OK RT

SCOUR ANALYSIS AND REPORTING FORM RaT

Bridge Structure No. 03286120 Date 7/17/12 Initials [illegible] Region (A B (C) D)

Site ______ Location 40470 202nd St, James River

~~Q_{100}~~ Q_{50} = ~~18000~~ 5860 by: drainage area ratio ~~[illegible]~~ flood freq. anal. ____ regional regression eq. RaT

Bridge discharge (Q_2) = 5860 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 324 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

Width (W_2) iteration = ______ ______ ______ ______

Avg. flow depth at bridge, y_2 iteration = ______ ______ ______ ______

Corrected channel width at bridge Section = W_2 times cos of flow angle = 304.46 ft* $q_2 = Q_2/W_2$ = 19.25 ft²/s

Bridge Vel, V_2 = 9.8 ft/s Final $y_2 = q_2/V_2$ = 19.6 ft Δh = 2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 21.5 ft

** NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD.

27.4

Water Surface Elev. = 6.0 ft 27.7

Low Steel Elev. = 21.1 ft >6.6

n (Channel) = 0.040

n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = ~~[illegible]~~ 2.9 ft

Pier Length = ~~[illegible]~~ 2.9 ft - see notes

Piers for 100 yr = 3 ft

PGRM: Contract

CONTRACTION SCOUR

Width of main channel at approach section W_1 = 375 ft

Width of left overbank flow at approach, W_{lob} = 324 ft Average left overbank flow depth, y_{lob} = 3.2 ft

Width of right overbank flow at approach, W_{rob} = 324 ft Average right overbank flow depth, y_{rob} = 7.6 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer) 21.8 −18.3 2.8 5.4 8.2

x = 11.64 From Figure 9 W_2 (effective) = 295.8 ft y_{cs} = 12.7 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} = ______ ft Average approach velocity, $V_1 = Q_{100}/(y_1W_1)$ = ______ ft/s

Critical approach velocity, $Vc = 11.52y_1^{1/6}D_{50}^{1/3}$ = ______ ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = ______ ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = ______ From Figure 10, y_{cs} = ______ ft

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.39 Using pier width a on Figure 11, ξ = 10.5 Pier scour y_{ps} = 9.1 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 3.2 ft right abutment, y_{aRT} = 7.6 ft

Shape coefficient K_1= 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, (0.55 for spill-through)

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 11.9 and ψ_{RT} = 19.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 11.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 19.5 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 03286120 Date 7/17/12 Initials RJ Region (A B (C) D)

Site 93100 Location 40470 202nd St

~~Q_{500}~~ Q_{100} = ~~32,100~~ 65231 by: drainage area ratio ~~__~~ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 65231 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

Bridge Width = 324 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

Width (W_2) iteration = ________ ________ ________ ________

Avg. flow depth at bridge, y_2 iteration = ________ ________ ________ ________

Corrected channel width at bridge Section = W_2 times cos of flow angle = 304.46 ft* $q_2 = Q_2/W_2$ = ~~[illegible]~~ 224.1 ft²/s

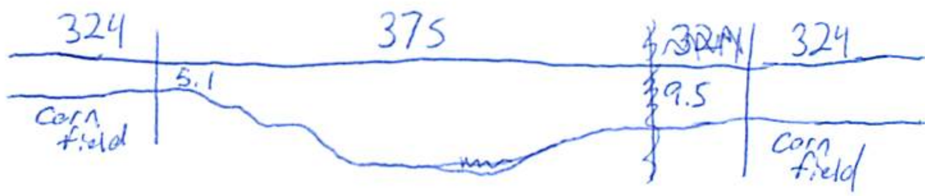
Bridge Vel, V_2 = ~~[illegible]~~ 10.6 ft/s Final $y_2 = q_2/V_2$ = ~~[illegible]~~ 21.1 ft Δh = 2.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 23.4 ft

** NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)*

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,

Water Surface Elev. = 6.0 ft
Low Steel Elev. = 21.1 ft
n (Channel) = 0.040
n (LOB) = 0.035
n (ROB) = 0.035
Pier Width = 2.9 ft
Pier Length = 2.9 ft
\# Piers for 500 yr = 3 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 375 ft

Width of left overbank flow at approach, W_{lob} = 324 ft Average left overbank flow depth, y_{lob} = 5.1 ft

Width of right overbank flow at approach, W_{rob} = 324 ft Average right overbank flow depth, y_{rob} = 9.5 ft

Live Bed Contraction Scour (use if bed material is small cobbles or finer)

x = 15.1 From Figure 9 W_2 (effective) = 295.8 ft y_{cs} = 15 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} = ________ ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1)$ = ________ ft/s

Critical approach velocity, $V_c = 11.52 y_1^{1/6} D_{50}^{1/3}$ = ________ ft/s

If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = ________ ft If $D_{50} >= D_{c50}$, $\chi = 0.0$

Otherwise, $\chi = 0.122 y_1[q_2/(D_{50}^{1/3} y_1^{7/6})]^{6/7} - y_1$ = ________ From Figure 10, y_{cs} = ________ ft

PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.41 Using pier width a on Figure 11, ξ = 10.5 Pier scour y_{ps} = 9.2 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 5.1 ft right abutment, y_{aRT} = 9.5 ft

Shape coefficient K_1= 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, (0.55 for spill-through)

Using values for y_{aLT} and y_{aRT} on figure 12, ψ_{LT} = 15.2 and ψ_{RT} = 20.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15.2 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 20.9 ft

Route 202 St Stream James River MRM ________ Date 7/17/12 Initials RaT

Bridge Structure No. 03286120 Location 40470 202nd St

GPS coordinates: N 44° 27' 26.0" W 98° 7' 14.6" taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27 ______

Drainage area = ~~13332.63~~ sq. mi. 13381.1

The average bottom of the main channel was 27.7 ft below top of guardrail at a point 199 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. ~~X~~ drainage area ratio X regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{50} (~~Q_{100}~~) =	~~186000~~ 58600		Q_{100} (~~Q_{500}~~) =	~~324000~~ 93100	
Estimated flow passing through bridge		58600			68231	
Estimated road overflow & overtopping		0			24869	
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping			X	X		
Chance of Pressure flow	X			X		
Armored appearance to channel		X			X	
Lateral instability of channel		X			X	

7/3

2	1680
5	6070
10	14300
25	34500
50	58600
100	93100
500	225000

Riprap at abutments? ____Yes X No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know some pier/contraction/abutment

Debris Potential? ____High ____Med X Low

Does scour countermeasure(s) appear to have been designed?

Riprap ____Yes X No ____Don't know ____NA

Spur Dike ____Yes X No ____Don't know ____NA

Other ______________ ____Yes X No ____Don't know ____NA

Bed Material Classification Based on Median Particle Size (D_{50})

Material	Silt/Clay X	Sand____	Gravel____	Cobbles____	Boulders____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

Comments, Diagrams & orientation of digital photos

1). left OB
2). main channel
3). right OB
4). pier
5-6). right abutment
7). left abutment
8-9). right abutment
10). right abutment
11-14) left abutment
15). main channel

Note: water too deep for accurate pier measurements.

Left and right overbanks are mature corn fields. Cannot ~~not accurate~~ accurately estimate elevation profile however, judging by the ~~tre~~ uniform height of the corn the fields are relatively level

Summary of Results

	~~Q100~~ Q_{50}	~~Q500~~ Q_{100}
Bridge flow evaluated	~~[illegible]~~ 58600	68231
Flow depth at left abutment (yaLT), in feet	~~[illegible]~~ 3.2	5.1
Flow depth at right abutment (yaRT), in feet	~~[illegible]~~ 7.6	9.5
Contraction scour depth (ycs), in feet	12.7	15
Pier scour depth (yps), in feet	9.1	9.2
Left abutment scour depth (yas), in feet	11.9	15.2
Right abutment scour depth (yas), in feet	19.5	20.9
1Flow angle of attack	20	20

See Comments/Diagram for justification where required