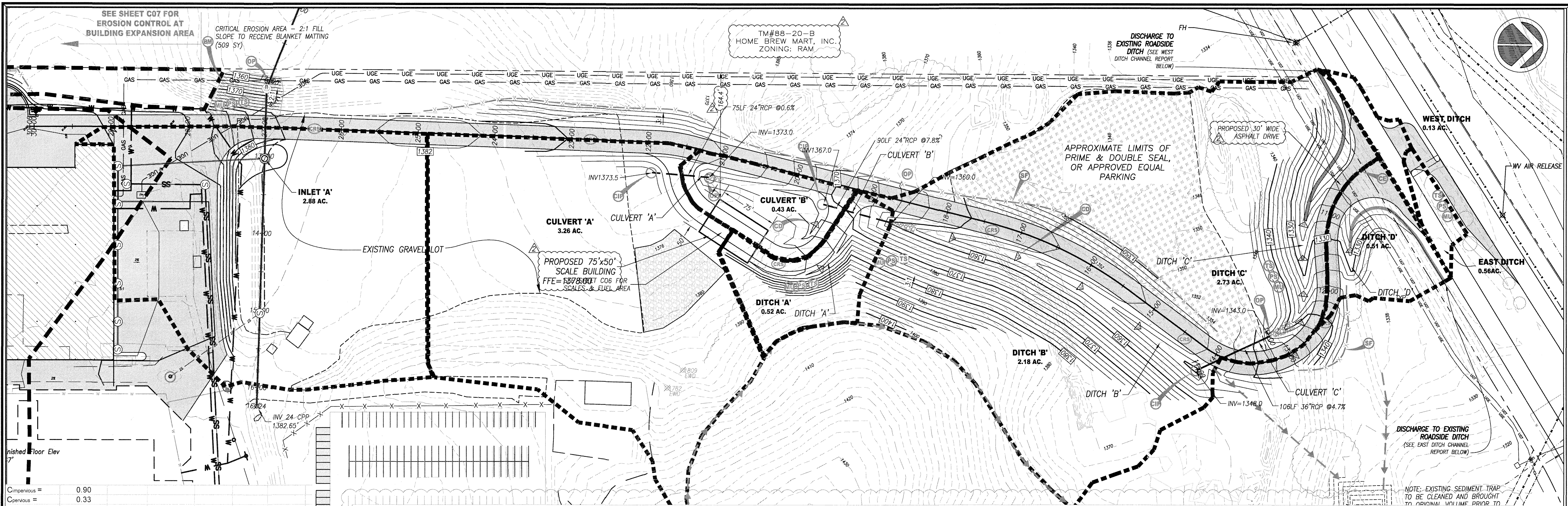




C _{impervious} =	0.90
C _{open} =	0.33
I ₂ =	4.51
I ₁₀ =	6.07
(Worse case Tc = 5 min. Botetourt County)	

Str. - Area	A _{impervious}	A _{open}	A _{total}	C _{weighted}	Q ₂	Q ₁₀
Inlet 'A'	2.47	0.41	2.88	0.82	10.6	14.3
Culvert 'A'	0.12	3.14	3.26	0.35	5.2	6.9
Culvert 'B'	0.20	0.23	0.43	0.60	1.2	1.6
Ditch 'A'	0.09	0.43	0.52	0.43	1.0	1.4
Ditch 'B'	0.15	2.03	2.18	0.37	3.6	4.9
Ditch 'C'	0.27	2.46	2.73	0.39	4.8	6.4
Ditch 'D'	0.08	0.43	0.51	0.42	1.0	1.3
West Ditch	0.12	0.01	0.13	0.86	0.5	0.7
East Ditch	0.05	0.06	0.56	0.12	0.3	0.4

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

East Ditch Q10 - Capacity

Triangular
Side Slopes (z:1) = 2.75, 8.30
Total Depth (ft) = 0.84
Invert Elev (ft) = 1322.00
Slope (%) = 0.85
N-Value = 0.026

Highlighted
Depth (ft) = 0.42
Q (cfs) = 1.70
Area (sqft) = 0.97
Velocity (ft/s) = 1.74
Wetted Perim (ft) = 4.74
Crit Depth, Yc (ft) = 0.36
Top Width (ft) = 4.64
EGL (ft) = 0.47

Calculations
Compute by: Known Q
Known Q (cfs) = 1.70

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Feb 6 2018

East Ditch Receiving - Lining

Triangular
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 1.00
Invert Elev (ft) = 1300.00
Slope (%) = 1.30
N-Value = 0.026

Highlighted
Depth (ft) = 0.44
Q (cfs) = 1.30
Area (sqft) = 0.58
Velocity (ft/s) = 2.24
Wetted Perim (ft) = 2.78
Crit Depth, Yc (ft) = 0.42
Top Width (ft) = 2.64
EGL (ft) = 0.52

Calculations
Compute by: Known Q
Known Q (cfs) = 1.30

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

West Ditch Q10 - Capacity

Triangular
Side Slopes (z:1) = 2.90, 9.50
Total Depth (ft) = 1.00
Invert Elev (ft) = 1320.00
Slope (%) = 1.37
N-Value = 0.026

Highlighted
Depth (ft) = 0.92
Q (cfs) = 20.50
Area (sqft) = 5.25
Velocity (ft/s) = 3.91
Wetted Perim (ft) = 11.81
Crit Depth, Yc (ft) = 0.93
Top Width (ft) = 11.41
EGL (ft) = 1.16

Calculations
Compute by: Known Q
Known Q (cfs) = 20.50

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Feb 6 2018

West Ditch Q10 - Lining

Triangular
Side Slopes (z:1) = 2.90, 9.50
Total Depth (ft) = 1.00
Invert Elev (ft) = 1320.00
Slope (%) = 1.37
N-Value = 0.026

Highlighted
Depth (ft) = 0.85
Q (cfs) = 16.30
Area (sqft) = 4.48
Velocity (ft/s) = 3.64
Wetted Perim (ft) = 10.73
Crit Depth, Yc (ft) = 0.85
Top Width (ft) = 10.54
EGL (ft) = 1.06

Calculations
Compute by: Known Q
Known Q (cfs) = 16.30

Culvert Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Culvert A - Q2

Invert Elev Dn (ft) = 1373.00
Pipe Length (ft) = 75.00
Slope (%) = 0.89
Invert Elev Up (ft) = 1373.45
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
N-Value = 0.013
Culvert Type = Circular Concrete
Culvert Entrance = Square edge whetstone (C)
Coeff. K₁M₁V₁K₂ = 0.0098, 2, 0.0366, 0.87, 0.5

Calculations
Q_{min} (cfs) = 5.20
Q_{max} (cfs) = 5.20
Tailwater Elev (ft) = (d+c)/2
Highlighted
Q_{total} (cfs) = 5.20
Q_{pipe} (cfs) = 5.20
Q_{overtop} (cfs) = 0.00
Veloc Dn (ft/s) = 2.21
Veloc Up (ft/s) = 4.41
HGL Dn (ft) = 1374.40
HGL Up (ft) = 1374.25
Hw Elev (ft) = 1374.58
Top Elevation (ft) = 1378.00
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Culvert Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Culvert B - Q2

Invert Elev Dn (ft) = 1390.00
Pipe Length (ft) = 90.00
Slope (%) = 0.89
Invert Elev Up (ft) = 1390.79
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
N-Value = 0.013
Culvert Type = Circular Concrete
Culvert Entrance = Square edge whetstone (C)
Coeff. K₁M₁V₁K₂ = 0.0098, 2, 0.0366, 0.87, 0.5

Calculations
Q_{min} (cfs) = 6.40
Q_{max} (cfs) = 6.40
Tailwater Elev (ft) = (d+c)/2
Highlighted
Q_{total} (cfs) = 6.40
Q_{pipe} (cfs) = 6.40
Q_{overtop} (cfs) = 0.00
Veloc Dn (ft/s) = 2.55
Veloc Up (ft/s) = 4.70
HGL Dn (ft) = 1391.45
HGL Up (ft) = 1391.70
Hw Elev (ft) = 1392.20
Top Elevation (ft) = 1395.00
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Culvert Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Culvert C - Q2

Invert Elev Dn (ft) = 1343.00
Pipe Length (ft) = 106.00
Slope (%) = 0.72
Invert Elev Up (ft) = 1343.80
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 1
N-Value = 0.013
Culvert Type = Circular Concrete
Culvert Entrance = Square edge whetstone (C)
Coeff. K₁M₁V₁K₂ = 0.0098, 2, 0.0366, 0.87, 0.5

Calculations
Q_{min} (cfs) = 10.00
Q_{max} (cfs) = 10.00
Tailwater Elev (ft) = (d+c)/2
Highlighted
Q_{total} (cfs) = 10.00
Q_{pipe} (cfs) = 10.00
Q_{overtop} (cfs) = 0.00
Veloc Dn (ft/s) = 2.00
Veloc Up (ft/s) = 4.35
HGL Dn (ft) = 1345.00
HGL Up (ft) = 1349.31
Hw Elev (ft) = 1349.44
Top Elevation (ft) = 1353.00
Top Width (ft) = 55.00
Crest Width (ft) = 10.00

Culvert Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Culvert A - Q10

Invert Elev Dn (ft) = 1373.00
Pipe Length (ft) = 75.00
Slope (%) = 0.89
Invert Elev Up (ft) = 1373.45
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
N-Value = 0.013
Culvert Type = Circular Concrete
Culvert Entrance = Square edge whetstone (C)
Coeff. K₁M₁V₁K₂ = 0.0098, 2, 0.0366, 0.87, 0.5

Calculations
Q_{min} (cfs) = 6.90
Q_{max} (cfs) = 6.90
Tailwater Elev (ft) = (d+c)/2
Highlighted
Q_{total} (cfs) = 6.90
Q_{pipe} (cfs) = 6.90
Q_{overtop} (cfs) = 0.00
Veloc Dn (ft/s) = 2.80
Veloc Up (ft/s) = 4.51
HGL Dn (ft) = 1374.47
HGL Up (ft) = 1374.38
Hw Elev (ft) = 1374.78
Top Elevation (ft) = 1378.00
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Culvert Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Culvert B - Q10

Invert Elev Dn (ft) = 1390.00
Pipe Length (ft) = 90.00
Slope (%) = 0.72
Invert Elev Up (ft) = 1390.79
Rise (in) = 24.0
Shape = Circular
Span (in) = 24.0
No. Barrels = 1
N-Value = 0.013
Culvert Type = Circular Concrete
Culvert Entrance = Square edge whetstone (C)
Coeff. K₁M₁V₁K₂ = 0.0098, 2, 0.0366, 0.87, 0.5

Calculations
Q_{min} (cfs) = 8.50
Q_{max} (cfs) = 8.50
Tailwater Elev (ft) = (d+c)/2
Highlighted
Q_{total} (cfs) = 8.50
Q_{pipe} (cfs) = 8.50
Q_{overtop} (cfs) = 0.00
Veloc Dn (ft/s) = 3.32
Veloc Up (ft/s) = 5.16
HGL Dn (ft) = 1391.52
HGL Up (ft) = 1395.04
Hw Elev (ft) = 1395.45
Top Elevation (ft) = 1398.00
Top Width (ft) = 30.00
Crest Width (ft) = 50.00

Culvert Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Culvert C - Q10

Invert Elev Dn (ft) = 1343.00
Pipe Length (ft) = 106.00
Slope (%) = 0.72
Invert Elev Up (ft) = 1343.80
Rise (in) = 36.0
Shape = Circular
Span (in) = 36.0
No. Barrels = 1
N-Value = 0.013
Culvert Type = Circular Concrete
Culvert Entrance = Square edge whetstone (C)
Coeff. K₁M₁V₁K₂ = 0.0098, 2, 0.0366, 0.87, 0.5

Calculations
Q_{min} (cfs) = 13.40
Q_{max} (cfs) = 13.40
Tailwater Elev (ft) = (d+c)/2
Highlighted
Q_{total} (cfs) = 13.40
Q_{pipe} (cfs) = 13.40
Q_{overtop} (cfs) = 0.00
Veloc Dn (ft/s) = 2.56
Veloc Up (ft/s) = 5.29
HGL Dn (ft) = 1345.08
HGL Up (ft) = 1349.16
Hw Elev (ft) = 1349.58
Top Elevation (ft) = 1353.00
Top Width (ft) = 55.00
Crest Width (ft) = 10.00

Inlet Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 19 2017

Inlet A - Q2

Drop Grate Inlet
Location = Sag
Curb Length (ft) = -0-
Throat Height (in) = -0-
Grate Area (sqft) = 6.25
Grate Width (ft) = 2.50
Grate Length (ft) = 2.50
Gutter Slope, Sw (ft/ft) = 0.068
Slope, Sx (ft/ft) = 0.068
Local Degr (in) = -0-
Gutter Width (ft) = 31.50
Gutter Slope (%) = -0-
Gutter n-value = -0-

Calculations
Compute by: Known Q
Known Q = 10.70
Highlighted
Q_{total} (cfs) = 10.70
Q_{capt} (cfs) = 10.70
Q_{bypass} (cfs) = -0-
Depth at Inlet (in) = 6.18
Efficiency (%) = 100
Gutter Vel (ft/s) = 48.29
Gutter Spread (ft) = -0-
Bypass Depth (in) = -0-

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 19 2017

Ditch A - Q10

Trapezoidal
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 1374.00
Slope (%) = 1.78
N-Value = 0.026

Highlighted
Depth (ft) = 0.58
Q (cfs) = 8.500
Area (sqft) = 4.00
Velocity (ft/s) = 3.92
Wetted Perim (ft) = 5.67
Crit Depth, Yc (ft) = 0.61
Top Width (ft) = 5.48
EGL (ft) = 0.82

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Tuesday, Sep 19 2017

Ditch B - Q10

Trapezoidal
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 1352.00
Slope (%) = 2.00
N-Value = 0.026

Highlighted
Depth (ft) = 0.45
Q (cfs) = 5.500
Area (sqft) = 1.51
Velocity (ft/s) = 3.65
Wetted Perim (ft) = 4.85
Crit Depth, Yc (ft) = 0.49
Top Width (ft) = 4.70
EGL (ft) = 0.86

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Ditch C - Q10

Trapezoidal
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 1322.00
Slope (%) = 1.10
N-Value = 0.026

Highlighted
Depth (ft) = 0.97
Q (cfs) = 19.80
Area (sqft) = 4.76
Velocity (ft/s) = 4.16
Wetted Perim (ft) = 8.13
Crit Depth, Yc (ft) = 0.95
Top Width (ft) = 7.82
EGL (ft) = 1.24

Channel Report

Hydroware Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Wednesday, Jan 24 2018

Ditch D - Q10

Trapezoidal
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 1324.00
Slope (%) = 1.10
N-Value = 0.026

Highlighted
Depth (ft) = 0.25
Q (cfs) = 1.300
Area (sqft) = 0.69
Velocity (ft/s) = 1.88
Wetted Perim (ft) = 3.58
Crit Depth, Yc (ft) = 0.22
Top Width (ft) = 3.50
EGL (ft) = 0.31

No.	Revision	By	Appd.	Date	Drawn
1	VOOT COMMENTS	ECI	RHW	2/5/18	Designed
2	BotCo COMMENTS 2/2/18	ECI	RHW	2/16/18	ECI
					Checked
					ECI
					Approved
					RHW