OK-RaT no calls for stream under bridge

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 10196342 Date 9-19-12 Initials RFT Region (A B C D)

Site _____ Location 2.2 mi N of HWY 212 on Arpan Rd ~~Beartt~~ Butte Co.

Q_{100} = max scour ~~7207~~ 4045 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = ~~2017~~ 4045 (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 = 68 ft. Flow angle at bridge = 20 ° Abut. Skew = 20 ° Effective Skew = 0 °

Width (W_2) iteration = 68 _____ _____ _____

Avg. flow depth at bridge, y_2 iteration = 9.5 _____ _____ _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 63.9 ft* $q_2 = Q_2/W_2$ = 63.3 ft²/s

Bridge Vel, V_2 = 6.7 ft/s Final $y_2 = q_2/V_2$ = 9.5 ft Δh = 0 ft ← no constriction of flow

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 9.5 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,

This is a bridge over an irrigation canal

Water Surface Elev. = 3.1 ft

Low Steel Elev. = ≈ 9.5 ft

n (Channel) = .020 smooth muddy

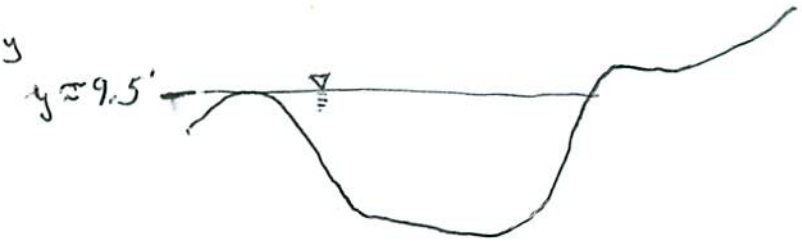
n (LOB) = .030

n (ROB) = .030

Pier Width = NA ft

Pier Length = NA ft

Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 68 ft

Width of left overbank flow at approach, W_{lob} = 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 0 ft Average right overbank flow depth, y_{rob} = 0 ft

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

x = .61 From Figure 9 W_2 (effective) = 63.9 ft y_{cs} = 1.0 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

PGRM: Pier

PIER SCOUR CALCULATIONS

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

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

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

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 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 1019634 2 Date _____ Initials _____ Region (A (B) C D)

Site _____ Location 2.2 mi N of HWY 212 on Aspen Rd

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

Bridge discharge (Q_2) = _____ (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 = _____ft. Flow angle at bridge = _____° Abut. Skew = _____° Effective Skew = _____°

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 = _____ft* $q_2 = Q_2/W_2$ = _____ft^2/s

Bridge Vel, V_2 = _____ft/s Final $y_2 = q_2/V_2$ = _____ft Δh = _____ft

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

n (Channel) = _____

n (LOB) = _____

n (ROB) = _____

Pier Width = _____ ft

Pier Length = _____ ft

Piers for 500 yr = _____ ft

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = _____ft

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

Width of right overbank flow at approach, W_{rob} = _____ft Average right overbank flow depth, y_{rob} = _____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} = _____ 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

PGRM: Pier

PIER SCOUR CALCULATIONS

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

Froude # at bridge = _____ Using pier width a on Figure 11, ξ = _____ Pier scour y_{ps} = _____ft

PGRM: Abutment

ABUTMENT SCOUR CALCULATIONS

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

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

Route Arpan Rd Stream South Canal MRM _____ Date _____ Initials _____

Bridge Structure No. ID196342 Location 2.2 mi N of Hwy 212 on Arpan Rd

GPS coordinates: N 44° 43.080' taken from: USL abutment ✓ centerline of ⇑ MRM end _____

W 103° 39.386' Datum of coordinates: WGS84 ✓ NAD27 _____

Drainage area = ~~*~~ 1.64/undefined sq. mi.

The average bottom of the main channel was 14.4 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}~~ = Qmax scour 4045			Q_{500} =		
Estimated flow passing through bridge	4045					
Estimated road overflow & overtopping	0					
Consideration	Yes	No	Possibly	Yes	No	Possibly
Chance of overtopping		X				
Chance of Pressure flow		X				
Armored appearance to channel		X				
Lateral instability of channel		X				

Riprap at abutments? ____Yes X No ____Marginal Visible scour on rt. abut under bridge

Evidence of past Scour? X Yes ____No ____Don't know

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 X	Cobbles____	Boulders____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

* see notes on back regarding peak estimates

Comments, Diagrams & orientation of digital photos

Pk	Q
2	33.1
5	96.5
10	166
25	275
50	379
100	501
500	874

← used estimated Qmax scour

Str. no.
approach from bridge
left levee from LOB
ROB
rt ~~left~~ abut. under bridge
bridge from approach

Summary of Results

	~~Q100~~ Qmax scour	Q500
Bridge flow evaluated	4045	
Flow depth at left abutment (yaLT), in feet	0	
Flow depth at right abutment (yaRT), in feet	0	
Contraction scour depth (ycs), in feet	1.0	
Pier scour depth (yps), in feet	NA	
Left abutment scour depth (yas), in feet	0	
Right abutment scour depth (yas), in feet	0	
1Flow angle of attack	20° (0° eff)	

See Comments/Diagram for justification where required

This bridge is over an irrigation canal and does not have a "natural" drainage area to compute peak flows. However, an area was estimated based on the amount of drainage area that might be intercepted if streams flowed into the canal instead of crossing it. Drainage area edited in Streamstats on 8-1-12 and flows calculated based on estimated area.

10196312

103.65675

44.71784