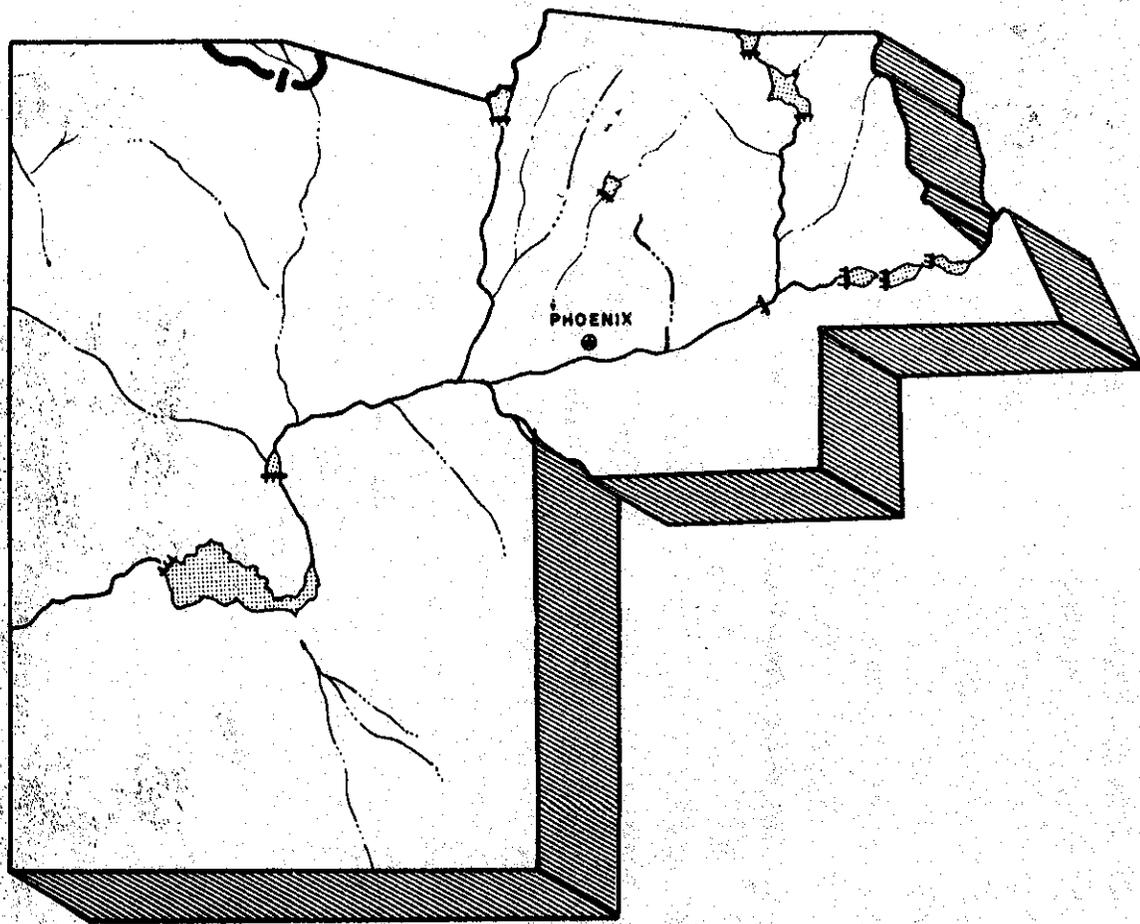
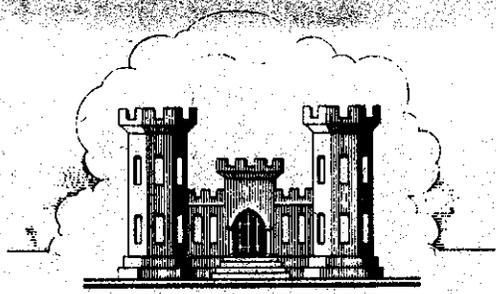


FLOOD PLAIN INFORMATION STUDY  
FOR  
MARICOPA COUNTY, ARIZONA



VOLUME IV  
WICKENBURG REPORT



U. S. ARMY-ENGINEER DISTRICT, LOS ANGELES  
CORPS OF ENGINEERS  
DECEMBER 1965

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FLOOD-PLAIN-INFORMATION STUDY  
FOR  
MARICOPA COUNTY, ARIZONA

VOLUME IV

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3.	Bibliography.

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SUMMARY

General

1. The Flood Control District of Maricopa County requested that the U.S. Army Corps of Engineers provide information about the flood hazards in flood plains along several streams in the County. An index map of the study areas is shown on plate 1. This report, the fourth in the series on Maricopa County, presents the results of the study made of several flood-plain reaches of five Hassayampa River tributaries in and near the Town of Wickenburg, Arizona. A study of the Hassayampa River flood plain in the Wickenburg area will be included in the Hassayampa River flood-plain study scheduled for the future.

Authorization

2. This report was prepared under the authority granted in section 206, Public Law 86-645, approved 14 July 1960. That section is quoted in appendix 1.

3. The authority of the Flood Control District of Maricopa County to participate in flood-control planning is derived from article 5, sections 45-2351 to 45-2370, inclusive, title 45,

chapter 10, Arizona Revised Statutes - and from a resolution of the Board of Supervisors of Maricopa County dated 3 August 1959, which established the flood-control district pursuant to the cited statutes.

4. Furthermore, Arizona has adopted State statutes enabling counties and cities to zone through the use of properly adopted resolutions and ordinances. Such zoning laws must be in the interest of promoting health, safety, morals, or general welfare, and are generally placed on referendum in a public election. Maricopa County has adopted zoning laws, but not in regard to flood hazards. However, flood-plain zoning could be adopted by the County because it would be in the interest of promoting health, safety, and general welfare.

5. On 26 September 1960 and 11 December 1961, the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County adopted resolutions requesting the U.S. Army Corps of Engineers to make a flood-plain-information study for Maricopa County - and giving assurances that the information in this report would be made available to all interested persons and organizations, and that the availability of the report would be adequately publicized. Those resolutions are quoted in appendix 1. On 14 April 1961, the Chief of Engineers, Department of the Army, Washington, D.C., approved the request for these Maricopa County studies.

6. The Arizona State Land Commissioner has been designated by the Governor of Arizona to coordinate and to assign priority to

applications for flood-plain-information studies. Upon approval for release of this report by the Arizona State Land Commissioner on 12 August 1965, the Chief of Engineers, Department of the Army, Washington, D.C., approved release of this report for publication on 24 August 1965.

#### Purpose of Study

7. The purpose of the study presented in this report is to provide information on flood hazards in the flood plains of several Hassayampa River tributaries flowing through and near the Town of Wickenburg, Arizona. This information is for the guidance of the State of Arizona and the Flood Control District of Maricopa County in (a) advising county and city planning organizations and private land developers about those hazards and (b) setting up appropriate controls to insure optimum and prudent use of the flood plains. The purpose of this report is not to discourage the use of flood plains - but rather to encourage development that will insure an optimum balance between the needs of man for use of the flood plains and the needs of nature for the discharge of floodwaters.

#### Scope

8. The request for the study from the Flood Control District of Maricopa County indicated an interest in parts of the flood plains of several streams flowing through and near Wickenburg, Arizona. The flood plains that local interests selected for study were on Powder House Wash, Sunset Wash, Casandro Wash, Flying "E" Wash, and Sols Wash (see pls. 4 and 5).

9. The study included consideration of past floods and of future floods in whose overflow areas methods of regulating development or construction of flood-control facilities might be warranted.

#### Use of the Report

10. The information in this report is presented for consideration and use by the State of Arizona, Maricopa County, other local agencies, and flood-plain users for planning the use and regulation of selected flood plains on five streams flowing through and near Wickenburg, Arizona. The State and County will make this information available to local interests. Further information on the use or availability of this report should be requested from the Flood Control District of Maricopa County, in Phoenix, Arizona.

11. Any regulation for flood-plain use resulting from this report would be undertaken by the State, by the County, or by some other local agency. This report is not intended to extend any Federal authority over zoning or other regulation of flood-plain use, and the information study and report are not to be construed as committing the Federal Government to investigating, planning, designing, constructing, operating, or maintaining any facilities discussed, or to imply any intent to undertake such activities unless specifically authorized by Congress.

#### Acknowledgment

12. The cooperation of the Flood Control District of Maricopa County and of individuals who directly or indirectly aided in the preparation of this report is gratefully acknowledged. An aerial

topographic mosaic map utilizing an aerial survey flown by Aerial Mapping Company was prepared for Sols Wash by Dibble & Associates. Aerial topographic mosaic maps, utilizing aerial surveys flown by Fairchild Aerial Surveys, Inc., were prepared for the other considered streams. These mosaic maps were used for the delineation of flood areas (see pls. 7 to 17, inclusive). General highway maps prepared by the Arizona Highway Department were used in preparing a map showing the location of the Wickenburg study area (see pl. 2). Pictures on pages 24 and 25 were supplied by Double B Photo, Wickenburg, Arizona.

#### Glossary of Selected Terms

13. A glossary of selected terms used in this report is included as appendix 2.

#### Bibliography

14. A bibliography of references used in preparing this report is included as appendix 3.

## DESCRIPTION OF STUDY AREA

### General Description

15. Wickenburg.--The Town of Wickenburg, which is about 53 miles northwest of Phoenix and about 60 miles southwest of Prescott (see pl. 2), is a tourist and trade center for a large surrounding area. The permanent population of Wickenburg is about 2,500, which is increased by another 1,000 during the winter tourist season. Tourists are attracted by the mild winter climate, as well as by the numerous guest ranches and the fine western shops and stores. At an elevation of about 2,100 feet above mean sea level, Wickenburg has a warm dry climate.

16. U.S. Highways Nos. 60, 70, and 89 and State Highway 93 extend through Wickenburg and cross the Hassayampa River within the town limits (see pl. 2). Five Hassayampa River tributaries in and near Wickenburg are under consideration in this study: Powder House Wash, Sunset Wash, Casandro Wash, Flying "E" Wash, and Sols Wash (see pl. 4). The extent of the various study areas is shown on plate 5, and an index to the various flood-area plates (pls. 7 to 17, inclusive) is shown on plate 6. Pertinent information on the streams under consideration is given in the following paragraphs.

17. Powder House Wash.--Powder House Wash rises in the mountains (elevation 2,600 feet above mean sea level) northeast of Wickenburg. The total length of the stream is about 6 miles, with a total drainage area of about 1.9 square miles. Powder House Wash flows southwestward from its source for about  $5\frac{1}{4}$  miles, where it

crosses Constellation Road from the north. From that crossing, some floodwaters flow down Constellation Road toward the Hassayampa River.

18. The reach of Powder House Wash considered in this study extends about 0.9 mile southwestward from a point about 1,500 feet upstream from where the stream crosses Constellation Road downstream to the Hassayampa River (see pl. 7). Elevations along Powder House Wash in the study area range from 2,130 feet at the upstream end to 2,040 feet at the downstream end at the Hassayampa River, and the natural channel slopes average about 110 feet per mile. In the upstream one-third of the study area, the natural channel of Powder House Wash is well defined; and in the downstream two-thirds of the study area, the natural channel is shallow and poorly defined (see pictures on p. 21). The width of the flood plain is as much as 500 feet near the Hassayampa River; and upstream from the river, the width of the flood plain ranges from 150 to 300 feet.

19. In the upstream part of the area under study, Powder House Wash flows through a mountainous area that is sparsely populated. In the downstream part, the stream flows through developing business and residential areas of Wickenburg on the east side of the Hassayampa River. Some development - including several motels and filling stations and a trailer court - has already occurred along Constellation Road, Jack Burden Road, and El Recreo Drive.

20. Sunset Wash.--Sunset Wash rises in the Vulture Mountains (elevation 2,500 feet) at a point near the Vulture Mine Road on the

west side of Wickenburg and just north of Los Caballeros Guest Ranch. The total length of the stream is 2.6 miles, with a total drainage area of 2.4 square miles. Sunset Wash flows northeastward from its source to the confluence with the Hassayampa River.

21. The reach of Sunset Wash considered in this study extends about 1.6 miles from Los Altos Drive generally eastward to the Hassayampa River (see pls. 8 and 9). In the study area, Sunset Wash flows eastward along the dedicated alinement for Sunset Drive, which at present is unimproved; and thence, flows southeastward along Grant Street to the intersection of Grant Street and Center Street (see lower picture on p. 22), where flow from Sunny Cove Wash - the principal tributary - enters Sunset Wash. From this confluence, the combined flow continues northeastward approximately parallel to Center Street to a point near the intersection of Center Street and Jackson Street; thence, eastward to Sylvan Road and along Sylvan Road (see middle picture on p. 22) to Cool Water Lane; and thence, northeastward along Cool Water Lane and through the Atchison, Topeka and Santa Fe railroad bridge (see upper picture on p. 22) to the Hassayampa River.

22. Elevations along Sunset Wash in the study area range from 2,160 feet at the upstream end to 2,030 feet at the Hassayampa River; and the natural channel slopes range from about 105 feet per mile in the upstream reach near Los Altos Drive to about 40 feet per mile near the Hassayampa River. In the upstream one-third of the area under study, the natural channel of Sunset Wash is narrow and well defined; and in the downstream two-thirds, most flow moves

along streets extending through residential areas. The width of the flood plain in the study area ranges from 100 to 900 feet.

23. In the upstream one-third of the area under study, Sunset Wash flows through an area that is typically mountainous desert in character and - at the present time - is sparsely populated. The only development in this area is along the north side, which is the high side, of Sunset Wash. In the downstream two-thirds of the study area, Sunset Wash flows through a highly developed residential area.

24. Casandro Wash.--Casandro Wash rises in the Vulture Mountains (elevation 2,500 feet) at a point near the Vulture Mine Road and a short distance south of U.S. Highway Nos. 60 and 70. The total length of the stream is about 3.5 miles, with a total drainage area of 1.5 square miles. Casandro Wash flows generally north-eastward from its source to the confluence with Sols Wash.

25. The reach of Casandro Wash considered in this study extends about 0.7 mile from Mariposa Drive to the A.T. & S.F. railroad bridge, which is just upstream from the confluence of Casandro Wash and Sols Wash (see pl. 10). In the study area, Casandro Wash flows eastward from Mariposa Drive through the Casandro Tract and Reed's Addition to a point near the intersection of Jackson and Navajo Streets (see lower picture on p. 23); thence, southeastward along and across Jackson Street to Mohave Street; and thence, north-eastward along Mohave Street to the A.T. & S.F. railroad bridge (see upper picture on p. 23). Thence, Casandro Wash flows through the bridge to its confluence with Sols Wash.

26. Elevations along Casandro Wash in the study area range from 2,110 feet at the upstream end to 2,060 feet at the downstream end; and the natural channel slopes range from about 120 feet per mile in the upstream reach to about 70 feet per mile near the downstream end. In the upstream part of the study area, the natural channel is well defined; and in the downstream part, most flow moves along streets extending through residential areas. The width of the flood plain just upstream from the railroad bridge is as much as 1,250 feet; and further upstream, the width of the flood plain ranges from 150 to 450 feet.

27. In the upstream part of the area under study - from Mariposa Drive to Avispa Street - Casandro Wash flows through an area that is typically desert in character and that as yet is an undeveloped part of the Casandro Tract, which is being developed just south of Casandro Wash. Downstream from Avispa Street, Casandro Wash flows through highly developed residential areas.

28. Flying "E" Wash.--Flying "E" Wash rises near Vulture Peak (elevation 2,900 feet) in the Vulture Mountains. The total length of the stream is about 8.4 miles, with a total drainage area of about 9.5 square miles. Flying "E" Wash flows northeastward from its source to the confluence with Sols Wash.

29. The reach of Flying "E" Wash considered in this study extends from Vulture Mine Road to the A.T. & S.F. railroad bridge near Sols Wash (see pls. 11 and 12), a distance of about 1 mile. In the study area, Flying "E" Wash flows northeastward across undeveloped property; thence, across the Wickenburg Country Club

golf course (see picture on p. 24); and thence, to the railroad bridge near the golf course. Thence, Flying "E" Wash flows through the bridge to its confluence with Sols Wash. The confluence is about 2 miles upstream from the confluence of Sols Wash and the Hassayampa River.

30. Elevations along Flying "E" Wash in the study area range from 2,220 feet at Vulture Mine Road to 2,130 feet at Sols Wash, and the natural channel slopes average about 80 feet per mile. The natural channel of Flying "E" Wash is a meandering channel. The width of the flood plain is as much as 3,000 feet just upstream from the railroad bridge; and further upstream, the width of the flood plain ranges from 350 to 1,000 feet.

31. In the upstream one-third of the area under study, Flying "E" Wash flows across undeveloped desert areas of high potential value. In the downstream two-thirds of the study area, Flying "E" Wash flows through the Wickenburg Country Club, which is the only recreational facility of its kind in the area. The club is well patronized by local residents and by guests of the various dude ranches in the area.

32. Sols Wash.--Sols Wash rises in the Date Creek Mountains (elevation 3,600 feet) in the southwestern part of Yavapai County. The total length of the stream is about 18 miles, with a total drainage area of about 145 square miles. Sols Wash flows generally southeastward to its confluence with the Hassayampa River in the Town of Wickenburg.

33. The reach of Sols Wash considered in this study extends southeastward about 4.1 miles from the A.T. & S.F. railroad bridge to the confluence with the Hassayampa River (see pls. 13 to 17, inclusive). Elevations along Sols Wash in the study area range from 2,230 feet at the upstream end to 2,050 feet at the downstream end, and the natural channel slopes average about 45 feet per mile. In the upstream part of the study area, the natural channel is shallow and meandering; and in the downstream part, the natural channel is fairly well entrenched (see pictures on p. 25). The width of the flood plain is as much as 2,400 feet near U.S. Highway No. 89; and further upstream, the width of the flood plain ranges from 350 to 1,200 feet.

34. In the upstream three-fourths of the study area, Sols Wash flows through an area that is typically desert in character. In the downstream one-fourth of the study area, Sols Wash flows through well-developed business and residential areas in the Town of Wickenburg.

#### Prospective Developments Affecting the Flood Plain

35. The Wickenburg area (including parts of the drainage areas of Powder House Wash, Sunset Wash, Casandro Wash, Flying "E" Wash, and Sols Wash) is experiencing a rapid increase in population and in urban development. This rapid development has also taken place in other parts of Arizona as well as in other parts of Maricopa County, including the Phoenix metropolitan area. Arizona was among the leaders in population growth from 1950 to 1960 and

was the actual leader among the States during the period from 1946 to 1950. The population growth in Arizona during the past 50 years has been concentrated in two counties: Maricopa and Pima Counties. Approximately half of Arizona's people live in Maricopa County. By 1970, the population of Maricopa County is expected to be almost double the 1960 figure; most of the increase will be in urban areas.

36. The population of Wickenburg almost tripled in the period 1940-60: In 1940, the permanent population was 995; and in 1960, the permanent population was 2,500. The winter tourist population augments the permanent population of Wickenburg by almost one-third. The substantial and steady growth that Wickenburg has experienced in the past 25 years is expected to continue. Real-estate values are stable, and new land-development projects are both under construction and in the planning stage.

37. The Town of Wickenburg, recognizing that guidelines must be established to meet foreseeable short- and long-term needs of community development, has already established a long-range planning program. Expansion plans of several private enterprises include the Wickenburg West subdivision; Las Casitas San Juan (Little Houses of St. John), a 7-acre building site under development; a new mobile-home park west of Wickenburg; Country Club Acres, a subdivision of residential lots; and other developments.

38. The tourist industry, which has played a major part in Wickenburg's development, is expected to grow at a more rapid rate in the future than in the past. Wickenburg, which calls itself the "Dude Ranch Capital of the World," attracts winter-season tourists

from all parts of the United States and from numerous foreign countries. The nationwide demand for outdoor recreational facilities and the worldwide increase in tourism are expected to be reflected in the economy of Wickenburg, which is on the main highway between Phoenix and the Las Vegas-Lake Mead area and between Phoenix and the Grand Canyon area. Expansion of existing tourist facilities - including guest ranches, motels, and restaurants - will be required to satisfy the expected future demand.

39. The development that has already taken place in the Wickenburg area has resulted in the encroachment of business, residential, and recreational areas on and adjacent to the flood plains in the study areas. Some of these improvements have been damaged several times in recent years by floods. The potential threat to life and property will increase as additional development takes place on the flood plains.

#### Nature and Extent of Flood Problem

40. Maricopa County, including the Wickenburg area, is experiencing a rapid increase in population and in urban development. This increase has sometimes led to the development on the flood plains of streams without due regard to the existence of flood hazards. The hazard that exists in the flood plains of the study-area streams in and near Wickenburg is not always apparent to the layman because the land is semiarid and because streamflow occurs only during storms. Storms in this area have caused - and will continue to cause - floods resulting in the inundation of extensive flood plains. The flood plains considered in this study are the

areas subject to complete flooding by the standard project flood and to partial flooding by the lesser 100-year and 50-year floods, as shown on the flood-area maps (pls. 7 to 17, inclusive). Pertinent information on the nature and extent of the flood problem in and near Wickenburg is given in the following paragraphs.

41. Wickenburg.--The highly developed resort Town of Wickenburg is extremely vulnerable to damage from floods on the five streams under consideration in this report. These streams all empty into the Hassayampa River or Sols Wash, a major tributary of the Hassayampa River, at points in or near the Town of Wickenburg. The flood plains of the streams in the study area merge with the flood plain of the Hassayampa River, a study of which will be included in a future report. In general, the stream channels in and near Wickenburg are poorly defined and are adequate to accommodate only minor flows. As a result, floodflows in the Wickenburg area spread out as overland flow and cause damage to business and residential development. Only minor and temporary flood-control works are in the area, and no flood-plain-zoning regulations are in existence.

42. Powder House Wash.--Floodwaters on Powder House Wash in the upstream part of the study area flow through a steep-walled canyon that accommodates all floodflows. From the mouth of the canyon to a point about 600 feet downstream, where Powder House Wash crosses Constellation Road (near section B on pl. 7), floodwaters flow in a well-entrenched channel that accommodates most floodflows; at Constellation Road, the flow moves along the road for a distance of

about 700 feet. This entire upstream area is relatively undeveloped. Thence, the floodwaters divide - some continuing down Constellation Road and some entering a floodway (see lower picture on p. 21) that parallels the left (southeast) side of the road and extends downstream to the first street that crosses Constellation Road upstream from the intersection of Constellation Road and Jack Burden Road (see upper picture on p. 21). At that intersection, the floodwaters reunite and flow overland to the Hassayampa River. The entire downstream area mostly is residential and business property. The flood plain of Powder House Wash is shown on the flood-area map, plate 7.

43. The floodway paralleling Constellation Road was constructed by local property owners. The floodway, which is about 50 feet wide and 900 feet long, consists of two parallel levees constructed with flood-borne material brought down by storm runoff from the upstream canyon (see lower picture on p. 21). Because both the floodway and the road are of limited capacity, floodwaters overflow onto adjacent property and move overland at comparatively shallow depths.

44. The only areas free from the threat of flood damage along the study area of Powder House Wash are the relatively undeveloped areas in the upstream reach where the channel of Powder House Wash is well entrenched. Floodwaters cause damage to residential and business property throughout developed areas along Powder House Wash in the study area. A motel in a low area between U.S. Highways Nos. 60, 70, and 89 and Jack Burden Road has been flooded several times in recent years.

45. Sunset Wash.--Floodwaters on Sunset Wash in the upstream part of the study area flow along dedicated Sunset Drive for a distance of about one-half mile through a relatively undeveloped area. Thence, near Ox Bow Circle, floodwaters enter a locally constructed temporary floodway in which they flow for a distance of about 1,700 feet through highly developed residential areas to the confluence with Sunny Cove Wash (see lower picture on p. 22); large floodflows overtop the floodway levees, overflow onto residential property, and move overland as sheet flow. Thence, downstream - also through highly developed residential areas - to the A.T. & S.F. railroad bridge (see upper picture on p. 22), floodwaters flow along streets (see middle picture on p. 22), overflow onto residential property, and move overland as sheet flow, which ponds just upstream from the railroad bridge. Thence, downstream from the railroad bridge, some floodwaters flow in a temporary floodway to the Hassayampa River and some overtop the levees and flow southward down the Hassayampa River flood plain - mostly undeveloped - entering the river at a point south of the study area. The flood plain of Sunset Wash is shown on the flood-area maps, plates 8 and 9.

46. The upstream temporary floodway, which was built near Ox Bow Circle by local property owners, consists of two parallel levees constructed of flood-borne material. The 1,700-foot-long floodway, which is about 30 feet wide and of limited capacity, extends through developed areas and in some reaches utilizes existing streets. The downstream temporary floodway, which was

constructed downstream from the railroad bridge by local interests, is also of inadequate capacity.

47. Floodwaters cause damage to residential property throughout the developed areas along Sunset Wash. In addition, the ponding of floodwaters at the railroad bridge causes damage to railroad property. No property on the flood plain of Sunset Wash in the study area is free from the threat of flood damage.

48. Casandro Wash.--Floodwaters on Casandro Wash in the upstream part of the study area to a point near Avispa Street flow eastward between two relatively high ridges; thence, downstream to Mohave Street, floodwaters flow along Jackson Street; and thence, floodwaters flow along Mohave Street through the A.T. & S.F. railroad bridge to Sols Wash. The flood plain of Casandro Wash is shown on the flood-area map, plate 10.

49. Upstream from Avispa Street, existing development along Casandro Wash in the study area is on high ground out of the flood plain. Downstream from Avispa Street, a high ridge extends along the north side of Casandro Wash; as a result, floodwaters moving along and across Jackson Street (see lower picture on p. 23) spread out onto residential areas on the low flat flood plain south of the wash. Floodwaters utilize Mohave Street as a channel; however, because the street can accommodate only low flows, large flows spread northwest - moving overland into adjacent residential areas. Extensive ponding occurs at the railroad bridge (see upper picture on p. 23).

50. Floodwaters cause damage to residential property throughout the developed areas along both sides of Casandro Wash downstream from Avispa Street except where high ground in some reaches prevents the overflow of floodwaters along one side. The ponding of floodwaters at the railroad bridge causes damage to railroad property.

51. Flying "E" Wash.--Floodwaters on Flying "E" Wash in the study area flow generally northeastward to the confluence with Sols Wash. Small floodflows flow in shallow poorly defined channels that meander across the flood plain. Floodwaters cause bank caving in various parts of the study area.

52. The entire reach of Flying "E" Wash in the study area is undeveloped except in the downstream part where the wash crosses the Wickenburg Country Club golf course (see picture on p. 24). Floodwaters on Flying "E" Wash flow across the golf course; thence, through the A.T. & S.F. railroad bridge; and thence, into Sols Wash. The flood plain of Flying "E" Wash is shown on the flood-area maps, plates 11 and 12.

53. Although the upstream reach of Flying "E" Wash in the study area is as yet undeveloped, the property, which is potentially valuable, could be developed if the threat of flood damage were removed. In the downstream reach, floodwaters cause extensive damage to the Wickenburg County Club golf course. In addition, floodwaters pond at the railroad bridge and cause damage to railroad property.

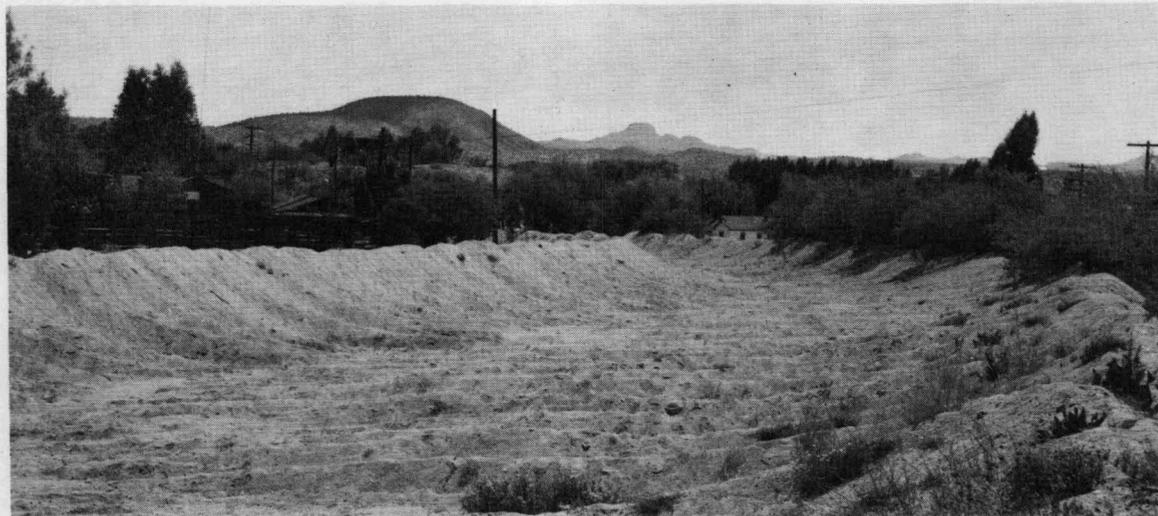
54. Sols Wash.--Floodwaters on Sols Wash in the study area flow generally southeastward to the confluence with the Hassayampa River. Small floodflows flow in shallow poorly defined channels that meander across the flood plain. Floodwaters cause bank caving in various parts of the study area.

55. The entire reach of Sols Wash in the study area is undeveloped except in the downstream part, which is within the Town of Wickenburg. Local interests have constructed wire-fence channel-training works along both banks of Sols Wash near the U.S. Highway No. 89 bridge to help contain the streamflow within the natural channel and to help prevent bank caving (see pictures on p. 25). The flood plain of Sols Wash is shown on the flood-area maps, plates 13 to 17, inclusive.

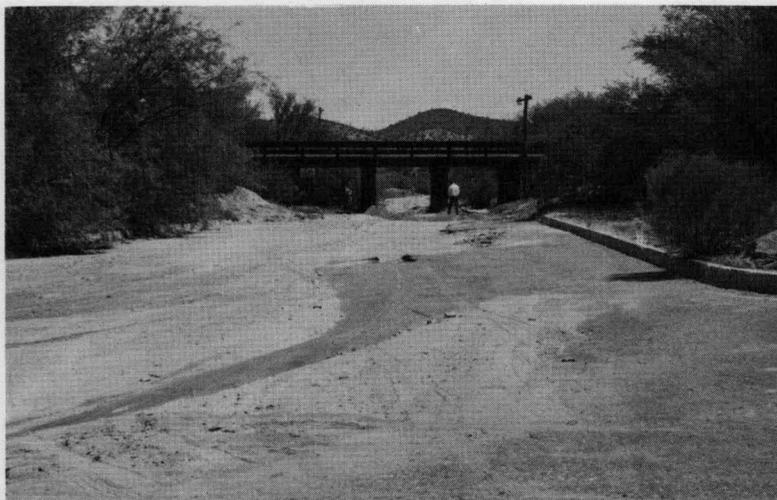
56. Floodwaters cause extensive damage to residential and business property in the developed area in the downstream 1 mile of Sols Wash. Floodwaters damage railroad property - including roadbeds, tracks, and bridges - and the U.S. Highway No. 89 bridge. The standard project flood would overtop the U.S. Highway No. 89 bridge. The study area on the north side of Sols Wash downstream from that bridge has been designated as a potential industrial area. However, this property is not suitable for industrial purposes unless the threat of flood damage is removed.



POWDER HOUSE WASH. View looking upstream (northeastward) along Constellation Road from Jack Burden Road to the Powder House Wash downstream crossing at upper center of picture. (See pl. 7.) From that crossing, most floodwaters flow down Constellation Road toward the Hassayampa River.



POWDER HOUSE WASH. View looking downstream (southwestward) along Powder House Wash from a point near the northern limits of Wickenburg (near sec. A on pl. 7). About 1,000 feet downstream, Powder House Wash crosses Constellation Road (see upper picture). Levees along each side of the floodway were bulldozed from flood-borne material. In this reach, Constellation Road is outside the levee at the right of the picture - and El Recreo Drive is outside the levee at the left of the picture.



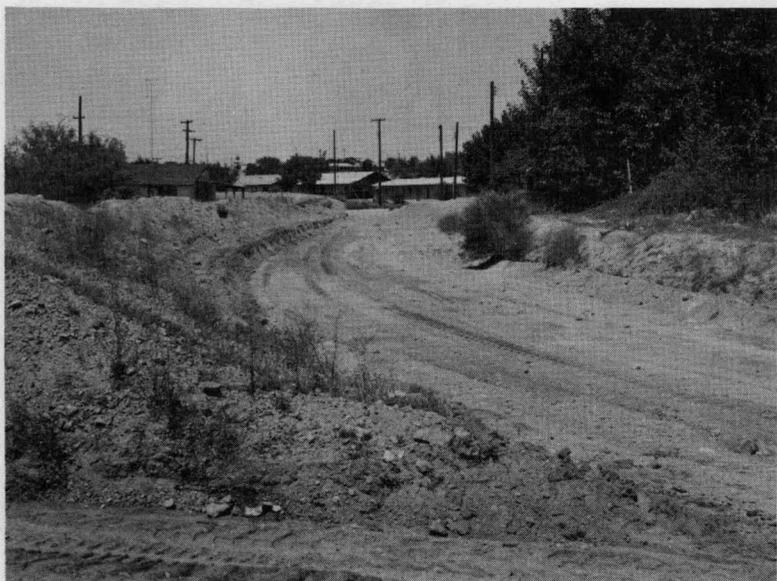
SUNSET WASH

View looking downstream northeastward along Cool Water Lane from Sylvan Road and toward mainline A.T. & S.F. railroad bridge. (See pl. 8.) Sylvan Road and Cool Water Lane serve as the channel for Sunset Wash.



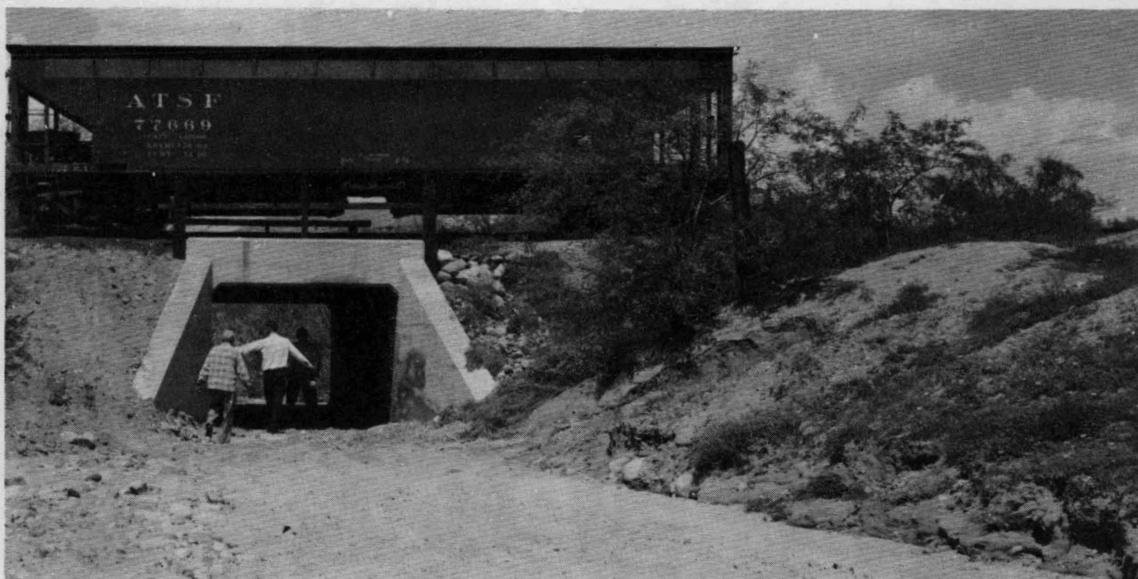
SUNSET WASH

View looking downstream (eastward) along Sylvan Road from intersection of Park Street. (See pl. 8.) Sylvan Road serves as the channel for Sunset Wash. Homes on both sides of Sylvan Road are within the flood plain.



SUNSET WASH

View looking upstream (northwestward) along Grant Street from intersection of Center Street and Sunny Cove Wash, a tributary of Sunset Wash. (See pl. 8.) Grant Street, shown with levees on each side, serves as the channel for Sunset Wash.



CASANDRO WASH. View looking downstream (northeastward) along Mohave Street toward mainline A.T. & S.F. railroad bridge. (See pl. 10.) Large flows on Mohave Street, which serves as the channel for Casandro Wash, pond in the areas between the railroad and high ground at (a) the right of the picture and (b) about 1,200 feet left of the railroad bridge and outside the picture.



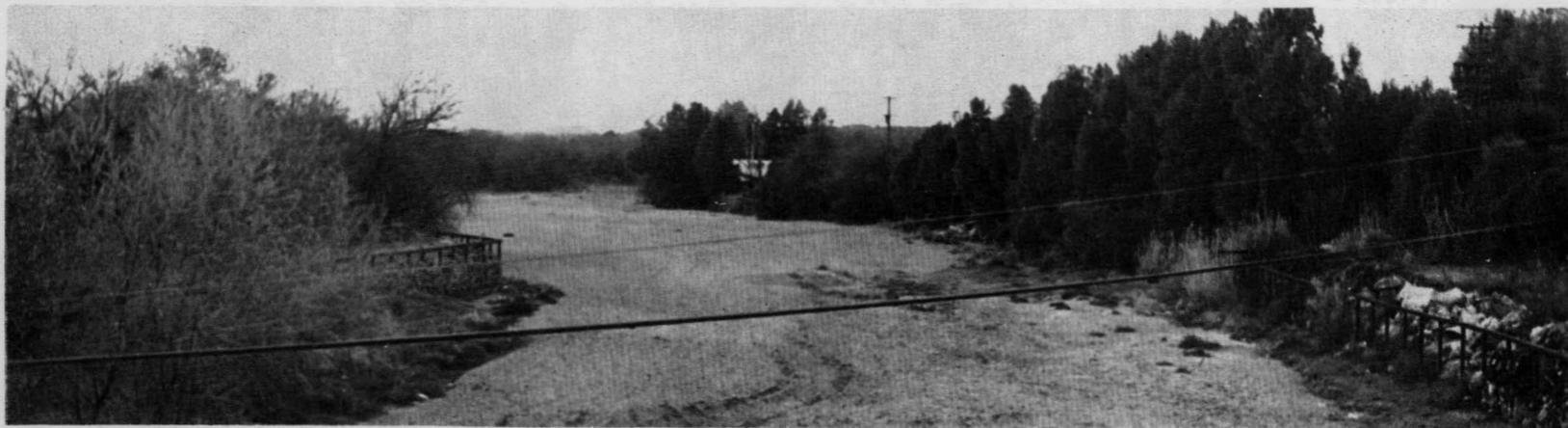
CASANDRO WASH. View looking southeastward up the Jackson Street hill from about 50 feet southeast of the intersection of Navajo and Jackson Streets. (See pl. 10.) Flow on Casandro Wash, which crosses Jackson Street in the center of the picture, is from the lower right of the picture to the intersection of the Wash and Mohave Street in middle left of the picture. Houses along Jackson Street, near the bottom of the hill, are within the flood plain.



FLYING "E" WASH. View looking upstream (southwestward) along Flying "E" Wash through the golf course. (See pl. 11.) That part of the golf course shown, as well as the tank at the left of the picture, is in the flood plain.



SOLS WASH. View looking downstream (eastward) along Sols Wash from U.S. Highway No. 89 bridge. (See pl. 13.) Wire-fence channel-training works are along the right bank. The wide flood plain extends into the left of the picture.



SOLS WASH. View looking upstream (westward) along Sols Wash from U.S. Highway No. 89 bridge. (See pl. 13.) Wire-fence channel-training works are along both banks. The house in the center of the picture is one of seven within the flood plain on Cavaness Avenue west of the highway.

## RAINFALL AND FLOODS

### General

55. Types of storms.--Three types of storms produce precipitation in the Wickenburg area: general winter storms, general summer storms, and local thunderstorms. Pertinent information on these storms is given in the following subparagraphs.

(a) General winter storms, usually occurring during the months of December through March, originate over the Pacific Ocean as a result of the interaction between cool polar Pacific and warm tropical Pacific airmasses and move eastward over the area. These storms often last for several days and are accompanied by widespread rainfall.

(b) General summer storms, which occur during the months of July through September, are associated with the influx of moist tropical air originating over the Gulf of Mexico or the south Pacific Ocean. These storms are often accompanied by relatively heavy precipitation over large areas for periods of up to 24 hours, with light showers continuing for as long as 3 days.

(c) Local thunderstorms can occur at any time of the year, either during general storms or as isolated phenomena. However, local thunderstorms are most common from July through September, covering relatively small areas and resulting in high-intensity precipitation for durations of 3 hours or less.

56. Past storms and floods.--Many severe local storms and floods have no doubt occurred in the Wickenburg area; but, prior to 1944, little data are available for the storms, rainfall, runoff,

and damages. Since 1944, as reported in the local newspaper, severe local storms and floods occurred in the area in 1945, 1951, 1953, 1955, 1957, 1958, and 1959.

57. Standard project flood.--The standard project flood (see definition in appendix 2) in the Wickenburg area - where only relatively small drainage areas are involved - would result from a severe thunderstorm occurring at critical locations within the area. Because of the intensity of rainfall during a thunderstorm, the flood peak would occur soon after the beginning of rainfall and the duration of the flood generally would be only a few hours.

58. Estimates of the standard-project-flood peak discharges for the Wickenburg area are based on a thunderstorm and on other data developed in studies of streams in the general region. Detailed information on the standard-project-flood peak discharges at various concentration points in the drainage areas of the streams under consideration in this study is given in the table on plate 5.

#### Flood Frequency

59. Information on the frequency of floods of various magnitudes is essential in planning for optimum use of the flood plain. The development of such information depends on rainfall and streamflow data. Although Maricopa County has a well-established system of precipitation and gaging stations, no such stations are in the drainage areas contributing to those reaches of streams that are under consideration in this study (see pls. 3 and 4). However, sufficient rainfall and streamflow data are available in the Arizona area to permit reasonable estimates of the frequency of occurrence

of floods of various magnitudes at various concentration points in the drainage areas of the streams under consideration in this study. A table giving the size of the 100-year flood for those concentration points, together with the size of the standard project and 50-year floods at those points, is shown on plate 5.

#### Flood Limits Delineated in This Report

60. General.--Specific information on actual areas inundated by past major floods in the study area is unavailable because no records of streamflow in the area are in existence. Information developed in this study indicates that most natural channels of streams in the study area generally range from shallow poorly defined watercourses to broad well-defined washes. The limits of the overflow areas for the 100-year flood, together with the limits of the overflow areas for the standard project and 50-year floods, are delineated on plates 7 to 17, inclusive. Other pertinent information on those floods is given in subsequent paragraphs.

61. Standard project flood.--For this study, the limits of the overflow area of the standard project flood were selected as the upper limits of the flood plains. Also, delineating the limits of the standard project flood permits a comparison of the size of the overflow area of the standard project flood with that of the 100-year flood.

62. 100-year flood.--At the request of the Flood Control District of Maricopa County, the 100-year flood was selected as the largest flood to be used for regulation purposes.

63. Although the 100-year flood was selected as the largest flood to be used for regulation purposes, natural channel and flow conditions on Flying "E" Wash and Sols Wash require a designated floodway that is as wide as the limits of the 100-year flood (see chart of Suggested Flood Zones under subsequent subheading titled "Preventive Measures"). Therefore, the restrictive zones in these two study areas should extend from the designated floodway to the limits of the flood plain (i.e., the limits of the standard project flood). Because bank conditions in parts of the restrictive zones and designated floodways of those streams require an additional allowance for protection against bank caving, provision should be made for an additional 100 feet of restrictive zone or designated floodway landward from the banks.

64. The 100-year flood was used as a basis for establishing encroachment limits (see subsequent paragraph titled "Floodway-Encroachment Lines"). Where the natural channel is shallow, the maximum width of overflow for the 100-year flood would be as follows: Powder House Wash, 350 feet; Sunset Wash, 1,000 feet; Casandro Wash, 550 feet; Flying "E" Wash, 1,000 feet; and Sols Wash, 2,100 feet. Where the natural channel is narrow, the maximum depth of overflow for the 100-year flood would be as follows: Powder House Wash,  $4\frac{1}{2}$  feet; Sunset Wash,  $5\frac{1}{2}$  feet; Casandro Wash, 3 feet; Flying "E" Wash, 4 feet; and Sols Wash,  $8\frac{1}{2}$  feet.

65. 50-year flood.--The 50-year flood is delineated to permit a comparison of the size of the overflow area of the 50-year flood with that of the 100-year flood. The 50-year flood coincides with

encroachment limits on Powder House Wash, Sunset Wash, and Casandro Wash (see subsequent paragraph titled "Floodway-Encroachment Lines").

66. Flood cross sections.--Typical cross sections showing the shape of the floodway and the depth of flow for the standard project flood, the 100-year flood, and the 50-year flood are shown on plates 18, 19, and 20. The cross sections were used in determining the flood limits of those floods on Powder House Wash, Sunset Wash, Casandro Wash, Flying "E" Wash, and Sols Wash. For convenience in reference, the locations of the cross sections are indicated by capital letters in hexagons on aerial topographic maps of the flood areas (see pls. 7 to 17, inclusive).

67. Flood profiles.--Flood profiles have not been shown because of the distortion in presenting water-surface profiles in areas - such as those under consideration in this study - where floodflows are divided and where floodflows move along a curving natural channel. A delineation of the flood profiles would show only the water surface at the centerline of the main floodflow and would not show the water surface along other parts of the overflow area.

68. The variations in the floodflow characteristics of Powder House Wash illustrate the problems that are typical of most streams in the areas under study. In one reach of Powder House Wash (see section A on pl. 18), the floodwaters divide - some flow moves down Constellation Road, some enters a floodway that parallels the left side of the road, and the rest overflows onto adjacent property and moves overland; about 900 feet downstream from the point where

the floodwaters divide, the flow from the road and the flow from the floodway unite and flow overland to the Hassayampa River. A water-surface profile of the elevation of the main floodflow (i.e., the flow in the floodway) on Powder House Wash would have no value because such a profile would have no relation to the rest of the floodflow including the floodflow on curves.

69. Floodway-encroachment lines.--The floodway-encroachment lines represent the limits of maximum occupancy or encroachment that can be allowed on the flood plains of streams under consideration in this study without increasing the depth of flooding more than 6 inches in the area immediately upstream from any floodway section constricted to encroachment width. Buildings and construction in the flood plain would not necessarily have much adverse effect on the capacity of the natural floodway outside encroachment limits. Such construction could be floodproofed either by filling the area to raise the ground elevation or by locating the floor level of buildings above the expected floodflow elevation. However, if the floodway is constricted within encroachment limits, a general rise in the upstream water surface would occur with a resultant increase in the flood hazard to the buildings, construction, and adjoining property. The area between the encroachment limits should be kept clear of further development until such time as flood-control improvements can be constructed to reduce flooding.

70. The floodway-encroachment lines coincide with the limits of the 100-year flood on Flying "E" Wash and Sols Wash and with the limits of the 50-year flood on Powder House Wash, Sunset Wash, and

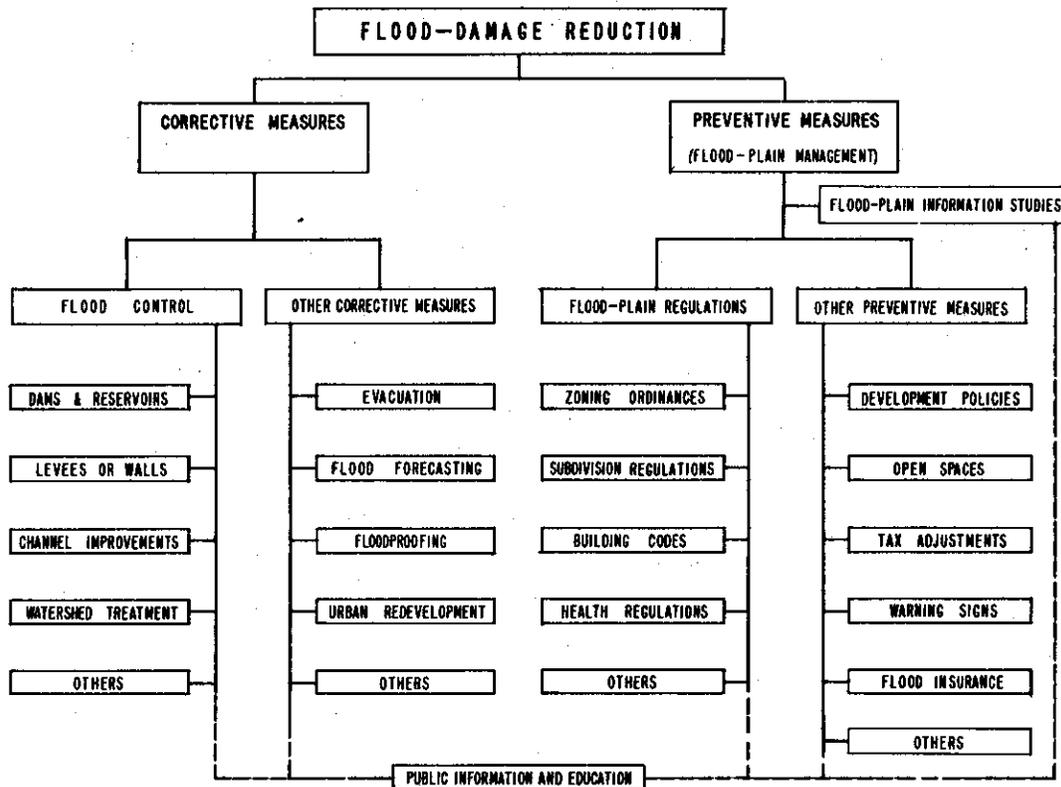
Casandro Wash (see pls. 7 to 17, inclusive). In addition, because bank conditions within the flood plains of Flying "E" Wash and Sols Wash require an allowance for protection against bank caving, provision for 100 feet of additional zone is required landward from the floodway-encroachment lines of those streams in areas where bank caving can occur.

## GUIDELINES FOR REDUCING FUTURE FLOOD DAMAGES

### General

71. The two broad categories of methods to reduce flood damages are corrective measures and preventive measures. Corrective measures are primarily the construction of dams and channel improvements. Preventive measures are primarily flood-plain-management methods - such as zoning ordinances that will preserve or establish floodways and thus provide partial protection. Flood-plain management is not only necessary in areas without corrective measures, but is also necessary after completion of corrective measures to preclude developments that would decrease the flood-carrying capacity of channels and floodways as well as to permit the development of these flood plains to the highest uses compatible with floodway needs.

72. In general, flood-plain-information studies such as those discussed in this report are concerned with developing a basis for preventive measures. However, the relationship of flood-plain-information studies to both preventive and corrective measures is shown on the following chart:



\* Adapted from chart shown in bibliography item No. 5 (see appendix 3).

### Corrective Measures

73. Flood control.--Flood-control works - one of the means of reducing flood damage - include dams, channel improvements, levees and floodwalls, and upstream watershed treatment. Dams and reservoirs store floodwaters and release them at rates that will not cause damage. Channel improvements include deepening, widening, or straightening existing stream channels, and constructing new channels to carry floodwaters without damage. Levees and floodwalls prevent rapidly flowing floodwaters from cutting channels across adjacent land. Upstream watershed treatment reduces flooding by permitting more rainfall to soak into the ground.

74. Consideration should be given to early planning for possible future corrective measures involving flood-control works. For example, if an improved channel is expected, the land required for rights-of-way should be reserved or acquired as soon as practicable. The early establishment of the alignment, the rights-of-way limits, and the required grades permit a better sequence of development - and at less cost. Once the type, size, and location of future channel improvements are determined, minor channel improvements might be undertaken to reduce the hazard from small floods. The earth excavated during the construction of such improvements could be used as land fill in low areas in the restrictive zones where raising the ground level would provide sites suitable for building.

75. Other corrective measures.--Among the other corrective measures that can be taken are (a) flood forecasting to provide warning of impending floods, (b) permanent evacuation of the flood plains to preclude loss of life, and (c) floodproofing of structures to reduce damage from overflow. However, two of these corrective measures are not feasible for the Wickenburg area: Flood forecasting is not feasible because the area is subject to flash floods, and permanent evacuation of the flood plains is not feasible because extensive residential and business development has already taken place on the flood plains of the various streams that empty into the Hassayampa River in and near Wickenburg.

76. Corrective measures may also be possible in connection with programs for urban redevelopment. This concludes the discussion of those corrective measures for flood-damage reduction that are charted on page 34.

## Preventive Measures

77. General.--Preventive measures for reducing flood damages require management of the flood plain. Flood-plain management involves controlling the use of the flood plain by legal and logical measures. Such management should be the means of realizing maximum community benefits, taking into account the most profitable or beneficial uses to which the flood plain can be put and the flood damages to which those uses would be subject. Some uses would be subject to very little damage; for example, recreational use for parks and playgrounds. Pertinent information on flood-plain regulations and other preventive measures is given in the following paragraphs (see chart on p. 34).

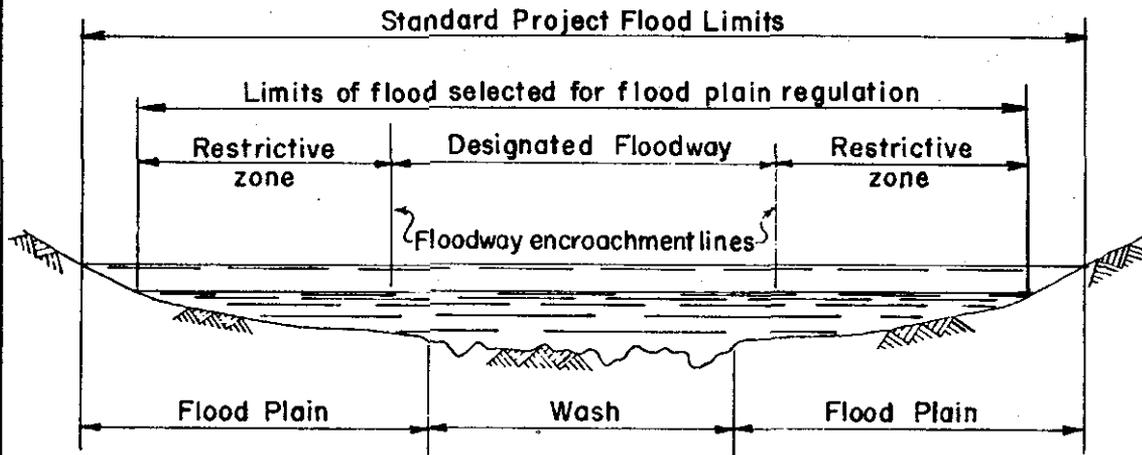
78. Flood-plain regulations.--When plans have been developed for use of the flood plain, the establishment of flood-plain regulations may be necessary to accomplish the desired results. Flood-plain regulations are established by State statutes, county resolutions, and city ordinances. Such regulations include zoning ordinances (including those setting up floodway-encroachment limits), subdivision regulations, building and housing codes, and other similar regulations. The type of measures necessary to regulate use of the flood plain depends on the nature of the hazard. The more restrictive measures would be used where the flood hazard might include loss of life, property damage, or floodway obstruction. Information on the relationship of some of those regulations to flood-plain zoning in the Wickenburg area is given in the following subparagraphs.

(a) Zoning ordinances.--The most universally accepted tools used by States, counties, and municipalities to regulate the use and development of land within their political boundaries are zoning ordinances. Arizona has adopted State statutes enabling counties and cities to zone through the use of properly adopted resolutions and ordinances. Such zoning resolutions and ordinances (i.e., zoning laws) must be in the interest of promoting health, safety, morals, or general welfare - and are customarily placed on referendum in a public election. Maricopa County has adopted zoning laws - but not in regard to flood hazards. Flood-plain-zoning laws could be adopted by the County because such zoning would be in the interest of promoting health, safety, and general welfare.

(b) Flood-plain-zoning laws may provide for the establishment of a designated floodway but usually provide also for the establishment of restrictive zones in which the degree of restriction would depend upon the flood hazard. Pertinent information about the establishment of a designated floodway and of restrictive zones, together with pertinent information about selecting the flood to be used as the basis for flood-plain regulation, is given in the following subparagraphs.

- (1) Designated floodway.--By establishing floodway-encroachment lines (see sketch on next page), a local zoning or regulatory agency could prohibit the building of permanent structures that would obstruct the natural flow of floodwaters within a designated floodway on the flood plain. That agency would

## SUGGESTED FLOOD ZONES



Note.--The suggested typical flood zones shown in the sketch are considered generally applicable to flood plains. However, in the flood plains considered in this report, two additional conditions require flood zones based on conditions other than those shown in the sketch as follows:

1. The first additional condition occurs where natural channel and flow conditions require a designated floodway that is as wide as the limits of the flood selected for flood-plain regulation (i.e., where the floodway-encroachment lines coincide with the limits of the flood selected for flood-plain regulation). Where such a condition occurs, the restrictive zones extend from the designated floodway to the limits of the flood plain (i.e., the limits of the standard project flood).

2. The second additional condition occurs where bank conditions within the flood plain shown in the sketch require an allowance for protection against bank caving. Where such a condition occurs, provision for 100 feet of additional zone is necessary landward from the bank.

determine the criteria for specifying the flood magnitude considered as the basis of flood-plain regulation: The floodway required for passage of the designated flood could then be determined, and the encroachment lines established.

- (2) Restrictive zones.--By establishing restrictive zones (see sketch on preceding page), a local zoning or regulatory agency could so control the elevation of floors, landfill, street grades, subdivision drainage, and other improvements as to permit the most effective use of land without undue risk of damage from flooding. The storage of large quantities of floatable material should be prohibited in the restrictive zones, because such material could cause damage to downstream improvements, could cause obstruction to floodflows at bridges, and could result in widening the overflow area.
- (3) Selecting the designated flood.--Flood damage in the flood plain can be reduced effectively only if the flood magnitude adopted in determining the width of the designated floodway is of infrequent occurrence, and only if the designated floodway results in raising the flood level in the restrictive zones by less than 6 inches. For the study area covered in this report, the Flood Control

District of Maricopa County indicated by letter dated 17 October 1963 to the Los Angeles District that the flood-plain area to be regulated should be of sufficient size to accommodate a flood with an occurrence frequency of about once in a hundred years. Under the criteria discussed on this page and on the three preceding pages, the width of the designated floodway coincides with the limits of the 100-year flood on Flying "E" Wash and Sols Wash - as shown on the flood-area maps for these streams (pls. 11 to 17, inclusive); and the width of the designated floodway coincides with the limits of the 50-year flood on Powder House Wash, Sunset Wash, and Casandro Wash - as shown on the flood-area maps for these streams (pls. 7 to 10, inclusive).

(c) Subdivision regulations.--The regulation of subdivisions provides one of the most immediately effective means of reducing flood damages in generally undeveloped areas. Cities and counties should proceed early and rapidly to establish regulations because of the opportunity of producing ideal developments not hampered by nonconforming existing uses. Designated floodways and restrictive zones can be established by subdivision regulations in the same manner as with zoning ordinances.

(d) Building codes.--Building codes could be developed to provide for the safety of buildings by requiring minimum elevations for floors and installed equipment, such as furnaces, in the restrictive zones of the flood plain.

79. Other preventive measures.--Reduction of future flood damage could also be accomplished by setting aside flood-plain land for parks and recreational areas on the basis of the future needs of the city and county for these uses. Any existing buildings in those parts of such recreational areas that are within the designated floodway should be relocated outside the designated floodway. Tax adjustments could be used to encourage flood-plain use that would not add a burden on the community by increasing the need for flood fighting, relief, and expenditures for repair of flood damages to service facilities. Preventive measures that could be used to alert potential builders to the threat of flood damage include (a) the placing of warning signs in the flood-plain areas and (b) the entering of flood-hazard information on the county land-title record for each land parcel subject to flooding. This concludes the discussion of those preventive measures for flood-damage reduction that are charted on page 34.

#### Need for Continuing Observation

80. Because quantitative records of precipitation and quantitative information on streamflow characteristics for the Wickenburg area were inadequate, the flood-magnitude estimates used in this report were based on available information on precipitation and streamflow for comparable drainage areas. Additional precipitation and stream-gaging stations properly located would provide information needed by engineers to improve the evaluation of present conditions and the prediction of future conditions.

Continuing Assistance of the Corps of Engineers

81. The technical assistance of the Corps of Engineers will be available, upon request of the State and local governmental agencies concerned, to interpret and explain information in this report and to provide any other flood data that become available for the use of the local planning agencies.

## CONCLUSIONS

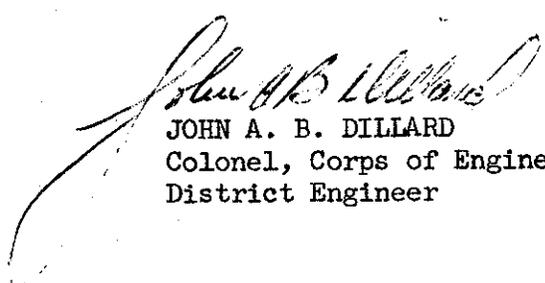
82. A potential flood hazard exists in the flood plains of the Wickenburg area including the drainage areas of Powder House Wash, Sunset Wash, Casandro Wash, Flying "E" Wash, and Sols Wash; and flood damage has occurred in the area. The hazard presents a special problem in the downstream reaches of these five streams, which all empty into the Hassayampa River or Sols Wash - a major tributary of the Hassayampa River - at points in or near the Town of Wickenburg.

83. The study indicates that the Town of Wickenburg, which is a highly developed resort, is extremely vulnerable to damage from floods. In general, the stream channels in and near the Town are poorly defined and are adequate to accommodate only minor flows. As a result, floodflows in the Wickenburg area spread out as over-land flow and cause damage to various types of property including business, residential, railroad, Town, County, State, and Federal property.

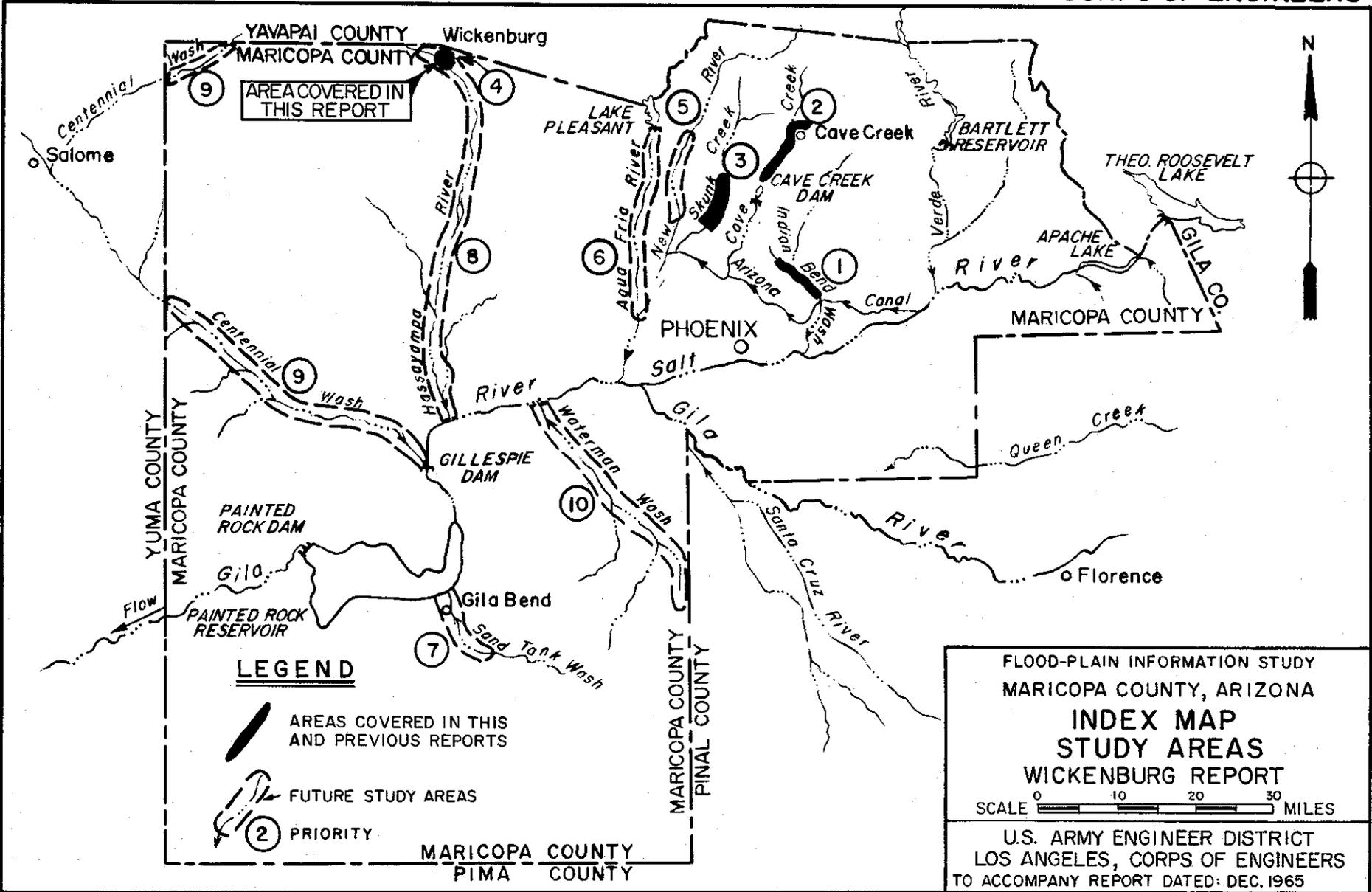
84. Although development has already encroached on the flood plains of the streams in the study area, the problem will become more acute in the future with the further increases in population and development that are expected to take place. Preventive measures should be taken as soon as possible to forestall any further encroachment that might lessen the flood-carrying capacity of the floodways.

85. The information in this report is intended to provide a factual basis for local governmental agencies in formulating

appropriate regulations and measures to control development in the flood plains of the Wickenburg area - and to provide information for the guidance of real-estate developers or private individuals in acquiring or developing land in these flood plains.

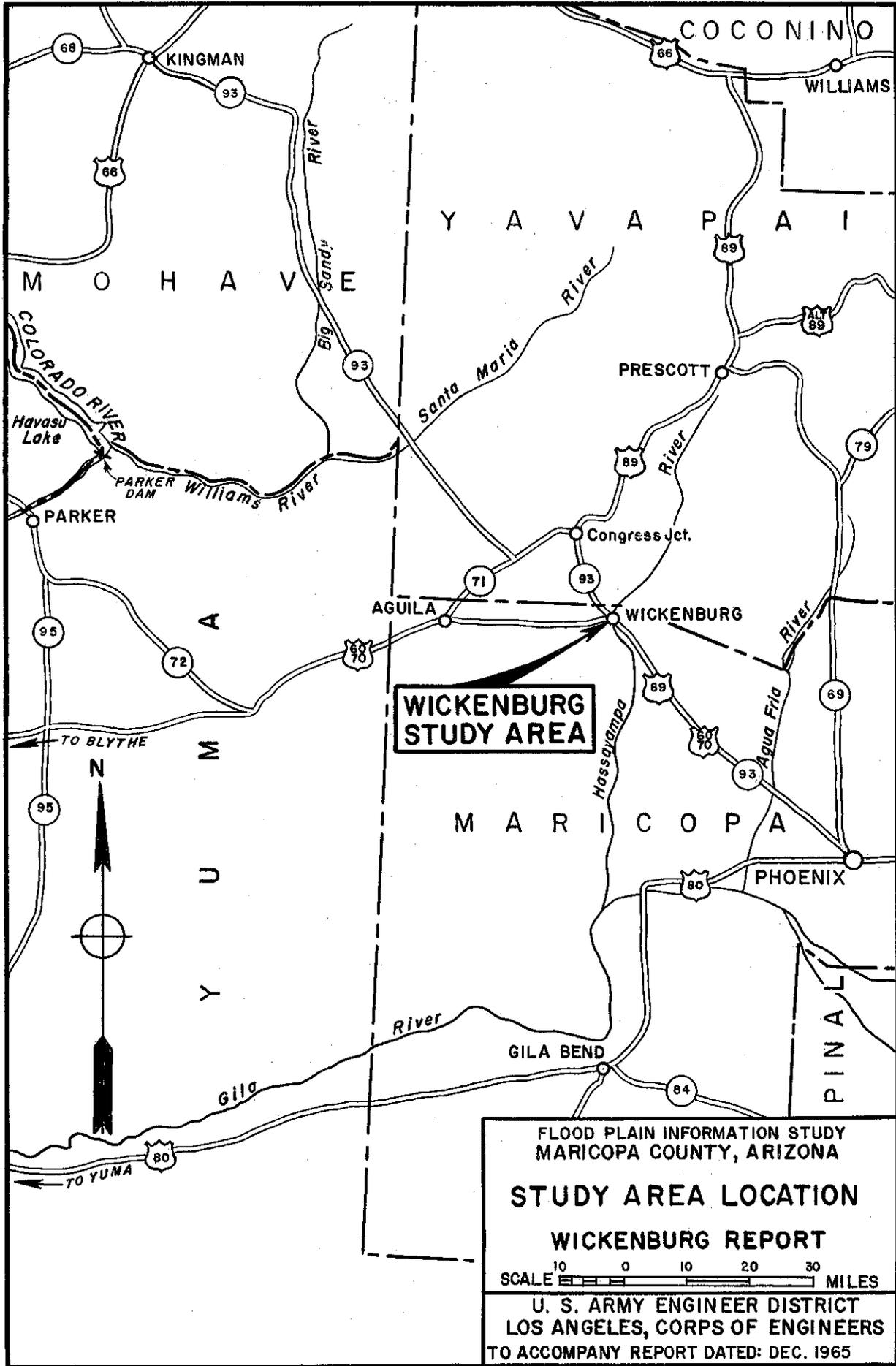


JOHN A. B. DILLARD  
Colonel, Corps of Engineers  
District Engineer



FILE NO. 203/193

PLATE I



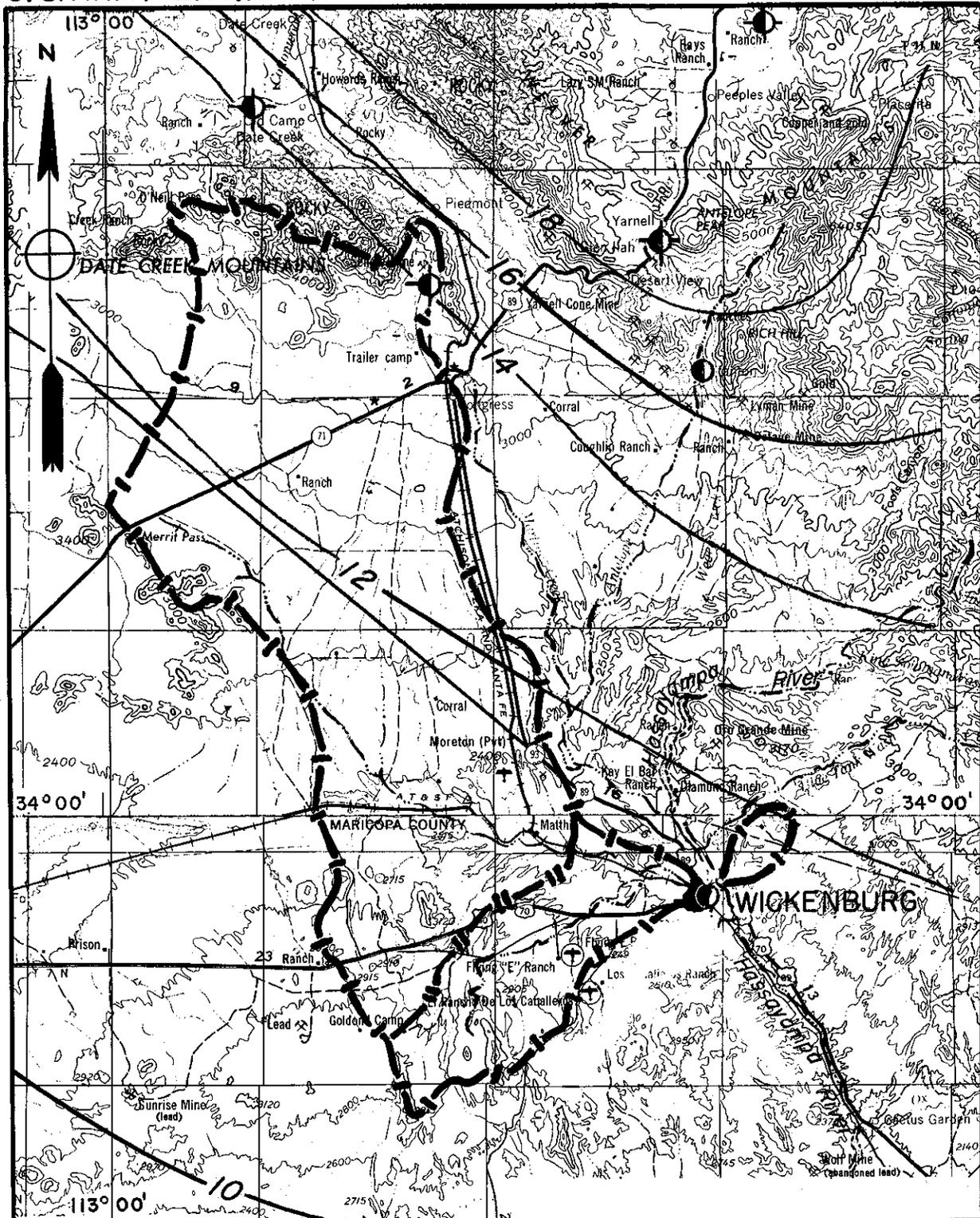
FLOOD PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA

**STUDY AREA LOCATION**

**WICKENBURG REPORT**

SCALE 10 0 10 20 30 MILES

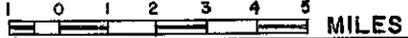
U. S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965



**LEGEND**

-  BOUNDARY OF PROJECT DRAINAGE AREA.
-  BOUNDARY OF PROJECT DRAINAGE SUB-AREA. ALSO SEE PLATE NO. 4 FOR LOCAL DRAINAGE AREAS.
-  LINE OF EQUAL 90-YEAR (1868-1957) MEAN ANNUAL PRECIPITATION IN INCHES
-  PRECIPITATION STATION (NON-RECORDING).
-  PRECIPITATION STATION (NON-RECORDING) DISCONTINUED.

FLOOD PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**HYDROLOGIC MAP**  
**MAJOR DRAINAGE AREAS**  
**WICKENBURG REPORT**

SCALE  MILES

U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965



**NOTES:**  
 1. SEE PLATE 3 FOR OVERALL MAJOR DRAINAGE AREAS.  
 2. SEE TABLE ON PLATE 5 FOR SIZES OF DRAINAGE AREAS IN SQUARE MILES AND MAGNITUDES OF VARIOUS FLOODS IN CUBIC FEET PER SECOND. (C.F.S.)

**LEGEND**  
 ——— BOUNDARY OF MAJOR DRAINAGE AREA  
 ——— BOUNDARY OF LOCAL DRAINAGE AREA  
 (2) POINT OF CONCENTRATION OF DRAINAGE AREA.

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**STREAM NAMES AND LOCAL DRAINAGE AREAS**  
 WICKENBURG REPORT  
 SCALE 1500 0 1500 FEET  
 U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965  
 FILE NO. 203/196 PLATE 4



D.A. No.	WASH	DRAINAGE AREA-Sq.Mi.	S.P.F. c.f.s.	100-yr c.f.s.	50-yr c.f.s.
1	POWDER HOUSE	1.8	3,500	1,900	1,300
2	POWDER HOUSE	1.9	3,500	1,900	1,300
3	SUNSET	2.4	4,000	2,100	1,400
4	SUNSET	1.3	2,000	1,050	700
5	SUNSET	0.4	1,000	520	360
6	CASANDRO	1.5	3,000	1,500	1,050
7	CASANDRO	1.3	2,500	1,280	900
8	FLYING E	9.5	14,500	7,500	5,000
9	FLYING E	8.4	12,500	6,500	4,500
10	SOLS	145.0	45,000	24,000	16,500
11	SOLS	120.0	40,000	21,500	14,200

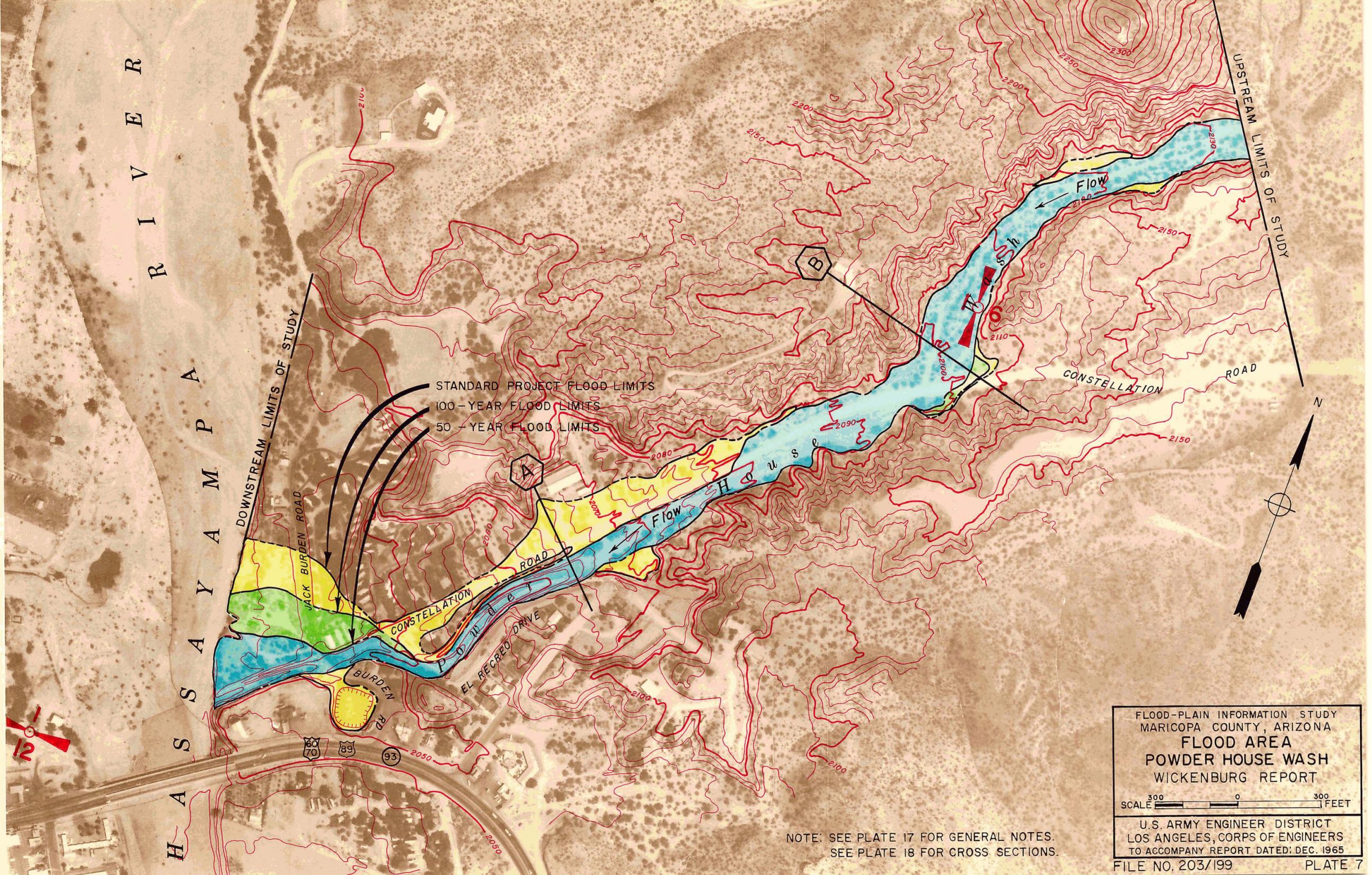
**LEGEND**  
 ② POINT OF CONCENTRATION OF DRAINAGE AREA. (D.A.No.)

**NOTE:**  
 SEE TABLE ON THIS PLATE FOR SIZES OF DRAINAGE AREAS IN SQUARE MILES AND MAGNITUDES OF VARIOUS FLOODS IN CUBIC FEET PER SECOND. (C.F.S.)

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**POINTS OF CONCENTRATION  
 FREQUENCIES-STUDY REACHES  
 WICKENBURG REPORT**  
 SCALE 1500 0 1500 FEET  
 U. S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965  
 FILE NO. 203/197 PLATE 5



FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**INDEX OF FLOOD AREAS**  
**WICKENBURG REPORT**  
 SCALE 1500 0 1500 FEET  
 U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965  
 FILE NO. 203/198 **PLATE 6**



R I V E R  
H A S S A Y A M P  
R I V E R

STANDARD PROJECT FLOOD LIMITS  
100-YEAR FLOOD LIMITS  
50-YEAR FLOOD LIMITS

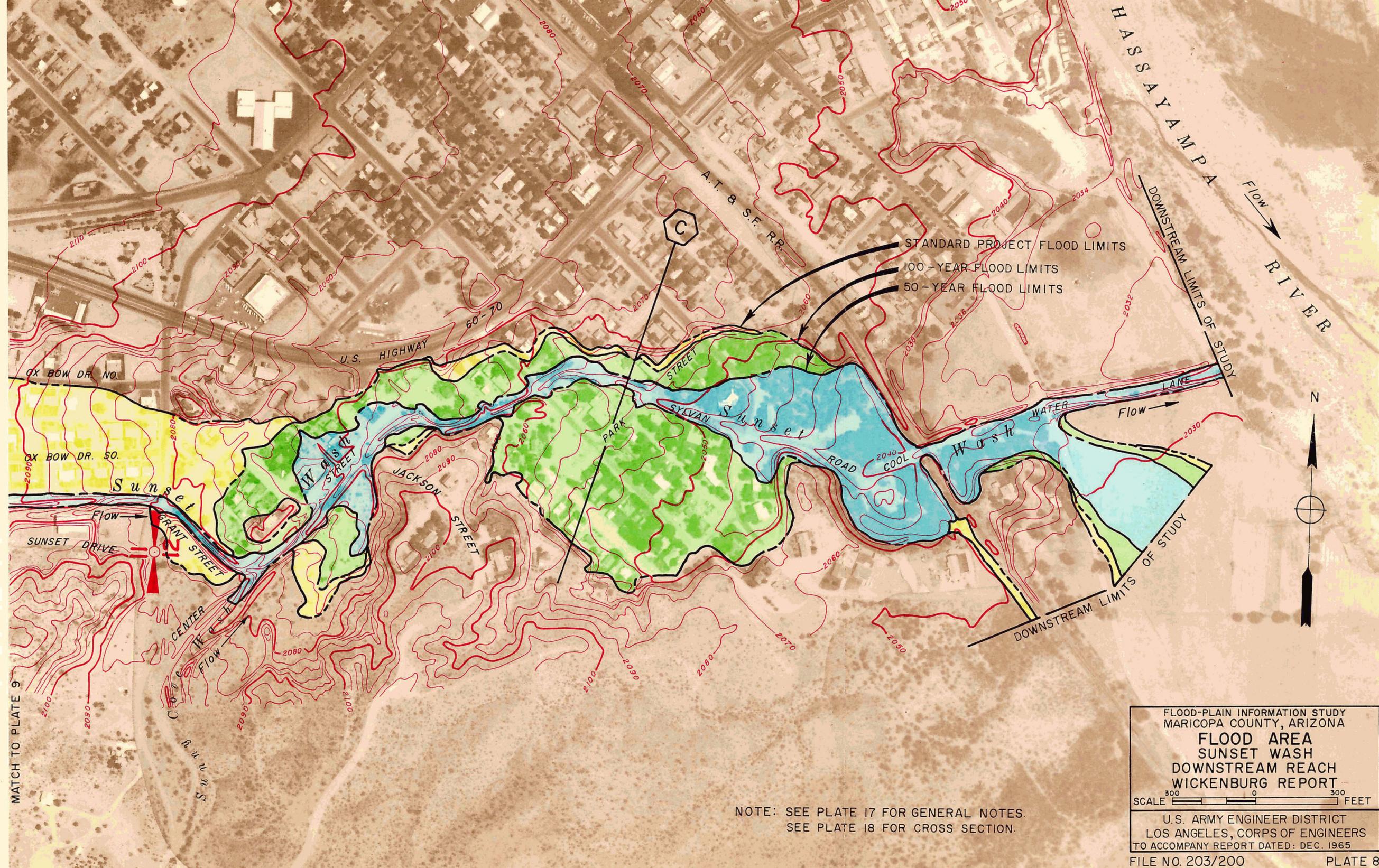
FLOOD-PLAIN INFORMATION STUDY  
MARICOPA COUNTY, ARIZONA  
**FLOOD AREA**  
POWDER HOUSE WASH  
WICKENBURG REPORT

SCALE 300 0 300 FEET

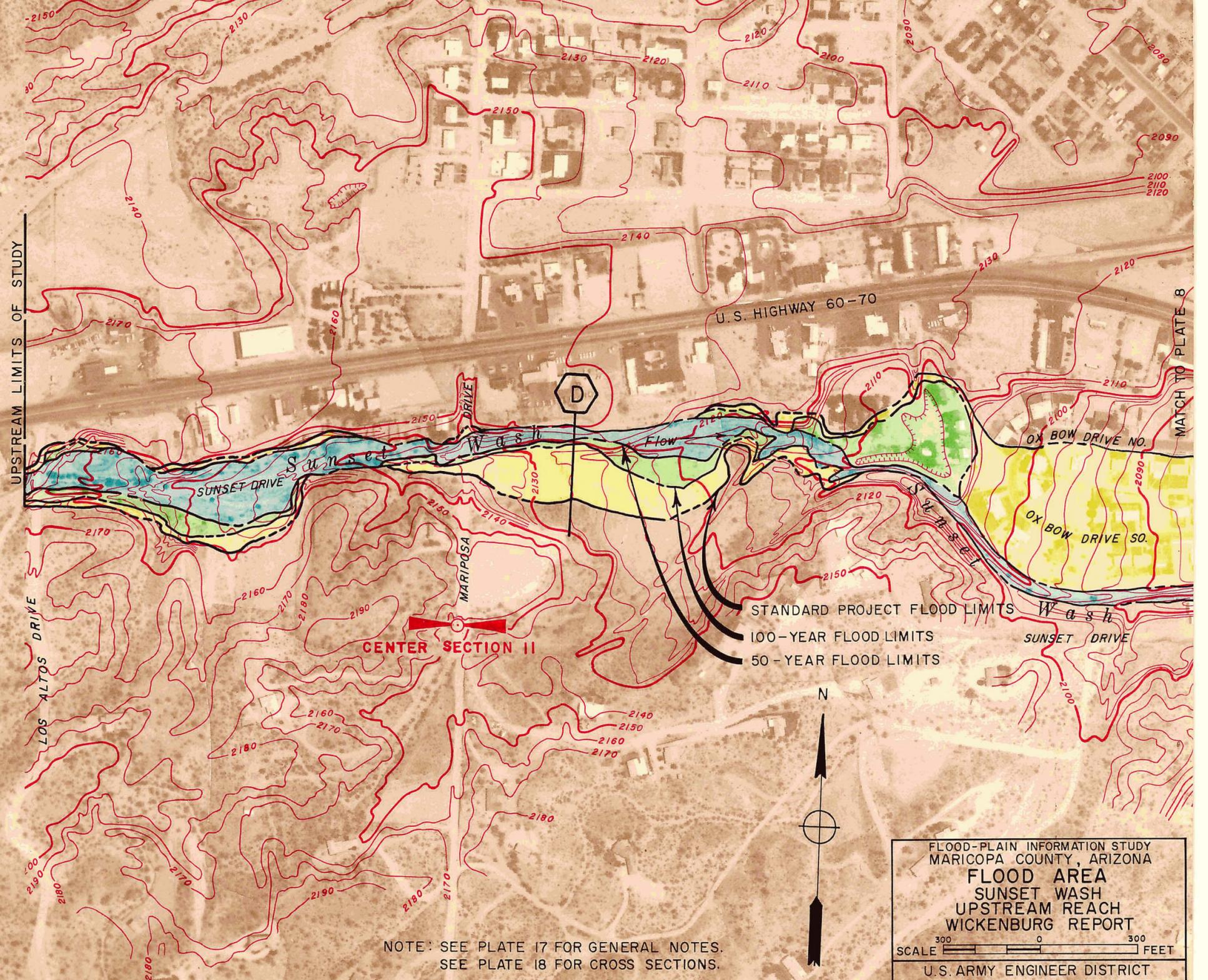
U.S. ARMY ENGINEER DISTRICT  
LOS ANGELES, CORPS OF ENGINEERS  
TO ACCOMPANY REPORT DATED: DEC. 1965

FILE NO. 203/199 PLATE 7

NOTE: SEE PLATE 17 FOR GENERAL NOTES.  
SEE PLATE 18 FOR CROSS SECTIONS.



10 11



NOTE: SEE PLATE 17 FOR GENERAL NOTES.  
SEE PLATE 18 FOR CROSS SECTIONS.

FLOOD-PLAIN INFORMATION STUDY  
MARICOPA COUNTY, ARIZONA  
**FLOOD AREA**  
SUNSET WASH  
UPSTREAM REACH  
WICKENBURG REPORT

U.S. ARMY ENGINEER DISTRICT  
LOS ANGELES, CORPS OF ENGINEERS  
TO ACCOMPANY REPORT DATED: DEC. 1965  
FILE NO. 203/201

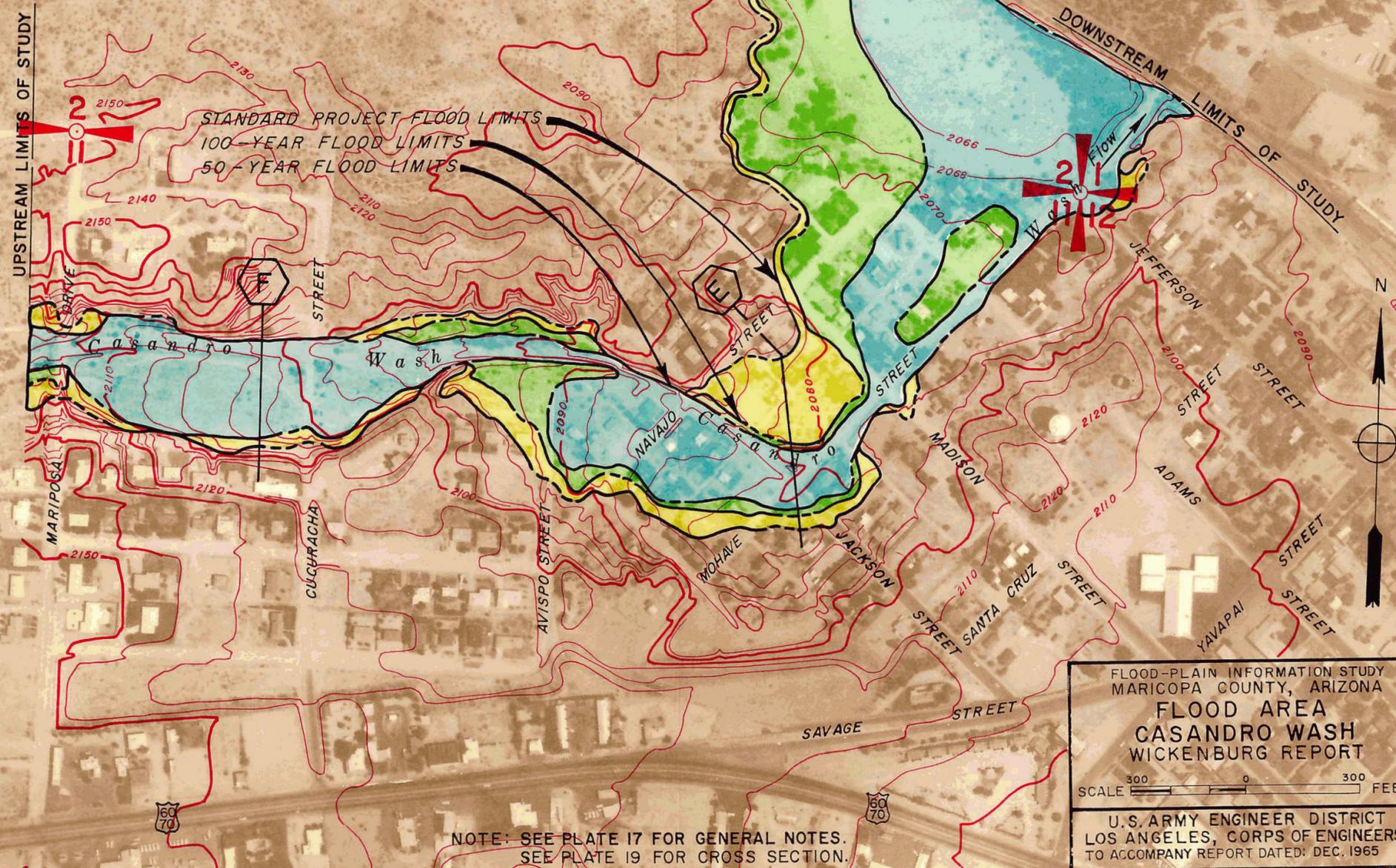
PLATE 9

UPSTREAM LIMITS OF STUDY

STANDARD PROJECT FLOOD LIMITS  
100-YEAR FLOOD LIMITS  
50-YEAR FLOOD LIMITS

DOWNSTREAM LIMITS OF STUDY

FOR OVERFLOW AREA DOWNSTREAM FROM RAILROAD SEE PLATE 13



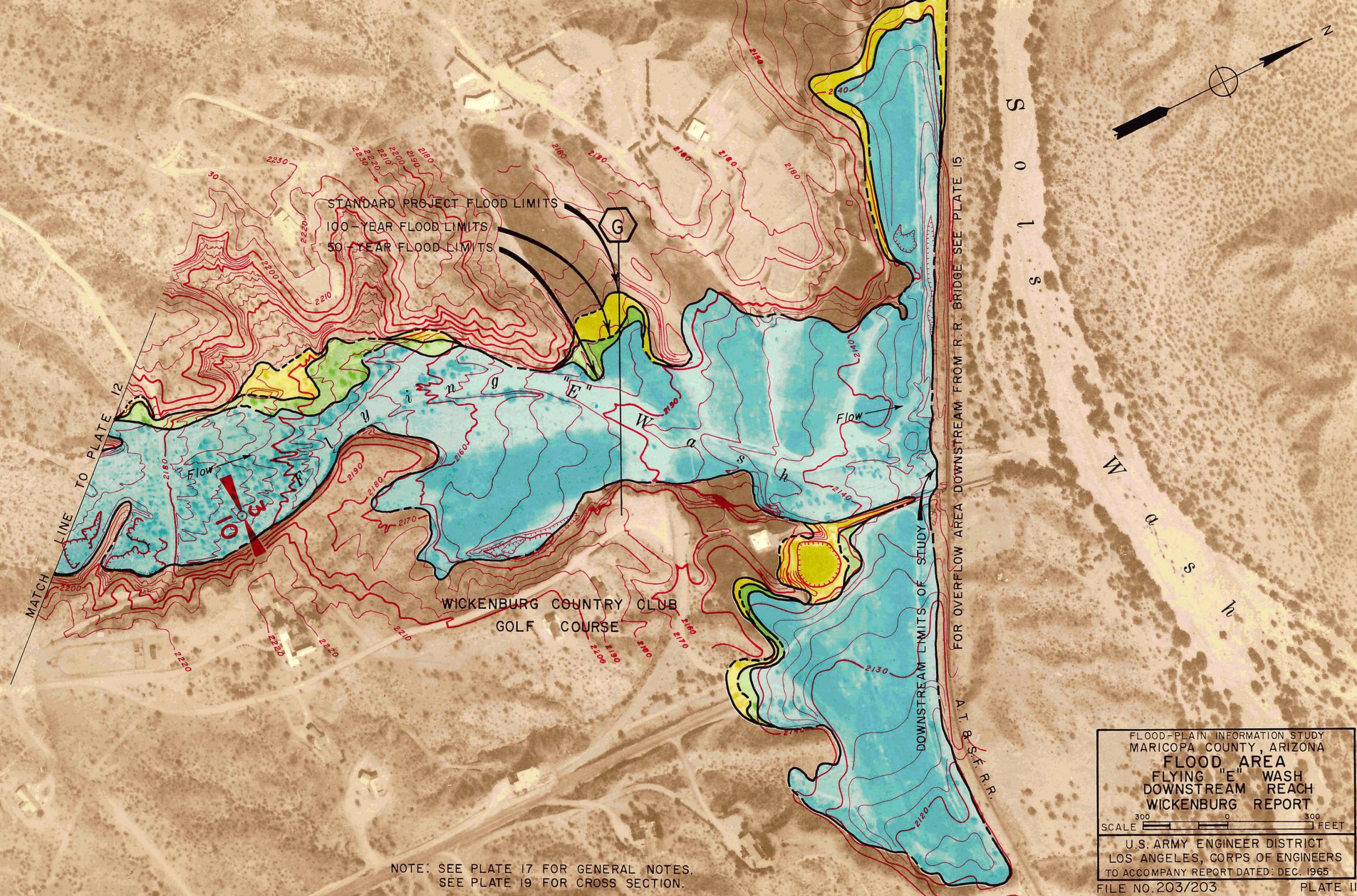
NOTE: SEE PLATE 17 FOR GENERAL NOTES.  
SEE PLATE 19 FOR CROSS SECTION.

FLOOD-PLAIN INFORMATION STUDY  
MARICOPA COUNTY, ARIZONA  
**FLOOD AREA**  
**CASANDRO WASH**  
**WICKENBURG REPORT**

SCALE 300 0 300 FEET

U.S. ARMY ENGINEER DISTRICT  
LOS ANGELES, CORPS OF ENGINEERS  
TO ACCOMPANY REPORT DATED: DEC. 1965

FILE NO. 203/202 PLATE 10



NOTE: SEE PLATE 17 FOR GENERAL NOTES.  
 SEE PLATE 19 FOR CROSS SECTION.

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**FLOOD AREA**  
 FLYING "E" WASH  
 DOWNSTREAM REACH  
 WICKENBURG REPORT

SCALE 300 0 300 FEET

U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965  
 FILE NO. 203/203 PLATE 11

VULTURE MINE ROAD

STANDARD PROJECT FLOOD LIMITS  
100-YEAR FLOOD LIMITS  
50-YEAR FLOOD LIMITS

UPSTREAM LIMITS OF STUDY

MATCH LINE TO PLATE II



9010

303

NOTE: SEE PLATE 17 FOR GENERAL NOTES.  
SEE PLATE 19 FOR CROSS SECTION.

FLOOD-PLAIN INFORMATION STUDY  
MARICOPA COUNTY, ARIZONA  
**FLOOD AREA**  
FLYING "E" WASH  
UPSTREAM REACH  
WICKENBURG REPORT

SCALE 300 0 300 FEET

U.S. ARMY ENGINEER DISTRICT  
LOS ANGELES, CORPS OF ENGINEERS  
TO ACCOMPANY REPORT DATED: DEC. 1965

FILE NO. 203/204 PLATE 12



STANDARD PROJECT FLOOD LIMITS  
 100-YEAR FLOOD LIMITS  
 50-YEAR FLOOD LIMITS

NOTE: SEE PLATE 17 FOR GENERAL NOTES.

FOR OVERFLOW AREA OF POWDER HOUSE WASH SEE PLATE 7.

DOWNSTREAM LIMITS OF STUDY

MATCH TO PLATE 14

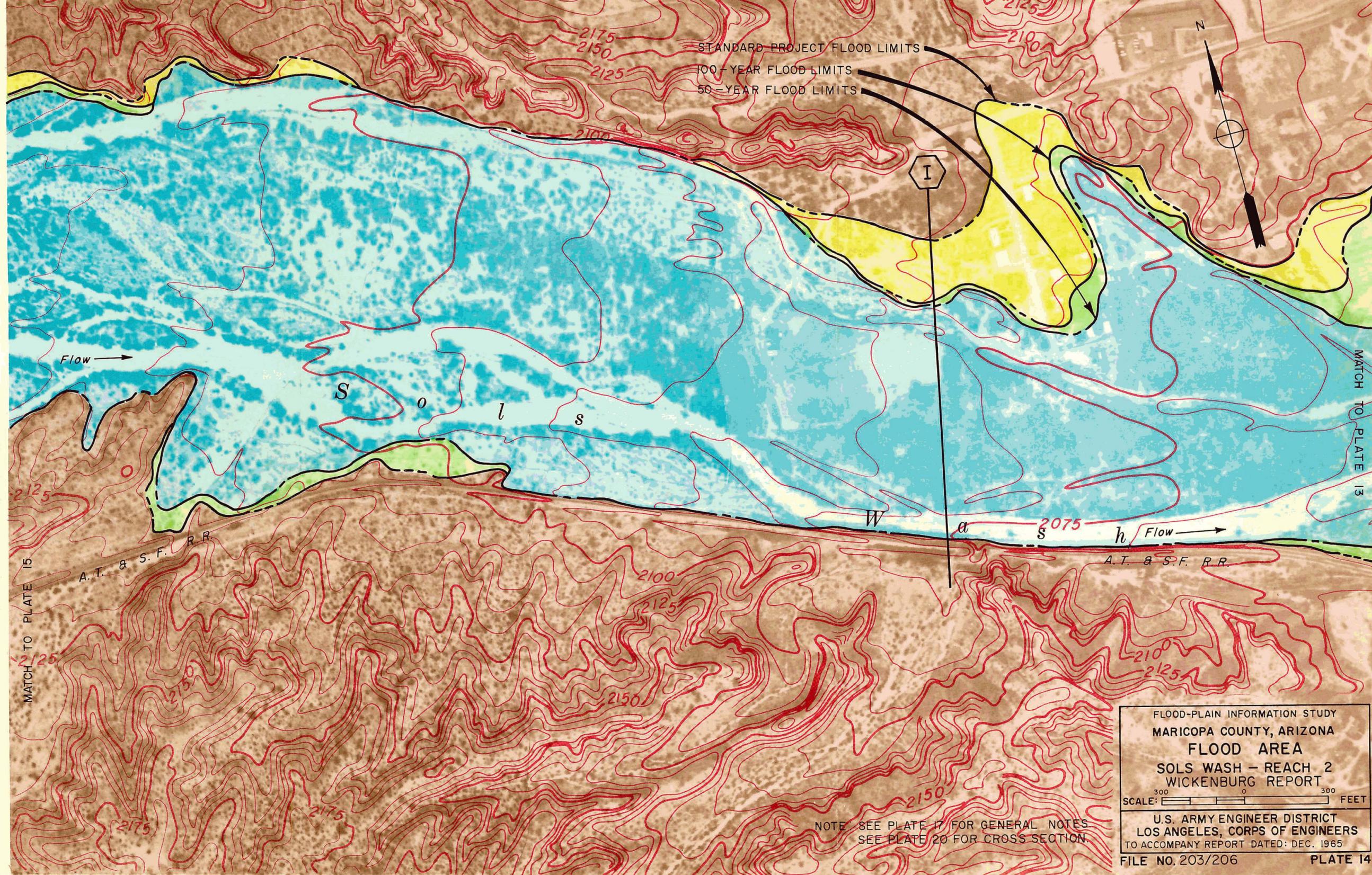
FOR OVERFLOW AREA OF CASANDRO WASH SEE PLATE 10.

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**FLOOD AREA**  
 SOLS WASH - REACH I  
 WICKENBURG REPORT

SCALE FEET

U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965

FILE NO. 203/205 PLATE 13



STANDARD PROJECT FLOOD LIMITS  
 100-YEAR FLOOD LIMITS  
 50-YEAR FLOOD LIMITS

MATCH TO PLATE 15

MATCH TO PLATE 13

A.T. & S.F. R.R.

A.T. & S.F. R.R.

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
 FLOOD AREA  
 SOLS WASH - REACH 2  
 WICKENBURG REPORT  
 SCALE: FEET

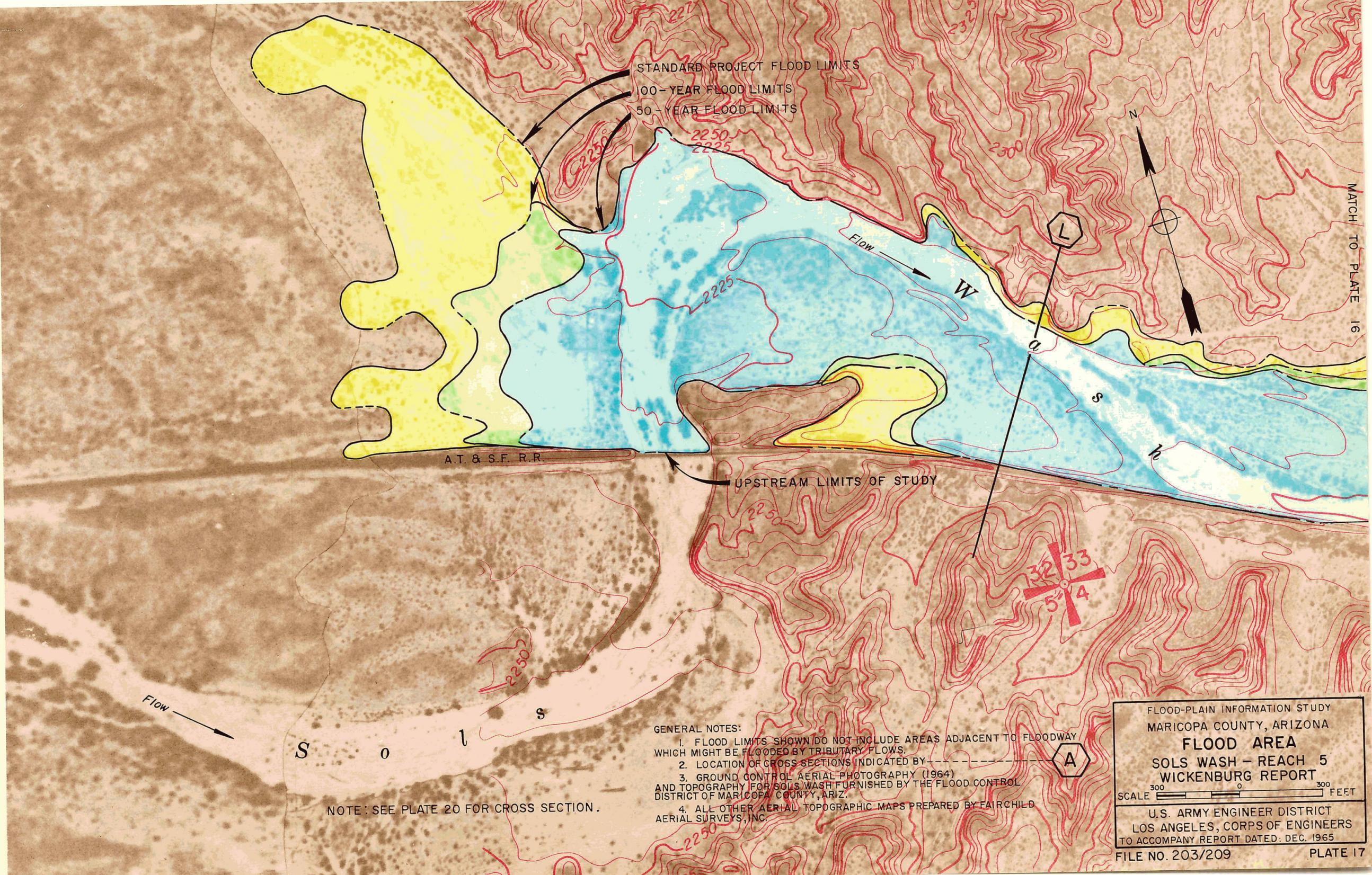
NOTE: SEE PLATE 17 FOR GENERAL NOTES  
 SEE PLATE 20 FOR CROSS SECTION

U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965

FILE NO. 203/206 PLATE 14







STANDARD PROJECT FLOOD LIMITS  
 100-YEAR FLOOD LIMITS  
 50-YEAR FLOOD LIMITS

A.T. & S.F. R.R.

UPSTREAM LIMITS OF STUDY

MATCH TO PLATE 16

Flow

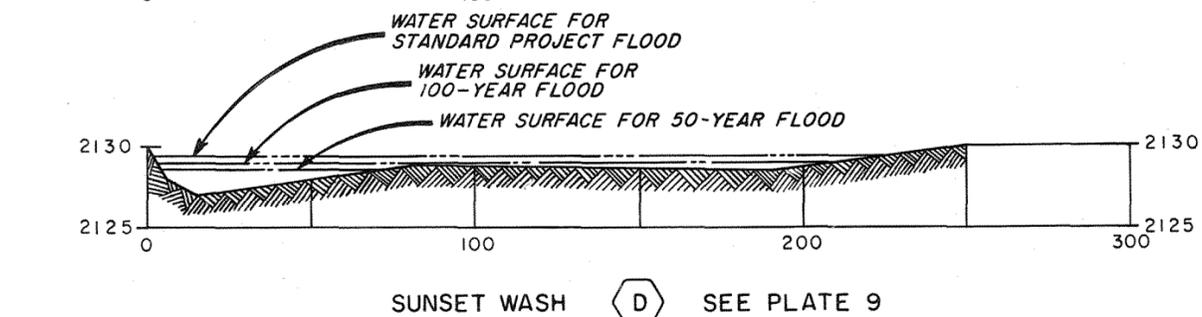
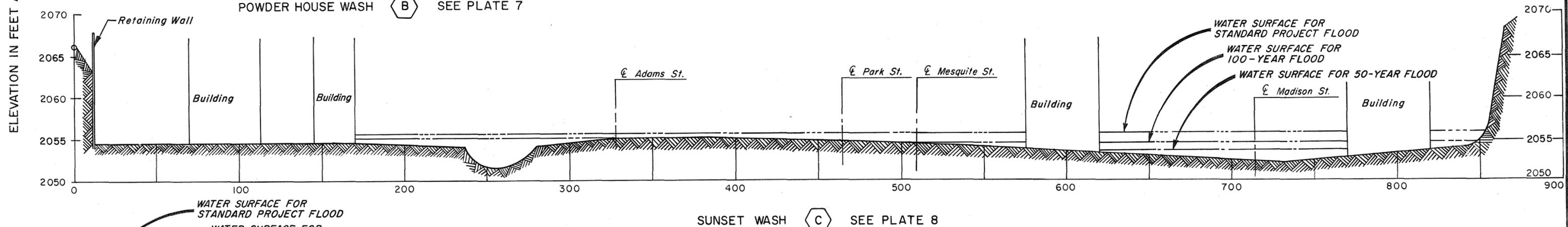
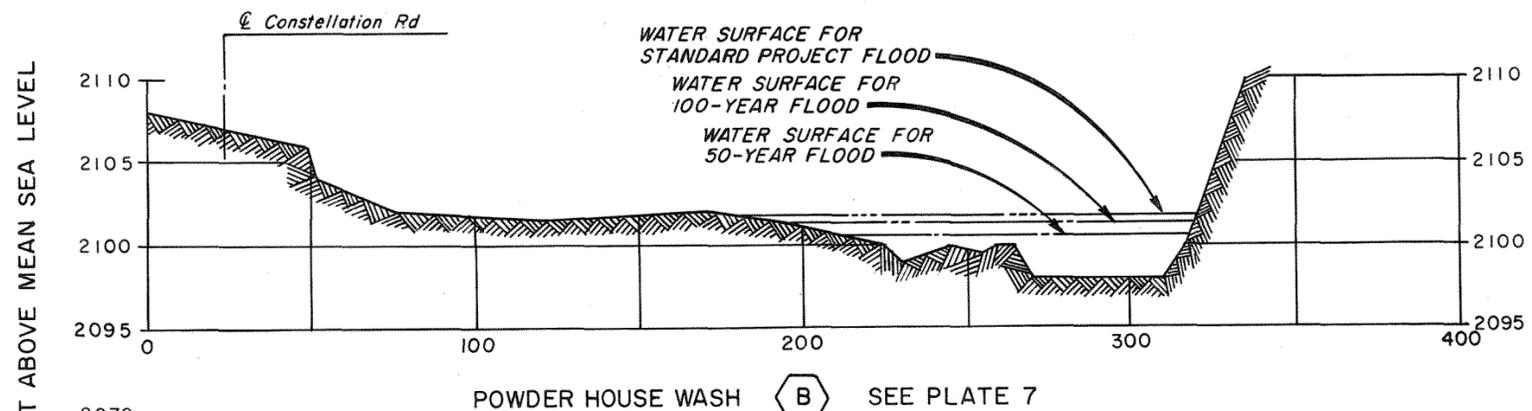
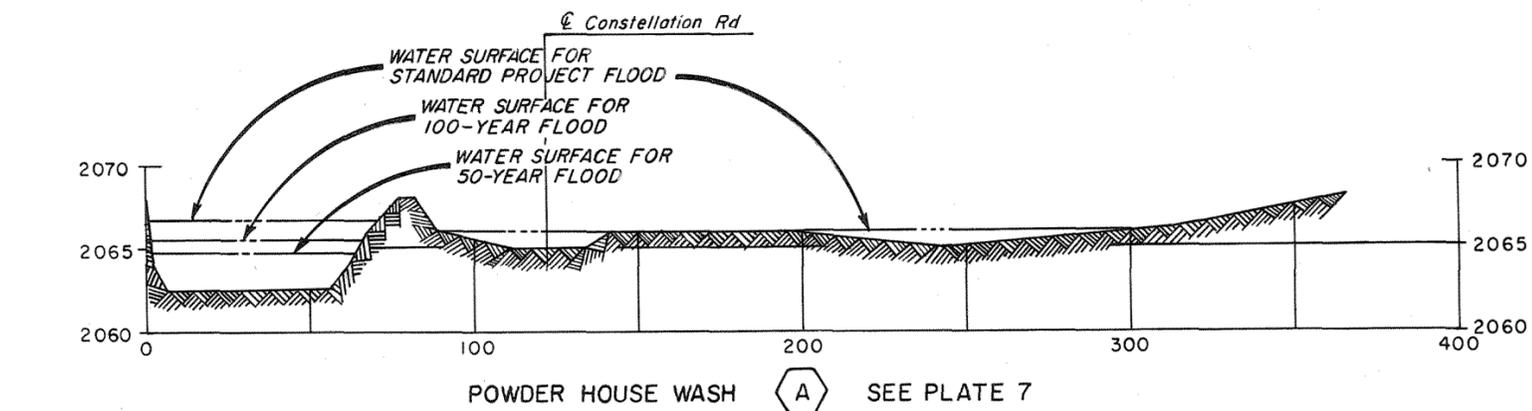
Flow

GENERAL NOTES:

1. FLOOD LIMITS SHOWN DO NOT INCLUDE AREAS ADJACENT TO FLOODWAY WHICH MIGHT BE FLOODED BY TRIBUTARY FLOWS.
2. LOCATION OF CROSS SECTIONS INDICATED BY - - - - -
3. GROUND CONTROL AERIAL PHOTOGRAPHY (1964) AND TOPOGRAPHY FOR SOLS WASH FURNISHED BY THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZ.
4. ALL OTHER AERIAL TOPOGRAPHIC MAPS PREPARED BY FAIRCHILD AERIAL SURVEYS, INC.

NOTE: SEE PLATE 20 FOR CROSS SECTION.

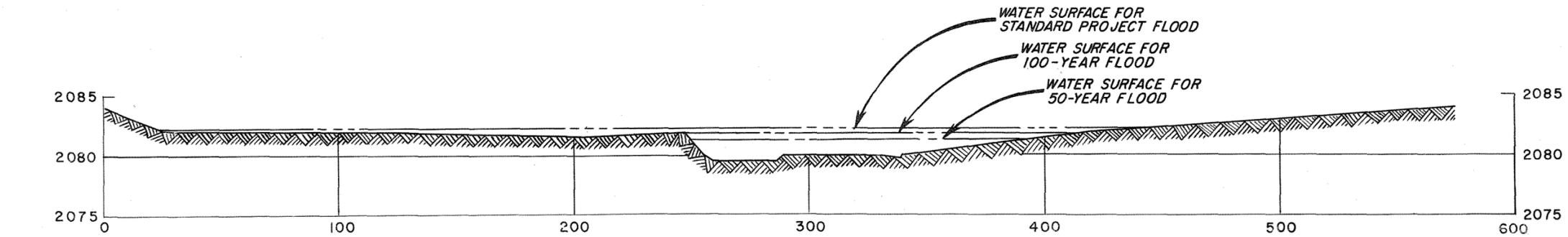
FLOOD-PLAIN INFORMATION STUDY	
MARICOPA COUNTY, ARIZONA	
<b>FLOOD AREA</b>	
<b>SOLS WASH - REACH 5</b>	
<b>WICKENBURG REPORT</b>	
SCALE  FEET	
U.S. ARMY ENGINEER DISTRICT	
LOS ANGELES, CORPS OF ENGINEERS	
TO ACCOMPANY REPORT DATED: DEC. 1965	
FILE NO. 203/209	PLATE 17



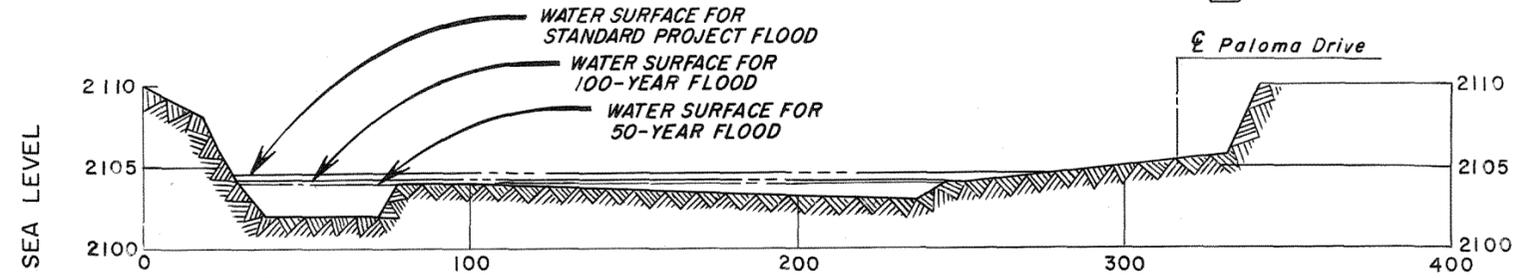
NOTES:

1. VIEWS ARE LOOKING DOWNSTREAM
2. SEE NOTE ON HORIZONTAL SCALE, PLATE 20 FOR CHANGE IN HORIZONTAL SCALE

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**CROSS SECTIONS**  
 WICKENBURG REPORT  
 DATUM IS MEAN SEA LEVEL SCALE: AS SHOWN  
 U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965

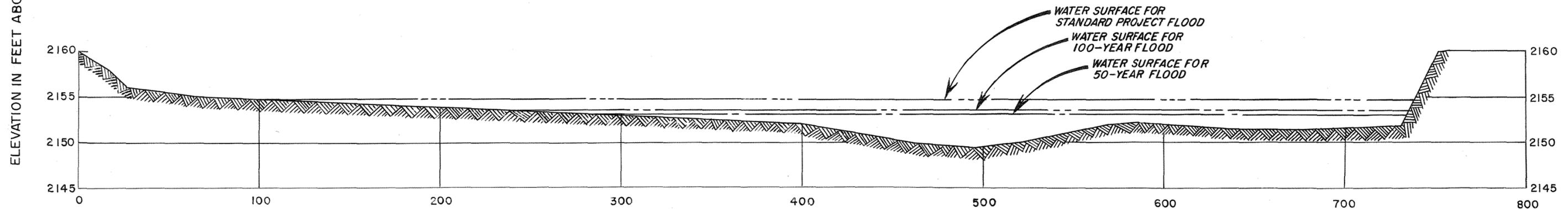


CASANDRO WASH (E) (SEE PLATE 10)

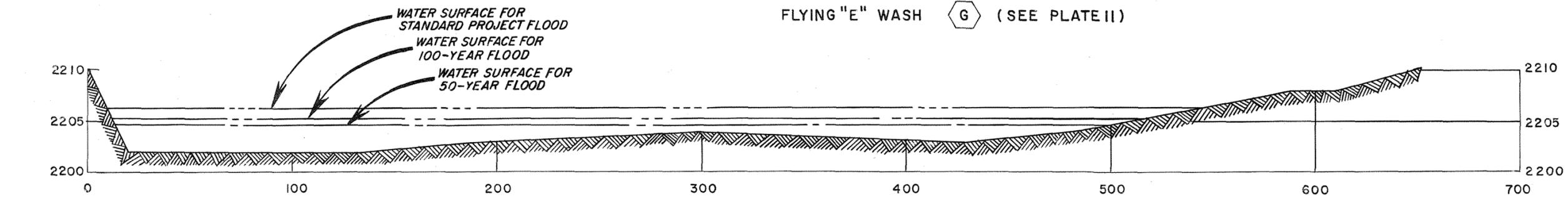


CASANDRO WASH (F) (SEE PLATE 10)

- NOTES:  
 1. VIEWS ARE LOOKING DOWNSTREAM  
 2. SEE NOTE ON HORIZONTAL SCALE, PLATE 20 FOR CHANGE IN HORIZONTAL SCALE

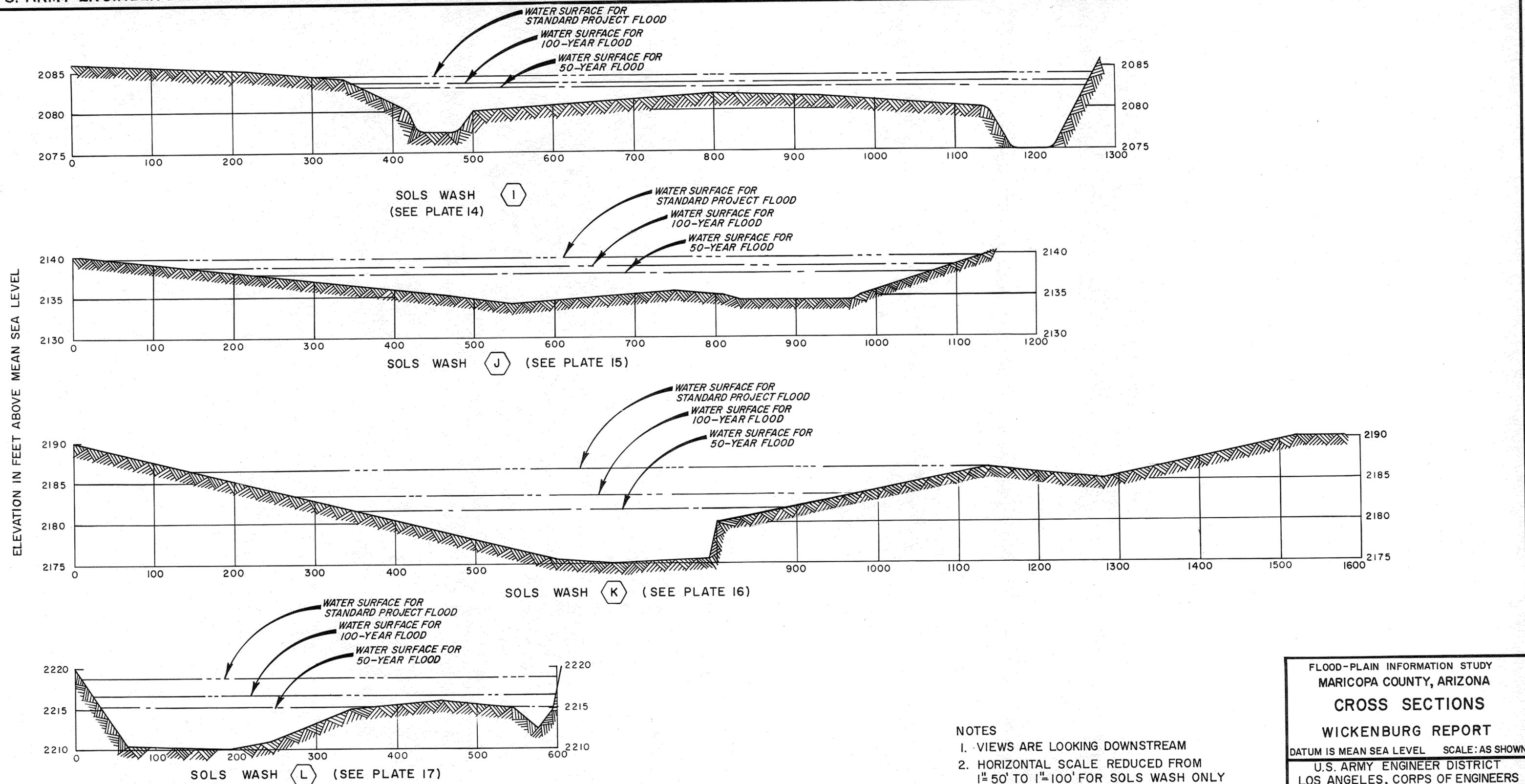


FLYING "E" WASH (G) (SEE PLATE 11)



FLYING "E" WASH (H) (SEE PLATE 12)

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**CROSS SECTIONS**  
 WICKENBURG REPORT  
 DATUM IS MEAN SEA LEVEL SCALE: AS SHOWN  
 U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965



- NOTES
1. VIEWS ARE LOOKING DOWNSTREAM
  2. HORIZONTAL SCALE REDUCED FROM 1"=50' TO 1"=100' FOR SOLS WASH ONLY

FLOOD-PLAIN INFORMATION STUDY  
 MARICOPA COUNTY, ARIZONA  
**CROSS SECTIONS**  
 WICKENBURG REPORT  
 DATUM IS MEAN SEA LEVEL SCALE: AS SHOWN  
 U.S. ARMY ENGINEER DISTRICT  
 LOS ANGELES, CORPS OF ENGINEERS  
 TO ACCOMPANY REPORT DATED: DEC. 1965

APPENDIX 1 - AUTHORIZATION  
FLOOD-PLAIN-INFORMATION STUDY  
FOR  
MARICOPA COUNTY, ARIZONA

VOLUME IV  
WICKENBURG REPORT

1. Scope.--This appendix presents supplemental material on (a) the congressional authorization providing authority for the U.S. Army Corps of Engineers to conduct flood-plain-information studies and (b) the Maricopa County resolutions requesting the Corps to make such studies in Maricopa County and providing assurances that information in the completed report will be disseminated and publicized.

2. Congressional authorization.--This report is prepared pursuant to act of Congress, Public Law 86-645, Eighty-sixth Congress, approved 14 July 1960, which reads in part as follows:

SEC. 206. (a) That, in recognition of the increasing use and development of the flood plains of the rivers of the United States and of the need for information on flood hazards to serve as a guide to such development, and as a basis for avoiding future flood hazards by regulation of use by States and municipalities, the Secretary of the Army, through the Chief of Engineers, Department of the Army, is hereby authorized to compile and disseminate information on floods and flood damages, including identification of areas subject to inundation by floods of various magnitudes and frequencies, and general criteria for guidance in the use of flood plain areas; and to provide engineering advice to local interests for their use in planning to ameliorate the flood hazard: Provided, That the necessary surveys and studies will be made and such information and advice will be provided for specific localities only upon the request of a State or a responsible local governmental agency and upon approval by the Chief of Engineers.

(b) The Secretary of the Army is hereby authorized to allot, from any appropriations hereafter made for flood control, sums not to exceed \$1,000,000 in any one fiscal year for the compilation and dissemination of such information.

\* \* \* \* \*

3. Maricopa County resolutions ---The Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County adopted resolutions on 26 September 1960 and 11 December 1961.

4. In the resolution of 26 September 1960, Maricopa County requested that the U.S. Army Corps of Engineers make a flood-plain-information study for Maricopa County. The resolution reads as follows:

#### R E S O L U T I O N

WHEREAS, the Flood Control District of Maricopa County is charged with responsibility for preparation of a comprehensive program of flood control within the county, and

WHEREAS, information on floods and flood damages, including identification of areas subject to inundation by floods of various frequencies, criteria for guidance in the use of flood plain areas and engineering advice for use in planning to ameliorate flood hazard are essential to the preparation of a comprehensive program of flood control, and

WHEREAS, the United States Army Corps of Engineers is authorized under Section 206 of the Flood Control Act of 1960 to furnish such information and advice

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County that the Corps of Engineers is requested to provide the assistance which it is authorized to furnish by the above cited Act, and

BE IT FURTHERMORE RESOLVED that the Flood Control District of Maricopa County will assist the Corps of Engineers in obtaining basic hydrologic and topographic data required for its studies and

BE IT FURTHERMORE RESOLVED that the County of Maricopa and the Flood Control District of Maricopa County intend to use the information provided for the purpose of developing flood plain zoning plans and a comprehensive program of flood control and

BE IT FURTHERMORE RESOLVED that information and assistance will be furnished municipalities within the county for their use in implementing such flood plain zoning plans as may be recommended within their boundaries.

BE IT FURTHERMORE RESOLVED, that this resolution be entered on the minutes of the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County.

Passed and approved this 26 day of Sept., 1960.

/s/ Ruth A. O'Neil  
Chairman of the Board  
of Supervisors of  
Maricopa County

/s/ Ruth A. O'Neil  
Chairman of the Board  
of Directors of the  
Flood Control District  
of Maricopa County

ATTEST:

/s/ Rhea Averill  
Clerk of the Board

5. In the resolution of 11 December 1961, Maricopa County added more specific assurances that the flood-plain information report will be made available to all interested organizations and individuals and that the availability of the report will be adequately publicized. The resolution reads as follows:

#### R E S O L U T I O N

WHEREAS, the Flood Control District of Maricopa County is charged with responsibility for preparation of a comprehensive program of flood control within the county, and

WHEREAS, information on floods and flood damages, including identification of areas subject to inundation by floods of various frequencies, criteria for guidance in the use of flood plain areas and engineering advice for use in planning to ameliorate flood hazard are essential to the preparation of a comprehensive program of flood control, and

WHEREAS, the United States Army Corps of Engineers is authorized under Section 206 of the Flood Control Act of 1960 to furnish such information and advice, and

WHEREAS, the United States Army Corps of Engineers has authorized a flood plain information study of Maricopa County, Arizona, in accordance with the application of the Maricopa County Flood Control District dated July 26, 1960; project allocations covering Indian Bend Wash, Cave Creek, Skunk Creek, New River, Agua Fria River and Wickenburg area, and

WHEREAS, the United States Army Corps of Engineers require certain assurances from the Maricopa County Flood Control District before work can be initiated

NOW, THEREFORE, BE IT RESOLVED by the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County that the applicant will publicize the information report in the community and area concerned, and make copies available for use or inspection by responsible interested parties and individuals, and

BE IT FURTHERMORE RESOLVED that zoning and other regulatory, development and planning agencies, and public information media, will be provided with the flood plain information for their guidance and appropriate action, and

BE IT FURTHERMORE RESOLVED that survey markers, monuments, etc., established in any Federal surveys undertaken for Sec. 206 studies, or in regular surveys in the area concerned will be preserved and safeguarded, and

BE IT FURTHERMORE RESOLVED, that this resolution be entered on the minutes of the Board of Supervisors of Maricopa County and the Board of Directors of the Flood Control District of Maricopa County, and that the Chief Engineer and General Manager of said Flood Control District be and he is hereby directed to forward a certified copy of this resolution to the District Engineer, U.S. Army Engineer District, Los Angeles, Corps of Engineers, P.O. Box 17277 Foy Station, Los Angeles 17, California.

PASSED AND APPROVED this 11 day of December, 1961.

/s/ B. W. Burns  
Chairman of the Board of Supervisors of Maricopa County

/s/ B. W. Burns  
Chairman of the Board of Directors of the Flood Control District of Maricopa County

ATTEST:

APPROVED:

/s/ Rhea Averill  
Clerk of the Board

Board of Supervisors

by /s/ Charles W. Miller  
Charles W. Miller  
County Manager

APPENDIX 2 - GLOSSARY OF SELECTED TERMS

FLOOD-PLAIN-INFORMATION STUDY  
FOR  
MARICOPA COUNTY, ARIZONA

VOLUME IV  
WICKENBURG REPORT

The definitions in this appendix are provided for consistency of use in flood-plain-information studies and for clarification of terms for nontechnical readers. The definitions are based on definitions of terms in general technical usage.

**BASIN** - The region drained by a stream and its tributaries. A basin is usually separated from adjacent basins by ridges or mountain ranges.

**CUBIC FEET PER SECOND (c.f.s.)** - A measure of the magnitude of streamflow (i.e., the number of cubic feet of water passing a point each second).

**DESIGNATED FLOODWAY** - The channel of a stream and that part of the adjoining flood plain designated by a regulatory agency to reasonably provide for passage of a selected flood. (See also definition of "floodway.")

**FLOOD** - As used in this report, any temporary rise in streamflow or water-surface level that results in significant adverse effects in the area under study. Adverse effects of floods may include damages from overflow of land areas, effects of temporary backwater on sewers and local drainage channels, bank erosion or channel shifts, unsanitary conditions or other unfavorable conditions resulting from deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and interruption of traffic at bridge crossings.

**FLOOD FREQUENCY** - The frequency of occurrence of a flood of some stated magnitude in terms of years. Based on statistical analysis of past flood records, a determination may be made of the probable number of times that a flood of some stated magnitude will be equaled or exceeded during some future period of time, say 100 years. A 25-year flood with a magnitude of 8,000 cubic feet per second is a flood that during a 100-year period probably will be equaled or exceeded four times. The term "25-year flood" does not mean that such a flood can occur only once in 25 years and that once it occurs the flood will not happen again for another 25 years. Because floods occur randomly, they may be grouped or spread out unevenly with respect to time.

**FLOOD PEAK** - The maximum instantaneous discharge of a flood at a given location. The discharge generally is expressed in cubic feet per second.

**FLOOD PLAIN** - The relatively flat area or lowlands adjoining the channel of a stream or watercourse and subject to overflow by floodwaters.

**FLOOD-PLAIN REGULATIONS** - A general term applied to the full range of codes, ordinances, and other regulations pertaining to land use and to construction within the channel and flood-plain areas. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, floodway encroachment laws, open-area regulations, and similar controls affecting the use and development of the flood-plain areas.

**FLOOD PROFILE** - A graph showing the relationship of water-surface elevation to location for the centerline of a stream of water flowing in an open channel. A flood profile for an improved channel has a fairly constant slope, whereas the flood profile for a natural widening, narrowing, and turning flood plain rises and falls from location to location. Such a profile represents the water-surface elevation at the center of the main wash area, not necessarily the elevation at the edge of the flood plain.

**FLOODPROOFING** - Measures taken to render structures, property, and lands less vulnerable to flood losses.

**FLOODWAY** - The channel of a stream and that part of the flood plain inundated by a flood and, therefore, used to carry flood-flow. (See also definition of "designated floodway.")

**FLOODWAY-ENCROACHMENT LINES** - Those lateral lines along streams that mark the limits of the designated floodway. (See also definition of "designated floodway.") No structure or fill may be placed in the area between these lines without reducing the flood-carrying capacity of that floodway. The locations of the lines should be such that the floodway between the lines will accommodate a designated floodflow except for minor overflow into the restrictive zone.

**GAGING STATION** - A facility on a stream or reservoir where systematic observations of stage (water-surface level) or discharge are made.

**PRECIPITATION STATION** - A facility where systematic observations of depth of rainfall are made.

**RESTRICTIVE ZONE** - That part of the floodway within the overflow limits of a selected flood and outside the designated floodway. (See also definitions of "floodway" and "designated floodway.") The restrictive zone is established by a zoning ordinance for the purpose of reducing the flood hazard to life and property by regulating development within the zone. (See also definition of "zoning ordinance.")

**STANDARD PROJECT FLOOD** - A flood that would result from a storm with the most severe flood-producing rainfall pattern of any storm that is considered reasonably characteristic of the region in which the drainage area is located, giving consideration to the runoff characteristics of the drainage area and excluding extremely rare combinations of meteorologic and hydrologic conditions. Such a flood provides a reasonable upper limit to be considered in designing flood-control improvements.

**ZONING ORDINANCE** - An ordinance adopted by a local governing body, with authority from a State zoning enabling law, which under the police power divides an entire local governmental area into districts and - within each district - regulates the use of land; the height, bulk, type, and use of buildings or other structures; and the density of population.

APPENDIX 3 - BIBLIOGRAPHY  
FLOOD-PLAIN-INFORMATION STUDY  
FOR  
MARICOPA COUNTY, ARIZONA

VOLUME IV  
WICKENBURG REPORT

The following is a sampling of published works, mostly recent, on flood-plain regulations and flood-plain-development problems.

1. American Society of Civil Engineers. "Guide for the Development of Flood Plain Regulations."\* Journal of the Hydraulics Division - Proceedings of the American Society of Civil Engineers. Progress report of the Task Force on Flood Plain Regulations, Committee on Flood Control, Hydraulics Division. Ann Arbor, Mich.: American Society of Civil Engineers, vol. 88, No. HY5 (Sept. 1962), part 1, pp. 73-119.
2. Cooter, Harriet H. "To Stay Out of Floods." National Civic Review, vol. L, No. 10 (Nov. 1961), pp. 534-39.
3. Dalrymple, Tate. "Flood Mapping Program of the U.S. Geological Survey."\* Highway Research Record No. 58. Washington, D.C.: Highway Research Board of the National Academy of Sciences - National Research Council, publication 1242, 1964, pp. 33-41.
4. Dunham, Allison. "Flood Control Via the Police Power."\* University of Pennsylvania Law Review, Philadelphia, Pa., vol. 107, No. 8 (June 1959), pp. 1098-1132.
5. Goddard, James E. "Flood Plain Management Improves Man's Environment."\* Journal of the Waterways and Harbors Division, Proceedings of the American Society of Civil Engineers. Ann Arbor, Mich.: American Society of Civil Engineers, vol. 89, No. WW4 (Nov. 1963), pp. 67-84.
6. Hogan, Thomas M. "State Flood-Plain Zoning."\* De Paul Law Review, vol. XII, No. 2 (spring-summer 1963), pp. 246-62.
7. Kates, Robert W. Hazard and Choice Perception in Flood Plain Management.\* Department of Geography Research Paper No. 78. Chicago, Ill.: University of Chicago, 1962.
8. Miller, Harold V. Flood Damage Prevention for Tennessee.\* Nashville, Tenn.: Tennessee State Planning Commission, TSPC Publication No. 309 (Nov. 1960).

\* Includes bibliographies and references useful for more extensive reading on the subject of flood-plain studies and related studies.

9. Morse, Henry F. Role of the States in Guiding Land Use in Flood Plains.\* Special Report No. 38, Engineering Experiment Station. Atlanta, Ga.: Georgia Institute of Technology, June 1962.
10. Murphy, Francis C. Regulating Flood-Plain Development.\* Department of Geography Research Paper No. 56. Chicago, Ill.: University of Chicago, Nov. 1958.
11. Sheaffer, John R. Flood Proofing: An Element in a Flood Damage Reduction Program.\* Department of Geography Research Paper No. 65. Chicago, Ill.: University of Chicago, 1960.
12. White, Gilbert F., and Cook, Howard L. "Making Wise Use of Flood Plains."\* Natural Resources, Energy, Water, and River Basin Development. Vol. 1 of U.S. Papers Prepared for United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. Washington, D.C.: U.S. Government Printing Office, 1962.
13. Wiitalo, Sulo W., Jetter, Karl R., and Sommerville, Alan J. Hydraulic and Hydrologic Aspects of Flood-Plain Planning.\* Geological Survey Water Supply Paper 1526. Washington, D.C.: U.S. Government Printing Office, 1961.

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\* Includes bibliographies and references useful for more extensive reading on the subject of flood-plain studies and related studies.