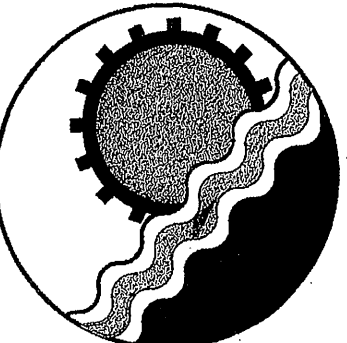
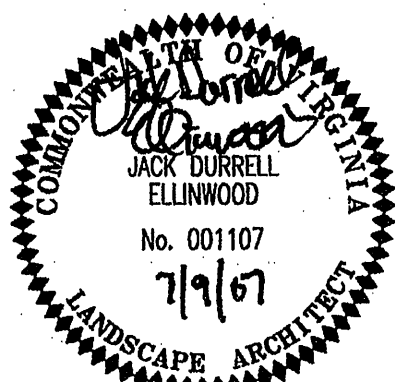




**3433 BRAMBLETON AVENUE, SUITE 200B
ROANOKE, VIRGINIA 24018
540.776.5715 FAX: 540.776.8543**

[illegible]

Q10 = 6.0 cfs
V10 = 2.7 fps
d10 = 0.86'

EXISTING DITCH SECTION -
ROUTE 460



PER DITCH CALCULATIONS SECTION 3
Q100 = 3.9 cfs - FROM S.W.M. POND MAX. 100 YR.

$d_{50} = 6''$
 $D_o = 1.25'$
 $3d_o = 3.75'$
 $L = 30'$

Q2 = 6.64 cfs - from SB #2(DESIGN)
V2 = 3.1 fps
d2 = 0.84'

Project Description		Project Description	
Friction Method	Manning Formula	Friction Method	Manning Formula
Solve For	Normal Depth	Solve For	Normal Depth
Input Data		Input Data	
Roughness Coefficient	0.035	Roughness Coefficient	0.05
Channel Slope	0.086 f/ft	Channel Slope	0.086 f/ft
Left Side Slope	3 f/ft (H:V)	Left Side Slope	3 f/ft (H:V)
Right Side Slope	3 f/ft (H:V)	Right Side Slope	3 f/ft (H:V)
Discharge	1.97 ft³/s	Discharge	2.71 ft³/s
Results		Results	
Normal Depth	0.4 ft	Normal Depth	0.52 ft
Flow Area	0.48 ft²	Flow Area	0.8 ft²
Wetted Perimeter	2.53 ft	Wetted Perimeter	3.26 ft
Top Width	2.4 ft	Top Width	3.09 ft
Critical Depth	0.48 ft	Critical Depth	0.55 ft
Critical Slope	0.03071 f/ft	Critical Slope	0.06006 f/ft
Velocity	4.1 ft/s	Velocity	3.41 ft/s
Velocity Head	0.28 ft	Velocity Head	0.18 ft
Specific Energy	0.66 ft	Specific Energy	0.7 ft
Froude Number	1.62	Froude Number	1.18
Flow Type	Supercritical	Flow Type	Supercritical

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.05
Channel Slope	0.096 /ftft
Left Side Slope	3 /ftft (H:V)
Right Side Slope	3 /ftft (H:V)
Discharge	2.71 ft ³ /s
Results	
Normal Depth	0.52 ft
Flow Area	0.81 ft ²
Wetted Perimeter	3.26 ft
Top Width	3.09 ft
Critical Depth	0.55 ft
Critical Slope	0.06068 /ftft
Velocity	3.41 ft/s
Velocity Head	0.18 ft
Specific Energy	0.7 ft
Froude Number	1.18
Flow Type	Supercritical

Friction Description		Project Description	
Friction Method	Manning Formula	Friction Method	Manning Formula
Solve For	Normal Depth	Solve For	Normal Depth
Input Data		Input Data	
Roughness Coefficient	0.035	Roughness Coefficient	0.05
Channel Slope	0.02 ft/ft	Channel Slope	0.02 ft/ft
Left Side Slope	3 ft/ft (HV)	Left Side Slope	3 ft/ft (HV)
Right Side Slope	3 ft/ft (HV)	Right Side Slope	3 ft/ft (HV)
Discharge	4.78 ft ³ /s	Discharge	6.58 ft ³ /s
Results		Results	
Normal Depth	0.73 ft	Normal Depth	0.94 ft
Flow Area	1.61 ft ²	Flow Area	2.67 ft ²
Wetted Perimeter	4.63 ft	Wetted Perimeter	5.97 ft
Top Width	4.4 ft	Top Width	5.66 ft
Critical Depth	0.69 ft	Critical Depth	0.79 ft
Critical Slope	0.02729 ft/ft	Critical Slope	0.05337 ft/ft
Velocity	2.97 ft/s	Velocity	2.46 ft/s
Velocity Head	0.14 ft	Velocity Head	0.09 ft
Specific Energy	0.87 ft	Specific Energy	1.04 ft
Froude Number	0.86	Froude Number	0.63
Flow Type	Subcritical	Flow Type	Subcritical

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.05
Channel Slope	0.02 ft/ft
Left Side Slope	3 ft/ft (HV)
Right Side Slope	3 ft/ft (HV)
Discharge	6.58 ft ³ /s
Results	
Normal Depth	0.94 ft
Flow Area	2.67 ft ²
Wetted Perimeter	5.97 ft
Top Width	5.66 ft
Critical Depth	0.79 ft
Critical Slope	0.05337 ft/ft
Velocity	2.46 ft/s
Velocity Head	0.09 ft
Specific Energy	1.04 ft
Froude Number	0.63
Flow Type	Subcritical

Project Description		Project Description	
Friction Method	Manning Formula	Friction Method	Manning Formula
Solve For	Normal Depth	Solve For	Normal Depth
Input Data		Input Data	
Roughness Coefficient	0.013	Roughness Coefficient	0.013
Channel Slope	0.0046 ft/ft	Channel Slope	0.0046 ft/ft
Left Side Slope	4 HV	Left Side Slope	4 HV
Right Side Slope	6 HV	Right Side Slope	6 HV
Discharge	1.23 ft ³ /s	Discharge	1.69 ft ³ /s
Results		Results	
Normal Depth	0.33 ft	Normal Depth	0.37 ft
Flow Area	0.54 ft ²	Flow Area	0.68 ft ²
Wetted Perimeter	3.34 ft	Wetted Perimeter	3.77 ft
Top Width	3.28 ft	Top Width	3.69 ft
Critical Depth	0.33 ft	Critical Depth	0.37 ft
Critical Slope	0.00463 ft/ft	Critical Slope	0.00443 ft/ft
Velocity	2.29 ft/s	Velocity	2.48 ft/s
Velocity Head	0.08 ft	Velocity Head	0.1 ft
Specific Energy	0.41 ft	Specific Energy	0.46 ft
Froude Number	1	Froude Number	1.02

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.0046 ft/ft
Left Side Slope	4 H/V
Right Side Slope	6 H/V
Discharge	1.69 ft ³ /s
Results	
Normal Depth	0.37 ft
Flow Area	0.68 ft ²
Wetted Perimeter	3.77 ft
Top Width	3.69 ft
Critical Depth	0.37 ft
Critical Slope	0.00443 ft/ft
Velocity	2.49 ft/s
Velocity Head	0.1 ft
Specific Energy	0.46 ft
Froude Number	1.02

Project Description		Project Description	
Friction Method	Manning Formula	Friction Method	Manning Formula
Solve For	Normal Depth	Solve For	Normal Depth
Input Data		Input Data	
Roughness Coefficient	0.013	Roughness Coefficient	0.013
Channel Slope	0.0048 ft/ft	Channel Slope	0.0048 ft/ft
Left Side Slope	4 H/V	Left Side Slope	4 H/V
Right Side Slope	6 H/V	Right Side Slope	6 H/V
Discharge	3.24 ft ³ /s	Discharge	4.46 ft ³ /s
Results		Results	
Normal Depth	0.47 ft	Normal Depth	0.53 ft
Flow Area	1.11 ft ²	Flow Area	1.41 ft ²
Wetted Perimeter	4.81 ft	Wetted Perimeter	5.42 ft
Top Width	4.71 ft	Top Width	5.31 ft
Critical Depth	0.48 ft	Critical Depth	0.55 ft
Critical Slope	0.00407 ft/ft	Critical Slope	0.0039 ft/ft
Velocity	2.92 ft/s	Velocity	3.16 ft/s
Velocity Head	0.13 ft	Velocity Head	0.16 ft
Specific Energy	0.6 ft	Specific Energy	0.69 ft
Energy Number	1.06	Energy Number	1.06

Project Description		
Friction Method	Manning Formula	
Solve For	Normal Depth	
Input Data		
Roughness Coefficient	0.013	
Channel Slope	0.0046	ft/ft
Left Side Slope	4	HV
Right Side Slope	6	HV
Discharge	4.46	ft ³ /s
Results		
Normal Depth	0.53	ft
Flow Area	1.41	ft ²
Wetted Perimeter	5.42	ft
Top Width	5.31	ft
Critical Depth	0.55	ft
Critical Slope	0.0038	ft/ft
Velocity	3.16	ft/s
Velocity Head	0.16	ft
Specific Energy	0.69	ft
Friction Number	1.00	

Project Description		Project Description	
Friction Method	Manning Formula	Friction Method	Manning Formula
Solve For	Normal Depth	Solve For	Normal Depth
Input Data		Input Data	
Roughness Coefficient	0.05	Roughness Coefficient	0.05
Channel Slope	0.006 ft/ft	Channel Slope	0.006 ft/ft
Left Side Slope	2 HV	Left Side Slope	2 HV
Right Side Slope	6 HV	Right Side Slope	6 HV
Discharge	1.38 ft ³ /s	Discharge	1.9 ft ³ /s
Results		Results	
Normal Depth	0.59 ft	Normal Depth	0.65 ft
Flow Area	1.39 ft ²	Flow Area	1.77 ft ²
Wetted Perimeter	4.9 ft	Wetted Perimeter	5.53 ft
Top Width	4.71 ft	Top Width	5.32 ft
Critical Depth	0.37 ft	Critical Depth	0.43 ft
Critical Slope	0.06706 ft/ft	Critical Slope	0.06427 ft/ft
Velocity	0.99 ft/s	Velocity	1.08 ft/s
Velocity Head	0.02 ft	Velocity Head	0.02 ft
Specific Energy	0.6 ft	Specific Energy	0.68 ft
Flow Number	0.32	Flow Number	0.33

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.05
Channel Slope	0.006 ft/ft
Left Side Slope	2 H:V
Right Side Slope	6 H:V
Discharge	1.9 ft ³ /s
Results	
Normal Depth	0.69 ft
Flow Area	1.77 ft ²
Wetted Perimeter	5.53 ft
Top Width	5.32 ft
Critical Depth	0.43 ft
Critical Slope	0.06427 ft/ft
Velocity	1.08 ft/s
Velocity Head	0.02 ft
Specific Energy	0.68 ft
Froude Number	0.33

Solve For Discharge							
Culvert Summary							
Allowable HW Elevation	1,031.47	ft	Headwater Depth/Height		3.18		
Computed Headwater Elevation	1,031.47	ft	Discharge		4.57	cfs	
Inlet Control HW Elev.	1,030.70	ft	Tailwater Elevation		1,028.67	ft	
Outlet Control HW Elev.	1,031.47	ft	Control Type		Outlet Control		
Girders							
Upstream Invert	1,028.29	ft	Downstream Invert		1,028.17	ft	
Length	24	ft	Constructed Slope		0.005	ft/ft	
Hydraulic Profile							
Profile	Composite	M&P Pressure Profile	Depth, Downstream		0.89	ft	
Slope Type		Mild	Normal Depth		N/A		
Flow Regime		Subcritical	Critical Depth		0.86	ft	
Velocity Downstream		6.18	ft/s	Critical Slope		0.049786	ft/ft
Section							
Section Shape		Circular	Manning's Coefficient		0.024		
Section Material		CMP	Span		1	ft	
Section Size		12 inch	Rise		1	ft	
Number Sections		1					
Outlet Control Properties							
Outlet Control HW Elev.	1,031.47	ft	Upsream Velocity Head		0.53	ft	
Ke		0.9	Entrance Loss		0.47	ft	
Inlet Control Properties							
Inlet Control HW Elev.	1,030.70	ft	Flow Control		Submerge		
Wing Type		Projecting	Area Full		0.6	ft ²	
K		0.034	HDS 5 Chart		2		
M		1.5	HDS 5 Scale		3		
G		0.0553	Equation Form		1		
Y		0.64					

No.	Revision	By	Appd	Date	Drawn	DRB
	CITY, COUNTY & VDOT NOV. COMMENTS	DRB	JDE	03/22/07	Designed	JDE
	CITY, COUNTY & VDOT APRIL COMMENTS	DRB	JDE	05/24/07	Checked	JDE
	CITY COMMENTS, 6/18/07	DRB	JDE	06/18/07	Approved	JDE
	CITY COMMENTS, 7/9/07	DRB	JDE	07/12/07		JDE

BLUE HILLS VILLAGE DITCH DRAINAGE CALCULATIONS
BLUE HILLS DRIVE & U.S. ROUTE 460 ROANOKE, VIRGINIA

SCALE: 1"=80'

OCT. 20, 2006

PROJECT: 06067

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