OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 18092210 Date 6/6/12 Initials [illegible] Region (A B (C) D)

Site ______ Location 8 mi W of Ethan on 265 St

Q_{100} = 1890 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1890 (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 = 47 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 46.82 ft* $q_2 = Q_2/W_2$ = 40.4 ft^2/s

Bridge Vel, V_2 = 4.5 ft/s Final $y_2 = q_2/V_2$ = 9 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.4 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. = 1.2 ft

Low Steel Elev. = 11.2 ft

n (Channel) = 0.035

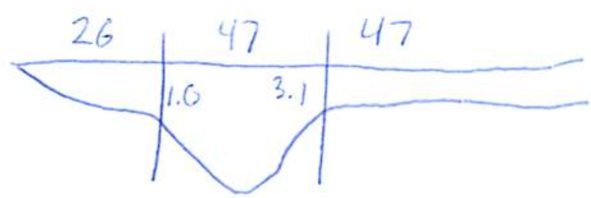
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 0 ft

Pier Length = 0 ft

Piers for 100 yr = 0 ft



PGRM: Contract

CONTRACTION SCOUR

Width of main channel at approach section W_1 = 47 ft

Width of left overbank flow at approach, W_{lob} = 26 ft Average left overbank flow depth, y_{lob} = 1.0 ft

$\frac{2}{3}\cdot 1.5$

Width of right overbank flow at approach, W_{rob} = 47 ft Average right overbank flow depth, y_{rob} = 3.1 ft

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

x = 1.65 From Figure 9 W_2 (effective) = 46.8 ft y_{cs} = 2.2 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 = ______ Correction factor for flow angle of attack (from Table 1), K2 = ______

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

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 1.0 ft right abutment, y_{aRT} = 3.1 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} = 4.3 and ψ_{RT} = 11.7

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 6.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 17.4 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 18092210 Date 6/6/12 Initials RaL Region (A B (C) D)

Site ____________ Location 8 mi W of Ethan on 265 St

Q_{500} = 3690 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 2951 (should be Q_{500} 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 = 47 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 46.82 ft* $q_2 = Q_2/W_2$ = 63 ft^2/s

Bridge Vel, V_2 = 5.6 ft/s Final $y_2 = q_2/V_2$ = 11.2 ft Δh = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 11.8 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. = 1.2 ft

Low Steel Elev. = 11.2 ft

n (Channel) = 0.035

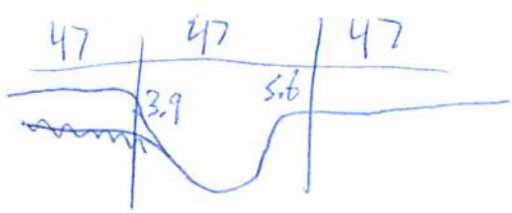
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 0 ft

Pier Length = 0 ft

\# Piers for 500 yr = 0 ft



PGRM: Contract

CONTRACTION SCOUR

Width of main channel at approach section W_1 = 47 ft

Width of left overbank flow at approach, W_{lob} = 47 ft Average left overbank flow depth, y_{lob} = 3.9 ft

Width of right overbank flow at approach, W_{rob} = 47 ft Average right overbank flow depth, y_{rob} = 5.6 ft

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

x = 5.34 From Figure 9 W_2 (effective) = 46.8 ft y_{cs} = 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, $V_1 = Q_{500}/(y_1W_1)$ = ________ 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

PGRM: Pie

PIER SCOUR CALCULATIONS

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

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

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 3.9 ft ~~right abutment~~, y_{aRT} = 5.6 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} = 13.1 and ψ_{RT} = 16.1

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 19.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 24 ft

98.14089
43.54197

Route 265 St Stream N Branch 12 Mile Ck MRM ________ Date ____________ Initials ________

Bridge Structure No. 18092210 Location 8 mi: W of Ethan on 265 St

GPS coordinates: N 43° 32' 31.2" W 98° 8' 27.1" taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 22.46 sq. mi.

The average bottom of the main channel was 16.4 ft below top of guardrail at a point 12 ft from left abutment.

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

530 8/23

2	~~68.2~~ 68.3
5	~~246~~ ~~247~~
10	467
25	~~898~~ 898
50	1340
100	1890
500	3690

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} =	1890		Q_{500} =	3690	
Estimated flow passing through bridge		1890			2951	
Estimated road overflow & overtopping		0			739	
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? _____Yes X No _____Marginal

Evidence of past Scour? X Yes _____No _____Don't know abutment contraction

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). main channel
2-3). right ab
4-5). left abd.
6). right OB
7). main channel
8). left OB

Summary of Results

	Q100	Q500
Bridge flow evaluated	1890	2951
Flow depth at left abutment (yaLT), in feet	1.0	3.9
Flow depth at right abutment (yaRT), in feet	3.1	5.6
Contraction scour depth (ycs), in feet	2.2	6
Pier scour depth (yps), in feet	N/A	N/A
Left abutment scour depth (yas), in feet	6.4	~~13.1~~ 19.5
Right abutment scour depth (yas), in feet	17.4	~~16.1~~ 24
1Flow angle of attack	5	5

See Comments/Diagram for justification where required