OK RJ

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 63165070 Date 5/23/12 Initials RAL Region (A B (C) D)

Site ______ Location 2.5 mi E of Parker on 275 St

Q_{100} = Grc 11300 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 11300 (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 = 157 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

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 = 147.52 ft* $q_2 = Q_2/W_2$ = 76.6 ft^2/s

Bridge Vel, V_2 = 6.2 ft/s Final $y_2 = q_2/V_2$ = 12.3 ft Δh = 0.8 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 13.1 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. = 0-20 ft

Low Steel Elev. = 13.1 ft 16.5 − 5.4 = 13.1

n (Channel) = 0.030

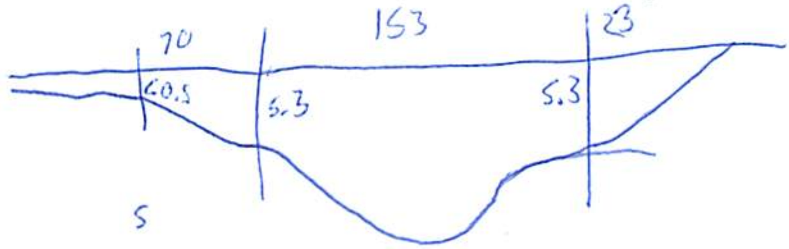
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2.1 ft

Pier Length = 2.1 ft

Piers for 100 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 157 ft

Width of left overbank flow at approach, W_{lob} = 70 ft Average left overbank flow depth, y_{lob} = 3.6 ft (5.3 · 2/3 = 10.6/3)

Width of right overbank flow at approach, W_{rob} = 23 ft Average right overbank flow depth, y_{rob} = 2.7 ft (5.3 · 1/2 = 2.7)

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

x = 2.02 From Figure 9 W_2 (effective) = 143.3 ft y_{cs} = 2.5 ft

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

PGRM: CWCSNEW

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 = 0.31 Using pier width a on Figure 11, ξ = 8.3 Pier scour y_{ps} = 7 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.6 ft right abutment, y_{aRT} = 2.7 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} = 12.6 and ψ_{RT} = 11

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.6 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 63165070 Date 5/23/12 Initials Rat Region (A B (C) D)

Site ✓ Location 2.5 mi E of Parker on 275 St

Q_{500} = Q_{100} 15200 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = 12726 (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 = 157 ft. Flow angle at bridge = 20 ° Abut. Skew = 0 ° Effective Skew = 20 °

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 = 147.52 ft* $q_2 = Q_2/W_2$ = 86.3 ft^2/s

Bridge Vel, V_2 = 6.6 ft/s Final $y_2 = q_2/V_2$ = 13.1 ft Δh = 0.9 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 14 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. = 0 - 2.0 ft

Low Steel Elev. = 13.1 ft

n (Channel) = 0.030

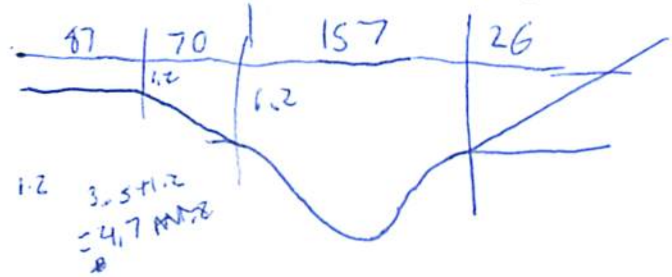
n (LOB) = 0.035

n (ROB) = 0.035

Pier Width = 2.1 ft

Pier Length = 2.1 ft

Piers for 500 yr = 2 ft



CONTRACTION SCOUR

PGRM: Contract

3.5/2 =

1.2 - 4.7

Width of main channel at approach section W_1 = 157 ft

Width of left overbank flow at approach, W_{lob} = ~~75~~ 157 ft Average left overbank flow depth, y_{lob} = 1.8 ft

Width of right overbank flow at approach, W_{rob} = 26 ft Average right overbank flow depth, y_{rob} = 3.1 ft

5.3+0.9=6.2/2 = 3.1

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

x = 1.94 From Figure 9 W_2 (effective) = ~~[illegible]~~ 143.3 ft y_{cs} = 2.5 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, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3}$ = ____ 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 = 0.32 Using pier width a on Figure 11, ξ = 8.3 Pier scour y_{ps} = 7 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.8 ft right abutment, y_{aRT} = 3.1 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} = 7.4 and ψ_{RT} = 11.7

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 7.4 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 11.7 ft

Route 275 St Stream E. Fk. Vermillion R. MRM ______ Date ______ Initials ______

Bridge Structure No. 63165070 Location 2.5 mi E of Parker on 275 St

GPS coordinates: N43 24' 7.5" / W97 4' 19.5" taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27 ______

Drainage area = 463 sq. mi.

The average bottom of the main channel was 18.5 ft below top of guardrail at a point 33 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Q100=

Flows	~~Q100~~ =Q50 11300			~~Q500~~ =Q100 15200		
Estimated flow passing through bridge	11300			12726		
Estimated road overflow & overtopping	0			2477		
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	

5/22

2	1110
5	2950
10	4840
25	8140
50	11300
100	15200
500	27300

Riprap at abutments? X Yes ____No ____Marginal pier, contraction

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 X Yes ____No ____Don't know ____NA

Spur Dike ____Yes X No ____Don't know ____NA

Other ______________ ____Yes X No ____Don't know ____NA

Bed Material Classification Based on Median Particle Size (D_{50})

Material	Silt/Clay X	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

1). main channel
2). Piers
3. R. Ab
4. L. Ab
5. Scour
6. R. OB
7. Main channel
8. LOB

Summary of Results

	~~Q100~~ Q50	~~Q500~~ Q100
Bridge flow evaluated	11300	12726
Flow depth at left abutment (yaLT), in feet	3.6	1.8
Flow depth at right abutment (yaRT), in feet	2.7	3.1
Contraction scour depth (ycs), in feet	2.3 2.5	2.5
Pier scour depth (yps), in feet	7	7
Left abutment scour depth (yas), in feet	12.6 12.6	2.4
Right abutment scour depth (yas), in feet	11	11.7
1Flow angle of attack	20	20

See Comments/Diagram for justification where required