Portsmouth Bypass
An Appalachian Development Highway

Stage 2 Submission

Drainage Calculations

Portsmouth Bypass, Phase 1

SCI-823-6.81
PID 19415

July 31, 2009

PREPARED FOR:
Ohio Department of Transportation
District 9
650 Eastern Avenue
Chillicothe, Ohio 45601

PREPARED BY:
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Cincinnati, Ohio 45242
513-984-7500

HDR
ONE COMPANY | *Many Solutions®*

SR 823 is a new four-lane median-divided highway in Scioto County near Portsmouth. The entire project consists of three separate phases: I, II, and III. Phase I is the middle segment of the project, extending from Shumway Hollow Road to CR 28. The project consists of rock cuts and high fill areas as the roadway traverses the mountainous terrain of southern Ohio.

Engineering work up through Stage 1 for the project was completed by TranSystems, with the Stage 1 submission reviewed by ODOT in December 2006. In Spring 2009, the mainline vertical alignment from Shumway Hollow Road north to CR 28 and the CR 28 interchange were modified by HDR, resulting in the need for changes to the proposed drainage design/calculations. Any portions of the calculations not modified for this Stage 2 submission are labeled with a TranSystems logo.

The drainage design criteria is summarized on LD 35 with the following exceptions.

Culverts:
Culverts with fill heights greater than 30 feet are designed per the Final Environmental Impact Statement (FEIS) August 2005. The FEIS determined that the Shawnee State Forest, the Wayne National Forest and their supporting ecosystems would be permanently separated by the new bypass. The FEIS suggests all culverts in high fills be increased in size by 1 foot in diameter to reduce the impact to the local ecosystem.

The driveway pipe on Flowers-Ison Road at Station 10+50 was analyzed as a culvert. This was due to its close proximity to the downstream culvert at CR 28 Sta 10+90. The drive pipe is larger than would be necessary for the driveway design year storm. The calculations for the drive pipe have been included with the calculations for the culvert at Sta. 10+90 Lucasville-Minford Road (CR 28).

Storm Sewers
There is one oversized storm sewer located at CR 28 Ramp A/B Sta 534+50. This storm sewer is the only outfall available for the BMP basin located in the infield of CR 28 Ramps A/B. The storm sewer was sized to allow for the 100 year storm to pass without over topping the ramps or CR 28.

Best Management Practices (BMP)
Approximately 9.4 acres of new impervious area can not be treated in a BMP because of topography and the nature of the soils in the area. As per part III.G.2.e of the OEPA permit OHC000003 and discussions with the OEPA, these untreated areas can be mitigated if:

> *a maintenance agreement or policy is established to ensure operations and treatment in perpetuity; the offsite location discharges to the same HUC-14 watershed unit; and the mitigation ratio of the WQv (Water Quality Volume) is 1.5 to 1 or the WQv at the point of retrofit, whichever is greater. (OEPA permit OHC000003 part III.G.2)*

WQv is the volume of runoff an area produces from a 0.75 inch rainfall event. WQv is calculated using the formula WQv = (C x P x A) / 12. Where C is the runoff coefficient based on land use, P is precipitation and A is the area.

HUC 14 (Hydraulic Unit Code) watershed units are drainage areas delineated by US NRCS (Natural Recourse Conservation Service). Three HUC 14 watersheds are crossed in Phase I as described in Table 1.

Table 1: HUC 14 Watersheds

Station Range	HUC 14	Acres	HUC 14 Name
86+50 to 383+00	05090103 040 050	25,816	Little Scioto River below Rocky Fork to Ohio River [except Frederick Cr.]
383+00 to 606+50	05090103 040 030	11,632	Long Run
CR 28 ramp A-B	05090103 040 020	15,772	Rocky Fork above McConnell Cr. to L. Scioto River [except Long Run]

The areas of the Phase I project that can not be treated in a BMP within each HUC 14 have been identified; see the BMP Schematic Plan in the BMP section of this document. These untreated areas are to be mitigated within the same HUC 14 watershed at a ratio of 1.5 to 1. Three types of possible mitigation areas have been identified:

- LA area - the portion of land between the possible Limited Access Right of Way (ROW) line and construction limits
- Current ODOT owned parcels - parcels are properties currently owned by ODOT under early acquisition.
- Possible land locked - parcels surrounded by land belonging to other persons or the residue of a parcel after a partial taking, where the remainder has no legal access or way to reach a public road

Only locations not contributing to a BMP can be used as mitigated areas. These areas have been identified as part of the preliminary ROW plans and are not yet final. The mitigation areas are summarized in Table 2.

Table 2: HUC 14 Mitigation Areas Summary

			Not contributing to a BMP				
HUC 14	Untreated area	Mitigated area required	LA ROW area	ODOT owned parcels	Land Locked Parcels	Total	Surplus
	acres	*acres*	*acres*	*acres*	*acres*	*acres*	*acres*
5090103040050	0.0	0.0	6.0	4.1	29.1	39.2	39.2
5090103040030	9.4	14.1	15.4	48.1	76.9	140.4	126.3
5090103040020	0.0	0.0	1.8	36.3	0.0	38.1	38.1

In conclusion, there is sufficient available area within each HUC 14 to provide protected mitigated easements compensating for the untreated areas in Phase I.

FORM LD-33
REV. 12-82

OHIO DEPARTMENT OF TRANSPORTATION
COUNTY ENGINEER
APPROVAL FORM

DATE SUBMITTED TO DISTRICT DEPUTY DIRECTOR _____

DATE SUBMITTED TO COUNTY ENGINEER _____

COUNTY Scioto ROUTE 823 SECTION 6.81

CULVERT DATA

STATION	SIZE & TYPE	ELEVATION OF CULVERT INVERT		ELEVATION OF EXISTING CHANNEL AT		SKEW
		INLET	OUTLET	INLET	OUTLET	
353+88 SR823	54" CMP	629.00	603.08	*	603.7	⊥
364+36 SR823	54" CMP	633.60	613.5	633.5	613.3	10.25 LF
375+08 SR823	78" CMP	645.58	621.69	*	*	32.75 LF
403+76 SR823	72" CMP	678.26	659.83	678.2	659.7	10.0 RF
412+26 SR823	48" CMP	707.30	662.17	*	662.17	24.3 LF
465+25 SR823	60" Concrete or 72" CMP	664.91	658.59	pond	pond	39.7 LF
473+75 SR823	54" CMP	677.56	649.40	*	649.4	30.1 LF
504+53 SR823	54" CMP	707.30	694.1	708.15	694.1	13.3 LF
535+50 SR823	42" Concrete or 48"CMP	714.00	710.00	◇	◇	⊥
171+80 SR139	72" CMP	625.6	624.8	*	*	⊥
383+50 TR234 Ramp B	36" CMP	656.00	647.00	◇	◇	⊥
379+00 TR234 Ramp C	42" CMP	666.7	665.0	◇	◇	⊥
17+00 TR234	48" Concrete	679.78	677.60	700.12	681.95	⊥
26+00 TR234	42" CMP	675.5	669.5	◇	◇	⊥
27+50 TR234	27" Concrete or 36" CMP	670.3	668.9	◇	◇	⊥
32+50 TR234	30" CMP	658.1	657.4	◇	◇	⊥

I have reviewed and hereby approve the drainage proposed for the highway designated hereon in accordance with the provisions of Section 6131.631 of the Revised Code of the State of Ohio.

_____ COUNTY ENGINEER _____ COUNTY
(SIGNATURE)

DATE _____

COMMENTS:

*Relocated Channel
◊ New Ditch Location

DOT - 2735

FORM LD-33
REV. 12-82

OHIO DEPARTMENT OF TRANSPORTATION
COUNTY ENGINEER
APPROVAL FORM

DATE SUBMITTED TO DISTRICT DEPUTY DIRECTOR _____

DATE SUBMITTED TO COUNTY ENGINEER _____

COUNTY Scioto ROUTE 823 SECTION 6.81

CULVERT DATA

STATION	SIZE & TYPE	ELEVATION OF CULVERT INVERT		ELEVATION OF EXISTING CHANNEL AT		SKEW
		INLET	OUTLET	INLET	OUTLET	
514+82 CR28 Ramp C	90" CMP	698.91	697.00	699.55	697.53	66 RF
10+90 CR28	54" CMP	702.7	699.00	*	*	12.2 LF
17+00 CR28	36" CMP	710.00	703.00	◇	◇	⊥
19+91 CR28	72" CMP	704.5	701.50	*	*	31 LF

I have reviewed and hereby approve the drainage proposed for the highway designated hereon in accordance with the provisions of Section 6131.631 of the Revised Code of the State of Ohio.

_____ COUNTY ENGINEER _____ COUNTY
(SIGNATURE)

DATE _____

COMMENTS:

*Relocated Channel
New Ditch Location

DOT - 2735

Form LD-35
Revised April 2005

GENERAL PROJECT INFORMATION

County	Route	Section
Scioto	SR 823	0.00
	(Attach Typical Section)	

AFFECTED ROADWAYS:	Route	Average Daily Traffic	Rural / Urban
INTERSTATE OR OTHER L/A FACILITIES	SCI 823	21,200 (2008)	Rural
ARTERIALS AND COLLECTORS	U.S. 52, U.S. 23, S.R. 140		
	Shumway-Hollow Rd Stout Hollow Road		
LOCALS			
CLEAR ZONE	30'		

All Units are English: Yes

PIPE POLICY:

The Pipe Policy of ODOT will be used for this project. (See Section 1002 for additional information)

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

(Please attach a copy of the written pipe policy. In lieu of a written policy, documentation of locally funded construction practices may be provided)

PROJECT SPECIFIC INFORMATION AFFECTING DRAINAGE:

Section A. Roadway Culverts (Type A Conduits)

1. DESIGN STORM FREQUENCY (1004.2):

   a. Mainline 50 Year

   b. Crossroads 25 Year

2. BANKFULL DESIGN (Yes) No (Circle yes if at least one culvert has bankfull design) *attach a list of culverts with bankfull designs*

3. FLOOD PLAIN CULVERT(S) NEEDED? (Yes) No (Circle yes if at least one culvert has flood plain culverts) *attach a list of culverts with flood plain culverts*

4. DURABILITY SERVICE LIFE 75 Year *attach a list of culverts with their durability service life if multiple culverts have different frequencies.*

5. ABRASIVE SITE? Yes (No) (Circle yes if at least one culvert has an abrasive site) *attach a list of culverts with their abrasive site assumptions if multiple culverts are different*

6. MAXIMUM ALLOWABLE HEADWATER FOR DESIGN STORM (1006.2):

   a. 2' below eop if drainage area >1000acres, 1' below eop if drainage area < 1000acres.

   b. 2' above crown in flat terrain, 4' above crown in a ravine.

   c.

7. METHOD USED TO ESTIMATE DESIGN DISCHARGE (Q) (1003):

   a. U.S.G.S. Rural Equations for areas $\geq$ 6acres.

   b. Rational Method for areas < 6 acres.

8. SCALE OF TOPOGRAPHIC MAPPING USED TO DELINEATE DRAINAGE AREAS (1101.1):

   a. 24,000:1

   b.

   c.

9. MANNING'S "n" USED FOR (1105.5.5):

   a. Smooth pipe 0.012

   b. Corrugated pipe:

2-$^2/_3$" x $^1/_2$":	Full flow	0.025
3" x 1":	Full flow	0.025
6" x 2":	Full flow	0.025

Section A. Roadway Culverts - Continued

10. ENTRANCE LOSS COEFFICIENT (k_e) (1105.5.6, table 1105-1):

    a. Corrugated pipe: HW-4 Headwall 0.9 Full Headwall 0.25

    b. Smooth Concrete pipe HW-4 Headwall 0.2 Full Headwall 0.25

    d. Box Shape Full Headwall 0.2

11. MINIMUM COVER (top of pipe to subgrade) FOR (1008):

    a. Rigid pipe ODOT L&D Vol. 2 Sec. 1008.2.2

    b. Flexible pipe ODOT L&D Vol. 2 Sec. 1008.1.4

12. MAXIMUM COVER FOR (1008):

    a. Rigid pipe ODOT L&D Vol. 2 Sec. 1008.1.4

    b. Flexible pipe ODOT L&D Vol. 2 Sec. 1008.1.4

13. MAXIMUM ALLOWABLE CULVERT OUTLET VELOCITY (1002.2.2) :

    a. Bare earth channel 2fps

    b. Rock channel protection 6-20fps

    c. Use Energy Dissapators for velocities in excess of 20 f.p.s.

14. HEADWALL TYPE (1106.2):

    a. Hw-1.1

    b. HW-2.1 or HW-2.2

15. CONTACT WILL BE MADE WITH COUNTY ENGINEER TO ESTABLISH:

    a. Floodplain Issues

    b. Farm tiles

16. MINIMUM PIPE SIZE (1002.3.1, Figure 1002-1) :

    a. Freeway or limited access facility 15"

    b. Other highways 12"

Section B. Storm Sewers (Type B & C Conduits)

1. DESIGN FREQUENCY (Just Full) 10 YEAR (1104.4.1)

2. HYDRAULIC GRADIENT SHALL NOT EXCEED (1104.4.2):

   a. 12 inches below edge of pavement for 25 year frequency storm.

   b. Pavement catch basin grate or lip of inlet for 25 year frequency storm.

   c. A point in a depressed pavement sag that would result in an impassible highway for a 25 year frequency storm.

   d. Other: See ODOT L&D Vol. 2 Sec. 1104.4.2

   e. The above is based on:

      i. A pipe roughness "n" = 0.015 for pipe sizes 60" and under and 0.013 for larger sizes.

      ii. _____

3. METHOD USED TO ESTIMATE DESIGN DISCHARGE (Q) (1003):
   a. Rational Method for areas under 6acres.

   b. U.S.G.S. Rural Equations – Report 89-4126 for areas 6acres or greater.

4. COEFFICIENT OF RUNOFF "C" FOR (1101.2.3):

   a. Pavement and paved shoulders 0.9

   b. Berms and slopes (4:1 and flatter) 0.5

   c. Berms and slopes (steeper than 4:1) 0.7

   d. Contributing areas:

      Residential 0.3-0.5 Woods 0.3-0.4 Cultivated 0.3-0.6

5. METHOD USED TO DETERMINE TIME TO FIRST CATCH BASIN OR PAVEMENT INLET (1101.2):

   a. Overland flow plus time in ditch.

   b.

6. MINIMUM TIME TO (1104.4.4):

   a. Ditch catch basin 15 minutes
   b. Pavement inlet or catch basin 10 minutes

Section B. Storm Sewers (Type B & C Conduits) - Continued

7. MINIMUM COVER OVER SEWERS (1104.2.1):

   a. Rigid pipe:

      i. Type B conduit (under pavement or paved shoulder) 9" from top of pipe to bottom of the subgrade

      ii. Type C conduit (beyond pavement or paved shoulder) 18"

   b. Flexible pipe:

      i. Type B conduit (under pavement or paved shoulder) 12"-24" from top of pipe to bottom of the subgrade

      ii. Type C conduit (beyond pavement or paved shoulder) 18"

8. DESIRABLE MINIMUM VELOCITY FOR DESIGN FLOW 3 f.p.s (1104.2.1).

9. MAXIMUM LENGTH BETWEEN MANHOLES OR SUITABLE CLEANOUT POINTS (1104.2.2) :

   a. Under 36"diameter 300'

   b. 36" - 60" diameter 500'

   c. Over 60" diameter 750' to 1000'

10. MINIMUM PIPE SIZE UNDER PAVEMENT (1104.4.6):

    a. Freeway or limited access facility 15"

    b. Other highways 12"

11. PROCEDURE TO FOLLOW WHEN EXISTING PRIVATE DRAINS ARE CUT BY PROPOSED SEWERS OR DITCHES: See Section 1104.2.1 ODOT L&D Vol. 2

Section C. Roadway Ditches

1. METHOD USED TO ESTIMATE DESIGN DISCHARGE (Q) (1003):

   a. Rational Method with minimum Tc for areas under 6 acres.

   b. U.S.G.S. Rural Equations fir areas ≥6 acres.

2. DESIGN FREQUENCY TO DETERMINE (1102.3.1 or 1102.4):

   ADT >2000:

   a. Depth of flow determination ___10___ year

   b. Shear Stress determination (for protection and width of protection) ___5___ year

   ADT <2000:

   c. Depth of flow determination ___5___ year

   d. Shear Stress determination (for protection and width of protection) ___5___ year

3. METHOD USED TO DETERMINE TIME OF FLOW TO DITCH (1101.2):

   ___Overland Flow_____

   _____

3. ALLOWABLE SHEAR STRESS FOR DITCH LINING (1102.3):

   Permanent Ditch Protection:

   a. Seed lining ___0.40___ psf.

   b. Sod or other temporary ditch protection ___1.0___ psf.

   c. Turf Reinforcing Mat (SS836), Type 1 ___2.00___ psf.

   d. Turf Reinforcing Mat (SS836), Type 2 ___3.00___ psf.

   e. Turf Reinforcing Mat (SS836), Type 3 ___5.00___ psf.

   f. RCP, Type B___6___psf.

   g. RCP, Type C___4___psf.

   h. RCP, Type D___2___psf.

   Temporary Ditch Protection (Item 670):

   a. Mat, Type A ___1.25___ psf.

   b. Mat, Type B ___1.50___ psf.

   c. Mat, Type C ___2.0___ psf.

   d. Mat, Type E ___2.25___ psf.

   e. Mat, Type F ___0.45___ psf.

f. Mat, Type G 1.75 psf.

4. MANNING'S "n" USED FOR (1102.3):

a. Seed lining 0.03

b. Sod, jute, or other temporary linings 0.04

c. Turf reinforcing mats 0.04

d. Tied Concrete Block Matting 0.021

e. Rock channel protection 0.04-0.06

5. DITCH CONFIGURATION (1102.2):

a. Cut section for roadway, with 18-3/4 inch minimum depth

b. Fill Section for toe of embankment, with 18 inch minimum depth

Section C. Roadway Ditches - Continued

7. TYPE OF DITCH CATCH BASIN (1102.3.4):
   a. 2-2A, 2-2B, 2-3, 2-4, CB-4, CB-5, CB-8, CB-4A, CB-5A, CB-8A, CB-7

8. MINIMUM LONGITUDINAL SLOPE OF DITCHES IN CUT SECTIONS (1102.1):

   a. 0.5% desirable minimum

   b. 0.25% absolute minimum

9. METHOD USED TO LOCATE EXISTING FARM TILE CROSSED BY HIGHWAYS?

   a. Contact with County Engineer

   b.

   c.

   d.

10. MINIMUM WIDTH OF DITCH LININGS (1102.3.1) :

   a. Sod 7.5 ft.

   b. Temporary linings 7.5 ft.

   c. Turf reinforcing mats 7.5 ft.

11. DESIGN FREQUENCY DEPTH SHALL NOT EXCEED (1102.3.1):

   a. 1' below eop for design discharge.

   b. Toe of slope ditch not to overtop ditch bank for design year.

   c.

Section D. Median Ditches

1. DITCH CONFIGURATIONS (1102.3):

   a. Depressed 60' Median

   b. Type of barrier Type A1

2. WIDTH BETWEEN PAVEMENT EDGES Varies 14'5-3/4" to 60' ft.

3. ALLOWABLE SHEAR STRESS FOR DITCH LINING (1102.3):

   Permanent Ditch Protection:

   a. Seed lining 0.40 psf.

   i. Sod or other temporary ditch protection 1.0 psf.

   j. Turf Reinforcing Mat (SS836), Type 1 2.00 psf.

   k. Turf Reinforcing Mat (SS836), Type 2 3.00 psf.

   l. Turf Reinforcing Mat (SS836), Type 3 5.00 psf.

   m. RCP, Type B 6 psf.

   n. RCP, Type C 4 psf.

   o. RCP, Type D 2 psf.

   Temporary Ditch Protection (Item 670):

   g. Mat, Type A 1.25 psf.

   h. Mat, Type B 1.50 psf.

   i. Mat, Type C 2.0 psf.

   j. Mat, Type E 2.25 psf.

   k. Mat, Type F 0.45 psf.

   l. Mat, Type G 1.75 psf.

4. METHOD USED TO ESTIMATE DESIGN DISCHARGE (Q) (1101.2):

   a. Rational Method for areas < 6 acres.

   b. U.S.G.S. Rural Equations for areas ≥6 acres.

5. CATCH BASIN SPACING WILL BE DETERMINED BY HYDRAULIC ANALYSIS USING (1102.3.4):

   a. 5 year frequency and "n" = 0.04 for velocity

   b. 10 year frequency and "n" = 0.04 for depth

c. Controls:

i. Design frequency depth shall not exceed:

(1) 1' below eop design discharge.

(2)

d. Catch basin spacing, depressed median, fill section:

	Median Width	84'	60'	40'
i.	Desirable maximum	1250'	1000'	800'
ii.	Absolute maximum	1500'	1250'	1000'

5. TYPE OF MEDIAN CATCH BASIN OR INLET (1102.3.4):

a. CB- 4, Inlet No. 3, Single Slope Barrier A1, Inlet No. 3, Single Slope Barrier Type C1.

7. MINIMUM LONGITUDINAL SLOPE OF DEPRESSED EARTH MEDIAN:

0.5% preferred minimum, 0.25% absolute mninum.

Section E. Drainage for Curbed Pavements

1. CONTROLS FOR THE DETERMINATION OF INLET OR CATCH BASIN SPACING (1103):

   a. Design storm frequency ____10____ year

   b. Check storm frequency____50____ year (for underpasses or depressed roadways where the storm sewer is the only outlet)

   c. METHOD USED TO DETERMINE TIME TO FIRST CATCH BASIN OR PAVEMENT INLET:

      i. Overland Flow

      ii. 10 minute minimum.

   d. Maximum spread of flow into traveled lane ___0_____ ft. (table 1103-1)

      Outside lane width greater than 12 feet ____4____ ft.

      Total allowable spread on pavement ____4____ ft.

   e. Maximum depth of flow at curb _____5_____ in .

   f. Manning's "n" for:

      i. Reinforced concrete pavement ___.015_____

      ii. Asphaltic concrete pavement ____.015_____

      iii. Paved shoulders ___.015_____

2. TYPE OF INLET OR CATCH BASIN PROPOSED FOR (1103):

   a. Continuous grades ___CB-3, CB-3A, CB-6, Inlet No.4 Type A, B, A1 and B1_____

   b. Sags _CB-3, CB-6, Inlet No.4 Type A, B, A1 and B1_____

4. INLET LIP OF CURB OPENING INLET WILL BE DEPRESSED _____ INCHES BELOW NORMAL GUTTER.

   a. A local depression of ____1/2___ inches will be used to determine spacing of combination grate and curb opening catch basins for a curb pavement section.

   b. A local depression of ____0_____ inches will be used to determine spacing of combination grate and curb opening catch basins for a combination curb and gutter section.

Section F. Post Construction Storm Water Management

1. THRESHOLD LIMITS (1115):

   c. Impervious surface width drained in one direction 30 ft.

   d. Project is located within an MS4 area. Yes (No) (Circle answer)

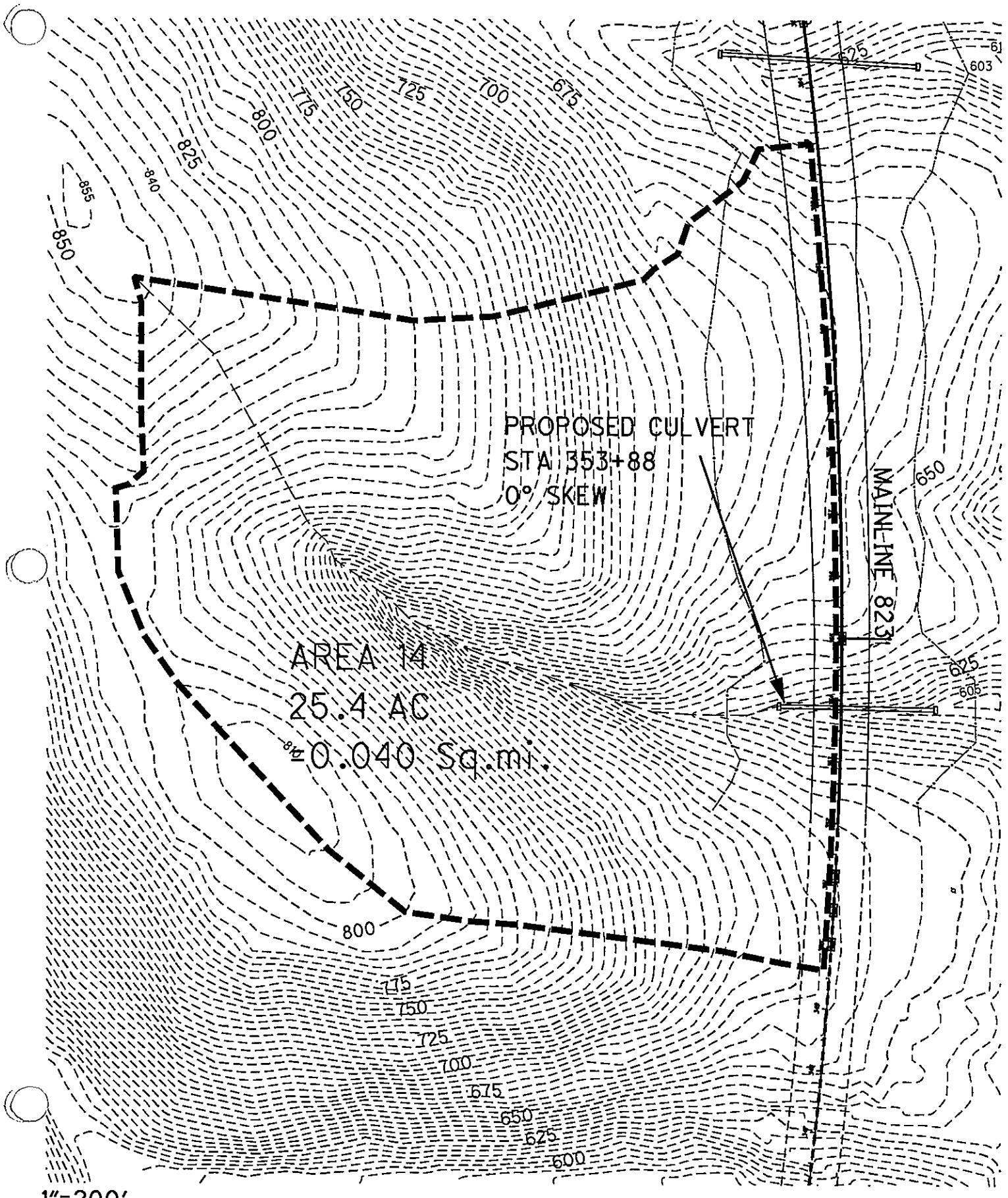
   e. More than 80% of the drained area is discharged through a storm sewer.

      Yes (No) (Circle answer)

   f. Storm water outfall is into a TMDL Regulated Stream.

      Yes (No) (Circle answer)

SR 823 STA 353+88



TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1106473.00	SQ. FT.	
0.040	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
1340.00	FT.	**TOTAL CHANNEL LENGTH**
134.00	FT.	L_{10} = 10% of the Distance along channel
640	FT.	$Elev_{10}$ = Elevation at point L_{10}
1139.00	FT.	L_{85} = 85% of the Distance along channel
770	FT.	$Elev_{85}$ = Elevation at point L_{85}
1005.00	FT.	**Length =** $L_{85} - L_{10}$
682.99	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	14	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	30	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	43	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	62	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	78	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	94	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 09/20/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 14, Sta. 353+88 **Designer :** KAG KMD

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.

Inlet Invert Elevation (ft.) : 629.00 **Outlet Invert Elevation (ft.) :** 603.80 **Tailwater Elevation (ft.) :** 605.07 **Overflow Elevation (ft.) :** 650.04

Allowable Headwater Elevation (ft.) : 648.54 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 252.00 **Culvert Slope (ft./ft.) :** 0.1000 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 78.00 @ 50 yrs. **Flood Discharge (cfs) :** 94.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Square Edge with Headwall							**Entrance Loss (Ke) :** 0.50			
78.00	1	42 in.	633.79	609.74	2 - E	28.95	1.13	2.76	0.0120	INLET	0.00	D	0.00
78.00	1	36 in.	635.71	612.43	2 - E	29.24	1.21	2.75	0.0120	INLET	0.00	D - 1	0.00
78.00	1	33 in.	637.57	615.16	2 - E	29.34	1.26	2.64	0.0120	INLET	0.00	D - 2	0.00
78.00	1	48 in.	633.04	N/A	1 - C	28.60	1.08	2.67	0.0120	INLET	0.00	D + 1	0.00
94.00	1	42 in.	634.97	611.14	2 - E	30.53	1.25	3.00	0.0120	INLET	0.00	F	0.00
94.00	1	36 in.	637.90	615.09	2 - E	30.74	1.34	2.87	0.0120	INLET	0.00	F - 1	0.00
94.00	1	33 in.	640.67	619.10	2 - E	30.79	1.41	2.70	0.0120	INLET	0.00	F - 2	0.00
94.00	1	48 in.	633.71	N/A	1 - C	30.18	1.18	2.94	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Headwall							**Entrance Loss (Ke) :** 0.25			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
78.00	1	42 in.	633.73	613.21	2 - E	17.63	1.64	2.76	0.0237	INLET	0.00	D	0.00

no concrete velocity > 20fps

Fill height > 30' upsize culvert 1' diameter per FEIS report
see analysis of CMP 54" with selected corrugations

UNIVERSAL CULVERT DESIGN

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.)
78.00	1	36 in.	635.53	620.82	2 - E	17.33	1.82	2.75	0.0241	INLET	0.00	D - 1	0.00
78.00	1	33 in.	637.30	628.58	2 - E	17.10	1.97	2.64	0.0241	INLET	0.00	D - 2	0.00
78.00	1	48 in.	632.98	N/A	1 - C	17.64	1.53	2.67	0.0235	INLET	0.00	D + 1	0.00
94.00	1	42 in.	634.86	616.17	2 - E	18.47	1.83	3.00	0.0237	INLET	0.00	F	0.00
94.00	1	36 in.	637.62	627.27	2 - E	17.98	2.08	2.87	0.0241	INLET	0.00	F - 1	0.00
94.00	1	33 in.	640.25	638.59	2 - E	17.24	2.37	2.70	0.0241	INLET	0.00	F - 2	0.00
94.00	1	48 in.	633.68	N/A	1 - C	18.56	1.69	2.94	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
78.00	1	42 in.	633.73	615.09	2 - E	15.64	1.80	2.76	0.0278	INLET	0.00	D	0.00
78.00	1	36 in.	635.53	625.05	2 - E	15.34	2.03	2.75	0.0281	INLET	0.00	D - 1	0.00
78.00	1	48 in.	632.98	N/A	1 - C	15.73	1.67	2.67	0.0275	INLET	0.00	D + 1	0.00
94.00	1	42 in.	634.86	618.90	2 - E	16.35	2.02	3.00	0.0278	INLET	0.00	F	0.00
94.00	1	36 in.	637.62	633.42	2 - E	15.73	2.36	2.87	0.0281	INLET	0.00	F - 1	0.00
94.00	1	48 in.	633.68	N/A	1 - C	16.51	1.85	2.94	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
78.00	1	60 in.	632.36	N/A	1 - C	13.53	1.67	2.50	0.0332	INLET	0.00	D	0.00
78.00	1	66 in.	632.17	N/A	1 - C	13.47	1.61	2.43	0.0330	INLET	0.00	D + 1	0.00
94.00	1	60 in.	632.81	N/A	1 - C	14.25	1.85	2.76	0.0332	INLET	0.00	F	0.00
94.00	1	66 in.	632.57	N/A	1 - C	14.21	1.77	2.68	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
78.00	1	60 in.	632.36	N/A	1 - C	16.13	1.47	2.50	0.0260	INLET	0.00	D	0.00
78.00	1	66 in.	632.17	N/A	1 - C	15.98	1.42	2.43	0.0260	INLET	0.00	D + 1	0.00
94.00	1	60 in.	632.81	N/A	1 - C	17.00	1.62	2.76	0.0260	INLET	0.00	F	0.00
94.00	1	66 in.	632.57	N/A	1 - C	16.86	1.57	2.68	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 09/27/2009 **Project :** SCI-823 **Location :** Portsmouth OH

Description : Drainage Area 14, Sta 353+88, Analysis CMP 0.5in corrigations **Designer :** KAG KMP

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 629.00 **Outlet Invert Elevation (ft.) :** 603.80
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 254.00 **Culvert Slope (ft./ft.) :** 0.0992
Pipe Size : 54 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI * (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY * (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
78.00	25.58	632.92	N/A	1 - C	17.56	1.45	2.58	0.0233	INLET	0.00	605.07
94.00	26.02	633.49	N/A	1 - C	18.49	1.60	2.84	0.0233	INLET	0.00	605.07

Design HW + Velocity

CULVERT ANALYSIS

PID : 19415 **Date :** 09/27/2009 **Project :** SCI-823 **Location :** Portsmouth OH

Description : Drainage Area 14, Sta 353+88, Analysis CMP 1 in corrigations **Designer :** KAG KMD

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.

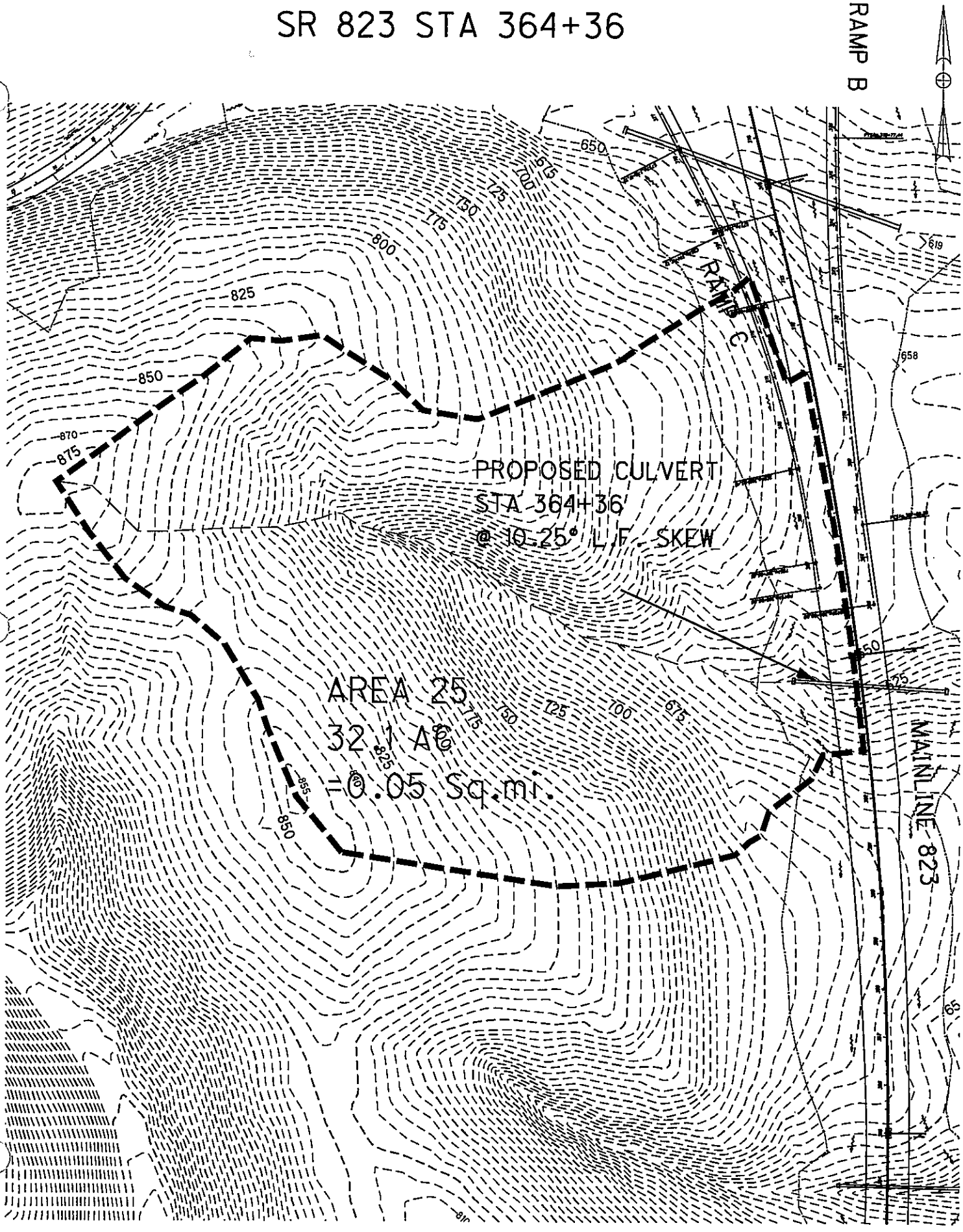
Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 629.00 **Outlet Invert Elevation (ft.) :** 603.80
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations) **Pipe Length (ft.) :** 254.00 **Culvert Slope (ft./ft.) :** 0.0992
Pipe Size : 54 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
78.00	25.58	632.92	N/A	1 - C	15.66	1.58	2.58	0.0273	INLET	0.00	605.07
94.00	26.02	633.49	N/A	1 - C	16.48	1.75	2.84	0.0273	INLET	0.00	605.07

SR 823 STA 364+36



1"=250'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1398221.00	SQ. FT.	
32.10	Acres	
0.050	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
1681.00	FT.	**TOTAL CHANNEL LENGTH**
168.10	FT.	L_{10} = 10% of the Distance along channel
670	FT.	$Elev_{10}$ = Elevation at point L_{10}
1428.85	FT.	L_{85} = 85% of the Distance along channel
850	FT.	$Elev_{85}$ = Elevation at point L_{85}
1260.75	FT.	**Length =** $L_{85} - L_{10}$
753.84	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge # = Frequency of Storm

Q_2	**17**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**37**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**53**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**76**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**96**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**115**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/27/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 25, Sta. 364+36 **Designer :** KAG KMD

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.

Inlet Invert Elevation (ft.) : 633.60 **Outlet Invert Elevation (ft.) :** 613.50 **Tailwater Elevation (ft.) :** 614.36 **Overflow Elevation (ft.) :** 667.32

Allowable Headwater Elevation (ft.) : 663.30 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 324.00 **Culvert Slope (ft./ft.) :** 0.0620 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 96.00 @ 50 yrs. **Flood Discharge (cfs) :** 115.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Square Edge with Headwall								**Entrance Loss (Ke) :** 0.50			
no Concrete velocity > 20fps	96.00	1	42 in.	639.80	621.58	2 - E	25.77	1.44	3.02	0.0120	INLET	0.00	D	0.00
	96.00	1	36 in.	642.86	626.42	2 - E	25.86	1.56	2.88	0.0120	INLET	0.00	D - 1	0.00
	96.00	1	33 in.	645.75	631.36	2 - E	25.78	1.65	2.70	0.0120	INLET	0.00	D - 2	0.00
	96.00	1	48 in.	638.48	619.57	2 - E	25.57	1.36	2.97	0.0120	INLET	0.00	D + 1	0.00
	115.00	1	42 in.	641.52	623.77	2 - E	27.05	1.59	3.21	0.0120	INLET	0.00	F	0.00
	115.00	1	36 in.	646.05	630.80	2 - E	27.01	1.74	2.94	0.0120	INLET	0.00	F - 1	0.00
	115.00	1	33 in.	650.28	637.95	2 - E	26.72	1.87	2.73	0.0120	INLET	0.00	F - 2	0.00
	115.00	1	48 in.	639.49	620.83	2 - E	26.88	1.49	3.24	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Headwall								**Entrance Loss (Ke) :** 0.25			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
→	96.00	1	42 in.	639.68	628.44	2 - E	15.45	2.15	3.02	0.0237	INLET	0.00	D	0.00

High fill Culvert Fill > 30' upsize 1' Per FEIS

UNIVERSAL CULVERT DESIGN

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.)
96.00	1	36 in.	642.57	642.96	2 - F	13.77	3.00	2.88	0.0241	OUTLET**	0.00	D - 1	0.00
96.00	1	33 in.	645.31	657.78	2 - F	16.23	2.75	2.70	0.0241	OUTLET**	0.00	D - 2	0.00
96.00	1	48 in.	638.45	622.82	2 - E	15.64	1.96	2.97	0.0235	INLET	0.00	D + 1	0.00
115.00	1	42 in.	641.32	633.62	2 - E	16.00	2.45	3.21	0.0237	INLET	0.00	F	0.00
115.00	1	36 in.	645.61	654.52	2 - F	16.35	3.00	2.94	0.0241	OUTLET**	0.00	F - 1	0.00
106.40	1	33 in.	649.62	675.87	2 - F	17.95	2.75	2.72	0.0241	OUTLET**	8.60	F - 2	0.00
115.00	1	48 in.	639.41	625.49	2 - E	16.34	2.19	3.24	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
→ 96.00	1	42 in.	639.68	632.11	2 - E	13.59	2.41	3.02	0.0278	INLET	0.00	D	0.00
96.00	1	36 in.	642.57	651.20	2 - F	13.77	3.00	2.88	0.0281	OUTLET**	0.00	D - 1	0.00
96.00	1	48 in.	638.45	624.56	2 - E	13.89	2.16	2.97	0.0275	INLET	0.00	D + 1	0.00
115.00	1	42 in.	641.32	638.88	2 - E	13.88	2.81	3.21	0.0278	INLET	0.00	F	0.00
115.00	1	36 in.	645.61	666.36	2 - F	16.35	3.00	2.94	0.0281	OUTLET**	0.00	F - 1	0.00
115.00	1	48 in.	639.41	627.98	2 - E	14.47	2.42	3.24	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
96.00	1	60 in.	637.56	N/A	1 - C	12.03	2.13	2.79	0.0332	INLET	0.00	D	0.00
96.00	1	66 in.	637.33	N/A	1 - C	12.02	2.03	2.71	0.0330	INLET	0.00	D + 1	0.00
115.00	1	60 in.	638.08	N/A	1 - C	12.61	2.36	3.06	0.0332	INLET	0.00	F	0.00
115.00	1	66 in.	637.79	N/A	1 - C	12.63	2.24	2.97	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
96.00	1	60 in.	637.56	N/A	1 - C	14.38	1.86	2.79	0.0260	INLET	0.00	D	0.00
96.00	1	66 in.	637.33	N/A	1 - C	14.29	1.79	2.71	0.0260	INLET	0.00	D + 1	0.00
115.00	1	60 in.	638.08	N/A	1 - C	15.11	2.06	3.06	0.0260	INLET	0.00	F	0.00
115.00	1	66 in.	637.79	N/A	1 - C	15.02	1.97	2.97	0.0260	INLET	0.00	F + 1	0.00

42 + 12 = 54

See analysis

CULVERT ANALYSIS

PID : 19415 **Date :** 06/27/2009 **Project :** SCI-823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 25, Sta. 364+36 **Designer :** KAG KMD

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 633.60 **Outlet Invert Elevation (ft.) :** 613.50
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 324.00 **Culvert Slope (ft./ft.) :** 0.0620
Pipe Size : 54 in.
Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

Entrance Type : Headwall **Loss Coef. Ke :** 0.2500 **K :** 0.0083 **M :** 2.00 **Max. Q :** 3.30
CD : 0.6405 **c :** 0.0379 **Y :** 0.6900 **Min. Q :** 3.80

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
96.00	20.69	637.88	N/A	1 - C	15.67	1.84	2.88	0.0233	INLET	0.00	615.75
115.00	21.19	638.52	N/A	1 - C	16.45	2.04	3.16	0.0233	INLET	0.00	615.75

Design Velocity + HW

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 633.60 **Outlet Invert Elevation (ft.) :** 613.50

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 324.00 **Culvert Slope (ft./ft.) :** 0.0620

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)

Pipe Size : 54 in.

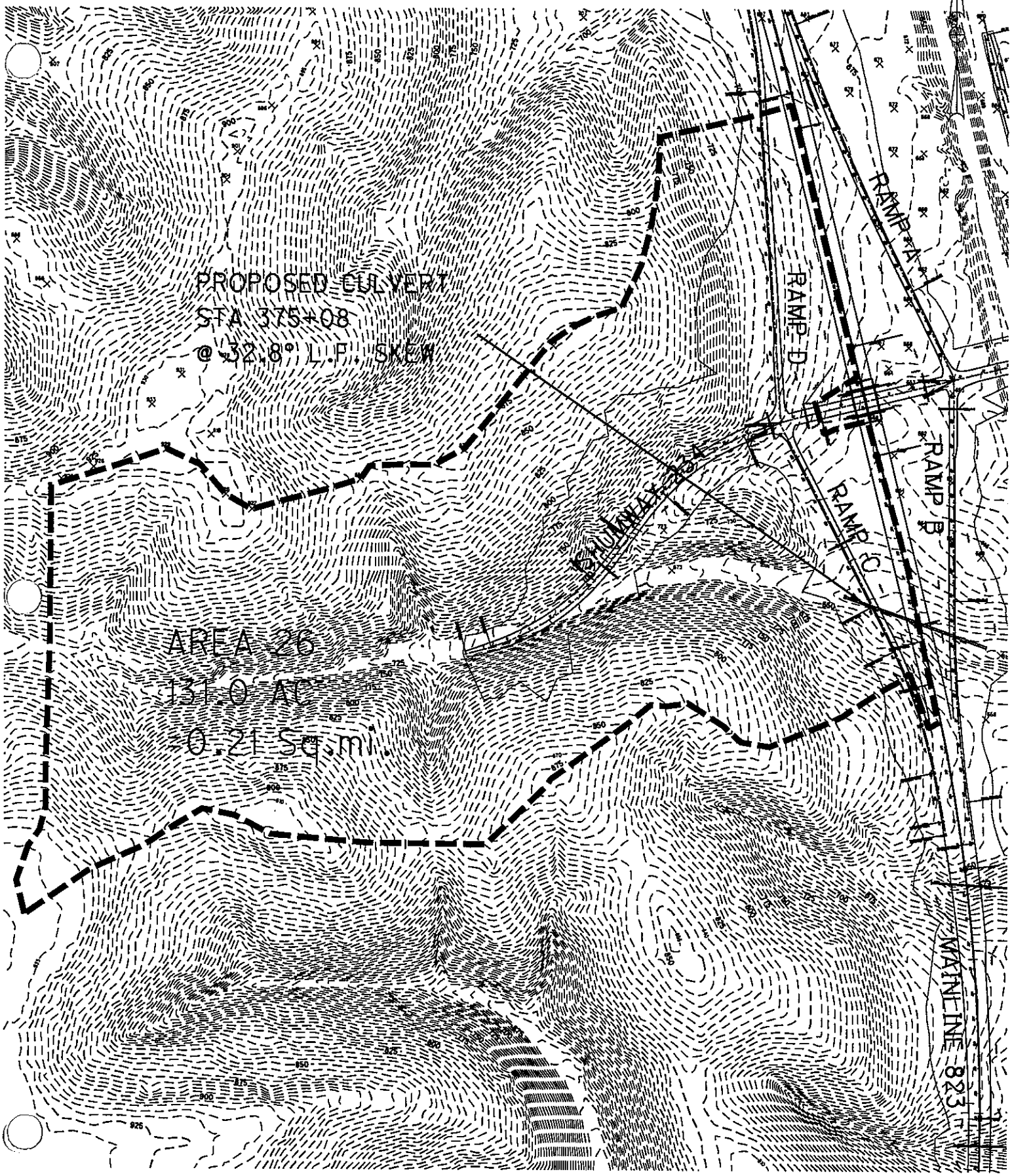
Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

Entrance Type : Headwall **Loss Coef. Ke :** 0.2500 **K :** 0.0083 **M :** 2.00 **Max. Q :** 3.30

CD : 0.6405 **c :** 0.0379 **Y :** 0.6900 **Min. Q :** 3.80

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
96.00	20.69	637.88	N/A	1 - C	13.96	2.01	2.88	0.0273	INLET	0.00	615.75
115.00	21.19	638.52	N/A	1 - C	14.61	2.23	3.16	0.0273	INLET	0.00	615.75

SR 823 STA 375+08



1"=500'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
5859587.00	SQ. FT.	
0.210	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
3900.00	FT.	**TOTAL CHANNEL LENGTH**
390.00	FT.	L_{10} = 10% of the Distance along channel
639	FT.	$Elev_{10}$ = Elevation at point L_{10}
3315.00	FT.	L_{85} = 85% of the Distance along channel
867	FT.	$Elev_{85}$ = Elevation at point L_{85}
2925.00	FT.	**Length =** $L_{85} - L_{10}$
410.67	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	50	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	100	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	140	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	190	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	240	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	290	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 26, Sta. 375+08 **Designer :** KMD KAG

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.

Inlet Invert Elevation (ft.) : 645.58 **Outlet Invert Elevation (ft.) :** 621.69 **Tailwater Elevation (ft.) :** 624.94 **Overflow Elevation (ft.) :** 682.62

Allowable Headwater Elevation (ft.) : 678.69 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 612.00 **Culvert Slope (ft./ft.) :** 0.0390 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 240.00 **@** 50 yrs. **Flood Discharge (cfs) :** 290.00 **@** 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH						**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20	
NO concrete velocity > 20 fps	240.00	1	60 in.	653.69	633.56	2 - E	27.32	2.29	4.36	0.0120	INLET	0.00	D	0.00
	240.00	1	54 in.	655.75	638.03	2 - E	27.34	2.43	4.24	0.0120	INLET	0.00	D - 1	0.00
	240.00	1	48 in.	659.48	646.92	2 - E	27.05	2.66	3.92	0.0120	INLET	0.00	D - 2	0.00
	240.00	1	66 in.	652.59	631.15	2 - E	27.22	2.19	4.33	0.0120	INLET	0.00	D + 1	0.00
	290.00	1	60 in.	655.81	637.00	2 - E	28.67	2.56	4.63	0.0120	INLET	0.00	F	0.00
	290.00	1	54 in.	658.91	643.60	2 - E	28.54	2.74	4.37	0.0120	INLET	0.00	F - 1	0.00
	290.00	1	48 in.	664.71	656.73	2 - E	27.83	3.09	3.96	0.0120	INLET	0.00	F - 2	0.00
	290.00	1	66 in.	654.03	633.43	2 - E	28.63	2.43	4.70	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED						**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90	
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
→	240.00	1	66 in.	654.09	639.43	2 - E	16.69	3.21	4.33	0.0231	INLET	0.00	D	0.00

Fill Height > 30 upsize culvert 1' diameter per FEIS report
See analysis for CMP 78" with selected corrugations

UNIVERSAL CULVERT DESIGN

	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.)
	240.00	1	60 in.	656.20	647.23	2 - E	16.43	3.48	4.36	0.0232	INLET	0.00	D - 1	0.00
	240.00	1	54 in.	659.54	661.90	2 - F	15.45	4.50	4.24	0.0233	OUTLET**	0.00	D - 2	0.00
	240.00	1	72 in.	652.86	635.00	2 - E	16.85	3.02	4.24	0.0229	INLET	0.00	D + 1	0.00
	290.00	1	66 in.	656.49	645.52	2 - E	17.37	3.64	4.70	0.0231	INLET	0.00	F	0.00
	290.00	1	60 in.	659.51	656.97	2 - E	16.74	4.13	4.63	0.0232	INLET	0.00	F - 1	0.00
	290.00	1	54 in.	664.07	678.45	2 - F	18.38	4.50	4.37	0.0233	OUTLET**	0.00	F - 2	0.00
	290.00	1	72 in.	654.55	638.98	2 - E	17.63	3.39	4.66	0.0229	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	240.00	1	66 in.	654.09	642.92	2 - E	14.81	3.55	4.33	0.0269	INLET	0.00	D	0.00
	240.00	1	60 in.	656.20	653.23	2 - E	14.32	3.98	4.36	0.0271	INLET	0.00	D - 1	0.00
	240.00	1	54 in.	659.54	672.75	2 - F	15.45	4.50	4.24	0.0273	OUTLET**	0.00	D - 2	0.00
	240.00	1	72 in.	652.86	637.18	2 - E	15.00	3.31	4.24	0.0267	INLET	0.00	D + 1	0.00
	290.00	1	66 in.	656.49	650.62	2 - E	15.28	4.10	4.70	0.0269	INLET	0.00	F	0.00
	290.00	1	60 in.	659.51	665.73	2 - F	15.28	5.00	4.63	0.0271	OUTLET**	0.00	F - 1	0.00
	264.00	1	54 in.	664.07	694.30	2 - F	16.83	4.50	4.32	0.0273	OUTLET**	26.00	F - 2	0.00
	290.00	1	72 in.	654.55	642.16	2 - E	15.65	3.74	4.66	0.0267	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
	240.00	1	66 in.	654.09	649.64	2 - E	12.48	4.15	4.33	0.0330	INLET	0.00	D	0.00
	240.00	1	60 in.	656.20	664.48	2 - F	13.22	5.00	4.36	0.0332	OUTLET**	0.00	D - 1	0.00
	240.00	1	72 in.	652.86	641.30	2 - E	12.81	3.78	4.24	0.0327	INLET	0.00	D + 1	0.00
	290.00	1	66 in.	656.49	660.43	2 - F	13.41	5.50	4.70	0.0330	OUTLET**	0.00	F	0.00
	290.00	1	60 in.	659.51	682.15	2 - F	15.28	5.00	4.63	0.0332	OUTLET**	0.00	F - 1	0.00
	290.00	1	72 in.	654.55	648.18	2 - E	13.26	4.34	4.66	0.0327	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)														

UNIVERSAL CULVERT DESIGN

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.)
240.00	1	66 in.	654.09	642.05	2 - E	15.21	3.47	4.33	0.0260	INLET	0.00	D	0.00
240.00	1	60 in.	656.20	651.45	2 - E	14.89	3.83	4.36	0.0260	INLET	0.00	D - 1	0.00
240.00	1	72 in.	652.86	636.75	2 - E	15.30	3.26	4.24	0.0260	INLET	0.00	D + 1	0.00
290.00	1	66 in.	656.49	649.34	2 - E	15.74	3.98	4.70	0.0260	INLET	0.00	F	0.00
290.00	1	60 in.	659.51	663.12	2 - F	15.28	5.00	4.63	0.0260	OUTLET**	0.00	F - 1	0.00
290.00	1	72 in.	654.55	641.54	2 - E	15.98	3.67	4.66	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 26, Sta. 375+08 **Designer :** KMD KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 645.58 **Outlet Invert Elevation (ft.) :** 621.69
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 612.00 **Culvert Slope (ft./ft.) :** 0.0390
Pipe Size : 78 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI * (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY * (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
240.00	12.73	652.16	644.90	1 - D	16.88	2.88	4.15	0.0228	INLET	0.00	639.43
290.00	13.95	653.38	647.41	1 - D	17.72	3.22	4.57	0.0228	INLET	0.00	639.43

Design HW and velocity

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 645.58 **Outlet Invert Elevation (ft.) :** 621.69

Pipe Quantity : 1

Culvert Type : Circular Corrugated

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations) **Pipe Length (ft.) :** 612.00 **Culvert Slope (ft./ft.) :** 0.0390

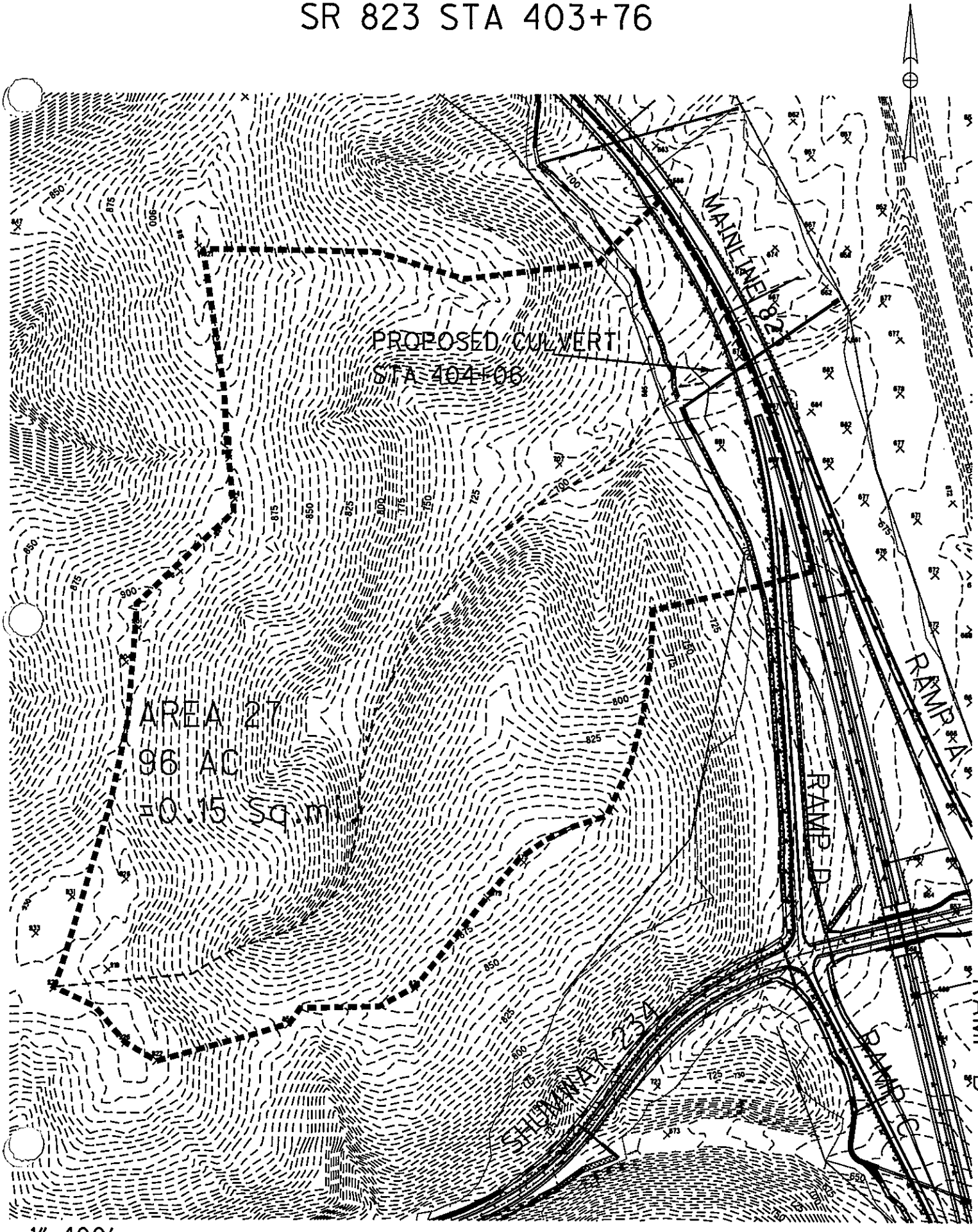
Pipe Size : 78 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
240.00	9.24	652.16	649.80	1 - D	15.05	3.15	4.15	0.0266	INLET	0.00	642.92
290.00	10.46	653.38	652.97	1 - D	15.77	3.53	4.57	0.0266	INLET	0.00	642.92

SR 823 STA 403+76



TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
4233681.00	SQ. FT.	
0.152	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
3231.00	FT.	**TOTAL CHANNEL LENGTH**
323.10	FT.	**L_{10} =** 10% of the Distance along channel
675	FT.	**$Elev_{10}$ =** Elevation at point **L_{10}**
2746.35	FT.	**L_{85} =** 85% of the Distance along channel
822	FT.	**$Elev_{85}$ =** Elevation at point **L_{85}**
2423.25	FT.	**Length = L_{85} - L_{10}**
320.30	FT./MI.	**SLOPE =** ($Elev_{10}$-$Elev_{85}$)/Length
	CFS	**$Q_{\#}$ =** Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**34.66**	CFS	**$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$**
Q_5	**70.98**	CFS	**$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$**
Q_{10}	**100.70**	CFS	**$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$**
Q_{25}	**141.24**	CFS	**$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$**
Q_{50}	**174.64**	CFS	**$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$**
Q_{100}	**207.96**	CFS	**$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$**

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 27, Sta. 403+76 **Designer :** KMD KAG

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.

Inlet Invert Elevation (ft.) : 678.26 **Outlet Invert Elevation (ft.) :** 659.83 **Tailwater Elevation (ft.) :** 662.83 **Overflow Elevation (ft.) :** 737.00

Allowable Headwater Elevation (ft.) : 737.00 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 605.00 **Culvert Slope (ft./ft.) :** 0.0305 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 175.00 @ 50 yrs. **Flood Discharge (cfs) :** 210.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
NO concrete velocity > 20 fps	175.00	1	54 in.	685.15	670.32	2 - E	23.03	2.17	3.84	0.0120	INLET	0.00	D	0.00
	175.00	1	48 in.	687.04	674.93	2 - E	22.95	2.34	3.75	0.0120	INLET	0.00	D - 1	0.00
	175.00	1	42 in.	690.77	684.97	2 - E	22.44	2.64	3.44	0.0120	INLET	0.00	D - 2	0.00
	175.00	1	60 in.	684.23	N/A	1 - C	22.96	2.06	3.79	0.0120	INLET	0.00	D + 1	0.00
	210.00	1	54 in.	686.79	673.22	2 - E	24.08	2.42	4.10	0.0120	INLET	0.00	F	0.00
	210.00	1	48 in.	689.62	679.93	2 - E	23.87	2.64	3.87	0.0120	INLET	0.00	F - 1	0.00
	210.00	1	42 in.	695.36	694.52	2 - E	21.83	3.50	3.47	0.0120	INLET	0.00	F - 2	0.00
	210.00	1	60 in.	685.29	669.86	2 - E	24.09	2.28	4.13	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
→	175.00	1	60 in.	685.31	675.22	2 - E	13.98	3.05	3.79	0.0232	INLET	0.00	D	0.00

Fill Height > 30" upsize culvert 1' diameter per FEIS report
See analysis of CMP 72" with selected corrugations

UNIVERSAL CULVERT DESIGN

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.)
175.00	1	54 in.	687.15	682.88	2 - E	13.65	3.38	3.84	0.0233	INLET	0.00	D - 1	0.00
175.00	1	48 in.	690.29	698.61	2 - F	14.30	4.00	3.75	0.0235	OUTLET**	0.00	D - 2	0.00
175.00	1	66 in.	684.33	N/A	1 - C	14.09	2.85	3.70	0.0231	INLET	0.00	D + 1	0.00
210.00	1	60 in.	687.11	680.22	2 - E	14.49	3.46	4.13	0.0232	INLET	0.00	F	0.00
210.00	1	54 in.	689.77	691.31	2 - F	13.81	4.50	4.10	0.0233	OUTLET**	0.00	F - 1	0.00
210.00	1	48 in.	693.99	714.02	2 - F	16.87	4.00	3.87	0.0235	OUTLET**	0.00	F - 2	0.00
210.00	1	66 in.	685.55	674.34	2 - E	14.71	3.19	4.06	0.0231	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
175.00	1	60 in.	685.31	678.37	2 - E	12.35	3.39	3.79	0.0271	INLET	0.00	D	0.00
175.00	1	54 in.	687.15	688.58	2 - F	12.10	4.50	3.84	0.0273	OUTLET**	0.00	D - 1	0.00
175.00	1	48 in.	690.29	709.38	2 - F	14.30	4.00	3.75	0.0275	OUTLET**	0.00	D - 2	0.00
175.00	1	66 in.	684.33	N/A	1 - C	12.54	3.13	3.70	0.0269	INLET	0.00	D + 1	0.00
210.00	1	60 in.	687.11	684.76	2 - E	12.65	3.94	4.13	0.0271	INLET	0.00	F	0.00
210.00	1	54 in.	689.77	699.53	2 - F	13.81	4.50	4.10	0.0273	OUTLET**	0.00	F - 1	0.00
210.00	1	48 in.	693.99	729.54	2 - F	16.87	4.00	3.87	0.0275	OUTLET**	0.00	F - 2	0.00
210.00	1	66 in.	685.55	676.99	2 - E	13.05	3.53	4.06	0.0269	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
175.00	1	60 in.	685.31	685.43	2 - F	10.96	4.02	3.79	0.0332	OUTLET*	0.00	D	0.00
175.00	1	66 in.	684.33	N/A	1 - C	10.69	3.58	3.70	0.0330	INLET	0.00	D + 1	0.00
210.00	1	60 in.	687.11	693.28	2 - F	12.12	5.00	4.13	0.0332	OUTLET**	0.00	F	0.00
210.00	1	66 in.	685.55	685.95	2 - F	11.18	4.12	4.06	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
175.00	1	60 in.	685.31	677.43	2 - E	12.77	3.29	3.79	0.0260	INLET	0.00	D	0.00
175.00	1	66 in.	684.33	N/A	1 - C	12.88	3.06	3.70	0.0260	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
210.00	1	60 in.	687.11	683.41	2 - E	13.14	3.79	4.13	0.0260	INLET	0.00	F	0.00
210.00	1	66 in.	685.55	676.32	2 - E	13.41	3.44	4.06	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 27, Sta. 403+76 **Designer :** KMD KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 678.26 **Outlet Invert Elevation (ft.) :** 659.83
Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 605.00 **Culvert Slope (ft./ft.) :** 0.0305
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)
Pipe Size : 72 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI * (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY * (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
175.00	8.60	683.82	679.54	1 - D	14.17	2.70	3.61	0.0229	INLET	0.00	675.22
210.00	9.46	684.68	681.44	1 - D	14.84	3.00	3.96	0.0229	INLET	0.00	675.22

Design HW and velocity

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 678.26 **Outlet Invert Elevation (ft.) :** 659.83

Pipe Quantity : 1

Culvert Type : Circular Corrugated

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations) **Pipe Length (ft.) :** 605.00 **Culvert Slope (ft./ft.) :** 0.0305

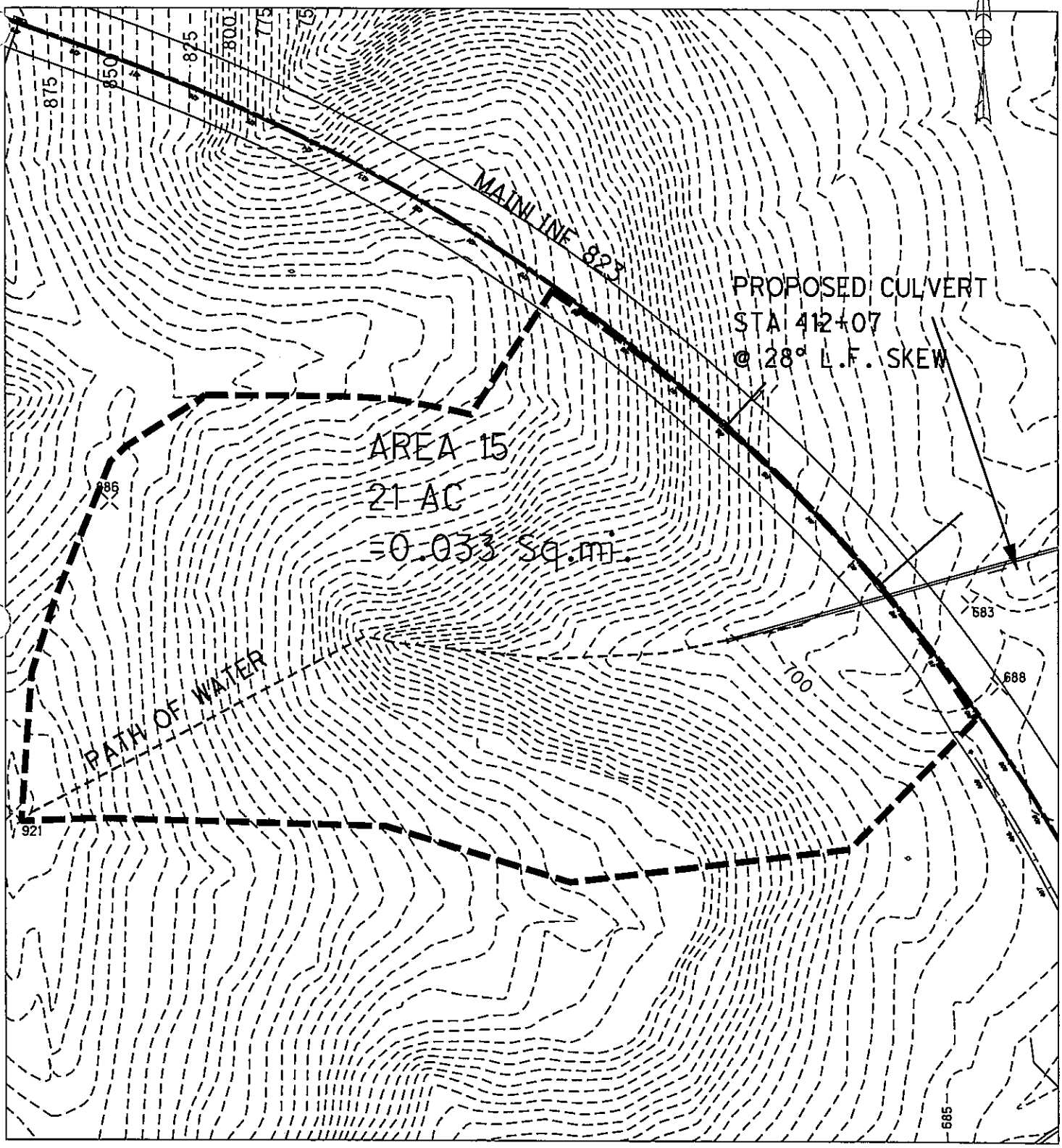
Pipe Size : 72 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
175.00	5.46	683.82	683.83	1 - B	6.19	2.95	3.61	0.0267	OUTLET	0.00	678.37
210.00	7.87	684.68	686.24	2 - G	7.43	3.29	3.96	0.0267	OUTLET	0.00	678.37

SR 823 STA 412+26



1"=220'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
928473.00	SQ. FT.	
0.033	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
1302.00	FT.	**TOTAL CHANNEL LENGTH**
130.20	FT.	L_{10} = 10% of the Distance along channel
707	FT.	$Elev_{10}$ = Elevation at point L_{10}
1106.70	FT.	L_{85} = 85% of the Distance along channel
870	FT.	$Elev_{85}$ = Elevation at point L_{85}
976.50	FT.	**Length =** $L_{85} - L_{10}$
881.35	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**10**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**30**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**40**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**60**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**70**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**90**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 15, Sta. 412+26 **Designer :** KMD KAG

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.

Inlet Invert Elevation (ft.) : 707.30 **Outlet Invert Elevation (ft.) :** 662.17 **Tailwater Elevation (ft.) :** 664.17 **Overflow Elevation (ft.) :** 765.00

Allowable Headwater Elevation (ft.) : 765.00 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 669.00 **Culvert Slope (ft./ft.) :** 0.0675 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 70.00 **@** 50 yrs. **Flood Discharge (cfs) :** 90.00 **@** 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20			
70.00	1	33 in.	713.51	677.36	2 - E	24.66	1.33	2.59	0.0120	INLET	0.00	D	0.00
70.00	1	30 in.	715.26	684.94	2 - E	24.63	1.41	2.44	0.0120	INLET	0.00	D - 1	0.00
70.00	1	27 in.	718.42	699.14	2 - E	24.37	1.53	2.23	0.0120	INLET	0.00	D - 2	0.00
70.00	1	36 in.	712.42	673.07	2 - E	24.61	1.27	2.66	0.0120	INLET	0.00	D + 1	0.00
90.00	1	33 in.	716.23	685.58	2 - E	26.22	1.54	2.69	0.0120	INLET	0.00	F	0.00
90.00	1	30 in.	719.37	698.21	2 - E	25.99	1.66	2.48	0.0120	INLET	0.00	F - 1	0.00
90.00	1	27 in.	728.92	721.83	2 - E	24.92	1.92	2.24	0.0120	INLET	0.00	F - 2	0.00
90.00	1	36 in.	714.39	678.43	2 - E	26.26	1.46	2.85	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
70.00	1	36 in.	714.09	693.07	2 - E	14.50	1.94	2.66	0.0241	INLET	0.00	D	0.00

No concrete
velocity > 20 fps

Fill Height > 30" upsize culvert 1' diameter per FEIS report
See analysis of CMP 48" with select. corrugations

UNIVERSAL CULVERT DESIGN

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.)
70.00	1	33 in.	715.82	708.99	2 - E	14.19	2.13	2.59	0.0241	INLET	0.00	D - 1	0.00
70.00	1	30 in.	718.39	738.89	2 - F	14.35	2.50	2.44	0.0244	OUTLET**	0.00	D - 2	0.00
70.00	1	42 in.	712.10	677.50	2 - E	14.82	1.73	2.62	0.0237	INLET	0.00	D + 1	0.00
90.00	1	36 in.	717.06	711.50	2 - E	15.06	2.36	2.85	0.0241	INLET	0.00	F	0.00
90.00	1	33 in.	719.77	737.87	2 - F	15.24	2.75	2.69	0.0241	OUTLET**	0.00	F - 1	0.00
81.30	1	30 in.	726.81	787.41	2 - F	16.61	2.50	2.47	0.0244	OUTLET**	8.70	F - 2	0.00
90.00	1	42 in.	713.87	685.67	2 - E	15.74	2.01	2.94	0.0237	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
70.00	1	36 in.	714.09	702.13	2 - E	12.78	2.17	2.66	0.0281	INLET	0.00	D	0.00
70.00	1	42 in.	712.10	681.52	2 - E	13.13	1.90	2.62	0.0278	INLET	0.00	D + 1	0.00
90.00	1	36 in.	717.06	726.47	2 - F	12.99	3.00	2.85	0.0281	OUTLET**	0.00	F	0.00
90.00	1	42 in.	713.87	692.32	2 - E	13.89	2.23	2.94	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
70.00	1	60 in.	710.77	N/A	1 - C	11.39	1.75	2.36	0.0332	INLET	0.00	D	0.00
70.00	1	66 in.	710.64	N/A	1 - C	11.35	1.68	2.29	0.0330	INLET	0.00	D + 1	0.00
90.00	1	60 in.	711.33	N/A	1 - C	12.20	2.01	2.69	0.0332	INLET	0.00	F	0.00
90.00	1	66 in.	711.15	N/A	1 - C	12.18	1.92	2.62	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
70.00	1	60 in.	710.77	N/A	1 - C	13.58	1.54	2.36	0.0260	INLET	0.00	D	0.00
70.00	1	66 in.	710.64	N/A	1 - C	13.46	1.49	2.29	0.0260	INLET	0.00	D + 1	0.00
90.00	1	60 in.	711.33	N/A	1 - C	14.57	1.76	2.69	0.0260	INLET	0.00	F	0.00
90.00	1	66 in.	711.15	N/A	1 - C	14.46	1.70	2.62	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 15, Sta. 412+26 **Designer :** KMD KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 707.30 **Outlet Invert Elevation (ft.) :** 662.17
Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 669.00 **Culvert Slope (ft./ft.) :** 0.0675
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)
Pipe Size : 48 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI * (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY * (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
70.00	18.22	711.29	699.15	1 - D	14.83	1.61	2.53	0.0235	INLET	0.00	693.07
90.00	19.25	712.32	703.12	2 - H	15.87	1.85	2.88	0.0235	INLET	0.00	693.07

Design HW and velocity

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 707.30 **Outlet Invert Elevation (ft.) :** 662.17

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 669.00 **Culvert Slope (ft./ft.) :** 0.0675

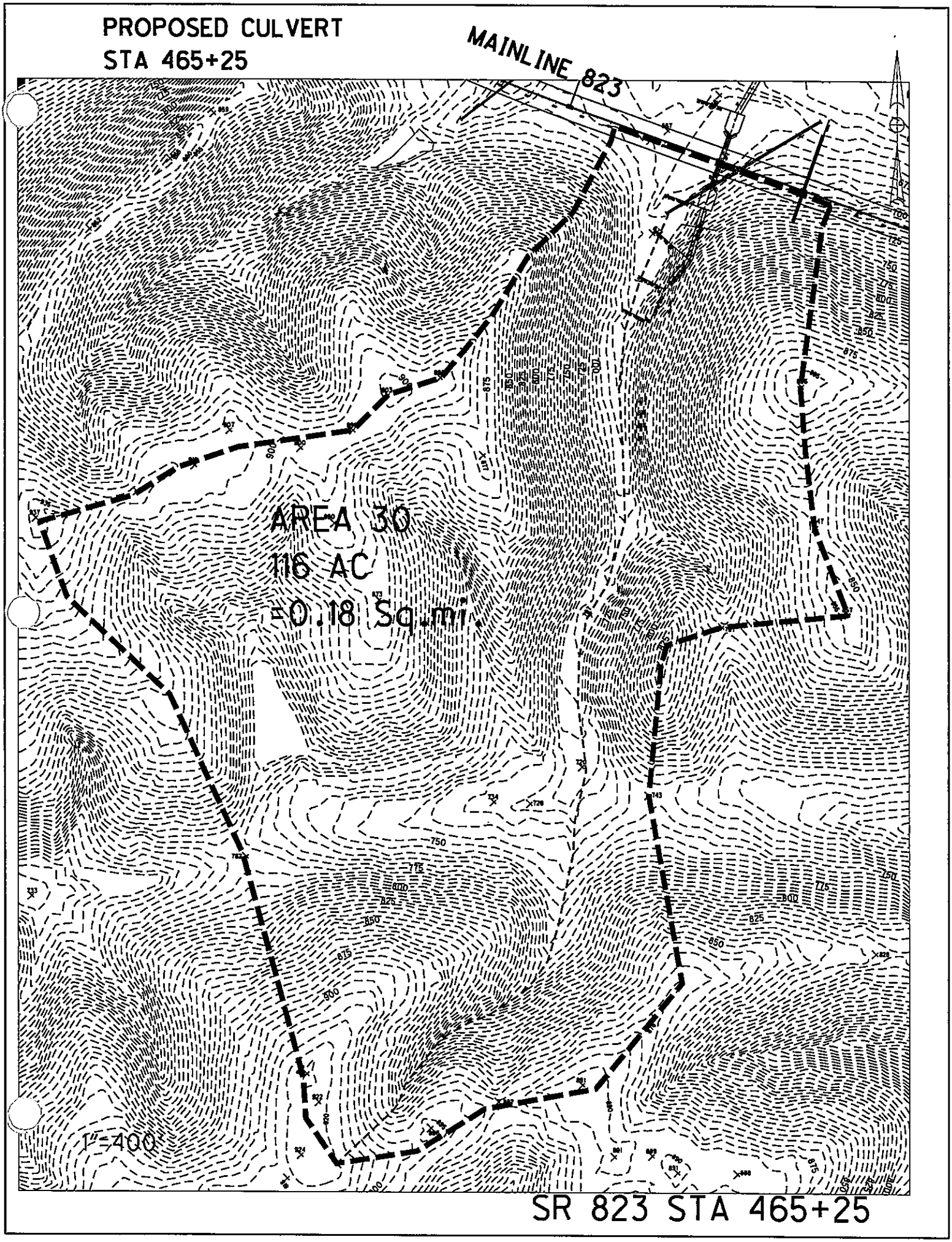
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)

Pipe Size : 48 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
70.00	9.16	711.29	710.11	1 - D	13.23	1.75	2.53	0.0275	INLET	0.00	702.13
90.00	13.20	712.32	715.33	2 - G	7.16	2.02	2.88	0.0275	OUTLET	0.00	702.13


PROPOSED CULVERT
STA 465+25
MAINLINE 823
AREA 30
116 AC
=0.18 Sq.mi.
1"=400'
SR 823 STA 465+25

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
5004578.00	SQ. FT.	
0.180	SQ. MI.	**CONTDA =** Contributing Drainage Area
27093.00	SQ. FT.	
0.54	%	**STORAGE =** Storage Area
3642.00	FT.	**TOTAL CHANNEL LENGTH**
364.20	FT.	L_{10} = 10% of the Distance along channel
677	FT.	$Elev_{10}$ = Elevation at point L_{10}
3095.70	FT.	L_{85} = 85% of the Distance along channel
820	FT.	$Elev_{85}$ = Elevation at point L_{85}
2731.50	FT.	**Length =** $L_{85} - L_{10}$
276.42	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**30**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**70**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**100**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**130**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**160**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**190**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 30, Sta. 466+45 **Designer :** KMD KAG

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.

Inlet Invert Elevation (ft.) : 664.91 **Outlet Invert Elevation (ft.) :** 658.59 **Tailwater Elevation (ft.) :** 662.20 **Overflow Elevation (ft.) :** 703.69

Allowable Headwater Elevation (ft.) : 703.69 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 616.00 **Culvert Slope (ft./ft.) :** 0.0103 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 160.00 @ 50 yrs. **Flood Discharge (cfs) :** 190.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
Velocity < 20 fps consider concrete	160.00	1	48 in.	672.71	671.92	2 - E	14.29	3.33	3.67	0.0120	INLET	0.00	D	0.00
	160.00	1	42 in.	675.81	680.55	2 - G	16.63	3.50	3.41	0.0120	OUTLET	0.00	D - 1	0.00
	160.00	1	36 in.	683.65	701.78	2 - G	22.64	3.00	2.98	0.0120	OUTLET	0.00	D - 2	0.00
	160.00	1	54 in.	671.19	668.03	2 - E	14.86	2.88	3.70	0.0120	INLET	0.00	D + 1	0.00
	190.00	1	48 in.	674.75	675.89	2 - F	15.38	4.00	3.81	0.0120	OUTLET**	0.00	F	0.00
	190.00	1	42 in.	679.20	688.08	2 - G	19.75	3.50	3.45	0.0120	OUTLET	0.00	F - 1	0.00
	163.80	1	36 in.	696.91	718.02	2 - G	23.17	3.00	2.98	0.0120	OUTLET	26.20	F - 2	0.00
	190.00	1	54 in.	672.46	670.35	2 - E	15.31	3.28	3.96	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	160.00	1	60 in.	671.30	672.22	2 - F	10.49	5.00	3.63	0.0232	OUTLET**	0.00	D	0.00

Fill Height > 30' upsize culvert 1' diameter per FEIS report
See analysis of CMP 72", 78", and Concrete 60"

UNIVERSAL CULVERT DESIGN

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.)
160.00	1	54 in.	672.78	678.70	2 - F	11.44	4.50	3.70	0.0233	OUTLET**	0.00	D - 1	0.00
160.00	1	48 in.	675.48	692.04	2 - F	13.26	4.00	3.67	0.0235	OUTLET**	0.00	D - 2	0.00
160.00	1	66 in.	670.53	671.15	1 - A	9.68	3.85	3.53	0.0231	OUTLET*	0.00	D + 1	0.00
190.00	1	60 in.	672.69	676.21	2 - F	11.44	5.00	3.94	0.0232	OUTLET**	0.00	F	0.00
190.00	1	54 in.	674.88	685.40	2 - F	12.81	4.50	3.96	0.0233	OUTLET**	0.00	F - 1	0.00
188.70	1	48 in.	678.47	704.26	2 - F	15.28	4.00	3.81	0.0235	OUTLET**	1.30	F - 2	0.00
190.00	1	66 in.	671.47	671.85	2 - F	10.67	4.47	3.86	0.0231	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
160.00	1	66 in.	670.53	671.10	1 - A	9.68	4.38	3.53	0.0269	OUTLET*	0.00	D	0.00
160.00	1	60 in.	671.30	674.91	2 - F	10.49	5.00	3.63	0.0271	OUTLET**	0.00	D - 1	0.00
160.00	1	54 in.	672.78	683.56	2 - F	11.44	4.50	3.70	0.0273	OUTLET**	0.00	D - 2	0.00
160.00	1	72 in.	670.13	670.79	1 - A	9.00	3.94	3.44	0.0267	OUTLET*	0.00	D + 1	0.00
190.00	1	66 in.	671.47	673.55	2 - F	10.67	5.50	3.86	0.0269	OUTLET**	0.00	F	0.00
190.00	1	60 in.	672.69	679.99	2 - F	11.44	5.00	3.94	0.0271	OUTLET**	0.00	F - 1	0.00
190.00	1	54 in.	674.88	692.25	2 - F	12.81	4.50	3.96	0.0273	OUTLET**	0.00	F - 2	0.00
190.00	1	72 in.	670.82	671.45	1 - A	10.18	4.49	3.76	0.0267	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
160.00	1	66 in.	670.53	673.40	2 - F	9.68	5.50	3.53	0.0330	OUTLET**	0.00	D	0.00
160.00	1	60 in.	671.30	679.94	2 - F	10.49	5.00	3.63	0.0332	OUTLET**	0.00	D - 1	0.00
160.00	1	72 in.	670.13	670.89	1 - A	9.00	4.61	3.44	0.0327	OUTLET*	0.00	D + 1	0.00
190.00	1	66 in.	671.47	677.79	2 - F	10.67	5.50	3.86	0.0330	OUTLET**	0.00	F	0.00
190.00	1	60 in.	672.69	687.09	2 - F	11.44	5.00	3.94	0.0332	OUTLET**	0.00	F - 1	0.00
190.00	1	72 in.	670.82	672.60	2 - F	10.18	6.00	3.76	0.0327	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													

UNIVERSAL CULVERT DESIGN

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.)
160.00	1	66 in.	670.53	671.09	1 - A	9.68	4.24	3.53	0.0260	OUTLET*	0.00	D	0.00
160.00	1	60 in.	671.30	674.11	2 - F	10.49	5.00	3.63	0.0260	OUTLET**	0.00	D - 1	0.00
160.00	1	72 in.	670.13	670.81	1 - A	9.00	3.86	3.44	0.0260	OUTLET*	0.00	D + 1	0.00
190.00	1	66 in.	671.47	673.00	2 - F	10.67	5.50	3.86	0.0260	OUTLET**	0.00	F	0.00
190.00	1	60 in.	672.69	678.86	2 - F	11.44	5.00	3.94	0.0260	OUTLET**	0.00	F - 1	0.00
190.00	1	72 in.	670.82	671.45	1 - A	10.18	4.39	3.76	0.0260	OUTLET*	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 30, Sta. 465+25 **Designer :** KMD KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 664.91 **Outlet Invert Elevation (ft.) :** 658.59
Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 616.00 **Culvert Slope (ft./ft.) :** 0.0103
Corrugation Type :
Pipe Size : 60 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
160.00	3.21	670.47	675.13	2 - G	8.15	2.68	3.63	0.0120	OUTLET	0.00	671.92
190.00	4.52	671.31	676.44	2 - G	9.68	2.98	3.94	0.0120	OUTLET	0.00	671.92

Design velocity

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 664.91 **Outlet Invert Elevation (ft.) :** 658.59

Pipe Quantity : 1

Culvert Type : Circular Corrugated

Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 616.00 **Culvert Slope (ft./ft.) :** 0.0103

Pipe Size : 72 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
160.00	3.66	670.13	675.88	2 - G	5.66	3.55	3.44	0.0229	OUTLET	0.00	672.22
190.00	5.16	670.82	677.38	2 - G	6.72	3.99	3.76	0.0229	OUTLET	0.00	672.22

Design HW

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 3 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 664.91 **Outlet Invert Elevation (ft.) :** 658.59

Pipe Quantity : 1

Culvert Type : Circular Corrugated

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations) **Pipe Length (ft.) :** 616.00 **Culvert Slope (ft./ft.) :** 0.0103

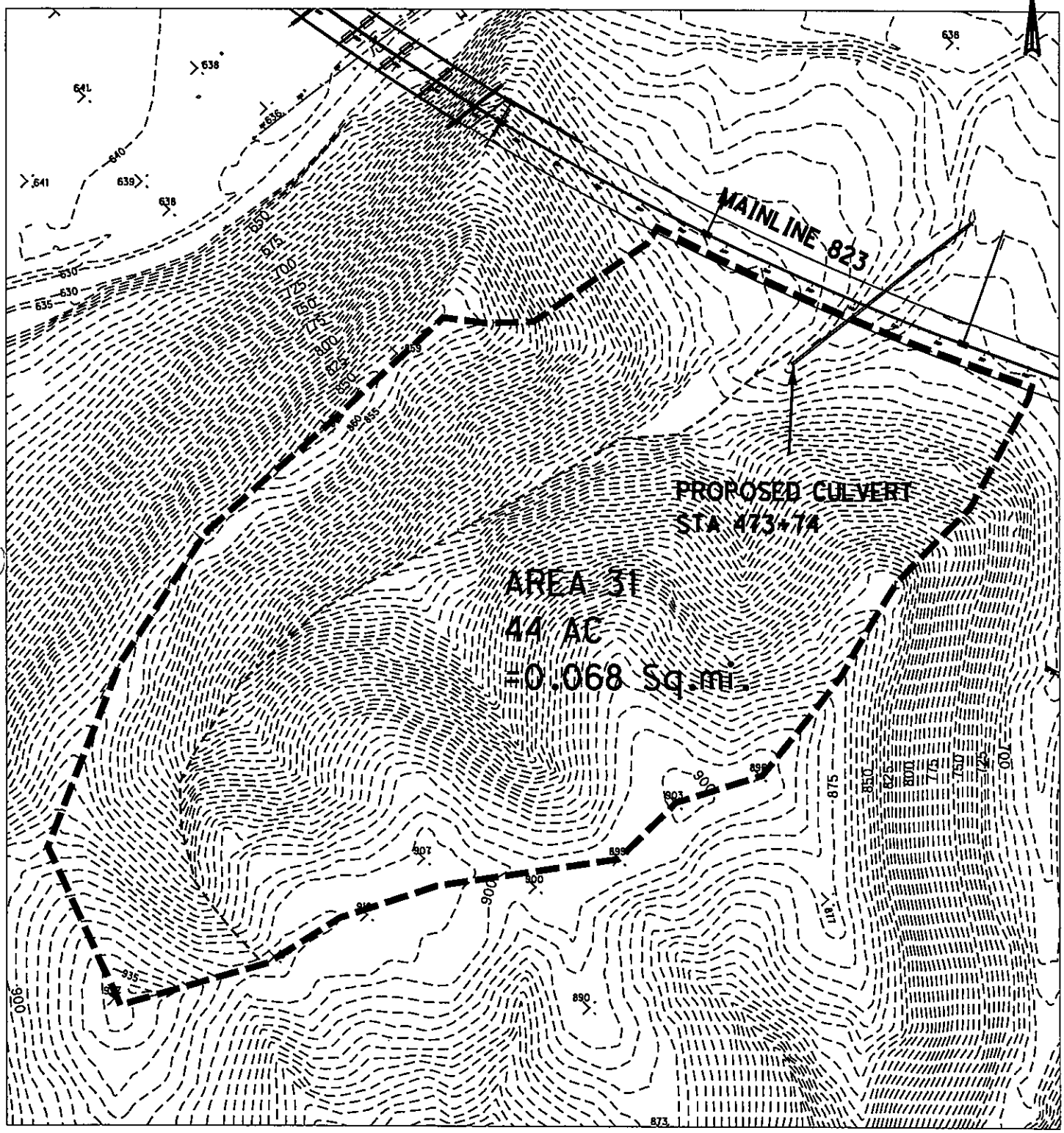
Pipe Size : 78 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
160.00	3.07	669.90	674.17	2 - G	4.82	3.69	3.36	0.0266	OUTLET	0.00	671.10
190.00	4.34	670.46	675.44	2 - G	5.73	4.13	3.67	0.0266	OUTLET	0.00	671.10

SR 823 STA 473+74



1"=300'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1886126.00	SQ. FT.	
0.068	SQ. MI.	**CONTDA =** Contributing Drainage Area
10154.00	SQ. FT.	
0.54	%	**STORAGE =** Storage Area
2079.00	FT.	**TOTAL CHANNEL LENGTH**
207.90	FT.	L_{10} = 10% of the Distance along channel
695	FT.	$Elev_{10}$ = Elevation at point L_{10}
1767.15	FT.	L_{85} = 85% of the Distance along channel
840	FT.	$Elev_{85}$ = Elevation at point L_{85}
1559.25	FT.	**Length =** $L_{85} - L_{10}$
491.01	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	20	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	40	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	50	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	70	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	90	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	110	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 31, Sta. 473+75 **Designer :** KMD KAG

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.

Inlet Invert Elevation (ft.) : 677.56 **Outlet Invert Elevation (ft.) :** 649.40 **Tailwater Elevation (ft.) :** 651.65 **Overflow Elevation (ft.) :** 728.96

Allowable Headwater Elevation (ft.) : 728.96 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 494.00 **Culvert Slope (ft./ft.) :** 0.0570 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 90.00 @ 50 yrs. **Flood Discharge (cfs) :** 110.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall									**Entrance Loss (Ke) :** 0.20		
NO concrete velocity > 20fps	90.00	1	42 in.	682.71	657.60	2 - E	24.59	1.42	2.94	0.0120	INLET	0.00	D	0.00
	90.00	1	36 in.	684.65	662.96	2 - E	24.65	1.54	2.85	0.0120	INLET	0.00	D - 1	0.00
	90.00	1	33 in.	686.49	668.52	2 - E	24.58	1.63	2.69	0.0120	INLET	0.00	D - 2	0.00
	90.00	1	48 in.	681.95	N/A	1 - C	24.36	1.34	2.88	0.0120	INLET	0.00	D + 1	0.00
	110.00	1	42 in.	684.04	660.17	2 - E	25.91	1.59	3.17	0.0120	INLET	0.00	F	0.00
	110.00	1	36 in.	687.05	668.26	2 - E	25.86	1.74	2.93	0.0120	INLET	0.00	F - 1	0.00
	110.00	1	33 in.	689.94	676.63	2 - E	25.62	1.87	2.72	0.0120	INLET	0.00	F - 2	0.00
	110.00	1	48 in.	682.73	656.87	2 - E	25.76	1.49	3.17	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall									**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
→	90.00	1	42 in.	684.13	668.27	2 - E	14.74	2.12	2.94	0.0237	INLET	0.00	D	0.00

Fill Height > 30' upsize culvert 1' diameter per FEIS report
See analysis of CMP 54" with selected corrugations

UNIVERSAL CULVERT DESIGN

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.)
90.00	1	36 in.	687.32	687.84	2 - F	12.99	2.61	2.85	0.0241	OUTLET**	0.00	D - 1	0.00
90.00	1	33 in.	690.03	707.78	2 - F	15.24	2.75	2.69	0.0241	OUTLET**	0.00	D - 2	0.00
90.00	1	48 in.	682.58	660.65	2 - E	14.91	1.94	2.88	0.0235	INLET	0.00	D + 1	0.00
110.00	1	42 in.	686.28	676.11	2 - E	15.33	2.44	3.17	0.0237	INLET	0.00	F	0.00
110.00	1	36 in.	690.79	705.43	2 - F	15.66	3.00	2.93	0.0241	OUTLET**	0.00	F - 1	0.00
105.70	1	33 in.	696.73	735.29	2 - F	17.84	2.75	2.72	0.0241	OUTLET**	4.30	F - 2	0.00
110.00	1	48 in.	683.87	664.66	2 - E	15.65	2.19	3.17	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
90.00	1	42 in.	684.13	673.18	2 - E	12.97	2.37	2.94	0.0278	INLET	0.00	D	0.00
90.00	1	36 in.	687.32	698.89	2 - F	12.99	3.00	2.85	0.0281	OUTLET**	0.00	D - 1	0.00
90.00	1	48 in.	682.58	662.98	2 - E	13.23	2.13	2.88	0.0275	INLET	0.00	D + 1	0.00
110.00	1	42 in.	686.28	683.44	2 - E	13.31	2.81	3.17	0.0278	INLET	0.00	F	0.00
110.00	1	36 in.	690.79	721.93	2 - F	15.66	3.00	2.93	0.0281	OUTLET**	0.00	F - 1	0.00
110.00	1	48 in.	683.87	668.14	2 - E	13.87	2.42	3.17	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
90.00	1	60 in.	681.59	N/A	1 - C	11.47	2.10	2.69	0.0332	INLET	0.00	D	0.00
90.00	1	66 in.	681.41	N/A	1 - C	11.46	2.01	2.62	0.0330	INLET	0.00	D + 1	0.00
110.00	1	60 in.	682.16	N/A	1 - C	12.09	2.36	2.99	0.0332	INLET	0.00	F	0.00
110.00	1	66 in.	681.89	N/A	1 - C	12.10	2.24	2.91	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
90.00	1	60 in.	681.59	N/A	1 - C	13.70	1.84	2.69	0.0260	INLET	0.00	D	0.00
90.00	1	66 in.	681.41	N/A	1 - C	13.61	1.77	2.62	0.0260	INLET	0.00	D + 1	0.00
110.00	1	60 in.	682.16	N/A	1 - C	14.48	2.05	2.99	0.0260	INLET	0.00	F	0.00
110.00	1	66 in.	681.89	N/A	1 - C	14.39	1.97	2.91	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 31, Sta. 473+75 **Designer :** KMD KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 677.56 **Outlet Invert Elevation (ft.) :** 649.40
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 494.00 **Culvert Slope (ft./ft.) :** 0.0570
Pipe Size : 54 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI * (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY * (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
90.00	13.63	681.90	672.52	1 - D	14.94	1.82	2.78	0.0233	INLET	0.00	668.27
110.00	14.43	682.70	674.62	1 - D	15.75	2.03	3.09	0.0233	INLET	0.00	668.27

Design HW and velocity

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 677.56 **Outlet Invert Elevation (ft.) :** 649.40

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 494.00 **Culvert Slope (ft./ft.) :** 0.0570

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)

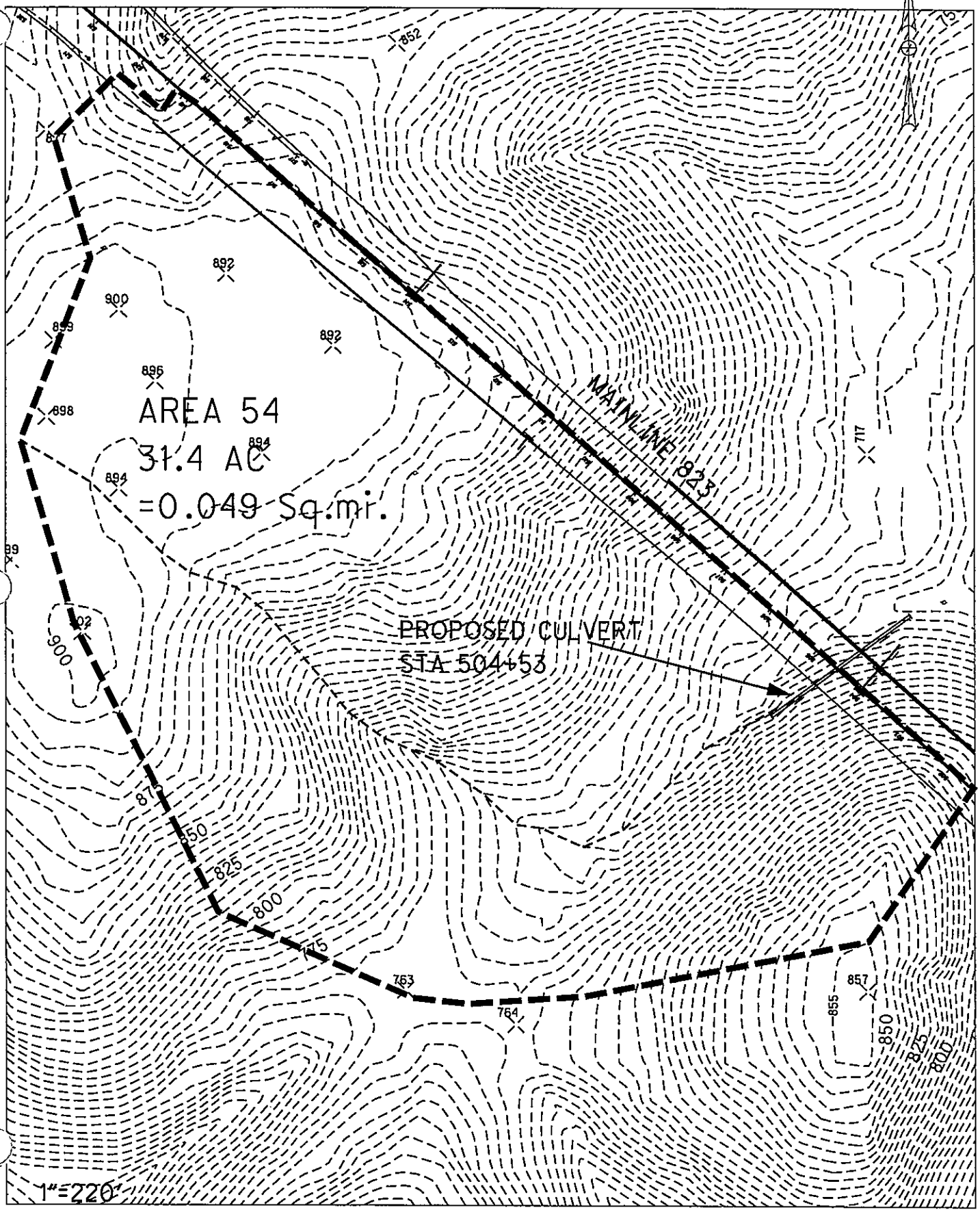
Pipe Size : 54 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
90.00	8.72	681.90	678.66	1 - D	13.29	1.99	2.78	0.0273	INLET	0.00	673.18
110.00	9.52	682.70	681.37	1 - D	14.00	2.23	3.09	0.0273	INLET	0.00	673.18

SR 823 STA 504+53



TECHNIQUES FOR ESTIMATING FLOOD-PEAK
DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A
U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1368285.00	SQ. FT.	
0.049	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
1591.00	FT.	**TOTAL CHANNEL LENGTH**
159.10	FT.	**L_{10} =** 10% of the Distance along channel
722	FT.	**$Elev_{10}$ =** Elevation at point **L_{10}**
1352.35	FT.	**L_{85} =** 85% of the Distance along channel
880	FT.	**$Elev_{85}$ =** Elevation at point **L_{85}**
1193.25	FT.	**Length = L_{85} - L_{10}**
699.13	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})$/Length
	CFS	**$Q_{\#}$ =** Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**20**	CFS	**$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$**
Q_5	**40**	CFS	**$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$**
Q_{10}	**50**	CFS	**$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$**
Q_{25}	**70**	CFS	**$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$**
Q_{50}	**90**	CFS	**$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$**
Q_{100}	**110**	CFS	**$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$**

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 54, Sta. 504+53 **Designer :** KMD KPG

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.

Inlet Invert Elevation (ft.) : 707.30 **Outlet Invert Elevation (ft.) :** 694.10 **Tailwater Elevation (ft.) :** 696.35 **Overflow Elevation (ft.) :** 742.99

Allowable Headwater Elevation (ft.) : 742.99 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 292.00 **Culvert Slope (ft./ft.) :** 0.0452 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 90.00 @ 50 yrs. **Flood Discharge (cfs) :** 110.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20			
No concrete	90.00	1	42 in.	712.45	700.93	2 - E	22.55	1.52	2.94	0.0120	INLET	0.00	D	0.00
	90.00	1	36 in.	714.39	704.55	2 - E	22.59	1.65	2.85	0.0120	INLET	0.00	D - 1	0.00
velocity > 20 fps	90.00	1	33 in.	716.23	708.26	2 - E	22.44	1.76	2.69	0.0120	INLET	0.00	D - 2	0.00
	90.00	1	48 in.	711.69	N/A	1 - C	22.42	1.42	2.88	0.0120	INLET	0.00	D + 1	0.00
	110.00	1	42 in.	713.78	702.83	2 - E	23.77	1.70	3.17	0.0120	INLET	0.00	F	0.00
	110.00	1	36 in.	716.79	708.31	2 - E	23.64	1.88	2.93	0.0120	INLET	0.00	F - 1	0.00
	110.00	1	33 in.	719.68	713.93	2 - E	23.22	2.05	2.72	0.0120	INLET	0.00	F - 2	0.00
	110.00	1	48 in.	712.47	700.56	2 - E	23.65	1.59	3.17	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
→	90.00	1	42 in.	713.87	707.63	2 - E	13.44	2.30	2.94	0.0237	INLET	0.00	D	0.00

Fill Height > 30' upsize culvert 1' diameter per FEIS report
See analysis of CMP 54" with selected corrugations

UNIVERSAL CULVERT DESIGN

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.)
90.00	1	36 in.	717.06	719.97	2 - F	12.99	3.00	2.85	0.0241	OUTLET**	0.00	D - 1	0.00
90.00	1	33 in.	719.77	732.49	2 - F	15.24	2.75	2.69	0.0241	OUTLET**	0.00	D - 2	0.00
90.00	1	48 in.	712.32	702.78	2 - E	13.65	2.08	2.88	0.0235	INLET	0.00	D + 1	0.00
110.00	1	42 in.	716.02	712.83	2 - E	13.86	2.69	3.17	0.0237	INLET	0.00	F	0.00
110.00	1	36 in.	720.53	731.35	2 - F	15.66	3.00	2.93	0.0241	OUTLET**	0.00	F - 1	0.00
102.30	1	33 in.	726.47	750.12	2 - F	17.27	2.75	2.71	0.0241	OUTLET**	7.70	F - 2	0.00
110.00	1	48 in.	713.61	705.51	2 - E	14.31	2.35	3.17	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
90.00	1	42 in.	713.87	710.53	2 - E	11.77	2.60	2.94	0.0278	INLET	0.00	D	0.00
90.00	1	36 in.	717.06	726.51	2 - F	12.99	3.00	2.85	0.0281	OUTLET**	0.00	D - 1	0.00
90.00	1	48 in.	712.32	704.15	2 - E	12.11	2.29	2.88	0.0275	INLET	0.00	D + 1	0.00
110.00	1	42 in.	716.02	717.16	2 - F	12.01	3.50	3.17	0.0278	OUTLET**	0.00	F	0.00
110.00	1	36 in.	720.53	741.11	2 - F	15.66	3.00	2.93	0.0281	OUTLET**	0.00	F - 1	0.00
110.00	1	48 in.	713.61	707.57	2 - E	12.65	2.61	3.17	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
90.00	1	60 in.	711.33	N/A	1 - C	10.53	2.25	2.69	0.0332	INLET	0.00	D	0.00
90.00	1	66 in.	711.15	N/A	1 - C	10.53	2.14	2.62	0.0330	INLET	0.00	D + 1	0.00
110.00	1	60 in.	711.90	N/A	1 - C	11.08	2.52	2.99	0.0332	INLET	0.00	F	0.00
110.00	1	66 in.	711.63	N/A	1 - C	11.12	2.39	2.91	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
90.00	1	60 in.	711.33	N/A	1 - C	12.60	1.96	2.69	0.0260	INLET	0.00	D	0.00
90.00	1	66 in.	711.15	N/A	1 - C	12.51	1.88	2.62	0.0260	INLET	0.00	D + 1	0.00
110.00	1	60 in.	711.90	N/A	1 - C	13.29	2.19	2.99	0.0260	INLET	0.00	F	0.00
110.00	1	66 in.	711.63	N/A	1 - C	13.23	2.10	2.91	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 54, Sta. 504+53 **Designer :** KMD KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 707.30 **Outlet Invert Elevation (ft.) :** 694.10

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)
Pipe Size : 54 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 292.00 **Culvert Slope (ft./ft.) :** 0.0452

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY * (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
90.00	4.01	711.64	710.53	1 - D	13.72	1.94	2.78	0.0233	INLET	0.00	707.63
110.00	4.81	712.44	711.96	1 - D	14.46	2.17	3.09	0.0233	INLET	0.00	707.63

Design velocity

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 707.30 **Outlet Invert Elevation (ft.) :** 694.10

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 292.00 **Culvert Slope (ft./ft.) :** 0.0452

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)

Pipe Size : 54 in.

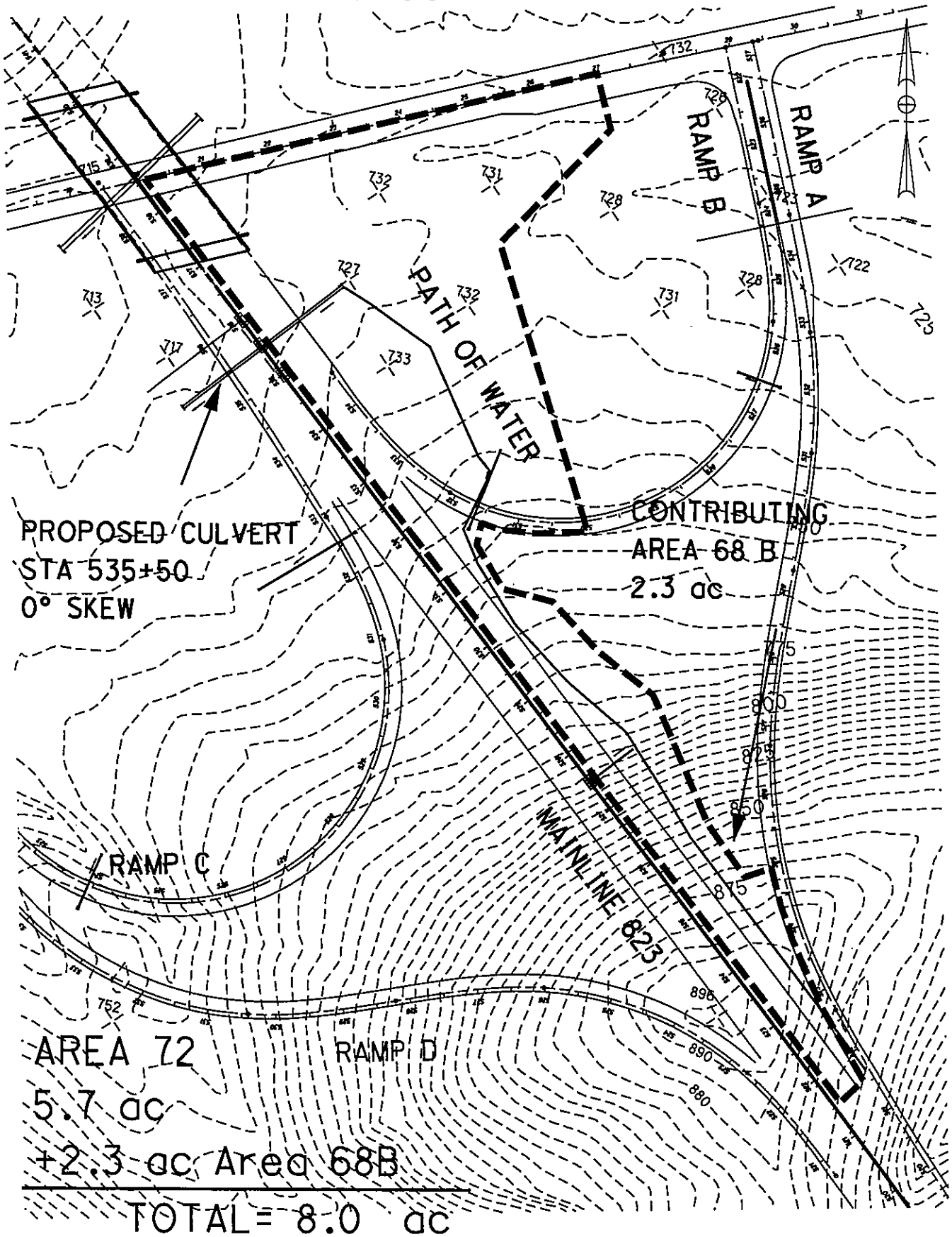
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO* (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
90.00	3.63	711.64	714.16	2 - G	5.66	2.12	2.78	0.0273	OUTLET	0.00	710.53
110.00	5.42	712.44	715.95	2 - G	6.92	2.39	3.09	0.0273	OUTLET	0.00	710.53

Design headwater

SR 823 STA 535+50



1"=200'

HDR | ONE COMPANY *Many Solutions*℠

234 STA. 535+50

Sheet: of

Client: ODOT
Subject: Pipe Culvert Calculations
Order No:

Computed by: KAG Date: 9/3/2008
Checked by: JF Date: 11/3/2008

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C	
Pavement Area	57617	1.32	0.9	
Non-paved Area	189911	4.36	0.5	Wieghted "C" for non-paved area
68 B	101688	2.33	0.71	
Total Area	349216	**8.01**	**acres**	**Weighted "C" =** **0.63**

Overland Flow

Length	30	
High Elevation	785.5	
Low Elevation	784.9	
Slope %	2	t_o 3.70

Shallow Concentrated Flow

Length	400	
High Elevation	753.5	
Low Elevation	714.0	
Slope %	9.88	
k	0.31	(Poor Grass - Table 1101-1)
V	3.14	(1101.2.2)
t_s	2.12	(1101.2.2)

Since the time of concentration = to + ts +ts

t_c **5.8** min
use t_c **10.0** min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	8.0	10	0.63	3.80	19
5 Years	118.822	18.7	0.969	8.0	10	0.63	4.59	23
10 Years	112.172	16.8	0.923	8.0	10	0.63	5.39	27
25 Years	198.92	19.3	1.004	8.0	10	0.63	6.70	34
50 Years	206.025	19.6	0.99	8.0	10	0.63	7.20	**36**
100 Years	355.551	23.199	1.076	8.0	10	0.63	8.21	**41**

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 09/08/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 72, Sta. 535+50 **Designer :** KAG

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.

Inlet Invert Elevation (ft.) : 714.00 **Outlet Invert Elevation (ft.) :** 708.00 **Tailwater Elevation (ft.) :** 712.50 **Overflow Elevation (ft.) :** 717.20

Allowable Headwater Elevation (ft.) : 720.00 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 461.00 **Culvert Slope (ft./ft.) :** 0.0130 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 36.00 @ 50 yrs. **Flood Discharge (cfs) :** 42.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Square Edge with Headwall							**Entrance Loss (Ke) :** 0.50			
30.50	1	30 in.	717.80	716.76	2 - H	10.80	1.40	1.88	0.0120	INLET	5.50	D	0.00
26.00	1	27 in.	718.76	719.69	2 - H	6.54	1.36	1.78	0.0120	INLET	10.00	D - 1	0.00
21.50	1	24 in.	720.55	725.45	2 - H	6.84	1.32	1.66	0.0120	INLET	14.50	D - 2	0.00
34.90	1	33 in.	717.29	715.17	1 - D	11.19	1.43	1.97	0.0120	INLET	1.10	D + 1	0.00
30.50	1	30 in.	718.57	718.30	2 - H	10.80	1.40	1.88	0.0120	INLET	11.50	F	0.00
26.00	1	27 in.	719.93	722.28	2 - H	6.54	1.36	1.78	0.0120	INLET	16.00	F - 1	0.00
21.50	1	24 in.	722.44	730.13	2 - H	6.84	1.32	1.66	0.0120	INLET	20.50	F - 2	0.00
34.90	1	33 in.	717.81	716.13	2 - H	11.19	1.43	1.97	0.0120	INLET	7.10	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Headwall							**Entrance Loss (Ke) :** 0.25			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
34.50	1	36 in.	717.00	717.59	1 - B	4.88	2.11	1.91	0.0241	OUTLET	1.50	D	0.00

UNIVERSAL CULVERT DESIGN

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.)
27.50	1	33 in.	717.27	720.51	2 - G	4.63	1.94	1.74	0.0241	OUTLET	8.50	D - 1	0.00
21.20	1	30 in.	717.75	725.98	2 - G	4.32	1.77	1.56	0.0244	OUTLET	14.80	D - 2	0.00
36.00	1	42 in.	716.70	714.72	1 - D	6.77	1.90	1.86	0.0237	INLET	0.00	D + 1	0.00
34.50	1	36 in.	717.37	719.43	2 - G	4.88	2.11	1.91	0.0241	OUTLET	7.50	F	0.00
27.50	1	33 in.	717.77	723.41	2 - G	4.63	1.94	1.74	0.0241	OUTLET	14.50	F - 1	0.00
21.20	1	30 in.	718.48	730.85	2 - G	4.32	1.77	1.56	0.0244	OUTLET	20.80	F - 2	0.00
42.00	1	42 in.	716.98	715.52	1 - D	7.00	2.09	2.02	0.0237	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
36.00	1	42 in.	716.70	715.46	1 - D	5.98	2.10	1.86	0.0278	INLET	0.00	D	0.00
30.00	1	36 in.	717.00	719.24	2 - G	4.24	2.13	1.77	0.0281	OUTLET	6.00	D - 1	0.00
36.00	1	48 in.	716.51	713.95	1 - D	6.05	1.92	1.79	0.0275	INLET	0.00	D + 1	0.00
42.00	1	42 in.	716.98	716.52	1 - D	6.17	2.33	2.02	0.0278	INLET	0.00	F	0.00
30.00	1	36 in.	717.37	721.68	2 - G	4.24	2.13	1.77	0.0281	OUTLET	12.00	F - 1	0.00
42.00	1	48 in.	716.76	714.47	1 - D	6.29	2.10	1.94	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
36.00	1	60 in.	716.28	713.14	1 - C	5.22	1.91	1.67	0.0332	INLET	0.00	D	0.00
36.00	1	66 in.	716.19	712.88	1 - C	5.21	1.83	1.62	0.0330	INLET	0.00	D + 1	0.00
42.00	1	60 in.	716.48	713.37	1 - C	5.45	2.08	1.81	0.0332	INLET	0.00	F	0.00
42.00	1	66 in.	716.39	713.02	1 - C	5.44	1.98	1.76	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
36.00	1	60 in.	716.28	712.92	1 - C	6.23	1.68	1.67	0.0260	INLET	0.00	D	0.00
36.00	1	66 in.	716.19	712.76	1 - C	6.18	1.62	1.62	0.0260	INLET	0.00	D + 1	0.00
42.00	1	60 in.	716.48	713.07	1 - C	6.50	1.82	1.81	0.0260	INLET	0.00	F	0.00
42.00	1	66 in.	716.39	712.85	1 - C	6.46	1.75	1.76	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 07/13/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 72, Sta 535+50 **Designer :** KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 714.00 **Outlet Invert Elevation (ft.) :** 708.00
Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 461.00 **Culvert Slope (ft./ft.) :** 0.0130
Corrugation Type :
Pipe Size : 42 in.
Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

Entrance Type : Square Edge with Headwall **Loss Coef. Ke :** 0.5000 **K :** 0.0098 **M :** 2.00 **Max. Q :** 3.30
CD : 0.6251 **c :** 0.0398 **Y :** 0.6700 **Min. Q :** 3.40

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
36.00	5.72	716.72	711.83	1 - C	11.19	1.29	1.86	0.0120	INLET	0.00	711.00
42.00	6.01	717.01	712.12	1 - C	11.66	1.40	2.02	0.0120	INLET	0.00	711.00

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 2 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 714.00 **Outlet Invert Elevation (ft.) :** 708.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated

Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 461.00 **Culvert Slope (ft./ft.) :** 0.0130

Pipe Size : 48 in.

Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

Entrance Type : Headwall **Loss Coef. Ke :** 0.2500 **K :** 0.0083 **M :** 2.00 **Max. Q :** 3.30

CD : 0.6405 **c :** 0.0379 **Y :** 0.6900 **Min. Q :** 3.80

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
36.00	5.51	716.51	712.10	1 - C	6.80	1.75	1.79	0.0235	INLET	0.00	711.00
42.00	5.76	716.76	712.50	1 - C	7.08	1.91	1.94	0.0235	INLET	0.00	711.00

CULVERT ANALYSIS

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)

Pipe Number : 3 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 714.00 **Outlet Invert Elevation (ft.) :** 708.00

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 461.00 **Culvert Slope (ft./ft.) :** 0.0130

Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)

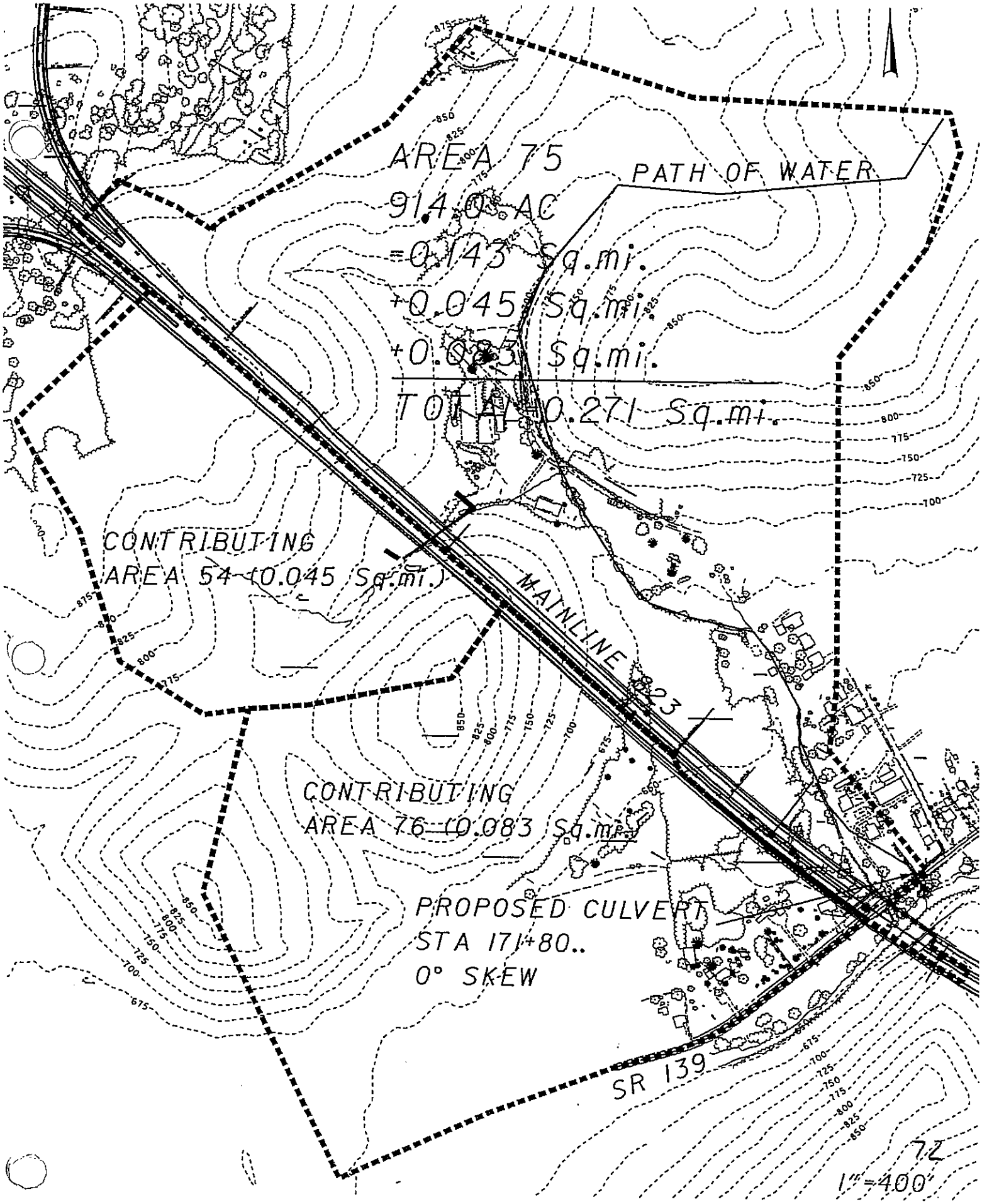
Pipe Size : 48 in.

Design Manning 'n' : (default) **Buried Manning 'n' :** N/A

Entrance Type : Headwall **Loss Coef. Ke :** 0.2500 **K :** 0.0083 **M :** 2.00 **Max. Q :** 3.30

CD : 0.6405 **c :** 0.0379 **Y :** 0.6900 **Min. Q :** 3.80

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
36.00	5.51	716.51	712.45	1 - C	6.05	1.92	1.79	0.0275	INLET	0.00	711.00
42.00	5.76	716.76	712.97	1 - C	6.29	2.10	1.94	0.0275	INLET	0.00	711.00


AREA 75
914.0 AC
=0.143 Sq.mi.
+0.045 Sq.mi.
+0.083 Sq.mi.
TOTAL 0.271 Sq.mi.
PATH OF WATER
CONTRIBUTING
AREA 54 (0.045 Sq.mi.)
MAINLINE 23
CONTRIBUTING
AREA 76 (0.083 Sq.mi.)
PROPOSED CULVERT
STA 171+80..
0° SKEW
SR 139
72
1"=400'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
7570455.00	SQ. FT.	
0.272	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
4140.00	FT.	**TOTAL CHANNEL LENGTH**
414.00	FT.	L_{10} = 10% of the Distance along channel
650	FT.	$Elev_{10}$ = Elevation at point L_{10}
3519.00	FT.	L_{85} = 85% of the Distance along channel
790	FT.	$Elev_{85}$ = Elevation at point L_{85}
3105.00	FT.	**Length =** $L_{85} - L_{10}$
238.07	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**52**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**104**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**146**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**203**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**250**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**297**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

For Long Run

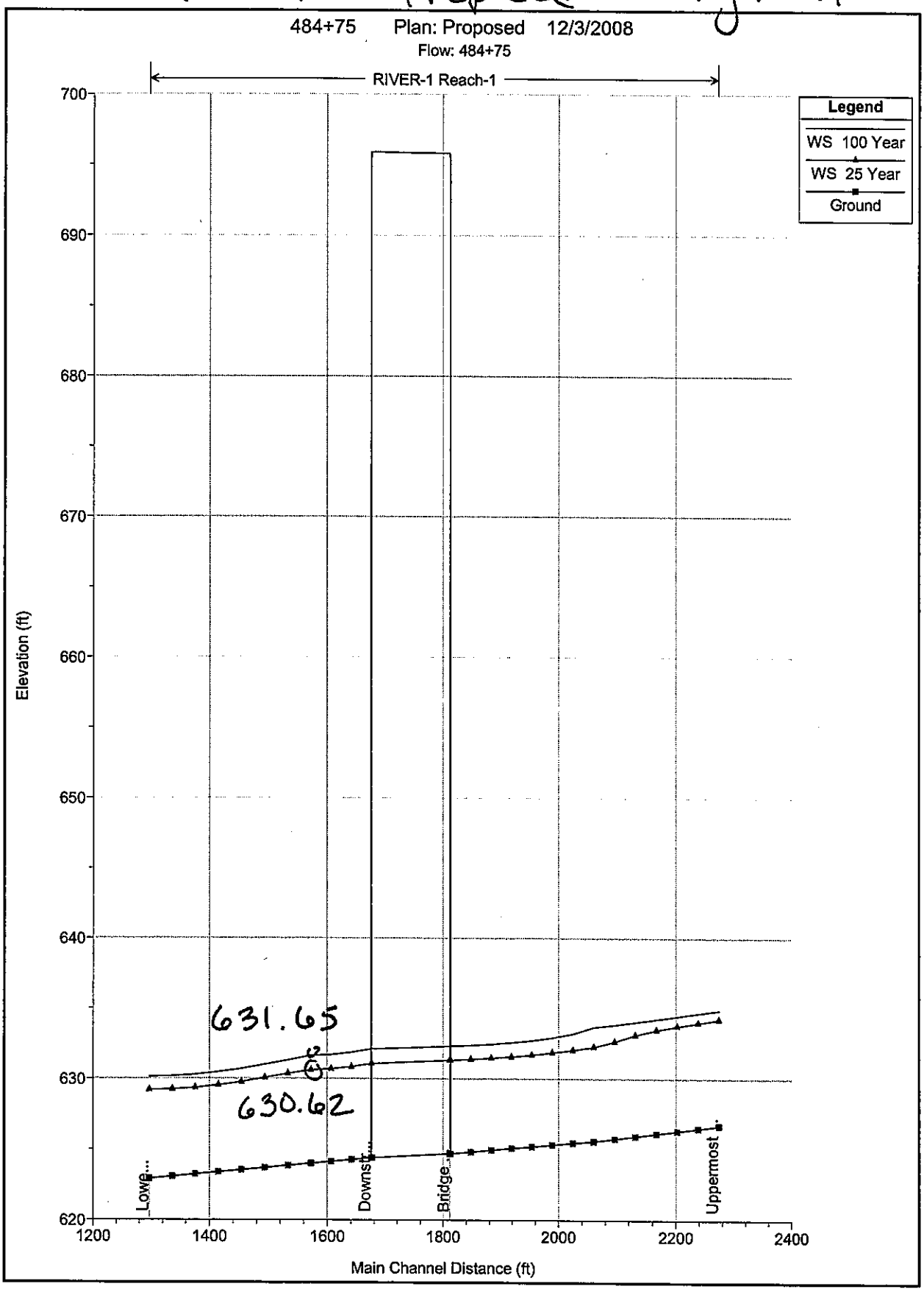
TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
374226426.10	SQ. FT.	
13.424	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
31530.00	FT.	**TOTAL CHANNEL LENGTH**
3153.00	FT.	L_{10} = 10% of the Distance along channel
743	FT.	$Elev_{10}$ = Elevation at point L_{10}
26800.50	FT.	L_{85} = 85% of the Distance along channel
810	FT.	$Elev_{85}$ = Elevation at point L_{85}
23647.50	FT.	**Length =** $L_{85} - L_{10}$
14.96	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**680.83**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**1131.99**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**1463.54**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**1896.48**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**2230.16**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**2571.80**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

HEC RAS Proposed Long Run



UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 08/22/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Oh

Description : DR 75, 76, 54 SR 139 Sta 171+80 **Designer :** KAG JF

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.

Inlet Invert Elevation (ft.) : 625.60 **Outlet Invert Elevation (ft.) :** 624.80 **Tailwater Elevation (ft.) :** 630.60 **Overflow Elevation (ft.) :** 635.24

Allowable Headwater Elevation (ft.) : 633.62 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 60.00 **Culvert Slope (ft./ft.) :** 0.0133 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 203.00 @ 25 yrs. **Flood Discharge (cfs) :** 297.00 @ 100 yrs.

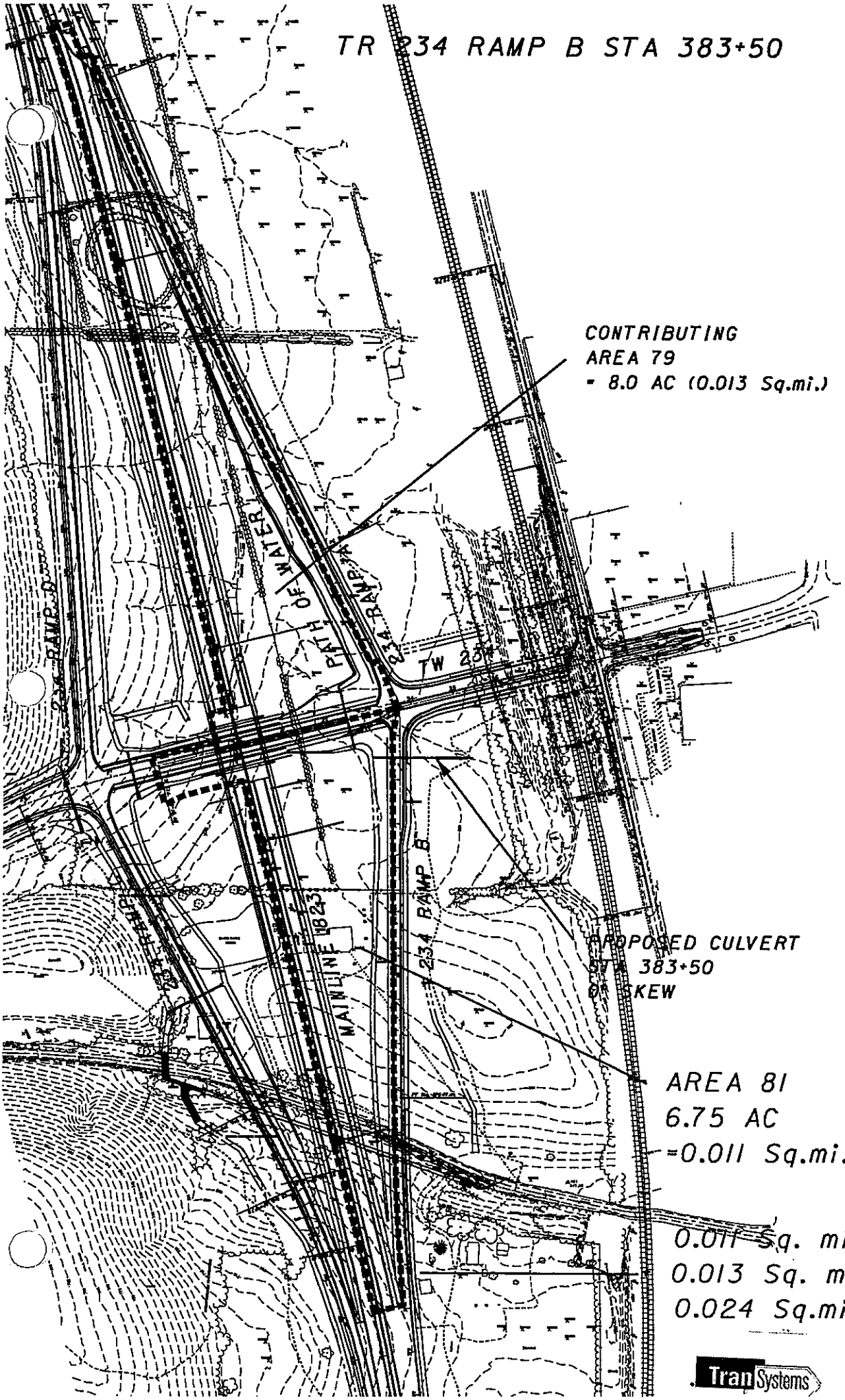
FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Square Edge with Headwall							**Entrance Loss (Ke) :** 0.50			
203.00	1	66 in.	632.15	632.49	2 - G	8.54	2.70	3.99	0.0120	OUTLET	0.00	D	0.00
203.00	1	60 in.	633.17	633.40	2 - G	10.34	2.86	4.06	0.0120	OUTLET	0.00	D - 1	0.00
203.00	1	54 in.	635.07	634.94	2 - H	17.28	3.12	4.06	0.0120	INLET	0.00	D - 2	0.00
203.00	1	72 in.	631.66	631.92	1 - B	7.25	2.58	3.89	0.0120	OUTLET	0.00	D + 1	0.00
291.50	1	66 in.	635.47	634.64	2 - H	19.10	3.37	4.71	0.0120	INLET	5.50	F	0.00
247.40	1	60 in.	638.02	636.59	2 - H	18.26	3.26	4.41	0.0120	INLET	49.60	F - 1	0.00
205.60	1	54 in.	642.46	639.88	2 - H	17.31	3.15	4.07	0.0120	INLET	91.40	F - 2	0.00
297.00	1	72 in.	633.97	633.42	2 - E	19.27	3.21	4.71	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Headwall							**Entrance Loss (Ke) :** 0.25			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
203.00	1	66 in.	632.12	632.71	2 - G	8.54	4.20	3.99	0.0231	OUTLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

	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.)
	203.00	1	60 in.	633.07	633.83	2 - G	10.34	5.00	4.06	0.0232	OUTLET	0.00	D - 1	0.00
	191.60	1	54 in.	634.85	635.80	2 - G	12.05	4.50	3.98	0.0233	OUTLET	11.40	D - 2	0.00
	203.00	1	72 in.	631.58	632.03	1 - B	7.25	3.81	3.89	0.0229	OUTLET	0.00	D + 1	0.00
	295.90	1	66 in.	635.28	635.11	2 - H	12.45	5.50	4.74	0.0231	INLET	1.10	F	0.00
	243.30	1	60 in.	637.69	637.51	2 - G	12.39	5.00	4.38	0.0232	OUTLET	53.70	F - 1	0.00
	191.60	1	54 in.	641.89	641.74	2 - G	12.05	4.50	3.98	0.0233	OUTLET	105.40	F - 2	0.00
	297.00	1	72 in.	633.88	633.65	2 - E	10.50	6.00	4.71	0.0229	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	203.00	1	66 in.	632.12	632.95	2 - G	8.54	5.50	3.99	0.0269	OUTLET	0.00	D	0.00
	203.00	1	60 in.	633.07	634.25	2 - G	10.34	5.00	4.06	0.0271	OUTLET	0.00	D - 1	0.00
	179.00	1	54 in.	634.85	636.57	2 - G	11.25	4.50	3.88	0.0273	OUTLET	24.00	D - 2	0.00
→	203.00	1	72 in.	631.58	632.18	1 - B	7.25	4.26	3.89	0.0267	OUTLET	0.00	D + 1	0.00
	285.20	1	66 in.	635.28	635.63	2 - G	12.00	5.50	4.67	0.0269	OUTLET	11.80	F	0.00
	228.80	1	60 in.	637.69	638.41	2 - G	11.65	5.00	4.28	0.0271	OUTLET	68.20	F - 1	0.00
	179.00	1	54 in.	641.89	643.37	2 - G	11.25	4.50	3.88	0.0273	OUTLET	118.00	F - 2	0.00
→	297.00	1	72 in.	633.88	633.98	2 - F	10.61	6.00	4.71	0.0267	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
	203.00	1	72 in.	631.58	632.47	1 - B	7.25	5.20	3.89	0.0327	OUTLET	0.00	D	0.00
	203.00	1	66 in.	632.12	633.42	2 - G	8.54	5.50	3.99	0.0330	OUTLET	0.00	D - 1	0.00
	203.00	1	60 in.	633.07	635.04	2 - G	10.34	5.00	4.06	0.0332	OUTLET	0.00	D - 2	0.00
	203.00	1	78 in.	631.24	631.89	1 - B	6.49	4.56	3.80	0.0325	OUTLET	0.00	D + 1	0.00
	297.00	1	72 in.	633.88	634.60	2 - F	10.61	6.00	4.71	0.0327	OUTLET	0.00	F	0.00
	260.30	1	66 in.	635.28	636.64	2 - G	10.96	5.50	4.49	0.0330	OUTLET	36.70	F - 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
207.50	1	60 in.	637.69	640.10	2 - G	10.57	5.00	4.10	0.0332	OUTLET	89.50	F - 2	0.00
297.00	1	78 in.	633.05	633.35	1 - A	9.50	5.93	4.63	0.0325	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
203.00	1	66 in.	632.12	632.89	2 - G	8.54	4.78	3.99	0.0260	OUTLET	0.00	D	0.00
203.00	1	60 in.	633.07	634.12	2 - G	10.34	5.00	4.06	0.0260	OUTLET	0.00	D - 1	0.00
203.00	1	72 in.	631.58	632.15	1 - B	7.25	4.17	3.89	0.0260	OUTLET	0.00	D + 1	0.00
289.00	1	66 in.	635.28	635.50	2 - G	12.16	5.50	4.70	0.0260	OUTLET	8.00	F	0.00
232.90	1	60 in.	637.69	638.14	2 - G	11.86	5.00	4.31	0.0260	OUTLET	64.10	F - 1	0.00
297.00	1	72 in.	633.88	633.92	2 - F	10.61	6.00	4.71	0.0260	OUTLET	0.00	F + 1	0.00


TR 234 RAMP B STA 383+50
CONTRIBUTING
AREA 79
= 8.0 AC (0.013 Sq.mi.)
234 RAMP A
PATH OF WATER
234 RAMP B
TW 234
MAINLINE I-823
234 RAMP B
PROPOSED CULVERT
STA 383+50
0° SKEW
AREA 81
6.75 AC
=0.011 Sq.mi.
0.011 Sq. mi.
0.013 Sq. mi.
0.024 Sq.mi.

TR 234 RAMP B STA. 383+50

Client: ODOT Sheet: of

Subject: Pipe Culvert Calculations Order No:

Computed by: DL Date: 12/31/2007

Checked by: KMG Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C	
Pavement Area	176579	4.05	0.9	
Non-paved Area	466742	10.71	0.5	Wieghted "C" for non-paved area
Other				
Total Area	643321	**14.77**	**acres**	**Weighted "C" = 0.61**

Overland Flow

Length	200
High Elevation	721
Low Elevation	719
Slope %	0.77

t_o 13.61 (1101.2.2)

t_o 0.00 Compare with Fig 1101-1 negligible

Shallow Concentrated Flow

Length	1588	
High Elevation	719	
Low Elevation	656	
Slope %	3.967254	
k	0.457	(Grassed waterways - Table 1101-1)
V	2.986534	(1101.2.2)
t_s	8.862001	(1101.2.2)

Since the time of concentration = to + ts

t_c **10.00** min

use t_c 15.00 min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	14.76862	15.00	0.61	3.23	29.07
5 Years	118.822	18.7	0.969	14.76862	15.00	0.61	3.93	35.41
10 Years	112.172	16.8	0.923	14.76862	15.00	0.61	4.60	41.46
25 Years	198.92	19.3	1.004	14.76862	15.00	0.61	5.72	51.49
50 Years	206.025	19.6	0.99	14.76862	15.00	0.61	6.17	55.56
100 Years	355.551	23.199	1.076	14.76862	15.00	0.61	7.06	63.55

Worksheet for SR 234 Ramp B STA 383+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05000	ft/ft
Left Side Slope	6.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	51.50	ft^3/s

Results

Normal Depth	0.87	ft
Flow Area	7.14	ft^2
Wetted Perimeter	13.57	ft
Top Width	13.43	ft
Critical Depth	1.13	ft
Critical Slope	0.01522	ft/ft
Velocity	7.22	ft/s
Velocity Head	0.81	ft
Specific Energy	1.68	ft
Froude Number	1.74	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.87	ft
Critical Depth	1.13	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.01522	ft/ft

TranSystems

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/31/2007 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 81, 234 Ramp B Sta. 383+50 **Designer :** DL

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.

Inlet Invert Elevation (ft.) : 656.00 **Outlet Invert Elevation (ft.) :** 647.00 **Tailwater Elevation (ft.) :** 647.90 **Overflow Elevation (ft.) :** 663.20

Allowable Headwater Elevation (ft.) : 662.20 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 146.00 **Culvert Slope (ft./ft.) :** 0.0616 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 51.50 @ 25 yrs. **Flood Discharge (cfs) :** 63.60 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
	51.50	1	33 in.	660.24	652.13	2 - E	22.01	1.14	2.36	0.0120	INLET	0.00	D	0.00
	51.50	1	30 in.	661.14	653.41	2 - E	22.10	1.20	2.32	0.0120	INLET	0.00	D - 1	0.00
	51.50	1	27 in.	662.71	655.77	2 - E	22.04	1.28	2.19	0.0120	INLET	0.00	D - 2	0.00
	51.50	1	36 in.	659.75	651.39	2 - E	21.90	1.10	2.33	0.0120	INLET	0.00	D + 1	0.00
	63.60	1	33 in.	661.46	653.57	2 - E	23.28	1.29	2.53	0.0120	INLET	0.00	F	0.00
	63.60	1	30 in.	662.90	655.56	2 - E	23.27	1.36	2.41	0.0120	INLET	0.00	F - 1	0.00
	53.90	1	27 in.	665.35	659.22	2 - E	22.28	1.32	2.20	0.0120	INLET	9.70	F - 2	0.00
	63.60	1	36 in.	660.60	652.41	2 - E	23.20	1.23	2.56	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	51.50	1	36 in.	660.51	654.21	2 - E	13.08	1.63	2.33	0.0241	INLET	0.00	D	0.00

TranSystems

UNIVERSAL CULVERT DESIGN

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.)
51.50	1	33 in.	661.49	656.50	2 - E	13.00	1.74	2.36	0.0241	INLET	0.00	D - 1	0.00
51.50	1	30 in.	663.01	660.72	2 - E	12.57	1.94	2.32	0.0244	INLET	0.00	D - 2	0.00
51.50	1	42 in.	659.57	N/A	1 - C	13.22	1.49	2.24	0.0237	INLET	0.00	D + 1	0.00
63.60	1	36 in.	661.94	656.71	2 - E	13.72	1.87	2.56	0.0241	INLET	0.00	F	0.00
62.30	1	33 in.	663.41	660.24	2 - E	13.45	2.00	2.52	0.0241	INLET	1.30	F - 1	0.00
52.40	1	30 in.	665.55	666.71	2 - E	11.00	1.98	2.33	0.0244	INLET	11.20	F - 2	0.00
63.60	1	42 in.	660.33	653.22	2 - E	13.98	1.68	2.50	0.0237	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
51.50	1	36 in.	660.51	655.28	2 - E	11.62	1.80	2.33	0.0281	INLET	0.00	D	0.00
51.50	1	42 in.	659.57	N/A	1 - C	11.77	1.63	2.24	0.0278	INLET	0.00	D + 1	0.00
63.60	1	36 in.	661.94	658.34	2 - E	12.12	2.09	2.56	0.0281	INLET	0.00	F	0.00
63.60	1	42 in.	660.33	653.94	2 - E	12.40	1.84	2.50	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
51.50	1	60 in.	658.92	N/A	1 - C	10.11	1.53	2.01	0.0332	INLET	0.00	D	0.00
51.50	1	66 in.	658.80	N/A	1 - C	10.07	1.47	1.96	0.0330	INLET	0.00	D + 1	0.00
63.60	1	60 in.	659.29	N/A	1 - C	10.73	1.71	2.25	0.0332	INLET	0.00	F	0.00
63.60	1	66 in.	659.16	N/A	1 - C	10.70	1.64	2.18	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
51.50	1	60 in.	658.92	N/A	1 - C	12.05	1.35	2.01	0.0260	INLET	0.00	D	0.00
51.50	1	66 in.	658.80	N/A	1 - C	11.93	1.31	1.96	0.0260	INLET	0.00	D + 1	0.00
63.60	1	60 in.	659.29	N/A	1 - C	12.80	1.50	2.25	0.0260	INLET	0.00	F	0.00
63.60	1	66 in.	659.16	N/A	1 - C	12.68	1.45	2.18	0.0260	INLET	0.00	F + 1	0.00

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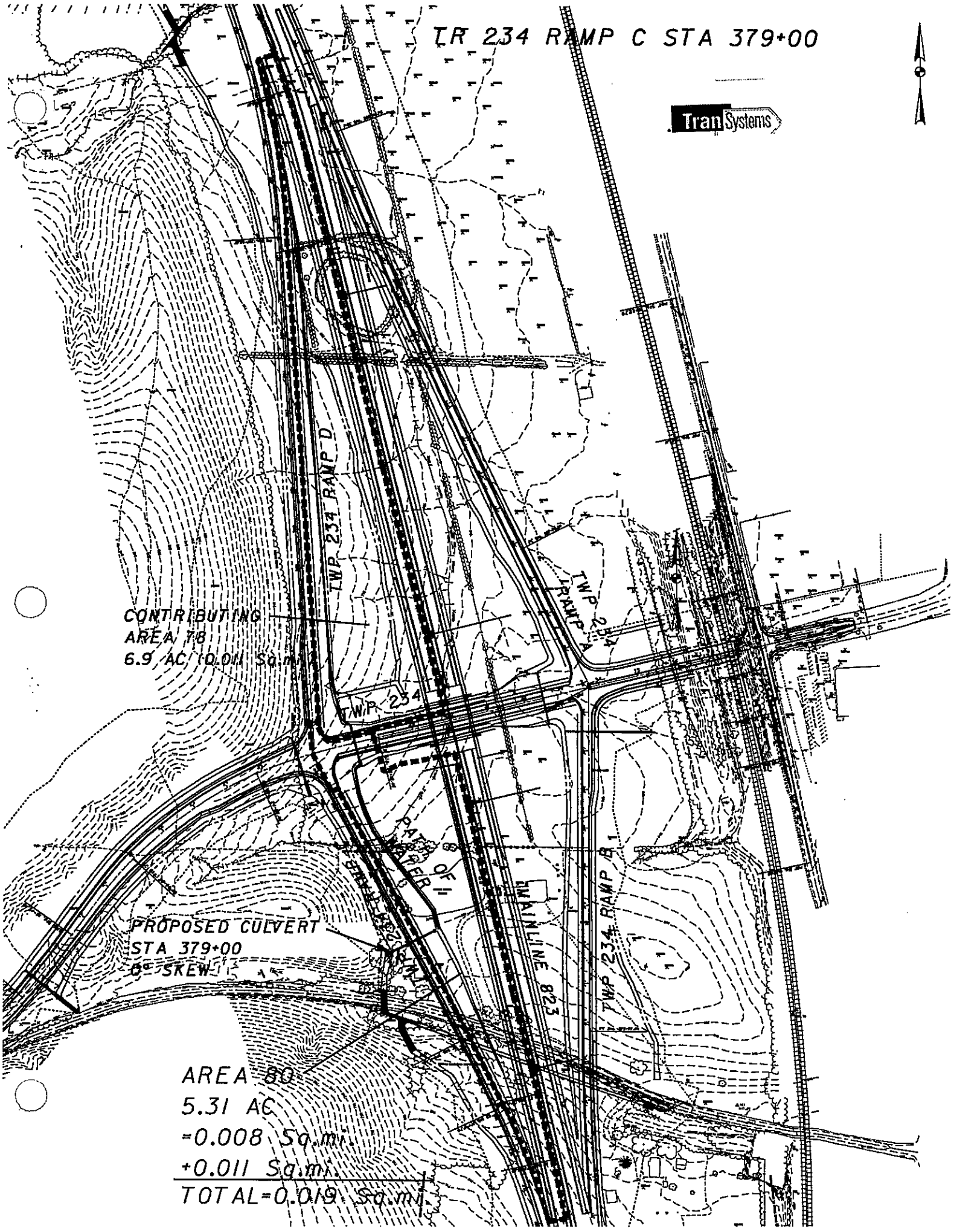
TR 234 RAMP C STA 379+00
TranSystems
TWP 234 RAMP D
TWP 234 RAMP A
TWP 234
CONTRIBUTING
AREA 78
6.9 AC (0.011 Sq.mi.)
PATH OF WATER
MAINLINE 823
TWP 234 RAMP B
PROPOSED CULVERT
STA 379+00
0° SKEW
AREA 80
5.31 AC
=0.008 Sq.mi.
+0.011 Sq.mi.
TOTAL=0.019 Sq.mi.

Client: ODOT Sheet: of

TranSystems

Subject: Pipe Culvert Calculations @ TR 234 RAMP C 379+00 Order No:

Computed by: DL Date: 12/20/2007

Checked by: Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C
Pavement Area	125386	2.88	0.9
Non-paved Area	406689	9.34	0.6
Other			
Total Area		**12.21** acres	**Weighted "C" =** **0.67**

Overland Flow

Length	10
High Elevation	721
Low Elevation	719
Slope %	20

t_o 0.90 (1101.2.2)

t_o **0.00** Compare with Fig 1101-1 Negligible

Shallow Concentrated Flow

Length	2328	
High Elevation	719	
Low Elevation	667	
Slope %	2.246564	
k	0.457	(Grassed waterways - Table 1101-1)
V	2.247407	(1101.2.2)
t_s	17.26434	(1101.2.2)

Since the time of concentration = to + ts t_c **17.26** min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	12.21476	17.26	0.67	3.02	24.76
5 Years	118.822	18.7	0.969	12.21476	17.26	0.67	3.69	30.25
10 Years	112.172	16.8	0.923	12.21476	17.26	0.67	4.32	35.40
25 Years	198.92	19.3	1.004	12.21476	17.26	0.67	5.36	43.93
50 Years	206.025	19.6	0.99	12.21476	17.26	0.67	5.79	47.47
100 Years	355.551	23.199	1.076	12.21476	17.26	0.67	6.63	54.34

Worksheet for SR 234 Ramp C STA 379+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.13150	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	43.93	ft^3/s

Results

Normal Depth	0.41	ft
Flow Area	4.84	ft^2
Wetted Perimeter	13.45	ft
Top Width	13.32	ft
Critical Depth	0.76	ft
Critical Slope	0.01573	ft/ft
Velocity	9.08	ft/s
Velocity Head	1.28	ft
Specific Energy	1.70	ft
Froude Number	2.66	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.76	ft
Channel Slope	0.13150	ft/ft
Critical Slope	0.01573	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 80, 234 Ramp C Sta. 379+00 **Designer :** dl

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.

Inlet Invert Elevation (ft.) : 666.70 **Outlet Invert Elevation (ft.) :** 665.00 **Tailwater Elevation (ft.) :** 665.41 **Overflow Elevation (ft.) :** 677.00

Allowable Headwater Elevation (ft.) : 676.00 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 120.00 **Culvert Slope (ft./ft.) :** 0.0142 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 43.93 @ 25 yrs. **Flood Discharge (cfs) :** 54.34 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
43.93	1	30 in.	670.92	670.01	2 - E	12.05	1.74	2.21	0.0120	INLET	0.00	D	0.00
43.93	1	27 in.	672.04	671.51	2 - E	11.05	2.25	2.14	0.0120	INLET	0.00	D - 1	0.00
43.93	1	24 in.	674.04	674.46	2 - F	14.04	2.00	1.97	0.0120	OUTLET**	0.00	D - 2	0.00
43.93	1	33 in.	670.32	669.20	2 - E	12.20	1.61	2.20	0.0120	INLET	0.00	D + 1	0.00
54.34	1	30 in.	672.23	671.49	2 - E	12.26	2.12	2.35	0.0120	INLET	0.00	F	0.00
54.34	1	27 in.	673.97	673.83	2 - E	13.67	2.25	2.20	0.0120	INLET	0.00	F - 1	0.00
50.74	1	24 in.	677.45	678.43	2 - F	16.18	2.00	1.98	0.0120	OUTLET**	3.60	F - 2	0.00
54.34	1	33 in.	671.21	670.21	2 - E	12.75	1.86	2.40	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
43.93	1	36 in.	670.47	670.62	2 - F	8.07	2.53	2.16	0.0241	OUTLET*	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

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.)
43.93	1	33 in.	671.14	671.92	2 - F	8.63	2.75	2.20	0.0241	OUTLET**	0.00	D - 1	0.00
43.93	1	30 in.	672.28	674.54	2 - F	9.58	2.50	2.21	0.0244	OUTLET**	0.00	D - 2	0.00
43.93	1	42 in.	669.86	670.37	1 - A	7.44	2.09	2.07	0.0237	OUTLET*	0.00	D + 1	0.00
54.34	1	36 in.	671.52	672.16	2 - F	8.99	3.00	2.39	0.0241	OUTLET**	0.00	F	0.00
54.34	1	33 in.	672.62	674.38	2 - F	9.87	2.75	2.40	0.0241	OUTLET**	0.00	F - 1	0.00
50.74	1	30 in.	674.28	678.42	2 - F	10.71	2.50	2.31	0.0244	OUTLET**	3.60	F - 2	0.00
54.34	1	42 in.	670.43	670.84	1 - A	8.08	2.43	2.31	0.0237	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
43.93	1	36 in.	670.47	671.14	2 - F	8.07	3.00	2.16	0.0281	OUTLET**	0.00	D	0.00
43.93	1	42 in.	669.86	670.25	1 - A	7.44	2.34	2.07	0.0278	OUTLET*	0.00	D + 1	0.00
54.34	1	36 in.	671.52	673.14	2 - F	8.99	3.00	2.39	0.0281	OUTLET**	0.00	F	0.00
54.34	1	42 in.	670.43	670.75	1 - A	8.08	2.78	2.31	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
43.93	1	60 in.	669.37	669.72	1 - A	6.64	2.08	1.85	0.0332	OUTLET*	0.00	D	0.00
43.93	1	66 in.	669.26	669.63	1 - A	6.50	1.99	1.80	0.0330	OUTLET*	0.00	D + 1	0.00
54.34	1	60 in.	669.71	670.10	1 - A	7.08	2.34	2.07	0.0332	OUTLET*	0.00	F	0.00
54.34	1	66 in.	669.59	669.99	1 - A	6.91	2.23	2.01	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
43.93	1	60 in.	669.37	N/A	1 - C	6.79	1.82	1.85	0.0260	INLET	0.00	D	0.00
43.93	1	66 in.	669.26	N/A	1 - C	6.75	1.75	1.80	0.0260	INLET	0.00	D + 1	0.00
54.34	1	60 in.	669.71	N/A	1 - C	7.20	2.04	2.07	0.0260	INLET	0.00	F	0.00
54.34	1	66 in.	669.59	N/A	1 - C	7.16	1.96	2.01	0.0260	INLET	0.00	F + 1	0.00

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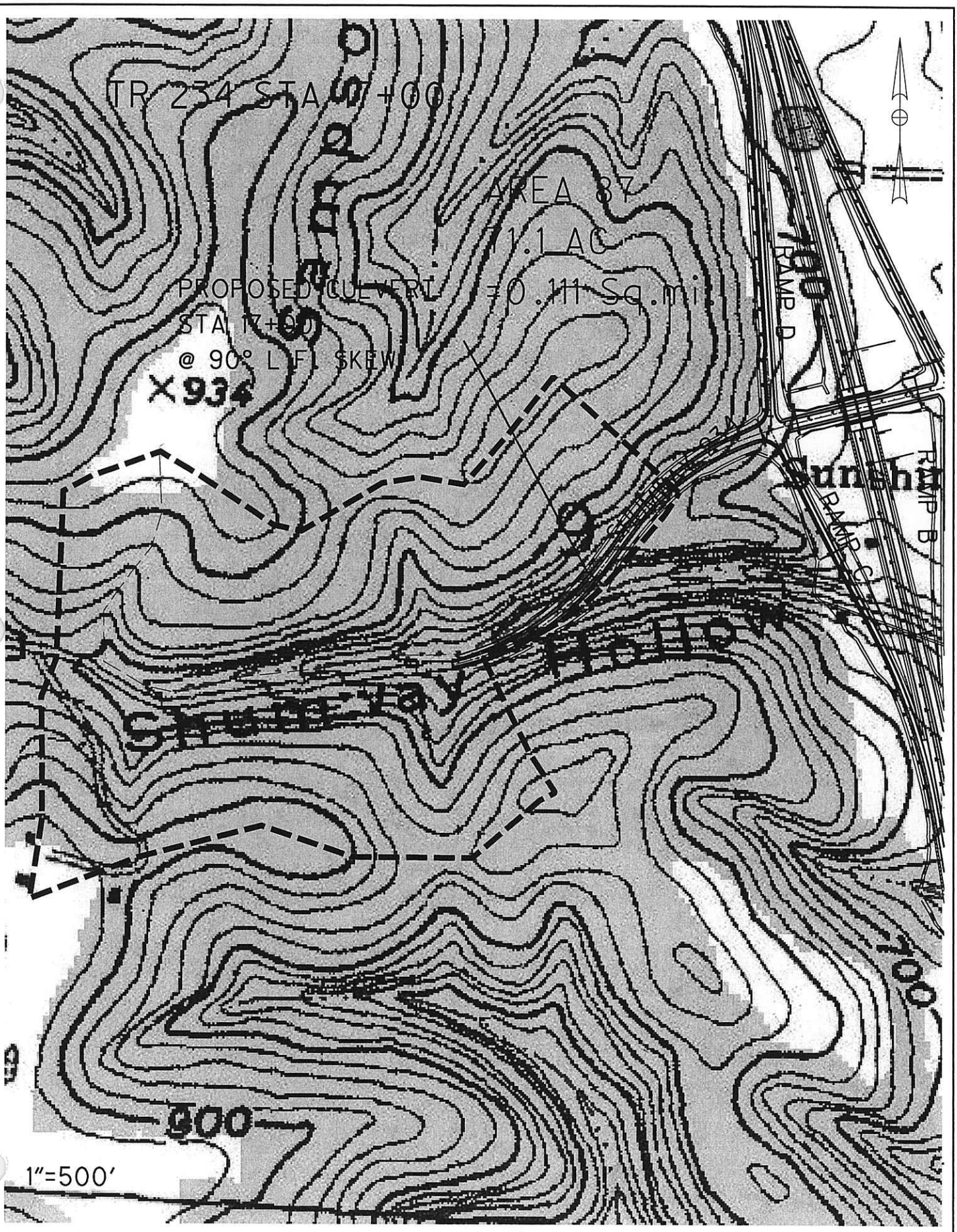

TR 234 STA 0+00
AREA 87
71.1 AC
PROPOSED CULVERT
=0.111 Sq.mi
STA 17+00
@ 90° LFL SKEW
X934
RAMP D
RAMP B
RAMP C
700
700
1"=500'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
3095420.00	SQ. FT.	
0.111	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
2958.00	FT.	**TOTAL CHANNEL LENGTH**
295.80	FT.	L_{10} = 10% of the Distance along channel
689	FT.	$Elev_{10}$ = Elevation at point L_{10}
2514.30	FT.	L_{85} = 85% of the Distance along channel
800	FT.	$Elev_{85}$ = Elevation at point L_{85}
2218.50	FT.	**Length =** $L_{85} - L_{10}$
264.18	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**26**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**53**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**76**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**110**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**130**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**160**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/05/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 87, TR 234 Sta. 17+00 **Designer :** KAG JF

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.

Inlet Invert Elevation (ft.) : 679.78 **Outlet Invert Elevation (ft.) :** 677.60 **Tailwater Elevation (ft.) :** 679.44 **Overflow Elevation (ft.) :** 688.60

Allowable Headwater Elevation (ft.) : 686.36 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 104.00 **Culvert Slope (ft./ft.) :** 0.0210 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 110.00 @ 25 yrs. **Flood Discharge (cfs) :** 160.00 @ 100 yrs.

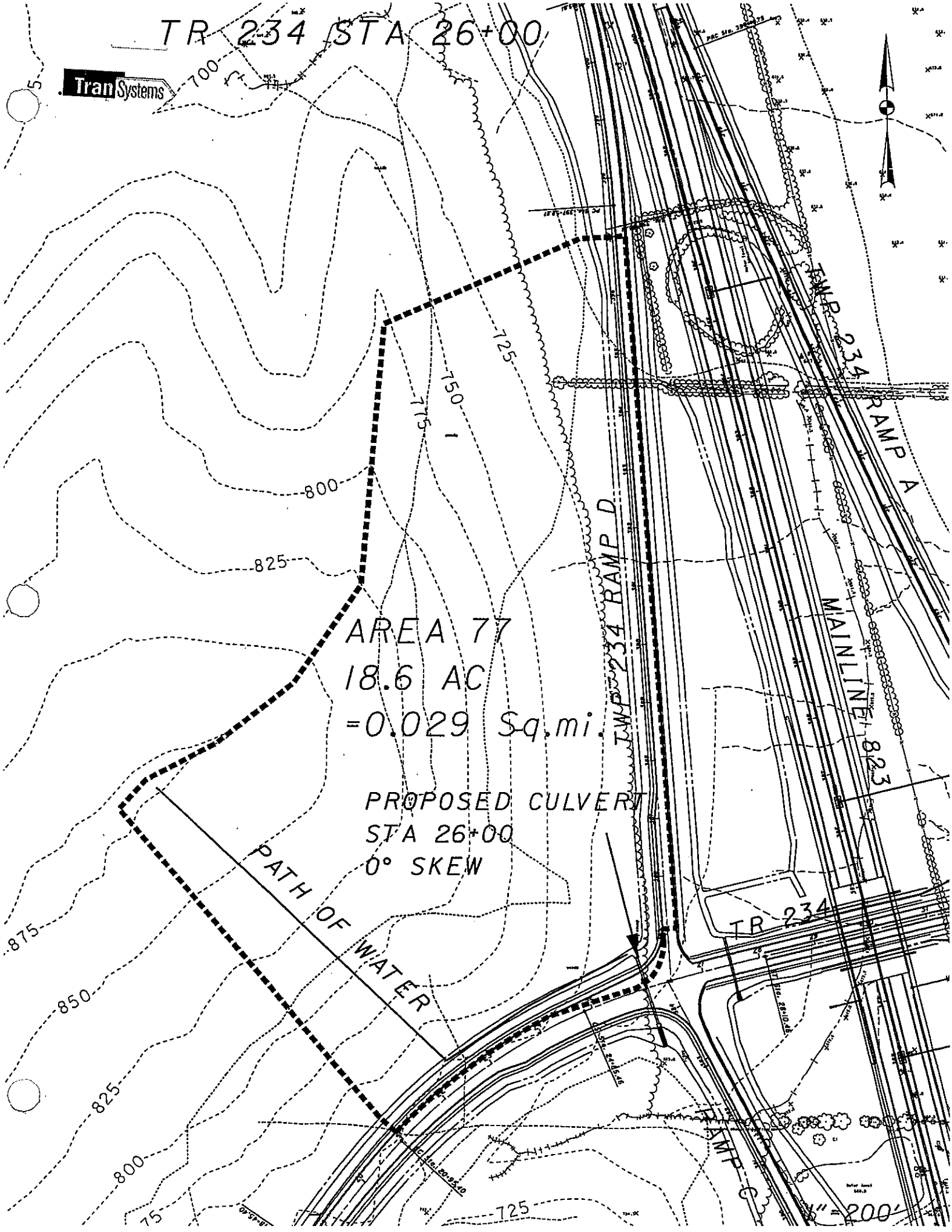
FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20			
110.00	1	48 in.	684.95	683.13	2 - E	17.83	1.97	3.17	0.0120	INLET	0.00	D	0.00
110.00	1	42 in.	686.26	684.42	2 - E	17.72	2.15	3.17	0.0120	INLET	0.00	D - 1	0.00
104.70	1	36 in.	689.27	687.47	2 - E	16.87	2.46	2.91	0.0120	INLET	5.30	D - 2	0.00
110.00	1	54 in.	684.40	N/A	1 - C	17.76	1.86	3.09	0.0120	INLET	0.00	D + 1	0.00
160.00	1	48 in.	687.58	685.55	2 - E	19.46	2.49	3.67	0.0120	INLET	0.00	F	0.00
138.40	1	42 in.	690.68	688.44	2 - E	18.50	2.54	3.35	0.0120	INLET	21.60	F - 1	0.00
104.70	1	36 in.	698.52	695.21	2 - E	16.87	2.46	2.91	0.0120	INLET	55.30	F - 2	0.00
160.00	1	54 in.	686.06	684.17	2 - E	19.57	2.30	3.70	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
110.00	1	54 in.	684.92	N/A	1 - C	10.78	2.75	3.09	0.0233	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

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.)
110.00	1	48 in.	686.09	685.43	2 - E	10.42	3.13	3.17	0.0235	INLET	0.00	D - 1	0.00
107.90	1	42 in.	688.50	688.90	2 - F	11.83	3.50	3.15	0.0237	OUTLET**	2.10	D - 2	0.00
110.00	1	60 in.	684.38	N/A	1 - C	10.87	2.56	2.99	0.0232	INLET	0.00	D + 1	0.00
160.00	1	54 in.	687.65	687.32	2 - E	11.38	3.72	3.70	0.0233	INLET	0.00	F	0.00
141.00	1	48 in.	690.35	690.41	2 - E	12.04	4.00	3.52	0.0235	INLET	19.00	F - 1	0.00
107.90	1	42 in.	694.94	697.91	2 - F	11.83	3.50	3.15	0.0237	OUTLET**	52.10	F - 2	0.00
160.00	1	60 in.	686.17	685.12	2 - E	11.83	3.25	3.63	0.0232	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
110.00	1	54 in.	684.92	N/A	1 - C	9.49	3.08	3.09	0.0273	INLET	0.00	D	0.00
110.00	1	48 in.	686.09	686.16	2 - F	10.30	4.00	3.17	0.0275	OUTLET**	0.00	D - 1	0.00
99.10	1	42 in.	688.50	690.44	2 - F	11.11	3.50	3.06	0.0278	OUTLET**	10.90	D - 2	0.00
110.00	1	60 in.	684.38	N/A	1 - C	9.66	2.82	2.99	0.0271	INLET	0.00	D + 1	0.00
160.00	1	54 in.	687.65	687.70	2 - F	11.44	4.50	3.70	0.0273	OUTLET**	0.00	F	0.00
133.00	1	48 in.	690.35	691.96	2 - F	11.56	4.00	3.44	0.0275	OUTLET**	27.00	F - 1	0.00
99.10	1	42 in.	694.94	701.18	2 - F	11.11	3.50	3.06	0.0278	OUTLET**	60.90	F - 2	0.00
160.00	1	60 in.	686.17	686.63	2 - F	10.49	3.66	3.63	0.0271	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
110.00	1	60 in.	684.38	684.99	1 - A	8.97	3.22	2.99	0.0332	OUTLET*	0.00	D	0.00
110.00	1	66 in.	684.11	684.82	1 - A	8.64	2.99	2.91	0.0330	OUTLET*	0.00	D + 1	0.00
160.00	1	60 in.	686.17	686.43	2 - F	10.49	5.00	3.63	0.0332	OUTLET*	0.00	F	0.00
160.00	1	66 in.	685.40	686.02	1 - A	9.92	3.84	3.53	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
110.00	1	60 in.	684.38	N/A	1 - C	9.97	2.74	2.99	0.0260	INLET	0.00	D	0.00
110.00	1	66 in.	684.11	N/A	1 - C	9.98	2.59	2.91	0.0260	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
160.00	1	60 in.	686.17	685.43	2 - E	10.77	3.54	3.63	0.0260	INLET	0.00	F	0.00
160.00	1	66 in.	685.40	N/A	1 - C	10.93	3.26	3.53	0.0260	INLET	0.00	F + 1	0.00


TR 234 STA 26+00
Tran Systems
AREA 77
18.6 AC
=0.029 Sq.mi.
PROPOSED CULVERT
STA 26+00
0° SKEW
PATH OF WATER
TWP 234 RAMP D
TWP 234 RAMP A
MAINLINE I-823
TR 234
RAMP C
700
725
750
775
800
825
850
875
1" = 200'

TranSystems

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
810646.00	SQ. FT.	
0.029	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1088.00	FT.	**TOTAL CHANNEL LENGTH**
108.80	FT.	L_{10} = 10% of the Distance along channel
679	FT.	$Elev_{10}$ = Elevation at point L_{10}
924.80	FT.	L_{85} = 85% of the Distance along channel
853	FT.	$Elev_{85}$ = Elevation at point L_{85}
816.00	FT.	**Length** = $L_{85} - L_{10}$
1125.88	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	11.81	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	26.29	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	38.70	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	56.04	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	70.70	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	85.28	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 234 STA 26+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.08680	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	56.04	ft^3/s

Results

Normal Depth	0.84	ft
Flow Area	5.47	ft^2
Wetted Perimeter	9.31	ft
Top Width	9.04	ft
Critical Depth	1.32	ft
Critical Slope	0.01433	ft/ft
Velocity	10.24	ft/s
Velocity Head	1.63	ft
Specific Energy	2.47	ft
Froude Number	2.32	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.84	ft
Critical Depth	1.32	ft
Channel Slope	0.08680	ft/ft
Critical Slope	0.01433	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 77, 234 Sta. 26+00, Revised By RN Dec 13, 2007 **Designer :** mdc

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.

Inlet Invert Elevation (ft.) : 675.49 **Outlet Invert Elevation (ft.) :** 669.52 **Tailwater Elevation (ft.) :** 670.36 **Overflow Elevation (ft.) :** 683.45

Allowable Headwater Elevation (ft.) : 682.45 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 119.50 **Culvert Slope (ft./ft.) :** 0.0500 **Design Manning 'n' :** 0.0120

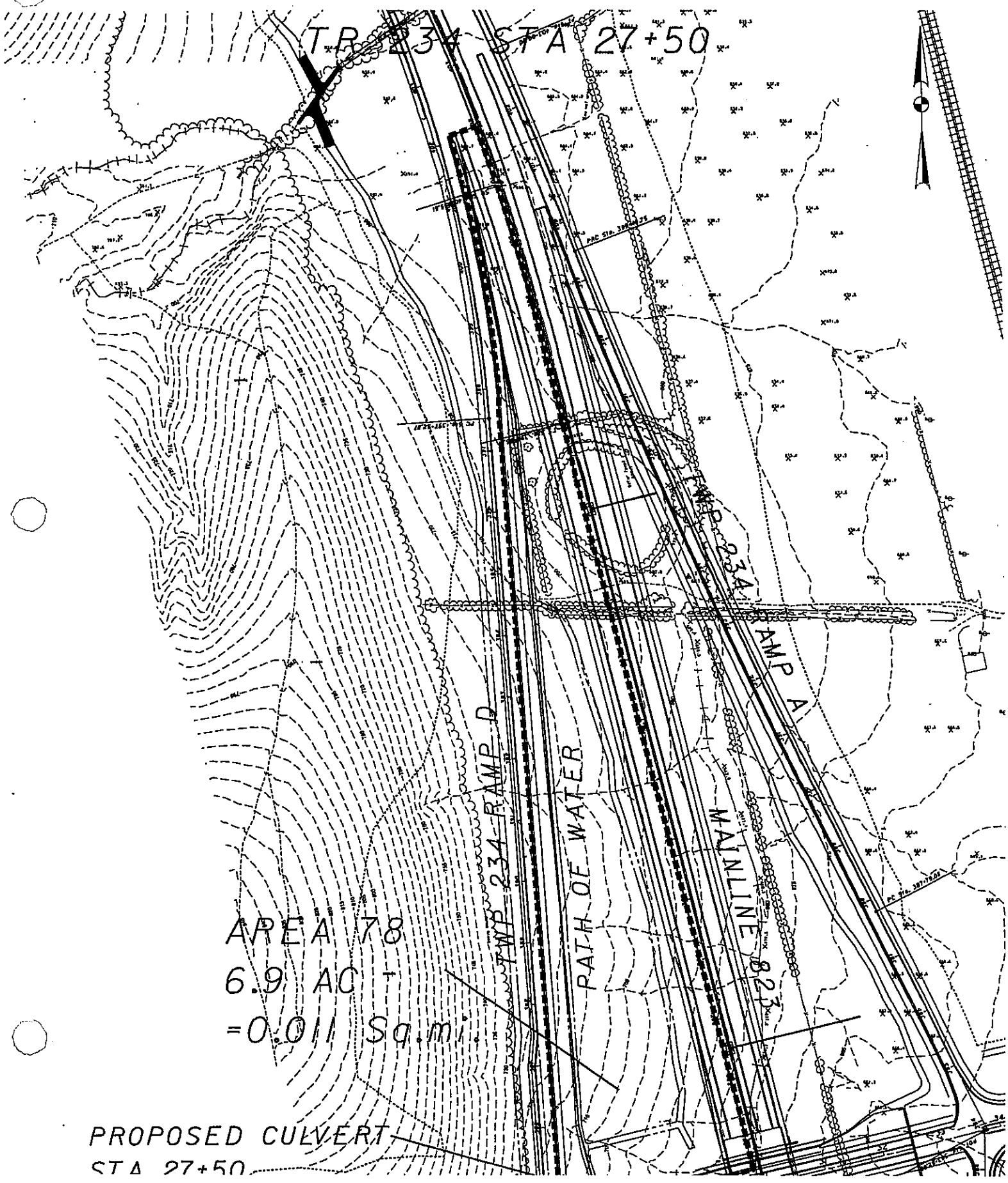
Design Discharge (cfs) : 56.00 @ 25 yrs. **Flood Discharge (cfs) :** 86.00 @ 100 yrs.

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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
56.00	1	33 in.	680.16	674.90	2 - E	20.84	1.27	2.43	0.0120	INLET	0.00	D	0.00
56.00	1	30 in.	681.25	676.26	2 - E	20.84	1.34	2.36	0.0120	INLET	0.00	D - 1	0.00
56.00	1	27 in.	683.11	678.75	2 - E	20.68	1.45	2.20	0.0120	INLET	0.00	D - 2	0.00
56.00	1	36 in.	679.53	674.12	2 - E	20.76	1.22	2.43	0.0120	INLET	0.00	D + 1	0.00
83.30	1	33 in.	683.83	678.82	2 - E	22.95	1.62	2.67	0.0120	INLET	2.70	F	0.00
70.00	1	30 in.	686.59	682.18	2 - E	21.92	1.55	2.44	0.0120	INLET	16.00	F - 1	0.00
57.60	1	27 in.	694.02	688.29	2 - E	20.80	1.48	2.21	0.0120	INLET	28.40	F - 2	0.00
86.00	1	36 in.	682.15	676.87	2 - E	23.19	1.56	2.82	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
56.00	1	42 in.	679.32	N/A	1 - C	12.50	1.66	2.34	0.0237	INLET	0.00	D	0.00

TranSystems

UNIVERSAL CULVERT DESIGN

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.)
56.00	1	36 in.	680.50	676.96	2 - E	12.29	1.84	2.43	0.0241	INLET	0.00	D - 1	0.00
56.00	1	33 in.	681.67	679.31	2 - E	12.11	2.00	2.43	0.0241	INLET	0.00	D - 2	0.00
56.00	1	48 in.	678.89	N/A	1 - C	12.51	1.54	2.25	0.0235	INLET	0.00	D + 1	0.00
86.00	1	42 in.	681.67	677.96	2 - E	13.86	2.15	2.89	0.0237	INLET	0.00	F	0.00
78.10	1	36 in.	684.63	683.59	2 - E	12.97	2.38	2.75	0.0241	INLET	7.90	F - 1	0.00
66.70	1	33 in.	687.07	689.22	2 - E	11.57	2.39	2.56	0.0241	INLET	19.30	F - 2	0.00
86.00	1	48 in.	680.28	N/A	1 - C	14.03	1.96	2.81	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
56.00	1	42 in.	679.32	N/A	1 - C	11.10	1.82	2.34	0.0278	INLET	0.00	D	0.00
56.00	1	36 in.	680.50	678.00	2 - E	10.87	2.05	2.43	0.0281	INLET	0.00	D - 1	0.00
56.00	1	48 in.	678.89	N/A	1 - C	11.16	1.68	2.25	0.0275	INLET	0.00	D + 1	0.00
86.00	1	42 in.	681.67	679.04	2 - E	12.19	2.41	2.89	0.0278	INLET	0.00	F	0.00
77.50	1	36 in.	684.63	686.03	2 - F	11.43	3.00	2.75	0.0281	OUTLET**	8.50	F - 1	0.00
86.00	1	48 in.	680.28	N/A	1 - C	12.46	2.16	2.81	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
56.00	1	60 in.	678.55	N/A	1 - C	9.60	1.69	2.10	0.0332	INLET	0.00	D	0.00
56.00	1	66 in.	678.43	N/A	1 - C	9.57	1.62	2.04	0.0330	INLET	0.00	D + 1	0.00
86.00	1	60 in.	679.41	N/A	1 - C	10.80	2.13	2.63	0.0332	INLET	0.00	F	0.00
86.00	1	66 in.	679.24	N/A	1 - C	10.79	2.03	2.55	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
56.00	1	60 in.	678.55	N/A	1 - C	11.45	1.49	2.10	0.0260	INLET	0.00	D	0.00
56.00	1	66 in.	678.43	N/A	1 - C	11.34	1.44	2.04	0.0260	INLET	0.00	D + 1	0.00
86.00	1	60 in.	679.41	N/A	1 - C	12.91	1.86	2.63	0.0260	INLET	0.00	F	0.00
86.00	1	66 in.	679.24	N/A	1 - C	12.81	1.79	2.55	0.0260	INLET	0.00	F + 1	0.00


TR 234 STA 27+50
TWP 234 RAMP A
MAINLINE 823
TWP 234 RAMP D
PATH OF WATER
AREA TO
6.9 AC +
=0.011 Sq. mi.
PROPOSED CULVERT
STA 27+50

Client: ODOT Sheet: of

Subject: Pipe Culvert Calculations @ TR 234 27+50 Order No:

Computed by: DL Date: 12/20/2007

Checked by: Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C
Pavement Area	61853	1.42	0.9
Non-paved Area	239027	5.49	0.6
Other			
Total Area		**6.91 acres**	**Weighted "C" =** **0.66**

Overland Flow

Length	10
High Elevation	721
Low Elevation	719
Slope %	22

t_o 0.89 (1101.2.2)

t_o 0.00 Compare with Fig 1101-1

Negligible

Shallow Concentrated Flow

Length	1728	
High Elevation	719	
Low Elevation	670	
Slope %	2.834491	
k	0.457	(Grassed waterways - Table 1101-1)
V	2.52441	(1101.2.2)
t_s	11.4086	(1101.2.2)

Since the time of concentration = to + ts t_c 11.41 min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	6.907254	11.41	0.66	3.62	16.55
5 Years	118.822	18.7	0.969	6.907254	11.41	0.66	4.39	20.04
10 Years	112.172	16.8	0.923	6.907254	11.41	0.66	5.14	23.50
25 Years	198.92	19.3	1.004	6.907254	11.41	0.66	6.39	29.20
50 Years	206.025	19.6	0.99	6.907254	11.41	0.66	6.88	31.43
100 Years	355.551	23.199	1.076	6.907254	11.41	0.66	7.85	35.87

Worksheet for SR 234 STA 27+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00400	ft/ft
Left Side Slope	6.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	29.20	ft^3/s

Results

Normal Depth	0.86	ft
Flow Area	12.35	ft^2
Wetted Perimeter	18.80	ft
Top Width	18.63	ft
Critical Depth	0.58	ft
Critical Slope	0.01700	ft/ft
Velocity	2.37	ft/s
Velocity Head	0.09	ft
Specific Energy	0.95	ft
Froude Number	0.51	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.86	ft
Critical Depth	0.58	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01700	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 05/28/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 78, TR234 Sta. 27+50 **Designer :** kag

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.

Inlet Invert Elevation (ft.) : 670.30 **Outlet Invert Elevation (ft.) :** 668.90 **Tailwater Elevation (ft.) :** 670.00 **Overflow Elevation (ft.) :** 676.22

Allowable Headwater Elevation (ft.) : 675.20 **or** Diameter + 2 ft. *(whichever is less)*

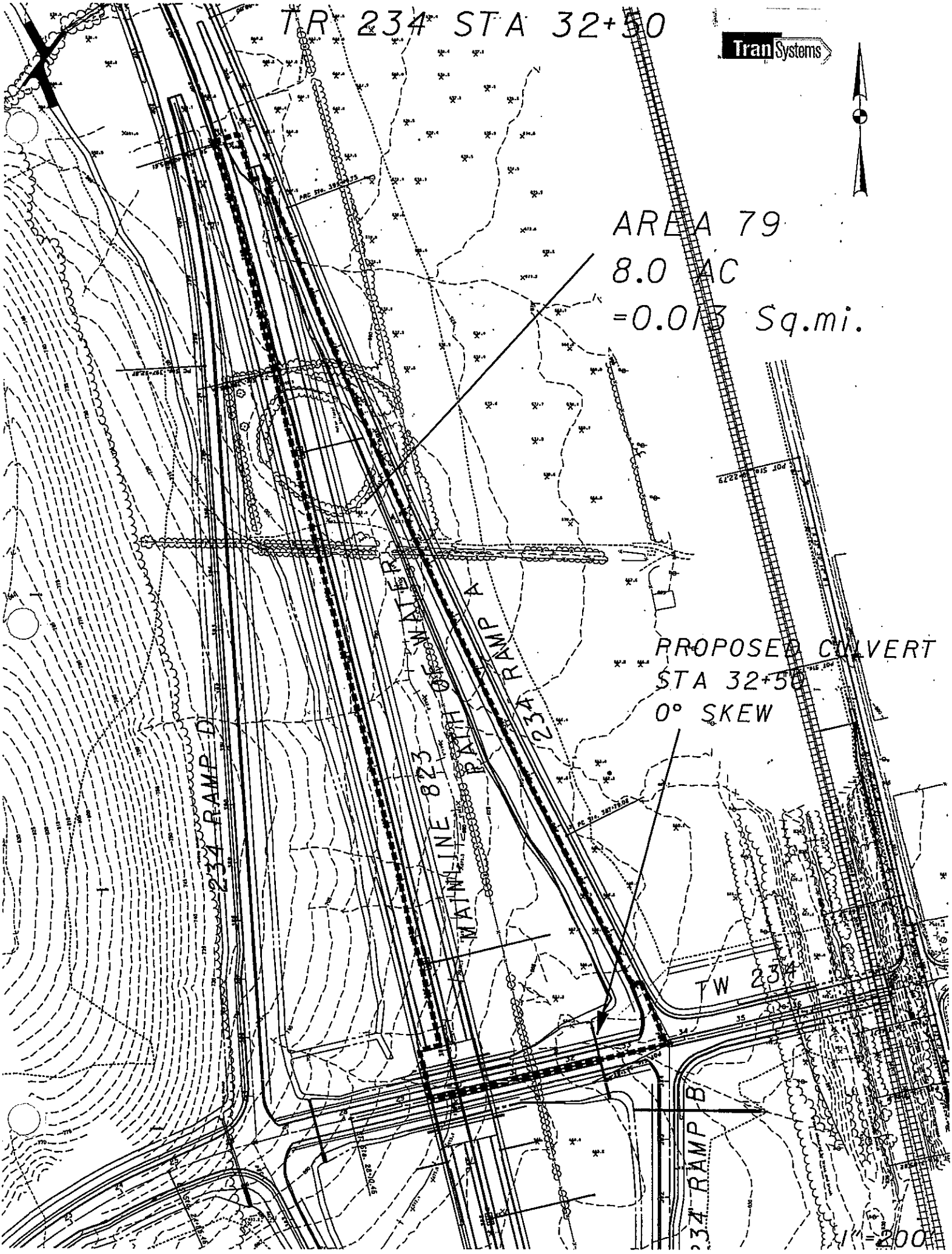
Pipe Length (ft.) : 95.00 **Culvert Slope (ft./ft.) :** 0.0147 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 29.20 @ 25 yrs. **Flood Discharge (cfs) :** 35.90 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
→	29.20	1	27 in.	673.54	672.68	2 - E	11.14	1.41	1.87	0.0120	INLET	0.00	D	0.00
	29.20	1	24 in.	674.36	673.78	2 - E	10.80	1.61	1.85	0.0120	INLET	0.00	D - 1	0.00
	29.20	1	21 in.	676.02	676.11	2 - F	12.21	1.75	1.71	0.0120	OUTLET**	0.00	D - 2	0.00
	29.20	1	30 in.	673.15	N/A	1 - C	11.21	1.31	1.84	0.0120	INLET	0.00	D + 1	0.00
→	35.90	1	27 in.	674.39	673.64	2 - E	11.56	1.64	2.03	0.0120	INLET	0.00	F	0.00
	35.90	1	24 in.	675.71	675.32	2 - E	11.43	2.00	1.93	0.0120	INLET	0.00	F - 1	0.00
	29.40	1	21 in.	678.33	678.92	2 - F	12.29	1.75	1.71	0.0120	OUTLET**	6.50	F - 2	0.00
	35.90	1	30 in.	673.70	672.78	2 - E	11.76	1.49	2.03	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	29.20	1	30 in.	673.60	673.72	2 - F	7.53	2.50	1.84	0.0244	OUTLET*	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

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.)
29.20	1	27 in.	674.41	675.54	2 - F	8.25	2.25	1.87	0.0245	OUTLET**	0.00	D - 1	0.00
23.70	1	24 in.	675.83	679.05	2 - F	8.22	2.00	1.73	0.0247	OUTLET**	5.50	D - 2	0.00
29.20	1	33 in.	673.19	673.49	1 - A	7.11	1.94	1.80	0.0241	OUTLET*	0.00	D + 1	0.00
35.90	1	30 in.	674.53	675.29	2 - F	8.40	2.50	2.03	0.0244	OUTLET**	0.00	F	0.00
31.20	1	27 in.	675.78	677.95	2 - F	8.60	2.25	1.93	0.0245	OUTLET**	4.70	F - 1	0.00
23.70	1	24 in.	677.78	683.30	2 - F	8.22	2.00	1.73	0.0247	OUTLET**	12.20	F - 2	0.00
35.90	1	33 in.	673.81	673.93	2 - F	7.78	2.36	1.99	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
29.20	1	36 in.	672.97	673.29	1 - A	6.82	1.99	1.75	0.0281	OUTLET*	0.00	D	0.00
29.20	1	42 in.	672.75	673.12	1 - A	6.45	1.77	1.67	0.0278	OUTLET*	0.00	D + 1	0.00
35.90	1	36 in.	673.42	673.71	1 - A	7.39	2.35	1.95	0.0281	OUTLET*	0.00	F	0.00
35.90	1	42 in.	673.07	673.47	1 - A	6.92	2.01	1.86	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
29.20	1	60 in.	672.40	672.74	1 - A	5.90	1.65	1.50	0.0332	OUTLET*	0.00	D	0.00
29.20	1	66 in.	672.31	672.66	1 - A	5.78	1.59	1.46	0.0330	OUTLET*	0.00	D + 1	0.00
35.90	1	60 in.	672.67	673.02	1 - A	6.26	1.84	1.67	0.0332	OUTLET*	0.00	F	0.00
35.90	1	66 in.	672.57	672.93	1 - A	6.13	1.77	1.62	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
29.20	1	60 in.	672.40	N/A	1 - C	6.14	1.46	1.50	0.0260	INLET	0.00	D	0.00
29.20	1	66 in.	672.31	N/A	1 - C	5.78	1.41	1.46	0.0260	INLET	0.00	D + 1	0.00
35.90	1	60 in.	672.67	N/A	1 - C	6.51	1.62	1.67	0.0260	INLET	0.00	F	0.00
35.90	1	66 in.	672.57	N/A	1 - C	6.13	1.56	1.62	0.0260	INLET	0.00	F + 1	0.00


TR 234 STA 32+50
TranSystems
AREA 79
8.0 AC
=0.013 Sq.mi.
PROPOSED CULVERT
STA 32+50
0° SKEW
234 RAMP D
MAINLINE 823
WATER
234 RAMP A
TW 234
234 RAMP B
1"=200'

TR 234 STA. 32+50

Client: ODOT Sheet: of

Subject: Pipe Culvert Calculations Order No:

Computed by: DL Date: 12/31/2007

Checked by: Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C	
Pavement Area	85139	1.95	0.9	
Non-paved Area	264216	6.07	0.5	Wieghted "C" for non-paved area
Other				
Total Area	349355	**8.02**	**acres**	**Weighted "C" = 0.60**

Overland Flow

Length	200		
High Elevation	721		
Low Elevation	719	t_o	13.96 (1101.2.2)
Slope %	0.77	t_o	0.00 Compare with Fig 1101-1
			negligible

Shallow Concentrated Flow

Length	1428	
High Elevation	719	
Low Elevation	658	
Slope %	4.264706	
k	0.457	(Grassed waterways - Table 1101-1)
V	3.096471	(1101.2.2)
t_s	7.68617	(1101.2.2)

Since the time of concentration = to + ts t_c **10.00** min

use t_c **15.00** min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	8.020087	15.00	0.60	3.23	15.47
5 Years	118.822	18.7	0.969	8.020087	15.00	0.60	3.93	18.84
10 Years	112.172	16.8	0.923	8.020087	15.00	0.60	4.60	22.06
25 Years	198.92	19.3	1.004	8.020087	15.00	0.60	5.72	27.40
50 Years	206.025	19.6	0.99	8.020087	15.00	0.60	6.17	29.56
100 Years	355.551	23.199	1.076	8.020087	15.00	0.60	7.06	33.82

Worksheet for SR 234 STA 32+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.08680	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	27.40	ft^3/s

Results

Normal Depth	0.59	ft
Flow Area	3.52	ft^2
Wetted Perimeter	9.03	ft
Top Width	8.91	ft
Critical Depth	0.88	ft
Critical Slope	0.01632	ft/ft
Velocity	7.78	ft/s
Velocity Head	0.94	ft
Specific Energy	1.53	ft
Froude Number	2.18	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.88	ft
Channel Slope	0.08680	ft/ft
Critical Slope	0.01632	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/31/2007 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 79, 234 Sta. 32+50 **Designer :** DL

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.

Inlet Invert Elevation (ft.) : 658.10 **Outlet Invert Elevation (ft.) :** 657.40 **Tailwater Elevation (ft.) :** 658.10 **Overflow Elevation (ft.) :** 666.00

Allowable Headwater Elevation (ft.) : 665.00 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 114.00 **Culvert Slope (ft./ft.) :** 0.0061 **Design Manning 'n' :** 0.0120

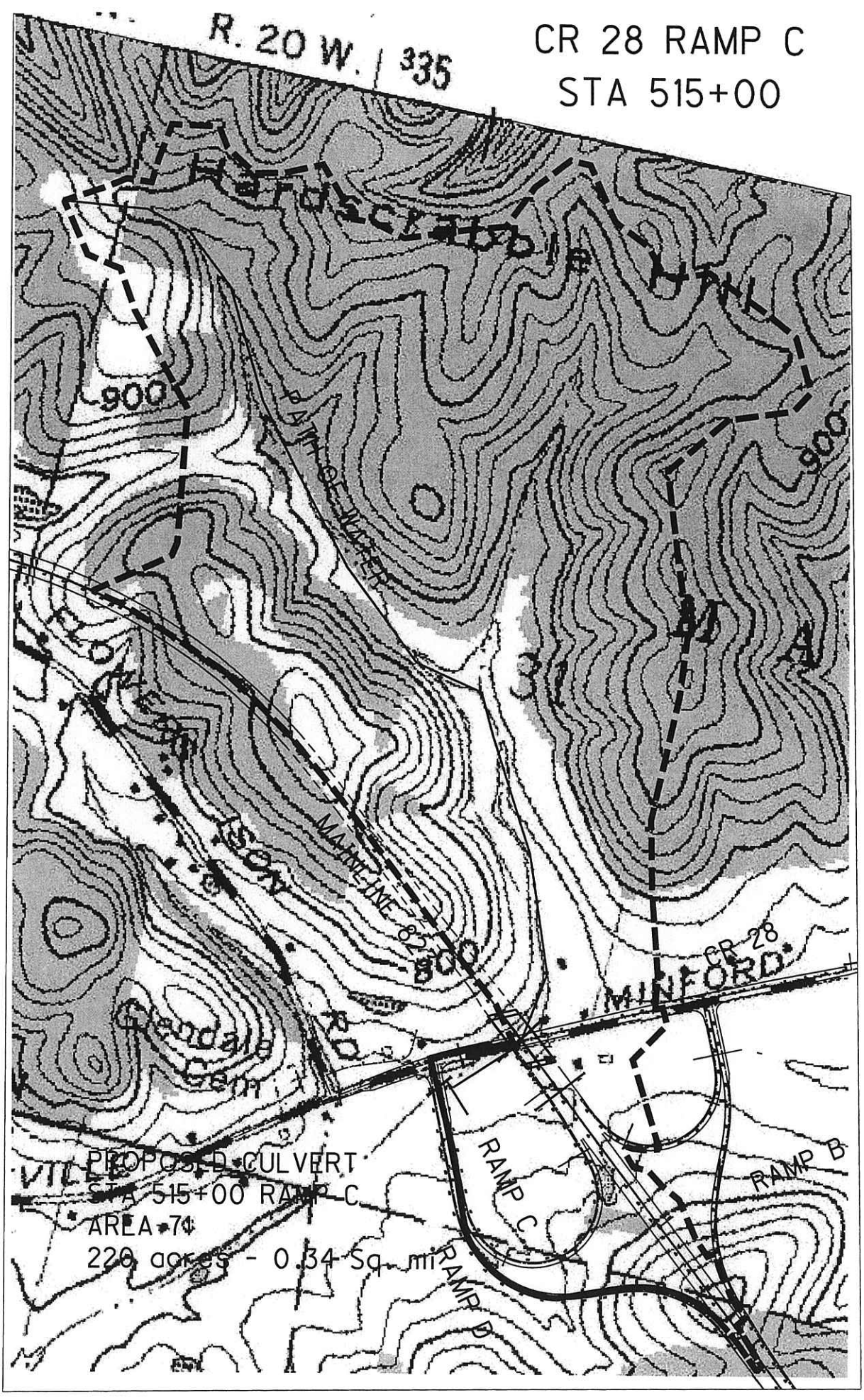
Design Discharge (cfs) : 27.40 @ 25 yrs. **Flood Discharge (cfs) :** 33.80 @ 100 yrs.

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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
27.40	1	27 in.	661.14	661.08	2 - E	7.51	1.94	1.82	0.0120	INLET	0.00	D	0.00
27.40	1	24 in.	661.85	662.14	2 - F	9.14	2.00	1.82	0.0120	OUTLET**	0.00	D - 1	0.00
27.40	1	21 in.	663.30	664.43	2 - F	11.49	1.75	1.70	0.0120	OUTLET**	0.00	D - 2	0.00
27.40	1	30 in.	660.82	N/A	1 - C	7.85	1.67	1.78	0.0120	INLET	0.00	D + 1	0.00
33.80	1	27 in.	661.90	662.02	2 - F	9.10	2.25	1.99	0.0120	OUTLET**	0.00	F	0.00
33.80	1	24 in.	663.06	663.67	2 - F	10.94	2.00	1.91	0.0120	OUTLET**	0.00	F - 1	0.00
31.10	1	21 in.	665.32	667.21	2 - F	12.98	1.75	1.72	0.0120	OUTLET**	2.70	F - 2	0.00
33.80	1	30 in.	661.32	661.30	2 - E	8.08	1.99	1.98	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
27.40	1	30 in.	661.19	662.24	2 - F	7.31	2.50	1.78	0.0244	OUTLET**	0.00	D	0.00

Tran Systems

UNIVERSAL CULVERT DESIGN

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.)
27.40	1	27 in.	661.88	663.99	2 - F	7.94	2.25	1.82	0.0245	OUTLET**	0.00	D - 1	0.00
24.70	1	24 in.	663.15	667.56	2 - F	8.46	2.00	1.75	0.0247	OUTLET**	2.70	D - 2	0.00
27.40	1	33 in.	660.84	661.24	1 - A	6.93	2.51	1.74	0.0241	OUTLET*	0.00	D + 1	0.00
33.80	1	30 in.	662.02	663.75	2 - F	8.12	2.50	1.98	0.0244	OUTLET**	0.00	F	0.00
32.70	1	27 in.	663.13	666.45	2 - F	8.89	2.25	1.96	0.0245	OUTLET**	1.10	F - 1	0.00
24.70	1	24 in.	664.94	671.90	2 - F	8.46	2.00	1.75	0.0247	OUTLET**	9.10	F - 2	0.00
33.80	1	33 in.	661.40	662.29	2 - F	7.57	2.75	1.94	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
27.40	1	36 in.	660.66	661.14	1 - A	6.67	2.74	1.69	0.0281	OUTLET*	0.00	D	0.00
27.40	1	42 in.	660.47	660.83	1 - A	6.32	2.25	1.61	0.0278	OUTLET*	0.00	D + 1	0.00
33.80	1	36 in.	661.07	661.88	2 - F	7.22	3.00	1.89	0.0281	OUTLET**	0.00	F	0.00
33.80	1	42 in.	660.77	661.21	1 - A	6.78	2.64	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
27.40	1	60 in.	660.13	660.49	1 - A	5.79	2.02	1.45	0.0332	OUTLET*	0.00	D	0.00
27.40	1	66 in.	660.04	660.40	1 - A	5.68	1.93	1.41	0.0330	OUTLET*	0.00	D + 1	0.00
33.80	1	60 in.	660.39	660.79	1 - A	6.15	2.27	1.62	0.0332	OUTLET*	0.00	F	0.00
33.80	1	66 in.	660.29	660.69	1 - A	6.03	2.16	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
27.40	1	60 in.	660.13	660.42	1 - A	5.79	1.77	1.45	0.0260	OUTLET*	0.00	D	0.00
27.40	1	66 in.	660.04	660.35	1 - A	5.68	1.70	1.41	0.0260	OUTLET*	0.00	D + 1	0.00
33.80	1	60 in.	660.39	660.70	1 - A	6.15	1.98	1.62	0.0260	OUTLET*	0.00	F	0.00
33.80	1	66 in.	660.29	660.62	1 - A	6.03	1.90	1.57	0.0260	OUTLET*	0.00	F + 1	0.00


CR 28 RAMP C
STA 515+00
R. 20 W.
335
900
900
900
MAINLINE
CR 28
MINFORD
RAMP C
RAMP B
RAMP B
PROPOSED CULVERT
STA 515+00 RAMP C
AREA = 71
220 acres - 0.34 Sq. mi
1"=650'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
9698918.00	SQ. FT.	
0.348	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
5400.00	FT.	**TOTAL CHANNEL LENGTH**
540.00	FT.	L_{10} = 10% of the Distance along channel
702	FT.	$Elev_{10}$ = Elevation at point L_{10}
4590.00	FT.	L_{85} = 85% of the Distance along channel
810	FT.	$Elev_{85}$ = Elevation at point L_{85}
4050.00	FT.	**Length =** $L_{85} - L_{10}$
140.80	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge # = Frequency of Storm

Q_2	**60**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**110**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**160**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**210**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**260**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**310**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 71, 728 RAMP C Sta. 514+82 **Designer :** KAG JF

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.

Inlet Invert Elevation (ft.) : 698.91 **Outlet Invert Elevation (ft.) :** 697.00 **Tailwater Elevation (ft.) :** 702.15 **Overflow Elevation (ft.) :** 713.05

Allowable Headwater Elevation (ft.) : 706.70 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 159.00 **Culvert Slope (ft./ft.) :** 0.0120 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 260.00 @ 50 yrs. **Flood Discharge (cfs) :** 310.00 @ 100 yrs.

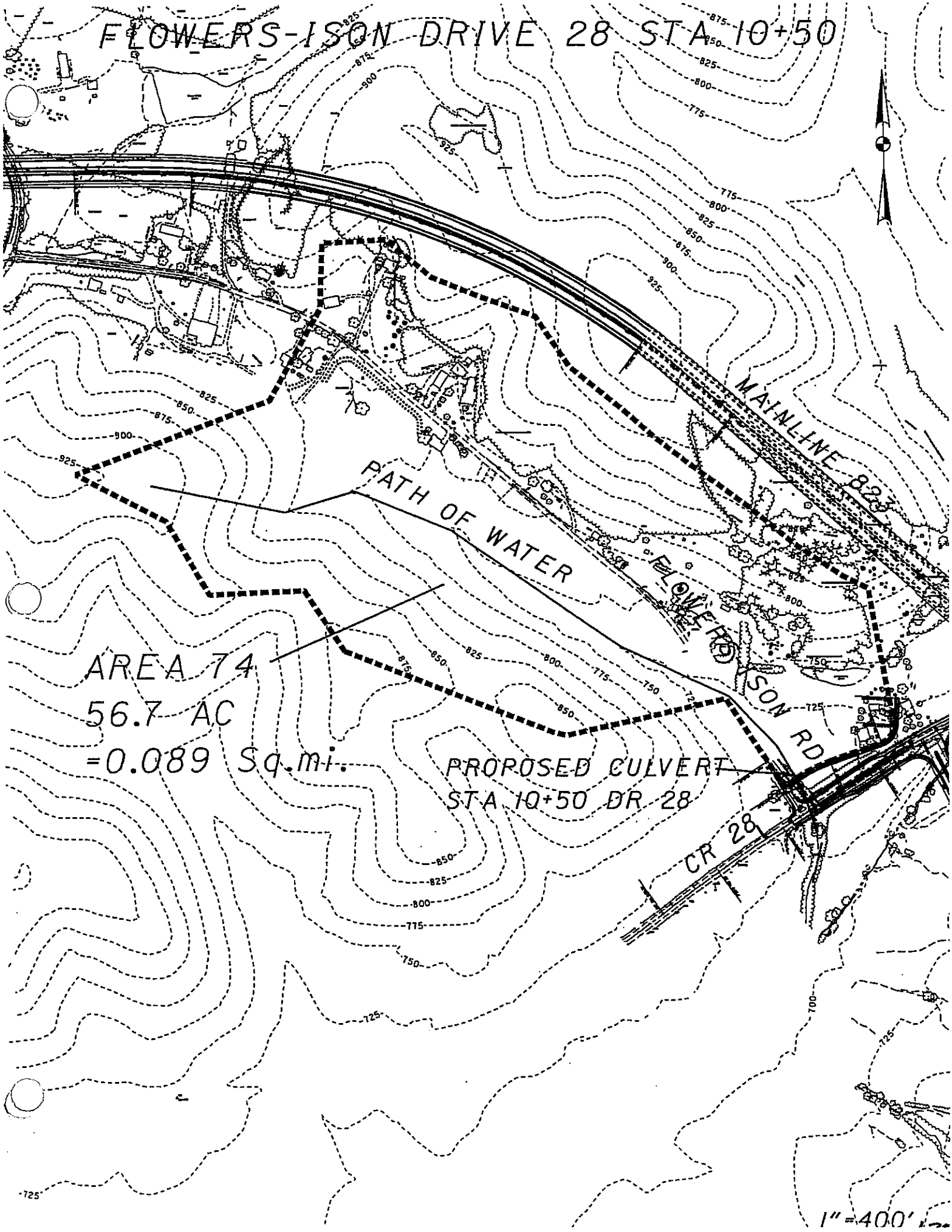
FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
260.00	1	72 in.	705.74	N/A	1 - C	17.93	3.06	4.42	0.0120	INLET	0.00	D	0.00
260.00	1	66 in.	706.46	705.19	2 - E	17.88	3.24	4.49	0.0120	INLET	0.00	D - 1	0.00
260.00	1	60 in.	707.82	706.76	2 - H	17.65	3.51	4.48	0.0120	INLET	0.00	D - 2	0.00
260.00	1	78 in.	705.33	N/A	1 - C	17.91	2.93	4.32	0.0120	INLET	0.00	D + 1	0.00
310.00	1	72 in.	706.83	705.36	2 - E	18.71	3.41	4.81	0.0120	INLET	0.00	F	0.00
310.00	1	66 in.	708.01	706.48	2 - E	18.55	3.64	4.82	0.0120	INLET	0.00	F - 1	0.00
310.00	1	60 in.	710.09	708.70	2 - H	17.95	4.11	4.70	0.0120	INLET	0.00	F - 2	0.00
310.00	1	78 in.	706.17	N/A	1 - C	18.74	3.24	4.73	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
260.00	1	84 in.	705.44	N/A	1 - C	11.09	4.10	4.23	0.0227	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

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.)
260.00	1	78 in.	705.95	706.82	2 - F	9.22	4.37	4.32	0.0228	OUTLET*	0.00	D - 1	0.00
260.00	1	72 in.	706.82	707.08	2 - F	10.07	4.85	4.42	0.0229	OUTLET*	0.00	D - 2	0.00
310.00	1	84 in.	706.43	N/A	1 - C	11.50	4.62	4.63	0.0227	INLET	0.00	F	0.00
310.00	1	78 in.	707.26	707.68	2 - F	10.99	5.04	4.73	0.0228	OUTLET*	0.00	F - 1	0.00
310.00	1	72 in.	708.65	708.58	2 - E	10.96	6.00	4.81	0.0229	INLET	0.00	F - 2	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
260.00	1	78 in.	705.95	706.59	1 - B	9.22	4.94	4.32	0.0266	OUTLET*	0.00	D	0.00
260.00	1	72 in.	706.82	707.22	2 - F	10.07	6.00	4.42	0.0267	OUTLET**	0.00	D - 1	0.00
260.00	1	66 in.	708.33	709.74	2 - F	11.24	5.50	4.49	0.0269	OUTLET	0.00	D - 2	0.00
260.00	1	84 in.	705.44	706.32	1 - B	8.57	4.55	4.23	0.0265	OUTLET*	0.00	D + 1	0.00
310.00	1	78 in.	707.26	707.58	2 - F	10.99	6.50	4.73	0.0266	OUTLET*	0.00	F	0.00
310.00	1	72 in.	708.65	709.52	2 - F	12.00	6.00	4.81	0.0267	OUTLET**	0.00	F - 1	0.00
310.00	1	66 in.	710.89	712.95	2 - F	13.41	5.50	4.82	0.0269	OUTLET**	0.00	F - 2	0.00
310.00	1	84 in.	706.43	707.11	1 - A	10.21	5.20	4.63	0.0265	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
260.00	1	84 in.	705.44	706.23	1 - A	8.57	5.30	4.23	0.0323	OUTLET*	0.00	D	0.00
260.00	1	78 in.	705.95	706.72	2 - F	9.22	6.50	4.32	0.0325	OUTLET*	0.00	D - 1	0.00
260.00	1	72 in.	706.82	708.47	2 - F	10.07	6.00	4.42	0.0327	OUTLET**	0.00	D - 2	0.00
260.00	1	90 in.	705.13	705.97	1 - B	8.04	4.90	4.14	0.0321	OUTLET*	0.00	D + 1	0.00
310.00	1	84 in.	706.43	707.19	1 - A	10.21	6.39	4.63	0.0323	OUTLET*	0.00	F	0.00
310.00	1	78 in.	707.26	708.64	2 - F	10.99	6.50	4.73	0.0325	OUTLET**	0.00	F - 1	0.00
310.00	1	72 in.	708.65	711.31	2 - F	12.00	6.00	4.81	0.0327	OUTLET**	0.00	F - 2	0.00
310.00	1	90 in.	705.93	706.76	1 - A	9.59	5.61	4.54	0.0321	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													

UNIVERSAL CULVERT DESIGN

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.)
260.00	1	78 in.	705.95	706.61	1 - B	9.22	4.84	4.32	0.0260	OUTLET*	0.00	D	0.00
260.00	1	72 in.	706.82	707.09	2 - F	10.07	6.00	4.42	0.0260	OUTLET**	0.00	D - 1	0.00
260.00	1	66 in.	708.33	709.47	2 - F	11.24	5.50	4.49	0.0260	OUTLET	0.00	D - 2	0.00
260.00	1	84 in.	705.44	706.34	1 - B	8.57	4.49	4.23	0.0260	OUTLET*	0.00	D + 1	0.00
310.00	1	78 in.	707.26	707.57	2 - F	10.99	6.50	4.73	0.0260	OUTLET*	0.00	F	0.00
310.00	1	72 in.	708.65	709.34	2 - F	12.00	6.00	4.81	0.0260	OUTLET**	0.00	F - 1	0.00
310.00	1	66 in.	710.89	712.57	2 - F	13.41	5.50	4.82	0.0260	OUTLET**	0.00	F - 2	0.00
310.00	1	84 in.	706.43	707.15	1 - B	10.21	5.12	4.63	0.0260	OUTLET*	0.00	F + 1	0.00


FLOWERS-ISON DRIVE 28 STA 10+50
MAINLINE 823
PATH OF WATER
FLOWERS-ISON RD
AREA 74
56.7 AC
=0.089 Sq.mi.
PROPOSED CULVERT
STA 10+50 DR 28
CR 28
1"=400'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
2574587.00	SQ. FT.	
0.092	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
2450.00	FT.	**TOTAL CHANNEL LENGTH**
245.00	FT.	L_{10} = 10% of the Distance along channel
713	FT.	$Elev_{10}$ = Elevation at point L_{10}
2082.50	FT.	L_{85} = 85% of the Distance along channel
795	FT.	$Elev_{85}$ = Elevation at point L_{85}
1837.50	FT.	**Length =** $L_{85} - L_{10}$
235.62	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**20**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**50**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**60**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**90**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**110**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**130**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/15/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 74, Drive 28 Sta 10+50 - Proposed **Designer :** KAG JF

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.

Inlet Invert Elevation (ft.) : 704.90 **Outlet Invert Elevation (ft.) :** 703.90 **Tailwater Elevation (ft.) :** 708.20 **Overflow Elevation (ft.) :** 712.00

Allowable Headwater Elevation (ft.) : 712.00 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 38.00 **Culvert Slope (ft./ft.) :** 0.0263 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 90.00 @ 25 yrs. **Flood Discharge (cfs) :** 130.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH					**Entrance Type :** Square Edge with Headwall						**Entrance Loss (Ke) :** 0.50		
90.00	1	48 in.	709.57	709.52	1 - D	18.41	1.65	2.88	0.0120	INLET	0.00	D	0.00
90.00	1	42 in.	710.68	710.50	2 - H	18.47	1.77	2.94	0.0120	INLET	0.00	D - 1	0.00
80.20	1	36 in.	713.32	712.56	2 - H	17.86	1.82	2.77	0.0120	INLET	9.80	D - 2	0.00
90.00	1	54 in.	709.12	709.01	1 - C	18.27	1.57	2.78	0.0120	INLET	0.00	D + 1	0.00
130.00	1	48 in.	711.79	710.96	2 - H	20.22	2.04	3.41	0.0120	INLET	0.00	F	0.00
105.60	1	42 in.	714.47	712.99	2 - H	19.18	1.95	3.13	0.0120	INLET	24.40	F - 1	0.00
80.20	1	36 in.	720.33	717.30	2 - H	17.86	1.82	2.77	0.0120	INLET	49.80	F - 2	0.00
130.00	1	54 in.	710.51	709.90	2 - E	20.19	1.91	3.36	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED					**Entrance Type :** Headwall						**Entrance Loss (Ke) :** 0.25		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
90.00	1	48 in.	709.54	709.68	1 - B	7.16	2.46	2.88	0.0235	OUTLET	0.00	D	0.00

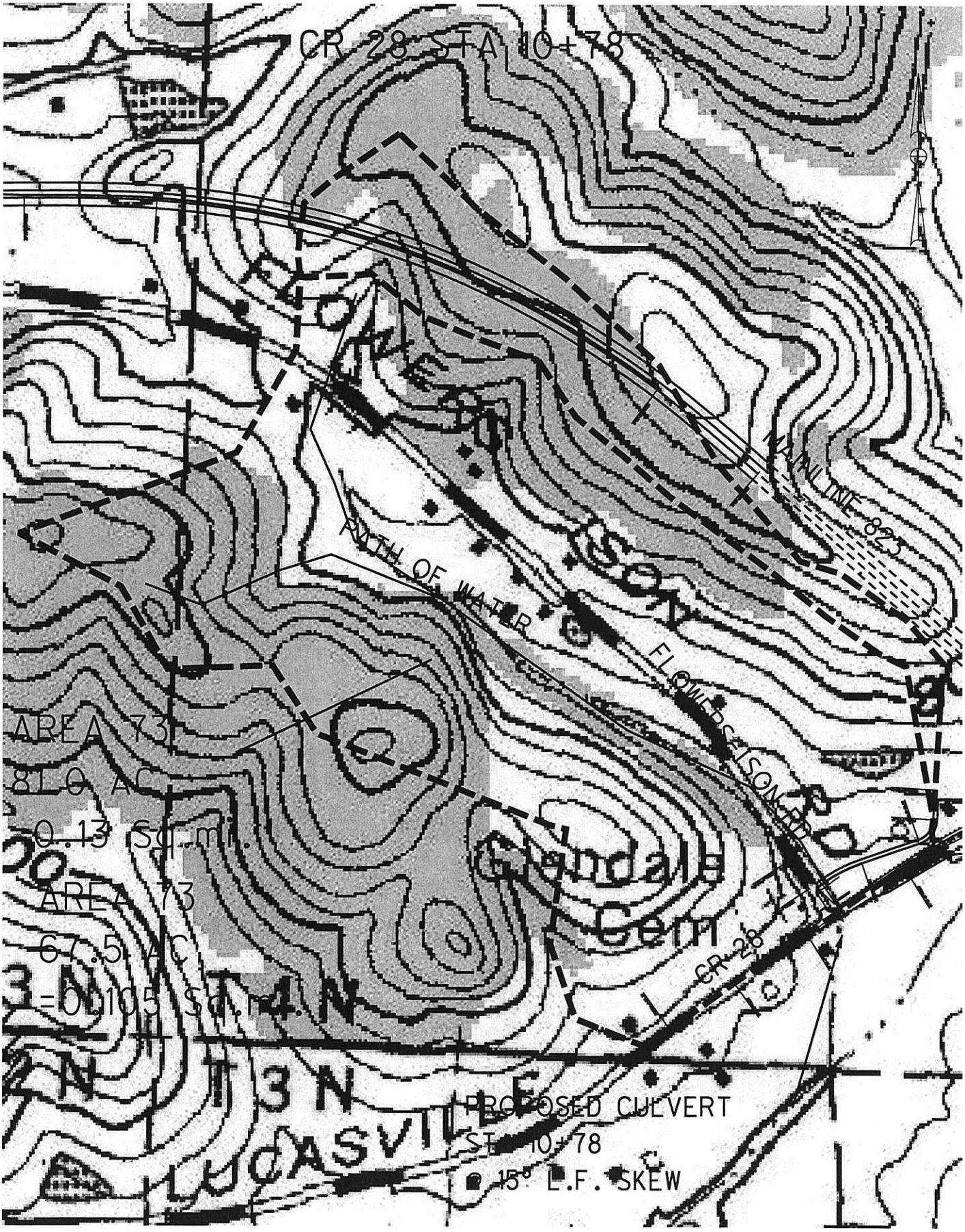
No Concuts High Velocity

UNIVERSAL CULVERT DESIGN

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.)
90.00	1	42 in.	710.59	710.90	2 - G	9.35	2.89	2.94	0.0237	OUTLET	0.00	D - 1	0.00
74.70	1	36 in.	713.07	713.71	2 - G	10.57	3.00	2.72	0.0241	OUTLET	15.30	D - 2	0.00
90.00	1	54 in.	709.07	709.08	1 - B	5.75	2.26	2.78	0.0233	OUTLET	0.00	D + 1	0.00
130.00	1	48 in.	711.66	711.29	2 - H	11.69	3.31	3.41	0.0235	INLET	0.00	F	0.00
106.70	1	42 in.	714.19	713.84	2 - G	11.09	3.50	3.14	0.0237	OUTLET	23.30	F - 1	0.00
74.70	1	36 in.	719.75	719.70	2 - G	10.57	3.00	2.72	0.0241	OUTLET	55.30	F - 2	0.00
130.00	1	54 in.	710.48	710.03	2 - E	12.22	2.85	3.36	0.0233	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
90.00	1	48 in.	709.54	709.86	2 - G	7.16	2.75	2.88	0.0275	OUTLET	0.00	D	0.00
90.00	1	42 in.	710.59	711.28	2 - G	9.35	3.50	2.94	0.0278	OUTLET	0.00	D - 1	0.00
69.50	1	36 in.	713.07	714.56	2 - G	9.83	3.00	2.65	0.0281	OUTLET	20.50	D - 2	0.00
90.00	1	54 in.	709.07	709.17	1 - B	5.75	2.49	2.78	0.0273	OUTLET	0.00	D + 1	0.00
130.00	1	48 in.	711.66	711.66	2 - H	10.35	4.00	3.41	0.0275	INLET	0.00	F	0.00
99.90	1	42 in.	714.19	714.63	2 - G	10.38	3.50	3.07	0.0278	OUTLET	30.10	F - 1	0.00
69.50	1	36 in.	719.75	721.47	2 - G	9.83	3.00	2.65	0.0281	OUTLET	60.50	F - 2	0.00
130.00	1	54 in.	710.48	710.23	2 - E	10.73	3.20	3.36	0.0273	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
90.00	1	60 in.	708.78	708.90	1 - B	5.01	2.63	2.69	0.0332	OUTLET	0.00	D	0.00
90.00	1	66 in.	708.58	708.65	1 - B	4.52	2.48	2.62	0.0330	OUTLET	0.00	D + 1	0.00
130.00	1	60 in.	709.89	709.66	1 - C	9.33	3.34	3.26	0.0332	INLET	0.00	F	0.00
130.00	1	66 in.	709.55	N/A	1 - C	9.46	3.09	3.17	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
90.00	1	60 in.	708.78	708.79	1 - B	5.01	2.28	2.69	0.0260	OUTLET	0.00	D	0.00
90.00	1	66 in.	708.58	708.59	1 - B	4.52	2.18	2.62	0.0260	OUTLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
130.00	1	60 in.	709.89	709.43	1 - C	11.31	2.84	3.26	0.0260	INLET	0.00	F	0.00
130.00	1	66 in.	709.55	N/A	1 - C	11.33	2.68	3.17	0.0260	INLET	0.00	F + 1	0.00


CR 28 STA 10+78
PATH OF WATER FLOW TO CULVERT
MAINLINE 823
AREA 73
810 AC
0.13 Sq. mi.
AREA 73
67.5 AC
=0.105 Sq. mi.
T 4 N
T 3 N
R 3 E
Grandall Gem
CR 28
PROPOSED CULVERT
STA 10+78
15° L.F. SKEW
1"=400'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Existing consitions

Values	Units	Definitions
3528713.00	SQ. FT.	
0.127	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
2575.00	FT.	**TOTAL CHANNEL LENGTH**
257.50	FT.	L_{10} = 10% of the Distance along channel
712	FT.	**$Elev_{10}$ =** Elevation at point L_{10}
2188.75	FT.	L_{85} = 85% of the Distance along channel
795	FT.	**$Elev_{85}$ =** Elevation at point L_{85}
1931.25	FT.	**Length =** $L_{85} - L_{10}$
226.92	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**30.00**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**60.00**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**80.00**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**110.00**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**140.00**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**160.00**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/15/2008 **Project :** Portsmouth Bypass **Location :** Portsmouth, OH

Description : CR 10+90 culvert, Drainage area 73 **Designer :** KAG JF

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.

Inlet Invert Elevation (ft.) : 702.70 **Outlet Invert Elevation (ft.) :** 699.00 **Tailwater Elevation (ft.) :** 701.00 **Overflow Elevation (ft.) :** 715.20

Allowable Headwater Elevation (ft.) : 713.20 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 87.00 **Culvert Slope (ft./ft.) :** 0.0425 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 110.00 @ 25 yrs. **Flood Discharge (cfs) :** 160.00 @ 100 yrs.

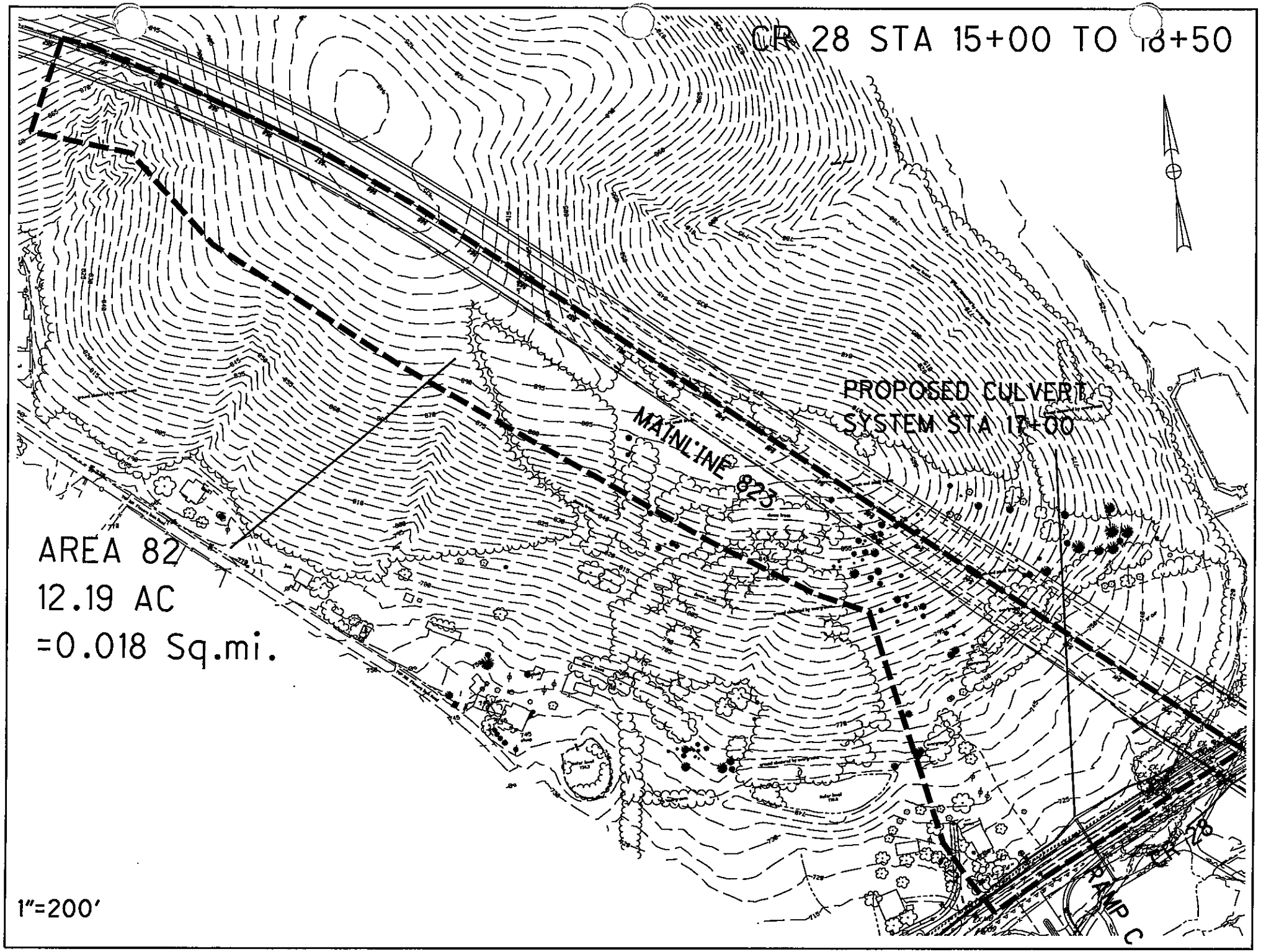
FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** No Headwall								**Entrance Loss (Ke) :** 0.20		
110.00	1	48 in.	707.89	704.45	2 - E	23.16	1.61	3.17	0.0120	INLET	0.00	D	0.00
110.00	1	42 in.	709.25	705.65	2 - E	23.23	1.73	3.17	0.0120	INLET	0.00	D - 1	0.00
110.00	1	36 in.	712.48	708.48	2 - E	23.07	1.92	2.93	0.0120	INLET	0.00	D - 2	0.00
110.00	1	54 in.	707.32	N/A	1 - C	22.98	1.53	3.09	0.0120	INLET	0.00	D + 1	0.00
160.00	1	48 in.	710.60	706.77	2 - E	25.51	2.00	3.67	0.0120	INLET	0.00	F	0.00
160.00	1	42 in.	713.92	709.47	2 - E	25.37	2.18	3.41	0.0120	INLET	0.00	F - 1	0.00
128.00	1	36 in.	721.86	715.78	2 - E	23.70	2.14	2.96	0.0120	INLET	32.00	F - 2	0.00
160.00	1	54 in.	709.00	705.47	2 - E	25.45	1.88	3.70	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** No Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
110.00	1	54 in.	708.22	705.07	2 - E	14.13	2.21	3.09	0.0233	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

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.)
110.00	1	48 in.	709.37	706.50	2 - E	13.98	2.40	3.17	0.0235	INLET	0.00	D - 1	0.00
110.00	1	42 in.	711.99	709.63	2 - E	13.47	2.77	3.17	0.0237	INLET	0.00	D - 2	0.00
110.00	1	60 in.	707.65	N/A	1 - C	14.13	2.09	2.99	0.0232	INLET	0.00	D + 1	0.00
160.00	1	54 in.	710.99	707.92	2 - E	15.42	2.79	3.70	0.0233	INLET	0.00	F	0.00
160.00	1	48 in.	714.03	711.12	2 - E	14.86	3.20	3.67	0.0235	INLET	0.00	F - 1	0.00
131.50	1	42 in.	720.40	717.89	2 - E	13.67	3.50	3.32	0.0237	INLET	28.50	F - 2	0.00
160.00	1	60 in.	709.52	706.31	2 - E	15.57	2.59	3.63	0.0232	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
110.00	1	54 in.	708.22	705.40	2 - E	12.54	2.43	3.09	0.0273	INLET	0.00	D	0.00
110.00	1	48 in.	709.37	707.12	2 - E	12.34	2.67	3.17	0.0275	INLET	0.00	D - 1	0.00
110.00	1	42 in.	711.99	710.92	2 - E	11.43	3.50	3.17	0.0278	INLET	0.00	D - 2	0.00
110.00	1	60 in.	707.65	N/A	1 - C	12.60	2.28	2.99	0.0271	INLET	0.00	D + 1	0.00
160.00	1	54 in.	710.99	708.61	2 - E	13.57	3.13	3.70	0.0273	INLET	0.00	F	0.00
160.00	1	48 in.	714.03	712.42	2 - E	12.73	4.00	3.67	0.0275	INLET	0.00	F - 1	0.00
131.50	1	42 in.	720.40	720.62	2 - E	13.95	3.50	3.32	0.0278	INLET	28.50	F - 2	0.00
160.00	1	60 in.	709.52	706.69	2 - E	13.83	2.85	3.63	0.0271	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
110.00	1	60 in.	707.65	N/A	1 - C	10.83	2.57	2.99	0.0332	INLET	0.00	D	0.00
110.00	1	66 in.	707.31	N/A	1 - C	10.87	2.43	2.91	0.0330	INLET	0.00	D + 1	0.00
160.00	1	60 in.	709.52	707.40	2 - E	11.79	3.26	3.63	0.0332	INLET	0.00	F	0.00
160.00	1	66 in.	708.75	N/A	1 - C	11.94	3.03	3.53	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
110.00	1	60 in.	707.65	N/A	1 - C	13.00	2.23	2.99	0.0260	INLET	0.00	D	0.00
110.00	1	66 in.	707.31	N/A	1 - C	12.94	2.13	2.91	0.0260	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
160.00	1	60 in.	709.52	706.58	2 - E	14.27	2.78	3.63	0.0260	INLET	0.00	F	0.00
160.00	1	66 in.	708.75	N/A	1 - C	14.29	2.63	3.53	0.0260	INLET	0.00	F + 1	0.00


CR 28 STA 15+00 TO 18+50
PROPOSED CULVERT
SYSTEM STA 17+00
MAINLINE 823
AREA 82
12.19 AC
=0.018 Sq.mi.
1"=200'
RAMP C

CR 28 STA. 17+00

HDR | ONE COMPANY *Many Solutions℠*

Client: ODOT Sheet: of

Subject: Pipe Culvert Calculations Order No:

Computed by: KAG Date: 8/15/2008

Checked by: JF Date: 11/3/2008

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C	
Pavement Area	131170	3.01	0.9	
Non-paved Area	399908	9.18	0.5	Weighted "C" for non-paved area
Other				
Total Area	531078	**12.19**	**acres**	**Weighted "C" = 0.60**

Overland Flow

Length	106	
High Elevation	860	
Low Elevation	820	t_o 2.77 (1101.2.2)
Slope %	37.7	

Shallow Concentrated Flow

Length	2200	
High Elevation	820	
Low Elevation	714	
Slope %	4.82	
k	0.305	(poor grass - Table 1101-1)
V	2.20	(1101.2.2)
t_s	16.7	(1101.2.2)

Since the time of concentration = to + ts t_c **19.46** min

use t_c 19.50 min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	12.1918733	19.50	0.60	2.84	21
5 Years	118.822	18.7	0.969	12.1918733	19.50	0.60	3.48	25
10 Years	112.172	16.8	0.923	12.1918733	19.50	0.60	4.07	30
25 Years	198.92	19.3	1.004	12.1918733	19.50	0.60	5.05	**37**
50 Years	206.025	19.6	0.99	12.1918733	19.50	0.60	5.47	40
100 Years	355.551	23.199	1.076	12.1918733	19.50	0.60	6.26	**46**

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 08/15/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 82, CR 28 Sta. 18+00 **Designer :** KAG

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.

Inlet Invert Elevation (ft.) : 710.00 **Outlet Invert Elevation (ft.) :** 703.00 **Tailwater Elevation (ft.) :** 703.10 **Overflow Elevation (ft.) :** 715.92

Allowable Headwater Elevation (ft.) : 715.92 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 121.00 **Culvert Slope (ft./ft.) :** 0.0579 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 37.00 @ 25 yrs. **Flood Discharge (cfs) :** 46.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Square Edge with Headwall								**Entrance Loss (Ke) :** 0.50		
37.00	1	30 in.	713.86	707.44	2 - E	19.78	1.02	2.06	0.0120	INLET	0.00	D	0.00
37.00	1	27 in.	714.89	708.63	2 - E	19.86	1.07	2.05	0.0120	INLET	0.00	D - 1	0.00
33.90	1	24 in.	716.80	710.94	2 - E	19.43	1.09	1.91	0.0120	INLET	3.10	D - 2	0.00
37.00	1	33 in.	713.31	706.79	2 - E	19.68	0.97	2.03	0.0120	INLET	0.00	D + 1	0.00
46.00	1	30 in.	715.10	708.71	2 - E	20.97	1.15	2.24	0.0120	INLET	0.00	F	0.00
42.10	1	27 in.	716.77	710.58	2 - E	20.50	1.15	2.12	0.0120	INLET	3.90	F - 1	0.00
33.90	1	24 in.	719.82	714.22	2 - E	19.43	1.09	1.91	0.0120	INLET	12.10	F - 2	0.00
46.00	1	33 in.	714.15	707.67	2 - E	20.89	1.09	2.25	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Headwall								**Entrance Loss (Ke) :** 0.25		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
37.00	1	30 in.	713.81	709.83	2 - E	11.60	1.55	2.06	0.0244	INLET	0.00	D	0.00

High Velocity

UNIVERSAL CULVERT DESIGN

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.)
37.00	1	27 in.	714.77	712.93	2 - E	11.30	1.73	2.05	0.0245	INLET	0.00	D - 1	0.00
32.30	1	24 in.	716.58	719.28	2 - F	10.50	2.00	1.89	0.0247	OUTLET**	4.70	D - 2	0.00
37.00	1	33 in.	713.29	N/A	1 - C	11.76	1.44	2.03	0.0241	INLET	0.00	D + 1	0.00
46.00	1	30 in.	714.98	712.41	2 - E	12.07	1.81	2.24	0.0244	INLET	0.00	F	0.00
42.90	1	27 in.	716.56	717.23	2 - E	11.03	2.25	2.13	0.0245	INLET	3.10	F - 1	0.00
32.30	1	24 in.	719.45	727.11	2 - F	10.50	2.00	1.89	0.0247	OUTLET**	13.70	F - 2	0.00
46.00	1	33 in.	714.09	709.79	2 - E	12.38	1.65	2.25	0.0241	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
37.00	1	36 in.	712.99	N/A	1 - C	10.49	1.50	1.98	0.0281	INLET	0.00	D	0.00
37.00	1	42 in.	712.67	N/A	1 - C	10.53	1.38	1.89	0.0278	INLET	0.00	D + 1	0.00
46.00	1	36 in.	713.59	N/A	1 - C	11.06	1.71	2.21	0.0281	INLET	0.00	F	0.00
46.00	1	42 in.	713.09	N/A	1 - C	11.15	1.55	2.12	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
37.00	1	60 in.	712.20	N/A	1 - C	9.00	1.31	1.69	0.0332	INLET	0.00	D	0.00
37.00	1	66 in.	712.10	N/A	1 - C	8.94	1.27	1.65	0.0330	INLET	0.00	D + 1	0.00
46.00	1	60 in.	712.50	N/A	1 - C	9.58	1.47	1.90	0.0332	INLET	0.00	F	0.00
46.00	1	66 in.	712.39	N/A	1 - C	9.53	1.41	1.84	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
37.00	1	60 in.	712.20	N/A	1 - C	10.71	1.16	1.69	0.0260	INLET	0.00	D	0.00
37.00	1	66 in.	712.10	N/A	1 - C	10.60	1.12	1.65	0.0260	INLET	0.00	D + 1	0.00
46.00	1	60 in.	712.50	N/A	1 - C	11.41	1.29	1.90	0.0260	INLET	0.00	F	0.00
46.00	1	66 in.	712.39	N/A	1 - C	11.29	1.25	1.84	0.0260	INLET	0.00	F + 1	0.00

FHWA Urban Drainage Design Program, HY-22
HYDRAULIC PARAMETERS OF OPEN CHANNELS

Trapezoidal, Rectangular, or Triangular X-Section
Date: 12/02/2008

Project No. :
Project Name.:
Computed by :

INPUT PARAMETERS

1.	Channel Slope (ft/ft)	0.0100
2.	Channel Bottom Width (ft)	10.00
3.	Left Side Slope (Horizontal to 1)	3.00
4.	Right Side Slope (Horizontal to 1)	2.00
5.	Manning's Coefficient	0.040
6.	Discharge (cfs)	250.00*
7.	Depth of Flow (ft)	2.68

Inputs

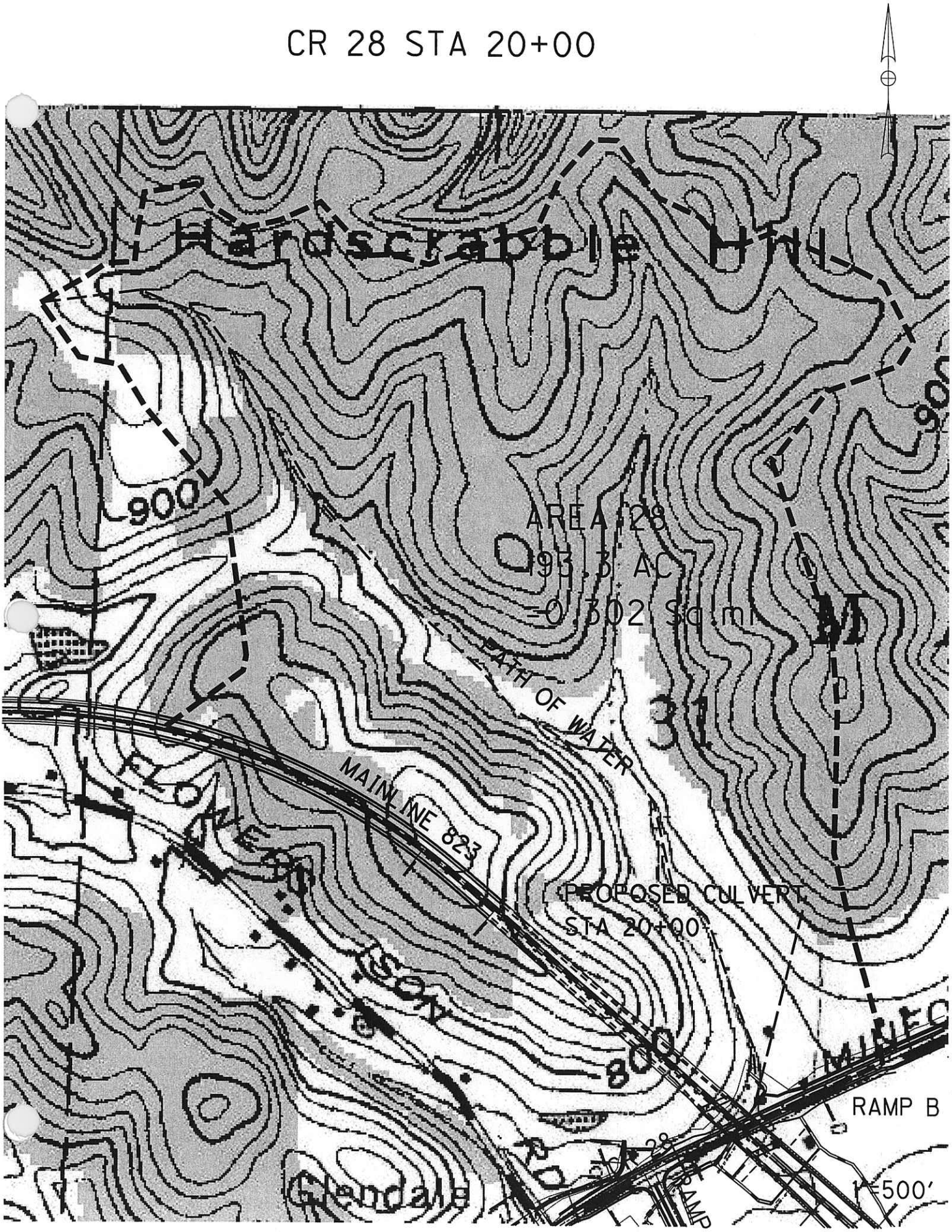
OUTPUT RESULTS

Cross Section Area (Sqft)	44.76
Average Velocity (ft/sec)	5.59
Top Width (ft)	23.40
Hydraulic Radius (ft)	1.83
Froude Number	0.71

* Q_{25} for culvert Sta 507+50 Ramp C/D CR28

Tailwater
Ditch elevation at outlet ~ 699.7
Depth of flow ~ 2.68
702.38

CR 28 STA 20+00



TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
8417326.00	SQ. FT.	
0.302	SQ. MI.	**CONTDA =** Contributing Drainage Area
	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
4996.00	FT.	**TOTAL CHANNEL LENGTH**
499.60	FT.	L_{10} = 10% of the Distance along channel
740	FT.	$Elev_{10}$ = Elevation at point L_{10}
4246.60	FT.	L_{85} = 85% of the Distance along channel
860	FT.	$Elev_{85}$ = Elevation at point L_{85}
3747.00	FT.	**Length =** $L_{85} - L_{10}$
169.10	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**53**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**105**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**146**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**201**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**246**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**291**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/03/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 28, CR 28 Sta. 20+00 **Designer :** KAG JF

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.

Inlet Invert Elevation (ft.) : 704.50 **Outlet Invert Elevation (ft.) :** 701.50 **Tailwater Elevation (ft.) :** 706.00 **Overflow Elevation (ft.) :** 717.51

Allowable Headwater Elevation (ft.) : 716.46 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 292.00 **Culvert Slope (ft./ft.) :** 0.0103 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 201.00 @ 25 yrs. **Flood Discharge (cfs) :** 291.00 @ 100 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Square Edge with Headwall							**Entrance Loss (Ke) :** 0.50			
201.00	1	66 in.	711.01	N/A	1 - C	15.85	2.90	3.97	0.0120	INLET	0.00	D	0.00
201.00	1	60 in.	712.00	709.94	2 - E	15.78	3.09	4.05	0.0120	INLET	0.00	D - 1	0.00
201.00	1	54 in.	713.85	712.30	2 - H	15.43	3.44	4.04	0.0120	INLET	0.00	D - 2	0.00
201.00	1	72 in.	710.52	N/A	1 - C	15.85	2.76	3.88	0.0120	INLET	0.00	D + 1	0.00
291.00	1	66 in.	714.13	711.96	2 - E	17.20	3.68	4.71	0.0120	INLET	0.00	F	0.00
291.00	1	60 in.	716.57	714.52	2 - E	16.59	4.18	4.63	0.0120	INLET	0.00	F - 1	0.00
252.30	1	54 in.	720.82	719.22	2 - H	15.86	4.50	4.28	0.0120	INLET	38.70	F - 2	0.00
291.00	1	72 in.	712.71	710.47	2 - E	17.36	3.44	4.66	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Headwall							**Entrance Loss (Ke) :** 0.25			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
201.00	1	66 in.	710.97	710.89	1 - C	9.14	4.80	3.97	0.0231	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

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.)
201.00	1	60 in.	711.90	713.56	2 - F	10.80	5.00	4.05	0.0232	OUTLET**	0.00	D - 1	0.00
190.20	1	54 in.	713.64	718.84	2 - G	11.96	4.50	3.97	0.0233	OUTLET	10.80	D - 2	0.00
201.00	1	72 in.	710.45	710.46	1 - B	8.84	4.15	3.88	0.0229	OUTLET*	0.00	D + 1	0.00
291.00	1	66 in.	713.95	716.40	2 - F	13.44	5.50	4.71	0.0231	OUTLET**	0.00	F	0.00
246.10	1	60 in.	716.25	722.13	2 - F	13.22	5.00	4.40	0.0232	OUTLET**	44.90	F - 1	0.00
190.20	1	54 in.	720.27	732.92	2 - G	11.96	4.50	3.97	0.0233	OUTLET	100.80	F - 2	0.00
291.00	1	72 in.	712.62	713.14	2 - F	12.34	6.00	4.66	0.0229	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
201.00	1	72 in.	710.45	710.57	1 - A	8.84	4.72	3.88	0.0267	OUTLET*	0.00	D	0.00
201.00	1	66 in.	710.97	712.08	2 - F	9.66	5.50	3.97	0.0269	OUTLET**	0.00	D - 1	0.00
201.00	1	60 in.	711.90	715.57	2 - F	10.80	5.00	4.05	0.0271	OUTLET**	0.00	D - 2	0.00
201.00	1	78 in.	710.12	710.26	1 - B	8.20	4.29	3.78	0.0266	OUTLET*	0.00	D + 1	0.00
291.00	1	72 in.	712.62	714.67	2 - F	12.34	6.00	4.66	0.0267	OUTLET**	0.00	F	0.00
275.20	1	66 in.	713.95	718.85	2 - F	12.96	5.50	4.60	0.0269	OUTLET**	15.80	F - 1	0.00
219.60	1	60 in.	716.25	726.33	2 - F	11.80	5.00	4.20	0.0271	OUTLET**	71.40	F - 2	0.00
291.00	1	78 in.	711.83	712.02	1 - A	11.65	5.93	4.58	0.0266	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
201.00	1	72 in.	710.45	711.56	1 - A	8.84	5.48	3.88	0.0327	OUTLET**	0.00	D	0.00
201.00	1	66 in.	710.97	714.33	2 - F	9.66	5.50	3.97	0.0330	OUTLET**	0.00	D - 1	0.00
186.80	1	60 in.	711.90	719.34	2 - F	10.04	5.00	3.91	0.0332	OUTLET	14.20	D - 2	0.00
201.00	1	78 in.	710.12	710.53	1 - A	8.20	5.04	3.78	0.0325	OUTLET*	0.00	D + 1	0.00
290.30	1	72 in.	712.62	717.56	2 - F	12.32	6.00	4.66	0.0327	OUTLET**	0.70	F	0.00
235.50	1	66 in.	713.95	723.57	2 - F	11.32	5.50	4.29	0.0330	OUTLET**	55.50	F - 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
186.80	1	60 in.	716.25	734.22	2 - F	10.04	5.00	3.91	0.0332	OUTLET	104.20	F - 2	0.00
291.00	1	78 in.	711.83	714.12	2 - F	11.65	6.50	4.58	0.0325	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
201.00	1	66 in.	710.97	711.78	2 - F	9.66	5.50	3.97	0.0260	OUTLET**	0.00	D	0.00
201.00	1	60 in.	711.90	714.97	2 - F	10.80	5.00	4.05	0.0260	OUTLET**	0.00	D - 1	0.00
201.00	1	72 in.	710.45	710.54	1 - A	8.84	4.61	3.88	0.0260	OUTLET*	0.00	D + 1	0.00
282.10	1	66 in.	713.95	718.24	2 - F	13.17	5.50	4.65	0.0260	OUTLET**	8.90	F	0.00
226.60	1	60 in.	716.25	725.08	2 - F	12.17	5.00	4.26	0.0260	OUTLET**	64.40	F - 1	0.00
291.00	1	72 in.	712.62	714.37	2 - F	12.34	6.00	4.66	0.0260	OUTLET**	0.00	F + 1	0.00

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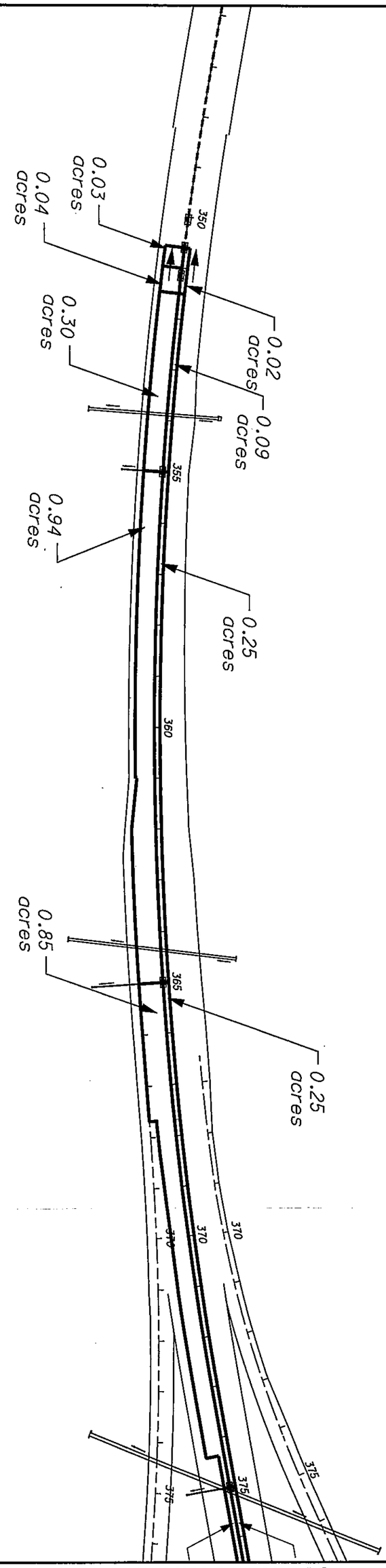

1/8	SCI-823-6.81	INLET DRAINAGE AREAS STA. 346+00 TO STA. 376+00	CALCULATED BEE CHECKED KAG	0 100 50 200 HORIZONTAL SCALE IN FEET

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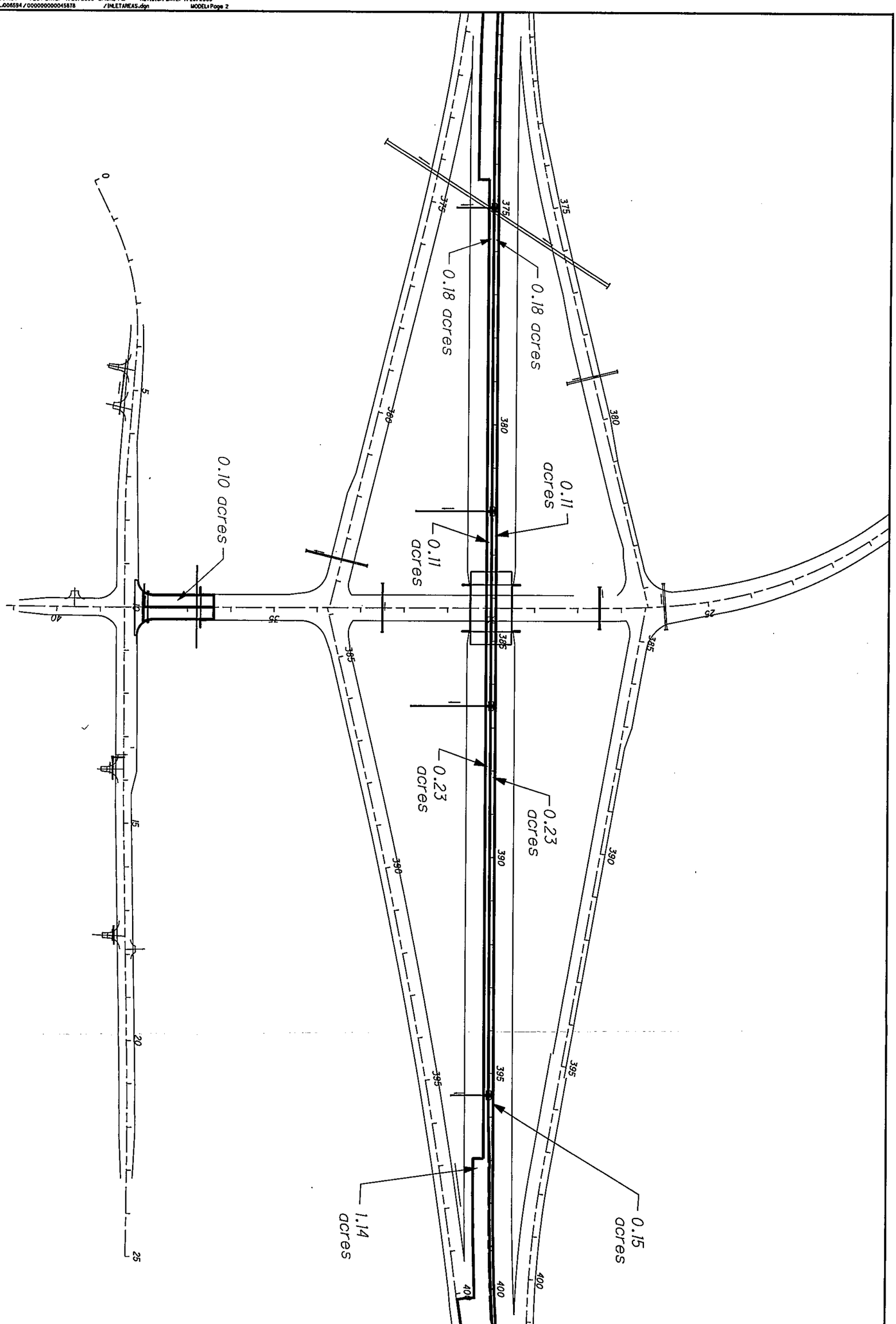

2/8	SCI-823-6.81	**INLET DRAINAGE AREAS** **STA. 371+00 TO STA. 400+00**	CALCULATED BEE CHECKED KAG	0 100 50 200 HORIZONTAL SCALE IN FEET

USER: belton PLOT DATE: 7/20/2009 3:45:20 PM REVISION DATE: 7/20/2009
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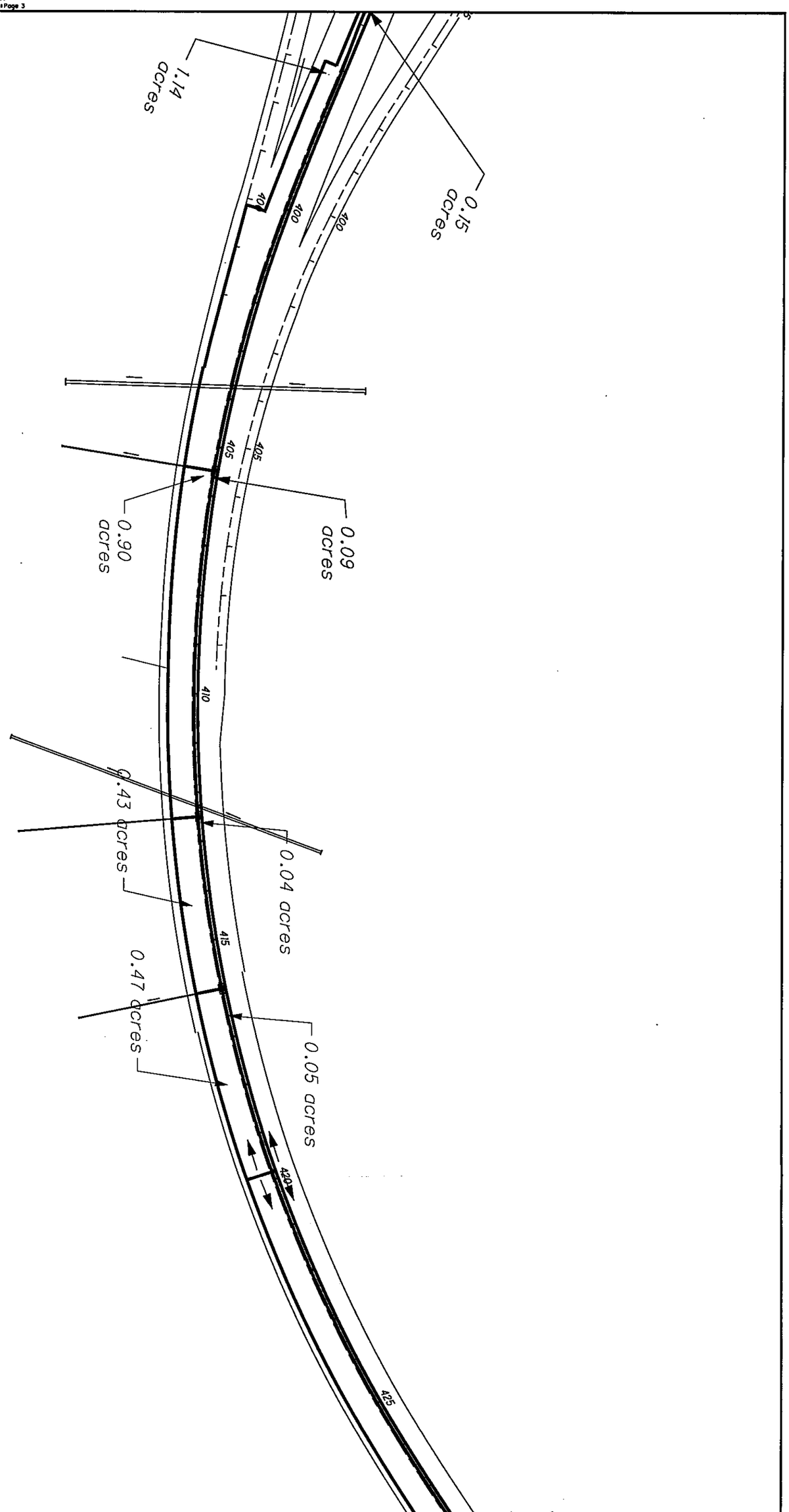


38 / 3	SCI-823-6.81	INLET DRAINAGE AREAS STA. 396+00 TO STA. 427+00	CALCULATED BEE CHECKED KAG	0 100 50 200 HORIZONTAL SCALE IN FEET

0.13 acres

0.15 acres

0.13 acres

0.14 acres

0.02 acres

0.23 acres

425

430

435

440

445

450

1.11 acres

0.16 acres

0.13 acres

0.14 acres

0.23 acres

0.02 acres

HORIZONTAL SCALE IN FEET

0 50 100 200

CALCULATED BEE
CHECKED KAG

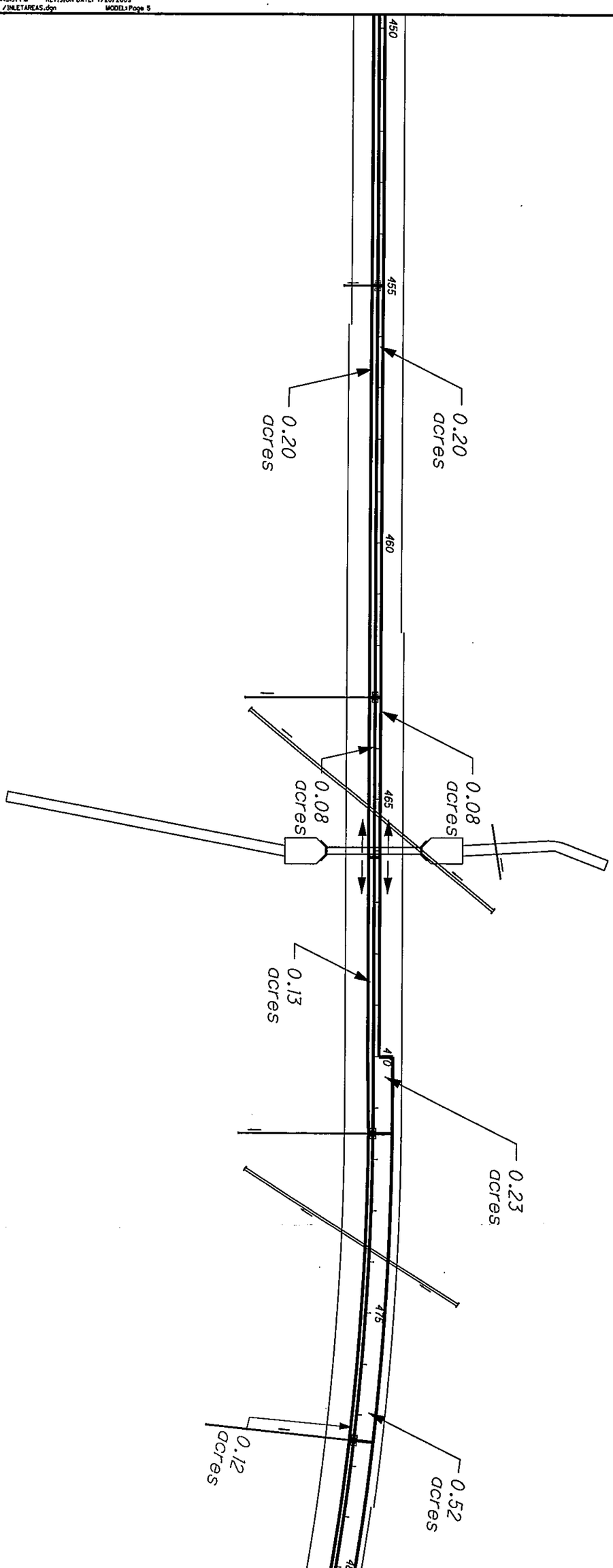
INLET DRAINAGE AREAS
STA. 422+00 TO STA. 452+00

SCI-823-6.81

4
8

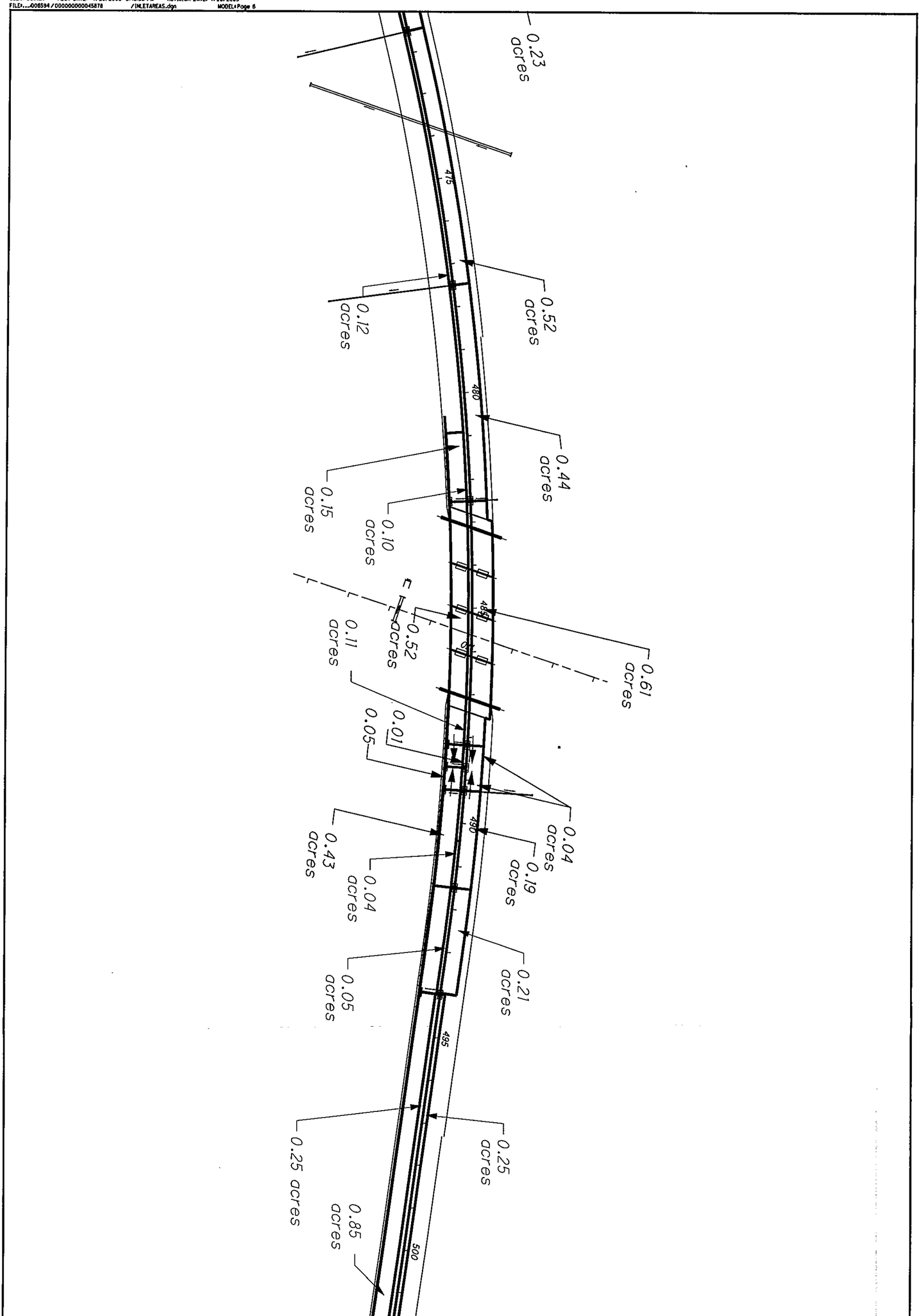
USER: balcon PLOT DATE: 7/20/2009 3:45:08 PM REVISION DATE: 7/20/2009
FILE: ...\005534 / 0000000000045878 /INLETAREAS.dgn MODEL: Page 4

USER: belkon PLOT DATE: 7/20/2009 3:45:31 PM REVISION DATE: 7/20/2009
FILE:...006594 / 0000000000045878 /INLETAREAS.dgn MODEL: Page 5



5/8	SCI-823-6.81	INLET DRAINAGE AREAS STA. 450+00 TO STA. 480+00	CALCULATED BEE CHECKED KAG	0 100 50 200 HORIZONTAL SCALE IN FEET

USER: belkon PLOT DATE: 7/20/2009 3:45:36 PM REVISION DATE: 7/20/2009
FILE:...006594/D0000000045878 /INLETAREAS.dgn MODEL:Page 6



6 of 8	SCI-823-6.81	INLET DRAINAGE AREAS STA. 472+00 TO STA. 501+00	CALCULATED BEE CHECKED KAG	0 100 50 200 HORIZONTAL SCALE IN FEET

0.04 acres
0.19 acres
0.21 acres
0.25 acres
0.25 acres
1.07 acres
0.15 acres

490 495 500 505 510 515 520

0.04 acres
0.05 acres
0.25 acres
0.85 acres
0.34 acres
0.25 acres
0.15 acres
0.43 acres

USER: bellton PLOT DATE: 7/20/2009 3:45:42 PM REVISION DATE: 7/20/2009
FILE: ...\086584\00000000045878 \INLETAREAS.dgn MODEL: Page 7

CALCULATED BEE
CHECKED KAG

HORIZONTAL SCALE IN FEET
0 50 100 200

INLET DRAINAGE AREAS
STA. 490+00 TO STA. 520+00

SCI-823-6.81

7
8

0.15
acres

0.19
acres

0.19
acres

A =0.02Ac.

A =0.19Ac.

A =0.20Ac.

A =0.19Ac.

A =0.02Ac.

A =0.20Ac.

A =0.08Ac.

535
530
525
520
540
515
545

HORIZONTAL SCALE IN FEET
0 50 100 200

CALCULATED BEE
CHECKED KAG

INLET DRAINAGE AREAS
STA. 516+00 TO STA. 546+00

SCI-823-6.81

8/8

USER: bshon PLOT DATE: 7/20/2009 3:45:47 PM REVISION DATE: 7/20/2009
FILE:...\006594\000000000045818\ ...\INLET\AREA15.dgn MODEL: Page 8

INLET SPACING DESIGN

PID : 19415 **Date :** 05/05/2009 **Project :** SCI-823 **Location :** Portsmouth

Description : Left Side **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 11.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
253+04	Begin																	
263+00	I-3C	996.00	0.90	0.42	1.61	7.24	10.00	0.0115	0.0400	0.0350	9.50	0.1670	5.39	1.78	0.26	2.04	0.232	5.80
266+00	I-3C	300.00	0.90	0.24	2.46	1.77	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.29	0.14	1.43	0.178	4.46
269+00	I-3C	300.00	0.90	0.24	2.46	1.81	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.22	0.09	1.30	0.172	4.31
273+00	I-3C	300.00	0.90	0.24	2.46	1.82	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.18	0.07	1.25	0.170	4.25
276+00	I-3C	300.00	0.90	0.24	2.46	1.83	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.23	0.169	4.22
279+00	I-3C	300.00	0.90	0.24	2.53	1.83	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.23	0.169	4.21
282+00	I-3C	300.00	0.90	0.24	1.32	1.81	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.22	0.168	4.21
285+00	I-3C	300.00	0.90	0.24	2.53	1.83	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.22	0.168	4.21
288+00	I-3C	300.00	0.90	0.24	2.53	1.83	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.16	0.06	1.22	0.168	4.21
298+00	I-3B	1000.00	0.90	0.35	2.53	5.79	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.47	0.29	1.76	0.193	4.82
306+50	I-3B	850.00	0.90	0.21	1.52	5.79	10.00	0.0180	0.0400	0.0000	9.50	0.1670	5.39	1.25	0.06	1.31	0.181	4.52
316+50	I-3C	1000.00	0.90	0.25	1.52	6.90	10.00	0.0180	0.0400	0.0000	9.50	0.1670	5.39	1.23	0.04	1.27	0.179	4.47
326+50	I-3C	1000.00	0.90	0.25	1.52	6.92	10.00	0.0180	0.0400	0.0000	9.50	0.1670	5.39	1.22	0.04	1.25	0.178	4.45
336+50	I-3C	1000.00	0.90	0.24	1.52	4.89	10.00	0.0443	0.0400	0.0000	9.50	0.1670	5.39	1.06	0.14	1.20	0.148	3.70
342+50	I-3C	600.00	0.90	0.15	1.52	3.18	10.00	0.0431	0.0400	0.0000	9.50	0.1670	5.39	0.87	0.00	0.87	0.132	3.29

Phase III

INLET SPACING DESIGN

Phase III

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
347+00	I-3C	450.00	0.90	0.11	1.52	3.58	10.00	0.0200	0.0400	0.0000	9.50	0.1670	5.39	0.53	0.00	0.53	0.127	3.17	
349+70	I-3C	270.00	0.90	0.06	1.52	3.96	10.00	0.0059	0.0400	0.0000	9.50	0.1670	5.39	0.29	0.00	0.29	0.127	3.17	
350+60	I-3C	90.00	0.90	0.02	3.51	3.12	10.00	0.0013	0.0400	0.0000	9.50	0.0000	5.39	******	******	0.10	0.112	2.80	Sag
419+83	Begin																		
416+50	I-3C	333.00	0.90	0.05	1.11	3.72	10.00	0.0136	0.0400	0.0650	4.00	0.1670	5.39	0.24	0.00	0.24	0.101	2.53	
412+50	I-3A	350.00	0.90	0.05	2.85	3.05	10.00	0.0272	0.0400	0.0650	4.00	0.0000	5.39	0.24	0.01	0.24	0.089	2.22	
405+50	I-3C	750.00	0.90	0.09	1.11	5.53	10.00	0.0290	0.0400	0.0650	4.00	0.1670	5.39	0.44	0.00	0.44	0.110	2.75	
395+50	I-3B	1000.00	0.90	0.15	1.52	6.81	10.00	0.0269	0.0400	0.0160	9.50	0.1670	5.39	0.73	0.00	0.73	0.135	3.36	
386+50	I-3B	900.00	0.90	0.23	1.52	6.86	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	1.12	0.00	1.12	0.176	4.41	
382+00	I-3B	450.00	0.90	0.11	1.52	4.01	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	0.53	0.00	0.53	0.134	3.34	
375+00	I-3B	700.00	0.90	0.18	1.52	5.60	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	0.87	0.00	0.87	0.161	4.02	
365+00	I-3C	1000.00	0.90	0.25	1.52	7.51	10.00	0.0150	0.0400	0.0280	9.50	0.1670	5.39	1.21	0.00	1.21	0.182	4.55	
355+00	I-3C	1000.00	0.90	0.25	1.52	7.51	10.00	0.0150	0.0400	0.0280	9.50	0.1670	5.39	1.21	0.00	1.21	0.182	4.55	
351+50	I-3C	350.00	0.09	0.09	1.52	9.55	11.07	0.0046	0.0400	0.0280	9.50	0.1670	5.20	0.04	0.00	0.04	0.064	1.61	
350+60	I-3C	90.00	0.90	0.02	1.52	17.24	18.77	0.0000	0.0400	0.0280	9.50	0.1670	4.15	******	******	0.08	0.242	6.05	End

SUMP DATA

Total Flow (cfs) : 0.18 **Ponded Depth (ft.) :** 0.033 **Spread on Pavement (ft.) :** 0.57

INLET SPACING DESIGN

PID : 19415 **Date :** 05/05/2009 **Project :** SCI-823 **Location :** Portsmouth

Description : Right Side **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
253+04	Begin																	
263+00	I-3C	996.00	0.90	0.19	3.50	9.11	12.61	0.0115	0.0400	0.0160	7.00	0.1670	4.95	0.85	0.00	0.85	0.167	4.17
266+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
269+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
276+00	I-3C	700.00	0.90	0.14	3.50	5.16	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.68	0.00	0.68	0.135	3.38
279+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
282+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
285+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
288+00	I-3C	300.00	0.90	0.07	3.50	2.56	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.34	0.00	0.34	0.104	2.60
298+00	I-3B	1000.00	0.90	0.25	3.92	6.47	10.38	0.0230	0.0400	0.0160	9.50	0.1670	5.32	1.15	0.05	1.20	0.167	4.18
306+50	I-3B	850.00	0.90	0.21	3.92	6.21	10.13	0.0180	0.0400	0.0160	9.50	0.1670	5.37	1.06	0.00	1.06	0.167	4.18
316+50	I-3C	1000.00	0.90	0.34	6.23	6.71	12.93	0.0180	0.0400	0.0160	9.50	0.1670	4.90	1.37	0.13	1.50	0.190	4.76
326+50	I-3C	1000.00	0.90	0.80	6.23	3.75	10.00	0.0440	0.0400	0.0160	9.50	0.1670	5.39	2.15	1.86	4.01	0.233	5.82
336+50	I-3C	1000.00	0.90	0.80	6.23	3.41	10.00	0.0443	0.0400	0.0160	9.50	0.1670	5.39	2.63	3.11	5.74	0.266	6.65
342+50	I-3C	600.00	0.90	0.48	6.23	2.09	10.00	0.0431	0.0400	0.0160	9.50	0.1670	5.39	2.57	2.87	5.44	0.262	6.55
347+00	I-3C	450.00	0.90	0.36	2.42	2.14	10.00	0.0200	0.0400	0.0000	9.50	0.1670	5.39	2.71	1.91	4.62	0.284	7.11

Phase II

INLET SPACING DESIGN

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
349+70	I-3C	270.00	0.90	0.22	2.42	2.27	10.00	0.0059	0.0400	0.0160	9.50	0.1670	5.39	2.50	0.47	2.98	0.303	7.58	
350+60	I-3C	90.00	0.90	0.07	2.42	1.85	10.00	0.0013	0.0400	0.0160	9.50	0.0000	5.39	******	******	0.81	0.248	6.21	Sag
425+25	Begin																		
416+00	I-3C	333.00	0.90	0.47	2.32	1.84	10.00	0.0141	0.0650	0.0650	11.00	0.1670	5.39	2.11	0.18	2.28	0.280	4.30	
412+50	I-3A	350.00	0.90	0.43	2.34	1.52	10.00	0.0270	0.0650	0.0650	11.00	0.0000	5.39	1.58	0.69	2.26	0.247	3.80	
405+50	I-3C	750.00	0.90	0.90	7.78	2.76	10.54	0.0290	0.0650	0.0650	11.00	0.1670	5.29	3.16	1.81	4.97	0.327	5.03	
395+50	I-3B	1000.00	0.90	1.14	1.52	3.74	10.00	0.0270	0.0400	0.0160	9.50	0.1670	5.39	3.35	4.00	7.34	0.320	8.00	
386+50	I-3B	900.00	0.90	0.23	1.52	4.72	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	3.04	2.08	5.11	0.312	7.80	
382+00	I-3B	450.00	0.90	0.11	1.52	2.78	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	2.01	0.60	2.61	0.242	6.06	
375+00	I-3C	700.00	0.90	0.18	1.53	4.95	10.00	0.0150	0.0400	0.0104	9.50	0.1670	5.39	1.39	0.09	1.48	0.196	4.89	
365+00	I-3C	1000.00	0.90	0.85	1.52	5.39	10.00	0.0150	0.0400	0.0280	9.50	0.1670	5.39	2.70	1.51	4.22	0.290	7.25	
355+00	I-3C	1000.00	0.90	0.94	1.52	4.94	10.00	0.0150	0.0400	0.0280	9.50	0.1670	5.39	3.37	2.71	6.08	0.333	8.32	
351+50	I-3C	350.00	0.90	0.30	2.42	2.96	10.00	0.0047	0.0400	0.0280	9.50	0.1670	5.39	3.25	0.92	4.16	0.359	8.97	
351+00	I-3C	50.00	0.90	0.07	2.42	0.77	10.00	0.0021	0.0400	0.0280	9.50	0.1670	5.39	1.26	0.00	1.26	0.267	6.67	
350+60	I-3C	40.00	0.90	0.03	2.42	6.53	10.00	0.0000	0.0400	0.0280	9.50	0.1670	5.39	******	******	0.16	0.303	7.59	End

SUMP DATA

Total Flow (cfs) : 0.97 **Ponded Depth (ft.) :** 0.100 **Spread on Pavement (ft.) :** 1.73

INLET SPACING DESIGN

PID : 19415 **Date :** 05/11/2009 **Project :** SCI-823 **Location :** Portsmouth

Description :419+83 to 466+12 LT **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
419+83	Begin																		
429+00	I-3B	917.00	0.90	0.13	10.00	6.34	16.34	0.0337	0.0400	0.0160	8.50	0.1670	4.43	0.52	0.00	0.52	0.114	2.84	
435+00	I-3B	600.00	0.90	0.15	10.00	3.40	13.40	0.0490	0.0400	0.0160	11.00	0.1670	4.83	0.65	0.00	0.65	0.115	2.89	
440+00	I-3B	1000.00	0.90	0.13	10.00	7.93	17.93	0.0240	0.0400	0.0160	11.00	0.1670	4.24	0.50	0.00	0.50	0.119	2.98	
445+50	I-3B	650.00	0.90	0.14	4.13	5.17	10.00	0.0190	0.0400	0.0160	11.00	0.1670	5.39	******	******	0.68	0.140	3.50	Sag
466+12	Begin																		
463+00	I-3B	312.00	0.90	0.08	3.92	3.74	10.00	0.0089	0.0400	0.0160	11.00	0.1670	5.39	0.39	0.00	0.39	0.131	3.27	
455+00	I-3B	800.00	0.90	0.20	3.92	6.42	10.34	0.0150	0.0400	0.0160	11.00	0.1670	5.33	0.96	0.00	0.96	0.167	4.16	
446+00	I-3B	900.00	0.90	0.23	3.92	14.05	17.97	0.0027	0.0400	0.0160	11.00	0.1670	4.24	0.88	0.00	0.88	0.222	5.55	
445+50	I-3B	50.00	0.90	0.02	3.92	1.66	10.00	0.0014	0.0400	0.0160	11.00	0.1670	5.39	******	******	0.10	0.110	2.75	End

SUMP DATA

Total Flow (cfs) : 0.78 **Ponded Depth (ft.) :** 0.024 **Spread on Pavement (ft.) :** 2.78

INLET SPACING DESIGN

PID : 19415 **Date :** 05/11/2009 **Project :** SCI-823 **Location :** Portsmouth

Description :419+83 to 466+12 RT **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
419+83	Begin																		
429+00	I-3B	917.00	0.90	0.95	10.00	3.78	13.78	0.0337	0.0400	0.0160	9.50	0.1670	4.77	2.29	1.79	4.08	0.246	6.16	
435+00	I-3B	600.00	0.90	0.16	10.00	2.43	12.43	0.0490	0.0400	0.0160	11.00	0.1670	4.98	1.61	0.90	2.51	0.191	4.78	
440+00	I-3B	1000.00	0.90	0.13	10.00	6.10	16.10	0.0240	0.0400	0.0160	11.00	0.1670	4.46	1.28	0.14	1.42	0.177	4.41	
445+50	I-3B	650.00	0.90	0.14	4.13	4.93	10.00	0.0190	0.0400	0.0160	11.00	0.1670	5.39	******	******	0.82	0.150	3.76	Sag
466+12	Begin																		
463+00	I-3B	312.00	0.90	0.08	3.92	3.74	10.00	0.0089	0.0400	0.0160	11.00	0.1670	5.39	0.39	0.00	0.39	0.131	3.27	
455+00	I-3B	800.00	0.90	0.20	3.92	6.42	10.34	0.0150	0.0400	0.0160	11.00	0.1670	5.33	0.96	0.00	0.96	0.167	4.16	
446+00	I-3B	900.00	0.90	0.23	3.92	14.05	17.97	0.0027	0.0400	0.0160	11.00	0.1670	4.24	0.88	0.00	0.88	0.222	5.55	
445+50	I-3B	50.00	0.90	0.02	3.92	1.66	10.00	0.0014	0.0400	0.0160	11.00	0.1670	5.39	******	******	0.10	0.110	2.75	End

SUMP DATA

Total Flow (cfs) : 0.92 **Ponded Depth (ft.) :** 0.037 **Spread on Pavement (ft.) :** 2.95

INLET SPACING DESIGN

PID : 19415 **Date :** 05/08/2009 **Project :** SCI-823 **Location :** Portsmouth

Description : Left Side **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
466+12	Begin																		
471+50	I-3B	538.00	0.90	0.23	2.75	4.09	10.00	0.0145	0.0400	0.0233	9.50	0.1670	5.39	1.12	0.00	1.12	0.177	4.43	
477+50	I-3C	600.00	0.90	0.52	2.50	6.76	10.00	0.0031	0.0400	0.0036	9.50	0.1670	5.39	2.40	0.12	2.52	0.321	8.03	
482+50	I-3C	500.00	0.90	0.44	2.50	5.56	10.00	0.0034	0.0400	0.0340	9.50	0.1670	5.39	2.19	0.07	2.26	0.303	7.58	
488+19	I-3C	569.00	0.90	0.61	2.50	6.20	10.00	0.0030	0.0400	0.0300	9.50	0.1670	5.39	2.76	0.27	3.03	0.347	8.66	
488+71	I-3C	50.00	0.90	0.04	2.51	2.04	10.00	0.0003	0.0400	0.0360	9.50	0.1670	5.39	******	******	0.46	0.264	6.60	Sag
520+01	Begin																		
514+00	I-3B	601.00	0.90	0.15	1.52	4.10	10.00	0.0250	0.0400	0.0160	9.50	0.1670	5.39	0.73	0.00	0.73	0.136	3.41	
504+00	I-3B	1000.00	0.90	0.25	1.52	4.85	10.00	0.0450	0.0400	0.0160	9.50	0.1670	5.39	1.07	0.15	1.21	0.148	3.70	
494+00	I-3B	1000.00	0.90	0.25	1.52	5.62	10.00	0.0289	0.0400	0.0007	9.50	0.1670	5.39	1.21	0.15	1.36	0.168	4.20	
489+25	I-3C	475.00	0.90	0.41	2.50	5.69	10.00	0.0029	0.0400	0.0360	9.50	0.1670	5.39	2.13	0.01	2.14	0.306	7.65	
488+71	I-3C	25.00	0.90	0.04	2.59	0.83	10.00	0.0008	0.0400	0.0360	9.50	0.1670	5.39	******	******	0.20	0.162	4.04	End

SUMP DATA

Total Flow (cfs) : 0.67 **Ponded Depth (ft.) :** 0.078 **Spread on Pavement (ft.) :** 1.35

INLET SPACING DESIGN

PID : 19415 **Date :** 05/08/2009 **Project :** SCI-823 **Location :** Portsmouth

Description : Right Side **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
466+12	Begin																		
471+50	I-3B	538.00	0.90	0.13	1.52	11.64	13.16	0.0015	0.0400	0.0148	9.50	0.1670	4.86	0.57	0.00	0.57	0.211	5.26	
477+50	I-3C	600.00	0.90	0.12	1.28	3.95	10.00	0.0314	0.0400	0.0360	7.00	0.1670	5.39	0.58	0.00	0.58	0.120	3.01	
482+50	I-3C	500.00	0.90	0.10	1.28	3.31	10.00	0.0343	0.0400	0.0360	7.00	0.1670	5.39	0.49	0.00	0.49	0.110	2.76	
488+19	I-3C	569.00	0.90	0.11	1.28	9.75	11.04	0.0030	0.0400	0.0360	7.00	0.1670	5.21	0.52	0.00	0.52	0.178	4.46	
488+71	I-3C	50.00	0.90	0.01	1.28	13.66	14.95	0.0000	0.0400	0.0360	7.00	0.1670	4.61	******	******	0.04	0.202	5.05	Sag
520+01	Begin																		
514+00	I-3B	601.00	0.90	0.15	1.52	4.27	10.00	0.0224	0.0400	0.0160	9.50	0.1670	5.39	0.73	0.00	0.73	0.139	3.48	
504+00	I-3B	1000.00	0.90	0.25	1.52	4.85	10.00	0.0450	0.0400	0.0160	9.50	0.1670	5.39	1.07	0.15	1.21	0.148	3.70	
494+00	I-3B	1000.00	0.90	0.25	1.52	5.60	10.00	0.0292	0.0400	0.0160	9.50	0.1670	5.39	1.21	0.15	1.36	0.168	4.19	
489+25	I-3C	425.00	0.90	0.09	1.28	6.88	10.00	0.0031	0.0400	0.0360	7.00	0.1670	5.39	0.59	0.00	0.59	0.186	4.65	
488+70	I-3C	25.00	0.90	0.01	1.52	2.00	10.00	0.0002	0.0400	0.0360	7.00	0.0000	5.39	******	******	0.05	0.122	3.05	End

SUMP DATA

Total Flow (cfs) : 0.09 **Ponded Depth (ft.) :** 0.020 **Spread on Pavement (ft.) :** 0.51

INLET SPACING DESIGN

PID : 19415 **Date :** 05/11/2009 **Project :** SCI-823 **Location :** Portsmouth

Description :419+83 to 466+12 RT **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
419+83	Begin																		
429+00	I-3B	917.00	0.90	1.11	10.00	3.64	13.64	0.0337	0.0400	0.0160	9.50	0.1670	4.79	2.51	2.28	4.79	0.261	6.54	
435+00	I-3B	600.00	0.90	0.16	10.00	2.32	12.32	0.0490	0.0400	0.0160	11.00	0.1670	4.99	1.79	1.21	3.00	0.205	5.11	
440+00	I-3B	1000.00	0.90	0.13	10.00	5.80	15.80	0.0240	0.0400	0.0160	11.00	0.1670	4.50	1.45	0.29	1.74	0.191	4.77	
445+50	I-3B	650.00	0.90	0.14	4.13	4.73	10.00	0.0190	0.0400	0.0160	11.00	0.1670	5.39	******	******	0.97	0.160	4.00	Sag
466+12	Begin																		
463+00	I-3B	312.00	0.90	0.08	3.92	3.74	10.00	0.0089	0.0400	0.0160	11.00	0.1670	5.39	0.39	0.00	0.39	0.131	3.27	
455+00	I-3B	800.00	0.90	0.20	3.92	6.42	10.34	0.0150	0.0400	0.0160	11.00	0.1670	5.33	0.96	0.00	0.96	0.167	4.16	
446+00	I-3B	900.00	0.90	0.23	3.92	14.05	17.97	0.0027	0.0400	0.0160	11.00	0.1670	4.24	0.88	0.00	0.88	0.222	5.55	
445+50	I-3B	50.00	0.90	0.02	3.92	1.66	10.00	0.0014	0.0400	0.0160	11.00	0.1670	5.39	******	******	0.10	0.110	2.75	End

SUMP DATA

Total Flow (cfs) : 1.07 **Ponded Depth (ft.) :** 0.050 **Spread on Pavement (ft.) :** 3.10

INLET SPACING DESIGN

PID : 19415 **Date :** 07/06/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :519+00 to 510+50, Left side Rock Barrier **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
519+00	Begin																		
510+50	I-3D	850.00	0.90	1.07	2.58	3.11	10.00	0.0356	0.0400	0.0160	10.00	0.0000	5.39	******	******	5.19	0.267	6.67	End

INLET SPACING DESIGN

PID : 19415 **Date :** 05/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :520+00 to 512+00, Left side **Designer :** KAG

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
520+00	Begin																		
512+00	I-3D	800.00	0.90	1.03	3.18	3.64	10.00	0.0210	0.0400	0.0000	12.00	0.1670	5.39	******	******	5.00	0.290	7.26	End

STORM SEWER SYSTEM

PID : 19415 **Date :** 06/27/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 355+00 median to RT **Designer :** KAG BEE

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	355+00	1.19	1.07	10.00	5.39	6.64	5.8	7.1	15	76.0	0.0101	646.52	5.22	6.06	0.0161	648.13	651.95	3.82	4.18	I 3B
begin		355+00	1.19	1.07									645.75				646.91	652.44			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 12/24/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 365+00 median storm outlet.

Designer : BEE
KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	END	365+00		1.10	0.99	10.00	5.39	6.65	5.3	6.6	15	70.0	0.0100	661.52	5.19	6.02	0.0138	662.93	666.93	4.00	4.16	I 3B
begin		365+00		1.10	0.99									660.82				661.96	664.07			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 12/22/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 375+00 median storm outlet. **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	375+00		0.36	0.32	10.00	5.39	6.63	1.7	2.1	15	78.0	0.0121	676.52	4.31	6.61	0.0015	677.03	681.93	4.90	4.16	I 3B
begin		375+00		0.36	0.32									675.58				676.50	678.80			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 382+00 median storm outlet.

Designer : BEE
KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	382+00	0.22	0.20	10.00	5.39	6.64	1.1	1.3	15	57.0	0.0100	687.02	3.51	6.02	0.0006	687.43	692.43	5.00	4.16	I 3B
begin		382+00	0.22	0.20									686.45				687.30	689.70			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 06/30/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 386+50 median storm outlet. **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	386+50	0.46	0.41	10.00	5.39	6.65	2.2	2.8	15	60.0	0.0102	693.77	4.33	6.07	0.0024	694.39	699.18	4.79	4.16	I 3B
begin		386+50	0.46	0.41									693.16				694.12	696.41			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 06/30/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 395+50 median storm outlet.

Designer : BEE
KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	395+50		1.29	1.16	10.00	5.39	6.67	6.3	7.7	15	82.0	0.0432	712.32	9.66	12.51	0.0191	713.07	717.73	4.66	4.16	I 3B
begin		395+50		1.29	1.16									708.78				709.96	712.03			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 405+50 median storm outlet.

Designer : BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	405+50		0.99	0.89	10.00	5.39	6.63	4.8	5.9	15	90.0	0.0100	740.69	5.13	6.02	0.0111	741.91	746.10	4.19	4.16	I 3C
begin		405+50		0.99	0.89									739.79				740.91	743.04			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 412+50 median storm outlet.

Designer : BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	412+50	0.47	0.42	10.00	5.39	6.63	2.3	2.8	15	83.0	0.0100	760.95	4.32	6.02	0.0025	761.58	766.35	4.77	4.15	I 3C
begin		412+50	0.47	0.42									760.12				761.08	763.37			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/06/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 416+00 median storm outlet.

Designer : BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	416+00	0.52	0.47	10.00	5.39	6.63	2.5	3.1	15	82.0	0.0100	768.18	4.45	6.02	0.0031	768.84	773.59	4.75	4.16	I 3C
begin		416+00	0.52	0.47									767.36				768.34	770.61			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 429+00 median storm outlet.

Designer : BEE
KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	JUNCTION To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	RAINFALL INTENSITY (25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	DISCHARGE (cfs.) (25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	429+00	1.24	1.12	10.00	5.39	6.64	6.0	7.4	18	60.0	0.0050	755.84	4.14	6.92	0.0066	757.34	761.11	3.77	3.77	I 3C
begin		429+00	1.24	1.12									755.54				756.82	758.79			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/12/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 435+00 median storm outlet. **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	435+00		0.31	0.28	10.00	5.39	6.64	1.5	1.9	15	90.0	0.0349	730.53	6.05	11.25	0.0011	730.89	735.92	5.03	4.14	I 3B
begin		435+00		0.31	0.28									727.39				728.29	730.64			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/07/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 440+00 to R CB storm outlet.

Designer : BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	440+00	0.26	0.23	10.00	5.39	6.64	1.3	1.6	15	53.0	0.0100	713.37	3.68	6.02	0.0008	713.82	718.78	4.96	4.16	I 3B
begin		440+00	0.26	0.23									712.84				713.71	716.09			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/14/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 445+58 to 446+10 median storm outlet.

Designer : BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	445+58	0.32	0.29	10.00	5.39	6.65	1.6	1.9	15	49.0	0.0104	706.89	3.96	6.14	0.0012	707.39	712.30	4.91	4.16	I 3B
begin		446+10	0.32	0.29									706.38				707.28	712.38			0.015
1	2	446+10	0.23	0.21	10.21	5.35	6.60	2.7	3.3	15	57.0	0.0098	706.37	4.47	5.97	0.0034	707.06	712.38	5.32	4.76	I 3B
final		446+10	0.55	0.50									705.81				706.80	709.06			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 455+00 median to R CB storm outlet.

Designer : BEE
KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	455+00	0.40	0.36	10.00	5.39	6.64	1.9	2.4	15	61.0	0.0100	718.82	4.14	6.02	0.0018	719.39	723.92	4.53	3.85	I 3B
begin		455+00	0.40	0.36									718.21				719.14	721.46			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 463+00 median storm outlet. **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	2	463+00		0.16	0.14	10.00	5.39	6.63	0.8	1.0	15	55.0	0.0100	729.79	3.21	6.02	0.0003	730.14	735.19	5.05	4.15	I 3B
begin		463+00		0.16	0.14									729.24				730.06	732.49			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 471+50 median storm outlet

Designer : BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	471+50	0.36	0.32	10.00	5.39	6.65	1.7	2.2	15	55.0	0.0100	727.15	4.04	6.02	0.0015	727.69	732.56	4.87	4.16	I 3B
begin		471+50	0.36	0.32									726.60				727.52	729.85			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/09/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 477+50 median storm outlet.

Designer : BEE
KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	477+50	0.64	0.58	10.00	5.39	6.66	3.1	3.8	15	62.0	0.0248	713.47	6.56	9.49	0.0047	714.05	718.87	4.82	4.15	I 3C
begin		477+50	0.64	0.58									711.93				712.95	715.18			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/09/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 482+50 I-3D to 482+50 median inlet out to LT **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	482+50	0.15	0.14	10.00	5.39	6.58	0.7	0.9	15	40.0	0.0097	695.49	3.13	5.95	0.0003	696.17	699.75	3.58	3.01	I 3D
begin		482+50	0.15	0.14									695.10				696.16	700.89			0.015
1	2	482+50	0.54	0.49	10.21	5.35	6.58	3.3	4.1	15	64.0	0.0050	695.09	3.61	4.26	0.0053	696.16	700.89	4.73	4.55	I 3B
final		482+50	0.69	0.62									694.77				695.80	698.23			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/13/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 489+25, 488+72, 488+19 median and outside barrier storm outlet **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / Σ AREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
A	1	488+19	0.52	0.47	10.00	5.39	6.40	2.5	3.0	15	40.0	0.0100	684.94	4.45	6.02	0.0029	686.37	689.20	2.83	3.01	I 3D
begin		488+19	0.52	0.47									684.54				686.26	690.33			0.015
1	2	488+19	0.72	0.65	10.15	5.36	6.40	6.0	7.1	18	50.0	0.0090	684.53	5.27	9.29	0.0061	686.26	690.33	4.07	4.30	I 3B
		488+72	1.24	1.12									684.08				685.95	690.25			0.015
B	2	488+72	0.06	0.05	10.00	5.39	6.40	0.3	0.3	15	40.0	0.0197	684.87	3.06	8.46	0.0000	685.95	689.12	3.17	3.00	I 3D
begin		488+72	1.30	1.17									684.08				685.95	690.25			0.015
2	3	488+72	0.08	0.07	10.31	5.34	6.40	6.6	7.9	18	50.0	0.0098	684.07	5.58	9.69	0.0076	685.95	690.25	4.30	4.68	I 3B
		489+25	1.38	1.24									683.58				685.57	690.33			0.015
C	3	489+25	0.43	0.39	10.00	5.39	6.40	2.1	2.5	15	40.0	0.0175	684.28	5.19	7.97	0.0020	685.65	689.20	3.55	3.67	I 3D
begin		489+25	1.81	1.63									683.58				685.57	690.33			0.015
D	4	494+00	0.85	0.77	10.00	5.39	6.67	4.1	5.1	15	40.0	0.0100	693.02	4.99	6.02	0.0083	694.03	697.27	3.24	3.00	I 3D
begin		494+00	2.66	2.39									692.62				693.70	697.74			0.015
4	4A	494+00	0.50	0.45	10.13	5.37	6.55	6.5	8.0	15	247.0	0.0225	692.61	7.57	9.04	0.0202	693.58	697.74	4.16	3.88	I 3B
		491+50	3.16	2.84									687.05				688.23	692.39			0.015
4A	3	491+50	0.26	0.23	10.68	5.27	6.40	7.6	9.3	18	222.0	0.0156	687.04	6.89	12.23	0.0104	688.07	692.39	4.32	3.85	I 3B
		489+25	3.42	3.08									683.58				685.57	690.33			0.015

STORM SEWER SYSTEM

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
3	OUT	489+25		0.23	0.21	11.21	5.18	6.40	17.0	21.0	24	61.0	0.0097	683.57	6.93	20.74	0.0115	685.57	690.33	4.76	4.76	I 3B
final		489+25		3.65	3.29									682.98				684.80	686.47			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/10/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 504+00 median storm outlet. **Designer :** BEE

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	504+00	0.50	0.45	10.00	5.39	6.65	2.4	3.0	15	40.0	0.0097	735.01	4.36	5.95	0.0029	735.80	740.42	4.62	4.16	I 3B
begin		504+00	0.50	0.45									734.62				735.69	739.79			0.015
1	2	504+00	0.34	0.31	10.15	5.36	6.65	4.1	5.0	15	10.0	0.0080	734.61	4.54	5.39	0.0081	735.69	739.96	4.27	4.10	I 3D
final		504+00	0.84	0.76									734.53				735.61	737.78			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/11/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 511+00 shoulder storm outlet **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	511+00		1.07	0.96	10.00	5.39	6.69	5.2	6.4	15	17.0	0.0600	765.49	10.41	14.75	0.0132	766.09	769.72	3.63	2.98	I 3D
begin		511+00		1.07	0.96									764.47				765.61	767.72			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/10/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 514+00 median storm outlet **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	514+00	0.30	0.27	10.00	5.39	6.62	1.5	1.8	15	66.0	0.0055	773.27	3.08	4.45	0.0010	773.87	778.68	4.81	4.16	I 3B
begin		514+00	0.30	0.27									772.91				773.80	776.14			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/11/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 527+50 median storm outlet **Designer :** BEE KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	527+50	0.38	0.34	10.00	5.39	6.61	1.8	2.3	15	78.0	0.0067	769.72	3.53	4.92	0.0016	770.34	774.96	4.62	3.99	I 3B
begin		527+50	0.38	0.34									769.20				770.13	772.40			0.015

STORM SEWER SYSTEM

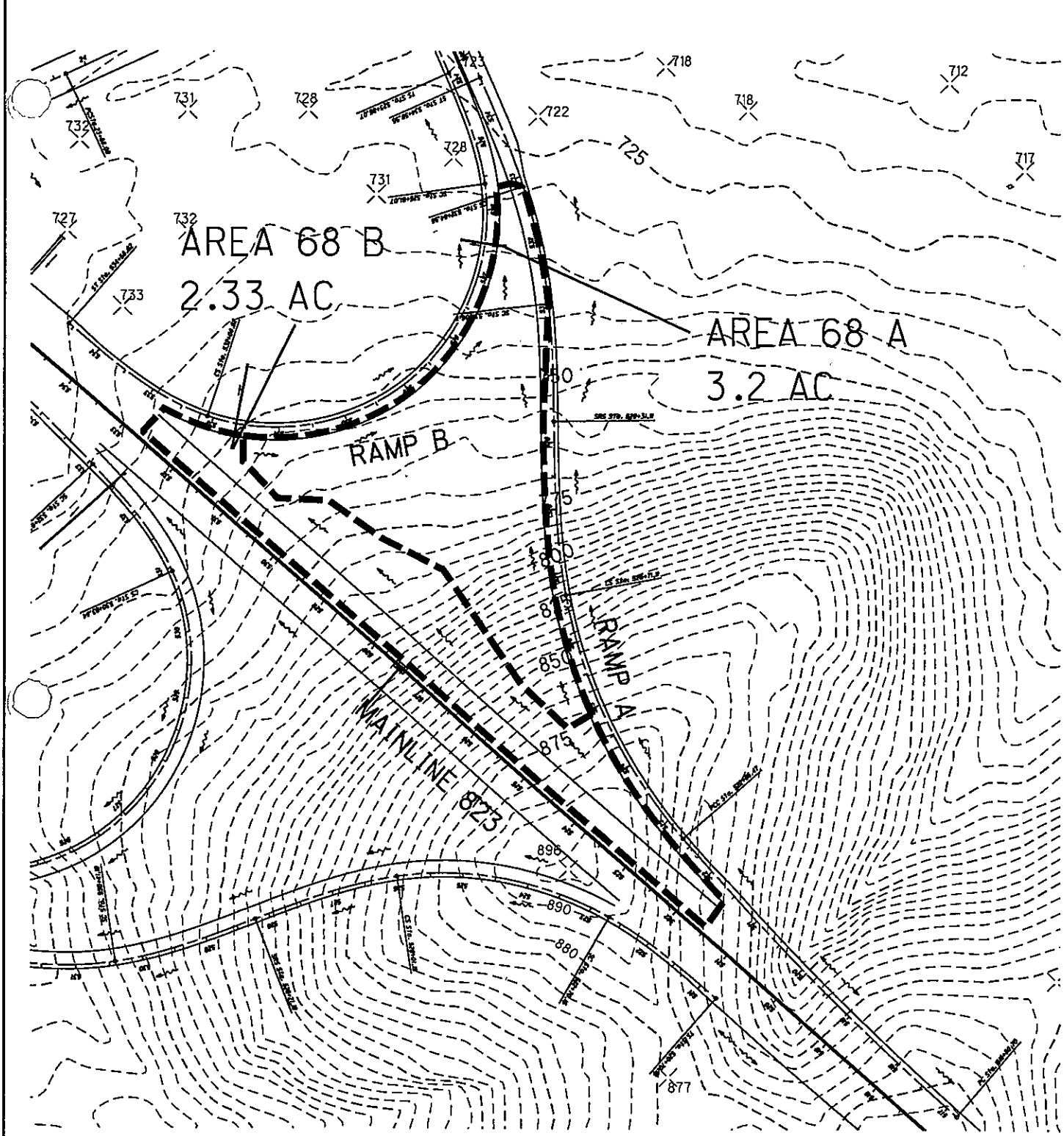
PID : 19415 **Date :** 07/14/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 535+00, 535+50, 536+00 median storm outlet. **Designer :** BEE

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	535+00	0.38	0.34	10.00	5.39	6.65	1.8	2.3	15	51.0	0.0106	754.73	4.17	6.20	0.0016	755.28	759.98	4.70	4.00	I 3B
begin		535+54	0.38	0.34									754.19				755.12	759.92			0.015
2	3	535+54	0.04	0.04	10.20	5.35	6.61	2.0	2.5	15	43.0	0.0109	754.18	4.33	6.30	0.0020	754.75	759.92	5.17	4.49	I 3B
		536+00	0.42	0.38									753.71				754.65	759.96			0.015
3	OUT	536+00	0.40	0.36	10.37	5.32	6.56	3.9	4.8	15	71.0	0.0099	753.70	4.91	5.98	0.0075	754.60	759.96	5.36	5.01	I 3B
final		536+00	0.82	0.74									753.00				754.07	756.25			0.015



CR 28 RAMP B
STA 527+50
STA 531+50

1"=200'

STORM SEWER SYSTEM

PID : 19415 **Date :** 06/30/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description :SS LT. STA. 532+00 CR 28 Ramp A/ 526+50 Ramp B - 68A **Designer :** KMD

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 0.00 **Tailwater Elevation (ft.):** 731.15

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	525+00	3.20	1.92	15.00	4.60	5.68	8.8	10.9	21	65.0	0.0066	730.73	5.15	12.01	0.0063	732.20	735.24	3.04	2.76	CB 2-2B
begin		532+00	3.20	1.92									730.30				731.79	733.30			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description : Storm sewer inlet at RT. STA. 531+50 823 and CR 28 Ramp B - 68A-B

Designer : KMD KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 740.45

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	531+50		2.33	1.40	15.00	4.60	5.69	6.4	8.0	18	62.0	0.0098	752.70	5.56	9.71	0.0076	753.86	758.68	4.82	4.48	CB 2-2B
begin		531+50		2.33	1.40									752.09				753.39	756.41			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/15/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description :SS RT. STA. 534+50 CR 28 Ramp A/B **Designer :** KMD

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 730.63

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	534+50	0.08	0.07	10.00	5.39	6.63	0.4	0.5	15	100.0	0.0730	727.30	5.30	16.27	0.0001	730.64	731.60	0.96	3.05	CB 3
begin		534+50	0.08	0.07									720.00				730.63	733.96			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/15/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description :SS RT. STA. 535+00 CR 28 Ramp A/B BMP BASIN OUTLET PIPE **Designer :** KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	535+00	8.00	4.80	13.20	4.86	5.96	23.3	28.6	27	192.0	0.0109	719.50	7.89	30.20	0.0113	721.63	723.30	1.67	1.55	CB 3
begin		535+00	8.00	4.80									717.40				719.45	733.96			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description :SS at LT. STA. 532+50 823 and CR 28 Ramp C **Designer :** KMD KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 730.14

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	525+00	2.26	1.42	15.00	4.60	5.69	6.6	8.1	18	53.0	0.0094	755.00	5.48	9.51	0.0079	756.22	760.90	4.68	4.40	CB 2-2B
begin		532+50	2.26	1.42									754.50				755.80	759.30			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description :SS RT. STA. 533+50 CR 28 Ramp D, 523+92 Ramp C **Designer :** KMD KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 730.63

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	523+50	4.25	3.40	15.00	4.60	5.69	15.7	19.4	18	86.0	0.0290	732.49	9.99	16.66	0.0452	735.37	735.70	0.33	1.71	CB 2-2B
begin		533+50	4.25	3.40									730.00				731.48	733.96			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description :SS RT. STA. 535+00 CR 28 Ramp D, 522+69.29 Ramp C **Designer :** KMD KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 730.63

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	535+00	0.26	0.16	15.00	4.60	5.67	0.7	0.9	15	116.0	0.0767	729.90	6.41	16.68	0.0002	730.66	732.80	2.14	1.65	CB 2-2B
begin		522+70	0.26	0.16									721.00				730.63	733.96			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 12/22/2008 **Project :** SR 823 Portsmouth **Location :** Portmouth Ohio

Description :SR 335 Sta 13+50 Storm Sewer

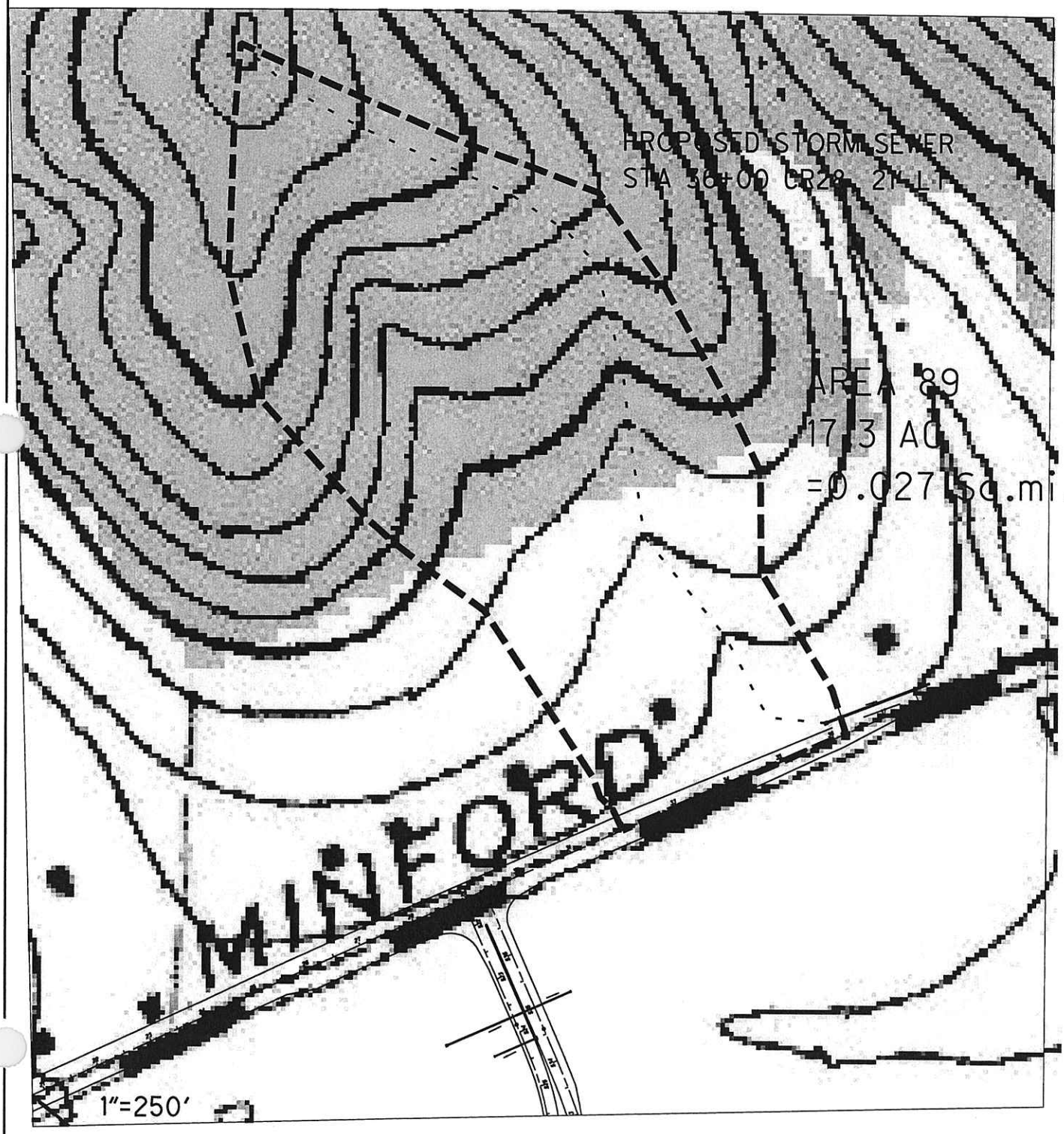
Designer : BEE KLG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 24.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	14+00	2.56	1.36	17.00	4.35	5.39	5.9	7.3	24	49.0	0.0469	656.00	9.54	45.69	0.0014	656.56	658.05	1.49	0.05	HW Half He
begin		13+50	2.56	1.36									653.70				655.18	656.30			0.015
2	3	13+50	0.73	0.44	17.09	4.34	5.38	7.8	9.6	24	28.0	0.0071	653.60	5.20	17.82	0.0024	655.02	656.30	1.28	0.70	CB 2-2B
		13+50	3.29	1.79									653.40				654.96	656.30			0.015
3	OUT	13+50	0.00	0.00	17.18	4.33	5.36	7.8	9.6	24	50.0	0.0520	653.30	10.70	48.09	0.0024	653.93	656.30	2.37	1.00	MH 1
final		13+50	3.29	1.79									650.70				652.25	685.80			0.015

CR 28 STA 36+00



TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Existing consitions

Values	Units	Definitions
751811.00	SQ. FT.	
0.027	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
1699.00	FT.	**TOTAL CHANNEL LENGTH**
169.90	FT.	L_{10} = 10% of the Distance along channel
730	FT.	$Elev_{10}$ = Elevation at point L_{10}
1444.15	FT.	L_{85} = 85% of the Distance along channel
920	FT.	$Elev_{85}$ = Elevation at point L_{85}
1274.25	FT.	**Length =** $L_{85} - L_{10}$
787.29	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	10	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	23	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	33	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	48	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	60	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	73	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

STORM SEWER SYSTEM

PID : 19415 **Date :** 12/08/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, OH

Description : CR 28 Sta 36+00 LT **Designer :** KAG

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	36+00	17.30	8.65	20.00	4.02	4.93	34.8	42.7	30	194.0	0.0086	720.85	7.60	35.48	0.0144	724.31	724.70	0.39	1.35	CB 2-4
begin		39+93	17.30	8.65									719.18				721.52	725.00			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 07/17/2009 **Project :** Portsmouth Bypass **Location :** Portsmouth, OH

Description :TR 234 Sta 38+00 Storm Sewer **Designer :** KAG JF

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 0.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
1	2	38+00	0.10	0.09	10.00	5.39	6.62	0.5	0.6	12	64.0	0.0109	656.90	2.95	3.47	0.0004	657.19	660.32	3.13	2.42	CB 3A
begin		38+00	0.10	0.09									656.20				656.86	660.32			0.015
2	OUT	38+00	0.10	0.09	10.36	5.33	6.60	1.0	1.2	12	18.0	0.0111	653.90	3.60	3.50	0.0015	654.46	660.20	5.74	5.30	CB 3A
final		38+00	0.20	0.18									653.70				654.43	662.00			0.015

DRAINAGE AREA MATCHLINE

A — A

DRAINAGE AREA MATCHLINE

A — A

A=5.96 Ac.

A=66.91 Ac.

A=7.08 Ac.

TR-234

A=6.11 Ac.

A=2.27 Ac.

A=10.84 Ac.

A=5.4Ac.

A=7.01Ac.

A=1.19 Ac.

A=7.37 Ac.

A=3.11 Ac.

A=5.6Ac.

A=4.96Ac.

A=4.35 Ac.

RAMP C

A=0.13 Ac.

RAMP D

A=2.93 Ac.

A=0.21 Ac.

A=3.7 Ac.

A=3.10 Ac.

350+00

375+00

400+00

A=0.80 Ac.

A=2.01 Ac.

A=0.85 Ac.

A=2.14 Ac.

A=5.45 Ac.

A=0.63 Ac.

A=6.09 Ac.

A=0.66 Ac.

A=1.86 Ac.

RAMP B

RAMP A

A=1.86 Ac.

A=0.90 Ac.

SR 335

A=0.85Ac.

A=1.10Ac.

A=0.73Ac.

A=1.52Ac.

A=0.39Ac.

HORIZONTAL SCALE IN FEET

0 100 200 400

CALCULATED KMD

CHECKED KAG

DITCH DRAINAGE AREAS

STA. 350+00.00 TO STA. 405+00.00

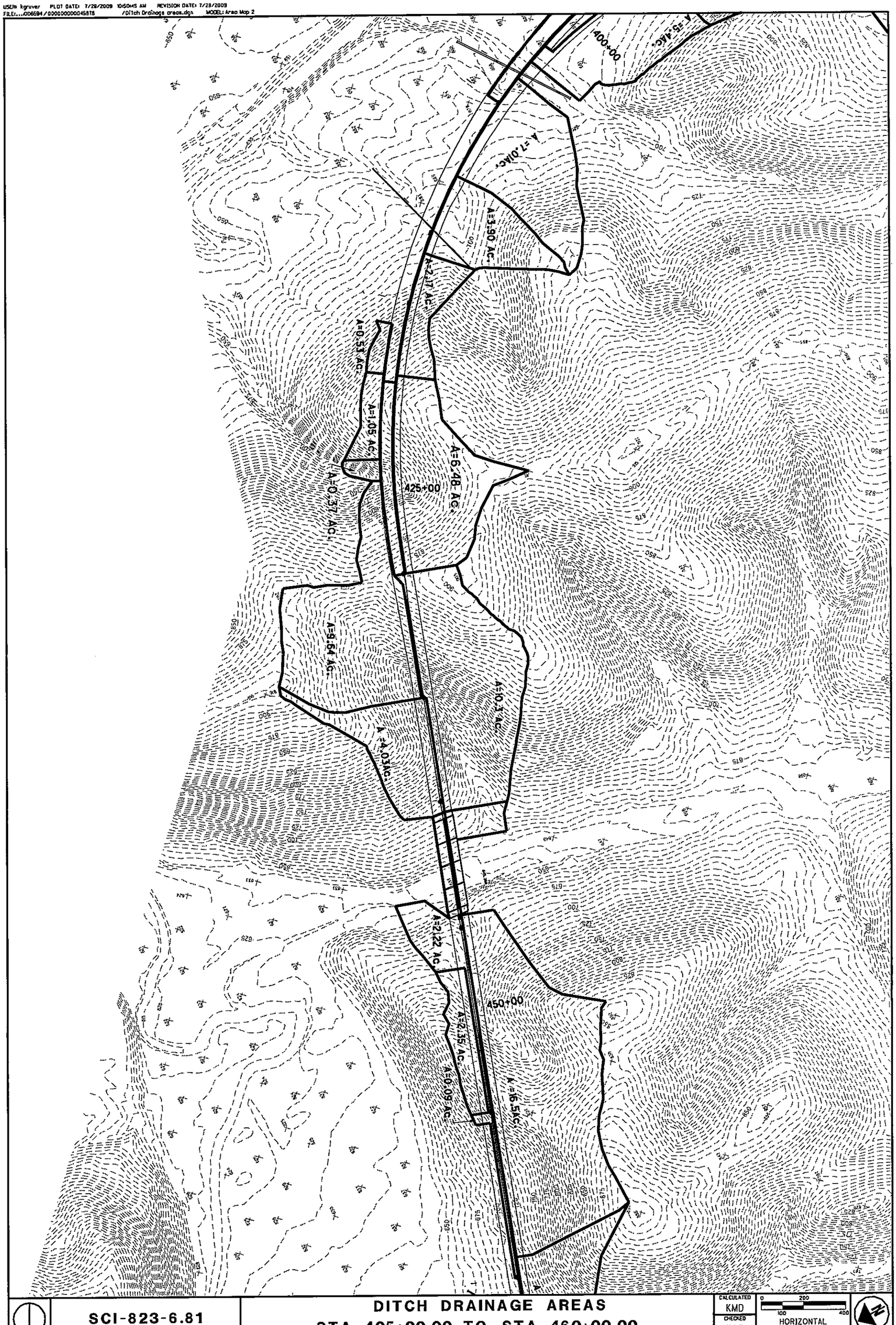
SCI-823-6.81

1

USER: kgruver PLOT DATE: 1/29/2009 10:48:05 AM REVISION DATE: 1/29/2009

FILE:...\206594 / 0000000000043818 /Ditch Drainage areas.dgn ACAD 2-Area Map 1

USER: kgruver PLOT DATE: 7/29/2009 10:50:45 AM REVISION DATE: 7/28/2009
FILE:...006594/0000000000045878 /Ditch Drainage areas.dgn MODEL: Area Map 2



SCI-823-6.81	DITCH DRAINAGE AREAS STA. 405+00.00 TO STA. 460+00.00	CALCULATED KMD CHECKED KAG	0 200 100 400 HORIZONTAL SCALE IN FEET

USER: kgruver PLOT DATE: 7/29/2009 10:52:53 AM REVISION DATE: 7/29/2009
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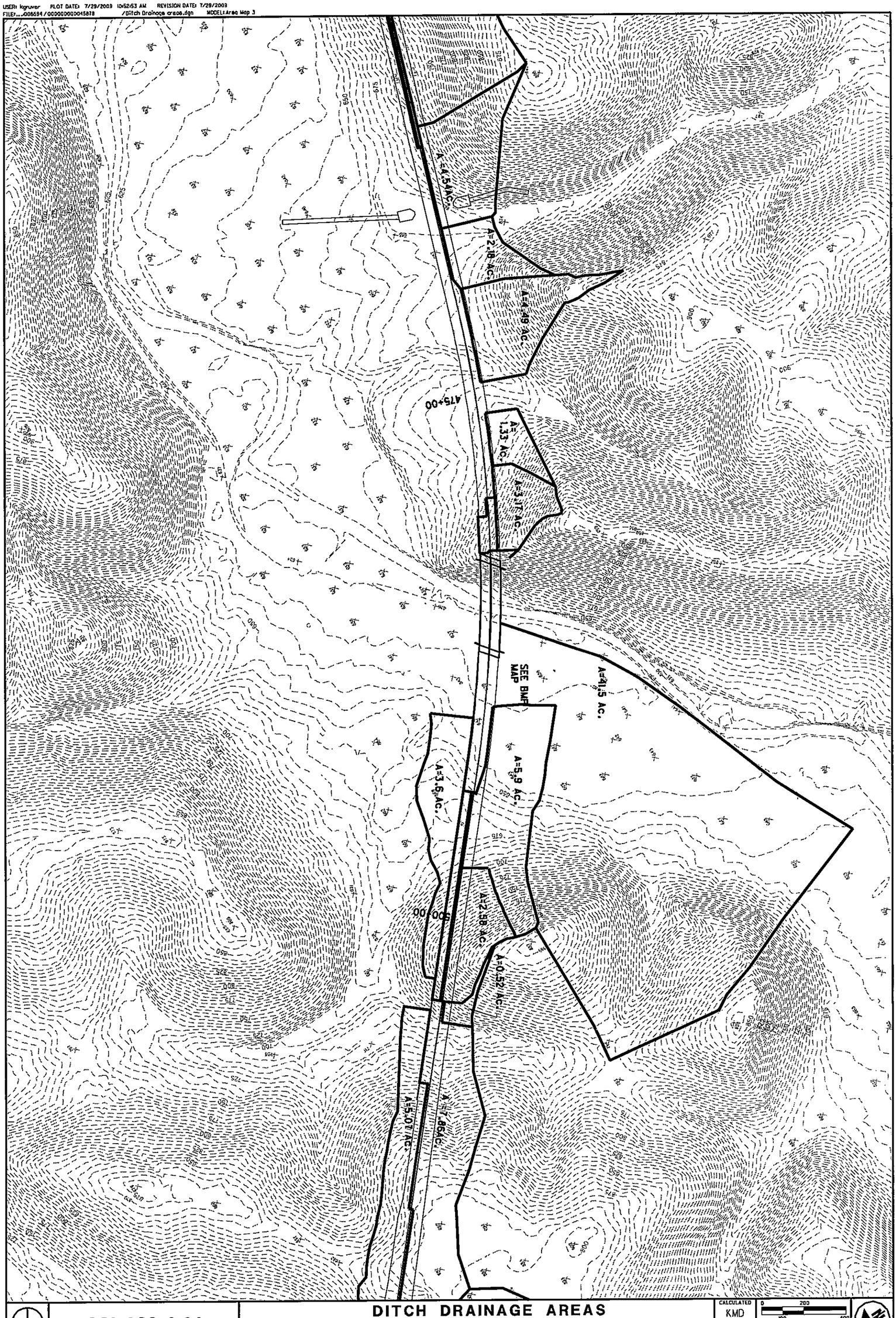
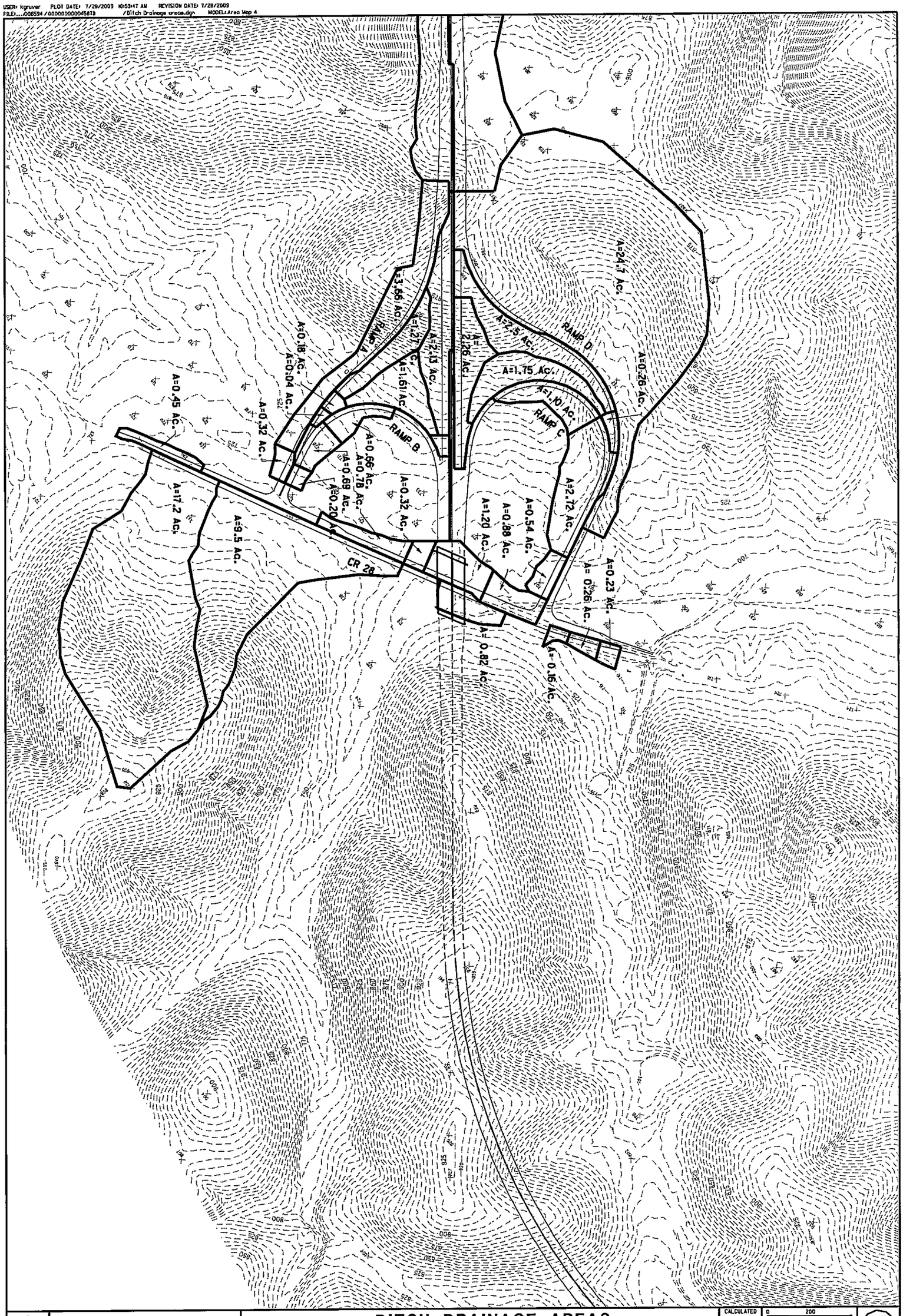
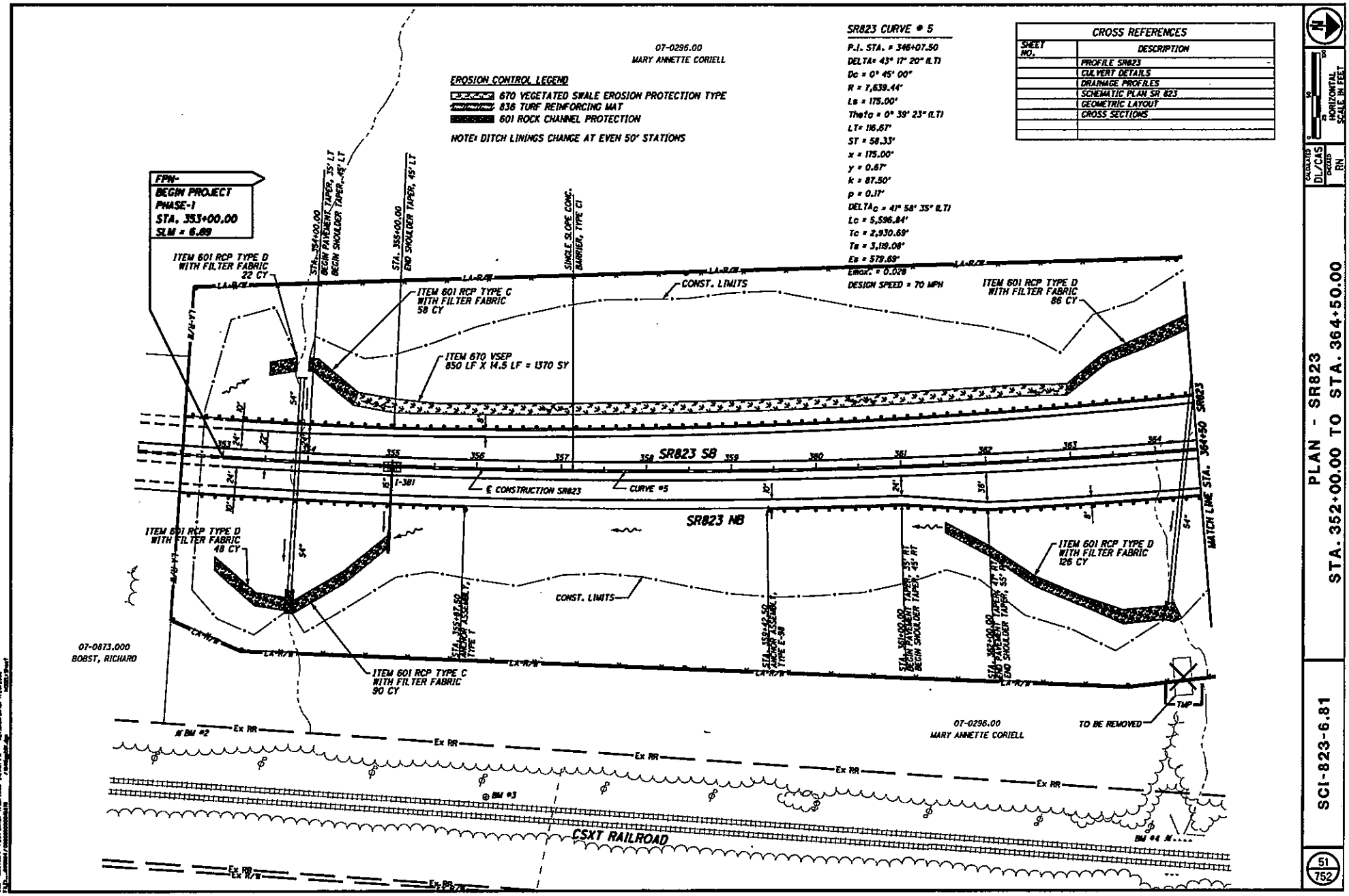


SCI-823-6.81	DITCH DRAINAGE AREAS STA. 460+00.00 TO STA. 515+00.00	CALCULATED KMD CHECKED KAG	0 200 100 400 HORIZONTAL SCALE IN FEET

USER: kgruver PLOT DATE: 7/29/2009 10:53:47 AM REVISION DATE: 7/29/2009
FILE:...006594 / 0000000000045878 /Ditch Drainage areas.dgn MODEL: Area Map 4



SCI-823-6.81	DITCH DRAINAGE AREAS STA. 515+00.00 TO STA. 536+50.00	CALCULATED KMD CHECKED KAG	0 200 100 400 HORIZONTAL SCALE IN FEET



PLAN - SR823
STA. 352+00.00 TO STA. 364+50.00

SCI-823-6.81

CALCULATED DL/CAS
DRAWN RN
HORIZONTAL SCALE IN FEET

51
752

DITCH ANALYSIS

PID : 19415 **Date :** 05/18/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 352+00 TO 353+50 Left **Designer :** KAG KMD BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
352+00	353+00	L	150.00	10.00	3.00	2.00	0.0040	1.04	1.04	0.63	0.66	Seed	4.29	5	0.030	12.13	1.14	0.06	2.82	0.23	11.17
												Seed	4.98	10	0.040	12.41	1.01	0.08	3.28	0.30	11.51
353+00	353+50	L	50.00	15.00	3.00	2.00	0.0400	0.01	1.05	0.40	0.66	Seed	4.23	5	0.030	12.55	2.00	0.23	2.80	0.09	15.46
												Seed	4.91	10	0.040	12.88	1.78	0.30	3.25	0.12	15.60
353+50	353+88	L	38.00	15.00	4.00	3.00	0.2300*	0.13	1.19	0.51	0.73	Seed	4.21	5	0.030	12.73	3.51	0.82	3.07	0.06	15.40
												Jute Mat	4.20	5	0.040	12.76	2.95	0.98	3.06	0.07	15.48
												Temp. Mat	4.20	5	0.040	12.76	2.95	0.98	3.06	0.07	15.48
												Temp. Mat	4.88	10	0.040	13.08	3.12	1.07	3.55	0.07	15.52

Use RCP Type D with Fabric

DITCH ANALYSIS

PID : 19415 **Date :** 05/18/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 363+00 TO 353+88 Left

KAG
Designer : DL
BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
363+00	356+50	L	650.00	10.00	3.00	2.00	0.0187	7.37	7.37	0.54	3.98	Seed	4.18	5	0.030	12.94	3.56	0.49	16.63	0.42	12.11
												Jute Mat	4.10	5	0.040	13.55	2.93	0.58	16.33	0.50	12.48
												Temp. Mat	4.10	5	0.040	13.55	2.93	0.58	16.33	0.50	12.48
												Temp. Mat	4.84	10	0.040	13.36	3.11	0.64	19.24	0.54	12.72
354+50	354+00	L	50.00	15.00	3.50	3.00	0.2900*	1.14	8.51	0.42	4.46	Seed	4.09	5	0.030	13.66	7.55	2.82	18.23	0.16	16.01
												Jute Mat	4.09	5	0.040	13.68	6.32	3.35	18.22	0.18	16.20
												Temp. Mat	4.09	5	0.040	13.68	6.32	3.35	18.22	0.18	16.20
												Perm, Type 1	4.09	5	0.040	13.68	6.32	3.35	18.22	0.18	16.20
												Perm, Type 2	4.09	5	0.040	13.68	6.32	3.35	18.22	0.18	16.20
												Perm, Type 3	4.09	5	0.040	13.68	6.32	3.35	18.22	0.18	16.20
												Perm, Type 3	4.82	10	0.040	13.48	6.72	3.69	21.47	0.20	16.33

RCPC with Temp. Liner

TranSystems

DITCH ANALYSIS

PID : 19415 **Date :** 05/18/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 363+00 TO SR823, 364+63 Left **Designer :** DL KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
363+00	364+00	L	100.00	10.00	3.50	3.00	0.1470*	2.06	2.06	0.43	0.89	Seed	4.53	5	0.030	10.42	3.95	0.90	4.01	0.10	10.64
												Jute Mat	4.52	5	0.040	10.50	3.31	1.07	4.00	0.12	10.76
												Temp. Mat	4.52	5	0.040	10.50	3.31	1.07	4.00	0.12	10.76
												Perm, Type 1	4.52	5	0.040	10.50	3.31	1.07	4.00	0.12	10.76
												Perm, Type 1	5.31	10	0.040	10.47	3.52	1.18	4.70	0.13	10.83
364+00	364+50	L	50.00	10.00	3.00	3.00	0.2140*	0.99	3.05	0.40	1.28	Seed	4.49	5	0.030	10.66	5.11	1.46	5.76	0.11	10.65
												Jute Mat	4.49	5	0.040	10.69	4.28	1.73	5.75	0.13	10.78
												Temp. Mat	4.49	5	0.040	10.69	4.28	1.73	5.75	0.13	10.78
												Perm, Type 1	4.49	5	0.040	10.69	4.28	1.73	5.75	0.13	10.78
												Perm, Type 1	5.27	10	0.040	10.65	4.55	1.90	6.76	0.14	10.85
364+50	364+63	L	13.00	10.00	2.00	3.00	0.0336	0.06	3.11	0.40	1.30	Seed	4.48	5	0.030	10.77	2.91	0.40	5.84	0.19	10.96
												Jute Mat	4.48	5	0.040	10.78	2.43	0.48	5.84	0.23	11.13
												Temp. Mat	4.48	5	0.040	10.78	2.43	0.48	5.84	0.23	11.13

RCP D w/ fabric

RCP D with fabric

TranSystems

DITCH ANALYSIS

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.)
												Temp. Mat	5.26	10	0.040	10.74	2.58	0.52	6.86	0.25	11.25

DITCH ANALYSIS

PID : 19415 **Date :** 10/03/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 352+00 RT TO SR823, 353+88 RT **Designer :** KAG Bee

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
352+00	352+50	R	50.00	10.00	3.00	2.00	0.0040	0.50	0.50	0.44	0.22	Seed	4.43	5	0.030	11.08	0.76	0.03	0.97	0.12	10.62
												Seed	5.18	10	0.040	11.22	0.67	0.04	1.13	0.16	10.81
352+50	353+00	R	50.00	15.00	3.00	2.00	0.1100*	0.10	0.60	0.44	0.26	Seed	4.37	5	0.030	11.52	1.90	0.27	1.15	0.04	15.20
												Seed	5.09	10	0.040	11.70	1.71	0.35	1.34	0.05	15.26
353+00	353+50	R	50.00	15.00	4.00	3.00	0.3200*	0.10	0.70	0.44	0.31	Seed	4.33	5	0.030	11.81	2.78	0.63	1.33	0.03	15.22
												Jute Mat	4.32	5	0.040	11.87	2.33	0.75	1.32	0.04	15.26
												Temp. Mat	4.32	5	0.040	11.87	2.33	0.75	1.32	0.04	15.26
												Temp. Mat	5.04	10	0.040	12.04	2.49	0.82	1.54	0.04	15.29
353+50	353+88	R	38.00	15.00	3.00	4.00	0.4400*	0.10	0.80	0.44	0.35	Seed	4.29	5	0.030	12.07	3.23	0.85	1.51	0.03	15.22
												Jute Mat	4.29	5	0.040	12.10	2.72	1.00	1.50	0.04	15.26
												Temp. Mat	4.29	5	0.040	12.10	2.72	1.00	1.50	0.04	15.26
												Perm, Type 1	4.29	5	0.040	12.10	2.72	1.00	1.50	0.04	15.26
												Perm, Type 1	5.00	10	0.040	12.26	2.88	1.11	1.75	0.04	15.28

RCP D w/ Fabric

RCP D with Fabric

Rock

DITCH ANALYSIS

PID : 19415 **Date :** 05/19/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 361+50 RT TO SR823, 353+88 RT **Designer :** KAG BGE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type 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.)
361+50	355+50	R	600.00	10.00	6.00	4.00	0.0162	1.70	1.70	0.74	1.26	Seed	3.99	5	0.030	14.49	2.12	0.22	5.02	0.21	12.14
												Seed	4.59	10	0.040	15.12	1.85	0.28	5.77	0.27	12.75
355+50	355+00	R	50.00	10.00	3.50	3.50	0.1000*	0.10	1.80	0.86	1.35	Seed	3.97	5	0.030	14.70	3.91	0.81	5.34	0.13	10.91
												Jute Mat	3.96	5	0.040	14.74	3.27	0.97	5.34	0.15	11.08
												Temp. Mat	3.96	5	0.040	14.74	3.27	0.97	5.34	0.15	11.08
												Temp. Mat	4.56	10	0.040	15.36	3.45	1.05	6.14	0.17	11.18
355+00	354+50	R	50.00	10.00	2.50	3.00	0.3000*	0.06	1.86	0.67	1.39	Seed	3.94	5	0.030	14.89	5.57	1.79	5.47	0.10	10.53
												Jute Mat	3.94	5	0.040	14.92	4.67	2.12	5.46	0.11	10.62
												Temp. Mat	3.94	5	0.040	14.92	4.67	2.12	5.46	0.11	10.62
												Perm, Type 1	3.94	5	0.040	14.92	4.67	2.12	5.46	0.11	10.62
												Perm, Type 2	3.94	5	0.040	14.92	4.67	2.12	5.46	0.11	10.62
												Perm, Type 2	4.53	10	0.040	15.53	4.92	2.31	6.29	0.12	10.68
354+50	354+00	R	50.00	15.00	2.50	3.00	0.5300*	0.14	2.01	0.69	1.49	Seed	3.92	5	0.030	15.06	5.83	2.18	5.83	0.07	15.36

RCP with Fabric

DITCH ANALYSIS

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.)
												Jute Mat	3.92	5	0.040	15.09	4.90	2.59	5.83	0.08	15.43
												Temp. Mat	3.92	5	0.040	15.09	4.90	2.59	5.83	0.08	15.43
												Perm, Type 1	3.92	5	0.040	15.09	4.90	2.59	5.83	0.08	15.43
												Perm, Type 2	3.92	5	0.040	15.09	4.90	2.59	5.83	0.08	15.43
												Perm, Type 2	4.51	10	0.040	15.69	5.17	2.81	6.71	0.09	15.47

RCP C
w/ fabric

DITCH ANALYSIS

PID : 19415 **Date :** 05/19/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 361+50 RT TO SR823, 364+00 RT **Designer :** KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

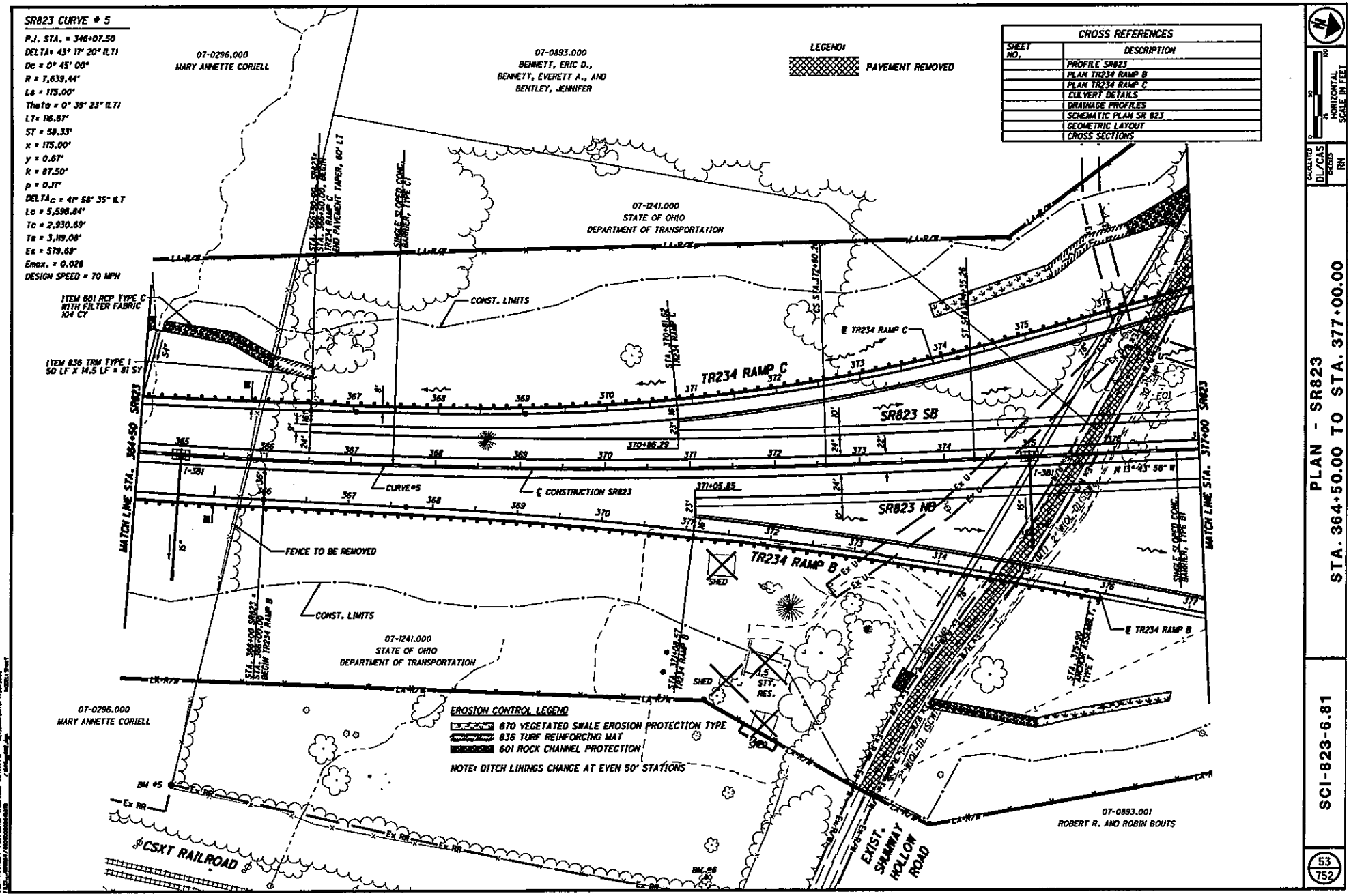
(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

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.)
361+50	363+50	R	150.00	10.00	4.50	3.00	0.1180*	0.65	0.65	0.53	0.35	Seed	4.45	5	0.030	10.97	2.55	0.44	1.54	0.06	10.44
												Jute Mat	4.42	5	0.040	11.16	2.14	0.51	1.53	0.07	10.52
												Temp. Mat	4.42	5	0.040	11.16	2.14	0.51	1.53	0.07	10.52
												Temp. Mat	5.20	10	0.040	11.09	2.27	0.57	1.80	0.08	10.58
363+00	363+50	R	50.00	10.00	4.00	3.00	0.2600*	0.18	0.84	0.60	0.46	Seed	4.39	5	0.030	11.39	3.59	0.89	2.00	0.05	10.38
												Jute Mat	4.38	5	0.040	11.43	3.01	1.05	2.00	0.06	10.45
												Temp. Mat	4.38	5	0.040	11.43	3.01	1.05	2.00	0.06	10.45
												Perm, Type 1	4.38	5	0.040	11.43	3.01	1.05	2.00	0.06	10.45
												Perm, Type 1	5.15	10	0.040	11.35	3.20	1.16	2.35	0.07	10.50
363+50	364+00	R	50.00	15.00	3.00	3.00	0.3160*	0.01	0.85	0.40	0.46	Seed	4.35	5	0.030	11.69	3.27	0.80	2.00	0.04	15.24
												Jute Mat	4.34	5	0.040	11.74	2.74	0.95	1.99	0.05	15.29
												Temp. Mat	4.34	5	0.040	11.74	2.74	0.95	1.99	0.05	15.29
												Temp. Mat	5.11	10	0.040	11.63	2.92	1.05	2.35	0.05	15.32

RCP D w/ Fabric

RCP D w/ Fabric

RCP D w/ Fabric


SR823 CURVE # 5
P.I. STA. = 346+07.50
DELTA= 43° 17' 20" (LT)
Dc = 0° 45' 00"
R = 7,639.44'
Ls = 175.00'
Theta = 0° 39' 23" (LT)
LT= 116.67'
ST = 58.33'
x = 175.00'
y = 0.67'
k = 87.50'
p = 0.17'
DELTAc = 41° 58' 35" (LT)
Lc = 5,598.84'
Tc = 2,930.69'
Ts = 3,119.08'
Es = 579.69'
Emax. = 0.028
DESIGN SPEED = 70 MPH
CROSS REFERENCES
SHEET NO.
DESCRIPTION
PROFILE SR823
PLAN TR234 RAMP B
PLAN TR234 RAMP C
CULVERT DETAILS
DRAINAGE PROFILES
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
LEGEND:
PAVEMENT REMOVED
07-0296.000
MARY ANNETTE CORIELL
07-0893.000
BENNETT, ERIC D.,
BENNETT, EVERETT A., AND
BENTLEY, JENNIFER
07-1241.000
STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
07-0893.001
ROBERT R. AND ROBIN BOUTS
ITEM 601 RCP TYPE C WITH FILTER FABRIC 104 CY
ITEM 836 TRM TYPE I 50 LF X 14.5 LF = 81 SY
CONST. LIMITS
TR234 RAMP C
SR823 SB
SR823 NB
TR234 RAMP B
CURVE#5
℄ CONSTRUCTION SR823
FENCE TO BE REMOVED
MATCH LINE STA. 364+50 SR823
MATCH LINE STA. 377+00 SR823
SHED
1.5 STY. RES.
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
BM #5
BM #6
CSXT RAILROAD
EXIST. SUMMAY HOLLOW ROAD
HORIZONTAL SCALE IN FEET
CALCULATED DL./CAS
CHECKED RH
PLAN - SR823
STA. 364+50.00 TO STA. 377+00.00
SCI-823-6.81
53
752

DITCH ANALYSIS

PID : 19415 **Date :** 05/19/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234 C, 373+00 TO SR823, 364+63 Left **Designer :** KAG KmD BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

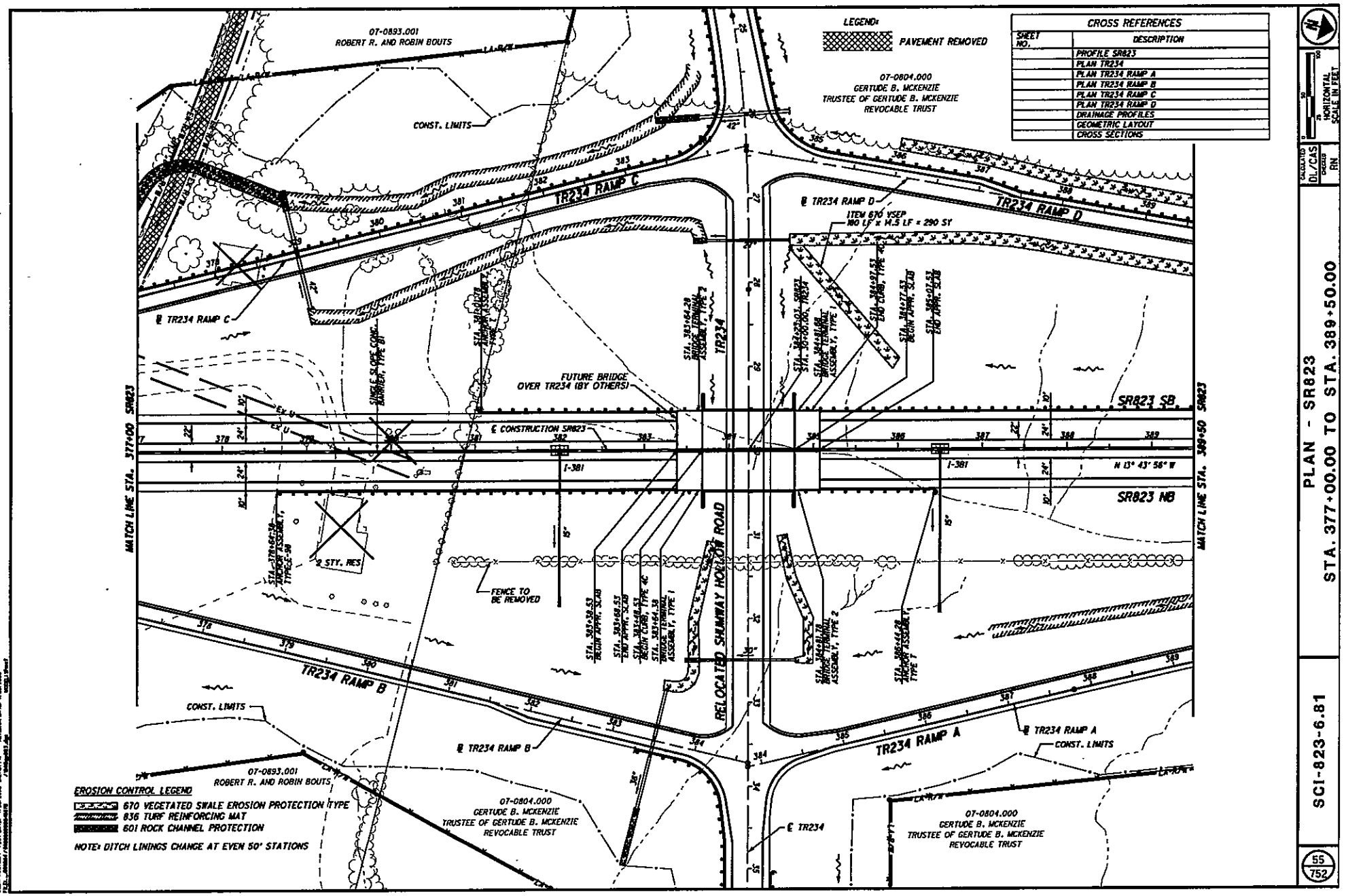
(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

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.)
373+00	366+50	L	700.00	10.00	3.00	2.00	0.0152	3.95	3.95	0.55	2.17	Seed	4.02	5	0.030	14.21	2.64	0.29	8.74	0.31	11.54
												Seed	4.63	10	0.040	14.78	2.31	0.38	10.07	0.40	11.98
366+50	366+00	L	50.00	10.00	3.00	2.00	0.0800	0.16	4.11	0.40	2.24	Seed	4.00	5	0.030	14.40	4.48	0.95	8.95	0.19	10.95
												Jute Mat	4.00	5	0.040	14.43	3.74	1.13	8.94	0.23	11.13
												Temp. Mat	4.00	5	0.040	14.43	3.74	1.13	8.94	0.23	11.13
												Perm, Type 1	4.00	5	0.040	14.43	3.74	1.13	8.94	0.23	11.13
												Perm, Type 1	4.61	10	0.040	14.99	3.95	1.23	10.30	0.25	11.23
366+00	365+50	L	50.00	10.00	4.00	3.00	0.1600*	0.19	4.30	0.40	2.31	Seed	3.98	5	0.030	14.58	5.56	1.57	9.20	0.16	11.10
												Jute Mat	3.98	5	0.040	14.61	4.64	1.86	9.19	0.19	11.30
												Temp. Mat	3.98	5	0.040	14.61	4.64	1.86	9.19	0.19	11.30
												Perm, Type 1	3.98	5	0.040	14.61	4.64	1.86	9.19	0.19	11.30
												Perm, Type 1	4.58	10	0.040	15.16	4.89	2.02	10.59	0.20	11.42
365+50	365+00	L	50.00	12.50	3.00	3.00	0.2380*	0.66	4.96	0.80	2.84	Seed	3.96	5	0.030	14.75	6.31	2.05	11.26	0.14	13.33

RCP C W/ Fabric

DITCH ANALYSIS

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.)
												Jute Mat	3.96	5	0.040	14.77	5.28	2.44	11.25	0.16	13.48
												Temp. Mat	3.96	5	0.040	14.77	5.28	2.44	11.25	0.16	13.48
												Perm, Type 1	3.96	5	0.040	14.77	5.28	2.44	11.25	0.16	13.48
												Perm, Type 2	3.96	5	0.040	14.77	5.28	2.44	11.25	0.16	13.48
												Perm, Type 2	4.56	10	0.040	15.31	5.58	2.65	12.97	0.18	13.57
365+00	364+63	L	37.00	12.50	4.00	2.00	0.1830*	0.10	5.06	0.40	2.88	Seed	3.95	5	0.030	14.88	5.84	1.72	11.38	0.15	13.40
												Jute Mat	3.94	5	0.040	14.90	4.89	2.04	11.37	0.18	13.57
												Temp. Mat	3.94	5	0.040	14.90	4.89	2.04	11.37	0.18	13.57
												Perm, Type 1	3.94	5	0.040	14.90	4.89	2.04	11.37	0.18	13.57
												Perm, Type 2	3.94	5	0.040	14.90	4.89	2.04	11.37	0.18	13.57
												Perm, Type 2	4.55	10	0.040	15.43	5.16	2.22	13.11	0.19	13.67


LEGEND:
PAVEMENT REMOVED
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE SR823
PLAN TR234
PLAN TR234 RAMP A
PLAN TR234 RAMP B
PLAN TR234 RAMP C
PLAN TR234 RAMP D
DRAINAGE PROFILES
GEOMETRIC LAYOUT
CROSS SECTIONS
HORIZONTAL SCALE IN FEET
CALCULATED DJL/CAS
CHECKED RN
PLAN - SR823
STA. 377+00.00 TO STA. 389+50.00
SCI-823-6.81
55
752
07-0893.001
ROBERT R. AND ROBIN BOUTS
07-0804.000
GERTUDE B. MCKENZIE
TRUSTEE OF GERTUDE B. MCKENZIE
REVOCABLE TRUST
CONST. LIMITS
TR234 RAMP C
TR234 RAMP D
TR234 RAMP B
TR234 RAMP A
ITEM 670 VSEP
180 LF x 14.5 LF = 290 SY
FUTURE BRIDGE
OVER TR234 (BY OTHERS)
SR823 SB
SR823 NB
I-381
N 13° 43' 56" W
RELOCATED SHAWAY HOLLOW ROAD
FENCE TO BE REMOVED
2 STY. RES
MATCH LINE STA. 377+00 SR823
MATCH LINE STA. 389+50 SR823
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS

DITCH ANALYSIS

PID : 19415 **Date :** 06/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 394+00 TO 385+50 Left **Designer :** KMD KAG BEE

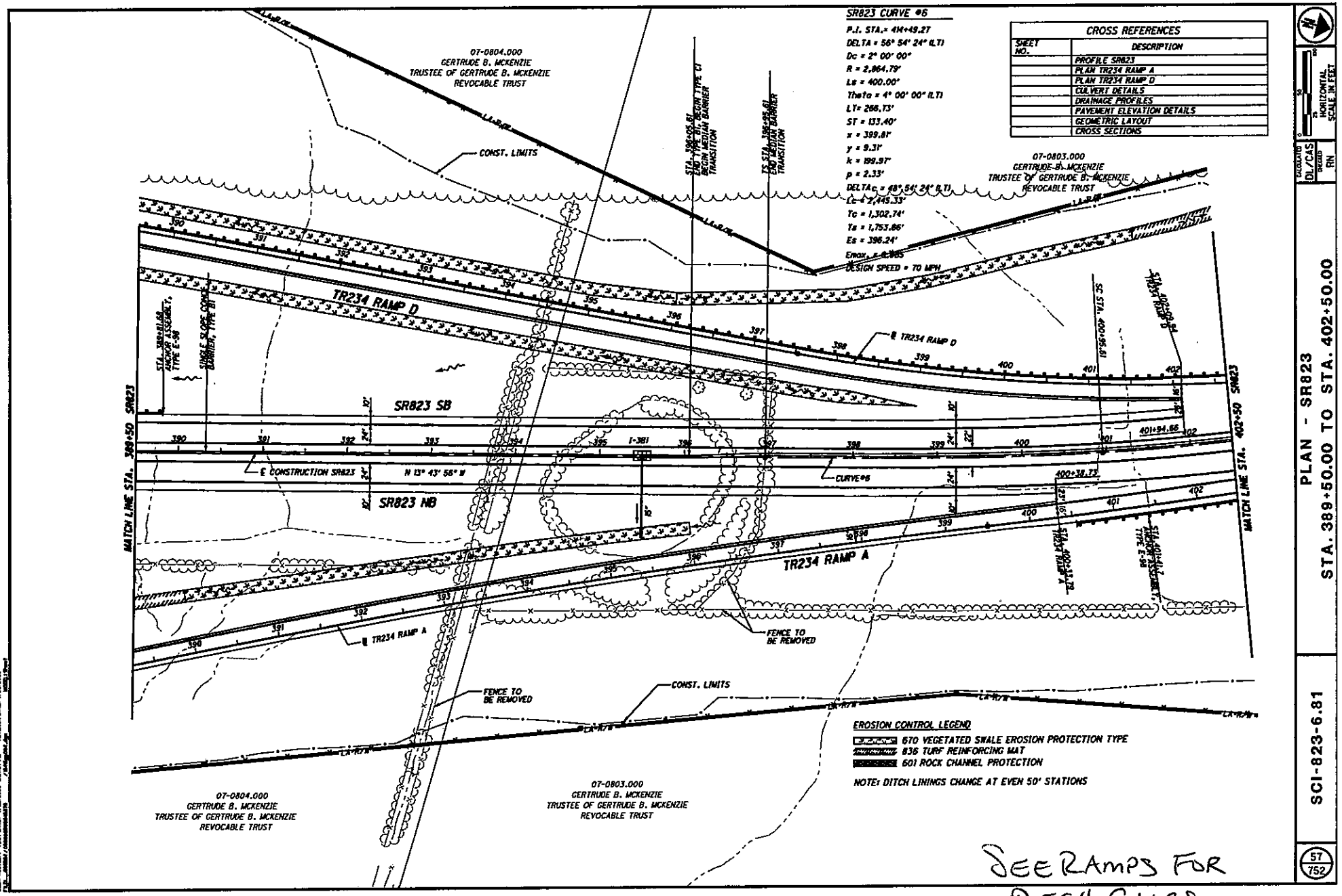
Rainfall Area : D

Allowable Shears

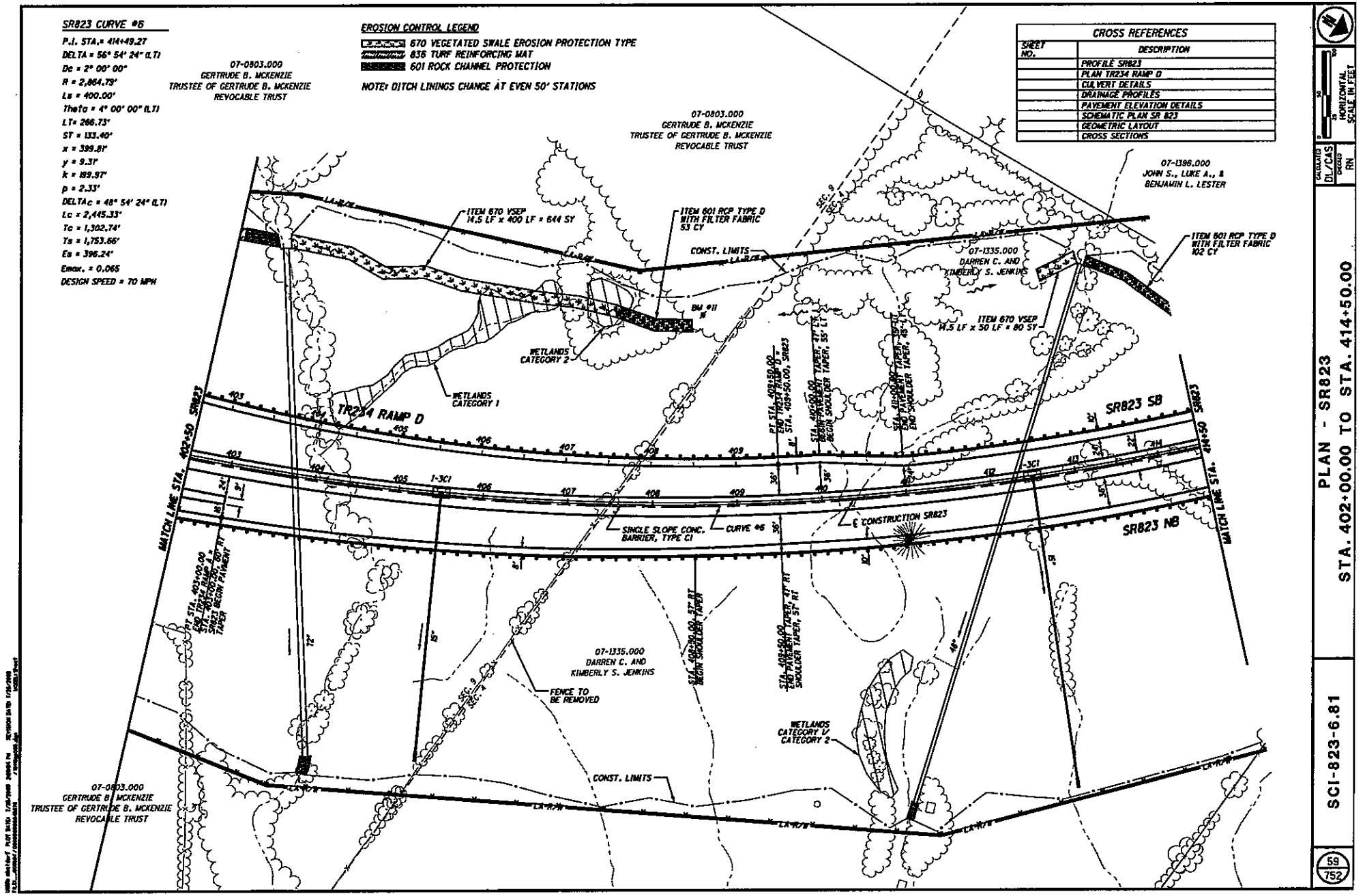
		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00			

(*) 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.)
394+00	386+00	L	750.00	10.00	6.00	3.00	0.0250	2.56	2.56	0.54	1.38	Seed	3.97	5	0.030	14.69	2.53	0.31	5.48	0.20	11.79
												Seed	4.56	10	0.040	15.33	2.21	0.40	6.30	0.26	12.30
386+00	385+00	L	180.00	10.00	6.00	3.00	0.0720	0.54	3.10	0.50	1.65	Seed	3.88	5	0.030	15.49	3.74	0.72	6.41	0.16	11.44
												Jute Mat	3.86	5	0.040	15.65	3.11	0.85	6.38	0.19	11.70
												Temp. Mat	3.86	5	0.040	15.65	3.11	0.85	6.38	0.19	11.70
												Temp. Mat	4.44	10	0.040	16.24	3.28	0.92	7.34	0.21	11.85



SEE RAMPS FOR DITCH CALCS


SR823 CURVE #6
P.I. STA.= 414+49.27
DELTA = 56° 54' 24" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
Ls = 400.00'
Theta = 4° 00' 00" (LT)
LT= 266.73'
ST = 133.40'
x = 399.81'
y = 9.31'
k = 199.97'
p = 2.33'
DELTAc = 48° 54' 24" (LT)
Lc = 2,445.33'
Tc = 1,302.74'
Ts = 1,753.66'
Es = 396.24'
Emax. = 0.065
DESIGN SPEED = 70 MPH
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE SR823
PLAN TR234 RAMP D
CULVERT DETAILS
DRAINAGE PROFILES
PAVEMENT ELEVATION DETAILS
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
07-0803.000
GERTRUDE B. MCKENZIE
TRUSTEE OF GERTRUDE B. MCKENZIE
REVOCABLE TRUST
07-1396.000
JOHN S., LUKE A., & BENJAMIN L. LESTER
07-1335.000
DARREN C. AND KIMBERLY S. JENKINS
ITEM 670 VSEP
14.5 LF x 400 LF = 644 SY
ITEM 601 RCP TYPE D WITH FILTER FABRIC
53 CY
ITEM 601 RCP TYPE D WITH FILTER FABRIC
102 CY
ITEM 670 VSEP
14.5 LF x 50 LF = 80 SY
CONST. LIMITS
WETLANDS CATEGORY 2
WETLANDS CATEGORY 1
WETLANDS CATEGORY V
CATEGORY 2
TR234 RAMP D
SR823 SB
SR823 NB
MATCH LINE STA. 402+50 SR823
MATCH LINE STA. 414+50 SR823
SINGLE SLOPE CONC. BARRIER, TYPE C1
CURVE #6
℄ CONSTRUCTION SR823
FENCE TO BE REMOVED
PT STA. 403+00.00 END TR234 RAMP D STA. 403+50.00, SR823
PT STA. 409+50.00 END TR234 RAMP D STA. 409+50.00, SR823
STA. 408+00.00 BEGIN PAVEMENT TAPER, 41' LT, BEGIN SHOULDER TAPER, 55' LT
STA. 411+00.00 END PAVEMENT TAPER, 45' LT END SHOULDER TAPER
STA. 403+00.00 BEGIN PAVEMENT TAPER, 41' RT BEGIN SHOULDER TAPER, 55' RT
STA. 408+00.00 END PAVEMENT TAPER, 41' RT END SHOULDER TAPER, 55' RT
SEC. 9
SEC. 4
CALCULATED DL/CAS
DRAWN RN
HORIZONTAL SCALE IN FEET
PLAN - SR823
STA. 402+00.00 TO STA. 414+50.00
SCI-823-6.81
59
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/26/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 4010+00 TO 403+50 Left **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
410+00	408+50	L	100.00	10.00	4.00	2.00	0.0400	0.84	0.84	0.46	0.39	Seed	4.32	5	0.030	11.87	1.89	0.21	1.67	0.09	10.52
												Seed	5.05	10	0.040	11.98	1.68	0.28	1.95	0.11	10.67
408+50	407+50	L	100.00	10.00	4.00	2.00	0.1400*	0.89	1.73	0.46	0.79	Seed	4.26	5	0.030	12.32	3.66	0.79	3.38	0.09	10.54
												Jute Mat	4.25	5	0.040	12.41	3.06	0.93	3.37	0.11	10.64
												Temp. Mat	4.25	5	0.040	12.41	3.06	0.93	3.37	0.11	10.64
												Temp. Mat	4.97	10	0.040	12.49	3.25	1.02	3.94	0.12	10.70
407+50	406+50	L	100.00	10.00	4.00	2.00	0.0650	0.97	2.69	0.45	1.23	Seed	4.19	5	0.030	12.90	3.39	0.59	5.15	0.15	10.87
												Jute Mat	4.17	5	0.040	13.00	2.83	0.70	5.13	0.17	11.04
												Temp. Mat	4.17	5	0.040	13.00	2.83	0.70	5.13	0.17	11.04
												Temp. Mat	4.88	10	0.040	13.04	3.00	0.77	6.01	0.19	11.14
406+50	404+50	L	200.00	10.00	4.00	2.00	0.0615	2.72	5.41	0.44	2.42	Seed	4.08	5	0.030	13.78	4.26	0.84	9.88	0.22	11.31
												Jute Mat	4.06	5	0.040	13.93	3.54	0.99	9.84	0.26	11.55
												Temp. Mat	4.06	5	0.040	13.93	3.54	0.99	9.84	0.26	11.55

RCP TYPE D

DITCH ANALYSIS

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.)
												Temp. Mat	4.75	10	0.040	13.92	3.75	1.09	11.53	0.28	11.70
404+50	403+50	L	100.00	10.00	4.00	4.00	0.0260	1.59	7.00	0.44	3.12	Seed	3.99	5	0.030	14.48	3.46	0.52	12.47	0.32	12.56
												Jute Mat	3.98	5	0.040	14.58	2.87	0.61	12.44	0.38	13.02
												Temp. Mat	3.98	5	0.040	14.58	2.87	0.61	12.44	0.38	13.02
												Temp. Mat	4.67	10	0.040	14.55	3.03	0.67	14.58	0.41	13.31

DITCH ANALYSIS

PID : 19415 **Date :** 06/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 410+00 to 412+50 LT **Designer :** KMD KAG BEE

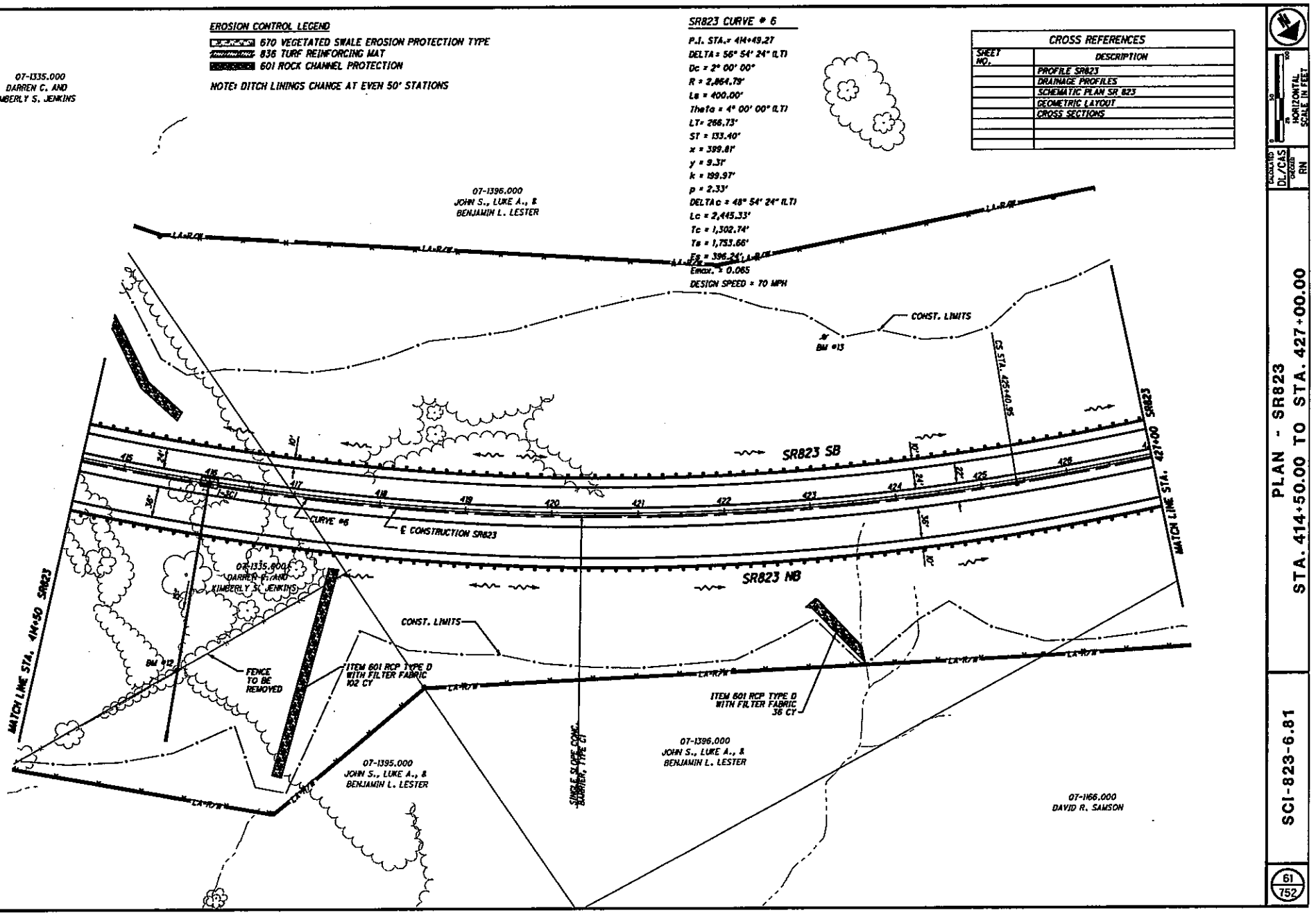
Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
410+00	411+00	L	100.00	10.00	4.00	2.00	0.0800	0.29	0.29	0.44	0.13	Seed	4.43	5	0.030	11.08	1.54	0.18	0.57	0.04	10.22
												Seed	5.18	10	0.040	11.20	1.37	0.24	0.66	0.05	10.29
411+00	413+00	L	200.00	10.00	4.00	2.00	0.0128	3.00	3.29	0.44	1.45	Seed	4.23	5	0.030	12.59	2.17	0.21	6.12	0.26	11.57
												Seed	4.90	10	0.040	12.92	1.91	0.27	7.10	0.34	12.03
413+00	413+50	L	50.00	10.00	4.00	2.00	0.0360	0.61	3.90	0.43	1.71	Seed	4.19	5	0.030	12.85	3.20	0.47	7.17	0.21	11.27
												Jute Mat	4.18	5	0.040	12.90	2.66	0.56	7.16	0.25	11.50
												Temp. Mat	4.18	5	0.040	12.90	2.66	0.56	7.16	0.25	11.50
												Temp. Mat	4.86	10	0.040	13.21	2.81	0.61	8.31	0.27	11.64


EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
SR823 CURVE # 6
P.I. STA.= 416+49.27
DELTA = 56° 54' 24" (LT)
Dc = 2° 00' 00"
R = 2,864.79'
Ls = 400.00'
Theta = 4° 00' 00" (LT)
LT= 266.73'
ST = 133.40'
x = 399.81'
y = 9.31'
k = 199.97'
p = 2.33'
DELTAc = 48° 54' 24" (LT)
Lc = 2,445.33'
Tc = 1,302.74'
Ts = 1,753.66'
Fx = 396.24' L.A.R/W
Emax. = 0.065
DESIGN SPEED = 70 MPH
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE SR823
DRAINAGE PROFILES
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
07-1335.000 DARREN C. AND KIMBERLY S. JENKINS
07-1396.000 JOHN S., LUKE A., & BENJAMIN L. LESTER
L.A.R/W
CONST. LIMITS
BM #13
CS STA. 425+40.25
SR823 SB
SR823 NB
CURVE #6
℄ CONSTRUCTION SR823
MATCH LINE STA. 414+50 SR823
MATCH LINE STA. 427+00 SR823
FENCE TO BE REMOVED
BM #12
ITEM 601 RCP TYPE D WITH FILTER FABRIC 102 CY
ITEM 601 RCP TYPE D WITH FILTER FABRIC 38 CY
SINGLE SLOPE CONC. BARRIER, TYPE C1
07-1395.000 JOHN S., LUKE A., & BENJAMIN L. LESTER
07-1166.000 DAVID R. SAMSON
HORIZONTAL SCALE IN FEET
DESIGNED DL/CAS
DRAWN RN
PLAN - SR823
STA. 414+50.00 TO STA. 427+00.00
SCI-823-6.81
61
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/09/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 419+50 TO 413+50 Left **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
419+50	415+50	L	400.00	10.00	3.00	0.50	0.0095	1.18	1.18	0.53	0.63	Seed	4.00	5	0.030	14.40	1.44	0.10	2.51	0.17	10.59
												Seed	4.61	10	0.040	14.94	1.27	0.13	2.89	0.22	10.77
415+50	413+50	L	200.00	10.00	3.00	2.00	0.2925*	0.99	2.17	0.48	1.10	Seed	3.93	5	0.030	15.05	5.05	1.53	4.32	0.08	10.42
												Jute Mat	3.91	5	0.040	15.18	4.23	1.81	4.31	0.10	10.50
												Temp. Mat	3.91	5	0.040	15.18	4.23	1.81	4.31	0.10	10.50
												Perm, Type 1	3.91	5	0.040	15.18	4.23	1.81	4.31	0.10	10.50
												Perm, Type 1	4.51	10	0.040	15.68	4.47	1.98	4.97	0.11	10.54

RCP D

DITCH ANALYSIS

PID : 19415 **Date :** 06/18/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 419+50 TO 423+50 Right **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
419+50	422+00	R	250.00	10.00	3.00	0.50	0.0050	0.57	0.57	0.44	0.25	Seed	3.96	5	0.030	14.75	0.83	0.04	1.00	0.12	10.41
												Seed	4.56	10	0.040	15.35	0.73	0.05	1.15	0.15	10.54
422+00	423+00	R	105.00	10.00	3.00	0.50	0.0943	0.29	0.86	0.43	0.37	Seed	3.88	5	0.030	15.49	2.34	0.36	1.45	0.06	10.22
												Seed	4.45	10	0.040	16.18	2.08	0.47	1.67	0.08	10.28
423+00	423+50	R	115.00	10.00	2.00	2.00	0.3930*	0.19	1.05	0.42	0.46	Seed	3.82	5	0.030	15.98	3.87	1.09	1.74	0.04	10.18
												Jute Mat	3.81	5	0.040	16.07	3.24	1.30	1.74	0.05	10.21
												Temp. Mat	3.81	5	0.040	16.07	3.24	1.30	1.74	0.05	10.21
												Perm, Type 1	3.81	5	0.040	16.07	3.24	1.30	1.74	0.05	10.21
												Perm, Type 1	4.38	10	0.040	16.74	3.44	1.41	2.00	0.06	10.23

RCP D

DITCH ANALYSIS

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 419+50 TO 417+50 Right **Designer :** KMD KAG BEE

Rainfall Area : D

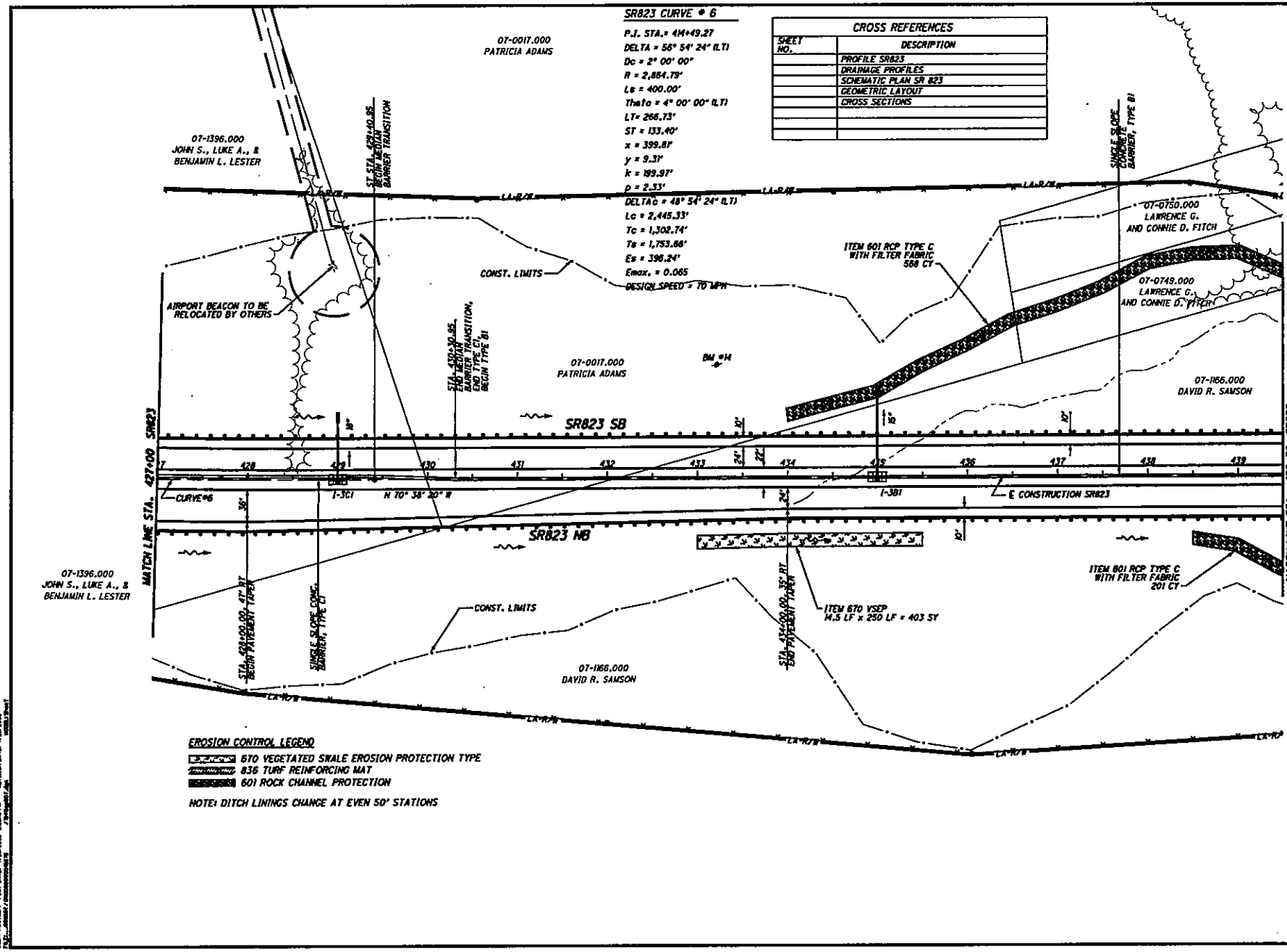
Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
419+50	418+00	R	150.00	10.00	3.00	0.50	0.0050	0.43	0.43	0.43	0.18	Seed	4.14	5	0.030	13.22	0.75	0.03	0.77	0.10	10.35
												Seed	4.80	10	0.040	13.59	0.66	0.04	0.89	0.13	10.46
417+50	417+50	R	280.00	10.00	4.00	2.00	0.2500*	0.10	0.53	0.40	0.22	Seed	3.93	5	0.030	14.99	2.58	0.53	0.88	0.03	10.20
												Jute Mat	3.90	5	0.040	15.33	2.15	0.63	0.88	0.04	10.24
												Temp. Mat	3.90	5	0.040	15.33	2.15	0.63	0.88	0.04	10.24
												Temp. Mat	4.53	10	0.040	15.59	2.30	0.68	1.02	0.04	10.26

RCP D



CALCULATED DL/CAS
CHECKED RN

HORIZONTAL SCALE IN FEET

PLAN - SR823
STA. 427+00.00 TO STA. 439+50.00

SCI-823-6.81

63
752

DITCH ANALYSIS

PID : 19415 **Date :** 07/01/2009 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 424+50 to 442+00 Right **Designer :** KAG KmO BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
424+50	432+00	R	750.00	10.00	3.00	0.50	0.0360	2.27	2.27	0.46	1.04	Seed	3.99	5	0.030	14.49	2.63	0.35	4.17	0.15	10.54
												Seed	4.60	10	0.040	15.05	2.33	0.45	4.80	0.20	10.70
432+00	438+00	R	600.00	10.00	3.00	0.50	0.0300	7.37	9.64	0.45	4.36	Seed	3.73	5	0.030	16.84	4.16	0.69	16.29	0.37	11.29
												Jute Mat	3.69	5	0.040	17.31	3.45	0.81	16.08	0.43	11.52
												Temp. Mat	3.69	5	0.040	17.31	3.45	0.81	16.08	0.43	11.52
												Temp. Mat	4.27	10	0.040	17.73	3.64	0.88	18.61	0.47	11.65
438+00	440+00	R	200.00	10.00	4.00	2.00	0.2000*	4.03	13.67	0.40	5.97	Seed	3.65	5	0.030	17.71	8.27	3.06	21.79	0.25	11.47
												Jute Mat	3.64	5	0.040	17.79	6.88	3.63	21.74	0.29	11.74
												Temp. Mat	3.64	5	0.040	17.79	6.88	3.63	21.74	0.29	11.74
												Perm, Type 1	3.64	5	0.040	17.79	6.88	3.63	21.74	0.29	11.74
												Perm, Type 2	3.64	5	0.040	17.79	6.88	3.63	21.74	0.29	11.74
												Perm, Type 3	3.64	5	0.040	17.79	6.88	3.63	21.74	0.29	11.74
												Perm, Type 3	4.22	10	0.040	18.19	7.26	3.95	25.18	0.32	11.90

Rock

RCP

DITCH ANALYSIS

PID : 19415 **Date :** 07/01/2009 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 419+50 to 442+00 left **Designer :** KAG KMD BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
419+00	423+00	L	350.00	10.00	3.00	0.50	0.0050	1.74	1.74	0.47	0.82	Seed	4.02	5	0.030	14.24	1.30	0.08	3.29	0.24	10.85
												Seed	4.63	10	0.040	14.79	1.15	0.10	3.79	0.31	11.09
423+00	429+50	L	350.00	10.00	3.00	0.50	0.0215	4.70	6.44	0.45	2.93	Seed	3.82	5	0.030	15.99	3.26	0.44	11.21	0.32	11.14
												Jute Mat	3.79	5	0.040	16.34	2.71	0.51	11.10	0.38	11.34
												Temp. Mat	3.79	5	0.040	16.34	2.71	0.51	11.10	0.38	11.34
												Temp. Mat	4.38	10	0.040	16.79	2.86	0.56	12.84	0.42	11.46
429+50	434+00	L	500.00	10.00	4.00	2.00	0.0400	2.97	9.41	0.46	4.30	Seed	3.60	5	0.030	18.21	4.37	0.81	15.48	0.32	11.94
												Jute Mat	3.56	5	0.040	18.59	3.62	0.95	15.32	0.38	12.28
												Temp. Mat	3.56	5	0.040	18.59	3.62	0.95	15.32	0.38	12.28
												Temp. Mat	4.13	10	0.040	18.93	3.82	1.03	17.78	0.41	12.48
434+00	437+50	L	350.00	10.00	4.00	2.00	0.1000*	4.21	13.62	0.43	6.11	Seed	3.48	5	0.030	19.47	6.58	1.85	21.29	0.30	11.78
												Jute Mat	3.47	5	0.040	19.65	5.46	2.19	21.19	0.35	12.11
												Temp. Mat	3.47	5	0.040	19.65	5.46	2.19	21.19	0.35	12.11

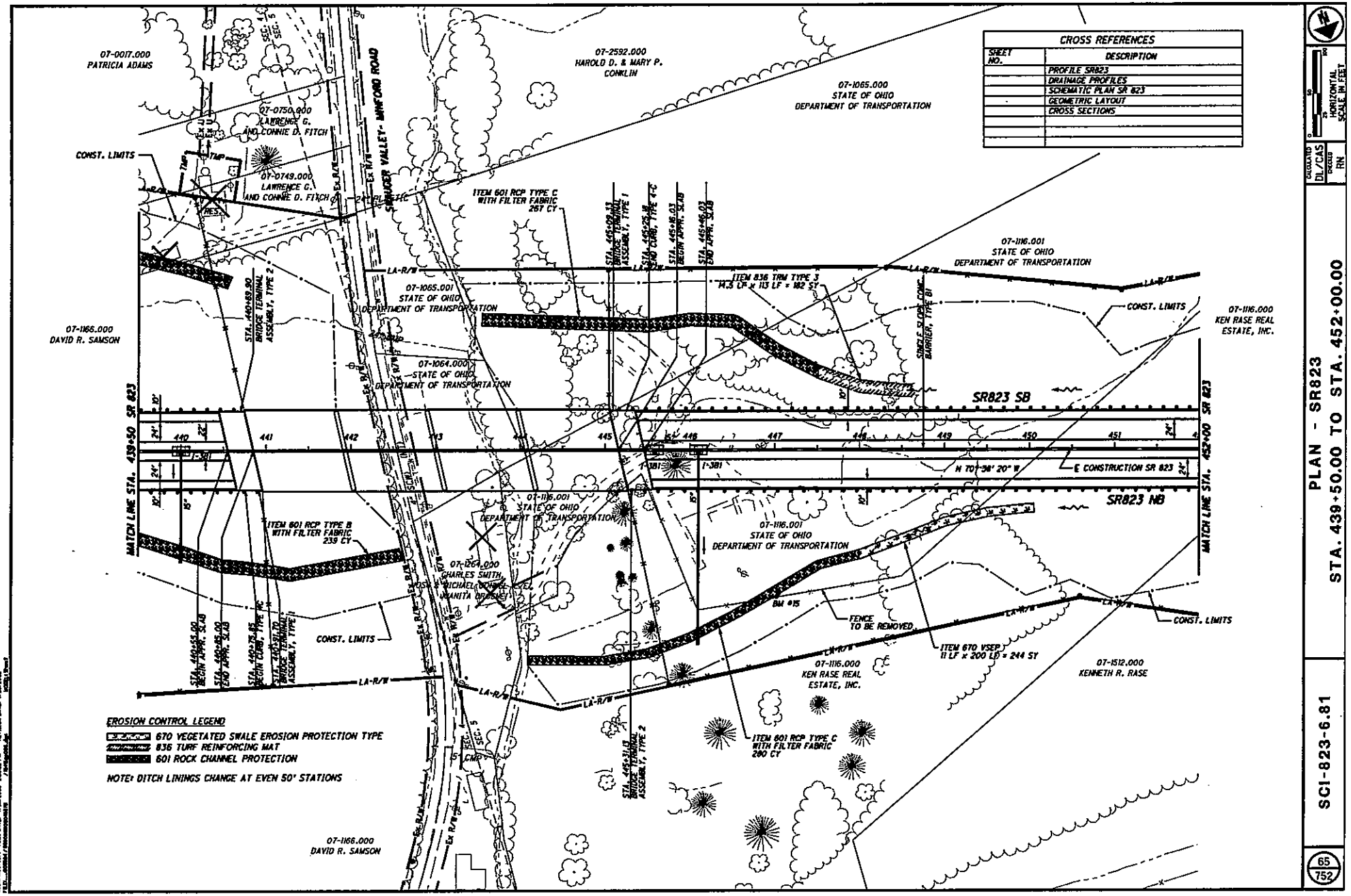
ROCK

RCP C

DITCH ANALYSIS

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.)
												Perm, Type 1	3.47	5	0.040	19.65	5.46	2.19	21.19	0.35	12.11
												Perm, Type 2	3.47	5	0.040	19.65	5.46	2.19	21.19	0.35	12.11
												Perm, Type 2	4.03	10	0.040	19.93	5.76	2.39	24.62	0.38	12.30
437+50	440+50	L	300.00	10.00	4.00	3.00	0.1500*	2.87	16.49	0.44	7.37	Seed	3.41	5	0.030	20.28	7.88	2.71	25.17	0.29	12.03
												Jute Mat	3.40	5	0.040	20.41	6.54	3.20	25.09	0.34	12.40
												Temp. Mat	3.40	5	0.040	20.41	6.54	3.20	25.09	0.34	12.40
												Perm, Type 1	3.40	5	0.040	20.41	6.54	3.20	25.09	0.34	12.40
												Perm, Type 2	3.40	5	0.040	20.41	6.54	3.20	25.09	0.34	12.40
												Perm, Type 3	3.40	5	0.040	20.41	6.54	3.20	25.09	0.34	12.40
												Perm, Type 3	3.96	10	0.040	20.65	6.90	3.50	29.19	0.37	12.62
440+50	441+00	L	50.00	10.00	2.00	2.00	0.0060	0.10	16.59	0.40	7.41	Seed	3.38	5	0.030	20.70	2.88	0.28	25.05	0.76	13.02
												Seed	3.93	10	0.040	20.98	2.50	0.36	29.11	0.97	13.90

RCP C



PLAN - SR823
STA. 439+50.00 TO STA. 452+00.00

SCI-823-6.81

65
752

DITCH ANALYSIS

PID : 19415 **Date :** 07/01/2009 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 455+50 to 448+00 LT **Designer :** KAG

KAG
BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
462+00	449+00	L	1300.0	10.00	3.00	2.00	0.0160	13.40	13.40	0.45	6.03	Seed	3.38	5	0.030	20.65	3.64	0.50	20.40	0.50	12.49
												Temp. Mat	3.29	5	0.040	21.83	2.98	0.58	19.83	0.58	12.90
												Temp. Mat	3.88	10	0.040	21.47	3.16	0.64	23.40	0.64	13.19
449+00	448+50	L	50.00	10.00	3.00	1.00	0.0150	1.36	14.76	0.46	6.66	Seed	3.27	5	0.030	22.06	3.69	0.50	21.77	0.53	12.13
												Temp. Mat	3.27	5	0.040	22.10	3.06	0.59	21.74	0.63	12.52
												Temp. Mat	3.86	10	0.040	21.73	3.24	0.65	25.67	0.70	12.78
448+50	447+50	L	100.00	10.00	3.00	0.50	0.0450	0.50	15.26	0.48	6.90	Seed	3.24	5	0.030	22.41	5.32	1.10	22.36	0.39	11.38
												Temp. Mat	3.24	5	0.040	22.48	4.42	1.31	22.33	0.47	11.63
												Perm, Type 1	3.24	5	0.040	22.48	4.42	1.31	22.33	0.47	11.63
												Perm, Type 1	3.82	10	0.040	22.09	4.70	1.45	26.37	0.51	11.80
447+50	443+50	L	300.00	10.00	3.00	2.00	0.1480*	1.30	16.56	0.40	7.42	Seed	3.19	5	0.030	23.11	7.82	2.61	23.66	0.28	11.41
												Temp. Mat	3.18	5	0.040	23.24	6.51	3.09	23.59	0.33	11.67
												Perm, Type 1	3.18	5	0.040	23.24	6.51	3.09	23.59	0.33	11.67

Rock

RCP TYPE C

DITCH ANALYSIS

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.)
											Perm, Type 2	3.18	5	0.040	23.24	6.51	3.09	23.59	0.33	11.67
											Perm, Type 3	3.18	5	0.040	23.24	6.51	3.09	23.59	0.33	11.67
											Perm, Type 3	3.76	10	0.040	22.80	6.91	3.41	27.88	0.37	11.85

DITCH ANALYSIS

PID : 19415 **Date :** 06/19/2009 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 455+50 to 448+00 RT **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

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

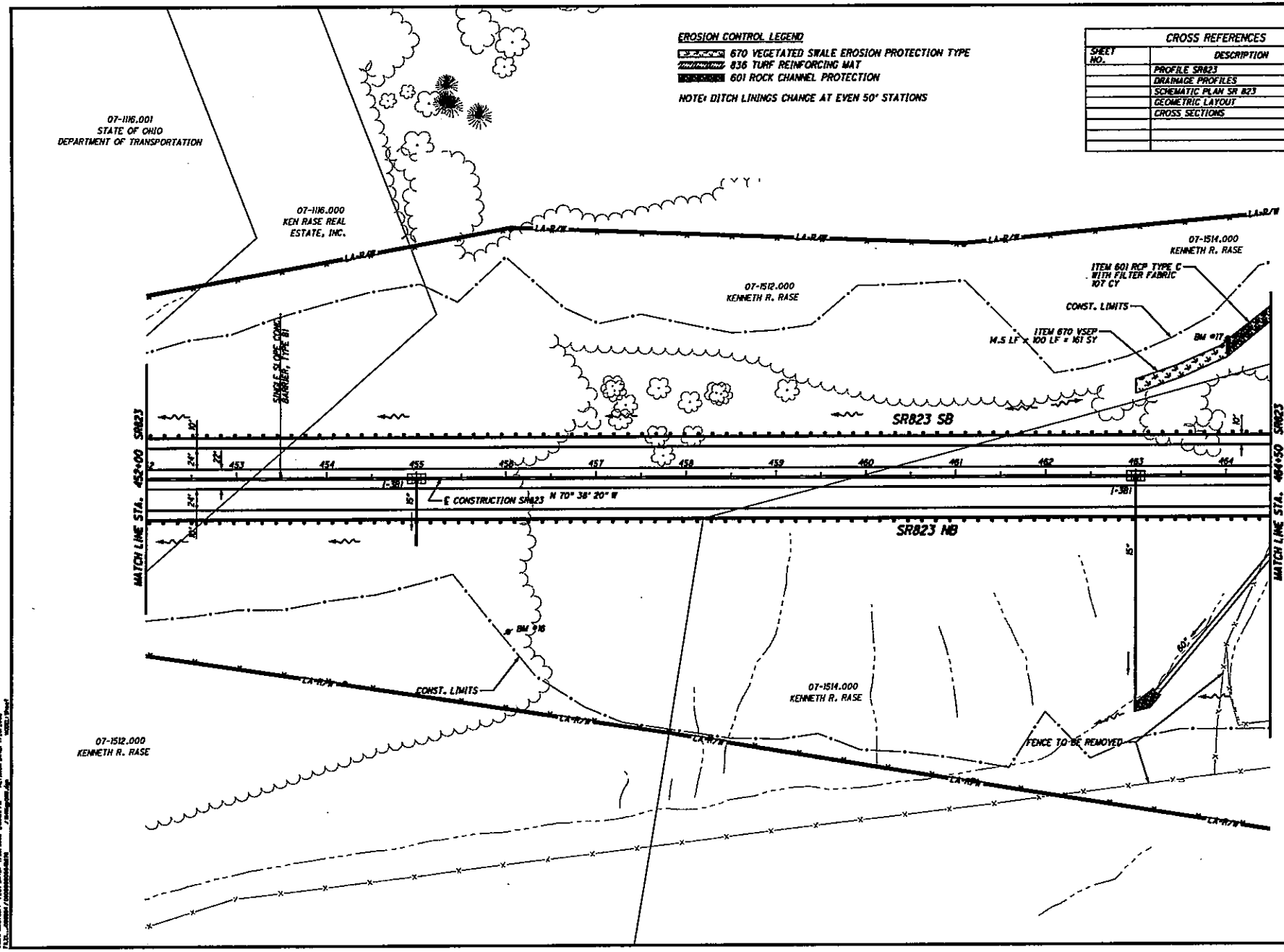
STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
455+50	455+00	R	50.00	10.00	3.00	2.00	0.0160	0.09	0.09	0.63	0.05	Seed	4.41	5	0.030	11.22	0.68	0.03	0.24	0.03	10.17
												Seed	5.15	10	0.040	11.39	0.60	0.05	0.28	0.05	10.23
455+00	454+50	R	50.00	10.00	3.00	1.00	0.0140	0.51	0.59	0.84	0.48	Seed	4.33	5	0.030	11.77	1.51	0.12	2.08	0.13	10.54
												Seed	5.04	10	0.040	12.01	1.34	0.15	2.42	0.17	10.70
454+50	450+00	R	450.00	10.00	3.00	0.50	0.0151	1.22	1.81	0.54	1.14	Seed	3.90	5	0.030	15.26	2.07	0.20	4.45	0.21	10.73
												Seed	4.48	10	0.040	15.96	1.82	0.25	5.10	0.27	10.94
450+00	448+00	R	200.00	10.00	3.00	2.00	0.0820	1.22	3.03	0.54	1.80	Seed	3.82	5	0.030	16.07	4.08	0.83	6.86	0.16	10.81
												Jute Mat	3.80	5	0.040	16.23	3.41	0.98	6.83	0.19	10.96
												Temp. Mat	3.80	5	0.040	16.23	3.41	0.98	6.83	0.19	10.96
												Temp. Mat	4.37	10	0.040	16.87	3.59	1.06	7.85	0.21	11.04
488+00	444+50	R	350.00	10.00	3.00	2.00	0.1571*	2.22	5.25	0.70	3.35	Seed	3.70	5	0.030	17.15	6.26	1.86	12.41	0.19	10.95
												Jute Mat	3.69	5	0.040	17.33	5.22	2.20	12.35	0.22	11.12
												Temp. Mat	3.69	5	0.040	17.33	5.22	2.20	12.35	0.22	11.12

ROCK

RCP TYPE C

DITCH ANALYSIS

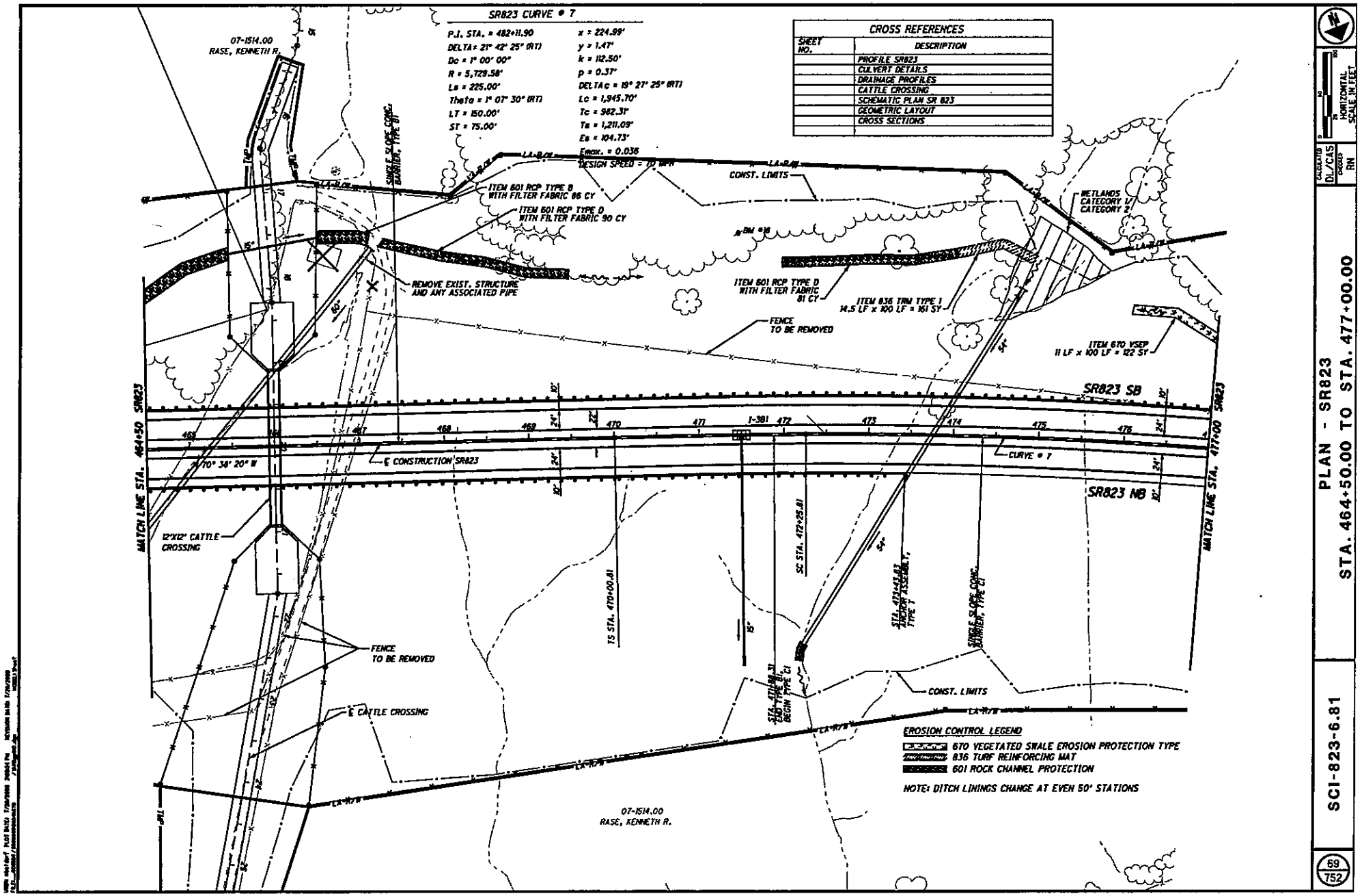
STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 1	3.69	5	0.040	17.33	5.22	2.20	12.35	0.22	11.12
												Perm, Type 2	3.69	5	0.040	17.33	5.22	2.20	12.35	0.22	11.12
												Perm, Type 2	4.25	10	0.040	17.92	5.50	2.39	14.23	0.24	11.22
444+50	444+00	R	50.00	10.00	3.00	2.00	0.0680	0.00	5.25	0.50	3.35	Seed	3.67	5	0.030	17.50	4.80	1.02	12.30	0.24	11.21
												Jute Mat	3.66	5	0.040	17.54	4.00	1.22	12.29	0.29	11.43
												Temp. Mat	3.66	5	0.040	17.54	4.00	1.22	12.29	0.29	11.43
												Perm, Type 1	3.66	5	0.040	17.54	4.00	1.22	12.29	0.29	11.43
												Perm, Type 1	4.22	10	0.040	18.12	4.22	1.32	14.16	0.31	11.56



PLAN - SR823
STA. 452+00.00 TO STA. 464+50.00

SCI-823-6.81

67
752



CALCULATED DL/CAS
CHECKED RN

HORIZONTAL SCALE IN FEET

PLAN - SR823
STA. 464+50.00 TO STA. 477+00.00

SCI-823-6.81

69
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/26/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 462+00 to 467+00 left **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
462+00	463+00	L	100.00	10.00	5.00	2.00	0.0120	1.18	1.18	0.43	0.51	Seed	4.43	5	0.030	11.13	1.46	0.11	2.25	0.15	11.02
												Seed	5.17	10	0.040	11.27	1.29	0.14	2.62	0.19	11.33
463+00	464+00	L	100.00	10.00	6.00	2.00	0.0580	0.89	2.07	0.44	0.90	Seed	4.35	5	0.030	11.69	2.92	0.46	3.90	0.13	11.02
												Jute Mat	4.33	5	0.040	11.80	2.44	0.54	3.89	0.15	11.20
												Temp. Mat	4.33	5	0.040	11.80	2.44	0.54	3.89	0.15	11.20
												Temp. Mat	5.06	10	0.040	11.91	2.58	0.60	4.54	0.17	11.32
464+00	465+50	L	150.00	10.00	4.00	2.00	0.2573*	1.23	3.30	0.45	1.45	Seed	4.27	5	0.030	12.25	5.57	1.73	6.20	0.11	10.65
												Jute Mat	4.26	5	0.040	12.34	4.66	2.05	6.19	0.13	10.77
												Temp. Mat	4.26	5	0.040	12.34	4.66	2.05	6.19	0.13	10.77
												Perm, Type 1	4.26	5	0.040	12.34	4.66	2.05	6.19	0.13	10.77
												Perm, Type 2	4.26	5	0.040	12.34	4.66	2.05	6.19	0.13	10.77
												Perm, Type 2	4.98	10	0.040	12.41	4.95	2.25	7.23	0.14	10.84
465+50	466+50	L	100.00	10.00	4.00	2.50	0.1750*	0.73	4.03	0.45	1.78	Seed	4.22	5	0.030	12.65	5.31	1.48	7.51	0.14	10.88

RCP C

DITCH ANALYSIS

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.)
												Jute Mat	4.21	5	0.040	12.71	4.43	1.76	7.50	0.16	11.05
												Temp. Mat	4.21	5	0.040	12.71	4.43	1.76	7.50	0.16	11.05
												Perm, Type 1	4.21	5	0.040	12.71	4.43	1.76	7.50	0.16	11.05
												Perm, Type 1	4.92	10	0.040	12.77	4.70	1.93	8.77	0.18	11.15
466+50	467+00	L	50.00	10.00	3.25	3.00	0.0100	0.41	4.44	0.45	1.97	Seed	4.16	5	0.030	13.08	2.23	0.21	8.19	0.33	12.08
												Seed	4.86	10	0.040	13.19	1.96	0.27	9.56	0.43	12.69

CATTLE CROSSING

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/10/2009 **Project :** Portsmouth Bypass **Location :** Portsmouth, OH

Description : Cattle Drive Pipe **Designer :** KAG BEE

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.

Inlet Invert Elevation (ft.) : 683.00 **Outlet Invert Elevation (ft.) :** 665.50 **Tailwater Elevation (ft.) :** 665.50 **Overflow Elevation (ft.) :** 692.93

Allowable Headwater Elevation (ft.) : 713.20 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 105.00 **Culvert Slope (ft./ft.) :** 0.1667 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 6.60 @ 5 yrs. **Flood Discharge (cfs) :** 7.50 @ 10 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.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** No Headwall								**Entrance Loss (Ke) :** 0.20		
6.60	1	12 in.	685.94	670.85	2 - E	19.13	0.45	0.97	0.0120	INLET	0.00	D	0.00
6.60	1	15 in.	684.78	668.11	2 - E	18.95	0.41	1.03	0.0120	INLET	0.00	D + 1	0.00
7.50	1	12 in.	686.59	672.13	2 - E	19.84	0.49	0.98	0.0120	INLET	0.00	F	0.00
7.50	1	15 in.	685.04	668.56	2 - E	19.59	0.44	1.09	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** No Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
6.60	1	15 in.	685.35	671.53	2 - E	11.07	0.61	1.03	0.0250	INLET	0.00	D	0.00
6.60	1	12 in.	687.57	681.92	2 - E	10.81	0.73	0.97	0.0251	INLET	0.00	D - 1	0.00
6.60	1	18 in.	684.74	N/A	1 - C	11.04	0.56	0.99	0.0249	INLET	0.00	D + 1	0.00
7.50	1	15 in.	685.80	672.98	2 - E	11.41	0.66	1.09	0.0250	INLET	0.00	F	0.00
7.50	1	12 in.	688.76	686.43	2 - E	10.94	0.82	0.98	0.0251	INLET	0.00	F - 1	0.00

UNIVERSAL CULVERT DESIGN

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.)
7.50	1	18 in.	684.95	669.26	2 - E	11.40	0.60	1.06	0.0249	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
6.60	1	36 in.	684.21	N/A	1 - C	9.42	0.47	0.81	0.0281	INLET	0.00	D	0.00
6.60	1	42 in.	684.19	N/A	1 - C	9.32	0.44	0.77	0.0278	INLET	0.00	D + 1	0.00
7.50	1	36 in.	684.29	N/A	1 - C	9.80	0.50	0.86	0.0281	INLET	0.00	F	0.00
7.50	1	42 in.	684.25	N/A	1 - C	9.66	0.47	0.82	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
6.60	1	60 in.	684.26	N/A	1 - C	7.82	0.44	0.70	0.0332	INLET	0.00	D	0.00
6.60	1	66 in.	684.31	N/A	1 - C	7.77	0.43	0.68	0.0330	INLET	0.00	D + 1	0.00
7.50	1	60 in.	684.30	N/A	1 - C	8.15	0.47	0.75	0.0332	INLET	0.00	F	0.00
7.50	1	66 in.	684.35	N/A	1 - C	8.06	0.45	0.73	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
6.60	1	60 in.	684.26	N/A	1 - C	9.27	0.39	0.70	0.0260	INLET	0.00	D	0.00
6.60	1	66 in.	684.31	N/A	1 - C	9.18	0.38	0.68	0.0260	INLET	0.00	D + 1	0.00
7.50	1	60 in.	684.30	N/A	1 - C	9.63	0.42	0.75	0.0260	INLET	0.00	F	0.00
7.50	1	66 in.	684.35	N/A	1 - C	9.52	0.40	0.73	0.0260	INLET	0.00	F + 1	0.00

DITCH ANALYSIS

PID : 19415 **Date :** 06/23/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 470+00 to 467+00 LT **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
470+00	469+50	L	50.00	10.00	4.00	2.00	0.0140	0.54	0.54	0.42	0.22	Seed	4.48	5	0.030	10.73	1.13	0.08	1.01	0.09	10.52
												Seed	5.24	10	0.040	10.82	1.00	0.10	1.18	0.11	10.68
469+50	468+50	L	100.00	10.00	4.00	2.00	0.1250*	0.76	1.29	0.45	0.57	Seed	4.41	5	0.030	11.26	3.13	0.61	2.50	0.08	10.47
							RCP D					Jute Mat	4.39	5	0.040	11.36	2.63	0.72	2.49	0.09	10.55
												Temp. Mat	4.39	5	0.040	11.36	2.63	0.72	2.49	0.09	10.55
												Temp. Mat	5.14	10	0.040	11.41	2.79	0.79	2.91	0.10	10.61
468+50	467+50	L	100.00	10.00	4.00	2.00	0.2760*	0.60	1.89	0.47	0.85	Seed	4.34	5	0.030	11.72	4.65	1.33	3.68	0.08	10.46
												Jute Mat	4.33	5	0.040	11.79	3.89	1.58	3.67	0.09	10.55
							RCP D					Temp. Mat	4.33	5	0.040	11.79	3.89	1.58	3.67	0.09	10.55
												Perm, Type 1	4.33	5	0.040	11.79	3.89	1.58	3.67	0.09	10.55
												Perm, Type 1	5.08	10	0.040	11.81	4.14	1.74	4.30	0.10	10.61
467+50	467+00	L	50.00	10.00	4.00	2.00	0.1200*	0.28	2.18	0.47	0.98	Seed	4.30	5	0.030	12.01	3.79	0.81	4.22	0.11	10.65
							RCP D					Jute Mat	4.30	5	0.040	12.05	3.17	0.96	4.21	0.13	10.77

DITCH ANALYSIS

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.)
											Temp. Mat	4.30	5	0.040	12.05	3.17	0.96	4.21	0.13	10.77
											Temp. Mat	5.04	10	0.040	12.06	3.38	1.05	4.94	0.14	10.84

DITCH ANALYSIS

PID : 19415 **Date :** 06/23/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 470+00 to 474+50 Left **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00	
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
RCP	**Type 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.)
470+00	471+00	L	100.00	10.00	4.00	2.00	0.0130	1.03	1.03	0.41	0.42	Seed	4.42	5	0.030	11.18	1.40	0.10	1.87	0.13	10.77
												Seed	5.16	10	0.040	11.32	1.24	0.14	2.18	0.17	11.00
471+00	472+00	L	100.00	10.00	4.00	2.00	0.0310	0.99	2.02	0.41	0.83	Seed	4.32	5	0.030	11.88	2.34	0.28	3.58	0.15	10.88
												Seed	5.03	10	0.040	12.12	2.08	0.37	4.16	0.19	11.14
472+00	474+00	L	200.00	10.00	4.00	2.00	0.1320*	2.07	4.10	0.41	1.68	Seed	4.23	5	0.030	12.57	4.77	1.18	7.10	0.14	10.86
												Jute Mat	4.21	5	0.040	12.71	3.98	1.39	7.07	0.17	11.01
												Temp. Mat	4.21	5	0.040	12.71	3.98	1.39	7.07	0.17	11.01
												Perm, Type 1	4.21	5	0.040	12.71	3.98	1.39	7.07	0.17	11.01
												Perm, Type 1	4.90	10	0.040	12.90	4.22	1.52	8.23	0.18	11.11
474+00	474+50	L	50.00	10.00	4.00	2.00	0.0200	0.40	4.49	0.41	1.84	Seed	4.17	5	0.030	13.01	2.72	0.33	7.68	0.26	11.57
												Seed	4.85	10	0.040	13.25	2.39	0.42	8.94	0.34	12.03

RCP D

DITCH ANALYSIS

PID : 19415 **Date :** 06/23/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 478+50 to 476+00 Left **Designer :** KMD KAG BEF

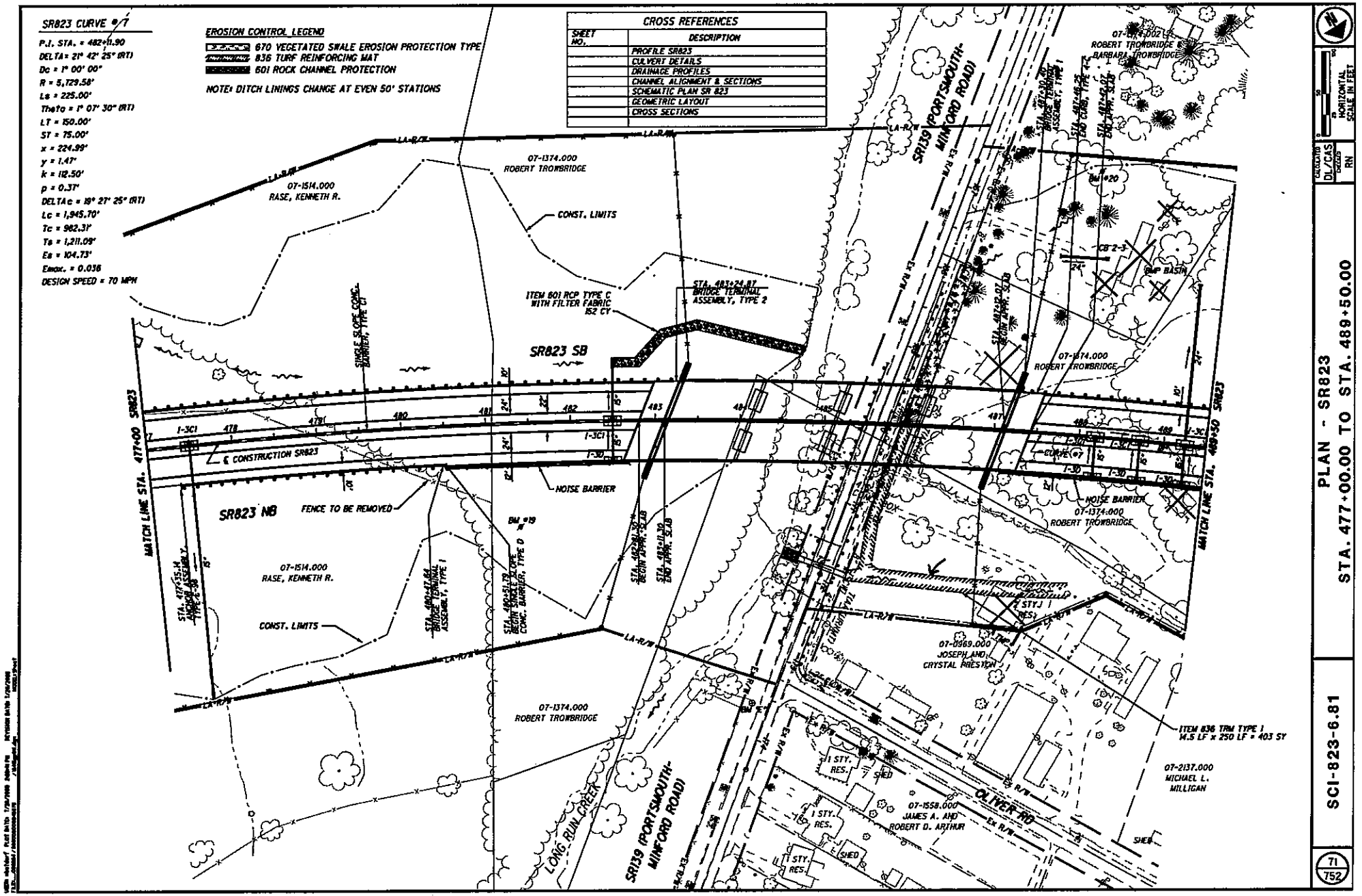
Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00	
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
	RCP	**Type B:**	7.00				

(*) 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.)
478+50	478+00	L	50.00	10.00	3.50	2.00	0.0100	0.19	0.19	0.43	0.08	Seed	4.42	5	0.030	11.20	0.69	0.03	0.36	0.05	10.29
												Seed	5.16	10	0.040	11.33	0.61	0.04	0.43	0.07	10.38
478+00	477+00	L	100.00	10.00	4.00	2.00	0.0540	0.60	0.79	0.42	0.33	Seed	4.30	5	0.030	12.04	1.95	0.24	1.43	0.07	10.43
												Seed	5.00	10	0.040	12.28	1.73	0.31	1.66	0.09	10.56
477+00	476+00	L	100.00	10.00	4.00	3.00	0.1070 *	0.60	1.38	0.42	0.58	Seed	4.22	5	0.030	12.60	2.97	0.54	2.46	0.08	10.56
												Jute Mat	4.21	5	0.040	12.70	2.48	0.64	2.45	0.10	10.67
												Temp. Mat	4.21	5	0.040	12.70	2.48	0.64	2.45	0.10	10.67
												Temp. Mat	4.90	10	0.040	12.91	2.63	0.70	2.86	0.10	10.73


SR823 CURVE #7
P.I. STA. = 482+11.90
DELTA= 21° 42' 25" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
Ls = 225.00'
Theta = 1° 07' 30" (RT)
LT = 150.00'
ST = 75.00'
x = 224.99'
y = 1.47'
k = 112.50'
p = 0.37'
DELTAc = 19° 27' 25" (RT)
Lc = 1,945.70'
Tc = 982.31'
Ts = 1,211.09'
Es = 104.73'
Emax. = 0.036
DESIGN SPEED = 70 MPH
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
CROSS REFERENCES
SHEET NO. DESCRIPTION
PROFILE SR823
CULVERT DETAILS
DRAINAGE PROFILES
CHANNEL ALIGNMENT & SECTIONS
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
SR139 (PORTSMOUTH-MINFORD ROAD)
07-1374.002
ROBERT TROWBRIDGE & BARBARA TROWBRIDGE
07-1374.000
ROBERT TROWBRIDGE
07-1514.000
RASE, KENNETH R.
CONST. LIMITS
ITEM 601 RCP TYPE C WITH FILTER FABRIC 152 CY
STA. 483+24.87 BRIDGE TERMINAL ASSEMBLY, TYPE 2
SINGLE SLOPE CONC. BARRIER, TYPE C1
SR823 SB
SR823 NB
MATCH LINE STA. 477+00 SR823
MATCH LINE STA. 489+50 SR823
CONSTRUCTION SR823
NOISE BARRIER
FENCE TO BE REMOVED
BM #19
BM #20
CB 2-3
DMP BASIN
CURVE #7
07-0969.000
JOSEPH AND CRYSTAL PRESTON
ITEM 836 TRM TYPE 1
W.5 LF x 250 LF = 403 SY
07-2137.000
MICHAEL L. MILLIGAN
07-1558.000
JAMES A. AND ROBERT D. ARTHUR
OLIVER RD
LONG RUN CREEK
1 STY. RES.
SHED
PLAN - SR823
STA. 477+00.00 TO STA. 489+50.00
SCI-823-6.81
HORIZONTAL SCALE IN FEET
71
752

DITCH ANALYSIS

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 478+50 to 484+00 Left **Designer :** KAG KMD BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
478+50	482+50	L	350.00	10.00	3.00	0.50	0.0350	2.03	2.03	0.43	0.87	Seed	4.27	5	0.030	12.27	2.50	0.32	3.73	0.15	10.51
												Seed	4.96	10	0.040	12.55	2.22	0.41	4.33	0.19	10.66
482+50	483+00	L	50.00	10.00	3.00	1.75	0.2000*	0.57	2.60	0.83	1.35	Seed	4.25	5	0.030	12.43	5.02	1.39	5.72	0.11	10.53
												Jute Mat	4.24	5	0.040	12.46	4.20	1.65	5.71	0.13	10.63
												Temp. Mat	4.24	5	0.040	12.46	4.20	1.65	5.71	0.13	10.63
												Perm, Type 1	4.24	5	0.040	12.46	4.20	1.65	5.71	0.13	10.63
												Perm, Type 1	4.93	10	0.040	12.74	4.45	1.80	6.64	0.14	10.68
483+00	483+50	L	50.00	10.00	3.50	2.50	0.3200*	0.36	2.96	0.42	1.50	Seed	4.22	5	0.030	12.60	6.00	2.04	6.33	0.10	10.61
												Jute Mat	4.22	5	0.040	12.63	5.02	2.43	6.32	0.12	10.73
												Temp. Mat	4.22	5	0.040	12.63	5.02	2.43	6.32	0.12	10.73
												Perm, Type 1	4.22	5	0.040	12.63	5.02	2.43	6.32	0.12	10.73
												Perm, Type 2	4.22	5	0.040	12.63	5.02	2.43	6.32	0.12	10.73
												Perm, Type 2	4.90	10	0.040	12.89	5.32	2.65	7.35	0.13	10.80

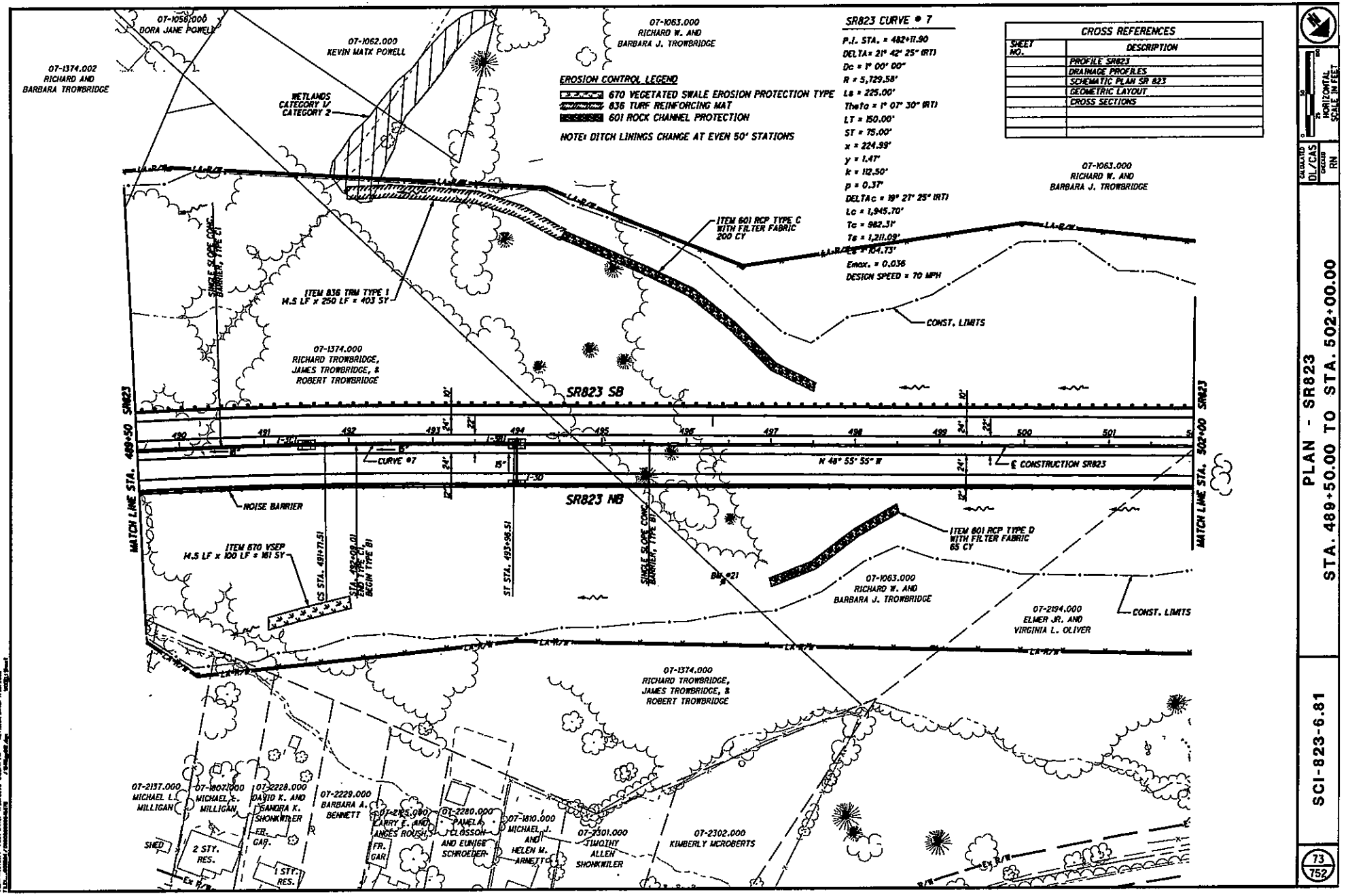
RCP C

RCP C

DITCH ANALYSIS

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.)
483+50	484+00	L	50.00	10.00	4.00	2.00	0.3200*	0.21	3.17	0.43	1.59	Seed	4.20	5	0.030	12.76	6.12	2.11	6.68	0.11	10.63
												Jute Mat	4.20	5	0.040	12.79	5.13	2.50	6.67	0.13	10.75
												Temp. Mat	4.20	5	0.040	12.79	5.13	2.50	6.67	0.13	10.75
												Perm, Type 1	4.20	5	0.040	12.79	5.13	2.50	6.67	0.13	10.75
												Perm, Type 2	4.20	5	0.040	12.79	5.13	2.50	6.67	0.13	10.75
												Perm, Type 2	4.88	10	0.040	13.05	5.43	2.74	7.75	0.14	10.82

RCP C


07-1056.000
DORA JANE POWELL
07-1062.000
KEVIN MATX POWELL
07-1063.000
RICHARD W. AND
BARBARA J. TROWBRIDGE
07-1374.002
RICHARD AND
BARBARA TROWBRIDGE
WETLANDS
CATEGORY 1/
CATEGORY 2
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
SR823 CURVE # 7
P.I. STA. = 482+11.90
DELTA = 21° 42' 25" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
Ls = 225.00'
Theta = 1° 07' 30" (RT)
LT = 150.00'
ST = 75.00'
x = 224.99'
y = 1.47'
k = 112.50'
p = 0.37'
DELTAc = 19° 27' 25" (RT)
Lc = 1,945.70'
Tc = 982.31'
Ts = 1,211.09'
Es = 104.73'
Emax. = 0.036
DESIGN SPEED = 70 MPH
CROSS REFERENCES
SHEET NO. / DESCRIPTION
PROFILE SR823
DRAINAGE PROFILES
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
HORIZONTAL SCALE IN FEET
CALCULATED DL/CAS
CHECKED RN
ITEM 601 RCP TYPE C
WITH FILTER FABRIC
200 CY
ITEM 836 TRM TYPE 1
M.S LF x 250 LF = 403 SY
SINGLE SLOPE CONC. BARRIER, TYPE C1
CONST. LIMITS
07-1374.000
RICHARD TROWBRIDGE,
JAMES TROWBRIDGE, &
ROBERT TROWBRIDGE
SR823 SB
SR823 NB
MATCH LINE STA. 489+50 SR823
MATCH LINE STA. 502+00 SR823
CURVE #7
N 48° 55' 55" W
℄ CONSTRUCTION SR823
NOISE BARRIER
ITEM 870 VSEP
M.S LF x 100 LF = 161 SY
CS STA. 491+71.51
STA. 492+09.01
END TYPE C1,
BEGIN TYPE B1
ST STA. 493+96.51
SINGLE SLOPE CONC. BARRIER, TYPE B1
BR #21
ITEM 601 RCP TYPE D
WITH FILTER FABRIC
65 CY
07-1063.000
RICHARD W. AND
BARBARA J. TROWBRIDGE
07-2194.000
ELMER JR. AND
VIRGINIA L. OLIVER
07-1374.000
RICHARD TROWBRIDGE,
JAMES TROWBRIDGE, &
ROBERT TROWBRIDGE
07-2137.000
MICHAEL L.
MILLIGAN
07-1807.000
MICHAEL L.
MILLIGAN
07-2228.000
DAVID K. AND
SANDRA K.
SHONKWILER
07-2229.000
BARBARA A.
BENNETT
07-2135.000
LARRY E. AND
AGNES ROUSH
07-2280.000
PAMELA
CLOSSON
AND EUNICE
SCHROEDER
07-1810.000
MICHAEL J.
AND
HELEN M.
ARNETT
07-2301.000
TIMOTHY
ALLEN
SHONKWILER
07-2302.000
KIMBERLY MCROBERTS
SHED
2 STY.
RES.
1 STY.
RES.
FR.
GAR.
ER.
GAR.
PLAN - SR823
STA. 489+50.00 TO STA. 502+00.00
SCI-823-6.81
73
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/23/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 504+00 to 492+00 Left **Designer :** KMD KAG BFF

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00	
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
	RCP	**Type 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.)
504+00	497+50	L	650.00	10.00	3.00	0.50	0.0428	2.58	2.58	0.51	1.32	Seed	4.12	5	0.030	13.38	3.08	0.46	5.43	0.17	10.60
												Jute Mat	4.04	5	0.040	14.04	2.56	0.54	5.32	0.20	10.70
												Temp. Mat	4.04	5	0.040	14.04	2.56	0.54	5.32	0.20	10.70
												Temp. Mat	4.77	10	0.040	13.80	2.72	0.59	6.28	0.22	10.78
497+00	494+00	L	300.00	10.00	3.50	2.00	0.1850*	2.90	5.48	0.44	2.59	Seed	3.95	5	0.030	14.85	6.10	1.85	10.23	0.16	10.88
												Jute Mat	3.93	5	0.040	15.01	5.10	2.19	10.19	0.19	11.05
												Temp. Mat	3.93	5	0.040	15.01	5.10	2.19	10.19	0.19	11.05
												Perm, Type 1	3.93	5	0.040	15.01	5.10	2.19	10.19	0.19	11.05
												Perm, Type 2	3.93	5	0.040	15.01	5.10	2.19	10.19	0.19	11.05
												Perm, Type 2	4.64	10	0.040	14.72	5.42	2.42	12.03	0.21	11.15
494+00	492+00	L	200.00	10.00	3.00	3.00	0.0400	3.06	8.54	0.84	5.16	Seed	3.85	5	0.030	15.70	4.79	0.93	19.90	0.37	12.24
												Jute Mat	3.84	5	0.040	15.84	3.97	1.10	19.82	0.44	12.65
												Temp. Mat	3.84	5	0.040	15.84	3.97	1.10	19.82	0.44	12.65

RCP C

DITCH ANALYSIS

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.)
												Perm, Type 1	3.84	5	0.040	15.84	3.97	1.10	19.82	0.44	12.65
												Perm, Type 1	4.54	10	0.040	15.50	4.21	1.21	23.43	0.49	12.92
492+00	487+50	L	450.00	10.00	4.00	3.00	0.0060	4.67	13.21	0.43	7.17	Seed	3.22	5	0.030	22.76	2.66	0.26	23.06	0.70	14.89
												Seed	3.73	10	0.040	23.20	2.29	0.33	26.71	0.89	16.23

DITCH ANALYSIS

PID : 19415 **Date :** 06/24/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 503+00 TO 490+50 Rt

Designer : KMD KAG BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.00		**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
503+00	498+50	R	450.00	10.00	3.00	0.50	0.0451	0.71	0.71	0.40	0.28	Seed	4.03	5	0.030	14.18	1.70	0.19	1.14	0.07	10.23
												Seed	4.65	10	0.040	14.68	1.51	0.24	1.32	0.09	10.30
498+50	497+00	R	150.00	10.00	4.00	3.00	0.2140*	0.13	0.84	0.40	0.34	Seed	3.93	5	0.030	15.04	2.88	0.60	1.32	0.04	10.31
				RCP D								Temp. Mat	3.91	5	0.040	15.21	2.41	0.71	1.31	0.05	10.37
												Temp. Mat	4.52	10	0.040	15.65	2.54	0.78	1.51	0.06	10.41
497+00	496+00	R	100.00	10.00	4.00	3.00	0.0820	0.29	1.13	0.40	0.45	Seed	3.83	5	0.030	15.90	2.38	0.36	1.73	0.07	10.50
												Seed	4.42	10	0.040	16.43	2.12	0.47	1.99	0.09	10.64
496+00	494+00	R	200.00	10.00	4.00	3.00	0.0590	0.65	1.77	0.40	0.71	Seed	3.70	5	0.030	17.20	2.53	0.37	2.62	0.10	10.70
												Seed	4.25	10	0.040	17.90	2.24	0.47	3.01	0.13	10.90
494+00	492+00	R	200.00	10.00	4.00	3.00	0.0225	1.18	2.95	0.40	1.18	Seed	3.56	5	0.030	18.66	2.24	0.25	4.20	0.18	11.23
												Seed	4.07	10	0.040	19.57	1.97	0.32	4.80	0.23	11.58
492+00	490+50	R	150.00	10.00	4.00	3.00	0.0900	0.65	3.60	0.40	1.44	Seed	3.50	5	0.030	19.33	3.70	0.73	5.04	0.13	10.91
												Temp. Mat	3.49	5	0.040	19.47	3.09	0.87	5.02	0.15	11.08

DITCH ANALYSIS

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.)
												Temp. Mat	3.99	10	0.040	20.33	3.25	0.94	5.75	0.17	11.17
490+50	488+50	R	200.00	10.00	2.00	2.00	0.0364	89.40	93.00	0.40	37.20	Seed	1.45	5	0.030	75.49	6.78	1.59	54.03	0.70	12.80
												Temp. Mat	1.45	5	0.040	75.59	5.60	1.88	53.97	0.83	13.31
												Perm, Type 1	1.45	5	0.040	75.59	5.60	1.88	53.97	0.83	13.31
												Perm, Type 1	1.72	10	0.040	75.56	5.93	2.07	64.02	0.91	13.65
488+00	485+30	R	270.00	10.00	2.00	2.00	0.0250	1.00	94.00	0.40	37.60	Seed	1.44	5	0.030	76.34	5.99	1.22	54.14	0.78	13.12
												Temp. Mat	1.44	5	0.040	76.50	4.95	1.44	54.05	0.92	13.69
												Perm, Type 1	1.44	5	0.040	76.50	4.95	1.44	54.05	0.92	13.69
												Perm, Type 1	1.71	10	0.040	76.42	5.24	1.59	64.16	1.02	14.07

Natural Channel

FHWA Urban Drainage Design Program, HY-22
HYDRAULIC PARAMETERS OF OPEN CHANNELS

Trapezoidal, Rectangular, or Triangular X-Section
Date: 12/01/2008

Project No. : SC1
Project Name.: Sta 488+50 To 485+70 Rt
Computed by : KAG

INPUT PARAMETERS

1.	Channel Slope (ft/ft)	0.0380
2.	Channel Bottom Width (ft)	10.00
3.	Left Side Slope (Horizontal to 1)	2.00
4.	Right Side Slope (Horizontal to 1)	2.00
5.	Manning's Coefficient	0.030
6.	Discharge (cfs)	223.00
7.	Depth of Flow (ft)	1.55

inputs

output depth

OUTPUT RESULTS

Cross Section Area (Sqft)	20.31
Average Velocity (ft/sec)	10.98
Top Width (ft)	16.20
Hydraulic Radius (ft)	1.20
Froude Number	1.73

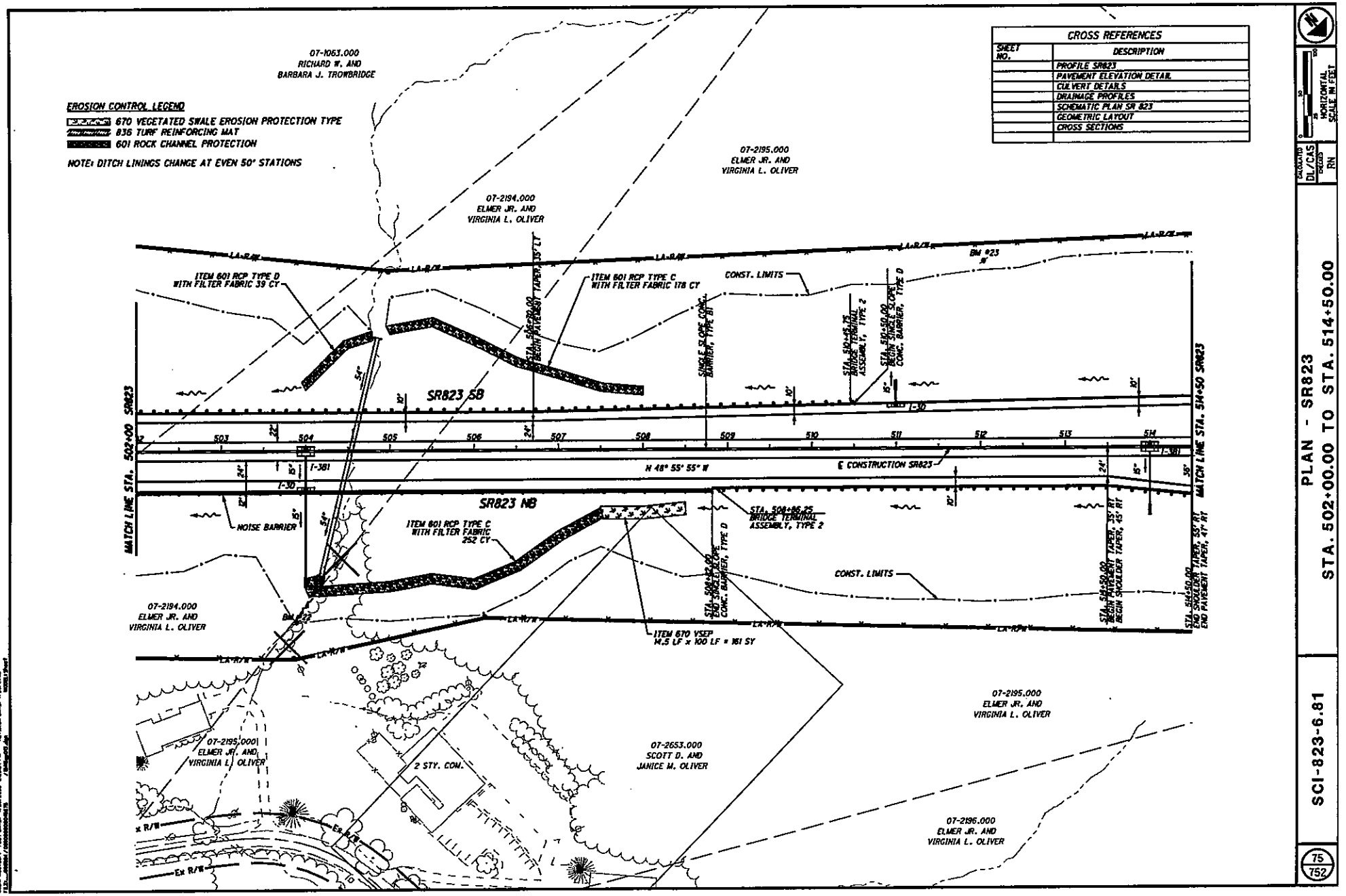
TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
5199646.00	SQ. FT.	
0.187	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
4140.00	FT.	**TOTAL CHANNEL LENGTH**
414.00	FT.	L_{10} = 10% of the Distance along channel
650	FT.	$Elev_{10}$ = Elevation at point L_{10}
3519.00	FT.	L_{85} = 85% of the Distance along channel
790	FT.	$Elev_{85}$ = Elevation at point L_{85}
3105.00	FT.	**Length =** $L_{85} - L_{10}$
238.07	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge # = Frequency of Storm

Q_2	**38.68**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**77.85**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**109.59**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**152.68**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**188.00**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**223.22**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

200.9


CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE SR823
PAVEMENT ELEVATION DETAIL
CULVERT DETAILS
DRAINAGE PROFILES
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
07-1063.000
RICHARD W. AND
BARBARA J. TROWBRIDGE
07-2195.000
ELMER JR. AND
VIRGINIA L. OLIVER
07-2194.000
ELMER JR. AND
VIRGINIA L. OLIVER
ITEM 601 RCP TYPE D
WITH FILTER FABRIC 39 CY
ITEM 601 RCP TYPE C
WITH FILTER FABRIC 178 CY
CONST. LIMITS
BM 923
SR823 SB
SR823 NB
I-381
I-30
N 48° 55' 55" W
E CONSTRUCTION SR823
MATCH LINE STA. 502+00 SR823
MATCH LINE STA. 514+50 SR823
NOISE BARRIER
ITEM 601 RCP TYPE C
WITH FILTER FABRIC
252 CY
ITEM 670 VSEP
14.5 LF x 100 LF = 161 SY
07-2194.000
ELMER JR. AND
VIRGINIA L. OLIVER
07-2195.000
ELMER JR. AND
VIRGINIA L. OLIVER
07-2653.000
SCOTT D. AND
JANICE M. OLIVER
07-2196.000
ELMER JR. AND
VIRGINIA L. OLIVER
2 STY. COM.
Ex R/W
CALCULATED DL/CAS
CHECKED RN
HORIZONTAL SCALE IN FEET
PLAN - SR823
STA. 502+00.00 TO STA. 514+50.00
SCI-823-6.81
75
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/24/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 504+00 to 505+00 Left **Designer :** KMD

KAG
BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
504+00	504+50	L	50.00	10.00	3.50	3.00	0.3980*	0.31	0.31	0.46	0.14	Seed	4.55	5	0.030	10.32	2.64	0.61	0.65	0.02	10.16
												Jute Mat	4.54	5	0.040	10.38	2.20	0.73	0.65	0.03	10.19
				RCP D								Temp. Mat	4.54	5	0.040	10.38	2.20	0.73	0.65	0.03	10.19
												Temp. Mat	5.33	10	0.040	10.35	2.34	0.80	0.76	0.03	10.21
504+50	505+00	L	50.00	10.00	4.00	3.00	0.1220*	0.16	0.47	0.52	0.23	Seed	4.48	5	0.030	10.76	2.20	0.35	1.02	0.05	10.32
				RCP D								Seed	5.25	10	0.040	10.77	1.96	0.45	1.20	0.06	10.42

DITCH ANALYSIS

PID : 19415 **Date :** 06/24/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 519+50 TO 504+50 Right **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
519+50	518+50	R	100.00	10.00	3.00	1.00	0.0050	0.35	0.35	0.57	0.20	Seed	4.29	5	0.030	12.09	0.78	0.03	0.85	0.11	10.43
												Seed	4.99	10	0.040	12.35	0.69	0.04	0.99	0.14	10.56
518+50	517+00	R	150.00	10.00	3.00	0.50	0.0050	0.57	0.92	0.54	0.50	Seed	4.01	5	0.030	14.33	1.09	0.06	2.02	0.18	10.63
												Seed	4.62	10	0.040	14.88	0.96	0.07	2.33	0.23	10.82
517+00	514+00	R	300.00	10.00	3.00	0.50	0.0165	1.02	1.93	0.55	1.06	Seed	3.75	5	0.030	16.72	2.04	0.19	3.99	0.19	10.66
												Seed	4.28	10	0.040	17.59	1.80	0.25	4.56	0.24	10.85
514+00	513+50	R	50.00	10.00	3.00	0.50	0.0220	0.46	2.39	0.78	1.42	Seed	3.71	5	0.030	17.05	2.48	0.28	5.29	0.21	10.72
												Seed	4.24	10	0.040	17.97	2.18	0.36	6.04	0.26	10.93
513+50	508+50	R	500.00	10.00	3.00	0.50	0.0338	1.55	3.95	0.53	2.25	Seed	3.48	5	0.030	19.52	3.29	0.48	7.82	0.23	10.80
												Temp. Mat	3.44	5	0.040	20.01	2.73	0.57	7.72	0.27	10.94
												Temp. Mat	3.95	10	0.040	20.79	2.88	0.62	8.86	0.29	11.02
508+50	507+50	R	100.00	10.00	3.00	2.00	0.0480	0.18	4.12	0.51	2.34	Seed	3.40	5	0.030	20.47	3.65	0.62	7.94	0.21	11.03
												Temp. Mat	3.39	5	0.040	20.56	3.05	0.73	7.92	0.24	11.22

ROCK

DITCH ANALYSIS

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.)
												Temp. Mat	3.90	10	0.040	21.30	3.21	0.80	9.10	0.27	11.33
507+50	507+00	R	50.00	10.00	3.00	3.00	0.2260*	0.08	4.21	0.40	2.37	Seed	3.38	5	0.030	20.70	5.90	1.84	8.01	0.13	10.78
												Temp. Mat	3.38	5	0.040	20.72	4.93	2.19	8.01	0.16	10.93
												Perm, Type 1	3.38	5	0.040	20.72	4.93	2.19	8.01	0.16	10.93
												Perm, Type 2	3.38	5	0.040	20.72	4.93	2.19	8.01	0.16	10.93
												Perm, Type 2	3.88	10	0.040	21.46	5.20	2.37	9.20	0.17	11.01
507+00	505+50	R	150.00	10.00	4.00	4.00	0.2040*	0.57	4.78	0.40	2.60	Seed	3.34	5	0.030	21.15	5.84	1.79	8.69	0.14	11.13
												Temp. Mat	3.34	5	0.040	21.23	4.87	2.12	8.67	0.17	11.33
												Perm, Type 1	3.34	5	0.040	21.23	4.87	2.12	8.67	0.17	11.33
												Perm, Type 2	3.34	5	0.040	21.23	4.87	2.12	8.67	0.17	11.33
												Perm, Type 2	3.84	10	0.040	21.95	5.13	2.31	9.97	0.18	11.45
505+50	504+50	R	100.00	10.00	4.00	4.00	0.1320*	0.29	5.07	0.40	2.71	Seed	3.31	5	0.030	21.56	5.16	1.35	8.98	0.16	11.31
												Temp. Mat	3.30	5	0.040	21.62	4.30	1.60	8.97	0.19	11.55
												Perm, Type 1	3.30	5	0.040	21.62	4.30	1.60	8.97	0.19	11.55
												Perm, Type 1	3.80	10	0.040	22.32	4.53	1.73	10.32	0.21	11.68

RCP C

RCP C

RCP C

DITCH ANALYSIS

PID : 19415 **Date :** 06/24/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 520+00 to 505+00 left side **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

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

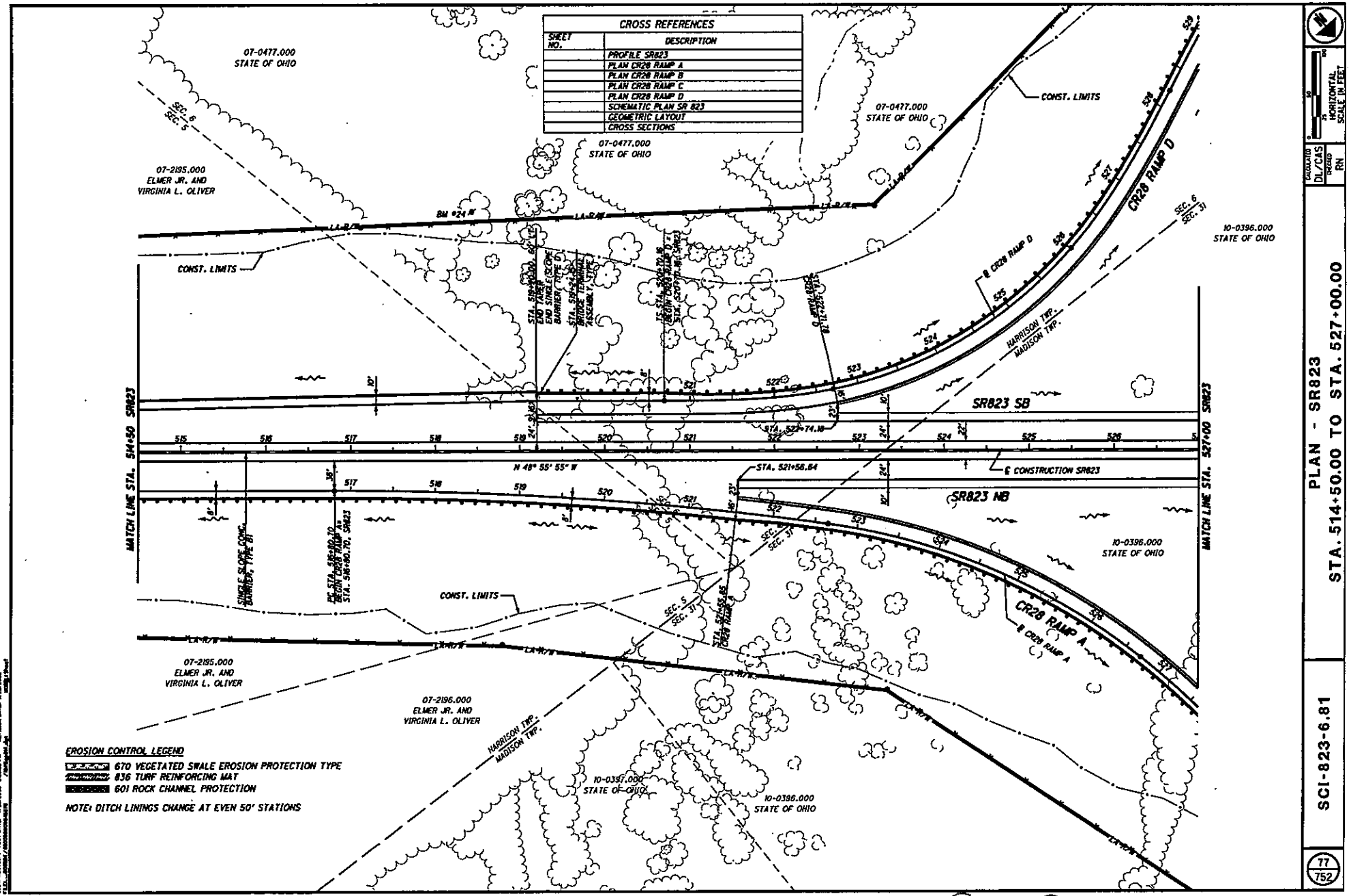
STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
520+00	517+00	L	300.00	10.00	3.00	0.50	0.0053	1.69	1.69	0.51	0.86	Seed	4.11	5	0.030	13.50	1.37	0.08	3.54	0.25	10.87
												Seed	4.75	10	0.040	13.95	1.21	0.11	4.09	0.32	11.12
517+00	514+50	L	250.00	10.00	3.00	0.50	0.0156	1.44	3.13	0.50	1.58	Seed	3.91	5	0.030	15.23	2.36	0.24	6.18	0.25	10.88
												Seed	4.48	10	0.040	15.92	2.08	0.31	7.09	0.32	11.13
514+50	512+00	L	250.00	10.00	3.00	0.50	0.0252	1.14	4.27	0.51	2.16	Seed	3.76	5	0.030	16.58	3.04	0.40	8.13	0.26	10.90
												Jute Mat	3.73	5	0.040	16.85	2.54	0.48	8.08	0.30	11.06
												Temp. Mat	3.73	5	0.040	16.85	2.54	0.48	8.08	0.30	11.06
												Temp. Mat	4.30	10	0.040	17.45	2.67	0.52	9.30	0.33	11.15
512+00	509+00	L	300.00	10.00	3.00	0.50	0.0353	1.09	5.36	0.53	2.74	Seed	3.60	5	0.030	18.21	3.64	0.57	9.87	0.26	10.91
												Jute Mat	3.58	5	0.040	18.47	3.03	0.68	9.80	0.31	11.07
												Temp. Mat	3.58	5	0.040	18.47	3.03	0.68	9.80	0.31	11.07
												Temp. Mat	4.13	10	0.040	18.99	3.20	0.74	11.31	0.33	11.17
509+00	507+50	L	150.00	10.00	3.00	2.00	0.0460	0.39	5.75	0.55	2.96	Seed	3.52	5	0.030	19.10	3.99	0.71	10.41	0.25	11.23

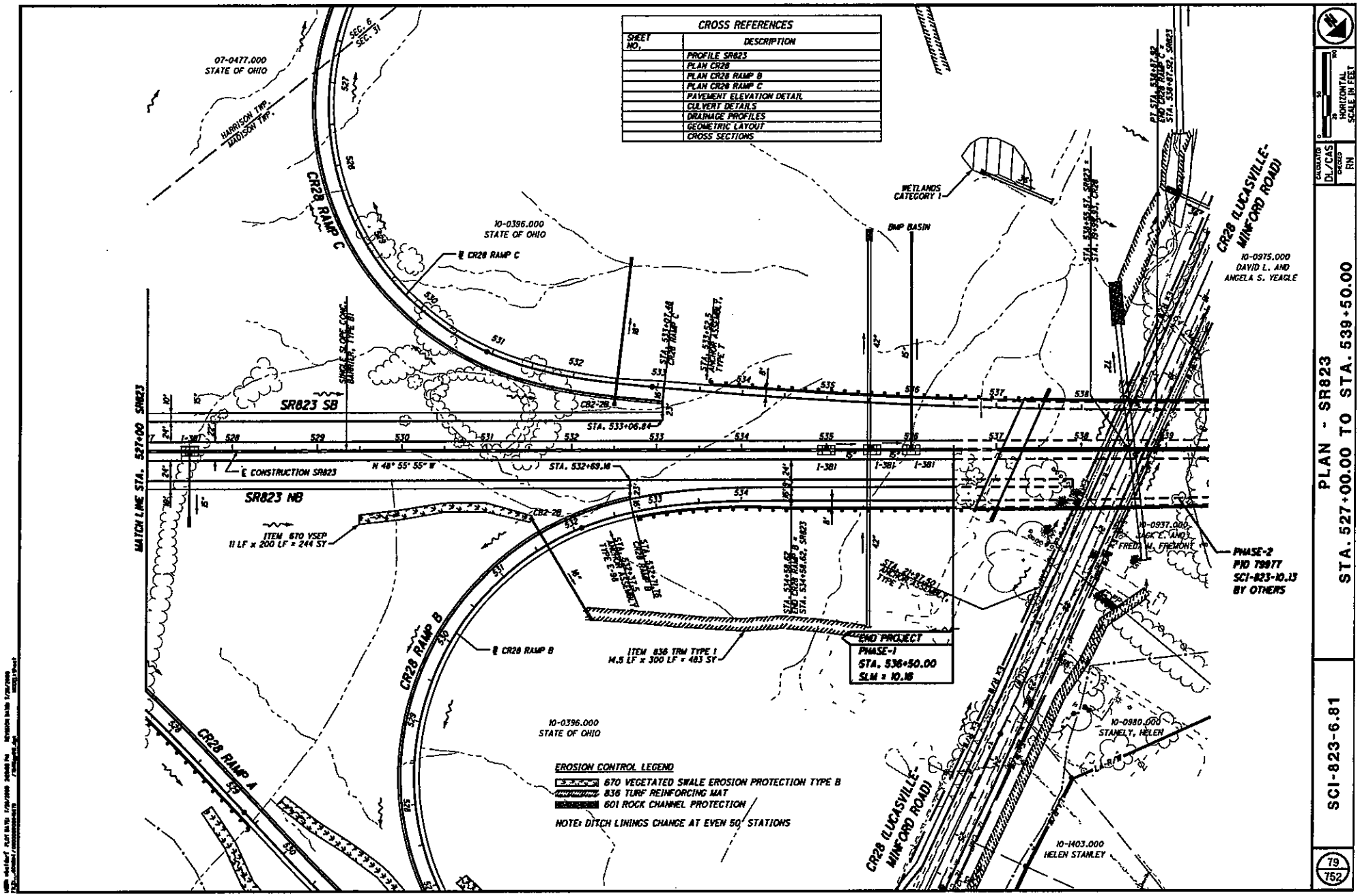
DITCH ANALYSIS

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.)
												Jute Mat	3.51	5	0.040	19.22	3.33	0.83	10.37	0.29	11.45
												Temp. Mat	3.51	5	0.040	19.22	3.33	0.83	10.37	0.29	11.45
												Temp. Mat	4.05	10	0.040	19.70	3.51	0.91	11.99	0.32	11.58
507+50	506+00	L	150.00	10.00	3.00	2.00	0.1473*	1.62	7.38	0.44	3.67	Seed	3.47	5	0.030	19.62	6.20	1.80	12.75	0.20	10.98
												Jute Mat	3.46	5	0.040	19.70	5.17	2.14	12.72	0.23	11.16
				RCP C								Temp. Mat	3.46	5	0.040	19.70	5.17	2.14	12.72	0.23	11.16
												Perm, Type 1	3.46	5	0.040	19.70	5.17	2.14	12.72	0.23	11.16
												Perm, Type 2	3.46	5	0.040	19.70	5.17	2.14	12.72	0.23	11.16
												Perm, Type 2	4.01	10	0.040	20.16	5.46	2.33	14.71	0.25	11.27
506+00	505+50	L	50.00	10.00	4.00	3.00	0.1920*	0.31	7.68	0.46	3.81	Seed	3.45	5	0.030	19.83	6.73	2.20	13.17	0.18	11.29
												Jute Mat	3.45	5	0.040	19.85	5.61	2.61	13.16	0.22	11.53
				RCP C								Temp. Mat	3.45	5	0.040	19.85	5.61	2.61	13.16	0.22	11.53
												Perm, Type 1	3.45	5	0.040	19.85	5.61	2.61	13.16	0.22	11.53
												Perm, Type 2	3.45	5	0.040	19.85	5.61	2.61	13.16	0.22	11.53
												Perm, Type 2	3.99	10	0.040	20.30	5.92	2.85	15.22	0.24	11.66
505+50	505+00	L	50.00	10.00	4.00	3.00	0.2200*	0.17	7.86	0.51	3.90	Seed	3.44	5	0.030	19.97	7.07	2.45	13.42	0.18	11.25
												Jute Mat	3.44	5	0.040	19.99	5.90	2.91	13.42	0.21	11.48
				RCP C								Temp. Mat	3.44	5	0.040	19.99	5.90	2.91	13.42	0.21	11.48
												Perm, Type 1	3.44	5	0.040	19.99	5.90	2.91	13.42	0.21	11.48
												Perm, Type 2	3.44	5	0.040	19.99	5.90	2.91	13.42	0.21	11.48

DITCH ANALYSIS

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.)
												Perm, Type 2	3.98	10	0.040	20.43	6.22	3.17	15.53	0.23	11.62


CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE SR823
PLAN CR28 RAMP A
PLAN CR28 RAMP B
PLAN CR28 RAMP C
PLAN CR28 RAMP D
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
07-0477.000 STATE OF OHIO
07-2195.000 ELMER JR. AND VIRGINIA L. OLIVER
07-2196.000 ELMER JR. AND VIRGINIA L. OLIVER
10-0396.000 STATE OF OHIO
10-0357.000 STATE OF OHIO
CONST. LIMITS
SR823 SB
SR823 NB
CR28 RAMP D
CR28 RAMP A
℄ CONSTRUCTION SR823
MATCH LINE STA. 514+50 SR823
MATCH LINE STA. 527+00 SR823
HARRISON TWP.
MADISON TWP.
N 48° 55' 55" W
STA. 521+56.64
STA. 522+74.18
SINGLE SLOPE CONC. BARRIER, TYPE B1
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
PLAN - SR823
STA. 514+50.00 TO STA. 527+00.00
SCI-823-6.81
77
752
See Ramps for Calcs


CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE SR823
PLAN CR28
PLAN CR28 RAMP B
PLAN CR28 RAMP C
PAVEMENT ELEVATION DETAIL
CULVERT DETAILS
DRAINAGE PROFILES
GEOMETRIC LAYOUT
CROSS SECTIONS
07-0477.000 STATE OF OHIO
HARRISON TWP.
MADISON TWP.
SEC. 6
SEC. 31
CR28 RAMP C
10-0396.000 STATE OF OHIO
℄ CR28 RAMP C
WETLANDS CATEGORY 1
BMP BASIN
CR28 (LUCASVILLE-MINFORD ROAD)
10-0975.000 DAVID L. AND ANGELA S. YEAGLE
SINGLE SLOPE CONC. BARRIER, TYPE B1
SR823 SB
SR823 NB
MATCH LINE STA. 527+00 SR823
℄ CONSTRUCTION SR823
N 48° 55' 55" W
STA. 532+69.18
STA. 533+06.84
I-381
ITEM 670 YSEP
11 LF x 200 LF = 244 SY
CR28 RAMP B
℄ CR28 RAMP B
ITEM 836 TRM TYPE I
14.5 LF x 300 LF = 483 SY
END PROJECT
PHASE-1
STA. 536+50.00
SLM = 10.18
PHASE-2
PID 79977
SCI-823-10.13
BY OTHERS
10-0937.000 JACK E. AND FREDA M. FREMONT
10-0980.000 STANLEY, HELEN
10-1403.000 HELEN STANLEY
CR28 RAMP A
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE B
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
HORIZONTAL SCALE IN FEET
PLAN - SR823
STA. 527+00.00 TO STA. 539+50.00
SCI-823-6.81
79
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/19/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 522+00 TO 531+50 Right **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
522+00	524+50	R	250.00	10.00	6.00	6.00	0.0224	0.46	0.46	0.66	0.31	Seed	4.19	5	0.030	12.87	1.41	0.12	1.28	0.09	11.04
												Seed	4.85	10	0.040	13.23	1.24	0.16	1.49	0.11	11.35
524+50	526+50	R	200.00	10.00	8.00	4.00	0.0070	0.43	0.89	0.58	0.55	Seed	3.86	5	0.030	15.62	1.18	0.07	2.14	0.17	11.98
												Seed	4.43	10	0.040	16.37	1.03	0.09	2.45	0.21	12.55
526+50	527+50	R	100.00	10.00	6.00	4.00	0.0540	0.28	1.17	0.54	0.70	Seed	3.79	5	0.030	16.29	2.45	0.35	2.66	0.10	11.03
												Seed	4.34	10	0.040	17.14	2.15	0.45	3.05	0.13	11.33
527+50	529+50	R	200.00	10.00	6.00	4.00	0.0305	0.59	1.76	0.53	1.02	Seed	3.65	5	0.030	17.71	2.32	0.28	3.71	0.15	11.49
												Seed	4.15	10	0.040	18.76	2.03	0.36	4.22	0.19	11.90
529+50	531+00	R	150.00	10.00	6.00	4.00	0.0053	0.30	2.06	0.59	1.19	Seed	3.48	5	0.030	19.49	1.38	0.09	4.16	0.27	12.66
												Seed	3.94	10	0.040	20.82	1.19	0.11	4.70	0.34	13.37
531+00	531+50	R	50.00	10.00	6.00	6.00	0.0820	0.07	2.12	0.69	1.24	Seed	3.46	5	0.030	19.75	3.31	0.62	4.29	0.12	11.45
												Temp. Mat	3.46	5	0.040	19.80	2.76	0.73	4.28	0.14	11.72
												Temp. Mat	3.91	10	0.040	21.11	2.89	0.79	4.85	0.15	11.84

DITCH ANALYSIS

PID : 19415 **Date :** 07/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 525+00 TO 532+50 Left **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
525+00	527+00	L	200.00	10.00	8.00	4.00	0.0225	0.73	0.73	0.53	0.38	Seed	4.29	5	0.030	12.10	1.55	0.14	1.65	0.10	11.21
												Seed	4.99	10	0.040	12.37	1.37	0.18	1.92	0.13	11.56
527+00	527+50	L	50.00	10.00	8.00	4.00	0.0700	0.59	1.32	0.75	0.83	Seed	4.25	5	0.030	12.38	2.93	0.49	3.53	0.11	11.35
												Temp. Mat	4.25	5	0.040	12.44	2.44	0.58	3.53	0.13	11.60
												Temp. Mat	4.94	10	0.040	12.69	2.58	0.64	4.10	0.15	11.75
527+50	532+50	L	500.00	10.00	8.00	6.00	0.0190	0.94	2.26	0.62	1.41	Seed	3.82	5	0.030	16.04	2.23	0.25	5.39	0.21	12.95
												Seed	4.37	10	0.040	16.84	1.93	0.32	6.18	0.27	13.77

DITCH ANALYSIS

PID : 19415 **Date :** 06/10/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SCI 823 sections 532+50 to 531+50 right side **Designer :** KMD

KAG
BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
532+50	531+50	R	100.00	10.00	8.00	4.00	0.0230	0.15	0.15	0.65	0.10	Seed	4.34	5	0.030	11.76	0.93	0.06	0.43	0.04	10.54
												Seed	5.05	10	0.040	11.94	0.82	0.08	0.50	0.06	10.71

DITCH ANALYSIS

PID : 19415 **Date :** 07/06/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis CR 28 Ramp B sections 531+50 TO MAIN535+50 Right **Designer :** kag

KMD
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.00	**Temporary Mat:**	1.00	
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
	RCP	**Type 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.)
531+50	534+00	R	500.00	10.00	3.00	3.00	0.0488	2.33	2.33	0.60	1.40	Seed	4.24	5	0.030	12.47	3.27	0.52	5.93	0.17	11.03
												Temp. Mat	4.18	5	0.040	12.96	2.72	0.62	5.84	0.20	11.22
												Temp. Mat	4.92	10	0.040	12.79	2.89	0.68	6.88	0.22	11.34
534+00	535+50	R	200.00	10.00	4.00	3.00	0.0907	2.60	4.93	0.60	2.96	Seed	4.10	5	0.030	13.60	5.15	1.24	12.12	0.22	11.53
												Temp. Mat	4.08	5	0.040	13.73	4.29	1.46	12.07	0.26	11.81
												Perm, Type 1	4.08	5	0.040	13.73	4.29	1.46	12.07	0.26	11.81
												Perm, Type 1	4.81	10	0.040	13.52	4.55	1.61	14.23	0.28	11.99

DITCH ANALYSIS

PID : 19415 **Date :** 07/06/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch 536+50 TO 535+50 Right **Designer :** kag

KMD
BEE

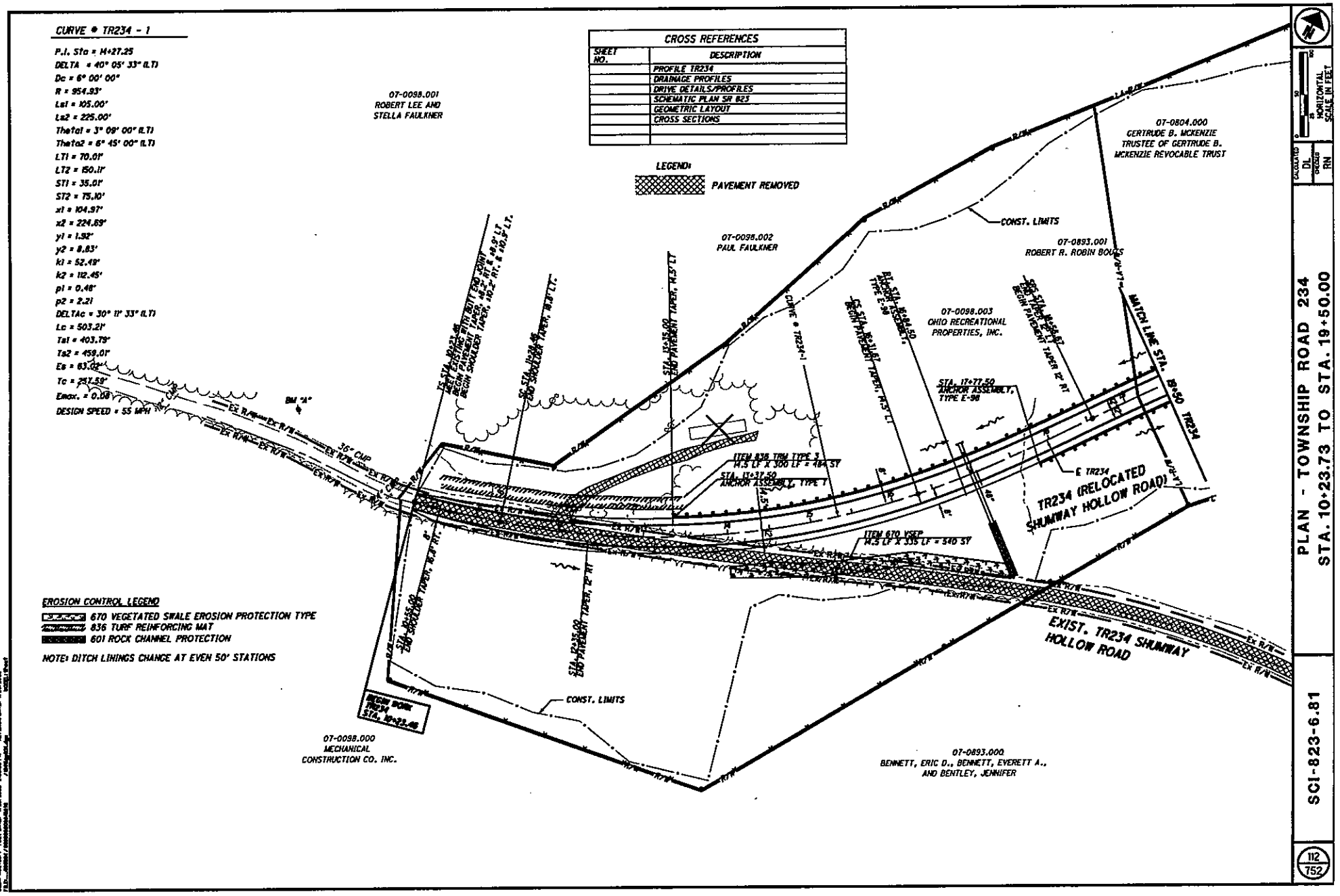
Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
537+00	535+50	R	100.00	10.00	3.00	3.00	0.0100	3.07	3.07	0.80	2.46	Seed	4.49	5	0.030	10.67	2.49	0.25	11.04	0.40	12.38
												Seed	5.25	10	0.040	10.76	2.17	0.32	12.90	0.51	13.09


CURVE # TR234 - 1
P.I. Sta = M+27.25
DELTA = 40° 05' 33" (LT)
Dc = 6° 00' 00"
R = 954.93'
Lsl = 105.00'
Ls2 = 225.00'
Theta1 = 3° 09' 00" (LT)
Theta2 = 6° 45' 00" (LT)
LT1 = 70.01'
LT2 = 150.11'
ST1 = 35.01'
ST2 = 75.10'
x1 = 104.97'
x2 = 224.89'
y1 = 1.92'
y2 = 8.83'
k1 = 52.49'
k2 = 112.45'
p1 = 0.48'
p2 = 2.21
DELTAc = 30° 11' 33" (LT)
Lc = 503.21'
Tal = 403.79'
Ta2 = 459.01'
Es = 63.02'
Tc = 257.59'
Emax. = 0.08
DESIGN SPEED = 55 MPH
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE TR234
DRAINAGE PROFILES
DRIVE DETAILS/PROFILES
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
LEGEND:
PAVEMENT REMOVED
07-0098.001
ROBERT LEE AND
STELLA FAULKNER
07-0098.002
PAUL FAULKNER
07-0098.003
OHIO RECREATIONAL
PROPERTIES, INC.
07-0804.000
GERTRUDE B. MCKENZIE
TRUSTEE OF GERTRUDE B.
MCKENZIE REVOCABLE TRUST
07-0893.001
ROBERT R. ROBIN BOLES
07-0098.000
MECHANICAL
CONSTRUCTION CO. INC.
07-0893.000
BENNETT, ERIC D., BENNETT, EVERETT A.,
AND BENTLEY, JENNIFER
CONST. LIMITS
CONST. LIMITS
BM "A"
36" CMP
TS STA. 10+23.46
BEGIN EXISTING PAVEMENT TAPER, 12' RT
BEGIN SHOULDER TAPER, 40.2' RT. & 40.2' LT.
ES STA. 11+38.46
END SHOULDER TAPER, 40.2' LT.
STA. 11+15.00
END PAVEMENT TAPER, 14.5' LT
CURVE # TR234-1
ES STA. 11+31.67
BEGIN PAVEMENT TAPER, 14.5' LT
PI STA. 11+84.50
ANCHOR ASSEMBLY,
TYPE E-98
SES STA. 11+89.67
END PAVEMENT TAPER 12' RT
STA. 17+77.50
ANCHOR ASSEMBLY,
TYPE E-98
MATCH LINE STA. 19+50 TR234
ITEM 836 TRM TYPE 3
14.5 LF X 300 LF = 484 SY
STA. 12+37.50
ANCHOR ASSEMBLY, TYPE T
ITEM 670 VSEP
14.5 LF X 335 LF = 540 SY
℄ TR234
TR234 (RELOCATED
SHUMWAY HOLLOW ROAD)
EXIST. TR234 SHUMWAY
HOLLOW ROAD
BEGIN WORK
TR234
STA. 10+23.46
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
HORIZONTAL SCALE IN FEET
CALCULATED DL
CHECKED RN
PLAN - TOWNSHIP ROAD 234
STA. 10+23.73 TO STA. 19+50.00
SCI-823-6.81
112
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/25/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234, 10+23 RT TO TR234, 17+00 RT

Designer : KMD
Checked: KAG

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
10+23	10+50	R	27.00	5.00	8.00	1.00	0.1281 *	0.49	0.49	0.41	0.20	Seed	4.57	5	0.030	10.16	2.71	0.52	0.92	0.06	5.58
												Jute Mat	4.56	5	0.040	10.20	2.28	0.61	0.92	0.08	5.68
												Temp. Mat	4.56	5	0.040	10.20	2.28	0.61	0.92	0.08	5.68
												Temp. Mat	5.36	10	0.040	10.19	2.42	0.67	1.08	0.08	5.75
10+50	11+00	R	50.00	5.00	6.00	0.50	0.0680	0.64	1.14	0.41	0.47	Seed	4.52	5	0.030	10.47	3.07	0.54	2.11	0.13	5.82
Rock												Jute Mat	4.51	5	0.040	10.52	2.55	0.64	2.10	0.15	5.98
												Temp. Mat	4.51	5	0.040	10.52	2.55	0.64	2.10	0.15	5.98
												Temp. Mat	5.30	10	0.040	10.49	2.70	0.70	2.47	0.17	6.07
11+00	12+50	R	150.00	5.00	6.00	0.50	0.0447	1.72	2.85	0.41	1.17	Seed	4.42	5	0.030	11.20	3.68	0.68	5.17	0.24	6.58
Rock												Jute Mat	4.40	5	0.040	11.34	3.03	0.80	5.15	0.29	6.86
												Temp. Mat	4.40	5	0.040	11.34	3.03	0.80	5.15	0.29	6.86
												Temp. Mat	5.17	10	0.040	11.27	3.20	0.87	6.05	0.31	7.04
12+50	14+50	R	200.00	5.00	5.00	1.00	0.0375	1.93	4.78	0.41	1.96	Seed	4.28	5	0.030	12.14	4.13	0.79	8.40	0.34	7.03
Rock																					

DITCH ANALYSIS

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.)
Rock												Jute Mat	4.26	5	0.040	12.31	3.39	0.93	8.35	0.40	7.38
												Temp. Mat	4.26	5	0.040	12.31	3.39	0.93	8.35	0.40	7.38
												Temp. Mat	5.01	10	0.040	12.19	3.58	1.02	9.83	0.44	7.61
14+50	16+50	R	200.00	10.00	4.00	2.00	0.0427	1.04	5.82	0.41	2.39	Seed	4.15	5	0.030	13.18	3.80	0.65	9.90	0.24	11.46
												Jute Mat	4.13	5	0.040	13.35	3.16	0.77	9.85	0.29	11.72
												Temp. Mat	4.13	5	0.040	13.35	3.16	0.77	9.85	0.29	11.72
												Temp. Mat	4.86	10	0.040	13.17	3.35	0.84	11.60	0.32	11.90
16+50	17+00	R	50.00	10.00	2.00	2.00	0.0420	0.14	5.96	0.42	2.44	Seed	4.10	5	0.030	13.57	3.85	0.65	10.02	0.25	10.99
												Jute Mat	4.10	5	0.040	13.61	3.22	0.77	10.01	0.29	11.17
												Temp. Mat	4.10	5	0.040	13.61	3.22	0.77	10.01	0.29	11.17
												Temp. Mat	4.83	10	0.040	13.42	3.42	0.85	11.79	0.32	11.30

DITCH ANALYSIS

PID : 19415 **Date :** 06/04/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 10+23 TO 17+00 Left **Designer :** KMD KAG BJG

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
10+23	11+00	L	67.00	5.00	4.00	2.00	0.0420	60.18	60.18	0.41	24.67	Seed	3.19	5	0.030	23.13	8.51	2.91	78.69	1.11	11.66
												Jute Mat	3.19	5	0.040	23.16	6.91	3.37	78.63	1.29	12.71
												Temp. Mat	3.19	5	0.040	23.16	6.91	3.37	78.63	1.29	12.71
												Perm, Type 1	3.19	5	0.040	23.16	6.91	3.37	78.63	1.29	12.71
												Perm, Type 2	3.19	5	0.040	23.16	6.91	3.37	78.63	1.29	12.71
												Perm, Type 3	3.19	5	0.040	23.16	6.91	3.37	78.63	1.29	12.71
												Perm, Type 3	3.73	10	0.040	23.15	7.21	3.65	92.02	1.39	13.35
11+00	11+50	L	50.00	5.00	4.00	2.00	0.0580	0.67	60.85	0.43	24.96	Seed	3.18	5	0.030	23.25	9.58	3.71	79.39	1.03	11.16
												Jute Mat	3.18	5	0.040	23.27	7.78	4.31	79.35	1.19	12.14
												Temp. Mat	3.18	5	0.040	23.27	7.78	4.31	79.35	1.19	12.14
												Perm, Type 1	3.18	5	0.040	23.27	7.78	4.31	79.35	1.19	12.14
												Perm, Type 2	3.18	5	0.040	23.27	7.78	4.31	79.35	1.19	12.14
												Perm, Type 3	3.18	5	0.040	23.27	7.78	4.31	79.35	1.19	12.14

DITCH ANALYSIS

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.)
												Perm, Type 3	3.72	10	0.040	23.26	8.13	4.66	92.88	1.29	12.73
11+50	13+50	L	200.00	5.00	4.00	2.00	0.0425	2.00	62.86	0.44	25.84	Seed	3.15	5	0.030	23.65	8.62	2.99	81.43	1.13	11.76
												Jute Mat	3.14	5	0.040	23.74	7.00	3.46	81.27	1.30	12.82
												Temp. Mat	3.14	5	0.040	23.74	7.00	3.46	81.27	1.30	12.82
												Perm, Type 1	3.14	5	0.040	23.74	7.00	3.46	81.27	1.30	12.82
												Perm, Type 2	3.14	5	0.040	23.74	7.00	3.46	81.27	1.30	12.82
												Perm, Type 3	3.14	5	0.040	23.74	7.00	3.46	81.27	1.30	12.82
												Perm, Type 3	3.68	10	0.040	23.71	7.31	3.74	95.16	1.41	13.46
13+50	14+00	L	50.00	10.00	3.00	2.00	0.0720	0.56	63.41	0.44	26.09	Seed	3.14	5	0.030	23.83	9.60	3.25	81.88	0.72	13.61
Rock												Jute Mat	3.14	5	0.040	23.85	7.92	3.83	81.84	0.85	14.26
												Temp. Mat	3.14	5	0.040	23.85	7.92	3.83	81.84	0.85	14.26
												Perm, Type 1	3.14	5	0.040	23.85	7.92	3.83	81.84	0.85	14.26
												Perm, Type 2	3.14	5	0.040	23.85	7.92	3.83	81.84	0.85	14.26
												Perm, Type 3	3.14	5	0.040	23.85	7.92	3.83	81.84	0.85	14.26
												Perm, Type 3	3.67	10	0.040	23.81	8.34	4.19	95.84	0.93	14.66
14+00	16+50	L	250.00	10.00	3.00	2.00	0.0160	2.54	65.95	0.44	27.21	Seed	3.09	5	0.030	24.56	5.83	1.12	83.99	1.13	15.63
Rock												Jute Mat	3.08	5	0.040	24.72	4.77	1.32	83.69	1.32	16.59
												Temp. Mat	3.08	5	0.040	24.72	4.77	1.32	83.69	1.32	16.59
												Perm, Type 1	3.08	5	0.040	24.72	4.77	1.32	83.69	1.32	16.59
												Perm, Type 1	3.61	10	0.040	24.64	5.01	1.44	98.11	1.44	17.20

DITCH ANALYSIS

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.)
16+50	17+00	L	50.00	10.00	3.00	2.00	0.0520	0.95	66.91	0.42	27.61	Seed	3.07	5	0.030	24.81	8.71	2.63	84.75	0.81	14.05
												Jute Mat	3.07	5	0.040	24.83	7.17	3.09	84.71	0.95	14.77
												Temp. Mat	3.07	5	0.040	24.83	7.17	3.09	84.71	0.95	14.77
												Perm, Type 1	3.07	5	0.040	24.83	7.17	3.09	84.71	0.95	14.77
												Perm, Type 2	3.07	5	0.040	24.83	7.17	3.09	84.71	0.95	14.77
												Perm, Type 3	3.07	5	0.040	24.83	7.17	3.09	84.71	0.95	14.77
												Perm, Type 3	3.60	10	0.040	24.75	7.55	3.38	99.31	1.04	15.22

Rock

HDR | ONE COMPANY *Many Solutions*℠

Client: ODOT Sheet: of

Subject: Ditch Runoff calc CR 234 sta 11+00 Order No:

Computed by: KAG Date: 9/29/2008

Checked by: Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Ac)	C
Pavement Area	1.30	0.9
Non-paved Area	63.70	0.4
Other		
Total Area	**65.00**	**acres**

Weighted "C" = **0.41**

Overland Flow

Length	100
High Elevation	933
Low Elevation	930
Slope %	3

t_o 8.61 (1101.2.2)

Shallow Concentrated Flow

Length	794
High Elevation	930
Low Elevation	800
Slope %	16.37
k	0.076 (forest w/heavy ground litter - Table 1101-1)
V	1.01 (1101.2.2)
t_s	13.12 (1101.2.2)

Shallow Concentrated Flow

Length	1500
High Elevation	800
Low Elevation	705.9
Slope %	6.27
k	0.305 (grassedwaterway - Table 1101-1)
V	2.51 (1101.2.2)
t_s	9.97 (1101.2.2)

Since the time of concentration = to + ts t_c **31.7** min

DITCH ANALYSIS

PID : 19415 **Date :** 09/29/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 21+00 TO 17+00 Left **Designer :** KAG KMP BEG

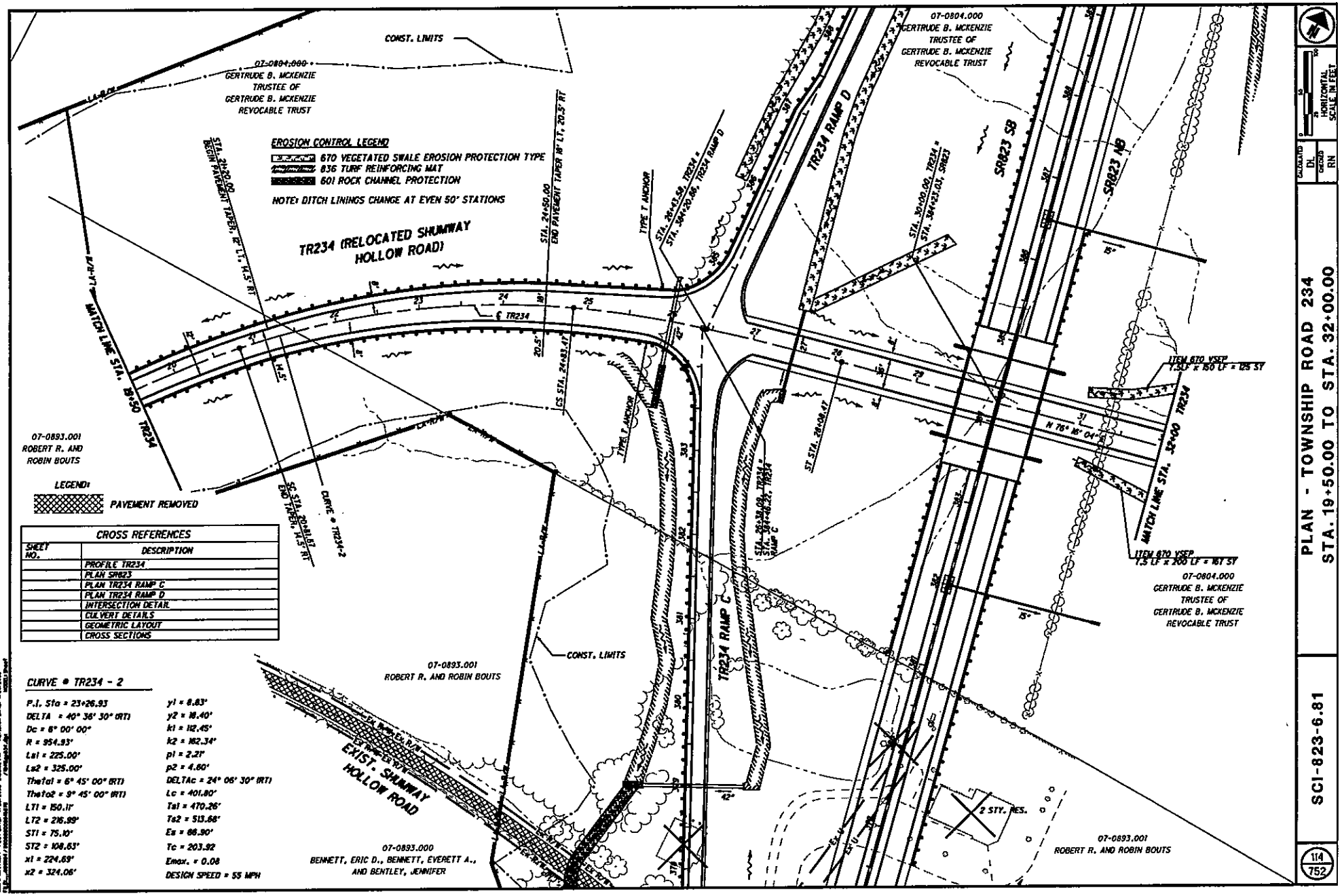
Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
21+00	17+50	L	350.00	10.00	3.00	2.00	0.0131	6.32	6.32	0.41	2.59	Seed	4.16	5	0.030	13.10	2.72	0.30	10.78	0.36	11.82
												Seed	4.83	10	0.040	13.38	2.38	0.38	12.52	0.47	12.35
17+50	17+00	L	50.00	10.00	3.00	2.00	0.0600	0.76	7.08	0.43	2.92	Seed	4.14	5	0.030	13.28	4.58	0.93	12.07	0.25	11.24
Rock												Jute Mat	4.13	5	0.040	13.31	3.82	1.10	12.06	0.29	11.47
												Temp. Mat	4.13	5	0.040	13.31	3.82	1.10	12.06	0.29	11.47
												Perm, Type 1	4.13	5	0.040	13.31	3.82	1.10	12.06	0.29	11.47
												Perm, Type 1	4.80	10	0.040	13.59	4.04	1.20	14.01	0.32	11.61



PLAN - TOWNSHIP ROAD 234
STA. 19+50.00 TO STA. 32+00.00

SCI-823-6.81

114
752

CALCULATED: DL
DRAWN: RN

HORIZONTAL SCALE: IN FEET
0 25 50 100

DITCH ANALYSIS

PID : 19415 **Date :** 06/04/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 21+00 TO 26+00 Left

Designer : KMD
Checked KAG
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
21+00	24+50	L	350.00	10.00	3.00	0.50	0.0131	5.51	5.51	0.40	2.20	Seed	4.28	5	0.030	12.17	2.62	0.28	9.43	0.34	11.19
	Rock											Seed	4.97	10	0.040	12.46	2.31	0.36	10.96	0.44	11.54
24+50	25+50	L	100.00	10.00	3.00	0.50	0.0330	0.48	5.99	0.41	2.40	Seed	4.22	5	0.030	12.63	3.60	0.55	10.13	0.27	10.94
	Rock											Jute Mat	4.21	5	0.040	12.72	3.00	0.66	10.10	0.32	11.12
												Temp. Mat	4.21	5	0.040	12.72	3.00	0.66	10.10	0.32	11.12
												Temp. Mat	4.89	10	0.040	12.98	3.17	0.72	11.74	0.35	11.22
25+50	26+00	L	50.00	10.00	3.00	0.50	0.0760	0.12	6.11	0.43	2.45	Seed	4.19	5	0.030	12.90	4.69	1.00	10.27	0.21	10.74
												Jute Mat	4.18	5	0.040	12.93	3.92	1.19	10.26	0.25	10.88
	Rock											Temp. Mat	4.18	5	0.040	12.93	3.92	1.19	10.26	0.25	10.88
												Perm, Type 1	4.18	5	0.040	12.93	3.92	1.19	10.26	0.25	10.88
												Perm, Type 1	4.86	10	0.040	13.18	4.14	1.30	11.93	0.27	10.96

DITCH ANALYSIS

PID : 19415 **Date :** 06/04/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 27+00 TO 27+50 Left **Designer :** KMD

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
27+00	27+50	L	50.00	5.00	6.00	5.00	0.0860	0.23	0.23	0.66	0.15	Seed	4.54	5	0.030	10.38	2.14	0.32	0.69	0.06	5.66
												Seed	5.31	10	0.040	10.44	1.90	0.42	0.81	0.08	5.86

DITCH ANALYSIS

PID : 19415 **Date :** 06/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 28+00 TO 32+50 Left **Designer :** KMD KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
28+00	28+50	L	50.00	5.00	4.00	6.00	0.0440	0.12	0.12	0.52	0.06	Seed	4.49	5	0.030	10.66	1.24	0.12	0.28	0.04	5.43
												Seed	5.26	10	0.040	10.75	1.09	0.15	0.32	0.06	5.56
28+50	31+00	L	250.00	2.00	6.00	4.00	0.0200	0.34	0.46	0.62	0.28	Seed	4.20	5	0.030	12.75	1.94	0.25	1.16	0.20	3.99
												Seed	4.86	10	0.040	13.19	1.66	0.31	1.34	0.25	4.48
31+00	31+50	L	50.00	2.00	5.00	4.00	0.0780	0.06	0.52	0.65	0.31	Seed	4.17	5	0.030	13.01	3.32	0.72	1.31	0.15	3.33
												Jute Mat	4.16	5	0.040	13.06	2.71	0.84	1.31	0.17	3.56
												Temp. Mat	4.16	5	0.040	13.06	2.71	0.84	1.31	0.17	3.56
												Temp. Mat	4.82	10	0.040	13.48	2.85	0.91	1.51	0.19	3.68
31+50	32+50	L	100.00	5.00	6.00	4.00	0.0320	0.38	0.90	0.56	0.52	Seed	4.08	5	0.030	13.76	2.35	0.31	2.14	0.16	6.57
												Seed	4.70	10	0.040	14.29	2.05	0.40	2.47	0.20	7.01

DITCH ANALYSIS

PID : 19415 **Date :** 06/25/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234, 28+00 to 32+50 **Designer :** KMD

KAG
BEE

Rainfall Area : D

Allowable Shears

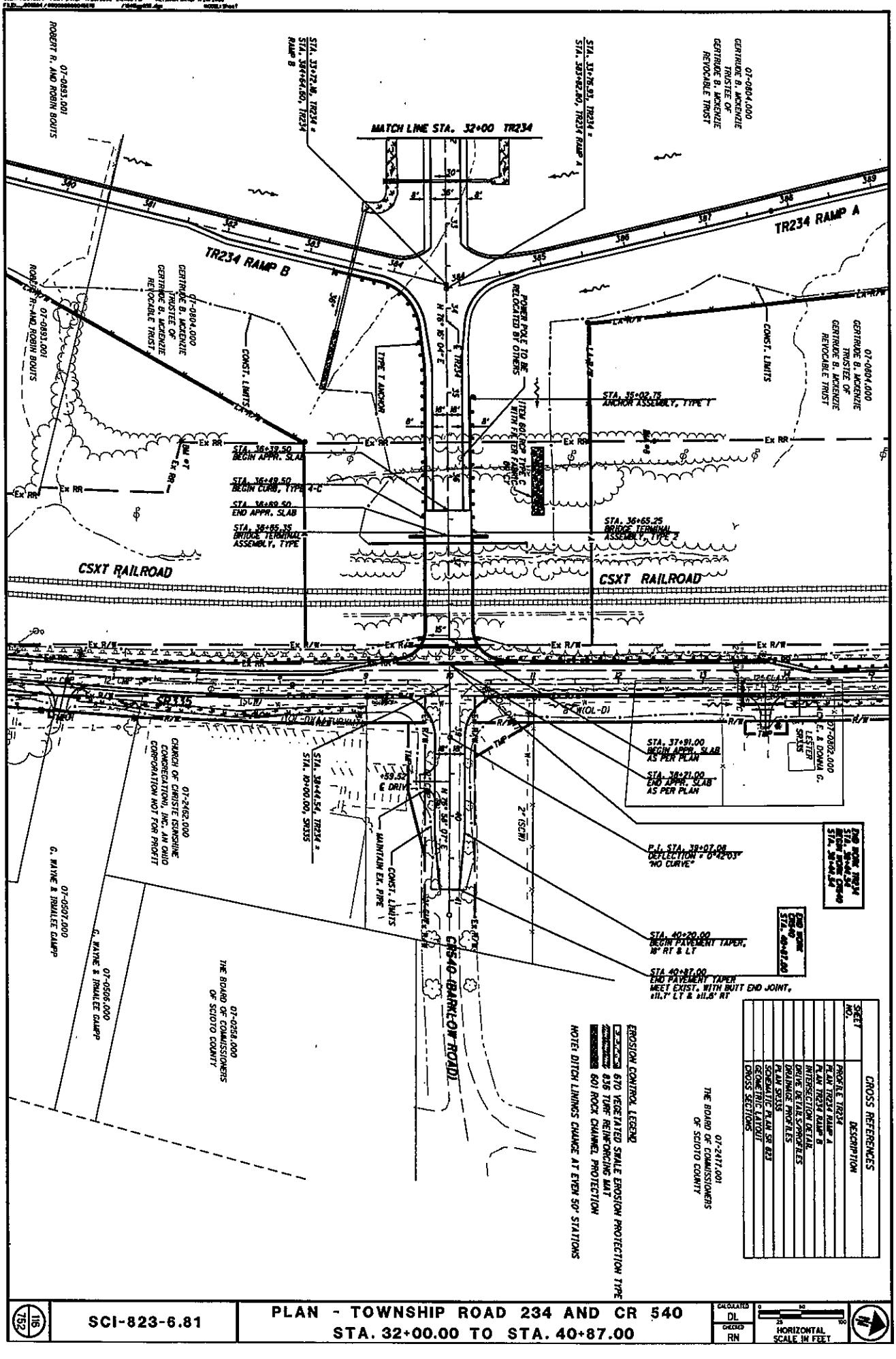
	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

(*) 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.)
28+00	28+50	R	50.00	5.00	6.00	4.00	0.0340	0.10	0.10	0.55	0.06	Seed	4.48	5	0.030	10.75	1.12	0.09	0.25	0.04	5.43
												Seed	5.24	10	0.040	10.84	0.99	0.12	0.29	0.06	5.56
28+50	31+00	R	250.00	2.00	6.00	4.00	0.0156	0.30	0.40	0.65	0.25	Seed	4.16	5	0.030	13.09	1.74	0.19	1.04	0.20	4.00
												Seed	4.80	10	0.040	13.60	1.47	0.24	1.20	0.25	4.51
31+00	31+50	R	50.00	2.00	6.00	4.00	0.0500	0.16	0.56	0.59	0.34	Seed	4.12	5	0.030	13.38	2.86	0.54	1.42	0.17	3.73
												Jute Mat	4.12	5	0.040	13.45	2.34	0.63	1.42	0.20	4.01
												Temp. Mat	4.12	5	0.040	13.45	2.34	0.63	1.42	0.20	4.01
												Temp. Mat	4.75	10	0.040	13.95	2.44	0.68	1.64	0.22	4.18
31+50	32+50	R	100.00	5.00	6.00	4.00	0.0520	0.06	0.62	0.65	0.38	Seed	4.03	5	0.030	14.12	2.47	0.37	1.55	0.11	6.13
												Seed	4.64	10	0.040	14.71	2.15	0.47	1.78	0.15	6.45
32+50	383+50	R	52.00	10.00	2.00	4.00	0.0269	11.53	12.15	0.57	6.95	Seed	4.01	5	0.030	14.30	4.73	0.86	27.91	0.51	13.07
												Jute Mat	4.01	5	0.040	14.34	3.91	1.01	27.88	0.60	13.62
												Temp. Mat	4.01	5	0.040	14.34	3.91	1.01	27.88	0.60	13.62

DITCH ANALYSIS

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.)
												Perm, Type 1	4.01	5	0.040	14.34	3.91	1.01	27.88	0.60	13.62
												Perm, Type 1	4.61	10	0.040	14.92	4.10	1.10	32.09	0.65	13.92



116 752

SCI-823-6.81

PLAN - TOWNSHIP ROAD 234 AND CR 540
STA. 32+00.00 TO STA. 40+87.00

CALCULATED DL
CHECKED RN

0 50 100
HORIZONTAL SCALE IN FEET

DITCH ANALYSIS

PID : 19415 **Date :** 06/08/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :TR 234 Ramp A Sta 386+50 to TR 234 36+39 LT **Designer :** KMD KAG

Rainfall Area : D

Allowable Shears

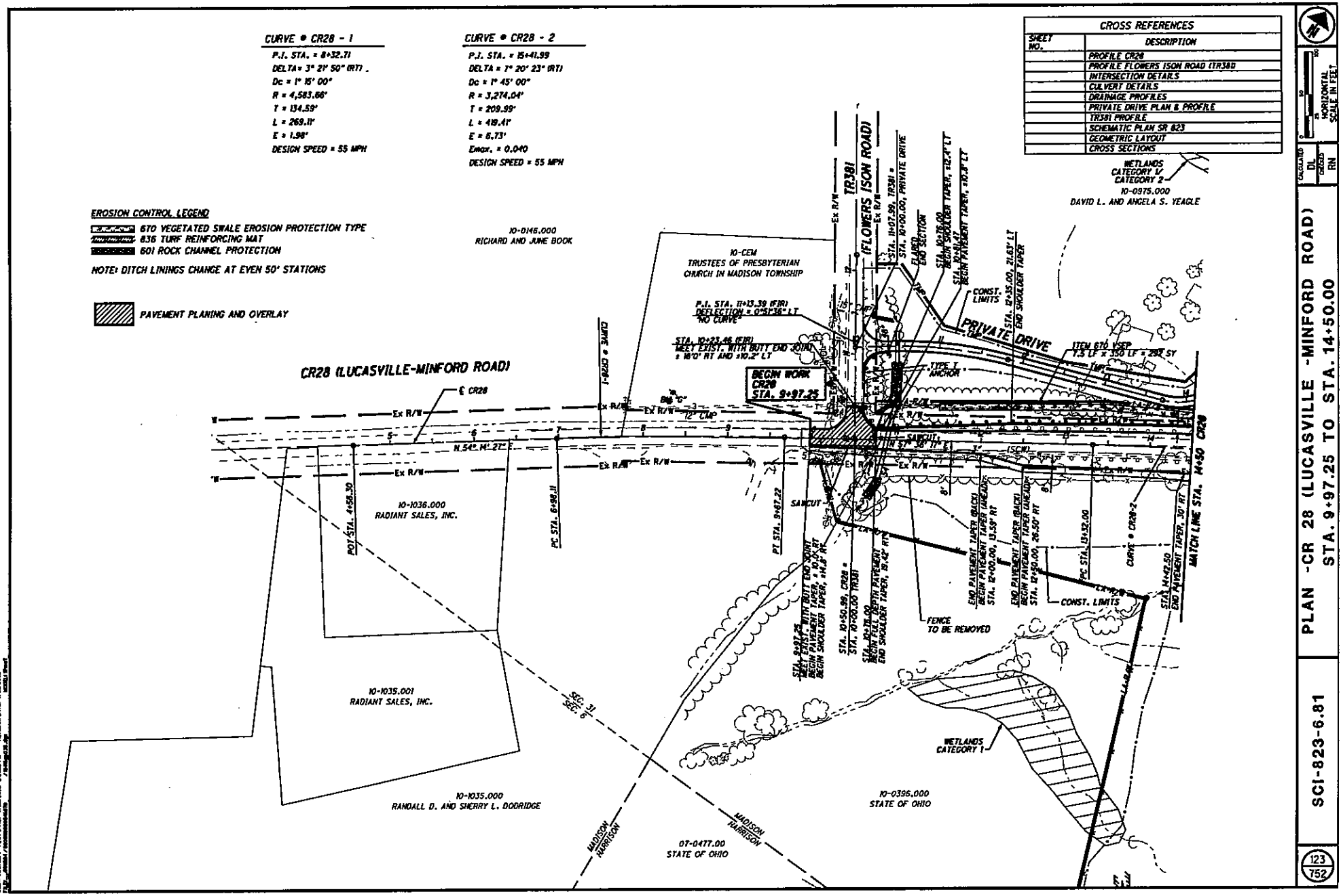
	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

(*) 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.)
386+50	386+00	R	50.00	10.00	6.00	3.00	0.0420	0.07	0.07	0.57	0.04	Seed	4.44	5	0.030	11.01	0.80	0.06	0.18	0.02	10.21
												Seed	5.19	10	0.040	11.12	0.72	0.08	0.22	0.03	10.27
386+00	385+50	R	50.00	10.00	6.00	3.00	0.0240	0.07	0.15	0.57	0.08	Seed	4.31	5	0.030	11.93	0.88	0.06	0.36	0.04	10.36
												Seed	5.02	10	0.040	12.17	0.78	0.08	0.42	0.05	10.47
385+50	385+00	R	50.00	10.00	6.00	3.00	0.0400	0.07	0.22	0.58	0.12	Seed	4.22	5	0.030	12.62	1.20	0.11	0.53	0.04	10.39
												Seed	4.90	10	0.040	12.94	1.06	0.14	0.61	0.06	10.51
385+00	34+00	L	22.00	10.00	4.00	4.00	0.0279	0.17	0.39	0.72	0.25	Seed	4.19	5	0.030	12.88	1.39	0.13	1.03	0.07	10.57
												Seed	4.85	10	0.040	13.23	1.24	0.16	1.19	0.09	10.74
34+00	34+50	L	50.00	10.00	4.00	4.00	0.0660	0.19	0.57	0.49	0.34	Seed	4.14	5	0.030	13.28	2.04	0.27	1.39	0.07	10.53
												Seed	4.79	10	0.040	13.69	1.81	0.35	1.61	0.09	10.69
34+50	36+00	L	150.00	10.00	4.00	4.00	0.0380	0.85	1.43	0.45	0.72	Seed	4.01	5	0.030	14.36	2.28	0.29	2.89	0.12	10.97
												Seed	4.62	10	0.040	14.92	2.01	0.37	3.33	0.16	11.25
36+00	36+39	L RCP	39.00	10.00	4.00	4.00	0.4684*	0.43	1.86	0.43	0.91	Seed	3.99	5	0.030	14.48	5.39	1.91	3.62	0.07	10.52

DITCH ANALYSIS

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.)
												Jute Mat	3.99	5	0.040	14.51	4.53	2.27	3.62	0.08	10.62
												Temp. Mat	3.99	5	0.040	14.51	4.53	2.27	3.62	0.08	10.62
												Perm, Type 1	3.99	5	0.040	14.51	4.53	2.27	3.62	0.08	10.62
												Perm, Type 2	3.99	5	0.040	14.51	4.53	2.27	3.62	0.08	10.62
												Perm, Type 2	4.60	10	0.040	15.05	4.78	2.47	4.17	0.08	10.68


CURVE # CR28 - 1
P.I. STA. = 8+32.71
DELTA = 3° 21' 50" (RT)
Dc = 1° 15' 00"
R = 4,583.66'
T = 134.59'
L = 269.11'
E = 1.98'
DESIGN SPEED = 55 MPH
CURVE # CR28 - 2
P.I. STA. = 15+41.99
DELTA = 7° 20' 23" (RT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 209.99'
L = 419.41'
E = 6.73'
Emax. = 0.040
DESIGN SPEED = 55 MPH
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE CR28
PROFILE FLOWERS ISON ROAD (TR381)
INTERSECTION DETAILS
CULVERT DETAILS
DRAINAGE PROFILES
PRIVATE DRIVE PLAN & PROFILE
TR381 PROFILE
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
PAVEMENT PLANING AND OVERLAY
CR28 (LUCASVILLE-MINFORD ROAD)
TR381 (FLOWERS ISON ROAD)
PRIVATE DRIVE
BEGIN WORK CR28 STA. 9+97.25
10-0146.000
RICHARD AND JUNE BOOK
10-CEM
TRUSTEES OF PRESBYTERIAN CHURCH IN MADISON TOWNSHIP
WETLANDS CATEGORY 1/ CATEGORY 2
10-0975.000
DAVID L. AND ANGELA S. YEAGLE
10-1036.000
RADIANT SALES, INC.
10-1035.001
RADIANT SALES, INC.
10-1035.000
RANDALL D. AND SHERRY L. DODRIDGE
07-0477.00
STATE OF OHIO
10-0396.000
STATE OF OHIO
WETLANDS CATEGORY 1
FENCE TO BE REMOVED
CONST. LIMITS
ITEM 670 VSEP
1.5 LF x 350 LF = 292 SY
TYP.
TYPE 1 ANCHOR
SAWCUT
MATCH LINE STA. 14+50 CR28
MADISON
HARRISON
SEC. 31
SEC. 6
N 54° 41' 27" E
12" CMP
1-BOLT @ 3 MPTS
POT STA. 4+58.30
PC STA. 6+98.11
PT STA. 9+97.22
PC STA. 13+12.00
CURVE # CR28-2
STA. 14+42.50
END PAVEMENT TAPER, 30' RT
CALCULATED DL
CHECKED RN
HORIZONTAL SCALE IN FEET
0 50 100
PLAN - CR 28 (LUCASVILLE - MINFORD ROAD)
STA. 9+97.25 TO STA. 14+50.00
SCI-823-6.81
123
752

DITCH ANALYSIS

PID : 19415 **Date :** 09/10/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 15+00 TO 11+50 Left **Designer :** KAG UD BEE

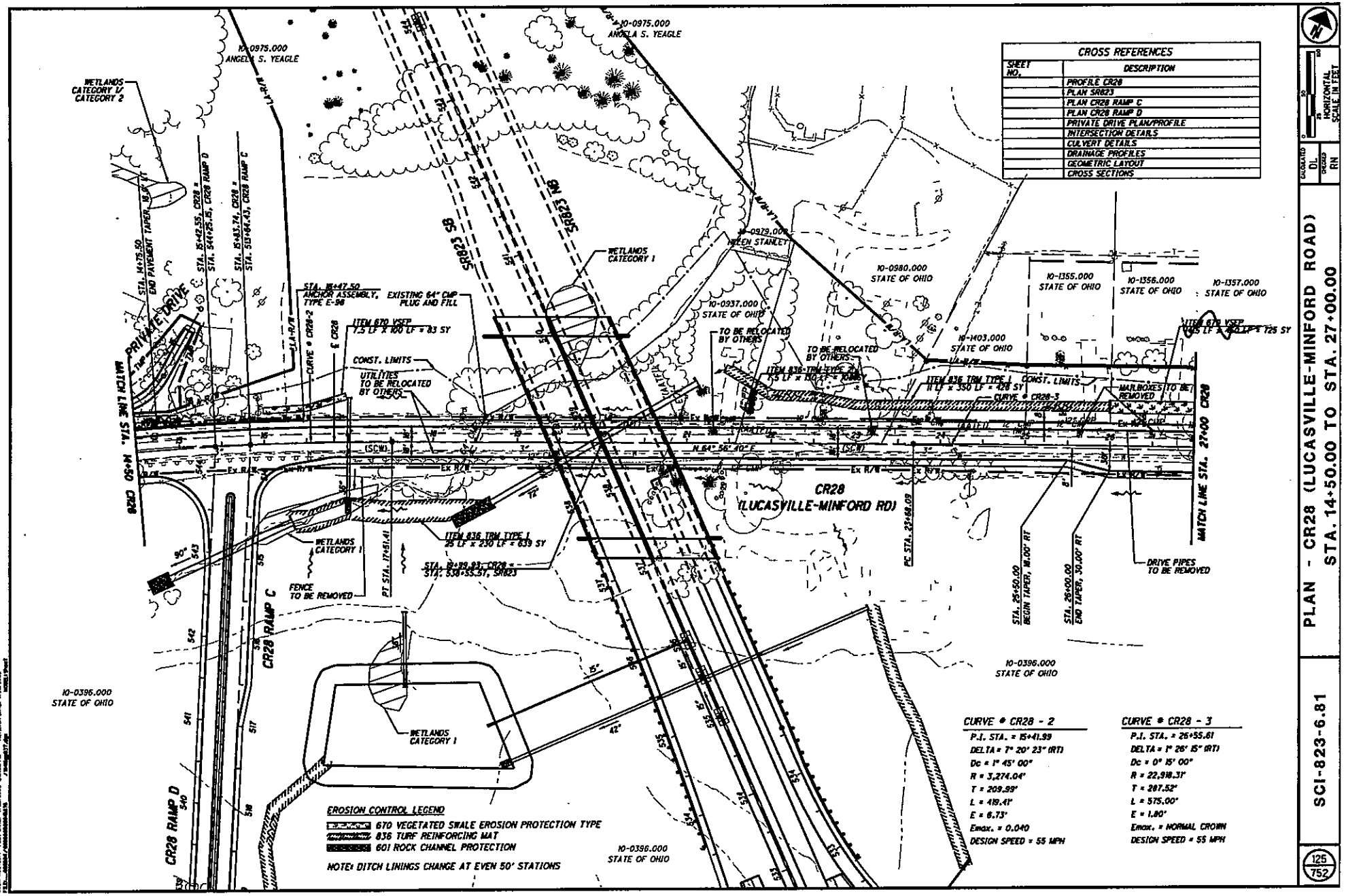
Rainfall Area : D

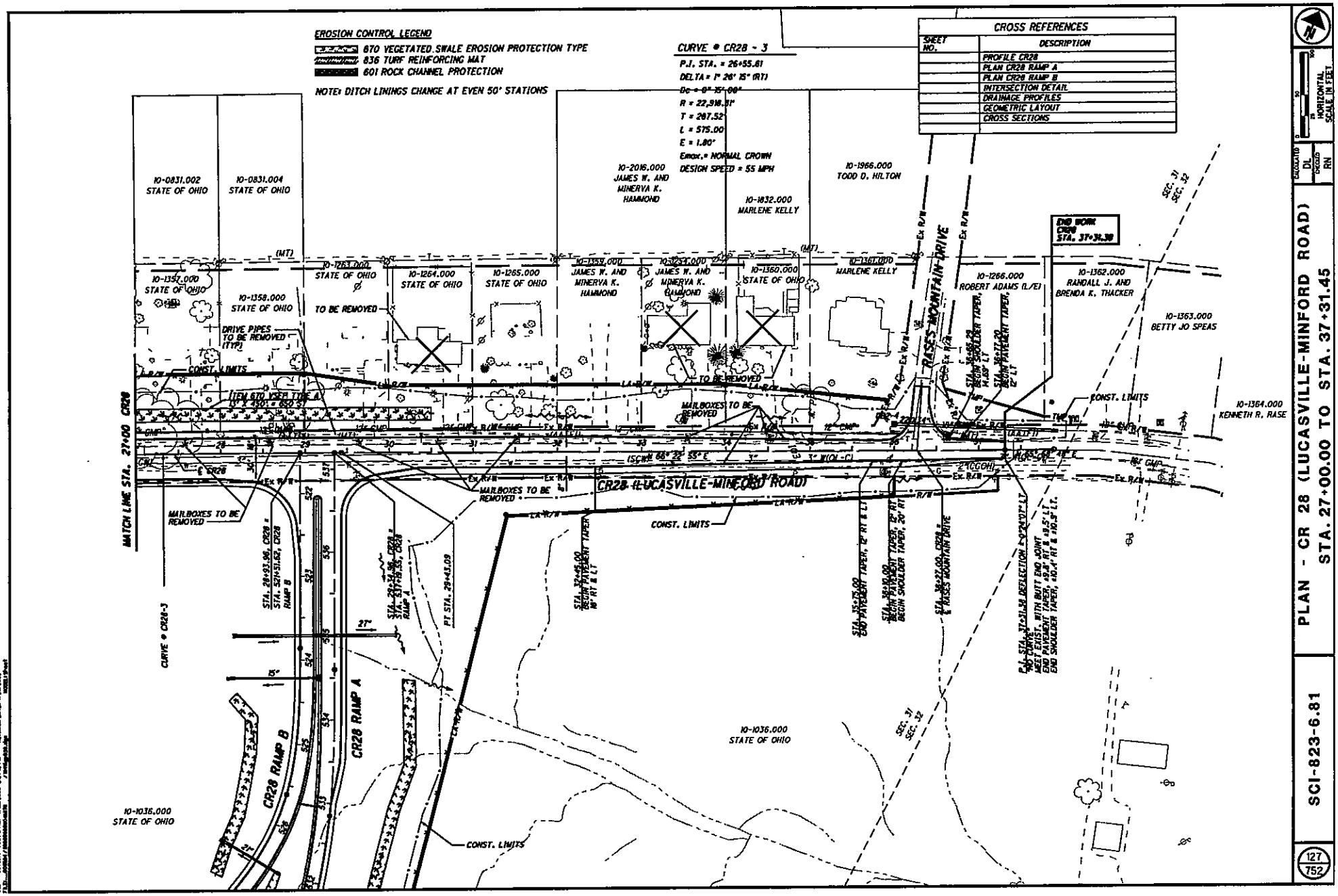
Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
15+00	14+00	L	100.00	0.00	3.00	3.00	0.0620	0.16	0.16	0.40	0.06	Seed	4.50	5	0.030	10.65	2.52	0.75	0.28	0.19	1.16
												Jute Mat	4.47	5	0.040	10.80	2.03	0.83	0.28	0.21	1.29
												Temp. Mat	4.47	5	0.040	10.80	2.03	0.83	0.28	0.21	1.29
												Temp. Mat	5.25	10	0.040	10.79	2.06	0.89	0.33	0.23	1.39
14+00	12+50	L	150.00	0.00	2.00	3.00	0.0200	0.26	0.42	0.47	0.19	Seed	4.32	5	0.030	11.92	2.22	0.48	0.81	0.38	1.91
												Jute Mat	4.28	5	0.040	12.19	1.78	0.53	0.80	0.42	2.12
												Temp. Mat	4.28	5	0.040	12.19	1.78	0.53	0.80	0.42	2.12
												Temp. Mat	5.02	10	0.040	12.13	1.85	0.56	0.94	0.45	2.26
12+50	11+50	L	100.00	0.00	2.00	3.00	0.0170	0.23	0.66	0.48	0.30	Seed	4.18	5	0.030	12.91	2.32	0.49	1.25	0.46	2.32
												Jute Mat	4.16	5	0.040	13.08	1.88	0.55	1.25	0.52	2.58
												Temp. Mat	4.16	5	0.040	13.08	1.88	0.55	1.25	0.52	2.58
												Temp. Mat	4.89	10	0.040	12.98	1.95	0.58	1.47	0.55	2.74


CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE CR28
PLAN SR823
PLAN CR28 RAMP C
PLAN CR28 RAMP D
PRIVATE DRIVE PLAN/PROFILE
INTERSECTION DETAILS
CULVERT DETAILS
DRAINAGE PROFILES
GEOMETRIC LAYOUT
CROSS SECTIONS
HORIZONTAL SCALE IN FEET
CALCULATED DJL
DRAWN RJN
PLAN - CR28 (LUCASVILLE-MINFORD ROAD)
STA. 14+50.00 TO STA. 27+00.00
SCI-823-6.81
125
752
10-0975.000 ANGELA S. YEAGLE
10-0979.000 HELEN STANLEY
10-0980.000 STATE OF OHIO
10-0937.000 STATE OF OHIO
10-1403.000 STATE OF OHIO
10-1355.000 STATE OF OHIO
10-1356.000 STATE OF OHIO
10-1357.000 STATE OF OHIO
10-0396.000 STATE OF OHIO
SR823 SB
SR823 NB
CR28 (LUCASVILLE-MINFORD RD)
CR28 RAMP C
CR28 RAMP D
PRIVATE DRIVE
MATCH LINE STA. 14+50 CR28
MATCH LINE STA. 27+00 CR28
WETLANDS CATEGORY 1/ CATEGORY 2
WETLANDS CATEGORY 1
STA. 14+75.50 END PAVEMENT TAPER, 18.00' RT
STA. 15+42.55, CR28 ℄ STA. 544+25.15, CR28 RAMP D
STA. 15+43.74, CR28 ℄ STA. 513+64.43, CR28 RAMP C
STA. 16+47.50 ANCHOR ASSEMBLY, TYPE E-98
EXISTING 64" CMP PLUG AND FILL
ITEM 670 VSEP 7.5 LF x 100 LF = 83 SY
CURVE # CR28-2
CONST. LIMITS
UTILITIES TO BE RELOCATED BY OTHERS
TO BE RELOCATED BY OTHERS
ITEM 836 TRM TYPE 1 25 LF x 230 LF = 639 SY
ITEM 836 TRM TYPE 1 11 LF x 350 LF = 428 SY
CURVE # CR28-3
MAILBOXES TO BE REMOVED
DRIVE PIPES TO BE REMOVED
FENCE TO BE REMOVED
PT STA. 17+51.41
PC STA. 23+68.09
STA. 25+50.00 BEGIN TAPER, 18.00' RT
STA. 26+00.00 END TAPER, 30.00' RT
STA. 8+29.93, CR28 ℄ STA. 538+55.51, SR823
N 64° 56' 40" E
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
CURVE # CR28 - 2
P.I. STA. = 15+41.99
DELTA = 7° 20' 23" (RT)
Dc = 1° 45' 00"
R = 3,274.04'
T = 209.99'
L = 419.41'
E = 6.73'
Emax. = 0.040
DESIGN SPEED = 55 MPH
CURVE # CR28 - 3
P.I. STA. = 26+55.61
DELTA = 1° 26' 15" (RT)
Dc = 0° 15' 00"
R = 22,918.31'
T = 287.52'
L = 575.00'
E = 1.80'
Emax. = NORMAL CROWN
DESIGN SPEED = 55 MPH


EROSION CONTROL LEGEND
870 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
CURVE # CR28 - 3
P.I. STA. = 26+55.81
DELTA = 1° 26' 15" (RT)
Dc = 0° 15' 00"
R = 22,918.31'
T = 287.52
L = 575.00
E = 1.80'
Emax.= NORMAL CROWN
DESIGN SPEED = 55 MPH
CROSS REFERENCES
SHEET NO.
DESCRIPTION
PROFILE CR28
PLAN CR28 RAMP A
PLAN CR28 RAMP B
INTERSECTION DETAIL
DRAINAGE PROFILES
GEOMETRIC LAYOUT
CROSS SECTIONS
10-0831.002 STATE OF OHIO
10-0831.004 STATE OF OHIO
10-2016.000 JAMES W. AND MINERVA K. HAMMOND
10-1832.000 MARLENE KELLY
10-1966.000 TODD D. HILTON
10-1357.000 STATE OF OHIO
10-1358.000 STATE OF OHIO
10-1263.000 STATE OF OHIO
10-1264.000 STATE OF OHIO
10-1265.000 STATE OF OHIO
10-1359.000 JAMES W. AND MINERVA K. HAMMOND
10-1360.000 STATE OF OHIO
10-1361.000 MARLENE KELLY
10-1266.000 ROBERT ADAMS (L/E)
10-1362.000 RANDALL J. AND BRENDA K. THACKER
10-1363.000 BETTY JO SPEAS
10-1364.000 KENNETH R. RASE
10-1036.000 STATE OF OHIO
END WORK CR28 STA. 37+31.39
MATCH LINE STA. 27+00 CR28
CR28 (LUCASVILLE-MINFORD ROAD)
RASES MOUNTAIN DRIVE
CR28 RAMP A
CR28 RAMP B
DRIVE PIPES TO BE REMOVED (TYP.)
MAILBOXES TO BE REMOVED
CONST. LIMITS
TO BE REMOVED
CURVE # CR28-3
PT STA. 29+43.09
STA. 32+45.00 BEGIN PAVEMENT TAPER 14' RT & LT
STA. 35+15.00 END PAVEMENT TAPER, 12' RT & LT
STA. 36+19.00 BEGIN SHOULDER TAPER, 28' RT
STA. 36+27.00 CR28 & RASES MOUNTAIN DRIVE
STA. 37+11.58 DEFLECTION 1°24'01" LT.
P.C. STA. 37+31.58 NO CURVE MEET EXIST. WITH BUTT END JOINT
END PAVEMENT TAPER, 49.8' RT & 49.5' LT.
END SHOULDER TAPER, 40.4' RT & 40.2' LT.
SEC. 31
SEC. 32
HORIZONTAL SCALE IN FEET
CALCULATED DL
DRAWN RN
PLAN - CR 28 (LUCASVILLE-MINFORD ROAD)
STA. 27+00.00 TO STA. 37+31.45
SCI-823-6.81
127
752

DITCH ANALYSIS

PID : 19415 **Date :** 08/16/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 21+50 TO 16+50 Right **Designer :** KAG LD BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
21+50	19+50	R	200.00	10.00	6.00	2.00	0.0135	0.21	0.21	0.69	0.14	Seed	4.10	5	0.030	13.54	0.90	0.05	0.59	0.06	10.50
												Seed	4.74	10	0.040	13.98	0.80	0.07	0.68	0.08	10.66
19+50	19+00	R	50.00	10.00	4.00	2.00	0.0820	0.06	0.27	0.65	0.18	Seed	4.04	5	0.030	14.03	1.72	0.22	0.74	0.04	10.25
												Seed	4.67	10	0.040	14.53	1.52	0.28	0.85	0.06	10.33
19+00	18+50	R	50.00	10.00	3.00	3.00	0.1660*	0.09	0.36	0.60	0.24	Seed	4.00	5	0.030	14.38	2.34	0.42	0.95	0.04	10.24
							RCP					Jute Mat	3.99	5	0.040	14.45	1.97	0.49	0.95	0.05	10.29
												Temp. Mat	3.99	5	0.040	14.45	1.97	0.49	0.95	0.05	10.29
												Temp. Mat	4.61	10	0.040	14.92	2.08	0.54	1.10	0.05	10.31
18+50	17+50	R	100.00	10.00	2.00	2.00	0.0100	196.3	196.6	0.60	118.0	Seed	1.72	5	0.030	60.25	6.66	1.33	203.38	2.14	18.55
												Jute Mat	1.72	5	0.040	60.31	5.43	1.56	203.24	2.50	19.98
												Temp. Mat	1.72	5	0.040	60.31	5.43	1.56	203.24	2.50	19.98
												Perm, Type 1	1.72	5	0.040	60.31	5.43	1.56	203.24	2.50	19.98
												Perm, Type 1	2.03	10	0.040	60.29	5.70	1.70	239.95	2.73	20.91

DITCH ANALYSIS

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.)
17+50	17+00	R	50.00	10.00	3.00	2.00	0.0100	12.00	208.6	0.50	124.0	Seed	1.72	5	0.030	60.43	6.54	1.33	213.24	2.13	20.64
												Jute Mat	1.72	5	0.040	60.46	5.32	1.54	213.16	2.47	22.37
												Temp. Mat	1.72	5	0.040	60.46	5.32	1.54	213.16	2.47	22.37
												Perm, Type 1	1.72	5	0.040	60.46	5.32	1.54	213.16	2.47	22.37
												Perm, Type 1	2.03	10	0.040	60.44	5.58	1.68	251.70	2.70	23.48
17+00	16+50	R	50.00	10.00	3.00	2.00	0.0120	0.29	208.9	0.61	124.1	Seed	1.72	5	0.030	60.58	6.98	1.52	213.16	2.03	20.14
												Jute Mat	1.72	5	0.040	60.61	5.68	1.77	213.08	2.36	21.80
												Temp. Mat	1.72	5	0.040	60.61	5.68	1.77	213.08	2.36	21.80
												Perm, Type 1	1.72	5	0.040	60.61	5.68	1.77	213.08	2.36	21.80
												Perm, Type 1	2.03	10	0.040	60.58	5.95	1.93	251.64	2.57	22.86

DITCH ANALYSIS

PID : 19415 **Date :** 09/11/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 15+00 TO 17+00 Left **Designer :** KAG

JF

RFE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
15+00	16+00	L	100.00	2.00	6.00	4.00	0.0150	1.00	1.00	0.40	0.40	Seed	4.47	5	0.030	10.83	1.99	0.25	1.79	0.27	4.69
												Seed	5.22	10	0.040	10.98	1.69	0.31	2.09	0.34	5.36
16+00	17+00	L	100.00	2.00	3.00	2.00	0.0440	0.93	1.93	0.40	0.77	Seed	4.41	5	0.030	11.25	3.95	0.85	3.40	0.31	3.55
												Jute Mat	4.40	5	0.040	11.34	3.22	1.00	3.39	0.36	3.81
												Temp. Mat	4.40	5	0.040	11.34	3.22	1.00	3.39	0.36	3.81
												Temp. Mat	5.13	10	0.040	11.47	3.38	1.08	3.96	0.39	3.97

DITCH ANALYSIS

PID : 19415 **Date :** 09/11/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 20+50 TO 17+00 Left **Designer :** KAG

JF
BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
20+50	19+00	L	150.00	2.00	6.00	2.00	0.0070	0.10	0.10	0.50	0.05	Seed	4.17	5	0.030	13.01	0.80	0.05	0.21	0.11	2.86
												Seed	4.84	10	0.040	13.31	0.71	0.06	0.24	0.13	3.07
19+00	17+00	L	200.00	2.00	3.00	2.00	0.0170	0.70	0.80	0.65	0.51	Seed	4.00	5	0.030	14.37	2.42	0.32	2.02	0.30	3.52
												Seed	4.62	10	0.040	14.91	2.06	0.41	2.33	0.38	3.91

DITCH ANALYSIS

PID : 19415 **Date :** 09/11/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 20+50 TO 21+00 Left **Designer :** KAG JF BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type 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.)
20+50	21+00	L	50.00	2.00	6.00	3.00	0.0100	0.29	0.29	0.50	0.15	Seed	4.50	5	0.030	10.63	1.33	0.11	0.66	0.18	3.60
												Seed	5.26	10	0.040	10.73	1.13	0.14	0.77	0.23	4.03

HDR | ONE COMPANY *Many Solutions*℠

Client: ODOT Sheet: of

Subject: Ditch Runoff calc CR 28 sta 30+50 Order No:

Computed by: KAG Date: 8/22/2008

Checked by: Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C
Pavement Area	39447	0.91	0.9
Non-paved Area	475444	10.91	0.45
Other			
Total Area		**11.82**	**acres**

Weighted "C" = 0.48

Overland Flow

Length	130
High Elevation	960
Low Elevation	940
Slope %	15.38462

t_o 5.08 (1101.2.2)

Shallow Concentrated Flow

Length	1333
High Elevation	940
Low Elevation	730
Slope %	15.75394
k	0.076 (forest w/heavy ground litter - Table 1101-1)
V	0.989725 (1101.2.2)
t_s	22.44732 (1101.2.2)

Since the time of concentration = to + ts t_c **27.53** min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	11.82027	27.53	0.48	2.35	13.45
5 Years	118.822	18.7	0.969	11.82027	27.53	0.48	2.89	16.58
10 Years	112.172	16.8	0.923	11.82027	27.53	0.48	3.39	19.40
25 Years	198.92	19.3	1.004	11.82027	27.53	0.48	4.18	23.96
50 Years	206.025	19.6	0.99	11.82027	27.53	0.48	4.54	26.02
100 Years	355.551	23.199	1.076	11.82027	27.53	0.48	5.20	29.78

DITCH ANALYSIS

PID : 19415 **Date :** 09/24/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 32+50 TO 22+00 Left **Designer :** KAG

JF
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
32+50	30+00	L	250.00	2.00	6.00	4.00	0.0060	12.00	12.00	0.48	5.76	Seed	2.77	5	0.030	29.62	2.55	0.35	15.97	0.94	11.37
												Seed	3.23	10	0.040	29.93	2.14	0.42	18.59	1.13	13.34
30+00	25+50	L	450.00	2.00	6.00	4.00	0.0090	4.20	16.20	0.45	7.65	Seed	2.65	5	0.030	31.97	3.15	0.53	20.26	0.95	11.51
												Jute Mat	2.62	5	0.040	32.54	2.54	0.60	20.04	1.07	12.73
												Temp. Mat	2.62	5	0.040	32.54	2.54	0.60	20.04	1.07	12.73
												Temp. Mat	3.06	10	0.040	32.73	2.64	0.64	23.40	1.15	13.47
25+50	23+00	L	250.00	2.00	6.00	4.00	0.0240	2.01	18.21	0.44	8.54	Seed	2.58	5	0.030	33.43	4.63	1.19	21.99	0.79	9.95
												Jute Mat	2.57	5	0.040	33.64	3.74	1.35	21.90	0.90	11.01
												Temp. Mat	2.57	5	0.040	33.64	3.74	1.35	21.90	0.90	11.01
												Perm, Type 1	2.57	5	0.040	33.64	3.74	1.35	21.90	0.90	11.01
												Perm, Type 1	3.00	10	0.040	33.80	3.89	1.44	25.60	0.96	11.64
23+00	22+50	L	50.00	2.00	7.00	4.00	0.0400	0.08	18.29	0.59	8.58	Seed	2.56	5	0.030	33.80	5.48	1.72	21.96	0.69	9.60
												Jute Mat	2.56	5	0.040	33.83	4.43	1.96	21.94	0.78	10.63

DITCH ANALYSIS

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.)
												Temp. Mat	2.56	5	0.040	33.83	4.43	1.96	21.94	0.78	10.63
												Perm, Type 1	2.56	5	0.040	33.83	4.43	1.96	21.94	0.78	10.63
												Perm, Type 1	2.99	10	0.040	33.98	4.61	2.10	25.65	0.84	11.25
22+50	22+00	L	50.00	2.00	4.00	3.00	0.0500	0.09	18.37	0.57	8.63	Seed	2.55	5	0.030	33.96	6.57	2.29	22.02	0.73	7.14
												Jute Mat	2.55	5	0.040	33.99	5.31	2.62	22.00	0.84	7.88
												Temp. Mat	2.55	5	0.040	33.99	5.31	2.62	22.00	0.84	7.88
												Perm, Type 1	2.55	5	0.040	33.99	5.31	2.62	22.00	0.84	7.88
												Perm, Type 2	2.55	5	0.040	33.99	5.31	2.62	22.00	0.84	7.88
												Perm, Type 2	2.98	10	0.040	34.13	5.53	2.82	25.72	0.90	8.32

DITCH ANALYSIS

PID : 19415 **Date :** 08/16/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 21+50 TO 22+50 Right **Designer :** KAG JF BFE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
21+50	22+00	R	50.00	2.00	24.00	2.00	0.0100	0.06	0.06	0.64	0.04	Seed	4.43	5	0.030	11.11	0.72	0.05	0.18	0.08	4.09
												Seed	5.16	10	0.040	11.31	0.66	0.06	0.21	0.10	4.51
22+00	22+50	R	50.00	2.00	12.00	2.00	0.0160	0.09	0.15	0.57	0.09	Seed	4.33	5	0.030	11.78	1.22	0.11	0.38	0.11	3.58
												Seed	5.03	10	0.040	12.10	1.05	0.14	0.45	0.14	3.99

DITCH ANALYSIS

PID : 19415 **Date :** 08/16/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 27+00 TO 22+50 Right **Designer :** KAG

JF
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
27+00	23+00	R	400.00	10.00	6.00	4.00	0.0200	0.57	0.57	0.59	0.34	Seed	3.98	5	0.030	14.54	1.39	0.12	1.35	0.09	10.93
												Seed	4.59	10	0.040	15.13	1.22	0.15	1.55	0.12	11.20
23+00	22+50	R	50.00	10.00	5.00	2.00	0.0500	0.19	0.76	0.56	0.45	Seed	3.94	5	0.030	14.95	2.06	0.26	1.75	0.08	10.58
												Seed	4.53	10	0.040	15.59	1.82	0.33	2.02	0.11	10.75

DITCH ANALYSIS

PID : 19415 **Date :** 11/18/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 32+50 TO 36+00 Right **Designer :** BEE KAG BEE

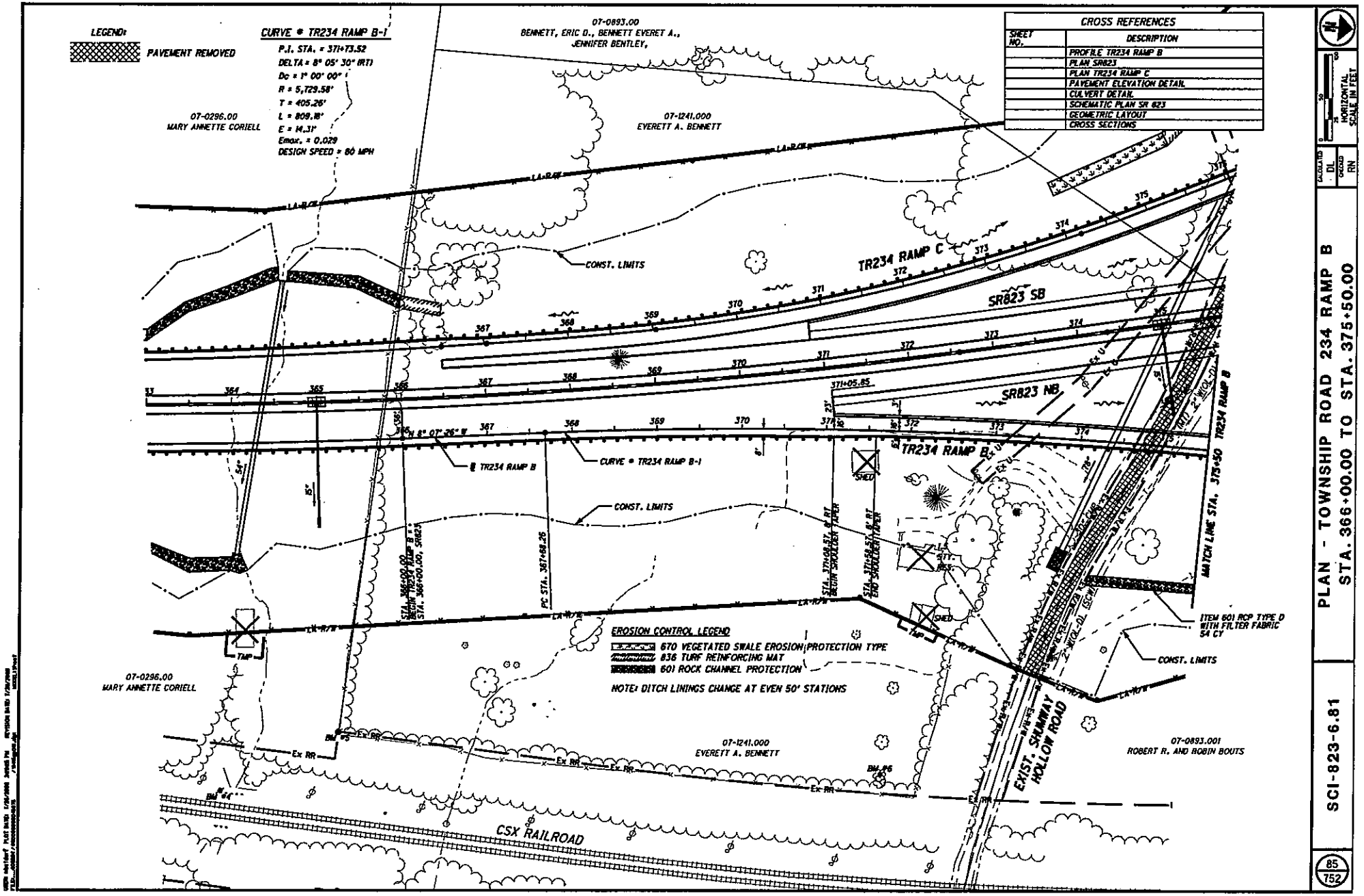
Rainfall Area : D

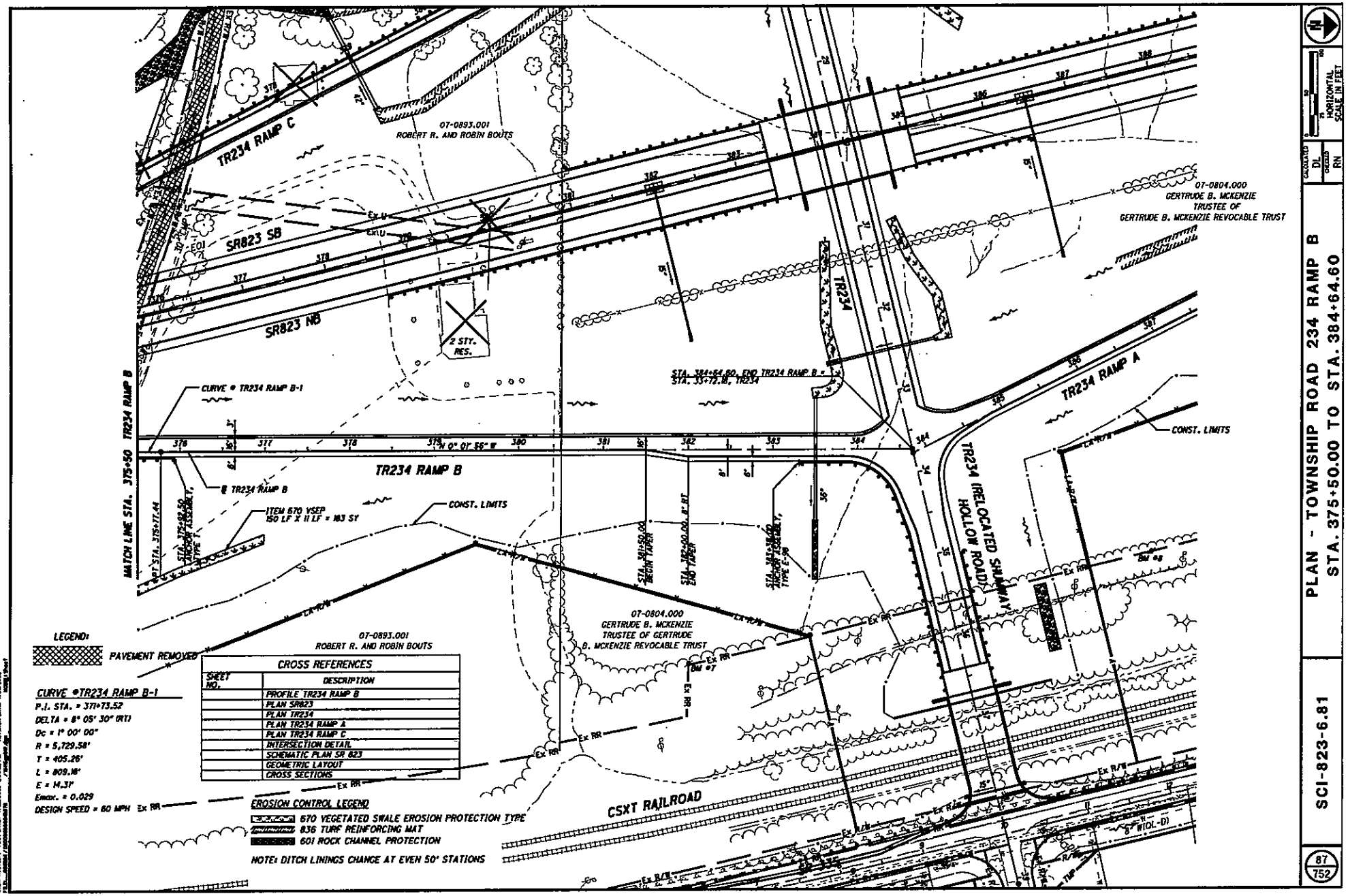
Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
32+50	36+00	R	350.00	4.00	7.20	4.00	0.0200	0.36	0.36	0.66	0.24	Seed	4.11	5	0.030	13.47	1.62	0.16	0.98	0.13	5.44
												Seed	4.74	10	0.040	14.00	1.41	0.20	1.13	0.16	5.83


LEGEND:
PAVEMENT REMOVED
CURVE # TR234 RAMP B-1
P.I. STA. = 371+73.52
DELTA = 8° 05' 30" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 405.26'
L = 809.18'
E = 14.31'
Emax. = 0.029
DESIGN SPEED = 60 MPH
07-0296.00
MARY ANNETTE CORIELL
07-0893.00
BENNETT, ERIC D., BENNETT EVERET A., JENNIFER BENTLEY,
07-1241.000
EVERETT A. BENNETT
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE TR234 RAMP B
PLAN SR823
PLAN TR234 RAMP C
PAVEMENT ELEVATION DETAIL
CULVERT DETAIL
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
CONST. LIMITS
TR234 RAMP C
SR823 SB
SR823 NB
371+05.85
TR234 RAMP B
℄ TR234 RAMP B
CURVE # TR234 RAMP B-1
N 8° 07' 26" W
SHED
STA. 366+00.00 BEGIN TR234 RAMP B SHOULDER TAPER
PC STA. 367+68.26
STA. 371+08.57, 8' RT BEGIN SHOULDER TAPER
STA. 371+58.57, 8' RT END SHOULDER TAPER
MATCH LINE STA. 375+50 TR234 RAMP B
ITEM 601 RCP TYPE D WITH FILTER FABRIC 54 CY
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
07-0296.00
MARY ANNETTE CORIELL
07-1241.000
EVERETT A. BENNETT
07-0893.001
ROBERT R. AND ROBIN BOUTS
EXIST. SKAWAY HOLLOW ROAD
CSX RAILROAD
Ex RR
BM #5
BM #6
TMP
HORIZONTAL SCALE IN FEET
CALCULATED DL
CHECKED RN
PLAN - TOWNSHIP ROAD 234 RAMP B
STA. 366+00.00 TO STA. 375+50.00
SCI-823-6.81
85
752


TR234 RAMP C
07-0893.001
ROBERT R. AND ROBIN BOUTS
SR823 SB
SR823 NB
2 STY. RES.
TR234
07-0804.000
GERTRUDE B. MCKENZIE
TRUSTEE OF
GERTRUDE B. MCKENZIE REVOCABLE TRUST
STA. 384+64.60, END TR234 RAMP B =
STA. 33+72.18, TR234
CURVE ⊕ TR234 RAMP B-1
TR234 RAMP A
CONST. LIMITS
MATCH LINE STA. 375+50 TR234 RAMP B
N 0° 01' 56" W
TR234 RAMP B
℄ TR234 RAMP B
ITEM 670 VSEP
150 LF X 11 LF = 183 SY
TR234 (RELOCATED SHAWNEY HOLLOW ROAD)
07-0804.000
GERTRUDE B. MCKENZIE
TRUSTEE OF GERTRUDE
B. MCKENZIE REVOCABLE TRUST
07-0893.001
ROBERT R. AND ROBIN BOUTS
CSXT RAILROAD
Ex RR
Ex R/W
LA R/W
BM #8
BM #7
8" W(OL-D)
LEGEND:
PAVEMENT REMOVED
CROSS REFERENCES
SHEET NO.
DESCRIPTION
PROFILE TR234 RAMP B
PLAN SR823
PLAN TR234
PLAN TR234 RAMP A
PLAN TR234 RAMP C
INTERSECTION DETAIL
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
CURVE ⊕TR234 RAMP B-1
P.I. STA. = 371+73.52
DELTA = 8° 05' 30" (RT)
Dc = 1° 00' 00"
R = 5,729.58'
T = 405.26'
L = 809.16'
E = 14.31'
Emax. = 0.029
DESIGN SPEED = 60 MPH
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
HORIZONTAL SCALE IN FEET
CALCULATED DL
CHECKED RN
PLAN - TOWNSHIP ROAD 234 RAMP B
STA. 375+50.00 TO STA. 384+64.60
SCI-823-6.81
87
752

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp B sections 373+00 TO 383+50 Left **Designer :** mdc KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
373+00	383+50	L	1050.0	10.00	6.00	4.00	0.0192	5.45	5.45	0.55	3.00	Seed	3.88	5	0.030	15.50	3.00	0.40	11.61	0.33	13.32
												Seed	4.43	10	0.040	16.33	2.59	0.51	13.28	0.42	14.23

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp B sections 378+50 TO 374+50 Right **Designer :** mdc KAG BEE

Rainfall Area : D

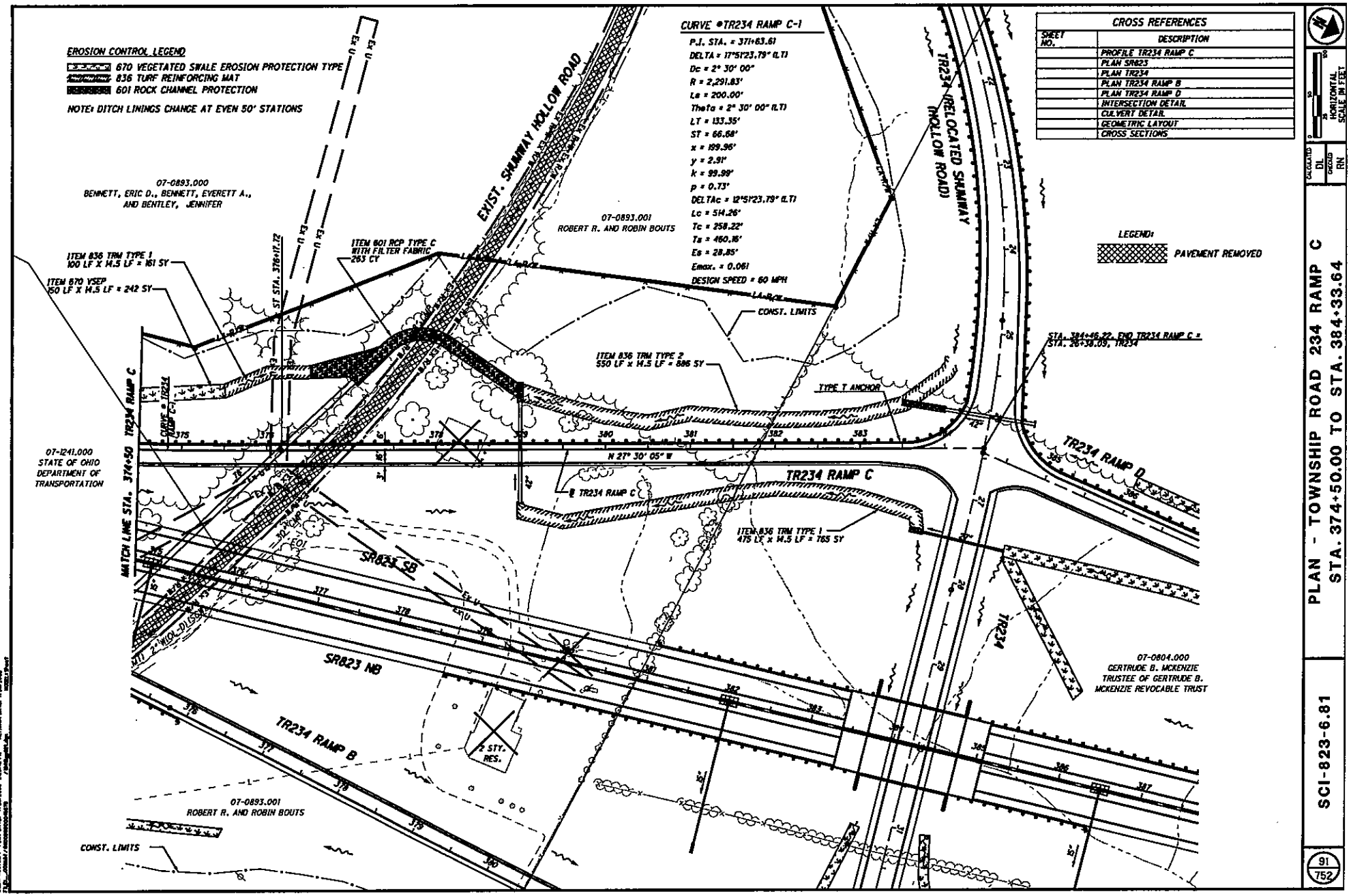
Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
378+50	377+00	R	150.00	10.00	4.00	4.00	0.0400	0.52	0.52	0.47	0.24	Seed	4.37	5	0.030	11.55	1.58	0.16	1.07	0.07	10.53
												Seed	5.09	10	0.040	11.74	1.41	0.21	1.24	0.09	10.68
377+00	375+50	R	150.00	10.00	4.00	4.00	0.0933	0.76	1.28	0.45	0.58	Seed	4.25	5	0.030	12.42	2.84	0.49	2.48	0.08	10.68
												Jute Mat	4.22	5	0.040	12.59	2.37	0.58	2.47	0.10	10.80
												Temp. Mat	4.22	5	0.040	12.59	2.37	0.58	2.47	0.10	10.80
												Temp. Mat	4.93	10	0.040	12.72	2.52	0.64	2.88	0.11	10.88
375+50	374+50	R	100.00	10.00	4.00	4.00	0.2100*	0.50	1.78	0.45	0.81	Seed	4.17	5	0.030	13.00	4.12	1.04	3.39	0.08	10.64
												Jute Mat	4.16	5	0.040	13.07	3.44	1.24	3.38	0.09	10.76
												Temp. Mat	4.16	5	0.040	13.07	3.44	1.24	3.38	0.09	10.76
												Perm, Type 1	4.16	5	0.040	13.07	3.44	1.24	3.38	0.09	10.76
												Perm, Type 1	4.86	10	0.040	13.17	3.65	1.36	3.95	0.10	10.83

RCP D


EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
CURVE #TR234 RAMP C-1
P.I. STA. = 371+63.61
DELTA = 17°51'23.79" (LT)
Dc = 2° 30' 00"
R = 2,291.83'
Le = 200.00'
Theta = 2° 30' 00" (LT)
LT = 133.35'
ST = 66.68'
x = 199.96'
y = 2.91'
k = 99.99'
p = 0.73'
DELTAc = 12°51'23.79" (LT)
Lc = 514.26'
Tc = 258.22'
Ts = 460.16'
Es = 28.85'
Emax. = 0.061
DESIGN SPEED = 60 MPH
CROSS REFERENCES
SHEET NO. DESCRIPTION
PROFILE TR234 RAMP C
PLAN SR823
PLAN TR234
PLAN TR234 RAMP B
PLAN TR234 RAMP D
INTERSECTION DETAIL
CULVERT DETAIL
GEOMETRIC LAYOUT
CROSS SECTIONS
LEGEND:
PAVEMENT REMOVED
EXIST. SHAWAY HOLLOW ROAD
TR234 (RELOCATED SHAWAY HOLLOW ROAD)
07-0893.000
BENNETT, ERIC D., BENNETT, EVERETT A., AND BENTLEY, JENNIFER
07-0893.001
ROBERT R. AND ROBIN BOUTS
ITEM 836 TRM TYPE 1
100 LF X 14.5 LF = 161 SY
ITEM 670 VSEP
150 LF X 14.5 LF = 242 SY
ITEM 601 RCP TYPE C WITH FILTER FABRIC
263 CY
ITEM 836 TRM TYPE 2
550 LF x 14.5 LF = 886 SY
ITEM 836 TRM TYPE 1
475 LF x 14.5 LF = 765 SY
TYPE T ANCHOR
CONST. LIMITS
STA. 384+46.22, END TR234 RAMP C = STA. 26+38.09, TR234
MATCH LINE STA. 374+50 TR234 RAMP C
07-1241.000
STATE OF OHIO DEPARTMENT OF TRANSPORTATION
TR234 RAMP C
℄ TR234 RAMP C
N 27° 30' 05" W
TR234 RAMP D
SR823 SB
SR823 NB
TR234 RAMP B
TR234
2 STY. RES.
07-0804.000
GERTRUDE B. MCKENZIE TRUSTEE OF GERTRUDE B. MCKENZIE REVOCABLE TRUST
07-0893.001
ROBERT R. AND ROBIN BOUTS
CONST. LIMITS
HORIZONTAL SCALE IN FEET
CALCULATED DL
CHECKED RN
PLAN - TOWNSHIP ROAD 234 RAMP C
STA. 374+50.00 TO STA. 384+33.64
SCI-823-6.81
91
752

DITCH ANALYSIS

PID : 19415 **Date :** 09/02/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234 , 373+00 RTTO 377+07 LT **Designer :** KAG KMO BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
373+00	374+00	L	100.00	10.00	3.00	2.00	0.0430	0.61	0.61	0.51	0.31	Seed	4.46	5	0.030	10.91	1.81	0.20	1.39	0.08	10.38
												Seed	5.21	10	0.040	11.02	1.62	0.26	1.62	0.10	10.49
374+00	375+50	L	250.00	10.00	4.00	3.00	0.0200	5.40	6.01	0.43	2.63	Seed	4.27	5	0.030	12.23	3.10	0.41	11.25	0.33	12.28
												Temp. Mat	4.24	5	0.040	12.50	2.56	0.48	11.16	0.38	12.69
												Temp. Mat	4.96	10	0.040	12.54	2.70	0.53	13.06	0.42	12.95
375+50	376+50	L	100.00	10.00	3.00	2.00	0.0900	0.05	6.06	0.90	2.68	Seed	4.19	5	0.030	12.83	5.07	1.18	11.23	0.21	11.05
												Temp. Mat	4.19	5	0.040	12.90	4.23	1.40	11.21	0.25	11.25
												Perm, Type 1	4.19	5	0.040	12.90	4.23	1.40	11.21	0.25	11.25
												Perm, Type 1	4.90	10	0.040	12.91	4.48	1.54	13.13	0.27	11.37
376+50	377+00	L	50.00	10.00	3.00	2.00	0.2000*	0.53	6.59	0.42	2.90	Seed	4.17	5	0.030	13.02	6.68	2.17	12.09	0.17	10.87
												Temp. Mat	4.17	5	0.040	13.05	5.58	2.57	12.08	0.21	11.03
												Perm, Type 1	4.17	5	0.040	13.05	5.58	2.57	12.08	0.21	11.03
												Perm, Type 2	4.17	5	0.040	13.05	5.58	2.57	12.08	0.21	11.03

RCPC

DITCH ANALYSIS

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.)
												Perm, Type 2	4.88	10	0.040	13.05	5.93	2.82	14.16	0.23	11.13

DITCH ANALYSIS

PID : 19415 **Date :** 10/01/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp C sections 371+00 TO 379+00 Right **Designer :** KAG KMO BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
371+00	373+00	R	200.00	0.00	4.00	4.00	0.0020	0.29	0.29	0.69	0.20	Seed	4.08	5	0.030	13.78	0.85	0.06	0.82	0.49	3.91
												Seed	4.66	10	0.040	14.55	0.71	0.07	0.93	0.57	4.60
373+00	375+50	R	250.00	0.00	4.00	4.00	0.0100	0.53	0.82	0.58	0.51	Seed	3.83	5	0.030	15.90	1.93	0.31	1.95	0.50	4.02
												Seed	4.34	10	0.040	17.10	1.61	0.37	2.20	0.59	4.68
375+50	379+00	R	350.00	6.00	2.00	2.00	0.0170	1.32	2.14	0.51	1.18	Seed	3.60	5	0.030	18.19	2.48	0.28	4.25	0.26	7.05
												Seed	4.05	10	0.040	19.75	2.15	0.35	4.78	0.33	7.33

DITCH ANALYSIS

PID : 19415 **Date :** 06/25/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR 234, 18+00 to Ramp C 379+00 Right **Designer :** KAG KMD BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
18+00	20+00	R	200.00	5.00	4.00	2.00	0.0250	0.65	0.65	0.50	0.32	Seed	4.35	5	0.030	11.68	1.93	0.21	1.40	0.13	5.81
												Seed	5.06	10	0.040	11.91	1.71	0.27	1.63	0.17	6.04
20+00	24+00	R	400.00	10.00	3.00	0.50	0.0110	1.09	1.73	0.57	0.94	Seed	3.89	5	0.030	15.35	1.74	0.14	3.67	0.20	10.71
												Seed	4.47	10	0.040	16.06	1.53	0.18	4.21	0.26	10.92
24+00	25+50	R	150.00	10.00	3.00	2.00	0.0280	0.39	2.13	0.62	1.19	Seed	3.79	5	0.030	16.35	2.49	0.30	4.49	0.17	10.86
												Seed	4.33	10	0.040	17.19	2.19	0.39	5.13	0.22	11.11
25+50	26+00	R	67.00	10.00	3.00	2.00	0.1454*	0.14	2.27	0.63	1.28	Seed	3.76	5	0.030	16.61	4.25	1.00	4.79	0.11	10.55
Rock												Jute Mat	3.75	5	0.040	16.66	3.56	1.18	4.79	0.13	10.65
												Temp. Mat	3.75	5	0.040	16.66	3.56	1.18	4.79	0.13	10.65
												Perm, Type 1	3.75	5	0.040	16.66	3.56	1.18	4.79	0.13	10.65
												Perm, Type 1	4.29	10	0.040	17.49	3.74	1.28	5.48	0.14	10.71
26+00	379+00	R	500.00	10.00	3.00	2.00	0.0058	18.60	20.87	0.40	8.72	Seed	3.49	5	0.030	19.39	2.98	0.31	30.43	0.84	14.22
												Seed	3.96	10	0.040	20.67	2.55	0.39	34.49	1.07	15.33

DITCH ANALYSIS

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.)
379+00	377+50	L	150.00	10.00	4.00	3.00	0.1000*	2.60	23.47	0.59	10.25	Seed	3.46	5	0.030	19.71	7.81	2.49	35.50	0.40	12.79
												Jute Mat	3.46	5	0.040	19.78	6.47	2.94	35.44	0.47	13.29
												Temp. Mat	3.46	5	0.040	19.78	6.47	2.94	35.44	0.47	13.29
												Perm, Type 1	3.46	5	0.040	19.78	6.47	2.94	35.44	0.47	13.29
												Perm, Type 2	3.46	5	0.040	19.78	6.47	2.94	35.44	0.47	13.29
												Perm, Type 2	3.92	10	0.040	21.04	6.75	3.16	40.19	0.51	13.54
377+50	377+07	R	43.00	10.00	4.00	3.00	0.0300	0.23	23.70	0.45	10.36	Seed	3.45	5	0.030	19.91	5.26	1.06	35.69	0.57	13.96
												Jute Mat	3.44	5	0.040	19.94	4.34	1.25	35.66	0.67	14.67
												Temp. Mat	3.44	5	0.040	19.94	4.34	1.25	35.66	0.67	14.67
												Perm, Type 1	3.44	5	0.040	19.94	4.34	1.25	35.66	0.67	14.67
												Perm, Type 1	3.91	10	0.040	21.20	4.52	1.34	40.45	0.72	15.01

DITCH ANALYSIS

PID : 19415 **Date :** 10/01/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp C sections 28+50 TO 379+00 Right **Designer :** KAG

KmD
BEE

Rainfall Area : D

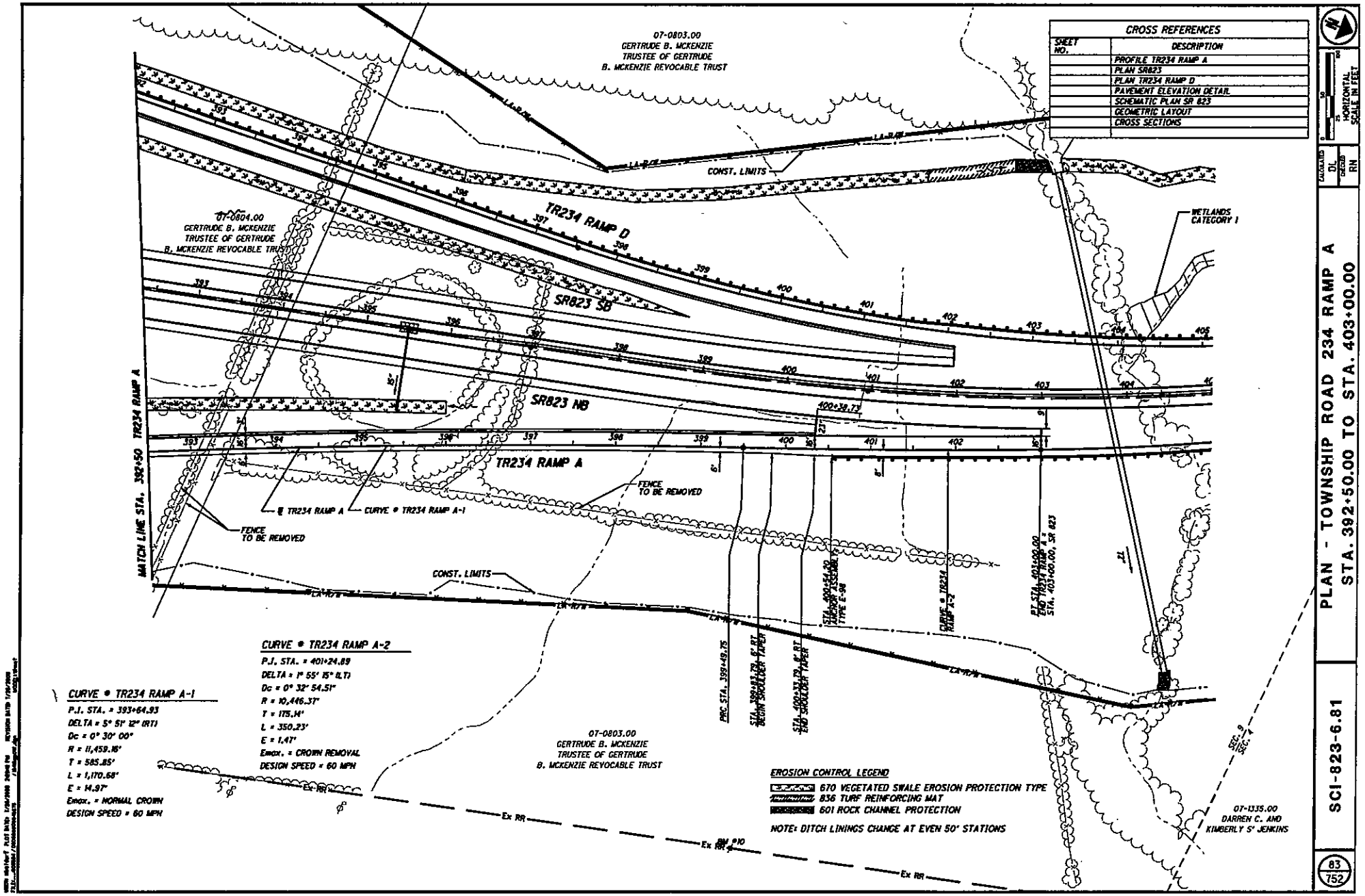
Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
28+00	27+50	R	50.00	10.00	6.00	6.00	0.0320	0.21	0.21	0.53	0.11	Seed	4.48	5	0.030	10.76	1.07	0.09	0.49	0.04	10.53
												Seed	5.24	10	0.040	10.85	0.95	0.12	0.57	0.06	10.69
27+50	383+50	R	50.00	10.00	6.00	6.00	0.0400	6.75	6.96	0.45	3.15	Seed	4.29	5	0.030	12.11	3.95	0.73	13.50	0.29	13.49
												Jute Mat	4.28	5	0.040	12.15	3.27	0.85	13.48	0.34	14.11
												Temp. Mat	4.28	5	0.040	12.15	3.27	0.85	13.48	0.34	14.11
												Temp. Mat	5.02	10	0.040	12.14	3.44	0.94	15.81	0.37	14.50
383+50	379+00	R	450.00	10.00	6.00	4.00	0.0500	2.79	9.75	0.50	4.54	Seed	4.09	5	0.030	13.68	4.83	1.03	18.56	0.33	13.30
												Jute Mat	4.05	5	0.040	14.01	3.98	1.21	18.39	0.39	13.87
												Temp. Mat	4.05	5	0.040	14.01	3.98	1.21	18.39	0.39	13.87
												Perm, Type 1	4.05	5	0.040	14.01	3.98	1.21	18.39	0.39	13.87
												Perm, Type 1	4.76	10	0.040	13.90	4.20	1.32	21.60	0.42	14.25

PLAN - TOWNSHIP ROAD 234 RAMP A
STA. 383+82.82 TO STA. 392+50.00
SCI-823-6.81
81
752
CALCULATED DL
CHECKED RN
HORIZONTAL SCALE IN FEET
CROSS REFERENCES
SHEET NO.
DESCRIPTION
PROFILE TR234 RAMP A
PLAN SR823
PLAN TR234
PLAN TR234 RAMP B
PLAN SR335
INTERSECTION DETAIL
SCHEMATIC PLAN SR 823
GEOMETRIC LAYOUT
CROSS SECTIONS
CURVE ⊕ TR234 RAMP A - 1
P.I. STA. = 393+64.93
DELTA = 5° 51' 12" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 585.85'
L = 1,170.68'
E = 14.97'
Emax. = NORMAL CROWN
DESIGN SPEED = 60 MPH
07-0804.000
GERTRUDE B. MCKENZIE / TRUSTEE OF GERTRUDE / B. MCKENZIE REVOCABLE TRUST
SR823 SB
SR823 NB
TR234 RAMP A
TR234 RAMP B
CSXT RAILROAD
SR335
MATCH LINE STA. 392+50 TR234 RAMP A
ITEM 670 VSEP
600 LF x 14.5 LF = 965 SY
ITEM 836 TRM TYPE I
500 LF x 14.5 LF = 483 SY
CURVE ⊕ TR234 RAMP A-1
CONST. LIMITS
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYP
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
TR234 RELOCATED SHAMWAY (HOLLOW RD)
07-0893.001
ROBERT R. AND ROBIN BOUTS
CHURCH OF CHRIST COMMUNITY, INC., AN OHIO CORPORATION (NOT FOR PROFIT)



CROSS REFERENCES	
SHEET NO.	DESCRIPTION
	PROFILE TR234 RAMP A
	PLAN SR823
	PLAN TR234 RAMP D
	PAVEMENT ELEVATION DETAIL
	SCHEMATIC PLAN SR 823
	GEOMETRIC LAYOUT
	CROSS SECTIONS

HORIZONTAL SCALE IN FEET
0 25 50

CALCULATED DL
CHECKED RN

CURVE ⊕ TR234 RAMP A-1

P.I. STA. = 393+64.93
DELTA = 5° 51' 12" (RT)
Dc = 0° 30' 00"
R = 11,459.16'
T = 585.85'
L = 1,170.68'
E = 14.97'
Emax. = NORMAL CROWN
DESIGN SPEED = 60 MPH

CURVE ⊕ TR234 RAMP A-2

P.I. STA. = 401+24.89
DELTA = 1° 55' 15" (LT)
Dc = 0° 32' 54.51"
R = 10,446.37'
T = 175.14'
L = 350.23'
E = 1.41'
Emax. = CROWN REMOVAL
DESIGN SPEED = 60 MPH

EROSION CONTROL LEGEND

670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION

NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS

PLAN - TOWNSHIP ROAD 234 RAMP A
STA. 392+50.00 TO STA. 403+00.00

SCI-823-6.81

83
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/04/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp A sections 400+00 TO 385+00 Left **Designer :** KMD

KAG
BEE

Rainfall Area : D

Allowable Shears

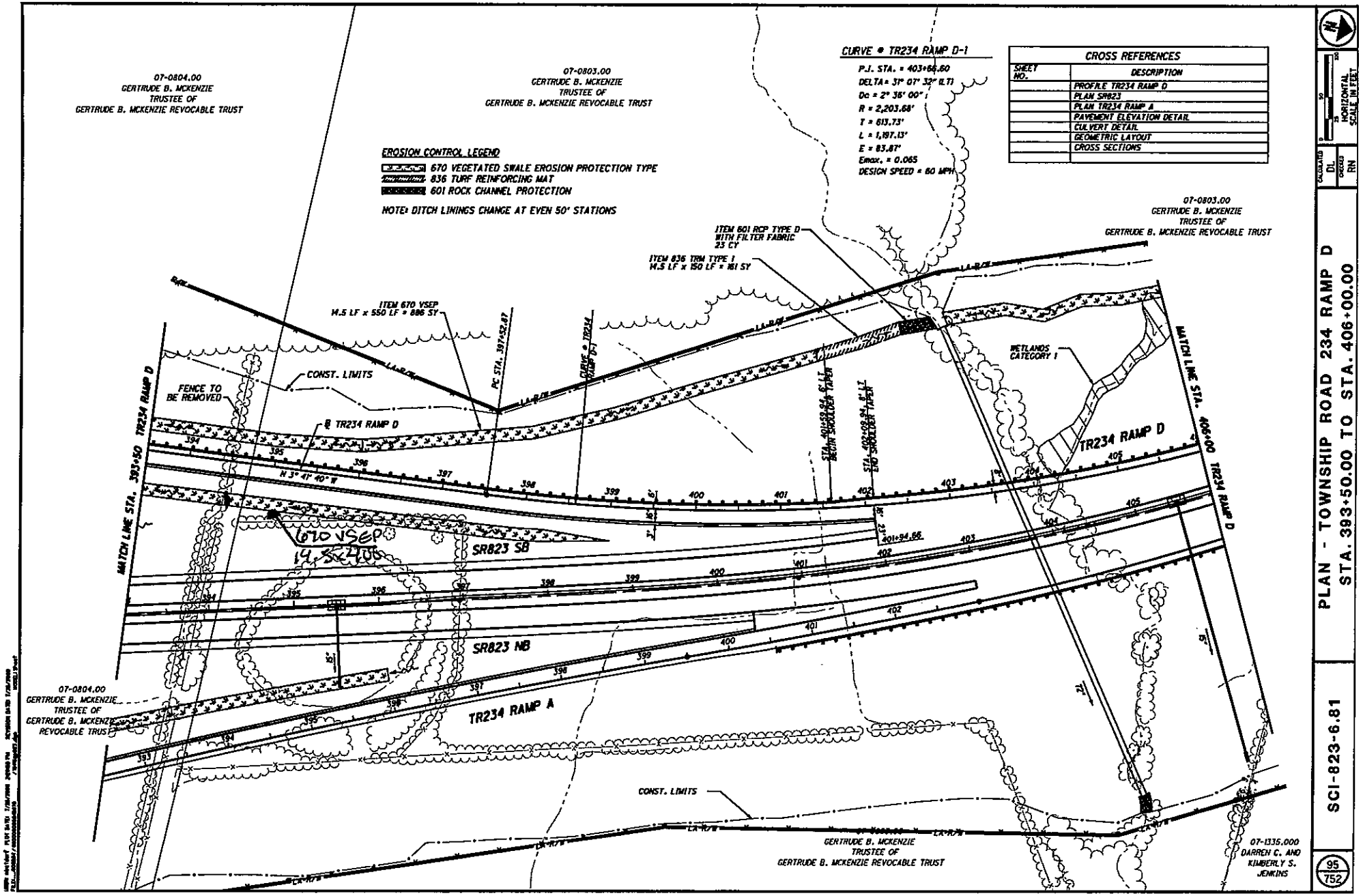
	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

(*) 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.)
400+00	395+50	L	450.00	10.00	6.00	4.00	0.0520	0.66	0.66	0.57	0.37	Seed	4.09	5	0.030	13.65	1.97	0.24	1.53	0.08	10.75
												Seed	4.73	10	0.040	14.12	1.74	0.32	1.77	0.10	10.97
395+50	395+00	L	50.00	10.00	6.00	4.00	0.0580	1.47	2.13	0.87	1.66	Seed	4.06	5	0.030	13.88	3.54	0.63	6.73	0.17	11.75
												Jute Mat	4.06	5	0.040	13.93	2.94	0.75	6.72	0.21	12.07
												Temp. Mat	4.06	5	0.040	13.93	2.94	0.75	6.72	0.21	12.07
												Temp. Mat	4.69	10	0.040	14.39	3.10	0.82	7.76	0.23	12.25
395+00	390+00	L	500.00	10.00	6.00	4.00	0.0562	1.91	4.04	0.51	2.63	Seed	3.83	5	0.030	15.95	4.05	0.78	10.07	0.22	12.24
												Jute Mat	3.78	5	0.040	16.36	3.35	0.92	9.95	0.26	12.63
												Temp. Mat	3.78	5	0.040	16.36	3.35	0.92	9.95	0.26	12.63
												Temp. Mat	4.39	10	0.040	16.69	3.53	1.00	11.54	0.29	12.86
390+00	387+00	L	300.00	10.00	6.00	4.00	0.0617	1.72	5.76	0.47	3.44	Seed	3.67	5	0.030	17.46	4.52	0.96	12.63	0.25	12.48
												Jute Mat	3.65	5	0.040	17.68	3.74	1.13	12.56	0.29	12.93
												Temp. Mat	3.65	5	0.040	17.68	3.74	1.13	12.56	0.29	12.93

DITCH ANALYSIS

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.)
												Perm, Type 1	3.65	5	0.040	17.68	3.74	1.13	12.56	0.29	12.93
												Perm, Type 1	4.24	10	0.040	17.95	3.94	1.23	14.59	0.32	13.19
387+00	386+50	L	50.00	10.00	6.00	4.00	0.0060	0.33	6.10	0.46	3.59	Seed	3.61	5	0.030	18.07	2.11	0.18	12.98	0.49	14.93
												Seed	4.19	10	0.040	18.40	1.82	0.24	15.06	0.63	16.29
386+50	386+00	L	50.00	10.00	6.00	4.00	0.0060	0.80	6.90	0.71	4.16	Seed	3.58	5	0.030	18.45	2.21	0.20	14.89	0.53	15.32
												Seed	4.14	10	0.040	18.84	1.90	0.25	17.25	0.68	16.78
386+00	385+00	L	100.00	10.00	6.00	4.00	0.0065	0.75	7.65	0.45	4.50	Seed	3.51	5	0.030	19.17	2.31	0.22	15.80	0.54	15.38
												Seed	4.06	10	0.040	19.67	1.99	0.28	18.25	0.68	16.84


07-0804.00
GERTRUDE B. MCKENZIE
TRUSTEE OF
GERTRUDE B. MCKENZIE REVOCABLE TRUST
07-0803.00
GERTRUDE B. MCKENZIE
TRUSTEE OF
GERTRUDE B. MCKENZIE REVOCABLE TRUST
CURVE # TR234 RAMP D-1
P.I. STA. = 403+66.60
DELTA = 31° 07' 32" (LT)
Dc = 2° 35' 00"
R = 2,203.68'
T = 613.73'
L = 1,197.13'
E = 83.87'
Emax. = 0.065
DESIGN SPEED = 60 MPH
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE TR234 RAMP D
PLAN SR823
PLAN TR234 RAMP A
PAVEMENT ELEVATION DETAIL
CULVERT DETAIL
GEOMETRIC LAYOUT
CROSS SECTIONS
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
ITEM 601 RCP TYPE D WITH FILTER FABRIC 23 CY
ITEM 836 TRM TYPE I 14.5 LF x 150 LF = 181 SY
ITEM 670 VSEP 14.5 LF x 550 LF = 886 SY
PC STA. 397+52.87
CURVE # TR234 RAMP D-1
STA. 401+53.94 6'-1" BEGIN SHOULDER TAPER
STA. 402+94.94 6'-1" END SHOULDER TAPER
WETLANDS CATEGORY I
MATCH LINE STA. 393+50 TR234 RAMP D
MATCH LINE STA. 406+00 TR234 RAMP D
FENCE TO BE REMOVED
CONST. LIMITS
℄ TR234 RAMP D
N 3° 41' 40" W
670 VSEP
14.5x206
SR823 SB
SR823 NB
TR234 RAMP A
TR234 RAMP D
401+94.66
CONST. LIMITS
GERTRUDE B. MCKENZIE
TRUSTEE OF
GERTRUDE B. MCKENZIE REVOCABLE TRUST
07-1335.000
DARREN C. AND
KIMBERLY S.
JENKINS
HORIZONTAL SCALE IN FEET
CALCULATED DL
CHECKED RN
PLAN - TOWNSHIP ROAD 234 RAMP D
STA. 393+50.00 TO STA. 406+00.00
SCI-823-6.81
95
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp D sections 398+50 TO 385+00 Right

Designer : KMD
Checked KAG
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
398+50	387+00	R	1150.0	10.00	6.00	3.00	0.0331	3.16	3.16	0.51	1.61	Seed	3.80	5	0.030	16.22	2.88	0.40	6.13	0.20	11.76
												Jute Mat	3.67	5	0.040	17.48	2.37	0.47	5.92	0.23	12.04
												Temp. Mat	3.67	5	0.040	17.48	2.37	0.47	5.92	0.23	12.04
Rock 394+50												Temp. Mat	4.34	10	0.040	17.07	2.51	0.52	7.01	0.25	12.26
387+00	385+00	R	200.00	10.00	6.00	3.00	0.0620	0.50	3.67	0.45	1.84	Seed	3.58	5	0.030	18.40	3.60	0.66	6.59	0.17	11.53
												Jute Mat	3.57	5	0.040	18.59	3.00	0.78	6.56	0.20	11.81
												Temp. Mat	3.57	5	0.040	18.59	3.00	0.78	6.56	0.20	11.81
												Temp. Mat	4.22	10	0.040	18.10	3.19	0.86	7.77	0.22	11.99

DITCH ANALYSIS

PID : 19415 **Date :** 06/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp D sections 396+00 to 385+00

Designer : KMD
checked: KAG

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
396+00	386+50	L	950.00	10.00	3.00	2.00	0.0285	9.38	9.38	0.43	4.03	Seed	4.08	5	0.030	13.74	4.06	0.66	16.45	0.37	11.86
												Jute Mat	3.99	5	0.040	14.50	3.35	0.77	16.08	0.43	12.17
												Temp. Mat	3.99	5	0.040	14.50	3.35	0.77	16.08	0.43	12.17
												Temp. Mat	4.71	10	0.040	14.26	3.55	0.85	18.97	0.48	12.39
386+50	385+00	L	150.00	10.00	3.00	0.50	0.0253	1.46	10.84	0.51	4.78	Seed	3.92	5	0.030	15.10	4.15	0.66	18.73	0.42	11.47
Rock												Jute Mat	3.91	5	0.040	15.22	3.45	0.79	18.67	0.50	11.74
												Temp. Mat	3.91	5	0.040	15.22	3.45	0.79	18.67	0.50	11.74
												Temp. Mat	4.61	10	0.040	14.93	3.66	0.87	22.04	0.55	11.92

DITCH ANALYSIS

PID : 19415 **Date :** 06/01/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp D sections 396+00 to 403+50

Designer : KMD
checked KAG
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00	
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
	RCP	**Type 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.)
396+00	399+00	L	300.00	10.00	4.00	4.00	0.0197	2.18	2.18	0.45	0.98	Seed	4.27	5	0.030	12.28	2.14	0.22	4.19	0.18	11.46
												Seed	4.95	10	0.040	12.58	1.88	0.29	4.86	0.24	11.89
399+00	400+00	L	100.00	10.00	4.00	4.00	0.0500	0.83	3.01	0.44	1.35	Seed	4.20	5	0.030	12.79	3.20	0.52	5.65	0.17	11.32
												Jute Mat	4.19	5	0.040	12.90	2.67	0.61	5.64	0.20	11.57
												Temp. Mat	4.19	5	0.040	12.90	2.67	0.61	5.64	0.20	11.57
												Temp. Mat	4.86	10	0.040	13.17	2.82	0.67	6.55	0.21	11.71
400+00	401+50	L	150.00	10.00	4.00	4.00	0.0327	1.29	4.30	0.44	1.91	Seed	4.09	5	0.030	13.68	3.15	0.46	7.82	0.23	11.82
												Jute Mat	4.07	5	0.040	13.84	2.62	0.55	7.78	0.27	12.15
												Temp. Mat	4.07	5	0.040	13.84	2.62	0.55	7.78	0.27	12.15
												Temp. Mat	4.73	10	0.040	14.07	2.76	0.60	9.05	0.29	12.35
401+50	402+00	L	50.00	10.00	4.00	4.00	0.1040*	0.41	4.71	0.45	2.10	Seed	4.05	5	0.030	14.02	4.69	1.10	8.50	0.17	11.36
												Jute Mat	4.04	5	0.040	14.05	3.91	1.30	8.49	0.20	11.61
												Temp. Mat	4.04	5	0.040	14.05	3.91	1.30	8.49	0.20	11.61

RCP D

DITCH ANALYSIS

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.)
												Perm, Type 1	4.04	5	0.040	14.05	3.91	1.30	8.49	0.20	11.61
												Perm, Type 1	4.70	10	0.040	14.27	4.13	1.43	9.88	0.22	11.76
402+00	403+00	L	100.00	10.00	4.00	4.00	0.0740	0.58	5.29	0.54	2.41	Seed	4.00	5	0.030	14.43	4.41	0.93	9.65	0.20	11.62
												Jute Mat	3.99	5	0.040	14.51	3.67	1.11	9.63	0.24	11.91
												Temp. Mat	3.99	5	0.040	14.51	3.67	1.11	9.63	0.24	11.91
												Perm, Type 1	3.99	5	0.040	14.51	3.67	1.11	9.63	0.24	11.91
												Perm, Type 1	4.65	10	0.040	14.69	3.88	1.21	11.21	0.26	12.09
403+00	403+50	L	50.00	10.00	4.00	4.00	0.0320	0.28	5.58	0.58	2.58	Seed	3.96	5	0.030	14.75	3.45	0.53	10.21	0.27	12.14
												Jute Mat	3.96	5	0.040	14.80	2.86	0.63	10.20	0.32	12.53
												Temp. Mat	3.96	5	0.040	14.80	2.86	0.63	10.20	0.32	12.53
												Temp. Mat	4.61	10	0.040	14.97	3.02	0.69	11.88	0.35	12.77

CURVE # CR28 RAMP A - 2	
P.I. STA. 525+50.54	k = 129.87'
Δ = 40° 10' 22" (RT)	p = 3.68'
Dc = 7° 30' 00"	Δc = 30° 25' 22" (RT)
R = 763.94'	Lc = 405.64'
Ls = 260.00'	Tc = 207.72
θ = 9° 45' 00" (RT)	Ts = 285.07'
LT = 173.60'	Es = 51.45'
ST = 86.91'	Emax = 0.08
x = 259.25'	DESIGN SPEED = 50 MPH
y = 14.72'	

CURVE # CR28 RAMP A - 3	
P.I. STA. 531+98.00	k = 87.47'
Δ = 22° 58' 26" (LT)	p = 1.45'
Dc = 6° 30' 00"	Δc = 11° 35' 56" (LT)
R = 881.47'	Lc = 178.44'
Ls = 175.00'	Tc = 89.53
θ = 5° 41' 15" (LT)	Ts = 266.89
LT = 116.73'	Es = 19.49'
ST = 58.39'	Emax = 0.063
x = 174.83'	DESIGN SPEED = 40 MPH
y = 5.79'	

CROSS REFERENCES	
SHEET NO.	DESCRIPTION
	PROFILE CR28 RAMP A
	PLAN SR823
	PLAN CR28 RAMP B
	PAVEMENT ELEVATION DETAILS
	DRAINAGE PROFILES
	GEOMETRIC LAYOUT
	CROSS SECTIONS

EROSION CONTROL LEGEND

- 670 VEGETATED SWALE EROSION PROTECTION TYPE
- 838 TURF REINFORCING MAT
- 601 ROCK CHANNEL PROTECTION

NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS

MATCH LINE STA. 528+00 CR28 RAMP A

CR28 RAMP A

CR28 RAMP B

CR28 (LUCASVILLE-MINFORD ROAD)

ITEM 670 VSEP
14.5 LF x 250 LF = 403 SY

ITEM 670 VSEP
14.5 LF x 550 LF = 886 SY

6" CONCRETE MEDIAN

CB 2-28

CB 3

ST STA. 534+59.55

STA. 537+19.55 END CR28 RAMP A =
STA. 29+34.96 CR28

CONST. LIMITS

CURVE # CR28 RAMP A-3

CS Sta. 532+84.55

SC Sta. 531+06.11

STA. 532+84.55 CR28 RAMP A BEGIN TAPER

STA. 533+00.00 6" RT. END TAPER

10-0396.000
STATE OF OHIO

10-0396.000
STATE OF OHIO

10-1403.000
STATE OF OHIO

10-1355.000
STATE OF OHIO

10-1356.000
STATE OF OHIO

10-0831.001
STATE OF OHIO

10-1357.000
EDWARD AND
STATE OF OHIO

10-0831.002
STATE OF OHIO

10-1358.000
STATE OF OHIO

10-0831.004
STATE OF OHIO

10-1283.000
STATE OF OHIO

10-1264.000
STATE OF OHIO

10-1265.000
STATE OF OHIO

10-1359.000
JAMES W. AND
MINERVA K. HAMMOND

HORIZONTAL SCALE IN FEET
0 25 50

CALDWELL NAB
CHECKED L.BD

PLAN - CR28 INTERCHANGE, RAMP A
STA. STA. 528+00.00 TO STA. 537+19.55

SCI-823-6.81

101
752

DITCH ANALYSIS

PID : 19415 **Date :** 05/27/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 519+50 TO 533+50 Right **Designer :** kmd

KAG
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.00	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
519+50	524+50	R	500.00	10.00	3.00	2.00	0.0162	1.23	1.23	0.58	0.71	Seed	3.99	5	0.030	14.46	1.77	0.16	2.85	0.16	10.78
												Seed	4.60	10	0.040	15.03	1.56	0.20	3.29	0.20	11.00
524+50	529+50	R	500.00	10.00	4.00	2.00	0.0435	1.48	2.71	0.49	1.44	Seed	3.71	5	0.030	17.13	3.03	0.45	5.34	0.17	11.01
												Temp. Mat	3.65	5	0.040	17.66	2.52	0.53	5.26	0.20	11.18
												Temp. Mat	4.23	10	0.040	18.06	2.66	0.58	6.09	0.21	11.29
529+50	531+00	R	150.00	10.00	4.00	4.00	0.0950	0.25	2.96	0.46	1.55	Seed	3.59	5	0.030	18.29	3.89	0.81	5.58	0.14	11.09
												Temp. Mat	3.58	5	0.040	18.42	3.25	0.95	5.56	0.16	11.29
												Temp. Mat	4.15	10	0.040	18.78	3.43	1.04	6.44	0.18	11.40
531+00	534+50	R	350.00	10.00	4.00	4.00	0.0520	0.71	3.66	0.45	1.87	Seed	3.43	5	0.030	20.11	3.39	0.57	6.41	0.18	11.41
												Temp. Mat	3.40	5	0.040	20.45	2.82	0.68	6.36	0.21	11.67
												Temp. Mat	3.95	10	0.040	20.71	2.98	0.74	7.40	0.23	11.82

DITCH ANALYSIS

PID : 19415 **Date :** 06/19/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 525+00 TO 532+00 Left **Designer :** KMD

KAG
BEC

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
525+00	529+50	L	450.00	10.00	8.00	4.00	0.0507	1.00	1.00	0.41	0.41	Seed	4.10	5	0.030	13.58	2.01	0.25	1.68	0.08	10.96
												Seed	4.74	10	0.040	14.03	1.77	0.33	1.94	0.10	11.24
529+50	531+00	L	150.00	10.00	5.00	7.00	0.0967	0.27	1.27	0.50	0.55	Seed	3.99	5	0.030	14.50	2.71	0.46	2.18	0.08	10.92
												Temp. Mat	3.97	5	0.040	14.67	2.26	0.55	2.17	0.09	11.09
												Temp. Mat	4.60	10	0.040	15.07	2.38	0.60	2.51	0.10	11.19
531+00	532+00	L	100.00	10.00	4.00	8.00	0.0180	1.81	3.09	0.41	1.29	Seed	3.88	5	0.030	15.44	2.16	0.23	5.01	0.21	12.48
												Seed	4.48	10	0.040	15.95	1.88	0.30	5.78	0.27	13.18

DITCH ANALYSIS

PID : 19415 **Date :** 06/11/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 532+00 TO 532+90 Left **Designer :** KMD

KAG
BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type 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.)
532+00	532+90	L	90.00	0.00	6.00	6.00	0.0050	0.04	0.04	0.48	0.02	Seed	4.27	5	0.030	12.23	0.63	0.05	0.08	0.15	1.80
												Seed	4.92	10	0.040	12.80	0.55	0.05	0.10	0.17	2.06
532+90	531+00	L	110.00	10.00	3.00	3.00	0.0100	0.17	0.21	0.80	0.16	Seed	4.01	5	0.030	14.35	0.84	0.05	0.62	0.07	10.44
												Seed	4.58	10	0.040	15.18	0.75	0.06	0.71	0.09	10.56

DITCH ANALYSIS

PID : 19415 **Date :** 05/27/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 536+00 TO 534+50 Right **Designer :** kmd

KAG
5EE

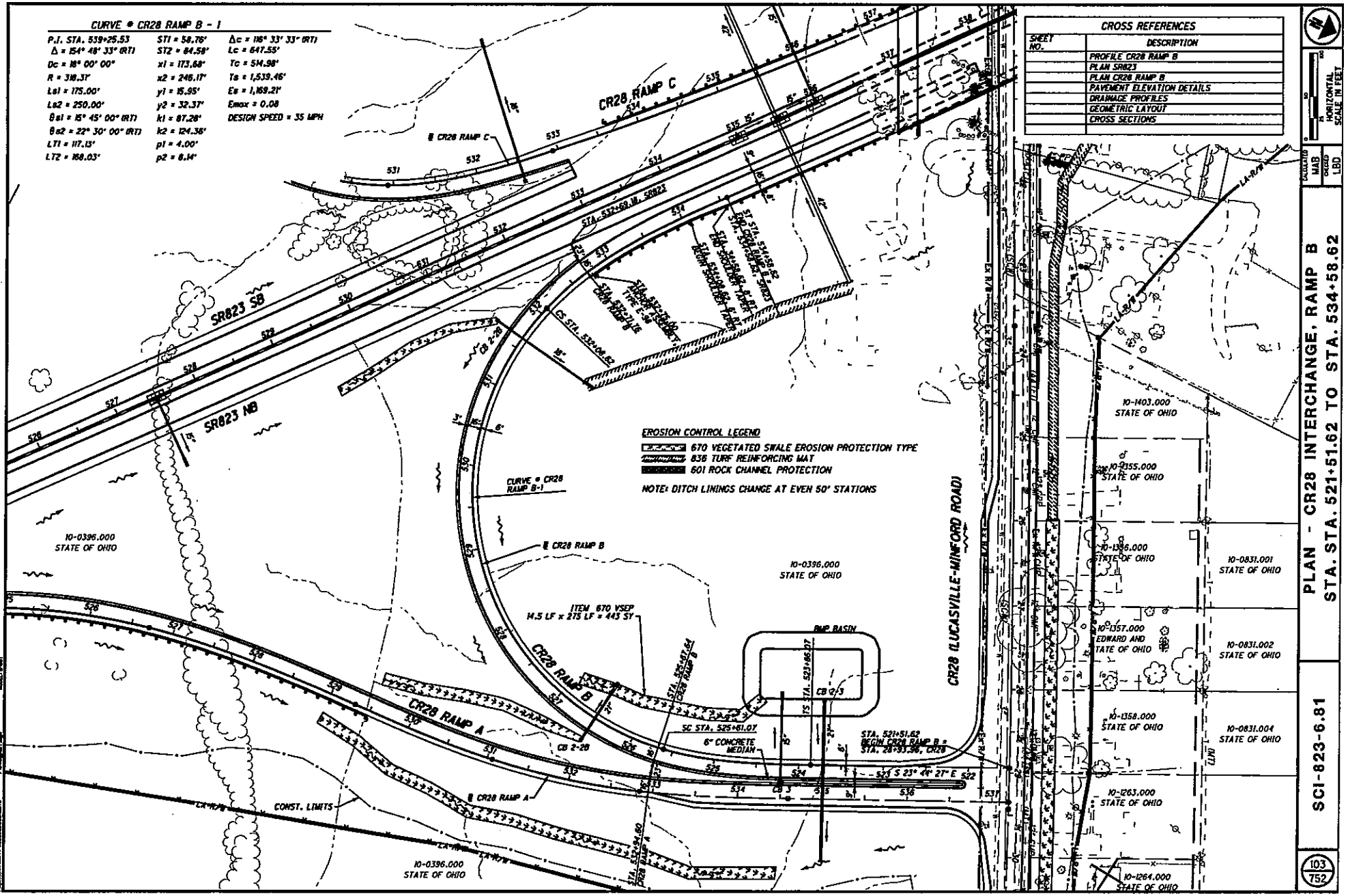
Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
536+00	534+50	R	150.00	10.00	4.00	4.00	0.0493	0.32	0.32	0.55	0.17	Seed	4.35	5	0.030	11.65	1.47	0.15	0.76	0.05	10.40
												Seed	5.07	10	0.040	11.86	1.32	0.20	0.88	0.07	10.52


CURVE # CR28 RAMP B - 1
P.I. STA. 539+25.53
Δ = 154° 48' 33" (RT)
Dc = 18° 00' 00"
R = 318.31'
Ls1 = 175.00'
Ls2 = 250.00'
θs1 = 15° 45' 00" (RT)
θs2 = 22° 30' 00" (RT)
LT1 = 117.13'
LT2 = 168.03'
ST1 = 58.78'
ST2 = 84.58'
x1 = 173.68'
x2 = 246.11'
y1 = 15.95'
y2 = 32.37'
k1 = 87.28'
k2 = 124.36'
p1 = 4.00'
p2 = 8.14'
Δc = 116° 33' 33" (RT)
Lc = 647.55'
Tc = 514.98'
Ts = 1,539.46'
Es = 1,159.21'
Emax = 0.08
DESIGN SPEED = 35 MPH
CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE CR28 RAMP B
PLAN SR823
PLAN CR28 RAMP B
PAVEMENT ELEVATION DETAILS
DRAINAGE PROFILES
GEOMETRIC LAYOUT
CROSS SECTIONS
HORIZONTAL SCALE IN FEET
CALCULATED MAB
CHECKED LBD
PLAN - CR28 INTERCHANGE, RAMP B
STA. STA. 521+51.62 TO STA. 534+58.62
SCI-823-6.81
103
752
CR28 RAMP C
SR823 SB
SR823 NB
CR28 RAMP B
CR28 RAMP A
CR28 (LUCASVILLE-MINFORD ROAD)
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
ITEM 670 VSEP
14.5 LF x 275 LF = 445 SY
BMP BASIN
6" CONCRETE MEDIAN
CONST. LIMITS
STA. 521+51.62
BEGIN CR28 RAMP B =
STA. 28+93.36, CR28
10-0396.000
STATE OF OHIO
10-1403.000
STATE OF OHIO
10-0355.000
STATE OF OHIO
10-1396.000
STATE OF OHIO
10-0831.001
STATE OF OHIO
10-1357.000
EDWARD AND
STATE OF OHIO
10-0831.002
STATE OF OHIO
10-1358.000
STATE OF OHIO
10-0831.004
STATE OF OHIO
10-1263.000
STATE OF OHIO
10-1264.000
STATE OF OHIO

DITCH ANALYSIS

PID : 19415 **Date :** 05/28/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp B sections 522+71 TO 523+71 Right **Designer :** kmd KAG BEE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	Jute Mat:	0.45	Temporary Mat:	1.00
Permanent Mat	Type 1:	2.00	Type 2:	3.00	Type 3:	5.00
RCP	Type 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.)
522+71	523+71	R	100.00	10.00	4.00	4.00	0.0380	0.20	0.20	0.54	0.11	Seed	4.38	5	0.030	11.43	1.13	0.10	0.48	0.04	10.33
												Seed	5.11	10	0.040	11.59	1.02	0.13	0.56	0.05	10.43

DITCH ANALYSIS

PID : 19415 **Date :** 05/28/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp B sections 529+50 TO 523+71 Right

Designer : KMD
KAG
BEC

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type 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.)
529+50	526+50	R	300.00	10.00	6.00	4.00	0.0503	0.55	0.55	0.52	0.28	Seed	4.21	5	0.030	12.74	1.76	0.21	1.19	0.07	10.66
												Seed	4.88	10	0.040	13.07	1.57	0.27	1.39	0.08	10.85
526+50	526+07	R	43.00	10.00	6.00	4.00	0.0419	0.12	0.66	0.48	0.34	Seed	4.15	5	0.030	13.14	1.77	0.20	1.41	0.08	10.77
												Seed	4.81	10	0.040	13.52	1.58	0.26	1.63	0.10	10.99
526+07	525+64	R	43.00	10.00	4.00	4.00	0.0465	0.67	1.33	0.85	0.91	Seed	4.12	5	0.030	13.41	2.68	0.38	3.75	0.13	11.06
												Seed	4.77	10	0.040	13.82	2.37	0.50	4.33	0.17	11.37
525+64	524+00	R	193.00	10.00	4.00	4.00	0.0100	0.59	1.92	0.56	1.24	Seed	3.92	5	0.030	15.15	1.82	0.15	4.85	0.24	11.94
												Seed	4.50	10	0.040	15.81	1.59	0.19	5.57	0.31	12.50

DITCH ANALYSIS

PID : 19415 **Date :** 06/19/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for ML RT 532+50 TO CR28 Ramp B 527+50 Left

Designer : KMD
KAG
BEK

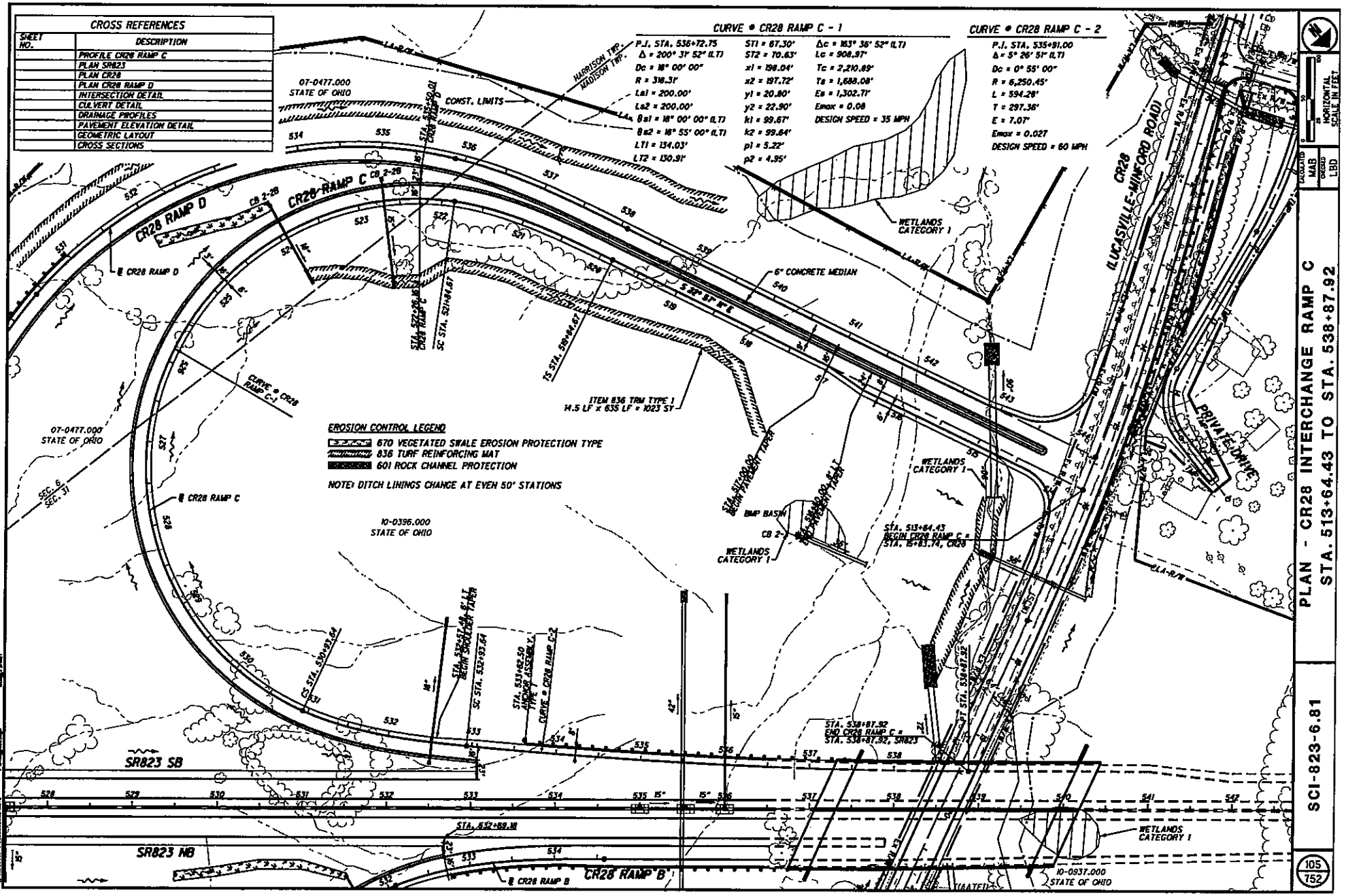
Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00	
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
	RCP	**Type 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.)
531+00	527+50	L	350.00	10.00	8.00	4.00	0.0494	1.61	1.61	0.40	0.64	Seed	4.25	5	0.030	12.37	2.39	0.33	2.73	0.11	11.29
												Seed	4.94	10	0.040	12.68	2.11	0.43	3.17	0.14	11.67


CROSS REFERENCES
SHEET NO. | DESCRIPTION
PROFILE CR28 RAMP C
PLAN SR823
PLAN CR28
PLAN CR28 RAMP D
INTERSECTION DETAIL
CULVERT DETAIL
DRAINAGE PROFILES
PAVEMENT ELEVATION DETAIL
GEOMETRIC LAYOUT
CROSS SECTIONS
CURVE # CR28 RAMP C - 1
P.I. STA. 536+72.75
Δ = 200° 31' 52" (LT)
Dc = 18° 00' 00"
R = 318.31'
Lsl = 200.00'
Ls2 = 200.00'
θsl = 18° 00' 00" (LT)
θs2 = 18° 55' 00" (LT)
LT1 = 134.03'
LT2 = 130.91'
ST1 = 67.30'
ST2 = 70.63'
xl = 198.04'
x2 = 197.72'
yl = 20.80'
y2 = 22.90'
kl = 99.67'
k2 = 99.84'
pl = 5.22'
p2 = 4.95'
Δc = 163° 36' 52" (LT)
Lc = 908.97'
Tc = 2,210.89'
Ts = 1,688.08'
Es = 1,302.71'
Emax = 0.08
DESIGN SPEED = 35 MPH
CURVE # CR28 RAMP C - 2
P.I. STA. 535+91.00
Δ = 5° 26' 51" (LT)
Dc = 0° 55' 00"
R = 6,250.45'
L = 594.28'
T = 297.36'
E = 7.07'
Emax = 0.027
DESIGN SPEED = 60 MPH
07-0477.000
STATE OF OHIO
CONST. LIMITS
HARRISON TWP.
MADISON TWP.
CR28 RAMP D
CR28 RAMP C
CB 2-28
WETLANDS CATEGORY 1
6" CONCRETE MEDIAN
CR28 (LUCASVILLE-MINFORD ROAD)
PRIVATE DRIVE
ITEM 836 TRM TYPE 1
14.5 LF x 635 LF = 1023 SY
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
10-0396.000
STATE OF OHIO
BMP BASIN
STA. 513+64.43
BEGIN CR28 RAMP C =
STA. 15+83.74, CR28
STA. 538+87.92
END CR28 RAMP C =
STA. 538+87.92, SR823
SR823 SB
SR823 NB
CR28 RAMP B
10-0937.000
STATE OF OHIO
PLAN - CR28 INTERCHANGE RAMP C
STA. 513+64.43 TO STA. 538+87.92
SCI-823-6.81
HORIZONTAL SCALE IN FEET
105
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/12/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calc for CR28 Ramp C Lt Sta 29+00 to CR28 Ramp D Rt Sta 543+00 **Designer :** KMD

KAS
BJE

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type 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.)
529+00	526+50	L	250.00	10.00	8.00	4.00	0.0424	0.55	0.55	0.56	0.31	Seed	4.26	5	0.030	12.35	1.73	0.19	1.31	0.07	10.87
												Seed	4.94	10	0.040	12.63	1.53	0.25	1.52	0.09	11.13
526+50	525+00	L	150.00	10.00	7.00	5.00	0.0800	0.40	0.95	0.51	0.51	Seed	4.13	5	0.030	13.33	2.53	0.40	2.12	0.08	10.96
												Seed	4.78	10	0.040	13.74	2.23	0.52	2.45	0.10	11.24
525+00	524+50	L	50.00	10.00	6.00	7.00	0.0480	0.15	1.10	0.50	0.59	Seed	4.09	5	0.030	13.69	2.25	0.30	2.40	0.10	11.30
												Seed	4.72	10	0.040	14.16	1.98	0.39	2.77	0.13	11.68
524+50	533+50	R	29.50	10.00	6.00	8.00	0.0406	4.43	5.53	0.45	2.58	Seed	4.07	5	0.030	13.83	3.59	0.63	10.49	0.25	13.48
Ramp D												Temp. Mat	4.07	5	0.040	13.86	2.97	0.74	10.49	0.29	14.10
												Temp. Mat	4.70	10	0.040	14.32	3.11	0.81	12.12	0.32	14.46
533+50	535+00	R	150.00	10.00	6.00	8.00	0.0600	0.80	6.33	0.52	2.99	Seed	4.00	5	0.030	14.44	4.28	0.90	11.97	0.24	13.36
Ramp D												Temp. Mat	3.98	5	0.040	14.56	3.53	1.06	11.93	0.28	13.95
												Perm, Type 1	3.98	5	0.040	14.56	3.53	1.06	11.93	0.28	13.95
												Perm, Type 1	4.61	10	0.040	14.99	3.71	1.15	13.79	0.31	14.29

DITCH ANALYSIS

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.)
535+00	536+00	R	100.00	10.00	4.00	4.00	0.0140	0.16	6.49	0.58	3.09	Seed	3.91	5	0.030	15.16	2.80	0.33	12.09	0.38	13.01
												Seed	4.52	10	0.040	15.67	2.43	0.42	13.94	0.48	13.85
536+00	539+50	R	350.00	10.00	4.50	4.00	0.0094	1.58	8.06	0.50	3.88	Seed	3.68	5	0.030	17.37	2.58	0.27	14.27	0.46	13.93
												Seed	4.21	10	0.040	18.23	2.22	0.34	16.32	0.59	14.99
539+50	541+00	R	150.00	10.00	5.00	3.00	0.0700	0.46	8.52	0.49	4.10	Seed	3.63	5	0.030	17.86	5.07	1.16	14.90	0.27	12.12
												Temp. Mat	3.62	5	0.040	17.96	4.21	1.37	14.86	0.31	12.51
												Perm, Type 1	3.62	5	0.040	17.96	4.21	1.37	14.86	0.31	12.51
												Perm, Type 1	4.15	10	0.040	18.80	4.41	1.48	17.02	0.34	12.72
541+00	541+50	R	50.00	10.00	4.00	4.00	0.0360	9.43	17.95	0.44	8.25	Seed	3.61	5	0.030	18.12	5.19	1.08	29.77	0.48	13.85
												Temp. Mat	3.61	5	0.040	18.16	4.28	1.27	29.74	0.57	14.53
												Perm, Type 1	3.61	5	0.040	18.16	4.28	1.27	29.74	0.57	14.53
												Perm, Type 1	4.13	10	0.040	18.98	4.48	1.37	34.06	0.61	14.89
541+50	543+00	R	150.00	10.00	3.50	4.00	0.0287	6.12	24.07	0.58	11.80	Seed	3.56	5	0.030	18.61	5.43	1.12	42.03	0.63	14.70
												Temp. Mat	3.55	5	0.040	18.71	4.46	1.32	41.92	0.74	15.52
												Perm, Type 1	3.55	5	0.040	18.71	4.46	1.32	41.92	0.74	15.52
												Perm, Type 1	4.07	10	0.040	19.52	4.66	1.42	48.05	0.79	15.96

DITCH ANALYSIS

PID : 19415 **Date :** 06/12/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp C sections 531+00 TO 524+50 Right

Designer : KMD
KAG
BEE

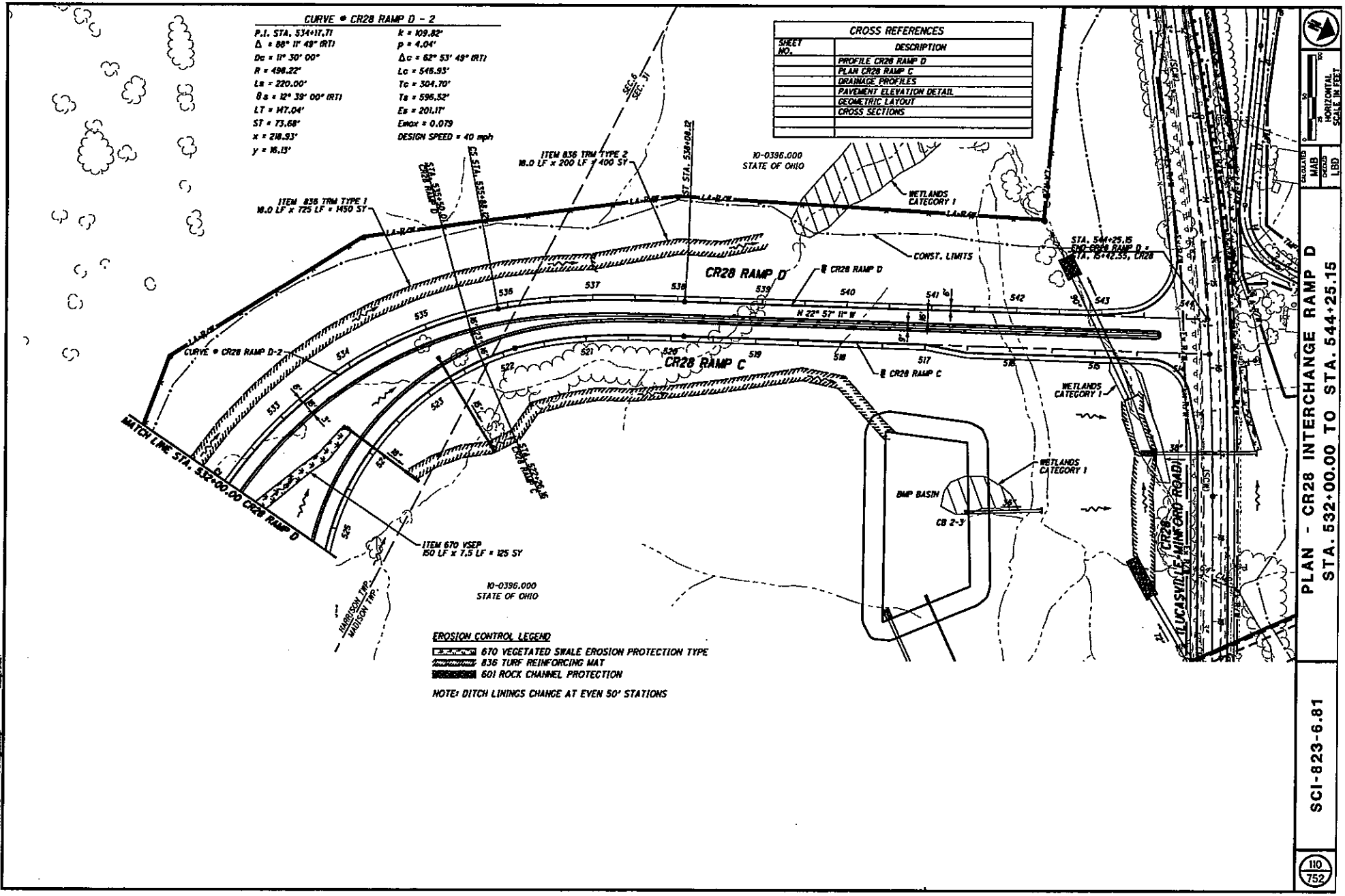
Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
531+00	529+00	R	200.00	10.00	8.00	4.00	0.0225	0.45	0.45	0.40	0.18	Seed	4.20	5	0.030	12.82	1.15	0.09	0.75	0.06	10.76
												Seed	4.86	10	0.040	13.16	1.02	0.12	0.87	0.08	10.98
529+00	527+50	R	150.00	10.00	8.00	4.00	0.0373	0.67	1.12	0.40	0.45	Seed	4.03	5	0.030	14.13	1.87	0.21	1.80	0.09	11.10
												Seed	4.65	10	0.040	14.65	1.65	0.27	2.08	0.12	11.41
527+50	533+00	R	550.00	10.00	8.00	4.00	0.0488	0.63	1.75	0.40	0.70	Seed	3.63	5	0.030	17.94	2.31	0.31	2.53	0.10	11.24
												Seed	4.13	10	0.040	18.99	2.03	0.40	2.88	0.13	11.58


CURVE ℄ CR28 RAMP D - 2
P.I. STA. 534+17.71
Δ = 88° 11' 49" (RT)
Dc = 11° 30' 00"
R = 498.22'
Ls = 220.00'
θs = 12° 39' 00" (RT)
LT = 147.04'
ST = 73.68'
x = 218.93'
y = 16.13'
k = 109.82'
p = 4.04'
Δc = 62° 53' 49" (RT)
Lc = 546.93'
Tc = 304.70'
Ts = 596.52'
Es = 201.11'
Emax = 0.079
DESIGN SPEED = 40 mph
CROSS REFERENCES
SHEET NO.
DESCRIPTION
PROFILE CR28 RAMP D
PLAN CR28 RAMP C
DRAINAGE PROFILES
PAVEMENT ELEVATION DETAIL
GEOMETRIC LAYOUT
CROSS SECTIONS
ITEM 836 TRM TYPE 1
16.0 LF x 725 LF = 1450 SY
ITEM 836 TRM TYPE 2
16.0 LF x 200 LF = 400 SY
10-0396.000
STATE OF OHIO
WETLANDS CATEGORY 1
CONST. LIMITS
CR28 RAMP D
℄ CR28 RAMP D
CR28 RAMP C
℄ CR28 RAMP C
N 22° 57' 11" W
STA. 544+25.15
END CR28 RAMP D =
STA. 15+42.35, CR28
CURVE ℄ CR28 RAMP D-2
MATCH LINE STA. 532+00.00 CR28 RAMP D
ITEM 670 VSEP
150 LF x 7.5 LF = 125 SY
BMP BASIN
CB 2-3
HARRISON TWP.
MADISON TWP.
LUCASVILLE-MINFORD ROAD (SR 23)
EROSION CONTROL LEGEND
670 VEGETATED SWALE EROSION PROTECTION TYPE
836 TURF REINFORCING MAT
601 ROCK CHANNEL PROTECTION
NOTE: DITCH LININGS CHANGE AT EVEN 50' STATIONS
HORIZONTAL SCALE IN FEET
CALCULATED MAB
DRAWN LBD
PLAN - CR28 INTERCHANGE RAMP D
STA. 532+00.00 TO STA. 544+25.15
SCI-823-6.81
18
752

DITCH ANALYSIS

PID : 19415 **Date :** 06/12/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calc for ML 823 Lt. Sta. 523+50 TO CR 28 Ramp D 533+50 Right

Designer : KMD
KAG
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.00	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
523+50	524+50	L	100.00	10.00	7.00	7.00	0.0420	0.29	0.29	0.64	0.18	Seed	4.42	5	0.030	11.15	1.43	0.14	0.82	0.06	10.77
												Seed	5.16	10	0.040	11.29	1.28	0.19	0.95	0.07	11.00
524+50	524+50	L	8.00	10.00	7.00	8.00	0.0773	0.08	0.37	0.63	0.24	Seed	4.41	5	0.030	11.22	1.90	0.26	1.05	0.05	10.80
												Seed	5.15	10	0.040	11.37	1.68	0.33	1.22	0.07	11.04
524+50	532+00	R	750.00	10.00	8.00	4.00	0.0416	1.98	2.35	0.45	1.13	Seed	3.86	5	0.030	15.65	2.69	0.39	4.35	0.15	11.78
Rock												Seed	4.42	10	0.040	16.41	2.35	0.49	4.99	0.19	12.29
532+00	532+50	R	50.00	10.00	7.00	4.50	0.0860	0.07	2.42	0.56	1.17	Seed	3.83	5	0.030	15.89	3.43	0.66	4.48	0.12	11.41
												Temp. Mat	3.83	5	0.040	15.94	2.85	0.78	4.47	0.14	11.66
												Temp. Mat	4.39	10	0.040	16.69	3.00	0.84	5.13	0.16	11.80
532+50	533+00	R	50.00	10.00	6.00	6.00	0.0660	0.07	2.50	0.56	1.21	Seed	3.80	5	0.030	16.20	3.18	0.55	4.60	0.13	11.61
												Temp. Mat	3.80	5	0.040	16.26	2.64	0.65	4.59	0.16	11.91
												Temp. Mat	4.35	10	0.040	16.99	2.78	0.71	5.27	0.17	12.06
533+00	533+50	R	50.00	10.00	6.00	8.00	0.0200	1.83	4.33	0.41	1.96	Seed	3.76	5	0.030	16.58	2.52	0.31	7.38	0.25	13.49

DITCH ANALYSIS

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.)
												Seed	4.31	10	0.040	17.37	2.18	0.40	8.45	0.32	14.44

DITCH ANALYSIS

PID : 19415 **Date :** 06/12/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calc for ML 823 Lt. Sta. 520+00 to CR28 Ramp D Lt. Sta. 539+41

Designer : KMD
KAG
BEB

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.00	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type 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.)
520+00	530+50	L	1050.0	10.00	3.00	0.50	0.0304	3.08	3.08	0.51	1.57	Seed	3.86	5	0.030	15.68	2.89	0.38	6.06	0.20	10.71
												Seed	4.43	10	0.040	16.39	2.54	0.50	6.95	0.26	10.92
530+50	531+00	L	50.00	10.00	5.50	2.00	0.0180	9.90	12.98	0.40	5.53	Seed	3.83	5	0.030	15.90	3.70	0.54	21.21	0.49	13.64
												Temp. Mat	3.83	5	0.040	15.95	3.05	0.64	21.18	0.57	14.29
												Temp. Mat	4.39	10	0.040	16.65	3.19	0.69	24.31	0.62	14.64
531+00	532+00	L	100.00	10.00	6.00	2.00	0.0370	8.46	21.44	0.40	8.92	Seed	3.80	5	0.030	16.25	5.46	1.19	33.84	0.51	14.11
												Temp. Mat	3.79	5	0.040	16.32	4.50	1.40	33.78	0.60	14.84
												Perm, Type 1	3.79	5	0.040	16.32	4.50	1.40	33.78	0.60	14.84
												Perm, Type 1	4.35	10	0.040	17.01	4.70	1.51	38.80	0.65	15.23
532+00	535+00	L	300.00	10.00	6.00	2.00	0.0370	2.39	23.83	0.41	9.90	Seed	3.70	5	0.030	17.20	5.60	1.24	36.60	0.54	14.30
												Temp. Mat	3.68	5	0.040	17.39	4.61	1.46	36.41	0.63	15.05
												Perm, Type 1	3.68	5	0.040	17.39	4.61	1.46	36.41	0.63	15.05
												Perm, Type 1	4.23	10	0.040	18.04	4.82	1.58	41.89	0.68	15.46

DITCH ANALYSIS

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.)
535+00	537+00	L	200.00	10.00	6.00	2.00	0.0385	0.31	24.14	0.44	10.03	Seed	3.62	5	0.030	17.98	5.67	1.27	36.34	0.53	14.23
												Temp. Mat	3.61	5	0.040	18.10	4.66	1.49	36.22	0.62	14.97
												Perm, Type 1	3.61	5	0.040	18.10	4.66	1.49	36.22	0.62	14.97
												Perm, Type 1	4.16	10	0.040	18.71	4.88	1.62	41.71	0.67	15.39
537+00	538+50	L	150.00	10.00	6.00	3.00	0.0700	0.31	24.45	0.48	10.18	Seed	3.58	5	0.030	18.47	6.84	1.94	36.41	0.44	13.99
												Temp. Mat	3.57	5	0.040	18.54	5.64	2.28	36.34	0.52	14.70
												Perm, Type 1	3.57	5	0.040	18.54	5.64	2.28	36.34	0.52	14.70
												Perm, Type 2	3.57	5	0.040	18.54	5.64	2.28	36.34	0.52	14.70
												Perm, Type 2	4.11	10	0.040	19.14	5.90	2.47	41.87	0.57	15.09
538+50	539+00	L	50.00	10.00	4.00	4.00	0.0920	0.13	24.58	0.52	10.25	Seed	3.56	5	0.030	18.65	7.58	2.37	36.47	0.41	13.30
												Temp. Mat	3.56	5	0.040	18.68	6.27	2.79	36.45	0.49	13.89
												Perm, Type 1	3.56	5	0.040	18.68	6.27	2.79	36.45	0.49	13.89
												Perm, Type 2	3.56	5	0.040	18.68	6.27	2.79	36.45	0.49	13.89
												Perm, Type 2	4.10	10	0.040	19.26	6.57	3.03	42.01	0.53	14.22
539+00	539+41	L	41.00	10.00	4.00	4.00	0.0488	0.11	24.69	0.52	10.30	Seed	3.55	5	0.030	18.79	6.15	1.51	36.54	0.50	13.97
												Temp. Mat	3.54	5	0.040	18.81	5.07	1.78	36.52	0.58	14.67
												Perm, Type 1	3.54	5	0.040	18.81	5.07	1.78	36.52	0.58	14.67
												Perm, Type 1	4.09	10	0.040	19.39	5.31	1.93	42.10	0.63	15.06

DITCH ANALYSIS

PID : 19415 **Date :** 06/12/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp D sections 533+50 TO 535+00 Right **Designer :** KMD KAG

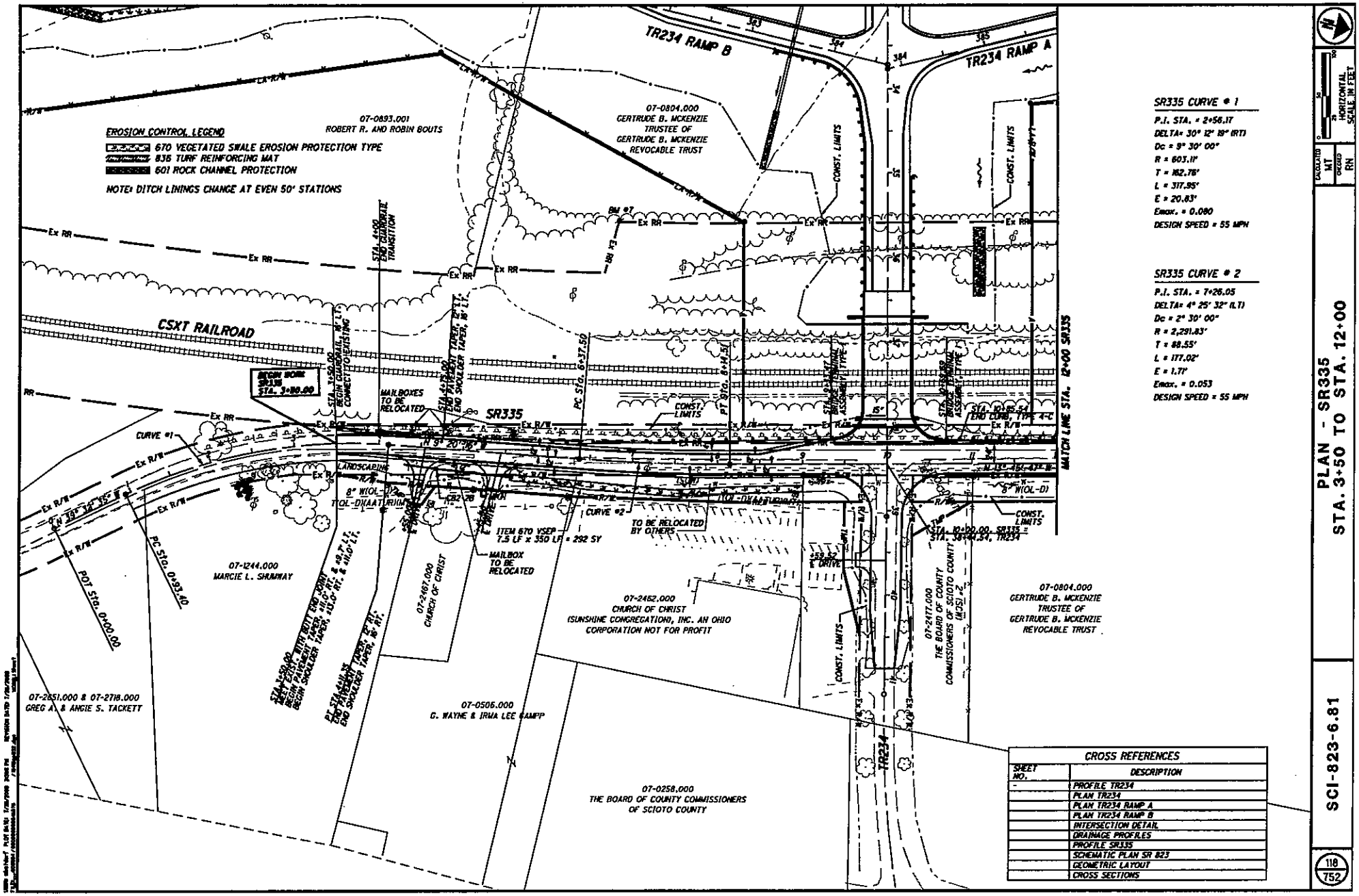
Rainfall Area : D

Allowable Shears

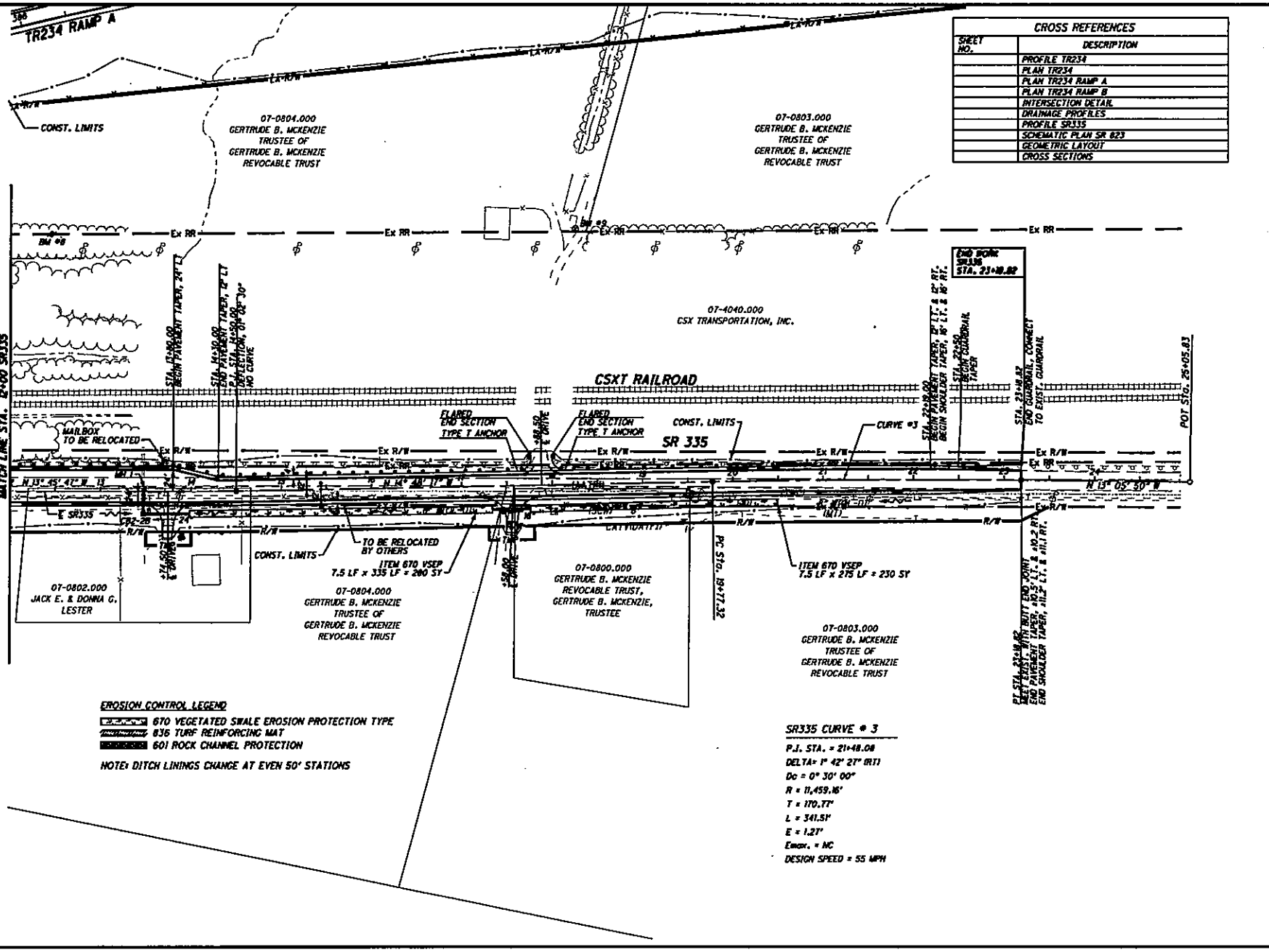
		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) 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.)
533+50	535+00	R	150.00	4.00	6.00	8.00	0.0193	0.25	0.25	0.59	0.14	Seed	4.33	5	0.030	11.81	1.35	0.12	0.63	0.10	5.39
												Seed	5.03	10	0.040	12.10	1.17	0.15	0.73	0.13	5.79



CROSS REFERENCES	
SHEET NO.	DESCRIPTION
-	PROFILE TR234
	PLAN TR234
	PLAN TR234 RAMP A
	PLAN TR234 RAMP B
	INTERSECTION DETAIL
	DRAINAGE PROFILES
	PROFILE SR335
	SCHEMATIC PLAN SR 823
	GEOMETRIC LAYOUT
	CROSS SECTIONS



CROSS REFERENCES	
SHEET NO.	DESCRIPTION
	PROFILE TR234
	PLAN TR234
	PLAN TR234 RAMP A
	PLAN TR234 RAMP B
	INTERSECTION DETAIL
	DRAINAGE PROFILES
	PROFILE SR335
	SCHEMATIC PLAN SR 823
	GEOMETRIC LAYOUT
	CROSS SECTIONS

HORIZONTAL SCALE IN FEET

CALCULATED MT
CHECKED RN

PLAN - SR335
STA. 12+00 TO STA. 23+18.82

SCI-823-6.81

120
752

DITCH ANALYSIS

PID : 19415 **Date :** 12/19/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SR 335 sections 4+50 TO 9+50 Right

BEG
Designer : KAG

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
9+50	7+00	R	250.00	2.00	3.00	3.00	0.0220	1.09	1.09	0.55	0.60	Seed	4.38	5	0.030	11.47	2.79	0.44	2.62	0.32	3.91
												Jute Mat	4.33	5	0.040	11.81	2.27	0.51	2.60	0.37	4.21
												Temp. Mat	4.33	5	0.040	11.81	2.27	0.51	2.60	0.37	4.21
												Temp. Mat	5.09	10	0.040	11.73	2.37	0.55	3.05	0.40	4.41
7+00	5+50	R	250.00	2.00	3.00	3.00	0.0280	0.59	1.68	0.50	0.89	Seed	4.17	5	0.030	13.03	3.36	0.63	3.73	0.36	4.16
												Jute Mat	4.13	5	0.040	13.31	2.73	0.73	3.70	0.42	4.50
												Temp. Mat	4.13	5	0.040	13.31	2.73	0.73	3.70	0.42	4.50
												Temp. Mat	4.86	10	0.040	13.16	2.86	0.79	4.35	0.45	4.72

DITCH ANALYSIS

PID : 19415 **Date :** 11/20/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SR 335 sections 11+00 TO 13+50 Right **Designer :** BEE KAG

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
11+00	13+50	R	250.00	2.00	6.00	3.00	0.0088	0.73	0.73	0.60	0.44	Seed	4.25	5	0.030	12.40	1.69	0.18	1.86	0.32	4.88
												Seed	4.91	10	0.040	12.83	1.44	0.22	2.15	0.40	5.57

DITCH ANALYSIS

PID : 19415 **Date :** 12/19/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for SR 335 sections 14+00 TO 20+00 Right **Designer :** BEG KAG

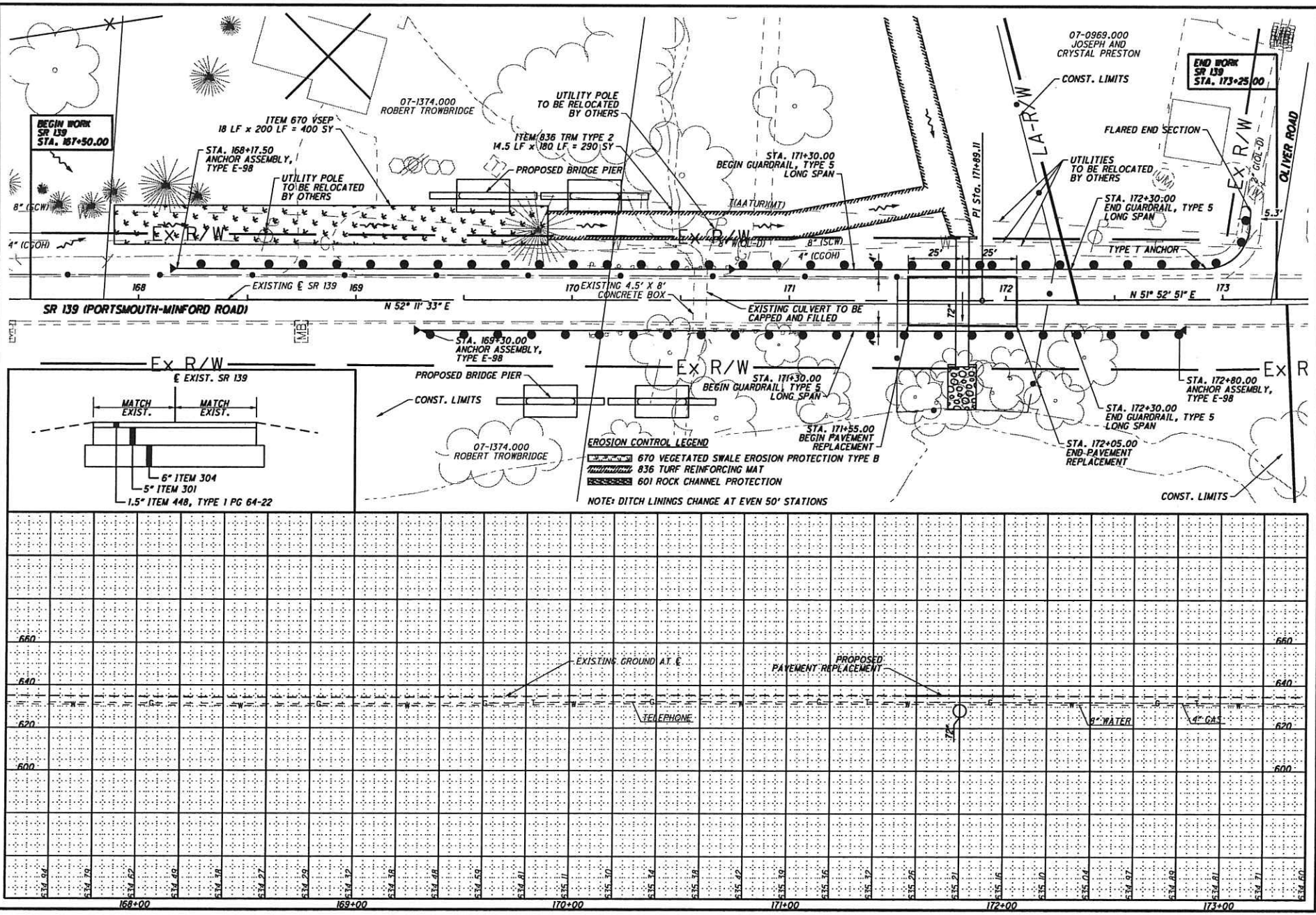
Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type 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.)
23+50	20+50	R	300.00	2.00	4.00	3.00	0.0073	0.88	0.88	0.63	0.55	Seed	4.20	5	0.030	12.76	1.77	0.18	2.32	0.39	4.73
												Seed	4.85	10	0.040	13.24	1.50	0.22	2.68	0.48	5.39
20+50	14+00	R	650.00	2.00	4.00	3.00	0.0142	1.68	2.56	0.48	1.36	Seed	3.77	5	0.030	16.51	2.80	0.44	5.12	0.49	5.44
												Jute Mat	3.68	5	0.040	17.39	2.26	0.50	5.00	0.56	5.92
												Temp. Mat	3.68	5	0.040	17.39	2.26	0.50	5.00	0.56	5.92
												Temp. Mat	4.27	10	0.040	17.70	2.35	0.53	5.80	0.60	6.21



CALCULATED LBD
CHECKED JMB

HORIZONTAL SCALE IN FEET
0 20 40

PLAN AND PROFILE - SR139
STA. 167+40.00 TO STA. 173+40.00

SCI-823-6.81

122
752

USER: mstorf PLOT DATE: 7/30/2009 2:43:23 PM REVISION DATED: 7/30/2009
FILE: c:\projects\...\sci823-6.81.dgn MODEL: Default

HDR | ONE COMPANY *Many Solutions*℠

Client: ODOT | Sheet: of

Subject: Ditch Runoff calc SR 139 | Order No:

Computed by: KAG | Date: 8/22/2008

Checked by: JF | Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C
Pavement Area	5000	0.11	0.9
Non-paved Area	2250829	51.67	0.45
Other			
Total Area		**51.79**	**acres**

Weighted "C" = 0.45

Overland Flow

Length	250
High Elevation	780
Low Elevation	760
Slope %	8

t_o 9.24 (1101.2.2)

Shallow Concentrated Flow

Length	841
High Elevation	760
Low Elevation	660
Slope %	11.89061
k	0.076 (forest w/heavy ground litter - Table 1101-1)
V	0.859848 (1101.2.2)
t_s	16.30133 (1101.2.2)

Length	1243
High Elevation	660
Low Elevation	629
Slope %	2.493966
k	0.305 (Grassed waterways - Table 1101-1)
V	1.580343 (1101.2.2)
t_s	13.10897 (1101.2.2)

Since the time of concentration = to + ts t_c **38.65** min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	51.78671	38.65	0.45	1.90	44.29
5 Years	118.822	18.7	0.969	51.78671	38.65	0.45	2.35	54.87
10 Years	112.172	16.8	0.923	51.78671	38.65	0.45	2.76	64.37
25 Years	198.92	19.3	1.004	51.78671	38.65	0.45	3.38	78.88
50 Years	206.025	19.6	0.99	51.78671	38.65	0.45	3.68	86.04
100 Years	355.551	23.199	1.076	51.78671	38.65	0.45	4.20	98.14

DITCH ANALYSIS

PID : 19415 **Date :** 08/22/2008 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR 139, 166+68 to 171+80 Left **Designer :** KAG

TF
BEE

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type 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.)
168+00	170+00	L	200.00	8.00	4.00	2.00	0.0050	51.80	51.80	0.45	23.31	Seed	2.34	5	0.030	38.97	3.43	0.41	54.46	1.33	15.96
												Jute Mat	2.33	5	0.040	39.19	2.79	0.48	54.26	1.54	17.25
												Temp. Mat	2.33	5	0.040	39.19	2.79	0.48	54.26	1.54	17.25
												Temp. Mat	2.73	10	0.040	39.14	2.92	0.52	63.72	1.68	18.06
170+00	170+50	L	50.00	8.00	3.20	2.00	0.0400	0.09	51.89	0.70	23.37	Seed	2.32	5	0.030	39.30	7.18	1.89	54.30	0.76	11.94
												Jute Mat	2.32	5	0.040	39.33	5.90	2.22	54.28	0.89	12.63
												Temp. Mat	2.32	5	0.040	39.33	5.90	2.22	54.28	0.89	12.63
												Perm, Type 1	2.32	5	0.040	39.33	5.90	2.22	54.28	0.89	12.63
												Perm, Type 2	2.32	5	0.040	39.33	5.90	2.22	54.28	0.89	12.63
												Perm, Type 2	2.73	10	0.040	39.27	6.21	2.43	63.76	0.97	13.07
170+50	171+50	L	100.00	8.00	2.00	2.00	0.0180	0.26	52.15	0.70	23.56	Seed	2.31	5	0.030	39.62	5.64	1.09	54.43	0.97	11.88
												Jute Mat	2.31	5	0.040	39.69	4.63	1.28	54.38	1.14	12.57
												Temp. Mat	2.31	5	0.040	39.69	4.63	1.28	54.38	1.14	12.57

DITCH ANALYSIS

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.)
												Perm, Type 1	2.31	5	0.040	39.69	4.63	1.28	54.38	1.14	12.57
												Perm, Type 1	2.71	10	0.040	39.61	4.87	1.40	63.89	1.25	13.00
171+50	171+80	L	30.00	8.00	2.00	2.00	0.0133	0.05	52.20	0.70	23.59	Seed	2.30	5	0.030	39.79	5.09	0.88	54.36	1.06	12.23
												Jute Mat	2.30	5	0.040	39.81	4.17	1.03	54.34	1.24	12.97
												Temp. Mat	2.30	5	0.040	39.81	4.17	1.03	54.34	1.24	12.97
												Perm, Type 1	2.30	5	0.040	39.81	4.17	1.03	54.34	1.24	12.97
												Perm, Type 1	2.71	10	0.040	39.73	4.38	1.13	63.86	1.36	13.44

BMP SCHEMATIC PLAN - SR823
STA. 335+00.00 TO STA. 390+00.00

SCI-823-6.81

HORIZONTAL SCALE IN FEET
0 100 200 400

CALCULATED | CHECKED

N

TS Sta. 10+23.46
BEGIN WORK
TR234
STA. 10+23.46

FPN -
BEGIN PROJECT
PHASE-1
STA. 352+00.00
SLM = 6.67

HUC 14
05090103 040 050

SEC. 16
SEC. 9

TWP237

335 SR823 340 345 350

CURVE # 5

CONST. LIMITS

L/A LINE

0.47

0.62

0.82

19.8

TR234

15

CONST. LIMITS

L/A Line

20

SHUMWAY RD.

RELOCATED

25

EXIST. SHUMWAY RD.

2.20

A =0.62Ac.

385

390

TR234 RAMP D

380

TR234 RAMP C

375

370

365

360

385

SR823

380

TR234 RAMP A

375

370

375 TR234 RAMP B

380

385

35 TR234

N 76°16'04" E

L/A LINE

N 13° 45' 47" W 15

3.86

3.36

3.24

0.26

0.75

3.77

CSXT RAILROAD

CONST. LIMITS

CSXT RAILROAD

SR335

5

0

SR335

40

BEGIN WORK
SR335
STA. 3+50.00

STA. 40+87.00
END WORK

PHASE-3
PID 77366
SCI-823-0.00
BY OTHERS

HUC 14
05090103 040 050

HUC 14
05090103 040 030

ODOT PARCELS NOT CONTRIBUTING TO BMP

PRELIMINARY LAND LOCKED PARCELS
NOT CONTRIBUTING TO BMP

LA AREA NOT CONTRIBUTING TO BMP

IMPERVIOUS AREA NOT TREATED IN BMP

DITCH DRAINAGE AREA

HUC DRAINAGE AREA

VEGETATED BIOFILTERS

BASIN DRAINAGE AREA

USER: $USER$ PLOT DATE: $DATE$ REVISION DATE: REV MODEL: $MODELNAME$
FILE: ...\CLIENT$\PROJECT\DS $TIME$ /$FILES$

HUC 14 AREA
05090103 040 050

HUC 14 AREA
05090103 040 030

SWAUGER VALLEY-MINFORD ROAD

SEC. 9
SEC. 4

SEC. 5
SEC. 4

MATCH LINE STA. 390+00 SR 823

TR234 RAMP D

TR234 RAMP A

SR823

L/A LINE

CONST. LIMITS

MATCH LINE STA. 445+00 SR 823

A =6.62Ac.

A =34.11Ac.

A =9.84Ac.

A =0.06Ac.

A =15.83Ac.

A =0.61Ac.

A =1.58Ac.

A =1.89Ac.

A =0.10Ac.

A =2.88Ac.

A =1.35Ac.

A =0.81Ac.

A =0.25Ac.

A =2.14Ac.

390 395 400 405 410 415 420 425 430 435 440

20 25

SEC. 9
SEC. 4

HUC 14 AREA
05090103 040 030

ODOT PARCELS NOT CONTRIBUTING TO BMP

PRELIMINARY LAND LOCKED PARCELS NOT CONTRIBUTING TO BMP

LA AREA NOT CONTRIBUTING TO BMP

IMPERVIOUS AREA NOT TREATED IN BMP

DITCH DRAINAGE AREA

HUC DRAINAGE AREA

VEGETATED BIOFILTERS

BASIN DRAINAGE AREA

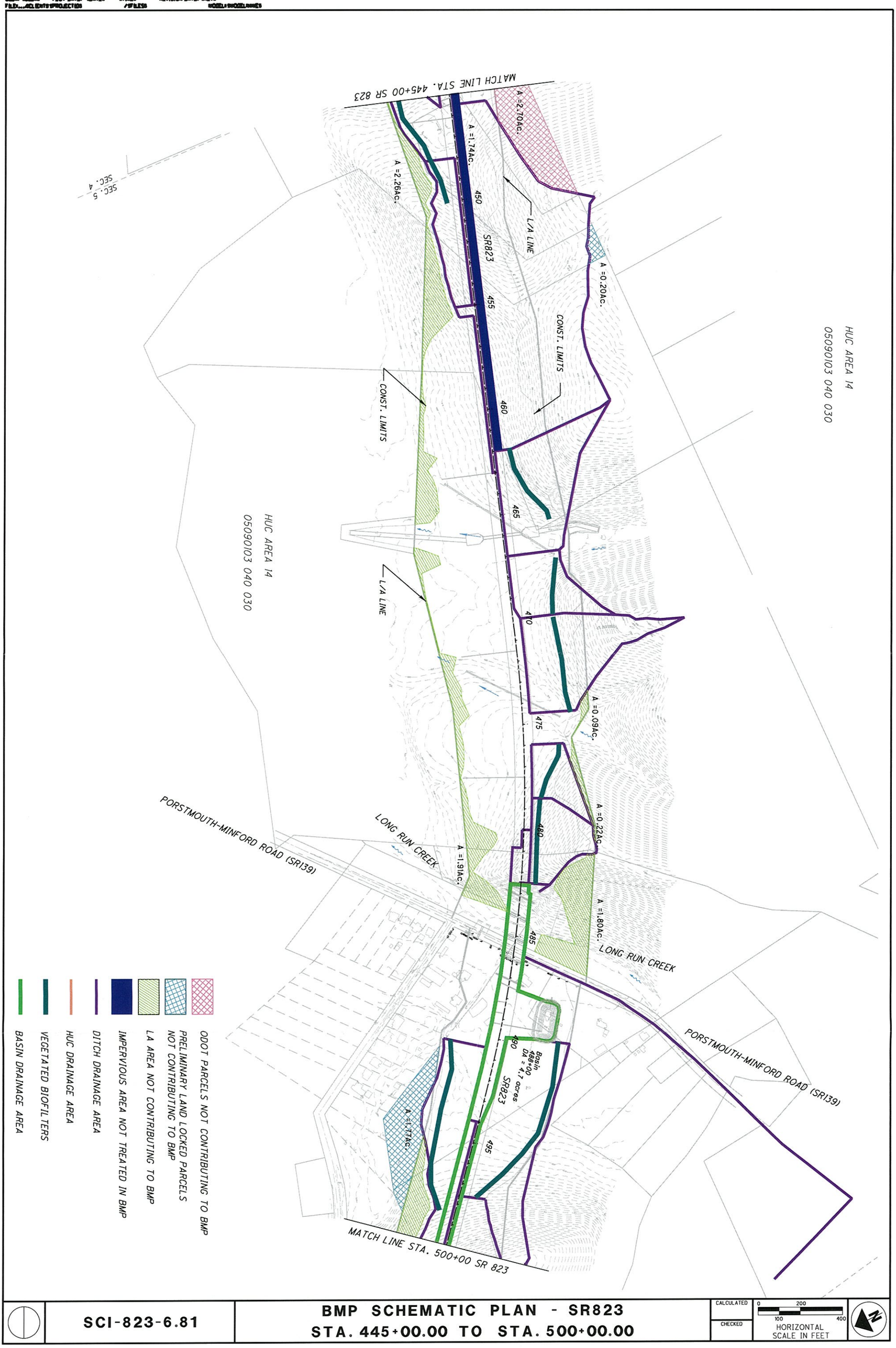
0 100 200 400
HORIZONTAL SCALE IN FEET

CALCULATED

CHECKED

BMP SCHEMATIC
STA. 390+00.00 TO STA. 445+00.00

SCI-823-6.81



SCI-823-6.81	BMP SCHEMATIC PLAN - SR823 STA. 445+00.00 TO STA. 500+00.00	CALCULATED CHECKED	0 200 100 400 HORIZONTAL SCALE IN FEET

ODOT PARCELS NOT CONTRIBUTING TO BMP

PRELIMINARY LAND LOCKED PARCELS NOT CONTRIBUTING TO BMP

LA AREA NOT CONTRIBUTING TO BMP

IMPERVIOUS AREA NOT TREATED IN BMP

DITCH DRAINAGE AREA

HUC DRAINAGE AREA

VEGETATED BIOFILTERS

BASIN DRAINAGE AREA

HUC 14 Area
05090103 040 030

MADISON TWP.
HARRISON TWP.

CR28
(LUCASVILLE-MINFORD ROAD)

SEC. 6
SEC. 31

SEC. 6
SEC. 5

STA. 9+97.25
BEGIN WORK
CR28
STA. 9+97.25

STA. 10+00.00
END WORK
FLOWERS ISON RD.
STA. 11+50.00

FLOWERS ISON ROAD
(TR381)

PRIVATE DRIVE

HARRISON TWP.
MADISON TWP.

A =4.82Ac.

A =0.77Ac.

A =40.55Ac.

A =1.36Ac.

L/A LINE

A =0.75Ac.

CONST. LIMITS

A =4.98Ac.

A =0.16Ac.

A =1.33Ac.

A =0.87Ac.

CR28 RAMP C

CR28 RAMP D

BASIN
CR 28 C/D
A = 26.6 acres

CR28

SR823

MATCH LINE STA. 500+00 SR 823

A =2.78Ac.

CONST. LIMITS

A =1.80Ac.

A =22.63Ac.

A =13.70Ac.

L/A LINE

CR28 RAMP A

CR28 RAMP B

BASIN
CR 28 A/B
A = 8.0 acres

N 48°55'55" W

PHASE-2
PID 79977
SCI-823-10.13
BY OTHERS

FPN =
END PROJECT
PHASE-1
STA. 536+50.00
SLM = 10.16

CR28 (LUCASVILLE-MINFORD ROAD)

RASES MOUNTAIN DRIVE
STA. 37+31.38

HARRISON TWP.
MADISON TWP.

HUC 14 Area
05090103 040 020

HUC 14 Area
05090103 040 030

HUC 14 Area
05090103 040 020

HORIZONTAL SCALE IN FEET
0 100 200 400

CALCULATED

CHECKED

BMP SCHEMATIC PLAN - SR823
STA. 500+00.00 TO STA. 555+00.00

SCI-823-6.81

USER NAME = PLOT DATE = 10/13/23
FILE... = PLOT SCALE = 1.0000 '/ INCH
REVISION DATED
REVISED SHEET(S)

Vegetative Biofilter Calculation

Calculated	KAG
Checked	BEE

From Station		To Station		L	Impervious	Area	Ratio	EBW	Ditch	Ditch	
				ft	ac	ac	i	$5.4A^{0.356}$	Width	Length	Notes
352+00	LT	353+88	LT	188		1.19		5.74	10	188	
355+00	LT	363+00	LT	800	0.81	7.37	0.11	11.00	**10**	800	Ditch bottom is 10 wide, 10' wide bench and 4:1 side slopes
363+00	LT	364+00	LT	100		3.11		8.09	10	100	
365+50	LT	373+00	234 R C LT	750		4.96		9.55	10	750	
373+00	234 R C LT	375+50	234 R C LT	250		5.60		9.97	10	250	
373+00	234 R C RT	379+00	234 R C RT	600		2.14		7.08	10	600	
386+00	LT	394+50	LT	850		3.10		8.08	10	850	
385+00	234 R D RT	399+00	234 R D RT	1400		3.68		8.58	10	1400	
385+00	234 R D LT	399+00	234 R D LT	1400	0.62	10.80	0.06	12.60	10	1400	All upstream areas treated in VBF, new impervious area flows over 10' bench
396+00	234 R D LT	402+00	LT	600		5.40		9.84	10	600	
405+00	LT	409+00	LT	400	0.61	7.00	0.09	10.80	10	400	Ditch bottom is 10 wide, 10' wide bench and 4:1 side slopes
410+00	LT	413+00	LT	300		3.90		8.77	10	300	
414+00	LT	419+50	LT	550		2.17		7.11	10	550	
420+00	LT	440+00	LT	2000	2.88	16.80	0.17	14.74	10	2000	Bench
445+00	LT	462+00	LT	1700	1.74	16.56	0.11	14.67	10	1700	Bench
467+00	LT	470+00	LT	300		2.18		7.13	10	300	
470+00	LT	474+00	LT	400		4.44		9.18	10	400	
476+00	LT	478+00	LT	200		1.33		5.98	10	200	
478+00	LT	483+00	LT	500		3.17		8.14	10	500	
488+00	LT	494+00	basin								
490+00	LT	494+00	LT	400	0.32	5.90	0.05	10.16	10	400	Bench
494+00	LT	504+00	LT	1000		2.58		7.57	10	1000	Bench
507+00	LT	520+00	LT	1300	1.33	7.86	0.17	11.25	10	1300	Bench
504+00	LT	504+50	LT	50		0.52		4.28	10	50	

Vegetative Biofilter Calculation

Calculated		KAG									
Checked		BEE									
				L	Imperv ious	Area	Ratio	EBW	Ditch	Ditch	
352+00	RT	353+88	RT	188		0.80		4.99	10	188	
355+00	RT	361+50	RT	650		2.01		6.92	10	650	
361+50	RT	363+50	RT	200		0.85		5.10	10	200	
365+00	RT	374+00	Sheet Flow					Sheet Flow			
374+50	234 R B RT	378+50	234 R B RT	400		1.86		6.74	10	400	
373+00	234 R B LT	383+00	234 R B LT	1000		5.45		9.88	10	1000	
385+00	234 R A RT	400+00	234 R A RT	1500		6.09		10.27	11	1500	
385+00	234 R A RT	36+00	TR 234	400		1.86		6.74	10	400	
395+50	RT	400+00	RT			0.66		4.66	10	0	
386+00	234 R A LT	404+00	234 R A LT	Sheet Flow				Sheet Flow			
386+00	234 R A LT	415+00	234 R A LT	Sheet Flow				Sheet Flow			
417+00	RT	419+50	RT	250		0.53		4.31	10	250	
419+50	RT	423+50	RT	400		1.05		5.49	10	400	
424+50	RT	440+00	RT	1550	1.06	13.70	0.08	13.71	10	1550	
440+00	RT	455+00	RT	1500		2.35		7.32	10	1500	
455+00	RT	481+00	RT	Flow							
490+50	RT	503+00	RT	1250		3.60		8.52	10	1250	
504+00	LT	504+50	LT	50		0.47		4.13	10	50	
504+00	RT	519+50	RT	1550		5.07		9.62	10	1550	
519+00	RT	534+50	28 R A RT	1550		3.66		8.57	10	200	

Vegetative Biofilter Calculation

Calculated		KAG									
Checked		BEE									
				L	Imperv ious	Area	Ratio	EBW	Ditch	Ditch	
CR 28											80 - 20
11+00	LT	15+00	LT	400		0.70		0.95	2	400	
21+50	LT	18+00	LT	350		0.86		1.03	2	350	
32+50	LT	22+00	LT	1050		9.50		2.41	3	950	
35+50	LT	32+50	LT	300		17.20		2.97	3	950	
32+50	RT	36+00	RT	350		0.47		0.83	4	350	
15+00	RT	18+00	RT	300		1.43		1.23	2	350	
SR 335											80 - 20
04+50	RT	10+00	RT	550		1.95		1.37	2	500	
10+00	RT	13+50	RT	350		0.73		0.97	2	300	
13+50	RT	23+19	RT	969		1.91		1.36	2	950	
TR 234											80 - 20
10+23	RT	17+00	RT	677		5.96		2.04	10	372	
19+00	RT	25+50	RT	650		2.27		1.45	10	372	
10+23	LT	17+00	LT	677		66.91		4.82	10	372	
17+00	LT	21+00	LT	400		7.08		2.17	10	372	
21+00	LT	26+00	LT	500		6.11		2.06	10	372	
28+00	RT	32+50	RT	450		0.84		1.02	5	372	
28+00	LT	32+50	LT	450		1.03		1.09	2	372	

HDR | ONE COMPANY *Many Solutions℠*

Project:	SCI -823-PH 1	Computed	KAG	Date: 7/20/09
Subject:	BMP	Checked:	BEE	Date: 7/22/09
Task:	HUC 14 areas			
Job #:	19415	No.:		

HUC 14 Area 05090103 040 050

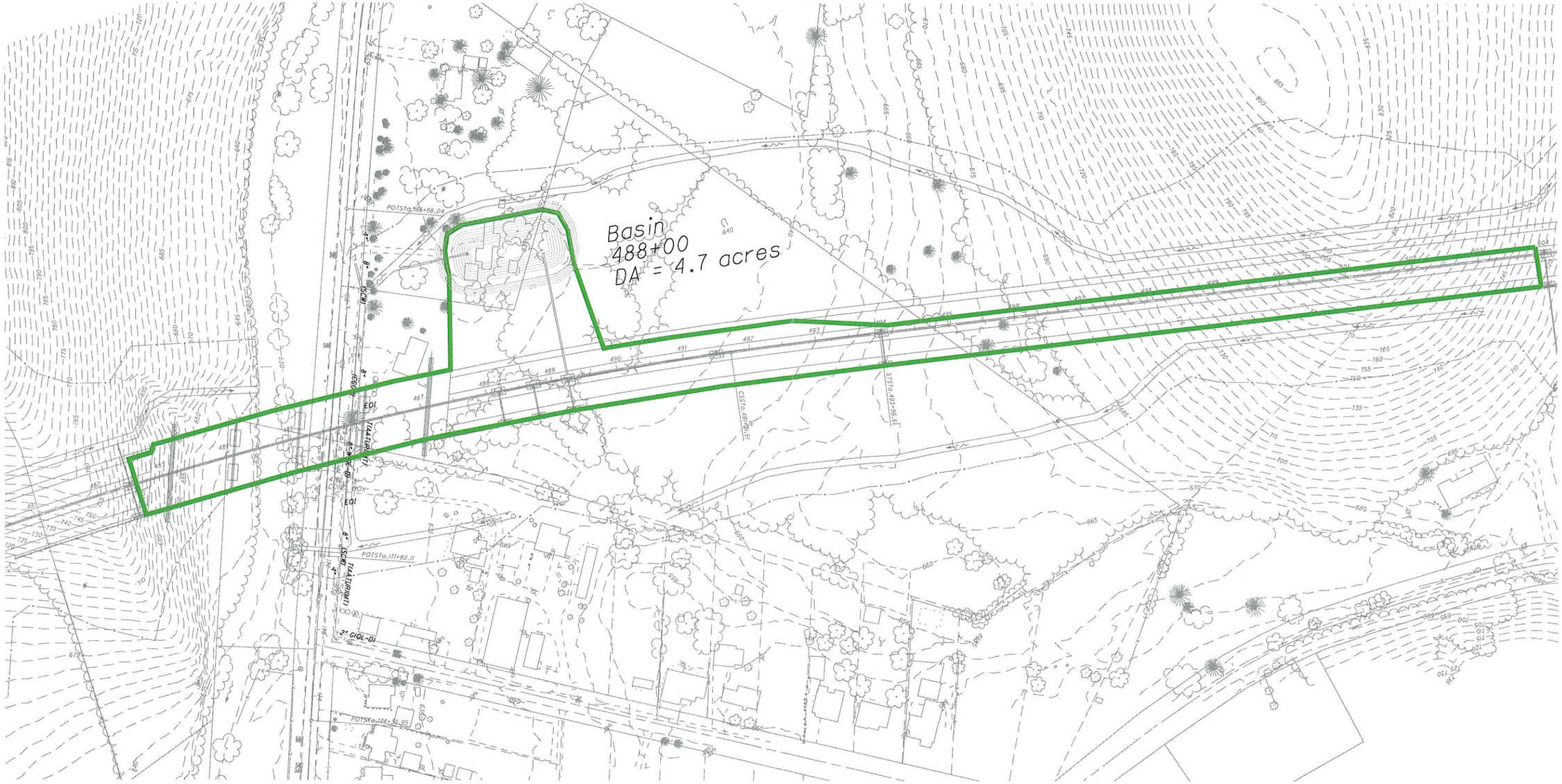
		Untreated acres	Protected acres	
Impervious area not treated Phase 1				
		0.00		
	Total	**0.0**	*acres*	
Area within LA not contributing BMP				
363+00 RT			0.47	
386+00 LT			3.86	
368+00 LT			0.62	
374+00 RT			0.26	
379+00 RT			0.75	
	Total		**6.0**	*acres*
ODOT parcels not contributing BMP				
367+00 LT			0.82	
368+00 RT			3.24	
	Total		**4.1**	*acres*
Land-Locked parcels not contributing BMP				
354+00 RT			3.36	
367+00 LT			19.80	
234 Ramp C			2.20	
374+00 RT			3.77	
	Total		**29.1**	*acres*

Area within LA not contributing BMP	6.0
ODOT parcels not contributing BMP	4.1
Land-Locked parcels not contributing BMP	29.1

Surplus Area HUC 050	**39.2**	acres

HUC 14 Area 05090103 040 030			
	Untreated acres	Protected acres	
Impervious area not treated Phase 1			
TR 234 Ramp D	0.62		
404+00 LT	0.61		
440+00 LT	2.88		
440+00 RT	1.35		
446+00 LT	1.74		
507+00 LT	1.33		
539+00 CR 28 Ramp C/D	0.87		
Total	**9.4**		
Mitigation Factor	1.5		
Required mitigated area		**14.1**	*acres*
Area within LA not contributing BMP			
388+00 RT		1.89	
403+00 LT		0.06	
415+00 LT		1.58	
428+00 RT		0.25	
429+00 LT		0.10	
441+00 RT		0.81	
448+00 RT		2.26	
475+00 LT		0.09	
477+00 LT		0.22	
481+00 LT		1.80	
481+00 RT		1.91	
503+00 LT		0.75	
503+00RT		2.78	
514+00 LT		0.16	
CR 28 RAMP C/D		0.77	
Total		**15.4**	*acres*
ODOT parcels not contributing BMP			
446+00 LT		2.70	
516+00 LT		4.82	
539+00 rampC		40.55	
Total		**48.1**	*acres*
Land-Locked parcels not contributing BMP			
234 Ramp D		6.62	
403+00 LT		9.84	
411+00 LT		34.11	
415+00 LT		15.83	
418+00 RT		2.14	
453+00 LT		0.20	
493+50 RT		1.77	
509+00 LT		1.36	
506+00 LT		4.98	
Total		**76.9**	*acres*
Area within LA not contributing BMP	15.4		
ODOT parcels not contributing BMP	48.1		
Land-Locked parcels not contributing BMP	76.9		
Grand Total		**140.4**	
Surplus Area HUC 30		**126.3**	acres

HUC 14 Area 05090103 040 020	Untreated *acres*	Protected *acres*	
Impervious area not treated Phase 1			
	0.00		
Total	**0.0**		
Mitigation Factor	1.5		
Required mitigated area		**0.0**	*acres*
Area within LA not contributing BMP			
534+00 ramp AB		1.80	
Total		**1.8**	*acres*
ODOT parcels not contributing BMP			
		22.63	
		13.70	
Total		**36.3**	*acres*
Area within LA not contributing BMP	1.80		
ODOT parcels not contributing BMP	36.3		
Grand Total		**38.1**	
Surplus Area HUC 020		**38.1**	acres



Basin Drainage Area

Basin 488+00 Location Map

HDR | ONE COMPANY *Many Solutions*℠

Project:	SCI -823-PH 1	Computed	KAG	Date: 7/7/09
Subject:	BMP Sta 488+00	Checked:	KMD	Date: 7/15/09
Task:	Basin Volume	Page:		of:
Job #:	19415	No.:		

Water Quality Control Preliminary Sizing

Outfall Station:
Pond drainage areas

Discription		A	C	CA
Pavement	167006	3.83	0.9	3.451
Slopes > 4:1	38700	0.89	0.7	0.622
Total		4.72		4.072
	C average			0.86

Use C average as Cq

Water Quality Volume (WQ_V) Calculation

1117.4.1 Detention Basin $WQ_v = (P*A*Cq)/12$

P	0.75	
A	4.72	
Cq	0.86	
WQ_V =	0.25	ac ft
WQ_V =	11100	cubic feet

Extended Detention Treatment - 48 hour draw down minimum time

Required Treatment	1.2	x WQV
Req'd Volume	13300	cubic feet
Volume	0.305	ac ft
Forebay Volume	1330	cubic feet

Countour	Area	Area	Avg Area	Delta V	Volume
	(sf)	(ac ft)	SF	Cu Ft	Cu Ft
Basin Sta 488+00					
632	639	0.014669	0	0	0
633	3587	0.082346	2113	2113	2113
634	4884	0.112121	4236	4236	6349
635	6243	0.14332	5564	5564	11912
636	7602	0.174518	6923	6923	18835
637	9115	0.209252	8359	8359	27193
638	10719	0.246074	9917	9917	37110
639	12408	0.284848	11564	11564	48674

WQV	13300
635.34	
$^1/_2$ WQV	6650
634.05	

Countour	Area	Area	Avg Area	Delta V	Volume
	(sf)	(ac ft)	SF	Cu Ft	Cu Ft
Forebay Volume					
633	766	0.017585	0	0	0
634	1120	0.025712	943	943	943
635	1513	0.034734	1317	1317	2260
636	1951	0.044789	1732	1732	3992

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID BMP

$i = b / ((T + d)^{**}e)$

Where: i = rainfall intensity (in/hr)
T = rainfall duration (min)
e, b, d = rainfall equation coefficients

Return Event	Rainfall Type	e coeff	b coeff	d coeff
2	e, b, d Coeff.	.9500	85.5680	16.5000
10	e, b, d Coeff.	.9230	112.1720	16.8000
100	e, b, d Coeff.	1.0760	355.5510	23.1990

WQV = 0.305
elev = 635.34
1/2 elev = 634.05

MASTER NETWORK SUMMARY
Modified Rational Method Network

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
BMP 488+00 IN	POND	2	.409		.2000	7.87		
BMP 488+00 IN	POND	10	.608		.2000	11.06		
BMP 488+00 IN	POND	100	.894		.2000	17.75		
BMP 488+00 OUT	POND	2	.407		.8000	.18	636.09	.443
BMP 488+00 OUT	POND	10	.606		.8000	5.51	636.74	.566
BMP 488+00 OUT	POND	100	.892		.6000	14.70	637.12	.643

MASTER NETWORK SUMMARY
Modified Rational Method Network

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUTFALL	JCT	2	.407		.8000	.18		
*OUTFALL	JCT	10	.606		.8000	5.51		
*OUTFALL	JCT	100	.892		.6000	14.70		
STA 488+00	AREA	2	.400	L	.1800	7.87		
STA 488+00	AREA	10	.596	L	.1800	11.06		
STA 488+00	AREA	100	.875	L	.1800	17.75		

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (ac-ft)	Volume Sum (ac-ft)
632.00	-----	639	0	.000	.000
633.00	-----	3587	5740	.044	.044
634.00	-----	4884	12657	.097	.141
635.00	-----	6243	16649	.127	.268
636.00	-----	7602	20734	.159	.427
637.00	-----	9115	25041	.192	.618
638.00	-----	10719	29719	.227	.846
639.00	-----	12408	34660	.265	1.111

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 632.00 ft
Increment = .10 ft
Max. Elev.= 639.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Orifice-Circular	O0	--->	TW	633.000	639.000
Weir-Rectangular	W0	--->	TW	636.300	639.000
Weir-Rectangular	W1	--->	TW	637.000	639.000

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

Structure ID = O0
Structure Type = Orifice-Circular

# of Openings = 1
Invert Elev. = 633.00 ft
Diameter = 2.00 in
Orifice Coeff. = .600

Structure ID = W0
Structure Type = Weir-Rectangular

# of Openings = 1
Crest Elev. = 636.30 ft
Weir Length = 6.00 ft
Weir Coeff. = 3.000000

Weir TW effects (Use adjustment equation)

Structure ID = W1
Structure Type = Weir-Rectangular

# of Openings = 1
Crest Elev. = 637.00 ft
Weir Length = 10.00 ft
Weir Coeff. = 3.000000

Weir TW effects (Use adjustment equation)

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
.0000	.00	10.63	10.63	.00	.00	.044	633.00
.1000	4.37	14.93	15.00	.00	.04	.062	633.21
.2000	7.87	27.00	27.17	.00	.08	.112	633.73
.3000	7.87	42.51	42.74	.00	.12	.176	634.30
.4000	7.87	57.97	58.24	.00	.14	.240	634.80
.5000	7.87	73.40	73.71	.00	.15	.304	635.24
.6000	7.46	88.39	88.73	.00	.17	.366	635.64
.7000	4.95	100.46	100.81	.00	.18	.416	635.94
.8000	1.17	106.21	106.58	.00	.18	.440	636.07
.9000	.00	107.02	107.38	.00	.18	.443	636.09
1.0000	.00	106.65	107.02	.00	.18	.441	636.08
1.1000	.00	106.29	106.65	.00	.18	.440	636.07
1.2000	.00	105.93	106.29	.00	.18	.438	636.07
1.3000	.00	105.56	105.93	.00	.18	.437	636.06
1.4000	.00	105.20	105.56	.00	.18	.435	636.05
1.5000	.00	104.84	105.20	.00	.18	.434	636.04
1.6000	.00	104.48	104.84	.00	.18	.432	636.03
1.7000	.00	104.12	104.48	.00	.18	.431	636.02
1.8000	.00	103.76	104.12	.00	.18	.429	636.02
1.9000	.00	103.40	103.76	.00	.18	.428	636.01
2.0000	.00	103.04	103.40	.00	.18	.427	636.00
2.1000	.00	102.68	103.04	.00	.18	.425	635.99
2.2000	.00	102.33	102.68	.00	.18	.424	635.98
2.3000	.00	101.97	102.33	.00	.18	.422	635.97
2.4000	.00	101.61	101.97	.00	.18	.421	635.96
2.5000	.00	101.26	101.61	.00	.18	.419	635.96
2.6000	.00	100.90	101.26	.00	.18	.418	635.95
2.7000	.00	100.55	100.90	.00	.18	.416	635.94
2.8000	.00	100.19	100.55	.00	.18	.415	635.93
2.9000	.00	99.84	100.19	.00	.18	.413	635.92
3.0000	.00	99.49	99.84	.00	.18	.412	635.91
3.1000	.00	99.13	99.49	.00	.18	.410	635.90
3.2000	.00	98.78	99.13	.00	.18	.409	635.90
3.3000	.00	98.43	98.78	.00	.18	.407	635.89
3.4000	.00	98.08	98.43	.00	.18	.406	635.88
3.5000	.00	97.73	98.08	.00	.18	.405	635.87
3.6000	.00	97.38	97.73	.00	.18	.403	635.86
3.7000	.00	97.03	97.38	.00	.17	.402	635.85
3.8000	.00	96.68	97.03	.00	.17	.400	635.85
3.9000	.00	96.33	96.68	.00	.17	.399	635.84
4.0000	.00	95.98	96.33	.00	.17	.397	635.83
4.1000	.00	95.64	95.98	.00	.17	.396	635.82

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
4.2000	.00	95.29	95.64	.00	.17	.394	635.81
4.3000	.00	94.94	95.29	.00	.17	.393	635.80
4.4000	.00	94.60	94.94	.00	.17	.392	635.79
4.5000	.00	94.25	94.60	.00	.17	.390	635.79
4.6000	.00	93.91	94.25	.00	.17	.389	635.78
4.7000	.00	93.56	93.91	.00	.17	.387	635.77
4.8000	.00	93.22	93.56	.00	.17	.386	635.76
4.9000	.00	92.88	93.22	.00	.17	.384	635.75
5.0000	.00	92.53	92.88	.00	.17	.383	635.74
5.1000	.00	92.19	92.53	.00	.17	.382	635.73
5.2000	.00	91.85	92.19	.00	.17	.380	635.73
5.3000	.00	91.51	91.85	.00	.17	.379	635.72
5.4000	.00	91.17	91.51	.00	.17	.377	635.71
5.5000	.00	90.83	91.17	.00	.17	.376	635.70
5.6000	.00	90.49	90.83	.00	.17	.375	635.69
5.7000	.00	90.15	90.49	.00	.17	.373	635.68
5.8000	.00	89.81	90.15	.00	.17	.372	635.67
5.9000	.00	89.48	89.81	.00	.17	.370	635.67
6.0000	.00	89.14	89.48	.00	.17	.369	635.66
6.1000	.00	88.80	89.14	.00	.17	.368	635.65
6.2000	.00	88.47	88.80	.00	.17	.366	635.64
6.3000	.00	88.13	88.47	.00	.17	.365	635.63
6.4000	.00	87.80	88.13	.00	.17	.363	635.62
6.5000	.00	87.46	87.80	.00	.17	.362	635.62
6.6000	.00	87.13	87.46	.00	.17	.361	635.61
6.7000	.00	86.80	87.13	.00	.17	.359	635.60
6.8000	.00	86.46	86.80	.00	.17	.358	635.59
6.9000	.00	86.13	86.46	.00	.17	.357	635.58
7.0000	.00	85.80	86.13	.00	.17	.355	635.57
7.1000	.00	85.47	85.80	.00	.17	.354	635.56
7.2000	.00	85.14	85.47	.00	.17	.352	635.56
7.3000	.00	84.81	85.14	.00	.16	.351	635.55
7.4000	.00	84.48	84.81	.00	.16	.350	635.54
7.5000	.00	84.15	84.48	.00	.16	.348	635.53
7.6000	.00	83.82	84.15	.00	.16	.347	635.52
7.7000	.00	83.50	83.82	.00	.16	.346	635.51
7.8000	.00	83.17	83.50	.00	.16	.344	635.50
7.9000	.00	82.84	83.17	.00	.16	.343	635.50
8.0000	.00	82.52	82.84	.00	.16	.342	635.49
8.1000	.00	82.19	82.52	.00	.16	.340	635.48
8.2000	.00	81.87	82.19	.00	.16	.339	635.47
8.3000	.00	81.55	81.87	.00	.16	.338	635.46

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
8.4000	.00	81.22	81.55	.00	.16	.336	635.45
8.5000	.00	80.90	81.22	.00	.16	.335	635.44
8.6000	.00	80.58	80.90	.00	.16	.334	635.44
8.7000	.00	80.26	80.58	.00	.16	.332	635.43
8.8000	.00	79.93	80.26	.00	.16	.331	635.42
8.9000	.00	79.61	79.93	.00	.16	.330	635.41
9.0000	.00	79.29	79.61	.00	.16	.328	635.40
9.1000	.00	78.98	79.29	.00	.16	.327	635.39
9.2000	.00	78.66	78.98	.00	.16	.326	635.39
9.3000	.00	78.34	78.66	.00	.16	.324	635.38
9.4000	.00	78.02	78.34	.00	.16	.323	635.37
9.5000	.00	77.70	78.02	.00	.16	.322	635.36
9.6000	.00	77.39	77.70	.00	.16	.320	635.35
9.7000	.00	77.07	77.39	.00	.16	.319	635.34
9.8000	.00	76.76	77.07	.00	.16	.318	635.33
9.9000	.00	76.44	76.76	.00	.16	.317	635.33
10.0000	.00	76.13	76.44	.00	.16	.315	635.32
10.1000	.00	75.82	76.13	.00	.16	.314	635.31
10.2000	.00	75.50	75.82	.00	.16	.313	635.30
10.3000	.00	75.19	75.50	.00	.16	.311	635.29
10.4000	.00	74.88	75.19	.00	.16	.310	635.28
10.5000	.00	74.57	74.88	.00	.16	.309	635.28
10.6000	.00	74.26	74.57	.00	.16	.307	635.27
10.7000	.00	73.95	74.26	.00	.15	.306	635.26
10.8000	.00	73.64	73.95	.00	.15	.305	635.25
10.9000	.00	73.33	73.64	.00	.15	.304	635.24
11.0000	.00	73.02	73.33	.00	.15	.302	635.23
11.1000	.00	72.72	73.02	.00	.15	.301	635.22
11.2000	.00	72.41	72.72	.00	.15	.300	635.22
11.3000	.00	72.10	72.41	.00	.15	.299	635.21
11.4000	.00	71.80	72.10	.00	.15	.297	635.20
11.5000	.00	71.49	71.80	.00	.15	.296	635.19
11.6000	.00	71.19	71.49	.00	.15	.295	635.18
11.7000	.00	70.88	71.19	.00	.15	.294	635.17
11.8000	.00	70.58	70.88	.00	.15	.292	635.17
11.9000	.00	70.28	70.58	.00	.15	.291	635.16
12.0000	.00	69.98	70.28	.00	.15	.290	635.15
12.1000	.00	69.68	69.98	.00	.15	.289	635.14
12.2000	.00	69.38	69.68	.00	.15	.287	635.13
12.3000	.00	69.08	69.38	.00	.15	.286	635.12
12.4000	.00	68.78	69.08	.00	.15	.285	635.11
12.5000	.00	68.48	68.78	.00	.15	.284	635.11

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
12.6000	.00	68.18	68.48	.00	.15	.282	635.10
12.7000	.00	67.88	68.18	.00	.15	.281	635.09
12.8000	.00	67.59	67.88	.00	.15	.280	635.08
12.9000	.00	67.29	67.59	.00	.15	.279	635.07
13.0000	.00	66.99	67.29	.00	.15	.277	635.06
13.1000	.00	66.70	66.99	.00	.15	.276	635.06
13.2000	.00	66.40	66.70	.00	.15	.275	635.05
13.3000	.00	66.11	66.40	.00	.15	.274	635.04
13.4000	.00	65.82	66.11	.00	.15	.273	635.03
13.5000	.00	65.53	65.82	.00	.15	.271	635.02
13.6000	.00	65.23	65.53	.00	.15	.270	635.01
13.7000	.00	64.94	65.23	.00	.15	.269	635.01
13.8000	.00	64.65	64.94	.00	.15	.268	635.00
13.9000	.00	64.36	64.65	.00	.14	.267	634.99
14.0000	.00	64.07	64.36	.00	.14	.265	634.98
14.1000	.00	63.78	64.07	.00	.14	.264	634.97
14.2000	.00	63.50	63.78	.00	.14	.263	634.96
14.3000	.00	63.21	63.50	.00	.14	.262	634.95
14.4000	.00	62.92	63.21	.00	.14	.261	634.95
14.5000	.00	62.64	62.92	.00	.14	.259	634.94
14.6000	.00	62.35	62.64	.00	.14	.258	634.93
14.7000	.00	62.07	62.35	.00	.14	.257	634.92
14.8000	.00	61.78	62.07	.00	.14	.256	634.91
14.9000	.00	61.50	61.78	.00	.14	.255	634.91
15.0000	.00	61.22	61.50	.00	.14	.254	634.90
15.1000	.00	60.93	61.22	.00	.14	.252	634.89
15.2000	.00	60.65	60.93	.00	.14	.251	634.88
15.3000	.00	60.37	60.65	.00	.14	.250	634.87
15.4000	.00	60.09	60.37	.00	.14	.249	634.86
15.5000	.00	59.81	60.09	.00	.14	.248	634.85
15.6000	.00	59.53	59.81	.00	.14	.247	634.85
15.7000	.00	59.26	59.53	.00	.14	.245	634.84
15.8000	.00	58.98	59.26	.00	.14	.244	634.83
15.9000	.00	58.70	58.98	.00	.14	.243	634.82
16.0000	.00	58.42	58.70	.00	.14	.242	634.81
16.1000	.00	58.15	58.42	.00	.14	.241	634.80
16.2000	.00	57.87	58.15	.00	.14	.240	634.80
16.3000	.00	57.60	57.87	.00	.14	.239	634.79
16.4000	.00	57.33	57.60	.00	.14	.237	634.78
16.5000	.00	57.05	57.33	.00	.14	.236	634.77
16.6000	.00	56.78	57.05	.00	.14	.235	634.76
16.7000	.00	56.51	56.78	.00	.14	.234	634.75

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
16.8000	.00	56.24	56.51	.00	.14	.233	634.75
16.9000	.00	55.97	56.24	.00	.14	.232	634.74
17.0000	.00	55.70	55.97	.00	.13	.231	634.73
17.1000	.00	55.43	55.70	.00	.13	.230	634.72
17.2000	.00	55.16	55.43	.00	.13	.228	634.71
17.3000	.00	54.90	55.16	.00	.13	.227	634.71
17.4000	.00	54.63	54.90	.00	.13	.226	634.70
17.5000	.00	54.36	54.63	.00	.13	.225	634.69
17.6000	.00	54.10	54.36	.00	.13	.224	634.68
17.7000	.00	53.83	54.10	.00	.13	.223	634.67
17.8000	.00	53.57	53.83	.00	.13	.222	634.66
17.9000	.00	53.30	53.57	.00	.13	.221	634.66
18.0000	.00	53.04	53.30	.00	.13	.220	634.65
18.1000	.00	52.78	53.04	.00	.13	.219	634.64
18.2000	.00	52.52	52.78	.00	.13	.218	634.63
18.3000	.00	52.26	52.52	.00	.13	.216	634.62
18.4000	.00	52.00	52.26	.00	.13	.215	634.61
18.5000	.00	51.74	52.00	.00	.13	.214	634.61
18.6000	.00	51.48	51.74	.00	.13	.213	634.60
18.7000	.00	51.22	51.48	.00	.13	.212	634.59
18.8000	.00	50.97	51.22	.00	.13	.211	634.58
18.9000	.00	50.71	50.97	.00	.13	.210	634.57
19.0000	.00	50.45	50.71	.00	.13	.209	634.57
19.1000	.00	50.20	50.45	.00	.13	.208	634.56
19.2000	.00	49.94	50.20	.00	.13	.207	634.55
19.3000	.00	49.69	49.94	.00	.13	.206	634.54
19.4000	.00	49.44	49.69	.00	.13	.205	634.53
19.5000	.00	49.19	49.44	.00	.13	.204	634.52
19.6000	.00	48.94	49.19	.00	.13	.203	634.52
19.7000	.00	48.68	48.94	.00	.13	.202	634.51
19.8000	.00	48.43	48.68	.00	.13	.201	634.50
19.9000	.00	48.19	48.43	.00	.12	.200	634.49
20.0000	.00	47.94	48.19	.00	.12	.199	634.48
20.1000	.00	47.69	47.94	.00	.12	.198	634.48
20.2000	.00	47.44	47.69	.00	.12	.197	634.47
20.3000	.00	47.20	47.44	.00	.12	.195	634.46
20.4000	.00	46.95	47.20	.00	.12	.194	634.45
20.5000	.00	46.70	46.95	.00	.12	.193	634.44
20.6000	.00	46.46	46.70	.00	.12	.192	634.44
20.7000	.00	46.22	46.46	.00	.12	.191	634.43
20.8000	.00	45.97	46.22	.00	.12	.190	634.42
20.9000	.00	45.73	45.97	.00	.12	.189	634.41

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
21.0000	.00	45.49	45.73	.00	.12	.188	634.40
21.1000	.00	45.25	45.49	.00	.12	.187	634.40
21.2000	.00	45.01	45.25	.00	.12	.186	634.39
21.3000	.00	44.77	45.01	.00	.12	.185	634.38
21.4000	.00	44.53	44.77	.00	.12	.184	634.37
21.5000	.00	44.30	44.53	.00	.12	.183	634.36
21.6000	.00	44.06	44.30	.00	.12	.183	634.36
21.7000	.00	43.82	44.06	.00	.12	.182	634.35
21.8000	.00	43.59	43.82	.00	.12	.181	634.34
21.9000	.00	43.35	43.59	.00	.12	.180	634.33
22.0000	.00	43.12	43.35	.00	.12	.179	634.32
22.1000	.00	42.89	43.12	.00	.12	.178	634.32
22.2000	.00	42.65	42.89	.00	.12	.177	634.31
22.3000	.00	42.42	42.65	.00	.12	.176	634.30
22.4000	.00	42.19	42.42	.00	.12	.175	634.29
22.5000	.00	41.96	42.19	.00	.12	.174	634.28
22.6000	.00	41.73	41.96	.00	.11	.173	634.28
22.7000	.00	41.50	41.73	.00	.11	.172	634.27
22.8000	.00	41.28	41.50	.00	.11	.171	634.26
22.9000	.00	41.05	41.28	.00	.11	.170	634.25
23.0000	.00	40.82	41.05	.00	.11	.169	634.24
23.1000	.00	40.60	40.82	.00	.11	.168	634.24
23.2000	.00	40.37	40.60	.00	.11	.167	634.23
23.3000	.00	40.15	40.37	.00	.11	.166	634.22
23.4000	.00	39.92	40.15	.00	.11	.165	634.21
23.5000	.00	39.70	39.92	.00	.11	.165	634.21
23.6000	.00	39.48	39.70	.00	.11	.164	634.20
23.7000	.00	39.26	39.48	.00	.11	.163	634.19
23.8000	.00	39.04	39.26	.00	.11	.162	634.18
23.9000	.00	38.82	39.04	.00	.11	.161	634.17
24.0000	.00	38.60	38.82	.00	.11	.160	634.17
24.1000	.00	38.38	38.60	.00	.11	.159	634.16
24.2000	.00	38.17	38.38	.00	.11	.158	634.15
24.3000	.00	37.95	38.17	.00	.11	.157	634.14
24.4000	.00	37.73	37.95	.00	.11	.156	634.14
24.5000	.00	37.52	37.73	.00	.11	.155	634.13
24.6000	.00	37.31	37.52	.00	.11	.155	634.12
24.7000	.00	37.09	37.31	.00	.11	.154	634.11
24.8000	.00	36.88	37.09	.00	.11	.153	634.11
24.9000	.00	36.67	36.88	.00	.11	.152	634.10
25.0000	.00	36.46	36.67	.00	.11	.151	634.09
25.1000	.00	36.25	36.46	.00	.10	.150	634.08

half of WQV must stay in basin for $\frac{1}{3}$ (48h) = 16

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
25.2000	.00	36.04	36.25	.00	.10	.149	634.08
25.3000	.00	35.83	36.04	.00	.10	.148	634.07
25.4000	.00	35.62	35.83	.00	.10	.148	634.06
25.5000	.00	35.42	35.62	.00	.10	.147	634.05
25.6000	.00	35.21	35.42	.00	.10	.146	634.05
25.7000	.00	35.01	35.21	.00	.10	.145	634.04
25.8000	.00	34.80	35.01	.00	.10	.144	634.03
25.9000	.00	34.60	34.80	.00	.10	.143	634.02
26.0000	.00	34.39	34.60	.00	.10	.143	634.02
26.1000	.00	34.19	34.39	.00	.10	.142	634.01
26.2000	.00	33.99	34.19	.00	.10	.141	634.00
26.3000	.00	33.79	33.99	.00	.10	.140	633.99
26.4000	.00	33.59	33.79	.00	.10	.139	633.99
26.5000	.00	33.39	33.59	.00	.10	.138	633.98
26.6000	.00	33.20	33.39	.00	.10	.138	633.97
26.7000	.00	33.00	33.20	.00	.10	.137	633.96
26.8000	.00	32.80	33.00	.00	.10	.136	633.96
26.9000	.00	32.61	32.80	.00	.10	.135	633.95
27.0000	.00	32.41	32.61	.00	.10	.134	633.94
27.1000	.00	32.22	32.41	.00	.10	.134	633.93
27.2000	.00	32.03	32.22	.00	.10	.133	633.93
27.3000	.00	31.83	32.03	.00	.10	.132	633.92
27.4000	.00	31.64	31.83	.00	.10	.131	633.91
27.5000	.00	31.45	31.64	.00	.10	.130	633.91
27.6000	.00	31.26	31.45	.00	.09	.130	633.90
27.7000	.00	31.07	31.26	.00	.09	.129	633.89
27.8000	.00	30.89	31.07	.00	.09	.128	633.88
27.9000	.00	30.70	30.89	.00	.09	.127	633.88
28.0000	.00	30.51	30.70	.00	.09	.126	633.87
28.1000	.00	30.33	30.51	.00	.09	.126	633.86
28.2000	.00	30.14	30.33	.00	.09	.125	633.86
28.3000	.00	29.96	30.14	.00	.09	.124	633.85
28.4000	.00	29.78	29.96	.00	.09	.123	633.84
28.5000	.00	29.59	29.78	.00	.09	.123	633.83
28.6000	.00	29.41	29.59	.00	.09	.122	633.83
28.7000	.00	29.23	29.41	.00	.09	.121	633.82
28.8000	.00	29.05	29.23	.00	.09	.120	633.81
28.9000	.00	28.88	29.05	.00	.09	.120	633.81
29.0000	.00	28.70	28.88	.00	.09	.119	633.80
29.1000	.00	28.52	28.70	.00	.09	.118	633.79
29.2000	.00	28.34	28.52	.00	.09	.117	633.79
29.3000	.00	28.17	28.34	.00	.09	.117	633.78

25.6 > 16 ∴

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
29.4000	.00	28.00	28.17	.00	.09	.116	633.77
29.5000	.00	27.82	28.00	.00	.09	.115	633.76
29.6000	.00	27.65	27.82	.00	.09	.115	633.76
29.7000	.00	27.48	27.65	.00	.09	.114	633.75
29.8000	.00	27.31	27.48	.00	.09	.113	633.74
29.9000	.00	27.14	27.31	.00	.08	.112	633.74
30.0000	.00	26.97	27.14	.00	.08	.112	633.73
30.1000	.00	26.80	26.97	.00	.08	.111	633.72
30.2000	.00	26.63	26.80	.00	.08	.110	633.72
30.3000	.00	26.47	26.63	.00	.08	.110	633.71
30.4000	.00	26.30	26.47	.00	.08	.109	633.70
30.5000	.00	26.14	26.30	.00	.08	.108	633.70
30.6000	.00	25.97	26.14	.00	.08	.108	633.69
30.7000	.00	25.81	25.97	.00	.08	.107	633.68
30.8000	.00	25.65	25.81	.00	.08	.106	633.68
30.9000	.00	25.49	25.65	.00	.08	.106	633.67
31.0000	.00	25.33	25.49	.00	.08	.105	633.66
31.1000	.00	25.17	25.33	.00	.08	.104	633.66
31.2000	.00	25.01	25.17	.00	.08	.104	633.65
31.3000	.00	24.85	25.01	.00	.08	.103	633.65
31.4000	.00	24.70	24.85	.00	.08	.102	633.64
31.5000	.00	24.54	24.70	.00	.08	.102	633.63
31.6000	.00	24.39	24.54	.00	.08	.101	633.63
31.7000	.00	24.23	24.39	.00	.08	.100	633.62
31.8000	.00	24.08	24.23	.00	.08	.100	633.61
31.9000	.00	23.93	24.08	.00	.08	.099	633.61
32.0000	.00	23.78	23.93	.00	.08	.099	633.60
32.1000	.00	23.63	23.78	.00	.08	.098	633.59
32.2000	.00	23.48	23.63	.00	.07	.097	633.59
32.3000	.00	23.33	23.48	.00	.07	.097	633.58
32.4000	.00	23.18	23.33	.00	.07	.096	633.58
32.5000	.00	23.04	23.18	.00	.07	.095	633.57
32.6000	.00	22.89	23.04	.00	.07	.095	633.56
32.7000	.00	22.75	22.89	.00	.07	.094	633.56
32.8000	.00	22.60	22.75	.00	.07	.094	633.55
32.9000	.00	22.46	22.60	.00	.07	.093	633.55
33.0000	.00	22.32	22.46	.00	.07	.092	633.54
33.1000	.00	22.18	22.32	.00	.07	.092	633.53
33.2000	.00	22.04	22.18	.00	.07	.091	633.53
33.3000	.00	21.90	22.04	.00	.07	.091	633.52
33.4000	.00	21.76	21.90	.00	.07	.090	633.52
33.5000	.00	21.62	21.76	.00	.07	.090	633.51

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
33.6000	.00	21.49	21.62	.00	.07	.089	633.50
33.7000	.00	21.35	21.49	.00	.07	.089	633.50
33.8000	.00	21.22	21.35	.00	.07	.088	633.49
33.9000	.00	21.08	21.22	.00	.07	.087	633.49
34.0000	.00	20.95	21.08	.00	.07	.087	633.48
34.1000	.00	20.82	20.95	.00	.07	.086	633.48
34.2000	.00	20.69	20.82	.00	.07	.086	633.47
34.3000	.00	20.56	20.69	.00	.06	.085	633.46
34.4000	.00	20.43	20.56	.00	.06	.085	633.46
34.5000	.00	20.31	20.43	.00	.06	.084	633.45
34.6000	.00	20.18	20.31	.00	.06	.084	633.45
34.7000	.00	20.05	20.18	.00	.06	.083	633.44
34.8000	.00	19.93	20.05	.00	.06	.083	633.44
34.9000	.00	19.81	19.93	.00	.06	.082	633.43
35.0000	.00	19.68	19.81	.00	.06	.082	633.43
35.1000	.00	19.56	19.68	.00	.06	.081	633.42
35.2000	.00	19.44	19.56	.00	.06	.081	633.42
35.3000	.00	19.32	19.44	.00	.06	.080	633.41
35.4000	.00	19.20	19.32	.00	.06	.080	633.41
35.5000	.00	19.08	19.20	.00	.06	.079	633.40
35.6000	.00	18.97	19.08	.00	.06	.079	633.39
35.7000	.00	18.85	18.97	.00	.06	.078	633.39
35.8000	.00	18.73	18.85	.00	.06	.078	633.38
35.9000	.00	18.62	18.73	.00	.06	.077	633.38
36.0000	.00	18.51	18.62	.00	.06	.077	633.37
36.1000	.00	18.40	18.51	.00	.06	.076	633.37
36.2000	.00	18.29	18.40	.00	.06	.076	633.36
36.3000	.00	18.18	18.29	.00	.05	.075	633.36
36.4000	.00	18.07	18.18	.00	.05	.075	633.35
36.5000	.00	17.96	18.07	.00	.05	.074	633.35
36.6000	.00	17.85	17.96	.00	.05	.074	633.34
36.7000	.00	17.75	17.85	.00	.05	.074	633.34
36.8000	.00	17.64	17.75	.00	.05	.073	633.34
36.9000	.00	17.54	17.64	.00	.05	.073	633.33
37.0000	.00	17.43	17.54	.00	.05	.072	633.33
37.1000	.00	17.33	17.43	.00	.05	.072	633.32
37.2000	.00	17.23	17.33	.00	.05	.071	633.32
37.3000	.00	17.13	17.23	.00	.05	.071	633.31
37.4000	.00	17.03	17.13	.00	.05	.071	633.31
37.5000	.00	16.93	17.03	.00	.05	.070	633.30
37.6000	.00	16.84	16.93	.00	.05	.070	633.30
37.7000	.00	16.74	16.84	.00	.05	.069	633.29

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
37.8000	.00	16.64	16.74	.00	.05	.069	633.29
37.9000	.00	16.55	16.64	.00	.05	.069	633.29
38.0000	.00	16.46	16.55	.00	.05	.068	633.28
38.1000	.00	16.37	16.46	.00	.05	.068	633.28
38.2000	.00	16.28	16.37	.00	.05	.067	633.27
38.3000	.00	16.19	16.28	.00	.04	.067	633.27
38.4000	.00	16.10	16.19	.00	.04	.067	633.26
38.5000	.00	16.01	16.10	.00	.04	.066	633.26
38.6000	.00	15.92	16.01	.00	.04	.066	633.26
38.7000	.00	15.84	15.92	.00	.04	.066	633.25
38.8000	.00	15.75	15.84	.00	.04	.065	633.25
38.9000	.00	15.67	15.75	.00	.04	.065	633.24
39.0000	.00	15.59	15.67	.00	.04	.065	633.24
39.1000	.00	15.51	15.59	.00	.04	.064	633.24
39.2000	.00	15.43	15.51	.00	.04	.064	633.23
39.3000	.00	15.35	15.43	.00	.04	.064	633.23
39.4000	.00	15.27	15.35	.00	.04	.063	633.23
39.5000	.00	15.19	15.27	.00	.04	.063	633.22
39.6000	.00	15.11	15.19	.00	.04	.063	633.22
39.7000	.00	15.04	15.11	.00	.04	.062	633.22
39.8000	.00	14.96	15.04	.00	.04	.062	633.21
39.9000	.00	14.89	14.96	.00	.04	.062	633.21
40.0000	.00	14.82	14.89	.00	.04	.061	633.20
40.1000	.00	14.74	14.82	.00	.04	.061	633.20
40.2000	.00	14.67	14.74	.00	.04	.061	633.20
40.3000	.00	14.60	14.67	.00	.03	.060	633.19
40.4000	.00	14.54	14.60	.00	.03	.060	633.19
40.5000	.00	14.47	14.54	.00	.03	.060	633.19
40.6000	.00	14.41	14.47	.00	.03	.060	633.19
40.7000	.00	14.34	14.41	.00	.03	.059	633.18
40.8000	.00	14.28	14.34	.00	.03	.059	633.18
40.9000	.00	14.22	14.28	.00	.03	.059	633.18
41.0000	.00	14.16	14.22	.00	.03	.059	633.17
41.1000	.00	14.10	14.16	.00	.03	.058	633.17
41.2000	.00	14.05	14.10	.00	.03	.058	633.17
41.3000	.00	13.99	14.05	.00	.03	.058	633.17
41.4000	.00	13.94	13.99	.00	.03	.058	633.16
41.5000	.00	13.88	13.94	.00	.03	.057	633.16
41.6000	.00	13.83	13.88	.00	.03	.057	633.16
41.7000	.00	13.78	13.83	.00	.03	.057	633.16
41.8000	.00	13.73	13.78	.00	.02	.057	633.15
41.9000	.00	13.68	13.73	.00	.02	.057	633.15

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
42.0000	.00	13.64	13.68	.00	.02	.056	633.15
42.1000	.00	13.59	13.64	.00	.02	.056	633.15
42.2000	.00	13.55	13.59	.00	.02	.056	633.14
42.3000	.00	13.50	13.55	.00	.02	.056	633.14
42.4000	.00	13.46	13.50	.00	.02	.056	633.14
42.5000	.00	13.42	13.46	.00	.02	.055	633.14
42.6000	.00	13.38	13.42	.00	.02	.055	633.14
42.7000	.00	13.33	13.38	.00	.02	.055	633.13
42.8000	.00	13.30	13.33	.00	.02	.055	633.13
42.9000	.00	13.26	13.30	.00	.02	.055	633.13
43.0000	.00	13.22	13.26	.00	.02	.055	633.13
43.1000	.00	13.18	13.22	.00	.02	.055	633.13
43.2000	.00	13.15	13.18	.00	.02	.054	633.12
43.3000	.00	13.11	13.15	.00	.02	.054	633.12
43.4000	.00	13.08	13.11	.00	.02	.054	633.12
43.5000	.00	13.04	13.08	.00	.02	.054	633.12
43.6000	.00	13.01	13.04	.00	.02	.054	633.12
43.7000	.00	12.98	13.01	.00	.02	.054	633.12
43.8000	.00	12.95	12.98	.00	.02	.054	633.11
43.9000	.00	12.92	12.95	.00	.02	.053	633.11
44.0000	.00	12.88	12.92	.00	.02	.053	633.11
44.1000	.00	12.86	12.88	.00	.01	.053	633.11
44.2000	.00	12.83	12.86	.00	.01	.053	633.11
44.3000	.00	12.80	12.83	.00	.01	.053	633.11
44.4000	.00	12.77	12.80	.00	.01	.053	633.11
44.5000	.00	12.74	12.77	.00	.01	.053	633.10
44.6000	.00	12.72	12.74	.00	.01	.053	633.10
44.7000	.00	12.69	12.72	.00	.01	.052	633.10
44.8000	.00	12.67	12.69	.00	.01	.052	633.10
44.9000	.00	12.64	12.67	.00	.01	.052	633.10
45.0000	.00	12.62	12.64	.00	.01	.052	633.10
45.1000	.00	12.59	12.62	.00	.01	.052	633.10
45.2000	.00	12.57	12.59	.00	.01	.052	633.10
45.3000	.00	12.55	12.57	.00	.01	.052	633.10
45.4000	.00	12.52	12.55	.00	.01	.052	633.09
45.5000	.00	12.50	12.52	.00	.01	.052	633.09
45.6000	.00	12.48	12.50	.00	.01	.052	633.09
45.7000	.00	12.46	12.48	.00	.01	.052	633.09
45.8000	.00	12.43	12.46	.00	.01	.051	633.09
45.9000	.00	12.41	12.43	.00	.01	.051	633.09
46.0000	.00	12.39	12.41	.00	.01	.051	633.09
46.1000	.00	12.37	12.39	.00	.01	.051	633.09

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
46.2000	.00	12.35	12.37	.00	.01	.051	633.09
46.3000	.00	12.33	12.35	.00	.01	.051	633.08
46.4000	.00	12.31	12.33	.00	.01	.051	633.08
46.5000	.00	12.29	12.31	.00	.01	.051	633.08
46.6000	.00	12.27	12.29	.00	.01	.051	633.08
46.7000	.00	12.25	12.27	.00	.01	.051	633.08
46.8000	.00	12.23	12.25	.00	.01	.051	633.08
46.9000	.00	12.21	12.23	.00	.01	.050	633.08
47.0000	.00	12.19	12.21	.00	.01	.050	633.08
47.1000	.00	12.17	12.19	.00	.01	.050	633.08
47.2000	.00	12.15	12.17	.00	.01	.050	633.08
47.3000	.00	12.13	12.15	.00	.01	.050	633.07
47.4000	.00	12.11	12.13	.00	.01	.050	633.07
47.5000	.00	12.10	12.11	.00	.01	.050	633.07
47.6000	.00	12.08	12.10	.00	.01	.050	633.07
47.7000	.00	12.06	12.08	.00	.01	.050	633.07
47.8000	.00	12.04	12.06	.00	.01	.050	633.07
47.9000	.00	12.03	12.04	.00	.01	.050	633.07
48.0000	.00	12.01	12.03	.00	.01	.050	633.07
48.1000	.00	11.99	12.01	.00	.01	.050	633.07
48.2000	.00	11.98	11.99	.00	.01	.049	633.07
48.3000	.00	11.96	11.98	.00	.01	.049	633.07
48.4000	.00	11.94	11.96	.00	.01	.049	633.07
48.5000	.00	11.93	11.94	.00	.01	.049	633.06
48.6000	.00	11.91	11.93	.00	.01	.049	633.06
48.7000	.00	11.90	11.91	.00	.01	.049	633.06
48.8000	.00	11.88	11.90	.00	.01	.049	633.06
48.9000	.00	11.87	11.88	.00	.01	.049	633.06
49.0000	.00	11.85	11.87	.00	.01	.049	633.06
49.1000	.00	11.84	11.85	.00	.01	.049	633.06
49.2000	.00	11.82	11.84	.00	.01	.049	633.06
49.3000	.00	11.81	11.82	.00	.01	.049	633.06
49.4000	.00	11.79	11.81	.00	.01	.049	633.06
49.5000	.00	11.78	11.79	.00	.01	.049	633.06
49.6000	.00	11.77	11.78	.00	.01	.049	633.06
49.7000	.00	11.75	11.77	.00	.01	.049	633.06
49.8000	.00	11.74	11.75	.00	.01	.048	633.06
49.9000	.00	11.73	11.74	.00	.01	.048	633.05
50.0000	.00	11.71	11.73	.00	.01	.048	633.05
50.1000	.00	11.70	11.71	.00	.01	.048	633.05
50.2000	.00	11.69	11.70	.00	.01	.048	633.05
50.3000	.00	11.67	11.69	.00	.01	.048	633.05

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
50.4000	.00	11.66	11.67	.00	.01	.048	633.05
50.5000	.00	11.65	11.66	.00	.01	.048	633.05
50.6000	.00	11.64	11.65	.00	.01	.048	633.05
50.7000	.00	11.62	11.64	.00	.01	.048	633.05
50.8000	.00	11.61	11.62	.00	.01	.048	633.05
50.9000	.00	11.60	11.61	.00	.01	.048	633.05
51.0000	.00	11.59	11.60	.00	.01	.048	633.05
51.1000	.00	11.58	11.59	.00	.01	.048	633.05
51.2000	.00	11.57	11.58	.00	.01	.048	633.05
51.3000	.00	11.55	11.57	.00	.01	.048	633.05
51.4000	.00	11.54	11.55	.00	.01	.048	633.05
51.5000	.00	11.53	11.54	.00	.01	.048	633.04
51.6000	.00	11.52	11.53	.00	.01	.048	633.04
51.7000	.00	11.51	11.52	.00	.01	.048	633.04
51.8000	.00	11.50	11.51	.00	.01	.048	633.04
51.9000	.00	11.49	11.50	.00	.01	.047	633.04
52.0000	.00	11.48	11.49	.00	.01	.047	633.04
52.1000	.00	11.47	11.48	.00	.01	.047	633.04
52.2000	.00	11.46	11.47	.00	.01	.047	633.04
52.3000	.00	11.45	11.46	.00	.01	.047	633.04
52.4000	.00	11.44	11.45	.00	.00	.047	633.04
52.5000	.00	11.43	11.44	.00	.00	.047	633.04
52.6000	.00	11.42	11.43	.00	.00	.047	633.04
52.7000	.00	11.41	11.42	.00	.00	.047	633.04
52.8000	.00	11.40	11.41	.00	.00	.047	633.04
52.9000	.00	11.39	11.40	.00	.00	.047	633.04
53.0000	.00	11.38	11.39	.00	.00	.047	633.04
53.1000	.00	11.37	11.38	.00	.00	.047	633.04
53.2000	.00	11.36	11.37	.00	.00	.047	633.04
53.3000	.00	11.35	11.36	.00	.00	.047	633.04
53.4000	.00	11.35	11.35	.00	.00	.047	633.04
53.5000	.00	11.34	11.35	.00	.00	.047	633.04
53.6000	.00	11.33	11.34	.00	.00	.047	633.03
53.7000	.00	11.32	11.33	.00	.00	.047	633.03
53.8000	.00	11.31	11.32	.00	.00	.047	633.03
53.9000	.00	11.30	11.31	.00	.00	.047	633.03
54.0000	.00	11.30	11.30	.00	.00	.047	633.03
54.1000	.00	11.29	11.30	.00	.00	.047	633.03
54.2000	.00	11.28	11.29	.00	.00	.047	633.03
54.3000	.00	11.27	11.28	.00	.00	.047	633.03
54.4000	.00	11.26	11.27	.00	.00	.047	633.03
54.5000	.00	11.26	11.26	.00	.00	.047	633.03

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - BMP 488+00 IN Pre 2
Outflow HYG file = work_pad.hyg - BMP 488+00 OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
54.6000	.00	11.25	11.26	.00	.00	.046	633.03
54.7000	.00	11.24	11.25	.00	.00	.046	633.03
54.8000	.00	11.23	11.24	.00	.00	.046	633.03
54.9000	.00	11.23	11.23	.00	.00	.046	633.03
55.0000	.00	11.22	11.23	.00	.00	.046	633.03
55.1000	.00	11.21	11.22	.00	.00	.046	633.03
55.2000	.00	11.20	11.21	.00	.00	.046	633.03
55.3000	.00	11.20	11.20	.00	.00	.046	633.03
55.4000	.00	11.19	11.20	.00	.00	.046	633.03
55.5000	.00	11.18	11.19	.00	.00	.046	633.03
55.6000	.00	11.18	11.18	.00	.00	.046	633.03
55.7000	.00	11.17	11.18	.00	.00	.046	633.03
55.8000	.00	11.16	11.17	.00	.00	.046	633.03
55.9000	.00	11.16	11.16	.00	.00	.046	633.03
56.0000	.00	11.15	11.16	.00	.00	.046	633.03
56.1000	.00	11.15	11.15	.00	.00	.046	633.03
56.2000	.00	11.14	11.15	.00	.00	.046	633.03
56.3000	.00	11.13	11.14	.00	.00	.046	633.03
56.4000	.00	11.13	11.13	.00	.00	.046	633.02
56.5000	.00	11.12	11.13	.00	.00	.046	633.02
56.6000	.00	11.11	11.12	.00	.00	.046	633.02

RATIONAL C COEFFICIENT DATA

Soil/Surface Description	C	Area acres	C x Area acres
Pavement	.9000	3.830	3.447
Slopes	.7000	.890	.623
WEIGHTED C & TOTAL AREA --->	.8623	4.720	4.070

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 2 yr `C' Adjustment = 1.000Allowable Q = 5.37 cfs

Hydrograph Storm Duration, Td = .6333 hrs Tc = .1800 hrs
Hydrograph File: Pre 2

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	Storage ac-ft
.862	.862	.1800	3.6979	4.720	15.18	.226	.146
.862	.862	.2500	3.2279	4.720	13.25	.274	.178
.862	.862	.3333	2.8063	4.720	11.52	.317	.203
.862	.862	.5000	2.2296	4.720	9.15	.378	.227
.862	.862	.6333	1.9175	4.720	7.87	.412	.231 Storage Maximum
.862	.862	.6667	1.8530	4.720	7.60	.419	.231
.862	.862	.8333	1.5872	4.720	6.51	.449	.224
.862	.862	1.0000	1.3894	4.720	5.70	.471	.209
.862	.862	2.0000	.8016	4.720	3.29	Qpeak < Qallow	

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 10 yr `C' Adjustment = 1.000Allowable Q = 7.70 cfs

Hydrograph Storm Duration, Td = .6667 hrs Tc = .1800 hrs
Hydrograph File: Pre 10

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.862	.862	.1800	5.2472	4.720	21.53	.320	.206
.862	.862	.2500	4.6041	4.720	18.90	.390	.254
.862	.862	.3333	4.0235	4.720	16.51	.455	.292
.862	.862	.5000	3.2229	4.720	13.23	.547	.330
**********						Storage Maximum	
.862	.862	.6667	2.6954	4.720	11.06	.609	.340
.862	.862	.6667	2.6954	4.720	11.06	.609	.340
.862	.862	.8333	2.3207	4.720	9.52	.656	.334
.862	.862	1.0000	2.0403	4.720	8.37	.692	.317
.862	.862	2.0000	1.1975	4.720	4.91	Qpeak < Qallow	

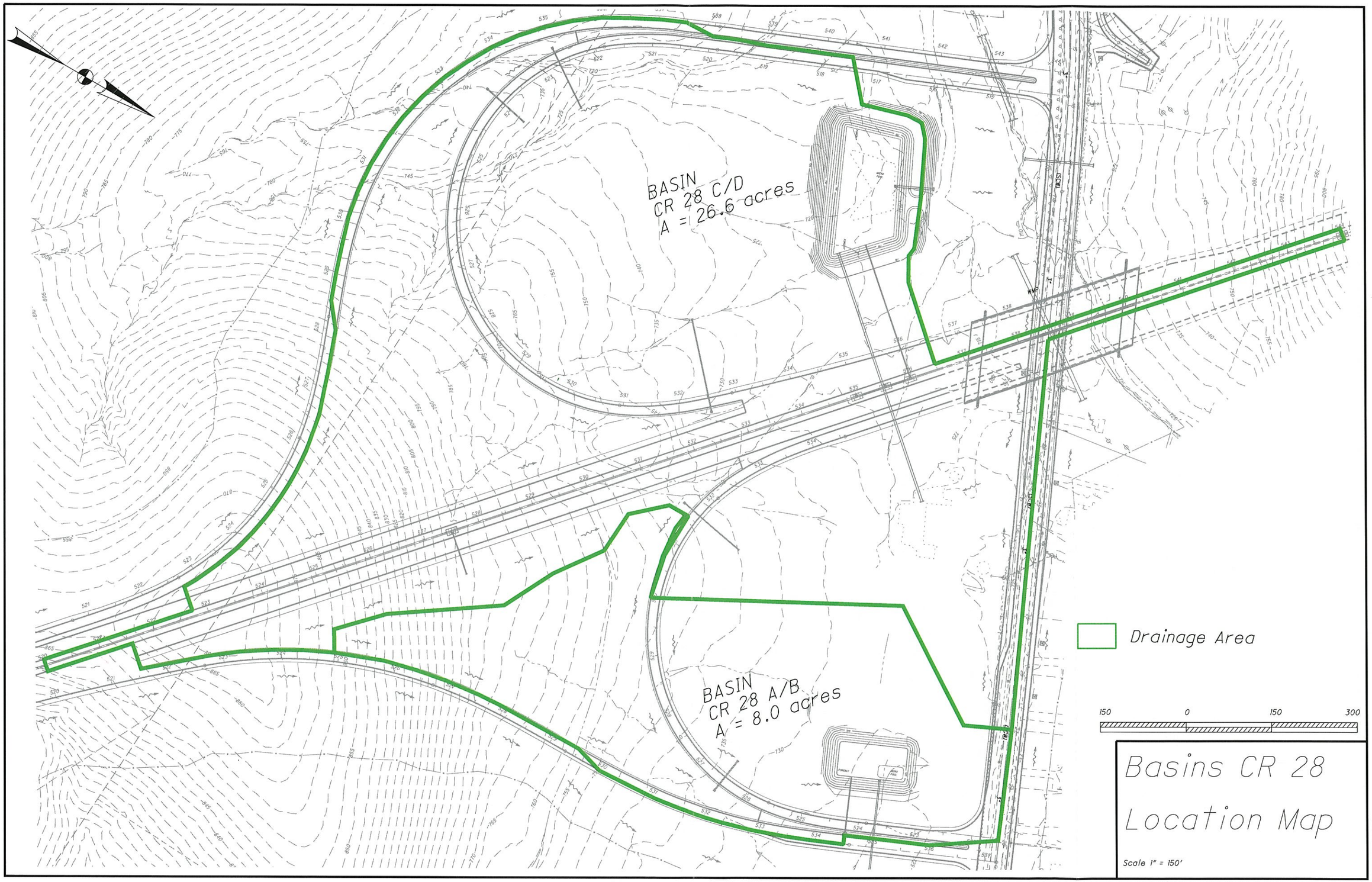
MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 100 yr `C' Adjustment = 1.000Allowable Q = 11.83 cfs

Hydrograph Storm Duration, Td = .6167 hrs Tc = .1800 hrs
Hydrograph File: Pre100

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.862	.862	.1800	7.9992	4.720	32.83	.488	.313
.862	.862	.2500	7.0569	4.720	28.96	.598	.388
.862	.862	.3333	6.1820	4.720	25.37	.699	.448
.862	.862	.5000	4.9412	4.720	20.28	.838	.506
**********						Storage Maximum	
.862	.862	.6167	4.3258	4.720	17.75	.905	.515
.862	.862	.6667	4.1052	4.720	16.85	.928	.514
.862	.862	.8333	3.5051	4.720	14.38	.991	.495
.862	.862	1.0000	3.0539	4.720	12.53	1.036	.459
.862	.862	2.0000	1.7026	4.720	6.99	Qpeak < Qallow	



Basins CR 28

Location Map

Scale 1" = 150'

HDR | ONE COMPANY *Many Solutions*℠

Project:	SCI-823-PH 1	Computed	KAG	Date: 7/7/09
Subject:	BMP CR 28 CD	Checked:	KMD	Date: 7/16/09
Task:	Basin Volume	Page:		of:
Job #:	19415	No.:		

Water Quality Control Preliminary Sizing

Outfall Station: **541+00 RT Ramp D**

Pond drainage areas

Discription		A	C	CA
Pavement	361313	8.29	0.9	7.47
Slopes > 4:1	799291	18.35	0.7	12.84
Total		26.6		20.31
	C average			0.76

Use C average as Cq

Water Quality Volume (WQ_V) Calculation

1117.4.1 Detention Basin $WQ_v = (P*A*Cq)/12$

P	0.75	
A	26.64	
Cq	0.76	
WQ_V =	1.27	ac ft
WQ_V =	55300	cubic feet

Extended Detention Treatment - 48 hour draw down minimum time

Required Treatment	1.2	x WQV
Req'd Volume	66400	cubic feet
Volume	1.524	ac ft
Forebay Volume	6640	cubic feet

Countour	Area	Area	Avg Area	Delta V	Volume
	(sf)	(ac ft)	SF	Cu Ft	Cu Ft
Basin CR 28 C D					
707.5	5749	0.131979	0	0	0
708	19724	0.452801	12737	6368	6368
709	24724	0.567585	22224	22224	28592
710	24163	0.554706	24444	24444	53036
711	27380	0.628558	25772	25772	78807
712	30137	0.69185	28759	28759	107566
713	32995	0.757461	31566	31566	139132
714	35953	0.825367	34474	34474	173606

WQV	66400
710.57	
$^1/_2$ WQV	33200
709.19	

Countour	Area	Area	Avg Area	Delta V	Volume
	(sf)	(ac ft)	SF	Cu Ft	Cu Ft
Forebay					
708	2660	0.061065	0	0	0
709	3404	0.078145	3032	3032	3032
710	4192	0.096235	3798	3798	6830
711	5022	0.115289	4607	4607	11437

CULVERT ANALYSIS

PID : 19415 **Date :** 07/25/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description : Culvert Sta 535+00 CR 28 Ramp A/B **Designer :** KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 707.50 **Outlet Invert Elevation (ft.) :** 706.90
Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 66.00 **Culvert Slope (ft./ft.) :** 0.0091
Corrugation Type :
Pipe Size : 36 in.
Design Manning 'n' : (default)

Entrance Type : No Headwall **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
32.00	0.86	710.18	N/A	1 - C	9.57	1.44	1.83	0.0120	INLET	0.00	706.90
63.00	2.40	712.08	711.66	2 - E	11.05	2.26	2.55	0.0120	INLET	0.00	706.90

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID BMP

i = b / ((T + d)**e)

Where: i = rainfall intensity (in/hr)
T = rainfall duration (min)
e, b, d = rainfall equation coefficients

Return Event	Rainfall Type	e coeff	b coeff	d coeff
2	e, b, d Coeff.	.9500	85.5680	16.5000
10	e, b, d Coeff.	.9230	112.1720	16.8000
100	e, b, d Coeff.	1.0760	355.5510	23.1990

MASTER NETWORK SUMMARY
Modified Rational Method Network

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

WQV = 1.524 ⇒ 710.57
½ WQV = ⇒ 709.19

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CR 28 CD	IN POND	2	2.107		.3000	37.31		
CR 28 CD	IN POND	10	3.141		.3000	51.83		
CR 28 CD	IN POND	100	4.631		.3000	84.05		
CR 28 CD	OUT POND	2	2.101		1.0000	1.33	711.58	2.177
CR 28 CD	OUT POND	10	3.135		.9000	26.35	712.51	2.819
CR 28 CD	OUT POND	100	4.624		.7000	69.90	712.99	3.180

MASTER NETWORK SUMMARY
Modified Rational Method Network

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
*OUTFALL	JCT	2	2.101		1.0000	1.33		
*OUTFALL	JCT	10	3.135		.9000	26.35		
*OUTFALL	JCT	100	4.624		.7000	69.90		
SUBAREA 30	AREA	2	2.107		.3000	37.31		
SUBAREA 30	AREA	10	3.141		.3000	51.83		
SUBAREA 30	AREA	100	4.631		.3000	84.05		

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (ac-ft)	Volume Sum (ac-ft)
707.50	-----	5749	0	.000	.000
708.00	-----	19724	36122	.138	.138
709.00	-----	24724	66531	.509	.647
710.00	-----	24163	73329	.561	1.208
711.00	-----	27380	77264	.591	1.800
712.00	-----	30137	86242	.660	2.460
713.00	-----	32995	94666	.724	3.184
714.00	-----	35953	103390	.791	3.975

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 707.50 ft
Increment = .10 ft
Max. Elev.= 714.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Orifice-Circular	O0	--->	TW	708.000	714.000
Weir-Rectangular	W1	--->	TW	712.000	714.000
Weir-Rectangular	W0	--->	TW	712.000	714.000

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

Structure ID = O0
Structure Type = Orifice-Circular

# of Openings	=	1
Invert Elev.	=	708.00 ft
Diameter	=	5.00 in
Orifice Coeff.	=	.660

Structure ID = W1
Structure Type = Weir-Rectangular

# of Openings	=	1
Crest Elev.	=	712.00 ft
Weir Length	=	15.00 ft
Weir Coeff.	=	3.000000

Weir TW effects (Use adjustment equation)

Structure ID = W0
Structure Type = Weir-Rectangular

# of Openings	=	1
Crest Elev.	=	712.00 ft
Weir Length	=	8.00 ft
Weir Coeff.	=	3.000000

Weir TW effects (Use adjustment equation)

OUTLET STRUCTURE INPUT DATA

Structure ID = TW
Structure Type = TW SETUP, DS Channel

USE DOWNSTREAM CHANNEL NORMAL DEPTH FOR TW...
Channel Type: Chn-Circular
Channel ID: 18"

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

USE DOWNSTREAM CHANNEL NORMAL DEPTH FOR TW...
Channel Type: Chn-Circular
Channel ID: 18"

Solution to Mannings Open Channel Flow Equation
(Computed values are based on normal depth.)

CIRCULAR CROSS SECTION

Slope = .010000 ft/ft
Mannings n = 0.01500
Invert Elev. = 707.50 ft
Top of Channel = 709.00 ft
Diameter = 18.00 in

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
.0000	.00	33.45	33.45	.00	.00	.138	708.00
.1000	12.44	45.83	45.88	.00	.03	.189	708.11
.2000	24.87	82.53	83.14	.00	.30	.342	708.43
.3000	37.31	143.51	144.71	.00	.60	.595	708.91
.4000	37.31	216.52	218.13	.00	.80	.898	709.44
.5000	37.31	289.22	291.15	.00	.96	1.199	709.98
.6000	37.31	361.65	363.84	.00	1.09	1.499	710.51
.7000	35.24	431.80	434.20	.00	1.20	1.789	710.98
.8000	22.80	487.28	489.84	.00	1.28	2.019	711.34
.9000	10.36	517.81	520.45	.00	1.32	2.145	711.54
1.0000	.00	525.52	528.18	.00	1.33	2.177	711.58
1.1000	.00	522.88	525.52	.00	1.32	2.166	711.57
1.2000	.00	520.24	522.88	.00	1.32	2.155	711.55
1.3000	.00	517.61	520.24	.00	1.32	2.144	711.53
1.4000	.00	514.98	517.61	.00	1.31	2.133	711.52
1.5000	.00	512.36	514.98	.00	1.31	2.123	711.50
1.6000	.00	509.75	512.36	.00	1.31	2.112	711.48
1.7000	.00	507.14	509.75	.00	1.30	2.101	711.47
1.8000	.00	504.54	507.14	.00	1.30	2.090	711.45
1.9000	.00	501.95	504.54	.00	1.30	2.079	711.44
2.0000	.00	499.36	501.95	.00	1.29	2.069	711.42
2.1000	.00	496.78	499.36	.00	1.29	2.058	711.40
2.2000	.00	494.20	496.78	.00	1.29	2.047	711.39
2.3000	.00	491.64	494.20	.00	1.28	2.037	711.37
2.4000	.00	489.08	491.64	.00	1.28	2.026	711.35
2.5000	.00	486.52	489.08	.00	1.28	2.016	711.34
2.6000	.00	483.97	486.52	.00	1.27	2.005	711.32
2.7000	.00	481.43	483.97	.00	1.27	1.995	711.31
2.8000	.00	478.90	481.43	.00	1.27	1.984	711.29
2.9000	.00	476.37	478.90	.00	1.26	1.974	711.27
3.0000	.00	473.85	476.37	.00	1.26	1.963	711.26
3.1000	.00	471.34	473.85	.00	1.26	1.953	711.24
3.2000	.00	468.83	471.34	.00	1.25	1.942	711.22
3.3000	.00	466.33	468.83	.00	1.25	1.932	711.21
3.4000	.00	463.83	466.33	.00	1.25	1.922	711.19
3.5000	.00	461.35	463.83	.00	1.24	1.911	711.18
3.6000	.00	458.87	461.35	.00	1.24	1.901	711.16
3.7000	.00	456.39	458.87	.00	1.24	1.891	711.14
3.8000	.00	453.93	456.39	.00	1.23	1.881	711.13
3.9000	.00	451.47	453.93	.00	1.23	1.871	711.11
4.0000	.00	449.01	451.47	.00	1.23	1.860	711.10
4.1000	.00	446.56	449.01	.00	1.22	1.850	711.08

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
4.2000	.00	444.13	446.56	.00	1.22	1.840	711.06
4.3000	.00	441.69	444.13	.00	1.22	1.830	711.05
4.4000	.00	439.27	441.69	.00	1.21	1.820	711.03
4.5000	.00	436.85	439.27	.00	1.21	1.810	711.02
4.6000	.00	434.43	436.85	.00	1.21	1.800	711.00
4.7000	.00	432.03	434.43	.00	1.20	1.790	710.98
4.8000	.00	429.63	432.03	.00	1.20	1.780	710.97
4.9000	.00	427.24	429.63	.00	1.20	1.770	710.95
5.0000	.00	424.85	427.24	.00	1.19	1.760	710.94
5.1000	.00	422.47	424.85	.00	1.19	1.751	710.92
5.2000	.00	420.10	422.47	.00	1.19	1.741	710.91
5.3000	.00	417.74	420.10	.00	1.18	1.731	710.89
5.4000	.00	415.38	417.74	.00	1.18	1.721	710.87
5.5000	.00	413.03	415.38	.00	1.18	1.711	710.86
5.6000	.00	410.69	413.03	.00	1.17	1.702	710.84
5.7000	.00	408.35	410.69	.00	1.17	1.692	710.83
5.8000	.00	406.02	408.35	.00	1.16	1.683	710.81
5.9000	.00	403.70	406.02	.00	1.16	1.673	710.80
6.0000	.00	401.38	403.70	.00	1.16	1.663	710.78
6.1000	.00	399.08	401.38	.00	1.15	1.654	710.76
6.2000	.00	396.77	399.08	.00	1.15	1.644	710.75
6.3000	.00	394.48	396.77	.00	1.15	1.635	710.73
6.4000	.00	392.19	394.48	.00	1.14	1.625	710.72
6.5000	.00	389.91	392.19	.00	1.14	1.616	710.70
6.6000	.00	387.64	389.91	.00	1.14	1.606	710.69
6.7000	.00	385.37	387.64	.00	1.13	1.597	710.67
6.8000	.00	383.12	385.37	.00	1.13	1.588	710.66
6.9000	.00	380.86	383.12	.00	1.13	1.578	710.64
7.0000	.00	378.62	380.86	.00	1.12	1.569	710.62
7.1000	.00	376.38	378.62	.00	1.12	1.560	710.61
7.2000	.00	374.15	376.38	.00	1.11	1.551	710.59
7.3000	.00	371.93	374.15	.00	1.11	1.541	710.58
7.4000	.00	369.72	371.93	.00	1.11	1.532	710.56
7.5000	.00	367.51	369.72	.00	1.10	1.523	710.55
7.6000	.00	365.31	367.51	.00	1.10	1.514	710.53
7.7000	.00	363.11	365.31	.00	1.10	1.505	710.52
7.8000	.00	360.93	363.11	.00	1.09	1.496	710.50
7.9000	.00	358.75	360.93	.00	1.09	1.487	710.49
8.0000	.00	356.57	358.75	.00	1.09	1.478	710.47
8.1000	.00	354.41	356.57	.00	1.08	1.469	710.46
8.2000	.00	352.25	354.41	.00	1.08	1.460	710.44
8.3000	.00	350.10	352.25	.00	1.07	1.451	710.43

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
8.4000	.00	347.96	350.10	.00	1.07	1.442	710.41
8.5000	.00	345.83	347.96	.00	1.07	1.433	710.40
8.6000	.00	343.70	345.83	.00	1.06	1.425	710.38
8.7000	.00	341.58	343.70	.00	1.06	1.416	710.37
8.8000	.00	339.47	341.58	.00	1.06	1.407	710.35
8.9000	.00	337.36	339.47	.00	1.05	1.398	710.34
9.0000	.00	335.26	337.36	.00	1.05	1.390	710.32
9.1000	.00	333.17	335.26	.00	1.05	1.381	710.31
9.2000	.00	331.09	333.17	.00	1.04	1.372	710.29
9.3000	.00	329.01	331.09	.00	1.04	1.364	710.28
9.4000	.00	326.94	329.01	.00	1.03	1.355	710.26
9.5000	.00	324.88	326.94	.00	1.03	1.347	710.25
9.6000	.00	322.83	324.88	.00	1.03	1.338	710.23
9.7000	.00	320.79	322.83	.00	1.02	1.330	710.22
9.8000	.00	318.75	320.79	.00	1.02	1.321	710.20
9.9000	.00	316.72	318.75	.00	1.02	1.313	710.19
10.0000	.00	314.69	316.72	.00	1.01	1.305	710.17
10.1000	.00	312.68	314.69	.00	1.01	1.296	710.16
10.2000	.00	310.67	312.68	.00	1.00	1.288	710.14
10.3000	.00	308.67	310.67	.00	1.00	1.280	710.13
10.4000	.00	306.68	308.67	.00	1.00	1.271	710.11
10.5000	.00	304.69	306.68	.00	.99	1.263	710.10
10.6000	.00	302.72	304.69	.00	.99	1.255	710.08
10.7000	.00	300.75	302.72	.00	.98	1.247	710.07
10.8000	.00	298.79	300.75	.00	.98	1.239	710.05
10.9000	.00	296.83	298.79	.00	.98	1.231	710.04
11.0000	.00	294.89	296.83	.00	.97	1.222	710.03
11.1000	.00	292.95	294.89	.00	.97	1.215	710.01
11.2000	.00	291.02	292.95	.00	.97	1.207	710.00
11.3000	.00	289.10	291.02	.00	.96	1.199	709.98
11.4000	.00	287.18	289.10	.00	.96	1.191	709.97
11.5000	.00	285.27	287.18	.00	.95	1.183	709.95
11.6000	.00	283.37	285.27	.00	.95	1.175	709.94
11.7000	.00	281.48	283.37	.00	.95	1.167	709.93
11.8000	.00	279.60	281.48	.00	.94	1.159	709.91
11.9000	.00	277.72	279.60	.00	.94	1.151	709.90
12.0000	.00	275.85	277.72	.00	.93	1.144	709.88
12.1000	.00	273.99	275.85	.00	.93	1.136	709.87
12.2000	.00	272.14	273.99	.00	.93	1.128	709.86
12.3000	.00	270.29	272.14	.00	.92	1.121	709.84
12.4000	.00	268.46	270.29	.00	.92	1.113	709.83
12.5000	.00	266.63	268.46	.00	.91	1.106	709.81

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
12.6000	.00	264.80	266.63	.00	.91	1.098	709.80
12.7000	.00	262.99	264.80	.00	.91	1.090	709.79
12.8000	.00	261.18	262.99	.00	.90	1.083	709.77
12.9000	.00	259.38	261.18	.00	.90	1.076	709.76
13.0000	.00	257.59	259.38	.00	.90	1.068	709.75
13.1000	.00	255.81	257.59	.00	.89	1.061	709.73
13.2000	.00	254.03	255.81	.00	.89	1.053	709.72
13.3000	.00	252.27	254.03	.00	.88	1.046	709.71
13.4000	.00	250.50	252.27	.00	.88	1.039	709.70
13.5000	.00	248.75	250.50	.00	.88	1.032	709.68
13.6000	.00	247.01	248.75	.00	.87	1.024	709.67
13.7000	.00	245.27	247.01	.00	.87	1.017	709.66
13.8000	.00	243.54	245.27	.00	.86	1.010	709.64
13.9000	.00	241.82	243.54	.00	.86	1.003	709.63
14.0000	.00	240.10	241.82	.00	.86	.996	709.62
14.1000	.00	238.40	240.10	.00	.85	.989	709.61
14.2000	.00	236.70	238.40	.00	.85	.982	709.59
14.3000	.00	235.01	236.70	.00	.85	.975	709.58
14.4000	.00	233.32	235.01	.00	.84	.968	709.57
14.5000	.00	231.65	233.32	.00	.84	.961	709.56
14.6000	.00	229.98	231.65	.00	.83	.954	709.54
14.7000	.00	228.32	229.98	.00	.83	.947	709.53
14.8000	.00	226.67	228.32	.00	.83	.940	709.52
14.9000	.00	225.02	226.67	.00	.82	.933	709.51
15.0000	.00	223.39	225.02	.00	.82	.926	709.49
15.1000	.00	221.76	223.39	.00	.81	.920	709.48
15.2000	.00	220.13	221.76	.00	.81	.913	709.47
15.3000	.00	218.52	220.13	.00	.81	.906	709.46
15.4000	.00	216.91	218.52	.00	.80	.900	709.45
15.5000	.00	215.31	216.91	.00	.80	.893	709.44
15.6000	.00	213.72	215.31	.00	.80	.886	709.42
15.7000	.00	212.14	213.72	.00	.79	.880	709.41
15.8000	.00	210.56	212.14	.00	.79	.873	709.40
15.9000	.00	208.99	210.56	.00	.78	.867	709.39
16.0000	.00	207.43	208.99	.00	.78	.860	709.38
16.1000	.00	205.88	207.43	.00	.78	.854	709.37
16.2000	.00	204.34	205.88	.00	.77	.848	709.35
16.3000	.00	202.80	204.34	.00	.77	.841	709.34
16.4000	.00	201.27	202.80	.00	.76	.835	709.33
16.5000	.00	199.75	201.27	.00	.76	.829	709.32
16.6000	.00	198.23	199.75	.00	.76	.822	709.31
16.7000	.00	196.72	198.23	.00	.75	.816	709.30

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
16.8000	.00	195.22	196.72	.00	.75	.810	709.29
16.9000	.00	193.73	195.22	.00	.75	.804	709.28
17.0000	.00	192.25	193.73	.00	.74	.797	709.27
17.1000	.00	190.77	192.25	.00	.74	.791	709.25
17.2000	.00	189.30	190.77	.00	.73	.785	709.24
17.3000	.00	187.84	189.30	.00	.73	.779	709.23
17.4000	.00	186.39	187.84	.00	.73	.773	709.22
17.5000	.00	184.94	186.39	.00	.72	.767	709.21
17.6000	.00	183.50	184.94	.00	.72	.761	709.20
17.7000	.00	182.07	183.50	.00	.72	.755	709.19
17.8000	.00	180.65	182.07	.00	.71	.749	709.18
17.9000	.00	179.23	180.65	.00	.71	.744	709.17
18.0000	.00	177.83	179.23	.00	.70	.738	709.16
18.1000	.00	176.43	177.83	.00	.70	.732	709.15
18.2000	.00	175.03	176.43	.00	.70	.726	709.14
18.3000	.00	173.65	175.03	.00	.69	.720	709.13
18.4000	.00	172.27	173.65	.00	.69	.715	709.12
18.5000	.00	170.90	172.27	.00	.68	.709	709.11
18.6000	.00	169.54	170.90	.00	.68	.703	709.10
18.7000	.00	168.18	169.54	.00	.68	.698	709.09
18.8000	.00	166.84	168.18	.00	.67	.692	709.08
18.9000	.00	165.50	166.84	.00	.67	.687	709.07
19.0000	.00	164.17	165.50	.00	.67	.681	709.06
19.1000	.00	162.84	164.17	.00	.66	.676	709.05
19.2000	.00	161.53	162.84	.00	.66	.670	709.04
19.3000	.00	160.22	161.53	.00	.65	.665	709.03
19.4000	.00	158.92	160.22	.00	.65	.659	709.02
19.5000	.00	157.62	158.92	.00	.65	.654	709.01
19.6000	.00	156.34	157.62	.00	.64	.649	709.00
19.7000	.00	155.06	156.34	.00	.64	.643	708.99
19.8000	.00	153.79	155.06	.00	.64	.638	708.98
19.9000	.00	152.52	153.79	.00	.63	.633	708.97
20.0000	.00	151.27	152.52	.00	.63	.628	708.97
20.1000	.00	150.02	151.27	.00	.62	.622	708.96
20.2000	.00	148.78	150.02	.00	.62	.617	708.95
20.3000	.00	147.55	148.78	.00	.62	.612	708.94
20.4000	.00	146.32	147.55	.00	.61	.607	708.93
20.5000	.00	145.11	146.32	.00	.61	.602	708.92
20.6000	.00	143.90	145.11	.00	.60	.597	708.91
20.7000	.00	142.69	143.90	.00	.60	.592	708.90
20.8000	.00	141.50	142.69	.00	.60	.587	708.89
20.9000	.00	140.31	141.50	.00	.59	.582	708.88

½ WQV must stay in basin for ⅓ (48 hours) or 16 hours

17.7 > 16 hours

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
21.0000	.00	139.14	140.31	.00	.59	.577	708.87
21.1000	.00	137.97	139.14	.00	.59	.572	708.87
21.2000	.00	136.80	137.97	.00	.58	.568	708.86
21.3000	.00	135.65	136.80	.00	.58	.563	708.85
21.4000	.00	134.50	135.65	.00	.57	.558	708.84
21.5000	.00	133.36	134.50	.00	.57	.553	708.83
21.6000	.00	132.23	133.36	.00	.57	.549	708.82
21.7000	.00	131.11	132.23	.00	.56	.544	708.81
21.8000	.00	129.99	131.11	.00	.56	.539	708.81
21.9000	.00	128.88	129.99	.00	.55	.535	708.80
22.0000	.00	127.78	128.88	.00	.55	.530	708.79
22.1000	.00	126.69	127.78	.00	.55	.526	708.78
22.2000	.00	125.61	126.69	.00	.54	.521	708.77
22.3000	.00	124.53	125.61	.00	.54	.517	708.76
22.4000	.00	123.47	124.53	.00	.53	.512	708.76
22.5000	.00	122.41	123.47	.00	.53	.508	708.75
22.6000	.00	121.36	122.41	.00	.53	.504	708.74
22.7000	.00	120.31	121.36	.00	.52	.499	708.73
22.8000	.00	119.28	120.31	.00	.52	.495	708.72
22.9000	.00	118.25	119.28	.00	.51	.491	708.72
23.0000	.00	117.23	118.25	.00	.51	.486	708.71
23.1000	.00	116.22	117.23	.00	.51	.482	708.70
23.2000	.00	115.22	116.22	.00	.50	.478	708.69
23.3000	.00	114.22	115.22	.00	.50	.474	708.68
23.4000	.00	113.23	114.22	.00	.49	.470	708.68
23.5000	.00	112.26	113.23	.00	.49	.466	708.67
23.6000	.00	111.29	112.26	.00	.48	.462	708.66
23.7000	.00	110.32	111.29	.00	.48	.458	708.65
23.8000	.00	109.37	110.32	.00	.48	.454	708.65
23.9000	.00	108.43	109.37	.00	.47	.450	708.64
24.0000	.00	107.49	108.43	.00	.47	.446	708.63
24.1000	.00	106.56	107.49	.00	.46	.442	708.62
24.2000	.00	105.64	106.56	.00	.46	.438	708.62
24.3000	.00	104.72	105.64	.00	.46	.435	708.61
24.4000	.00	103.82	104.72	.00	.45	.431	708.60
24.5000	.00	102.92	103.82	.00	.45	.427	708.59
24.6000	.00	102.03	102.92	.00	.44	.423	708.59
24.7000	.00	101.15	102.03	.00	.44	.420	708.58
24.8000	.00	100.28	101.15	.00	.44	.416	708.57
24.9000	.00	99.42	100.28	.00	.43	.412	708.57
25.0000	.00	98.57	99.42	.00	.43	.409	708.56
25.1000	.00	97.72	98.57	.00	.42	.405	708.55

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
25.2000	.00	96.89	97.72	.00	.42	.402	708.55
25.3000	.00	96.06	96.89	.00	.41	.398	708.54
25.4000	.00	95.24	96.06	.00	.41	.395	708.53
25.5000	.00	94.42	95.24	.00	.41	.392	708.53
25.6000	.00	93.62	94.42	.00	.40	.388	708.52
25.7000	.00	92.82	93.62	.00	.40	.385	708.51
25.8000	.00	92.04	92.82	.00	.39	.382	708.51
25.9000	.00	91.26	92.04	.00	.39	.379	708.50
26.0000	.00	90.49	91.26	.00	.38	.375	708.49
26.1000	.00	89.74	90.49	.00	.38	.372	708.49
26.2000	.00	89.00	89.74	.00	.37	.369	708.48
26.3000	.00	88.28	89.00	.00	.36	.366	708.48
26.4000	.00	87.57	88.28	.00	.35	.363	708.47
26.5000	.00	86.88	87.57	.00	.35	.360	708.46
26.6000	.00	86.20	86.88	.00	.34	.357	708.46
26.7000	.00	85.53	86.20	.00	.33	.355	708.45
26.8000	.00	84.88	85.53	.00	.33	.352	708.45
26.9000	.00	84.23	84.88	.00	.32	.349	708.44
27.0000	.00	83.60	84.23	.00	.31	.347	708.44
27.1000	.00	82.99	83.60	.00	.31	.344	708.43
27.2000	.00	82.38	82.99	.00	.30	.342	708.43
27.3000	.00	81.79	82.38	.00	.30	.339	708.42
27.4000	.00	81.21	81.79	.00	.29	.337	708.42
27.5000	.00	80.64	81.21	.00	.29	.334	708.41
27.6000	.00	80.08	80.64	.00	.28	.332	708.41
27.7000	.00	79.53	80.08	.00	.27	.330	708.40
27.8000	.00	78.99	79.53	.00	.27	.328	708.40
27.9000	.00	78.46	78.99	.00	.26	.325	708.39
28.0000	.00	77.94	78.46	.00	.26	.323	708.39
28.1000	.00	77.43	77.94	.00	.26	.321	708.39
28.2000	.00	76.93	77.43	.00	.25	.319	708.38
28.3000	.00	76.44	76.93	.00	.25	.317	708.38
28.4000	.00	75.95	76.44	.00	.24	.315	708.37
28.5000	.00	75.48	75.95	.00	.24	.313	708.37
28.6000	.00	75.01	75.48	.00	.23	.311	708.37
28.7000	.00	74.55	75.01	.00	.23	.309	708.36
28.8000	.00	74.10	74.55	.00	.23	.307	708.36
28.9000	.00	73.66	74.10	.00	.22	.305	708.35
29.0000	.00	73.22	73.66	.00	.22	.303	708.35
29.1000	.00	72.79	73.22	.00	.21	.302	708.35
29.2000	.00	72.37	72.79	.00	.21	.300	708.34
29.3000	.00	71.96	72.37	.00	.21	.298	708.34

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
29.4000	.00	71.55	71.96	.00	.20	.296	708.34
29.5000	.00	71.15	71.55	.00	.20	.295	708.33
29.6000	.00	70.76	71.15	.00	.20	.293	708.33
29.7000	.00	70.37	70.76	.00	.19	.291	708.33
29.8000	.00	70.00	70.37	.00	.19	.290	708.32
29.9000	.00	69.62	70.00	.00	.19	.288	708.32
30.0000	.00	69.26	69.62	.00	.18	.287	708.32
30.1000	.00	68.90	69.26	.00	.18	.285	708.31
30.2000	.00	68.54	68.90	.00	.18	.284	708.31
30.3000	.00	68.20	68.54	.00	.17	.282	708.31
30.4000	.00	67.86	68.20	.00	.17	.281	708.30
30.5000	.00	67.52	67.86	.00	.17	.280	708.30
30.6000	.00	67.19	67.52	.00	.16	.278	708.30
30.7000	.00	66.87	67.19	.00	.16	.277	708.30
30.8000	.00	66.55	66.87	.00	.16	.276	708.29
30.9000	.00	66.23	66.55	.00	.16	.274	708.29
31.0000	.00	65.92	66.23	.00	.16	.273	708.29
31.1000	.00	65.61	65.92	.00	.15	.272	708.29
31.2000	.00	65.31	65.61	.00	.15	.270	708.28
31.3000	.00	65.01	65.31	.00	.15	.269	708.28
31.4000	.00	64.72	65.01	.00	.15	.268	708.28
31.5000	.00	64.43	64.72	.00	.14	.267	708.27
31.6000	.00	64.15	64.43	.00	.14	.266	708.27
31.7000	.00	63.87	64.15	.00	.14	.264	708.27
31.8000	.00	63.59	63.87	.00	.14	.263	708.27
31.9000	.00	63.32	63.59	.00	.14	.262	708.27
32.0000	.00	63.05	63.32	.00	.13	.261	708.26
32.1000	.00	62.79	63.05	.00	.13	.260	708.26
32.2000	.00	62.53	62.79	.00	.13	.259	708.26
32.3000	.00	62.27	62.53	.00	.13	.258	708.26
32.4000	.00	62.02	62.27	.00	.13	.257	708.25
32.5000	.00	61.77	62.02	.00	.12	.256	708.25
32.6000	.00	61.53	61.77	.00	.12	.255	708.25
32.7000	.00	61.29	61.53	.00	.12	.254	708.25
32.8000	.00	61.05	61.29	.00	.12	.253	708.25
32.9000	.00	60.81	61.05	.00	.12	.252	708.24
33.0000	.00	60.58	60.81	.00	.12	.251	708.24
33.1000	.00	60.35	60.58	.00	.11	.250	708.24
33.2000	.00	60.13	60.35	.00	.11	.249	708.24
33.3000	.00	59.91	60.13	.00	.11	.248	708.24
33.4000	.00	59.69	59.91	.00	.11	.247	708.23
33.5000	.00	59.48	59.69	.00	.11	.246	708.23

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
33.6000	.00	59.27	59.48	.00	.11	.245	708.23
33.7000	.00	59.06	59.27	.00	.10	.244	708.23
33.8000	.00	58.85	59.06	.00	.10	.244	708.23
33.9000	.00	58.65	58.85	.00	.10	.243	708.22
34.0000	.00	58.45	58.65	.00	.10	.242	708.22
34.1000	.00	58.26	58.45	.00	.10	.241	708.22
34.2000	.00	58.06	58.26	.00	.10	.240	708.22
34.3000	.00	57.87	58.06	.00	.10	.239	708.22
34.4000	.00	57.68	57.87	.00	.09	.239	708.22
34.5000	.00	57.50	57.68	.00	.09	.238	708.21
34.6000	.00	57.32	57.50	.00	.09	.237	708.21
34.7000	.00	57.14	57.32	.00	.09	.236	708.21
34.8000	.00	56.96	57.14	.00	.09	.236	708.21
34.9000	.00	56.79	56.96	.00	.09	.235	708.21
35.0000	.00	56.62	56.79	.00	.09	.234	708.21
35.1000	.00	56.45	56.62	.00	.08	.234	708.21
35.2000	.00	56.28	56.45	.00	.08	.233	708.20
35.3000	.00	56.12	56.28	.00	.08	.232	708.20
35.4000	.00	55.95	56.12	.00	.08	.232	708.20
35.5000	.00	55.79	55.95	.00	.08	.231	708.20
35.6000	.00	55.64	55.79	.00	.08	.230	708.20
35.7000	.00	55.48	55.64	.00	.08	.230	708.20
35.8000	.00	55.33	55.48	.00	.08	.229	708.20
35.9000	.00	55.17	55.33	.00	.08	.228	708.19
36.0000	.00	55.02	55.17	.00	.08	.228	708.19
36.1000	.00	54.87	55.02	.00	.07	.227	708.19
36.2000	.00	54.72	54.87	.00	.07	.226	708.19
36.3000	.00	54.58	54.72	.00	.07	.226	708.19
36.4000	.00	54.43	54.58	.00	.07	.225	708.19
36.5000	.00	54.29	54.43	.00	.07	.225	708.19
36.6000	.00	54.14	54.29	.00	.07	.224	708.19
36.7000	.00	54.00	54.14	.00	.07	.223	708.18
36.8000	.00	53.86	54.00	.00	.07	.223	708.18
36.9000	.00	53.73	53.86	.00	.07	.222	708.18
37.0000	.00	53.59	53.73	.00	.07	.222	708.18
37.1000	.00	53.45	53.59	.00	.07	.221	708.18
37.2000	.00	53.32	53.45	.00	.07	.221	708.18
37.3000	.00	53.19	53.32	.00	.07	.220	708.18
37.4000	.00	53.06	53.19	.00	.07	.219	708.18
37.5000	.00	52.93	53.06	.00	.06	.219	708.17
37.6000	.00	52.80	52.93	.00	.06	.218	708.17
37.7000	.00	52.67	52.80	.00	.06	.218	708.17

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
37.8000	.00	52.55	52.67	.00	.06	.217	708.17
37.9000	.00	52.42	52.55	.00	.06	.217	708.17
38.0000	.00	52.30	52.42	.00	.06	.216	708.17
38.1000	.00	52.18	52.30	.00	.06	.216	708.17
38.2000	.00	52.06	52.18	.00	.06	.215	708.17
38.3000	.00	51.94	52.06	.00	.06	.215	708.17
38.4000	.00	51.82	51.94	.00	.06	.214	708.16
38.5000	.00	51.70	51.82	.00	.06	.214	708.16
38.6000	.00	51.59	51.70	.00	.06	.213	708.16
38.7000	.00	51.47	51.59	.00	.06	.213	708.16
38.8000	.00	51.36	51.47	.00	.06	.212	708.16
38.9000	.00	51.25	51.36	.00	.06	.212	708.16
39.0000	.00	51.13	51.25	.00	.06	.211	708.16
39.1000	.00	51.02	51.13	.00	.05	.211	708.16
39.2000	.00	50.92	51.02	.00	.05	.210	708.16
39.3000	.00	50.81	50.92	.00	.05	.210	708.16
39.4000	.00	50.70	50.81	.00	.05	.210	708.15
39.5000	.00	50.60	50.70	.00	.05	.209	708.15
39.6000	.00	50.49	50.60	.00	.05	.209	708.15
39.7000	.00	50.39	50.49	.00	.05	.208	708.15
39.8000	.00	50.29	50.39	.00	.05	.208	708.15
39.9000	.00	50.18	50.29	.00	.05	.207	708.15
40.0000	.00	50.08	50.18	.00	.05	.207	708.15
40.1000	.00	49.98	50.08	.00	.05	.207	708.15
40.2000	.00	49.89	49.98	.00	.05	.206	708.15
40.3000	.00	49.79	49.89	.00	.05	.206	708.15
40.4000	.00	49.69	49.79	.00	.05	.205	708.15
40.5000	.00	49.60	49.69	.00	.05	.205	708.15
40.6000	.00	49.50	49.60	.00	.05	.205	708.14
40.7000	.00	49.41	49.50	.00	.05	.204	708.14
40.8000	.00	49.32	49.41	.00	.05	.204	708.14
40.9000	.00	49.23	49.32	.00	.05	.203	708.14
41.0000	.00	49.14	49.23	.00	.05	.203	708.14
41.1000	.00	49.05	49.14	.00	.04	.203	708.14
41.2000	.00	48.96	49.05	.00	.04	.202	708.14
41.3000	.00	48.87	48.96	.00	.04	.202	708.14
41.4000	.00	48.78	48.87	.00	.04	.202	708.14
41.5000	.00	48.70	48.78	.00	.04	.201	708.14
41.6000	.00	48.61	48.70	.00	.04	.201	708.14
41.7000	.00	48.53	48.61	.00	.04	.201	708.14
41.8000	.00	48.45	48.53	.00	.04	.200	708.13
41.9000	.00	48.36	48.45	.00	.04	.200	708.13

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
42.0000	.00	48.28	48.36	.00	.04	.200	708.13
42.1000	.00	48.20	48.28	.00	.04	.199	708.13
42.2000	.00	48.12	48.20	.00	.04	.199	708.13
42.3000	.00	48.04	48.12	.00	.04	.199	708.13
42.4000	.00	47.96	48.04	.00	.04	.198	708.13
42.5000	.00	47.89	47.96	.00	.04	.198	708.13
42.6000	.00	47.81	47.89	.00	.04	.198	708.13
42.7000	.00	47.73	47.81	.00	.04	.197	708.13
42.8000	.00	47.66	47.73	.00	.04	.197	708.13
42.9000	.00	47.58	47.66	.00	.04	.197	708.13
43.0000	.00	47.51	47.58	.00	.04	.196	708.13
43.1000	.00	47.44	47.51	.00	.04	.196	708.13
43.2000	.00	47.37	47.44	.00	.04	.196	708.13
43.3000	.00	47.29	47.37	.00	.04	.195	708.12
43.4000	.00	47.22	47.29	.00	.04	.195	708.12
43.5000	.00	47.15	47.22	.00	.03	.195	708.12
43.6000	.00	47.09	47.15	.00	.03	.195	708.12
43.7000	.00	47.02	47.09	.00	.03	.194	708.12
43.8000	.00	46.95	47.02	.00	.03	.194	708.12
43.9000	.00	46.88	46.95	.00	.03	.194	708.12
44.0000	.00	46.82	46.88	.00	.03	.193	708.12
44.1000	.00	46.75	46.82	.00	.03	.193	708.12
44.2000	.00	46.68	46.75	.00	.03	.193	708.12
44.3000	.00	46.62	46.68	.00	.03	.193	708.12
44.4000	.00	46.56	46.62	.00	.03	.192	708.12
44.5000	.00	46.49	46.56	.00	.03	.192	708.12
44.6000	.00	46.43	46.49	.00	.03	.192	708.12
44.7000	.00	46.37	46.43	.00	.03	.192	708.12
44.8000	.00	46.31	46.37	.00	.03	.191	708.12
44.9000	.00	46.25	46.31	.00	.03	.191	708.12
45.0000	.00	46.19	46.25	.00	.03	.191	708.11
45.1000	.00	46.13	46.19	.00	.03	.191	708.11
45.2000	.00	46.07	46.13	.00	.03	.190	708.11
45.3000	.00	46.01	46.07	.00	.03	.190	708.11
45.4000	.00	45.95	46.01	.00	.03	.190	708.11
45.5000	.00	45.90	45.95	.00	.03	.190	708.11
45.6000	.00	45.84	45.90	.00	.03	.189	708.11
45.7000	.00	45.79	45.84	.00	.03	.189	708.11
45.8000	.00	45.73	45.79	.00	.03	.189	708.11
45.9000	.00	45.68	45.73	.00	.03	.189	708.11
46.0000	.00	45.62	45.68	.00	.03	.189	708.11
46.1000	.00	45.57	45.62	.00	.03	.188	708.11

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
46.2000	.00	45.52	45.57	.00	.03	.188	708.11
46.3000	.00	45.46	45.52	.00	.03	.188	708.11
46.4000	.00	45.41	45.46	.00	.03	.188	708.11
46.5000	.00	45.36	45.41	.00	.03	.188	708.11
46.6000	.00	45.31	45.36	.00	.03	.187	708.11
46.7000	.00	45.26	45.31	.00	.03	.187	708.11
46.8000	.00	45.21	45.26	.00	.02	.187	708.11
46.9000	.00	45.16	45.21	.00	.02	.187	708.11
47.0000	.00	45.11	45.16	.00	.02	.186	708.11
47.1000	.00	45.06	45.11	.00	.02	.186	708.10
47.2000	.00	45.02	45.06	.00	.02	.186	708.10
47.3000	.00	44.97	45.02	.00	.02	.186	708.10
47.4000	.00	44.92	44.97	.00	.02	.186	708.10
47.5000	.00	44.88	44.92	.00	.02	.186	708.10
47.6000	.00	44.83	44.88	.00	.02	.185	708.10
47.7000	.00	44.78	44.83	.00	.02	.185	708.10
47.8000	.00	44.74	44.78	.00	.02	.185	708.10
47.9000	.00	44.70	44.74	.00	.02	.185	708.10
48.0000	.00	44.65	44.70	.00	.02	.185	708.10
48.1000	.00	44.61	44.65	.00	.02	.184	708.10
48.2000	.00	44.57	44.61	.00	.02	.184	708.10
48.3000	.00	44.52	44.57	.00	.02	.184	708.10
48.4000	.00	44.48	44.52	.00	.02	.184	708.10
48.5000	.00	44.44	44.48	.00	.02	.184	708.10
48.6000	.00	44.40	44.44	.00	.02	.184	708.10
48.7000	.00	44.35	44.40	.00	.02	.183	708.10
48.8000	.00	44.31	44.35	.00	.02	.183	708.10
48.9000	.00	44.27	44.31	.00	.02	.183	708.10
49.0000	.00	44.23	44.27	.00	.02	.183	708.10
49.1000	.00	44.19	44.23	.00	.02	.183	708.10
49.2000	.00	44.15	44.19	.00	.02	.182	708.10
49.3000	.00	44.11	44.15	.00	.02	.182	708.10
49.4000	.00	44.07	44.11	.00	.02	.182	708.10
49.5000	.00	44.02	44.07	.00	.02	.182	708.10
49.6000	.00	43.98	44.02	.00	.02	.182	708.10
49.7000	.00	43.94	43.98	.00	.02	.182	708.09
49.8000	.00	43.90	43.94	.00	.02	.181	708.09
49.9000	.00	43.86	43.90	.00	.02	.181	708.09
50.0000	.00	43.82	43.86	.00	.02	.181	708.09
50.1000	.00	43.78	43.82	.00	.02	.181	708.09
50.2000	.00	43.74	43.78	.00	.02	.181	708.09
50.3000	.00	43.71	43.74	.00	.02	.181	708.09

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
50.4000	.00	43.67	43.71	.00	.02	.180	708.09
50.5000	.00	43.63	43.67	.00	.02	.180	708.09
50.6000	.00	43.59	43.63	.00	.02	.180	708.09
50.7000	.00	43.55	43.59	.00	.02	.180	708.09
50.8000	.00	43.51	43.55	.00	.02	.180	708.09
50.9000	.00	43.47	43.51	.00	.02	.180	708.09
51.0000	.00	43.43	43.47	.00	.02	.180	708.09
51.1000	.00	43.40	43.43	.00	.02	.179	708.09
51.2000	.00	43.36	43.40	.00	.02	.179	708.09
51.3000	.00	43.32	43.36	.00	.02	.179	708.09
51.4000	.00	43.28	43.32	.00	.02	.179	708.09
51.5000	.00	43.24	43.28	.00	.02	.179	708.09
51.6000	.00	43.21	43.24	.00	.02	.179	708.09
51.7000	.00	43.17	43.21	.00	.02	.178	708.09
51.8000	.00	43.13	43.17	.00	.02	.178	708.09
51.9000	.00	43.10	43.13	.00	.02	.178	708.09
52.0000	.00	43.06	43.10	.00	.02	.178	708.09
52.1000	.00	43.02	43.06	.00	.02	.178	708.09
52.2000	.00	42.99	43.02	.00	.02	.178	708.09
52.3000	.00	42.95	42.99	.00	.02	.177	708.09
52.4000	.00	42.91	42.95	.00	.02	.177	708.09
52.5000	.00	42.88	42.91	.00	.02	.177	708.09
52.6000	.00	42.84	42.88	.00	.02	.177	708.08
52.7000	.00	42.80	42.84	.00	.02	.177	708.08
52.8000	.00	42.77	42.80	.00	.02	.177	708.08
52.9000	.00	42.73	42.77	.00	.02	.177	708.08
53.0000	.00	42.70	42.73	.00	.02	.176	708.08
53.1000	.00	42.66	42.70	.00	.02	.176	708.08
53.2000	.00	42.63	42.66	.00	.02	.176	708.08
53.3000	.00	42.59	42.63	.00	.02	.176	708.08
53.4000	.00	42.56	42.59	.00	.02	.176	708.08
53.5000	.00	42.52	42.56	.00	.02	.176	708.08
53.6000	.00	42.49	42.52	.00	.02	.176	708.08
53.7000	.00	42.45	42.49	.00	.02	.175	708.08
53.8000	.00	42.42	42.45	.00	.02	.175	708.08
53.9000	.00	42.38	42.42	.00	.02	.175	708.08
54.0000	.00	42.35	42.38	.00	.02	.175	708.08
54.1000	.00	42.32	42.35	.00	.02	.175	708.08
54.2000	.00	42.28	42.32	.00	.02	.175	708.08
54.3000	.00	42.25	42.28	.00	.02	.175	708.08
54.4000	.00	42.21	42.25	.00	.02	.174	708.08
54.5000	.00	42.18	42.21	.00	.02	.174	708.08

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
54.6000	.00	42.15	42.18	.00	.02	.174	708.08
54.7000	.00	42.11	42.15	.00	.02	.174	708.08
54.8000	.00	42.08	42.11	.00	.02	.174	708.08
54.9000	.00	42.05	42.08	.00	.02	.174	708.08
55.0000	.00	42.01	42.05	.00	.02	.174	708.08
55.1000	.00	41.98	42.01	.00	.02	.173	708.08
55.2000	.00	41.95	41.98	.00	.02	.173	708.08
55.3000	.00	41.92	41.95	.00	.02	.173	708.08
55.4000	.00	41.88	41.92	.00	.02	.173	708.08
55.5000	.00	41.85	41.88	.00	.02	.173	708.08
55.6000	.00	41.82	41.85	.00	.02	.173	708.08
55.7000	.00	41.79	41.82	.00	.02	.173	708.08
55.8000	.00	41.76	41.79	.00	.02	.173	708.08
55.9000	.00	41.72	41.76	.00	.02	.172	708.07
56.0000	.00	41.69	41.72	.00	.02	.172	708.07
56.1000	.00	41.66	41.69	.00	.02	.172	708.07
56.2000	.00	41.63	41.66	.00	.02	.172	708.07
56.3000	.00	41.60	41.63	.00	.02	.172	708.07
56.4000	.00	41.57	41.60	.00	.02	.172	708.07
56.5000	.00	41.54	41.57	.00	.02	.172	708.07
56.6000	.00	41.51	41.54	.00	.02	.171	708.07
56.7000	.00	41.47	41.51	.00	.02	.171	708.07
56.8000	.00	41.44	41.47	.00	.02	.171	708.07
56.9000	.00	41.41	41.44	.00	.02	.171	708.07
57.0000	.00	41.38	41.41	.00	.02	.171	708.07
57.1000	.00	41.35	41.38	.00	.02	.171	708.07
57.2000	.00	41.32	41.35	.00	.02	.171	708.07
57.3000	.00	41.29	41.32	.00	.02	.171	708.07
57.4000	.00	41.26	41.29	.00	.02	.170	708.07
57.5000	.00	41.23	41.26	.00	.01	.170	708.07
57.6000	.00	41.20	41.23	.00	.01	.170	708.07
57.7000	.00	41.17	41.20	.00	.01	.170	708.07
57.8000	.00	41.14	41.17	.00	.01	.170	708.07
57.9000	.00	41.11	41.14	.00	.01	.170	708.07
58.0000	.00	41.08	41.11	.00	.01	.170	708.07
58.1000	.00	41.06	41.08	.00	.01	.170	708.07
58.2000	.00	41.03	41.06	.00	.01	.169	708.07
58.3000	.00	41.00	41.03	.00	.01	.169	708.07
58.4000	.00	40.97	41.00	.00	.01	.169	708.07
58.5000	.00	40.94	40.97	.00	.01	.169	708.07
58.6000	.00	40.91	40.94	.00	.01	.169	708.07
58.7000	.00	40.88	40.91	.00	.01	.169	708.07

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
58.8000	.00	40.85	40.88	.00	.01	.169	708.07
58.9000	.00	40.83	40.85	.00	.01	.169	708.07
59.0000	.00	40.80	40.83	.00	.01	.169	708.07
59.1000	.00	40.77	40.80	.00	.01	.168	708.07
59.2000	.00	40.74	40.77	.00	.01	.168	708.07
59.3000	.00	40.71	40.74	.00	.01	.168	708.07
59.4000	.00	40.69	40.71	.00	.01	.168	708.07
59.5000	.00	40.66	40.69	.00	.01	.168	708.07
59.6000	.00	40.63	40.66	.00	.01	.168	708.06
59.7000	.00	40.60	40.63	.00	.01	.168	708.06
59.8000	.00	40.58	40.60	.00	.01	.168	708.06
59.9000	.00	40.55	40.58	.00	.01	.167	708.06
60.0000	.00	40.52	40.55	.00	.01	.167	708.06
60.1000	.00	40.49	40.52	.00	.01	.167	708.06
60.2000	.00	40.47	40.49	.00	.01	.167	708.06
60.3000	.00	40.44	40.47	.00	.01	.167	708.06
60.4000	.00	40.41	40.44	.00	.01	.167	708.06
60.5000	.00	40.39	40.41	.00	.01	.167	708.06
60.6000	.00	40.36	40.39	.00	.01	.167	708.06
60.7000	.00	40.33	40.36	.00	.01	.167	708.06
60.8000	.00	40.31	40.33	.00	.01	.166	708.06
60.9000	.00	40.28	40.31	.00	.01	.166	708.06
61.0000	.00	40.26	40.28	.00	.01	.166	708.06
61.1000	.00	40.23	40.26	.00	.01	.166	708.06
61.2000	.00	40.20	40.23	.00	.01	.166	708.06
61.3000	.00	40.18	40.20	.00	.01	.166	708.06
61.4000	.00	40.15	40.18	.00	.01	.166	708.06
61.5000	.00	40.13	40.15	.00	.01	.166	708.06
61.6000	.00	40.10	40.13	.00	.01	.166	708.06
61.7000	.00	40.07	40.10	.00	.01	.166	708.06
61.8000	.00	40.05	40.07	.00	.01	.165	708.06
61.9000	.00	40.02	40.05	.00	.01	.165	708.06
62.0000	.00	40.00	40.02	.00	.01	.165	708.06
62.1000	.00	39.97	40.00	.00	.01	.165	708.06
62.2000	.00	39.95	39.97	.00	.01	.165	708.06
62.3000	.00	39.92	39.95	.00	.01	.165	708.06
62.4000	.00	39.90	39.92	.00	.01	.165	708.06
62.5000	.00	39.87	39.90	.00	.01	.165	708.06
62.6000	.00	39.85	39.87	.00	.01	.165	708.06
62.7000	.00	39.83	39.85	.00	.01	.164	708.06
62.8000	.00	39.80	39.83	.00	.01	.164	708.06
62.9000	.00	39.78	39.80	.00	.01	.164	708.06

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
63.0000	.00	39.75	39.78	.00	.01	.164	708.06
63.1000	.00	39.73	39.75	.00	.01	.164	708.06
63.2000	.00	39.70	39.73	.00	.01	.164	708.06
63.3000	.00	39.68	39.70	.00	.01	.164	708.06
63.4000	.00	39.66	39.68	.00	.01	.164	708.06
63.5000	.00	39.63	39.66	.00	.01	.164	708.06
63.6000	.00	39.61	39.63	.00	.01	.164	708.06
63.7000	.00	39.59	39.61	.00	.01	.163	708.06
63.8000	.00	39.56	39.59	.00	.01	.163	708.06
63.9000	.00	39.54	39.56	.00	.01	.163	708.06
64.0000	.00	39.52	39.54	.00	.01	.163	708.05
64.1000	.00	39.49	39.52	.00	.01	.163	708.05
64.2000	.00	39.47	39.49	.00	.01	.163	708.05
64.3000	.00	39.45	39.47	.00	.01	.163	708.05
64.4000	.00	39.42	39.45	.00	.01	.163	708.05
64.5000	.00	39.40	39.42	.00	.01	.163	708.05
64.6000	.00	39.38	39.40	.00	.01	.163	708.05
64.7000	.00	39.36	39.38	.00	.01	.163	708.05
64.8000	.00	39.33	39.36	.00	.01	.162	708.05
64.9000	.00	39.31	39.33	.00	.01	.162	708.05
65.0000	.00	39.29	39.31	.00	.01	.162	708.05
65.1000	.00	39.27	39.29	.00	.01	.162	708.05
65.2000	.00	39.24	39.27	.00	.01	.162	708.05
65.3000	.00	39.22	39.24	.00	.01	.162	708.05
65.4000	.00	39.20	39.22	.00	.01	.162	708.05
65.5000	.00	39.18	39.20	.00	.01	.162	708.05
65.6000	.00	39.15	39.18	.00	.01	.162	708.05
65.7000	.00	39.13	39.15	.00	.01	.162	708.05
65.8000	.00	39.11	39.13	.00	.01	.162	708.05
65.9000	.00	39.09	39.11	.00	.01	.161	708.05
66.0000	.00	39.07	39.09	.00	.01	.161	708.05
66.1000	.00	39.05	39.07	.00	.01	.161	708.05
66.2000	.00	39.03	39.05	.00	.01	.161	708.05
66.3000	.00	39.00	39.03	.00	.01	.161	708.05
66.4000	.00	38.98	39.00	.00	.01	.161	708.05
66.5000	.00	38.96	38.98	.00	.01	.161	708.05
66.6000	.00	38.94	38.96	.00	.01	.161	708.05
66.7000	.00	38.92	38.94	.00	.01	.161	708.05
66.8000	.00	38.90	38.92	.00	.01	.161	708.05
66.9000	.00	38.88	38.90	.00	.01	.161	708.05
67.0000	.00	38.86	38.88	.00	.01	.160	708.05
67.1000	.00	38.84	38.86	.00	.01	.160	708.05

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
67.2000	.00	38.82	38.84	.00	.01	.160	708.05
67.3000	.00	38.79	38.82	.00	.01	.160	708.05
67.4000	.00	38.77	38.79	.00	.01	.160	708.05
67.5000	.00	38.75	38.77	.00	.01	.160	708.05
67.6000	.00	38.73	38.75	.00	.01	.160	708.05
67.7000	.00	38.71	38.73	.00	.01	.160	708.05
67.8000	.00	38.69	38.71	.00	.01	.160	708.05
67.9000	.00	38.67	38.69	.00	.01	.160	708.05
68.0000	.00	38.65	38.67	.00	.01	.160	708.05
68.1000	.00	38.63	38.65	.00	.01	.160	708.05
68.2000	.00	38.61	38.63	.00	.01	.159	708.05
68.3000	.00	38.59	38.61	.00	.01	.159	708.05
68.4000	.00	38.57	38.59	.00	.01	.159	708.05
68.5000	.00	38.55	38.57	.00	.01	.159	708.05
68.6000	.00	38.54	38.55	.00	.01	.159	708.05
68.7000	.00	38.52	38.54	.00	.01	.159	708.05
68.8000	.00	38.50	38.52	.00	.01	.159	708.05
68.9000	.00	38.48	38.50	.00	.01	.159	708.05
69.0000	.00	38.46	38.48	.00	.01	.159	708.05
69.1000	.00	38.44	38.46	.00	.01	.159	708.05
69.2000	.00	38.42	38.44	.00	.01	.159	708.04
69.3000	.00	38.40	38.42	.00	.01	.159	708.04
69.4000	.00	38.38	38.40	.00	.01	.159	708.04
69.5000	.00	38.36	38.38	.00	.01	.158	708.04
69.6000	.00	38.34	38.36	.00	.01	.158	708.04
69.7000	.00	38.33	38.34	.00	.01	.158	708.04
69.8000	.00	38.31	38.33	.00	.01	.158	708.04
69.9000	.00	38.29	38.31	.00	.01	.158	708.04
70.0000	.00	38.27	38.29	.00	.01	.158	708.04
70.1000	.00	38.25	38.27	.00	.01	.158	708.04
70.2000	.00	38.23	38.25	.00	.01	.158	708.04
70.3000	.00	38.21	38.23	.00	.01	.158	708.04
70.4000	.00	38.20	38.21	.00	.01	.158	708.04
70.5000	.00	38.18	38.20	.00	.01	.158	708.04
70.6000	.00	38.16	38.18	.00	.01	.158	708.04
70.7000	.00	38.14	38.16	.00	.01	.158	708.04
70.8000	.00	38.12	38.14	.00	.01	.157	708.04
70.9000	.00	38.11	38.12	.00	.01	.157	708.04
71.0000	.00	38.09	38.11	.00	.01	.157	708.04
71.1000	.00	38.07	38.09	.00	.01	.157	708.04
71.2000	.00	38.05	38.07	.00	.01	.157	708.04
71.3000	.00	38.03	38.05	.00	.01	.157	708.04

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
71.4000	.00	38.02	38.03	.00	.01	.157	708.04
71.5000	.00	38.00	38.02	.00	.01	.157	708.04
71.6000	.00	37.98	38.00	.00	.01	.157	708.04
71.7000	.00	37.97	37.98	.00	.01	.157	708.04
71.8000	.00	37.95	37.97	.00	.01	.157	708.04
71.9000	.00	37.93	37.95	.00	.01	.157	708.04
72.0000	.00	37.91	37.93	.00	.01	.157	708.04
72.1000	.00	37.90	37.91	.00	.01	.157	708.04
72.2000	.00	37.88	37.90	.00	.01	.156	708.04
72.3000	.00	37.86	37.88	.00	.01	.156	708.04
72.4000	.00	37.85	37.86	.00	.01	.156	708.04
72.5000	.00	37.83	37.85	.00	.01	.156	708.04
72.6000	.00	37.81	37.83	.00	.01	.156	708.04
72.7000	.00	37.80	37.81	.00	.01	.156	708.04
72.8000	.00	37.78	37.80	.00	.01	.156	708.04
72.9000	.00	37.76	37.78	.00	.01	.156	708.04
73.0000	.00	37.75	37.76	.00	.01	.156	708.04
73.1000	.00	37.73	37.75	.00	.01	.156	708.04
73.2000	.00	37.71	37.73	.00	.01	.156	708.04
73.3000	.00	37.70	37.71	.00	.01	.156	708.04
73.4000	.00	37.68	37.70	.00	.01	.156	708.04
73.5000	.00	37.66	37.68	.00	.01	.156	708.04
73.6000	.00	37.65	37.66	.00	.01	.155	708.04
73.7000	.00	37.63	37.65	.00	.01	.155	708.04
73.8000	.00	37.62	37.63	.00	.01	.155	708.04
73.9000	.00	37.60	37.62	.00	.01	.155	708.04
74.0000	.00	37.58	37.60	.00	.01	.155	708.04
74.1000	.00	37.57	37.58	.00	.01	.155	708.04
74.2000	.00	37.55	37.57	.00	.01	.155	708.04
74.3000	.00	37.54	37.55	.00	.01	.155	708.04
74.4000	.00	37.52	37.54	.00	.01	.155	708.04
74.5000	.00	37.51	37.52	.00	.01	.155	708.04
74.6000	.00	37.49	37.51	.00	.01	.155	708.04
74.7000	.00	37.47	37.49	.00	.01	.155	708.04
74.8000	.00	37.46	37.47	.00	.01	.155	708.04
74.9000	.00	37.44	37.46	.00	.01	.155	708.04
75.0000	.00	37.43	37.44	.00	.01	.155	708.04
75.1000	.00	37.41	37.43	.00	.01	.154	708.04
75.2000	.00	37.40	37.41	.00	.01	.154	708.04
75.3000	.00	37.38	37.40	.00	.01	.154	708.04
75.4000	.00	37.37	37.38	.00	.01	.154	708.04
75.5000	.00	37.35	37.37	.00	.01	.154	708.04

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
75.6000	.00	37.34	37.35	.00	.01	.154	708.04
75.7000	.00	37.32	37.34	.00	.01	.154	708.04
75.8000	.00	37.31	37.32	.00	.01	.154	708.03
75.9000	.00	37.29	37.31	.00	.01	.154	708.03
76.0000	.00	37.28	37.29	.00	.01	.154	708.03
76.1000	.00	37.26	37.28	.00	.01	.154	708.03
76.2000	.00	37.25	37.26	.00	.01	.154	708.03
76.3000	.00	37.23	37.25	.00	.01	.154	708.03
76.4000	.00	37.22	37.23	.00	.01	.154	708.03
76.5000	.00	37.21	37.22	.00	.01	.154	708.03
76.6000	.00	37.19	37.21	.00	.01	.154	708.03
76.7000	.00	37.18	37.19	.00	.01	.154	708.03
76.8000	.00	37.16	37.18	.00	.01	.153	708.03
76.9000	.00	37.15	37.16	.00	.01	.153	708.03
77.0000	.00	37.13	37.15	.00	.01	.153	708.03
77.1000	.00	37.12	37.13	.00	.01	.153	708.03
77.2000	.00	37.11	37.12	.00	.01	.153	708.03
77.3000	.00	37.09	37.11	.00	.01	.153	708.03
77.4000	.00	37.08	37.09	.00	.01	.153	708.03
77.5000	.00	37.06	37.08	.00	.01	.153	708.03
77.6000	.00	37.05	37.06	.00	.01	.153	708.03
77.7000	.00	37.04	37.05	.00	.01	.153	708.03
77.8000	.00	37.02	37.04	.00	.01	.153	708.03
77.9000	.00	37.01	37.02	.00	.01	.153	708.03
78.0000	.00	37.00	37.01	.00	.01	.153	708.03
78.1000	.00	36.98	37.00	.00	.01	.153	708.03
78.2000	.00	36.97	36.98	.00	.01	.153	708.03
78.3000	.00	36.96	36.97	.00	.01	.153	708.03
78.4000	.00	36.94	36.96	.00	.01	.153	708.03
78.5000	.00	36.93	36.94	.00	.01	.153	708.03
78.6000	.00	36.92	36.93	.00	.01	.152	708.03
78.7000	.00	36.90	36.92	.00	.01	.152	708.03
78.8000	.00	36.89	36.90	.00	.01	.152	708.03
78.9000	.00	36.88	36.89	.00	.01	.152	708.03
79.0000	.00	36.86	36.88	.00	.01	.152	708.03
79.1000	.00	36.85	36.86	.00	.01	.152	708.03
79.2000	.00	36.84	36.85	.00	.01	.152	708.03
79.3000	.00	36.82	36.84	.00	.01	.152	708.03
79.4000	.00	36.81	36.82	.00	.01	.152	708.03
79.5000	.00	36.80	36.81	.00	.01	.152	708.03
79.6000	.00	36.78	36.80	.00	.01	.152	708.03
79.7000	.00	36.77	36.78	.00	.01	.152	708.03

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
79.8000	.00	36.76	36.77	.00	.01	.152	708.03
79.9000	.00	36.75	36.76	.00	.01	.152	708.03
80.0000	.00	36.73	36.75	.00	.01	.152	708.03
80.1000	.00	36.72	36.73	.00	.01	.152	708.03
80.2000	.00	36.71	36.72	.00	.01	.152	708.03
80.3000	.00	36.70	36.71	.00	.01	.152	708.03
80.4000	.00	36.68	36.70	.00	.01	.151	708.03
80.5000	.00	36.67	36.68	.00	.01	.151	708.03
80.6000	.00	36.66	36.67	.00	.01	.151	708.03
80.7000	.00	36.65	36.66	.00	.01	.151	708.03
80.8000	.00	36.63	36.65	.00	.01	.151	708.03
80.9000	.00	36.62	36.63	.00	.01	.151	708.03
81.0000	.00	36.61	36.62	.00	.01	.151	708.03
81.1000	.00	36.60	36.61	.00	.01	.151	708.03
81.2000	.00	36.59	36.60	.00	.01	.151	708.03
81.3000	.00	36.57	36.59	.00	.01	.151	708.03
81.4000	.00	36.56	36.57	.00	.01	.151	708.03
81.5000	.00	36.55	36.56	.00	.01	.151	708.03
81.6000	.00	36.54	36.55	.00	.01	.151	708.03
81.7000	.00	36.53	36.54	.00	.01	.151	708.03
81.8000	.00	36.52	36.53	.00	.01	.151	708.03
81.9000	.00	36.50	36.52	.00	.01	.151	708.03
82.0000	.00	36.49	36.50	.00	.01	.151	708.03
82.1000	.00	36.48	36.49	.00	.01	.151	708.03
82.2000	.00	36.47	36.48	.00	.01	.151	708.03
82.3000	.00	36.46	36.47	.00	.01	.151	708.03
82.4000	.00	36.45	36.46	.00	.01	.151	708.03
82.5000	.00	36.43	36.45	.00	.01	.150	708.03
82.6000	.00	36.42	36.43	.00	.01	.150	708.03
82.7000	.00	36.41	36.42	.00	.01	.150	708.03
82.8000	.00	36.40	36.41	.00	.01	.150	708.03
82.9000	.00	36.39	36.40	.00	.01	.150	708.03
83.0000	.00	36.38	36.39	.00	.01	.150	708.03
83.1000	.00	36.37	36.38	.00	.01	.150	708.03
83.2000	.00	36.35	36.37	.00	.01	.150	708.03
83.3000	.00	36.34	36.35	.00	.01	.150	708.03
83.4000	.00	36.33	36.34	.00	.01	.150	708.03
83.5000	.00	36.32	36.33	.00	.01	.150	708.03
83.6000	.00	36.31	36.32	.00	.01	.150	708.03
83.7000	.00	36.30	36.31	.00	.01	.150	708.03
83.8000	.00	36.29	36.30	.00	.01	.150	708.03
83.9000	.00	36.28	36.29	.00	.01	.150	708.03

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
84.0000	.00	36.27	36.28	.00	.01	.150	708.03
84.1000	.00	36.26	36.27	.00	.01	.150	708.03
84.2000	.00	36.25	36.26	.00	.01	.150	708.03
84.3000	.00	36.23	36.25	.00	.01	.150	708.03
84.4000	.00	36.22	36.23	.00	.01	.150	708.03
84.5000	.00	36.21	36.22	.00	.01	.150	708.03
84.6000	.00	36.20	36.21	.00	.01	.150	708.02
84.7000	.00	36.19	36.20	.00	.01	.149	708.02
84.8000	.00	36.18	36.19	.00	.01	.149	708.02
84.9000	.00	36.17	36.18	.00	.01	.149	708.02
85.0000	.00	36.16	36.17	.00	.01	.149	708.02
85.1000	.00	36.15	36.16	.00	.01	.149	708.02
85.2000	.00	36.14	36.15	.00	.01	.149	708.02
85.3000	.00	36.13	36.14	.00	.01	.149	708.02
85.4000	.00	36.12	36.13	.00	.01	.149	708.02
85.5000	.00	36.11	36.12	.00	.01	.149	708.02
85.6000	.00	36.10	36.11	.00	.01	.149	708.02
85.7000	.00	36.09	36.10	.00	.01	.149	708.02
85.8000	.00	36.08	36.09	.00	.01	.149	708.02
85.9000	.00	36.07	36.08	.00	.01	.149	708.02
86.0000	.00	36.06	36.07	.00	.01	.149	708.02
86.1000	.00	36.05	36.06	.00	.00	.149	708.02
86.2000	.00	36.04	36.05	.00	.00	.149	708.02
86.3000	.00	36.03	36.04	.00	.00	.149	708.02
86.4000	.00	36.02	36.03	.00	.00	.149	708.02
86.5000	.00	36.01	36.02	.00	.00	.149	708.02
86.6000	.00	36.00	36.01	.00	.00	.149	708.02
86.7000	.00	35.99	36.00	.00	.00	.149	708.02
86.8000	.00	35.98	35.99	.00	.00	.149	708.02
86.9000	.00	35.97	35.98	.00	.00	.149	708.02
87.0000	.00	35.96	35.97	.00	.00	.149	708.02
87.1000	.00	35.95	35.96	.00	.00	.148	708.02
87.2000	.00	35.94	35.95	.00	.00	.148	708.02
87.3000	.00	35.93	35.94	.00	.00	.148	708.02
87.4000	.00	35.92	35.93	.00	.00	.148	708.02
87.5000	.00	35.91	35.92	.00	.00	.148	708.02
87.6000	.00	35.90	35.91	.00	.00	.148	708.02
87.7000	.00	35.89	35.90	.00	.00	.148	708.02
87.8000	.00	35.88	35.89	.00	.00	.148	708.02
87.9000	.00	35.88	35.88	.00	.00	.148	708.02
88.0000	.00	35.87	35.88	.00	.00	.148	708.02
88.1000	.00	35.86	35.87	.00	.00	.148	708.02

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
88.2000	.00	35.85	35.86	.00	.00	.148	708.02
88.3000	.00	35.84	35.85	.00	.00	.148	708.02
88.4000	.00	35.83	35.84	.00	.00	.148	708.02
88.5000	.00	35.82	35.83	.00	.00	.148	708.02
88.6000	.00	35.81	35.82	.00	.00	.148	708.02
88.7000	.00	35.80	35.81	.00	.00	.148	708.02
88.8000	.00	35.79	35.80	.00	.00	.148	708.02
88.9000	.00	35.78	35.79	.00	.00	.148	708.02
89.0000	.00	35.78	35.78	.00	.00	.148	708.02
89.1000	.00	35.77	35.78	.00	.00	.148	708.02
89.2000	.00	35.76	35.77	.00	.00	.148	708.02
89.3000	.00	35.75	35.76	.00	.00	.148	708.02
89.4000	.00	35.74	35.75	.00	.00	.148	708.02
89.5000	.00	35.73	35.74	.00	.00	.148	708.02
89.6000	.00	35.72	35.73	.00	.00	.148	708.02
89.7000	.00	35.71	35.72	.00	.00	.148	708.02
89.8000	.00	35.70	35.71	.00	.00	.147	708.02
89.9000	.00	35.70	35.70	.00	.00	.147	708.02
90.0000	.00	35.69	35.70	.00	.00	.147	708.02
90.1000	.00	35.68	35.69	.00	.00	.147	708.02
90.2000	.00	35.67	35.68	.00	.00	.147	708.02
90.3000	.00	35.66	35.67	.00	.00	.147	708.02
90.4000	.00	35.65	35.66	.00	.00	.147	708.02
90.5000	.00	35.65	35.65	.00	.00	.147	708.02
90.6000	.00	35.64	35.65	.00	.00	.147	708.02
90.7000	.00	35.63	35.64	.00	.00	.147	708.02
90.8000	.00	35.62	35.63	.00	.00	.147	708.02
90.9000	.00	35.61	35.62	.00	.00	.147	708.02
91.0000	.00	35.60	35.61	.00	.00	.147	708.02
91.1000	.00	35.60	35.60	.00	.00	.147	708.02
91.2000	.00	35.59	35.60	.00	.00	.147	708.02
91.3000	.00	35.58	35.59	.00	.00	.147	708.02
91.4000	.00	35.57	35.58	.00	.00	.147	708.02
91.5000	.00	35.56	35.57	.00	.00	.147	708.02
91.6000	.00	35.55	35.56	.00	.00	.147	708.02
91.7000	.00	35.55	35.55	.00	.00	.147	708.02
91.8000	.00	35.54	35.55	.00	.00	.147	708.02
91.9000	.00	35.53	35.54	.00	.00	.147	708.02
92.0000	.00	35.52	35.53	.00	.00	.147	708.02
92.1000	.00	35.51	35.52	.00	.00	.147	708.02
92.2000	.00	35.51	35.51	.00	.00	.147	708.02
92.3000	.00	35.50	35.51	.00	.00	.147	708.02

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
92.4000	.00	35.49	35.50	.00	.00	.147	708.02
92.5000	.00	35.48	35.49	.00	.00	.147	708.02
92.6000	.00	35.48	35.48	.00	.00	.147	708.02
92.7000	.00	35.47	35.48	.00	.00	.146	708.02
92.8000	.00	35.46	35.47	.00	.00	.146	708.02
92.9000	.00	35.45	35.46	.00	.00	.146	708.02
93.0000	.00	35.44	35.45	.00	.00	.146	708.02
93.1000	.00	35.44	35.44	.00	.00	.146	708.02
93.2000	.00	35.43	35.44	.00	.00	.146	708.02
93.3000	.00	35.42	35.43	.00	.00	.146	708.02
93.4000	.00	35.41	35.42	.00	.00	.146	708.02
93.5000	.00	35.41	35.41	.00	.00	.146	708.02
93.6000	.00	35.40	35.41	.00	.00	.146	708.02
93.7000	.00	35.39	35.40	.00	.00	.146	708.02
93.8000	.00	35.38	35.39	.00	.00	.146	708.02
93.9000	.00	35.38	35.38	.00	.00	.146	708.02
94.0000	.00	35.37	35.38	.00	.00	.146	708.02
94.1000	.00	35.36	35.37	.00	.00	.146	708.02
94.2000	.00	35.35	35.36	.00	.00	.146	708.02
94.3000	.00	35.35	35.35	.00	.00	.146	708.02
94.4000	.00	35.34	35.35	.00	.00	.146	708.02
94.5000	.00	35.33	35.34	.00	.00	.146	708.02
94.6000	.00	35.33	35.33	.00	.00	.146	708.02
94.7000	.00	35.32	35.33	.00	.00	.146	708.02
94.8000	.00	35.31	35.32	.00	.00	.146	708.02
94.9000	.00	35.30	35.31	.00	.00	.146	708.02
95.0000	.00	35.30	35.30	.00	.00	.146	708.02
95.1000	.00	35.29	35.30	.00	.00	.146	708.02
95.2000	.00	35.28	35.29	.00	.00	.146	708.02
95.3000	.00	35.28	35.28	.00	.00	.146	708.02
95.4000	.00	35.27	35.28	.00	.00	.146	708.02
95.5000	.00	35.26	35.27	.00	.00	.146	708.02
95.6000	.00	35.25	35.26	.00	.00	.146	708.02
95.7000	.00	35.25	35.25	.00	.00	.146	708.02
95.8000	.00	35.24	35.25	.00	.00	.146	708.02
95.9000	.00	35.23	35.24	.00	.00	.146	708.02
96.0000	.00	35.23	35.23	.00	.00	.146	708.02
96.1000	.00	35.22	35.23	.00	.00	.145	708.02
96.2000	.00	35.21	35.22	.00	.00	.145	708.02
96.3000	.00	35.21	35.21	.00	.00	.145	708.02
96.4000	.00	35.20	35.21	.00	.00	.145	708.02
96.5000	.00	35.19	35.20	.00	.00	.145	708.02

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 CD IN Dev 2
Outflow HYG file = work_pad.hyg - CR 28 CD OUT Dev 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
96.6000	.00	35.19	35.19	.00	.00	.145	708.02
96.7000	.00	35.18	35.19	.00	.00	.145	708.02
96.8000	.00	35.17	35.18	.00	.00	.145	708.02
96.9000	.00	35.17	35.17	.00	.00	.145	708.02
97.0000	.00	35.16	35.17	.00	.00	.145	708.02
97.1000	.00	35.15	35.16	.00	.00	.145	708.02
97.2000	.00	35.15	35.15	.00	.00	.145	708.02
97.3000	.00	35.14	35.15	.00	.00	.145	708.02
97.4000	.00	35.13	35.14	.00	.00	.145	708.02
97.5000	.00	35.13	35.13	.00	.00	.145	708.02
97.6000	.00	35.12	35.13	.00	.00	.145	708.02
97.7000	.00	35.11	35.12	.00	.00	.145	708.02
97.8000	.00	35.11	35.11	.00	.00	.145	708.02
97.9000	.00	35.10	35.11	.00	.00	.145	708.02
98.0000	.00	35.10	35.10	.00	.00	.145	708.01
98.1000	.00	35.09	35.10	.00	.00	.145	708.01
98.2000	.00	35.08	35.09	.00	.00	.145	708.01
98.3000	.00	35.08	35.08	.00	.00	.145	708.01
98.4000	.00	35.07	35.08	.00	.00	.145	708.01
98.5000	.00	35.06	35.07	.00	.00	.145	708.01
98.6000	.00	35.06	35.06	.00	.00	.145	708.01
98.7000	.00	35.05	35.06	.00	.00	.145	708.01
98.8000	.00	35.05	35.05	.00	.00	.145	708.01
98.9000	.00	35.04	35.05	.00	.00	.145	708.01
99.0000	.00	35.03	35.04	.00	.00	.145	708.01
99.1000	.00	35.03	35.03	.00	.00	.145	708.01
99.2000	.00	35.02	35.03	.00	.00	.145	708.01
99.3000	.00	35.02	35.02	.00	.00	.145	708.01
99.4000	.00	35.01	35.02	.00	.00	.145	708.01
99.5000	.00	35.00	35.01	.00	.00	.145	708.01

File.... G:\KGruver\Exports\BMP Basin\CR 28 CD.ppw

RATIONAL C COEFFICIENT DATA

Soil/Surface Description	C	Area acres	C x Area acres
	.9000	8.290	7.461
	.7000	18.350	12.845
WEIGHTED C & TOTAL AREA --->	.7622	26.640	20.306

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 2 yr `C' Adjustment = 1.000Allowable Q = 23.92 cfs

Hydrograph Storm Duration, Td = .6833 hrs Tc = .3000 hrs
Hydrograph File: Dev 2

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.762	.762	.3000	2.9606	26.640	60.62	1.503	.910
.762	.762	.3333	2.8063	26.640	57.46	1.583	.957
.762	.762	.5000	2.2296	26.640	45.65	1.886	1.096
.762	.762	.6667	1.8530	26.640	37.94	2.090	1.135
.762	.762	.6833	1.8223	26.640	37.31	2.107	1.135 Storage Maximum
.762	.762	.8333	1.5872	26.640	32.50	2.238	1.118
.762	.762	1.0000	1.3894	26.640	28.45	2.351	1.066
.762	.762	2.0000	.8016	26.640	16.41	Qpeak < Qallow	

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 10 yr `C' Adjustment = 1.000Allowable Q = 34.58 cfs

Hydrograph Storm Duration, Td = .7333 hrs Tc = .3000 hrs
Hydrograph File: Dev 10

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.762	.762	.3000	4.2365	26.640	86.74	2.151	1.293
.762	.762	.3333	4.0235	26.640	82.38	2.269	1.364
.762	.762	.5000	3.2229	26.640	65.99	2.727	1.584
.762	.762	.6667	2.6954	26.640	55.19	3.041	1.659
.762	.762	.7333	2.5313	26.640	51.83	3.141	1.665
.762	.762	.8333	2.3207	26.640	47.51	3.272	1.653
.762	.762	1.0000	2.0403	26.640	41.77	3.452	1.595
.762	.762	2.0000	1.1975	26.640	24.52	Qpeak < Qallow	

Storage Maximum

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 100 yr `C' Adjustment = 1.000Allowable Q = 53.01 cfs

Hydrograph Storm Duration, Td = .6667 hrs Tc = .3000 hrs
Hydrograph File: Dev100

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.762	.762	.3000	6.5055	26.640	133.20	3.302	1.988
.762	.762	.3333	6.1820	26.640	126.57	3.487	2.099
.762	.762	.5000	4.9412	26.640	101.17	4.180	2.428
.762	.762	.6667	4.1052	26.640	84.05	4.631	2.513
.762	.762	.6667	4.1052	26.640	84.05	4.631	2.513
.762	.762	.8333	3.5051	26.640	71.76	4.942	2.460
.762	.762	1.0000	3.0539	26.640	62.53	5.167	2.320
.762	.762	2.0000	1.7026	26.640	34.86	Qpeak < Qallow	

********** Storage Maximum

HDR | ONE COMPANY *Many Solutions*™

Project:	SCI-823-PH 1	Computed	KAG	Date: 7/7/09
Subject:	BMP CR 28 AB	Checked:	KMD	Date: 7/16/09
Task:	Basin Volume	Page:		of:
Job #:	19415	No.:		

Water Quality Control Preliminary Sizing

Outfall Station: **534+50 LT RAMP A**

Pond drainage areas

Discription		A	C	CA
Pavement	50879	1.17	0.9	1.051
Slopes > 4:1	297601	6.83	0.7	4.782
Total		8.00		5.834
	C average			0.73

Use C average as Cq

Water Quality Volume (WQ_V) Calculation

1117.4.1 Detention Basin $WQ_v = (P*A*Cq)/12$

P	0.75	
A	8.00	
Cq	0.73	
WQ_V =	0.36	ac ft
WQ_V =	15900	cubic feet

Extended Detention Treatment - 48 hour draw down minimum time

Required Treatment	1.2	x WQV
Req'd Volume	19100	cubic feet
Volume	0.438	ac ft
Forebay Volume	1910	cubic feet

Countour	Area	Area	Avg Area	Delta V	Volume		
	(sf)	(ac ft)	SF	Cu Ft	Cu Ft		
Basin CR 28 A B							
719.5	935	0.021465	0	0	0		
720	7184	0.164922	4060	2030	2030	WQV	19100
721	8690	0.199495	7937	7937	9967	**721.97**	
722	10264	0.235629	9477	9477	19444	$^1/_2$ WQV	9550
723	11928	0.273829	11096	11096	30540	**720.95**	
724	13682	0.314096	12805	12805	43345		
725	15569	0.357415	14626	14626	57970		
726	17456	0.400735	16513	16513	74483		

Countour	Area	Area	Avg Area	Delta V	Volume
	(sf)	(ac ft)	SF	Cu Ft	Cu Ft
Forebay					
720	865	0.019858	0	0	0
721	1117	0.025643	991	991	991
722	1386	0.031818	1252	1252	2243
723	1677	0.038499	1532	1532	3774

CULVERT ANALYSIS

PID : 19415 **Date :** 07/25/2009 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description : Culvert Sta 535+00 CR 28 Ramp A/B **Designer :** KAG

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.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 719.50 **Outlet Invert Elevation (ft.) :** 717.40
Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 192.00 **Culvert Slope (ft./ft.) :** 0.0109
Corrugation Type :
Pipe Size : 27 in.
Design Manning 'n' : (default)

Entrance Type : No Headwall **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
18.00	2.43	721.70	N/A	1 - C	8.88	1.14	1.48	0.0120	INLET	0.00	717.40
28.00	3.17	722.62	721.70	2 - E	9.80	1.52	1.84	0.0120	INLET	0.00	717.40

from Pond Pac output for 100yr Storm

MASTER DESIGN STORM SUMMARY

Default Network Design Storm File, ID BMP

i = b / ((T + d)**e)

Where: i = rainfall intensity (in/hr)
T = rainfall duration (min)
e, b, d = rainfall equation coefficients

Return Event	Rainfall Type	e coeff	b coeff	d coeff
2	e, b, d Coeff.	.9500	85.5680	16.5000
10	e, b, d Coeff.	.9230	112.1720	16.8000
100	e, b, d Coeff.	1.0760	355.5510	23.1990

MASTER NETWORK SUMMARY
Modified Rational Method Network

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

WQV = 0.438 ⇒ 721.97
1/2 WQV ⇒ 720.95

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CR 28 AB	IN POND	2	.557	R	.3000	12.36		
CR 28 AB	IN POND	10	.819	R	.3000	17.26		
CR 28 AB	IN POND	100	1.234	R	.3000	27.40		
CR 28 AB	OUT POND	2	.512		.7000	.16	722.45	.550
CR 28 AB	OUT POND	10	.774		.8000	3.21	723.30	.780
CR 28 AB	OUT POND	100	1.189		.6000	14.96	723.88	.950

MASTER NETWORK SUMMARY
Modified Rational Method Network

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID	Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
CR RAMP AB	AREA	2	.562	L	.2200	12.36		
CR RAMP AB	AREA	10	.828	L	.2200	17.26		
CR RAMP AB	AREA	100	1.246	L	.2200	27.40		
*OUTFALL	JCT	2	.512		.7000	.16		
*OUTFALL	JCT	10	.774		.8000	3.21		
*OUTFALL	JCT	100	1.189		.6000	14.96		

Elevation (ft)	Planimeter (sq.in)	Area (sq.ft)	A1+A2+sqr(A1*A2) (sq.ft)	Volume (ac-ft)	Volume Sum (ac-ft)
719.50	-----	935	0	.000	.000
720.00	-----	7184	10711	.041	.041
721.00	-----	8690	23775	.182	.223
722.00	-----	10264	28398	.217	.440
723.00	-----	11928	33257	.254	.695
724.00	-----	13682	38385	.294	.988
725.00	-----	15569	43846	.336	1.324
726.00	-----	17456	49511	.379	1.703

POND VOLUME EQUATIONS

* Incremental volume computed by the Conic Method for Reservoir Volumes.

Volume = (1/3) * (EL2-EL1) * (Area1 + Area2 + sq.rt.(Area1*Area2))

where: EL1, EL2 = Lower and upper elevations of the increment
Area1,Area2 = Areas computed for EL1, EL2, respectively
Volume = Incremental volume between EL1 and EL2

REQUESTED POND WS ELEVATIONS:

Min. Elev.= 719.50 ft
Increment = .10 ft
Max. Elev.= 726.00 ft

****
OUTLET CONNECTIVITY
****

---> Forward Flow Only (UpStream to DnStream)
<--- Reverse Flow Only (DnStream to UpStream)
<---> Forward and Reverse Both Allowed

Structure	No.		Outfall	E1, ft	E2, ft
Orifice-Circular	O0	--->	TW	720.000	726.000
Weir-Rectangular	W0	--->	TW	723.000	726.000

TW SETUP, DS Channel

OUTLET STRUCTURE INPUT DATA

Structure ID = O0
Structure Type = Orifice-Circular

# of Openings = 1
Invert Elev. = 720.00 ft
Diameter = 2.00 in
Orifice Coeff. = .600

Structure ID = W0
Structure Type = Weir-Rectangular

# of Openings = 1
Crest Elev. = 723.00 ft
Weir Length = 6.00 ft
Weir Coeff. = 3.000000

Weir TW effects (Use adjustment equation)

Structure ID = TW
Structure Type = TW SETUP, DS Channel

FREE OUTFALL CONDITIONS SPECIFIED

CONVERGENCE TOLERANCES...
Maximum Iterations= 40
Min. TW tolerance = .01 ft
Max. TW tolerance = .01 ft
Min. HW tolerance = .01 ft
Max. HW tolerance = .01 ft
Min. Q tolerance = .00 cfs
Max. Q tolerance = .00 cfs

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
.0000	.00	.00	.00	.00	.00	.000	719.50
.1000	5.62	5.62	5.62	.00	.00	.023	719.87
.2000	11.24	22.38	22.47	.00	.05	.093	720.30
.3000	12.36	45.79	45.97	.00	.09	.190	720.83
.4000	12.36	70.28	70.51	.00	.12	.291	721.33
.5000	12.36	94.72	95.00	.00	.14	.392	721.79
.6000	9.21	116.00	116.30	.00	.15	.480	722.17
.7000	3.93	128.82	129.14	.00	.16	.533	722.38
.8000	.56	133.00	133.32	.00	.16	.550	722.45
.9000	.00	132.67	133.00	.00	.16	.549	722.45
1.0000	.00	132.35	132.67	.00	.16	.548	722.44
1.1000	.00	132.03	132.35	.00	.16	.546	722.43
1.2000	.00	131.71	132.03	.00	.16	.545	722.43
1.3000	.00	131.39	131.71	.00	.16	.544	722.42
1.4000	.00	131.07	131.39	.00	.16	.542	722.42
1.5000	.00	130.74	131.07	.00	.16	.541	722.41
1.6000	.00	130.42	130.74	.00	.16	.540	722.41
1.7000	.00	130.10	130.42	.00	.16	.538	722.40
1.8000	.00	129.78	130.10	.00	.16	.537	722.40
1.9000	.00	129.47	129.78	.00	.16	.536	722.39
2.0000	.00	129.15	129.47	.00	.16	.534	722.39
2.1000	.00	128.83	129.15	.00	.16	.533	722.38
2.2000	.00	128.51	128.83	.00	.16	.532	722.38
2.3000	.00	128.19	128.51	.00	.16	.530	722.37
2.4000	.00	127.88	128.19	.00	.16	.529	722.37
2.5000	.00	127.56	127.88	.00	.16	.528	722.36
2.6000	.00	127.24	127.56	.00	.16	.526	722.36
2.7000	.00	126.93	127.24	.00	.16	.525	722.35
2.8000	.00	126.61	126.93	.00	.16	.524	722.35
2.9000	.00	126.29	126.61	.00	.16	.522	722.34
3.0000	.00	125.98	126.29	.00	.16	.521	722.33
3.1000	.00	125.66	125.98	.00	.16	.520	722.33
3.2000	.00	125.35	125.66	.00	.16	.519	722.32
3.3000	.00	125.04	125.35	.00	.16	.517	722.32
3.4000	.00	124.72	125.04	.00	.16	.516	722.31
3.5000	.00	124.41	124.72	.00	.16	.515	722.31
3.6000	.00	124.10	124.41	.00	.16	.513	722.30
3.7000	.00	123.78	124.10	.00	.16	.512	722.30
3.8000	.00	123.47	123.78	.00	.16	.511	722.29
3.9000	.00	123.16	123.47	.00	.16	.510	722.29
4.0000	.00	122.85	123.16	.00	.16	.508	722.28
4.1000	.00	122.54	122.85	.00	.16	.507	722.28

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
4.2000	.00	122.23	122.54	.00	.16	.506	722.27
4.3000	.00	121.92	122.23	.00	.16	.504	722.27
4.4000	.00	121.61	121.92	.00	.15	.503	722.26
4.5000	.00	121.30	121.61	.00	.15	.502	722.26
4.6000	.00	120.99	121.30	.00	.15	.501	722.25
4.7000	.00	120.68	120.99	.00	.15	.499	722.25
4.8000	.00	120.37	120.68	.00	.15	.498	722.24
4.9000	.00	120.06	120.37	.00	.15	.497	722.24
5.0000	.00	119.76	120.06	.00	.15	.495	722.23
5.1000	.00	119.45	119.76	.00	.15	.494	722.23
5.2000	.00	119.14	119.45	.00	.15	.493	722.22
5.3000	.00	118.83	119.14	.00	.15	.492	722.21
5.4000	.00	118.53	118.83	.00	.15	.490	722.21
5.5000	.00	118.22	118.53	.00	.15	.489	722.20
5.6000	.00	117.92	118.22	.00	.15	.488	722.20
5.7000	.00	117.61	117.92	.00	.15	.487	722.19
5.8000	.00	117.31	117.61	.00	.15	.485	722.19
5.9000	.00	117.00	117.31	.00	.15	.484	722.18
6.0000	.00	116.70	117.00	.00	.15	.483	722.18
6.1000	.00	116.39	116.70	.00	.15	.482	722.17
6.2000	.00	116.09	116.39	.00	.15	.480	722.17
6.3000	.00	115.79	116.09	.00	.15	.479	722.16
6.4000	.00	115.49	115.79	.00	.15	.478	722.16
6.5000	.00	115.18	115.49	.00	.15	.477	722.15
6.6000	.00	114.88	115.18	.00	.15	.475	722.15
6.7000	.00	114.58	114.88	.00	.15	.474	722.14
6.8000	.00	114.28	114.58	.00	.15	.473	722.14
6.9000	.00	113.98	114.28	.00	.15	.472	722.13
7.0000	.00	113.68	113.98	.00	.15	.470	722.13
7.1000	.00	113.38	113.68	.00	.15	.469	722.12
7.2000	.00	113.08	113.38	.00	.15	.468	722.12
7.3000	.00	112.78	113.08	.00	.15	.467	722.11
7.4000	.00	112.48	112.78	.00	.15	.465	722.11
7.5000	.00	112.18	112.48	.00	.15	.464	722.10
7.6000	.00	111.89	112.18	.00	.15	.463	722.10
7.7000	.00	111.59	111.89	.00	.15	.462	722.09
7.8000	.00	111.29	111.59	.00	.15	.460	722.09
7.9000	.00	111.00	111.29	.00	.15	.459	722.08
8.0000	.00	110.70	111.00	.00	.15	.458	722.08
8.1000	.00	110.40	110.70	.00	.15	.457	722.07
8.2000	.00	110.11	110.40	.00	.15	.456	722.06
8.3000	.00	109.81	110.11	.00	.15	.454	722.06

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
8.4000	.00	109.52	109.81	.00	.15	.453	722.05
8.5000	.00	109.22	109.52	.00	.15	.452	722.05
8.6000	.00	108.93	109.22	.00	.15	.451	722.04
8.7000	.00	108.64	108.93	.00	.15	.449	722.04
8.8000	.00	108.34	108.64	.00	.15	.448	722.03
8.9000	.00	108.05	108.34	.00	.15	.447	722.03
9.0000	.00	107.76	108.05	.00	.15	.446	722.02
9.1000	.00	107.46	107.76	.00	.15	.445	722.02
9.2000	.00	107.17	107.46	.00	.15	.443	722.01
9.3000	.00	106.88	107.17	.00	.15	.442	722.01
9.4000	.00	106.59	106.88	.00	.15	.441	722.00
9.5000	.00	106.30	106.59	.00	.15	.440	722.00
9.6000	.00	106.01	106.30	.00	.15	.439	721.99
9.7000	.00	105.72	106.01	.00	.14	.437	721.99
9.8000	.00	105.43	105.72	.00	.14	.436	721.98
9.9000	.00	105.14	105.43	.00	.14	.435	721.98
10.0000	.00	104.85	105.14	.00	.14	.434	721.97
10.1000	.00	104.56	104.85	.00	.14	.433	721.97
10.2000	.00	104.28	104.56	.00	.14	.431	721.96
10.3000	.00	103.99	104.28	.00	.14	.430	721.96
10.4000	.00	103.70	103.99	.00	.14	.429	721.95
10.5000	.00	103.41	103.70	.00	.14	.428	721.95
10.6000	.00	103.13	103.41	.00	.14	.427	721.94
10.7000	.00	102.84	103.13	.00	.14	.426	721.94
10.8000	.00	102.56	102.84	.00	.14	.424	721.93
10.9000	.00	102.27	102.56	.00	.14	.423	721.93
11.0000	.00	101.99	102.27	.00	.14	.422	721.92
11.1000	.00	101.70	101.99	.00	.14	.421	721.92
11.2000	.00	101.42	101.70	.00	.14	.420	721.91
11.3000	.00	101.14	101.42	.00	.14	.418	721.91
11.4000	.00	100.85	101.14	.00	.14	.417	721.90
11.5000	.00	100.57	100.85	.00	.14	.416	721.90
11.6000	.00	100.29	100.57	.00	.14	.415	721.89
11.7000	.00	100.00	100.29	.00	.14	.414	721.89
11.8000	.00	99.72	100.00	.00	.14	.413	721.88
11.9000	.00	99.44	99.72	.00	.14	.411	721.88
12.0000	.00	99.16	99.44	.00	.14	.410	721.87
12.1000	.00	98.88	99.16	.00	.14	.409	721.87
12.2000	.00	98.60	98.88	.00	.14	.408	721.86
12.3000	.00	98.32	98.60	.00	.14	.407	721.86
12.4000	.00	98.04	98.32	.00	.14	.406	721.85
12.5000	.00	97.76	98.04	.00	.14	.405	721.85

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
12.6000	.00	97.48	97.76	.00	.14	.403	721.84
12.7000	.00	97.21	97.48	.00	.14	.402	721.84
12.8000	.00	96.93	97.21	.00	.14	.401	721.83
12.9000	.00	96.65	96.93	.00	.14	.400	721.83
13.0000	.00	96.37	96.65	.00	.14	.399	721.82
13.1000	.00	96.10	96.37	.00	.14	.398	721.82
13.2000	.00	95.82	96.10	.00	.14	.397	721.81
13.3000	.00	95.55	95.82	.00	.14	.395	721.81
13.4000	.00	95.27	95.55	.00	.14	.394	721.80
13.5000	.00	95.00	95.27	.00	.14	.393	721.80
13.6000	.00	94.72	95.00	.00	.14	.392	721.79
13.7000	.00	94.45	94.72	.00	.14	.391	721.79
13.8000	.00	94.17	94.45	.00	.14	.390	721.78
13.9000	.00	93.90	94.17	.00	.14	.389	721.78
14.0000	.00	93.63	93.90	.00	.14	.387	721.77
14.1000	.00	93.36	93.63	.00	.14	.386	721.77
14.2000	.00	93.08	93.36	.00	.14	.385	721.76
14.3000	.00	92.81	93.08	.00	.14	.384	721.76
14.4000	.00	92.54	92.81	.00	.14	.383	721.75
14.5000	.00	92.27	92.54	.00	.14	.382	721.75
14.6000	.00	92.00	92.27	.00	.14	.381	721.74
14.7000	.00	91.73	92.00	.00	.14	.380	721.74
14.8000	.00	91.46	91.73	.00	.13	.378	721.73
14.9000	.00	91.19	91.46	.00	.13	.377	721.73
15.0000	.00	90.92	91.19	.00	.13	.376	721.72
15.1000	.00	90.65	90.92	.00	.13	.375	721.72
15.2000	.00	90.39	90.65	.00	.13	.374	721.71
15.3000	.00	90.12	90.39	.00	.13	.373	721.71
15.4000	.00	89.85	90.12	.00	.13	.372	721.70
15.5000	.00	89.58	89.85	.00	.13	.371	721.70
15.6000	.00	89.32	89.58	.00	.13	.370	721.69
15.7000	.00	89.05	89.32	.00	.13	.369	721.69
15.8000	.00	88.79	89.05	.00	.13	.367	721.68
15.9000	.00	88.52	88.79	.00	.13	.366	721.68
16.0000	.00	88.26	88.52	.00	.13	.365	721.67
16.1000	.00	87.99	88.26	.00	.13	.364	721.67
16.2000	.00	87.73	87.99	.00	.13	.363	721.66
16.3000	.00	87.46	87.73	.00	.13	.362	721.66
16.4000	.00	87.20	87.46	.00	.13	.361	721.65
16.5000	.00	86.94	87.20	.00	.13	.360	721.65
16.6000	.00	86.68	86.94	.00	.13	.359	721.64
16.7000	.00	86.41	86.68	.00	.13	.358	721.64

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
16.8000	.00	86.15	86.41	.00	.13	.357	721.63
16.9000	.00	85.89	86.15	.00	.13	.355	721.63
17.0000	.00	85.63	85.89	.00	.13	.354	721.62
17.1000	.00	85.37	85.63	.00	.13	.353	721.62
17.2000	.00	85.11	85.37	.00	.13	.352	721.61
17.3000	.00	84.85	85.11	.00	.13	.351	721.61
17.4000	.00	84.59	84.85	.00	.13	.350	721.61
17.5000	.00	84.33	84.59	.00	.13	.349	721.60
17.6000	.00	84.07	84.33	.00	.13	.348	721.60
17.7000	.00	83.82	84.07	.00	.13	.347	721.59
17.8000	.00	83.56	83.82	.00	.13	.346	721.59
17.9000	.00	83.30	83.56	.00	.13	.345	721.58
18.0000	.00	83.05	83.30	.00	.13	.344	721.58
18.1000	.00	82.79	83.05	.00	.13	.343	721.57
18.2000	.00	82.53	82.79	.00	.13	.342	721.57
18.3000	.00	82.28	82.53	.00	.13	.340	721.56
18.4000	.00	82.02	82.28	.00	.13	.339	721.56
18.5000	.00	81.77	82.02	.00	.13	.338	721.55
18.6000	.00	81.52	81.77	.00	.13	.337	721.55
18.7000	.00	81.26	81.52	.00	.13	.336	721.54
18.8000	.00	81.01	81.26	.00	.13	.335	721.54
18.9000	.00	80.76	81.01	.00	.13	.334	721.53
19.0000	.00	80.50	80.76	.00	.13	.333	721.53
19.1000	.00	80.25	80.50	.00	.13	.332	721.52
19.2000	.00	80.00	80.25	.00	.13	.331	721.52
19.3000	.00	79.75	80.00	.00	.13	.330	721.51
19.4000	.00	79.50	79.75	.00	.13	.329	721.51
19.5000	.00	79.25	79.50	.00	.13	.328	721.50
19.6000	.00	79.00	79.25	.00	.12	.327	721.50
19.7000	.00	78.75	79.00	.00	.12	.326	721.49
19.8000	.00	78.50	78.75	.00	.12	.325	721.49
19.9000	.00	78.25	78.50	.00	.12	.324	721.49
20.0000	.00	78.00	78.25	.00	.12	.323	721.48
20.1000	.00	77.75	78.00	.00	.12	.322	721.48
20.2000	.00	77.51	77.75	.00	.12	.321	721.47
20.3000	.00	77.26	77.51	.00	.12	.320	721.47
20.4000	.00	77.01	77.26	.00	.12	.319	721.46
20.5000	.00	76.77	77.01	.00	.12	.318	721.46
20.6000	.00	76.52	76.77	.00	.12	.317	721.45
20.7000	.00	76.28	76.52	.00	.12	.316	721.45
20.8000	.00	76.03	76.28	.00	.12	.315	721.44
20.9000	.00	75.79	76.03	.00	.12	.314	721.44

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
21.0000	.00	75.54	75.79	.00	.12	.313	721.43
21.1000	.00	75.30	75.54	.00	.12	.312	721.43
21.2000	.00	75.06	75.30	.00	.12	.311	721.42
21.3000	.00	74.81	75.06	.00	.12	.310	721.42
21.4000	.00	74.57	74.81	.00	.12	.309	721.41
21.5000	.00	74.33	74.57	.00	.12	.308	721.41
21.6000	.00	74.09	74.33	.00	.12	.307	721.41
21.7000	.00	73.85	74.09	.00	.12	.306	721.40
21.8000	.00	73.61	73.85	.00	.12	.305	721.40
21.9000	.00	73.37	73.61	.00	.12	.304	721.39
22.0000	.00	73.13	73.37	.00	.12	.303	721.39
22.1000	.00	72.89	73.13	.00	.12	.302	721.38
22.2000	.00	72.65	72.89	.00	.12	.301	721.38
22.3000	.00	72.41	72.65	.00	.12	.300	721.37
22.4000	.00	72.17	72.41	.00	.12	.299	721.37
22.5000	.00	71.94	72.17	.00	.12	.298	721.36
22.6000	.00	71.70	71.94	.00	.12	.297	721.36
22.7000	.00	71.46	71.70	.00	.12	.296	721.35
22.8000	.00	71.22	71.46	.00	.12	.295	721.35
22.9000	.00	70.99	71.22	.00	.12	.294	721.34
23.0000	.00	70.75	70.99	.00	.12	.293	721.34
23.1000	.00	70.52	70.75	.00	.12	.292	721.34
23.2000	.00	70.28	70.52	.00	.12	.291	721.33
23.3000	.00	70.05	70.28	.00	.12	.290	721.33
23.4000	.00	69.82	70.05	.00	.12	.289	721.32
23.5000	.00	69.58	69.82	.00	.12	.288	721.32
23.6000	.00	69.35	69.58	.00	.12	.287	721.31
23.7000	.00	69.12	69.35	.00	.12	.286	721.31
23.8000	.00	68.89	69.12	.00	.12	.285	721.30
23.9000	.00	68.65	68.89	.00	.12	.284	721.30
24.0000	.00	68.42	68.65	.00	.12	.283	721.29
24.1000	.00	68.19	68.42	.00	.12	.282	721.29
24.2000	.00	67.96	68.19	.00	.12	.281	721.29
24.3000	.00	67.73	67.96	.00	.11	.280	721.28
24.4000	.00	67.50	67.73	.00	.11	.279	721.28
24.5000	.00	67.27	67.50	.00	.11	.278	721.27
24.6000	.00	67.05	67.27	.00	.11	.277	721.27
24.7000	.00	66.82	67.05	.00	.11	.277	721.26
24.8000	.00	66.59	66.82	.00	.11	.276	721.26
24.9000	.00	66.36	66.59	.00	.11	.275	721.25
25.0000	.00	66.14	66.36	.00	.11	.274	721.25
25.1000	.00	65.91	66.14	.00	.11	.273	721.24

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
25.2000	.00	65.68	65.91	.00	.11	.272	721.24
25.3000	.00	65.46	65.68	.00	.11	.271	721.24
25.4000	.00	65.23	65.46	.00	.11	.270	721.23
25.5000	.00	65.01	65.23	.00	.11	.269	721.23
25.6000	.00	64.79	65.01	.00	.11	.268	721.22
25.7000	.00	64.56	64.79	.00	.11	.267	721.22
25.8000	.00	64.34	64.56	.00	.11	.266	721.21
25.9000	.00	64.12	64.34	.00	.11	.265	721.21
26.0000	.00	63.89	64.12	.00	.11	.264	721.20
26.1000	.00	63.67	63.89	.00	.11	.264	721.20
26.2000	.00	63.45	63.67	.00	.11	.263	721.20
26.3000	.00	63.23	63.45	.00	.11	.262	721.19
26.4000	.00	63.01	63.23	.00	.11	.261	721.19
26.5000	.00	62.79	63.01	.00	.11	.260	721.18
26.6000	.00	62.57	62.79	.00	.11	.259	721.18
26.7000	.00	62.35	62.57	.00	.11	.258	721.17
26.8000	.00	62.13	62.35	.00	.11	.257	721.17
26.9000	.00	61.91	62.13	.00	.11	.256	721.16
27.0000	.00	61.69	61.91	.00	.11	.255	721.16
27.1000	.00	61.48	61.69	.00	.11	.254	721.16
27.2000	.00	61.26	61.48	.00	.11	.254	721.15
27.3000	.00	61.04	61.26	.00	.11	.253	721.15
27.4000	.00	60.83	61.04	.00	.11	.252	721.14
27.5000	.00	60.61	60.83	.00	.11	.251	721.14
27.6000	.00	60.40	60.61	.00	.11	.250	721.13
27.7000	.00	60.18	60.40	.00	.11	.249	721.13
27.8000	.00	59.97	60.18	.00	.11	.248	721.13
27.9000	.00	59.75	59.97	.00	.11	.247	721.12
28.0000	.00	59.54	59.75	.00	.11	.246	721.12
28.1000	.00	59.33	59.54	.00	.11	.246	721.11
28.2000	.00	59.11	59.33	.00	.11	.245	721.11
28.3000	.00	58.90	59.11	.00	.11	.244	721.10
28.4000	.00	58.69	58.90	.00	.11	.243	721.10
28.5000	.00	58.48	58.69	.00	.11	.242	721.10
28.6000	.00	58.27	58.48	.00	.11	.241	721.09
28.7000	.00	58.06	58.27	.00	.11	.240	721.09
28.8000	.00	57.85	58.06	.00	.10	.239	721.08
28.9000	.00	57.64	57.85	.00	.10	.239	721.08
29.0000	.00	57.43	57.64	.00	.10	.238	721.07
29.1000	.00	57.22	57.43	.00	.10	.237	721.07
29.2000	.00	57.01	57.22	.00	.10	.236	721.07
29.3000	.00	56.81	57.01	.00	.10	.235	721.06

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
29.4000	.00	56.60	56.81	.00	.10	.234	721.06
29.5000	.00	56.39	56.60	.00	.10	.233	721.05
29.6000	.00	56.19	56.39	.00	.10	.233	721.05
29.7000	.00	55.98	56.19	.00	.10	.232	721.04
29.8000	.00	55.77	55.98	.00	.10	.231	721.04
29.9000	.00	55.57	55.77	.00	.10	.230	721.04
30.0000	.00	55.37	55.57	.00	.10	.229	721.03
30.1000	.00	55.16	55.37	.00	.10	.228	721.03
30.2000	.00	54.96	55.16	.00	.10	.227	721.02
30.3000	.00	54.75	54.96	.00	.10	.227	721.02
30.4000	.00	54.55	54.75	.00	.10	.226	721.01
30.5000	.00	54.35	54.55	.00	.10	.225	721.01
30.6000	.00	54.15	54.35	.00	.10	.224	721.01
30.7000	.00	53.95	54.15	.00	.10	.223	721.00
30.8000	.00	53.75	53.95	.00	.10	.223	721.00
30.9000	.00	53.55	53.75	.00	.10	.222	720.99
31.0000	.00	53.35	53.55	.00	.10	.221	720.99
31.1000	.00	53.15	53.35	.00	.10	.220	720.99
31.2000	.00	52.95	53.15	.00	.10	.219	720.98
31.3000	.00	52.75	52.95	.00	.10	.218	720.98
31.4000	.00	52.55	52.75	.00	.10	.218	720.97
31.5000	.00	52.35	52.55	.00	.10	.217	720.97
31.6000	.00	52.16	52.35	.00	.10	.216	720.96
31.7000	.00	51.96	52.16	.00	.10	.215	720.96
31.8000	.00	51.76	51.96	.00	.10	.214	720.96
31.9000	.00	51.57	51.76	.00	.10	.213	720.95
32.0000	.00	51.37	51.57	.00	.10	.213	720.95
32.1000	.00	51.18	51.37	.00	.10	.212	720.94
32.2000	.00	50.98	51.18	.00	.10	.211	720.94
32.3000	.00	50.79	50.98	.00	.10	.210	720.94
32.4000	.00	50.60	50.79	.00	.10	.209	720.93
32.5000	.00	50.40	50.60	.00	.10	.209	720.93
32.6000	.00	50.21	50.40	.00	.10	.208	720.92
32.7000	.00	50.02	50.21	.00	.10	.207	720.92
32.8000	.00	49.83	50.02	.00	.10	.206	720.92
32.9000	.00	49.64	49.83	.00	.10	.205	720.91
33.0000	.00	49.45	49.64	.00	.10	.205	720.91
33.1000	.00	49.26	49.45	.00	.10	.204	720.90
33.2000	.00	49.07	49.26	.00	.09	.203	720.90
33.3000	.00	48.88	49.07	.00	.09	.202	720.90
33.4000	.00	48.69	48.88	.00	.09	.202	720.89
33.5000	.00	48.50	48.69	.00	.09	.201	720.89

$\frac{1}{2}$ WQV must stay in basin for $\frac{1}{3}$(48hr)

16 h

31.9 > 16

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
33.6000	.00	48.31	48.50	.00	.09	.200	720.88
33.7000	.00	48.12	48.31	.00	.09	.199	720.88
33.8000	.00	47.94	48.12	.00	.09	.198	720.88
33.9000	.00	47.75	47.94	.00	.09	.198	720.87
34.0000	.00	47.56	47.75	.00	.09	.197	720.87
34.1000	.00	47.38	47.56	.00	.09	.196	720.86
34.2000	.00	47.19	47.38	.00	.09	.195	720.86
34.3000	.00	47.01	47.19	.00	.09	.195	720.86
34.4000	.00	46.83	47.01	.00	.09	.194	720.85
34.5000	.00	46.64	46.83	.00	.09	.193	720.85
34.6000	.00	46.46	46.64	.00	.09	.192	720.84
34.7000	.00	46.28	46.46	.00	.09	.192	720.84
34.8000	.00	46.09	46.28	.00	.09	.191	720.84
34.9000	.00	45.91	46.09	.00	.09	.190	720.83
35.0000	.00	45.73	45.91	.00	.09	.189	720.83
35.1000	.00	45.55	45.73	.00	.09	.189	720.83
35.2000	.00	45.37	45.55	.00	.09	.188	720.82
35.3000	.00	45.19	45.37	.00	.09	.187	720.82
35.4000	.00	45.01	45.19	.00	.09	.186	720.81
35.5000	.00	44.83	45.01	.00	.09	.186	720.81
35.6000	.00	44.65	44.83	.00	.09	.185	720.81
35.7000	.00	44.47	44.65	.00	.09	.184	720.80
35.8000	.00	44.30	44.47	.00	.09	.183	720.80
35.9000	.00	44.12	44.30	.00	.09	.183	720.79
36.0000	.00	43.94	44.12	.00	.09	.182	720.79
36.1000	.00	43.77	43.94	.00	.09	.181	720.79
36.2000	.00	43.59	43.77	.00	.09	.180	720.78
36.3000	.00	43.42	43.59	.00	.09	.180	720.78
36.4000	.00	43.24	43.42	.00	.09	.179	720.78
36.5000	.00	43.07	43.24	.00	.09	.178	720.77
36.6000	.00	42.89	43.07	.00	.09	.178	720.77
36.7000	.00	42.72	42.89	.00	.09	.177	720.76
36.8000	.00	42.55	42.72	.00	.09	.176	720.76
36.9000	.00	42.38	42.55	.00	.09	.175	720.76
37.0000	.00	42.20	42.38	.00	.09	.175	720.75
37.1000	.00	42.03	42.20	.00	.09	.174	720.75
37.2000	.00	41.86	42.03	.00	.09	.173	720.75
37.3000	.00	41.69	41.86	.00	.09	.173	720.74
37.4000	.00	41.52	41.69	.00	.08	.172	720.74
37.5000	.00	41.35	41.52	.00	.08	.171	720.73
37.6000	.00	41.18	41.35	.00	.08	.170	720.73
37.7000	.00	41.02	41.18	.00	.08	.170	720.73

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
37.8000	.00	40.85	41.02	.00	.08	.169	720.72
37.9000	.00	40.68	40.85	.00	.08	.168	720.72
38.0000	.00	40.51	40.68	.00	.08	.168	720.72
38.1000	.00	40.35	40.51	.00	.08	.167	720.71
38.2000	.00	40.18	40.35	.00	.08	.166	720.71
38.3000	.00	40.02	40.18	.00	.08	.166	720.71
38.4000	.00	39.85	40.02	.00	.08	.165	720.70
38.5000	.00	39.69	39.85	.00	.08	.164	720.70
38.6000	.00	39.52	39.69	.00	.08	.164	720.69
38.7000	.00	39.36	39.52	.00	.08	.163	720.69
38.8000	.00	39.19	39.36	.00	.08	.162	720.69
38.9000	.00	39.03	39.19	.00	.08	.162	720.68
39.0000	.00	38.87	39.03	.00	.08	.161	720.68
39.1000	.00	38.71	38.87	.00	.08	.160	720.68
39.2000	.00	38.55	38.71	.00	.08	.160	720.67
39.3000	.00	38.39	38.55	.00	.08	.159	720.67
39.4000	.00	38.23	38.39	.00	.08	.158	720.67
39.5000	.00	38.07	38.23	.00	.08	.158	720.66
39.6000	.00	37.91	38.07	.00	.08	.157	720.66
39.7000	.00	37.75	37.91	.00	.08	.156	720.66
39.8000	.00	37.59	37.75	.00	.08	.156	720.65
39.9000	.00	37.43	37.59	.00	.08	.155	720.65
40.0000	.00	37.28	37.43	.00	.08	.154	720.64
40.1000	.00	37.12	37.28	.00	.08	.154	720.64
40.2000	.00	36.96	37.12	.00	.08	.153	720.64
40.3000	.00	36.81	36.96	.00	.08	.152	720.63
40.4000	.00	36.65	36.81	.00	.08	.152	720.63
40.5000	.00	36.50	36.65	.00	.08	.151	720.63
40.6000	.00	36.34	36.50	.00	.08	.150	720.62
40.7000	.00	36.19	36.34	.00	.08	.150	720.62
40.8000	.00	36.04	36.19	.00	.08	.149	720.62
40.9000	.00	35.88	36.04	.00	.08	.149	720.61
41.0000	.00	35.73	35.88	.00	.08	.148	720.61
41.1000	.00	35.58	35.73	.00	.08	.147	720.61
41.2000	.00	35.43	35.58	.00	.08	.147	720.60
41.3000	.00	35.28	35.43	.00	.08	.146	720.60
41.4000	.00	35.13	35.28	.00	.08	.145	720.60
41.5000	.00	34.98	35.13	.00	.07	.145	720.59
41.6000	.00	34.83	34.98	.00	.07	.144	720.59
41.7000	.00	34.68	34.83	.00	.07	.144	720.59
41.8000	.00	34.53	34.68	.00	.07	.143	720.58
41.9000	.00	34.38	34.53	.00	.07	.142	720.58

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
42.0000	.00	34.23	34.38	.00	.07	.142	720.58
42.1000	.00	34.09	34.23	.00	.07	.141	720.57
42.2000	.00	33.94	34.09	.00	.07	.141	720.57
42.3000	.00	33.79	33.94	.00	.07	.140	720.57
42.4000	.00	33.65	33.79	.00	.07	.139	720.56
42.5000	.00	33.50	33.65	.00	.07	.139	720.56
42.6000	.00	33.36	33.50	.00	.07	.138	720.56
42.7000	.00	33.22	33.36	.00	.07	.138	720.55
42.8000	.00	33.07	33.22	.00	.07	.137	720.55
42.9000	.00	32.93	33.07	.00	.07	.136	720.55
43.0000	.00	32.79	32.93	.00	.07	.136	720.54
43.1000	.00	32.64	32.79	.00	.07	.135	720.54
43.2000	.00	32.50	32.64	.00	.07	.135	720.54
43.3000	.00	32.36	32.50	.00	.07	.134	720.53
43.4000	.00	32.22	32.36	.00	.07	.133	720.53
43.5000	.00	32.08	32.22	.00	.07	.133	720.53
43.6000	.00	31.94	32.08	.00	.07	.132	720.53
43.7000	.00	31.80	31.94	.00	.07	.132	720.52
43.8000	.00	31.66	31.80	.00	.07	.131	720.52
43.9000	.00	31.53	31.66	.00	.07	.131	720.52
44.0000	.00	31.39	31.53	.00	.07	.130	720.51
44.1000	.00	31.25	31.39	.00	.07	.129	720.51
44.2000	.00	31.12	31.25	.00	.07	.129	720.51
44.3000	.00	30.98	31.12	.00	.07	.128	720.50
44.4000	.00	30.84	30.98	.00	.07	.128	720.50
44.5000	.00	30.71	30.84	.00	.07	.127	720.50
44.6000	.00	30.57	30.71	.00	.07	.127	720.49
44.7000	.00	30.44	30.57	.00	.07	.126	720.49
44.8000	.00	30.31	30.44	.00	.07	.125	720.49
44.9000	.00	30.17	30.31	.00	.07	.125	720.49
45.0000	.00	30.04	30.17	.00	.07	.124	720.48
45.1000	.00	29.91	30.04	.00	.07	.124	720.48
45.2000	.00	29.78	29.91	.00	.07	.123	720.48
45.3000	.00	29.65	29.78	.00	.07	.123	720.47
45.4000	.00	29.52	29.65	.00	.07	.122	720.47
45.5000	.00	29.39	29.52	.00	.06	.122	720.47
45.6000	.00	29.26	29.39	.00	.06	.121	720.46
45.7000	.00	29.13	29.26	.00	.06	.121	720.46
45.8000	.00	29.00	29.13	.00	.06	.120	720.46
45.9000	.00	28.87	29.00	.00	.06	.120	720.46
46.0000	.00	28.75	28.87	.00	.06	.119	720.45
46.1000	.00	28.62	28.75	.00	.06	.118	720.45

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
46.2000	.00	28.49	28.62	.00	.06	.118	720.45
46.3000	.00	28.37	28.49	.00	.06	.117	720.44
46.4000	.00	28.24	28.37	.00	.06	.117	720.44
46.5000	.00	28.12	28.24	.00	.06	.116	720.44
46.6000	.00	27.99	28.12	.00	.06	.116	720.44
46.7000	.00	27.87	27.99	.00	.06	.115	720.43
46.8000	.00	27.74	27.87	.00	.06	.115	720.43
46.9000	.00	27.62	27.74	.00	.06	.114	720.43
47.0000	.00	27.50	27.62	.00	.06	.114	720.42
47.1000	.00	27.38	27.50	.00	.06	.113	720.42
47.2000	.00	27.26	27.38	.00	.06	.113	720.42
47.3000	.00	27.14	27.26	.00	.06	.112	720.42
47.4000	.00	27.02	27.14	.00	.06	.112	720.41
47.5000	.00	26.90	27.02	.00	.06	.111	720.41
47.6000	.00	26.78	26.90	.00	.06	.111	720.41
47.7000	.00	26.66	26.78	.00	.06	.110	720.40
47.8000	.00	26.54	26.66	.00	.06	.110	720.40
47.9000	.00	26.42	26.54	.00	.06	.109	720.40
48.0000	.00	26.30	26.42	.00	.06	.109	720.40
48.1000	.00	26.19	26.30	.00	.06	.108	720.39
48.2000	.00	26.07	26.19	.00	.06	.108	720.39
48.3000	.00	25.95	26.07	.00	.06	.107	720.39
48.4000	.00	25.84	25.95	.00	.06	.107	720.39
48.5000	.00	25.72	25.84	.00	.06	.107	720.38
48.6000	.00	25.61	25.72	.00	.06	.106	720.38
48.7000	.00	25.50	25.61	.00	.06	.106	720.38
48.8000	.00	25.38	25.50	.00	.06	.105	720.37
48.9000	.00	25.27	25.38	.00	.06	.105	720.37
49.0000	.00	25.16	25.27	.00	.06	.104	720.37
49.1000	.00	25.05	25.16	.00	.06	.104	720.37
49.2000	.00	24.94	25.05	.00	.06	.103	720.36
49.3000	.00	24.83	24.94	.00	.06	.103	720.36
49.4000	.00	24.72	24.83	.00	.05	.102	720.36
49.5000	.00	24.61	24.72	.00	.05	.102	720.36
49.6000	.00	24.50	24.61	.00	.05	.101	720.35
49.7000	.00	24.39	24.50	.00	.05	.101	720.35
49.8000	.00	24.28	24.39	.00	.05	.101	720.35
49.9000	.00	24.18	24.28	.00	.05	.100	720.35
50.0000	.00	24.07	24.18	.00	.05	.100	720.34
50.1000	.00	23.96	24.07	.00	.05	.099	720.34
50.2000	.00	23.86	23.96	.00	.05	.099	720.34
50.3000	.00	23.75	23.86	.00	.05	.098	720.34

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
50.4000	.00	23.65	23.75	.00	.05	.098	720.33
50.5000	.00	23.54	23.65	.00	.05	.097	720.33
50.6000	.00	23.44	23.54	.00	.05	.097	720.33
50.7000	.00	23.34	23.44	.00	.05	.097	720.33
50.8000	.00	23.23	23.34	.00	.05	.096	720.32
50.9000	.00	23.13	23.23	.00	.05	.096	720.32
51.0000	.00	23.03	23.13	.00	.05	.095	720.32
51.1000	.00	22.93	23.03	.00	.05	.095	720.32
51.2000	.00	22.83	22.93	.00	.05	.095	720.31
51.3000	.00	22.73	22.83	.00	.05	.094	720.31
51.4000	.00	22.63	22.73	.00	.05	.094	720.31
51.5000	.00	22.53	22.63	.00	.05	.093	720.31
51.6000	.00	22.43	22.53	.00	.05	.093	720.31
51.7000	.00	22.33	22.43	.00	.05	.092	720.30
51.8000	.00	22.23	22.33	.00	.05	.092	720.30
51.9000	.00	22.14	22.23	.00	.05	.092	720.30
52.0000	.00	22.04	22.14	.00	.05	.091	720.30
52.1000	.00	21.94	22.04	.00	.05	.091	720.29
52.2000	.00	21.85	21.94	.00	.05	.090	720.29
52.3000	.00	21.75	21.85	.00	.05	.090	720.29
52.4000	.00	21.66	21.75	.00	.05	.090	720.29
52.5000	.00	21.56	21.66	.00	.05	.089	720.28
52.6000	.00	21.47	21.56	.00	.05	.089	720.28
52.7000	.00	21.38	21.47	.00	.05	.089	720.28
52.8000	.00	21.29	21.38	.00	.05	.088	720.28
52.9000	.00	21.20	21.29	.00	.05	.088	720.28
53.0000	.00	21.10	21.20	.00	.05	.087	720.27
53.1000	.00	21.01	21.10	.00	.05	.087	720.27
53.2000	.00	20.92	21.01	.00	.04	.087	720.27
53.3000	.00	20.84	20.92	.00	.04	.086	720.27
53.4000	.00	20.75	20.84	.00	.04	.086	720.27
53.5000	.00	20.66	20.75	.00	.04	.086	720.26
53.6000	.00	20.57	20.66	.00	.04	.085	720.26
53.7000	.00	20.48	20.57	.00	.04	.085	720.26
53.8000	.00	20.40	20.48	.00	.04	.084	720.26
53.9000	.00	20.31	20.40	.00	.04	.084	720.25
54.0000	.00	20.23	20.31	.00	.04	.084	720.25
54.1000	.00	20.14	20.23	.00	.04	.083	720.25
54.2000	.00	20.06	20.14	.00	.04	.083	720.25
54.3000	.00	19.97	20.06	.00	.04	.083	720.25
54.4000	.00	19.89	19.97	.00	.04	.082	720.24
54.5000	.00	19.81	19.89	.00	.04	.082	720.24

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
54.6000	.00	19.72	19.81	.00	.04	.082	720.24
54.7000	.00	19.64	19.72	.00	.04	.081	720.24
54.8000	.00	19.56	19.64	.00	.04	.081	720.24
54.9000	.00	19.48	19.56	.00	.04	.081	720.23
55.0000	.00	19.40	19.48	.00	.04	.080	720.23
55.1000	.00	19.32	19.40	.00	.04	.080	720.23
55.2000	.00	19.24	19.32	.00	.04	.080	720.23
55.3000	.00	19.16	19.24	.00	.04	.079	720.23
55.4000	.00	19.08	19.16	.00	.04	.079	720.23
55.5000	.00	19.01	19.08	.00	.04	.079	720.22
55.6000	.00	18.93	19.01	.00	.04	.078	720.22
55.7000	.00	18.85	18.93	.00	.04	.078	720.22
55.8000	.00	18.78	18.85	.00	.04	.078	720.22
55.9000	.00	18.70	18.78	.00	.04	.077	720.22
56.0000	.00	18.62	18.70	.00	.04	.077	720.21
56.1000	.00	18.55	18.62	.00	.04	.077	720.21
56.2000	.00	18.47	18.55	.00	.04	.076	720.21
56.3000	.00	18.40	18.47	.00	.04	.076	720.21
56.4000	.00	18.33	18.40	.00	.04	.076	720.21
56.5000	.00	18.25	18.33	.00	.04	.076	720.21
56.6000	.00	18.18	18.25	.00	.04	.075	720.20
56.7000	.00	18.11	18.18	.00	.04	.075	720.20
56.8000	.00	18.04	18.11	.00	.04	.075	720.20
56.9000	.00	17.97	18.04	.00	.04	.074	720.20
57.0000	.00	17.90	17.97	.00	.04	.074	720.20
57.1000	.00	17.83	17.90	.00	.03	.074	720.20
57.2000	.00	17.76	17.83	.00	.03	.074	720.19
57.3000	.00	17.69	17.76	.00	.03	.073	720.19
57.4000	.00	17.62	17.69	.00	.03	.073	720.19
57.5000	.00	17.56	17.62	.00	.03	.073	720.19
57.6000	.00	17.49	17.56	.00	.03	.072	720.19
57.7000	.00	17.43	17.49	.00	.03	.072	720.19
57.8000	.00	17.36	17.43	.00	.03	.072	720.18
57.9000	.00	17.30	17.36	.00	.03	.072	720.18
58.0000	.00	17.24	17.30	.00	.03	.071	720.18
58.1000	.00	17.17	17.24	.00	.03	.071	720.18
58.2000	.00	17.11	17.17	.00	.03	.071	720.18
58.3000	.00	17.05	17.11	.00	.03	.071	720.18
58.4000	.00	16.99	17.05	.00	.03	.070	720.17
58.5000	.00	16.93	16.99	.00	.03	.070	720.17
58.6000	.00	16.87	16.93	.00	.03	.070	720.17
58.7000	.00	16.82	16.87	.00	.03	.070	720.17

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
58.8000	.00	16.76	16.82	.00	.03	.069	720.17
58.9000	.00	16.70	16.76	.00	.03	.069	720.17
59.0000	.00	16.65	16.70	.00	.03	.069	720.17
59.1000	.00	16.59	16.65	.00	.03	.069	720.17
59.2000	.00	16.54	16.59	.00	.03	.068	720.16
59.3000	.00	16.48	16.54	.00	.03	.068	720.16
59.4000	.00	16.43	16.48	.00	.03	.068	720.16
59.5000	.00	16.38	16.43	.00	.03	.068	720.16
59.6000	.00	16.32	16.38	.00	.03	.068	720.16
59.7000	.00	16.27	16.32	.00	.03	.067	720.16
59.8000	.00	16.22	16.27	.00	.03	.067	720.16
59.9000	.00	16.17	16.22	.00	.03	.067	720.15
60.0000	.00	16.12	16.17	.00	.02	.067	720.15
60.1000	.00	16.07	16.12	.00	.02	.066	720.15
60.2000	.00	16.02	16.07	.00	.02	.066	720.15
60.3000	.00	15.98	16.02	.00	.02	.066	720.15
60.4000	.00	15.93	15.98	.00	.02	.066	720.15
60.5000	.00	15.88	15.93	.00	.02	.066	720.15
60.6000	.00	15.83	15.88	.00	.02	.065	720.15
60.7000	.00	15.79	15.83	.00	.02	.065	720.15
60.8000	.00	15.74	15.79	.00	.02	.065	720.14
60.9000	.00	15.70	15.74	.00	.02	.065	720.14
61.0000	.00	15.65	15.70	.00	.02	.065	720.14
61.1000	.00	15.61	15.65	.00	.02	.065	720.14
61.2000	.00	15.57	15.61	.00	.02	.064	720.14
61.3000	.00	15.52	15.57	.00	.02	.064	720.14
61.4000	.00	15.48	15.52	.00	.02	.064	720.14
61.5000	.00	15.44	15.48	.00	.02	.064	720.14
61.6000	.00	15.40	15.44	.00	.02	.064	720.14
61.7000	.00	15.36	15.40	.00	.02	.064	720.13
61.8000	.00	15.32	15.36	.00	.02	.063	720.13
61.9000	.00	15.28	15.32	.00	.02	.063	720.13
62.0000	.00	15.24	15.28	.00	.02	.063	720.13
62.1000	.00	15.20	15.24	.00	.02	.063	720.13
62.2000	.00	15.16	15.20	.00	.02	.063	720.13
62.3000	.00	15.12	15.16	.00	.02	.063	720.13
62.4000	.00	15.08	15.12	.00	.02	.062	720.13
62.5000	.00	15.05	15.08	.00	.02	.062	720.13
62.6000	.00	15.01	15.05	.00	.02	.062	720.13
62.7000	.00	14.97	15.01	.00	.02	.062	720.13
62.8000	.00	14.94	14.97	.00	.02	.062	720.12
62.9000	.00	14.90	14.94	.00	.02	.062	720.12

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
63.0000	.00	14.86	14.90	.00	.02	.061	720.12
63.1000	.00	14.83	14.86	.00	.02	.061	720.12
63.2000	.00	14.79	14.83	.00	.02	.061	720.12
63.3000	.00	14.76	14.79	.00	.02	.061	720.12
63.4000	.00	14.73	14.76	.00	.02	.061	720.12
63.5000	.00	14.69	14.73	.00	.02	.061	720.12
63.6000	.00	14.66	14.69	.00	.02	.061	720.12
63.7000	.00	14.63	14.66	.00	.02	.060	720.12
63.8000	.00	14.60	14.63	.00	.02	.060	720.12
63.9000	.00	14.56	14.60	.00	.02	.060	720.12
64.0000	.00	14.53	14.56	.00	.02	.060	720.11
64.1000	.00	14.50	14.53	.00	.02	.060	720.11
64.2000	.00	14.47	14.50	.00	.02	.060	720.11
64.3000	.00	14.44	14.47	.00	.02	.060	720.11
64.4000	.00	14.41	14.44	.00	.02	.060	720.11
64.5000	.00	14.38	14.41	.00	.01	.059	720.11
64.6000	.00	14.35	14.38	.00	.01	.059	720.11
64.7000	.00	14.32	14.35	.00	.01	.059	720.11
64.8000	.00	14.29	14.32	.00	.01	.059	720.11
64.9000	.00	14.26	14.29	.00	.01	.059	720.11
65.0000	.00	14.24	14.26	.00	.01	.059	720.11
65.1000	.00	14.21	14.24	.00	.01	.059	720.11
65.2000	.00	14.18	14.21	.00	.01	.059	720.11
65.3000	.00	14.15	14.18	.00	.01	.059	720.11
65.4000	.00	14.13	14.15	.00	.01	.058	720.10
65.5000	.00	14.10	14.13	.00	.01	.058	720.10
65.6000	.00	14.07	14.10	.00	.01	.058	720.10
65.7000	.00	14.05	14.07	.00	.01	.058	720.10
65.8000	.00	14.02	14.05	.00	.01	.058	720.10
65.9000	.00	14.00	14.02	.00	.01	.058	720.10
66.0000	.00	13.97	14.00	.00	.01	.058	720.10
66.1000	.00	13.95	13.97	.00	.01	.058	720.10
66.2000	.00	13.92	13.95	.00	.01	.058	720.10
66.3000	.00	13.90	13.92	.00	.01	.057	720.10
66.4000	.00	13.87	13.90	.00	.01	.057	720.10
66.5000	.00	13.85	13.87	.00	.01	.057	720.10
66.6000	.00	13.83	13.85	.00	.01	.057	720.10
66.7000	.00	13.80	13.83	.00	.01	.057	720.10
66.8000	.00	13.78	13.80	.00	.01	.057	720.10
66.9000	.00	13.76	13.78	.00	.01	.057	720.10
67.0000	.00	13.73	13.76	.00	.01	.057	720.09
67.1000	.00	13.71	13.73	.00	.01	.057	720.09

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
67.2000	.00	13.69	13.71	.00	.01	.057	720.09
67.3000	.00	13.66	13.69	.00	.01	.056	720.09
67.4000	.00	13.64	13.66	.00	.01	.056	720.09
67.5000	.00	13.62	13.64	.00	.01	.056	720.09
67.6000	.00	13.59	13.62	.00	.01	.056	720.09
67.7000	.00	13.57	13.59	.00	.01	.056	720.09
67.8000	.00	13.55	13.57	.00	.01	.056	720.09
67.9000	.00	13.53	13.55	.00	.01	.056	720.09
68.0000	.00	13.51	13.53	.00	.01	.056	720.09
68.1000	.00	13.48	13.51	.00	.01	.056	720.09
68.2000	.00	13.46	13.48	.00	.01	.056	720.09
68.3000	.00	13.44	13.46	.00	.01	.056	720.09
68.4000	.00	13.42	13.44	.00	.01	.055	720.09
68.5000	.00	13.40	13.42	.00	.01	.055	720.09
68.6000	.00	13.38	13.40	.00	.01	.055	720.09
68.7000	.00	13.36	13.38	.00	.01	.055	720.09
68.8000	.00	13.33	13.36	.00	.01	.055	720.09
68.9000	.00	13.31	13.33	.00	.01	.055	720.08
69.0000	.00	13.29	13.31	.00	.01	.055	720.08
69.1000	.00	13.27	13.29	.00	.01	.055	720.08
69.2000	.00	13.25	13.27	.00	.01	.055	720.08
69.3000	.00	13.23	13.25	.00	.01	.055	720.08
69.4000	.00	13.21	13.23	.00	.01	.055	720.08
69.5000	.00	13.19	13.21	.00	.01	.055	720.08
69.6000	.00	13.17	13.19	.00	.01	.054	720.08
69.7000	.00	13.15	13.17	.00	.01	.054	720.08
69.8000	.00	13.13	13.15	.00	.01	.054	720.08
69.9000	.00	13.11	13.13	.00	.01	.054	720.08
70.0000	.00	13.09	13.11	.00	.01	.054	720.08
70.1000	.00	13.07	13.09	.00	.01	.054	720.08
70.2000	.00	13.05	13.07	.00	.01	.054	720.08
70.3000	.00	13.04	13.05	.00	.01	.054	720.08
70.4000	.00	13.02	13.04	.00	.01	.054	720.08
70.5000	.00	13.00	13.02	.00	.01	.054	720.08
70.6000	.00	12.98	13.00	.00	.01	.054	720.08
70.7000	.00	12.96	12.98	.00	.01	.054	720.08
70.8000	.00	12.94	12.96	.00	.01	.053	720.08
70.9000	.00	12.92	12.94	.00	.01	.053	720.07
71.0000	.00	12.90	12.92	.00	.01	.053	720.07
71.1000	.00	12.89	12.90	.00	.01	.053	720.07
71.2000	.00	12.87	12.89	.00	.01	.053	720.07
71.3000	.00	12.85	12.87	.00	.01	.053	720.07

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
71.4000	.00	12.83	12.85	.00	.01	.053	720.07
71.5000	.00	12.81	12.83	.00	.01	.053	720.07
71.6000	.00	12.80	12.81	.00	.01	.053	720.07
71.7000	.00	12.78	12.80	.00	.01	.053	720.07
71.8000	.00	12.76	12.78	.00	.01	.053	720.07
71.9000	.00	12.74	12.76	.00	.01	.053	720.07
72.0000	.00	12.73	12.74	.00	.01	.053	720.07
72.1000	.00	12.71	12.73	.00	.01	.053	720.07
72.2000	.00	12.69	12.71	.00	.01	.052	720.07
72.3000	.00	12.68	12.69	.00	.01	.052	720.07
72.4000	.00	12.66	12.68	.00	.01	.052	720.07
72.5000	.00	12.64	12.66	.00	.01	.052	720.07
72.6000	.00	12.63	12.64	.00	.01	.052	720.07
72.7000	.00	12.61	12.63	.00	.01	.052	720.07
72.8000	.00	12.59	12.61	.00	.01	.052	720.07
72.9000	.00	12.58	12.59	.00	.01	.052	720.07
73.0000	.00	12.56	12.58	.00	.01	.052	720.07
73.1000	.00	12.54	12.56	.00	.01	.052	720.07
73.2000	.00	12.53	12.54	.00	.01	.052	720.07
73.3000	.00	12.51	12.53	.00	.01	.052	720.06
73.4000	.00	12.50	12.51	.00	.01	.052	720.06
73.5000	.00	12.48	12.50	.00	.01	.052	720.06
73.6000	.00	12.47	12.48	.00	.01	.052	720.06
73.7000	.00	12.45	12.47	.00	.01	.051	720.06
73.8000	.00	12.43	12.45	.00	.01	.051	720.06
73.9000	.00	12.42	12.43	.00	.01	.051	720.06
74.0000	.00	12.40	12.42	.00	.01	.051	720.06
74.1000	.00	12.39	12.40	.00	.01	.051	720.06
74.2000	.00	12.37	12.39	.00	.01	.051	720.06
74.3000	.00	12.36	12.37	.00	.01	.051	720.06
74.4000	.00	12.34	12.36	.00	.01	.051	720.06
74.5000	.00	12.33	12.34	.00	.01	.051	720.06
74.6000	.00	12.31	12.33	.00	.01	.051	720.06
74.7000	.00	12.30	12.31	.00	.01	.051	720.06
74.8000	.00	12.29	12.30	.00	.01	.051	720.06
74.9000	.00	12.27	12.29	.00	.01	.051	720.06
75.0000	.00	12.26	12.27	.00	.01	.051	720.06
75.1000	.00	12.24	12.26	.00	.01	.051	720.06
75.2000	.00	12.23	12.24	.00	.01	.051	720.06
75.3000	.00	12.21	12.23	.00	.01	.050	720.06
75.4000	.00	12.20	12.21	.00	.01	.050	720.06
75.5000	.00	12.19	12.20	.00	.01	.050	720.06

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
75.6000	.00	12.17	12.19	.00	.01	.050	720.06
75.7000	.00	12.16	12.17	.00	.01	.050	720.06
75.8000	.00	12.15	12.16	.00	.01	.050	720.06
75.9000	.00	12.13	12.15	.00	.01	.050	720.06
76.0000	.00	12.12	12.13	.00	.01	.050	720.05
76.1000	.00	12.10	12.12	.00	.01	.050	720.05
76.2000	.00	12.09	12.10	.00	.01	.050	720.05
76.3000	.00	12.08	12.09	.00	.01	.050	720.05
76.4000	.00	12.06	12.08	.00	.01	.050	720.05
76.5000	.00	12.05	12.06	.00	.01	.050	720.05
76.6000	.00	12.04	12.05	.00	.01	.050	720.05
76.7000	.00	12.03	12.04	.00	.01	.050	720.05
76.8000	.00	12.01	12.03	.00	.01	.050	720.05
76.9000	.00	12.00	12.01	.00	.01	.050	720.05
77.0000	.00	11.99	12.00	.00	.01	.050	720.05
77.1000	.00	11.98	11.99	.00	.01	.049	720.05
77.2000	.00	11.96	11.98	.00	.01	.049	720.05
77.3000	.00	11.95	11.96	.00	.01	.049	720.05
77.4000	.00	11.94	11.95	.00	.01	.049	720.05
77.5000	.00	11.93	11.94	.00	.01	.049	720.05
77.6000	.00	11.91	11.93	.00	.01	.049	720.05
77.7000	.00	11.90	11.91	.00	.01	.049	720.05
77.8000	.00	11.89	11.90	.00	.01	.049	720.05
77.9000	.00	11.88	11.89	.00	.01	.049	720.05
78.0000	.00	11.86	11.88	.00	.01	.049	720.05
78.1000	.00	11.85	11.86	.00	.01	.049	720.05
78.2000	.00	11.84	11.85	.00	.01	.049	720.05
78.3000	.00	11.83	11.84	.00	.01	.049	720.05
78.4000	.00	11.82	11.83	.00	.01	.049	720.05
78.5000	.00	11.81	11.82	.00	.01	.049	720.05
78.6000	.00	11.79	11.81	.00	.01	.049	720.05
78.7000	.00	11.78	11.79	.00	.01	.049	720.05
78.8000	.00	11.77	11.78	.00	.01	.049	720.05
78.9000	.00	11.76	11.77	.00	.01	.049	720.05
79.0000	.00	11.75	11.76	.00	.01	.049	720.05
79.1000	.00	11.74	11.75	.00	.01	.048	720.05
79.2000	.00	11.73	11.74	.00	.01	.048	720.05
79.3000	.00	11.72	11.73	.00	.01	.048	720.04
79.4000	.00	11.71	11.72	.00	.01	.048	720.04
79.5000	.00	11.69	11.71	.00	.01	.048	720.04
79.6000	.00	11.68	11.69	.00	.01	.048	720.04
79.7000	.00	11.67	11.68	.00	.01	.048	720.04

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
79.8000	.00	11.66	11.67	.00	.01	.048	720.04
79.9000	.00	11.65	11.66	.00	.01	.048	720.04
80.0000	.00	11.64	11.65	.00	.01	.048	720.04
80.1000	.00	11.63	11.64	.00	.01	.048	720.04
80.2000	.00	11.62	11.63	.00	.01	.048	720.04
80.3000	.00	11.61	11.62	.00	.01	.048	720.04
80.4000	.00	11.60	11.61	.00	.01	.048	720.04
80.5000	.00	11.59	11.60	.00	.01	.048	720.04
80.6000	.00	11.58	11.59	.00	.01	.048	720.04
80.7000	.00	11.57	11.58	.00	.01	.048	720.04
80.8000	.00	11.56	11.57	.00	.01	.048	720.04
80.9000	.00	11.55	11.56	.00	.00	.048	720.04
81.0000	.00	11.54	11.55	.00	.00	.048	720.04
81.1000	.00	11.53	11.54	.00	.00	.048	720.04
81.2000	.00	11.52	11.53	.00	.00	.048	720.04
81.3000	.00	11.51	11.52	.00	.00	.048	720.04
81.4000	.00	11.50	11.51	.00	.00	.047	720.04
81.5000	.00	11.49	11.50	.00	.00	.047	720.04
81.6000	.00	11.48	11.49	.00	.00	.047	720.04
81.7000	.00	11.47	11.48	.00	.00	.047	720.04
81.8000	.00	11.46	11.47	.00	.00	.047	720.04
81.9000	.00	11.45	11.46	.00	.00	.047	720.04
82.0000	.00	11.44	11.45	.00	.00	.047	720.04
82.1000	.00	11.43	11.44	.00	.00	.047	720.04
82.2000	.00	11.42	11.43	.00	.00	.047	720.04
82.3000	.00	11.41	11.42	.00	.00	.047	720.04
82.4000	.00	11.41	11.41	.00	.00	.047	720.04
82.5000	.00	11.40	11.41	.00	.00	.047	720.04
82.6000	.00	11.39	11.40	.00	.00	.047	720.04
82.7000	.00	11.38	11.39	.00	.00	.047	720.04
82.8000	.00	11.37	11.38	.00	.00	.047	720.04
82.9000	.00	11.36	11.37	.00	.00	.047	720.04
83.0000	.00	11.35	11.36	.00	.00	.047	720.04
83.1000	.00	11.34	11.35	.00	.00	.047	720.04
83.2000	.00	11.33	11.34	.00	.00	.047	720.04
83.3000	.00	11.33	11.33	.00	.00	.047	720.04
83.4000	.00	11.32	11.33	.00	.00	.047	720.03
83.5000	.00	11.31	11.32	.00	.00	.047	720.03
83.6000	.00	11.30	11.31	.00	.00	.047	720.03
83.7000	.00	11.29	11.30	.00	.00	.047	720.03
83.8000	.00	11.28	11.29	.00	.00	.047	720.03
83.9000	.00	11.28	11.28	.00	.00	.047	720.03

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
84.0000	.00	11.27	11.28	.00	.00	.047	720.03
84.1000	.00	11.26	11.27	.00	.00	.047	720.03
84.2000	.00	11.25	11.26	.00	.00	.046	720.03
84.3000	.00	11.24	11.25	.00	.00	.046	720.03
84.4000	.00	11.23	11.24	.00	.00	.046	720.03
84.5000	.00	11.23	11.23	.00	.00	.046	720.03
84.6000	.00	11.22	11.23	.00	.00	.046	720.03
84.7000	.00	11.21	11.22	.00	.00	.046	720.03
84.8000	.00	11.20	11.21	.00	.00	.046	720.03
84.9000	.00	11.19	11.20	.00	.00	.046	720.03
85.0000	.00	11.19	11.19	.00	.00	.046	720.03
85.1000	.00	11.18	11.19	.00	.00	.046	720.03
85.2000	.00	11.17	11.18	.00	.00	.046	720.03
85.3000	.00	11.16	11.17	.00	.00	.046	720.03
85.4000	.00	11.16	11.16	.00	.00	.046	720.03
85.5000	.00	11.15	11.16	.00	.00	.046	720.03
85.6000	.00	11.14	11.15	.00	.00	.046	720.03
85.7000	.00	11.13	11.14	.00	.00	.046	720.03
85.8000	.00	11.13	11.13	.00	.00	.046	720.03
85.9000	.00	11.12	11.13	.00	.00	.046	720.03
86.0000	.00	11.11	11.12	.00	.00	.046	720.03
86.1000	.00	11.10	11.11	.00	.00	.046	720.03
86.2000	.00	11.10	11.10	.00	.00	.046	720.03
86.3000	.00	11.09	11.10	.00	.00	.046	720.03
86.4000	.00	11.08	11.09	.00	.00	.046	720.03
86.5000	.00	11.08	11.08	.00	.00	.046	720.03
86.6000	.00	11.07	11.08	.00	.00	.046	720.03
86.7000	.00	11.06	11.07	.00	.00	.046	720.03
86.8000	.00	11.05	11.06	.00	.00	.046	720.03
86.9000	.00	11.05	11.05	.00	.00	.046	720.03
87.0000	.00	11.04	11.05	.00	.00	.046	720.03
87.1000	.00	11.03	11.04	.00	.00	.046	720.03
87.2000	.00	11.03	11.03	.00	.00	.046	720.03
87.3000	.00	11.02	11.03	.00	.00	.046	720.03
87.4000	.00	11.01	11.02	.00	.00	.045	720.03
87.5000	.00	11.01	11.01	.00	.00	.045	720.03
87.6000	.00	11.00	11.01	.00	.00	.045	720.03
87.7000	.00	10.99	11.00	.00	.00	.045	720.03
87.8000	.00	10.99	10.99	.00	.00	.045	720.03
87.9000	.00	10.98	10.99	.00	.00	.045	720.03
88.0000	.00	10.97	10.98	.00	.00	.045	720.03
88.1000	.00	10.97	10.97	.00	.00	.045	720.03

LEVEL POOL ROUTING CALCULATIONS

HYG Dir = G:\KGruver\Exports\BMP Basin\
Inflow HYG file = work_pad.hyg - CR 28 AB IN Pre 2
Outflow HYG file = work_pad.hyg - CR 28 AB OUT Pre 2

Time hrs	Inflow cfs	2S/t - O cfs	2S/t + O cfs	Infilt. cfs	Outflow cfs	Storage ac-ft	Elev. ft
88.2000	.00	10.96	10.97	.00	.00	.045	720.03
88.3000	.00	10.96	10.96	.00	.00	.045	720.03
88.4000	.00	10.95	10.96	.00	.00	.045	720.03
88.5000	.00	10.94	10.95	.00	.00	.045	720.03
88.6000	.00	10.94	10.94	.00	.00	.045	720.03
88.7000	.00	10.93	10.94	.00	.00	.045	720.03
88.8000	.00	10.92	10.93	.00	.00	.045	720.03
88.9000	.00	10.92	10.92	.00	.00	.045	720.02
89.0000	.00	10.91	10.92	.00	.00	.045	720.02
89.1000	.00	10.91	10.91	.00	.00	.045	720.02
89.2000	.00	10.90	10.91	.00	.00	.045	720.02
89.3000	.00	10.89	10.90	.00	.00	.045	720.02

RATIONAL C COEFFICIENT DATA

Soil/Surface Description	C	Area acres	C x Area acres
Pavement	.9000	1.170	1.053
Slopes	.7000	6.830	4.781
WEIGHTED C & TOTAL AREA --->	.7293	8.000	5.834

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 2 yr `C' Adjustment = 1.000Allowable Q = 9.10 cfs

Hydrograph Storm Duration, Td = .5500 hrs Tc = .2200 hrs
Hydrograph File: Pre 2

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.729	.729	.2200	3.4134	8.000	20.08	.365	.200
.729	.729	.2500	3.2279	8.000	18.99	.392	.216
.729	.729	.3333	2.8063	8.000	16.51	.455	.247
.729	.729	.5000	2.2296	8.000	13.12	.542	.271
.729	.729	.5500	2.1011	8.000	12.36	.562	.272
.729	.729	.6667	1.8530	8.000	10.90	.601	.267
.729	.729	.8333	1.5872	8.000	9.34	.643	.247
.729	.729	1.0000	1.3894	8.000	8.17	Qpeak < Qallow	

Storage Maximum

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 10 yr `C' Adjustment = 1.000Allowable Q = 13.05 cfs

Hydrograph Storm Duration, Td = .5833 hrs Tc = .2200 hrs
Hydrograph File: Pre 10

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.729	.729	.2200	4.8585	8.000	28.58	.520	.282
.729	.729	.2500	4.6041	8.000	27.09	.560	.306
.729	.729	.3333	4.0235	8.000	23.67	.652	.354
.729	.729	.5000	3.2229	8.000	18.96	.783	.395
.729	.729	.5833	2.9347	8.000	17.26	.832	.399
.729	.729	.6667	2.6954	8.000	15.86	.874	.396
.729	.729	.8333	2.3207	8.000	13.65	.940	.372
.729	.729	1.0000	2.0403	8.000	12.00	Qpeak < Qallow	

MODIFIED RATIONAL METHOD
---- Summary for Single Storm Frequency ----

Q = CiA * Units Conversion; Where Conversion = 43560 / (12 * 3600)

RETURN FREQUENCY: 100 yr `C' Adjustment = 1.000Allowable Q = 20.05 cfs

Hydrograph Storm Duration, Td = .5500 hrs Tc = .2200 hrs
Hydrograph File: Pre100

Wtd. `C'	Adjusted 'C'	Duration hrs	Intens. in/hr	Area acres	Qpeak cfs	VOLUMES Inflow ac-ft	VOLUMES Storage ac-ft
.729	.729	.2200	7.4331	8.000	43.73	.795	.431
.729	.729	.2500	7.0569	8.000	41.52	.858	.468
.729	.729	.3333	6.1820	8.000	36.37	1.002	.544
.729	.729	.5000	4.9412	8.000	29.07	1.201	.605
.729	.729	.5500	4.6579	8.000	27.40	1.246	.608 Storage Maximum
.729	.729	.6667	4.1052	8.000	24.15	1.331	.596
.729	.729	.8333	3.5051	8.000	20.62	1.420	.548
.729	.729	1.0000	3.0539	8.000	17.97	Qpeak < Qallow	