BRIDGE SCOUR EVALUATIONS

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

Cave Creek Wash Bridge at Carefree Highway

(SN9825)

Preliminary Report

Submitted to:

Maricopa County
Department of Transportation

Submitted by:

PB PARSONS BRINCKERHOFF
100 YEARS

Survey info shall be stamped by RLS

HYDRAULIC ANALYSIS FOR THE CAREFREE HIGHWAY BRIDGE OVER THE CAVE CREEK WASH

MARICOPA COUNTY, ARIZONA

April 1, 1996

Submitted by:

Parsons Brinckerhoff Quade & Douglas

Tempe, Arizona

PB 100 YEARS

Table of Contents

1.0 INTRODUCTION

The existing Carefree Highway Bridge carries vehicular traffic over the Cave Creek Wash in Maricopa County, Arizona. Construction plans were prepared by the Maricopa County Department of Transportation and are dated February 1982. Spanning approximately 354 feet the bridge is composed of four equal spans of 87'-6". The abutments are supported on footings that have a bottom elevation of 1,837'. The piers are supported on spread footings founded on quartzite bedrock and have a bottom elevation of 1,837'. The plan channel bed elevation was 1,856' (at the time of design), which is one to two feet lower than the elevation obtained from the field survey. Therefore, some aggradation has occured since being designed. The bridge carries two lanes of traffic and is approximately 39'-2" wide, (including 1/2' barriers). The roadway is oriented in an east-west direction and the profile is a vertical curve, except for the bridge approaches. The east and west approach roadways have a one percent grade, at -1.0 and +1.0% grades respectively, connected by a 400 ft. vertical curve that crests at the center of the bridge. The watershed tributary to the bridge encompasses an area of 127 square miles and lies 6 miles upstream of Cave Buttes Dam.

1856
1837
0018'

Evaluating the scour potential of the existing bridge is the primary goal of the project. This report provides data on Cave Creek Wash hydrology and hydraulics in the bridge vicinity. Using the hydraulic data, a complete scour analysis is performed for the Carefree Highway Bridge.

Total scour depths for the 100-year flood are estimated to be 32.7 feet at the east abutment and 31.9 for the west abutment, and 34.0 feet for all piers. Total scour for the 500-year flood is estimated to be 47.6 feet at the east abutment and 46.8 for the west abutment, and 49.0 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 Carefree Highway Bridge over the Cave Creek Wash, project number 07100 dated 1981. U.S. 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.

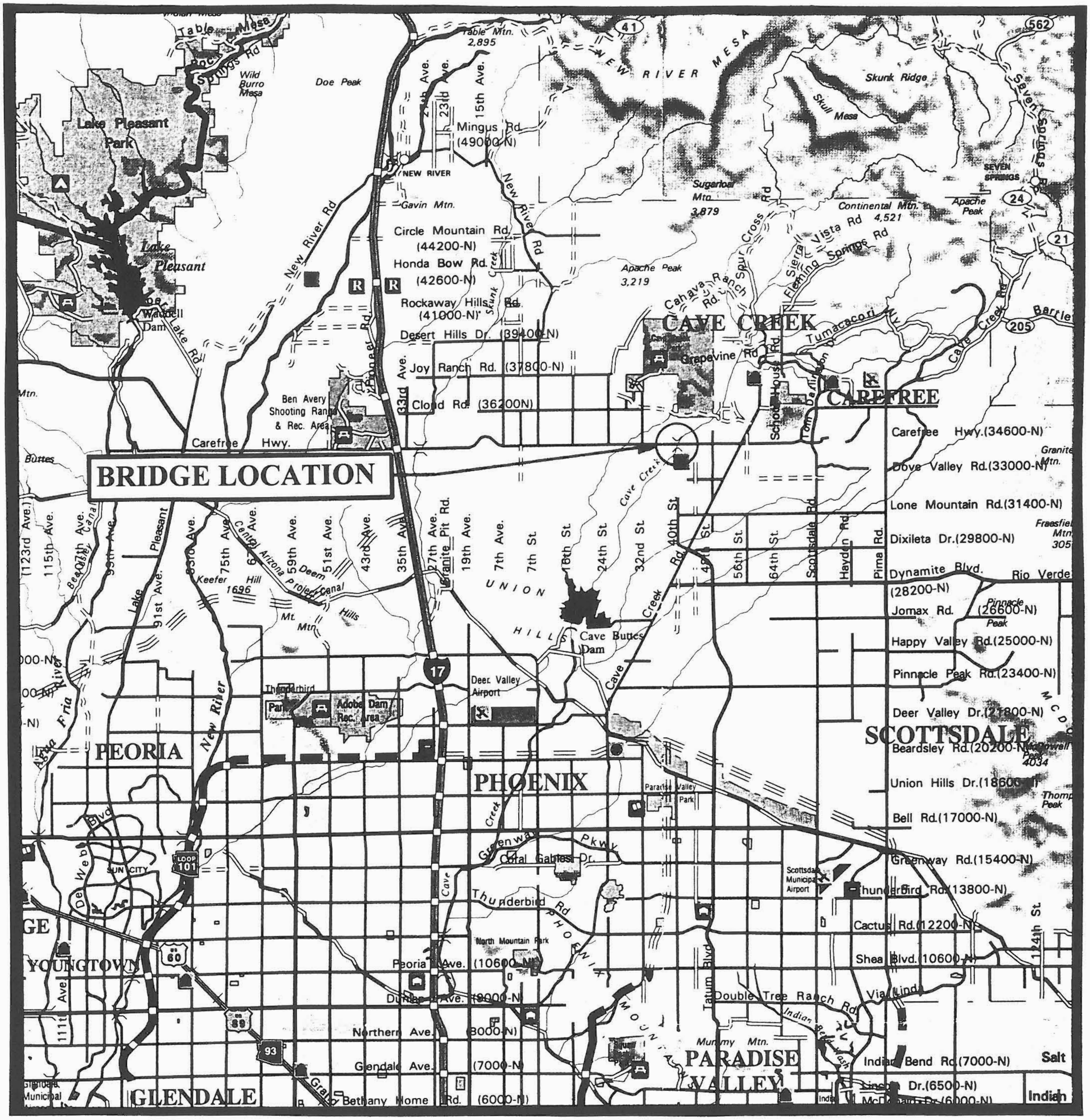
Parsons Brinckerhoff conducted a site visit on April 18, 1995. Extensive photographs of the site were taken and a visual survey of the bridge and surrounding area was made. A simple survey of the channel cross section was performed on April 18, 1995.

The scour screening procedure for the National Bridge Inventory System is completed for the Carefree Highway Bridge. The screening forms are included in the Appendix. The Carefree Highway Bridge over the Cave Creek Wash is rated as a scour critical bridge with a recommended Item 113 rating of 3C and may need a detailed scour analysis. The risk is rated as potentially severe and countermeasures are recommended along with screening. In order to verify the screening results and demonstrate the validity of the screening procedures a scour analysis was performed for the Carefree Highway Bridge. This information may be used in a structural stability analysis to verify that the bridge has an adequate foundation.

3.0 SITE DESCRIPTION

As shown in Figure 1, the site lies in the north corner of Phoenix in Maricopa County. The bridge lies approximately 6 miles upstream from the Cave Buttes Dam and the terrain in the immediate area is mountainous. On the left bank, riprap protection starts about 80 feet in front of the abutment and shows no evidence of erosion. On the right bank, about 300 feet in front of the bridge, there is evidence of some erosion. Near the right bank the channel is 40' wide and approximately 4' deeper than the remaining riverbed. At this point (about 300 feet in front of the bridge) the erosion stops. The remaining portion of the right bank with steep (about 1:1) slopes is covered by the vegetation and looks healthy. Riprap protection starts about 50 feet in front of the bridge. The bridge is on a 30° skew angle, right to the existing wash and road. One quater to one half mile upstream the wash bends to the east (right) and consequently bend scour is not anticipated for this bridge.

Figure 1


BRIDGE LOCATION
Lake Pleasant Park
Lake Pleasant
Table Mesa
Wild Burro Mesa
Doe Peak
NEW RIVER MESA
Skunk Ridge
Skull Mesa
Seven Springs Rd
Table Mtn. 2,895
Mingus Rd. (49000-N)
NEW RIVER
Gavin Mtn.
Circle Mountain Rd. (44200-N)
Honda Bow Rd. (42600-N)
Rockaway Hills Rd. (41000-N)
Desert Hills Dr. (39400-N)
Joy Ranch Rd. (37800-N)
Cloud Rd. (36200N)
New River Rd
Sugarloaf Mtn. 3,879
Continental Mtn. 4,521
Apache Peak
Apache Peak 3,219
Cahava Ranch Rd.
Spur Cross Rd
Sierra Vista Rd
Fleming Springs Rd
CAVE CREEK
Grapevine Rd
Tumacacori
CAREFREE
Carefree Hwy.
Ben Avery Shooting Range & Rec. Area
Carefree Hwy.(34600-N)
Dove Valley Rd.(33000-N)
Lone Mountain Rd.(31400-N)
Dixileta Dr.(29800-N)
Dynamite Blvd. (28200-N)
Rio Verde
Jomax Rd. (26600-N)
Pinnacle Peak
Happy Valley Rd.(25000-N)
Pinnacle Peak Rd.(23400-N)
Deer Valley Dr.(21800-N)
SCOTTSDALE
Beardsley Rd.(20200-N)
McDowell Peak 4034
Union Hills Dr.(18600-N)
Thompson Peak
Bell Rd.(17000-N)
Greenway Rd.(15400-N)
Thunderbird Rd.(13800-N)
Cactus Rd.(12200-N)
Shea Blvd.(10600-N)
Via Linda
Indian Bend Rd.(7000-N)
Lincoln Dr.(6500-N)
Salt
Cave Creek
UNION HILLS
Cave Buttes Dam
Deer Valley Airport
Adobe Dam Rec. Area
Thunderbird Park
PEORIA
PHOENIX
Paradise Valley Park
Greenway Pkwy
Coral Gables Dr.
Thunderbird Rd
North Mountain Park
Peoria Ave. (10600-N)
Dunlap Ave. (9000-N)
Northern Ave. (8000-N)
Glendale Ave. (7000-N)
Bethany Home Rd. (6000-N)
Scottsdale Municipal Airport
Tatum Blvd
Double Tree Ranch Rd
Mummy Mtn.
PARADISE VALLEY
PHOENIX MOUNTAINS
SUN CITY
YOUNGTOWN
GLENDALE
Grand Ave
Del Webb Blvd
Central Arizona Project Canal
Beardsley Canal
Agua Fria River
New River
Lake Pleasant Rd
Pioneer Rd.
Keefer Hill 1696
Deem Hills
Granite Pit Rd.
Scottsdale Rd
Hayden Rd
Pima Rd
124th St.

3.1 Geotechnical Evaluation

The original geotechnical investigation for this bridge was performed by Speedie & Associates (date of investigation not noted on plans). Test pits were excavated to maximum depths below adjacent existing ground surface of about 20 feet, with bottom elevations varying from about elevation 1,846 to 1,835.8 feet. The materials encountered in the test pits consisted predominantly of sand-gravel-cobbles mixtures, with varying amounts of boulders to a maximum size of 36 inches, and with traces of silty clay in some intervals. Bedrock was not encountered in any of the test pits. Cemented soils were noted at a few locations in the test pits, and are visible in the west bank of the channel upstream of the bridge. The estimated D_{50} particle size, based on plan review and field reconnaissance, is 30 mm for the bed materials, and 25 mm for the banks and overbanks. The soil is composed of sand, gravel and cobbles with some silt and silty clay. The amount of boulders up to 24-inch diameter increases with depth.

The riverbed is flat and consists predominantly of coarse sand, gravel, up to 10-inch diameter rocks, and occasionally up to 3-foot diameter boulders. No water was present in the channel at the time of inspection. During the field reconnaissance on April 18, 1995, scour holes were noted at some piers, with a maximum depth of about 1/2 to 1 foot. Vegetation was sparse in the channel bed at the bridge, but somewhat denser upstream and downstream; vegetation on banks and overbanks was sparse. Accumulated vegetative and other debris were noted on the upstream edges of several piers.

3.2 Structural Evaluation

The Carefree Highway bridge over the Cave Creek Wash is located on Carefree Highway between Stations 433+23 and 436+77. The total length of the bridge is 354 feet, and total width is 39'-2". The bridge crosses Cave Creek at the 30-degree skew angle to the right.

The bridge structure is a four-span precast prestressed AASHTO I-girder beam (Type IV), composite with a cast-in-place reinforced concrete deck slab. The superstructure is made continuous over the piers and is pin connected to pier bents. The supports at abutments are expansion type simple supports with elastomeric bearing pads. The uplift movement at abutments is prevented by anchor bolts protruding from the bearing seat through the slotted holes in steel plates attached to the AASHTO girders above the elastomeric bearing pads.

Stub abutments are constructed as two-bay frames having three 4'-0" diameter columns and spread footings embedded about 19 feet below the existing riverbed. Similar description applies to the pier bents. Existing bridge plans show bottom of channel elevations as 1,856, and bottom of footings as 1,837. The superstructure consists of 6 lines of precast, prestressed AASHTO Type IV I-girders at 6'-8" center-to-center, composite with 8 1/2" thick reinforced concrete, cast-in-place deck slab. At both ends of the bridge, there are standard 15 feet long approach slabs. No evidence of abnormal soil settlements are visible on the roadway in the vicinity of the bridge.

Presently, 2:1 slopes at the abutments are protected by a layer of dumped riprap in good condition. Riprap consists of the loose granite pieces up to five feet diameter. Dumped riprap approximately 4.5 feet thick was also called for on the plans around each pier. The bridge superstructure appears to be in excellent condition The structural members show no evidence of differential settlements, cracks, corrosion or other visible distress.

Looking upstream, East end of bridge.

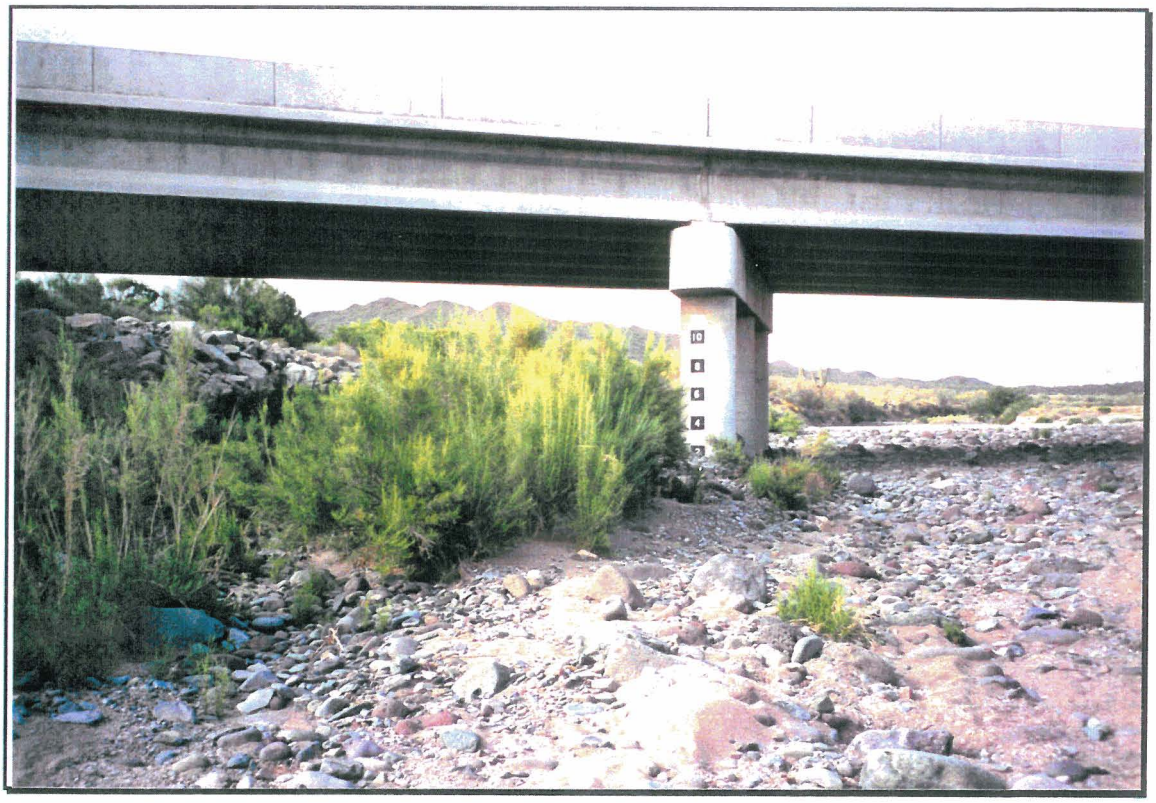
Downstream channel; East end of bridge.

CAREFREE HIGHWAY (CAVE CREEK WASH)

Looking downstream; West end of bridge.

View at bridge from downstream.

Middle pier.



Last pier; West end of bridge.

CAREFREE HIGHWAY (CAVE CREEK WASH)

4.0 HYDRAULIC ANALYSIS

As shown in Table 1, the 100-year design flood flow for the existing conditions is 35,900 cfs and the 500-year flood flow is 51,000 cfs. The HEC-2 output for the existing conditions calculates the maximum velocity at the bridge to be 12 fps for the 100-year flood event. Water surface elevation at the bridge is 1,868.8 feet for the 100-year flood conditions. The maximum velocity at the bridge is calculated as 13.3 fps for the 500-year flood. The Computed water surface elevation at the bridge is 1,870.5 feet for the 500-year flood. The minimum freeboard requirement of 3 feet for the 100-year flood event is met at the Carefree Highway Bridge.

Table 1

	100-Year Flood Existing Conditions	500-year Flood Existing Conditions
Discharge (cfs)	**35,900**	**51,000**
Velocity (fps)	**12.0**	**13.3**
WSEL (feet)	**1,868.8**	**1,870.5**

5.0 SCOUR ANALYSIS

A scour analysis is performed for the proposed conditions for both the 100-year flood 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, bend scour (if applicable), contraction scour, 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 observations for long-term degradation for this bridge can be found 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 well 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 contact 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 Carefree Highway Bridge is skewed 30° to the Cave Creek Wash, however, the angle of attack is 0°, i.e. the flow is normal to the piers. Maps of the area show the Cave Creek Wash flowing in a relatively straight line both upstream and downstream of the bridge, thereby indicating that the flow is parallel with the channel and 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 plus any debris accumulation. The pier width used for scour calculations is 8.0 feet. Debris accumulation was estimated at twice the pier width for all piers.

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 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.

No bend scour is predicted to occur at the Carefree Highway Bridge. The Cave Creek Wash flows in a relatively straight line and does not flow around any bends in the bridge vicinity.

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 finally 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. 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

Based on survey data taken during the site visit on April 18, 1995 it appears aggradation of approximately one foot has occurred at the bridge. Lateral migration of the thalweg may occur, although the river tends to flow in a relatively straight line in the bridge vicinity. The floodplain and the sandy soil combine to create a condition where extensive lateral migration may occur with each flood event. Because the thalweg could shift to different points in the floodway, a constant invert elevation of 1,856 feet is used for scour calculations for the entire cross section. This was the elevation used in the design plans in 1982 and should be conservative, since the current bed elevation is 1 to 2 feet higher.

6.2 Contraction Scour

As shown in Table 2, contraction scour is estimated at approximately 19 feet for the 100-year flood event and 33 feet for the 500-year flood event. The upstream width is approximately 370 feet, which represents the distance across the top of the upstream main channel. The high scour depths are due to the contraction between the approach section and the bridge section. In the approach to the bridge the water is spread out over a wide area but as the water nears the bridge the flow is contracted significantly by the canyon walls. This loss in flow area causes the high scour depths calculated. All of the 100-year and 500-year flows are contained within the bridge structure. No flow overtops the approach roadway.

6.3 Pier Scour

Local pier scour is predicted to occur at the bridge site for each of the flood events. The effective width used in the scour calculations was equal to twice the pier width to account for debris accumulation. The maximum pier scour is estimated to be approximately 16 feet for the 100-year flood and 17 feet for the 500-year flood scenario. The maximum estimated pier scour may occur

at any of the piers. The dumped riprap at the piers should reduce scour depths, however, the calculations do not reflect the presence of riprap protection. Calculations for pier scour are included in the Appendix.

Table 2

100-Year Flood Existing Conditions	East Abutment	Pier	West Abutment
Aggradation	1.0 foot	1.0 foot	1.0 foot
Local Scour	14.7 feet	16.0 feet	13.9 feet
Contraction	19.0 feet	19.0 feet	19.0 feet
Total Scour	**32.7 feet**	**34.0 feet**	**31.9 feet**
Remaining Pile Depth	-13.7 feet	-15 feet	-12.9 feet
500-year Flood Existing Conditions	**East Abutment**	**Pier**	**West Abutment**
Aggradation	1.0 foot	1.0 foot	1.0 foot
Local Scour	15.6 feet	17.0 feet	14.8 feet
Contraction	33.0 feet	33.0 feet	33.0 feet
Total Scour	**47.6 feet**	**49.0 feet**	**46.8 feet**
Remaining Pile Depth	-28.6 feet	-30 feet	-27.8 feet

6.4 Abutment Scour

The east and west abutment scour estimates for each of the floods are shown in Table 2. Please note that the abutment scour equation recommended by HEC-18 is inherently conservative and includes a large factor of safety. The riprap should adequately protect the abutments and should greatly reduce the predicted maximum scour depth. Table 2 shows the abutment scour for the east abutment is 14.7 feet and 15.6 feet for the 100-year and 500-year flood events. The scour at

the west abutment is 13.9 feet for the 100-year flood event and 14.8 feet for the 500-year flood event.

HEC-18 recommends placing abutment footings at least 6 feet below the depth reached by long-term degradation and contraction scour. A lateral stability analysis is warranted because the total scour depths extend well below this elevation.

6.5 Total Scour

Table 2 summarizes the total scour predicted at each pier and abutment for the 100-year and 500-year flood event, this includes an amount for aggradation of the channel. 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. Debris accumulation is not shown in the scour plot, however, accumulation of twice the pier width was used to calculate the scour depths. Scour computations are included in the appendix. Both the 100-year and 500-year flood event scour depths completely expose the footings.

Scour due to the Sand & Gravel mining u/s of the bridge shall be analyzed.

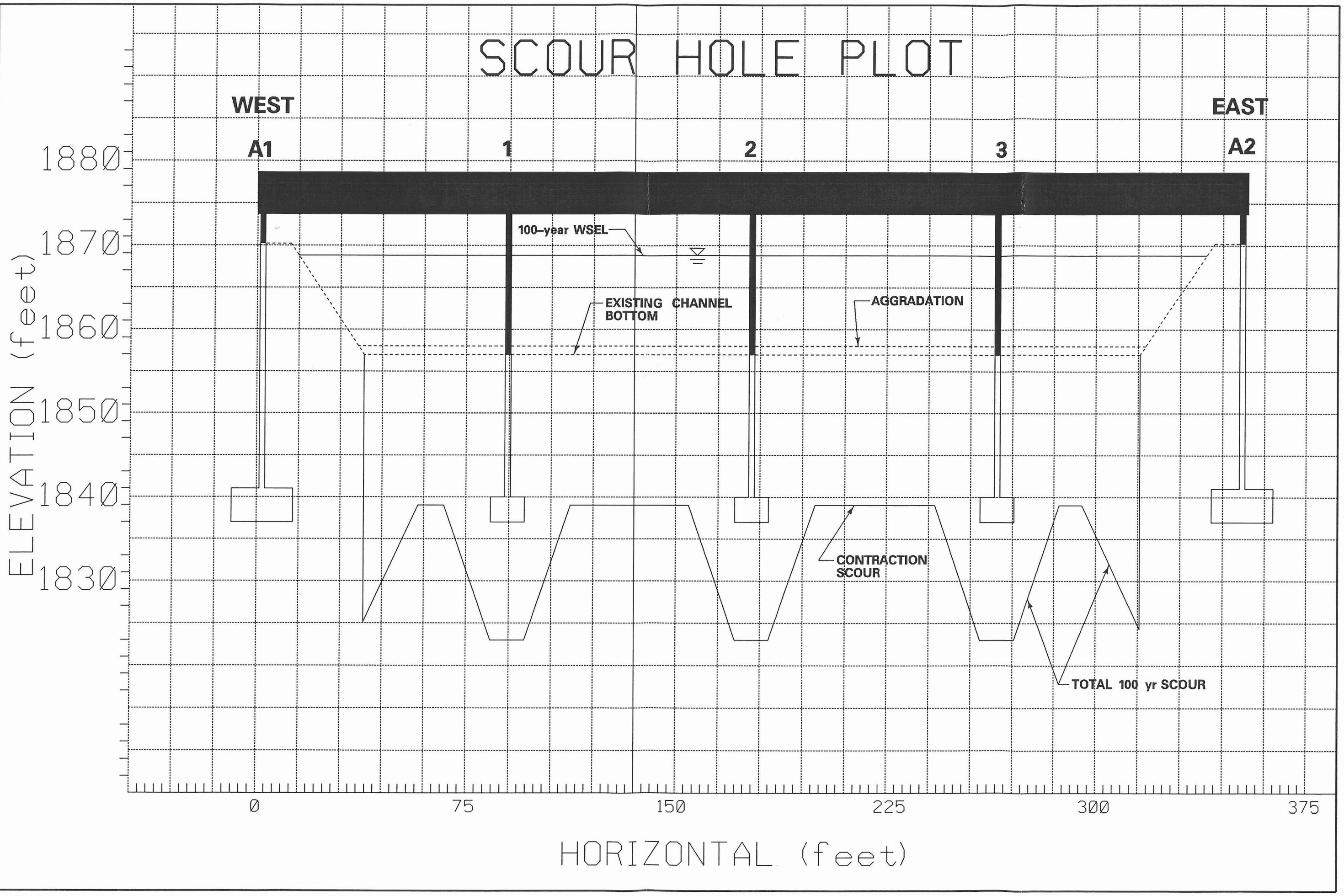
7.0 INITIAL EVALUATION

The Carefree Highway Bridge over the Cave Creek Wash is scour critical. High scour depths are calculated at both abutments, however the riprap protection should prevent scour of the magnitude calculated. The dumped riprap at the piers should help alleviate some scour depths from occurring around the piers. The scour depths extend beyond the footings for both the 100-year and 500-year floods.

Debris accumulation was observed on the piers. This debris blockage should be removed from around the piers because it creates a larger obstruction to the flow and may cause deeper scour depths. The scour calculations were performed assuming debris blockage equal to twice the pier width. The removal of debris from around the piers would reduce scour depths. Riprap at the abutments should be inspected after each major flood event and replaced or repaired if necessary.

The Carefree Highway Bridge over the Cave Creek Wash is rated as a scour-critical bridge with a recommended Item 113 rating of 3C and will need a detailed scour analysis. The screening forms are included in the appendix. The bridge should be closely monitored to keep abreast of any scour damage that may occur.

SCOUR HOLE PLOT



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CHECKED BY _____ DATE _____
APPROVED BY _____ DATE _____

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New River Rd.
Carefree Hwy.
Cave Creek


New River Rd.
Carefree Hwy.
Cave Creek

CAREFREE HIGHWAY BRIDGE OVER THE CAVE CREEK WASH

CONTRACTION SCOUR

CASE 1 - LIVE BED	SEE NOTE	100-YEAR	500-YEAR
Y1 - AVE. DEPTH IN UPSTREAM MAIN CHANNEL(FT)	1	11.0	14.6
W1 - WIDTH OF UPSTREAM MAIN CHANNEL(FT)		370	370
W2 - WIDTH OF CONTRACTED SECTION(FT)	2	281	281
N1 - AT MAIN CHANNEL		0.042	0.042
N2 - AT CONTRACTED SECTION		0.042	0.042
Q_1 - FLOW IN UPSTREAM MAIN CHANNEL (CFS)		13,552	15,664
Q_2 - FLOW IN CONTRACTED SECTION (CFS)		35,900	51,000
$(Q_2/Q_1)^{6/7}$		2.30	2.75
S1 - SLOPE OF ENERGY GRADE LINE IN US CHANNEL (FT/FT)	3	0.00343	0.00179
V*c - SHEAR VELOCITY(FPS) = [32.2(Y1)(S1)]^0.5		1.10	0.92
K1	4	0.59	0.59
(W1/W2)^K1		1.18	1.18
$Y2/Y1 = Q_2/Q_1^{(6/7)}(W1/W2)^{K1}$		2.71	3.24
Ys = Y2-Y1 = SCOUR (FT)	5,6	19	33

NOTES:

1. Y1 IS AVE. DEPTH IN MAIN CHANNEL.

2. W2 = (TOP WIDTH)-(SUM OF EFFECTIVE PIER WIDTHS). 305'-(3x8') = 281'

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

4. K1 VALUE ASSUMES MOSTLY CONTACT 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)

CAREFREE HIGHWAY BRIDGE OVER THE CAVE CREEK WASH

PIER SCOUR - EXISTING CONDITIONS

		100-YEAR			500-YEAR		
THREE COLUMN BENT	**SEE NOTE**	**LEFT OVERBANK**	**MAIN CHANNEL**	**RIGHT OVERBANK**	**LEFT OVERBANK**	**MAIN CHANNEL**	**RIGHT OVERBANK**
PIER NUMBER(S)			1-3			1-3	
SKEW ANGLE (DEGREES)			0			0	
a - PIER WIDTH (FT)	1		8			8	
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		12.0			13.3	
Y1 - DEPTH OF FLOW UPSTRM. FACE OF PIER (FT)	4		10.7			13.4	
Fr1 - FROUDE NUMBER = V1/(32.2*Y1)^1/2			0.65			0.64	
[a/Y1]^0.65			0.83			0.72	
Ys/Y1 = 2K1K2K3(a/Y1)^.65(Fr1)^.43	5		1.51			1.30	
Ys SCOUR DEPTH (FT)			16			17	

NOTES:

1. TWICE THE PIER WIDTH IS USED FOR THE EFFECTIVE PIER WIDTH 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. THE MAXIMUM VELOCITY IS USED BECAUSE THE THALWEG MAY MOVE TO ANY PIER IN THE CHANNEL. VELOCITY OBTAINED FROM HEC-2 OUTPUT.

4. DEPTH VARIES AT DIFF. PIERS. MAX VALUE IS OBTAINED FROM HEC-2 OUTPUT TO. ACCOUNT FOR POSSIBLE THALWEG MOVEMENT.

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

CAREFREE HIGHWAY BRIDGE OVER THE CAVE CREEK WASH

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)		5.35	5.35	6.70	6.70
a'- ABUT. LENGTH NORMAL TO FLOW (FT)		15	15	10	10
(a'/Ya)^0.43		1.56	1.56	1.19	1.19
Ve = Qe/Ae	1	12.00	12.00	13.30	13.30
Fre = Ve/(32.2*Ya)^(1/2) = FROUDE NO.		0.91	0.91	0.91	0.91
Fre^0.61		0.95	0.95	0.94	0.94
(THETA) = ANGLE BTWN. ABUT. AND FLOW	2	60	30	60	30
K2 = ((THETA)/90)^0.13		0.948655	0.86691	0.948655	0.86691
K1	3	0.55	0.55	0.55	0.55
Ys/Ya = 2.27K1K2* (a'/Ya)^0.43(Fre^0.61) + 1		2.7	2.6	2.3	2.2
Ys SCOUR (FT)		14.7	13.9	15.6	14.8

NOTES:

1. Ve TAKEN FROM HEC-2 VELOCITY IN MAIN CHANNEL.

2. THETA < 90 IF POINTED DOWNSTREAM, > 90 IF POINTED UPSTREAM.
   THETA = 60 FOR EAST ABUTMENT, 30 FOR WEST ABUTMENT.

3. K1 = 0.55 FOR SPILLTHROUGH ABUTMENT.

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*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    28MAR96    TIME   18:30:40  *
*******************************************
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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
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THIS RUN EXECUTED 28MAR96 18:30:40

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

 Version   4.6.2;  May 1991
***************************************
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            CAREFREE HIGHWAY BRIDGE OVER THE CAVE CREEK WASH
            FILE NAME CAVE
            PARSONS BRINCKERHOFF - TEMPE, ARIZONA
            AN EXISTING HEC-2 RUN PROVIDED BY THE MARICOPA COUNTY
            FLOOD CONTROL DISTRICT WAS EDITED TO REFLECT THE SURVEY
            DATA AT THE BRIDGE SECTION.
            DEBRIS BLOCKAGE WAS ESTIMATED USING TWICE THE PIER WIDTH
            FOR ALL PIERS.
 1          MCDOT HYDRAULIC ANALYSIS
 2          100-yr SUB-CRITICAL RUN FOR THE CAREFREE HIGHWAY BRIDGE
T3          CAVE CREEK WASH

 1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

       0         2         0         0                                              1866.22

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

      1                 -1                                                                     15


 3  VARIABLE CODES FOR SUMMARY PRINTOUT

    100        105        150
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```
NC     .050      .050      .042      .300      .500
QT        2     35900     51000         0         0         0
ET        0         0         0         0         0       9.1         0         0      1520      2050
X1   29.570        19      1950      2050         0         0         0
GR     1880       900      1872       990      1868      1010      1864      1050      1856      1160
GR     1860      1250      1856      1460      1856      1510      1858      1570      1856      1600
GR     1852      1650      1852      1800      1855      1860      1856      1950      1848      1980
GR     1848      2025      1856      2050      1868      2085      1869      2160

ET        0         0         0         0         0       9.1         0         0      1548      2083
          EXIT SECTION - 680' FROM DOWNSTREAM FACE OF BRIDGE
X1     29.7        15      1915      2050       700       600       680
GR     1880       960      1876      1200      1868      1280      1863      1470      1865      1670
GR     1864      1800      1860      1840      1856      1915      1854      1950      1854      2040
GR     1860      2050      1864      2170      1868      2180      1872      2580      1876      2740

ET        0         0         0                   0       9.1         0         0      1580      2100
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          DOWNSTREAM FACE OF BRIDGE
X1    29.73        15      1890      2050       350        50       140
X3       10
GR     1881      1000      1880      1130      1868      1190      1868      1280      1869      1380
GR     1868      1610      1864      1700      1860      1810      1860      1890      1856      1950
GR     1856      2040      1858      2050      1860      2080      1864      2250      1868      2380

ET        0         0         0         0         0       9.1         0         0      1570      2100
SB     1.05       1.5         3         0       240        24      4260         2      1857      1857
          UPSTREAM FACE OF BRIDGE
X1    29.74        20      1900      2205        80        20        20
X2                             1    1872.7   1877.93                                          15
X3       10
BT        2      1900   1877.93                2205   1877.93
GR     1881      1000      1880      1075      1872      1120      1870      1300      1872      1360
GR     1872      1420      1868      1570      1864      1710   1877.93      1900      1859      1931
GR   1856.9      1975    1856.9      2050    1859.7      2067    1856.7      2097    1856.9      2127
GR   1858.9      2180    1877.9      2205      1864      2260      1868      2390      1880      4000

ET        0         0         0         0         0       9.1         0         0      1550      2050
          APPROACH SECTION - 330' FROM UPSTREAM FACE OF BRIDGE
X1     29.8        18      1930      2050       130       280       330
X2                                                                                          15
GR     1880      1040      1872      1100      1876      1200      1872      1320      1868      1350
GR     1866      1410      1868      1560      1864      1680      1864      1800      1862      1835
GR     1864      1850      1865      1890      1864      1930      1860      1960      1860      2040
GR     1864      2050      1872      2070      1876      2150
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   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
0
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 CCHV=      .300 CEHV=      .500
 *SECNO 29.570
     29.570      18.22    1866.22        .00    1866.22    1866.41        .19        .00        .00    1856.00
    35900.0    27882.5     7735.4      282.2     8987.6     1602.0      152.3         .0         .0    1856.00
        .00       3.10       4.83       1.85       .050       .042       .050       .000    1848.00    1027.80
    .000475         0.         0.         0.          0          0          0        .00    1052.01    2079.81


 FLOW DISTRIBUTION FOR SECNO=      29.57          CWSEL=    1866.22

 STA=    1028.     1160.     1250.     1460.     1510.     1570.     1650.     1800.     1860.     1950.     2050.     2080.
   PER Q=       4.2       5.4      12.7       4.3       4.4       8.0      22.6       7.5       8.5      21.5        .8
    AREA=     708.8     739.8    1726.2     511.0     553.2     887.6    2133.0     763.2     964.8    1602.0     152.3
     VEL=       2.1       2.6       2.6       3.1       2.8       3.2       3.8       3.5       3.2       4.8       1.9
   DEPTH=       5.4       8.2       8.2      10.2       9.2      11.1      14.2      12.7      10.7      16.0       5.1

 *SECNO 29.700

 3301 HV CHANGED MORE THAN HVINS

 7185 MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
              EXIT SECTION - 680' FROM DOWNSTREAM FACE OF BRIDGE
     29.700      12.08    1866.08    1866.08        .00    1868.45       2.37        .81       1.09    1856.00
    35900.0     9835.5    23016.8     3047.7     1569.5     1565.5      494.7      114.0       14.8    1860.00
        .02       6.27      14.70       6.16       .050       .042       .050       .000    1854.00    1353.05
    .006690       700.       680.       600.          3         14          0        .00     822.14    2175.19


 FLOW DISTRIBUTION FOR SECNO=      29.70          CWSEL=    1866.08

 STA=    1353.     1470.     1670.     1800.     1840.     1915.     2050.     2170.     2175.
   PER Q=       1.6       4.6       1.9       2.8      16.5      64.1       8.5         .0
    AREA=     180.0     415.5     205.1     163.1     605.8    1565.5     489.3       5.4
     VEL=       3.2       4.0       3.3       6.2       9.8      14.7       6.2       2.4
   DEPTH=       1.5       2.1       1.6       4.1       8.1      11.6       4.1       1.0

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    28MAR96       18:30:40                                                                          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 29.730

 3265 DIVIDED FLOW

 3280 CROSS SECTION      29.73 EXTENDED        .75 FEET


 3301 HV CHANGED MORE THAN HVINS


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.64
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DOWNSTREAM FACE OF BRIDGE

29.730	12.75	1868.75	.00	.00	1869.60	.85	.69	.46	1860.00
35900.0	9213.5	17596.7	9089.8	1849.6	1909.5	1796.4	134.6	20.3	1858.00
.02	4.98	9.22	5.06	.050	.042	.050	.000	1856.00	1186.27
.002494	350.	140.	50.	3	0	0	.00	1110.10	2380.00

FLOW DISTRIBUTION FOR SECNO= 29.73 CWSEL= 1868.75

STA=	1186.	1280.	1355.	1610.	1700.	1810.	1890.	2050.	2080.	2250.	2380.
PER Q=	.2	.1	.1	2.0	11.0	12.3	49.0	5.5	16.9	2.9	
AREA=	68.6	27.9	64.1	247.2	742.1	699.7	1909.5	292.4	1146.9	357.1	
VEL=	1.2	.8	.8	2.9	5.3	6.3	9.2	6.8	5.3	2.9	
DEPTH=	.7	.4	.3	2.7	6.7	8.7	11.9	9.7	6.7	2.7	

SPECIAL BRIDGE

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	1.05	1.50	3.00	.00	240.00	24.00	4260.00	2.00	1857.00	1857.00

*SECNO 29.740

3301 HV CHANGED MORE THAN HVINS

CLASS A LOW FLOW

3420 BRIDGE W.S.= 1867.69 BRIDGE VELOCITY= 14.15 CALCULATED CHANNEL AREA= 2537.

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

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
.00	1871.19	.19	0.	35900.	4260.	3884.	1872.70	1877.93	0.

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1877.93 ELREA= 1877.90

UPSTREAM FACE OF BRIDGE

29.740	12.24	1868.94	.00	.00	1871.19	2.24	1.59	.00	1877.93
35900.0	.0	35900.0	.0	.0	2987.1	.0	137.9	21.1	1877.90
.02	.00	12.02	.00	.000	.042	.000	.000	1856.70	1914.72
.005033	80.	20.	20.	0	0	0	.00	278.50	2193.21

LOW DISTRIBUTION FOR SECNO= 29.74 CWSEL= 1868.94

TA= 1915. 2205.
PER Q= 100.0
AREA= 2987.1
VEL= 12.0

DEPTH= 10.7

*SECNO 29.800

3301 HV CHANGED MORE THAN HVINS

APPROACH SECTION - 330' FROM UPSTREAM FACE OF BRIDGE

29.800	11.72	1871.72	.00	.00	1872.68	.96	1.11	.39	1864.00
35900.0	22044.6	13552.2	303.2	3666.5	1325.8	74.4	159.9	23.5	1864.00
.03	6.01	10.22	4.08	.050	.042	.050	.000	1860.00	1322.14
.003431	130.	330.	280.	4	0	0	.00	747.15	2069.29

FLOW DISTRIBUTION FOR SECNO= 29.80 CWSEL= 1871.72

STA=	1322.	1350.	1410.	1560.	1680.	1800.	1835.	1850.	1890.	1930.	2050.	2069.
PER Q=	.4	3.9	9.6	10.6	17.5	6.3	2.7	5.2	5.2	37.7	.8	
AREA=	51.8	282.9	707.3	685.8	925.8	305.0	130.7	288.6	288.6	1325.8	74.4	
VEL=	2.6	4.9	4.9	5.6	6.8	7.4	7.3	6.5	6.5	10.2	4.1	
DEPTH=	1.9	4.7	4.7	5.7	7.7	8.7	8.7	7.2	7.2	11.0	3.9	

1

T1 MCDOT HYDRAULIC ANALYSIS
T2 500-yr SUB-CRITICAL RUN FOR THE CAREFREE HIGHWAY BRIDGE
T3 CAVE CREEK WASH

T1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0	3	0	0					1867.59	

T2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	2		-1							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

CHV= .300 CEHV= .500
SECNO 29.570

29.570	19.59	1867.59	.00	1867.59	1867.89	.30	.00	.00	1856.00
51000.0	40161.1	10377.2	461.7	10260.4	1739.0	195.9	.0	.0	1856.00
.00	3.91	5.97	2.36	.050	.042	.050	.000	1848.00	1014.10
.000651	0.	0.	0.	0	0	0	.00	1069.70	2083.80

FLOW DISTRIBUTION FOR SECNO= 29.57 CWSEL= 1867.59

STA=	1014.	1160.	1250.	1460.	1510.	1570.	1650.	1800.	1860.	1950.	2050.	2084.
PER Q=	4.9	5.8	13.5	4.4	4.6	8.0	21.7	7.3	8.5	20.3	.9	
AREA=	899.3	863.1	2013.9	579.5	635.4	997.2	2338.5	845.4	1088.1	1739.0	195.9	
VEL=	2.8	3.4	3.4	3.9	3.7	4.1	4.7	4.4	4.0	6.0	2.4	
DEPTH=	6.2	9.6	9.6	11.6	10.6	12.5	15.6	14.1	12.1	17.4	5.8	

*SECNO 29.700

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
EXIT SECTION - 680' FROM DOWNSTREAM FACE OF BRIDGE

29.700	13.44	1867.44	1867.44	.00	1870.16	2.71	1.06	1.21	1856.00
51000.0	17178.3	28686.8	5134.9	2371.7	1749.7	667.9	134.7	15.4	1860.00
.02	7.24	16.40	7.69	.050	.042	.050	.000	1854.00	1301.20
.007172	700.	680.	600.	3	19	0	.00	877.41	2178.61

FLOW DISTRIBUTION FOR SECNO= 29.70 CWSEL= 1867.44

STA=	1301.	1470.	1670.	1800.	1840.	1915.	2050.	2170.	2179.
PER Q=	3.1	7.7	3.9	3.3	15.6	56.2	10.0	.1	
AREA=	374.9	688.4	382.5	217.7	708.2	1749.7	653.1	14.8	
VEL=	4.3	5.7	5.2	7.8	11.2	16.4	7.8	3.4	
DEPTH=	2.2	3.4	2.9	5.4	9.4	13.0	5.4	1.7	

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 29.730
3280 CROSS SECTION 29.73 EXTENDED 2.52 FEET

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.72

DOWNSTREAM FACE OF BRIDGE

29.730	14.52	1870.52	.00	.00	1871.43	.92	.74	.54	1860.00
51000.0	15440.6	21836.9	13722.5	3093.4	2192.9	2380.9	164.7	21.5	1858.00
.02	4.99	9.96	5.76	.050	.042	.050	.000	1856.00	1177.41
.002421	350.	140.	50.	4	0	0	.00	1202.59	2380.00

FLOW DISTRIBUTION FOR SECNO= 29.73 CWSEL= 1870.52

STA=	1177.	1190.	1280.	1380.	1610.	1700.	1810.	1890.	2050.	2080.	2250.	2380.
PER Q=	.1	1.2	.9	2.1	3.2	11.2	11.6	42.8	5.0	17.3	4.5	

AREA=	15.9	226.6	201.8	464.1	406.6	937.0	841.4	2192.9	345.5	1448.1	587.3
VEL=	1.7	2.7	2.3	2.3	4.0	6.1	7.0	10.0	7.4	6.1	3.9
DEPTH=	1.3	2.5	2.0	2.0	4.5	8.5	10.5	13.7	11.5	8.5	4.5

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 1865.71 , NOT 1870.52 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

3B XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
1.05	1.50	3.00	.00	240.00	24.00	4260.00	2.00	1857.00	1857.00

*SECNO 29.740

3301 HV CHANGED MORE THAN HVINS

CLASS B LOW FLOW

3420 BRIDGE W.S.= 1868.57 BRIDGE VELOCITY= 18.44 CALCULATED CHANNEL AREA= 2766.

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

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD	WEIRLN
1873.86	1874.71	.00	0.	51000.	4260.	3884.	1872.70	1877.93	0.

495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1877.93 ELREA= 1877.90

UPSTREAM FACE OF BRIDGE

29.740	15.27	1871.97	.00	.00	1874.71	2.73	3.27	.00	1877.93
51000.0	.0	51000.0	.0	.0	3844.1	.0	169.5	22.3	1877.90
.02	.00	13.27	.00	.000	.042	.000	.000	1856.70	1909.76
.004605	80.	20.	20.	0	0	0	.00	287.44	2197.20

FLOW DISTRIBUTION FOR SECNO= 29.74 CWSEL= 1871.97

TA=	1910.	2205.
PER Q=	100.0	
AREA=	3844.1	
VEL=	13.3	
DEPTH=	13.4	

SECNO 29.800

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.60

APPROACH SECTION - 330' FROM UPSTREAM FACE OF BRIDGE

29.800	15.32	1875.32	.00	.00	1876.03	.71	.71	.61	1864.00
51000.0	34482.7	15664.6	852.7	6203.8	1757.5	256.0	200.8	25.3	1864.00
.03	5.56	8.91	3.33	.050	.042	.050	.000	1860.00	1075.15
.001791	130.	330.	280.	3	0	0	.00	1023.31	2136.26

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= 29.80 CWSEL= 1875.32

STA=	1075.	1410.	1560.	1680.	1800.	1835.	1890.	1930.	2050.	2136.
PER Q=	7.4	12.6	12.2	16.9	5.7	7.6	5.2	30.7	1.7	
AREA=	1001.1	1246.9	1117.5	1357.5	431.0	617.2	432.5	1757.5	256.0	
VEL=	3.8	5.2	5.6	6.3	6.7	6.3	6.1	8.9	3.3	
DEPTH=	3.0	8.3	9.3	11.3	12.3	11.2	10.8	14.6	3.0	

1

THIS RUN EXECUTED 28MAR96 18:30:41

****

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

CAVE CREEK WASH

SUMMARY PRINTOUT TABLE 100

SECNO	EGLWC	ELLC	EGPRS	ELTRD	QPR	QWEIR	CLASS	H3	DEPTH	CWSEL	VCH	EG
29.740	1871.19	1872.70	.00	1877.93	35900.00	.00	1.00	.19	12.24	1868.94	12.02	1871.19
29.740	1874.71	1872.70	1873.86	1877.93	51000.00	.00	2.00	.00	15.27	1871.97	13.27	1874.71

1

CAVE CREEK WASH

SUMMARY PRINTOUT TABLE 105

	SECNO	CWSEL	HL	OLOSS	TOPWID	QLOB	QCH	QROB
*	29.700	1866.08	.81	1.09	822.14	9835.47	23016.79	3047.74
*	29.700	1867.44	1.06	1.21	877.41	17178.29	28686.79	5134.93
*	29.730	1868.75	.69	.46	1110.10	9213.51	17596.68	9089.81
*	29.730	1870.52	.74	.54	1202.59	15440.57	21836.90	13722.52
	29.740	1868.94	1.59	.00	278.50	.00	35900.00	.00
*	29.740	1871.97	3.27	.00	287.44	.00	51000.00	.00
	29.800	1871.72	1.11	.39	747.15	22044.59	13552.22	303.20
*	29.800	1875.32	.71	.61	1023.31	34482.71	15664.56	852.73

CAVE CREEK WASH

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
	29.570	.00	.00	.00	1848.00	35900.00	1866.22	.00	1866.41	4.75	4.83	10741.93	16467.05
	29.570	.00	.00	.00	1848.00	51000.00	1867.59	.00	1867.89	6.51	5.97	12195.30	19993.51
*	29.700	680.00	.00	.00	1854.00	35900.00	1866.08	1866.08	1868.45	66.90	14.70	3629.71	4389.16
*	29.700	680.00	.00	.00	1854.00	51000.00	1867.44	1867.44	1870.16	71.72	16.40	4789.23	6022.04
*	29.730	140.00	.00	.00	1856.00	35900.00	1868.75	.00	1869.60	24.94	9.22	5555.42	7188.51
*	29.730	140.00	.00	.00	1856.00	51000.00	1870.52	.00	1871.43	24.21	9.96	7667.20	10364.05
	29.740	20.00	1877.93	1872.70	1856.70	35900.00	1868.94	.00	1871.19	50.33	12.02	2987.11	5060.33
*	29.740	20.00	1877.93	1872.70	1856.70	51000.00	1871.97	.00	1874.71	46.05	13.27	3844.11	7515.81
	29.800	330.00	.00	.00	1860.00	35900.00	1871.72	.00	1872.68	34.31	10.22	5066.72	6129.36
*	29.800	330.00	.00	.00	1860.00	51000.00	1875.32	.00	1876.03	17.91	8.91	8217.37	12051.13

1

CAVE CREEK WASH

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	29.570	35900.00	1866.22	.00	.00	.00	1052.01	.00
	29.570	51000.00	1867.59	1.37	.00	.00	1069.70	.00
*	29.700	35900.00	1866.08	.00	-.14	.00	822.14	680.00

*	29.700	51000.00	1867.44	1.36	-.15	.00	877.41	680.00
*	29.730	35900.00	1868.75	.00	2.67	.00	1110.10	140.00
*	29.730	51000.00	1870.52	1.77	3.08	.00	1202.59	140.00
	29.740	35900.00	1868.94	.00	.19	.00	278.50	20.00
*	29.740	51000.00	1871.97	3.03	1.45	.00	287.44	20.00
	29.800	35900.00	1871.72	.00	2.77	.00	747.15	330.00
*	29.800	51000.00	1875.32	3.60	3.35	.00	1023.31	330.00

1

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 29.700 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 29.700 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 29.700 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 29.700 PROFILE= 2 MINIMUM SPECIFIC ENERGY

WARNING SECNO= 29.730 PROFILE= 1 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO= 29.730 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO= 29.740 PROFILE= 2 HYDRAULIC JUMP D.S.

WARNING SECNO= 29.800 PROFILE= 2 CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

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.: *9825*
ROUTE: *CAREFREE HIGHWAY* STREAM: *CAVE CREEK WASH*

SCREEN 1 - BRIDGE INSPECTOR'S SCREEN

EVALUATOR'S NAME: _____ DATE: *4/18/95*
RECOMMENDATION: ☐ RATE BRIDGE: 3C ☒ 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	0
• 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 18, 1995;CAREFREE HIGHWAY BRIDGE (CAVE CREEK WASH)*

Attendees:

Bridge No.: *9825* Date Built on Bridge Plans: *6/86*

Description of Bridge/Bridge Type: *4 SPAN AASHTO TYPE IV GIRDER ON 36" DIA. COLUMNS WITH SPREAD FOOTINGS.*

Route: *CAREFREE HIGHWAY* Water Course: *CAVE CREEK WASH*

Underclearance at thalweg (ft): *+-15*

Elevation of stream thalweg (ft): *+-1857*

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

Reported high water elevation: *1869.3*

Description of flood: *50-year;*

Description of approach and "getaway" conditions: *FLAT BED WITH FORMED MAIN STREAM CHANNEL ON LEFT SIDE APPROXIMATELY 40' WIDE AND 4' DEEPER THAN THE REST OF THE CHANNEL AREA. SCATTERED VEGETATION PRESENT.*

Description of bed load: *COURSE SAND, STONES 4" TO 10" IN DIA., BOULDERS 2' TO 3' IN DIA.*

Condition of banks; evidence of lateral movement, degradation or aggradation: *LEFT BANK: HEAVY RIPRAP APPROX. 80' IN FRONT OF ABUTMENT, NO EVIDENCE OF SCOUR. RIGHT BANK: HEAVY EROSION APPROX. 300' BEFORE BRIDGE. 1:1 NATURAL SLOPES LOOK OKAY. RIPRAP 50' BEFORE BRIDGE.*

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

Stage rise to overtopping: _____

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

Confluences: *N/A*

BRIDGE NUMBER 9825

Description of flood plain: *SEMI-MOUNTAINOUS TERRAIN WITH MODERATE VEGETATION.*

Item 321 rating: 6
Item 71 rating: 9
Item 61 rating: 7

ABUTMENTS		
	LEFT	RIGHT
TYPE	*SPILL THROUGH*	*SPILL THROUGH*
SPREAD/PILES	*SPREAD*	*SPREAD*
EXPOSED FOOTINGS	*NO*	*NO*
FOOTING ELEVATION	*1837*	*1837*
ROCK ELEVATION AND DESCRIPTION	*N/A*	*N/A*
SOIL ELEVATION AND DESCRIPTION	*1857'* *SAND, GRAVEL, COBBLE MIXTURE*	*1857'* *SAND, GRAVEL, COBBLE MIXTURE*
ANGLE OF ATTACK OF FLOOD FLOWS ON ABUTMENT	*0*	*0*
DESCRIPTION OF RIPRAP OR OTHER SCOUR PROTECTION	*LOOSE GRANITE ROCKS UP TO 5' DIA.*	*LOOSE GRANITE ROCKS UP TO 5' DIA.*
ITEM 113 RATING	*3C*	*3C*

GENERAL COMMENTS:

1.) *VERY LARGE RIPRAP ON ABUTMENTS IS IN FAIR CONDITION.*

2.) *A RATING OF 3C WAS GIVEN BECAUSE OF THE SCOUR DEPTHS CALCUALTED AND THE EXPOSURE TO THE FOOTINGS THESE SCOUR DEPTHS WOULD CAUSE.*

BRIDGE NUMBER 9825

PIERS						
	1	2	3	4	5	6
CHANNEL/FLOODPLAIN	*CH.*					
PIER WIDTH	*48" DIA*					
SPREAD/PILES	*S*					
EXPOSED FOOTINGS	*NO*					
FOOTING HEIGHT	*3'*					
FOOTING ELEVATION AND WIDTH	*1837* *12'x44'*					
ROCK ELEVATION/TYPE	*N/A*					
ELEVATION OF TOP OF GROUND OR CHANNEL; SOIL TYPE	*1857* *SAND, GRAVEL, COBBLE MIXTURE*					
ANGLE OF ATTACK (DEG)	*0*					
RIPRAP OR OTHER PROTECTION	*NONE*					
ITEM 113 RATING	*3C*					

General Comments/Assessment:

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

2) *A RATING OF 3C WAS GIVEN BECAUSE OF THE EXPOSURE TO THE FOOTINGS CAUSED BY THE SCOUR DEPTHS CALCULATED.*

Recommended Item 113 and Risk Ratings:

3C, SEVERE

BRIDGE NUMBER 9825

SCREEN 3 - HYDRAULIC ENGINEER'S SCREEN

NAME: *CAREFREE HIGHWAY (CAVE CREEK WASH)* DATE: *4/18/95*

AGENCY: *PARSONS BRINCKERHOFF*

THE RECOMMENDED ITEM 113 RATING FOR THIS STRUCTURE IS: *3C*

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 9825

SCREEN 4 - FOUNDATION/GEOTECHNICAL ENGINEER'S SCREEN

NAME: *CAREFREE HIGHWAY (CAVE CREEK WASH)* Date: *4/18/95*

AGENCY: *AGRA - EARTH AND ENVIRONMENTAL INC.*

THE RECOMMENDED ITEM 113 RATING FOR THIS STRUCTURE IS: *3C*

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 9825

REVIEW BY INTERDISCIPLINARY SCOUR EVALUATION TEAM

DATE: _____ ITEM 113 RATING: _____

RISK RATING: _____

PROPOSED ACTIONS:

1.) _____

_____

_____

Notes:

BRIDGE NUMBER 9825

SCREEN 5 - BRIDGE MANAGER'S SCREEN

NAME/SIGNATURE : *PARSONS BRINCKERHOFF* DATE: 4/18/95

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

- ITEM 113 RATING: *3C* DESCRIPTION: *SCOUR CALCULATIONS SHOW DEPTHS BELOW THE FOOTINGS. HOWEVER ONLY MINOR SCOUR WAS OBSERVED IN THE FIELD.*

- RISK RATING (FOR ITEM 113 RATING CODES 3 AND 6): *SEVERE*

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.

SCHEMATIC
NOT FOR CONSTRUCTION

CAVE CREEK WASH BRIDGE

SURVEYED BY : JWB, KJS 4-13-95

DRAWN BY : KJS 4-24-95