OK RJ

SCOUR ANALYSIS AND REPORTING FORM

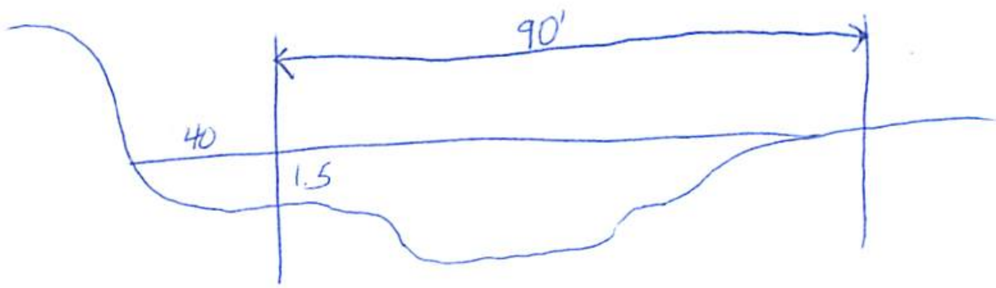
Bridge Structure No. 52450399 Date 11/5/10 Initials CW Region ((A) B C D)
Site 06408500 Location Spring Creek on 145th Avenue
Q_{100} = 1670 by: drainage area ratio____ flood freq. anal. ✓ regional regression eq. ____
Bridge discharge (Q_2) = 1670 (should be Q_{100} unless there is a relief bridge, road overflow, or bridge overtopping)

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

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 87 ft. Flow angle at bridge = 15 ° Abut. Skew = 15 ° Effective Skew = 0 °
Width (W_2) iteration = 87 66 75 69
Avg. flow depth at bridge, y_2 iteration = 3.6 4.2 3.9 4.1
Corrected channel width at bridge Section = W_2 times cos of flow angle = 69 ft* $q_2 = Q_2/W_2$ = 242 ft^2/s
Bridge Vel, V_2 = 5.9 ft/s Final $y_2 = q_2/V_2$ = 4.1 ft Δh = 0.7 ft
Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 4.8 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. = 6.2 ft
n (Channel) = 0.040
n (LOB) = 0.035
n (ROB) = ~~0.037~~ 0.045
Pier Width = 0.9 ft
Pier Length = 32 ft
Piers for 100 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 90 ft
Width of left overbank flow at approach, W_{lob} = 40 ft Average left overbank flow depth, y_{lob} = 1.5 ft
Width of right overbank flow at approach, W_{rob} = ~~[illegible]~~ 0 ft Average right overbank flow depth, y_{rob} = ~~[illegible]~~ 0.0 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) ~~z=2.267~~ ~~z=.763~~ z=0
Estimated bed material D_{50} = 0.2 ft Average approach velocity, $V_1 = Q_{100}/(y_1W_1)$ = ~~3.87~~ ft/s 2.68
Critical approach velocity, $Vc = 11.52y_1^{1/6}D_{50}^{1/3}$ = 8.48 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.
$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.035 ft If $D_{50} >= D_{c50}$, $\chi = 0.0$
Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1$ = ~~X~~ 0 From Figure 10, y_{cs} = 0.0 ft

PIER SCOUR CALCULATIONS

PGRM: Pier

L/a ratio = 35.6 Correction factor for flow angle of attack (from Table 1), K2 = 1.0
Froude # at bridge = 0.51 Using pier width a on Figure 11, ξ = 4.4 Pier scour y_{ps} = 4.0 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 1.5 ft right abutment, y_{aRT} = 0.0 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} = 6.3 and ψ_{RT} = 0.0
Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 6.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 0.0 ft

6.9 14
10.4
4.4
5.6
1.56
3
27.1
4.1

SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52450399 Date 11/5/10 Initials Cw Region ((A) B C D)

Site 06408500 Location Spring Creek on 145th Avenue

Q_{500} = 27 000 by: drainage area ratio ____ flood freq. anal. ✓ regional regression eq. ____

Bridge discharge (Q_2) = 7348 (should be Q_{500} unless there is a relief bridge, road overflow, or bridge overtopping)

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

Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method

Bridge Width = 87 ft. Flow angle at bridge = 15 ° Abut. Skew = 15 ° Effective Skew = 0 °

Width (W_2) iteration = 87 ______ ______ ______

Avg. flow depth at bridge, y_2 iteration = 16.7 > 8.2 RD Overflow

Corrected channel width at bridge Section = W_2 times cos of flow angle = 87 ft* $q_2 = Q_2/W_2$ = 84.9 ft^2/s

Bridge Vel, V_2 = 10.4 ft/s Final $y_2 = q_2/V_2$ = 8.2 ft Δh = 2.2 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 10.4 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. = 8.2 ft

n (Channel) = 0.040

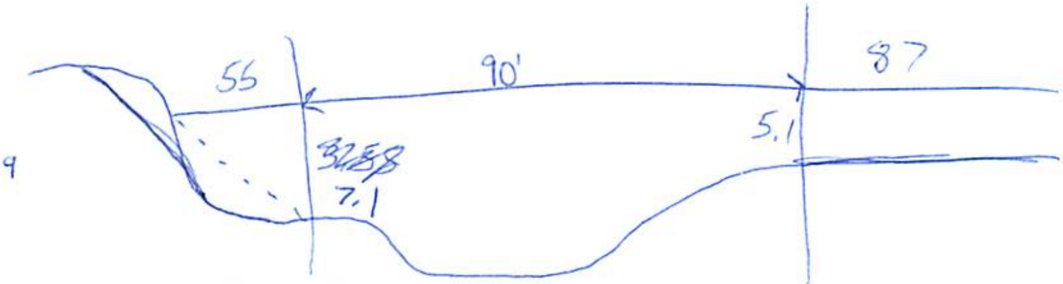
n (LOB) = ~~0.040~~ 0.035

n (ROB) = ~~0.035~~ 0.045

Pier Width = ~~0.037 0.045~~ ft 0.9

Pier Length = 32 ft

\# Piers for 500 yr = 1 ft



CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section W_1 = 90 ft

Width of left overbank flow at approach, W_{lob} = 55 ft Average left overbank flow depth, y_{lob} = 3.55 ft

Width of right overbank flow at approach, W_{rob} = 87 ft Average right overbank flow depth, y_{rob} = 5.1 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) ~~Z = 2.2669~~ Z=0

Estimated bed material D_{50} = 0.2 ft Average approach velocity, $V_1 = Q_{500}/(y_1 W_1)$ = ~~7.87~~ ft/s 3.06

Critical approach velocity, $Vc = 11.52 y_1^{1/6} D_{50}^{1/3}$ = 9.65 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.

$D_{c50} = 0.0006(q_2/y_1^{7/6})^3$ = 0.101 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} = 0.0 ft

PIER SCOUR CALCULATIONS

PGRM: Pie

L/a ratio = 35.6 Correction factor for flow angle of attack (from Table 1), K2 = 1.0

Froude # at bridge = 0.64 Using pier width a on Figure 11, ξ = 4.4 Pier scour y_{ps} = 4.1 ft

ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, y_{aLT} = 3.55 ft right abutment, y_{aRT} = 5.1 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} = 12.5 and ψ_{RT} = 15.2

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 12.5 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 15.2 ft

Route 145th Ave Stream Spring Creek MRM________ Date 11/5/10 Initials Ch

Bridge Structure No. 52450399 Location Spring Creek on 145th Avenue

GPS coordinates: N43°56'30.1" W103°09'32.7" taken from: USL abutment X centerline of ⇑ MRM end ______

Datum of coordinates: WGS84 X NAD27_____

Drainage area = 205.60 sq. mi.

The average bottom of the main channel was 12.7 ft below top of guardrail at a point 25 ft from left abutment.

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

MISCELLANEOUS CONSIDERATIONS

Flows	Q_{100} = 1670			Q_{500} = 27000		
Estimated flow passing through bridge	1670			7388		
Estimated road overflow & overtopping	—			19612		
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? ____Yes X No ____Marginal

Evidence of past Scour? X Yes ____No ____Don't know Scour out sed to left of R. abut See Photo

Debris Potential? X High ____Med ____Low

Does scour countermeasure(s) appear to have been designed?

Riprap ____Yes ____No ____Don't know X NA

Spur Dike ____Yes ____No ____Don't know X NA

Other ________________ ____Yes ____No ____Don't know X NA

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

Material	Silt/Clay____	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

App. XS @ Staff gage

Photos -
1445 - ID
46 - US
47 - US RB
44 - US LB
49 - L. Abut
50 - R. Abut
51 - Pier Config
52 - Scour
53 - US Face Bridge

Summary of Results

	Q100	Q500
Bridge flow evaluated	1670	7388
Flow depth at left abutment (yaLT), in feet	1.5	3.55
Flow depth at right abutment (yaRT), in feet	0.0	5.1
Contraction scour depth (ycs), in feet	0.0	0.0
Pier scour depth (yps), in feet	4.0	4.1
Left abutment scour depth (yas), in feet	6.3	12.5
Right abutment scour depth (yas), in feet	0.0	15.2
1Flow angle of attack	0°	0°

See Comments/Diagram for justification where required

$0.2\,ft\left(\frac{12\,in}{1\,ft}\right) = 2.4\,in = 6.096\,cm$ 60 mm