	SCOUR ANALYSIS AND REPORTING FORM							
	Bridge Structure No. 12510206 Date 10-12-12 Initials RFT Region (ABCD)							
	Site Location 8.1 mi W Wagner on 395 Ave							
	Q <sub>M0</sub> =							
	Bridge discharge $(Q_2) = 10100$ (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 = $140$ ft. Flow angle at bridge = $25$ ° Abut. Skew = $30$ ° Effective Skew = $5$ °							
"RegionA", "RegionB", IC", or "RegionD"	Width $(W_2)$ iteration = $140$							
	Avg. flow depth at bridge, $y_2$ iteration = $9.3$							
	Corrected channel width at bridge Section = $W_2$ times cos of flow angle = $139.47$ ft* $q_2 = Q_2/W_2 = 43.7$ ft²/s							
	Bridge Vel, $V_2 = 4.7$ ft/s Final $y_2 = q_2/V_2 = 9.3$ ft $\Delta h = 0.4$ ft							
ار ال								
PGRM:	* NOTE: repeat above calculations until $y_2$ changes by less than 0.2 Effective pier width = $L \sin(q) + a \cos(q)$							
٣ ۾	If y 2 is above LS, then account for Road Overflow using PRGM: RDOVREGA, RDOVREGB, RDOVREGC, or RDOVREGD,							
	Water Surface Elev. = dry ft							
	Low Steel Elev. = 10.3 ft							
	n  (Channel) = 0.30							
	$ \frac{n \text{ (LOB)} = 0.030}{n \text{ (ROB)} = 0.030} \text{ pasture} $							
	Pier Width = 1/1/7 ft							
	Pier Length = $\frac{1}{1}$							
	CONTRACTION SCOUR							
	Width of main channel at approach section $W_1 = 140$ ft							
ract	Width of left overbank flow at approach, $W_{lob} = \frac{140}{140}$ ft Average left overbank flow depth, $y_{lob} = \frac{4}{140}$ ft							
PGRM: Contract								
Σ̈́	Width of right overbank flow at approach, $W_{rob} = 140$ ft Average right overbank flow depth, $y_{rob} = 6$ ft							
PGR	Live Bed Contraction Scour (use if bed material is small cobbles or finer)							
	$x = 7.38$ From Figure 9 $W_2$ (effective) = $132-8$ ft $y_{cs} = 8 \cdot 2$ ft							
ΕW	Clear Water Contraction Scour (use if bed material is larger than small cobbles)							
PGRM: CWCSNEW	Estimated bed material $D_{50} \neq \underline{\hspace{1cm}}$ ft Average approach velocity, $V_1 = Q_{100}/(y_1W_1) = \underline{\hspace{1cm}}$ ft/s							
Š	Critical approach velocity, $V_c = 11.17y_1^{1/6}D_{50}^{1/3} = ft/s$							
≅	If $V_1 < V_c$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed/scour equation above.							
PG	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 =                                   $							
	$D_{c50} = 0.0006(q_2/y_1^{-1})^2 = \underbrace{tt} \qquad \text{If } D_{50} > = D_{c50}, \chi = 0.0$ Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{-1/3}y_1^{-7/6})]^{6/7} - y_1 = \underbrace{tt} \qquad \text{From Figure 10, } y_{cs} = \underbrace{tt}$							
	•							
Picr	PIER SCOUR CALCULATIONS							
PGRM: Picr	L/a ratio = Correction factor for flow angle of attack (from Table 1), K2 =							
<u> P</u>	Froude # at bridge = $0.27$ Using pier width a on Figure 11, $\xi = 7$ Pier scour $y_{ps} = 5.7$ ft							
	A DUMNATINE COOLID OAT OUR ATIONS							
ıcııt	ABUTMENT SCOUR CALCULATIONS  Assume of the second by the second part of the second part							
Average flow depth blocked by: left abutment, $y_{aLT} = \frac{4 \Omega}{100}$ ft right abutment, $y_{aRT} = \frac{5.2}{100}$ ft								
PGRM: Abutment	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, $\psi_{LT} = 14.8$ and $\psi_{RT} = 15.4$ Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = 15.4$ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) = 15.4$ ft							
GR	Left abutment scour $v = w_{ext}(K_{e}/0.55) = 14.8$ ft Right abutment scour $v_{ext} = w_{ext}(K_{e}/0.55) = 15.4$ ft							
<u> </u>	Port monutation 200 A LIVING TO TO THE TOTAL TO THE TOTAL TO							

Site \$\frac{-\text{TOLOD}{\text{Dist}}}{\text{Dist}}\$\text{Dist}{\text{Contraction}}{\text{Dist}		Bridge Structure No. 12510206 Date Initials Region (A BCD)
Oligo Priode Olischarge (Q <sub>1</sub> ) = 274   Q (should be Q <sub>100</sub> unless there is a relief bridge, road overflow, or bridge overdopping)  Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method  Bridge Width = 140		
Bridge discharge (Q <sub>2</sub> ) = 2949 (should be Q <sub>300</sub> unless there is a relief bridge, road overflow, or bridge overtoopping)  Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method  Bridge Width = 140 n. Flow angle at bridge = 25 ° Abut. Skew = 30 ° Effective Skew = 5 °  Width (W <sub>2</sub> ) iteration = 1410  Avg. flow depth at bridge, y, iteration = 11.3  Avg. flow depth at bridge, y, iteration = 11.3  Avg. flow depth at bridge, y, iteration = 11.3  Avg. flow depth at bridge, y, iteration = 11.3  Avg. flow depth at bridge, y, iteration = 11.3  Bridge Vidth - 140 n. Flow angle at bridge = 25 ° Abut. Skew = 30 ° Effective Skew = 5 °  Width of the bridge, y, iteration = 11.3  Avg. flow depth at bridge, y, iteration = 11.3  Avg. flow depth at bridge Section = W <sub>2</sub> times cos of flow angle = 139.417 ft ° q <sub>2</sub> = Q <sub>2</sub> /W <sub>2</sub> = (Δ <sup>1</sup> / <sub>2</sub> ≥ ft <sup>2</sup> / <sub>2</sub> )  Bridge Vidth = 1.4 n. ft		
Analytical Procedure for Estimating Hydraulic Variables Needed to Apply Method  Bridge Width = 1410	PGRM: "RegionA", "RegionB", "RegionC", or "RegionD"	
Parigo Width ( H) iteration =  H  O   N   Flow angle at bridge =  Z  O   Abut. Skew =  Z  O   Effective Skew =  Z  O   Width (Wy) iteration =  H  O   Avg. flow depth at bridge, yy, iteration =  H  O   Avg. flow depth at bridge Section = Wy times cos of flow angle =  39.41   R   O   O   O   O   O   O   O   O   O		Bridge discharge $(Q_2) = 2979$ (should be $Q_{500}$ unless there is a relief bridge, road overflow, or bridge overtopping)
Width of main channel at approach section $W_1 = \frac{IUO}{I}$ ft  Width of left overbank flow at approach, $W_{tob} = \frac{IUO}{I}$ ft  Average left overbank flow depth, $y_{tob} = \frac{7 \cdot I}{f}$ ft  Width of right overbank flow at approach, $W_{rob} = \frac{IUO}{I}$ ft  Average right overbank flow depth, $y_{rob} = \frac{7 \cdot I}{f}$ ft  Width of right overbank flow at approach, $W_{rob} = \frac{IUO}{I}$ ft  Average right overbank flow depth, $y_{rob} = \frac{7 \cdot I}{f}$ ft  Width of right overbank flow at approach, $W_{rob} = \frac{IUO}{I}$ ft  Average right overbank flow depth, $y_{rob} = \frac{7 \cdot I}{f}$ ft  Live Bed Contraction Scour (use if bed material is small cobbles or finer) $x = \frac{1}{I}$ $\frac{1}{I}$		Bridge Width = $140$ ft. Flow angle at bridge = $25$ ° Abut. Skew = $30$ ° Effective Skew = $5$ ° Width (W <sub>2</sub> ) iteration = $140$ Avg. flow depth at bridge, y <sub>2</sub> iteration = $11.3$ Corrected channel width at bridge Section = W <sub>2</sub> times cos of flow angle = $139.47$ ft* $129.47$
Width of main channel at approach section $W_1 = \frac{IUO}{I}$ ft  Width of left overbank flow at approach, $W_{tob} = \frac{IUO}{I}$ ft  Average left overbank flow depth, $y_{tob} = \frac{7 \cdot I}{f}$ ft  Width of right overbank flow at approach, $W_{rob} = \frac{IUO}{I}$ ft  Average right overbank flow depth, $y_{rob} = \frac{7 \cdot I}{f}$ ft  Width of right overbank flow at approach, $W_{rob} = \frac{IUO}{I}$ ft  Average right overbank flow depth, $y_{rob} = \frac{7 \cdot I}{f}$ ft  Width of right overbank flow at approach, $W_{rob} = \frac{IUO}{I}$ ft  Average right overbank flow depth, $y_{rob} = \frac{7 \cdot I}{f}$ ft  Live Bed Contraction Scour (use if bed material is small cobbles or finer) $x = \frac{1}{I}$ $\frac{1}{I}$		CONTRACTION SCOUR
Width of left overbank flow at approach, $W_{tob} = \frac{ U }{ U } = \frac{1}{ U } =$		
$x = \underbrace{\begin{array}{c} x = \underbrace{\begin{array}{c} 1.52} \\ $	act	
$x = \underbrace{\begin{array}{c} x = \underbrace{\begin{array}{c} 1.52} \\ $	ontr	width of left overbank flow at approach, $w_{lob} = \frac{120}{120}$ it  Average left overbank flow depth, $y_{lob} = \frac{7}{120}$ in
$x = \underbrace{\begin{array}{c} x = \underbrace{\begin{array}{c} 1.52} \\ $	Ξ Ο	width of right overbank flow at approach, $w_{rob} = 140$ it  Average right overbank flow depth, $y_{rob} = 1/4$ it
$x = \underline{\hspace{0.5cm}} \begin{array}{c} x = \underline{\hspace{0.5cm}} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{c} \end{array}{$	PGR	Live Bed Contraction Scour (use if bed material is small cobbles or finer)
Clear Water Contraction Scour (use if bed material is larger than small cobbles)  Estimated bed material $D_{50} = 1$ ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1) = 1$ ft/s  Critical approach velocity, $V_0 = 11.17y_1^{1/6}D_{50}^{1/3} = 1$ If $V_1 < V_0$ and $D_{50} >= 0.2$ ft, use clear water equation below, otherwise use live bed scour equation above. $D_{050} = 0.0006(q_2/y_1^{7/6})^3 = 1$ Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1 = 1$ From Figure 10, $y_0 = 1$ Correction factor for flow angle of attack (from Table 1), $K_0 = 1$ Froude # at bridge = $0.73$ Outhor Material is larger than small cobbles)  PL/s  From Figure 10, $y_0 = 1$ From Figure 10, $y_0 = 1$ ABUTMENT SCOUR CALCULATIONS  Average flow depth blocked by: left abutment, $y_{alt} = \frac{7}{7!}$ ft right abutment, $y_{aRT} = \frac{7.2!}{9.53}$ for spill-through		
Estimated bed material $D_{50} = 1$ ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1) = 1$ ft/s  Critical approach velocity, $V_C = 11.17y_1^{1/6}D_{50}^{1/3} = 1$ 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. $D_{c50} = 0.0006(q_2/y_1^{7/6})^3 = 1$ ft $D_{50} >= 0.2$ ft, $D_{c50} = 0.0006(q_2/y_1^{7/6})^3 = 1$ ft $D_{50} >= 0.0$		
Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1 =$	E¥	Clear Water Contraction Scour (use if bed material is larger than small cobbles)
Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1 =$	SSN	Estimated bed material $D_{50} = $ ft Average approach velocity, $V_1 = Q_{500}/(y_1W_1) = $ ft/s
Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1 =$	Š	
Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1 =$	≅	
PIER SCOUR CALCULATIONS  L/a ratio = Correction factor for flow angle of attack (from Table 1), K2 = Using pier width a on Figure 11, $\xi = _{\frac{1}{2}}$ Pier scour $y_{ps} = _{\frac{5}{2}}$ ft  ABUTMENT SCOUR CALCULATIONS  Average flow depth blocked by: left abutment, $y_{aLT} = _{\frac{7}{2}}$ ft right abutment, $y_{aRT} = _{\frac{7}{2}}$ ft  Shape coefficient $K_1$ = 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, $0.55$ for spill-through	PG	$D_{c50} = 0.0006(q_2/y_1^{7/6})^3 = $ If $D_{50} > = D_{c50}$ , $\chi = 0.0$
ABUTMENT SCOUR CALCULATIONS  Average flow depth blocked by: left abutment, $y_{aLT} = \frac{7}{l}$ ft right abutment, $y_{aRT} = \frac{7.4}{0.55}$ ft spill-through		Otherwise, $\chi = 0.122y_1[q_2/(D_{50}^{1/3}y_1^{7/6})]^{6/7} - y_1 =ft$
ABUTMENT SCOUR CALCULATIONS  Average flow depth blocked by: left abutment, $y_{aLT} = \frac{7}{l}$ ft right abutment, $y_{aRT} = \frac{7.4}{0.55}$ ft spill-through		
ABUTMENT SCOUR CALCULATIONS  Average flow depth blocked by: left abutment, $y_{aLT} = \frac{7}{l}$ ft right abutment, $y_{aRT} = \frac{7.4}{0.55}$ ft spill-through	Pic	PIER SCOUR CALCULATIONS
ABUTMENT SCOUR CALCULATIONS  Average flow depth blocked by: left abutment, $y_{aLT} = \frac{7}{l}$ ft right abutment, $y_{aRT} = \frac{7.4}{0.55}$ ft spill-through	Έ. M	L/a ratio = Correction factor for flow angle of attack (from Table 1), K2 =
Average flow depth blocked by: left abutment, $y_{aLT} = \frac{7 \cdot l}{ft}$ ft right abutment, $y_{aRT} = \frac{7 \cdot l}{ft}$ ft  Shape coefficient $K_1 = 1.00$ for vertical-wall, 0.82 for vertical-wall with wingwalls, $0.55$ for spill-through	2	Froude # at bridge = $\frac{1}{2}$ Using pier width a on Figure 11, $\xi = \frac{1}{2}$ Pier scour $y_{ps} = \frac{5 \cdot 8}{2}$ ft
Average flow depth blocked by: left abutment, $y_{aLT} = \frac{7 \cdot l}{ft}$ ft right abutment, $y_{aRT} = \frac{7 \cdot l}{ft}$ ft  Shape coefficient $K_1 = 1.00$ for vertical-wall, 0.82 for vertical-wall with wingwalls, $0.55$ for spill-through	_	ARUTMENT SCOUR CALCULATIONS
Shape coefficient $K_1$ = 1.00 for vertical-wall, 0.82 for vertical-wall with wingwalls, Using values for $y_{aLT}$ and $y_{aRT}$ on figure 12, $\psi_{LT} = \frac{1\%.\%}{1000}$ and $\psi_{RT} = \frac{19.\%}{1000}$ for spill-through Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = \frac{19.\%}{1000}$ ft	men	
Using values for $y_{aLT}$ and $y_{aRT}$ on figure 12, $\psi_{LT} = \frac{18.8}{19.3}$ and $\psi_{RT} = \frac{19.3}{19.3}$ Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = \frac{19.8}{19.3}$ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) = \frac{19.3}{19.3}$ ft	Abut	
Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = 18.8$ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) = 19.3$ ft	K	
	PGF	Left abutment scour, $y_{as} = \psi_{LT}(K_1/0.55) = 18.8$ ft Right abutment scour $y_{as} = \psi_{RT}(K_1/0.55) = 19.3$ ft

Route 395 Ave Stream Chotea	u Creek	MRM	Dat	e	Ini	tials					
Bridge Structure No. 12510206	Location 8.1	mi N W	Lacare	50 395 ave							
GPS coordinates: N 43° 12.116	taken from:	USL abutmen		centerline of \( \text{MRM end} \)							
W 98° 17.2531	Datum of c	oordinates: W	GS84 /	NAD27							
Bridge Structure No. $12510206$ Location $8.1 \text{ mi } N$ Wagner on $395 \text{ ave}$ GPS coordinates: $12510206$ Location $12510206$ Centerline of $11006$ MRM end Datum of coordinates: WGS84 NAD27 Sq. mi.											
The average bottom of the main channel was $14.0$ ft below top of guardrail at a point $8.5$ ft from left abutment.											
Method used to determine flood flows:Freq. Analdrainage area ratio regional regression equations.											
MISCELLANEOUS CONSIDERATIONS											
Flows	Q\$8=	Q\$8= 6100			Qsim = 9060						
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?YesNoMarginal											
Evidence of past Scour? Yes	No	Don't knov	naputm	4N+							
Debris Potential?High	Medv	Low									
Does scour countermeasure(s) appear to have b											
Riprap	_Yes?	No Doi	n't know	√NA							
Spur Dike	Yes ?	esNoDon't know			√NA						
Other	Ves 1	esNoDon't know			NA NA						
	Outer 1 cs Doll t know NA										
Bed Material Classification Based on Median Particle Size (D <sub>50</sub> )											
•		Gravel		Cobbles		Boulders					
·		00 2.00-64				>250					
512c range, in min <0.002 0.00.	2-2.00	2.00-04		64-250		<b>~230</b>					
Comments, Diagrams & orientation of digital p	photos										
CHI PD.	niotos	. 0									
		let oc	. لم ن								
'oridge from approad	`										
(T, aput,											
20B approach from criege											
Show a series of the series of											
Summary of Results											
		Q100			Q500 may sour						
Bridge flow evaluated		4100			2949						
Flow depth at left abutment (yaLT), in feet		4,9			7.1						
Flow depth at right abutment (yaRT), in feet		5,2			7.4						
Contraction scour depth (ycs), in feet		2.2 5.7			ما.2						
Pier scour depth (yps), in feet					5.2						
Left abutment scour depth (yas), in feet		14,2			3.81						
Right abutment scour depth (yas), in feet		15.4			19.3						

25° (5° est.)

1Flow angle of attack