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**FLOOD INSURANCE STUDY
FOR CATERPILLAR TANK AND TWIN BUTTES WASHES
FROM AGUA FRIA RIVER TO C.A.P. CANAL
MARICOPA COUNTY, ARIZONA**

Contract FCD 90-09

AGK Project No. 310.42

June 1991

Prepared by:

AGK Engineers, Inc.
2255 North 44th Street, Suite 330
Phoenix, AZ 85008
(602) 244-2566

 ENGINEERS, INC.

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- D West Garambullo Wash HEC-2 Output & Check Sheets
- E East Garambullo Wash HEC-2 Output & Check Sheets
- F Caterpillar Tank Wash HEC-2 Output & Check Sheets
- G N Value Determination Report
- H Docket 350 United States Board on Geographic Names, Washington D.C.,
June 13, 1991 Meeting

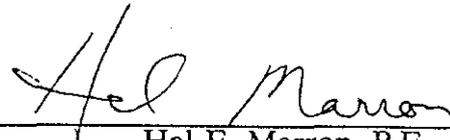
FLOOD INSURANCE STUDY FOR
CATERPILLAR TANK AND TWIN BUTTES WASHES
FROM AGUA FRIA RIVER TO C.A.P. CANAL
MARICOPA COUNTY, ARIZONA

This is to certify that all work accomplished in the conduct of this study was done in accordance with the Statement of Work and General Provision of Contract FCD 90-09, and all amendments thereto, together with all such modifications, either written or oral, as the Project Officers and/or the Contracting Officer or their representatives have directed, as such modifications affect this contract, and that all such work has been accomplished in accordance with sound and accepted engineering practice within the contract provision for respective phases of the work.

Signed:



Samuel E. Kao, Ph.D., P.E.
Vice President
AGK Engineers, Inc.



Hal E. Marron, P.E.
Associate
AGK Engineers, Inc.

1.0 INTRODUCTION

1.1 Purpose of this Study

This Flood Insurance Study investigates the existence and severity of flood hazards for Caterpillar Tank and Twin Buttes Washes from Agua Fria River to C.A.P. Canal, Maricopa County, Arizona, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for the study area that will be used to establish actuarial flood insurance rates and assist the County Flood Control District and local officials in their efforts to promote sound floodplain management. Minimum flood management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria takes precedence, and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgements

The sources of authority for this Flood Control Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by AGK Engineers, Inc. for the Flood Control District of Maricopa County, under Contract FCD 90-09. This study was completed in June 1991.

1.3 Coordination

Streams requiring detailed study were identified in Exhibit A of the Study Contract dated August 6, 1990.

The following agencies were contacted for information and comments during the study:

- Federal Emergency Management Agency (FEMA)
- U.S. Army Corps of Engineers (COE)
- U.S. Geological Survey (USGS)
- U.S. Soil Conservation Service (SCS)
- U.S. Bureau of Reclamation
- Federal Bureau of Land Management
- U.S. Fish and Wildlife Service
- Arizona Department of Water Resources (ADWR)
- Arizona Department of Transportation (ADOT)
- Arizona Game and Fish Department

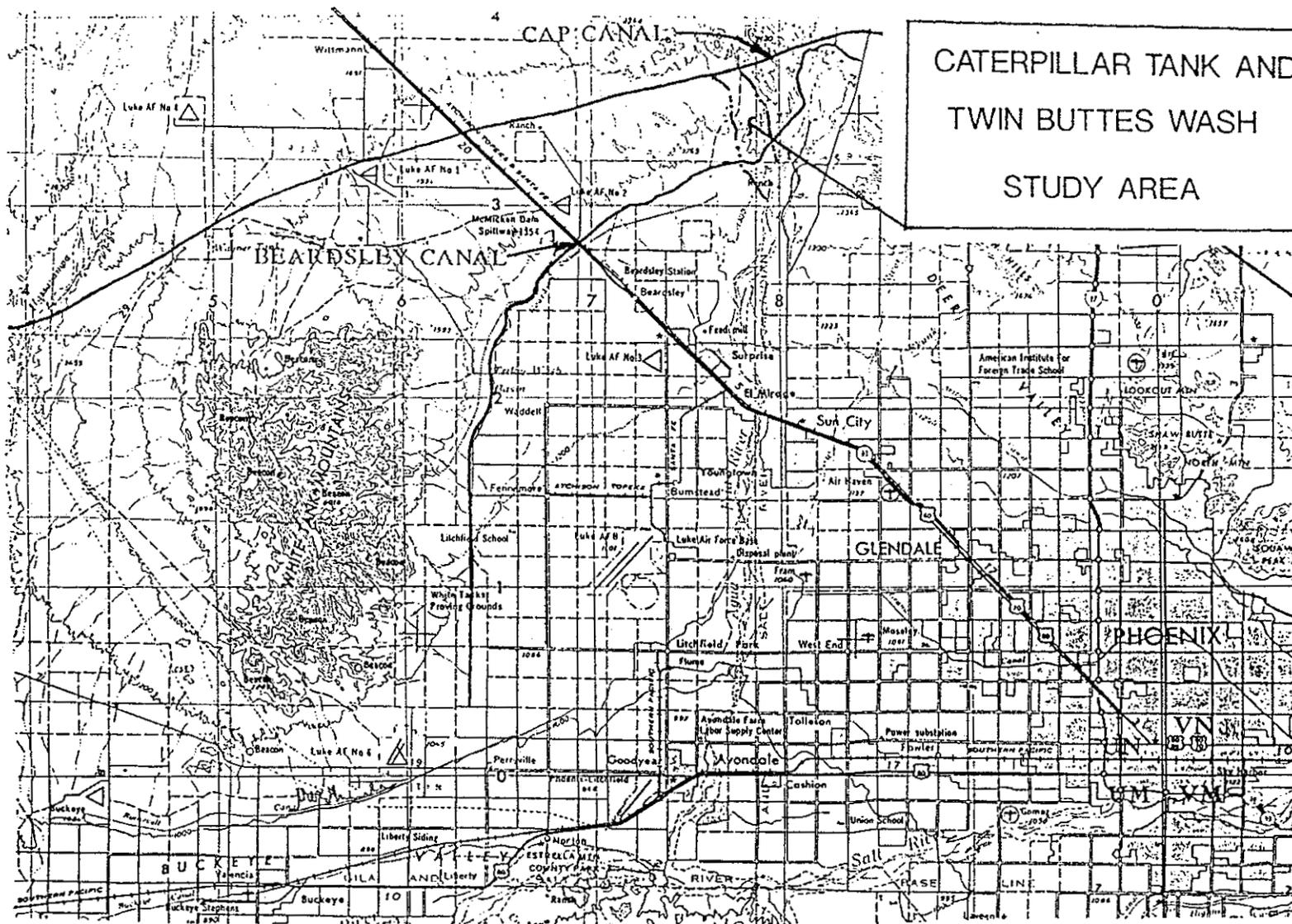
Vertical control data, used to establish the network of elevation reference marks, was obtained from the U.S. Geological Survey and the U.S. National Geodetic Survey.

The results of the study were submitted to the Flood Control District of Maricopa County for review on June 26, 1991. The study was acceptable to the County.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers an unincorporated area in Maricopa County, Arizona. The area which is traversed by the Central Arizona Project (C.A.P.) Canal is located approximately a mile west of the Agua Fria River, as shown in Figure 1.

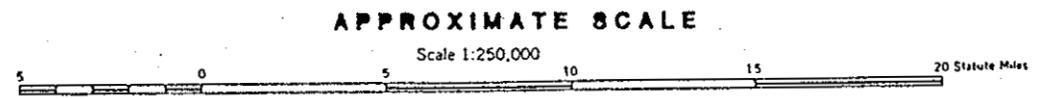


CATERPILLAR TANK AND
TWIN BUTTES WASH
STUDY AREA

FIGURE 1

TWIN BUTTES WASH AND
CATERPILLAR TANK WASH
STUDY AREA

MARICOPA COUNTY, ARIZONA



VICINITY MAP

Riverine flooding of the following streams was studied by detailed methods:

Caterpillar Tank Wash - from the confluence with the Agua Fria River upstream to the C.A.P. Canal.

Twin Buttes Wash - from the confluence with the Agua Fria River upstream to the C.A.P. Canal.

White Peak Wash - from the confluence with Twin Buttes Wash upstream to the C.A.P. Canal.

West Fork of White Peak Wash - from the confluence with White Peak Wash upstream to the C.A.P. Canal.

Garambullo Wash - from the confluence with Twin Buttes Wash upstream to the confluence with both East and West Garambullo Washes.

East Garambullo Wash - from the confluence of Garambullo Wash upstream to the C.A.P. Canal.

West Garambullo Wash - from the confluence of Garambullo Wash upstream to the C.A.P. Canal.

The area studied was selected with priority given to all known flood hazard areas.

2.2 Study Area Description

Caterpillar Tank and Twin Buttes Washes, tributaries to the Agua Fria River, are situated approximately 3 miles west of Lake Pleasant Road and six miles north of Deer Valley Drive. The total size of the watershed is approximately 12.2 square miles, of which 3.4 square miles for Caterpillar Tank Wash and 8.8 square miles for Twin Buttes Wash. Twin Buttes Wash has two major tributaries, namely, White Peak Wash and Garambullo Wash. White Peak Wash has one major tributary,

namely, West Fork of White Peak Wash. Garambullo Wash has two major tributaries, namely, East and West Garambullo Washes, which join Garambullo Wash at a common confluence point.

The watershed drains generally from north to south. However, the natural drainage pattern of the upper watershed has been slightly altered since the C.A.P. Canal was constructed in the early 1980's. A portion of the runoff from the upper watershed is now intercepted by the canal and routed along the canal to Caterpillar Tank and Twin Buttes Washes through 6 pipe culverts under the canal. The sizes and locations of the pipe culverts are as follows:

<u>Crossing No.</u>	<u>C.A.P. Station</u>	<u>Pipe Size</u>	<u>Upstream Inv. Elev.</u>	<u>Downstream Inv. Elev.</u>	<u>Riverine Name</u>
1	561+40	72"	1508.00	1505.95	Caterpillar Tank
2	549+00	30"	1513.94	1508.09	East Garambullo
3	538+25	30"	1518.99	1510.74	West Garambullo
4	492+30	4 - 72"	1500.13	1494.08	Twin Buttes
5	480+90	30"	1515.92	1512.09	White Peak
6	459+30	30"	1519.13	1512.93	West Fork of White Peak

A stock pond, known as Caterpillar Tank, is located immediately south of the C.A.P. Canal to collect and store the storm runoff from Caterpillar Tank Wash for stock grazing.

Topography in the watershed is generally desert rangeland with rolling hills on the east and isolated steep bare rock hills north of the C.A.P. Canal. The predominant rock hilly terrain is known as Twin Buttes, which is located at the north central portion of the watershed.

The climate of the study area is characterized by hot summer, mild winter and infrequent rainfall. The mean annual rainfall is about 7.5 inches, falling normally in two seasons. One season, primarily resulting from local convective storms, lasts from July to mid-September; the other season, mainly formed by cyclonic (frontal) storms, extends from December through March.

Soils in the watershed are predominantly sandy loam and clay loam. The land within the watershed is virtually in its natural state. Natural vegetation is sparse with plant species being typical to desert areas. Cacti, along with other desert shrubs, grow throughout the watershed. Scattered trees, such as palo verde and mesquite, exist among the shrubs. The vegetation tends to be thicker along and adjacent to the stream courses. Perennial grasses grow after winter rains.

2.3 Principal Flood Problems

During the summer months, convective storms are an important source of rainfall and runoff in Arizona. This type of storm is considered to be a more critical flood producing event than the frontal storms in this area.

Except the main channels to be studied by detailed methods, existing channels in the watershed are generally small and their courses are sometimes poorly defined. Floodwater in many portions of the watershed moves overland as sheet flow. During floods, brush and other vegetation growing in the water courses can impede flood flows, thus causing backwater and raising flood stages.

The C.A.P. Canal is the major manmade obstruction to the floodwater from the natural water courses. The pipe culverts under the canal will cause backwater and ponding effect to the area immediately north of the canal during the 100-year event. Brush may be washed out by floodwater and become an obstruction to restrict flows at these culverts.

The Beardsley Canal is also a major manmade feature across the watersheds. However, the supports of canal crossings are in the form of steel trusses that represent a very small percentage of channel cross-sectional areas. Therefore, they were not considered as obstructions to flood flows.

Flood damage has not been reported in the study area because no residential or commercial development exists in the watershed at the present time.

2.4 Flood Protection Measures

There are no existing flood control structures or measures within the study area. The existing stock pond in the Caterpillar Tank Wash Watershed should not be considered as a flood control structure because it was not properly engineered and certified as being constructed to withstand flood flows.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the study area, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood event of a magnitude which is expected to be equalled or exceeded once on the average during a 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equalled or exceeded during any one year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods of greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the study area at the time of this study's completion. The analyses reported herein reflect current conditions in the

watersheds of the flooding sources. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for Caterpillar Tank and Twin Buttes Washes and their tributaries. In the absence of historical gaging data in this area, the peak flows in this study were obtained through hydrologic modeling. The hydrologic modeling was performed by means of the HEC-1 computer program as developed by the U.S. Army Corps of Engineers (Reference 1). The estimation procedures for model parameters and components were generally based on the Hydrologic Design Manual (hereinafter referred to as the Manual) published by the Flood Control District of Maricopa County (Reference 2).

The watershed was divided into 23 subareas to form an interconnected system of stream network components. Boundaries of the subareas were determined based on the USGS quadrangle maps (Reference 6), and the 1" = 400' topographic maps prepared by Aerial Mapping Company (Reference 7). Field verification supplemented mapping inadequacies in the determination of subarea boundaries. Information on soil groups was obtained from the *Soil Survey of Aguila - Carefree Area*, published by the Soil Conservation Service (SCS) in April 1986 (Reference 3). Soil information for areas outside the detailed soil survey area was taken from the *General Soil Map for Maricopa County* (Reference 4).

The estimated rainfall depths for various durations and frequencies were obtained from the charts derived from the NOAA Atlas published for Arizona (Reference 5). The 100-year, 6-hour storm was used as the input for peak flow estimation, while the 100-year, 24-hour storm was used for flow volume estimation. Rainfall depths for the 100-year, 6-hour and 24-hour storms were estimated to be 3.32 and 4.14 inches, respectively.

The distribution and areal reduction for the 6-hour storm were obtained by use of a computer program known as MCUHP1, which was developed by the District. The SCS Type II Distribution was used for the 24-hour storm. An areal reduction of 0.987 (as obtained from NOAA HYDRO-40) was applied for the 24-hour storm.

Rainfall losses, which consist of surface retention loss and infiltration loss, were computed from the Green-Ampt method. The parameter estimation for the Green-Ampt method is discussed below.

Surface Retention Loss - The surface retention loss (IA) for each soil group was estimated on the basis of land use pattern and soil slopes obtained from Reference 3, as well as the criteria given in the Manual (Reference 2).

Percent of Outcrop - The weighted value of percent of rock outcrop (RTIMP) for each subarea was computed according to the information obtained from Reference 3.

Infiltration Loss - The three parameters as coded in HEC-1 for infiltration loss are:

- Hydraulic conductivity at natural saturation (XKSAT)
- Wetting front capillary suction (PSIF)
- Volumetric soil moisture deficit (DTHETA)

The parameter values for various soil groups were taken from the Manual, according to soil textures. The weighted values of these parameters were subsequently computed for all the subareas. The selection of DTHETA was based on the dry antecedent soil moisture condition. In addition, the values for XKSAT were adjusted according to a vegetation cover of 20 percent for all soil groups other than Brios-Carrizo Complex, which is composed of sands and loamy sand soils.

The southern tip of the watershed is located outside the detailed soil study limits. However, the *SCS General Soil Map for Maricopa County* (Reference 4), indicates that the soil in this area is basically of the Rillito-Gunsight-Pinal

Association. Therefore, the values of XKSAT, PSIF, and DTHETA were still estimated from Table 4.2 of the Manual; and XKSAT was adjusted according to a vegetation cover of 20 percent.

The Clark unit hydrograph was used in the computation of peak discharges in this study because all the subareas are less than 5 square miles in size. The Clark unit hydrograph consists of three parameters:

Time of Concentration - The Papadakis method was used for estimating the time of concentration. It is a function of length and slope of the flow path, average rainfall intensity, and the watershed resistance coefficient, which is a function of watershed type and size. The length and slope of the flow path for each subarea were obtained from the topographic map. A slope adjustment procedure was applied to several subareas where the slopes are greater than 200 feet per mile. The rainfall intensity for each subarea was automatically computed by the MCUHP1 computer program. The values for resistance coefficient were determined from the Manual. The parameters m and b were determined as -0.01375 and 0.08 , respectively, based on a land classification of bare or nearly bare ground because the watershed is near bare between rainy seasons.

Storage Coefficient and Time-Area Relation - The storage coefficient is a function of time of concentration, the watershed size and the length of flow path. The time-area relation is a parameter showing the equal travel-time zones in a watershed.

The computation for time of concentration, storage coefficient and time-area relation was performed by means of trial-and-error method through the computer program of MCUHP1. A review of the results indicated that all areas are suitable for the Clark method.

The 1988 version of HEC-1 computer model (Reference 1) was used for the development of hydrologic model. A time step of 5 minutes was used in the computation. Flows through the existing culverts under the C.A.P. Canal were modeled by the level-pool reservoir routing method, as contained in the HEC-1 program. The relationships among stage, storage, and outflow at the existing C.A.P. culverts were developed from the 1" = 200' topographic map (Reference 7). The normal depth routing method was used for routing flow from one concentration point to the next. The channel cross sections used for the normal depth routing were digitized from the topographic map base (Reference 7).

The existing stock pond in the Caterpillar Tank Wash Watershed was not included in the model because it was not properly engineered and certified as being constructed to withstand the 100-year flood.

The existing C.A.P. Canal was evaluated as a levee in this study. The water surface elevations resulting from ponding behind the canal were estimated by use of the level-pool reservoir routing method in the HEC-1 program. For Twin Buttes Wash, elevations resulting from both 6-hour and 24-hour storms were analyzed. For Caterpillar Tank Wash, the following three conditions were analyzed:

- Ponding elevation from a 6-hour storm with the stock pond in place and full at the beginning of the storm
- Ponding elevation from a 6-hour storm without the stock pond downstream of the 72-inch pipe culvert with assumed inlet control
- Ponding elevation from a 24-hour storm with the stock pond in place and full at the beginning of the storm

The 6-hour storm yielded the maximum ponding elevations behind the C.A.P. Canal for the Twin Buttes Wash Watershed. On the other hand, the 6-hour storm with stock pond in place produced the maximum ponding elevation for the Caterpillar Tank Wash Watershed.

The U.S. Bureau of Reclamation has certified the embankments associated with the C.A.P. construction up to the top of the concrete lining. Values for heights of lining were obtained from the Bureau of Reclamation design drawings (Reference 8). In view of the levee analysis results, it appears that the maximum ponding elevation at each pipe culvert is well below the top of lining of the C.A.P. Canal. Therefore, the canal was assumed to be adequate for withholding the flow resulting from a 100-year storm.

The 100-year peak discharges (resulting from both 6-hour and 24-hour storms) at each concentration point were estimated by means of the HEC-1 computer program. The computer analysis indicated that the 6-hour storm yielded a higher peak rate at each concentration point. The peak flow rates resulting from a 100-year, 6-hour storm are tabulated in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations for a flood of the 100-year recurrence interval.

Cross-section data for the backwater analyses were determined by obtaining digitized cross sections from topographic maps, at a scale of 1 inch = 400 feet and 4-foot contour intervals, prepared specifically for this project by Aerial Mapping Company, Inc., flown in September 1990 (Reference 7). Locations of selected cross-sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1), and on the Flood Boundary and Floodway Maps (Exhibit 2).

Detailed methods were used to determine the water-surface elevations for the 100-year flood, using the U.S. Army Corps of Engineers HEC-2 step backwater computer program (Reference 13).

TABLE 1
SUMMARY OF DISCHARGES

Flood Source and Location	Drainage Area (sq. miles)	100-year Peak Discharges (cfs)
<u>Caterpillar Tank Wash</u>		
Immediately downstream from C.A.P. Canal	1.03	489
At Beardsley Canal	3.03	1375
At confluence with Agua Fria River	3.36	1315
<u>Twin Buttes Wash</u>		
Immediately downstream from C.A.P. Canal	3.03	2154
Above confluence with Garambullo Wash	3.32	2163
Above confluence with White Peak Wash	4.65	2424
At Beardsley Canal	8.04	2779
At confluence with Agua Fria River	8.77	2746
<u>Garambullo Wash</u>		
At confluence with Twin Buttes Wash	0.99	651
<u>East Garambullo Wash</u>		
Immediately downstream from C.A.P. Canal	0.15	93
At confluence with Garambullo Wash	0.37	259
<u>West Garambullo Wash</u>		
Immediately downstream from C.A.P. Canal	0.12	94
At confluence with Garambullo Wash	0.62	483
<u>White Peak Wash</u>		
Immediately downstream from C.A.P. Canal	0.38	97
Above confluence with West Fork of White Peak Wash	0.69	395
At confluence with Twin Buttes Wash	1.59	721
<u>West Fork of White Peak Wash</u>		
Immediately downstream from C.A.P. Canal	0.15	90
At confluence with White Peak Wash	0.28	294

Hydraulic roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgement, based on field observations of the streams and floodplain areas, and the guidelines provided in References 10, 11, and 12. The channel "n" values used in this study range from .024 to .055, and the overbank "n" values range from .036 to .060.

Starting water surface elevations for both Caterpillar Tank and Twin Buttes Washes were obtained from the Flood Control District of Maricopa County's study results for the Agua Fria River in 1989 (Reference 14).

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps, and are described in the attached tables.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For each stream studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 7).

The 100-year floodplain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment of floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the floodplain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (see attached Table 2).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the 100-year floodplain boundaries is termed the "floodway fringe." The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A: corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE: corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses, are shown at selected intervals within this zone.

Zone AH: corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO: corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

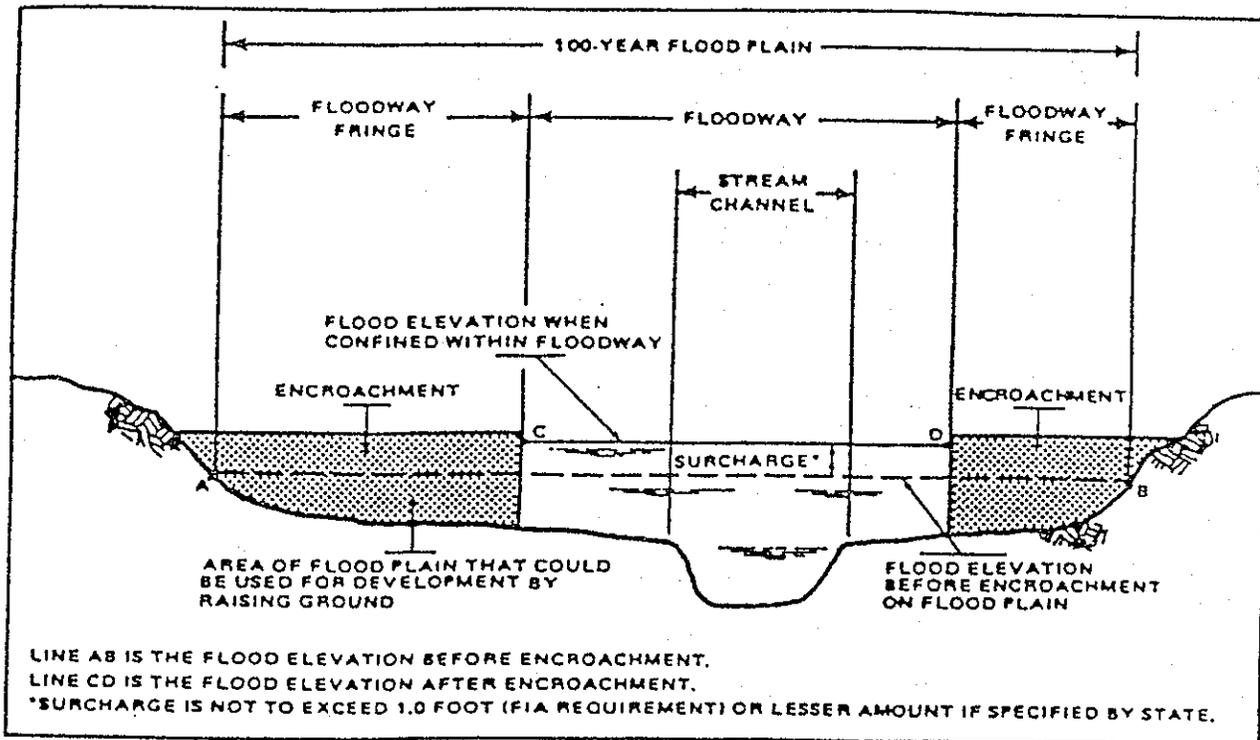


Figure 2. Floodway Schematic

Zone A99: corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V: corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE: corresponds to the 100-year costal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X: corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D: corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance rate zones as described in Section 5.0 and in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

The Flood Control District of Maricopa County provided a flood insurance study for the Agua Fria River in 1989 (Reference 14). The 100-year water surface elevations obtained from that study were used to determine the starting water surface elevations in this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Flood Control District of Maricopa County, 3335 West Durango Street, Phoenix, Arizona, 85009.

9.0 BIBLIOGRAPHY AND REFERENCES

1. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, *Generalized Computer Program 723-X6-L2010, HEC-1 Flood Hydrograph Package*, Davis, California, February 1981, Revised August 1988.
2. Flood Control District of Maricopa County, *Hydrologic Design Manual*, September 1990.
3. U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey of Aguila-Carefree Area*, April 1986.
4. U.S. Department of Agriculture, Soil Conservation Service, *General Soil Map for Maricopa County*, 1973.
5. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, *Precipitation-Frequency Atlas of the Western United States, Volume VIII - Arizona*, 1973.
6. U.S. Department of the Interior, Geological Survey, *15-Minute Series Topographic Maps*, Scale 1:24,000 Contour Intervals vary: Baldy Mountain and Calderwood Butte, Maricopa County, Arizona.
7. Aerial Mapping Company, Inc., Topographic Maps for C.A.P. Overchutes, Scale 1" = 400', Contour Interval = 4 feet; Scale 1" = 200', Contour Interval = 2 feet for areas north of C.A.P. Canal; September 13, 1990.
8. U.S. Bureau of Reclamation, Design Drainages for Granite Reef Aqueduct, Reach 9, Drawing No. 344-330-1325, October 1975.
9. Sellers, W.D., Hill, H.D. and Sanderson-Rae, M., *Arizona Climate - The First Hundred Years*, University of Arizona, Undated.
10. Aldridge, B.N. and Garrett, J.M., *Roughness Coefficients for Stream Channels in Arizona*, USGS Open-File Report, Tucson, Arizona, February 1973.
11. Chow, Ven T., *Open Channel Hydraulics*, New York: McGraw-Hill Book Company, 1959.
12. Thomsen, B.W. and Hjalmarson, H.W., *Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*, July 1990.
13. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center. *Generalized Computer Program 723-X6-L202A, HEC-2 Water Surface Profiles*. Davis, California, February 1989.
14. Flood Control District of Maricopa County, *Agua Fria River Flood Insurance Study*, January 1989.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Twin Buttes Wash								
A	1,000	105	288	9.5	1242.2	1242.2	1242.2	.0
B	1,500	112	345	7.9	1247.8	1247.8	1247.8	.0
C	2,000	158	385	7.1	1252.0	1252.0	1252.2	.2
D	2,500	136	328	8.4	1257.1	1257.1	1257.2	.1
E	3,000	192	380	7.2	1263.5	1263.5	1263.5	.0
F	3,500	103	312	8.8	1268.4	1268.4	1268.6	.2
G	4,000	224	416	6.6	1272.9	1272.9	1273.1	.2
H	4,500	103	390	7.0	1275.3	1275.3	1275.9	.6
I	5,000	109	289	9.5	1280.8	1280.8	1280.8	.0
J	5,500	125	415	6.6	1285.4	1285.4	1285.5	.1
K	6,000	224	380	7.2	1290.2	1290.2	1290.2	.0
L	6,500	392	698	3.9	1293.4	1293.4	1293.8	.4
M	7,000	254	551	5.0	1295.4	1295.4	1296.3	.9
N	7,500	145	423	6.5	1300.2	1300.2	1300.3	.1
O	8,000	184	518	5.3	1303.3	1303.3	1304.1	.8
P	8,500	63	321	8.6	1306.4	1306.4	1307.4	1.0
Q	9,000	103	530	5.2	1310.9	1310.9	1310.9	.0
R	9,500	161	502	5.5	1313.0	1313.0	1313.5	.5
S	9,700	132	427	6.4	1315.1	1315.1	1315.1	.0
T	10,100	231	693	4.0	1318.2	1318.2	1318.4	.2
U	10,120	240	644	4.3	1318.3	1318.3	1318.5	.2
V	10,500	230	549	5.1	1321.3	1321.3	1321.6	.3
W	11,000	168	512	5.4	1324.2	1324.2	1325.2	1.0
X	11,420	124	411	6.8	1326.3	1326.3	1327.3	1.0
Y	12,000	59	307	9.1	1330.6	1330.6	1331.3	.7
Z	12,500	148	520	5.3	1334.5	1334.5	1334.9	.4

1) Distance in feet above confluence with Agua Fria River

FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOODWAY DATA

MARICOPA COUNTY (UNINCORPORATED)
MARICOPA COUNTY, ARIZONA

TWIN BUTTES WASH

TABLE 2

K. E. JOHNSON, INC.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT.PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Twin Buttes Wash								
AA	13,000	174	406	6.9	1337.9	1337.9	1337.9	.0
AB	13,500	132	548	5.1	1340.7	1340.7	1340.8	.1
AC	14,000	73	295	9.4	1342.6	1342.6	1342.6	.0
AD	14,500	119	443	6.3	1346.9	1346.9	1347.0	.1
AE	15,000	97	322	8.6	1350.2	1350.2	1350.2	.0
AF	15,500	61	339	8.2	1353.8	1353.8	1354.0	.2
AG	16,000	86	338	8.2	1356.9	1356.9	1357.2	.3
AH	16,500	175	685	4.1	1359.8	1359.8	1360.0	.2
AI	17,000	78	309	9.0	1360.7	1360.7	1361.2	.5
AJ	17,500	144	500	5.6	1365.0	1365.0	1365.3	.3
AK	18,000	91	375	7.4	1366.6	1366.6	1367.6	1.0
AL	18,300	206	513	5.4	1370.0	1370.0	1370.3	.3
AM	18,500	206	703	4.0	1371.0	1371.0	1371.3	.3
AN	19,000	154	341	7.1	1372.7	1372.7	1372.9	.2
AO	19,500	138	401	6.1	1377.3	1377.3	1377.3	.0
AP	20,000	147	336	7.2	1380.3	1380.3	1380.5	.2
AQ	20,500	122	377	6.4	1383.7	1383.7	1384.1	.4
AR	21,000	154	404	6.0	1386.7	1386.7	1387.7	1.0
AS	21,500	223	483	5.0	1391.6	1391.6	1391.7	.1
AT	22,000	248	604	4.0	1394.0	1394.0	1394.0	.0
AU	22,500	109	268	9.0	1396.9	1396.9	1396.9	.0
AV	23,000	283	685	3.5	1401.4	1401.4	1401.6	.2
AW	23,500	174	405	6.0	1404.0	1404.0	1404.5	.5
AX	24,000	126	310	7.8	1409.5	1409.5	1409.6	.1
AY	24,500	344	748	3.2	1412.5	1412.5	1413.1	.6
AZ	25,000	371	402	6.0	1416.2	1416.2	1416.2	.0

1) Distance in feet above confluence with Agua Fria River

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY (UNINCORPORATED)
MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

TWIN BUTTES WASH

TABLE 2

ENCIPHER, INC.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT.PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Twin Buttes Wash								
BA	25,300	239	501	4.3	1419.8	1419.8	1420.3	.5
BB	26,000	268	430	5.0	1425.8	1425.8	1426.4	.6
BC	26,500	256	494	4.4	1430.5	1430.5	1431.4	.9
BD	26,750	139	325	6.7	1433.4	1433.4	1433.8	.4
BE	27,000	120	369	5.9	1435.8	1435.8	1436.4	.6
BF	27,500	83	252	8.6	1440.9	1440.9	1440.9	.0
BG	28,000	102	388	5.6	1444.6	1444.6	1444.6	.0
BH	28,500	122	258	8.4	1448.1	1448.1	1448.1	.0
BI	29,000	128	315	6.9	1453.7	1453.7	1453.7	.0
BJ	29,500	108	249	8.7	1459.8	1459.8	1459.8	.0
BK	30,000	137	364	5.9	1465.6	1465.6	1465.9	.3
BL	30,500	213	518	4.2	1469.3	1469.3	1469.3	.0
BM	31,000	116	283	7.6	1472.3	1472.3	1472.6	.3
BN	31,500	92	282	7.7	1477.2	1477.2	1477.7	.5
BO	32,000	116	256	8.4	1483.2	1483.2	1483.2	.0
BP	32,500	59	266	8.1	1486.9	1486.9	1487.1	.2
BQ	33,000	54	198	10.9	1492.9	1492.9	1492.9	.0
BR	33,500	93	306	7.1	1500.7	1500.7	1500.7	.0
BS	33,700	82	227	9.5	1505.9	1505.9	1505.9	.0

1) Distance in feet above confluence with Agua Fria River

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FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY (UNINCORPORATED)
 MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

TWIN BUTTES WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
White Peak Wash								
A	500	75	108	6.7	1374.7	1374.7	1374.7	.0
B	1,000	102	246	2.9	1377.2	1377.2	1378.0	.8
C	1,500	52	149	4.8	1379.8	1379.8	1379.8	.0
D	2,000	45	102	7.1	1383.3	1383.3	1383.6	.3
E	2,500	126	247	2.9	1387.4	1387.4	1387.4	.0
F	3,000	27	76	9.5	1390.7	1390.7	1390.7	.0
G	3,500	104	209	3.4	1396.1	1396.1	1396.3	.2
H	4,000	77	139	5.2	1398.9	1398.9	1399.5	.6
I	4,500	72	159	4.5	1404.0	1404.0	1404.0	.0
J	5,000	44	122	5.9	1407.5	1407.5	1407.5	.0
K	5,500	49	122	5.9	1412.2	1412.2	1412.2	.0
L	6,000	69	155	4.6	1416.6	1416.6	1416.6	.0
M	6,500	37	104	6.9	1420.9	1420.9	1420.9	.0
N	7,000	80	176	4.1	1424.7	1424.7	1425.3	.6
O	7,500	38	127	5.7	1427.4	1427.4	1428.1	.7
P	7,800	36	84	7.1	1430.0	1430.0	1430.1	.1
Q	8,000	44	120	5.0	1430.8	1430.8	1431.7	.9
R	8,500	38	74	8.1	1436.5	1436.5	1436.5	.0
S	9,000	36	89	6.7	1442.0	1442.0	1442.0	.0
T	9,500	23	64	9.4	1447.1	1447.1	1447.1	.0
U	10,000	37	87	6.9	1453.5	1453.5	1453.5	.0
V	10,400	53	91	6.6	1457.6	1457.6	1457.6	.0
W	10,500	53	100	4.0	1458.8	1458.8	1458.8	.0
X	11,000	31	53	7.5	1462.5	1462.5	1462.5	.0
Y	11,500	39	63	6.2	1469.5	1469.5	1469.5	.0
Z	12,000	46	81	4.9	1474.0	1474.0	1474.0	.0

1) Distance in feet above confluence with Twin Buttes Wash

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
 MARICOPA COUNTY (UNINCORPORATED)
 NARUCIOA COUNTY, ARIZONA

FLOODWAY DATA

WHITE PEAK WASH

K ENVIRONMENTAL, INC.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE 1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
White Peak Wash								
AA	12,500	35	55	7.2	1478.9	1478.9	1478.9	.0
AB	13,000	39	75	5.2	1484.1	1484.1	1484.1	.0
AC	13,500	37	55	7.1	1489.6	1489.6	1489.6	.0
AD	14,000	29	65	6.1	1495.2	1495.2	1495.2	.0
AE	14,500	33	59	6.7	1499.7	1499.7	1499.7	.0
AF	15,000	32	53	7.4	1507.0	1507.0	1507.0	.0
AG	15,500	29	53	7.4	1514.5	1514.5	1514.5	.0
AH	15,600	36	107	3.7	1515.6	1515.6	1515.6	.0

1) Distance in feet above confluence with Twin Buttes Wash

CA
 K
 ENGINEERS, INC.

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY (UNINCORPORATED)
 MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

WHITE PEAK WASH

TABLE 2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE 1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Fork of White Peak Wash								
A	500	56	54	5.5	1464.4	1464.4	1464.4	.0
B	1,000	24	45	6.5	1471.0	1471.0	1471.0	.0
C	1,500	30	42	6.9	1479.2	1479.2	1479.5	.3
D	2,000	30	55	5.4	1485.0	1485.0	1485.3	.3
E	2,500	19	37	7.9	1494.1	1494.1	1494.1	.0
F	3,000	24	41	7.2	1501.9	1501.9	1501.9	.0
G	3,500	26	41	7.2	1512.4	1512.4	1512.4	.0
H	3,900	27	49	6.0	1517.3	1517.3	1517.3	.0

1) Distance in feet above confluence with White Peak Wash

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 C
 TABLE 2
 ENVIRONMENTAL, INC.

FEDERAL EMERGENCY MANAGEMENT AGENCY
 MARICOPA COUNTY (UNINCORPORATED)
 MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

WEST FORK OF WHITE PEAK WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE 1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
West Garambullo Wash								
A ²⁾	500	46	84	7.7	1422.2	1422.2	1422.2	.0
B ²⁾	750	102	216	3.0	1424.2	1424.2	1424.2	.0
C	1,000	28	58	8.3	1424.8	1424.8	1424.8	.0
D	1,500	58	115	4.2	1430.0	1430.0	1430.3	.3
E	2,000	65	134	3.6	1435.9	1435.9	1436.0	.1
F	2,500	35	63	7.6	1438.9	1438.9	1438.9	.0
G	3,000	48	120	4.0	1443.0	1443.0	1443.2	.2
H	3,500	21	52	9.2	1448.4	1448.4	1448.4	.0
I	4,000	52	112	4.3	1453.2	1453.2	1453.5	.3
J	4,500	39	68	7.2	1457.8	1457.8	1458.1	.3
K	5,000	24	78	6.2	1463.1	1463.1	1463.6	.5
L	5,500	40	79	6.1	1468.3	1468.3	1468.3	.0
M	6,000	28	61	7.9	1474.6	1474.6	1474.7	.1
N	6,500	33	79	6.1	1481.2	1481.2	1481.2	.0
O	7,000	32	62	7.8	1487.2	1487.2	1487.2	.0
P	7,500	30	69	7.0	1495.0	1495.0	1495.0	.0
Q	8,000	46	79	6.1	1501.8	1501.8	1501.8	.0
R	8,500	24	62	7.8	1508.5	1508.5	1508.5	.0
S	8,900	24	55	8.8	1516.1	1516.1	1516.1	.0

1) Distance in feet above confluence with Twin Buttes Wash

2) Common cross sections with East Garambullo Wash (Aka: Garambullo Wash)

FEDERAL EMERGENCY MANAGEMENT AGENCY
 MARICOPA COUNTY (UNINCORPORATED)
 MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

WEST GARAMBULLO WASH

TABLE 2

CA
 K ENGINEERS, INC.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE 1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
East Garambullo Wash								
A 2)	500	46	84	7.7	1422.2	1422.2	1422.2	.0
B 2)	750	36	131	5.0	1424.2	1424.2	1424.4	.2
C	1,000	151	98	2.6	1426.8	1426.8	1426.8	.0
D	1,500	39	53	4.8	1431.0	1431.0	1431.2	.2
E	2,000	24	44	5.9	1435.8	1435.8	1436.2	.4
F	2,500	38	74	3.5	1439.4	1439.4	1439.7	.3
G	3,000	23	36	7.2	1446.1	1446.1	1446.1	.0
H	3,500	48	70	3.7	1451.9	1451.9	1451.9	.0
I	4,000	46	45	5.7	1459.2	1459.2	1459.2	.0
J	4,500	88	90	2.9	1464.9	1464.9	1464.9	.0
K	5,000	32	40	6.4	1471.2	1471.2	1471.2	.0
L	5,500	32	53	4.9	1478.3	1478.3	1478.3	.0
M	6,000	19	37	7.0	1484.0	1484.0	1484.0	.0
N	6,500	28	41	6.3	1492.5	1492.5	1492.5	.0
O	7,000	38	47	5.5	1501.2	1501.2	1501.2	.0
P	7,550	26	39	6.6	1510.8	1510.8	1510.8	.0

- 1) Distance in feet above confluence with Twin Buttes Wash
2) Common cross sections with West Garambullo Wash (Aka: Garambullo Wash)

CA
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TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY (UNINCORPORATED)
MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

EAST GARAMBULLO WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE (1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT. PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caterpillar Tank Wash								
A	0	117	191	6.9	1262.1	1262.1	1262.1	.0
B	500	59	248	5.3	1265.2	1265.2	1265.2	.0
C	1,000	102	174	7.5	1270.7	1270.7	1270.7	.0
D	1,500	85	219	6.0	1276.9	1276.9	1276.9	.0
E	2,000	75	171	7.7	1282.3	1282.3	1282.4	.1
F	2,500	85	207	6.4	1289.8	1289.8	1289.9	.1
G	3,000	108	193	6.8	1297.0	1297.0	1297.2	.2
H	3,500	73	191	6.9	1305.0	1305.0	1305.0	.0
I	4,000	83	239	5.5	1310.3	1310.3	1310.3	.0
J	4,350	130	188	7.0	1315.8	1315.8	1315.8	.0
K	4,400	209	335	4.1	1317.1	1317.1	1317.1	.0
L	5,000	108	192	7.1	1324.6	1324.6	1324.6	.0
M	5,500	56	185	7.4	1330.1	1330.1	1330.5	.4
N	6,000	51	153	9.0	1335.5	1335.5	1335.6	.1
O	6,500	95	199	6.9	1343.0	1343.0	1343.0	.0
P	7,000	77	215	6.4	1348.1	1348.1	1348.1	.0
Q	7,500	81	223	6.2	1351.8	1351.8	1351.9	.1
R	8,000	71	185	7.4	1356.0	1356.0	1356.2	.2
S	8,500	119	272	5.0	1360.6	1360.6	1360.9	.3
T	9,000	73	224	6.1	1364.5	1364.5	1364.5	.0
U	9,500	38	137	10.1	1369.6	1369.6	1369.6	.0
V	10,000	77	232	5.9	1375.3	1375.3	1376.0	.7
W	10,500	68	203	6.4	1379.3	1379.3	1379.8	.5
X	11,000	126	349	3.7	1382.7	1382.7	1382.9	.2
Y	11,500	116	203	6.4	1385.7	1385.7	1385.8	.1
Z	12,000	75	217	6.0	1391.4	1391.4	1391.7	.3

(1) Distance in feet above confluence with Agua Fria River

K
 ENGINEERING, INC.
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TABLE
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FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY (UNINCORPORATED)
 MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

CATERPILLAR TANK WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE (1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT.PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caterpillar Tank Wash								
AA	12,500	336	493	2.6	1394.3	1394.3	1394.5	.2
AB	13,000	67	159	8.2	1397.8	1397.8	1397.8	.0
AC	13,500	100	290	4.5	1401.2	1401.2	1401.8	.6
AD	14,000	88	170	7.6	1404.7	1404.7	1405.0	.3
AE	14,500	76	239	5.4	1409.7	1409.7	1409.7	.0
AF	15,000	65	148	8.7	1413.6	1413.6	1413.7	.1
AG	15,500	60	245	5.3	1417.2	1417.2	1417.9	.7
AH	16,000	65	201	6.4	1419.8	1419.8	1420.2	.2
AI	16,500	69	228	5.7	1422.9	1422.9	1423.1	.2
AJ	17,000	127	298	4.4	1425.6	1425.6	1425.6	.0
AK	17,500	99	175	7.4	1429.4	1429.4	1429.4	.0
AL	18,000	144	340	3.8	1433.9	1433.9	1434.3	.4
AM	18,500	67	171	7.6	1437.5	1437.5	1437.8	.3
AN	19,000	118	272	4.8	1443.6	1443.6	1443.6	.0
AO	19,500	42	175	7.4	1446.4	1446.4	1446.8	.4
AP	19,700	76	182	5.3	1447.8	1447.8	1448.8	1.0
AQ	20,000	106	241	4.0	1450.5	1450.5	1450.9	.4
AR	20,500	63	144	6.7	1454.7	1454.7	1454.7	.0
AS	21,000	77	200	4.9	1459.0	1459.0	1459.4	.4
AT	21,500	46	114	8.5	1462.8	1462.8	1463.1	.3
AU	22,000	126	206	4.7	1466.6	1466.6	1467.1	.5
AV	22,500	60	155	6.3	1468.8	1468.8	1469.5	.7
AW	23,000	49	112	8.6	1474.7	1474.7	1474.7	.0
AX	23,500	50	134	7.3	1479.6	1479.6	1479.9	.3
AY	24,000	40	126	7.7	1483.8	1483.8	1483.8	.0
AZ	24,500	34	100	9.7	1488.4	1488.4	1488.4	.0

(1) Distance in feet above confluence with Agua Fria River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

MARICOPA COUNTY (UNINCORPORATED)
MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

CATERPILLAR TANK WASH

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NGVD)			
CROSS SECTION	DISTANCE (1)	WIDTH (FEET)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (FT.PER SEC.)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Caterpillar Tank Wash								
BA	25,000	55	154	6.3	1493.3	1493.3	1493.5	.2
BB	25,700	202	221	4.4	1499.1	1499.1	1499.1	.0
BC	26,200	67	146	6.7	1506.1	1506.1	1506.2	.1
BD	26,300	59	118	8.2	1508.8	1508.8	1508.8	.0

(1) Distance in feet above confluence with Agua Fria River

CA
 K ENGINEERS, INC.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

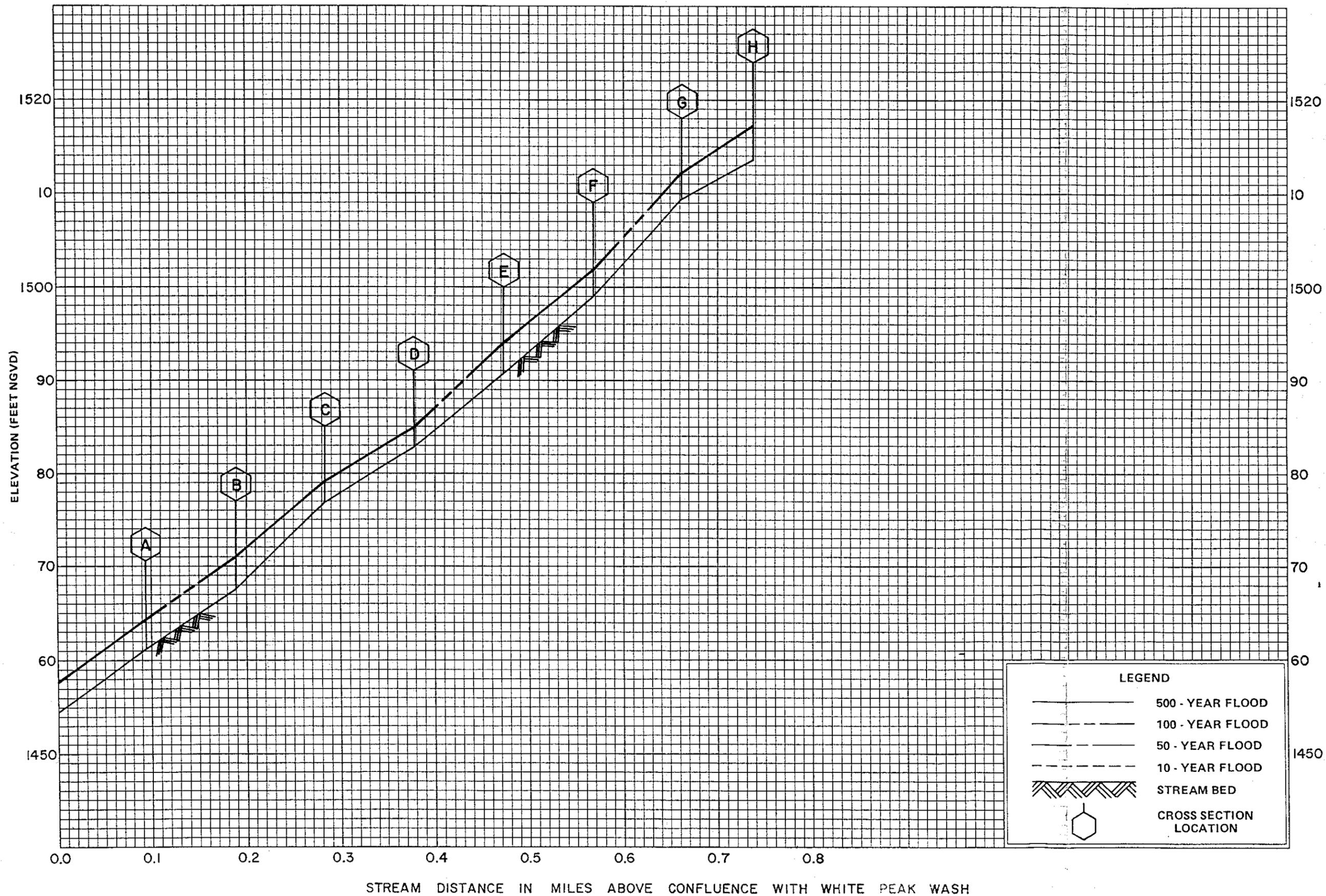
MARICOPA COUNTY (UNINCORPORATED)
 MARICOPA COUNTY, ARIZONA

FLOODWAY DATA

CATERPILLAR TANK WASH

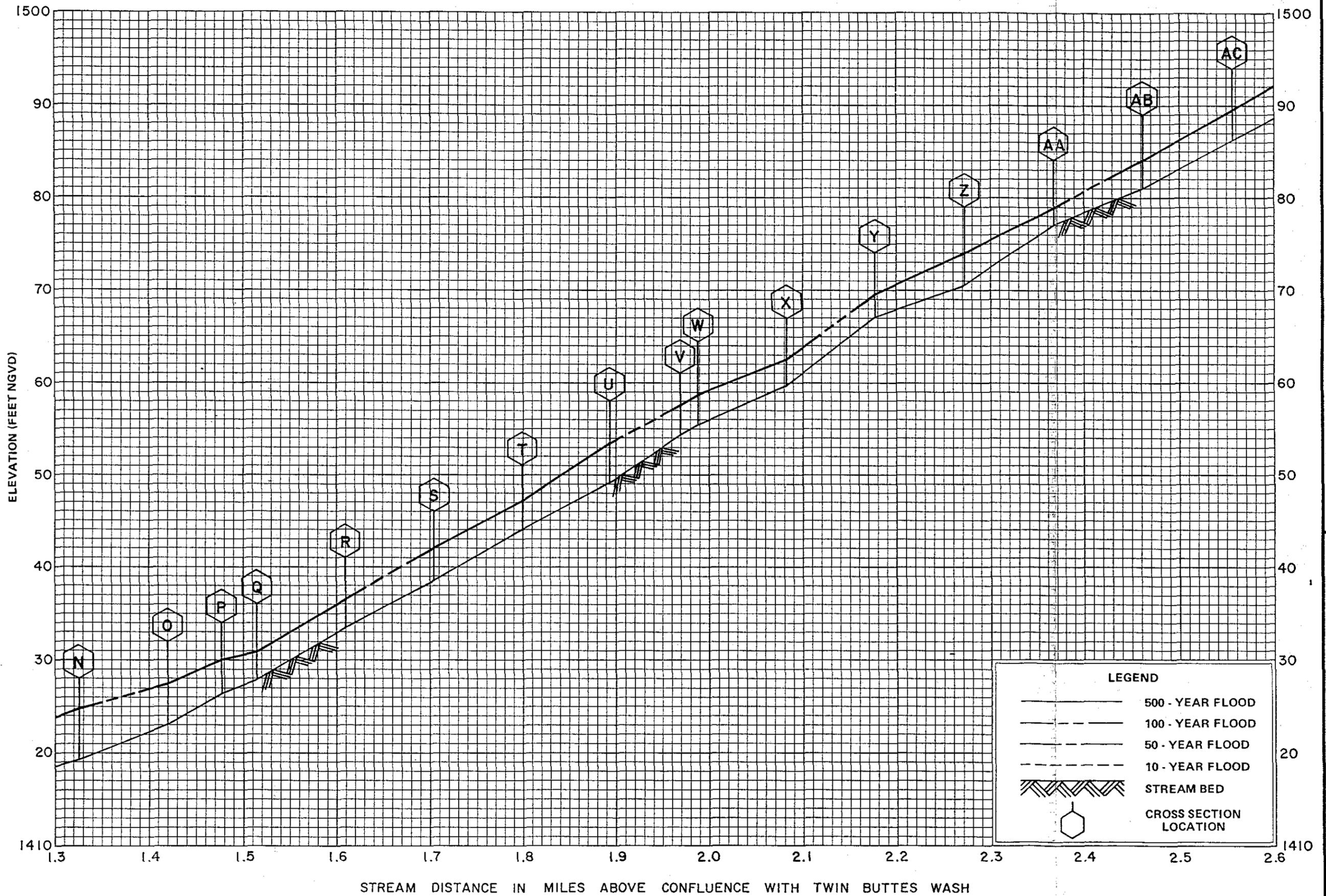
EXHIBIT 1

Flood Profiles



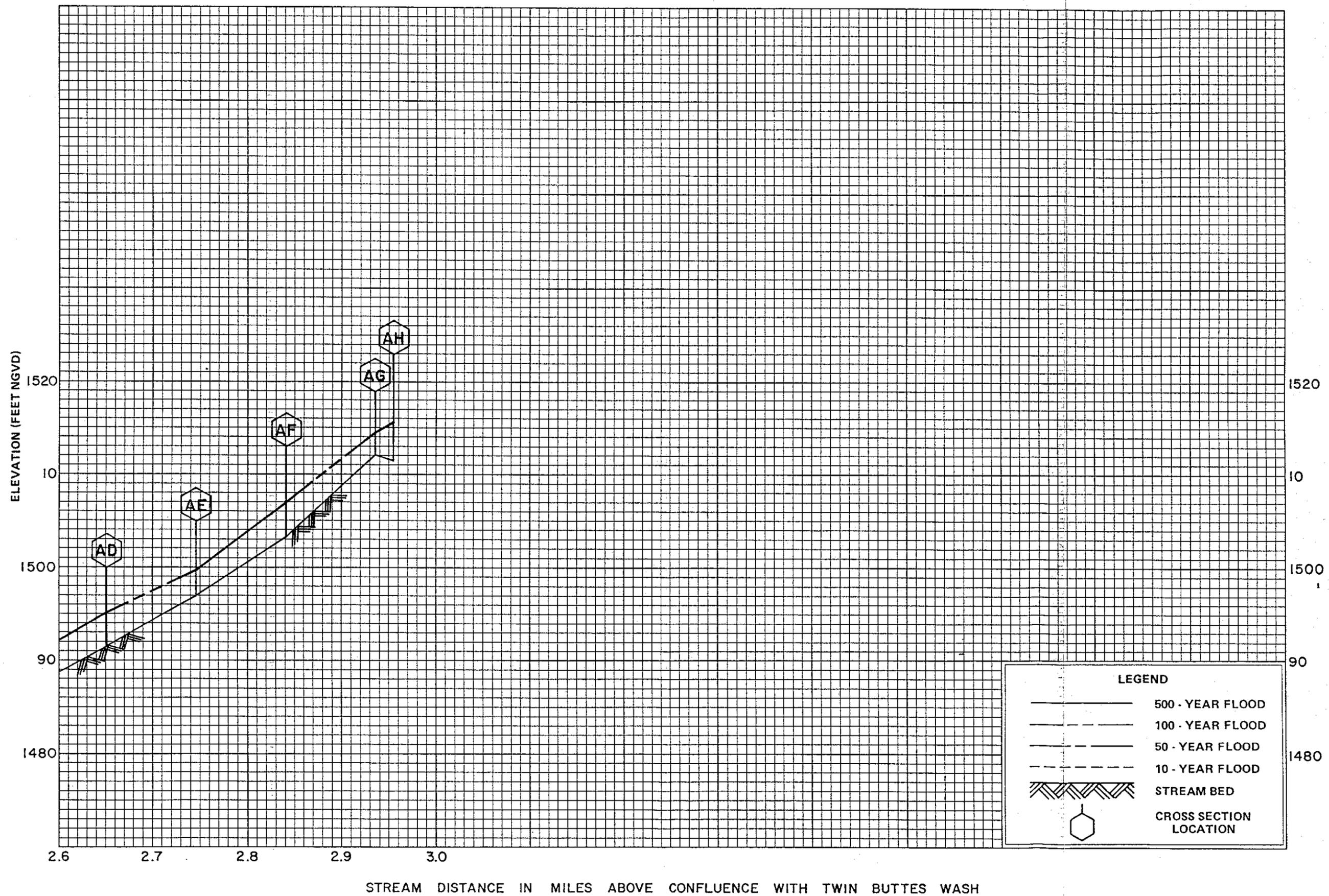
FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA

FLOOD PROFILES
 W. FORK WHITE PEAK WASH



FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA

FLOOD PROFILES
 WHITE PEAK WASH

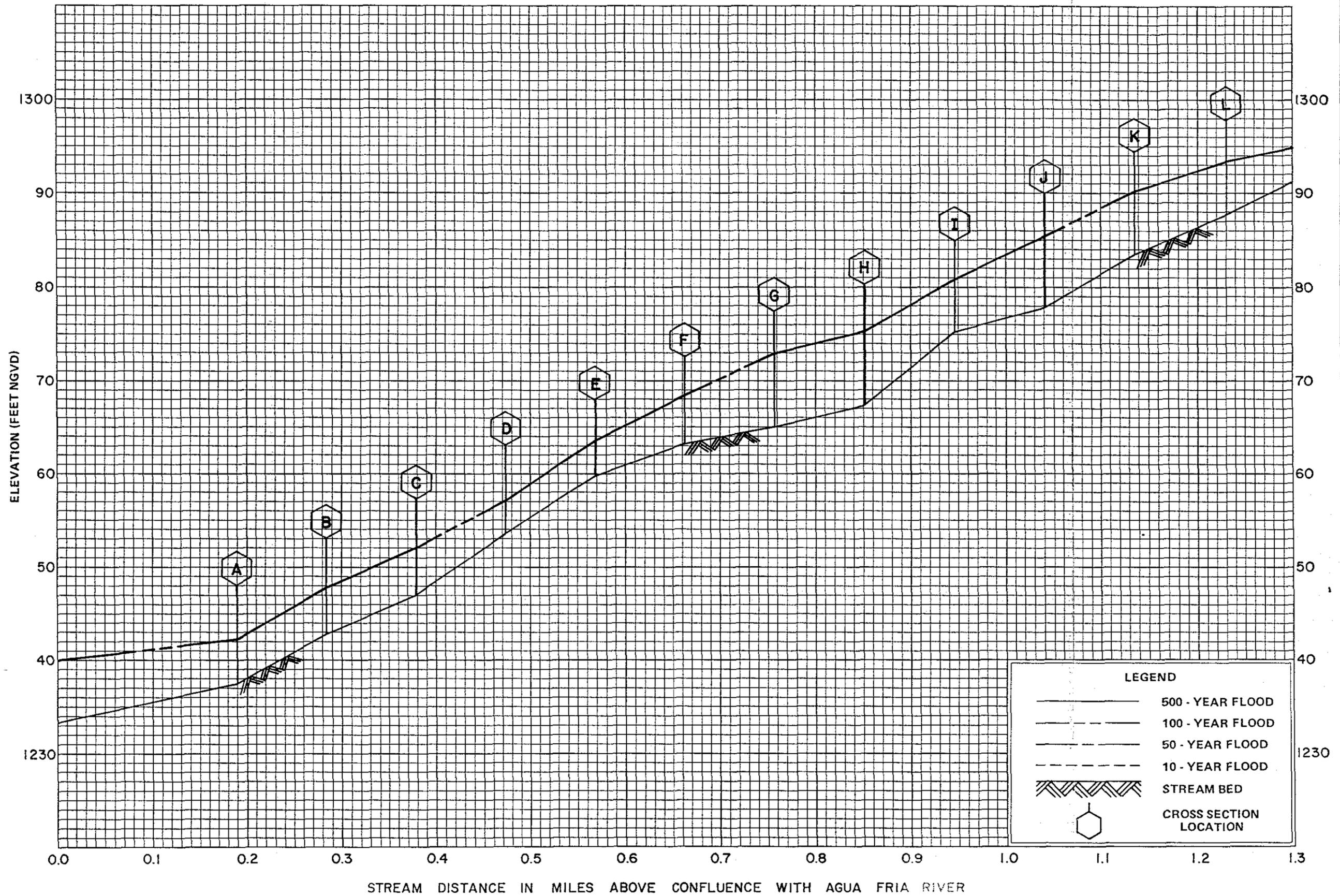


FLOOD PROFILES

WHITE PEAK WASH

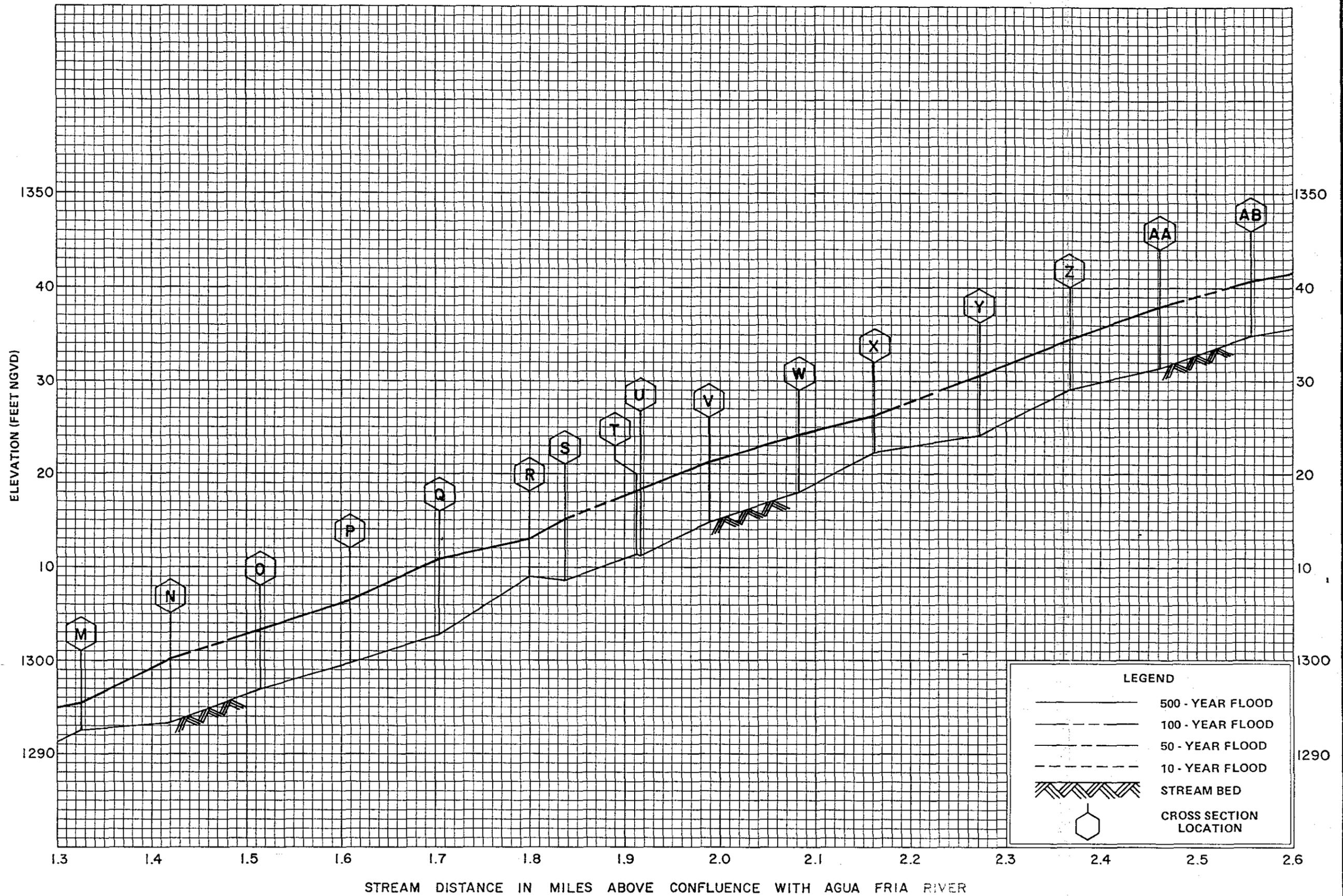
FEDERAL EMERGENCY MANAGEMENT AGENCY

FLOOD CONTROL DISTRICT
MARICOPA COUNTY, ARIZONA



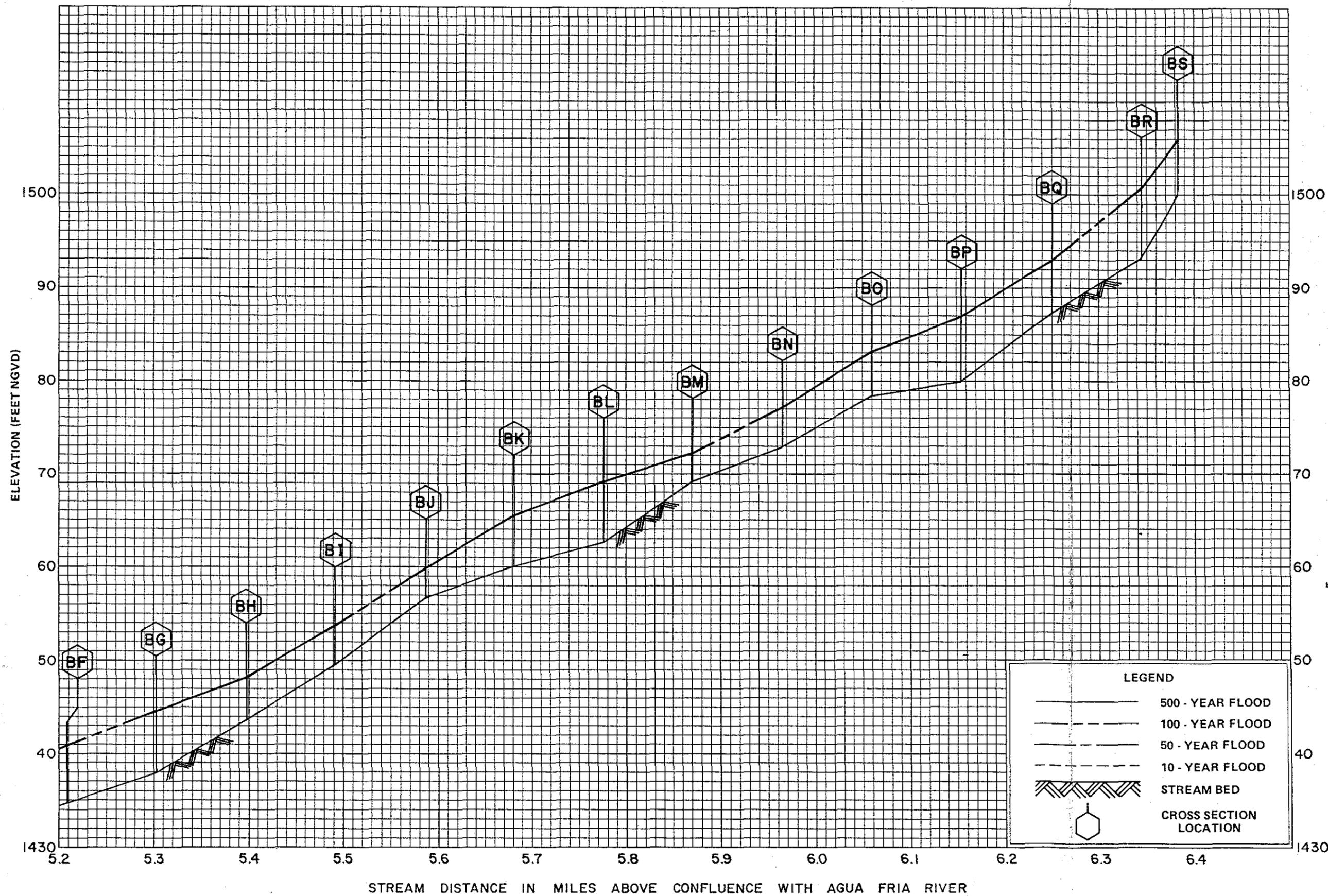
FLOOD PROFILES
TWIN BUTTES WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
FLOOD CONTROL DISTRICT
MARICOPA COUNTY, ARIZONA



FLOOD PROFILES
TWIN BUTTES WASH

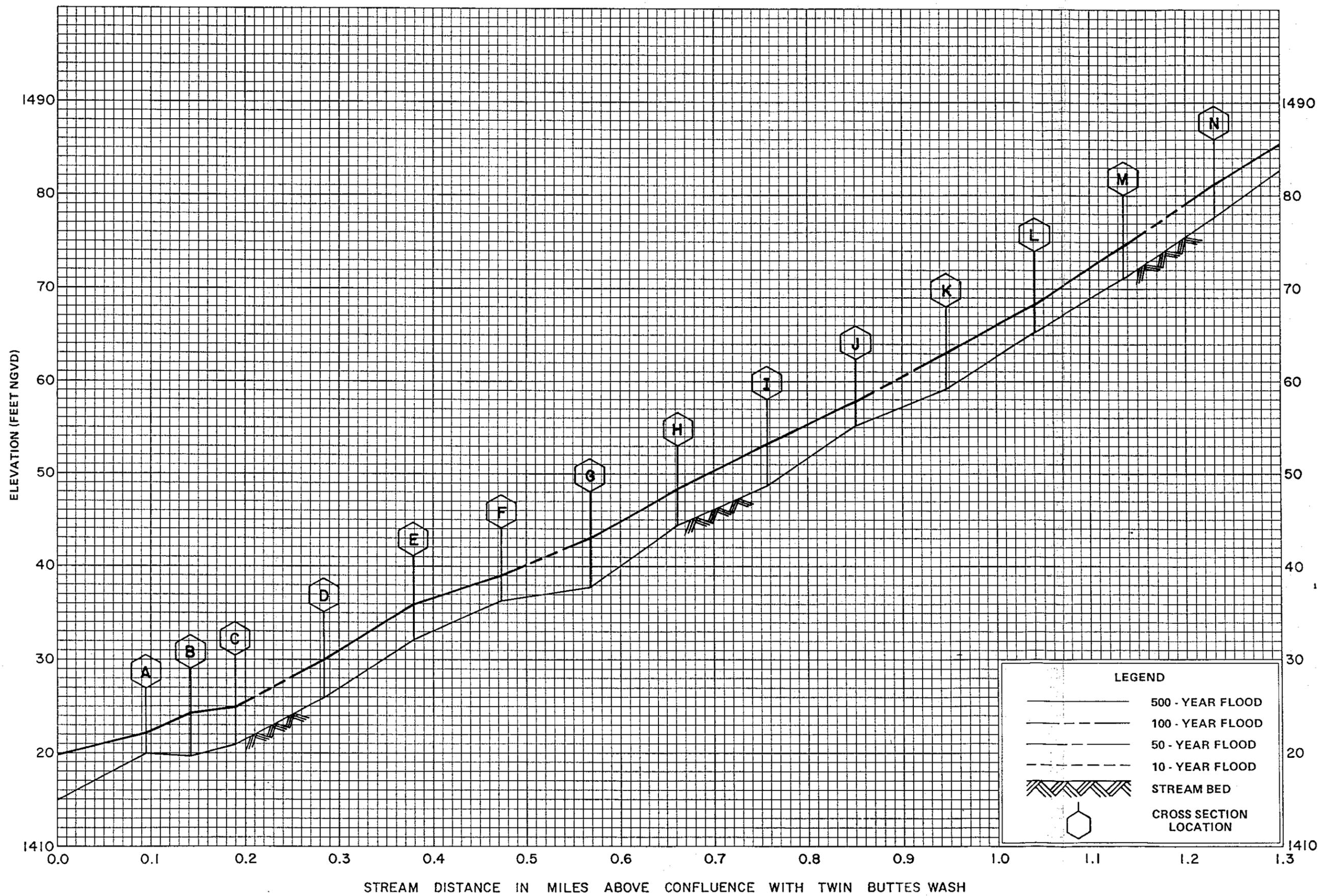
FEDERAL EMERGENCY MANAGEMENT AGENCY
FLOOD CONTROL DISTRICT
MARICOPA COUNTY, ARIZONA



FLOOD PROFILES

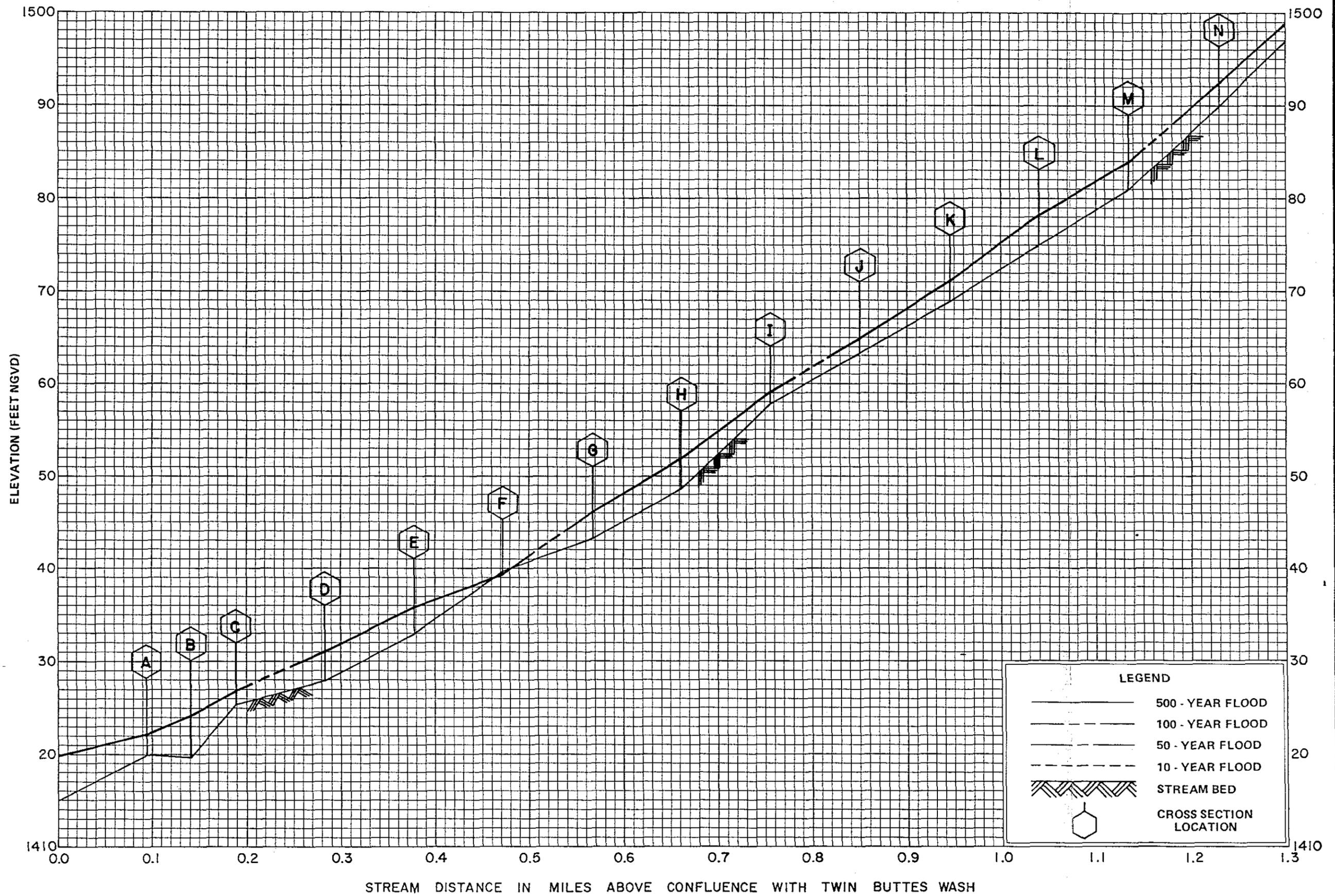
TWIN BUTTES WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA



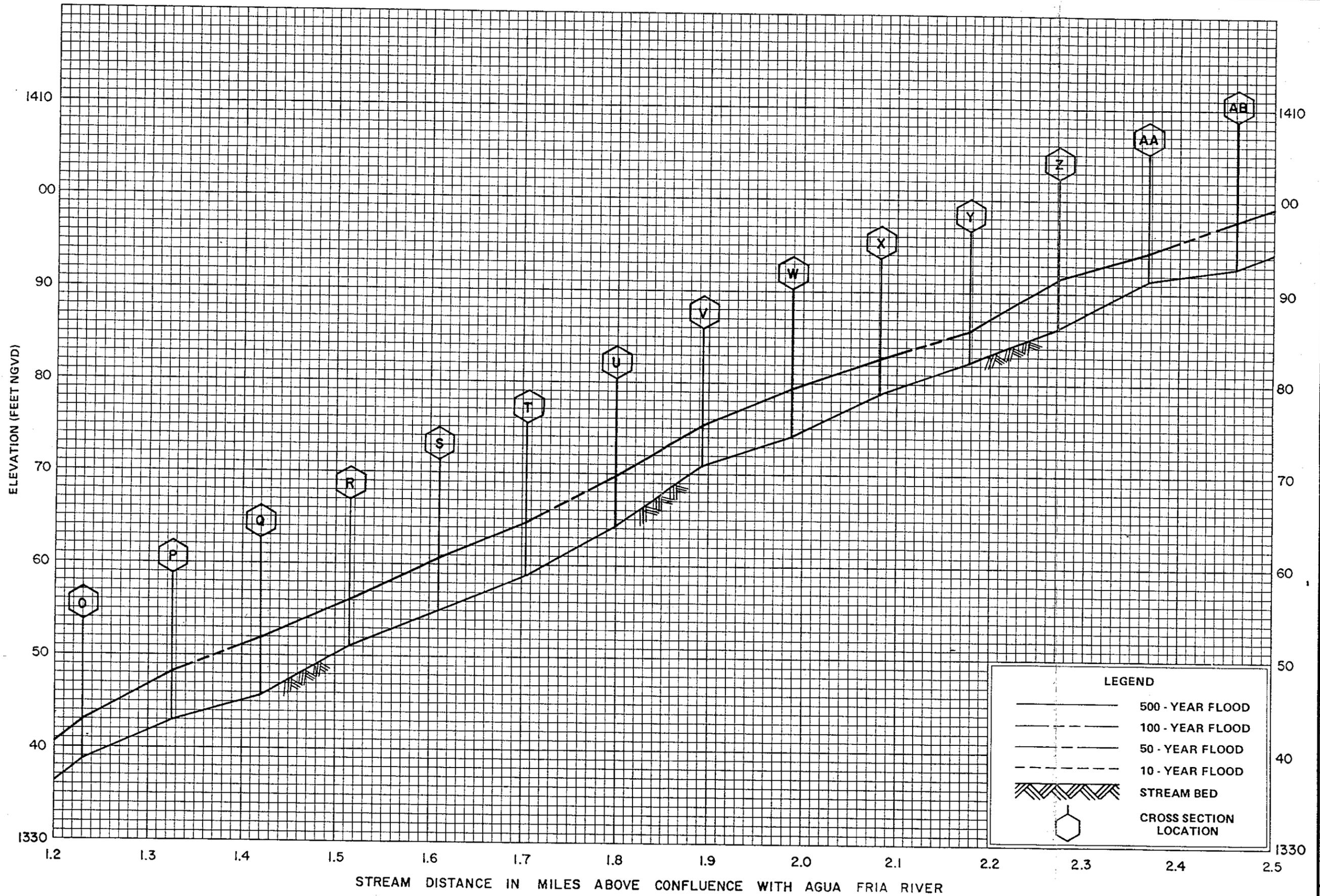
FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA

FLOOD PROFILES
 WEST GARAMBULLO WASH



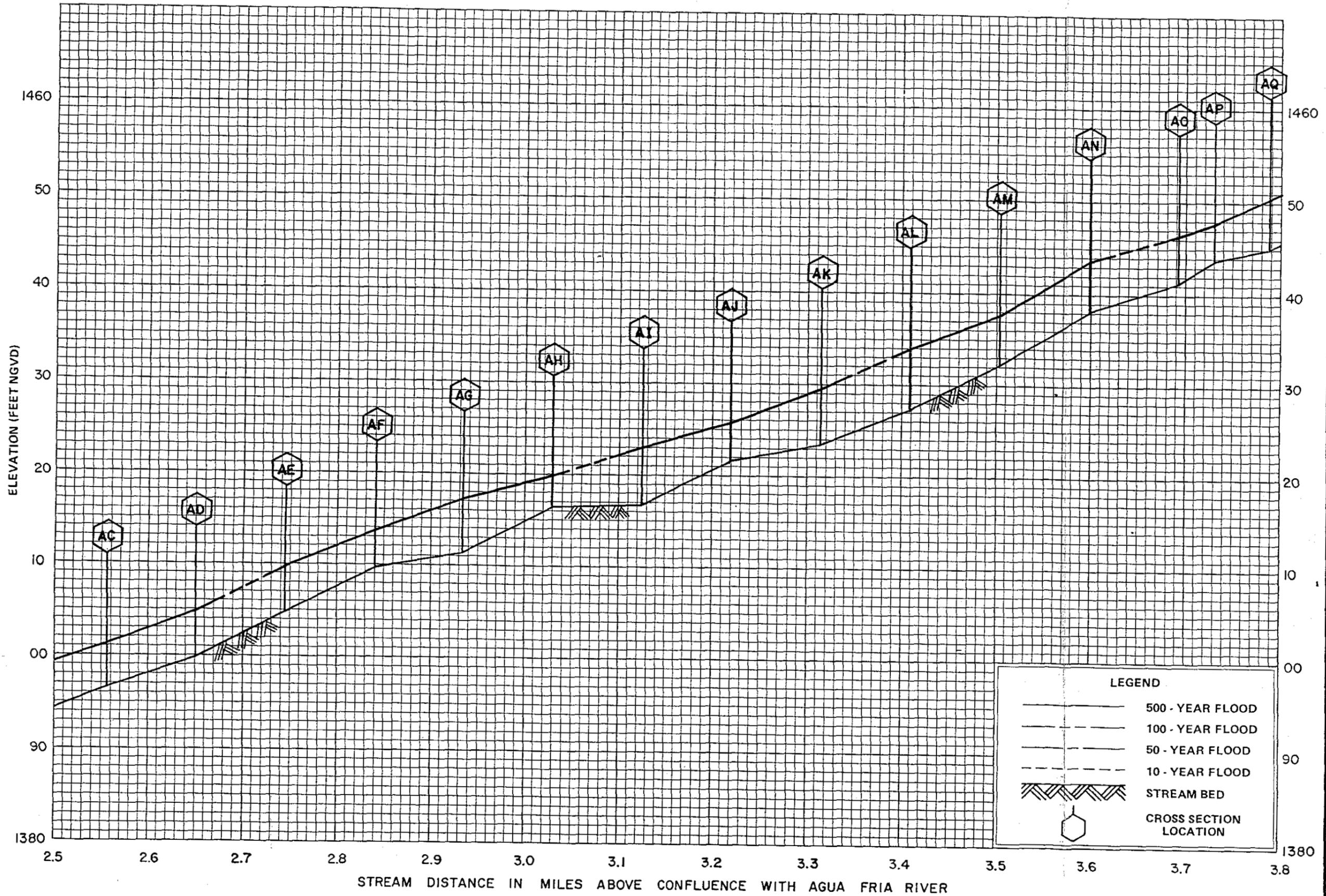
FLOOD PROFILES
EAST GARAMBULLO WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA



FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA

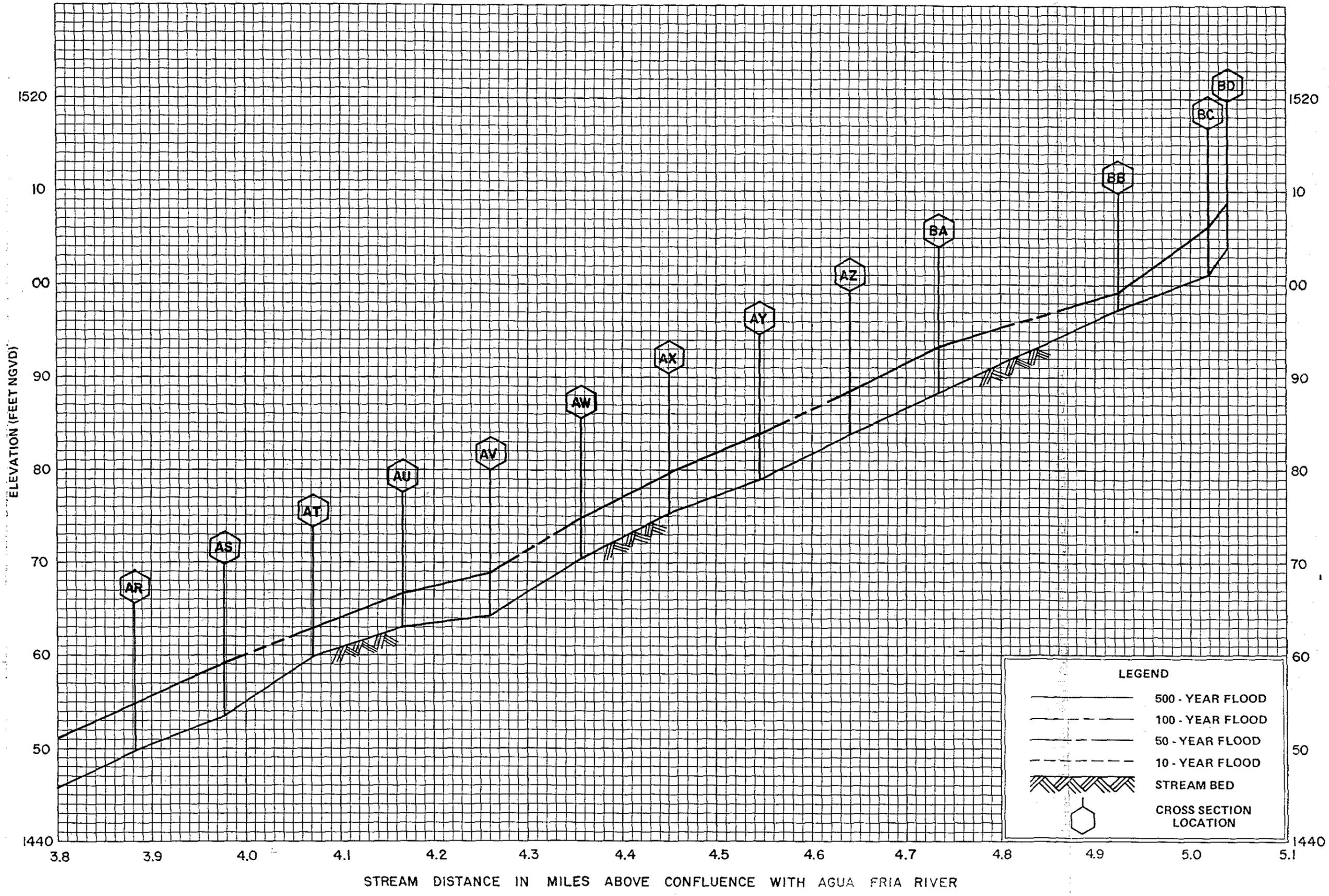
FLOOD PROFILES
 CATERPILLAR TANK WASH



FLOOD PROFILES

CATERPILLAR TANK WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
FLOOD CONTROL DISTRICT
MARICOPA COUNTY, ARIZONA

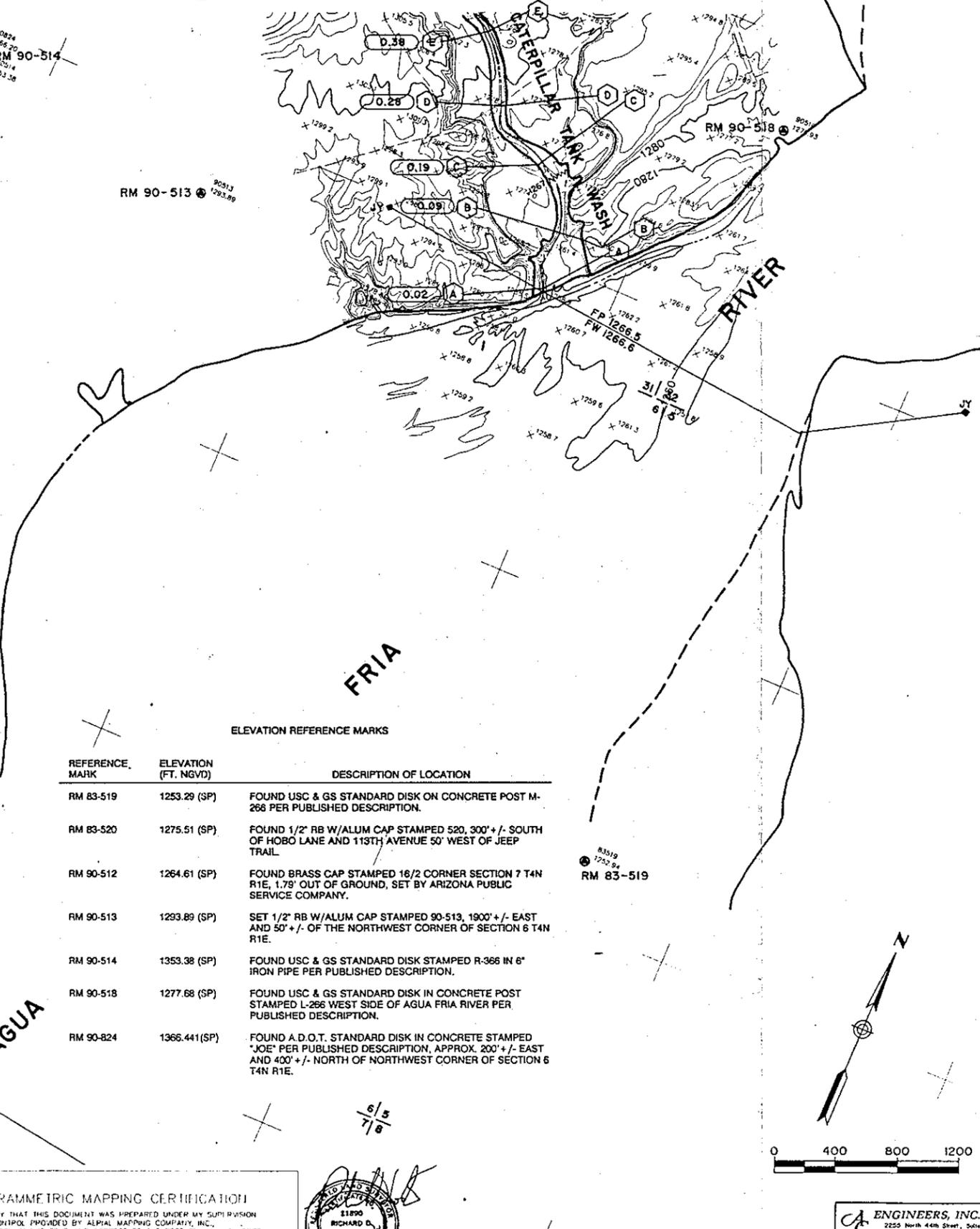
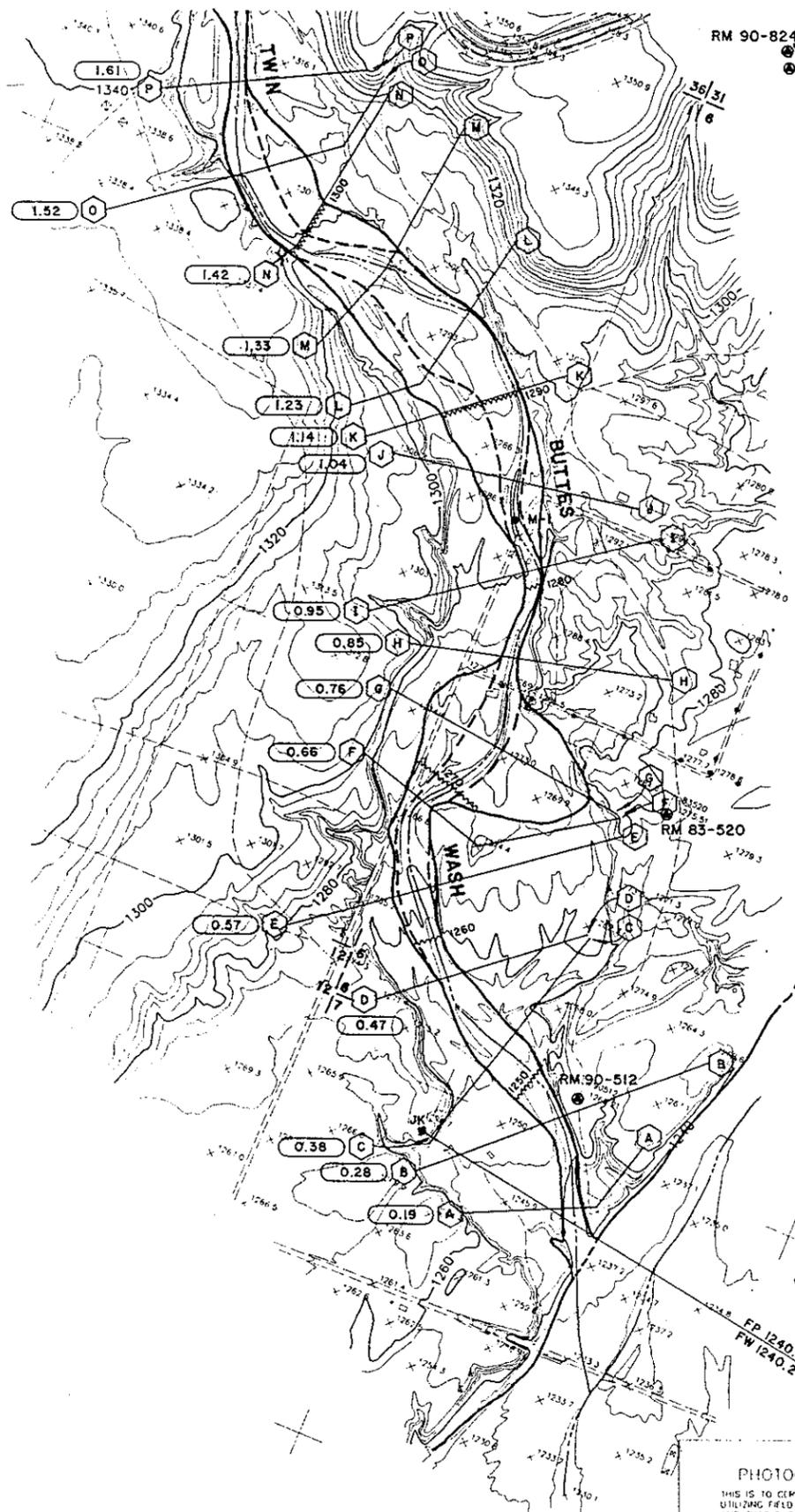


FEDERAL EMERGENCY MANAGEMENT AGENCY
 FLOOD CONTROL DISTRICT
 MARICOPA COUNTY, ARIZONA

FLOOD PROFILES
 CATERPILLAR TANK WASH

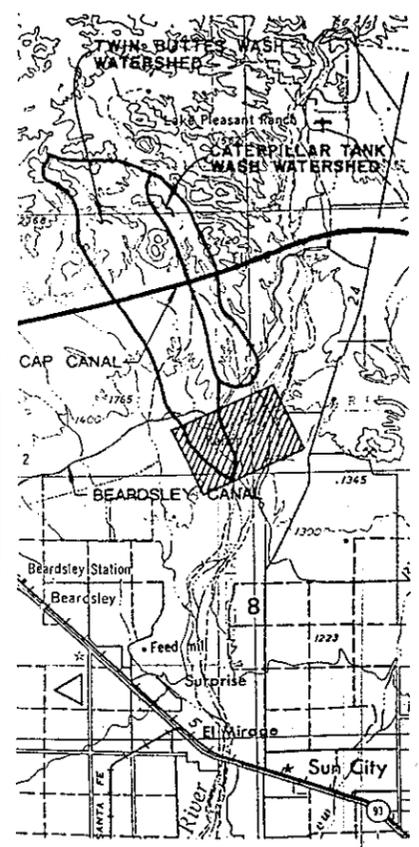
EXHIBIT 2

Flood Insurance Rate Maps



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 83-519	1253.29 (SP)	FOUND USC & GS STANDARD DISK ON CONCRETE POST M-266 PER PUBLISHED DESCRIPTION.
RM 83-520	1275.51 (SP)	FOUND 1/2" RB W/ALUM CAP STAMPED 520, 300' +/- SOUTH OF HOBBO LANE AND 113TH AVENUE 50' WEST OF JEEP TRAIL.
RM 90-512	1264.61 (SP)	FOUND BRASS CAP STAMPED 16/2 CORNER SECTION 7 T4N R1E, 1.78' OUT OF GROUND, SET BY ARIZONA PUBLIC SERVICE COMPANY.
RM 90-513	1293.89 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-513, 1900' +/- EAST AND 50' +/- OF THE NORTHWEST CORNER OF SECTION 6 T4N R1E.
RM 90-514	1353.38 (SP)	FOUND USC & GS STANDARD DISK STAMPED R-366 IN 6" IRON PIPE PER PUBLISHED DESCRIPTION.
RM 90-518	1277.68 (SP)	FOUND USC & GS STANDARD DISK IN CONCRETE POST STAMPED L-296 WEST SIDE OF AGUA FRIA RIVER PER PUBLISHED DESCRIPTION.
RM 90-824	1366.441 (SP)	FOUND A D.O.T. STANDARD DISK IN CONCRETE STAMPED 'JOE' PER PUBLISHED DESCRIPTION, APPROX. 200' +/- EAST AND 400' +/- NORTH OF NORTHWEST CORNER OF SECTION 6 T4N R1E.



- LEGEND
- 100 - YEAR FLOOD LIMITS
 - - - FLOODWAY LIMITS
 - ~~~~~ BASE FLOOD ELEVATION
 - 20+00 STATIONING IN RIVER FEET UPSTREAM FROM AGUA FRIA RIVER
 - M-1 STATIONING IN RIVER MILE
 - C ○ CROSS - SECTION NUMBER
 - RM 90-513 REFERENCE MARK
 - CONTROL LINE
 - 1.52 CROSS - SECTION STATIONING

NOTES:

THIS FLOOD INSURANCE STUDY WORK MAP HAS BEEN PREPARED IN ACCORDANCE WITH FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) GUIDELINES

THE STUDY HAS BEEN APPROVED BY FEMA WRP BASED ON 1" = 400' TOPOGRAPHIC MAPPING PREPARED BY AERIAL MAPPING COMPANY, INC. FROM PHOTOGRAPHS TAKEN ON SEPTEMBER 13, 1990

ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

PHOTOGRAMMETRIC MAPPING CERTIFICATION

THIS IS TO CERTIFY THAT THIS DOCUMENT WAS PREPARED UNDER MY SUPERVISION UTILIZING FIELD CONTROL PROVIDED BY AERIAL MAPPING COMPANY, INC. AND THAT THIS DOCUMENT IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF. THIS DOCUMENT IS AN INSTRUMENT OF PROFESSIONAL SERVICES ONLY. AERIAL MAPPING COMPANY, INC. MAKES NO WARRANTIES TO THIRD PARTIES



ENGINEERS, INC.

2255 North 44th Street, Suite 330
Phoenix, Arizona 85009
Telephone: (602) 244-2556

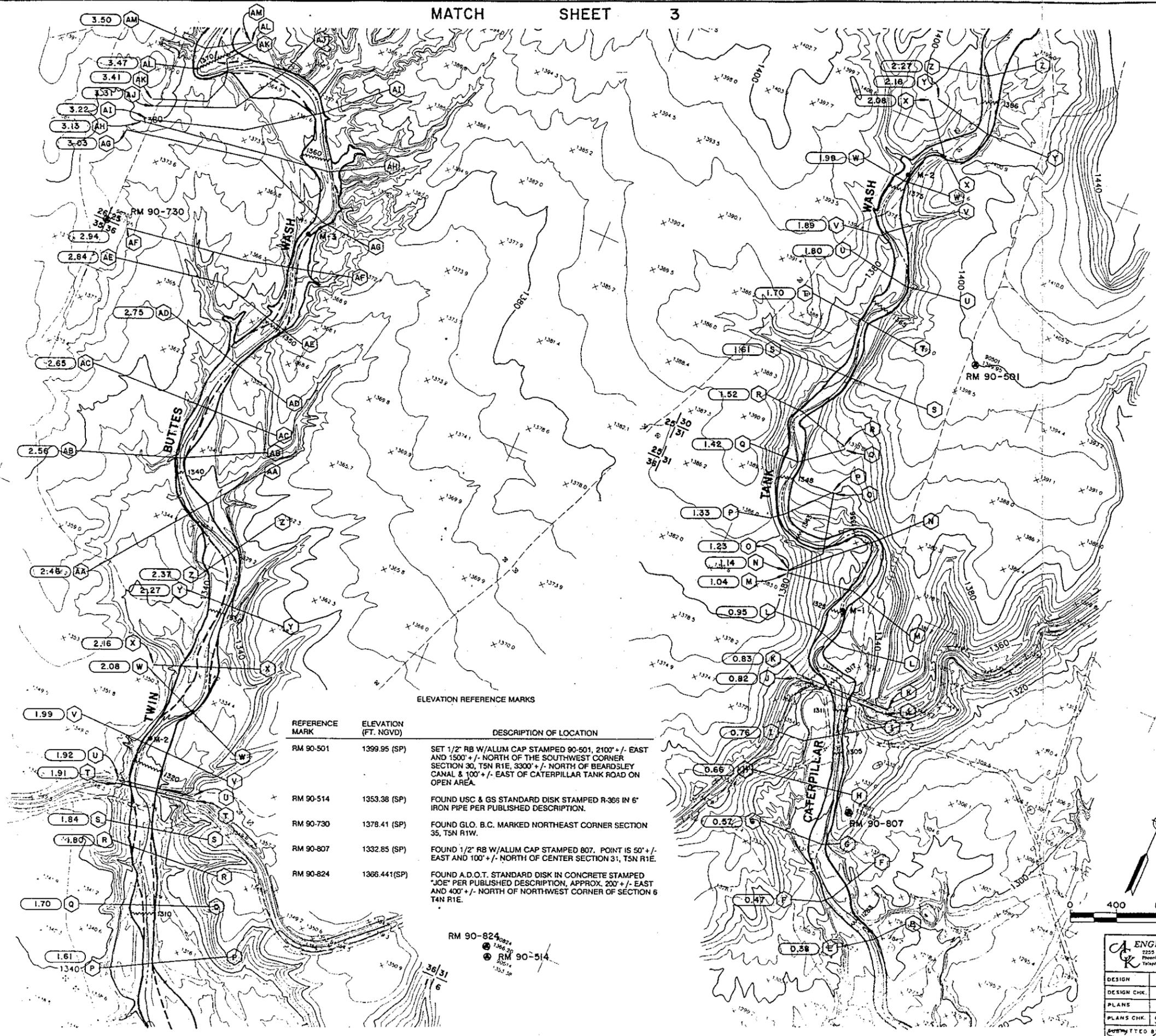
DESIGN BY	HEM	DATE
DESIGN CHK.	SEK	
PLANS	JSD	
PLANS CHK.	SEK	
SUBMITTED BY	[Signature]	
DATE	4/16/91	

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CAP OVERCHUTES FCD 90-09

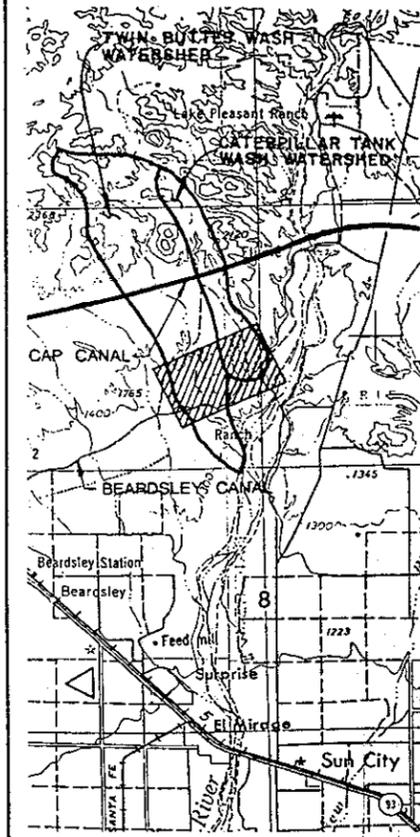
AGUA FRIA FLOODPLAIN DELINEATION

RECOMMENDED BY:	DATE	SHEET
APPROVED BY:	DATE	4
CHIEF ENGINEER & GENERAL MANAGER		



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 90-501	1399.95 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-501, 2100' +/- EAST AND 1500' +/- NORTH OF THE SOUTHWEST CORNER SECTION 30, TSN R1E, 3300' +/- NORTH OF BEARDSLEY CANAL & 100' +/- EAST OF CATERPILLAR TANK ROAD ON OPEN AREA.
RM 90-514	1353.38 (SP)	FOUND USC & GS STANDARD DISK STAMPED R-365 IN 6" IRON PIPE PER PUBLISHED DESCRIPTION.
RM 90-730	1378.41 (SP)	FOUND GLO. B.C. MARKED NORTHEAST CORNER SECTION 35, TSN R1W.
RM 90-807	1332.85 (SP)	FOUND 1/2" RB W/ALUM CAP STAMPED 807. POINT IS 50' +/- EAST AND 100' +/- NORTH OF CENTER SECTION 31, TSN R1E.
RM 90-824	1366.441(SP)	FOUND A.D.O.T. STANDARD DISK IN CONCRETE STAMPED "JOE" PER PUBLISHED DESCRIPTION, APPROX. 200' +/- EAST AND 400' +/- NORTH OF NORTHWEST CORNER OF SECTION 6 T4N R1E.



- LEGEND
- 100 - YEAR FLOOD LIMITS
 - FLOODWAY LIMITS
 - ~~~~~ BASE FLOOD ELEVATION
 - 20+00 STATIONING IN RIVER FEET UPSTREAM FROM AGUA FRIA RIVER
 - M-1 STATIONING IN RIVER MILE
 - C CROSS - SECTION NUMBER
 - RM 90-513 REFERENCE MARK
 - CONTROL LINE
 - 1.52 CROSS-SECTION STATIONING

NOTES:

THIS FLOOD INSURANCE STUDY WORK MAP HAS BEEN PREPARED IN ACCORDANCE WITH FEDERAL EMERGENCY MANAGEMENT AGENCY (F.E.M.A.) GUIDELINES

THE STUDY HAS BEEN APPROVED BY F.E.M.A. MAP BASED ON F. 400' TOPOGRAPHIC MAPPING PREPARED BY AERIAL MAPPING COMPANY, INC. FROM PHOTOGRAPHS TAKEN ON SEPTEMBER 13, 1990

ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929

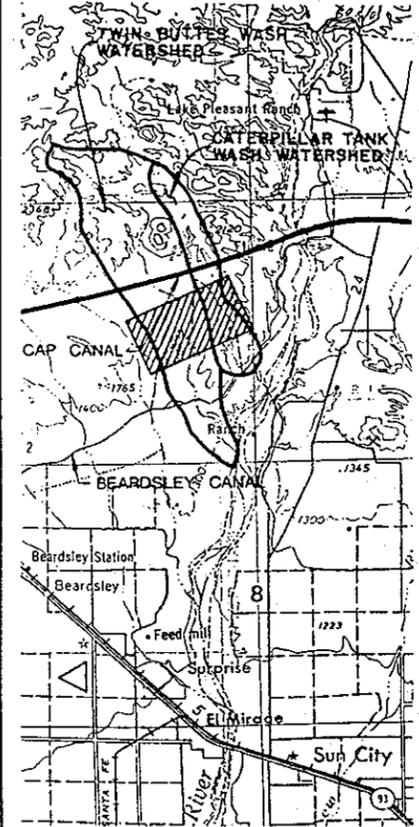
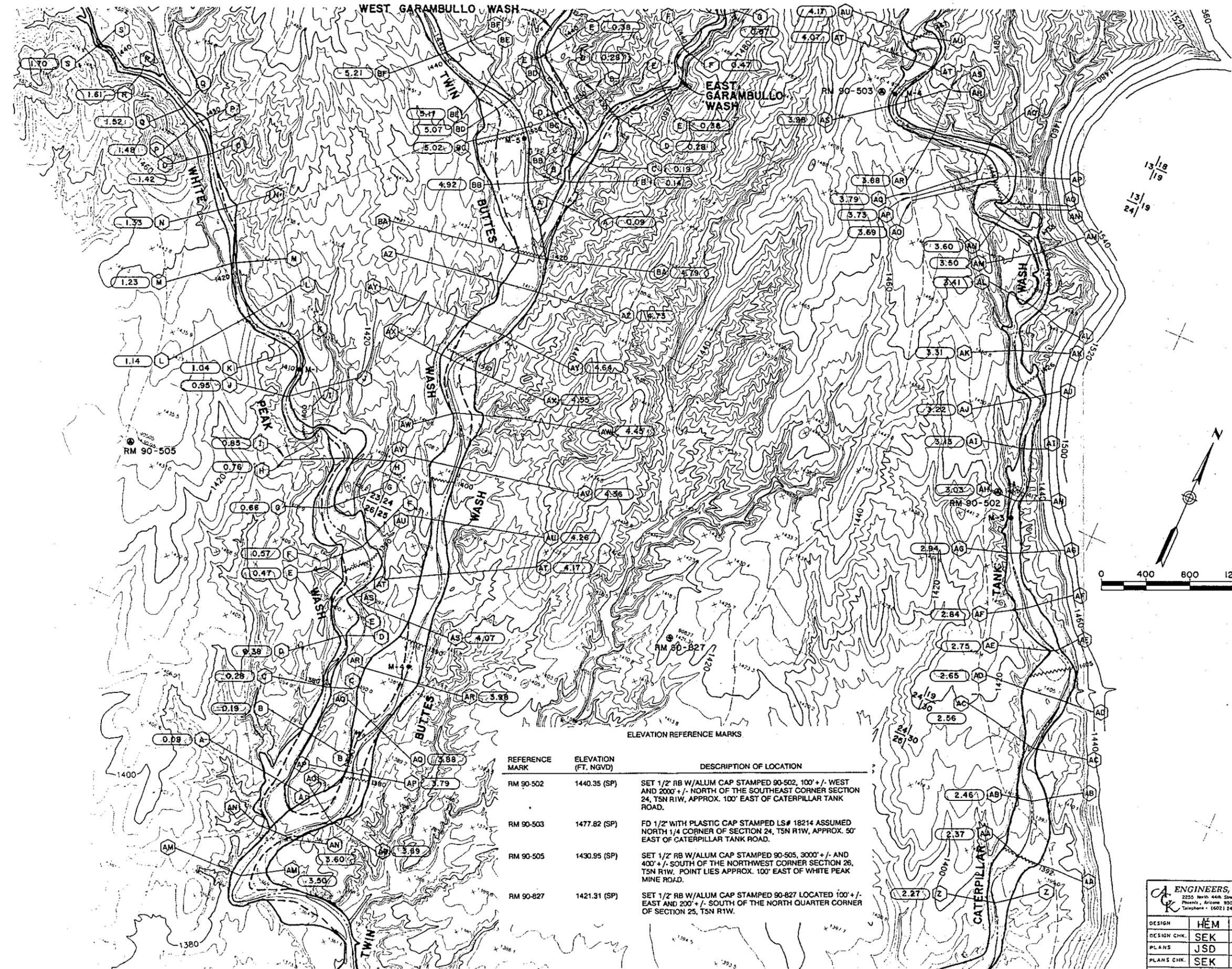
ENGINEERS, INC.
 2225 North 44th Street, Suite 330
 Phoenix, Arizona 85008
 Telephone: (602) 244-2546

DESIGN	HEM	DATE
DESIGN CHK.	SEK	
PLANS	JSD	
PLANS CHK.	SEK	
CHECKED BY:	DATE: 6/16/91	

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CAP OVERCHUTES FCD 90-09		
AGUA FRIA FLOODPLAIN DELINEATION		
RECOMMENDED BY:	DATE	SHEET 2
APPROVED BY:	DATE	OF 4
CHIEF ENGINEER & GENERAL MANAGER		

MATCH SHEET 4



- LEGEND
- 100 - YEAR FLOOD LIMITS
 - FLOODWAY LIMITS
 - ~~~~~ BASE FLOOD ELEVATION
 - 20+00 STATIONING IN RIVER FEET UPSTREAM FROM AGUA FRIA RIVER
 - M-1 STATIONING IN RIVER MILE
 - C CROSS - SECTION NUMBER
 - ⊙ RM 90-513 REFERENCE MARK
 - CONTROL LINE
 - 1.52 CROSS - SECTION STATIONING

NOTES:

THIS FLOOD INSURANCE STUDY WORK MAP HAS BEEN PREPARED IN ACCORDANCE WITH FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) GUIDELINES.

THE STUDY HAS BEEN APPROVED BY FEMA MAP BASED ON 1" = 400' TOPOGRAPHIC MAPPING PREPARED BY AERIAL MAPPING COMPANY, INC. FROM PHOTOGRAPHS TAKEN ON SEPTEMBER 13, 1990

ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 90-502	1440.35 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-502, 100' +/- WEST AND 2000' +/- NORTH OF THE SOUTHWEST CORNER SECTION 24, TSN R1W, APPROX. 100' EAST OF CATERPILLAR TANK ROAD.
RM 90-503	1477.82 (SP)	FD 1/2" WITH PLASTIC CAP STAMPED LS# 18214 ASSUMED NORTH 1/4 CORNER OF SECTION 24, TSN R1W, APPROX. 90' EAST OF CATERPILLAR TANK ROAD.
RM 90-505	1430.95 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-505, 3000' +/- AND 400' +/- SOUTH OF THE NORTHWEST CORNER SECTION 26, TSN R1W, POINT LIES APPROX. 100' EAST OF WHITE PEAK MINE ROAD.
RM 90-827	1421.31 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-827 LOCATED 100' +/- EAST AND 200' +/- SOUTH OF THE NORTH QUARTER CORNER OF SECTION 25, TSN R1W.

A ENGINEERS, INC.
 2255 North 44th Street, Suite 330
 Phoenix, Arizona 85008
 Telephone: (602) 244-2565

DESIGN	HEM	DATE
DESIGN CHK.	SEK	
PLANS	JSD	
PLANS CHK.	SEK	
SUBMITTED BY:	DATE: 5/6/91	

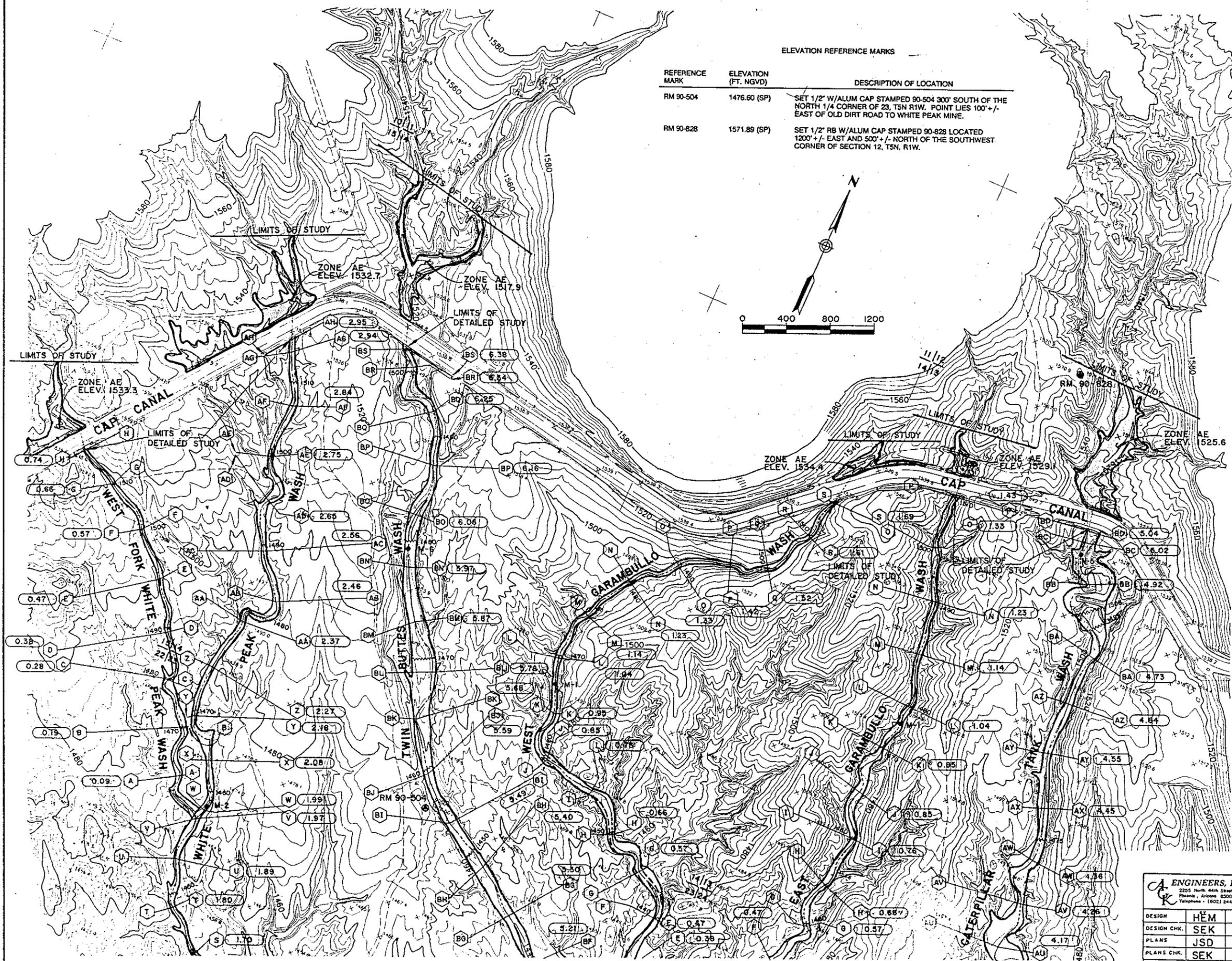
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CAP OVERCHUTES FCD 90-09
 AGUA FRIA FLOODPLAIN DELINEATION

RECOMMENDED BY:	DATE	SHEET 3
APPROVED BY:	DATE	of 4

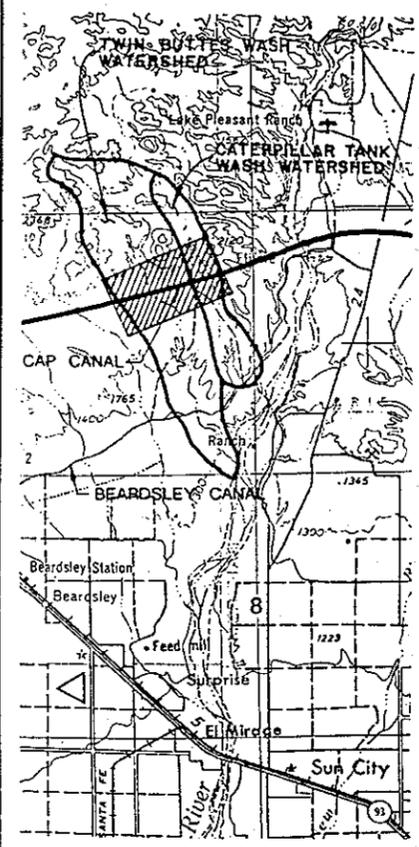
CHIEF ENGINEER & GENERAL MANAGER

MATCH SHEET 2



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 90-504	1476.60 (SP)	SET 1/2" W/ALUM CAP STAMPED 90-504 300' SOUTH OF THE NORTH 1/4 CORNER OF 23, TSN R1W. POINT LIES 100' +/- EAST OF OLD DIRT ROAD TO WHITE PEAK MINE.
RM 90-828	1571.89 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-828 LOCATED 1200' +/- EAST AND 500' +/- NORTH OF THE SOUTHWEST CORNER OF SECTION 12, 15N, R1W.



- LEGEND
- 100 - YEAR FLOOD LIMITS
 - FLOWWAY LIMITS
 - ~~~~~ BASE FLOOD ELEVATION
 - 20+00 STATIONING IN RIVER FEET UPSTREAM FROM AGUA FRIA RIVER
 - M-1 STATIONING IN RIVER MILE
 - (C) (C) CROSS - SECTION NUMBER
 - RM 90-513 REFERENCE MARK
 - CONTROL LINE
 - (1.52) CROSS - SECTION STATIONING

NOTES:

THIS FLOOD INSURANCE STUDY WORK MAP HAS BEEN PREPARED IN ACCORDANCE WITH FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) GUIDELINES

THE STUDY HAS BEEN APPROVED BY FEMA MAP BASED ON 1" = 400' TOPOGRAPHIC MAPPING PREPARED BY AERIAL MAPPING COMPANY, INC. FROM PHOTOGRAPHS TAKEN ON SEPTEMBER 13, 1990

ELEVATIONS BASED ON NATIONAL GEODETIC VERTICAL DATUM OF 1929



ENGINEERS, INC.
2205 North 44th Street, Suite 330
Phoenix, Arizona 85008
Telephone - (602) 244-2566

DESIGN	HEM	DATE
DESIGN CHK.	SEK	
PLANS	JSD	
PLANS CHK.	SEK	
SUBMITTED BY:		DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY	
CAP OVERCHUTES FCD 90-09	
AGUA FRIA FLOODPLAIN DELINEATION	
RECOMMENDED BY:	DATE
APPROVED BY:	DATE
CHIEF ENGINEER & GENERAL MANAGER	

SHEET 4
of 4

EXHIBIT 3

Elevation Reference Marks

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 90-504	1476.60 (SP)	SET 1/2" W/ALUM CAP STAMPED 90-504 300' SOUTH OF THE NORTH 1/4 CORNER OF 23, T5N R1W. POINT LIES 100'+/- EAST OF OLD DIRT ROAD TO WHITE PEAK MINE.
RM 90-828	1571.89 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-828 LOCATED 1200'+/- EAST AND 500'+/- NORTH OF THE SOUTHWEST CORNER OF SECTION 12, T5N, R1W.
RM 90-502	1440.35 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-502, 100'+/- WEST AND 2000'+/- NORTH OF THE SOUTHEAST CORNER SECTION 24, T5N R1W, APPROX. 100' EAST OF CATERPILLAR TANK ROAD.
RM 90-503	1477.82 (SP)	FD 1/2" WITH PLASTIC CAP STAMPED LS# 18214 ASSUMED NORTH 1/4 CORNER OF SECTION 24, T5N R1W, APPROX. 50' EAST OF CATERPILLAR TANK ROAD.
RM 90-505	1430.95 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-505, 3000'+/- AND 400'+/- SOUTH OF THE NORTHWEST CORNER SECTION 26, T5N R1W. POINT LIES APPROX. 100' EAST OF WHITE PEAK MINE ROAD.
RM 90-827	1421.31 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-827 LOCATED 100'+/- EAST AND 200'+/- SOUTH OF THE NORTH QUARTER CORNER OF SECTION 25, T5N R1W.
RM 90-501	1399.95 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-501, 2100'+/- EAST AND 1500'+/- NORTH OF THE SOUTHWEST CORNER SECTION 30, T5N R1E, 3300'+/- NORTH OF BEARDSLEY CANAL & 100'+/- EAST OF CATERPILLAR TANK ROAD ON OPEN AREA.
RM 90-514	1353.38 (SP)	FOUND USC & GS STANDARD DISK STAMPED R-366 IN 6" IRON PIPE PER PUBLISHED DESCRIPTION.
RM 90-730	1378.41 (SP)	FOUND GLO. B.C. MARKED NORTHEAST CORNER SECTION 35, T5N R1W.
RM 90-807	1332.85 (SP)	FOUND 1/2" RB W/ALUM CAP STAMPED 807. POINT IS 50'+/- EAST AND 100'+/- NORTH OF CENTER SECTION 31, T5N R1E.
RM 90-824	1366.441 (SP)	FOUND A.D.O.T. STANDARD DISK IN CONCRETE STAMPED "JOE" PER PUBLISHED DESCRIPTION, APPROX. 200'+/- EAST AND 400'+/- NORTH OF NORTHWEST CORNER OF SECTION 6 T4N R1E.

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM 83-519	1253.29 (SP)	FOUND USC & GS STANDARD DISK ON CONCRETE POST M-266 PER PUBLISHED DESCRIPTION.
RM 83-520	1275.51 (SP)	FOUND 1/2" RB W/ALUM CAP STAMPED 520, 300' +/- SOUTH OF HOBO LANE AND 113TH AVENUE 50' WEST OF JEEP TRAIL.
RM 90-512	1264.61 (SP)	FOUND BRASS CAP STAMPED 16/2 CORNER SECTION 7 T4N R1E, 1.79' OUT OF GROUND, SET BY ARIZONA PUBLIC SERVICE COMPANY.
RM 90-513	1293.89 (SP)	SET 1/2" RB W/ALUM CAP STAMPED 90-513, 1900' +/- EAST AND 50' +/- OF THE NORTHWEST CORNER OF SECTION 6 T4N R1E.
RM 90-514	1353.38 (SP)	FOUND USC & GS STANDARD DISK STAMPED R-366 IN 6" IRON PIPE PER PUBLISHED DESCRIPTION.
RM 90-518	1277.68 (SP)	FOUND USC & GS STANDARD DISK IN CONCRETE POST STAMPED L-266 WEST SIDE OF AGUA FRIA RIVER PER PUBLISHED DESCRIPTION.
RM 90-824	1366.441 (SP)	FOUND A.D.O.T. STANDARD DISK IN CONCRETE STAMPED "JOE" PER PUBLISHED DESCRIPTION, APPROX. 200' +/- EAST AND 400' +/- NORTH OF NORTHWEST CORNER OF SECTION 6 T4N R1E.