REPORT SUPPLEMENT TO

INVESTIGATION OF NORTH PHOENIX MOUNTAINS FLOOD DETENTION BASINS

CITY OF PHOENIX, ARIZONA

1973

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ENGINEERING DEPARTMENT • 700 MUNICIPAL BUILDING • 251 WEST WASHINGTON • PHOENIX, ARIZONA 85003

February 20, 1973

Col. John C. Lowry
Maricopa County Flood Control District
3325 West Durango Street
Phoenix, Arizona 85009

Dear Col. Lowry:

Investigation of North Phoenix
Mountains Flood Detention Basins,
Project No. ST-71185.00

We are forwarding two reports of the North Phoenix Mountains Flood Detention Basin Study prepared by John Carollo Engineers for your information and use.

If you have any questions concerning these reports, contact Fred May, phone 262-6651.

Very truly yours,

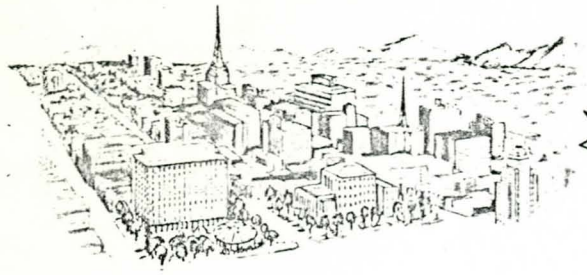
J. E. ATTEBERY, P.E., City Engineer

Reginald Swartz

Reginald Swartz, P. E.
Engineering Supervisor

FJM:jmh

c: Mr. Attebery



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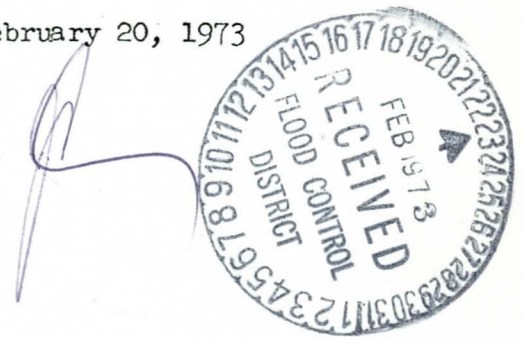
February 20, 1973



Department of the Army
U.S. Corps of Engineers
Post Office Box 2711
Los Angeles, California 90053

Attention Mr. Vance Carson

Gentlemen:

Investigation of North Phoenix Mountains
Flood Detention Basins, Project ST-71185.00

In response to your telephone request, we are forwarding two reports of the North Phoenix Mountains Flood Detention Basin Study prepared by John Carollo Engineers for your information and use.

If you have any questions concerning these reports, contact Fred May, telephone 262-6651.

Very truly yours,

J. E. ATTEBERY, P.E., City Engineer

FJM:rmb

Reginald Swartz, P.E.
Engineering Supervisor

Attachments

c: Mr. Attebery
Col. Lowry
Major Worthington (w/reports)

April 17, 1973

Mr. James Attebery, City Engineer
700 Municipal Building
251 West Washington
Phoenix, Arizona 85033

Attention Mr. Reginald Swartz, P.E.

Gentlemen:

RE: INVESTIGATION OF NORTH PHOENIX MOUNTAINS FLOOD DETENTION BASINS, PROJECT NO. ST-71185.00.

Plate I indicates a Dreamy Draw Service Center. It is my understanding this Service Center is not to be established. I have no other comments.

Sincerely,

John C. Lowry
Chief Engineer and General Manager

JCL/aa

CITY OF PHOENIX
ARIZONA

ENGINEERING DEPARTMENT • 700 MUNICIPAL BUILDING • 251 WEST WASHINGTON • PHOENIX, ARIZONA 85003

April 9, 1973

Col. John C. Lowry
Maricopa County Flood Control District
3325 West Durango Street
Phoenix, Arizona 85009

Dear Col. Lowry:

Investigation of North Phoenix
Mountains Flood Detention Basins,
Project No. ST-71185.00.

In reference to our transmittal of February 20, 1973, we are forwarding a supplemental report of the North Phoenix Mountains Flood Detention Basin study, prepared by John Carollo Engineers, for your information and use. This report proposes alternatives for Basins 2a, 2b, and 5.

If you have any questions concerning this report, contact Fred May at 262-6651.

Very truly yours,

J. E. ATTEBERY, P.E., City Engineer

Reginald Swartz

Reginald Swartz, P.E.
Engineering Supervisor

FJM:ncg
Attachments

c: Mr. Attebery
Mr. Vance Carson (w/report)
Maj. Will Worthington (w/report)

RT TO COUNTY

JOHN CAROLLO ENGINEERS

PHOENIX ARIZONA | WALNUT CREEK CALIFORNIA | SANTA ANA CALIFORNIA

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ROBERT G. WILLIAMS, P.E.
DONALD R. PREISLER, P.E.
GAIL P. LYNCH, P.E.

3308 NORTH THIRD STREET
PHOENIX, ARIZONA 85012
AREA CODE: (602) 248-0400

March 28, 1973

Engineering Department
City of Phoenix
700 Municipal Building
251 West Washington
Phoenix, Arizona 85003

Attention: Mr. J. E. Attebery, City Engineer

Re: Job No. ST 71185.00

Gentlemen:

We submit herewith our Report Supplement to Investigation of North Phoenix Mountains Flood Detention Basins in accordance with Supplemental Agreement to Contract No. 13580 dated February 13, 1973.

We wish to thank you and the City's staff for your cooperation in the preparation of this Report.

Respectfully submitted,

JOHN CAROLLO ENGINEERS

Donald R. Preisler, Partner
Arizona Registration No. 2501

DRP/lc

REPORT SUPPLEMENT TO

INVESTIGATION OF NORTH PHOENIX MOUNTAINS FLOOD DETENTION BASINS

CITY OF PHOENIX

ARIZONA

1973

JOHN CAROLLO ENGINEERS

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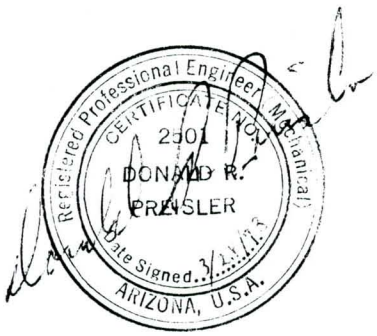
PLATES

Appendix



REPORT SUPPLEMENT TO

INVESTIGATION OF NORTH PHOENIX MOUNTAINS FLOOD DETENTION BASINS

CITY OF PHOENIX, ARIZONA

1973

SCOPE OF REPORT

The purpose of this Report is to study additional flood detention basin sites for regulation of surface runoff from the higher elevations in the Phoenix Mountains due to a 100-year design storm. Release of impounded water is to be controlled by fixed openings at outlets from each basin for discharge at rates suitable to existing downstream channel capacity. For storms greater than the 100-year recurrence, an emergency spillway is to be provided with freeboard capacity sufficient to pass the maximum probable storm runoff. Sites for flood detention basins are to be selected by field reconnaissance in conjunction with aerial photographs and the use of two-foot contour topography maps at the scale of one inch equals one hundred feet. Landscaping is to be considered in each plan of improvement. Reservoir ponding areas are to be defined and the land areas required for each project determined. Estimates of cost will be prepared for each basin and shall include the costs for land, construction, and landscaping.

DETENTION BASIN LOCATIONS

Investigations for detention basins in the Phoenix Mountains have been made at the following locations:

Basin No. 2c 7th Street and Thunderbird Road

Basin No. 5a 7th Street and Peoria Avenue

The various watersheds have been indicated on a map of the North Phoenix Mountains area included on the following page as Plate 1 of this Report. Also shown are the watershed locations of City of Phoenix Basin No. 1 (design complete status) and Dreamy Draw Detention Basin, now under construction.

CRITERIA FOR DESIGN

Soil Conservation Service criteria and procedure are to be applied in the design of each detention basin. Where failure of an earth dam could result in loss of human life or serious damage to buildings and important public utilities, the Soil Conservation Service has established, in memorandum form, the following requirements:

Basin Design Feature	Requirement
a. Sediment storage	Provide for 100-year accumulation below the principal spillway
b. Storage capacity and principal spillway	Regulate 6-hour 100-year storm runoff
c. Emergency spillway	Provide for peak flow from 6-hour precipitation determined by formula $P = P_{100} + 0.26(PMP - P_{100})$
d. Emergency spillway freeboard	Provide for peak flow from 6-hour probable maximum precipitation

For design of the basins, in this study, no sediment storage has been provided below the principal spillway. This step avoids extended ponding of water which can be an attractive nuisance. A surveillance and maintenance program will be required to ascertain and remove any excess accumulation of sediments.

Thunderbird Road
Sweetwater Street
Cactus Road
Peoria Avenue
Shea Blvd.
Mountain View Road
Hatcher Road
Dunlap Avenue
Northern Avenue
Arizona Canal
Cave Creek
PHOENIX MOUNTAIN PRESERVE
PARK DRIVE
FUTURE PARK
NORTH MOUNTAIN PARK
FUTURE PHOENIX MOUNTAIN PRESERVE DRIVE
PHOENIX MOUNTAIN PRESERVE FREEWAY
FUTURE DREAMY DRAW SERVICE CENTER
DREAMY DRAW LOCATION
7th Street
16th Street
19th Avenue
7th Avenue
Central Avenue
7th Avenue
24th Street
28th Street
32nd Street
36th Street
Avenue
Road
ST.
1
2
3
4
5a
6

BASIN LOCATION MAP

0 1 2 3 4
THOUSANDS OF FEET

WATERSHED AREA
DETENTION BASIN NO.

ONLY SHADED WATERSHEDS HAVE BEEN ANALYZED IN THIS REPORT

PLATE NO. 1

JOHN CAROLLO ENGINEERS
PHOENIX ARIZONA · LAFAYETTE CALIFORNIA · SANTA ANA CALIFORNIA
JOHN A. CAROLLO, P.E. (1906-1971)
H. HARVEY HUNT, P.E.
HOWARD M. WAY, P.E.
ROBERT G. WILLIAMS, P.E.
DONALD R. PREISLER, P.E.

CITY OF PHOENIX, ARIZONA
NORTH PHOENIX MOUNTAIN
FLOOD DETENTION BASIN LOCATIONS

DESIGNED	CHECKED	DATE		DRAWING NO.	SHEET
J.H.S.		★			No. OF
DRAWN	TRACED	REVISED			
R.A.G.					

The Los Angeles County Flood Control District has planned and developed a notable flood control system over the past forty years. Detention dams and major channels were designed to contain the runoff from a storm equivalent to a fifty-year frequency while the local storm drain network was designed for the runoff from a ten-year frequency storm. These design criteria were established to achieve a balance between the necessity of flood protection works and their considerable cost.

HYDROLOGICAL DATA

Since stream flow measurements are not available for these small desert watersheds, estimation of runoff will be based upon rainfall determined from U.S. Weather Bureau Precipitation Records and Maps. The following table summarizes in brief the general relation of precipitation magnitude for the area of study versus frequency of occurrence for storms of various duration.

PHOENIX MOUNTAINS PRECIPITATION - INCHES

Storm Duration	Recurrence Interval 10 Years	25 Years	50 Years	100 Years	Observed Maximum	Probable Maximum
1-Hour[1]	1.6	1.9	2.2	2.4	3.0[2]	13.0[3]
3-Hour[4]	1.8	2.1	2.5	2.7	3.5[4]	15.3[4]
6-Hour[5]	2.0	2.4	2.8	3.1	4.0[4]	18.0[3]
24-Hr[5]	2.4	2.9	3.4	3.8	5.0[3]	23.0[3]
10-Day[6]	5.4	7.0	7.8	8.3	-	-

(1) Technical Paper No. 40 - U.S. Weather Bureau, 1961
(2) U.S. Weather Bureau, Tempe, Arizona, Sept. 14, 1969
(3) Technical Paper No. 38 - U.S. Weather Bureau, 1960
(4) JCE interpolation - T.P. No. 40, U.S. Weather Bureau
(5) Precipitation Maps - U.S. Weather Bureau, SCS (AHD Rev. 1970)
(6) Technical Paper No. 49 - U.S. Weather Bureau, 1964

SURFACE RUNOFF

Examination of the Phoenix Mountains watersheds reveals the upper slopes and hills to be steep and rocky while the lower slopes and valleys are caliche cemented talus through which drainage channels are deeply cut. Reference to the Soil Conservation Service "General Soil Map of Maricopa County" indicates the water sheds to be rock outcroppings, stony mountainous soils on steep slopes, and recent alluvial soil with conservative infiltration rates of 0.05 to 0.15 inch per hour. For this study a surface runoff factor (SCS - curve number) of 91 has been selected after consideration of the slopes, soil types, and ground cover.

SEDIMENT

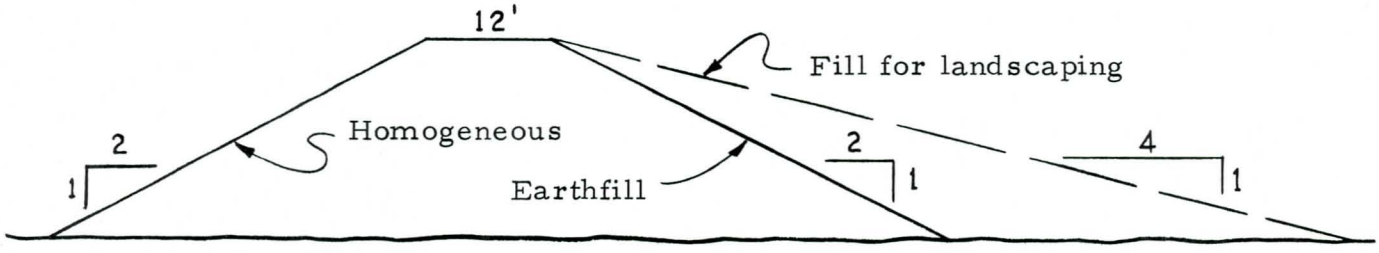
Investigations of silt accumulation have been made for several reservoirs in Arizona. Results of these studies are noted below in terms of average accumulation per year. Also included are average sediment accumulation values applied in designated project design reports.

SEDIMENT ACCUMULATION TABLE

Location	Period	Rate Ac-Ft per Sq Mile per Year
1. San Carlos Reservoir - Gila River	1928-37	0.18
	1937-47	0.37
2. Roosevelt Lake - Salt River	1925-35	0.15
	1935-39	0.85
	1939-46	0.42
3. Little Box Canyon Reservoir - Mineral Creek	1952-67	0.27
4. Magma No. 1 near Florence	1948-59	0.15
Magma No. 2 near Florence	1954-59	0.15
Magma No. 3 near Florence	1949-59	0.03
5. Big Horn Mountain Tank No. 1 near Tonopah	1960-64	0.11
Big Horn Mountain Tank No. 2 near Tonopah	1960-64	0.11
6. Guadalupe south of Tempe	Design Report	0.13
7. Trilby Wash near Beardsley	Design Report	0.20
8. Santa Rosa Wash near Casa Grande	Design Report	0.20
9. Sands Draw Detention Dam near Safford	Design Report	0.15

STANDARD SECTION FOR FLOOD DETENTION DAM

In this study the typical cross section illustrated below summarizes simply the results of preliminary design for development of cost estimates. In general, the crest of an earth dam acts as a single lane roadway and, for ease of construction with power equipment, should be not less than twelve feet in width. The upstream and downstream slopes of 2 : 1 are typical of small homogeneous flood control dams on an impervious foundation. To permit landscaping, the downstream slope has been modified to 4 : 1 and the cost thereof included as a separate item. The total height of embankment includes the ponding depth resulting from routing of the one hundred-year, six-hour storm runoff, plus three feet for the emergency spillway hydrograph peak discharge, plus three feet for freeboard in the spillway channel.



EMBANKMENT SECTION

LANDSCAPING

Considering the location of these detention basins in a water deficient area adjacent to the Phoenix Mountain Preserve where mountain forms a desert vistas are to be preserved, we recommend that desert landscaping be adopted. This can be achieved through the protection, salvage, and relocation of existing desert plants with some supplemental planting during construction. Natural revegetation can be expected to complete restoration of desert cover.

Placement of additional uncompacted fill on the downstream slope as a landscaping measure could lessen the public awareness of detention basin embankments. Modification of the slope increases the embankment volume and area requiring landscape treatment. A policy will have to be established regarding landscape fill placement. In this Report for estimating purposes a uniform fill to a 1:4 slope has been used. Should exotic landscaping be considered, costs of various elements are approximated as follows:

Nursery stock and planting	$2,500 per acre
Water distribution system	$7,500 per acre
Maintenance and water	$1,000 per acre per year

DOWNSTREAM CHANNELS

Field inspection was made of the existing downstream flood channels. These are typically desert shrub lined, sand, rock, and caliche bottom courses encroached upon by some structures, fill material, and trash. The capacity of the channels downstream of Basin No. 5a exceeds 20 cubic feet per second, and the capacity downstream of Basin No. 2c exceeds 60 cubic feet per second. Principal spillways have been considered individually in this Report.

SOIL CONSERVATION SERVICE DESIGN PROCEDURE

For orderly computation a hydraulic design data sheet was prepared for tabulation of watershed physical and computed characteristics. This form and a copy of the Soil Conservation Service Design Hydrograph Computation Sheet used in computing Principal Spillway, Emergency Spillway, and Emergency Spillway Freeboard Hydrographs are included in the Appendix.

The Principal Spillway Hydrograph for this study has been computed for a six-hour one hundred-year storm runoff utilizing the Soil Conservation Service Emergency Spillway dimensionless hydrograph procedure outlined in Chapter 21, Section 4, Hydrology of the National Engineering Handbook. The capacity of the reservoir was then determined by routing the hydrograph flow through the reservoir and orifice controlled outlet to ascertain the storage and emergency spillway level and time required for the reservoir to drain. Orifice size was selected after field inspection of the downstream channel and consideration of the orifice head-discharge capacity.

Design of the emergency spillway is based upon the peak discharge of the Emergency Spillway Hydrograph computed by Soil Conservation Service procedure and the six-hour design minimum precipitation computed by the formula:

$$P = P_{100} + 0.26(PMP - P_{100})$$

Width of the spillway is determined assuming three feet of available head at the channel inlet and computing the width for critical depth at the control section. In this design, since the channels are not overly long, the grade of the spillway can be level.

The Emergency Spillway Freeboard Hydrograph is also constructed following the Soil Conservation Service dimensionless hydrograph procedure by utilizing the Probable Maximum Precipitation. From the peak hydrograph discharge and the width of the spillway, total depth of flow is computed as the minimum height of the detention dam embankment above the spillway channel.

A summary of references, applicable design curves, and six-hour precipitation maps utilized in design of detention basins in this Report appear in the Appendix.

PRINCIPAL SPILLWAY – CONTROLLED OUTLET

This structure is composed of three elements: a large trash rack surrounding a rectangular steel orifice plate bolted to the inlet headwall for a 27-inch outlet pipe laid to a grade greater than critical slope at maximum head. Advantages include the generally vandal-proof system, orifice control independent of pipe length which can be altered, and a discharge pipe suitable for inspection and repair. This sytem was devised for use at the Shaw Butte Detention Dams (Basin No. 1) and has been adopted in this Report.

EMERGENCY SPILLWAY

Each basin must have an emergency spillway to prevent overtopping and failure of the embankment section due to runoff from the maximum probable storm. The structure is generally an excavated section all in natural ground. However, at the Phoenix Mountains sites studied in this Report, there was not a section suitable for a spillway in natural ground and a concrete lined trapezoidal section in the embankment was used as the emergency spillway.

DETENTION BASIN ANALYSIS

BASIN NO. 2c: 7TH STREET AND THUNDERBIRD ROAD: In the previous Report on this site the water shed area was divided in two. For this Report the site was selected for a dam running parallel to Thunderbird Road to 7th Street and then southerly, parallel to 7th Street. This dam will control runoff from one hundred percent of the basin whereas the previous dam design of two detention basins would control runoff from only ninety-one percent of the basin. Part of the land required is State-owned and part is privately owned. The site for Basin No. 2c is shown on Plate 2.

BASIN NO. 5a: 7TH STREET AND PEORIA AVENUE: Field reconnaissance indicated one possible site for the detention basin. This site, as shown on Plate 3, was chosen in conjunction with the possible extension of Peoria Avenue from 12th Street to 7th Street. The natural contours enclosed by the embankment provide the necessary storage to control runoff from the six-hour, one hundred-year storm. Land required for this detention basin is privately owned.

On the following pages are included design data summary, estimate of costs, and preliminary design drawing of each detention basin in numerical order. The basin designated No. 1, not a part of this Report, has been investigated and designed by the City of Phoenix. Approval to construct the two detention basins has been received from the Arizona Water Commission.

DESIGN DATA SUMMARY

DETENTION BASIN NO. 2c, 7th Street and Thunderbird Road

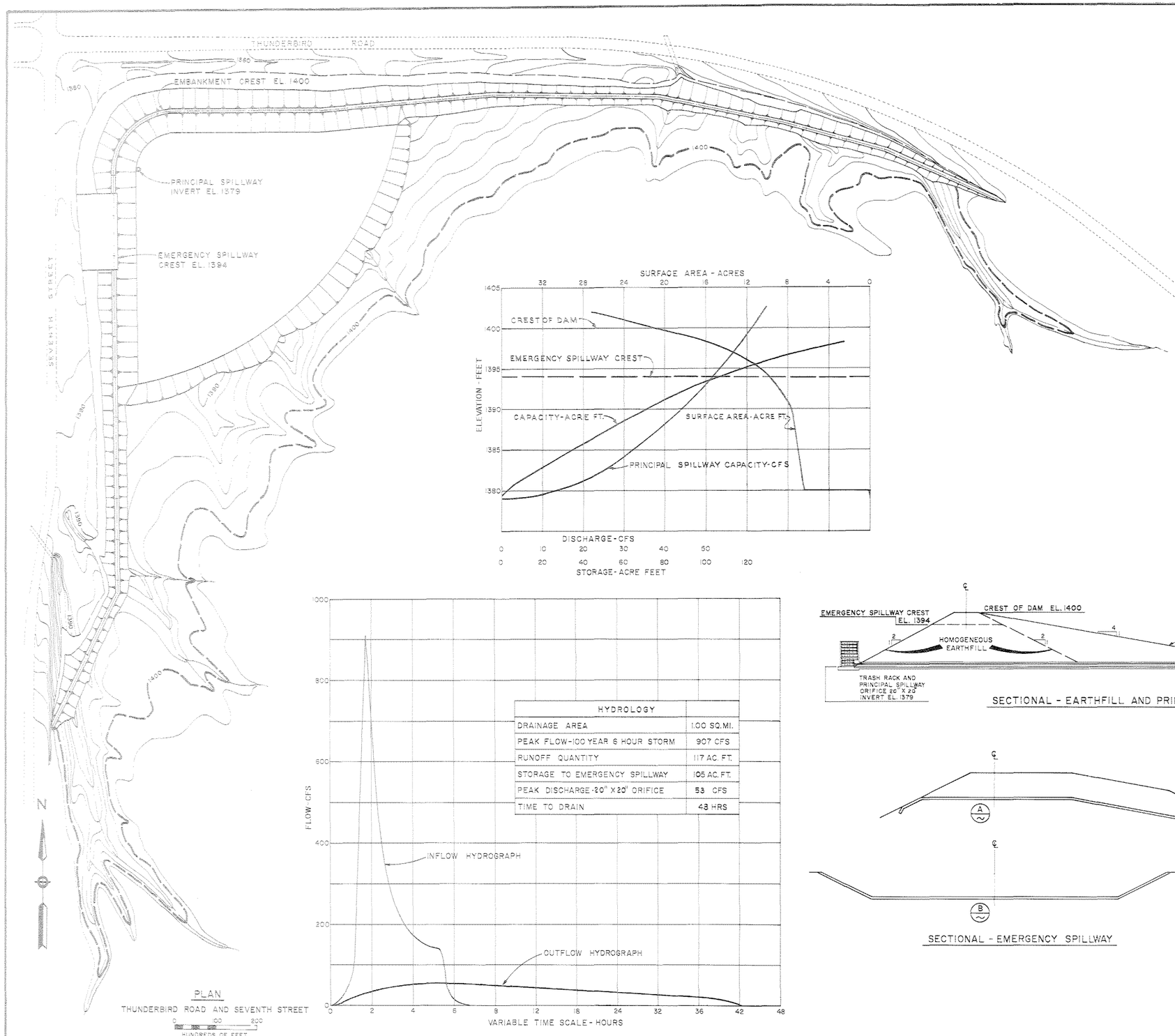
Item	Unit	Total
Class of Structure	-	C
Drainage Area	Sq Mi	1.00
Average Area Slope	%	9.3
Width Factor	-	0.89
Curve No. (1-day) (AMC II)	-	91
T_c	Hrs	0.38
Elevation: Top of Dam	Ft	1400
Crest Emergency Spillway	Ft	1394
Invert Principal Spillway	Ft	1379
Maximum Height of Dam	Ft	25
Crest Width	Ft	12
Volume of Embankment 2 : 1 Slopes	Cu Yds	50,600
Volume of Landscape Fill to 4 : 1 Slope	Cu Yds	17,500
Capacity		
Sediment - 100 Yrs @ 0.15 A-F/SM/Yr	Ac-Ft	15.0
Retarding Storage	Ac-Ft	125
Crest Contour	Ac-Ft	147
Surface Area		
Sediment Pool	Acres	0
Retarding Pool	Acres	13.5
Crest Contour	Acres	31.5
Principal Spillway		
Rainfall Volume (PSH) (areal)	Inches	3.1
Runoff Volume (PSH)	Inches	2.2
Capacity at Emergency Spillway Crest	cfs	45
Size of Orifice	Inches	20x20
Size of Conduit	Diam-In.	27
Minimum Slope of Conduit	Ft/Ft	0.016
Emergency Spillway		
Rainfall Volume (ESH) (areal)	Inches	7.0
Runoff Volume (ESH)	Inches	6.0
Soil Type	-	Caliche
Bottom Width	Ft	188
Velocity of Flow (V_e)	Ft/Sec	8
Slope of Exit Channel	Ft/Ft	Level
Maximum Water Surface Elevation	Ft	1397
Freeboard		
Rainfall Volume (FH) (areal)	Inches	18
Runoff Volume (FH)	Inches	17
Maximum Water Surface Elevation	Ft	1397

ESTIMATE OF COST - 1973

DETENTION BASIN NO. 2c, 7th Street and Thunderbird Road

No.	Item	Unit	Quantity	Unit Price	Cost*
1	Embankment	CY	50,600	$ 2.00	$101,200
2	Basin Excavation	CY	46,000	3.00	138,000
3	Spillway Construction	LS	1	57,600.00	57,600
4	Outlet Works	LS	1	9,000.00	9,000
	Basin Construction Cost				$305,800
5	Landscape Fill	CY	17,500	$ 1.50	$ 26,300
6	Desert Landscaping	Ac	2.8	1,000.00	2,800
7	Land Purchase	Ac	61	8,000.00	488,000
8	Incidental Costs 20% Items 1 through 6				66,500
	Total Project Cost				$889,400

* Figures are rounded.

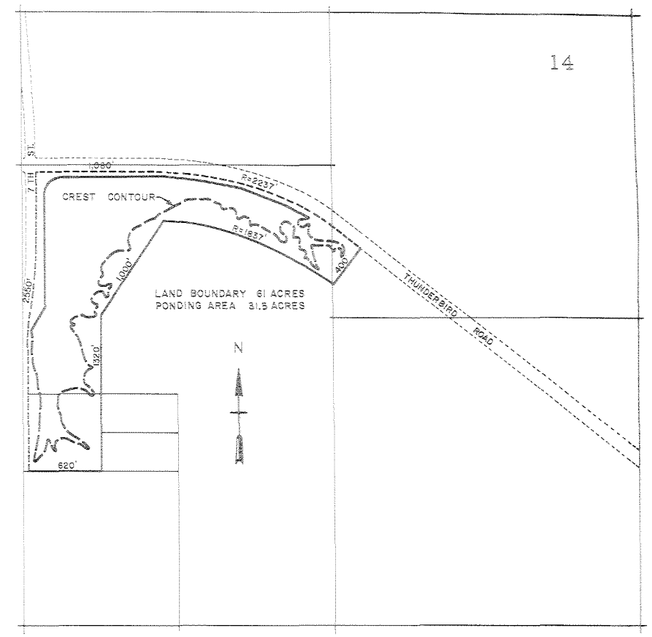


PLAN

THUNDERBIRD ROAD AND SEVENTH STREET

0 100 200

HUNDREDS OF FEET



LAND ACQUISITION MAP

0 500 1000 1500

HUNDREDS OF FEET

HYDROLOGY	
DRAINAGE AREA	1.00 SQ.MI.
PEAK FLOW-100 YEAR 6 HOUR STORM	907 CFS
RUNOFF QUANTITY	117 AC. FT.
STORAGE TO EMERGENCY SPILLWAY	105 AC. FT.
PEAK DISCHARGE-20" X 20" ORIFICE	53 CFS
TIME TO DRAIN	48 HRS

SECTIONAL - EARTHFILL AND PRINCIPAL SPILLWAY

SECTIONAL - EMERGENCY SPILLWAY

PLATE 2

JOHN CAROLLO ENGINEERS

PHOENIX ARIZONA · LAFAYETTE, CALIFORNIA · SANTA ANA, CALIFORNIA

CITY OF PHOENIX, ARIZONA
NORTH PHOENIX MOUNTAINS
FLOOD DETENTION BASIN NO. 2C

DESIGNED T.K.M.	CHECKED	DATE -73		DRAWING NO.	SHEET No.
DRAWN W.E.L.	TRACED	REVISED			

DESIGN DATA SUMMARY

DETENTION BASIN NO. 5a, 7th Street and Peoria Avenue

Item	Unit	Total
Class of Structure	-	C
Drainage Area	Sq Mi	0.35
Average Area Slope	%	9.4
Width Factor	-	0.89
Curve No. (1-day)(AMC II)	-	91
T_c	Hrs	0.32
Elevation: Top of Dam	Ft	1345
Crest Emergency Spillway	Ft	1339
Invert Principal Spillway	Ft	1329
Maximum Height of Dam	Ft	16
Crest Width	Ft	12
Volume of Embankment 2 : 1 Slopes	Cu Yds	30,800
Volume of Landscape Fill to 4 : 1 Slope	Cu Yds	12,600
Capacity		
Sediment - 100 Yrs @ 0.15 A-F/SM/Yr	Ac-Ft	5.3
Retarding Storage	Ac-Ft	43.0
Crest Contour	Ac-Ft	153.0
Surface Area		
Sediment Pool	Acres	0
Retarding Pool	Acres	12.7
Crest Contour	Acres	23.8
Principal Spillway		
Rainfall Volume (PSH) (areal)	Inches	3.1
Runoff Volume (PSH)	Inches	2.2
Capacity at Emergency Spillway Crest	cfs	15
Size of Orifice	Inches	12 x 12
Size of Conduit	Diam-In.	27
Minimum Slope of Conduit	Ft/Ft	0.002
Emergency Spillway		
Rainfall Volume (ESH) (areal)	Inches	7.0
Runoff Volume (ESH)	Inches	6.0
Soil Type	-	Caliche
Bottom Width	Ft	60
Velocity of Flow (V_e)	Ft/Sec	8
Slope of Exit Channel	Ft/Ft	Level
Maximum Water Surface Elevation	Ft	1342
Freeboard		
Rainfall Volume (FH) (areal)	Inches	18
Runoff Volume (FH)	Inches	17
Maximum Water Surface Elevation	Ft	1342

ESTIMATE OF COST - 1973

DETENTION BASIN NO. 5a, 7th Street and Peoria Avenue

No.	Item	Unit	Quantity	Unit Price	Cost*
1	Embankment	CY	30,800	$ 2.00	$ 61,600
2	Channel Excavation	CY	6,600	3.00	19,800
3	Spillway Construction	LS	1	13,800.00	13,800
4	Outlet Works	LS	1	9,000.00	9,000
			Basin Construction Cost		$104,200
5	Landscape Fill	CY	12,600	$ 1.50	$ 18,900
6	Desert Landscaping	Ac	2.1	1,000.00	2,100
7	Land Purchase	Ac	44.3	6,500.00	288,000
8	Incidental Costs 20% Items 1 through 6				25,000
			Total Project Cost		$438,200

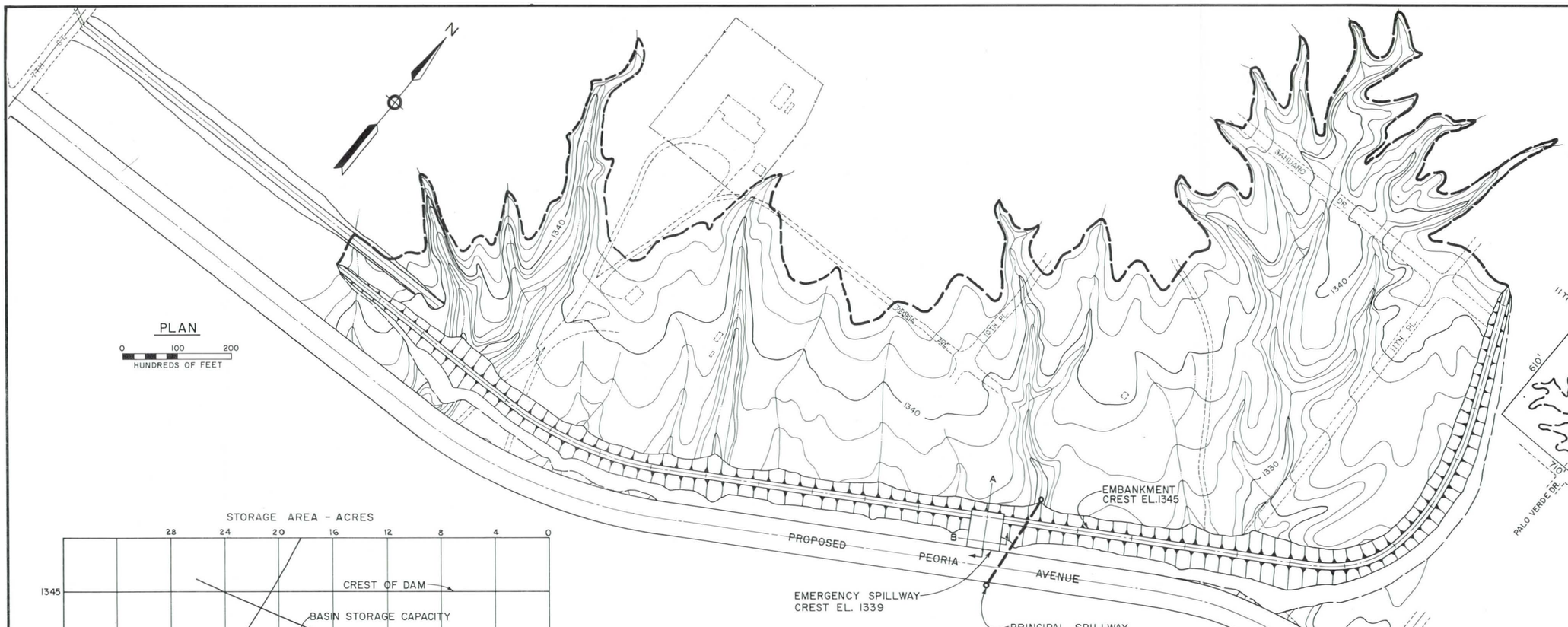
* Figures are rounded.

ESTIMATE OF COST - 1973

PEORIA AVENUE, 7th Street to 12th Street

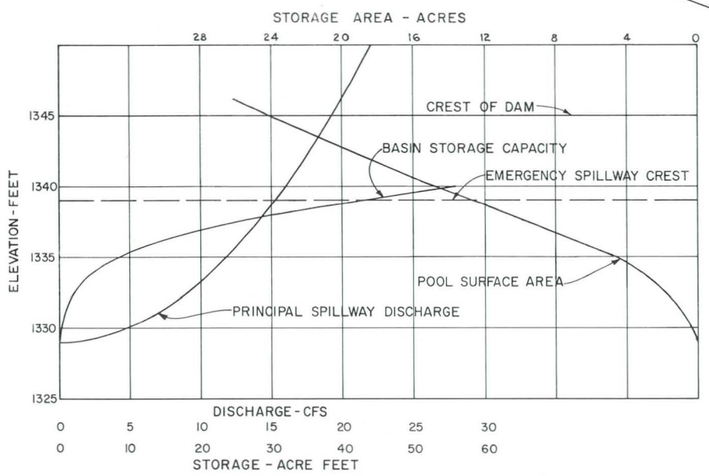
No.	Item	Unit	Quantity	Unit Price	Cost*
1	Earthwork	CY	3,900	$ 2.00	$ 7,800
2	Prepare Subbase	SY	11,100	0.30	3,300
3	Base Course	SY	11,100	1.70	18,900
4	Bituminous Paving	SY	11,100	2.25	25,000
5	Painting	LF	8,310	0.06	500
	Highway Construction Cost				$55,500
6	Land Purchase	Ac	1.8	$6,500.00	$11,700
7	Incidental Costs 20% Items 1 through 5				11,100
	Total Project Cost				$78,300

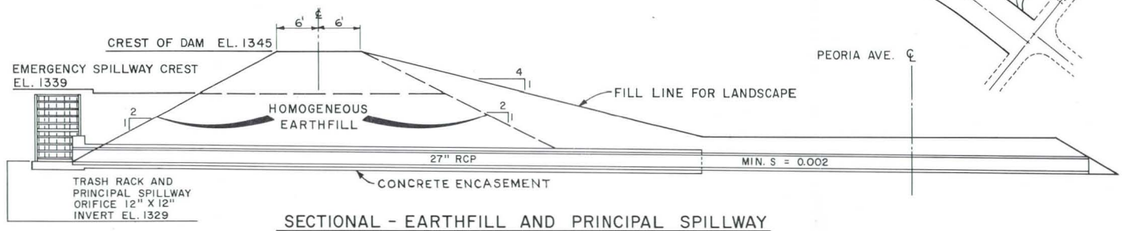
* Figures are rounded.



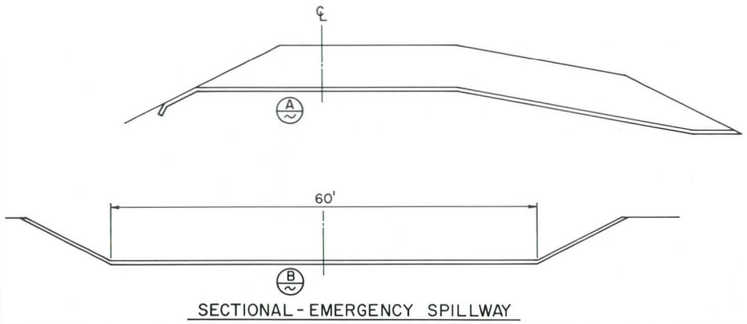
PLAN

0 100 200
HUNDREDS OF FEET

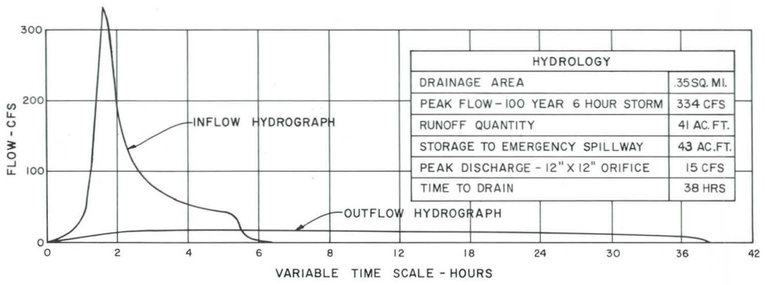




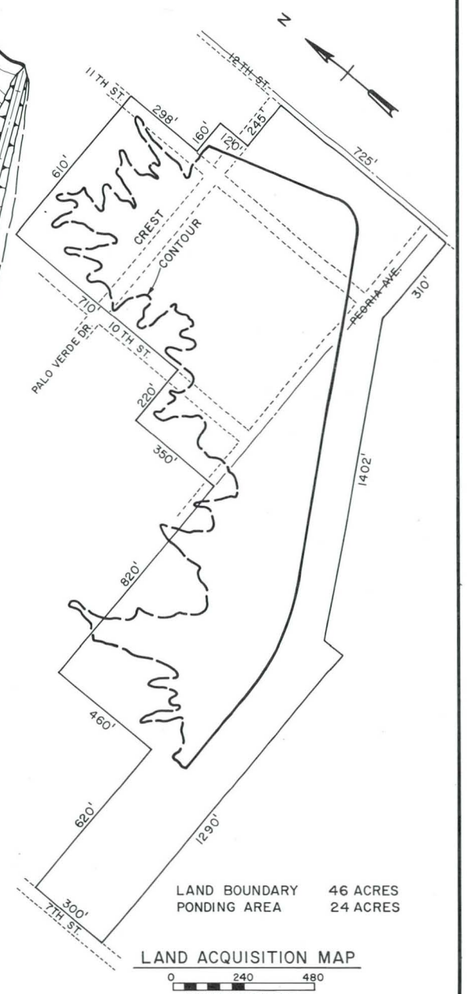
SECTIONAL - EARTHFILL AND PRINCIPAL SPILLWAY



SECTIONAL - EMERGENCY SPILLWAY



HYDROLOGY	
DRAINAGE AREA	35 SQ. MI.
PEAK FLOW - 100 YEAR 6 HOUR STORM	334 CFS
RUNOFF QUANTITY	41 AC. FT.
STORAGE TO EMERGENCY SPILLWAY	43 AC. FT.
PEAK DISCHARGE - 12" X 12" ORIFICE	15 CFS
TIME TO DRAIN	38 HRS



LAND BOUNDARY 46 ACRES
PONDING AREA 24 ACRES

LAND ACQUISITION MAP

0 240 480
HUNDREDS OF FEET

PLATE 3

JOHN CAROLLO ENGINEERS

PHOENIX ARIZONA LAFAYETTE CALIFORNIA SANTA ANA CALIFORNIA

JOHN A. CAROLLO (1908-1971)
JOHN W. DAY
HOWARD M. WAT
ROBERT G. WILLIAMS
DONALD R. PREISLER
GAIL P. LYNCH

CITY OF PHOENIX, ARIZONA
NORTH PHOENIX MOUNTAINS
FLOOD DETENTION BASIN NO. 5A

Designed T.K.M.	Checked	Date 1- -73		Drawing No.	Sheet No. Of
Drawn W.E.L.	Traced	Revised			

6/72 DIETERICH-POST 2112B .003 FILM

REPORT CONCLUSION

No cost benefit ratios have been determined in this study of detention basins located above developing residential and commercial properties in the City of Phoenix. Total costs for land, detention basin construction, and overall project including landscaping, engineering, and administration are summarized as follows:

Detention Basin Number	Watershed Area Acres	Ponding Area Acres	Land Cost	Construction Cost	Project Cost
2c	640	19	$488,000	$305,600	$889,400
5a	224	24	288,000	104,200	438,200
5a *	224	24	299,700	159,700	516,500

Examination of the cost tabulation indicates land to be the major cost item and that the utilization thereof should be increased. This was done in the solution for Detention Basin No. 2c by excavating material from the retarding basin area. Cost reduction may result from a decrease in the land area and quantity of embankment required, but design is dependent upon the determination of adequate quantities of material suitable for embankment within the retarding basin area.

* Includes cost of Peoria Avenue construction.

APPENDIX

REFERENCES

1. National Engineering Handbook, Soil Conservation Service. Section 4, Hydrology, January 1971

2. U.S. Weather Bureau, Precipitation Maps Prepared for Soil Conservation Service, 1967, Revised 1970, obtained from reference No. 6 below

3. U.S. Weather Bureau, Technical Paper No. 38, Generalized Estimates of Probable Maximum Precipitation for the United States West of the 105th Meridian

4. Storm Drainage Report for Maricopa Association of Governments, 1970, Yost and Gardner Engineers.

5. Design of Small Dams, U.S. Bureau of Reclamation, First Edition, 1960

6. Hydrologic Design for Highway Drainage, Arizona Highway Department, Bridge Division, including 1970 Revised Weather Bureau Precipitation Maps

7. Hydrology of Spillway Design, Journal of Hydraulic Division, ASCE, May 1964, p. 235

8. Los Angeles County Flood Control System,Civil Engineering, ASCE, January 1970

9. Flood Control Planning in Arizona, 14th Annual Arizona Watershed Symposium, Proceedings September 1970

10. Summary of Reservoir Sediment Deposition Surveys U.S. Department of Agriculture Miscellaneous Publication No. 1143.

HYDROLOGIC DESIGN DATA SHEET

SOIL CONSERVATION SERVICE METHOD

LOCATION DATA:

Place _____ County _____

Location _____

Project No. _____

Watershed _____

DESIGN DATA:

Design Storm	_____	year
Drainage Area	_____	square miles
Drainage Length	_____	feet
Average Area Width	_____	feet
Width Factor	_____	
Elevation		
Top of Drainage Area	_____	feet
At Structure	_____	feet
Drainage Area Slope	_____	percent
Time of Concentration	_____	hour
Vegetative Cover Type	_____	
Vegetative Cover Density	_____	percent
Soil Group	_____	
Curve Number	_____	
Antecedent Moisture Condition	_____	
Precipitation		
P = 6-hour 100-year	_____	inches
$P = P_{100} + 0.26(PMP-P_{100})$	_____	inches
P = 6-hr Probable maximum	_____	inches

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Rev. (2 - 66)

DESIGN HYDROGRAPH COMPUTATION

DATE _____
COMPUTED BY _____
CHECKED BY _____

WATERSHED OR PROJECT _____

STATE _____

STRUCTURE SITE OR SUBAREA _____

DR. AREA _____ SQ. MI. STRUCTURE CLASS _____

T_c _____ HR. STORM DURATION _____ HR.

POINT RAINFALL _____ IN.

ADJUSTED RAINFALL:

AREAL : FACTOR _____ IN. _____

DURATION : FACTOR _____ IN. _____

RUNOFF CURVE NO. _____

Q _____ IN.

HYDROGRAPH FAMILY NO. _____

COMPUTED T_p _____ HR.

T_o _____ HR.

(T_o / T_p):

COMPUTED _____ ; USED _____

REVISED T_p _____

$q_p = \frac{484A}{\text{REV. } T_p} =$ _____ CFS.

$(Q \times q_p) =$ _____ CFS.

t(COLUMN) = (t / T_p) REV. T_p q(COLUMN) = $(q_c / q_p) \times Q \times q_p$

Q(COLUMN) = $(Q_t / Q) Q$

	$t = (t/T_p)$Rev. T_p	$q = (q_c/q_p) \times Q \times (q_p)$	$Q_t = (Q_t / Q) Q$
	t . . HOURS	q CFS	Q INCHES
1	0	0	0
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3			
4			
5			
6			
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USDA-SCS HYATTSVILLE MD

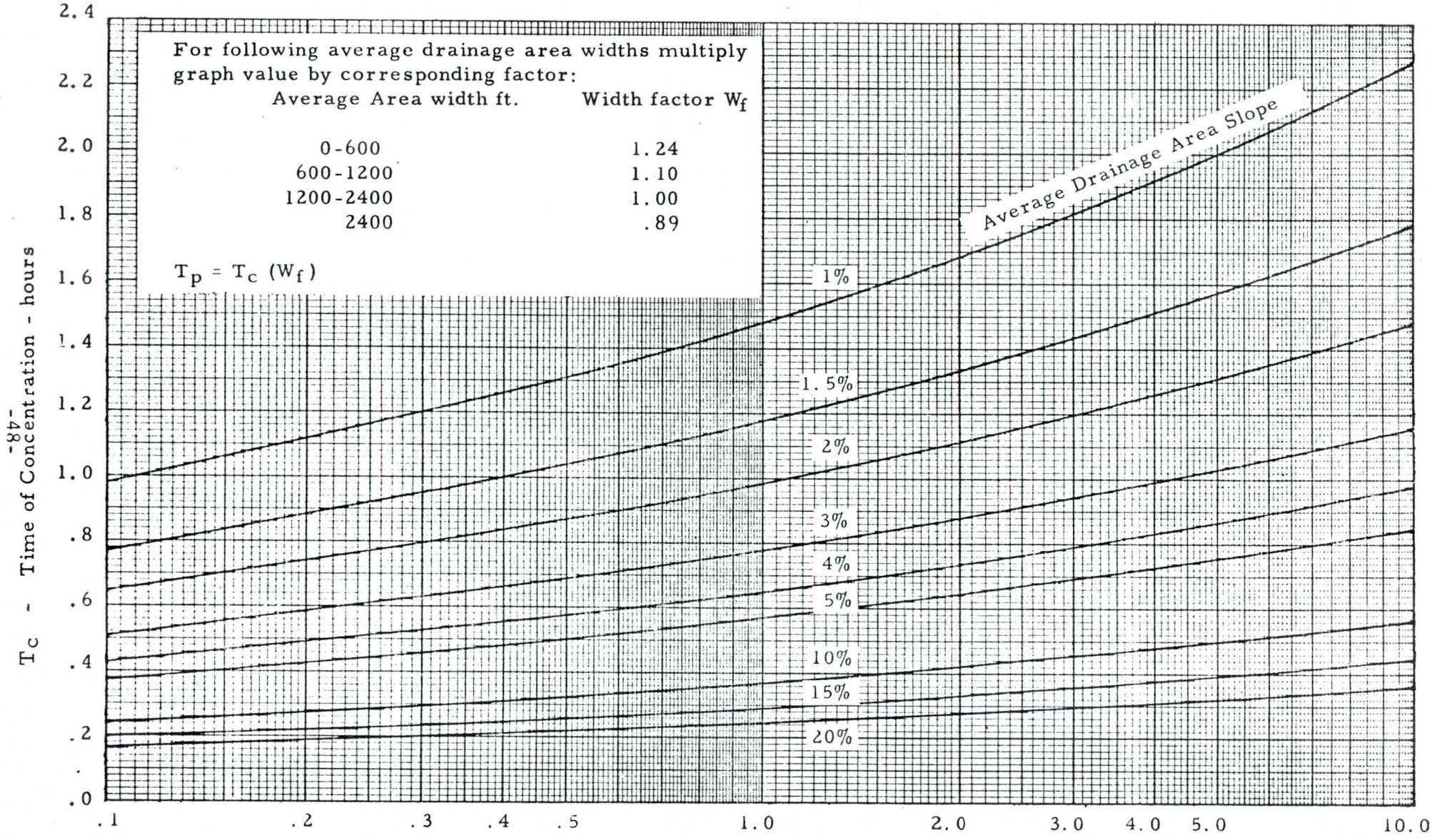
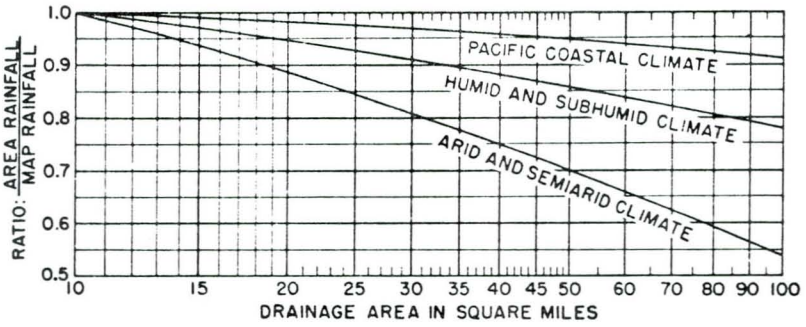


Fig. 2-5

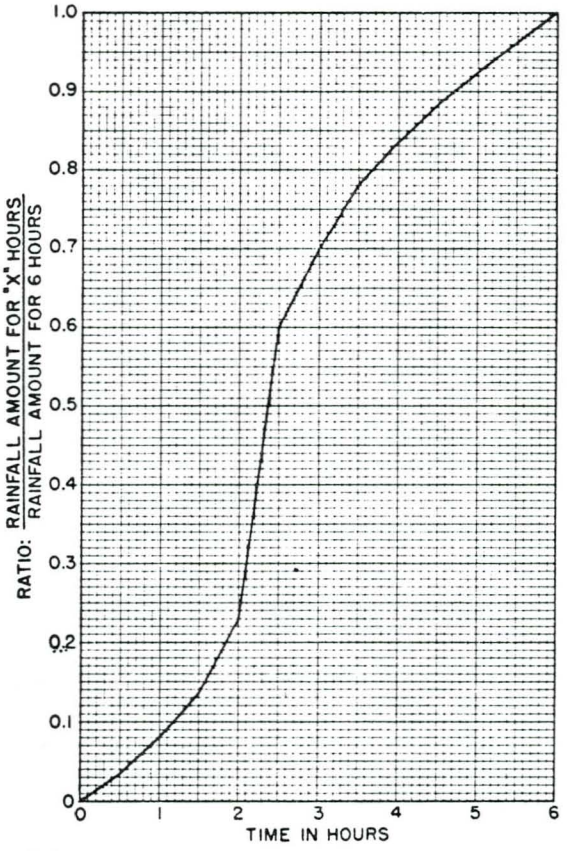
TIME OF CONCENTRATION
FOR
DRAINAGE AREAS LESS THAN 10 SQ. MILES

Soil Conservation Service
A.H.D.Hydraulic Design

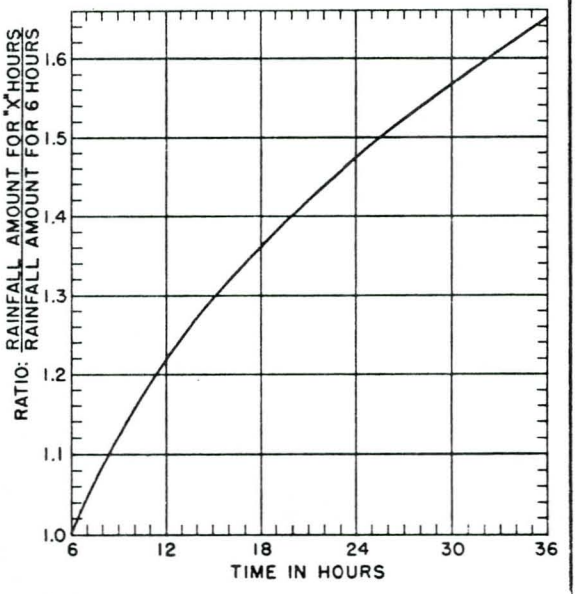
HYDROLOGY: CRITERIA FOR DESIGN STORMS USED IN DEVELOPING EMERGENCY SPILLWAY DESIGN AND FREEBOARD HYDROGRAPHS



(a) RAINFALL RATIOS FOR DRAINAGE AREAS OF 10 TO 100 SQUARE MILES



(b) SIX HOUR DESIGN STORM DISTRIBUTION



(c) RELATIVE INCREASE IN RAINFALL AMOUNT FOR STORM DURATIONS OVER SIX HOURS

FIGURE 21.2

REFERENCE	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - CENTRAL TECHNICAL UNIT	STANDARD DWG. NO. ES-1003 SHEET 1 OF 1 DATE 7-2-56 REVISED 9-10-63

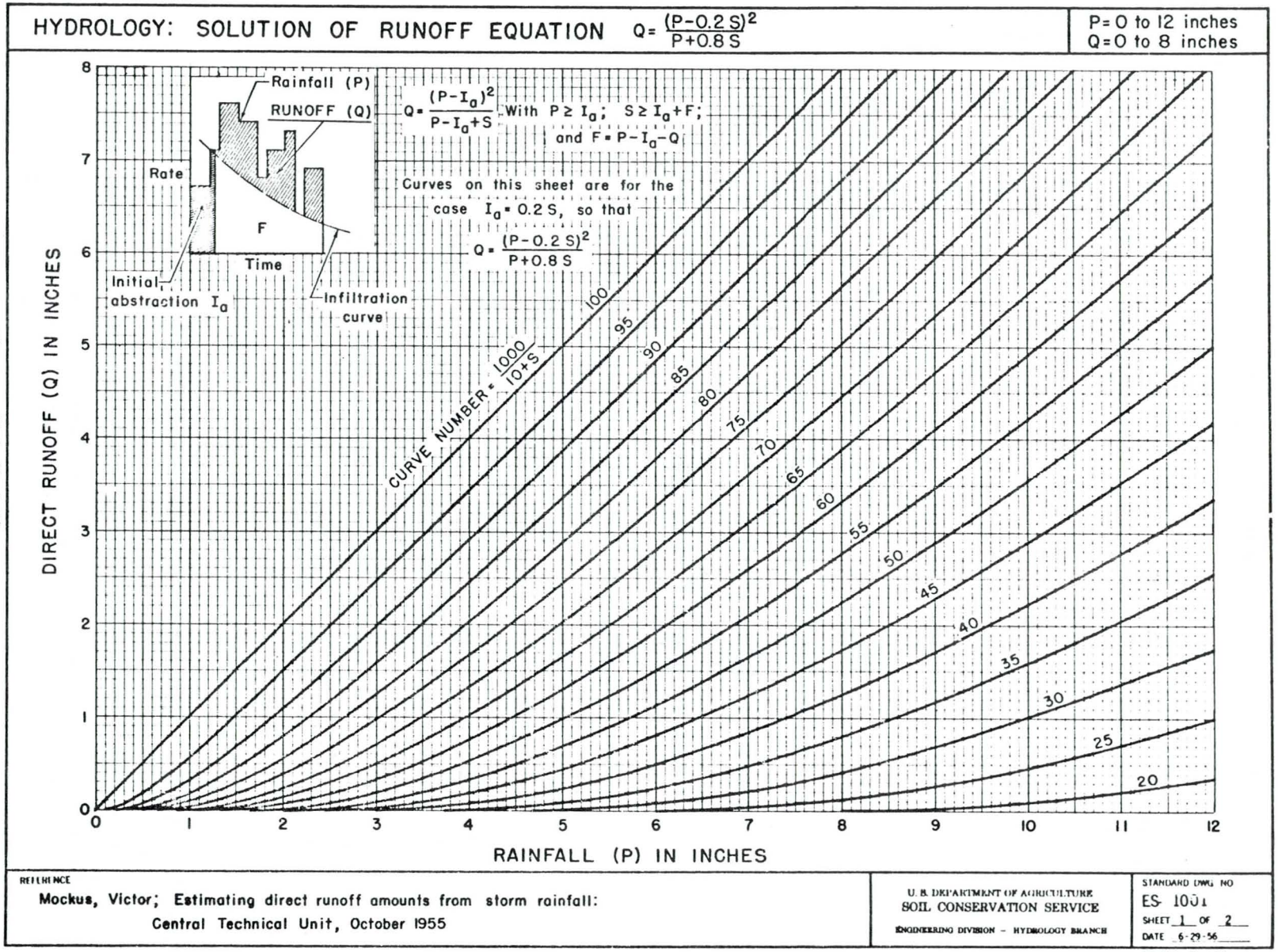


Figure - 10.1 (1 of 2)

REFERENCE

Mockus, Victor; Estimating direct runoff amounts from storm rainfall: Central Technical Unit, October 1955

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION – HYDROLOGY BRANCH

STANDARD DWG NO
ES- 1001
SHEET 1 OF 2
DATE 6-29-56
REVISED 10 1 64

HYDROLOGY: SOLUTION OF RUNOFF EQUATION $Q=\frac{(P-0.2S)^2}{(P+0.8S)}$

P=8 to 40 inches
Q=0. to 40 inches

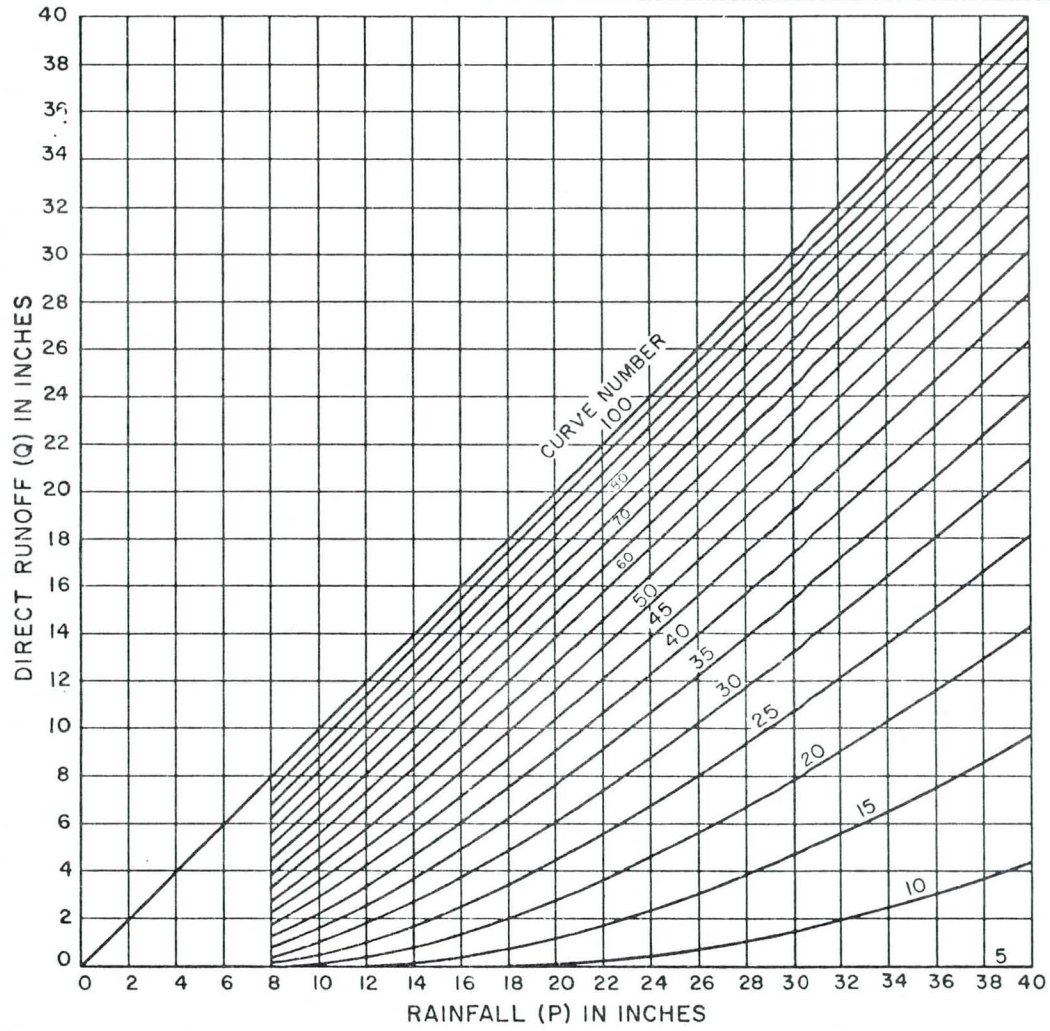


Figure 10.1 (2 of 2)

REFERENCE

Mockus, Victor; Estimating direct runoff amounts from storm rainfall: Central Technical Unit, October 1955.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ENGINEERING DIVISION – HYDROLOGY BRANCH

STANDARD DWG. NO.
ES- 1001
SHEET 2 OF 2
DATE 6 27 56

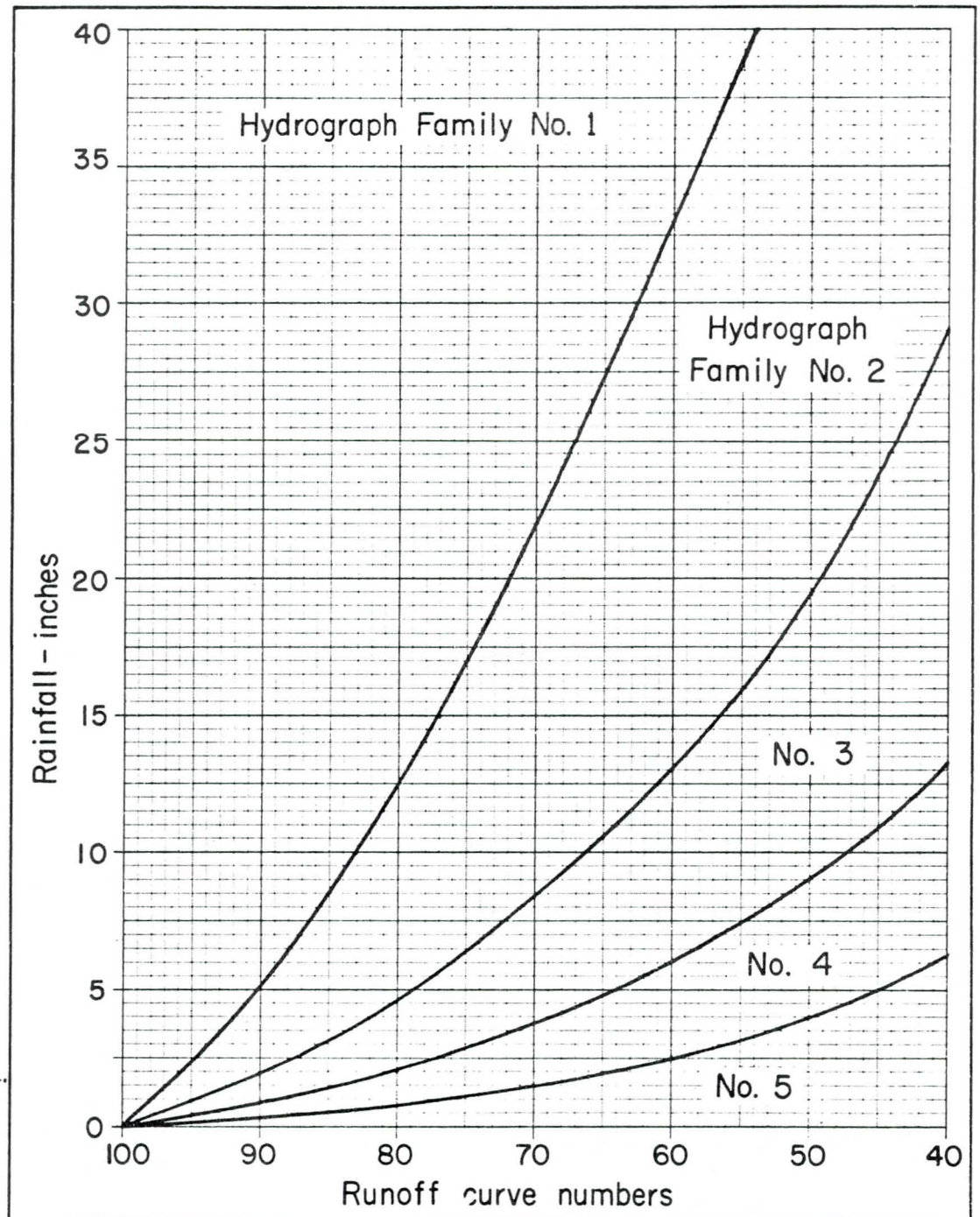
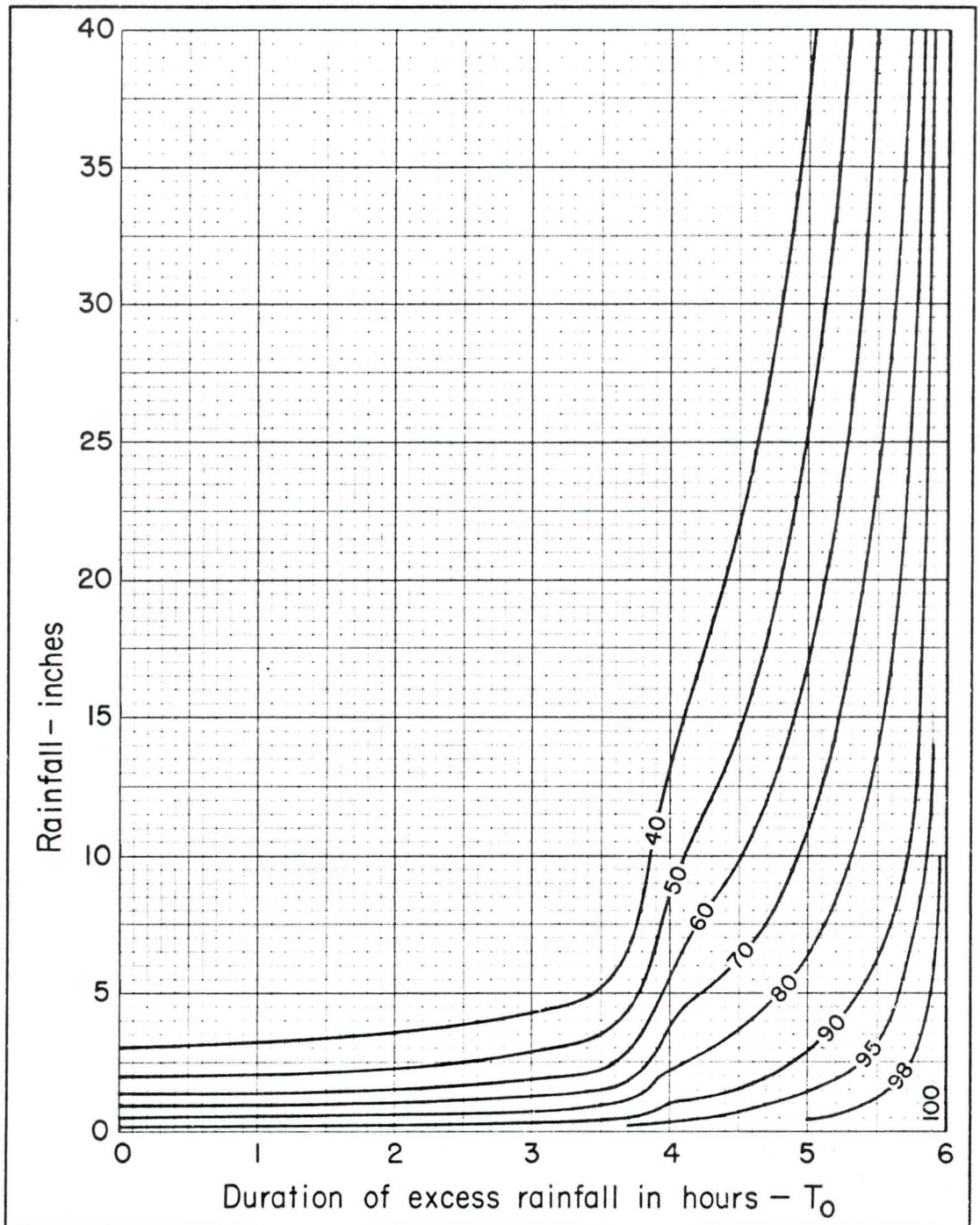


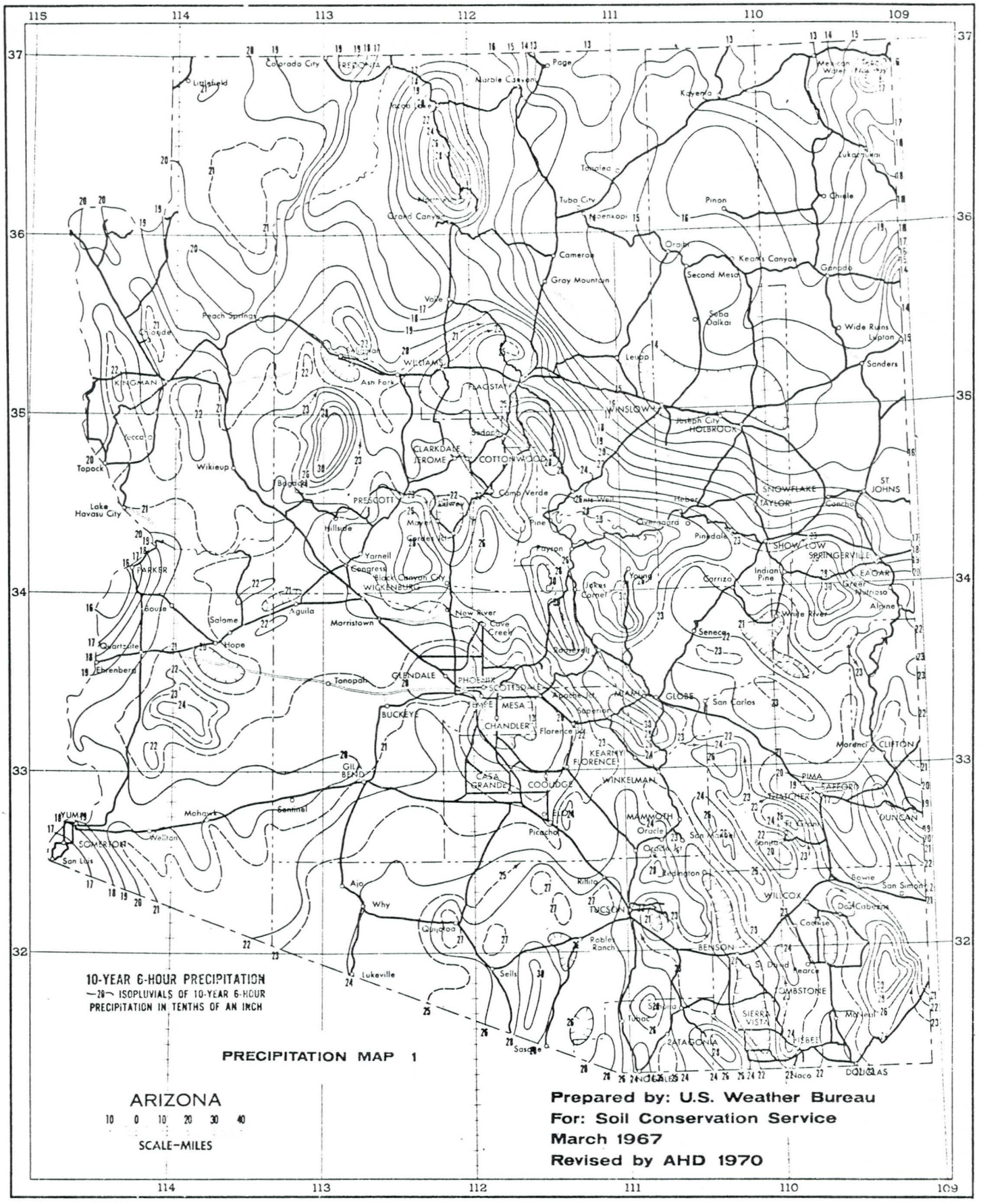
FIGURE 21.3 – Chart for selecting a hydrograph family for a given 6-hour rainfall and runoff curve number.



REFERENCE CENTRAL TECHNICAL UNIT	U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE ENGINEERING DIVISION - HYDROLOGY BRANCH	STANDARD DWG. NO. ES- 1012 SHEET 1 OF 1 DATE 2-14-58

REVISED 10-12-64

FIGURE 21.4 – Duration of excess rainfall for runoff curve numbers 40 to 100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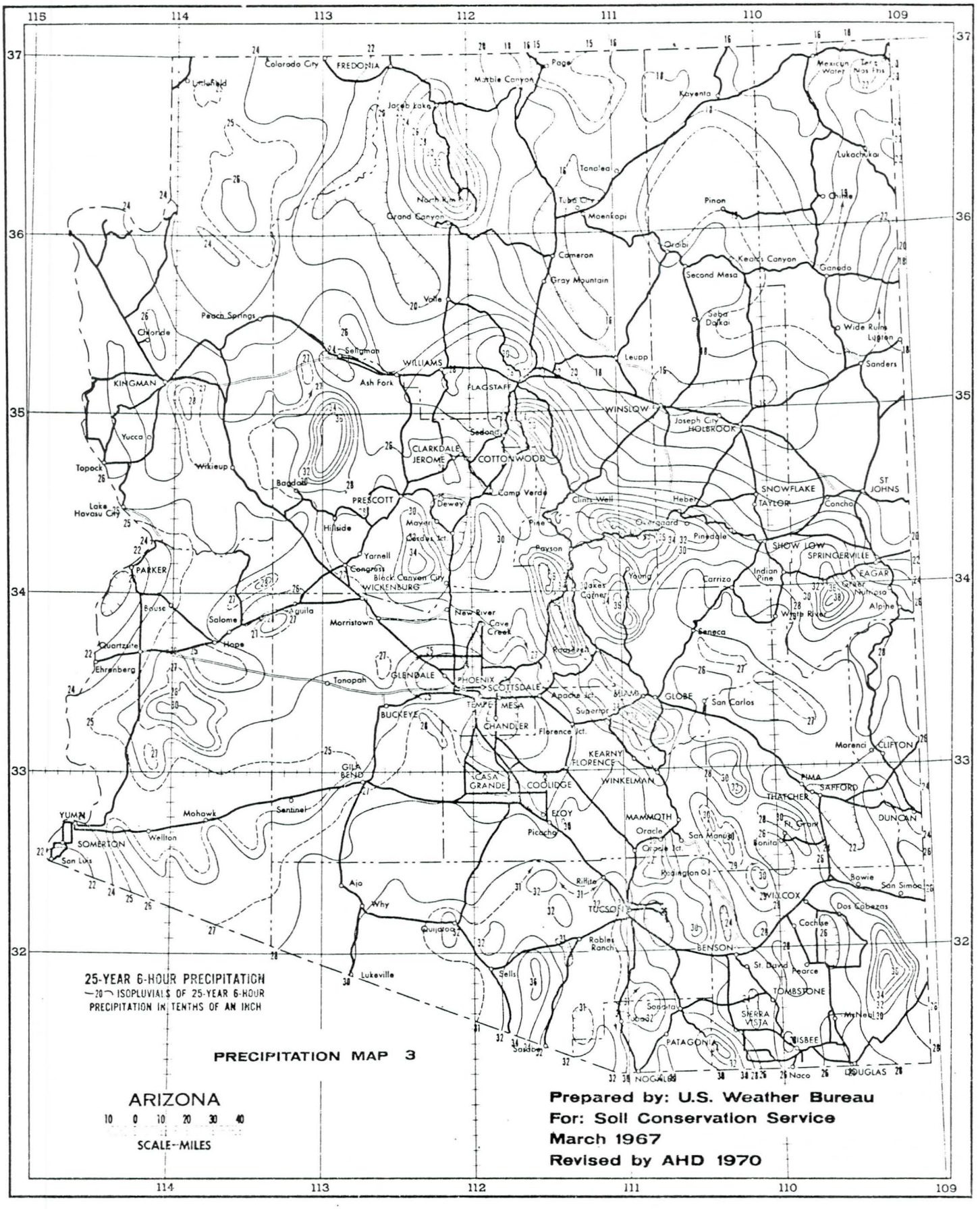
10-YEAR 6-HOUR PRECIPITATION
—20— ISOPLUVIALS OF 10-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 1
ARIZONA
10 0 10 20 30 40
SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970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Tuba City
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Grand Canyon
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Cameron
Gray Mountain
Orabi
Keams Canyon
Ganado
Second Mesa
Valle
Peach Springs
Seligman
Chloride
WILLIAMS
Ash Fork
FLAGSTAFF
Leupp
Seba Dalkai
Wide Ruins
Lupton
Sanders
KINGMAN
Yucca
WINSLOW
Joseph City
HOLBROOK
Sedona
CLARKDALE
JEROME
COTTONWOOD
Topock
Wikieup
Baddoo
PRESCOTT
Dewey
Camp Verde
Clints Well
Heber
SNOWFLAKE
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Cordes Jct.
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Indian Pine
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Cave Creek
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Quartzsite
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YUMA
Mohawk
Sentinel
ELOY
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DUNCAN
SOMERTON
Wellton
Picacho
Oracle
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Bowie
San Simon
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Rillito
TUCSON
WILCOX
Dos Cabezas
Cochise
Quijotoa
Robles Ranch
BENSON
St. David
Pearce
Lukeville
Sells
TOMBSTONE
Sonoita
SIERRA VISTA
McNeal
PATAGONIA
BISBEE
Saxton
NOGALES
Naco
DOUGLAS
25-YEAR 6-HOUR PRECIPITATION
—20— ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 3
ARIZONA
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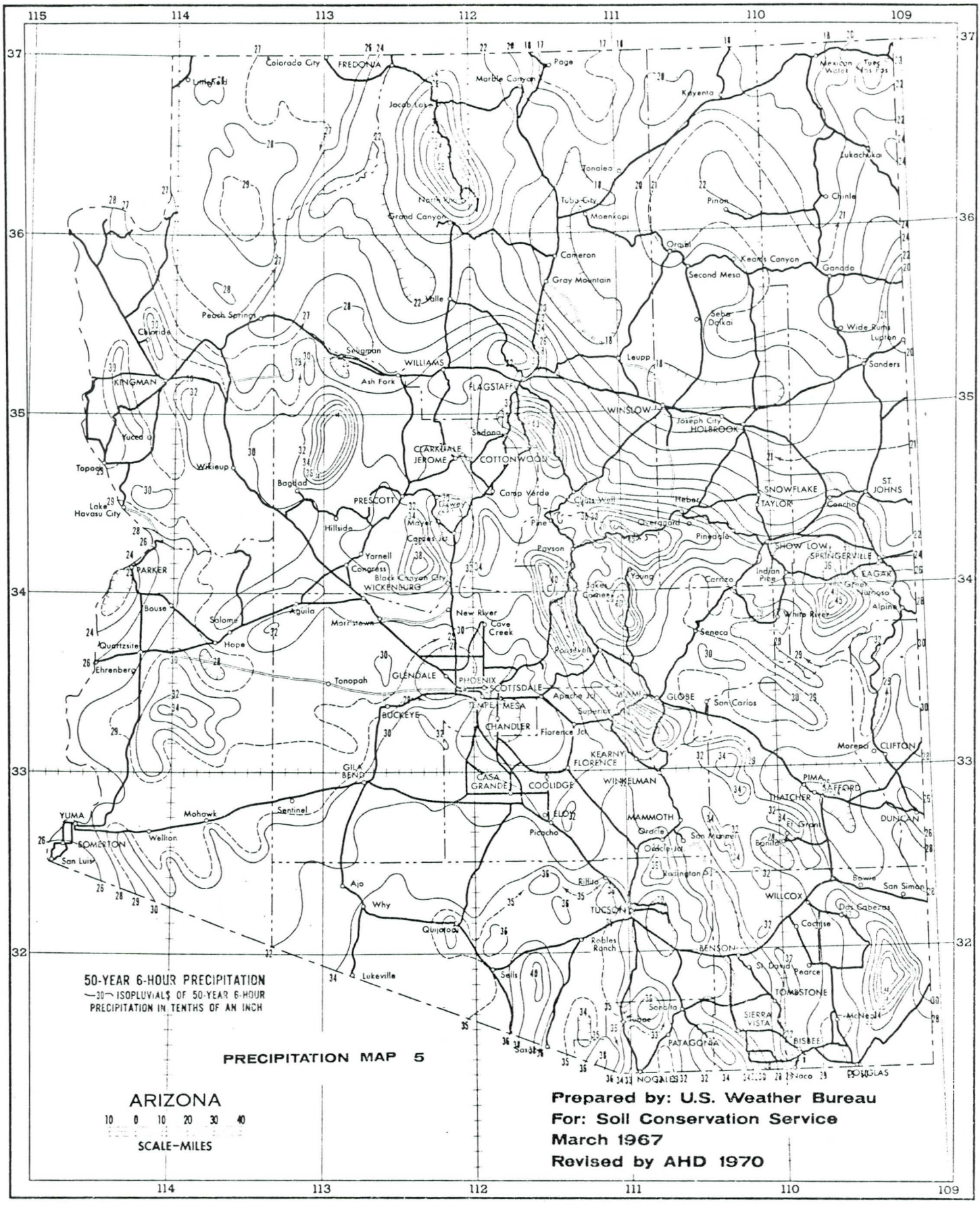
SCALE--MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970


50-YEAR 6-HOUR PRECIPITATION
—30— ISOPLUVIALS OF 50-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 5
ARIZONA
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SCALE-MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970
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Cameron
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Peach Springs
Seligman
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KINGMAN
Yucca
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Lake Havasu City
Wikieup
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Joseph City
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PRESCOTT
Camp Verde
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SNOWFLAKE
TAYLOR
ST JOHNS
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Pinedale
Yarnell
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Black Canyon City
WICKENBURG
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Mohawk
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ELOY
MAMMOTH
Oracle
Oracle Jct
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DUNCAN
Bonita
SOMERTON
Wellton
San Luis
Kearsing
Bowie
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WILLCOX
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Rillito
TUCSON
Das Cabezas
Cochise
Quijotoa
Robles Ranch
BENSON
Lukeville
Sells
St David
Pearce
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Sonoita
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McNeal
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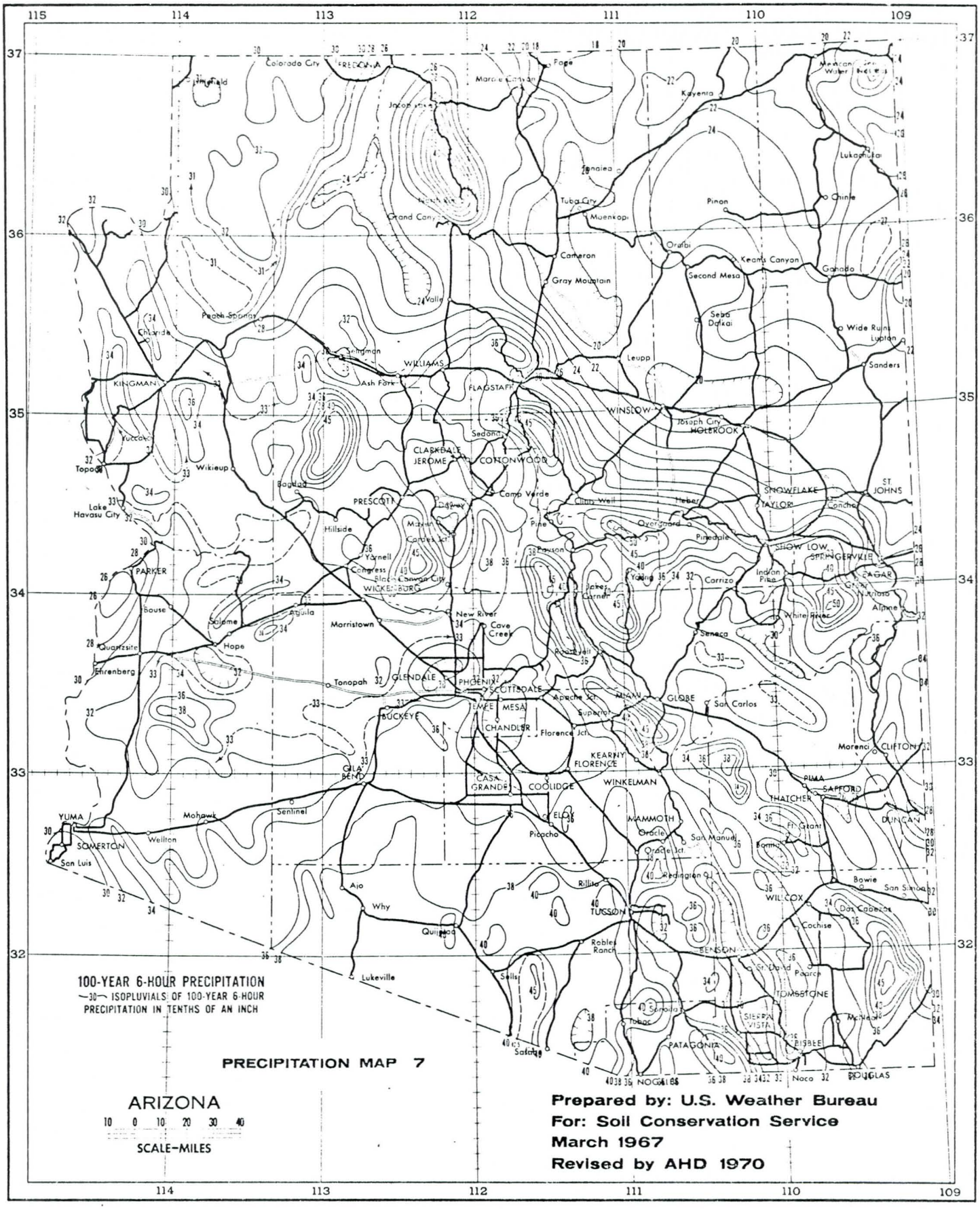
BISBEE
NOGALES
Naco
DOUGLAS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Peach Springs
Chloride
KINGMAN
Seligman
WILLIAMS
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Wikieup
Sedona
CLARKDALE
JEROME
COTTONWOOD
Camp Verde
Clints Well
Heber
SNOWFLAKE
TAYLOR
ST JOHNS
Concho
Lake Havasu City
PRESCOTT
Hillside
Mayer
Cordes Jct
Pine
Overgaard
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Payson
SHOW LOW
SPRINGERVILLE
EAGAR
PARKER
Yarnell
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WICKENBURG
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Nutrioso
Alpine
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Salome
Aguila
Morristown
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Cave Creek
White River
Seneca
Quartzsite
Hope
Ehrenberg
Tonopah
GLENDALE
PHOENIX
SCOTTSDALE
Apache Jct
MIAMI
GLOBE
San Carlos
BUCKEYE
TEMPE
MESA
CHANDLER
Superior
Florence Jct
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CLIFTON
KEARNY
FLORENCE
GILA BEND
CASA GRANDE
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Wellton
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Ajo
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Quijotoa
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Redington
Bowie
San Simon
WILCOX
TUCSON
Dos Cabezas
Cochise
Robles Ranch
BENSON
Lukeville
Sells
Tohono
Sonoita
TOMBSTONE
Pearce
SIERRA VISTA
PATAGONIA
McNeal
FIRBLE
Sasabe
NOGALES
Naco
DOUGLAS
100-YEAR 6-HOUR PRECIPITATION
—30— ISOPLUVIALS OF 100-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH
PRECIPITATION MAP 7
ARIZONA
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SCALE—MILES
Prepared by: U.S. Weather Bureau
For: Soil Conservation Service
March 1967
Revised by AHD 1970