86	117	161	199	240

### Culvert Analysis

The culvert analysis was performed using the culvert hydraulic analysis program (HY-8). The low edge of the pavement at PRE-725-1383 (43" x 64") is 913.54 ft, while 911.20 ft at PRE-725-1394 (44" x 72"). Per ODOT L&D Manual Vol. 2, the design storm shall be at least 1 ft below the low edge of the pavement. A 25-year design storm and a 100-year check storm were selected for the culvert analysis. ODOT CDSS software was utilized to determine the hydraulically appropriate pipe, which was 63" x 98" elliptical. Then, the proposed culverts were analyzed using HY-8. The results for the proposed pipes indicate them to be hydraulically adequate, as the headwater elevations for the design and check storms meet those specified by ODOT. Based on the design velocities, Rock Channel Protection Types B was suggested at the proposed culvert outlets. Inlet riprap was proposed where channel grading was necessary.

See [Appendix 4](#) for the culvert analysis.

See [Appendix 5](#) for the rock channel protection design.

### Driveway pipe Analysis

The driveway pipes located at stations; 723+02.37, 724+00.00, 728+29.70 and 729+61.50 were analyzed using ODOT CDSS software. The results indicate that existing pipe sizes are hydraulically adequate.

See [Appendix 6](#) for the driveway pipe analysis.

### Ditch Analysis

The ditch analysis was conducted using ODOT CDSS software.

See [Appendix 7](#) for the ditch analysis.

### Post Construction Best Management Practices (BMPs) Calculations

For this project, there is greater than 1 acre of earth disturbed area (EDA). Therefore, this project will require post construction BMP's. While this project is not constrained entirely within existing R/W, no new impervious area will be proposed beyond the existing R/W limits and thus can be considered a "Redevelopment Project" as defined in L&D Volume 2: section 1111.6. Due to this, only water quality treatment will be required. This limits the type of BMP to one of the following: 1) manufactured system 2) vegetated biofilter (widened ditches) and 3) vegetated filter strips (VFS). Typically, vegetation-based water quality BMPs are the preferred option, as they are cheaper and easier to maintain. To avoid the

need to construct ditches with steeper slopes and widened ditch bottoms, VFS are the preferred vegetation-based water quality BMP options. In order to use VFS, the L&D Volume 2: section 1113.2.1 states that the following conditions must be satisfied:

- The minimum VFS width is equal to the width of the contributing impervious area
- The maximum slope of the VFS is 3:1
- All runoff must be sheet flow, with no concentrated flows to the VFS

These conditions are currently met on the southern portion of the project. From Station 724+50 to 735+00, there will be more than 15' of width provided along the grassed portion of the graded shoulder down to the toe of the ditch, which will meet the requirements per L&D Volume 2 table 1117-3.

It has been determined that the project earth disturbed area (EDA) – as defined in the L&D Volume 2: section 1109.1 – is approximately 2.50 acres total.

Due to the project being considered “redevelopment project” – the treatment % (T%) for this project will be 20%. Table 1 below summarizes the overall project BMP treatment requirements.

<b>Table 1: BMP Treatment Requirements</b>		
<b>Description</b>	<b>Area</b>	<b>Unit</b>
PRE-SR725-13.60 – Earth Disturbed Area (EDA)	2.70	Acre
Required Treatment, T% (Redevelopment Project)	20%	
<b>Required Treatment Area</b>	<b>2.50 x 20% = 0.54</b>	<b>Acre</b>

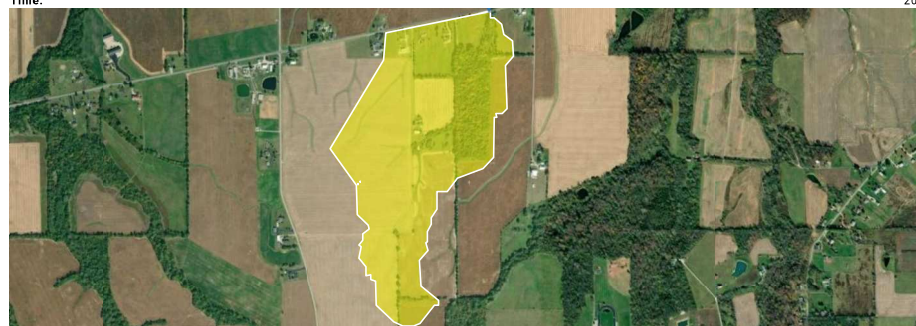
Vegetated filter strips have been chosen as this project’s BMP. The BMP calculations and treatment area location can all be found in the [Appendix 8](#).

# Appendix 1

## StreamStats Report

Region ID:  
 Workspace ID:  
 Clicked Point (Latitude, Longitude):  
 Time:

OH  
 OH20231006125726398000  
 39.64243, -84.56295  
 2023-10-06 08:58:21 -0400



PRE-725-1383

Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	59.1	feet per mi
DRNAREA	Area that drains to a point on a stream	0.25	square miles
FOREST	Percentage of area covered by forest	6.84	percent
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees
LC92STOR	Percentage of water bodies and wetlands determined from the NLCD	0	percent
LONG_CENT	Longitude Basin Centroid	84.5666	decimal degrees
OHREGA	Ohio Region A Indicator	0	dimensionless
OHREGC	Ohio Region C Indicator	1	dimensionless
PRECIPCENT	Mean Annual Precip at Basin Centroid	37.8	inches
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.56	dimensionless

General Disclaimers

This watershed has been edited, computed flows and basin characteristics may not apply. For more information, submit a support request from the 'Help' button in the upper-right of the screen, attach a pdf of this report and request assistance from your local StreamStats regional representative.

Maximum Probable Flood Statistics

Maximum Probable Flood Statistics Parameters [Crippen Bue Region 6]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	0.1	10000

Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 6]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	2110	ft <sup>3</sup> /s

Maximum Probable Flood Statistics Citations

Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (<https://pubs.usgs.gov/wsp/1887/report.pdf>)

Peak-Flow Statistics

Peak-Flow Statistics Parameters [Peak Flow Full Model Reg C SIR2019 5018]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	0.26	2514
OHREGC	Ohio Region C Indicator 1 if in C else 0	1	dimensionless	0	1
OHREGA	Ohio Region A Indicator 1 if in A else 0	0	dimensionless	0	1
CSL1085LFP	Stream Slope 10 and 85 Longest Flow Path	59.1	feet per mi	3.24	131
LC92STOR	Percent Storage from NLCD1992	0	percent	0	1.23

Peak-Flow Statistics Disclaimers [Peak Flow Full Model Reg C SIR2019 5018]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Peak-Flow Statistics Flow Report [Peak Flow Full Model Reg C SIR2019 5018]

Statistic	Value	Unit
50-percent AEP flood	64.8	ft <sup>3</sup> /s
20-percent AEP flood	115	ft <sup>3</sup> /s
10-percent AEP flood	156	ft <sup>3</sup> /s
4-percent AEP flood	216	ft <sup>3</sup> /s
2-percent AEP flood	265	ft <sup>3</sup> /s
1-percent AEP flood	319	ft <sup>3</sup> /s
0.2-percent AEP flood	463	ft <sup>3</sup> /s

Peak-Flow Statistics Citations

Koltun, G.F.,2019, Flood-frequency estimates for Ohio streamgages based on data through water year 2015 and techniques for estimating flood-frequency characteristics of rural, unregulated Ohio streams: U.S. Geological Survey Scientific Investigations Report 2019-5018, 25 p. (<https://dx.doi.org/10.3133/sir20195018>)

Low-Flow Statistics

Low-Flow Statistics Parameters [Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
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Low-Flow Statistics

Low-Flow Statistics Parameters [Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.24	1.12

Low-Flow Statistics Disclaimers [Low Flow Region A 2012 5138]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Low-Flow Statistics Flow Report [Low Flow Region A 2012 5138]

Statistic	Value	Unit
1 Day 10 Year Low Flow	0.00332	ft <sup>3</sup> /s
7 Day 10 Year Low Flow	0.00426	ft <sup>3</sup> /s
30 Day 10 Year Low Flow	0.00669	ft <sup>3</sup> /s
90 Day 10 Year Low Flow	0.0105	ft <sup>3</sup> /s

Low-Flow Statistics Citations

Koltun, G.F., and Kula, S.P., 2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012-5138, 195 p. (<http://pubs.usgs.gov/sir/2012/5138/>)

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.24	1.12

Flow-Duration Statistics Disclaimers [Low Flow Region A 2012 5138]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Flow-Duration Statistics Flow Report [Low Flow Region A 2012 5138]

Statistic	Value	Unit
80 Percent Duration	0.0222	ft <sup>3</sup> /s

Flow-Duration Statistics Citations

Koltun, G.F., and Kula, S.P., 2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012-5138, 195 p. (<http://pubs.usgs.gov/sir/2012/5138/>)

Annual Flow Statistics

Annual Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	0.12	7422
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2
PRECPCENT	Mean Annual Precip at Basin Centroid	37.8	inches	34	43.2

Annual Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIU: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
Mean Annual Flow	0.236	ft <sup>3</sup> /s	11.4	11.4

Annual Flow Statistics Citations

Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (<https://pubs.er.usgs.gov/publication/wri024068>)

Monthly Flow Statistics

Monthly Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
PRECPCENT	Mean Annual Precip at Basin Centroid	37.8	inches	34	43.2
FOREST	Percent Forest	6.84	percent	0	99.1
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.25	1.13

Monthly Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIU: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
January Mean Flow	0.329	ft <sup>3</sup> /s	16.6	16.6
February Mean Flow	0.449	ft <sup>3</sup> /s	11.9	11.9
March Mean Flow	0.474	ft <sup>3</sup> /s	14	14
April Mean Flow	0.464	ft <sup>3</sup> /s	11.2	11.2
May Mean Flow	0.311	ft <sup>3</sup> /s	19.5	19.5
June Mean Flow	0.193	ft <sup>3</sup> /s	27	27
July Mean Flow	0.112	ft <sup>3</sup> /s	28.2	28.2
August Mean Flow	0.0765	ft <sup>3</sup> /s	36.8	36.8
September Mean Flow	0.0418	ft <sup>3</sup> /s	43.6	43.6
October Mean Flow	0.0459	ft <sup>3</sup> /s	50.8	50.8
November Mean Flow	0.108	ft <sup>3</sup> /s	37.5	37.5

Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (<https://pubs.er.usgs.gov/publication/wri024068>)

Monthly Flow Statistics Citations

General Flow Statistics



Monthly Flow Statistics Citations

➤ General Flow Statistics

General Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2

General Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIU: Prediction Interval-Upper, ASEP: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEP
Harmonic Mean Streamflow	0.026	ft <sup>3</sup> /s	65.9	65.9

General Flow Statistics Citations

Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p. (https://pubs.er.usgs.gov/publication/wri024068)

➤ Flow Percentile Statistics

Flow Percentile Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2
LONG_CENT	Longitude of Basin Centroid	84.5666	decimal degrees	80.53	84.6

Flow Percentile Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIU: Prediction Interval-Upper, ASEP: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEP
25th Percentile Flow	0.0652	ft <sup>3</sup> /s	29.2	29.2
50th Percentile Flow Median	0.123	ft <sup>3</sup> /s	40.3	40.3
75th Percentile Flow	0.247	ft <sup>3</sup> /s	47.9	47.9

Flow Percentile Statistics Citations

Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p. (https://pubs.er.usgs.gov/publication/wri024068)

➤ Probability Statistics

Probability Statistics Parameters [P zero Flow 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.25	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.24	1.12

Probability Statistics Disclaimers [P zero Flow 2012 5138]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

Probability Statistics Flow Report [P zero Flow 2012 5138]

Statistic	Value	Unit
Probability zero flow 1Day	0.0349	dim
Probability zero flow 7Day	0.0151	dim
Probability zero flow 30Day	0.000646	dim

Probability Statistics Citations

Koltun, G.F., and Kula, S.P., 2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012-5138, 195 p. (http://pubs.usgs.gov/sir/2012/5138/)

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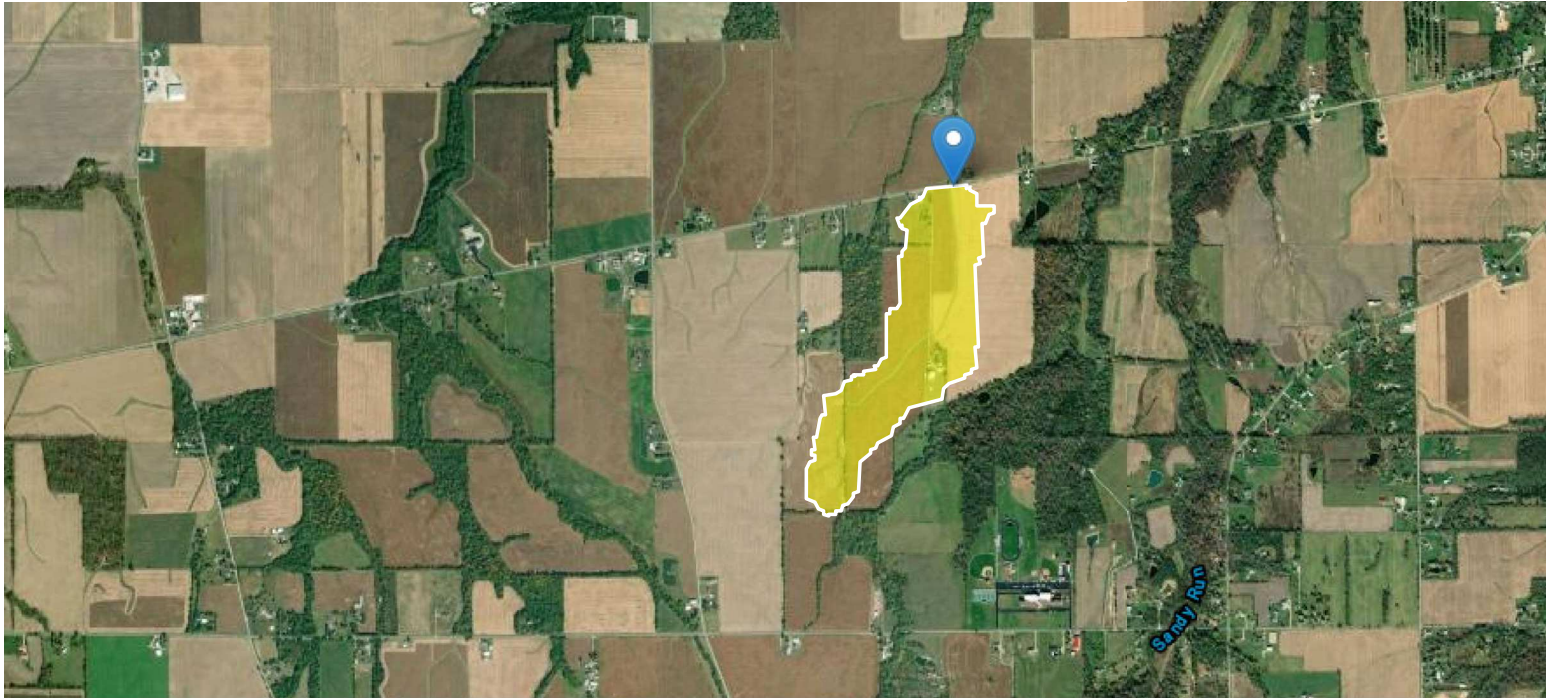
USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.17.0  
StreamStats Services Version: 1.2.22  
NSS Services Version: 2.2.1

# PRE-SR725-13.60\_44" x 72" Twin CMP\_STA. 744+20.18\_StreamStats Report

**Region ID:** OH  
**Workspace ID:** OH20230524140346418000  
**Clicked Point (Latitude, Longitude):** 39.64287, -84.55950  
**Time:** 2023-05-24 10:04:50 -0400

PRE-725-1394



[+ Collapse All](#)

## ➤ Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	59.4	feet per mi
DRNAREA	Area that drains to a point on a stream	0.17	square miles
FOREST	Percentage of area covered by forest	0	percent
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees
LC92STOR	Percentage of water bodies and wetlands determined from the NLCD	0	percent
LONG_CENT	Longitude Basin Centroid	84.5616	decimal degrees
OHREGA	Ohio Region A Indicator	0	dimensionless
OHREGC	Ohio Region C Indicator	1	dimensionless
PRECIPCENT	Mean Annual Precip at Basin Centroid	37.8	inches

Parameter Code	Parameter Description	Value	Unit
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.56	dimensionless

## ➤ Peak-Flow Statistics

### Peak-Flow Statistics Parameters [Peak Flow Full Model Reg C SIR2019 5018]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.26	2514
OHREGC	Ohio Region C Indicator 1 if in C else 0	1	dimensionless	0	1
OHREGA	Ohio Region A Indicator 1 if in A else 0	0	dimensionless	0	1
CSL1085LFP	Stream Slope 10 and 85 Longest Flow Path	59.4	feet per mi	3.24	131
LC92STOR	Percent Storage from NLCD1992	0	percent	0	1.23

### Peak-Flow Statistics Disclaimers [Peak Flow Full Model Reg C SIR2019 5018]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

### Peak-Flow Statistics Flow Report [Peak Flow Full Model Reg C SIR2019 5018]

Statistic	Value	Unit
50-percent AEP flood	48	ft <sup>3</sup> /s
20-percent AEP flood	85.9	ft <sup>3</sup> /s
10-percent AEP flood	117	ft <sup>3</sup> /s
4-percent AEP flood	161	ft <sup>3</sup> /s
2-percent AEP flood	199	ft <sup>3</sup> /s
1-percent AEP flood	240	ft <sup>3</sup> /s
0.2-percent AEP flood	350	ft <sup>3</sup> /s

#### Peak-Flow Statistics Citations

Koltun, G.F., 2019, Flood-frequency estimates for Ohio streamgages based on data through water year 2015 and techniques for estimating flood-frequency characteristics of rural, unregulated Ohio streams: U.S. Geological Survey Scientific Investigations Report 2019–5018, 25 p. (<https://dx.doi.org/10.3133/sir20195018>)

## ➤ Low-Flow Statistics

### Low-Flow Statistics Parameters [Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	1	1250

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.24	1.12

#### Low-Flow Statistics Disclaimers [Low Flow Region A 2012 5138]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

#### Low-Flow Statistics Flow Report [Low Flow Region A 2012 5138]

Statistic	Value	Unit
1 Day 10 Year Low Flow	0.00226	ft <sup>3</sup> /s
7 Day 10 Year Low Flow	0.0029	ft <sup>3</sup> /s
30 Day 10 Year Low Flow	0.00455	ft <sup>3</sup> /s
90 Day 10 Year Low Flow	0.00717	ft <sup>3</sup> /s

#### Low-Flow Statistics Citations

**Koltun, G.F., and Kula, S.P.,2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012–5138, 195 p. (<http://pubs.usgs.gov/sir/2012/5138/>)**

### ➤ Flow-Duration Statistics

#### Flow-Duration Statistics Parameters [Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.24	1.12

#### Flow-Duration Statistics Disclaimers [Low Flow Region A 2012 5138]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

#### Flow-Duration Statistics Flow Report [Low Flow Region A 2012 5138]

Statistic	Value	Unit
80 Percent Duration	0.0151	ft <sup>3</sup> /s

#### Flow-Duration Statistics Citations

**Koltun, G.F., and Kula, S.P.,2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012–5138, 195 p. (<http://pubs.usgs.gov/sir/2012/5138/>)**

## ➤ Annual Flow Statistics

### Annual Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.12	7422
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2
PRECIPCENT	Mean Annual Precip at Basin Centroid	37.8	inches	34	43.2

### Annual Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
Mean Annual Flow	0.16	ft <sup>3</sup> /s	11.4	11.4

#### Annual Flow Statistics Citations

**Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (<https://pubs.er.usgs.gov/publication/wri024068>)**

## ➤ Monthly Flow Statistics

### Monthly Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
PRECIPCENT	Mean Annual Precip at Basin Centroid	37.8	inches	34	43.2
FOREST	Percent Forest	0	percent	0	99.1
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.25	1.13

### Monthly Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
January Mean Flow	0.223	ft <sup>3</sup> /s	16.6	16.6
February Mean Flow	0.284	ft <sup>3</sup> /s	11.9	11.9
March Mean Flow	0.291	ft <sup>3</sup> /s	14	14
April Mean Flow	0.293	ft <sup>3</sup> /s	11.2	11.2
May Mean Flow	0.187	ft <sup>3</sup> /s	19.5	19.5
June Mean Flow	0.131	ft <sup>3</sup> /s	27	27

Statistic	Value	Unit	SE	ASEp
July Mean Flow	0.0757	ft <sup>3</sup> /s	28.2	28.2
August Mean Flow	0.0518	ft <sup>3</sup> /s	36.8	36.8
September Mean Flow	0.0228	ft <sup>3</sup> /s	43.6	43.6
October Mean Flow	0.0308	ft <sup>3</sup> /s	50.8	50.8
November Mean Flow	0.0726	ft <sup>3</sup> /s	37.5	37.5
December Mean Flow	0.139	ft <sup>3</sup> /s	21.8	21.8

*Monthly Flow Statistics Citations*

**Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (<https://pubs.er.usgs.gov/publication/wri024068>)**

➤ General Flow Statistics

General Flow Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2

General Flow Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
Harmonic Mean Streamflow	0.0175	ft <sup>3</sup> /s	65.9	65.9

*General Flow Statistics Citations*

**Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (<https://pubs.er.usgs.gov/publication/wri024068>)**

➤ Flow Percentile Statistics

Flow Percentile Statistics Parameters [Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	0	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	39.637	decimal degrees	38.68	41.2

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
LONG_CENT	Longitude of Basin Centroid	84.5616	decimal degrees	80.53	84.6

### Flow Percentile Statistics Flow Report [Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, ASEp: Average Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	ASEp
25th Percentile Flow	0.0465	ft <sup>3</sup> /s	29.2	29.2
50th Percentile Flow Median	0.0859	ft <sup>3</sup> /s	40.3	40.3
75th Percentile Flow	0.17	ft <sup>3</sup> /s	47.9	47.9

#### Flow Percentile Statistics Citations

**Koltun, G. F., and Whitehead, M. T., 2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p** (<https://pubs.er.usgs.gov/publication/wri024068>)

## ➤ Bankfull Statistics

### Bankfull Statistics Parameters [Interior Plains D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.19305	59927.7393

### Bankfull Statistics Parameters [Central Lowland P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.200772	59927.66594

### Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.07722	59927.7393

### Bankfull Statistics Disclaimers [Interior Plains D Bieger 2015]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

### Bankfull Statistics Flow Report [Interior Plains D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	6.3	ft
Bieger_D_channel_depth	1.07	ft
Bieger_D_channel_cross_sectional_area	9.35	ft <sup>2</sup>

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

## Bankfull Statistics Flow Report [Central Lowland P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	7.4	ft
Bieger_P_channel_depth	1.37	ft
Bieger_P_channel_cross_sectional_area	9.22	ft <sup>2</sup>

## Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	6.64	ft
Bieger_USA_channel_depth	0.827	ft
Bieger_USA_channel_cross_sectional_area	6.56	ft <sup>2</sup>

## Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	6.3	ft
Bieger_D_channel_depth	1.07	ft
Bieger_D_channel_cross_sectional_area	9.35	ft <sup>2</sup>
Bieger_P_channel_width	7.4	ft
Bieger_P_channel_depth	1.37	ft
Bieger_P_channel_cross_sectional_area	9.22	ft <sup>2</sup>
Bieger_USA_channel_width	6.64	ft
Bieger_USA_channel_depth	0.827	ft
Bieger_USA_channel_cross_sectional_area	6.56	ft <sup>2</sup>

*Bankfull Statistics Citations*

**Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G., 2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. ([https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm\\_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm\\_medium=PDF&utm\\_campaign=PDFCoverPages](https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_campaign=PDFCoverPages))**

## ➤ Probability Statistics

## Probability Statistics Parameters [P zero Flow 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.56	dimensionless	0.24	1.12



One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors.

## Probability Statistics Flow Report [P zero Flow 2012 5138]

Statistic	Value	Unit
Probability zero flow 1Day	0.0349	dim
Probability zero flow 7Day	0.0151	dim
Probability zero flow 30Day	0.000646	dim

*Probability Statistics Citations*

**Koltun, G.F., and Kula, S.P.,2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012–5138, 195 p. (<http://pubs.usgs.gov/sir/2012/5138/>)**

## ➤ Maximum Probable Flood Statistics

## Maximum Probable Flood Statistics Parameters [Crippen Bue Region 6]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.17	square miles	0.1	10000

## Maximum Probable Flood Statistics Flow Report [Crippen Bue Region 6]

Statistic	Value	Unit
Maximum Flood Crippen Bue Regional	1500	ft <sup>3</sup> /s

*Maximum Probable Flood Statistics Citations*

**Crippen, J.R. and Bue, Conrad D.1977, Maximum Floodflows in the Conterminous United States, Geological Survey Water-Supply Paper 1887, 52p. (<https://pubs.usgs.gov/wsp/1887/report.pdf>)**

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# Appendix 2

## Ditch Drainage Area Map



DA	AREA	RUNOFF COEFFICIENT	TIME OF CONCENTRATION
1	1.68	0.58	16.3
2	14.83	0.58	54.4
3	15.29	0.57	65.5
4	4.45	0.58	27.8
5	6.06	0.58	32.4
4	19.17	0.60	71.8
5	0.49	0.60	15.0
9	0.13	0.72	10.0
10	0.18	0.69	10.0
11	0.15	0.69	10.0
12	0.17	0.68	10.0
13	0.15	0.69	10.0
14	0.09	0.68	10.0
15	1.47	0.46	63.4
16	2.38	0.46	57.0
17	2.50	0.46	30.0

# Appendix 3

## Ditch Time of Concentration Calculations

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 1  
**BEGIN STATION:** 724+00.00  
**END STATION:** 728+00.00

Total Area	1.68	acres
------------	------	-------

		C value	Area (ac.)		CA
	Woods	0.3	0.09		0.03
		0.35			
		0.4			
		0.45			
	Residential	0.5	0.52		0.26
		0.55			
	Cultivated	0.6	0.89		0.54
		0.65			
		0.7			
	Paved	0.9	0.17		0.16
C avg. (Runoff coeff.)	0.58	Total Area	1.68	Total CA	0.98

Sheet Elevations	
High Pt.	Low Pt.
964.95	960.10

Shallow Elevations	
High Pt.	Low Pt.
960.10	920.01

Ditch Elevations	
High Pt.	Low Pt.
920.01	917.43

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	145.00	199.95
S [Slope (%)]	1.616	27.647	1.290
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		3.67	1.70
Time of Conc. (min)	13.7	0.7	2.0
Total time (min)			16.3

<b>Min. Tc (min)</b>	15
----------------------	----

Use Tc: 16.3 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 2  
**BEGIN STATION:** 728+00.00  
**END STATION:** 729+00.00

Total Area	14.83	acres
------------	-------	-------

		C value	Area (ac.)		CA
	Woods	0.3	0.70		0.21
		0.35			
		0.4			
		0.45			
	Residential	0.5	0.58		0.29
		0.55			
	Cultivated	0.6	13.50		8.10
		0.65			
		0.7			
	Paved	0.9	0.05		0.04
C avg. (Runoff coeff.)		0.58	Total Area	14.83	Total CA
					8.64

Sheet Elevations	
High Pt.	Low Pt.
964.95	960.10

Shallow Elevations	
High Pt.	Low Pt.
960.10	917.04

Ditch Elevations	
High Pt.	Low Pt.
917.04	915.91

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	2290.91	84.02
S [Slope (%)]	1.616	1.880	1.346
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.96	1.74
Time of Conc. (min)	13.7	39.9	0.8
Total time (min)			54.4

Min. Tc (min)	15
---------------	----

Use Tc: 54.4 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 3  
**BEGIN STATION:** 729+00.00  
**END STATION:** 730+00.00

Total Area	15.29	acres
------------	-------	-------

	C value	Area (ac.)	CA
Woods	0.3	1.03	0.31
	0.35		
	0.4		
	0.45		
Residential	0.5	1.63	0.82
	0.55		
Cultivated	0.6	12.58	7.55
	0.65		
	0.7		
Paved	0.9	0.05	0.04
<b>C avg. (Runoff coeff.)</b>	<b>0.57</b>	<b>Total Area 15.29</b>	<b>Total CA 8.72</b>

Sheet Elevations	
High Pt.	Low Pt.
966.68	964.04

Shallow Elevations	
High Pt.	Low Pt.
964.04	915.61

Ditch Elevations	
High Pt.	Low Pt.
915.61	914.52

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	2670.78	90.05
S [Slope (%)]	0.878	1.813	1.209
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.94	1.65
Time of Conc. (min)	17.3	47.3	0.9
Total time (min)			65.5

Min. Tc (min)	15
---------------	----

Use Tc: 65.5 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 4  
**BEGIN STATION:** 730+00.00  
**END STATION:** 734+50.00

Total Area	4.45	acres
------------	------	-------

		C value	Area (ac.)		CA
	Woods	0.3	0.86		0.26
		0.35			
		0.4			
		0.45			
	Residential	0.5	0.09		0.05
		0.55			
	Cultivated	0.6	3.30		1.98
		0.65			
		0.7			
	Paved	0.9	0.20		0.18
C avg. (Runoff coeff.)	0.55	Total Area	4.45	Total CA	2.46

Sheet Elevations	
High Pt.	Low Pt.
935.00	928.92

Shallow Elevations	
High Pt.	Low Pt.
928.92	913.06

Ditch Elevations	
High Pt.	Low Pt.
913.06	909.83

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	713.33	282.30
S [Slope (%)]	2.026	2.224	1.145
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		1.04	1.60
Time of Conc. (min)	13.5	11.4	2.9
Total time (min)			27.8

<b>Min. Tc (min)</b>	15
----------------------	----

Use Tc: 27.8 min



### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 5  
**BEGIN STATION:** 735+50.00  
**END STATION:** 739+40.00

Total Area	6.06	acres
------------	------	-------

	C value	Area (ac.)	CA
Woods	0.3	0.47	0.14
	0.35		
	0.4		
	0.45		
Residential	0.5	0.14	0.07
	0.55		
Cultivated	0.6	5.31	3.18
	0.65		
	0.7		
Paved	0.9	0.14	0.12
C avg. (Runoff coeff.)	0.58	Total Area 6.06	Total CA 3.52

Sheet Elevations	
High Pt.	Low Pt.
932.19	927.37

Shallow Elevations	
High Pt.	Low Pt.
927.37	912.30

Ditch Elevations	
High Pt.	Low Pt.
912.30	910.52

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	966.63	21.30
S [Slope (%)]	1.607	1.559	8.339
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.87	4.33
Time of Conc. (min)	13.8	18.5	0.1
Total time (min)			32.4

Min. Tc (min)	15
---------------	----

Use Tc: 32.4 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 6  
**BEGIN STATION:** 721+85.00  
**END STATION:** 723+05.00

<b>Total Area</b>	19.17	acres
-------------------	-------	-------

		C value	Area (ac.)		CA
	Woods	0.3			
		0.35			
		0.4			
		0.45			
	Residential	0.5	0.24		0.12
		0.55			
	Cultivated	0.6	18.93		11.36
		0.65			
		0.7			
	Paved	0.9			
C avg. (Runoff coeff.)	0.60		Total Area 19.17	Total CA	11.48

Sheet Elevations	
High Pt.	Low Pt.
970.81	967.92

Shallow Elevations	
High Pt.	Low Pt.
967.92	923.14

Ditch Elevations	
High Pt.	Low Pt.
923.14	922.34

	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	2902.38	32.04
S [Slope (%)]	0.963	1.543	2.497
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.87	2.37
Time of Conc. (min)	15.8	55.7	0.2
<b>Total time (min)</b>			71.8

<b>Min. Tc (min)</b>	15
----------------------	----

Use Tc: 71.8 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 7  
**BEGIN STATION:** 723+05.00  
**END STATION:** 724+00.00

Total Area	0.49	acres
------------	------	-------

	C value	Area (ac.)	CA
Woods	0.3		
	0.35		
	0.4		
	0.45		
Residential	0.5		
	0.55		
Cultivated	0.6	0.49	0.29
	0.65		
	0.7		
Paved	0.9		
C avg. (Runoff coeff.)	0.60	Total Area	Total CA
		0.49	0.29

Sheet Elevations	
High Pt.	Low Pt.
930.05	923.83

Shallow Elevations	
High Pt.	Low Pt.
923.83	921.54

Ditch Elevations	
High Pt.	Low Pt.
921.54	921.27

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	4.47	29.91
S [Slope (%)]	2.073	51.230	0.903
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		5.00	1.42
Time of Conc. (min)	12.2	0.0	0.3
Total time (min)			12.6

Min. Tc (min)	15
---------------	----

Use Tc: 15.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 9  
**BEGIN STATION:** 724+16.09  
**END STATION:** 726+00.00

Total Area	0.13	acres
------------	------	-------

		C value	Area (ac.)	CA	
	Woods	0.3			
		0.35			
		0.4			
		0.45			
	Residential	0.5			
		0.55			
	Cultivated	0.6	0.08	0.05	
		0.65			
		0.7			
	Paved	0.9	0.05	0.05	
C avg. (Runoff coeff.)	0.72	Total Area	0.13	Total CA	0.09

Sheet Elevations	
High Pt.	Low Pt.

Shallow Elevations	
High Pt.	Low Pt.
0.00	

Ditch Elevations	
High Pt.	Low Pt.
0.00	

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)			
S [Slope (%)]			
k (Intercept coeff.)		0.213	0.457
Velocity (fps)			
Time of Conc. (min)			
Total time (min)			

Min. Tc (min)	15
---------------	----

Use Tc: 10.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 10  
**BEGIN STATION:** 726+00.00  
**END STATION:** 728+00.00

Total Area	0.18	acres
------------	------	-------

		C value	Area (ac.)	CA
	Woods	0.3		
		0.35		
		0.4		
		0.45		
	Residential	0.5		
		0.55		
	Cultivated	0.6	0.12	0.07
		0.65		
		0.7		
	Paved	0.9	0.05	0.05
C avg. (Runoff coeff.)	0.69	Total Area	0.18	Total CA
				0.12

Sheet Elevations	
High Pt.	Low Pt.

Shallow Elevations	
High Pt.	Low Pt.
0.00	

Ditch Elevations	
High Pt.	Low Pt.
0.00	

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)			
S [Slope (%)]			
k (Intercept coeff.)		0.213	0.457
Velocity (fps)			
Time of Conc. (min)			
Total time (min)			

Min. Tc (min)	15
---------------	----

Use Tc: 10.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 11  
**BEGIN STATION:** 728+00.00  
**END STATION:** 730+00.00

Total Area	0.15	acres
------------	------	-------

		C value	Area (ac.)	CA
	Woods	0.3		
		0.35		
		0.4		
		0.45		
	Residential	0.5		
		0.55		
	Cultivated	0.6	0.11	0.06
		0.65		
		0.7		
	Paved	0.9	0.05	0.04
C avg. (Runoff coeff.)	0.69	Total Area	0.15	Total CA
				0.11

Sheet Elevations	
High Pt.	Low Pt.

Shallow Elevations	
High Pt.	Low Pt.
0.00	

Ditch Elevations	
High Pt.	Low Pt.
0.00	

	Sheet	Shallow	Ditch
<b>NEIGHBOR</b>			
L (Length of flow, ft.)			
S [Slope (%)]			
k (Intercept coeff.)		0.213	0.457
Velocity (fps)			
Time of Conc. (min)			
Total time (min)			

Min. Tc (min)	15
---------------	----

Use Tc: 10.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 12  
**BEGIN STATION:** 730+00.00  
**END STATION:** 732+00.00

Total Area	0.17	acres
------------	------	-------

		C value	Area (ac.)	CA
	Woods	0.3		
		0.35		
		0.4		
		0.45		
	Residential	0.5		
		0.55		
	Cultivated	0.6	0.13	0.08
		0.65		
		0.7		
	Paved	0.9	0.04	0.04
C avg. (Runoff coeff.)	0.68	Total Area	0.17	Total CA
				0.12

Sheet Elevations	
High Pt.	Low Pt.

Shallow Elevations	
High Pt.	Low Pt.
0.00	

Ditch Elevations	
High Pt.	Low Pt.
0.00	

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)			
S [Slope (%)]			
k (Intercept coeff.)		0.213	0.457
Velocity (fps)			
Time of Conc. (min)			
Total time (min)			

Min. Tc (min)	15
---------------	----

Use Tc: 10.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 13  
**BEGIN STATION:** 732+00.00  
**END STATION:** 734+00.00

Total Area	0.15	acres
------------	------	-------

		C value	Area (ac.)	CA
	Woods	0.3		
		0.35		
		0.4		
		0.45		
	Residential	0.5		
		0.55		
	Cultivated	0.6	0.10	0.06
		0.65		
		0.7		
	Paved	0.9	0.05	0.04
C avg. (Runoff coeff.)	0.69	Total Area	0.15	Total CA
				0.10

Sheet Elevations	
High Pt.	Low Pt.

Shallow Elevations	
High Pt.	Low Pt.
0.00	

Ditch Elevations	
High Pt.	Low Pt.
0.00	

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)			
S [Slope (%)]			
k (Intercept coeff.)		0.213	0.457
Velocity (fps)			
Time of Conc. (min)			
Total time (min)			

Min. Tc (min)	15
---------------	----

Use Tc: 10.0 min



### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 14  
**BEGIN STATION:** 734+00.00  
**END STATION:** 735+02.35

Total Area	0.09	acres
------------	------	-------

		C value	Area (ac.)	CA
	Woods	0.3		
		0.35		
		0.4		
		0.45		
	Residential	0.5		
		0.55		
	Cultivated	0.6	0.07	0.04
		0.65		
		0.7		
	Paved	0.9	0.03	0.02
C avg. (Runoff coeff.)	0.68	Total Area	0.09	Total CA
				0.06

Sheet Elevations	
High Pt.	Low Pt.

Shallow Elevations	
High Pt.	Low Pt.
0.00	

Ditch Elevations	
High Pt.	Low Pt.
0.00	

NEIGHBOR	Sheet	Shallow	Ditch
L (Length of flow, ft.)			
S [Slope (%)]			
k (Intercept coeff.)		0.213	0.457
Velocity (fps)			
Time of Conc. (min)			
Total time (min)			

Min. Tc (min)	15
---------------	----

Use Tc: 10.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 15  
**BEGIN STATION:** 741+88  
**END STATION:** 743+20

Total Area	1.47	acres
------------	------	-------

	C value	Area (ac.)	CA
Woods	0.3		
	0.35		
	0.4		
	0.45	1.43	0.64
	0.5		
Residential	0.55		
	0.6		
Cultivated	0.65		
	0.7		
Paved	0.9	0.04	0.04
C avg. (Runoff coeff.)	0.46	Total Area	Total CA
		1.47	0.68

Sheet Elevations	
High Pt.	Low Pt.
934.4	933.18

Shallow Elevations	
High Pt.	Low Pt.
933.18	911.62

Ditch Elevations	
High Pt.	Low Pt.
911.62	908.48

	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	1690.00	122.00
S [Slope (%)]	0.407	1.276	2.574
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.79	2.41
Time of Conc. (min)	26.8	35.7	0.8
Total time (min)			63.4

Min. Tc (min)	15
---------------	----

Use Tc: 63.4 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 16  
**BEGIN STATION:** 743+20  
**END STATION:** 744+16

Total Area	2.38	acres
------------	------	-------

	C value	Area (ac.)	CA
Woods	0.3		
	0.35		
	0.4		
	0.45	2.35	1.06
	0.5		
Residential	0.55		
	0.6		
Cultivated	0.65		
	0.7		
Paved	0.9	0.03	0.03
C avg. (Runoff coeff.)	0.46	Total Area	Total CA
		2.38	1.09

Sheet Elevations	
High Pt.	Low Pt.
934.4	931.91

Shallow Elevations	
High Pt.	Low Pt.
931.91	908.48

Ditch Elevations	
High Pt.	Low Pt.
908.48	904.77

	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	1717.00	103.00
S [Slope (%)]	0.831	1.364	3.602
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.82	2.85
Time of Conc. (min)	21.4	35.1	0.6
Total time (min)			57.0

Min. Tc (min)	15
---------------	----

Use Tc: 57.0 min

### TIME OF CONCENTRATION

**PID:** 117246  
**AREA:** 17  
**BEGIN STATION:** 746+59  
**END STATION:** 744+29

Total Area	2.50	acres
------------	------	-------

	C value	Area (ac.)	CA
Woods	0.3		
	0.35		
	0.4		
	0.45	2.43	1.09
Residential	0.5		
	0.55		
Cultivated	0.6		
	0.65		
Paved	0.9	0.07	0.06
C avg. (Runoff coeff.)	0.46	Total Area	Total CA
		2.50	1.16

Sheet Elevations	
High Pt.	Low Pt.
923.1832	919.45

Shallow Elevations	
High Pt.	Low Pt.
919.45	912.25

Ditch Elevations	
High Pt.	Low Pt.
912.25	904.77

	Sheet	Shallow	Ditch
L (Length of flow, ft.)	300.00	529.00	143.00
S [Slope (%)]	1.244	1.361	5.231
k (Intercept coeff.)		0.213	0.457
Velocity (fps)		0.82	3.43
Time of Conc. (min)	18.5	10.8	0.7
Total time (min)			30.0

Min. Tc (min)	15
---------------	----

Use Tc: 30.0 min

# Appendix 4

## Culvert Analysis

# Existing: PRE-725-1383

## HY-8 Culvert Analysis Report: Existing

### 43" x 64" CMP

#### Crossing Discharge Data

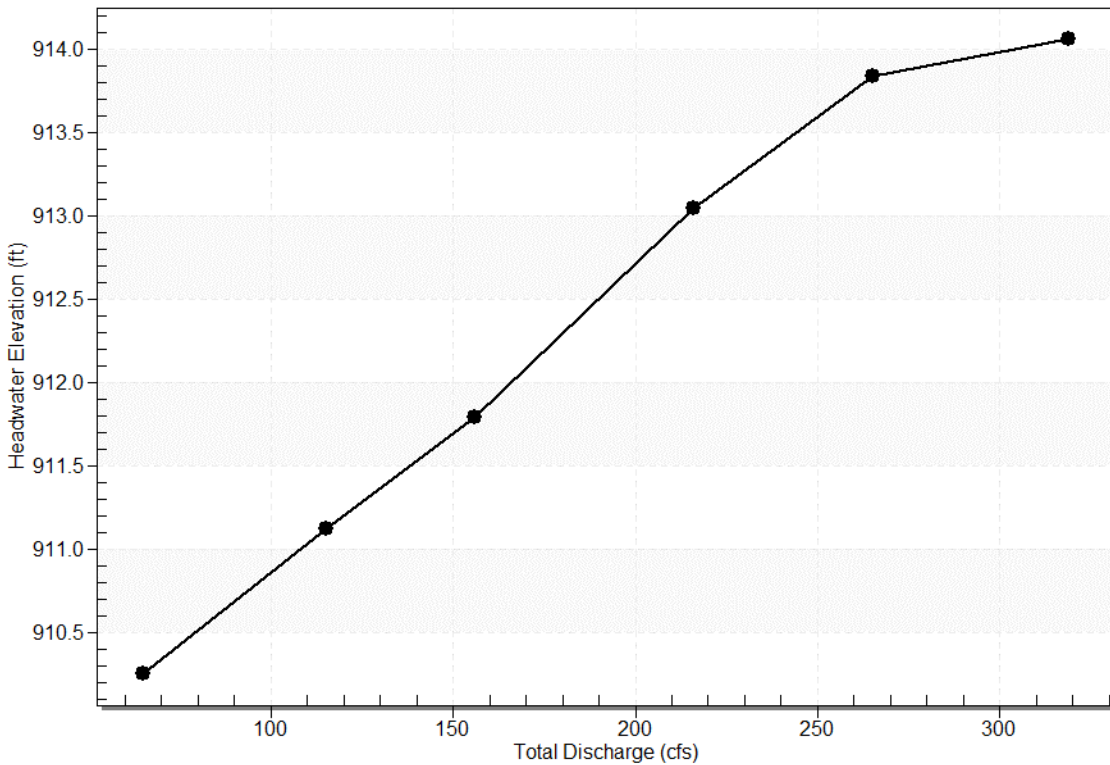
Discharge Selection Method: Recurrence

**Table 1 - Summary of Culvert Flows at Crossing: Sta. 735+16.10**

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Ex. 43 x 64 Twin CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
910.25	2 year	64.80	64.80	0.00	1
911.12	5 year	115.00	115.00	0.00	1
911.79	10 year	156.00	156.00	0.00	1
913.05	25 year	216.00	216.00	0.00	1
913.84	50 year	265.00	246.91	18.02	7
914.06	100 year	319.00	254.56	64.15	6
913.62	Overtopping	235.21	235.21	0.00	Overtopping

#### Rating Curve Plot for Crossing: Sta. 735+16.10

Total Rating Curve  
Crossing: Sta. 735+16.10



# Existing: PRE-725-1383

## Culvert Data: Ex. 43 x 64 Twin CMP

Table 2 - Culvert Summary Table: Ex. 43 x 64 Twin CMP

Discharge Names	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)
2 year	64.80 cfs	64.80 cfs	910.25	1.76	2.334	3-M2t	3.58	1.39	1.60	1.60	4.84	6.81
5 year	115.00 cfs	115.00 cfs	911.12	2.59	3.202	3-M2t	3.58	1.88	1.99	1.99	6.58	7.86
10 year	156.00 cfs	156.00 cfs	911.79	3.17	3.868	3-M2t	3.58	2.22	2.23	2.23	7.80	8.48
25 year	216.00 cfs	216.00 cfs	913.05	4.20	5.130	7-M2c	3.58	2.64	2.64	2.52	8.94	9.20
50 year	265.00 cfs	246.91 cfs	913.84	4.80	5.921	7-M2c	3.58	2.83	2.83	2.72	9.50	9.68
100 year	319.00 cfs	254.56 cfs	914.06	4.95	6.141	7-M2t	3.58	2.88	2.92	2.92	9.51	10.14

### Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 907.92 ft,

Outlet Elevation (invert): 907.86 ft

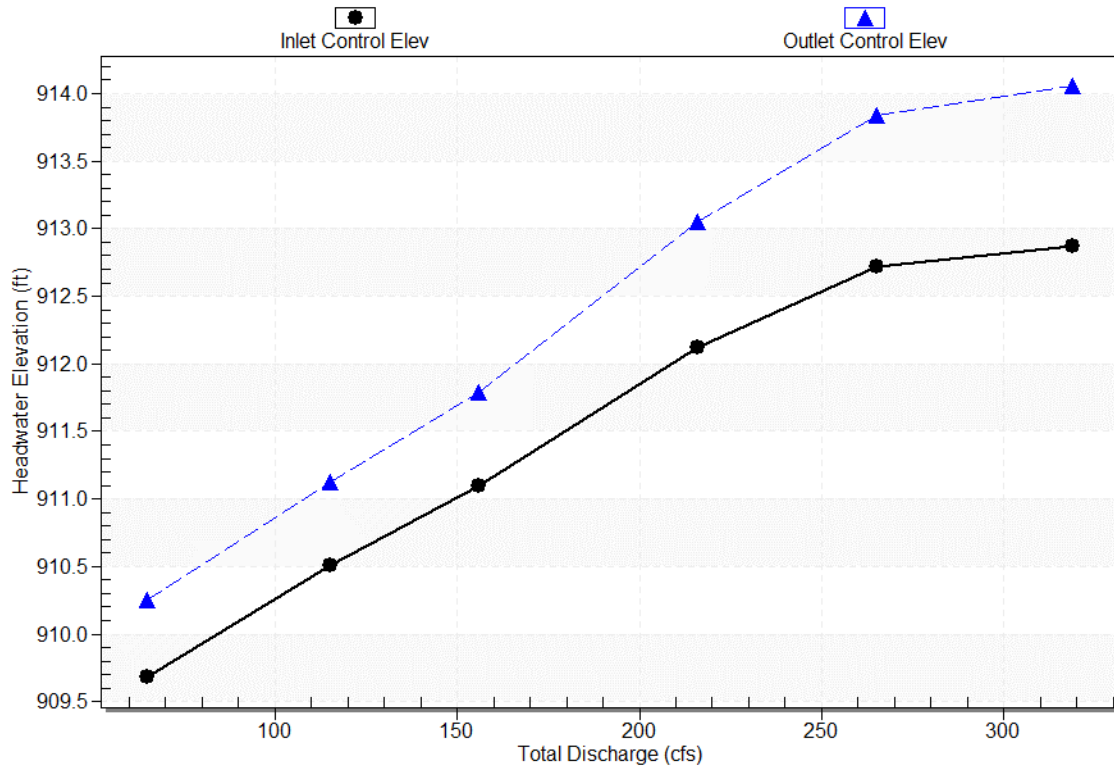
Culvert Length: 39.86 ft,

Culvert Slope: 0.0015

# Existing: PRE-725-1383

Culvert Performance Curve Plot: Ex. 43 x 64 Twin CMP

Performance Curve  
Culvert: Ex. 43 x 64 Twin CMP



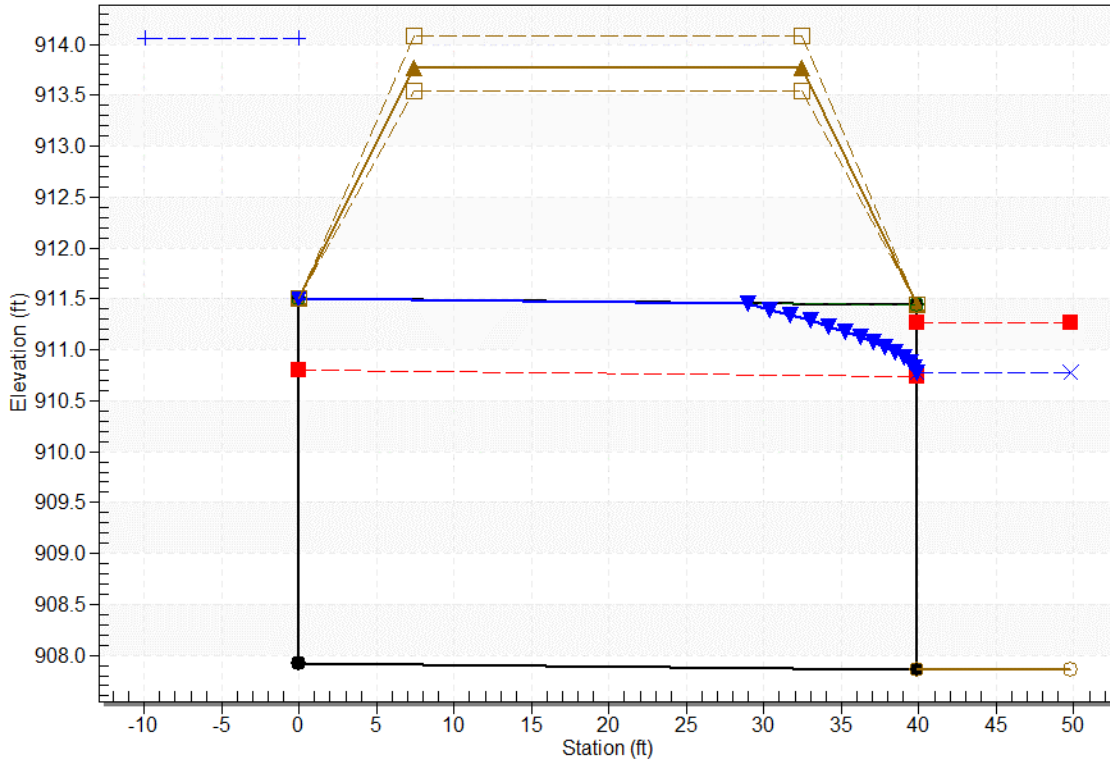


# Existing: PRE-725-1383

## Water Surface Profile Plot for Culvert: Ex. 43 x 64 Twin CMP

Crossing - Sta. 735+16.10, Design Discharge - 319.0 cfs

Culvert - Ex. 43 x 64 Twin CMP, Culvert Discharge - 254.6 cfs



### Site Data - Ex. 43 x 64 Twin CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 907.92 ft

Outlet Station: 39.86 ft

Outlet Elevation: 907.86 ft

Number of Barrels: 2

### Culvert Data Summary - Ex. 43 x 64 Twin CMP

Barrel Shape: User Defined

Barrel Span: 5.33 ft

Barrel Rise: 3.58 ft

Barrel Material: Corrugated Metal Riveted or Welded

Embedment: 0.00 in

# Existing: PRE-725-1383

Barrel Manning's n: 0.0350 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

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

Inlet Depression: None

## Tailwater Data for Crossing: Sta. 735+16.10

Table 3 - Downstream Channel Rating Curve (Crossing: Sta. 735+16.10)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
64.80	909.46	1.60	6.81	3.62	1.34
115.00	909.85	1.99	7.86	4.49	1.39
156.00	910.09	2.23	8.48	5.04	1.42
216.00	910.38	2.52	9.20	5.69	1.44
265.00	910.58	2.72	9.68	6.14	1.46
319.00	910.78	2.92	10.14	6.59	1.48

## Tailwater Channel Data - Sta. 735+16.10

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 3.70 (1:1)

Channel Slope: 0.0362

Channel Manning's n: 0.0350

Channel Invert Elevation: 907.86 ft

## Roadway Data for Crossing: Sta. 735+16.10

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

### Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	73450.00	913.54
1	73475.00	913.62
2	73500.00	913.69
3	73525.00	913.81
4	73550.00	913.95
5	73575.00	914.08

Roadway Surface: Paved

Roadway Top Width: 25.00 ft

# Proposed: PRE-725-1383

## HY-8 Culvert Analysis Report: Proposed 63" x 98" Elliptical (Sta. 735+16.10)

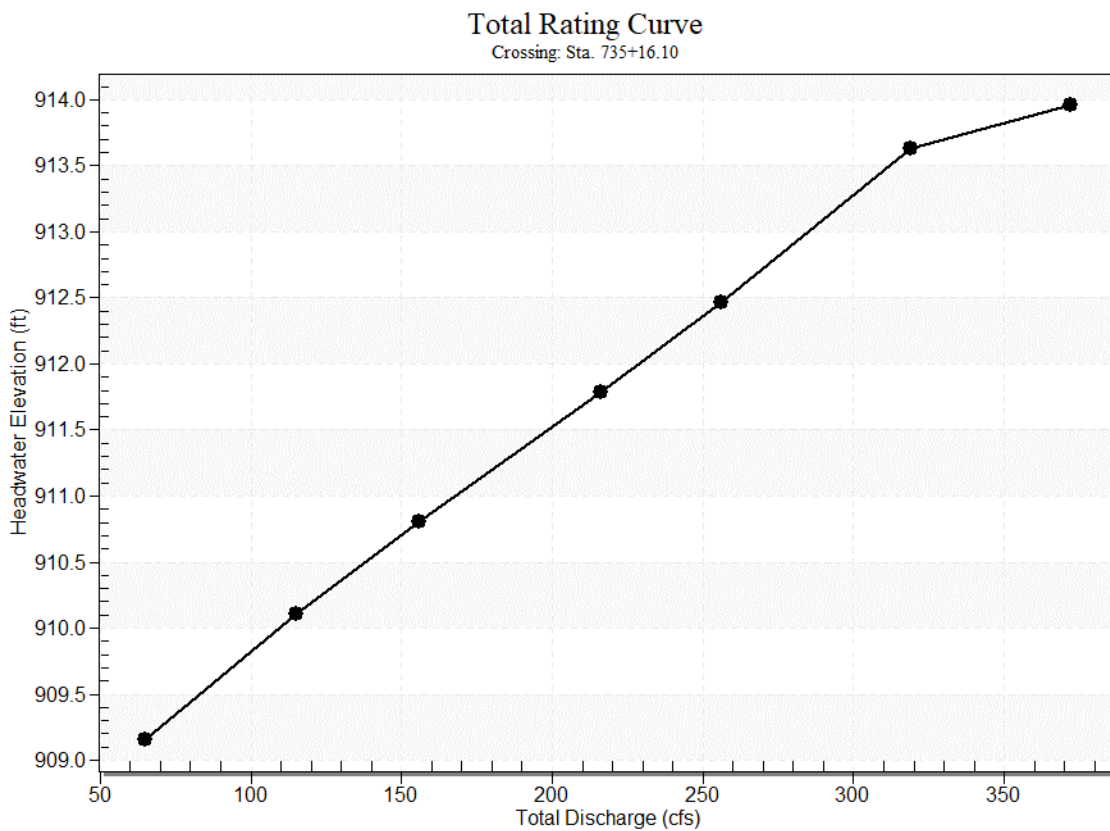
### Crossing Discharge Data

Discharge Selection Method: Recurrence

**Table 1 - Summary of Culvert Flows at Crossing: Sta. 735+16.10**

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pr. Culvert 63 x 98 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
909.16	2 year	64.80	64.80	0.00	1
910.11	5 year	115.00	115.00	0.00	1
910.80	10 year	156.00	156.00	0.00	1
911.78	25 year	216.00	216.00	0.00	1
912.46	50 year	256.00	256.00	0.00	1
913.63	100 year	319.00	317.78	0.94	17
913.62	Overtopping	313.09	313.09	0.00	Overtopping

### Rating Curve Plot for Crossing: Sta. 735+16.10



# Proposed: PRE-725-1383

## Culvert Data: Pr. Culvert 63 x 98

Table 2 - Culvert Summary Table: Pr. Culvert 63 x 98

Discharge Name	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)
2 year	64.80 cfs	64.80 cfs	909.16	2.35	1.348	1-S2n	1.41	1.72	1.45	1.60	8.08	6.81
5 year	115.00 cfs	115.00 cfs	910.11	3.30	2.158	1-S2n	1.89	2.33	1.98	1.99	9.46	7.86
10 year	156.00 cfs	156.00 cfs	910.80	3.99	2.811	1-S2n	2.23	2.74	2.36	2.23	10.25	8.48
25 year	216.00 cfs	216.00 cfs	911.78	4.97	3.823	1-S2n	2.67	3.27	2.84	2.52	11.25	9.20
50 year	256.00 cfs	256.00 cfs	912.46	5.65	4.546	5-S2n	2.95	3.58	3.15	2.68	11.82	9.60
100 year	319.00 cfs	317.78 cfs	913.63	6.82	6.366	5-S2n	3.38	4.01	3.59	2.92	12.62	10.14

### Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 906.81 ft,

Outlet Elevation (invert): 906.35 ft

Culvert Length: 92.00 ft,

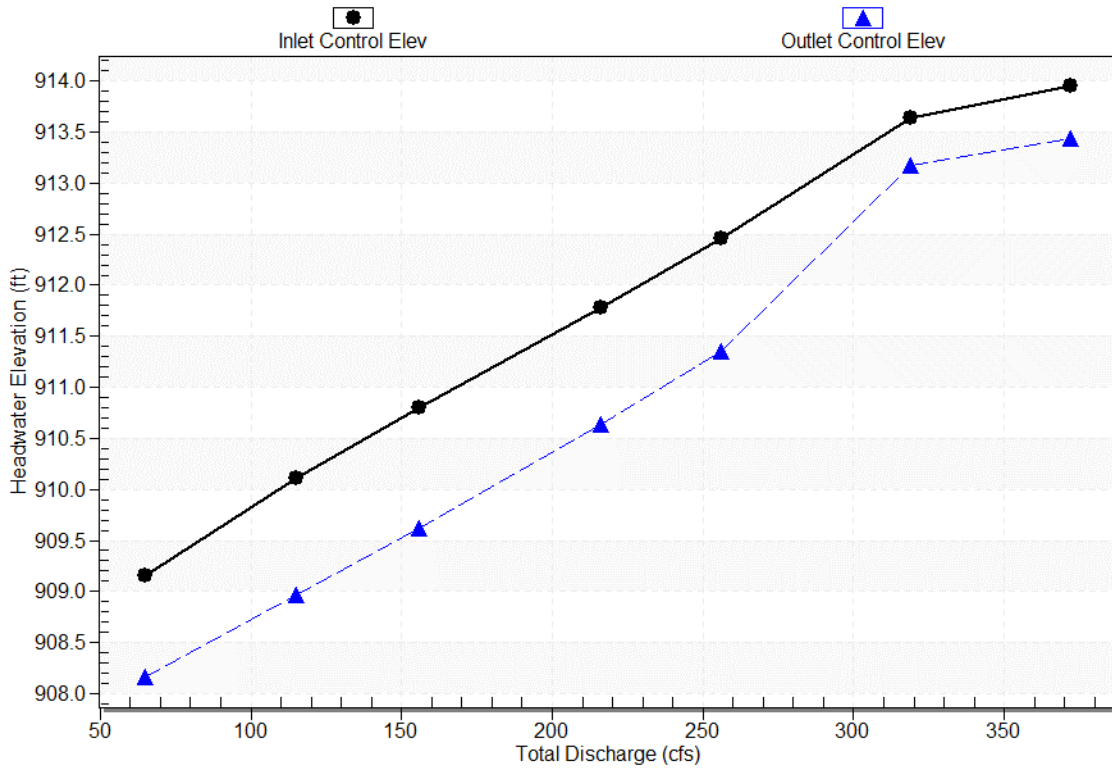
Culvert Slope: 0.0050

# Proposed: PRE-725-1383

Culvert Performance Curve Plot: Pr. Culvert 63 x 98

Performance Curve

Culvert: Pr. Culvert 63 x 98

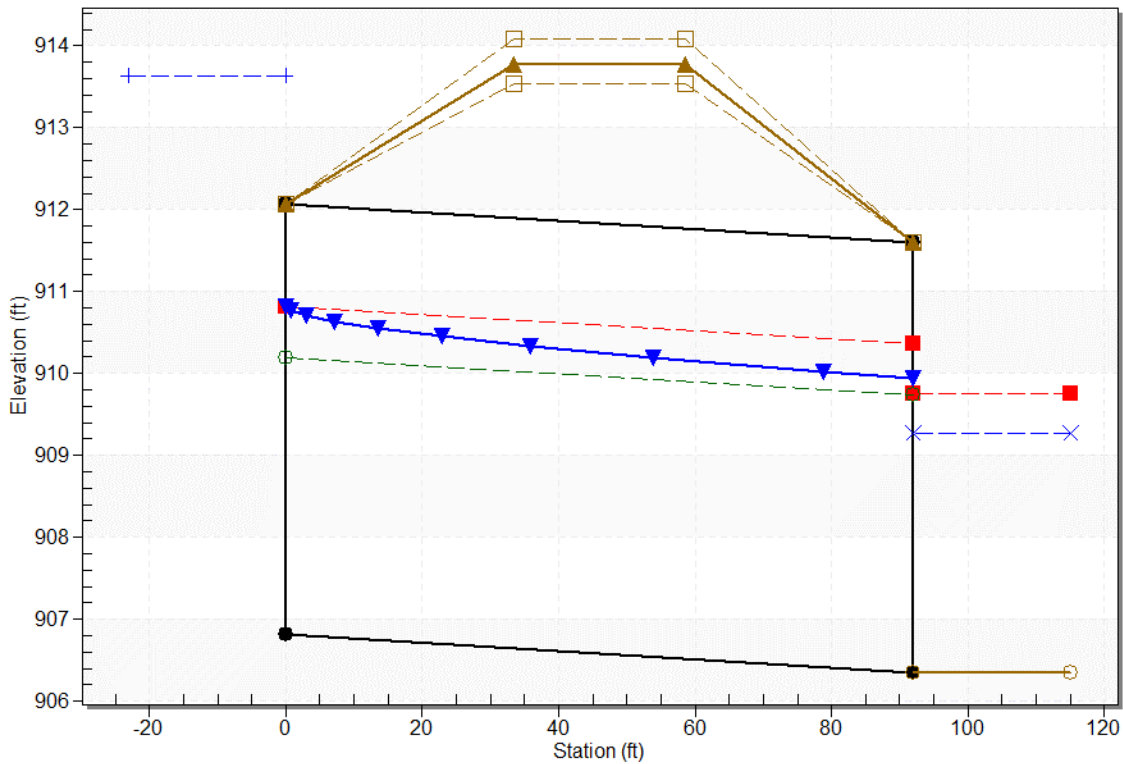


# Proposed: PRE-725-1383

## Water Surface Profile Plot for Culvert: Pr. Culvert 63 x 98

Crossing - Sta. 735+16.10, Design Discharge - 319.0 cfs

Culvert - Pr. Culvert 63 x 98, Culvert Discharge - 317.8 cfs



### Site Data - Pr. Culvert 63 x 98

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 906.81 ft

Outlet Station: 92.00 ft

Outlet Elevation: 906.35 ft

Number of Barrels: 1

### Culvert Data Summary - Pr. Culvert 63 x 98

Barrel Shape: Elliptical

Barrel Span: 98.00 in

Barrel Rise: 63.00 in

Barrel Material: Concrete

Embedment: 0.00 in

# Proposed: PRE-725-1383

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: Sta. 735+16.10

Table 3 - Downstream Channel Rating Curve (Crossing: Sta. 735+16.10)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
64.80	907.95	1.60	6.81	3.62	1.34
115.00	908.34	1.99	7.86	4.49	1.39
156.00	908.58	2.23	8.48	5.04	1.42
216.00	908.87	2.52	9.20	5.69	1.44
256.00	909.03	2.68	9.60	6.06	1.46
319.00	909.27	2.92	10.14	6.59	1.48

## Tailwater Channel Data - Sta. 735+16.10

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 3.70 (:1)

Channel Slope: 0.0362

Channel Manning's n: 0.0350

Channel Invert Elevation: 906.35 ft

## Roadway Data for Crossing: Sta. 735+16.10

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

### Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	73450.00	913.54
1	73475.00	913.62
2	73500.00	913.69
3	73525.00	913.81
4	73550.00	913.95
5	73575.00	914.08

Roadway Surface: Paved

Roadway Top Width: 25.00 ft

# Existing: PRE-725-1394

## HY-8 Culvert Analysis Report: Existing

### 44" x 72" CMP

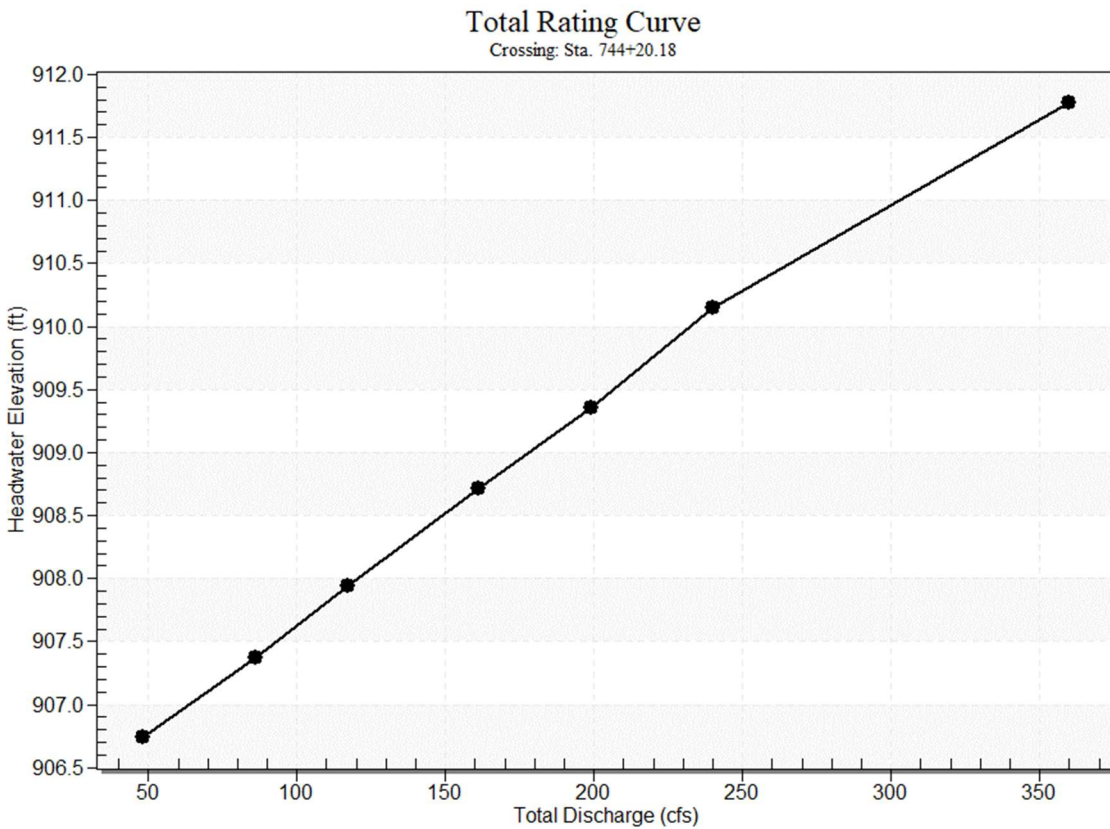
#### Crossing Discharge Data

Discharge Selection Method: Recurrence

**Table 1 - Summary of Culvert Flows at Crossing: Sta. 744+20.18**

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Ex. 44 x 72 Twin CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
906.74	2 year	48.00	48.00	0.00	1
907.37	5 year	85.90	85.90	0.00	1
907.94	10 year	117.00	117.00	0.00	1
908.71	25 year	161.00	161.00	0.00	1
909.35	50 year	199.00	199.00	0.00	1
910.14	100 year	240.00	240.00	0.00	1
911.36	Overtopping	293.33	293.33	0.00	Overtopping

#### Rating Curve Plot for Crossing: Sta. 744+20.18





## Existing: PRE-725-1394

### Culvert Data: Ex. 44 x 72 Twin CMP

Table 2 - Culvert Summary Table: Ex. 44 x 72 Twin CMP

Discharge Names	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)
2 year	48.00 cfs	48.00 cfs	906.74	1.50	1.304	1- JS1t	0.87	1.18	1.60	1.60	3.37	7.21
5 year	85.90 cfs	85.90 cfs	907.37	2.13	1.833	1- S2n	1.14	1.58	1.27	1.99	8.30	8.33
10 year	117.00 cfs	117.00 cfs	907.94	2.70	2.250	1- S2n	1.33	1.85	1.50	2.24	8.96	9.00
25 year	161.00 cfs	161.00 cfs	908.71	3.47	2.869	1- S2n	1.56	2.18	1.80	2.52	9.66	9.75
50 year	199.00 cfs	199.00 cfs	909.35	4.11	3.451	5- S2n	1.74	2.43	2.09	2.73	9.91	10.28
100 year	240.00 cfs	240.00 cfs	910.14	4.83	4.904	3- M2t	3.67	2.67	2.93	2.93	8.19	10.78

### Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 905.24 ft,

Outlet Elevation (invert): 904.88 ft

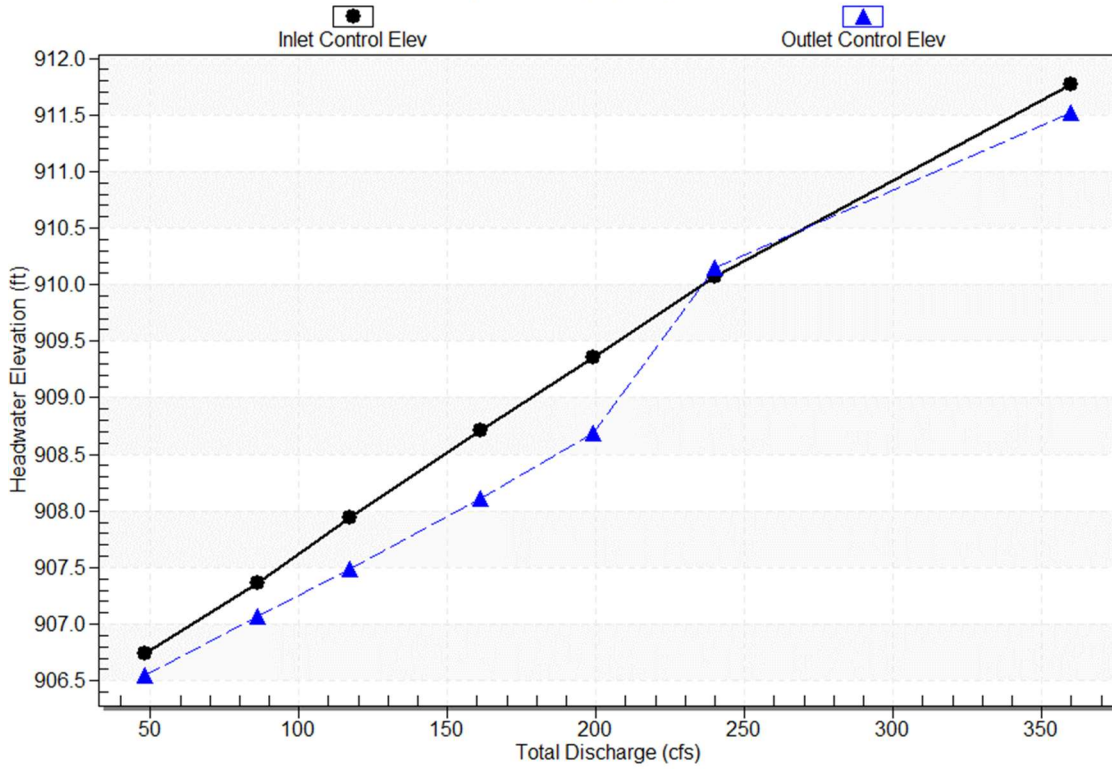
Culvert Length: 38.40 ft,

Culvert Slope: 0.0094

# Existing: PRE-725-1394

Culvert Performance Curve Plot: Ex. 44 x 72 Twin CMP

Performance Curve  
Culvert: Ex. 44 x 72 Twin CMP

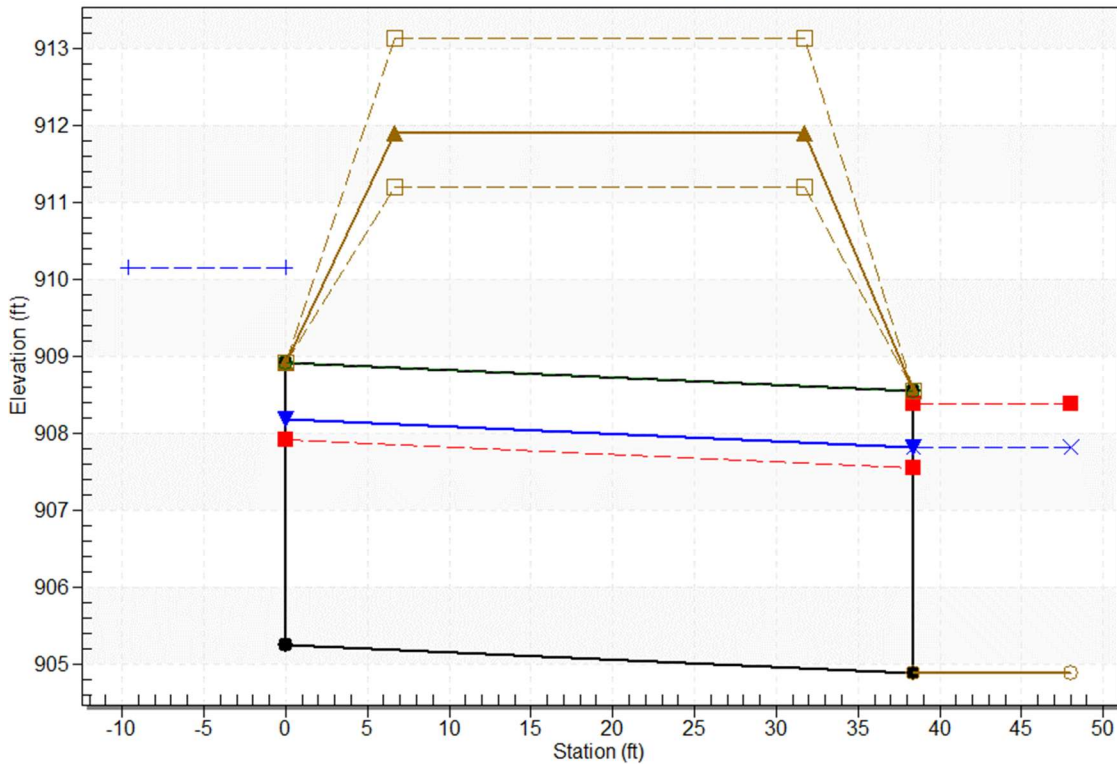


# Existing: PRE-725-1394

## Water Surface Profile Plot for Culvert: Ex. 44 x 72 Twin CMP

Crossing - Sta. 744+20.18, Design Discharge - 240.0 cfs

Culvert - Ex. 44 x 72 Twin CMP, Culvert Discharge - 240.0 cfs



### Site Data - Ex. 44 x 72 Twin CMP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 905.24 ft

Outlet Station: 38.40 ft

Outlet Elevation: 904.88 ft

Number of Barrels: 2

### Culvert Data Summary - Ex. 44 x 72 Twin CMP

Barrel Shape: User Defined

Barrel Span: 6.00 ft

Barrel Rise: 3.67 ft

Barrel Material: Corrugated Metal Riveted or Welded

Embedment: 0.00 in

# Existing: PRE-725-1394

Barrel Manning's n: 0.0350 (top and sides)

Manning's n: 0.0120 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting (Ke=0.9)

Inlet Depression: None

## Tailwater Data for Crossing: Sta. 744+20.18

Table 3 - Downstream Channel Rating Curve (Crossing: Sta. 744+20.18)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
48.00	906.48	1.60	7.21	4.24	1.42
85.90	906.87	1.99	8.33	5.28	1.47
117.00	907.12	2.24	9.00	5.93	1.50
161.00	907.40	2.52	9.75	6.68	1.53
199.00	907.61	2.73	10.28	7.24	1.55
240.00	907.81	2.93	10.78	7.76	1.57

## Tailwater Channel Data - Sta. 744+20.18

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 2.60 (.:1)

Channel Slope: 0.0425

Channel Manning's n: 0.0350

Channel Invert Elevation: 904.88 ft

## Roadway Data for Crossing: Sta. 744+20.18

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

### Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	74350.00	911.20
1	74375.00	911.36
2	74400.00	911.52
3	74425.00	912.00
4	74450.00	912.57
5	74475.00	913.13

Roadway Surface: Paved

Roadway Top Width: 25.00 ft

# Proposed: PRE-725-1394

## HY-8 Culvert Analysis Report: Proposed 63" x 98" Elliptical (Sta. 744+20.18)

### Crossing Discharge Data

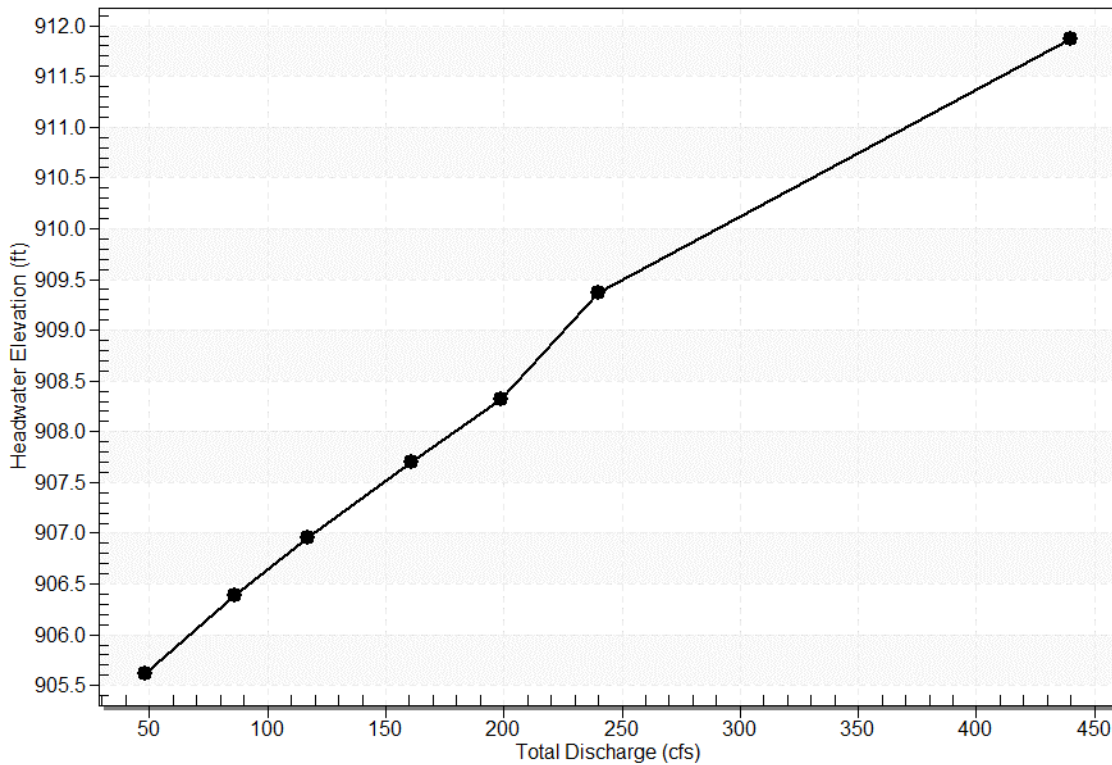
Discharge Selection Method: Recurrence

**Table 1 - Summary of Culvert Flows at Crossing: Sta. 744+20.18**

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Pr. Culvert 63 x 98 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
905.62	2 year	48.00	48.00	0.00	1
906.38	5 year	85.90	85.90	0.00	1
906.96	10 year	117.00	117.00	0.00	1
907.70	25 year	161.00	161.00	0.00	1
908.32	50 year	199.00	199.00	0.00	1
909.37	100 year	240.00	240.00	0.00	1
911.36	Overtopping	352.58	352.58	0.00	Overtopping

### Rating Curve Plot for Crossing: Sta. 744+20.18

Total Rating Curve  
Crossing: Sta. 744+20.18



# Proposed: PRE-725-1394

## Culvert Data: Pr. Culvert 63 x 98

Table 2 - Culvert Summary Table: Pr. Culvert 63 x 98

Discharge Names	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)
2 year	48.00 cfs	48.00 cfs	905.62	2.00	1.418	1- JS1t	1.43	1.47	1.60	1.60	5.26	7.20
5 year	85.90 cfs	85.90 cfs	906.38	2.76	1.923	1- S2n	1.93	1.99	1.93	1.99	7.32	8.33
10 year	117.00 cfs	117.00 cfs	906.96	3.34	2.418	1- S2n	2.28	2.35	2.28	2.23	8.04	9.00
25 year	161.00 cfs	161.00 cfs	907.70	4.08	3.120	1- S2n	2.72	2.79	2.72	2.52	8.84	9.74
50 year	199.00 cfs	199.00 cfs	908.32	4.70	3.754	1- S2n	3.09	3.13	3.09	2.72	9.38	10.27
100 year	240.00 cfs	240.00 cfs	909.37	5.38	5.745	7- M2c	3.48	3.46	3.46	2.92	9.93	10.77

### Culvert Barrel Data

Culvert Barrel Type Straight Culvert

Inlet Elevation (invert): 903.62 ft,

Outlet Elevation (invert): 903.39 ft

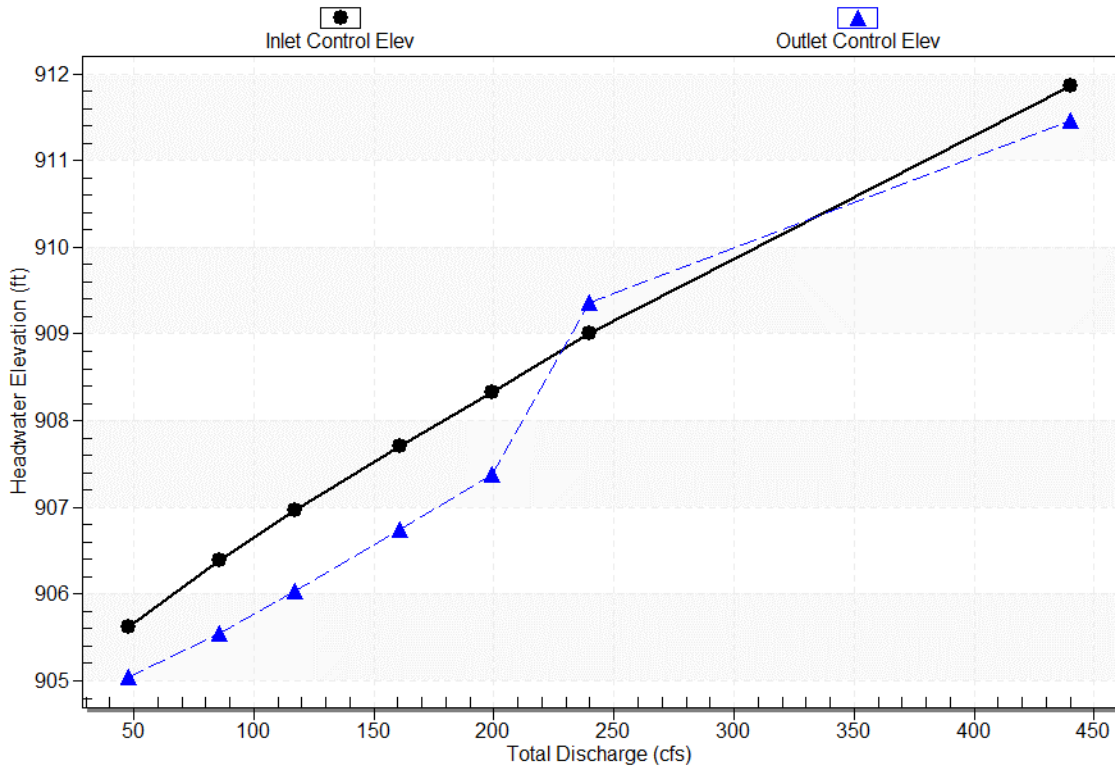
Culvert Length: 88.00 ft,

Culvert Slope: 0.0026

# Proposed: PRE-725-1394

Culvert Performance Curve Plot: Pr. Culvert 63 x 98

Performance Curve  
Culvert: Pr. Culvert 63 x 98

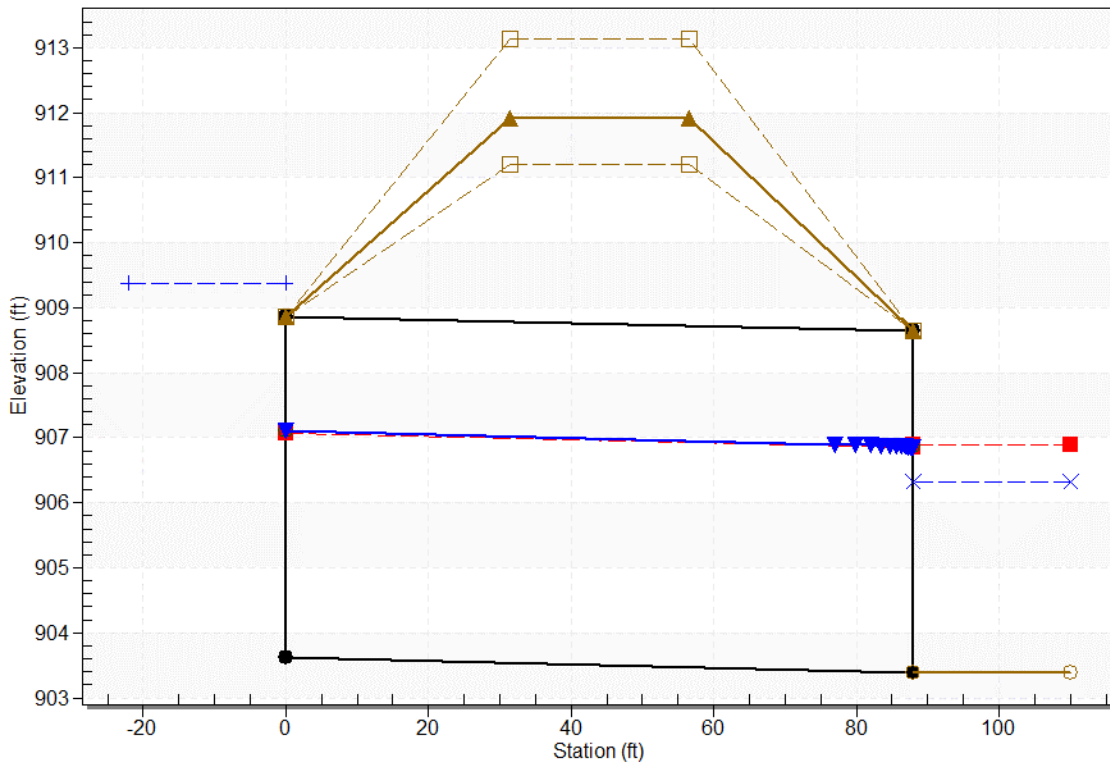


# Proposed: PRE-725-1394

## Water Surface Profile Plot for Culvert: Pr. Culvert 63 x 98

Crossing - Sta. 744+20.18, Design Discharge - 240.0 cfs

Culvert - Pr. Culvert 63 x 98, Culvert Discharge - 240.0 cfs



### Site Data - Pr. Culvert 63 x 98

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 903.62 ft

Outlet Station: 88.00 ft

Outlet Elevation: 903.39 ft

Number of Barrels: 1

### Culvert Data Summary - Pr. Culvert 63 x 98

Barrel Shape: Elliptical

Barrel Span: 98.00 in

Barrel Rise: 63.00 in

Barrel Material: Concrete

Embedment: 0.00 in



# Proposed: PRE-725-1394

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: Sta. 744+20.18

Table 3 - Downstream Channel Rating Curve (Crossing: Sta. 744+20.18)

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
48.00	904.99	1.60	7.20	4.24	1.42
85.90	905.38	1.99	8.33	5.27	1.47
117.00	905.62	2.23	9.00	5.92	1.50
161.00	905.91	2.52	9.74	6.67	1.53
199.00	906.11	2.72	10.27	7.22	1.55
240.00	906.31	2.92	10.77	7.75	1.57

## Tailwater Channel Data - Sta. 744+20.18

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 2.61 (:1)

Channel Slope: 0.0425

Channel Manning's n: 0.0350

Channel Invert Elevation: 903.39 ft

## Roadway Data for Crossing: Sta. 744+20.18

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

### Irregular Roadway Cross-Section

Coord No.	Station (ft)	Elevation (ft)
0	74350.00	911.20
1	74375.00	911.36
2	74400.00	911.52
3	74425.00	912.00
4	74450.00	912.57
5	74475.00	913.13

Roadway Surface: Paved

Roadway Top Width: 25.00 ft

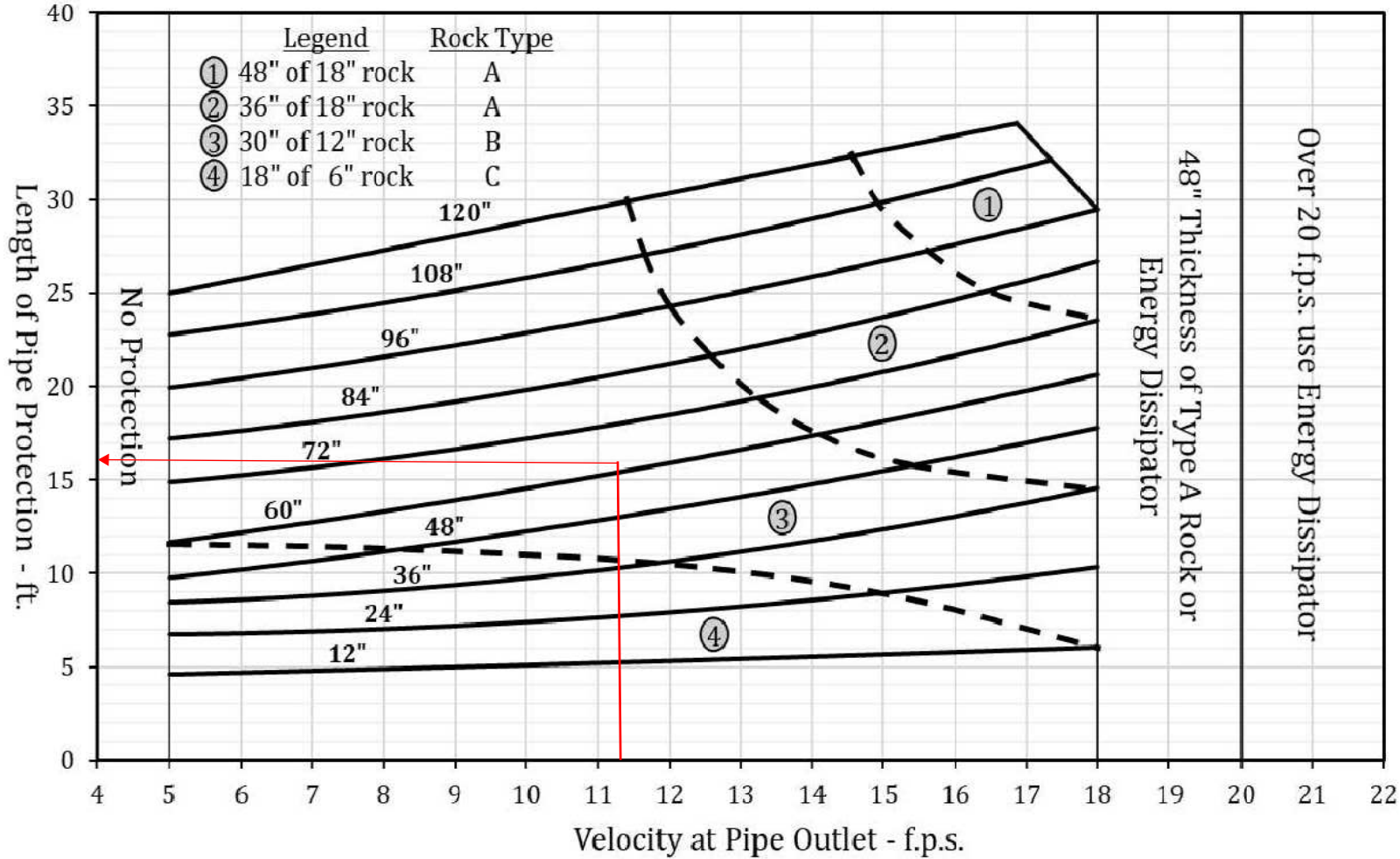
# Appendix 5

## Rock Channel Protection Design

63" x 98" Conduit, Sta. 735+16.10  
 Design Velocity = 11.25 ft/s  
 RCP= 16'- 30" Type B

# Proposed: PRE-725-1383

## Rock Channel Protection at Culvert and Storm Drain Outlets

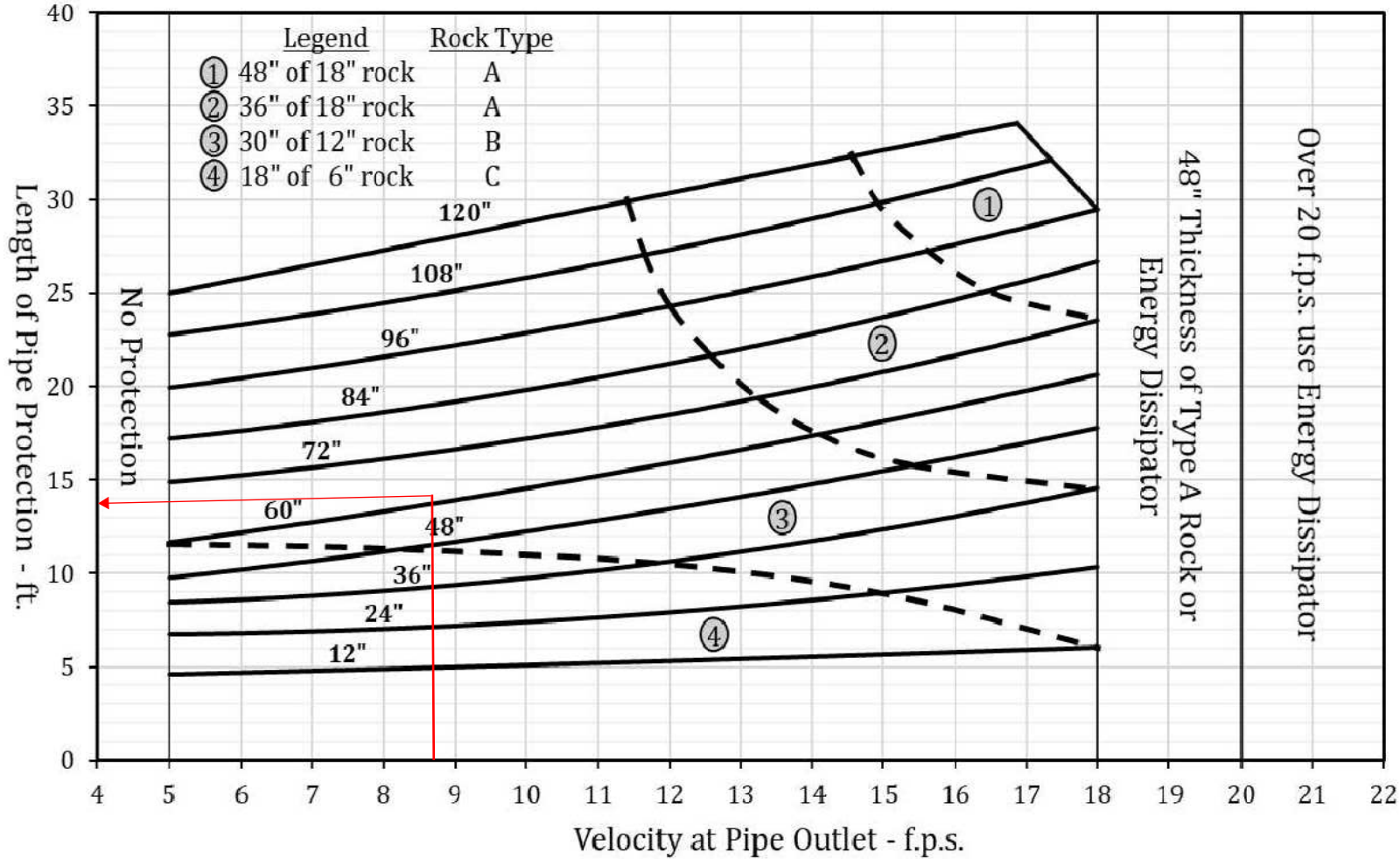


ROCK CHANNEL PROTECTION AT CULVERT AND STORM SEWER OUTLETS	1002-4
	REFERENCE SECTION 1002.2.3

63" x 98" Conduit, Sta.744+20.18  
 Design Velocity = 8.84 ft/s  
 RCP = 14'- 30" Type B

# Proposed: PRE-725-1394

## Rock Channel Protection at Culvert and Storm Drain Outlets



ROCK CHANNEL PROTECTION AT CULVERT AND STORM SEWER OUTLETS	1002-4
	REFERENCE SECTION 1002.2.3

July 2021

# Appendix 6

## Driveway Pipes Analysis



# UNIVERSAL CULVERT DESIGN

**PID :** 117246    **Date :** 10/05/2023    **Project :** PRE-SR725-13.60

**Location :** Drive Pipe 723+02.37

**Description :** Drive Pipe - Sta. 723+02.37

**Designer :** JJR

**HEADWATER CONTROL CODES:** INLET - Inlet Control.  
 OUTLET - Outlet Control.  
 OUTLET\* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.  
 OUTLET\*\* - Outlet Control - See Figure III - 7D in HDS 5 for type flow.  
 N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

1' below near EOP

Roadway Crown

**Inlet Invert Elevation (ft.) :** 922.31    **Outlet Invert Elevation (ft.) :** 922.04    **Tailwater Elevation (ft.) :** 922.12    **Overflow Elevation (ft.) :** 925.40  
**Allowable Headwater Elevation (ft.) :** 924.55    or Diameter + 2 ft.    (*whichever is less*)  
**Pipe Length (ft.) :** 16.00    **Culvert Slope (ft./ft.) :** 0.0169    **Design Manning 'n' :** 0.0120    **Ex. Drive Pipe = 24" RCP**  
**Design Discharge (cfs) :** 16.08    @ 5 yrs.    **Flood Discharge (cfs) :** N/A    @ 25 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
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**CULVERT TYPE :** CIRCULAR SMOOTH

**Entrance Type :** No Headwall

**Entrance Loss (Ke) :** 0.20

16.08	1	24 in.	924.53	N/A	1 - C	10.15	1.01	1.45	0.0120	INLET	0.00	D	0.00
16.08	1	21 in.	924.93	924.63	2 - E	10.09	1.10	1.48	0.0120	INLET	0.00	D - 1	0.00
14.18	1	18 in.	925.98	N/A	2 - E	9.52	1.18	1.39	0.0120	INLET	1.90	D - 2	0.00
16.08	1	27 in.	924.36	N/A	1 - C	10.13	0.95	1.40	0.0120	INLET	0.00	D + 1	0.00



# UNIVERSAL CULVERT DESIGN

**PID :** 117246    **Date :** 10/05/2023    **Project :** PRE-SR725-13.60

**Location :** Drive Pipe 724+00.00

**Description :** Drive Pipe - Sta. 724+00.00

**Designer :** JJR

**HEADWATER CONTROL CODES:** INLET - Inlet Control.  
 OUTLET - Outlet Control.  
 OUTLET\* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.  
 OUTLET\*\* - Outlet Control - See Figure III - 7D in HDS 5 for type flow.  
 N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

1' below near EOP

Roadway Crown

**Inlet Invert Elevation (ft.) :** 921.27    **Outlet Invert Elevation (ft.) :** 921.17    **Tailwater Elevation (ft.) :** 921.25    **Overflow Elevation (ft.) :** 924.90  
**Allowable Headwater Elevation (ft.) :** 923.82    or Diameter + 2 ft.    (*whichever is less*)  
**Pipe Length (ft.) :** 24.00    **Culvert Slope (ft./ft.) :** 0.0042    **Design Manning 'n' :** 0.0120  
**Design Discharge (cfs) :** 16.29    @ 5 yrs.    **Flood Discharge (cfs) :** N/A    @ 25 yrs.

Ex. Drive Pipe = 24" CPP

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
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**CULVERT TYPE :** CIRCULAR SMOOTH

**Entrance Type :** No Headwall

**Entrance Loss (Ke) :** 0.20

16.29	1	24 in.	923.51	923.55	1 - A	6.66	1.70	1.45	0.0120	OUTLET*	0.00	D	0.00
16.29	1	21 in.	923.93	923.86	2 - E	6.77	1.75	1.49	0.0120	INLET	0.00	D - 1	0.00
15.89	1	18 in.	925.01	924.71	2 - E	8.99	1.50	1.42	0.0120	INLET	0.40	D - 2	0.00
16.29	1	27 in.	923.33	923.39	1 - A	6.22	1.46	1.41	0.0120	OUTLET*	0.00	D + 1	0.00



# UNIVERSAL CULVERT DESIGN

**PID :** 117246    **Date :** 10/05/2023    **Project :** PRE-SR725-13.60

**Location :** Drive Pipe 728+29.7

**Description :** Drive Pipe - Sta. 728+29.7

**Designer :** JJR

**HEADWATER CONTROL CODES:** INLET - Inlet Control.  
 OUTLET - Outlet Control.  
 OUTLET\* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.  
 OUTLET\*\* - Outlet Control - See Figure III - 7D in HDS 5 for type flow.  
 N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

1' below near EOP

Roadway Crown

**Inlet Invert Elevation (ft.) :** 916.67    **Outlet Invert Elevation (ft.) :** 916.46    **Tailwater Elevation (ft.) :** 916.54    **Overflow Elevation (ft.) :** 920.71  
**Allowable Headwater Elevation (ft.) :** 919.50    or Diameter + 2 ft.    (*whichever is less*)  
**Pipe Length (ft.) :** 20.00    **Culvert Slope (ft./ft.) :** 0.0105    **Design Manning 'n' :** 0.0120  
**Design Discharge (cfs) :** 17.15    @ 5 yrs.    **Flood Discharge (cfs) :** N/A    @ 25 yrs.

Ex. Drive Pipe = 24" CPP

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
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**CULVERT TYPE :** CIRCULAR SMOOTH

**Entrance Type :** No Headwall

**Entrance Loss (Ke) :** 0.20

17.15	1	21 in.	919.48	919.24	2 - E	8.33	1.40	1.52	0.0120	INLET	0.00	D	0.00
17.15	1	18 in.	920.71	920.14	2 - E	9.70	1.50	1.44	0.0120	INLET	0.00	D - 1	0.00
12.25	1	15 in.	923.91	922.54	2 - E	9.98	1.25	1.22	0.0120	INLET	4.90	D - 2	0.00
17.15	1	24 in.	919.00	N/A	1 - C	8.60	1.21	1.49	0.0120	INLET	0.00	D + 1	0.00





# UNIVERSAL CULVERT DESIGN

**PID :** 117246    **Date :** 10/05/2023    **Project :** PRE-SR725-13.60

**Location :** Drive Pipe 729+61.5

**Description :** Drive Pipe - Sta. 729+61.5

**Designer :** JJR

**HEADWATER CONTROL CODES:** INLET - Inlet Control.  
 OUTLET - Outlet Control.  
 OUTLET\* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.  
 OUTLET\*\* - Outlet Control - See Figure III - 7D in HDS 5 for type flow.  
 N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

1' below near EOP

Roadway Crown

**Inlet Invert Elevation (ft.) :** 915.01    **Outlet Invert Elevation (ft.) :** 914.74    **Tailwater Elevation (ft.) :** 914.80    **Overflow Elevation (ft.) :** 918.80  
**Allowable Headwater Elevation (ft.) :** 918.50    or Diameter + 2 ft.    (*whichever is less*)  
**Pipe Length (ft.) :** 23.00    **Culvert Slope (ft./ft.) :** 0.0117    **Design Manning 'n' :** 0.0120  
**Design Discharge (cfs) :** 27.57    @ 5 yrs.    **Flood Discharge (cfs) :** N/A    @ 25 yrs.

Ex. Drive Pipe = 36" CPP

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
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**CULVERT TYPE :** CIRCULAR SMOOTH

**Entrance Type :** No Headwall

**Entrance Loss (Ke) :** 0.20

Proposed 36" - do not want to go smaller size than existing.

27.57	1	27 in.	918.08	917.83	2 - E	10.06	1.47	1.83	0.0120	INLET	0.00	D	0.00
27.37	1	24 in.	918.83	N/A	2 - E	9.62	1.70	1.82	0.0120	INLET	0.20	D - 1	0.00
21.67	1	21 in.	920.40	919.50	2 - E	9.01	1.75	1.63	0.0120	INLET	5.90	D - 2	0.00
27.57	1	30 in.	917.74	N/A	1 - C	10.14	1.36	1.79	0.0120	INLET	0.00	D + 1	0.00

# Appendix 7

## Ditch Analysis



# DITCH ANALYSIS

**PID :** 117246    **Date :** 11/18/2024    **Project :** PRE-SR275-13.06

**Location :** Preble County, Ohio

**Description :** Left Side Ditch - Sta. 724+16.09 to Sta. 735+02.35

**Designer :** MAK

**Rainfall Area :** C

**Allowable Shears**

	<b>Seed:</b>	0.40	<b>Jute Mat:</b>	0.45	<b>Temporary Mat:</b>	1.00
<b>Permanent Mat</b>	<b>Type 1:</b>	2.00	<b>Type 2:</b>	3.00	<b>Type 3:</b>	5.00
<b>RCP</b>	<b>Type B:</b>	6.00				

(\*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
724+16	726+00	L	184.00	4.00	4.00	4.00	0.0146	0.13	0.13	0.72	0.09	Seed	4.34	5	0.030	12.71	1.09	0.08	0.41	0.09	4.69
												Seed	4.76	10	0.040	13.09	0.94	0.10	0.45	0.11	4.86
726+00	728+00		200.00	4.00	4.00	4.00	0.0144	0.18	0.31	0.69	0.22	Seed	4.01	5	0.030	14.96	1.43	0.12	0.87	0.13	5.07
												Seed	4.37	10	0.040	15.73	1.23	0.15	0.95	0.17	5.33
728+00	730+00		200.00	4.00	4.00	4.00	0.0058	0.15	0.46	0.69	0.32	Seed	3.67	5	0.030	17.70	1.18	0.08	1.18	0.21	5.65
												Seed	3.98	10	0.040	18.96	1.00	0.09	1.28	0.26	6.04
730+00	732+00		200.00	4.00	4.00	4.00	0.0070	0.17	0.63	0.68	0.44	Seed	3.43	5	0.030	20.09	1.36	0.10	1.50	0.22	5.79
												Seed	3.69	10	0.040	21.79	1.14	0.12	1.61	0.28	6.21
732+00	734+00		200.00	4.00	4.00	4.00	0.0176	0.15	0.78	0.69	0.54	Seed	3.27	5	0.030	21.76	1.96	0.21	1.77	0.19	5.52
												Seed	3.52	10	0.040	23.79	1.65	0.26	1.90	0.23	5.87
734+00	735+02		102.00	4.00	4.00	4.00	0.0537	0.19	0.97	0.68	0.67	Seed	3.23	5	0.030	22.32	3.03	0.52	2.16	0.15	5.24
												Jute Mat	3.22	5	0.040	22.44	2.49	0.61	2.15	0.18	5.46
												Temp. Mat	3.22	5	0.040	22.44	2.49	0.61	2.15	0.18	5.46



# DITCH ANALYSIS

**PID :** 117246    **Date :** 05/15/2023    **Project :** PRE-SR725-13.60

**Location :** SR 725 SLM 13.60 PREBLE COUNTY OHIO

**Description :** Right Side Ditch - Sta. 721+85.00 to Sta. 734+50.00

**Designer :**

**Rainfall Area :** C

**Allowable Shears**

	<b>Seed:</b>	0.40	<b>Jute Mat:</b>	0.45	<b>Temporary Mat:</b>	1.50
<b>Permanent Mat</b>	<b>Type 1:</b>	3.00	<b>Type 2:</b>	4.00	<b>Type 3:</b>	5.00
<b>RCP</b>	<b>Type B:</b>	6.00				

(\*) Warning: Grade is steeper than allowable.      If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
721+85	723+05	R	120.00	4.00	4.00	4.00	0.0233	19.17	19.17	0.60	11.50	Seed	1.46	5	0.030	72.26	4.32	0.88	16.75	0.60	8.83
												Jute Mat	1.45	5	0.040	72.37	3.51	1.02	16.73	0.70	9.60
												Temp. Mat	1.45	5	0.040	72.37	3.51	1.02	16.73	0.70	9.60
												Temp. Mat	1.67	10	0.040	72.35	3.65	1.09	19.26	0.75	10.02
723+05	724+00		95.00	4.00	4.00	4.00	0.0094	0.40	19.57	0.60	11.74	Seed	1.45	5	0.030	72.87	3.12	0.45	16.99	0.77	10.15
												Jute Mat	1.45	5	0.040	72.99	2.53	0.52	16.97	0.89	11.10
												Temp. Mat	1.45	5	0.040	72.99	2.53	0.52	16.97	0.89	11.10
												Temp. Mat	1.66	10	0.040	72.95	2.63	0.56	19.54	0.95	11.61
724+00	728+00	R	400.00	4.00	4.00	4.00	0.0108	16.80	36.37	0.58	21.49	Seed	1.42	5	0.030	74.71	3.86	0.67	30.51	0.99	11.93
												Jute Mat	1.41	5	0.040	75.11	3.12	0.77	30.38	1.14	13.10
												Temp. Mat	1.41	5	0.040	75.11	3.12	0.77	30.38	1.14	13.10
												Temp. Mat	1.63	10	0.040	74.99	3.24	0.82	35.02	1.22	13.74
728+00	729+00	R	100.00	4.00	4.00	4.00	0.0110	14.83	51.20	0.58	30.09	Seed	1.41	5	0.030	75.51	4.24	0.79	42.38	1.16	13.26



# DITCH ANALYSIS

STATION BEGIN	STATION END		SIDE (ft.)	LENGTH RADIUS (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Jute Mat	1.41	5	0.040	75.60	3.43	0.91	42.34	1.33	14.61
												Temp. Mat	1.41	5	0.040	75.60	3.43	0.91	42.34	1.33	14.61
												Temp. Mat	1.62	10	0.040	75.46	3.56	0.97	48.81	1.42	15.34
729+00	730+00	R	100.00	4.00	4.00	4.00	0.0095	15.29	66.49	0.57	38.80	Seed	1.40	5	0.030	75.99	4.29	0.80	54.39	1.35	14.79
												Jute Mat	1.40	5	0.040	76.08	3.47	0.91	54.34	1.54	16.33
												Temp. Mat	1.40	5	0.040	76.08	3.47	0.91	54.34	1.54	16.33
												Temp. Mat	1.61	10	0.040	75.92	3.60	0.98	62.66	1.65	17.16
730+00	734+96	R	496.00	4.00	4.00	3.00	0.0136	4.47	70.96	0.55	41.26	Seed	1.38	5	0.030	77.70	5.09	1.11	56.87	1.30	13.13
												Jute Mat	1.37	5	0.040	78.08	4.11	1.27	56.66	1.49	14.45
												Temp. Mat	1.37	5	0.040	78.08	4.11	1.27	56.66	1.49	14.45
												Temp. Mat	1.58	10	0.040	77.85	4.27	1.35	65.38	1.60	15.18



# DITCH ANALYSIS

**PID :** 117246    **Date :** 11/18/2024    **Project :** PRE-SR725-13.60

**Location :** SR 725 SLM 13.60 PREBLE COUNTY OHIO

**Description :** Right Side Ditch - Sta. 737+00.00 to Sta. 735+09.00

**Designer :** MAK

**Rainfall Area :** C

**Allowable Shears**

	<b>Seed:</b>	0.40	<b>Jute Mat:</b>	0.45	<b>Temporary Mat:</b>	1.50
<b>Permanent Mat</b>	<b>Type 1:</b>	3.00	<b>Type 2:</b>	4.00	<b>Type 3:</b>	5.00
<b>RCP</b>	<b>Type B:</b>	6.00				

(\*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
737+00	735+09	R	191.00	4.00	4.00	4.00	0.0288	6.10	6.10	0.58	3.54	Seed	2.52	5	0.030	33.22	3.88	0.73	8.93	0.41	7.27
												Jute Mat	2.51	5	0.040	33.40	3.16	0.86	8.90	0.48	7.81
												Temp. Mat	2.51	5	0.040	33.40	3.16	0.86	8.90	0.48	7.81
												Temp. Mat	2.87	10	0.040	33.36	3.29	0.92	10.15	0.51	8.09



# DITCH ANALYSIS

**PID :** 117246    **Date :** 11/18/2024    **Project :** PRE-SR725-13.60

**Location :** SR 725 SLM 13.60 PREBLE COUNTY OHIO

**Description :** Right Side Ditch - Sta. 743+20 to Sta. 744+16

**Designer :** MAK

**Rainfall Area :** C

**Allowable Shears**

	<b>Seed:</b>	0.40	<b>Jute Mat:</b>	0.45	<b>Temporary Mat:</b>	1.50
<b>Permanent Mat</b>	<b>Type 1:</b>	3.00	<b>Type 2:</b>	4.00	<b>Type 3:</b>	5.00
<b>RCP</b>	<b>Type B:</b>	6.00				

(\*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
741+88	743+20	R	122.00	0.00	8.00	12.00	0.0257	1.47	1.47	0.46	0.68	Seed	1.59	5	0.030	64.46	1.92	0.38	1.07	0.24	4.73
												Seed	1.82	10	0.040	64.67	1.59	0.45	1.23	0.28	5.56
743+20	744+16	R	103.00	2.00	4.00	3.00	0.0360	2.38	3.85	0.46	1.77	Seed	1.58	5	0.030	64.98	3.29	0.64	2.79	0.28	3.98
												Jute Mat	1.57	5	0.040	65.09	2.69	0.74	2.79	0.33	4.30
												Temp. Mat	1.57	5	0.040	65.09	2.69	0.74	2.79	0.33	4.30
												Temp. Mat	1.81	10	0.040	65.28	2.80	0.79	3.20	0.35	4.47

Existing - leading up to proposed ditch



# DITCH ANALYSIS

**PID :** 117246    **Date :** 11/18/2024    **Project :** PRE-SR725-13.60

**Location :** SR 725 SLM 13.60 PREBLE COUNTY OHIO

**Description :** Right Side Ditch - Sta. 744+29 to Sta. 745+20 RT

**Designer :** MAK

**Rainfall Area :** C

**Allowable Shears**

	<b>Seed:</b>	0.40	<b>Jute Mat:</b>	0.45	<b>Temporary Mat:</b>	1.50
<b>Permanent Mat</b>	<b>Type 1:</b>	3.00	<b>Type 2:</b>	4.00	<b>Type 3:</b>	5.00
<b>RCP</b>	<b>Type B:</b>	6.00				

(\*) Warning: Grade is steeper than allowable.

If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
741+88	743+20	R	43.00	2.00	4.00	3.00	0.0843	1.47	1.47	0.46	0.68	Seed	1.60	5	0.030	63.62	3.30	0.70	1.08	0.13	2.93
												Jute Mat	1.60	5	0.040	63.66	2.73	0.82	1.08	0.16	3.09
												Temp. Mat	1.60	5	0.040	63.66	2.73	0.82	1.08	0.16	3.09
												Temp. Mat	1.84	10	0.040	63.65	2.84	0.89	1.24	0.17	3.18



# Appendix 8

## Post Construction Best Management Practices (BMPs) Calculations



# Ohio Department of Transportation - Office of Hydraulic Engineering

## Post-Construction BMP Calculation Spreadsheet

### Post Construction - Project Summary

#### Project Data

		Units
Project EDA	2.70	acres
Is the Project Routine Maintenance per L&D Vol. 2, Sec. 1112.2	No	
BMPs Required?	BMPs Required	NA
Ain (New Impervious Area in New Permanent R/W)	0	acres
Does Entire Site Drain to Large River (>100 sq. miles)?	No	
Water Quality Treatment Required	Yes	
Water Quantity Treatment Required	No	

#### Treatment Percent and Treatment Requirement

Aix (Project EDA that is inside the existing right-of-way)	1.04	acres
Ain (New Impervious Area in New Permanent R/W)	0	acres
<b>T% (Treatment Percent)</b>	<b>20.00</b>	<b>%</b>
<b>Treatment Requirement</b>	<b>0.54</b>	<b>acres</b>

#### BMPs Provided

BMP Name	BMP Type	Contributing Drainage Area (acres)	Contributing Drainage Area in ODOT R/W (acres)
VFS1	Vegetated Filter Strip	0.48	0.478
VFS2	Vegetated Filter Strip	0.08	0.075

#### Treatment Provided

Total Area with ODOT R/W Treated (acres)	0.55
Treatment Requirements (acres)	0.54
Treatment Check	Good

#### BMP Submittal Requirements (Per L&D, Vol. 2, Sec. 1112.2)

1. Estimated Project Earth Disturbed Area	Yes	Good
2. Treatment Percent Calculation	Yes	Good
3. BMP Selected for use	Yes	Good
4. Drainage area mapping for post-construction BMPs that show the total contributing drainage area and the amount of contributing area within ODOT right-of-way	Yes	Good
5. Plan sheets showing locations of post-construction BMP	Yes	Good
6. Calculations for each BMP	Yes	Good
7. Explanation for any area that is not treated	Yes	Good



# Ohio Department of Transportation - Office of Hydraulic Engineering

## Post-Construction BMP Calculation Spreadsheet

### Vegetated Filter Strip

Filter Strip	Route	Begin Station	End Station	Side	Pavement Width (FT)	Filter Strip Width (FT)	Filter Strip Slope (z:1)	Filter Strip Length (FT)	Drainage Area (acres)	Filter Strip Area (SF)	Item 659 Topsoil Volume (CY)	Item 670 Erosion Protection Area (SY)
Filter Strip #1	SR 725	725+98	732+80	LT	11	16	4	682	0.48	10,924	134.9	1,213.8
Filter Strip #2	SR 725	731+50	732+50	RT	11	17.5	4	100	0.08	1,777	21.9	197.4
Filter Strip #3								0			0.0	0.0
Filter Strip #4								0			0.0	0.0
Filter Strip #5								0			0.0	0.0
Filter Strip #6								0			0.0	0.0
Filter Strip #7								0			0.0	0.0
Filter Strip #8								0			0.0	0.0
Filter Strip #9								0			0.0	0.0
Filter Strip #10								0			0.0	0.0

156.8      1,411.2

**Total Treatment Credit Earned from Vegetated Filter Strips** 0.55 acres

(Treatment is for quality only, not quantity)

#### BMP Design Considerations

	BMP Design Considerations	Answer	Design Check
1	Is the min. filter strip width 15-25 ft wide depending on L&D Table 1113-3?	Yes	Good
2	Is the slope 3:1 or flatter for 34 ft or narrower pavement drainage width	Yes	Good
3	Is the slope 6:1 or flatter for 35 - 48 ft pavement drainage width	NA	Good
4	Is the only contributing drainage to the filter strip from the road and shoulder?	Yes	Good
5	Does any concentrated flow or any outlets discharge to the filter strip?	No	Good
6	Is 4" of Item 659, Topsoil, included for the filter strip?	Yes	Good
7	Is Item 670, Slope Erosion Protection, included for the filter strip?	Yes	Good

# Appendix 9

## Ohio Drainage Design Criteria Form (LD-35)

**PROJECT INFORMATION:**

COUNTY	ROUTE	SECTION	PID
Preble	S.R. 725	13.60	117246

**PIPE POLICY:**

The Pipe Policy of ODOT will be used for this project.

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(Attach a copy of the written pipe policy or furnish a link to the policy. In lieu of a written policy, documentation of locally funded construction practices may be provided)

**POST CONSTRUCTION BMP POLICY:**

The Post Construction BMP Policy of ODOT will be used for this project.

If a policy other than ODOT's is being used, the following BMP's are permitted:

N/A

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**DRAINAGE WATERSHED(S):**

N/A

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**PROJECT SPECIFIC INFORMATION AFFECTING DRAINAGE:**

N/A

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