OK by RFT 3rd

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52341445 Date 9/2/12 Initials RAT Region ( A B C D )

Site _____ Location 1.5 mi S of Hainey on CR330 or Playhouse Rd

$Q_{100}$ = 1820 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge ($Q_2$) = 1820 (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 = 45 ft. Flow angle at bridge = 5 ° Abut. Skew = 0 ° Effective Skew = 5 °

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 = 44.83 ft* $q_2 = Q_2/W_2$ = 40.6 $ft^2/s$

Bridge Vel, $V_2$ = 7.4 ft/s Final $y_2 = q_2/V_2$ = 5.5 ft $\Delta h$ = 1.1 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 6.6 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. = 0 ft

Low Steel Elev. = 12.5 ft

n (Channel) = 0.045

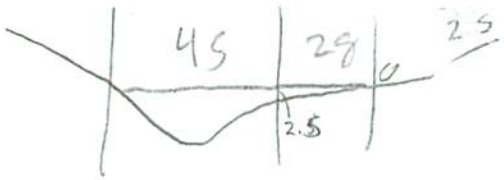
n (LOB) = 0.031

n (ROB) = 0.035

Pier Width = X ft

Pier Length = X ft

# Piers for 100 yr = X ft




### CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section $W_1$ = 45 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, $W_{rob}$ = 28 ft Average right overbank flow depth, $y_{rob}$ = 1.3 ft

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

x = 0.38 From Figure 9 $W_2$ (effective) = 44.8 ft $y_{cs}$ = 0.6 ft

PGRM: CWCSNEW

Clear Water Contraction Scour (use if bed material is larger than small cobbles) see notes

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

### PIER SCOUR CALCULATIONS

PGRM: Pier

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

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

### ABUTMENT SCOUR CALCULATIONS

PGRM: Abutment

Average flow depth blocked by: left abutment, $y_{aLT}$ = 0 ft right abutment, $y_{aRT}$ = 1.3 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, $\psi_{LT}$ = 0 and $\psi_{RT}$ = 5.5

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 0 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 9.9 ft

## SCOUR ANALYSIS AND REPORTING FORM

Bridge Structure No. 52341445 Date 9/2/12 Initials AAJ Region (A B C D)

Site _____ Location 1.5 mi S & Harney on Playhouse Rd

$Q_{500}$ = 4400 by: drainage area ratio ____ flood freq. anal. ____ regional regression eq. X

Bridge discharge ($Q_2$) = 4400 (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 = 45 ft. Flow angle at bridge = 5 ° Abut. Skew = C ° Effective Skew = 5 °

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 = 44.83 ft* $q_2 = Q_2/W_2$ = 98.2 ft²/s

Bridge Vel, $V_2$ = 11.1 ft/s Final $y_2 = q_2/V_2$ = 8.9 ft $\Delta h$ = 2.5 ft

Average main channel depth at approach section, $y_1 = \Delta h + y_2$ = 11.4 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. = 0 ft

Low Steel Elev. = 12.4 ft

n (Channel) = 0.015

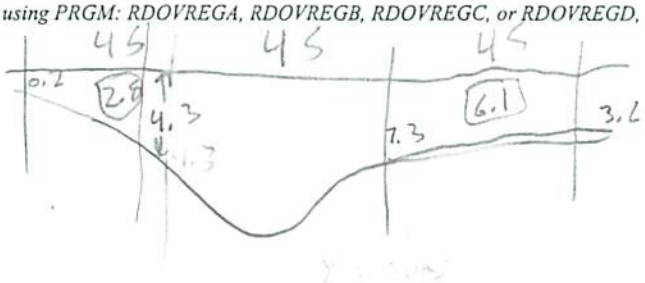
n (LOB) = 0.030

n (ROB) = 0.035

Pier Width = X ft

Pier Length = X ft

# Piers for 500 yr = X ft




### CONTRACTION SCOUR

PGRM: Contract

Width of main channel at approach section $W_1$ = 45 ft

Width of left overbank flow at approach, $W_{lob}$ = 45 ft Average left overbank flow depth, $y_{lob}$ = 2.8 ft

Width of right overbank flow at approach, $W_{rob}$ = 45 ft Average right overbank flow depth, $y_{rob}$ = 6.1 ft

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

$x$ = 6.89 From Figure 9 $W_2$ (effective) = 44.8 ft $y_{cs}$ = 1.7 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, $\xi$ = _____ Pier scour $y_{ps}$ = _____ ft

PGRM: Abutment

### ABUTMENT SCOUR CALCULATIONS

Average flow depth blocked by: left abutment, $y_{aLT}$ = 2.8 ft right abutment, $y_{aRT}$ = 6.1 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, $\psi_{LT}$ = 11.2 and $\psi_{RT}$ = 1.7

Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55)$ = 20.3 ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55)$ = 30.9 ft

43° 52' 25.66"
103° 22' 42.996

103.37861
43.8734

right on playhouse rd

Route Playhouse Rd Stream IRON Ck MRM _____ Date 9/2/12 Initials MAT

Bridge Structure No. 5234145 Location 1.5 mi S of Harney on CR330 or Playhouse Rd

GPS coordinates: N 43° 52' 25.5" taken from: USL abutment X centerline of ↑ MRM end _____

W103° 22' 43.4" Datum of coordinates: WGS84 X NAD27 _____

Drainage area = 17.59 sq. mi.

The average bottom of the main channel was 17 ft below top of guardrail at a point 17 ft from left abutment.

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

## MISCELLANEOUS CONSIDERATIONS

| Flows | $Q_{100}$ = 1820 | | | $Q_{500}$ = 4400 | | |
|---|---|---|---|---|---|---|
| Estimated flow passing through bridge | 1820 | | | 4400 | | |
| Estimated road overflow & overtopping | 0 | | | 0 | | |
| 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 | |

7/3

| | |
|---|---|
| 2 | 51.7 |
| 5 | 175 |
| 10 | 344 |
| 25 | 708 |
| 50 | 1180 |
| 100 | 1820 |
| 500 | 4400 |

Riprap at abutments? ____Yes X No ____Marginal

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

Debris Potential? ____High ____Med X Low

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

Riprap ____Yes X No ____Don't know ____NA

Spur Dike ____Yes X No ____Don't know ____NA

Other _____ ____Yes X No ____Don't know ____NA

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

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

Comments, Diagrams & orientation of digital photos

1). left CB
2). main channel
3). right CB
4-5). bed material → Note: slow flow region of bridge is gravel/cobbles. Full flow region is silt. Consider clear water scour.
6-7). right abutments
8-9). left abutment
10). main channel

Summary of Results

| | Q100 | Q500 |
|---|---|---|
| Bridge flow evaluated | 1820 | 4400 |
| Flow depth at left abutment (yaLT), in feet | 0 | 2.8 |
| Flow depth at right abutment (yaRT), in feet | 1.3 | 6.1 |
| Contraction scour depth (ycs), in feet | X 0.6 | 7.7 |
| Pier scour depth (yps), in feet | X | X |
| Left abutment scour depth (yas), in feet | 0 | 20.3 |
| Right abutment scour depth (yas), in feet | 9.9 | 30.9 |
| 1Flow angle of attack | 5 | 5 |

See Comments/Diagram for justification where required