OK RT

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34094020 Date 6/7/12 Initials RaT Region (A B C D)

Site _____ Location 2.7 mi E of Dimock on 270 St

Q_{100}^{50} = ~~2250~~ 1540 by: drainage area ratio____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = ~~2250~~ 1540 (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 = 47 ft. Flow angle at bridge = 25 ° Abut. Skew = 0 ° Effective Skew = 25 °

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 = 42.66 ft* $q_2 = Q_2/W_2$ = ~~95.8~~ 37.1 ft^2/s

Bridge Vel, V_2 = ~~4.3~~ 4.3 ft/s Final $y_2 = q_2/V_2$ = ~~10.3~~ 9.6 ft Δh = ~~0.5~~ 0.4 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = ~~10.8~~ 9 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. = 4.4 ft

Low Steel Elev. = ~~10.7~~ 9.7 ft

n (Channel) = 0.048

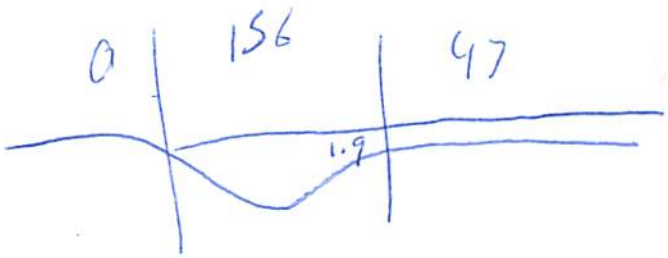
n (LOB) = 0.030

n (ROB) = 0.038

Pier Width = _____ ft

Pier Length = 0 ft

Piers for 100 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 156 ft

Width of left overbank flow at approach, W_{lob} = ~~47~~ 0 ft Average left overbank flow depth, y_{lob} = 0 ft

Width of right overbank flow at approach, W_{rob} = 47 ft Average right overbank flow depth, y_{rob} = 1.9 ft

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

x = 25.15 From Figure 9 W_2 (effective) = 42.6 ft y_{cs} = 20.5 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, $V_1 = Q_{100}/(y_1W_1)$ = _____ 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} = 0.5 ft right abutment, y_{aRT} = 1.9 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} = 2.3 and ψ_{RT} = ~~2.7~~ 7.8

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 4.2 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 14.2 ft

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 34094020 Date 06/7/12 Initials RM Region (A B C D)

Site Q100 Location 2.7 mi E of Dimock on 270 St

Q_{500} = ~~2750~~ 2250 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge (Q_2) = ~~2450~~ 2013 (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 = 47 ft. Flow angle at bridge = 25 ° Abut. Skew = 0 ° Effective Skew = 25 °

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 = 42.6 ft* $q_2 = Q_2/W_2$ = ~~152.5~~ 47.3 ft^2/s

Bridge Vel, V_2 = ~~4.9~~ 4.9 ft/s Final $y_2 = q_2/V_2$ = ~~9.7~~ 9.7 ft Δh = ~~0.5~~ 0.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = ~~10.2~~ 10.2 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. = 4.4 ft

Low Steel Elev. = ~~9.7~~ 9.7 ft

n (Channel) = 0.045

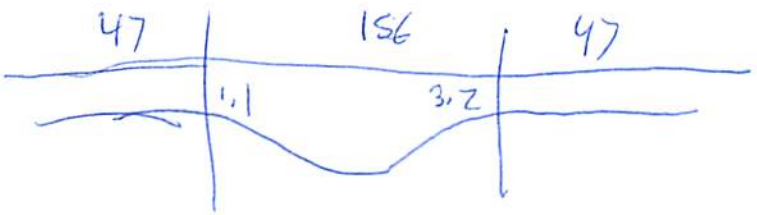
n (LOB) = 0.030

n (ROB) = 0.030

Pier Width = 0 ft

Pier Length = 0 ft

Piers for 500 yr = 0 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 156 ft

Width of left overbank flow at approach, W_{lob} = 47 ft Average left overbank flow depth, y_{lob} = 1.1 ft

Width of right overbank flow at approach, W_{rob} = 47 ft Average right overbank flow depth, y_{rob} = 3.2 ft

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

x = 30.2 From Figure 9 W_2 (effective) = 42.6 ft y_{cs} = 23.2 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} = 1.1 ft right abutment, y_{aRT} = 3.2 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} = 4.7 and ψ_{RT} = 11.9

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 8.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 21.6 ft

97.93029
43.4711

Route 270 St Stream Coffee Ck MRM _____ Date 6/7/12 Initials kat

Bridge Structure No. 34094020 Location 2.7 mi E of Dimock on 270 St

GPS coordinates: N 43° 28' 15.91" W 97° 55' 49.61" taken from: USL abutment X centerline of ⫛ MRM end _____

Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 28.6 sq. mi.

The average bottom of the main channel was 14.8 ft below top of guardrail at a point 30 ft from left abutment.

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

5/24
8/24

	Q100
2	78.2
5	286
10	546
25	1060
50	1580
100	2250
500	4440

MISCELLANEOUS CONSIDERATIONS

Flows	$Q_{\cancel{100}}^{50}$ = 1580			Q_{500} = ~~4440~~ 2250		
Estimated flow passing through bridge	1580			~~2450~~ 2013		
Estimated road overflow & overtopping	0			~~0~~ 237		
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	

Riprap at abutments? X Yes ____No ____Marginal

Evidence of past Scour? X Yes ____No ~~X~~ Don't know contraction

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

~~X~~ loose riprap on outside of abutment

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

Material	Silt/Clay X	Sand	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
2-3) left abutment
4). left OB
5). left OB
6). main channel
7). right OB
~~8). right abut~~
8-9). right abut

Summary of Results

	~~Q100~~ Q50	~~Q500~~ Q100
Bridge flow evaluated	2250	2450
Flow depth at left abutment (yaLT), in feet	6	1.1
Flow depth at right abutment (yaRT), in feet	1.9	3.2
Contraction scour depth (ycs), in feet	~~20.5~~ 20.5	23.2
Pier scour depth (yps), in feet	N/A	N/A
Left abutment scour depth (yas), in feet	4.2	~~6.6~~ 8.5
Right abutment scour depth (yas), in feet	11.2	21.6
1Flow angle of attack	25	25

See Comments/Diagram for justification where required