OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52327321 Date 10/14/2010 Initials CW Region (A circled B C D)

Site ______ Location downstream 0.1 mile from int. Hisega Lane + Triangle Trail

Q_{100} = 867 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 867 (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 = 50 ft. Flow angle at bridge = 45 ° Abut. Skew = 20 ° Effective Skew = 25 °

Width (W_2) iteration = Vert Abut ____ ____

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

Corrected channel width at bridge Section = W_2 times cos of flow angle = 45.32 ft* $q_2 = Q_2/W_2$ = 19.1 ft^2/s

Bridge Vel, V_2 = 5.3 ft/s Final $y_2 = q_2/V_2$ = 3.6 ft Δh = 0.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 4.2 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. = — ft

n (Channel) = 0.040

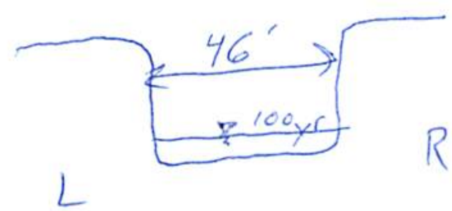
n (LOB) = 0.035

n (ROB) = 0.040

Pier Width = — ft

Pier Length = — ft

\# Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = ~~46~~ 50 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0.0 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0.0 ft

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

x = 0.06 From Figure 9 W_2 (effective) = ~~[illegible]~~ 45.3 ft y_{cs} = 0.1 ft See comments

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) z=0 ~~z=0.567~~ ~~z=0.499~~ z=0

Estimated bed material D_{50} = ~~[illegible]~~ 0.2 ft Average approach velocity, $V_1 = Q_{100}/(y_1 W_1)$ = ~~4.49~~ ft/s 4.13

Critical approach velocity, $V_c = 11.52 y_1^{1/6} D_{50}^{1/3}$ = 8.3 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.0276 ft If $D_{50} >= D_{c50}$, $\chi = 0.0$ (circled)

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} = 0.0 ft

PIER SCOUR CALCULATIONS

PGRM: Pier

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

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0.0 ft right abutment, y_{aRT} = 0.0 ft

Shape coefficient K_1= (1.00 circled) 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} = 0.0 and ψ_{RT} = 0.0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0.0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0.0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52327321 Date 10/14/2010 Initials CW Region ((A) B C D)

Site ____________ Location downstream 0.1 mile from int. Hisega Ln and Triangle Tr.

Q_{500} = 1290 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 1290 (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 = 50 ft. Flow angle at bridge = 45 ° Abut. Skew = 20 ° Effective Skew = 25 °

Width (W_2) iteration = Vert Abut ____

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

Corrected channel width at bridge Section = W_2 times cos of flow angle = 45.32 ft* $q_2 = Q_2/W_2$ = 28.5 ft^2/s

Bridge Vel, V_2 = 6.3 ft/s Final $y_2 = q_2/V_2$ = 4.5 ft Δh = 0.8 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 5.3 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. = — ft

n (Channel) = 0.040

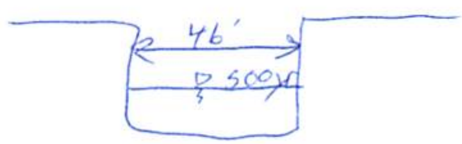
n (LOB) = 0.035

n (ROB) = 0.040

Pier Width = — ft

Pier Length = — ft

\# Piers for 500 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = ~~46~~ 50 ft

Width of left overbank flow at approach, W_{lob} = 0.0 ft Average left overbank flow depth, y_{lob} = 0.0 ft

Width of right overbank flow at approach, W_{rob} = 0.0 ft Average right overbank flow depth, y_{rob} = 0.0 ft

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

x = 0.55 From Figure 9 W_2 (effective) = 45.3 ft y_{cs} = 0.9 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) ~~Z = 0.816~~ ~~Z = 0.499~~ Z = 0

Estimated bed material D_{50} = 0.2 ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1)$ = ~~5.27~~ ft/s 4.87

Critical approach velocity, $Vc = 11.52y_1^{1/6}D_{50}^{1/3}$ = 4.63 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.0405 ft If $D_{50} >= D_{c50}$, (χ = 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} = 0.0 ft

PIER SCOUR CALCULATIONS

PGRM: Pier

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

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 0.0 ft right abutment, y_{aRT} = 0.0 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} = 0.0 and ψ_{RT} = 0.0

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0.0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0.0 ft

Route Hisega Ln Stream Rapid Creek MRM_____ Date 10/14/10 Initials CW

Bridge Structure No. 52327321 Location downstream 0.1 mi from int. Hisega Ln and Triangle Tr.

GPS coordinates: N44°03'06.8" W103°24'02.8" taken from: USL abutment X centerline of ⇑ MRM end ____

Datum of coordinates: WGS84 X NAD27____

Drainage area = 341.38 sq. mi.

The average bottom of the main channel was 9 ft below top of guardrail at a point 15.3 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} =	867		Q_{500} =	1290	
Estimated flow passing through bridge		867			1290	
Estimated road overflow & overtopping		—			—	
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? ____Yes X No ____Don't know

Debris Potential? X High ____Med ____Low

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

Riprap	____Yes	____No	____Don't know	X NA
Spur Dike	____Yes	____No	____Don't know	X NA
Other large Wing Wall	X Yes	____No	____Don't know	____NA

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

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

Comments, Diagrams & orientation of digital photos

D_{50} is probably smaller than 0.2 ft → Bed material large gravel & small cobbles

I do not suspect much erosion. But ran live bed just to see. Both say basically 0.

Photos 1312 - ID
13 - US
14 - US LB
15 - US RB
16 - R. Wing Wall
17 - L. Wing Wall
18 - US Face of bridge from US XS
19 - R. overbank at approach XS
20 - R. Wing Wall

Summary of Results

	Q100	Q500
Bridge flow evaluated	867	1290
Flow depth at left abutment (yaLT), in feet	0.0	0.0
Flow depth at right abutment (yaRT), in feet	0.0	0.0
Contraction scour depth (ycs), in feet	0.0	0.0
Pier scour depth (yps), in feet	NA	NA
Left abutment scour depth (yas), in feet	0.0	0.0
Right abutment scour depth (yas), in feet	0.0	0.0
1Flow angle of attack	25°	25°

See Comments/Diagram for justification where required