DUP. ok-RaT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52314371 Date 9-20-12 Initials RFT Region ([✓ A] B C D)

Site ______ Location First bridge downstream from Mountain Park Rd

Q_{100} = 3010 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 3010 (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 = 98 ft. Flow angle at bridge = 37 ° Abut. Skew = 45 ° Effective Skew = 8 °

Width (W_2 iteration = 76 82 79

Avg. flow pth at bridge, y_2 iteration = 6.1 5.9 6.0

Corrected annel width at bridge Section = W_2 times cos of flow angle = 63.09 ft* $q_2 = Q_2/W_2$ = 47.7 ft^2/s

Bridge Vel V_2 = 8.0 ft/s Final $y_2 = q_2/V_2$ = 6.0 ft Δh = 1.3 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 7.3 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. = ≈ 12 ft at west pier set

n (Channel) = .040

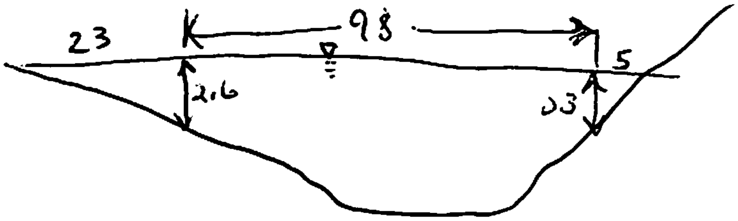
n (LOB) = .040

n (ROB) = .055

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 = 98 ft

Width of left overbank flow at approach, W_{lob} = 23 ft Average left overbank flow depth, y_{lob} = 1.3 ft

Width of right overbank flow at approach, W_{rob} = 5 ft Average right overbank flow depth, y_{rob} = 0.3 ft

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

x = ______ From Figure 9 W_2 (effective) = ______ ft y_{cs} = ______ ft

PGRM: CWCSNEW

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

Estimated bed material D_{50} = 0.3 ft Average approach velocity, $V_1 = Q_{100}/(y_1W_1)$ = 3.27 ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = 10.41 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = .062 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} = 0 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 = 0.58 Using pier width a on Figure 11, ξ = 8 Pier scour y_{ps} = 7.3 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.3 ft right abutment, y_{aRT} = 0.3 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} = 5.5 and ψ_{RT} = 1.4

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 5.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 1.4 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52314371 Date ______ Initials ______ Region ([✓ A] B C D)

Site ______ Location ______

Q_{500} = 22400 by: drainage area ratio ✓ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 11360 (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 = 98 ft. Flow angle at bridge = 37 ° Abut. Skew = 45 ° Effective Skew = 8 °

Width (W_2) iteration = 98 ____ ____ ____

Avg. flow depth at bridge, y_2 iteration = 11 ____ ____ ____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 78.27 ft* $q_2 = Q_2/W_2$ = 145.1 ft²/s

Bridge Vel, V_2 = 13.2 ft/s Final $y_2 = q_2/V_2$ = 11 ft Δh = 3.6 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 14.6 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.

road overflow will begin (east of bridge) at y ≈ 11.00. Assume Q max sc. occurs at y ≈ 11.0

Water Surface Elev. = ____ ft

Low Steel Elev. = 12 ft

n (Channel) = .040

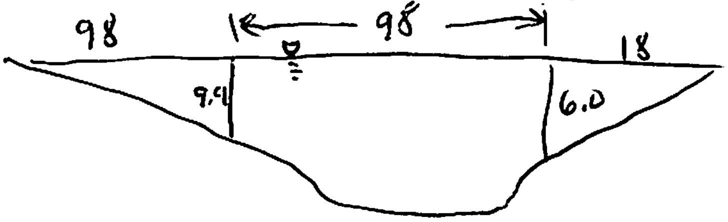
n (LOB) = .040

n (ROB) = .055

Pier Width = 2 ft

Pier Length = 2 ft

\# Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 98 ft

Width of left overbank flow at approach, W_{lob} = 98 ft Average left overbank flow depth, y_{lob} = 4.95 ft

Width of right overbank flow at approach, W_{rob} = 18 ft Average right overbank flow depth, y_{rob} = 3.0 ft

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

x = ____ From Figure 9 W_2 (effective) = ____ ft y_{cs} = ____ ft

PGRM: CWCSNEW

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

Estimated bed material D_{50} = 0.3 ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1)$ = 3.64 ft/s

Critical approach velocity, $Vc = 11.17y_1^{1/6}D_{50}^{1/3}$ = 11.69 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.154 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} = 0 ft

PIER SCOUR CALCULATIONS

PGRM: Pie

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

Froude # at bridge = 0.7 Using pier width a on Figure 11, ξ = 8 Pier scour y_{ps} = 7.6 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 4.95 ft right abutment, y_{aRT} = 3.0 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} = 14.9 and ψ_{RT} = 11.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 14.9 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.5 ft

Route Sheridan Lake Rd Stream Spring Creek MRM________ Date____________ Initials________

Bridge Structure No. 52314371 Location First bridge downstream from Mountain Park Rd

GPS coordinates: N 43° 58.935' taken from: USL abutment_____ centerline of ⇑ MRM end _____
W 103° 25.941' Datum of coordinates: WGS84_____ NAD27_____

Drainage area = 150.84 sq. mi.

The average bottom of the main channel was 16.1 ft below top of guardrail at a point 31 ft from left abutment.

Method used to determine flood flows: ____Freq. Anal. __✓__drainage area ratio ____regional regression equations.

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 3010			Q_{500} = 22400		
Estimated flow passing through bridge	3010			$Q_{max\ scour}$ = 11360		
Estimated road overflow & overtopping	0			11040		
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 Some riprap under bridge on right abutment?

Evidence of past Scour? _____Yes _____No _____Don't know ↑

Debris Potential? _____High __✓__Med _____Low probably naturally occurring rock

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_____	Gravel_____	Cobbles X	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
approach from bridge
LOB from approach
ROB from approach
bridge from approach

left abut.
rt. abut.

Summary of Results

	Q100	Q~~500~~ Max Scour
Bridge flow evaluated	3010	11360
Flow depth at left abutment (yaLT), in feet	1.3	4.95
Flow depth at right abutment (yaRT), in feet	0.3	3.0
Contraction scour depth (ycs), in feet	0	0
Pier scour depth (yps), in feet	7.3	7.6
Left abutment scour depth (yas), in feet	5.5	14.9
Right abutment scour depth (yas), in feet	1.4	11.5
1Flow angle of attack	37° (8° eff)	37° (8° eff)

See Comments/Diagram for justification where required