False Bottom Creek

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 41165066 Date 4/11/12 Initials Cn Region ((A) B C D)

Site ____________ Location 2.5 mi S of St. Onge

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

Bridge discharge (Q_2) = ____________ (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 = 120 ft. Flow angle at bridge = 30 ° Abut. Skew = 0 ° Effective Skew = 30 °

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 = ______ft* $q_2 = Q_2/W_2$ = ______ft^2/s

Bridge Vel, V_2 = ______ft/s Final $y_2 = q_2/V_2$ = ______ft Δh = ______ft

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

Low Steel Elev. = 12.5 ft

n (Channel) = 0.04

n (LOB) = ______

n (ROB) = ______

Pier Width = ______ ft

Pier Length = ______ ft

\# Piers for 100 yr = ______ ft

Q500 passes through bridge → no smaller flow calc'd

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = ______ft

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

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

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

x = ______ From Figure 9 W_2 (effective) = ______ft y_{cs} = ______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, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = ______ 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 = 1 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

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

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

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

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

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 41165066 Date 4/11/12 Initials Cn Region ((A) B C D)

Site ________ Location 2.5 mi S of St. Onge

Q_{500} = 8310 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 8310 (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 = 120 ft. Flow angle at bridge = 30 ° Abut. Skew = 0 ° Effective Skew = 30 °

Width (W_2) iteration = 120 102 107 105

Avg. flow depth at bridge, y_2 iteration = 7.2 4.7 8.4 8.5

Corrected channel width at bridge Section = W_2 times cos of flow angle = 90.93 ft* $q_2 = Q_2/W_2$ = 91.4 ft^2/s

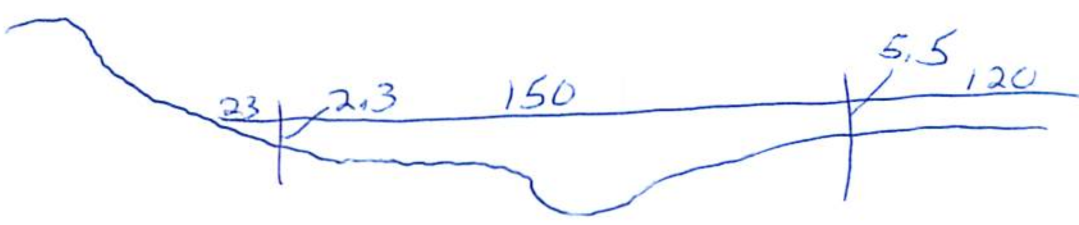
Bridge Vel, V_2 = 10.7 ft/s Final $y_2 = q_2/V_2$ = 8.5 ft Δh = 2.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10.9 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. = ____ ft
Low Steel Elev. = 12.5 ft
n (Channel) = 0.035
n (LOB) = 0.037
n (ROB) = 0.035
Pier Width = 0.8 ft
Pier Length = 0.8 ft
\# Piers for 500 yr = 4 ft



PGRM: Contract

CONTRACTION SCOUR

Width of main channel at approach section W_1 = 150 ft

Width of left overbank flow at approach, W_{lob} = 23 ft Average left overbank flow depth, y_{lob} = 2.3/2 1.15 ft

Width of right overbank flow at approach, W_{rob} = 120 ft Average right overbank flow depth, y_{rob} = 5.5 ft

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

~~x = ____ From Figure 9 W_2 (effective) = ____ ft y_{cs} = ____ ft~~

PGRM: CWCSNEW

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

Estimated bed material D_{50} = 0.2 ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1)$ = 2.6 ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = 9.73 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.107 ft If $D_{50} >= D_{c50}$, (($\chi = 0.0$))

Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = X From Figure 10, y_{cs} = 0.0 ft

PGRM: Pier

PIER SCOUR CALCULATIONS

L/a ratio = 1.0 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.65 Using pier width a on Figure 11, ξ = 3.9 Pier scour y_{ps} = 3.6 ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 1.15 ft right abutment, y_{aRT} = 5.5 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} = 4.9 and ψ_{RT} = 15.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 4.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 15.9 ft

Route St. Onge Rd. Stream False Bottom Ck MRM________ Date 4/11/12 Initials CL

Bridge Structure No. 41165066 Location 2.5 mi S of St. Onge

GPS coordinates: N 44° 30' 32.00" W 103° 43' 10.0" taken from: USL abutment X centerline of 1 MRM end ______

Datum of coordinates: WGS84 X NAD27______

Drainage area = 29.05 sq. mi.

The average bottom of the main channel was 16.5 ft below top of guardrail at a point 43 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} =			Q_{500} = 8310		
Estimated flow passing through bridge				8310		
Estimated road overflow & overtopping				—		
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping					X	
Chance of Pressure flow					X	
Armored appearance to channel					X	
Lateral instability of channel					X	

Riprap at abutments? ____Yes ____No X Marginal

Evidence of past Scour? X Yes ____No ____Don't know Channel is a little incised

Debris Potential? ____High X Med ____Low

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

Riprap	X Yes	____No	____Don't know	____NA
Spur Dike	____Yes	____No	____Don't know	X NA
Other ________________	____Yes	____No	____Don't know	X NA

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

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

Comments, Diagrams & orientation of digital photos

[illegible]	
2	75.3
5	274
10	561
25	1200
50	2050
100	3260
500	8310

Photos

2199 - ID
2200 - US
01 - US RB
02 - US LB
03 - US Face
04 - L. App XS
05 - RB App XS
06 - L. Abut
07 - R. Abut
08 - Piers

Summary of Results

	Q100	Q500
Bridge flow evaluated		8310
Flow depth at left abutment (yaLT), in feet		1.15
Flow depth at right abutment (yaRT), in feet		5.5
Contraction scour depth (ycs), in feet		0.0
Pier scour depth (yps), in feet		3.6
Left abutment scour depth (yas), in feet		4.9
Right abutment scour depth (yas), in feet		15.9
1Flow angle of attack		30°

See Comments/Diagram for justification where required