

SCOUR ANALYSIS AND REPORTING FORM

OK RT
check
Lake Thompson

Bridge Structure No. 39203220 Date 8/4/12 Initials RAT Region (A B C D) C - no flow this
 Site _____ Location 6.8 mi W of Oldham on 218 St
 Q_{100} = _____ by: drainage area ratio _____ flood freq. anal. _____ regional regression eq. X
 Bridge discharge (Q_2) = _____ (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

Bridge Width = 41 ft. Flow angle at bridge = 0 ° Abut. Skew = 0 ° Effective Skew = 0 °
 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* $q_2 = Q_2/W_2 =$ _____ ft²/s

Bridge Vel, $V_2 =$ _____ ft/s Final $y_2 = q_2/V_2 =$ _____ ft $\Delta h =$ _____ 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. = 7.3 @ depth
6-9 ft
 Low Steel Elev. = _____ ft
 n (Channel) = _____
 n (LOB) = _____
 n (ROB) = _____
 Pier Width = 0 ft
 Pier Length = 0 ft
 # Piers for 100 yr = 0 ft

Site likely impounded, very windy - hard to judge flow rate

CONTRACTION SCOUR

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

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, $V_c = 11.17 y_1^{1/6} D_{50}^{1/3} =$ _____ 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

L/a ratio = _____ Correction factor for flow angle of attack (from Table 1), $K_2 =$ _____

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

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, $\psi_{LT} =$ _____ and $\psi_{RT} =$ _____

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

PRGM: "RegionA", "RegionB", "RegionC", or "RegionD"

PRGM: Contract

PRGM: CWCSNEW

PRGM: Pier

PRGM: Abutment

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 39203220 Date 8/4/12 Initials RAJ Region (A B C D) (D)
 Site _____ Location 6.8 mi W of Oldham on 218 St
 Q_{500} = _____ by: drainage area ratio _____ flood freq. anal. _____ regional regression eq. X
 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

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* $q_2 = Q_2/W_2 =$ _____ ft²/s

Bridge Vel, $V_2 =$ _____ ft/s Final $y_2 = q_2/V_2 =$ _____ ft $\Delta h =$ _____ 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

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

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 $D_{50} \geq 0.2$ 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 $D_{50} \geq D_{c50}$, $\chi = 0.0$

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

L/a ratio = _____ Correction factor for flow angle of attack (from Table 1), $K_2 =$ _____
 Froude # at bridge = _____ Using pier width a on Figure 11, $\xi =$ _____ Pier scour $y_{ps} =$ _____ ft

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

PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"

PGRM: Contract

PGRM: CWCSNEW

PGRM: Pie

PGRM: Abutment

Peak Flow Computations

Total Drainage Area from Stream Stats on 8-1-12 = 470.66 mi²
 Approx. 90% subregion A
 Approx. 10% subregion B

PII = 0.99

manual calcs from spreadsheet:

pk	A	B	weighted
2	683	640 251	640
5	1860	1790 1170	1790
10	3000	2480	2950
25	4880	5340	4930
50	6600	8520	6790
100	8540	12800	8970
500	13900	27800	15300

Note: these peaks are likely overestimated. The lakes upstream of this bridge likely attenuate peaks to a large degree.

97.26 43.21

97.4459
 44.22392

Route 218 St Stream LK Thompson Outlet MRM _____ Date 8/4/12 Initials RAT
 Bridge Structure No. 39203220 Location 6.8 mi. W of Oldham on 218 St
 GPS coordinates: N 44° 13' 26.211 taken from: USL abutment centerline of \uparrow MRM end _____
W 97° 26' 45.311 Datum of coordinates: WGS84 NAD27 _____

Drainage area = 470.66 sq. mi.
 The average bottom of the main channel was 17.7 ft below top of guardrail at a point 23 ft from left abutment.
 Method used to determine flood flows: _____ Freq. Anal. _____ drainage area ratio regional regression equations.

MISCELLANEOUS CONSIDERATIONS

6/20

Flows	Q ₁₀₀ =			Q ₅₀₀ =		
Estimated flow passing through bridge						
Estimated road overflow & overtopping						
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 *on outside abutments only*
 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 *-rose quartz*
 Spur Dike Yes No Don't know NA
 Other _____ Yes No Don't know NA

Bed Material Classification Based on Median Particle Size (D₅₀)

Material	Silt/Clay _____	Sand _____	Gravel _____	Cobbles _____	Boulders _____
Size range, in mm	<0.062	0.062-2.00	2.00-64	64-250	>250

see back of this page for peak calcs. *unknown - likely silt/sand*

- 1). left abutment
- 2). right abutment
- 3). main channel

Summary of Results

	Q100	Q500
Bridge flow evaluated		
Flow depth at left abutment (yaLT), in feet		
Flow depth at right abutment (yaRT), in feet		
Contraction scour depth (yca), in feet		
Pier scour depth (ypp), in feet		
Left abutment scour depth (yas), in feet		
Right abutment scour depth (yas), in feet		
Flow angle of attack		

See Comments/Diagram for justification where required