OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50124080 Date 6/27/12 Initials RGT Region (A B (C) D)

Site ______ Location 0.5 mi N & 0.5 mi W of Lyons on 252 St

Q_{100} = Q5 2980 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 2980 (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 = 142 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

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 = 142 ft* $q_2 = Q_2/W_2$ = 21 ft^2/s

Bridge Vel, V_2 = 3.2 ft/s Final $y_2 = q_2/V_2$ = 6.5 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.7 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. = 07.0 ft

Low Steel Elev. = 8.2 ft

n (Channel) = 0.060 very weedy

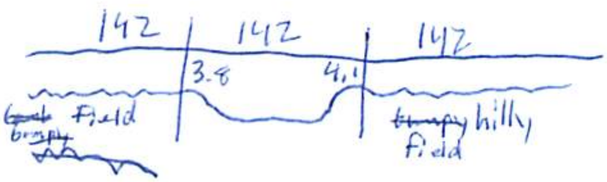
n (LOB) = 0.045 high grass

n (ROB) = 0.045

Pier Width = 1.85 ft

Pier Length = 1.65 ft

\# Piers for 100 yr = 4 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 142 ft

Width of left overbank flow at approach, W_{lob} = 142 ft Average left overbank flow depth, y_{lob} = 3.8 ft

Width of right overbank flow at approach, W_{rob} = 142 ft Average right overbank flow depth, y_{rob} = 4.1 ft

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

x = 8.19 From Figure 9 W_2 (effective) = 134.6 ft y_{cs} = 9 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

PIER SCOUR CALCULATIONS

PGRM: Pier

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

Froude # at bridge = 0.22 Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.8 ft right abutment, y_{aRT} = 4.1 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} = 12.9 and ψ_{RT} = 13.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 13.4 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 50124080 Date 6/27/12. Initials RA Region (A B (C) D)

Site ______ Location 0.5 mi N + 0.5 mi W of Lyons on 252 St

Q_{500} = Q_{10} 4620 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 4620 (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

"RegionC", or "RegionD"

Bridge Width = 142 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

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 = 142 ft* $q_2 = Q_2/W_2$ = 32.5 ft^2/s

Bridge Vel, V_2 = 4 ft/s Final $y_2 = q_2/V_2$ = 8.1 ft Δh = 0.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.4 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. = 0-1.0 ft

Low Steel Elev. = 8.2 ft

n (Channel) = 0.060

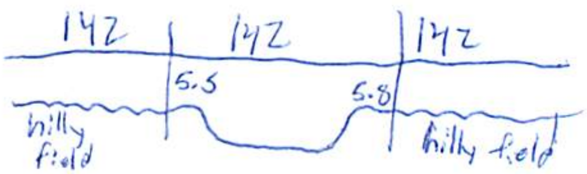
n (LOB) = 0.045

n (ROB) = 0.045

Pier Width = 1.85 ft

Pier Length = 1.85 ft

\# Piers for 500 yr = 4 ft



CONTRACTION SCOUR

Width of main channel at approach section W_1 = 142 ft

Width of left overbank flow at approach, W_{lob} = 142 ft Average left overbank flow depth, y_{lob} = 5.5 ft

Width of right overbank flow at approach, W_{rob} = 142 ft Average right overbank flow depth, y_{rob} = 5.8 ft

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

x = 12.67 From Figure 9 W_2 (effective) = 134.6 ft y_{cs} = 13.7 ft

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, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = ______ 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

L/a ratio = 1

Froude # at bridge = 0.25

Correction factor for flow angle of attack (from Table 1), K2 = 1

Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 6.1 ft

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 5.5 ft right abutment, y_{aRT} = 5.8 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} = 15.9 and ψ_{RT} = 16.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 16.5 ft

96° 38' 48.408''
43° 43 56.1''

~~96.88235~~
~~43.73215~~
96.64678
43.73225

Route 252 St Stream Skunk Ck MRM ______ Date 6/27/12 Initials RaT

Bridge Structure No. 50124080 Location 0.5 mi N & 0.5 mi W of Lyons on 252 St

GPS coordinates: N 43° 43' 55.9'' taken from: USL abutment X centerline of ⇑ MRM end ______

W 96° 52' 56.5'' Datum of coordinates: WGS84 X NAD27 ______

Drainage area = 290.15 sq. mi.

The average bottom of the main channel was 11.9 ft below top of guardrail at a point 56 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = Q_5			Q_{500} = Q_{10}		
Estimated flow passing through bridge	2980			4620		
Estimated road overflow & overtopping	0			0		
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 some pier/contraction/abutment

Debris Potential? ____High ____Med X Low

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

Riprap X Yes ____No ____Don't know ____NA rose quartz

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) pier scour
6-7) left abutment
8-9) right abutment
10) main channel

Summary of Results

	Q100 5	Q500 10
Bridge flow evaluated	2980	4620
Flow depth at left abutment (yaLT), in feet	3.8	5.5
Flow depth at right abutment (yaRT), in feet	4.1	5.8
Contraction scour depth (ycs), in feet	9	13.7
Pier scour depth (yps), in feet	6	6.1
Left abutment scour depth (yas), in feet	12.9	15.9
Right abutment scour depth (yas), in feet	13.4	16.5
1Flow angle of attack	0	0

See Comments/Diagram for justification where required

6.52
6/18

2	231
5	571
10	871
25	1330
50	1720
100	2150
500	3234

6/27

2	1200
5	2980
10	4620
25	7180
50	9470
100	12000
500	18800