



## Memorandum

**From:** Ellen O'Brien, Northstar Hydro, Inc.

**To:** Garrett Gustafson, Maine DOT

**Date:** 9/4/19

**ADDENDUM** added 11/12/19, REV 11/15/19

**Re: Review of Hydrology and Hydraulics for Palmer Bridge #5141 over Magotty Meadow Brook In Litchfield, Maine - WIN 022246.0. HECRAS Analysis added in Addendum.**

Northstar Hydro, Inc. (NHI) has prepared this review of hydrologic and hydraulic analyses for the replacement of Palmer Bridge #5141 over Magotty Meadow Brook in Litchfield, Maine.

This is an interesting site where rapid flow and potential backwater may influence water levels and have an impact on bridge size selection, specifically low chord or top of box elevation.

As shown in photos in the PDR report and inspection photos, an existing cmp culvert rests on bedrock, with a pool upstream and a drop of several feet on bedrock downstream. Downstream of the culvert is a pool, similar to a scour pool that might result from an undersized bridge or culvert, but likely also related to the rock face/slope below the culvert.



*Figure 1. Downstream face of Bridge #5141. Photo courtesy MaineDOT*

Magotty Meadow Brook has a drainage basin of 6.4 square miles, a 100-year flow of 815 cfs and a computed bankfull width of 20' according to StreamStats. Field measured BFW by ME DOT's Environmental Section was listed as 21' according to the PDR report.

Thoughts on proposed replacement.

- The current hydraulic opening is 148.5 square feet. 50-year flow fills less than half of the existing culvert. 100-year flow fills about half of the culvert.
- Flows through the culvert under existing conditions are very rapid. For the 50-year flow, existing velocity is computed to be 16.7 fps at the outlet. Rapid flow depresses the water surface, but the energy grade line of flow is higher. Where flow is slow, such as at the entrance to the culvert along the wingwalls or embankments, water surface elevation will approach the energy grade line.
- Design guidance for culverts is to have  $HW/D < 0.9$  for the 50-year flow.
- It is proposed to downsize the hydraulic opening to 114.5 square feet. The proposed replacement is planned to be set about 1' lower than existing at the inlet, and is proposed to be 15' (at the footings) to 17' wide. Inlet rise is proposed at 7', compared to existing rise of nearly 14'.
- HY 8 was used to compute hydraulic performance of the existing and proposed culverts.  $HW/D$  for the existing culvert for the 50- and 100-year floods is computed at 0.4 and 0.5 respectively. For the proposed box, these values are 0.9 and 1.0. Proposed headwater elevation is computed to be lower than existing.
- The upstream invert of the proposed culvert will be lower than existing. Comparing upstream depth for existing and proposed yields higher depths for the proposed culvert.
- Downsizing the hydraulic opening is not generally recommended without careful consideration of consequences. While the proposed culvert would increase stream width, it does not reach BFW. Upstream depths will be higher than existing, although water surface elevations are not expected to be higher. Proposed condition 50-year and 100-year water levels will be very close to the low chord of the new box.
- While the culvert slope is decreased in the proposed condition, there is an increase in outlet velocities from the existing condition for all flow scenarios. The reduction in channel width at the culvert also likely increases culvert velocities above natural channel velocities which is not recommended for fish passage.
- While the numbers work as far as water surface elevations and  $HW/D$ , it is recommended that a second check on size/performance be performed for final design.
- HECRAS computes both WSEL and EGL in greater detail than HY8 and may provide additional insight into this site. In this case, where it is proposed to downsize the replacement culvert, a check on WSEL vs EGL is recommended. A simple HECRAS model may provide additional information on downstream water levels, velocities in the culvert, and full energy grade line at the inlet to the culvert.

We have reviewed Hydrologic and HY-8 calculations and the PDR report. We recommend compiling a basic HECRAS model for the site to cross check the HY-8 conclusions. If the culvert is subject to fish passage criteria, we recommend considering a culvert that spans the bank full width of 21'.

#### **Addendum:**

MaineDOT requested that NHI compile a HECRAS analysis for the project site, exploring options for the replacement bridge that meet DOT design guidance. The RAS model was compiled in HEC Geo-RAS

using project survey provided by MDOT and available LIDAR. NHI has designed this addendum to address DOT Bridge design criteria and potential fish passage requirements.

NHI analyzed the existing culvert and MDOT's proposed 17' X 7' Box Arch option using HECRAS. NHI also analyzed two a bridge options based on Bank Full Width and 1.2 X Bank Full Width (BFW) as recommended for fish passage. All bridges were assumed to have identical inverts, low chord and length. Each box arch was assumed to be set on footings identical to the 17' option, i.e. 1' wide from wall to edge, flat grade and 2.5' high at the upstream end, 4.2' high at the downstream end. No stream bottom modifications specific to fish passage were evaluated for this phase of design.

Figures 2 and 3 illustrate computed water surface profiles for the 17' X 7' option and the 25' X 7' option. Flows range from median low flows in August and September to 500-year flood peak.

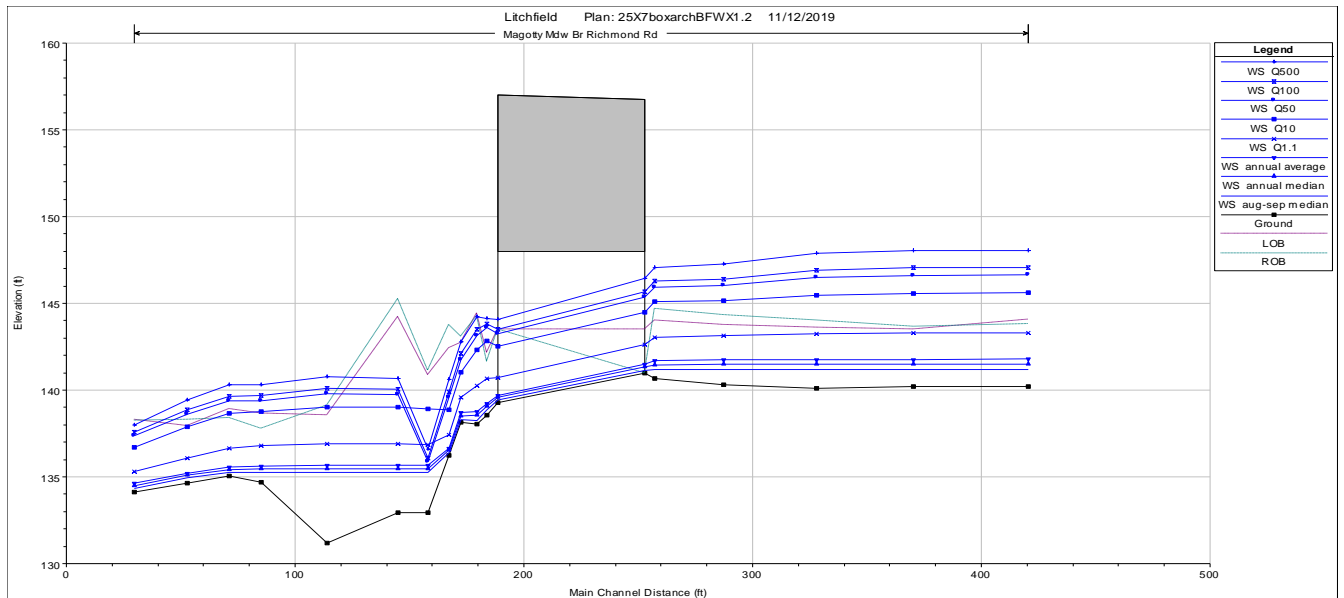


Figure 2. Water surface profiles for recommended 25' X 7' span, BFW X 1.2

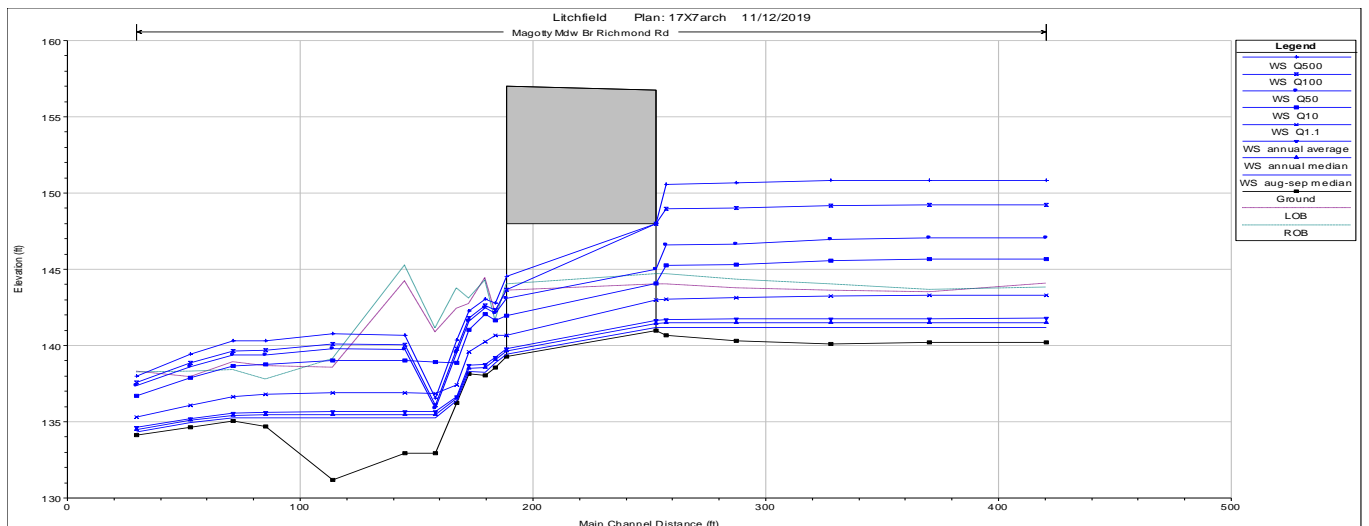


Figure 3. Water surface profiles, 17' X 7'.

Other details are listed in table 1 which summarizes assumed geometries, HECRAS model results and design clearances.

<b>Litchfield Palmer Hydraulic Analysis Summary Table</b>	<b>Q, cfs</b>	<b>Existing 13.5' Diam. CMP</b>	<b>MDOT design, 17' Span, 7' Rise</b>	<b>BFW 21'Span X7' Rise</b>	<b>1.2 BFW 25' Span X7' Rise</b>
Invert Down		138.7	139.3	139.3	139.3
Invert Up		140.9	140.98	140.98	140.98
Low Chord- US		154.4	148	148	148
Length		68.6	64	64	64
Slope		0.03206997	0.02625	0.02625	0.02625
Bridge Area, ft2		143.1	114.7	156.6	175.7
<b>WSELS upstream (sec. 287.3)</b>					
Aug-Sep Median	1.3	141.2	141.21	141.18	141.17
Annual Median	6.1	141.7	141.49	141.49	141.49
Annual Average	12.6	142	141.74	141.73	141.73
Q1.1	107	144.2	143.15	143.16	143.15
Q10	451	147.9	145.29	145.21	145.15
Q50	695	149.8	146.66	146.14	146.03
Q100	815	150.6	149.04	146.53	146.39
Q500	1105	152.5	150.67	149.03	147.26
<b>Velocity</b>					
Aug-Sep Median	1.3	2.5	0.6	0.49	0.45
Annual Median	6.1	4.1	1.3	1.03	0.96
Annual Average	12.6	5.2	1.8	1.43	1.32
Q1.1	107	9.9	5.2	3.36	3.09
Q10	451	14.4	11.2	6.51	5.86
Q50	695	16	12.3	8.35	7.35
Q100	815	16.7	12.4	9.43	8.09
Q500	1105	18	13.6	10.72	9.63
<b>Design Criteria</b>					
Clearance, Q50 (Bridges, 2' recommended)	695	4.6	1.34	1.86	1.97
Clearance, Q100 (Bridge recommends no overtopping)	815	3.8	-1.04	1.47	1.61
HW/D, Q50 (Culvert recommended <0.9)	695	0.66	0.81	0.74	0.72
Low Flow velocity		2.5	0.6	0.49	0.45

**Table 1.** Hydraulic Analysis, Bridge # 5141

Findings using the RAS model include:

- The model was started at the downstream end below the pool, and below the drop downstream of the pool. Normal depth was assumed with a slope equal to the slope of the most downstream segment of the model, or 0.024. The model was run in mixed flow mode.
- Higher flows experience a hydraulic jump at the base of the steeper rock section, dropping into the pool.
- The existing CMP has sufficient clearance, but does not meet fish passage criteria in terms of width, grade or fish friendly design.
- It is assumed that design goals for this location would be 2' clearance for the 50-year storm and no overtopping for the 100-year storm.
- The 17' X 7' option provides only 1.3' of clearance for the 50- year event, and while not overtopping during a 100-year event, this option is likely to surcharge.
- A 21' span would be equivalent to bank full width within the culvert, but not at the footings. Width for low flows would be 19' due to the footings.
- The 21' span would have approximately 1.9' of clearance for a 50-year event.
- The 25' span meets BFW X 1.2 criteria, although width at footings would be slightly less, 23'.
- 50-year clearance for the 25' span would be 2'.
- Low flow velocities for each option are listed in Table 1.

The HECRAS model can be modified to simulate other options in rise, span or slope.

Additional hydraulic information using Energy Grade Line (EGL) Elevations is included in table 2. With high velocities, EGL, provides additional insight into potential freeboard issues. With the 7' rise, Q50 freeboard is very close to the recommended 2' for WSEL, and less than 2' using EGL for even the 25' span.

A higher rise would

- Improve freeboard.
- Allow modification of stream bottom for fish passage, i.e. adding rocks or weirs for resting locations.

Geometry	Q	Existing 13.5' Diam. CMP	MDOT design, 17' Span, 7' Rise	BFW 21'Span X7' Rise	1.2 BFW 25' Span X7' Rise
Invert Down		138.7	139.3	139.3	139.3
Invert Up		140.9	140.98	140.98	140.98
Low Chord- US		154.4	148	148	148
Length		68.6	64	64	64
Slope		0.032	0.026	0.026	0.026
Bridge Area, ft2		143.1	114.7	156.6	175.7
<b>WSELS upstream (section 287.3)</b>					
Aug-Sep Median	1.3	141.2	141.2	141.2	141.2
Annual Median	6.1	141.7	141.5	141.5	141.5
Annual Average	12.6	142.0	141.7	141.7	141.7
Q1.1	107	144.2	143.2	143.2	143.2
Q10	451	147.9	145.3	145.2	145.2
Q50	695	149.8	146.7	146.1	146.0
Q100	815	150.6	149.0	146.5	146.4
Q500	1105	152.5	150.7	149.0	147.3
<b>Energy Grade Line upstream, section 287.3</b>					
Aug-Sep Median	1.3	141.5	141.2	141.2	141.2
Annual Median	6.1	141.9	141.5	141.5	141.5
Annual Average	12.6	142.2	141.8	141.8	141.7
Q1.1	107	144.4	143.3	143.3	143.3
Q10	451	148.3	145.7	145.6	145.6
Q50	695	150.3	147.1	146.7	146.6
Q100	815	151.2	149.2	147.2	147.1
Q500	1105	153.2	150.9	149.4	148.0
<b>Q50 Clearance, EGL</b>					
		4.1	0.9	1.3	1.4
<b>Depth Upstream, WSEL @ 287.3- US invert. Section 287.3</b>					
Aug-Sep Median	1.3	0.3	0.2	0.2	0.2
Annual Median	6.1	0.8	0.5	0.5	0.5
Annual Average	12.6	1.1	0.8	0.8	0.8
Q1.1	107	3.3	2.2	2.2	2.2
Q10	451	7.0	4.3	4.2	4.2
Q50	695	8.9	5.7	5.2	5.1
Q100	815	9.7	8.1	5.6	5.4
Q500	1105	11.6	9.7	8.1	6.3

**Table 2.** WSEL compared to EGL, and computed upstream depths.



**Additional Site Photographs:**



*Figure 4. Downstream Face. note sharp drop below culvert into pool.*



*Figure 5. Looking downstream. Note pool and riffle area downstream of pool.*





*Figure 6. Looking downstream. Note drop at lip of culvert concrete pad.*



*Figure 7. Drop at downstream end of culvert.*





*Figure 8. Looking downstream from left bank.*



*Figure 9. Looking upstream from roadway.*

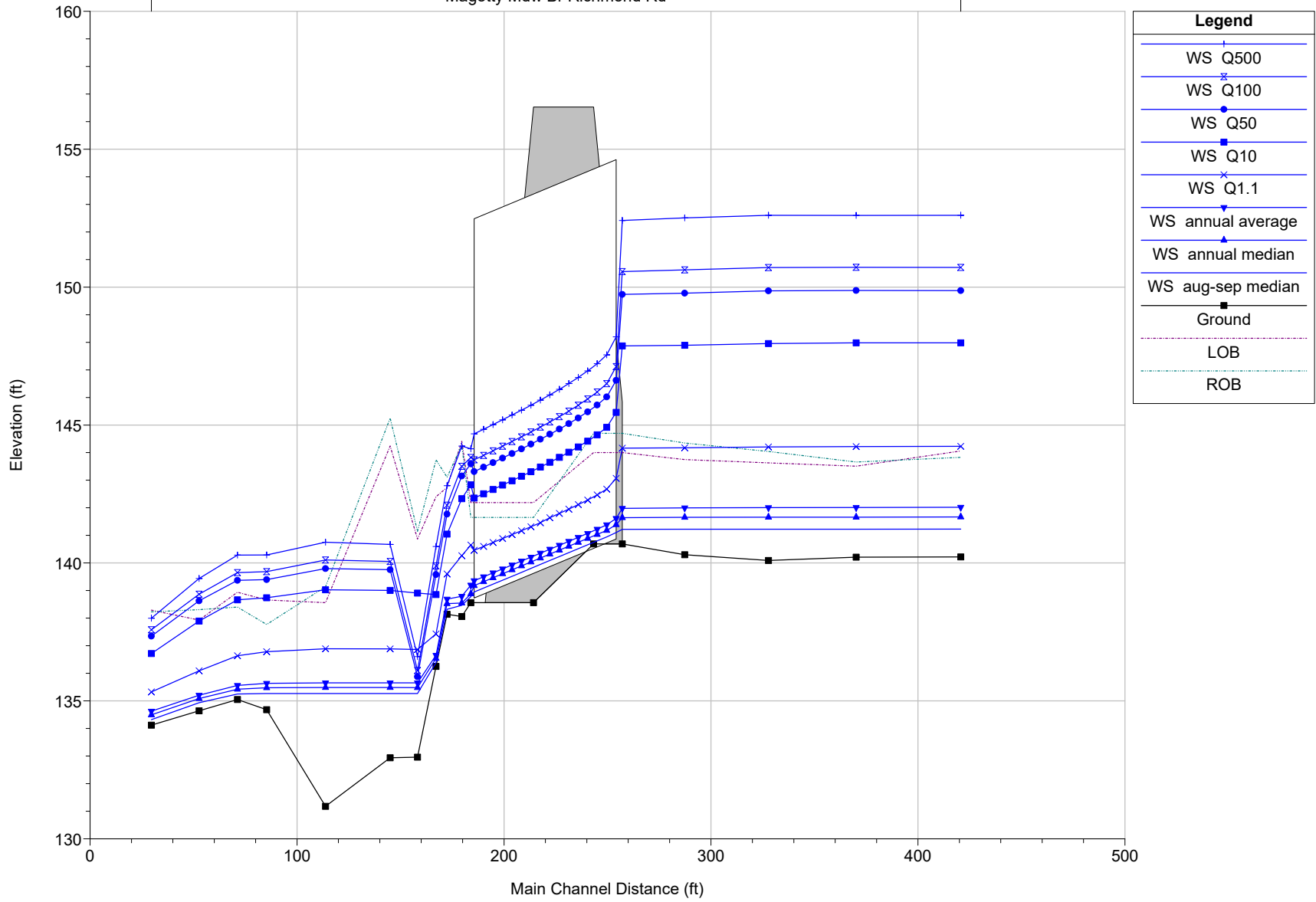




*Figure 10. Upstream end of existing culvert, note drop into culvert from upstream pool.*

Litchfield Plan: Existing BR 11/8/2019

Magotty Mdw Br Richmond Rd

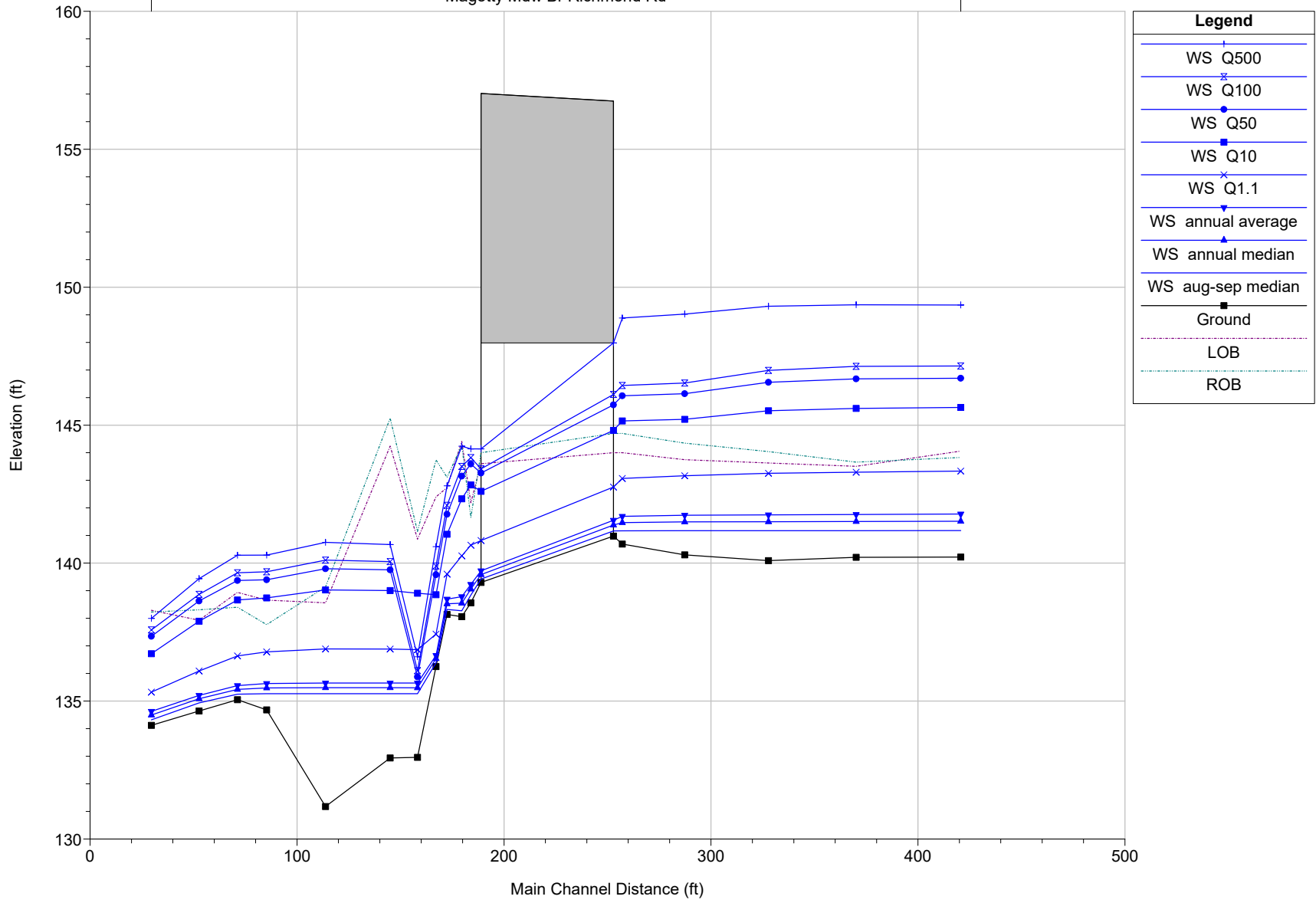






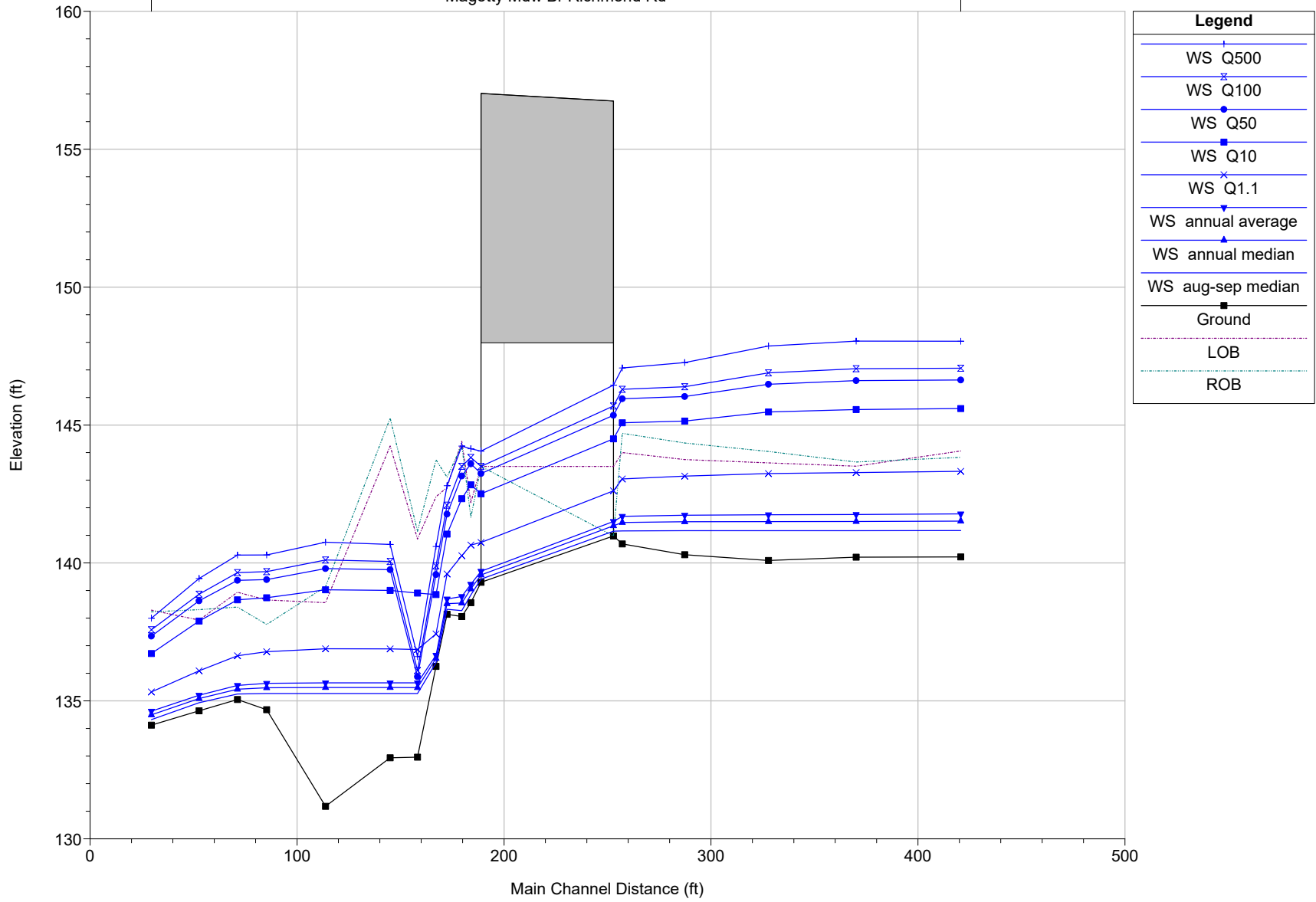
Litchfield Plan: 21X7boxarch 11/12/2019

Magotty Mdw Br Richmond Rd



Litchfield Plan: 25X7boxarchBFWX1.2 11/12/2019

Magotty Mdw Br Richmond Rd





HEC-RAS Plan: EX River: Magotty Mdw Br Reach: Richmond Rd

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
Richmond Rd	287.3074	aug-sep median	141.22	141.22	0.00	0.00	0.00		1.26		12.48
Richmond Rd	287.3074	annual median	141.66	141.65	0.00	0.01	0.00		6.10		15.04
Richmond Rd	287.3074	annual average	142.00	142.00	0.01	0.01	0.00		12.60		16.80
Richmond Rd	287.3074	Q1.1	144.22	144.18	0.05	0.02	0.00	0.10	106.90		25.15
Richmond Rd	287.3074	Q10	147.99	147.89	0.10	0.01	0.00	54.77	375.95	20.28	109.87
Richmond Rd	287.3074	Q50	149.88	149.78	0.10	0.01	0.00	104.09	523.40	67.51	152.90
Richmond Rd	287.3074	Q100	150.73	150.62	0.10	0.01	0.00	126.63	583.43	104.94	163.05
Richmond Rd	287.3074	Q500	152.61	152.51	0.10	0.01	0.01	178.62	716.42	209.96	195.13
Richmond Rd	257.1795	aug-sep median	141.22	141.22	0.00				1.26		11.54
Richmond Rd	257.1795	annual median	141.65	141.64	0.01				6.10		14.58
Richmond Rd	257.1795	annual average	141.99	141.98	0.01				12.60		16.77
Richmond Rd	257.1795	Q1.1	144.21	144.16	0.04			0.01	106.99		29.26
Richmond Rd	257.1795	Q10	147.97	147.87	0.11			4.64	442.42	3.94	77.45
Richmond Rd	257.1795	Q50	149.87	149.73	0.14			8.65	668.20	18.15	126.14
Richmond Rd	257.1795	Q100	150.71	150.56	0.15			10.67	776.89	27.44	139.73
Richmond Rd	257.1795	Q500	152.59	152.42	0.18			15.64	1036.74	52.62	162.65
Richmond Rd	220.8936		Culvert								
Richmond Rd	183.9802	aug-sep median	138.96	138.78	0.18				1.26		3.41
Richmond Rd	183.9802	annual median	139.75	138.88	0.87	0.66	0.14		6.10		5.09
Richmond Rd	183.9802	annual average	139.42	139.20	0.22	0.17	0.02		12.60		9.32
Richmond Rd	183.9802	Q1.1	141.04	140.65	0.39	0.05	0.03		107.00		14.35
Richmond Rd	183.9802	Q10	143.52	142.83	0.69	0.04	0.04	0.30	449.79	0.90	28.23
Richmond Rd	183.9802	Q50	144.58	143.59	0.99	0.04	0.04	1.57	691.07	2.36	31.09
Richmond Rd	183.9802	Q100	145.01	143.82	1.19	0.05	0.02	2.21	809.74	3.05	32.06
Richmond Rd	183.9802	Q500	145.99	144.14	1.85	0.05	0.07	3.62	1096.77	4.61	33.64
Richmond Rd	179.6062	aug-sep median	138.50	138.46	0.03	0.11	0.00		1.26		3.64
Richmond Rd	179.6062	annual median	138.96	138.55	0.41	0.19	0.01		6.10		4.17
Richmond Rd	179.6062	annual average	139.22	138.79	0.43	0.26	0.06		12.60		5.72
Richmond Rd	179.6062	Q1.1	140.96	140.26	0.69	0.19	0.04		107.00		11.53
Richmond Rd	179.6062	Q10	143.44	142.33	1.11	0.16	0.10		451.00		24.03
Richmond Rd	179.6062	Q50	144.50	143.15	1.34	0.15	0.11		695.00		27.78
Richmond Rd	179.6062	Q100	144.94	143.50	1.43	0.14	0.12		815.00		29.49
Richmond Rd	179.6062	Q500	145.87	144.24	1.64	0.13	0.12		1105.00		33.09

HEC-RAS Plan: EX River: Magotty Mdw Br Reach: Richmond Rd

Reach	River Sta	Profile	E.G. US. (ft)	W.S. US. (ft)	E.G. IC (ft)	E.G. OC (ft)	Min El Weir Flow (ft)	Q Culv Group (cfs)	Q Weir (cfs)	Delta WS (ft)	Culv Vel US (ft/s)	Culv Vel DS (ft/s)
Richmond Rd	220.8936 Culvert #1	aug-sep median	141.22	141.22	140.97	141.22	156.73	1.26		2.38	2.24	2.53
Richmond Rd	220.8936 Culvert #1	annual median	141.65	141.64	141.35	141.65	156.73	6.10		2.58	3.35	4.12
Richmond Rd	220.8936 Culvert #1	annual average	141.99	141.98	141.65	141.99	156.73	12.60		2.75	4.02	5.21
Richmond Rd	220.8936 Culvert #1	Q1.1	144.21	144.16	143.62	144.21	156.73	107.00		3.51	6.99	9.90
Richmond Rd	220.8936 Culvert #1	Q10	147.97	147.87	147.01	147.97	156.73	451.00		5.03	10.38	14.43
Richmond Rd	220.8936 Culvert #1	Q50	149.87	149.73	148.79	149.87	156.73	695.00		6.14	11.81	16.04
Richmond Rd	220.8936 Culvert #1	Q100	150.71	150.56	149.59	150.71	156.73	815.00		6.74	12.42	16.67
Richmond Rd	220.8936 Culvert #1	Q500	152.59	152.42	151.46	152.59	156.73	1105.00		8.28	13.74	17.95

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: aug-sep median

Q Culv Group (cfs)	1.26	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	2.24
Q Barrel (cfs)	1.26	Culv Vel DS (ft/s)	2.53
E.G. US. (ft)	141.22	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	141.22	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	138.91	Culv Frctn Ls (ft)	2.14
W.S. DS (ft)	138.84	Culv Exit Loss (ft)	0.14
Delta EG (ft)	2.32	Culv Entr Loss (ft)	0.04
Delta WS (ft)	2.38	Q Weir (cfs)	
E.G. IC (ft)	140.97	Weir Sta Lft (ft)	
E.G. OC (ft)	141.22	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	141.11	Weir Max Depth (ft)	
Culv WS Outlet (ft)	138.95	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	0.22	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	0.24	Min El Weir Flow (ft)	156.73

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: annual median

Q Culv Group (cfs)	6.10	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	3.35
Q Barrel (cfs)	6.10	Culv Vel DS (ft/s)	4.12
E.G. US. (ft)	141.65	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	141.64	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	139.19	Culv Frctn Ls (ft)	2.12
W.S. DS (ft)	139.06	Culv Exit Loss (ft)	0.26
Delta EG (ft)	2.46	Culv Entr Loss (ft)	0.09
Delta WS (ft)	2.58	Q Weir (cfs)	
E.G. IC (ft)	141.35	Weir Sta Lft (ft)	
E.G. OC (ft)	141.65	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	141.39	Weir Max Depth (ft)	
Culv WS Outlet (ft)	139.18	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	0.45	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	0.52	Min El Weir Flow (ft)	156.73

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: annual average

Q Culv Group (cfs)	12.60	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	4.02
Q Barrel (cfs)	12.60	Culv Vel DS (ft/s)	5.21
E.G. US. (ft)	141.99	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	141.98	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	139.41	Culv Frctn Ls (ft)	2.09
W.S. DS (ft)	139.23	Culv Exit Loss (ft)	0.36
Delta EG (ft)	2.58	Culv Entr Loss (ft)	0.13
Delta WS (ft)	2.75	Q Weir (cfs)	
E.G. IC (ft)	141.65	Weir Sta Lft (ft)	
E.G. OC (ft)	141.99	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	141.62	Weir Max Depth (ft)	
Culv WS Outlet (ft)	139.36	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	0.63	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	0.75	Min El Weir Flow (ft)	156.73



Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: Q1.1

Q Culv Group (cfs)	107.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	6.99
Q Barrel (cfs)	107.00	Culv Vel DS (ft/s)	9.90
E.G. US. (ft)	144.21	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	144.16	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	141.04	Culv Frctn Ls (ft)	1.84
W.S. DS (ft)	140.65	Culv Exit Loss (ft)	0.94
Delta EG (ft)	3.16	Culv Entr Loss (ft)	0.38
Delta WS (ft)	3.51	Q Weir (cfs)	
E.G. IC (ft)	143.62	Weir Sta Lft (ft)	
E.G. OC (ft)	144.21	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	143.07	Weir Max Depth (ft)	
Culv WS Outlet (ft)	140.46	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.73	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.20	Min El Weir Flow (ft)	156.73

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: Q10

Q Culv Group (cfs)	451.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	10.38
Q Barrel (cfs)	451.00	Culv Vel DS (ft/s)	14.43
E.G. US. (ft)	147.97	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	147.87	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	143.52	Culv Frctn Ls (ft)	1.55
W.S. DS (ft)	142.83	Culv Exit Loss (ft)	2.07
Delta EG (ft)	4.45	Culv Entr Loss (ft)	0.84
Delta WS (ft)	5.03	Q Weir (cfs)	
E.G. IC (ft)	147.01	Weir Sta Lft (ft)	
E.G. OC (ft)	147.97	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	145.46	Weir Max Depth (ft)	
Culv WS Outlet (ft)	142.35	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	3.50	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	4.59	Min El Weir Flow (ft)	156.73

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: Q50

Q Culv Group (cfs)	695.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	11.81
Q Barrel (cfs)	695.00	Culv Vel DS (ft/s)	16.04
E.G. US. (ft)	149.87	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	149.73	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	144.58	Culv Frctn Ls (ft)	1.48
W.S. DS (ft)	143.59	Culv Exit Loss (ft)	2.73
Delta EG (ft)	5.29	Culv Entr Loss (ft)	1.08
Delta WS (ft)	6.14	Q Weir (cfs)	
E.G. IC (ft)	148.79	Weir Sta Lft (ft)	
E.G. OC (ft)	149.87	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	146.62	Weir Max Depth (ft)	
Culv WS Outlet (ft)	143.31	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	4.37	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	5.75	Min El Weir Flow (ft)	156.73

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: Q100

Q Culv Group (cfs)	815.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	12.42
Q Barrel (cfs)	815.00	Culv Vel DS (ft/s)	16.67
E.G. US. (ft)	150.71	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	150.56	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	145.01	Culv Frctn Ls (ft)	1.46
W.S. DS (ft)	143.82	Culv Exit Loss (ft)	3.04
Delta EG (ft)	5.70	Culv Entr Loss (ft)	1.20
Delta WS (ft)	6.74	Q Weir (cfs)	
E.G. IC (ft)	149.59	Weir Sta Lft (ft)	
E.G. OC (ft)	150.71	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	147.12	Weir Max Depth (ft)	
Culv WS Outlet (ft)	143.74	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	4.76	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	6.25	Min El Weir Flow (ft)	156.73

Plan: EX Magotty Mdw Br Richmond Rd RS: 220.8936 Culv Group: Culvert #1 Profile: Q500

Q Culv Group (cfs)	1105.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	13.74
Q Barrel (cfs)	1105.00	Culv Vel DS (ft/s)	17.95
E.G. US. (ft)	152.59	Culv Inv El Up (ft)	140.87
W.S. US. (ft)	152.42	Culv Inv El Dn (ft)	138.73
E.G. DS (ft)	145.99	Culv Frctn Ls (ft)	1.44
W.S. DS (ft)	144.14	Culv Exit Loss (ft)	3.69
Delta EG (ft)	6.60	Culv Entr Loss (ft)	1.47
Delta WS (ft)	8.28	Q Weir (cfs)	
E.G. IC (ft)	151.46	Weir Sta Lft (ft)	
E.G. OC (ft)	152.59	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	148.20	Weir Max Depth (ft)	
Culv WS Outlet (ft)	144.68	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	5.60	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	7.33	Min El Weir Flow (ft)	156.73

HEC-RAS Plan: 17X7boxarch River: Magotty Mdw Br Reach: Richmond Rd

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
Richmond Rd	287.3074	aug-sep median	141.21	141.21	140.44	0.00	0.00	12.38		1.26		0.15
Richmond Rd	287.3074	annual median	141.50	141.49	140.63	0.01	0.00	14.10		6.10		0.51
Richmond Rd	287.3074	annual average	141.75	141.74	140.79	0.02	0.00	15.55		12.60		0.80
Richmond Rd	287.3074	Q1.1	143.25	143.15	141.88	0.06	0.00	19.36		107.00		2.62
Richmond Rd	287.3074	Q10	145.68	145.29	143.63	0.08	0.01	56.67	14.03	435.97	1.00	5.14
Richmond Rd	287.3074	Q50	147.08	146.66	144.54	0.06	0.00	80.79	61.01	621.76	12.22	5.48
Richmond Rd	287.3074	Q100	149.23	149.04	145.08	0.02	0.00	136.94	115.13	638.04	61.83	3.91
Richmond Rd	287.3074	Q500	150.86	150.67	145.86	0.02	0.01	163.85	171.95	788.62	144.42	3.99
Richmond Rd	257.1795	aug-sep median	141.21	141.20	140.94			11.39		1.26		0.44
Richmond Rd	257.1795	annual median	141.49	141.47	141.15			13.34		6.10		0.99
Richmond Rd	257.1795	annual average	141.73	141.70	141.30			14.98		12.60		1.34
Richmond Rd	257.1795	Q1.1	143.18	143.04	142.26			22.57		107.00		3.03
Richmond Rd	257.1795	Q10	145.59	145.23	143.86	0.03	0.10	50.07	1.75	449.16	0.09	4.80
Richmond Rd	257.1795	Q50	147.01	146.60	144.60	0.02	0.14	63.12	5.47	687.24	2.28	5.19
Richmond Rd	257.1795	Q100	149.21	148.97	144.89			105.23	9.55	790.43	15.03	3.95
Richmond Rd	257.1795	Q500	150.83	150.56	145.56			139.67	14.46	1053.39	37.15	4.30
Richmond Rd	221 BR U	aug-sep median	141.20	141.20	141.05			14.92		1.26		0.38
Richmond Rd	221 BR U	annual median	141.46	141.45	141.15			14.94		6.10		0.87
Richmond Rd	221 BR U	annual average	141.68	141.65	141.27			14.95		12.60		1.25
Richmond Rd	221 BR U	Q1.1	143.17	142.97	142.15			15.06		107.00		3.58
Richmond Rd	221 BR U	Q10	145.46	144.08	144.08	1.22	0.01	17.28		451.00		9.44
Richmond Rd	221 BR U	Q50	146.85	145.00	145.00	1.24	0.02	17.22		695.00		10.91
Richmond Rd	221 BR U	Q100	149.21	147.98	145.41					815.00		7.11
Richmond Rd	221 BR U	Q500	150.83	147.98	146.33					1105.00		9.64
Richmond Rd	221 BR D	aug-sep median	139.45	139.45	139.36			14.91		1.26		0.58
Richmond Rd	221 BR D	annual median	139.65	139.63	139.47			14.92		6.10		1.25
Richmond Rd	221 BR D	annual average	139.83	139.78	139.58			14.92		12.60		1.75
Richmond Rd	221 BR D	Q1.1	141.10	140.67	140.47			14.97		107.00		5.22
Richmond Rd	221 BR D	Q10	143.94	141.98	142.35	0.17	0.01	15.03		451.00		11.24
Richmond Rd	221 BR D	Q50	145.42	143.07	143.37	0.16	0.07	15.08		695.00		12.30
Richmond Rd	221 BR D	Q100	146.05	143.66	143.95			17.31		815.00		12.39
Richmond Rd	221 BR D	Q500	147.43	144.55	144.88			17.25		1105.00		13.61
Richmond Rd	183.9802	aug-sep median	138.91	138.84	138.84	0.29	0.03	4.39		1.26		2.05
Richmond Rd	183.9802	annual median	139.19	139.06	139.06	0.20	0.03	8.54		6.10		2.89
Richmond Rd	183.9802	annual average	139.41	139.23	139.23	0.15	0.03	9.49		12.60		3.46
Richmond Rd	183.9802	Q1.1	141.04	140.65	140.34	0.05	0.03	14.35		107.00		5.02
Richmond Rd	183.9802	Q10	143.76	141.65	142.29	0.10	0.30	23.10		451.00		11.65
Richmond Rd	183.9802	Q50	145.19	142.09	143.02	0.17	0.23	25.33		694.76	0.24	14.12
Richmond Rd	183.9802	Q100	145.78	142.30	143.35	0.18	0.22	26.24	0.01	814.33	0.66	14.96
Richmond Rd	183.9802	Q500	147.12	142.76	144.05	0.19	0.20	27.95	0.58	1102.39	2.03	16.77
Richmond Rd	179.6062	aug-sep median	138.59	138.27	138.36	0.11	0.00	2.45		1.26		4.51
Richmond Rd	179.6062	annual median	138.95	138.55	138.68	0.19	0.01	4.19		6.10		5.12
Richmond Rd	179.6062	annual average	139.23	138.78	138.92	0.17	0.01	5.66		12.60		5.37
Richmond Rd	179.6062	Q1.1	140.96	140.26	140.26	0.19	0.04	11.53		107.00		6.68
Richmond Rd	179.6062	Q10	143.49	142.05	142.33	0.21	0.08	22.78		451.00		9.60
Richmond Rd	179.6062	Q50	144.80	142.46	143.15	0.25	0.05	24.62		695.00		12.29
Richmond Rd	179.6062	Q100	145.39	142.65	143.50	0.27	0.05	25.50		815.00		13.26
Richmond Rd	179.6062	Q500	146.73	143.05	144.24	0.31	0.04	27.28		1105.00		15.39



HEC-RAS Plan: 17X7boxarch River: Magotty Mdw Br Reach: Richmond Rd (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Richmond Rd	158.1909	annual median	6.10	132.96	135.48	133.62	135.48	0.000024	0.24	25.03	19.31	0.04
Richmond Rd	158.1909	annual average	12.60	132.96	135.65	133.84	135.66	0.000073	0.44	28.42	20.22	0.07
Richmond Rd	158.1909	Q1.1	107.00	132.96	136.86	135.09	136.92	0.000758	1.91	56.04	25.39	0.23
Richmond Rd	158.1909	Q10	451.00	132.96	138.91	136.79	139.15	0.001740	3.95	114.13	31.50	0.37
Richmond Rd	158.1909	Q50	695.00	132.96	135.86	137.55	142.92	0.149175	21.33	32.59	21.08	3.02
Richmond Rd	158.1909	Q100	815.00	132.96	136.07	137.88	143.54	0.140548	21.92	37.18	22.00	2.97
Richmond Rd	158.1909	Q500	1105.00	132.96	136.52	138.62	144.89	0.127801	23.20	47.63	23.95	2.90
Richmond Rd	144.998	aug-sep median	1.26	132.94	135.27	133.20	135.27	0.000001	0.04	34.66	32.58	0.01
Richmond Rd	144.998	annual median	6.10	132.94	135.48	133.44	135.48	0.000009	0.15	41.80	34.18	0.02
Richmond Rd	144.998	annual average	12.60	132.94	135.65	133.62	135.66	0.000027	0.26	47.77	35.46	0.04
Richmond Rd	144.998	Q1.1	107.00	132.94	136.89	134.75	136.90	0.000237	1.12	95.50	41.21	0.13
Richmond Rd	144.998	Q10	451.00	132.94	139.00	136.05	139.09	0.000531	2.38	189.46	47.23	0.21
Richmond Rd	144.998	Q50	695.00	132.94	139.76	136.61	139.90	0.000751	3.08	225.60	49.13	0.25
Richmond Rd	144.998	Q100	815.00	132.94	140.06	136.86	140.23	0.000856	3.39	240.46	49.94	0.27
Richmond Rd	144.998	Q500	1105.00	132.94	140.67	137.41	140.93	0.001102	4.07	271.70	51.63	0.31
Richmond Rd	113.7663	aug-sep median	1.26	131.18	135.27	131.46	135.27	0.000000	0.01	91.39	42.17	0.00
Richmond Rd	113.7663	annual median	6.10	131.18	135.48	131.76	135.48	0.000001	0.06	100.51	43.01	0.01
Richmond Rd	113.7663	annual average	12.60	131.18	135.65	131.99	135.66	0.000002	0.12	107.95	43.68	0.01
Richmond Rd	113.7663	Q1.1	107.00	131.18	136.89	133.26	136.90	0.000048	0.85	164.85	48.37	0.06
Richmond Rd	113.7663	Q10	451.00	131.18	139.03	134.56	139.07	0.000200	1.58	285.59	70.57	0.13
Richmond Rd	113.7663	Q50	695.00	131.18	139.80	135.13	139.86	0.000279	2.07	349.56	90.43	0.16
Richmond Rd	113.7663	Q100	815.00	131.18	140.11	135.38	140.19	0.000313	2.28	378.07	94.48	0.17
Richmond Rd	113.7663	Q500	1105.00	131.18	140.75	135.92	140.87	0.000391	2.74	442.47	104.86	0.20
Richmond Rd	85.30657	aug-sep median	1.26	134.68	135.27	134.80	135.27	0.000082	0.21	6.07	15.18	0.06
Richmond Rd	85.30657	annual median	6.10	134.68	135.48	134.97	135.48	0.000550	0.64	9.59	18.66	0.16
Richmond Rd	85.30657	annual average	12.60	134.68	135.64	135.12	135.65	0.001037	0.98	12.82	20.84	0.22
Richmond Rd	85.30657	Q1.1	107.00	134.68	136.78	135.98	136.88	0.002206	2.56	41.83	28.10	0.37
Richmond Rd	85.30657	Q10	451.00	134.68	138.74	137.32	139.03	0.002466	4.36	115.80	64.50	0.44
Richmond Rd	85.30657	Q50	695.00	134.68	139.40	138.01	139.81	0.002826	5.31	173.37	114.98	0.48
Richmond Rd	85.30657	Q100	815.00	134.68	139.68	138.36	140.13	0.002868	5.61	206.62	118.39	0.49
Richmond Rd	85.30657	Q500	1105.00	134.68	140.29	139.16	140.80	0.002893	6.19	281.68	132.86	0.50
Richmond Rd	71.2343	aug-sep median	1.26	135.05	135.25	135.21	135.26	0.010549	0.96	1.31	12.53	0.53
Richmond Rd	71.2343	annual median	6.10	135.05	135.42	135.34	135.46	0.009583	1.51	4.04	18.36	0.57
Richmond Rd	71.2343	annual average	12.60	135.05	135.56	135.45	135.62	0.008446	1.91	6.60	19.21	0.57
Richmond Rd	71.2343	Q1.1	107.00	135.05	136.64	136.20	136.83	0.005380	3.54	30.26	24.48	0.56
Richmond Rd	71.2343	Q10	451.00	135.05	138.66	137.69	138.98	0.003878	4.66	116.34	72.22	0.53
Richmond Rd	71.2343	Q50	695.00	135.05	139.37	138.48	139.76	0.003622	5.27	174.44	103.89	0.53
Richmond Rd	71.2343	Q100	815.00	135.05	139.65	138.72	140.08	0.003594	5.57	207.53	124.77	0.54
Richmond Rd	71.2343	Q500	1105.00	135.05	140.29	139.21	140.74	0.003213	5.91	289.68	132.75	0.52
Richmond Rd	52.64112	aug-sep median	1.26	134.64	134.93	134.92	134.97	0.028781	1.44	0.87	9.70	0.85
Richmond Rd	52.64112	annual median	6.10	134.64	135.08	135.08	135.18	0.026740	2.42	2.52	12.17	0.94
Richmond Rd	52.64112	annual average	12.60	134.64	135.21	135.21	135.35	0.026640	3.06	4.12	13.93	0.99
Richmond Rd	52.64112	Q1.1	107.00	134.64	136.09	136.09	136.63	0.018709	5.87	18.22	17.32	1.01
Richmond Rd	52.64112	Q10	451.00	134.64	137.90	137.90	138.80	0.012985	7.70	64.73	50.25	0.94
Richmond Rd	52.64112	Q50	695.00	134.64	138.63	138.63	139.60	0.010424	8.19	111.68	75.85	0.87
Richmond Rd	52.64112	Q100	815.00	134.64	138.87	138.87	139.91	0.010304	8.61	130.61	82.75	0.86
Richmond Rd	52.64112	Q500	1105.00	134.64	139.44	139.44	140.58	0.009425	9.25	183.99	107.27	0.87
Richmond Rd	29.62342	aug-sep median	1.26	134.12	134.32	134.30	134.35	0.024011	1.47	0.86	8.12	0.80
Richmond Rd	29.62342	annual median	6.10	134.12	134.49	134.47	134.58	0.024008	2.42	2.52	11.28	0.90
Richmond Rd	29.62342	annual average	12.60	134.12	134.63	134.61	134.77	0.024036	3.00	4.20	13.63	0.95
Richmond Rd	29.62342	Q1.1	107.00	134.12	135.32	135.49	136.06	0.031885	6.87	15.57	17.62	1.29
Richmond Rd	29.62342	Q10	451.00	134.12	136.72	137.18	138.29	0.030992	10.07	44.78	27.61	1.39
Richmond Rd	29.62342	Q50	695.00	134.12	137.35	137.98	139.14	0.029770	10.73	65.82	52.34	1.40
Richmond Rd	29.62342	Q100	815.00	134.12	137.58	138.23	139.46	0.029369	11.05	79.09	62.99	1.40
Richmond Rd	29.62342	Q500	1105.00	134.12	138.00	138.65	140.12	0.029766	11.89	109.57	87.33	1.44



Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: aug-sep median

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.21	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.20	E.G. Elev (ft)	141.20	139.45
Q Total (cfs)	1.26	W.S. Elev (ft)	141.20	139.45
Q Bridge (cfs)	1.26	Crit W.S. (ft)	141.05	139.36
Q Weir (cfs)		Max Chl Dpth (ft)	0.22	0.15
Weir Sta Lft (ft)		Vel Total (ft/s)	0.38	0.58
Weir Sta Rgt (ft)		Flow Area (sq ft)	3.28	2.16
Weir Submerg		Froude # Chl	0.14	0.27
Weir Max Depth (ft)		Specif Force (cu ft)	0.38	0.18
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.22	0.15
Min El Prs (ft)	147.98	W.P. Total (ft)	15.34	15.19
Delta EG (ft)	2.30	Conv. Total (cfs)	49.9	25.0
Delta WS (ft)	2.36	Top Width (ft)	14.92	14.91
BR Open Area (sq ft)	114.69	Frctn Loss (ft)		
BR Open Vel (ft/s)	0.58	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.01	0.02
BR Sel Method	Momentum	Power Total (lb/ft s)	0.00	0.01

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: annual median

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.49	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.47	E.G. Elev (ft)	141.46	139.65
Q Total (cfs)	6.10	W.S. Elev (ft)	141.45	139.63
Q Bridge (cfs)	6.10	Crit W.S. (ft)	141.15	139.47
Q Weir (cfs)		Max Chl Dpth (ft)	0.47	0.33
Weir Sta Lft (ft)		Vel Total (ft/s)	0.87	1.25
Weir Sta Rgt (ft)		Flow Area (sq ft)	7.02	4.87
Weir Submerg		Froude # Chl	0.22	0.39
Weir Max Depth (ft)		Specif Force (cu ft)	1.82	1.03
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.47	0.33
Min El Prs (ft)	147.98	W.P. Total (ft)	15.84	15.55
Delta EG (ft)	2.30	Conv. Total (cfs)	173.4	95.4
Delta WS (ft)	2.41	Top Width (ft)	14.94	14.92
BR Open Area (sq ft)	114.69	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.25	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.03	0.08
BR Sel Method	Momentum	Power Total (lb/ft s)	0.03	0.10

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: annual average

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.73	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.70	E.G. Elev (ft)	141.68	139.83
Q Total (cfs)	12.60	W.S. Elev (ft)	141.65	139.78
Q Bridge (cfs)	12.60	Crit W.S. (ft)	141.27	139.58
Q Weir (cfs)		Max Chl Dpth (ft)	0.67	0.48
Weir Sta Lft (ft)		Vel Total (ft/s)	1.25	1.75
Weir Sta Rgt (ft)		Flow Area (sq ft)	10.06	7.20
Weir Submerg		Froude # Chl	0.27	0.44
Weir Max Depth (ft)		Specif Force (cu ft)	3.88	2.42
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.67	0.48
Min El Prs (ft)	147.98	W.P. Total (ft)	16.25	15.87
Delta EG (ft)	2.31	Conv. Total (cfs)	310.3	180.6
Delta WS (ft)	2.47	Top Width (ft)	14.95	14.92
BR Open Area (sq ft)	114.69	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.75	C & E Loss (ft)		

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: annual average (Continued)

BR Sluice Coef		Shear Total (lb/sq ft)	0.06	0.14
BR Sel Method	Momentum	Power Total (lb/ft s)	0.08	0.24

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q1.1

E.G. US. (ft)	143.18	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	143.04	E.G. Elev (ft)	143.17	141.10
Q Total (cfs)	107.00	W.S. Elev (ft)	142.97	140.67
Q Bridge (cfs)	107.00	Crit W.S. (ft)	142.15	140.47
Q Weir (cfs)		Max Chl Dpth (ft)	1.99	1.37
Weir Sta Lft (ft)		Vel Total (ft/s)	3.58	5.22
Weir Sta Rgt (ft)		Flow Area (sq ft)	29.88	20.49
Weir Submerg		Froude # Chl	0.45	0.79
Weir Max Depth (ft)		Specif Force (cu ft)	41.66	31.41
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	1.98	1.37
Min El Prs (ft)	147.98	W.P. Total (ft)	18.89	17.65
Delta EG (ft)	2.14	Conv. Total (cfs)	1722.2	961.1
Delta WS (ft)	2.39	Top Width (ft)	15.06	14.97
BR Open Area (sq ft)	114.69	Frctn Loss (ft)		
BR Open Vel (ft/s)	5.22	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.38	0.90
BR Sel Method	Momentum	Power Total (lb/ft s)	1.36	4.69

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q10

E.G. US. (ft)	145.59	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	145.23	E.G. Elev (ft)	145.46	143.94
Q Total (cfs)	451.00	W.S. Elev (ft)	144.08	141.98
Q Bridge (cfs)	451.00	Crit W.S. (ft)	144.08	142.35
Q Weir (cfs)		Max Chl Dpth (ft)	3.10	2.68
Weir Sta Lft (ft)		Vel Total (ft/s)	9.44	11.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	47.76	40.13
Weir Submerg		Froude # Chl	0.95	1.21
Weir Max Depth (ft)		Specif Force (cu ft)	204.52	211.27
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	2.76	2.67
Min El Prs (ft)	147.98	W.P. Total (ft)	23.32	20.27
Delta EG (ft)	1.83	Conv. Total (cfs)	3270.2	2686.9
Delta WS (ft)	3.58	Top Width (ft)	17.28	15.03
BR Open Area (sq ft)	114.69	Frctn Loss (ft)	1.22	0.17
BR Open Vel (ft/s)	11.24	C & E Loss (ft)	0.01	0.01
BR Sluice Coef		Shear Total (lb/sq ft)	2.43	3.48
BR Sel Method	Energy only	Power Total (lb/ft s)	22.97	39.14

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q50

E.G. US. (ft)	147.01	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	146.60	E.G. Elev (ft)	146.85	145.42
Q Total (cfs)	695.00	W.S. Elev (ft)	145.00	143.07
Q Bridge (cfs)	695.00	Crit W.S. (ft)	145.00	143.37
Q Weir (cfs)		Max Chl Dpth (ft)	4.02	3.77
Weir Sta Lft (ft)		Vel Total (ft/s)	10.91	12.30
Weir Sta Rgt (ft)		Flow Area (sq ft)	63.71	56.51
Weir Submerg		Froude # Chl	0.96	1.12
Weir Max Depth (ft)		Specif Force (cu ft)	359.34	371.98
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	3.70	3.75
Min El Prs (ft)	147.98	W.P. Total (ft)	25.17	22.44

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q50 (Continued)

Delta EG (ft)	1.82	Conv. Total (cfs)	5023.8	4440.0
Delta WS (ft)	4.51	Top Width (ft)	17.22	15.08
BR Open Area (sq ft)	114.69	Frctn Loss (ft)	1.24	0.16
BR Open Vel (ft/s)	12.30	C & E Loss (ft)	0.02	0.07
BR Sluice Coef		Shear Total (lb/sq ft)	3.02	3.85
BR Sel Method	Energy only	Power Total (lb/ft s)	33.00	47.37

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q100

E.G. US. (ft)	149.21	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	148.97	E.G. Elev (ft)	149.21	146.05
Q Total (cfs)	815.00	W.S. Elev (ft)	147.98	143.66
Q Bridge (cfs)	815.00	Crit W.S. (ft)	145.41	143.95
Q Weir (cfs)		Max Chl Dpth (ft)	7.00	4.36
Weir Sta Lft (ft)		Vel Total (ft/s)	7.11	12.39
Weir Sta Rgt (ft)		Flow Area (sq ft)	114.69	65.76
Weir Submerg		Froude # Chl	0.47	1.05
Weir Max Depth (ft)		Specif Force (cu ft)	569.64	456.21
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)		3.80
Min El Prs (ft)	147.98	W.P. Total (ft)	48.13	25.83
Delta EG (ft)	3.43	Conv. Total (cfs)	8686.5	5204.6
Delta WS (ft)	6.67	Top Width (ft)		17.31
BR Open Area (sq ft)	114.69	Frctn Loss (ft)		
BR Open Vel (ft/s)	7.11	C & E Loss (ft)		
BR Sluice Coef	0.41	Shear Total (lb/sq ft)	1.31	3.90
BR Sel Method	Press Only	Power Total (lb/ft s)	9.31	48.30

Plan: 17X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q500

E.G. US. (ft)	150.83	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	150.56	E.G. Elev (ft)	150.83	147.43
Q Total (cfs)	1105.00	W.S. Elev (ft)	147.98	144.55
Q Bridge (cfs)	1105.00	Crit W.S. (ft)	146.33	144.88
Q Weir (cfs)		Max Chl Dpth (ft)	7.00	5.25
Weir Sta Lft (ft)		Vel Total (ft/s)	9.64	13.61
Weir Sta Rgt (ft)		Flow Area (sq ft)	114.69	81.19
Weir Submerg		Froude # Chl	0.64	1.05
Weir Max Depth (ft)		Specif Force (cu ft)	720.54	675.32
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)		4.71
Min El Prs (ft)	147.98	W.P. Total (ft)	48.13	27.62
Delta EG (ft)	3.71	Conv. Total (cfs)	8686.5	7072.7
Delta WS (ft)	7.80	Top Width (ft)		17.25
BR Open Area (sq ft)	114.69	Frctn Loss (ft)		
BR Open Vel (ft/s)	9.64	C & E Loss (ft)		
BR Sluice Coef	0.48	Shear Total (lb/sq ft)	2.41	4.48
BR Sel Method	Press Only	Power Total (lb/ft s)	23.19	60.97

HEC-RAS Plan: 21X7boxarch River: Magotty Mdw Br Reach: Richmond Rd

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
Richmond Rd	287.3074	aug-sep median	141.18	141.18	140.44	0.00	0.00	12.19		1.26		0.16
Richmond Rd	287.3074	annual median	141.50	141.49	140.63	0.01	0.00	14.09		6.10		0.51
Richmond Rd	287.3074	annual average	141.75	141.73	140.79	0.02	0.00	15.53		12.60		0.81
Richmond Rd	287.3074	Q1.1	143.27	143.16	141.88	0.06	0.00	19.40		107.00		2.59
Richmond Rd	287.3074	Q10	145.63	145.21	143.63	0.09	0.01	55.61	12.46	437.70	0.83	5.26
Richmond Rd	287.3074	Q50	146.70	146.14	144.54	0.09	0.01	71.99	47.71	640.25	7.04	6.24
Richmond Rd	287.3074	Q100	147.15	146.53	145.08	0.09	0.00	78.60	67.89	734.47	12.65	6.63
Richmond Rd	287.3074	Q500	149.38	149.03	145.86	0.04	0.01	136.63	155.85	865.88	83.27	5.31
Richmond Rd	257.1795	aug-sep median	141.17	141.17	140.94			10.76		1.26		0.51
Richmond Rd	257.1795	annual median	141.48	141.47	141.15			13.33		6.10		0.99
Richmond Rd	257.1795	annual average	141.72	141.69	141.30			14.95		12.60		1.35
Richmond Rd	257.1795	Q1.1	143.20	143.07	142.26			22.64		107.00		2.98
Richmond Rd	257.1795	Q10	145.53	145.15	143.86			49.49	1.62	449.32	0.06	4.92
Richmond Rd	257.1795	Q50	146.60	146.06	144.60			55.14	4.53	689.31	1.16	5.88
Richmond Rd	257.1795	Q100	147.05	146.44	144.89			61.97	6.10	806.65	2.24	6.31
Richmond Rd	257.1795	Q500	149.33	148.88	145.56			102.39	12.84	1072.81	19.35	5.43
Richmond Rd	221 BR U	aug-sep median	141.17	141.17	141.03			20.91		1.26		0.32
Richmond Rd	221 BR U	annual median	141.39	141.38	141.12			20.93		6.10		0.73
Richmond Rd	221 BR U	annual average	141.57	141.55	141.20			20.95		12.60		1.05
Richmond Rd	221 BR U	Q1.1	142.89	142.76	141.92			21.04		107.00		2.87
Richmond Rd	221 BR U	Q10	145.26	144.81	143.41			23.21		451.00		5.41
Richmond Rd	221 BR U	Q50	146.42	145.73	144.26			23.15		695.00		6.63
Richmond Rd	221 BR U	Q100	146.91	146.11	144.59			23.13		815.00		7.17
Richmond Rd	221 BR U	Q500	149.33	147.98	145.35					1105.00		7.05
Richmond Rd	221 BR D	aug-sep median	139.43	139.42	139.35			20.91		1.26		0.49
Richmond Rd	221 BR D	annual median	139.60	139.58	139.44			20.91		6.10		1.03
Richmond Rd	221 BR D	annual average	139.75	139.72	139.52			20.92		12.60		1.43
Richmond Rd	221 BR D	Q1.1	141.00	140.82	140.23			20.97		107.00		3.36
Richmond Rd	221 BR D	Q10	143.26	142.60	141.74			21.06		451.00		6.51
Richmond Rd	221 BR D	Q50	144.35	143.26	142.54			21.09		695.00		8.35
Richmond Rd	221 BR D	Q100	144.80	143.42	142.91			21.10		815.00		9.43
Richmond Rd	221 BR D	Q500	145.99	144.14	143.84			23.26		1105.00		10.72
Richmond Rd	183.9802	aug-sep median	138.91	138.84	138.84	0.29	0.03	4.39		1.26		2.05
Richmond Rd	183.9802	annual median	139.19	139.06	139.06	0.20	0.03	8.54		6.10		2.89
Richmond Rd	183.9802	annual average	139.41	139.23	139.23	0.15	0.03	9.49		12.60		3.46
Richmond Rd	183.9802	Q1.1	141.04	140.65	140.34	0.05	0.03	14.35		107.00		5.02
Richmond Rd	183.9802	Q10	143.52	142.83	142.29	0.04	0.04	28.23	0.30	449.79	0.90	6.65
Richmond Rd	183.9802	Q50	144.58	143.59	143.02	0.04	0.04	31.09	1.57	691.07	2.36	7.99
Richmond Rd	183.9802	Q100	145.01	143.82	143.35	0.05	0.02	32.06	2.21	809.74	3.05	8.78
Richmond Rd	183.9802	Q500	145.99	144.14	144.05	0.05	0.07	33.64	3.62	1096.77	4.61	10.96
Richmond Rd	179.6062	aug-sep median	138.59	138.27	138.36	0.11	0.00	2.45		1.26		4.51
Richmond Rd	179.6062	annual median	138.95	138.55	138.68	0.19	0.01	4.19		6.10		5.12
Richmond Rd	179.6062	annual average	139.23	138.78	138.92	0.17	0.01	5.66		12.60		5.37
Richmond Rd	179.6062	Q1.1	140.96	140.26	140.26	0.19	0.04	11.53		107.00		6.68
Richmond Rd	179.6062	Q10	143.44	142.33	142.33	0.16	0.10	24.03		451.00		8.44
Richmond Rd	179.6062	Q50	144.50	143.15	143.15	0.15	0.11	27.78		695.00		9.29
Richmond Rd	179.6062	Q100	144.94	143.50	143.50	0.14	0.12	29.49		815.00		9.61
Richmond Rd	179.6062	Q500	145.87	144.24	144.24	0.13	0.12	33.09		1105.00		10.26





HEC-RAS Plan: 21X7boxarch River: Magotty Mdw Br Reach: Richmond Rd (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Richmond Rd	158.1909	annual median	6.10	132.96	135.48	133.62	135.48	0.000024	0.24	25.03	19.31	0.04
Richmond Rd	158.1909	annual average	12.60	132.96	135.65	133.84	135.66	0.000073	0.44	28.42	20.22	0.07
Richmond Rd	158.1909	Q1.1	107.00	132.96	136.86	135.09	136.92	0.000758	1.91	56.04	25.39	0.23
Richmond Rd	158.1909	Q10	451.00	132.96	138.91	136.79	139.15	0.001740	3.95	114.13	31.50	0.37
Richmond Rd	158.1909	Q50	695.00	132.96	135.88	137.55	142.75	0.143308	21.03	33.04	21.18	2.97
Richmond Rd	158.1909	Q100	815.00	132.96	136.10	137.88	143.28	0.132670	21.48	37.94	22.15	2.89
Richmond Rd	158.1909	Q500	1105.00	132.96	136.61	138.62	144.31	0.113870	22.27	49.62	24.31	2.75
Richmond Rd	144.998	aug-sep median	1.26	132.94	135.27	133.20	135.27	0.000001	0.04	34.66	32.58	0.01
Richmond Rd	144.998	annual median	6.10	132.94	135.48	133.44	135.48	0.000009	0.15	41.80	34.18	0.02
Richmond Rd	144.998	annual average	12.60	132.94	135.65	133.62	135.66	0.000027	0.26	47.77	35.46	0.04
Richmond Rd	144.998	Q1.1	107.00	132.94	136.89	134.75	136.90	0.000237	1.12	95.50	41.21	0.13
Richmond Rd	144.998	Q10	451.00	132.94	139.00	136.05	139.09	0.000531	2.38	189.46	47.23	0.21
Richmond Rd	144.998	Q50	695.00	132.94	139.76	136.61	139.90	0.000751	3.08	225.60	49.13	0.25
Richmond Rd	144.998	Q100	815.00	132.94	140.06	136.86	140.23	0.000856	3.39	240.46	49.94	0.27
Richmond Rd	144.998	Q500	1105.00	132.94	140.67	137.41	140.93	0.001102	4.07	271.70	51.63	0.31
Richmond Rd	113.7663	aug-sep median	1.26	131.18	135.27	131.46	135.27	0.000000	0.01	91.39	42.17	0.00
Richmond Rd	113.7663	annual median	6.10	131.18	135.48	131.76	135.48	0.000001	0.06	100.51	43.01	0.01
Richmond Rd	113.7663	annual average	12.60	131.18	135.65	131.99	135.66	0.000002	0.12	107.95	43.68	0.01
Richmond Rd	113.7663	Q1.1	107.00	131.18	136.89	133.26	136.90	0.000048	0.65	164.85	48.37	0.06
Richmond Rd	113.7663	Q10	451.00	131.18	139.03	134.56	139.07	0.000200	1.58	285.59	70.57	0.13
Richmond Rd	113.7663	Q50	695.00	131.18	139.80	135.13	139.86	0.000279	2.07	349.56	90.43	0.16
Richmond Rd	113.7663	Q100	815.00	131.18	140.11	135.38	140.19	0.000313	2.28	378.07	94.48	0.17
Richmond Rd	113.7663	Q500	1105.00	131.18	140.75	135.92	140.87	0.000391	2.74	442.47	104.86	0.20
Richmond Rd	85.30657	aug-sep median	1.26	134.68	135.27	134.80	135.27	0.000082	0.21	6.07	15.18	0.06
Richmond Rd	85.30657	annual median	6.10	134.68	135.48	134.97	135.48	0.000550	0.64	9.59	18.66	0.16
Richmond Rd	85.30657	annual average	12.60	134.68	135.64	135.12	135.65	0.001037	0.98	12.82	20.84	0.22
Richmond Rd	85.30657	Q1.1	107.00	134.68	136.78	135.98	136.88	0.002206	2.56	41.83	28.10	0.37
Richmond Rd	85.30657	Q10	451.00	134.68	138.74	137.32	139.03	0.002466	4.36	115.80	64.50	0.44
Richmond Rd	85.30657	Q50	695.00	134.68	139.40	138.01	139.81	0.002826	5.31	173.37	114.98	0.48
Richmond Rd	85.30657	Q100	815.00	134.68	139.68	138.36	140.13	0.002868	5.61	206.62	118.39	0.49
Richmond Rd	85.30657	Q500	1105.00	134.68	140.29	139.16	140.80	0.002893	6.19	281.68	132.86	0.50
Richmond Rd	71.2343	aug-sep median	1.26	135.05	135.25	135.21	135.26	0.010549	0.96	1.31	12.53	0.53
Richmond Rd	71.2343	annual median	6.10	135.05	135.42	135.34	135.46	0.009583	1.51	4.04	18.36	0.57
Richmond Rd	71.2343	annual average	12.60	135.05	135.56	135.45	135.62	0.008446	1.91	6.60	19.21	0.57
Richmond Rd	71.2343	Q1.1	107.00	135.05	136.64	136.20	136.83	0.005380	3.54	30.26	24.48	0.56
Richmond Rd	71.2343	Q10	451.00	135.05	138.66	137.69	138.98	0.003878	4.66	116.34	72.22	0.53
Richmond Rd	71.2343	Q50	695.00	135.05	139.37	138.48	139.76	0.003622	5.27	174.44	103.89	0.53
Richmond Rd	71.2343	Q100	815.00	135.05	139.65	138.72	140.08	0.003594	5.57	207.53	124.77	0.54
Richmond Rd	71.2343	Q500	1105.00	135.05	140.29	139.21	140.74	0.003213	5.91	289.68	132.75	0.52
Richmond Rd	52.64112	aug-sep median	1.26	134.64	134.93	134.92	134.97	0.028781	1.44	0.87	9.70	0.85
Richmond Rd	52.64112	annual median	6.10	134.64	135.08	135.08	135.18	0.026740	2.42	2.52	12.17	0.94
Richmond Rd	52.64112	annual average	12.60	134.64	135.21	135.21	135.35	0.026640	3.06	4.12	13.93	0.99
Richmond Rd	52.64112	Q1.1	107.00	134.64	136.09	136.09	136.63	0.018709	5.87	18.22	17.32	1.01
Richmond Rd	52.64112	Q10	451.00	134.64	137.90	137.90	138.80	0.012985	7.70	64.73	50.25	0.94
Richmond Rd	52.64112	Q50	695.00	134.64	138.63	138.63	139.60	0.010424	8.19	111.68	75.85	0.87
Richmond Rd	52.64112	Q100	815.00	134.64	138.87	138.87	139.91	0.010304	8.61	130.61	82.75	0.86
Richmond Rd	52.64112	Q500	1105.00	134.64	139.44	139.44	140.58	0.009425	9.25	183.99	107.27	0.87
Richmond Rd	29.62342	aug-sep median	1.26	134.12	134.32	134.30	134.35	0.024011	1.47	0.86	8.12	0.80
Richmond Rd	29.62342	annual median	6.10	134.12	134.49	134.47	134.58	0.024008	2.42	2.52	11.28	0.90
Richmond Rd	29.62342	annual average	12.60	134.12	134.63	134.61	134.77	0.024036	3.00	4.20	13.63	0.95
Richmond Rd	29.62342	Q1.1	107.00	134.12	135.32	135.49	136.06	0.031866	6.87	15.57	17.62	1.29
Richmond Rd	29.62342	Q10	451.00	134.12	136.72	137.18	138.29	0.030992	10.07	44.78	27.61	1.39
Richmond Rd	29.62342	Q50	695.00	134.12	137.35	137.98	139.14	0.029770	10.73	65.82	52.34	1.40
Richmond Rd	29.62342	Q100	815.00	134.12	137.58	138.23	139.46	0.029369	11.05	79.09	62.99	1.40
Richmond Rd	29.62342	Q500	1105.00	134.12	138.00	138.65	140.12	0.029766	11.89	109.57	87.33	1.44

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: aug-sep median

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.17	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.17	E.G. Elev (ft)	141.17	139.43
Q Total (cfs)	1.26	W.S. Elev (ft)	141.17	139.42
Q Bridge (cfs)	1.26	Crit W.S. (ft)	141.03	139.35
Q Weir (cfs)		Max Chl Dpth (ft)	0.19	0.12
Weir Sta Lft (ft)		Vel Total (ft/s)	0.32	0.49
Weir Sta Rgt (ft)		Flow Area (sq ft)	3.93	2.60
Weir Submerg		Froude # Chl	0.13	0.24
Weir Max Depth (ft)		Specif Force (cu ft)	0.38	0.18
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.19	0.12
Min El Prs (ft)	147.98	W.P. Total (ft)	21.28	21.15
Delta EG (ft)	2.27	Conv. Total (cfs)	54.0	27.2
Delta WS (ft)	2.33	Top Width (ft)	20.91	20.91
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	0.49	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.01	0.02
BR Sel Method	Momentum	Power Total (lb/ft s)	0.00	0.01

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: annual median

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.48	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.47	E.G. Elev (ft)	141.39	139.60
Q Total (cfs)	6.10	W.S. Elev (ft)	141.38	139.58
Q Bridge (cfs)	6.10	Crit W.S. (ft)	141.12	139.44
Q Weir (cfs)		Max Chl Dpth (ft)	0.40	0.28
Weir Sta Lft (ft)		Vel Total (ft/s)	0.73	1.03
Weir Sta Rgt (ft)		Flow Area (sq ft)	8.37	5.91
Weir Submerg		Froude # Chl	0.20	0.34
Weir Max Depth (ft)		Specif Force (cu ft)	1.81	1.03
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.40	0.28
Min El Prs (ft)	147.98	W.P. Total (ft)	21.70	21.47
Delta EG (ft)	2.30	Conv. Total (cfs)	188.5	106.1
Delta WS (ft)	2.41	Top Width (ft)	20.93	20.91
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.03	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.03	0.06
BR Sel Method	Momentum	Power Total (lb/ft s)	0.02	0.06

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: annual average

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.72	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.69	E.G. Elev (ft)	141.57	139.75
Q Total (cfs)	12.60	W.S. Elev (ft)	141.55	139.72
Q Bridge (cfs)	12.60	Crit W.S. (ft)	141.20	139.52
Q Weir (cfs)		Max Chl Dpth (ft)	0.57	0.42
Weir Sta Lft (ft)		Vel Total (ft/s)	1.05	1.43
Weir Sta Rgt (ft)		Flow Area (sq ft)	11.99	8.81
Weir Submerg		Froude # Chl	0.24	0.39
Weir Max Depth (ft)		Specif Force (cu ft)	3.84	2.41
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.57	0.42
Min El Prs (ft)	147.98	W.P. Total (ft)	22.05	21.74
Delta EG (ft)	2.31	Conv. Total (cfs)	339.0	204.7
Delta WS (ft)	2.47	Top Width (ft)	20.95	20.92
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.43	C & E Loss (ft)		

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: annual average (Continued)

BR Sluice Coef		Shear Total (lb/sq ft)	0.05	0.10
BR Sel Method	Momentum	Power Total (lb/ft s)	0.05	0.14

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q1.1

E.G. US. (ft)	143.20	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	143.07	E.G. Elev (ft)	142.89	141.00
Q Total (cfs)	107.00	W.S. Elev (ft)	142.76	140.82
Q Bridge (cfs)	107.00	Crit W.S. (ft)	141.92	140.23
Q Weir (cfs)		Max Chl Dpth (ft)	1.78	1.52
Weir Sta Lft (ft)		Vel Total (ft/s)	2.87	3.36
Weir Sta Rgt (ft)		Flow Area (sq ft)	37.26	31.81
Weir Submerg		Froude # Chl	0.38	0.48
Weir Max Depth (ft)		Specif Force (cu ft)	42.62	35.34
Min EI Weir Flow (ft)	157.03	Hydr Depth (ft)	1.77	1.52
Min EI Prs (ft)	147.98	W.P. Total (ft)	24.46	23.94
Delta EG (ft)	2.16	Conv. Total (cfs)	2094.8	1632.4
Delta WS (ft)	2.41	Top Width (ft)	21.04	20.97
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	3.36	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.25	0.36
BR Sel Method	Momentum	Power Total (lb/ft s)	0.71	1.20

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q10

E.G. US. (ft)	145.53	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	145.15	E.G. Elev (ft)	145.26	143.26
Q Total (cfs)	451.00	W.S. Elev (ft)	144.81	142.60
Q Bridge (cfs)	451.00	Crit W.S. (ft)	143.41	141.74
Q Weir (cfs)		Max Chl Dpth (ft)	3.83	3.30
Weir Sta Lft (ft)		Vel Total (ft/s)	5.41	6.51
Weir Sta Rgt (ft)		Flow Area (sq ft)	83.39	69.31
Weir Submerg		Froude # Chl	0.49	0.63
Weir Max Depth (ft)		Specif Force (cu ft)	231.70	205.56
Min EI Weir Flow (ft)	157.03	Hydr Depth (ft)	3.59	3.29
Min EI Prs (ft)	147.98	W.P. Total (ft)	30.72	27.51
Delta EG (ft)	2.01	Conv. Total (cfs)	6889.3	5448.2
Delta WS (ft)	2.32	Top Width (ft)	23.21	21.06
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.51	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.73	1.08
BR Sel Method	Momentum	Power Total (lb/ft s)	3.93	7.01

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q50

E.G. US. (ft)	146.60	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	146.06	E.G. Elev (ft)	146.42	144.35
Q Total (cfs)	695.00	W.S. Elev (ft)	145.73	143.26
Q Bridge (cfs)	695.00	Crit W.S. (ft)	144.26	142.54
Q Weir (cfs)		Max Chl Dpth (ft)	4.75	3.96
Weir Sta Lft (ft)		Vel Total (ft/s)	6.63	8.35
Weir Sta Rgt (ft)		Flow Area (sq ft)	104.82	83.23
Weir Submerg		Froude # Chl	0.54	0.74
Weir Max Depth (ft)		Specif Force (cu ft)	386.11	345.10
Min EI Weir Flow (ft)	157.03	Hydr Depth (ft)	4.53	3.95
Min EI Prs (ft)	147.98	W.P. Total (ft)	32.57	28.83

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q50 (Continued)

Delta EG (ft)	2.02	Conv. Total (cfs)	9700.3	7163.7
Delta WS (ft)	2.47	Top Width (ft)	23.15	21.09
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	8.35	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	1.03	1.70
BR Sel Method	Momentum	Power Total (lb/ft s)	6.84	14.17

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q100

E.G. US. (ft)	147.05	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	146.44	E.G. Elev (ft)	146.91	144.80
Q Total (cfs)	815.00	W.S. Elev (ft)	146.11	143.42
Q Bridge (cfs)	815.00	Crit W.S. (ft)	144.59	142.91
Q Weir (cfs)		Max Chl Dpth (ft)	5.13	4.12
Weir Sta Lft (ft)		Vel Total (ft/s)	7.17	9.43
Weir Sta Rgt (ft)		Flow Area (sq ft)	113.61	86.45
Weir Submerg		Froude # Chl	0.56	0.82
Weir Max Depth (ft)		Specif Force (cu ft)	466.09	416.49
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	4.91	4.10
Min El Prs (ft)	147.98	W.P. Total (ft)	33.33	29.14
Delta EG (ft)	2.04	Conv. Total (cfs)	10924.1	7578.1
Delta WS (ft)	2.62	Top Width (ft)	23.13	21.10
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	9.43	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	1.18	2.14
BR Sel Method	Momentum	Power Total (lb/ft s)	8.50	20.20

Plan: 21X7boxarch Magotty Mdw Br Richmond Rd RS: 221 Profile: Q500

E.G. US. (ft)	149.33	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	148.88	E.G. Elev (ft)	149.33	145.99
Q Total (cfs)	1105.00	W.S. Elev (ft)	147.98	144.14
Q Bridge (cfs)	1105.00	Crit W.S. (ft)	145.35	143.84
Q Weir (cfs)		Max Chl Dpth (ft)	7.00	4.84
Weir Sta Lft (ft)		Vel Total (ft/s)	7.05	10.72
Weir Sta Rgt (ft)		Flow Area (sq ft)	156.63	103.05
Weir Submerg		Froude # Chl	0.47	0.86
Weir Max Depth (ft)		Specif Force (cu ft)	778.76	614.21
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)		4.43
Min El Prs (ft)	147.98	W.P. Total (ft)	60.06	32.74
Delta EG (ft)	3.34	Conv. Total (cfs)	12598.5	9396.2
Delta WS (ft)	4.75	Top Width (ft)		23.26
BR Open Area (sq ft)	156.63	Frctn Loss (ft)		
BR Open Vel (ft/s)	7.05	C & E Loss (ft)		
BR Sluice Coef	0.40	Shear Total (lb/sq ft)	1.25	2.72
BR Sel Method	Press Only	Power Total (lb/ft s)	8.84	29.14



HEC-RAS Plan: BFW1.225X7 River: Magotty Mdw Br Reach: Richmond Rd

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
Richmond Rd	287.3074	aug-sep median	141.17	141.17	140.44	0.00	0.00	12.16		1.26		0.16
Richmond Rd	287.3074	annual median	141.50	141.49	140.63	0.01	0.00	14.09		6.10		0.51
Richmond Rd	287.3074	annual average	141.74	141.73	140.79	0.02	0.00	15.52		12.60		0.81
Richmond Rd	287.3074	Q1.1	143.25	143.15	141.88	0.06	0.00	19.37		107.00		2.62
Richmond Rd	287.3074	Q10	145.58	145.15	143.63	0.09	0.01	54.65	11.07	439.22	0.71	5.36
Richmond Rd	287.3074	Q50	146.63	146.03	144.54	0.10	0.01	69.99	44.69	644.15	6.15	6.41
Richmond Rd	287.3074	Q100	147.06	146.39	145.08	0.11	0.00	76.32	63.85	740.14	11.01	6.86
Richmond Rd	287.3074	Q500	148.04	147.26	145.86	0.11	0.01	94.55	117.49	955.07	32.44	7.57
Richmond Rd	257.1795	aug-sep median	141.17	141.16	140.94			10.62		1.26		0.52
Richmond Rd	257.1795	annual median	141.48	141.47	141.15			13.33		6.10		0.99
Richmond Rd	257.1795	annual average	141.72	141.69	141.30			14.93		12.60		1.36
Richmond Rd	257.1795	Q1.1	143.19	143.04	142.26			22.57		107.00		3.02
Richmond Rd	257.1795	Q10	145.47	145.08	143.86			48.81	1.50	449.46	0.04	5.03
Richmond Rd	257.1795	Q50	146.52	145.95	144.60			54.18	4.31	689.72	0.97	6.04
Richmond Rd	257.1795	Q100	146.95	146.30	144.89			57.36	5.81	807.30	1.89	6.52
Richmond Rd	257.1795	Q500	147.93	147.07	145.56			66.99	9.82	1089.77	5.41	7.47
Richmond Rd	221 BR U	aug-sep median	141.15	141.15	141.03			24.91		1.26	0.00	0.29
Richmond Rd	221 BR U	annual median	141.35	141.35	141.10			24.93		6.10	0.00	0.67
Richmond Rd	221 BR U	annual average	141.52	141.51	141.18			24.94		12.60	0.00	0.96
Richmond Rd	221 BR U	Q1.1	142.72	142.61	141.81			25.03		106.99	0.01	2.63
Richmond Rd	221 BR U	Q10	144.91	144.50	143.15			25.23	0.07	450.82	0.10	5.13
Richmond Rd	221 BR U	Q50	145.98	145.35	143.87			25.17	0.12	694.72	0.16	6.36
Richmond Rd	221 BR U	Q100	146.44	145.69	144.19			25.15	0.14	814.88	0.17	6.92
Richmond Rd	221 BR U	Q500	147.46	146.45	144.91			25.10	0.17	1104.63	0.20	8.09
Richmond Rd	221 BR D	aug-sep median	139.42	139.42	139.35			23.91		1.26		0.45
Richmond Rd	221 BR D	annual median	139.58	139.57	139.42			23.91		6.10		0.96
Richmond Rd	221 BR D	annual average	139.73	139.70	139.51			23.92		12.60		1.32
Richmond Rd	221 BR D	Q1.1	140.89	140.75	140.15			23.97		107.00		3.09
Richmond Rd	221 BR D	Q10	143.04	142.51	141.53			24.05		451.00		5.86
Richmond Rd	221 BR D	Q50	144.08	143.24	142.27			24.09		695.00		7.35
Richmond Rd	221 BR D	Q100	144.51	143.50	142.61			24.10		815.00		8.09
Richmond Rd	221 BR D	Q500	145.50	144.05	143.34			25.26	0.03	1104.96	0.01	9.63
Richmond Rd	183.9802	aug-sep median	138.91	138.84	138.84	0.29	0.03	4.39		1.26		2.05
Richmond Rd	183.9802	annual median	139.19	139.06	139.06	0.20	0.03	8.54		6.10		2.89
Richmond Rd	183.9802	annual average	139.41	139.23	139.23	0.15	0.03	9.49		12.60		3.46
Richmond Rd	183.9802	Q1.1	141.04	140.65	140.34	0.05	0.03	14.35		107.00		5.02
Richmond Rd	183.9802	Q10	143.52	142.83	142.29	0.04	0.04	28.23	0.30	449.79	0.90	6.65
Richmond Rd	183.9802	Q50	144.58	143.59	143.02	0.04	0.04	31.09	1.57	691.07	2.36	7.99
Richmond Rd	183.9802	Q100	145.01	143.82	143.35	0.05	0.02	32.06	2.21	809.74	3.05	8.78
Richmond Rd	183.9802	Q500	145.99	144.14	144.05	0.05	0.07	33.64	3.62	1096.77	4.61	10.96
Richmond Rd	179.6062	aug-sep median	138.59	138.27	138.36	0.11	0.00	2.45		1.26		4.51
Richmond Rd	179.6062	annual median	138.95	138.55	138.68	0.19	0.01	4.19		6.10		5.12
Richmond Rd	179.6062	annual average	139.23	138.78	138.92	0.17	0.01	5.66		12.60		5.37
Richmond Rd	179.6062	Q1.1	140.96	140.26	140.26	0.19	0.04	11.53		107.00		6.68
Richmond Rd	179.6062	Q10	143.44	142.33	142.33	0.16	0.10	24.03		451.00		8.44
Richmond Rd	179.6062	Q50	144.50	143.15	143.15	0.15	0.11	27.78		695.00		9.29
Richmond Rd	179.6062	Q100	144.94	143.50	143.50	0.14	0.12	29.49		815.00		9.61
Richmond Rd	179.6062	Q500	145.87	144.24	144.24	0.13	0.12	33.09		1105.00		10.26

HEC-RAS Plan: BFW1.225X7 River: Magotty Mdw Br Reach: Richmond Rd

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Frctn Loss (ft)	C & E Loss (ft)	Top Width (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Vel Chnl (ft/s)
Richmond Rd	287.3074	aug-sep median	141.17	141.17	140.44	0.00	0.00	12.16		1.26		0.16
Richmond Rd	287.3074	annual median	141.50	141.49	140.63	0.01	0.00	14.09		6.10		0.51
Richmond Rd	287.3074	annual average	141.74	141.73	140.79	0.02	0.00	15.52		12.60		0.81
Richmond Rd	287.3074	Q1.1	143.25	143.15	141.88	0.06	0.00	19.37		107.00		2.62
Richmond Rd	287.3074	Q10	145.58	145.15	143.63	0.09	0.01	54.65	11.07	439.22	0.71	5.36
Richmond Rd	287.3074	Q50	146.63	146.03	144.54	0.10	0.01	69.99	44.69	644.15	6.15	6.41
Richmond Rd	287.3074	Q100	147.06	146.39	145.08	0.11	0.00	76.32	63.85	740.14	11.01	6.86
Richmond Rd	287.3074	Q500	148.04	147.26	145.86	0.11	0.01	94.55	117.49	955.07	32.44	7.57
Richmond Rd	257.1795	aug-sep median	141.17	141.16	140.94			10.62		1.26		0.52
Richmond Rd	257.1795	annual median	141.48	141.47	141.15			13.33		6.10		0.99
Richmond Rd	257.1795	annual average	141.72	141.69	141.30			14.93		12.60		1.36
Richmond Rd	257.1795	Q1.1	143.19	143.04	142.26			22.57		107.00		3.02
Richmond Rd	257.1795	Q10	145.47	145.08	143.86			48.81	1.50	449.46	0.04	5.03
Richmond Rd	257.1795	Q50	146.52	145.95	144.60			54.18	4.31	689.72	0.97	6.04
Richmond Rd	257.1795	Q100	146.95	146.30	144.89			57.36	5.81	807.30	1.89	6.52
Richmond Rd	257.1795	Q500	147.93	147.07	145.56			66.99	9.82	1089.77	5.41	7.47
Richmond Rd	221 BR U	aug-sep median	141.15	141.15	141.03			24.91		1.26	0.00	0.29
Richmond Rd	221 BR U	annual median	141.35	141.35	141.10			24.93		6.10	0.00	0.67
Richmond Rd	221 BR U	annual average	141.52	141.51	141.18			24.94		12.60	0.00	0.96
Richmond Rd	221 BR U	Q1.1	142.72	142.61	141.81			25.03		106.99	0.01	2.63
Richmond Rd	221 BR U	Q10	144.91	144.50	143.15			25.23	0.07	450.82	0.10	5.13
Richmond Rd	221 BR U	Q50	145.98	145.35	143.87			25.17	0.12	694.72	0.16	6.36
Richmond Rd	221 BR U	Q100	146.44	145.69	144.19			25.15	0.14	814.88	0.17	6.92
Richmond Rd	221 BR U	Q500	147.46	146.45	144.91			25.10	0.17	1104.63	0.20	8.09
Richmond Rd	221 BR D	aug-sep median	139.42	139.42	139.35			23.91		1.26		0.45
Richmond Rd	221 BR D	annual median	139.58	139.57	139.42			23.91		6.10		0.96
Richmond Rd	221 BR D	annual average	139.73	139.70	139.51			23.92		12.60		1.32
Richmond Rd	221 BR D	Q1.1	140.89	140.75	140.15			23.97		107.00		3.09
Richmond Rd	221 BR D	Q10	143.04	142.51	141.53			24.05		451.00		5.86
Richmond Rd	221 BR D	Q50	144.08	143.24	142.27			24.09		695.00		7.35
Richmond Rd	221 BR D	Q100	144.51	143.50	142.61			24.10		815.00		8.09
Richmond Rd	221 BR D	Q500	145.50	144.05	143.34			25.26	0.03	1104.96	0.01	9.63
Richmond Rd	183.9802	aug-sep median	138.91	138.84	138.84	0.29	0.03	4.39		1.26		2.05
Richmond Rd	183.9802	annual median	139.19	139.06	139.06	0.20	0.03	8.54		6.10		2.89
Richmond Rd	183.9802	annual average	139.41	139.23	139.23	0.15	0.03	9.49		12.60		3.46
Richmond Rd	183.9802	Q1.1	141.04	140.65	140.34	0.05	0.03	14.35		107.00		5.02
Richmond Rd	183.9802	Q10	143.52	142.83	142.29	0.04	0.04	28.23	0.30	449.79	0.90	6.65
Richmond Rd	183.9802	Q50	144.58	143.59	143.02	0.04	0.04	31.09	1.57	691.07	2.36	7.99
Richmond Rd	183.9802	Q100	145.01	143.82	143.35	0.05	0.02	32.06	2.21	809.74	3.05	8.78
Richmond Rd	183.9802	Q500	145.99	144.14	144.05	0.05	0.07	33.64	3.62	1096.77	4.61	10.96
Richmond Rd	179.6062	aug-sep median	138.59	138.27	138.36	0.11	0.00	2.45		1.26		4.51
Richmond Rd	179.6062	annual median	138.95	138.55	138.68	0.19	0.01	4.19		6.10		5.12
Richmond Rd	179.6062	annual average	139.23	138.78	138.92	0.17	0.01	5.66		12.60		5.37
Richmond Rd	179.6062	Q1.1	140.96	140.26	140.26	0.19	0.04	11.53		107.00		6.68
Richmond Rd	179.6062	Q10	143.44	142.33	142.33	0.16	0.10	24.03		451.00		8.44
Richmond Rd	179.6062	Q50	144.50	143.15	143.15	0.15	0.11	27.78		695.00		9.29
Richmond Rd	179.6062	Q100	144.94	143.50	143.50	0.14	0.12	29.49		815.00		9.61
Richmond Rd	179.6062	Q500	145.87	144.24	144.24	0.13	0.12	33.09		1105.00		10.26

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: aug-sep median

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.17	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.16	E.G. Elev (ft)	141.15	139.42
Q Total (cfs)	1.26	W.S. Elev (ft)	141.15	139.42
Q Bridge (cfs)	1.26	Crit W.S. (ft)	141.03	139.35
Q Weir (cfs)		Max Chl Dpth (ft)	0.17	0.12
Weir Sta Lft (ft)		Vel Total (ft/s)	0.29	0.45
Weir Sta Rgt (ft)		Flow Area (sq ft)	4.30	2.79
Weir Submerg		Froude # Chl	0.12	0.23
Weir Max Depth (ft)		Specif Force (cu ft)	0.38	0.18
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.17	0.12
Min El Prs (ft)	147.98	W.P. Total (ft)	25.25	24.13
Delta EG (ft)	2.26	Conv. Total (cfs)	56.3	28.1
Delta WS (ft)	2.32	Top Width (ft)	24.91	23.91
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	0.45	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.01	0.01
BR Sel Method	Momentum	Power Total (lb/ft s)	0.00	0.01

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: annual median

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.48	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.47	E.G. Elev (ft)	141.35	139.58
Q Total (cfs)	6.10	W.S. Elev (ft)	141.35	139.57
Q Bridge (cfs)	6.10	Crit W.S. (ft)	141.10	139.42
Q Weir (cfs)		Max Chl Dpth (ft)	0.37	0.27
Weir Sta Lft (ft)		Vel Total (ft/s)	0.67	0.96
Weir Sta Rgt (ft)		Flow Area (sq ft)	9.16	6.37
Weir Submerg		Froude # Chl	0.19	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	1.81	1.03
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.37	0.27
Min El Prs (ft)	147.98	W.P. Total (ft)	25.64	24.43
Delta EG (ft)	2.30	Conv. Total (cfs)	197.6	110.4
Delta WS (ft)	2.41	Top Width (ft)	24.93	23.91
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	0.96	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.02	0.05
BR Sel Method	Momentum	Power Total (lb/ft s)	0.01	0.05

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: annual average

Element	Value	Element	Inside BR US	Inside BR DS
E.G. US. (ft)	141.72	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	141.69	E.G. Elev (ft)	141.52	139.73
Q Total (cfs)	12.60	W.S. Elev (ft)	141.51	139.70
Q Bridge (cfs)	12.60	Crit W.S. (ft)	141.18	139.51
Q Weir (cfs)		Max Chl Dpth (ft)	0.53	0.40
Weir Sta Lft (ft)		Vel Total (ft/s)	0.96	1.32
Weir Sta Rgt (ft)		Flow Area (sq ft)	13.10	9.52
Weir Submerg		Froude # Chl	0.23	0.37
Weir Max Depth (ft)		Specif Force (cu ft)	3.82	2.41
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	0.53	0.40
Min El Prs (ft)	147.98	W.P. Total (ft)	25.95	24.70
Delta EG (ft)	2.30	Conv. Total (cfs)	357.3	214.0
Delta WS (ft)	2.46	Top Width (ft)	24.94	23.92
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.32	C & E Loss (ft)		

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: annual average (Continued)

BR Sluice Coef		Shear Total (lb/sq ft)	0.04	0.08
BR Sel Method	Momentum	Power Total (lb/ft s)	0.04	0.11

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: Q1.1

E.G. US. (ft)	143.19	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	143.04	E.G. Elev (ft)	142.72	140.89
Q Total (cfs)	107.00	W.S. Elev (ft)	142.61	140.75
Q Bridge (cfs)	107.00	Crit W.S. (ft)	141.81	140.15
Q Weir (cfs)		Max Chl Dpth (ft)	1.63	1.45
Weir Sta Lft (ft)		Vel Total (ft/s)	2.62	3.09
Weir Sta Rgt (ft)		Flow Area (sq ft)	40.80	34.61
Weir Submerg		Froude # Chl	0.36	0.45
Weir Max Depth (ft)		Specif Force (cu ft)	42.04	35.29
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	1.63	1.44
Min El Prs (ft)	147.98	W.P. Total (ft)	28.17	26.79
Delta EG (ft)	2.14	Conv. Total (cfs)	2302.4	1742.8
Delta WS (ft)	2.39	Top Width (ft)	25.03	23.97
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	3.09	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.20	0.30
BR Sel Method	Momentum	Power Total (lb/ft s)	0.51	0.94

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: Q10

E.G. US. (ft)	145.47	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	145.08	E.G. Elev (ft)	144.91	143.04
Q Total (cfs)	451.00	W.S. Elev (ft)	144.50	142.51
Q Bridge (cfs)	451.00	Crit W.S. (ft)	143.15	141.53
Q Weir (cfs)		Max Chl Dpth (ft)	3.52	3.21
Weir Sta Lft (ft)		Vel Total (ft/s)	5.11	5.86
Weir Sta Rgt (ft)		Flow Area (sq ft)	88.27	76.92
Weir Submerg		Froude # Chl	0.48	0.58
Weir Max Depth (ft)		Specif Force (cu ft)	226.82	205.44
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	3.50	3.20
Min El Prs (ft)	147.98	W.P. Total (ft)	32.14	30.32
Delta EG (ft)	1.95	Conv. Total (cfs)	8113.6	6074.7
Delta WS (ft)	2.25	Top Width (ft)	25.23	24.05
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	5.86	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.53	0.87
BR Sel Method	Momentum	Power Total (lb/ft s)	2.71	5.12

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: Q50

E.G. US. (ft)	146.52	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	145.95	E.G. Elev (ft)	145.98	144.08
Q Total (cfs)	695.00	W.S. Elev (ft)	145.35	143.24
Q Bridge (cfs)	695.00	Crit W.S. (ft)	143.87	142.27
Q Weir (cfs)		Max Chl Dpth (ft)	4.37	3.94
Weir Sta Lft (ft)		Vel Total (ft/s)	6.33	7.35
Weir Sta Rgt (ft)		Flow Area (sq ft)	109.75	94.58
Weir Submerg		Froude # Chl	0.54	0.65
Weir Max Depth (ft)		Specif Force (cu ft)	376.73	344.90
Min El Weir Flow (ft)	157.03	Hydr Depth (ft)	4.36	3.93
Min El Prs (ft)	147.98	W.P. Total (ft)	33.84	31.79

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: Q50 (Continued)

Delta EG (ft)	1.94	Conv. Total (cfs)	11651.3	8306.8
Delta WS (ft)	2.36	Top Width (ft)	25.17	24.09
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	7.35	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.72	1.30
BR Sel Method	Momentum	Power Total (lb/ft s)	4.56	9.56

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: Q100

E.G. US. (ft)	146.95	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	146.30	E.G. Elev (ft)	146.44	144.51
Q Total (cfs)	815.00	W.S. Elev (ft)	145.69	143.50
Q Bridge (cfs)	815.00	Crit W.S. (ft)	144.19	142.61
Q Weir (cfs)		Max Chl Dpth (ft)	4.71	4.20
Weir Sta Lft (ft)		Vel Total (ft/s)	6.89	8.09
Weir Sta Rgt (ft)		Flow Area (sq ft)	118.29	100.75
Weir Submerg		Froude # Chl	0.56	0.70
Weir Max Depth (ft)		Specif Force (cu ft)	453.35	416.09
Min EI Weir Flow (ft)	157.03	Hydr Depth (ft)	4.70	4.18
Min EI Prs (ft)	147.98	W.P. Total (ft)	34.52	32.30
Delta EG (ft)	1.94	Conv. Total (cfs)	13198.6	9131.6
Delta WS (ft)	2.47	Top Width (ft)	25.15	24.10
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	8.09	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	0.82	1.55
BR Sel Method	Momentum	Power Total (lb/ft s)	5.62	12.55

Plan: BFW1.225X7 Magotty Mdw Br Richmond Rd RS: 221 Profile: Q500

E.G. US. (ft)	147.93	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	147.07	E.G. Elev (ft)	147.46	145.50
Q Total (cfs)	1105.00	W.S. Elev (ft)	146.45	144.05
Q Bridge (cfs)	1105.00	Crit W.S. (ft)	144.91	143.34
Q Weir (cfs)		Max Chl Dpth (ft)	5.47	4.75
Weir Sta Lft (ft)		Vel Total (ft/s)	8.05	9.62
Weir Sta Rgt (ft)		Flow Area (sq ft)	137.23	114.82
Weir Submerg		Froude # Chl	0.61	0.78
Weir Max Depth (ft)		Specif Force (cu ft)	652.17	601.97
Min EI Weir Flow (ft)	157.03	Hydr Depth (ft)	5.47	4.55
Min EI Prs (ft)	147.98	W.P. Total (ft)	36.03	34.59
Delta EG (ft)	1.93	Conv. Total (cfs)	16906.3	11110.2
Delta WS (ft)	2.93	Top Width (ft)	25.10	25.26
BR Open Area (sq ft)	175.66	Frctn Loss (ft)		
BR Open Vel (ft/s)	9.62	C & E Loss (ft)		
BR Sluice Coef		Shear Total (lb/sq ft)	1.02	2.05
BR Sel Method	Momentum	Power Total (lb/ft s)	8.18	19.73