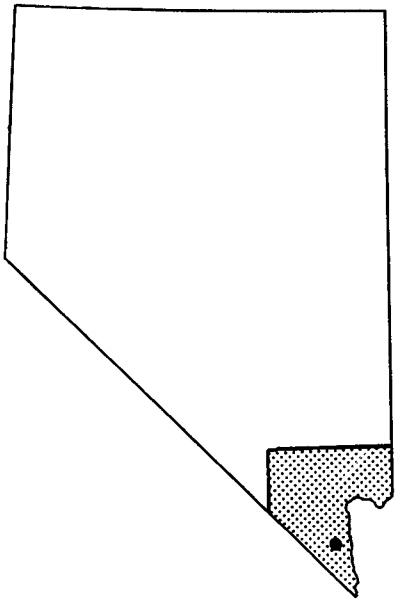
FLOOD INSURANCE STUDY

CITY OF BOULDER CITY, NEVADA
CLARK COUNTY



MARCH 16, 1981

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 320004

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FLOOD INSURANCE STUDY

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Boulder City, Clark County, Nevada, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Boulder City to the regular program of flood insurance by the Federal Insurance Administration. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The Boulder City Flood Insurance Study evolved from the Clark County Flood Insurance Study (Reference 1) started in January 1975. In April 1976, the Clark County study was divided into five principal areas. At that time, the individual time and cost estimates for this study were formulated. The initial meeting for this study was held in June 1975, and was attended by representatives from the community, the study contractor, and the Federal Insurance Administration.

Meetings with the Boulder City Engineer were held in January and April 1978 to discuss historical flood problems and flood protection measures.

The Boulder City News was contacted in April 1978 concerning newspaper accounts of past flooding. Much useful information was obtained.

On July 20, 1978, the results of the study were reviewed at the intermediate coordination meeting attended by representatives of the study contractor, the Federal Insurance Administration, and the community officials. The study was acceptable to the community.

The results of this study were reviewed at a final community coordination meeting held on October 7, 1980. Attending the meeting were representatives of the Federal Insurance Administration, the study contractor, and the city. This study incorporates all appropriate comments, and all problems have been resolved.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Soil Conservation Service, for the Federal Insurance Administration, under Inter-Agency Agreement No. IAA-H-8-77, Project Order No. 1. This work, which was completed in November 1978, covered all significant flooding sources affecting the City of Boulder City.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Boulder City, Clark County, Nevada. The area of study is shown on the Vicinity Map (Figure 1).

Five areas were studied by detailed methods. Hemenway Wash was studied from the mouth upstream to Lakeview Drive extended. The wash that parallels Georgia Avenue, referred to as the Georgia Avenue Wash in this study, was studied from the corporate limits to the north end of Sierra Vista Place. Approximately 1 mile of the upstream end of Wash C, which flows from near the intersection of Utah Street and Adams Boulevard to the corporate limits, was studied in detail. Wash D, which crosses U.S. Highway 93 1.3 miles west of the junction with Nevada Highway, was studied from U.S. Highway 93 downstream 0.4 mile. Wash B, which parallels U.S. Highway 93 (Business) was also studied by detailed methods.

Areas studied by approximate methods include some of those that were mapped for the Flood Hazard Boundary Map (Reference 2). Approximate flood areas from this map not included in this report are those for which the drainage characteristics have been altered since 1974, the flooding situation has been determined to be shallow flooding, or the wash is being included as detailed study. The downstream reaches of both Wash C and Wash D were studied by approximate methods.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1983.

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 the Federal Insurance Administration and Boulder City.

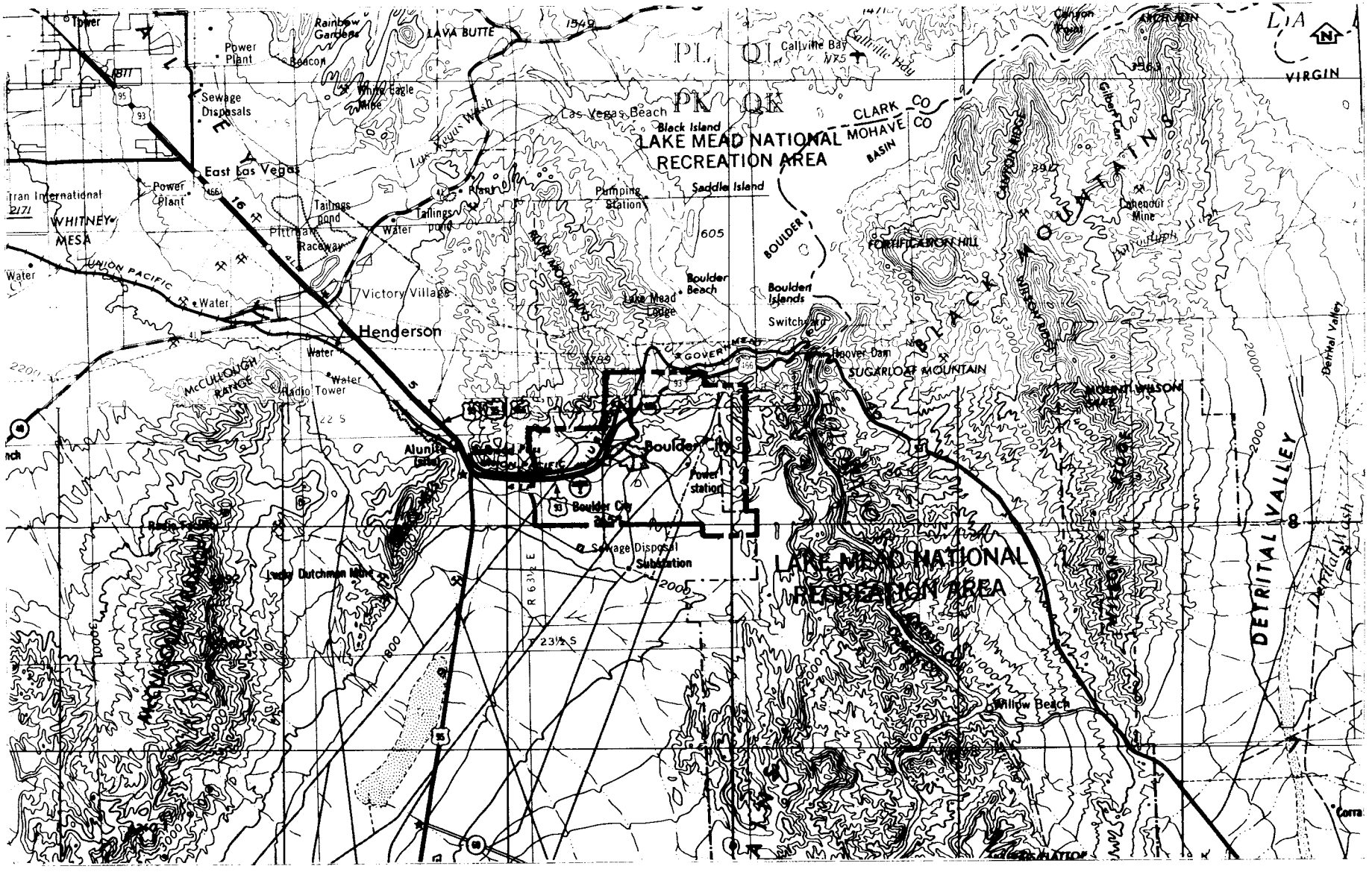

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

2.2 Community Description

Boulder City is located in southern Clark County, in southeastern Nevada. It is 5 miles from Lake Meade and 23 miles southeast of Las Vegas. Situated on the drainage divide between the Colorado River and the Eldorado Valley, the elevations within the corporate limits range from 2000 feet in the Hemenway Wash and Eldorado Valley areas to more than 3600 feet in the River Mountains, located in the northwest portion of the city. The city encompasses approximately 32 square miles, a large portion of which is undeveloped. The population of Boulder City was 4059 in 1960 and 5223 in 1970 (Reference 3). In 1975, the estimated population was 7785 (Reference 4).

Commercial development is primarily located along the Nevada Highway and U.S. Highway 93, west of the center of the city. Major residential development has occurred to the east and south in the past several years. Residential developments are being constructed on the northwest side of the Hemenway Wash valley. These developments are located at the base of the mountains.

The flood plains of Hemenway Wash, Wash B, Wash C, and Wash D are undeveloped. The flood plain of the Georgia Avenue Wash is undeveloped except for two areas. Georgia Avenue, between Fairway Drive and Mendota Drive, is developed and Highland Drive and Sierra Vista Place are paved; but, at the time of this study, no residences have been constructed there.

The two basic natural features which affect flooding in Boulder City are the mountain washes and alluvial fans. Rainfall on the mountain wash area in the northwest portion of the city concentrates very quickly into large runoff quantities due to very steep slopes, rock outcroppings, and sparse vegetative cover. At the base of the mountains, this water flows out onto an alluvial fan, which spreads the flow among a number of small rills and gullies. Erosion and deposition is continually occurring on the alluvial fan, resulting in changing drainage patterns. The northwestern and western portions of Boulder City are classified as mountain wash and alluvial fan topography.

The largest wash in Boulder City is Hemenway Wash, located in the northern portion of the city. At the corporate limits, this wash has a drainage area of approximately 4.1 square miles. The Georgia Avenue Wash in the southern portion of the city has a drainage area of approximately 1.9 square miles at the corporate limits. There are a number of washes with drainage areas of approximately 1.0 square mile or less, and alluvial fan areas with distributary drainage patterns.

The five washes studied in detail have well-defined drainageways and carry flows only after rainstorms. Much erosion and deposition occurs in these washes, evidenced by sand and gravel bars, vertical banks in many areas, and very little vegetation in the wash itself. The vegetation on the undeveloped areas is desert brush with approximately 5 percent cover. The soils in Boulder City are of the loam type category. Arizo, Akela Rock Outcrop, Bluepoint, Tonopah, Hobog, and Canutia-Akela complex are the major soil groups found in Boulder City.

The climate of Boulder City is arid. The average annual rainfall is 5.4 inches. The precipitation is evenly distributed throughout the year with the exception of May and June when averages of 0.17 and 0.06 inches occur, respectively (Reference 5).

Boulder City was founded in 1931, during the construction of the Hoover Dam. It served as a residence for those involved in the construction on the dam. The community was designed to house as many as 2500 workers.

Boulder City became incorporated in 1960 when the U.S. Bureau of Reclamation deeded the area to self-government.

2.3 Principal Flood Problems

Most heavy flood-producing rains occur as thunderstorms, usually during the months of May through September. The storms are usually of high intensity and short duration. Because there are no stream gages in Boulder City from which to estimate flood frequency, recurrence intervals for the following floods (where they are mentioned) are based on the estimated recurrence interval of the precipitation amount.

Newspaper accounts of flood damage in and around Boulder City date back to July 11, 1932, when a large storm extending from Indian Springs on the west to Boulder City on the east caused damage to the Boulder Dam Highway (Reference 6). Other flood damage in Boulder City occurred on September 24, 1935; March 3, 1938; June 29, 1938; September 7, 1939; July 27, 1952; and, October 27, 1974 (Reference 7).

The heaviest rainfall recorded at Boulder City since a weather station was established there in 1931 occurred on September 11, 1976. The rainfall recorded for the day was 2.62 inches, which reportedly occurred within a 3-hour time span. The Boulder City News of September 16, 1976, reported that:

> All of the stores on the Nevada Highway on the block between Avenue B and Ash were drenched, causing leakage and drainage of property inventory..... Virtually every section of Boulder City was affected to varying degrees.

The amount of precipitation which occurred from this storm exceeded that which would be expected once in 100 years.

The Boulder City News of March 9, 1978, reported that during the heavy rainfall of March 2, 1978:

> Avenues in the older section of the city were awash as rushing waters topping the curbs... Mud and gravel temporarily closed Ville and Pacifica Drives in the Hemenway Valley. The truck route (in Hemenway Wash) was closed to traffic...and re-opened.

The rainfall amount recorded was 1.13 inches, which fell within 1.5 hours. This event is estimated to have a recurrence interval of 8 years.

The flood problems of Boulder City may be classified into two categories. In the washes, where runoff collects rapidly, there is flooding to significant depths, and almost all other areas are subject to surface runoff and shallow flooding.

2.4 Flood Protection Measures

One floodwater-retarding structure exists in Boulder City. It is located in the Hemenway Wash drainage area and protects the development on Aaron Way and Kendall Lane. It was constructed in 1978 and has approximately 10 acre-feet of storage to the elevation of the emergency spillway. The principal outlet consists of a concrete riser with an outlet pipe that is 3.5 feet in diameter. This outlet pipe carries flow around the development and into Hemenway Wash. The dam was designed for a 100-year frequency flood. The drainage area behind the dam is approximately 230 acres.

A large system of floodwater diversions has been constructed between U.S. Highway 93 and Bootleg Wash, west of the center of the city. These diversions are constructed across the slope of the alluvial fan and intercept surface runoff. The area protected is approximately 250 acres. The level of protection is unknown due to variation in diversion design and construction.

Boulder City has no Flood Plain Management Ordinance in effect, but utilizes flood plain studies in reviewing subdivision plans.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail 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 which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium 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 equalled 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 short 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 which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 to 10). The analyses reported here 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 the peak discharge-frequency relationships for floods of the selected recurrence intervals for each stream studied in detail in the community.

The U.S. Soil Conservation Service TR-20 computer program (Reference 8) was used to compute peak discharges at several locations within Boulder City. The program is a rainfall-runoff computer model. The basic parameters needed to operate the program (drainage area, runoff curve number, and time of concentration) were computed for each location where a peak discharge was desired.

Rainfall values used as input to the computer program were obtained from the National Oceanic and Atmospheric Administration Rainfall Atlas (Reference 9). Three rainfall durations (3-, 6-, and 24-hour), and 4 rainfall frequencies (2-, 10-, 50-, and 100-year) were used, resulting in a set of 12 discharges computed for each location. The 500-year discharge was obtained by extending the discharge-frequency curve as drawn on log-probability paper to the 500-year probability line.

For purposes of this Flood Insurance Study, the discharge associated with the 3-hour storm is used to compute the depths of flooding. The 3-hour storm was used in order to be consistent with results obtained from a regional analysis of stream and rain gages in southern Nevada (Reference 10).

There are no stream gages in Boulder City; however, there are 18 gages operating in the Las Vegas Valley and 1 in the Eldorado Valley south of Boulder City (Reference 11). There is a daily recording rain gage in Boulder City (Reference 12) with 46 years of record.

Peak discharges for the alluvial fan and sheet flow areas were computed using the U.S. Soil Conservation Service TR-20 computer program. Representative locations in different parts of the community were selected for computation of discharges.

Peak discharge-drainage area relationships for Hemenway and Georgia Avenue Washes, and Washes B, C, and D are shown in Table 1.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of streams in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each stream studied in the community.

Water-surface profiles for the 10-, 50-, 100-, and 500-year flood frequencies were computed using the U.S. Soil Conservation Service WSP-2 computer program (Reference 13).

The cross section data for the streams studied in detail consisted of 11 cross sections digitized from aerial photogrammetry, 4 cross sections surveyed, and 15 cross sections for which data was derived from 2-foot contour interval maps (Reference 14).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Manning's "n" values were estimated in the field according to standard U.S. Soil Conservation Service guidelines (Reference 15).

Table 1. Summary Of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Hemenway Wash					
At Cross Section C	2.86	290	635	815	1380
At Cross Section E	1.06	80	195	260	420
Georgia Avenue Wash					
At Cross Section A	1.88	225	450	570	850
At Cross Section C	1.10	155	305	385	580
At Cross Section E	0.45	50	105	130	195
Wash B					
At Cross Section A	0.41	140	255	315	460
Wash C					
At Cross Section A	1.04	120	265	335	490
At Cross Section C	0.81	90	195	250	390
At Cross Section D	0.60	70	150	195	300
Wash D					
At Cross Section D	1.38	205	400	490	740

The ranges of "n" values are as follows:

Wash	Channel "n"	Overbank "n"
Hemenway Wash	0.028	0.045
Georgia Avenue Wash	0.020 to 0.035	0.035 to 0.045
Wash B	0.035	0.045
Wash C	0.035	0.045
Wash D	0.040	0.045

Starting water-surface elevations were computed by normal depth analysis.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals (Exhibit 1).

Shallow flooding (or alluvial fan flooding) is a problem in many areas within Boulder City. This type of flooding occurs on the relatively flatter terrain of the community, where the runoff collects in a number of small gullies or waterways. These drainageways change in size and location over the years thus being potential flood hazards for the entire alluvial fan area. An approximate method of analysis was used to determine the depth of flooding. The 100-year peak discharge was divided by the number of waterways, and the depth was determined for an average waterway cross section (Reference 16). This method was applied at representative locations in Boulder City where shallow flooding is a problem.

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

The hydraulic analyses for this study 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.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the Federal Insurance Administration as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2400, with a contour interval of 2 feet (Reference 14).

In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown.

Approximate flood boundaries were determined with the use of the following information and data:

1. Shallow flood depth as determined
2. Flood Hazard Boundary Map for Boulder City (Reference 2)
3. U.S. Geological Survey Flood-Prone Area Map (Reference 17)
4. Historical flood data

These four information sources were combined with engineering judgment in determining the approximate flood boundaries.

The study contractor has determined that some areas shown on the Federal Insurance Administration Flood Hazard Boundary Map (Reference 2) are areas of minimal flooding; therefore, they were not delineated on the maps.

The boundary of the 100- and 500-year flood is shown on the Flood Boundary and Floodway Map (Exhibit 2).

Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity and increases flood heights, thus increasing flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the

area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. As minimum standards, the Federal Insurance Administration limits such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced.

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

In the areas studied in detail where no floodway is shown, the concept of a floodway does not apply because of shifting channels (upstream portions of Hemenway Wash, Georgia Avenue Wash and Wash D), and no overbank flooding (Wash B and Wash C).

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were determined at cross sections; between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood boundaries are close together, only the floodway boundary has been shown.

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

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
						(FEET NGVD)		
Hemenway Wash								
A	4420	150	325	3.25	2000.2	2000.2	2001.2	1.0
B	4790	30	141	7.48	2020.0	2020.0	2021.0	1.0
C	7540	170	186	4.38	2155.8	2155.8	2156.8	1.0
D	7740	50	120	6.79	2168.4	2168.4	2169.4	1.0
E	8705	80	39	6.69	2218.2	2218.2	2219.2	1.0

[1]Feet Above Mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

FLOODWAY DATA

HEMENWAY WASH

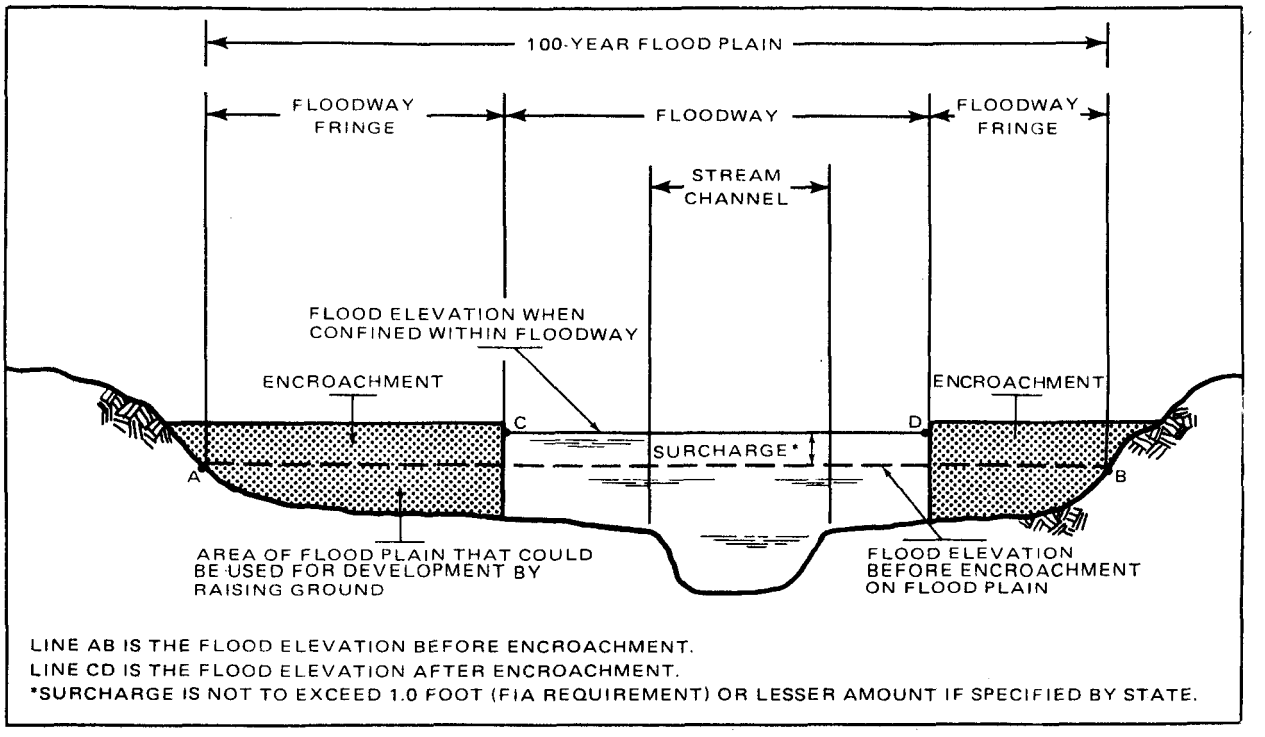

Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Insurance Administration has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Boulder City.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

Average Difference Between 10- and 100-year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the City of Boulder City are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is the Federal Insurance Administration device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective Flood Hazard Factors, the entire incorporated area of the City of Boulder City was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or Flood Hazard Factors determined.
Zones A1 and A2:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to Flood Hazard Factors.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION (FEET NGVD)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Hemenway Wash Reach 1	0004	-0.8	-0.1	0.3	010	A2	Varies - See Map
Wash B Reach 1	0004	-0.8	-0.2	0.3	010	A2	Varies - See Map
Wash C Reach 1	0003	-0.6	-0.2	0.3	005	A1	Varies - See Map
Wash D Reach 1	0001,0003	-1.1	-0.5	0.2	010	A2	Varies - See Map
Georgia Avenue Wash Reach 1	0003	-0.7	-0.2	0.5	005	A1	Varies - See Map

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

FLOOD INSURANCE ZONE DATA

HEMENWAY WASH-WASH B-WASH C-WASH D-GEORGIA AVENUE WASH

	100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, Flood Hazard Factors, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Boulder City is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Insurance Administration.

6.0 OTHER STUDIES

Flood Insurance Studies in Clark County, Nevada, include Las Vegas (Reference 18), North Las Vegas (Reference 19), Henderson (Reference 20), and unincorporated areas of Clark County (Reference 1). The results of this Flood Insurance Study are in agreement with the data developed for these Flood Insurance Studies.

Boulder City completed a flood plain study (Reference 21) in 1975. The 100-year peak discharges at given locations as they compare with the study follow:

Location	100-Year Peak Discharge (Cubic Feet per Second) 1975 Boulder City Study	Boulder City FIS
Wash C		
At Cross Section A	395	335
Georgia Avenue Wash		
At Cross Section A	690	570
Hemenway Wash		
At Cross Section C	1220	1055
Wash D		
At Cross Section D	213	490

The construction of floodwater diversions in the neighborhood of Wash D since 1975 greatly increased the contributing drainage area.

No flood elevations, flood profiles, or floodways were computed for that study. Flood boundaries were drawn approximately and in nearly all cases were within the limits of the 100-year flood boundary as determined for this Flood Insurance Study. However, the flood plains of many other waterways with very small drainage areas were too small to include in this Flood Insurance Study.

Another study completed in Boulder City was the Hemenway Wash Inventory and Evaluation (Reference 22). Flood boundaries were not drawn for that study; only peak discharges were computed. Flood elevations, flood profiles, and floodways were not computed, and extensive cross section surveys were not made. Peak discharges were computed at different locations than those in this Flood Insurance Study. A comparison which can be made between the Hemenway Wash study and this Flood Insurance Study is the discharge-versus-drainage area plot. For an equivalent drainage area, the discharge computed for the Hemenway Wash study is generally less than the discharge used in this Flood Insurance Study. The difference between the two sets of discharges lies in the use of the Antecedent Moisture Condition parameter of the U.S. Soil Conservation Service TR-20 computer program (Reference 8).

For this Flood Insurance Study, a higher soil moisture level was assumed, resulting in greater runoff and higher discharges. The Antecedent Moisture Condition used for this Flood Insurance Study was the same as that used in the other Flood Insurance Studies referred to at the beginning of this section. Antecedent Moisture Condition (average soil moisture) was used for three reasons.

1. Regional analysis of stream gages in Clark County indicated that it is the soil moisture level to use.

2. Lawn watering gives many areas an amount of antecedent moisture.

3. The 3-hour storm may be a part of a longer-duration storm which could give an area a sufficient amount of antecedent moisture.

The Federal Insurance Administration previously published a Flood Hazard Boundary Map for the City of Boulder City (Reference 2). Information from that map was incorporated in this Flood Insurance Study.

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

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Insurance and Mitigation Division, Federal Emergency Management Agency, 211 Main Street, Room 220, San Francisco, California 94105.

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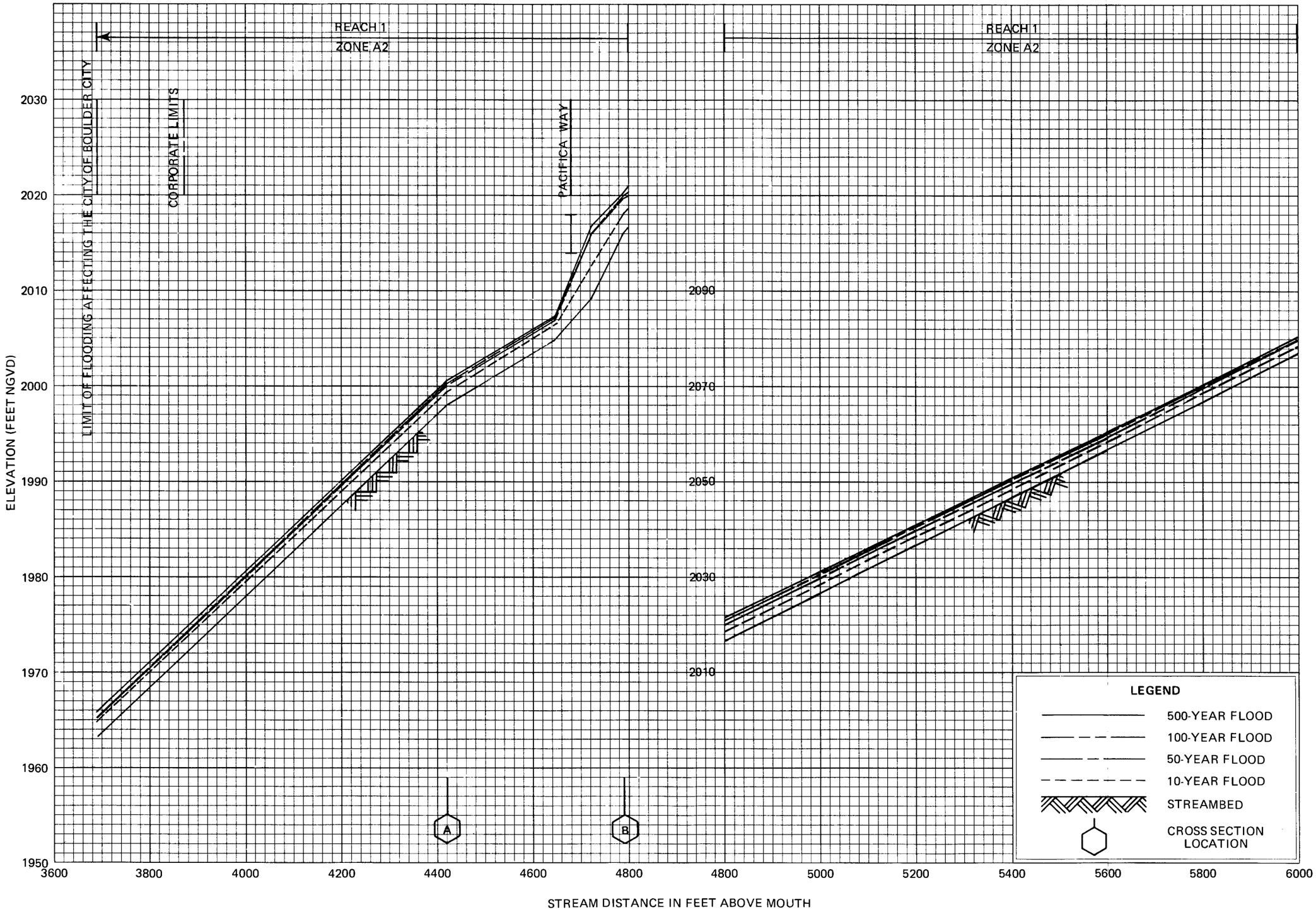


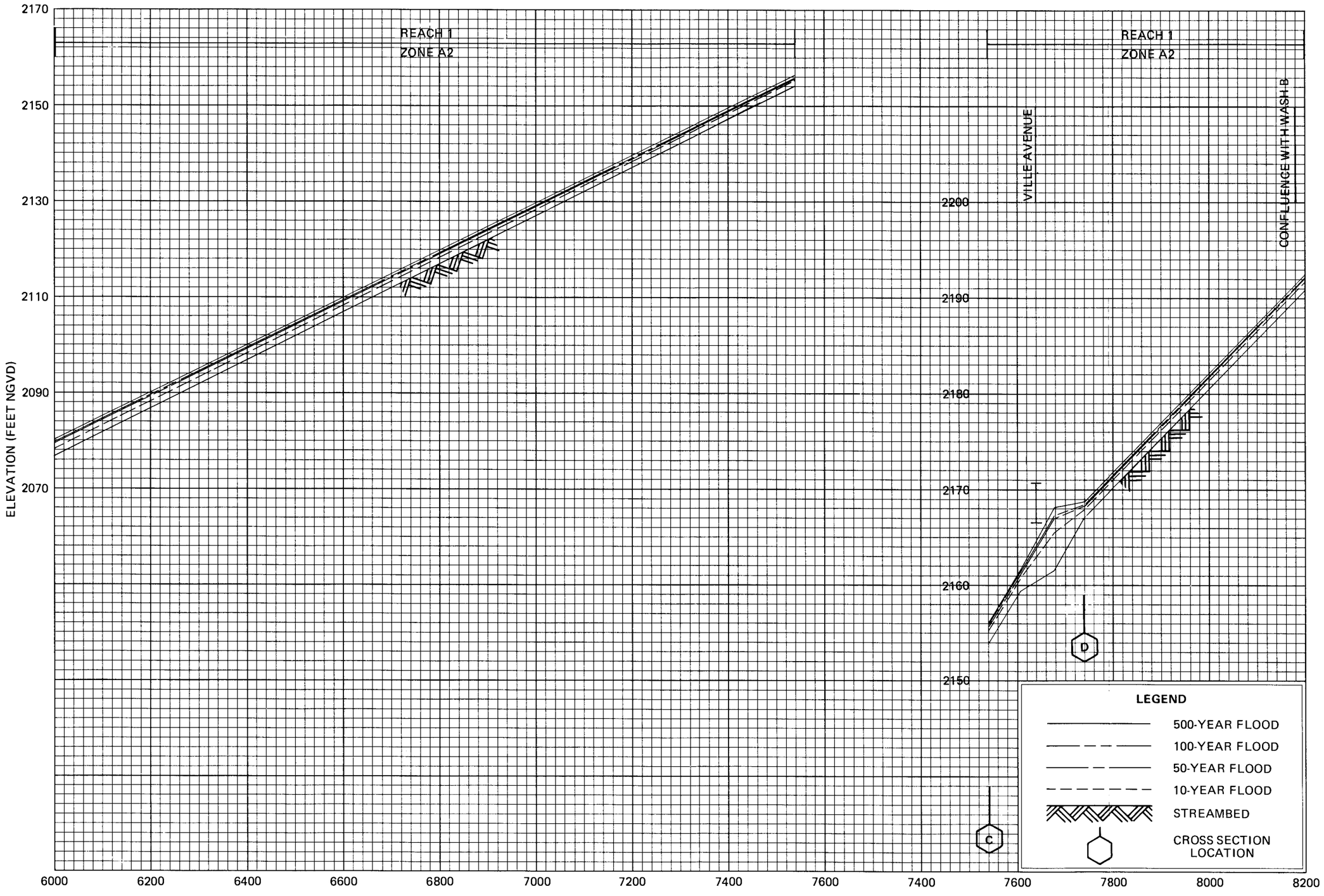
FLOOD PROFILES

HEMENWAY WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

01P



FLOOD PROFILES

HEMENWAY WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF BOULDER CITY, NV
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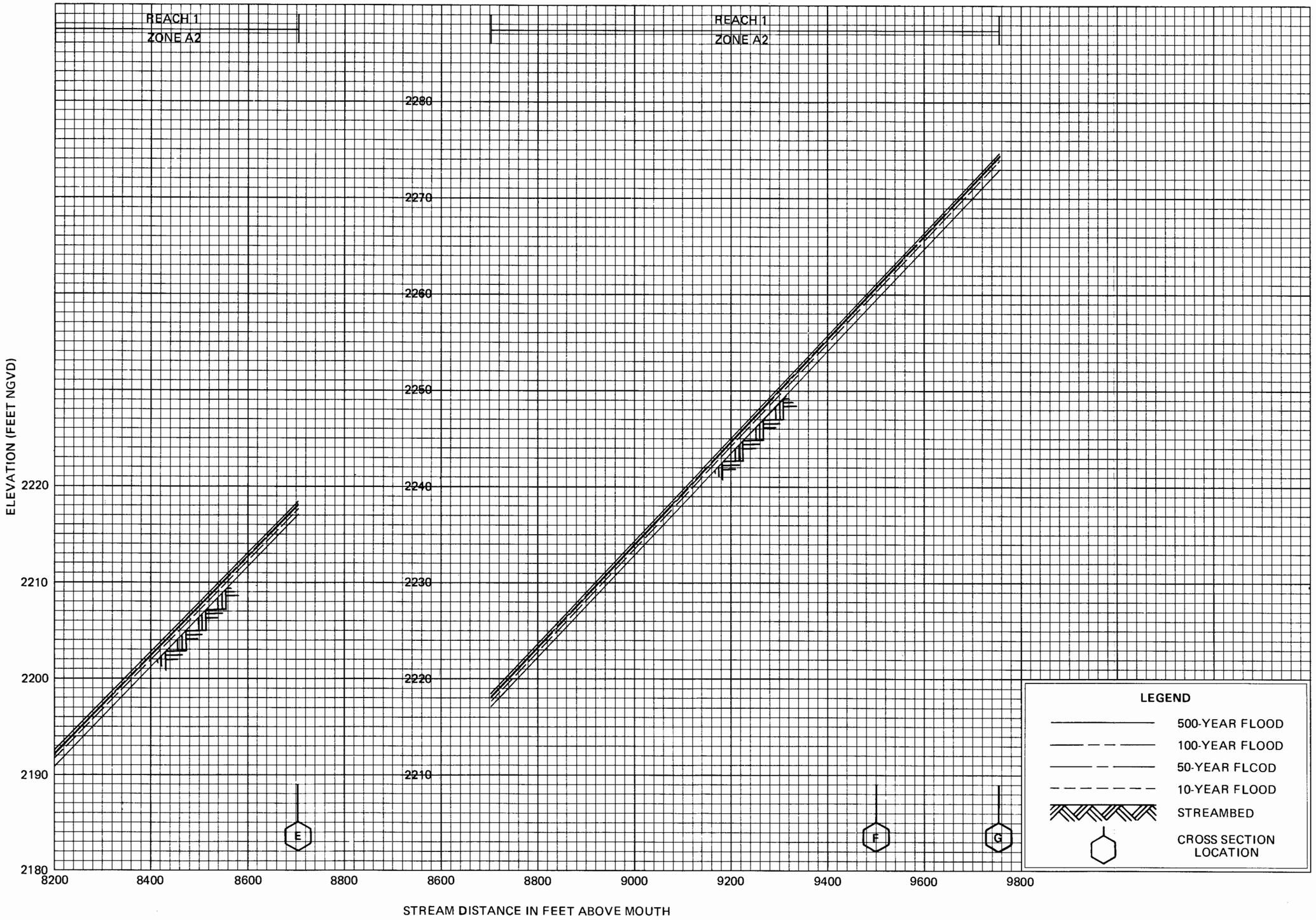
02P



FLOOD PROFILES

HEMENWAY WASH

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Federal Insurance Administration

CITY OF BOULDER CITY, NV
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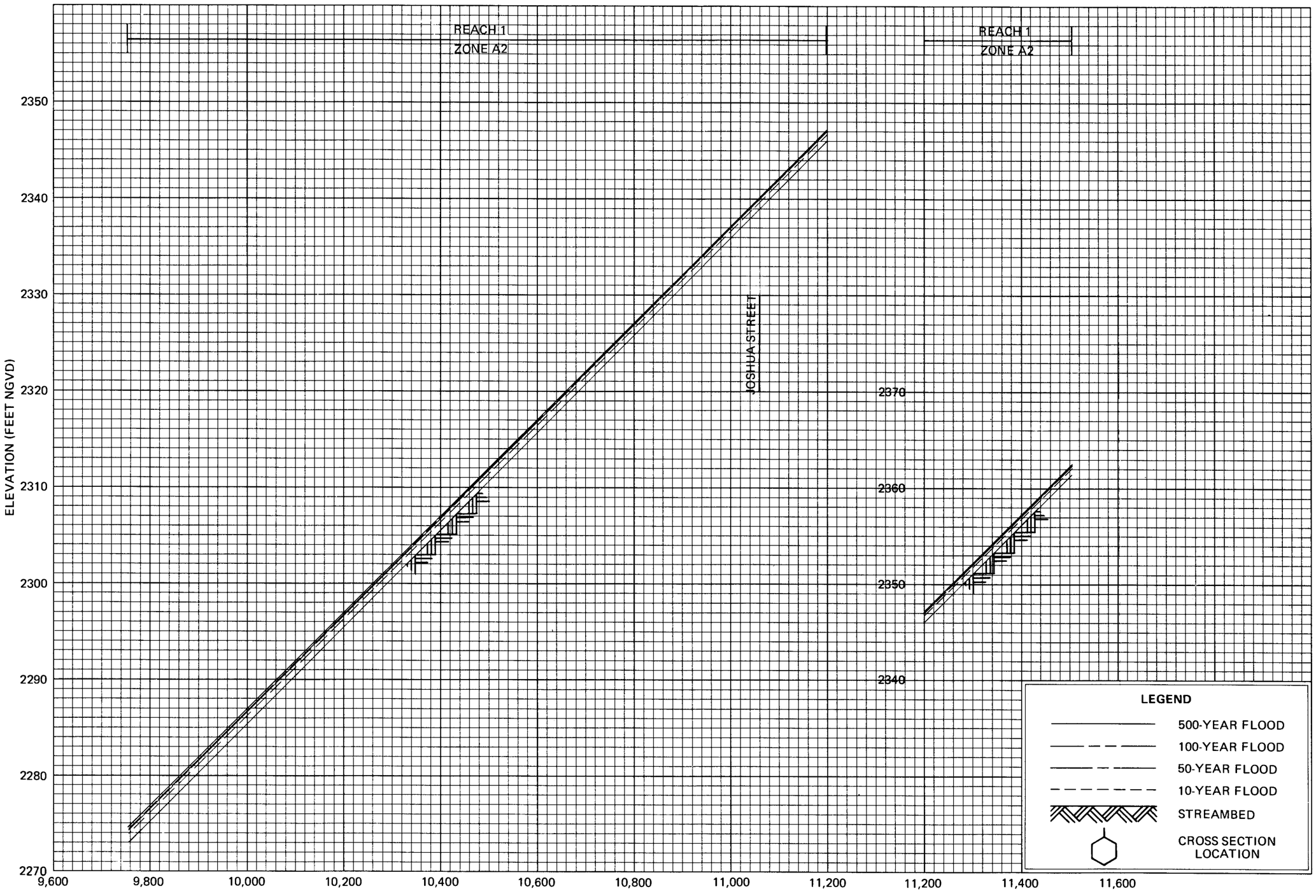
03P



FLOOD PROFILES

HEMENWAY WASH

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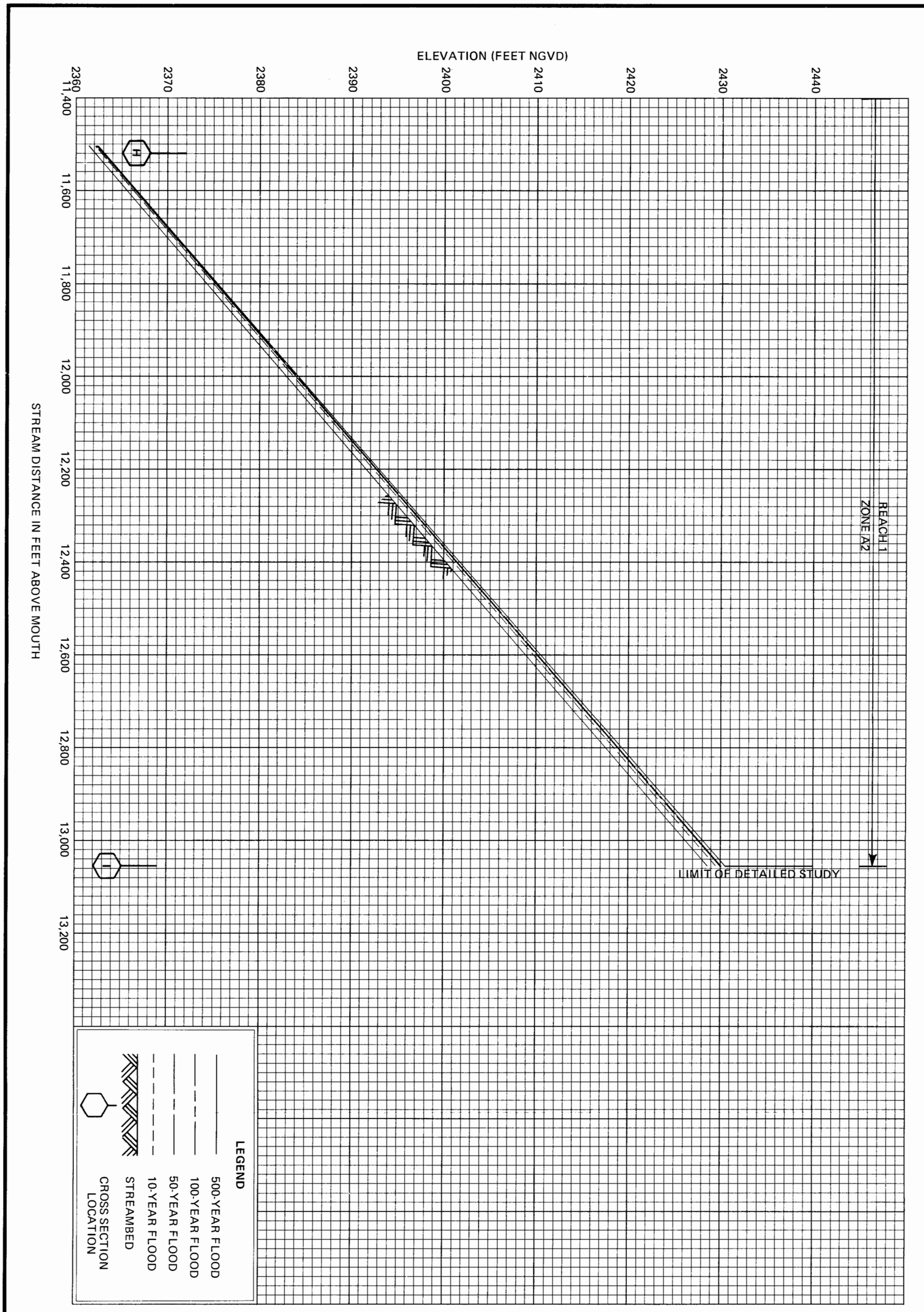
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

04P



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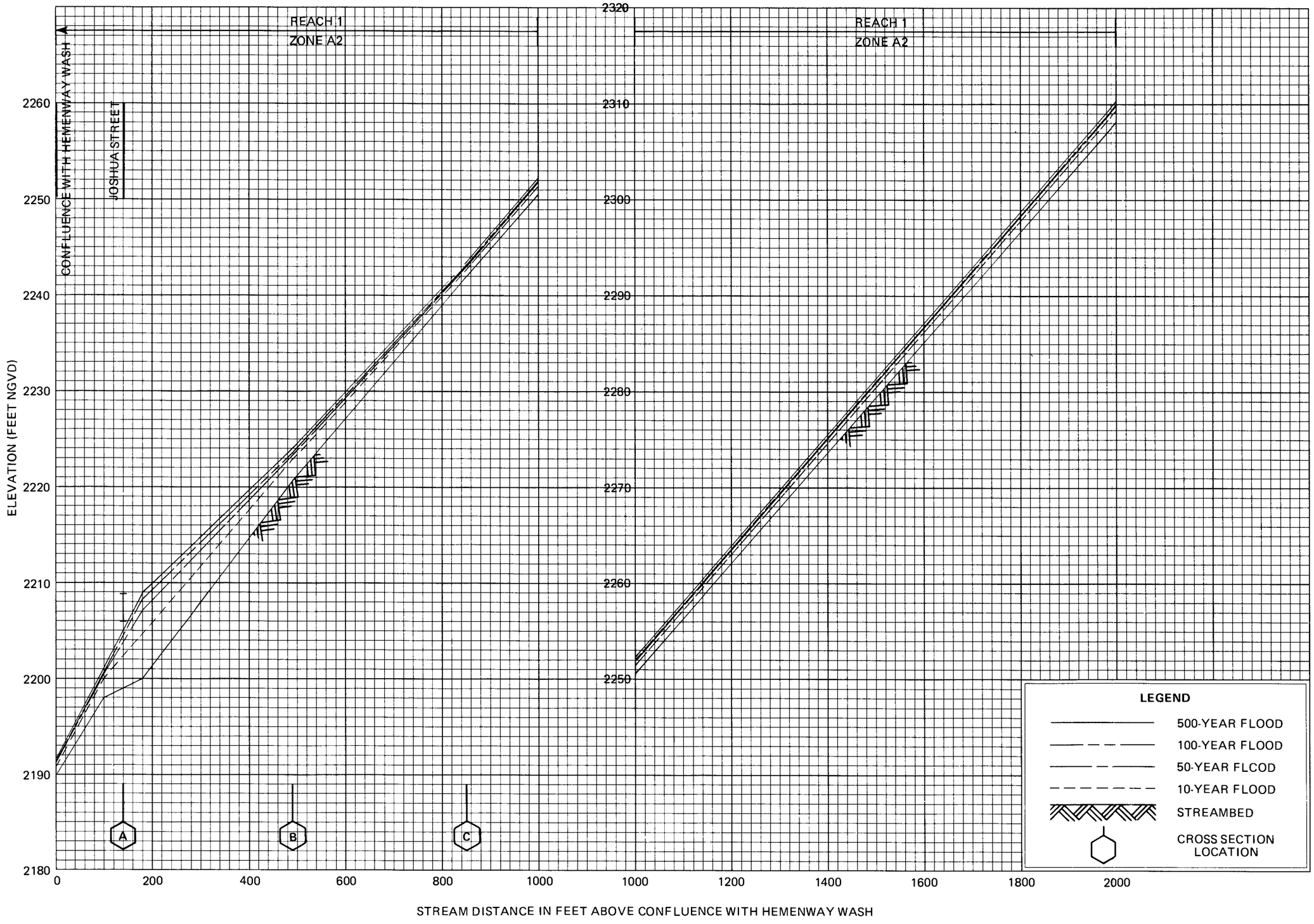
FLOOD PROFILES

HEMENWAY WASH



FLOOD PROFILES

WASH B

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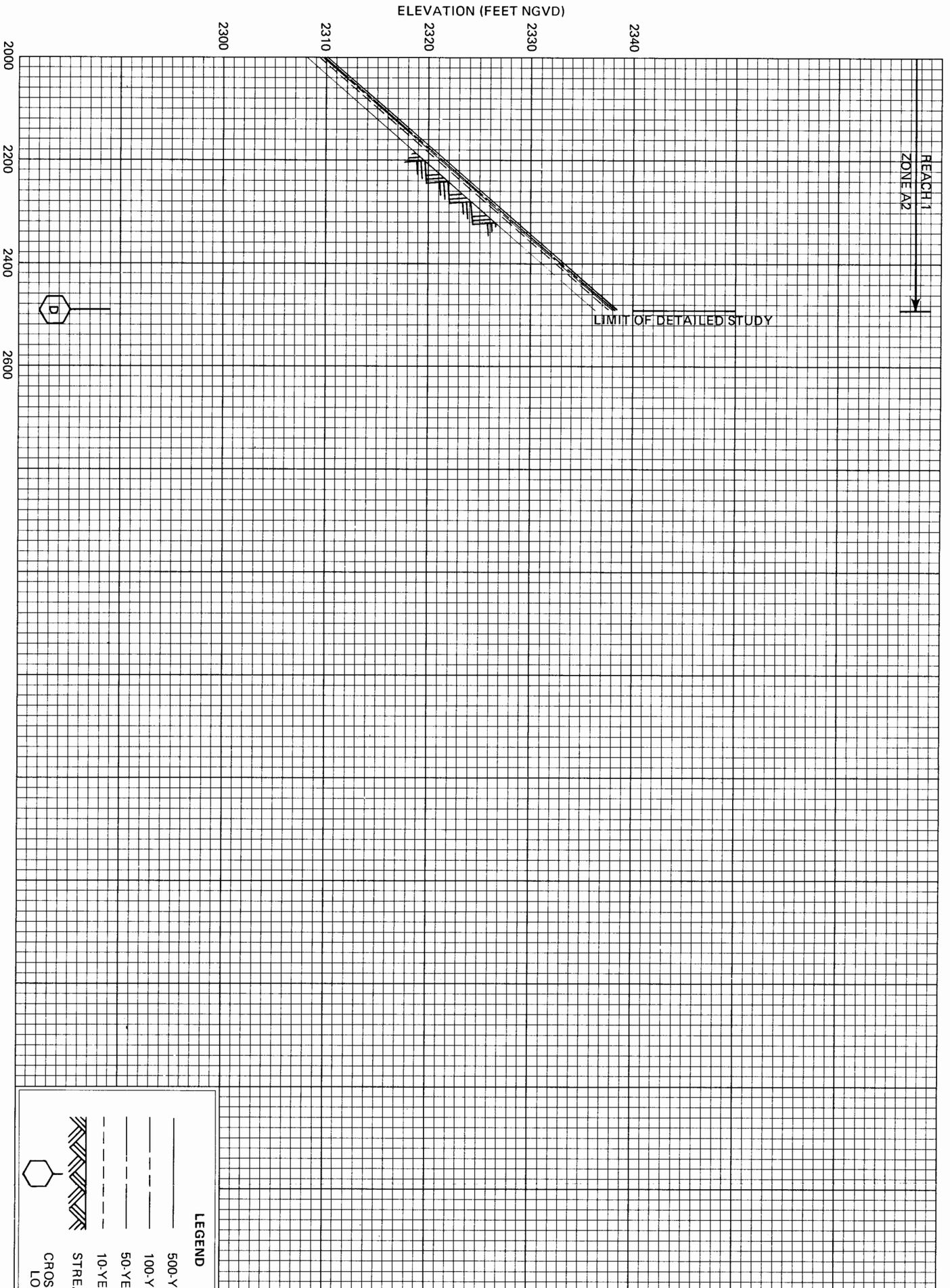
CITY OF BOULDER CITY, NV
(CLARK CO.)

06P



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Federal Insurance Administration

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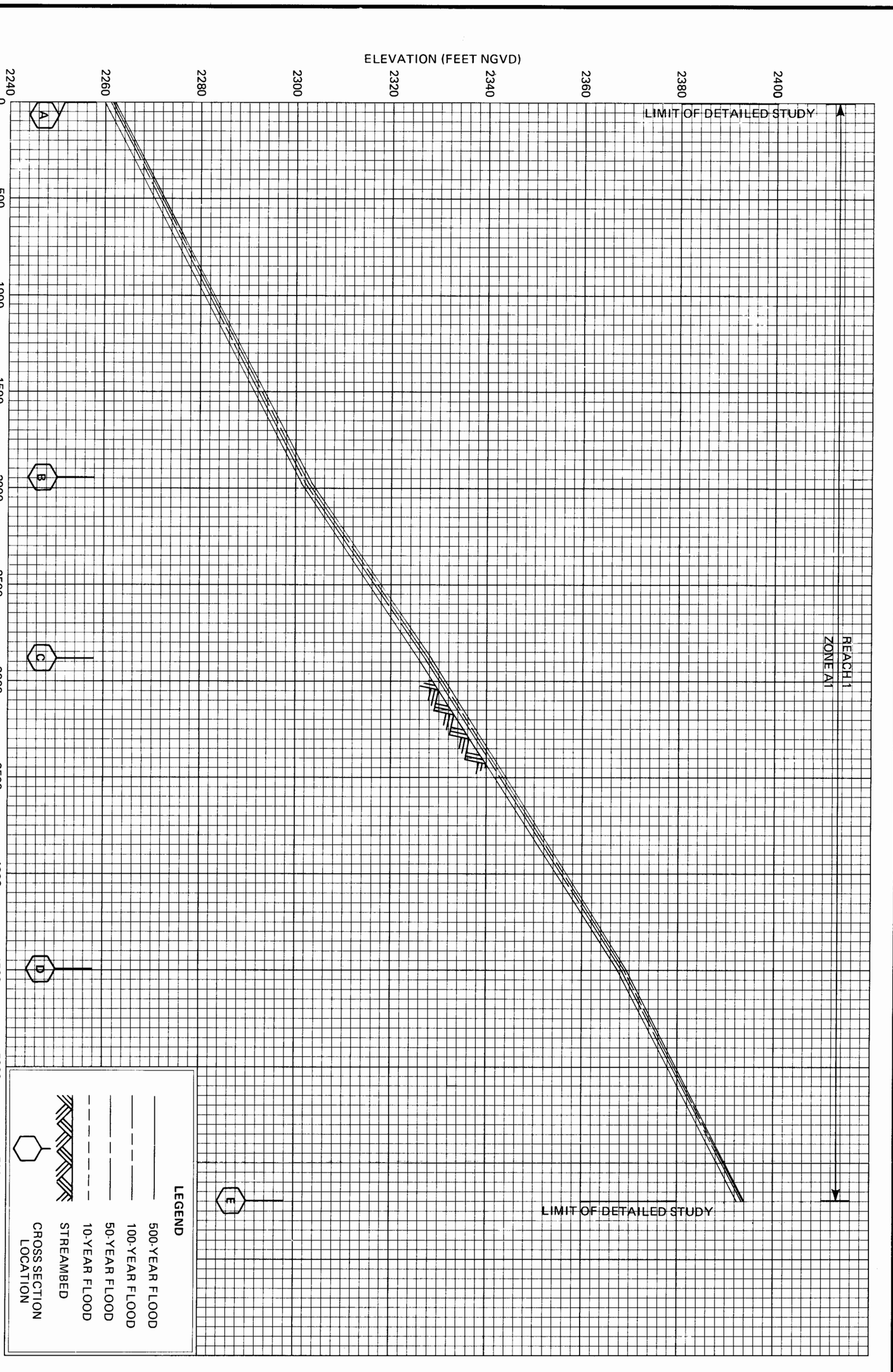
(CLARK CO.)

FLOOD PROFILES

WASH B



08P

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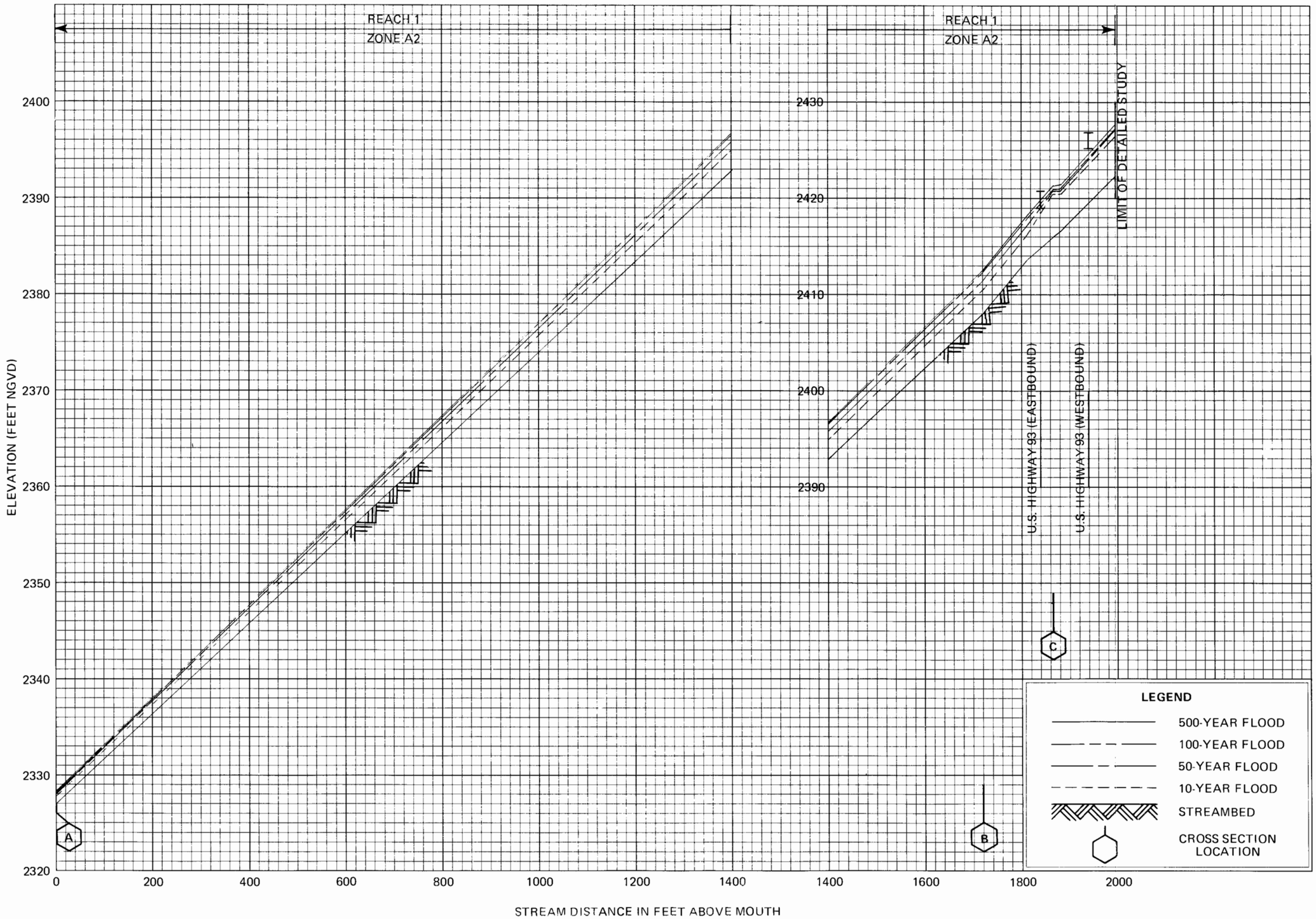
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

FLOOD PROFILES

WASH C



FLOOD PROFILES

WASH D

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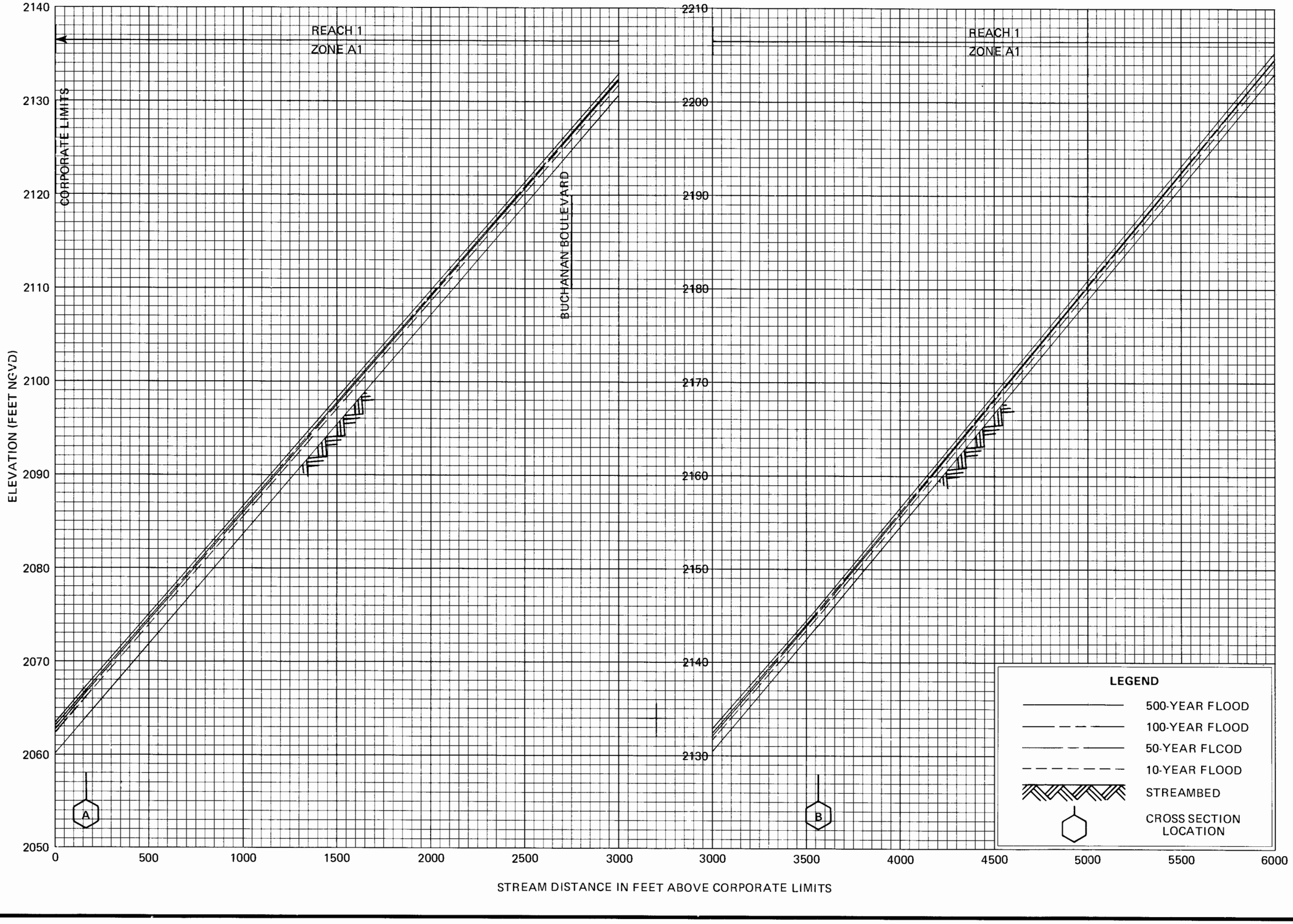
(CLARK CO.)

09P



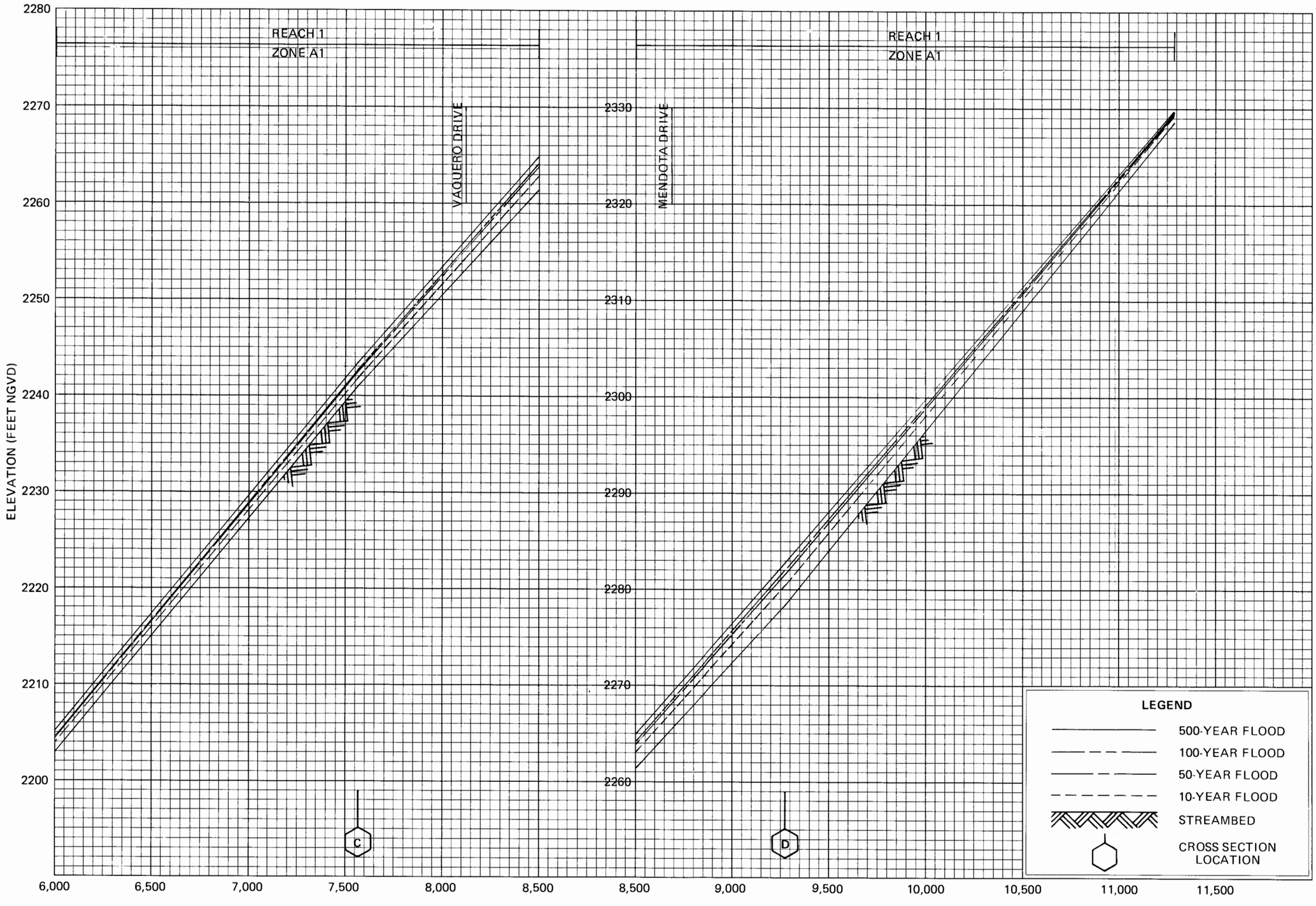
FLOOD PROFILES

GEORGIA AVENUE WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

CITY OF BOULDER CITY, NV
(CLARK CO.)

10P



FLOOD PROFILES

GEORGIA AVENUE WASH

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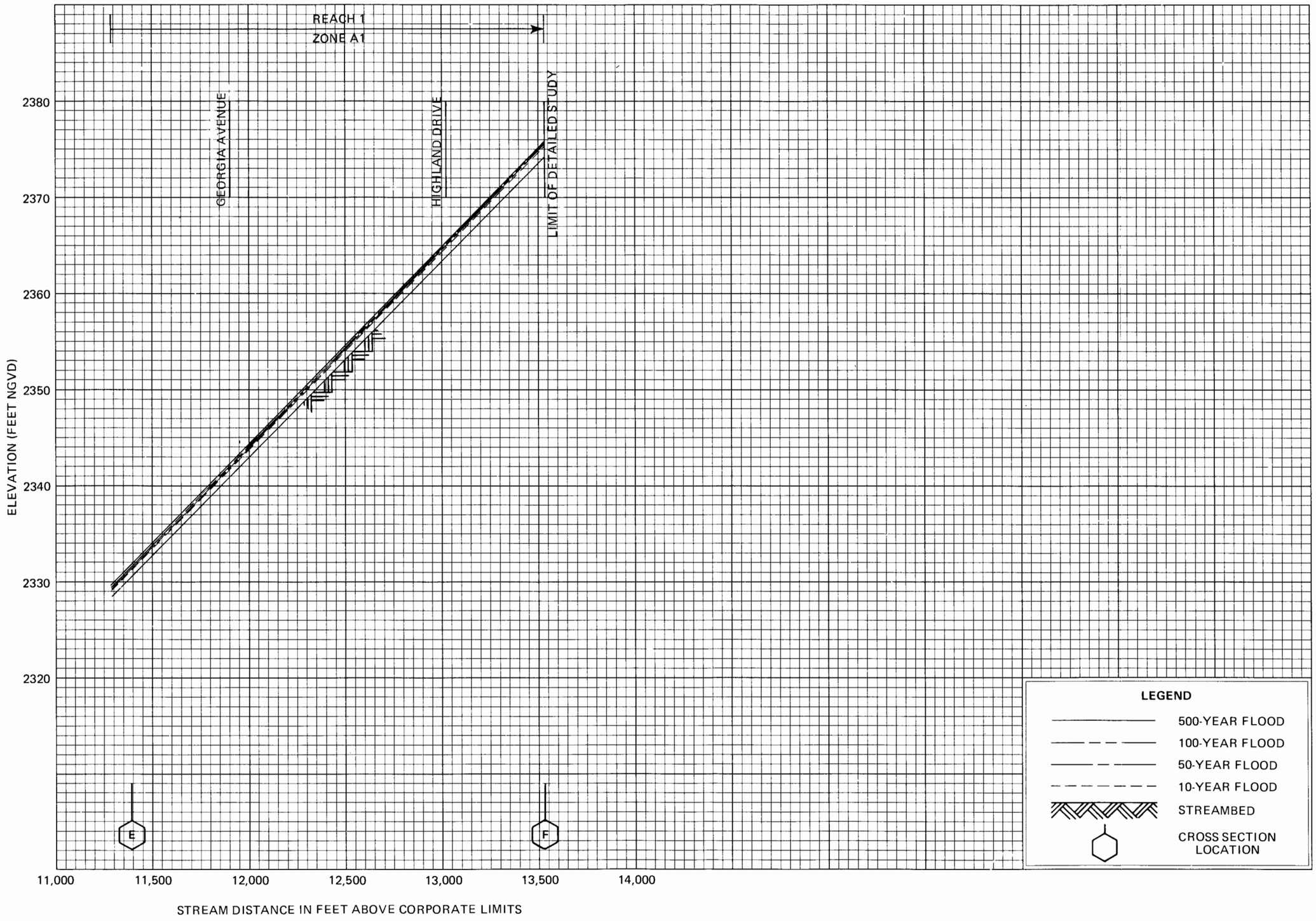
11P



FLOOD PROFILES

GEORGIA AVENUE WASH

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12P

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