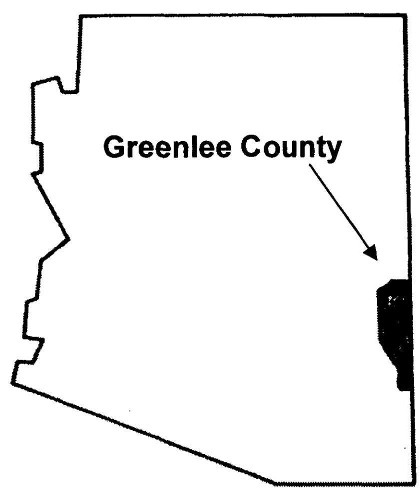
FLOOD INSURANCE STUDY

GREENLEE COUNTY, ARIZONA

AND INCORPORATED AREAS



Community Name	Community Number
GREENLEE COUNTY, UNINCORPORATED AREAS	040110
CLIFTON, TOWN OF	040035
DUNCAN, TOWN OF	040036

September 28, 2007

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
04011CV000A

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g. floodways, cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (Shaded)
C	X (Unshaded)

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: September 28, 2007

TABLE OF CONTENTS

FIGURES

TABLES

EXHIBITS

PUBLISHED SEPARATELY: Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
GREENLEE COUNTY, ARIZONA AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and supersedes the FIS reports, Flood Insurance Rate Maps (FIRM), and/or Flood Boundary and Floodway Maps (FBFM) in the geographic area of Greenlee County, AZ, including the Towns of Clifton and Duncan and unincorporated areas of Greenlee County (hereinafter referred to collectively as Greenlee County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by Greenlee County to update existing floodplain regulations as part of the Regular Phase of the NFIP, and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than those on which this federally supported study is based. These criteria take precedence over the minimum Federal criteria for purposes of regulating development in the floodplain, as set forth in the Code of Federal Regulations at 44 CFR, 60.3(c). In such cases, however, it shall be understood that the State (or other jurisdictional agency) shall be able to explain these requirements and criteria.

1.2 Authority and Acknowledgments

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

The FIS was prepared to include the unincorporated areas of, and incorporated areas, within Greenlee County in a countywide format. Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Planimetric base map information was provided in digital format for FIRM panels. Public Land Survey System (PLSS) and land ownership data were provided by ALRIS. Information on roads was taken from the effective FIRMs. Digital Orthophotographic Quarter Quadrangles (DOQQ) was provided by U.S. Geological Survey (USGS). Users of this FIRM should be aware that minor adjustments may have been made to specific base map features.

The coordinate system used for the production of this FIRM is Universal Transverse Mercator (UTM), North American Datum of 1983 (NAD 83), and GRS 1980 spheroid. Corner coordinates shown on the FIRM are in latitude and longitude referenced to NAD 83. Differences in datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features and at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

The hydrologic and hydraulic analyses for Greenlee County and the Towns of Clifton and Duncan were performed by Benito A. Sinclair & Associates, the study contractor, for the Federal Emergency Management Agency (FEMA), under Contract No. H-4516. This work was completed in April 1981, and covered all significant flooding sources affecting these areas. A revised hydrologic and hydraulic analysis for Chase Creek in the Town of Clifton was performed by Dames & Moore in January 1983 under Contract No. C-0970.

In September 2007, HDR Engineering, Inc. completed a countywide DFIRM and FIS for the County of Greenlee. HDR Engineering, Inc. was hired as an IDIQ study contractor for FEMA Region IX under contract number EMF-2003-CO-0045, Task Order 10. The DFIRM process included digitizing floodplain boundaries from the effective paper FIRMs and fitting them to a digital base map, thus converting the existing manually produced FIRMs to digitally produced FIRMs, referred to as DFIRMs. Individual community effective FIS reports were also combined into one report for the entire county.

1.3 Coordination

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this countywide FIS. An initial CCO meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is typically held with the representatives of FEMA, the community, and the study contractor to review the results of the study.

Greenlee County
The Greenlee County, Arizona FIS includes the detailed study of Gila River from the Town of Duncan, Arizona FIS (Federal Emergency Management Agency, August 2, 1982). The study contractor produced floodplain delineations and elevations along the Gila River, which continued outside the corporate limits of the Town of Duncan. FEMA therefore requested that a map revision begin immediately to include this detailed-study information outside the corporate limits of Town of Duncan and that the FIRM effective dates of July 18, 1985, continue for Greenlee County, Arizona.

Town of Clifton
Streams requiring detailed study were identified at a meeting on August 3, 1977. The meeting was attended by representatives of the study contractor, FEMA, and the Town of Clifton.

Results of the hydrologic analyses were coordinated with the U.S. Army Corps of Engineers (COE); U.S. Geological Survey (USGS); Arizona Water Commission; U.S. Department of Agriculture, Science and Education Administration; U.S. Soil Conservation Service; Arizona Department of Transportation; Greenlee County; and the Town of Clifton.

The results of this study were reviewed at the final meeting held on April 7, 1981. Representatives of the study contractor, FEMA, and community officials attended the meeting. No problems were raised at this meeting.

Town of Duncan
Streams requiring detailed study were identified at a meeting held on August 3, 1977. Representatives of the study contractor, FEMA, and the Town of Duncan attended the meeting.

The results of the study were reviewed at an intermediate/final meeting held on April 7, 1981. The meeting was attended by representatives of the study contractor, FEMA, and community officials. The study was acceptable to the community.

The dates of the initial and final CCO meetings held for Greenlee County and the incorporated communities in its boundaries are shown in Table 1, "Initial and Final CCO Meetings."

Table 1 - INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Greenlee County (Unincorporated Areas)	August 3, 1977	April 7, 1981
Clifton, Town of	August 3, 1977	April 7, 1981
Duncan, Town of	August 3, 1977	April 7, 1981

On February 2, 2005, the initial CCO meeting for the Greenlee Countywide DFIRM and FIS was held. Attending the meeting were representatives of FEMA Region IX, HDR Engineering, Greenlee County, and Towns of Clifton and Duncan.

The Final CCO for the Greenlee Countywide DFIRM and FIS was held on February 28, 2007. This meeting was attended by representatives of HDR Engineering, FEMA Region IX, Arizona Department of Water Resources, and Towns of Clifton and Duncan.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Greenlee County, Arizona. The scope and methodologies used in preparation of this FIS were agreed upon in joint consultation between FEMA and Greenlee County. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Greenlee County
Flooding from Gila River was studied by detailed methods within Greenlee County.

The 100-year floodplains for all of the streams studied in the county of were taken from the FIRMs prepared for Greenlee County.

Town of Clifton
Flooding for Chase Creek, the San Francisco River, and Ward Canyon Creek was studied by detailed methods within the Town of Clifton. The San Francisco River from its confluence with Ward Canyon Creek to the southern corporate limits was studied by approximate methods.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA and the Town of Clifton.

Town of Duncan
Flooding from Gila River was studied by detailed methods within the Town of Duncan.

Incoming River North and Incoming River East were initially studied by detailed methods along the downstream reaches within Duncan (approximately 600 feet along Incoming River North and approximately 2700 feet along Incoming River East). However, detailed studies were terminated on streams where the 100-year floodplains were consistently less than 200 feet wide within the originally designated detailed study reaches. This, in effect, eliminated all of the detailed areas within Duncan along Incoming River North and Incoming River East. The 100-year floodplains along the detailed reaches were converted to approximate flooding. Approximate flood boundaries for the upstream portions of Incoming River North and Incoming River East were taken from the Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, September 13, 1974). However, analysis showed that the 100-year floodplain along Incoming River North was consistently less than 200 feet wide within Duncan. Therefore, the area was designated a zone of minimal flood hazards.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles and on the FIRM.

Table 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS

Chase Creek	Gila River
San Francisco River	Ward Canyon Creek

All or portions of the flooding sources listed in Table 3, "Flooding Sources Studied by Approximate Methods," were studied by approximate methods. Approximate analyses were used to study only those areas having a low development potential or minimal flood hazards.

Table 3 - FLOODING SOURCES STUDIED BY APPROXIMATE MEHTODS

Al Creek	Antelope Canyon Creek	Apache Creek	Ash Peak Canyon Creek
Ash Spring Creek	Bar F Canyon Creek	Bear Canyon Creek	Bear Creek
Beaver Creek	Bee Canyon Creek	Beeler Creek	Benton Creek
Big Dry Canyon Creek	Bird Canyon Creek	Bitter Creek	Blackfield Canyon Creek
Blue River	Board Canyon Creek	Bull Creek	Burro Wash
Buzzard Roost Canyon Creek	Campbell Blue Creek	Canyon Creek	Castle Creek
Cedar Springs Canyon Creek	China Camp Canyon Creek	Cienega Creek	Citizen Canyon Creek
Clear Creek	Coal Creek	Coalson Canyon Creek	Colorado Gulch
Conklin Creek	Cottonwood Canyon Creek	Cow Canyon Creek	Coyote Wash
Dam Canyon Creek	Dix Creek	Dorsey Gulch	Dromedary Creek
Dry Prong Canyon Creek	Eagle Creek	Fish Creek	Fishhook Creek
Foote Creek	Fritz Canyon Creek	Gila River	Goat Camp Canyon Creek

Table 3 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Grant Creek	Greaser Wash	Guthrie Canyon Creek	Hackberry Gulch
Hannagan Creek	Harden Cienega Creek	Harris Camp Canyon Creek	Heifer Canyon Creek
Hickey Canyon Creek	Horse Canyon Creek	Horseshoe Gulch	Hot Springs Canyon Creek
Incoming River East	Jackson Canyon Creek	Johns Canyon Creek	Johnson Canyon Creek
Jones Canyon Creek	Juan Miller Creek	K P Creek	Kaywood Wash
Lanphier Canyon Creek	Largo Creek	Linden Creek	Little Grayhorse Canyon Creek
Lop Ear Creek	Maple Canyon Creek	Middle Prong Creek	Moonshine Canyon Creek
Morenci Gulch	Mud Springs Canyon Creek	Negro Canyon Creek	New Model Canal
Nigger Creek	Noland Creek	Oak Creek	Olney Well Draw
Open Draw Tank	Orejana Canyon Creek	Owl Creek	Palace Canyon Creek
Pigeon Creek	Pumroy Canyon Creek	Railroad Wash	Rainville Wash
Rattlesnake Canyon Creek	Robinson Canyon Creek	Rocky Gulch	Rocky John Canyon Creek
Round Mountain Draw	Rustlers Canyon Creek	S Canyon Creek	San Francisco River
Sand Wash	Sanders Wash	Sands Draw	Santa Cruz Canyon Creek
Sardine Canyon Creek	Sexton Canyon Creek	Sheep Wash	Silver Creek
Skully Creek	Snake Creek	South Corral Creek	South Smith Canyon Creek
Steeple Canyon Creek	Stock Pen Canyon Creek	Stocks Canyon Creek	Strayhorse Creek
Swafford Canyon Creek	Sweetie Canyon Creek	Sycamore Canyon Creek	Thomas Creek
Tollhouse Canyon Creek	Tornado Creek	Trail Canyon Creek	Turkey Creek
Tutt Creek			

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revisions [LOMR], Letter of Map Revision – based on Fill [LOMR-F], and Letter of Map Amendment [LOMA], as shown in Table 4, "Letters of Map Change."

Table 4 - LETTER OF MAP CHANGE

Community	Flooding Source(s)/Project Identifier	Date Issued	Type	Case Number
Town of Clifton	Clifton Flood Control Project	8/23/1999	102	99-09-361P
Town of Clifton	Lower Chase Creek Dam	09/29/2006	LOMR	06-09-B068P

2.2 Community Description

Greenlee County

Greenlee County is located in southeastern Arizona at the border of Arizona and New Mexico. The county has developed adjacent to State Highway 70 within the deeply filled Duncan Valley along the Gila River. Other developed areas within Greenlee include the Towns of Clifton, Duncan, Morenci, and Stargio. According to the U.S. Bureau of the Census figures, the population of Greenlee County was 11,406 in 1980 (U.S. Department of Commerce, 1982) and was 8,547 in 2000 (U.S. Census Bureau, State and County Quickfacts for Greenlee County, AZ, 2000). Adjacent communities include Apache, Graham, and Cochise counties in Arizona, and Hidalgo, Grant, and Carton counties in New Mexico.

Topographic features in the Duran Valley range from rich agricultural bottom land to moderately sloping terraces and foothills. Most of the community is engaged in agriculture; the principal crops are cotton, milo, and alfalfa.

The Gila River, which flows westerly through the community, drains approximately 3,200 square miles of mostly mountainous area in New Mexico west of the Continental Divide. There are several major tributaries to the Gila River as it flows through the county. The tributaries (designated in this report as Incoming River North and Incoming River East) are ephemeral streams that drain hundreds of square miles of foothills and rapidly eroding terraces throughout Greenlee County.

The climate of the county is generally influenced by five types of airmasses including: (1) cool, moist Polar Pacific from the northern Pacific Ocean; (2) warm, moist Tropical Pacific from the southern Pacific Ocean; (3) warm, moist Tropical Gulf from the Gulf of Mexico; (4) cold, dry Polar Continental from Canada; and (5) hot, dry Tropical Continental from Mexico. Although the amount of moisture and the weather in general are influenced by these airmasses, some airmasses are predominant in individual areas and seasons.

In the Duncan Valley, Polar Pacific and Polar Continental airmasses account for most of the moisture in winter (November through April), whereas the Tropical Continental type predominates in the spring (May and June), and the Tropical Gulf type predominates in the summer (July through October). Tropical pacific airmasses also move over the basin frequently, occasionally bringing large amounts of precipitation. These airmasses are generated as a result of low-pressure areas between Hawaii and southern California. The airmasses move eastward across the southwestern part of the United States, usually in late summer or early winter.

Streamflow is classified as either winter flow or summer flow. Winter flow is the result of precipitation from November through April, and summer flow is the result of precipitation from July through October. The small amount of precipitation in May and June seldom, if ever, results in direct runoff.

Winter flow is mainly from frontal storms, snowmelt, or outflow from ground-water storage, and generally is a combination of the three. The flow rate may be fairly constant for several days. The causes of major winter floods include: (1) widespread, heavy rainfall of long duration; (2) warm weather after a large snow accumulation; or (3) widespread rainfall on snow.

Thunderstorms are the main source of summer flow. Individual summer thunderstorms characteristically produce high unit rates and volumes of flow from small watersheds, but only rarely do they produce large volumes of flow from large watersheds. The crest of a flood from a thunderstorm is typically very sharp near the source of the surface flow but may become rounded or flattened downstream because of the regulating effects of the conveyance system. At times, where the runoff from a thunderstorm enters a dry stretch of channel, the flood crest disappears because the flow sinks into the underlying alluvium. The summer flow of the Gila River through the study area is the composite runoff that results from thunderstorms at several localities.

Town of Clifton

The Town of Clifton is located in central Greenlee County in east-central Arizona. It is bordered on all sides by unincorporated areas of Greenlee County. The San Francisco River flows southerly through the town on its way to the Gila River. Two tributaries of the San Francisco River (Ward Canyon Creek and Chase Creek) flow through portions of the community and the confluences of these creeks at the San Francisco River are located within the corporate limits.

The corporate limits of Clifton encompass approximately 7 square miles; however, only a small percentage of this land is developable due to the excessive slopes of the mountain terrain. The community has developed along the narrow San Francisco River and Ward and Chase Creek basins, where in each case these narrow developed areas are bounded by very steep mountain slopes. The Town of Clifton had a population of 5,087 in 1970 which decreased to 4,245 by 1980 according to the U.S. Bureau of Census (U.S. Department of Commerce, September 1981). In 2000, the population of Clifton was 2,596 (U.S. Census Bureau, State and County Quickfacts for Town of Clifton, AZ, 2000).

The soils on the San Francisco River floodplain were formed in recent mixed alluvium and are generally very gravelly clay barns. These soils are subject to frequent flooding during prolonged, high-intensity storms and, therefore, limit homesite development. The soils in the uplands range from very gravelly barns to very cobbled clay barns and were derived dominantly from volcanic rock. The shallow depths and low strengths of the soils restrict development and limit the use of the land for septic tank absorption (U.S. Department of Agriculture, July 1981).

The climate of the drainage area varies from arid to humid, with large precipitation and temperature changes, plentiful sunshine, and low humidity. Mean annual precipitation varies from approximately 10 inches in the Clifton area to 30 inches or more in the vicinity of Hannagan Meadows in the northern part of the drainage area. Approximately one-half of the annual precipitation occurs during July, August, and September and comes as brief, but often heavy, showers and thunderstorms. Light to moderate precipitation occurs during the winter months. The average annual snowfall ranges from approximately 2 inches at Clifton to approximately 70 inches at Hannagan Meadows (U.S. Department of Commerce, 1973).

Three types of storms produce precipitation on most of the study area: (1) general winter storms; (2) general summer storms; and (3) local storms. General winter storms normally occur over the southwestern United States during the cooler months (November through March) as extratropical cyclones, and move inland from the Pacific Ocean or Gulf of Mexico spreading light to moderate precipitation over large areas for durations up to several days. Orographic effects are usually quite pronounced, with the mountains receiving much greater precipitation than the lower elevations. Much of the precipitation in the higher elevations also falls as snow during this type of storm. At times however, warm, heavy rain can fall on top of a ripe snowpack creating conditions favorable for heavy runoff. General summer storms normally occur between July and October and may be associated with a tropical storm. These storms usually consist of general steady or intermittent rain over large areas, with moderate heavy thunderstorms often embedded. Local storms are defined as rain storms of high to very high intensity, occurring over small areas for short durations. They are most common during the summer months, but can occur at anytime of the year.

Normally the months of July, August, and September produce the greatest runoff peaks. Greater-than-normal flows occur during and immediately following excess rainfall. Historically, snowmelt has been a significant contributor to large floods. General summer storms have also caused significant floods.

The San Francisco River flows perennially in the Clifton area, with an average discharge of approximately 200 cfs (U.S. Department of the Army, June 1979). Near Clifton, the San Francisco River has a drainage area of 2,750 square miles. High runoffs from the mountains in the northern and western parts of the basin result in the largest contribution to major floods on the river. A significant portion of this high runoff enters the San Francisco River at its confluence with the Blue River, 12 miles northeast of Clifton.

Climatic and drainage characteristics are not conducive to continuous runoff in the Ward Creek and Chase Creek tributaries. On these streams, flow increases rapidly in response to effective rainfall. Snowmelt and baseflow do not add significantly to the flood peaks on these tributaries.

Town of Duncan

The Town of Duncan is located in southeastern Greenlee County, in southeastern Arizona, approximately 35 miles west of Lordsburg, New Mexico. The community has developed adjacent to State Highway 70 within the deeply filled Duncan valley along Gila River. According to the U.S. census figures, the population of Duncan was placed at 773 in 1970 (U.S. Department of Commerce, 1970) and was 812 in 2000 (U.S. Census Bureau, State and County Quickfacts for Town of Duncan, AZ, 2000).

Topographic features of the Town of Duncan range from the rich agricultural bottom land of the Duncan valley to moderately sloping terraces and footslopes. Most of the community is engaged in agriculture; the principal crops are cotton, milo, and alfalfa.

Gila River, which flows westerly through the community, drains approximately 3,200 square miles of mostly mountainous area in New Mexico west of the Continental Divide. There are two major tributaries to Gila River as it flows through Duncan. The tributaries (designated in this report as Incoming River North and Incoming River East) are ephemeral streams that drain approximately 13 square miles of foothills and rapidly eroding terraces north of the town.

The climate of the Duncan valley is generally influenced by five types of airmasses including: (1) cool, moist Polar Pacific from the northern Pacific Ocean; (2) warm, moist Tropical Pacific from the southern Pacific Ocean; (3) warm, moist Tropical Gulf from the Gulf of Mexico; (4) cold, dry Polar Continental from Canada; and (5) hot, dry Tropical Continental from Mexico.

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2.3 Principal Flood Problems

Greenlee County and Town of Duncan

Tropical storms are an important source of rainfall and runoff in the study area during the summer. These storms are responsible for some of the most devastating floods in the area, causing damage to roads, crops, and homes, and imperiling human life. There is a high probability that tropical storms will produce more damage in the future. The highest annual probability of tropical storms for the southwestern United States has been estimated at 10 percent (State of Arizona, Office of the State Climatologist, 1978).

The Gila River and its tributaries have a long history of flooding in southeastern Arizona. Historical references to destructive floods along the Gila River in and near the study area extend back to 1862, but records of peak flow are available only for the periods of 1914 to 1915 and 1927 to the present. The greatest floods of record (prior to December 1978) occurred in September 1941, August 1959, and October 1972 resulting in discharges of 41,700 cubic feet per second (cfs), 16,400 cfs, and 27,200 cfs, respectively. The estimated return periods for floods of these magnitudes are approximately 500 years, 17 years, and 83 years, respectively.

Documentation of major historical floods in southeastern Arizona can be found in Major Storms and Floods in Arizona 1862-1977 (State of Arizona, Office of the State Climatologist, 1978). In describing the flood of September 1941, this report states, "The storm of the 28th and 29th brought heavy rains on the tributaries of the upper Gila River above Coolidge Dam and resulted in one of the worst floods ever experienced in Duncan and vicinity. There was also high water in the Safford area. The crest of the flood reached Duncan on the evening of the 29th, inundating a large part of the residential areas and farmlands. Damage to crops and homes and farmland along the Gila River from Duncan to Coolidge Dam was conservatively estimated at near $500,000."

The greatest urban losses caused by the Gila River flood of October 1972 occurred in Duncan Valley when the levees protecting the Town of Duncan were overtopped and eroded, and most of the town was inundated with water up to 4 feet deep. Several adobe structures were destroyed or sufficiently damaged to require demolition. Silt over 4 inches deep in many places was deposited in yards and inside homes and stores; bedding, furniture, appliances, carpets, draperies, and automobiles were damaged or ruined; hardwood floors in many homes buckled as a result of soaking; and foundations and walls cracked in several homes as a result of settling. The largest single structural loss was the elementary school building of the Duncan Unified School District. Floodwaters over 4 feet deep swept through the old building. Restoration costs for the building were estimated at more than the $300,000 over the value of the structure. Total nonagricultural damage in Duncan Valley was over $1.5 million, nearly all of which was in the Town of Duncan. Losses in Duncan might have been significantly reduced because the residents of the town received several hours warning of the impending flood. However, very few people used the time to remove, raise, or otherwise protect those possessions that could be protected. Most of the people were still in their homes when the levee failed.

Town of Clifton

The San Francisco River drainage area is essentially unaltered by man. Runoff flows relatively unimpeded throughout the basin. One exception, which has significant impact on the Town of Clifton, is the Chase Creek channel. It has been blocked at six locations by mine wastes from the Morenci and Metcalf Pits operated by Phelps-Dodge Corporation.

Clifton has developed amidst the mountains and has been plagued by severe floods on the San Francisco River, and to a lesser extent, Chase Creek, since its inception. The San Francisco River has been gaged only since 1927, but several large floods were reported prior to this. The largest of these occurred in December 1906, and was estimated at 70,000 cfs. Other dates of reported high flows include February 1891, January and November 1905, and January and October 1916. In the early 1900s some 30 people were said to have perished during floods at Clifton.

Since the stream gage was established in 1927, significant flows were recorded in 1949, 1965, 1972, and 1975. Damaging flows also occurred in 1934 and 1948. The most disastrous flood during the gaged period has been that of October 1972. It is estimated that 64,000 cfs roared down the San Francisco River, inundating North Clifton to a depth of 5.5 feet. The estimated return period for a flood of this magnitude is approximately 50 years (U.S. Department of the Army, Corps of Engineers, June 1979).

2.4 Flood Protection Measures

Greenlee County and Town of Duncan

A few levees are located along the Gila River floodplain. The levees have no effect on the 100- and 500-year floods.

No major programs for controlling floodwaters have been instituted, and none are anticipated in the foreseeable future.

Town of Clifton

The Town of Clifton has tried various means to alleviate the flood problem. Prior to 1918, the town constructed a slag and stone masonry floodwall along portions of the San Francisco River.

This wall, which ranges in height to 20 feet above the thalweg, confines the river through a large portion of town. Through the years, the community has raised the floodwalls at vulnerable points as funds became available.

In 1967, the COE completed a snagging and clearing project on a 1-mile reach of the San Francisco River. The work included clearing of phreatophytes and removal of two natural flow constrictions (where the mountains pinched the floodplain from approximately 400 feet to 230 feet). This work increased channel capacity below the railroad bridge and afforded protection to South Clifton (east of the river).

There are no major programs for controlling floodwaters in the Town of Clifton.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 2-, 1-, or 0.2-percent annual chance period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at shorter intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Each incorporated community within, and the unincorporated areas of Greenlee County, has previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

Greenlee County and Town of Duncan
The flood-frequency analysis developed by the USGS (Arizona Department of Transportation, 1978) for the Gila River was adopted for this study. This analysis was based on data from several gaged sites along the Gila River (Arizona Highway Department, December 1, 1968) and adjusted for the effects of regulation and diversions. A relationship between discharge and distance in miles from Coolidge Dam was provided for selected recurrence intervals.

For the ungaged tributaries, Incoming River North and Incoming River East, flood discharges were obtained by calculating runoff from rainfall. The calculations were calibrated by using data from gaged streams having similar watersheds and located in or near the study area (Benito A. Sinclair & Associates, Inc., April 1980).

Town of Clifton
In May of 1977, flood-frequency analysis developed by the COE (U.S. Department of the Army, Corps of Engineers, May 1977) for the San Francisco River and its tributaries was adopted for this study. The discharge-frequency relationship for the San Francisco River was based on a continuous record extending from 1911 to 1975 obtained from a USGS stream gage at Clifton. The U.S. Water Resources Council guidelines (U.S. Water Resources Council, March 1976) were used in the analysis.

The frequency analysis for the tributaries to the San Francisco River was based on data from 14 gaging stations that have similar drainage areas and are within the vicinity of Clifton. Statistics for the gaging stations were computed and were used to develop "standard deviation versus area" and "annual peak discharges versus area" curves. These curves were used to determine the discharge-frequency relationships for Ward Canyon Creek and Chase Creek.

The drainage area of Chase Creek is reduced by mine waste embankments that dam Chase Creek at six sites. These impoundments have been investigated by the COE and the COE has concluded that there is no threat to life and property in Clifton due to overtopping of any of the dams on Chase Creek (U.S. Department of the Army, June 1979).

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 5, "Summary of Peak Discharges."

Table 5 - SUMMARY OF PEAK DISCHARGES

		Peak Discharges (cfs)			
Flooding Source and Location	Drainage Area (sq. mi.)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
Chase Creek					
At confluence with San Francisco River	1.65	255	620	825	1,450
Gila River					
At State Highway 75	3,200	13,700	23,800	28,500	42,500
San Francisco River					
At Southern Pacific Railroad	2,750	28,500	64,000	84,100	155,000
Ward Canyon Creek					
At Southern Pacific Railroad	7.6	1,500	2,800	4,100	7,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were performed to provide estimates of the flood elevations of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps and field surveys. All bridges, dam, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed, selected cross-section locations are also shown on the FIRM.

The hydraulic analyses for these studies were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodectic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First of Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the Firm with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classifications. NSRS vary widely in vertical stability classifications. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)
- Stability B: Monuments which generally hold their postion/elevation well (e.g., concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument blow frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM in the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purposes of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

Each incorporated community within, and the unincorporated areas of, Greenlee County has a previously printed FIS report. The hydraulic analyses described in those reports have been compiled and are summarized below.

Greenlee County and Town of Duncan
Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, November 1976). Cross sections for backwater analyses were obtained from topographic maps developed from aerial photographs (Cooper Aerial Survey Company, May 1980). Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed, selected cross section locations are also shown on the FIRM.

Composite roughness factors (Manning's "n") for the Gila River were developed by use of the COE HEC-2 step-backwater computer program (U.S. Department of the Army, Corps of Engineers, November 1976) using estimated river stages and discharges obtained from a report on damage from the October 1972 flood published by the COE (U.S. Department of the Army, Corps of Engineers, August 1971). Roughness values for the Gila River cross sections ranged from 0.014 to 0.107.

Roughness factors used in the hydraulic computations for Incoming River North and Incoming River East were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness values for creek cross sections ranged from 0.030 to 0.043, and roughness values for overbank and floodplains ranged from 0.043 to 0.060 for all floods.

Starting water-surface elevations of the Gila River were calculated using the slope-area method. Starting water-surface elevations for Incoming River North and Incoming River East were determined from normal-depth calculations. For Incoming River North and Incoming River East, elevations were developed through COE HEC-2 analysis (U.S. Department of the Army, Corps of Engineers, November 1976) and normal-depth calculations. Flood profiles were drawn showing computed water-surface elevations to the accuracy of 0.5 foot for floods of the selected recurrence intervals.

Town of Clifton
Cross sections for backwater analyses were obtained from cross section data and topographic maps at a scale of 1:2,400 developed by the COE (U.S. Department of the Army, Corps of Engineers, 1972), and planimetric maps at a scale of 1:4,800 developed from aerial photographs flown in May 1980 (Cooper Aerial Survey Co., May 1980). All bridges and culverts were field checked to obtain elevation data and structural geometry.

Channel roughness factors used in the hydraulic computations were chosen by engineering judgment and based on field observations of the streams and floodplain areas. Roughness values for the main channel of the San Francisco River ranged from 0.025 to 0.035, while overbank roughness values ranged from 0.030 to 0.065. Roughness values for the main channel of Chase Creek ranged from 0.035 to 0.040, while overbank roughness values ranged from 0.035 to 0.060.

The roughness value for the main channel of Ward Canyon Creek was 0.035; its overbank roughness value was also 0.035.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 step backwater computer program (U.S. Department of the Army, Corps of Engineers, November 1976). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. Starting water-surface elevations for the San Francisco River were calculated using the slope-area method.

For Chase Creek, it was determined that floodflows would follow two paths due to a breakout of flow from the main channel to the left overbank area at the Morales Highway parking lot culvert. From this point downstream, it was determined that the masonry wall along Chase Creek would prevent flow in the left overbank area from returning to the main channel. This results in different water-surface elevations being computed for the main channel (which includes spillover into the right overbank area) and for the left overbank area long U.S. Highway 666.

For the left overbank flow area, water-surface elevations were determined using normal-depth calculations as developed by the COE (U.S. Department of the Army, June 1979) and Benito A. Sinclair & Associates. From these calculations, it was determined that shallow flooding would result with depths for the 100-year event being between 1 and 3 feet.

The 10-, 50-, and 100-year flood profiles for the Chase Creek channel were developed from the COE Planning Assistance Study (U.S. Department of the Army, Corps of Engineers, June 1979). The 500-year flood profile was developed from the COE Standard Project Flood.

The COE developed rating curves for common cross sections for the 10-, 50-, 100-, and Standard Project Flood computer runs. From these curves, water-surface elevation profiles were developed for the 10-, 50-, and 100-year flood events. For the 500-year event, the discharges developed by Benito A. Sinclair & Associates for the downstream end of the reach (4,250 cfs) and the upstream end of the reach (3,620 cfs) were adopted during this investigation. The 500-year flood discharge at the intermediate rating curve locations was developed from the COE Standard Project Flood flow distributions. In order to develop the 500-year water-surface elevation profile for the entire study reach, the differences in elevation at the rating curve locations between the 100- and 500-year flood levels were plotted as a function of stream distance. The upper envelope curve from this plot was used to estimate the 500-year flood profile along Chase Creek.

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of this countrywide FIS is shown below.

Table 6 contains a summary of Manning's "n" values used in this countywide FIS study.

Table 6 - MANNING'S "n" VALUES

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
Chase Creek	0.035 – 0.060	0.035 – 0.040	0.035 – 0.060
Gila River	0.014 – 0.107	0.014 – 0.107	0.014 – 0.107
San Francisco River	0.030 – 0.060	0.025 – 0.035	0.030 – 0.060

Stream	Left Overbank "n"	Channel "n"	Right Overbank "n"
Ward Canyon Creek	0.035	0.035	0.035

The conversion factor for each stream studied by detailed methods is shown below in Table 7, "Stream Conversion Factors."

Table 7 - STREAM CONVERSION FACTORS

Stream Name	Elevation (feet NAVD above NGVD)
Chase Creek	2.4
Gila River	2.2
San Francisco River	2.4
Ward Canyon Creek	2.4

3.3 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the finalization of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are being prepared using NAVD as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD. Structure and ground elevations in the community must, therefore, be referenced to NAVD. It is important to note that adjacent communities may be referenced to NGVD. This may result in differences in Base (1-percent-annual-chance) Flood Elevations (BFEs) across the corporate limits between the communities.

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Springs, MD 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for purpose of establishing local vertical control. Although these monuments are not shown on the

FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1-percent annual chance and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section.

For this countywide FIS, between cross sections, the boundaries were interpolated using topographic maps at scales of 1:4,800, with a contour interval of 2 feet, developed from aerial photographs (Cooper Aerial Survey Company, May 1980) for Greenlee County, at scales of 1:2,400 and 1:1,200, with contour intervals of 2 and 5 feet (U.S. Department of the Army, June 1979) and planimetric manuscript maps at a scale of 1:4,800 (Cooper Aerial Survey Co., May 1980) developed from stereoscopic photography for the Town of Clifton, and at a scale of 1:4,800, with a contour interval of 2 feet, developed from aerial photographs (Cooper Aerial Survey Co., May 1980) for the Town of Duncan.

The approximate 100-year boundaries for Incoming River North and Incoming River East were delineated using topographic maps at a scale of 1:4,800 (Cooper Aerial Survey Company, May 1980).

For the flooding sources studied by approximate methods, the boundaries of the 1-percent annual chance floodplains were delineated using topographic maps taken from the previously printed FIS reports, FHBMs, and/or FIRMS for all of the incorporated and unincorporated jurisdictions within Greenlee County.

Approximate flood boundaries for the San Francisco River were taken from the Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, March 1977). Approximate flood boundaries in some portions of the study area were taken from the Flood Hazard Boundary Map (U.S. Department of Housing and Urban Development, September 13, 1974). Approximate 100-year floodplain boundaries in some portions of the study area were taken directly from the effective FIRM (Federal Emergency Management Agency, July 18, 1985).

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the FIRM. On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown because of limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the FIRM.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections. In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only floodway boundary is shown.

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain.

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 8, Floodway Data). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

As shown on the FBFM, the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

Due to the unusual flow conditions on Chase Creek and the necessity to calculate hydraulic profiles using hand methods, it was determined that a floodway was not applicable for Chase Creek.

Encroachment into areas subject to inundation by floodwater having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside floodway.

The area between the floodway and the boundary of the 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

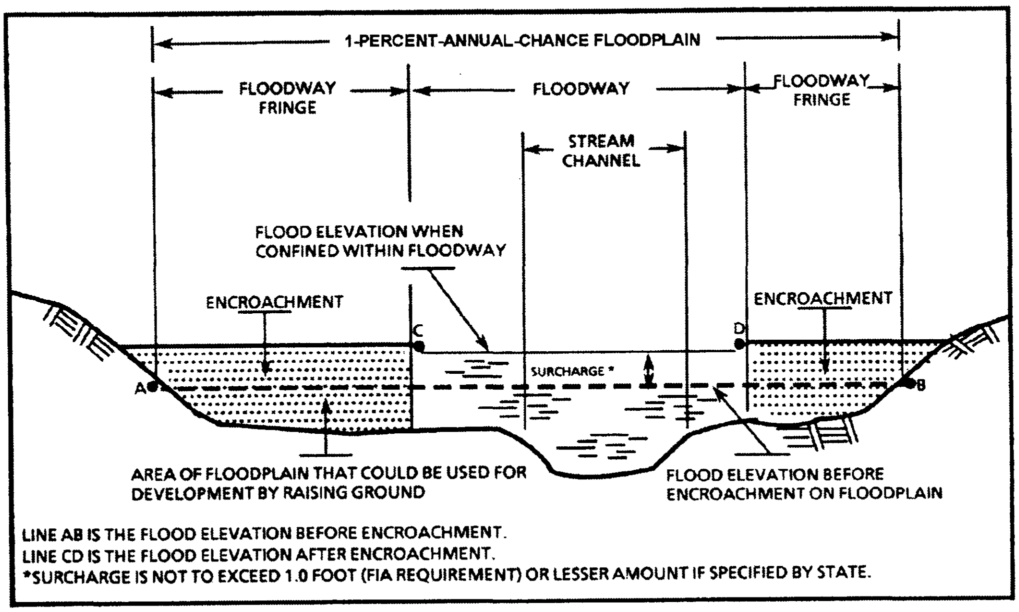

Figure 1. FLOODWAY SCHEMATIC

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Gila River								
A	0	1,308	5,784	4.9	3622.6	3,622.6	3,623.5	0.9
B	5,700	2,083	9,353	3.0	3633.9	3,633.9	3,634.8	0.9
C	11,520	1,411	6,951	4.1	3644.3	3,644.3	3,645.2	0.9
D	14,485	1,830/ 840[2]	8,183	3.5	3650.3	3,650.3	3,651.2	0.9
E	14,595	1,770/ 820[2]	7,813	3.6	3650.4	3,650.4	3,651.3	0.9
F	18,040	905	4,673	6.1	3654.5	3,654.5	3,655.4	0.9
G	22,515	2,071	12,812	2.2	3665.2	3,665.2	3,666.2	1.0
H	25,465	1,302	5,737	5.0	3668.2	3,668.2	3,669.1	0.9
I	30,600	847	3,204	8.9	3676.6	3,676.6	3,677.1	0.5

[1] Feet above Limit of Detailed Study

[2] Width/Width Within City of Duncan

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GREENLEE COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

GILA RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
San Francisco River								
A	115	244	3,762	22.4	3441.0	3,441.0	3,441.0	0.0
B	770	470	7,088	11.9	3447.6	3,447.6	3,447.8	0.2
C	1,530	365	5,802	14.5	3448.5	3,448.5	3,449.1	0.6
D	2,180	351	5,139	16.4	3450.0	3,450.0	3,450.0	0.0
E	2,650	401	7,247	11.6	3453.0	3,453.0	3,453.5	0.5
F	3,172	331	5,651	14.9	3453.0	3,453.0	3,453.5	0.5
G	4,010	571	4,812	17.5	3453.9	3,453.9	3,454.2	0.3
H	4,725	505	7,802	10.8	3464.9	3,464.9	3,464.9	0.0
I	5,485	670	10,581	7.9	3467.2	3,467.2	3,467.2	0.0
J	6,170	573	5,182	16.2	3467.2	3,467.2	3,467.2	0.0
K	6,870	633	8,311	10.1	3471.4	3,471.4	3,471.4	0.0
L	7,663	695	9,920	8.5	3475.1	3,475.1	3,475.1	0.0
M	8,460	380	5,878	14.3	3475.2	3,475.2	3,475.2	0.0
N	9,215	630	7,861	10.7	3477.5	3,477.5	3,477.6	0.1
O	9,715	520	6,679	12.6	3478.0	3,478.0	3,478.2	0.2
P	10,650	450	9,086	9.3	3485.0	3,485.0	3,485.0	0.0
Q	11,385	530	6,865	12.2	3485.0	3,485.0	3,485.0	0.0
R	12,285	730	12,967	6.5	3489.4	3,489.4	3,489.4	0.0
S	12,685	352	6,305	13.3	3489.4	3,488.1	3,489.1	1.0
T	14,185	661	11,570	7.3	3494.5	3,494.5	3,495.3	0.8

[1] Feet above Limit of Detailed Study along Profile Baseline

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GREENLEE COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

SAN FRANCISCO RIVER

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Ward Canyon Creek								
A	400	69	331	12.4	3449.1	3449.1[2]	3,449.1	0.0
B	620	96	365	11.2	3452.7	3,452.7	3,452.7	0.0
C	1,460	134	412	10.0	3471.2	3,471.2	3,471.2	0.0

[1] Feet above Confluence with San Francisco River

[2] Elevation Computed without Consideration of Backwater Effect from San Francisco River

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

GREENLEE COUNTY, ARIZONA

AND INCORPORATED AREAS

FLOODWAY DATA

WARD CANYON CREEK

5.0 INSURANCE APPLICATION

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

Zone A
Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplain that is determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE
Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplain that is determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X
Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No BFEs or base flood depths are shown within this zone.

Zone D
Zone D is the flood insurance risk zone that corresponds to unstudied area where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 1- and 0.2-percent annual chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Greenlee County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified as flood-prone. The countywide FIRM also includes flood hazard information that was presented separately on FBFMs, where applicable. Historical data relating to the maps prepared for each community are presented in Table 9, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Clifton, Town of	June 7, 1974	March 25, 1977	March 1, 1984	N/A
Duncan, Town of	September 13, 1974	December 5, 1975	August 2, 1982	N/A
Greenlee County (Unincorporated Areas)	October 25, 1977	N/A	July 18, 1985	September 4, 1987

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

GREENLEE COUNTY, AZ

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Greenlee County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FBFMs, and FIRMs for all of the incorporated and unincorporated jurisdictions within Greenlee County.

This study is authoritative for the purposes of the NFIP; data presented herein either supersede or are compatible with all previous determinations.

Greenlee County
A FIRM has been published for Greenlee County (Federal Emergency Mangement Agency, Flood Insurance Rate Map, Greenlee County, Az, 1985). Some of the floodplain boundaries from that map have been incorporated into this study. No other flood studies were found to exist at the time of this study.

Town of Clifton
Hydrologic studies have been done by the COE to determine the Standard Project Flood, 100-, 50-, and 10-year flood peak discharges on the San Francisco River and its tributaries in the vicinity of Clifton, Arizona(U.S. Department of the Army, Corps of Engineers, May 1977).

A Planning Assistance Study was subsequently produced by the COE combining hydrologic, hydraulic, and floodplain management concepts to aid the Town of Clifton in identifying key problems and determining measures to reduce the severity of local flood problems. (U.S. Department of the Army, Corps of Engineers, June 1979). The results of this study will agree with the COE studies mentioned above.

In all detailed study areas, this study represents a more recent and comprehensive analysis; therefore, it supersedes the Flood Hazard Boundary Map published for Clifton (U.S. Department of Housing and Urban Development, Federal Insurance Administration, March 1977).

A Flood Hazard Boundary Map was prepared for the unincorporated areas of Greenlee County (U.S. Department of Housing and Urban Development, Federal Insurance Administration, March 1977). The detailed information for the San Francisco River and Ward Canyon Creek is compatible with information shown in the Greenlee County study. Approximate boundaries for the San Francisco River agree with those for the Greenlee County study.

Town of Duncan
A FHBM has been prepared for the Town of Duncan (U.S. Department of Housing and Urban Development, September 13, 1974). Some of the flood boundaries from this map have been incorporated into this study. No other flood studies were found to exist at the time of this study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Region IX, Federal Insurance and Mitigation Administration, 1111 Broadway, Suite 1200, Oakland, California 94607-4052.

9.0 BIBLIOGRAPHY AND REFERENCES

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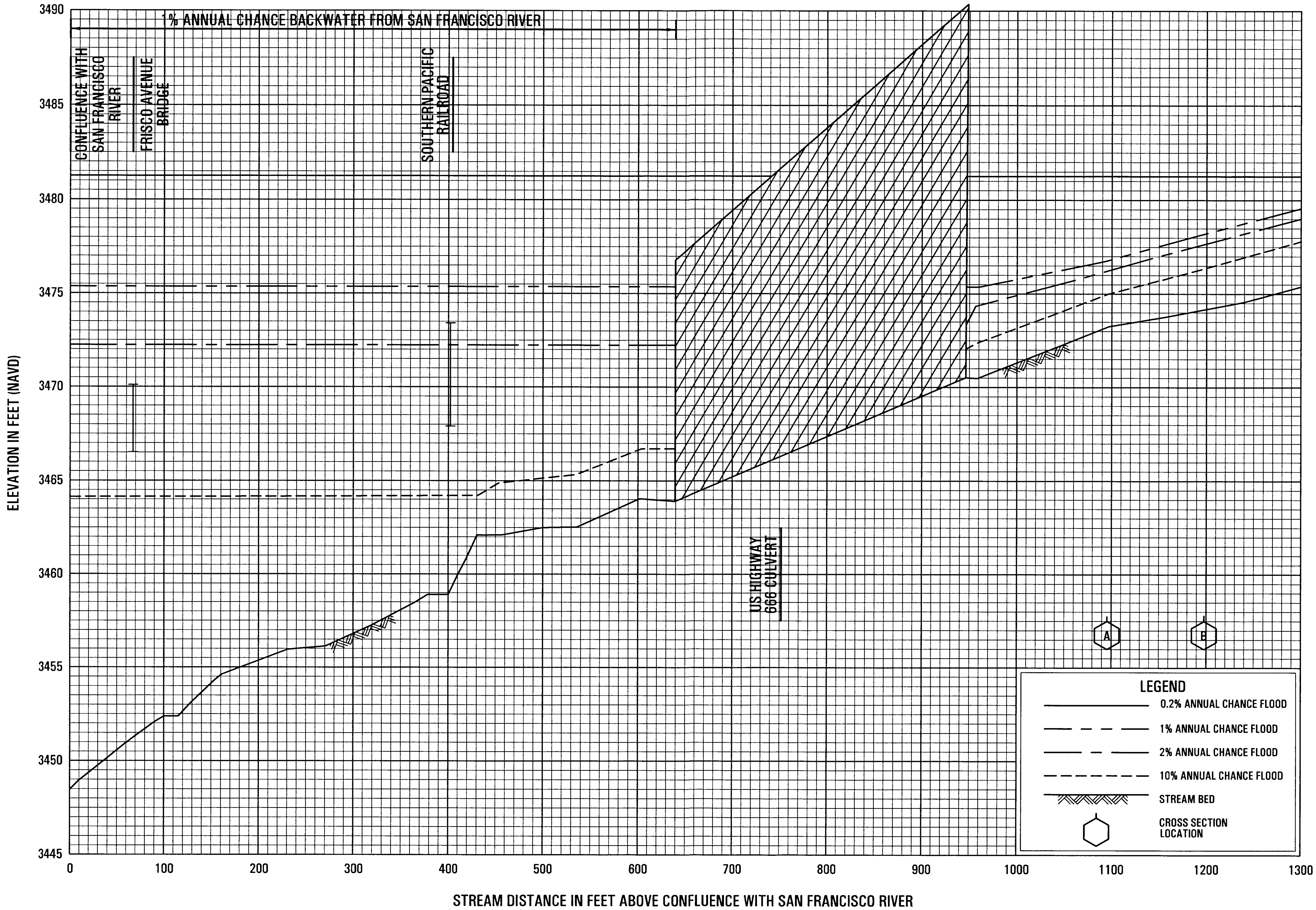


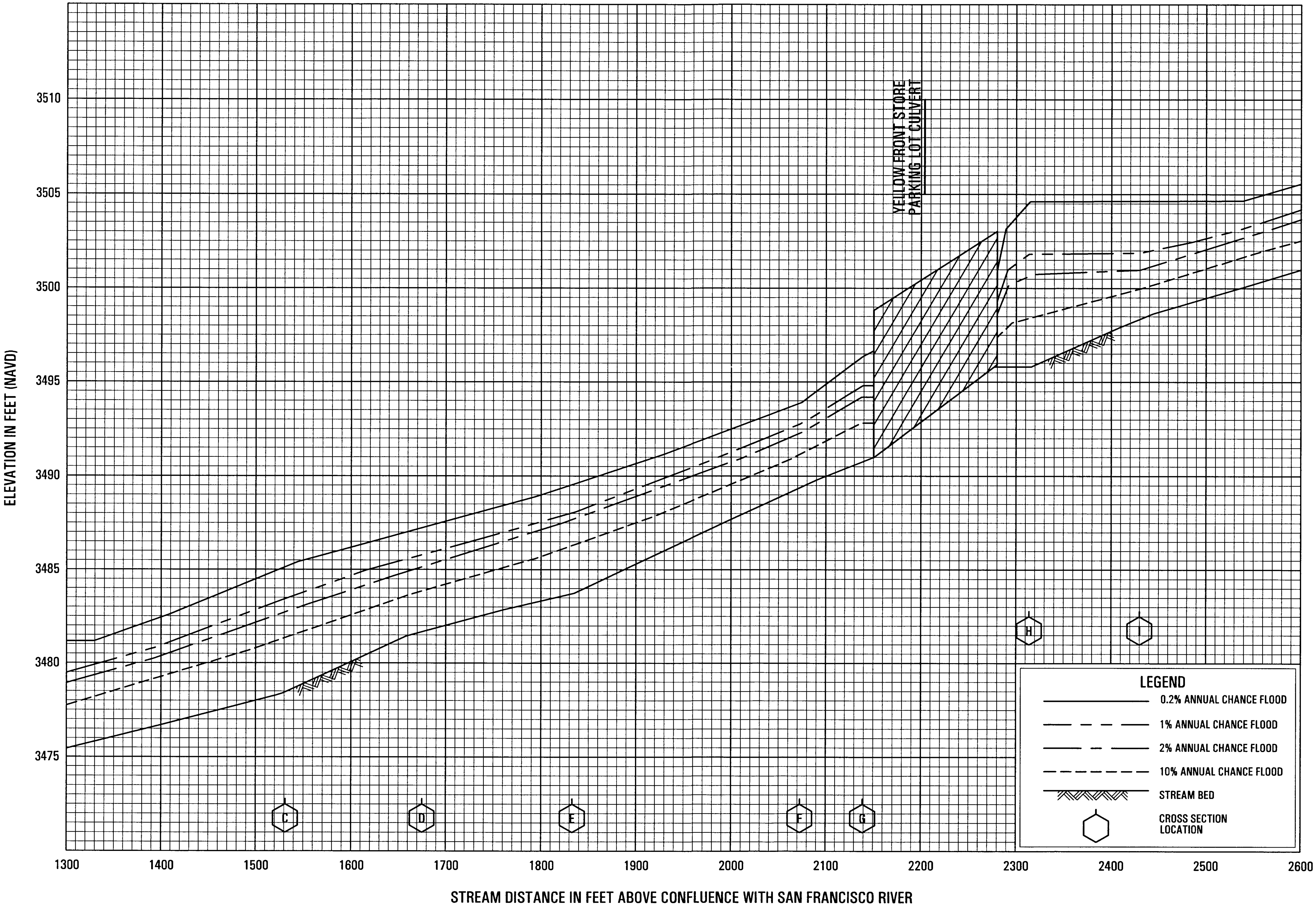
FLOOD PROFILES

CHASE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GREENLEE COUNTY, AZ

AND INCORPORATED AREAS



FLOOD PROFILES

CHASE CREEK

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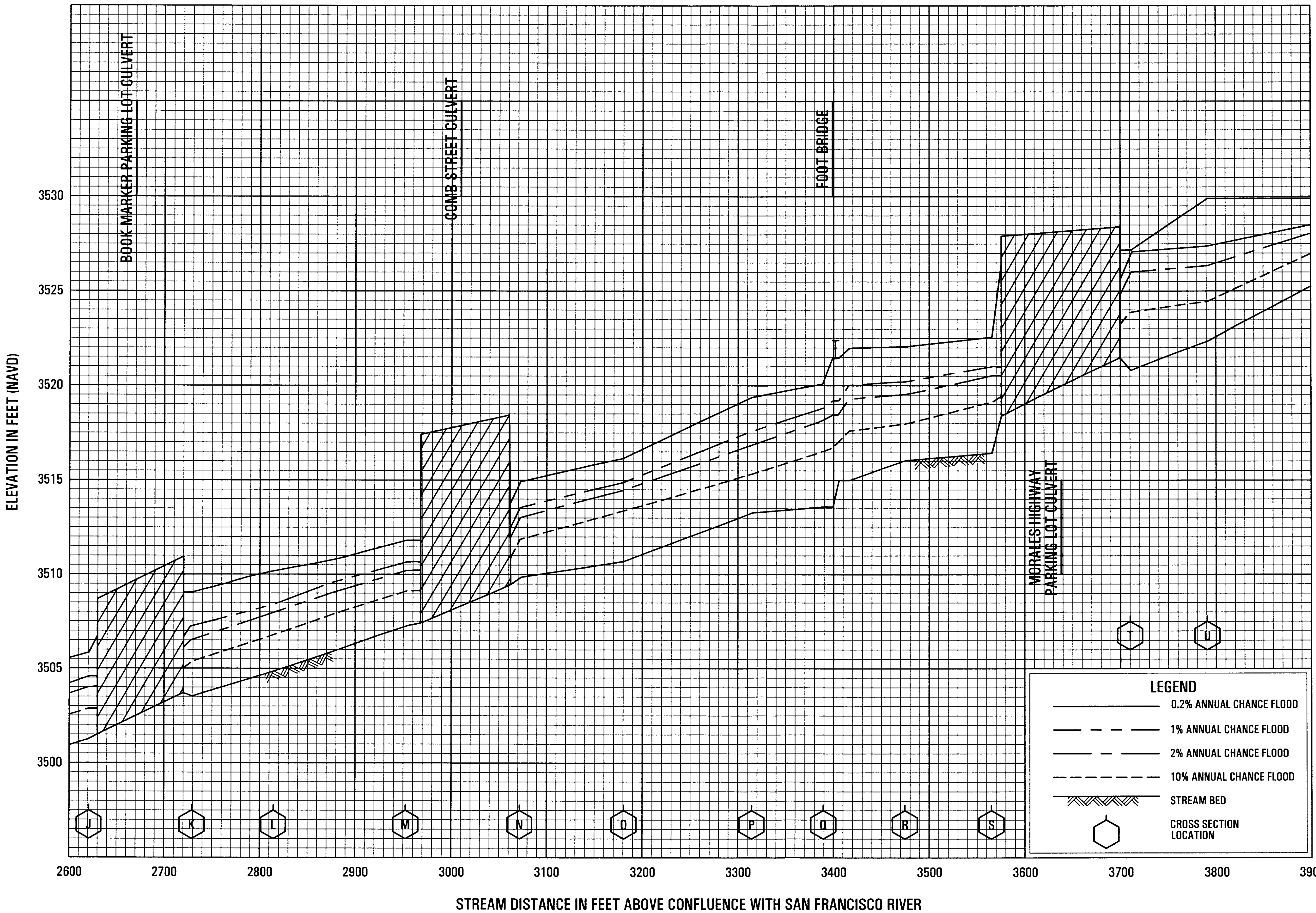

FLOOD PROFILES

CHASE CREEK

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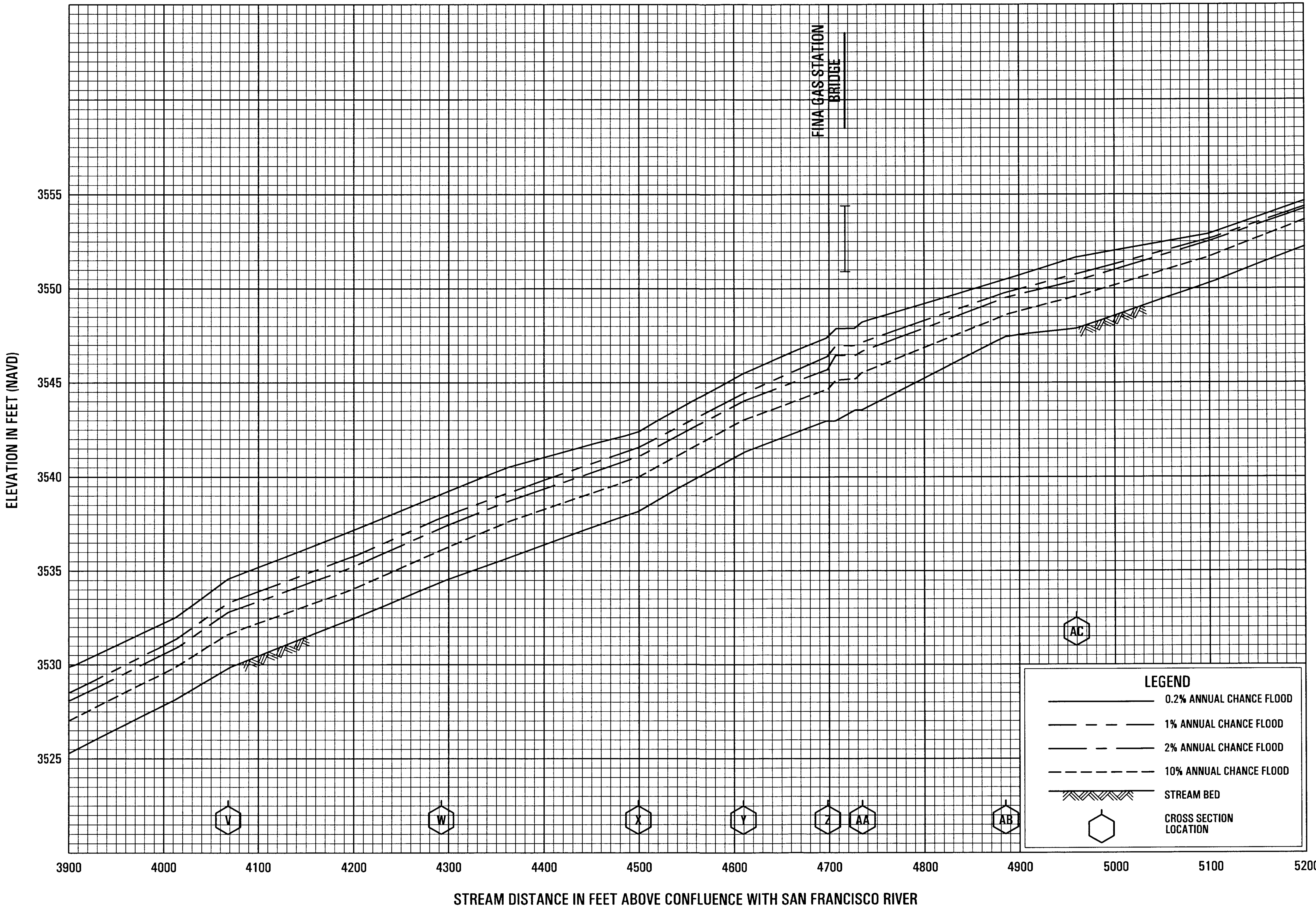
03P



FLOOD PROFILES

CHASE CREEK

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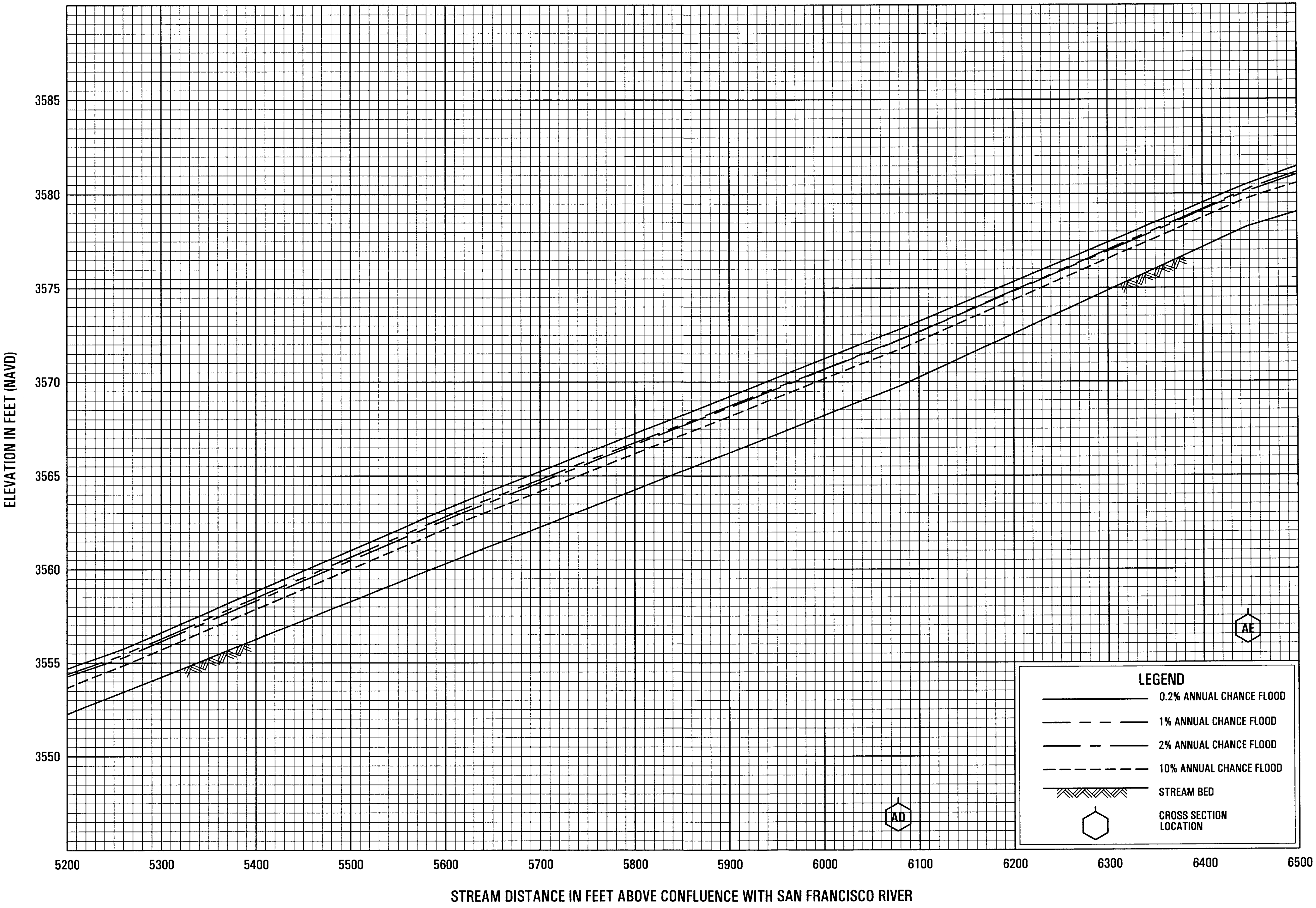
04P



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CHASE CREEK

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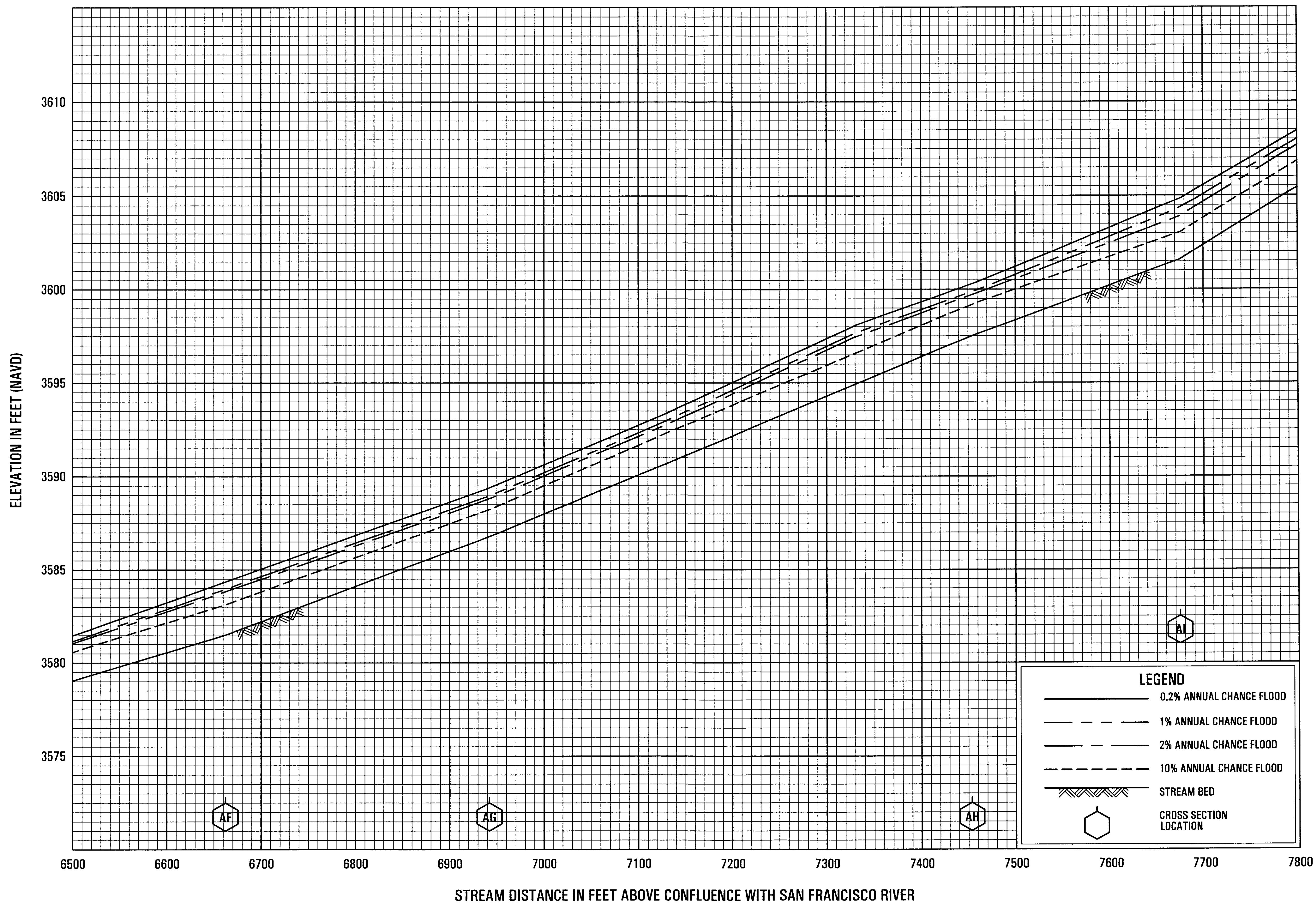

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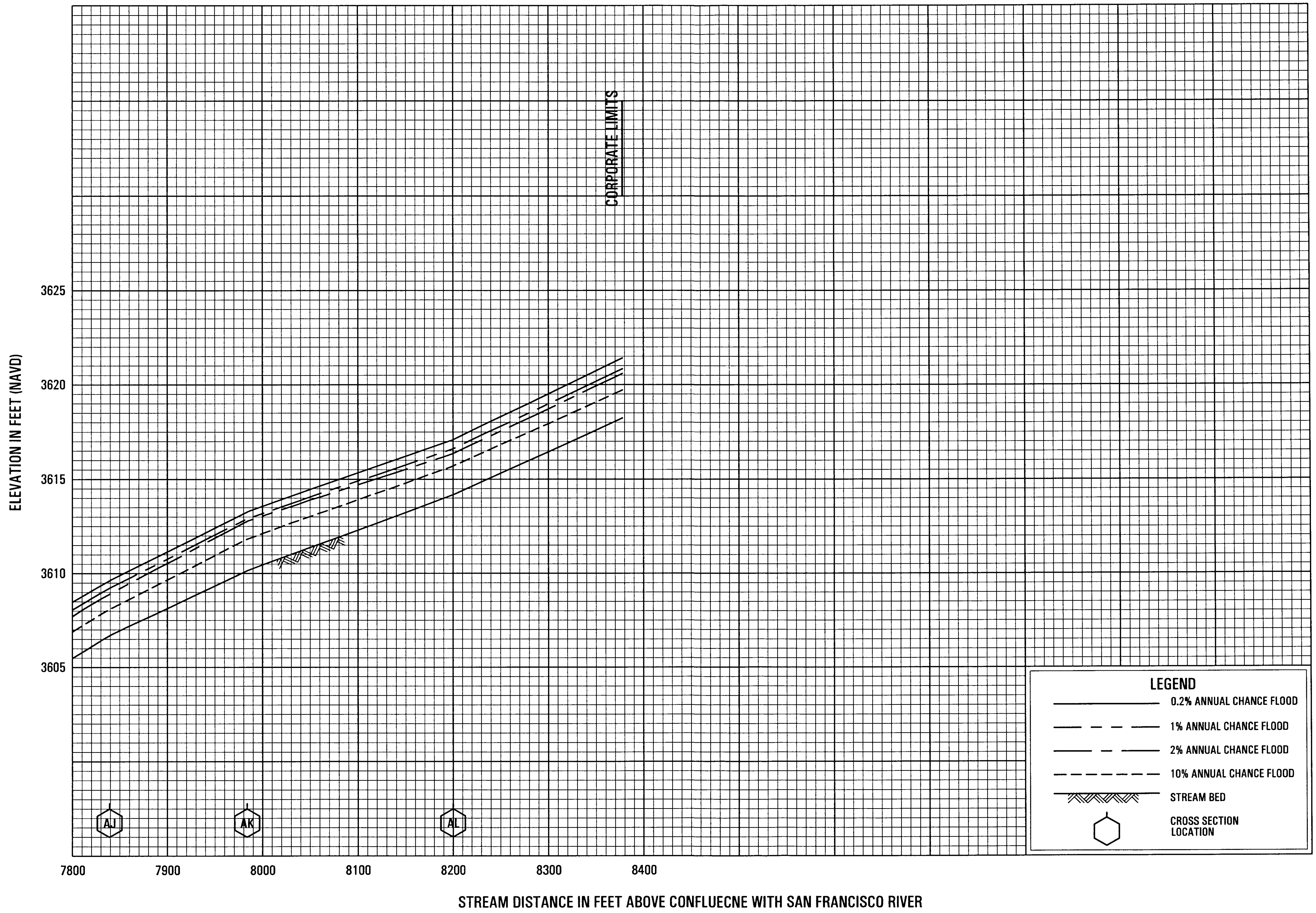

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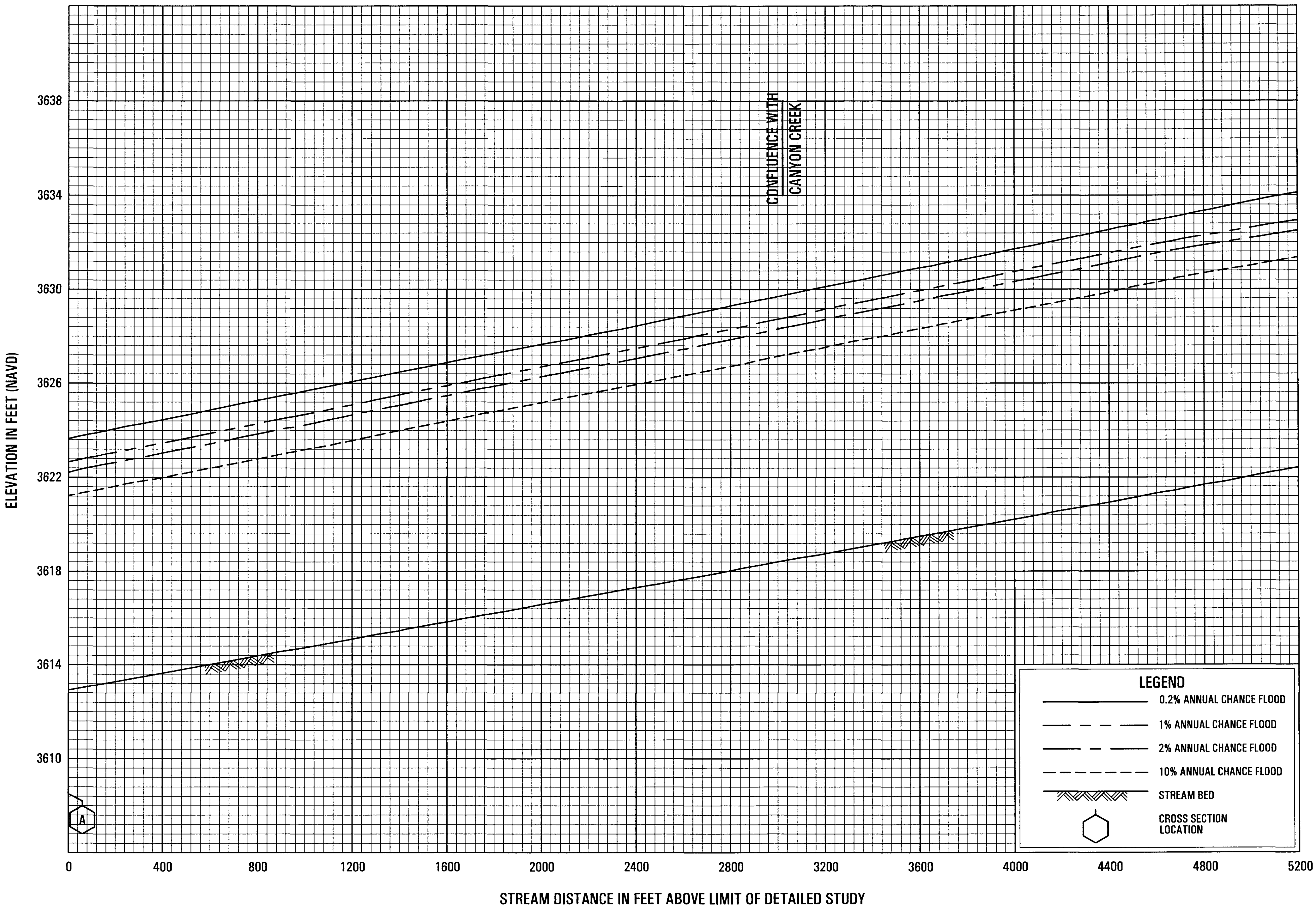

FLOOD PROFILES

GILA RIVER

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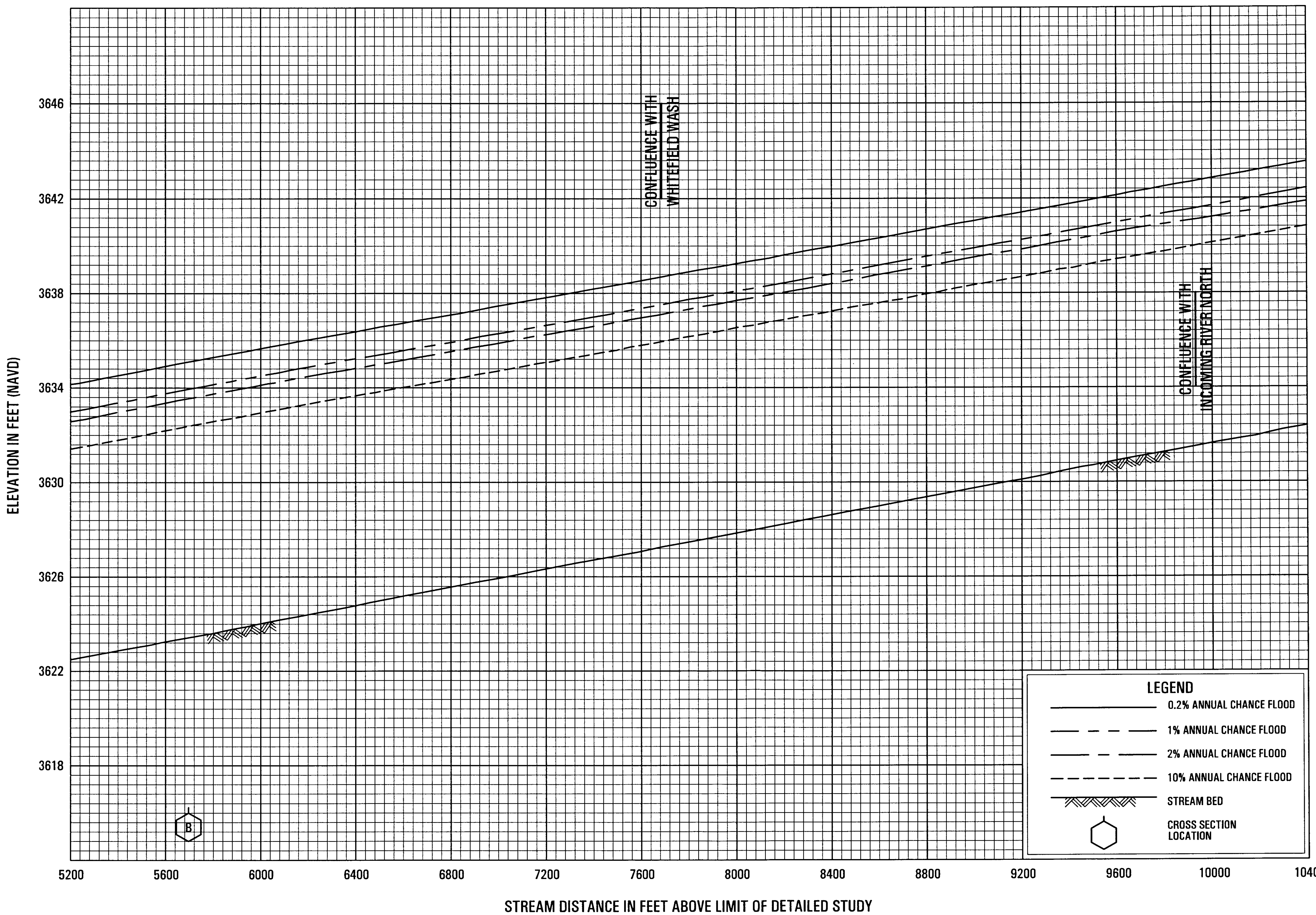

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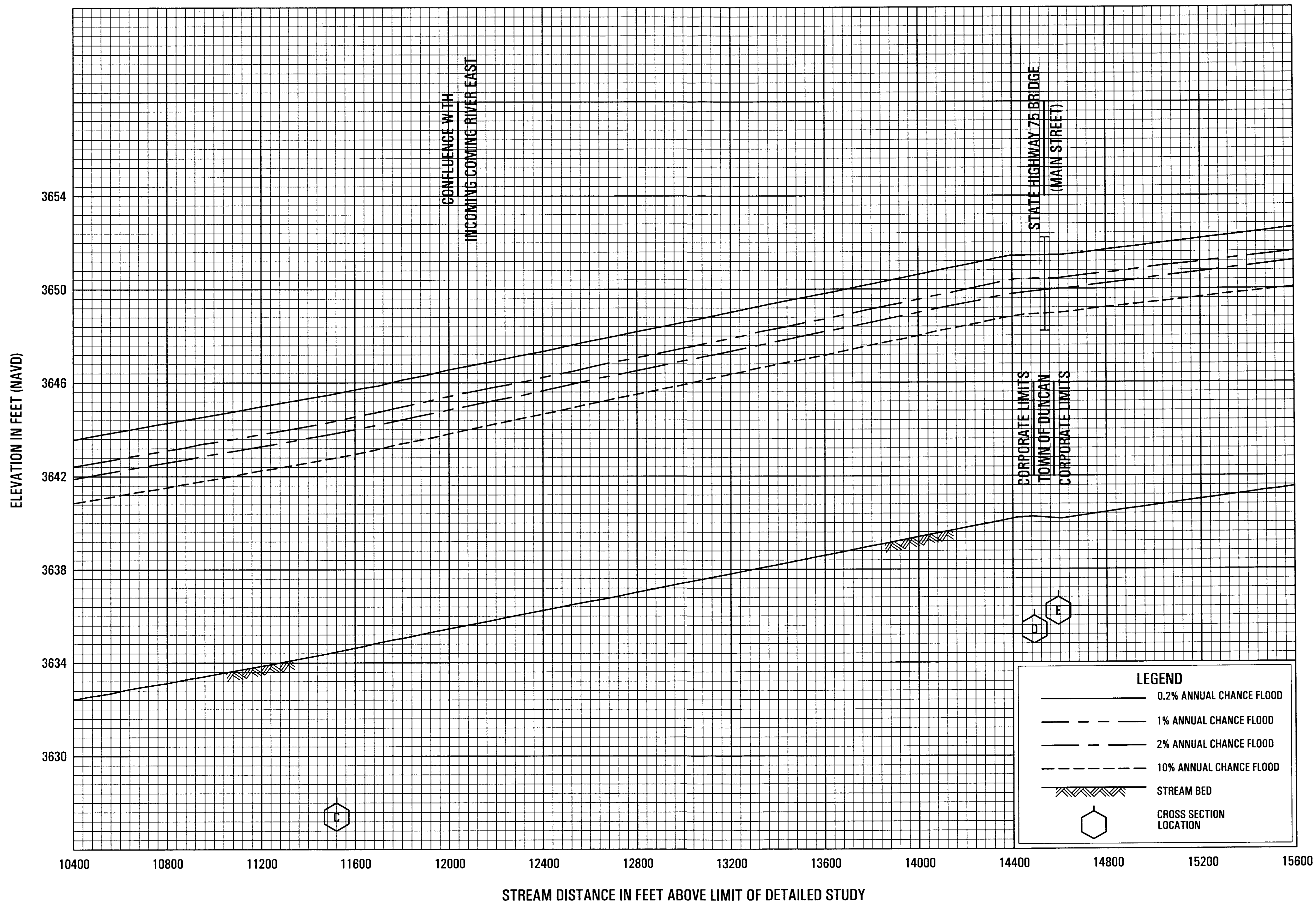

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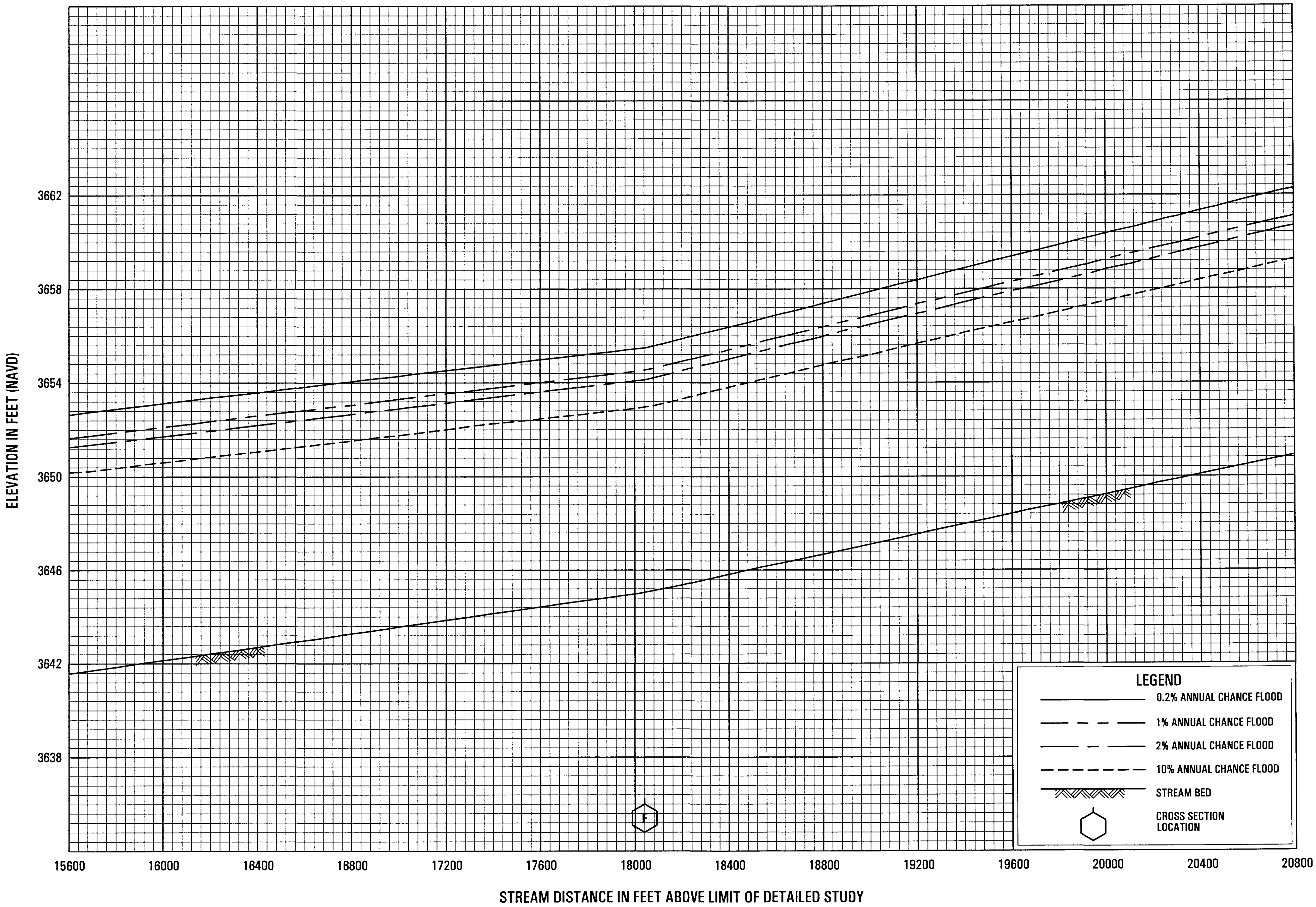

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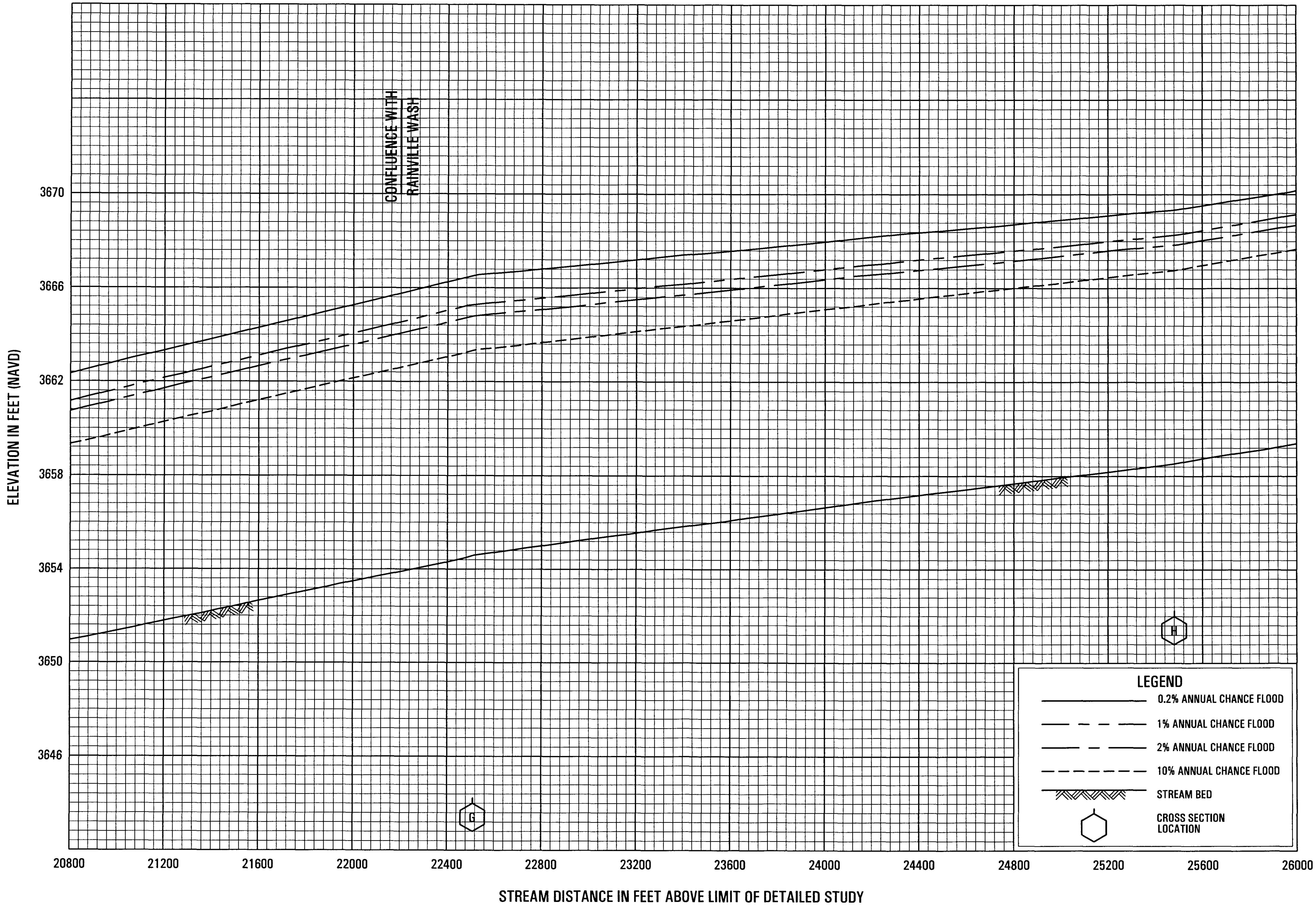

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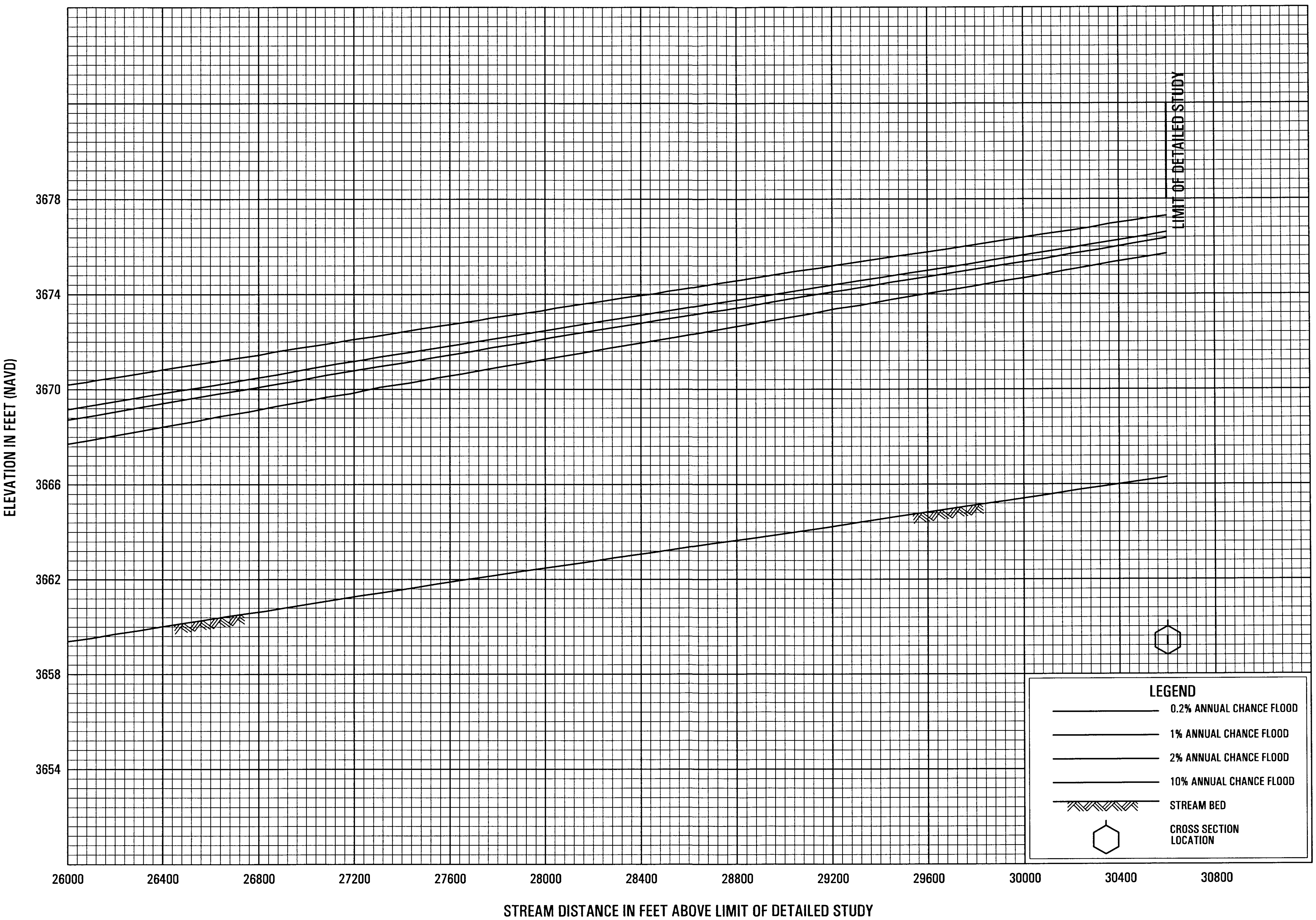

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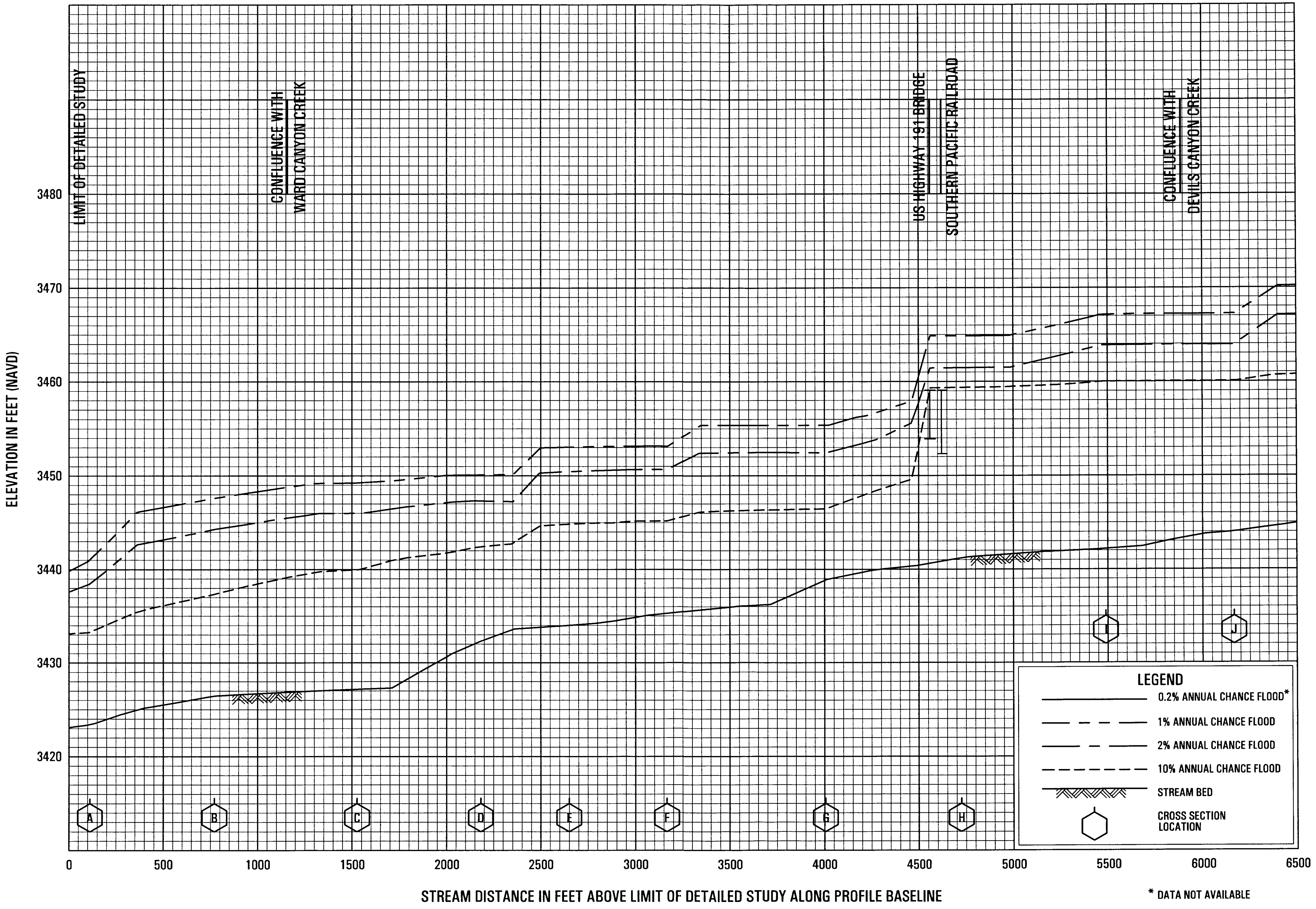

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SAN FRANCISCO RIVER

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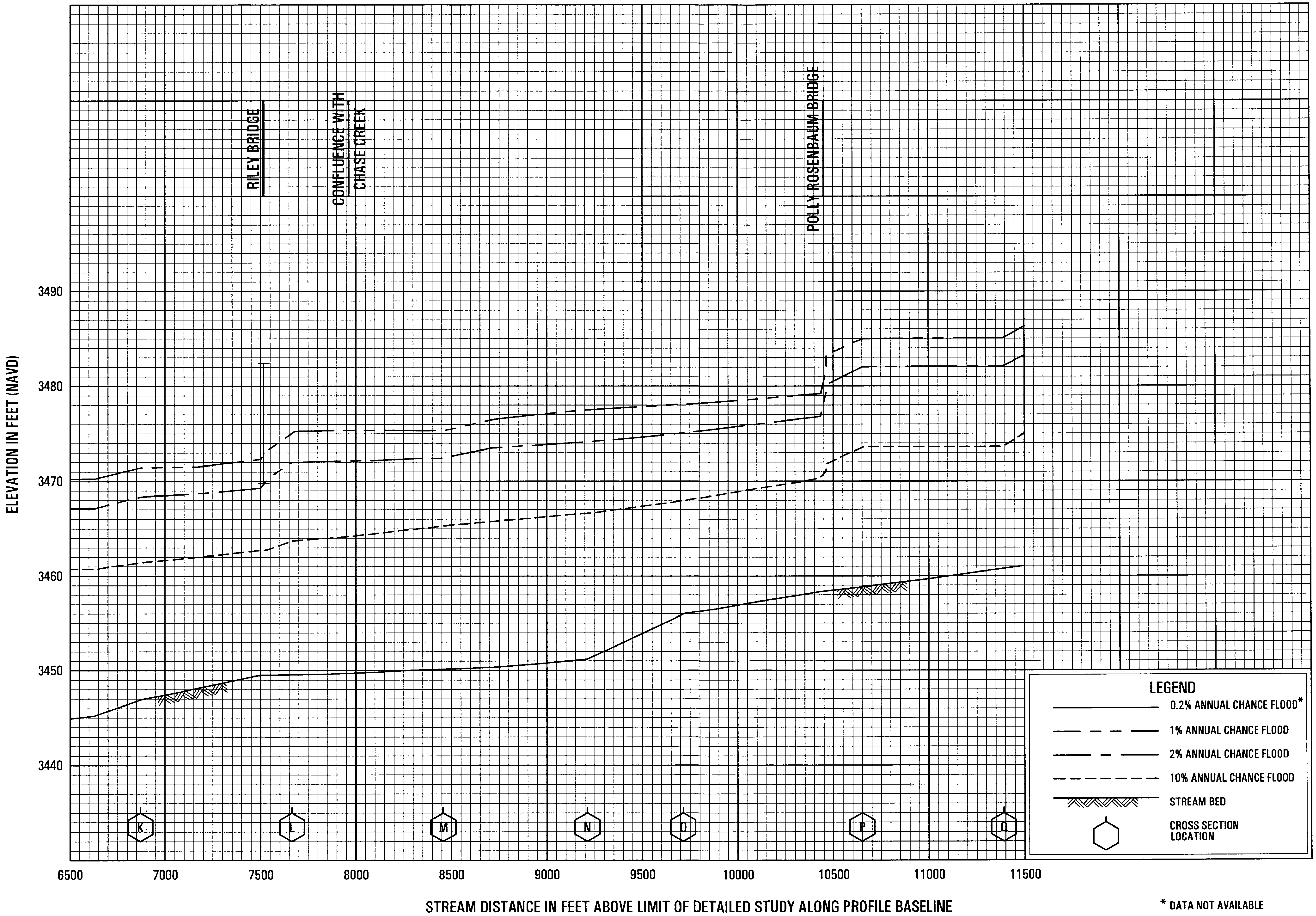

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SAN FRANCISCO RIVER

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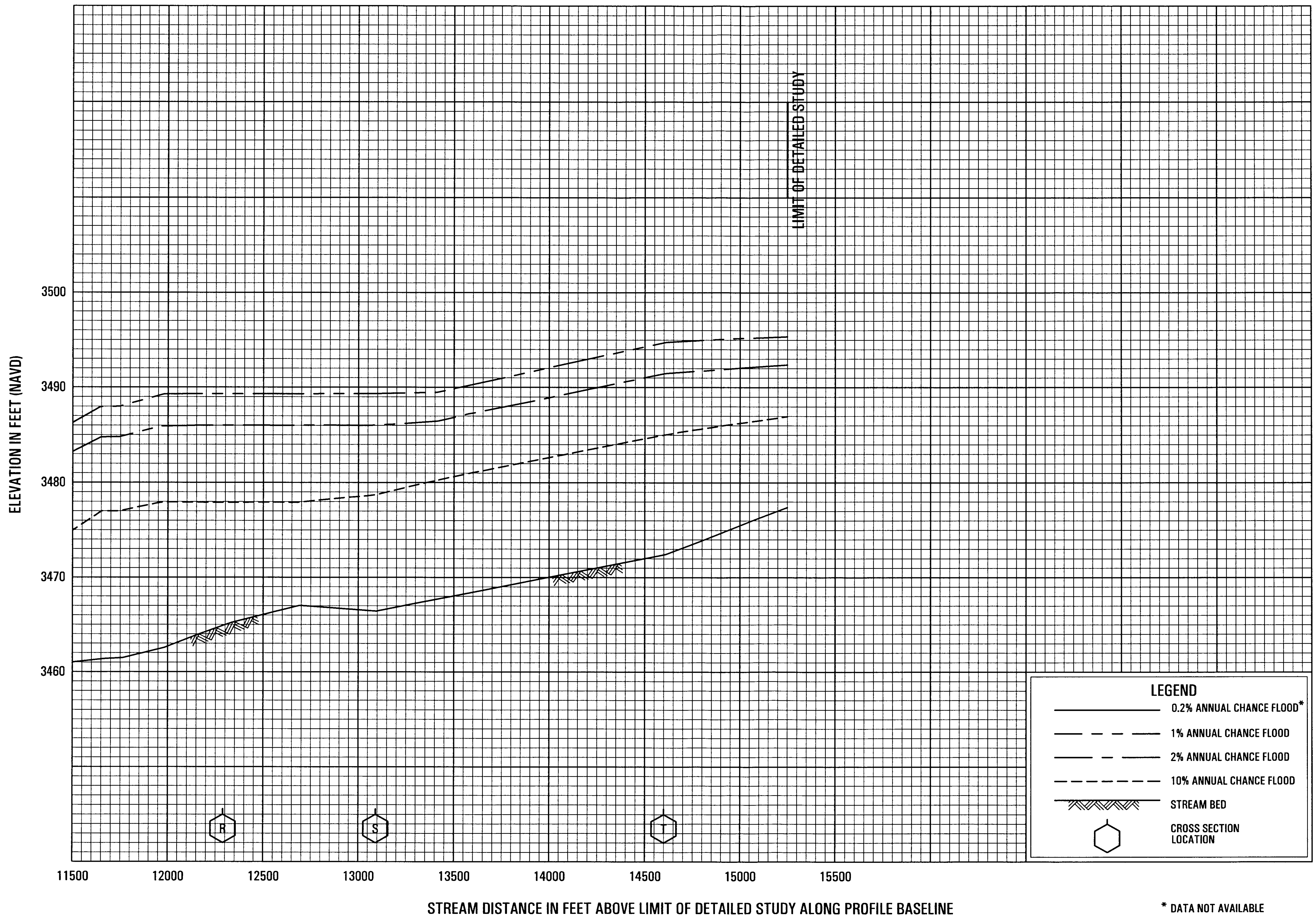

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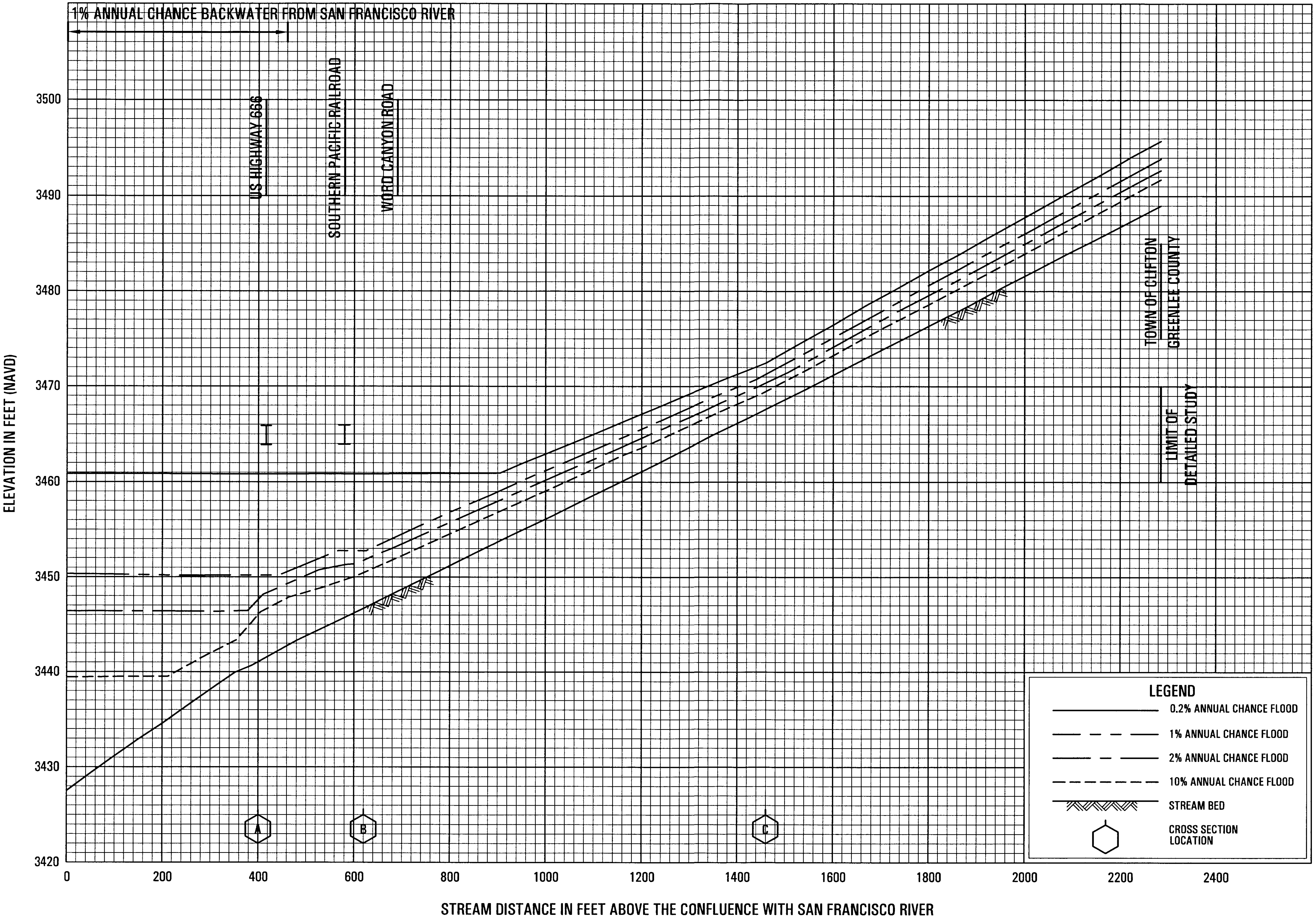

FLOOD PROFILES

WARD CANYON CREEK

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