HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

Stormwater Report

Road Realignment

280 Between the Lakes Road
Salisbury, Connecticut

PREPARED FOR:
Great Falls Construction

June 18, 2024
JN: 4010128.001

Report Prepared By:
Haley Ward, Inc.
140 Willow Street, Suite 8 | Winsted, Connecticut 06098

Corporate Office
One Merchants Plaza
Suite 701
Bangor, ME 04401
T: 207.989.4824
F: 207.989.4881

HALEYWARD.COM

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

TABLE OF CONTENTS

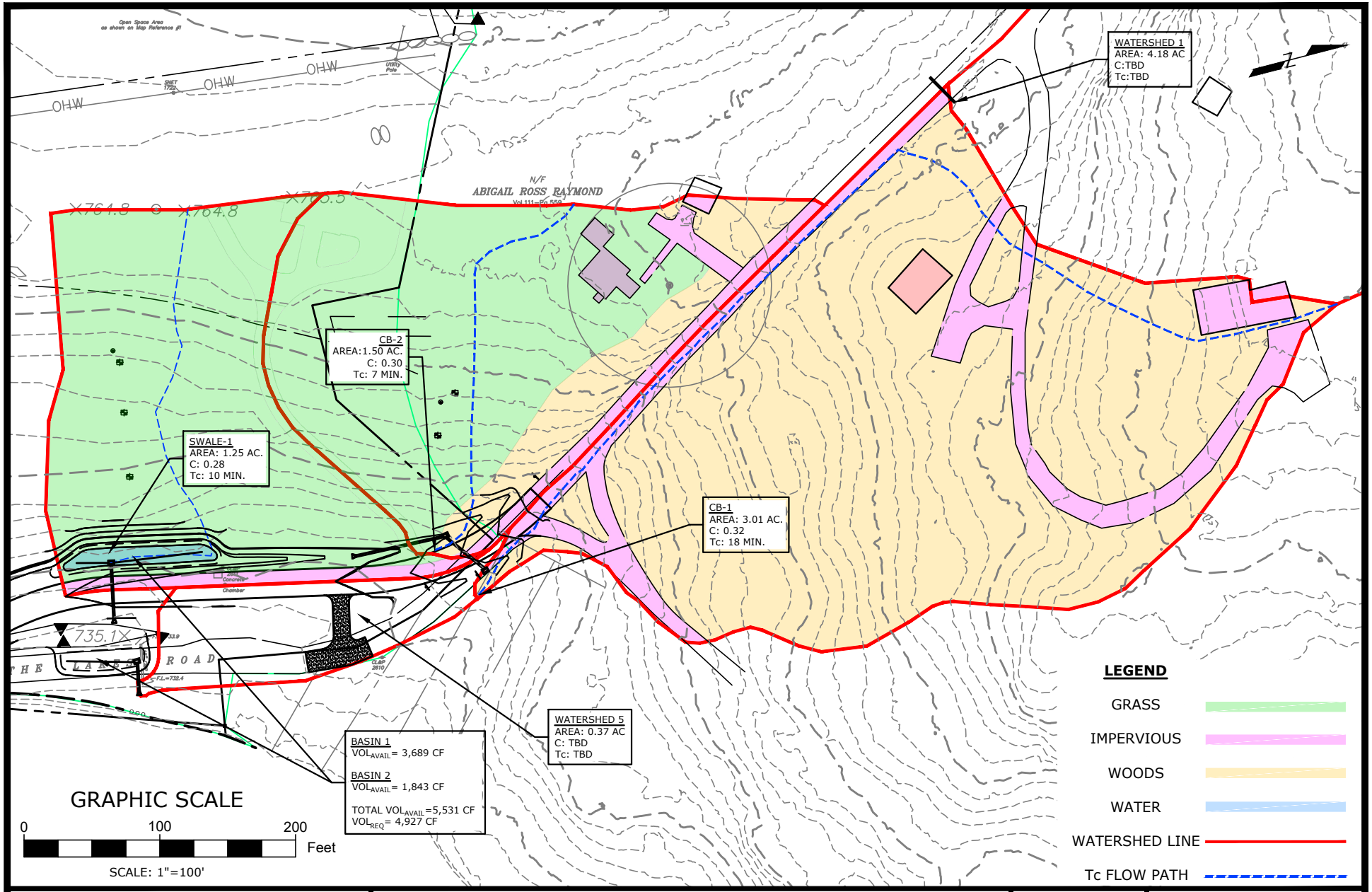
Project Description

This project involves the relocation of a portion of Between the Lakes Road. Several measures will be taken to improve stormwater quality. Runoff will be collected in catch basins and directed to two water quality basins that will capture the Water Quality Volume before the runoff is released to the lake.

The storm sewer network is sized for the 10-year storm based on the Rational Method.

The riprap outlet is sized based on the Connecticut Department of Transportation Drainage Manual.

The stormwater basins are sized for the Water Quality Volume based on the 2024 DEEP Stormwater Quality Manual.



FILE LOCATION: P:\CT\4010128-GREAT_FALLS_CONSTRUCTION\128.001 - 280 BETWEEN THE LAKE RD. - TAP\02-CAD_FILES\PROJECT 2.DWG, 2024.06.19, 9:34 AM

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT
ROAD REALIGNMENT
280 BETWEEN THE LAKES ROAD, SALISBURY, CONNECTICUT

TITLE
POST DEVELOPMENT WATERSHED MAP

DATE
2024-06-18

SCALE
AS NOTED

DRAWN BY
CG

PROJECT No.
4010128.001

DRAWING No.
WS MAP

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road , Salisbury, CT

SUBJECT: Runoff Coefficient Worksheet

COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

Runoff Coefficients per ConnDOT Drainage Manual - Chapter 6:

Table 6-3 - Recommended Coefficients for Pervious Areas:

	NRCS Hydrologic Soil Group			
Slope	**A**	**B**	**C**	**D**
Flat: (0%-1%)	0.04 - 0.09	0.07 - 0.12	0.11 - 0.16	0.15 - 0.20
Ave.: (2%-6%)	0.09 - 0.14	0.12 - 0.17	0.16 - 0.21	0.20 - 0.25
Steep: (> 6%)	0.13 - 0.18	0.18 - 0.24	0.23 - 0.31	0.28 - 0.38

Table 6-5 - Runoff Coefficients for Impervious Areas

Asphalt Streets	Concrete Streets	Drives & Walks	Roofs
0.70 - 0.95	0.80 - 0.95	0.75 - 0.85	0.75 - 0.95

Table 6-4 - Recommended Coefficients for Various Selected Land Uses:

Downtown Areas	Neighbor-hood Areas	Single Family Areas	Multi Units Detached	Multi Units Attached	Suburban	Resi-dential (>1.2 Ac.)	Apartment Dwelling Areas	Light Industrial Areas	Heavy Industrial Areas	Parks & Cemetery	Play-grounds	Rail Yard Areas	Un-Improved Areas
0.70 - 0.95	0.50 - 0.70	0.30 - 0.50	0.40 - 0.60	0.60 - 0.75	0.25 - 0.40	0.30 - 0.45	0.50 - 0.70	0.50 - 0.80	0.60 - 0.90	0.10 - 0.25	0.20 - 0.40	0.20 - 0.40	0.10 - 0.30

Calculate Composite Runoff Coefficient and Adjust for Infrequent Storms:

Area I.D.	Total Area (Acres)	Asphalt Streets (Acres) C = **0.90**	Grass HSG B (Acres) C = **0.17**	Woods HSG B (Acre) C = **0.22**	Water (Acre) C = **0.90**	Other (Acres) C =	Check S Area (Acres)	S A x C	Composite Runoff Coefficient C'	C_A - Runoff Coefficient Adjusted for Infrequent Storms: Recurrence Interval 2-Year C_F = **1.00**	5-Year C_F = **1.00**	10-Year C_F = **1.00**	25-Year Max.C_F = **1.10**	50-Year Max.C_F = **1.20**	100-Year Max.C_F = **1.25**
Watershed 1	4.18	0.46					ERROR	0.413	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
CB-1	3.01	0.45		2.56			3.01	0.968	0.32	0.32	0.32	0.32	0.35	0.39	0.40
CB-2	1.50	0.24	1.01	0.25			1.50	0.443	0.30	0.30	0.30	0.30	0.32	0.35	0.37
Swale-1	1.25	0.15	1.07		0.03		1.25	0.344	0.28	0.28	0.28	0.28	0.30	0.33	0.34
Watershed 5	0.37	0.13					ERROR	0.116	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
Total	10.31	1.43					ERROR	1.285	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!
% Impervious		14%													

(1) Area of individual cover types measured from plans

(2) Runoff coefficient for individual cover types selected from reference tables above.

(3) Composite Runoff Coefficient C' = S(A x C) / SA

(4) Frequency Factors (C_F) from ConnDOT Drainage Manual 2000 - Table 6-2

(5) Per ConnDOT Drainage Manual 2000 Section 6.9.5: $C_A = 1.00$ where $C' * C_F >= 1.00$ $C_A = C' * C_F$ where $C' * C_F < 1.00$

(6) Watershed 1 will be directed away from the lake.

(7) Watershed 5 does not drain to the stormwater basins.

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

Watershed I.D.: CB-1

Estimate Time of Concentration using the "Velocity Method".

Reference: USDA-NRCS National Engineering Handbook - Part 630 -Hydrology; Chapter 15 - Time of Concentration and USDA-NRCS TR-55 - June 1986

SHEET FLOW

Step No.	Data	Seg. I.D.:	1	Seg. I.D.:	2	
1A	Select Surface Description Identifier (Table 3-1)	F				
1B	Surface Description (Table 3-1)	Grass: Dense Grasses				
2	Manning's Roughness Coefficient "n" (Table 3-1)	0.240				
3	Flow Length "L" (FT) - Note: Total L must be <= 100 FT	80				
4	Two-Year 24-Hour Rainfall "P_2" (Inches)	3.09				
5	Land Slope "S" (FT / FT)	0.014				T_T =
6	Travel Time "T_T" (Hours)	0.234				**0.234**

$$T_T = \frac{0.007 \times (n \times L)^{0.8}}{P_2^{0.5} \times S^{0.4}}$$

NRCS TR-55 Table 3-1

Identifier	Surface Description	Manning's "n"
A	Smooth Surfaces (Conc., Asph., Grav., Bare Soil)	0.011
B	Fallow (No Residue)	0.050
C	Cultivated Soils (Residue Cover <= 20%)	0.060
D	Cultivated Soils (Residue Cover > 20%)	0.170
E	Grass: Short Grass Prairie	0.150
F	Grass: Dense Grasses	0.240
G	Grass: Bermuda Grass	0.410
H	Range (Natural)	0.130
I	Woods: Light Underbrush	0.400
J	Woods: Dense Underbrush	0.800

SHALLOW CONCENTRATED FLOW

		Segment I.D.					
Step No.	Data	3	4	5	6	7	8
7	Surface Description (Paved or Unpaved)	U	U	P	P		
8	Flow Length "L" (FT)	83	67	141	100		
9	Watercourse Slope "S" (FT/FT)	0.0770	0.1540	0.0730	0.0080		
10	Average Velocity "V" (FT/SEC) Figure 3-1	4.48	6.33	5.49	1.82		
11	Travel Time "T_T" (Hours)	0.005	0.003	0.007	0.015		

$$T_T = \frac{L}{3600 \times V}$$

Unpaved Condition: $V = 16.1345 \times S^{0.5}$

Paved Condition: $V = 20.3282 \times S^{0.5}$

T_T = **0.030**

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

OPEN CHANNEL FLOW

Note: Hydraulic properties estimated from the worksheets that follow below.

		Segment I.D.						
Step No.	Data	7	8	9	10	11	12	13
12A	Channel or Pipe Flow? (C or P)	C						
12B	Cross Sectional Flow Area (SF)	1.08						
13	Wetted Perimeter (FT)	15.00						
14	Hydraulic Radius (FT)	0.07						
14	Channel or Pipe Slope (FT/FT)	0.1020						
16	Manning's Roughness Coefficient	0.026						
17	Velocity (FT/SEC)	3.16						
18	Flow Length (L) (FT)	348						
19	Travel Time "T_T" (Hours)	0.031						
							T_T =	**0.031**

$$T_T = \frac{L}{3600 \times V}$$

Step 20: Watershed Time of Concentration (Add T_T from Steps 6, 11, and 19):

Step 6: T_T Sheet Flow		Step 11: T_T Shallow Concentrated Flow		Step 19: T_T Channel Flow			
0.234	+	0.030	+	0.031	=	**0.295**	Hours

Tc Converted to Minutes: **18** **Minutes**

Notes:

1. The sum of all sheet-flow travel lengths is <= 100 FT as recommended in NRCS NEH Part 630 Chapter 15.
2. The sum of sheet-flow travel length is <= 10% of total hydraulic length (OK)
3. The sheet flow travel time is less than 80% of Tc (OK)
4. The sum of shallow-concentrated flow segment lengths is < 1,000 FT (OK)

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

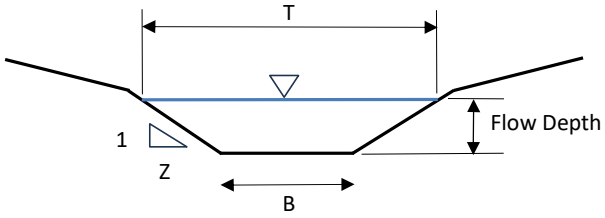
PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

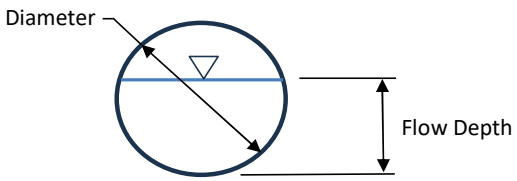
COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

The following worksheets estimate velocity and flow rate for a channel with simple geometry or a round storm sewer. The calculations are used to estimate travel time for open-channel flow conditions. Individual segments may be either channel flow or pipe flow, but not both.

Notes:
1. Flow rate in the various segments should gradually build (in general proportion to drainage area) toward the computed two-year recurrence-interval flood at the point of analysis.
2. In the case of flow in natural or man-made channels, flow depth should not exceed bank-full height.



Open Channel



Storm Sewer

Open Channel Segments

		Segment I.D.						
	Item	7	8	9	10	11	12	13
Channel Geometry	Flow Depth (FT)	0.12						
	Channel Slope (FT/FT)	0.1020						
	Manning's Roughness Coefficient	0.026						
	Bank Slope (Z:1)	50.00						
	B - Channel Base Width (FT)	3.00						
Channel Hydraulics	T - Flow Top Width (FT)	15						
	Flow Area (SF)	1.08						
	Wetted Perimeter (FT)	15.00						
	Hydraulic Radius (FT)	0.072						
	Flow (CFS)	3.41						
	Average Velocity (FT/SEC)	**3.16**						

Pipe Segments

		Segment I.D.						
	Item	7	8	9	10	11	12	13
Pipe Characteristics	Pipe Diameter (FT)							
	Pipe Manning's Coefficient							
	Pipe Slope (FT/FT)							
	Full Pipe Area (SF)							0.0000
	Hydraulic Radius - Full Pipe (FT)							0.000
	Q_{FULL} - Full Pipe Flow (CFS)							#DIV/0!
	V_{FULL} - Full Pipe Velocity (FT/SEC)							#DIV/0!
Pipe Hydraulics	R_D - Flow Depth Ratio							
	Flow Depth (FT)							0.00
	Cross Sectional Area of Flow (SF)							0.000
	Wetted Perimeter (FT)							0.000
	Hydraulic Radius (FT)							#DIV/0!
	Q - Estimated Flow in Pipe (CFS)							#DIV/0!
	V - Estimated Velocity in Pipe (FT/SEC)							**#DIV/0!**
	Q / Q_{FULL}							#DIV/0!
	V / V_{FULL}							#DIV/0!

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

COMP. BY: CG CHK. BY: TAP DATE: 6/181/2024

Watershed I.D.: CB-2

Estimate Time of Concentration using the "Velocity Method".

Reference: USDA-NRCS National Engineering Handbook - Part 630 -Hydrology; Chapter 15 - Time of Concentration and USDA-NRCS TR-55 - June 1986

SHEET FLOW

Step No.	Data	Seg. I.D.:	1	Seg. I.D.:	2	
1A	Select Surface Description Identifier (Table 3-1)	F		I		
1B	Surface Description (Table 3-1)	Grass: Dense Grasses				
2	Manning's Roughness Coefficient "n" (Table 3-1)	0.240				
3	Flow Length "L" (FT) - Note: Total L must be <= 100 FT	30				
4	Two-Year 24-Hour Rainfall "P_2" (Inches)	3.09				
5	Land Slope "S" (FT / FT)	0.025				T_T =
6	Travel Time "T_T" (Hours)	0.084				**0.084**

$$T_T = \frac{0.007 \times (n \times L)^{0.8}}{P_2^{0.5} \times S^{0.4}}$$

NRCS TR-55 Table 3-1

Identifier	Surface Description	Manning's "n"
A	Smooth Surfaces (Conc., Asph., Grav., Bare Soil)	0.011
B	Fallow (No Residue)	0.050
C	Cultivated Soils (Residue Cover <= 20%)	0.060
D	Cultivated Soils (Residue Cover > 20%)	0.170
E	Grass: Short Grass Prairie	0.150
F	Grass: Dense Grasses	0.240
G	Grass: Bermuda Grass	0.410
H	Range (Natural)	0.130
I	Woods: Light Underbrush	0.400
J	Woods: Dense Underbrush	0.800

SHALLOW CONCENTRATED FLOW

		Segment I.D.					
Step No.	Data	3	4	5	6	7	8
7	Surface Description (Paved or Unpaved)	U	U	P			
8	Flow Length "L" (FT)	82	99	64			
9	Watercourse Slope "S" (FT/FT)	0.0250	0.1020	0.1530			
10	Average Velocity "V" (FT/SEC) Figure 3-1	2.55	5.15	7.95			
11	Travel Time "T_T" (Hours)	0.009	0.005	0.002			

$$T_T = \frac{L}{3600 \times V}$$

Unpaved Condition: $V = 16.1345 \times S^{0.5}$

Paved Condition: $V = 20.3282 \times S^{0.5}$

T_T = **0.016**

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

COMP. BY: CG CHK. BY: TAP DATE: 6/181/2024

OPEN CHANNEL FLOW

Note: Hydraulic properties estimated from the worksheets that follow below.

		Segment I.D.						
Step No.	Data	7	8	9	10	11	12	13
12A	Channel or Pipe Flow? (C or P)	C						
12B	Cross Sectional Flow Area (SF)	5.40						
13	Wetted Perimeter (FT)	15.06						
14	Hydraulic Radius (FT)	0.36						
14	Channel or Pipe Slope (FT/FT)	0.0750						
16	Manning's Roughness Coefficient	0.400						
17	Velocity (FT/SEC)	0.51						
18	Flow Length (L) (FT)	37						
19	Travel Time "T_T" (Hours)	0.020						
							T_T =	**0.020**

$$T_T = \frac{L}{3600 \times V}$$

Step 20: Watershed Time of Concentration (Add T_T from Steps 6, 11, and 19):

Step 6: T_T Sheet Flow		Step 11: T_T Shallow Concentrated Flow		Step 19: T_T Channel Flow			
0.084	+	0.016	+	0.020	=	**0.121**	Hours

Tc Converted to Minutes: **7** **Minutes**

Notes:

1. The sum of all sheet-flow travel lengths is <= 100 FT as recommended in NRCS NEH Part 630 Chapter 15.
2. The sum of sheet-flow travel length is <= 10% of total hydraulic length (OK)
3. The sheet flow travel time is less than 80% of Tc (OK)
4. The sum of shallow-concentrated flow segment lengths is < 1,000 FT (OK)

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

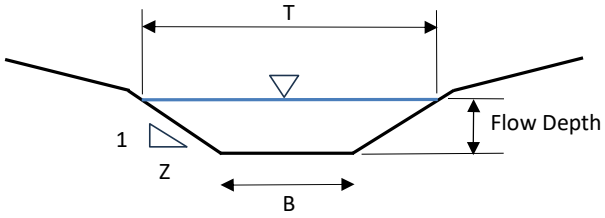
PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

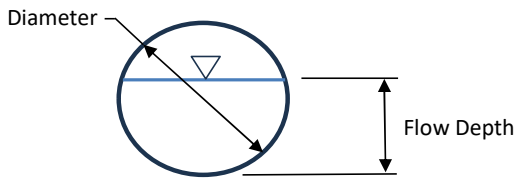
COMP. BY: CG CHK. BY: TAP DATE: 6/181/2024

The following worksheets estimate velocity and flow rate for a channel with simple geometry or a round storm sewer. The calculations are used to estimate travel time for open-channel flow conditions. Individual segments may be either channel flow or pipe flow, but not both.

Notes:
1. Flow rate in the various segments should gradually build (in general proportion to drainage area) toward the computed two-year recurrence-interval flood at the point of analysis.
2. In the case of flow in natural or man-made channels, flow depth should not exceed bank-full height.



Open Channel



Storm Sewer

Open Channel Segments

		Segment I.D.						
	Item	7	8	9	10	11	12	13
Channel Geometry	Flow Depth (FT)	0.60						
	Channel Slope (FT/FT)	0.0750						
	Manning's Roughness Coefficient	0.4						
	Bank Slope (Z:1)	10.00						
	B - Channel Base Width (FT)	3.00						
Channel Hydraulics	T - Flow Top Width (FT)	15						
	Flow Area (SF)	5.40						
	Wetted Perimeter (FT)	15.06						
	Hydraulic Radius (FT)	0.359						
	Flow (CFS)	2.77						
	Average Velocity (FT/SEC)	**0.51**						

Pipe Segments

		Segment I.D.						
	Item	7	8	9	10	11	12	13
Pipe Characteristics	Pipe Diameter (FT)							
	Pipe Manning's Coefficient							
	Pipe Slope (FT/FT)							
	Full Pipe Area (SF)							0.0000
	Hydraulic Radius - Full Pipe (FT)							0.000
	Q_{FULL} - Full Pipe Flow (CFS)							#DIV/0!
	V_{FULL} - Full Pipe Velocity (FT/SEC)							#DIV/0!
Pipe Hydraulics	R_D - Flow Depth Ratio							
	Flow Depth (FT)							0.00
	Cross Sectional Area of Flow (SF)							0.000
	Wetted Perimeter (FT)							0.000
	Hydraulic Radius (FT)							#DIV/0!
	Q - Estimated Flow in Pipe (CFS)							#DIV/0!
	V - Estimated Velocity in Pipe (FT/SEC)							**#DIV/0!**
	Q / Q_{FULL}							#DIV/0!
	V / V_{FULL}							#DIV/0!

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

Watershed I.D.: Swale-1

Estimate Time of Concentration using the "Velocity Method".

Reference: USDA-NRCS National Engineering Handbook - Part 630 -Hydrology; Chapter 15 - Time of Concentration and USDA-NRCS TR-55 - June 1986

SHEET FLOW

Step No.	Data	Seg. I.D.:	1	Seg. I.D.:	2	
1A	Select Surface Description Identifier (Table 3-1)	F				
1B	Surface Description (Table 3-1)	Grass: Dense Grasses				
2	Manning's Roughness Coefficient "n" (Table 3-1)	0.240				
3	Flow Length "L" (FT) - Note: Total L must be <= 100 FT	33				
4	Two-Year 24-Hour Rainfall "P_2" (Inches)	3.09				
5	Land Slope "S" (FT / FT)	0.010				T_T =
6	Travel Time "T_T" (Hours)	0.132				**0.132**

$$T_T = \frac{0.007 \times (n \times L)^{0.8}}{P_2^{0.5} \times S^{0.4}}$$

NRCS TR-55 Table 3-1

Identifier	Surface Description	Manning's "n"
A	Smooth Surfaces (Conc., Asph., Grav., Bare Soil)	0.011
B	Fallow (No Residue)	0.050
C	Cultivated Soils (Residue Cover <= 20%)	0.060
D	Cultivated Soils (Residue Cover > 20%)	0.170
E	Grass: Short Grass Prairie	0.150
F	Grass: Dense Grasses	0.240
G	Grass: Bermuda Grass	0.410
H	Range (Natural)	0.130
I	Woods: Light Underbrush	0.400
J	Woods: Dense Underbrush	0.800

SHALLOW CONCENTRATED FLOW

		Segment I.D.					
Step No.	Data	3	4	5	6	7	8
7	Surface Description (Paved or Unpaved)	U	U	P			
8	Flow Length "L" (FT)	12	60	62			
9	Watercourse Slope "S" (FT/FT)	0.0100	0.1200	0.0740			
10	Average Velocity "V" (FT/SEC) Figure 3-1	1.61	5.59	5.53			
11	Travel Time "T_T" (Hours)	0.002	0.003	0.003			

T_T = **0.008**

$$T_T = \frac{L}{3600 \times V}$$

Unpaved Condition: $V = 16.1345 \times S^{0.5}$

Paved Condition: $V = 20.3282 \times S^{0.5}$

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

OPEN CHANNEL FLOW

Note: Hydraulic properties estimated from the worksheets that follow below.

		Segment I.D.						
Step No.	Data	7	8	9	10	11	12	13
12A	Channel or Pipe Flow? (C or P)	C	C					
12B	Cross Sectional Flow Area (SF)	1.00	0.56					
13	Wetted Perimeter (FT)	7.02	5.61					
14	Hydraulic Radius (FT)	0.14	0.10					
14	Channel or Pipe Slope (FT/FT)	0.1180	0.0130					
16	Manning's Roughness Coefficient	0.150	0.011					
17	Velocity (FT/SEC)	0.93	3.31					
18	Flow Length (L) (FT)	92	85					
19	Travel Time "T_T" (Hours)	0.028	0.007					
							T_T =	**0.035**

$$T_T = \frac{L}{3600 \times V}$$

Step 20: Watershed Time of Concentration (Add T_T from Steps 6, 11, and 19):

Step 6: T_T Sheet Flow		Step 11: T_T Shallow Concentrated Flow		Step 19: T_T Channel Flow			
0.132	+	0.008	+	0.035	=	**0.175**	Hours

Tc Converted to Minutes: **10** **Minutes**

Notes:

1. The sum of all sheet-flow travel lengths is <= 100 FT as recommended in NRCS NEH Part 630 Chapter 15.
2. The sum of sheet-flow travel length is <= 10% of total hydraulic length (OK)
3. The sheet flow travel time is less than 80% of Tc (OK)
4. The sum of shallow-concentrated flow segment lengths is < 1,000 FT (OK)

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

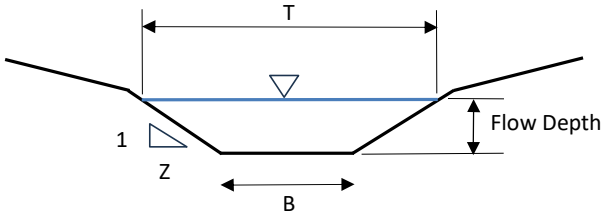
PROJECT: Road Realignment, 280 Between The Lakes Road

SUBJECT: Time of Concentration Calculations

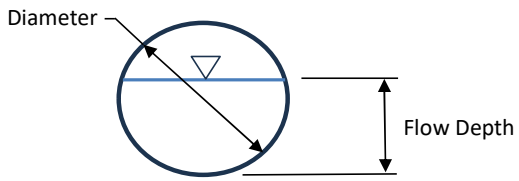
COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

The following worksheets estimate velocity and flow rate for a channel with simple geometry or a round storm sewer. The calculations are used to estimate travel time for open-channel flow conditions. Individual segments may be either channel flow or pipe flow, but not both.

Notes:
1. Flow rate in the various segments should gradually build (in general proportion to drainage area) toward the computed two-year recurrence-interval flood at the point of analysis.
2. In the case of flow in natural or man-made channels, flow depth should not exceed bank-full height.



Open Channel



Storm Sewer

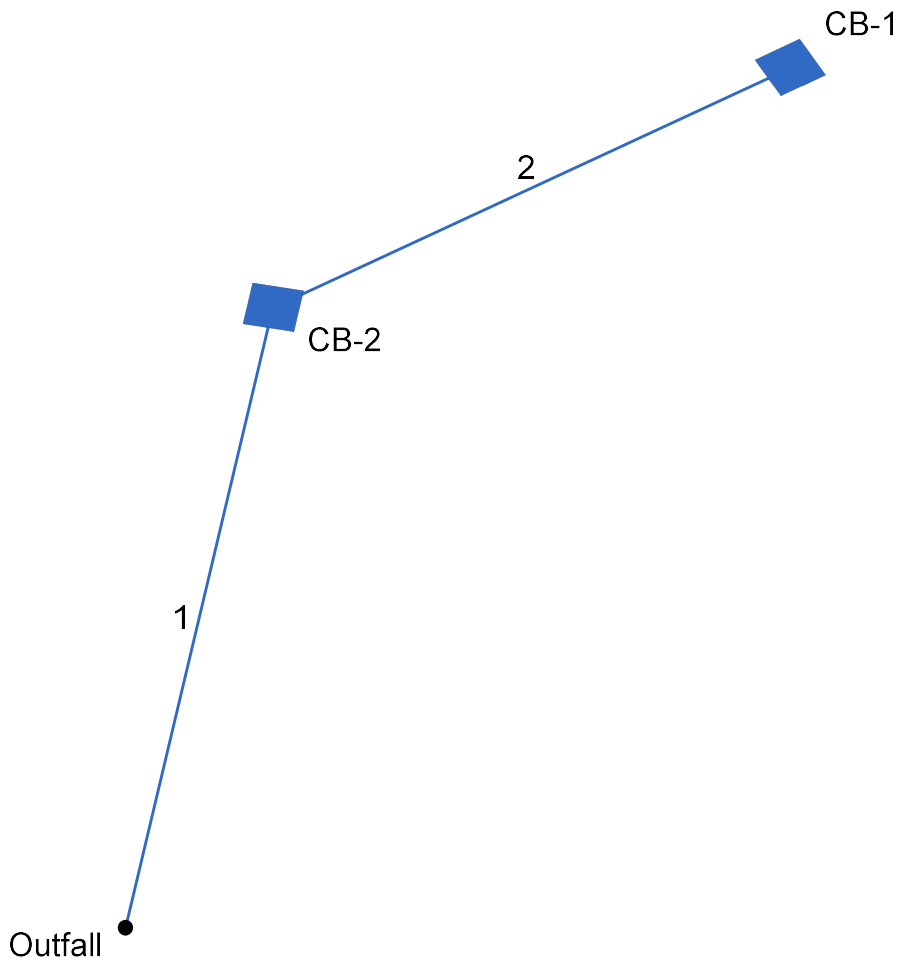
Open Channel Segments

		Segment I.D.						
	Item	7	8	9	10	11	12	13
Channel Geometry	Flow Depth (FT)	0.20	0.13					
	Channel Slope (FT/FT)	0.1180	0.0130					
	Manning's Roughness Coefficient	0.15	0.011					
	Bank Slope (Z:1)	10.00	10.00					
	B - Channel Base Width (FT)	3.00	3.00					
Channel Hydraulics	T - Flow Top Width (FT)	7	5.6					
	Flow Area (SF)	1.00	0.56					
	Wetted Perimeter (FT)	7.02	5.61					
	Hydraulic Radius (FT)	0.142	0.100					
	Flow (CFS)	0.93	1.85					
	Average Velocity (FT/SEC)	**0.93**	**3.31**					

Pipe Segments

		Segment I.D.						
	Item	7	8	9	10	11	12	13
Pipe Characteristics	Pipe Diameter (FT)							
	Pipe Manning's Coefficient							
	Pipe Slope (FT/FT)							
	Full Pipe Area (SF)							0.0000
	Hydraulic Radius - Full Pipe (FT)							0.000
	Q_{FULL} - Full Pipe Flow (CFS)							#DIV/0!
	V_{FULL} - Full Pipe Velocity (FT/SEC)							#DIV/0!
Pipe Hydraulics	R_D - Flow Depth Ratio							
	Flow Depth (FT)							0.00
	Cross Sectional Area of Flow (SF)							0.000
	Wetted Perimeter (FT)							0.000
	Hydraulic Radius (FT)							#DIV/0!
	Q - Estimated Flow in Pipe (CFS)							#DIV/0!
	V - Estimated Velocity in Pipe (FT/SEC)							**#DIV/0!**
	Q / Q_{FULL}							#DIV/0!
	V / V_{FULL}							#DIV/0!

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 128.001 Proposed Storm Drainage.stm	Number of lines: 2	Date: 5/13/2024

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	61.1	1.50	4.51	0.30	0.45	1.41	7.0	18.2	3.6	5.14	8.95	4.94	15	1.64	738.10	739.10	739.18	740.02	739.40	741.20	Pipe from CB-2
2	1	46.3	3.01	3.01	0.32	0.96	0.96	18.0	18.0	3.7	3.52	7.27	4.09	15	1.08	739.10	739.60	740.02	740.36	741.20	741.80	Pipe from CB-1

Project File: 128.001 Proposed Storm Drainage.stm

Number of lines: 2

Run Date: 5/13/2024

NOTES:Intensity = 30.48 / (Inlet time + 3.30) ^ 0.69; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Report

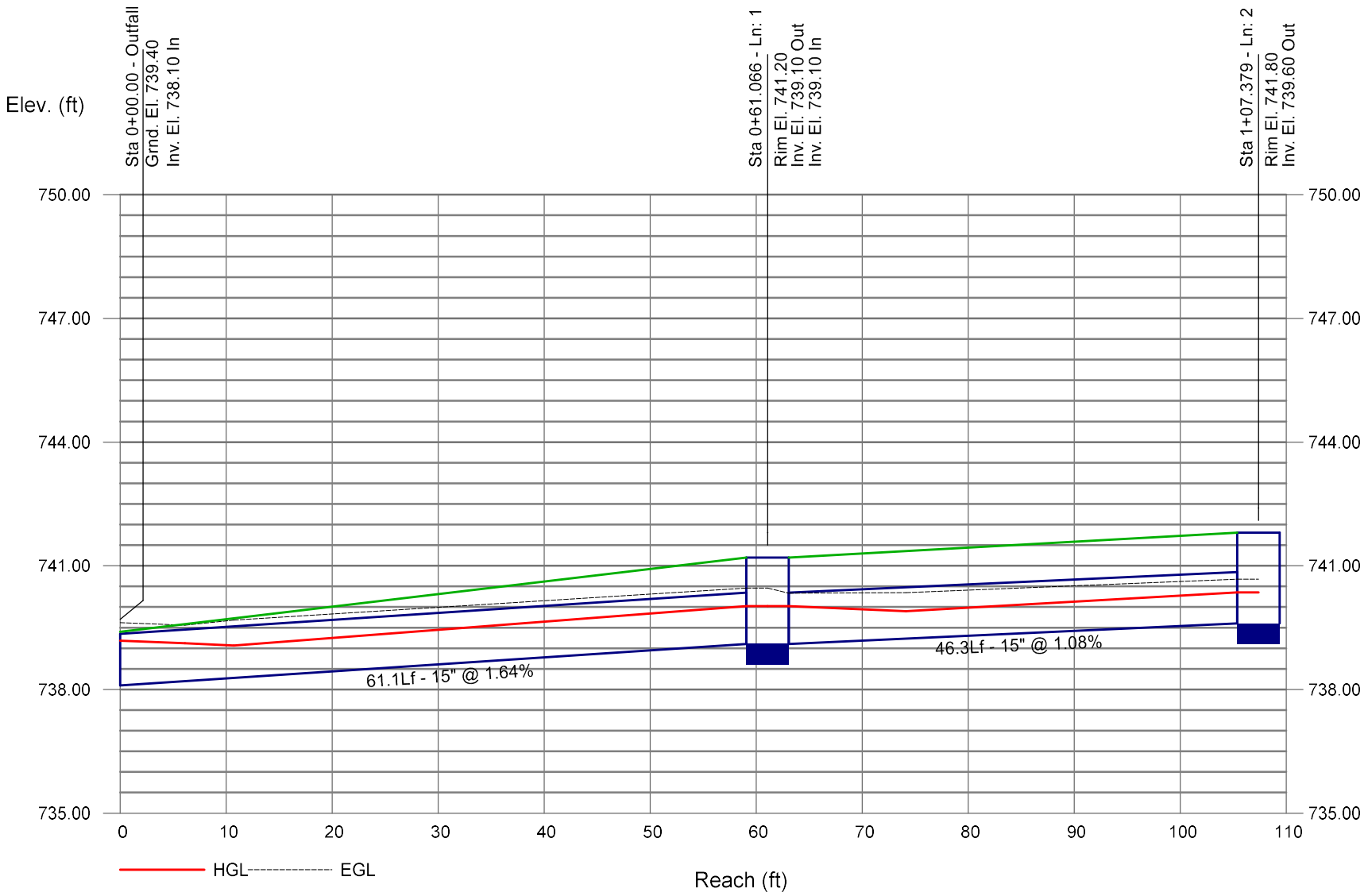
Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	CB-2	2.72	0.00	2.72	0.00	DrGrt	0.0	0.00	3.12	1.35	2.31	Sag	2.00	0.020	0.020	0.013	0.25	27.17	0.25	27.17	0.0	Off
2	CB-1	3.52	0.00	1.01	2.52	DrGrt	0.0	0.00	0.00	1.35	2.31	0.020	2.00	0.020	0.020	0.013	0.14	16.10	0.14	16.10	0.0	Off

Project File: 128.001 Proposed Storm Drainage.stm | Number of lines: 2 | Run Date: 5/13/2024

NOTES: Inlet N-Values = 0.016; Intensity = 30.48 / (Inlet time + 3.30) ^ 0.69; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Storm Sewer Profile

Proj. file: 128.001 Proposed Storm Drainage.stm



HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road
SUBJECT: Peformed Scour Hole Design- Basin 2
COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

Structure: Basin #2

Data Input:

Q =	5.33	CFS	Design discharge
S_P =	1.20	FT	Circular pipe I.D. or maximum inside span for non-circular pipe
R_P =	1.20	FT	Maximum inside pipe rise. Set $R_P = S_P$ for circular sections
INV_{OUT} =	732.50	FT	Elevation of invert at culvert outlet
E_{TW} =	732.79		Elevation of tailwater at culvert outlet
TW =	0.29	FT	Tail water depth

Available Riprap Sizes:

From ConnDOT Drainage Manual 2000 - Table 7-2 & FHWA - HEC-11 Design of Riprap Revetments

Type No.	Description	D_{50} (FT)
1	Special Riprap	0.083
2	Modified Riprap	0.417
3	Intermediate Riprap	0.667
4	Facing Riprap	0.950
5	Standard Riprap	1.250
6	Light Riprap	1.300
7	Quarter-Ton Riprap	1.800
8	Half-Ton Riprap	2.250
9	One-Ton Riprap	2.850
10	Two-Ton Riprap	3.600

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road
SUBJECT: Peformed Scour Hole Design- Basin 2
COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

Structure: Basin #2

For Type 1 Preformed Scour Hole (Depression = 0.5 R_P):

d_{50} = 0.31 FT $d_{50} = (0.0125\ R_P^2 / TW) \times (Q / R_P^{2.5})^{1.333}$

Minimum riprap size required for a stable scour hole

Select Type: 3 Intermediate Riprap D_{50} = 0.667 FT

Comment: *OK - D50 Size for selected riprap equals or exceeds minimum required D50 size*

$2S_P$ = 2.4 FT Floor Width

$3S_P$ = 3.6 FT Floor Length

F = 0.60 FT Basin Depression: $F = 0.5R_P$ for Type 1 Preformed Scour Hole

C = 7.2 FT Basin Length: $C = 3S_P + 6F$

B = 6.0 FT Basin Inlet and Outlet Width $B = 2S_P + 6F$

For Type 2 Preformed Scour Hole (Depression = 1.0 R_P):

d_{50} = 0.21 FT $d_{50} = (0.0082R_P^2 / TW) \times (Q / R_P^{2.5})^{1.333}$

Minimum riprap size required for a stable scour hole

Select Type: 3 Intermediate Riprap D_{50} = 0.667 FT

Comment: *OK - D50 Size for selected riprap equals or exceeds minimum required D50 size*

$2S_P$ = 2.4 FT Floor Width

$3S_P$ = 3.6 FT Floor Length

F = 1.2 FT Basin Depression: $F = 1.0\ R_P$ for Type 2 Preformed Scour Hole

C = 10.8 FT Basin Length: $C = 3S_P + 6F$

B = 9.6 FT Basin Inlet and Outlet Width $B = 2S_P + 6F$

Structure: Basin #2

Figure 11-15 from ConnDOT Drainage Manual 2000

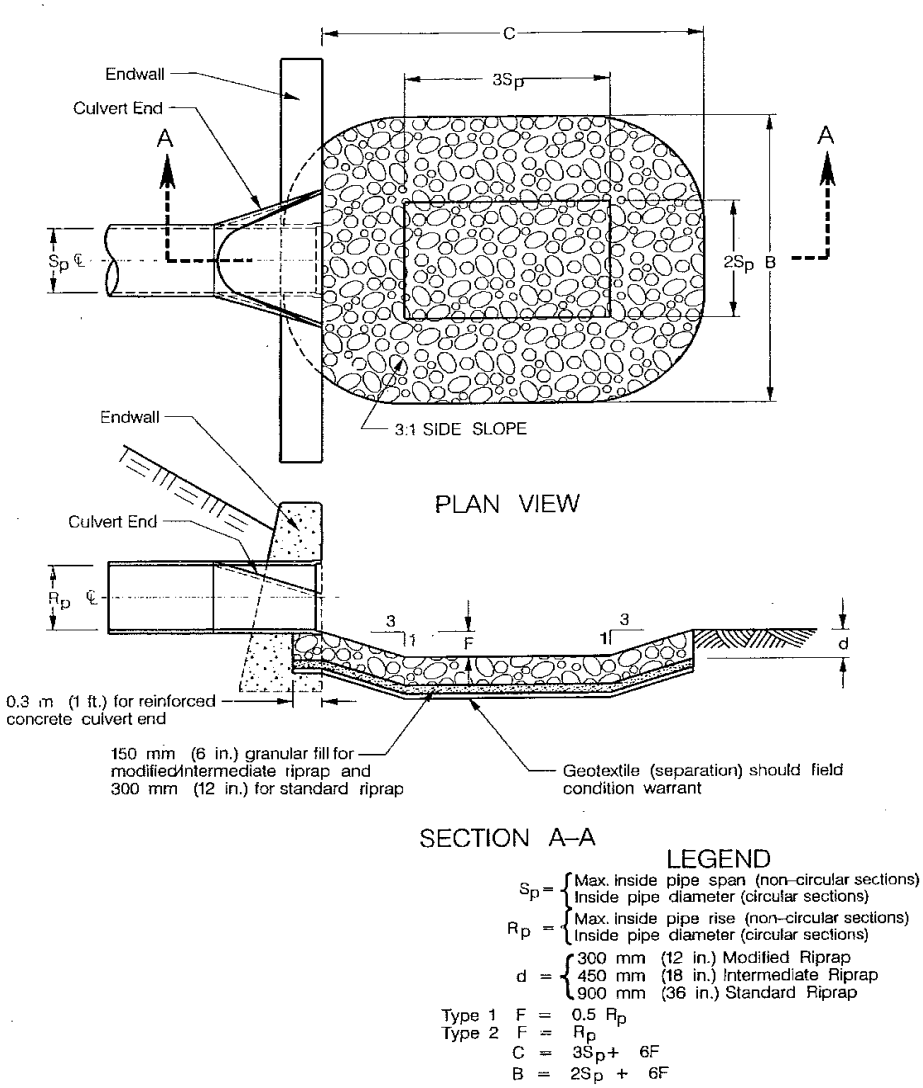


Figure 11-15 Preformed Scour Hole Type 1 and Type 2

HALEY WARD
ENGINEERING | ENVIRONMENTAL | SURVEYING

PROJECT: Road Realignment, 280 Between The Lakes Road , Salisbury, CT

SUBJECT: Water Quality Volume and Flow Calculations

COMP. BY: CG CHK. BY: TAP DATE: 06/18/24

I. Determine Volume of Water Quality Basin

WQV = (1.3"(R)(A))/12 Where:

WQV	=	Water Quality Volume (ac-ft)
R	=	Volumetric Runoff Coefficient
	=	0.05+0.009(I)
I	=	Percent Impervious Cover (whole number)
A	=	Site Area (acres) = Watershed area excluding bottom of basin

Watershed	Area (acres)	Impervious	Coefficient	Volume (ac-ft)	Volume (CF)
CB-1	3.01	15	0.18	0.0602	2,621
CB-2	1.50	16	0.19	0.0315	1,373
Swale-1	1.25	12	0.16	0.0214	932
Total	5.76	15	0.18	0.1131	4,927

GRV = ((D)(A)(I))/12 Where:

GRV	=	Groundwater Recharge Volume
D	=	Depth of Runoff to be Recharged (Table 7.4 of Stormwater Quality Manual)
A	=	Site Area (acres)
I	=	Percent Impervious Cover (decimal)

Watershed Number	Watershed Area (acres)	Percent Impervious	Groundwater Recharge Depth (D)	Groundwater Recharge Volume (ac.ft)	Groundwater Recharge Volume (CF)
					-
1	5.76	0.15	0.25	0.0175	762

Table 7.4

NRCS Hydrologic Soil Group	Average Annual Recharge	Groundwater Recharge Depth (D)
A	18 in/year	0.4 inch
B	12 in/year	0.25 inch
C	6 in/year	0.1 inch
D	3 in/year	0 inch

For Hydrologic Soil Group, see Web Soil Survey
The majority of development occurs over soil with hydrologic group B
For Design Use WQV since it is higher than GRV

Volume of Proposed Water Quality Basin #1

Contour Elevation	Elevation Difference (ft)	Area (sq. ft.)	Volume (CF)	Cumulative Volume (CF)
736.0	-	1,354		
737.6	1.6	3,257	3,689	3,689

Volume of Proposed Water QualityBasin #2

Contour Elevation	Elevation Difference (ft)	Area (sq. ft.)	Volume (CF)	Cumulative Volume (CF)
735.0	-	857		
736.0	1.0	2,828	1,843	1,843

Total Storage Volume Available **Total → 5,531 > 4927 CF - OK**