OL RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 29230115 Date 7/31/12 Initials NaT Region (A B C D)

Site _____ Location 3.6 mi W & 0.5 mi N of Dempster on 459 Ave

Q_{100} = Q_{max} 3750 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. x

Bridge discharge (Q_2) = 3750 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

See notes.

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

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

Bridge Width = 106 ft. Flow angle at bridge = 46 ° Abut. Skew = 0 ° Effective Skew = 46 °

Width (W_2) iteration = 109 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 9.5 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 62.73 ft* $q_2 = Q_2/W_2$ = 45.3 ft²/s

Bridge Vel, V_2 = 4.8 ft/s Final $y_2 = q_2/V_2$ = 9.5 ft Δh = 0.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10 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,

depth 2.6

Water Surface Elev. = 0.6-9.0 ft

Low Steel Elev. = 9.5 ft

n (Channel) = 0.033

n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 1.85 ft

Pier Length = 1.85 ft

Piers for 100 yr = 2 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 132 ft

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

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

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

x = 6.7 From Figure 9 W_2 (effective) = 79 ft y_{cs} = 7.5 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 = 0.27 Using pier width a on Figure 11, ξ = 7.5 Pier scour y_{ps} = 6.2 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.1 ft right abutment, y_{aRT} = 4.6 ft

3.1 4.6

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} = 11.7 and ψ_{RT} = 14.3

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 21.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 26 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 29230115 Date 7/31/12 Initials LaT Region (A B C D)

Site _____ Location 3.6 mi W + 0.5 mi N of Dempster on 459 Ave

Q_{500} = 1500 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1500 (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

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

Bridge Width = 106 ft. Flow angle at bridge = 40 ° Abut. Skew = 0 ° Effective Skew = 40 °

Width (W_2) iteration = 106 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 6 _____ _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 82.73 ft* $q_2 = Q_2/W_2$ = 18.1 ft^2/s

Bridge Vel, V_2 = 3 ft/s Final $y_2 = q_2/V_2$ = 6 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.2 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. = 2.6 0-4.0 ft

Low Steel Elev. = 9.5 ft

n (Channel) = 0.033

n (LOB) = 0.039

n (ROB) = 0.035

Pier Width = 1.85 ft

Pier Length = 1.85 ft

Piers for 500 yr = 2 ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 106 ft

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

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

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

x = 2.27 From Figure 9 W_2 (effective) = 79 ft y_{cs} = 2.8 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

PGRM: Pier

PIER SCOUR CALCULATIONS

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

Y_2 Yart
10 - 4.6 = 5.4 6.2 Y_2 - 5.4

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 0 ft right abutment, y_{aRT} = 0.8 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} = 0 and ψ_{RT} = 3.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 6.3 ft

44° 38' 13.11"
97° 1' 37.489"

97.02705
44.63719

Route 459 Ave Stream Boswell Diversion Ditch MRM _____ Date 7/31/12 Initials RAT

Bridge Structure No. 29230115 Location 3.6 mi W of 0.5 mi N of Dempster on 459 Ave

GPS coordinates: N 40° 38' 13.0" W 97° 1' 37.4" taken from: USL abutment X centerline of ⇑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 7.09 sq. mi.

The average bottom of the main channel was 13.5 ft below top of guardrail at a point 58 ft from left abutment.

Method used to determine flood flows: ___Freq. Anal. ___drainage area ratio X regional regression equations.

7/3
8/23

2	79.3
5	219
10	353
25	567
50	754
100	960
500	1500

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = Q_{max} 3750			Q_{500} = 1500		
Estimated flow passing through bridge	3750			1500		
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? ____Yes ____No X Marginal - on outside, right abutment and left abutment under bridge only

Evidence of past Scour? X Yes ____No ____Don't know lots of pier/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). left OB
2). main channel
3). right OB
4). pier
5). right abutment
6-8). left abutment
9-11). right abutment

1). main channel

Note: Assume flow east → west. There appears to be a decommissioned dam east of bridge on 460 Ave & 189 St, this may drastically reduce the flood flow levels.

Note: High water levels much > than flow levels. Calc. @ low steel

Summary of Results

	Q100-Q_{max}	Q500
Bridge flow evaluated	3750	1500
Flow depth at left abutment (yaLT), in feet	0	0
Flow depth at right abutment (yaRT), in feet	0	0
Contraction scour depth (ycs), in feet	7.5	2.8
Pier scour depth (yps), in feet	6.2	6
Left abutment scour depth (yas), in feet	21.3	0
Right abutment scour depth (yas), in feet	26.0	6.3
1Flow angle of attack	40	40

See Comments/Diagram for justification where required