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BRIDGE SCOUR EVALUATIONS

Work Order No. 80407
Contract No. CY 1995-11

Elliot Road Bridge over the East Maricopa Floodway

(SN9828)

Preliminary Report

Submitted to:

Maricopa County Department of Transportation

Submitted by:

PARSONS BRINCKERHOFF

HYDRAULIC ANALYSIS FOR THE ELLIOT ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

MARICOPA COUNTY, ARIZONA

April 1, 1996

Submitted by:

Parsons Brinckerhoff Quade & Douglas

Tempe, Arizona

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1.0 INTRODUCTION

The existing Elliot Road Bridge carries vehicular traffic over the East Maricopa Floodway in Maricopa County, Arizona. Construction plans for the Elliot Road Bridge over the East Maricopa Floodway were prepared by Sverdrup & Parcel and Associates, Inc. and are dated April 1980. The plans show the as-built date as December 1983. The total length of the bridge is approximately 200'-2". The plans are for a 6-span bridge with the two end spans about 28.5 feet in length and the four center spans about 35.5 feet in length. The abutments are supported on five drilled-and-belled piers with a bell diameter of 4.0 feet and a tip elevation of 1,321.43 feet. The piers are supported on five spread-type footings bearing at an elevation of 1,313.83 feet. Plan bed elevation is about 1,326.5', which is approximately equal to the elevation of the channel obtained from the field survey. The bridge carries two lanes of traffic and is approximately 62 feet wide. The roadway is oriented in a east-west direction and the profile is a vertical curve, except for the bridge approaches. The east approach roadway has a 1.26 percent grade, while the west approach roadway has a 1.30 percent grade.

Evaluating the scour potential of the existing bridge is the primary goal of the project. This report provides data on East Maricopa Floodway hydrology and hydraulics in the bridge vicinity. Using the hydraulic data, a complete scour analysis is performed for the Elliot Road Bridge.

Total scour depths for the 100-year flood are estimated to be 7.3 feet at the east abutment, 7.5 feet at the west abutment, and 6 feet for all piers. Total scour for the 500-year flood is estimated to be 8.0 feet at the east abutment, 8.1 feet at the west abutment, and 6 feet for all piers.

Section 2.0 describes data collection followed by the site description in section 3.0. Section 4.0 summarizes the results of the hydraulic HEC-2 modeling. Section 5.0 explains scour processes and procedures for calculating bridge scour. Section 6.0 provides the results of the scour calculations. Section 7.0 provides an initial evaluation of the bridge and lists any deficiencies. No recommendations are provided in this report, they will be deferred to the final report.

2.0 DATA COLLECTION

Data was supplied by the Maricopa County Department of Transportation in the form of final plans for the Elliot Road Bridge at the East Maricopa Floodway, project number FCD-82-31 dated 1982. US Army Corps of Engineers HEC-2 output data files for the 100-year flood were supplied by the Maricopa County Flood Control District. Floodplain maps prepared by the Corps of Engineers for the Flood Control District were obtained along with USGS topographic maps for the bridge site.

There was a discrepancy in the bridge plans regarding the benchmark elevation on the bridge. The benchmark elevation of 1343.86' on plan sheet 12 was correct, but the benchmark elevation of 1344.72' on plan sheet 22 was incorrect. The elevations obtained in the field agreed with the benchmark elevation of 1343.86' on sheet 12. The elevations on sheet 22 are too low by 4.63 feet and any reference to elevations listed on this plan sheet have been adjusted by that amount. These adjusted elevations were used as input into HEC-2.

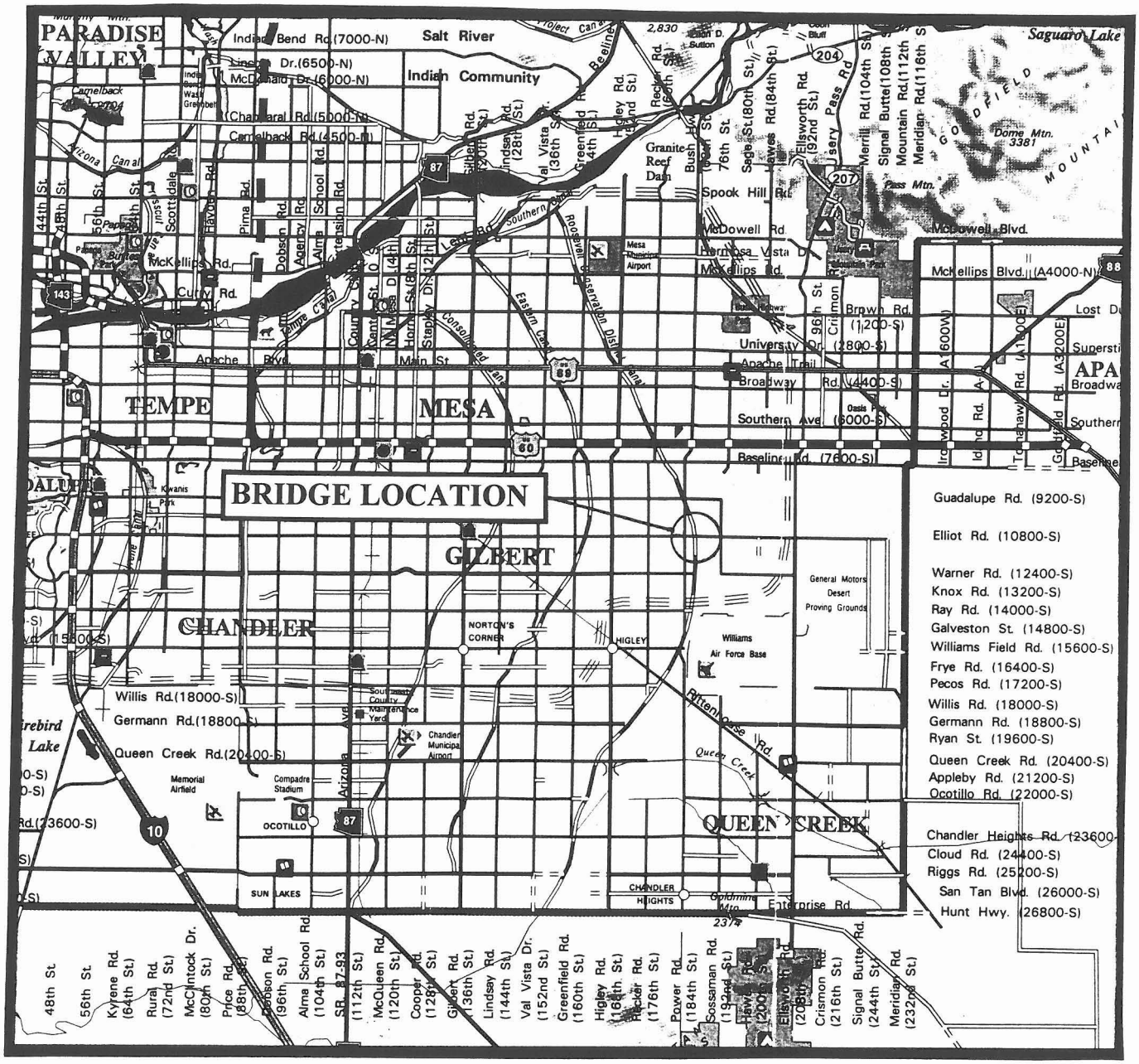
Parsons Brinckerhoff conducted a site visit on April 17, 1995. Extensive photographs of the site were taken and a visual survey of the bridge and surrounding area was made. A simple survey of the channel cross section was performed on April 17, 1995.

The scour screening procedure for the National Bridge Inventory System is completed for the Elliot Road Bridge. The screening forms are included in the Appendix. The Elliot Road Bridge is rated as a low risk bridge with a recommended Item 113 rating of 8L and does not need a detailed scour analysis. No additional scour countermeasures are recommended as a result of the screening. In order to verify the screening results and demonstrate the validity of the screening procedures, a scour analysis was performed for the Elliot Road Bridge. This information may be used in a structural stability analysis to verify the bridge has an adequate foundation. However, it is not warranted at this bridge location.

3.0 SITE DESCRIPTION

As shown in Figure 1, the site lies in the northeast portion of the town of Gilbert on the east side of Maricopa County. The Elliot Road Bridge is just downstream of the Power Road and Guadalupe Road bridges. It crosses the East Maricopa Floodway in the Apache Junction-Gilbert Watershed and is regulated by the Maricopa County Flood Control District. The terrain in the immediate area is relatively flat. Approximately 200 to 250 feet north of the bridge on the east bank is a 175' broad crested wier. It is lined with grouted riprap and is used as an irrigation outfall. The East Maricopa Floodway in the vicinity of the Elliot Road Bridge is a man-made channel of trapezoidal shape. It is relatively dry most of the year, but during the field inspection there was standing water underneath the bridge.

Figure 1


BRIDGE LOCATION
PARADISE VALLEY
Salt River
Indian Community
Saguaro Lake
Granite Reef Dam
Spook Hill Rd.
McDowell Rd.
McDowell Blvd.
McKellips Rd.
McKellips Blvd. (A4000-N)
Curry Rd.
Apache Blvd.
Main St.
University Dr. (2800-S)
Apache Trail
Broadway Rd. (4400-S)
Southern Ave. (6000-S)
Baseline Rd. (7600-S)
TEMPE
MESA
GILBERT
CHANDLER
QUEEN CREEK
Mesa Municipal Airport
General Motors Desert Proving Grounds
Williams Air Force Base
NORTON'S CORNER
HIGLEY
Chandler Municipal Airport
Memorial Airfield
Compadre Stadium
OCOTILLO
SUN LAKES
CHANDLER HEIGHTS
Queen Creek
Ritten House Rd.
Guadalupe Rd. (9200-S)
Elliot Rd. (10800-S)
Warner Rd. (12400-S)
Knox Rd. (13200-S)
Ray Rd. (14000-S)
Galveston St. (14800-S)
Williams Field Rd. (15600-S)
Frye Rd. (16400-S)
Pecos Rd. (17200-S)
Willis Rd. (18000-S)
Germann Rd. (18800-S)
Ryan St. (19600-S)
Queen Creek Rd. (20400-S)
Appleby Rd. (21200-S)
Ocotillo Rd. (22000-S)
Chandler Heights Rd. (23600-
Cloud Rd. (24400-S)
Riggs Rd. (25200-S)
San Tan Blvd. (26000-S)
Hunt Hwy. (26800-S)
Enterprise Rd.
48th St.
56th St.
Kyrene Rd. (64th St.)
Rural Rd. (72nd St.)
McClintock Dr. (80th St.)
Price Rd. (88th St.)
Dobson Rd. (96th St.)
Alma School Rd. (104th St.)
SR. 87-93
McQueen Rd. (120th St.)
Cooper Rd. (128th St.)
Gilbert Rd. (136th St.)
Lindsay Rd. (144th St.)
Val Vista Dr. (152nd St.)
Greenfield Rd. (160th St.)
Higley Rd. (168th St.)
Recker Rd. (176th St.)
Power Rd. (184th St.)
Sossaman Rd. (192nd St.)
Ellsworth Rd. (208th St.)
Crismon Rd. (216th St.)
Signal Butte Rd. (244th St.)
Meridian Rd. (232nd St.)

3.1 Geotechnical Evaluation

The boring log sheets shown on the plans indicate that the soils underlying the bridge site consist of stratified deposits of silty sands and silty clays with minor amounts of gravel. It appears that the soils are weakly cemented near the surface and become moderately to strongly cemented with depth. The estimated D_{50} particle size, based on the plan review and field reconnaissance, is 0.074 mm for the channel bed and banks.

The channel sideslopes are 3:1. The full section of the channel including the sideslopes is not scour protected. The sideslopes and bottom of the channel, downstream and upstream, are in very good condition. The sideslopes and channel bed are covered with dense, grass-like vegetation. Little standing water was present in the channel at the time of inspection.

During the field reconnaissance on April 17, 1995, minor scour (less than 1.0 foot) was noted at Pier Number 3. Also, there was minor erosion on the slopes of the channel directly beneath the bridge deck drains. There was little or no vegetation directly beneath the bridge. A moderate to heavy growth of grass was present in the channel both up and downstream of the bridge.

3.2 Structural Evaluation

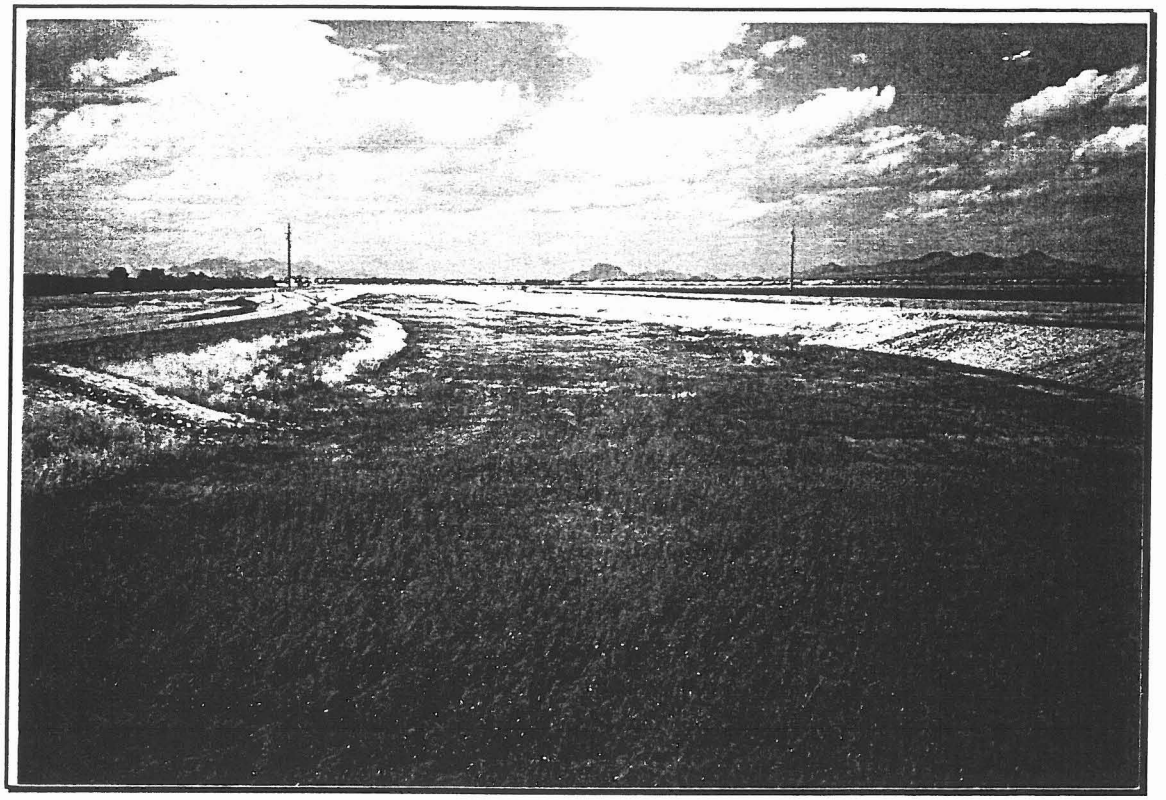
The Elliot Road Bridge over RWCD canal is located on Elliot Road between Stations 12+50 and 14+50, east of the intersection of Elliot Road with Power Road. The bridge structures is a six-span continuous, cast-in-place, reinforced concrete slab. The total length of the bridge is 200 feet and the total width is 62 feet. The bridge crosses the RWCD canal at a zero degree skew angle.

The wall type stub abutments are pin connected to the superstructure slab and are supported by a series of two-foot-diameter drilled shafts. There are five shafts under each abutment. The abutment shafts are about 16 feet long and are embedded in the layer of hard mottled brown silty

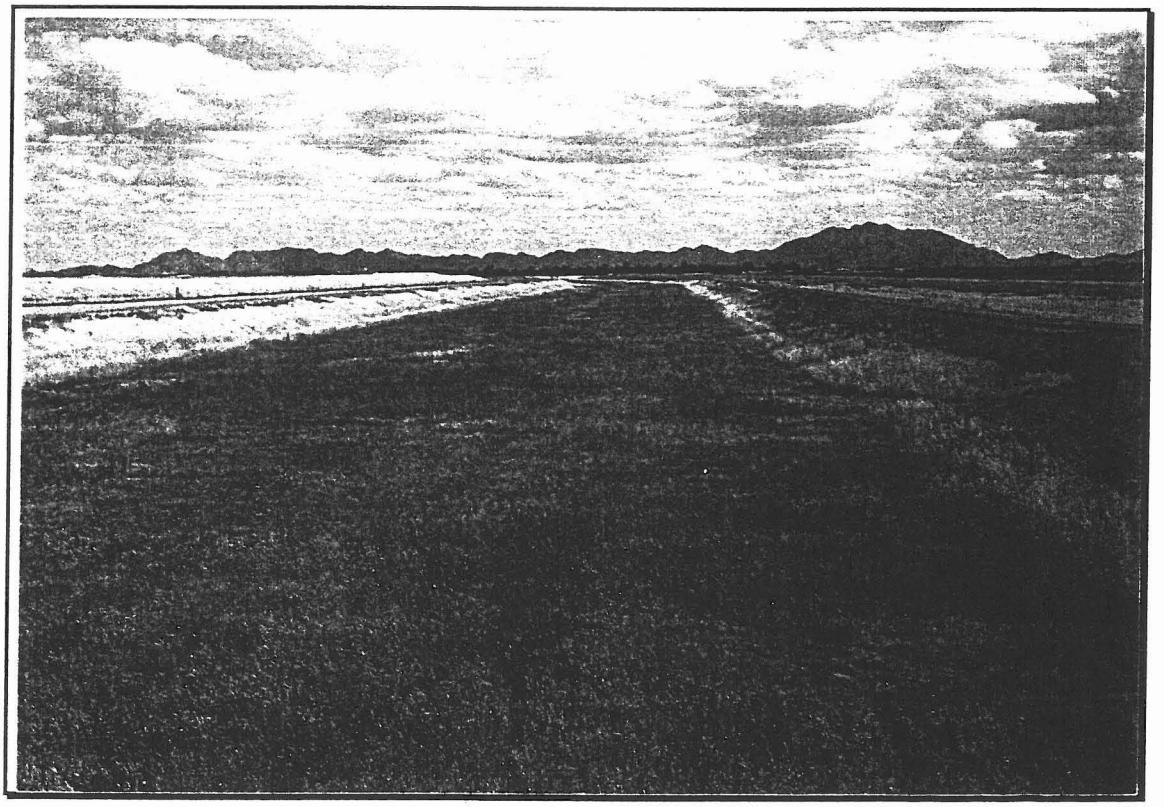
clay with traces of sand. Each pier bent is composed of five columns 12 feet center to center. The columns are three feet diameter reinforced concrete columns pin connected to the superstructure deck and supported on spread footings about 13 feet below the existing channel bottom. Pier footings are supported by a layer of hard mottled brown silty clay underlain by very compact muttled lightly cemented gray sand with silt.

The superstructure is a reinforced concrete, continuous 1'-5½" thick slab. At both ends of the bridge there are standard 15-foot long approach slabs. No evidence of abnormal soil settlements are visible on the roadway in the vicinity of the bridge.

The bridge itself appears to be in excellent condition. No cracks, corrosion or other deficiencies of structural members are visible. Vertical cracks appearing on the barrier are unrelated to the bridge safety. They are most probably caused by the shrinkage, temperature changes, and deflections of the flexible deck slab under the live load.

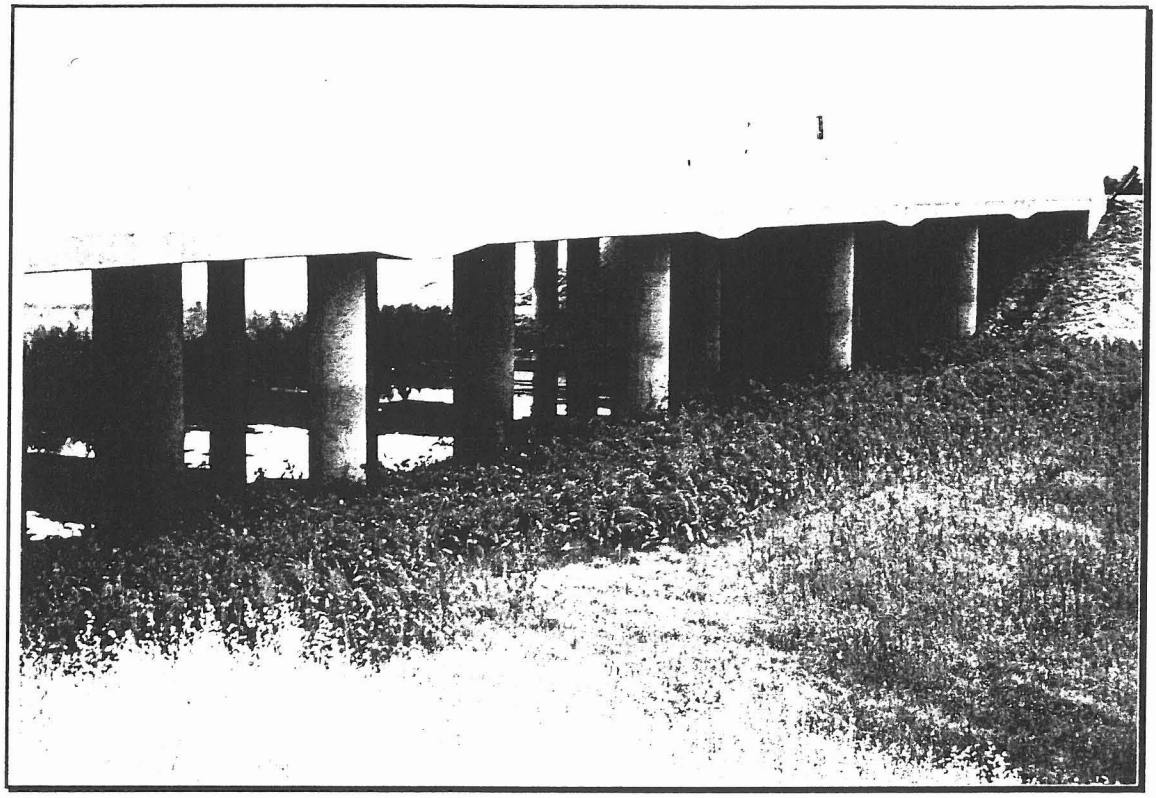


Looking upstream.

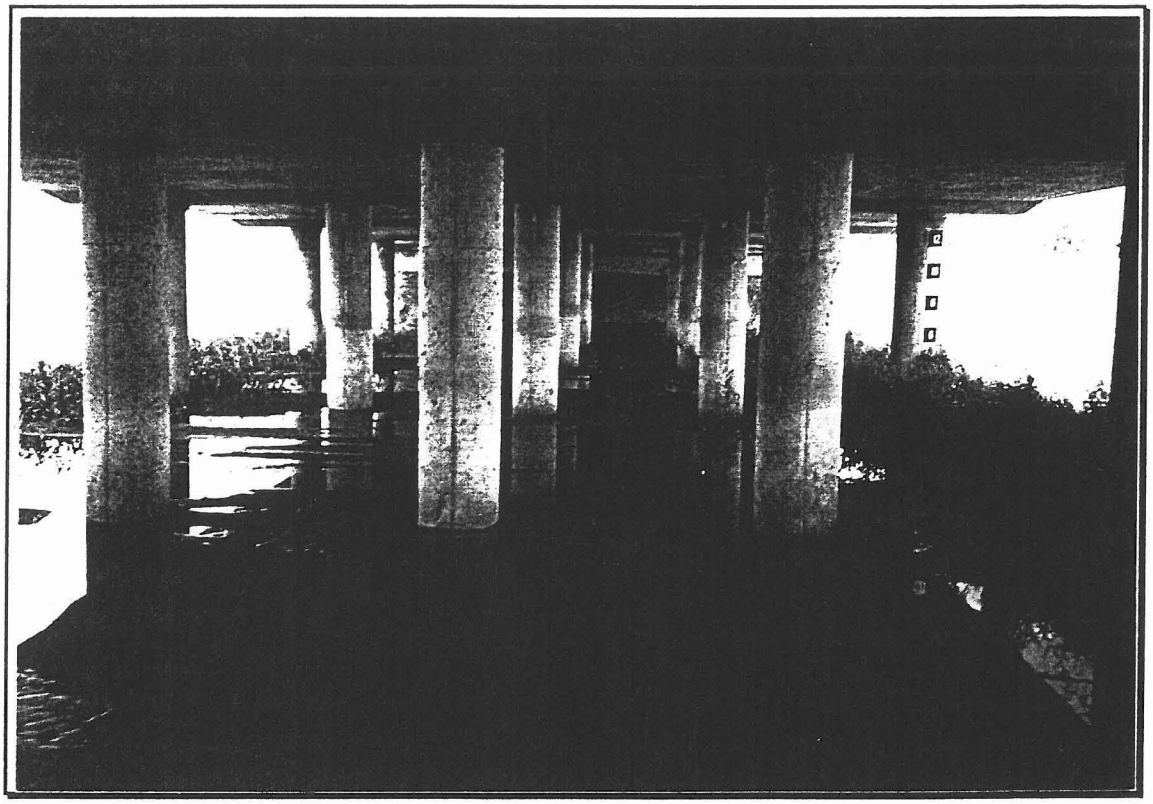


Looking downstream.

ELLIOT ROAD



Upstream face looking West.



Looking East underneath bridge.

ELLIOT ROAD

4.0 HYDRAULIC ANALYSIS

The 100-year and 500-year flood discharges are 5,100 cfs and 6,200 cfs respectively. A chosen multiplication factor of approximately 1.2 was used to obtain the 500-year discharge, as this information could not be supplied by FCDMC. As displayed in Table 1, the HEC-2 output for the existing conditions calculates the average velocity at the bridge to be 5.3 fps for the 100-year flood event. The water surface elevation at the bridge is 1,333.2 feet for the 100-year flood at existing conditions. Average velocity at the bridge is calculated as 5.8 fps for the 500-year flood. Computed water surface elevation at the bridge is 1333.8 feet for the 500-year flood. The minimum freeboard requirement of 3 feet for the 100-year flood event is met at the Elliot Road Bridge.

Table 1

	100-Year Flood Existing Conditions	500-year Flood Existing Conditions
Discharge (cfs)	**5,100**	**6,200**
Velocity (fps)	**5.3**	**5.8**
WSEL (feet)	**1,333.2**	**1,333.8**

5.0 SCOUR ANALYSIS

A scour analysis is performed for the proposed conditions for both the 100-year and 500-year flood scenarios. The potential for scour damage to the bridge piers and abutments is evaluated using the guidelines and procedures presented in Hydraulic Engineering Circular Number 18 (HEC-18). Total scour is comprised of four components: long-term trends, contraction scour, bend scour (where applicable), and local scour.

5.1 Long-Term Trends

Long-term trends in channel aggradation, degradation, and lateral migration are predicted qualitatively based on available sources of information including mapping, field observations, history of flooding and erosion, previous inspection reports, geomorphology, soil characteristics, land uses, flow patterns, control works, and any other factors which may have an influence on the river. The prediction of long-term trends is given in section 6.1.

5.2 Contraction Scour

Contraction scour is caused by the channel width decreasing at the bridge crossing. Contraction scour occurs when the area of flow is decreased, resulting in increases in both velocity and bed shear stress in the contracted area. There are two basic forms of contraction scour, live-bed and clear-water, both of which are based on the principle of conservation of sediment transport. Live-bed is the condition where bed material upstream of the crossing is being transported. For live-bed scour, material is removed until equilibrium is reached between sediment transported into and out of the contracted section. Clear-water is the condition where there is no transportation of upstream bed material.

Live bed conditions exist at the site because the critical velocity for beginning sediment motion is less than the average channel velocity. Critical velocities for the flood conditions are below the average flow velocities calculated in the hydraulic analysis.

FHWA recommends the modified version of Laursen's 1960 equation for estimating live-bed contraction scour. Input parameters for the equation include average depth, discharge, bottom

width, and D_{50} of the bed material. It should be noted that Laursen's equation will overestimate scour if the contraction is the result of bridge piers and abutments. Using the median grain size, k_1 conservatively assumes transported sediment is mostly suspended bed material discharge. The equation is

$$\frac{Y_2}{Y_1} = \left(\frac{Q_2}{Q_1}\right)^{\frac{6}{7}} \left(\frac{W_1}{W_2}\right)^{k_1}$$

where

Y_1 = average depth in the upstream main channel
Y_2 = average depth in the contracted section
W_1 = bottom width of the upstream main channel
W_2 = bottom width of the contracted section
Q_1 = flow in the upstream channel transporting sediment
Q_2 = flow in the contracted channel
k_1 = relates to the mode of bed material transport (contact bed material vs. suspended bed load.
$Y_S = Y_2 - Y_1$ = average scour depth.

5.3 Local Scour

Local scour is the result of water flowing around a pier, abutment, or other obstruction. These obstructions induce the formation of vortex systems caused by the acceleration of the flow around the obstruction. A horseshoe vortex is formed by water hitting the upstream surface of the obstruction and then traveling down the pier. In addition, piers have horizontal vortices, referred to as wake vortices, acting transverse to the pier downstream of the obstruction. Both vortices remove material from the base of the obstruction. However, the intensity of the vortices diminishes downstream from the obstruction.

The Colorado State University (CSU) equation is recommended for both live-bed and clear water pier scour. The basic input parameters are flow depth, pier shape, Froude number, pier width, and angle of attack. The angle of attack at the Elliot Road Bridge over the East Maricopa Floodway is 0 degrees, i.e. the flow is normal to the bridge. Since the angle of attack is 0 degrees

and because the columns are arranged in a straight line longitudinally, the pier width is the width of a single column. The pier width used for scour calculations is 3.0 feet. No debris blockage is anticipated for the bridge because of the man-made channel and the location of the bridge.

The CSU equation estimates equilibrium scour depths. Depending on the bed configuration, adding a recommended correction factor to the equilibrium scour yields the estimated maximum scour. The general lack of large vegetation precludes debris collecting at the bridge piers. The CSU equation is

$$\frac{Y_s}{Y_1} = 2.0 K_1 K_2 K_3 \left(\frac{a}{Y_1}\right)^{0.65} Fr_1^{0.43}$$

where

Y_s = scour depth
Y_1 = flow depth just upstream of the pier
K_1 = correction for pier nose shape
K_2 = correction for angle of attack
K_3 = correction for bed configuration
a = pier width
Fr_1 = Froude number; $Fr_1 = V_1/(gY_1)^{1/2}$
V_1 = Mean Velocity of flow directly upstream of the pier.

Froehlich's live-bed equation, shown below, is used for estimating live-bed and clear-water scour at abutments. The equation is based entirely on laboratory data and provides very conservative estimates of scour. The basic input parameters are Froude number, shape, and projection of abutment, skew, and depth of flow. The use of engineering judgment is recommended in using these estimates of abutment scour depth, because cost will be the deciding factor between greater foundation depth or protection of the abutment area.

$$\frac{Y_s}{Y_a} = 2.27 K_1 K_2 \left(\frac{a'}{Y_a}\right)^{0.43} Fr^{0.61} + 1$$

Where

K_1 = coefficient for abutment shape

K_2 = coefficient for angle of embankment to flow

$a' = A_e/Y_a$ = length of abutment projected normal to flow

A_e = flow area of the approach cross section obstructed by the embankment

$Fr_e = V_e/(gY_a)$ = Froude number of approach flow upstream of the abutment

$V_e = Q_e/A_e$

Q_e = flow obstructed by the abutment and approach embankment

Y_a = average depth of flow on the floodplain

Y_s = scour depth.

The East Maricopa Floodway flows in a relatively straight line in the vicinity of the bridge, therefore, no bend scour is predicted to occur at the Elliot Road Bridge.

5.4 Total Scour

Total scour at any location is estimated as the sum of any long term trends, contraction scour, and local scour. The total scour is then plotted on a cross section view of the bridge. Any estimated scour depth due to long-term trend predictions is plotted below the existing channel bottom. The estimated scour depth due to contraction scour is then plotted a computed distance below the revised channel bottom. Local scour is plotted for each pier and abutment in the shape of a scour hole. The top width of a scour hole is estimated to be 2.8 times the predicted scour depth. Debris blockage will add to the effective width of the piers and thus increase the scour depth. This increase in the scour depth has a direct result on the width of the scour hole as noted above. However, because of the lack of significant vegetation in the area, no debris blockage is predicted to occur at this bridge. If the estimated limits of scour holes overlap, the resulting scour may be deeper than originally estimated.

6.0 RESULTS

6.1 Long-Term Trends

The elevation of the channel obtained in the field is approximately equal to the adjusted elevation of the channel obtained from the bridge plans. No evidence of aggradation or degradation was visible at the bridge site during the field visit. Velocities through the bridge are stable and the channel is lined with thick grass to help control sediment movement. No aggradation or degradation of the channel is expected to occur at this bridge.

The man-made channel will prevent any lateral migration of the floodway. A constant elevation of 1,327 feet will be used for the invert for all scour calculations. This will allow remaining pile depths to be estimated and will help indicate critical scour depths.

6.2 Contraction Scour

As shown in Table 2, contraction scour is not predicted to occur for the flood events. The upstream width is taken as approximately 200 feet, which represents the distance across the top of the main channel. The two flood events have no contraction scour depths, because flow through the contracted section is equal to the total main channel flow upstream for the 100-year and 500-year floods. All of the 100-year and 500-year flows are contained within the bridge structure. No flow overtops the approach roadway.

Table 2

100-Year Flood Existing Conditions	East Abutment	Pier	West Abutment
Local Scour	7.3 feet	6.0 feet	7.5 feet
Contraction	0 feet	0 feet	0 feet
Total Scour	**7.3 feet**	**6.0 feet**	**7.5 feet**
Remaining Depth to Bottom of Footing	5.9 feet*	7.2 feet	5.7 feet*
500-year Flood Existing Conditions	**East Abutment**	**Pier**	**West Abutment**
Local Scour	8.0 feet	6.0 feet	8.1 feet
Contraction	0 feet	0 feet	0 feet
Total Scour	**8.0 feet**	**6.0 feet**	**8.1 feet**
Remaining Depth to Bottom of Footing	5.2 feet*	7.2 feet	5.1 feet*

Remaining pile depths were taken using the footing elevations for pier #2 and pier #6, This was done because the point where abutment scour would occur would effect these piers more than the abutment piers.

Why? See page 1, it says the pier dia. be 4'.

6.3 Local Scour

Local pier scour is predicted to occur at the bridge site for each of the flood events. The pier width used in the calculations was 3.0 feet. No significant debris accumulation was predicted to occur at this bridge because of the man-made channel and the location of the bridge. Maximum pier scour is estimated to be approximately 6 feet for both the 100-year and 500-year flood scenarios. The maximum estimated pier scour may occur at any of the piers. Calculations for pier scour are included in the Appendix.

As shown in Table 2, the scour estimates for the 100-year flood at the east and west abutments are 7.3 and 7.5 feet respectively. The scour estimates for the 500-year flood at the east and west abutments are 8.0 and 8.1 feet.

Please note that the abutment scour equation recommended by HEC-18 is inherently conservative and includes a large factor of safety. There is no riprap on either abutment to help protect against scour.

6.4 Total Scour

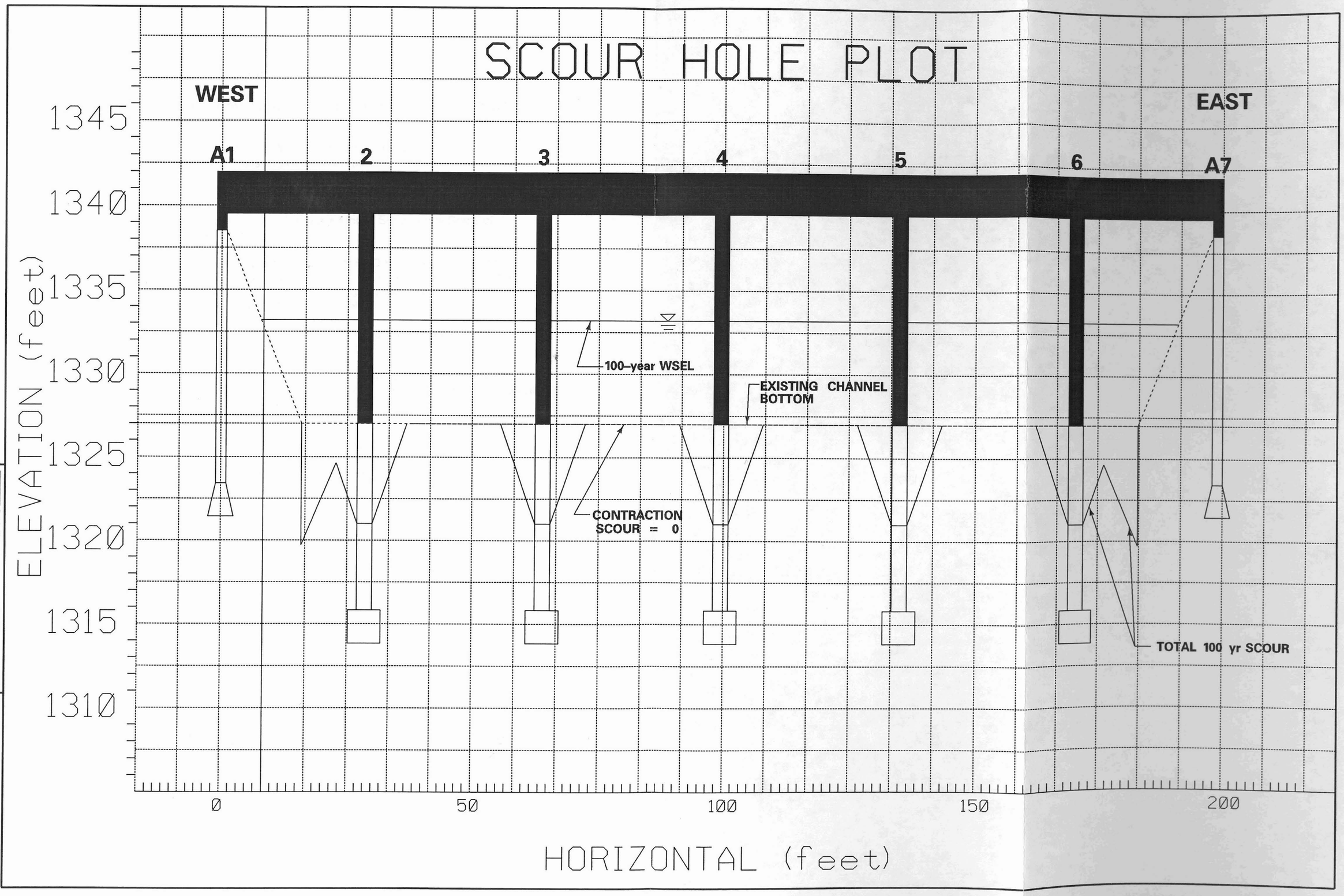
Table 2 summarizes the total scour predicted at each pier and abutment for the 100-year and 500-year flood event. The effective pier width used in the scour calculations was the actual width of the pier because debris accumulation was not predicted to occur at this bridge. It is possible for the maximum pier scour depth to occur at each pier, therefore only one representative pier is displayed in the table. Figure 2 shows the plotted scour holes associated with the 100-year flood. The 500-year flood is not plotted, because the scour depths are similar to the 100-year flood event. Scour computations are included in the appendix.

HEC-18 recommends placing abutment footings at least 6 feet below the depth reached by long-term degradation and contraction scour. The abutment piles do not extend below the recommended depth, however, because the piles are set back from the toe of the abutment slope approximately 25 feet and velocities are mild, abutment scour is not expected to be problematic at the Elliot Road Bridge.

7.0 INITIAL EVALUATION

The existing pier configuration should adequately protect the piers during both the 100-year and 500-year floods. Moderate scour depths are calculated at both abutments, however abutment scour is not expected to be a problem at the Elliot Road Bridge. Because of the absence of riprap protection the abutments need to be checked after each flood event to ensure excessive erosion does not occur. Table 2 shows remaining pile depths for both the 100-year and 500-year flood events.

The Elliot Road Bridge is rated as a low-risk bridge with a recommended Item 113 rating of 8L and does not need a detailed scour analysis. No additional scour countermeasures are recommended as a result of the screening.


SCOUR HOLE PLOT
WEST
EAST
A1
2
3
4
5
6
A7
1345
1340
1335
1330
1325
1320
1315
1310
ELEVATION (feet)
100-year WSEL
EXISTING CHANNEL BOTTOM
CONTRACTION SCOUR = 0
TOTAL 100 yr SCOUR
0
50
100
150
200
HORIZONTAL (feet)
PREPARED BY
CHECKED BY
APPROVED BY
DATE
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ELLIOT ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

CONTRACTION SCOUR

CASE 1 - LIVE BED	SEE NOTE	100-YEAR	500-YEAR
Y1 - AVE. DEPTH IN UPSTREAM MAIN CHANNEL(FT)	1	6.3	6.8
W1 - WIDTH OF UPSTREAM MAIN CHANNEL(FT)		200	200
W2 - WIDTH OF CONTRACTED SECTION(FT)	2	185	185
N1 - AT MAIN CHANNEL		0.032	0.032
N2 - AT CONTRACTED SECTION		0.032	0.032
Q_1 - FLOW IN UPSTREAM MAIN CHANNEL (CFS)		5,100	6,200
Q_2 - FLOW IN CONTRACTED SECTION (CFS)		5,100	6,200
(Q_2/Q_1)^6/7		1.00	1.00
S1 - SLOPE OF ENERGY GRADE LINE IN US CHANNEL (FT/FT)	3	0.00079	0.00087
V*c - SHEAR VELOCITY(FPS) = [32.2(Y1)(S1)]^0.5		0.40	0.44
K1	4	0.69	0.69
(W1/W2)^K1		1.06	1.06
Y2/Y1 = Q_2/Q_1^(6/7)(W1/W2)^K1		1.06	1.06
Ys = Y2-Y1 = SCOUR (FT)	5,6	0	0

NOTES:

1. Y1 IS AVE. DEPTH IN MAIN CHANNEL.

2. W2 = (TOP WIDTH)-(SUM OF EFFECTIVE PIER WIDTHS). 200'-(5x3') = 185'

3. ENERGY GRADE LINE (USED TO OBTAIN K1).TAKEN FROM HEC-2.

4. K1 VALUE ASSUMES MOSTLY SUSPENDED BED MATERIAL DISCHARGE.

5. EQ. ASSUMES SEDIMENT TRANSPORT IN CHANNEL UPSTRM = SEDIM. TRANSP. AT CONTRACTED SECTION.

6. ASSUMES LIVE BED CONTRACTION SCOUR BECAUSE Vc<Vmean.
Vc=10.95Y1^(1/6)(D50)^(1/3)

ELLIOT ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

PIER SCOUR - EXISTING CONDITIONS

		100-YEAR			500-YEAR		
FIVE COLUMN BENT	SEE NOTE	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK
PIER NUMBER(S)			1-5			1-5	
SKEW ANGLE (DEGREES)			0			0	
a - PIER WIDTH (FT)	1		3 4'			3 4'	
K1	2		1.0			1.0	
K2	2		1.0			1.0	
K3	2		1.1			1.1	
V1 - VELOCITY, UPSTREAM FACE OF PIER (FT)	3		5.30			5.80	
Y1 - DEPTH OF FLOW UPSTRM. FACE OF PIER (FT)	4		5.60			6.1	
Fr1 - FROUDE NUMBER = V1/(32.2*Y1)^1/2			0.39			0.41	
[a/Y1]^0.65			0.67			0.63	
Ys/Y1 = 2K1K2K3(a/Y1)^.65(Fr1)^.43	5		0.98			0.95	
Ys SCOUR DEPTH (FT)			6			6	

$$\frac{y_s}{y_1} = 2.0 K_1 K_2 \times \left(\frac{a}{y_1}\right)^{0.65} \times Fr^{0.43}$$

$$= 2.0 \times 1.1 \times \left(\frac{4}{5.6}\right)^{0.65} \times (.67)^{.43}$$

$$= 8.33'$$

NOTES:

1. NO EXTRA PIER WIDTH IS USED TO ACCOUNT FOR DEBRIS ACCUMULATION.

2. K1=1.0 SINCE CIRCULAR CYLINDER PIERS.
   K2=1.0 SINCE ANGLE OF ATTACK IS 0.
   K3=1.1 FOR PLANE BED

3. VELOCITY OBTAINED FROM HEC-2 OUTPUT.

4. DEPTH VARIES AT DIFF. PIERS. MAX VALUE IS OBTAINED FROM HEC-2 OUTPUT.

5. THE C.S.U. EQ. ESTIMATES EQUILIBRIUM SCOUR.

$$Fr = \frac{V}{\sqrt{gy}} = \frac{5.3}{\sqrt{(32.2)(5.6)}} = \underline{5.3}$$

ELLIOT ROAD BRIDGE OVER THE EAST MARICOPA FLOODWAY

ABUTMENT SCOUR

SPILLTHROUGH	SEE NOTE	100-YEAR EAST ABUTMENT	100-YEAR WEST ABUTMENT	500-YEAR EAST ABUTMENT	500-YEAR WEST ABUTMENT
Ya - DEPTH AT ABUT. (FT)		2.80	2.80	3.05	3.05
a'- ABUT. LENGTH NORMAL TO FLOW (FT)		11.5	12.5	11.9	12.8
(a'/Ya)^0.43		1.84	1.90	1.80	1.85
Ve = Qe/Ae	1	5.30	5.30	5.80	5.80
Fre = Ve/(32.2*Ya)^(1/2) = FROUDE NO.		0.56	0.56	0.59	0.59
Fre^0.61		0.70	0.70	0.72	0.72
(THETA) = ANGLE BTWN. ABUT. AND FLOW	2	90	90	90	90
K2 = ((THETA)/90)^0.13		1	1	1	1
K1	3	0.55	0.55	0.55	0.55
Ys/Ya=2.27K1K2* (a'/Ya)^0.43(Fre^0.61)+1		2.6	2.7	2.6	2.7
Ys SCOUR (FT)		7.3	7.5	8.0	8.1

NOTES:

1. Ve TAKEN FROM HEC-2 VELOCITY IN MAIN CHANNEL. Ve=0 BECAUSE ABUTMENT DOES NOT OBSTRUCT FLOW.

2. THETA < 90 IF POINTED DOWNSTREAM, > 90 IF POINTED UPSTREAM. THE ABUTMENTS DO NOT OBSTRUCT FLOW.

3. K1 = 0.55 FOR SPILLTHROUGH ABUTMENT.

```
*********************************************
*  HEC-2 WATER SURFACE PROFILES             *
*                                           *
*  Version   4.6.2;  May 1991               *
*                                           *
*  RUN DATE    28MAR96    TIME   18:30:01   *
*********************************************
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****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

1

28MAR96 18:30:01 PAGE 1

THIS RUN EXECUTED 28MAR96 18:30:01

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*************************************
HEC-2 WATER SURFACE PROFILES

Version   4.6.2;  May 1991
*************************************
```

ELLIOT ROAD BRIDGE OVER EAST MARICOPA FLOODWAY
FILE NAME ELLIOT
PARSONS BRINCKERHOFF - TEMPE, ARIZONA
The gradient slope from the 100-year HEC-2 run was used to
approximate the 500-year flood.
The benchmark used for this bridge was obtained from sheet 12
of the bridge plans. The benchmark on sheet 22 is incorrect.
See report for more information.
No extra width was used for debris blockage since the bridge
is located on the East Maricopa Floodway.

T1 MCDOT HYDRAULIC ANALYSIS
T2 100-yr SUB-CRITICAL RUN FOR ELLIOT ROAD BRIDGE
T3 EAST MARICOPA FLOODWAY

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	2	0	0	0	0	0	0	1332.5	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1	0	-1	0	0	0	0	0	0	15

J3 VARIABLE CODES FOR SUMMARY PRINTOUT

```
   100        105        150          0          0          0          0          0          0          0

QT        2       5100       6200          0          0          0          0          0          0          0
NC    0.032      0.032      0.032        0.1        0.3          0          0          0          0          0
            EXIT SECTION -  500' FROM DOWNSTREAM FACE OF BRIDGE
X1     1000          8        500        700          0          0          0          0          0          0
X3       10          0          0          0          0          0          0       1338     1336.3          0
GR     1350      -3500       1340      -1400       1330        200       1338        500     1326.5        525
GR   1326.5        675     1336.3        700       1320       2700          0          0          0          0

X1     1300          4        500        700        300        300        300          0          0          0
GR   1338.1        500     1326.6        525     1327.4        675     1337.2        700

            DOWNSTREAM FACE OF BRIDGE
X1     1500          4        500        700        200        200        200          0          0          0
X3       10          0          0          0          0          0          0   1341.19    1342.18          0
GR   1339.4        500     1327.6        525     1326.9        675       1340        700
1
   28MAR96      18:30:01                                                                          PAGE     2


SB      0.9        1.5        3.0          0        150         15       2363          2       1327     1326.9
            UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD
X1     1562          0          0          0         62         62         62          0          0          0
X2        0          0          1     1340.5       1342          0          0       1.33          0          0
X3       10          0          0          0          0          0          0   1341.19    1342.18          0
BT        3        500    1341.19     1340.5        600       1342     1340.5        700    1342.18     1340.5

            APPROACH SECTION - 200' FROM UPSTREAM FACE OF BRIDGE
X1     1762          4        500        700        200        200        200          0          0          0
GR   1335.1        500     1326.4        525     1326.9        675     1337.7        700
1
   28MAR96      18:30:01                                                                          PAGE     3


   SECNO      DEPTH      CWSEL      CRIWS      WSELK         EG         HV         HL      OLOSS   L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB        ACH       AROB        VOL        TWA   R-BANK ELEV
   TIME       VLOB       VCH        VROB        XNL       XNCH        XNR        WTN      ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR     ITRIAL        IDC      ICONT      CORAR    TOPWID     ENDST


*PROF 1


CCHV=      .100 CEHV=      .300
*SECNO 1000.000
3280 CROSS SECTION   1000.00 EXTENDED     12.50 FEET


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1338.00 ELREA=      1336.30

            EXIT SECTION -  500' FROM DOWNSTREAM FACE OF BRIDGE
 1000.000      6.00   1332.50       .00   1332.50   1332.92       .42       .00       .00   1338.00
   5100.0        .0    5100.0        .0        .0     985.0        .0        .0        .0   1336.30
      .00       .00      5.18       .00      .000      .032      .000      .000   1326.50    511.96
  .001296        0.        0.        0.         0         0         0       .00    178.35    690.31


FLOW DISTRIBUTION FOR SECNO=   1000.00          CWSEL=   1332.50
```

```
STA=     512.     700.
  PER Q=    100.0
   AREA=    985.0
    VEL=      5.2
  DEPTH=      5.5

*SECNO 1300.000
  1300.000      6.29   1332.89       .00       .00   1333.32       .43       .40       .01   1338.10
    5100.0        .0    5100.0        .0        .0     964.8        .0       6.7       1.2   1337.20
       .02       .00      5.29       .00      .000      .032      .000      .000   1326.60    511.33
   .001382      300.      300.      300.         0         0         0       .00    177.67    689.00


FLOW DISTRIBUTION FOR SECNO=   1300.00          CWSEL=   1332.89

STA=     511.     700.
  PER Q=    100.0
   AREA=    964.8
    VEL=      5.3
  DEPTH=      5.4

1
   28MAR96      18:30:01                                                                                PAGE    4


    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


*SECNO 1500.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1341.19 ELREA=      1342.18

           DOWNSTREAM FACE OF BRIDGE
  1500.000      6.26   1333.16       .00       .00   1333.60       .44       .28       .00   1339.40
    5100.0        .0    5100.0        .0        .0     956.1        .0      11.1       2.0   1340.00
       .03       .00      5.33       .00      .000      .032      .000      .000   1326.90    513.23
   .001387      200.      200.      200.         0         0         0       .00    173.71    686.94


FLOW DISTRIBUTION FOR SECNO=   1500.00          CWSEL=   1333.16

STA=     513.     700.
  PER Q=    100.0
   AREA=    956.1
    VEL=      5.3
  DEPTH=      5.5


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RLIEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
     .90      1.50      3.00       .00    150.00     15.00   2363.00      2.00   1327.00   1326.90

*SECNO 1562.000
CLASS A LOW FLOW
```

3420 BRIDGE W.S.= 1333.10 BRIDGE VELOCITY= 5.62 CALCULATED CHANNEL AREA= 899.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1333.66	.07	0.	5100.	2363.	2187.	1340.50	1342.00	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1341.19 ELREA= 1342.18

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

1562.000	6.34	1333.24	.00	.00	1333.66	.43	.06	.00	1339.40
5100.0	.0	5100.0	.0	.0	969.7	.0	12.5	2.3	1340.00
.03	.00	5.26	.00	.000	.032	.000	.000	1326.90	513.06
.001326	62.	62.	62.	0	0	0	.00	174.03	687.09

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1562.00 CWSEL= 1333.24

STA= 513. 700.
PER Q= 100.0
AREA= 969.7
VEL= 5.3
DEPTH= 5.6

*SECNO 1762.000

APPROACH SECTION - 200' FROM UPSTREAM FACE OF BRIDGE

1762.000	7.18	1333.58	.00	.00	1333.88	.30	.20	.01	1335.10
5100.0	.0	5100.0	.0	.0	1165.4	.0	17.4	3.1	1337.70
.04	.00	4.38	.00	.000	.032	.000	.000	1326.40	504.37
.000784	200.	200.	200.	2	0	0	.00	186.10	690.47

FLOW DISTRIBUTION FOR SECNO= 1762.00 CWSEL= 1333.58

STA= 504. 700.
PER Q= 100.0
AREA= 1165.4
VEL= 4.4
DEPTH= 6.3

T1 MCDOT HYDRAULIC ANALYSIS
T2 500-yr SUB-CRITICAL RUN FOR ELLIOT ROAD BRIDGE
T3 EAST MARICOPA FLOODWAY

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ

0	3	0	0	0	0	0	0	1333	0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	2	0	-1	0	0	0	0	0	0	15

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 2
0

CCHV= .100 CEHV= .300
*SECNO 1000.000
3280 CROSS SECTION 1000.00 EXTENDED 13.00 FEET

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1338.00 ELREA= 1336.30

EXIT SECTION - 500' FROM DOWNSTREAM FACE OF BRIDGE

1000.000	6.50	1333.00	.00	1333.00	1333.52	.52	.00	.00	1338.00
6200.0	.0	6200.0	.0	.0	1074.8	.0	.0	.0	1336.30
.00	.00	5.77	.00	.000	.032	.000	.000	1326.50	510.87
.001460	0.	0.	0.	0	0	0	.00	180.71	691.58

FLOW DISTRIBUTION FOR SECNO= 1000.00 CWSEL= 1333.00

STA= 511. 700.
PER Q= 100.0
AREA= 1074.8
VEL= 5.8
DEPTH= 5.9

*SECNO 1300.000

1300.000	6.84	1333.44	.00	.00	1333.97	.53	.45	.00	1338.10
6200.0	.0	6200.0	.0	.0	1063.0	.0	7.4	1.2	1337.20
.01	.00	5.83	.00	.000	.032	.000	.000	1326.60	510.14
.001510	300.	300.	300.	0	0	0	.00	180.27	690.40

FLOW DISTRIBUTION FOR SECNO= 1300.00 CWSEL= 1333.44

STA= 510. 700.
PER Q= 100.0
AREA= 1063.0
VEL= 5.8
DEPTH= 5.9

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1500.000

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1341.19 ELREA= 1342.18

DOWNSTREAM FACE OF BRIDGE

1500.000	6.83	1333.73	.00	.00	1334.27	.53	.30	.00	1339.40
6200.0	.0	6200.0	.0	.0	1057.0	.0	12.2	2.1	1340.00
.02	.00	5.87	.00	.000	.032	.000	.000	1326.90	512.00
.001496	200.	200.	200.	0	0	0	.00	176.04	688.04

FLOW DISTRIBUTION FOR SECNO= 1500.00 CWSEL= 1333.73

STA= 512. 700.
PER Q= 100.0
AREA= 1057.0
VEL= 5.9
DEPTH= 6.0

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	.90	1.50	3.00	.00	150.00	15.00	2363.00	2.00	1327.00	1326.90

*SECNO 1562.000
CLASS A LOW FLOW

3420 BRIDGE W.S.= 1333.65 BRIDGE VELOCITY= 6.23 CALCULATED CHANNEL AREA= 987.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1334.35	.10	0.	6200.	2363.	2187.	1340.50	1342.00	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1341.19 ELREA= 1342.18

UPSTREAM FACE OF BRIDGE - SPECIAL BRIDGE METHOD

1562.000	6.93	1333.83	.00	.00	1334.35	.52	.08	.00	1339.40
6200.0	.0	6200.0	.0	.0	1073.9	.0	13.7	2.3	1340.00
.03	.00	5.77	.00	.000	.032	.000	.000	1326.90	511.80
.001423	62.	62.	62.	0	0	0	.00	176.42	688.23

1

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV

Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

FLOW DISTRIBUTION FOR SECNO= 1562.00 CWSEL= 1333.83

STA= 512. 700.
PER Q= 100.0
AREA= 1073.9
VEL= 5.8
DEPTH= 6.1

*SECNO 1762.000
APPROACH SECTION - 200' FROM UPSTREAM FACE OF BRIDGE

1762.000	7.82	1334.22	.00	.00	1334.58	.36	.22	.02	1335.10
6200.0	.0	6200.0	.0	.0	1285.2	.0	19.2	3.2	1337.70
.04	.00	4.82	.00	.000	.032	.000	.000	1326.40	502.53
.000857	200.	200.	200.	2	0	0	.00	189.41	691.94

FLOW DISTRIBUTION FOR SECNO= 1762.00 CWSEL= 1334.22

STA= 503. 700.
PER Q= 100.0
AREA= 1285.2
VEL= 4.8
DEPTH= 6.8

THIS RUN EXECUTED 28MAR96 18:30:02

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 100

SECNO	EGLWC	ELLC	EGPRS	ELTRD	QPR	QWEIR	CLASS	H3	DEPTH	CWSEL	VCH	EG
1562.000	1333.66	1340.50	.00	1342.00	5100.00	.00	1.00	.07	6.34	1333.24	5.26	1333.66
1562.000	1334.35	1340.50	.00	1342.00	6200.00	.00	1.00	.10	6.93	1333.83	5.77	1334.35

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 105

SECNO	CWSEL	HL	OLOSS	TOPWID	QLOB	QCH	QROB
1300.000	1332.89	.40	.01	177.67	.00	5100.00	.00
1300.000	1333.44	.45	.00	180.27	.00	6200.00	.00
1500.000	1333.16	.28	.00	173.71	.00	5100.00	.00
1500.000	1333.73	.30	.00	176.04	.00	6200.00	.00
1562.000	1333.24	.06	.00	174.03	.00	5100.00	.00
1562.000	1333.83	.08	.00	176.42	.00	6200.00	.00
1762.000	1333.58	.20	.01	186.10	.00	5100.00	.00
1762.000	1334.22	.22	.02	189.41	.00	6200.00	.00

EAST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
1000.000	.00	.00	.00	1326.50	5100.00	1332.50	.00	1332.92	12.96	5.18	985.05	1416.43
1000.000	.00	.00	.00	1326.50	6200.00	1333.00	.00	1333.52	14.60	5.77	1074.81	1622.71
1300.000	300.00	.00	.00	1326.60	5100.00	1332.89	.00	1333.32	13.82	5.29	964.76	1371.71
1300.000	300.00	.00	.00	1326.60	6200.00	1333.44	.00	1333.97	15.10	5.83	1063.00	1595.74
1500.000	200.00	.00	.00	1326.90	5100.00	1333.16	.00	1333.60	13.87	5.33	956.12	1369.55
1500.000	200.00	.00	.00	1326.90	6200.00	1333.73	.00	1334.27	14.96	5.87	1057.05	1603.22
1562.000	62.00	1342.00	1340.50	1326.90	5100.00	1333.24	.00	1333.66	13.26	5.26	969.74	1400.38
1562.000	62.00	1342.00	1340.50	1326.90	6200.00	1333.83	.00	1334.35	14.23	5.77	1073.93	1643.50
1762.000	200.00	.00	.00	1326.40	5100.00	1333.58	.00	1333.88	7.84	4.38	1165.39	1821.81
1762.000	200.00	.00	.00	1326.40	6200.00	1334.22	.00	1334.58	8.57	4.82	1285.21	2118.10

AST MARICOPA FLOODWAY

SUMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
1000.000	5100.00	1332.50	.00	.00	.00	178.35	.00
1000.000	6200.00	1333.00	.50	.00	.00	180.71	.00

1300.000	5100.00	1332.89	.00	.39	.00	177.67	300.00
1300.000	6200.00	1333.44	.55	.44	.00	180.27	300.00
1500.000	5100.00	1333.16	.00	.27	.00	173.71	200.00
1500.000	6200.00	1333.73	.57	.30	.00	176.04	200.00
1562.000	5100.00	1333.24	.00	.07	.00	174.03	62.00
1562.000	6200.00	1333.83	.59	.10	.00	176.42	62.00
1762.000	5100.00	1333.58	.00	.35	.00	186.10	200.00
1762.000	6200.00	1334.22	.64	.39	.00	189.41	200.00

SUMMARY OF ERRORS AND SPECIAL NOTES

MARYLAND SHA CODING GUIDE FOR ITEM 113
SCOUR CRITICAL BRIDGES

CODE		DESCRIPTION
1ST DIGIT	2ND DIGIT	
N	-	BRIDGE NOT OVER WATERWAY
9	-	BRIDGE FOUNDATIONS (INCLUDING PILES) WELL ABOVE FLOOD WATER ELEVATIONS (SEE NOTE 1)
8	P	BRIDGE IS A STRUCTURE WITH A FULL LENGTH PAVED BOTTOM
8	L	BRIDGE HAS BEEN EVALUATED/ASSESSED IN THE FIELD AND OFFICE AS A LOW RISK STRUCTURE; NO FURTHER STUDY IS PLANNED
7	-	COUNTERMEASURES HAVE BEEN INSTALLED SINCE THE ORIGINAL CONSTRUCTION TO CORRECT A PROBLEM WITH SCOUR; BRIDGE IS NO LONGER SCOUR CRITICAL
6	-	BRIDGE HAS NOT BEEN EVALUATED FOR SCOUR
6	R	BRIDGE IS SCHEDULED FOR MAJOR REHABILITATION OR REPLACEMENT WITHIN THE NEXT 5 YEARS; THE SCOUR STUDY IS DEFERRED TO THE LOCATION/DESIGN PHASE OF THE BRIDGE PROJECT
6	T	TIDAL FLOW PREDOMINATES FOR WORST SCOUR CONDITIONS; THE ITEM 113 RATING IS DEFERRED WHERE THERE IS NO INDICATION OF SEVERE SCOUR CONDITIONS
6	U	THE BRIDGE FOUNDATIONS ARE UNKNOWN. THE BRIDGE SITE CONDITIONS HAVE BEEN EVALUATED/ASSESSED WITH CURSORY STUDY IN THE FIELD AND OFFICE AND THE RISK OF POTENTIAL DAMAGE FROM SCOUR IS JUDGED TO BE MODERATE OR MILD. STRUCTURE HAS NO HISTORY OF SCOUR PROBLEMS. FURTHER EVALUATION IS DEFERRED. (SEE NOTE 1)
5	-	A DETAILED SCOUR STUDY (ANALYSIS) HAS BEEN MADE AND THE STRUCTURE IS RATED AS STABLE.
4	-	BRIDGE FOUNDATIONS DETERMINED TO BE STABLE ON THE BASIS OF A FIELD AND OFFICE SCOUR EVALUATION OR ANALYSIS; BRIDGE INSPECTION REVEALS THAT ACTION IS REQUIRED TO PROTECT EXPOSED PILES FROM EFFECTS OF ADDITIONAL EROSION AND CORROSION

3	A	BRIDGE IS RATED AS SCOUR CRITICAL ON THE BASIS OF A FIELD AND OFFICE EVALUATION OR AN ANALYSIS; THE POTENTIAL RISK IS JUDGED TO BE MILD, AND NO ACTIONS ARE PLANNED OTHER THAN MONITORING.
3	B	BRIDGE IS RATED AS SCOUR CRITICAL ON THE BASIS OF A FIELD AND OFFICE EVALUATION OR AN ANALYSIS; THE POTENTIAL RISK IS JUDGED TO BE MODERATE AND NO ACTIONS ARE PLANNED OTHER THAN MONITORING.
3	C	BRIDGE IS RATED AS SCOUR CRITICAL ON THE BASIS OF A FIELD AND OFFICE EVALUATION OR AN ANALYSIS; THE POTENTIAL RISK IS JUDGED TO BE SEVERE AND SCOUR COUNTERMEASURES ARE PLANNED. MONITORING IS TO BE UTILIZED UNTIL SCOUR COUNTERMEASURES ARE IN PLACE.
2	-	BRIDGE IS SCOUR CRITICAL; FIELD REVIEW INDICATES THAT EXTENSIVE SCOUR HAS OCCURRED AT A BRIDGE FOUNDATION. IMMEDIATE ACTION IS REQUIRED TO PROVIDE SCOUR COUNTERMEASURES.
1	-	BRIDGE IS SCOUR CRITICAL; FIELD REVIEW INDICATES THAT FAILURE OF PIERS/ABUTMENTS IS IMMINENT. BRIDGE IS CLOSED TO TRAFFIC.
0	-	BRIDGE IS SCOUR CRITICAL; BRIDGE HAS FAILED AND IS CLOSED TO TRAFFIC.

NOTE 1: IF THE RISK OF DAMAGE FROM POTENTIAL OR ACTUAL SCOUR DAMAGE IS JUDGED TO BE SEVERE, ADDITIONAL SCOUR STUDIES WILL BE UNDERTAKEN INCLUDING BORINGS OR OTHER MEANS OF SUBSURFACE EXPLORATION TO ASCERTAIN FOUNDATION AND SUPPORTING SOIL CONDITIONS.

STRUCTURES INVENTORY AND APPRAISAL
(NATIONAL BRIDGE INVENTORY SYSTEM)

SCREENING PROCEDURE FOR
RATING BRIDGES FOR ITEM 113, SCOUR CRITICAL BRIDGE

AGENCY: *PARSONS BRINCKERHOFF* BRIDGE NO.: *9828*
ROUTE: *ELLIOT ROAD* STREAM: *EAST MARICOPA FLOODWAY*

SCREEN 1 - BRIDGE INSPECTOR'S SCREEN

EVALUATOR'S NAME: _____ DATE: *4/20/95*
RECOMMENDATION: ☐ RATE BRIDGE: 8L ☒ GO TO SCREEN 2

CRITERIA	RESPONSE		ITEM 113 RATING
	YES	NO	
1-1. BRIDGE OVER WATERWAY?	CONTINUE	RATE BRIDGE	N
1-2. BRIDGE INSPECTION REPORTS INDICATE:			
• BRIDGE FAILED/CLOSED DUE TO SCOUR	RATE BRIDGE	CONTINUE	O
• BRIDGE CLOSED; FAILURE IMMINENT DUE TO SCOUR	RATE BRIDGE	CONTINUE	1
• FOOTING EXPOSED; PROMPT ACTION REQUIRED TO PROTECT BRIDGE FROM SCOUR	NOTIFY OWNER; RATE BR.	CONTINUE	2
• SCOUR HOLES HAVE FORMED TO DEPTHS NEAR BOTTOM OF SPREAD FOOTINGS	NOTIFY OWNER; RATE BR.	CONTINUE	2
• EXPOSED PILES REQUIRE PROTECTION	NOTIFY OWNER; RATE BR.	CONTINUE	4
1-3. BRIDGE IS A CULVERT WITH A PAVED INVERT	RATE BRIDGE	CONTINUE	8C
1-4. TIDAL FLOWS GOVERN BRIDGE HYDRAULICS FOR WORST SCOUR CONDITIONS	RATE BRIDGE (INTERIM RATING)	CONTINUE	6T

1-5. BRIDGE IS ON THE 5 YEAR CAPITAL REPLACE. PROGRAM	RATE BRIDGE	CONTINUE	6R
1-6 BRIDGE IS ON THE 2 YEAR PROGRAM FOR REMEDIAL WORK	RATE BRIDGE	CONTINUE SCREEN 2	6R

SCOUR EVALUATION FORM FOR
RATING BRIDGES FOR ITEM 113

SCREEN 2 - BRIDGE ENGINEER'S SCREEN

Agency: *PARSONS BRINCKERHOFF*

Date/Placeof Meeting: *APRIL 20, 1995;ELLIOT ROAD BRIDGE*

Attendees:

Bridge No.: *9828* Date Built on Bridge Plans: *12\83*

Description of Bridge/Bridge Type: *REINF. CONCRETE CIP CONTINUOUS 6 SPAN SLAB ON SPREAD FOOTINGS; SPAN ARRANGEMENT (28'-6")-(35'-6")-(35'-6")-(35'-6")-(35'-6")-(28'-6")*

Route: *ELLIOT ROAD* Water Course: *EAST MARICOPA FLOODWAY*

Underclearance at thalweg (ft): *+-13*

Elevation of stream thalweg (ft): *+-1327*

Normal water elevation (ft): *N/A*

Reported high water elevation: *1329.2*

Description of flood: *100-year;5100 cfs*

Description of approach and "getaway" conditions: *MUDDY, CLAYEY BOTTOM; OCCASIONAL BOULDERS (1'dia.), NO SIGNS OF EROSION, HIGH GRASS PRESENT*

Description of bed load: *NO SIGNS OF EROSION (SEE ABOVE)*

Condition of banks; evidence of lateral movement, degradation or aggradation: *BANKS ARE NOT PROTECTED, MINOR EVIDENCE OF EROSION DIRECTLY BENEATH THE BRIDGE DECK DRAINS. NO EVIDENCE OF DEGRADATION OR AGGRADATION.*

Overtopping Q (cfs)/Recurrence interval: *> Q500 cfs/*

Stage rise to overtopping: _____

Depth/velocity through bridge at overtopping: *> Q500*

Confluences: *N/A*

BRIDGE NUMBER 9828

Description of flood plain: *WIDE FLAT FLOODPLAIN WITH SPARSE VEGETATION*

Item 321 rating: 8 L
Item 71 rating: 9
Item 61 rating: 8 L

ABUTMENTS		
	LEFT	RIGHT
TYPE	*SPILL THROUGH*	*SPILL THROUGH*
SPREAD/PILES	*2' DIA PILES*	*2' DIA PILES*
EXPOSED FOOTINGS	*N/A*	*N/A*
FOOTING ELEVATION	*N/A*	*N/A*
ROCK ELEVATION AND DESCRIPTION	*N/A*	*N/A*
SOIL ELEVATION AND DESCRIPTION	*1327' SILTY-SAND AND SILTY-CLAYS*	*1327' SILTY-SAND AND SILTY-CLAYS*
ANGLE OF ATTACK OF FLOOD FLOWS ON ABUTMENT	*0*	*0*
DESCRIPTION OF RIPRAP OR OTHER SCOUR PROTECTION	*NONE*	*NONE*
ITEM 113 RATING	*8L*	*8L*

GENERAL COMMENTS:

1.) GROUTED RIPRAP UNDER DOWNSPOUTES FROM THE BRIDGE DECK AT ABUTMENT SLOPES.

BRIDGE NUMBER 9828

PIERS						
	1	2	3	4	5	6
CHANNEL/FLOODPLAIN	*CH.*					
PIER WIDTH	*36" DIA*					
SPREAD/PILES	*S*					
EXPOSED FOOTINGS	*NO*					
FOOTING HEIGHT	*N/A*					
FOOTING ELEVATION AND WIDTH	*1313.8'*					
ROCK ELEVATION/TYPE	*N/A*					
ELEVATION OF TOP OF GROUND OR CHANNEL; SOIL TYPE	*1327' SILTY-SAND, SILTY-CLAY*					
ANGLE OF ATTACK (DEG)	*0*					
RIPRAP OR OTHER PROTECTION	*NONE*					
ITEM 113 RATING	*8L*					

General Comments/Assessment:

1.) *PIER 1 IS TYPICAL FOR ALL PIERS.*

Recommended Item 113 and Risk Ratings:

8L

BRIDGE NUMBER 9828

SCREEN 3 - HYDRAULIC ENGINEER'S SCREEN

NAME: *ELLIOT ROAD* DATE: *4/20/95*

AGENCY: *PARSONS BRINCKERHOFF*

THE RECOMMENDED ITEM 113 RATING FOR THIS STRUCTURE IS: *8L*

THIS RECOMMENDATION IS BASED ON:

X A SCOUR EVALUATION

X A FULL OR DETAILED SCOUR ANALYSIS

THE RECOMMENDATION HAS BEEN APPROPRIATELY COORDINATED WITH THE BRIDGE/FOUNDATION/GEOTECHNICAL ENGINEERS WHO HAVE PREPARED SCREENS 1, 2 AND 4.

COMMENTS ON SCREEN 3:

- USE OF SCREEN 3 IS RECOMMENDED WHEN THERE ARE QUESTIONS OR ISSUES WHICH HAVE NOT BEEN FULLY ADDRESSED DURING THE ITEM 113 BRIDGE SCOUR EVALUATION UTILIZING SCREEN 2.

- **AS A FIRST STEP, THE HYDRAULIC ENGINEER IS ENCOURAGED TO REVIEW APPROPRIATE AVAILABLE INFORMATION AND TO INSPECT THE BRIDGE SITE TO DETERMINE IF ADEQUATE INFORMATION CAN BE DEVELOPED TO RESPOND TO THE ISSUES ON SCOUR RAISED IN THE SCREEN 2 REVIEW WITHOUT CONDUCTING A FULL OR DETAILED SCOUR ANALYSIS.**

- SINCE THE ITEM 113 RATING REQUIRES THE EVALUATION OF THE STABILITY OF THE STRUCTURE UNDER WORST CASE SCOUR CONDITIONS, THE HYDRAULIC ENGINEER WILL GENERALLY NEED TO CONDUCT THE EVALUATION/ANALYSIS IN COOPERATION WITH A FOUNDATION/GEOTECHNICAL ENGINEER, AND SCREEN 4 SHOULD BE PREPARED AS APPROPRIATE.

- THE HYDRAULIC ENGINEER SHOULD DOCUMENT THE BASIS FOR HIS OR HER RECOMMENDATION OF THE ANTICIPATED EXTENT OF SCOUR TO BE EXPECTED AT THE BRIDGE. SCOUR ANALYSES SHOULD BE BASED ON THE PROCEDURES SET FORTH IN THE MARYLAND SHA PPM ON SCOUR EVALUATION OF BRIDGES DATED 6/17/91 AND IN THE FHWA HYDRAULIC ENGINEERING CIRCULARS 18 AND 20.

BRIDGE NUMBER 9828

SCREEN 4 - FOUNDATION/GEOTECHNICAL ENGINEER'S SCREEN

NAME: *ELLIOT ROAD* Date: *4/20/95*

AGENCY: *AGRA - EARTH AND ENVIRONMENTAL INC.*

THE RECOMMENDED ITEM 113 RATING FOR THIS STRUCTURE IS: *8L*

THIS RECOMMENDATION IS BASED ON:

X A SCOUR EVALUATION

☐ A FULL OR DETAILED SCOUR AND STRUCTURAL STABILITY ANALYSIS

THE RECOMMENDATION HAS BEEN APPROPRIATELY COORDINATED WITH THE BRIDGE AND HYDRAULIC ENGINEERS WHO HAVE PREPARED SCREENS 1, 2 AND 3.

COMMENTS ON SCREEN 4:

- USE OF SCREEN 4 IS RECOMMENDED WHEN THERE ARE QUESTIONS OR ISSUES WHICH HAVE NOT BEEN FULLY ADDRESSED DURING THE ITEM 113 BRIDGE SCOUR EVALUATION UTILIZING SCREEN 2.
- **AS A FIRST STEP, THE FOUNDATION/GEOTECHNICAL ENGINEER IS ENCOURAGED TO REVIEW APPROPRIATE AVAILABLE INFORMATION AND TO INSPECT THE BRIDGE SITE TO DETERMINE IF ADEQUATE INFORMATION CAN BE DEVELOPED TO RESPOND TO THE ISSUES ON SCOUR RAISED IN THE SCREEN 2 REVIEW WITHOUT CONDUCTING A FULL OR DETAILED SCOUR ANALYSIS.**
- SINCE THE ITEM 113 RATING REQUIRES THE EVALUATION OF THE STABILITY OF THE STRUCTURE IN ACCORDANCE WITH AASHTO STABILITY CRITERIA UNDER WORST CASE SCOUR CONDITIONS, THE FOUNDATION/GEOTECHNICAL ENGINEER WILL GENERALLY NEED TO CONDUCT THE EVALUATION/ANALYSIS IN COOPERATION WITH A HYDRAULICS ENGINEER TO ADDRESS PERTINENT SCREEN ISSUES.
- THE FOUNDATION/GEOTECHNICAL ENGINEER SHOULD DOCUMENT THE BASIS FOR HIS OR HER RECOMMENDATION REGARDING THE STABILITY OF THE BRIDGE FOR THE ANTICIPATED WORST CASE SCOUR CONDITIONS AND THE EXTENT OF SCOUR TO BE EXPECTED AT THE BRIDGE. PARTICULAR ATTENTION SHOULD BE GIVEN TO:
  - FOUNDATIONS ON ROCK AND THE DEGREE TO WHICH THE ROCK IS SCOUR- RESISTANT.
  - THE STABILITY OF FOUNDATIONS ON PILES, IF THE PILING CAN BE EXPECTED TO BE EXPOSED BY SCOUR.
  - EVALUATION OF EXISTING INFORMATION TO DETERMINE OR ESTIMATE FOUNDATION CONDITIONS WHEN THE BRIDGE PLAN DETAILS ARE INCOMPLETE

BRIDGE NUMBER 9828

REVIEW BY INTERDISCIPLINARY SCOUR EVALUATION TEAM

DATE: _____ ITEM 113 RATING: _____

RISK RATING: _____

PROPOSED ACTIONS:

1.) _____

_____

_____

Notes:

BRIDGE NUMBER 9828

SCREEN 5 - BRIDGE MANAGER'S SCREEN

NAME/SIGNATURE *PARSONS BRINCKERHOFF* DATE: 4/20/95

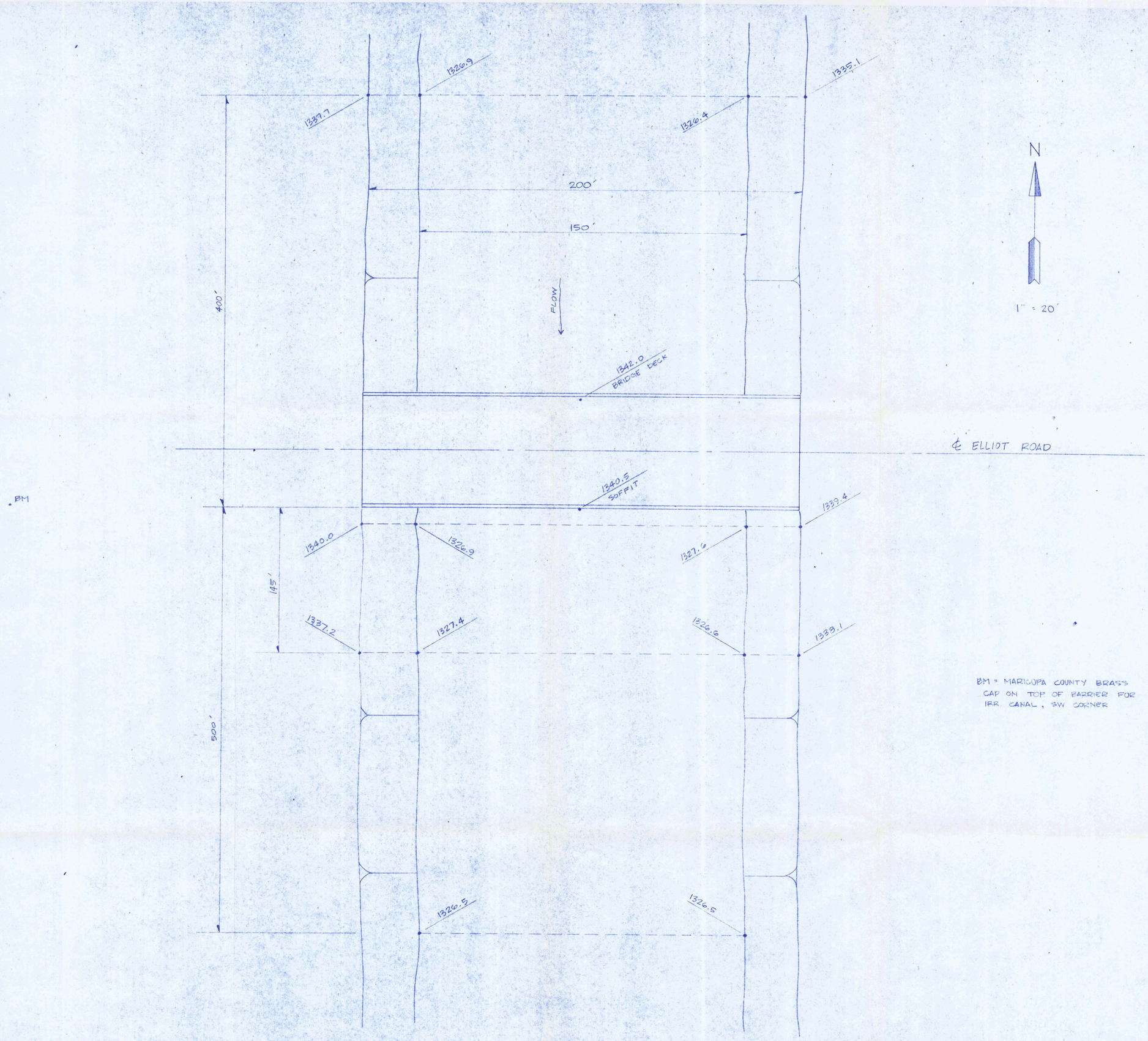
I HAVE REVIEWED SCREENS 1-4 AND CONCUR WITH THE FOLLOWING RATINGS:

- ITEM 113 RATING: *8L* DESCRIPTION:
- RISK RATING (FOR ITEM 113 RATING CODES 3 AND 6): *N/A*

COMMENTS ON SCREEN 5:

1. THE CODES SET FORTH IN TABLE 1, ARE TO BE USED IN RATING BRIDGES FOR ITEM 113.

2. EACH BRIDGE MANAGER/OWNER NEEDS TO DEVELOP AN ACTION PLAN FOR SCOUR CRITICAL BRIDGES (SEE FHWA HEC- 18, CHAPTER 7) THIS PLAN SHOULD ADDRESS MONITORING OF SCOUR CRITICAL BRIDGES DURING HIGH WATER AND SCHEDULING AND INSTALLATION OF SCOUR COUNTERMEASURES WHERE DETERMINED TO BE NECESSARY. IT IS RECOMMENDED THAT SCOUR CRITICAL BRIDGES BE PRIORITIZED (ACCORDING TO THE ENGINEER'S JUDGMENT AS TO THE RELATIVE RISK OF SUSTAINING DAMAGE DUE TO SCOUR IN A FUTURE FLOOD) AS SEVERE (3), MODERATE (2) OR MILD (1). BRIDGES CODED AS 6 U SHOULD ALSO BE GIVEN A RISK RATING AS DESCRIBED IN TABLE 1.



BM = MARICOPA COUNTY BRASS CAP ON TOP OF BARRIER FOR IRR. CANAL, SW CORNER

SCHEMATIC
NOT FOR CONSTRUCTION

ELLIOT ROAD BRIDGE

SURVEYED BY : JVB, KJS 4-17-95

DRAWN BY : KJS 4-19-95