OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 03334240 Date 5/15/12 Initials CW, RT, RAT Region (A B C D)

Site _____ Location 6 mi S Carroll, 0.4 mi E on 214 St.

Q_{100}^{10} = >43 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 743 (should be Q_{100} 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 = 52 ft. Flow angle at bridge = 75 ° Abut. Skew = 0 ° Effective Skew = 75 °

Width (W_2) iteration = 52 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 10.5 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 13.46 ft* $q_2 = Q_2/W_2$ = 55.2 ft^2/s

Bridge Vel, V_2 = 5.3 ft/s Final $y_2 = q_2/V_2$ = 10.5 ft Δh = 5.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 11 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. = 2.1 ft

Low Steel Elev. = 10.6 ft

n (Channel) = 0.035

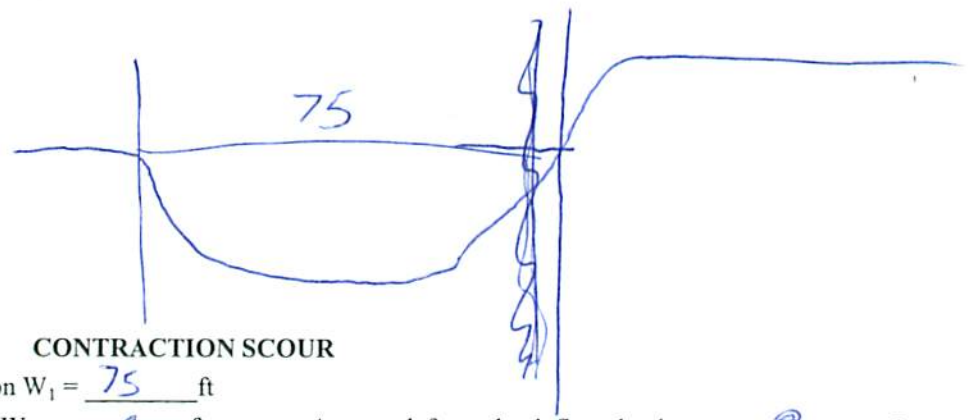
n (LOB) = 0.032

n (ROB) = 0.030

Pier Width = 1.7 ft

Pier Length = 3.3 ft

Piers for 100 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 75 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0 ft

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

x = 59.15 From Figure 9 W_2 (effective) = 11.8 ft y_{cs} = ~~16.3~~ 2.8 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, $V_1 = Q_{100}/(y_1 W_1)$ = _____ ft/s

Critical approach velocity, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 2 Correction factor for flow angle of attack (from Table 1), K2 = 1.45

Froude # at bridge = 0.29 Using pier width a on Figure 11, ξ = 7 Pier scour y_{ps} = 8.5 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 0 ft

Shape coefficient K_1 = 0 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} = 0 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 03334240 Date 5/15/12 Initials CW, RFT, RAT Region (A B C D)

Site _____ Location 6 mi S, 0.4 mi E on 214 St

Q_{500} (225) 1460 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = >60 (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 = 52 ft. Flow angle at bridge = 75 ° Abut. Skew = 0 ° Effective Skew = 75 °

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 = 13.46 ft* $q_2 = Q_2/W_2$ = 56.5 ft^2/s

Bridge Vel, V_2 = 5.3 ft/s Final $y_2 = q_2/V_2$ = 10.6 ft Δh = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 11.2 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. = 21 ft

Low Steel Elev. = 10.6 ft

n (Channel) = 0.035

n (LOB) = 0.032

n (ROB) = 0.036

Pier Width = 1.7 ft

Pier Length = 3.3 ft

Piers for 500 yr = 1 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 75 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0 ft

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

x = 0.23 From Figure 9 W_2 (effective) = 13.4 ft y_{cs} = ~~16.3~~ 2.8 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, $V_1 = Q_{500}/(y_1W_1)$ = _____ ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = _____ 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

PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 2 Correction factor for flow angle of attack (from Table 1), K2 = 1.415

Froude # at bridge = 0.29 Using pier width a on Figure 11, ξ = 7 Pier scour y_{ps} = 4.5 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 0 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} = 0 and ψ_{RT} = 0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

Route 214 St Stream Middle Pearl Ck MRM ______ Date 5/15/12 Initials CW, RFT, RAT

Bridge Structure No. 03334240 Location 6 mi S, (Gavons) & 0.4 mi E on ~~[illegible]~~ 214 St

GPS coordinates: N 44° 16' 56.5" / W 98° 1' 34.6" taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 ✓ NAD27 ______

Drainage area = ~~$~~ 55.7 sq. mi.

The average bottom of the main channel was 14.9 ft below top of guardrail at a point 15 ft from left abutment.

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

5/14 ~~8/22~~

2	95.9
5	378
10	743
25	1480
50	2250
100	3240
500	6510

MISCELLANEOUS CONSIDERATIONS

Flows	~~Q100~~ = Q10 = 743			~~Q500~~ = Q25 = 1480		
Estimated flow passing through bridge	743			760		
Estimated road overflow & overtopping	0			720		
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	

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know

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 X	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

2209 Str. no.
2210 bridge from approach
2211 rt abutment from approach
2212 LOB from ROB
2213 ROB
2214 Bridge from ROB
2215 ROB from bridge
2216 ROB from LOB
2217 approach from bridge

Summary of Results

	~~Q100~~ Q10	~~Q500~~ Q25
Bridge flow evaluated	743	760
Flow depth at left abutment (yaLT), in feet	0	0
Flow depth at right abutment (yaRT), in feet	0	0
Contraction scour depth (ycs), in feet	~~16.3~~ 2.8	~~16.3~~ 2.8
Pier scour depth (yps), in feet	8.5	8.5
Left abutment scour depth (yas), in feet	0	0
Right abutment scour depth (yas), in feet	0	0
1Flow angle of attack	75	75

See Comments/Diagram for justification where required