ok TRT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 02040063 Date 6/12/12 Initials RAT Region (A B C D)

Site _____ Location 7.7 miles North of White Lake on 374 Ave - Aurora Co.

Q_{100} = 1320 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1320 (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 = 62 ft. Flow angle at bridge = 85 40° Abut. Skew = 10 30° Effective Skew = 10 °

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 = 61.06 ft* $q_2 = Q_2/W_2$ = 21.6 ft^2/s

Bridge Vel, V_2 = 3.3 ft/s Final $y_2 = q_2/V_2$ = 6.6 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.5 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. = 2.7 ft

Low Steel Elev. = 6.6 ft

n (Channel) = 0.040

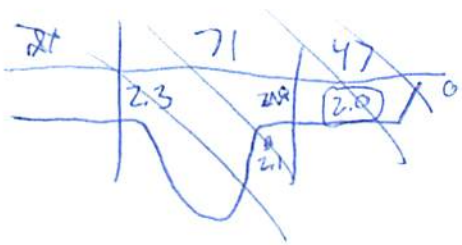
n (LOB) = 0.035

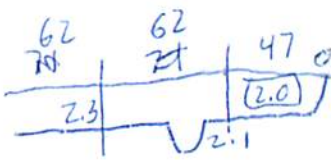
n (ROB) = 0.030

Pier Width = 1.2 ft

Pier Length = Va 1.2 ft

Piers for 100 yr = 3 ft





CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 62 ft

Width of left overbank flow at approach, W_{lob} = 62 ft Average left overbank flow depth, y_{lob} = 2.3 ft

Width of right overbank flow at approach, W_{rob} = 47 ft Average right overbank flow depth, y_{rob} = 2.0 ft

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

x = 2.56 From Figure 9 W_2 (effective) = 57.5 ft y_{cs} = 3.5 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 = 0.23 Using pier width a on Figure 11, ξ = 5.5 Pier scour y_{ps} = 4.4 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.3 ft right abutment, y_{aRT} = 2.0 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} = 9.4 and ψ_{RT} = 8.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 14 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.3 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 02040063 Date 6/12/17 Initials RaT Region (A B C D)

Site _____ Location 7.7mi N of White Lake on 374 Ave

Q_{500} = 2520 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 1534 (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 = _____ ft. Flow angle at bridge = 40 ° Abut. Skew = 30 ° Effective Skew = 10 °

Width (W_2) iteration = _____ _____ _____ _____

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

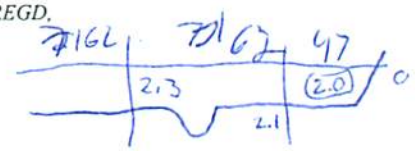
Corrected channel width at bridge Section = W_2 times cos of flow angle = 61.06 ft* $q_2 = Q_2/W_2$ = 21.8 ft^2/s

Bridge Vel, V_2 = 3.3 ft/s Final $y_2 = q_2/V_2$ = 6.6 ft Δh = 0.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.8 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. = 2.7 ft

Low Steel Elev. = 6.6 ft

n (Channel) = 0.040

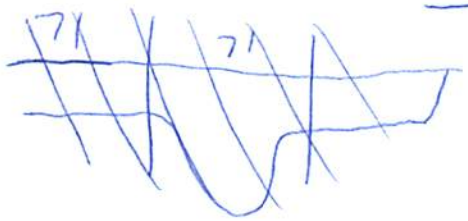
n (LOB) = 0.035

n (ROB) = 0.030

Pier Width = 1.2 ft

Pier Length = 1.2 ft

Piers for 500 yr = 3 ft



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Width of right overbank flow at approach, W_{rob} = 47 ft Average right overbank flow depth, y_{rob} = 2.0 ft

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

x = 2.66 From Figure 9 W_2 (effective) = ~~58.7~~ 57.5 ft y_{cs} = ~~3.7~~ 3.5 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, $V_1 = Q_{500}/(y_1 W_1)$ = _____ 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

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PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, y_{aLT} = 2.3 ft right abutment, y_{aRT} = 2 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} = 9.1 and ψ_{RT} = 8.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 14 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.3 ft

96° 42' 51.3"
43° 50' 41.28"

96.71425
43.8448

PS 56
left mid

Route 374 Ave Stream _____ MRM _____ Date 6/12/12 Initials RET

Bridge Structure No. 02040063 Location 7.7 mi N of White Lake on 374 Ave - Aurora Co.

GPS coordinates: N 43° 50 40.6" taken from: USL abutment X centerline of ⇑ MRM end _____

W 98° 42 51.1" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 14.25 sq. mi.

The average bottom of the main channel was 10.5 ft below top of guardrail at a point 8 ft from left abutment.

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

6/12

Pk Z	52					
5	184					
10	345					
25	653					
50	941					
100	1350					
500	2580					

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 1320			Q_{500} = 2520		
Estimated flow passing through bridge	1320			1334		
Estimated road overflow & overtopping	0			1186		
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	

5/30

2	11.9	2	51.1
5	31.5	5	181
10	52.2	10	338
25	86.7	25	639
50	119	50	943
100	156	100	1320
500	262	500	2520
	0.45		13.75

Riprap at abutments? ____Yes X No ____Marginal

Evidence of past Scour? ____Yes ____No X Don't know

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 _____	X Yes	____No	____Don't know	____NA

bridge layout

note: stream stats shows two adjacent stream cells crossing the road

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

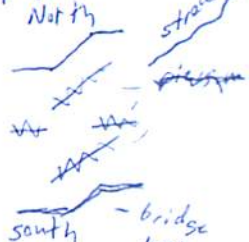
Comments, Diagrams & orientation of digital photos

2	51.1
5	181
10	338
25	639
50	943
100	1326
500	2520

1). left cb
2). main channel
3). right cb
4-6) pier
7-10), right abutment
11-14). left abutment

15). Road Crack
16). main channel

Note: bridge top view



piers = +

There are 0 road cracks outlining the change from concrete to wood piers/abutments sections deep enough to see through to the water. Angled sections are concrete. Straight sections are wood

Summary of Results

	Q100	Q500
Bridge flow evaluated	1320	1334
Flow depth at left abutment (yaLT), in feet	2.3	2.3
Flow depth at right abutment (yaRT), in feet	2.0	0
Contraction scour depth (ycs), in feet	3.5	3.5
Pier scour depth (yps), in feet	4.1	4.1
Left abutment scour depth (yas), in feet	14	~~12.3~~ 14
Right abutment scour depth (yas), in feet	12.3	~~14~~ 12.3
1Flow angle of attack	10	10

See Comments/Diagram for justification where required

Pier width/length. Channel too muddy/deep to get an accurate measurement. Had to estimate.