Platte Creek

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 02014138 Date 10/10/11 Initials CW Region (A B C D)

Site _____ Location ~3 mi W of White Lake on I-90W

Q_{100} = 4310 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 4310 (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 = 104 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 104 58 70 63 66 65

Avg. flow depth at bridge, y_2 iteration = 9.1 12.2 11.1 11.7 11.4 11.5

Corrected channel width at bridge Section = W_2 times cos of flow angle = 65 ft* $q_2 = Q_2/W_2$ = 66.3 ft^2/s

Bridge Vel, V_2 = 5.6 ft/s Final $y_2 = q_2/V_2$ = 11.5 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 12.2 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. = 20.2 ft

n (Channel) = 0.045

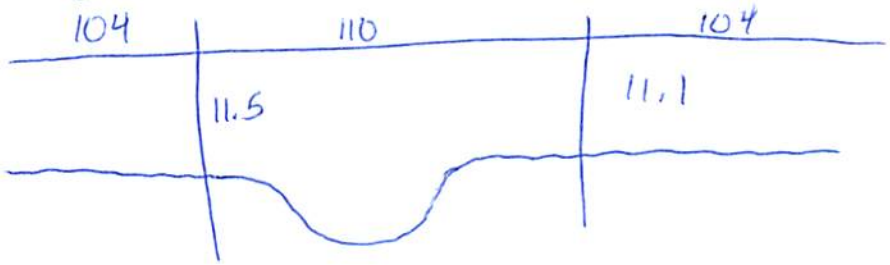
n (LOB) = 0.080

n (ROB) = 0.050

Pier Width = 2.0 ft

Pier Length = 2.0 ft

Piers for 100 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 110 ft

Width of left overbank flow at approach, W_{lob} = 104 ft Average left overbank flow depth, y_{lob} = 11.5 ft

Width of right overbank flow at approach, W_{rob} = 104 ft Average right overbank flow depth, y_{rob} = 11.1 ft

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

x = 36.39 From Figure 9 W_2 (effective) = 61.6 ft y_{cs} = 26.5 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 = 1.0 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.3 Using pier width a on Figure 11, ξ = 8.0 Pier scour y_{ps} = 6.7 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 11.5 ft right abutment, y_{aRT} = 11.1 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} = 22.6 and ψ_{RT} = 22.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 22.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 22.2 ft

6.5
4.4
11.1

6.5
5.1
1.4

5.1 > 2.0

2.0 I 7.0 5.0

I 1.4

6.5 — 5.1 = 1.4

6.5
2.1
5.1
0

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 02014138 Date 10/10/11 Initials CW Region (A B C D)

Site _____ Location ~3 mi W of White Lake on I-90 W

Q_{500} = 8790 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 5790 (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 = 104 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 104 ~~76~~ ~~95~~ 76 95 80 81

Avg. flow depth at bridge, y_2 iteration = 13.0 ~~15.2~~ ~~13.6~~ 15.2 13.6 14.8 14.7

Corrected channel width at bridge Section = W_2 times cos of flow angle = 81.0 ft* $q_2 = Q_2/W_2$ = 109.5 ft^2/s

Bridge Vel, V_2 = 7.4 ft/s Final $y_2 = q_2/V_2$ = 14.7 ft Δh = 1.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 15.8 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. = _____ ft

Low Steel Elev. = 20.2 ft

n (Channel) = 0.045

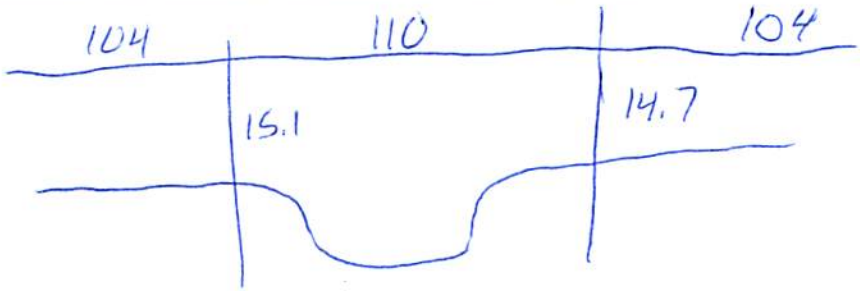
n (LOB) = 0.080

n (ROB) = 0.050

Pier Width = 2.0 ft

Pier Length = 2.0 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 110 ft

Width of left overbank flow at approach, W_{lob} = 104 ft Average left overbank flow depth, y_{lob} = 15.1 ft

Width of right overbank flow at approach, W_{rob} = 104 ft Average right overbank flow depth, y_{rob} = 14.7 ft

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

x = 34.93 From Figure 9 W_2 (effective) = 77.0 ft y_{cs} = 25.7 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: Pie

L/a ratio = 1.0 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.34 Using pier width a on Figure 11, ξ = 8.0 Pier scour y_{ps} = 6.8 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 15.1 ft right abutment, y_{aRT} = 14.7 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} = 25.6 and ψ_{RT} = 25.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 25.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 25.2 ft

Route I-90 W Stream Platte Ck MRM _____ Date 10/10/11 Initials CM

Bridge Structure No. 02014138 Location ~3 mi W of White Lake on I-90 W

GPS coordinates: N 43° 44' 09.1" W 96° 46' 09.5" taken from: USL abutment X centerline of ↑↑ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = _____ sq. mi.

The average bottom of the main channel was 24.2 ft below top of guardrail at a point 39 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 4310			Q_{500} = 8790		
Estimated flow passing through bridge	4310			8790		
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? X Yes ____No ____Don't know Abutment

Debris Potential? ____High ____Med X Low

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

Riprap ____Yes ____No ____Don't know ____NA

Spur Dike ____Yes ____No ____Don't know X NA

Other _____ ____Yes ____No ____Don't know X 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

10/4/11

2	114
5	472
10	950
25	1930
50	2960
100	4310
500	8790

Photos

2092 - 1D

93 - US

94 - US RB

95 - US LB

96 - L. Abut Scour

*Very windy → hard to read tape

97 - R. Abut

98 - US Face

Summary of Results

	Q100	Q500
Bridge flow evaluated	4310	8790
Flow depth at left abutment (yaLT), in feet	11.5	15.1
Flow depth at right abutment (yaRT), in feet	11.1	14.7
Contraction scour depth (ycs), in feet	26.5	25.7
Pier scour depth (yps), in feet	6.7	6.9
Left abutment scour depth (yas), in feet	22.6	25.6
Right abutment scour depth (yas), in feet	22.2	25.2
1Flow angle of attack	0	0

See Comments/Diagram for justification where required