Antelope Creek

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 53190443 Date 8/10/11 Initials CW Region (A (B) C D)

Site ______ Location 4 mi W & 15 mi S of Bison on Bixby Rd (174 Ave)

Q_{100} = 6800 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. ✓

Bridge discharge (Q_2) = 6800 (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 = 110 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 110 97 99

Avg. flow depth at bridge, y_2 iteration = 9.4 10.0 9.9

Corrected channel width at bridge Section = W_2 times cos of flow angle = 99 ft* $q_2 = Q_2/W_2$ = 68.7 ft^2/s

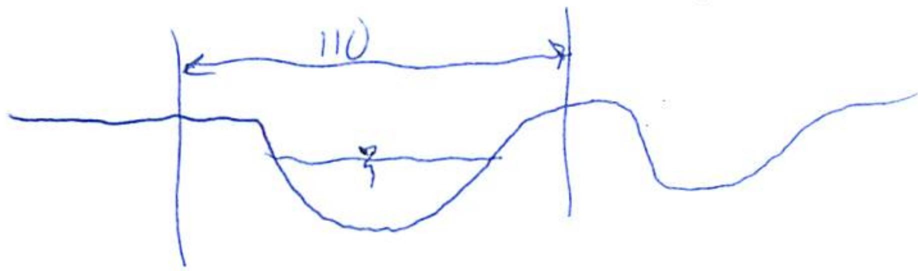
Bridge Vel, V_2 = 6.9 ft/s Final $y_2 = q_2/V_2$ = 9.9 ft Δh = 1.0 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10.9 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. = 15.6 ft
n (Channel) = 0.035
n (LOB) = 0.033
n (ROB) = 0.033
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} = ~~110~~ 0 ft Average left overbank flow depth, y_{lob} = ~~0.6~~ 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 = 1.72 From Figure 9 W_2 (effective) = 95 ft y_{cs} = 2.2 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles)

Estimated bed material D_{50} ... Average approach velocity, $V_1 = Q_{100}/(y_1W_1)$ = ____ ft/s

Critical approach velocity, ... ____ ft/s

If $V_1<V_c$ and D_{50} >= 0.2 ft ... otherwise use live bed scour equation above.

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

Otherwise, $\chi = 0.122y_1[q_2/$... From Figure 10, y_{cs} = ____ ft

Level 2 ↓
Level 1.5

...CULATIONS

PGRM: Pier

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

Froude # at bridge = 0.39 Using pier width a on Figure 11, ξ = 8 Pier scour y_{ps} = 6.9 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

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

2.25 + 1.5 = 3.75

14.4 + 3.4 = 15.6

13.7 − 10.9 = 3.8

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 53190443 Date 8/10/11 Initials CM Region (A (B) C D)

Site _____ Location 4 mi W & 15 mi S of Bison on Bixby Rd

Q_{500} = 11300 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 11300 (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 = 110 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °

Width (W_2) iteration = 110 110 _____ _____

Avg. flow depth at bridge, y_2 iteration = 12.3 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 110 ft* $q_2 = Q_2/W_2$ = 102.7 ft^2/s

Bridge Vel, V_2 = 8.4 ft/s Final $y_2 = q_2/V_2$ = 12.3 ft Δh = 1.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 13.7 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. = 15.6 ft

n (Channel) = 0.035

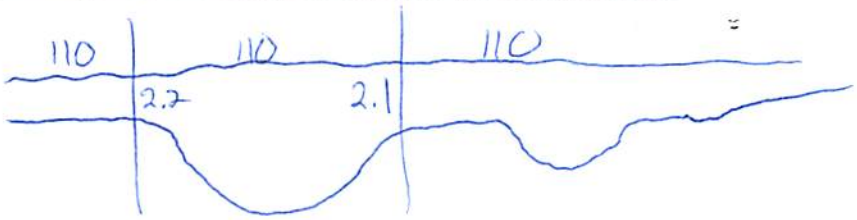
n (LOB) = 0.033

n (ROB) = 0.033

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} = 110 ft Average left overbank flow depth, y_{lob} = 2.2 ft

Width of right overbank flow at approach, W_{rob} = 110 ft Average right overbank flow depth, y_{rob} = 2.1 ft

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

x = 1.89 From Figure 9 W_2 (effective) = 106 ft y_{cs} = 2.4 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, $V_1 = Q_{500}/(y_1W_1)$ = _____ ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = _____ 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, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = _____ 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 = 0.42 Using pier width a on Figure 11, ξ = 8 Pier scour y_{ps} = 7.0 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.2 ft right abutment, y_{aRT} = 2.1 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} = 9.0 and ψ_{RT} = 8.6

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 9.0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 8.6 ft

Route Bixby Rd Stream Antelope Ck MRM _____ Date 3/10/11 Initials CH

Bridge Structure No. 53190443 Location 4mi W & 1.5 mi S of Bison on Bixby Rd

GPS coordinates: N 45°18'47.0" taken from: USL abutment____ centerline of ÎÎ MRM end _____

W 102°34'12.4" Datum of coordinates: WGS84____ NAD27____

Drainage area = 163.94 sq. mi.

The average bottom of the main channel was 19.4 ft below top of guardrail at a point 34 ft from left abutment.

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

Peak calc on 8/8

Pk2	455
5	1380
10	2390
25	3850
50	5230
100	6800
500	11300

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 6800			Q_{500} = 11300		
Estimated flow passing through bridge	6800			11300		
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

Debris Potential? ____High ____Med X 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 _____ ____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

This site appears to be incised.

Photos

1461- ID

62 - US

63 - US RB

64 - US LB

65 - R. Abut

66 - L. Abut.

67 - L. Abut scour

68 - US face of bridge

Summary of Results

	Q100	Q500
Bridge flow evaluated	6800	11300
Flow depth at left abutment (yaLT), in feet	0.0	2.2
Flow depth at right abutment (yaRT), in feet	0.0	2.1
Contraction scour depth (ycs), in feet	2.2	2.4
Pier scour depth (yps), in feet	6.9	7.0
Left abutment scour depth (yas), in feet	0.0	9.0
Right abutment scour depth (yas), in feet	0.0	8.6
1Flow angle of attack	0	0

See Comments/Diagram for justification where required