Dup. ok-RaT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34140101 Date 10-15-12 Initials RFT Region (A B [✓ C] D)

Site 66478280 Location 27810 418 Ave, S. Br. Dry Creek

Q_{100} = 1940 by: drainage area ratio____ flood freq. anal. ✓ regional regression eq. ____

Bridge discharge (Q_2) = 1940 (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 = 54 ft. Flow angle at bridge = 16 ° Abut. Skew = 0 ° Effective Skew = 16 °

Width (W_2) iteration = 52 50 51 ______

Avg. flow depth at bridge, y_2 iteration = 8.8 9.0 8.9 ______

Corrected channel width at bridge Section = W_2 times cos of flow angle = 49.02 ft* $q_2 = Q_2/W_2$ = 39.6 ft^2/s

Bridge Vel, V_2 = 4.5 ft/s Final $y_2 = q_2/V_2$ = 8.9 ft Δh = 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.3 ft 0.964 1.538

** 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. = dry ft

Low Steel Elev. = 14.0 ft

n (Channel) = .040

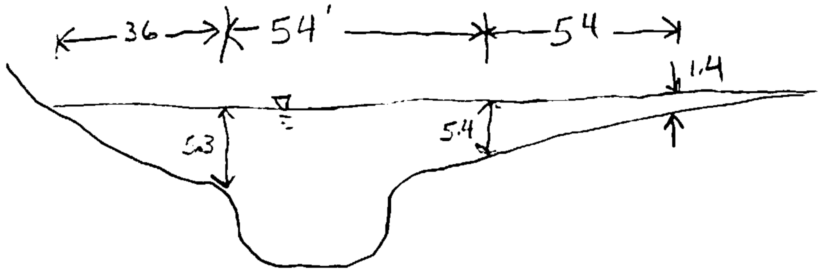
n (LOB) = .035

n (ROB) = .035

Pier Width = 1.6 ft eff = 2.50

Pier Length = 3.5 ft

\# Piers for 100 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 54 ft

Width of left overbank flow at approach, W_{lob} = 36 ft Average left overbank flow depth, y_{lob} = 2.65 ft

Width of right overbank flow at approach, W_{rob} = 54 ft Average right overbank flow depth, y_{rob} = 3.4 ft

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

x = 4.82 From Figure 9 W_2 (effective) = 46.5 ft y_{cs} = 5.5 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, $V_1 = Q_{100}/(y_1W_1)$ = ______ 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}, χ = 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 = 2.2 Correction factor for flow angle of attack (from Table 1), K2 = 1.3

Froude # at bridge = 0.27 Using pier width a on Figure 11, ξ = 6.7 Pier scour y_{ps} = 7.2 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 2.65 ft right abutment, y_{aRT} = 3.4 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} = 10.8 and ψ_{RT} = 12.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 10.8 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 12.2 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34140101 Date ________ Initials ________ Region (A B [✓ C] D)

Site 06478280 Location ________

Q_{500} = 4810 by: drainage area ratio ____ flood freq. anal. X regional regression eq. ____

Bridge discharge (Q_2) = 4810 (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 = 54 ft. Flow angle at bridge = 16 ° Abut. Skew = 0 ° Effective Skew = 16 °

Width (W_2) iteration = 54 ____ ____ ____

Avg. flow depth at bridge, y_2 iteration = 13.6 ____ ____ ____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 51.91 ft* $q_2 = Q_2/W_2$ = 92.7 ft^2/s

Bridge Vel, V_2 = 6.8 ft/s Final $y_2 = q_2/V_2$ = 13.6 ft Δh = 1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 14.5 ft

** NOTE: repeat above calculations until y_2 changes by less than 0.2* *Effective pier width = L sin(q) + a cos(q)* = 2.5

If y_2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,

Water Surface Elev. = dry ft

Low Steel Elev. = 14.0 ft

n (Channel) = .040

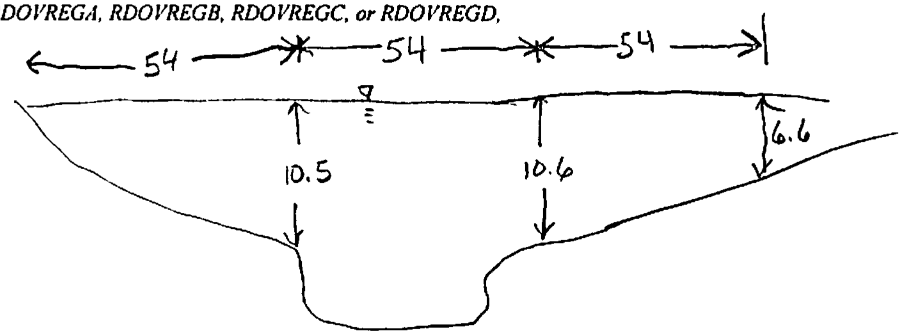
n (LOB) = .035

n (ROB) = .035

Pier Width = 1.6 ft

Pier Length = 3.5 ft

Piers for 500 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 54 ft

Width of left overbank flow at approach, W_{lob} = 54 ft Average left overbank flow depth, y_{lob} = 5.25 ft

Width of right overbank flow at approach, W_{rob} = 54 ft Average right overbank flow depth, y_{rob} = 8.6 ft

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

x = 12.26 From Figure 9 W_2 (effective) = 49.4 ft y_{cs} = 13.3 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: Pie

L/a ratio = 2.2 Correction factor for flow angle of attack (from Table 1), K2 = 1.3

Froude # at bridge = 0.32 Using pier width a on Figure 11, ξ = 6.7 Pier scour y_{ps} = 7.4 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 5.25 ft right abutment, y_{aRT} = 8.6 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} = 15.5 and ψ_{RT} = 20.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 15.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 20.2 ft

Route 418 Ave Stream S. Branch Dry Ck MRM________ Date ____________ Initials________

Bridge Structure No. 34140101 Location 27810 418 Ave

GPS coordinates: N 43° 21.272' taken from: USL abutment ✓ centerline of ⇑ MRM end ______

W97° 50.214 Datum of coordinates: WGS84 ✓ NAD27_____

Drainage area = 25.76 sq. mi.

The average bottom of the main channel was 18.9 ft below top of guardrail at a point 17 ft from left abutment.

Method used to determine flood flows: [✓ Freq. Anal.] ____drainage area ratio ____regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 1940			Q_{500} = 4810		
Estimated flow passing through bridge	1940			4810		
Estimated road overflow & overtopping	0			0		
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 contraction scour? pier footing exposed it looks like the abutments were scouring before the riprap was placed

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 X	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

str. no.
bridge from approach
LOB
ROB

left abut.
rt. abut
pier footing
approach from bridge

Summary of Results

	Q100	Q500
Bridge flow evaluated	1940	4810
Flow depth at left abutment (yaLT), in feet	2.65	5.25
Flow depth at right abutment (yaRT), in feet	3.4	8.6
Contraction scour depth (ycs), in feet	5.5	13.3
Pier scour depth (yps), in feet	7.2	7.4
Left abutment scour depth (yas), in feet	10.8	15.5
Right abutment scour depth (yas), in feet	12.2	20.2
1Flow angle of attack	16°	16°

See Comments/Diagram for justification where required