ok-Rat

no calls for stream under bridge.

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 24373070 Date 9-21-12 Initials RFT Region (A (B) C D)

Site _____ Location 0.4 mi E of int. of 137 Av & 278 St on 278 St

Q_{100} = 2116 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. ____

Bridge discharge (Q_2) = 2116 (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 = 64 ft. Flow angle at bridge = 20 ° Abut. Skew = 20 ° Effective Skew = 0 °

Width (W_2) iteration = 43 ~~46~~ ~~45~~ _____

Avg. flow depth at bridge, y_2 iteration = ~~8.3~~ ~~8.0~~ 8.1 _____

Corrected channel width at bridge Section = W_2 times cos of flow angle = 45 ft* $q_2 = Q_2/W_2$ = 47 ft^2/s

Bridge Vel, V_2 = 5.8 ft/s Final $y_2 = q_2/V_2$ = 8.1 ft Δh = 0.7 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 8.8 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. = 15.8 ft

n (Channel) = .027

n (LOB) = .033

n (ROB) = .033

Pier Width = NA ft

Pier Length = NA ft

Piers for 100 yr = 0 ft

Because this is an irrigation canal, it doesn't have a "natural" drainage area and the flows from StreamStats are too small. Assume ~~[illegible]~~ single analysis of Q ≈ 2116, the same Q as at the upstream bridge

CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 57 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 = 2.35 From Figure 9 W_2 (effective) = 45 ft y_{cs} = 2.9 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. 24373070 Date _____ Initials _____ Region (A (B) C D)

Site _____ Location 0.4 mi E of int of 137 Av & 278 St

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, $V_1 = Q_{500}/(y_1W_1)$ = _____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

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 278 St Stream Angostura Main Canal MRM _____ Date _____ Initials _____

Bridge Structure No. 24373070 Location 0.4 mi. E of int of 137 Av & 278 St on 278

GPS coordinates: N 44° 22.574' taken from: USL abutment ✓ centerline of ⇑ MRM end _____

W 103° 18.919' Datum of coordinates: WGS84 ✓ NAD27 _____

Drainage area = undefined sq. mi.

The average bottom of the main channel was 20.6 ft below top of guardrail at a point 22 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	$Q_{\cancel{100}}$ = 2116			Q_{500} =		
Estimated flow passing through bridge	2116					
Estimated road overflow & overtopping	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 X Marginal some riprap at left abutment, there is erosion from road runoff in that location

Evidence of past Scour? ✓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 X	Sand ____	Gravel X	Cobbles ____	Boulders ____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

Comments, Diagrams & orientation of digital photos

2 30.0
5 86.8
10 149
25 248
50 344
100 457
500 808

from StreamStats on 4-10-12 RFT

Str. no.
approach from bridge
LOB from bridge
ROB from bridge

bridge from approach
left abut. under bridge
rt abut under bridge

Summary of Results

$Q_{max\,scour}$ upstream at 24338080

	$Q_{\cancel{100}}$	Q500
Bridge flow evaluated	2116	
Flow depth at left abutment (yaLT), in feet	0	
Flow depth at right abutment (yaRT), in feet	0	
Contraction scour depth (ycs), in feet	2.9	
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

The bridge at this location ~~indicates~~ ~~that~~ is over an irrigation canal, so drainage area is probably not determined by contours. However, a point was delineated at a location on a stream grid cell approx. 0.173 miles SE from the bridge. This location may approximate the amount of natural drainage area entering the canal.

~~43.37076~~
103.3156
43.37605