Maricopa County
Department of
Transportation

Bridge Scour Investigation
and
Design of Corrective Measures

Contract No. CY 1997-26
Work Order No. 80407

Final Report

Old U.S. 80 Highway Bridge over Hassayampa River

Submitted October 24, 1997

Registered Professional Engineer (Structural)
CERTIFICATE NO. 30340
DENNIS J. TREFREN
Date Signed 10/24/97
ARIZONA, U.S.A.

Prepared By:
INCA
INCA ENGINEERS, INC.
Wood/Patel & Associates
Maxim Technologies Inc.

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Registered Professional Engineer (Structural)
CERTIFICATE NO.
30340
DENNIS J.
TREFREN
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ARIZONA, U.S.A.

Bridge Scour Investigation and Design of Corrective Measures

FINAL REPORT

INTRODUCTION

The Maricopa County Department of Transportation retained two consultants in 1995 under Work Order Number 80407 to evaluate the scour potential during 100 and 500 year flood events for existing bridges in their jurisdiction over waterways. The results of that study classified some of the bridges as scour critical.

INCA Engineers, Inc. was retained by the County to review the previous reports for five bridges classified as scour critical, determine the extent of possible scour damage, recommend methods to prevent scour damage, and prepare contract documents for scour countermeasures.

The Old U.S. 80 Highway Bridge over Hassayampa River was evaluated as scour critical by Cannon and Associates, Inc. and documented in their report dated July 1996 (Revised November 1996).

Bridge Location and Description:

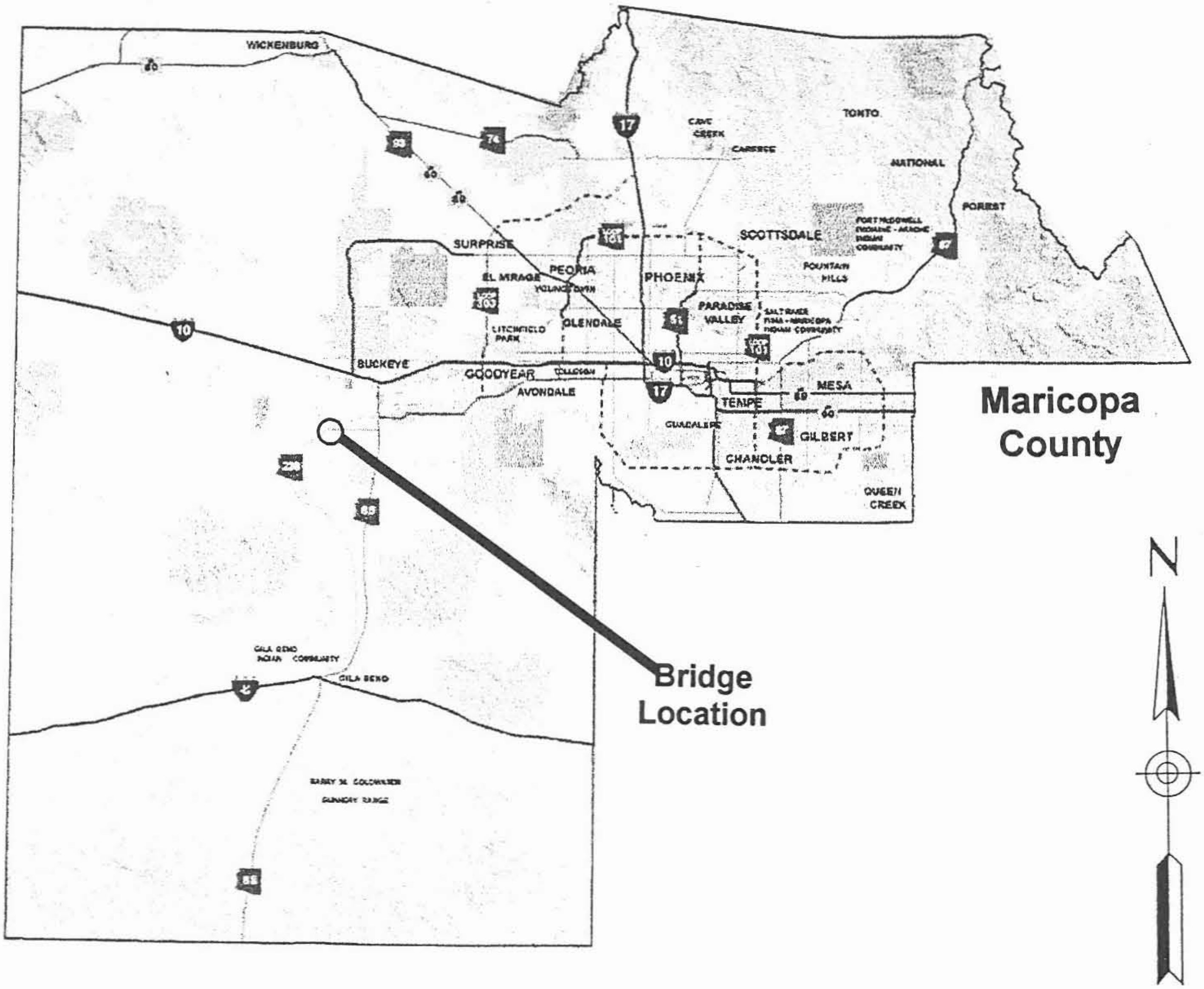
The Old U.S. 80 Bridge crossing of the Hassayampa River is located in the southwest quadrant of Maricopa County in Section 13 , T1S, R5W, Gila and Salt River Baseline and Meridian. It is located on Old U.S. 80 Highway approximately 5 miles west of the Town of Buckeye, AZ.

REVIEW OF PREVIOUS REPORT

Cannon & Associates, Inc. performed a scour investigation and structural stability analysis of this site and submitted a report in July of 1996 (Revised November 1996) documenting their findings. Wood/Patel has reviewed this report and the existing analysis appears to have been adequate for the purposes of the initial report but that additional analyses will be necessary for the development of scour countermeasures for this site. Items for further consideration include:

- Vegetation: The river vegetation has increased over the past year and now includes tamarisk in the banks and a new growth of tamarisk and willow in the low flow channel due to irrigation tailwater flow.

Figure 1
Location Map



- Stream Stability: All of the banks in the vicinity of the bridge are dikes constructed by local agricultural interests, and are relatively straight. Sustained flows of Q_{50} through Q_{500} may cause some lateral erosion and/or overtopping of the dikes. Any dike failure or overtopping would result in serious risk to the abutments.

- The statement that the scour at the abutments is negligible may be true in theory due to the approaching river geometry. However the banks are artificially placed, probably without any design. Lateral erosion and overtopping may result in an exposed abutment, and with the shorter drilled shaft foundations, the abutments would be scour critical. Lateral erosion has occurred since construction (with only small flows) as evidenced by photo numbers 4 and 5 in the original report.

- The list of deficiencies should include the possibility of flows breaching the levees resulting in an inadequate embedment of the abutment drilled shafts.

SITE INVESTIGATION

On June 19, 1997, a review of the site conditions was conducted by Dennis Trefren, P.E. and Richard Bruesch, P.E. of INCA, Jeff Holzmeister, P.E. and Rick Hiner, P.E. of Wood/Patel, Dave Thomas, P.E. of Maxim Technologies and Tom Sonnemann, P.E. of MCDOT. Observations were noted as the following:

1. By sighting along the underside of the pier caps, from the east bank, it appears that the west bank in the vicinity of the west pier is lower than the elevation of the bottom of the pier caps. The elevation of the bottom of the pier caps is approximately elevation 845. This suggests that for all flows from something less than Q_{100} (elevation of 847.9) through Q_{500}, there is overtopping of the banks.

2. When the existing banks are overtopped, the flood flow will spread significantly. It may not be possible to contain any floods above the Q_{50}.

3. If the banks are eroded in a small flood, the abutments may be at the most risk due to the shorter drilled shafts.

4. It may be possible to alter the 5:1 and 8:1 side slopes under the bridge to increase the capacity of the channel.

5. The channel soils appear to be well suited for soil cement.

6. There is insufficient right-of-way to construct large spur dikes. Spur dikes may be needed to protect the abutments.

7. Additional hydraulic modeling is warranted to better evaluate the site.

8. The observations noted in the previous report were verified by the field investigation and additional data was collected for office review and analysis. The assumption of zero

contraction scour and abutment scour was verified by observation of the channel characteristics in the vicinity of the bridge.

HYDROLOGY RECOMMENDATIONS

Wood/Patel reviewed the hydrology from the Final Bridge Scour Assessment Report prepared by Cannon & Associates, Inc. The 100-year discharge of 73,500 cfs (FCDMD) and 500-year discharge of 125,700 cfs (USGS Regression) were utilized in the review of the existing study.

HYDRAULICS RECOMMENDATIONS

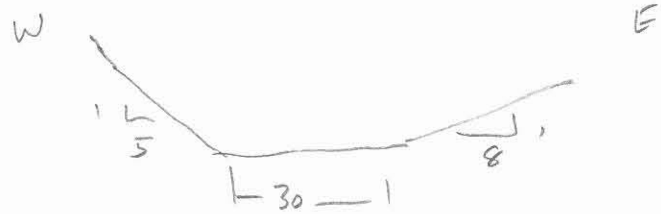
The hydraulics performed in the Final Bridge Scour Assessment Report prepared by Cannon & Associates, Inc. used a single section to determine the hydraulic characteristics of the bridge crossing. In our examination of possible mitigation alternatives, it was necessary to construct a multi-section HEC-RAS hydraulic model of the site in order to evaluate the different hydraulic characteristics of the alternatives.

The existing channel cross section at the bridge has a fairly narrow (approximately 30') bottom width and relatively flat side slopes (5:1 on the west bank and 8:1 on the east bank). These side slopes could be steepened as part of the mitigation to increase the flow area through the bridge structure. Due to the relatively flat slope of the river (0.0029 ft/ft) and the fact that the river will narrow again downstream of the structure, this will not result in a significant change in the water surface elevation at the bridge. It will, however, decrease the flow velocity and Froude number at the bridge section, which should decrease the magnitude of local scour at the bridge piers.

In order to protect the bridge abutments from scour during events, spur dikes will be placed at the east abutment and at either the west abutment or at pier #1. The hydraulic characteristics of the site will be identical for either location of the west spur dike because the channel flow is confined to the second and third spans only and is blocked from entering the first span. One foot of freeboard has been provided over the 100-year WSEL. Events exceeding this elevation may over flow through the first span.

The results of this analysis are presented in Appendix E.

$Q_{100} = 73,500$
$Q_{500} = 125,700$



SCOUR ANALYSIS

A review of the methodology used indicates that reasonable assumptions were made and the procedures utilized to compute scour are in accordance with HEC-18 methodology. Since, however, we are exploring an alternative that involves channelization through the bridge reach, new scour values had to be computed for the channelized option. The results of the revised analysis are presented below:

Flow Condition	100-year	100-year	Overtopping	Overtopping	Comments
Channel Condition	Existing	Design	Existing	Design	
Contraction Scour	0.0	0.0	0.0	0.0	Uniform Channel
Pier Scour (Local Scour)	35.9	26.9	36.78	26.97	
Long-Term Scour	4.0	4.0	4.0	4.0	Previous Study
Abutment Scour	0.0	0.0	0.0	0.0	Flow is Contained
Total Scour	39.9	30.9	40.78	30.97	
Remaining Embedment	14.8	24.1	13.92	24.03	

It should be noted that the widening of the channel through the bridge (as in the design condition) will increase the potential angle-of-attack of the approach flow on the piers (especially pier #3). Because of this, a 10° angle-of-attack was used for scour analysis in the design condition rather than the 5° angle used in the existing condition.

Contraction scour and the total scour at the abutments for the overtopping event is assumed to be 0.0 feet since the upstream channel is very uniform and the flow approaching the bridge is contained between the channel banks.

ALTERNATIVE COUNTERMEASURES

The following is a discussion of the most feasible countermeasures.

Alternative 1:

This alternate consists of constructing new spur dikes at the abutments. The spur dikes will be constructed of soil cement with a 1:1 slope and a parabolic shape on the upstream ends. The upstream side of the west spur dike will remain within the existing right-of-way. However, additional right-of-way is required to construct the upstream side of the east spur dike. The downstream end of the spur dikes will be parallel to the centerlines of the substructure. An earthen dike at the downstream end of the west spur dike will be needed to connect to the existing bank downstream. The first span will remain as it is in the existing condition and will function only as an emergency overflow channel (the additional capacity of the overflow section is relatively insignificant). The channel bank slopes will be regraded to a 3:1 slope at pier 1 and the east abutment. A soil cement floor will be constructed between the spur dikes to prevent local pier scour.

Due to the presence of water in the channel, the floor needs to be constructed in stages. The water can be diverted to the east end of the bridge by using temporary dikes while constructing the floor on the west side of the bridge. Once the west side is completed, the water can be diverted to the west side in order to construct the east side.

The upper eight feet of the bank protection under the bridge will be constructed with wet process shotcrete due to the limited headroom under the bridge near the abutments. Refer to details shown in Appendix B.

Advantages of this alternative are:

- Increases the hydraulic capacity through the bridge to the maximum possible.

- Reduces the velocity through the bridge.

Disadvantages are the following:

- Will require new right-of-way from developed agricultural owner directly downstream of the west abutment.

- Requires an earthen dike to connect to the west bank downstream.

The estimated cost for this alternative is $1,090,000.

Alternative 2:

This alternative is the same as Alternative No. 1 except that the west spur dikes will be located at Pier 1 instead of at the west abutment. The spur dike will be angled to the west to block the west abutment. The channel bank slopes will be regraded to a 1:1 slope at Pier 1 and the east abutment. A soil cement floor will be constructed between the spur dikes to prevent local pier scour.

Due to the presence of water in the channel, the floor needs to be constructed in stages. The water can be diverted to the east side by using temporary dikes while constructing the floor on the west side. Once the west side is completed, the water can be diverted to the west side in order to construct the east side.

The upper eight feet of the bank protection under the bridge will be constructed with wet process shotcrete due to the limited headroom under the bridge near the pier and abutment. Refer to details shown in Appendix C.

The advantages of this alternative are:

- Increases the hydraulic capacity through the bridge.

- Reduces the velocity through the bridge.
- Least costly alternative.

Disadvantages are the following:

- Will require new right-of-way from developed agricultural owner directly downstream of the west abutment.
- Requires an earthen dike to connect to the west bank downstream.

The estimated cost for this alternative is $896,000.

Alternative 3:

This alternative consists of constructing a wire tied riprap floor and bank protection similar to the layout for Alternative No. 2. The slopes for this alternative are 3:1. The construction of the floor would be staged similar to that discussed for Alternative No. 2.

The advantages of this alternative are:

- Provides a scour resistant floor around the piers.
- Protects the abutments from lateral erosion.
- A flexible system that will settle if undercut.
- Utilizes a proven material and construction method.

Disadvantages are the following:

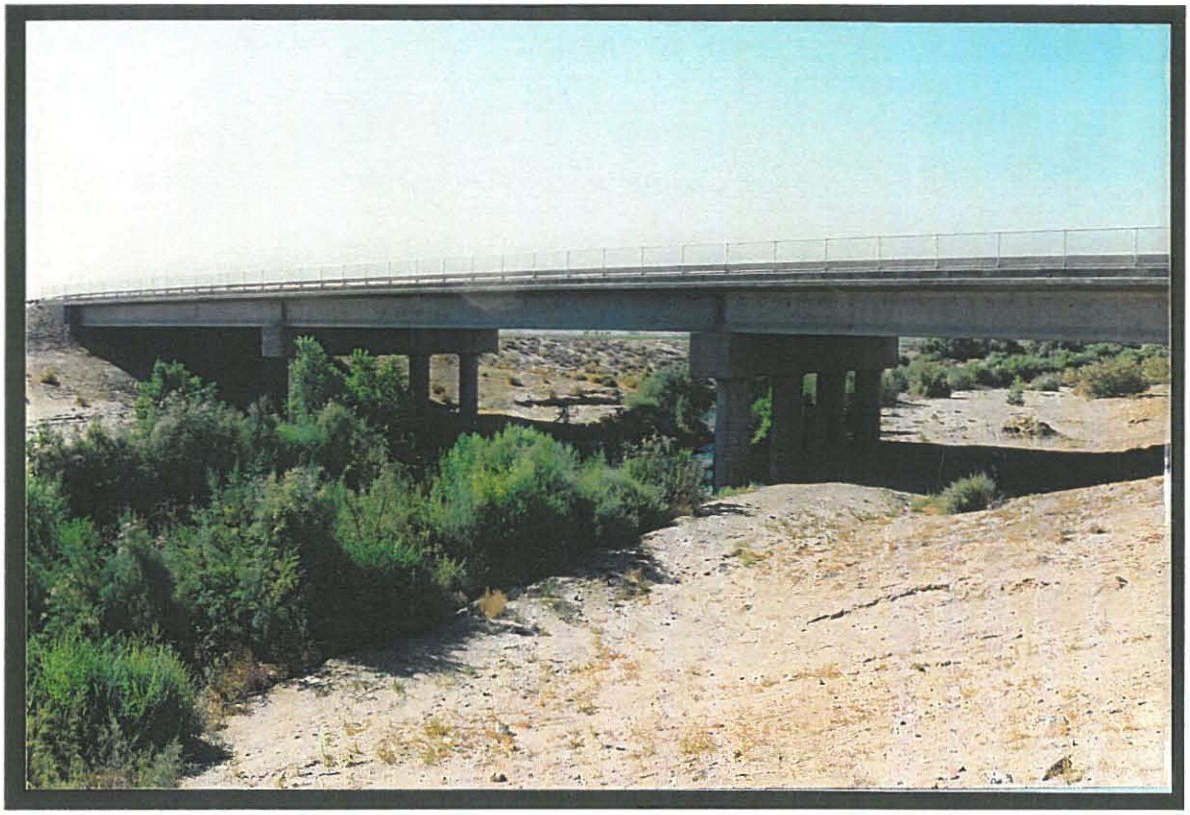
- Requires large excavations for toe-down sections.
- The wire is subject to abrasion and corrosion damage.
- Labor intensive system.
- Difficult to place against the abutment and pier under the bridge due to limited vertical clearance.
- The upper portion of the slopes under the bridge deck need to be hand placed.
- Requires more right-of-way than the soil cement alternatives.
- The most costly alternative.

The estimated cost for this alternative is $2,490,000.

PREFERRED ALTERNATIVE

We recommend Alternative 2 to be constructed since it offers the best scour protection at the lowest cost.

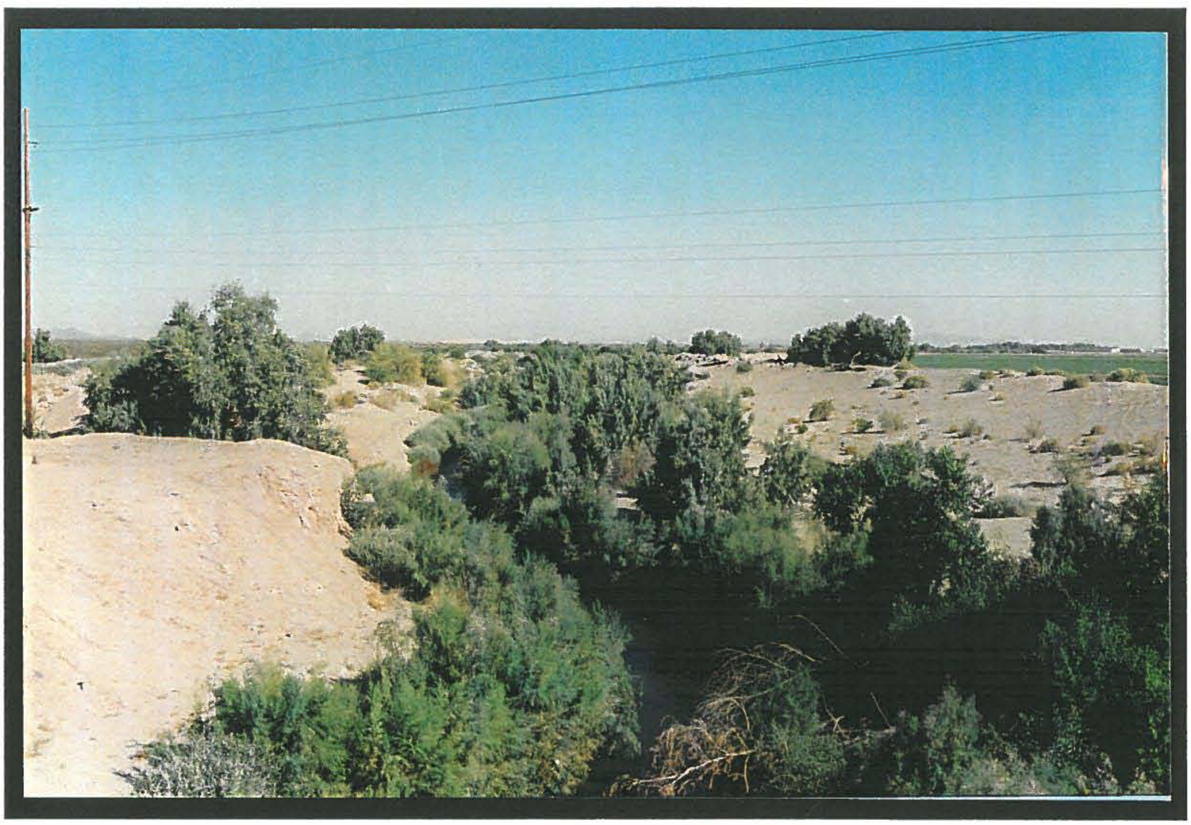
Appendix A
Photographs



Looking Downstream

Looking Downsteam in Span 2

Erosion at Pier 2

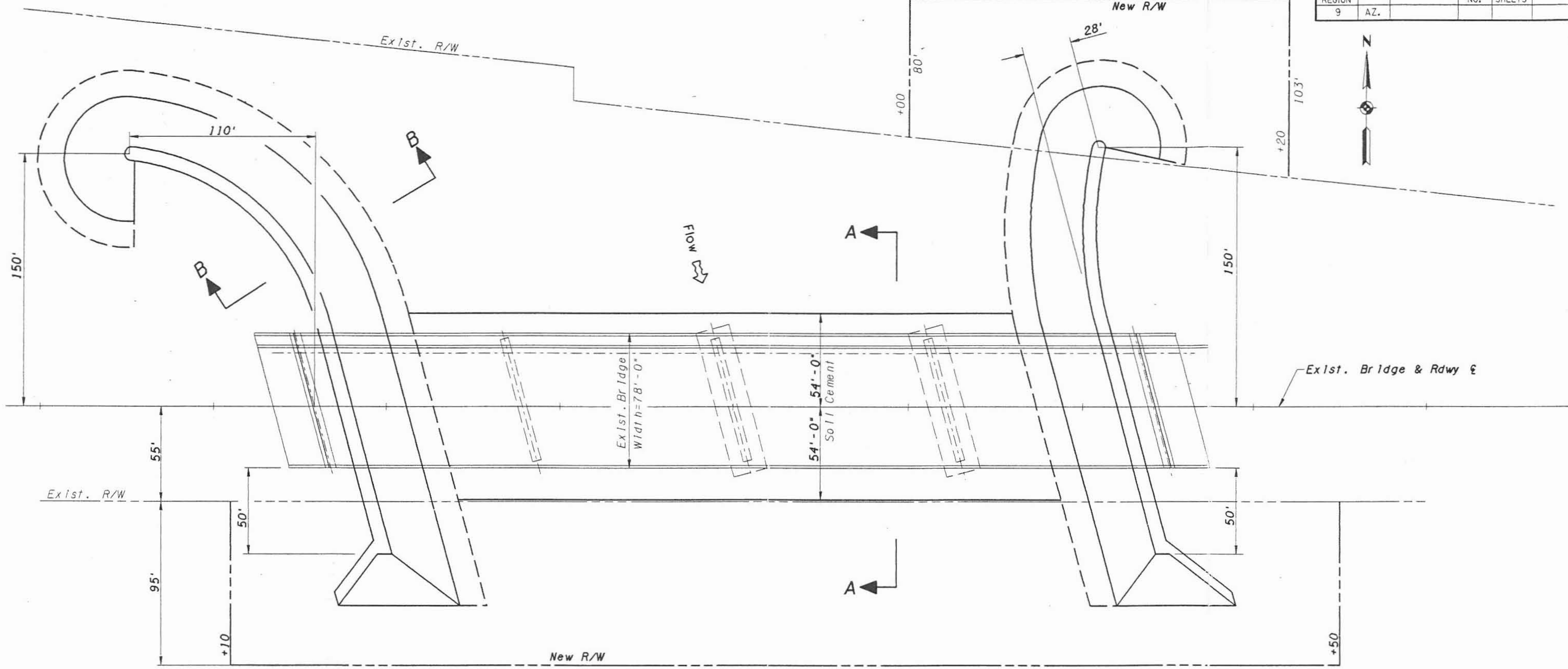


Looking Upstream

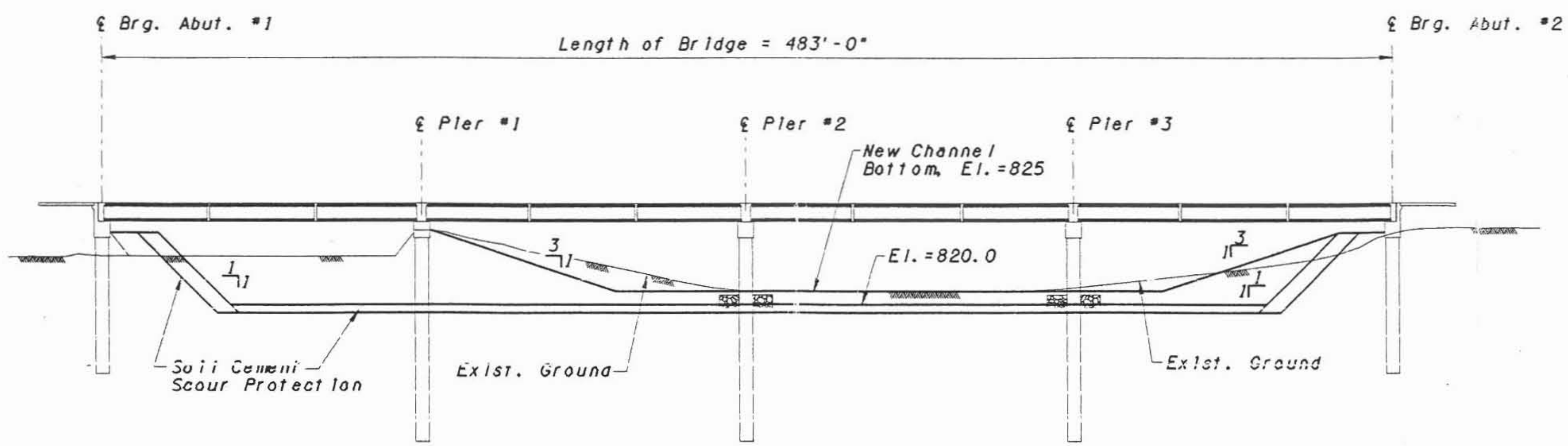
Looking Upstream Near East Abutment

Appendix B
Alternative 1 Details

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.				



PLAN



SECTION ALONG CONSTR. ℄

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HASSAYAMPA RIVER BRIDGE
@ OLD U.S. 80

	BY	DATE
DESIGNED	DAVE CHAPIN	10/21/97
DRAWN	RON WIETZEMA	10/21/97
CHECKED	DENNIS TREFREN	10/21/97

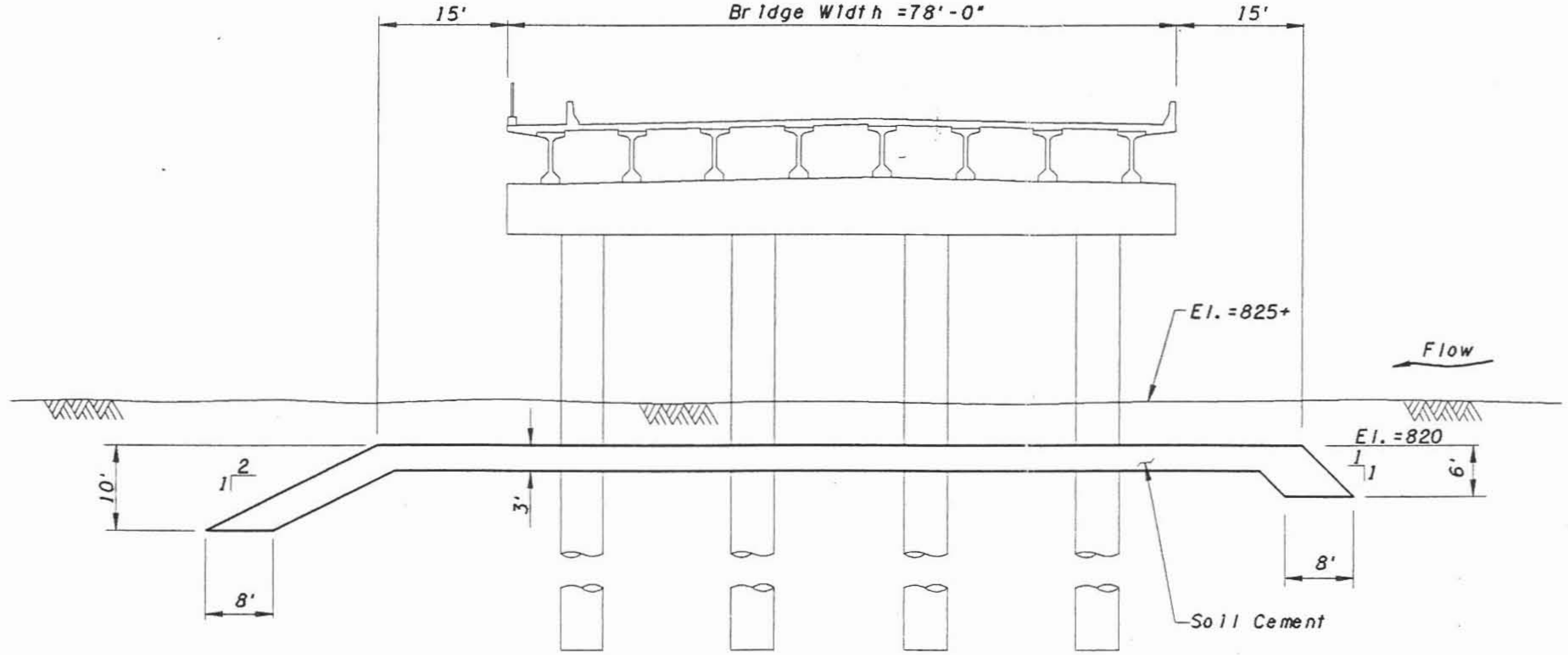
PRELIMINARY NOT FOR CONSTRUCTION

INCA ENGINEERS INC.

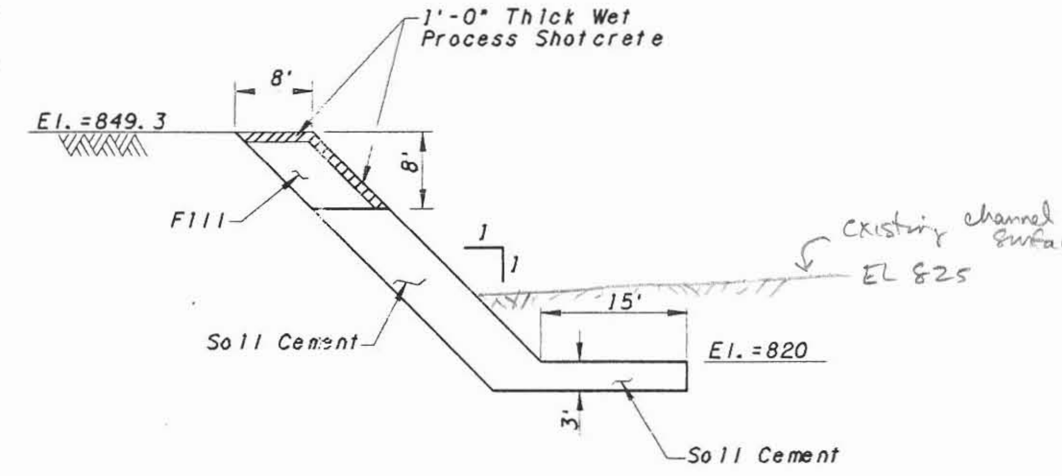
ALTERNATIVE NO. 1

SHEET OF

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.				



SECTION A-A



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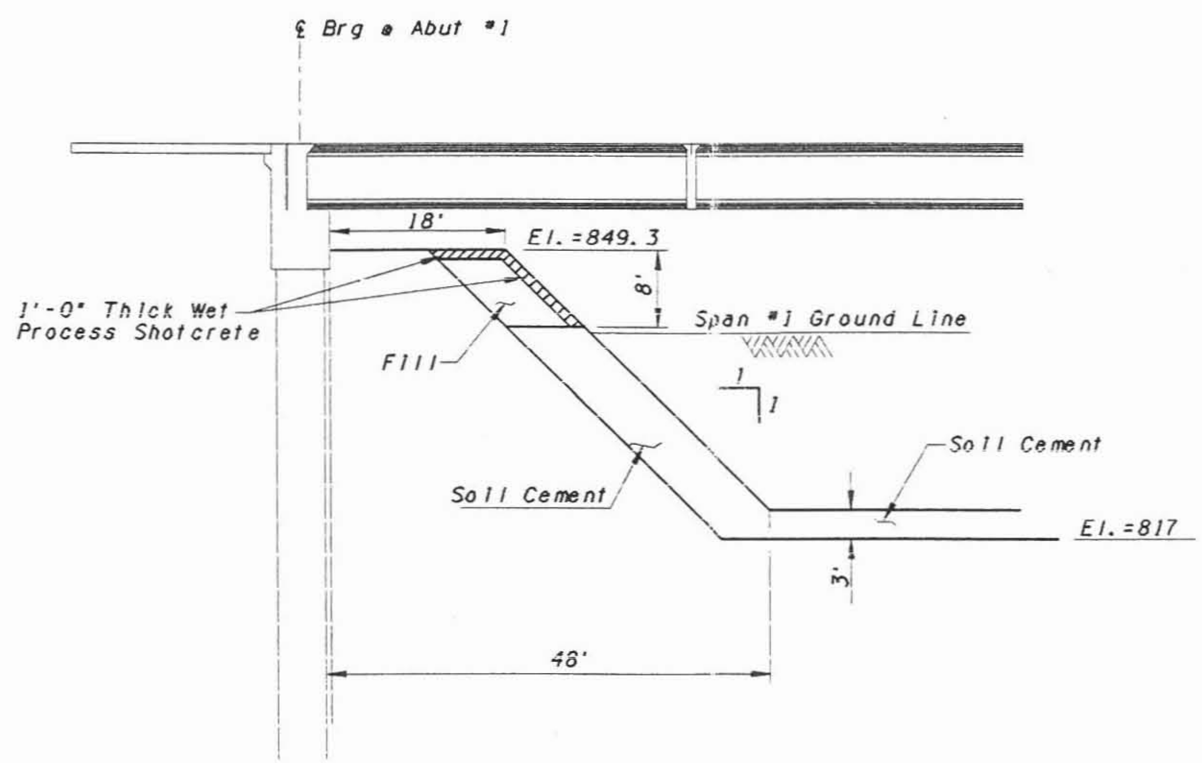

SECTION LOOKING UPSTREAM

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HASSAYAMPA RIVER BRIDGE
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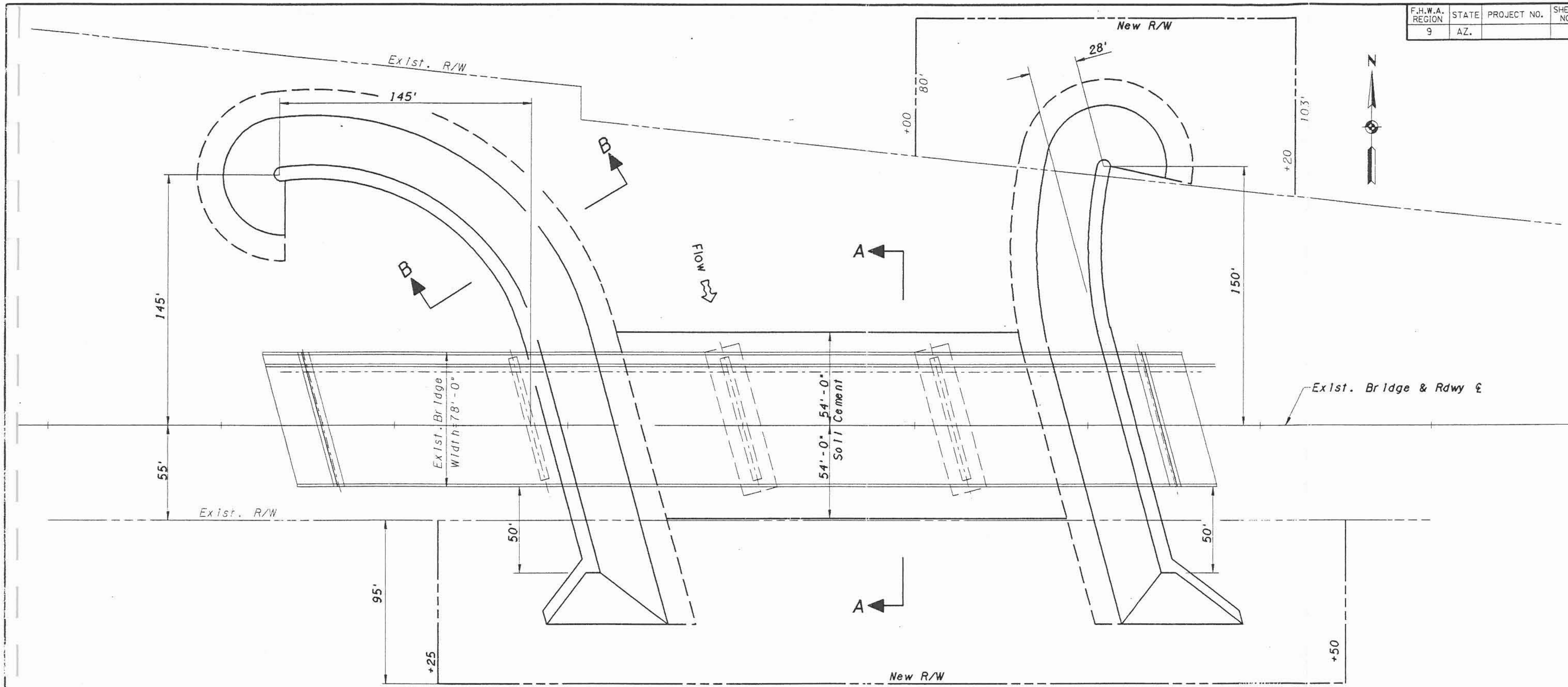
INCA ENGINEERS INC.

ALTERNATIVE NO. 1

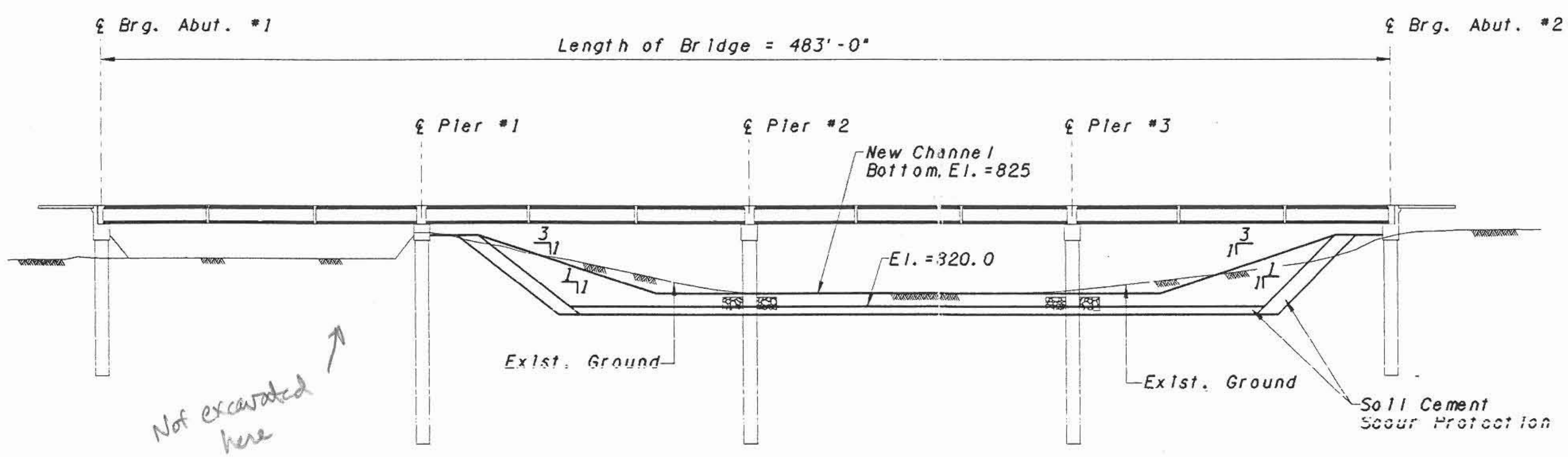
SHEET OF

Appendix C
Alternative 2 Details

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.				



PLAN



SECTION ALONG CONSTR. ℄

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HASSAYAMPA RIVER BRIDGE
@ OLD U.S. 80

PRELIMINARY NOT FOR CONSTRUCTION		BY	DATE
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	DRAWN	RON WIETZEMA	10/21/97
	CHECKED	DENNIS TREFREN	10/21/97

INCA
INCA ENGINEERS INC.

ALTERNATIVE NO. 2

SHEET OF

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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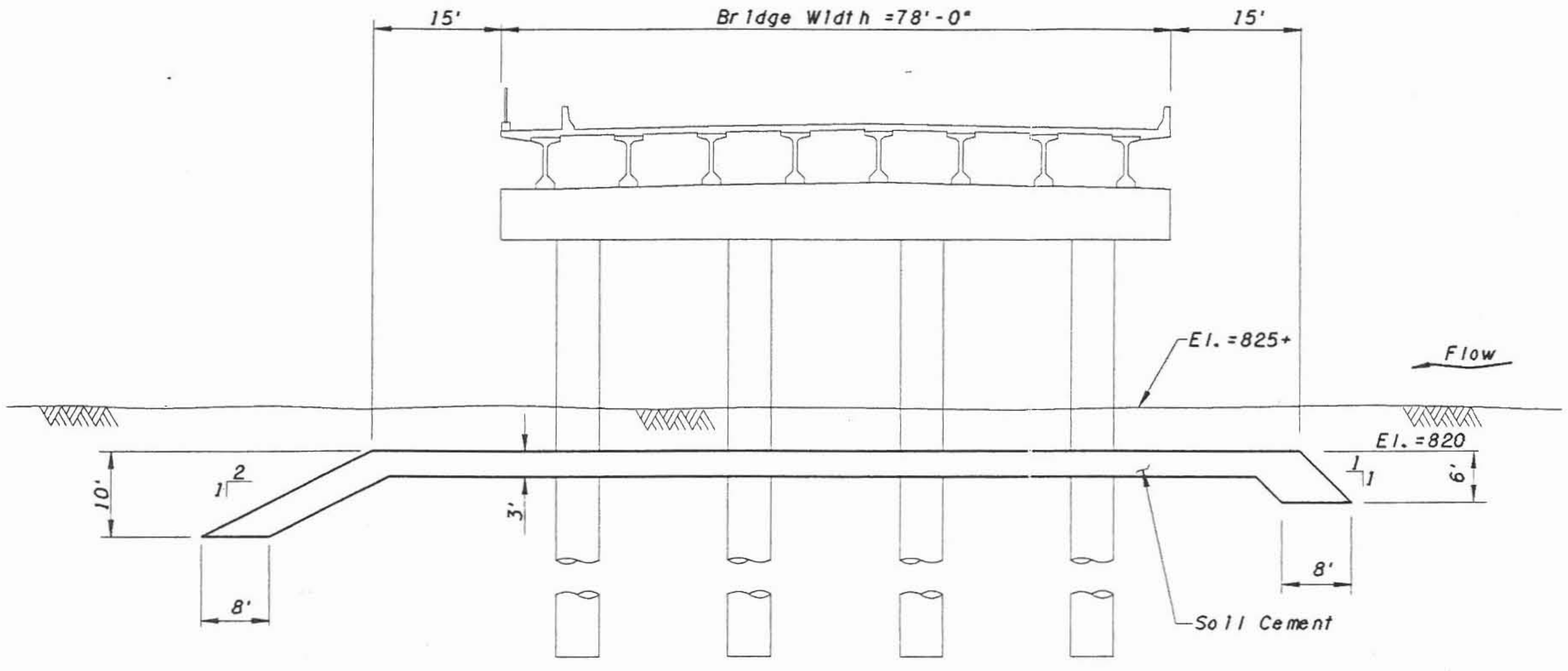
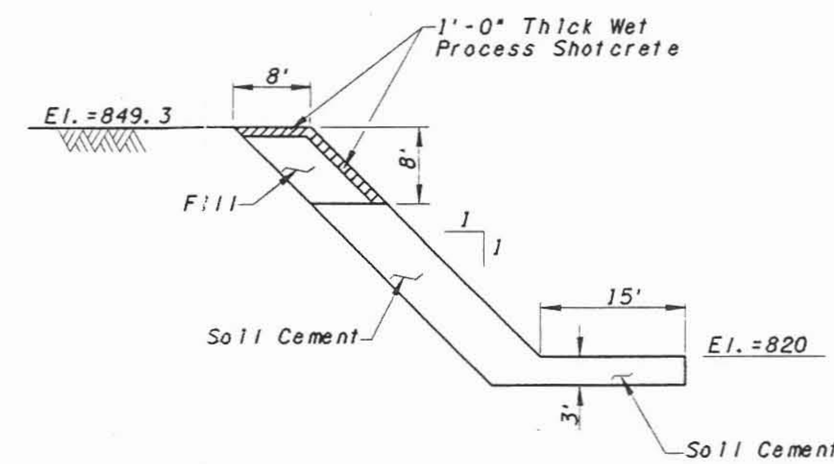


SECTION A-A



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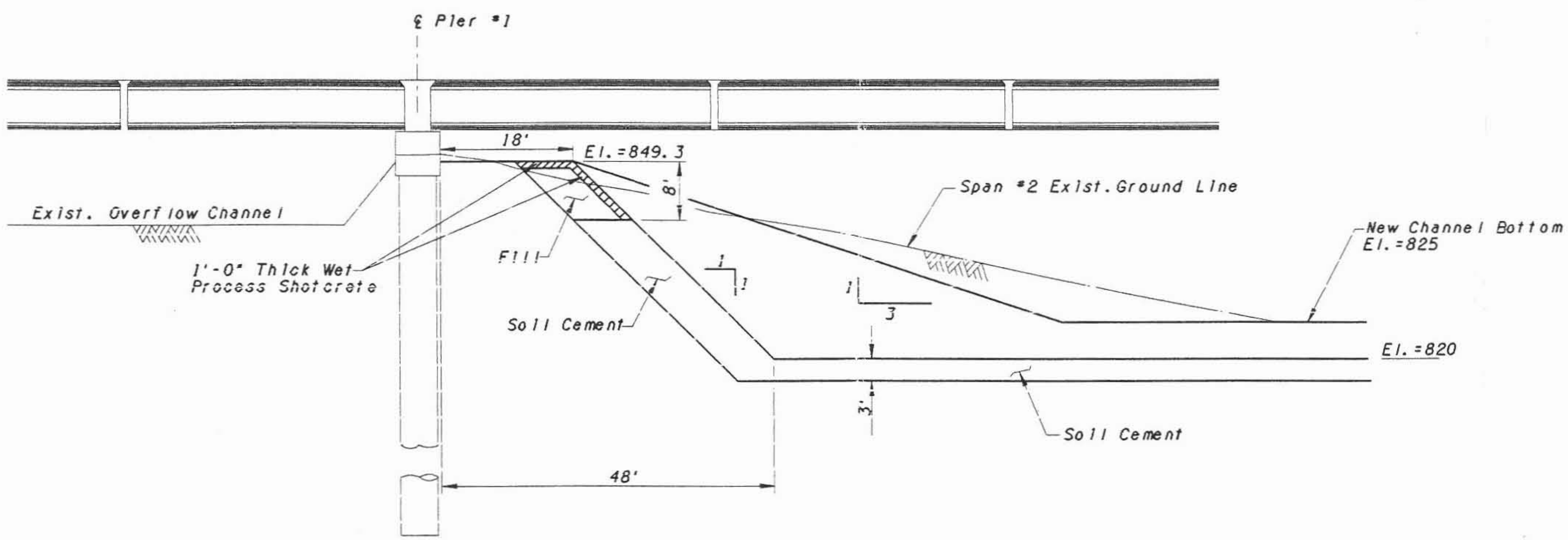

SECTION LOOKING UPSTREAM

NO.	REVISION	BY	DATE
1			
2			
3			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HASSAYAMPA RIVER BRIDGE
@ OLD U.S. 80

PRELIMINARY NOT FOR CONSTRUCTION

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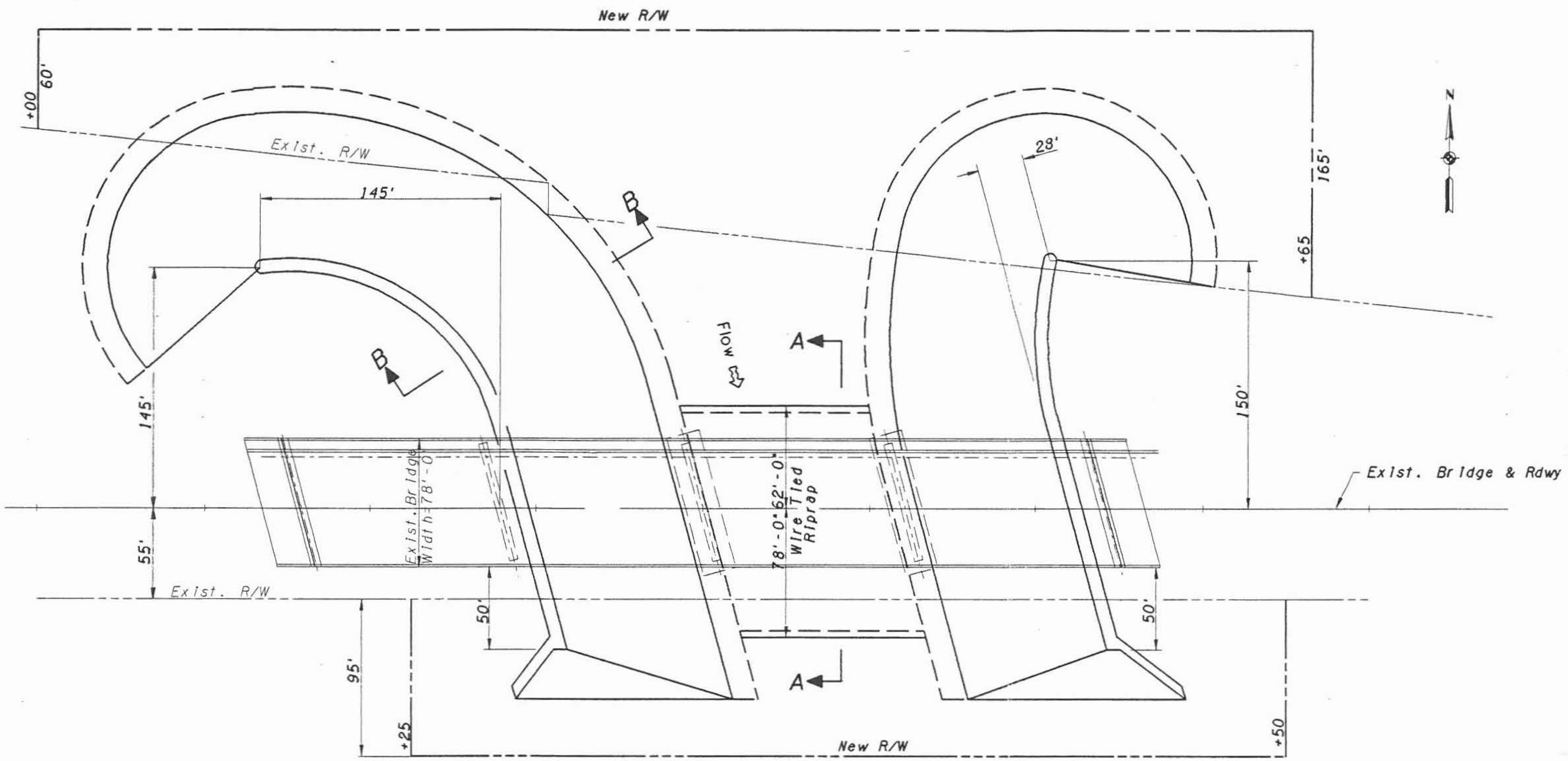
INCA ENGINEERS INC.

ALTERNATIVE NO. 2

SHEET OF

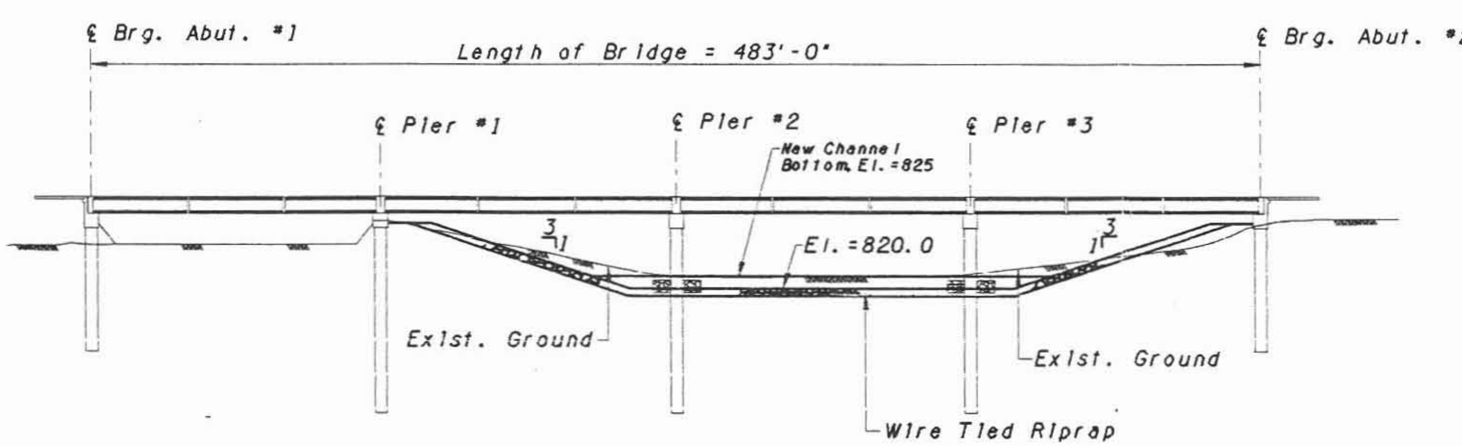
Appendix D
Alternative 3 Details

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
9	AZ.				



PLAN

SCALE: 1"=40'



SECTION ALONG CONSTR. ℄

SCALE: 1"=40'

NO.	REVISION	BY	DATE
3			
2			
1			

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HASSAYAMPA RIVER BRIDGE
@ OLD U.S. 80

		BY	DATE
PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED	DAVE CHAPIN	10/21/97
	DRAWN	RON WIETZEMA	10/21/97
	CHECKED	DENNIS TREFREN	10/21/97

INCA ENGINEERS INC.

ALTERNATIVE NO. 3

SHEET OF

F.H.W.A. REGION	STATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	RECORD DRAWING
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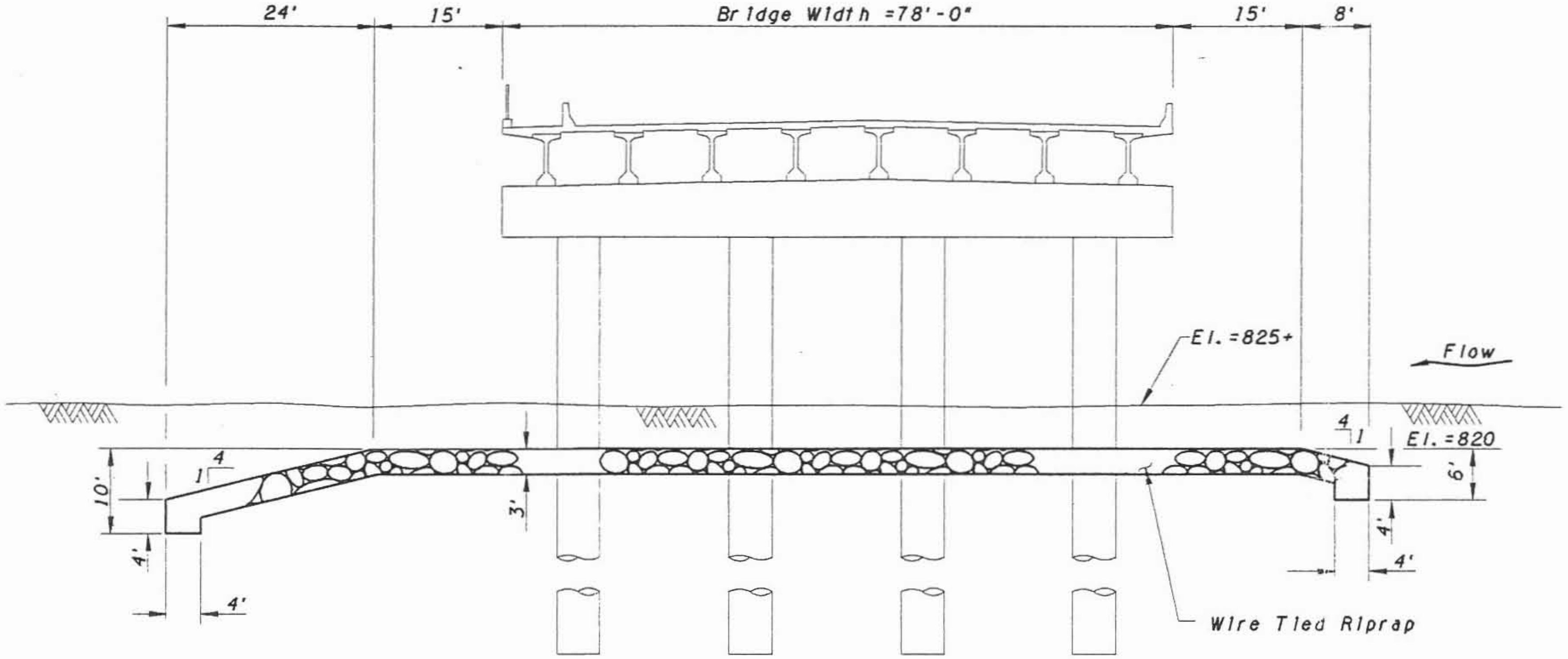
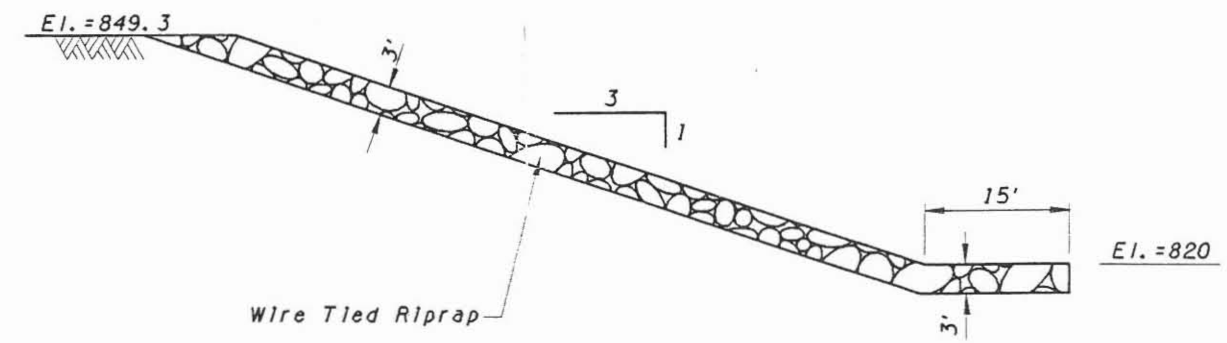


SECTION A-A



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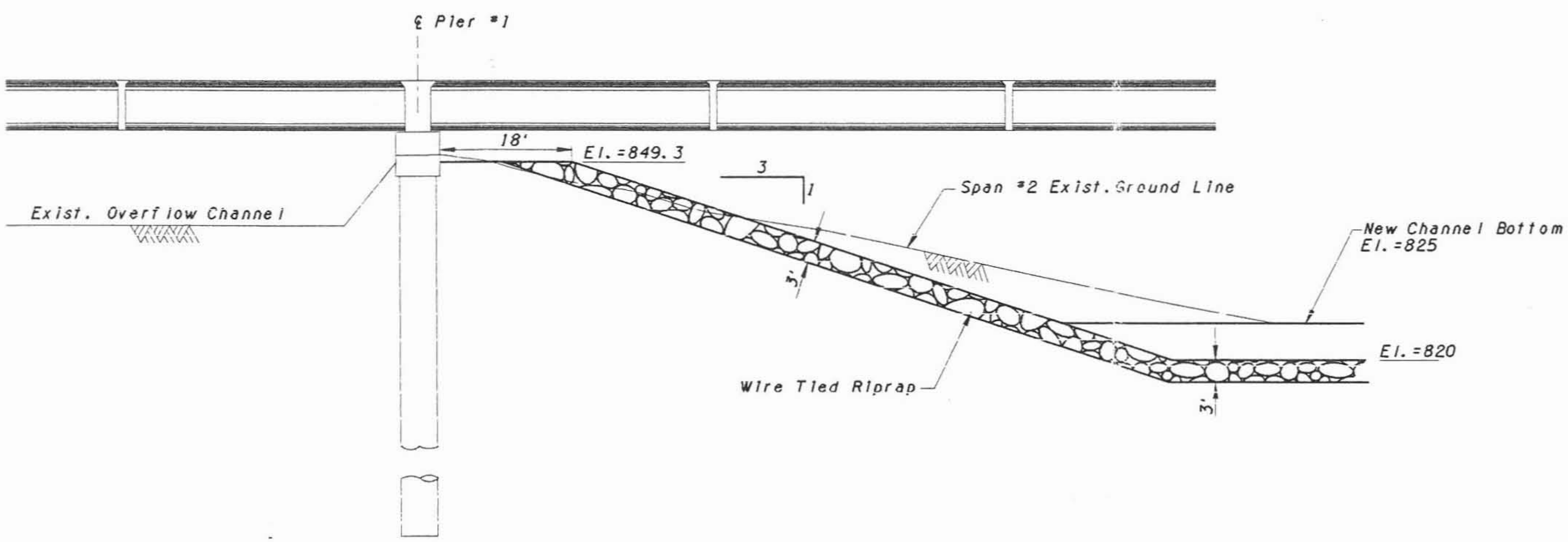

SECTION LOOKING UPSTREAM

NO.	REVISION	BY	DATE

MARICOPA COUNTY
DEPARTMENT OF TRANSPORTATION
ENGINEERING DIVISION

HASSAYAMPA RIVER BRIDGE
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	DRAWN	RON WIETZEMA	10/21/97
	CHECKED	DENNIS TREFREN	10/21/97

INCA ENGINEERS INC.

ALTERNATIVE NO. 3

SHEET OF

Appendix E
Hydraulic Calculations

PIER SCOUR CALCULATION SHEET

Consultant: **Wood, Patel & Associates, Inc.** Project # **97629** **Sheet # 1 of 1**

References: **FHWA's HEC-18 (third edition) and Interum Procedure for Estimating Pier Scour with Debris**

Project Name: **MCDOT Bridge Scour Evaluation** Date: **08/28/97**

Existing Conditions

Engineer: **R. Hiner** Checked By: Structure #: **Old US80 @ Hassayampa**

HYDROLOGIC/HYDRAULIC PARAMETERS

Cella Bar Shows 844

Return Interval	**100** yrs.		Hydraulics:	HEC-RAS	
Hydrology Source	FCDMC		Top Width (T)	5.21	ft.
Discharge (Q)	73,500	cfs	Flow Area (A)	111.06	ft^2
→ Water Surface Elev.	848.13	ft. – 844	Chan. Slope (S)	0.00290	ft/ft
Thalweg Elevation	824.70	ft. – 828	Max. Vel. (Vm)	25.18	ft/sec
Max. Depth of Flow (Y1)	**23.43**	ft.	Froude No. (Fr)	**0.92360**	(Vm^2*T/g*A)^.5

PIER SCOUR CALCULATIONS

Pier Type: Stemwall ______ Columns X

Foundation Type: Spread Ftng ______ Piles/Drilled Shaft X

K1 = 1.1 Correction factor for pier nose shape (assume square nose pier K1=1.1 Table 2, pg. 40, HEC-18. For multiple column piers and stemwalls skewed to the flow, K1=1.0)

Angle of Attack (theta) = 5° (15 degree min. for stemwall piers if there is potential channel meandering)

Pier Width (Wp) = 5 ft. No. of Columns/Piles per bent: 4

Dist. Between Columns = 15 ft. (Clear space must exceed 5 pier diameters for independent analysis)

Debris Blockout (Wd) = 4 ft. (Based on debris potential; low = 2 ft., medium = 3 ft., high = 4 ft.)

Length of Pier (L) = 70 ft. Coefficient for bed condition - K3= 1.1 (Table 1, pg. 39)

Effective Pier Length (L') = 60 ft. L' = L or 12*Wp whichever is less.

Effective Pier Width (a) = 12.22 ft. (The greater of Wp*cos(theta)+Wd or (Wp*cos(theta)+Wd/2)+L'sin(theta))

K2 = 1.0 (For stemwall, multiple column, and single column piers K2=1.0)

Colorado State University Equation (HEC-18 pg. 52)

$$Y_s = Y_1 2.0 K_1 K_2 K_3 \left(\frac{a}{Y_1}\right)^{0.65} Fr^{0.43}$$

Local Pier Scour Depth = 35.90 ft. Length of Exposed Piling = 39.90 ft.

Long-Term Degradation = 4 ft. Remaining Pile Embedment = 14.80 ft.

Depth of Pier Scour Hole = **39.90** ft. below existing bed elevation.

Elev. @ Btm of Scour Hole= 784.80 ft.

Elev. @ Bottom of Footing= 824.7 ft.

Elev. @ Min. Tip of Pile= 770 ft. **Bridge may have insufficient embedment - Structural Evaluation**

PIER SCOUR CALCULATION SHEET

Consultant: **Wood, Patel & Associates, Inc.** Project # **97629** **Sheet # 1 of 1**

References: **FHWA's HEC-18 (third edition) and Interum Procedure for Estimating Pier Scour with Debris**

Project Name: **MCDOT Bridge Scour Evaluation** Date: **08/28/97**

Modified Conditions

Engineer: **R. Hiner** Checked By: Structure #: **Old US80 @ Hassayampa**

HYDROLOGIC/HYDRAULIC PARAMETERS

Return Interval	**100**	yrs.	Hydraulics:	HEC-RAS	
Hydrology Source	FCDMC		Top Width (T)	7.47	ft.
Discharge (Q)	73,500	cfs	Flow Area (A)	172.69	ft^2
Water Surface Elev.	848.28	ft.	Chan. Slope (S)	0.00290	ft/ft
Thalweg Elevation	825.00	ft.	Max. Vel. (Vm)	14.36	ft/sec
Max. Depth of Flow (Y1)	**23.28**	ft.	Froude No. (Fr)	**0.27698**	(Vm^2*T/g*A)^.5

PIER SCOUR CALCULATIONS

Pier Type:	Stemwall		Columns	X
Foundation Type:	Spread Ftng		Piles/Drilled Shaft	X

K1 = 1.1 Correction factor for pier nose shape (assume square nose pier K1=1.1 Table 2, pg. 40, HEC-18. For multiple column piers and stemwalls skewed to the flow, K1=1.0)

Angle of Attack (theta) = 10° (15 degree min. for stemwall piers if there is potential channel meandering)

Pier Width (Wp) = 5 ft. No. of Columns/Piles per bent: 4

Dist. Between Columns = 15 ft. (Clear space must exceed 5 pier diameters for independent analysis)

Debris Blockout (Wd) = 4 ft. (Based on debris potential; low = 2 ft., medium = 3 ft., high = 4 ft.)

Length of Pier (L) = 70 ft. Coefficient for bed condition - K3= 1.1 (Table 1, pg. 39)

Effective Pier Length (L') = 60 ft. L' = L or 12*Wp whichever is less.

Effective Pier Width (a) = 17.45 ft. (The greater of Wp*cos(theta)+Wd or (Wp*cos(theta)+Wd)/2+L'sin(theta))

K2 = 1.0 (For stemwall, multiple column, and single column piers K2=1.0)

Colorado State University Equation (HEC-18 pg. 52)

$$Y_s = Y_1 2.0 K_1 K_2 K_3 \left(\frac{a}{Y_1}\right)^{0.65} Fr^{0.43}$$

Local Pier Scour Depth =	26.90	ft.	Length of Exposed Piling =	30.90	ft.
Long-Term Degradation =	4	ft.	Remaining Pile Embedment =	24.10	ft.
Depth of Pier Scour Hole =	**30.90**	ft. below existing bed elevation.			
Elev. @ Btm of Scour Hole=	794.10	ft.			
Elev. @ Bottom of Footing=	825	ft.			
Elev. @ Min. Tip of Pile=	770	ft.	**Bridge may have insufficient embedment - Structural Evaluation**		

PIER SCOUR CALCULATION SHEET

Consultant:	**Wood, Patel & Associates, Inc.**	Project #	**97629**	**Sheet # 1 of 1**	
References:	**FHWA's HEC-18 (third edition) and Interum Procedure for Estimating Pier Scour with Debris**				
Project Name:	**MCDOT Bridge Scour Evaluation**	Date:	**08/28/97**		
			Existing Conditions		
Engineer:	**R. Hiner**	Checked By:		Structure #:	**Old US80 @ Hassayampa**

HYDROLOGIC/HYDRAULIC PARAMETERS

Return Interval	**Overtop**	yrs.	Hydraulics:	HEC-RAS	
Hydrology Source	N/A		Top Width (T)	5.21	ft.
Discharge (Q)	88,000	cfs	Flow Area (A)	120.86	ft^2
Water Surface Elev.	850.59	ft.	Chan. Slope (S)	0.00290	ft/ft
Thalweg Elevation	824.70	ft.	Max. Vel. (Vm)	25.94	ft/sec
Max. Depth of Flow (Y1)	**25.89**	ft.	Froude No. (Fr)	**0.90071**	(Vm^2*T/g*A)^.5

PIER SCOUR CALCULATIONS

Pier Type:	Stemwall		Columns	X
Foundation Type:	Spread Ftng		Piles/Drilled Shaft	X

K1 = 1.1 Correction factor for pier nose shape (assume square nose pier K1=1.1 Table 2, pg. 40, HEC-18. For multiple column piers and stemwalls skewed to the flow, K1=1.0)

Angle of Attack (theta) = 5° (15 degree min. for stemwall piers if there is potential channel meandering)

Pier Width (Wp) = 5 ft. No. of Columns/Piles per bent: 4

Dist. Between Columns = 15 ft. (Clear space must exceed 5 pier diameters for independent analysis)

Debris Blockout (Wd) = 4 ft. (Based on debris potential; low = 2 ft., medium = 3 ft., high = 4 ft.)

Length of Pier (L) = 70 ft. Coefficient for bed condition - K3= 1.1 (Table 1, pg. 39)

Effective Pier Length (L') = 60 ft. L' = L or 12*Wp whichever is less.

Effective Pier Width (a) = 12.22 ft. (The greater of Wp*cos(theta)+Wd or (Wp*cos(theta)+Wd/2)+L'sin(theta))

K2 = 1.0 (For stemwall, multiple column, and single column piers K2=1.0)

Colorado State University Equation (HEC-18 pg. 52)

$$Y_s = Y_1 2.0 K_1 K_2 K_3 \left(\frac{a}{Y_1}\right)^{0.65} Fr^{0.43}$$

Local Pier Scour Depth =	36.78	ft.	Length of Exposed Piling =	40.78	ft.
Long-Term Degradation =	4	ft.	Remaining Pile Embedment =	13.92	ft.
Depth of Pier Scour Hole =	**40.78**	ft. below existing bed elevation.			
Elev. @ Btm of Scour Hole=	783.92	ft.			
Elev. @ Bottom of Footing=	824.7	ft.			
Elev. @ Min. Tip of Pile=	770	ft.	**Bridge may have insufficient embedment - Structural Evaluation**		

PIER SCOUR CALCULATION SHEET

Consultant: **Wood, Patel & Associates, Inc.** Project # **97629** **Sheet # 1 of 1**

References: **FHWA's HEC-18 (third edition) and Interum Procedure for Estimating Pier Scour with Debris**

Project Name: **MCDOT Bridge Scour Evaluation** Date: **08/28/97**

Modified Conditions

Engineer: **R. Hiner** Checked By: ______ Structure #: **Old US80 @ Hassayampa**

HYDROLOGIC/HYDRAULIC PARAMETERS

Return Interval	**Overtop**	yrs.	Hydraulics:	HEC-RAS	
Hydrology Source	N/A		Top Width (T)	7.21	ft.
Discharge (Q)	88,000	cfs	Flow Area (A)	181.40	ft^2
Water Surface Elev.	850.29	ft.	Chan. Slope (S)	0.00290	ft/ft
Thalweg Elevation	825.00	ft. – 828	Max. Vel. (Vm)	14.53	ft/sec
Max. Depth of Flow (Y1)	**25.29**	ft.	Froude No. (Fr)	**0.26057**	(Vm^2*T/g*A)^.5

PIER SCOUR CALCULATIONS

Pier Type:	Stemwall		Columns	X
Foundation Type:	Spread Ftng		Piles/Drilled Shaft	X

K1 = 1.1 Correction factor for pier nose shape (assume square nose pier K1=1.1 Table 2, pg. 40, HEC-18. For multiple column piers and stemwalls skewed to the flow, K1=1.0)

Angle of Attack (theta) = 10° (15 degree min. for stemwall piers if there is potential channel meandering)

Pier Width (Wp) = 5 ft. No. of Columns/Piles per bent: 4

Dist. Between Columns = 15 ft. (Clear space must exceed 5 pier diameters for independent analysis)

Debris Blockout (Wd) = 4 ft. (Based on debris potential; low = 2 ft., medium = 3 ft., high = 4 ft.)

Length of Pier (L) = 70 ft. Coefficient for bed condition - K3= 1.1 (Table 1, pg. 39)

Effective Pier Length (L') = 60 ft. L' = L or 12*Wp whichever is less.

Effective Pier Width (a) = 17.45 ft. (The greater of Wp*cos(theta)+Wd or (Wp*cos(theta)+Wd/2)+L'sin(theta))

K2 = 1.0 (For stemwall, multiple column, and single column piers K2=1.0)

Colorado State University Equation (HEC-18 pg. 52)

$$Y_s = Y_1 2.0 K_1 K_2 K_3 \left(\frac{a}{Y_1}\right)^{0.65} Fr^{0.43}$$

Local Pier Scour Depth =	26.97	ft.	Length of Exposed Piling =	30.67	ft.
Long-Term Degradation =	4	ft.	Remaining Pile Embedment =	24.03	ft.
Depth of Pier Scour Hole =	**30.97**	ft. below existing bed elevation.			
Elev. @ Btm of Scour Hole=	794.03	ft.			
Elev. @ Bottom of Footing=	824.7	ft.			
Elev. @ Min. Tip of Pile=	770	ft.	**Bridge may have insufficient embedment - Structural Evaluation**		

Existing 100-year

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 BR U Profile: PF#1

W.S. Elev (ft)	848.13	Element	Left OB	Channel	Right OB
Vel Head (ft)	4.81	Wt. n-Val.	0.035	0.035	0.035
E.G. Elev (ft)	852.94	Reach Len. (ft)	80.00	80.00	80.00
Crit W.S. (ft)	847.46	Flow Area (sq ft)	658.49	3225.85	513.92
E.G. Slope (ft/ft)	0.006008	Area (sq ft)	658.49	3225.85	513.92
Q Total (cfs)	73500.00	Flow (cfs)	7716.04	60311.42	5472.54
Top Width (ft)	350.92	Top Width (ft)	95.91	168.00	87.01
Vel Total (ft/s)	16.71	Avg. Vel. (ft/s)	11.72	18.70	10.65
Max Chl Dpth (ft)	23.43	Hydr. Depth (ft)	6.87	19.20	5.91
Conv. Total (cfs)	948234.2	Conv. (cfs)	99545.7	778086.4	70602.1
Length Wtd. (ft)	80.00	Wetted Per. (ft)	98.00	238.21	91.84
Min Ch El (ft)	824.70	Shear (lb/sq ft)	2.52	5.08	2.10
Alpha	1.11	Stream Power (lb/ft s)	29.53	94.97	22.35
Frctn Loss (ft)	0.57	Cum Volume (acre-ft)	2.14	26.13	2.52
C & E Loss (ft)	0.14	Cum SA (acres)	0.49	1.57	0.45

Existing 100-year

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 BR U Profile: PF#1

Left Sta	Right Sta	Flow	Area	W.P.	% Conv.	Hydr D.	Velocity
(ft)	(ft)	(cfs)	(sq ft)	(ft)		(ft)	(ft/s)
-200.00	-141.00	1806.75	198.99	56.24	2.46	3.57	9.08
-141.00 LB	-135.79	516.50	40.40	5.24	0.70	7.76	12.78
-135.79	-130.58	580.86	43.35	5.24	0.79	8.32	13.40
-130.58	-125.37	648.21	46.30	5.24	0.88	8.89	14.00
-125.37	-120.16	718.48	49.25	5.24	0.98	9.45	14.59
-120.16	-114.95	791.18	52.18	5.24	1.08	10.02	15.16
-114.95	-109.74	863.84	55.00	5.24	1.18	10.56	15.71
-109.74	-104.53	938.57	57.81	5.24	1.28	11.10	16.24
-104.53	-99.33	1015.76	60.61	5.24	1.38	11.64	16.76
-99.33	-94.12	1095.38	63.42	5.24	1.49	12.17	17.27
-94.12	-88.91	1177.38	66.23	5.24	1.60	12.71	17.78
-88.91	-83.70	1261.72	69.03	5.24	1.72	13.25	18.28
-83.70	-78.49	439.27	60.60	18.41	0.60	13.75	7.25
-78.49	-73.28	46.49	14.71	15.51	0.06	14.55	3.16
-73.28	-68.07	1528.55	77.46	5.24	2.08	14.87	19.73
-68.07	-62.86	1622.00	80.26	5.24	2.21	15.41	20.21
-62.86	-57.65	1718.64	83.15	5.24	2.34	15.96	20.67
-57.65	-52.44	1837.13	86.60	5.25	2.50	16.62	21.21
-52.44	-47.23	1965.09	90.17	5.25	2.67	17.31	21.79
-47.23	-42.02	2096.48	93.74	5.25	2.85	18.00	22.36
-42.02	-36.81	2231.25	97.32	5.25	3.04	18.68	22.93
-36.81	-31.60	2369.36	100.89	5.25	3.22	19.37	23.49
-31.60	-26.40	2510.77	104.46	5.25	3.42	20.05	24.04
-26.40	-21.19	2656.22	107.99	5.25	3.61	20.73	24.60
-21.19	-15.98	2734.58	109.58	5.21	3.72	21.04	24.96
-15.98	-10.77	2755.14	110.07	5.21	3.75	21.13	25.03
-10.77	-5.56	2775.76	110.57	5.21	3.78	21.22	25.11
-5.56	-0.35	2796.43	111.06	5.21	3.80	21.32	25.18
-0.35	4.86	2796.27	111.06	5.21	3.80	21.32	25.18
4.86	10.07	2769.62	110.42	5.21	3.77	21.20	25.08
10.07	15.28	2742.98	109.79	5.21	3.73	21.07	24.98
15.28	20.49	2662.96	108.26	5.26	3.62	20.78	24.60
20.49	25.70	2477.79	103.87	5.28	3.37	19.94	23.86
25.70	30.91	2297.30	99.26	5.28	3.13	19.05	23.14
30.91	36.12	2122.31	94.65	5.28	2.89	18.17	22.42
36.12	41.33	163.13	34.14	19.37	0.22	17.56	4.78
41.33	46.53	368.66	56.48	20.07	0.50	16.25	6.53
46.53	51.74	1631.24	80.82	5.28	2.22	15.52	20.18
51.74	56.95	1479.20	76.22	5.28	2.01	14.63	19.41
56.95	62.16	1333.17	71.61	5.28	1.81	13.75	18.62
62.16	67.37	1193.27	67.00	5.28	1.62	12.86	17.81
67.37	72.58	1072.39	62.70	5.25	1.46	12.04	17.10
72.58	77.79	1008.45	60.29	5.22	1.37	11.57	16.73
77.79	83.00 RB	950.93	58.21	5.22	1.29	11.17	16.34
83.00	154.10	2932.56	245.83	46.13	3.99	5.49	11.93

Modified 100-year

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 BR U Profile: PF#1

W.S. Elev (ft)	848.28	Element	Left OB	Channel	Right OB
Vel Head (ft)	2.47	Wt. n-Val.	0.035	0.028	0.035
E.G. Elev (ft)	850.75	Reach Len. (ft)	80.00	80.00	80.00
Crit W.S. (ft)	840.72	Flow Area (sq ft)	31.69	5821.05	5.68
E.G. Slope (ft/ft)	0.001650	Area (sq ft)	31.69	5821.05	5.68
Q Total (cfs)	73500.00	Flow (cfs)	70.94	73424.94	4.12
Top Width (ft)	352.00	Top Width (ft)	21.00	311.00	20.00
Vel Total (ft/s)	12.55	Avg. Vel. (ft/s)	2.24	12.61	0.73
Max Chl Dpth (ft)	23.28	Hydr. Depth (ft)	1.51	18.72	0.28
Conv. Total (cfs)	1809484.0	Conv. (cfs)	1746.4	1807637.0	101.5
Length Wtd. (ft)	80.00	Wetted Per. (ft)	21.43	411.24	20.85
Min Ch El (ft)	825.00	Shear (lb/sq ft)	0.15	1.46	0.03
Alpha	1.01	Stream Power (lb/ft s)	0.34	18.39	0.02
Frctn Loss (ft)		Cum Volume (acre-ft)	0.48	40.68	0.66
C & E Loss (ft)		Cum SA (acres)	0.20	2.15	0.20

Modified 100-year

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 BR U Profile: PF#1

Left Sta	Right Sta	Flow	Area	W.P.	% Conv.	Hydr D.	Velocity
(ft)	(ft)	(cfs)	(sq ft)	(ft)		(ft)	(ft/s)
-199.00	-178.00	39.45	20.95	18.89	0.05	1.12	1.88
-178.00 LB	-170.53	103.24	26.22	7.89	0.14	3.51	3.94
-170.53	-163.07	256.94	45.31	7.89	0.35	6.07	5.67
-163.07	-155.60	461.68	64.41	7.89	0.63	8.63	7.17
-155.60	-148.14	711.64	83.50	7.89	0.97	11.19	8.52
-148.14	-140.67	1003.04	102.60	7.89	1.36	13.74	9.78
-140.67	-133.21	1333.09	121.69	7.89	1.81	16.30	10.95
-133.21	-125.74	1699.63	140.78	7.89	2.31	18.86	12.07
-125.74	-118.28	2100.94	159.88	7.89	2.86	21.42	13.14
-118.28	-110.81	2456.49	172.41	7.54	3.34	23.10	14.25
-110.81	-103.35	2479.18	172.69	7.47	3.37	23.13	14.36
-103.35	-95.88	2479.18	172.69	7.47	3.37	23.13	14.36
-95.88	-88.42	2479.18	172.69	7.47	3.37	23.13	14.36
-88.42	-80.95	2479.18	172.69	7.47	3.37	23.13	14.36
-80.95	-73.49	111.98	57.03	48.73	0.15	23.13	1.96
-73.49	-66.02	2479.18	172.69	7.47	3.37	23.13	14.36
-66.02	-58.56	2479.18	172.69	7.47	3.37	23.13	14.36
-58.56	-51.09	2479.18	172.69	7.47	3.37	23.13	14.36
-51.09	-43.63	2479.18	172.69	7.47	3.37	23.13	14.36
-43.63	-36.16	2479.18	172.69	7.47	3.37	23.13	14.36
-36.16	-28.70	2479.18	172.69	7.47	3.37	23.13	14.36
-28.70	-21.23	2479.18	172.69	7.47	3.37	23.13	14.36
-21.23	-13.77	2479.18	172.69	7.47	3.37	23.13	14.36
-13.77	-6.30	2479.18	172.69	7.47	3.37	23.13	14.36
-6.30	1.16	2479.18	172.69	7.47	3.37	23.13	14.36
1.16	8.63	2479.18	172.69	7.47	3.37	23.13	14.36
8.63	16.09	2479.18	172.69	7.47	3.37	23.13	14.36
16.09	23.56	2479.18	172.69	7.47	3.37	23.13	14.36
23.56	31.02	2479.18	172.69	7.47	3.37	23.13	14.36
31.02	38.49	885.46	162.78	30.17	1.20	23.13	5.44
38.49	45.95	222.17	66.94	26.03	0.30	23.13	3.32
45.95	53.42	2479.18	172.69	7.47	3.37	23.13	14.36
53.42	60.88	2479.18	172.69	7.47	3.37	23.13	14.36
60.88	68.35	2479.18	172.69	7.47	3.37	23.13	14.36
68.35	75.81	2443.75	172.14	7.57	3.32	23.06	14.20
75.81	83.28	2075.69	158.65	7.88	2.82	21.25	13.08
83.28	90.74	1680.18	139.75	7.88	2.29	18.72	12.02
90.74	98.21	1318.83	120.85	7.88	1.79	16.19	10.91
98.21	105.67	993.35	101.96	7.88	1.35	13.66	9.74
105.67	113.14	705.84	83.06	7.88	0.96	11.13	8.50
113.14	120.60	459.02	64.16	7.88	0.62	8.59	7.15
120.60	128.07	256.60	45.26	7.88	0.35	6.06	5.67
128.07	135.53	104.23	26.36	7.88	0.14	3.53	3.95
135.53	143.00 RB	14.02	7.57	7.05	0.02	1.13	1.85

Overtopping - Existing Channel

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 Profile: PF#2 Opening: Bridge #1

E.G. US. (ft)	855.27	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	850.55	E.G. Elev (ft)	855.24	854.52
Q Total (cfs)	88000.00	W.S. Elev (ft)	850.59	847.85
Q Bridge (cfs)	88000.00	Crit W.S. (ft)	848.91	847.85
Q Weir (cfs)		Max Chl Dpth (ft)	25.89	23.25
Weir Sta Lft (ft)		Vel Total (ft/s)	16.72	20.02
Weir Sta Rgt (ft)		Flow Area (sq ft)	5261.63	4396.35
Weir Submerg		Froude # Chl	0.70	0.90
Weir Max Depth (ft)		Specif Force (cu ft)	96165.35	93376.51
Min Top Rd (ft)	858.69	Hydr Depth (ft)	14.99	13.41
Min El Prs (ft)	852.43	W.P. Total (ft)	447.73	403.51
Delta EG (ft)	1.09	Conv. Total (cfs)	1211782.0	973099.1
Delta WS (ft)	3.19	Top Width (ft)	350.97	327.89
BR Open Area (sq ft)	5824.78	Frctn Loss (ft)	0.52	0.01
BR Open Vel (ft/s)	20.02	C & E Loss (ft)	0.20	0.02
Coef of Q		Shear Total (lb/sq ft)	3.87	5.56
Br Sel Mthd	Energy only	Power Total (lb/ft s)	64.71	111.35

Overtopping - Existing Channel

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 BR U Profile: PF#2

Left Sta	Right Sta	Flow	Area	W.P.	% Conv.	Hydr D.	Velocity
(ft)	(ft)	(cfs)	(sq ft)	(ft)		(ft)	(ft/s)
-200.00	-141.00	3563.36	308.29	61.59	4.05	5.23	11.56
-141.00 LB	-135.79	722.32	50.21	5.24	0.82	9.64	14.39
-135.79	-130.58	794.42	53.16	5.24	0.90	10.20	14.95
-130.58	-125.37	869.25	56.11	5.24	0.99	10.77	15.49
-125.37	-120.16	946.74	59.05	5.24	1.08	11.34	16.03
-120.16	-114.95	1026.41	61.98	5.24	1.17	11.90	16.56
-114.95	-109.74	1105.57	64.80	5.24	1.26	12.44	17.06
-109.74	-104.53	1186.55	67.61	5.24	1.35	12.98	17.55
-104.53	-99.33	1269.79	70.41	5.24	1.44	13.52	18.03
-99.33	-94.12	1355.28	73.22	5.24	1.54	14.06	18.51
-94.12	-88.91	1442.99	76.03	5.24	1.64	14.59	18.98
-88.91	-83.70	1532.87	78.84	5.24	1.74	15.13	19.44
-83.70	-78.49	496.40	68.90	20.29	0.56	15.63	7.20
-78.49	-73.28	51.36	16.61	17.39	0.06	16.43	3.09
-73.28	-68.07	1815.40	87.26	5.24	2.06	16.75	20.81
-68.07	-62.86	1913.78	90.07	5.24	2.17	17.29	21.25
-62.86	-57.65	2015.06	92.95	5.24	2.29	17.84	21.68
-57.65	-52.44	2138.90	96.41	5.25	2.43	18.51	22.19
-52.44	-47.23	2272.56	99.98	5.25	2.58	19.19	22.73
-47.23	-42.02	2409.44	103.55	5.25	2.74	19.88	23.27
-42.02	-36.81	2549.49	107.12	5.25	2.90	20.56	23.80
-36.81	-31.60	2692.70	110.69	5.25	3.06	21.25	24.33
-31.60	-26.40	2839.02	114.26	5.25	3.23	21.93	24.85
-26.40	-21.19	2989.46	117.79	5.25	3.40	22.61	25.38
-21.19	-15.98	3071.47	119.38	5.21	3.49	22.92	25.73
-15.98	-10.77	3092.66	119.87	5.21	3.51	23.01	25.80
-10.77	-5.56	3113.91	120.37	5.21	3.54	23.11	25.87
-5.56	-0.35	3135.21	120.86	5.21	3.56	23.20	25.94
-0.35	4.86	3135.03	120.86	5.21	3.56	23.20	25.94
4.86	10.07	3107.56	120.23	5.21	3.53	23.08	25.85
10.07	15.28	3080.10	119.59	5.21	3.50	22.96	25.76
15.28	20.49	2996.03	118.06	5.26	3.40	22.66	25.38
20.49	25.70	2804.02	113.67	5.28	3.19	21.82	24.67
25.70	30.91	2617.13	109.06	5.28	2.97	20.94	24.00
30.91	36.12	2435.44	104.45	5.28	2.77	20.05	23.32
36.12	41.33	176.93	37.79	21.25	0.20	19.44	4.68
41.33	46.53	405.90	63.01	21.95	0.46	18.13	6.44
46.53	51.74	1922.26	90.63	5.28	2.18	17.40	21.21
51.74	56.95	1762.13	86.02	5.28	2.00	16.51	20.49
56.95	62.16	1607.63	81.41	5.28	1.83	15.63	19.75
62.16	67.37	1458.84	76.80	5.28	1.66	14.74	18.99
67.37	72.58	1330.24	72.50	5.25	1.51	13.92	18.35
72.58	77.79	1262.20	70.09	5.22	1.43	13.46	18.01
77.79	83.00 RB	1200.18	68.01	5.22	1.36	13.05	17.65
83.00	154.10	4286.01	338.43	56.49	4.87	6.16	12.66

Overtopping - Modified Channel

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 Profile: PF#2 Opening: Bridge #1

E.G. US. (ft)	853.08	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	850.68	E.G. Elev (ft)	852.96	852.48
Q Total (cfs)	88000.00	W.S. Elev (ft)	850.29	849.76
Q Bridge (cfs)	88000.00	Crit W.S. (ft)	841.42	841.01
Q Weir (cfs)		Max Chl Dpth (ft)	25.29	25.16
Weir Sta Lft (ft)		Vel Total (ft/s)	12.97	13.12
Weir Sta Rgt (ft)		Flow Area (sq ft)	6787.44	6708.64
Weir Submerg		Froude # Chl	0.49	0.50
Weir Max Depth (ft)		Specif Force (cu ft)	115362.10	114608.30
Min Top Rd (ft)	858.72	Hydr Depth (ft)	19.85	19.62
Min El Prs (ft)	852.43	W.P. Total (ft)	458.45	457.19
Delta EG (ft)	0.61	Conv. Total (cfs)	2273921.0	2239961.0
Delta WS (ft)	0.69	Top Width (ft)	341.99	341.99
BR Open Area (sq ft)	7441.29	Frctn Loss (ft)		
BR Open Vel (ft/s)	13.12	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.38	1.41
Br Sel Mthd	Momentum	Power Total (lb/ft s)	17.95	18.55

Overtopping - Modified Channel

Plan: OldUS80 River: Hassayampa R. Reach:Old US80 Bridge Riv Sta: 256 BR U Profile: PF#2

Left Sta	Right Sta	Flow	Area	W.P.	% Conv.	Hydr D.	Velocity
(ft)	(ft)	(cfs)	(sq ft)	(ft)		(ft)	(ft/s)
-192.22	-171.93	199.62	61.01	22.20	0.23	3.01	3.27
-171.93 LB	-164.72	231.68	44.25	8.13	0.26	6.14	5.24
-164.72	-157.51	513.78	71.35	8.13	0.58	9.90	7.20
-157.51	-150.30	878.72	98.46	8.13	1.00	13.65	8.92
-150.30	-143.09	1317.88	125.56	8.13	1.50	17.41	10.50
-143.09	-135.88	1825.39	152.67	8.13	2.07	21.17	11.96
-135.88	-128.67	2419.96	177.15	7.73	2.75	24.57	13.66
-128.67	-121.46	2636.04	181.40	7.21	3.00	25.16	14.53
-121.46	-114.24	2636.04	181.40	7.21	3.00	25.16	14.53
-114.24	-107.03	2636.05	181.40	7.21	3.00	25.16	14.53
-107.03	-99.82	2636.05	181.40	7.21	3.00	25.16	14.53
-99.82	-92.61	2636.04	181.40	7.21	3.00	25.16	14.53
-92.61	-85.40	2636.05	181.40	7.21	3.00	25.16	14.53
-85.40	-78.19	752.49	153.75	31.27	0.86	25.16	4.89
-78.19	-70.98	288.24	83.26	28.47	0.33	25.16	3.46
-70.98	-63.77	2636.05	181.40	7.21	3.00	25.16	14.53
-63.77	-56.56	2636.05	181.40	7.21	3.00	25.16	14.53
-56.56	-49.35	2636.05	181.40	7.21	3.00	25.16	14.53
-49.35	-42.14	2636.05	181.40	7.21	3.00	25.16	14.53
-42.14	-34.93	2636.05	181.40	7.21	3.00	25.16	14.53
-34.93	-27.72	2636.05	181.40	7.21	3.00	25.16	14.53
-27.72	-20.51	2636.05	181.40	7.21	3.00	25.16	14.53
-20.51	-13.29	2636.05	181.40	7.21	3.00	25.16	14.53
-13.29	-6.08	2636.05	181.40	7.21	3.00	25.16	14.53
-6.08	1.13	2636.05	181.40	7.21	3.00	25.16	14.53
1.13	8.34	2636.05	181.40	7.21	3.00	25.16	14.53
8.34	15.55	2636.05	181.40	7.21	3.00	25.16	14.53
15.55	22.76	2636.05	181.40	7.21	3.00	25.16	14.53
22.76	29.97	2636.05	181.40	7.21	3.00	25.16	14.53
29.97	37.18	2636.05	181.40	7.21	3.00	25.16	14.53
37.18	44.39	97.79	55.61	52.52	0.11	25.16	1.76
44.39	51.60	2636.05	181.40	7.21	3.00	25.16	14.53
51.60	58.81	2636.05	181.40	7.21	3.00	25.16	14.53
58.81	66.02	2636.04	181.40	7.21	3.00	25.16	14.53
66.02	73.23	2636.05	181.40	7.21	3.00	25.16	14.53
73.23	80.44	2636.05	181.40	7.21	3.00	25.16	14.53
80.44	87.66	2636.04	181.40	7.21	3.00	25.16	14.53
87.66	94.87	2590.71	181.03	7.36	2.94	25.11	14.31
94.87	102.08	2038.00	163.24	8.15	2.32	22.64	12.48
102.08	109.29	1500.82	135.87	8.15	1.71	18.84	11.05
109.29	116.50	1031.45	108.49	8.15	1.17	15.05	9.51
116.50	123.71	635.25	81.11	8.15	0.72	11.25	7.83
123.71	130.92	319.80	53.73	8.15	0.36	7.45	5.95
130.92	138.13 RB	97.56	26.36	8.15	0.11	3.66	3.70
138.13	162.28	87.63	38.01	23.40	0.10	1.76	2.31