Dup.

OK-RAT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58064260 Date 10-5-12 Initials RFT Region (A B (C) D)

Site _____ Location 2.7W from S. edge Redfield on 174St

Q_{100} = 16800 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 16800 (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 = 181 ft. Flow angle at bridge = 18 ° Abut. Skew = 0 ° Effective Skew = 18 °

Width (W_2) iteration = 158 157 ____ ____

Avg. flow depth at bridge, y_2 iteration = 14.9 15 ____ ____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 149.32 ft* $q_2 = Q_2/W_2$ = 112.5 ft²/s

Bridge Vel, V_2 = 7.5 ft/s Final $y_2 = q_2/V_2$ = 15.0 ft Δh = 1.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 16.1 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. = 4.1 ft

Low Steel Elev. = 21.6 ft

n (Channel) = .030

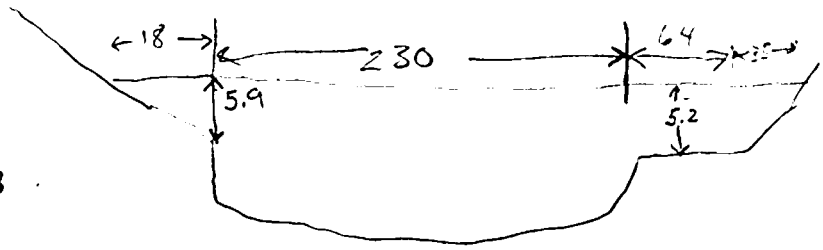
n (LOB) = .035

n (ROB) = .035

Pier Width = 2.75 ft

Pier Length = 2.75 ft

Piers for 100 yr = 2 ft



CONTRACTION SCOUR

This site is somewhat impounded from dam near Redfield

PGRM: Contract

Width of main channel at approach section W_1 = 228 ft

Width of left overbank flow at approach, W_{lob} = 18 ft Average left overbank flow depth, y_{lob} = 2.95 ft

Width of right overbank flow at approach, W_{rob} = 99 ft Average right overbank flow depth, y_{rob} = 4.28 ft

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

x = 10.57 From Figure 9 W_2 (effective) = 143.8 ft y_{cs} = 11.6 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.34 Using pier width a on Figure 11, ξ = 10.1 Pier scour y_{ps} = 8.6 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 2.95 ft right abutment, y_{aRT} = 4.28 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} = 11.4 and ψ_{RT} = 13.7

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 11.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 13.7 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 58064260 Date _____ Initials _____ Region (A B (C) D)

Site _____ Location _____

Q_{500} = 33900 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 33900 (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 = 181 ft. Flow angle at bridge = 18 ° Abut. Skew = 0 ° Effective Skew = 18 °

Width (W_2) iteration = 181 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 19.8 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 172.14 ft* $q_2 = Q_2/W_2$ = 196.9 ft²/s

Bridge Vel, V_2 = 10 ft/s Final $y_2 = q_2/V_2$ = 19.8 ft Δh = 2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 21.8 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. = 4.1 ft

Low Steel Elev. = 21.6 ft

n (Channel) = .030

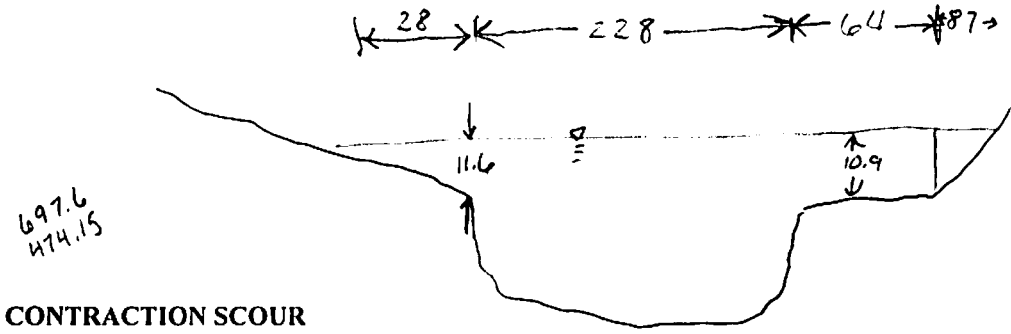
n (LOB) = .035

n (ROB) = .035

Pier Width = 2.75 ft

Pier Length = 2.75 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 228 ft

Width of left overbank flow at approach, W_{lob} = 28 ft Average left overbank flow depth, y_{lob} = 5.8 ft

Width of right overbank flow at approach, W_{rob} = 151 ft Average right overbank flow depth, y_{rob} = 7.76 ft

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

x = 11.4 From Figure 9 W_2 (effective) = 166.6 ft y_{cs} = 12.4 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, $Vc = 11.17 y_1^{1/6} D_{50}^{1/3}$ = _____ 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1

Froude # at bridge = 0.40 Using pier width a on Figure 11, ξ = 10.1 Pier scour y_{ps} = 8.8 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 5.8 ft right abutment, y_{aRT} = 7.76 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} = 16.5 and ψ_{RT} = 19.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 16.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 19.6 ft

Route 174 St Stream Turtle Creek MRM _____ Date _____ Initials _____

Bridge Structure No. 5806 4260 Location 2.7mi W from S. edge Redfield on 174 St

GPS coordinates: N 44° 51.906' taken from: USL abutment ✓ centerline of ⇑ MRM end _____

W 98° 34.676' Datum of coordinates: WGS84 ✓ NAD27 _____

Drainage area = 1403.48 sq. mi.

The average bottom of the main channel was 28.4 ft below top of guardrail at a point 47 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. ✓drainage area ratio ____regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 16800			Q_{500} = 33900		
Estimated flow passing through bridge	16800			33900		
Estimated road overflow & overtopping	0			0		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		✓			✓	
Chance of Pressure flow		✓			✓	
Armored appearance to channel		✓			✓	
Lateral instability of channel		✓			✓	

Riprap at abutments? ____Yes ✓No ____Marginal some cobble/coarse gravel, but no proper rip rap

Evidence of past Scour? ✓Yes ____No ____Don't know some abut. scour under bridge

Debris Potential? ____High ____Med ✓Low

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

Riprap ____Yes ✓No ____Don't know ____NA

Spur Dike ____Yes ____No ____Don't know ✓NA

Other _____ ____Yes ____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

str. no.
bridge from approach
LOB from ROB
ROB
left abut.
right abut.
approach from bridge

Summary of Results

	Q100	Q500
Bridge flow evaluated	16800	33900
Flow depth at left abutment (yaLT), in feet	2.95	5.8
Flow depth at right abutment (yaRT), in feet	4.28	7.76
Contraction scour depth (ycs), in feet	11.6	12.4
Pier scour depth (yps), in feet	8.6	8.8
Left abutment scour depth (yas), in feet	11.4	16.5
Right abutment scour depth (yas), in feet	13.7	19.6
Flow angle of attack	18°	18°

See Comments/Diagram for justification where required