Possible Dnt

OK by RFT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52423324 Date 9/21/12 Initials RoT Region (A B C D) — A circled

Site ______ Location Elm Avenue & Drainage Ditch in RC

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

Bridge discharge (Q_2) = ______ (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

Not Scourable! – See pictures

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

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

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. = ______ ft

n (Channel) = ______

n (LOB) = ______

n (ROB) = ______

Pier Width = ______ ft

Pier Length = ______ ft

\# Piers for 100 yr = ______ ft

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, $V_1 = Q_{100}/(y_1 W_1)$ = ______ ft/s

Critical approach velocity, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3}$ = ______ 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 = ______ 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} = ______ 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. 52423324 Date 9/21/12 Initials RaT Region (A B C D) [A circled]

Site ______ Location Elm Avenue & Drainage Ditch in RC

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

Bridge discharge (Q_2) = ______ (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 = ____ ft. Flow angle at bridge = ____ ° Abut. Skew = ____ ° Effective Skew = ____ °

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. = ____ ft

n (Channel) = ____

n (LOB) = ____

n (ROB) = ____

Pier Width = ____ ft

Pier Length = ____ ft

\# Piers for 500 yr = ____ ft

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, $V_1 = Q_{500}/(y_1 W_1)$ = ____ 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

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} = ____ 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

44° 2' 52.72"
103° 12' 24.012"

103.20667
44.047[illegible]98

Elm/E Centennial

St. Jo → Campbell → E. Minnesota

Route Elm Avenue Stream Drainage Ditch MRM________ Date 9/21/12 Initials RAT

Bridge Structure No. 52423324 Location Elm Avenue & Drainage Ditch in RC

GPS coordinates: N 44° 7' 52.6'' W 103° 12' 23.9'' taken from: USL abutment x centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 x NAD27_____

Drainage area = 1.13 sq. mi.

The average bottom of the main channel was ________ft below top of guardrail at a point _________ft from left abutment.

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

7/3	
2	8.78
5	23.6
10	41.3
25	79.9
50	114
100	164
500	330

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} =			Q_{500} =		
Estimated flow passing through bridge						
Estimated road overflow & overtopping						
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

Evidence of past Scour? _____Yes _____No _____Don't know

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_____	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 abutment
2). main channel
3). right abutment
4). main channel

Note: Bridge not scourable! all concrete.

Summary of Results

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

See Comments/Diagram for justification where required