DITCH ANALYSIS

PID : 110867 **Date :** 03/24/2022 **Project :** HEN-108-17.40 **Location :** CITY OF NAPOLEON, HENRY COUNTY, OHIO

Description : S.R. 108 DITCH LT, FROM STA. 924+53.02 TO EX. DT. AT STA 921+54, OUTTO CB-2-2B **Designer :** N.M. GOODMAN

Rainfall Area : B

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.)
924+53	923+50	L	103.02	2.00	4.00	4.00	0.0050	0.16	0.16	0.90	0.15	Seed	4.38	5	0.030	11.63	1.04	0.07	0.64	0.21	3.72
												Seed	5.13	10	0.040	11.90	0.89	0.08	0.75	0.27	4.17
923+50	922+00	L	150.00	2.00	4.00	4.00	0.0100	0.06	0.22	0.55	0.18	Seed	4.18	5	0.030	13.40	1.39	0.12	0.75	0.19	3.55
												Seed	4.87	10	0.040	13.97	1.20	0.15	0.87	0.24	3.96
922+00	921+54	L	46.00	2.00	4.00	4.00	0.0150	0.18	0.40	0.55	0.28	Seed	4.13	5	0.030	13.82	1.82	0.20	1.14	0.22	3.74
												Seed	4.81	10	0.040	14.46	1.55	0.26	1.33	0.28	4.20

DITCH ANALYSIS

PID : 110867 **Date :** 03/24/2022 **Project :** HEN-108-17.40 **Location :** CITY OF NAPOLEON, HENRY COUNTY, OHIO

Description : U.S.-24 OFF-RAMP RIGHT DITCH FROM INTERSECTION TO OUTLET EAST **Designer :** N.M. GOODMAN

Rainfall Area : B

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.)
918+49	70+25	R	141.00	8.00	4.00	3.00	0.0050	0.69	0.69	0.62	0.43	Seed	4.33	5	0.030	12.08	1.11	0.06	1.85	0.19	9.35
												Seed	5.07	10	0.040	12.35	0.97	0.08	2.17	0.25	9.76
70+25	71+91	R	166.48	8.00	4.00	3.00	0.0080	0.59	1.28	0.62	0.79	Seed	4.13	5	0.030	13.81	1.58	0.12	3.28	0.23	9.64
												Seed	4.83	10	0.040	14.31	1.39	0.15	3.83	0.30	10.13

DITCH ANALYSIS

PID : 110867 **Date :** 03/29/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : S.R. 108, RT - FROM 923+50.71 TO STA. 922+93.20 **Designer :** N.M. GOODMAN

Rainfall Area : B

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.)
923+51	Concent							0.11		0.63	0.07					10.00					
923+51	922+93	R	57.51	2.00	2.00	2.00	0.0203	0.09	0.20	0.69	0.13	Seed	4.52	5	0.030	10.54	1.75	0.18	0.58	0.15	2.58
												Seed	5.31	10	0.040	10.62	1.53	0.24	0.68	0.19	2.75

DITCH ANALYSIS

PID : 110867 **Date :** 03/29/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : S.R. 108, RT - FROM 922+63.11 TO PROP PIPE STA. 921+25 **Designer :** N.M. GOODMAN

Rainfall Area : B

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.)
922+63	Concent							0.20		0.66	0.13					11.00					
922+63	921+25	R	138.47	4.00	3.00	3.00	0.0091	0.31	0.51	0.53	0.29	Seed	4.27	5	0.030	12.58	1.44	0.11	1.26	0.19	5.14
												Seed	5.01	10	0.040	12.81	1.26	0.14	1.48	0.25	5.48

INLET SPACING DESIGN

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : SPREAD CALCS FROM STA. 60+00 US24W ON-RAMP TO EX CB-3 LT 917+25 SR 108 **Designer :** N.M. GOODMAN

Rainfall Area: B **Storm Frequency (yr.) :** 2 **Total Allow. Spread (ft.) :** 8.00 **Allowable Depth (ft.)** 0.42

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.)	
60+00	Begin																		
917+25	CB-3A	291.08	0.77	0.25	10.00	1.62	11.62	0.0304	0.0833	0.0160	2.00	0.0000	3.63	******	******	0.70	0.170	2.24	End

INLET SPACING DESIGN

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : SPREAD CALCS FROM STA. 101+47.89 REF CC TO EX CB-3 RT 917+25 SR 108 **Designer :** N.M. GOODMAN

Rainfall Area: B **Storm Frequency (yr.) :** 2 **Total Allow. Spread (ft.) :** 8.00 **Allowable Depth (ft.)** 0.42

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.)	
101+48	Begin																		
917+25	CB-3A	324.46	0.84	0.23	10.00	1.87	11.87	0.0281	0.0833	0.0160	2.00	0.0000	3.60	******	******	0.70	0.173	2.38	End

INLET SPACING DESIGN

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : SPREAD CALCS FROM REF CC 102+50 TO STA. 160+40 REF LINE NW, SAG CURB OPENING **Designer :** N.M. GOODMAN

Rainfall Area: B **Storm Frequency (yr.) :** 2 **Total Allow. Spread (ft.) :** 8.00 **Allowable Depth (ft.)** 0.42

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.)	
160+00	Begin																		
160+40	CURB OPENING	38.10	0.90	0.00	10.00	0.59	10.59	0.0270	0.0833	0.0160	2.00	0.0000	3.73	******	******	0.01	0.039	0.47	Sag
102+50	Begin																		
160+40	CURB OPENING	81.09	0.81	0.11	10.00	0.53	10.53	0.0325	0.0833	0.0100	2.00	0.0000	3.74	******	******	0.33	0.127	1.53	End

SUMP DATA

Total Flow (cfs) : 0.34 **Ponded Depth (ft.) :** 0.020 **Spread on Pavement (ft.) :** 1.64

INLET SPACING DESIGN

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : SPREAD CALCS FROM STA. 102+50 REF CC TO 924+00 SR 108, LEFT **Designer :** N.M. GOODMAN

Rainfall Area: B **Storm Frequency (yr.) :** 2 **Total Allow. Spread (ft.) :** 8.00 **Allowable Depth (ft.)** 0.42

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.)	
102+50	Begin																		
920+75	CB-3	24.29	0.90	0.02	10.00	0.72	10.72	0.0020	0.0833	0.0160	2.00	0.0000	3.72	******	******	0.05	0.106	1.27	Sag
924+00	Begin																		
920+75	CB-3	326.55	0.90	0.15	10.00	3.97	14.07	0.0060	0.0833	0.0160	2.00	0.0000	3.40	******	******	0.45	0.194	3.70	End

SUMP DATA

Total Flow (cfs) : 0.50 **Ponded Depth (ft.) :** 0.039 **Spread on Pavement (ft.) :** 1.87

INLET SPACING DESIGN

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : SPREAD CALCS FROM STA. 920+60 TO 924+00 SR 108, RIGHT **Designer :** N.M. GOODMAN

Rainfall Area: B **Storm Frequency (yr.) :** 2 **Total Allow. Spread (ft.) :** 8.00 **Allowable Depth (ft.)** 0.42

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.)	
920+60	Begin																		
920+85	CB-3	27.41	0.90	0.02	10.00	0.72	10.72	0.0020	0.0833	0.0160	2.00	0.0000	3.72	******	******	0.08	0.128	1.54	Sag
924+00	Begin																		
920+85	CB-3	318.35	0.90	0.15	10.00	4.72	14.72	0.0040	0.0833	0.0160	2.00	0.0000	3.34	******	******	0.45	0.207	4.50	End

SUMP DATA

Total Flow (cfs) : 0.53 **Ponded Depth (ft.) :** 0.043 **Spread on Pavement (ft.) :** 1.92

INLET SPACING DESIGN

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : SPREAD CALCS FROM REF CC 102+50 TO STA. 174+90.62 REF. LINE 'NE', SHEET FLOW OUT **Designer :** N.M. GOODMAN

Rainfall Area: B **Storm Frequency (yr.) :** 2 **Total Allow. Spread (ft.) :** 8.00 **Allowable Depth (ft.)** 0.42

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.)	
102+50	Begin																		
174+90	SHEET-FLOW OUT	143.76	0.84	0.15	10.00	0.97	10.97	0.0238	0.0833	0.0160	2.00	0.0000	3.69	******	******	0.47	0.154	1.84	End

STORM SEWER SYSTEM

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : STORM SYSTEM SR 108, EX-CB LT STA 920+50.18 OUTLET RT PIPE EXT. STA 920+50.26 **Designer :** N.M. GOODMAN

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

Minimum Pipe Size : 12.00 **Tailwater Elevation (ft.):** 673.75

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	OUT	920+50		2.67	1.91	15.00	4.75	5.73	9.1	11.0	24	127.0	0.0048	673.17	4.64	14.62	0.0031	674.55	676.37	1.81	1.20	CB 2-2B
begin		920+50		2.67	1.91									672.56				674.15	674.56			0.015

STORM SEWER SYSTEM

PID : 110867 **Date :** 03/30/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : STORM SYSTEM SR108, CROSSING FROM 920+75 LT TO 920+85 RT, OUTLET EAST OFF-RAMP **Designer :** N.M. GOODMAN

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

Minimum Pipe Size : 12.00 **Tailwater Elevation (ft.):** 672.79

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	3	921+25	0.51	0.30	12.81	5.01	6.11	1.5	1.8	12	34.0	0.0406	677.18	6.48	6.69	0.0034	677.55	678.62	1.07	0.44	HW Half He
begin		920+90	0.51	0.30									675.80				676.59	680.45			0.015
1	2	920+75	0.17	0.15	12.50	5.05	6.12	0.8	0.9	15	47.0	0.0040	676.28	2.31	3.83	0.0003	676.92	679.97	3.05	2.44	CB 3
begin		920+85	0.68	0.45									676.09				676.91	679.79			0.015
2	3	920+85	0.17	0.15	12.84	5.01	6.12	1.5	1.9	15	7.0	0.0414	676.09	6.48	12.26	0.0011	676.70	679.79	3.09	2.45	CB 3
		920+90	0.85	0.60									675.80				676.70	680.45			0.015
3	OUT	920+90	0.00	0.00	12.90	5.00	6.09	3.0	3.7	15	54.0	0.0650	675.80	9.21	15.35	0.0043	676.23	680.45	4.22	3.40	MH 3
final		920+55	0.85	0.60									672.29				673.30	673.73			0.015

UNIVERSAL CULVERT DESIGN

PID : 110867 **Date :** 03/29/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : PIPE UNDER WALK WESTERN LEG OF ROUNDABOUT **Designer :** N. M. GOODMAN

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.) : 676.55 **Outlet Invert Elevation (ft.) :** 676.07 **Tailwater Elevation (ft.) :** 676.72 **Overflow Elevation (ft.) :** 678.87

Allowable Headwater Elevation (ft.) : 677.96 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 36.00 **Culvert Slope (ft./ft.) :** 0.0133 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 3.95 **@** 5 yrs. **Flood Discharge (cfs) :** 4.61 **@** 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 :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
3.95	1	15 in.	677.73	N/A	1 - C	6.54	0.62	0.80	0.0120	INLET	0.00	D	0.00
3.95	1	12 in.	678.03	677.84	2 - E	6.42	0.73	0.84	0.0120	INLET	0.00	D - 1	0.00
3.95	1	18 in.	677.64	N/A	1 - C	6.51	0.56	0.76	0.0120	INLET	0.00	D + 1	0.00
4.61	1	15 in.	677.86	N/A	1 - C	6.80	0.68	0.87	0.0120	INLET	0.00	F	0.00
4.61	1	12 in.	678.31	678.17	2 - E	6.45	0.85	0.89	0.0120	INLET	0.00	F - 1	0.00
4.61	1	18 in.	677.74	N/A	1 - C	6.79	0.61	0.82	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)													
3.95	1	15 in.	677.83	677.95	1 - A	4.74	1.05	0.80	0.0250	OUTLET*	0.00	D	0.00
3.45	1	12 in.	678.44	679.38	2 - F	5.16	1.00	0.79	0.0251	OUTLET**	0.50	D - 1	0.00
3.95	1	18 in.	677.68	677.82	1 - A	4.39	0.86	0.76	0.0249	OUTLET*	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

PID : 110867 **Date :** 03/29/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : DRIVE PIPE FROM SR 108 STA 923+79.25 TO STA. 923+50.71 **Designer :** N. M. GOODMAN

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.) : 680.40 **Outlet Invert Elevation (ft.) :** 679.74 **Tailwater Elevation (ft.) :** 679.89 **Overflow Elevation (ft.) :** 681.92

Allowable Headwater Elevation (ft.) : 680.92 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 29.00 **Culvert Slope (ft./ft.) :** 0.0228 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 0.27 **@** 5 yrs. **Flood Discharge (cfs) :** 0.30 **@** 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		
Diameter exceeds 1.25 HWA	0.27	1	12 in.	680.67	N/A	1 - C	3.75	0.15	0.21	0.0120	INLET	0.00	D	0.00
	0.27	1	15 in.	680.66	N/A	1 - C	3.68	0.14	0.20	0.0120	INLET	0.00	D + 1	0.00
	0.30	1	12 in.	680.69	N/A	1 - C	3.93	0.15	0.23	0.0120	INLET	0.00	F	0.00
	0.30	1	15 in.	680.67	N/A	1 - C	3.79	0.14	0.21	0.0120	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	0.14	2	12 in.	680.59	N/A	1 - C	3.10	0.10	0.15	0.0120	INLET	0.00	D	0.00
	0.14	2	15 in.	680.60	N/A	1 - C	2.96	0.10	0.14	0.0120	INLET	0.00	D + 1	0.00
	0.15	2	12 in.	680.60	N/A	1 - C	3.18	0.11	0.16	0.0120	INLET	0.00	F	0.00
	0.15	2	15 in.	680.60	N/A	1 - C	3.06	0.10	0.15	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)														
Diameter exceeds 1.25 HWA	0.27	1	12 in.	680.73	N/A	1 - C	2.25	0.21	0.21	0.0251	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

PID : 110867 **Date :** 03/29/2022 **Project :** HEN-108-17.40 **Location :** HENRY COUNTY, OHIO

Description : DRIVE PIPE FROM SR 108 STA 922+93.20 TO STA. 922+63.11 **Designer :** N. M. GOODMAN

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.) : 678.57 **Outlet Invert Elevation (ft.) :** 678.44 **Tailwater Elevation (ft.) :** 678.77 **Overflow Elevation (ft.) :** 682.39

Allowable Headwater Elevation (ft.) : 681.39 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 30.00 **Culvert Slope (ft./ft.) :** 0.0043 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 0.60 **@** 5 yrs. **Flood Discharge (cfs) :** 0.66 **@** 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		
0.60	1	12 in.	679.00	679.03	1 - A	2.65	0.33	0.32	0.0120	OUTLET*	0.00	D	0.00
0.60	1	15 in.	678.96	679.00	1 - B	2.32	0.30	0.30	0.0120	OUTLET*	0.00	D + 1	0.00
0.66	1	12 in.	679.03	679.05	1 - A	2.82	0.35	0.34	0.0120	OUTLET*	0.00	F	0.00
0.66	1	15 in.	678.98	679.02	1 - B	2.55	0.32	0.32	0.0120	OUTLET*	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)													
0.60	1	12 in.	679.05	679.10	1 - A	2.65	0.50	0.32	0.0251	OUTLET*	0.00	D	0.00
0.60	1	15 in.	679.03	679.05	1 - A	2.32	0.44	0.30	0.0250	OUTLET*	0.00	D + 1	0.00
0.66	1	12 in.	679.08	679.13	1 - A	2.82	0.52	0.34	0.0251	OUTLET*	0.00	F	0.00
0.66	1	15 in.	679.05	679.08	1 - A	2.55	0.47	0.32	0.0250	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													