CENTENNIAL WASH

CDA Review

Percolation Losses

Synthetic Storm CN

A333.908

State of Arizona

DEPARTMENT OF WATER RESOURCES

15 South 15th Avenue, Phoenix, AZ 85007

. Governor
. Director

LETTER OF TRANSMITTAL

To: Joe Tram, P.E.
Maricopa Co. Flood Control District

Date: 10-19-89

File Name:

Attention:

Greetings:
We are sending you the following items by:

___ Drawings ___ Prints ___ Plans ___ Samples
✓ Copy of Letter ___ Change Order ___ Specifications
___ Other

Copies	Date	Description
1	1-26-89	Memo - Review of 2nd CBA Centennial Wash Report (1-6-89)
		JRM
		Copy of Centennial 1st & 2nd comments
		G

These are transmitted as checked below:

___ For approval ___ Approved as submitted ___ For instruction
✓ For your use ___ Approved as noted ___ Resubmit ___ copies for approval
___ As requested ___ Returned for corrections ___ Return ___ corrected prints
___ For review & comment

Remarks Supplemental item not included in batch from Morris. (10/18/89) Sorry. Jim asked me to track this to you

Copy To:

Signed: D. F. Creighton, Jr.
Engineering Division/
Flood Management Section
(602) 542-1541

Think Conservation!

DEPARTMENT OF WATER RESOURCES
ENGINEERING DIVISION
FLOOD MANAGEMENT SECTION

MEMORANDUM

TO: James R. Morris, P.E.

FROM: David E. Creighton, Jr.

DATE: January 26, 1989

SUBJECT: Review of Second CBA Centennial Wash Report (January 6, 1989)

There is no evidence that a professional engineer had any involvement in this revision.

The following comments are in addition to the comments dated October 28, 1988.

1. CBA did run the HEC-1 model with subdividing of 4 of the 7 subareas requested by MCFCD, and did insert an RL card for channel percolation losses.

2. The reach routings RS (NSTPS) values in numerous cases appear to have created lengths too short for the computation interval with a resulting 21 warning messages. Channel subreaches (NSTPS) need to be examined for number to reduce or eliminate the 21 warning messages. Reaches have been reduced to too short lengths for the computation time interval.

3. Lag-times should be based on computed travel time for channel and overland flow. The CN number and upland flow methods in SCS Chapter 15 are humid area expedients for drainage areas not to exceed 2,000 acres. Revision is needed and computation sheets need to be submitted for review. The pattern of lag-time revision is inconsistent with previously submitted materials. Reason for choice of method needs to be stated. The HEC-1 line 3 ID Card Title Curve Numbers determined by Upland Method and Line 11 KM. Lag-time = Hydraulic Length, average watershed slope and CN create confusion in understanding what CBA actually did. The line 11 KM phrase indicates the Curve Number method equation 15.4 was used in spite of the 2000 acre upper limit.

4. Channel N-values should be specifically supported. Many still appear to be too low.

5. Curve Numbers should be determined by field transect vegetation sampling and soil type sample transects using the best available information. References need to be supplemented by the SCS Soil Survey of: 1) Yavapai County, Arizona, Western Part, March 1976, and 2.) Aguila-Carefree area, parts of Maricopa and Pinal Counties, Arizona, April 1986. The TR-55

(References 17) Table 2-2d is useful guidance when the appropriate level of ground cover is factored in.

6. The text of the report ignores channel percolation losses. A statement needs to be included. The percolation losses on sheet or shallow flow plain areas are not realistically accounted for due to the variation between channel flow surface area for a single path as the conventional reach cross-section implies. The Centennial Wash watershed has major groundwater recharge. The watershed stream flow record data from 1961 through 1985 provide indications of the magnitude of losses from stream flow through the volume of runoff occurring during the runoff period for general area wide rainfall events.

7. Overtopping of cross-sections or dams must be examined and eliminated or justified by individual case discussion in the report text. The overtopping locations with extent of overtopping are:

Location	Overtop Amount
Reach 5	1.47'
Reach 7	7.33'
Narrows Dam	4.83'
Reach 8	0.99'
Reach 13	1.99'
Eagletail Detention	3.18'
Reach 16	3.44'
Old Camp Detention	52.29'
Reach 20	2.26'

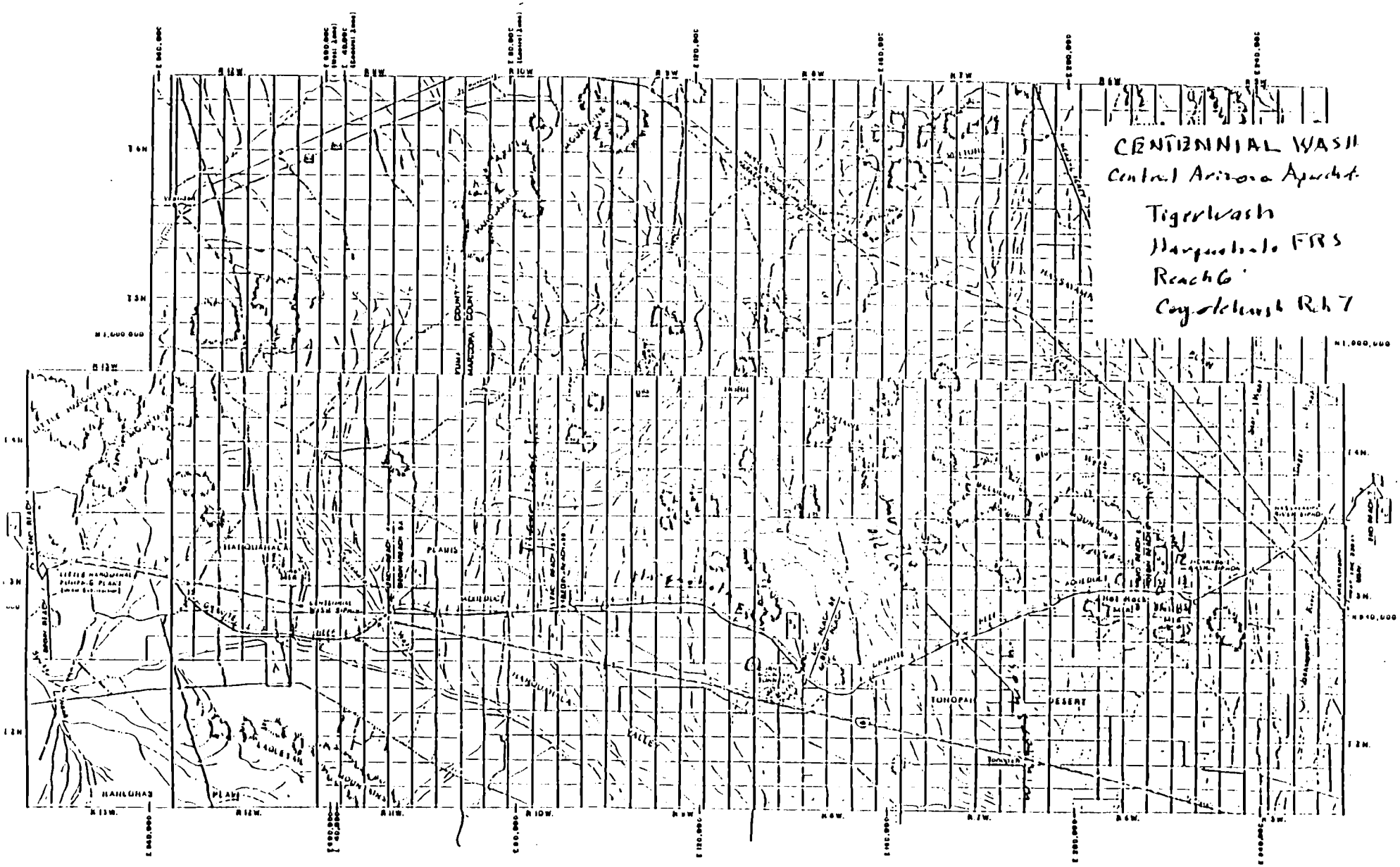
8. Subareas without flood control structures needing revision or subdivision are:
   a. Ritter Dam belongs in Subareas 2 instead of 1. See attached Map.
   b. Subarea 2 needs to be divided into 2 or 3 subareas.

9. Subareas with flood control structures needing revision and correction are 21, 26, 27, 29, 30, 31, 35, 36 and CAP Reach 7 at Coyote Wash Flume. The following discussions details the deficiencies in modeling and analysis logic.

   The Tiger Wash Detention, Harquahala FRS, Saddleback FRS, Harquahala Floodway, Saddleback Floodway, Eagletail Reach and Old Camp Wash (Reach CAP GRA Reach 6 or 7) require analytical examination of their physical characteristics in order to properly configure the HEC-1 model. The detention structures and floodways are not reservoirs in the model sense. Rather, they are long, non-symmetrical channels approximating a wide, flat triangle with a 2 1/2:1 slope side and a variable slope of the uphill ground from the dam alinement to the upslope flood flow contact.

   These definition structure flood convergence channels result in a continuous communication channel receiving several concentrations of runoff at locations along the channel in addition to sheet or plain flow adjacent to the wash channel.

Examination of the 10 point diffusion of discharges leads to examination of the wash channel occurrences at the end of the Belmont Mountains. This division point between CAP Reachs 6 and 7 shows that critical examination for definition of the Coyote Wash drainage area is necessary and should have been done originally. The cross drainage protective works for CAP Reach 7, at Coyote Wash. The discharge at aqueduct station 180+50 of 1458 cfs is for approximately 30 square miles of watershed that CBA omitted from the model.


CENTENNIAL WASH
Central Arizona Project
Tigerwash
Hassayampa FRS
Reach 6
Coyote Wash Rch 7
PINAL COUNTY
MARICOPA COUNTY
PLAINS
TOHOPAH
DESERT
HAILGHAS
PLAIN

Interchange of CAP Reach 6 & Reach 7 into Arizona

1,030 acres added to community venture off I-10

By Joan Novotny
The Arizona Republic

A Phoenix development company and two British corporations have purchased additional land west of Phoenix on which they plan to build a master-planned community. Burns International Inc. and its British partners had previously purchased almost 25,000 acres for the development.

The acquisition of an additional 1,030 acres brings the size of the parcel held by the Burns/Rosehaugh/Mountleigh Joint Venture to about 26,000 acres. The partnership plans to build moderate-priced housing.

The group is still working on the specific plans for the area and now is conducting the various engineering and hydrology studies needed for the master plan. No starting date has been established.

The community, which has not yet been named, would be completed in 20 to 25 years, according to Brian McBain, executive vice president of marketing and communications for Burns International Inc. of Phoenix.

Other partners are Rosehaugh PLC and Mountleigh PLC, both publicly held, diversified British corporations.

The new acquisition straddles Interstate 10 from the Hassayampa River west to Tonopah and provides the joint venture with interstate access to the greater portion of the planned development.

That portion begins about a mile north of I-10 and previously had no direct access to it.

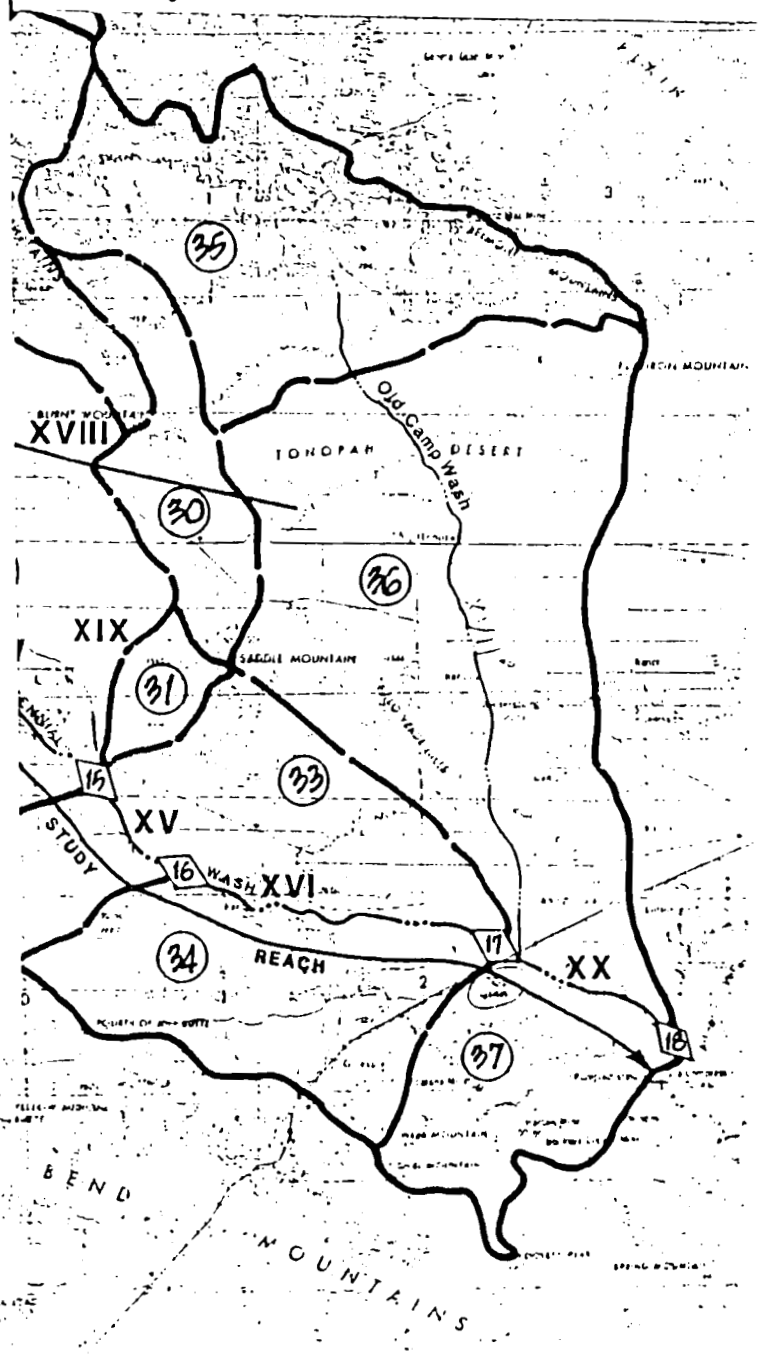
The newly acquired parcel will provide access from two interchanges — 339th Avenue and 411th Avenue — and provide land for commercial development along the interstate. There is a quarter-mile of frontage on each side of I-10 near 355th Avenue.

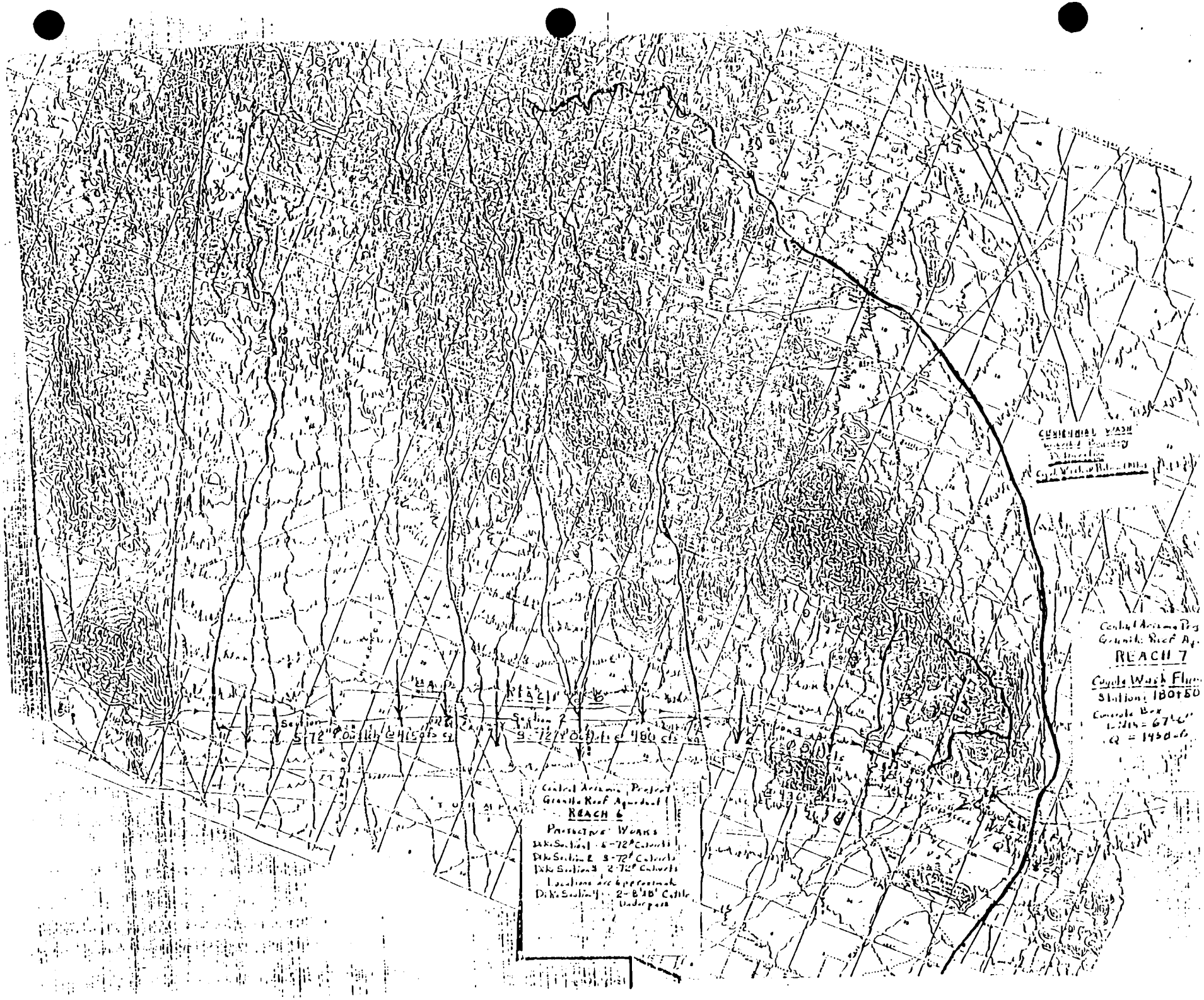
The parcel is an assemblage of land that previously was held by several different people. No purchase price was revealed.

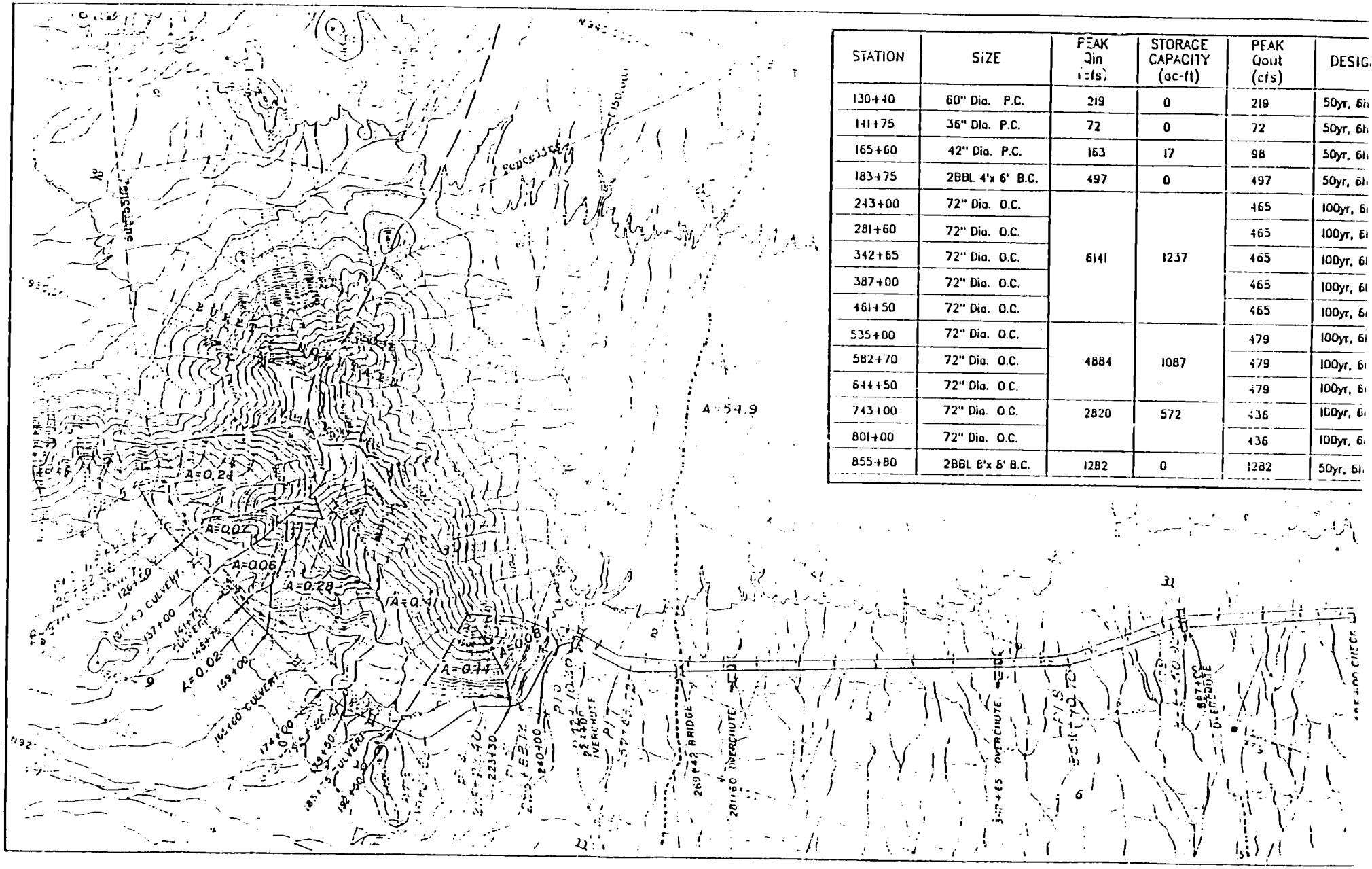
Roger Howson of Rosehaugh PLC said the partnership is banking on a dramatic increase in Arizona's population in the next 20 years to provide it with home buyers for the community.

"Clearly, the lion's share of that population growth will be the people who keep America's businesses operating," he said. "These people will need affordable housing — something the papers tell us is in short supply the country over — and we will be able to provide it.

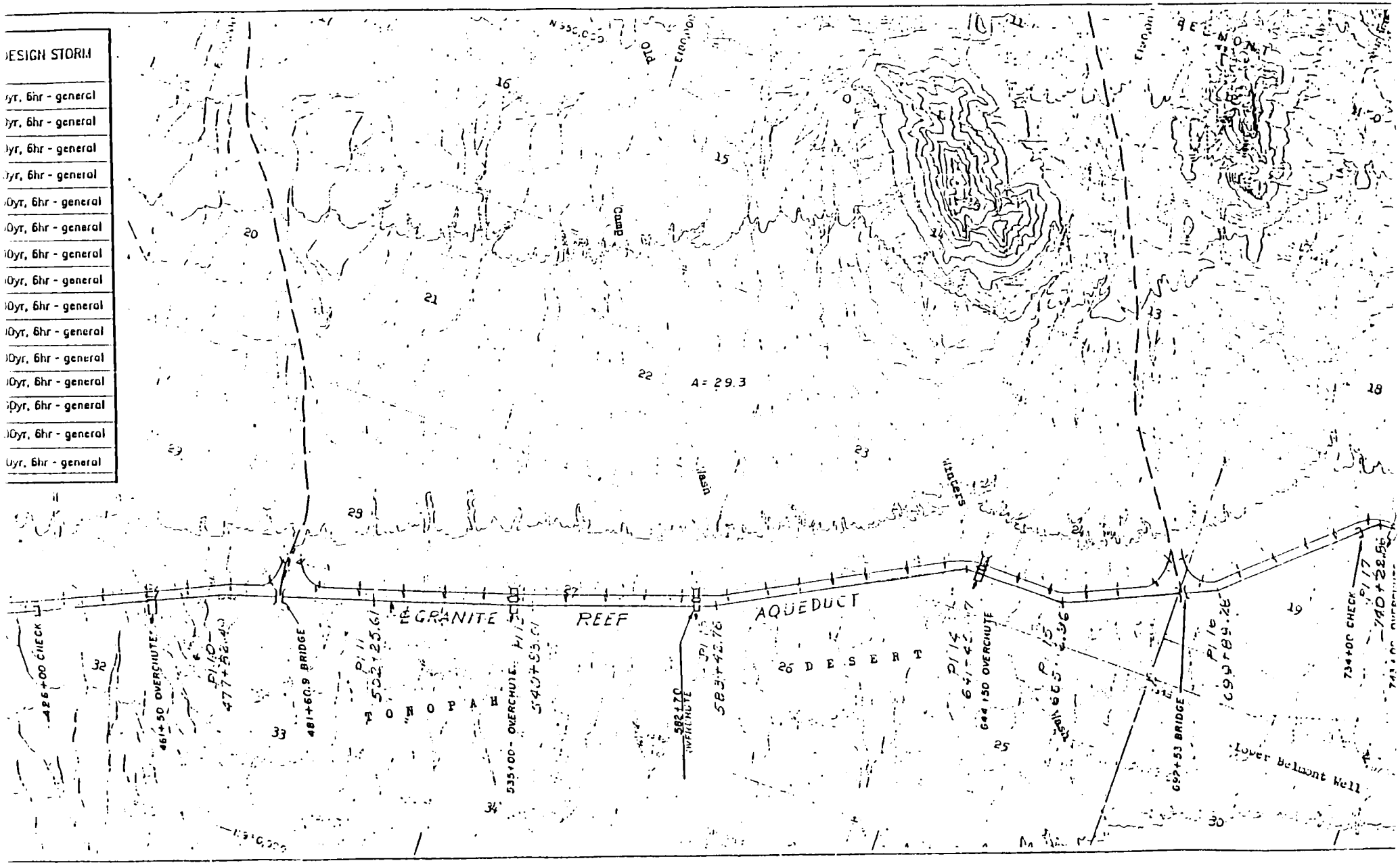
"In turn, this affordable housing and cost of doing business should prove to be an important incentive for businesses looking to relocate or establish new operating hubs."

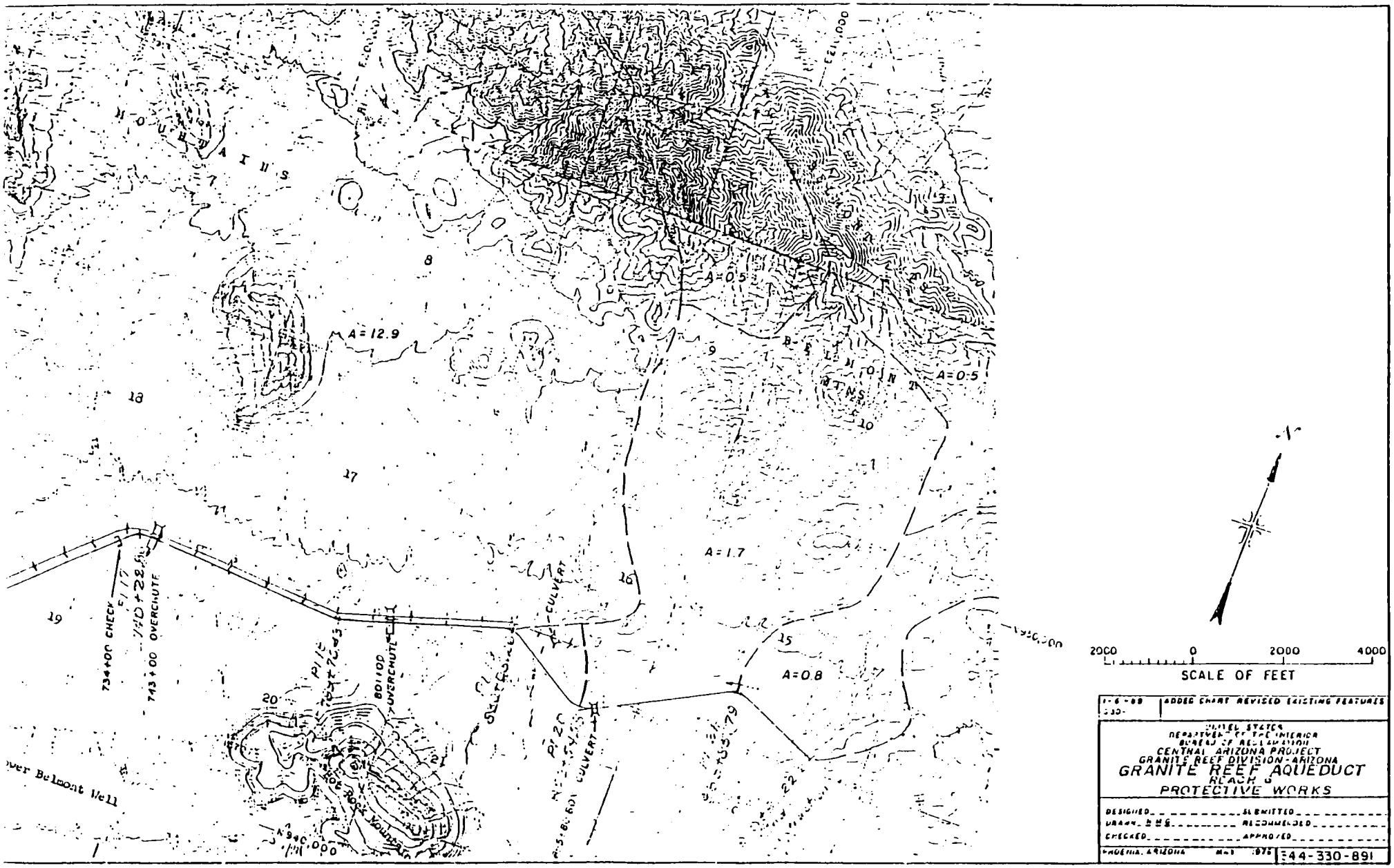



REACH 7
Section 1
Section 2
Central Arizona Project
Granite Reef Aqueduct
REACH 6
Protective Works
Dike Section 1 6-72" Culverts
Dike Section 2 8-72" Culverts
Dike Section 3 2-72" Culverts
Locations are approximate
Dike Section 4 2-8'x8' Cattle Underpass



STATION	SIZE	PEAK Qin (cfs)	STORAGE CAPACITY (ac-ft)	PEAK Qout (cfs)	DESIG
130+40	60" Dia. P.C.	219	0	219	50yr, 6h
141+75	36" Dia. P.C.	72	0	72	50yr, 6h
165+60	42" Dia. P.C.	163	17	98	50yr, 6h
183+75	2BBL 4'x 6' B.C.	497	0	497	50yr, 6h
243+00	72" Dia. O.C.			465	100yr, 6h
281+60	72" Dia. O.C.			465	100yr, 6h
342+65	72" Dia. O.C.	6141	1237	465	100yr, 6h
387+00	72" Dia. O.C.			465	100yr, 6h
461+50	72" Dia. O.C.			465	100yr, 6h
535+00	72" Dia. O.C.			479	100yr, 6h
582+70	72" Dia. O.C.	4884	1087	479	100yr, 6h
644+50	72" Dia. O.C.			479	100yr, 6h
743+00	72" Dia. O.C.	2820	572	436	100yr, 6h
801+00	72" Dia. O.C.			436	100yr, 6h
855+80	2BBL 8'x 8' B.C.	1282	0	1282	50yr, 6h


DESIGN STORM
yr, 6hr - general
yr, 6hr - general
yr, 6hr - general
yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
0yr, 6hr - general
A = 29.3
GRANITE REEF AQUEDUCT
TONOPAH
DESERT
426+00 CHECK
461+50 OVERCHUTE
481+60.9 BRIDGE
535+00 OVERCHUTE
582+70 OVERCHUTE
644+50 OVERCHUTE
692+53 BRIDGE
734+00 CHECK
Lower Belmont Well

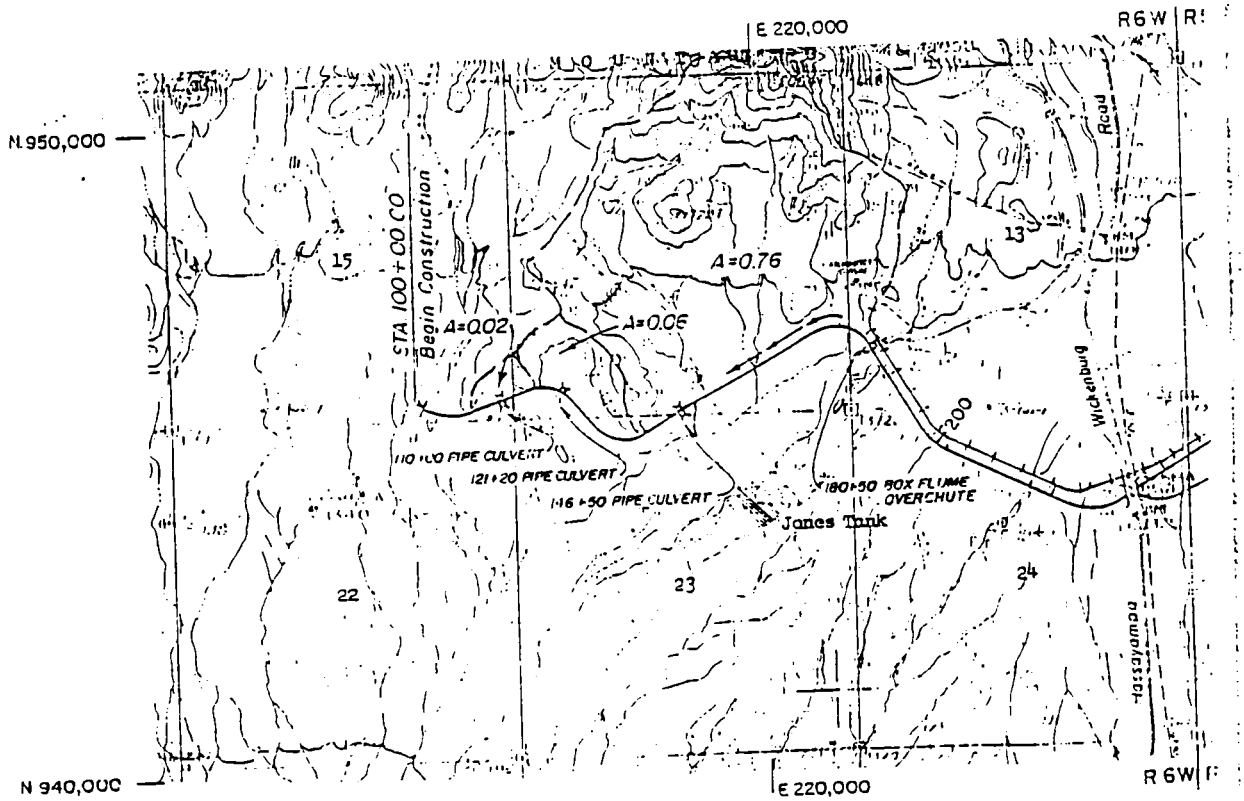

A = 12.9
A = 0.5
A = 0.5
A = 1.7
A = 0.8
8
9
10
15
16
17
18
19
20
734+00 CHECK
743+00 OVERCHUTE
801+00 OVERCHUTE
CULVERT
CULVERT
SCALE OF FEET
2000
0
2000
4000
ADDED CHART REVISED EXISTING FEATURES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL ARIZONA PROJECT
GRANITE REEF DIVISION - ARIZONA
GRANITE REEF AQUEDUCT
REACH 6
PROTECTIVE WORKS
DESIGNED
SUBMITTED
DRAWN
RECOMMENDED
CHECKED
APPROVED
PHOENIX, ARIZONA
44-330-891

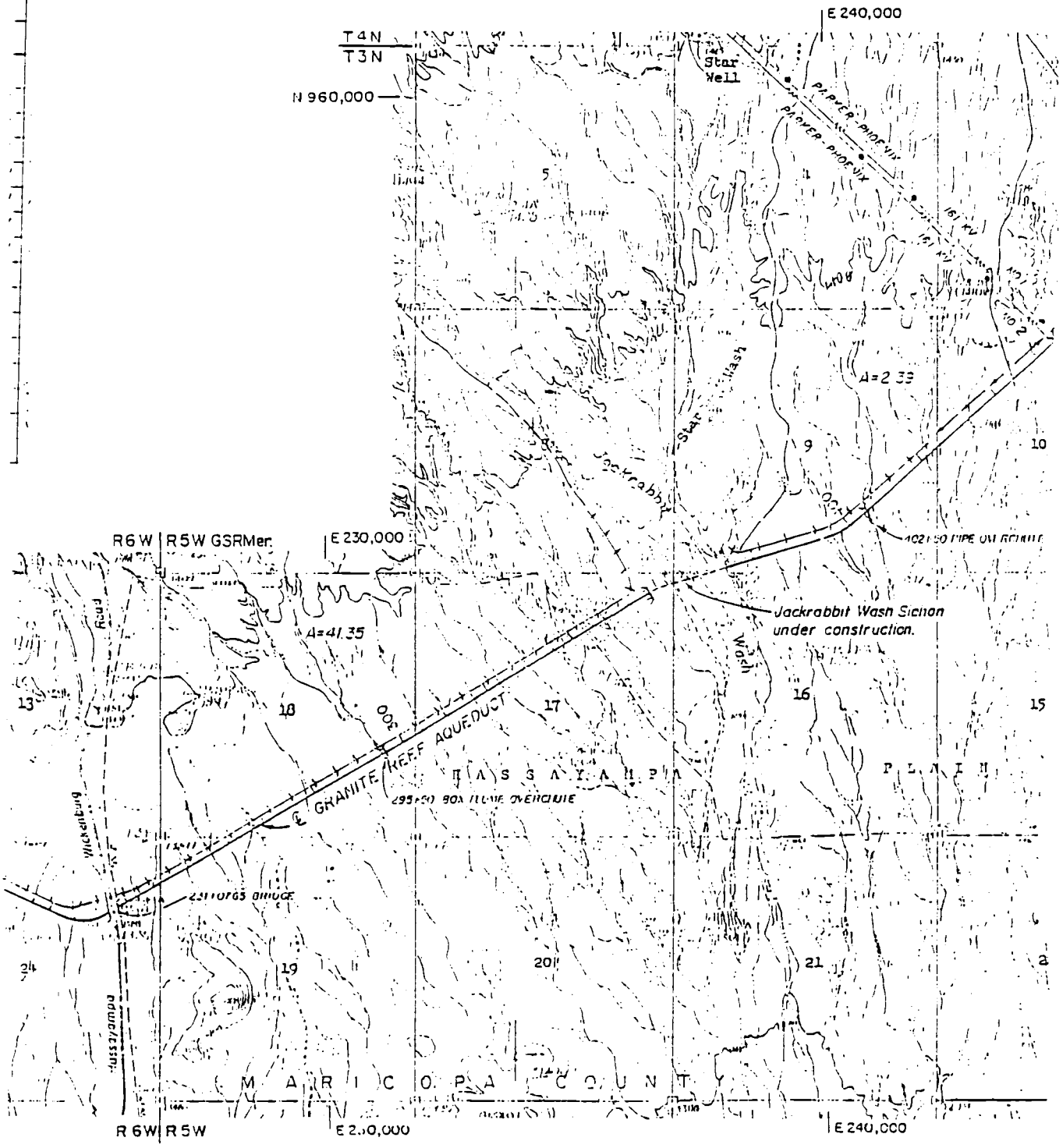
EXPLANATION

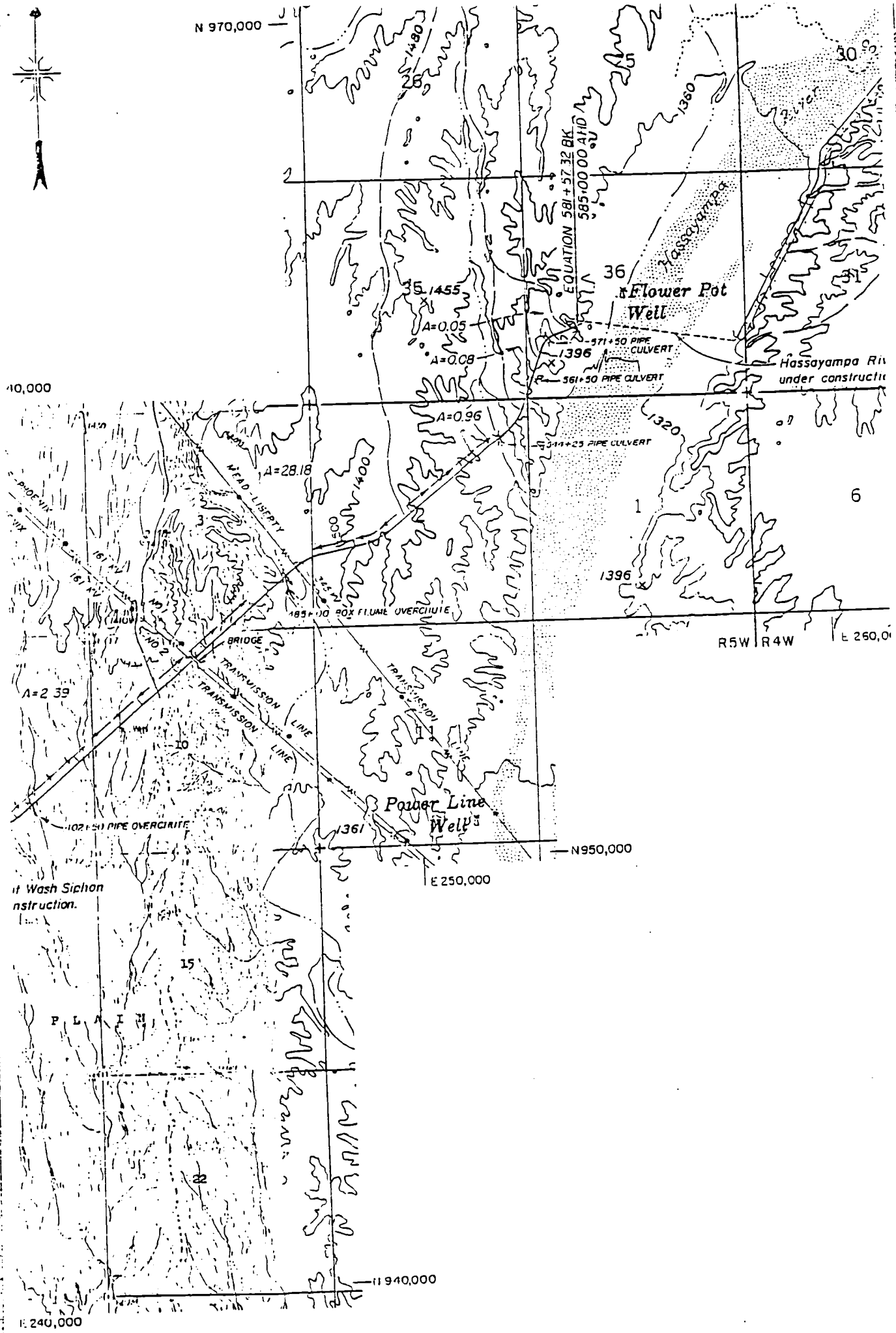
- Open aqueduct and bridge
- Siphon and check
- Transmission line
- Overchute
- Culvert
- Dike
- Drainage ditch

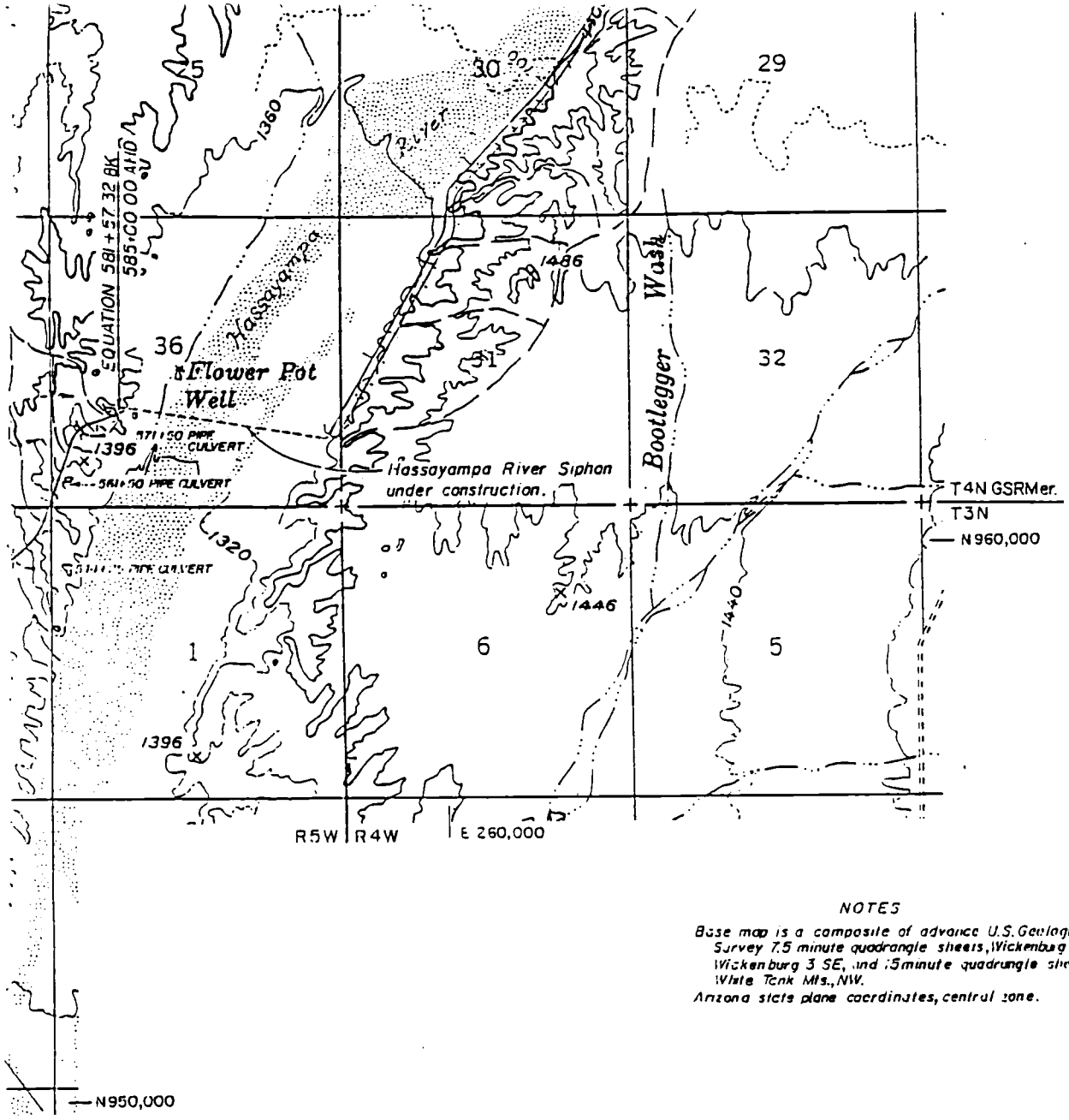
CROSS DRAINAGE STRUCTURES

STATION	SIZE	PEAK Q in (cfs)	STORAGE CAPACITY (ac-ft)	PEAK Q out (cfs)	DESIGN STORM
110+00	30" DIA. PIPE CULVERT	4	0	4	50yr, 6hr GENERAL STORM
121+60	30" DIA. PIPE CULVERT	16	0	16	50yr, 6hr GENERAL STORM
146+50	48" 2BBL PIPE CULVERT	406	16	184	50yr, 6hr GENERAL STORM
180+50	67'-6" WIDE OVERCHUTE	2917	0	1458	6hr, 100yr GENERAL STORM
293+50	67'-6" WIDE OVERCHUTE			1458	6hr, 100yr GENERAL STORM
358+33	JACK RABBIT WASH SIPHON				6hr, 100yr GENERAL STORM
374+75	JACK RABBIT WASH SIPHON				6hr, 100yr GENERAL STORM
393+00	66" DIA. PIPE OVERCHUTE	325	24	69	50yr, 6hr GENERAL STORM
402+50	66" DIA. PIPE OVERCHUTE			69	50yr, 6hr GENERAL STORM
485+00	47'-4" WIDE OVERCHUTE	1710	163	1576	50yr, 6hr GENERAL STORM
544+25	36" 2BBL PIPE CULVERT	170	2	163	50yr, 6hr GENERAL STORM
561+50	30" DIA. PIPE CULVERT	17	0	17	50yr, 6hr GENERAL STORM
571+50	30" DIA. PIPE CULVERT	9	0	9	50yr, 6hr GENERAL STORM
585+00	HASSAYAMPA RIVER SIPHON				
623+35	HASSAYAMPA RIVER SIPHON				




E 240,000
T4N
T3N
N 960,000
Star Well
PIPER PHOENIX
PIPER PHOENIX
A=2.33
Star Wash
Jackrabbit Wash
R6W R5W GSRMer.
E 230,000
A=41.35
Jackrabbit Wash Siphon under construction.
GRANITE REEF AQUEDUCT
MASSAYAMPA PLAIN
Wickenburg Road
MARICOPA COUNTY
R6W R5W
E 230,000
E 240,000


N 970,000
Flower Pot Well
Hassayampa
EQUATION 581+57.32 BK = 585+00.00 AHD
571+50 PIPE CULVERT
561+50 PIPE CULVERT
Hassayampa Ri
under constructi
A=0.05
A=0.08
A=0.96
A=28.18
A=2.39
MEAD-LISBETH
BRIDGE
TRANSMISSION LINE
Power Line Well
N950,000
E 250,000
R5W
R4W
E 260,0
N 940,000
E 240,000
PLAIN



NOTES

Base map is a composite of advance U.S. Geological Survey 7.5 minute quadrangle sheets, Wickenburg 3 NE, Wickenburg 3 SE, and 7.5 minute quadrangle sheet, White Tank Mts., NW.

Arizona state plane coordinates, central zone.

2000 0 2000 4000 6000

SCALE OF FEET

CONTOUR INTERVAL OF 40 FEET

DOTTED LINES REPRESENT CONTOUR INTERVAL OF 20 FEET

01-07-87 330-	ADDED CROSS DRAINAGE STRUCTURES CHART.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
CENTRAL ARIZONA PROJECT
GRANITE REEF DIVISION-ARIZONA

GRANITE REEF AQUEDUCT

REACH 7

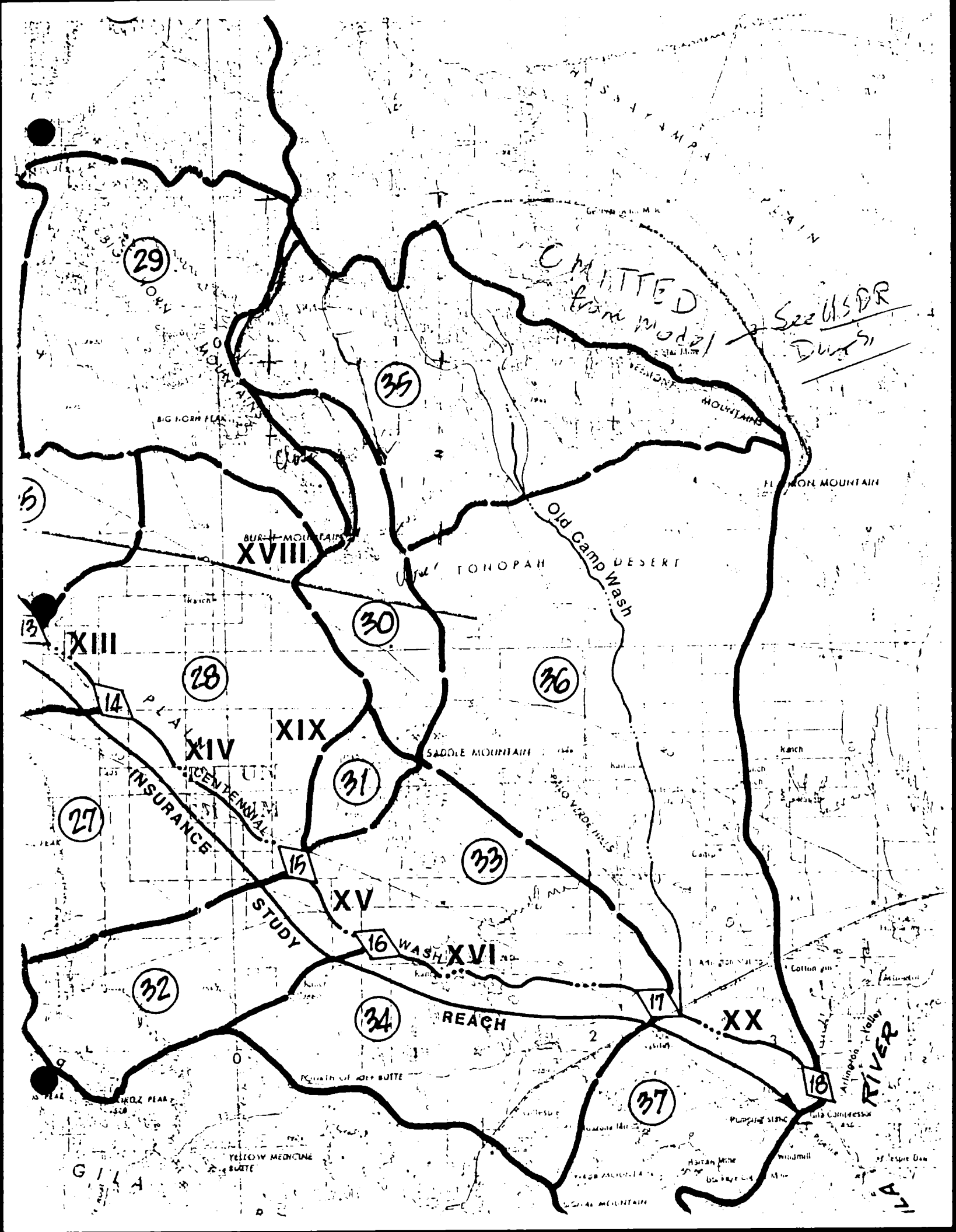
PROTECTIVE WORKS

DESIGNED DMN SUBMITTED

DRAWN RECOMMENDED

CHECKED APPROVED

PHOENIX, ARIZONA FEBRUARY 25, 1977 344-330-1546


29
35
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36
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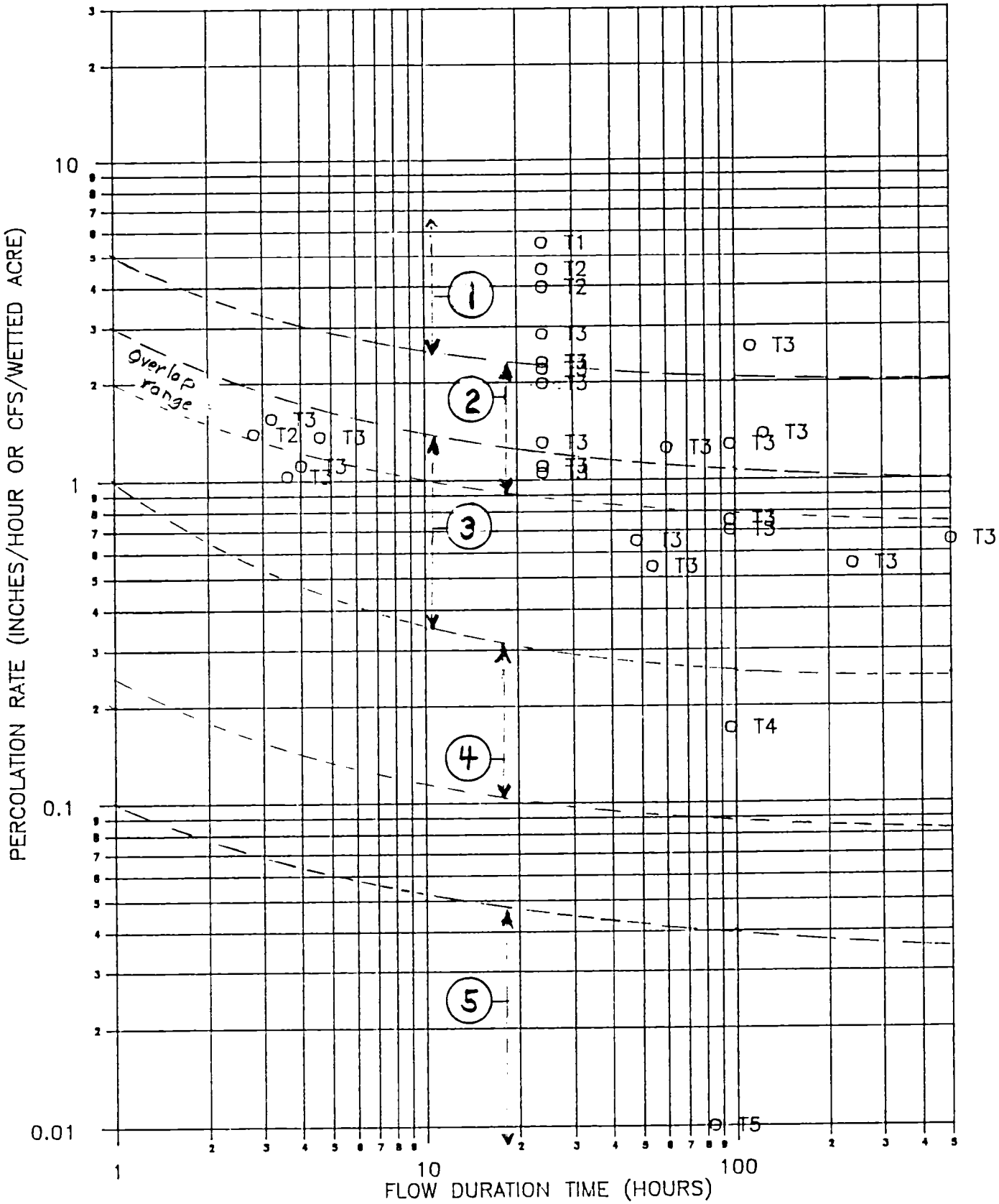
XVIII
XIII
XIX
XIV
XV
XVI
XX
14
15
16
17
18
CHANTED
from model
See USDR
Dwg 51
BIG HORN PEAK
BURRO MOUNTAIN
TONOPAH
DESERT
Old Camp Wash
SADDLE MOUNTAIN
PLAINS
CENTENNIAL
INSURANCE
STUDY
WASH
REACH
RIVER
GILA
YELLOW MEDICINE BUTTE
Windmill
Cotton gin
Ranch

APPLIED AND HYPOTHETICAL PERCOLATION LOSS RATES

Percolation Rate Values
in Conceptual Regions
for Bed Material Groups



Percolation Rate guidance Chart.

Table 13-1.—Relationships between bed material characteristics and curve parameters for a unit cascade [average antecedent conditions]

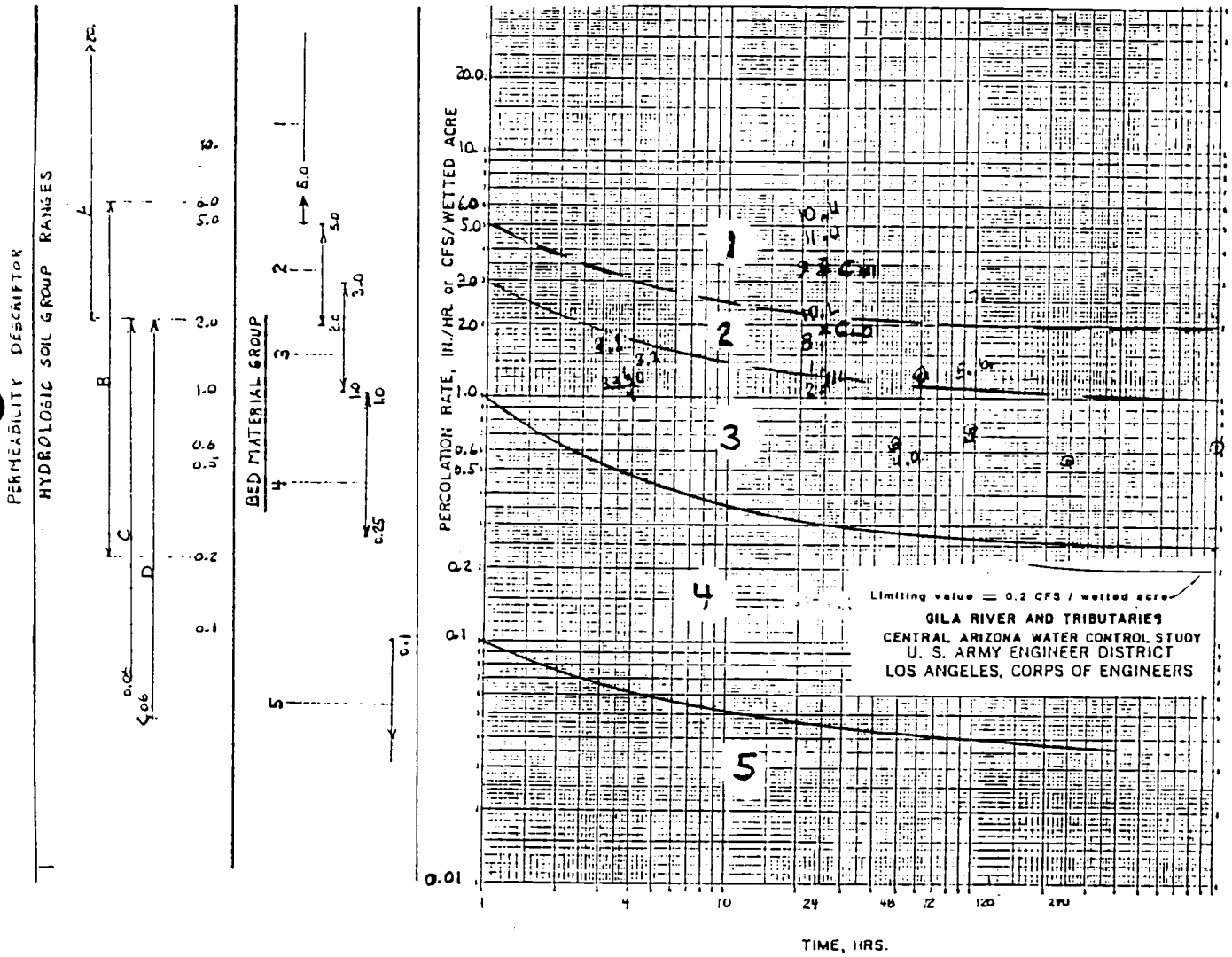
Bed material group	Bed material characteristics	Effective hydraulic conductivity,[1] k	Unit cascade parameters	
			Intercept,[2] i	Decay factor,[3] c
		(inch/hr)	(inch/hr)	(1/min)
1 Very high loss rate	Very clean gravel and large sand	>5	< −0.023	>0.030
2 High loss rate	Clean sand and gravel, fine conditions	2.0–5.0	−0.0093 to −0.023	0.0120 to 0.030
3 Moderately high loss rate	Sand and gravel mixture with low silt-clay content	1.0–2.0	−0.0047 to −0.014	0.0060 to 0.018
4 Moderate loss rate	Sand and gravel mixture with high silt-clay content	0.25–1.0	−0.0012 to −0.0047	0.0015 to 0.0060
5 Intermittent to low loss rate	Consolidated bed material high silt-clay content	0.001–0.10	-5×10^{-5} to -5×10^{-4}	6×10^{-5} to 6×10^{-4}

[1] See Appendix 3 for sources of basic data.
[2] Values are for unit duration, $D = 1$ hr. For other durations, $i(D) = -0.0045(D)$.
[3] Values are for unit duration and volume, $D/P = 1$. For other durations and volumes,

use $c(D,P) = -1.09 \ln\left[1.0 - 0.0545\frac{(D)}{P}\right]$.

Conceptual Regions for Bed Material Group Percolation Rate Values

6-30-89
Rv. 517-89



High and Low percolation loss Values for Storm of August 26, 1984

Note: 1in/hr ≈ 1cfs/wetted acre

APPLIED AND HYPOTHETICAL PERCOLATION LOSS RATE CURVE

FLOOD CONTROL DISTRICT
of
Maricopa County

3335 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 262-1501

D. E. Sagramoso, P.E., Chief Engineer and General Manager

BOARD of DIRECTORS
Tom Freestone, Chairman
George L. Campbell
Carole Carpenter
Fred Koory, Jr.
Ed Pastor

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DEC 01 1988

DRL		JRM		WCJ	
NJN				KMH	
D K		DEC			
AMB		MTM		GDC	
FILE					

Mr. Shoja Amani
Cella Barr Associates
2075 North 6th Avenue
Tucson, Arizona 85705

SUBJECT: CENTENNIAL WASH FIS

Dear Mr. Amani:

We have reviewed the subject hydrology report submitted September 22, 1988, and have the following comments:

1. The rainfall amounts used for the area need to be revised to show an average point rainfall for the area that surrounds the isohyetes as shown in the NOAA Atlas II published by the National Weather Service. The areal reduction then, will only apply to the sub-basin affected by that point rainfall amount, not the total Centennial Basin.

2. Our office was informed that the lag times from table one and those used in the HEC-1 input will be revised in the amended report.

3. All of the reach routings (RS record) must be revised as follows:

NSTPS (AmSKK)

a. First field must specify the number of sub-reaches based on the average velocity of that reach. HEC-1 manual outlines the procedure involved in estimating this parameter in detail.

b. Second field must be alpha-numeric specifying the type of the initial condition to be used in the third field.

c. Fourth field of this record can be utilized to account for the wedge storage.

4. The "n" value used for the reach routing (RC record) should be increased for the mesquite thickets.

5. The RL record must be utilized to ensure that the infiltration losses are accounted for. We have done several in-house sensitivity analysis using the different methods suggested by the available literature on the subject. It appears that in most of the cases, Centennial Wash does not meet the requirements and the assumptions that govern these methods. Therefore, we suggest a loss rate of 0.2 cfs per wetted acre for this normally dry channel be used as suggested by the U. S. Army Corps of Engineers Publication: " Gila River and Tributaries, Central Arizona Water Control Study, USACOE, Los Angeles District, May, 1982." This value was suggested for the Salt River below Granite Reef Dam and appears to be the best available data for the study area.

Too Low Should be minimum of 2.0

6. Rainfall distribution for Sub-basin 29 and 31 will have to be revised to include an IN card for the intended interval. Current distribution shows 1.93 inches of rainfall over a 15 minute period.

7. Watersheds 4, 6, 8, 10, 12, 21 and 35 need to be further sub-divided to isolate the mountainous areas which will produce their own peak discharge due to a short response time.

8. Please change the classifications of Crag and Harcuvar to Rail Road sidings.

If you have any questions, please contact Amir Motamedi or me at 262-1501.

Sincerely,

Joe Tram

Joe Tram
Floodplain Branch Supervisor

Copy to: David E. Creighton Jr., P.E.

DEPARTMENT OF WATER RESOURCES
ENGINEERING DIVISION
FLOOD CONTROL SECTION

MEMORANDUM

TO: James R. Morris, P.E.

FROM: David E. Creighton, P.E.

DATE: October 28, 1988

SUBJECT: Review of CBA September 22, 1988, draft of Centennial Wash Study (FEMA Flood Insurance Re-Study)

The initial impact and impression of the text and HEC-1 model input is that the basic nature of the watershed as a losing stream due to percolation, and significant heavy vegetation thickets or mesquite bosques along the flow paths has not been recognized. The general alluvial plain (fan) nature of subareas is not recognized. The resulting fictional model has erroneously modified subarea boundaries, under-rated channel friction losses, artificially reduced lag times, and ignored percolation losses.

Historic events have been ignored and interpretation of the stream flow with historic precipitation and storm event data appears deficient, if it was attempted. In addition the text has been written without an adequate knowledge of civil community organization and watershed development. The documentation is inadequate to support the HEC-1 input and output as having validity for the intended purpose.

The dismissal out-of-hand of the USGS WRI 79-5 frequency flow estimates in favor of a synthetic model appears ill-advised. In this instance for Centennial Wash, the USGS frequency flow estimates based on Station #09517500 are considered to more correctly reflect flow frequency with the percolation losses under historic conditions than the HEC-1 model as presented.

The following comments are more specifically oriented.

Watershed Description

"Towns" has conveyed legal status to three communities (unincorporated) and two railroad sidings Harcuvar and Crag. The watershed characterization ignores its losing stream nature due to percolation loses which must be recognized. The mesquite thickets and bosques of the flood plain have segments where "n" values in the range of 0.1 would be more appropriate than the 0.05-0.035 used.

A large portion of the basin still remains in native watershed status, only the bottom floodplain lands have been significantly subjugated for irrigation. The extent of mesquite thickets (bosques) on the bottom needs to be recognized philosophically and computation wise.

The Ritter Dam reference (Page 7) calls attention to the quadsheet location and watershed subarea boundaries. The Ritter Dam is part of Subarea 2 not Subarea 1.

1.1 Structural Features

Specific information on the structural features needs to be included as supporting text or appended material. The text currently is inadequate.

The July 29 and 30, 1975 storm and domino failure of about five Upper Centennial and one Lower Centennial detention structures should be specifically associated with the reported (non-USWB sources) three inches to six inches during about five hours. This local storm might be greater than a 100-year small area event. This storm provided zero reported runoff at the USGS Centennial Gage #09517500, unless the mean daily flow of 2.3 cfs on August 6 and 2.2 cfs August 7 was a result of the travel time for the event. The Tiger Wash gage (#09517280, 65.2sm) had an estimated 100 cfs reported for July 30, 1975. Winters Wash (#09517400,47.85sm) had 275 cfs reported for July 29, 1975. The Narrows Dam spilled during this 1975 event.

1.2 Lower Centennial Basin

Crag is the site for a railroad siding. Reference only to the McArthur report is inadequate for report documentation and review. Specific data for the several structures needs to be included with the discharge locations and spillway (outlet works and channels) given and located. A specific sketch drawing to integrate these structures into the Centennial and Tiger Wash flow paths should be included. Figures 2 and 3 are not adequate for this purpose.

It is improper to attempt to relocate the Tiger Wash from that shown on the USGS/USCE/SCS maps. Board of Geographic Name procedures have not been followed if justified.

2. Available Information

In addition to the four Centennial Wash gaging stations providing historic data for interpretation and analysis, the frequency data in WRI 79-5 and the Roske Report should be considered. In this instance, the 35,000 to 38,000 cfs 100-year discharges are undoubtedly a more valid interpretation than to use HEC-1 without using the RL-channel loss procedures. This losing stream when properly modeled may produce less than the frequency analysis. The McArthur Report is based on a TR-20 model without channel losses and may also overstate the discharge. The Tiger Wash 4,550 cfs discharge on August 20, 1970 apparently also was completely attenuated and consumed before reaching the Centennial Wash gage. A more significant event as a general storm would be the September 25-26, 1976 flows following tropical storm Kathleen and the subsequent tropical air surge.

3. Drainage Basins

Smaller watersheds would have more credibility, especially Tiger Wash, Subarea 2 and 36 and others in ranges of 90 to 120sm, if they were reduced in size.

Tiger Wash should probably be broken at the USGS discontinued gage site.

The location of Tiger Wash (Subarea 21) on Figure 2 is not in agreement with the topographic and soil survey mapping by USGS and SCS. The renaming of Tiger Wash at a location other then mapped by the USGS/USCE/SCS is a breach of Board of Geographic Names protocol and procedure.

The artificial Centennial Wash channel between Concentration Points 1 and 2 is not in accord with the topographical mapping and the soil survey aerial mappings which shows flow paths by vegetative growth concentrations.

Old Camp Wash is a tributary of Winters Wash (Subarea 35). Winters Wash has a USGS partial record station record with reported peak flows during three years when the downstream Centennial Wash USGS station record reports zero flow for those water years.

The braiding(ed) channels of the alluvial plain from the Harquahala and Big Horn Mountain create problems of watershed and boundary delineation for the Tiger Wash (Subarea 21) drainage in particular. The Tiger Wash detention structure outlet works and spillway location is not sufficient reason to relocate by five miles the mapped location of the wash.

4. Subarea Delineation and Reach Labeling

Subareas 1 and 2 need to be redrawn to properly place the Ritter Dam and watershed in Subarea 2.

Reach 1 needs to recognize the manipulated channel path from Sections 31, 32, T8N, R8W through Aguila and west along the southerly margin of the developed lands to below Concentration Point 3 and west of the La Paz-Maricopa County line (S.19, T7N, R10W)

The lack of mapped continuity of the water channels on the USGS quadrangle sheets should be interpreted with caution for inferring that there actually are continuous identifiable flow channels. This is critically important for Subareas 1 and 2 as well as 21 and 36.

The mapped physical characteristics of lost or discontinuities in the surface drainage pattern across low relief slopes and plains supports the need for exceptional care in subarea delineation, channel identification or misidentification, and lag time or time of concentration determination.

Drainage basins should be checked for validity especially to recognize the braided alluvial slopes such as Tiger Wash and the distributary slope west of the properly identified Tiger Wash primary pathway.

Watercourse lengths reported to the nearest 1 foot for this watershed creates a low-credibility factor.

The Reach input data needs to be reviewed and revised as appropriate to reflect the Reach elements of channel width, left and right overbank location and depth, and section station, Manning's n, Reach length, and channel percolation loss (RL to be added.) The RX and RY data points need to be reviewed comparing the maximum water surface elevation from the computation and summary with the input data for overtopping or inadequate flood plain width. At 9 sections, the maximum water surface is higher then the cross-section beginning and/or end elevations by amounts ranging from 0.31 feet to 9.51 feet. Supporting explanation for right or left overbank beginning points at the bottom of the cross-section channel need to be given if revisions are not made to reduce the extent of indicated overtopping due to insufficient width of flood plain.

Figure 2 omits identifying Reach XVII and the Winters Wash Reach in Subarea 36. To route all of Subarea 27 runoff through the Eagletail Reach Detention at midpoint across the subarea is improper, and shows overtopping of the structure by 3.15 feet.

The introduction of non-consecutive numbers at KK cards where retention storage routings (6) are included with Reach routings (20), introduces a confusion in the summary table which records only Routed To identification using the KK (1) identification.

5. Physical Characteristics

Vegetation cover densities should be supported by data from several long transects with correctly identified plant species.

The soil associations have moderate to moderately rapid infiltration rates. The vegetation, channels and soil type information should be based on the SCS March 1976, September 1977, and April 1986, detailed soil reports rather than the obsolete (in part) General Soil maps. The permeability (infiltration) rates of 0.6 to 6.0 inches per hour should be used as guidance for the RL (3) PERCRT value (cfs/acre) to be used.

The use of the SCS detailed soil survey photo maps for the La Paz (Yuma), Maricopa, and Yavapai counties should be used to the maximum extent possible to properly evaluate the flow paths and heavy vegetation growth on flowpaths. Subarea 2 in particular needs to be reexamined for re-evaluating the lag time. The following detailed survey reports, with maps, by areas and dates are:

Parts of Maricopa and Pinal Counties

Aguila--Carefree Area, Part	April 1986
Maricopa Country--Central Part	September 1977
Yavapai County--Western Part	March 1976

The NASA satellite 1:250,000 IR color image shows the vegetation development across the Centennial Wash flow path. The description text of the report suggests a complete lack of recognition of the nature of the Lower Centennial watershed and flood water flow path. Recourse should be taken to the detailed Soil Survey photo base mapping sheets.

A gross fiction appears to have been created for Subarea 21 to expand the subarea and alter the Tiger Wash flow path. The split flow braiding in Sect 34, T5N, R10W, and Sect 4, T4N, R10W needs to be adequately supported to distribute the flow between the mapped Tiger Wash and the CBA Tiger Wash which approximates the Centennial Wash siphon of the Granite Reef Aqueduct. The subdivision of Subarea 21 into two or more areas would be appropriate.

6. Hydrologic Analysis

The Centennial Wash Drainage Basin is a losing stream due to the permeability of the flow path. The percolation losses cannot be ignored. The channel is pervious and has losses. The flats and broad mesquite bosques, and the irrigated farm lands occupying the flow path cannot continue to be ignored.

The extent of farms located across the flood path raises questions regarding the validity of the study due to the lack of use of percolation loss procedures in the routing model. The extent of mesquite bosques or thickets located across the flow path occur sufficiently to raise questions on the validity of the Reach cross-section and vegetation flow friction factors.

The RL card for channel loss rates must be used to provide a credible and valid analysis. The n values for the Reach channels are suspect particularly through mesquite bosque areas.

6.1 Lag Time

The lag times need to be re-evaluated and the salient element data should be displayed by proper documentation. Explanation is needed for the discrepancies between the Schematic display and the HEC-1 Input listing. Subarea 2 appears to be a particularly flagrant example of travel time misdetermination. The water flow path from Concentration Point #2 to the head watershed points approximate 127,000 feet along a heavily vegetated course. The Schematic time of 9 hours appears more nearly proper than the 2.44 hours in the model.

Further, the Lag Times segment is misleading and inaccurate in the following items:

1. Omission of large bracket confuses what is to be raised to the power (0.38 in this source form).

2. The units of measurement are omitted from the defining L, Lca, and S.

3. The phrasing and use of Reference 8 is misleading because:
   a. SCS does not use this method, but rather uses Lg = 0.6 Tc
   b. Reclamation in the 1987 Edition of Design of Small Dams uses the form

$$L_g = C\left(\frac{LL_{ca}}{S^{0.5}}\right)^N$$

in which $C = 26\ K_n$,
where K_n = average Manning's "n" value for the drainage network hydraulic characteristics,
and $N = 0.33$.

c. The Los Angeles District (USCE) is reported to often use $C = 20$ "n", where "n" is the estimated mean Manning's "n" for all the channels within an area, and $N = 0.38$.

6.2 Curve Numbers

Why do curve numbers on Table 1 and Input data differ from those on the schematic? What is the technical basis for using 3 digit CNs?

6.3 Precipitation

The precipitation description without a display of historic maximums at the several locations is considered inadequate. Increasingly the validity of NOAA 2 Atlas values are being questioned.

What constitutes "acceptability" for the precipitation to support the incremental patterns used in the HEC-1 model input and output for Subareas 28 and 31, in comparison to the other subareas? Is it supposed to be based on the SCS IIA distribution?

MEMORANDUM

TO: All Employees

FROM: Bill Plummer

DATE: January 31, 1989

SUBJECT: **"CLEAN AIR FORCE State Government Challenge Week"**

WE DID IT! WE WON! That's right, DWR beat all medium size State agencies during **"CLEAN AIR FORCE State Government Challenge Week"!** Approximately 65% of our Phoenix based staff participated in the Clean Air Campaign. The second place team in the medium size agency category was the Coliseum, with a 48% participation rate. There were 19 medium size state agencies (from 100 to 499 employees) that we competed against.

Your all-out effort made this win possible. You set an example for other state employees and proved that by working together cleaner air can become a reality for the Valley.

I'd also like to thank Beverly Beddow, Lin Stevens and Catherine Balzano for coordinating the Department's Clean Air Campaign.

On February 2nd, I will be representing DWR at Governor Mofford's Clean Air Campaign Reception and will accept a trophy for our achievement. The trophy will be placed in the 2nd Floor North reception area.

During the reception there will be prize drawings for campaign representatives and all participating state employees. If any DWR employees' names are selected, Lin Stevens will be sure to let you know.

CONGRATULATIONS FOR A JOB WELL DONE!

Bill Plummer

#09517500

CENTENNIAL WASH
near Arlington.

DA = 1,810± sm

Water Year.	Qmax cfs	Date.	GH ft		Runoff AF.
1961	14,500	7-23-61	4.70		7,500
62	11,110	9-6-62	3.09	2 days - September	522
63	Ø	—	—		Ø
64	2,890	7-31-64	3.74		1,950
65	1,040	2-7-65	3.27	3 days - Feb 377	443
66	5,500	9-13-66	4.13	Sept 3960	4,090
67	1,040	9-5-67	3.27	Sept 928	942
68	5,330	12-19-68	4.11		3330
69	990	8-29-69	3.25		796
1970	11,900	9-5-70		Sept 8690	8760
71	2,040	8-20-71	3.91		3350
72	Ø	—	—		Ø
73	9,340	10-7-72	4.52	Oct 7930, Jul 1490	8920
74	105	8-4-74	2.93		107
75	755	10-28-74	3.55	Oct 260	269
76	7,800	9-26-76	4.38	only Sept	5,230
77	Ø	No Flow	for Entire	Year.	Ø
78	10,900	3-2-78	4.64		9,190
1979	818	1-17-79	3.53	4 days only.	729
1980	193	8-24-80	7.89		N.R.
81	87	7-11-81	6.39	731 mnd. 17 ft.	1380
82	191	9-11-82	7.87		1130
83	103	12-1-82	6.67	Nov 62	125
84	15,600	9-2-84	11.34	Sept 6940	6970
85	No Natural flow for entire year. Discontinued.				

Remarks

SCS - Storms

Horsethole
7-29, 3870
mnd. 180, 9-6, 4 83, 9-23
Sept 9-10, 1963
8-26-64, 9-13-64
2/6-7/65

1. 5574 AF - 2 days
2. 1926 AF = 2 days

Jul 946 5 days
Aug 924 Sept 79
2/7 177
2/8 313
2/9 34
Sept 3980, 1860, 139, 83
3 days
4 days Sept
185, 47, 224, 54

Dec 3370 AF
Dec 1510 (8) 706 AF in Aug
352 mnd 8-29

NORMA
August 1971
No Flow entire year
3 days
30, 3500, 218
3 days
2,390 (14)
5 days
No Flow entire year
Jan (1) Feb (3) Mar (4)
AF=408
Dec 44 Jan 403 Aug 277
Since 8-23-7
7-13 1950 cfs
1 day 750 mnd
8/2 1.8
4 23
5 29
24 25 26 27 28
11 200 1750 584 10
2,420 AF (16)
1030 7060 691 (2092) 2820 - (17)

New Station Start. 5-15-80
Return Flows.
return flows Mar-Sept 60-200 AF
return flows Mar-Sept 90-200 AF
return flow
9-2 mnd 3320

64 SM
129
348
229
219
1.6

CSPAR 5-15-80
09517490 1800 cfs

WY 1963—Ø
WY 1962

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'05", long 112°47'50", on line between secs.7 and 8, T.2 S., R.5 W., on upstream side of ford on former U. S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1963.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Extremes.--No flow during year.
1961-63: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--No flow since Sept. 24, 1962. Observations of no flow generally made once a month. Figures of discharge for calendar year 1962 are as follows: Maximum, 180 cfs; minimum, 0; mean, 0.7 cfs; runoff, 522 acre-ft.

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'12" (revised), long 112°47'50", in sec.7, T.2 S., R.5 W., on upstream side of ford on former U.S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1967.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Average discharge.--6 years, 1.82 cfs (1,320 acre-ft per year).

Extremes.--Maximum and minimum for the water years 1964-67 are contained in the following table:

Water year	Maximum			Minimum	
		Discharge (cfs)	Gage height (feet)	Date	Discharge (cfs)
1964	July 31, 1964	2,890	3.74	Most of year	0
1965	Feb. 7, 1965	1,040	3.27	Most of year	0
1966	Sept.13, 1966	5,500	4.13	Most of year	0
1967	Sept. 5, 1967	1,040	3.27	Most of year	0

1961-67: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--Records fair except flows below 100 cfs, which are poor. Flow regulated by several small retention dams in upper end of basin.

Discharge, in cubic feet per second, water year October 1963 to September 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1										0	229	0
2										0	219	0
3										0	1.8	0
4										0	0	0
5										0	0	0
6										0	0	0
7										0	0	0
8										0	0	0
9										0	0	0
10										0	0	0
11										0	0	0
12										0	0	0
13										0	0	0
14										0	0	32
15										0	0	7.8
16										0	0	0
17										0	0	0
18										0	0	0
19										0	0	0
20										0	0	0
21										0	0	0
22										0	0	0
23										0	0	0
24										0	0	0
25										0	0	0
26										0	0	0
27										0	11	0
28										0	4.6	0
29										0	0	0
30					-----					129	0	0
31		-----			-----		-----		-----	348	0	-----
Total	0	0	0	0	0	0	0	0	0	477	465.6	39.8
Mean	0	0	0	0	0	0	0	0	0	15.4	15.0	1.33
Max	0	0	0	0	0	0	0	0	0	348	229	32
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	0	0	0	0	0	0	0	946	924	79

Cal yr 1963:	Total	0	Mean	0	Max	0	Min	0	Ac-ft	0
Wtr yr 1964:	Total	982.4	Mean	2.69	Max	348	Min	0	Ac-ft	1,950

Peak discharge (base, 1,000 cfs).--July 31 (1730) 2,890 cfs (3.74 ft).

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					0						0	
2					0						0	
3					0						0	
4					0						0	
5					0						0	
6					0						0	
7					177						0	
8					9.3						0	
9					3.6						0	
10					0						0	
11					0						0	
12					0						0	
13					0						0	
14					0						28	
15					0						5.4	
16					0						0	
17					0						0	
18					0						0	
19					0						0	
20					0						0	
21					0						0	
22					0						0	
23					0						0	
24					0						0	
25					0						0	
26					0						0	
27					0						0	
28					0						0	
29					-						0	
30					- - - - -						0	
31		- - - - -			- - - - -		- - - - -		- - - - -		0	- - - - -
Total	0	0	0	0	189.9	0	0	0	0	0	33.4	0
Mean	0	0	0	0	6.78	0	0	0	0	0	1.08	0
Max	0	0	0	0	177	0	0	0	0	0	28	0
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	0	0	377	0	0	0	0	0	66	0

Cal yr 1964: Total 982.4 Mean 2.69 Max 348 Min 0 Ac-ft 1,950
Wtr yr 1965: Total 223.3 Mean 0.61 Max 177 Min 0 Ac-ft 443

Peak discharge (base, 1,000 cfs).--Feb. 7 (1100) 1,040 cfs (3.27 ft).

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1965 to September 1966

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0									0
2			0									0
3			0									0
4			0									0
5			0									0
6			0									0
7			0									0
8			0									0
9			0									0
10			69									0
11			27									0
12			0									1,860
13			0									139
14			0									83
15			0									0
16			0									0
17			10									0
18			10									0
19			0									0
20			0									0
21			0									0
22			0									0
23			0									0
24			0									0
25			0									0
26			0									0
27			0									0
28			0									0
29			0		-							0
30			0		- - - - -							0
31		- - - - -	0		- - - - -		- - - - -		- - - - -			- - - - -
Total	0	0	53.9	0	0	0	0	0	0	0	0	2,007.3
Mean	0	0	1.74	0	0	0	0	0	0	0	0	66.9
Max	0	0	27	0	0	0	0	0	0	0	0	1,860
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	107	0	0	0	0	0	0	0	0	3,980

Cal yr 1965: Total 277.2 Mean 0.76 Max 177 Min 0 Ac-ft 550
Wtr yr 1966: Total 2,061.2 Mean 5.65 Max 1,860 Min 0 Ac-ft 4,090

Peak discharge (base, 1,500 cfs).--Sept. 13 (0730) 5,500 cfs (4.13 ft).

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0											0
2	0											0
3	0											185
4	7.3											4.7
5	0											224
6	0											5.4
7	0											0
8	0											0
9	0											0
10	0											0
11	0											0
12	0											0
13	0											0
14	0											0
15	0											0
16	0											0
17	0											0
18	0											0
19	0											0
20	0											0
21	0											0
22	0											0
23	0											0
24	0											0
25	0											0
26	0											0
27	0											0
28	0											0
29	0											0
30	0				- - - - -							0
31	0	- - - - -			- - - - -		- - - - -		- - - - -			- - - - -
Total	7.3	0	0	0	0	0	0	0	0	0	0	467.7
Mean	0.24	0	0	0	0	0	0	0	0	0	0	15.6
Max	7.3	0	0	0	0	0	0	0	0	0	0	224
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	14	0	0	0	0	0	0	0	0	0	0	928

Cal yr 1966: Total 2,014.6 Mean 5.52 Max 1,860 Min 0 Ac-ft 4,000
Wtr yr 1967: Total 475.0 Mean 1.30 Max 224 Min 0 Ac-ft 942

Peak discharge (base, 1,000 cfs).--Sept. 5 (2030) 1,040 cfs (3.27 ft).

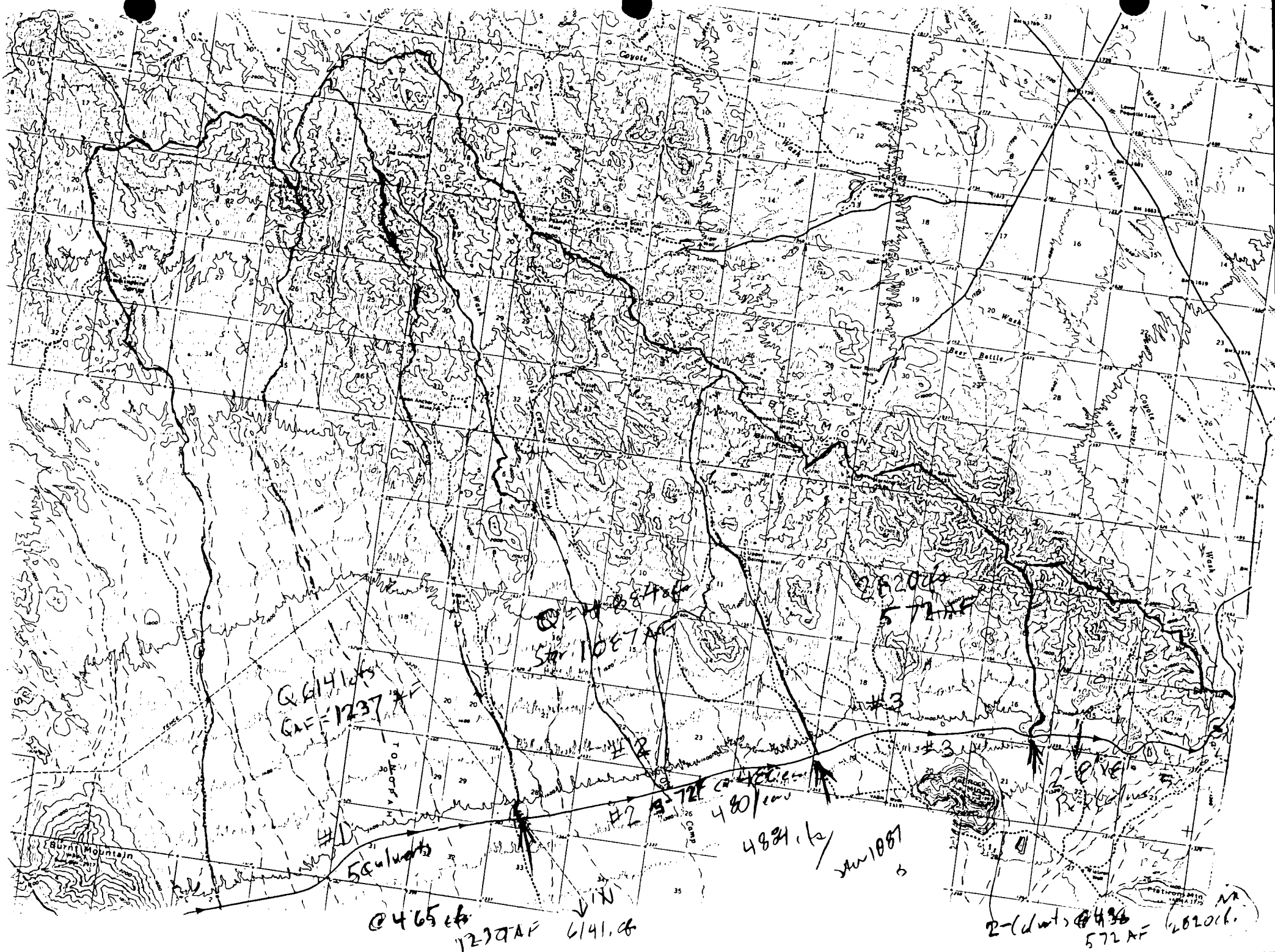
PROJECT: _____ TYPE: _____

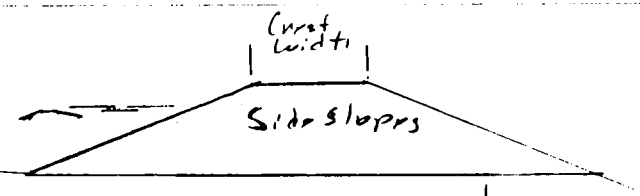
COUNTY: _____ FILE NUMBER: _____

RECORD OF CONTACT

DATE	PERSON / AGENCY	DISCUSSION
1/24/89	Lowell Heaton USBR 870-2495 15 structures Culverts - 72" Pipe to Ed Hot Rode - Box Culvert Double 8X8 3 Major. Protective works Dangs - Attn: Heaton,	GRA - CAR Reach No. Bu. 6 Burnt Mtn. - Belmont Mtn. 7 Belmont Mtn to Hassayampa 8 Hassayampa R - US 60/89 9 US 60/89 - ~~Agua Fria~~ New River 10 New River / Cave Creek Thru Tucson Reach 4,
1/25/89	Lowell 870-2495 Coyote Wash - 10 41.35 2 in one dike. Q = 14500	Box Flume Overchute 67'-6" wide 2 - 67' Box Fl 1 - @ Coyote. 180+50 Sect 13 1 - by Jackrabbit. 293+50 NE Sec 2 3 N 5W.

SHEET OF

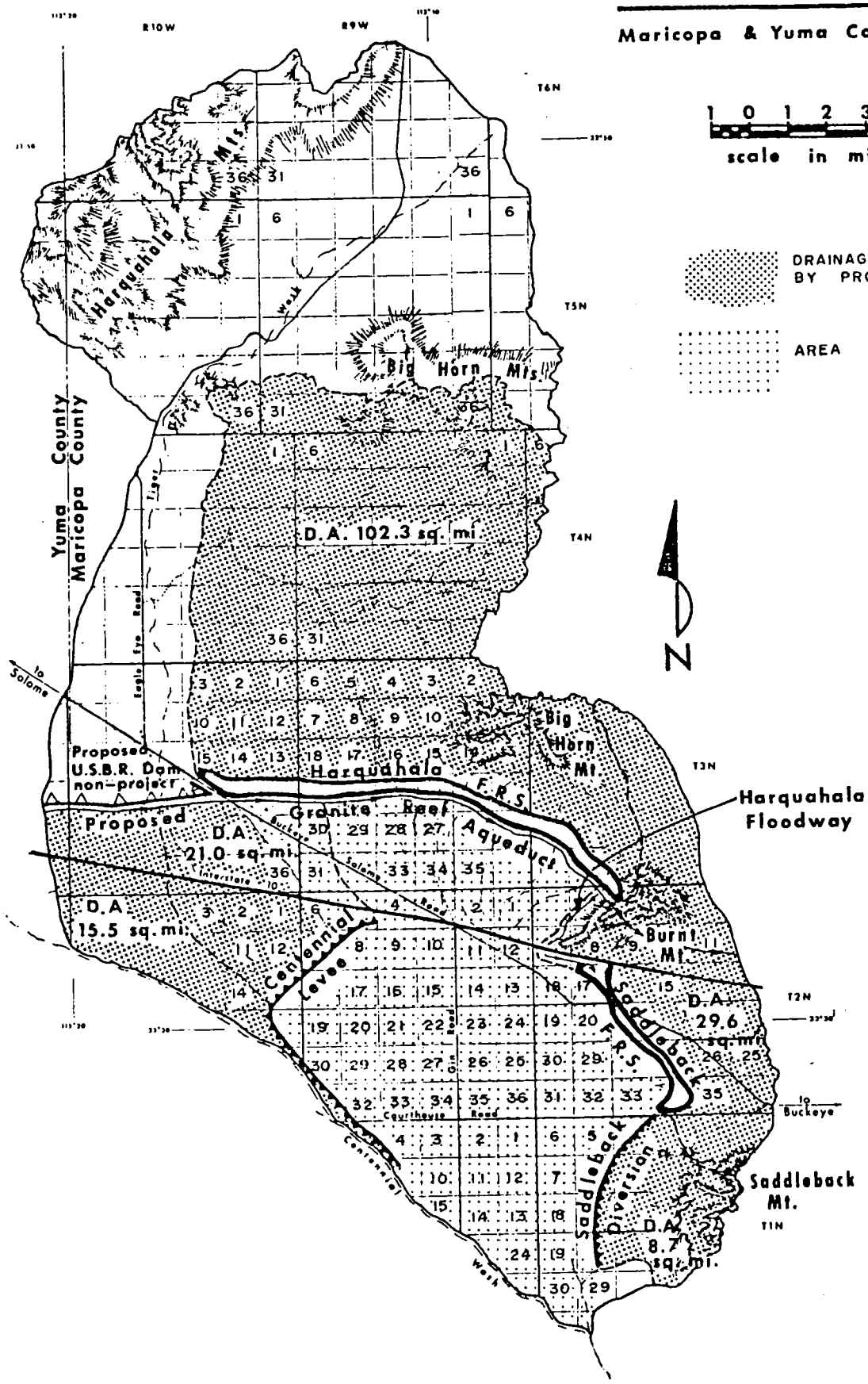

Coyote
Weak
Blue
Bear Belle
Burnt Mountain
Q 614 cfs
GAF = 1237 AF
#2
#3
4 cfs
5 cfs
@ 465 cfs
1237 AF
614 cfs
480 cfs
4 cfs
572 AF
2 cfs
572 AF



Structure Name.	Embankment. Elevation	Width.	Height	US. Slope	DS. Slope.	Drain Channel Length	Length	Spillway Elev.	OW Elev.	Capacity AF
Tiger Wash Detention USBR	1413.0	14.0'		2½:1	2½:1	40,000	32,000	1405.0	1392.0	
Harquahala FRS SCS 102.3 sm	1422.2 to 1419.7	14.0'	43'	3:1	2:1	61,008		1408.4 Q=485	1387.3	10,911 AF
Harquahala Floodway SCS 0.98 sm.						18,128		Q=485 + 780 1265		
Saddleback FRS SCS 23.6 sm.	1193.0 to 1199.0	12.0'	22'	3:1	2:1	25,732		1176.9 Q=800	Basin #2 1185.7 Basin #1 1178.1	4,247 AF
Saddleback Diversion Floodway. SCS 8.65 sm						24,480		Q=1356 to 7218		
Reach 6 Granite Reef Aqueduct Old Camp-Waterman Wash USBR										Q 5-72" @ 465 cfs 3-72" @ 480 cfs 2-72" @ 436 cfs 2-8'x8' Box Culv.
Reach 7-GRA Coyote Wash Flume. USBR		67'-6"								Q=1458 cfs

PROJECT MAP
Harquahala Vall
Watershed

Maricopa & Yuma Counties, Ariz



LOCATION

Runoff in AF = Drainage area sm x 640 Ac/sm x $\frac{\text{Runoff}''}{12}$

Runoff'' = DA x $\frac{640}{12}$ = 53.33 DA

$\frac{\text{Precipitation}''}{12}$ x DA x 640 = Rainfall

Rainfall Amount = Vol AF = 53.33 DA x P''

Relationship.

Precipitation to Runoff = = basis for CN
Curve Number

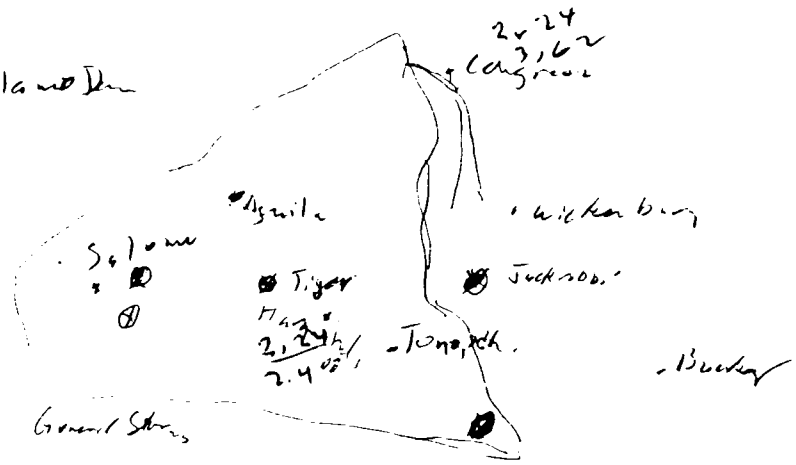
R

(1800 x 53.33) P = AF

P = $\frac{AF}{95994}$ = $\frac{10,000 AF}{0.1042}$

Rainfall 4'' = 95994 P'' = 383,976 AF

Runoff 2'' = 191,988 AF



Bouse	1.15	1.15
+ Salome	1.06 x 2	2.12
Congress	3.60	3.60
+ Wickenburg	2 3.72	4.74
+ Jackson	2.40	2.40
Buckey	1.89	1.89
25		15.98
		1.99

10

Q = .092

Storm Events General Storms

Sept 5-6, 1970
Oct 1972 1977
1978

Jamie July 1975

P = 1.99 1.77

Q =

Year	Runoff (gpm)	Storm
1953	9/5/70	8760
	10/1/72 73	8520
1984	Dec 1967	3390
	March 1978	9190
1985	9-26-76	5230
	9-2-84	6970

August 26, 1964 Flood - occurred from storm over the drainage areas controlled by Hargrove Lake - Saddleback FRS
Saddleback Diversion & Field Centennial Lake

inundated 8,400 cultivated Acres. Once in 7 years.

Hargrove Lake Pool Level since 8/26/64 by 4,400 Cult Acres

FIS - gr 4 Harg FRS, Elding Saddleback & Saddleback Div Control
140.6 sm or 39.8% of watershed Area

contributing Reach 1 3.7 miles long DA 21 sm
Height 0-9.5' Slope 0.0002 ft/ft n = 1.2 hr

Reach 2. 5.75 mi present spreader flow near Allison Tank
"near-wooded"
DA @ start = 652 sm excluding of above Narrows at Tiger Creek.
Ht. = 2.5 → 9.5' S = 0.00243 n = 3.5 hr
Centerline Reach - S =

Allison Tank Constructed 1930's by CCC

FIS Pg 37 Drainage Area 239,360 Acres watershed.

Flood Dates Hargrove Lake

1. 1951 NSE Damage to EPNG 26" & 30"
2. 1960 8 miles Gin Road Centerline at 514 miles Centerline Figure 1 Center & Tiger
3. Sept 9-10, 1963 5753 Acres
4. Aug 26, 1964 Fig 2, 8400 Acres 7-31-64 2.5" on Blood Creek Q = 7,000
Hrlngh
Qp

Fig 3 7/1965 cfs 377.

Sept 13, 1964	7-31-64
Feb 6-7, 1965	2-7-65
Aug 16, 1965	2-7-65
Aug 1971	8 20-71

NATIONAL 42-381 50 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE

RANKING OF DISCHARGE & RUNOFF.

Gaging Station Name: Continental Wash near Arlington
DA 1810/Basin No. 09517500/490

RANK	DISCHARGE Q cfs.	Date.		Event Duration	RUNOFF Annual W.Y. AF	Storm Event AF	Date.	Precipitation (inches)
1	15600	9-2-84		3 day	9190	6895	3-2-78	50-hr. Prob. Storm Jan W.Y. J403, F1030
2	14500	7-23-61		3 day	8,920	7490	10-7-72	
3	11,900	9-5-70		3 day	8,760	8690	9-5-70	
4	10,900	3-2-78		2 day	7,500	5573.6	7-23-61	
5	9340	10-7-72		5 day	6,970	6932	9-2-84	
6	7800	9-26-76		5 day	5,230	5230	9-26-76	
7	5500	9-13-66		3 day	4,090	3981	9-13-66	
8	5930	12-19-67		2 day	3390	3370	12-19-67	
9	2890	7-31-64			3350		8-20-71	
10	2040	8-20-71		7/30-8/3 5 day	1,950	1838	7-31-64	
11	1100	9-6-62			1,380	34±	7-11-81	
12	1040	2-7-65		Return Flow Apr. → Sept 2-7 day	1,130	mostly return flow	9-11-82	
13	1040	9-5-67			942	928	9-5-67	
14	990	8-29-69			795		8-29-69	
15	818	1-17-79		2 day	729	402.8	1-17-79	
16	755	10-28-74		Q_{max} = 180 1 Day	522	357	9-6-62	
17	193	8-24-80	not in high flows?	Q_{max} = 50 Flow Dominated 5 day	442	376.7	2-7-65	
18	191	9-11-82			270		10-28-74	
19	105	8-4-74			125		12-1-82	
20	103	12-1-82			107		8-4-74	
21	87	7-11-81			NR		8-24-80	
22	Ø	1963			Ø		1963	
23	Ø	1972			Ø		1972	
24	Ø	1977			Ø		1977	
25	Ø	1985			Ø		1985	

Centennial - Hassayampa

Precipitation

1976

Sept.	22	23	24	25	26	27	28	Σ 4 day	3 day
Bagdad		111	8	69	T				0.77
Bumble bee			54	42	103		T		
Castle Hot Spring	missing							4'	
Congress		20	23	59	3			1.05	0.85
Crown King			86	39	26	47	T	1.98	
Hillside 4NNE		56	6	39	3				a40
Prescott	T	1	40	96	18	37		1.92	
Skull Valley		31		44	1	13			
Walnut Grove		35	5	80	10			1.30	0.95
Alamo Dam			53	156				2.09	2.09
Bouse		91	29	72				1.92	1.01
Ehrenberg	missing								
Kofa Mtn		8	3	416	19			4.46	4.38
Aguila			45	88				1.33	1.33
Brenda		T	81	33	15			1.29	1.29
Buckeye		22	88	150				2.60	2.38
Griggs 3W			50	68	5			1.23	1.23
Harquahala Plain		50	110	160				3.20	2.70
Wickenburg			206	145	80	4		4.35	4.31
Ajo			94	14	3			111	
Dateland			66	56					

Sept 1984	1	2	3
Ajo			
Aguila			
Buckeye		137	
Griggs 3W	128		
Lowen 3SSE	91		
Litchfield Park		170	
Tollson 1E	62		
Tonopah	300		
Wickenburg		135	
Bouse	–	–	–
Kofa Mine	42		
Hillside 4NNE		1	
Walnut Grove	–	–	–

Centennial Wash.

Flooding Reference in SCS EIS - Hargrave Valley & Segment of Centennial Wash.

SCS Referenced Flooding: [illegible] 9-70 [illegible]

Date	Centennial Wash Gage Q Annual Max	Flow & Runoff Flooding Data. Predv. Mean. Date:, AF	TIGER WASH Simultaneous Discharge	Max Annl Peak WINTERS WASH
1930's	None			
1951	None			
1960	Annual Max. NONE			
Sept 9-10, 1963	NO FLOW	NO FLOW	NO	NO
✓ August 26, 1964	7-31-64 2890 cfs 1838 AF	< base 11 cfs 8-26-64	31.3 NO	NO
Sept 13, 1964	7-31-64	< base 32 9-14-64	78.9	
February 6-7, 1965	2-7-65 1040 cfs 377 AF		NO	YES
August 1971 Probably 20,	8-20-71 2040 cfs 2300 hrs 4 days Runoff Thru 8-23 3350 AF	1720 570 8-22 1000 hrs 4 days 400/770/570/10. 2000 TIGER WASH 8-20-71	3350 YES 3000 9 London.	YES 1900
✓ Oct 6-7, 1972 JOANNE	10-7-72 9340 cfs 7430 AF	Same & only event in Oct.	7430 YES 1750	YES 2100
✓ Sept 26, 1976	9-26-76 7800 cfs 1930 5230	Same and only annual Event	YES 9-25 3000 9 LEN DAN	YES 9-25 3640
Tropical Storm NORMA 9-5-1970	14,500 cfs 8690 AF	No Mention of Flooding in Hargrave Valley.	NO	YES 91 London Yes
Tiger Wash Max Q 1970 WY on 8-20-70	4,550 cfs			

2/22/89
$

Centennial Work

Reach #	Length	Width	Elev. High	Elev. Low	WSElev.	
1	53,500	2100	2206	2200	2202.93	
2	34,375	2460	2087	2080	2085.05	
3	18,750	2700	2028	2020	2024.21	
4	38,541	2100	1946	1940	1944.79	
5	18,229	1480	188.7	1880	1889.47	
6	26,042	2600	1827/24	1820	1825.04	
7	26,562	1700	1764	1760	1771.33	
Centennial Dam						
8	49,479	1500	1610/1608	1600	1610.99	
9	17,708	4500	1450/48	1440	1444.86	
Tiger Work 21	63400	2220	1725	1720	1724.49	
10	19271	4500	1370/68	1360	1365.29	
11	10,937	4500	1290/88	1280	1286.23	
12	17,708	4500	1274/75	1265	1270.48	
Horsethief 13	21,354	7470	1181.4	1179.9	1183.35	
Horsethief 14	46,354	8140	1100/1098	1190	1097.23	
18	31771	183	1205.5/1205	1200	1201.00	15
19	43229	270	1149.5/1147	1143	1144.38	16
Horsethief 15	20833	4300	1056/1056.6	1044	1052.10	17
Horsethief 16 To SPRR	58,333	2100	930	920	933.44	18
old Camp 17 Winters	105600	1400	1004	1000	1002.75	19
20 SPRR - Arlington	30729	2300	848	840	850.26	

Horsethief (15) to SPRR (17)
79,166

Area = $\frac{20833 \times 4300}{43560}$ = 2056.5 Acres

$\frac{58333 \times 2100}{43,560}$ = 2812 Acres

4868 Acres

Centennial

Hassayampa

Precipitation

NORMA

Sept 5 1970	3	4	5	6
Congress Lake		64	114	
Hillside		100	12	
Walnut Grove		165	865	
Yuma 6 ESE		190	7	38
Alamo		13	32	
Bouse		20	5	
Kofa	M			
Quartzsite	Ø			
Salome	Ø			
Beardsley		82	290	132
Buckeye		38	157	230
Gila Bend		93	13	60
Grigg 3W		48	4	447
Harquahala Plains 1		95	25	5
Lowell 3 SSE	57	24	85	79
Litchfield Park		48	100	242
Phx WSO AP	14	16	243	T
So. Phx		32	1.56	84
Wickenburg		143	42	157
Ajo		39	30	52 T

FEB - MAR 1978	27	28	1	2	3	4	5	6
Congress	13	45	153	-	-	-	-	
Hillside	15	74	116	52	42	4	86	16
Sky Valley	51	101	105	95	36	2	64	20
Walnut Grove		100	210	63	40		57	
Alamo Dam	T	39	93	7	3	1	22	T
Bouse	5	48	37	T	2	T	19	
Kofa	3	59	295	32		2		
Aguila	3	14	127					
Beardsley	3	77	M					
Buckeye		83	23	95				
Gila Bend		16	17	5	4		1	5
Grigg 3W	T	120	287	14				
Harquahala Plains 1	M			119	10	5		
Lowell 3 SSE	10	74	32	25				
Litchfield Park		137	35	181			26	1
Phx So. Mtn.		64	72	36				60
Phx WSO AP	15	38	64	22	1		44	
So. Phx	3	60	65	87	5		53	
Wickenburg		38	169	190	54		34	
Ajo	T	16	38	5	3		T	17

Centennial
Hassayampa.

Precipitation

December 1967	13	14	15	16	17	18	19	20	21	Σ
Alamo		80	6	56	5	50	22			
Bouse	T	12	52	15	2	16	33			
Kofa	T	12	77	4	1	T	91	T		
Quartzite	T	4	33	7		10	50			
Salome	P	10	26	72	20	4	24	84		
Aguila	8	m —								
Buckeye		89	128	2	16	18	212	3		
Beardsley	5	65	182	5	22	42	155	2	1	
Gila Bend		65	93		43	9		90		
Griggs		63	166	x	x	90	135			
Hassayampa Plant 1	24	41	65	3	6	18	139	10		
Laveen 3SSE T	12	100	182	1	15	22	92	30		
Litchfield Park		76	176	2	9	35	145	23		
Phx PO.	T	66	177	16	10	3	27	112		
Tonopah 2S	m									
Wickenburg	2	40	143	55	35		65	131		
Ajo	T	62	96	27	31	T	3	89	1	

Sept 1968	10	11	12	13	14	15
Alamo						
Bouse				3	7	
Kofa				128	10	
Quartzsite				13	22	
Salome 1ESE	m					
Aguila	m					
Beardsley			18	x	95	78 1
Gila Bend				67	22	
Griggs 3ne				231	41	2
Hassayampa Plant			T	58	40	
Laveen 3SSE		T	76	135	8	T
Litchfield Park			33	204	19	2
Phx PO.		2	T	269	9	T
Tonopah 2S	m					
Wickenburg				170	2	14 6
Ajo.				107	66	13 T
Buckeye			65	135	15	
Runoff - Centennial				1860	139	8.3

Σ=3980 AF.

$$S = \frac{P^2 - PQ}{Q}$$

$$CN = \frac{1000}{10+S}$$

Stream	DA.	Event Date	Q Runoff (AF)	Event (In.)	P Event Rainfall (In.)	S	CN $\frac{1000}{10+S}$	
Centennial below Narrows	1810 / 1080	3-2-78	6895	0.071				
				0.120				
		10-7-72 ✓	7430	.077	1.99	49.44	16.8	JOANNE
				.129	1.99	28.71	25.8	
		9-5-70 ✓	8690	.090				NORMA
				.151				
		7-23-61	5574	.0577				
				.097				
		9-2-84	6932	.0718				
				0.120				
		9-26-76 ✓	5230	.0542				
				0.0908				
CBA	1870.3	100yr. 24 hr.	180,725	1.812"	3.937	4.617	68.4	

LAG TIME

CBA

Centennial - $L_{ag} = 24N \frac{(L_c)(L_{ca})}{S^{1/2}}$ 0.38

Waterman - $L_{ag} = 0.6\,T_c$

USBR Small Dams. 3rd Edition 1987

$L_{ag} = C\left(\frac{L\,L_{ca}}{S^{0.5}}\right)^N$ L miles, L_{ca} miles, S: ft./mile.

$= 26\,K_n\left(\frac{L\,L_{ca}}{S^{0.5}}\right)^{0.33}$

$K_n \cong$

0.070 – 0.032	Great Plains
0.260 – 0.130	Rocky mtns
0.160 or less	PMF –
0.073 – 0.050	100yr. T Storm
0.070 – 0.042	SW Desert: AZ, NM, SC,
.07	Cont. Basin NV, UT
.042	usual desert.
0.150 PMF. → 0.08	Rocky Mountain
.080	Sparsely veg. [illegible]

USCE Tribby Creek 1953 $L_g = 1.1\,(\quad)^{0.38}$

Dreamy Draw (1971) $L_g = 1.2\,(\quad)^{0.38}$ or .20 n

$\bar{n}$ (K_n)

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'05", long 112°47'50", on line between secs.7 and 8, T.2 S., R.5 W., on upstream side of ford on former U. S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1963.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Extremes.--No flow during year.
1961-63: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--No flow since Sept. 24, 1962. Observations of no flow generally made once a month. Figures of discharge for calendar year 1962 are as follows: Maximum, 180 cfs; minimum, 0; mean, 0.7 cfs; runoff, 522 acre-ft.

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0											0
2	0											0
3	0											185
4	7.3											4.7
5	0											224
6	0											54
7	0											0
8	0											0
9	0											0
10	0											0
11	0											0
12	0											0
13	0											0
14	0											0
15	0											0
16	0											0
17	0											0
18	0											0
19	0											0
20	0											0
21	0											0
22	0											0
23	0											0
24	0											0
25	0											0
26	0											0
27	0											0
28	0											0
29	0				-							0
30	0				- - - - -							0
31	0	- - - - -			- - - - -		- - - - -		- - - - -			- - - - -
Total	7.3	0	0	0	0	0	0	0	0	0	0	467.7
Mean	0.24	0	0	0	0	0	0	0	0	0	0	15.6
Max	7.3	0	0	0	0	0	0	0	0	0	0	224
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	14	0	0	0	0	0	0	0	0	0	0	928

Cal yr 1966: Total 2,014.6 Mean 5.52 Max 1,860 Min 0 Ac-ft 4,000
Wtr yr 1967: Total 475.0 Mean 1.30 Max 224 Min 0 Ac-ft 942

Peak discharge (base, 1,000 cfs).--Sept. 5 (2030) 1,040 cfs (3.27 ft).

ARIZONA

STATUTE MILES

10 0 10 20 30 40

ALL STATIONS USE 105TH MERIDIAN TIME

NORTHWEST

NORTHEAST

NORTH CENTRAL

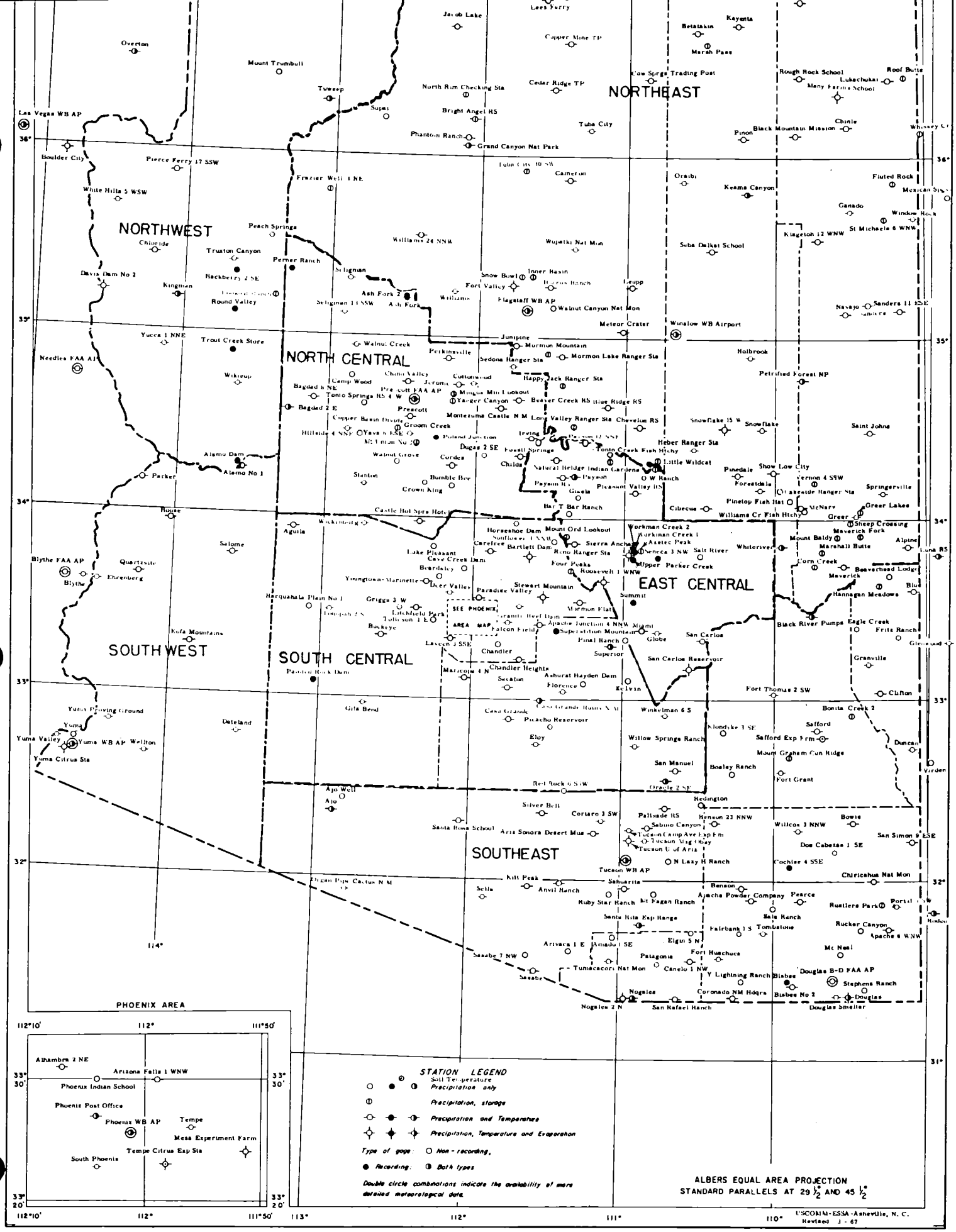
EAST CENTRAL

SOUTHWEST

SOUTH CENTRAL

SOUTHEAST

Gunlock PH
Orderville
Zion NP
St George
Colorado City
Kanab
Beaver Dam
Pipe Springs Natl Mon
Fredonia
Jacob Lake
Overton
Mount Trumbull
Tuweep
Supai
Las Vegas WB AP
Boulder City
Pierce Ferry 17 SSW
White Hills 5 WSW
Frazier Well 4 NE
Peach Springs
Chloride
Truxton Canyon
Hackberry 2 SE
Davis Dam No 2
Kingman
Round Valley
Seligman
Ash Fork 2
Williams
Williams 24 NNW
Wupatki Nat Mon
Wahweap
Page
Lees Ferry
Copper Mine TP
North Rim Checking Sta
Cedar Ridge TP
Bright Angel RS
Phantom Ranch
Grand Canyon Nat Park
Tuba City
Tuba City 10 NW
Cameron
Navajo Mtn
Monument Valley Mission
Mexican Hat
Bluff
Aneth Plant
Teec Nos Pos
Dinnehotso
Kayenta
Betatakin
Marsh Pass
Cow Springs Trading Post
Rough Rock School
Lukachukai
Many Farms School
Roof Butte
Chinle
Black Mountain Mission
Pinon
Oraibi
Keams Canyon
Fluted Rock
Mexican Stack
Ganado
Window Rock
St Michaels 6 WNW
Klagetoh 12 WNW
Seba Dalkai School
Winslow Wtr Airport
Meteor Crater
Leupp
Flagstaff WB AP
Walnut Canyon Nat Mon
Fort Valley
Inner Basin
Hart Ranch
Snow Bowl
Navajo
Sanders 11 ESE
Yucca 1 NNE
Trout Creek Store
Needles FAA AP
Wikieup
Walnut Creek
Perkinsville
Jerome
Cottonwood
Chino Valley
Camp Wood
Prescott FAA AP
Prescott
Bagdad 8 NE
Tonto Springs RS 4 W
Bagdad 2 E
Copper Basin Divide
Groom Creek
Hillside 4 NNE
Yava 6 ESE
Mt Union No 3
Poland Junction
Dugas 2 SE
Walnut Grove
Cordes
Stanton
Bumble Bee
Crown King
Alamo Dam
Alamo No 1
Parker
Mormon Mountain
Mormon Lake Ranger Sta
Sedona Ranger Sta
Happy Jack Ranger Sta
Mingus Mtn Lookout
Yarger Canyon
Beaver Creek RS
Blue Ridge RS
Montezuma Castle N M
Long Valley Ranger Sta
Chevelon RS
Irving
Payson 12 NNE
Tonto Creek Fish Hchy
Heber Ranger Sta
Fossil Springs
Childs
Natural Bridge Indian Gardens
Little Wildcat
W Ranch
Payson
Payson RS
Pleasant Valley RS
Gisela
Bar T Bar Ranch
Holbrook
Petrified Forest NP
Pinedale
Show Low City
Vernon 4 SSW
Forestdale
Clakeside Ranger Sta
Springerville
Pinetop Fish Hat
McNary
Greer Lakes
Williams Cr Fish Hchy
Greer
Cibecue
Sheep Crossing
Maverick Fork
Mount Baldy
Marshall Butte
Alpine
Luna RS
Whiteriver
Salt River
Corn Creek
Beaverhead Lodge
Maverick
Hannagan Meadows
Blue
Black River Pumps
Eagle Creek
Fritz Ranch
Glenwood
Granville
Clifton
Fort Thomas 2 SW
Bonita Creek 2
Safford
Safford Exp Frm
Mount Graham Fun Hdqrs
Duncan
Virden
Bowie
San Simon 9 ESE
Dos Cabezas 1 SE
Cochise 4 SSE
Chiricahua Nat Mon
Portal 1 SW
Rodeo
Rustlers Park
Rucker Canyon
Apache 6 WNW
Mc Neal
Douglas B-D FAA AP
Stephens Ranch
Douglas
Douglas Smelter
Bisbee No 2
Bisbee
Y Lightning Ranch
Coronado NM Hdqrs
Nogales
Nogales 2 N
San Rafael Ranch
Sasabe
Sasabe 7 NW
Tumacacori Nat Mon
Canelo 1 NW
Patagonia
Fort Huachuca
Arivaca 1 E
Amado 1 SE
Elgin 5 N
Sonoita
Sells
Anvil Ranch
Ruby Star Ranch
Mt Pagan Ranch
Santa Rita Exp Range
Fairbank 1 S
Tombstone
Sala Ranch
Apache Powder Company
Pearce
Benson
Sahuarita
Kitt Peak
Organ Pipe Cactus N M
Tucson WB AP
N Lazy H Ranch
Tucson Ag Exp Stn
Tucson U of Ariz
Tucson Camp Ave Exp Frm
Sabino Canyon
Pallisade RS
Benson 23 NNW
Willcox 3 NNW
Cortaro 3 SW
Silver Bell
Santa Rosa School
Aria Sonora Desert Mus
Redington
Red Rock 6 SSW
Oracle 2 SE
San Manuel
Bosley Ranch
Fort Grant
Ajo Well
Ajo
Kofa Mountains
Quartzsite
Blythe FAA AP
Blythe
Ehrenberg
Salome
Bouse
Wickenburg
Castle Hot Spgs Hotel
Aguila
Harquahala Plain No 1
Tonopah 2 S
Grigg 3 W
Litchfield Park
Tolleson 1 E
Buckeye
Laveen 3 SSE
Chandler
Chandler Heights
Maricopa 4 N
Sacaton
Ashurst Hayden Dam
Florence
Kelvin
Winkelman 6 S
Superior
Pinal Ranch
Apache Junction 4 NNW
Superstition Mountain
Miami
Globe
San Carlos
San Carlos Reservoir
Klondyke 1 SE
Willow Springs Ranch
Eloy
Picacho Reservoir
Casa Grande
Casa Grande Ruins N M
Gila Bend
Dateland
Yuma Proving Ground
Yuma
Yuma Valley
Yuma WB AP
Yuma Citrus Sta
Wellton
Painted Rock Dam
Lake Pleasant
Cave Creek Dam
Bartlett Dam
Horseshoe Dam
Sunflower 1 NNW
Carefree
Mount Ord Lookout
Sierra Anchas
Aztec Peak
Workman Creek 2
Workman Creek 1
Seneca 3 NW
Upper Parker Creek
Roosevelt 1 WNW
Four Peaks
Reno Ranger Sta
Bearsley
Youngtown-Martinette
Deer Valley
Paradise Valley
Stewart Mountain
Mormon Flat
Summit
Tonto Basin
Roosevelt Dam
Falcon Field
SEE PHOENIX AREA MAP
Phoenix Indian School
Phoenix Post Office
Alhambra 4 NE
Arizona Falls 1 WNW
Phoenix WB AP
Sell Temperature
Precipitation only
Precipitation, storage
Precipitation and Temperature


NORTHEAST
NORTHWEST
NORTH CENTRAL
EAST CENTRAL
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
SEE PHOENIX AREA MAP
PHOENIX AREA
Overton
Mount Trumbull
Tuweep
Supai
Jacob Lake
Lees Ferry
Cedar Ridge TP
North Rim Checking Sta
Bright Angel RS
Phantom Ranch
Grand Canyon Nat Park
Tuba City
Betatakin
Kayenta
Marsh Pass
Cow Springs Trading Post
Rough Rock School
Roof Butte
Many Farms School
Chinle
Black Mountain Mission
Pinon
Las Vegas WB AP
Boulder City
Pierce Ferry 17 SSW
White Hills 5 WSW
Frazier Well 1 NE
Cameron
Oraibi
Keams Canyon
Fluted Rock
Ganado
Window Rock
St Michaels 6 WNW
Kingeton 12 WNW
Seba Dalkai School
Peach Springs
Chloride
Truxton Canyon
Perner Ranch
Seligman
Davis Dam No 2
Kingman
Hackberry 2 NE
Round Valley
Seligman 11 SSW
Ash Fork 2
Ash Fork
Williams 24 NNW
Williams
Wupatki Nat Mon
Snow Bowl
Inner Basin
Fort Valley
Flagstaff WB AP
Walnut Canyon Nat Mon
Leupp
Navajo
Sanders 11 ESE
Meteor Crater
Winslow WB Airport
Yucca 1 NNE
Trout Creek Store
Needles FAA AP
Walnut Creek
Perkinsville
Jerome
Mormon Mountain
Sedona Ranger Sta
Mormon Lake Ranger Sta
Holbrook
Petrified Forest NP
Wikieup
Bagdad 2 NE
Tonto Springs RS 4 W
Prescott FAA AP
Mingus Mtn Lookout
Yarger Canyon
Beaver Creek RS
Blue Ridge RS
Montezuma Castle N M
Long Valley Ranger Sta
Chevelon RS
Snowflake 15 W
Snowflake
Saint Johns
Copper Basin Divide
Groom Creek
Hillside 4 NNE
Yava 8 ESE
Dugas 2 SE
Forest Springs
Tonto Creek Fish Hchy
Heber Ranger Sta
Alamo Dam
Alamo No 1
Parker
Walnut Grove
Cordes
Stanton
Bumble Bee
Crown King
Childs
Natural Bridge Indian Gardens
Little Wildcat
Payson
O W Ranch
Pinedale
Show Low City
Forestdale
Vernon 4 SSW
Springerville
Pleasant Valley RS
Gisela
Bar T Bar Ranch
Pinetop Fish Hat
McNary
Greer Lakes
Cibecue
Williams Cr Fish Hchy
Greer
Sheep Crossing
Maverick Fork
Mount Baldy
Marshall Butte
Alpine
Luna RS
Whiteriver
Corn Creek
Beaverhead Lodge
Maverick
Hannagan Meadows
Blue
Black River Pumps
Eagle Creek
Fritz Ranch
Glenwood
Grenville
Clifton
Bonita Creek 2
Safford
Safford Exp Frm
Duncan
Virden
Mount Graham Cun Ridge
Boaley Ranch
Fort Grant
Bowie
San Simon 9 ESE
Willcox 3 NNW
Dos Cabezas 1 SE
Cochise 4 SSE
Chiricahua Nat Mon
Pearce
Rustlers Park
Portal
Rucker Canyon
Apache 6 WNW
Mc Neal
Douglas B-D FAA AP
Stephens Ranch
Douglas
Douglas Smelter
Bisbee
Bisbee No 2
Coronado NM Hdqrs
Y Lightning Ranch
Canelo 1 NW
Fort Huachuca
Elgin 5 N
Patagonia
Sonoita
Nogales
Nogales 2 N
San Rafael Ranch
Tumacacori Nat Mon
Sasabe
Sasabe 7 NW
Arivaca 1 E
Amado 1 SE
Sells
Anvil Ranch
Kitt Peak
Ruby Star Ranch
Mt Fagan Ranch
Ajacho Powder Company
Benson
Sahuarita
Tucson WB AP
Tucson Camp Ave Exp Fm
Tucson Mag Obsy
Tucson U of Ariz
N Lazy H Ranch
Pallisade RS
Sabino Canyon
Henson 23 NNW
Santa Rita Exp Range
Fairbank 1 S
Tombstone
Sale Ranch
Oracle 2 SE
Redington
Red Rock 6 SW
Silver Bell
Cortaro 3 SW
Santa Rosa School
Aria Sonora Desert Mus
Ajo Well
Ajo
Organ Pipe Cactus N M
Gila Bend
Casa Grande
Casa Grande Ruins N M
Picacho Reservoir
Eloy
Willow Springs Ranch
Kondyke 3 SE
San Manuel
Winkelman 6 S
Kelvin
Florence
Ashurst Hayden Dam
Sacaton
Chandler Heights
Maricopa 4 N
Chandler
Laveen 3 SSE
Buckeye
Tolleson 1 E
Litchfield Park
Tonopah 2 N
Harquahala Plain No 1
Grigg 3 W
Yuma Proving Ground
Yuma
Yuma Valley
Yuma WB AP
Wellton
Yuma Citrus Sta
Dateland
Kofa Mountains
Blythe FAA AP
Blythe
Ehrenberg
Quartzsite
Salome
Aguila
Wickenburg
Castle Hot Spra Hotel
Rosse
Yiungtown-Marinette
Deer Valley
Paradise Valley
Stewart Mountain
Granite Reef Dam
Mormon Flat
Falcon Field
Apache Junction 4 NNW
Superstition Mountain
Miami
Globe
Pinal Ranch
Superior
San Carlos
San Carlos Reservoir
Summit
Roosevelt 1 WNW
Four Peaks
Upper Parker Creek
Salt River
Seneca 3 NW
Sierra Anchas
Roop Ranger Sta
Bartlett Dam
Horseshoe Dam
Mount Ord Lookout
Workman Creek 2
Workman Creek 1
Aztec Peak
Carefree
Cave Creek Dam
Lake Pleasant
Beardsley
Pacific Rock Dam
Fort Thomas 2 SW
Mount Graham Cun Ridge
Alondyke 3 SE
Willow Springs Ranch
Boaley Ranch
Fort Grant
Oracle 2 SE
Redington
Silver Bell
Cortaro 3 SW
Santa Rosa School
Aria Sonora Desert Mus
Palisade RS
Sabino Canyon
Henson 23 NNW
Willcox 3 NNW
Bowie
San Simon 9 ESE
Dos Cabezas 1 SE
Cochise 4 SSE
Chiricahua Nat Mon
Tucson WB AP
N Lazy H Ranch
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Benson
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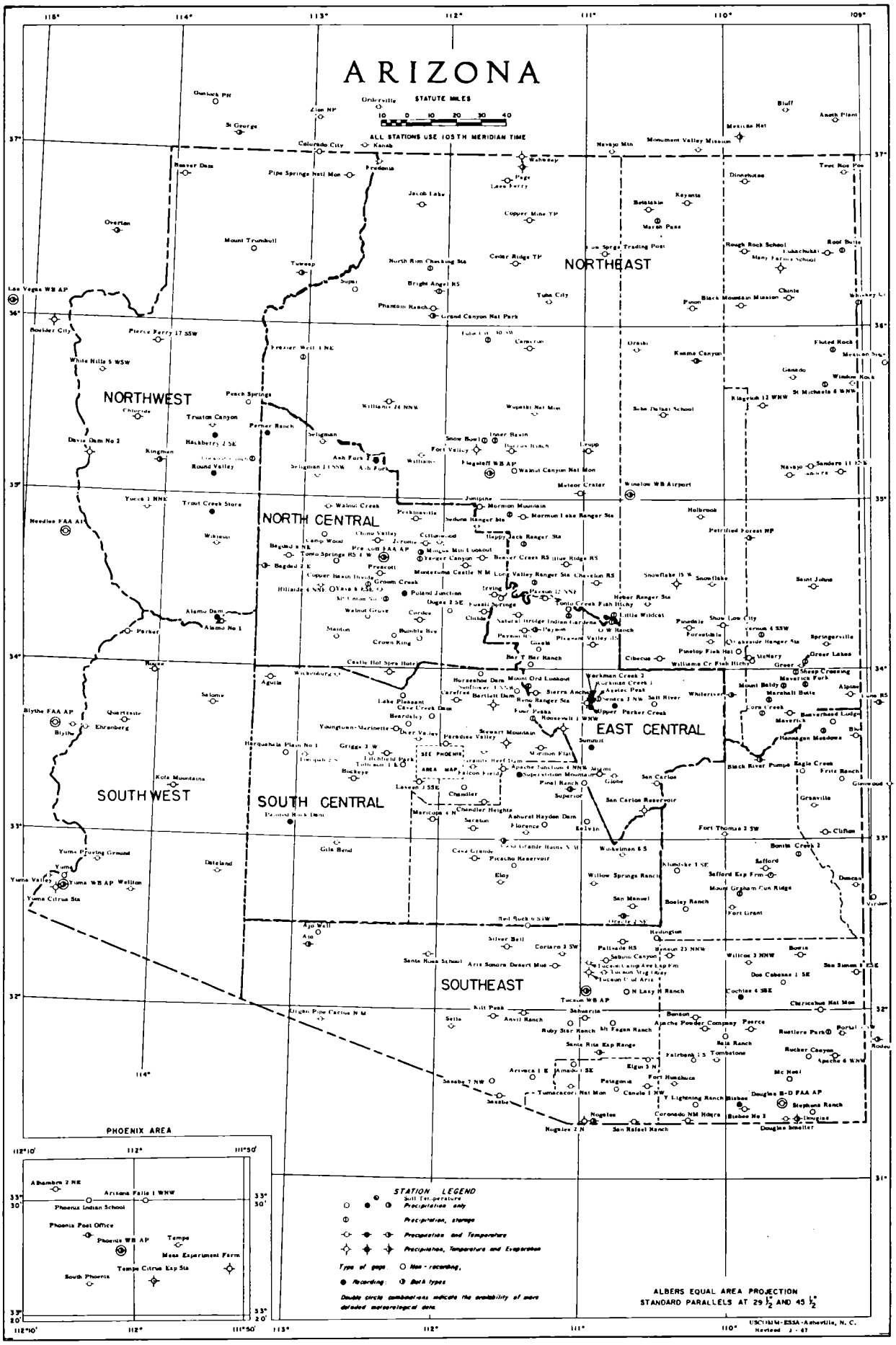
Rucker Canyon
Apache 6 WNW
Mc Neal
Douglas B-D FAA AP
Stephens Ranch
Douglas
Douglas Smelter
Bisbee
Bisbee No 2
Coronado NM Hdqrs
Y Lightning Ranch
Canelo 1 NW
Fort Huachuca
Elgin 5 N
Patagonia
Sonoita
Nogales
Nogales 2 N
San Rafael Ranch
Tumacacori Nat Mon
Sasabe
Sasabe 7 NW
Arivaca 1 E
Amado 1 SE
Sells
Anvil Ranch
Kitt Peak
Ruby Star Ranch
Mt Fagan Ranch
Santa Rita Exp Range
Fairbank 1 S
Tombstone
Sale Ranch
Alhambra 2 NE
Arizona Falls 1 WNW
Phoenix Indian School
Phoenix Post Office
Phoenix WB AP
Tempe
Mesa Experiment Farm
Tempe Citrus Exp Sta
South Phoenix
112°10'
112°
111°50'
33° 30'
33° 20'
STATION LEGEND
Soil Temperature
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording,
Recording: Both types
Double circle combinations indicate the availability of more detailed meteorological data.
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29 1/2° AND 45 1/2°
113°
112°
111°
110°
USCOMM-ESSA-Asheville, N. C.
Revised 3-67


ARIZONA
STATUTE MILES
10 0 10 20 30 40
ALL STATIONS USE 105TH MERIDIAN TIME
NORTHEAST
NORTHWEST
NORTH CENTRAL
EAST CENTRAL
SOUTHWEST
SOUTH CENTRAL
SOUTHEAST
PHOENIX AREA
STATION LEGEND
Soil Temperature
Precipitation only
Precipitation, storage
Precipitation and Temperature
Precipitation, Temperature and Evaporation
Type of gage: Non-recording,
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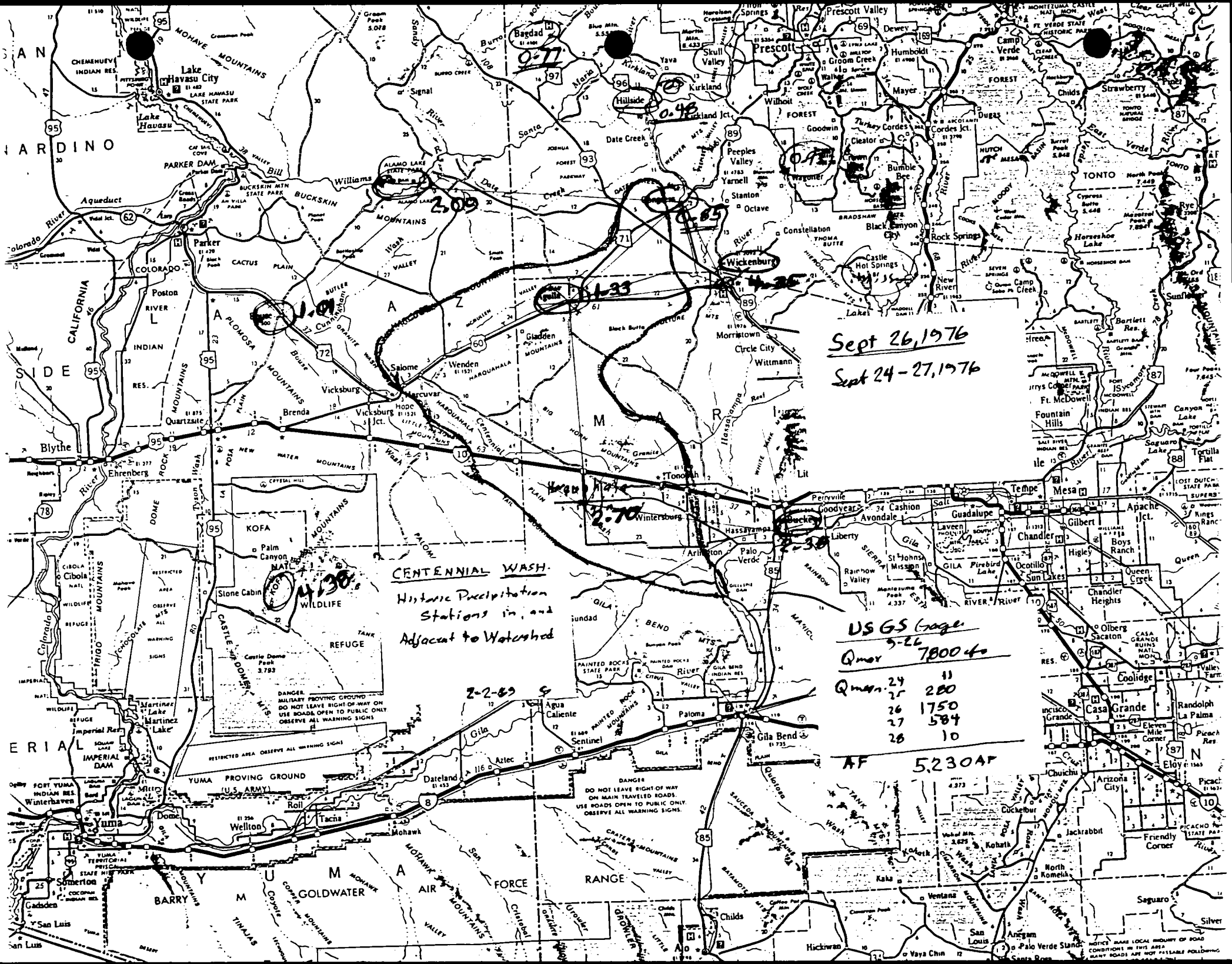
Double circle combinations indicate the availability of more detailed meteorological data.
ALBERS EQUAL AREA PROJECTION
STANDARD PARALLELS AT 29 1/2° AND 45 1/2°
USCOMM-ESSA-Asheville, N. C.
Revised 3-67

NATIONAL 42-381 50 SHEETS 5 SQUARE 42-382 100 SHEETS 5 SQUARE 42-389 200 SHEETS 5 SQUARE

RANKING OF DISCHARGE & RUNOFF

RANK	DISCHARGE Q cfs	DISCHARGE Date	DISCHARGE Event Duration	RUNOFF Annual W.Y. AF	RUNOFF Storm Event AF	RUNOFF Date	Precipitation (inches)
1	15600	9-2-84		9190		3-2-78	
2	14500	7-23-61		8920		10-7-72	
3	11900	9-5-70	SAME	8760		9-5-70	
4	10,900	3-2-78		7,500		7-23-61	
5	9340	10-7-72		6970		9-2-84	
6	7800	9-26-76	SAME	5230		9-26-76	
7	5500	9-13-66	SAME	4090		9-13-66	
8	5930	12-19-67	SAME	3390		12-19-67	
9	2890	7-31-64		3350		8-20-71	
10	2040	8-20-71		1,950		7-31-64	
11	1100	9-6-62		1,380		7-11-81	
12	1040	2-7-65		1,130		9-11-82	
13	1040	9-5-67	SAME	942		9-5-67	
14	990	8-29-69	SAME	795		8-29-69	
15	818	1-1-79	SAME	729		1-1-79	
16	755	10-28-74		522		9-6-62	
17	193	8-24-80		442		2-7-65	
18	191	9-11-82		270		10-28-74	
19	105	8-4-74		125		12-1-82	
20	103	12-1-82		107		8-4-74	
21	87	7-11-81		NR		8-24-80	
22	Ø	1963		Ø		1963	
23	Ø	1972		Ø		1972	
24	Ø	1977		Ø		1977	
25	Ø	1985		Ø		1985	

Gaging Station Name Centennial Wash nr Arlington
DA 1810/Basin No. 09517500/490


Sept 26, 1976
Sept 24 - 27, 1976
CENTENNIAL WASH.
Historic Precipitation Stations in, and Adjacent to Watershed
USGS Gage
Qmax 7800 cfs
Qmean 24 11
25 280
26 1750
27 584
28 10
AF 5,230 AF
0.77
0.48
0.43
2.09
0.85
1.33
4.35
1.01
2.70
2.30
4.30
2-2-83
Lake Havasu City
Prescott
Prescott Valley
Kingman
Wickenburg
Parker
Blythe
Quartzsite
Ehrenberg
Yuma
Gila Bend
Casa Grande
Tucson
Phoenix
Mesa
Tempe
Chandler
Gilbert
Apache Jct.
Superior
Globe
Miami
Eloy
Coolidge
Randolph
Sacaton
Olberg
Arizona City
Somerton
Winterhaven
Imperial Dam
Martinez Lake
Palm Canyon
Stone Cabin
Cibola
Castle Dome Peak 3,793
DANGER MILITARY PROVING GROUND DO NOT LEAVE RIGHT-OF-WAY ON USE ROADS OPEN TO PUBLIC ONLY OBSERVE ALL WARNING SIGNS
DANGER DO NOT LEAVE RIGHT OF WAY ON MAIN TRAVELED ROADS. USE ROADS OPEN TO PUBLIC ONLY. OBSERVE ALL WARNING SIGNS.
YUMA PROVING GROUND (U.S. ARMY)
BARRY M. GOLDWATER AIR FORCE RANGE
Agua Caliente
Sentinel
Paloma
Dateland
Aztec
Wellton
Tacna
Roll
Mohawk
Childs
Hickiwan
Ajo
Kaka
Ventana
Kohatk
Cuchebur
Jackrabbit
Friendly Corner
Saguaro
Silver
Palo Verde Stand
Vaya Chin
Anegam
San Luis
Gadsden
Somerton
Yuma
Winterhaven
Martinez Lake
Imperial Res.
Dome
Mitty
Roll
Tacna
Wellton
Mohawk
Dateland
Aztec
Agua Caliente
Sentinel
Paloma
Gila Bend
Tonopah
Wickenburg
Morristown
Circle City
Wittmann
Wintersburg
Arlington
Palo Verde
Buckeye
Hassayampa
Liberty
Rainbow Valley
St Johns Mission
Montezuma Castle Nat. Mon.
Ft. Verde State Historic Park
Camp Verde
Cottonwood
Clarkdale
Jerome
Cordes Jct.
Cordes
Bumble Bee
Black Canyon City
Rock Springs
New River
Castle Hot Springs
Constellation
Peeples Valley
Yarnell
Stanton
Octave
Wickenburg
Date Creek
Kirkland Jct.
Kirkland
Hillside
Skull Valley
Humboldt
Dewey
Mayer
Wilhoit
Groom Creek
Goodwin
Cleator
Crown King
Strawberry
Childs
Dugas
Rye
Sunflower
Fountain Hills
Ft. McDowell
Tempe
Mesa
Chandler
Gilbert
Higley
Boys Ranch
Queen Creek
Chandler Heights
Sun Lakes
Ocotillo
Guadalupe
Laveen
Avondale
Goodyear
Cashion
Perryville
Casa Grande
Coolidge
Eloy
Randolph
La Palma
Picacho
Arizona City
Chuichu
Cuchebur
Jackrabbit
Kohatk
Friendly Corner
Saguaro
Silver
Palo Verde Stand
Vaya Chin
Anegam
San Luis
Hickiwan
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Somerton
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Martinez Lake
Imperial Res.
Dome
Mitty
Stone Cabin
Palm Canyon
Cibola
Castle Dome Peak 3,793
Quartzsite
Brenda
Vicksburg
Vicksburg Jct.
Hope
Salome
Wenden
Gladden
Morristown
Circle City
Wittmann
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Tonopah
Wintersburg
Arlington
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Buckeye
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Clarkdale
Jerome
Cordes Jct.
Cordes
Bumble Bee
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Groom Creek
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Fountain Hills
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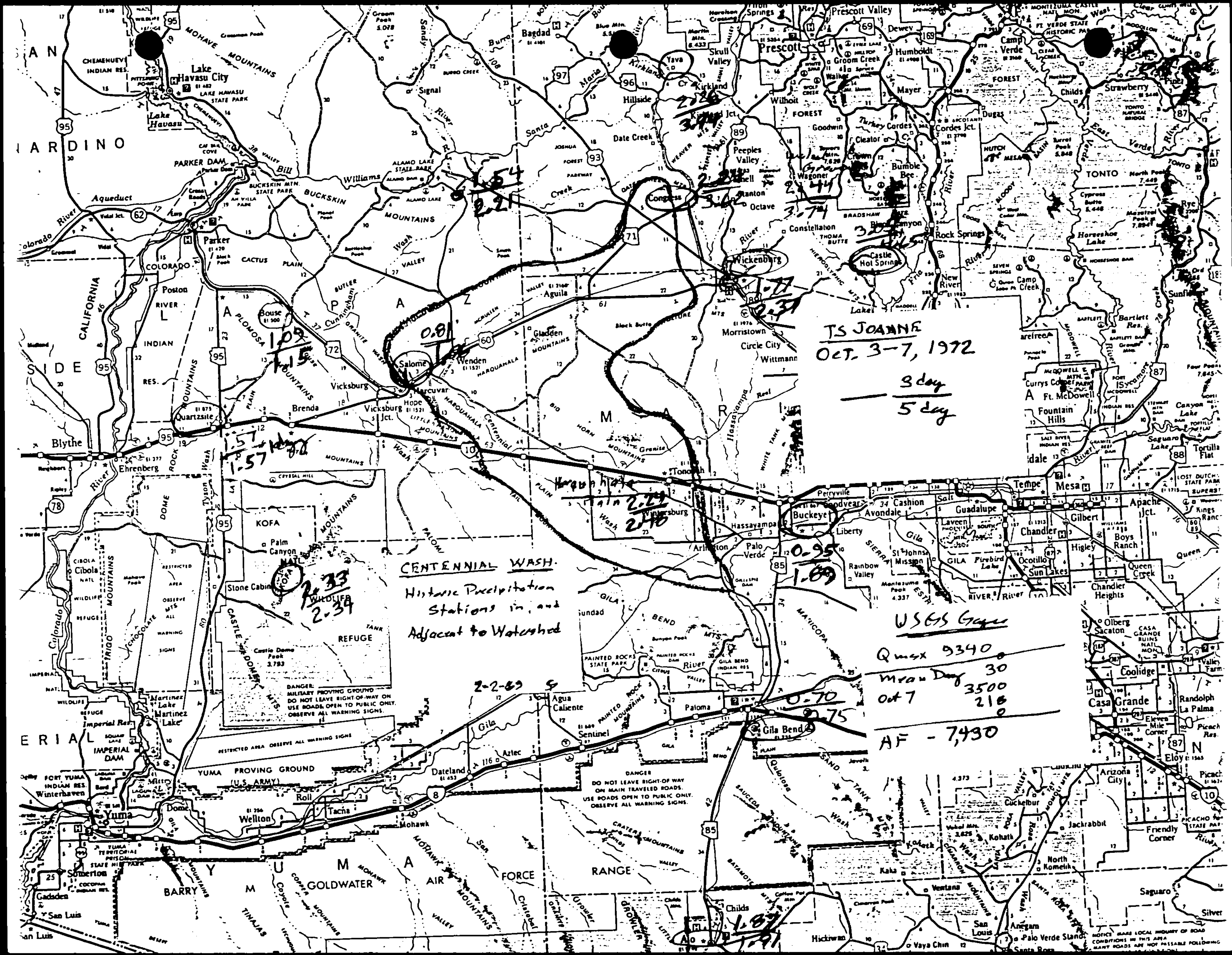
Ventana


TS JOANNE
Oct. 3-7, 1972
3 day
5 day
CENTENNIAL WASH.
Historic Precipitation Stations in, and Adjacent to Watershed
USGS Gage
Qmax 9340
Mean Day 30
Oct 7 3500
218
AF - 7,430
2-2-89
1.54
2.21
1.77
2.37
0.81
1.09
1.15
1.57
1.57
2.29
2.40
0.95
1.89
2.33
2.34
0.70
0.75
1.87
1.91

JOANNE

DAILY PRECIPITATION

ARIZONA
OCTOBER 1972

Continued

Day of Month

Station	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NATURAL BRIDGE	11.36				3.40		1.98	1.03											.26	3.05	1.05					.32					.27	
PAYSON 12 NNE	13.25			.01	4.38	.13	.86	1.81								T			.36	4.66	.41	.01				.34		.19	.02		.06	.09
PAYSON RANGER STATION	10.21			.02	2.10	.49	.34	2.47								T			.11	3.81	.35	T				.33	.03	.11			.05	
PAYSON	10.32			.02	1.99	.63	.49	2.30	.08							T		T	.11	3.89	.35					.35		.10	.02		.02	.01
PLEASANT VALLEY R. S.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RENO RANGER STATION	9.01				.60	1.77	.26	2.85	.12									T		2.02	1.22	.10					.07	T				
ROOSEVELT 1 WNW	8.57				.66	1.35	.35	2.25											T	2.54	1.25	.14					.03					
SAN CARLOS	5.47			.10	.10	1.43	.30	.65											.50	.53	1.67	.19										
SAN CARLOS RESERVOIR	5.96				.36	1.26	.62	.67						.32					.04	.67	1.84	.05					.10		.03			
SIERRA ANCHA	14.23			.22	1.95	1.65	.49	3.89										.09	.86	4.79	.25					.03			.02			.05
TONTO CREEK FISH HTCHY	12.69				1.12	1.83	.37	2.96	.42										.12	2.70	2.60		.08			.06	.02	.07	.05	T	.23	
• • •																																
SOUTHWEST 05																																
ALAMO DAM 6 ESE	3.86			.03	.64	.02	.78	.74							T	.05	.04		.81	.30	T							.43				
BOUSE	2.01			.01	.05		.85	.24									T		.39	.01	.27							.19				
DATELAND WHITEWNG RCH	2.53						2.02												.01	.40								.10				
EHRENBERG	2.61						1.95								T				.40	T	.22							.04				
KOFA MOUNTAINS	2.72			T	.01	T	2.10	.21											.32	.02	.05											
PARKER	1.55						.67	.20									T	T	.32	T	T							.16				
QUARTZSITE	2.10						1.37											.03	.31	.07	.03							.09				
SALOME	1.87			.02	.23	.28	.20	.23							.02				.51	.26								.02				
TACNA 3 NE	3.13			.15			2.33													.35	.12	.01							.17			
WELLTON	3.11			.03	.07	.08	2.23												.30	.15	.09							.16				
YUMA CITRUS STATION	3.86			T			1.57	1.82							T	.04			.08	.25	.09	.01					T					
YUMA PROVING GROUND	3.78			.02	T	.02	3.02									T			.22	.49	.01											
YUMA VALLEY	2.94			T	.02		.81	1.67							.02				.14	.19	.07	.04										
YUMA WSO AP R	2.49			T		.05	2.16												.23	.02	.01											
YUMA	3.22			T	T		.69	1.94											.05	.29	.25											
• • •																																
SOUTH CENTRAL 06																																
ALHAMBRA 2 NE	3.34			.05	.98	.02	.53												.04	1.62	.02					.04		.04				
APACHE JUNCTION	4.42				1.29	.07	.44	.72										.02	.15	1.65	.08					T		T				
ASHURST HAYDEN DAM	4.94				.25	.25	.24	.63											.08	.75	2.35						.35			.02	.02	
BARTLETT DAM	6.89				.74	1.57	.07	2.17	.01									T	.02	1.44	.63	.09				.05	.04	.03	.03			
BEARDSLEY	3.04			.11	.59	T	.15	.76												1.38	T					.05		T				
BUCKEYE	3.10			.15	.79	.04	.28	.63								T			.02	.97	.04	.15						.03				
CAREFREE	7.90			T	1.80	.22	.12	1.85											.09	3.60	.10	.03				.03		T	.06			
CASA GRANDE	3.70				.19	.09	.40	.19										.05	.26	1.84	.47					.19		.02				
CASA GRANDE RUINS N M	5.22			T	.40	.06	.13	.53										.10	.14	3.20	.49					.06	.18	.03				
CHANDLER	3.54				.25	.43	1.13											•	•	•	1.73											
CHANDLER HEIGHTS	3.79				.42	.13	.15	.95										.02	.10	1.20	.80					.02						
DEER VALLEY	4.49			.03	1.24	.04	1.08	.03					T						.17	1.78						.08		.04				
ELOY	4.72		T	.37	.16	.15	.30											.15	2.03	1.27	.07					.16		.04		.02		
FALCON FIELD	4.71				.95	.60	.19	1.02											.20	1.42	.17					.10		.08				
FLORENCE	5.75			T	.52	.06	.29	.74										.14	.12	2.70	.68					.45	.05				T	
GILA BEND	2.02			.05			.10	.57	.03										.06		1.15								.06			
GRANITE REEF DAM	4.55				.56	.73	.14	1.26										.02	.02	1.30	.43					.07						.02
HIGGS 3 W	2.94				.28	.56	.11	.91											.02	.72	.34											
HUACHUCA PLAINS NO.1	3.11			.04	.20		1.22	1.02							.02				.26	.31	.04											
HORSESHOE DAM	7.97			.66	1.39	.13	1.80												.03	3.03	.65	.01			.10	.10	T	.03			.04	
KELVIN	7.32			.08	.92	.23	.22	.82											.50	.28	2.45	1.48				.31				.03	T	
LAKE PLEASANT	3.94			.06	.60	.08	.38	1.20											.04	1.32	.20					.05		.03				
LAVEEN 3 SSE	4.29				1.00	.14	.93												.10	2.10												
LITCHFIELD PARK	3.26			.03	.83	.02	.15	.67											.05	1.42	.07					.03		.02				
MARICOPA 6 N	3.57			.05	.54	.08	.11	.76											.22	1.76	.02					.01		.02				
MESA EXPERIMENT FARM	3.72				.33	.48	.11	1.02	.01									.04	.02	.98	.60					.06	.01	T	.06			
MORMON FLAT	9.40				.70	.89	.16	2.55	.05									.04	T	2.32	1.40	1.29	T			T						
MUMMY MTN	6.82			.05	1.50	.06	1.74											.07	.83	2.47	.03					.02		.03				.02
ORACLE 2 SE	6.75			.39	1.65	.86	.38	T										.25	.90	1.77	.09					.42	T	.04			T	
PHOENIX INDIAN SCHOOL	4.72			.01	1.19	.02	.02											T	.12	2.51	.04					.01		T				
PHOENIX WSO AP R	4.40			.09	.91	.05	.88	.01										T	.70	1.69	T	T				.06		.01				
PHOENIX CITY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PICACHO RESERVOIR	4.19				.28	.42	.47											.15		2.70	.08					.06		.03				
PINAL RANCH	11.88				1.01	1.13	.40	2.93	.03					T					.18	3.10	2.37	.24					.40		.06		.03	
RED ROCK 6 SSW	4.42			.20	.42	.24	.34	.15										.19	.10	1.50	1.07					.10		.12			T	
SACATON	3.87				.20	.24	.21	.82										T	.02	1.24	.90					.03	.14		.07			
SAN MANUEL	4.19			.25	.66	.60	.38	.02										.45	.14	.81	.36	.18					.31		.03			
SCOTTSDALE	5.14				.43	1.25	.11	1.15	.02										.03	1.45	.40	.20				.03	.04		.03			
SOUTH PHOENIX	4.51			T	.90	.08	.16	1.07										.03	.15	1.96	.06				.05			.09				
STEWART MOUNTAIN	6.69				.76	1.57	.15	1.73											T	1.83	.43	.03				.07	.04	T	.06			
SUNFLOWER 3 NNW	11.59			.20	3.77	.11	3.29	.29										.07	2.13	.97	.38	.08				.17		.12				.01
SUPERIOR	8.68				1.02	.43	.38		2.07								.10	.10		2.82	1.46	T					.23	.03			T	T
TEMPE	4.54				.25	.95	.09	1.17											.05	1.16	.45	.31	.01			.04	.01		.05			
TEMPE U OF A CIT EX ST	4.11				.32	.64	.08	1.22	.01									.01	.07	1.13	.50					.06	.02	T	.05			
TOLLESON 1 E	3.51		.02	T	.60	.04	.68	.32											.08	1.46						.09		.04				
WICKENBURG	3.84			T	.60	.04	.28	1.45											.09	.90	.48					T		T				
WILLOW SPRINGS RANCH	4.72			.69	.70	.56	.30	.02	T									.05	.76	1.55	.04							.03				
WINKELMAN 8 S	4.34			.13	1.30	.27	T	.34										.08	1.63	.15				T		.18		.24		T		
YOUNGTOWN	3.94			T	.75	T	.76	1.13											.04	1.17	.06					.01		.02				
• • •																																
SOUTHEAST 07																																
AJO	3.24			T	.04	.01	.09	1.77										.03	.02	.79	.44	T						.03		.02		
AJO WELL	2.77				.01	.02	.18	1.26										.06	.05		1.23					.02						
ANADO	4.58			.51	1.02	.14	.71	.05										.21	.39	1.53	.23											
ANVIL RANCH	3.47			.04	.25	.06	.76	.01	.10					.26		.04				1.90	.14	T										.24
APACHE 6 WNW	8.07					.90	.03												2.00	1.91	1.23	1.37					.07					
APACHE POWDER COMPANY	3.56			.17	.60	.09	.70						.01	.09				.11	.54	.84	.12	.04					.16	.02			.03	.02
ARIVACA 1 E	4.71			.44	.19	.18	.62	.07										.03	.39	2.10	.56					.10	.01	.01	.01			
ARIZ SONORA DESERT MUS	4.27			.44	.25	.59	.31	.03										.23	1.17	.99	.01						.02					.23
BENSON	3.51			.25	.63	.11	.16						T	T				.55	.75	.63	.15					.03	.24	.01			T	
BISBEE MD 2	2.92			.01	.34	.52	.09						T					.02	.10	1.33	.32	.13						.03			.01	T
BLACK RIVER PUMPS	6.84				.59	1.75	.43	.39	.05					.07				.15	.37	.90	1.92	T	.03			.03		.02	.06		.04	.06
BLUE	13.79				1.00	1.01	.55	1.02	.45					.40		.23	.35	.50	.60	4.40	1.90	.65				.55					.14	.04
BOWIE	4.39			.05	.35	.05	.18									.05		.19	1.04	1.85	.20	.15				.01	.22				.03	.02
CANELO 1 NW	2.81			.28	.31	.23	.02											.01	.71	.73	.32						.05	.03			.12	
CASCABEL	3.86			.16	.50	.33	.15											.96	.34	.81	.20	.05				.04	.28	.04				T
CHIRICAHUA NAT MON	4.14				.66	.03	.10						.09					.02	.20	1.24	.80	.04					.34				.52	.10
CLIFTON	4.30				.65	.30		.40											.95	.85	*	1.00									.13	
COLONADO NM HDQRS	4.10			.20	.76	.05												.02	1.35	1.05	.32	.18							.02			
DARO 3 SW	4.50			.45	.28	.47	.37												.22	1.81	.75	.07					.03	.05				
DOS CABEZAS 1 SE	3.67				.43	.36	.32											.50	.33	.22	1.05								.46			
DOUGLAS	3.68			T	1.08	.08	.30						.09					.26	.07	.27	1.40	.02	.09				.02					
DOUGLAS 8 D FAA AP	4.76			.11	.51		.13						.01				.02	.26	1.58	1.43	.22	.24				.05	T	.06			.14	
DOUGLAS SHELTER	3.02			T	.78		.23						.11					.04	.10	.20	1.38	.04	T			.02		.02			.08	
DUNCAN	4.40				.42	.11	1.30	.06				.07	.03					.06	.55	1.25	.39	.07				.06	.03		T			
EAGLE CREEK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FAIRBANK 1 S	2.62				.75	.12	.30							.22				.11	.20	.51	.41						.26		.05		.02	.18
FORT GRANT	5.39			T	.91	.45	.78	.10					T			T		.58	.32	1.19	.89	.04				.15		.03		.05		
FORT HUACHUCA	2.72			.35	.33	.20	.23						T	T				T	.41	.68	.20	.09				.10		.01				.02
FORT THOMAS 2 SW	3.09			.05		.16							T					.57	.35	1.50	.32	.01				.12						.06
FRITZ RANCH	8.02			.30	1.28	1.00	.15						.70			T	T	.59	.50	3.00	.15	.17										

See reference notes following Station Index

Jeanne DAILY PRECIPITATION

ARIZONA
OCTOBER 1972

Contu

Station	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
		Day of Month																														
GRANVILLE	6.72										.04		.03						1.72	1.58	1.78	1.39					.03		.05		.10	.08
KITT PEAK	8.41			T	.14	1.07	1.08	.88						.03					.65	2.78	1.61	.09				.25			T			T
KLONDYKE 3 SE	5.46					1.80	.18	.10										.40	1.20	1.45	.08											
MC NEAL	3.01				.50														.30	1.26	.75											
N LAZY H RANCH	4.41			.37	.87	.16	.20	.09										.02	.59	1.41	.58					.04	.09	.02			T	.01
NOGALES	3.12			.58	.62	.06	.15	.22										T	.25	.87	.31							.09			.02	
NOGALES 6 N	4.33			.54	.53	.40	.20	.93	.03									T	.40	.60	.83	.03					.15		.04	.05	T	
ORGAN PIPE CACTUS N M	2.79			T	.26	.02	.72	.92										.15	.05	2.02								.05		T		
PALISADE R S	8.44			.42	1.33	1.45	.56	.12											.85	2.40	1.10	T							.29			.12
PATAGONIA	3.97			.71	.36	.46		.14										.09	.41	.98	.44	.06	.03				.14				.12	.02
PEARCE	1.53			T	.33	.10	T						.01			T		.05	.20	.65	.10	.04				T					.05	
PORTAL 4 SW	6.56				.70	.03	.49							.53		.25		.10	.43	1.42	1.35	.24				.63		.03			.36	
REDINGTON	4.25				.77	.92	.25												.40	.65	1.18	.08						.21		.02		
RUBY STAR RANCH	4.22			1.10	.10	.39		.12										.08	.80	1.48	.10							.03	.02			T
RUCKER CANYON	5.66				.75		.12												1.75	2.24		.25										.55
SABINO CANYON	5.24			.52	1.18	.12	.29	.40					.05	T				.11	.71	1.28	.60					T	.01	.01	T		T	.01
BAFFORD	2.00			.26	.51	.01	.65							.03			.01	.18	.52	.58				.10		.13						
BAFFORD EXPERIMENT FRM	3.68			T	.27	.51	T	.89									.30	T	.17	.78	.76	.08	.02				.12		T			T
BALA RANCH	4.05			.07	.49	.09	.66		.02			.02						.25	.27	1.40	.28	.08	.03				.29	.03	.02		.07	.01
SAN SIMON 9 ESE	2.86			T	.20	.07	.22						T	.14	T	.03		.02	.14	.60	1.00	.08				T	T	.26				.10
SANTA RITA EXP RANGE	5.64			.68	.24	.22	.49	.09									.08		.24	2.70	.36					.42		.03			.09	
SANTA ROSA SCHOOL	2.76				.16	.05	.20											.27			2.08											
SASABE	4.53				.50	.49	.85	.30												2.30							.08	.01				
SASABE 7 NW	4.33			T	.36		1.22						.01						.32	1.56	.83					T	.03				.02	
BELLS	5.99			.03	.01	1.10	.32	.30											2.70	1.50												
SILVER BELL	5.60				.25	.53	.40			.45									.15	1.35	1.75			.25	.17		.16					.08	.06
STEPHENS RANCH	3.34				.75	.10							.04	.10		.03	T	T	.70	1.19	2.41	.02				T	T	T			T	
TOMBSTONE	2.71			.08	.45	.10	.10										.03	.45	.40	1.00	.05										.08	
TUCSON CAMP AVE EXP FM	4.49			1.10	.72	.49	.05											.08	.63	1.42						T						T
TUCSON MAGNETIC OBSY	5.15			.08	1.28	.18	.26	.87											.48	1.24	1.31	T					.01		T			.02
TUCSON UNIV OF ARIZONA	4.82		.02	.50	1.53	.35	.03	.01									.01	.05	.48	1.82						.01		T				.01
TUCSON WSO AP R	4.51			.59	.63	.38	T						T					.07	1.01	1.75	.01					.07		T				T
TUMACACORI NAT MON	4.25			.54	.89	.14	.30	.03						.02				.05	.64	.63	.44	.08					.43	.04				
WILLCOX	3.76			T	.55	.72	.03						.01			T		.17	.62	1.01	.30	.05				T	.26	T	T		.02	T
Y LIGHTNING RANCH	2.90			.36	.15	.30	.47											.30	.42	.75	.10		.05									

EXTREMES

HIGHEST TEMPERATURE SACATON	108	DATE	02
LOWEST TEMPERATURE SUNRISE MOUNTAIN	- 5	DATE	31
GREATEST TOTAL PRECIPITATION JUNIPINE	14.74		
LEAST TOTAL PRECIPITATION WILLOW BEACH	.50		
GREATEST 1 DAY PRECIPITATION SIERRA ANCHA	4.79	DATE	19
GREATEST TOTAL SNOWFALL FORT VALLEY	14.5		
GREATEST DEPTH OF SNOW FORT VALLEY	11	DATE	24

SUPPLEMENTAL DATA

	Wind (Speed — m.p.h.)						Relative humidity averages-percent, Standard of Time MOUNTAIN				Number of days with precipitation							Percent of Possible sunshine	Average sky cover sunrise to sunset
	Resultant Direction	Resultant Speed	Average	Fastest mile	Direction of fastest mile	Date of fastest mile	05	11	17	23	Trace	.01-.09	.10-.49	.50-.99	1.00-1.99	2.00 and over	Total		
FLAGSTAFF WSO AP	20	2.2	6.2	24	NE	31	65	48	49	64	5	2	7	1	5	0	20	51	7.0
PHOENIX WSO AP	14	1.9	6.7	30 %	SSE	06	71	53	42	61	3	5	0	3	1	0	12	65	5.6
TUCSON WSO AP	18	2.4	7.2	32	SW	06	78	51	44	71	4	3	1	2	2	0	12	66	4.9
WINSLOW WSO AP	22	1.6	6.7	29++	24	15	86	65	53	82	2	7	5	0	3	0	17	-	6.5
YUMA WSO AP	34	1.9	6.6	27	N	30	69	48	42	60	1	4	1	0	0	1	7	68	5.5

% GUST

See reference notes following Station Index

Tropical Storm

DAILY PRECIPITATION

JOANNE

ARIZONA
OCTOBER 1972

[redacted]tion	Total	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
NORTHWEST 01																																
BEAVER DAM	1.57				.26	.05				.06	.55					.35				.06	.10					.02			.03	.09		
COLORADO CITY	2.53			T	.79	T	.27		.01				T		T	.23		.08	.37	.24	.34				.04	.05		T		.11		
DAVIS DAM NO 2	.76				.32		.12											.01	.08	.22	T							.01	—			
KINGMAN NO 2	1.98				.50	.02	.48				.11					.10	.06	.06	.29	.31		.02						.03				
LAKE HAVASU	1.47						.06	.65								.02		.40	.16									.14	.04			
MOUNT TRUMBULL	2.79			.45			.35			.05						.26	.20	.21	.09	.04	.54	.50	.10									
PEACH SPRINGS	3.40				.52		.06	.87									.56	.12	.80	.32	.03					T	T	.01	.01		.10	
PIERCE FERRY 17 SSW	.90							.25			T					.14	.13	.03	.10	.12	.02						.08	.03				
PIPE SPRINGS NATL MON	3.57				.50		.41	.10							T	.87		.12	.53	.38	.36				.15	.05				.10		
TRUXTON CANYON	2.78			.03	.10		.55	.05		T					T	.35	.02	.08	.87	.67	.01	.01						.03		.01		
TUWEEP	2.87				.67			.66								.50			.54		.34				.03					.13		
WILLOW BEACH	.50													.27				.06	.06	.06	.03							.02				
YUCCA 1 NNE	1.29			T			.04	.51			.06						.03	T	.41	.24									T			
NORTHEAST 02																																
ALPINE	10.08			T	1.07	1.03	1.04	.83					.02	.85			.20	.45	.14	2.48	1.26	.27				.10		.01			.10	.29
BETATAKIN	9.01				1.16		.31	1.30								.36	.37	1.22	1.43	1.74	.43				.01	.43		.10	T	.14	T	.01
BLUE RIDGE RS	9.59			1.08	1.23	.22	1.91	.07											.08	2.52	1.09				T	.53		.08	.03		.32	.42
BRIGHT ANGEL RS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CAMERON	6.83			.19	1.15		.96	.69								.01	.90	.17	1.08	1.01	.02				.11	.47		.06	.01	T		T
CANYON DE CHELLY	4.47				.37	.70	.07	.80	.03				.04	.43		.01	.10	.10	.49	.72	.38	.01				.24		.09	.02	T	.17	.04
CHEVELON RS	6.39			.06	.75	.51	.82	1.05											.02	2.10	*	*	*	*	.53	.11					*	.39
CIBECUE	7.81			.22	.69	.76	.35	1.74	T				T					.24	.15	2.85	.63				.10	T	T				.05	.03
CLAY SPRINGS	6.57			.38	.68	.52	1.50	.03					.02	T			T	1.17	1.25	.19		.12			T	105		T		.44	.22	
COPPER MINE TP	6.35				T	.95		.20	.84								.45	.35	.14	.75	1.32				.10		.15				1.05	.09
DINNEHOTSO	5.24				.92		.17	.71					.12	.06		.08	.18	.75	.38	.94	.42				.06	.32					.06	.09
FLAGSTAFF WSO AP //R	9.86			.27	1.60	.01	1.70	1.13					T		T	.17	.21	.25	1.39	1.52	.21				.07	.92		.15	T	.26	T	T
FORT VALLEY	9.55			1.13	.75	.28	1.46	T							.17	.18	.49	1.01	1.49	1.00					1.10			.31			.18	
FREDONIA	3.06			T	.48		.34	.17								.37		.12	.64	.39	.28				.14					.13		
GANADO	D 3.87				.11	.45	.12	.60	.15					.10					.50	.40	.60					.01	.26		.17			D .20
GRAND CANYON NAT PARK	6.09			.40	1.10			.95	.04							.49	.11	.51	.86	1.08	.13	.01			.04	.13		.09		.13		
GREER	7.20			T	.66	.67	.82	.73					.10	.24	.01	.06				2.39	.84	.07				.26		.03			.24	.08
HAPPY JACK RANGER STA	9.04				1.48	1.57	.18		.04											2.55	1.05	.01	.07			1.10		.10	.11	T	.69	.09
HAWLEY LAKE	9.93				.54	3.05	.70	.60						T		.01		T	.44	.93	2.65	.10	T			T	.10	.10	.07		.35	.29
HEBER RANGER STATION	7.42			.12	.38	1.04	.65	1.16	.01					.02				.02	.11	2.52	.56				.02	.16	.02	.03	.01		.51	.08
HOLBROOK	-				.93	.38	.22	.82								*	*	*	*	*	*	1.70			-	-	-	-	-	-	-	-
JACOB LAKE	D 8.44			T	.80	.15	.22	1.21					T			1.45	T	.52	.48	.52	1.80				.27			.32		.42	D .02	D .23
JUNIPINE	14.74			*	2.00		.29	3.15	.04							.06	.06	1.45	2.33	2.48	.93	.05			.22	.92		.22	.12	.22	.20	T
KAYENTA	4.94				.10	.57		.90	.65							.19	.24	.20	.67	.71	.25					.20	.21					.05
KEAMS CANYON	4.67				1.75		.69												.33	.53	.81	.02	T			.22				.10	.22	T
KLAGETOH 12 WNW	5.98				.82	.18	.53	.50					.07	.05				.49	.22	1.08	.46	.05	.21			1.01		.16	.07		.07	.01
LAKESIDE RANGER STA	7.67				.25	1.63	.18	1.35					.01					.78	T	1.60	1.10	.12	.02		T	.01		.01	.20		.25	.16
LEES FERRY	3.15					.58	.05	.15	.48							.36	.02	.01	.35	.77	.18				.20							
LEUPP	6.94			.10	1.40	.03	.70	.90									.03	.30	.40	1.50	.15	.24			.56	.21		.14			.28	T
LUKACH[redacted]	4.77					.65		.70						.20			.10	.58	.35	.58						.10	.30		.26		.35	.60
MAN[redacted]	-				*	.70	.30		*	1.10						.10	.04	.21		-	.10					.37		.20			.15	
MC[redacted]	8.15				.30	1.90	.78	.48	.03						.07			.34	.19	.42	2.59	.14	.05	T		.04	.10	.07	.05		.28	.32
NAV[redacted]	3.72			.16	.62	.19	.52	.28				.13	.62						.60	.32					.02	.08						.18
PAGE //	3.89				.37	.16	T	.71		.01							.46	.02	.17	.87	.53				T	.48	.01		.03		.07	
PETRIFIED FOREST NP	3.95			.03	.12	.49	.35	.32					.38	.28		T				.85	.44	.21	.01			.19		.07			.21	T
PHANTOM RANCH	3.63			.20	.87	T	.27	.47	.01							.25	.06	.22	.55	.63	T									.10		
PINETOP FISH HATCHERY	6.50			.16	.30	1.57	.25						.05				.89	.85		1.78	.10					T	.03				.52	
PINON	D 6.31				1.05	.04	.60	.88	.10				T	.01	.51	.46	.17	.45	.98	.51					T	.20	.01	.23	.02	.05	.02	D .02
RED SANDS TRADING POST	4.21					1.25	.27	.91										.36	.01	1.40						.01						
ROUGH ROCK SCHOOL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SAINT JOHNS	3.28			.23	.57	.48	.33	.14						.06			T	.03	.18	.56	.25					.18		.07			.20	
SANDERS	5.51				.25	.60	1.10	.73		.02			.21	.36		.03		.05	T	1.02	.52	.22				T		.10			.12	.18
SANDERS 11 ESE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SEDONA RANGER STATION	9.83			.08	1.28		.13	2.11								.04	.05	.75	1.21	1.80	.97	.18			T	.94		.02	.01	T	.26	
SHOW LOW CITY	6.91			.05	.52	1.06	.69	1.08					.15	.31				.22		1.77	.87	T				.09	T	.02				.10
SNOWFLAKE	4.83			.12	.16	.92	.39	.52					.03					.02	.19	1.12	.45	.20				.30		.06			.28	.07
SNOWFLAKE 15 W	4.26			.14	.58	.36			.83				.01			T			.90	.74	.26				.03	.20	T			.21		
SPRINGERVILLE	3.20				.15	.46	.45	.03					.09	.39				.04		.74	.19	.19			.03	.03	.07				.18	.16
SUNRISE MOUNTAIN	10.46				.73	1.65	.43	1.47						.14			.04	T	.17	1.69	3.20	.02	T				T	.24			.27	.41
SUNSET CRATER N.M.	8.90			.21	2.00		1.42	1.78								.04	.24	.15	.92	.91	.26				.10	.74		.04		.02	.04	.03
SUPAI	3.68				.48		.43	.43								.84		.07	.66	.55	.04					.02		.03		.13		
TUBA CITY	7.69				.63	.56	.80			1.72							.08	.83	.21	1.37	.69					.56	.14				.04	.06
WAHWEAP	3.83				.52	.01	.18	.59								.66	.04	.05	.38	.76	.13	.01			.36	.06		T		.04	.02	.02
WALNUT CANYON NAT MON	9.38	.15			2.00		.80	2.25								T	.22	.22	1.09	1.31	.44				.16	.39		.12		.05	.18	T
WHITERIVER	6.53				.30	2.91	.27	.21						.30					.22	.35	1.44	.08	.13			T	.14	.07	.07		.02	.02
WILLIAMS	10.51			.19	1.77	T	.51	1.49								.49	.39	.14	1.94	2.19	.44	.03			T	.46	.03	.22		.22		T
WILLIAMS CR FISH HTCHY	D 7.18					2.10		1.25					.19						.65	2.63						.13		.09			.09	D .13
WINDOW ROCK	9.54				.30	.40	.15	1.88	.13				.28		.01				.20	.31	1.05	.01	.01			.01	.38				.18	.36
WINSLOW WSO AP //R	5.61			.04	1.04	.02	1.57	.09					T			.01		T	.21	1.86	.07	.18				.04		.05		.10	.25	.10
WUPATKI NAT MON	7.85			1.83		.02	.68	1.67									.74	.07	.91	.82	.26					.81		.04	T	T	T	T
NORTH CENTRAL 03																																
ASH FORK	8.01			.19	1.89		.36	1.82								.24		.42	.64	2.13	.08					.12		.12				
BAGDAD	5.94			.11	1.07		.95	1.23								.14	.12		1.16	.57	.14	.03						.42				
BAGDAD 8 NE	6.99			.36	1.60		.63	1.20								.14	.11		1.36	.93	.10	.08				T		.45		.03		
BEAVER CREEK RS	7.35					1.05	.65	2.06									.03		.21	1.80	.54					.77		.09			.15	T
BUMBLE BEE	7.37			.07	.78	T	.93	2.82										.12	.80	1.40	.23					.13		.03			.06	
CAMP WOOD	9.34			.43	1.51		.51	1.99									.39		1.54	1.64	.18							1.15				
CASTLE HOT SPRS HOTEL	7.00			.08	1.05		1.15	2.40											.37	1.75	.15					.05						
CHILDS	9.24				1.10	.77	.18	3.90	.05								.02		.05	1.52	1.40	.13				.48	.02	.04	T		.32	.22
CHINO VALLEY	7.05			.02	1.10	.40	.24	1.84	.02							.06		.13	.54	1.50	.80	.01				.12		.04	.15	.01	.05	.02
CONGRESS	6.80			.45	.93		1.19	1.05								.03			.70	1.32	1.00					.07		.06				
CORDES	6.17			.11	1.08	.10	2.00	T								.02	.04	T	.27	1.88	.16					.23	.02	.06		T	.08	.12
COTTONWOOD	7.34			.09	1.34		.42	2.32								.07		.29	.84	1.37	.20					.31		.06		.03		
CROWN KING	3.88			.15	1.94	.03	.30	.12								.15	.05		.05	.04	.48					.21						.36
DUGAS 2 SE	6.76				.20	1.05	1.49												1.44	1.50						.48				.26	.34	
GROOM CREEK	8.27			.43	1.16		1.50	1.80								.13		.05		1.90	.53				.01	.34		.05		.11	.01	.29
HILLSIDE 4 NNE	7.69			.78	1.25		.72	.95								.10	.21	T	1.43	1.50	.50					T		.25		T		
IRVING	8.04				1.20	.76	.12	2.20	.11										.08	1.72	1.16					.60	T	.09				
JEROME	8.74				.77	.58	.35	3.00								.03	.01		.85	1.39	.98	.01				.48		.03	.04		.22	
MONTEZU[redacted]CASTLE N M	6.81			.03	.76		.11	2.09								.11			.68	1.23	.35					.74		.12			.50	.09
PRESC[redacted]	7.82			.01	1.12	.48	.31	1.88	T							.15	.26		.73	1.62	.76	T				.23	.13	T	.04		.01	.09
SEL[redacted]	-			.17	1.11		.35	.97								.11	.10	.11	.87	.57		.04				-	-	-	-	-	-	-
SELI[redacted]SW	5.39			1.30		.04	1.80		T							.17	T	.25	.32	.95	.18	.08							.30			
SKULL[redacted]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WALNUT C[redacted]EEK	7.18			.27	1.41		.57	1.80								.24	.06	1.30	.88	.23							.42					
WALNUT GROVE	6.29			.30	1.00		.58	1.86								.10			1.95	.40							.10					
YAVA 6 ESE	6.72				1.68	.15	.25	1.86								.13		.20	.30	1.25	.90											
EAST CENTRAL 04																																
BAR T BAR RANCH	9.79				.40	2.55	.25	2.80											.85	2.70	.20											
GISELA	7.38				1.50	.54	.25	1.92										T	.14	2.35	.52	.05	.03	.02				.06				
GLOBE	6.15				.38	.48	.26	1.04						.02				.08	.11	1.95	1.15	.14	T			.39	.03	.06			.06	
MIAMI	7.59				.57	.60	.41	1.21	.02					.02				.12	.06	3.12	1.10	.14	T				.13	T	.02	.01		

3.5 / 4.65   3d   2.24 / 3.62 51g   2.44 / 3.74   2.26 / 3.94

See reference notes following Station Index.

is obtained for areas having several soil-cover complexes. The example area contains a Group B soil. The weighted number can be more easily obtained by accumulative multiplication on a calculator.

TABLE A-6.—*Sample computation, weighting of hydrologic soil-cover complex numbers*

Complex	Curve number	Percent of area	Number times percent
Row crop, straight row, good rotation	78	56.2	4,384
Legumes, contoured, good rotation	69	37.5	2,588
Meadow, permanent	58	6.3	365
Total		100	7,337

Weighted number $=\frac{7,337}{100}=73.37$ (U.S. Soil Conservation Service.)
Round-off to 73.

A-5. *Estimation of Direct Runoff From Rainfall.* —(a) *General Storm Rainfall.*—The method uses three variables in estimating runoff: rainfall, antecedent moisture condition, and the hydrologic soil-cover complex.

(1) *Runoff equation.*—The curves of figure A-4 are obtained using the equation:

$$Q=\frac{(P-0.2S)^2}{P+0.8S} \tag{1}$$

where:

Q=direct runoff, in inches
P=storm rainfall, in inches, and
S=maximum potential difference between P and Q, in inches, at time of storm's beginning.

Equation (1) is derived by starting with the proportion:

$$\frac{P-Q}{S}=\frac{Q}{P} \tag{2}$$

where $\frac{P-Q}{S}$ is visualized as the ratio of actual to potential difference between P and Q, and $\frac{Q}{P}$ is visualized as the ratio of actual to potential runoff.

Solving for Q gives:

$$Q=\frac{P^2}{P+S} \tag{3}$$

Equation (3) is useful under conditions where there is a possibility of runoff whenever there is rainfall. For the condition that $Q=0$ at a value of P greater than zero, use of an initial abstraction, I_a, is required (see the diagram on fig. A-4). With the condition that I_a cannot be greater than P, equation (2) then becomes:

$$\frac{(P-I_a)-Q}{S}=\frac{Q}{(P-I_a)} \tag{4}$$

And solving for Q gives:

$$Q=\frac{(P-I_a)^2}{(P-I_a+S)} \tag{5}$$

Since S includes I_a, an empirical relation between the variables can be developed to simplify equation (5). Data from watershed in various parts of the country give:

$$I_a=0.2S \tag{6}$$

Substituting $(0.2S)$ for I_a in equation (5) gives equation (1).

Equation (5) can be further expanded to recognize other given conditions or factors. However, such expansions in themselves do not mean greater accuracy in runoff estimating, since this would require that the terms expressing additional factors be of a high order of accuracy.

(2) *Significance of S.*—Plottings of direct runoff, Q, versus storm rainfall, P, on natural watersheds show that Q approaches P as P continues to increase in the storm. The same data show that $(P-Q)$ approaches a constant as P continues to increase. The quantities can be shown together as in equation (2), above, and it is apparent that the constant S is the maximum difference $(P-Q)$ that could occur for the given storm and watershed conditions. The proportion can be made more complex (as discussed above), but not all the additional factors can be related to S.

The variable S is therefore a maximum potential $(P-Q)$. During a storm, the actual $(P-Q)$ that occurs is limited by either soil-water storage or an infiltration rate as P increases. The maximum potential $(P-Q)$ or S, therefore, is dependent on soil-water storage and the infiltration rates of a watershed.

(3) *Significance of* I_a.—The insert on figure A–4 shows that I_a is equal to the rainfall that occurs before runoff starts. Physically, I_a consists principally of interception, infiltration, and surface storage. Equation (6), which relates I_a to S, is based on data from large and small watersheds in various parts of the country. Further refinement of equation (6) is not recommended, since the data needed to break I_a into components of interception, infiltration, and surface storage are seldom available on a watershed basis. For the same reason, adjustment of the coefficient 0.2 in equation (6) is not recommended.

(4) *System of curve numbering.*—For convenience in interpolation, the curves of figure A–4 are numbered from 100 to zero. The numbers are related to S as follows:

$$\text{Curve number} = \frac{1{,}000}{10+S} \qquad (7)$$

A curve for the case $I_a=0$, equation (3), is displaced to the right for the case $I_a=0.2S$, equation (1), by the amount of $0.2S$. Therefore, the curve numbers given in table A–2 should be used only with figure A–4 or with equation (1).

(5) *Antecedent moisture conditions.*—The amount of rainfall in a period of 5 to 30 days preceding a particular storm is referred to as antecedent rainfall, and the resulting condition of the watershed in regard to potential runoff is referred to as an antecedent condition. In general, the heavier the antecedent rainfall, the greater the direct runoff that occurs from a given storm. The effects of infiltration and evapo-transpiration during the antecedent period are also important, as they may increase or lessen the effect of antecedent rainfall.

Because of the difficulties of determining antecedent storm conditions from data normally

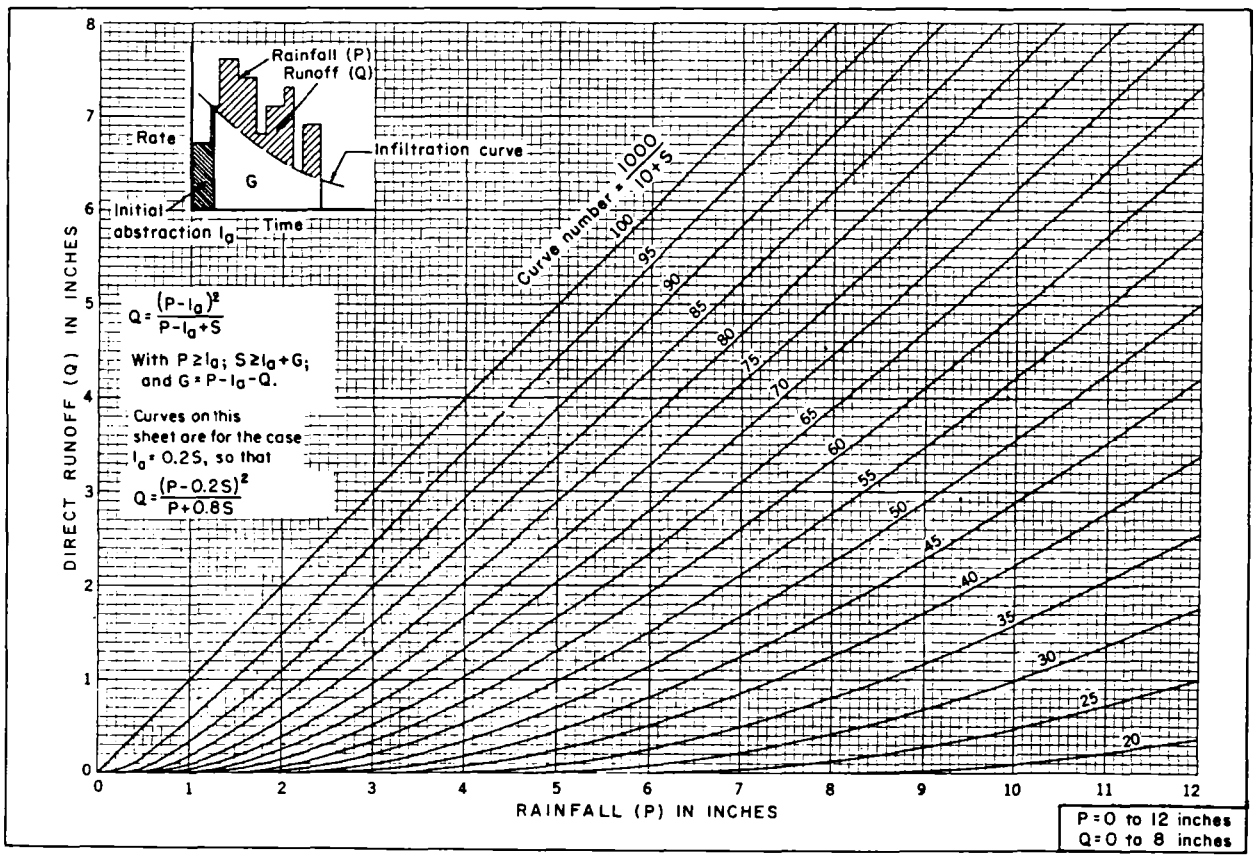


Figure A–4. Solution of runoff equation, $Q=\frac{(P-0.2S)^2}{P+0.8S}$. (Sheet 1 of 2.) (U.S. Soil Conservation Service.) 288–D–2549.

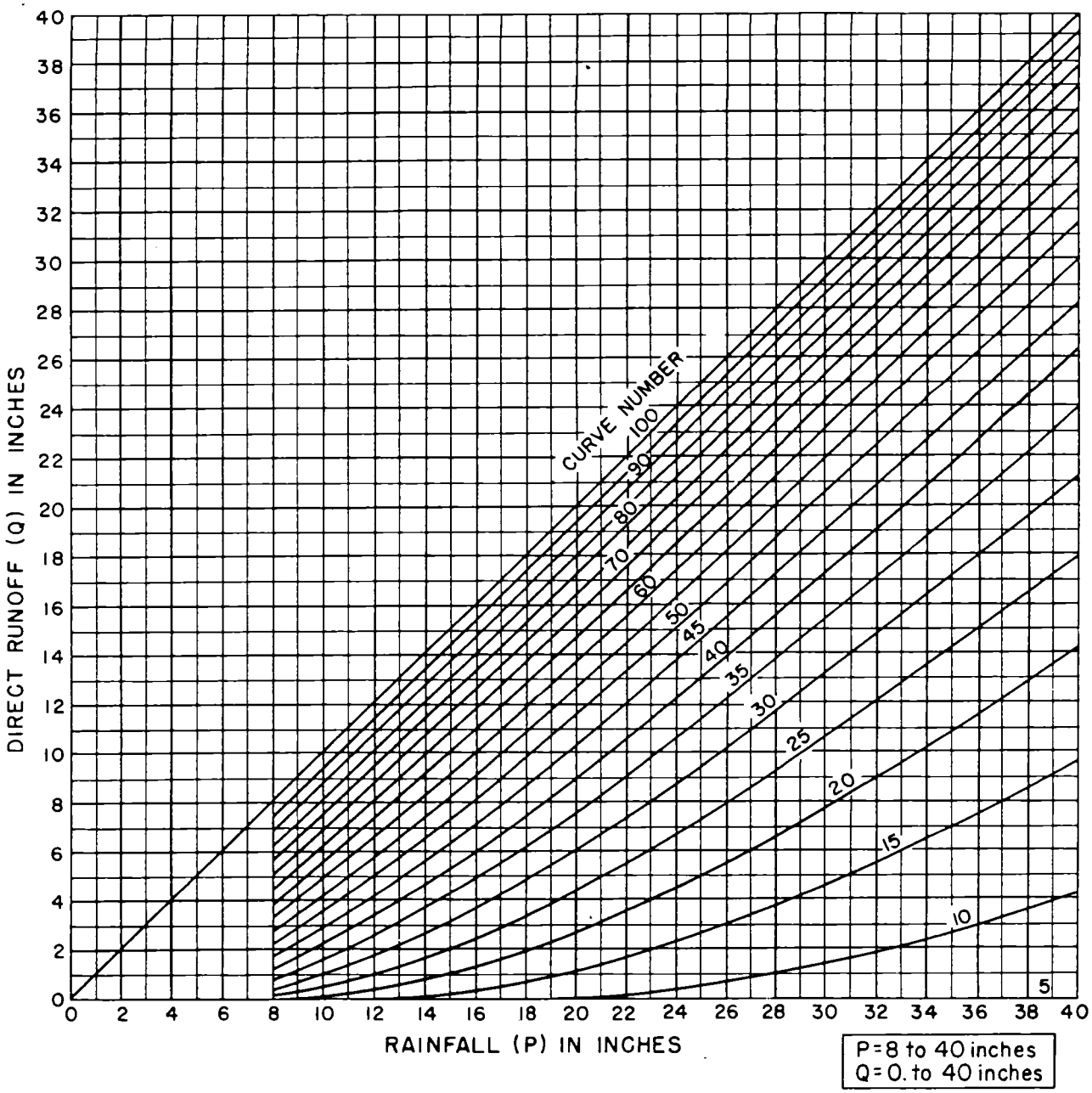


Figure A–4. Solution of runoff equation, $Q=\frac{(P-0.2S)^2}{P+0.8S}$. (Sheet 2 of 2.) (U.S. Soil Conservation Service.) 288–D–2549.

available, the conditions are reduced to the following three cases:

AMC–I.—A condition of watershed soils where the soils are dry but not to the wilting point, and when satisfactory plowing or cultivation takes place. (This condition is *not* considered applicable to the design flood computation methods presented in this text.)

AMC-II.—The average case for *annual floods*, that is, an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds.

AMC-III.—When heavy rainfall or light rainfall and low temperatures have occurred during the 5 days previous to the given storm, and the soil is nearly saturated.

The numbers on tables A–2, A–3, A–4 and A–5 and figures A–2 and A–3 are for the average watershed condition, AMC-II. Curve numbers for one antecedent moisture condition may be converted to a different antecedent moisture condition by the use of table A–7. For example, the computations in table A–6 give an AMC-II number of 73. The corresponding curve number for AMC-I and AMC-III can be obtained from columns 2 and 3 of table A–7. The curve numbers for AMC-I and AMC-III are 54 and 87, respectively.

(b) *Thunderstorm Rainfall.*—Estimates of direct runoff from thunderstorm rainfall are more difficult than for general storm rainfall because data for thunderstorm-caused floods are meager. Type and density of vegetative cover on a watershed, as well as the time-sequence of rainfall, appear to have more influence on thunderstorm runoff than do antecedent moisture condition and soil group.

A definite time-sequence of 15-minute incremental rainfall has been assigned for each designated geographical zone for thunderstorm precipitation values given in this text. A simplified "Thunderstorm Cover Index" relating to vegetative cover type and ground cover density for watersheds west of the 105° meridian has been developed. After design thunderstorm precipitation values have been arranged in respective time-sequence magnitude (see table A–8), direct runoff increments are computed by the procedure in the examples, section 58(c), using appropriate runoff curve number, table A–9, and minimum 15-minute retention loss rate for respective hydrologic soil group, table A–10.

TABLE A–7.—*Curve numbers (CN) and constants*

[*For the case* $I_a=0.2S$]

(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(4)	(5)
CN for condition II	*CN* for conditions I	*CN* for conditions III	*S* values[1] inches	Curve[1] starts where *P* = , inches	*CN* for condition II	*CN* for conditions I	*CN* for conditions III	*S* values[1] inches	Curve[1] starts where *P* = , inches
100	100	100	0.	0.	60	40	78	6.67	1.33
99	97	100	.101	.02	59	39	77	6.95	1.39
98	94	99	.204	.04	58	38	76	7.24	1.45
97	91	99	.309	.06	57	37	75	7.54	1.51
96	89	99	.417	.08	56	36	75	7.86	1.57
95	87	98	.526	.11	55	35	74	8.18	1.64
94	85	98	.638	.13	54	34	73	8.52	1.70
93	83	98	.753	.15	53	33	72	8.87	1.77
92	81	97	.870	.17	52	32	71	9.23	1.85
91	80	97	.989	.20	51	31	70	9.61	1.92
90	78	96	1.11	.22	50	31	70	10.0	2.00
89	76	96	1.24	.25	49	30	69	10.4	2.08
88	75	95	1.36	.27	48	29	68	10.8	2.16
87	73	95	1.49	.30	47	28	67	11.3	2.26
86	72	94	1.63	.33	46	27	66	11.7	2.34
85	70	94	1.76	.35	45	26	65	12.2	2.44
84	68	93	1.90	.38	44	25	64	12.7	2.54
83	67	93	2.05	.41	43	25	63	13.2	2.64
82	66	92	2.20	.44	42	24	62	13.8	2.76
81	64	92	2.34	.47	41	23	61	14.4	2.88
80	63	91	2.50	.50	40	22	60	15.0	3.00
79	62	91	2.66	.53	39	21	59	15.6	3.12
78	60	90	2.82	.56	38	21	58	16.3	3.26
77	59	89	2.99	.60	37	20	57	17.0	3.40
76	58	89	3.16	.63	36	19	56	17.8	3.56
75	57	88	3.33	.67	35	18	55	18.6	3.72
74	55	88	3.51	.70	34	18	54	19.4	3.88
73	54	87	3.70	.74	33	17	53	20.3	4.06
72	53	86	3.89	.78	32	16	52	21.2	4.24
71	52	86	4.08	.82	31	16	51	22.2	4.44
70	51	85	4.28	.86	30	15	50	23.3	4.66
69	50	84	4.49	.90					
68	48	84	4.70	.94	25	12	43	30.0	6.00
67	47	83	4.92	.98	20	9	37	40.0	8.00
66	46	82	5.15	1.03	15	6	30	56.7	11.34
65	45	82	5.38	1.08	10	4	22	90.0	18.00
64	44	81	5.62	1.12	5	2	13	190.0	38.00
63	43	80	5.87	1.17	0	0	0	in-	in-
62	42	79	6.13	1.23				finity	finity
61	41	78	6.39	1.28					

[1] For CN in column 1.

TABLE A–8.—*Design thunderstorm precipitation time-sequence in 15-minute intervals*

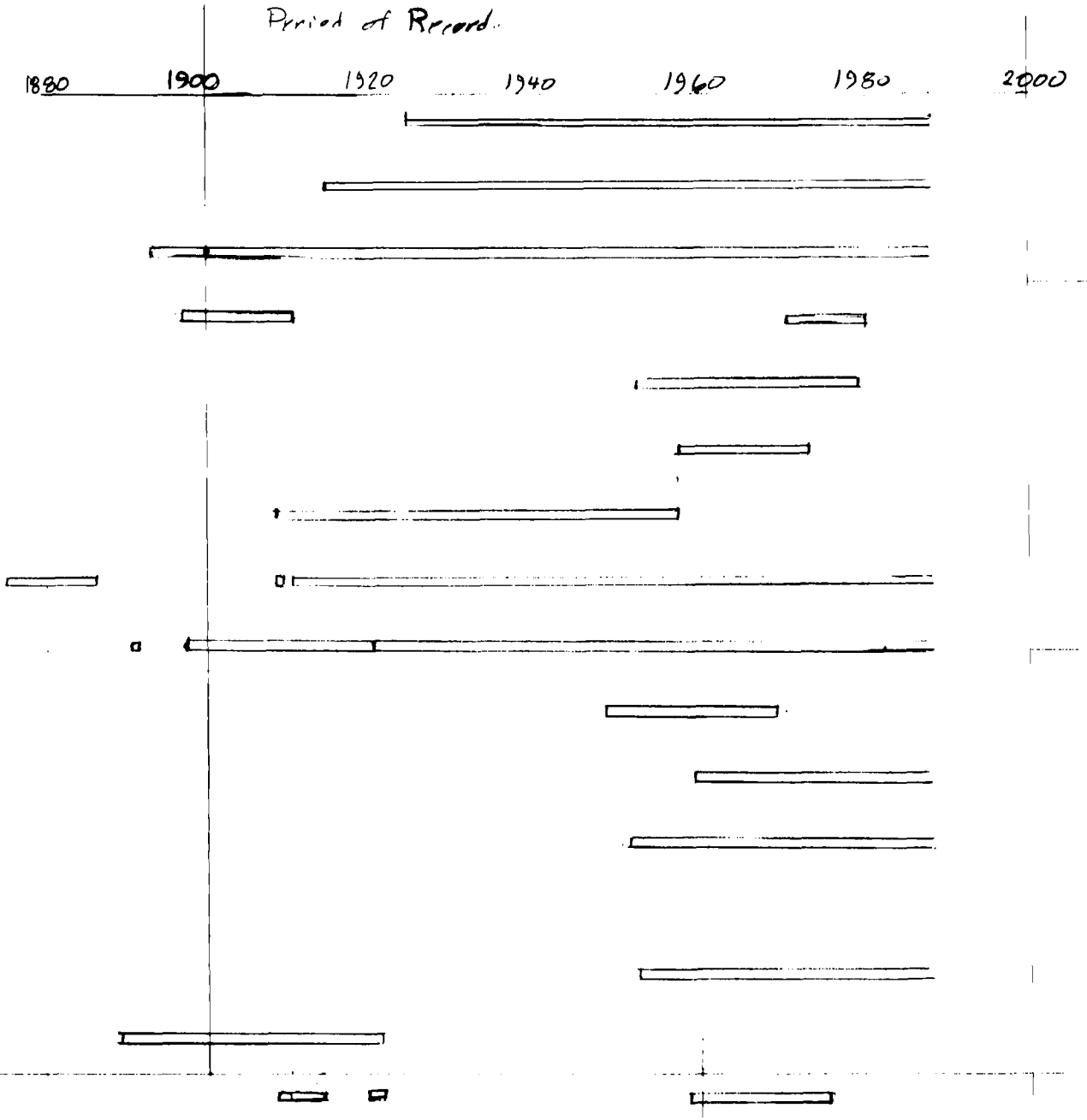
Time, hour	Order of magnitude	
	Zones I and III	Zone II
0.0	0	0
0.25	4	3
.50	3	2
.75	2	1
1.00	1	[1]4
1.25	5	
1.50	6	
1.75	7	
2.00	8	
2.25	9	
2.50	10	
2.75	11	
3.00	[1]12	

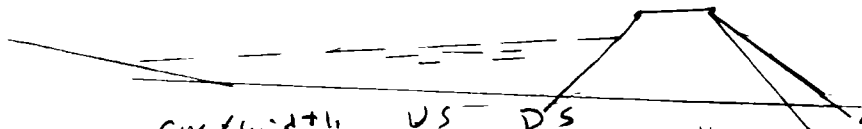
[1] Duration limit of zone rainfall.

PRECIPITATION

Centennial Wash Drainage Basin and Adjacent Stations

	Station	No. Years	Period	Max 24 hrs Inches	
		Sellers: 11:11 → 84	12/82	Mo/Year	
1	Aguila	51	5/24 – 12/82 +	3.50	8-63
2	Ajo	68	5/14 – 12/82	4.15	3.80 9-46 8/51
47	Buckeye	80	1/00 – 12/82 9/99 – 12/21	3.29	2.80 9-16 8/51
80	Congress	10	3/70 – 5/80 1/97 – 12/10	2.50	11-78
149	Hassayampa Plain 1	24	4/52 – 12/79	2.25	9-63
278	Salome	13	5/57 – 1/73	2.40	8-58
279	Salome 6E	48	1/08 – 4/57 12/07	2.60	8-09
340	Wickenburg	71	3/08 – 12/82 11/75 – 1/86	3.01	8-35
361	Walnut Grove	81	1/00 – 12/82 1/97 – 12/20	4.00	7-16
315	Stanton 7S	21	7/48 – 12/69	4.51	8-51 8/26-30
61	Castle Hot Springs	23	3/54 12/82	4.00	9-66
337	Tonopah 2S	10	9/51 – 12/82	3.05	3.09 9-62 9-84
	Tonopah 33°-28' 112°-57' 1110'	90			
43	Bouse	30	1/52 – 12/82	2.75	8-82
128	Gila Bend	77	1/00 – 12/82 7/09 – 12/21	2.61	8-51
260	Quartzsite	15	1/59 6/75 1/08 – 1/13 1/15-1/21	1.67	9-63





Tiw D 2½:1

	Crest Width	US Slope	DS Slope	H:	Length
Tiger Wash Slope: 0.00185	14.0	2½:1	2½:1	1400 / 1398 / 2	140,000± End
Hargrave Hole FRS	14.0	3:1	2:1	Slope 6'	32,500 Channel
Saddle back FRS	12.0	3:1	2:1		61000±
	Old Invert Elev		Spring Invert Elev		25732 Crest Elev
Tiger Wash	1404 / 1398+6	1392.0 +6 = 1398		1405	1413.0
Hargrave Hole		1387.3		1405.4	1420.0-1422.8 ↓ 1422.1 → 1420.6 - 1420.5 ↓ 1419 →
Saddle back		Crest 1185.7 Basin #2 1178.1 Basin #1		1176.9	Varies: 0.0400 1193.0 1194.0 @ 172+00

422+75
95+00±
324+75
+32
47+00

272+70
15+38
257+32
1045+08
433+50
611+58
Slope 1400 / 1390 / 10'

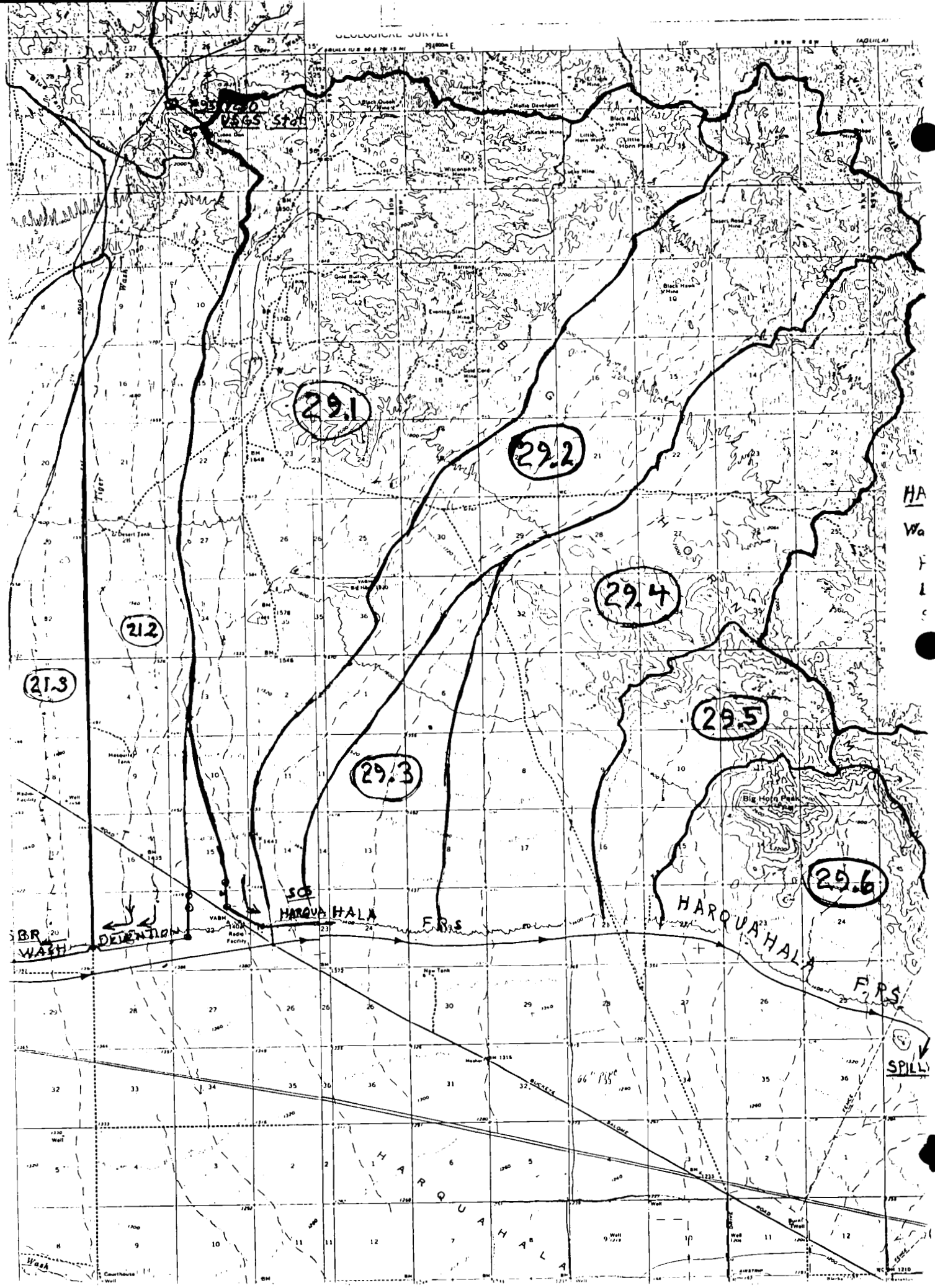
1. Cut Against Embankment Siphons & Pipe-

Over Cross Sections-
How was flow routed across CAP Canal-

2. SCS- Buckeye FRS - #1, 2, & 3.
How was This covered or was it omitted.

3. Max 24 hour Precip — Sellers Hill, Mc Rae Table 13

Aguila	(51)	3.50 (8-83)	Bouse (80) 2.75 (8/82)
Wickenburg	(71)	3.01 (8-35)	
Congress	(10)	(2.50) (11-78)	Salome LE (48) 2.60 (8/09)
Walnut Grove	(81)	4.00 (7-16)	
Stanton	(21)	4.51 (8-51)	
Castle Hot Springs	(23)	4.00 (9-66)	
" " " 4N	(9)	5.32 (8-51)	
Tonopah 2S	(10)	3.05 (9-62)	3.0 (9-85)
Hargrave Hole	(24)	2.25 (9-63	
Salome	(13)	2.40 (8/58)	


USGS Stat
29.1
29.2
29.4
29.5
29.3
29.6
21.2
21.3
SOB
HARQUA HALA
F.R.S
DETENTION
BR
WASH
HARQUAHALA
F.R.S
SPILL
66" PIPE
Big Horn Peak
Desert Tank
Mesquite Tank
New Tank
Radio Facility
Courthouse Well
Tiger
Wash

CBA - Centennial Week.

USGS - 09517490 DA - 1800 sm ± Continuous Crest Stage -

9.0 mi US Gilbertsville. Publ: >300

Max Q - 15,600 9/2/54 Precip. Topaz 9/1 3.00" Wednesday 1.35"

WY. ~~[illegible]~~ Flow natural gas.

USGS 09517500. DA = 1810 sm. Jan 1961 - Disc. 9/79

3.0 mi US Gilbertsville.

Max Q 14,500 cfs 7-23-61 1st Year of record

11,900 cfs 9-5-70

BLM 541 Centennial Week	Pg 17	1) Inner Centennial (Centre)	33°-55.1'/113°-23.1'	14 ex.	Hgt 4 1. Normal	Const.	
			3410 AF	28'	78 AF	1959	
	Crest = 6500'	Spwy Lg = 1200	Q 8500		DA.		
			33-43.4/113°-30.6'				
	pg 18	Centennial Narrows	2100 AF	35'	150 AF	1953	
	L = 1075	Spw = 300'	Q = 6700 cfs				
		Bob Crowder Memorial	33-28.5/113-43.6				
Bousfi	19	Coyote Peak	50	25'	50 AF	1965	
	L = 3367	Spw 300'	~~Rt 7000 cfs~~				

~~II~~ Climax 1-5-77 Big Dam Seepage Ht. 40' Rapid Sinkhole

7/29 ~~3~~ 0/1975 Aguila - Lucenden 3" in 5 hrs. w/ 1.06"

Aguila - 1.78 USWB. AMC - "drought [illegible]"

PAGE ① NOT TOWNS - but Communities RR Sidings - Hope & Con -

2 Towns are legal subdivision - Incorporate -

② attenuation due to ① percolation & ② overbank storage -

5. Overstated - "large portion" - "Numerous"

Centennial

1810
Above Narrows 730
Below 1080 sm
Narrows

Q = direct runoff in inches

P = Storm rainfall

10/4-8/72 JOANNE

P = 1.99

$Q = \frac{74.30}{53.3 \times 1810 \times 1080} = 0.077''$ = $1080Q = 0.129$? $= \frac{(2.94^2 - 2.94 \times .129)}{.129} = 36.66$

$1.99^2 - (1.99 \times .129)$

$\frac{Q}{P} = \frac{P-Q}{S}$ $S = \frac{P^2 - PQ}{Q}$

$= \frac{1.99^2 - 1.99 \times .077}{0.077}$

$= \frac{3.9601 - 0.1532}{.077} = \frac{3.8069}{.077} = 49.4403$

CN = 21.4

$CN = \frac{1000}{10+S} = \frac{1000}{10+49.4403} = 16.82$

(59.4402)

CBN P = 3.94
Q = 1.81

$S = \frac{3.94^2 - (3.94 \times 1.81)}{1.81} = 4.637$

CN = 65.32

Tiger Wash - 1750 cfs
85.2 sm

SCR Continental Oct 1983 93740 AF Qin = 1.045''
1682 sm.

P = 7.8

$S = \frac{7.8^2 - 7.8 \times 1.045}{1.045} = \frac{52.647}{1.045} = 50.42$

1 Canelo	5.41
2 Patagonia	5.61
3 Santa Rita	9.77
4 Tumacacori	9.54
5 Nogales	9.72
6 Ruby Stan	8.77
7 Sonoita	7.86

Area Σ = 54.68
Area 7 = 7.81

$CN = \frac{1000}{10+50.42} = \frac{1000}{60.42} = 16.55$

Area DS of Narrows Dam 1080 sm.

Sept 1976 storm $Q = \frac{8690}{1080 \times 53.3} = 0.151$

P =

SCR Lochiel 82.8 sm 93790 AF 0.001''

SCR Nogales

P/Q/S/CN

CENTENNIAL WASH. | near. Arlington.

GILA RIVER BASIN

* 09517500 CENTENNIAL WASH NEAR ARLINGTON, AZ

LOCATION.--Lat 33°16'12", long 112°47'50", in sec.7, T.2 S., R.5 W., Maricopa County, Hydrologic Unit 15070104, on upstream side of ford on former U.S. Highway 80, 3.0 mi (4.8 km) upstream from Gillespie Dam and 4.4 mi (7.1 km) southwest of Arlington.

DRAINAGE AREA.--1,810 mi^2 (4,690 km^2), approximately.

GILA RIVER BASIN

** 09517490 CENTENNIAL WASH AT SOUTHERN PACIFIC RAILROAD BRIDGE, NEAR ARLINGTON, AZ

LOCATION.--Lat 33°18'37", long 112°52'52", in SW¼NW¼SW¼ sec.28, T.1 S., R.6 W., Maricopa County, Hydrologic Unit 15070104, on downstream side of bridge, 9.0 mi upstream from Gillespie Dam and 7.2 mi southwest of Arlington.

DRAINAGE AREA.--1,800 mi^2, approximately.

PERIOD OF RECORD.--May 15, 1980 to September 1985 (discontinued). Daily discharge greater than 300 ft^3/s only published October 1984 to September 1985.

GAGE.--Water-stage recorder. Datum of gage is 841.06 ft above National Geodetic Vertical Datum of 1929 (Maricopa County flood control bench mark).

REMARKS.--Estimated daily discharges: Oct. 1 to Nov. 15, were well below the 300 ft^3/s limit. There was no daily discharge this year at or above 300 ft^3/s. Flow regulated by several small retention dams in upper end of basin. Small diversions above station for irrigation.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 15,600 ft^3/s Sept. 2, 1984, gage height, 11.34 ft, from rating curve extended above 200 ft^3/s on basis of step-back water analysis; no flow for many days each year.

EXTREMES FOR CURRENT YEAR.--No natural flow gaged for the year.

	No	WY	Date	Gage Ht.	Qcfs.	Precipitation Notes Runoff AF/yr	Rank		RANKING No	Qcfs	Date
	1	1961	7-23-61	4.70	14,500	7500	14		1	15,600	
	2	62	9-6-62	3.09	1100	522	16		2	14,500	
	3	63	--	--	Ø	Ø	22		3	11,900	
	4	64	7-31-64	3.74	2890	1950	10		4	10,900	
	5	65	2-7-65	3.27	1040	442	17		5	9,340	
	6	66	9-13-66	4.13	5500	4090	7		6	7800	
	7	67	9-5-67	3.27	1040	942	13		7	5500	
	8	68	12-19-67	4.11	5330	3390	8		8	5330	
	9	69	8-29-69	3.25	990	795	14		9	2890	
	10	70	9-5-70	4.71	11,900	8760	3		10	2040	
	11	71	8-20-71	3.91	2040	3350	9		11	1100	
	12	72	--	--	Ø	Ø	23		12	1040	
	13	73	10-7-72	4.52	9340	8920	2		13	1040	
	14	74	8-4-74	2.93	105	107	20		14	990	
	15	75	10-28-74	3.55	755	270	18		15	818	
	16	76	9-26-76	4.38	7800	5230	6		16	755	
	17	77	--	--	Ø	Ø	24		17	193	
	18	78	3-2-78	4.64	10,900	9190	1		18	191	
1810 *	19	79	1-17-79	3.53	818	729	15	7	19	105	
1800 **	20	80	8-24-80	7.89	193	NR	21	6	20	103	
	21	81	7-11-81	6.39	87	1380	11	5	21	87	
	22	82	9-11-82	7.87	191	1130	12	4	22	Ø	
	23	83	12-1-82	6.67	103	125	19	3	23	Ø	
	24	84	9-2-84	11.34	15,600	6970	5	2	24	Ø	
disc.	25	85	--	--	Ø	Ø	25	1	25	Ø	

Σ = 65792

RUNOFF Ave 25 = 263 AF

0.027" Inches.

TABLE 3

STRUCTURAL DATA - REVISED

FLOODWATER RETARDING STRUCTURES

Harquahala Valley Watershed, Arizona

Item	Unit	Harquahala FRS	Saddleback FRS	Total
Class of Structure		b	a	
Drainage Area (Total)	Sq.Mi.	102.3	29.6	131.9
Average Curve Number (1-day AMC II)		86	89	
Elevation Top of Dam	M.S.L.	1419	1194.2	
Elevation Crest Emergency Spillway	M.S.L.	1409	1190.5 3/	
Elevation Crest Principal Spillway	M.S.L.	1392.8	1179.0	
Maximum Height of Dam	Ft.	43.0	22.0	
Volume of Fill	Cu.Yd.	4,530,558	584,051	5,114,609
Length	Mi.	11.5	5.27	16.77
Maximum Bottom Width	Ft.	234	133 2/	
Top Width	Ft.	14	11	
Upstream Slope Z:1		3	3	
Downstream Slope Z:1		2	2	
Total Capacity 1/	AF	10,911	4,247	15,157.5
Sediment (50 yr.)	AF	414	120 2/	534
Retarding	AF	10,497	4,127	14,624
Surface Area				
Sediment Pool	Ac.	77	89 7/	166
Retarding Pool 1/	Ac.	1304	879	2,183
Principal Spillway Design				
Rainfall Volume (Areal, 1-day)	In.	3.87	3.98	
Rainfall Volume (Areal, 10-day)	In.	5.99	6.08	
Runoff Volume (10-day)	In.	2.61	3.22	
Capacity	C.F.S.	485	800	
Frequency Operation-Emergency Spillway	%	1.0	No Spillway	
Dimensions of Conduit	Ft.	4x4x370	10x4x85	
Tailwater Elevation	M.S.L.	1360	1178	
Type of Outlet		S.A.F.	P.W.D.	
Drawdown Time	Days	9.08	8.5	
Emergency Spillway Design				
Rainfall Volume (ESH, areal)	In.	3.49	3.81	
Runoff Volume (ESH)	In.	2.24	2.71	
Storm Duration	Hours	6	6	
Type		Concrete Chute	No Spillway	
Bottom Width	Ft.	100		
Velocity of Flow (Ve)	F.P.S.	2.18		
Slope of Exit Channel	Ft./Ft.	.02		
Maximum Reservoir Water Surface Elevation	M.S.L.	1409.9	1190.5 3/	
Side Slopes Z:1		0		
Maximum Outflow from ESH Routing	C.F.S.	400	801 6/	
Freeboard Design				
Rainfall Volume (FH, Areal)	In.	7.35	6.55	
Runoff Volume (FH)	In.	5.91	5.38	
Storm Duration	Hours	6	6	
Maximum Reservoir Water Surface Elevation	M.S.L.	1418.8	1194.2 4/	
Maximum Outflow from FH Routing	C.F.S.	9650	914 6/	
Capacity Equivalents				
Sediment Volume	In.	.0759	.0761	
Retarding Volume	In.	1.93	2.62	

1/ At crest of emergency spillway.

2/ Includes berm width.

3/ No emergency spillway. Elevation shown is that attained by routing of emergency spillway hydrograph.

4/ No emergency spillway. Elevation shown is that attained by routing of freeboard spillway hydrograph.

5/ This includes 80 AF in Basin #1, 21 AF in Basin #2, and 19 AF in area between basins.

6/ Outflow through principal spillway.

7/ Includes 55 ac. of nondraining areas.

March 1976

TABLE 3A - Revised

STRUCTURE DATA FOR DIVERSIONS, LEVEES, AND FLOODWAYS

Reach	Beginning Station	Drainage Area (Sq.Mi.)	Capacity (cfs) Req'd	Capacity (cfs) Design	Channel Dimensions: Bottom Width (ft)	Bottom Slope (ft/ft)	Depth of Flow (ft)	Side Slopes z_u	Side Slopes z_d	"n" Value Aged	"n" Value As Built	Velocities (fps) Aged	Velocities (fps) As Built	Type of Work 5/	Before Project 3/-4/
Saddleback Diversion - 4.64 mi.															
1	8+20	0	800	810	35	.0017	4.5	2	2	.035	.035	4.09	4.09 6/	I-R	O-E
2	13+36	(4 - 10'x 5', 90°, Box Culvert at Courthouse Road, L = 28')													
3	13+64		800	810	50	.000797	4.0	5	3	.035	.035	2.83	2.83	"	"
4	16+60	.30	800	857	56	.000797	"	"	"	.03	.025	2.53	3.11	I-E	"
5	23+20		1040	1663	56	.003	"	"	"	"	"	4.90	6.03	"	"
6	44+00	.86	1499	"	56	"	"	"	"	"	"	"	"	"	"
7	51+90		1499	1762	60	"	"	"	"	"	"	4.96	6.07	"	"
8	59+80		1499	1912	66	"	"	"	"	"	"	5.05	6.12	"	"
9	66+70		1499	2064	72	"	"	"	"	"	"	5.12	6.16	"	"
10	75+60		1499	2267	80	"	"	"	"	"	"	5.21	6.21	"	"
11	83+50	1.94	2197	2524	90	"	"	"	"	"	"	5.31	6.26	"	"
12	94+25		2197	3042	110	"	"	"	"	"	"	5.48	6.34	"	"
13	105+00	3.27	3029	3619	132	"	"	"	"	"	"	5.63	6.40	"	"
14	115+34		3029	3963	145	"	"	"	"	"	"	5.70	6.43	"	"
15	125+68		3029	4361	160	"	"	"	"	"	"	5.78	6.46	"	"
16	136+00	5.58	4230	5000	184	"	"	"	"	"	"	5.88	6.50	"	"
17	153+00		4230	5322	196	"	"	"	"	"	"	5.92	6.51	"	"
18	170+00		4230	5644	208	"	"	"	"	"	"	5.96	6.53	"	"
19	187+00		4230	5966	220	"	"	"	"	"	"	6.00	6.54	"	"
20	204+00	8.21	5467	6289	232	"	"	"	"	"	"	6.03	6.55	"	"
21	227+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
22	250+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
	253+00	8.65	5610	(Natural Channel Outlet)											
Harquahala Floodway - 3.43 mi.															
1	11+72	0	485	500	18	.000215	6.80	3	3	.03	.025	1.59	1.91	I-E	N-E
2	22+00		485	500	(Natural channel)										N-E
3	120+00	.96	1265	1265	(I-10 crossing, 3 - 10'x 5' C.B.C.)										M(1964)-E
4	122+10		1265	1265	35	.0090	3.61	2	2	.035	.035	7.02	7.02	I-R	O-E
	177+00	.98	1265	1265	35	.0045	4.38	2	2	.035	.035	5.59	5.59	I-E	N-E
	185+00		1265	1265	35	0.0	4.38	2	2	.035	.035	5.59	4.49	I-E	N-E
	193+00		1265	(Natural Channel Outlet)											
Centennial Levee - 9.45 mi.															
1	41+00	0	0	7540		0 1/	0 2/			.035		0		I-E	O-E
	70+00	2.44	854	"		1356	380			"		.63		"	"
	95+00	6.08	1979	"		2249	800			"		.88		"	"
	120+00	10.18	3562	"		2944	952			"		1.21		"	"
	160+00	14.91	5218	"		4208	1330			"		1.24		"	"
	180+00	15.57	5450	"		4395	1500			"		1.24		"	"
	200+00	16.24	5683	"		4697	1288			"		1.21		"	"
2	238+00	20.99	7539	"		5026	1099			"		1.50		II-E	N-E
	300+00	652-	26390	26400		7411	5100			.035		3.56		"	"
	331+00	"	"	"		9356	5000			&		2.82		"	"
	361+50	"	"	"		7533	3550			.045		3.50		"	"
	388+50	"	"	"		8466	4000			"		3.12		"	"
	416+00	"	"	"		7317	3450			"		3.61		"	"
	442+50	"	"	"		7910	4650			"		3.34		"	"
	469+00	"	"	"		8192	4470			"		3.22		"	"
	498+00	"	"	"		7616	4000			"		3.47		"	"
	525+00	"	"	"		7584	3750			"		3.48		"	"
End Levee	540+00	652	"	"		7218	3350			"		3.66		"	"

540.00
41
499.00

1/ Cross sectional area below hydraulic grade line, (Ft.^{2}).

2/ Wetted perimeter below hydraulic grade line, (Ft.).

3/ N - An unmodified, well defined natural channel or stream.
M() - Manmade ditch or previously modified channel (approximate date of original major construction).
O - None or practically no defined channel.

4/ Pr - Perennial - flows at all times except during extreme drought.
I - Intermittent - continuous flow through some seasons of the year but little or no flow through other seasons.
E - Ephemeral - flows only during periods of surface run-off, otherwise dry.
S - Ponded water with no noticeable flow - caused by lack of outlet or high groundwater table.

5/ I - Establishment of new channel including necessary stabilization measures.
II - Enlargement or realignment of existing channel or stream.
III - Cleaning out natural or manmade channel (includes bar removal and major clearing and snagging operation).
IV - Clearing and removal of loose debris within channel section.
V - Stabilization as primary purpose (by continuous treatment or localized problem areas - present capacity adequate).

E - Earth channel.
R - Rock riprap channel.

6/ 10YR-24HR storm depth = 3.0' (low flow channel).

March 1976

Previous T-1 to not HEC-1 UD - 1989 Rev...

TABLE 1

CENTENNIAL WASH

PARAMETERS USED IN THE HEC-1 ANALYSIS

Drainage Sub-Basins	Drainage Area (square miles)		Lag Time (hours)		Curve Number	Precipitation (24 hrs. - 100-yr.) (in.)
1	67.0	6.77	5.80	3.43	78.0	3.88
2	185.0	9.96	15.70	2.44	81.0	3.88
3	43.0	5.64	4.81	2.62	80.0	3.88
4	40.1 { 21.6	3.13	3.27	2.03	81.0	3.88
4A	18.5		3.40	↓	81.0	3.88
5	48.7	2.84	2.90	1.92	79.0	3.88
6	23.7	2.75	2.59	1.75	81.0	3.88
7	44.7	3.51	4.01	2.53	79.0	3.88
8	47.5 { 31.3	2.95	2.89	1.97	80.0	3.88
8A	16.2		2.33	↓	80.0	3.88
9	52.2	2.84	3.02	1.77	80.0	3.88
10	17.0	3.10	2.50	1.72	79.0	3.88
11	20.2	5.79	3.04	2.36	78.0	3.88
12	20.5 { 10.6	2.77	1.98	1.53	79.0	3.88
12A	9.9	↓	1.62	↓	79.0	3.88
13	68.7	6.87	3.96	2.81	78.0	3.88
14	13.7	1.00	0.71	1.0	84.0	3.88
15	18.6	4.65	3.41	2.23	79.0	3.88
16	19.7	4.50	1.59	2.05	82.0	3.88
17	21.0	5.50	1.98	2.32	80.0	3.88
18	24.4	6.59	2.89	2.97	80.0	3.88

Table 1 Previous Lag. Quicker Slower. If use Jannet UD MCFCD El Comm. PB PC Dropped Decimal

Structures

			Crosstieu AF	Maywski	Data
1. Ritter Dam	mentioned in text	pg 7			NO
2. Seven detention structures 7/29-30/1971	Bam	pg 7			NO.
3. Narrows Dam	(16)	pg 9	25386 / 2900		KK 192,3
4. Tiger Wash	Fig 3	pg 9	1410 / 15428		KK 255,6
5. Hargrave Lake	FRS (29)	Fig 3	pg 9	1411 / 14200	KK 355,6
6. Centennial Lake. Rehj. No.	Fig 3	pg 9			∅
7. Saddle Back	FRS (30)	Fig 3	Pg 9	1197 / 10500	KK 402,3
8. Old Crapp Lake (35) Lake	Fig 3	pg 10 Casual.	16 / 1344 AF		KK 455,6
9. Eagle Tail Reg.	Res 26 (27)	Fig 3	pg 10	12570 / 2355	KK 347,9

MCFCD
7 further subdivide
4, 6, 8, 10, 12, 21, 35
DID
DID NOT

TABLE 1 (Cont.)

CENTENNIAL WASH

PARAMETERS USED IN THE HEC-1 ANALYSIS

No change

Drainage Sub-Basins	Drainage Area (square miles)		Lag Time (hours)		Curve Number	Precipitation (24 hrs. - 100-yr.) (in.)	
19	10.6	3.56	1.18	1.41	77.0	3.88	PB PC
20	50.7	6.28	6.63	4.03	80.0	3.88	
21	76.8	12.50	7.00	5.85	84.0	3.88	
21A	84.4		7.20	↓	84.0	3.88	
22	25.1	2.95	2.51	1.56	79.0	3.88	
23	7.9	6.00	2.00	1.55	77.0	3.88	
24	11.2	6.77	2.51	1.80	77.0	3.88	
25	24.9	9.30	4.21	2.37	77.0	3.88	New PB
26	42.4	5.60	3.19	2.36	79.0	4.12	Same PC
27	62.1	9.30	4.35	3.13	77.0	4.12	
28	84.4	17.80	15.06	4.48	75.0	4.12	
29	101.3	7.55	4.85	2.24	83.0	3.93	Same PC
30	28.6	0.78	4.75	0.78	78.0	3.93	
31	12.0	0.76	0.96	0.76	86.0	4.12	
32	52.4	5.38	5.05	2.69	79.0	3.93	
33	47.0	4.51	4.00	2.20	80.0	3.93	
34	64.3	6.20	4.64	2.65	81.0	3.93	
X 35	99.6	2.70	4.73	2.70	87.0	3.93	
X 36	163.1	5.40	12.25	5.4	79.0	3.93	
37	45.8	4.33	4.43	2.43	83.0	3.93	

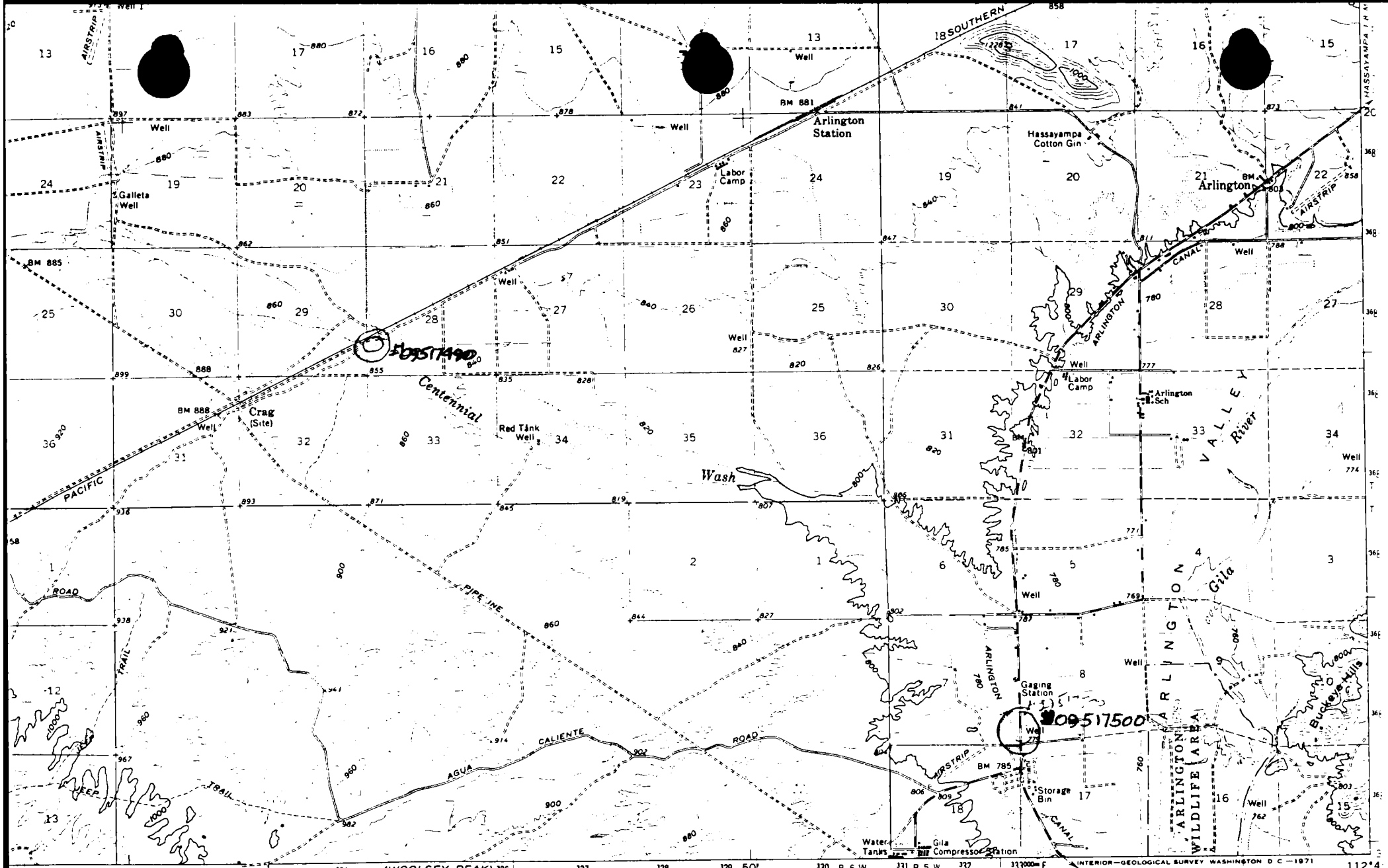
X – Did not Breakdown as MCFCD Said to Do

P	Sm	(AF)	AF
3.88" x	1067.3	= 56922.1	220859.95
	203.9		45643.69
4.12 x	[illegible]	= [illegible]	41507.63
3.93 x	6022.1	= 32112.9	126200.16
min. = 3.937	18070.30		392703.80 AF

640 / 12 x 18070.30 = 53.33 x 18070.30

1 = 12

160,725 = 1.812"



THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225 OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

Table 1.--Regression equations for flood magnitudes at selected recurrence intervals and corresponding standard error of estimate

Q: Flood magnitude in cubic feet per second for indicated recurrence interval.
A: Drainage area in square miles.
E: Mean basin elevation in thousands of feet above mean sea level.
P: Mean annual precipitation in inches.

Equation	Standard error of estimate, in percent	
REGION 1—NORTHWEST PLATEAU AREA (17 STATIONS)		
$Q_2 = 19.0A^{0.660}$	93	
$Q_5 = 66.3A^{0.600}$	81	
$Q_{10} = 127A^{0.566}$	80	
$Q_{25} = 252A^{0.532}$	83	
$Q_{50} = 393A^{0.510}$	86	
$Q_{100} = 584A^{0.490}$	91	
$Q_{500} = 1,300A^{0.451}$	105	
		Centennial 1810 Sm
REGION 2—SOUTHWEST DESERT AREA (26 STATIONS)		
$Q_2 = 87.0A^{0.433}$	76	2239.
$Q_5 = 218A^{0.462}$	53	6974
$Q_{10} = 352A^{0.475}$	53	12415
$Q_{25} = 586A^{0.487}$	62	22615
$Q_{50} = 815A^{0.494}$	72	33148
$Q_{100} = 1,100A^{0.499}$	83	46449
$Q_{500} = 2,000A^{0.509}$	111	91031

CDA. Hoquiam - Saddleback

ID.	DA	Length.
Subarea 29.	101.30	

Route 29 ⇒
Hoquiam FRS.

Hoquiam Flooding
Sta. 14+18.5
Pg 83

Route ⇒ R18
29 thru Reach 18

SCS FIS 18,128 FT.
CBA. 31771. ft.

Sta 193+00
11+72
181 28 ft.

6.017 miles

Hydrograph @ Sta. 15 (This is on Centennial Creek)
to CP 15

SCS Hoquiam Flooding. from dam to Sta. 0+00
(Geology Rep.)

AP Flooding - Sta 195+00± + 500 = 195+80

79042
610+55
179+54

Saddleback Dam. 272+70 − 5+83. = 266+87 ℄ on 272+70 − 3+00 = 269+70

Saddleback Flooded Diversion 250+00 − 0+00 = 25,000 Begins

Subarea
Reach 30 28.6

Route 30 thru Saddleback - 28.6

Saddleback Diversion
Route 30 thru R19

28.6 + 8.65

SCS 253+00 − 8+20 = 244+80

CBA. 43,229 ft.

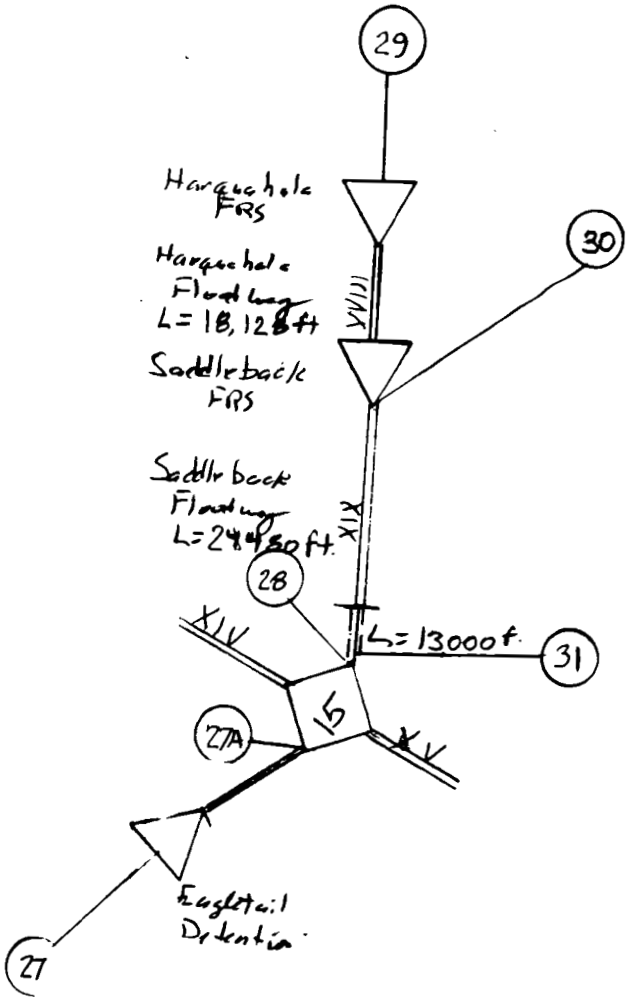
pg 87 Combine 1-31 w/ 29930 1392.10
24500 ft.
SCS Σ DA = 140.6 sm 4.64 mi²

Route 1-31 ⇒ R 15 20833

1-18-89
6

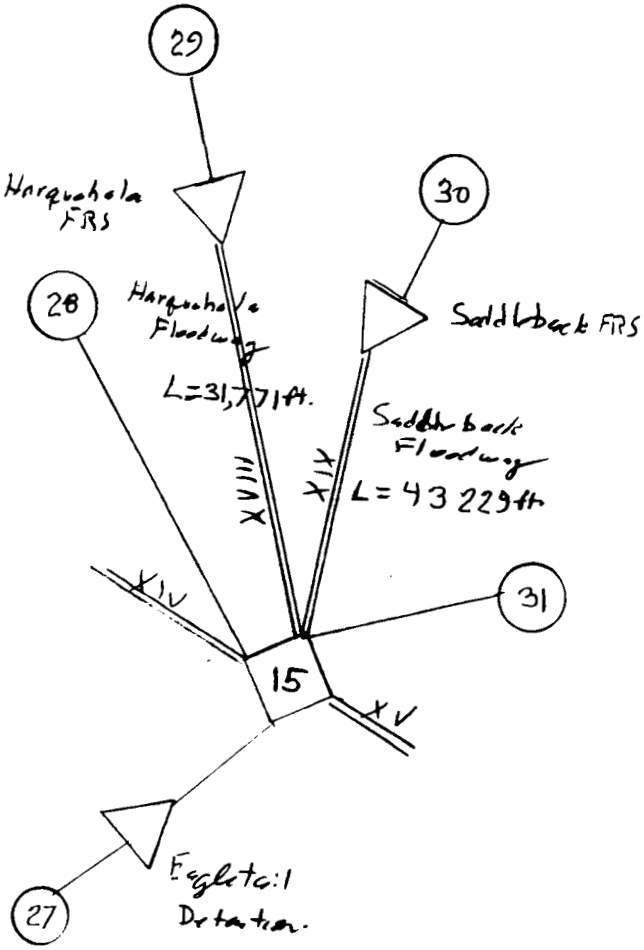
Harquahala - Saddleback FRS & Floodways

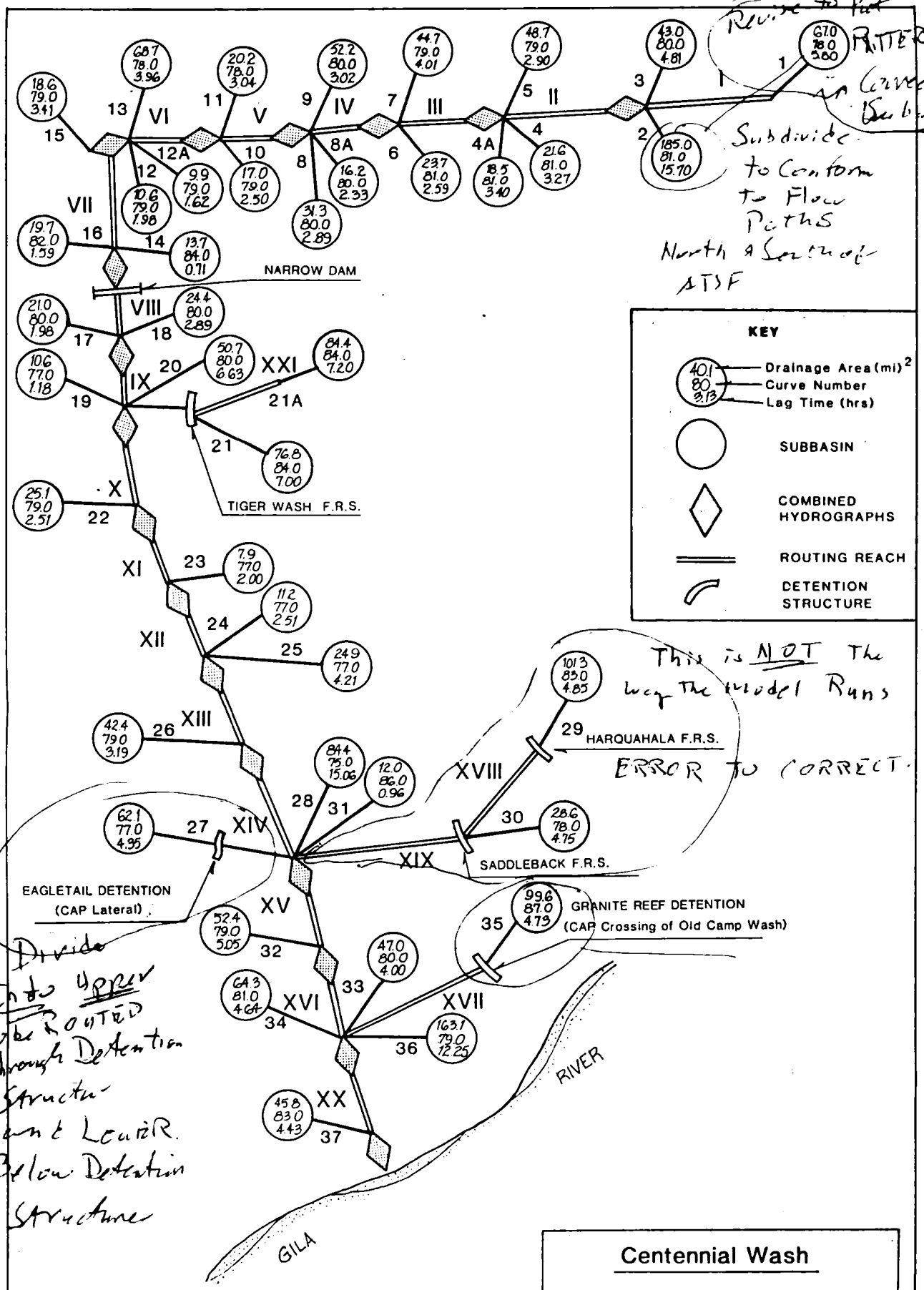
Should be



CBA Model

Is INCORRECT





Centennial Wash

SCHEMATIC OF THE BASIN LOGIC USED IN HEC-1

CELLA BARR ASSOCIATES
2076 North Sixth Avenue
Tucson, Arizona 85705
(602) 624-7401

JOB NO. 04856-03-74 JANUARY 1989

Soil Types/Groups (Hydrologic)

1-19-84

G

__B __A

__C

__D

Yavapai: Camber

Sheets.

147 Mt WgC Vm

137 (Continued) CuC, (Cave) CID (Graham) GrB (Graham) GsE (Anthony) ApB (Whitlock) WgC Vm ArA Rock land (Inverable) Br CrF

148 (Whitlock) WgC, (Vekol) Vm (Anthony) ArA B CrF, (Mohave) Mt (Lutene) Lc, CuC (Graham) GsE

157 Vm Mt (Anthony) ArA (Continued) CsC CrF, CrF (Anthony) ApB, (Gila) Go Lh (Continued) CuD

158 (Vekol) Vm, (Mohave) Mt, (Lutene) Lc, Lu CgC (Anthony) ArA, (Cellar) CrF, (Cave) CID, (Continued) CsC, CrF CuD ApB WgC

166 ArA Mt - ApB, CsC, Sa, Mt CrF, ArA Vm, (Gila) Go, (Rock) Br, CuD Lutene Lc (Anthony) ApB.

167 Vm CrF ArA, (Cave) CIP (Cellar) CsC Mt, (Lutene) Lc

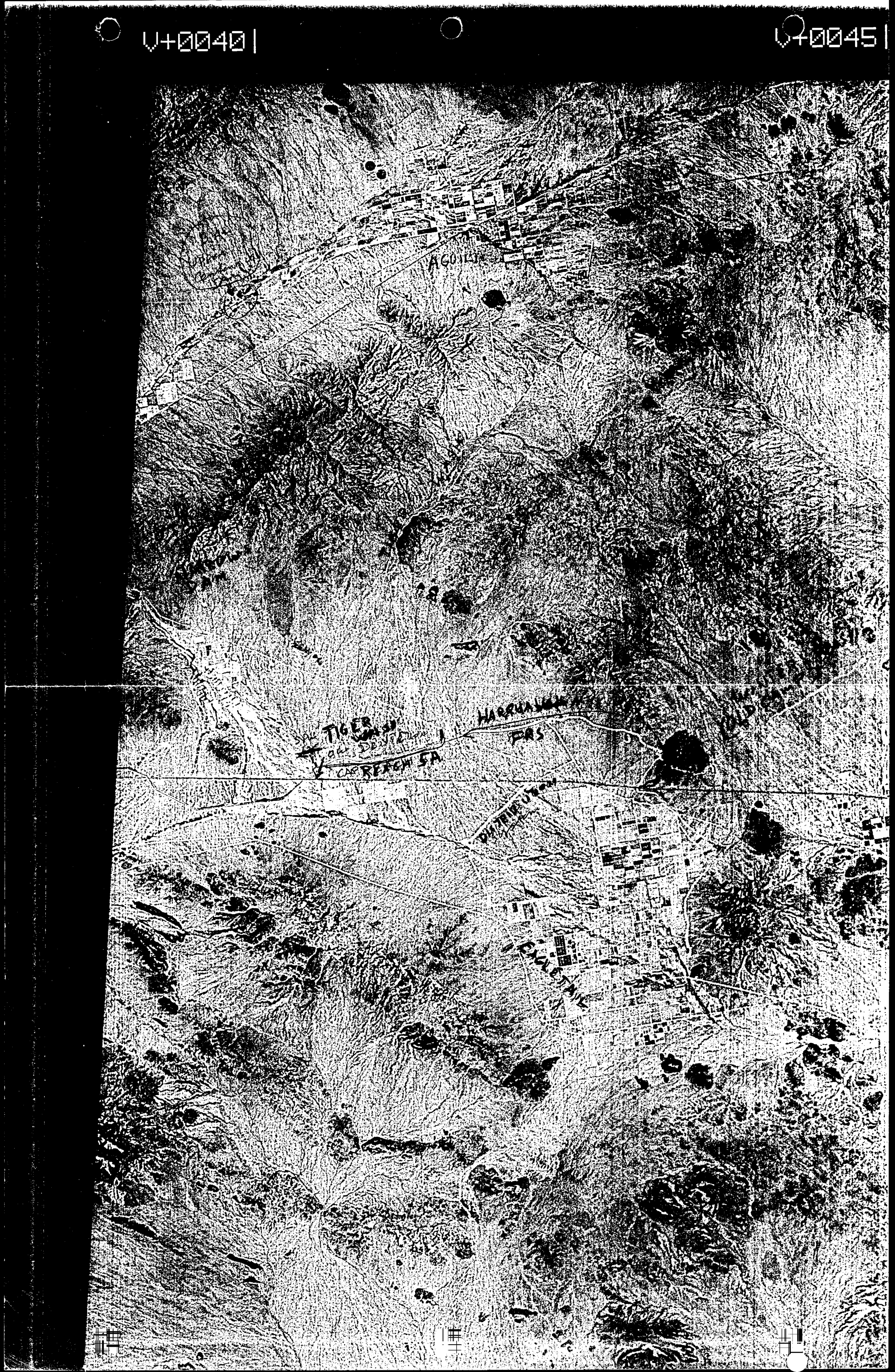
156 (Continued) CuD, (Cellar) CrF, (Continued) CsC, ArA, (Lehman) Lh, (Cellar) CsC (Cellar) CoD Br Lr Lh

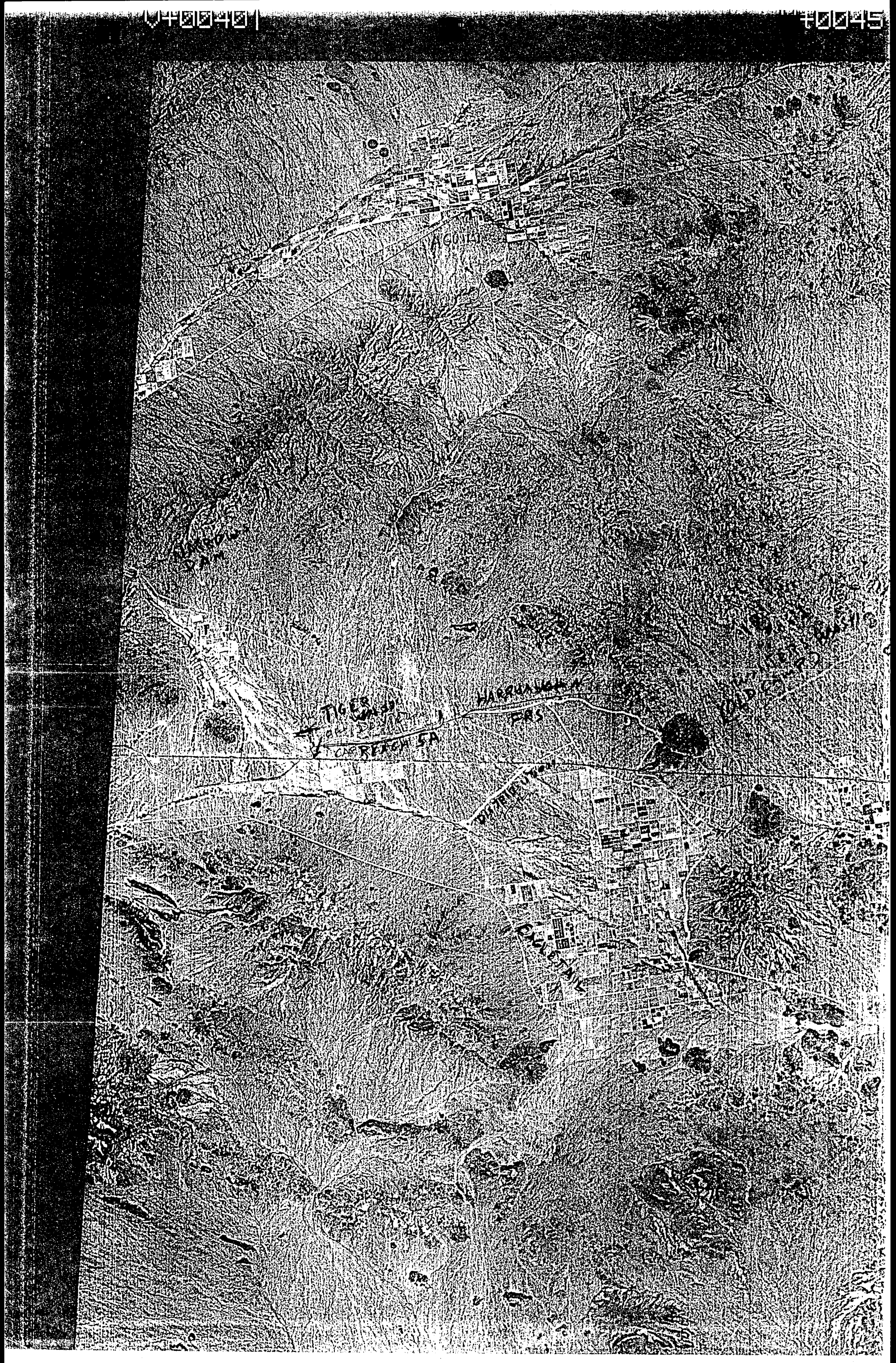
159 (Cellar) CrF Sa Vm CsC (Lutene) Lc CrF

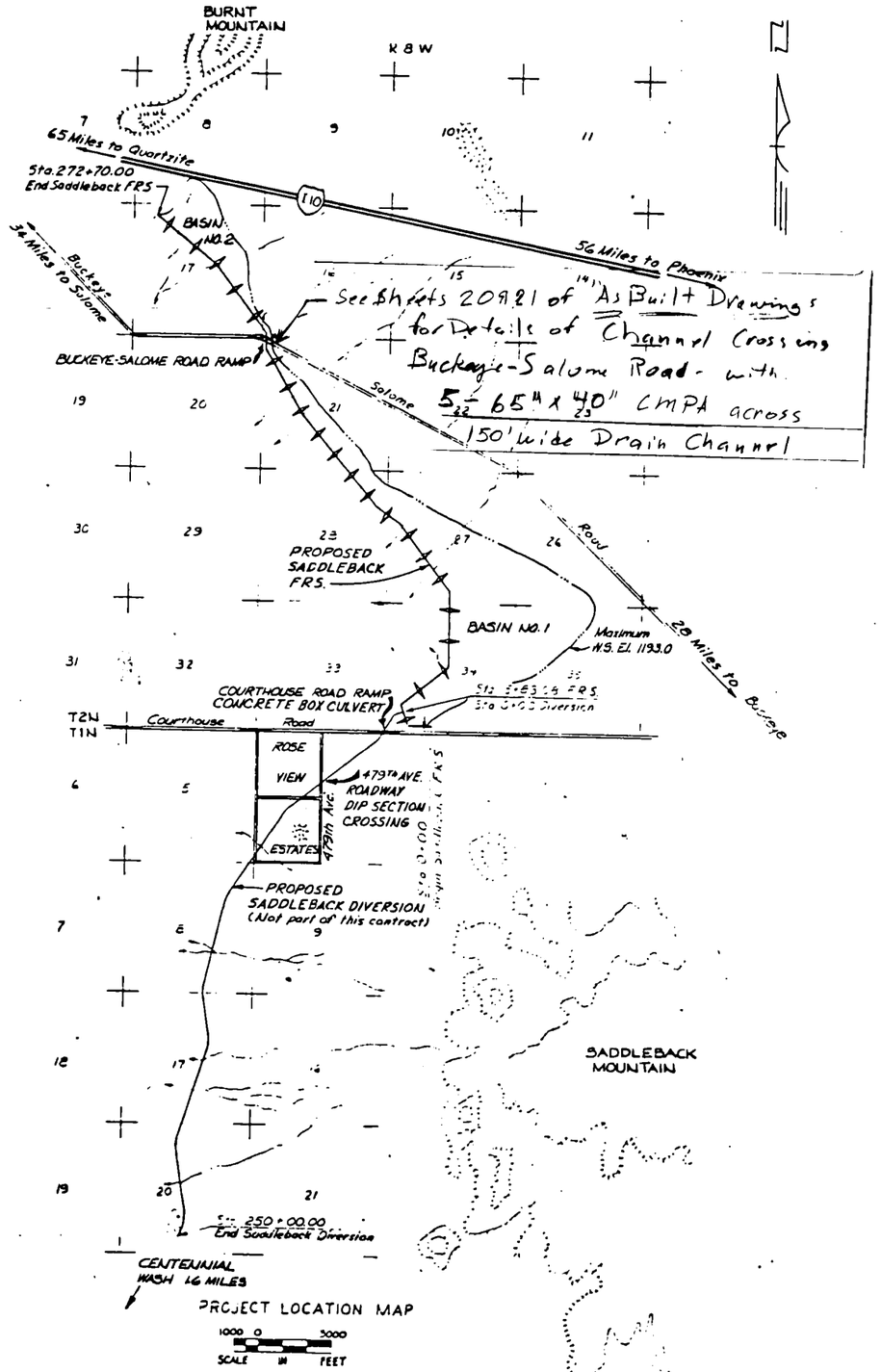
WARNING MESSAGES

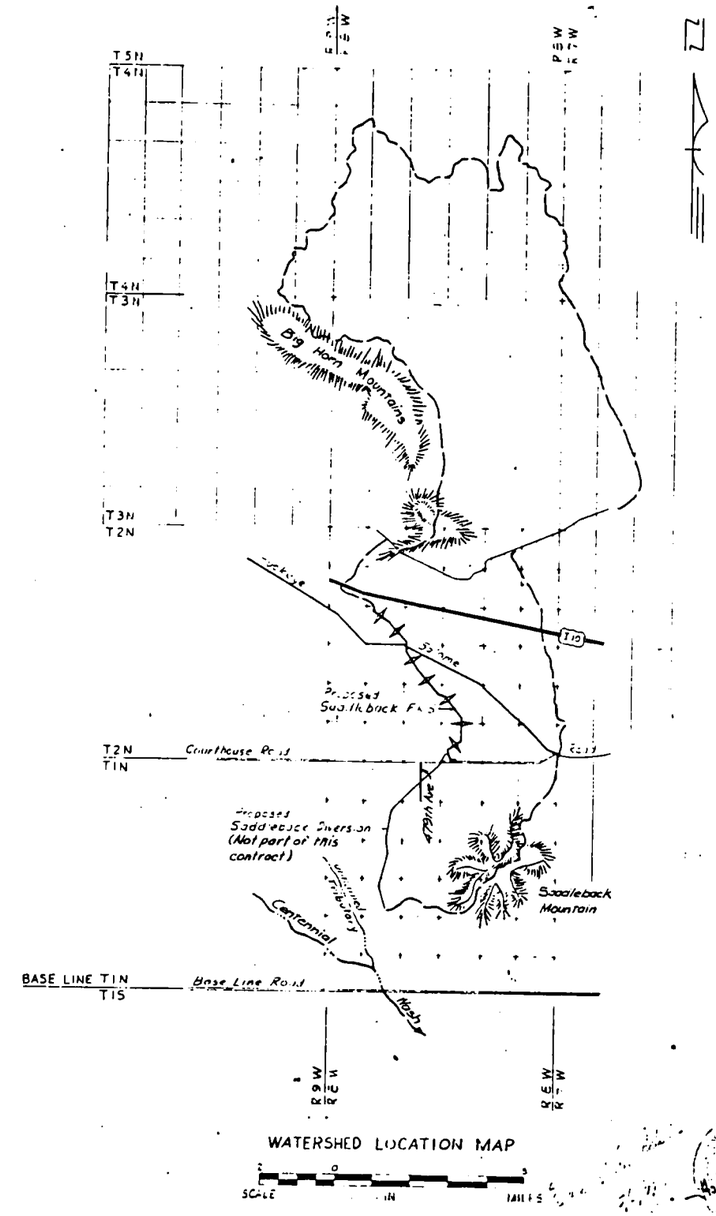
0.5 Hrs
30 minute Comp Interval

	Saddleback (30)	April DA 22.26					
		McFCD 28.60					
		CBA 29.60					
	Harquahala McFCD	102.3					
(29)	CBA	101.30	1	53500	10	8441 - 37097	7110
2			2	34375	8	11853 - 37791	16451
3			3	18750	10	969 - 73,435	19501
4			4	38541	10	5679 - 41,979	26730
5	OT 1.47'		5	18,229	6	330 - 23752	36.672
6			6	26,042	6	12024 - 78251	38617
7	OT 7.33'		7	26562	6	838 - 1290	44034
8 N/	OT 4.83' NARROWS DAM			← RESVOR →		0 - 160	44251
9	OT 0.99'		8	49479	10	875 - 33805	43685
10			9	17708	4	9016 - 249381	44836
NONE			21	63400	6	— — — —	9161
11		(No OT.) TIGER WASH DAM.		RESVOR 15428 AF @	1410.	0 - 903	7509
12			10	19271	10	707 - 230223	51882
13			11	10,937	2	53874 - 156098	52,220
14			12	17,708	4	18045 - 216831	52,163
15	OT 1.99'		13	21354	6	22852 - 76781	52664
16			14	46354	14	1662 - 136501	52167
None OT	OT 3.18' EAGLETAIL			RESVOR	—	—	952
17		@CP15/(18)		31771	6	233 - 2927	340
None	Saddleback Dam			RESVOR	—	—	700
18		19/Sta 16		43229	12	216 - 11504	
19		15/Sta. 17		20833	4	4350 - 150104	58088
20	OT. 3.44	16/Sta. 18		58333	14	297 - 16443	57432
OT-2.29'	Old Comp Debatin			RESVOR			
21		17/Sta 19		105600	24	2585 - 14690	6175
None	OT 2.26'	20		30729	6	— — —	67261


V+0040
V+0045
AGUILA
TIGER WASH
HARQUAHALA
FRS
REACH 5A
EAGLE TAIL


AGUILA
TIGER WASH
HARQUAHALA
FRS
CARREFOUR 5A
DISTRIBUTION





AS BUILT

DATE MAY 1982

LOCATION MAP

SADDLEBACK F.R.S.

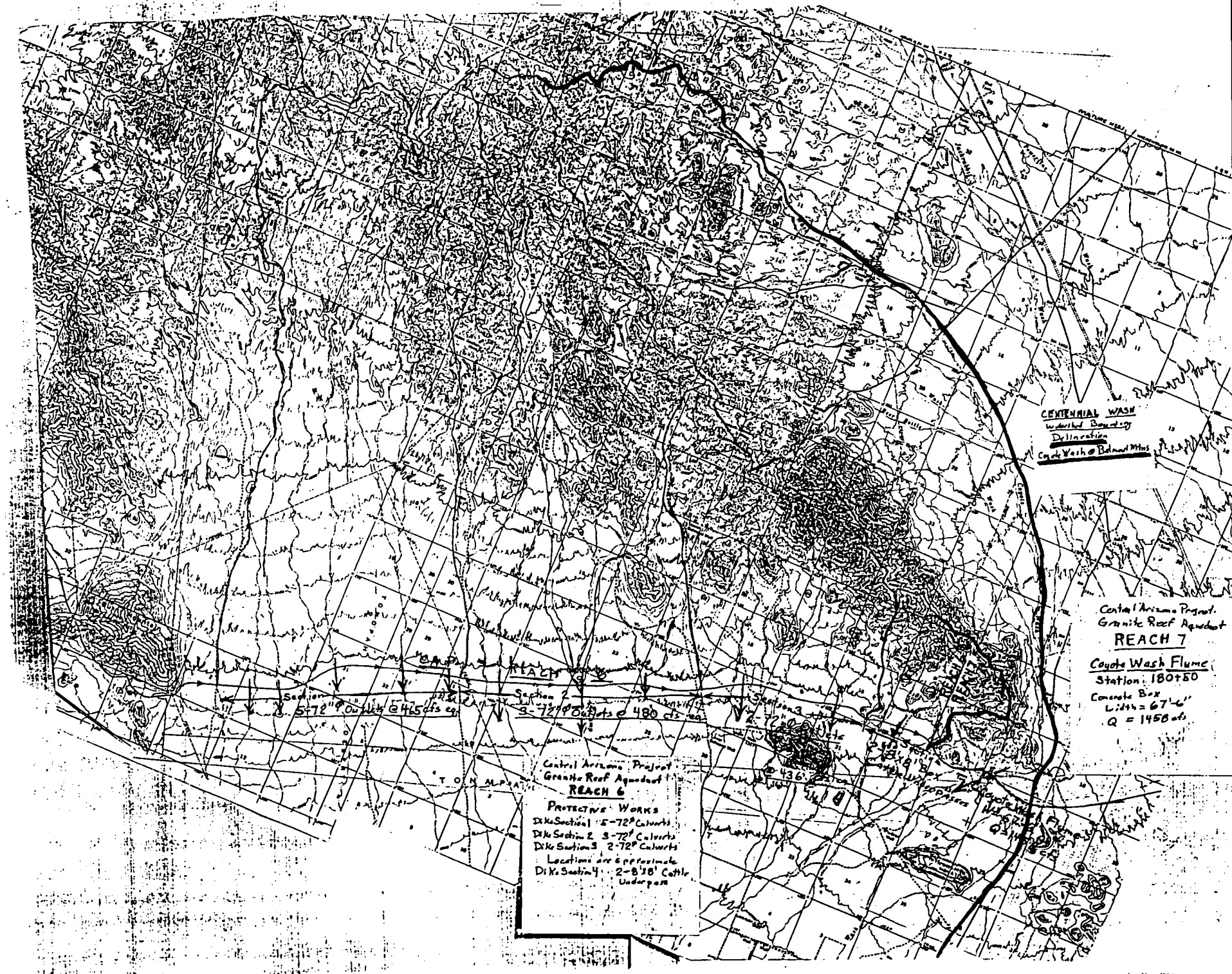
HARQUAHALA VALLEY W.P.P.

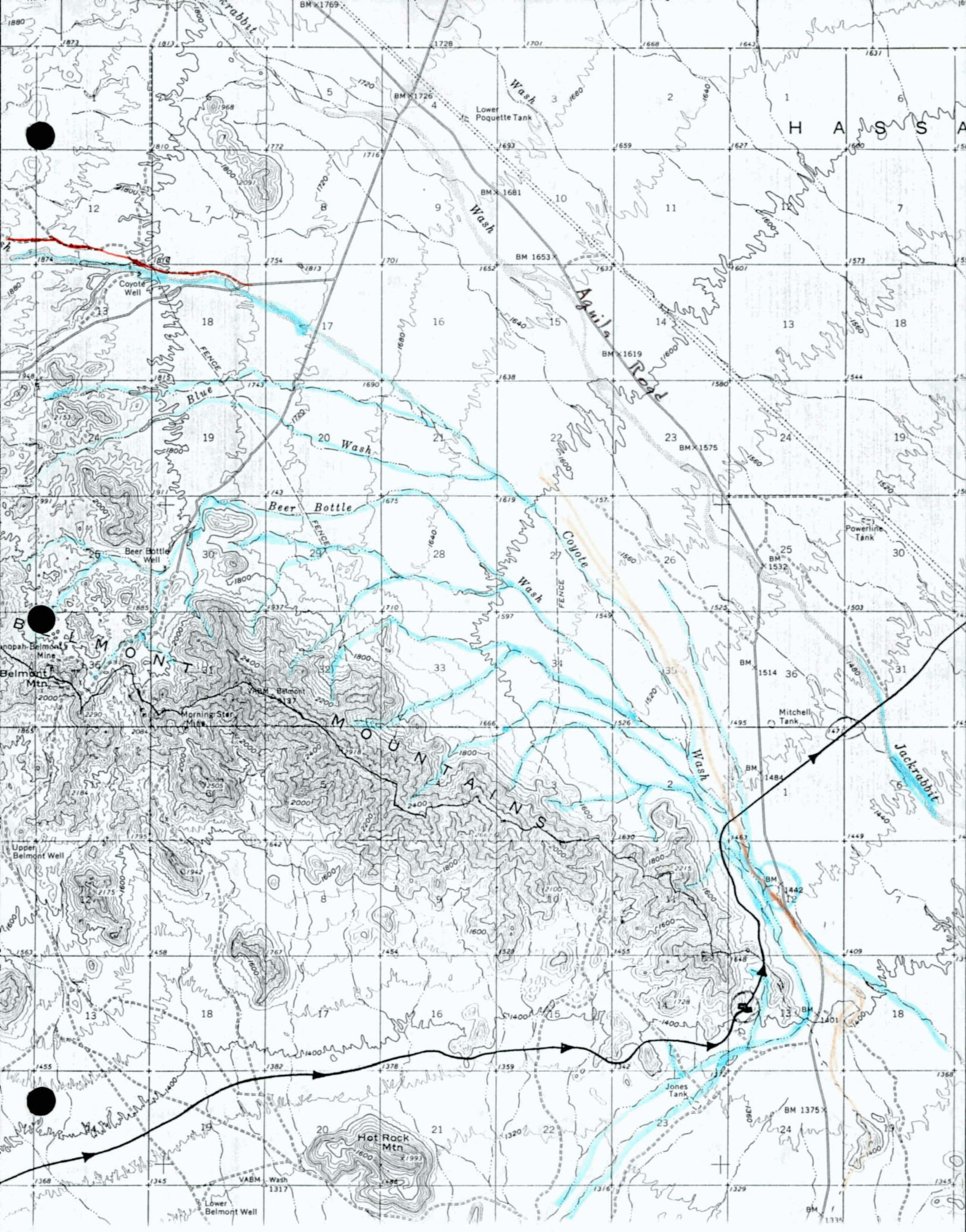
MARICOPA COUNTY ARIZONA

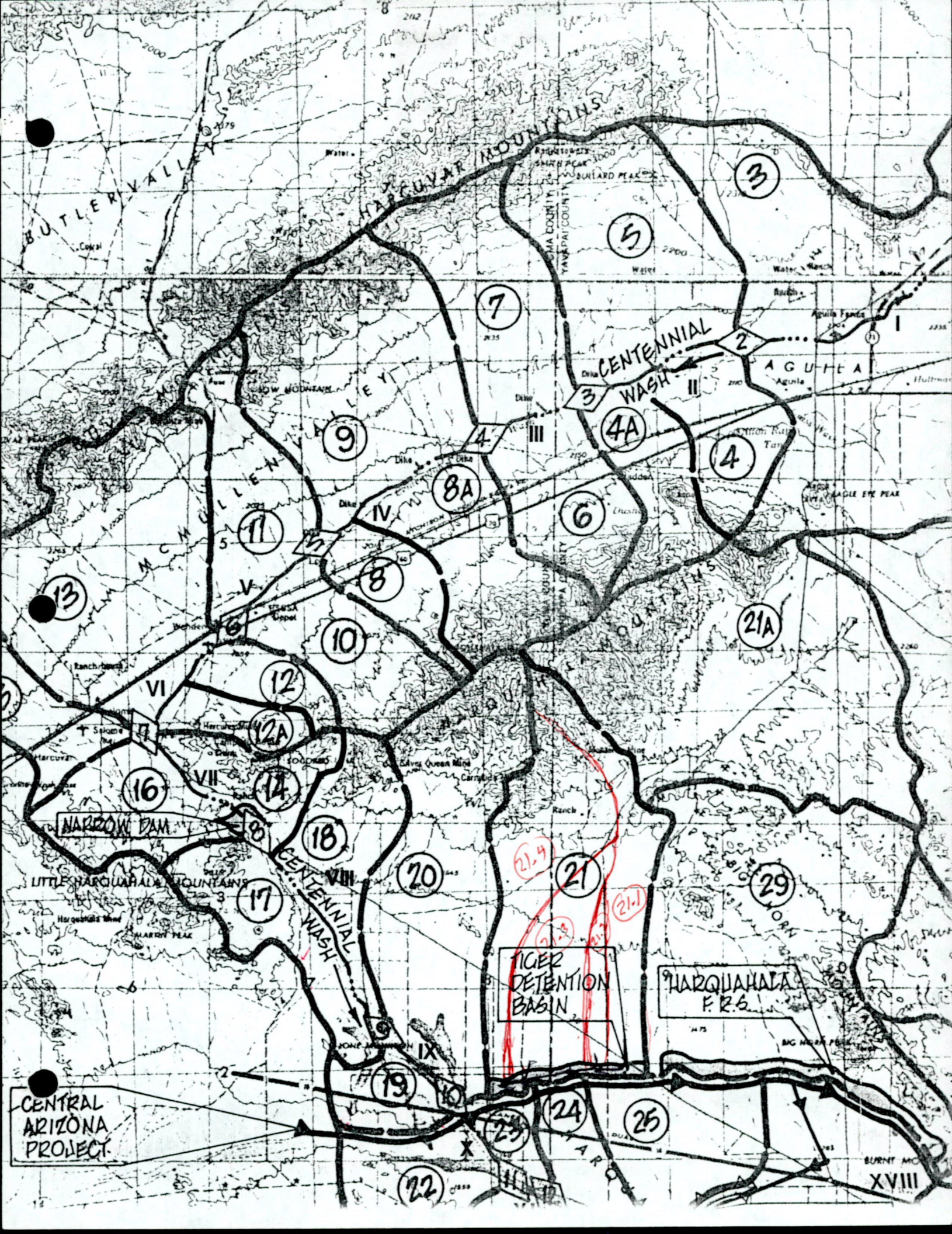
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

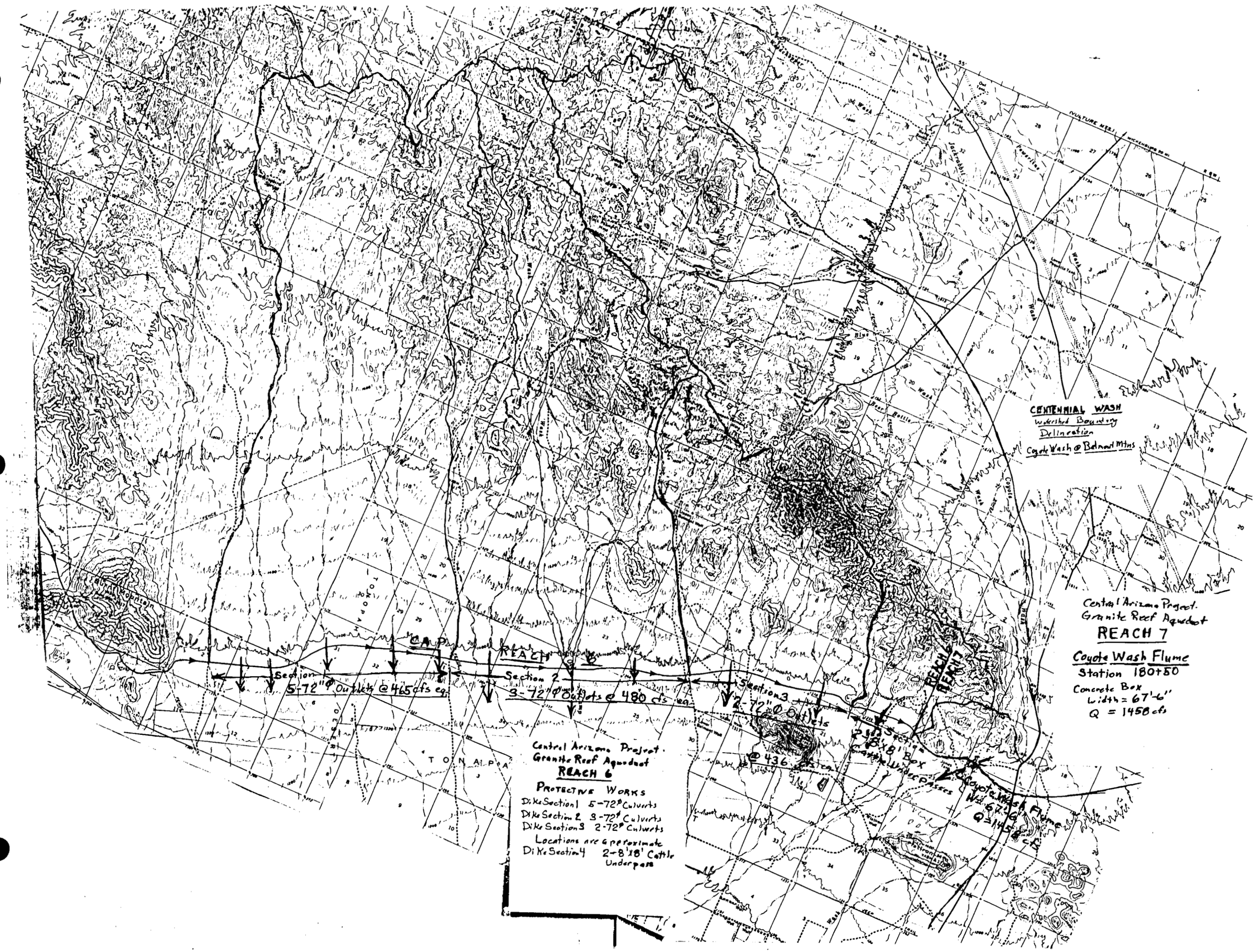
Designed A.P.	Date 5-78	Approved by	
Drawn L.J.C.	11-78	Title	
Traced		Title	
Checked E.A.A.	11-78	Sheet No. 2 of	Drawing no. 7-E-24039

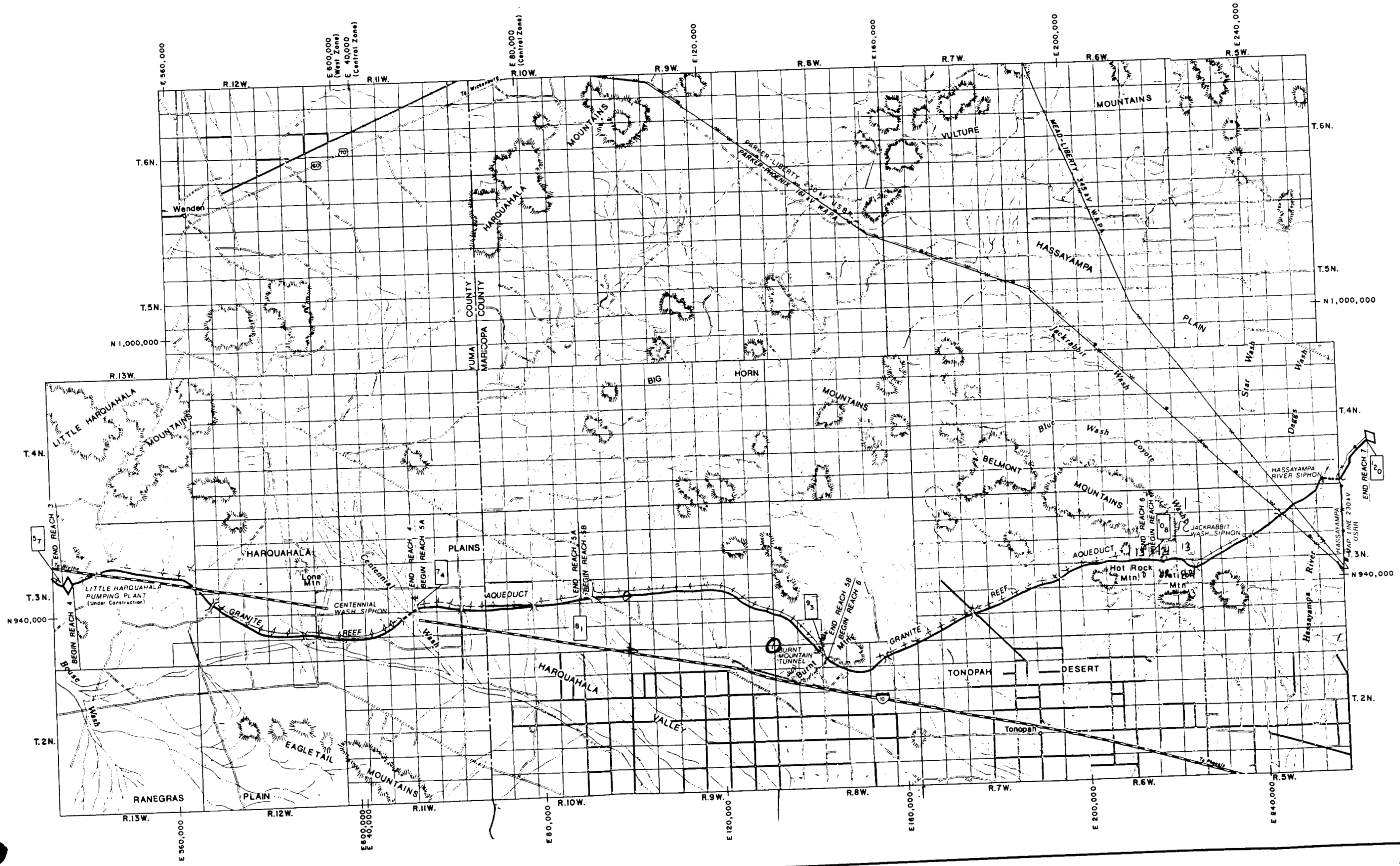
52 FORM SCS-313C

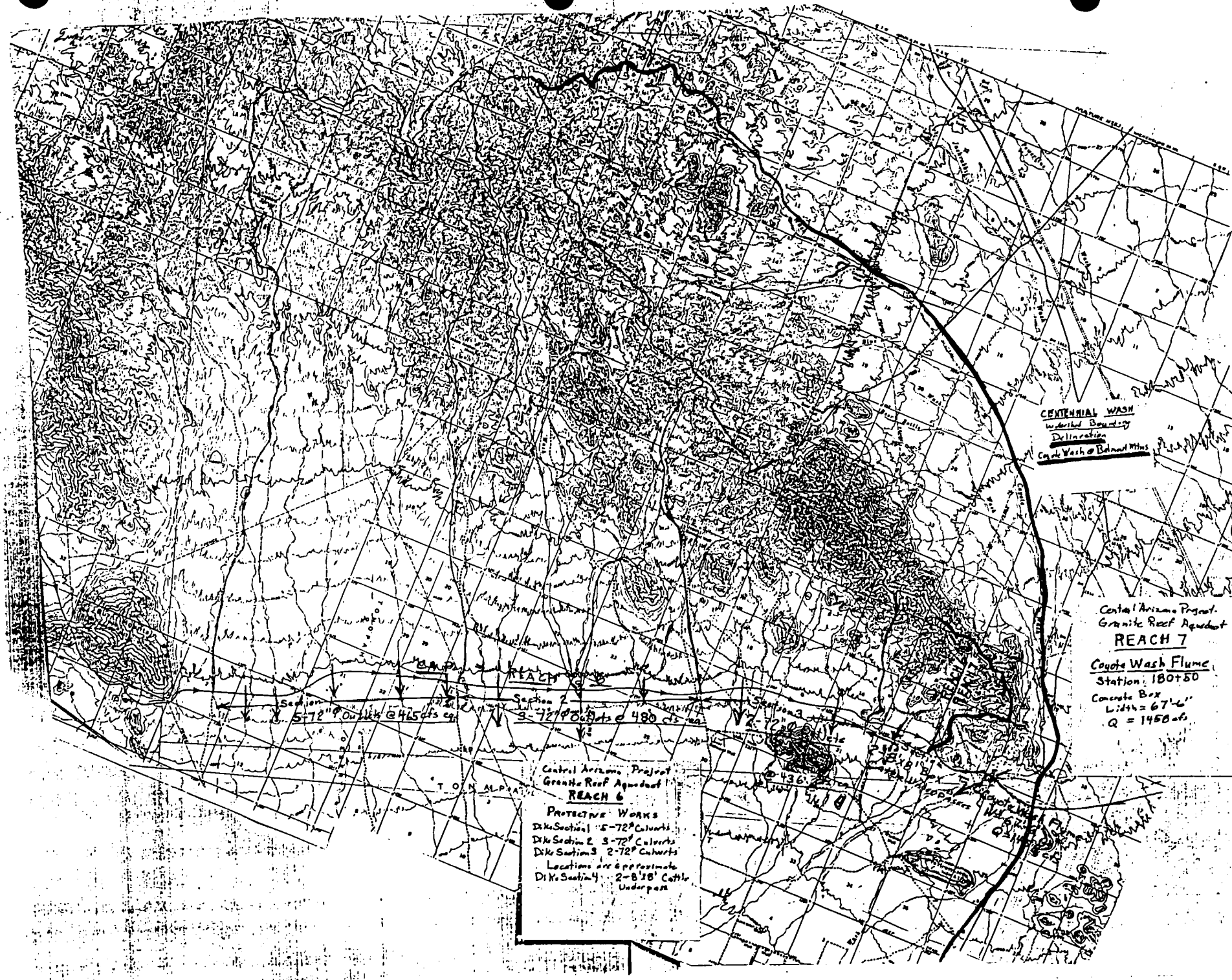

CENTENNIAL WASH
Watershed Boundary
Delineation
Coyote Wash @ Belmont Mtns
Central Arizona Project
Granite Reef Aqueduct
REACH 7
Coyote Wash Flume
Station: 180+50
Concrete Box
Width = 67'-6"
Q = 1450 cfs
REACH 6
Section 1
5-72" ϕ Outlets @ 465 cfs ea
Section 2
3-72" ϕ Outlets @ 480 cfs ea
Section 3
2-72" ϕ Outlets
Central Arizona Project
Granite Reef Aqueduct
REACH 6
PROTECTIVE WORKS
Dike Section 1 5-72" Culverts
Dike Section 2 3-72" Culverts
Dike Section 3 2-72" Culverts
Locations are approximate
Dike Section 4 2-8'x8' Cattle Underpass
436

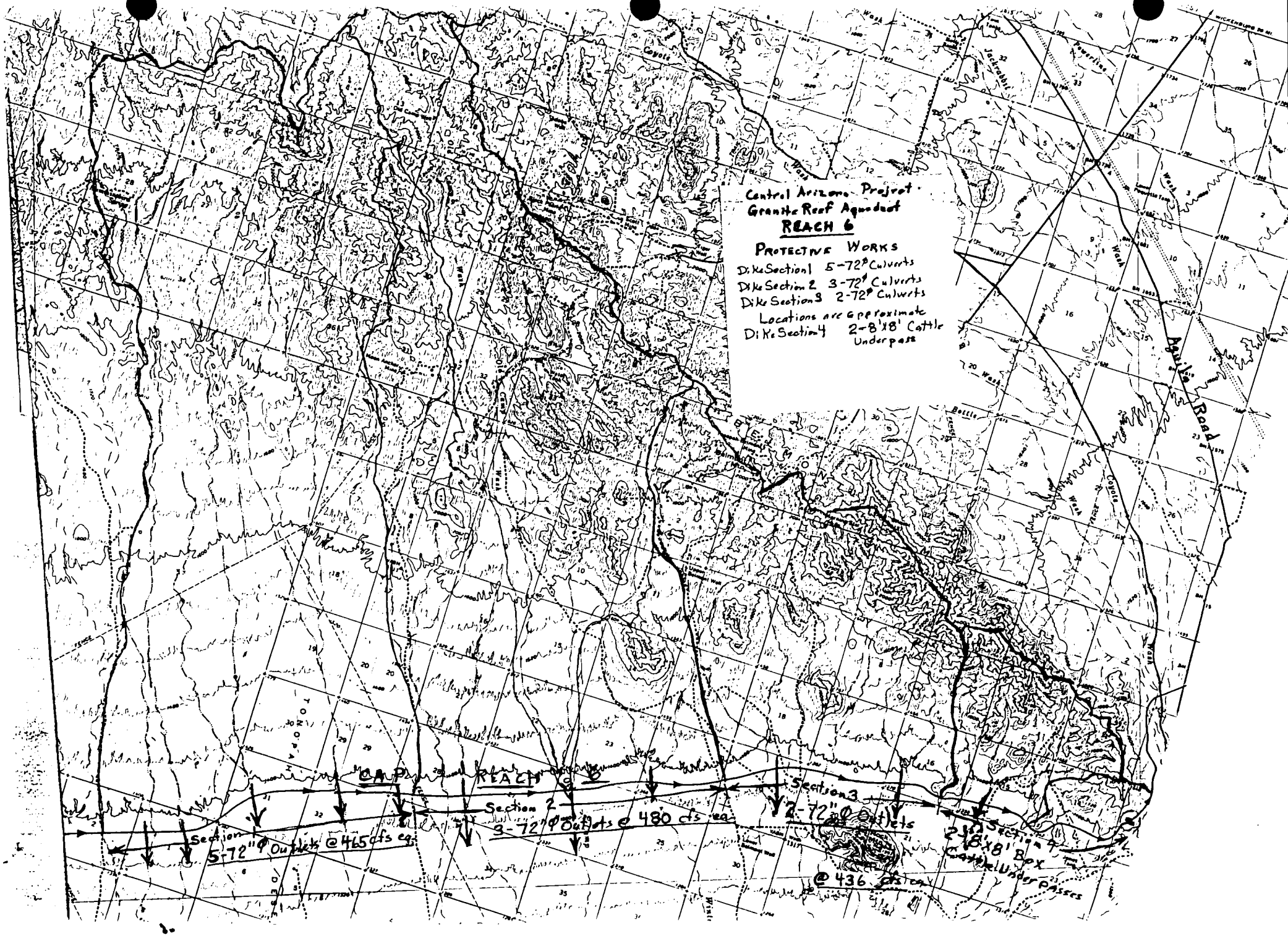

BM 1769
Jackrabbit
BM 1726
Lower Poquette Tank
Wash
H A S S A
BM 1681
Wash
BM 1653
Coyote Well
Aguila Road
BM 1619
FENCE
Blue
Wash
BM 1575
Beer Bottle
FENCE
Beer Bottle Well
Coyote
Wash
FENCE
Powerline Tank
BM 1532
B E L M O N T
Belmont Mtn
Morning Star Mine
M O U N T A I N S
Mitchell Tank
BM 1514
Wash
Jackrabbit
BM 1484
Upper Belmont Well
BM 1442
BM 1401
Jones Tank
BM 1375
Hot Rock Mtn
VABM Wash 1317
Lower Belmont Well

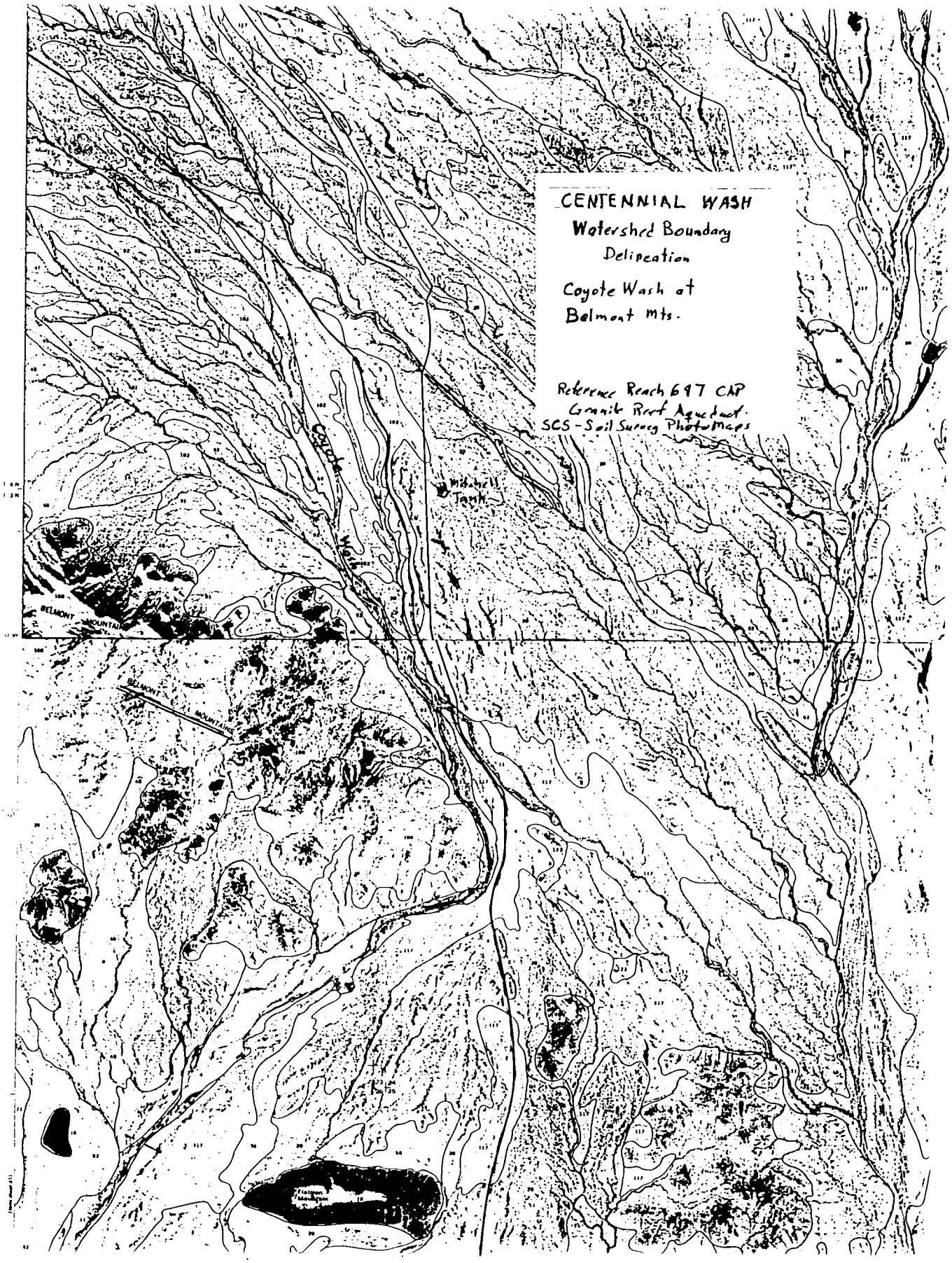

BUTLER VALLEY
HARQUAHALA MOUNTAINS
MCMULLEN VALLEY
CENTENNIAL WASH
AGUILA
NARROW DAM
LITTLE HARQUAHALA MOUNTAINS
TIGER DETENTION BASIN
HARQUAHALA F.R.S.
CENTRAL ARIZONA PROJECT
BURNT MO
XVIII

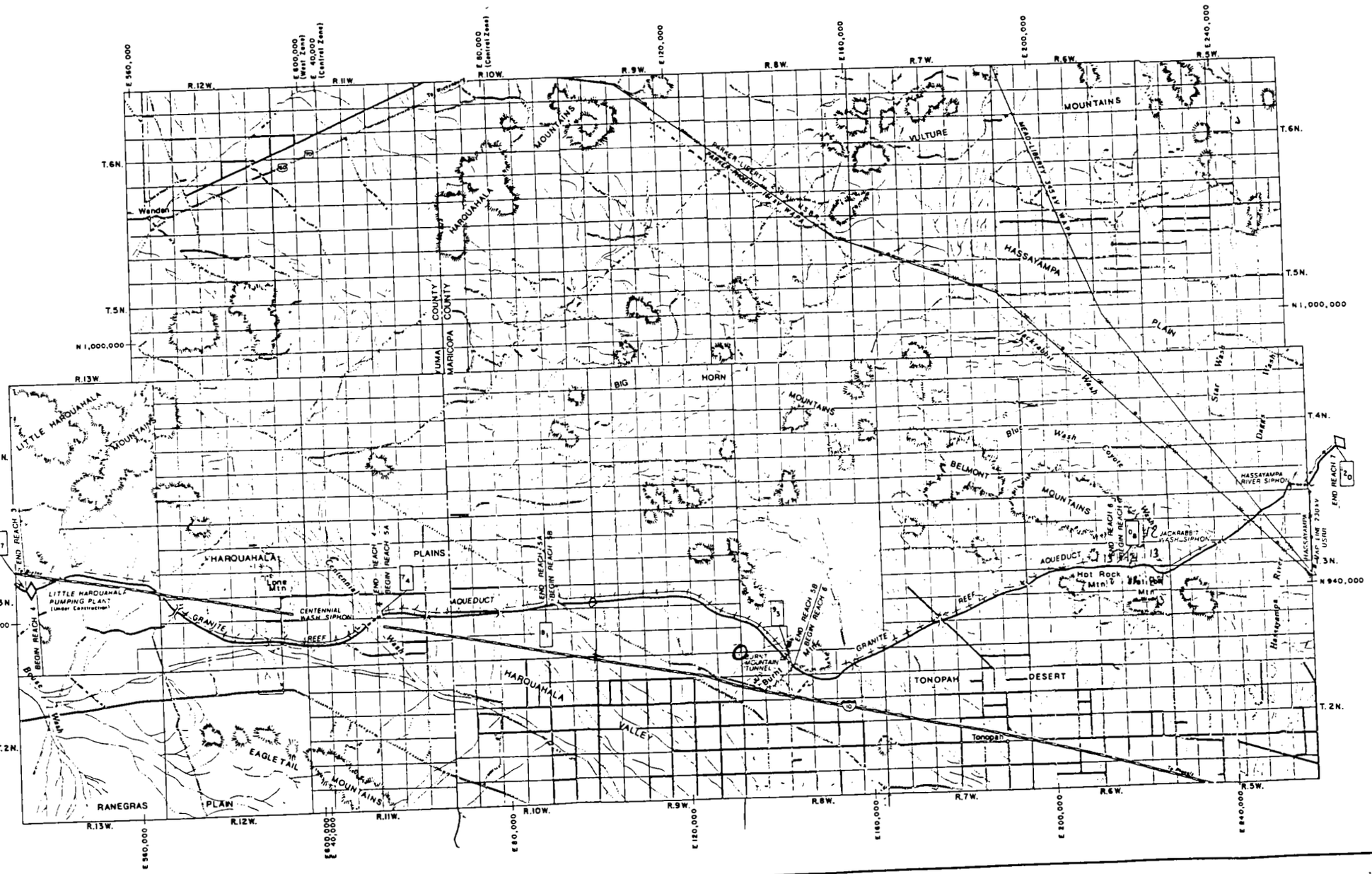

CENTENNIAL WASH
Watershed Boundary
Delineation
Coyote Wash @ Belmont Mtns
Central Arizona Project.
Granite Reef Aqueduct
REACH 7
Coyote Wash Flume
Station 180+50
Concrete Box
Width = 67'-6"
Q = 1458 cfs
REACH 6
Section 1
5-72" Φ Outlets @ 465 cfs ea
Section 2
3-72" Φ Outlets @ 480 cfs ea
Section 3
2-72" Φ Outlets
@ 436 cfs ea
2-8'x8' Box
Cattle Underpasses
Coyote Wash Flume
W = 67'-6"
Q = 1458 cfs
Central Arizona Project.
Granite Reef Aqueduct
REACH 6
PROTECTIVE WORKS
Dike Section 1 5-72" Culverts
Dike Section 2 3-72" Culverts
Dike Section 3 2-72" Culverts
Locations are approximate
Dike Section 4 2-8'x8' Cattle Underpass
TONALEA
Coyote
Wash
Jackrabbit
Powerline
Blue
Deer Bottle
Fence
Tall Mountain


E 560,000
E 600,000 (West Zone)
E 40,000 (Central Zone)
E 80,000 (Central Zone)
E 120,000
E 160,000
E 200,000
E 240,000
R.13W.
R.12W.
R.11W.
R.10W.
R.9W.
R.8W.
R.7W.
R.6W.
R.5W.
T.6N.
T.5N.
T.4N.
T.3N.
T.2N.
N 1,000,000
N 940,000
To Wickenburg
Wenden
70
60
LITTLE HAROUAHALA MOUNTAINS
HAROUAHALA MOUNTAINS
YUMA COUNTY
MARICOPA COUNTY
BIG HORN MOUNTAINS
VULTURE MOUNTAINS
PARKER-LIBERTY 230 kV U.S.B.R.
PARKER-PHOENIX 161 kV W.A.P.A.
MEAD-LIBERTY 345 kV W.A.P.A.
HASSAYAMPA PLAIN
Jackrabbit Wash
Star Wash
Dasies Wash
Blue Wash
Coyote Wash
BELMONT MOUNTAINS
HASSAYAMPA RIVER SIPHON
END REACH 7
END REACH 3
BEGIN REACH 4
LITTLE HAROUAHALA PUMPING PLANT (Under Construction)
Boise Wash
HAROUAHALA PLAINS
Lone Mtn
Centennial Wash
CENTENNIAL WASH SIPHON
END REACH 4
BEGIN REACH 5A
END REACH 5A
BEGIN REACH 5B
END REACH 5B
BEGIN REACH 6
END REACH 6
BEGIN REACH 7
JACKRABBIT WASH SIPHON
AQUEDUCT
GRANITE REEF
Burnt Mountain Wash
BURNT MOUNTAIN TUNNEL
Hot Rock Mtn
Hassayampa River
HASSAYAMPA 230 kV TAP LINE USBR
HAROUAHALA VALLEY
TONOPAH DESERT
Tonopah
To Phoenix
EAGLETAIL MOUNTAINS
RANEGRAS PLAIN


CENTENNIAL WASH
Watershed Boundary
Delineation
Coyote Wash @ Belmont Mtns
Central Arizona Project
Granite Reef Aqueduct
REACH 7
Coyote Wash Flume
Station: 180+50
Concrete Box
Width = 67'-6"
Q = 1450 cfs
REACH 6
Section 1
5-72" Outlets @ 465 cfs ea.
Section 2
3-72" Outlets @ 480 cfs ea.
Section 3
2-72"
Central Arizona Project
Granite Reef Aqueduct
REACH 6
PROTECTIVE WORKS
Dike Section 1 5-72" Culverts
Dike Section 2 3-72" Culverts
Dike Section 3 2-72" Culverts
Locations are approximate
Dike Section 4 2-8'x8' Cattle Underpass
@ 436'
Coyote Wash Flume


Central Arizona Project
Granite Reef Aqueduct
REACH 6
PROTECTIVE WORKS
Dike Section 1 5-72" Culverts
Dike Section 2 3-72" Culverts
Dike Section 3 2-72" Culverts
Locations are approximate
Dike Section 4 2-8'x8' Cattle Underpass
Apache Road
Section 1
5-72" Outlets @ 465 cfs ea.
Section 2
3-72" Outlets @ 480 cfs ea.
Section 3
2-72" Outlets
Section 4
2-8'x8' Box Cattle Underpasses
@ 436 cfs ea.


CENTENNIAL WASH
Watershed Boundary
Delineation
Coyote Wash at
Belmont mts.
Reference Reach 697 CAP
Granite Reef Aqueduct.
SCS - Soil Survey Photo Maps
Coyote
Wash
Mitchell
Tank
BELMONT MOUNTAINS
BELMONT MOUNTAINS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E 640,000 (Central Zone)
E 80,000 (Central Zone)
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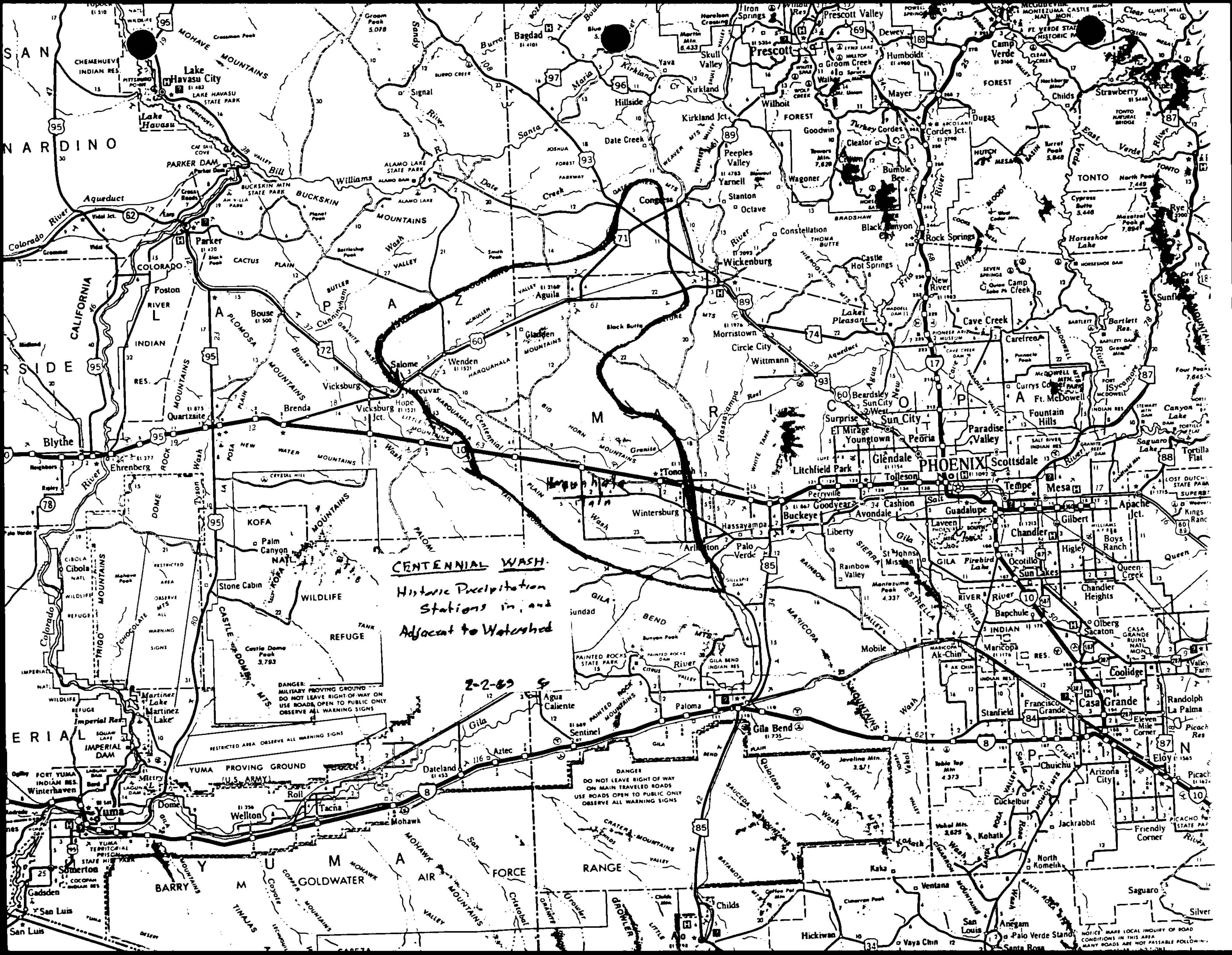
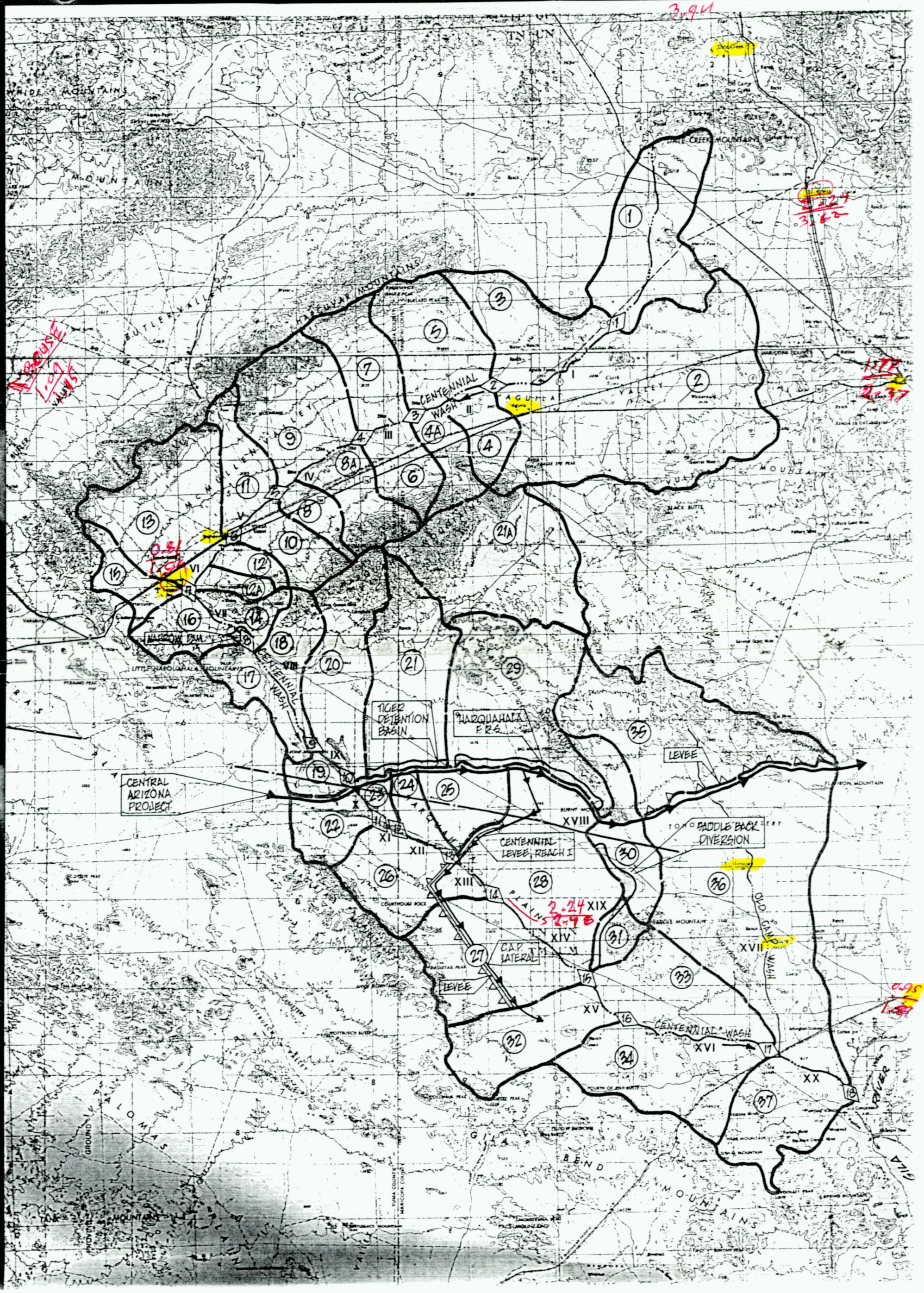
PARKER-LIBERTY 230 kv
PARKER-KOFA 161 kv
MEAD-LIBERTY 345 kv
HASSAYAMPA
PLAIN
YUMA COUNTY
MARICOPA COUNTY
BIG
HORN
MOUNTAINS
Jackrabbit Wash
Star Wash
Date Wash
Blue Wash
Coyote Wash
BELMONT
MOUNTAINS
HASSAYAMPA RIVER SIPHON
END REACH 7
LITTLE HAROUAHALA
MOUNTAINS
END REACH 3
BEGIN REACH 4
LITTLE HAROUAHALA PUMPING PLANT (Under Construction)
HAROUAHALA
PLAINS
Long Mtn
Centennial Wash
END REACH 4
BEGIN REACH 5A
CENTENNIAL WASH SIPHON
AQUEDUCT
END REACH 5A
BEGIN REACH 5B
END REACH 5B
BEGIN REACH 6
GRANITE REEF
AQUEDUCT
JURY MOUNTAIN TUNNEL
Burro Wash
END REACH 6
BEGIN REACH 7
JACKRABBIT WASH SIPHON
AQUEDUCT
Hot Rock Mtn
Hot Rock Mtn
GRANITE REEF
HASSAYAMPA RIVER
HASSAYAMPA 230 kv
MAP LINE USGS
END REACH 7
TONOPAH
DESERT
HAROUAHALA
VALLEY
Tonopah
Burro Wash
EAGLE TAIL
MOUNTAINS
RANEGRAS
PLAIN



CENTENNIAL WASH
Historic Precipitation Stations in, and Adjacent to Watershed
2-2-89
PHOENIX
Scottsdale
Tempe
Mesa
Glendale
Peoria
Sun City
Youngtown
El Mirage
Surprise
Litchfield Park
Tolleson
Goodyear
Avondale
Cashion
Buckeye
Liberty
Hassayampa
Arlington
Palo Verde
Tonopah
Wintersburg
Wickenburg
Morristown
Circle City
Wittmann
Congress
Yarnell
Peeples Valley
Stanton
Octave
Aguila
Wenden
Salome
Hope
Harcuvar
Vicksburg
Vicksburg Jct.
Brenda
Quartzsite
Blythe
Ehrenberg
Bouse
Parker
Poston
Lake Havasu City
Parker Dam
Prescott
Prescott Valley
Skull Valley
Kirkland
Kirkland Jct.
Bagdad
Hillside
Date Creek
Wilhoit
Mayer
Humboldt
Dewey
Camp Verde
Cordes Jct.
New River
Cave Creek
Carefree
Fountain Hills
Paradise Valley
Chandler
Gilbert
Apache Jct.
Guadalupe
Laveen
Maricopa
Mobile
Gila Bend
Paloma
Sentinel
Agua Caliente
Aztec
Dateland
Tacna
Roll
Wellton
Mohawk
Yuma
Somerton
Gadsden
San Luis
Winterhaven
Casa Grande
Coolidge
Eloy
Stanfield
Ajo
Childs
Hickiwan
Kaka
Ventana
Sells
Kofa National Wildlife Refuge
Yuma Proving Ground (U.S. Army)
Luke Air Force Range
Centennial
Hassayampa River
Gila River
Colorado River
Maricopa
Yavapai
Yuma
La Paz
Pinal


WHITE MOUNTAINS
DUCK CREEK MOUNTAINS
HARQUAHALA MOUNTAINS
BUTLER VALLEY
CENTENNIAL WASH
AGUILA
VALLEY
MOUNTAINS
BLACK BUTTE
HASSAYAMPA
MARICOPA COUNTY
YAVAPAI COUNTY
NARROWS DAM
LITTLE HARQUAHALA MOUNTAINS
TIGER DETENTION BASIN
HARQUAHALA F.R.S.
LEVEE
CENTRAL ARIZONA PROJECT
SADDLE BACK DIVERSION
CENTENNIAL LEVEE, REACH I
C.A.P. LATERAL
LEVEE
OLD CAMP WASH
CENTENNIAL WASH
COURTHOUSE ROCK
SADDLE MOUNTAIN
TIGER MOUNTAIN
GILA BEND MOUNTAINS
GILA RIVER
SALOMAS
YUMA COUNTY
MARICOPA COUNTY
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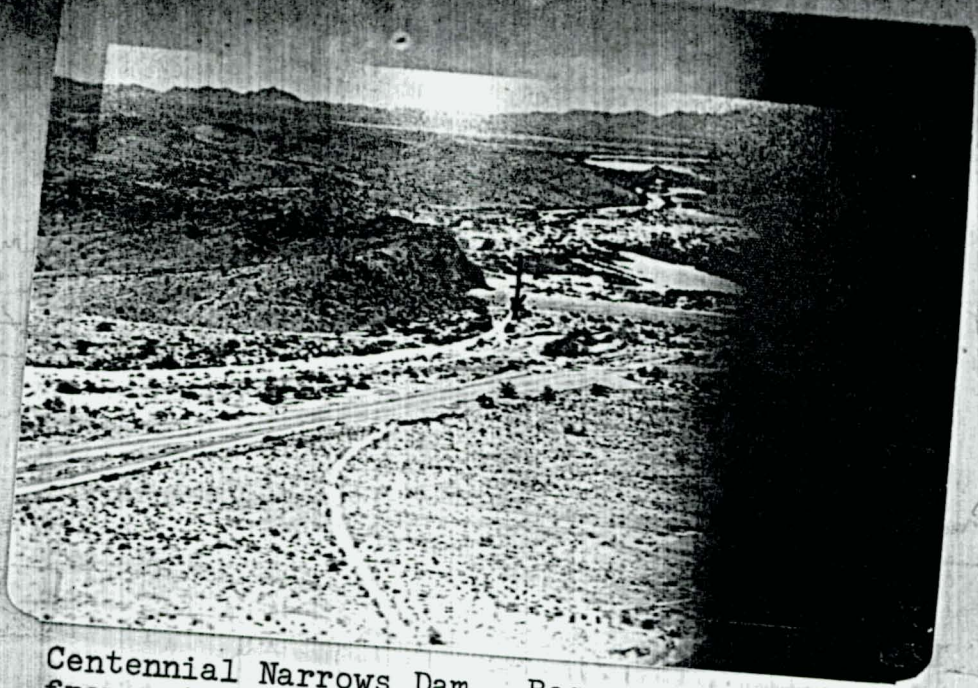
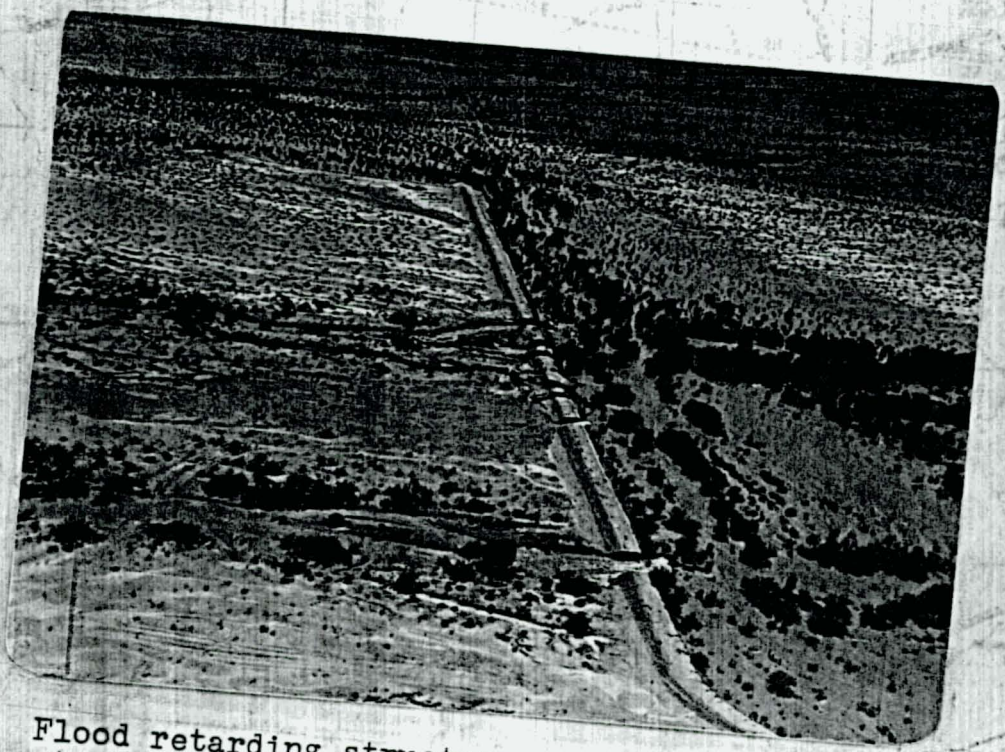


Centennial Narrows Dam. Reservoir discharge from outlet (arrow).

32

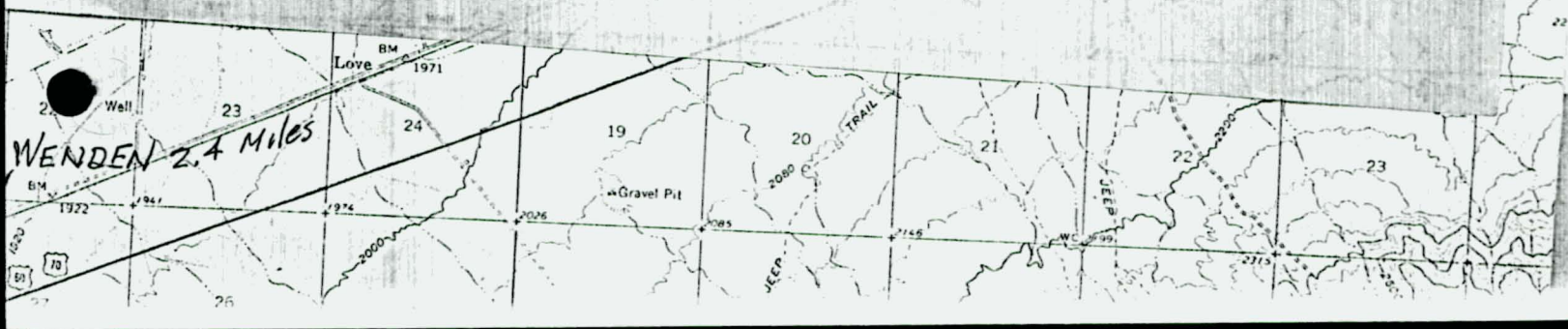
31 other Picture

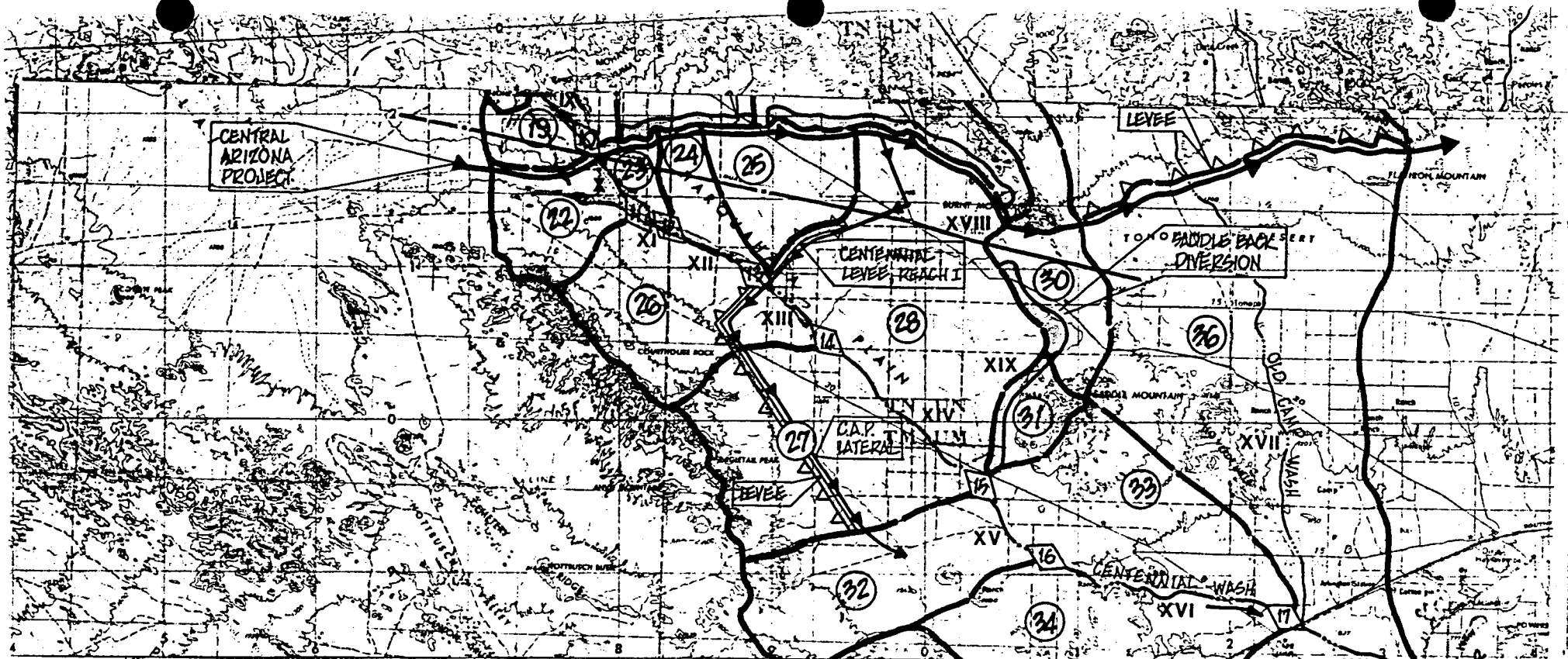
Debris up to 2± ' below crest depth ? 4-5' esp



33

Flood retarding structure approx. 4 miles downstream from Centennial Narrows Dam on Centennial Wash. Embankment breach, probably from overtopping.




CENTRAL ARIZONA PROJECT
LEVEE
CENTENNIAL LEVEE REACH I
BACKLE BACK DIVERSION
C.A.P. LATERAL
LEVEE
CENTENNIAL WASH
OLD CAMP WASH
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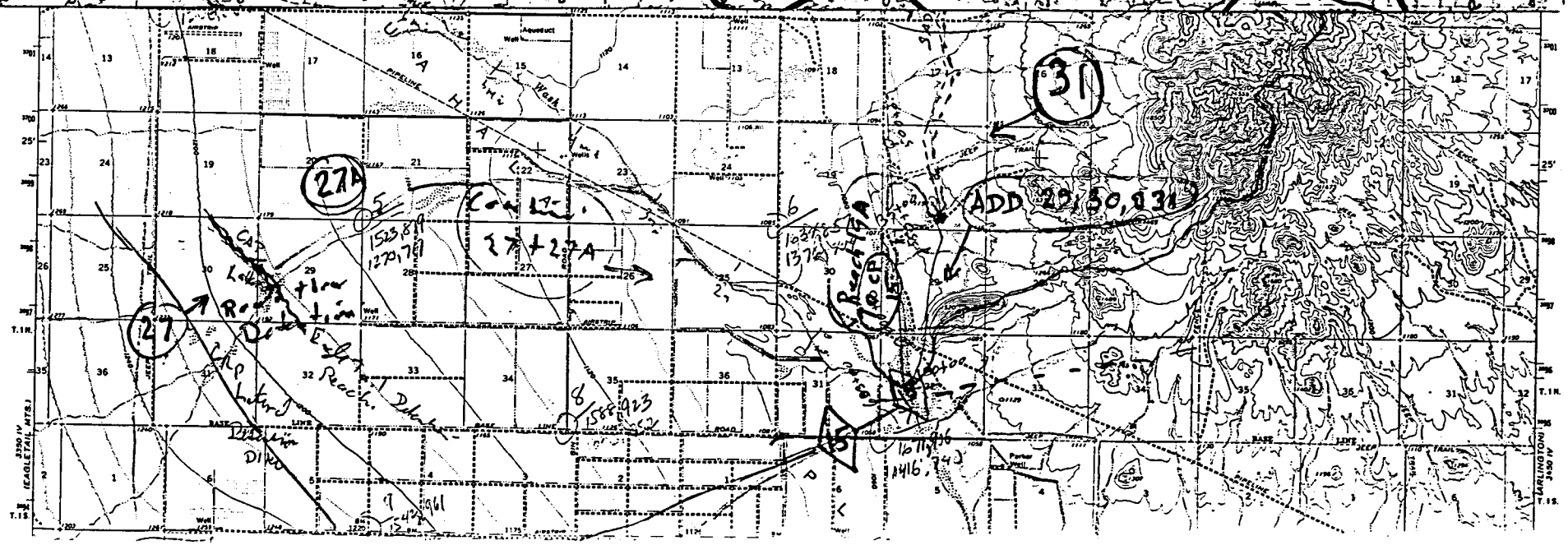
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Reach 993
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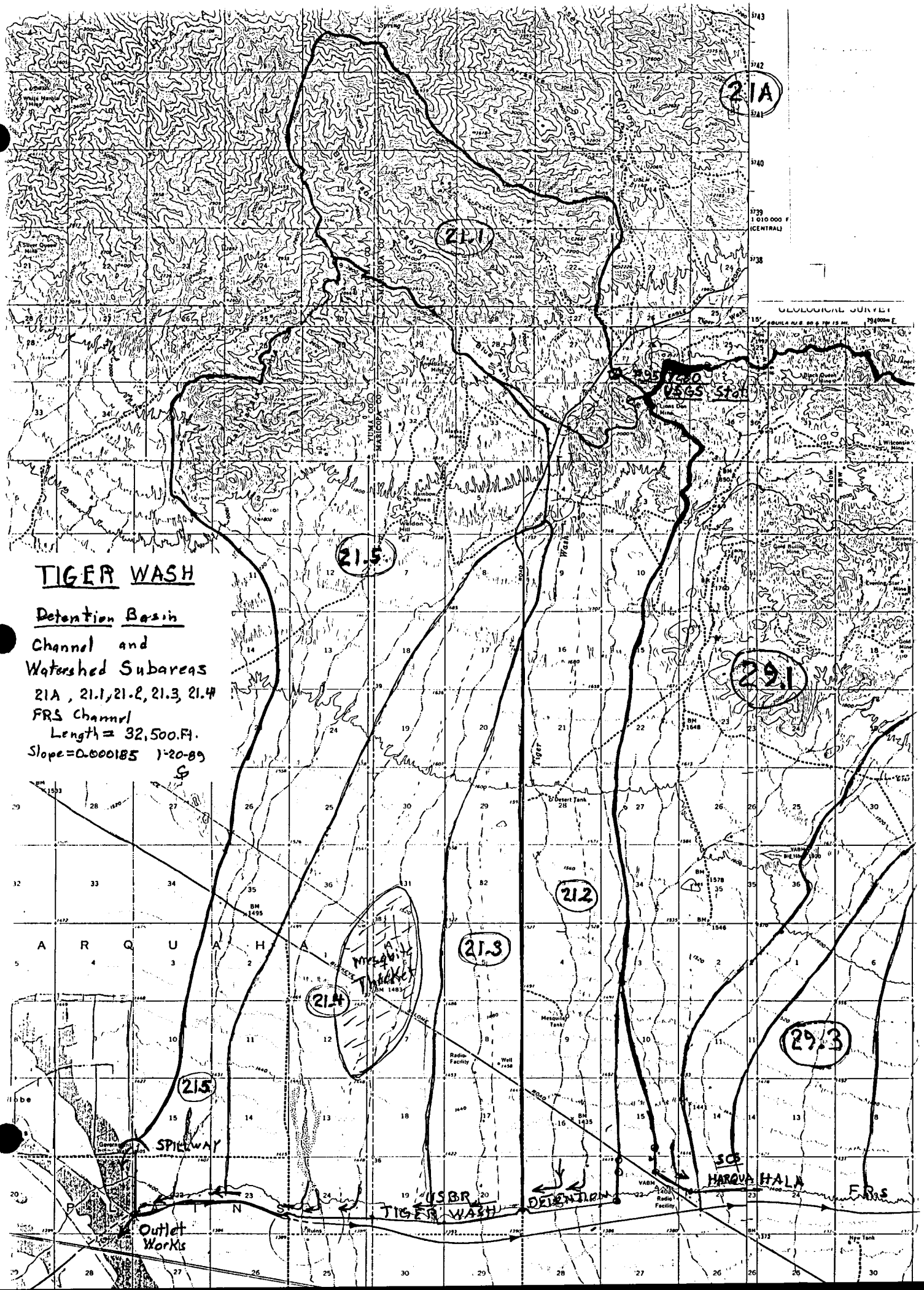
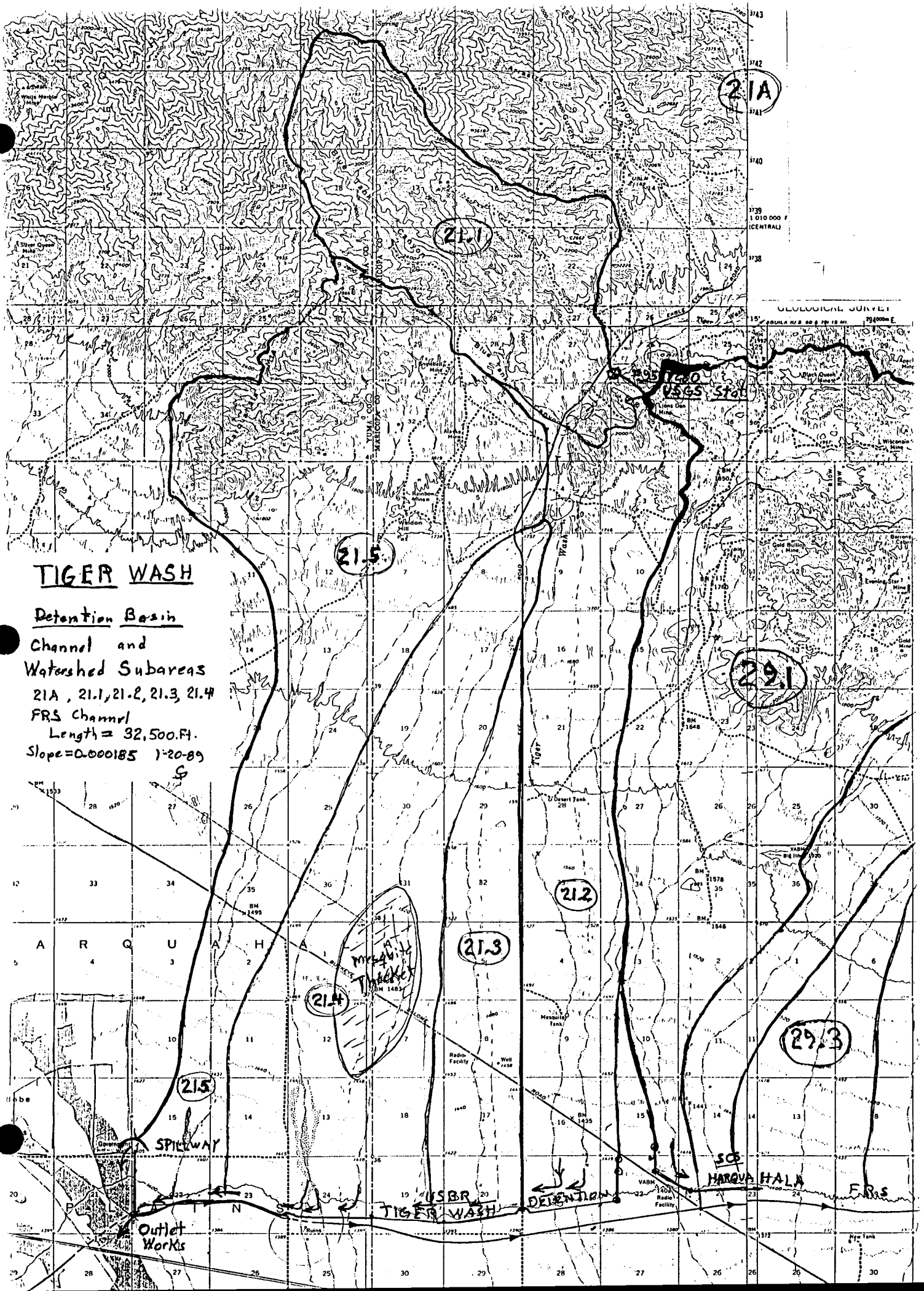
Reach 995
Reach 996
Reach 997
Reach 998
Reach 999
Reach 1000


TIGER WASH
Detention Basin
Channel and
Watershed Subareas
21A, 21.1, 21.2, 21.3, 21.4
FRS Channel
Length = 32,500 Ft.
Slope = 0.000185 1-20-89
21A
21.1
21.2
21.3
21.4
21.5
29.1
29.3
USGS Stat
Mesquite Thicket
SPILLWAY
Outlet Works
USBR DETENTION
TIGER WASH
HARQUAHALA
FRS
ARQUAHALA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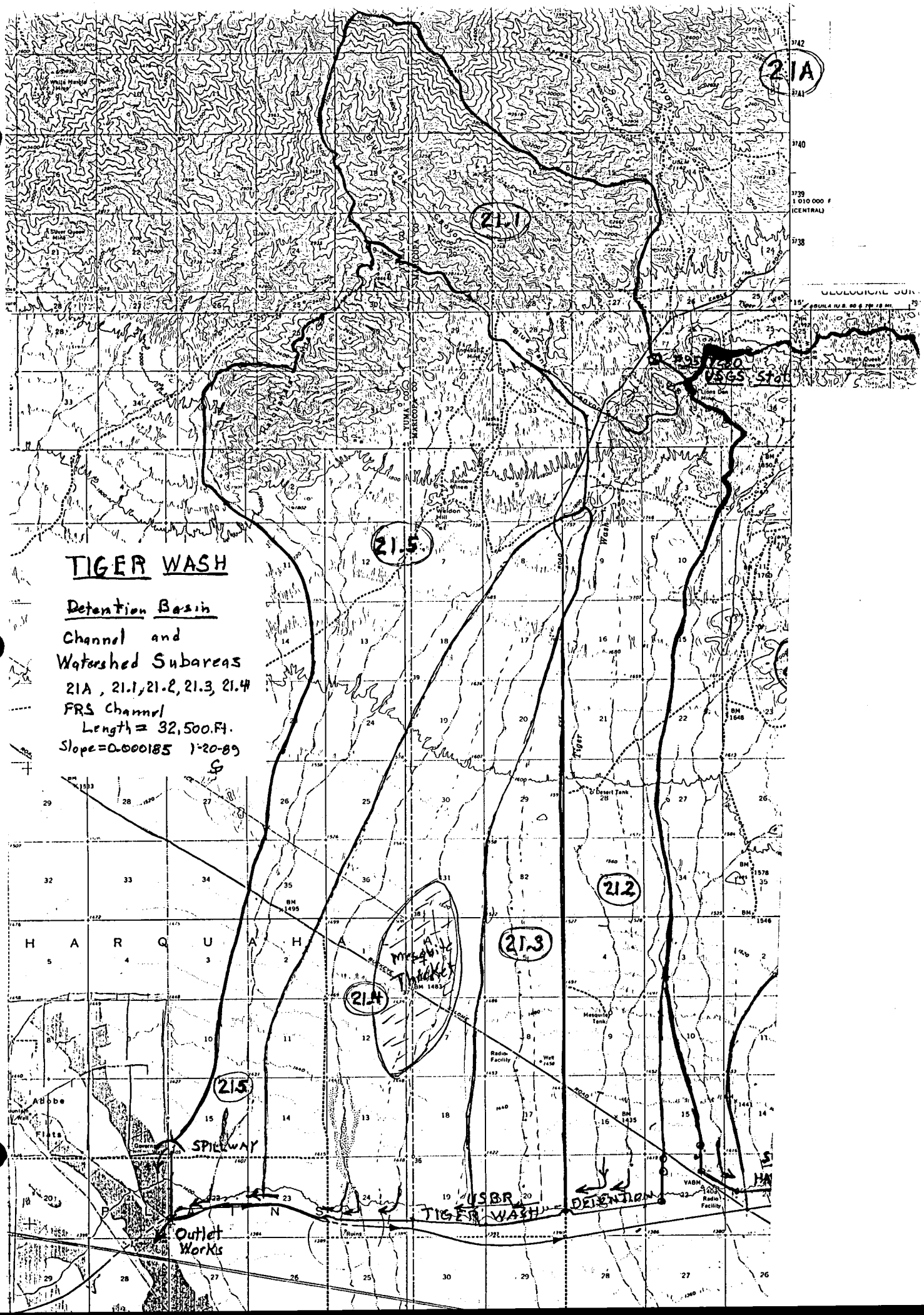
Detention Basin
Channel and
Watershed Subareas
21A, 21.1, 21.2, 21.3, 21.4
FRS Channel
Length = 32,500 Ft.
Slope = 0.000185 1-20-89
21A
21.1
21.2
21.3
21.4
21.5
29.1
29.3
USGS Stat
SPILLWAY
Outlet Works
USBR
TIGER WASH
DETENTION
SCS
HARQUAHALA
FRS
Tiger Wash
Desert Tank
Mesquite Tank
Radio Facility
Well
Ruins
Rainbow Mine
Weldon Hill
Lions Den Mine
Black Queen Mine
Wisconsin Mine
Gold Bullion Mine
Evening Star Mine
Silver Queen Mine
White Mountain Mine
Alaska Mine
Blue Bell Mine
Tiger Mine
Mesquite Thicket
Governor's Mansion
A R Q U A H A L A
P L A T N S
TUMA CO
MARICOPA CO
YUMA CO
GEOLOGICAL SURVEY
AGUILA 10 U.S. 60 & 70 18 MI.
1 010 000 F
(CENTRAL)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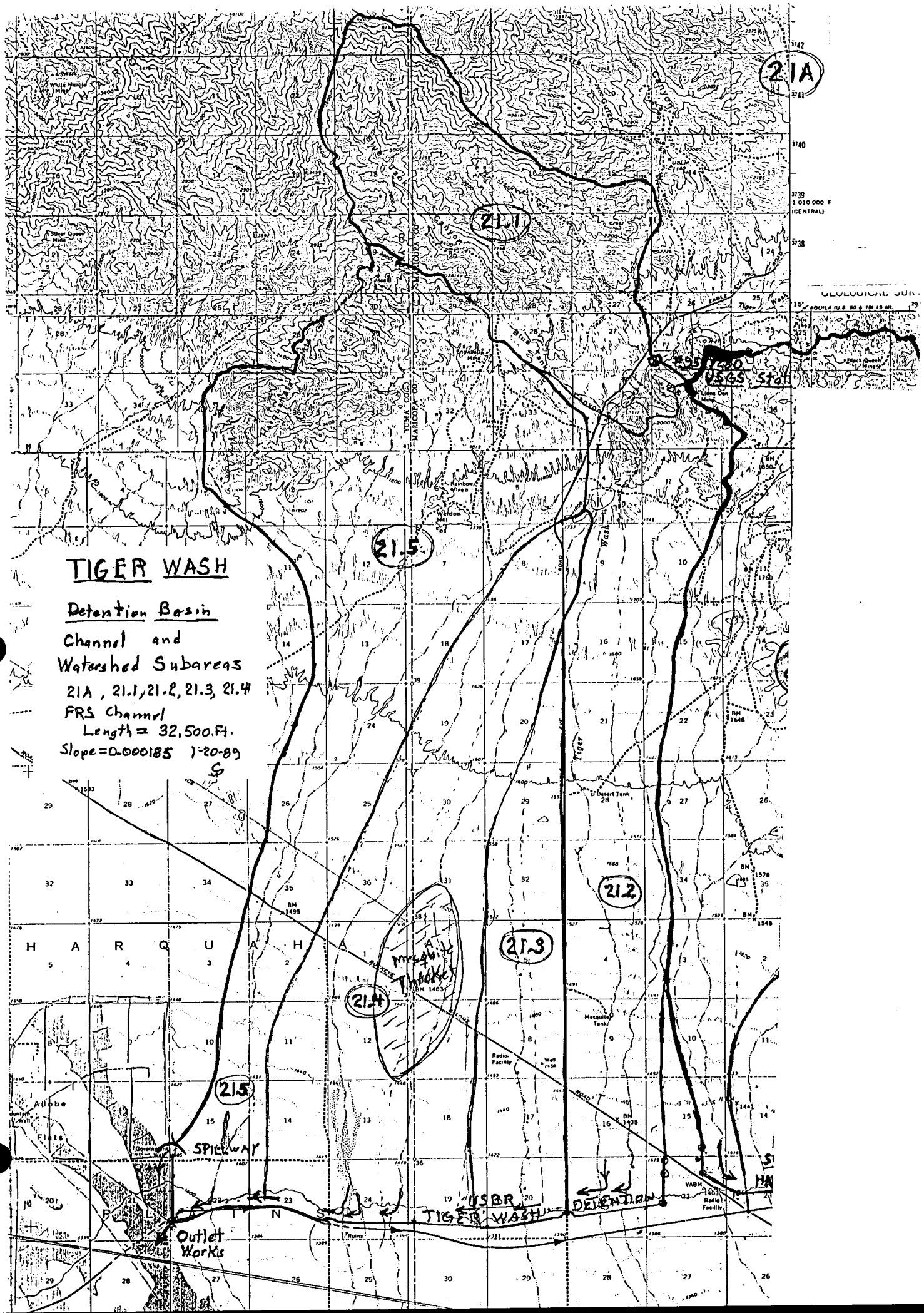
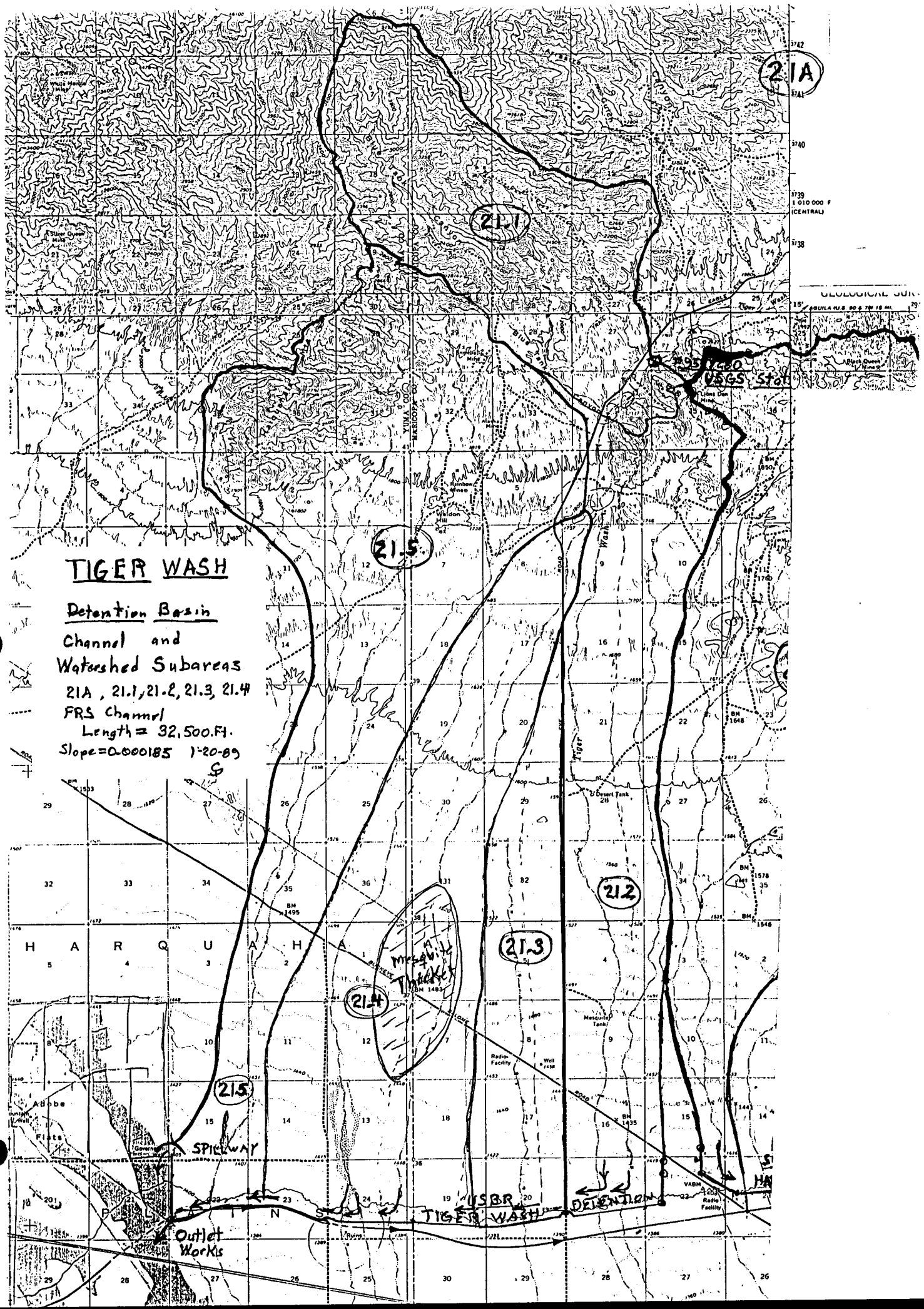
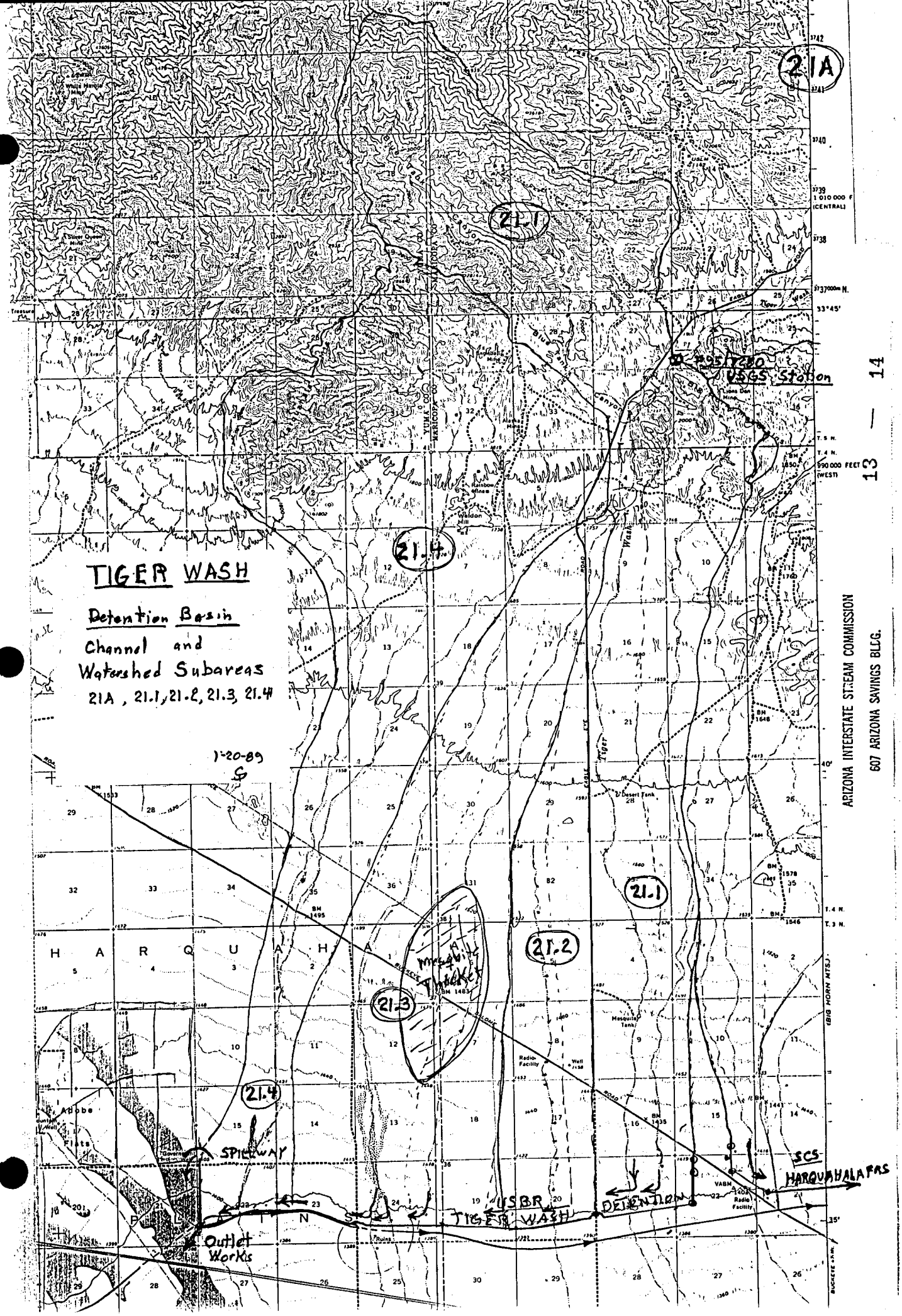
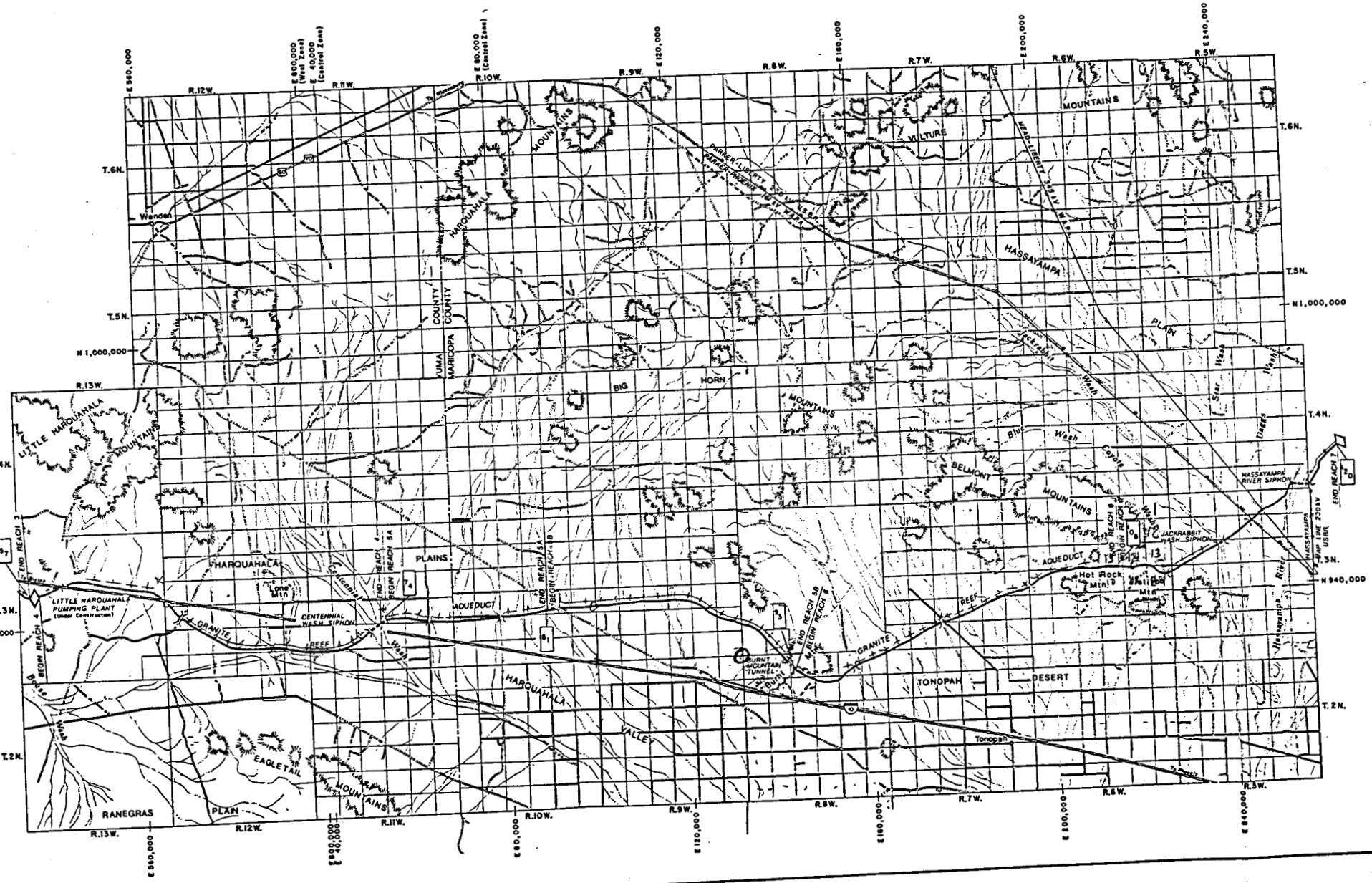
Detention Basin
Channel and
Watershed Subareas
21A, 21.1, 21.2, 21.3, 21.4
FRS Channel
Length = 32,500 Ft.
Slope = 0.000185 1-20-89
21A
21.1
21.2
21.3
21.4
21.5
21.5
USGS Stat
SPILLWAY
USBR
TIGER WASH
DETENTION
Outlet Works
H A R Q U A H A L A
Mesquite Thicket
Tiger Wash
Desert Tank
Mesquite Tank
Radio Facility
Well
Abbe
Flats
Waldon Hill
Rainbow Mine
Alaska Mine
Tiger Dam Mine
Black Queen Mine
Silver Queen Mine
White Hawk Mine
YUMA CO
MARICOPA CO
Ruins
VABM


21A
21.1
21.2
21.3
21.4
21.5
21.5
TIGER WASH
Detention Basin
Channel and
Watershed Subareas
21A, 21.1, 21.2, 21.3, 21.4
FRS Channel
Length = 32,500 Ft.
Slope = 0.000185 1-20-89
USGS Stat
Mesquite Thicket
SPILLWAY
Outlet Works
USBR
DETENTION
TIGER WASH
H A R Q U A H A L A
Tiger Wash
Desert Tank
Mesquite Tank
Radio Facility
Well
Ruins
Abbe
Flats
Waldon Hill
Rainbow Mines
Alamo Mine
Silver Queen Mine
White Hedge Mine
Black Queen Mine
Eagle Eye Mine
Tiger Mine
Blue Bird Mine
Tonopah Mine
YUMA CO
MARICOPA CO
GEOLOGICAL SUR
1 010 000 F (CENTRAL)


TIGER WASH
Detention Basin
Channel and
Watershed Subareas
21A, 21.1, 21.2, 21.3, 21.4
FRS Channel
Length = 32,500 Ft.
Slope = 0.000185 1-20-89
21A
21.1
21.2
21.3
21.4
21.5
USGS Stat
SPILLWAY
Outlet Works
USBR
DETENTION
TIGER WASH
H A R Q U A H A
Mesquite Thicket
Adobe
Flats
Mesquite Tank
Desert Tank
Radio Facility
Well
Rainbow Mine
Weldon Hill
Black Queen Mine
Silver Queen Mine
Tiger Wash
Road


TIGER WASH
Detention Basin
Channel and
Watershed Subareas
21A, 21.1, 21.2, 21.3, 21.4
1-20-89
21A
21.1
21.2
21.3
21.4
USGS Station
SPILLWAY
Outlet Works
USBR
TIGER WASH
DETENTION
SCS
HARQUAHALA FRS
H A R Q U A H A
P L A I N S
Mesquite Thicket
Mesquite Tank
Radio Facility
Rainbow Mine
Waldon Hill
Alpha Mine
Tiger Wash
Desert Tank
Adobe
Ruins
YUMA CO
MARICOPA CO
BIG HORN MTS
BUCKEYE S.H.
T. 5 N.
T. 4 N.
T. 3 N.
33°45'
1 010 000 FEET (CENTRAL)
990 000 FEET (WEST)
ARIZONA INTERSTATE STREAM COMMISSION
607 ARIZONA SAVINGS BLDG.


E 560,000
E 800,000 (West Zone)
E 40,000 (Central Zone)
E 80,000 (Central Zone)
E 120,000
E 160,000
E 200,000
E 240,000
R.13W.
R.12W.
R.11W.
R.10W.
R.9W.
R.8W.
R.7W.
R.6W.
R.5W.
T.6N.
T.5N.
T.4N.
T.3N.
T.2N.
N 1,000,000
N 940,000
Wenden
MOUNTAINS
VULTURE
HASSAYAMPA
PLAIN
PARKER-LIBERTY 230 kv
PARKER-PHOENIX 161 kv
MESA-LIBERTY 230 kv
YUMA COUNTY
MARICOPA COUNTY
HARQUAHALA
BIG
HORN
MOUNTAINS
LITTLE HARQUAHALA
MOUNTAINS
Blue Wash
Coyote
Star Wash
Dagger
BELMONT
MOUNTAINS
HASSAYAMPA RIVER SIPHON
JACKRABBIT WASH SIPHON
END REACH 7
HASSAYAMPA
AQUEDUCT
Hot Rock Mine
Mine
END REACH 8
BEGIN REACH 8
END REACH 9
BEGIN REACH 9
HARQUAHALA
PLAINS
Lone Mtn
END REACH 4
BEGIN REACH 4
END REACH 5A
BEGIN REACH 5A
END REACH 5B
BEGIN REACH 5B
LITTLE HARQUAHALA PUMPING PLANT (Under Construction)
CENTENNIAL WASH SIPHON
GRANITE
REEF
AQUEDUCT
BURNT MOUNTAIN TUNNEL
END REACH 3
BEGIN REACH 3
END REACH 1
BEGIN REACH 1
TONOPAH
DESERT
HARQUAHALA
VALLEY
Tonopah
Hassayampa
River
Burro
Wash
EAGLETAIL
MOUNTAINS
RANEGRAS
PLAIN

Narrows

```
189 KK      11      COMBINE 1-15 WITH 14 AND 16

                ADD THREE HYDROGRAPHS

191 HC      HYDROGRAPH COMBINATION
                ICOMP          3  NUMBER OF HYDROGRAPHS TO COMBINE

                HYDROGRAPH AT STATION      11

PEAK FLOW    TIME                      MAXIMUM AVERAGE FLOW
                              6-HR      24-HR      72-HR     99.50-HR
+  (CFS)     (HR)
                   (CFS)
+  [illegible]991.   21.50          41164.     27682.     12492.      9105.
                (INCHES)            0.524      1.410      1.908      1.922
                (AC-FT)            20412.     54907.     74334.     74874.

                CUMULATIVE AREA =  730.30 SQ MI

192 KK       1      ROUTE (LOWER CENTENNIAL - NARROWS DAM)

                ROUTE TOTAL HYDROGRAPH THROUGH RESERVOIR

            HYDROGRAPH ROUTING DATA

174 RL      ROUTING LOSSES
                QLOSS        0.00  INITIAL LOSS
                CLOSS        0.00  ADDITIONAL FRACTION LOST

194 RS      STORAGE ROUTING
                NSTPS           1  NUMBER OF SUBREACHES
                 ITYP        ELEV  TYPE OF INITIAL CONDITION
                RSVRIC      224.00  INITIAL CONDITION
                     X        0.00 WORKING R AND D COEFFICIENT

195 SV        STORAGE        0.0       0.0       0.0     500.0     850.0    1240.0    1700.0    2300.0    2620.0    2900.0

196 SE      ELEVATION      224.00    232.00    236.86    243.86    245.86    247.86    249.86    251.86    252.86    253.86
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Narrows Dam

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197 SQ        DISCHARGE        0.      20.     160.     547.    1030.    3150.    7550.   14000.   18000.   22500.

                                                   ***

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN        0. TO      160.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

    ***          ***          ***          ***          ***
                     HYDROGRAPH AT STATION       1

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     99.50-HR
+  (CFS)       (HR)
                          (CFS)
+  44251.      22.50                40703.     27585.     12386.      9061.
                          (INCHES)   0.518      1.405      1.892      1.913
                          (AC-FT)   20183.     54713.     73705.     74512.

 PEAK STORAGE  TIME                          MAXIMUM AVERAGE STORAGE
                                     6-HR       24-HR      72-HR     99.50-HR
+  (AC-FT)     (HR)
   4253.       22.50                 4033.      3208.      1955.      1496.

 PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                     6-HR       24-HR      72-HR     99.50-HR
+  (FEET)      (HR)
   258.69      22.50               257.91     254.98     250.35     246.73

                          CUMULATIVE AREA =  730.30 SQ MI

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          ***************
          *             *
198 KK    *         8   *      ROUTE HYDROGRAPH 1-16 THROUGH REACH 8
          *             *
          ***************

            HYDROGRAPH ROUTING DATA

199 RL        ROUTING LOSSES
                   QLOSS        0.00  INITIAL LOSS
                   CLOSS        0.00  ADDITIONAL FRACTION LOST

200 RS        STORAGE ROUTING
                   NSTPS          10  NUMBER OF SUBREACHES
                    ITYP        FLOW  TYPE OF INITIAL CONDITION
                  RSVRIC       -1.00  INITIAL CONDITION
                       X        0.00  WORKING R AND D COEFFICIENT

201 RC        NORMAL DEPTH CHANNEL ROUTING
```

Dam Crest 253.86

OT. 4.83 ft

253.86 / 4.83

29, X

HARQUAHALA → SADDLE BACK → 30 → 37 → 15

SUBBASIN RUNOFF DATA

371 BA SUBBASIN CHARACTERISTICS
TAREA 101.30 SUBBASIN AREA

PRECIPITATION DATA

372 PB STORM 3.93 BASIN TOTAL PRECIPITATION   0.50 hr. Interval

373 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
0.02	0.03	0.05	0.38	0.07	0.04	0.03	0.02	0.02	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		

.17
.06
.08
.38
.07
.11
.19
106%

383 LS SCS LOSS RATE
STRTL 0.41 INITIAL ABSTRACTION
CRVNBR 83.00 CURVE NUMBER
RTIMP 0.00 PERCENT IMPERVIOUS AREA

384 UD SCS DIMENSIONLESS UNITGRAPH
TLAG 4.85 LAG
3.24

***

UNIT HYDROGRAPH
50 END-OF-PERIOD ORDINATES

282.	933.	1773.	2885.	4361.	6120.	7660.	8761.	9401.	9580.
9523.	9062.	8426.	7698.	6809.	5736.	4735.	3981.	3382.	2876.
2481.	2138.	1829.	1546.	1313.	1125.	959.	818.	694.	590.
500.	429.	365.	314.	266.	229.	194.	165.	139.	121.
103.	92.	81.	69.	58.	47.	38.	28.	19.	9.

*** *** *** *** ***

HYDROGRAPH AT STATION SUB29

TOTAL RAINFALL = 3.93, TOTAL LOSS = 1.70, TOTAL EXCESS = 2.23

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)					
		(CFS)				
+ 15962.	17.00		13675.	6022.	2021.	1462.
21313	15.50	(INCHES)	1.255	2.211	2.226	2.226
		(AC-FT)	6781.	11945.	12024.	12024.

CUMULATIVE AREA = 101.30 SQ MI

*** ***

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***************
*             *
385 KK  *      4      *     ROUTE (HARQUAHALA F.R.S.)
*             *
```

Spillway 1408.4
Crest 1387.3,0
Dam Crest Elev. 1422.2
1420.5
1420.15
1419.7

Hargenbal. ERS

ROUTE HYDROGRAPH 29 THROUGH DETENTION STRUCTURE

HYDROGRAPH ROUTING DATA

337 RL ROUTING LOSSES
QLOSS 0.00 INITIAL LOSS
CLOSS 0.00 ADDITIONAL FRACTION LOST

387 RS STORAGE ROUTING
NSTPS 1 NUMBER OF SUBREACHES
ITYP ELEV TYPE OF INITIAL CONDITION
RSVRIC 1393.00 INITIAL CONDITION
X 0.00 WORKING R AND D COEFFICIENT

388 SV	STORAGE	0.0	1000.0	1500.0	2300.0	3500.0	5000.0	7000.0	8500.0	12000.0	14200.0
389 SE	ELEVATION	1393.00	1395.00	1397.00	1399.00	1401.00	1403.00	1405.00	1407.00	1409.00	1411.00
390 SQ	DISCHARGE	0.	121.	172.	210.	243.	272.	298.	322.	344.	1214.

*** *** *** *** *** ***

HYDROGRAPH AT STATION 4

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
+ 340.	35.00	(CFS)	340.	339.	336.	281.
340	31,0	(INCHES)	0.031	0.125	0.370	0.428
		(AC-FT)	169.	673.	1998.	2315.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	99.50-HR
+ 11424.	35.00	11409.	11259.	10689.	8646.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	99.50-HR
+ 1408.67	35.00	1408.66	1408.58	1408.25	1405.57

CUMULATIVE AREA = 101.30 SQ MI

*** ***

Connecting Point

391 KK 15 ROUTE HYDROGRAPH 29 THROUGH REACH 18 — ID

****

HYDROGRAPH ROUTING DATA

392 RL	ROUTING LOSSES			
		QLOSS	0.00	INITIAL LOSS
		CLOSS	0.00	ADDITIONAL FRACTION LOST
393 RS	STORAGE ROUTING			
		NSTPS	6	NUMBER OF SUBREACHES
		ITYP	FLOW	TYPE OF INITIAL CONDITION
		RSVRIC	-1.00	INITIAL CONDITION
		X	0.00	WORKING R AND D COEFFICIENT
394 RC	NORMAL DEPTH CHANNEL ROUTING			
		ANL	0.040	LEFT OVERBANK N-VALUE
		ANCH	0.028	MAIN CHANNEL N-VALUE
		ANR	0.040	RIGHT OVERBANK N-VALUE
		RLNTH	31771.	REACH LENGTH
		SEL	0.0041	ENERGY SLOPE
		ELMAX	0.0	MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

Harquahala Floodway

SCS L=18128

ERROR

CROSS-SECTION DATA

--- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---

RY	ELEVATION	1205.50	1205.50	1203.50	1203.50	1200.00	1200.00	1203.50	1205.00
RX	DISTANCE	0.00	10.00	14.00	24.00	36.00	71.00	83.00	183.00

w = 35

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	7.60	15.62	24.05	32.91	42.19	51.88	61.99	72.53	83.48
OUTFLOW	0.00	15.26	48.95	97.21	158.66	232.57	318.50	416.19	525.49	646.33
ELEVATION	1200.00	1200.29	1200.58	1200.87	1201.16	1201.45	1201.74	1202.03	1202.32	1202.61
STORAGE	94.85	106.64	118.85	134.96	155.44	180.12	208.99	242.06	278.26	314.72
OUTFLOW	778.66	922.51	1077.91	1119.80	1328.10	1568.37	1841.09	2148.64	2515.77	2926.57
ELEVATION	1202.89	1203.18	1203.47	1203.76	1204.05	1204.34	1204.63	1204.92	1205.21	1205.50

17

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 233. TO 2927.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

*** *** *** *** ***

HYDROGRAPH AT STATION 15 Concentration point

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)					
		(CFS)				
+ 340.	36.00		340.	339.	336.	275.
325		(INCHES)	0.031	0.125	0.370	0.419
		(AC-FT)	169.	673.	1998.	2262.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	99.50-HR
+ (AC-FT)	(HR)					
9.	35.50		9.	9.	9.	7.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	99.50-HR
1201.80	36.00	1201.80	1201.80	1201.79	1201.48

OK

CUMULATIVE AREA = 101.30 SQ MI Hargrave Lake

397 KK SUB30

RUNOFF FROM SUBBASIN 30

SUBBASIN RUNOFF DATA

399 BA SUBBASIN CHARACTERISTICS

TAREA 28.60 SUBBASIN AREA

PRECIPITATION DATA

372 PB STORM 3.93 BASIN TOTAL PRECIPITATION

373 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
0.02	0.03	0.05	0.38	0.07	0.04	0.03	0.02	0.02	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		

400 LS SCS LOSS RATE

STRTL 0.56 INITIAL ABSTRACTION

CRVNBR 78.00 CURVE NUMBER

RTIMP 0.00 PERCENT IMPERVIOUS AREA

401 UD SCS DIMENSIONLESS UNITGRAPH

TLAG 4.75 LAG

0.78

UNIT HYDROGRAPH

50 END-OF-PERIOD ORDINATES

83.	276.	525.	857.	1299.	1824.	2266.	2570.	2735.	2763.
2735.	2570.	2376.	2155.	1879.	1547.	1271.	1078.	912.	774.
673.	572.	489.	406.	351.	296.	254.	213.	182.	152.
131.	111.	95.	80.	69.	58.	50.	41.	36.	30.
27.	24.	20.	17.	14.	11.	8.	6.	3.	0.

HYDROGRAPH AT STATION SUB30

TOTAL RAINFALL = 3.93, TOTAL LOSS = 2.10, TOTAL EXCESS = 1.83

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)					
		(CFS)				
+ 3710.	17.00		3166.	1401.	469.	340.
		(INCHES)	1.029	1.822	1.831	1.831
		(AC-FT)	1570.	2779.	2793.	2793.

CUMULATIVE AREA = 28.60 SQ MI

*** :

402 KK 5 ROUTE (SADDLEBACK F.R.S.)

ROUTE HYDROGRAPH 30 THROUGH DETENTION STRUCTURE

HYDROGRAPH ROUTING DATA

392 RL ROUTING LOSSES
- QLOSS 0.00 INITIAL LOSS
- CLOSS 0.00 ADDITIONAL FRACTION LOST

404 RS STORAGE ROUTING
- NSTPS 1 NUMBER OF SUBREACHES
- ITYP ELEV TYPE OF INITIAL CONDITION
- RSVRIC 1179.00 INITIAL CONDITION
- X 0.00 WORKING R AND D COEFFICIENT

405 SV	STORAGE	0.0	200.0	400.0	1000.0	1750.0	3000.0	4500.0	6800.0	9300.0	10500.0
406 SE	ELEVATION	1179.00	1181.00	1183.00	1185.00	1187.00	1189.00	1191.00	1193.00	1195.00	1197.00
407 SQ	DISCHARGE	0.	100.	240.	440.	670.	830.	1030.	1200.	1310.	1450.

***

*** *** *** *** ***

HYDROGRAPH AT STATION 5

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)					
		(CFS)				
+ 700.	28.00		698.	653.	431.	324.
		(INCHES)	0.227	0.849	1.680	1.746
		(AC-FT)	346.	1295.	2563.	2663.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	99.50-HR

```
+ (AC-FT)     (HR)
   1987.     28.00                1968.      1743.      1030.       769.

 PEAK STAGE   TIME                        MAXIMUM AVERAGE STAGE
                                   6-HR      24-HR      72-HR     99.50-HR
+  (FEET)     (HR)
  1187.38    28.00              1187.35    1186.89    1184.76    1183.41

                      CUMULATIVE AREA =   28.60 SQ MI
```

OK,

*** ***

```
            ***************
            *             *
408 KK      *        16   *     ROUTE HYDROGRAPH 30 THROUGH REACH 19
            *             *
            ***************

              HYDROGRAPH ROUTING DATA

409 RL          ROUTING LOSSES
                     QLOSS        0.00  INITIAL LOSS
                     CLOSS        0.00  ADDITIONAL FRACTION LOST

410 RS          STORAGE ROUTING
                     NSTPS          12  NUMBER OF SUBREACHES
                      ITYP        FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC       -1.00  INITIAL CONDITION
                         X        0.00 WORKING R AND D COEFFICIENT

411 RC          NORMAL DEPTH CHANNEL ROUTING
                       ANL       0.040  LEFT OVERBANK N-VALUE
                      ANCH       0.030  MAIN CHANNEL N-VALUE
                       ANR       0.040  RIGHT OVERBANK N-VALUE
                     RLNTH       43229.  REACH LENGTH
                       SEL      0.0038  ENERGY SLOPE
                     ELMAX         0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION
```

24,400 plus 13,000

```
                                  CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
413 RY       ELEVATION   1149.50   1149.50   1146.00   1146.00   1143.00   1143.00   1146.00   1147.00
412 RX       DISTANCE       0.00     10.00     24.00     64.00     73.00    205.00    220.00    270.00

                                              ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA
          STORAGE       0.00     45.28     91.49    138.63    186.69    235.69    285.61    336.47    388.25    444.24
          OUTFLOW       0.00     67.90    216.45    427.17    692.77   1008.94   1372.76   1782.10   2235.35   2346.87
        ELEVATION    1143.00   1143.34   1143.68   1144.03   1144.37   1144.71   1145.05   1145.39   1145.74   1146.08
          STORAGE     515.37    592.77    676.16    761.41    847.13    933.31   1019.95   1107.06   1194.64   1282.68
          OUTFLOW    2938.74   3606.89   4354.90   5188.90   6088.56   7051.61   8076.16   9160.64  10303.70  11504.13
        ELEVATION    1146.42   1146.76   1147.11   1147.45   1147.79   1148.13   1148.47   1148.82   1149.16   1149.50
```

13

```
*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN      216. TO    11504.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
```

35

OLD CAMP WATERS

373 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
0.02	0.03	0.05	0.38	0.07	0.04	0.03	0.02	0.02	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		

453 LS SCS LOSS RATE

STRTL	0.30	INITIAL ABSTRACTION
CRVNBR	87.00	CURVE NUMBER
RTIMP	0.00	PERCENT IMPERVIOUS AREA

454 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	4.73	LAG
	2.70	

UNIT HYDROGRAPH
49 END-OF-PERIOD ORDINATES

293.	973.	1850.	3020.	4578.	6414.	7952.	9004.	9568.	9657.
9539.	8952.	8268.	7481.	6500.	5348.	4398.	3726.	3151.	2677.
2323.	1974.	1683.	1402.	1208.	1019.	873.	732.	625.	523.
450.	380.	326.	275.	236.	199.	170.	142.	123.	104.
93.	81.	69.	58.	47.	37.	27.	17.	8.	

HYDROGRAPH AT STATION SUB35

TOTAL RAINFALL = 3.93, TOTAL LOSS = 1.36, TOTAL EXCESS = 2.57

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)	(CFS)				
+ 18727.	17.00		15876.	6837.	2297.	1662.
27634	14.50	(INCHES)	1.482	2.553	2.573	2.573
		(AC-FT)	7872.	13561.	13665.	13665.

CUMULATIVE AREA = 99.60 SQ MI

455 KK 6 ROUTE (OLD CAMP DETENTION BASIN)

ROUTE HYDROGRAPH 35 THROUGH OLD CAMP DETENTION (UPSTRM OF C.A.P.)

HYDROGRAPH ROUTING DATA

432 RL ROUTING LOSSES

QLOSS	0.00	INITIAL LOSS
CLOSS	0.00	ADDITIONAL FRACTION LOST

457 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	0.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

458 SV	STORAGE	0.0	163.0	326.0	489.0	652.0	816.0	978.0	1141.0	1222.0	1344.0
459 SE	ELEVATION	0.00	2.00	4.00	6.00	8.00	10.00	12.00	14.00	15.00	16.00
460 SQ	DISCHARGE	0.	156.	315.	585.	825.	1020.	1200.	1335.	1410.	1500.

*** *** *** *** *** ***

HYDROGRAPH AT STATION 6

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)					
		(CFS)				
+ 6206.	23.50		6113.	4938.	2281.	1659.
6569	20.00	(INCHES)	0.571	1.844	2.556	2.568
		(AC-FT)	3031.	9795.	13576.	13641.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	99.50-HR
+ (AC-FT)	(HR)				
7724.	23.50	7597.	6005.	2624.	1907.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	99.50-HR
+ (FEET)	(HR)				
68.29	23.50	67.25	54.20	24.92	18.14

CUMULATIVE AREA = 99.60 SQ MI

99.63

OT = 52.29

*** ***

461 KK ROUTE HYDROGRAPH 35 THROUGH REACH 17

19

HYDROGRAPH ROUTING DATA

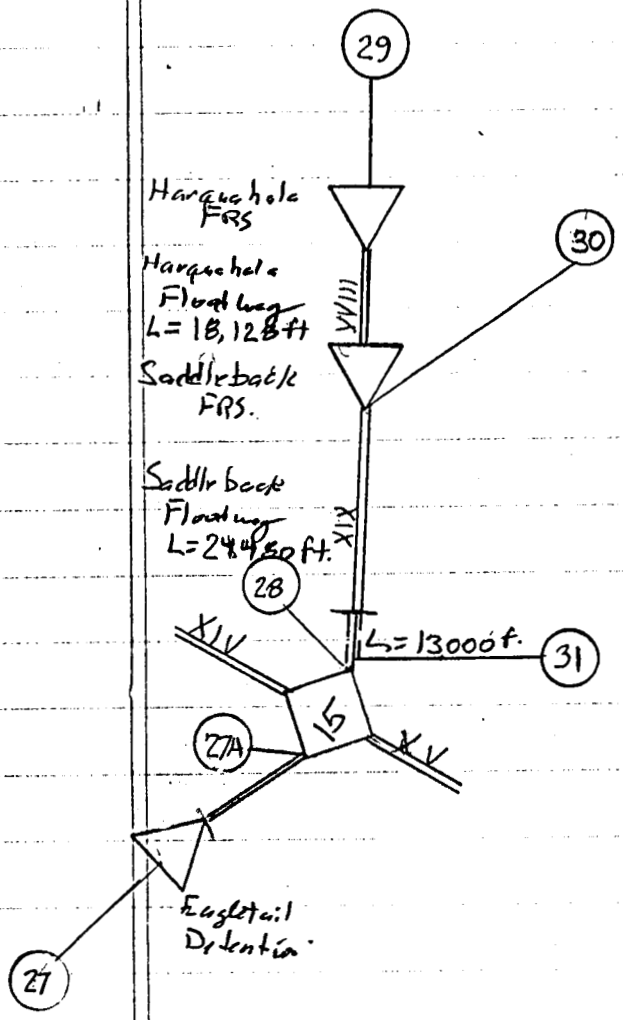
462 RL ROUTING LOSSES

QLOSS	0.00	INITIAL LOSS
CLOSS	0.00	ADDITIONAL FRACTION LOST

1-18-89
G

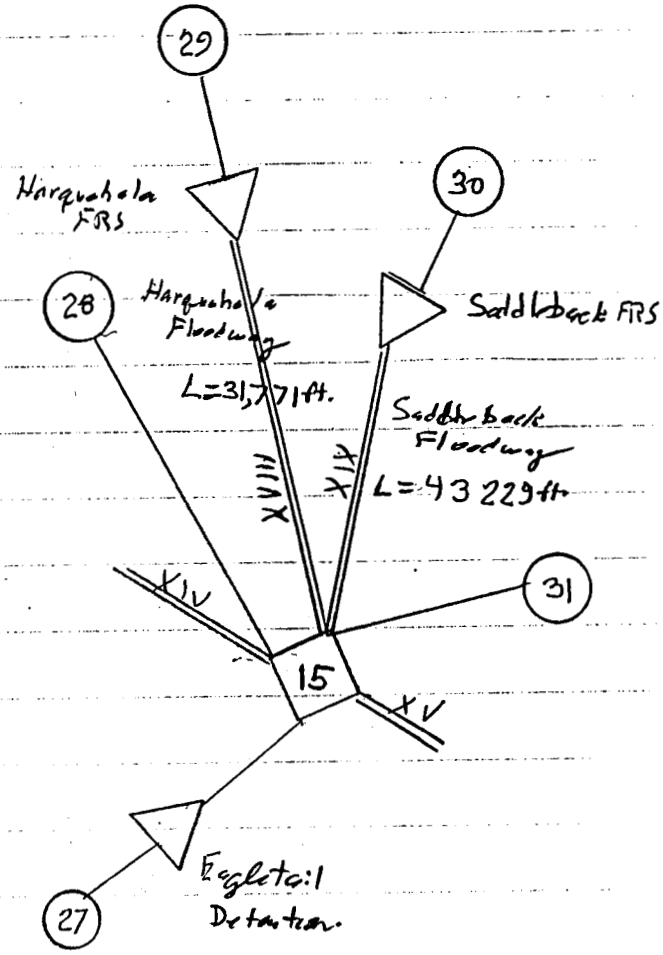
Harquahala – Saddleback FRS & Floodways.

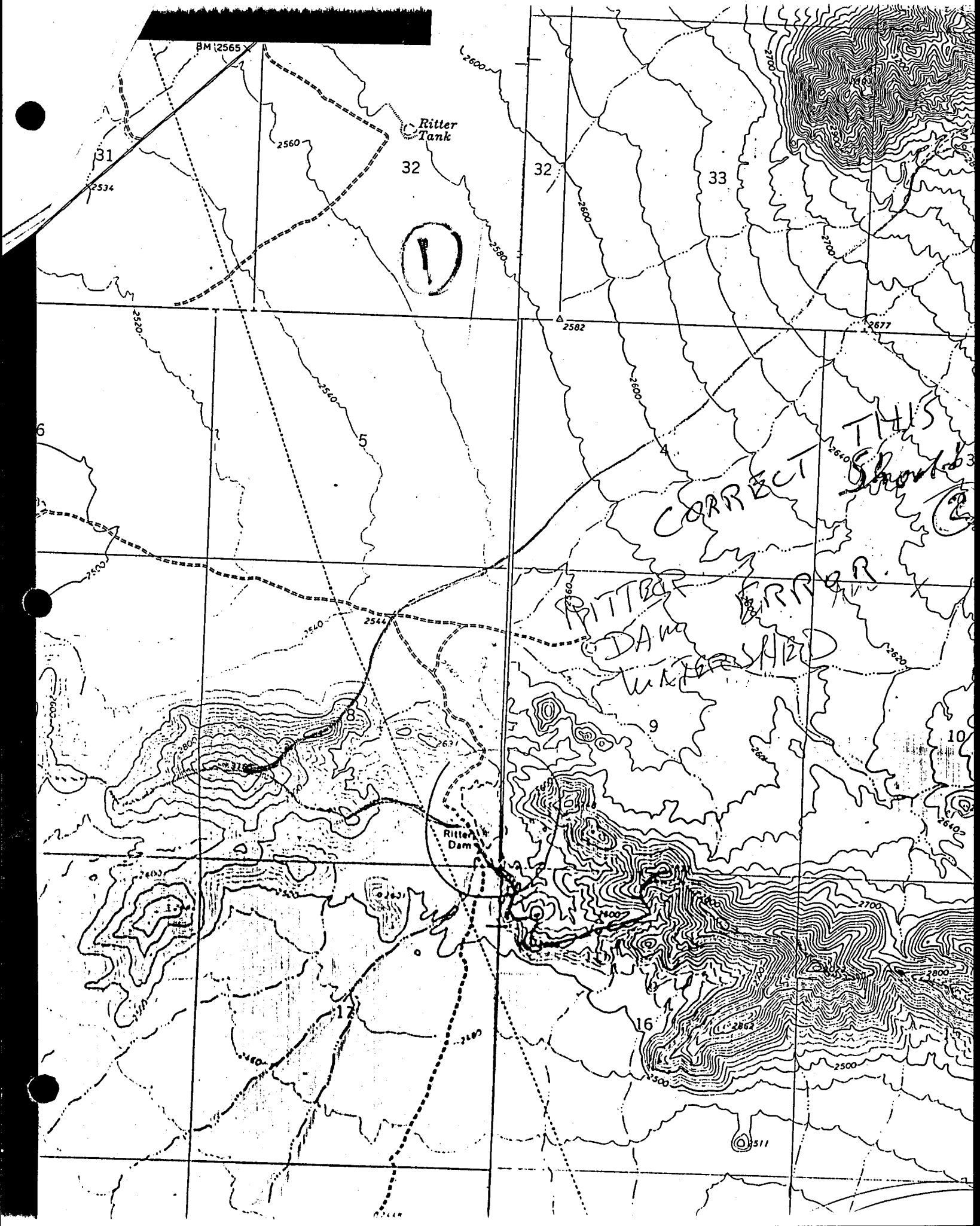
Should be



CBA Model

IS INCORRECT



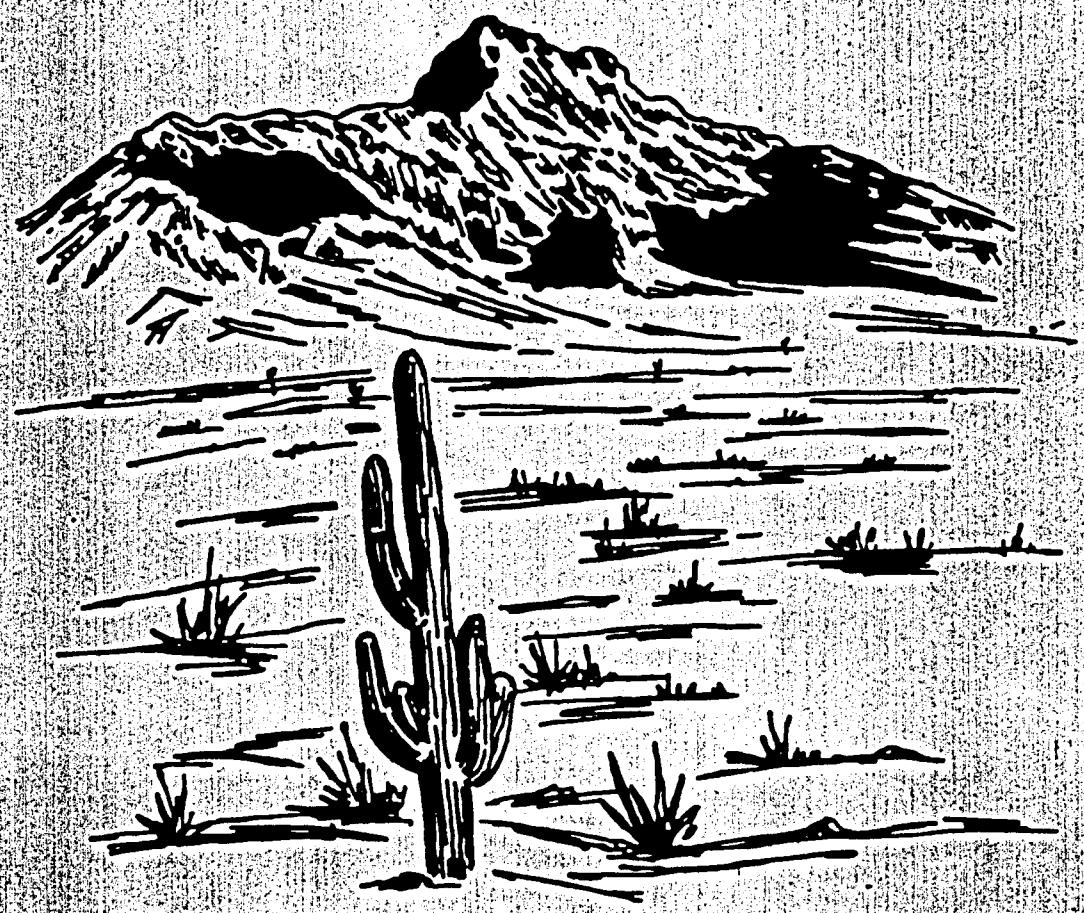

BM 2565
Ritter Tank
31
32
32
33
2534
2560
2600
2580
2700
2520
2582
2677
2540
2600
6
5
4
3
2500
2544
2640
2620
9
10
8
2800
2631
Ritter Dam
2700
2800
17
16
2862
2500
2511
CORRECT THIS
Should
RITTER DAM ERROR.
WATERSHED

07.52

SADDLEBACK F.R.S. AND DIVERSION

AS-BUILTS

HARQUAHALA W.P.P.



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WATER RESOURCES

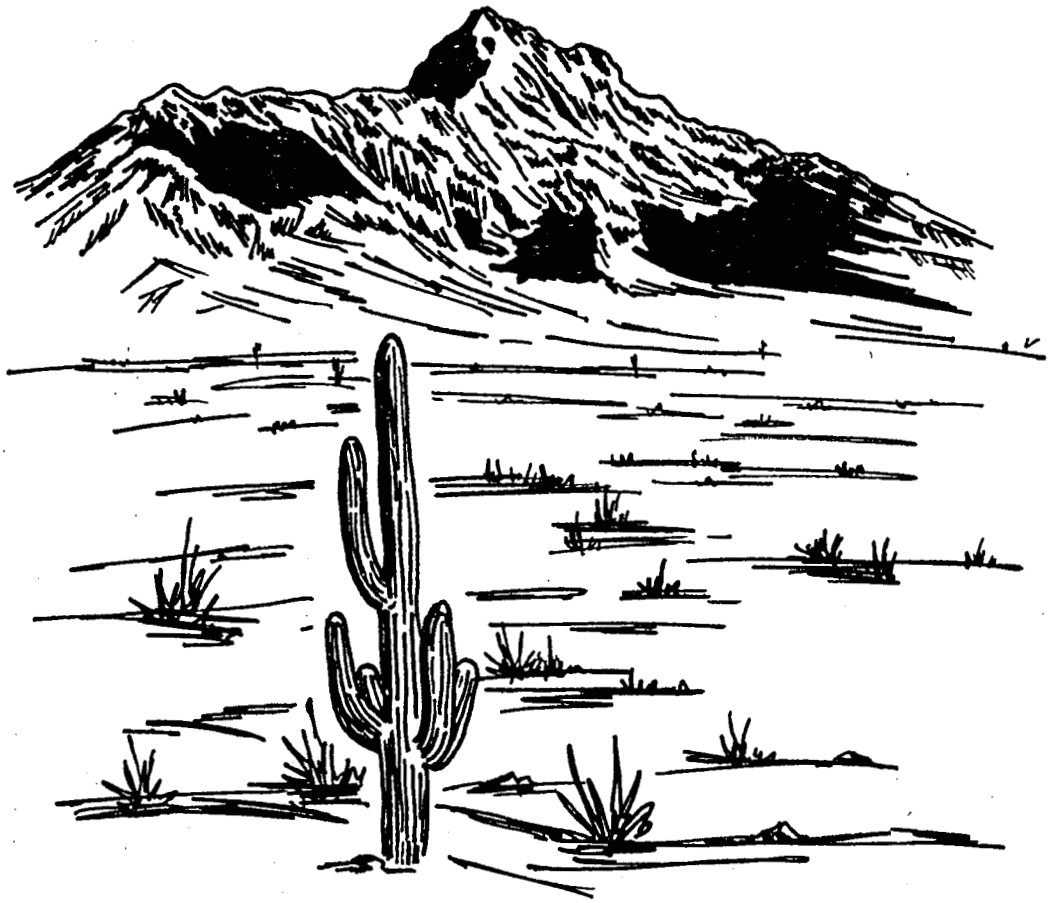
U.S. Department of Agriculture
Soil Conservation Service

FINAL

Environmental Impact Statement

Harquahala Valley Watershed

Maricopa and Yuma Counties, Arizona March, 1977



D
HAR

U. S. Department of Agriculture
Soil Conservation Service

DRAFT

Supplemental Watershed Work Plan Nº 1

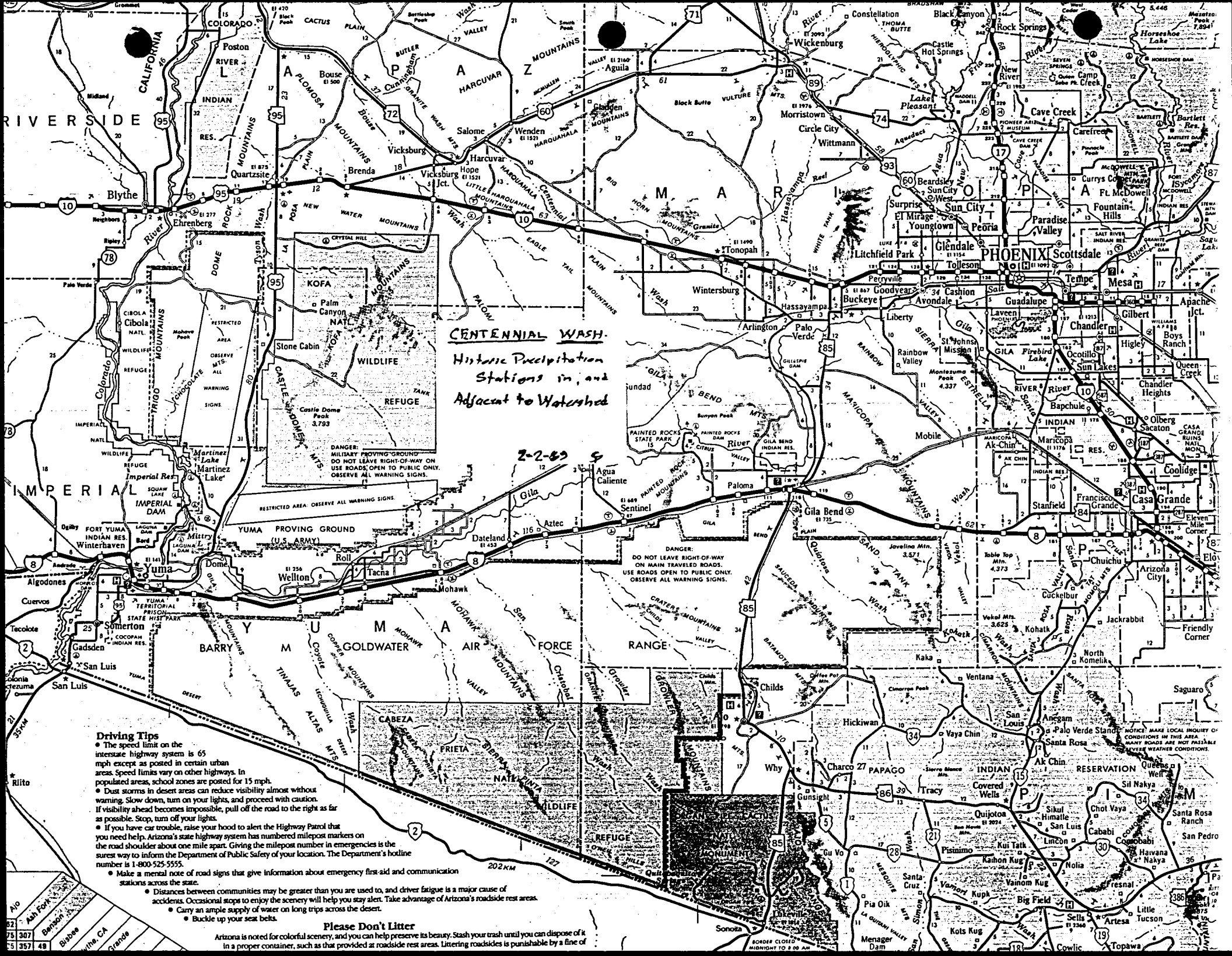
Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona

March, 1976

Prepared under the authority of the Watershed Protection & Flood Prevention Act (Public law 566, 83rd. Congress, 68 Stat. 666) as amended.

04D
HARs



Driving Tips

- The speed limit on the interstate highway system is 65 mph except as posted in certain urban areas. Speed limits vary on other highways. In populated areas, school zones are posted for 15 mph.
- Dust storms in desert areas can reduce visibility almost without warning. Slow down, turn on your lights, and proceed with caution. If visibility ahead becomes impossible, pull off the road to the right as far as possible. Stop, turn off your lights.
- If you have car trouble, raise your hood to alert the Highway Patrol that you need help. Arizona's state highway system has numbered milepost markers on the road shoulder about one mile apart. Giving the milepost number in emergencies is the surest way to inform the Department of Public Safety of your location. The Department's hotline number is 1-800-525-5555.
- Make a mental note of road signs that give information about emergency first-aid and communication stations across the state.
- Distances between communities may be greater than you are used to, and driver fatigue is a major cause of accidents. Occasional stops to enjoy the scenery will help you stay alert. Take advantage of Arizona's roadside rest areas.
- Carry an ample supply of water on long trips across the desert.
- Buckle up your seat belts.

Please Don't Litter

Arizona is noted for colorful scenery, and you can help preserve its beauty. Stash your trash until you can dispose of it in a proper container, such as that provided at roadside rest areas. Littering roadsides is punishable by a fine of

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'12" (revised), long 112°47'50", in sec.7, T.2 S., R.5 W., on upstream side of ford on former U.S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1968.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Average discharge.--7 years, 2.23 cfs (1,610 acre-ft per year).

Extremes.--Maximum discharge during year, 5,330 cfs Dec. 19 (gage height, 4.11 ft); no flow for most of year.
1961-68: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time each year.

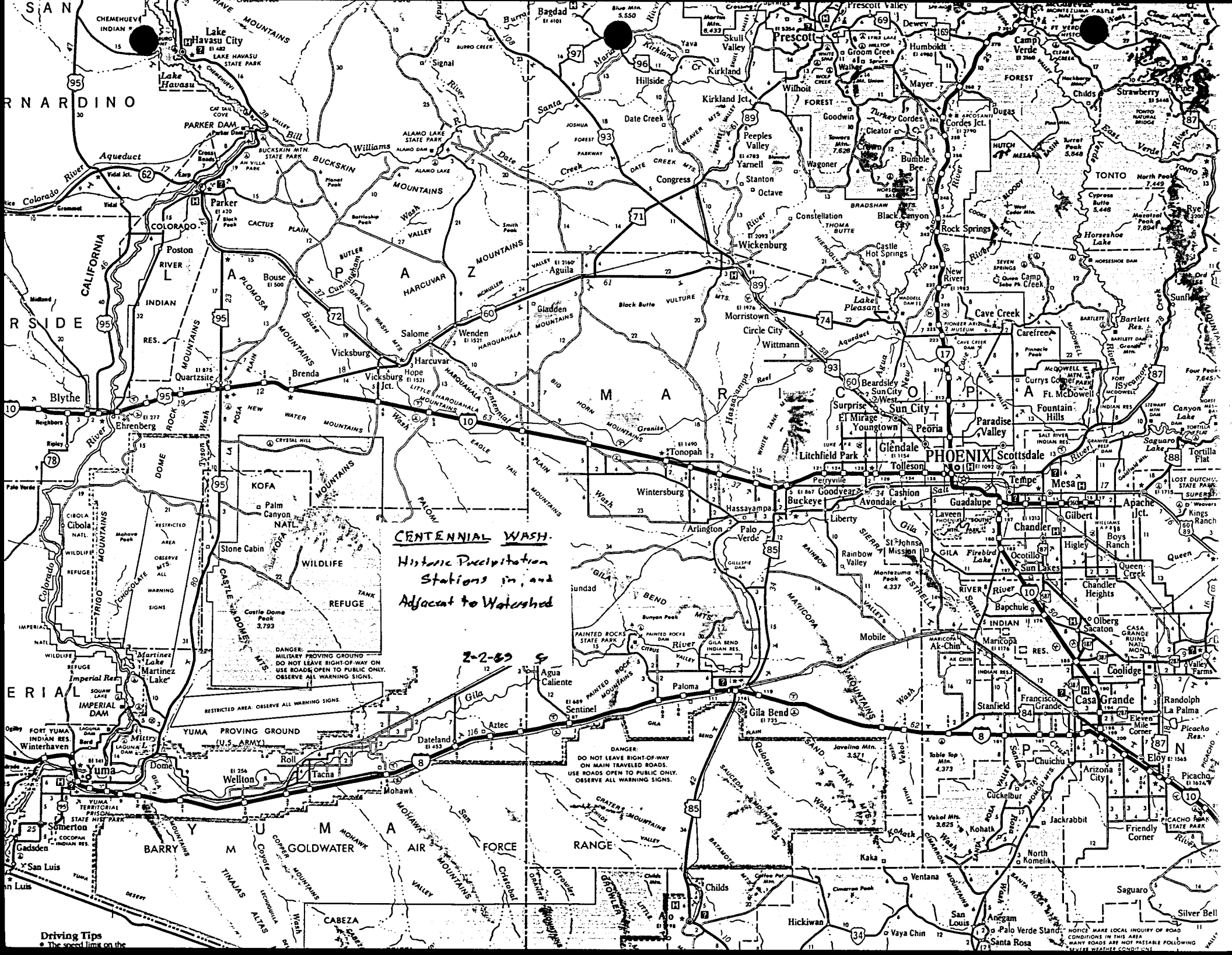
Remarks.--Records fair except flows below 100 cfs, which are poor. Flow regulated by several small retention dams in upper end of basin.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	4.4	0	0
7	0	0	0	0	0	0	0	0	0	.50	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	3.6	0	0	0	0	0	0	0
15	0	0	0	0	1.2	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	690	0	0	0	0	0	0	0	0	0
20	0	0	1,010	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	------	0	0	0	0	0	0	0
31	0	------	0	0	------	0	------	0	------	0	0	------
TOTAL	0	0	1,700	0	4.8	0	0	0	0	4.90	0	0
MEAN	0	0	54.8	0	.17	0	0	0	0	.16	0	0
MAX	0	0	1,010	0	3.6	0	0	0	0	4.4	0	0
MIN	0	0	0	0	0	0	0	0	0	0	0	0
AC-FT	0	0	3,370	0	9.5	0	0	0	0	9.7	0	0

CAL YR 1967	TOTAL 2,167.70	MEAN 5.94	MAX 1,010	MIN 0	AC-FT 4,300
WTR YR 1968	TOTAL 1,709.70	MEAN 4.67	MAX 1,010	MIN 0	AC-FT 3,390

Peak discharge (base, 1,000 cfs).--Dec. 19 (2400) 5,330 cfs (4.11 ft).


CENTENNIAL WASH.
Historic Precipitation Stations in, and Adjacent to Watershed
2-2-83
DANGER: MILITARY PROVING GROUND DO NOT LEAVE RIGHT-OF-WAY ON USE ROADS OPEN TO PUBLIC ONLY. OBSERVE ALL WARNING SIGNS.
DANGER: DO NOT LEAVE RIGHT-OF-WAY ON MAIN TRAVELED ROADS. USE ROADS OPEN TO PUBLIC ONLY. OBSERVE ALL WARNING SIGNS.
RESTRICTED AREA: OBSERVE ALL WARNING SIGNS.
YUMA PROVING GROUND (U.S. ARMY)
BARRY M. GOLDWATER AIR FORCE RANGE
PHOENIX
Prescott
Lake Havasu City
Yuma
Tucson
Driving Tips
• The speed limit on the
NOTICE: MAKE LOCAL INQUIRY OF ROAD CONDITIONS IN THIS AREA. MANY ROADS ARE NOT PASSABLE FOLLOWING SEVERE WEATHER CONDITIONS

****

Sub 26

26/27
EAGLETAIL
Detention

```
331 LS        SCS LOSS RATE
                 STRTL        0.53  INITIAL ABSTRACTION
                 CRVNBR      79.00  CURVE NUMBER
                 RTIMP        0.00  PERCENT IMPERVIOUS AREA

332 UD        SCS DIMENSIONLESS UNITGRAPH
                 TLAG         3.19  LAG
                              2.36

                                        ***

                                   UNIT HYDROGRAPH
                              34 END-OF-PERIOD ORDINATES
          368.    1082.    2191.    3722.    5061.    5799.    5948.    5674.    5085.    4328.
         3345.    2556.    2004.    1592.    1276.    1009.     791.     623.     493.     389.
          304.     239.     191.     152.     119.      93.      75.      61.      50.      40.
           29.      21.      12.       3.

    ***         ***         ***         ***         ***
              HYDROGRAPH AT STATION    SUB26

  TOTAL RAINFALL =  4.12, TOTAL LOSS =  2.06, TOTAL EXCESS =  2.06

PEAK FLOW    TIME                    MAXIMUM AVERAGE FLOW
                             6-HR       24-HR       72-HR      99.50-HR

+  (CFS)     (HR)
                      (CFS)
+   8348.    15.50              6240.      2348.        783.        567.
                    (INCHES)    1.368      2.059       2.061       2.061
    10378            (AC-FT)    3094.      4657.       4661.       4661.

              CUMULATIVE AREA =    42.40 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          ***************
          *             *
333 KK    *      19     *   COMBINE 1-25 WITH 26
          *             *
          ***************
                    ADD TWO HYDROGRAPHS

335 HC       HYDROGRAPH COMBINATION
                 ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                        ***

    ***         ***         ***         ***         ***
              HYDROGRAPH AT STATION        19

PEAK FLOW    TIME                    MAXIMUM AVERAGE FLOW
                             6-HR       24-HR       72-HR      99.50-HR

+  (CFS)     (HR)
                      (CFS)
+  53202.    28.00             50235.     36818.      18346.      13611.
```

```
                    (INCHES)     0.421       1.234       1.844       1.891
                     (AC-FT)    24910.      73027.     109164.     111929.

                    CUMULATIVE AREA = 1109.70 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
336 KK      *       14   *      ROUTE HYDROGRAPH 1-26 THROUGH REACH 14
            *            *
            **************

              HYDROGRAPH ROUTING DATA

337 RL          ROUTING LOSSES
                     QLOSS        0.00  INITIAL LOSS
                     CLOSS        0.00  ADDITIONAL FRACTION LOST

338 RS          STORAGE ROUTING
                     NSTPS          14  NUMBER OF SUBREACHES
                      ITYP        FLOW  TYPE OF INITIAL CONDITION
                    RSVRIC       -1.00  INITIAL CONDITION
                         X        0.00 WORKING R AND D COEFFICIENT

339 RC          NORMAL DEPTH CHANNEL ROUTING
                       AML       0.065  LEFT OVERBANK N-VALUE
                      ANCH       0.045  MAIN CHANNEL N-VALUE
                       ANR       0.065  RIGHT OVERBANK N-VALUE
                     RLNTH      46354.  REACH LENGTH
                       SEL      0.0027  ENERGY SLOPE
                     ELMAX         0.0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
341 RY       ELEVATION  1100.00  1096.00  1092.00  1090.00  1088.00  1090.00  1092.00  1098.00
340 RX       DISTANCE      0.00  2900.00  5300.00  5440.00  5630.00  5720.00  5730.00  8140.00

                                                 ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA
          STORAGE       0.00    29.71   118.85   267.42   465.83   696.47   958.94  1340.65  2125.70  3335.93
          OUTFLOW       0.00    22.28   141.44   417.03   932.09  1662.43  2610.83  3958.31  5971.77  8887.00
        ELEVATION    1088.00  1088.63  1089.26  1089.89  1090.53  1091.16  1091.79  1092.42  1093.05  1093.68
          STORAGE    4971.35  7031.95  9517.74 12431.66 15812.03 19670.65 24005.14 28706.59 33715.77 39032.71
          OUTFLOW   12947.70 18367.96 25343.48 33994.13 44481.53 57141.51 72368.65 91153.86 112509.87 136501.47
        ELEVATION    1094.32  1094.95  1095.58  1096.21  1096.84  1097.47  1098.11  1098.74  1099.37  1100.00

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN     1662. TO   136501.
          THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
          THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

    ***          ***          ***          ***          ***
                   HYDROGRAPH AT STATION      14
```

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	99.50-HR
+ (CFS)	(HR)					
		(CFS)				
+ 52167.	31.50		49473.	36666.	18325.	13516.
62177	28.50	(INCHES)	0.415	1.229	1.842	1.878
		(AC-FT)	24532.	72726.	109042.	111143.
						113096

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	99.50-HR
+ (AC-FT)	(HR)					
1297.	31.50		1238.	945.	478.	353.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	99.50-HR
+ (FEET)	(HR)					
1097.23	31.50		1097.09	1096.32	1094.39	1093.04

CUMULATIVE AREA = 1109.70 SQ MI

*** ***

```
              **************
              *            *
 342 KK       *   SUB27    *
              *            *
              **************
                        RUNOFF FROM SUBBASIN 27

                SUBBASIN RUNOFF DATA

 344 BA           SUBBASIN CHARACTERISTICS
                        TAREA        62.10  SUBBASIN AREA

                  PRECIPITATION DATA

 320 PB                 STORM         4.12  BASIN TOTAL PRECIPITATION

 321 PI             INCREMENTAL PRECIPITATION PATTERN
                      0.00    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01
                      0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.02    0.02
                      0.02    0.03    0.05    0.38    0.07    0.04    0.03    0.02    0.02    0.01
                      0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01
                      0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01

 345 LS           SCS LOSS RATE
                        STRTL         0.60  INITIAL ABSTRACTION
                        CRVNBR       77.00  CURVE NUMBER
                        RTIMP         0.00  PERCENT IMPERVIOUS AREA

 346 UD           SCS DIMENSIONLESS UNITGRAPH
                        TLAG          4.35  LAG
                        3             3.13
```

***

UNIT HYDROGRAPH
45 END-OF-PERIOD ORDINATES

235.	754.	1443.	2385.	3604.	4849.	5785.	6338.	6508.	6466.
6083.	5587.	5003.	4265.	3454.	2822.	2357.	1968.	1671.	1412.
1189.	976.	828.	689.	583.	484.	406.	337.	284.	239.
200.	169.	140.	118.	97.	83.	70.	62.	53.	45.
36.	28.	21.	14.	7.					

HYDROGRAPH AT STATION SUB27

TOTAL RAINFALL = 4.12, TOTAL LOSS = 2.21, TOTAL EXCESS = 1.91

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
		(CFS)				
8912.	16.50		7451.	3172.	1061.	768.
11083		(INCHES)	1.116	1.900	1.906	1.906
		(AC-FT)	3695.	6292.	6313.	6313.

CUMULATIVE AREA = 62.10 SQ MI

*** ***

```
              ***************
              *             *
347 KK        *        3    *     ROUTE (EAGLETAIL REACH)
              *             *
              ***************
```

ROUTE HYDROGRAPH THROUGH DETENTION STRUCTURE

HYDROGRAPH ROUTING DATA

```
337 RL        ROUTING LOSSES
                   QLOSS        0.00  INITIAL LOSS
                   CLOSS        0.00  ADDITIONAL FRACTION LOST

349 RS        STORAGE ROUTING
                   NSTPS          1  NUMBER OF SUBREACHES
                    ITYP        ELEV  TYPE OF INITIAL CONDITION
                  RSVRIC     1252.50  INITIAL CONDITION
                       X        0.00  WORKING R AND D COEFFICIENT

350 SV          STORAGE        5.0     50.0    155.0    310.0    525.0    790.0   1110.0   1485.0   1905.0   2355.0

351 SE        ELEVATION    1252.50  1253.00  1253.50  1254.00  1254.50  1255.00  1255.50  1256.00  1256.50  1257.00

352 SQ        DISCHARGE        0.      20.      50.      90.     140.     200.     260.     325.     400.     475.
```

***

29

HYDROGRAPH AT STATION 3

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
		(CFS)				
952.	29.00		946.	888.	695.	554.
948		(INCHES)	0.142	0.532	1.250	1.376
		(AC-FT)	469.	1761.	4138.	4558.

PEAK STORAGE (AC-FT)	TIME (HR)	MAXIMUM AVERAGE STORAGE 6-HR	24-HR	72-HR	99.50-HR
5220.	29.00	5184.	4832.	3678.	2902.

PEAK STAGE (FEET)	TIME (HR)	MAXIMUM AVERAGE STAGE 6-HR	24-HR	72-HR	99.50-HR
1260.18	29.00	1260.14	1259.75	1258.47	1257.35

57.0
3.18

CUMULATIVE AREA = 62.10 SQ MI

OT 3.18

OVERTOP
1257.00

353 KK 20 COMBINE 1-26 WITH 27

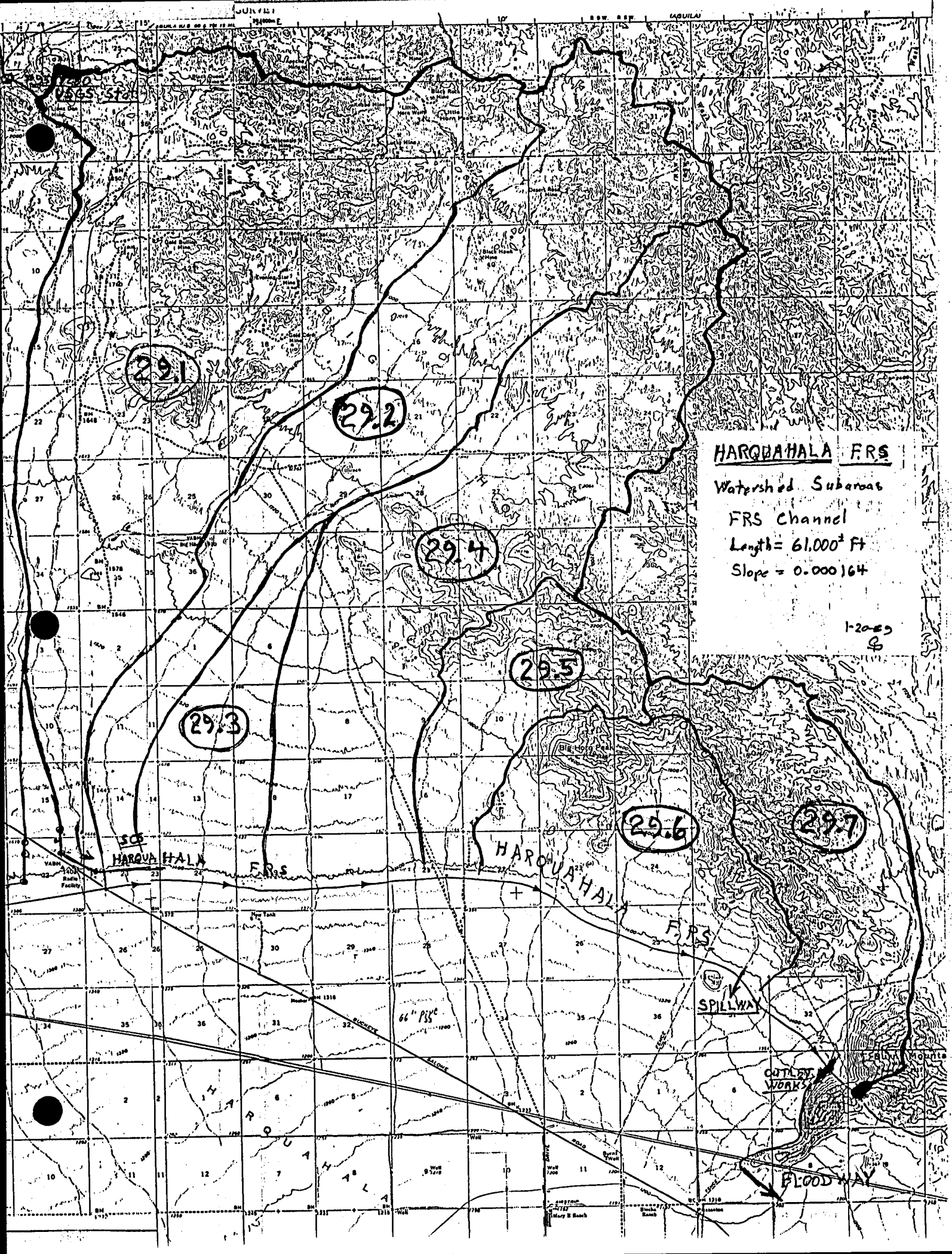
ADD TWO HYDROGRAPHS

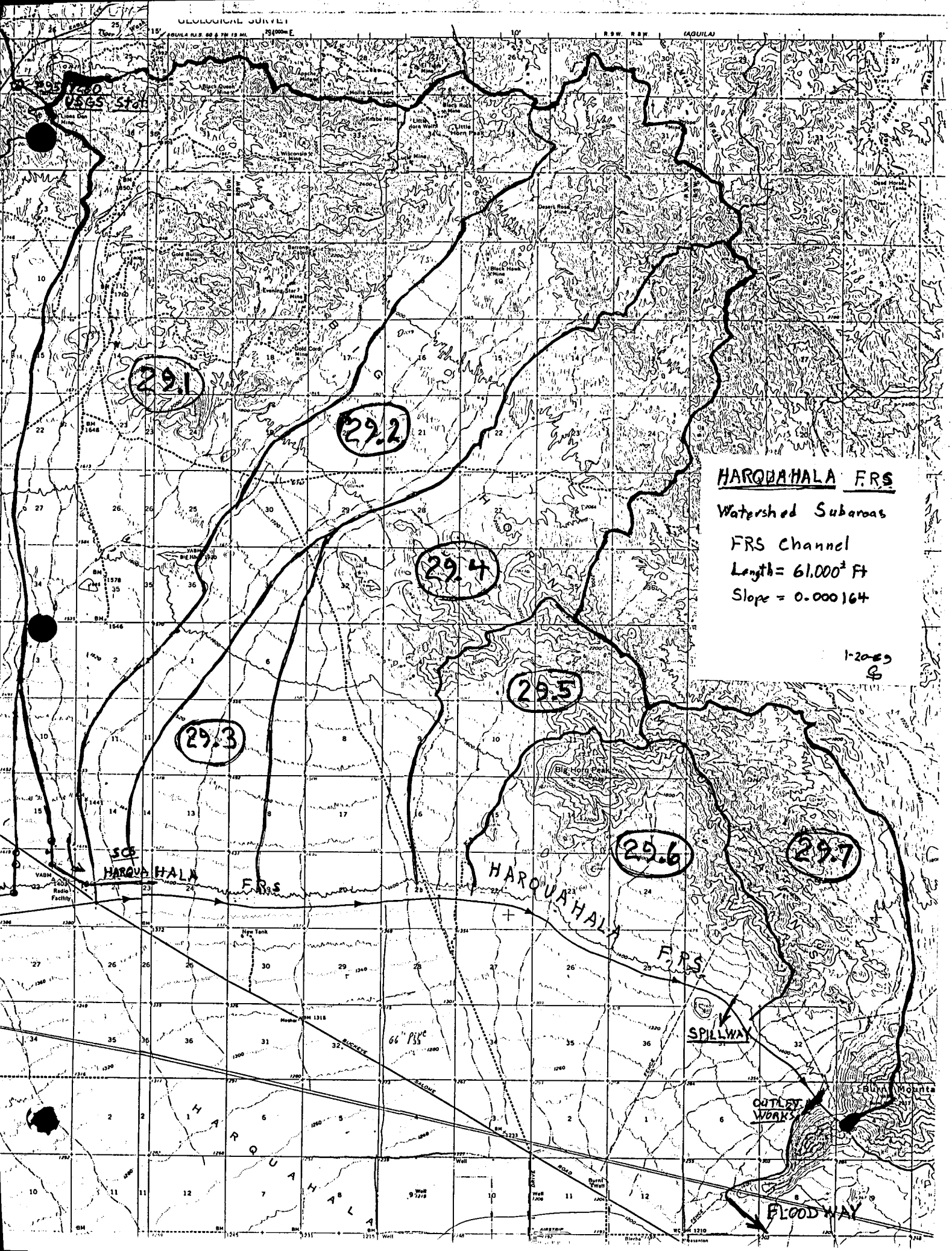
355 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

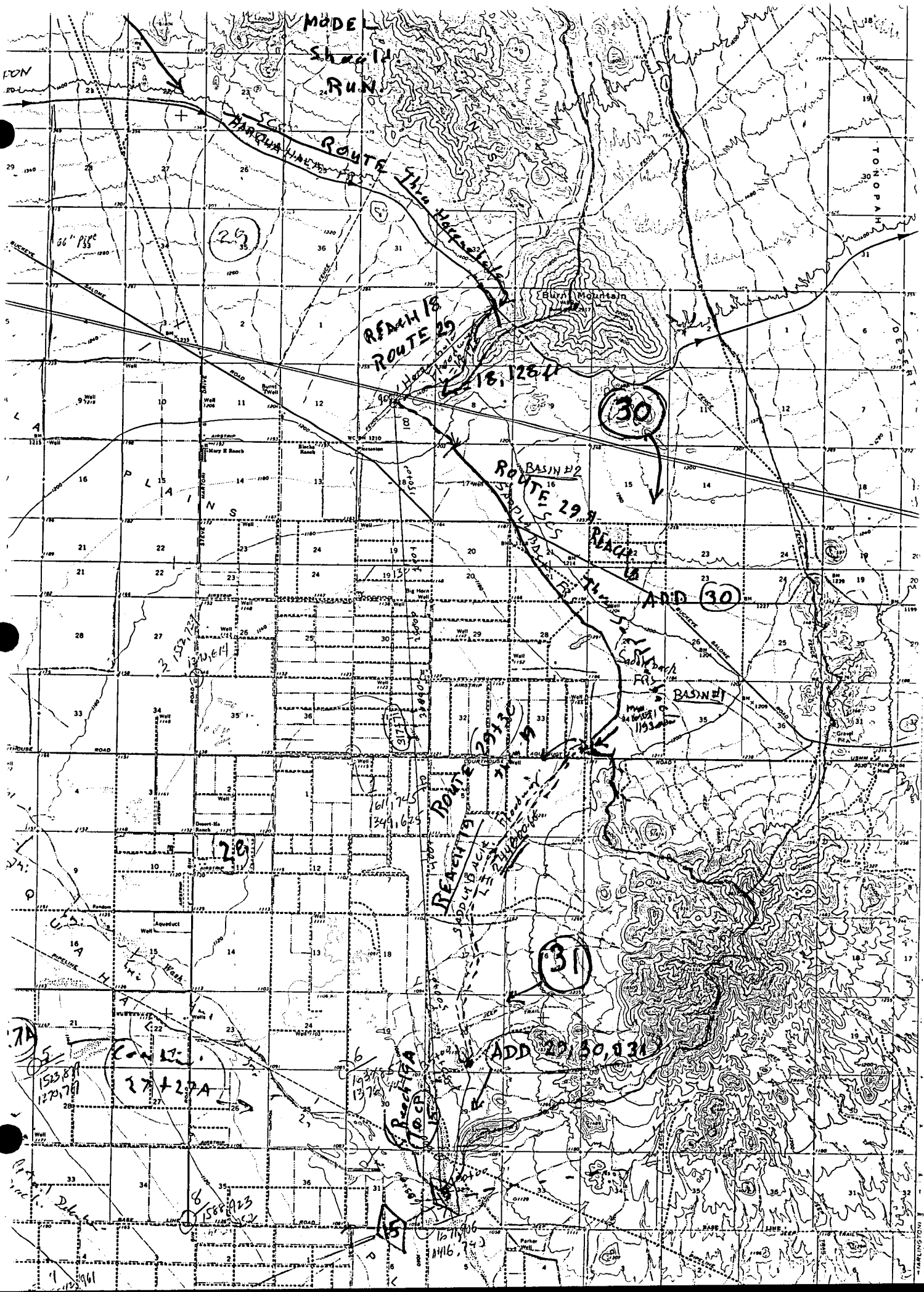
HYDROGRAPH AT STATION 20

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
		(CFS)				
+ 53110.	31.50		50410.	37547.	19020.	14070.
63117	29.0	(INCHES)	0.400	1.192	1.811	1.851
		(AC-FT)	24997.	74473.	113179.	115701.

CUMULATIVE AREA = 1171.80 SQ MI


USGS Stat
29.1
29.2
29.4
29.5
29.3
29.6
29.7
HARQUAHALA FRS
Watershed Subareas
FRS Channel
Length = 61,000 Ft
Slope = 0.000164
1-20-89
SCS
HARQUAHALA FRS
HARQUAHALA FRS
SPILLWAY
OUTLET WORKS
FLOOD WAY
66" PSC


HARQUAHALA F.R.S
Watershed Subareas
FRS Channel
Length = 61,000 Ft
Slope = 0.000164
1-20-89
29.1
29.2
29.3
29.4
29.5
29.6
29.7
SCS
HARQUAHALA F.R.S
HARQUAHALA F.R.S
SPILLWAY
OUTLET WORKS
FLOOD WAY
Big Horn Peak
Radio Facility
New Tank
66" Pipe
Desert Rose Mine
Black Hawk Mine
Evening Star Mine
Gold Cord Mine
Gold Bullion Mine
Wisconsin Mine
Little Horn Peak
Black Rock Mine
Hollis Development
Lions Den Mine
Dead Horse Tank
Well
Burnt Well
Airstrip
Ranch
Reservation


MODEL
Should
RUN
ROUTE Thru Harquahala
Burnt Mountain
REACH 18
ROUTE 25
18,128 cfs
30
BASIN #2
ROUTE 29
REACH 19
ADD 30
BASIN #1
Saddle Back Flats
Route 29
REACH 19
31
ADD 29, 30, & 31
Cont. 27 + 27A
REACH 17
15
TONOPAH
DESERT
LA PLAINS
HARQUAHALA
Aqueduct
Mary E Ranch
Desert-Ele Ranch
Big Horn Well
Courthouse
Airstrip
Burnt Well
Parker Well
Random
Well
Fence
Pipeline
Wash
Road
Trail
Jeep
Base Line
Buckeye
Salome
Tribune
Harrison
Steele
Courtland
Arlington

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
		(CFS)				
+ 15639.	23.00		14636.	9426.	3274.	2369.
22143.	16.50	(INCHES)	0.844	2.175	2.266	2.266
		(AC-FT)	7257.	18697.	19479.	19479.

CUMULATIVE AREA = 161.20 SQ MI

255 KK ROUTE (TIGER WASH DETENTION BASIN)

ROUTE HYDROGRAPH THROUGH TIGER WASH DETENTION BASIN

Hd = 1.0 Q = 3.06 x 800 x 1 = 2400

Spwy W = 800

Invert Elev. 1389

Borrowpit 1389.00

Spwy 1405.00

Ow Crest 1392.0

HYDROGRAPH ROUTING DATA

256 RL ROUTING LOSSES

QLOSS	0.00	INITIAL LOSS
CLOSS	0.00	ADDITIONAL FRACTION LOST

257 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	1390.00	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

258 SV	STORAGE	0.0	0.0	0.0	1716.0	6218.0	6973.0	7765.0	9460.0	11302.0	15428.0
259 SE	ELEVATION	Borrow pit 1390.00	1393.00	1397.00	1401.00	1405.00	1405.50	1406.00	1407.00	1408.00	1410.00
260 SQ	DISCHARGE	0.	591.	903.	1132.	1322.	1637.	2287.	4307.	7108.	14651.

Invert 1392.0

1H +2400 3700+

***

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 0. TO 903.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

HYDROGRAPH AT STATION 2

PEAK FLOW (CFS)	TIME (HR)		MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	99.50-HR
		(CFS)				
+ 7509.	31.50		7311.	5258.	2675.	2109.

```
                    (INCHES)    0.422      1.213      1.851      2.017
                    (AC-FT)     3625.     10429.     15918.     17340.

 PEAK STORAGE   TIME                    MAXIMUM AVERAGE STORAGE
                                   6-HR       24-HR      72-HR    99.50-HR
+ (AC-FT)       (HR)
   11521.      31.50              11411.     10011.      6836.      5223.

 PEAK STAGE     TIME                    MAXIMUM AVERAGE STAGE
                                   6-HR       24-HR      72-HR    99.50-HR
+ (FEET)        (HR)
  1408.11      31.50            1408.05     1407.28    1405.15    1402.61

                    CUMULATIVE AREA =  161.20 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          ***************
          *             *
 261 KK   *        15   *     COMBINE 1-20 WITH 21
          *             *
          ***************
                       ADD TWO HYDROGRAPHS

 263 HC        HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE

                                                   ***

     ***            ***            ***            ***            ***
                       HYDROGRAPH AT STATION      15

 PEAK FLOW      TIME                    MAXIMUM AVERAGE FLOW
                                   6-HR       24-HR      72-HR    99.50-HR
+ (CFS)         (HR)
                       (CFS)
+ 51945.       25.00              48694.     35132.     16794.     12461.
 69245         23.5   (INCHES)    0.454      1.309      1.877      1.925
                       (AC-FT)    24146.     69683.     99932.    102466.

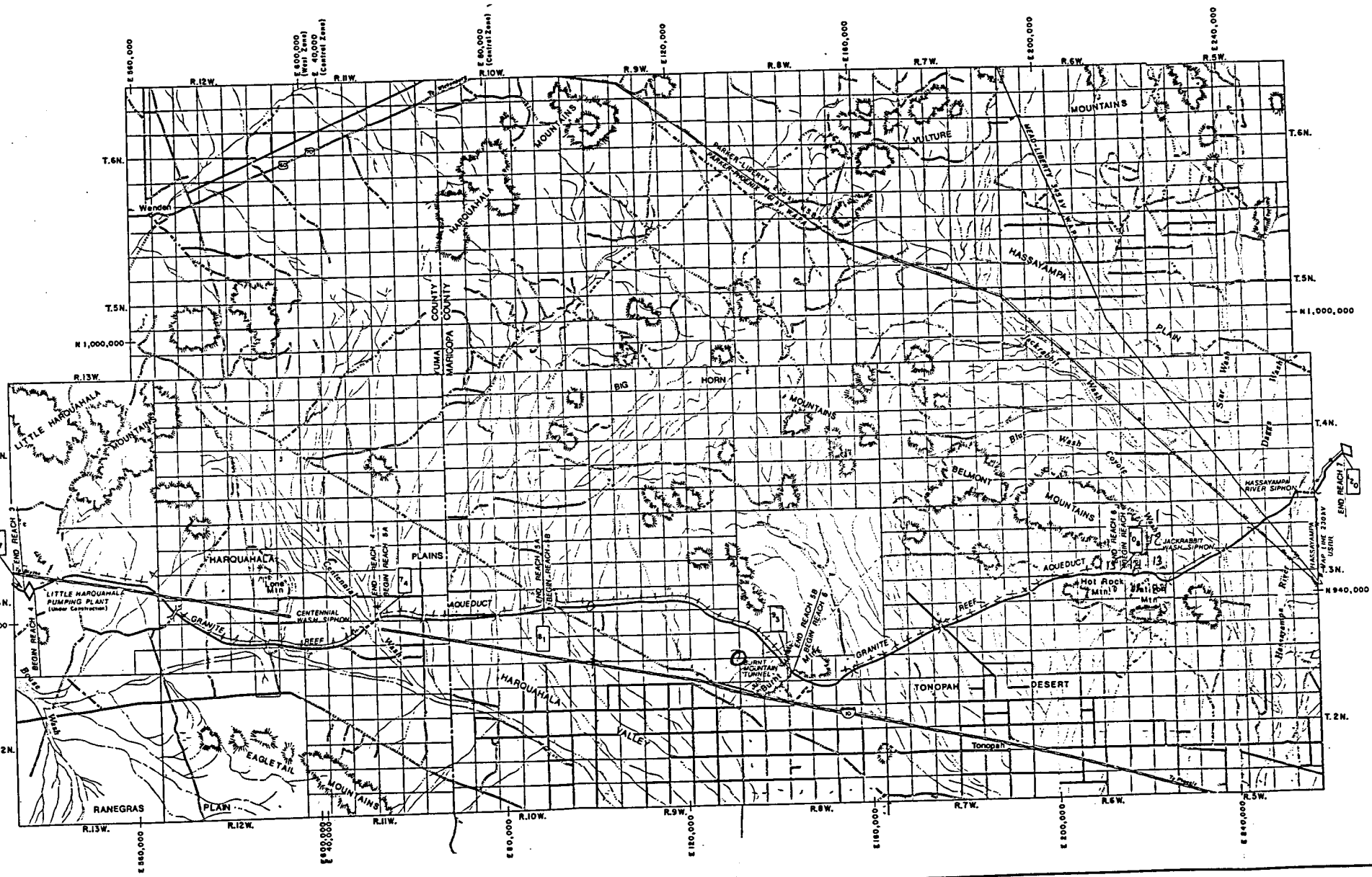
                    CUMULATIVE AREA =  998.20 SQ MI

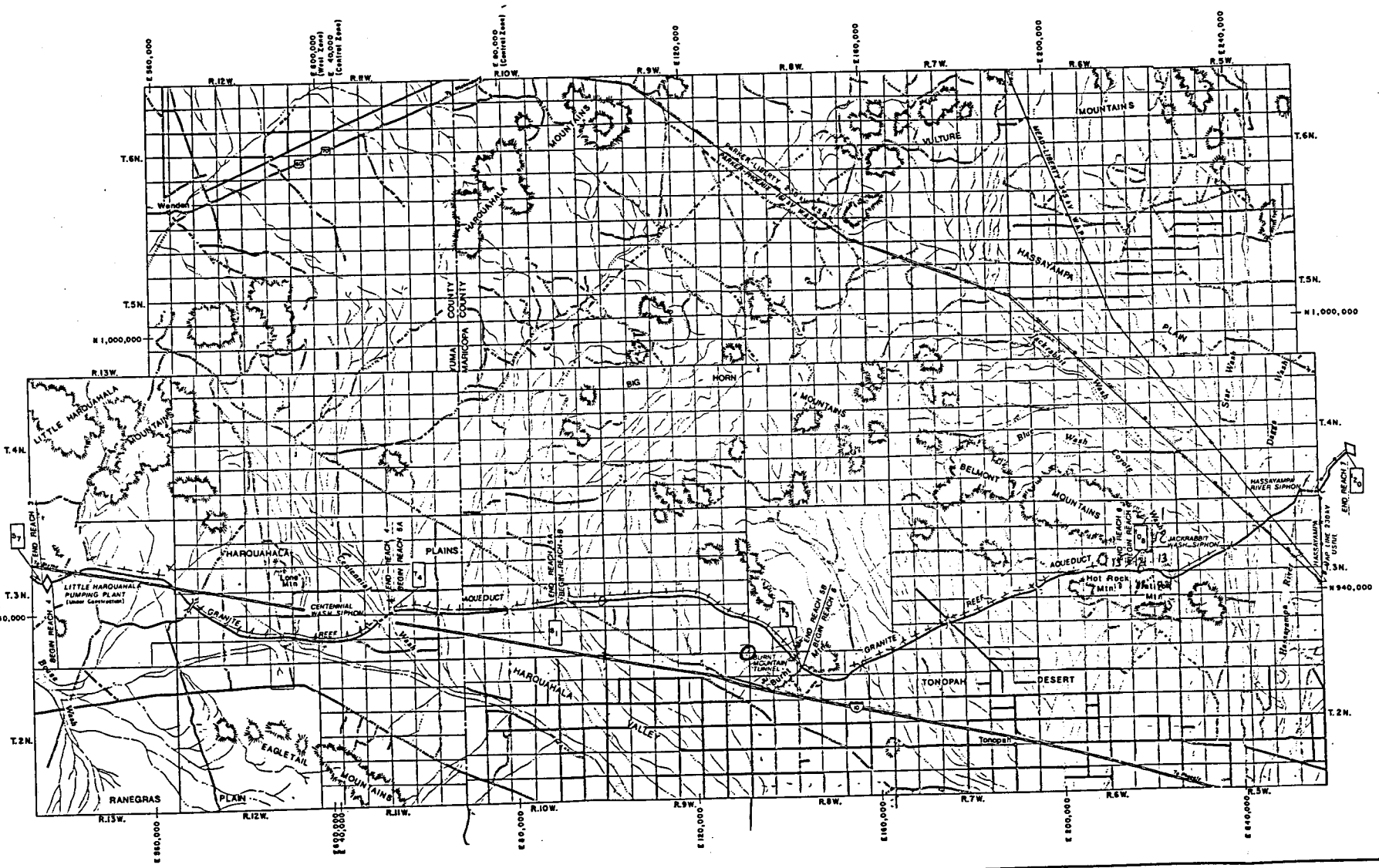

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

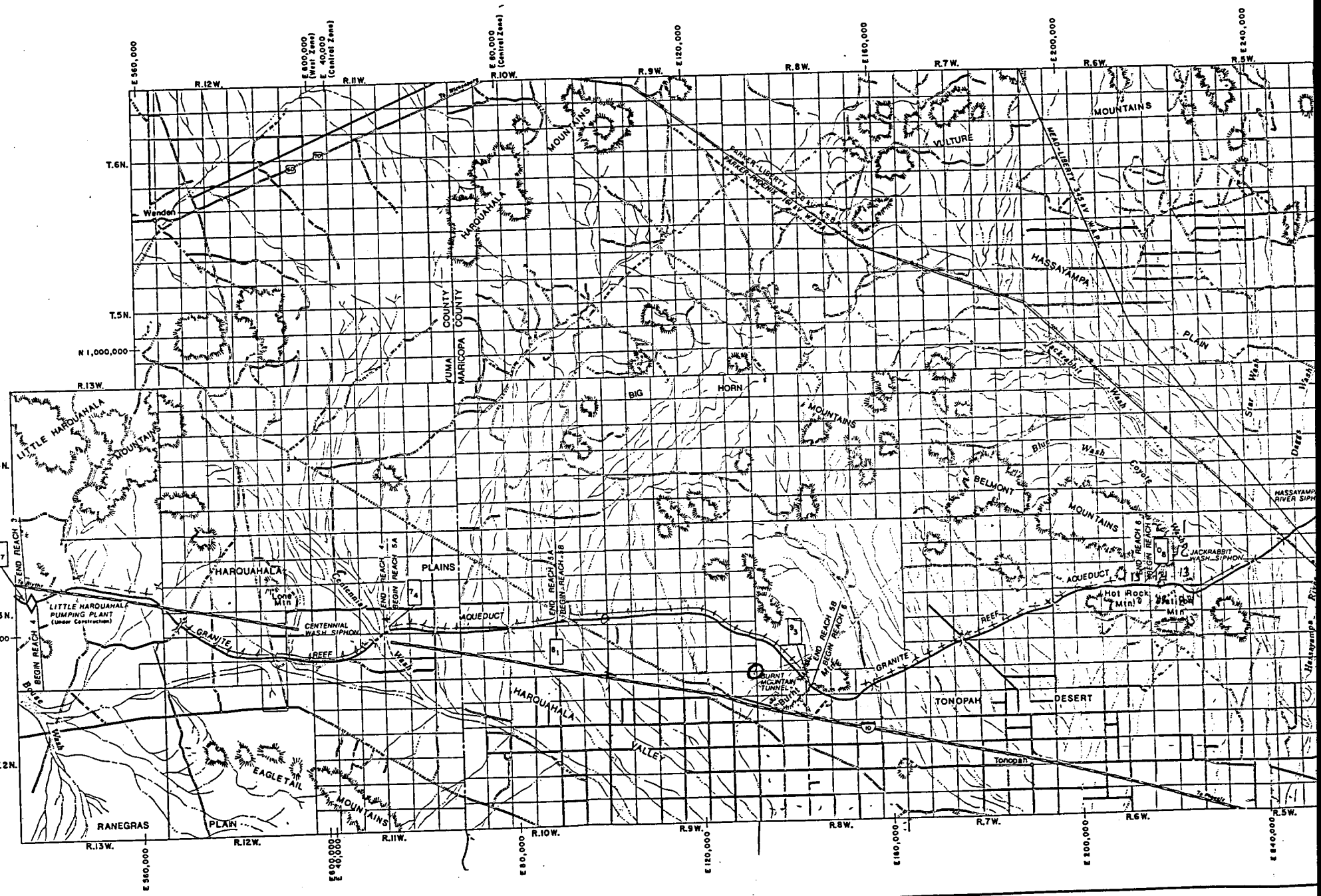
          ***************
          *             *
 264 KK   *        10   *     ROUTE HYDROGRAPH 1-21 THROUGH REACH 10
          *             *
          ***************

          HYDROGRAPH ROUTING DATA

 265 RL        ROUTING LOSSES
```


E 560,000
E 600,000 (West Zone)
E 40,000 (Central Zone)
E 80,000 (Central Zone)
E 120,000
E 160,000
E 200,000
E 240,000
R.13W.
R.12W.
R.11W.
R.10W.
R.9W.
R.8W.
R.7W.
R.6W.
R.5W.
T.6N.
T.5N.
T.4N.
T.3N.
T.2N.
N 1,000,000
N 940,000
Wendel
LITTLE HARQUAHALA MOUNTAIN
HARQUAHALA MOUNTAINS
YUMA COUNTY
MARICOPA COUNTY
VULTURE MOUNTAINS
HASSAYAMPA PLAIN
BIG HORN MOUNTAINS
BELMONT MOUNTAINS
HARQUAHALA PLAINS
HARQUAHALA VALLEY
TONOPAH DESERT
RANEGRAS PLAIN
EAGLETAIL MOUNTAINS
LITTLE HARQUAHALA PUMPING PLANT (Under Construction)
CENTENNIAL WASH SIPHON
GRANITE REEF AQUEDUCT
BURNT MOUNTAIN TUNNEL
HASSAYAMPA RIVER SIPHON
JACKRABBIT WASH SIPHON
Hot Rock Mtn
Tonopah
BEGIN REACH 4
END REACH 2
END REACH 4
BEGIN REACH 5A
END REACH 5A
BEGIN REACH 5B
END REACH 5B
BEGIN REACH 6
END REACH 6
BEGIN REACH 7
END REACH 7
HASSAYAMPA 230 KV TRANSMISSION LINE


T.6N.
T.5N.
T.4N.
T.3N.
T.2N.
R.13W.
R.12W.
R.11W.
R.10W.
R.9W.
R.8W.
R.7W.
R.6W.
R.5W.
E 960,000
E 800,000 (West Zone)
E 40,000 (Central Zone)
E 80,000 (Central Zone)
E 120,000
E 160,000
E 200,000
E 240,000
N 1,000,000
N 940,000
Wendel
LITTLE HARQUAHALA MOUNTAINS
HARQUAHALA MOUNTAINS
YUMA COUNTY
MARICOPA COUNTY
VULTURE MOUNTAINS
HASSAYAMPA PLAIN
BIG HORN MOUNTAINS
BELMONT MOUNTAINS
HARQUAHALA PLAINS
HARQUAHALA VALLEY
TONOPAH DESERT
RANEGRAS PLAIN
EAGLETAIL MOUNTAINS
LITTLE HARQUAHALA PUMPING PLANT (Under Construction)
CENTENNIAL WASH SIPHON
AQUEDUCT
GRANITE REEF
BURNT MOUNTAIN TUNNEL
HASSAYAMPA RIVER SIPHON
MACRABBIT WASH SIPHON
Hot Rock Mtn.
Tonopah
BEGIN REACH 1
END REACH 1
BEGIN REACH 2
END REACH 2
BEGIN REACH 5A
END REACH 5A
BEGIN REACH 5B
END REACH 5B
BEGIN REACH 6
END REACH 6
BEGIN REACH 7
END REACH 7
Hassayampa River
Big Sandy Wash
Blue Wash
Copper Wash
Star Wash
Date Wash
Wash


E 560,000
E 600,000 (West Zone)
E 40,000 (Central Zone)
E 80,000 (Central Zone)
E 120,000
E 160,000
E 200,000
E 240,000
R.13W.
R.12W.
R.11W.
R.10W.
R.9W.
R.8W.
R.7W.
R.6W.
R.5W.
T.6N.
T.5N.
T.4N.
T.3N.
T.2N.
N 1,000,000
N 940,000
Wenden
HARQUAHALA
MOUNTAINS
VULTURE
MOUNTAINS
HASSAYAMPA
PLAIN
YUMA COUNTY
MARICOPA COUNTY
BIG
HORN
MOUNTAINS
LITTLE HARQUAHALA
MOUNTAINS
BELMONT
MOUNTAINS
HARQUAHALA
PLAINS
Long Mtn
Centennial
END REACH 4
BEGIN REACH 5A
END REACH 5A
BEGIN REACH 5B
END REACH 5B
BEGIN REACH 6
END REACH 6
BEGIN REACH 7
END REACH 2
BEGIN REACH 4
LITTLE HARQUAHALA PUMPING PLANT (Under Construction)
CENTENNIAL WASH SIPHON
AQUEDUCT
GRANITE REEF
Wash
BURNT MOUNTAIN TUNNEL
HARQUAHALA VALLEY
TONOPAH
DESERT
Tonopah
Hot Rock Min
Mtn
JACKRABBIT WASH SIPHON
HASSAYAMPA RIVER SIPH
Blue Wash
Coyote Wash
Star Wash
Desert Wash
Hassayampa River
PARKER-LIBERTY
PARKER-PHOENIX
HEAD-LIBERTY
EAGLE TAIL
MOUNTAINS
RANEGRAS
PLAIN

MEMORANDUM

DEPARTMENT OF WATER RESOURCES
OFFICE OF THE DIRECTOR

TO: All Employees

FROM: Lin Stevens Lin

DATE: January 18, 1989

SUBJECT: Monthly Inter-divisional Talk

This is a reminder to staff that at 12 noon on next Wednesday, January 25th, there will be a "Brown Bag" luncheon.

Tom Carr and Carol Russel of The Department Of Environmental Quality will discuss "Controlling Nitrogen Pollution". Their presentation will be in the Basement Training Room, Room B014.

All staff are encouraged to attend.

OLB
Ar47w

USDA-SCS-EIS-WS-(ADM)-76-2-(F)-AZ

RECEIVED
JUN 16 1977
Arizona Water Commission

HARQUAHALA VALLEY WATERSHED
Maricopa and Yuma Counties,
Arizona

Final
Environmental Impact Statement

Responsible Federal Official

Thomas G. Rockenbaugh, State Conservationist
UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
3008 Federal Building
230 N. First Avenue
Phoenix, Arizona 85025

Sponsoring Local Organizations

Flood Control District of Maricopa County
3335 W. Durango, Phoenix, Arizona 85009

Buckeye-Roosevelt Natural Resource Conservation District
Rt. 2, Box 199, Buckeye, Arizona 85326

Wickenburg Natural Resource Conservation District
Box 146, Salome, Arizona 85348

March 1977

Prepared By

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
3008 Federal Building
230 N. First Avenue
Phoenix, Arizona 85025

Assisted By

STATE OF ARIZONA
Arizona Water Commission
222 N. Central, Ste. 800
Phoenix, Arizona 85004

VII. List of Entities from Which Written Comments Have Been Received

Federal Government

Department of Agriculture, Office of Equal Opportunity
Department of the Army
Department of Health, Education, and Welfare
Department of the Interior
Department of Transportation
Environmental Protection Agency

State and Local Agencies

Governor of Arizona
Arizona Department of Transportation
Arizona Game and Fish Department
Arizona State Land Department
Arizona State Museum
Mineral Resources Department
Arizona Water Commission
Maricopa County Board of Supervisors (includes comments from Maricopa County Parks and Recreation Department)
Maricopa County Highway Department

Other Groups

Buckeye-Roosevelt Natural Resource Conservation District
El Paso Natural Gas Company
Sierra Club

Individuals

E. Billie Bennett
Barto B. Price

VIII. Draft Statement transmitted to CEQ on April 9, 1976

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SECTION III

PROJECT IDENTIFICATION AND ENVIRONMENTAL SETTING

III. PROJECT IDENTIFICATION AND ENVIRONMENTAL SETTING

USDA SOIL CONSERVATION SERVICE
FINAL ENVIRONMENTAL IMPACT STATEMENT*

for

A. Harquahala Valley Watershed, Arizona

Installation of this project constitutes an administrative action. Federal assistance will be provided under authority of Public Law 83-566 83rd Congress, 68 Sta. 666, as amended.

B. Sponsoring Local Organizations

Flood Control District of Maricopa County
Buckeye Roosevelt Natural Resource Conservation District
Wickenburg Natural Resource Conservation District
Endorsing Organization: Harquahala Valley Association

C. Project History, Purpose and Goals

1. Introduction [1]

This statement for proposed works of improvement in Harquahala Valley Watershed is submitted in compliance with Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969 (Pub. L. 91-190, 83 Stat. 852 (42 U.S.C. 4321 et seq.), the Council on Environmental Quality Guidelines for Environmental Impact Statements, August 1, 1973 (38 FR 20550-20562), and Secretary of Agriculture Memorandum 1695, Supplement 4, as revised (Environmental Impact Statements). It covers a planned program of conservation land treatment and flood prevention for the Harquahala Valley Watershed area located primarily in western Maricopa County, Arizona. (See Project Map - Appendix B.)

2. History of Project [2,3]

On August 17, 1961, the Sponsoring Local Organizations submitted an application to the Secretary of Agriculture requesting assistance in preparing a plan for works of improvement for the Harquahala Valley Watershed under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666). The Secretary of Agriculture accepted this application as valid under the authorities of Public Law 566 and authorized the USDA-Soil Conservation Service to assist the watershed sponsors in preparing a plan for works of improvement.

During the period 1963-1968, the watershed sponsors and the Soil Conservation Service conducted detailed studies and

---

* All information and data, except as otherwise noted, were collected by the Arizona Water Commission, SCS, and Forest Service.

completed a final plan titled, "Watershed Work Plan, Harquahala Valley Watershed, USDA-SCS, January 1967." On April 1, 1969, the Congress authorized the Soil Conservation Service to prepare detailed design plans and proceed with construction of the recommended structural measures. The watershed sponsors, because of financial constraints, failed to secure necessary land rights and to date none of the structural measures recommended in the 1967 plan have been constructed.

Between 1967 and 1973, there were several developments which have a significant impact on the Harquahala Valley area. The construction of Interstate Highway 10 was completed. The highway modified drainage patterns and created conflicts with several of the structures proposed in the 1967 Work Plan. Also of major significance was the authorization of the Central Arizona Project which will be constructed through upper Harquahala Valley. The Harquahala Valley Irrigation District has made a commitment to contract for water from the project and has developed preliminary plans for an extensive water distribution system in Harquahala Valley.

In view of these changes in watershed conditions, the watershed sponsors recognized that the 1967 Work Plan should be revised. Early in 1973, the sponsors requested that the Soil Conservation Service restudy the Harquahala Valley Watershed and prepare a supplement to the approved 1967 Work Plan if changes in the works of improvement were feasible. Due to restrictions in funding and personnel, the Soil Conservation Service could not complete the necessary investigations within the desired time without detracting from other ongoing projects. Therefore, the restudy of the project was conducted by the Arizona Water Commission with the assistance of SCS. Several important changes in the original works of improvement are recommended. This Statement is for the proposed works of improvement as presented in Supplement No. 1 Watershed Work Plan Harquahala Valley Watershed March 1977.

3. Project Purpose and Goals

The sponsors of the Harquahala Valley Watershed project have as their objectives a watershed protection and conservation land treatment program to prevent and reduce floodwater, sediment, and erosion damages to productive agricultural lands, existing irrigation facilities, Interstate Highway 10, county and farm roads, commercial establishments, residences and public facilities. It is also desired that project measures provide maximum protection and benefit for the proposed Granite Reef Aqueduct of the Central Arizona Project and the proposed system of canals, laterals, and other improvements that will be installed in Harquahala Valley to distribute Central Arizona Project water in the valley.

APPENDIX B

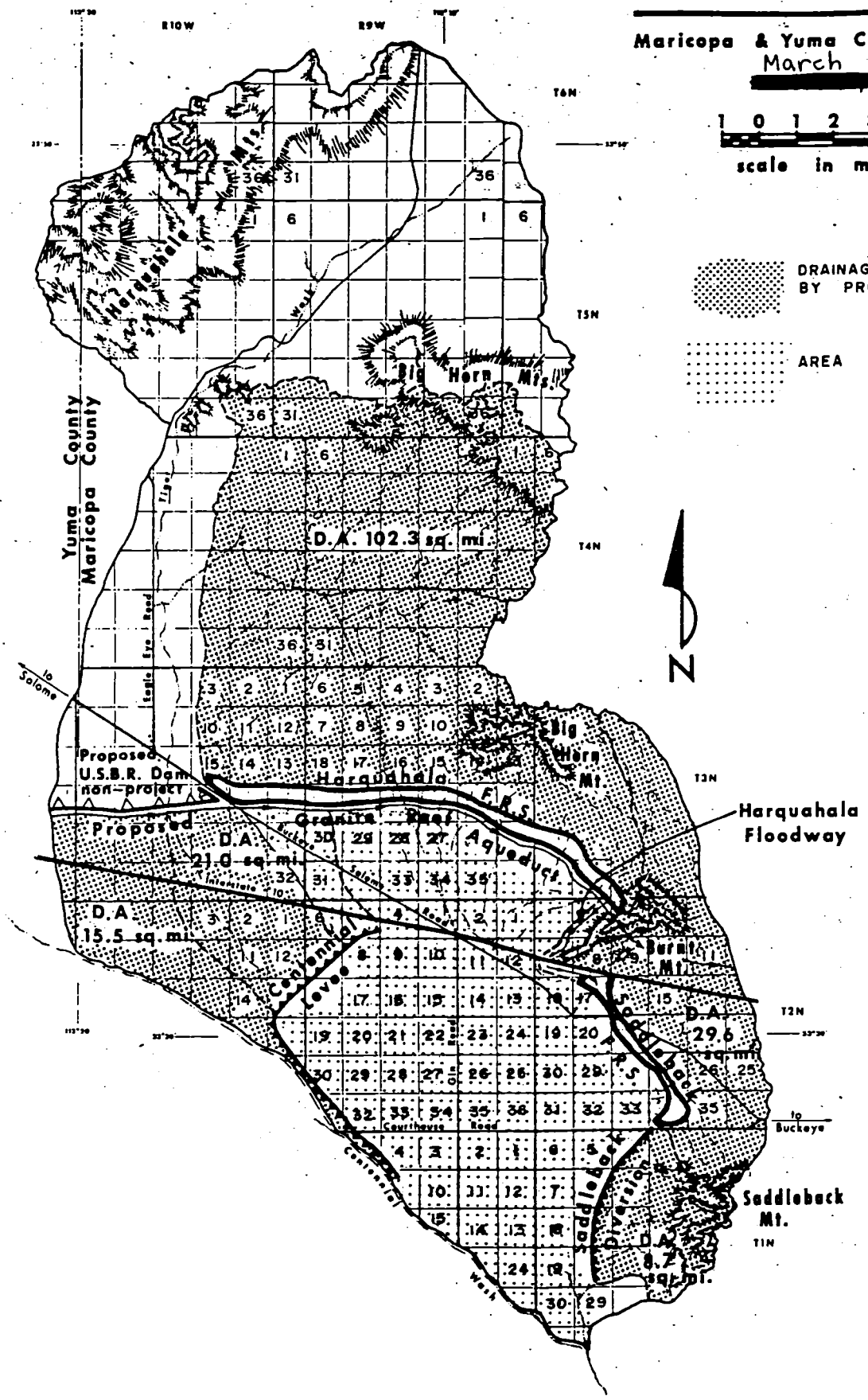
PROJECT MAP
Harquahala Valley Watershed

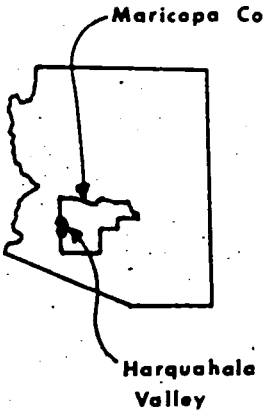
Maricopa & Yuma Counties, Arizona
March 1976

1 0 1 2 3 4 5
scale in miles

DRAINAGE AREA CONTROLLED BY PROJECT STRUCTURES

AREA BENEFITED





LOCATION MAP

The sponsors propose to provide a level of protection consistent with current and expected agricultural use and the highest level of economic return.

The sponsors' goals for installing land treatment measures include the reduction of erosion rates on cropland and other lands, increased infiltration rates and water holding capacities of the soils, and improved agricultural water management.

Due to the need for supplemental water in the watershed, the sponsors desire that all proposed dams be designed, wherever possible, to retain floodwater runoff for controlled release into irrigation canals and as additional water sources for wildlife.

The planned project will meet all of the sponsors objectives with the possible exception of retainment of floodwater runoff. At present, the program includes limited provisions for floodwater storage, however, downstream water rights may preclude this possibility. Possible program restrictions due to water rights are discussed in Section V.

D. Planned Project

1. General

To meet the sponsors' objectives in the watershed, the planned project measures will employ a combination of conservation land treatment and structural measures.

2. Land Treatment Measures [2,4]

Land treatment measures to be installed are an integral part of the overall watershed protection and flood prevention objective. The measures reduce erosion and sediment, increase infiltration and water holding capacity of the soil, and contribute to better agriculture water management. Measures are to be installed on private lands and land leased from the State of Arizona.

Land treatment is installed, operated, and maintained voluntarily by individuals or groups of farmers and ranchers. There are no specific state or local regulations that will insure its implementation. The treatment results from technical assistance provided by the Soil Conservation Service to the private landusers who enter into cooperative agreements with the Buckeye-Roosevelt or Wickenburg Natural Resource Conservation Districts to use the land within its capabilities and treat it according to its needs for protection and sustained production.

Land treatment measures to be installed on the irrigated

cropland include conservation cropping systems and crop residue use, irrigation ditch and canal lining, irrigation field ditches, irrigation land leveling, irrigation pipelines, irrigation tail-water recovery systems, irrigation water management, pumping plants for water control and structures for water control. Approximately 13,000 acres (67%) of the cropland will be adequately treated at the end of the installation period. The installation cost of the land treatment program is estimated at $1,936,000.

On public lands the Bureau of Land Management will continue its existing multiple use conservation program, including Proper Grazing Use. This program is primarily the control of grazing by adjusting the number of livestock and time of use to maintain vegetative cover on the land and protect the multiple use values of the resources. The program is applied to 163,887 acres of public rangeland in the watershed.

3. Structural Measures for Flood Prevention

a. General

The structural measures to be installed in the watershed under the authorities of Public Law 566 consist of two floodwater retarding structures (Harquahala F.R.S. and Saddleback F.R.S.), one floodway (Harquahala Floodway), one floodwater diversion (Saddleback Diversion), and one levee to limit the floodplain area of Centennial Wash (Centennial Levee). The locations of these measures are as shown on the Project Map in Appendix B.

In addition to the above mentioned structures, the U.S. Bureau of Reclamation is constructing a floodwater retarding structure immediately upstream of the proposed Granite Reef Aqueduct extending from the Buckeye-Salome Road westward to Centennial Wash. The structure will be approximately 6 miles long of which 4½ miles will be within the boundaries of the Harquahala Valley Watershed. This structure is not a part of the planned project under the authorities of Public Law 566, and therefore, is not considered as a "project structural measure" for the purposes of the Environmental Impact Statement. Further details concerning the proposed Bureau of Reclamation structure are presented in the section of this statement titled, "Projects of Other Agencies."

226,090 sm.

The combined Harquahala F.R.S., Harquahala Floodway, Saddleback F.R.S., and Saddleback Diversion will control 140.6 square miles or 39.8 percent of the watershed area. These structures are designed to function as a system in operational series rather than as individual units. Each upstream structure is dependent upon the lower structures for proper operation and drainage. Harquahala F.R.S. will drain through Harquahala Floodway, Saddleback F.R.S., and Saddleback Diversion.

Located on the western side of Harquahala Valley, Centennial Levee will control 21 square miles of the residual drainage area below Harquahala F.R.S. and the Bureau of Reclamation structure. The levee will also limit the area in Harquahala Valley that will be subject to inundation from Centennial Wash.

The current design criteria and policy for dams require that both Saddleback F.R.S. and Harquahala F.R.S. be designed to control the 100-year flood event. Saddleback Diversion will provide a 50-year level of protection and Centennial Levee a 100-year level of protection. The design frequency of these two structures was determined based on optimization of benefits.

Special consideration has been given in the location and design of all of the proposed structures to minimize wildlife losses and maintain aesthetic values.

The planned structural program presented in this statement is considered the best means to meet the objectives of the sponsors. It is recognized that some changes in the program could be necessitated following detailed design investigations and as improved data from continuing environmental studies and evaluations becomes available.

b. Floodwater Retarding Structures

(1) Saddleback F.R.S.

Plate 1 shows the location and structural details of Saddleback F.R.S. and Table I is a summary of data of the structure. See Figures P1, P2, and P3 for photographs of the alignment.

Design floodrouting computations, and consequently the sizing of the structure, were based on the assumption that the upstream Harquahala F.R.S. would be releasing its maximum discharge of 485 cubic feet per second as a base flow through Saddleback F.R.S. at the same time that the peak discharge from the 29.6 sq. mi. uncontrolled drainage area above Saddleback F.R.S. would occur. This design assumption would be an extreme condition and is equivalent to a simultaneous occurrence of storms over the Harquahala F.R.S. and Saddleback F.R.S. drainage areas. Although not evaluated, the probabilities of simultaneous peak discharges is considered extremely remote.

The Bureau of Reclamation is currently conducting studies in the Tonopah Watershed area immediately adjacent and east of Harquahala Valley. One tentative proposal is for the construction of a dike above the Granite Reef Aqueduct. If

constructed, this proposed dike could extend into Harquahala Valley Watershed and intercept approximately 6.26 sq. mi. of drainage area presently contributing to Saddleback F.R.S. Since the possible construction of this dike is uncertain, the current hydrologic design and sizing of Saddleback F.R.S. was made with the assumption that the drainage area above the structure will not be modified. If construction becomes definite, then any change in drainage area will be accounted for in the final design of Saddleback F.R.S.

Floodwater runoff will be temporarily impounded behind the dam and released into Saddleback Diversion through a 10 foot by 4 foot reinforced concrete box culvert principal spillway. The spillway will be ungated, with a straight drop inlet. A steel trash rack on the inlet will prevent debris clogging of the box culvert.

This structure will not employ the normal excavated earth or concrete open chute type of emergency spillway system that is usually associated with an earth dam. The principal spillway will therefore also serve as the emergency spillway for the structure. Saddleback F.R.S. was located to allow adequate floodwater impoundments without inundating Interstate Highway 10. For that reach of Interstate 10 which could possibly be influenced by backwater from the dam, the low point in the eastbound roadbed is at elevation 1195.5. This elevation compares with an elevation of 1178.0 for the crest of the principal spillway of Saddleback F.R.S., an elevation of 1190.5 for the maximum water surface attained during passage of the 100-year 10-day storm, and a top of dam elevation of 1194.2. The top of the dam is 1.3 feet lower than the low point of the Interstate 10 roadbeds. The final design of the structure will be fully coordinated with the Arizona Department of Transportation.

The Saddleback F.R.S. embankment will be located essentially along a contour, however, at two locations, the embankment will be located downslope from the contour and create basins which will retain floodwater. These basins are shown as Basin Nos. 1 and 2 on Plate 1. Both basins have been located at points where the dike embankment intersects a major drainageway and where concentrated sediment deposition is anticipated. The basins are sized so that the pool volume of storage above natural ground is equal to the anticipated sediment accumulation for a 50-year period. Basin No. 1 will have an above natural ground storage of 80 acre-feet, with a surface area of 42.7 acres and maximum depth above natural ground of 5.3 feet. Basin No. 2 will have an above natural ground storage of 21 acre-feet, with a surface area of 12.3 acres and maximum depth above natural ground of 4.7 feet. The estimated average annual yield from the 132 square mile contributing drainage area (includes area above Harquahala F.R.S. which is diverted through Saddleback F.R.S.) is about 540 acre-feet. This water could provide at lease some semipermanent storage pools behind the dam. Water rights will be required.

Two gated and two ungated vegetative maintenance conduits will be strategically located to maintain a continued water supply for downstream pseudoriparian vegetation. (See Plate 1.)

Foundation treatment for the site will consist of stripping and recompaction of the loose surface soils to the width of the embankment for the total length of the structure. Depth of stripping will vary from 2 to 5 feet. For the two reaches that will have nondraining sediment pools, a cutoff trench will be installed to insure against excessive seepage and the possibility of piping. The depth of the trench will be approximately 7 feet for Basin No. 1 and 6 feet for Basin No. 2.

The main part of the embankment will be constructed as a compacted homogeneous fill of approximately 584,050 cubic yards. The estimated amount of material to be taken from borrow to provide this fill is 698,000 cubic yards. Borrow areas will be located upstream from the dam within the flood pool. The results of geologic investigations that will be conducted prior to final design, and soil conditions as encountered during construction, will determine the final location, size and depth of the borrow areas. Influencing factors include suitability of material as embankment, physical limitations on depth of cut because of underlying caliche, economical haul distances, aesthetic values, and the need to minimize vegetative disturbances.

One location of concentrated borrow excavation is in an area of high ground in the northwest 1/4 section 21, and the southwest 1/4 section 16, T2N, R8W. This high ground was encountered along the alignment because the embankment was located upslope off the contour in order to clear a telephone cable booster station located in the southeast 1/4 section 17, T2N, R8W, and a proposed subdivision in section 20, T2N, R8W. Excavation through the high ground will be required to drain the northern sections of the flood pool area through the principal spillway. Approximately 150,000 cubic yards of material will come from this area. The cut will be approximately 200 feet wide for a distance of 6,000 feet. This borrow area will free drain.

The dike embankment will cross four roads, one underground telephone cable, one abandoned concrete irrigation ditch and one abandoned unlined irrigation ditch.

Two of the roads are unimproved farm roads that provide access to an abandoned farmstead located near the east 1/4 corner of section 17. The irrigation ditches are immediately adjacent to and parallel the farm roads. These ditches were originally used to convey water to the south and west from an irrigation well located at the farmstead. The farmstead consists of a

small frame house, which has been badly vandalized, and the abandoned irrigation well. The well pump and motor have been removed. The elevations of the pump base and of the house floor are both approximately one foot higher than the top of dam elevation. (See Figure P4.)

It is highly improbable that the abandoned farmhouse will be repaired for future use, with or without the construction of Saddleback F.R.S. After construction, access to the abandoned farmstead will be from the Buckeye-Salome Road.

The dam will cross two county roads, Courthouse Road and Buckeye-Salome Road. Courthouse Road is paved and well traveled. Buckeye-Salome Road is unpaved and carries minimal traffic.

The top elevation of the dam at the Courthouse Road crossing will be approximately two feet higher than the present roadbed elevation. Courthouse Road will be raised to cross over the embankment. This will require the raising and repaving of approximately 260 feet of road. After construction, approximately 440 feet of Courthouse Road on the eastern side of the embankment will be within the maximum design flood pool area of the dam, however, the reservoir elevation of the 100-year event is 1.5 feet lower than the low point of the roadbed. The planned program includes the placing of warning signs on Courthouse Road advising that a portion of the road is located within a flood pool area. However, if a storm condition of such severity did occur that would cause backwater over Courthouse Road, in all probability traffic would already be stopped at other points along the road due to flow in the numerous washes that cross the road by dip section.

The Buckeye-Salome Road crossing will be accomplished by ramping over the dike embankment. The dike will be approximately 5 feet high at the point of crossing. Approximately 900 feet of the road will be within the flood pool area of the dam. Warning signs will also be placed along this road advising that the road is impassable under flood condition.

Before installing the structure, a written right or permission to flood both Courthouse Road and Buckeye-Salome Road will be obtained from Maricopa County which has jurisdiction over both roads.

The dike will cross an underground telephone cable in the southwest 1/4 section 16, T2N, R8W. Construction of the dike embankment and upstream borrow channel will necessitate the lowering of this cable.

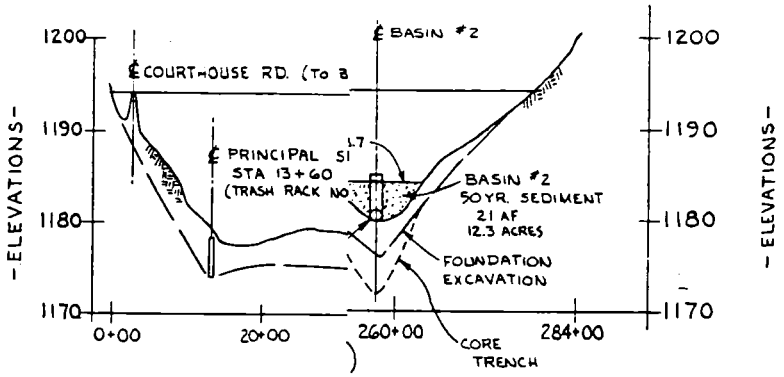
TABLE I

STRUCTURAL DATA

SADDLEBACK FLOODWATER RETARDING STRUCTURE

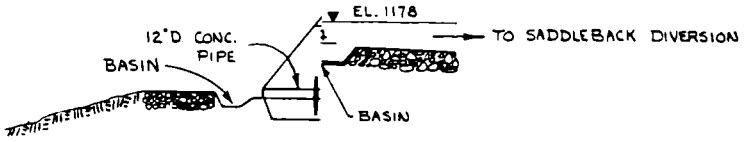
Item	Unit	Data
Drainage Area	Sq.Mi.	29.6
Storm Protection Frequency	Yr.	100
Total Length	Mi.	5.27
Maximum Height	Ft.	22
Average Height	Ft.	15
Top Width	Ft.	11
Maximum Bottom Width	Ft.	133
Average Bottom Width	Ft.	86
Side Slopes	Ft./Ft.	
Upstream		3
Downstream		2
Storage Capacity	Ac.-Ft.	
Floodwater Retarding		4,127
Sediment (50 yr)		120
Total		4,247
Principal Spillway 1/		
Reservoir Drawdown Time	Days	8.5
Maximum Release Rate	C.F.S.	800

1/ For 100-year storm protection frequency.



VEGETATION

SEEP COLLARS
2' C.C.



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VEGETATION M

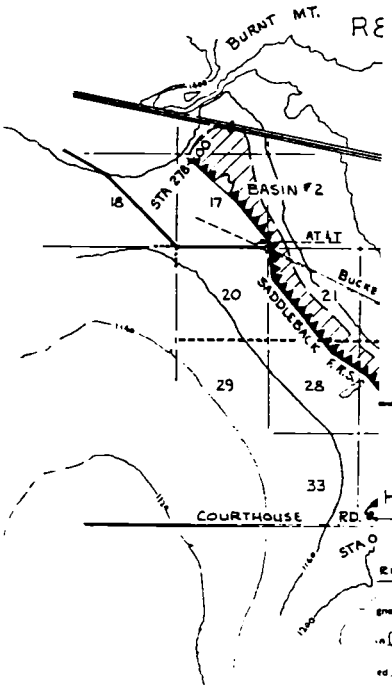

PLATE 1

SADDLEBACK FLOODWATER RETARDING STRUCTURE

HARQUAHALA VALLEY WATERSHED

MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS

MARCH, 1976

RIZONA WATER COMMISSION

STATE OF ARIZONA

		Date	
gned	BJF	2/10/76	Approved by
		2/12/76	Title
ed			Title
ked			Sheet No. of / Drawing No

SCS-ENG-313-B Rev. 7-69

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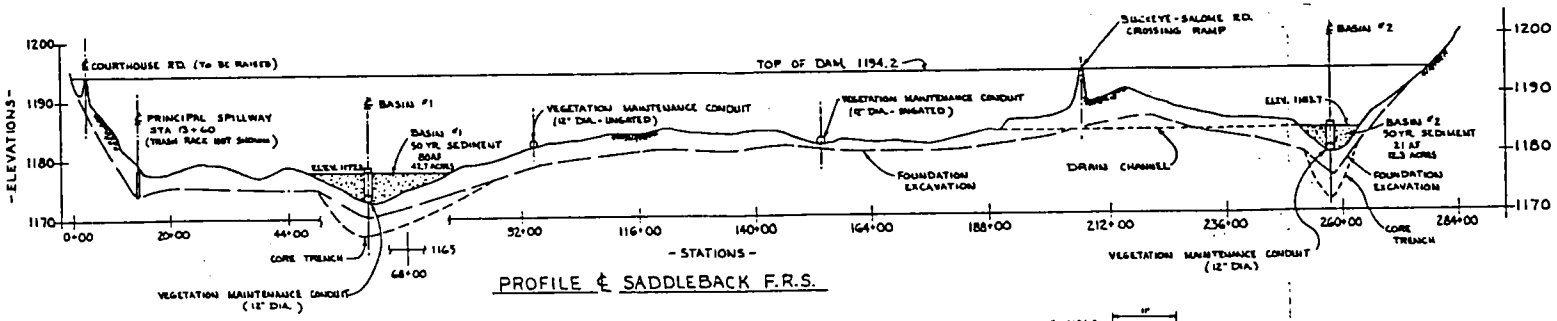
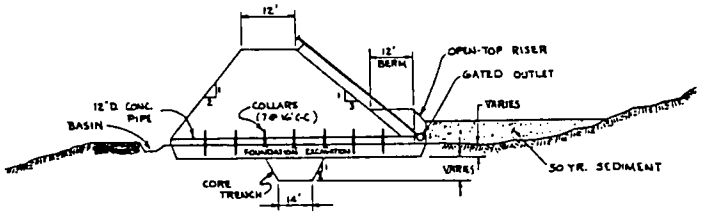
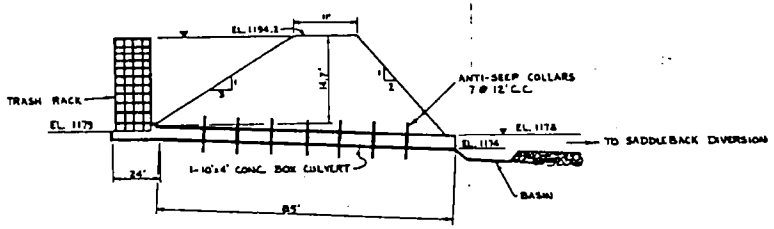


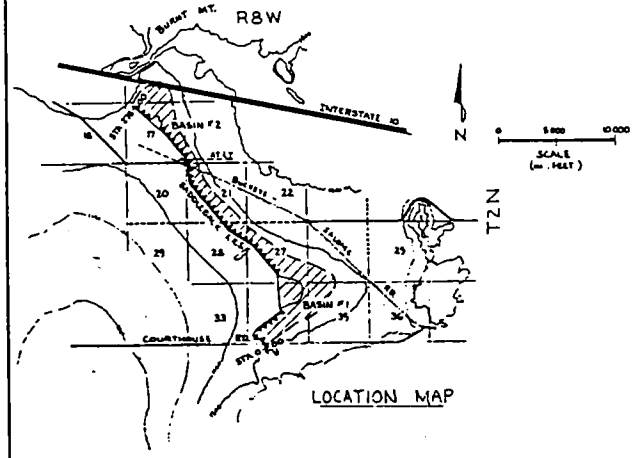
PROFILE ℄ SADDLEBACK F.R.S.



CROSS-SECTIONS
VEGETATION MAINTENANCE CONDUITS AT BASINS #1 & #2



CROSS-SECTION
PRINCIPAL SPILLWAY AT STA. 13+60
(FOUNDATION NOT SHOWN)



LOCATION MAP

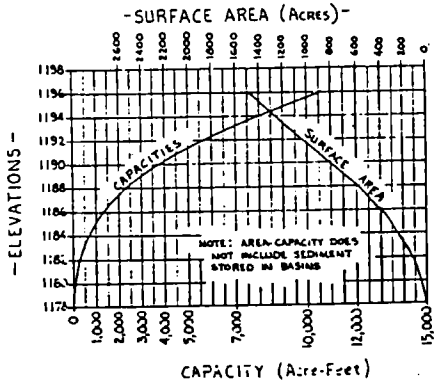
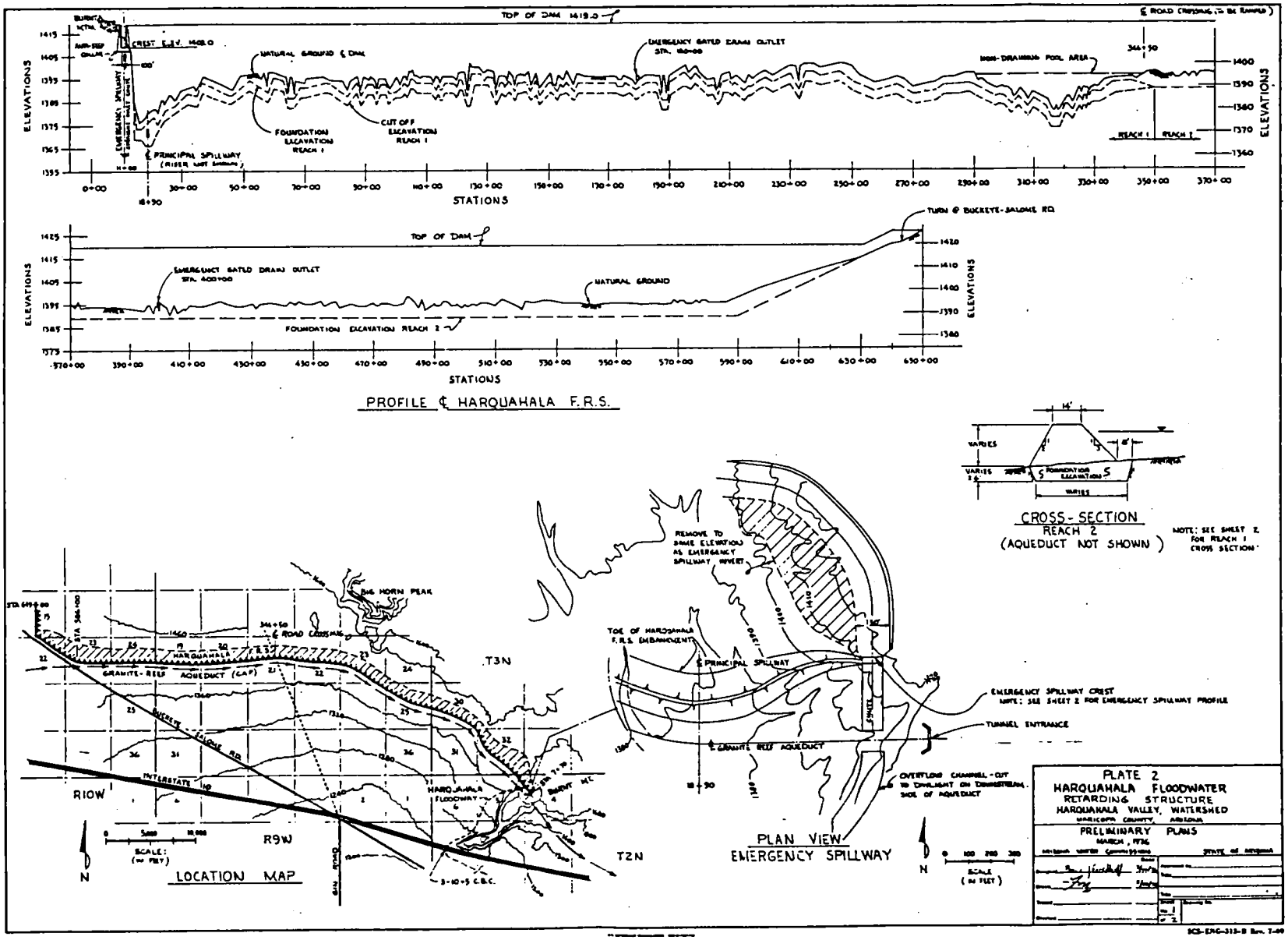


PLATE I
SADDLEBACK FLOODWATER RETARDING STRUCTURE
HARQUAHALA VALLEY WATERSHED
PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION
STATE OF ARIZONA

SCS-ERC-313-B Rev. 7-69


TOP OF DAM 1419.0
℄ ROAD CROSSING (TO BE RAISED)
CREST E.S.V. 1408.0
NATURAL GROUND ℄ DAM
EMERGENCY GATED DRAIN OUTLET STA. 150+00
NON-DRAINING POOL AREA
FOUNDATION EXCAVATION REACH 1
CUT OFF EXCAVATION REACH 1
℄ PRINCIPAL SPILLWAY (RISER NOT SHOWN)
REACH 1
REACH 2
ELEVATIONS
STATIONS
TURN @ BUCKEYE-SALOME RD.
TOP OF DAM
EMERGENCY GATED DRAIN OUTLET STA. 400+00
NATURAL GROUND
FOUNDATION EXCAVATION REACH 2
PROFILE ℄ HARQUAHALA F.R.S.
CROSS-SECTION
REACH 2
(AQUEDUCT NOT SHOWN)
NOTE: SEE SHEET 2 FOR REACH 1 CROSS SECTION
VARIES
FOUNDATION EXCAVATION
REMOVE TO SAME ELEVATION AS EMERGENCY SPILLWAY INVERT
TOE OF HARQUAHALA F.R.S. EMBANKMENT
℄ PRINCIPAL SPILLWAY
EMERGENCY SPILLWAY CREST
NOTE: SEE SHEET 2 FOR EMERGENCY SPILLWAY PROFILE
TUNNEL ENTRANCE
℄ GRANITE REEF AQUEDUCT
OVERFLOW CHANNEL - CUT TO DAYLIGHT ON DOWNSTREAM SIDE OF AQUEDUCT
PLAN VIEW
EMERGENCY SPILLWAY
SCALE (IN FEET)
BIG HORN PEAK
℄ ROAD CROSSING
HARQUAHALA
GRANITE REEF AQUEDUCT (CAP)
BUCKEYE-SALOME RD.
INTERSTATE 10
HARQUAHALA FLOODWAY
T3N
T2N
R10W
R9W
SCALE: (IN FEET)
LOCATION MAP
N
PLATE 2
HARQUAHALA FLOODWATER RETARDING STRUCTURE
HARQUAHALA VALLEY, WATERSHED
MARICOPA COUNTY, ARIZONA
PRELIMINARY PLANS
MARCH, 1986
STATE OF ARIZONA
SCS-ENG-313-B Rev. 7-69

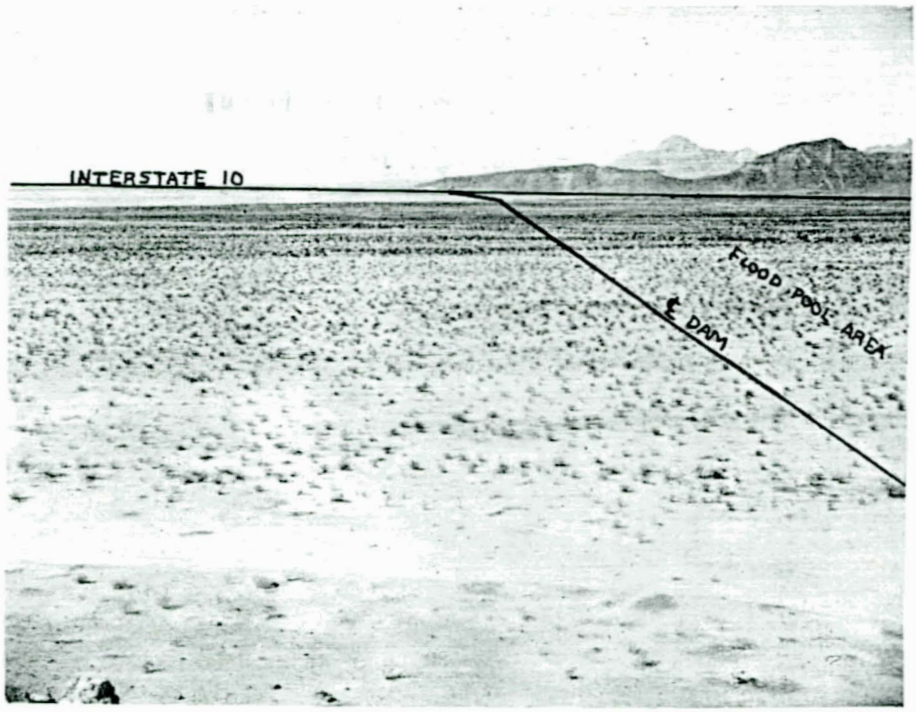


Figure P3. Burnt Mountain, Interstate 10 and alignment of Saddleback F.R.S. Looking northwest from andesite knoll, Section 27,T2N,R8W.

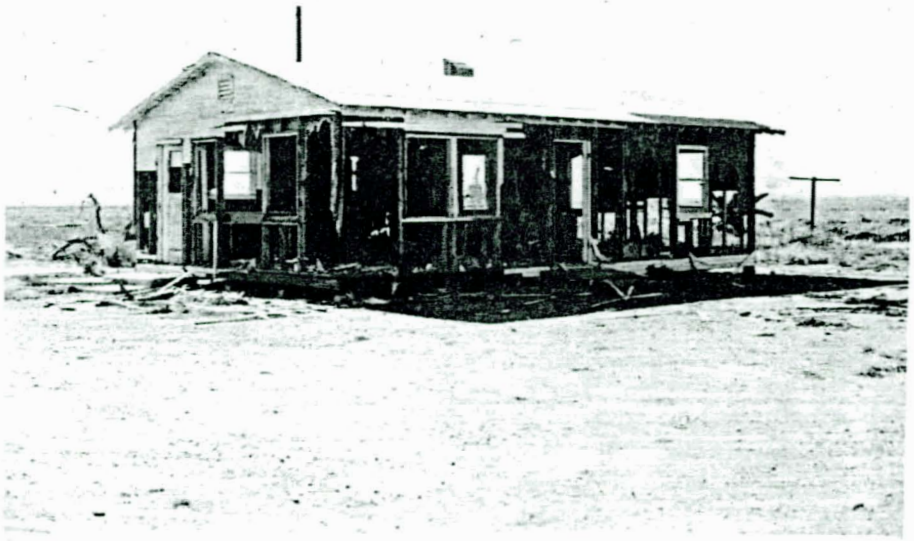


Figure P4. Abandoned farmhouse located in Section 17,T2N,R8W, immediately above the floodpool of Saddleback F.R.S.

An electric power line runs east-west on the south section line of Section 17, T2N, R8W. Construction of the dike will necessitate the relocation of one pole and raising of approximately 500 feet of line.

The construction of Saddleback F.R.S. will require land rights acquisition of 1,266.2 acres encompassed by the dam, borrow areas, and flood pool. Of the 1,266.2 acre total, approximately 515 acres are in private ownership, 281 acres are State Trust lands administered by the Arizona State Land Department, 464 acres of public land administered by the U.S. Bureau of Land Management, 5 acres of State land within the Interstate 10 right-of-way administered by the Arizona Department of Transportation, and an estimated 1.2 acres are under the jurisdiction of Maricopa County for Courthouse and Buckeye-Salome Roads rights-of-way.

All of the land required is unimproved desert except 85 acres of previously irrigated land located in the south 1/2 Section 17, T2N, R8W.

No relocation of people, businesses, or farm operations will result from the construction of the dam.

(2) Harquahala F.R.S.

Harquahala F.R.S. will be located immediately above and parallel to the proposed Central Arizona Project Granite Reef Aqueduct. About 6.1 miles of the alignment lies across mountain foot slope terrain of the Big Horn Mountains and 5.4 miles across valley soils of the Harquahala Plains. (See Project Map, Plates 2 and 2a, and Figures P5, P6, and P7. Structural Data is shown in Table II.)

The average natural ground elevation at the base of the dam drops about 4.0 feet from west to east in the entire length between Buckeye-Salome Road and Burnt Mountain. This elevation drop results in the parallel alignment with the Granite Reef Aqueduct, which has a slope of about 0.0008 ft. per ft. (0.4 ft. per mile). Floodwater runoff from intercepted drainages will be temporarily impounded and rerouted eastward along the dam alignment for controlled release through the principal spillway.

The principal spillway will be located just west of Burnt Mountain. It will consist of a 4 foot by 4 foot reinforced concrete box culvert constructed as a continuous closed conduit through the dam foundation and underneath the aqueduct. The spillway will be ungated, with a reinforced concrete standard covered top riser at the inlet and a S.A.F. (Saint Anthony Falls) Basin outlet. There will be an 83 foot long transition between the box culvert conduit and the S.A.F. Basin.

Floodwater releases through the principal spillway will enter an existing unnamed wash (designated as Harquahala Floodway) to be conveyed via this wash through existing box culverts under Interstate 10, diverted eastward into Saddleback F.R.S. and then southward through Saddleback Diversion to an outlet in Centennial Wash.

The emergency spillway for the dam will be located in the east abutment. The spillway will be a straight inlet rectangular concrete chute with a 100-foot bottom width, outletting into the Granite Reef Aqueduct. Flows greater than those expected on the average of once in 100 years will pass through the spillway. This is equivalent to a runoff of 2.61 inches from the total 102.3 square mile drainage area in a six hour period. Maximum discharge through the spillway with reservoir stage to top of dam elevation will be 9,650 cfs.

Geologic investigations were conducted along the alignment at intervals ranging from 1,000 to 1,500 feet, alternating between centerline of the dam and centerline of the aqueduct. Results showed a distinct difference occurs in the soils and foundation conditions where the dike alignment leaves the mountain foot slope terrain and proceeds across alluvial fan deposits of the Harquahala Plains. This change in soil effectively divides the dam into two separate reaches, requiring separate methods of foundation treatment and embankment design. The two reaches will be discussed separately.

Reach 1 constitutes the eastern 6.1 miles of the dam. Soils consist of shallow to moderately deep alluvial fan deposits generally having a well developed erosion pavement. Based on soil conditions as evaluated to date, the embankment for Reach 1 will consist of a homogeneous fill. Oversized cobbles unsuitable for fill will be raked out. Selective placement of material will be utilized with the coarser material placed on the outside and toes of the embankment grading inward to finer material. A core trench of 15 foot bottom width and 2:1 side slopes will key the embankment to the foundation. Depth of the core trench will average about 5 feet.

Reach 2 constitutes the western 5.4 mile length of the dam across the flat alluvium of the Harquahala Plains. Soils consist of fine grained alluvial fan deposits.

Present design of the embankment for Reach 2 also calls for a homogeneous fill, however, foundation conditions in this area are inferior to those encountered along Reach 1. Foundation treatment will consist of complete removal of weak or questionable material for the entire base width of the dam. Depth of foundation excavation will average 6 feet. (See Plate 2.)

At the west end, the dam alignment will depart from the aqueduct and parallel Buckeye-Salome Road.

The western end of the dam will be extended to direct flow from a series of washes into the dam proper. This extension to the dam will consist of a diversion type embankment.

The embankment section for Reaches 1 and 2 will require 4,530,558 cubic yards of compacted fill. This material will be obtained as excavation from the Granite Reef Aqueduct section.

There are three proposed outlets through the embankment. The principal spillway will be located on the east end at Burnt Mountain. A small low flow channel will be constructed upstream of the embankment draining from west to east to the principal spillway.

Harquahala F.R.S. is a very long structure (11.5 miles). Two 24-inch diameter gated drain outlets will be spaced along the dam alignment. These will serve as emergency drains in the extremely unlikely event that a debris plug should separate parts of the reservoir. One of the outlets will also serve to drain the pool area described in the Environmental Features Section.

The alignment of the dam is over terrain that provides relatively east movement by four-wheel drive and other off-road type vehicles. There are several faint vehicular roads or trails along the alignment that will be intersected by the dam and aqueduct. These roads were created by off-road vehicle use on State and public lands. The planned program does not include any crossings over the dam embankment for roads of this type. However, the dam embankment will lie across three unimproved roads that are used on an infrequent basis. They are unsuited for passenger type automobile use.

Of these three roads, only one is considered to have significant use and purpose to warrant a crossing over the embankment and aqueduct. This crossing will be to provide access to an abandoned mine located in Section 15, T3N, R9W, and ranching operations north of Harquahala F.R.S. Access to this mine is currently provided by an unimproved road passable only under favorable weather conditions. This road is actually a fork off another unimproved road located to the west. The fork occurs approximately 3/4 mile south of Harquahala F.R.S. The two roads proceed north independently and essentially parallel of each other. At the point of intersection with the dam, the roads are approximately 1/2 mile apart. The dam and Granite Reef Aqueduct will intersect both roads. A crossing over the dam will be provided for the west fork in Section 21, T3N, R9W, to match a bridge over the aqueduct. The east road will be severed. An approximately 1/2 mile long detour road, to be located through the flood pool area or other suitable location, will connect the two roads. Due to the infrequent use of this road, the planned program does not include any

TABLE II

STRUCTURAL DATA

HARQUAHALA FLOODWATER RETARDING STRUCTURE

Item	Unit	Data
Drainage Area	Sq.Mi.	102.3
Storm Protection Frequency	Yr.	100
Total Length	Mi.	11.5
Maximum Height	Ft.	43
Average Height	Ft.	25
Top Width	Ft.	14
Maximum Bottom Width	Ft.	234
Average Bottom Width	Ft.	140
Side Slopes	Ft./Ft.	
Upstream		3
Downstream		2
Storage Capacity 1/	Ac.-Ft.	
Floodwater Retarding		10,497
Sediment (50yr)		414
Total		10,911
Principal Spillway 2/		
Reservoir Drawdown Time	Days	9.08
Maximum Release Rate	C.F.S.	485

1/ At emergency spillway crest elevation.

2/ For 100-year storm protection frequency.

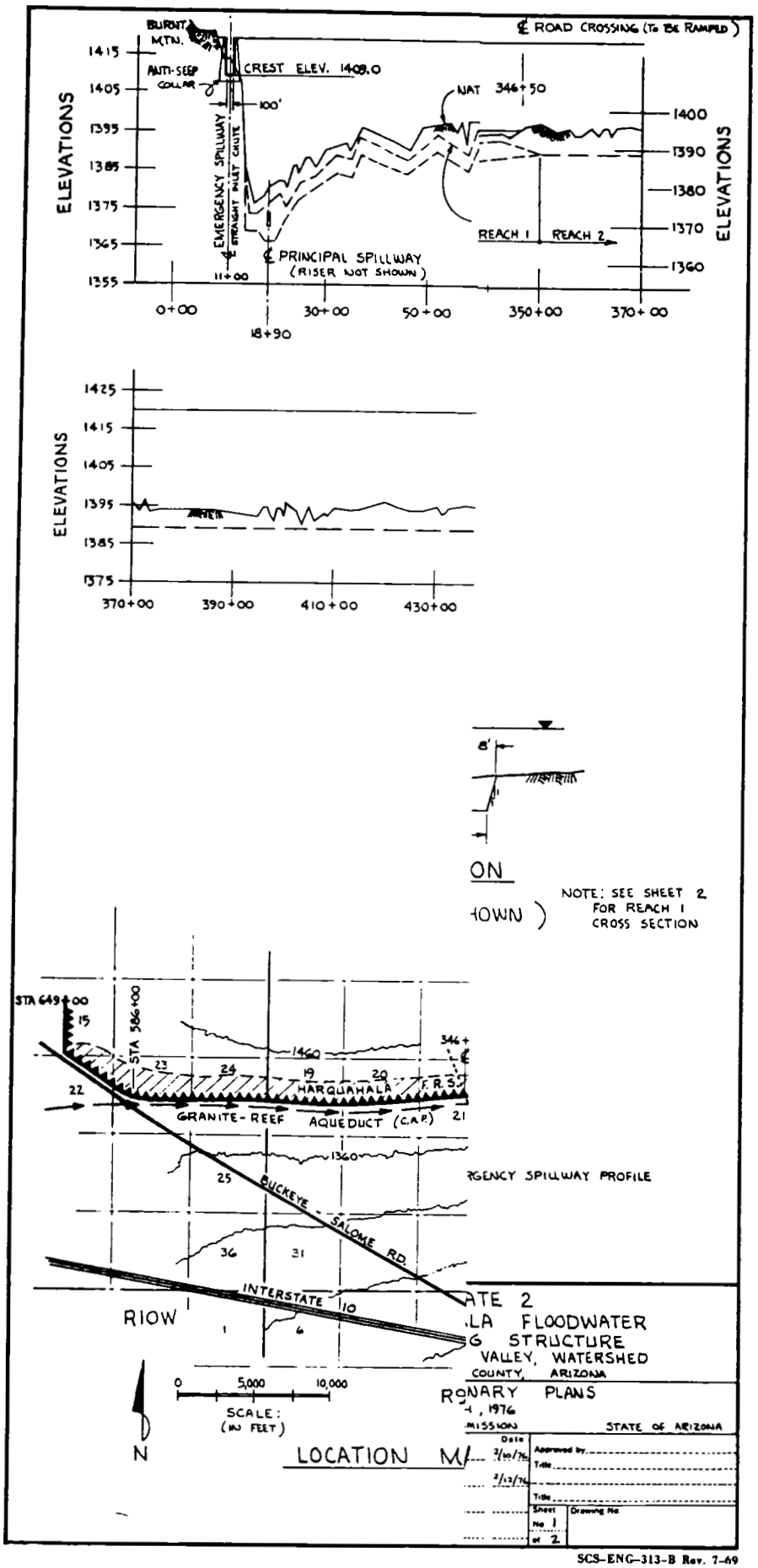


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TABLE 3

STRUCTURAL DATA - REVISED

FLOODWATER RETARDING STRUCTURES

Harquahala Valley Watershed, Arizona

Item	Unit	Harquahala FRS	Saddleback FRS	Total
Class of Structure		b	a	
Drainage Area (Total)	Sq.Mi.	102.3	29.6	131.9
Average Curve Number (1-day AMC II)		86	89	
Elevation Top of Dam	M.S.L.	1419	1194.2	
Elevation Crest Emergency Spillway	M.S.L.	1409	1190.5 3/	
Elevation Crest Principal Spillway	M.S.L.	1392.8	1179.0	
Maximum Height of Dam	Ft.	43.0	22.0	
Volume of Fill	Cu.Yd.	4,530,558	584,051	5,114,609
Length	Mi.	11.5	5.27	16.77
Maximum Bottom Width	Ft.	234	133 2/	
Top Width	Ft.	14	11	
Upstream Slope Z:1		3	3	
Downstream Slope Z:1		2	2	
Total Capacity 1/	AF	10,911	4,247	15,157.5
Sediment (50 yr.)	AF	414	120 5/	534
Retarding	AF	10,497	4,127	14,624
Surface Area				
Sediment Pool	Ac.	77	89 7/	166
Retarding Pool 1/	Ac.	1304	879	2,183
Principal Spillway Design				
Rainfall Volume (Areal, 1-day)	In.	3.87	3.98	
Rainfall Volume (Areal, 10-day)	In.	5.99	6.08	
Runoff Volume (10-day)	In.	2.61	3.22	
Capacity	C.F.S.	485	800	
Frequency Operation-Emergency Spillway	%	1.0	No Spillway	
Dimensions of Conduit	Ft.	4x4x370	10x4x85	
Tailwater Elevation	M.S.L.	1360	1178	
Type of Outlet		S.A.F.	P.W.D.	
Drawdown Time	Days	9.08	8.5	
Emergency Spillway Design				
Rainfall Volume (ESH, areal)	In.	3.49	3.81	
Runoff Volume (ESH)	In.	2.24	2.71	
Storm Duration	Hours	6	6	
Type		Concrete Chute	No Spillway	
Bottom Width	Ft.	100		
Velocity of Flow (Ve)	F.P.S.	2.18		
Slope of Exit Channel	Ft./Ft.	.02		
Maximum Reservoir Water Surface Elevation	M.S.L.	1409.9	1190.5 3/	
Side Slopes Z:1		0		
Maximum Outflow from ESH Routing	C.F.S.	400	801 6/	
Freeboard Design				
Rainfall Volume (FH, Areal)	In.	7.35	6.55	
Runoff Volume (FH)	In.	5.91	5.38	
Storm Duration	Hours	6	6	
Maximum Reservoir Water Surface Elevation	M.S.L.	1418.8	1194.2 4/	
Maximum Outflow from FH Routing	C.F.S.	9650	914 6/	
Capacity Equivalents				
Sediment Volume	In.	.0759	.0761	
Retarding Volume	In.	1.93	2.62	

1/ At crest of emergency spillway.

2/ Includes berm width.

3/ No emergency spillway. Elevation shown is that attained by routing of emergency spillway hydrograph.

4/ No emergency spillway. Elevation shown is that attained by routing of freeboard spillway hydrograph.

5/ This includes 80 AF in Basin #1, 21 AF in Basin #2, and 19 AF in area between basins.

6/ Outflow through principal spillway.

7/ Includes 55 ac. of nondraining areas.

March 1976

TABLE 3A - Revised

STRUCTURE DATA FOR DIVERSIONS, LEVEES, AND FLOODWAYS

Reach	Beginning Station	Drainage Area (Sq.Mi.)	Capacity (cfs) Req'd	Capacity (cfs) Design	Channel Dimensions: Bottom Width (ft)	Bottom Slope (ft/ft)	Depth of Flow (ft)	Side Slopes z_u	Side Slopes z_d	"n" Value Aged	"n" Value As Built	Velocities (fps) Aged	Velocities (fps) As Built	Type of Work 5/	Before Project 3/-4/
Saddleback Diversion - 4.64 mi.															
1	8+20	0	800	810	35	.0017	4.5	2	2	.035	.035	4.09	4.09 6/	I-R	O-E
2	13+36	(4 - 10'x 5', 90°, Box Culvert at Courthouse Road, L = 28')													
3	13+64		800	810	50	.000797	4.0	5	3	.035	.035	2.83	2.83	"	"
4	16+60	.30	800	857	56	.000797	"	"	"	.03	.025	2.53	3.11	I-E	"
5	23+20		1040	1663	56	.003	"	"	"	"	"	4.90	6.03	"	"
6	44+00	.86	1499	"	56	"	"	"	"	"	"	"	"	"	"
7	51+90		1499	1762	60	"	"	"	"	"	"	4.96	6.07	"	"
8	59+80		1499	1912	66	"	"	"	"	"	"	5.05	6.12	"	"
9	66+70		1499	2064	72	"	"	"	"	"	"	5.12	6.16	"	"
10	75+60		1499	2267	80	"	"	"	"	"	"	5.21	6.21	"	"
11	83+50	1.94	2197	2524	90	"	"	"	"	"	"	5.31	6.26	"	"
12	94+25		2197	3042	110	"	"	"	"	"	"	5.48	6.34	"	"
13	105+00	3.27	3029	3619	132	"	"	"	"	"	"	5.63	6.40	"	"
14	115+34		3029	3963	145	"	"	"	"	"	"	5.70	6.43	"	"
15	125+68		3029	4361	160	"	"	"	"	"	"	5.78	6.46	"	"
16	136+00	5.58	4230	5000	184	"	"	"	"	"	"	5.88	6.50	"	"
17	153+00		4230	5322	196	"	"	"	"	"	"	5.92	6.51	"	"
18	170+00		4230	5644	208	"	"	"	"	"	"	5.96	6.53	"	"
19	187+00		4230	5966	220	"	"	"	"	"	"	6.00	6.54	"	"
20	204+00	8.21	5467	6289	232	"	"	"	"	"	"	6.03	6.55	"	"
21	227+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
22	250+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
	253+00	8.65	5610	(Natural Channel Outlet)											
Harquahala Floodway - 3.43 mi.															
1	11+72	0	485	500	18	.000215	6.80	3	3	.03	.025	1.59	1.91	I-E	N-E
2	22+00		485	500	(Natural channel)										N-E
3	120+00	.96	1265	1265	(I-10 crossing, 3 - 10'x 5' C.B.C.)										M(1964)-E
4	122+10		1265	1265	35	.0090	3.61	2	2	.035	.035	7.02	7.02	I-R	O-E
	177+00	.98	1265	1265	35	.0045	4.38	2	2	.035	.035	5.59	5.59	I-E	N-E
	185+00		1265	1265	35	0.0	4.38	2	2	.035	.035	5.59	4.49	I-E	N-E
	193+00		1265	(Natural Channel Outlet)											
Centennial Levee - 9.45 mi.															
1	41+00	0	0	7540		0 1/	0 2/			.035		0		I-E	O-E
	70+00	2.44	854	"		1356	380			"		.63		"	"
	95+00	6.08	1979	"		2249	800			"		.88		"	"
	120+00	10.18	3562	"		2944	952			"		1.21		"	"
	160+00	14.91	5218	"		4208	1330			"		1.24		"	"
	180+00	15.57	5450	"		4395	1500			"		1.24		"	"
	200+00	16.24	5683	"		4697	1288			"		1.21		"	"
2	238+00	20.99	7539	"		5026	1099			"		1.50		II-E	N-E
	300+00	652-	26390	26400		7411	5100			.035		3.56		"	"
	331+00	"	"	"		9356	5000			&		2.82		"	"
	361+50	"	"	"		7533	3550			.045		3.50		"	"
	388+50	"	"	"		8466	4000			"		3.12		"	"
	416+00	"	"	"		7317	3450			"		3.61		"	"
	442+50	"	"	"		7910	4650			"		3.34		"	"
	469+00	"	"	"		8192	4470			"		3.22		"	"
	498+00	"	"	"		7616	4000			"		3.47		"	"
	525+00	"	"	"		7584	3750			"		3.48		"	"
End Levee	540+00	652	"	"		7218	3350			"		3.66		"	"

540.00
51
5590

1/ Cross sectional area below hydraulic grade line, (Ft.^{2}).

2/ Wetted perimeter below hydraulic grade line, (Ft.).

3/ N - An unmodified, well defined natural channel or stream.
M() - Manmade ditch or previously modified channel (approximate date of original major construction).
O - None or practically no defined channel.

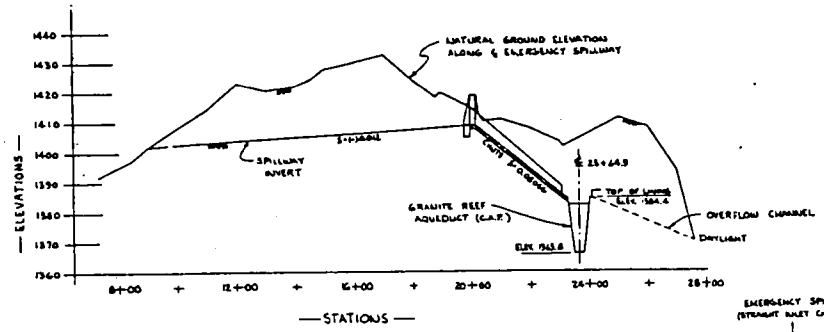
4/ Pr - Perennial - flows at all times except during extreme drought.
I - Intermittent - continuous flow through some seasons of the year but little or no flow through other seasons.
E - Ephemeral - flows only during periods of surface run-off, otherwise dry.
S - Ponded water with no noticeable flow - caused by lack of outlet or high groundwater table.

5/ I - Establishment of new channel including necessary stabilization measures.
II - Enlargement or realignment of existing channel or stream.
III - Cleaning out natural or manmade channel (includes bar removal and major clearing and snagging operation).
IV - Clearing and removal of loose debris within channel section.
V - Stabilization as primary purpose (by continuous treatment or localized problem areas - present capacity adequate).

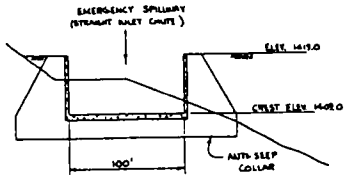
E - Earth channel.
R - Rock riprap channel.

6/ 10YR-24HR storm depth = 3.0' (low flow channel).

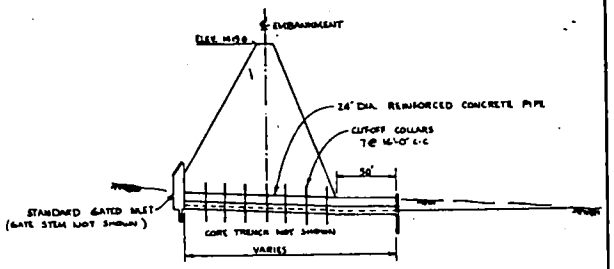
March 1976



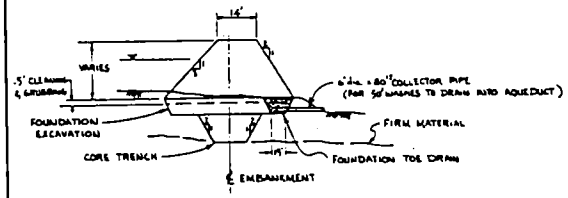
℄ PROFILE
EMERGENCY SPILLWAY



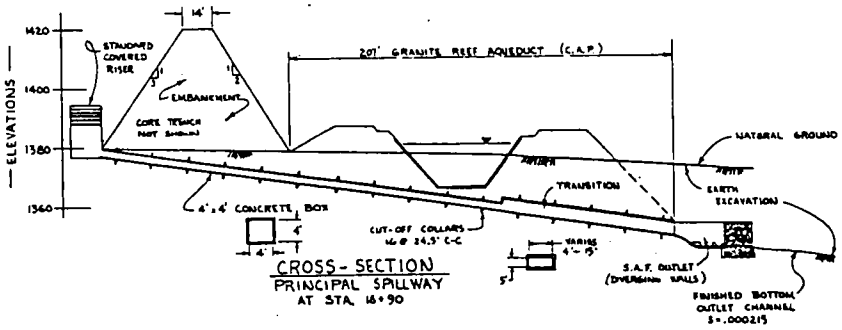
CROSS-SECTION
EMERGENCY SPILLWAY



EMERGENCY GATED DRAIN OUTLETS



CROSS-SECTION
REACH 1



CROSS-SECTION
PRINCIPAL SPILLWAY
AT STA. 16+90

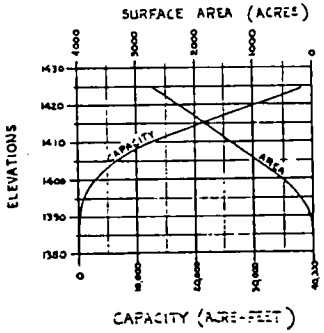
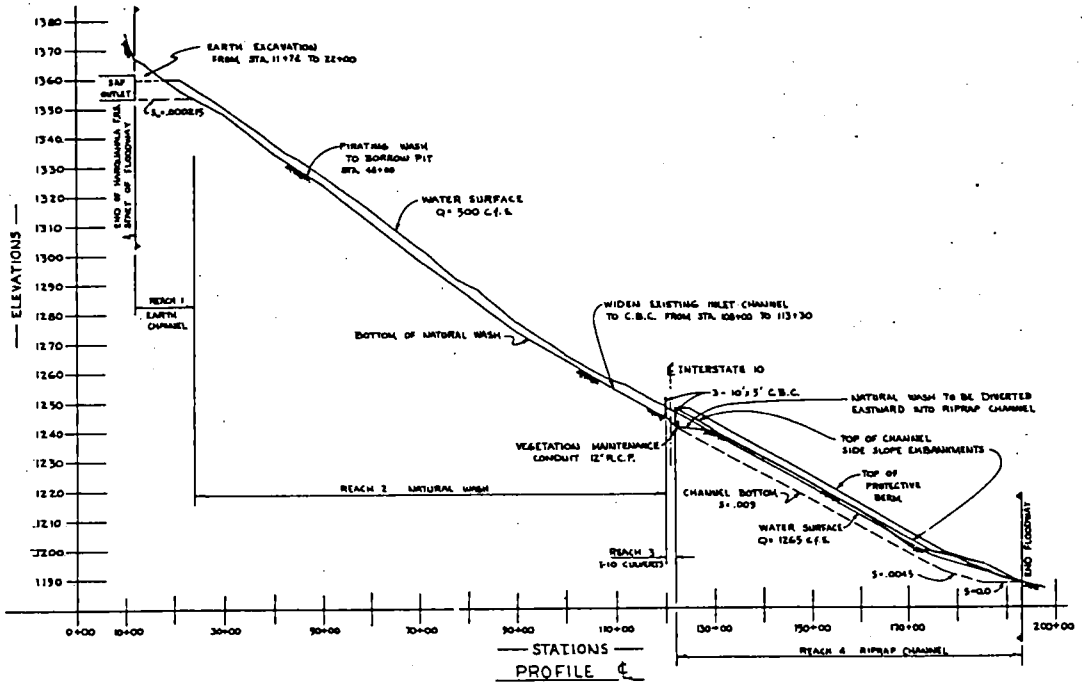


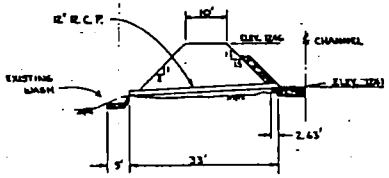
PLATE 2a
HARQUAHALA FLOODWATER
RETARDING STRUCTURE
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976

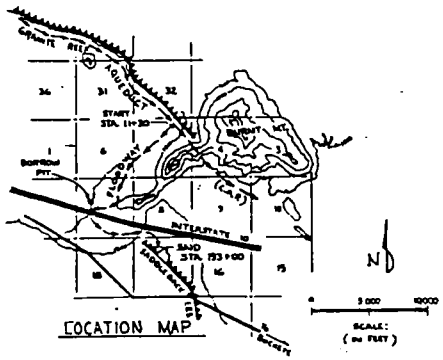
SCS-ERC-313-B Rev. 3-69



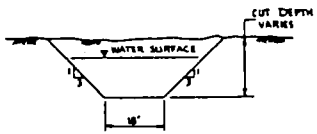
PROFILE ℄
HARQUAHALA FLOODWAY



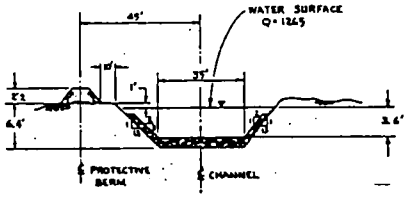
CROSS - SECTION
VEGETATION MAINTENANCE CONDUIT
STA. 123+00



LOCATION MAP



CROSS - SECTION
REACH 1



CROSS SECTION
REACH 4

PLATE 3
HARQUAHALA FLOODWAY
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION
STATE OF ARIZONA

SCS-ENG-313-B Rev. 7-69

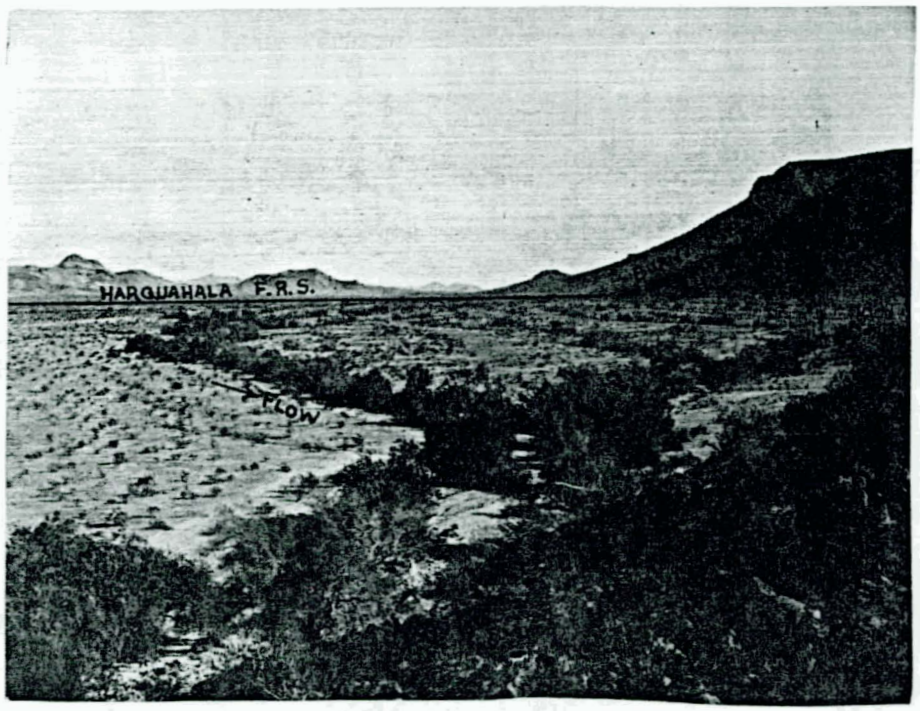


Figure P7. Looking north showing location of Harquahala F.R.S. and the natural wash section of Harquahala Floodway.

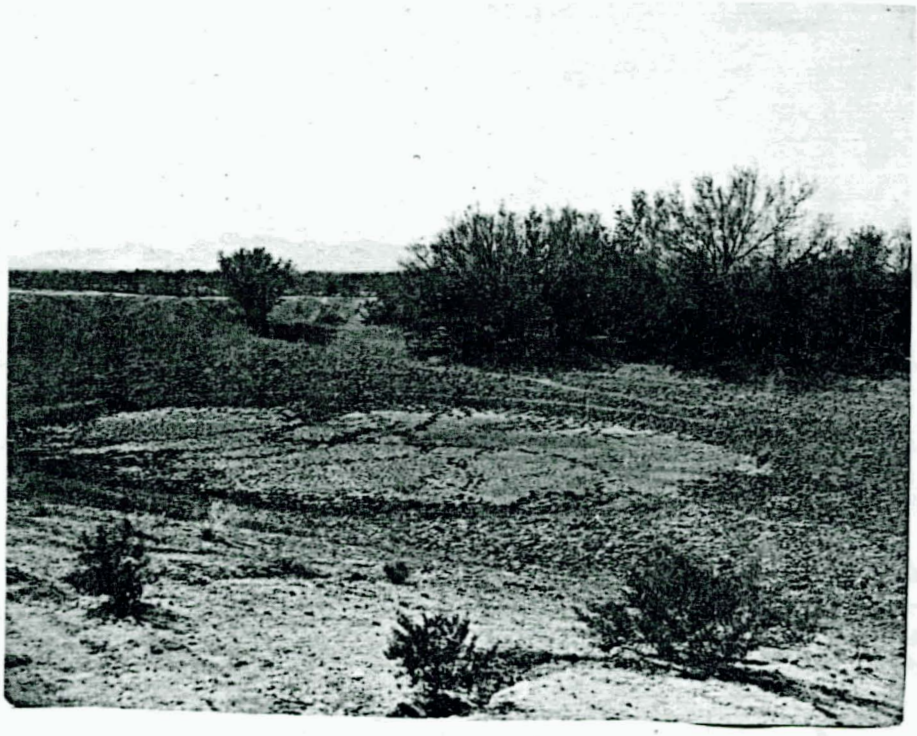


Figure P8. New Tank, Section 30,T3N,R9W.

culverts in the flood pool, therefore, floodwater impoundment will temporarily limit access from the south terminal of the road. However, access to the mines and ranch operations served by the road could still be accomplished by detouring in from the north terminal at the Eagle Eye Road junction.

The Harquahala Valley Irrigation District has requested that a gated outlet be provided to allow release of floodwater impoundments behind the dam into the District's proposed system for distribution of water from the Central Arizona Project. The actual sizing and installation of such a feature will be dependent upon several factors including water rights. Engineering studies presented to date for the distribution system are inadequate to serve as a basis for design of an outlet through Harquahala F.R.S., therefore, such a feature is not included as a part of the planned project. It can be added during the final design. Any costs associated with such a facility will be nonproject and ineligible for assistance under the Public Law 566 Act.

The construction of the dam will require land rights acquisition on 2,274 acres of land. This is for the area encompassed by the dam, flood pool, and emergency spillway. Of this total, 854 acres are in private ownership and 1,340 acres are public lands administered by the U.S. Bureau of Land Management and 80 acres are State Trust. All of the land required is unimproved rangeland.

No relocations of people, businesses, or farm operations will result from construction of the dam.

c. Channels and Floodways

(1) Harquahala Floodway

Harquahala Floodway will convey floodwater releases from Harquahala F.R.S. into Saddleback F.R.S. Total length of the floodway is 18,128 feet or 3.43 miles. (See Project Map, Plate 3, and Figures P7, P9, and P10. Structural Data is shown in Table III.)

For purposes of discussion, the floodway is divided into four reaches differentiated by the type of construction proposed. Progression is downstream in the direction of flow.

Reach 1 consists of a 1,028 foot excavated channel from the Harquahala F.R.S. outlet to an existing wash. Channel bottom width is 18 feet with 3:1 side slopes. Channel slope is 0.000215 ft./ft. Average velocity of flow at the design peak flow of approximately 500 cubic feet per second is about 1.9 feet per second. Design depth of flow is about 6.8 feet. Depth of cut varies from a maximum of 16.5 feet at the

inlet to 0.0 feet where the natural wash is intercepted. The channel bottom is founded on caliche fanglomerate or basalt rock for the first 1,000 feet, where the bottom grades into a GM-GW soil. No special stabilizing actions will be necessary except for the first 14 feet immediately downstream from the inlet where rock riprap will be placed to prevent localized scour.

Reach 2 of the floodway consists of 9,800 feet of natural channel between Reach 1 and Interstate 10. (See Figure P7.) The channel consists of a main wash that overflows into parallel secondary washes. All overflow out of the main wash is naturally reunited before reaching the Interstate 10 box culverts except for one reach where overflow enters a borrow pit left from theconstruction of Interstate 10.

Instead of altering this condition, the planned program will allow the flow to continue to braid with a portion entering the borrow pit. The borrow pit will trap sediments and debris that otherwise would be transported through the Interstate 10 box culverts. Vegetative growth within the borrow pit should also be aided. To assure that overflow from the borrow pit flows back into the floodway wash and on through the Interstate 10 box culverts, a small channel will be constructed. All upstream overflow out of the floodway wash will then be reunited prior to crossing Interstate 10.

The planned program will also include excavation of a channel about 700 feet upstream from the highway where rock revetment now exists. Construction will consist of widening the right or west side of the wash along the revetment reach from the present 6 foot bottom width to about 31 feet. Length of cut will be about 200 feet and approximately 710 cubic yards of material will be removed.

The two items of excavation, one to increase existing wash capacity along the revetment and the other to connect the borrow pit with the Interstate 10 box culverts, are the only construction activities to be conducted along Reach 2. No other modifications to existing conditions are planned.

Floodway Reach 3 consists of three existing 10 foot by 5 foot concrete box culverts through Interstate 10. They are designed for the 50-year flood event and have a capacity of 1,050 cfs. (See Figure P9.)

Between the dam and Interstate 10 there are 0.98 square miles of drainage area. The estimated 50-year peak discharge from this area is 765 cfs. The simultaneous peaking of the design release from Harquahala F.R.S. (485-500cfs) plus the 50-year discharge from the uncontrolled drainage area would result in a peak discharge to the culverts of 1,265 cfs

which would increase headwater depth by about 6 inches. The box culverts have sufficient capacity to handle this increased discharge without endangering the Interstate 10 roadbeds even if this highly improbable simultaneous peaking of discharges does occur.

Floodway Reach 4 extends from Interstate 10 to Saddleback F.R.S. It consists of a diversion of the natural channel immediately downstream from the box culverts eastward through a channel across the foot slope extension of Burnt Mountain to an outlet into Saddleback F.R.S. Total length of this reach is 7,090 feet. (See Figures P9 and P10.)

Soil conditions require that riprap be used for channel stabilization. The channel will have a 35 foot bottom width and 2:1 side slopes. Slope of the channel bottom will vary from .009 ft./ft. to 0.0 ft./ft. The channel will be maintained entirely in cut for aesthetic purposes. Where suitable, excavated material will be used as a part of the embankment of Saddleback F.R.S. A small berm approximately 2 feet in height will be constructed on the upstream (north) side of the channel to prevent local runoff from uncontrolled entry into the channel over the side riprap.

Two different discharges were used to design this channel. A design flow of 765 cfs was used to set the height of riprap. Depth of flow with 765 cfs is 2.1 feet. A design flow of 1,265 cfs was used to set the depth of channel excavation. Depth of flow with 1,265 cfs is 3.6 feet. With an added 1 foot of freeboard, the average depth of the channel cut below natural ground is about 4.6 feet.

Construction activities will be performed on 17.5 acres of land. This includes 1.8 acres in Reach 1 where a channel cut will be made in order to drain Harquahala F.R.S. into the wash, .4 acres in Reach 2 for the channel cut into the borrow pit and channel widening along the existing revetment, and 15.3 acres in Reach 4 where a new channel will be constructed. With the exception of 5.8 acres of private land on Reach 4, all work will be on public lands administered by the U.S. Bureau of Land Management or State lands administered by the Arizona Department of Transportation. In Reach 4, an additional 7.2 acres of private land and 47.8 acres of public lands between the structure and Interstate 10 may also be required due to severance.

Fee simple acquisition of land rights will be required for the private lands in Reach 4. Land Rights by permit may be possible for those areas where construction activities will be conducted on federal or State lands. Flowage easements will be required on the natural wash at least for the 485 cfs release rate from Harquahala F.R.S. All required right-of-way is on unimproved rangeland.

d. Floodwater Diversions and Levees

(1) Saddleback Diversion

Saddleback Diversion begins at the principal spillway outlet of Saddleback F.R.S. and proceeds in a generally southern direction along the west foot slopes of Saddleback Mountain for a distance of 4.64 miles outletting into an unnamed wash about 1.4 miles above its confluence with Centennial Wash. (See Project Map, Plate 4, and Figure P11. Structural Data is shown on Table III.)

The diversion is designed to carry the maximum outflow from Saddleback F.R.S. plus the 50-year flood event from the diversion drainage area. Design capacity varies from 810 cfs at the Saddleback F.R.S. outlet to 6,289 cfs at the end of the diversion (see Plate 4). The diversion will carry floodwater releases from Harquahala F.R.S. and Saddleback F.R.S. The total drainage area contributing runoff to the diversion is 140.6 square miles, of which 102.3 square miles are controlled by Harquahala F.R.S., 29.6 square miles are controlled by Saddleback F.R.S. and 8.65 square miles are above the diversion proper.

The diversion consists of a compacted earth embankment varying from 2 to 5.5 feet in height and an excavated earth channel of 3 feet average depth varying in bottom width from 35 to 232 feet. Design depth of flow for the 50-year event is 3.5 feet. The slope of the diversion is .0017 ft./ft. for the first 544 feet, .000797 for the next 956 feet, and .003 ft./ft. thereafter.

The diversion is designed to safely convey design discharges without excessive scour or excessive sediment deposition. However, geologic conditions show that some scour will initially occur in the channel bottom followed by the formation of erosion resistant pavement. At the outlet of the diversion, flood flows will be released over unimproved rangeland to a drainageway leading to Centennial Wash. Excessive scour is not expected due to the presence of shallow deposits of caliche conglomerate, gravelly and cobbly material, and very compact silty sands. The end of the diversion embankment ties into a basalt hill and is protected by the hill. The low flow channel at the end of the diversion is on caliche conglomerate and not subject to excessive erosion.

The diversion will cross Courthouse Road through four 10 foot by 5 foot concrete box culverts. Rock riprap will be placed at the inlet and outlet of the culverts as protection against localized scour.

Construction will require land rights acquisition on 177.3 acres of land. An additional 68 acres (State Trust lands) will be required as flowage right-of-way on the unimproved rangeland between the diversion outlet and Centennial Wash.

Of the 177.3 acres total, 19 acres are in private ownership, 42 acres are State Trust lands administered by the State Land Department, 116 acres are public lands administered by the U.S. Bureau of Land Management, and an estimated .3 acres are under the jurisdiction of Maricopa County at the Courthouse Road box culvert crossing.

Of the right-of-way required, 158 acres are unimproved rangeland. In section 4, T1N, R8W, 19 acres are in an inactive subdivision, however, there are no improvements in the area traversed by the diversion other than bladed roads.

No relocations of people, businesses, or farm operations will result from the construction of the diversion.

(2) Centennial Levee

Centennial Levee will be located on the west side of Harquahala Valley to provide protection from floodwaters to 7,440 acres of land that are either presently being irrigated or have a history of irrigation. Although the levee will be constructed as a continuous unit, for purposes of discussion it will be divided into two reaches. (See Project Map, Plate 5, and Figure P12. Structural Data is shown in Table III.)

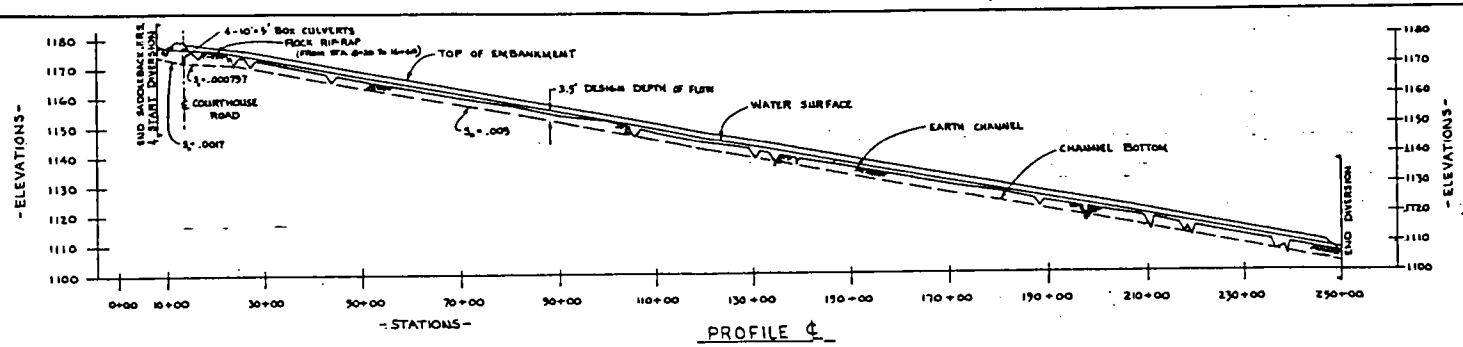
Reach 1 has a northeast to southwest trend. The levee begins just south of Interstate 10 and extends about 3.7 miles to the Centennial Wash floodplain. The levee will prevent runoff from a 21 square mile residual drainage area downstream of the Granite Reef Aqueduct from entering the project area.

The levee has been located far enough to the west so as to protect a proposed canal that will distribute water from the Granite Reef Aqueduct into Harquahala Valley.

Reach 1 is designed to provide protection against the 100-year flood event. Design capacity is 7,540 cfs.

The levee for Reach 1 consists of a compacted earth embankment varying in height from 0 feet to 9.5 feet. Levee slope is .0002 ft./ft. Average velocity of flow is 1.2 feet per second. Velocity of flow has been kept very low to prevent scour in the prevailing light soils. Extra embankment height has been added to allow for expected sediment deposition behind the levee.

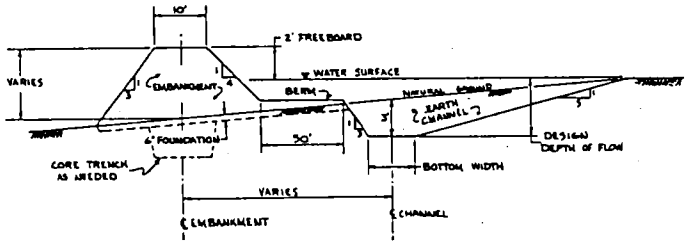
Reach 2 parallels Centennial Wash for approximately 5.75 miles. It will prevent the existing spreading of flow that presently occurs near Allison Tank. This condition is described in the Water and Related Land Resource Problems-Floodwater Damage section of this statement. (Also see Figures 1 and 2.)



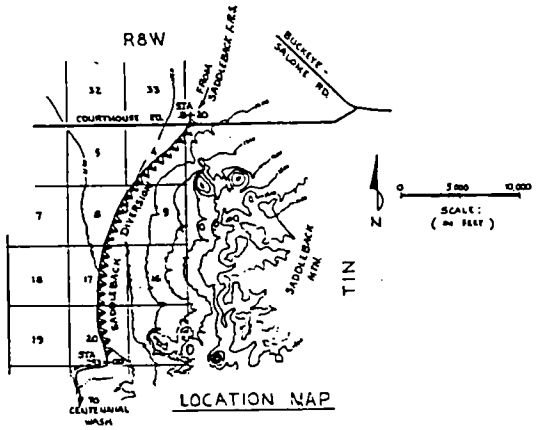
PROFILE ℄
SADDLEBACK DIVERSION

CHANNEL DESCRIPTION

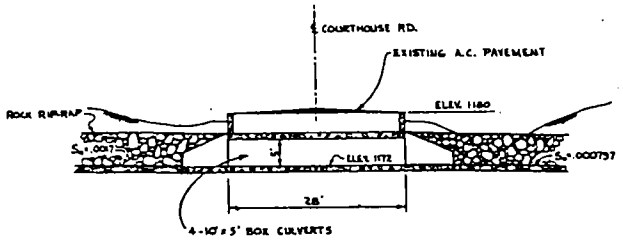
REACH	BEGINNING STATION	DRAINAGE AREA (SQ. MILES)	BOTTOM WIDTH (FT.)	DESIGN CAPACITY (C.F.S.)
1	8+20		35	810
2	13+36		4-10'x5' CBC	810
3	13+64		50	810
4	16+60	.302	56	857
5	23+20		56	1663
6	44+00	.861	56	1663
7	51+90		60	1762
8	59+80		66	1912
9	66+70		72	2064
10	75+60		80	2267
11	85+50	1.94	90	2524
12	94+25		110	3042
13	105+00	3.27	132	3619
14	115+34		145	3963
15	125+68		160	4361
16	136+00	5.58	184	5000
17	153+00		196	5322
18	170+00		208	5644
19	187+00		220	5966
20	204+00	8.21	232	6289
21	227+00		232	6289
22	250+00		232	6289
OUTLET	253+00	8.65	NATURAL CHANNEL	6289



CROSS - SECTION
CHANNEL & EMBANKMENT



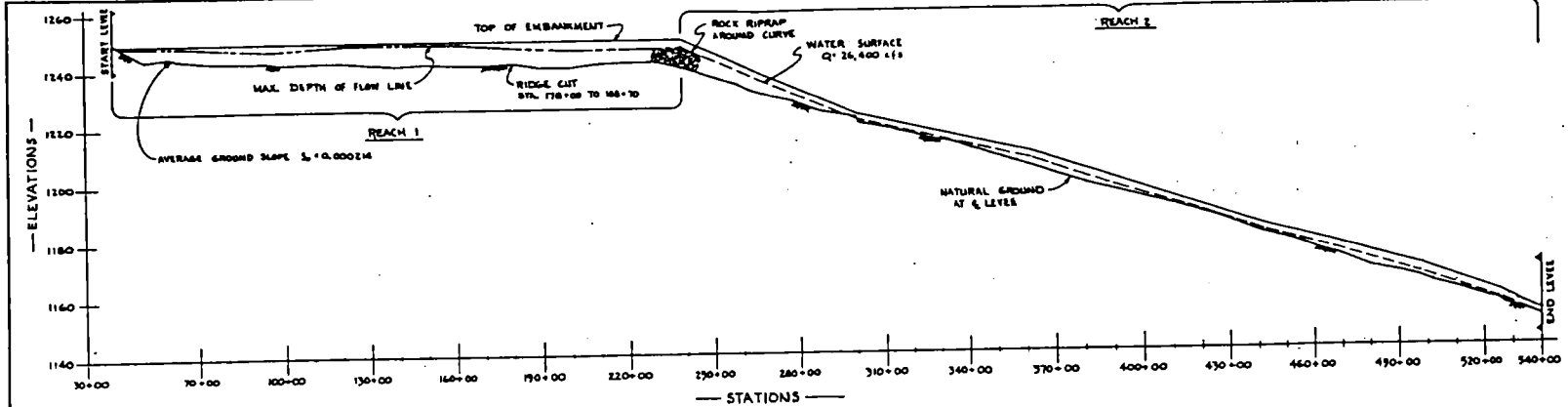
LOCATION MAP



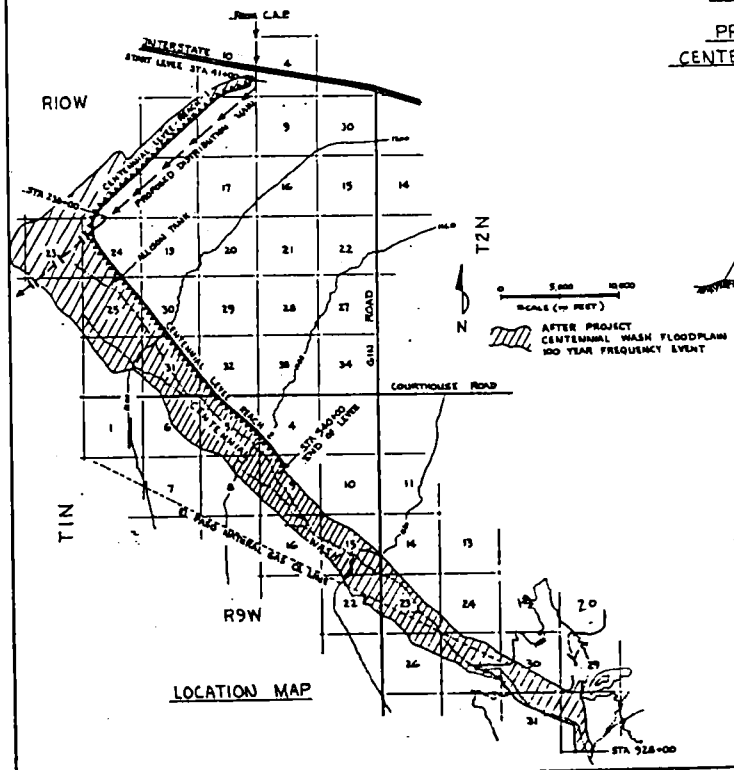
CROSS - SECTION
COURTHOUSE ROAD

PLATE 4
SADDLEBACK DIVERSION
HARQUAHALA VALLEY WATERSHED
MARICOPA & YUMA COUNTIES, ARIZONA
PRELIMINARY PLANS
MARCH 4, 1976
ARIZONA WATER COMMISSION
STATE OF ARIZONA

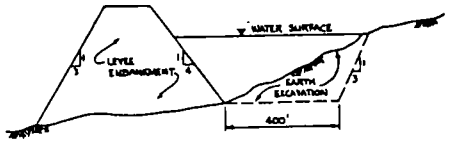
SCS-ENG-313-8 Rev. 7-69



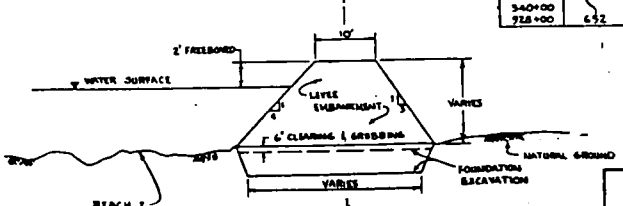
PROFILE ℄
CENTENNIAL LEVEE



LOCATION MAP



CROSS-SECTION
RIDGE CUT
(STATION 178+00 TO 188+70)



CROSS-SECTION
LEVEE EMBANKMENT
(TYPICAL)

LEVEE DESCRIPTION

STATION	D. A. (sq. miles)	REQUIRED CAPACITY (C.F.S.)	VELOCITY (F.P.S.)	NATURAL GRADING (FT/FT)
REACH 1		13 EVENT		
41+00	0	0	0	.000214
70+00	2.44	854	1.28	
95+00	6.08	1979	.88	
120+00	10.18	3562	1.21	
160+00	14.91	5218	1.24	
180+00	15.57	5450	1.24	
200+00	16.24	5683	1.21	
230+00	20.99	7339	1.50	.000214
REACH 2				
238+00	652 -	26,400		
300+00			3.56	.0039
331+00			2.82	.0021
361+50			3.50	.0025
388+50			3.12	.0028
416+00			3.61	.0034
448+50			3.34	.0031
469+00			3.22	.0026
498+00			3.47	.0031
525+00			3.48	.0036
540+00			3.66	.0032
540+00			NATURAL WASH	
928+00	652	26,400		

PLATE 5
CENTENNIAL LEVEE
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH 1976
ARIZONA WATER COMMISSION
STATE OF ARIZONA

SCS-ENG-313-B Rev. 3-69

Reach 2 will confine Centennial Wash flows to a definite floodplain. Drainage area at the beginning of the reach is approximately 652 square miles. This excludes the drainage area on Centennial Wash above the Bureau of Land Management's dam near Wendon and 166 square miles to be controlled by the Tiger Wash Detention Basin (U.S. Bureau of Reclamation).

Reach 2 is designed to protect for the 100-year flood event. Design capacity is 26,400 cfs. This includes flow diverted from Reach 1.

The levee for Reach 2 consists of a compacted earth embankment varying in height from 2.5 feet to 9 feet. Maximum height occurs where the curve is made into Reach 1. (See Plate 5.) The slope of Centennial Wash averages .00248 ft./ft. Velocity of flow during the design event will average 3.5 feet per second.

The embankment section for both reaches will have a 10 foot top width, an upstream side slope of 4:1, and a downstream side slope of 3:1.

Construction of the levee embankment will require 485,000 cubic yards of fill, of which 325,000 cubic yards are for Reach 1 and 160,000 cubic yards are for Reach 2. For Reach 1, this material will come from channel cuts upstream from the levee and within the required right-of-way line. As this reach is designed very flat with siltation expected, channel scour problems will not occur. However, on Reach 2, primary concern is to eliminate channel scour or head-cut formation; therefore excavation by borrow channel will not be conducted. Borrow material for Reach 2 can be obtained from several sources. The soils throughout the entire area traversed by the levee are basically similar so this is not a controlling factor. One source would be to expand the channel cuts for Reach 1 and haul the material to Reach 2. This would require haul distances of up to 6 miles. The material could be obtained by shallow borrow pits, either located upstream of the levee within the flood easement line of Centennial Wash or downstream of the levee in a combination borrow-leveling operation from downstream properties or agricultural lands. Reach 2 will require 160,000 cubic yards. This is equivalent to about 120 acre-feet of material with allowance for compaction shrinkage. This corresponds to a one foot cut on 120 acres, or a two foot cut on 60 acres, etc.

One source of borrow for both Reach 1 and Reach 2 is from expansion and deepening of Allison Tank. This tank provides valuable permanent surface water storage for livestock and wildlife (see Figure P28). Siltation since construction by the C.C.C. in the 1930's has greatly reduced storage capacity. A representative of the owner of this impoundment has verbally requested that borrow material for the

construction of Centennial Levee be obtained from the confines of Allison Tank to increase the available storage. This would be a beneficial endeavor. Final design of the levee may incorporate borrow excavation from the tank if the soils are suitable for dike construction and there are no conflicts with downstream water rights. No such conflicts are anticipated. Securing of all water rights is the responsibility of the project sponsors.

2-1-89 Constructed

2-1-89 Don Paula Reach 1 in Reach 2 on Hold.

Construction of Reach 1 will require land sition of approximately 348 acres of land, including private ownership, 126 acres of State Trust lands by the State Land Department, and 63 acres of ic lands administered by the U.S. Bureau of Land Required right-of-way is for the area encompassed embankment, borrow channels, and flowage line up ear frequency event. All 348 acres are unimproved

2-1-89 on Hold.

Construction of Reach 2 will require land sition on 6,307 acres, including 5,117 acres in private ownership (585 acres of presently irrigated cropland and 4,532 acres of unimproved rangeland or idle cropland), 1,152 acres of State Trust land and 38 acres of federal public land administered by the U.S. Bureau of Land Management. Of the total land, only about 98 acres are required for actual levee construction. The remainder are for the 100-year frequency flood delineation on Centennial Wash. (See Plate 5.)

Reach 2 will be constructed on the existing floodplain of Centennial Wash. The project sponsors will obtain land rights by flowage easements or fee simple title for the 100-year frequency event where significant changes in flooding occur to properties as a result of the project measure. The after-project 100-year flood lines on Centennial Wash are shown on Plate 5. The delineation covers a reach length of approximately 13 miles. The majority of these lands are already in the Centennial Wash floodplain and subject to floodwater damage under present flow conditions. An unofficial delineation of the 100-year flood lines under present conditions is as shown on Figure 2. The Flood Control District of Maricopa County is anticipating official floodplain delineations prior to project construction. These will serve as a basis for the before-project (existing) condition. The amount of land purchased by fee simple title will vary, depending upon the outcome of individual negotiations with affected landowners. Flowage easement would not preclude all future productive uses of these lands.

The cost of obtaining land rights for Centennial Levee is estimated at $712,450, of which $47,970 is for Reach 1 and $664,480 for Reach 2.

TABLE III

STRUCTURE DATA FOR DIVERSIONS, LEVEES, AND FLOODWAYS

Reach	Beginning Station	Drainage Area (Sq.Mi.)	Capacity (cfs) Req'd	Capacity (cfs) Design	Channel Dimensions: Bottom Width (ft)	Bottom Slope (ft/ft)	Depth of Flow (ft)	Side Slopes z_u	Side Slopes z_d	"n" Value Aged	"n" Value As Built	Velocities (fps) Aged	Velocities (fps) As Built	Type of Work 5/	Before Project 3/-4/
Saddleback Diversion - 4.64 mi.															
1	8+20	0	800	810	35	.0017	4.5	2	2	.035	.035	4.09	4.09 6/	I-R	O-E
2	13+36	(4 - 10'x 5', 90°, Box Culvert at Courthouse Road, L = 28')													
3	13+64		800	810	50	.000797	4.0	5	3	.035	.035	2.83	2.83	"	"
4	16+60	.30	800	857	56	.000797	"	"	"	.03	.025	2.53	3.11	I-E	"
5	23+20		1040	1663	56	.003	"	"	"	"	"	4.90	6.03	"	"
6	44+00	.86	1499	"	56	"	"	"	"	"	"	"	"	"	"
7	51+90		1499	1762	60	"	"	"	"	"	"	4.96	6.07	"	"
8	59+80		1499	1912	66	"	"	"	"	"	"	5.05	6.12	"	"
9	66+70		1499	2064	72	"	"	"	"	"	"	5.12	6.16	"	"
10	75+60		1499	2267	80	"	"	"	"	"	"	5.21	6.21	"	"
11	83+50	1.94	2197	2524	90	"	"	"	"	"	"	5.31	6.26	"	"
12	94+25		2197	3042	110	"	"	"	"	"	"	5.48	6.34	"	"
13	105+00	3.27	3029	3619	132	"	"	"	"	"	"	5.63	6.40	"	"
14	115+34		3029	3963	145	"	"	"	"	"	"	5.70	6.43	"	"
15	125+68		3029	4361	160	"	"	"	"	"	"	5.78	6.46	"	"
16	136+00	5.58	4230	5000	184	"	"	"	"	"	"	5.88	6.50	"	"
17	153+00		4230	5322	196	"	"	"	"	"	"	5.92	6.51	"	"
18	170+00		4230	5644	208	"	"	"	"	"	"	5.96	6.53	"	"
19	187+00		4230	5966	220	"	"	"	"	"	"	6.00	6.54	"	"
20	204+00	8.21	5467	6289	232	"	"	"	"	"	"	6.03	6.55	"	"
21	227+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
22	250+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
	253+00	8.65	5610	(Natural Channel Outlet)											
Harquahala Floodway - 3.43 mi.															
1	11+72	0	485	500	18	.000215	6.80	3	3	.03	.025	1.59	1.91	I-E	N-E
2	22+00		485	500	(Natural channel)										N-E
3	120+00	.96	1265	1265	(I-10 crossing, 3 - 10'x 5' C.B.C.)										M(1964)-E
4	122+10		1265	1265	35	.0090	3.61	2	2	.035	.035	7.02	7.02	I-R	O-E
	177+00	.98	1265	1265	35	.0045	4.38	2	2	.035	.035	5.59	5.59	I-E	N-E
	185+00		1265	1265	35	0.0	4.38	2	2	.035	.035	5.59	4.49	I-E	N-E
	193+00		1265	(Natural Channel Outlet)											
Centennial Levee - 9.45 mi.															
1	41+00	0	0	7540		0 1/	0 2/			.035		0		I-E	O-E
	70+00	2.44	854	"		1356	380			"		.63		"	"
	95+00	6.08	1979	"		2249	800			"		.88		"	"
	120+00	10.18	3562	"		2944	952			"		1.21		"	"
	160+00	14.91	5218	"		4208	1330			"		1.24		"	"
	180+00	15.57	5450	"		4395	1500			"		1.24		"	"
	200+00	16.24	5683	"		4697	1288			"		1.21		"	"
2	238+00	20.99	7539	"		5026	1099			"		1.50		II-E	N-E
	300+00	652-	26390	26400		7411	5100			.035		3.56		"	"
	331+00	"	"	"		9356	5000			&		2.82		"	"
	361+50	"	"	"		7533	3550			.045		3.50		"	"
	388+50	"	"	"		8466	4000			"		3.12		"	"
	416+00	"	"	"		7317	3450			"		3.61		"	"
	442+50	"	"	"		7910	4650			"		3.34		"	"
	469+00	"	"	"		8192	4470			"		3.22		"	"
	498+00	"	"	"		7616	4000			"		3.47		"	"
	525+00	"	"	"		7584	3750			"		3.48		"	"
End Levee	540+00	652	"	"		7218	3350			"		3.66		"	"

1/ Cross sectional area below hydraulic grade line, (Ft.^{2}).

2/ Wetted perimeter below hydraulic grade line, (Ft.).

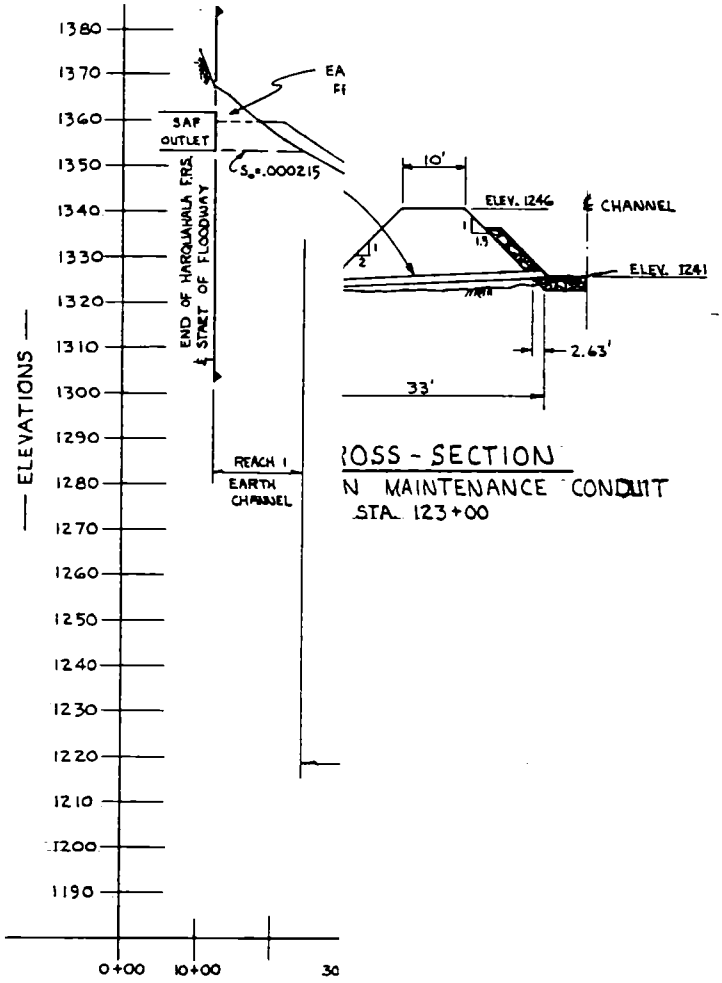
3/ N - An unmodified, well defined natural channel or stream.
M() - Manmade ditch or previously modified channel (approximate date of original major construction).
O - None or practically no defined channel.

4/ Pr - Perennial - flows at all times except during extreme drought.
I - Intermittent - continuous flow through some seasons of the year but little or no flow through other seasons.
E - Ephemeral - flows only during periods of surface run-off, otherwise dry.
S - Ponded water with no noticeable flow - caused by lack of outlet or high groundwater table.

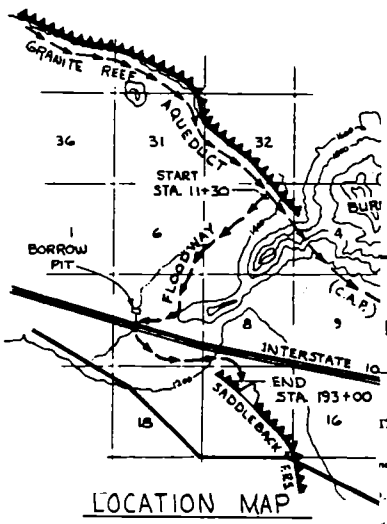
5/ I - Establishment of new channel including necessary stabilization measures.
II - Enlargement or realignment of existing channel or stream.
III - Cleaning out natural or manmade channel (includes bar removal and major clearing and snagging operation).
IV - Clearing and removal of loose debris within channel section.
V - Stabilization as primary purpose (by continuous treatment or localized problem areas - present capacity adequate).

E - Earth channel.
R - Rock riprap channel.

6/ 10YR-24HR storm depth = 3.0' (low flow channel).



ROSS - SECTION
N MAINTENANCE CONDUIT
STA. 123+00



LOCATION MAP

PLATE 3
HARQUAHALA FLOODWAY
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976

ARIZONA WATER COMMISSION

STATE OF ARIZONA

		Date	
ned	B. Friedhoff	2/10/76	Approved by
		2/13/76	Title
d			Title
ed			Sheet No. of / Drawing No

SCS-ENG-313-B Rev. 7-69

Figure P11. Looking southwest from Section 4,T1N,R8W, showing alignment of Saddleback Diversion. Area in foreground is idle subdivision.

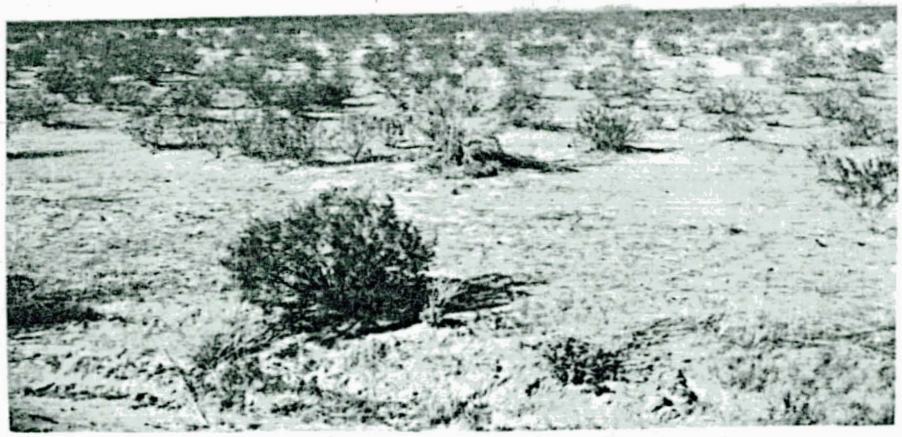


Figure P12. Typical terrain along the alignment of Centennial Levee.

No relocation of people, businesses, or farm operations will result from the construction of Centennial Levee.

A 12 foot by 15 foot log cabin exists in the middle of section 15, T1N, R9W. This structure is within the flowage easement line for Centennial Wash. Local valley residents relate that transients living in the cabin found the structure (origin unknown) lying in the ditch along Gin Road and dragged it to its current location. The provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 - Public Law 91-646, are deemed unapplicable. Costs for removing the structure from the floodplain will be treated as a land rights item.

Hog pens have been constructed in the middle of section 25, T1N, R9W, at the south edge of a salt cedar thicket. These pens are within the 100-year flowage line, but are not currently in use and do not constitute a flow obstacle. No costs are included for their relocation.

4. Environmental Features

The proposed project has the potential to damage the natural environment, primarily, wildlife populations and aesthetic values. Adverse impacts on wildlife populations in the area are generally proportional to losses of woody pseudo-riparian vegetation. Specific species of value are mesquite, ironwood, paloverde and acacia trees. Impacts on aesthetic values result primarily from the protrusion of an unnatural shape into the existing landscape or from a change in the shape of the terrain. This impact is compounded if the vegetative pattern on the changed landscape does not blend with the surrounding natural area.

Since changes in vegetation will produce the principal impact on the natural environment, several features and provisions will be incorporated into the design and construction of the proposed structures to minimize these impacts.

All structure embankment slopes will be treated to reduce rilling and the adverse visual departure from the surrounding natural setting. Several methods of such treatment have been utilized on other structures with varying results. Studies are underway to determine the best method. The U.S. Bureau of Reclamation has established vegetative test plots on the Paradise Valley Detention Dike. The Soil Conservation Service has also established vegetation plantings on the Buckeye and Guadalupe Structures, and their Plant Materials Center is conducting an intensive planting and evaluation program. The Center is presently experimenting with germination of ironwood trees. Results to date appear very promising.

E. Environmental Setting

Harquahala - pronounced Har-kwa-hey-la, from Mohave Indian word Ah-ha-qua-hale meaning "water there is high up." Referred to a spring on the south side of the Harquahala Mountains. White man attempts to pronounce the indian word resulted in various spellings. Generally spelt Harquahala since about 1869.

.....Arizona Place Names

1. Physical Resources

a. Physical Setting [2,7,27,28]

Harquahala Valley Watershed is in west central Arizona, approximately halfway between Phoenix and the Colorado River. The watershed contains 239,360 acres - 235,410 in Maricopa County and 3,950 acres in Yuma County. The watershed includes the southern end of the Harquahala Mountains, the Big Horn Mountains, Burnt Mountain, the west slopes of Saddleback Mountains, and a broad alluvial plain referred to as the Harquahala Plains.

The watershed is within the Gila Water Resource subregion of the Lower Colorado Region as defined by the U.S. Water Resources Council. The Lower Colorado Region includes the State of Arizona and parts of Nevada, Utah, and New Mexico. The Gila River, the largest surface water system in the Region, originates in western New Mexico and flows generally west through Arizona to the Colorado River at Yuma. The Harquahala Valley Watershed is drained by Centennial Wash which enters the Gila River approximately 10 miles southwest of Buckeye, Arizona. The watershed is approximately 23 miles upstream on Centennial Wash from this point.

The physical characteristics of the Gila subregion vary from the broad open expanses of the Sonoran Desert to high rugged mountains. Harquahala Valley Watershed is entirely within the Sonoran Desert portion of the subregion. The watershed is well-defined as an arid, remote setting within the subregion. Of the total watershed area, 85% could be properly classified as uninhabited.

There are no towns in the watershed although some businesses have been established. The developed farming area is about 40 miles west of Buckeye, population 5,000, and 70 miles west of Phoenix.

The unincorporated community of Aguila is located

on U.S. Highway 60 about 5 miles north of the upper end of the watershed and 35 miles north of Harquahala Valley. Access to Aguila from the valley is via the unpaved Eagle Eye Road.

The unincorporated communities of Salome and Wenden, which are also on U.S. Highway 60, are located 11 miles northwest of the watershed area and 35 miles from Harquahala Valley. Access to Salome is via the Buckeye-Salome Road. The portion of this road within the watershed is unpaved.

The first settlement in the area, Harrisburg, was established in 1886 in a small valley, later called Harrisburg Valley, where Centennial Wash passes between the Harquahala and Little Harquahala Mountains about 8 miles west of the western boundary of the watershed. The Bonanza, or Harquahala vein system, was discovered in 1888 and the mine became the largest in the area, with a total production of more than 2½ million dollars in gold, mostly prior to 1900. This find stimulated interest in the area and numerous smaller mines were developed.

The Arizona and California Railroad (now a part of the Atchison, Topeka, and Santa Fe Railroad) was completed through the McMullen Valley in 1907 and the towns of Salome and Wenden were founded along the railroad. McMullen Valley is located about 10 miles north of the watershed boundary.

Cattle ranching has been practiced in the area for many years. The first farming on the Harquahala Plains was an attempt at dry farming by homesteaders during the depression years beginning in about 1928. Veterans were allowed 320 acres and non-veterans were allowed 160 acres. There were many homesteaders in the valley during the late 1920's and early 1930's. In the words of a resident of the area during that period, "In the evening, the locations of homesteads appeared as a vast sea of lantern lights across the valley." 27/

The remains of abandoned homesteads are to be found throughout the area. Some homesteaders had wells for domestic, stock, and small gardens but evidently no successful attempt was made to use groundwater for irrigation. At the abandoned Mosher homestead in section 31, T3N, R9W, the well was reportedly dug entirely by hand to a depth of about 330 feet. In the late thirties, wells in the lower end of the valley were developed for irrigation, but most of the water was transported to land out of the Harquahala Valley.

Concentrated agricultural development began in the early 1950's, with the first well being drilled in 1951. Development proceeded at a rapid pace. By 1963, the irrigated land had increased to about 19,000 acres and has remained relatively static since that time.

Interstate Highway 10 was completed through the watershed in 1973. Until that time, the entire watershed could only be described as being in a remote area. There are several county roads, of which two, Courthouse Road and Gin Road, are paved through the developed areas of Harquahala Valley. A major gas line of the El Paso Natural Gas Company system and an A.T.&T buried main telephone cable also traverse the watershed. The alignment of the authorized Granite Reef Aqueduct of the Central Arizona Project traverses the watershed about 5 miles north of the developed agricultural areas.

b. Major Soil and Water Resource Problem Areas

The major problem area in the watershed is on the portion of the alluvial floodplain of Harquahala Valley which has been highly developed for irrigated agriculture. The floodplain is directly below the desert mountains which produce floodwaters that enter the floodplain from the northwest and west. Natural, well-defined flood channels are almost nonexistent on and adjacent to the floodplain. Floodwater is primarily overland flow. The topography of the floodplain is such that regardless of origin, the floodwater funnels down through the center of the developed farmland. Grades are so flat that almost all of the farmland is inundated by large storms.

Land is being intensively farmed and is highly productive. As a result, flood damage to irrigation systems, roads, homes, and equipment is severe.

c. Topography

Elevations in the watershed range from 1,050 feet on Centennial Wash to 5,681 feet in the Harquahala Mountains. Over 44 percent of the area is in the hills and mountains where slopes range from 5 percent to vertical.

d. Soils [2,4,40]

On the mountains and mountain foot slopes, soils are rocky, cobbly or gravelly with shallow and very shallow depths. In the steeper areas, as in the Harquahala, Big Horn, Burnt, and Saddleback Mountain ranges, soils are very shallow and from 40 to 60 percent of the surface is rock outcrop. In the less sloping areas the soils are from 4 to 14 inches deep and have a thin, medium, or moderately coarse textured gravelly to stony surface soil. The deeper soils have a medium or moderately fine gravelly to stony subsoil. Most of the soils are residual on granite, gneiss, limestone, schist, andesite, basalt, or shale. Smoother slopes generally have a dark desert varnish coating on the gravel

surfaces. Local areas of soils have a strongly cemented lime hardpan. Soils here are only slightly erosive. The coarse testures of the soils, gravelly surfaces, and lime hardpans are factors which impeded erosion in the area. The soils have a high runoff potential because shallow soils and rock outcrops have a very slow rate of water transmission and very slow infiltration rates when thoroughly wetted.

Deep or moderately deep soils on alluvial outwash plains constitute most of the plains area. Medium or moderately fine surface soils and subsoils are found on the smoother slopes near the center of the valley. Coarse or moderately coarse textured soils comprise the upper fans of washes from the granitic mountains. Along the foot of the mountains, there is usually an area of shallow to moderately deep residual soils. These often have a medium textured surface with gravel that is covered with dark desert varnish. They have moderately fine textured subsoils underlain at 12 to 28 inches by a strongly cemented lime hardpan. Alluvium for the valley fill soils originates in the granite, granite gneiss, schist, limestone, andesite, basalt, and shale rocks of the adjacent mountains. Slightly to moderately erosive soils are present. Where the land slope is relatively flat and a sheet flow runoff condition prevails, erosion is generally not significant. Erosion is active, however, in some of the channels and diversions constructed in and around the cultivated area where flood flows are concentrated. Generally, the soils have a slow to very slow rate of water transmission and a slow to very slow infiltration rate when thoroughly wetted because of moderately fine to fine texture. These soils have a moderately high to high runoff potential.

e. Land Capabilities

Water is the limiting factor in this watershed. There are approximately 60,000 acres of potential irrigable land in the watershed of which about 40,000 acres are located in the flatter portions of the Harquahala Plains that would be highly productive if sufficient water was available for development. The area is ideally suited to irrigated agriculture with a growing season of about 310 days.

f. Geology [8,9]

Physiographically, southwestern Arizona lies in the Sonoran section of the Basin and Range Province and is characterized by northwest trending mountains separated by wide alluvial plains. The topography of the area suggests that the mountains are tilted or uplifted fault blocks, and the basins are the downfaulted counterparts. The mountains are composed of a variety of rock types. The basins are filled with alluvium from the weathering

and transportation of rock material from adjacent highlands.

The portion of the Harquahala Mountains included in the watershed area is composed mainly of Pre-Cambrian granite gneiss and schist; Paleozoic and Mesozoic shale, quartzite, limestone; and Laramide granite and related crystalline rocks. The portion of the Big Horn Mountains included in the watershed is made up of Cretaceous andesite and andesitic tuff; Pre-Cambrian granite and granite gneiss; and Quaternary basalt with small areas of rhyolite, shale, quartzite, and limestone. The Saddleback Mountains are composed mainly of Pre-Cambrian schist, Cretaceous andesite and andesitic tuff, and Quaternary basalt. Burnt Mountain is composed of Quaternary basalt.

Gentle alluvial slopes extend basinward from the mountains. Quaternary-Tertiary sand, gravel, and conglomerate are present near the mountain fronts with Quaternary clay, silt, sand, and gravel occurring at the lower elevations.

The maximum thickness of alluvial materials in the basin is not known, although limited well log data indicates basement rock in excess of 2,000 feet deep. The upper part of the alluvial fill is considered to be of Quaternary age, but alluvial beds of Tertiary age probably are present at depth.

Vulcanism is believed to have begun in the Cretaceous period and to have continued intermittently into the Quaternary period. The era of vulcanism was marked by minor structural movements and periods of explosive activity. Some of the tuffs accompanying the vulcanism probably were deposited in water. Basin and Range block faulting probably began in the early Tertiary, although the landforms resulting from this activity have since been modified and in some places obliterated. The block faulting that produced the present mountains probably occurred at the beginning of the Quaternary period. Since that time erosion of the mountains and deposition of alluvial material in the basins have been the principal geologic agents at work.

g. Climate

Climate in the watershed is arid with average annual precipitation ranging from 7.5 to 10 inches. During July, August, and September, high intensity thunderstorms and dissipating tropical disturbances moving north and east from the Gulf of California and Pacific Ocean account for the heaviest rains. Mean monthly precipitation is as follows:

Month	Mean Precipitation (Inches)
January	.92
February	.92
March	.69
April	.35
May	.06
June	.11
July	1.11
August	1.37
September	.62
October	.50
November	.39
December	.92
Total	7.96

Precipitation and temperature distributions at Salome, 15 miles north of the watershed boundary, are typical for the watershed. Mean monthly temperatures range from 48.7°F. in January to 88.1°F. in July with a mean annual temperature of 67.1°F. The highest recorded temperature was 118°F. in 1929 and the lowest was 15°F. in 1950. There are an average of 321 days with minimum temperatures above 28°F. Estimated annual mean relative humidities are 46 percent at 6:00 A.M. and 21 percent at 6:00 P.M.

h. Mineral Resources

The mineral resources of the watershed were investigated in 1967 by the Bureau of Mines, U.S. Department of the Interior, as part of the agency's review of the original watershed work plan. Comments made by the Bureau are paraphrased below:

1. The Aguila manganese district is situated in the north central part of the watershed area. This district centers around the township, T5N, R9W. About 25 manganese mines occur in the district from which about 35,000 tons of ore have been obtained. The mines in this district are now idle.

2. Several gold mines occur in the same area as the manganese mines. Production records are very poor, but one mine (El Tigre) yielded ore valued at nearly $15,000 in 1923. It is probable that the total district production of gold is less than $100,000.

3. In 1953, sections 20, 21, 22, 23, 28, 29, 31, and the north halves of sections 26 and 27, T4N, R9W

were covered with placer claims. The 32 placer claims, called the Black Magic Group, were held in 1953 by the Black Magic Mining Association of Phoenix, Arizona. Another group of claims, the E. N. Greenleaf group, was located south of the Black Magic claims. Thorite and monazite had been reported in the black sand, but neither was found in five samples taken by a Bureau of Mines engineer in a 1953 examination. Most of the black sand was found instead to contain magnetite, and the slight radioactivity was due to, or associated with, sphene and altered zircon. No ore reserves could be calculated for the Black Magic claims.

4. A few copper prospects are located high on the north flank of Saddleback Mountain.

At the present time, there are no known mining operations being conducted in the watershed.

i. Land Use 2,4,32

The watershed contains 239,360 acres. Of the total, 19,000 acres (7.9%) is irrigated cropland of which about 1,500 acres were idle in 1974. (See Land Status and Resources Unit Map - Appendix B.)

Road right-of-way occupies 3,760 acres (1.6%). Approximately 0.8 percent of the total watershed area, or 1,600 acres, has been approved for subdivision by the Maricopa County Planning and Zoning Commission. All of this is located in Harquahala Valley. Except for a few isolated houses and mobile homes, these subdivisions have not been developed.

Of the total watershed area, 213,500 acres (89%) is unimproved desert classified as multiple-use land primarily for livestock grazing, wildlife, and limited recreation. Some of this area is within the higher elevations of the Saddleback and Big Horn Mountains which are too steep and rugged for cattle.

Approximately 1,500 acres (0.6%) are occupied by farmsteads, businesses, old mines, and other miscellaneous uses.

j. Surface Water Resources 2,4

The term to best describe the surface water resources in this watershed is "meager." There are no perennial streams. The average annual runoff from the total watershed ~~to~~ Centennial Wash is approximately 0.1 inches per year which is 1.2 percent of the average annual rainfall.

Average Annual Runoff. (25 years) = 2631 AF from
1810 sm = 0.027"

43 $\frac{0.027}{7.96''}$ = 0.339 %

There are numerous intermittent flow washes in the watershed with characteristics typical of the semi-arid setting. The major washes head in the Harquahala, Big Horn, and Saddleback Mountains. Surface water flows occur after intense thunderstorms or prolonged rains. From the mountains, the wash channels increase in size attaining maximum width at slopes of about one percent. When slopes approach .5 percent, the flows can no longer sustain heavy bedload transport and the channels fan or braid out into smaller ill-defined washes. Bedload deposits remain in the drainage pattern and result in constant shifting of channels.

The entire watershed is tributary to Centennial Wash which forms the southwestern boundary for about 17 miles. Centennial Wash is an ephemeral stream with most of its drainage area outside of the Harquahala Valley Watershed boundary. The drainage area above Harquahala Valley exceeds 700 square miles. above Narrows CDA = 730 sm WPI USGS 684

Tiger Wash is the main wash within the watershed boundary. The wash originates in the Harquahala and Big Horn Mountains and drains the extreme northern and western areas of the watershed. Major tributaries are Browns Canyon Wash and Pump Mine Wash. At the developed areas in Harquahala Valley, Tiger Wash has a drainage area of about 160 square miles with a length of 35 miles. In the upper reaches, Tiger Wash is well-defined. However, as the wash leaves the mountains at a narrow gap between the Harquhala and Big Horn Mountains and enters the flatter Harquahala Plains area, the wash braids out into several smaller washes; therefore, flows from Tiger Wash enter the downstream Harquahala Valley area at widely separated points in a sheet flow condition.

There are seventeen manmade stock watering tanks scattered over the watershed. This equates to one surface water impoundment for every 22 square miles of area. Eight are in the lower Harquahala Plains area and the remainder in the upper portions of the watershed. Sixteen of the tanks are solely dependent upon surface water runoff. The exception is a small tank located at the southeast corner of the watershed in section 30, T1N, R8W. This tank is maintained by irrigation tailwater and consequently has a more permanent nature than the others.

The total area of semipermanent surface water is estimated at no more than 10 acres, a very low proportion when compared to the total watershed area of 239,360 acres. 374 SM

There are five natural springs in the watershed. All five are located in the Harquahala Mountains at elevations above 3,500 feet.

k. Groundwater Resources 2,4,8,9,10,11

The Harquahala Valley watershed, for the purpose of

however, the Maricopa County Planning and Zoning Department projects the watershed to remain largely in its existing state as uninhabited rangeland and irrigated agriculture.

The twenty farm operations on 19,000 acres of cropland within the watershed are cooperators with the Buckeye-Roosevelt Natural Resource Conservation District. Ten of the cooperators have developed conservation plans on more than 11,000 acres. One of the above ten cooperators has entered into a long-term agreement with the Agricultural Stabilization and Conservation Service, in which he is obligated to accomplish the planned land treatment. An additional five active cooperators are now developing conservation plans. Nearly 9,000 acres are considered to be adequately treated at the present time.

There are six ranching operations utilizing the noncropland within the watershed. Investments made to date by these operators have been primarily limited to development of livestock water, fencing, and application of proper grazing use.

9. Projects of Other Agencies [2,3,31]

No projects have been completed by other agencies in the watershed. The Granite Reef Aqueduct of the authorized Central Arizona Project will traverse the watershed from west to east. The aqueduct will be a concrete lined canal, 24 feet bottom width and 16.43 feet deep. Design capacity is 3,000 cubic feet per second. A 20 foot diameter tunnel is proposed through Burnt Mountain. The aqueduct will be located immediately downstream from Harquahala F.R.S. for approximately a 10½ mile reach length from Buckeye-Salome Road eastward to Burnt Mountain. The emergency spillway for Harquahala F.R.S. will discharge into the aqueduct.

The U.S. Bureau of Reclamation is constructing a floodwater retarding dike (Tiger Wash Detention Basin) upstream of the aqueduct and extending from Buckeye-Salome Road westward to Centennial Wash. Total drainage area above the dike is 166 square miles, of which 140 square miles are within the boundaries of the Harquahala Valley Watershed. The dike will control the Tiger Wash drainage area. Floodwater releases and the emergency spillway will outlet into Centennial Wash upstream from where Interstate 10 crosses the wash. The dike will be located approximately 6 miles upstream from Centennial Levee. This structure will reduce the drainage area and therefore the installation cost of Centennial Levee. Construction began in August 1976. (See Project Map.)

The Harquahala Valley Irrigation District has prepared a preliminary irrigation water distribution plan for the

distribution of water from the Granite Reef Aqueduct. In general, the plan is designed to take advantage of the flood control structures currently proposed. Detailed designs will be prepared when a firm allocation of Central Arizona Project water is made to the District. Centennial Levee has been located immediately upstream from the proposed canal on the west side of the valley. The levee will provide flood protection for about a 3.7 mile length of the canal. On the east side, Saddleback F.R.S. and Saddleback Diversion would protect about a 10.8 mile reach if a canal is to be located below these structures. Protection to the proposed irrigation laterals and associated facilities would be provided by all of the project structural measures.

Two large floodwater retarding reservoirs and three water spreading systems, constructed by the Bureau of Land Management, are located on Centennial Wash. One structure* is located 11 miles northeast of the town of Wenden. The other is 7 miles southeast of the town of Salome (Narrows Dam). Although the dams are not located in the watershed, their detention capacity does provide the lower agricultural area of the watershed some protection from Centennial Wash flooding.

F. Water and Related Land Resource Problems

1. Land and Water Management [2,4]

A major portion of the watershed is rangeland. Because of climatic conditions the area supports few perennial grasses and forbs. Principal plants are chiefly desert shrubs and trees. Heavy use of the range by livestock has further reduced the amount of palatable vegetation. All of the range sites in the proposed structure area are presently in poor or fair condition. Most of the grazing is during the spring when the grasses are most abundant.

Changes in vegetation types and amounts have been characterized by a reduction of perennial grasses and desirable shrubs and an increase in annual grasses and unpalatable shrubs, such as creosotebush. These vegetative changes have increased the already large amount of bare soil subject to erosion.

Improved management of the land and the establishment of vegetation is necessary in many areas to improve cover conditions. Economic return per acre on these desert lands is low. (Most grazing is done on an open range basis.) Ranchers cannot afford to spend large sums of money to treat the land.

By 1978 it was

*NOTE: This structure failed in July 1975. To date it has not been repaired.

In the irrigated areas, the lack of a dependable water supply and reoccurring floodwater damages limit the ability of landowners and operators to obtain maximum economic return from the land. Although the land is highly productive, irrigated farming in the desert requires considerable expenditures. Pumping costs are high. Well establishment and the deepening of existing wells is expensive. Mechanized farming requires large investments in machinery and related operation and maintenance costs. All of these necessary expenses detract from the installation of land treatment measures and other farm improvements.

2. Floodwater Damage [2,4.27,28]

Floodwater damage in the watershed is concentrated in the Harquahala Valley since this area is the only part of the watershed where development has occurred.

The majority of the land in the valley is considered as floodplain land. Grades are so flat that almost all of the farmland is inundated by the larger storms. Natural well-defined flood channels are almost nonexistent.

On the east side and south of Courthouse Road, floodwaters from the west slopes of Saddleback Mountain enter the valley via numerous small washes on approximately a 5 mile front. Total drainage area above the perimeter of the valley is about 11.0 square miles. Floodwater damage occurs to irrigated farmland and a partially developed subdivision located in section 8, T1N, R8W.

On the east side and north of Courthouse Road, floodwaters are generated from the north slopes of Saddleback Mountain, the south and east slopes of Burnt Mountain, the alluvial fan between the mountains, and an alluvial fan area on the east side of the Big Horn Mountains. Total drainage area above the perimeter of the valley is about 30.3 square miles. Concentration of flood flows occur at three major locations. A small diversion along the west section line of section 34, T2N, R8W, directs runoff northward into a channel running west along the north section lines of sections 32 and 33, T2N, R8W. The channel decreases in size and capacity as it enters the irrigated areas and eventually becomes nonexistent. There is also a small diversion running north to south along the east section line of section 20, T2N, R8W, that funnels floodwater down into the irrigation areas. The third point of concentration occurs around the northeast quarter of section 19, T2N, R8W, resulting from a diversion constructed around the southwest quarter of section 17, T2N, R8W.

Floodwaters occurring in the north part of the valley originate in the Big Horn Mountains and a large alluvial area

between the mountains and Interstate 10. Floodwater must pass through about a 5 mile reach of Interstate 10 before entering the valley. In this reach, there are concrete box culverts at 12 major wash crossings. Pipe culverts are located at numerous smaller reach crossings. The drainage area above this reach is about 48.5 square miles.

A major concentration of flow occurs just west of the Buckeye-Salome Road overpass. Ten 10 feet by 5 feet concrete box culverts under Interstate 10 funnel floodwater southward in a channel adjacent to Gin Road.

Floodwater enters the northwestern part of the valley primarily as sheet flow on about a 3 mile front. Total drainage area affecting the northwest side is about 92 square miles measuring from the northwest edge of the irrigated lands. Contributing drainage area includes the Big Horn Mountains and a large alluvial fan area between the mountains and the valley. Drainageways are intersected by about 4 miles of Interstate 10 between the Gin Road box culverts and the middle of section 35, T3N, R10W. Pipe culverts are located at many small wash crossings, however, the only major drain is through fifteen 10 feet by 5 feet concrete box culverts located approximately where Interstate 10 crosses the north section line of section 1, T2N, R10W.

The valley is particularly vulnerable to damage from the west where two large drainage areas, Tiger Wash and Centennial Wash, enter.

Tiger Wash drains the northern and western parts of the watershed. The wash is well-defined until it leaves the mountains and enters the flatter Harquahala Plains where braiding of flow occurs in section 4, T4N, R10W, and the wash splits into two separate forks. The east fork continues across the Harquahala Plains and enters Harquahala Valley as primarily sheet flow through section 19, T2N, R9W, and section 24, T2N, R10W. The wash crosses Interstate 10 through twelve 10 feet by 5 feet concrete box culverts located in section 34, T3N, R10W. The west fork enters Centennial Wash on a broad front several miles northwest of the irrigated lands in the valley. The total drainage area of Tiger Wash above the west side of the irrigated lands is about 160 square miles. Floodwater from this drainage area enters the valley either as direct sheet flow or comingled with flow from Centennial Wash.

Centennial Wash enters the valley from the west and serves as a drain for the entire watershed. The total drainage area of Centennial Wash at Gin Road, including Tiger Wash, is about 835 square miles.* A major division of flow occurs in

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*NOTE: Drainage area as shown for Centennial Wash is that downstream from the U.S. Bureau of Land Management dam near Wendon.

Centennial Wash at Allison Tank where floodwater goes north and south around the tank. The north division continues due east for several miles and swings southward through the heart of the irrigated lands in Harquahala Valley. All along this eastern path, the flood flows continuously spread over the valley. Under high stage, floodwater advances on a broad front of approximately 3½ miles in width across the valley. The 100-year frequency flood on Centennial Wash would inundate an estimated 8,000 acres of irrigated land in Harquahala Valley. (See Figure 2.) The extreme vulnerability of the valley to flood flows from the Centennial Wash and Tiger Wash drainage area is illustrated on Figure 1, which depicts the actual path of the 1960 flood. The frequency of this flood was not determined, however, it was not a rare occurrence.

The total drainage area affecting Harquahala Valley is summarized below:

Area	Drainage Area
East Side	
South of Courthouse Road	11.0 square miles
North of Courthouse Road	30.3 " "
North Side	48.5 " "
Northwest Side	92.0 " "
West Side	
Tiger Wash	160.0 " "
Centennial Wash	675.0* " "
Total	1,016.8 square miles

*NOTE: Drainage area as shown for Centennial Wash is that downstream from the U.S. Bureau of Land Management dam near Wendon.

The farmland is highly productive and is being intensively farmed. Most of the irrigation ditches are concrete lined. Farm roads are well maintained. Expensive homes have been built on many of the farms. Each farm has a large inventory of expensive equipment that is vulnerable to flooding. Regardless of where a storm may center, sediment laden floodwater flows across the floodplain. Crops are either damaged or destroyed. Concrete lined irrigation ditches are broken and field ditches and furrows are eroded. Floodwater either scours or deposits sediment on county and farm roads. Floodwater flows through homes damaging structures, contents, and yards. Mechanical parts and interiors of vehicles are damaged. Sheep and other livestock drown. Fences and farm structures are damaged.

A storm expected to occur once every 100 years, on the average, will inundate 16,000 cultivated acres and cause damages estimated at $2,638,000. This would seriously affect the economy of this watershed for several years.

A storm expected to occur once every other year will inundate 3,050 cultivated acres. Damages estimated at $503,000 would result from a storm of this size.

The principal floodwater damage results from overland flow during high intensity summer storms. An estimated 48 percent of all floods are expected to occur during the months of July, August, and September.

The history of flooding in the valley coincides with the history of development. The accounts of a resident of the area during the homesteading period describe the washing away of a farmhome during a flood on Centennial Wash in the 1930's.

In 1951 heavy rains fell in the mountains to the north and east of Harquahala Valley and caused a flood in Centennial Wash. The floodwaters floated out one mile of 26-inch and 30-inch diameter pipe of the El Paso Natural Gas Company. Cost of repairs totalled approximately $200,000.

In 1960 a storm washed out 8 miles of Gin Road from Salome Road to Centennial Wash. The storm also washed out about 4 miles of Courthouse Road and uncovered Arizona Public Service gas lines which had to be repositioned and recovered. The actual area inundated from flows that occurred on Centennial and Tiger Washes is shown on Figure 1.

The storm of September 9 and 10, 1963, caused extensive damage. Electrical power to the valley was lost for 32 hours due to downed lines. Five miles of concrete irrigation ditch was washed out or damaged. Floodwaters inundated 5,753 irrigated acres and caused an estimated $442,600 in damages.

An August 26, 1964, storm which inundated 8,400 cultivated acres was the principal storm evaluated. (See Figure 3.) During this storm 2.5 inches of rain fell on the south slopes of Burnt Mountain and produced a peak discharge of about 7,000 cfs. Floodwater, sediment, erosion, and indirect damages amounted to approximately $883,500. More than forty miles of farm roads were damaged. About 10 miles of concrete lined ditch and 70 miles of earth ditch were either destroyed or filled with sediment. Twenty-nine homes and apartments were flooded to interior depths of from 2 to 8 inches. Values of these homes range from $2,000 to $20,000. Furniture was damaged as were carpets, electrical appliances, and improvements. Several miles of dike were overtopped and broken by this flood. The manmade channels were filled beyond capacity and had to be reworked following the flood only to be damaged again the following September and again in February. Agricultural damages due to floodwater from the August 1964 storm are estimated at $489,200. Damages, other than agricultural, are estimated at $35,500. This storm killed 204 head of sheep and 65 head of cattle were either killed or unaccounted for. (See Figures P15, P16, and P17.)

The September 13, 1964, flood inundated 5,000 acres of irrigated cropland and washed out ditches and roads. Damage amounted to $400,000. Frequency of occurrence of this storm is estimated to be 44 percent.

The February 6 and 7, 1965, flood with an estimated frequency of occurrence of 50 percent, inundated 3,000 acres of irrigated cropland. Damages were approximately $387,410.

The August 16, 1965, flood caused damages on both the east and west sides of the valley. Storms were centered on the east side of the valley and over the mountains in the Tiger Wash drainage area. Total damages were not evaluated. One residential home had 18 inches of water around it and floated off the foundation. There was extensive damage to roads. An estimated 360 acres of cropland required releveling.

No Mention of 9/5/70

A major storm occurred during August 1971, causing considerable damage in the valley. Floodwaters entered the valley from the north off Burnt Mountain and the Big Horn Mountains, and from the northwest and west in Tiger Wash and Centennial Wash. The actual extent of flood damages was not documented, however, many photographs were taken both from the ground and from the air during and following the flood. These photographs show extensive flooding and damage. (See Figure P19.)

At the time of the flood, Interstate 10 was not open for traffic, but construction of the highway was essentially completed. Roadbeds were up to rough grade but not paved. Cross drainage concrete box culverts and pipes were in place. The flood damaged an estimated 8 to 10 mile reach of the highway. Roadbeds were overtopped at many locations with considerable erosion. Drainage culverts were undercut primarily at the outlets and left hanging in the air supported only in cantilever. (See Figure P18.)

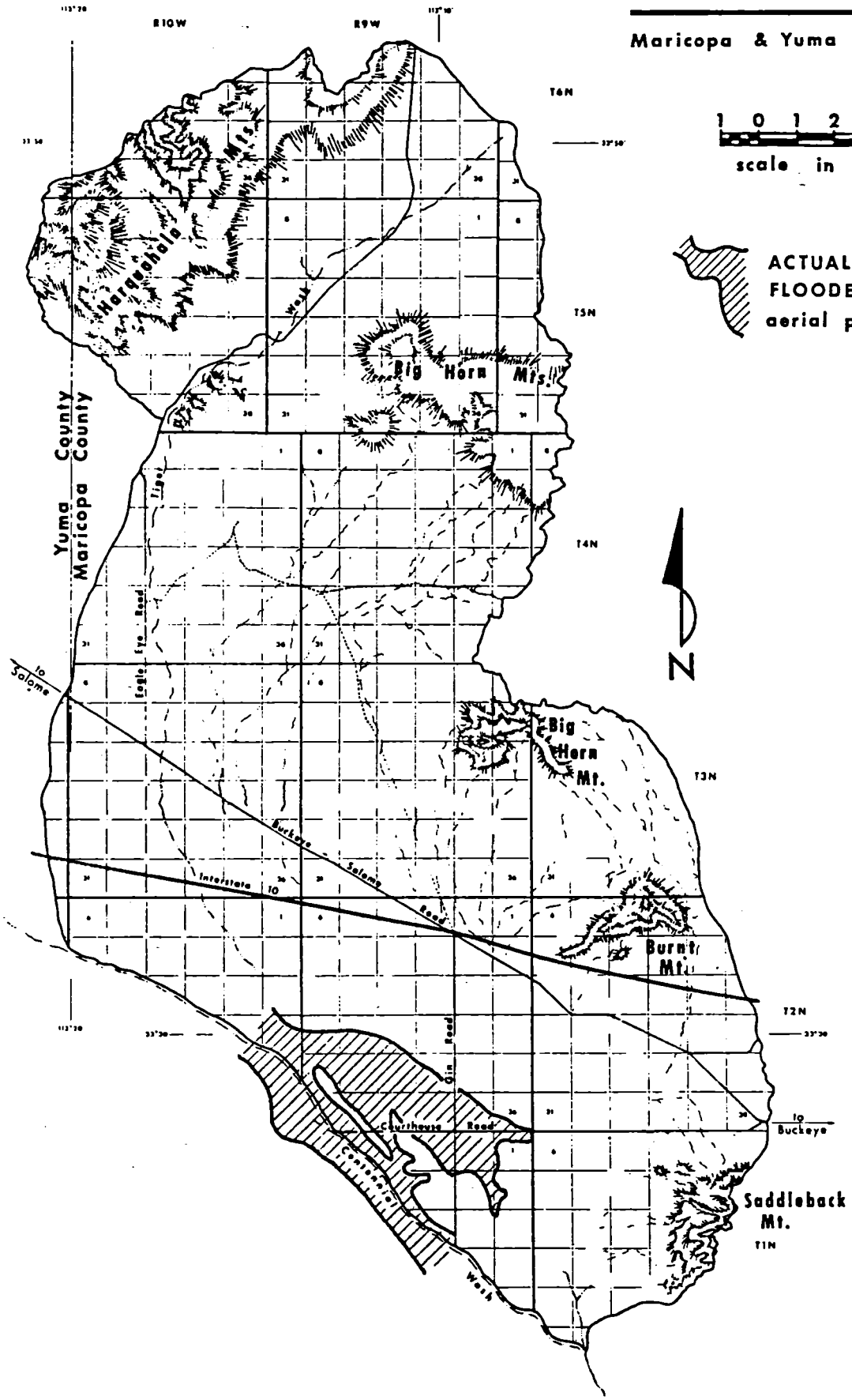
Although total damage to the highway is unknown, considerable expense was obviously involved in repair. Following the storm, additional drainage structures were installed through the highway. As an example, the concrete box culverts at the Buckeye-Salome Road overpass that outlets down Gin Road were increased 67 percent in size and capacity by adding four more 10 feet by 5 feet openings to the existing six 10 feet by 5 feet concrete box culverts. Flow from these culverts washed out an 8 foot width of the paved Gin Road roadbeds for about 4 miles. Flow undercut and washed out about 60 feet of a 24-inch diameter concrete irrigation pipe at a siphon under Gin Road. (See Figure P20.)

Flood flows into the west side of the valley came from the Tiger Wash and Centennial Wash drainages. The path

CENTENNIAL WASH FLOOD PLAIN
1960 FLOOD

Harquahala Valley Watershed

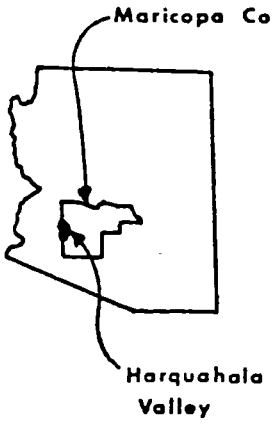
Maricopa & Yuma Counties, Arizona



1 0 1 2 3 4 5

scale in miles

ACTUAL MINIMUM AREA FLOODED. Determined from aerial photo during flood.



LOCATION MAP

Figure 1

70-1

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'12" (revised), long 112°47'50", in sec.7, T.2 S., R.5 W., on upstream side of ford on former U.S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,310 sq mi, approximately.

Records available.--January 1961 to September 1967.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Average discharge.--6 years, 1.82 cfs (1,320 acre-ft per year).

Extremes.--Maximum and minimum for the water years 1964-67 are contained in the following table:

Water year	Maximum			Minimum	
		Discharge (cfs)	Gage height (feet)	Date	Discharge (cfs)
1964	July 31, 1964	2,890	3.74	Most of year	0
1965	Feb. 7, 1965	1,040	3.27	Most of year	0
1966	Sept.13, 1966	5,500	4.13	Most of year	0
1967	Sept. 5, 1967	1,040	3.27	Most of year	0

1961-67: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--Records fair except flows below 100 cfs, which are poor. Flow regulated by several small retention dams in upper end of basin.

Discharge, in cubic feet per second, water year October 1963 to September 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1										0	229	0
2										0	219	0
3										0	1.8	0
4										0	0	0
5										0	0	0
6										0	0	0
7										0	0	0
8										0	0	0
9										0	0	0
10										0	0	0
11										0	0	0
12										0	0	0
13										0	0	0
14										0	0	32
15										0	0	7.8
16										0	0	0
17										0	0	0
18										0	0	0
19										0	0	0
20										0	0	0
21										0	0	0
22										0	0	0
23										0	0	0
24										0	0	0
25										0	0	0
26										0	0	0
27										0	11	0
28										0	4.8	0
29										0	0	0
30					-----					129	0	0
31		-----			-----		-----		-----	348	0	-----
Total	0	0	0	0	0	0	0	0	0	477	465.6	39.8
Mean	0	0	0	0	0	0	0	0	0	15.4	15.0	1.33
Max	0	0	0	0	0	0	0	0	0	348	229	32
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	0	0	0	0	0	0	0	946	924	79

Cal yr 1963:	Total	0	Mean	0	Max	0	Min	0	Ac-ft 0
Wtr yr 1964:	Total	982.4	Mean	2.69	Max	348	Min	0	Ac-ft 1,950

Peak discharge (base, 1,000 cfs).--July 31 (1730) 2,890 cfs (3.74 ft).

FLOOD OF AUGUST 26, 1964

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona

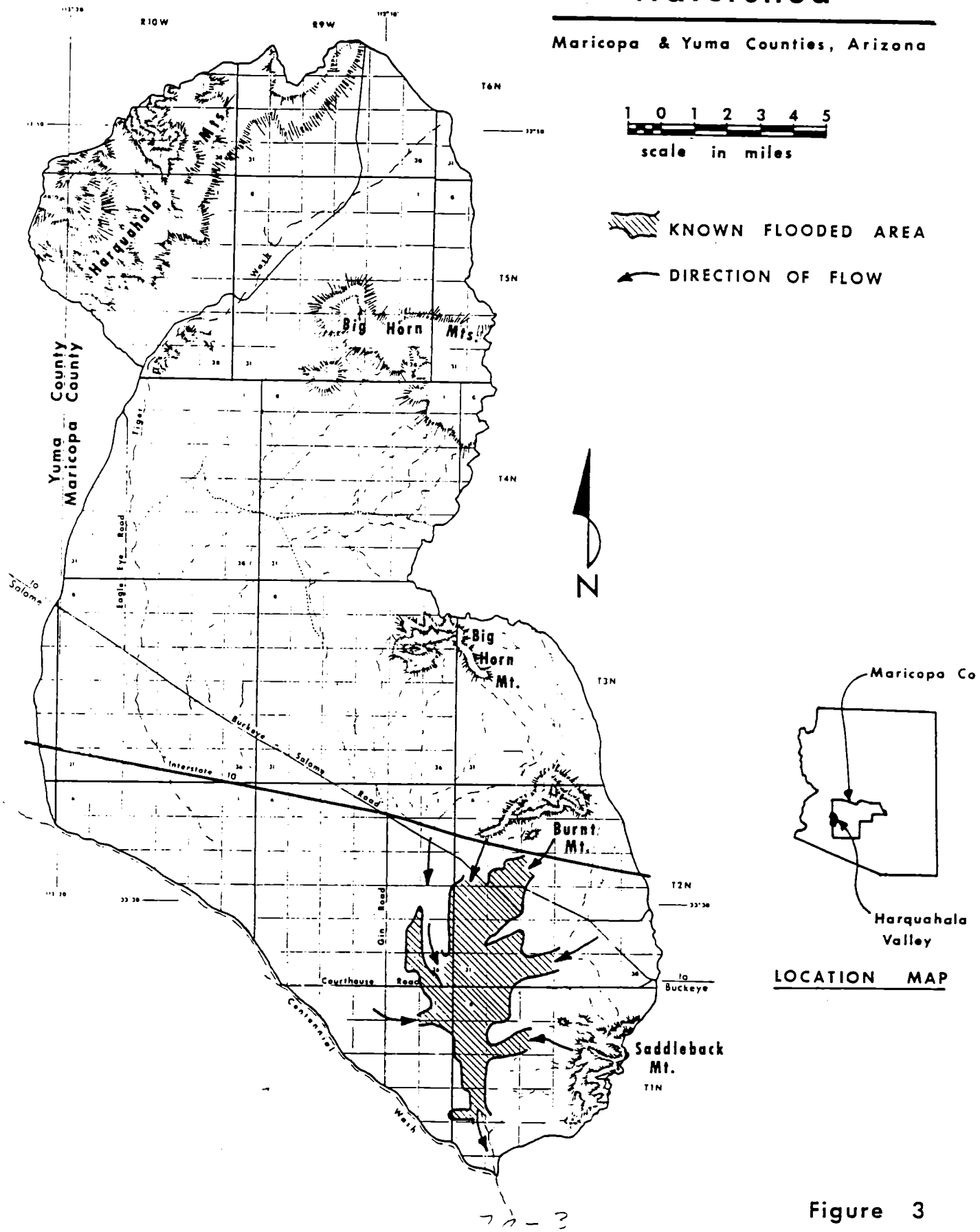


Figure 3

Centennial Gage Starts January 1961

A storm expected to occur once every other year will inundate 3,050 cultivated acres. Damages estimated at $503,000 would result from a storm of this size.

Distance from COA (15) → (18) = 20.8 miles 109,900 ft.

The principal floodwater damage results from overland flow during high intensity summer storms. An estimated 48 percent of all floods are expected to occur during the months of July, August, and September.

The history of flooding in the valley coincides with the history of development. The accounts of a resident of the area during the homesteading period describe the washing away of a farmhome during a flood on Centennial Wash in the 1930's.

In 1951 heavy rains fell in the mountains to the north and east of Harquahala Valley and caused a flood in Centennial Wash. The floodwaters floated out one mile of 26-inch and 30-inch diameter pipe of the El Paso Natural Gas Company. Cost of repairs totalled approximately $200,000.

In 1960 a storm washed out 8 miles of Gin Road from Salome Road to Centennial Wash. The storm also washed out about 4 miles of Courthouse Road and uncovered Arizona Public Service gas lines which had to be repositioned and recovered. The actual area inundated from flows that occurred on Centennial and Tiger Washes is shown on Figure 1.

WY 1963 NO Flow Since Sept 24, 1962

The storm of September 9 and 10, 1963, caused extensive damage. Electrical power to the valley was lost for 32 hours due to downed lines. Five miles of concrete irrigation ditch was washed out or damaged. Floodwaters inundated 5,753 irrigated acres and caused an estimated $442,600 in damages.

Runoff 31.3 AF = Aug 27 - 11 cfs 28 4.8 15.8 cfs

An August 26, 1964, storm which inundated 8,400 cultivated acres was the principal storm evaluated. (See Figure 3.) During this storm 2.5 inches of rain fell on the south slopes of Burnt Mountain and produced a peak discharge of about 7,000 cfs. Floodwater, sediment, erosion, and indirect damages amounted to approximately $883,500. More than forty miles of farm roads were damaged. About 10 miles of concrete lined ditch and 70 miles of earth ditch were either destroyed or filled with sediment. Twenty-nine homes and apartments were flooded to interior depths of from 2 to 8 inches. Values of these homes range from $2,000 to $20,000. Furniture was damaged as were carpets, electrical appliances, and improvements. Several miles of dike were overtopped and broken by this flood. The manmade channels were filled beyond capacity and had to be reworked following the flood only to be damaged again the following September and again in February. Agricultural damages due to floodwater from the August 1964 storm are estimated at $489,200. Damages, other than agricultural, are estimated at $35,500. This storm killed 204 head of sheep and 65 head of cattle were either killed or unaccounted for. (See Figures P15, P16, and P17.)

Centennial Wash at Allison Tank where floodwater goes north and south around the tank. The north division continues due east for several miles and swings southward through the heart of the irrigated lands in Harquahala Valley. All along this eastern path, the flood flows continuously spread over the valley. Under high stage, floodwater advances on a broad front of approximately 3½ miles in width across the valley. The 100-year frequency flood on Centennial Wash would inundate an estimated 8,000 acres of irrigated land in Harquahala Valley. (See Figure 2.) The extreme vulnerability of the valley to flood flows from the Centennial Wash and Tiger Wash drainage area is illustrated on Figure 1, which depicts the actual path of the 1960 flood. The frequency of this flood was not determined, however, it was not a rare occurrence.

The total drainage area affecting Harquahala Valley is summarized below:

Area	Drainage Area
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North of Courthouse Road	30.3 " "
North Side	48.5 " "
Northwest Side	92.0 " "
West Side	
Tiger Wash	160.0 " "
Centennial Wash	675.0* " "
Total	1,016.8 square miles

*NOTE: Drainage area as shown for Centennial Wash is that downstream from the U.S. Bureau of Land Management dam near Wendon.

The farmland is highly productive and is being intensively farmed. Most of the irrigation ditches are concrete lined. Farm roads are well maintained. Expensive homes have been built on many of the farms. Each farm has a large inventory of expensive equipment that is vulnerable to flooding. Regardless of where a storm may center, sediment laden floodwater flows across the floodplain. Crops are either damaged or destroyed. Concrete lined irrigation ditches are broken and field ditches and furrows are eroded. Floodwater either scours or deposits sediment on county and farm roads. Floodwater flows through homes damaging structures, contents, and yards. Mechanical parts and interiors of vehicles are damaged. Sheep and other livestock drown. Fences and farm structures are damaged.

A storm expected to occur once every 100 years, on the average, will inundate 16,000 cultivated acres and cause damages estimated at $2,638,000. This would seriously affect the economy of this watershed for several years.

For WY 1961
1962

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'05", long 112°47'50", on line between secs.7 and 8, T.2 S., R.5 W., on upstream side of ford on former U. S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi.

Records available.--January 1961 to September 1962.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Extremes.--1961: Maximum discharge during period January to September, 14,500 cfs July 23 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of period.
1961-62: Maximum discharge during water year, 1,110 cfs Sept. 6 (gage height, 3.09 ft); no flow for most of year.

Remarks.--Records poor. Discharge measurements or observations of no flow generally made once a month.

Discharge, in cubic feet per second, January to September 1961

July 23	2,790	July 29	952
24	20	30	20

Month	Cfs-days	Maximum	Minimum	Mean	Runoff in acre-feet
July 1961	3,782	2,790	0	122	7,500

Peak discharge (base, 1,000 cfs).--July 23 (0630) 14,500 cfs (4.70 ft); July 29 (0830) 3,870 cfs (3.71 ft).
Note.--Record began Jan. 17. Flow occurred only on days listed above. No gage-height record Jan. 1-16.

Discharge, in cubic feet per second, water year October 1961 to September 1962

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1												0
2												0
3												0
4												0
5												0
6												180
7												0
8												0
9												0
10												0
11												0
12												0
13												0
14												0
15												0
16												0
17												0
18												0
19												0
20												0
21												0
22												0
23												83
24												0
25												0
26												0
27												0
28												0
29												0
30												0
31		----------			----------		----------		----------			----------
Total	0	0	0	0	0	0	0	0	0	0	0	263
Mean	0	0	0	0	0	0	0	0	0	0	0	8.8
Ac-ft	0	0	0	0	0	0	0	0	0	0	0	522

Calendar year 1961: Max 2,750 Min 0 Mean 10.4 Ac-ft 7,500
Water year 1961-62: Max 180 Min 0 Mean 0.7 Ac-ft 522

Peak discharge (base, 1,000 cfs).--Sept. 6 (0700) 1,110 cfs (3.09 ft).

Note.--No gage-height record Oct. 3 to Nov. 1, Nov. 30 to Jan. 3, Feb. 28 to Apr. 2.

WY1963

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'05", long 112°47'50", on line between secs.7 and 8, T.2 S., R.5 W., on upstream side of ford on former U. S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1963.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Extremes.--No flow during year.
1961-63: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--No flow since Sept. 24, 1962. Observations of no flow generally made once a month. Figures of discharge for calendar year 1962 are as follows: Maximum, 180 cfs; minimum, 0; mean, 0.7 cfs; runoff, 522 acre-ft.

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'12" (revised), long 112°47'50", in sec.7, T.2 S., R.5 W., on upstream side of ford on former U.S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1967.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Average discharge.--6 years, 1.82 cfs (1,320 acre-ft per year).

Extremes.--Maximum and minimum for the water years 1964-67 are contained in the following table:

Water year	Maximum			Minimum	
		Discharge (cfs)	Gage height (feet)	Date	Discharge (cfs)
1964	July 31, 1964	2,890	3.74	Most of year	0
1965	Feb. 7, 1965	1,040	3.27	Most of year	0
1966	Sept.13, 1966	5,500	4.13	Most of year	0
1967	Sept. 5, 1967	1,040	3.27	Most of year	0

1961-67: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--Records fair except flows below 100 cfs, which are poor. Flow regulated by several small retention dams in upper end of basin.

Discharge, in cubic feet per second, water year October 1963 to September 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1										0	229	0
2										0	219	0
3										0	1.8	0
4										0	0	0
5										0	0	0
6										0	0	0
7										0	0	0
8										0	0	0
9										0	0	0
10										0	0	0
11										0	0	0
12										0	0	0
13										0	0	32
14										0	0	7.8
15										0	0	0 39.8 cfs
16										0	0	0
17										0	0	0
18										0	0	0 79.9 Ac
19										0	0	0
20										0	0	0
21										0	0	0
22										0	0	0
23										0	0	0
24										0	0	0
25										0	0	0
26										0	11	0
27										0	4.8	0
28										0	0	0
29					- - - - -					129	0	0
30		- - - - -			- - - - -		- - - - -		- - - - -	348	0	- - - - -
31												
Total	0	0	0	0	0	0	0	0	0	477	465.6	39.8
Mean	0	0	0	0	0	0	0	0	0	15.4	15.0	1.33
Max	0	0	0	0	0	0	0	0	0	348	229	32
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	0	0	0	0	0	0	0	946	924	79

Cal yr 1963: Total 0 Mean 0 Max 0 Min 0 Ac-ft 0
Wtr yr 1964: Total 982.4 Mean 2.69 Max 348 Min 0 Ac-ft 1,950

Peak discharge (base, 1,000 cfs).--July 31 (1730) 2,890 cfs (3.74 ft).

1558 cfs
31.3 Ac

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1964 to September 1965

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1					0						0	
2					0						0	
3					0						0	
4					0						0	
5					0						0	
6					0						0	
7					177						0	
8					9.3						0	
9					3.6						0	
10					0						0	
11					0						0	
12					0						0	
13					0						0	
14					0						28	
15					0						5.4	
16					0						0	
17					0						0	
18					0						0	
19					0						0	
20					0						0	
21					0						0	
22					0						0	
23					0						0	
24					0						0	
25					0						0	
26					0						0	
27					0						0	
28					0						0	
29					-						0	
30					- - - - -						0	
31		- - - - -			- - - - -		- - - - -		- - - - -		0	- - - - -
Total	0	0	0	0	189.9	0	0	0	0	0	33.4	0
Mean	0	0	0	0	6.78	0	0	0	0	0	1.08	0
Max	0	0	0	0	177	0	0	0	0	0	28	0
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	0	0	377	0	0	0	0	0	66	0

Storm Flood, Feb 6 & 7, 1965

1899 cfs of

377 af

August 1, 1965

Flood 8-16-65

Ø runoff

Cal yr 1964: Total 982.4 Mean 2.69 Max 348 Min 0 Ac-ft 1,950
Wtr yr 1965: Total 223.3 Mean 0.61 Max 177 Min 0 Ac-ft 443

Peak discharge (base, 1,000 cfs).--Feb. 7 (1100) 1,040 cfs (3.27 ft).

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1965 to September 1966

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1			0									0
2			0									0
3			0									0
4			0									0
5			0									0
6			0									0
7			0									0
8			0									0
9			0									0
10			69									0
11			27									0
12			0									1,860
13			0									139
14			0									83
15			0									0
16			0									0
17			10									0
18			10									0
19			0									0
20			0									0
21			0									0
22			0									0
23			0									0
24			0									0
25			0									0
26			0									0
27			0									0
28			0									0
29			0		-							0
30			0		- - - - -							- - - - -
31		- - - - -	0		- - - - -		- - - - -		- - - - -			
Total	0	0	53.9	0	0	0	0	0	0	0	0	2,007.3
Mean	0	0	1.74	0	0	0	0	0	0	0	0	66.9
Max	0	0	27	0	0	0	0	0	0	0	0	1,860
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	107	0	0	0	0	0	0	0	0	3,980

Cal yr 1965: Total 277.2 Mean 0.76 Max 177 Min 0 Ac-ft 550
Wtr yr 1966: Total 2,061.2 Mean 5.65 Max 1,860 Min 0 Ac-ft 4,090

Peak discharge (base, 1,000 cfs).--Sept. 13 (0730) 5,500 cfs (4.13 ft).

9-5175. Centennial Wash near Arlington, Ariz.--Continued

Discharge, in cubic feet per second, water year October 1966 to September 1967

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	0											0
2	0											0
3	0											185
4	7.3											4.7
5	0											224
6	0											5
7	0											0
8	0											0
9	0											0
10	0											0
11	0											0
12	0											0
13	0											0
14	0											0
15	0											0
16	0											0
17	0											0
18	0											0
19	0											0
20	0											0
21	0											0
22	0											0
23	0											0
24	0											0
25	0											0
26	0											0
27	0											0
28	0											0
29	0											0
30	0											0
31	0	-----			-----		-----		-----			-----
Total	7.3	0	0	0	0	0	0	0	0	0	0	467.7
Mean	0.24	0	0	0	0	0	0	0	0	0	0	15.6
Max	7.3	0	0	0	0	0	0	0	0	0	0	224
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	14	0	0	0	0	0	0	0	0	0	0	928

Cal yr 1966: Total 2,014.6 Mean 5.52 Max 1,860 Min 0 Ac-ft 4,000
Wtr yr 1967: Total 475.0 Mean 1.30 Max 224 Min 0 Ac-ft 942

Peak discharge (base, 1,000 cfs).--Sept. 5 (2030) 1,040 cfs (3.27 ft).

09517500. Centennial Wash near Arlington, Ariz.

LOCATION.--Lat 33°16'12", long 112°47'50", in sec.7, T.2 S., R.5 W., Maricopa County, on upstream side of ford on former U.S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

DRAINAGE AREA.--1,810 sq mi, approximately.

PERIOD OF RECORD.--January 1961 to current year.

GAGE.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level.

AVERAGE DISCHARGE.--10 years, 3.34 cfs (2,420 acre-ft per year); median of yearly mean discharges, 2.4 cfs (1,700 acre-ft per year).

EXTREMES.--Current year: Maximum discharge, 2,040 cfs Aug. 20 (gage height, 3.91 ft); no flow for most of year.
Period of record: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs; maximum gage height, 4.71 ft Sept. 5, 1970; no flow for most of time each year.

REMARKS.--Records poor. Flow regulated by several small retention dams in upper end of basin. Records do not include irrigation return flow past station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1											0	
2											0	
3											0	
4											0	
5											0	
6											0	
7											0	
8											0	
9											0	
10											0	
11											0	
12											0	
13											0	
14											0	
15											0	
16											0	
17											0	
18											0	@ 2300 hrs.
19											0	
20											400	← 2040 cfs
21											770	
22											510	← 1720 cfs
23											10	
24											0	@ 1000 hrs
25											0	
26											0	
27											0	
28											0	
29					------						0	
30					------						0	
31		------			------		------		------		0	------
TOTAL	0	0	0	0	0	0	0	0	0	0	1,690	0
MEAN	0	0	0	0	0	0	0	0	0	0	54.5	0
MAX	0	0	0	0	0	0	0	0	0	0	770	0
MIN	0	0	0	0	0	0	0	0	0	0	0	0
AC-FT	0	0	0	0	0	0	0	0	0	0	3,350	0

CAL YR 1970 TOTAL 4,417.40 MEAN 12.1 MAX 3,030 MIN 0 AC-FT 8,760
WTR YR 1971 TOTAL 1,690 MEAN 4.63 MAX 770 MIN 0 AC-FT 3,350

PEAK DISCHARGE (BASE, 1,000 CFS).--Aug. 20 (2300) 2,040 cfs (3.91 ft); Aug. 22 (1000) 1,720 cfs (3.84 ft).

Annual maximum discharge at crest-stage partial-record stations during water years 1970-71--Continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Gila River basin--continued					
09504100	Hull Canyon near Jerome, Ariz.	Lat 34°44'20", long 112°08'35", in NW¼ sec.28, T.16 N., R.2 E., Yavapai County, at U.S. Highway Alt. 89, 2 miles west of Jerome.	0.91	1963-71	9- 5-70 1971	7.90 ----	b100 (d)
09504400	Munds Canyon tributary near Sedona, Ariz.	Lat 34°55'20", long 111°38'40", in SW¼ sec.22, T.18 N., R.7 E., Coconino County, at State Highway 79, 7 miles northeast of Sedona.	1.19	h1964-71	9- 5-70 1971	11.1 ----	705 <1
09504800	Oak Creek tributary near Cornville, Ariz.	Lat 34°42'45", long 111°52'50", in NW¼ sec.12, T.15 N., R.4 E., Yavapai County, at county road, 2.5 miles east of Cornville.	.048	1963-71	9- 5-70 9-29-71	6.02 2.72	47 b<1
09505600	Dirty Neck Canyon near Clints Well, Ariz.	Lat 34°30'45", long 111°21'30", in N½ sec.23, T.13 N., R.9 E., Coconino County, at county road, 4 miles southwest of Clints Well, and 18 miles north of Payson.	3.42	1965-71	9- 5-70 i1971	7.88 2.48	210 <1
09505900	Cottonwood Wash near Camp Verde, Ariz.	Lat 34°30'20", long 111°45'10", in NE¼ sec.19, T.13 N., R.6 E., Yavapai County, at Camp Verde-Pine road, 7 miles southeast of Camp Verde.	.64	1964-71	8-14-70 9-29-71	3.23 5.94	b10 195
09510170	Camp Creek near Sunflower, Ariz.	Lat 33°45'35", long 111°29'44", in SW¼ sec.24, T.5 N., R.8 E., Maricopa County, on right bank at upstream side of culvert on State Highway 87, half a mile upstream from mouth, and 7 miles south of Sunflower.	2.6	1963-66‡, 1967-71	9- 5-70 6-19-71	2.55 1.70	136 68
09512300	Cave Creek near Cave Creek, Ariz.	Lat 33°47'00", long 112°00'24", in SW¼ sec.12, T.5 N., R.3 E., Maricopa County, on left bank 200 ft upstream from Prescott-to-Mesa transmission line, 5 miles southwest of town of Cave Creek, and 5.0 miles upstream from Cave Creek Dam.	121	1958-67‡, 1968-71	9- 5-70 8- 4-71	5.38 2.36	2,700 364
09512420	Lynx Creek tributary near Prescott, Ariz.	Lat 34°32'51", long 112°23'58", in SE¼ sec.31, T.14 N., R.1 W., Yavapai County, on Walker Road, 400 ft south of State Highway 69, and 4 miles east of Prescott.	.95	1969-71	(s) (s) 9-13-69 9- 4-70 8- -71	---- ---- 4.74 7.39 6.80	820 b300 b10 205 160
09512700	Agua Fria River tributary No. 2 near Rock Springs, Ariz.	Lat 34°01'55", long 112°08'45", in SW¼ sec.15, T.8 N., R.2 E., Maricopa County, at State Highway 69, 1 mile south of Rock Springs.	a1.11	1963-71	7-21-70 8-21-71	5.45 5.30	(f) (f)
09513650	Agua Fria River at El Mirage, Ariz.	Lat 33°36'24", long 112°18'14", in NW¼NW¼ sec.18, T.3 N., R.1 E., Maricopa County, at Grand Avenue 0.75 mile southeast of El Mirage.	a1,637	1963-71	9- 5-70 8- -71	4.60 1.87	5,000 250
09513820	Deadman Wash near New River, Ariz.	Lat 33°50'30", long 112°08'40", in NW¼ sec.27, T.6 N., R.2 E., Maricopa County, at State Highway 69, 4.5 miles south of New River.	11.1	1960-71	9- 5-70 8-21-71	5.58 5.07	1,630 1,300
09513890	New River at Peoria, Ariz.	Lat 33°35'43", long 112°15'45", in SE¼ sec.16, T.3 N., R.1 E., Maricopa County, at Grand Avenue, 1.75 miles northwest of Peoria.	317	1960-71	9- 5-70 8-21-71	10.28 6.23	20,000 7,430
09513910	New River near Glendale, Ariz.	Lat 33°32'12", long 112°16'52", in NE¼NW¼ sec.8, T.2 N., R.1 E., Maricopa County, at Glendale Avenue, 2 miles upstream from mouth, and 6 miles west of Glendale.	323	1961-63, 1964-70‡, 1971	12-23-65 8-21-71	4.15 8.6	a1,300 e7,000
09514200	Waterman Wash near Buckeye, Ariz.	Lat 33°19'49", long 112°30'33", in SW¼NE¼ sec.24, T.1 S., R.3 W., Maricopa County, 2.4 miles above mouth, 5.2 miles southeast of Buckeye.	403	h1964-71	8- 9-70 8-11-71	5.21 5.55	3,800 2,080
09515800	Hartman Wash near Wickenburg, Ariz.	Lat 33°57'46", long 112°49'40", in SE¼ sec.12, T.7 N., R.6 W., Maricopa County, at U.S. Highway 60, 5.7 miles west of Wickenburg.	5.57	h1964-71	9- 5-70 8-19-71	7.00 4.95	1,600 1,000
09516500	Hassayampa River near Morristown, Ariz.	Lat 33°53'06", long 112°39'41", in SW¼SE¼ sec.3, T.6 N., R.4 W., Maricopa County, 3.0 miles northwest of Morristown, 7 miles southeast of Wickenburg.	774	1939-47‡, 1954,1956, 1964-71	9-13-69 9- 5-70 8-18-71	8.15 19.0 9.07	650 47,500 2,000
09516600	Ox Wash near Morristown, Ariz.	Lat 33°53'00", long 112°39'00", in NW¼ sec.11, T.6 N., R.4 W., Maricopa County, at U.S. Highway 60, 2.4 miles northwest of Morristown.	6.31	1963-71	9- 5-70 8-20-71	1.97 2.26	160 250
09516800	Jack Rabbit Wash near Tonopah, Ariz.	Lat 33°39'32", long 112°49'40", in NE¼SE¼ sec.25, T.4 N., R.6 W., Maricopa County, 100 feet upstream from the Wickenburg-Hassayampa Road, 4.5 miles upstream from Star Wash, and 14 miles northeast of Tonopah.	137	1964-71	4- 4-65 9-13-66 9- 5-70 8-17-71	8.05 8.10 10.00 9.31	ae200 ae200 e5,000 e2,500
09517000	Hassayampa River near Arlington, Ariz.	Lat 33°20'50", long 112°43'30", in NW¼ sec.13, T.1 S., R.5 W., Maricopa County, at former U.S. Highway 80, 1.8 miles upstream from mouth, and 2.8 miles northeast of Arlington.	1,470	1961-71	9-15-67 9- 5-70 8-11-71	3.95 8.40 4.02	e500 39,000 1,230
09517200	Centennial Wash tributary near Wenden, Ariz.	Lat 33°50'40", long 113°27'00", in SW¼SW¼ sec.24, T.6 N., R.12 W., Maricopa County, at U.S. Highway 60, 5 miles northeast of Wenden.	2.79	1963-71	9- 5-70 8-20-71	4.66 2.84	720 170

Annual maximum discharge at crest-stage partial-record stations during water years 1970-71--Continued

Station No.	Station name	Location	Drainage area (sq mi)	Period of record	Annual maximum		
					Date	Gage height (feet)	Discharge (cfs)
		Gila River basin--continued					
09517280	Tiger Wash near Aguila, Ariz.	Lat 33°44'30", long 113°16'43", in SW¼SW¼ sec.26, T.5 N., R.10 W., Maricopa County, 17 miles south of Aguila.	85.2	1963-71	9-13-66	7.96	1,450
					8-14-67	6.94	620
					12-19-67	6.67	440
					8-20-70	10.2	4,550
					8-20-71	8.5	2,000
09517400	Winters Wash near Tonopah, Ariz.	Lat 33°29'22", long 112°55'05", in SW¼NW¼ sec.30, T.2 N., R.6 W., Maricopa County, 0.3 mile downstream from Airline Road, and 1 mile east of Tonopah.	47.8	1962-71	8- -64	6.00	850
					2- 7-65	5.91	810
					12-10-65	4.96	390
					9- 3-67	6.11	900
					12-19-67	6.86	1,350
					11-15-68	6.2	960
					9- 5-70	5.15	460
					8-20-71	5.10	1,000
09519600	Rainbow Wash tributary near Buckeye, Ariz.	Lat 33°14'35", long 112°38'15", in NE¼ sec.23, T.2 S., R.4 W., Maricopa County, at U.S. Highway 80, 9.5 miles southwest of Buckeye.	g3.45 (1.02)	1963-71	8- 8-70	5.76	810
					7- -71	5.11	660
09519750	Bender Wash near Gila Bend, Ariz.	Lat 32°54'25", long 112°33'05", in NW¼ sec.15, T.6 S., R.3 W., Maricopa County, along side of Interstate Highway 8, 10 miles southeast of Gila Bend. Prior to Oct. 1, 1966, at site 0.65 mile downstream.	68.8	1963-71	8-14-70	4.40	b100
					8- -71	7.35	2,670
09519760	Sauceda Wash near Gila Bend, Ariz.	Lat 32°52'14", long 112°45'30", in SE¼SW¼ sec.27, T.6 S., R.5 W., Maricopa County, at State Highway 85, 5.3 miles south of Gila Bend.	u126	1963-71	a10- 2-67	a2.75	a840
					8- -70	5.80	2,850
					8- -71	3.80	1,500
09519780	Windmill Wash near Gila Bend, Ariz.	Lat 33°02'54", long 112°50'17", in SE¼ sec.25, T.4 S., R.6 W., Maricopa County, at county road, 10.5 miles northwest of Gila Bend.	12.9	1964-71	9-15-69	7.70	a150
					8-12-70	7.39	65
					8-15-71	9.83	1,850
09520070	Baragan Wash near Hyder, Ariz.	Lat 32°58'52", long 113°25'25", in SW¼NW¼ sec.20, T.5 S., R.11 W., Yuma County, on left bank 250 ft downstream from road crossing, and 15.1 miles north and northeast of Dateland exit from Interstate 8.	v248	1971	9-29-71	2.65	500
09520100	Military Wash near Sentinel, Ariz.	Lat 32°50'43", long 113°16'44", in SW¼ sec.3, T.7 S., R.10 W., Maricopa County, at U.S. Highway 80, 4.1 miles west of Sentinel.	8.70	1963-71	8-30-63	3.03	ae200
					10-19-63	2.16	ae 60
					1- 6-65	1.29	e12
					8-20-70	1.77	e30
					12- -70	1.65	e20
09520110	Hot Shot Arroyo near Ajo, Ariz.	Lat 32°20'49", long 112°48'31", in SW¼ sec.29, T.12 S., R.5 W., Pima County, at State Highway 85, 3 miles southeast of Ajo.	.44	1966-71	7-27-70	5.91	170
					i1971	5.27	116
09520130	Darby Arroyo near Ajo, Ariz.	Lat 32°21'19", long 112°49'31", in NW¼ sec.30, T.12 S., R.5 W., Pima County, at State Highway 85, 2 miles southeast of Ajo.	4.72	1966-71	8- 2-70	7.77	960
					8-19-71	7.32	e500
09520160	Gibson Arroyo at Ajo, Ariz.	Lat 32°22'48", long 112°51'40", in NW¼SW¼ sec.14, T.12 S., R.6 W., Pima County, at 2nd Avenue next to railroad tracks in Ajo.	2.18	1967-71	8- 2-70	7.60	1,800
					8-19-71	----	<10
09520200	Black Gap Wash near Ajo, Ariz.	Lat 32°42'23", long 112°50'43", in NW¼NE¼ sec.26, T.8 S., R.6 W., Maricopa County, at State Highway 85, 5.7 miles north of Midway, and 23 miles north of Ajo.	12.1	1963-71	8-20-70	----	b10
					9-30-71	8.40	735
09520230	Crater Range Wash near Ajo, Ariz.	Lat 32°33'44", long 112°52'37", in NW¼NW¼ sec.15, T.10 S., R.6 W., Maricopa County, at State Highway 85, 4.1 miles north of Maricopa-Pima County line, and 13.5 miles north of Ajo.	1.49	1963-71	9-13-66	1.56	e50
					1970	----	(d)
					9- -71	2.62	300
09520300	Alamo Wash tributary near Ajo, Ariz.	Lat 32°06'00", long 112°46'15", in SW¼ sec.22, T.15 S., R.5 W. (unsurveyed), Pima County, at State Highway 85, 20 miles southeast of Ajo.	.90	1963-71	8- 2-70	2.85	210
					i1971	.93	b5
09520350	Mohawk Pass Wash at Mohawk, Ariz.	Lat 32°43'44", long 113°44'30", in SE¼SW¼ sec.17, T.8 S., R.14 W., Yuma County, at Southern Pacific Railroad crossing, 0.6 mile east of Mohawk.	.09	1963-71	8- 1-70	4.70	117
					9-29-71	2.97	20
09520380	Mohawk Wash near Tacna, Ariz.	Lat 32°42'32", long 113°52'52", in SW¼SW¼ sec.23, T.8 S., R.16 W., Yuma County, over inverted siphon on Mohawk Canal, 4.4 miles east of Tacna.	503	1971	1971	----	(d)
09520400	Ligurta Wash at Ligurta, Ariz. w/	Lat 32°40'33", long 114°17'38", in NW¼NW¼ sec.2, T.9 S., R.20 W., Yuma County, at U.S. Highway 80 at Ligurta, and 9.0 miles west of Wellton.	1.99	1963-71	2-10-70	2.43	175
					9-29-71	2.33	156
09520480	Castle Dome Wash near Dome, Ariz.	Lat 32°46'22", long 114°23'02", in SW¼SE¼ sec.35, T.7 S., R.21 W., Yuma County, on Dome Valley Road, 0.2 mile east of U.S. Highway 95, and 1.7 miles northwest of Dome.	237	1971	9-29-71	5.54	e3,000
09520600	Fortuna Wash near Blaisdell, Ariz.	Lat 32°42'46", long 114°26'55", in NW¼NE¼ sec.30, T.8 S., R.21 W., Yuma County, 0.3 mile downstream from Gila Gravity Main Canal, and 11.5 miles east of Yuma.	39.3	1971	9-29-71	6.24	1,600

No Peak above Base = 1000 cfs)

9-14 32
-15 7.8
39.8 = 78.9 AF

The September 13, 1964, flood inundated 5,000 acres of irrigated cropland and washed out ditches and roads. Damage amounted to $400,000. Frequency of occurrence of this storm is estimated to be 44 percent.

The February 6 and 7, 1965, flood with an estimated frequency of occurrence of 50 percent, inundated 3,000 acres of irrigated cropland. Damages were approximately $387,410. 377 AF

No runoff after August 14, 15,

The August 16, 1965, flood caused damages on both the east and west sides of the valley. Storms were centered on the east side of the valley and over the mountains in the Tiger Wash drainage area. Total damages were not evaluated. One residential home had 18 inches of water around it and floated off the foundation. There was extensive damage to roads. An estimated 360 acres of cropland required releveling.

No Monitor at 9/5/70

A major storm occurred during August 1971, causing considerable damage in the valley. Floodwaters entered the valley from the north off Burnt Mountain and the Big Horn Mountains, and from the northwest and west in Tiger Wash and Centennial Wash. The actual extent of flood damages was not documented, however, many photographs were taken both from the ground and from the air during and following the flood. These photographs show extensive flooding and damage. (See Figure P19.)

Runoff @ Gregory Sta 4 days 8/20-23/71 3350 AF

At the time of the flood, Interstate 10 was not open for traffic, but construction of the highway was essentially completed. Roadbeds were up to rough grade but not paved. Cross drainage concrete box culverts and pipes were in place. The flood damaged an estimated 8 to 10 mile reach of the highway. Roadbeds were overtopped at many locations with considerable erosion. Drainage culverts were undercut primarily at the outlets and left hanging in the air supported only in cantilever. (See Figure P18.)

Qmax 2040 8/20 1720 8/22 2 Peaks

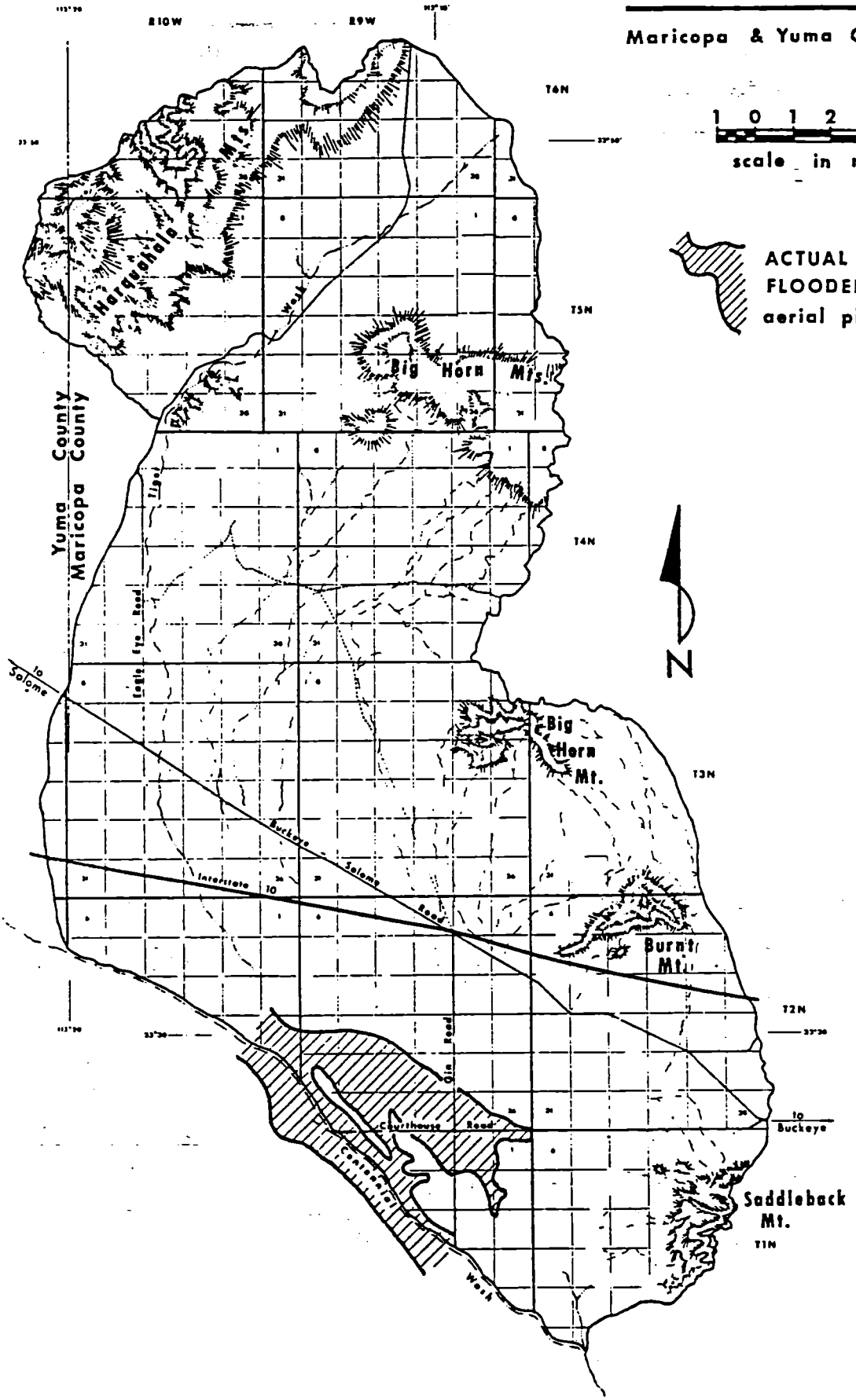
Although total damage to the highway is unknown, considerable expense was obviously involved in repair. Following the storm, additional drainage structures were installed through the highway. As an example, the concrete box culverts at the Buckeye-Salome Road overpass that outlets down Gin Road were increased 67 percent in size and capacity by adding four more 10 feet by 5 feet openings to the existing six 10 feet by 5 feet concrete box culverts. Flow from these culverts washed out an 8 foot width of the paved Gin Road roadbeds for about 4 miles. Flow undercut and washed out about 60 feet of a 24-inch diameter concrete irrigation pipe at a siphon under Gin Road. (See Figure P20.)

Flood flows into the west side of the valley came from the Tiger Wash and Centennial Wash drainages. The path

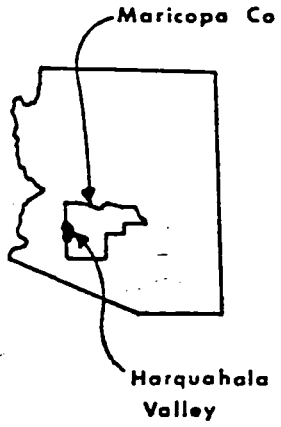
CENTENNIAL WASH FLOOD PLAIN
1960 FLOOD

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona



ACTUAL MINIMUM AREA FLOODED. Determined from aerial photo during flood.



LOCATION MAP

Figure 1

70-1

CENTENNIAL WASH FLOOD PLAIN
MAJOR EVENT

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona

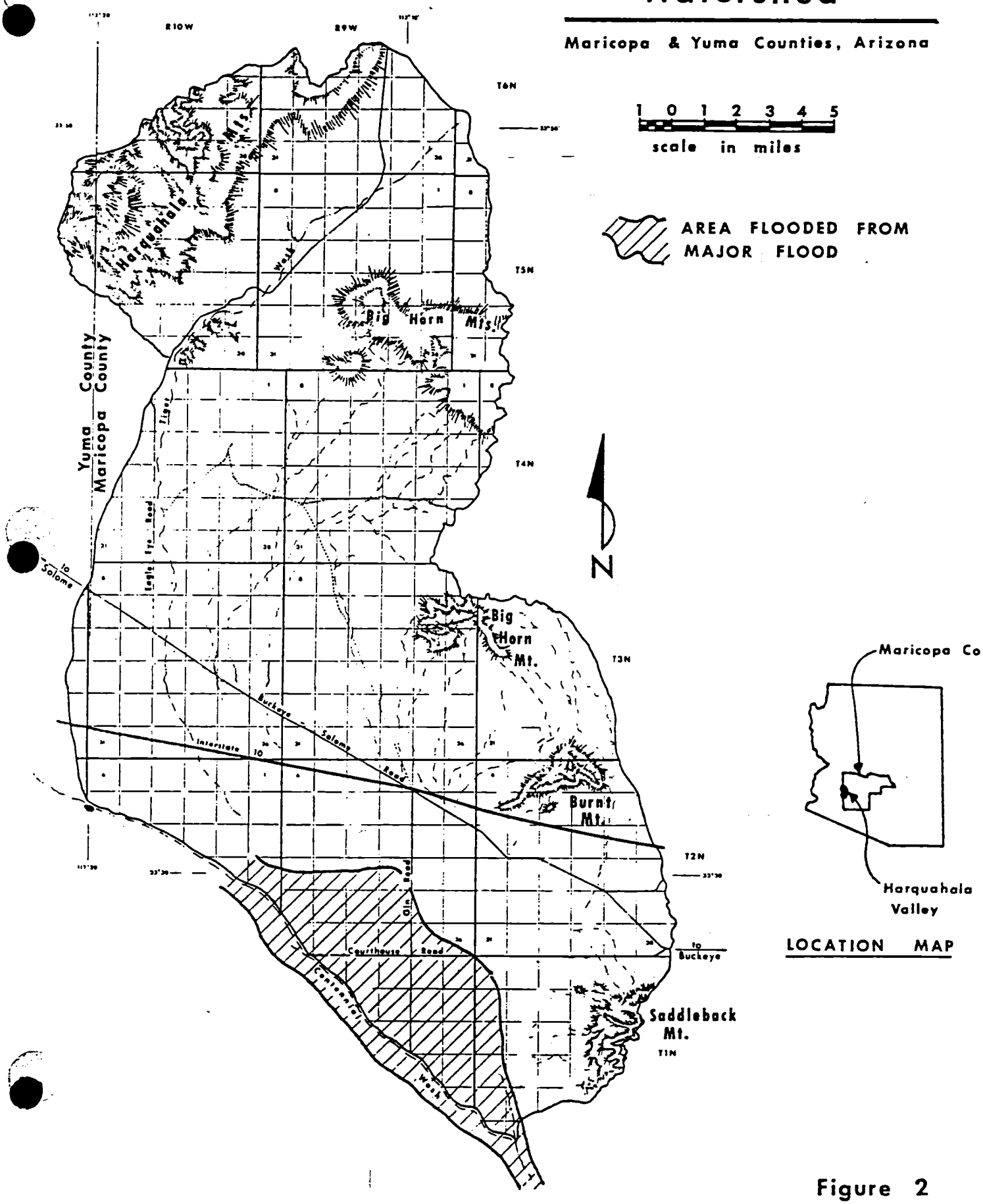


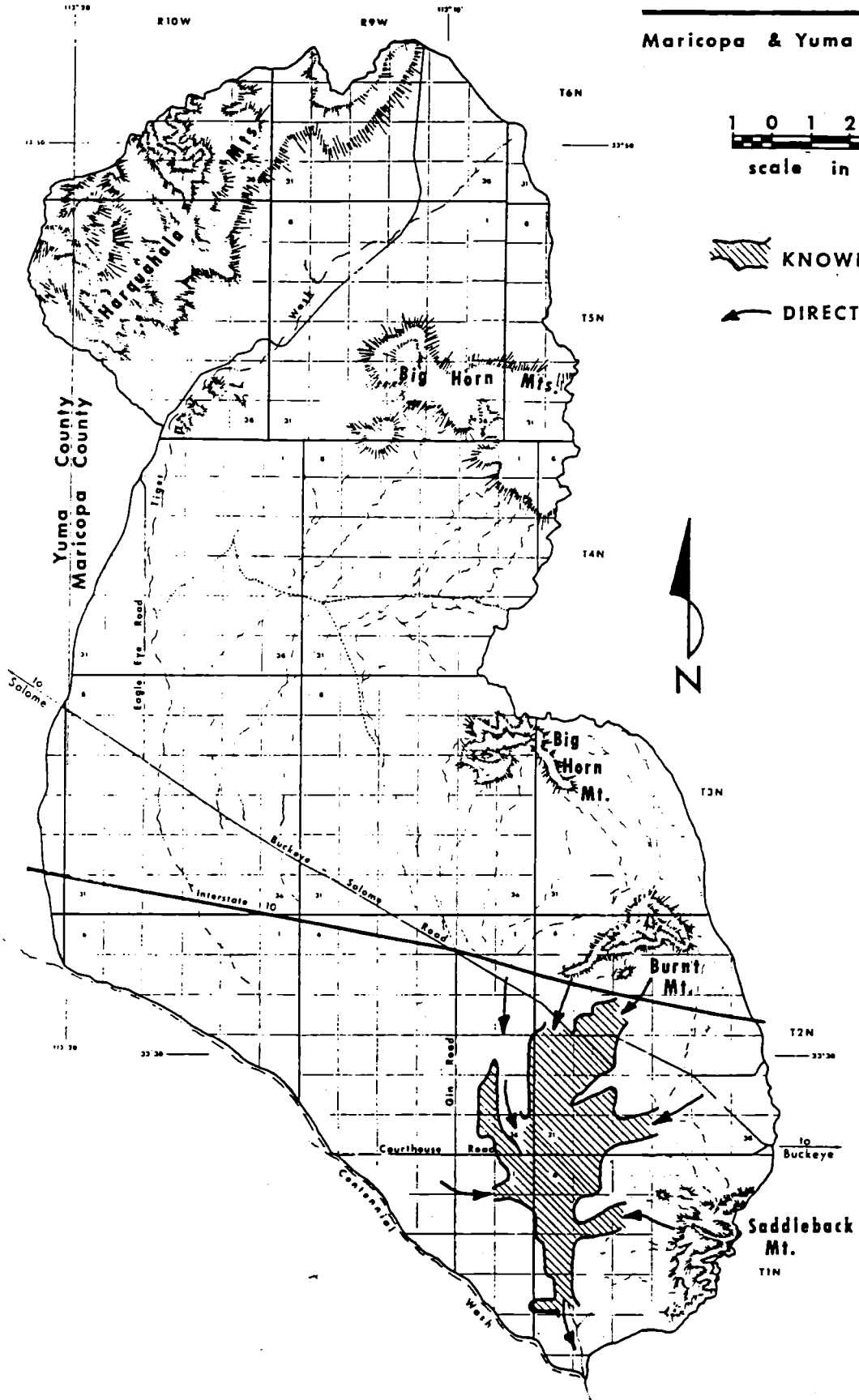
Figure 2

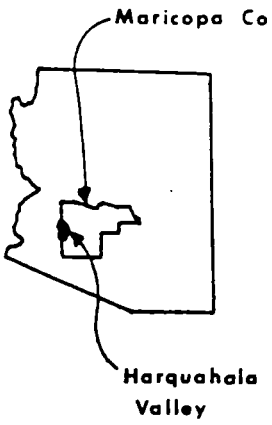
70-2

FLOOD OF AUGUST 26, 1964

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona





LOCATION MAP

70-3

Figure 3

CENTENNIAL WASH FLOOD PLAIN
MAJOR EVENT

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona

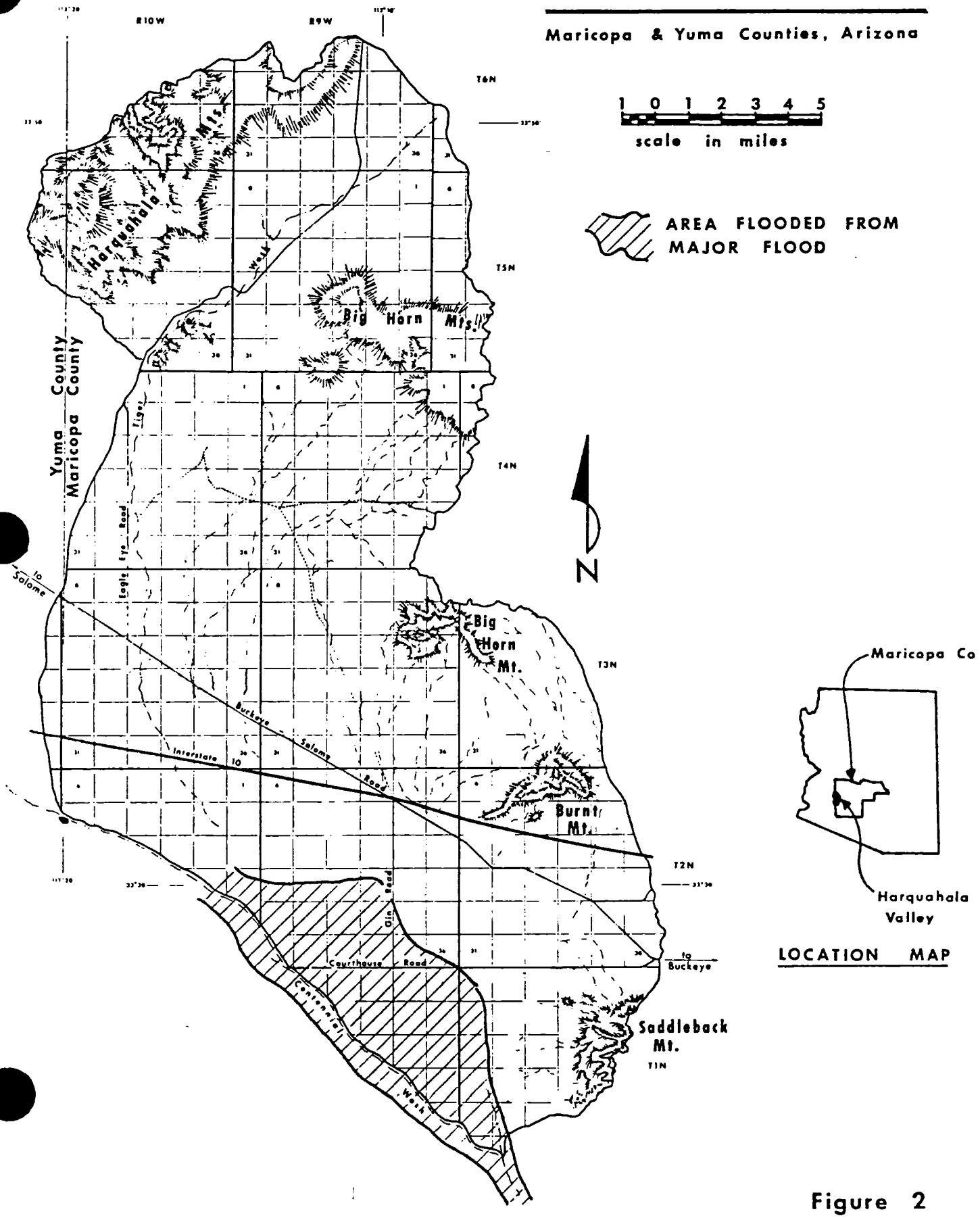


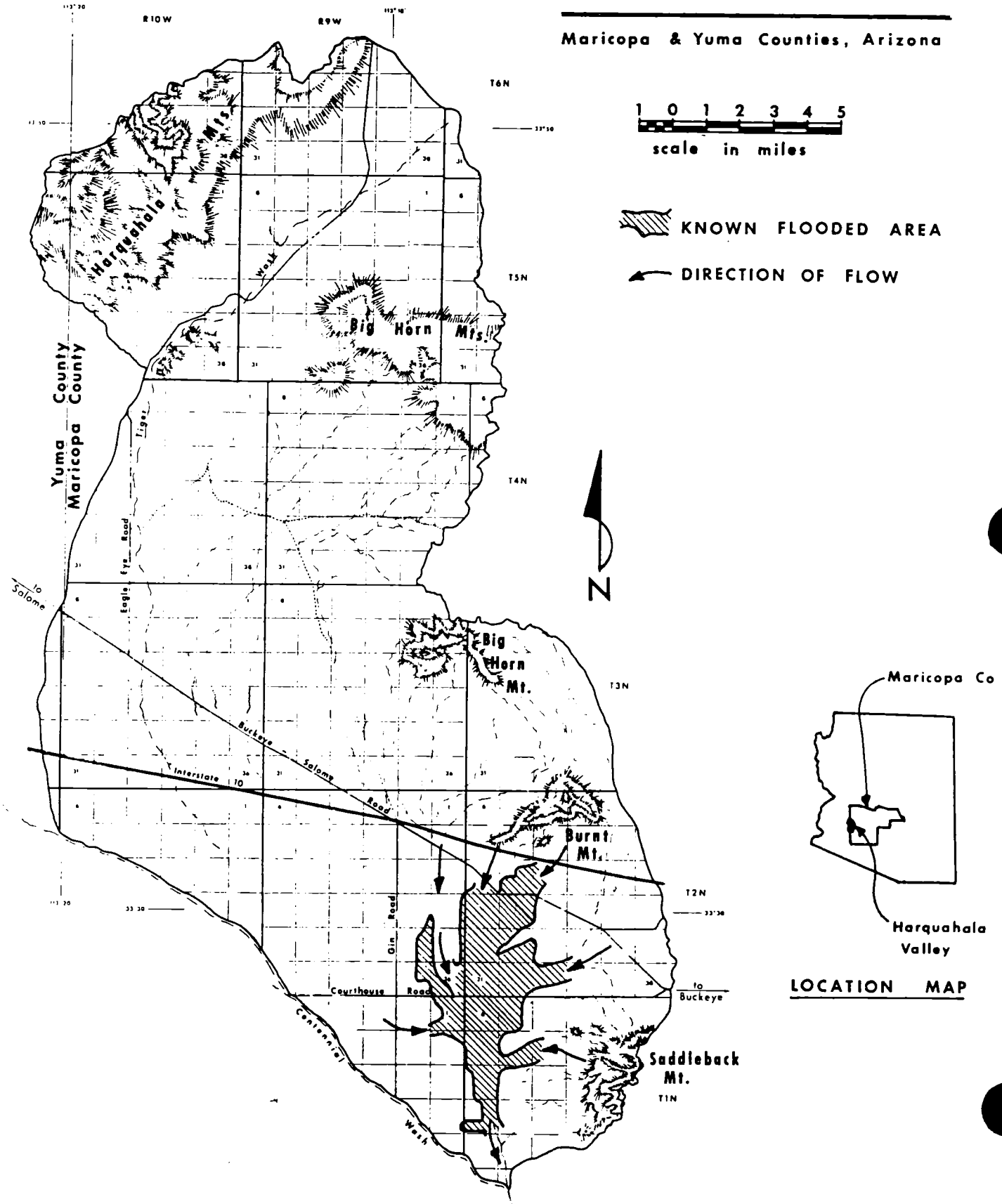
Figure 2

70-2

FLOOD OF AUGUST 26, 1964

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona



70-3

Figure 3

9-5175. Centennial Wash near Arlington, Ariz.

Location.--Lat 33°16'12" (revised), long 112°47'50", in sec.7, T.2 S., R.5 W., on upstream side of ford on former U.S. Highway 80, 3.0 miles upstream from Gillespie Dam and 4.4 miles southwest of Arlington.

Drainage area.--1,810 sq mi, approximately.

Records available.--January 1961 to September 1967.

Gage.--Water-stage recorder. Datum of gage is 773.22 ft above mean sea level, datum of 1929.

Average discharge.--6 years, 1.82 cfs (1,320 acre-ft per year).

Extremes.--Maximum and minimum for the water years 1964-67 are contained in the following table:

Water year	Maximum			Minimum	
		Discharge (cfs)	Gage height (feet)	Date	Discharge (cfs)
1964	July 31, 1964	2,890	3.74	Most of year	0
1965	Feb. 7, 1965	1,040	3.27	Most of year	0
1966	Sept.13, 1966	5,500	4.13	Most of year	0
1967	Sept. 5, 1967	1,040	3.27	Most of year	0

1961-67: Maximum discharge, 14,500 cfs July 23, 1961 (gage height, 4.70 ft), from rating curve extended above 5,500 cfs by logarithmic plotting; no flow for most of time.

Remarks.--Records fair except flows below 100 cfs, which are poor. Flow regulated by several small retention dams in upper end of basin.

Discharge, in cubic feet per second, water year October 1963 to September 1964

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1										0	229	0
2										0	219	0
3										0	1.8	0
4										0	0	0
5										0	0	0
6										0	0	0
7										0	0	0
8										0	0	0
9										0	0	0
10										0	0	0
11										0	0	0
12										0	0	0
13										0	0	0
14										0	0	32
15										0	0	7.8
16										0	0	0
17										0	0	0
18										0	0	0
19										0	0	0
20										0	0	0
21										0	0	0
22										0	0	0
23										0	0	0
24										0	0	0
25										0	0	0
26										0	0	0
27										0	11	0
28										0	4.6	0
29										0	0	0
30					-----					129	0	0
31		-----			-----		-----		-----	348	0	-----
Total	0	0	0	0	0	0	0	0	0	477	465.6	39.8
Mean	0	0	0	0	0	0	0	0	0	15.4	15.0	1.33
Max	0	0	0	0	0	0	0	0	0	348	229	32
Min	0	0	0	0	0	0	0	0	0	0	0	0
Ac-ft	0	0	0	0	0	0	0	0	0	946	924	79

Cal yr 1963: Total 0 Mean 0 Max 0 Min 0 Ac-ft 0
Wtr yr 1964: Total 982.4 Mean 2.69 Max 348 Min 0 Ac-ft 1,950

Peak discharge (base, 1,000 cfs).--July 31 (1730) 2,890 cfs (3.74 ft).

Figure P15. Flood and sediment damages in Harquahala Valley from storm of August 26-27, 1964.

Figure P16. Floodwaters from the storm of August 26-27, 1964. Looking west along Courthouse Road.

Figure P17. Irrigation canal washed out by the flood of August 26-27, 1964. Looking east along mid-section line, Section 7, T1N,R8W.

Figure P18. Flood damage to Interstate 10 culverts from storm of August 1971.

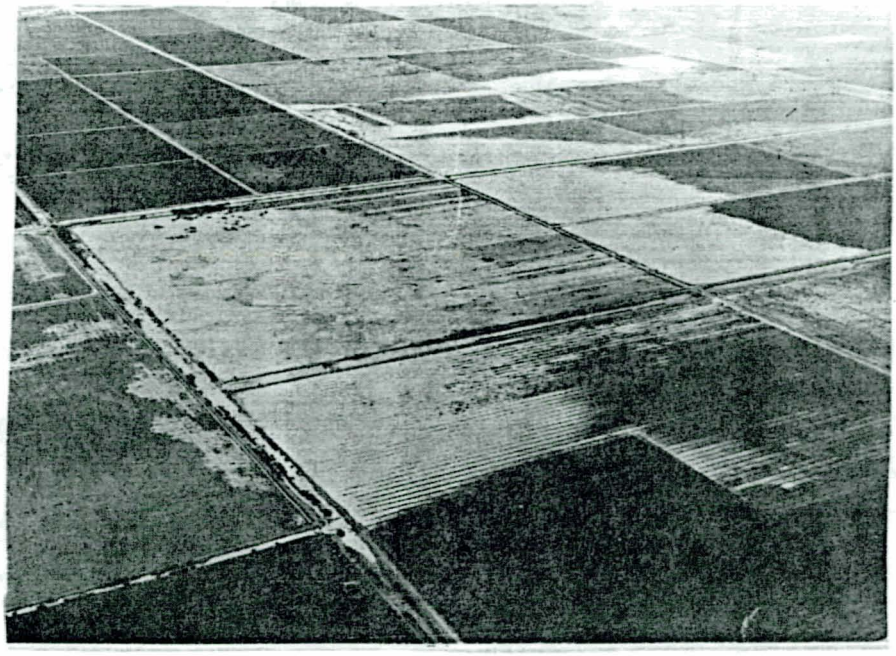


Figure P19. Looking northwest across irrigated lands of Harquahala Valley showing floodwaters from storm of August 1971.

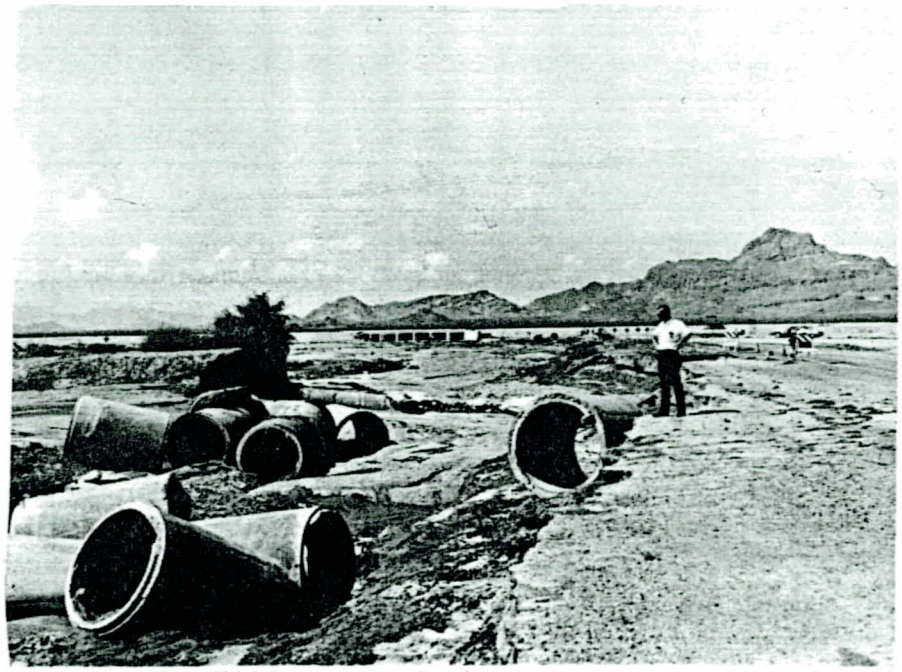


Figure P20. Flood damage to pavement and irrigation pipeline washed out from storm of August 1971. Looking north along Gin Road toward Interstate 10.

of the flood followed the same path as the 1960 flood previously discussed and shown on Figure 1. The flow braided out in the vicinity of Allison Tank and entered the valley on a broad front. The actual acres inundated by the 1971 flood were not determined, however, the flood did not appear to have the extent of the 1960 flood. Frequency of the 1971 flood and peak discharge was not determined.

The storm of October 6 and 7, 1972, centered over the north side of the valley and produced runoff from the south slopes of Burnt Mountain and the Big Horn Mountains. As in 1971 floodwater went through the Interstate 10 box culverts at the Buckeye-Salome Road overpass and washed out about 3 miles of Gin Road including from 2 to 5 feet of the west edge of the paved roadbed. There was no damage to Interstate 10 except for some minor ponding. About one mile of concrete ditch was either washed out or filled with sediment. In sections 26 and 35, T2N, R9W, the water that had been flowing along Gin Road broke to the east and flooded idle land. The damages from this storm were not extensive and are probably in the range of annual to biannual storm damages.

The storm of September 26, 1976, inundated approximately 3,800 acres of agricultural land. Most of the floodwaters came from Centennial Wash and followed the path as shown on Figure 2. Direct crop and road damages were high. Total damages were estimated at $250,000. These damages would have been prevented by Centennial Levee.

3. Erosion Damage [2,4]

A total of eight Hydrologic Soil Groups were mapped in the watershed. On-site erosion rates for these units are shown on Figure 4. The rates range from a low of 103 tons/sq.mi./year for fine grained basin fill deposits to 300 tons/sq.mi./year for the rocky higher mountains. Figure 4 does not reflect erosion rates for irrigated lands in production. These rates are quite low, averaging about 50 tons/sq.mi./year.

Erosion has not caused any major problems in the undeveloped portions of the watershed. The few unimproved roads are periodically washed out at wash crossings causing travel delay and access problems.

The major erosion damages occur in Harquahala Valley. In 1970 and again in 1971 approximately 3 miles of the paved Gin Road roadbed was washed out from flow through Interstate 10 box culverts. There is annual damage to farm and county roads, irrigation ditch berms, borders, fields and crops.

4. Sediment Damage [2,4]

Sediment yield is a function of several factors - runoff, type of soil, underlying soil conditions, vegetation

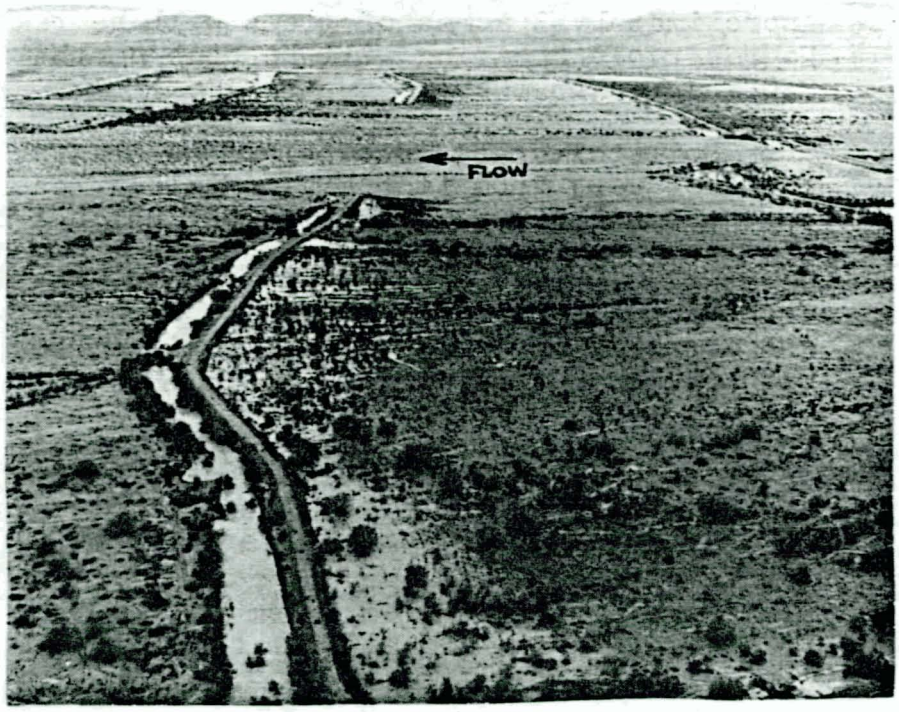


Figure P25. Looking west across Centennial Wash showing heavy growth induced upstream of water-spreaders constructed in the 1950's by the U.S. Bureau of Land Management.

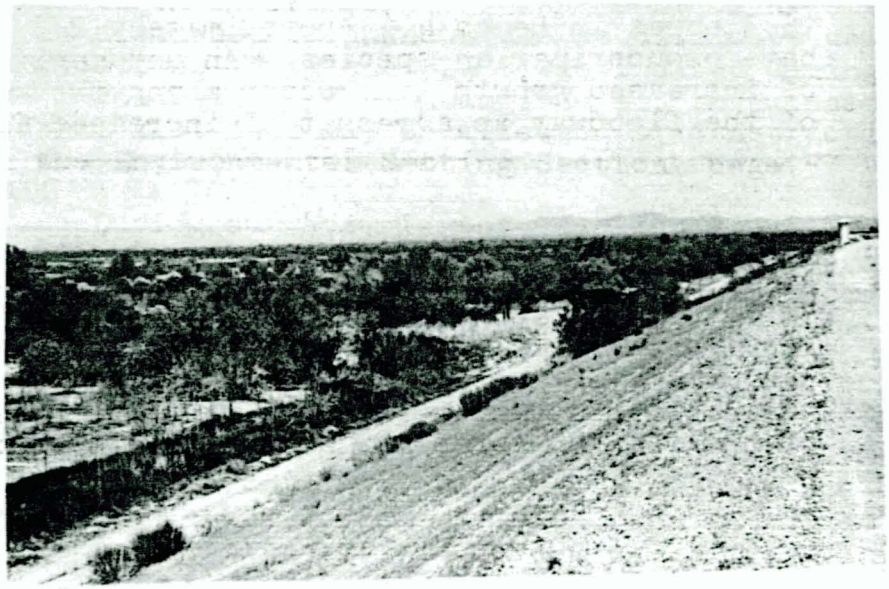


Figure P26. Growth in the flood pool of McMicken Dam. Looking north from top of dam.

temporary storage increases availability of soil moisture. This will be particularly true of pseudoriparian tree species which are important to wildlife. At other areas within the flood pool where temporary storage is infrequent, existing vegetation will be somewhat more vigorous with little change in plant species composition. Siltation and prolonged inundation of some areas may periodically destroy, retard growth, or cause a change in plant species. It is not anticipated that any reduction will be significant or frequent. Evaluation of other flood control structures in southern Arizona shows a general increase in woody growth in reservoir and diversion areas. (See Figures P25 and P26.)

A study to determine the net overall impact of flood retarding structures in southern Arizona is being undertaken by the Office of Arid Land Studies, University of Arizona, for the Soil Conservation Service, Arizona Water Commission, and other interested agencies. The results should indicate the impacts on vegetation, and give a measure of the parameters involved.

Specific anticipated impacts of each structure are as follows:

Saddleback F.R.S.

Clearing for construction will destroy 160 acres of native vegetation. This includes 60 acres for the embankment and 100 acres for the borrow areas and low flow channel. Approximately 12 acres of trees will be removed. Creosotebush immediately downstream of the structure will either be lost or heavily stressed. Most pseudoriparian trees along washes below the structure will receive a continued water supply from pipes through the embankment. An estimated 150 acres within the reservoir will have increased vegetation induced by the extra moisture from temporary storage.

Harquahala F.R.S.

Construction of Harquahala F.R.S. will require complete removal of native vegetation from an estimated 250 acres. This includes 191 acres for the embankment and upstream berms; 29 acres for the upstream low flow channel; 28 acres for cuts through ridges; and 2 acres for the emergency spillway.

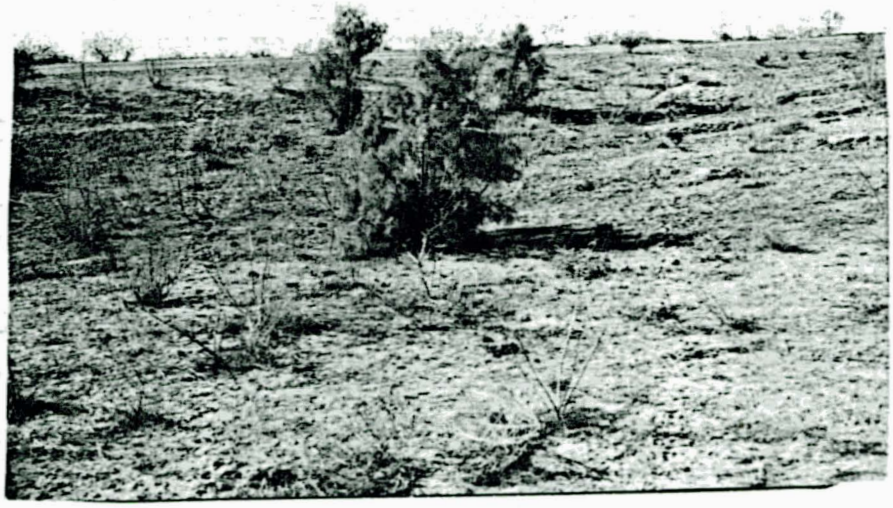


Figure P27. Salt Cedar Intrusion into Interstate 10 borrow pit.

Figure P28. Allison Tank, Section 25,T2N,R10W.

10. Social and Economic

a. Land Requirement and Tax Base

The securing of required right-of-way for the proposed structures will remove a minimum of 1,560 acres of private land from the tax rolls and possibly 6,677 acres, depending upon the type of land rights obtained for the 100-year flowage easement on Centennial Wash. Minimum net tax loss will be $13,000 per year. The project will also require 1,681 acres of State Trust lands and 2,107 acres of public lands administered by the U.S. Bureau of Land Management.

b. Health and Safety of Watershed Residents

Threat of loss of life will be greatly reduced. Health problems due to flooding of cesspools and domestic wells will be virtually eliminated. Another benefit, unmeasurable in monetary terms, will be the peace of mind of the residents.

c. Local Sociological Impact

The influx of construction personnel into Harquahala Valley will tax local facilities. At least some construction personnel will be expected to find local housing and related community services. Few of the necessary services are available in Harquahala Valley. Additional school facilities are not anticipated. Impacts will be felt in Buckeye and Salome.

d. Land Use Changes

The project is not expected to stimulate any land use changes in the irrigated lands of Harquahala Valley. However, the structures will provide flood protection to 27,300 acres of unimproved land that is presently subject to flooding, primarily from sheet flows. This includes 10,480 acres of private, 5,300 acres of State, and 11,520 acres of public lands administered by the U.S. Bureau of Land Management. A change in ownership and/or land use should not occur on the protected State or Federal public lands for many years - if ever. However, the private lands will be more suited for development than at present. Some subdividing of these lands could occur. It is possible that by reducing losses, marginal lands will stay in production longer if water supply becomes scarce.

11. Reoccurring Operation and Maintenance

No significant impact is expected from these activities. Maintenance personnel will be in the area on an infrequent basis. Some temporary dust problem and wildlife disturbances could be caused by travel at the sites. Minor expenditures may be made locally in renting backhoes or trucks to remove debris.

12. Downstream Impacts

Downstream is defined as being that area from the mouth of the watershed to Gillespie Dam on the Gila River. It includes a 23 mile length of Centennial Wash from the watershed mouth to junction with the Gila River and another 2 miles along the Gila River to the dam.

Impacts include flooding on downstream improvements, underground water supplies, surface water supplies, and sedimentation, and other environmental considerations. Discussion includes both the effects of the project on peak discharges and watershed yield and long duration flows from the project dams.

a. Downstream Flooding

The first improvement is about 13 miles downstream of the watershed mouth in section 24, T1S, R7W, where an 80 acre field has been cleared for irrigated agriculture within the Centennial Wash floodplain. The wash has been channelized to the south around this development. Flow from Winters Wash enters Centennial Wash 15½ miles downstream on about a 2 mile front. Southern Pacific Railroad tracks cross where the washes comingle. There are two 300 feet long wooden trestles where the railroad crosses Centennial Wash proper and another two 300 feet long trestles about 1½ miles to the northeast.

The major downstream development occurs in the Arlington Valley area. The Arlington Canal crosses Centennial Wash about 2 miles above the Gila River. The entire Centennial Wash floodplain in this reach has been completely developed into agriculture. There are no defined channels. Large flows spread out through the irrigated lands seeking a course to the Gila River.

The project dams will control 132 square miles of the total 1,810 square miles above the Arlington Canal. U.S. Bureau of Reclamation Tiger Wash Detention Basin will control an additional 166 square miles.

The evaluation of downstream flooding potential is a study of probabilities. The project will not have any measurable downstream impact if a 100-year storm should occur for the total Centennial Wash drainage area. The floodwater retarding effect of the project dams is offset by the fact that Centennial Levee will prevent floods from spreading out over Harquahala Valley and thus decrease downstream peak discharges.

Peak discharges at the downstream railroad crossing resulting from a 100-year storm occurring only above Harquahala F.R.S., Saddleback F.R.S., Saddleback Diversion and Centennial Levee Reach 1 will be reduced by 84 percent - from 17,190 cfs to 2,700 cfs. Flood damages will be reduced accordingly.

Peak discharges at the Arlington Canal, resulting from a 50-year storm occurring only above Saddleback Diversion will be increased by one third - from 3,000 cfs to 4,000 cfs. This is because the diversion prevents flows from spreading out over the irrigated lands of Harquahala Valley. Centennial Wash can easily handle this flow without damage to improvements for the entire reach except through Arlington Valley, where there are no channels.

Centennial Levee will modify flow conditions on Centennial Wash. Flood flows presently spread out through Harquahala Valley and peaks are reduced. The peak discharge at the downstream railroad resulting from a 100-year storm occurring only over the drainage area controlled by Centennial Levee will be increased by one third - from 15,000 cfs to 20,000 cfs. This is assuming the Tiger Wash Detention Basin is in place. Railroad drainage facilities are adequate to convey this flow; however the irrigated lands in Arlington Valley will be adversely affected.

An attempt has been made here to reflect the worst possible conditions in regard to the potential of flooding in the Arlington Valley area. It should be borne in mind, however, that all of the irrigated lands that are subject to flooding from the Centennial Wash drainage area lie within the flood prone area of the Gila River as determined by the U.S. Geological Survey.

b. Downstream Groundwater Supplies

Runoff from high frequency rainfall events occurring in the drainage areas above the floodwater retarding structures will be effectively contained by the structures. The highest percentage of recharge occurring from project impoundment will occur within the Harquahala Plains Basin. Downstream recharge will be greatest when larger storms occur. High flows will be slowed, routed around the water absorbing agricultural lands of Harquahala Valley, and released into Centennial Wash at a nondamaging rate for a longer duration than would occur under pre-project conditions. As the duration of flow is increased, more time is available for water to infiltrate through the bottom of Centennial Wash into the underground system. This amount will not be large. No attempt has been made to quantify the average annual increase in downstream recharge as there will be many years in which no flow at all will occur. It is estimated, however, that for a 100-year event over the project structures, downstream recharge will be increased by about 100 percent over pre-project conditions.

c. Downstream Surface Water Supply

Gillespie Dam serves as a diversion point for

two canal systems, the Gila Bend Canal on the east and the Enterprise Canal on the west. Neither are dependent upon flow from Centennial Wash.

U.S. Geological Survey gage records at a measuring station on Centennial Wash about 1 mile upstream from the Gila River show that for the 12 year period between 1962 and 1973 there was no flow recorded for 123 months out of the total 144 months of record.

The impact of the project on downstream surface water supplies is minimal. Of the total 1,810 square miles of drainage area at the gaging station, the project dams will slow runoff rates from about 132 square miles or less than 8 percent of the total drainage area.

d. Other Downstream Environmental Considerations

The 100-year storm event would be released from the project dams in about 10 days. Over this period, project flow rates would decrease from a high of 500 cfs to no flow. This flow should aid the growth of vegetation along the course of Centennial Wash and make water available for a longer period for use by wildlife. The flow should all infiltrate before reaching downstream irrigated lands in the Arlington Valley area and the Gila River.

13. Land Subsidence and Earth Cracks

Irrigation pumpage in the project agricultural areas has resulted in substantial lowering of the water table. Similar situations throughout the State have been accompanied by land subsidence and earth cracks.

The Soil Conservation Service and the Arizona Water Commission have examined the basin searching for any land disturbances. In 1966, an earth crack was discovered in the SW¼ section 36, T2N, R9W. This location is approximately 3½ miles west of Saddleback F.R.S. The earth crack was backfilled with 5 to 6 feet of compacted soil and to date no settlement has been noted. The land subsidence appears to have been an isolated case, and there have not been any reported occurrences since that time. Its location is not in the vicinity of any proposed structures, however, it does underscore the potential for subsidence within the project area.

Aware of the subsidence potential, the U.S. Bureau of Reclamation has conducted precise leveling surveys along the Granite Reef Aqueduct alignment. The surveys were started in 1971 and to date no appreciable subsidence has been recorded.

Earth cracking can occur in an erratic pattern and cannot always be predicted even with detailed studies. None

VI. ALTERNATIVES

A. Alternative of Accelerated Land Treatment Only

The majority of floodwater, erosion, and sediment damages in the watershed occur to improvements in Harquahala Valley. Damaging floodwaters come from 341.8 square miles of watershed drainage area adjacent to the valley and 675 square miles of Centennial Wash drainage area. The control of floodwater by land treatment measure would require a structural and vegetative program on the total 1,016.8 square miles.

Since 1954 the U. S. Bureau of Land Management has conducted an intensive land treatment program on Centennial Wash. The program consists of two large dams that meter floodwater out to approximately fifty downstream waterspreading dikes. This system has been very effective in healing headcuts, preventing gully and sheet erosion, increasing vegetative growth and improving wildlife habitat. However, as shown on Figure 1, Centennial Wash Flood of 1960, flood damages along Centennial Wash have not been reduced to acceptable levels.

In this arid climatic area adequate amounts of vegetative and structural land treatment measures could not be installed and maintained to prevent flooding in Harquahala Valley. Legal restraints imposed by downstream water rights limit the applicability of structural land treatment measures on upstream watersheds in the State of Arizona.

B. Alternative of Nonstructural Measures

The nonstructural measures considered in combination with an accelerated land treatment program included floodplain zoning, floodproofing, flood insurance and outright purchase of improvements subject to damage.

Under the authority of the State Flood Control Act of 1973, Maricopa County has enacted floodplain regulations governing developments in floodplain areas. The county, however, has not delineated the floodplain in Harquahala Valley.

When fully implemented and enforced, county floodplain regulations will prevent flood damage to new nonagricultural developments. They will not prevent damage to new agricultural developments. They will not prevent damages to the existing improvements or to agricultural development in the valley.

Floodproofing is the installation of individual protective devices for existing property. The floodproofing measures

considered included raising of floor levels, protective berms/ channels, watertight closure doors, relocation of structures, and protective structural walls. A limited number of improvements in Harquahala Valley could be effectively floodproofed by employing these measures either singularly or in combination. The structures most receptive are the elementary school and the cotton gin. Protective berms could be placed around these units at an estimated cost of $15,000. To prevent floodwater from entering irrigation wells, protective concrete structural walls could be placed around the pumps and engines/motors at an estimated cost of $1,850 for each well. To prevent floodwaters and sediment from entering the tailwater pumpback sumps, protective dikes could be placed around these sumps at an estimated cost of $3,600 for each sump. Buried gas lines and telephone cables could be lowered to prevent washout.

Floodproofing measures are not applicable to crops, land, farm roads, irrigation ditches, livestock, county roads, Interstate 10, and most of the residential, commercial and industrial buildings. Most buildings are set on concrete slabs and for the most part with less than six inches of elevation between the floor and natural ground. It would be very expensive to attempt to raise these buildings.

The floodproofing alternate was investigated without regard to legal constraints or what impact individual measures would have on adjoining or downstream properties and improvements. Dikes, channels, protective berms, protective walls, etc., cannot be placed so as to protect an individual without the possibility of inducing damages to others. Because most of the improvements in Harquahala Valley cannot be practically floodproofed, the planned structural program would still be required.

Flood insurance would reduce the local adverse economic impact of flooding on owners of existing developments; however, the financial burden would transfer to other sectors of the national economy. No net benefit would be realized.

The outright purchase of all improvements in Harquahala Valley that are subject to floodwater damages would require an expenditure in excess of an estimated $50,000,000 (1974 costs). Approximately 16,000 acres of developed and highly productive irrigated cropland would be removed from the national economy.

C. Alternative of Installing the Approved 1967 Plan with Revisions [2]

Details of the approved 1967 Plan are contained in the publication, "Watershed Work Plan - Harquahala Valley Watershed - U.S.D.A. - Soil Conservation Service." Proposed structural

measures included two floodwater retarding structures (Burnt Mountain F.R.S. and Big Horn F.R.S.); two floodways (Burnt Mountain and Big Horn); three diversions (Saddleback, Burnt Well, and Little Horn); and one levee (Centennial Levee).

The plan was completed prior to the construction of Interstate 10. The highway has now been completed and it crosses the alignment of two of the proposed structures, Saddleback Diversion and Big Horn Floodway. No crossings were provided through the highway for these units.

The extremely high expense and requirement for traffic control involved in crossing Interstate 10 eliminates the installation of the 1967 Plan without some revision. During the investigations for this statement, studies were conducted to revise the 1967 Plan.

The installation of the Revised 1967 Plan would cost an estimated $10,540,530 in installation cost of which $9,122,570 would be Public Law 566 costs and $1,417,960 from other funds. Costs reflect updating to current design criteria and 1975 costs. This plan would provide an 8 percent higher level of protection to existing development but would be more costly than the recommended plan.

The environmental impacts would not be appreciably different from those of the recommended plan as presented in the "Environmental Impacts" section except in two major instances. The Revised 1967 Plan would not protect the Granite Reef Aqueduct or the proposed western main canal of the Harquahala Valley irrigation water distribution system. Protection features for these facilities would still have to be constructed with resulting dual adverse environmental impacts. Burnt Mountain F.R.S. would be located one-half to one mile above Interstate 10, creating aesthetic distraction.

D. Major Alternatives in the Selection and Design of Components of the Recommended Plan

1. Alternative of Dam across Main Watercourse of Centennial Wash

The project sponsors and other interested parties have suggested that a dam be constructed across the main watercourse of Centennial Wash as a substitute for the proposed Centennial Levee.

The total drainage area of Centennial Wash at a point

immediately above Harquahala Valley is approximately 652 square miles or 417,280 acres. This exceeds the authorization limit of 250,000 acres maximum under Public Law 566 and consequently is beyond the jurisdiction of the Soil Conservation Service. Although a dam could conceivably be constructed by other agencies or groups, there is not a good efficient damsite anywhere on Centennial Wash that is close to Harquahala Valley. The most efficient site is 23 miles upstream at the location of the existing Narrows Dam. This dam could possibly be enlarged, however, the site is geologically suspect. There appears to be a fault on the left abutment and sinkholes have appeared in past instances in the flood pool.

A dam constructed across the wide alluvial floodplain nearer to Harquahala Valley would be expensive. Rough estimates of such a structure are $12,000,000. This greatly exceeds the installation cost of Centennial Levee without a corresponding increase in flood reduction benefits.

2. Alternative of Channelization of Centennial Wash

It has been suggested that the main watercourse of Centennial Wash be restricted and channelized through Harquahala Valley. The proposal would require dikes on the west side of the valley to funnel the existing widespread sheet flow into a confined channel. The channel would extend 13 miles through the valley. This channel system could not be constructed under the authorities of Public Law 566 because of the same restraints on drainage area size as discussed in number 1 above.

A channel of design capacity equivalent to the protection afforded by Centennial Levee would cost an estimated $1,500,000 (1974 prices). Extensive stabilization measures would be required to prevent channel scour and degradation. Level of benefits would remain the same as in the recommended plan.

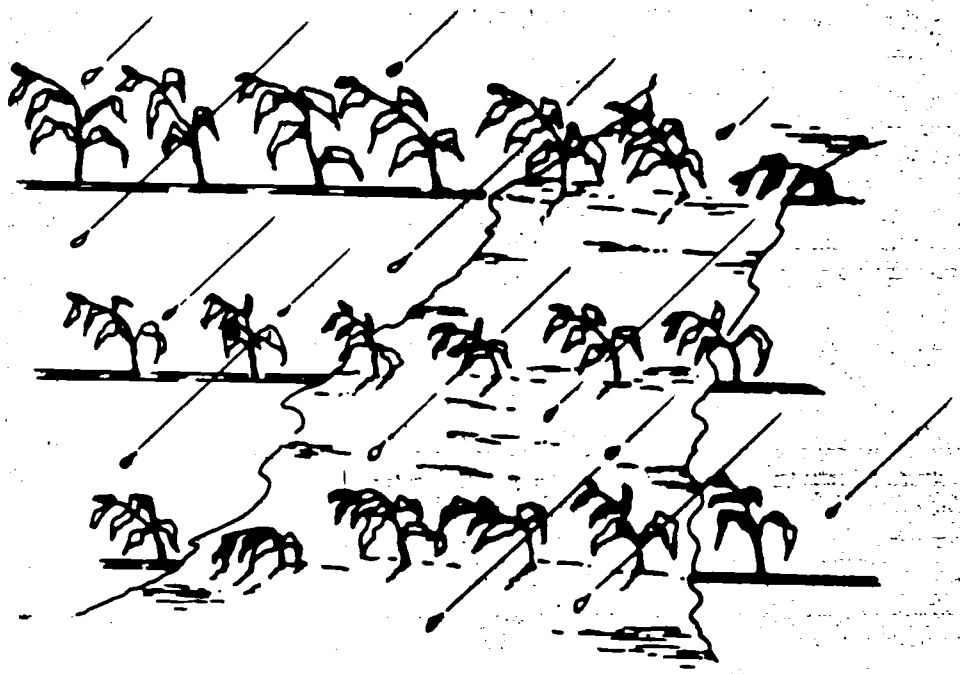
3. Alternative of Installing a Channel System in Place of Saddleback F.R.S.

This alternative would replace Saddleback F.R.S. with a channel system constructed through the developed areas of Harquahala Valley.

Channels would be constructed along the east section lines of sections 20 and 29, T2N, R8W; along the north and east section lines of section 33, T2N, R8W; along the north section line of section 32, T2N, R8W; and a channel would extend 4 miles due south from the northwest corner of section 32 outletting

HARQUAHALA VALLEY

FLOOD OF SEPTEMBER 24-26, 1976



NOVEMBER, 1976

ARIZONA WATER COMMISSION

HARQUAHALA VALLEY

Flood of September 24-26, 1976

2 WEEKS AFTER NATHLEEN
Sept 10-13, 1976

Severe flooding occurred in Harquahala Valley on Friday evening September 24, 1976, and again on Sunday morning, September 26, 1976. Extensive damages resulted throughout the watershed. The flooding inundated approximately 3,800 acres of prime agricultural land. Direct crop and road damages were high. Total damages were estimated to be about $250,000.

The flood event that occurred on September 24-26, 1976, was estimated to have a recurrence interval of about once in four years. Heavy damages from a low frequency occurrence indicate the severity of the Harquahala flood problem. The Soil Conservation Service has proposed a P.L. 566 project that will furnish needed flood control protection to the Harquahala Valley. Had the project been constructed, all major flood damages would have been prevented.

A field flood evaluation of the watershed was initiated by the Flood Control District of Maricopa County (FCDMC), Soil Conservation Service (SCS), and the Arizona Water Commission (AWC). The resultant data are enclosed:

1. SCS trip report by R. McArthur, Harquahala Watershed - Flood Observation - Sept. 28-29, 1976.
2. Map showing approximate inundation area. (Flood of Sept. 24-26, 1976.)
3. Photographs and captions showing flood damages (Flood of Sept. 24-26, 1976).

Precipitation Sept	23	24	25	26	27	28	Σ	1976
~~Aguila~~		.46	.88					
Buckeye	.22	.06	1.60					
Bouse	.41	.29	.77					
Congress	.20	.23	.59	.03				
Harquahala Plain	.50	1.10	1.60					
Gila Bend		1.72	.70					
Skull Valley	.31	—	.44	.27	.59	.14	.12	
Walnut Grove	.35	.05	.80	.10				
Wickenburg		2.06	1.45	.80	.04			

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE River Basin-Watershed Planning Staff

Suite 326, Arizona Title Building, 111 W. Monroe St., Phoenix, AZ 85003

SUBJECT: WS - Harquahala Watershed - Trip Report of Flood Observations - September 28-29, 1976

DATE: October 15, 1976

TO: Ronnie L. Clark
RB/WP Staff Leader

On Monday, September 27, we received a telephone call from John Fronske, DC, Buckeye Field Office. He reported to Dick Reidhead that they had experienced flooding within the Harquahala Watershed on Friday night, September 24, and again Sunday morning, September 26.

We discussed the need for flood data and decided to drive into the area the next day. Tuesday, September 28, Dick Reidhead, Steve Erb, John Fronske, and I drove into the Eagle Tail and Harquahala Watersheds.

We observed the effects from minor flooding and related damages from runoff within the Eagle Tail Watershed. It appeared that the main damages were to road systems.

Harquahala Valley was more severely flooded with most of the water coming from Centennial Wash, but an appreciable amount from the Big Horn Mountains. Major flood damages appear to be land scouring and sedimentation, crop damages and road damages. Some of the farmland will require cleaning and releveling. The effected cropland will have some reduction in yields but the main impact will be the reduction in quality; this is especially true for cotton. Road damages were quite extensive. Farmers were busy repairing the less damaged roads but some of the more severely damaged roads will require hauling and rebuilding 200 to 800 foot stretches of roadway. There were several on-farm concrete ditches that were heavily damaged.

We looked at damages on the Frank Rogers, Clyde Tramps and Harry Porterfield farms. John Porterfield, son of Harry Porterfield, took us over their farm in his jeep. This farm was one of the most severely damaged.

At the conclusion of the day we decided that most of the effected area could still be seen from the air and aerial photos would be the most efficient way to map out the flooded area. John Fronske said he could meet with some of the effected landowners or operators and acquire flood damage information. Reidhead and Fronske took photos of damaged areas.

On Wednesday, September 29, I made arrangements with Chandler Flyers for a charter flight. We invited Bob Ward, FCDMC, and Steve Erb, AWC, to go along. We left Sky Harbor Airport at 1 p.m. and returned at 3:15 p.m. The flight followed a route taking us along the Gila River, up Centennial Wash to Harquahala Valley, four sweeps through the valley and out of the valley following Buckeye Road.

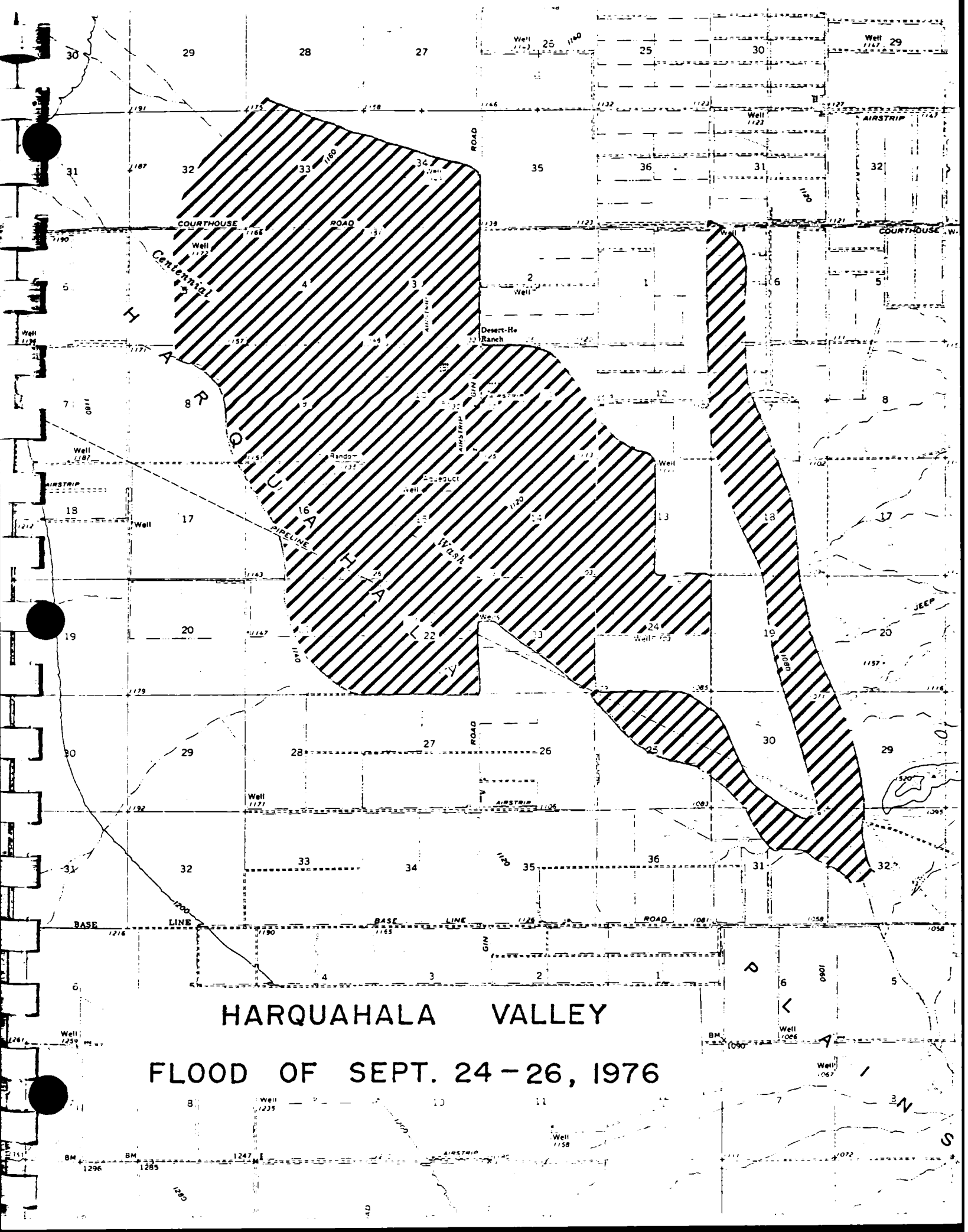
RECEIVED
OCT 15 1976
Arizona Water Commission

Ward, Erb, and I took photos. I took about 60 photos which I have located on a map. Weaver, Reidhead, and I reviewed these and have sent them to the Arizona Water Commission. They have agreed to study them and map out the flooded area as well as possible.

Robin P. McArthur

Robin P. McArthur
Hydraulic Engineer

cc:
John W. Peterson Asst. STC
John Fronske, DC, Buckeye FO
Steve Erb, AWC
John Weaver, Civil Engineer, RB/WP Staff
Richard Reidhead, Jr., Agricultural Engineer, RB/WP Staff


HARQUAHALA VALLEY
FLOOD OF SEPT. 24-26, 1976
COURTHOUSE ROAD
Centennial
Wash
Desert-He Ranch
AIRSTRIP
PIPELINE
BASE LINE ROAD
JEEP
Well

09517500. CENTENNIAL WASH NEAR ARLINGTON, ARIZ.

LOCATION.--Lat 33°16'12", long 112°47'50", in sec.7, T.2 S., R.5 W., Maricopa County, on upstream side of ford on former U.S. Highway 80, 3.0 mi (4.8 km) upstream from Gillespie Dam and 4.4 mi (7.1 km) southwest of Arlington.

DRAINAGE AREA.--1,810 mi^2 (4,690 km^2), approximately.

PERIOD OF RECORD.--January 1961 to current year.

GAGE.--Water-stage recorder. Datum of gage is 773.22 ft (235.677 m) above mean sea level.

AVERAGE DISCHARGE.--15 years, 3.56 ft^3/s (0.101 m^3/s), 2,580 acre-ft/yr (3.18 hm^3/yr); median of yearly mean discharges, 2.1 ft^3/s (0.060 m^3/s), 1,500 acre-ft/yr (1.85 hm^3/yr).

EXTREMES.--Current year: Maximum discharge, 7,800 ft^3/s (221 m^3/s) Sept. 26 (gage height, 4.38 ft or 1.335 m), from rating curve extended above 5,500 ft^3/s (160 m^3/s); no flow most of time.
Period of record: Maximum discharge, 14,500 ft^3/s (411 m^3/s) July 23, 1961 (gage height, 4.70 ft or 1.433 m), from rating curve extended above 5,500 ft^3/s (160 m^3/s); maximum gage height, 4.71 ft (1.436 m) Sept. 5, 1970; no flow for most of time each year.

REMARKS.--Records poor. Flow regulated by several small retention dams in upper end of basin. Records do not include irrigation return flow past station.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1975 TO SEPTEMBER 1976
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1												0
2												0
3												0
4												0
5												0
6												0
7												0
8												0
9												0
10												0
11												0
12												0
13												0
14												0
15												0
16												0
17												0
18												0
19												0
20												0
21												0
22												0
23												0
24												11
25												280
26												1750
27												584
28												10
29												0
30					---							0
31		---			---		---		---			---
TOTAL	0	0	0	0	0	0	0	0	0	0	0	2635
MEAN	0	0	0	0	0	0	0	0	0	0	0	87.8
MAX	0	0	0	0	0	0	0	0	0	0	0	1750
MIN	0	0	0	0	0	0	0	0	0	0	0	0
AC-FT	0	0	0	0	0	0	0	0	0	0	0	5230

CAL YR 1975 TOTAL 4.50 MEAN .012 MAX 2.3 MIN 0 AC-FT 8.9
WTR YR 1976 TOTAL 2635.00 MEAN 7.20 MAX 1750 MIN 0 AC-FT 5230

PEAK DISCHARGE (BASE, 1,000 CFS).--Sept. 26 (1930) 7,800 cfs (4.38 ft).

CLEAN AIR FORCE
Don't drive one in five

MEMORANDUM

TO Fellow Staff Members

FROM: Lin Stevens

DATE: January 4,1989

SUBJECT: **Rideshare And Vanpool Brown Bag Luncheon**

January 16th-20th is "**CLEAN AIR FORCE State Government Challenge Week**". To encourage participation by DWR employees a brown bag luncheon has been scheduled.

Next **Tuesday, January 10th** at 12 noon in the Basement Training Room, **B014**, employees are invited to meet Melody Girard and Rachael Lutjeans. Melody is with the **Capitol Rideshare** program and Rachael works for the **Vanpool** program.

This is an opportunity to learn more about each program, ask questions and sign up. **Homemade cookies, cake and punch will be served.**

If you have any questions, please call me at 1553.