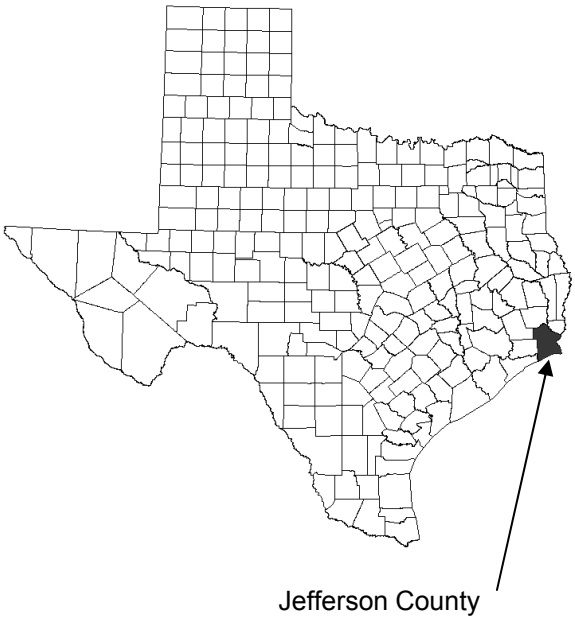
FLOOD INSURANCE STUDY

JEFFERSON COUNTY, TEXAS
AND INCORPORATED AREAS

Community Name	Community Number
Beaumont, City of	485457
Bevil Oaks, City of	480878
China, City of	481298
Groves, City of	485475
Jefferson County Unincorporated Areas	480385
Nederland, City of	485492
Nome, City of	481297
Port Arthur, City of	485499
Port Neches, City of	485500
Taylor Landing, City of	481698



Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
48245CV000A

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 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 panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map 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
C	X

This preliminary revised Flood Insurance Study contains profiles presented at a reduced scale to minimize reproduction costs. All profiles will be included and printed at full scale in the final published report.

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

Initial Countywide FIS Effective Date:

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FLOOD INSURANCE STUDY
JEFFERSON COUNTY, TEXAS AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Jefferson County, including the Cities of Beaumont, Bevil Oaks, China, Groves, Nederland, Nome, Port Arthur, Port Neches, Taylor Landing; and the unincorporated areas of Jefferson County (referred to collectively herein as Jefferson 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 and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (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 the minimum Federal requirements. In such cases, the more restrictive criteria take precedence, and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

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

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

Beaumont, City of	The hydrologic and hydraulic analyses for the City of Beaumont were performed by Tetra Tech, Inc., for the Federal Emergency Management Agency (FEMA), under Contract No. H-4788. This study was completed in July 1980 (Reference 1). Hydrologic and hydraulic analyses of Walker Branch and Walker Branch Tributary performed by Bernard Johnson Inc., during the preparation of the Flood Insurance Study for the City of Beaumont under the direction of FEMA, were revised by Dewberry and Davis in December 1982 (Reference 2). Hydrologic and hydraulic analyses for the City of Beaumont (Hillebrandt Bayou watershed) were revised in August 1998. That revision was prepared by Turner Collie and Braden, Inc., for FEMA under Contract No. EMT-97-CO-0034 (Reference 1).

Bevil Oaks, City of	The hydrologic and hydraulic analyses for the City of Bevil Oaks were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This study was completed in June 1980 (Reference 3). Hydrologic and hydraulic analyses for the City of Bevil Oaks were revised in September 1987. That revision was prepared by the Galveston District of the U.S. Army Corps of Engineers (USACE) during the preparation of a feasibility study for the Pine Island Bayou watershed (Reference 3).
Groves, City of	The hydrologic and hydraulic analyses for the City of Groves were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This study was completed in June 1980 (Reference 4).
Jefferson County, Unincorporated Areas	The hydrologic and hydraulic analyses for Jefferson County Unincorporated Areas were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This study was completed in July 1980 (Reference 2). Hydrologic and hydraulic analyses for Jefferson County Unincorporated Areas (Hillebrandt Bayou, Taylor Bayou and Pine Island Bayou watersheds) were revised in August 1998. That revision was prepared by Turner Collie and Braden, Inc., for FEMA under Contract No. EMT-97-CO-0034 (Reference 2).
Nome, City of	The hydrologic and hydraulic analyses for the City of Nome were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This study was completed in August 1981 (Reference 5).
Port Arthur, City of	The hydrologic and hydraulic analyses for the City of Port Arthur were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This study was completed in June 1980 (Reference 6).
Port Neches, City of	The hydrologic and hydraulic analyses for the City of Port Neches were performed by Tetra Tech, Inc., for FEMA, under Contract No. H-4788. This study was completed in June 1980 (Reference 7).

There was no effective FIS found for the City of Nederland. The Cities of China and Taylor Landing were previously part of the unincorporated areas of Jefferson County, so study information for these communities is as applies from the FIS performed for the unincorporated areas.

For this revision, redelineation of Special Flood Hazard Areas (SFHAs) was performed by Comprehensive Flood Risk Resources and Response Joint Venture (CF3R), for FEMA under contract number EMT-2002-CO-0049. This work was completed in December 2011.

The coordinate system used for the production of this FIRM is North American Datum (NAD) 83, Texas State Plane South Central, FIPS 4204. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

The initial Consultation Coordination Officer (CCO) meeting is attended by representatives of FEMA, the communities, and the study contractor for purposes of discussing and acquiring information related to the study.

The results of the study are reviewed at the final CCO meeting, which is attended by representatives of FEMA, the communities and the study contractor.

TABLE 1 – HISTORIC CONSULTATION COORDINATION OFFICER MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Beaumont, City of	**	January 25, 1982
	February 19, 1997	**
Bevil Oaks, City of	**	September, 4, 1986
China, City of	*	*
Groves, City of	**	January 28, 1982
Jefferson County, Unincorporated Areas	**	June 7, 1982
	February 19, 1997	**
Nederland, City of	*	*
Nome, City of	**	March 2, 1982
Port Arthur, City of	**	March 17, 1982
Port Neches, City of	**	January 25, 1982
Taylor Landing, City of	**	January 25, 1982
	February 19,1997	**

* No previous meeting held
** The date for the CCO meeting was not available.

For this first time countywide revision, an initial CCO meeting was held on May 29, 2007, and was attended by representatives of FEMA, CF3R and the community.

The results of this study were reviewed at the final CCO meeting held on _____and attended by representatives of _____. All problems raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of Jefferson County, Texas, including the incorporated communities listed in Section 1.1.

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction.

The following streams, or portions of the following streams, were studied by detailed methods:

TABLE 2 – DETAILED STUDY STREAMS

Flooding Source	Limits of Detailed Study
Amelia Cut-Off	From the confluence with Willow Marsh Bayou approximately 2,240 feet downstream of Brooks Road to the confluence with Janes Gully approximately 1,528 feet upstream of Washington Boulevard
Bayou Din	From the confluence with Hillebrandt Bayou approximately 12,197 feet downstream of La Belle Road to approximately 6,593 feet upstream of Boyt Road
Bayou Din Tributary	From the confluence with Bayou Din to just downstream of Koelemay Drive
Channel Connector	From the confluence with Janes Gully to the confluence with Channel to Janes Gully
Channel to Janes Gully	From the confluence with Janes Gully to just upstream of McLean Street
Cotton Creek	From just upstream of State Highway 326 to just downstream of Southern Pacific Railroad
Ditch 505	From approximately 4,122 feet downstream of State Highway 124 to approximately 4,767 feet upstream of Clubb Road
Ditch 505 Tributary	From the confluence with Ditch 505 to approximately 2,124 feet upstream of Clubb Road
Green Pond Gully (Ditch 607)	From just downstream of South Pine Island Road to just upstream of Galler Road
Hillebrandt Bayou	From the confluence with Taylor Bayou to approximately 4,700 feet downstream of State Highway 124
Hillebrandt Bayou (Caldwood Cut-Off)	From approximately 4,700 feet downstream of State Highway 124 to approximately 2,270 feet upstream of Folsom Road

Flooding Source	Limits of Detailed Study
Hillebrandt Oxbow	From the confluence with Hillebrandt Bayou to approximately 1,396 feet upstream of Sparrow Way
Janes Gully	From the confluence with Hillebrandt Bayou to just downstream of McLean Street
Janes Gully Diversion	From the confluence with Janes Gully to the confluence with Janes Gully
Keith Ditch	From the confluence with Hillebrandt Bayou to just downstream of Delaware Extension Street
Kidd Gully	From the confluence with Bayou Din to just downstream of Kidd Road
Mayhaw Bayou	From just downstream of State Highway 73 to approximately 1200 ft upstream of Interstate Highway 10
Mayhaw Bayou Tributary	From the confluence with Mayhaw Bayou to the corporate limits of Jefferson County
Neches River	From the mouth at the Gulf of Mexico to the confluence with Pine Island Bayou
Pine Island Bayou	From the confluence with Neches River to the corporate limits of the City of Bevil Oaks
Quinn Ditch	From the confluence with Pine Island Bayou to approximately 450 feet upstream of Tram Road
Rhodair Gully	From the confluence with Taylor Bayou to U.S. Highway 69
South Fork Taylor Bayou	From the confluence with Taylor Bayou to just upstream of Interstate Highway 10
Taylor Bayou/North Fork Taylor Bayou	From the confluence with Intracoastal Waterway to just upstream of Boondocks Road
Walker Branch	From the confluence with Pine Island Bayou to B1 Canal
Walker Branch Relief Ditch	From the confluence with Walker Branch to the confluence with Walker Branch Tributary
Walker Branch Tributary	From the confluence with Walker Branch to approximately 1,107 feet upstream of Spurlock Road
Willow Marsh Bayou	From the confluence with Hillebrandt Bayou to U. S. Highway 90 and Southern Pacific Railroad

For this countywide study, all detailed study streams were re-delineated.

This countywide FIS also incorporates the determination of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision – based on Fill [LOMR-F], and Letter of Map Amendment [LOMA]) as shown in Table 3, "Letters of Map Change."

TABLE 3 – LETTERS OF MAP CHANGE

Community Name	LOMC Type	Case Number	Effective Date	Project Identifier	New Panel No.	New Zone
Beaumont, City of	LOMR	02-06-2312P	11/19/2003	Keith Ditch – from approximately 100 feet downstream of Dowlen Road to approximately 1,320 feet upstream of Major Drive	0130 0135	AE
Beaumont, City of	LOMR	09-06-2516P	10/15/2010	Janes Gully Watershed	0130 0135 0140 0145	AE
Jefferson County, Unincorporated Areas	LOMR	10-06-1909P	11/4/2011	Walker Branch and Walker Branch Relief Ditch	0040	AE

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 Jefferson County.

The following streams were studied by approximate analyses: Alligator Gully, Atlantic Canal, Aubey Gully, B1 Canal, Barnes Slough, Big Hill Bayou, Big Hill Reservoir, Blind Bayou, Block Bayou, Brakes Bayou, Burrell Gully, Byrd Gully, Coffee Bean Slough, Crane Bayou, Derring Gully, Devers East Canal, Fish Box Gully, Gallier Canal, Garner Canal, Grays Bayou, Ground Bridge Gully, Intracoastal Waterway, Jefferson Canal, Johns Gully, Lawson Canal, Left Prong Molasses Bayou, Lower Neches Valley Authority Canal, Main "B" Canal, Main "C" Canal, Main Outfall Canal, Molasses Bayou, Mud Bayou, North Fork Taylor Bayou, Pevitot Gully, Port Arthur Canal, Port Authority Fresh Water Canal, Red Haw Gully, Right Prong Molasses Bayou, Sabine Neches Canal, Sabine Pass, Salt Bayou, Salt Bayou (Fivemile Cut), Salt Bayou (Tenmile Cut), Spindletop Bayou, Spindletop Ditch, Taylor Bayou Outfall Canal, Texas Bayou, Tiger Bayou, Uncle Charlie Slough, Union Canal, West Crane Bayou, Willie Slough Gully, Willow Creek, and Willow Slough.

2011 Coastal Study:

The coastal wave height analysis for this countywide study was prepared by CF3R. This new analysis resulted in revisions to the FIRM for the City of Beaumont, City of Groves, City of Port Arthur, City of Port Neches, City of Taylor Landing and Jefferson County, Unincorporated Areas.

2.2 Community Description

Jefferson County is approximately 937 square miles in area and is located in the southeast region of Texas. The City of Beaumont is the county seat. Jefferson County is bordered by Hardin County to the north, Orange County to the northeast, Cameron Parish (Louisiana) to the southeast, Chambers County to the southwest, the Gulf of Mexico to the south and Liberty County to the northwest. In 2010, Jefferson County's population was estimated at 252,273 (Reference 8). The county has an agricultural and petrochemical economy (Reference 9).

The elevations of Jefferson County range from sea level along the Gulf Coast to approximately 50 feet above sea level, North American Vertical Datum of 1988 (NAVD88) in the northwestern part of the county. Natural drainage is generally poor – the streams are generally just above sea level and have sluggish flow through shallow meandering channels.

The county is comprised mainly of grassy plains, with a dense forest belt crossing the northwestern part of the county. The southern portion of the county consists of marshy saltgrass terrain good for cattle raising, the central part of the county is coastal prairie used for grazing and rice culture, and the northern part of the county is heavily forested with hardwoods and southern yellow pine. Beach sands and ocean sediments make up soils along the coast. The northern border is surfaced by light-colored, loamy soils over deep, reddish clayey or loamy subsoils with hardened calcium deposits, and the remainder of the county has light to dark loamy surfaces over clayey subsoils or gray to black, clayey soils. Geologically, the county is noted for its Beaumont Clay formation and the Spindletop and Big Hill salt domes, which contain sulfur and petroleum. The mean annual temperature is 69° F, and the average annual rainfall is fifty-three inches. The subtropical, humid climate features warm, moist summers tempered by Gulf breezes (Reference 9).

The County naturally drains north to south; Bayou Din and its tributaries, Cotton Creek, Hillebrandt Bayou with its tributaries, Kidd Gully, Mayhaw Bayou, Neches River, Pine Island Bayou and its tributaries, Rhodair Gully, Taylor Bayou and its tributaries, Walker Branch and Walker Branch Tributary, and Willow Marsh Bayou are the largest streams. Sabine Lake is the County's largest body of water, with an approximate 24 square mile area within Jefferson County.

2.3 Principal Flood Problems

Flooding in Jefferson County results primarily from stream overflow caused by rainfall-runoff, ponding and sheet flow, and from tidal surges and associated waves caused by hurricanes and tropical storms in the coastal areas of the county. Because of the flatness of the terrain, many inland areas are susceptible to shallow flooding during heavy rainfall events. According to Drainage District #6 (DD6) rainfall gage data, during a storm event from October 17 and 18, 1994, rainfall depths reached as much as 12.1 inches in the Hillebrandt Bayou watershed, 14.6 inches in the Taylor Bayou watershed, and 19.5 inches in the Pine Island Bayou watershed in a 48-hour period.

During another storm event on September 27, 1996, rainfall depths reached as high as 10.6 inches in the Hillebrandt Bayou watershed, 7.6 inches in the Taylor Bayou watershed and 4.8 inches in the Pine Island Bayou watershed in a 24-hour period (Reference 10).

Not all coastal storms that pass close to the study area produce extremely high tides. Similarly, storms that produce extreme conditions in one area may not necessarily produce critical conditions in other locations. The Neches River and Taylor Bayou are broad estuaries and, under certain conditions, tides generated at their mouths in Sabine Lake can intrude far upstream. The rainfall which usually accompanies hurricanes can aggravate the tidal flood situation.

Coastal storms passing Texas in the vicinity of Jefferson County have produced severe floods as well as structural damage. Tropical storms and hurricanes recorded as impacting this area, and reaching as far back as 1886 have caused severe inundation that extended several miles inland, highlighting that the Sabine Pass and Port Arthur areas are most vulnerable to storm surge. Hurricane Carla, which occurred from September 9 to 12, 1961, caused some of the most severe damages recorded. Hurricane Carla inundated 40 percent of the county's total land area and caused $30.6 million in damages.

More recently, Hurricanes Rita (2005), Ike and Gustav (2008) caused some damage because of storm surge, but caused much more structural damage due to high wind speeds.

2.4 Flood Protection Measures

The Hurricane Flood Protection Project in the northern part of Port Arthur protects areas from hurricane surges up to 14 feet above Mean Sea Level (MSL). Incorporated into the system are other areas which lie in the county. The system consists of more than 29 miles of earthen levee and 7 miles of floodwall with top elevation varying from 14 to 19 feet. The ability of the system to withstand a 1-percent-annual chance flood event is currently being evaluated by FEMA (Reference 11). There are gated gravity drainage structures that convey normal drainage from behind the flood protection system at various locations. In addition, five pumping plants provide interior drainage when gated drainage structures are closed during periods of high lake stage and high runoff. There have been modifications to the spoil banks along Sabine Lake, as well as Taylor Bayou and the Gulf Intracoastal Waterway to provide additional protection measures to the area (Reference 2).

Non-structural flood protection measures include ordinances which place controls on the construction and types of activities permissible in floodplains.

In 2005, FEMA funded $1.35 million to the State of Texas to fund flood protection measures in Jefferson County. The project will remove 48 repetitively flooded homes from the 1-percent-annual-chance floodplain and will protect more than 2,000 homes. The project, known as the Caldwood Cut-Off and Hillebrandt Bayou Flood Mitigation Project, includes the construction of two detention basins and a collector channel. The project will also increase flood carrying capacity by widening the Caldwood Cut-Off and raising a bridge. Jefferson County Drainage District No. 6 is the project sponsor (Reference 12).

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 is expected to be equaled 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 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 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 that equals or exceeds the 1-percent-annual-chance 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.

Pre-Countywide

Flood magnitude and frequency for areas subject to runoff flooding in Rhodair Gully were estimated using the USACE's HEC-1 Flood Hydrograph Package (Reference 13). Regionalized unit hydrography and rainfall loss rate parameters were developed by hydrograph reconstitution studies using 30 storms in 6 gaged basins. The transposition of the HEC-1 model parameters from gaged to ungaged basins was based on hydrologic similarity as assessed from soil maps (Reference 14), USGS topographic maps (Reference 15), aerial photos (Reference 16) and field reconnaissance. Urbanized watersheds were studied using methodology developed by Beard (References 17 and 18). Rainfall data were developed from hourly rainfall records from the National Climatic Center (Reference 19) and from TP-40 (Reference 20). The resulting "synthetic" storms used to generate peak discharges of selected frequency have depth-area-duration characteristics consistent with the Texas Gulf Coast Area.

The Lakeside, Port Acres and Crane Bayou watersheds lie within the Hurricane Protection System. During storms, the pumping stations within the watersheds are unable to divert water adequately, and a ponding condition occurs at that time. The ponding elevations in these areas were adopted from the USACE report (Reference 21).

The hydrologic analysis for Pine Island Bayou was obtained from the USACE feasibility report on the Pine Island Bayou watershed (Reference 22). In that study, the Pine Island Bayou watershed was modeled using the generalized storm network computation capability of the HEC-1 computer program (Reference 13). The watershed was divided into sub-basin areas and routing reaches. Snyder's unit hydrograph coefficients were selected based on the results of storm studies completed in June 1973 and June 1975.

Flood magnitude and related frequencies for areas subject to flooding from Cotton Creek, Janes Gully, Hillebrandt Bayou, Hillebrandt Oxbow, Walker Branch, Walker Branch

Tributary, Neches River, Keith Ditch and Amelia Cut-Off were estimated using the USACE HEC-1 Flood Hydrograph Package (Reference 13). Regionalized unit hydrograph and rainfall loss rate parameters were developed by hydrograph reconstitution studies using thirty storms in six gaged basins. The transportation of the HEC-1 model parameters from gaged to ungaged basin is based on hydrologic similarity as assessed from soil maps (Reference 14), USGS topographic maps (Reference 15), aerial photos (Reference 16) and field reconnaissance. Urbanized watersheds were studied using a methodology developed by Beard (References 17 and 18). Rainfall data were developed from hourly rainfall records from the National Climatic Center (Reference 19) and from TP-40 (Reference 20). The resulting "synthetic" storms used to generate peak discharges of selected frequency have depth-area-duration characteristics consistent with the Texas Gulf Coast area.

The determination of inundation from the Neches River caused by passage of a hurricane was approached by the Joint Probability Method (Reference 23). The storm population was described by probability distributions of 5 parameters that influence surge heights. These were (1) central pressure depression (which measures the intensity of the storm), (2) radius to maximum winds, (3) forward speed of the storm, (4) shoreline crossing point and (5) crossing angle. These characteristics were described statistically based on any analysis of observed storms in the vicinity of Jefferson County. Primary sources of data were the National Weather Service (References 24 to 26); the National Hurricane Research Project (Reference 27); and the Monthly Weather Review (Reference 28). The determination of maximum wave crest elevations associated with the 10- and 1-percent-annual chance events was approached by the method recommended by the National Academy of Sciences (Reference 29).

The updated flood frequency-discharge values for Walker Branch and Walker Branch Tributary within the unincorporated areas of Jefferson County were determined using the USACE HEC-1 Flood Hydrograph Package (Reference 13).

Hydrologic analyses were performed to determine peak discharges, total runoff volumes, and time distributions of flood hydrographs for floods of the selected recurrence intervals for each flooding source studied in detail within the Hillebrandt Bayou, Taylor Bayou and Pine Island Bayou watersheds affecting Jefferson County unincorporated areas and the City of Beaumont. The USACE HEC-1 Flood Hydrograph Package was used for these analyses (Reference 30).

For the 2002 revision to unincorporated areas of Jefferson County, ARCVIEW GIS software was used to overlay all of the information related to hydrology and to generate digital work maps. ARCVIEW coverages that were either developed for that project or incorporated to assist in the hydrologic analysis included the county boundary, planimetric base map data, drainage areas, digital USGS Quad maps with 5-foot contours, USGS Land Use/Land Cover (LULC), Digital Orthophotgraphic Quarter Quads (DOQQs), HEC-1 routing reaches and analysis points, locations of detention ponds and pertinent rainfall and stream gages, DFIRMs and elevation reference marks (ERMs) (Reference 2).

Drainage areas were delineated using watershed maps from previous studies (References 31 and 32) and digital USGS topographic maps (Reference 33), and then digitized using ARCVIEW GIS software. Land use was obtained from USGS LULC GIS coverages (Reference 34) and verified/updated using DOQQs from the USGS, dated February 2, 1989 (Reference 35).

Runoff volumes and time distributions were determined using the Soil Conservation Service (SCS) "Curve Number" (CN) technique (Reference 36). CNs were developed using LULC data and soil maps from the Natural Resources Conservation Service Jefferson County, Texas, Soil Survey (References 34 and 14). A CN value of 100 was used for water features, and a CN of 95 for wetlands.

Rainfall frequency data were obtained from the U.S. Weather Bureau Technical Paper No. 40 (TP-40) and Hydro-35 (References 20 and 37). The 0.2-percent-annual-chance point rainfall was extrapolated using log-probability paper. Area correction was applied to the point rainfall to take into account larger drainage areas according to the area-depth relationship developed in TP-40.

The Clark Unit Hydrograph method was used; parameters were developed using criteria from local drainage studies (References 31 and 38) and for models obtained from the local community that had been calibrated against historical storms.

The Modified Puls routing method was used for study stream reaches; Muskingum routing was used for non-study stream reaches within the watershed models.

Gage data in the study watersheds was very limited. DD6 had a growing system of gages, but a short period of record. Historical storms were run on the hydrologic models for Taylor Bayou, Quinn Ditch and Hillebrandt Bayou. For each of these watersheds, it was only possible to check the water-surface elevations versus gage heights at one location in the watershed. The computed hydrograph for Quinn Ditch matched closely with the gage data. For Taylor Bayou, the computed water-surface elevation, which was interpolated using a downstream rating curve, matched closely with measured gage heights.

Countywide

Peak discharge-drainage area relationships for the selected recurrence intervals developed in pre-countywide studies are shown in Table 4, "Summary of Discharges". There were no new hydrologic analyses performed for riverine flooding sources for this study.

TABLE 4 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Amelia Cut-Off					
At confluence with Willow Marsh Bayou	5.2	2,808	3,207	3,441	3,841
Upstream of junction with Janes Gully	2.0	1,366	1,629	1,788	2,232
Bayou Din					
Upstream of confluence with Kidd Gully	7.2	1,688	2,342	2,603	3,282
At Interstate Highway 10	3.8	956	1,381	1,539	1,943
Bayou Din Tributary					
At confluence with Bayou Din	1.9	761	1,023	1,130	1,460
Cotton Creek					
At State Highway 326	8.3	1,450	1,850	2,000	2,350
Ditch 505					
At State Highway 124	10.9	2,291	3,196	3,529	4,415
At Interstate Highway 10	4.1	972	1,298	1,421	1,749
Upstream of Ditch 505 Tributary	2.7	654	883	970	1,198
Ditch 505 Tributary					
At mouth	1.4	345	487	539	677
Greenpond Gully/ Ditch 607					
At Old Sour Lake Road	6.0	1,215	1,584	1,732	2,118
At U.S. Highway 90	3.7	866	1,216	1,347	1,679
At South Pine Island Road	2.1	398	611	741	1,161

TABLE 4 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Hillebrandt Bayou					
Downstream of Rhodair Gully	165.0	7,800	11,100	13,000	15,900
Upstream of Rhodair Gully	149.0	7,390	10,500	12,300	15,000
Downstream of John's Gully	142.0	7,200	10,200	12,000	14,700
Upstream of John's Gully	134.0	6,960	9,900	11,600	14,300
Downstream of Bayou Din	128.0	6,800	9,700	11,400	13,900
Upstream of Bayou Din	86.0	5,500	7,700	9,170	11,200
Downstream of Willow Marsh Bayou	70.2	21,143	27,558	30,138	36,694
Upstream of Willow Marsh Bayou	47.0	4,000	5,600	6,600	8,000
Hillebrandt Bayou (Caldwood Cut-Off)					
At Atchison, Topeka and Santa Fe Railway	28.9	12,032	16,245	18,145	21,788
At Interstate Highway 10	26.1	11,577	15,928	17,636	20,559
At Washington Boulevard Bridge	17.1	5,530	7,665	8,383	9,757
At Southern Pacific Railroad Bridge	12.3	3,866	5,179	5,463	5,988
Downstream of Keith Ditch	11.6	3,595	4,944	5,293	6,215
Upstream of Keith Ditch	7.0	2,823	3,596	3,999	4,715
At Gladys Avenue	6.4	2,447	3,567	4,163	5,450
Downstream of Folsom Street	0.9	620	859	955	1,190
Hillebrandt Oxbow					
At confluence with Hillebrandt Bayou	7.9	2,250	2,950	3,330	4,000
Janes Gully					
At confluence with Hillebrandt Bayou	3.3	1,431	2,038	2,279	2,707

TABLE 4 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Keith Ditch					
At confluence with Hillebrandt Bayou	4.6	1,317	1,826	2,039	2,565
At Westgate Road	4.1	872	1,235	1,389	1,794
Downstream of Diversion to Amelia Cut-Off	3.7	108	220	273	470
Upstream of Diversion to Amelia Cut-Off	3.7	948	1,213	1,326	1,650
At North Major Road	3.0	616	956	1,144	1,665
Kidd Gully					
At confluence with Bayou Din	7.0	2,000	2,700	2,930	3,500
Mayhaw Bayou					
At mouth	65.8	6,761	10,217	11,710	16,324
At State Highway 73	22.5	2,879	4,823	5,576	7,876
At Interstate Highway 10	1.4	680	990	1,112	1,409
Mayhaw Bayou Tributary					
At mouth	6.5	1,567	2,330	2,604	3,332
At Brush Island Road	0.9	427	627	698	885
Neches River					
At Beaumont	10,000	60,000	107,000	136,000	240,000
North Fork Taylor Bayou					
At downstream confluence with Burrell Gully	148.5	8,082	10,545	11,091	12,533
At Boondocks Road	135.4	8,340	10,652	11,159	12,776
Pine Island Bayou					
At confluence with Neches River	657	17,300	33,600	41,400	61,200
At confluence with Walker Branch	567	18,597	26,671	31,206	39,228

TABLE 4 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Pine Island Bayou (Continue)					
Below confluence with Little Pine Island Bayou	487	15,400	29,200	36,000	55,000
Above confluence with Little Pine Island Bayou	354	11,400	21,400	26,300	40,700
Quinn Ditch					
At mouth	2.9	1,402	2,037	2,301	2,926
Rhodair Gully					
At confluence with Hillebrandt Bayou	16.0	2,620	3,460	3,930	4,790
At Southern Pacific Railroad	6.0	1,920	2,530	2,640	3,150
South Fork Taylor Bayou					
At mouth	101.7	11,215	13,778	15,231	19,406
At State Highway 124	18.8	3,296	5,010	5,577	7,187
At Interstate Highway 10	12.3	3,067	4,495	5,037	6,456
Taylor Bayou					
Upstream of the confluence with Hillebrandt Bayou	280.0	10,300	14,800	17,400	21,500
Downstream of La Belle Road	273.2	9,261	12,209	13,527	17,036
Walker Branch					
At confluence with Pine Island Bayou	11.99	6,593	9,098	10,078	11,951
At confluence with Walker Branch Tributary	2.9	1,214	1,712	1,896	2,247
Walker Branch Tributary					
At confluence with Walker Branch	9.9	2,575	3,298	3,703	4,407

TABLE 4 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Willow Marsh Bayou At confluence with Hillebrandt Bayou	22.0	7,190	8,923	9,518	10,809

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods 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.

Pre-Countywide

Cross sectional data for Hillebrandt Bayou, Neches River and Willow Marsh Bayou were available from the USACE, Galveston District, and were supplemented with field survey data. Cross section data for the hydraulic computation performed in the City of Bevil Oaks were based on field surveys dated May 1981. Cross sections for the backwater analysis of the remaining streams were obtained from field surveys and USGS 7.5-minute topographic maps (Reference 15). All bridges, dams and culverts were field checked to obtain elevation data and structural geometry necessary for backwater analysis.

Channel cross section information for the 2002 revision (Reference 2) of the study reaches of the Hillebrandt Bayou, Taylor Bayou and Pine Island Bayou watersheds was obtained from various sources, including as built construction record drawings, other construction plans, field surveys conducted in support of the study, and field surveys done for past projects in Jefferson County (References 39 through 46). Sources for overbank elevation data include 4-foot contour topography generated by Analytical Surveys, Inc., (ASI) developed for the study from aerial photography provided by Jefferson County Appraisal District (Reference 47). USGS Quadrangle maps were also used in some cases where the other sources were insufficient.

Information on structures, such as culverts and bridges, for the revision of the study were obtained from the Texas Department of Transportation (TxDOT), as-built drawings, other as-built plans from local government agencies, field surveys performed for the study and/or existing hydraulic computer models. All public road crossing structures were photographed during site visits in order to verify information obtained from as-built plans and existing hydraulic models. DOQQs were used to identify any private road crossing structures which were not readily accessible from public roads. Field crews were then sent to survey these private road crossings.

For areas subject to stream overflow, water-surface elevations for floods of the selected recurrence intervals were developed using the USACE HEC-2 water-surface profile computer model (References 48 and 49). Starting water-surface elevations for the Neches River at its confluence with Sabine Lake, Hillebrandt Bayou at its confluence with Taylor Bayou, and Rhodair Gully were set equal to the mean high tide. Starting water-surface elevations for Bayou Din, Kidd Gully and Mayhaw Bayou were set equal to normal depth. The starting water surface elevations for Pine Island Bayou were obtained using an estimated water surface elevation on the Neches River at the confluence with Pine Island Bayou. Starting water-surface elevations for Bayou Din Tributary, Walker Branch, and Walker Branch Tributary were set equal to the elevation of the major streams at their respective confluences. Critical depth was used as the starting water-surface elevation for Cotton Creek at State Route 326 and Janes Gully due to a weir at the outfall.

For the 2002 revision to unincorporated areas of the county, the USACE HEC-2 backwater analysis program (Reference 50) was used for Bayou Din, Bayou Din Tributary, Mayhaw Bayou, Mayhaw Bayou Tributary, Walker Branch and Walker Branch Tributary. HEC-RAS (Reference 51) was used for Ditch 505, Ditch 505 Tributary, Greenpond Gully (Ditch 607), Quinn Ditch, South Fork Taylor Bayou and Taylor Bayou/North Fork Taylor Bayou. Starting water-surface elevations for each study stream were determined by normal depth.

In the City of Groves, ponding water elevations for the Crane Bayou area were adopted from USACE report (Reference 21).

In the City of Port Arthur, flood profiles were drawn for Rhodair Gully showing computed water-surface elevations to an accuracy of 0.5-foot for floods of the selected recurrence intervals. Flood profiles were not plotted for Taylor Bayou and Neches River because the flooding in the rivers was predominated by surge. Locations of selected cross sections used in the hydraulic analyses are shown on the flood profiles (Exhibit 1).

In the City of Beaumont, hydraulic modeling was complicated by the presence of several divided flow situations. In the northern section of Beaumont, part of the flow is diverted from Walker Branch to Walker Branch Relief Ditch which flows into the Walker Branch Tributary. A channel improvement project was performed on Amelia Cut-off which flows in a north/south direction west of Interstate Highway 10 and empties into Willow Marsh Bayou. A divided flow occurs at the upper end of Amelia Cut-Off where part of the Keith Ditch flow is diverted into Amelia Cut-Off. The next divided flow occurs downstream where Amelia Cut-Off intersects Janes Gully at a skewed angle. The method for handling these divided flow problems is described by Chow (Reference 52).

Computations for flood levels along the rivers resulting from either coastal surges or rainfall were independently performed. The results of each were combined statistically to obtain flood levels for each return period.

Channel roughness factors (Mannings “n”) used in hydraulic computations, were chosen based on field observations, aerial photos of the streams and floodplain areas, USACE feasibility study for the Pine Island Bayou watershed (Reference 22) and USGS Water Supply Paper 1849 (Reference 53). Roughness values for streams studied by detailed methods are shown in Table 5 “Manning’s “n” Values”.

TABLE 5 – MANNING'S "N" VALUES

Flooding Source	Roughness Coefficients	
	Channel	Overbank
Amelia Cut-Off	0.020 – 0.050	0.050 – 0.100
Upper Bayou Din	0.025 – 0.040	0.060 – 0.080
Bayou Din	0.025 – 0.040	0.060 – 0.080
Bayou Din Tributary	0.014* - 0.040	0.060 – 0.090
Channel Connector	**	**
Channel to Janes Gully	**	**
Cotton Creek	0.035	0.150
Ditch 505	0.050	0.080 – 0.100
Ditch 505 Tributary	0.050	0.080 – 0.100
Greenpond Gully (Ditch 607)	0.018* - 0.040	0.090 – 0.100
Hillebrandt Bayou	0.020 – 0.050	0.050 – 0.100
Hillebrandt Bayou (Caldwood Cut-Off)	0.020 – 0.050	0.050 – 0.100
Keith Ditch	0.013* - 0.050	0.070 – 0.100
Hillebrandt Oxbow	0.020 – 0.050	0.050 – 0.100
Janes Gully	0.020 – 0.050	0.050 – 0.100
Janes Gully Diversion	**	**
Keith Ditch	0.020 – 0.050	0.050 – 0.100
Kidd Gully	0.020 – 0.050	0.050 – 0.100
Mayhaw Bayou	0.018* - 0.040	0.090 – 0.100
Mayhaw Bayou Tributary	0.018* - 0.040	0.900 – 0.100
Neches River	0.020 – 0.050	0.050 – 0.100
Pine Island Bayou	0.050	0.120
Quinn Ditch	0.018* - 0.040	0.090 – 0.100
Rhodair Gully	0.014 – 0.030	0.060
South Fork Taylor Bayou	0.018* - 0.040	0.090 – 0.100
Taylor Bayou/North Fork Taylor Bayou	0.040	0.080 – 0.100
Walker Branch	0.018* - 0.040	0.090 – 0.100
Walker Branch Relief Ditch	0.020 – 0.050	0.050 – 0.100
Walker Branch Tributary	0.018* - 0.040	0.090 – 0.100
Willow Marsh Bayou	0.018* - 0.040	0.090 – 0.100

*Denotes "n" value used for concrete-lined segment
**Roughness values were not available

Countywide

The hydraulic analyses for the riverine flooding sources in this study were not revised from the pre-countywide conditions and are based on unobstructed flow. The flood elevations as shown on the profiles are thus considered valid only if hydraulic structures in general remain unobstructed and do not fail.

3.3 Coastal Analysis

The hydraulic characteristics of coastal flood sources were analyzed to provide estimates of flood elevations for 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 in the coastal data tables and flood profiles provided in the FIS Report.

3.3.1 Storm Surge Analysis and Modeling

Pre-Countywide

The determination of coastal inundation caused by passage of a hurricane was approached by the joint probability method (Reference 23). The storm populations were described by probability distribution of five parameters that influence surge heights. These were (1) central pressure depression (which indicates the intensity of the storm), (2) radius to maximum winds, (3) forward speed of the storm, (4) shoreline crossing point and (5) crossing angle. These characteristics were described statistically based on an analysis of observed storms in the vicinity of Jefferson County. Primary sources of data for this analysis were the National Weather Service (References 24 to 26), the National Hurricane Research Project (Reference 27) and the Monthly Weather Review (Reference 28).

For areas subject to flooding directly from the Gulf of Mexico/Sabine Lake/Neches River, FEMA's standard coastal surge model was used to simulate the coastal surge generated by any chosen storm (that is, any combination of the five storm parameters defined previously). Performing such simulations for a large number of storms, each of known total probability, permitted the establishment of a frequency distribution of surge height as a function of coastal location. The distribution incorporated the large-scale surge behavior but did not include the analysis if the added effects associated with much finer scale wave phenomena such as wave height, setup, or runup. The astronomic tide for the region was then statistically combined with the computed storm surge to yield recurrence intervals of total water level. The precountywide model used a grid pattern approximating the geographical features of the study area and the adjoining areas. Surges were computed using grids of 5 nautical miles for open coast computation, 1 nautical mile for Sabine Lake computations and 1.5 miles for overland computations.. The effects of the Sabine Lake and Neches River were included in the model.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the National Academy of Sciences report (Reference 29). The method is based on 3 major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest elevation is 70 percent of the total wave height plus the Stillwater elevation.

Second, the wave height may be diminished due to the presence of obstructions such as sand dunes, dikes and seawalls, building and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in Reference 54. Third is that the wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Wave heights for Jefferson County Unincorporated Areas, the City of Port Arthur and the City of Port Neches were computed along transects (cross section lines) that were located along the coastal areas in accordance with the Users Manual for Wave Height Analysis (Reference 54). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent condition in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at larger intervals. It was necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

The transects were continued inland until the wave dissipated or until flooding from another source with equal or greater elevation was reached. Along each transect wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation and physical features. The Stillwater elevations for the 1-percent annual chance flood were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. Areas with a wave component 3-feet or greater were designated as velocity zones. Other areas subject to wave action were designated as A zones with base flood elevation adjusted to include wave crest elevations.

Countywide

For areas subject to coastal flood effects, the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations were taken directly from a detailed storm surge study documented in *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* prepared by the U.S. Army Corps of Engineers (Reference 55). This storm surge study was completed in November 2011.

The Advanced Circulation (ADCIRC) model for coastal ocean hydrodynamics developed by the USACE was applied to calculate stillwater elevations for coastal Texas. The ADCIRC model uses an unstructured grid and is a finite element long wave model. It has the capability to simulate tidal circulation and storm surge propagation over large areas and is able to provide highly detailed resolution in areas of interest along shorelines, open coasts and inland bays. It solves three dimensional equations of motion, including tidal potential, Coriolis, and non-linear terms of the governing equations. The model is formulated from the depth-averaged shallow water equations for conservation of mass and momentum which result in the generalized wave continuity equation.

In performing the coastal analyses, nearshore waves were required as inputs to wave runup and overland wave propagation calculations, and wave momentum (radiation stress) was considered as contribution to elevated water levels (wave setup). The Steady State Spectral Wave (STWAVE) model was used to generate and transform waves to the

shore for the Texas Joint Storm Surge (JSS) Study. STWAVE is a finite difference model that calculates wave spectra on a rectangular grid. The model outputs zero-moment wave height, peak wave period (Tp), and mean wave direction at all grid points and two-dimensional spectra at selected grid points. STWAVE includes an option to input spatially variable wind and storm surge field. Storm surge significantly alters wave transformation and generation for the hurricane simulations in shallow-flooded areas.
STWAVE was applied on five grids for the Texas JSS: NE, CE, SW, NEn, and CEn. Three large grids (NE, CE, SW) with offshore boundaries at depths near 100 feet (30 meters) encompassed the entire coast of Texas and applied the efficient half-plane version of STWAVE (which must approximately align with the shoreline). Two nested grids (NEn and CEn) covered Galveston Bay and Corpus Christi Bay and applied the fullplane version of STWAVE to allow generation of wind waves in all directions. Notably, memory requirements for the full-plane model precluded its use for the large grids with offshore boundaries. The input for each grid includes the bathymetry (interpolated from the ADCIRC domain), surge fields (interpolated from ADCIRC surge fields), and wind fields (interpolated from the ADCIRC wind fields, which apply land effects to the base wind fields). The wind and surge applied in STWAVE are spatially and temporally variable for all domains. STWAVE was run at 30-minute intervals for 93 quasi-time steps (46.5 hours).

The ADCIRC model computational domain and the geometric/topographic representation developed for the Joint Coastal Surge effort was designated as the TX2008 mesh. This provided a common domain and mesh from the Texas-Mexico border to western Louisiana, extends inland across the floodplains of Coastal Texas (to the 30- to 75-foot contour NAVD88), and extends over the entire Gulf of Mexico to the deep Atlantic Ocean. The TX2008 domain boundaries were selected to ensure the correct development, propagation, and attenuation of storm surge without necessitating nesting solutions or specifying ad hoc boundary conditions for tides or storm surge. The TX2008 computational mesh contains more than 2.8 million nodes and nodal spacing varies significantly throughout the mesh. Grid resolution varies from approximately 12 to15 miles in the deep Atlantic Ocean to about 100 ft. in Texas. Further details about the terrain data as well as the ADCIRC mesh creation and grid development process can be found in *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* (Reference 55).

3.3.2 Statistical Analysis

The Joint Probability Method (JPM) is a simulation methodology that relies on the development of statistical distributions of key hurricane input variables such as central pressure, radius to maximum wind speed, maximum wind speed, translation speed, track heading, etc., and sampling from these distributions to develop model hurricanes. The resulting simulation results in a family of modeled storms that preserve the relationships between the various input model components, but provides a means to model the effects and probabilities of storms that historically have not occurred.

Due to the excessive number of simulations required for the traditional JPM method, the JPM-Optimum Sampling (JPM-OS) was utilized to determine the stillwater elevations associated with tropical events. JPM-OS is a modification of the JPM method and is intended to minimize the number of synthetic storms that are needed as input to the ADCIRC model. The methodology entails sampling from a distribution of model storm

parameters (e.g., central pressure, radius to maximum wind speed, maximum wind speed, translation speed, and track heading) whose statistical properties are consistent with historical storms impacting the region, but whose detailed tracks differ. The methodology inherently assumes that the hurricane climatology over the past 60 to 65 years (back to 1940) is representative of the past and future hurricanes likely to occur along the Texas coast.

A set of 446 storms (two sets of 152 low frequency storms + two sets of 71 higher frequency storms) was developed by combining the "probable" combinations of central pressure, radius to maximum winds, forward speed, angle of track relative to coastline, and track. Tracks were defined by five primary tracks and four secondary tracks. Storm parameters for synthetic storms are provided in Table 11 of *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* (Reference 55). The estimated range of storm frequencies using the selected parameters was between the 10-percent- and 0.2-percent-annual-chance storm events. The ADCIRC-STWAVE modeling system was validated using five historic storms: Hurricanes Carla (1961), Allen (1980), Bret (1999), Rita (2005), and Ike (2008).

3.3.3 Stillwater Elevations

The results of the ADCIRC model and JPM-OS provided 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations which include wave setup effects. Stillwater elevations are assigned at individual ADCIRC mesh nodes throughout the Texas coast. Triangular Irregular Networks (TINs) and raster datasets were built from these nodes for use in wave analysis and floodplain mapping.

An Independent Technical Review (ITR) was performed on the overall storm surge study process. This review process was performed in accordance with USACE regulations. The ITR team was composed of experts in the fields of coastal engineering and science, and was engaged throughout the study. Appendix K of *Flood Insurance Study: Coastal Counties, Texas Intermediate Submission 2 – Scoping and Data Review* includes all comments received from the ITR panel, as well as responses to those comments (Reference 55).

3.3.4 Wave Height Analysis

Using storm surge study results, wave height analysis was performed to identify areas of the coastline subject to overland wave propagation or wave runup hazards. Wave heights were computed along transects (cross section lines) that were located along the coastal areas, as illustrated in Figure 1 "Transect Location Map".

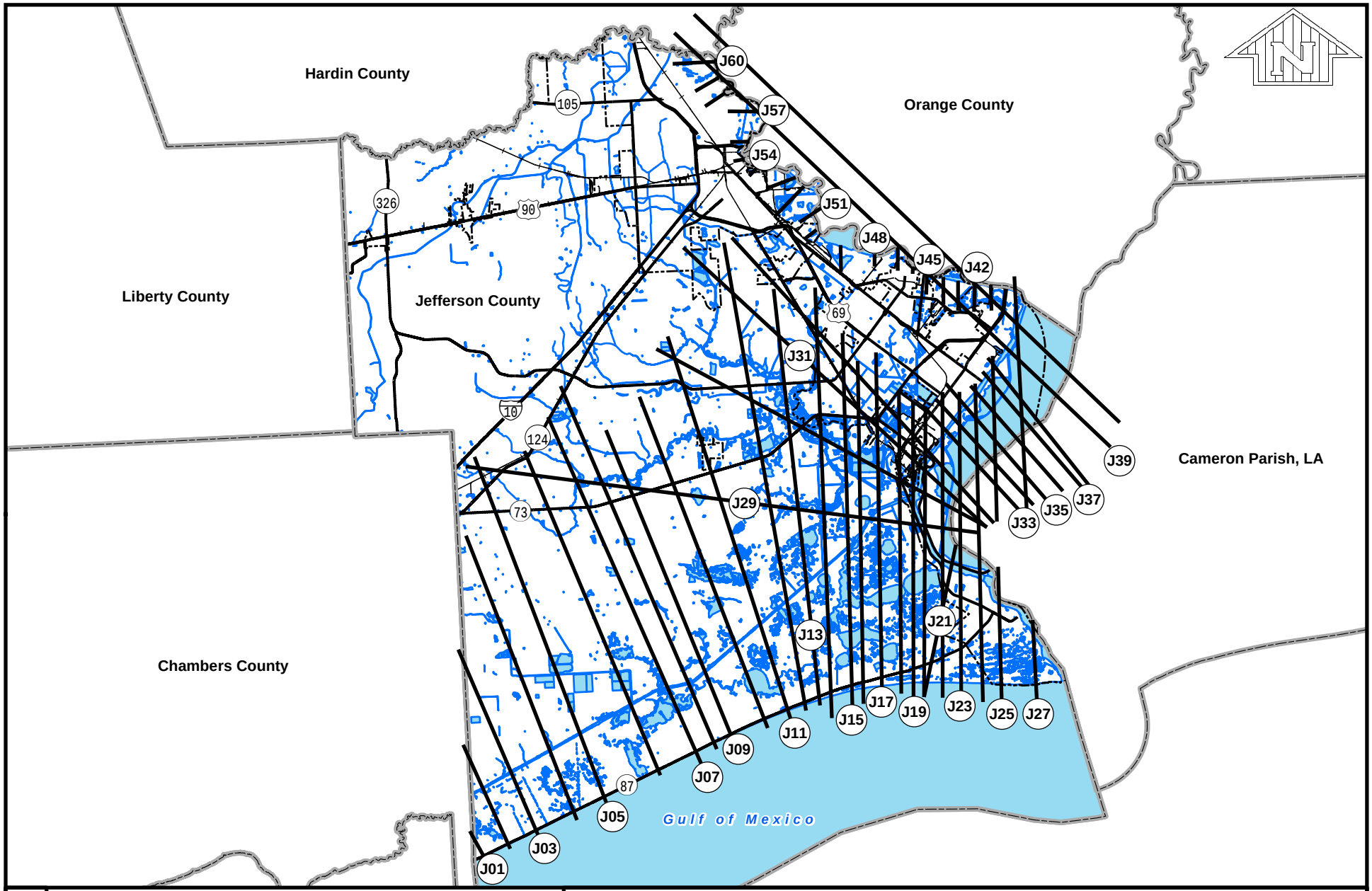

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

APPROXIMATE SCALE

0 37,500 75,000 112,500 150,000 Feet

TRANSECT LOCATION MAP

Figure 2 shows a cross-section for a typical coastal analysis transect, illustrating the effects of energy dissipation and regeneration of wave action over inland areas. This figure shows the wave crest elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Figure 2 also illustrates the relationship between the local stillwater elevations, the ground profile, and the location of the VE/AE Zone boundary at the limit of 3 ft. breaking waves. This inland limit of the coastal high hazard area is delineated to ensure that adequate insurance rates apply and appropriate construction standards are imposed, should local agencies permit building in this coastal high hazard area.

Coastal BFEs are calculated as the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1-percent-annual chance storm plus the additional flood hazard from overland wave effects (storm-induced erosion, overland wave propagation, wave runup and wave overtopping).

Where they apply, coastal BFEs are calculated along transects extending from offshore to the limit of coastal flooding onshore. Results of these analyses are accurate until local topography, vegetation, or development type and density within the community undergoe major changes.

It has been shown in laboratory tests and observed in field investigations that wave heights as little as 1.5 feet can cause damage to and failure of typical Zone AE construction. Therefore, for advisory purposes only, a Limit of Moderate Wave Action (LiMWA) boundary has been added in coastal areas subject to wave action. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave.

The effects of wave hazards in the Zone AE between the Zone VE (or shoreline in areas where VE Zones are not identified) and the limit of the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot breaking waves are projected during a 1-percent-annualchance flooding event.

In areas where wave runup elevations dominate over wave heights, such as areas with steeply sloped beaches, bluffs, and/or shore-parallel flood protection structures, there is no evidence to date of significant damage to residential structures by runup depths less than 3 feet. However, to simplify representation, the LiMWA was continued immediately landward of the VE/AE boundary in areas where wave runup elevations dominate. Similarly, in areas where the Zone VE designation is based on the presence of a primary frontal dune or wave overtopping, the LiMWA was also delineated immediately landward of the Zone VE/AE boundary.

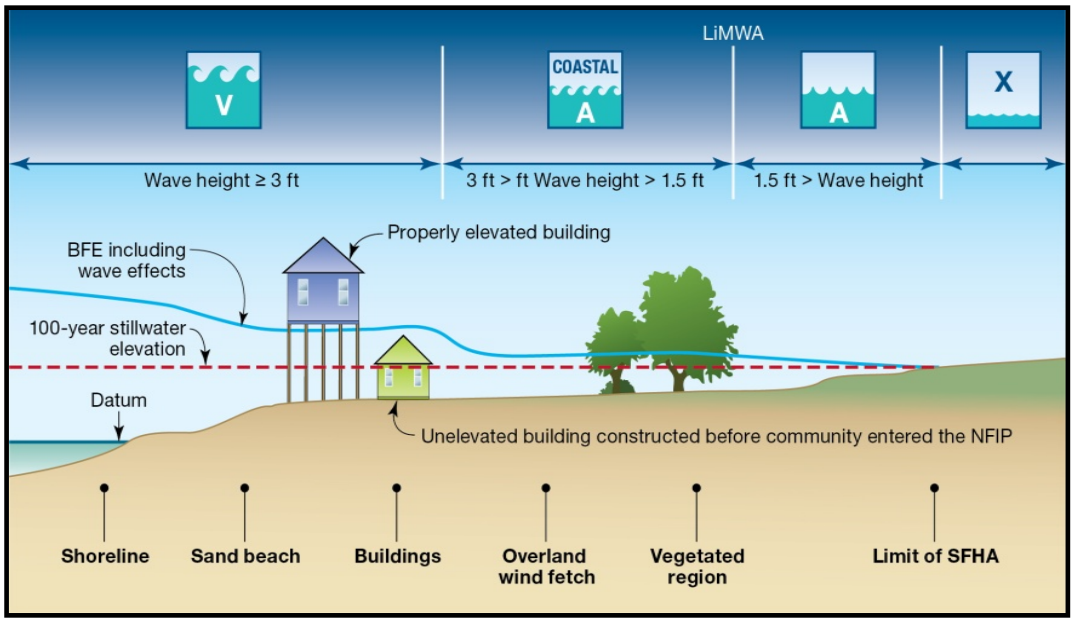

FIGURE 2 - TRANSECT SCHEMATIC

A summary of the results from the coastal analyses, which reflects the stillwater elevation determined along each transect at the 10-, 2-, 1-, and 0.2-percent-annual-chance recurrence intervals is shown in Table 6, "Coastal Data Table."

Table 6. COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of WHAFIS Transect (NAD83)		Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD 88)				Zone Designation and BFE (feet NAVD88)
					10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Jefferson County	J01	Located at west end of County, traversing south to north from Gulf Coast to northern County Line	29.5648	94.3452	7.9 5.8 7.9	10.7 10.4 11.1	13.7 13.2 13.9	18.5 17.5 18.9	AE 15-16 VE 15-21
Jefferson County	J02	Located to the east of transect J01, traversing south to north	29.5731	94.3235	7.8 4.5 7.9	10.9 9 11	13.8 11.5 13.9	17.9 15.9 18.6	AE 13-16 VE 14-21
Jefferson County	J03	Located to the east of transect J02, traversing south to north	29.5826	94.2988	7.7 3.4 7.8	11.1 8 11.1	13.9 11 14.1	18.2 15.6 18.9	AE 11-16 VE 13-21
Jefferson County	J04	Located to the east of transect J03, traversing south to north	29.5959	94.2657	7.7 3.3 7.8	11.0 6.7 11.2	13.9 9.2 14.0	18.4 11.1 18.6	AE 1-16 VE 12-21
Jefferson County	J05	Located to the east of transect J04, traversing south to north	29.6064	94.2389	7.7 3.4 7.7	10.9 6.9 11.2	13.7 7 13.9	18.1 11.1 18.7	AE 1-16 VE 12-21
Jefferson County	J06	Located to the east of transect J05, traversing south to north	29.6250	94.1911	7.6 3.5 7.6	10.8 6.6 10.8	13.6 7 13.6	18.1 9.6 18.5	AE 7-16 VE 16-21
Jefferson County	J07	Located to the east of transect J06, traversing south to north	29.6380	94.1579	7.5 3.6 7.5	10.7 4.3 10.7	13.5 5.4 13.5	18.1 9.5 18.4	AE 5-16 VE 13-21
Jefferson County	J08	Located to the east of transect J07, traversing south to north	29.6441	94.1417	7.4 3.5 7.5	10.6 4 10.6	13.4 5.4 13.4	18.0 9.6 18.1	AE 5-15 VE 13-21
Jefferson County	J09	Located to the east of transect J08, traversing south to north	29.6496	94.1269	7.2 3.5 7.5	10.7 4 10.7	13.7 5.4 13.7	18.6 9.7 18.6	AE 5-16 VE 12-20
Jefferson County	J10	Located to the east of transect J09, traversing south to north	29.6596	94.0970	7.4 3.4 7.4	10.2 4.1 10.4	13.3 5.9 13.3	18.1 10 19.0	AE 6-15 VE 13-20
Jefferson County	J11	Located to the east of transect J10, traversing south to north	29.6656	94.0762	7.4 2.5 7.4	10.5 5.3 10.5	13.3 7.3 13.3	17.9 9.6 18.4	AE 7-15 VE 12-20
Jefferson County	J12	Located to the east of transect J11, traversing south to north	29.6696	94.0613	7.3 2.9 7.3	10.4 4.6 10.4	13.2 5.2 13.2	17.7 9.2 18.6	AE 5-15 VE 11-20
Jefferson County	J13	Located to the east of transect J12, traversing south to north	29.6727	94.0486	7.4 3 7.4	10.4 5.9 10.5	13.1 6.3 13.3	17.7 11.4 18.6	AE 8-15 VE 11-20

Table 6. COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of WHAFIS Transect (NAD83)	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD 88)				Zone Designation and BFE (feet NAVD88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Jefferson County	J14	Located to the east of transect J13, traversing south to north	29.6749 94.0385	7.4 3 7.4	10.4 5.9 10.4	13.1 7.5 13.2	17.7 11.7 18.0	AE 1-15 VE 11-20
Jefferson County	J15	Located to the east of transect J14, traversing south to north	29.6784 94.0201	7.2 3.2 7.2	10.2 5.4 10.2	12.9 8.6 12.9	17.4 13.1 17.4	AE 9-15 VE 11-20
Jefferson County	J16	Located to the east of transect J15, traversing south to north	29.6797 94.0102	7.1 3.5 7.2	10.2 6.1 10.3	12.9 8.5 13.1	17.6 13.2 18.0	AE 9-15 VE 11-20
Jefferson County	J17	Located to the east of transect J16, traversing south to north	29.6811 93.9939	7.2 4.1 7.2	10 5.9 10.1	12.7 8.4 12.9	17.2 10.8 17.6	AE 9-15 VE 11-19
Jefferson County	J18	Located to the east of transect J17, traversing south to north	29.6821 93.9771	7.0 4 7.1	10.0 6.9 10.1	12.7 8.8 12.9	17.5 13.3 18.1	AE 9-15 VE 12-19
Jefferson County	J19	Located to the east of transect J18, traversing south to north	29.6826 93.9664	6.6 3.8 7.2	10.0 7.2 10.1	12.7 8.9 12.8	17.3 13.5 17.7	AE 9-15 VE 12-19
Jefferson County	J20	Located to the east of transect J19, traversing south to north	29.6822 93.9572	7.15 3.8 7.3	9.95 7.0 10	12.7 8.7 12.7	17.1 13.1 17.3	AE 9-15 VE 12-19
Jefferson County	J21	Located to the east of transect J20, traversing south to north	29.6823 93.9547	7.1 3.8 7.3	9.95 7.3 10	12.6 8.9 12.6	17.0 13.5 17.9	AE 9-15 VE 12-19
Jefferson County	J22	Located to the east of transect J21, traversing south to north	29.6825 93.9411	7.1 4.4 7.3	9.95 6.8 10.1	12.6 8.7 12.7	17.0 13.2 17.6	AE 9-15 VE 11-19
Jefferson County	J23	Located to the east of transect J22, traversing south to north	29.6820 93.9252	7.1 5.1 7.3	9.96 7.1 10.0	12.5 8.8 12.5	16.9 13.1 16.9	AE 9-15 VE 11-19
Jefferson County	J24	Located to the east of transect J23, traversing south to north	29.6809 93.9067	7.05 3.5 7.1	11.3 6.97 11.4	13.5 8.7 13.5	17.9 13.3 18	AE 9-16 VE 11-21
Jefferson County	J25	Located to the east of transect J24, traversing south to north	29.6798 93.8904	6.97 6.4 7	11.6 9.2 11.6	13.6 11.1 13.6	18.1 15.2 18.1	AE 12-16 VE 13-21
Jefferson County	J26	Located to the east of transect J25, traversing south to north	29.8022 93.8880	3.5 3.5 5.5	6.7 6.7 7.3	8.5 8.5 9.2	12.8 12.8 13.7	AE 9-11 VE 11-15

Table 6. COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of WHAFIS Transect (NAD83)	Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD 88)				Zone Designation and BFE (feet NAVD88)
				10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Jefferson County	J27	Located to the east of transect J26, traversing south to north	29.6783 93.8603	6.9 5.9 6.9	11.7 11.4 11.9	13.8 13.4 13.8	18.2 17.6 18.3	AE 15-16 VE 16-21
Jefferson County	J28	Located to the east of transect J27, traversing south to north	29.8101 93.8616	3.4 3.4 5.5	6.7 6.7 7.6	8.3 8.3 9.4	12.5 12.5 14.3	AE 1-11 VE 10-16
Jefferson County	J29	Located at southwest of Sabine Lake, traversing east to west	29.7943 93.9040	3.6 3.4 6	6.9 3.9 8.5	8.9 5.4 10.6	13.1 9.6 15.6	AE 5-13 VE 11-15
Jefferson County	J30	Located to the east of transect J29, traversing east to west	29.7984 93.8967	3.5 2.5 6	6.8 5.3 8.3	8.6 6.9 10.4	12.9 9.8 15.6	AE 1-12 VE 11-15
Jefferson County	J31	Located to the east of transect J30, traversing east to west	29.7981 93.8972	3.5 2.6 5.9	6.8 2.1 8.3	8.6 2.5 10.4	12.9 3.8 14.9	AE 1-12 VE 11-15
Jefferson County	J32	Located to the east of transect J31, traversing east to west	29.8011 93.8906	3.5 3.5 5.8	6.8 4.6 7.9	8.5 5.2 9.9	12.8 9.3 15	AE 1-11 VE 11-15
Jefferson County	J33	Located to the east of transect J32, traversing east to west	29.8109 93.8689	3.1 3.1 5.7	6.7 6.7 7.75	8.2 8.2 9.6	12.7 12.7 13.9	AE 9-11 VE 10-16
Jefferson County	J34	Located to the east of transect J33, traversing east to west	29.8136 93.8556	3.4 3.4 5.6	6.7 6.7 7.7	8.3 8.3 9.6	12.5 12.5 13.9	AE 9-11 VE 10-16
Jefferson County	J35	Located to the east of transect J34, traversing east to west	29.8175 93.8447	3.4 3.4 5.6	6.7 6.7 7.5	8.2 8.2 9.2	12.5 12.5 13.6	AE 9-11 VE 10-16
Jefferson County	J36	Located to the east of transect J35, traversing east to west	29.8232 93.8296	3.3 3.3 5.5	6.6 6.6 7.4	8.1 8.1 9.2	12.4 12.4 13.5	AE 9-11 VE 10-16
Jefferson County	J37	Located to the east of transect J36, traversing east to west	29.8262 93.8136	3.3 3.3 5.5	6.6 6.6 7.4	8.1 8.1 9.3	12.3 12.3 13.8	AE 9-11 VE 10-16
Jefferson County	J38	Located to the east of transect J37, traversing east to west	29.8270 93.8070	3.2 3.2 5.5	6.8 6.8 7.3	8.2 8.1 9.2	12.4 12.3 13.8	AE 9-11 VE 10-16
Jefferson County	J39	Located to the east of transect J38, traversing east to west	29.8549 93.7864	3.1 3.1 5.8	6.7 4.8 7.7	8.0 5.6 9.3	12.7 6.5 13.7	AE 6-11 VE 10-17

Table 6. COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of WHAFIS Transect (NAD83)		Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD 88)				Zone Designation and BFE (feet NAVD88)
					10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Jefferson County	J40	Located to the east of transect J39, traversing east to west	29.8731	93.7775	3.2 3.2 5.9	7.4 4.8 7.7	9.3 5.7 9.4	14.9 7.3 13.9	AE 6-11 VE 11-17
Jefferson County	J41	Located at mouth of Neches River at Sabine Lake, traversing east to west	29.9806	93.8843	5.27 4.3 5.3	7.5 7.1 7.5	9.2 8.9 9.2	13.5 13.3 13.8	AE 9-11 VE 11-13
Jefferson County	J42	Located to the east of transect J41, traversing east to west	29.9827	93.8982	5.3 4.4 5.3	7.4 7.15 7.5	9.1 8.9 9.2	13.4 13 13.8	AE 10-11 VE 11-13
Jefferson County	J43	Located to the east of transect J42, traversing east to west	29.9854	93.9126	5.35 4.2 5.4	7.4 6.7 7.4	9.1 8.7 9.1	13.2 12.6 13.7	AE 9-11 VE 11-13
Jefferson County	J44	Located to the east of transect J43, traversing east to west	29.9885	93.9253	5.38 4.5 5.4	7.4 5.95 7.4	8.8 8.5 9.0	13.2 12.5 13.5	AE 9-11
Jefferson County	J45	Located to the east of transect J44, traversing east to west	29.9924	93.9394	5.4 5.2 5.4	7.4 7.3 7.4	9 9.0 9.0	12.8 12.2 13.5	AE 9-10
Jefferson County	J46	Located to the east of transect J45, traversing east to west	29.9971	93.9514	5.4 5.37 5.4	7.3 7.27 7.3	9 9.0 9.0	12.6 12.0 12.7	AE 9-11
Jefferson County	J47	Located to the east of transect J46, traversing east to west	30.0123	93.9639	5.47 4.8 5.5	7.4 6.1 7.4	8.9 8.7 9.2	12.5 11.8 13.6	AE 9-10
Jefferson County	J48	Located to the east of transect J47, traversing east to west	30.0071	93.9842	5.5 5.46 5.5	7.28 7.2 7.3	8.8 8.8 8.9	12.3 11.7 12.3	AE 9-11
Jefferson County	J49	Located to the east of transect J48, traversing east to west	30.0161	94.0134	5.5 4.7 5.5	7.3 5.4 7.3	8.7 8.0 9.0	11.8 11.4 12.7	AE 8-11 VE 11-12
Jefferson County	J50	Located to the east of transect J49, traversing east to west	30.0293	94.0340	5.5 5.2 5.6	7.1 6.5 7.4	8.8 8.5 8.9	12.0 11.7 12.7	AE 9-10
Jefferson County	J51	Located to the east of transect J50, traversing east to west	30.0452	94.0300	5.5 4.9 5.6	7.4 7.0 7.5	8.9 8.6 9.0	12.0 11.6 12.3	AE 9-11 VE 11
Jefferson County	J52	Located to the east of transect J51, traversing east to west	30.0626	94.0433	5.5 4.8 5.6	7.25 6.3 7.5	8.8 8.0 9.2	11.7 11.5 13.1	AE 8-10

Table 6. COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of WHAFIS Transect (NAD83)		Starting Stillwater Elevations (feet NAVD 88) Range of Stillwater Elevations (feet NAVD 88)				Zone Designation and BFE (feet NAVD88)
					10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
Jefferson County	J53	Located to the east of transect J52, traversing east to west	30.0690	94.0525	5.5 4.8 5.6	7.4 6.1 7.4	8.8 7.4 8.9	11.6 10.2 12.4	AE 8-11
Jefferson County	J54	Located to the east of transect J53, traversing east to west	30.0760	94.0862	5.58 5.5 5.6	7.3 7.3 7.3	8.8 8.7 8.8	11.4 10.9 11.4	AE 9-11
Jefferson County	J55	Located to the east of transect J54, traversing east to west	30.0852	94.0951	5.5 5.5 5.6	7.3 7.29 7.3	8.6 8.6 8.6	11.0 10.8 11.0	AE 10
Jefferson County	J56	Located to the east of transect J55, traversing east to west	30.0985	94.0902	5.5 5.2 5.5	7.1 6.8 7.2	8.3 8.3 8.5	10.4 10.3 10.7	AE 8-9
Jefferson County	J57	Located to the east of transect J56, traversing east to west	30.1209	94.0785	5.5 5.2 5.5	6.9 6.6 7.1	8 7.7 8.3	9.9 9.9 10.5	AE 8-9
Jefferson County	J58	Located to the east of transect J57, traversing east to west	30.1358	94.1090	5.1 5.1 5.3	5.3 4.8 5.35	6.7 5.9 6.8	8.8 8.7 8.8	AE 6-7
Jefferson County	J59	Located to the east of transect J58, traversing east to west	30.1479	94.1136	5.0 5 5.1	5.25 5.2 5.3	6.6 6.6 6.8	8.5 8.5 8.5	AE 7
Jefferson County	J60	Located to the east of transect J59, traversing east to west	30.1602	94.1157	4.8 4.8 5.1	5.05 5 5.1	6.6 5.6 6.7	9.3 8.6 9.7	AE 6-7

3.3.5 Combined Probability Analysis

The combined probability analysis was performed by developing tables for the rate of occurrence versus the flood levels along several riverine and the coastal flooding sources, in accordance with FEMA's Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update (Reference 56). This data was used to develop the graph used to construct the 1-percent annual chance composite profiles representing the combined probability for the riverine flooding sources detailed below and the coastal SWEL.

Flooding Source	Combined Coastal and Riverine Base Flood Water-Surface Elevation (feet NAVD88)	
	1% Annual Chance	0.2% Annual Chance
Bayou Din	9.7	13.0
Hillebrandt Bayou	9.7	13.0
Taylor Bayou / North Fork Taylor Bayou	10.0	12.1
Rhodair Gully	9.6	13.1
Willow Marsh Bayou	9.7	13.0

3.4 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 used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD). With the completion of the North American Vertical Datum of 1988 (NAVD), many FIS reports and FIRMs are now prepared using NAVD as the referenced vertical datum.

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. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The datum conversion factor from NGVD29 to NAVD88 in Jefferson County is -0.004 feet.

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
SSMC-3, #9202
National Geodetic Survey
1315 East-West Highway
Silver Spring, Maryland 20910-3282

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the 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 associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

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

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 report 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- and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS report 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 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been re-delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using contour data developed from LiDAR data, with a contour interval of 2 feet (Reference 57).

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, AE, AH, and VE), 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 due to 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 base flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1 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 that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were determined at cross sections; between cross sections, the boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 7, "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.

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
AMELIA CUT-OFF								
A	1,200	105	1,047	3.3	16.5	14.3[2]	14.3[2]	0.0
B	2,288	103	1,038	3.3	16.5	14.7[2]	14.7[2]	0.0
C	3,688	109	1,072	3.2	16.5	15.1[2]	15.1[2]	0.0
D	5,688	102	1,027	2.9	16.5	15.7[2]	15.7[2]	0.0
E	7,738	104	1,027	2.9	16.5	16.2[2]	16.2[2]	0.0
F	8,976	108	1,043	2.3	16.5	16.4[2]	16.4[2]	0.0
G	10,736	112	1,196	2.6	18.0	18.0	18.1	0.1
H	12,456	112	1,177	2.6	18.1	18.1	18.2	0.1
I	13,955	62	434	5.3	19.3	19.3	19.4	0.1
J	15,565	57	386	5.3	19.9	19.9	20.0	0.1
K	16,951	61	412	3.0	21.5	21.5	21.5	0.0
L	18,851	54	355	3.4	21.6	21.6	21.6	0.0
M	19,911	52	325	3.2	21.7	21.7	21.7	0.0
N	20,639	48	275	3.8	21.7	21.7	21.7	0.0
O	21,884	51	299	3.0	24.0	24.0	24.0	0.0
P	23,064	50	305	2.9	24.0	24.0	24.0	0.0

[1] Feet above mouth [2] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

AMELIA CUT-OFF

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
BAYOU DIN								
A	11,736[1]	2,256	7,440	0.9	9.7[2]	8.6	9.5	0.9
B	19,136[1]	2,623	10,750	0.6	9.7[2]	9.7	10.6	0.9
C	25,236[1]	2,017	8,077	0.9	11.0	11.0	12.0	1.0
D	34,401[1]	1,494	6,111	0.4	13.5	13.5	14.5	1.0
E	36,601[1]	103	527	2.9	15.3	15.3	16.1	0.8
F	42,319[1]	272	1,053	1.4	21.2	21.2	21.9	0.7
G	42,649[1]	812	5,405	0.3	25.3	25.3	26.0	0.7
H	44,849[1]	827	4,890	0.3	25.4	25.4	26.1	0.7
I	46,536[1]	633	3,085	0.5	25.6	25.6	26.4	0.8
J	48,536[1]	445	2,512	0.6	25.7	25.7	26.5	0.8

[1] Feet above mouth at Hillebrandt Bayou [2] Combined Coastal and Riverine Backwater via Hillebrandt Bayou

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

BAYOU DIN

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
BAYOU DIN								
K	50,534[1]	1,532	3,152	0.2	25.9	25.9	26.7	0.8
L	51,934[1]	4,033	5,504	0.1	25.9	25.9	26.7	0.8
M	55,102[1]	446	1,763	0.3	26.1	26.1	26.8	0.7
N	59,415[1]	300	620	0.1	29.5	29.5	30.0	0.5
O	63,791[1]	140	1,171	0.6	31.0	31.0	31.5	0.5
P	71,068[1]	100	663	1.0	31.0	31.0	31.8	0.8
Q	77,199[1]	271	1,519	0.3	31.0	31.0	32.0	1.0
BAYOU DIN TRIBUTARY								
A	753[2]	50	300	3.8	16.8	16.8	17.8	1.0
B	4,290[2]	66	413	2.7	19.9	19.9	20.8	0.9
C	7,023[2]	46	446	2.4	22.0	22.0	22.7	0.7
D	10,037[2]	120	786	0.7	22.6	22.6	23.6	1.0

[1] Feet above mouth [2] Feet above mouth at Hillebrandt Bayou

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

BAYOU DIN – BAYOU DIN TRIBUTARY

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
CHANNEL CONNECTOR								
A	50	22	61	3.0	23.6	23.6	23.6	0.0
B	1,295	25	81	2.3	24.6	24.6	24.6	0.0
CHANNEL TO JANES GULLY								
A	80	26	66	1.9	22.5	22.5	22.5	0.0
B	930	26	67	1.9	22.6	22.6	22.6	0.0
C	2,054	89	157	1.6	23.1	23.1	23.1	0.0
D	3,005	30	90	4.9	24.8	24.8	24.8	0.0
E	3,759	32	108	2.0	25.6	25.6	25.6	0.0
F	4,043	30	100	2.2	25.6	25.6	25.7	0.1
G	4,461	46	80	2.7	26.7	26.7	26.7	0.0
H	4,857	17	33	1.5	27.2	27.2	27.2	0.0
I	5,209	56	65	0.8	27.6	27.6	27.6	0.0
J	5,459	56	81	0.3	28.0	28.0	28.0	0.0
K	5,872	30	52	0.5	28.1	28.1	28.1	0.0

[1] Feet above confluence with Janes Gully

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

CHANNEL CONNECTOR – CHANNEL TO JANES GULLY

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
COTTON CREEK								
A	410	563	2,105	1.0	40.7	40.7	40.8	0.1
B	6,510	1,161	5,158	0.4	41.4	41.4	41.9	0.5
C	9,780	1,262	3,643	0.4	41.7	41.7	42.3	0.6
D	9,980	1,491	6,056	0.2	41.6	41.6	42.2	0.6
E	12,600	2,566	8,363	0.2	42.2	42.2	42.2	0.0
F	14,400	2,246	6,932	0.2	42.2	42.2	42.2	0.0
DITCH 505								
A	4,400	1,380	4,526	0.8	13.4	13.4	14.2	0.8
B	7,863	1,610	13,998	0.1	14.1	14.1	14.9	0.8
C	12,663	100	550	3.4	15.0	15.0	15.6	0.6
D	17,806	716	2,869	0.5	17.6	17.6	18.3	0.7
E	23,335	436	1,738	0.5	18.6	18.6	19.4	0.8

[1] Feet above mouth

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

COTTON CREEK – DITCH 505

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
DITCH 505 TRIBUTARY								
A	1,460	596	2,043	0.3	17.7	17.7	18.3	0.6
B	3,900	150	307	2.4	17.4	17.4	18.2	0.8
C	6,130	310	923	0.8	18.8	18.8	19.6	0.8
GREEN POND GULLY (DITCH 607)								
A	50,880	636	2,088	0.6	27.4	27.4	28.4	1.0
B	52,668	63	447	2.7	28.1	28.1	28.8	0.7
C	57,131	1,554	3,501	0.4	30.7	30.7	31.0	0.3
D	61,248	167	609	2.2	32.2	32.2	32.9	0.7
E	65,798	2,397	7,587	0.2	33.1	33.1	33.8	0.7
F	70,077	50	328	2.3	34.1	34.1	34.7	0.6
G	73,364	63	377	2.0	34.8	34.8	35.5	0.7
H	78,018	1,598	4,001	0.2	35.3	35.3	36.2	0.9
I	80,922	57	401	1.8	36.1	36.1	36.9	0.8
J	83,815	490	2,970	0.2	40.2	40.2	40.7	0.5

[1] Feet above mouth

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

DITCH 505 TRIBUTARY – GREEN POND GULLY (DITCH 607)

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
HILLEBRANDT BAYOU								
A	8,190	769	8,102	1.5	9.7[2]	3.8	4.6	0.8
B	11,004	934	5,684	2.2	9.7[2]	4.4	5.2	0.8
C	15,190	2,058	9,953	1.2	9.7[2]	4.8	5.6	0.8
D	20,490	1,902	10,013	1.2	9.7[2]	5.4	6.2	0.8
E	21,790	1,931	7,908	1.5	9.7[2]	5.5	6.3	0.8
F	24,660	420	5,018	2.3	9.7[2]	5.7	6.5	0.8
G	28,640	640	5,004	2.3	9.7[2]	6.0	6.8	0.8
H	31,080	1,000	6,549	1.8	9.7[2]	6.4	7.2	0.8
I	33,680	1,109	7,160	1.6	9.7[2]	6.6	7.5	0.9
J	35,480	1,028	7,315	1.6	9.7[2]	6.6	7.5	0.9
K	37,560	700	4,609	2.0	9.7[2]	6.9	7.7	0.8
L	43,590	485	4,231	2.2	9.7[2]	7.2	8.1	0.9
M	48,240	1,464	7,675	1.2	9.7[2]	7.6	8.5	0.9
N	54,100	3,669	17,285	0.5	9.7[2]	7.9	8.8	0.9

[1] Feet above mouth [2] Combined Coastal and Riverine Backwater

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

HILLEBRANDT BAYOU

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
HILLEBRANDT BAYOU								
O	55,670	213	2,438	2.7	9.7[2]	7.9	8.8	0.9
P	61,250	218	3,012	2.2	9.7[2]	8.4	9.2	0.8
Q	65,280	229	2,280	2.7	9.7[2]	9.0	9.7	0.7
R	67,480	203	2,128	2.7	9.7[2]	9.2	9.8	0.6
HILLEBRANDT BAYOU (CALDWOOD CUT-OFF)								
S	72,380	195	2,602	4.1	13.0	13.0	13.1	0.1
T	75,510	222	3,081	3.5	13.6	13.6	13.7	0.1
U	76,100	206	3,095	3.5	13.9	13.9	14.0	0.1
V	79,050	262	3,022	3.0	14.0	14.0	14.0	0.0
W	81,090	303	3,429	2.7	14.1	14.1	14.2	0.1
X	82,970	116	1,423	4.5	14.3	14.3	14.4	0.1
Y	85,210	118	1,111	5.8	15.3	15.3	15.4	0.1
Z	89,760	108	1,041	4.3	17.9	17.9	18.1	0.2

[1] Feet above mouth [2] Combined Coastal and Riverine Backwater

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

HILLEBRANDT BAYOU / HILLEBRANDT BAYOU (CALDWOOD CUT-OFF)

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
HILLEBRANDT BAYOU (CALDWOOD CUT-OFF)								
AA	91,410	90	839	5.4	18.4	18.4	19.0	0.6
AB	95,010	100	1,358	3.3	20.4	20.4	20.8	0.4
AC	98,430	75	773	3.6	20.8	20.8	21.2	0.4
AD	99,810	90	884	3.3	21.3	21.3	21.7	0.4
AE	104,340	51	566	4.9	22.2	22.2	22.5	0.3
AF	108,500	54	422	6.5	26.6	26.6	26.6	0.0
AG	110,880	118	429	6.4	27.3	27.3	27.6	0.3
HILLEBRANDT OXBOW								
A	360	86	616	5.3	14.1	7.5[2]	8.5[2]	1.0
B	2,560	88	654	5.0	14.1	8.2[2]	9.0[2]	0.8
C	5,190	73	587	5.6	14.1	8.7[2]	9.6[2]	0.9
D	8,110	81	516	5.3	14.1	9.7[2]	10.3[2]	0.6
E	10,560	70	433	6.4	14.1	10.7[2]	11.7[2]	1.0

[1] Feet above mouth [2] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

HILLEBRANDT BAYOU (CALDWOOD CUT-OFF) – HILLEBRANDT OXBOW

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
HILLEBRANDT OXBOW								
F	12,090	97	683	3.2	14.1	11.7[2]	12.4[2]	0.7
G	13,200	68	768	2.8	16.2	16.2	16.2	0.0
H	14,100	71	358	3.0	16.3	16.3	16.3	0.0
I	16,460	79	380	2.8	16.7	16.7	16.8	0.1
JANES GULLY								
A	780	56	321	6.3	15.3	14.9[2]	14.9[2]	0.0
B	2,280	71	341	5.9	15.5	15.5	15.5	0.0
C	3,019	91	643	2.1	17.2	17.2	17.8	0.6
D	4,063	87	586	2.3	17.4	17.4	17.9	0.5
E	5,470	87	567	2.4	18.1	18.1	18.5	0.4
F	7,218	79	406	3.3	18.6	18.6	18.9	0.3
G	8,213	51	318	0.4	20.6	20.6	20.7	0.1
H	8,951	47	264	0.5	20.6	20.6	20.7	0.1
I	9,936	37	203	0.6	20.7	20.7	20.8	0.1
J	10,627	34	172	0.7	20.8	20.8	20.9	0.1

[1] Feet above mouth [2] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

HILLEBRANDT OXBOW – JANES GULLY

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
JANES GULLY								
K	11,441[1]	45	152	0.8	20.9	20.9	20.9	0.0
L	14,043[1]	48	227	2.7	22.1	22.1	22.1	0.0
M	15,633[1]	44	176	2.4	22.5	22.5	22.6	0.1
N	16,329[1]	32	119	2.3	24.3	24.3	24.3	0.0
O	17,443[1]	29	96	1.4	24.4	24.4	24.4	0.0
P	19,136[1]	26	75	1.3	25.0	25.0	25.0	0.0
JANES GULLY DIVERSION								
A	167[2]	83	560	1.3	20.5	20.5	20.6	0.1
B	775[2]	77	496	1.4	20.7	20.7	20.8	0.1
C	1,587[2]	71	402	1.8	20.8	20.8	20.8	0.0
D	2,275[2]	61	342	2.1	21.0	21.0	21.1	0.1
E	3,256[2]	164	831	0.9	21.3	21.3	21.4	0.1

[1] Feet above mouth [2] Feet above confluence with Janes Gully

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

JANES GULLY – JANES GULLY DIVERSION

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
KEITH DITCH								
A	3,320	200	700	2.0	22.9	22.6[2]	23.5[2]	0.9
B	7,564	115	505	2.5	26.1	26.1	26.7	0.6
C	10,242	65	334	2.5	26.9	26.9	27.1	0.2
D	12,500	56	238	1.8	27.3	27.3	27.5	0.2
KIDD GULLY								
A	4,000	2,107	6,265	0.5	14.5	14.5	15.5	1.0
B	7,000	1,100	2,691	1.1	15.8	15.8	16.7	0.9
C	8,640	1,100	4,885	0.6	19.2	19.1	19.5	0.4
D	10,320	2,150	6,371	0.5	19.4	19.4	19.8	0.4
E	12,040	900	3,318	0.9	20.0	20.0	20.8	0.8
F	15,860	1,100	2,307	1.3	23.2	23.2	24.0	0.8

[1] Feet above mouth [2] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

KEITH DITCH – KIDD GULLY

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
MAYHAW BAYOU								
A	33,259	10,000	21,375	0.3	11.2	11.2	12.1	0.9
B	46,244	6,528	20,754	0.3	13.7	13.7	13.8	0.1
C	48,900	2,000	4,458	1.1	15.4	15.4	15.8	0.4
D	61,774	145	735	1.5	22.1	22.1	22.8	0.7
MAYHAW BAYOU TRIBUTARY								
A	2,025	150	911	2.5	17.9	17.9	18.6	0.7
NECHES RIVER								
A	108,600	7,000	67,481	2.0	10.8	10.8	11.2	0.4
B	116,100	9,664	112,933	1.2	11.9	11.9	12.5	0.6
C	120,600	13,926	156,204	0.9	12.4	12.4	13.0	0.6
D	124,100	15,458	179,937	0.8	12.8	12.8	13.6	0.8
E	128,500	9,045	104,945	1.3	13.2	13.2	14.0	0.8

[1] Feet above mouth

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

MAYHAW BAYOU – MAYHAW BAYOU TRIBUTARY – NECHES RIVER

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
NECHES RIVER								
F	139,000	14,711	194,385	0.7	14.0	14.0	14.9	0.9
G	146,200	7,898	92,964	1.5	14.7	14.7	15.6	0.9
PINE ISLAND BAYOU								
A	16,150	6,668	36,901	1.1	15.0	9.6[2]	10.5[2]	0.9
B	17,610	6,547	40,332	1.0	15.0	10.0[2]	10.9[2]	0.9
C	23,910	4,047	28,310	1.4	15.0	11.4[2]	12.3[2]	0.9
D	30,010	2,154	11,131	3.6	15.0	13.5[2]	14.3[2]	0.8
E	33,110	4,197	31,175	1.3	15.0	14.8[2]	15.5[2]	0.7
F	36,210	2,340	21,939	1.8	15.3	15.3	16.0	0.7
G	38,610	859	10,786	3.7	15.7	15.7	16.4	0.7
H	40,660	300	7,078	5.7	16.4	16.4	17.2	0.8
I	42,810	557	9,293	4.3	17.5	17.5	18.3	0.8
J	45,960	1,598	19,294	2.1	18.3	18.3	19.1	0.8

[1] Feet above mouth [2] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

NECHES RIVER - PINE ISLAND BAYOU

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
PINE ISLAND BAYOU								
K	48,460	2,977	23,675	1.7	18.9	18.9	19.7	0.8
L	53,910	2,939	25,592	1.6	20.0	20.0	20.9	0.9
M	58,660	2,804	33,895	1.2	20.5	20.5	21.4	0.9
N	66,210	2,977	37,672	1.0	21.1	21.1	22.0	0.9
O	75,610	2,650	35,011	0.9	21.5	21.5	22.4	0.9
P	77,510	1,585	23,325	1.3	21.8	21.8	22.6	0.8
Q	82,560	1,880	26,153	1.9	22.2	22.2	23.1	0.9
R	89,160	2,228	28,635	1.1	22.9	22.9	23.7	0.8
S-W*								
QUINN DITCH								
A	1,865	442	1,299	1.6	11.4	11.4	11.7	0.3
B	3,565	92	373	4.8	13.4	13.4	13.4	0.0
C	4,965	70	266	5.8	16.2	16.2	16.2	0.0
D	6,255	54	226	5.9	19.5	19.5	19.5	0.0

[1] Feet above mouth *No floodway data computed

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

PINE ISLAND BAYOU – QUINN DITCH

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
RHODAIR GULLY								
A	14,330[1]	570	2,525	1.1	9.6[2]	5.0[3]	6.0[3]	1.0
B	24,600[1]	100	797	3.3	9.6[2]	7.3[3]	7.7[3]	0.4
C	31,260[1]	114	973	2.7	9.6[2]	9.3[3]	9.7[3]	0.4
D	32,400[1]	87	831	3.2	10.1	9.7[3]	10.7[3]	1.0
E	35,560[1]	99	818	3.2	12.2	12.2	12.7	0.5
F	39,160[1]	243	918	2.9	13.1	13.1	13.8	0.7
G	42,210[1]	939	2,384	1.1	13.9	13.9	14.8	0.9
H	42,740[1]	1,258	4,094	0.6	14.9	14.9	15.7	0.8
SOUTH FORK TAYLOR BAYOU								
A	34,700[4]	1,732	6,249	0.9	12.4	12.4	13.4	1.0
B	40,229[4]	4,670	20,986	0.3	13.5	13.5	14.1	0.6
C	43,723[4]	3,343	21,015	0.3	14.4	14.4	15.0	0.6
D	50,868[4]	2,463	6,666	0.8	14.6	14.6	15.4	0.8
E	56,981[4]	813	2,806	1.9	17.8	17.8	17.9	0.1

[1] Feet above mouth [2] Combined Coastal and Riverine Backwater
[3] Elevations computed without consideration of coastal flooding effects from Gulf of Mexico [4] Feet above confluence with Taylor Bayou

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

RHODAIR GULLY – SOUTH FORK TAYLOR BAYOU

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
TAYLOR BAYOU/NORTH FORK TAYLOR BAYOU								
A	24,000	2,932	21,593	0.8	10.0[2]	9.8	10.8	1.0
B	26,200	1,507	17,092	1.0	10.9	10.9	11.9	1.0
C	31,000	1,714	15,941	1.1	10.9	10.9	11.9	1.0
D	35,000	318	5,368	2.5	10.5	10.5	11.4	0.9
E	48,696	6,950	56,116	0.3	11.1	11.1	12.1	1.0
F	57,283	3,381	25,522	0.4	11.2	11.2	12.2	1.0
G	63,203	1,465	11,405	1.0	11.5	11.5	12.5	1.0
WALKER BRANCH								
A	2,840	620	2,015	8.0	21.0	14.7[3]	14.7[3]	0.0
B	4,200	618	2,155	7.8	21.0	15.9[3]	15.9[3]	0.0
C	10,403	78	471	6.4	21.7	21.7	21.7	0.0
D	11,526	82	707	4.2	22.7	22.7	22.7	0.0
E	15,125	84	451	4.4	23.7	23.7	23.7	0.0

[1] Feet above mouth [2] Combined Coastal and Riverine Backwater

[3] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

TAYLOR BAYOU/NORTH FORK TAYLOR BAYOU – WALKER BRANCH

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
WALKER BRANCH								
F	16,600	86	476	4.3	24.2	24.2	24.2	0.0
G	19,250	53	250	5.5	25.8	25.8	25.8	0.0
H	20,600	53	226	5.2	26.5	26.5	26.5	0.0
I	22,990	49	209	3.0	28.2	28.2	28.2	0.0
WALKER BRANCH RELIEF DITCH								
A	100	80	651	0.3	23.0	23.0[2]	23.6[2]	0.6
B	3,050	79	313	0.7	23.0	23.0[2]	23.6[2]	0.6
C	3,300	80	336	0.6	23.6	23.6	24.2	0.8
D	4,300	73	339	0.6	23.6	23.6	24.2	0.8
WALKER BRANCH TRIBUTARY								
A	1,375	400	1,207	4.6	21.9	21.2[2]	22.0[2]	0.8
B	6,180	300	1,403	1.9	23.2	23.2	23.9	0.7
C	8,575	90	583	4.6	25.3	25.3	25.8	0.5

[1] Feet above mouth [2] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

WALKER BRANCH - WALKER BRANCH RELIEF DITCH – WALKER BRANCH TRIBUTARY

FLOODING SOURCE	FLOODWAY				BASE FLOOD WATER-SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION (SQUARE FEET)	MEAN VELOCITY (FEET/ SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET)	WITH FLOODWAY (FEET)	INCREASE
WALKER BRANCH TRIBUTARY								
D	11,045	88	690	1.7	29.4	29.4	29.9	0.5
E	13,070	75	587	2.0	30.8	30.8	31.2	0.4
WILLOW MARSH BAYOU								
A	2,100	1,286	2,362	1.8	9.7[2]	7.4[3]	8.4[3]	1.0
B	3,960	447	1,778	2.4	10.2	10.2	10.8	0.6
C	7,380	736	2,893	1.4	11.4	11.4	12.3	0.9
D	10,064	3,896	12,065	0.8	13.6	13.6	14.6	1.0
E	16,330	5,167	35,876	0.3	16.2	16.2	17.1	0.9
F	18,703	592	3,173	2.9	16.3	16.3	16.5	0.2
G	21,072	130	1,834	5.1	16.5	16.5	16.6	0.1
H	24,179	1,306	3,556	1.5	17.8	17.8	18.4	0.6
I	32,118	3,096	5,432	0.7	23.3	23.3	23.8	0.5
J	34,080	2,827	6,620	0.7	23.7	23.7	24.4	0.7

[1] Feet above mouth [2] Combined Coastal and Riverine Backwater via Hillebrandt Bayou [3] Elevations computed without consideration of backwater effects

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

FLOODWAY DATA

WALKER BRANCH TRIBUTARY - WILLOW MARSH BAYOU

The area between the floodway and 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 (WSEL) of the base flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3, Floodway Schematic.

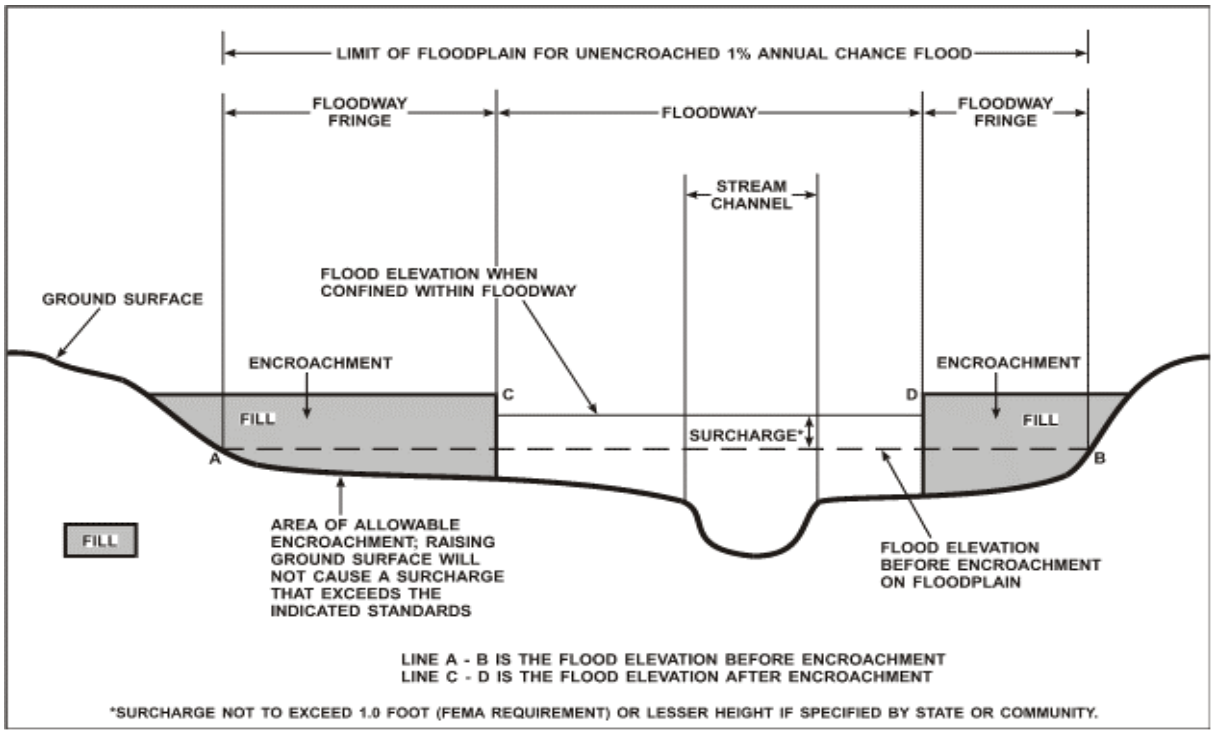

FIGURE 3 – FLOODWAY SCHEMATIC

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are 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 AH

Zone AH is the flood insurance rate zone that corresponds to the 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulics 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 (sq. mi.), and areas protected from the base flood by levees. No BFEs or depths are shown within this zone.

Boundaries of the John H. Chafee Coastal Barrier Resources System (CBRS) shown on the FIRM were transferred from the official CBRS source maps and depicted on the FIRM for informational purposes only. The official CBRS maps are enacted by Congress via the Coastal Barrier Resources Act, as amended, and maintained by the U.S. Fish and Wildlife Service (FWS). The official CBRS maps used to determine whether or not an area is located within CBRS are available for download at http://www.fws.gov. For an official determination of whether or not an area is located within the CBRS, or for any questions regarding the CBRS, please contact with the FWS field office at 281-286-8282.

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 as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use 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 county-wide FIRM presents flooding information for the entire geographic area of Jefferson County. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the county identified as flood-prone. This county-wide FIRM also includes flood-hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community are presented in Table 8, "Community Map History."

7.0 OTHER STUDIES

Studies are currently being performed in Chambers, Harris and Orange Counties, Texas. The flood insurance study for Cameron Parish, Louisiana was issued November 16, 2012, and the flood insurance study for Hardin, TX was issued April 6, 2010.

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA Region VI, Federal Insurance and Mitigation Division, 800 North Loop 288, Denton, Texas 76209.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FIRM EFFECTIVE DATE	FIRM REVISIONS (DATES)
Beaumont, City of	September 2, 1970	None	August 6, 2002	August 6, 2002
Bevil Oaks, City of	May 13, 1977	None	September 4, 1987	
China, City of	August 6, 2002	None	August 6,2002	
Groves, City of	March 26, 1970	None	January 6, 1983	
Jefferson County Unincorporated Areas	August 30, 1977	None	June 1, 1983	November 20, 1991 August 6, 2002
Nederland, City of	November 17, 1970	None	June 3, 1991	
Nome, City of	July 12, 1977	None	February 2, 1983	
Port Arthur, City of	May 26, 1970	None	May 26, 1970	July 1, 1974 January 3, 1975 October 8, 1976 March 20, 1981 October 1, 1983 April 17, 1984 May 4, 1992
Port Neches, City of	November 17, 1970	None	January 6, 1983	January 6, 1983
Taylor Landing, City of	November 14, 2008	None	August 6, 2002	

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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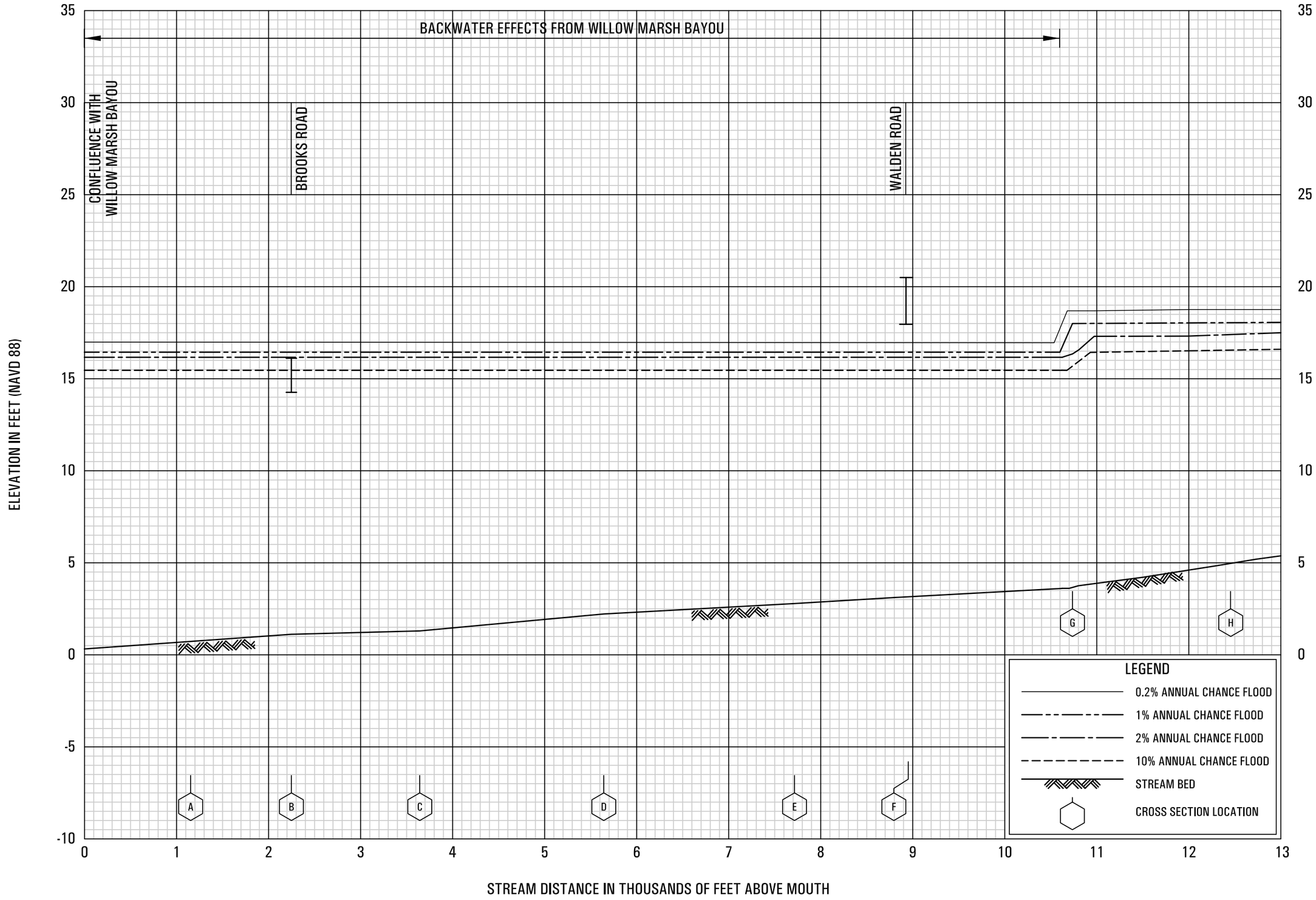

FLOOD PROFILES

AMELIA CUT-OFF

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

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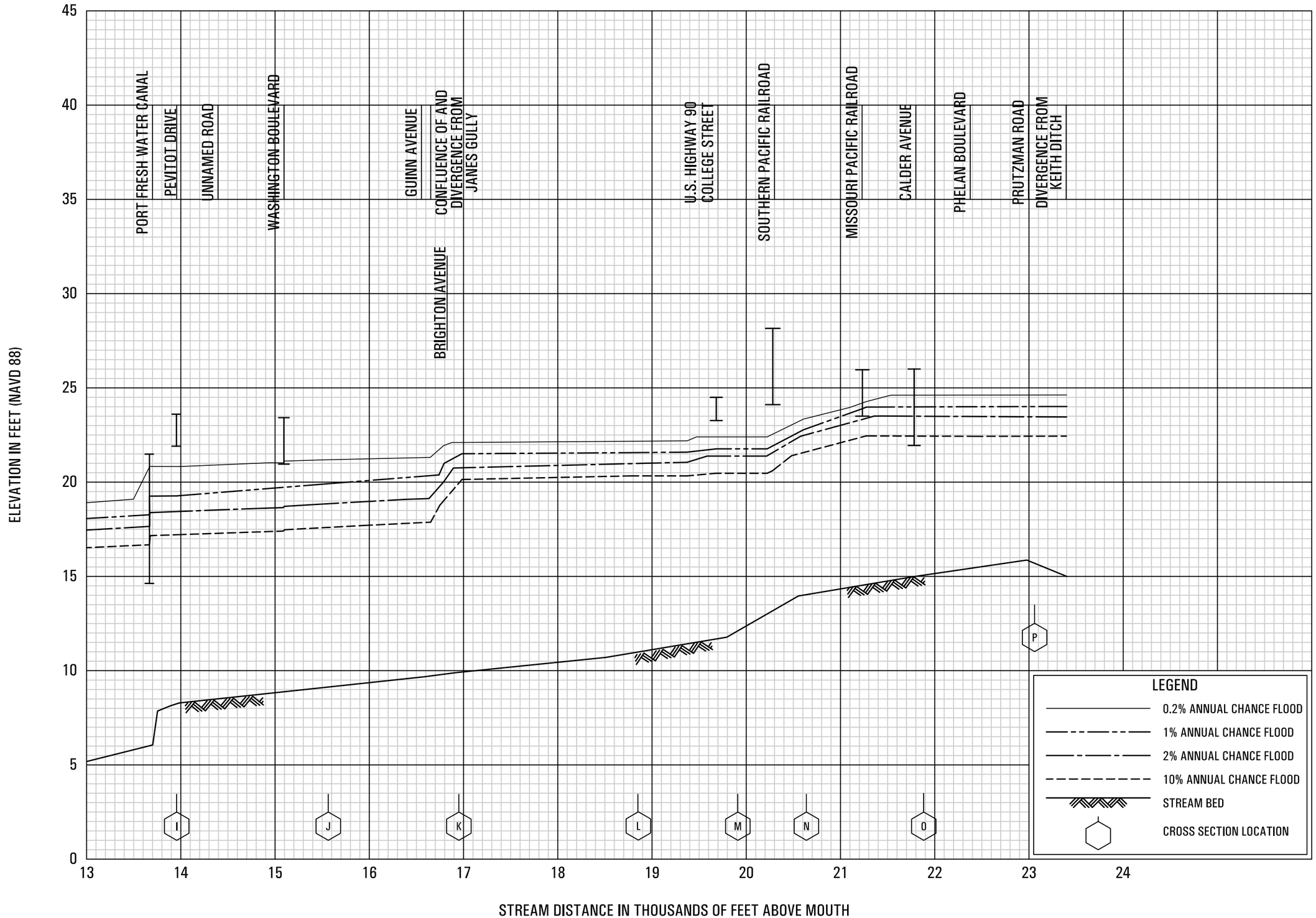

FLOOD PROFILES

AMELIA CUT-OFF

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

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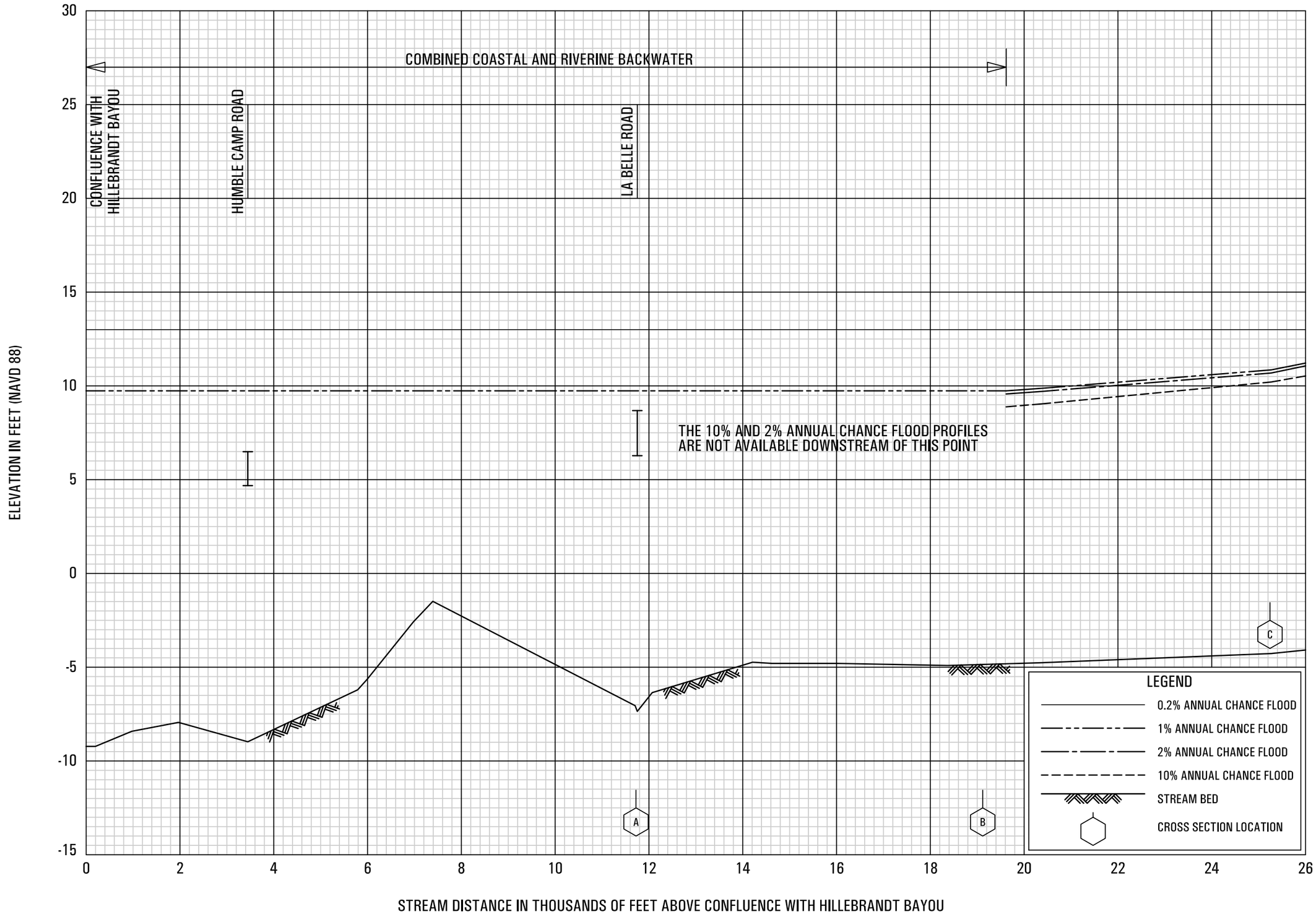


FLOOD PROFILES

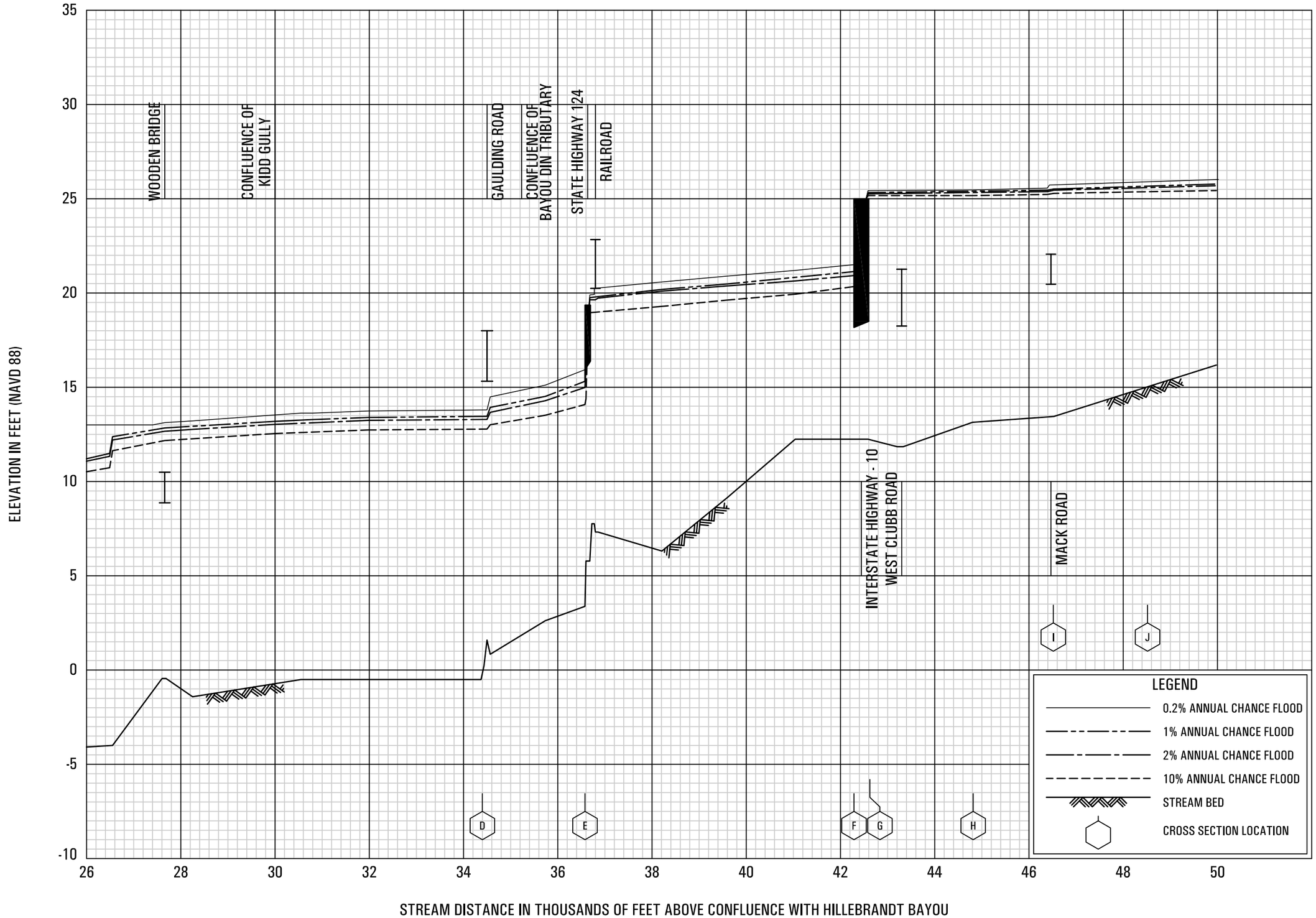
BAYOU DIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

03P



FLOOD PROFILES

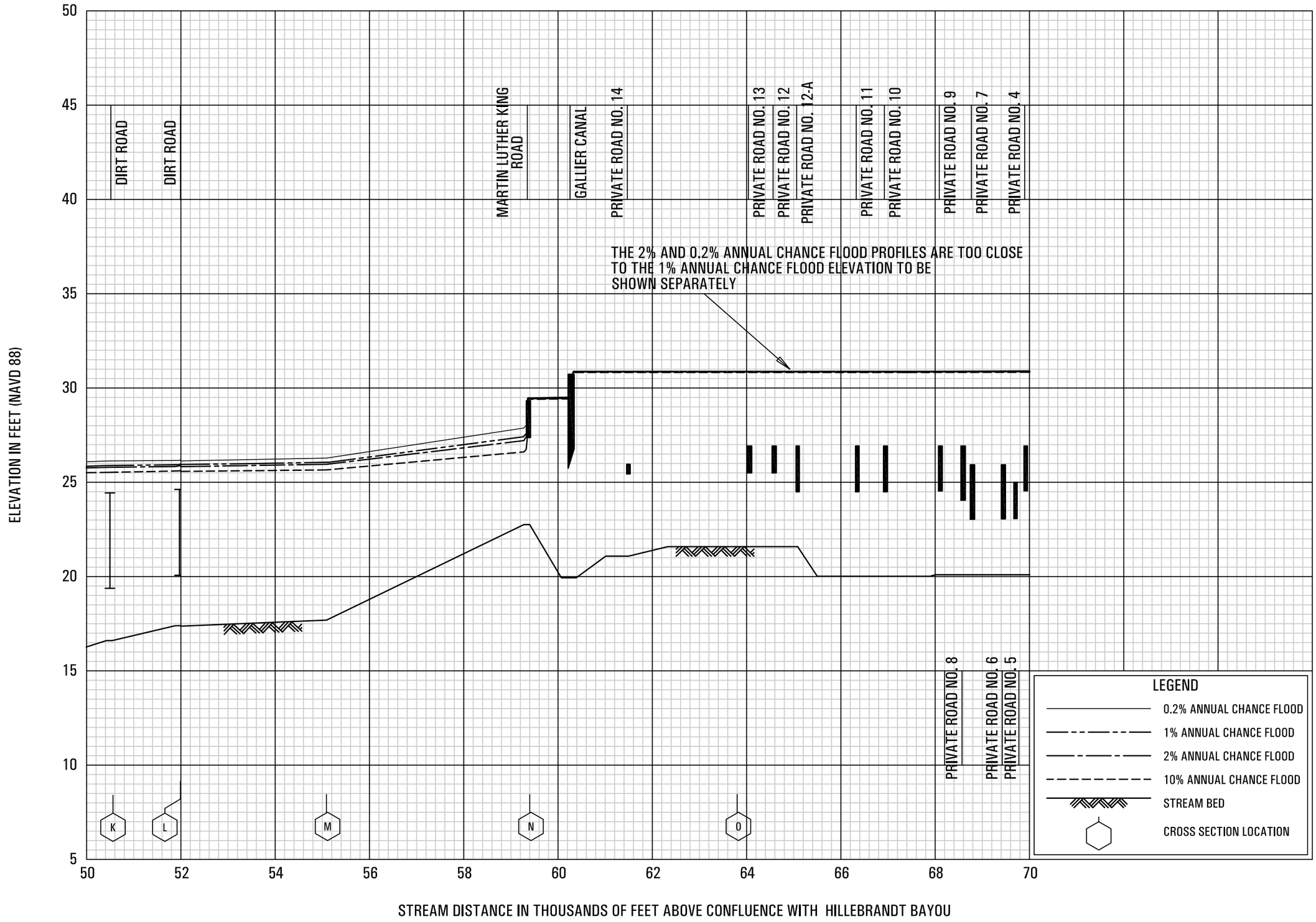
BAYOU DIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

04P



FLOOD PROFILES

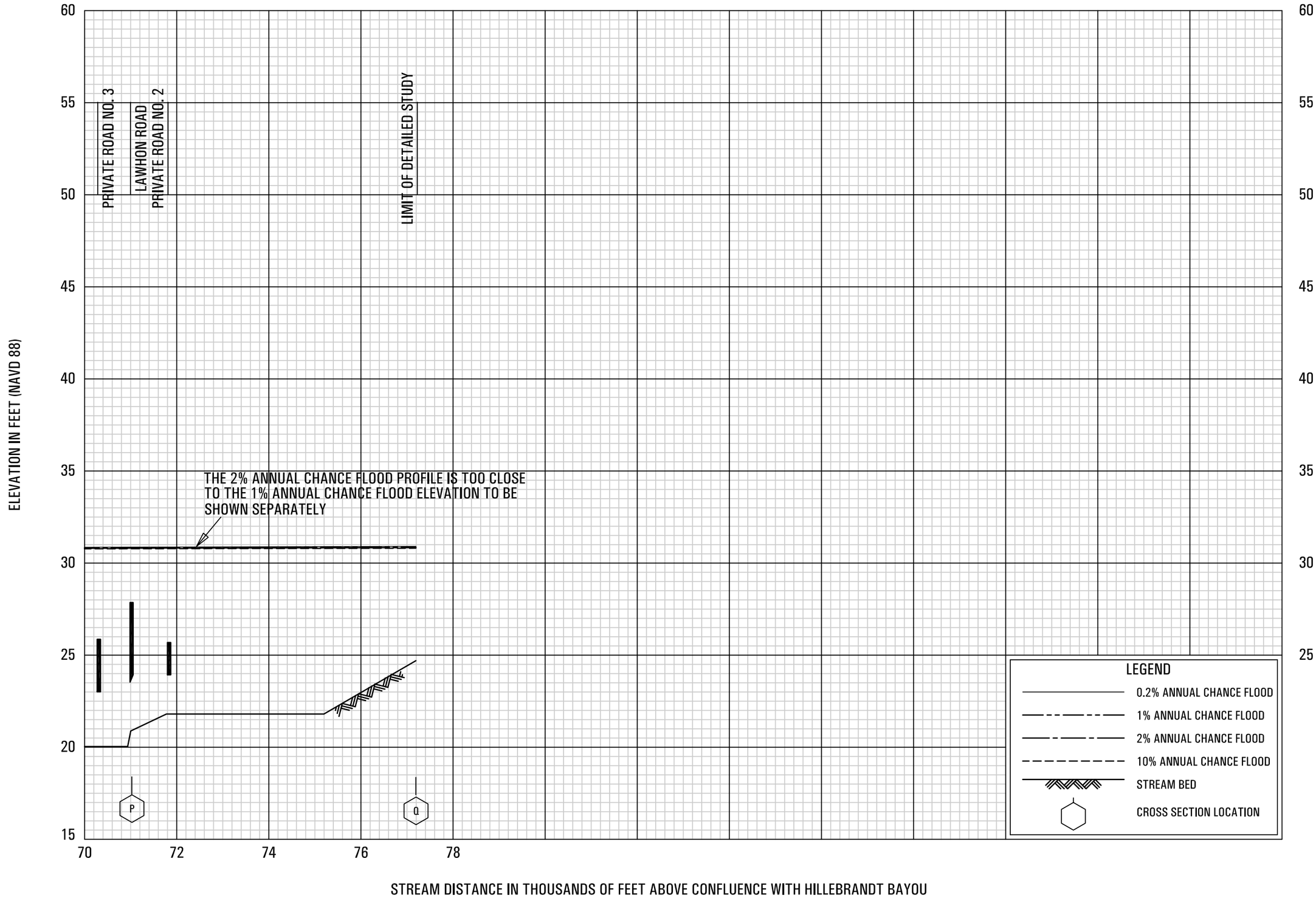
BAYOU DIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

05P



FLOOD PROFILES

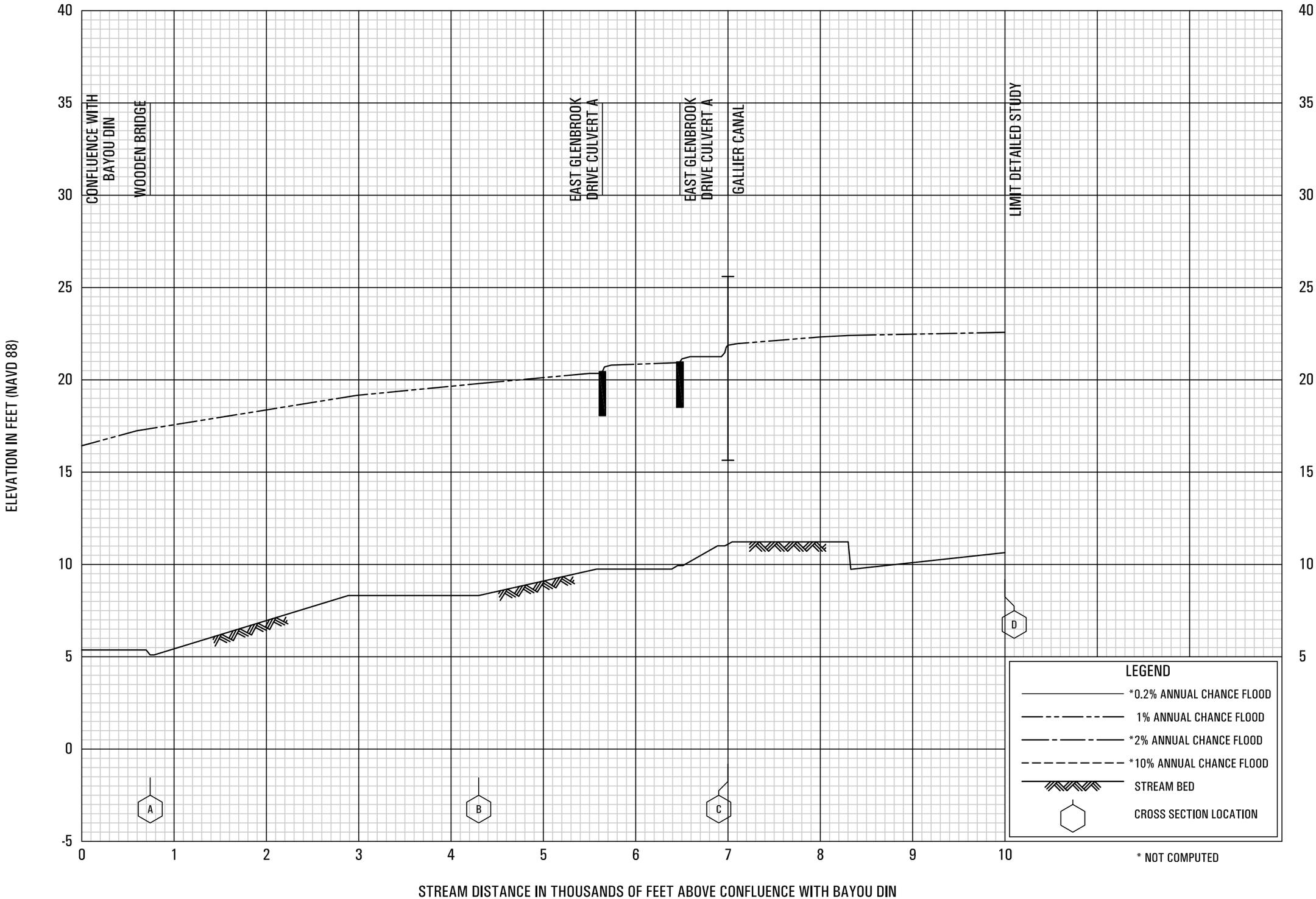
BAYOU DIN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

06P



FLOOD PROFILES

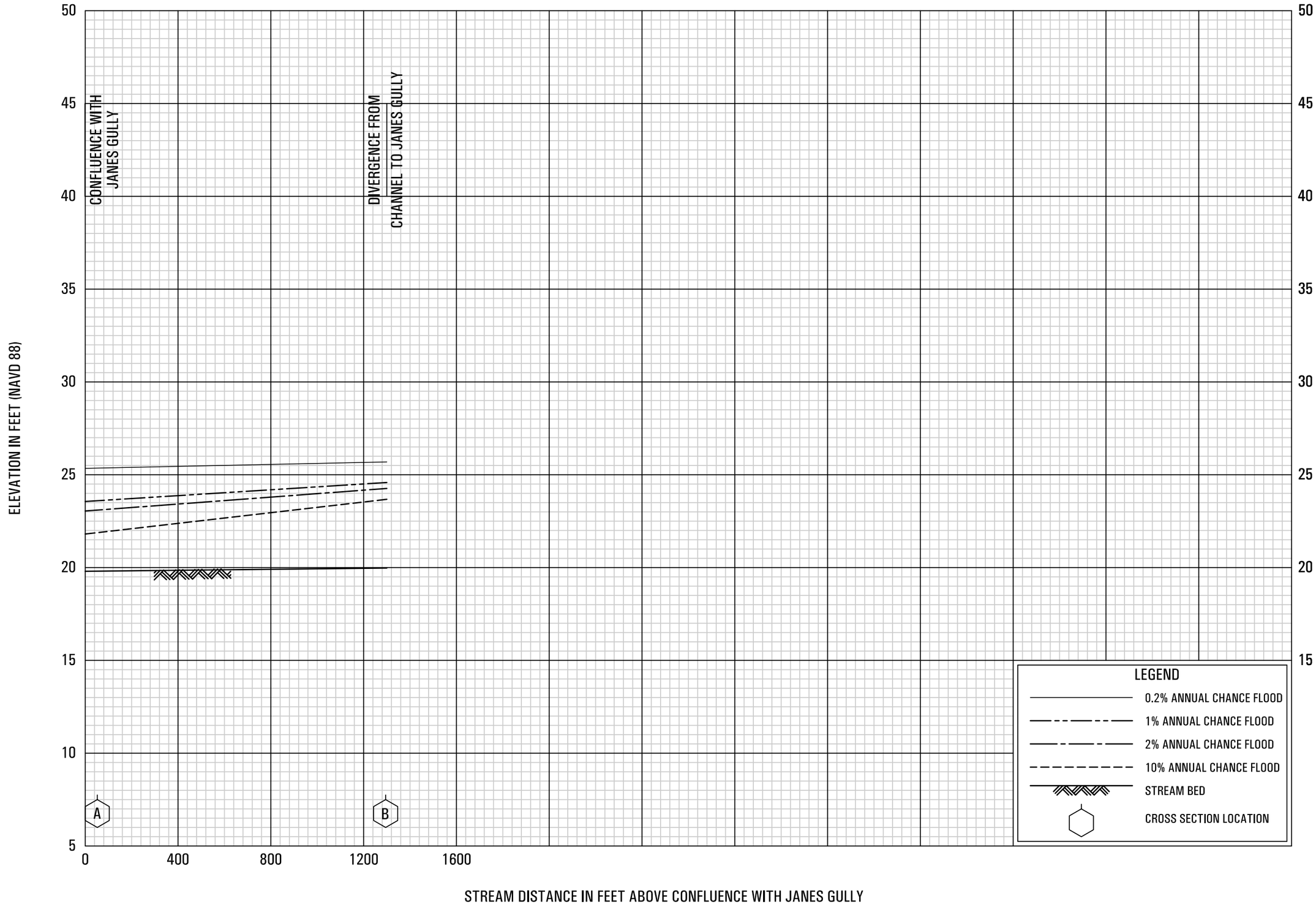
BAYOU DIN TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

07P



FLOOD PROFILES

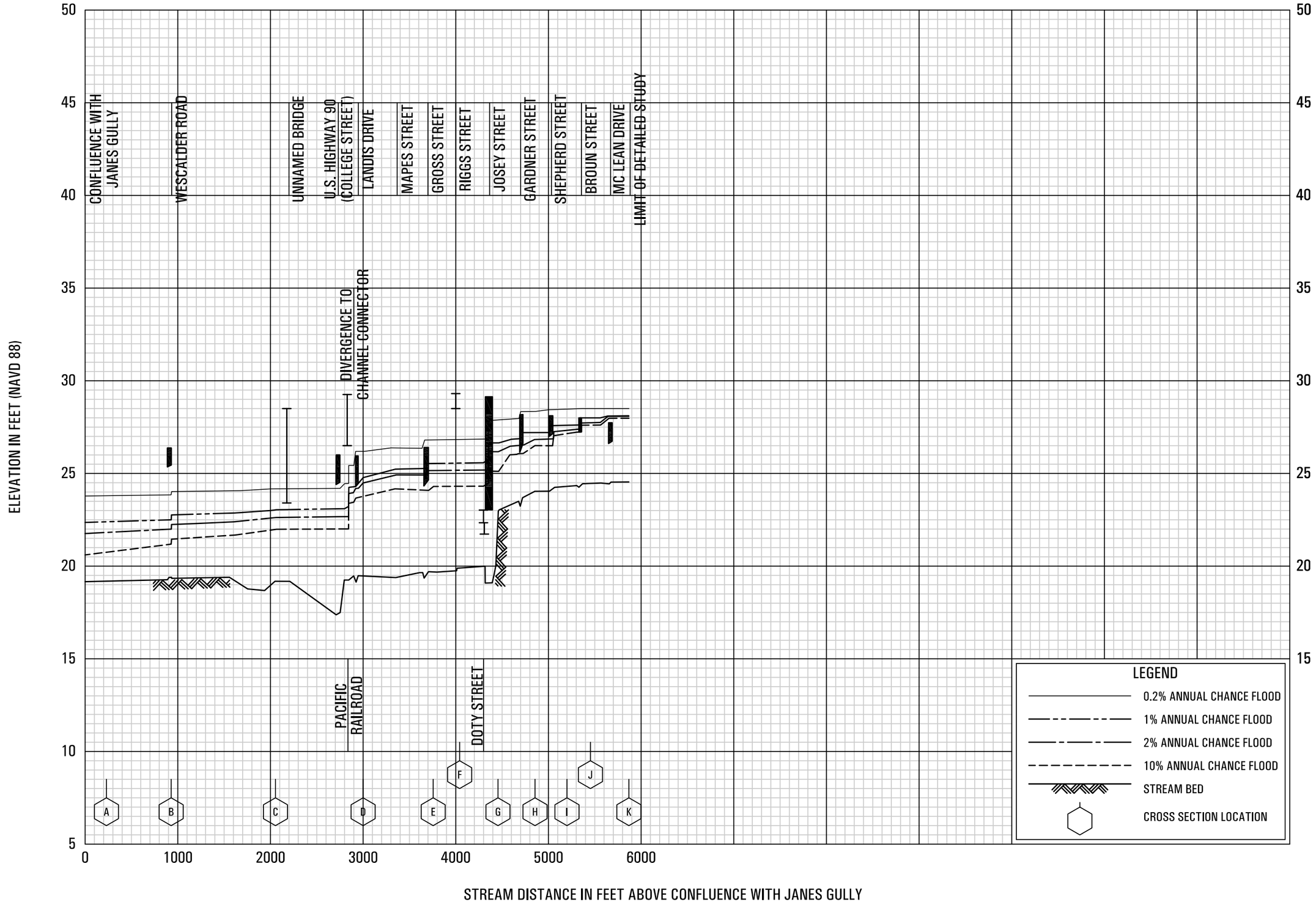
CHANNEL CONNECTOR

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

08P



FLOOD PROFILES

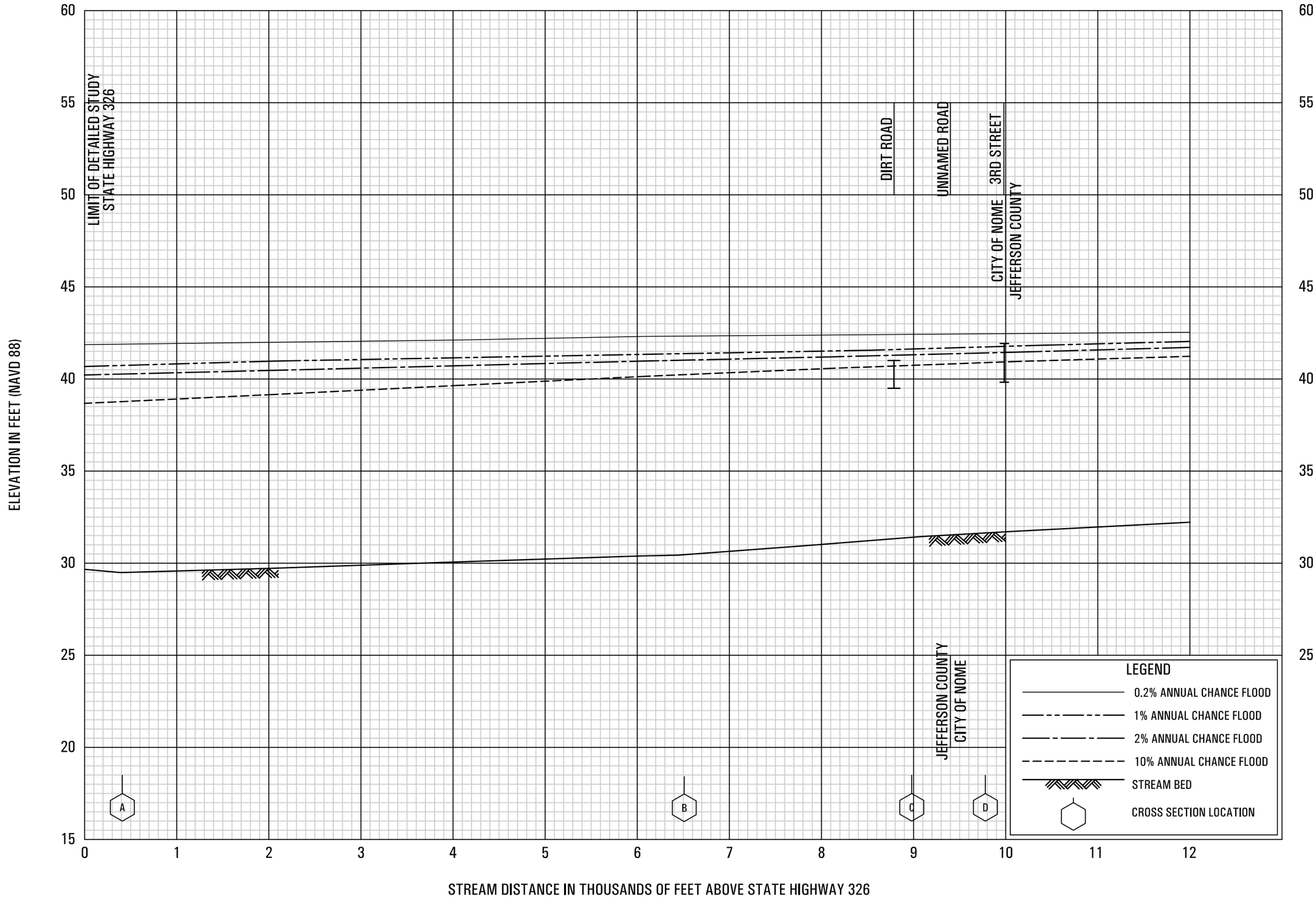
CHANNEL TO JANES GULLY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

09P



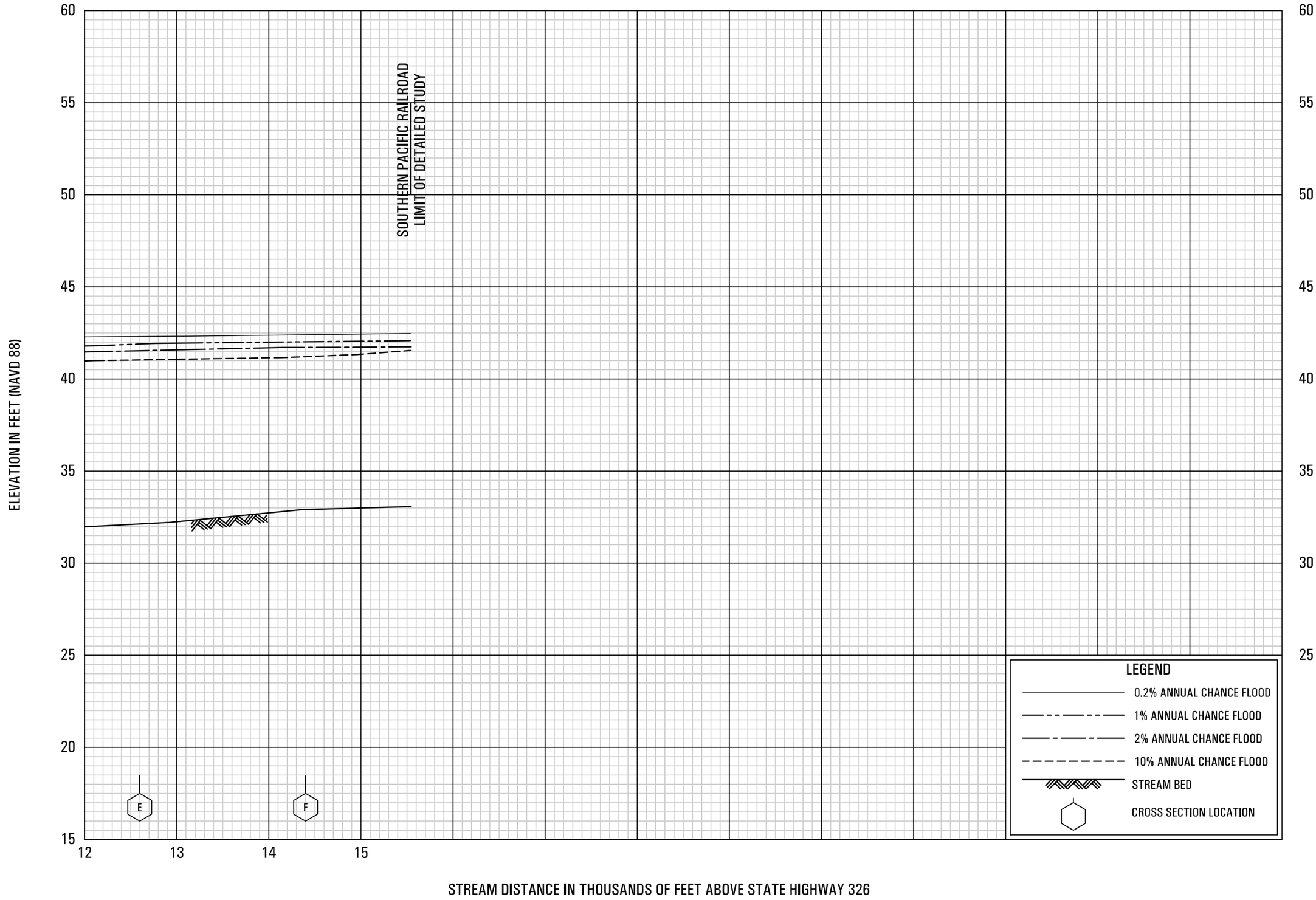
FLOOD PROFILES

COTTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



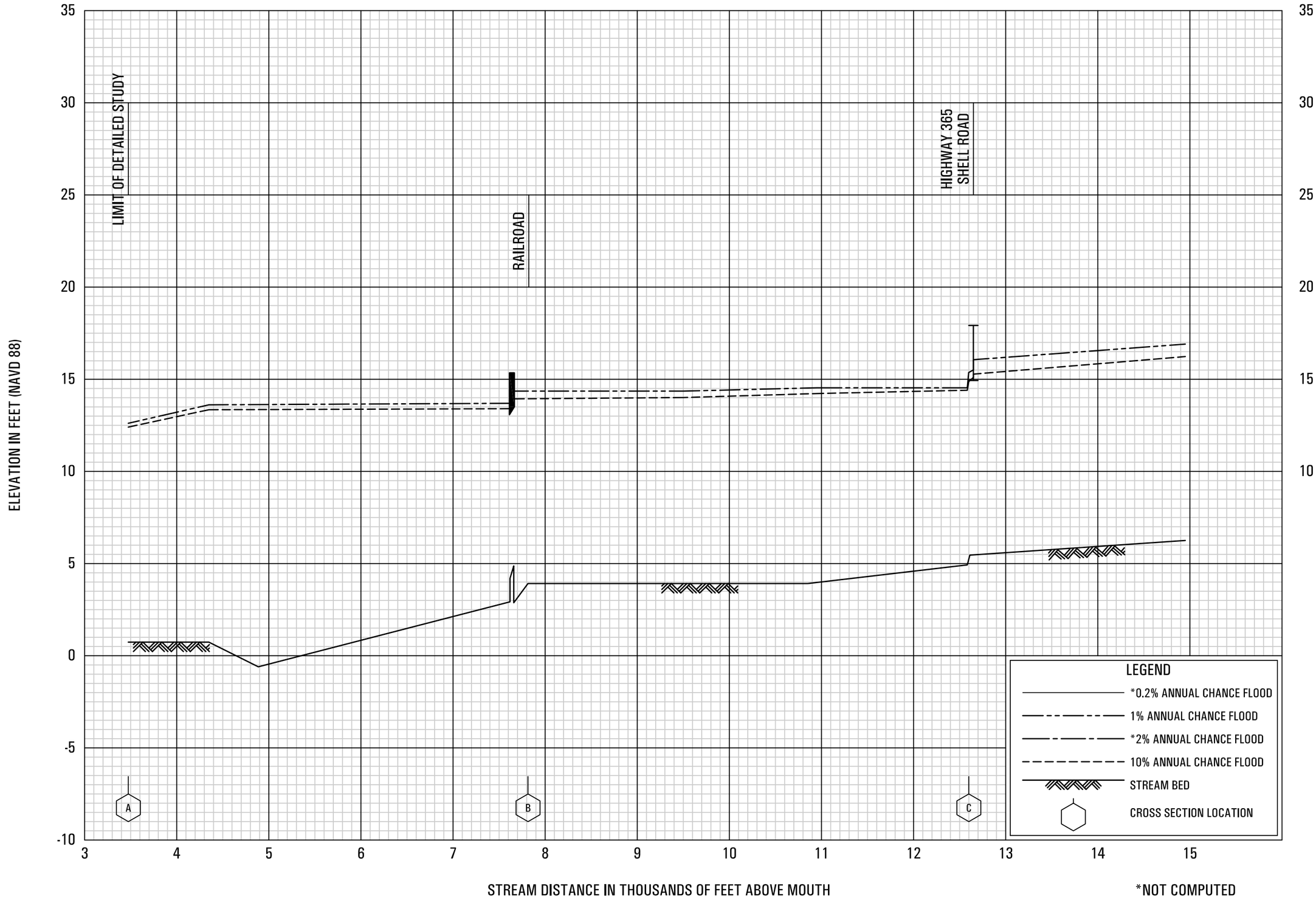
FLOOD PROFILES

COTTON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



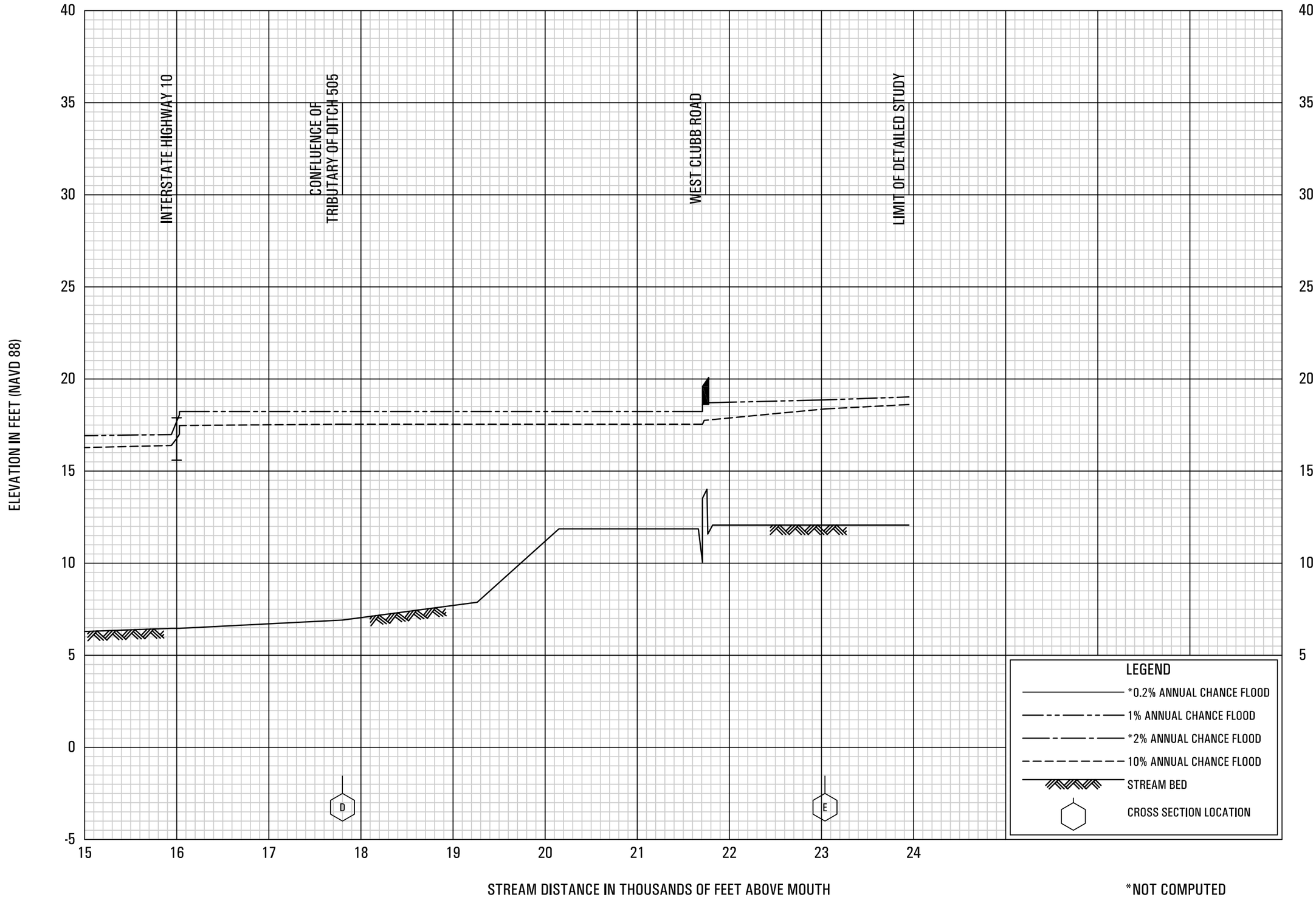
FLOOD PROFILES

DITCH 505

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



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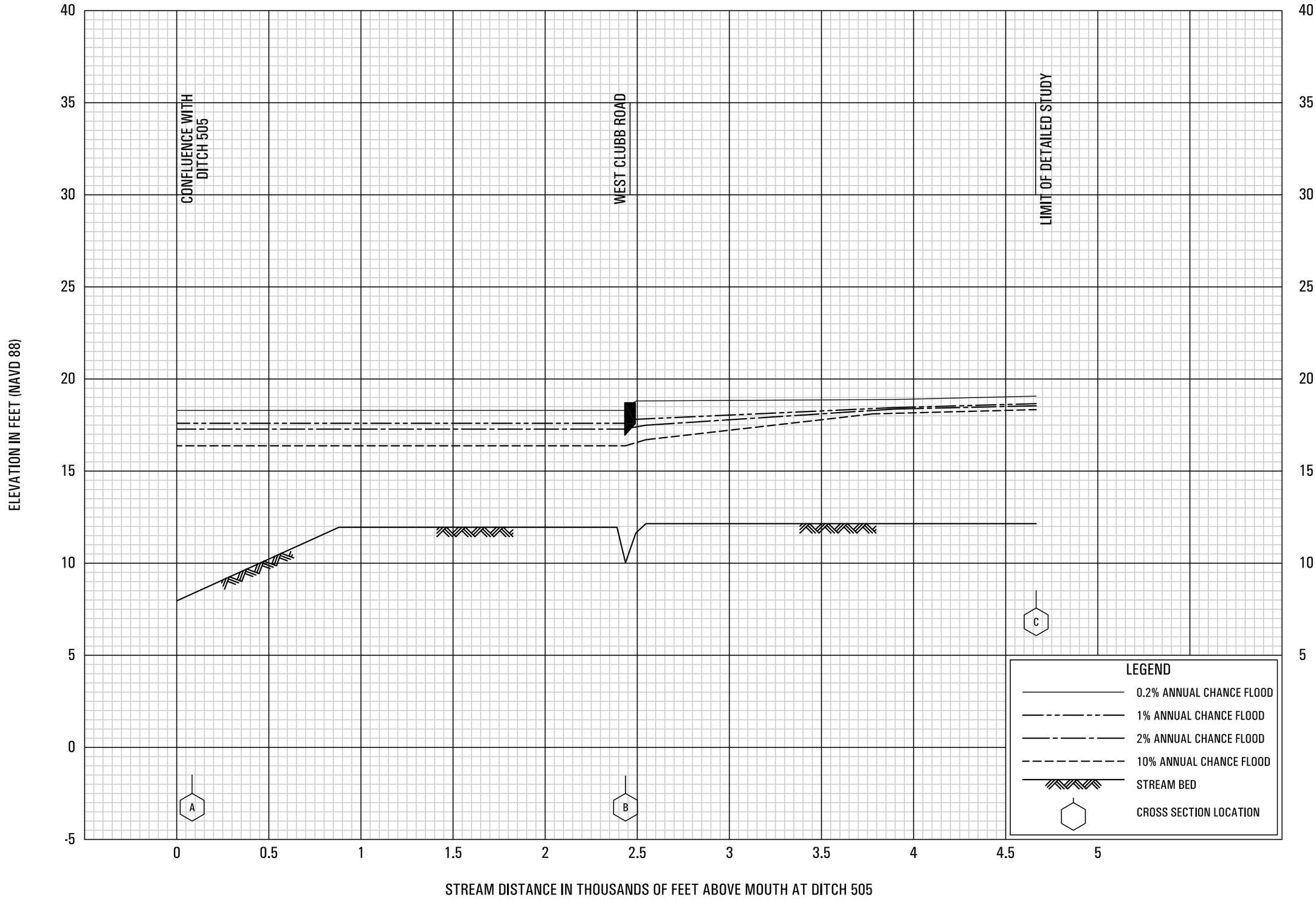
FLOOD PROFILES

DITCH 505

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



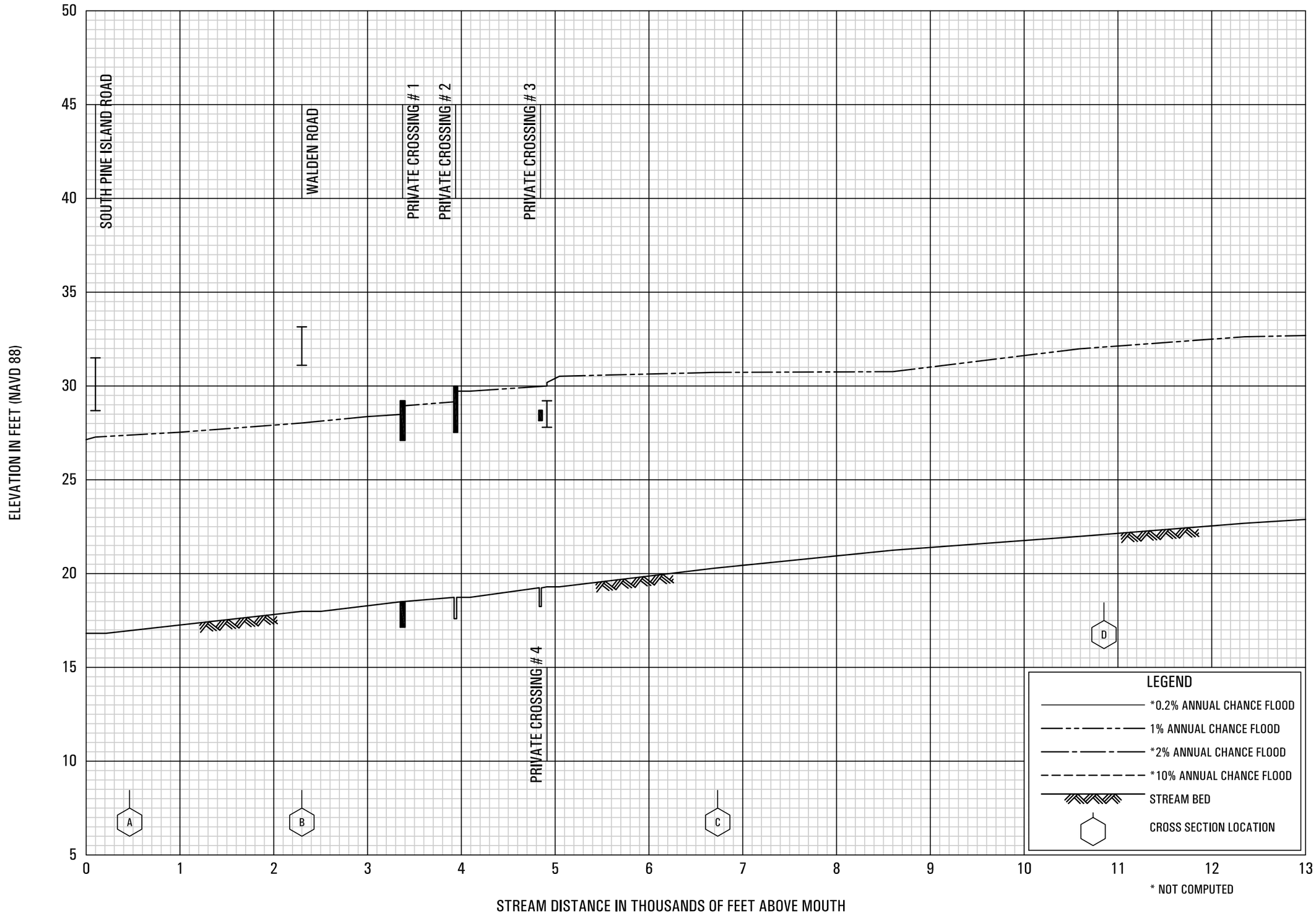
FLOOD PROFILES

DITCH 505 TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



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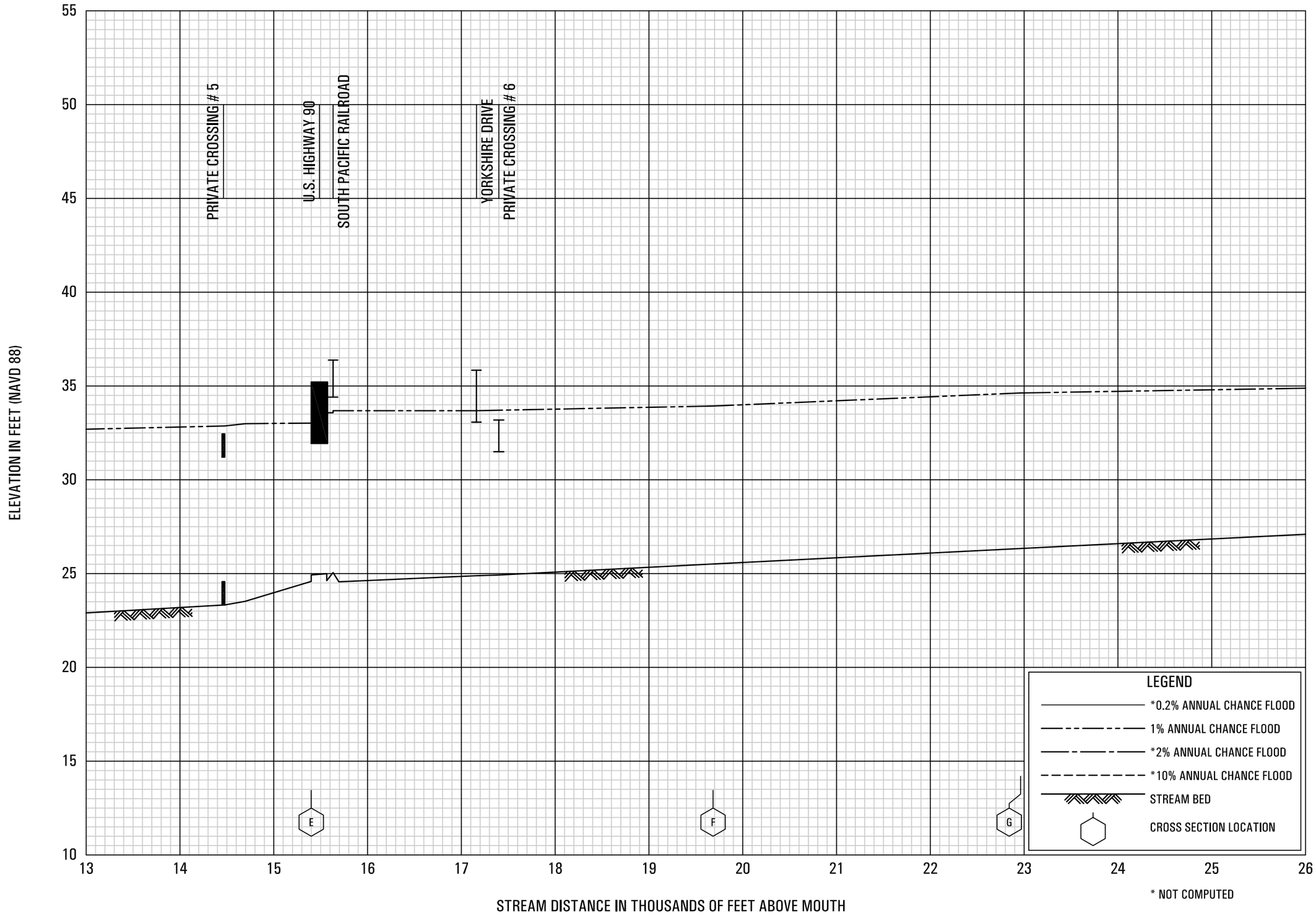
FLOOD PROFILES

GREEN POND GULLY (DITCH 607)

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



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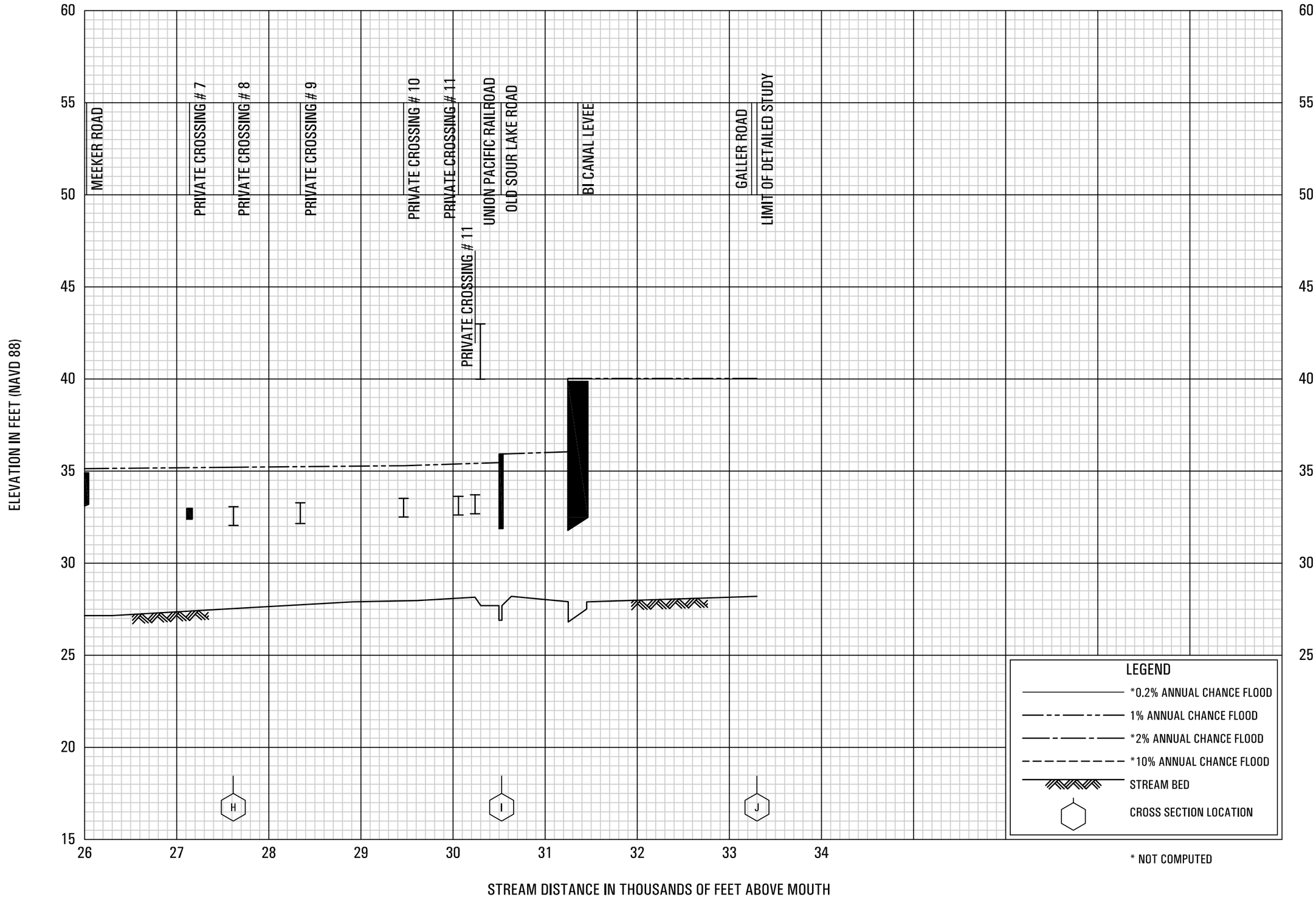
FLOOD PROFILES

GREEN POND GULLY (DITCH 607)

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



FLOOD PROFILES

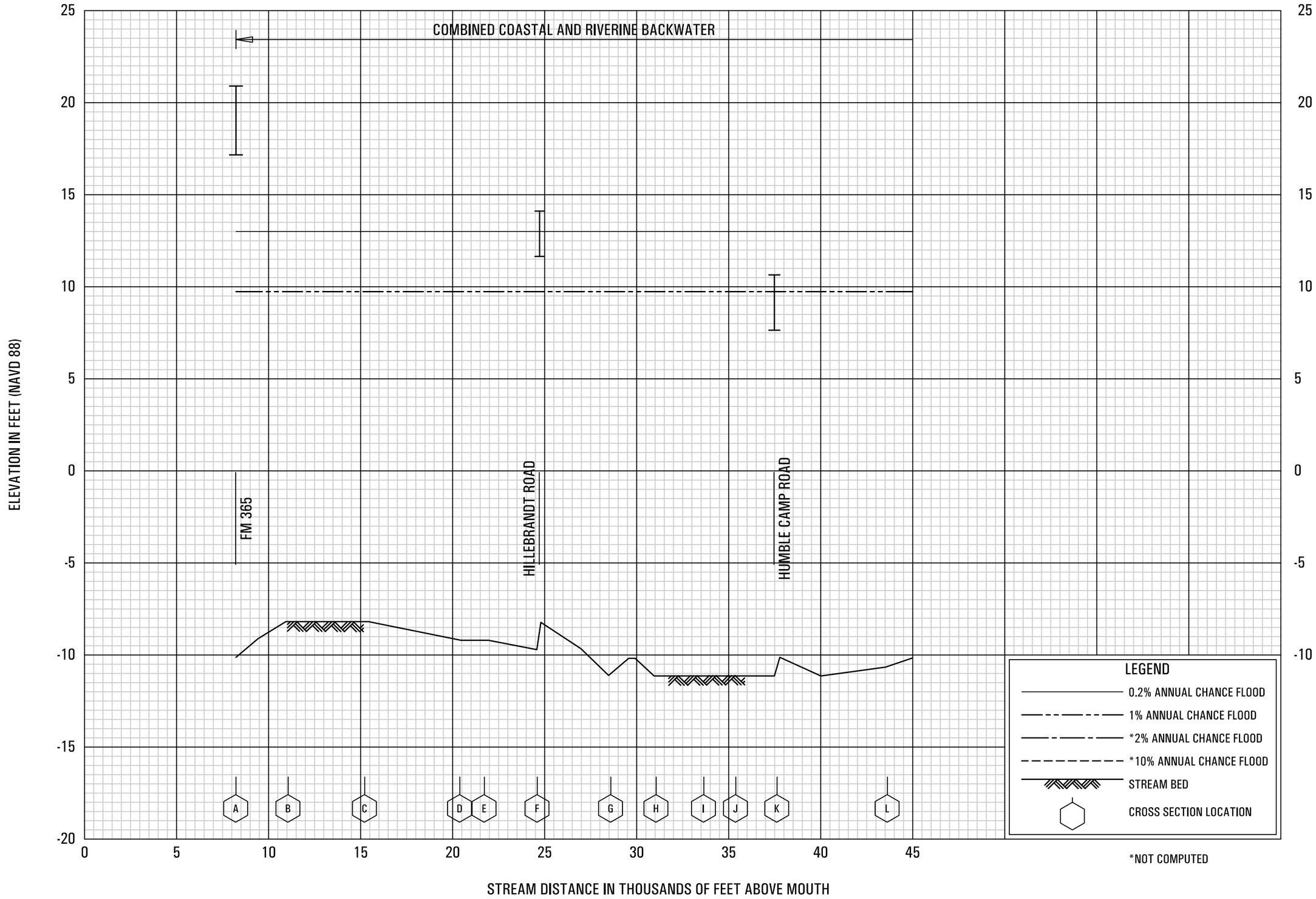
GREEN POND GULLY (DITCH 607)

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

17P



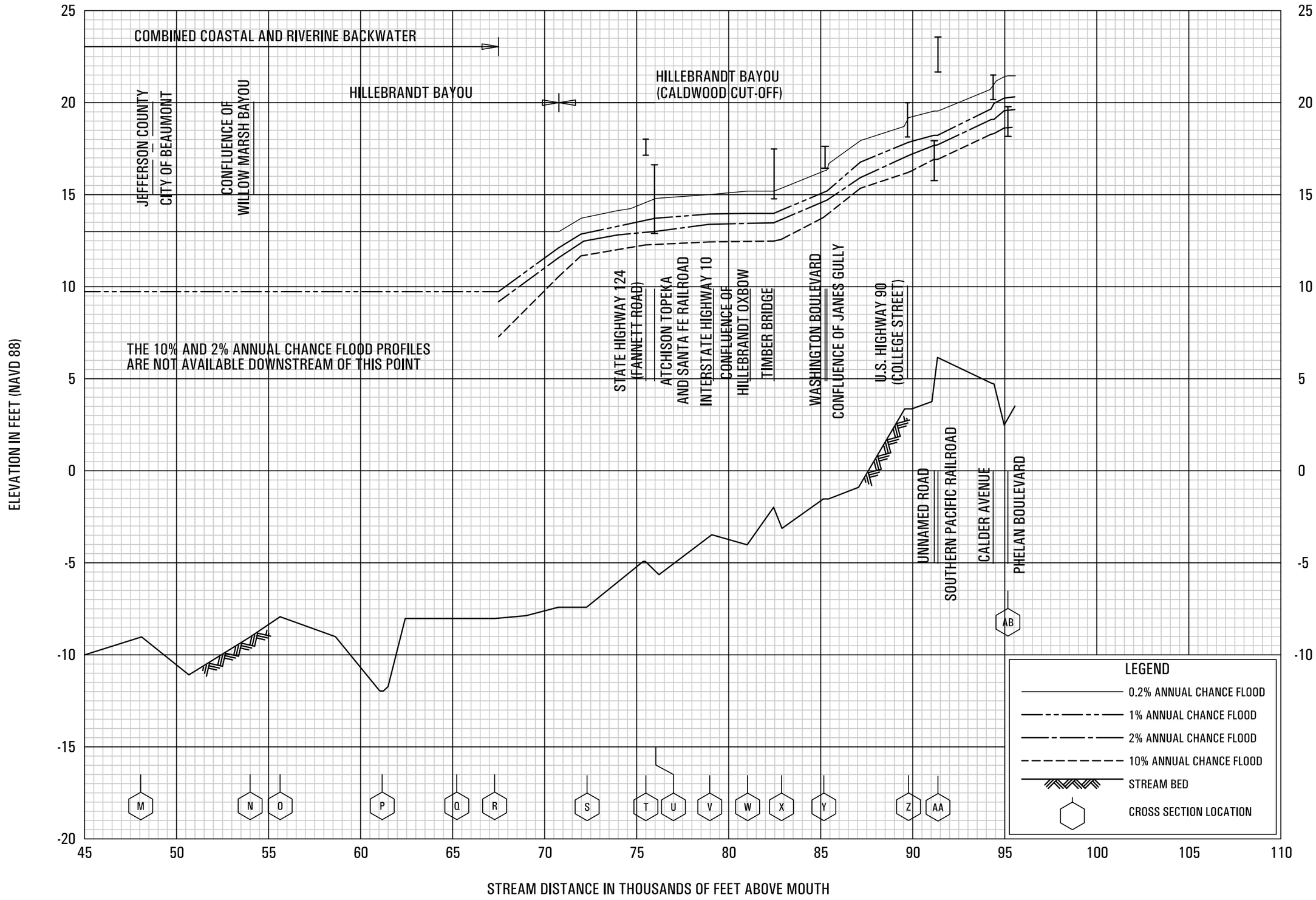
FLOOD PROFILES

HILLEBRANDT BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



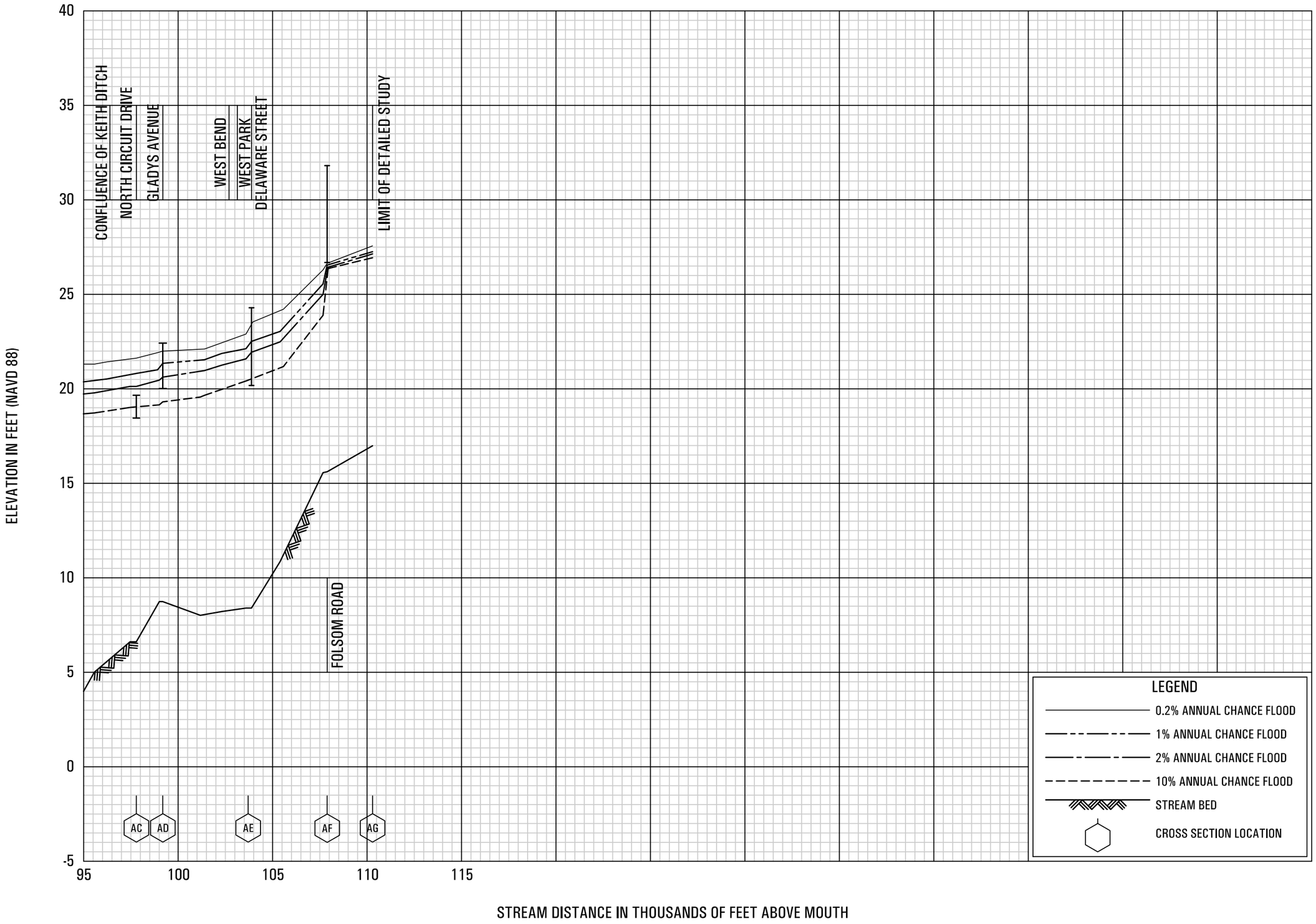
FLOOD PROFILES

HILLEBRANDT BAYOU AND HILLEBRANDT BAYOU (CALDWOOD CUT-OFF)

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



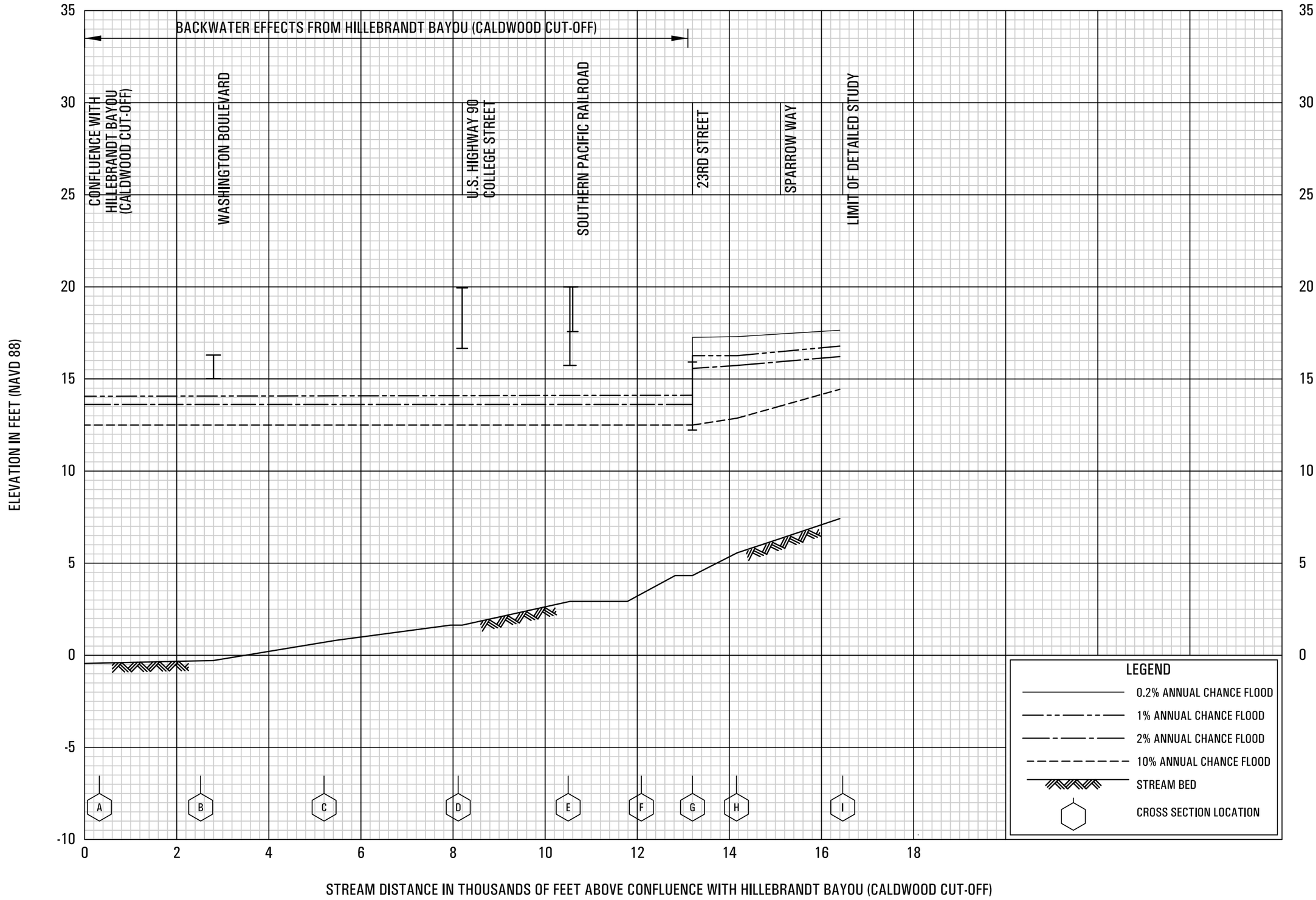
FLOOD PROFILES

HILLEBRANDT BAYOU (CALDWOOD CUT-OFF)

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



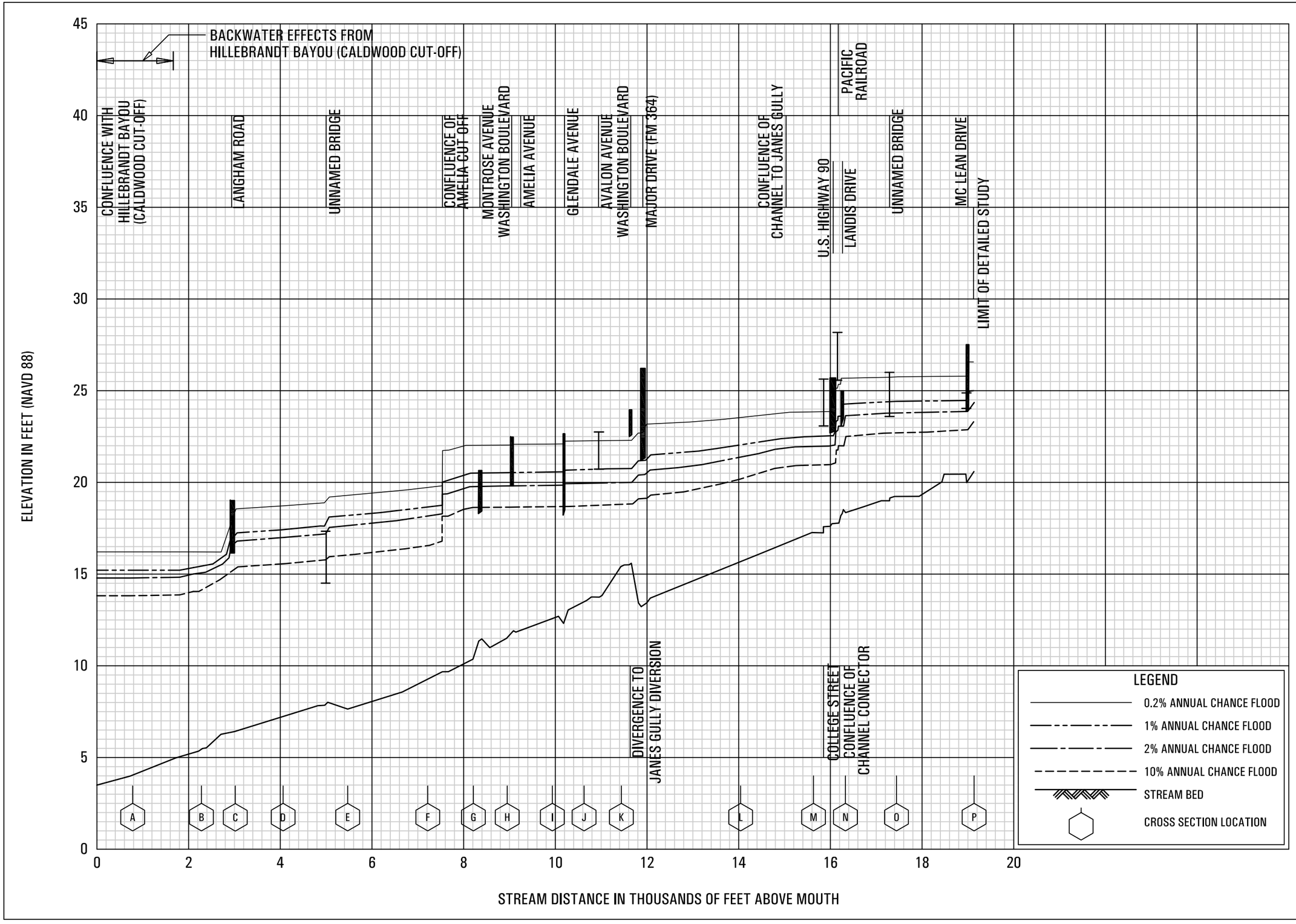
FLOOD PROFILES

HILLEBRANDT OXBOW

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



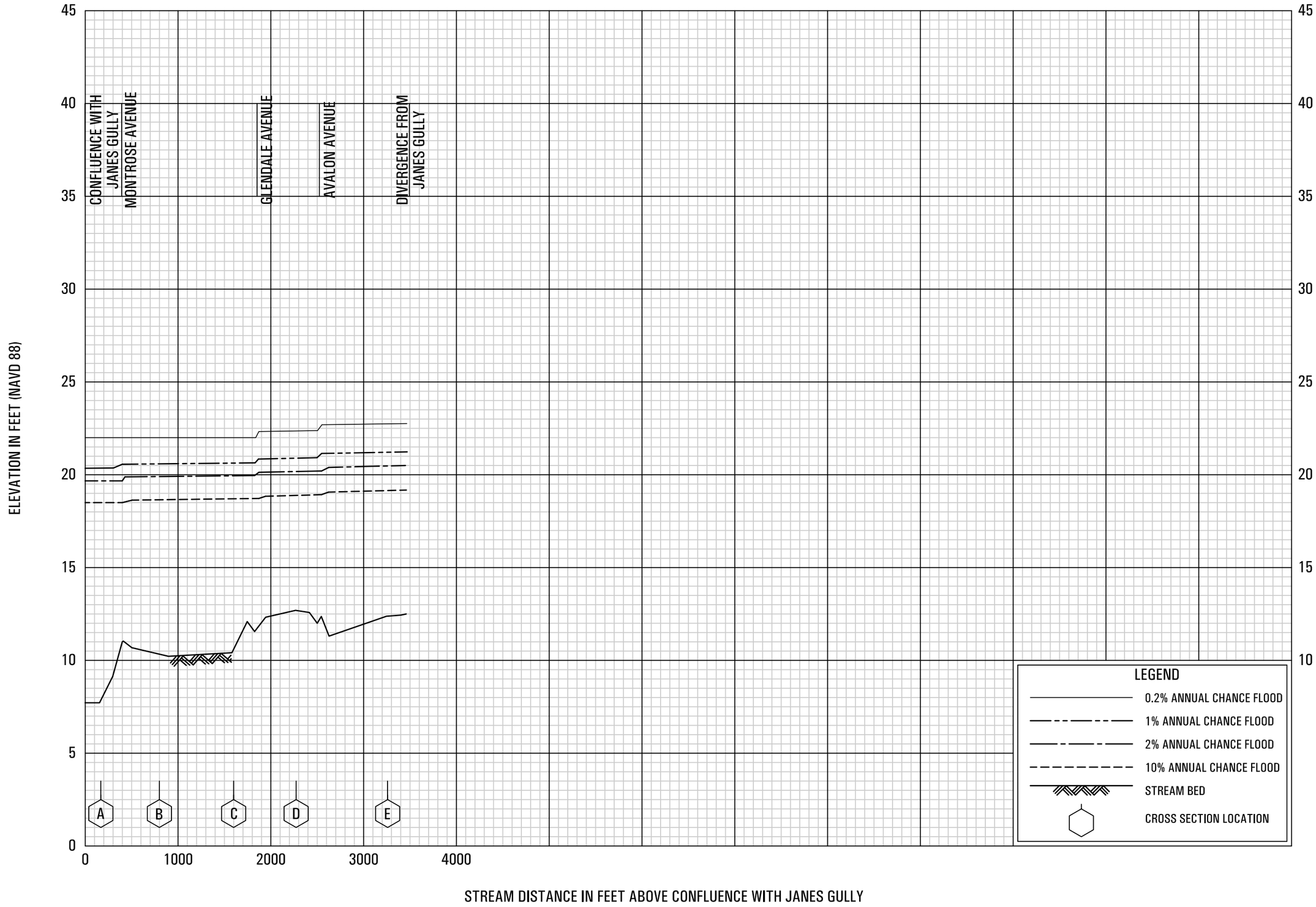
FLOOD PROFILES

JANES GULLY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



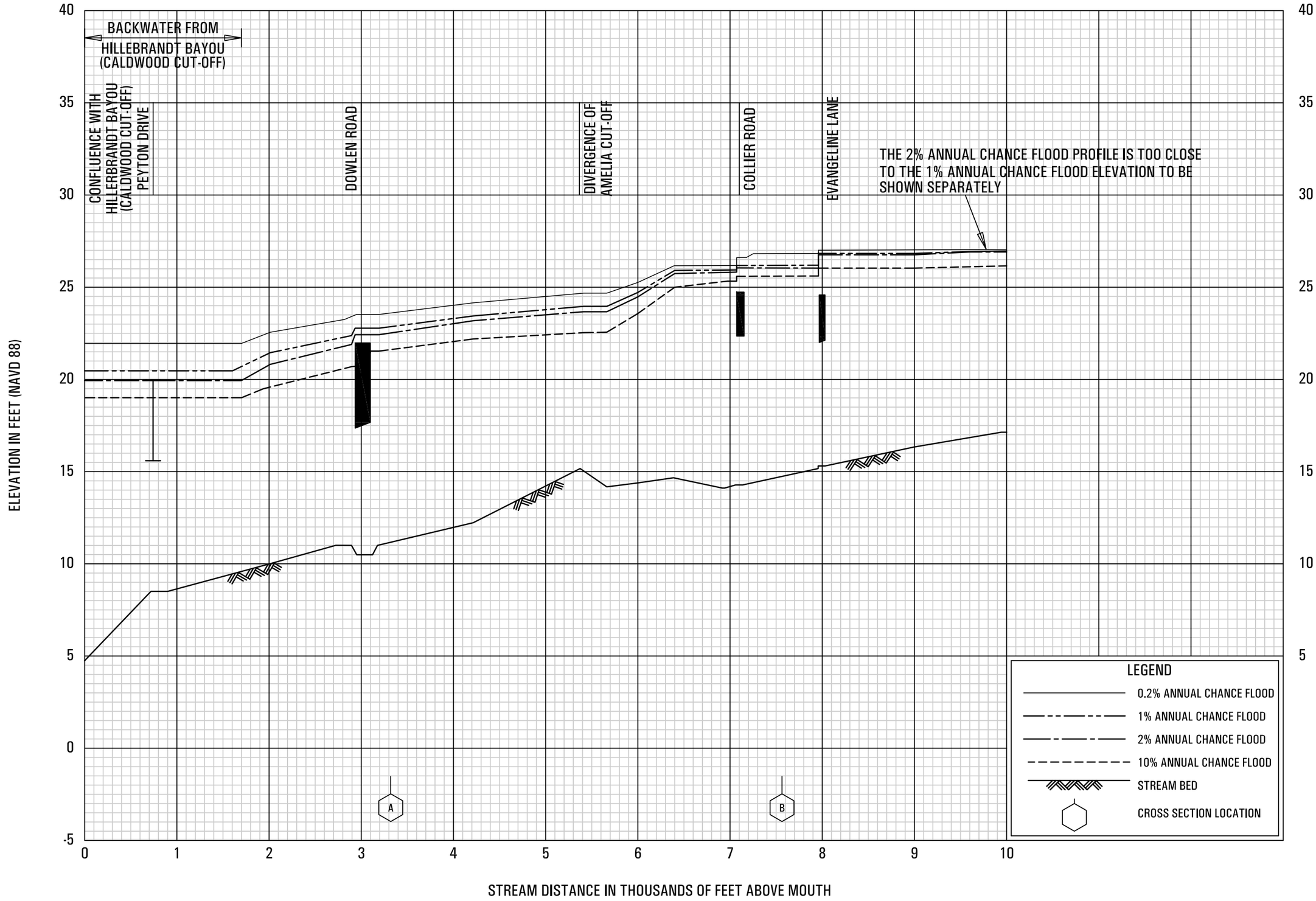
FLOOD PROFILES

JANES GULLY DIVERSION

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



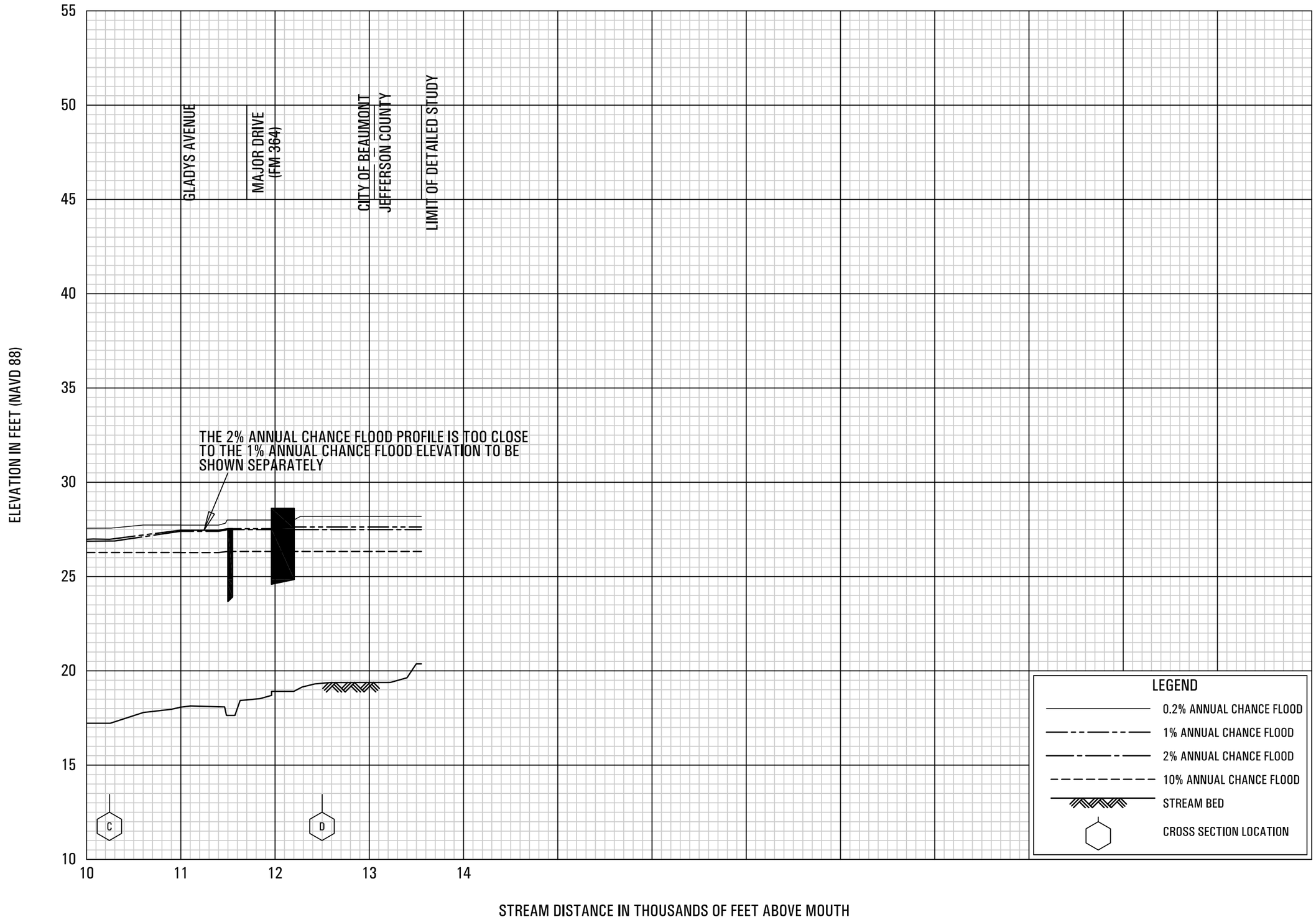
FLOOD PROFILES

KEITH DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



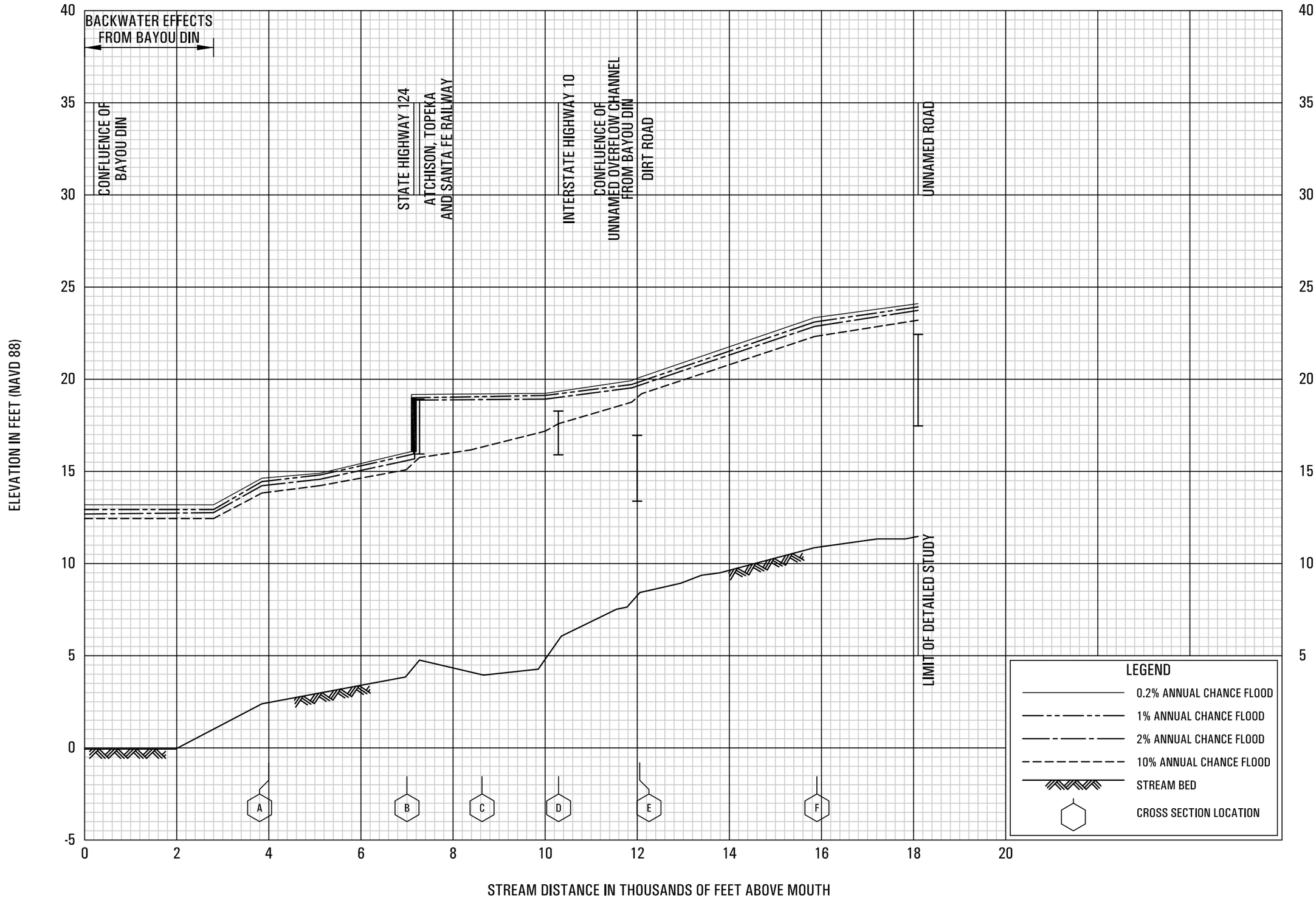
FLOOD PROFILES

KEITH DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



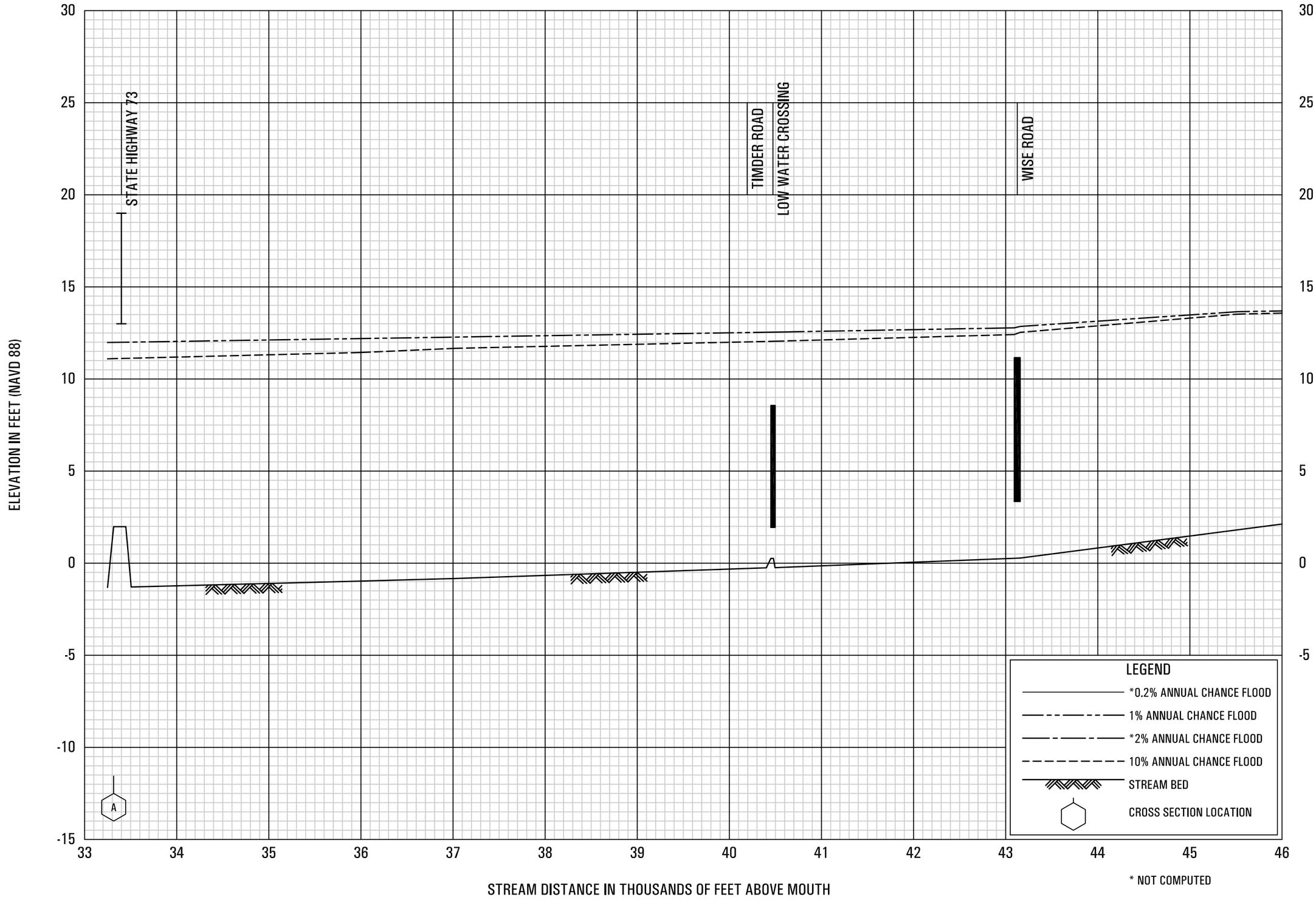
FLOOD PROFILES

KIDD GULLY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



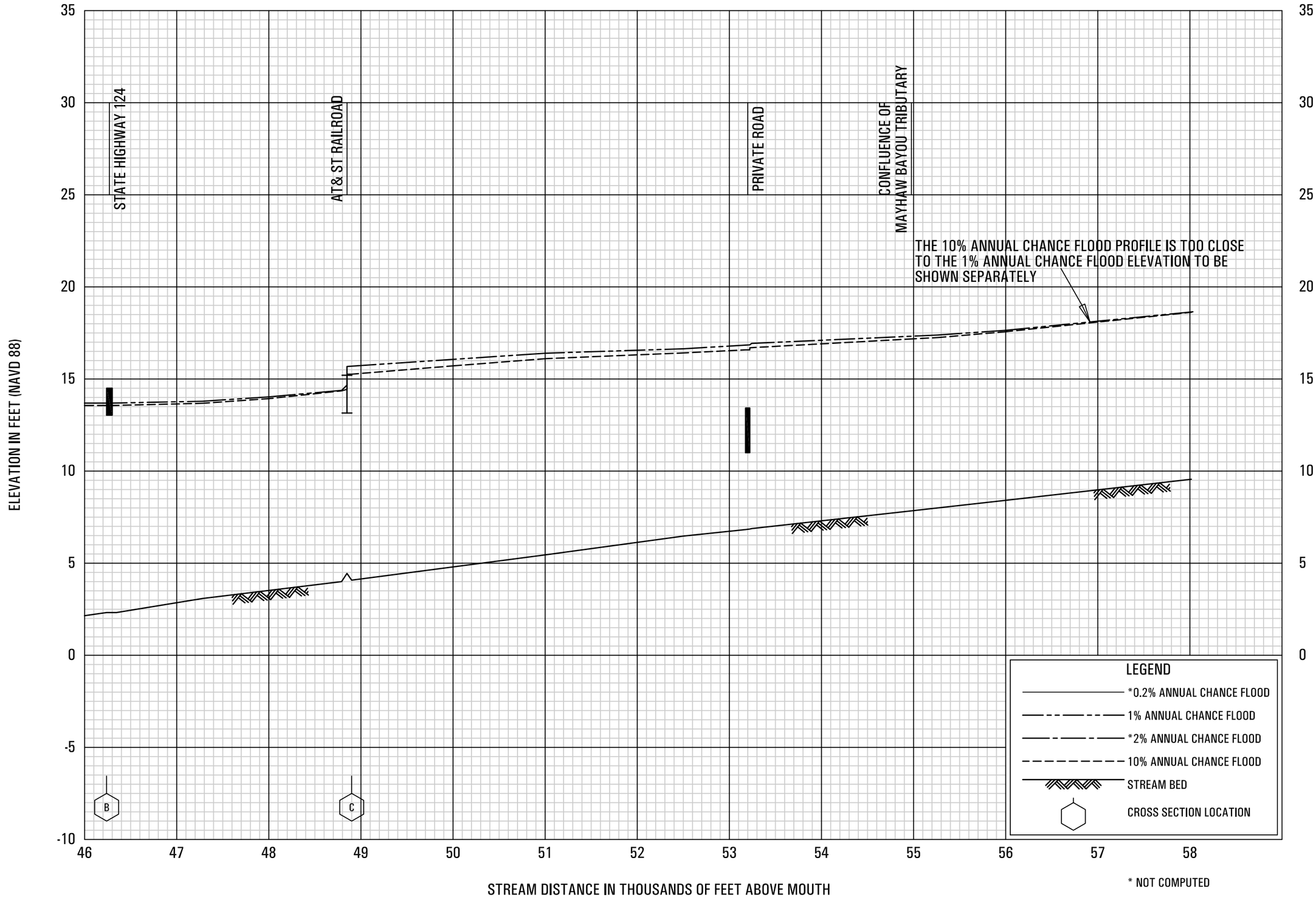
FLOOD PROFILES

MAYHAW BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



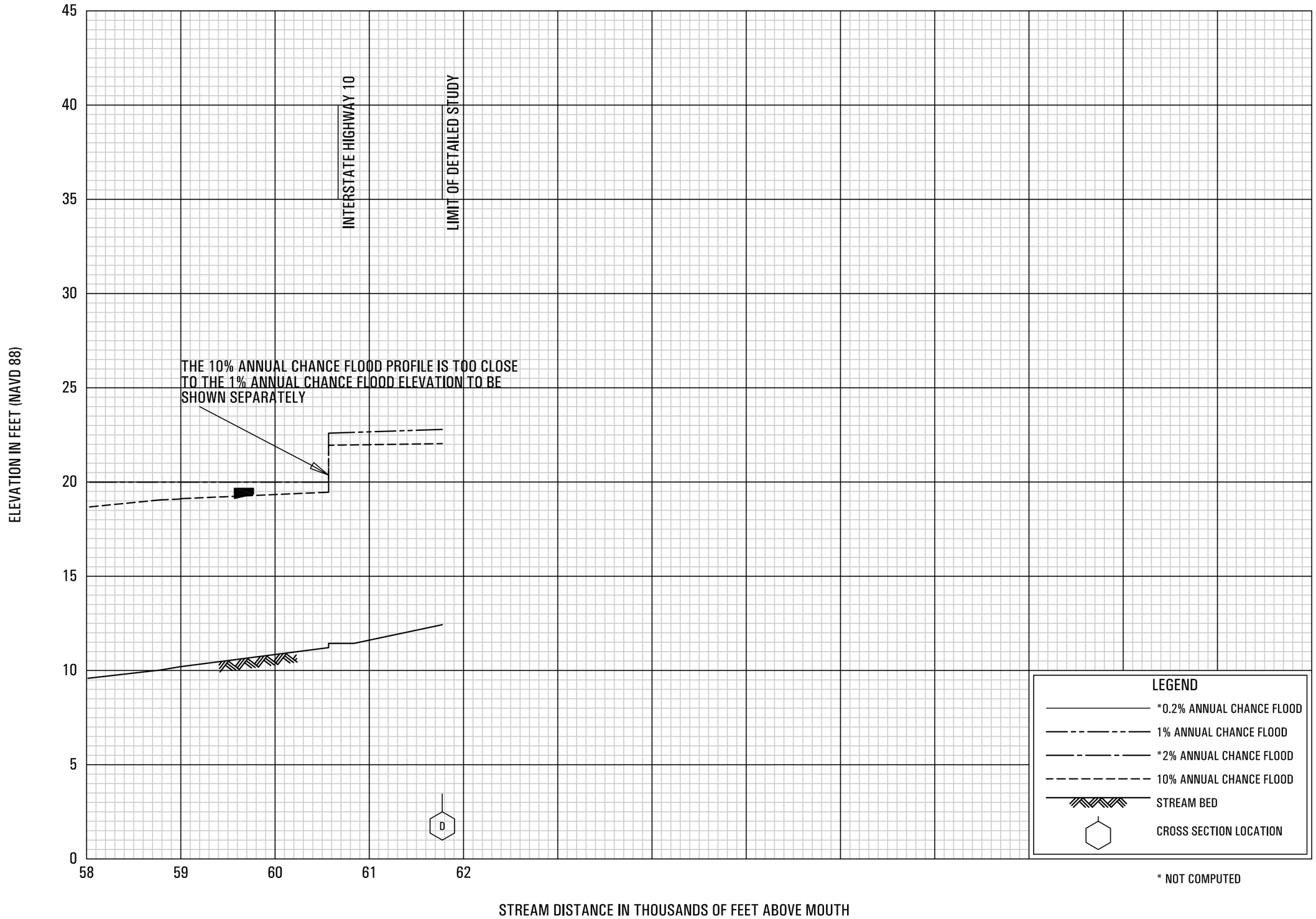
FLOOD PROFILES

MAYHAW BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



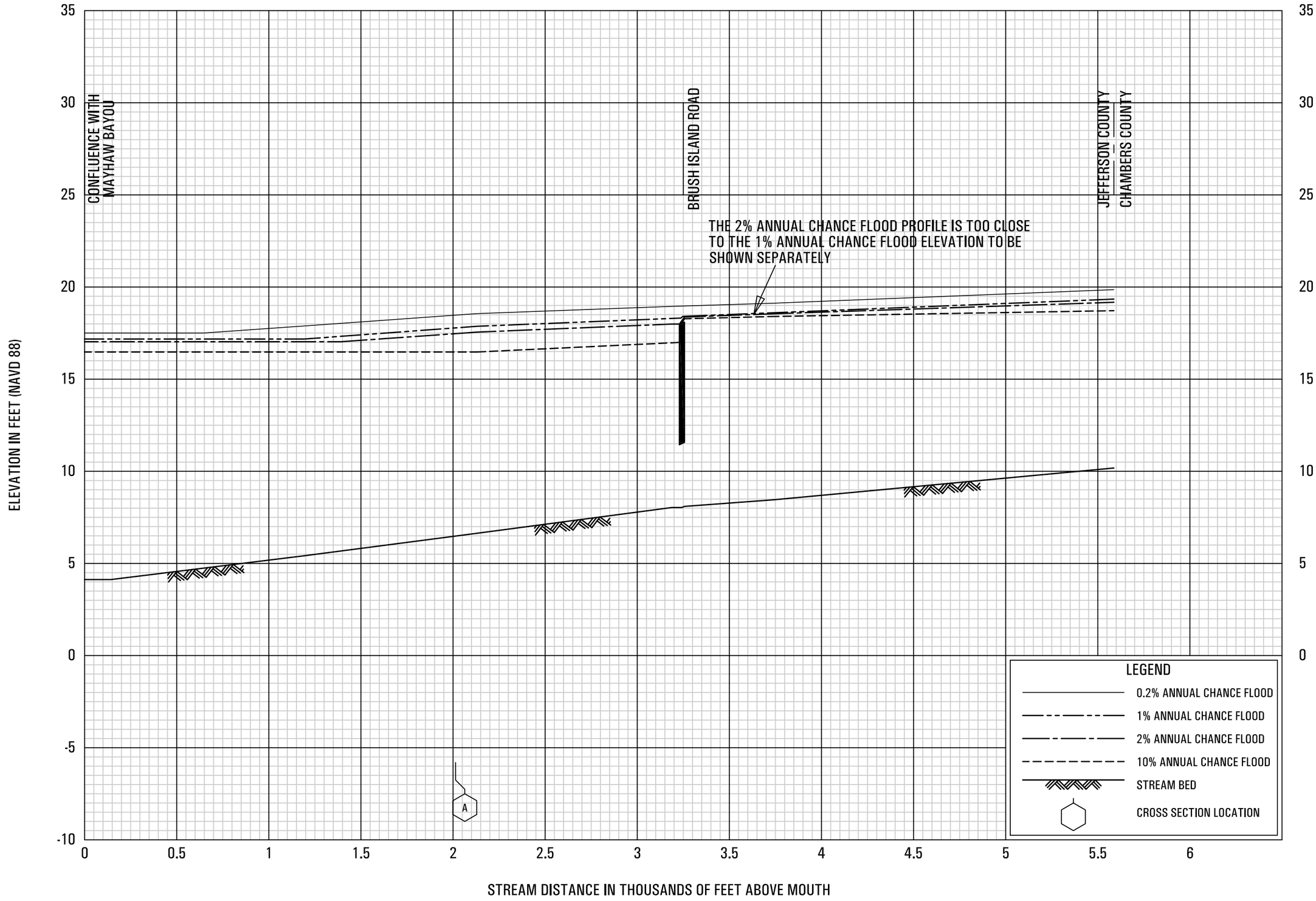
FLOOD PROFILES

MAYHAW BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



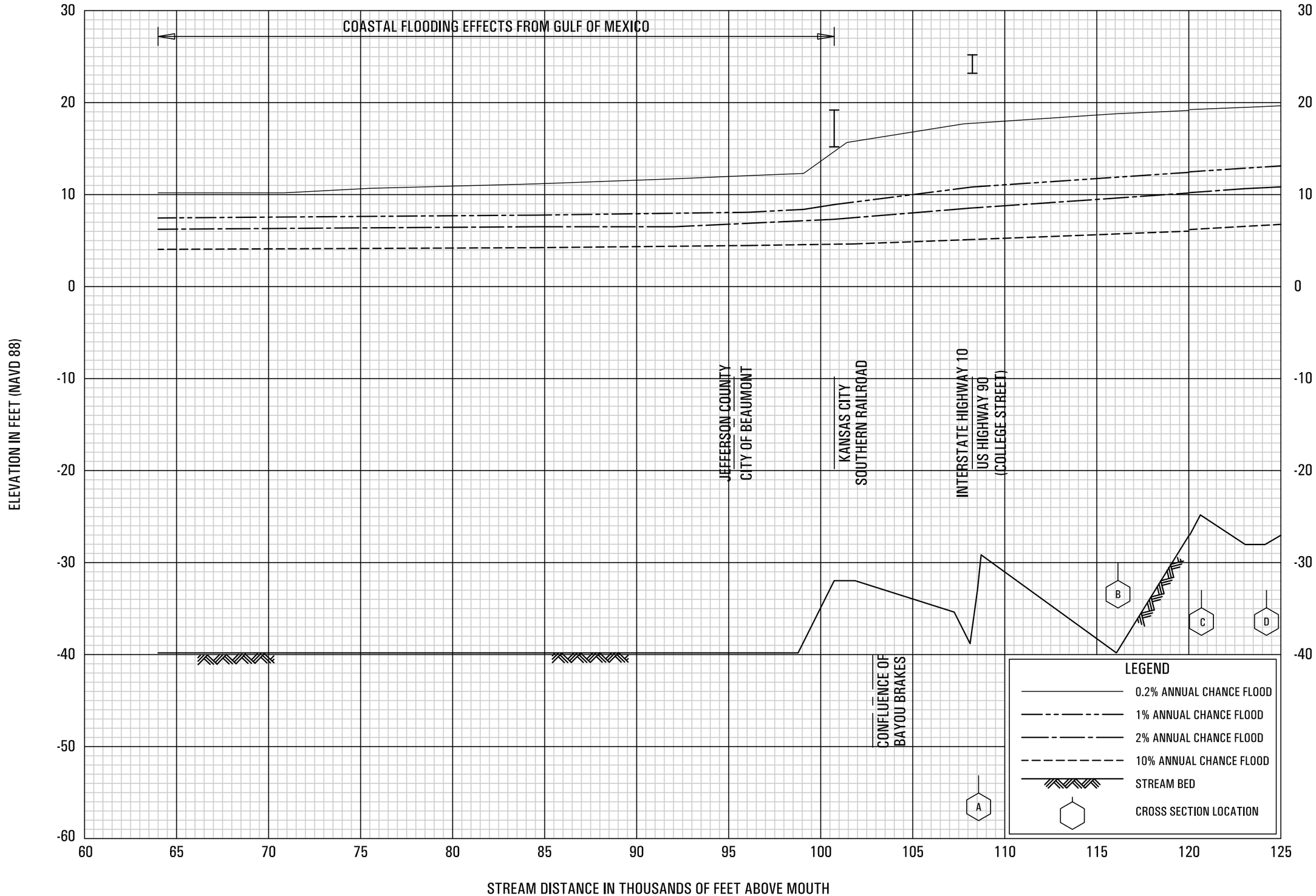
FLOOD PROFILES

MAYHAW BAYOU TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



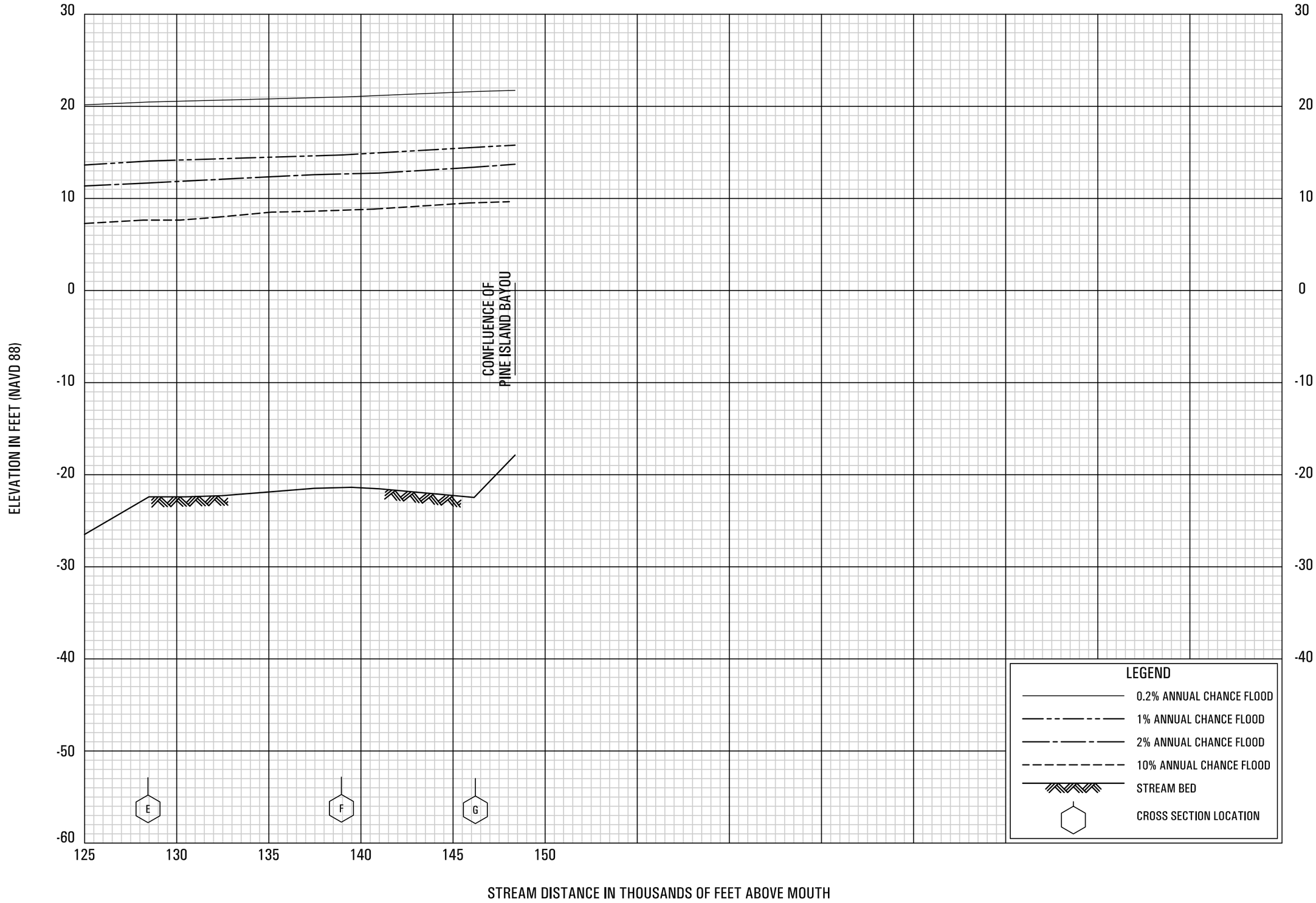
FLOOD PROFILES

NECHES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



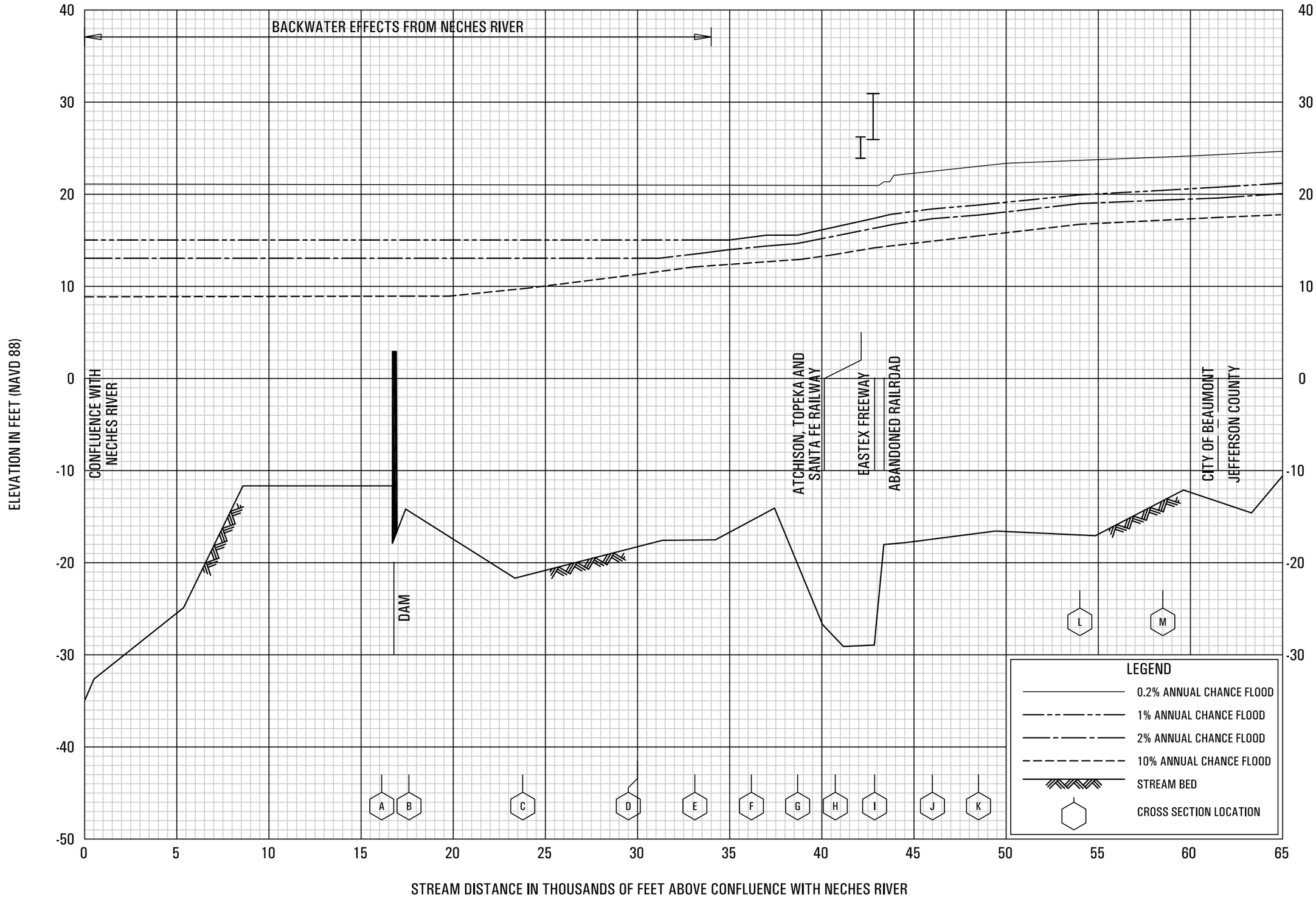
FLOOD PROFILES

NECHES RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



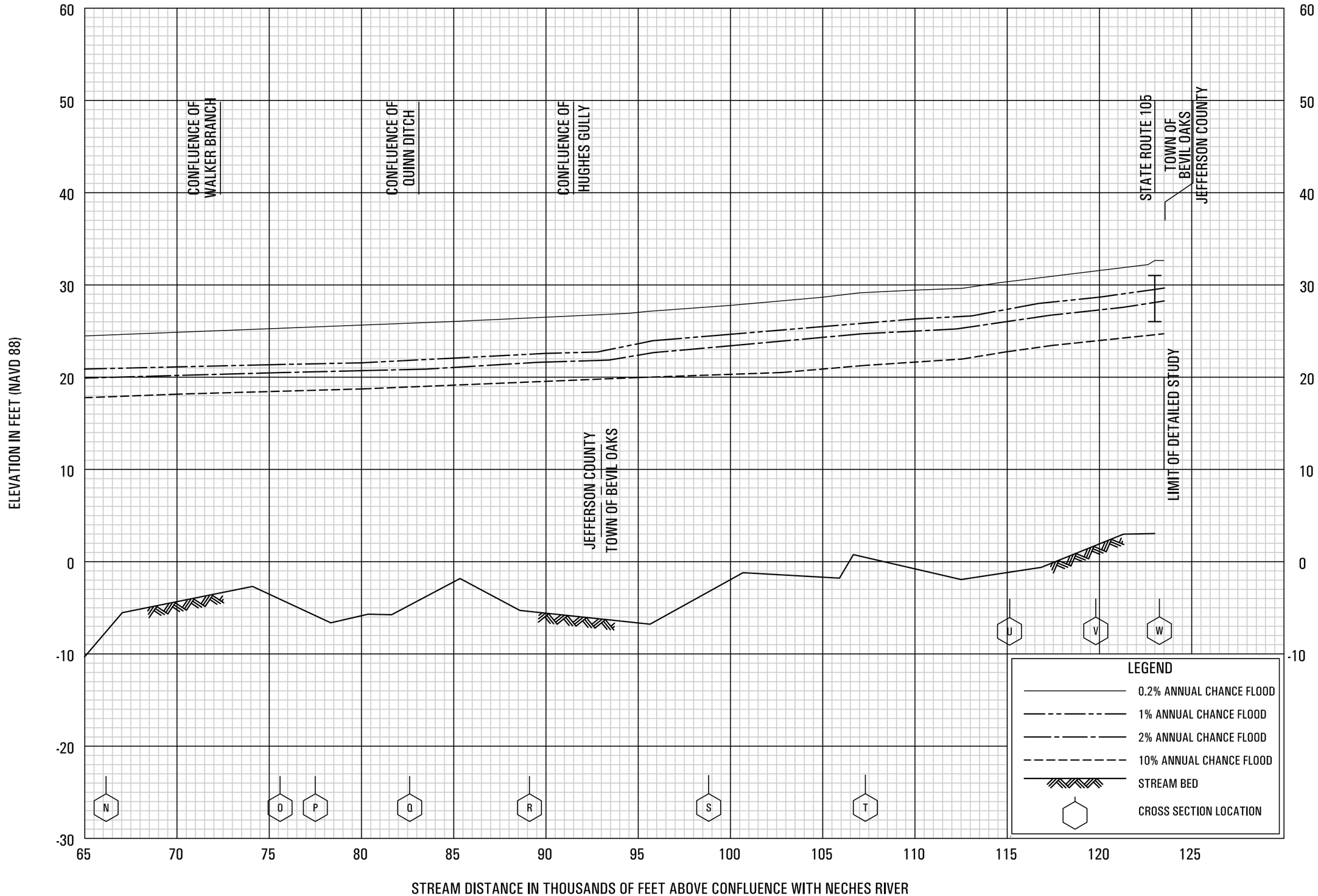
FLOOD PROFILES

PINE ISLAND BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



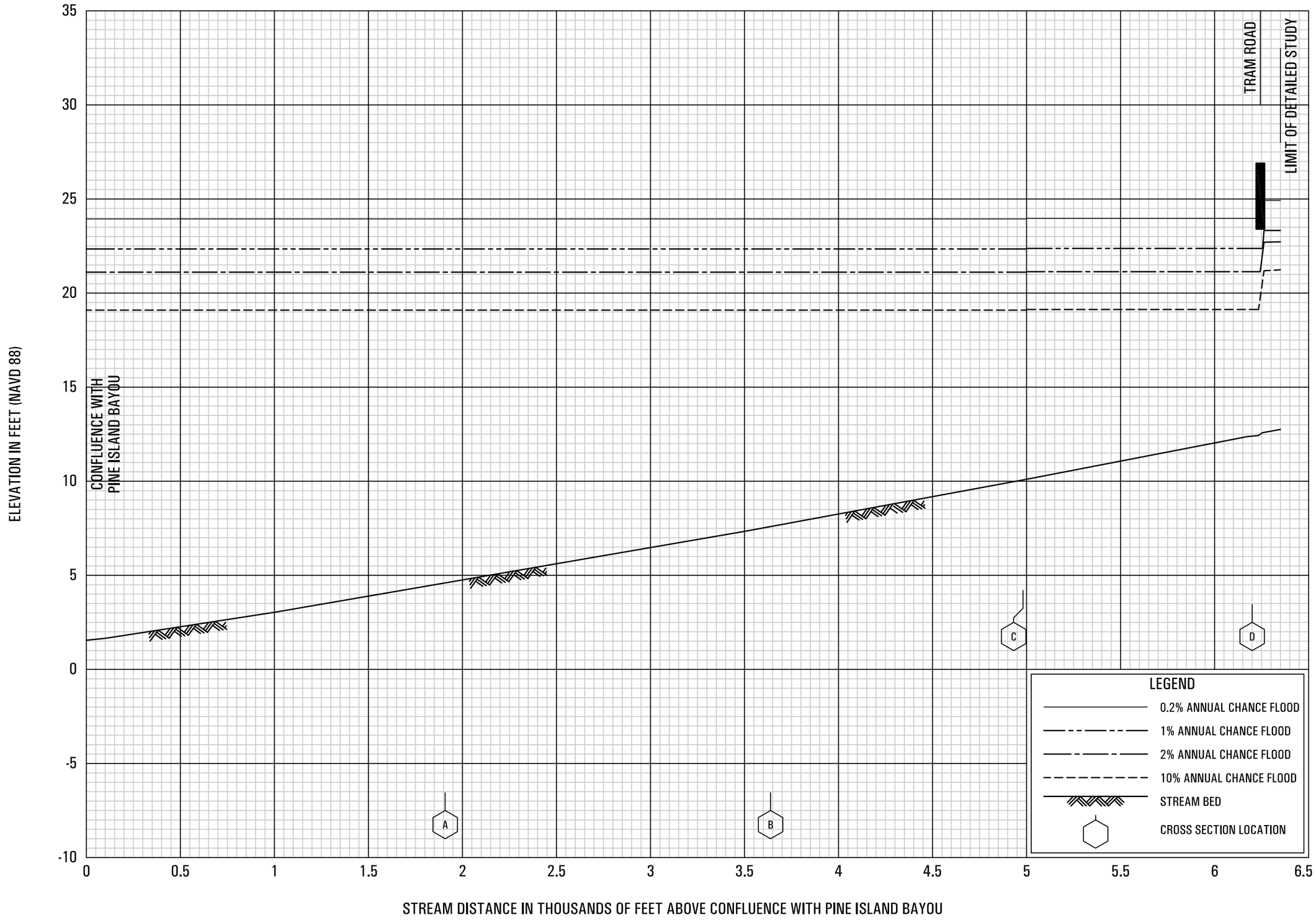
FLOOD PROFILES

PINE ISLAND BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



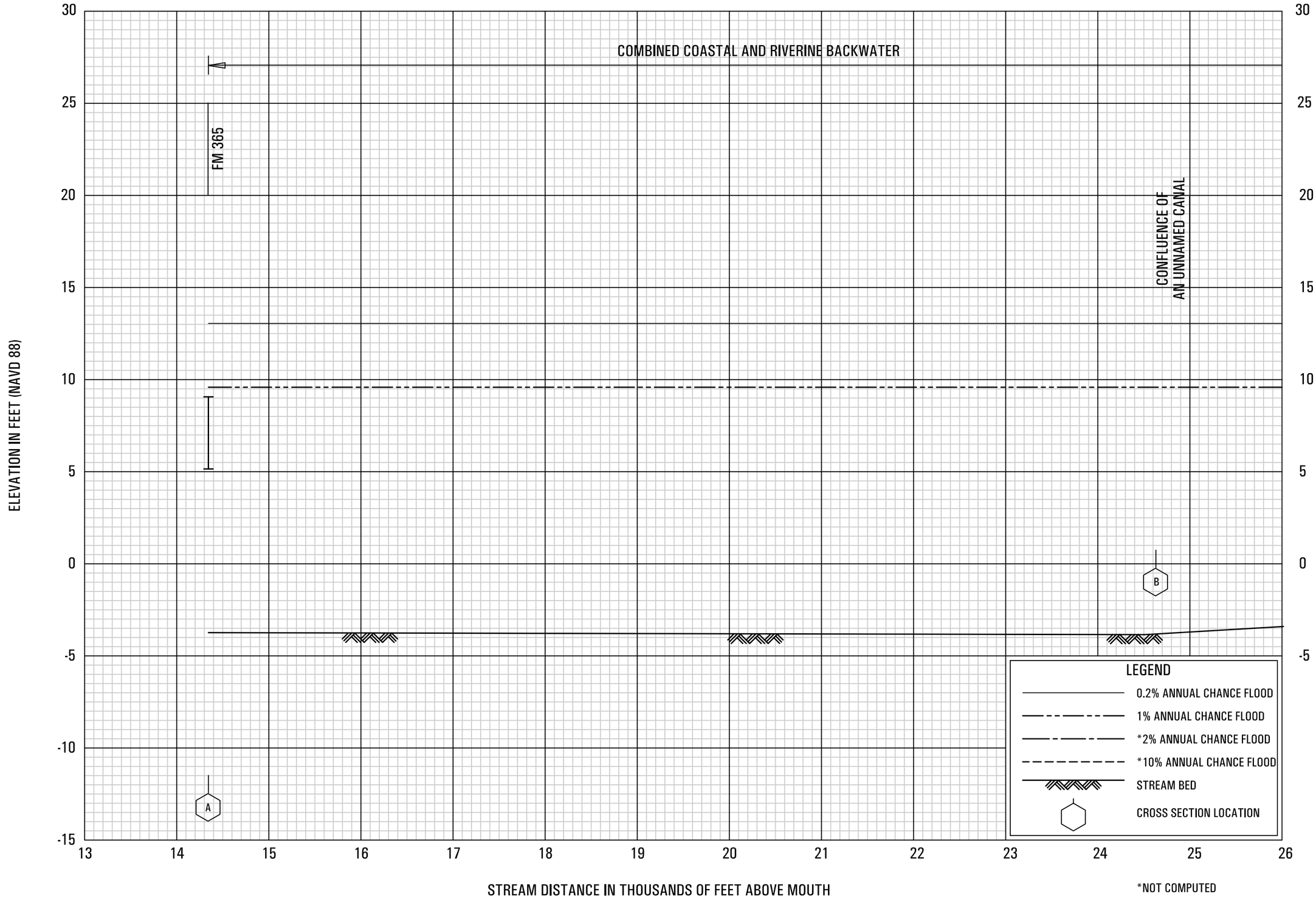
FLOOD PROFILES

QUINN DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



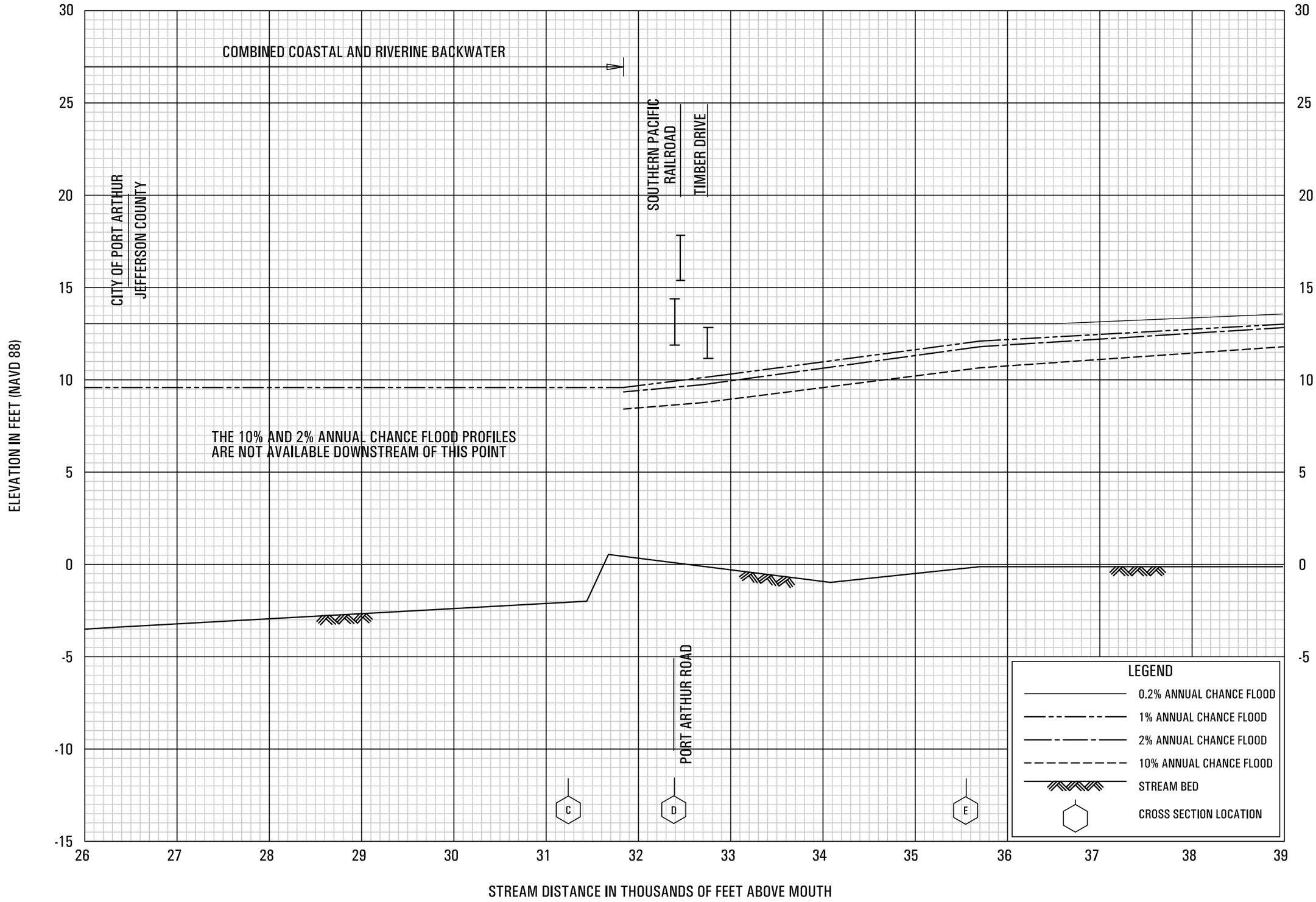
FLOOD PROFILES

RHODAIR GULLY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



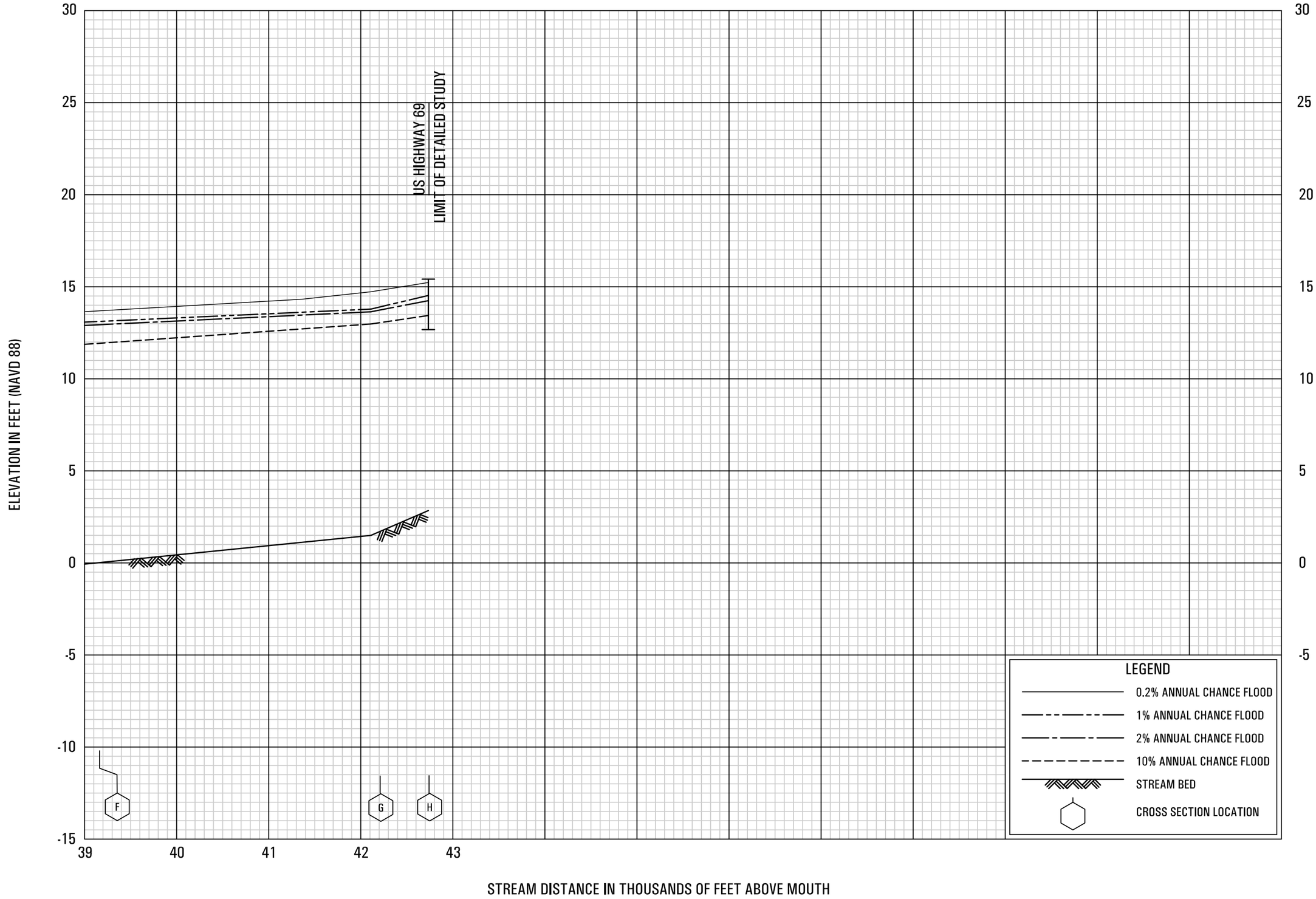
FLOOD PROFILES

RHODAIR GULLY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



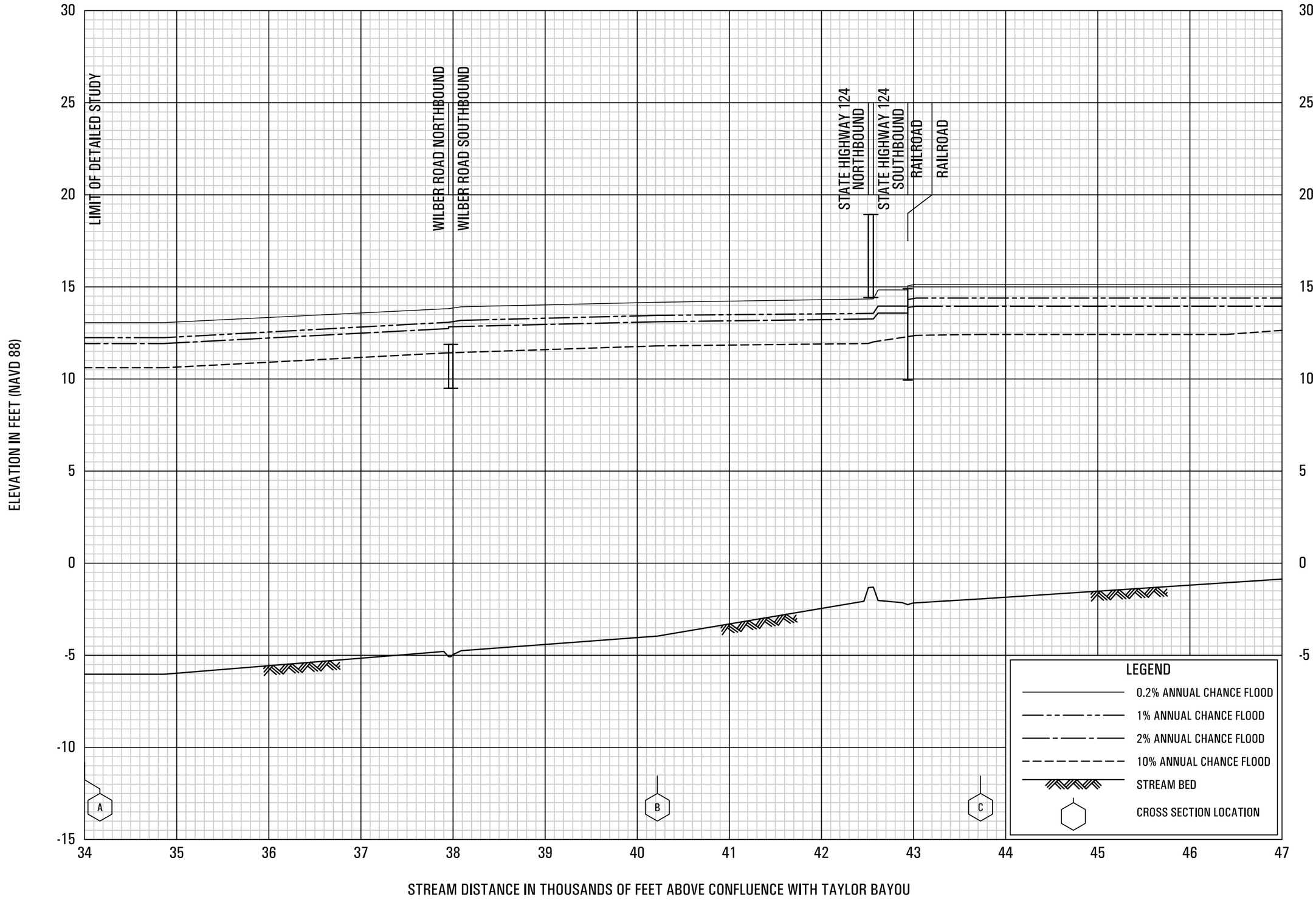
FLOOD PROFILES

RHODAIR GULLY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



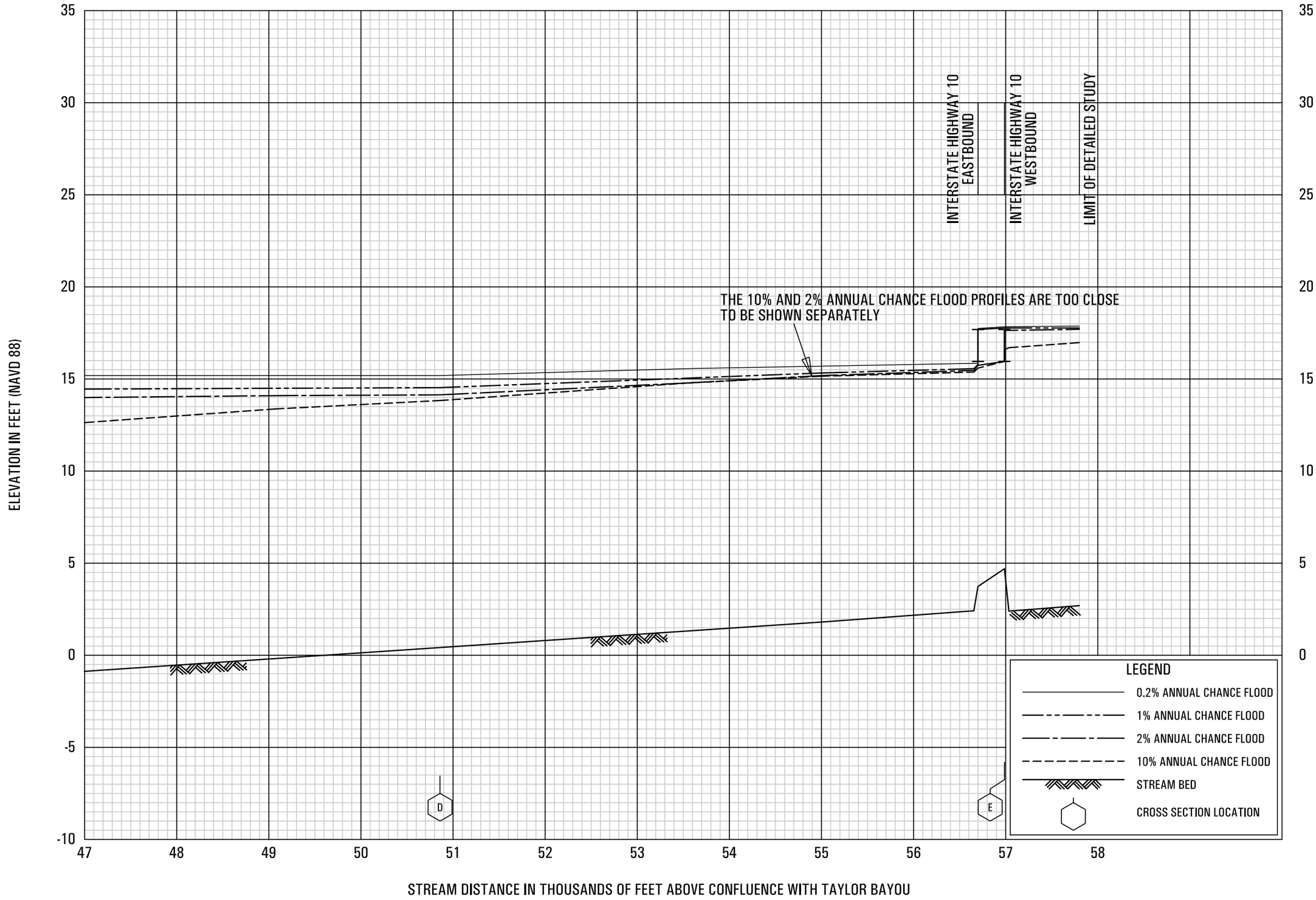
FLOOD PROFILES

SOUTH FORK TAYLOR BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



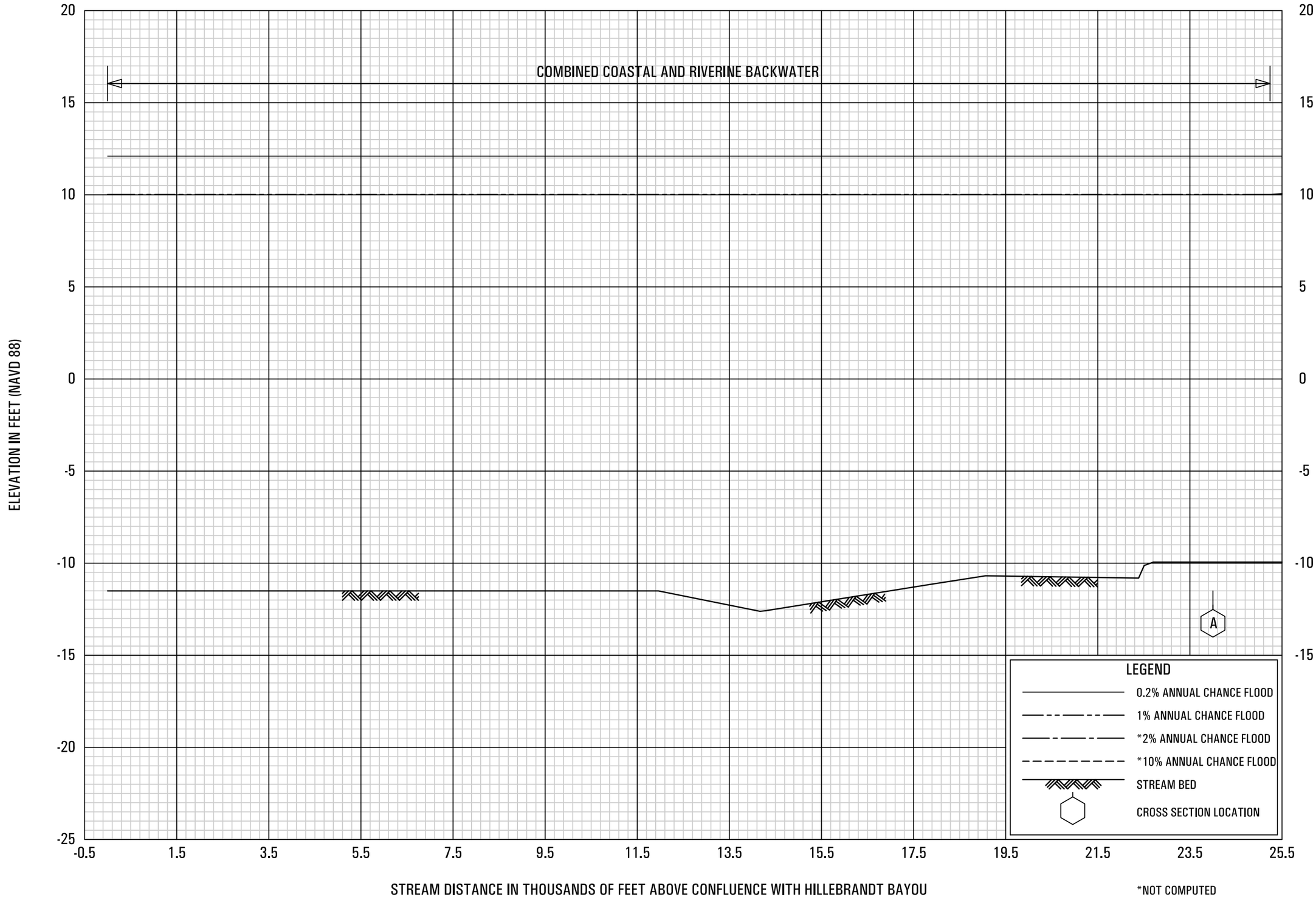
FLOOD PROFILES

SOUTH FORK TAYLOR BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



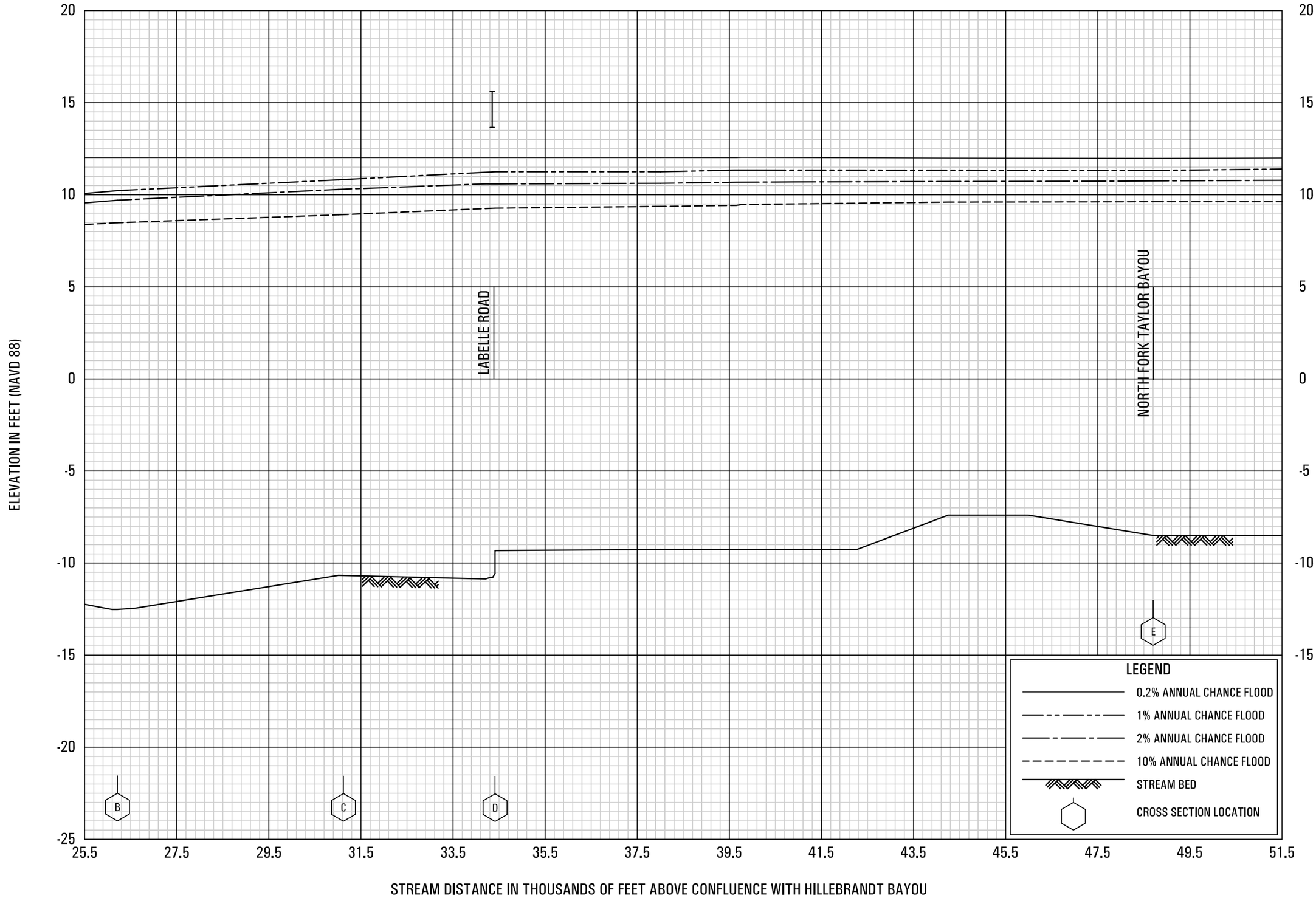
FLOOD PROFILES

TAYLOR BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



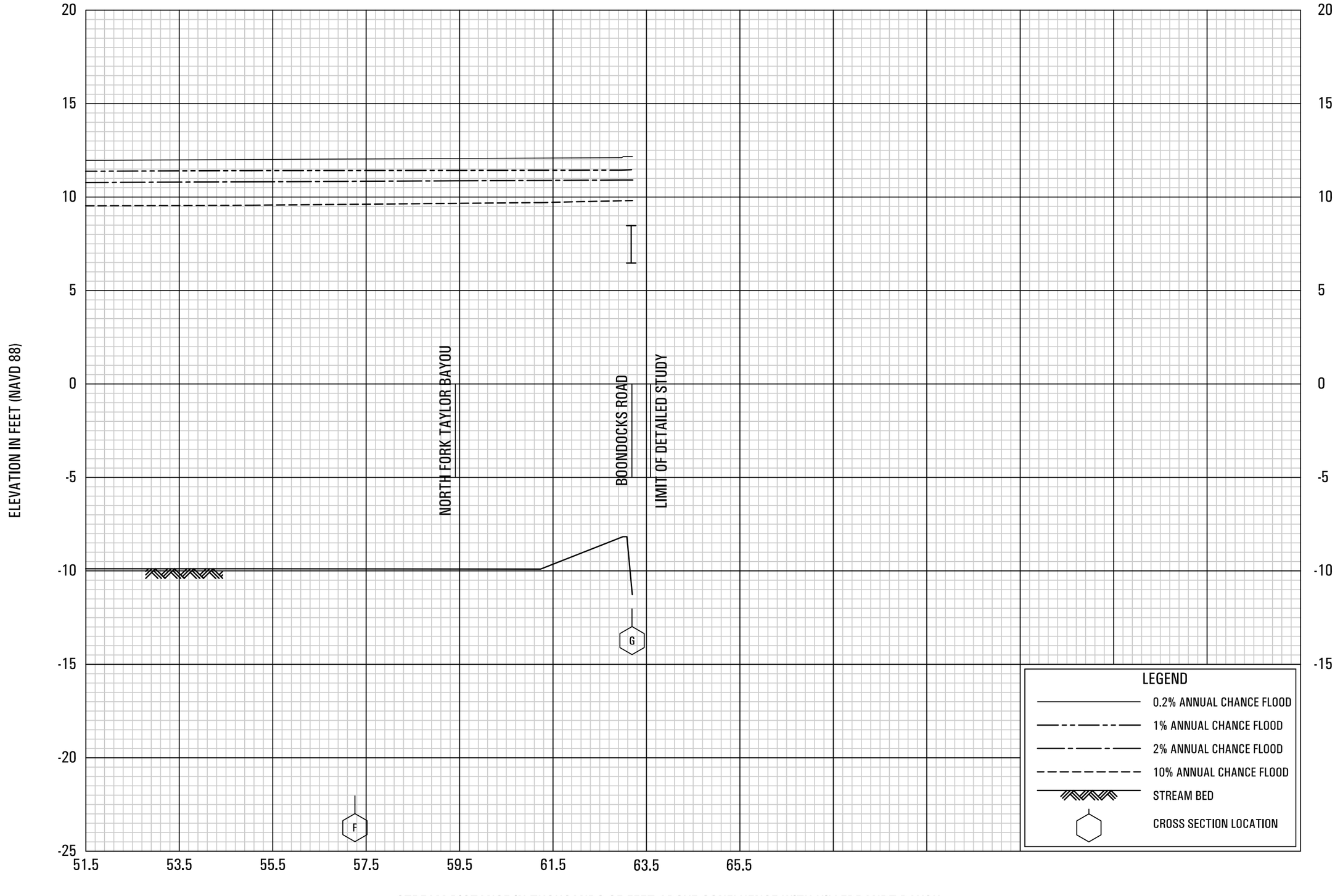
FLOOD PROFILES

TAYLOR BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



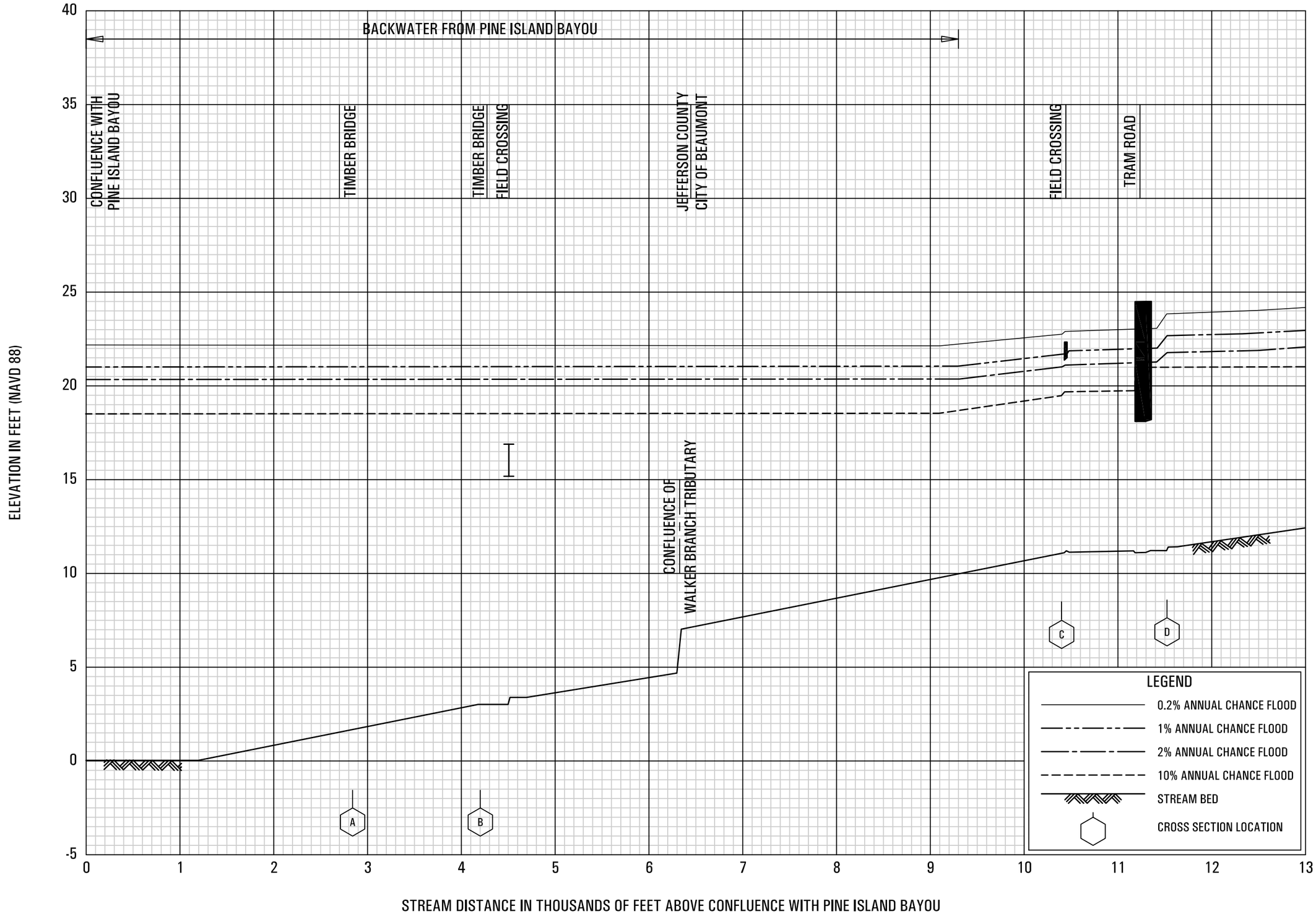
FLOOD PROFILES

TAYLOR BAYOU / NORTH FORK TAYLOR BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



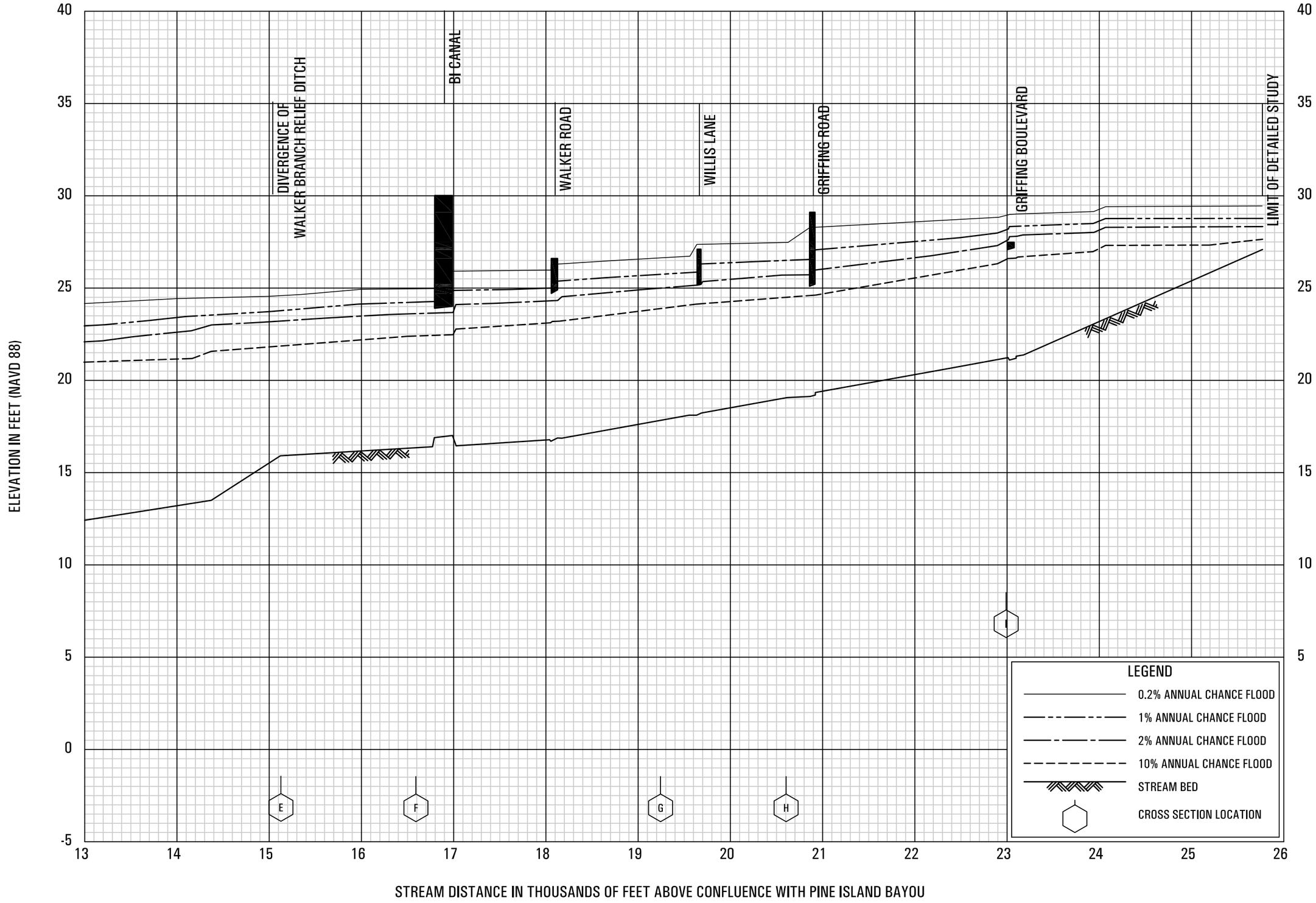
FLOOD PROFILES

WALKER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



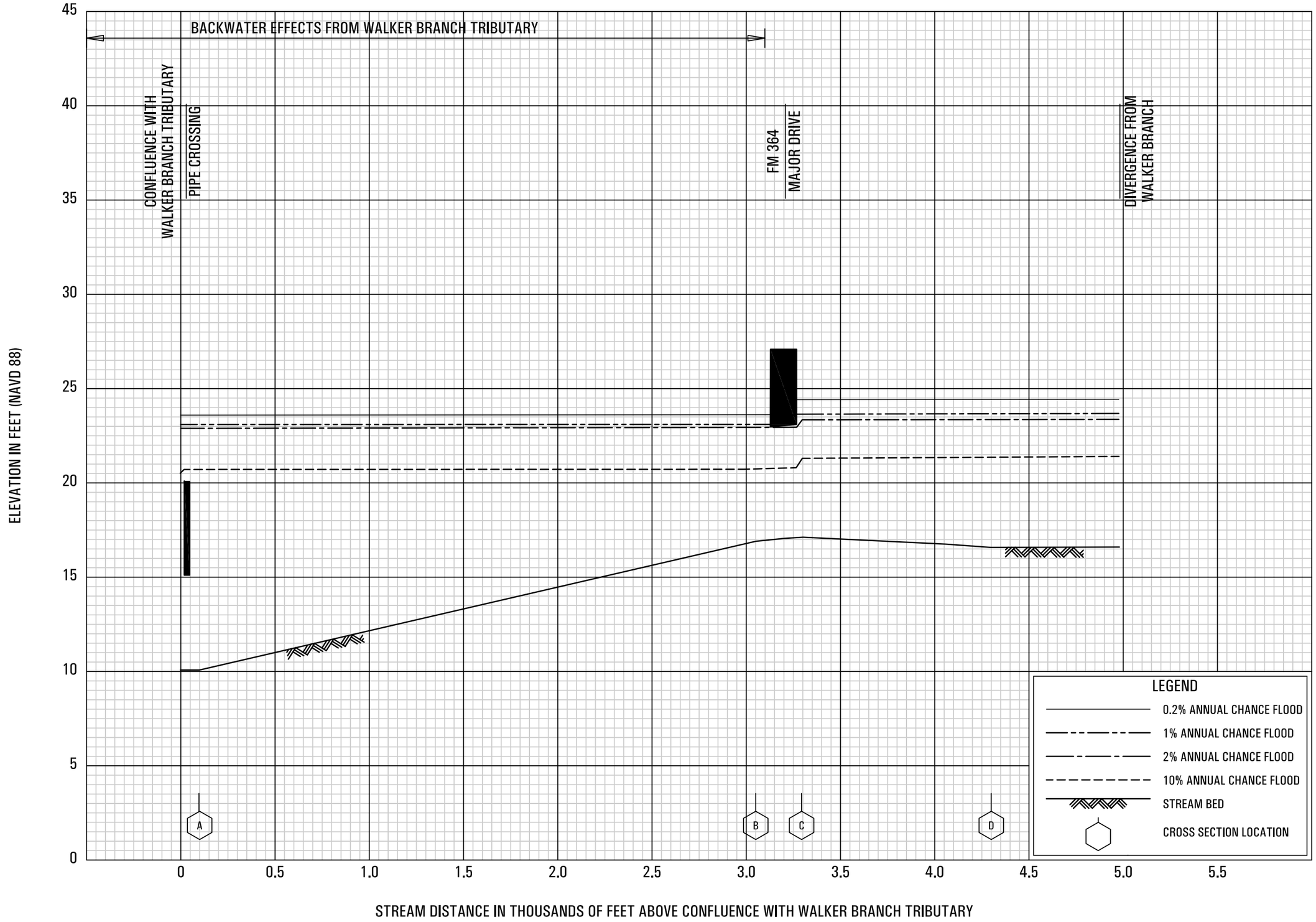
FLOOD PROFILES

WALKER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



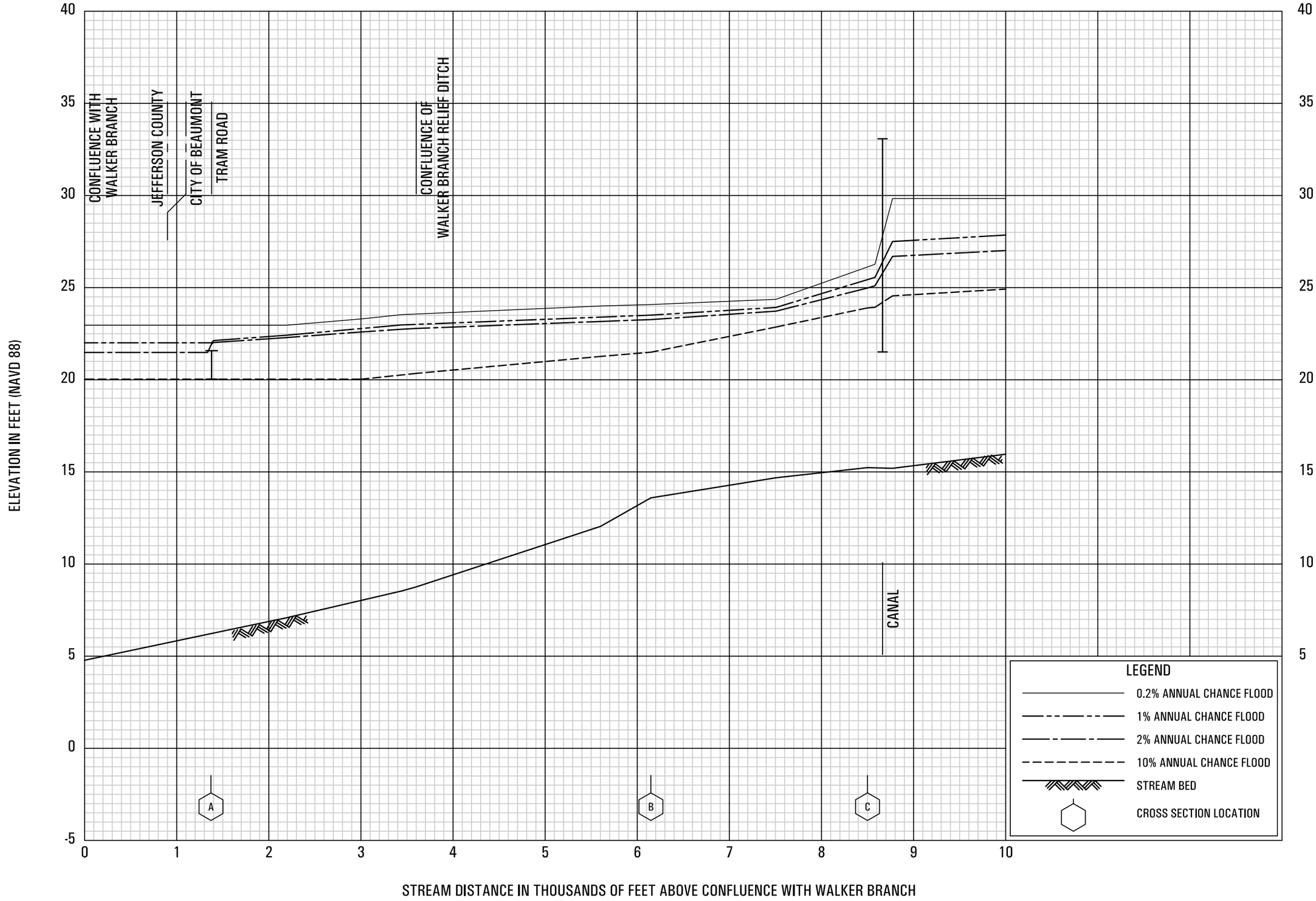
FLOOD PROFILES

WALKER BRANCH RELIEF DITCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



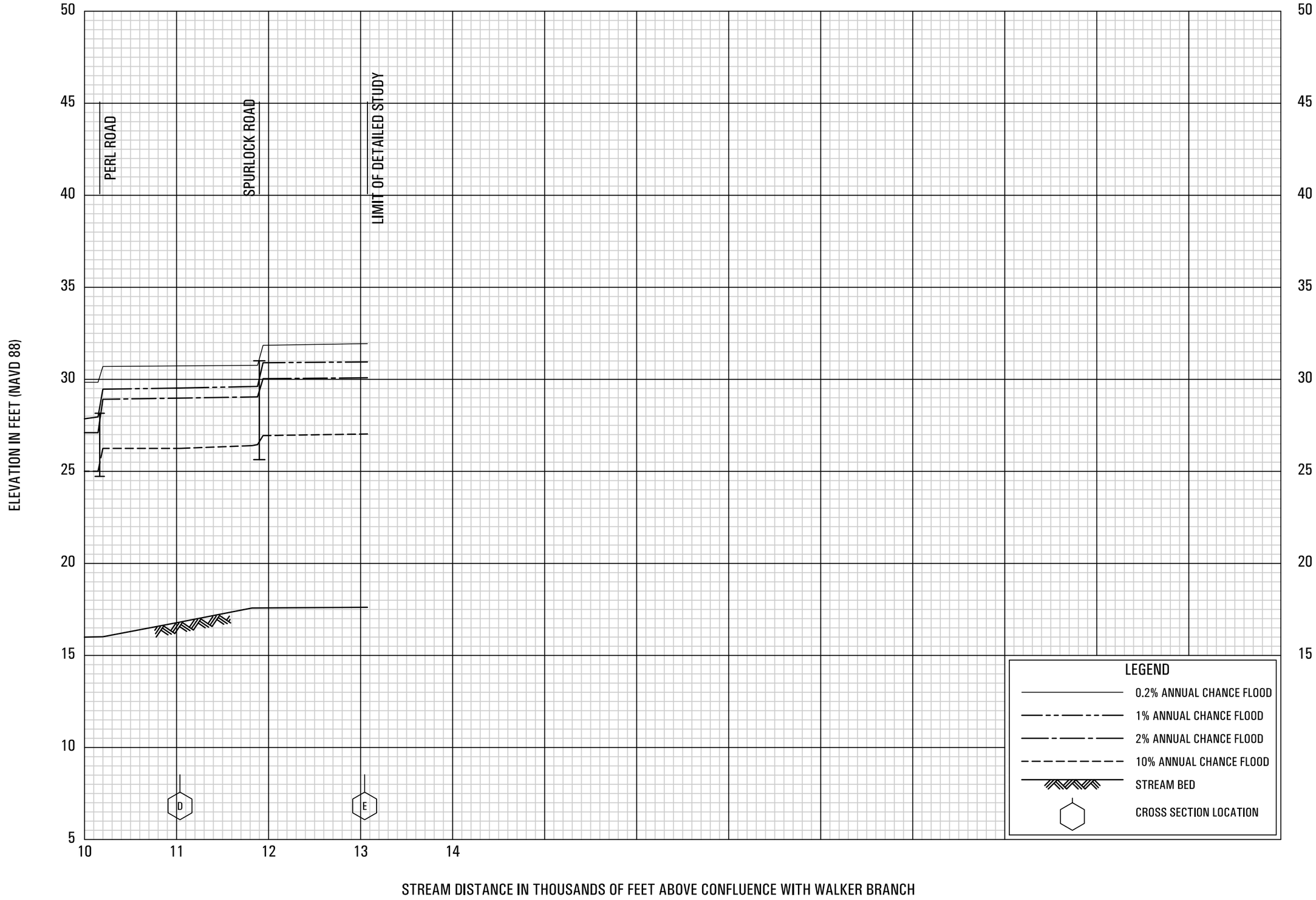
FLOOD PROFILES

WALKER BRANCH TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



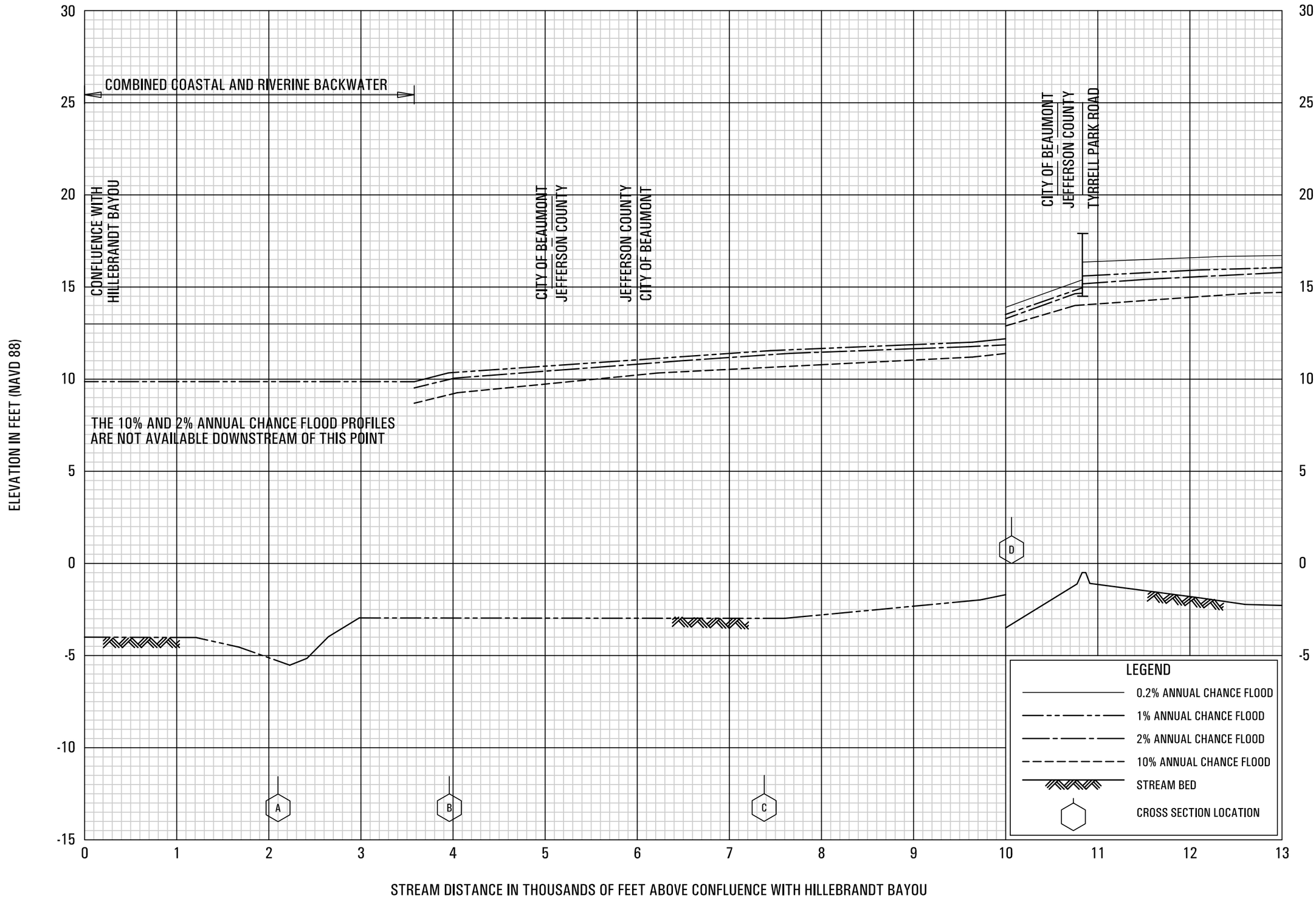
FLOOD PROFILES

WALKER BRANCH TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



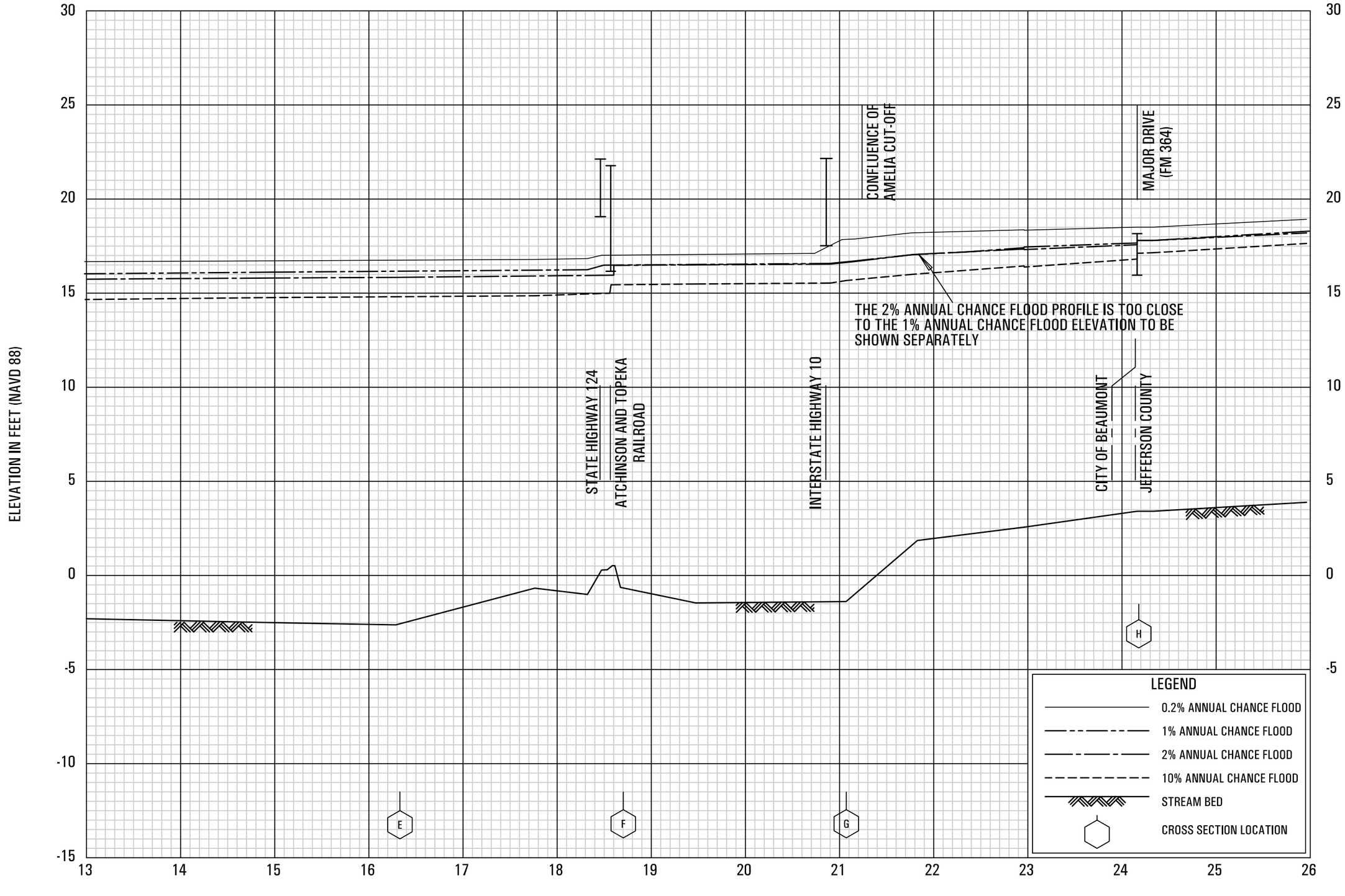
FLOOD PROFILES

WILLOW MARSH BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



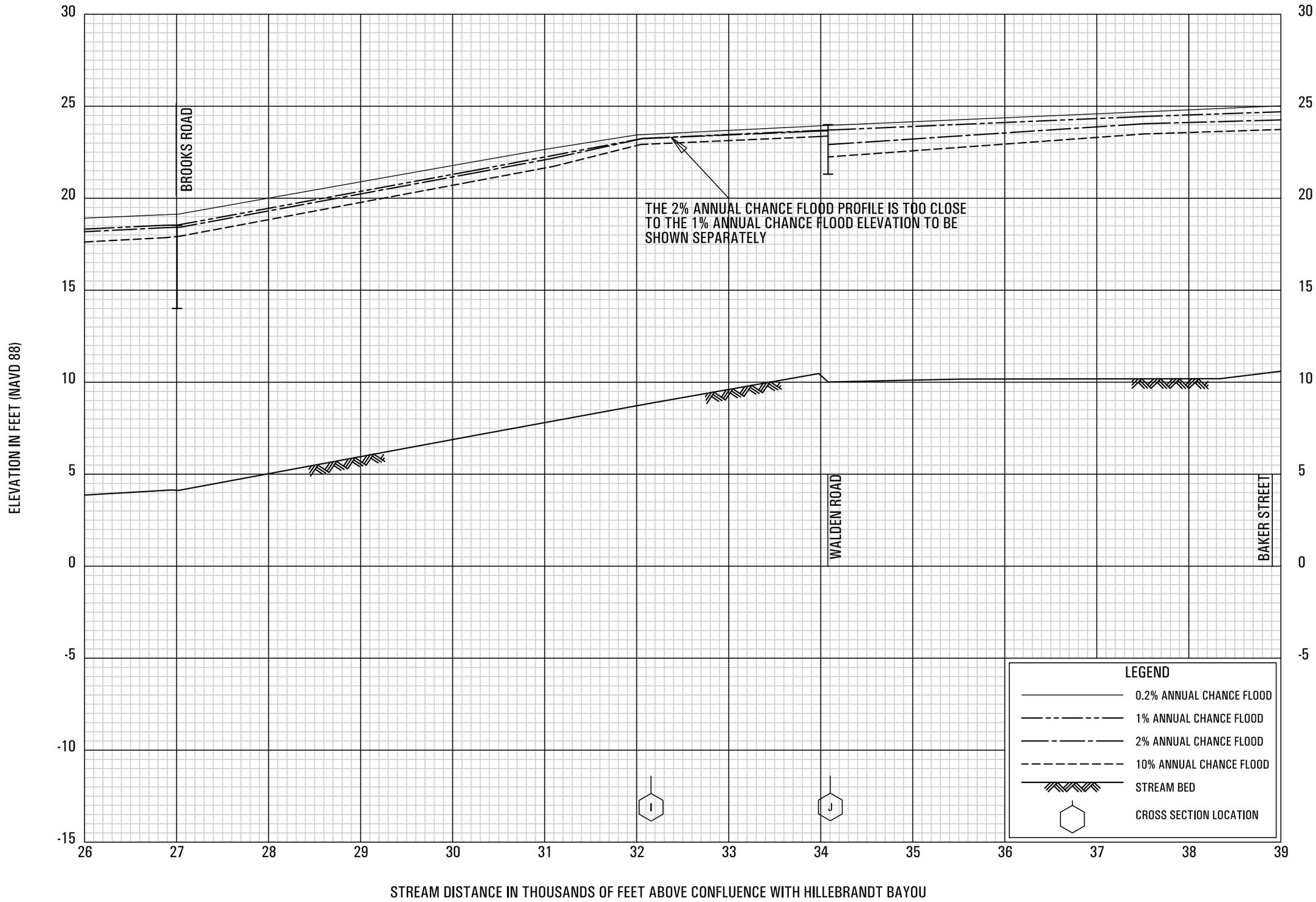
FLOOD PROFILES

WILLOW MARSH BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



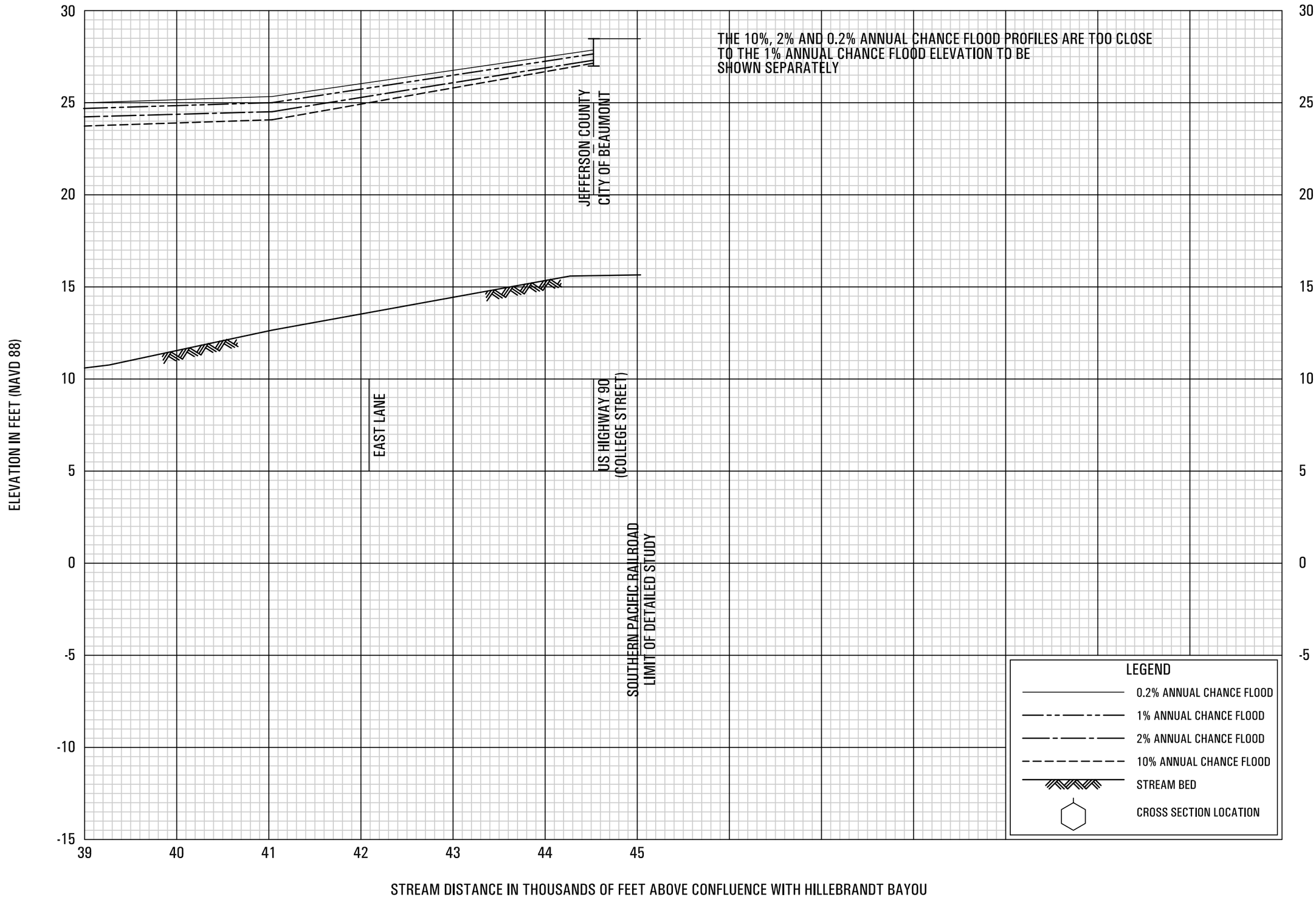
FLOOD PROFILES

WILLOW MARSH BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



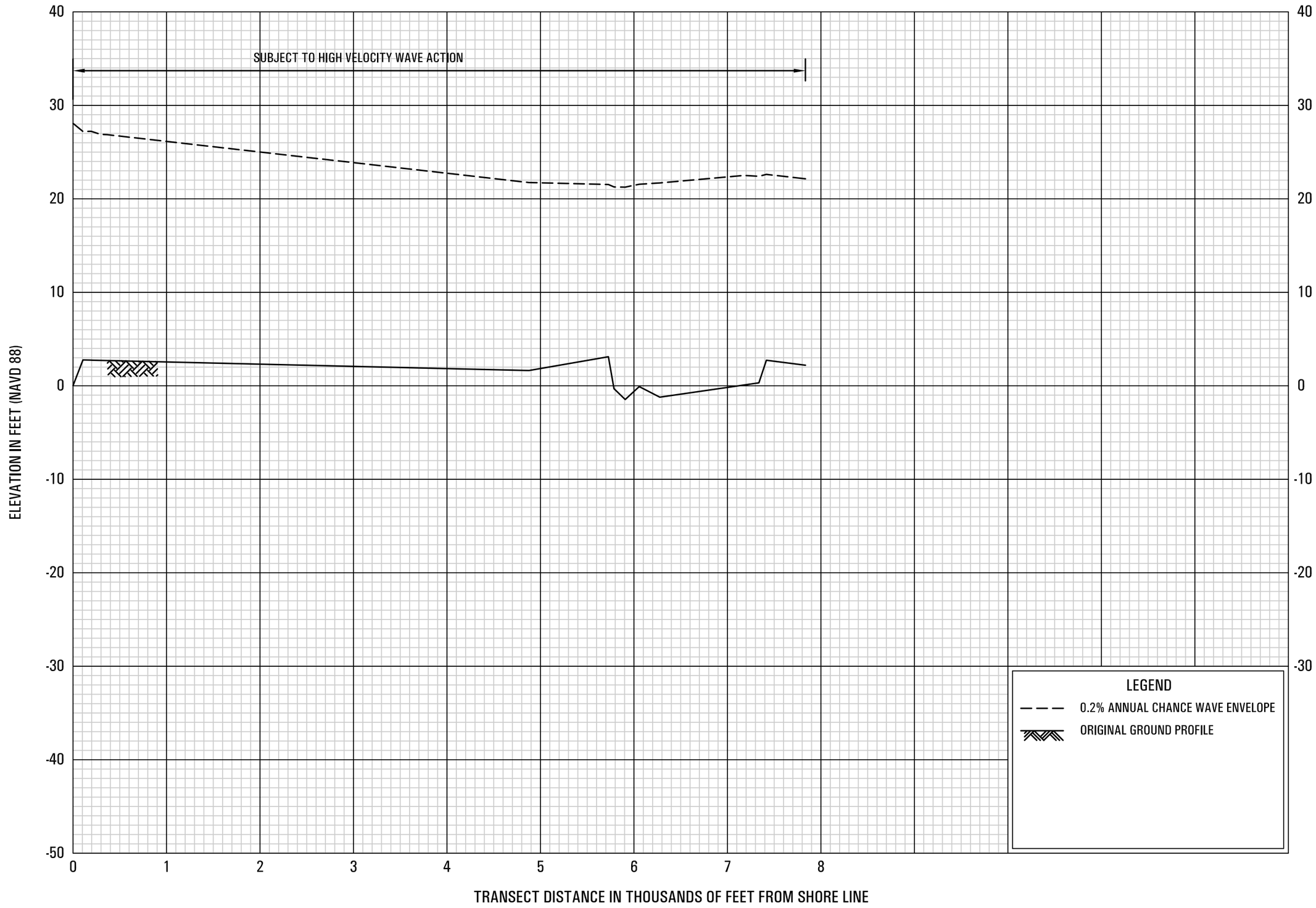
FLOOD PROFILES

WILLOW MARSH BAYOU

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

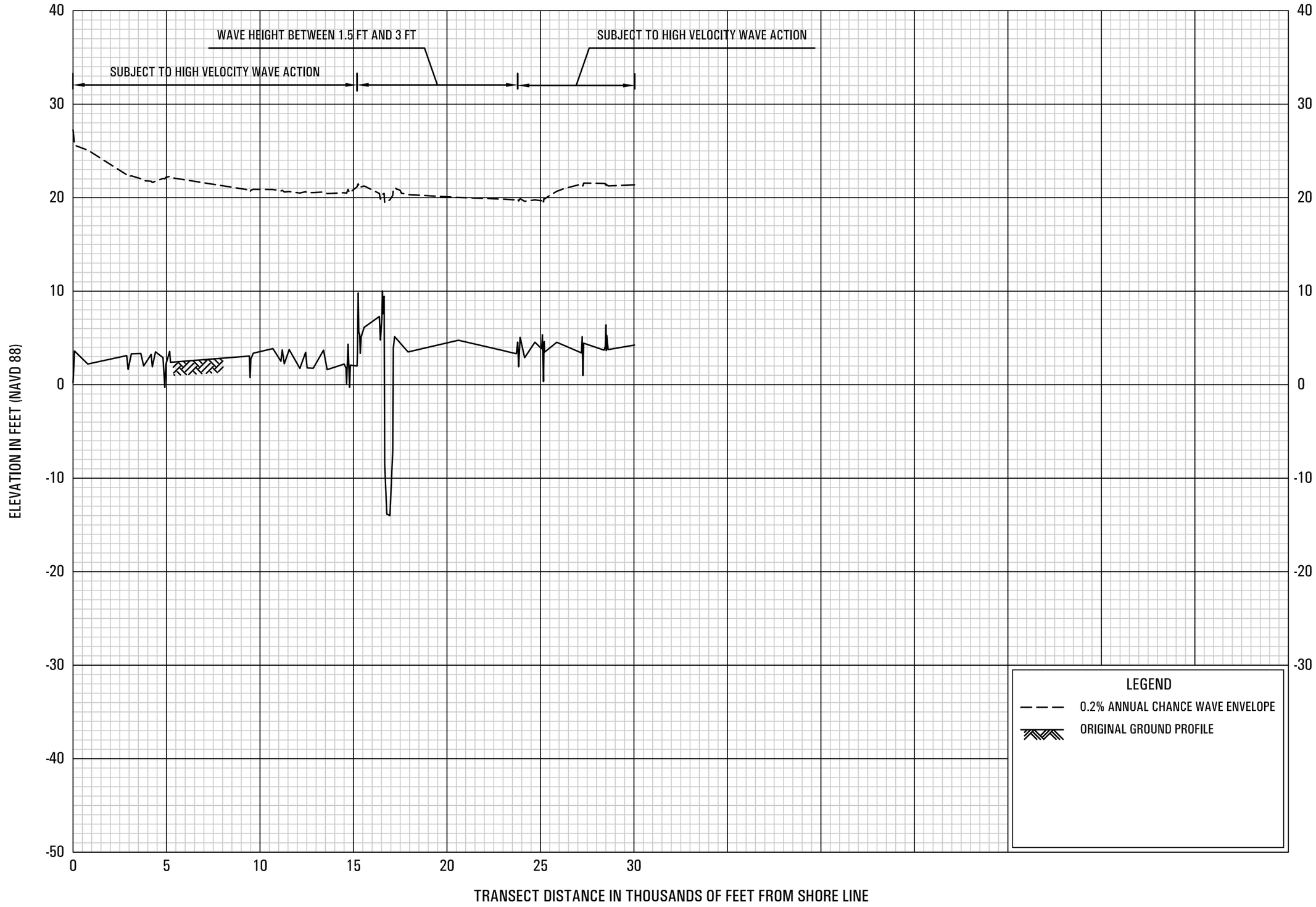
TRANSECT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

01P



0.2% ANNUAL CHANCE WAVE ENVELOPE

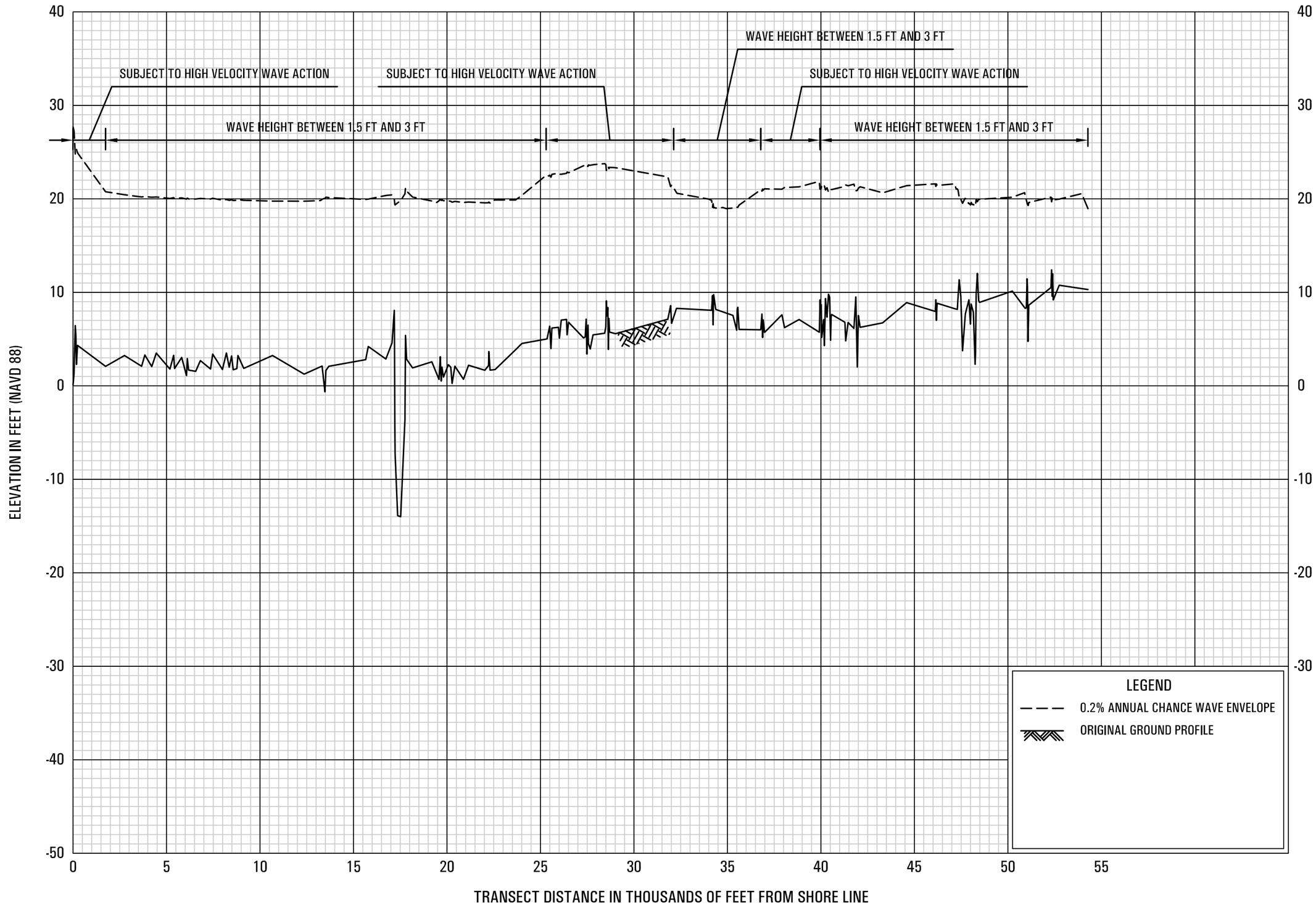
TRANSECT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

02P



0.2% ANNUAL CHANCE WAVE ENVELOPE

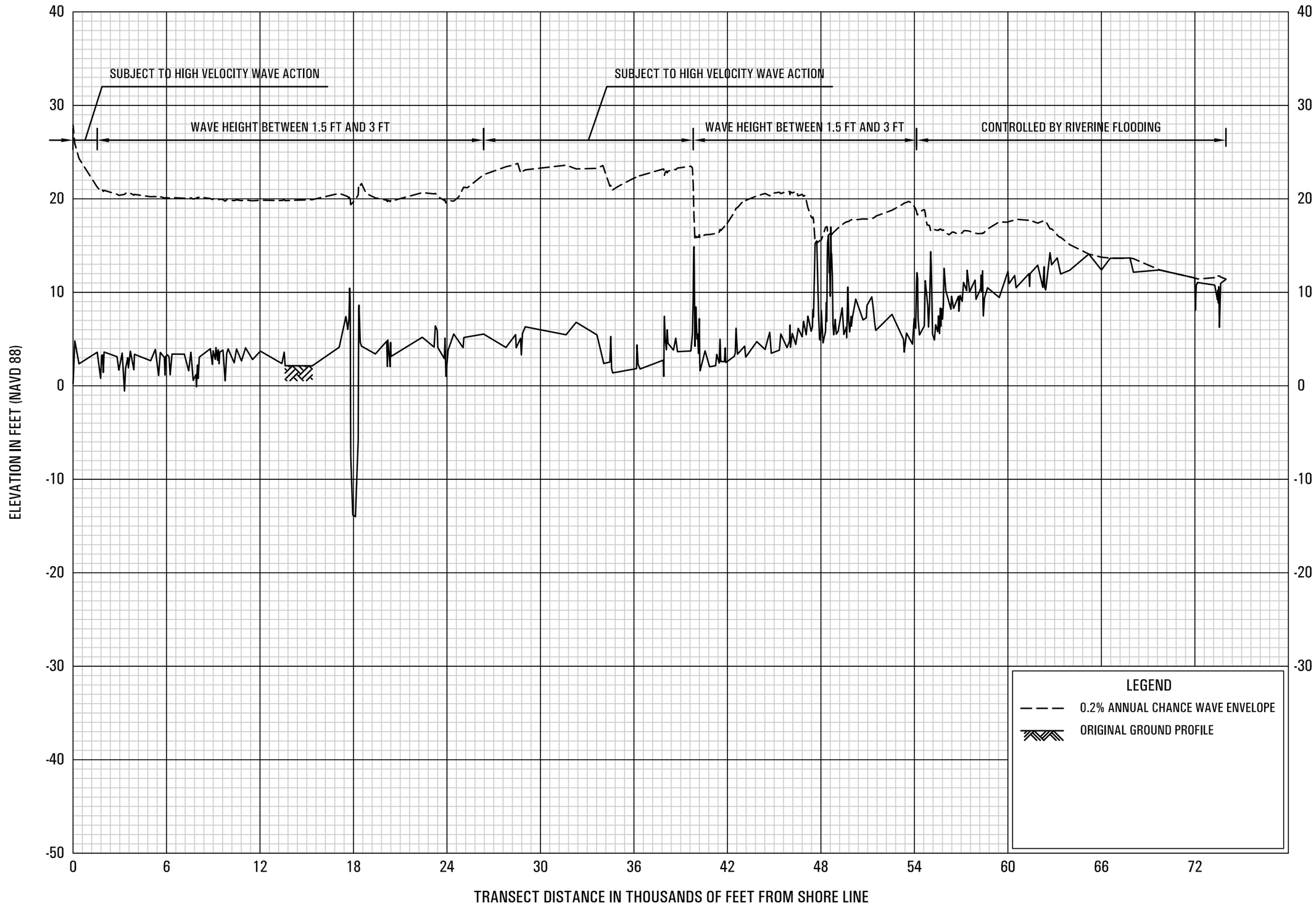
TRANSECT 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

03P



0.2% ANNUAL CHANCE WAVE ENVELOPE

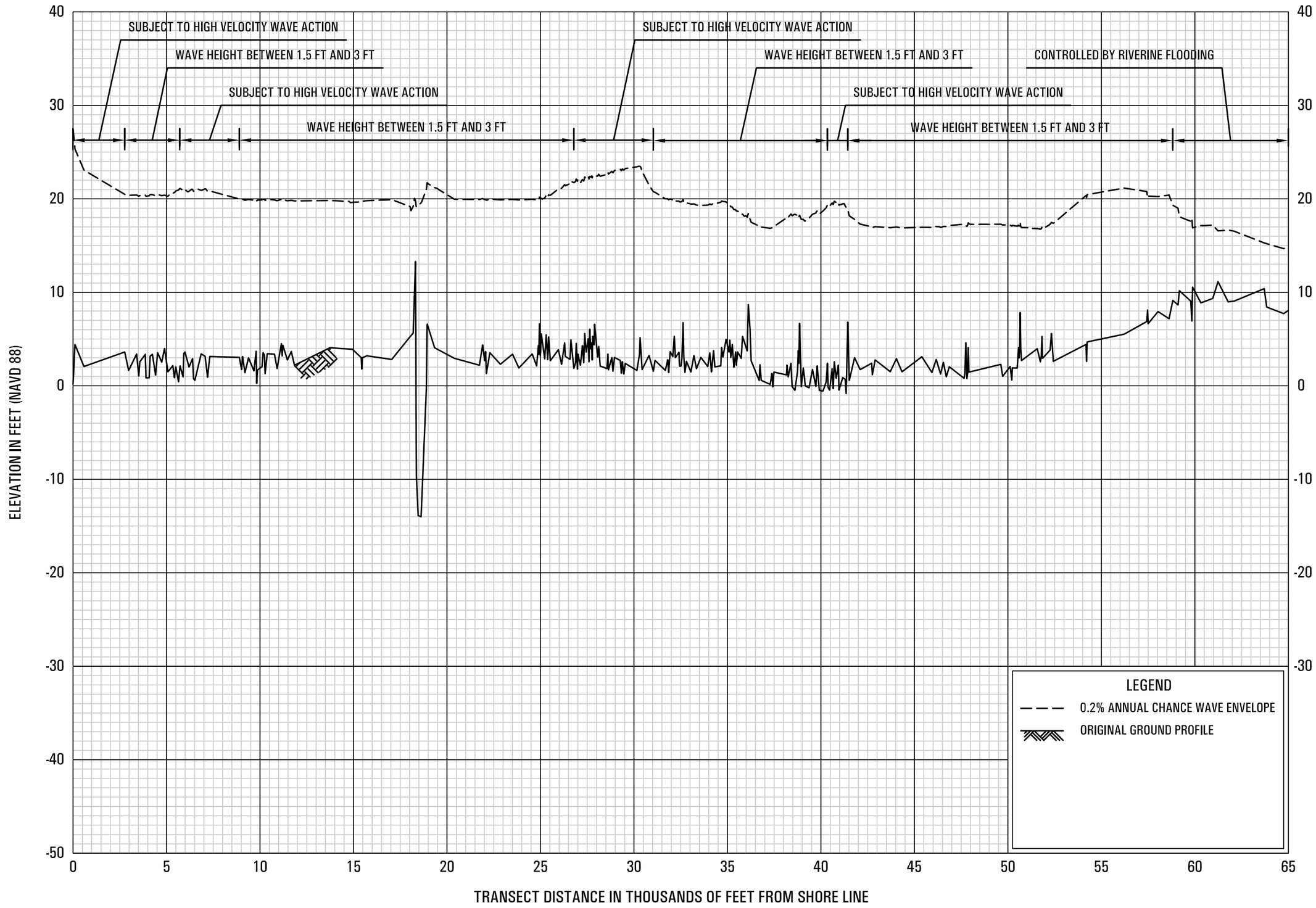
TRANSECT 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

04P



0.2% ANNUAL CHANCE WAVE ENVELOPE

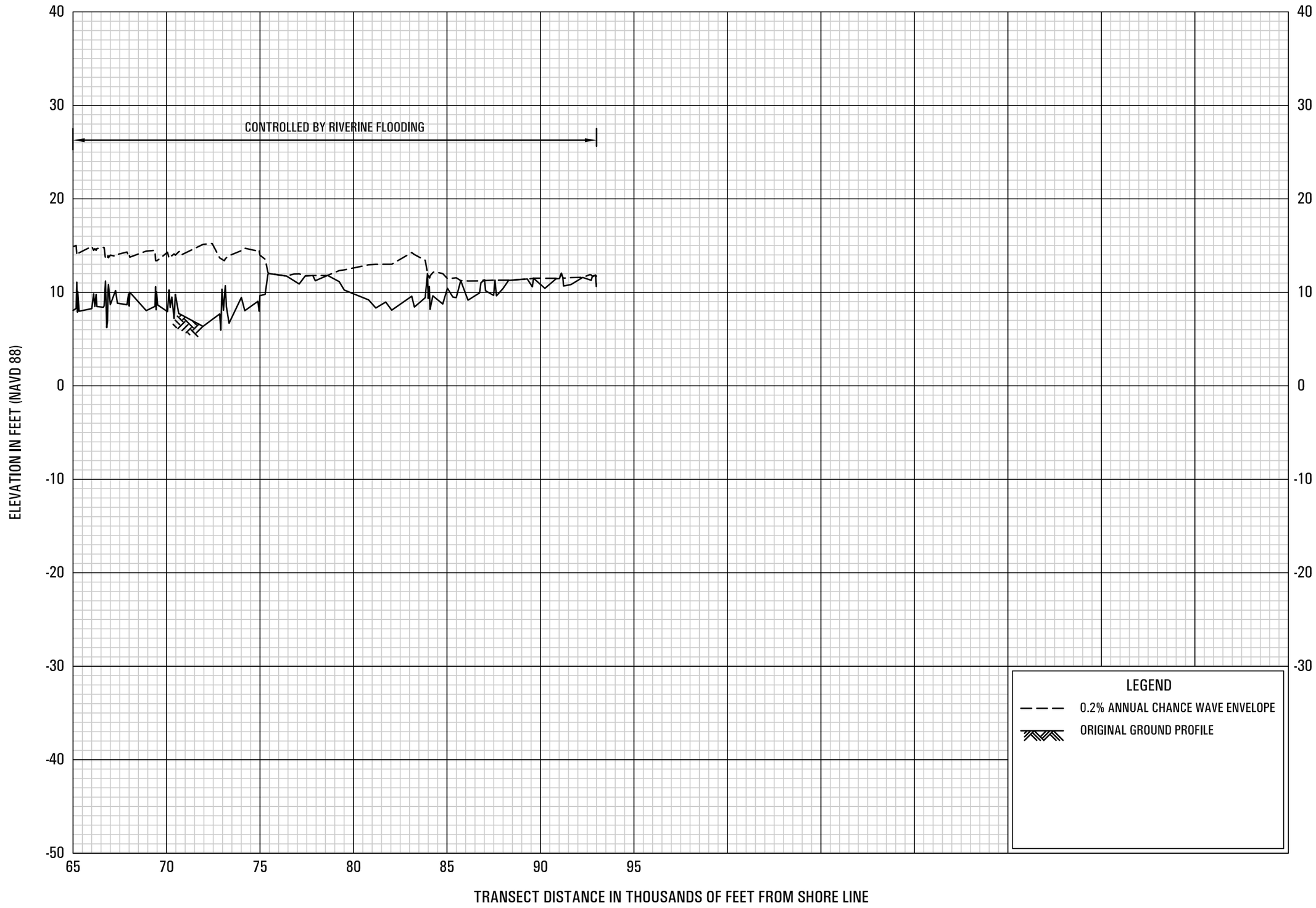
TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

05P



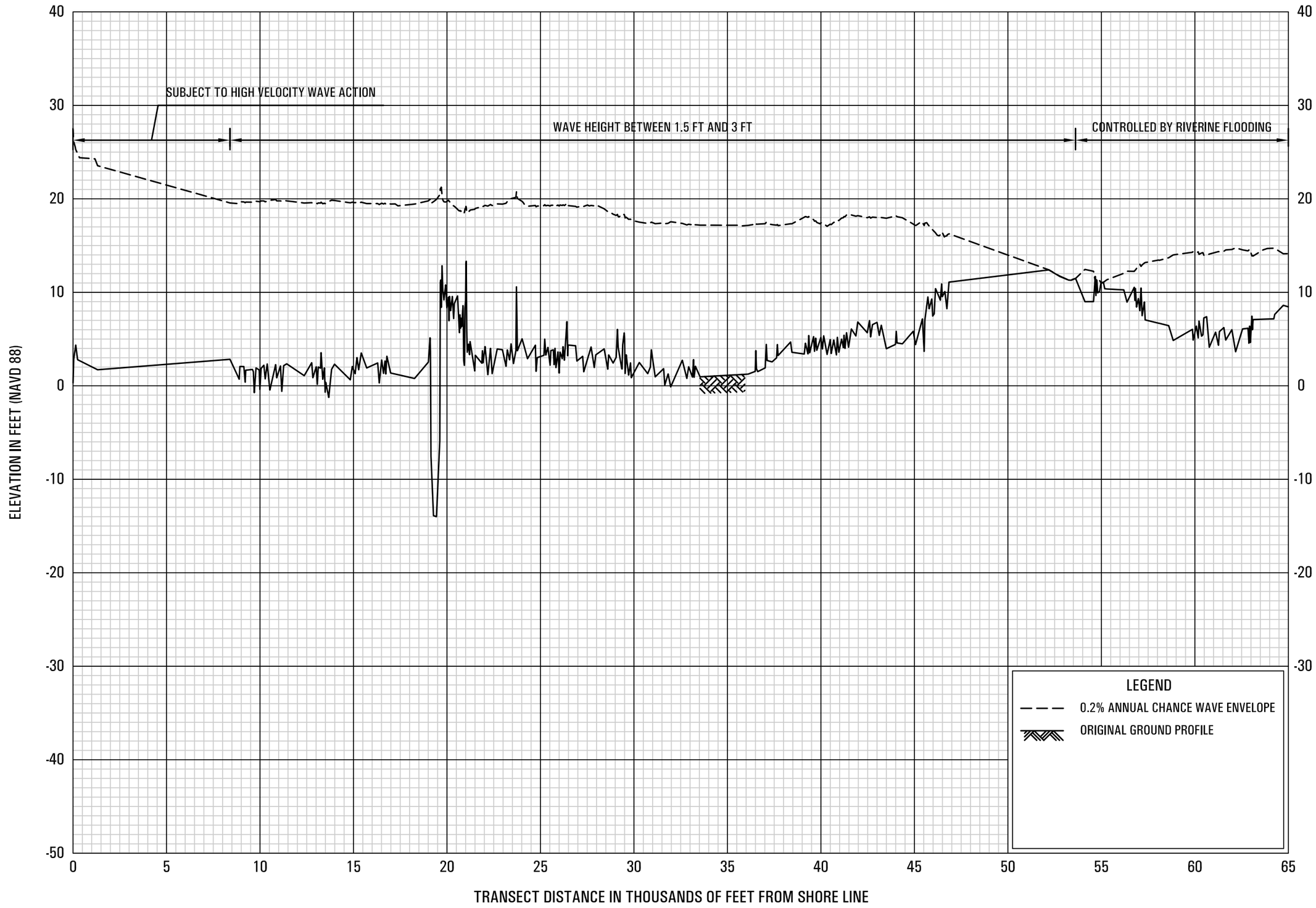
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

06P



0.2% ANNUAL CHANCE WAVE ENVELOPE

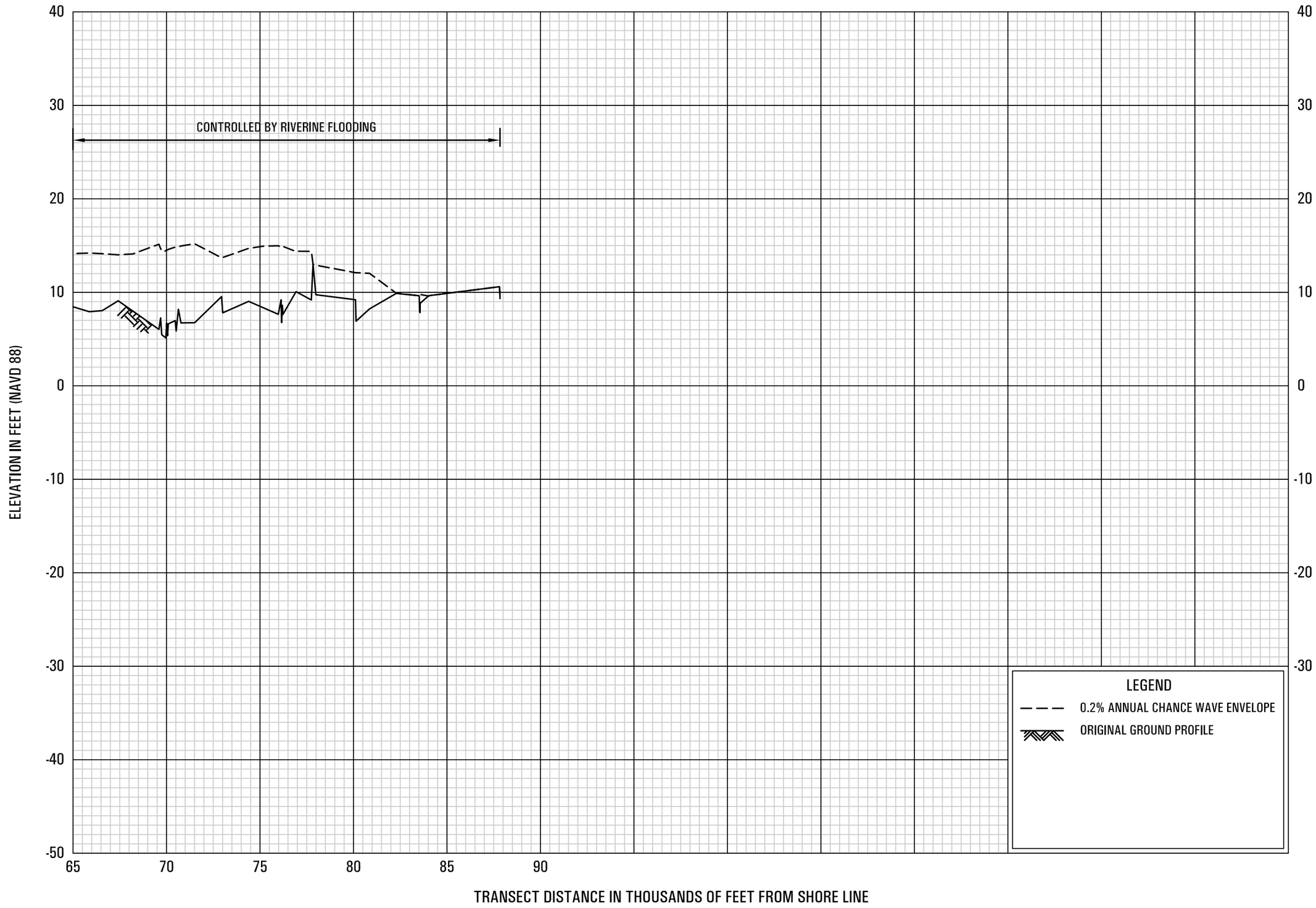
TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

07P



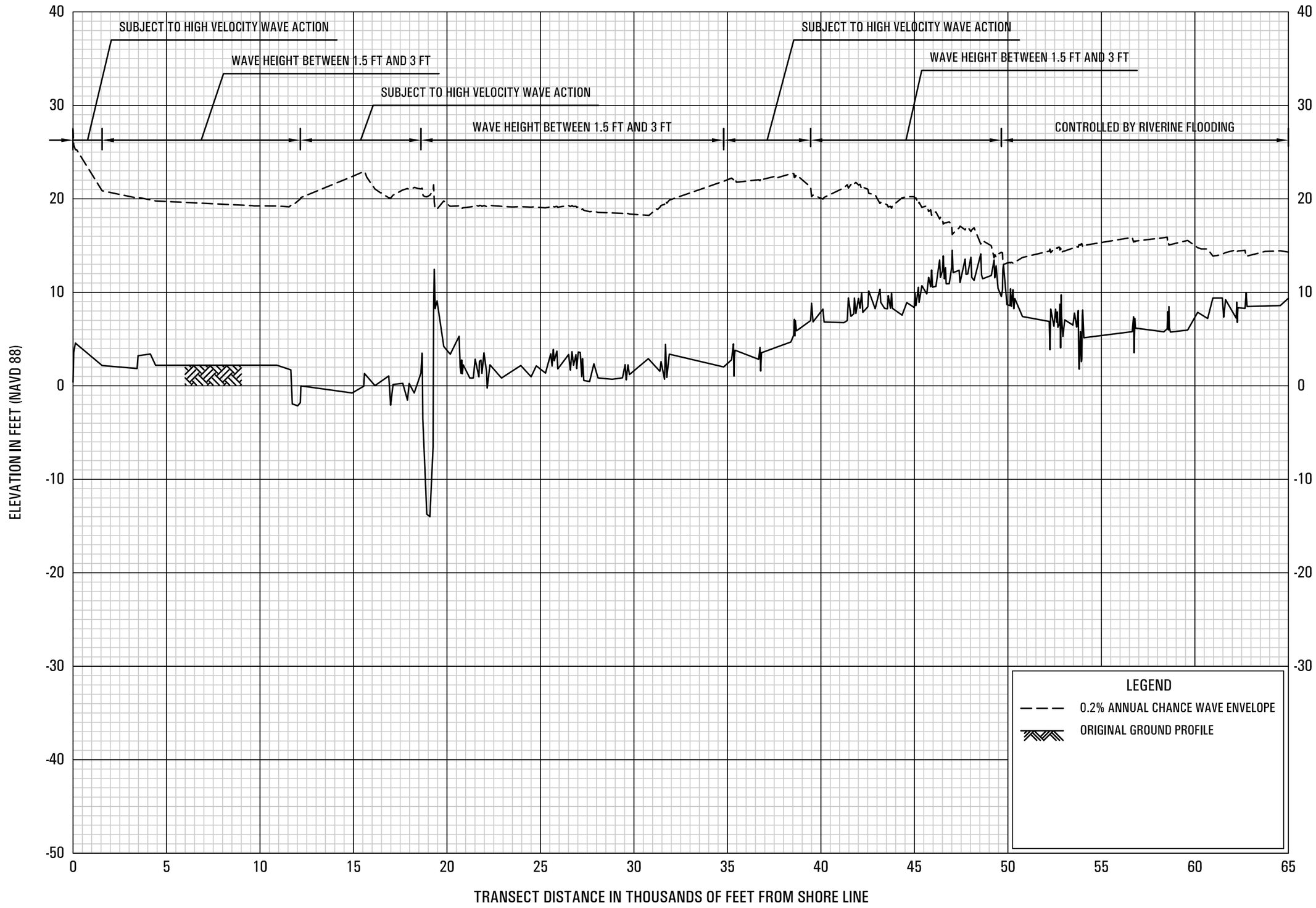
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

08P



0.2% ANNUAL CHANCE WAVE ENVELOPE

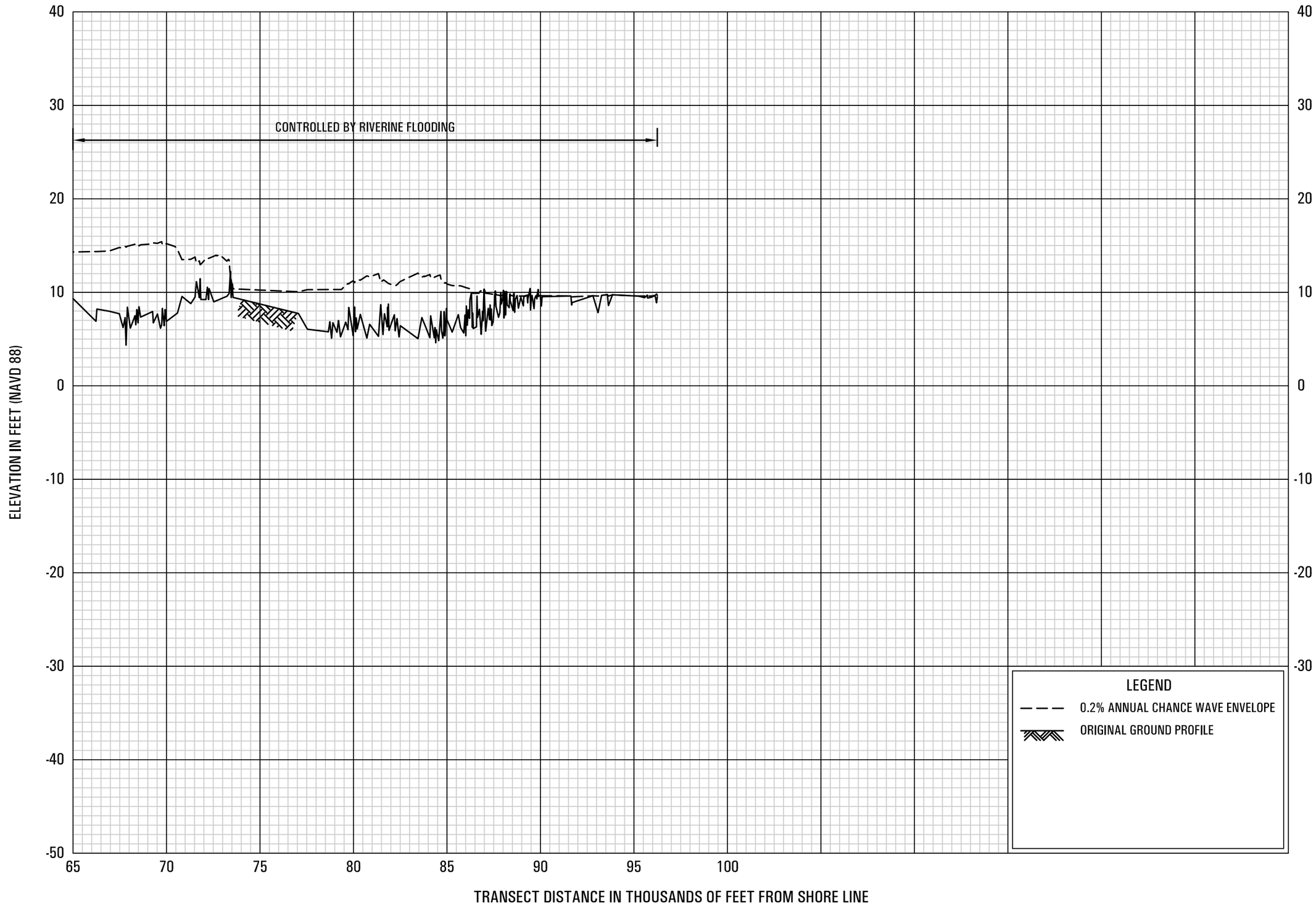
TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

09P



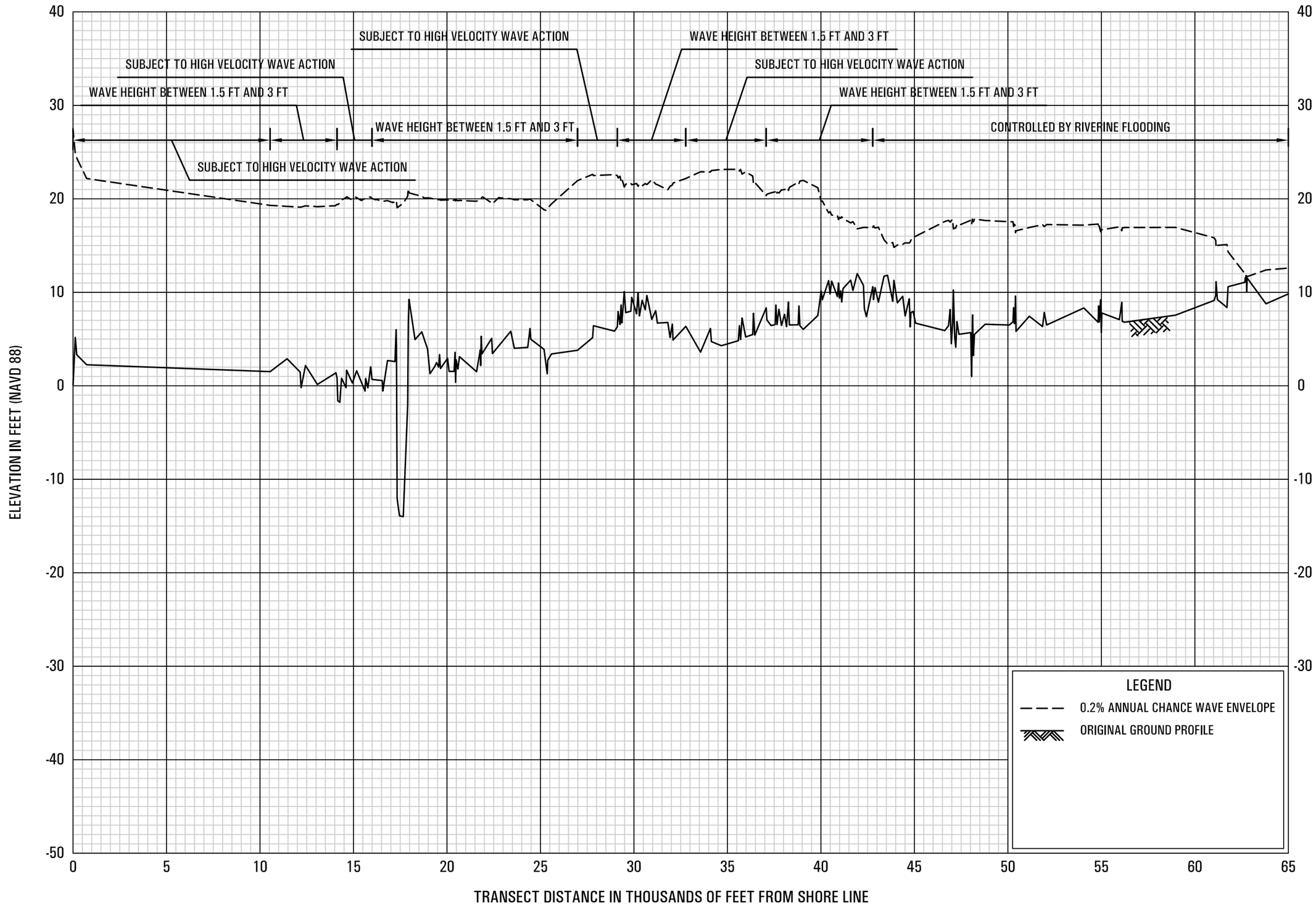
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

10P



0.2% ANNUAL CHANCE WAVE ENVELOPE

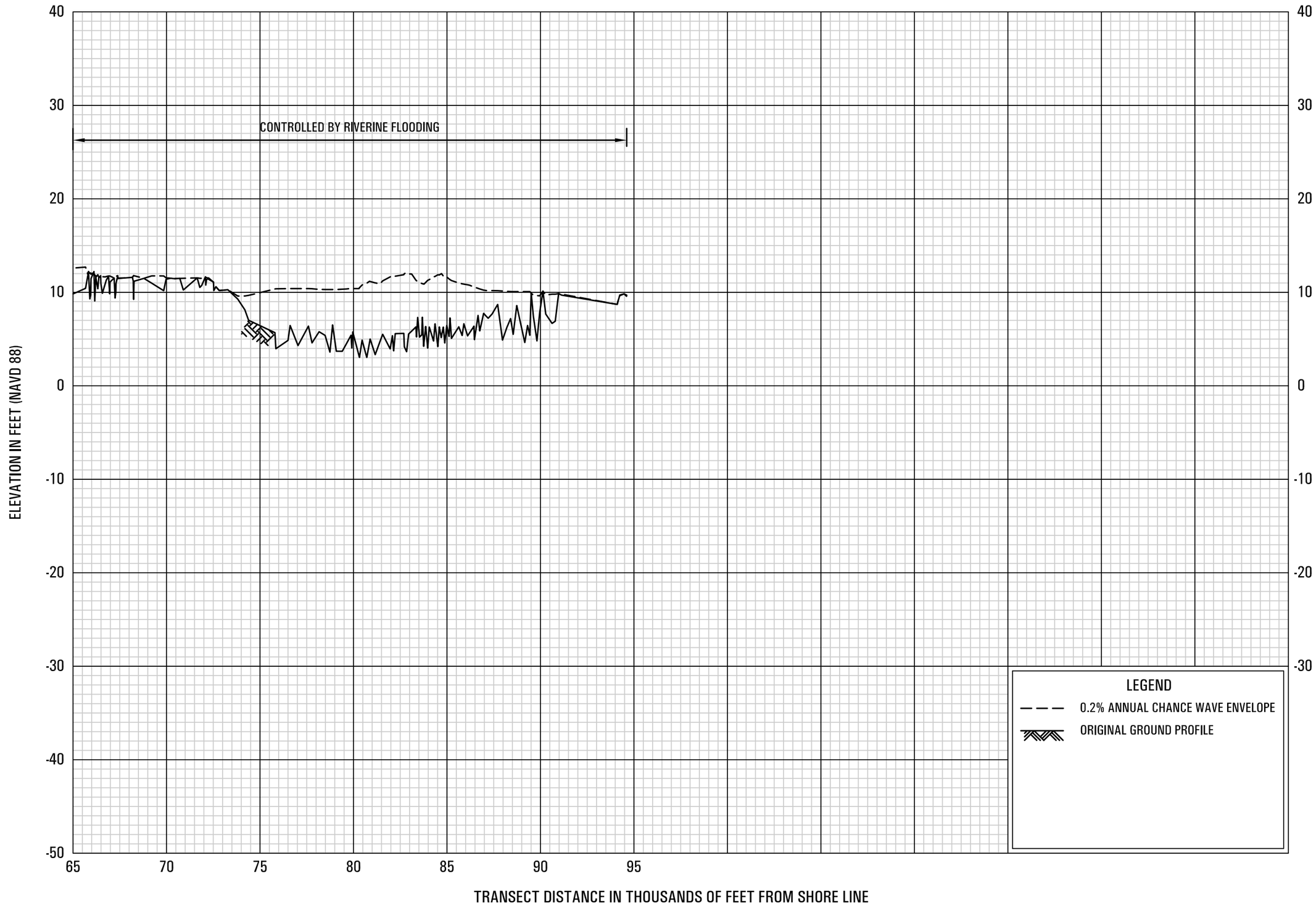
TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

11P



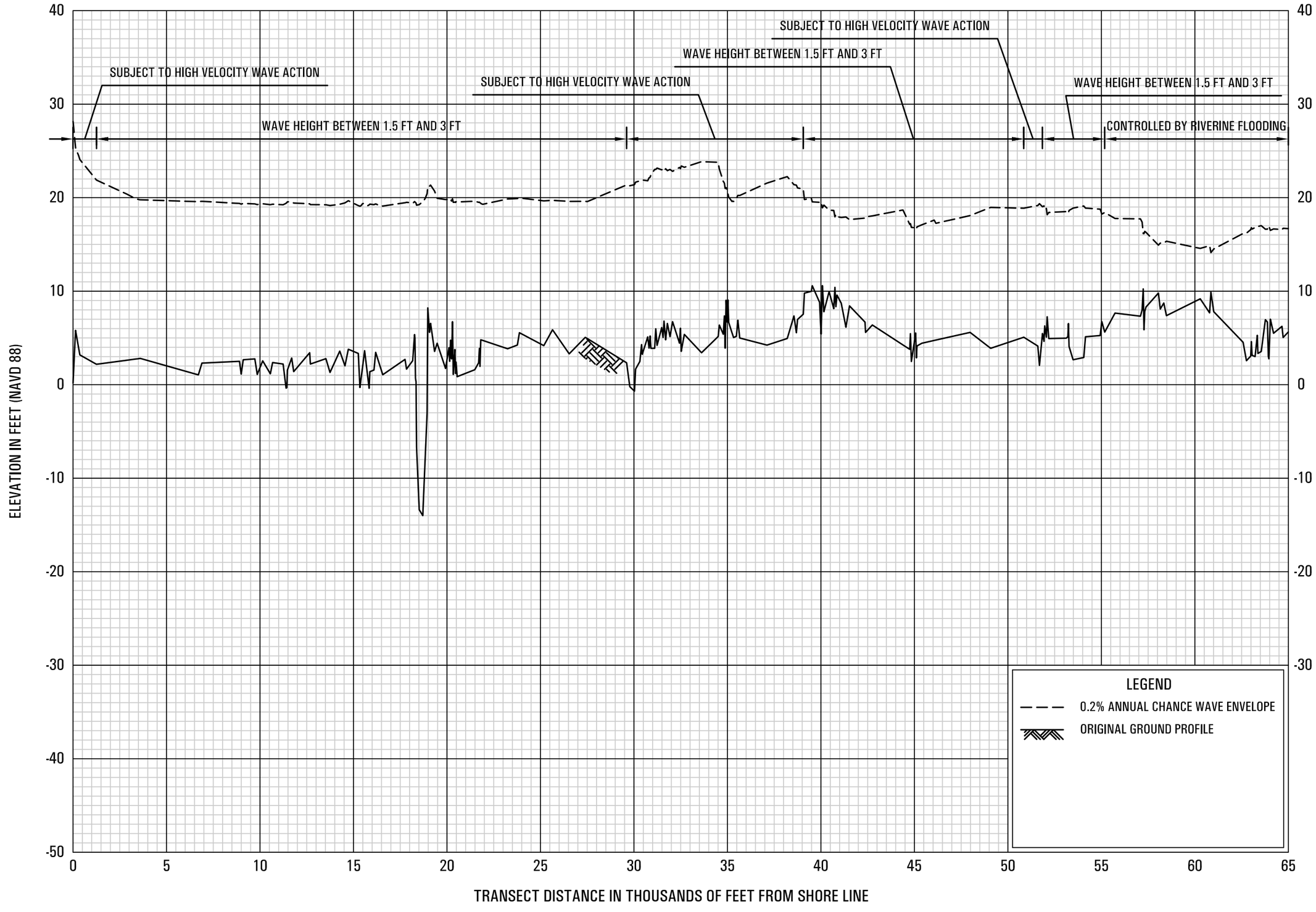
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

12P



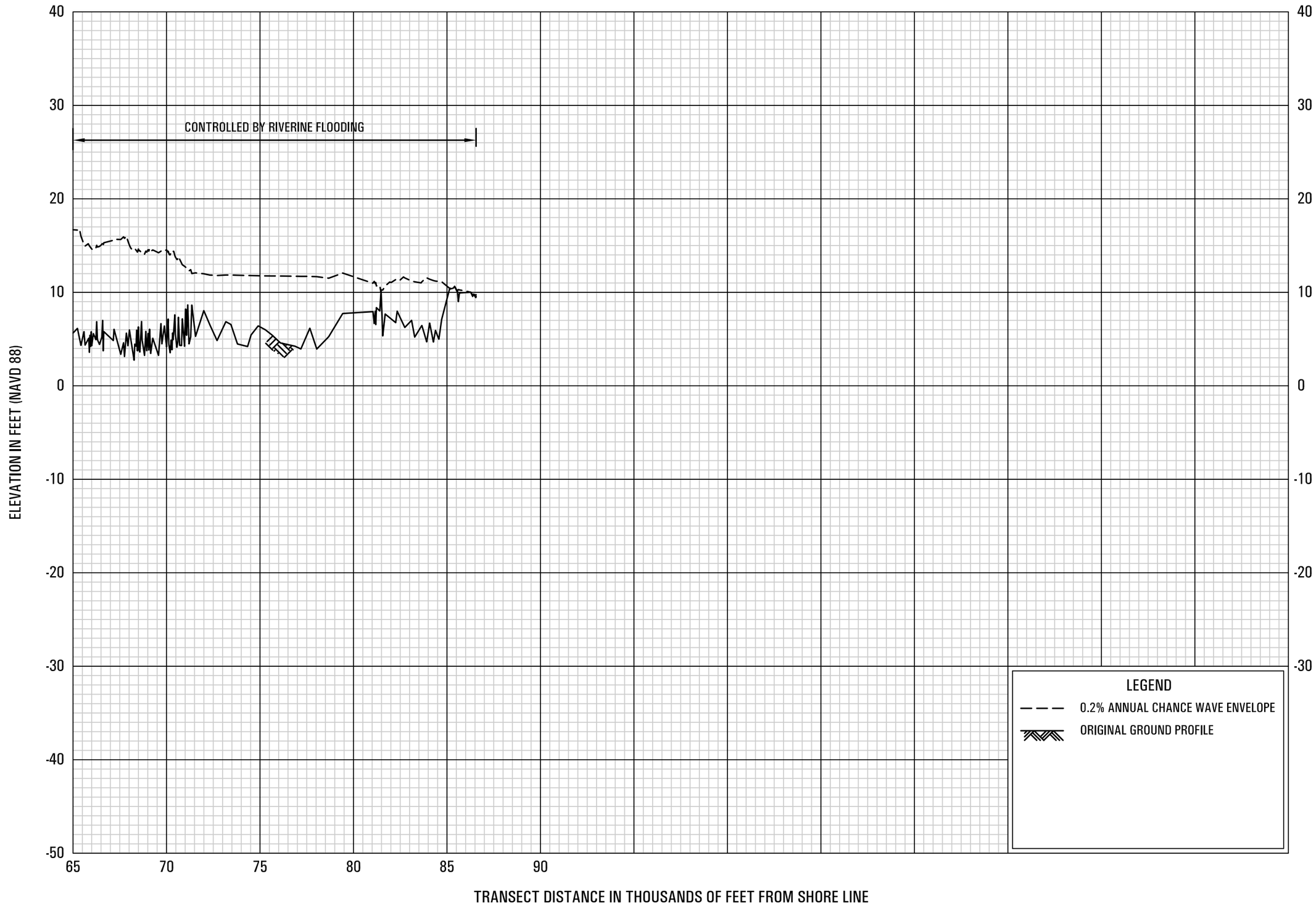
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

13P



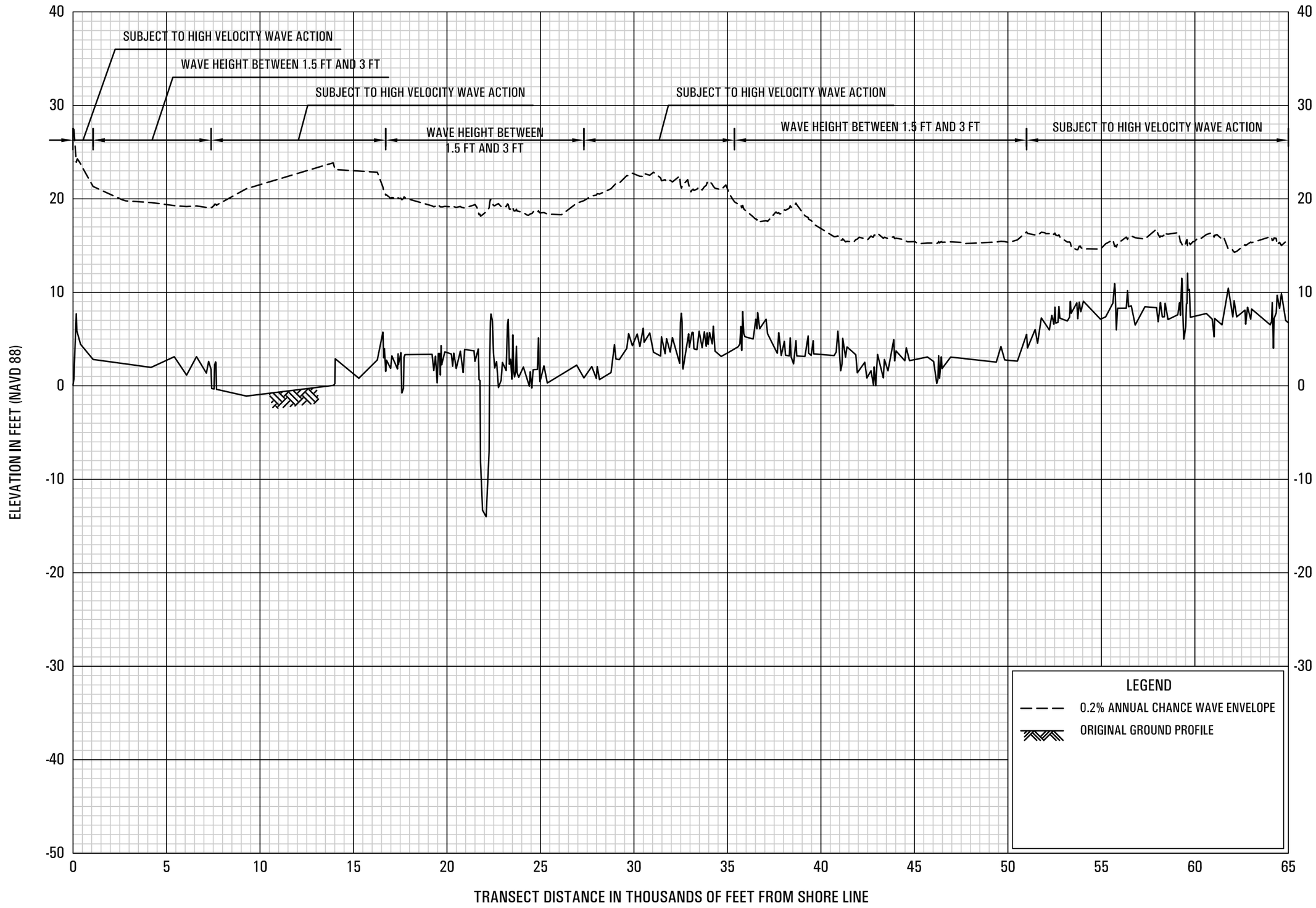
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

14P



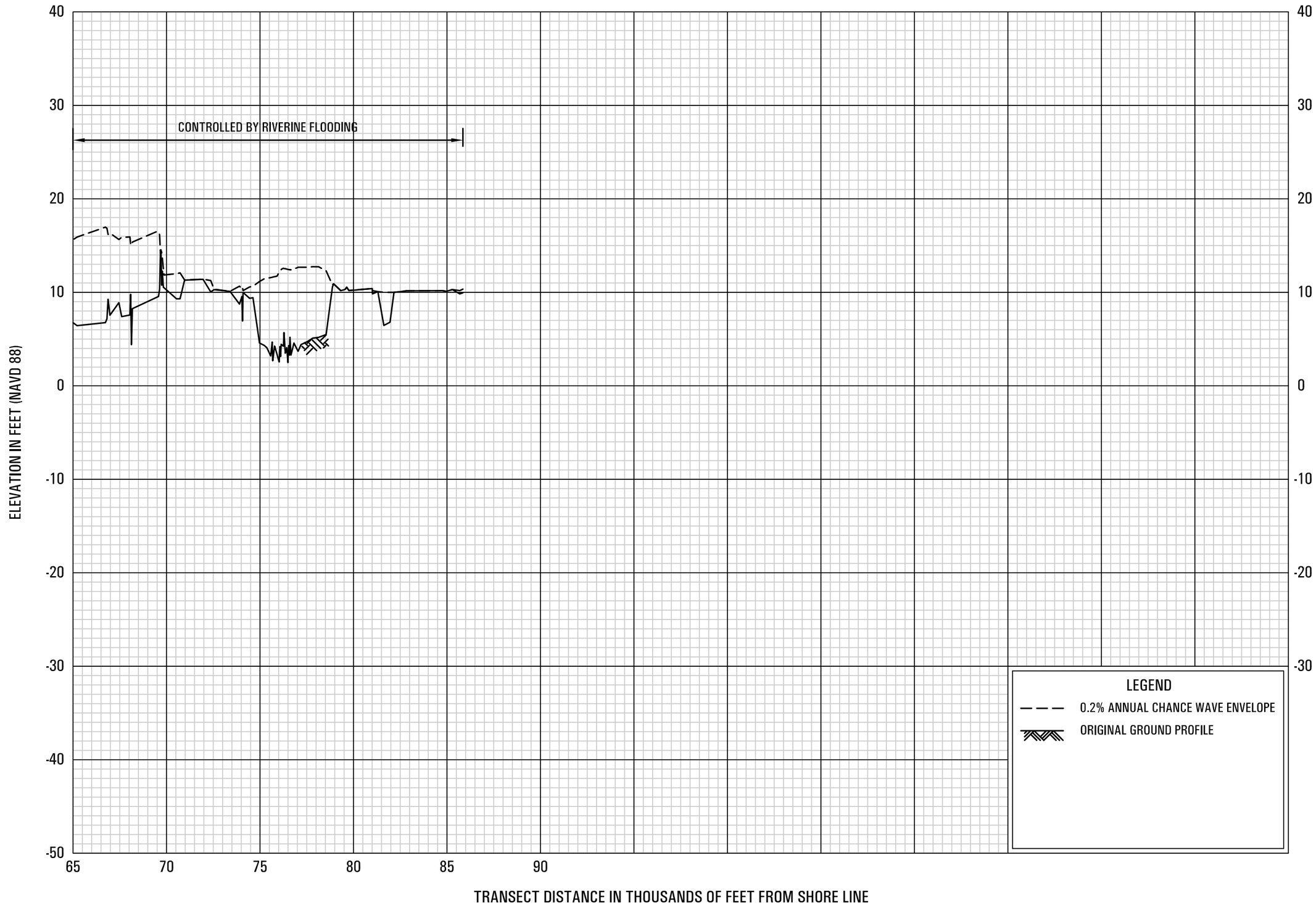
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

15P



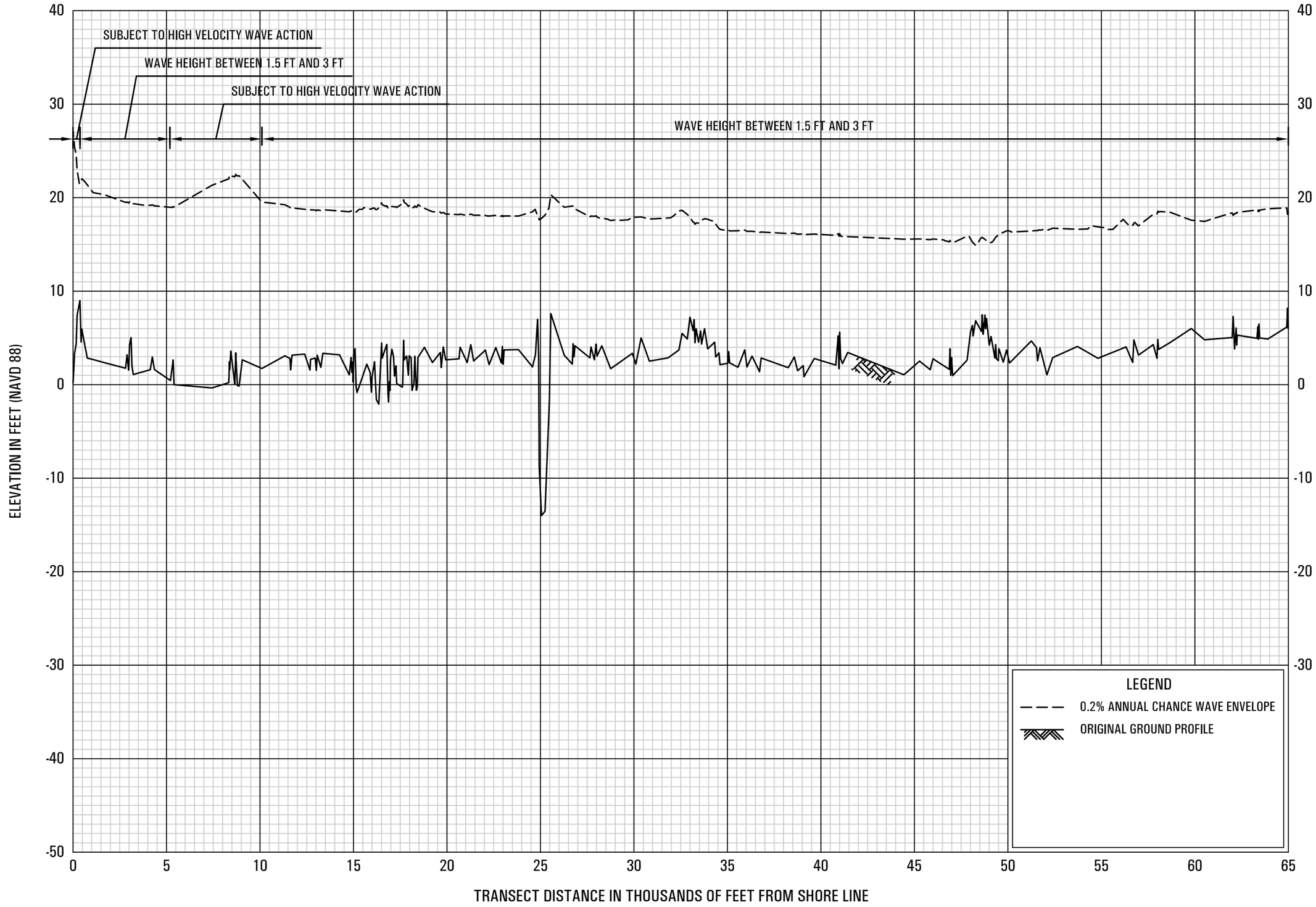
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

16P



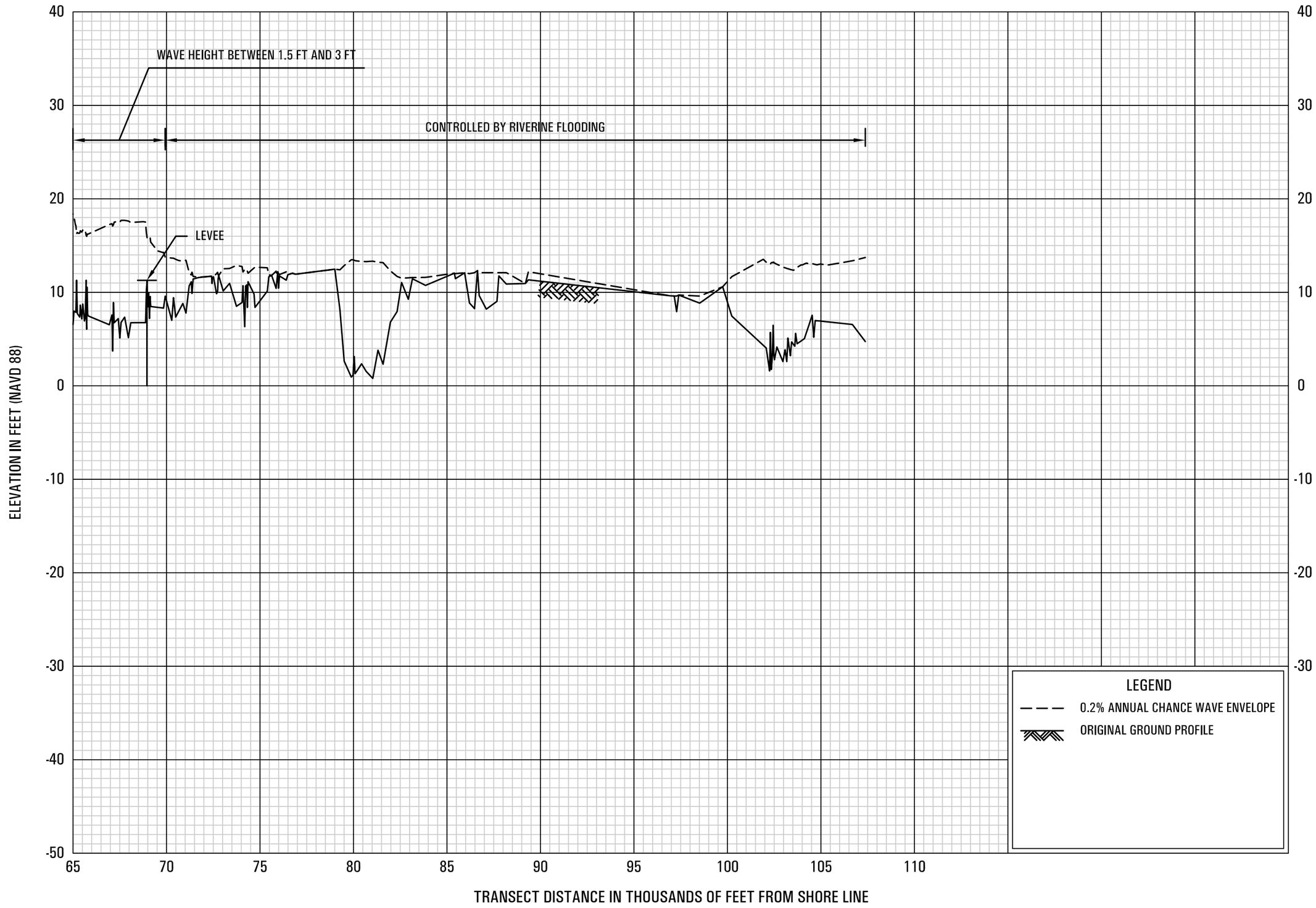
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

17P

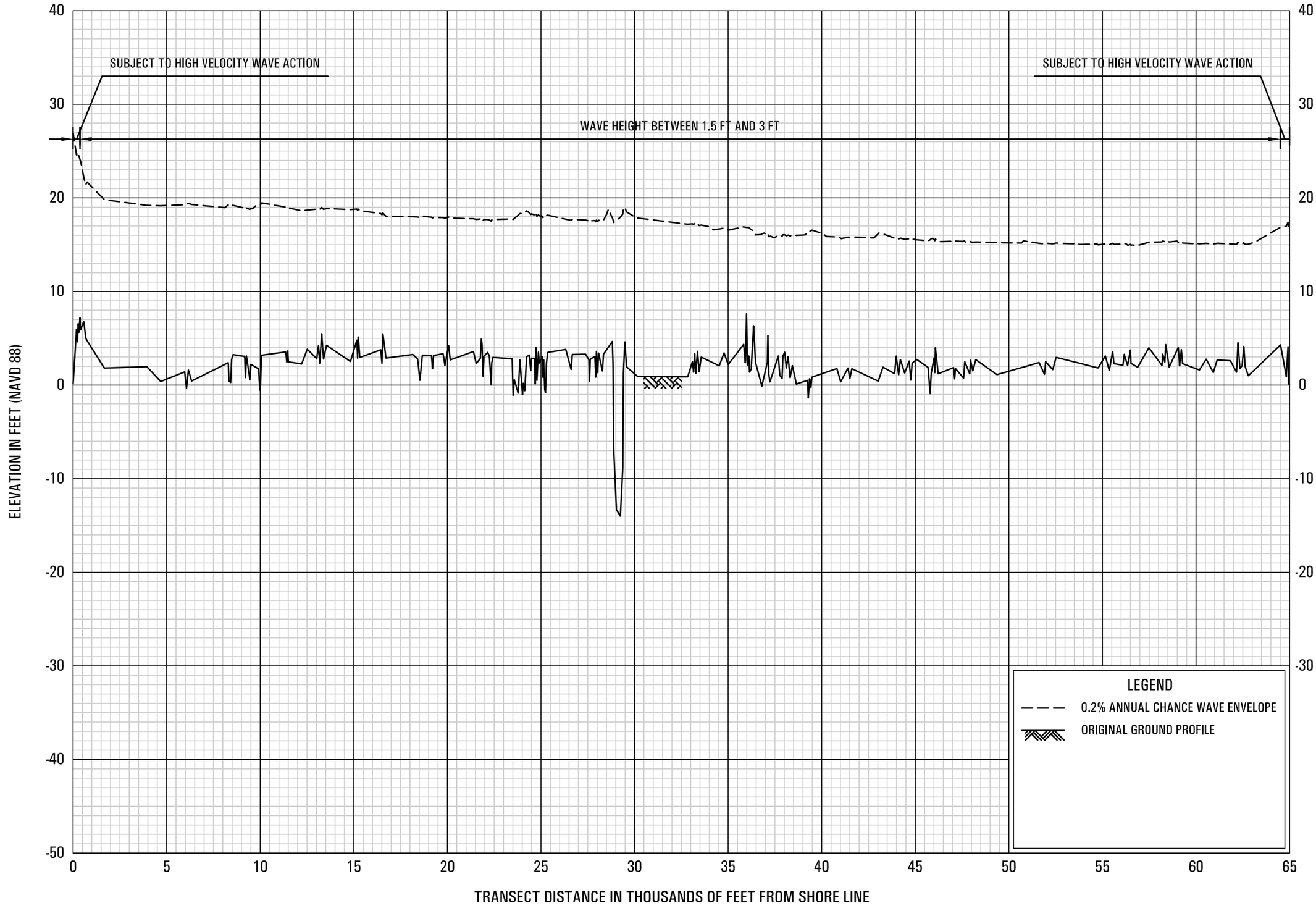


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

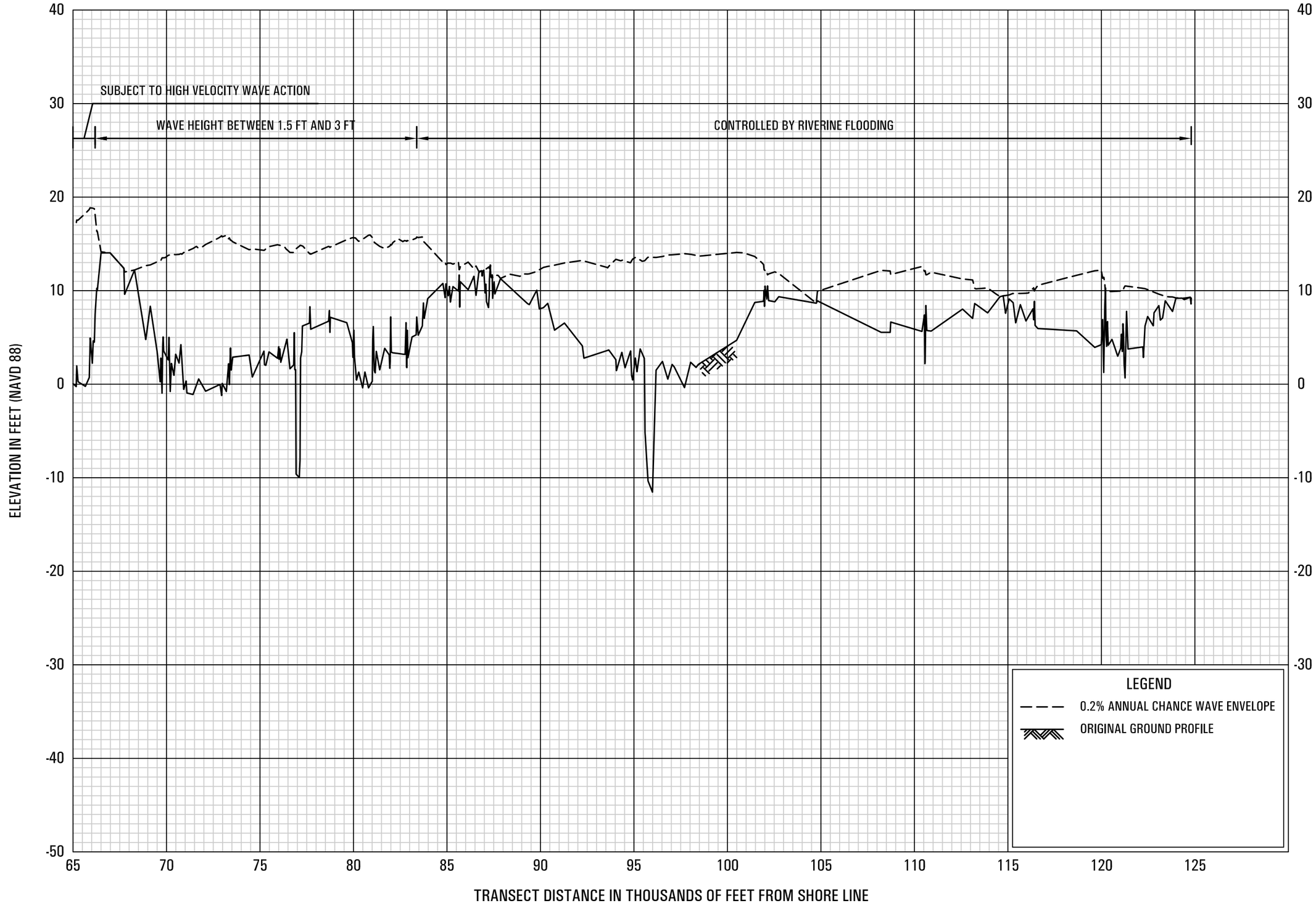


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

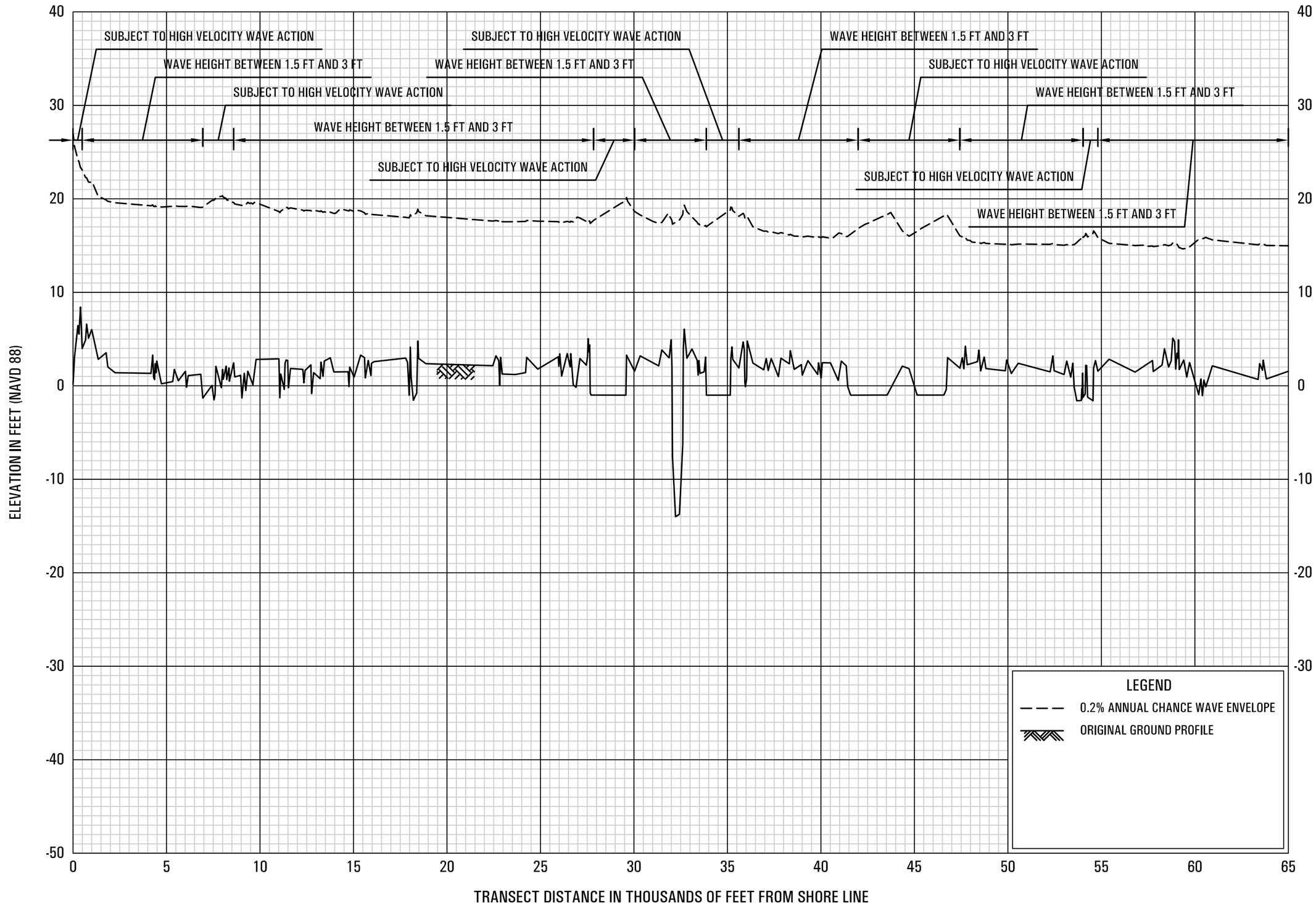
TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

20P



0.2% ANNUAL CHANCE WAVE ENVELOPE

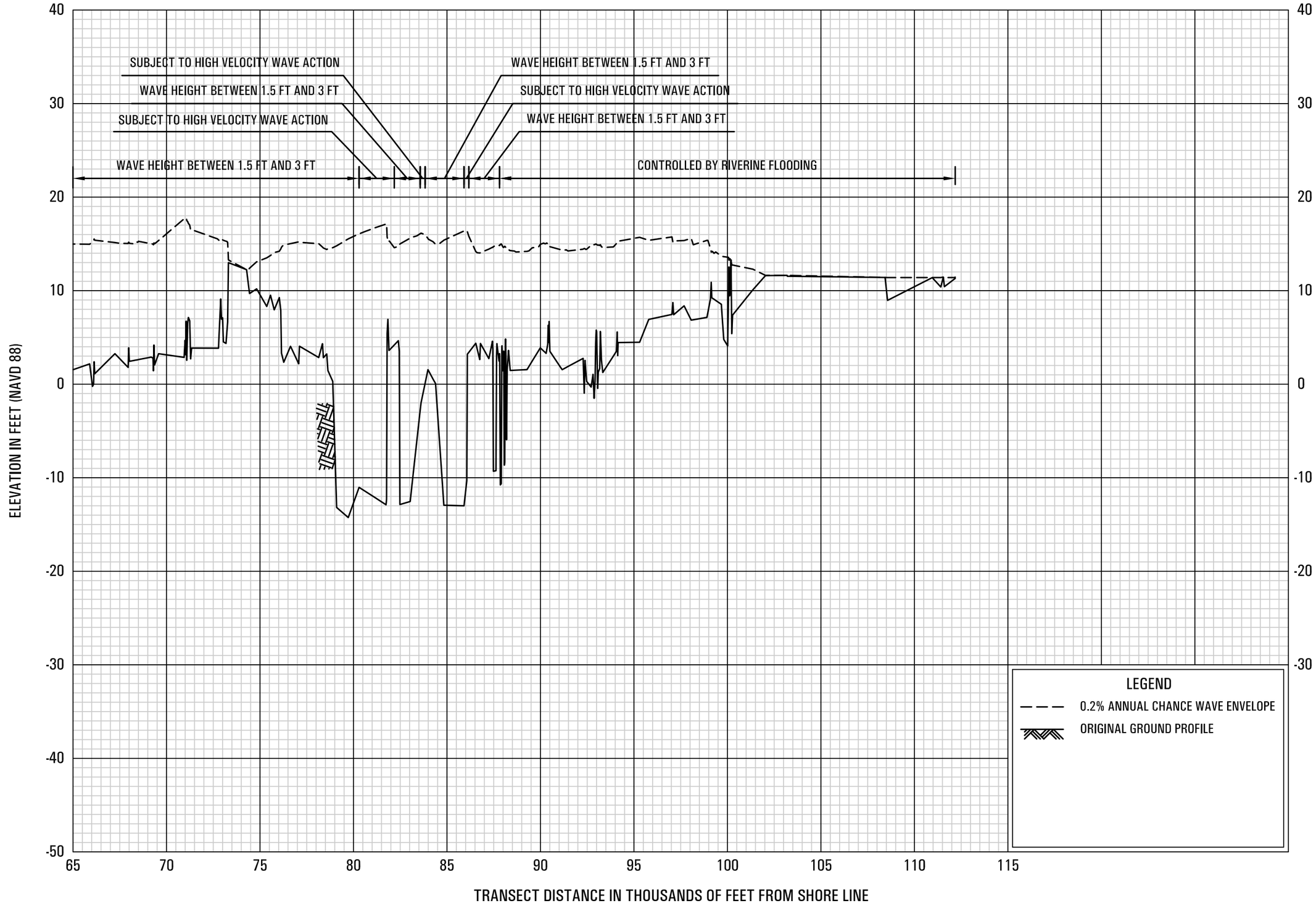
TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

21P



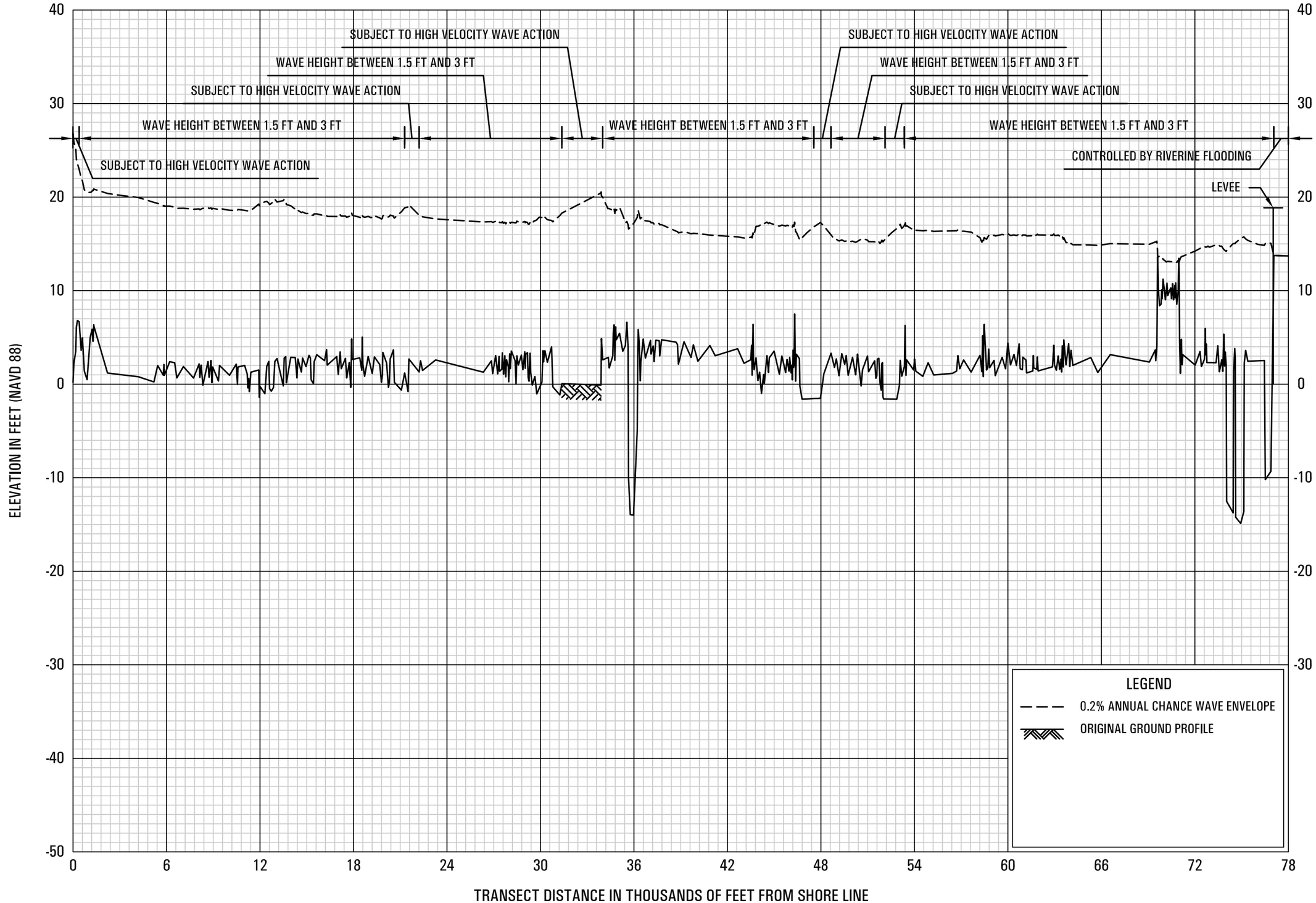
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

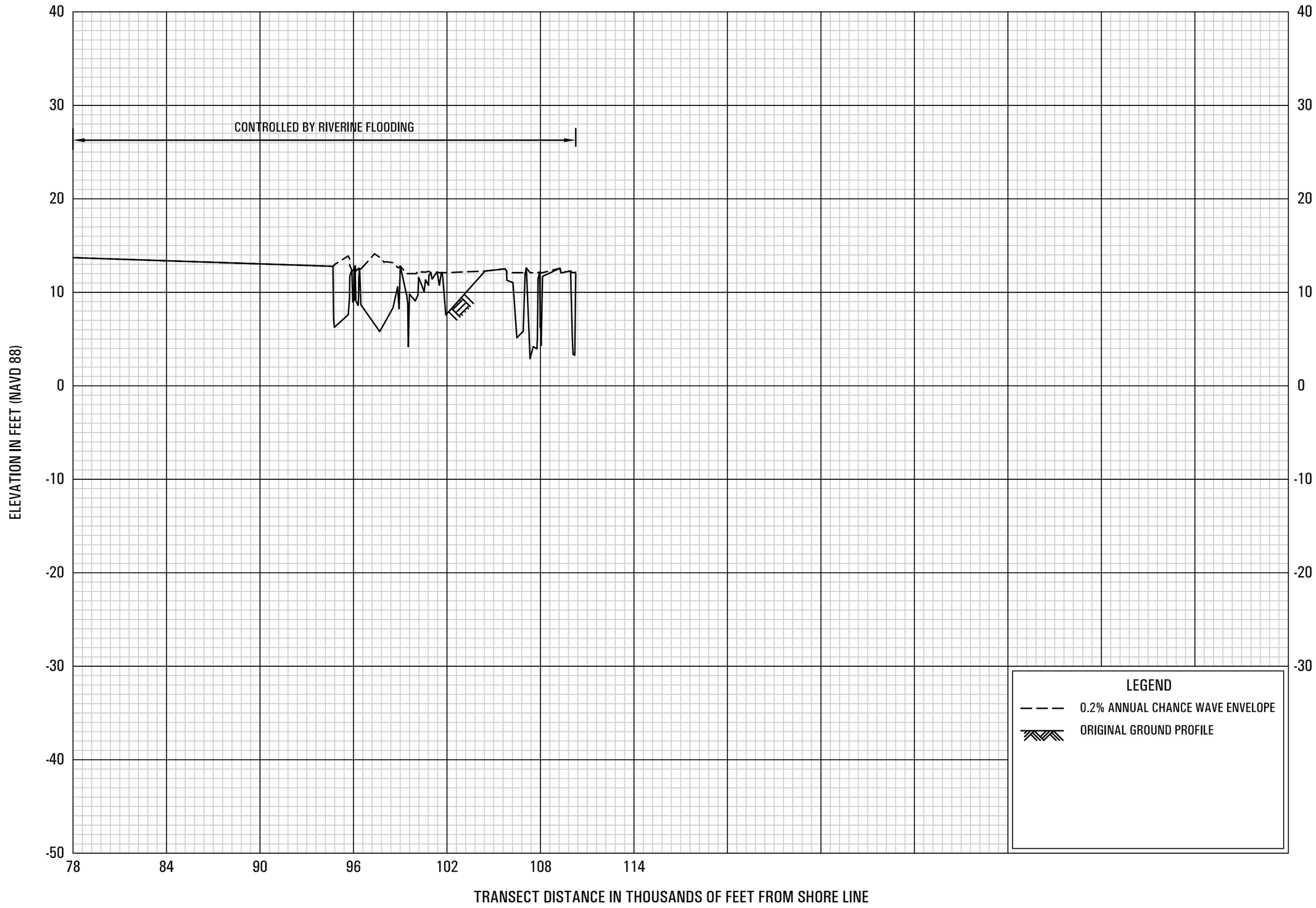


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



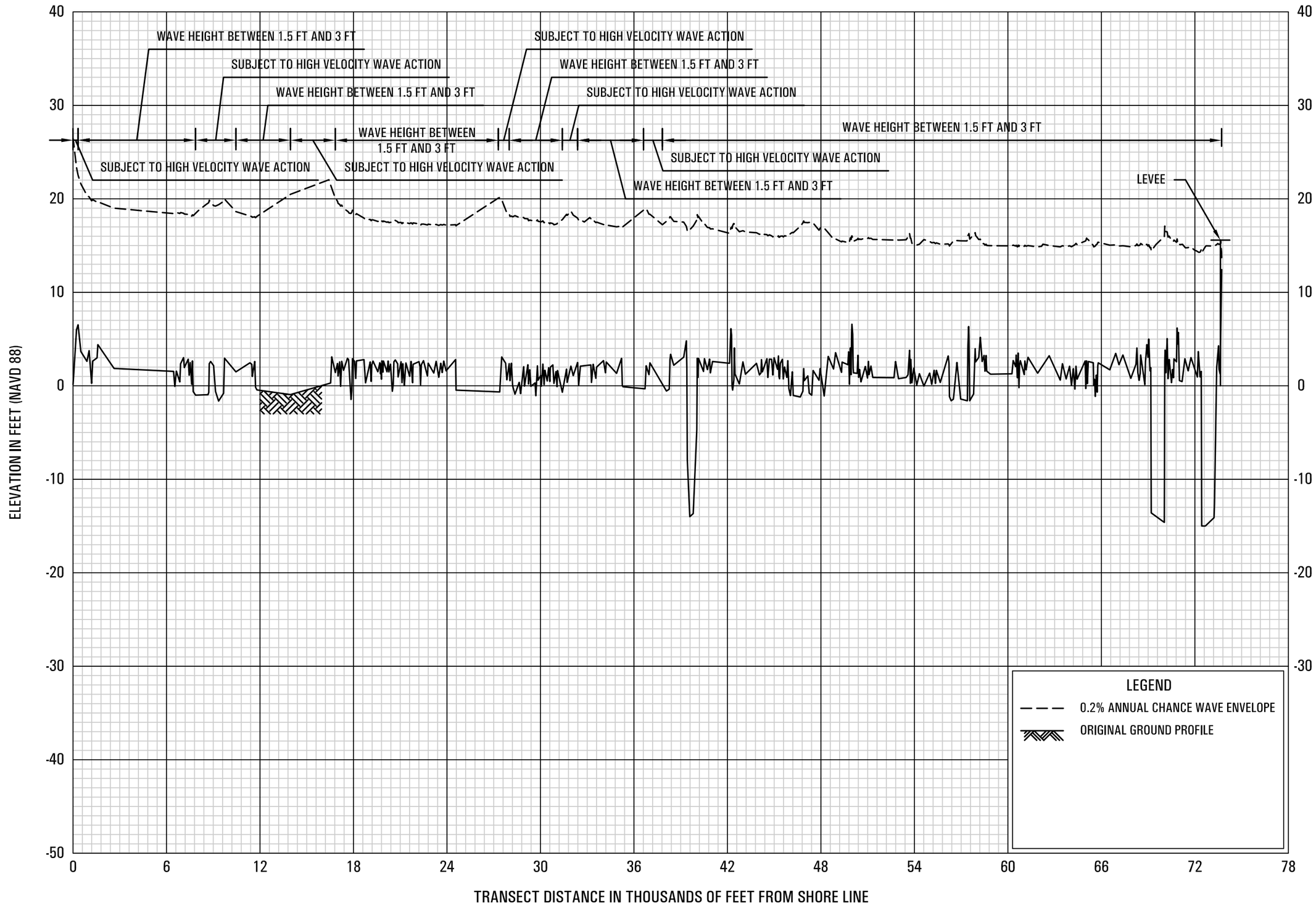
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

24P



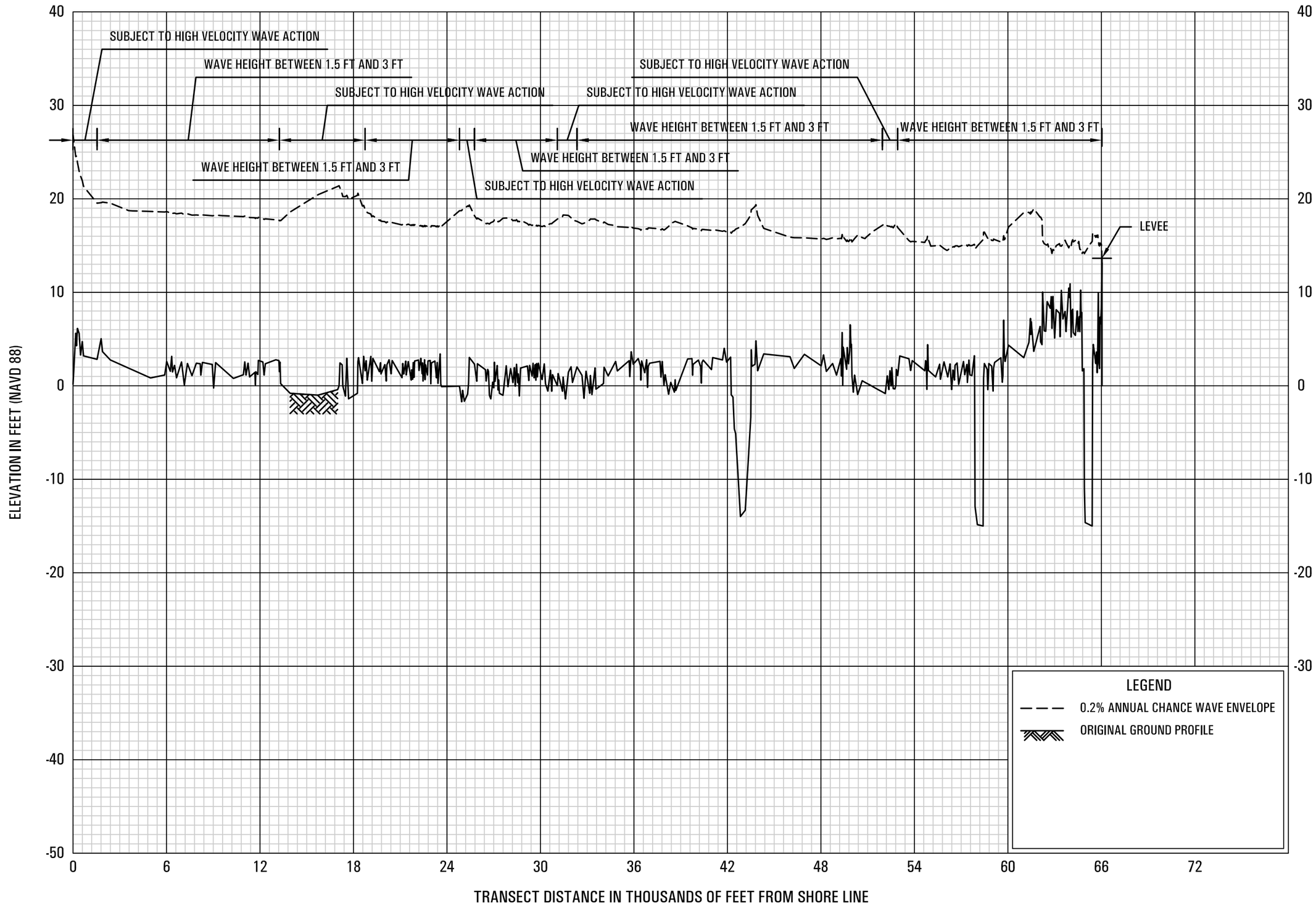
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

25P



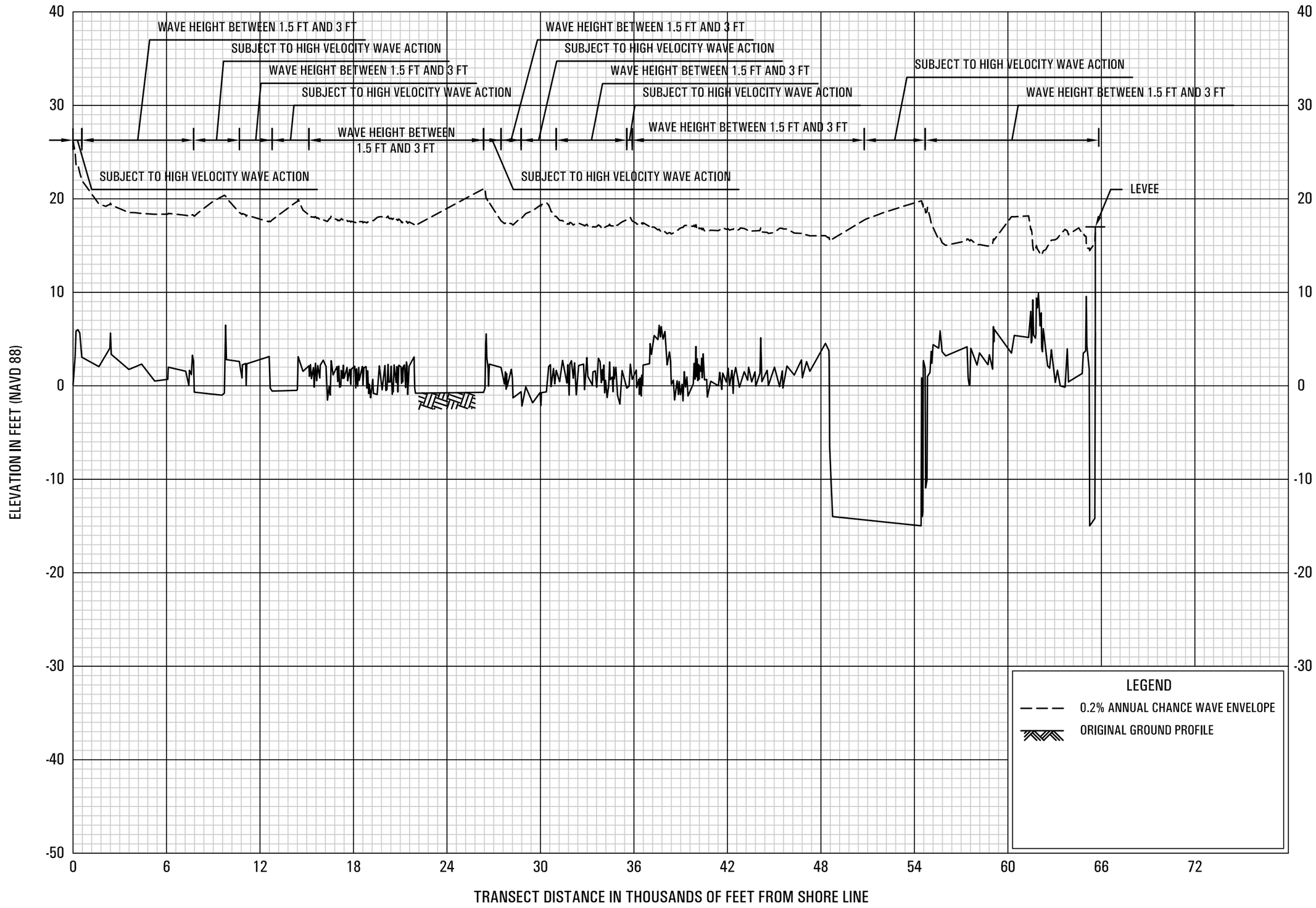
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

26P

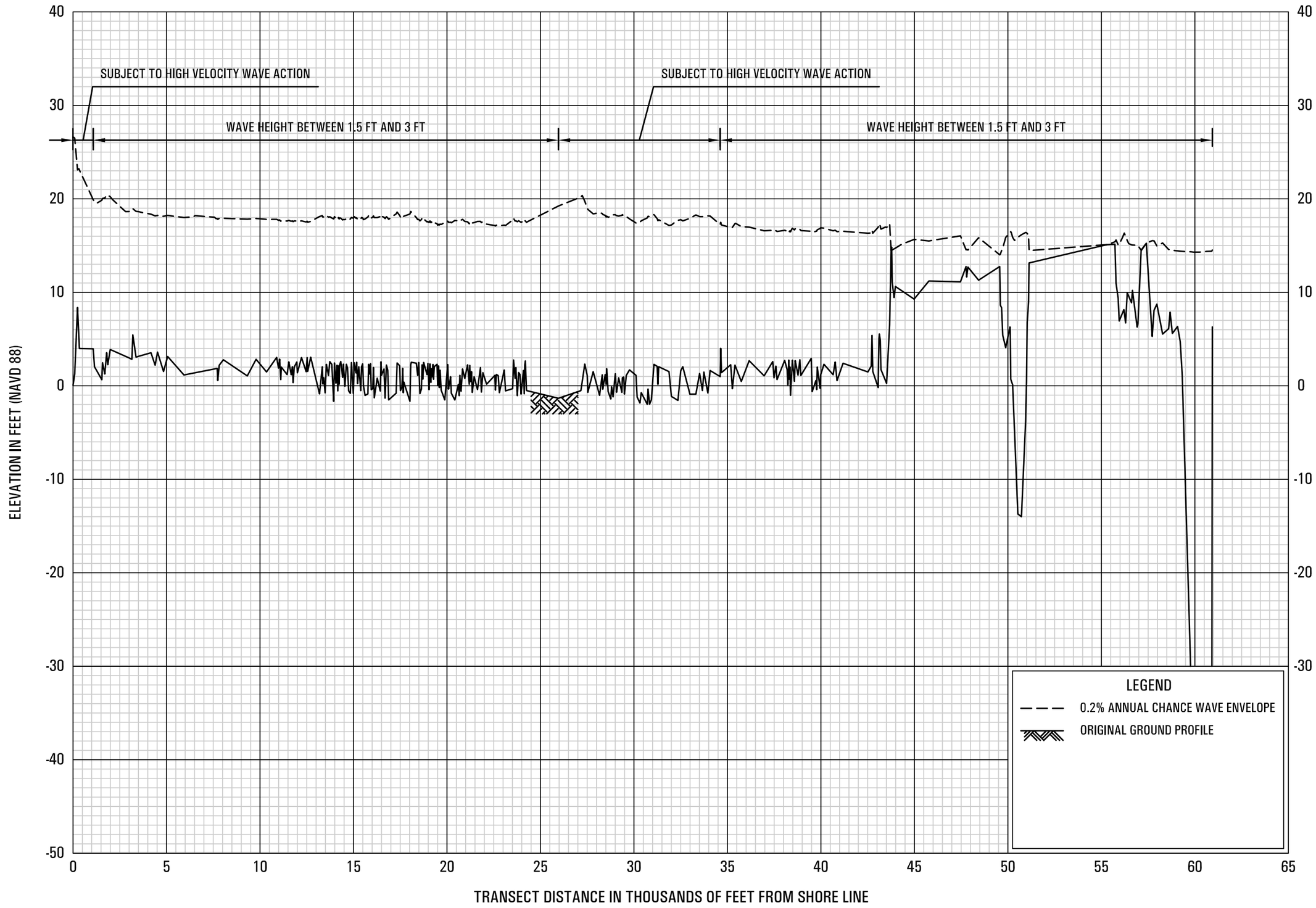


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

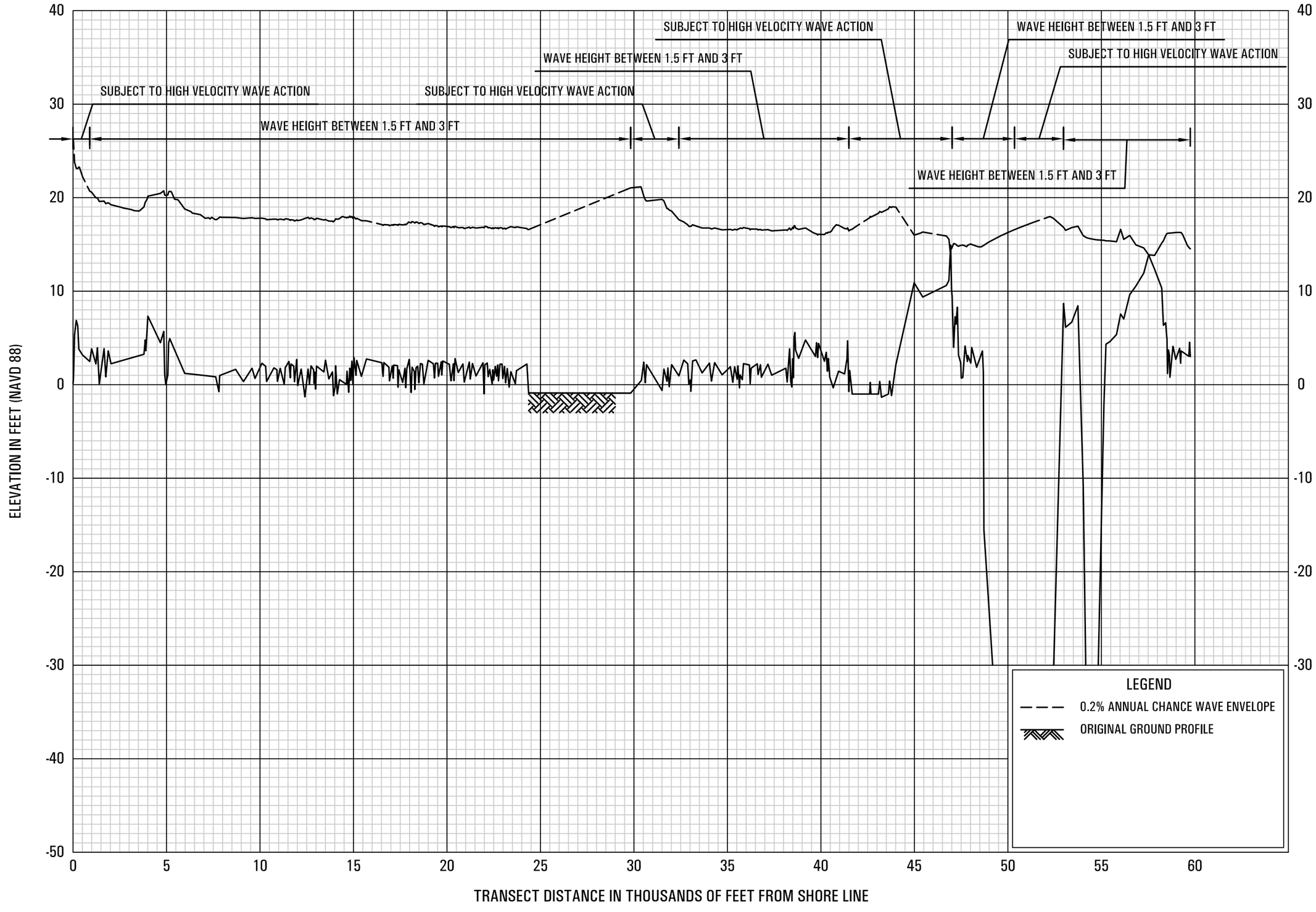


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

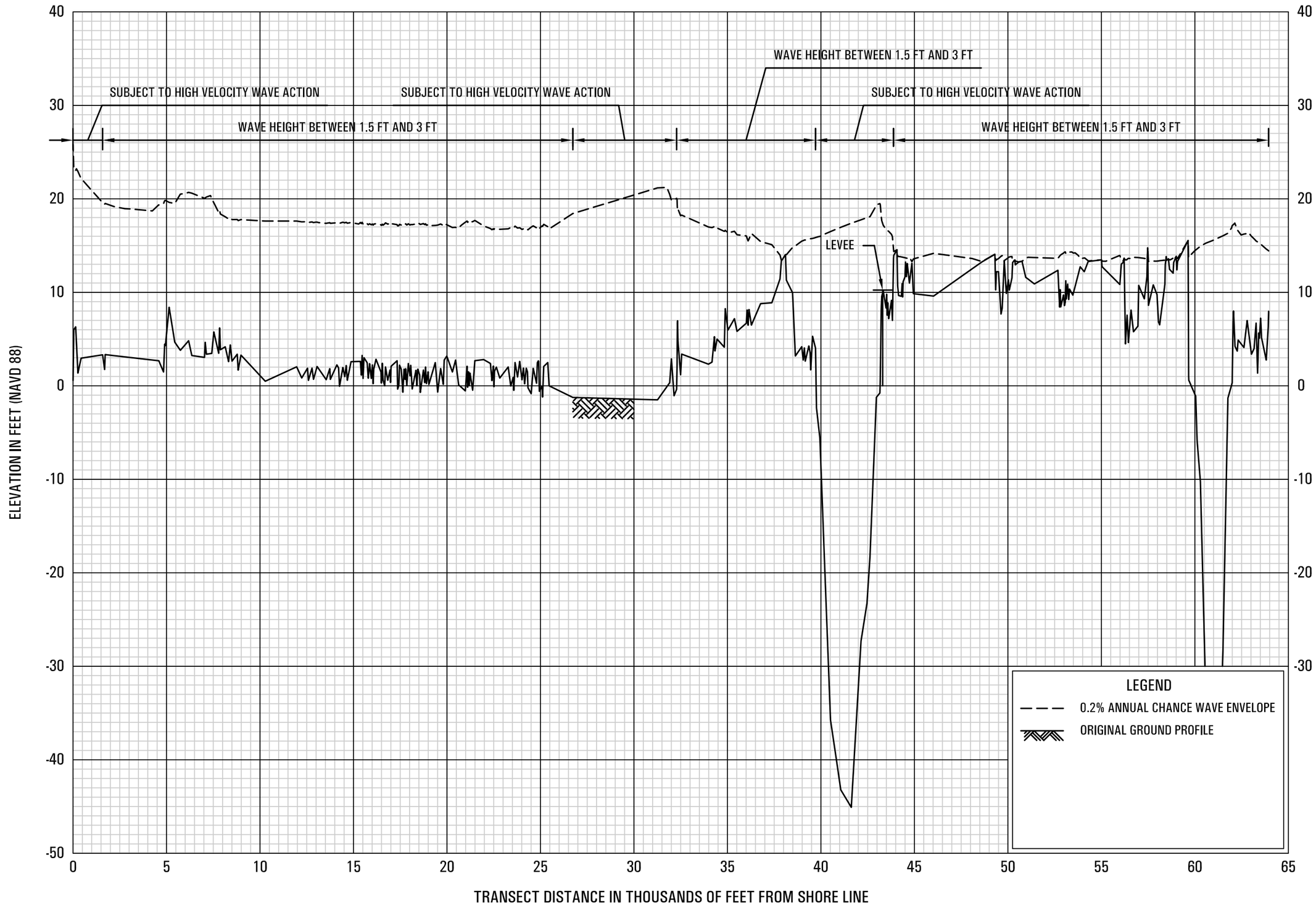
TRANSECT 19

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

29P



0.2% ANNUAL CHANCE WAVE ENVELOPE

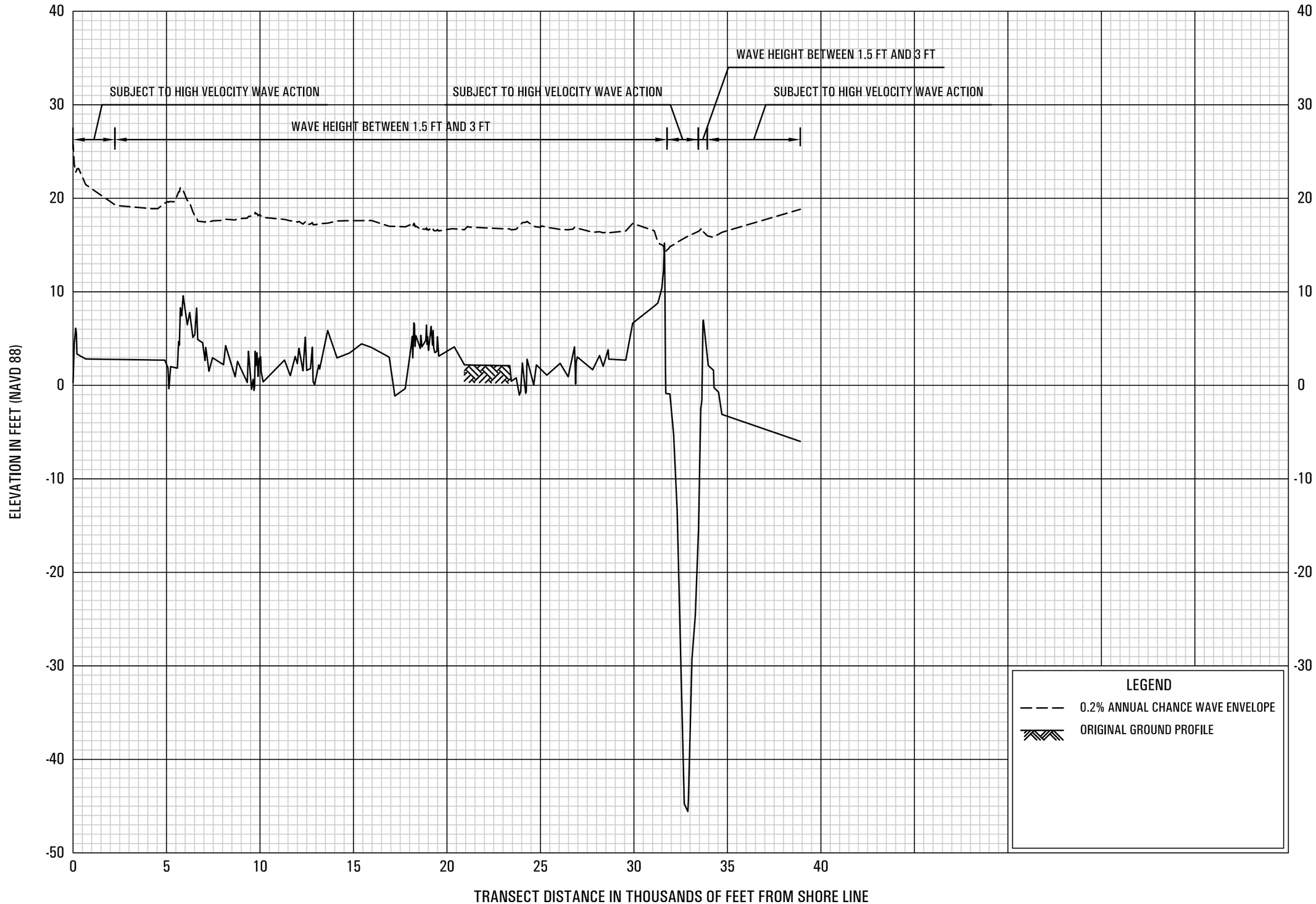
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

30P



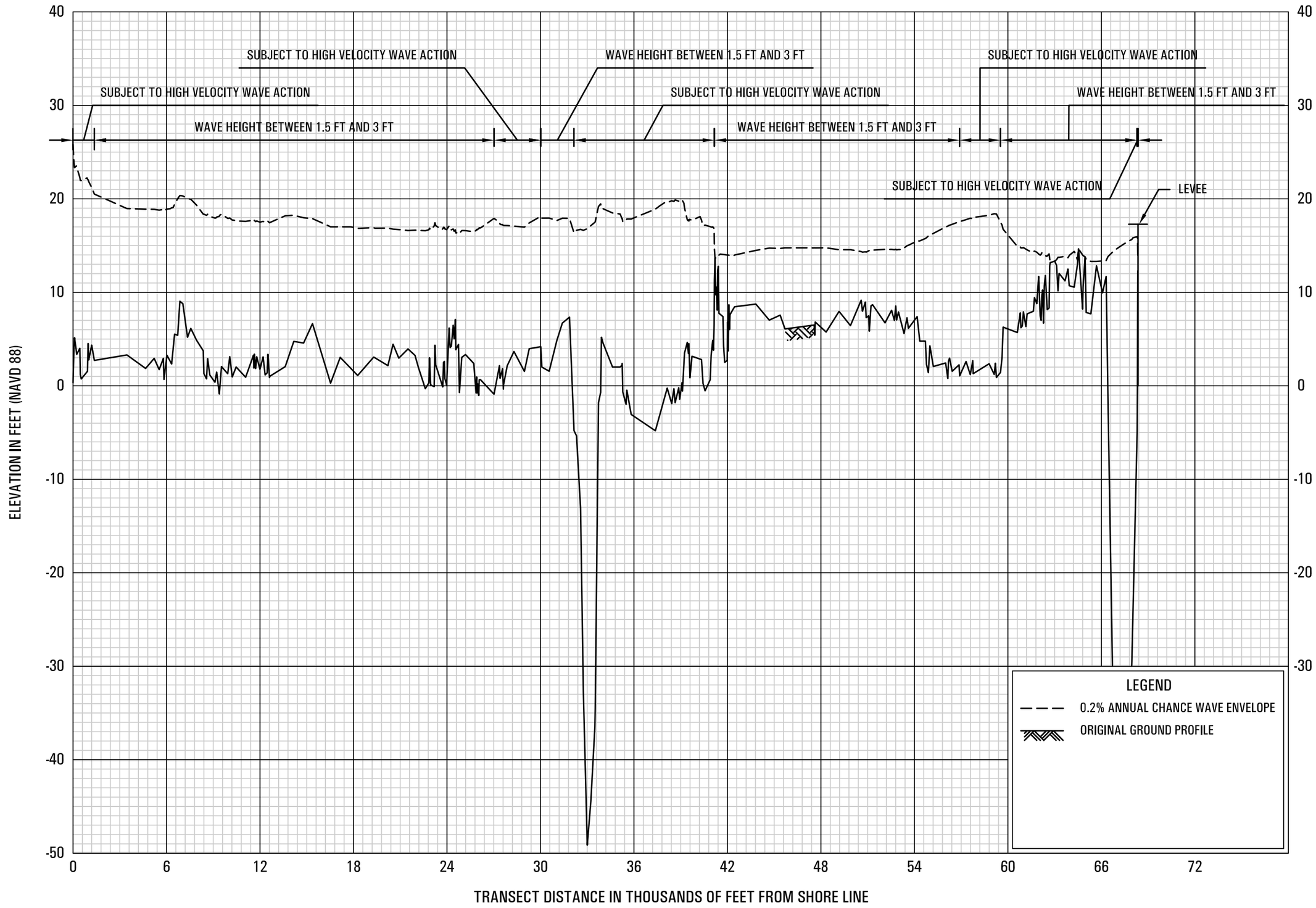
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



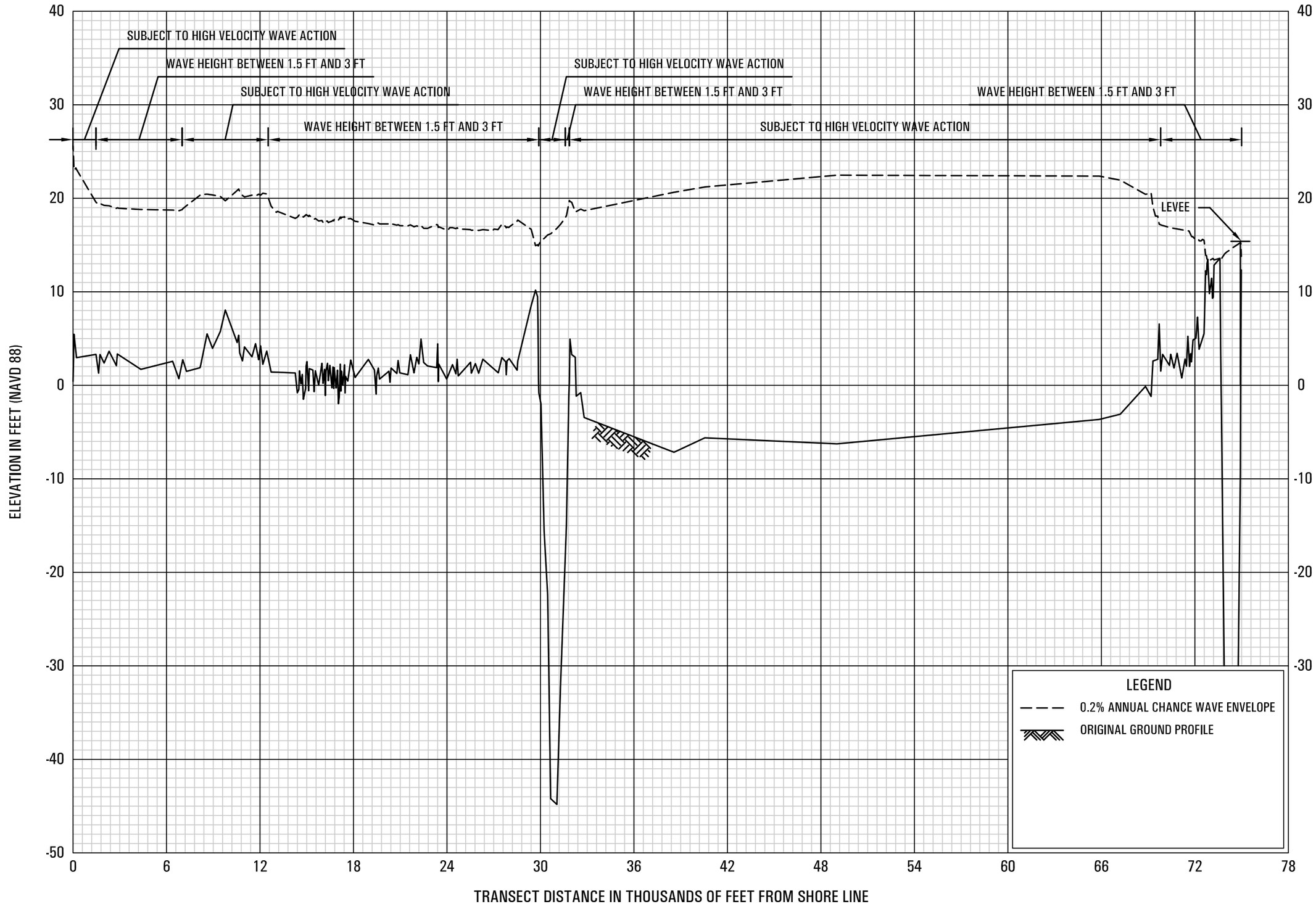
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 22

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

32P



0.2% ANNUAL CHANCE WAVE ENVELOPE

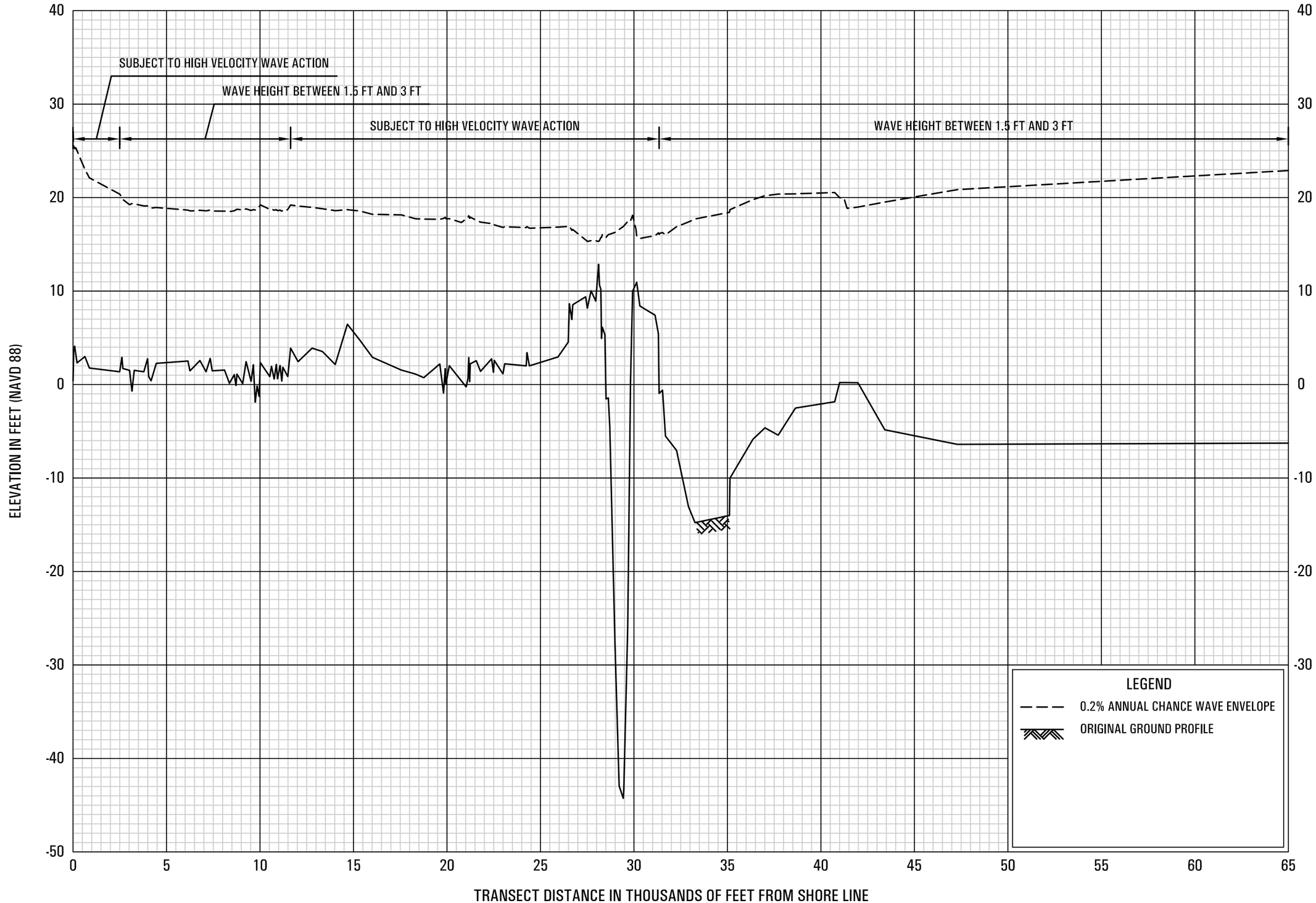
TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

33P



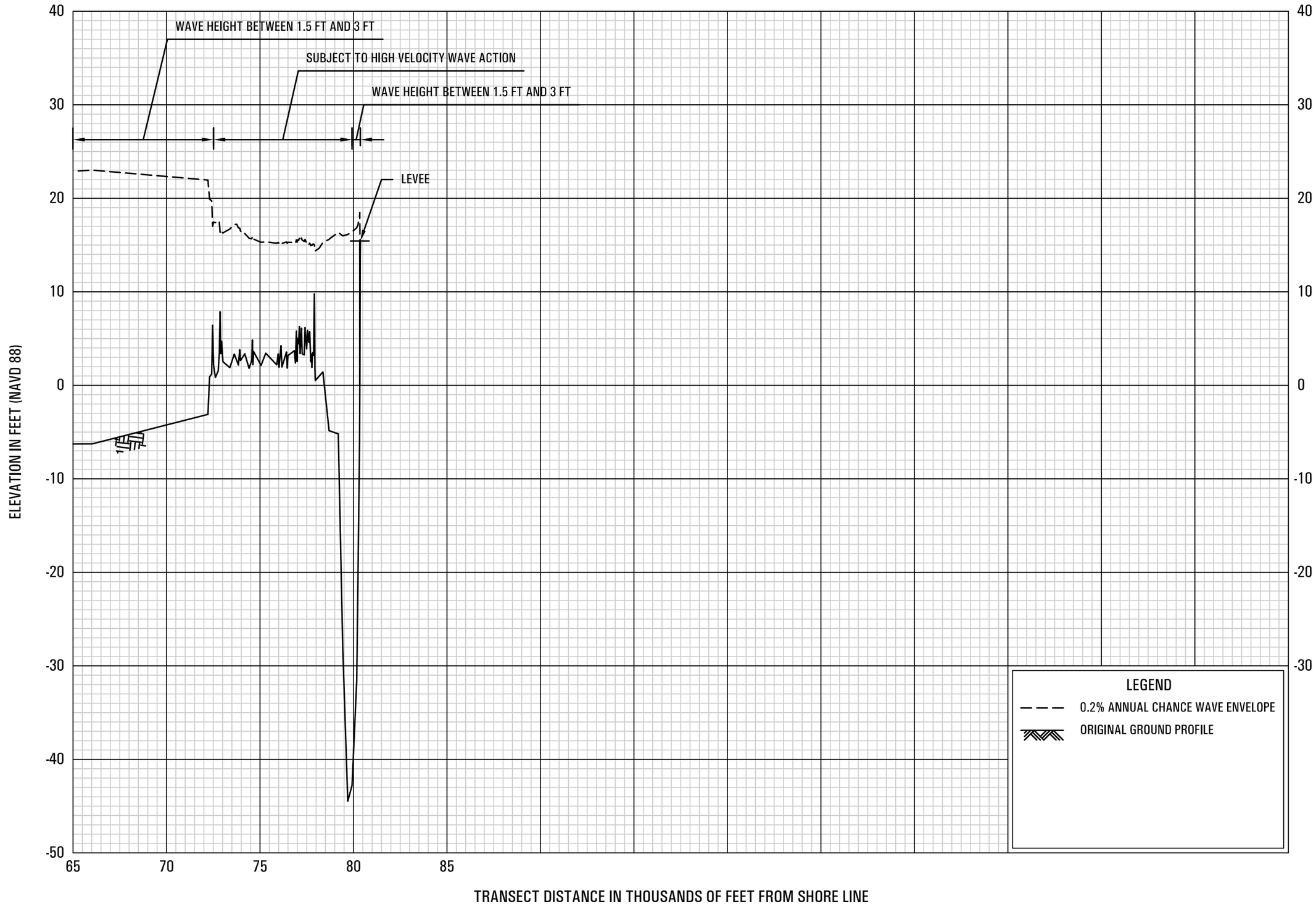
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 224

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

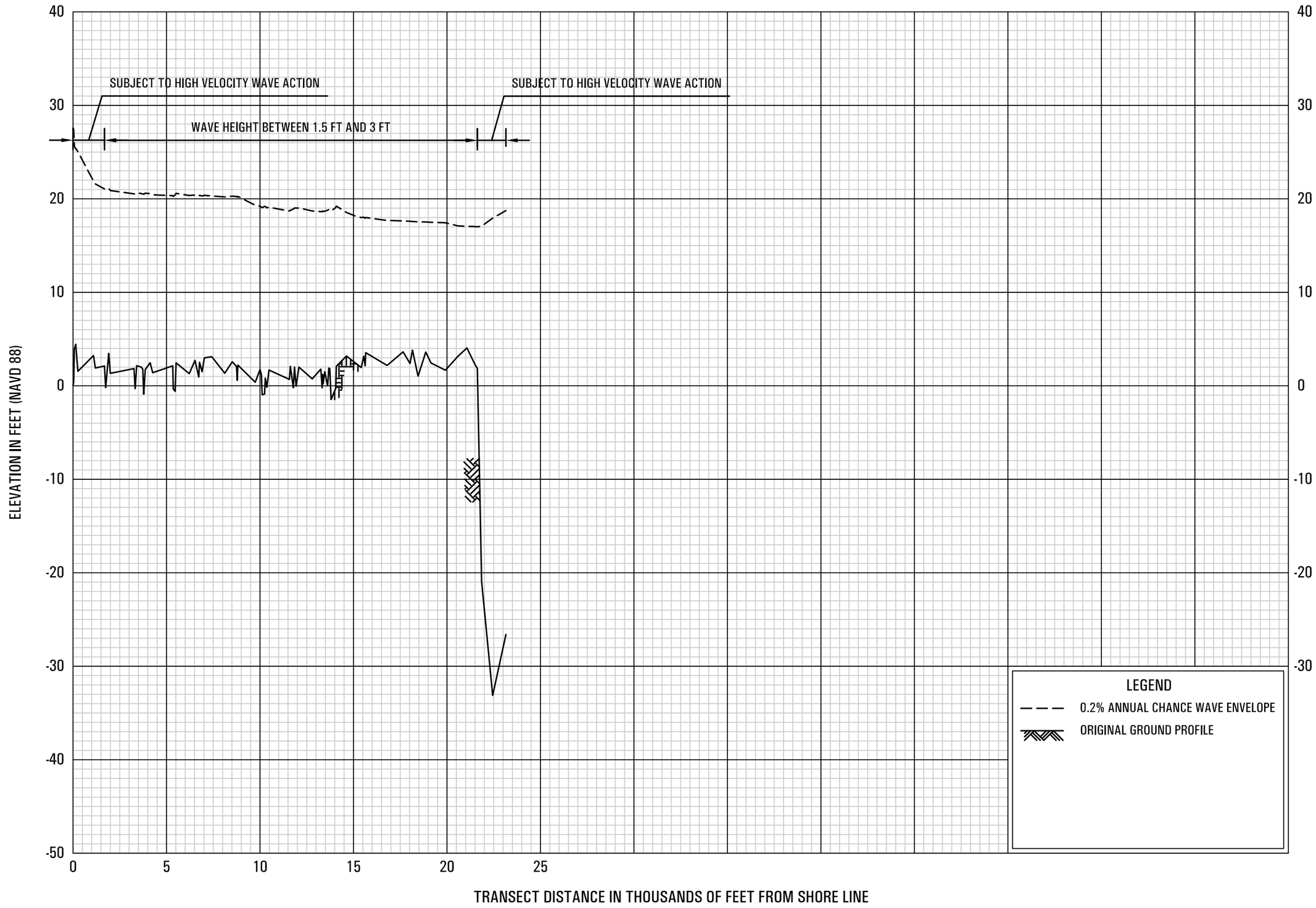
TRANSECT 24

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

35P



0.2% ANNUAL CHANCE WAVE ENVELOPE

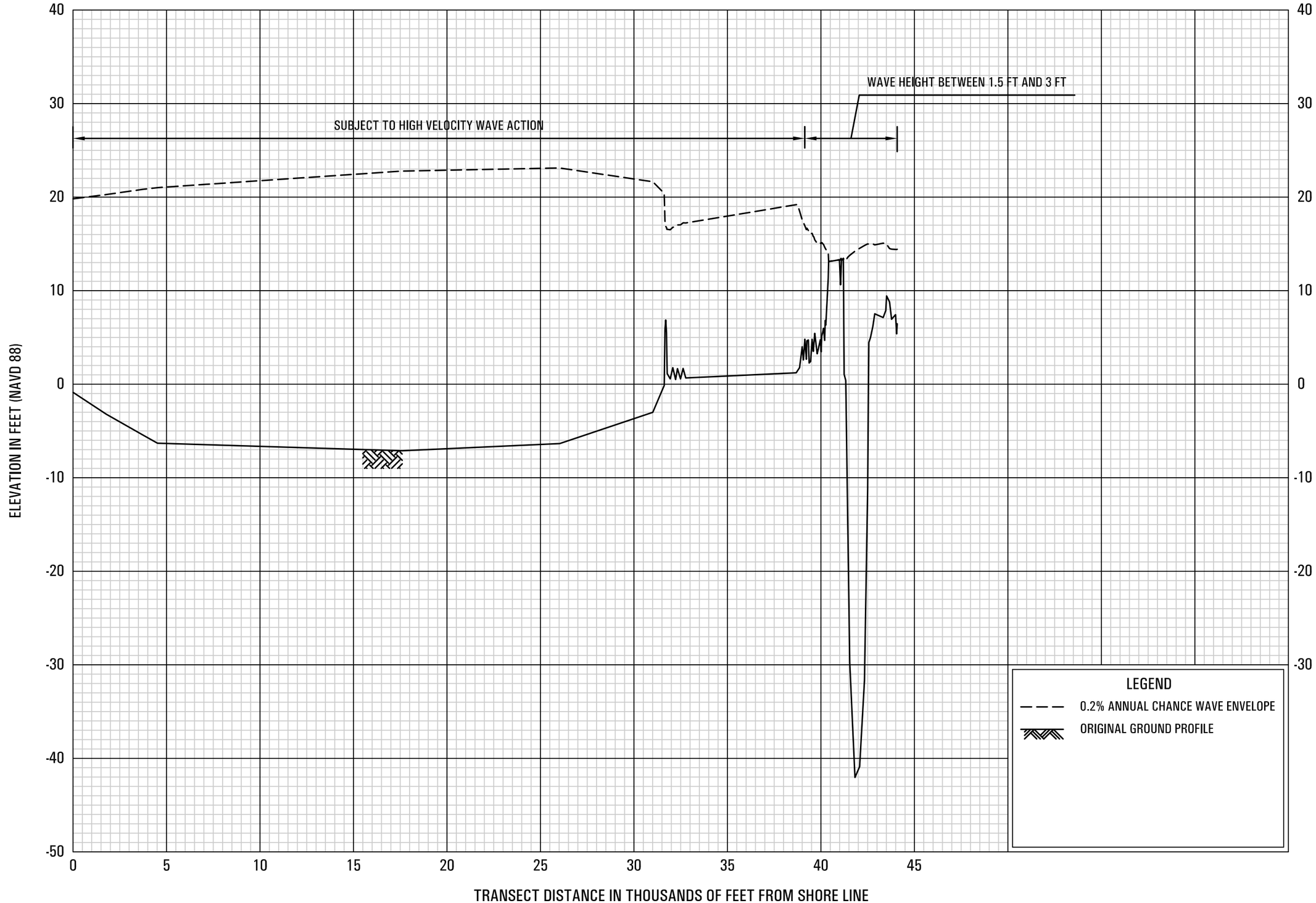
TRANSECT 25

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

36P

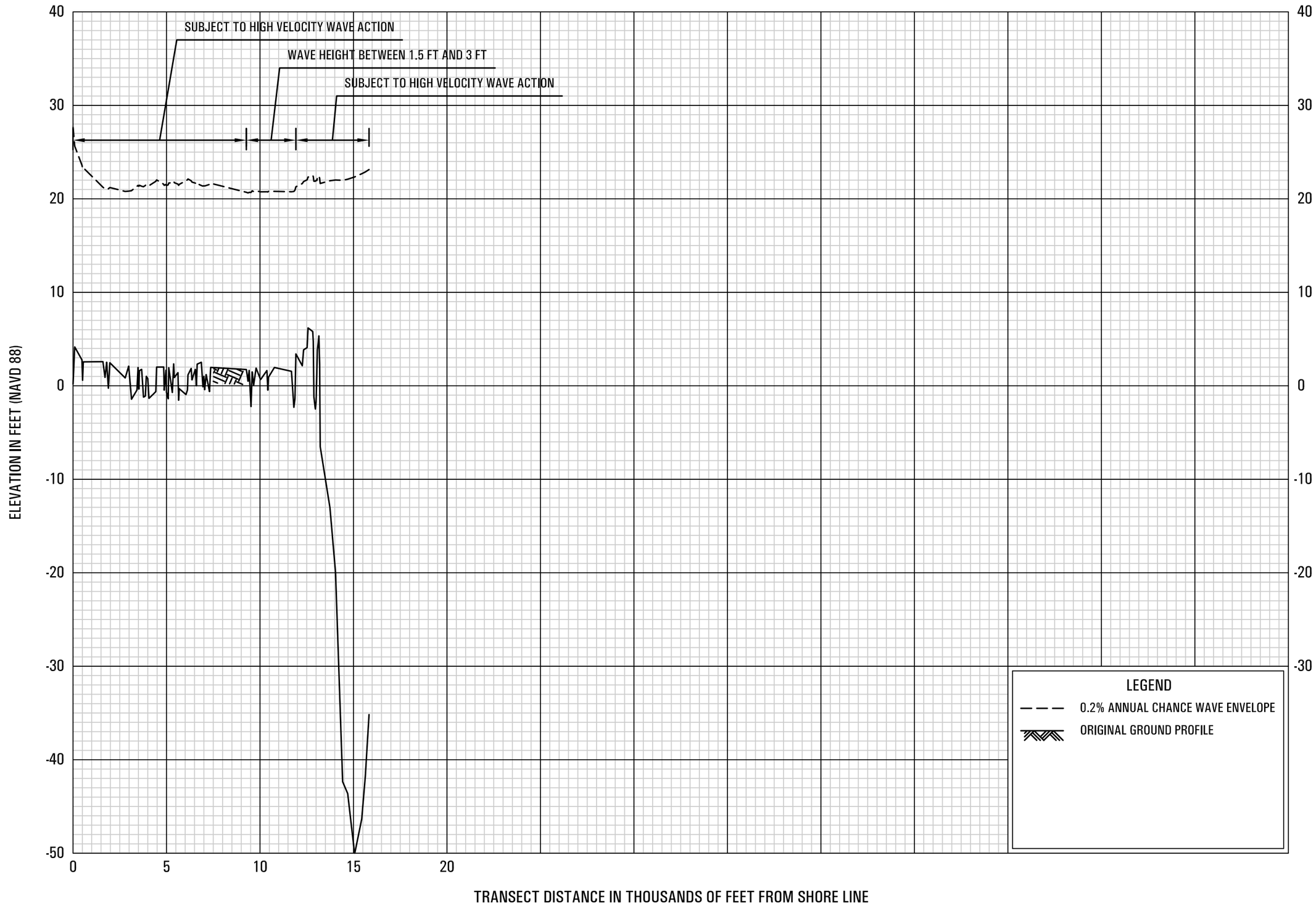


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 26

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



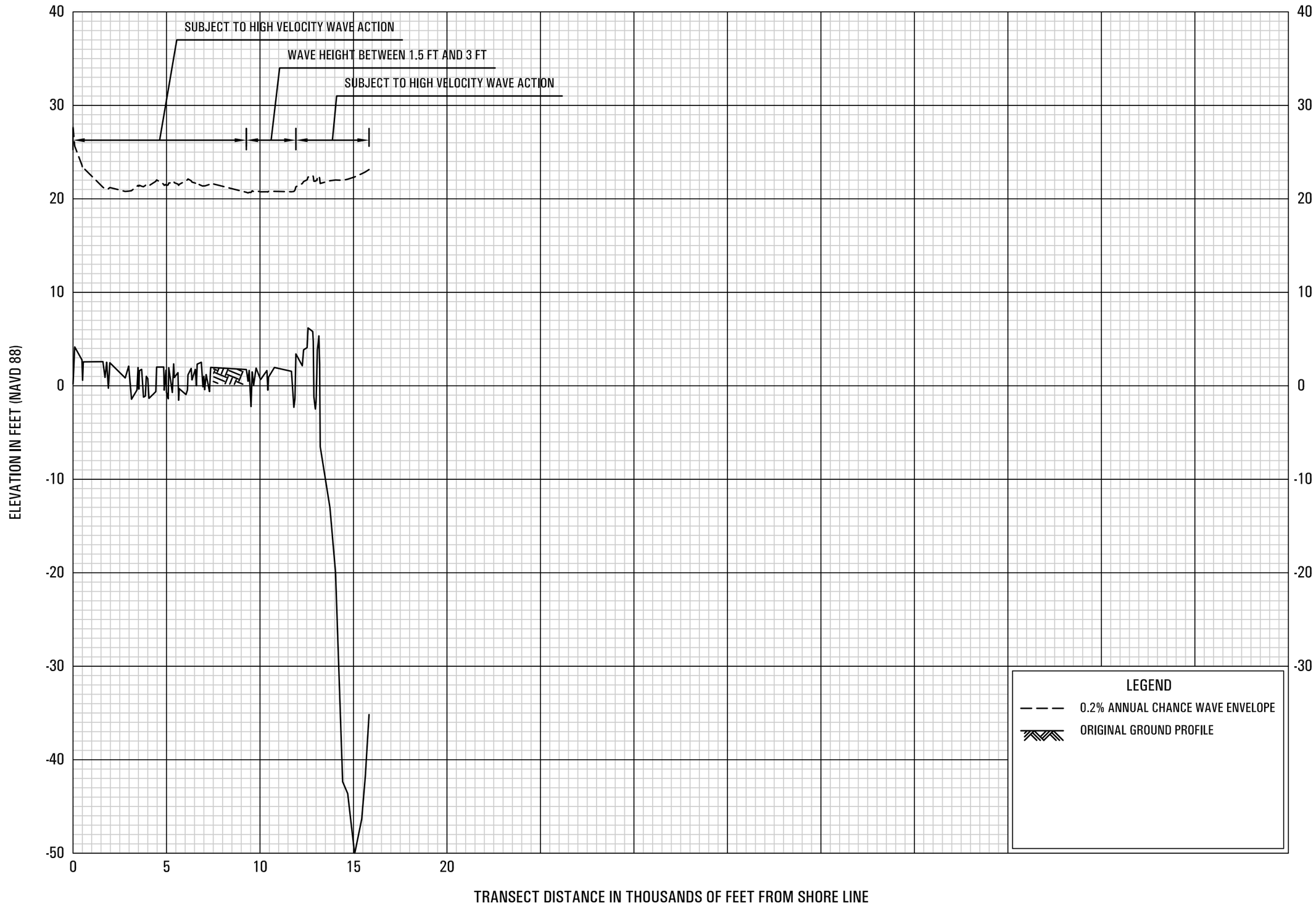
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 27

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

38P



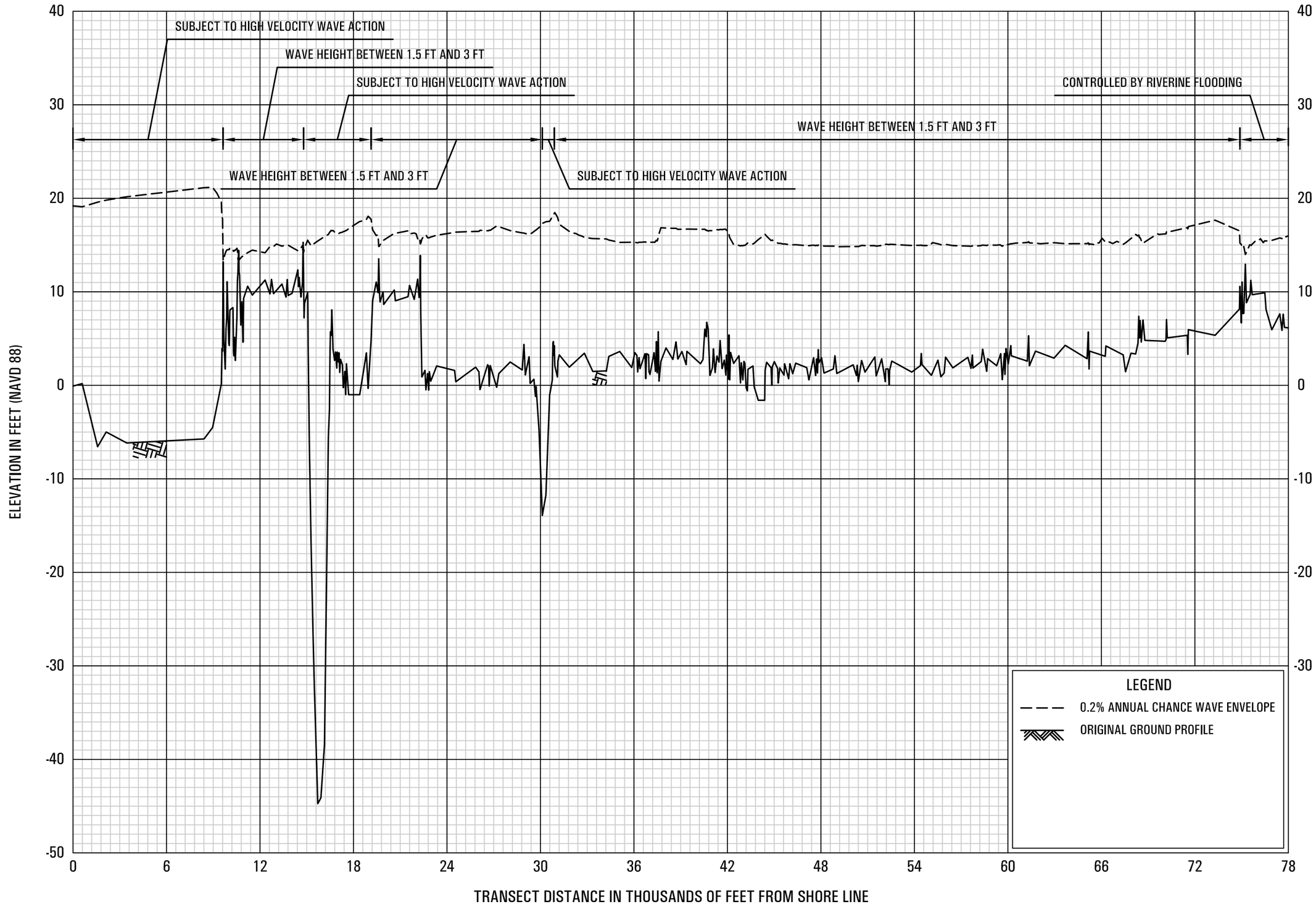
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 28

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



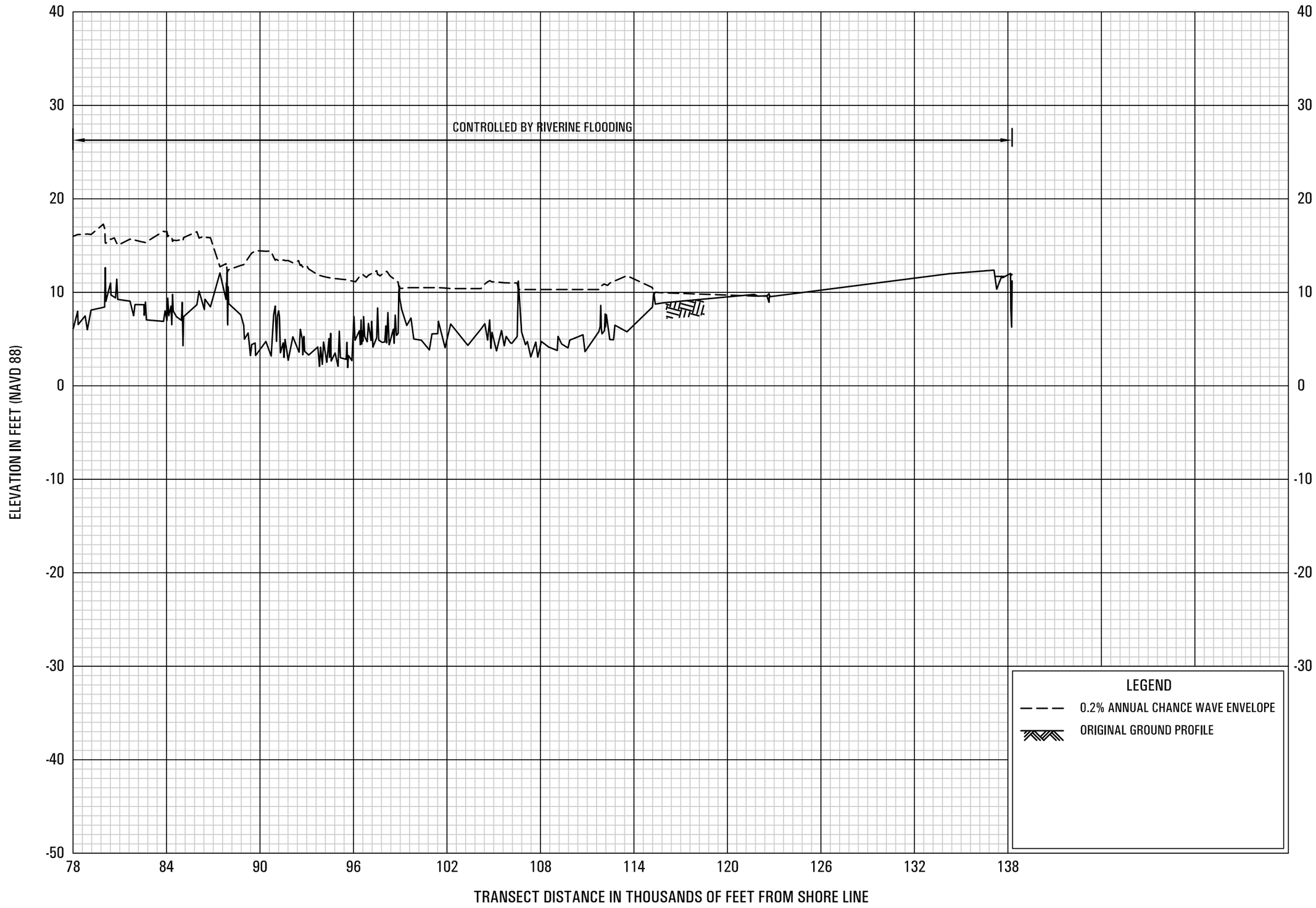
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 29

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

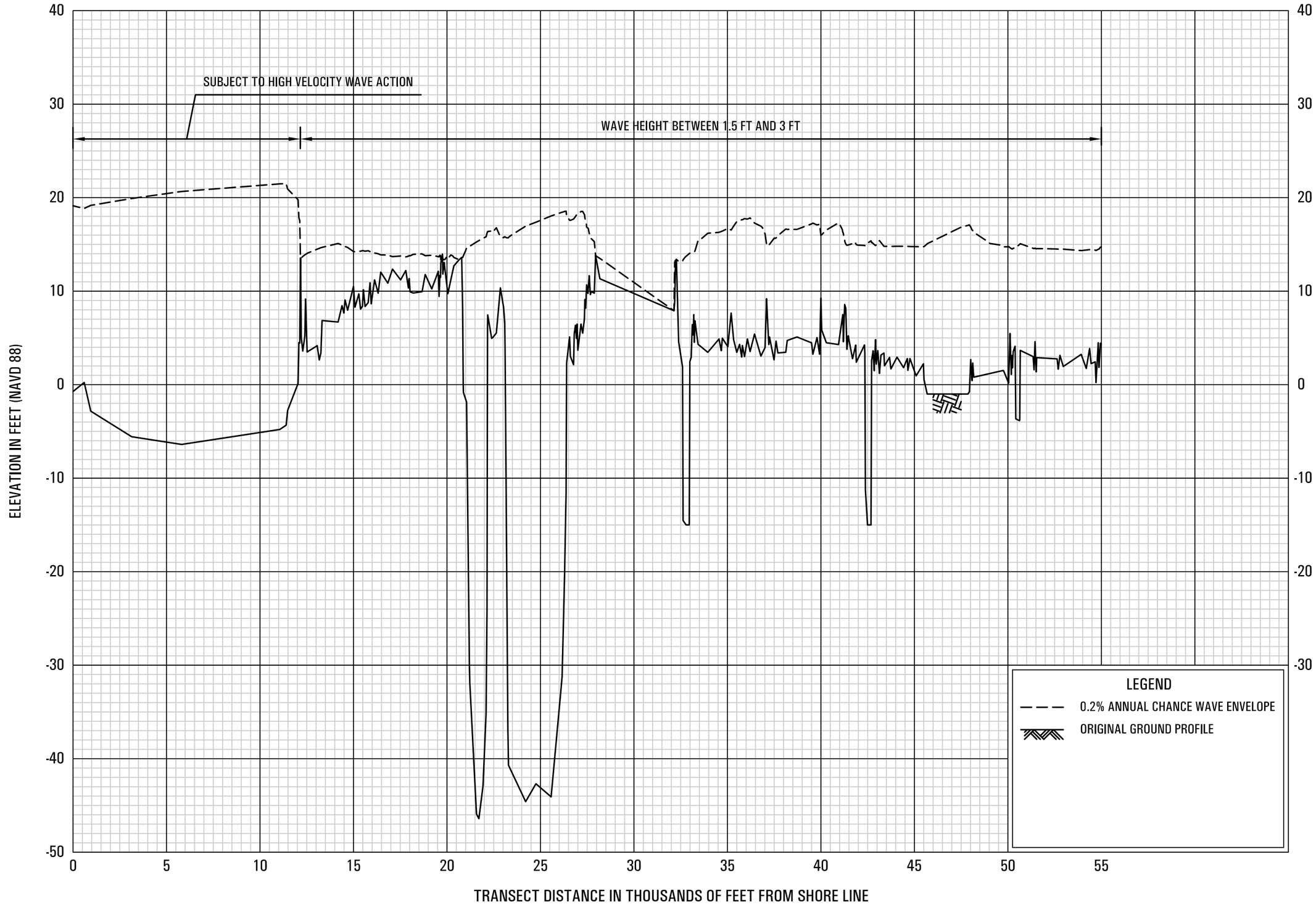
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

41P



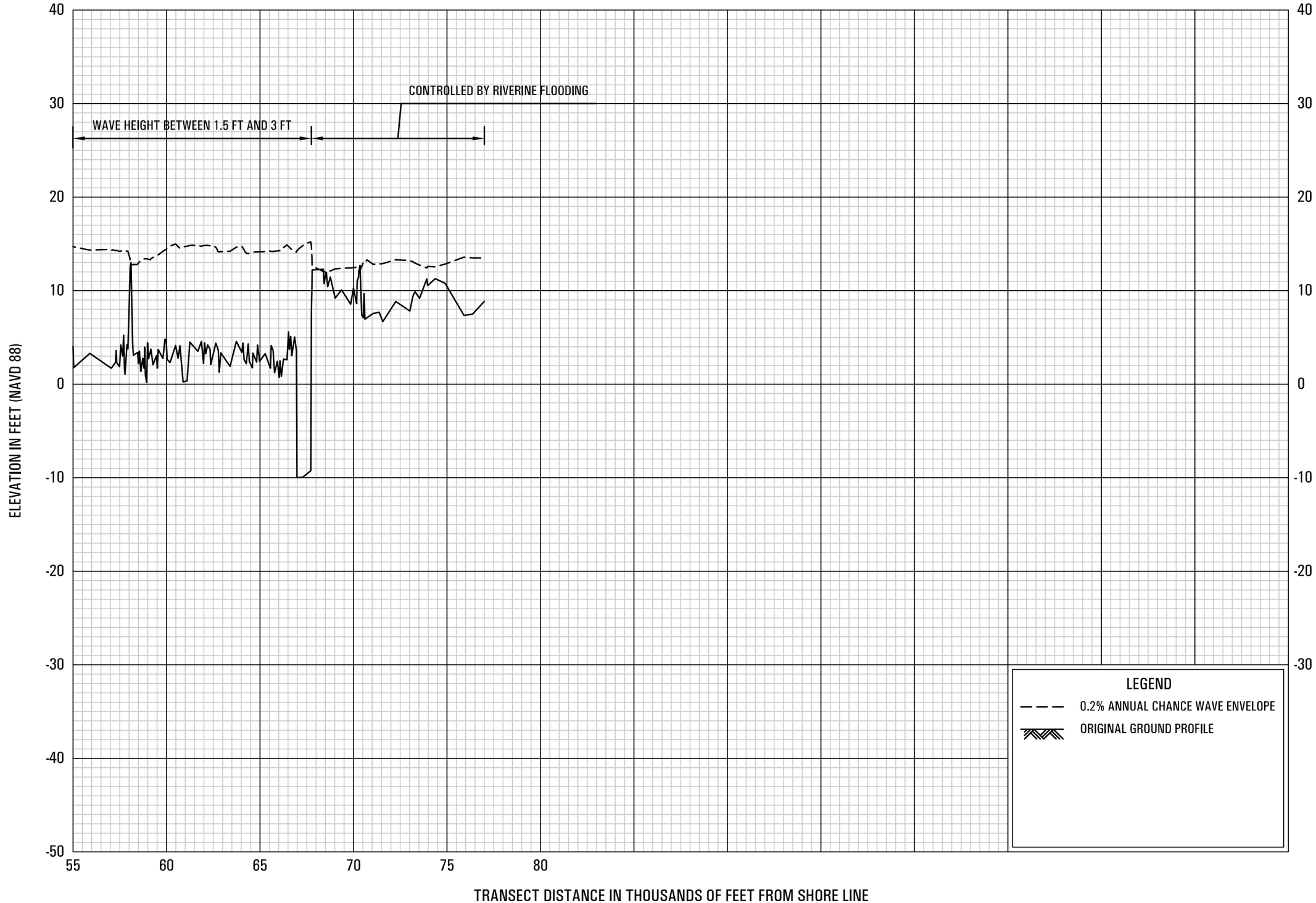
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 30

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

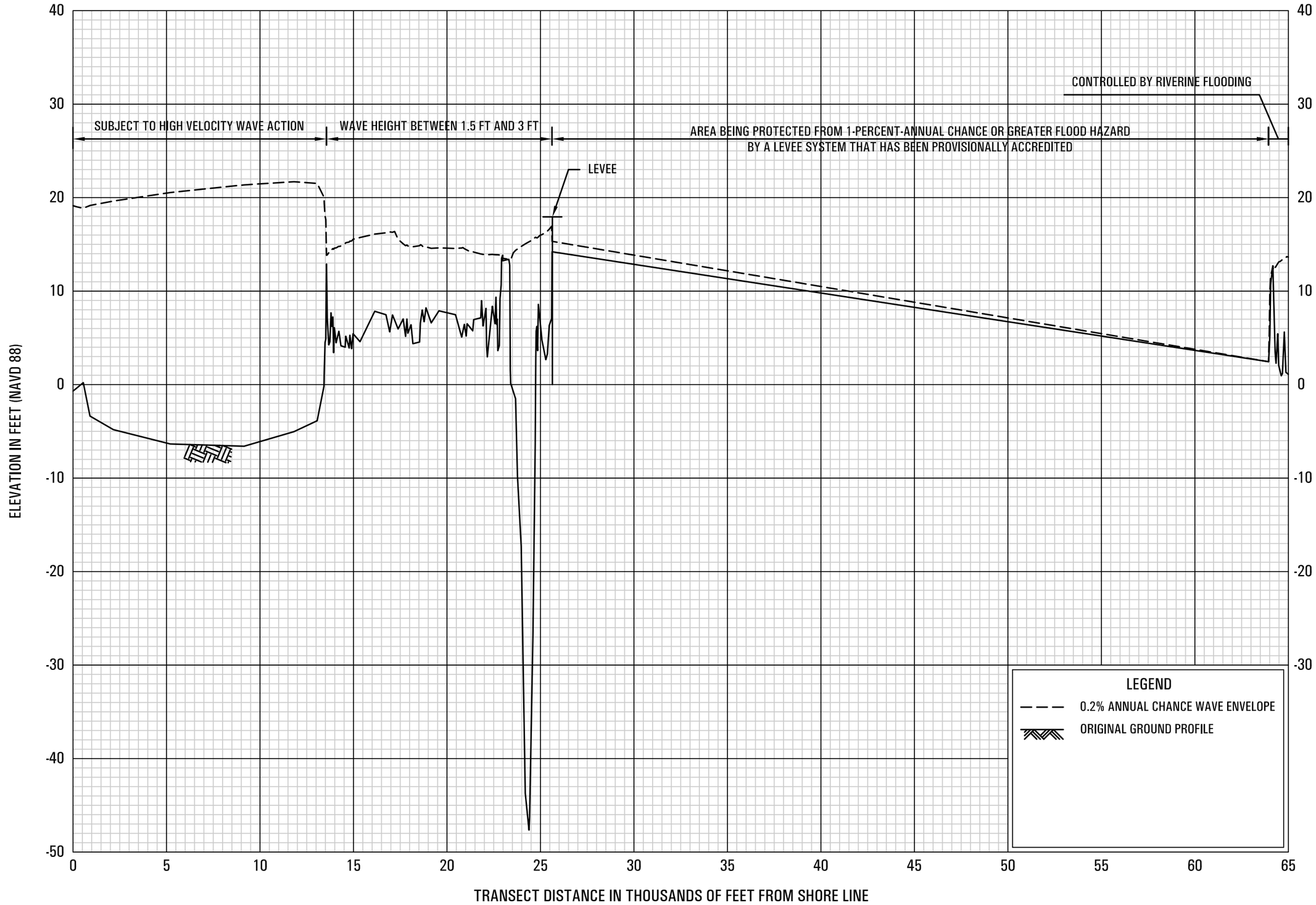


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 30

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



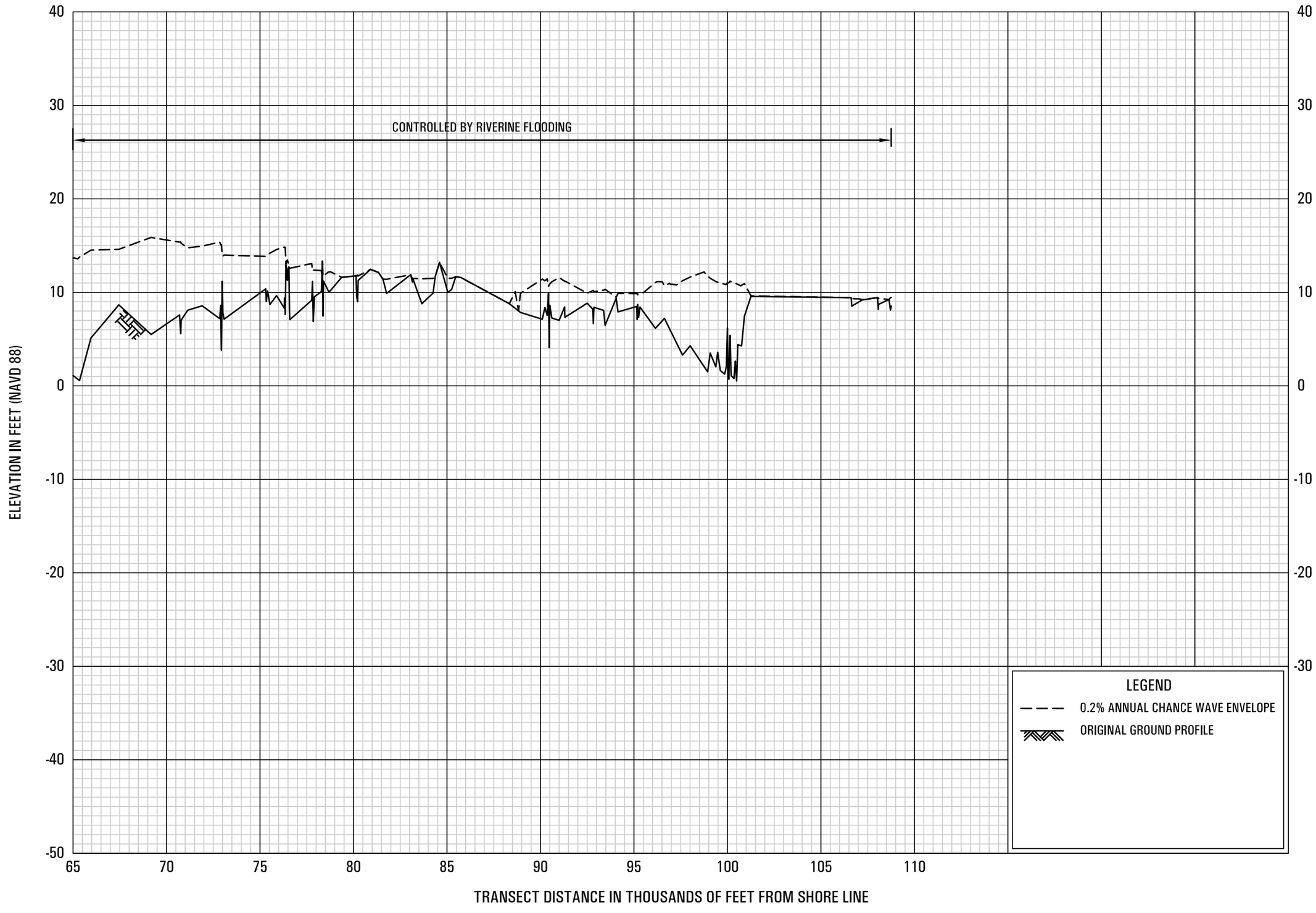
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 31

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

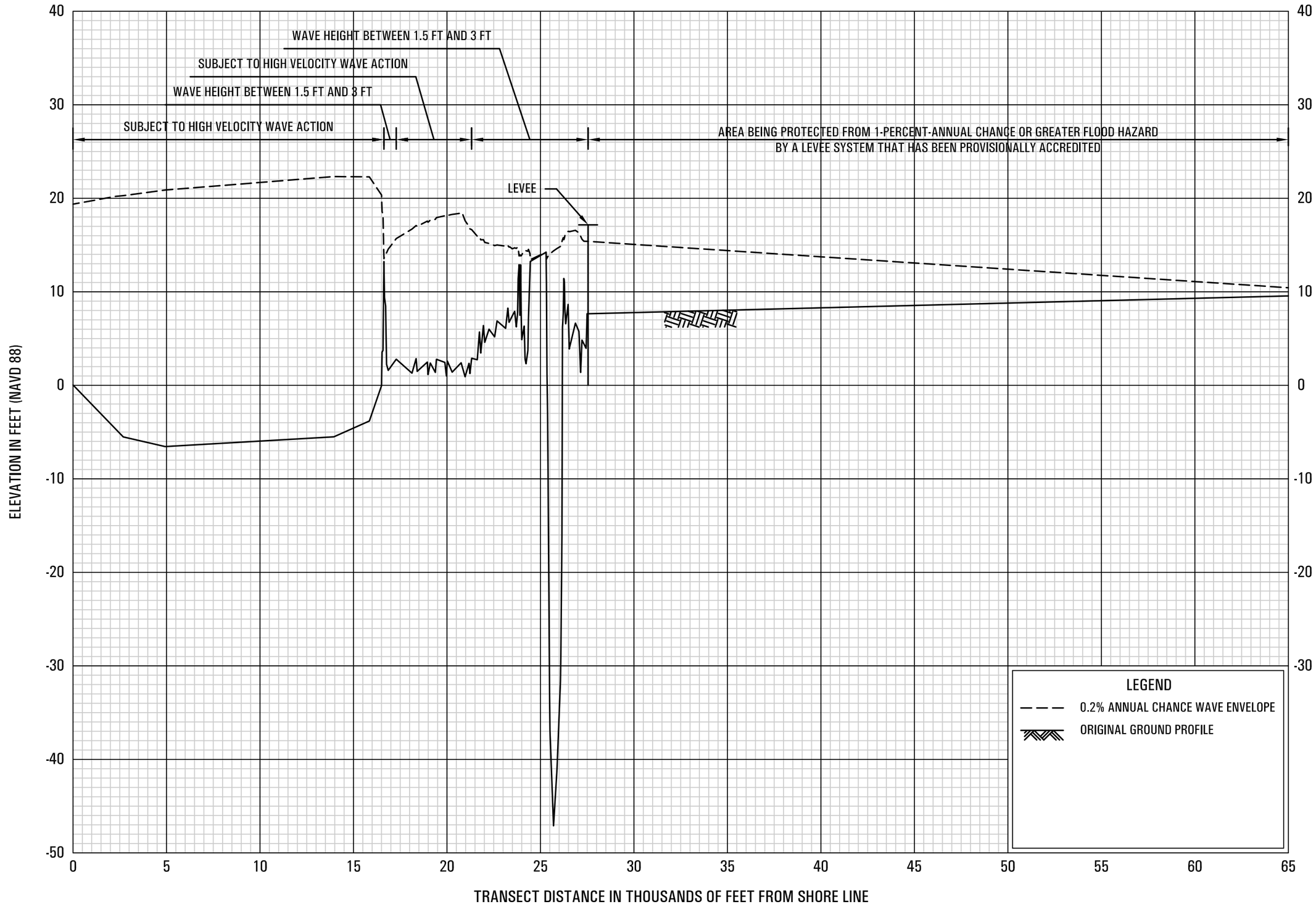


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 31

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

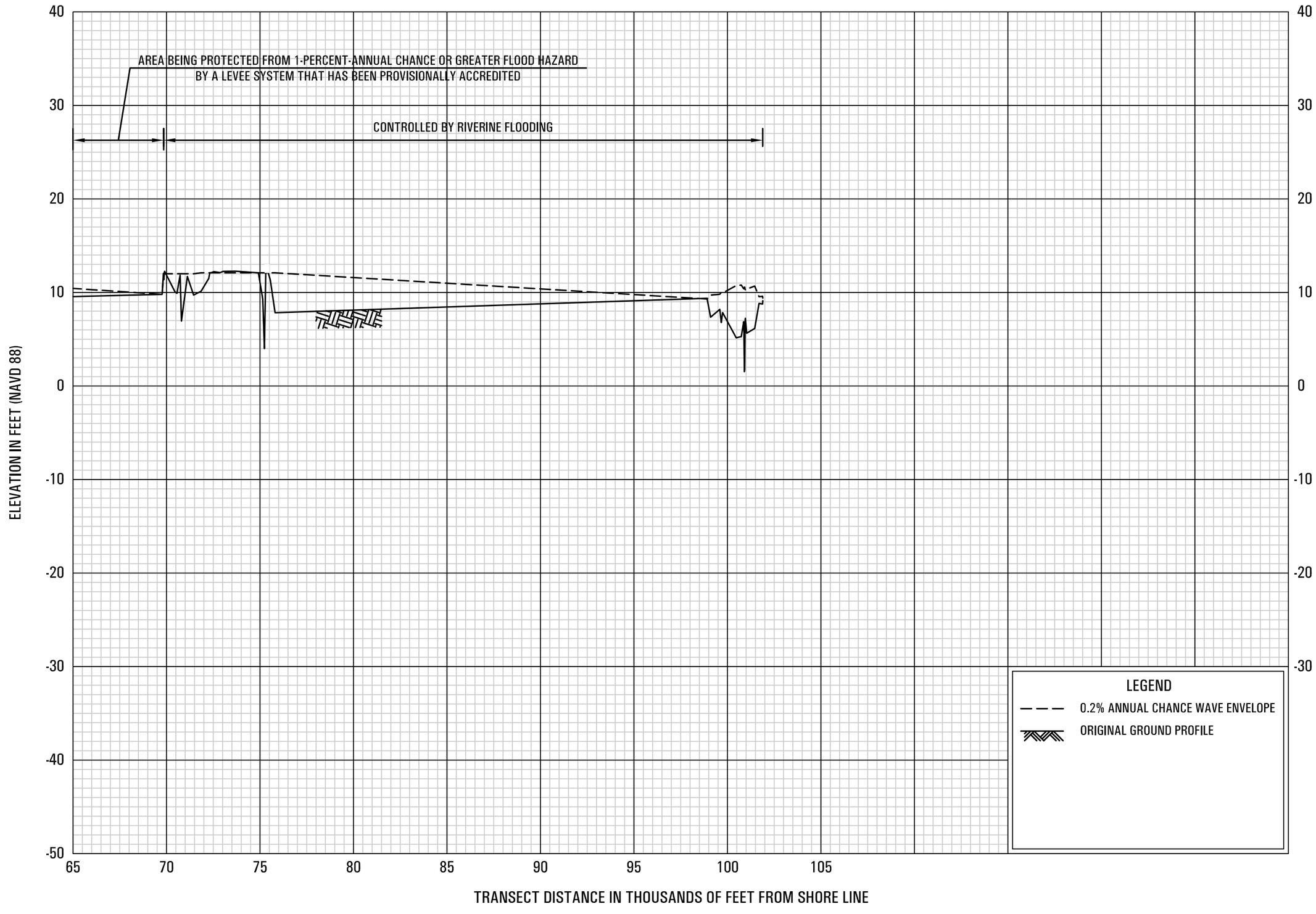
TRANSECT 32

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

46P

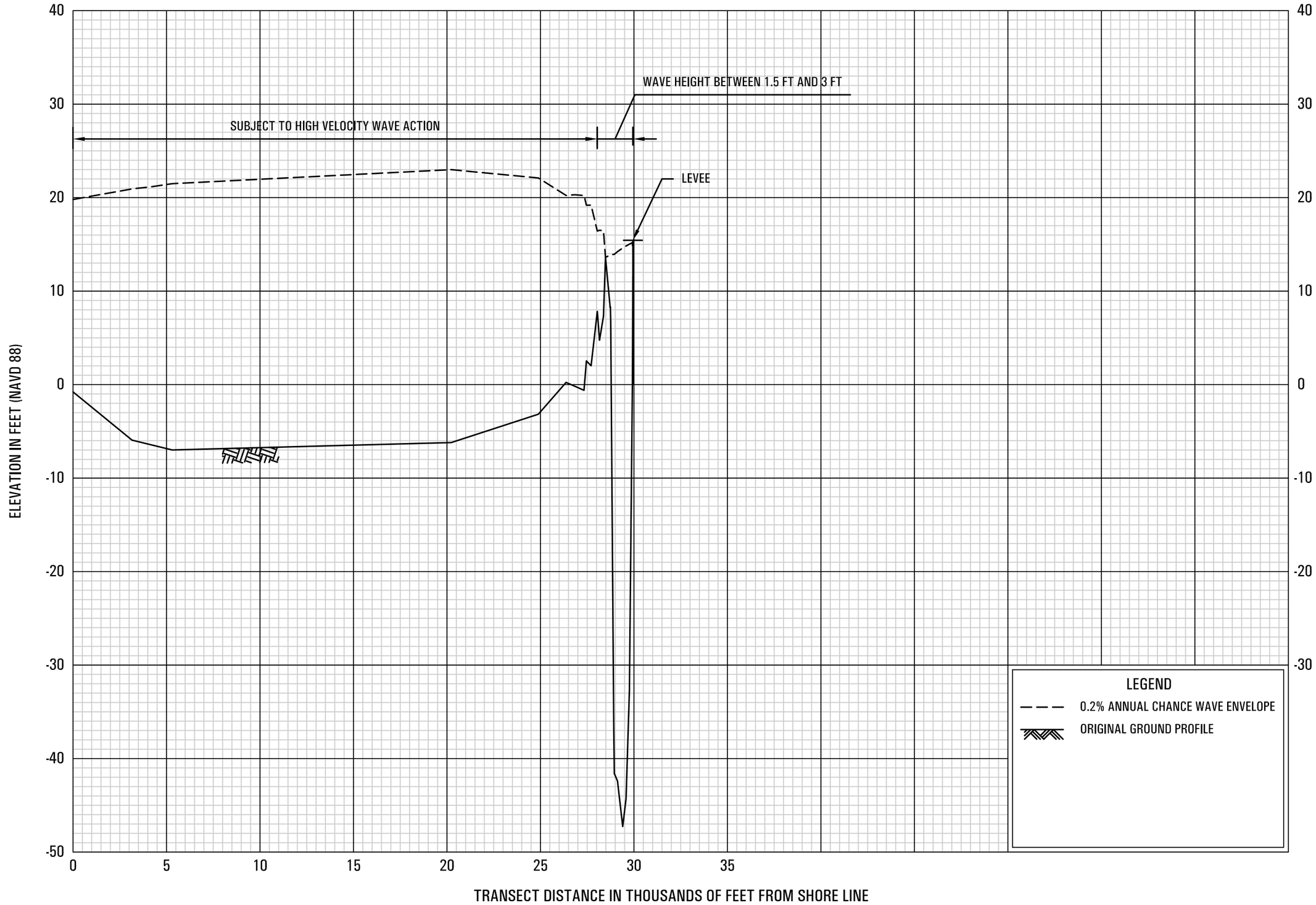


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 32

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



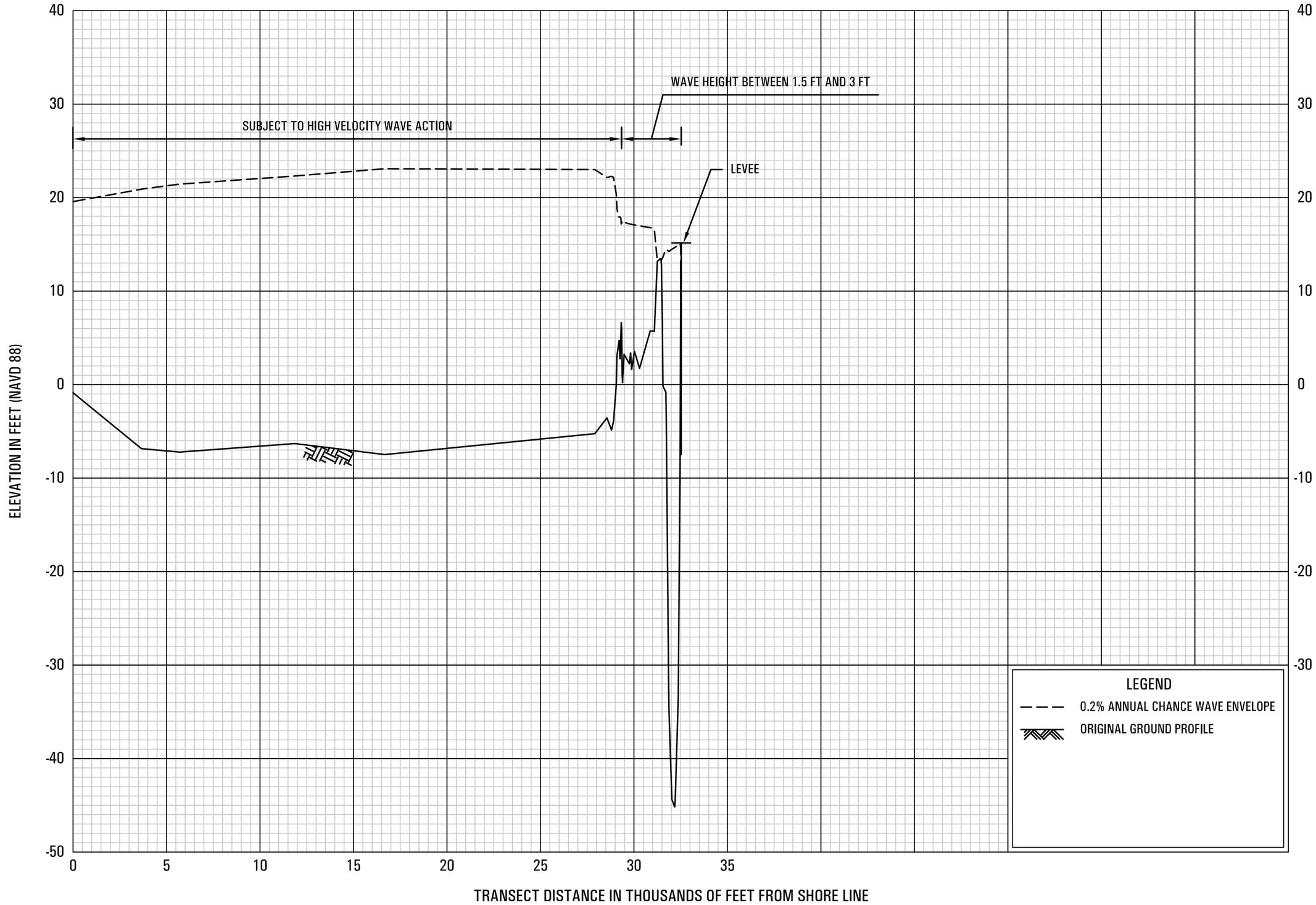
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 33

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



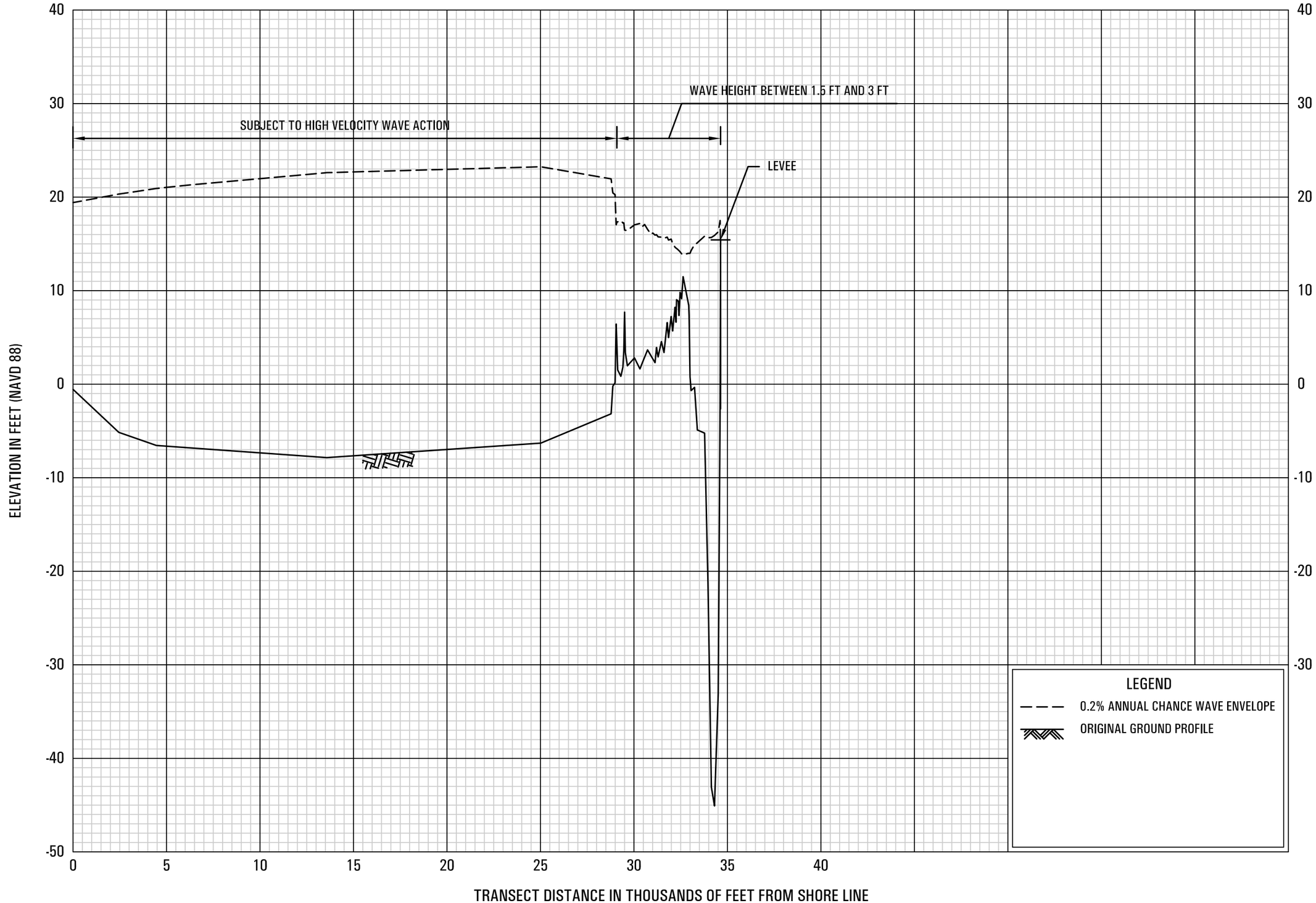
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 34

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

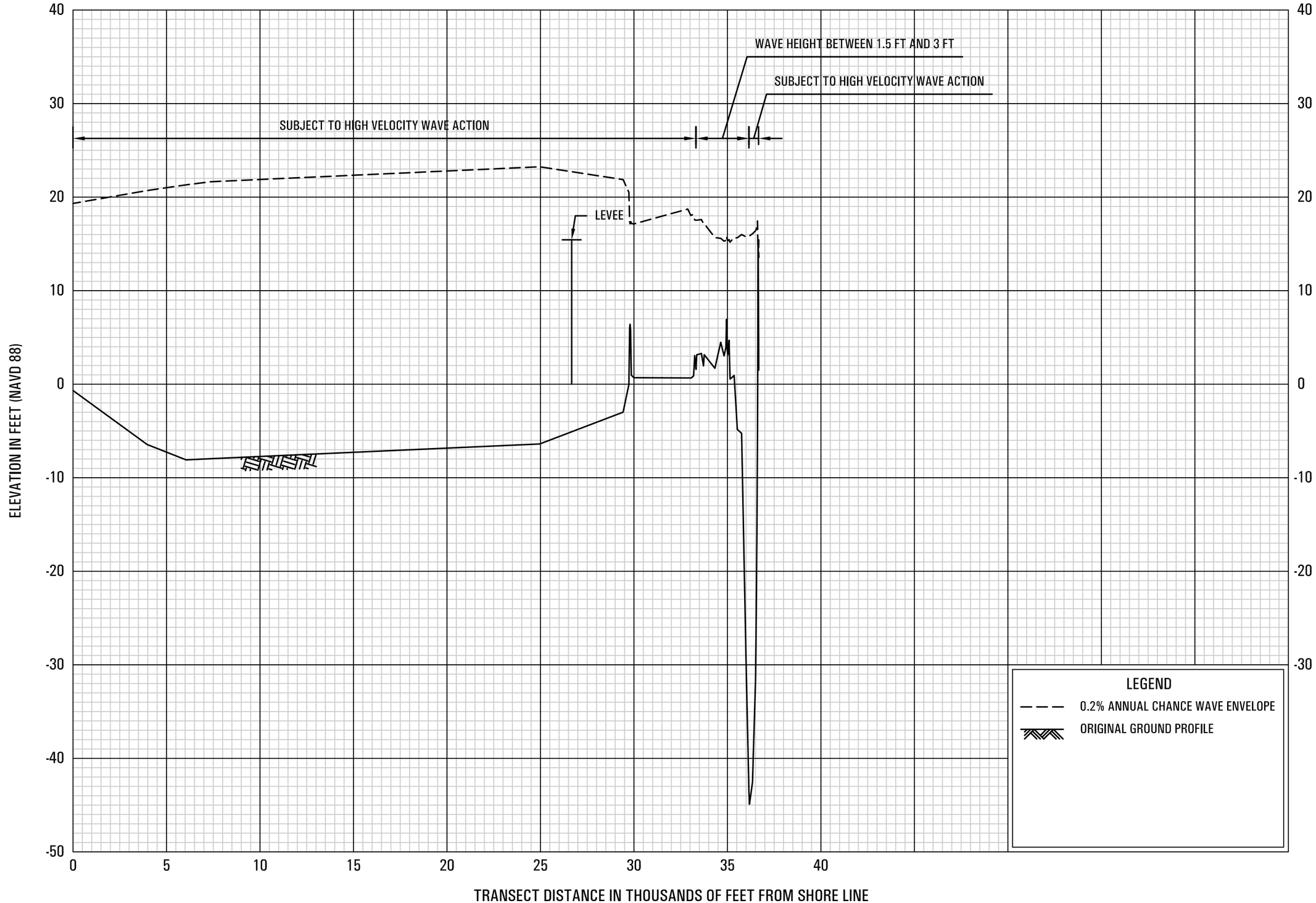


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 35

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

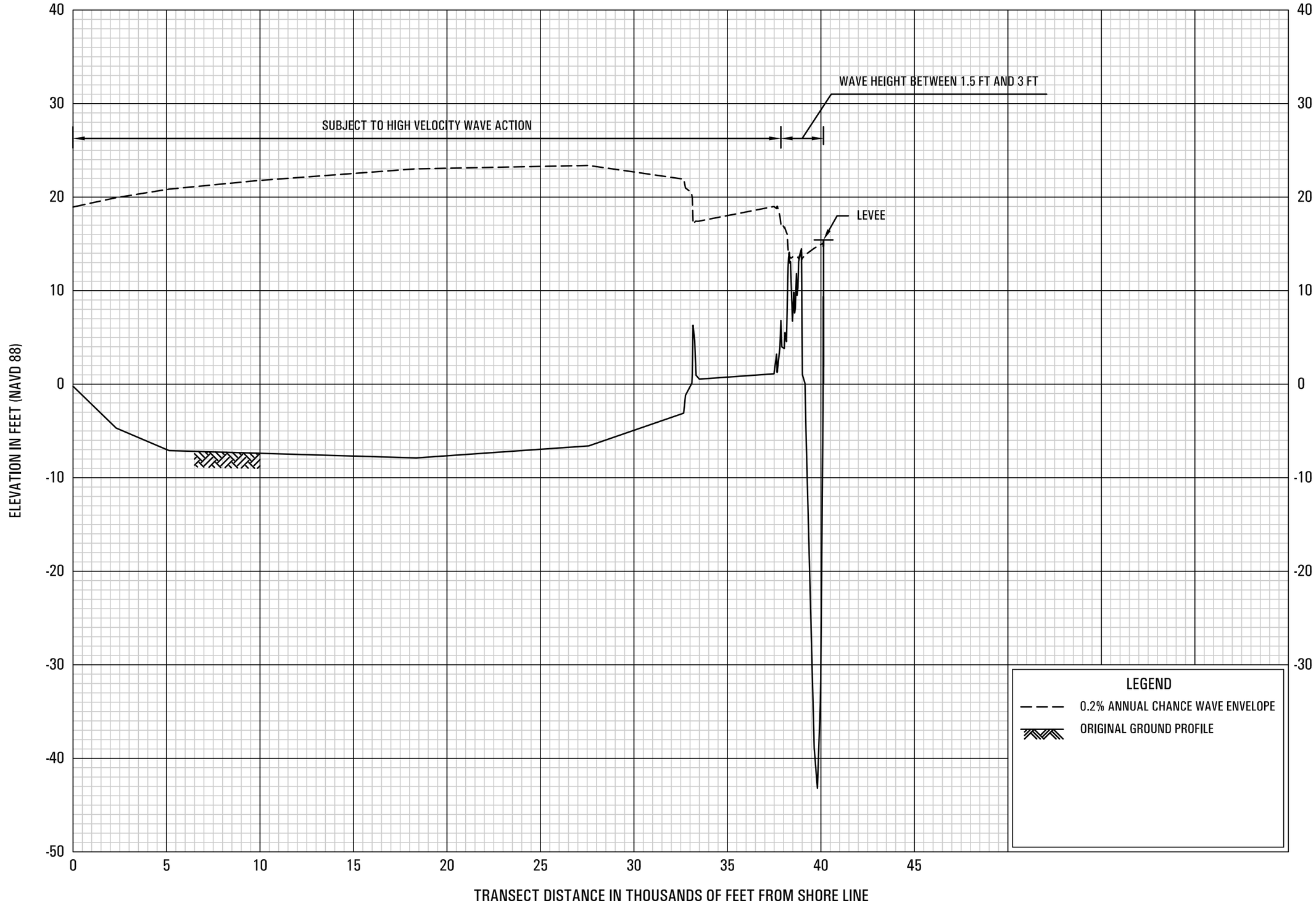


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 36

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

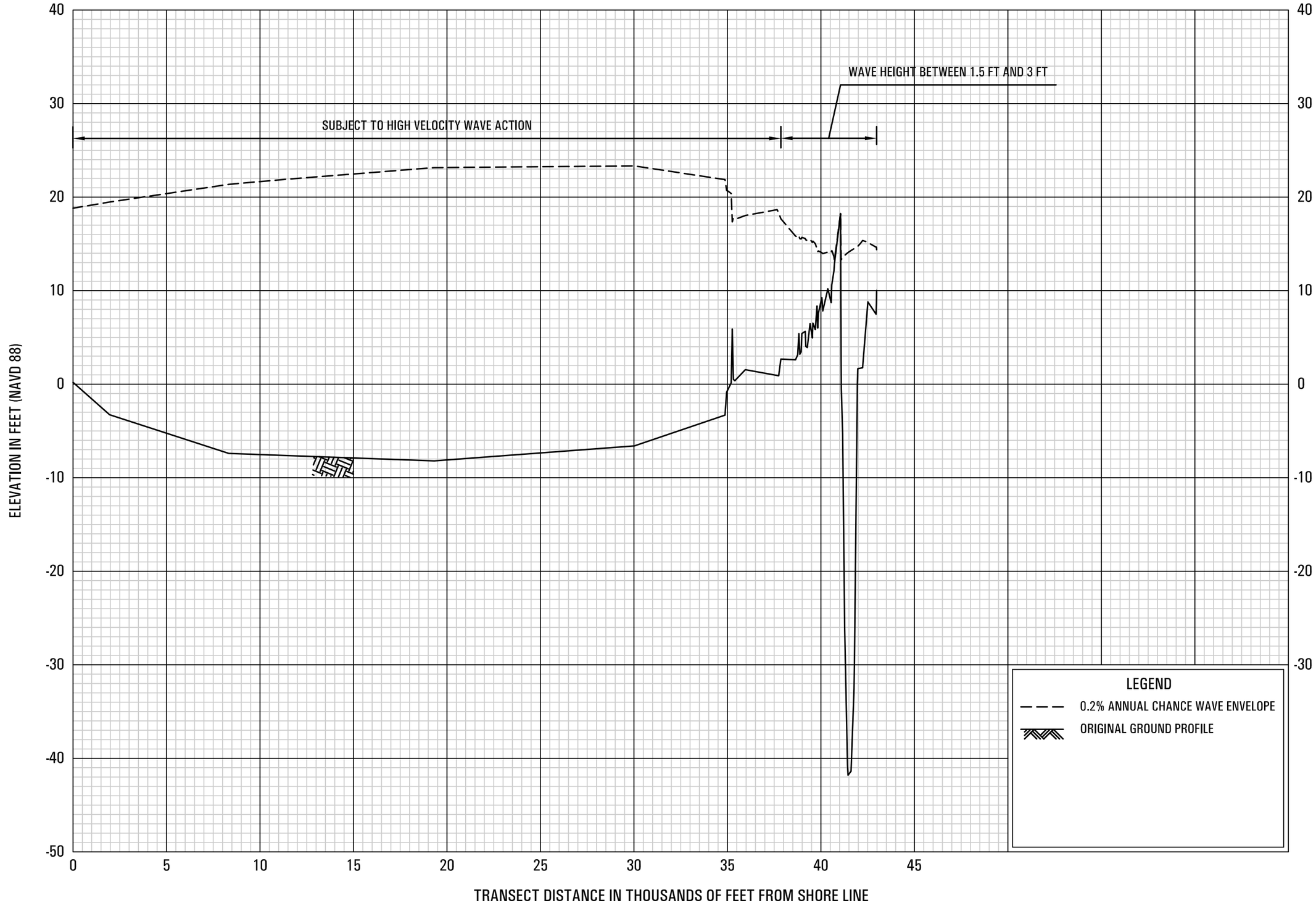


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 37

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



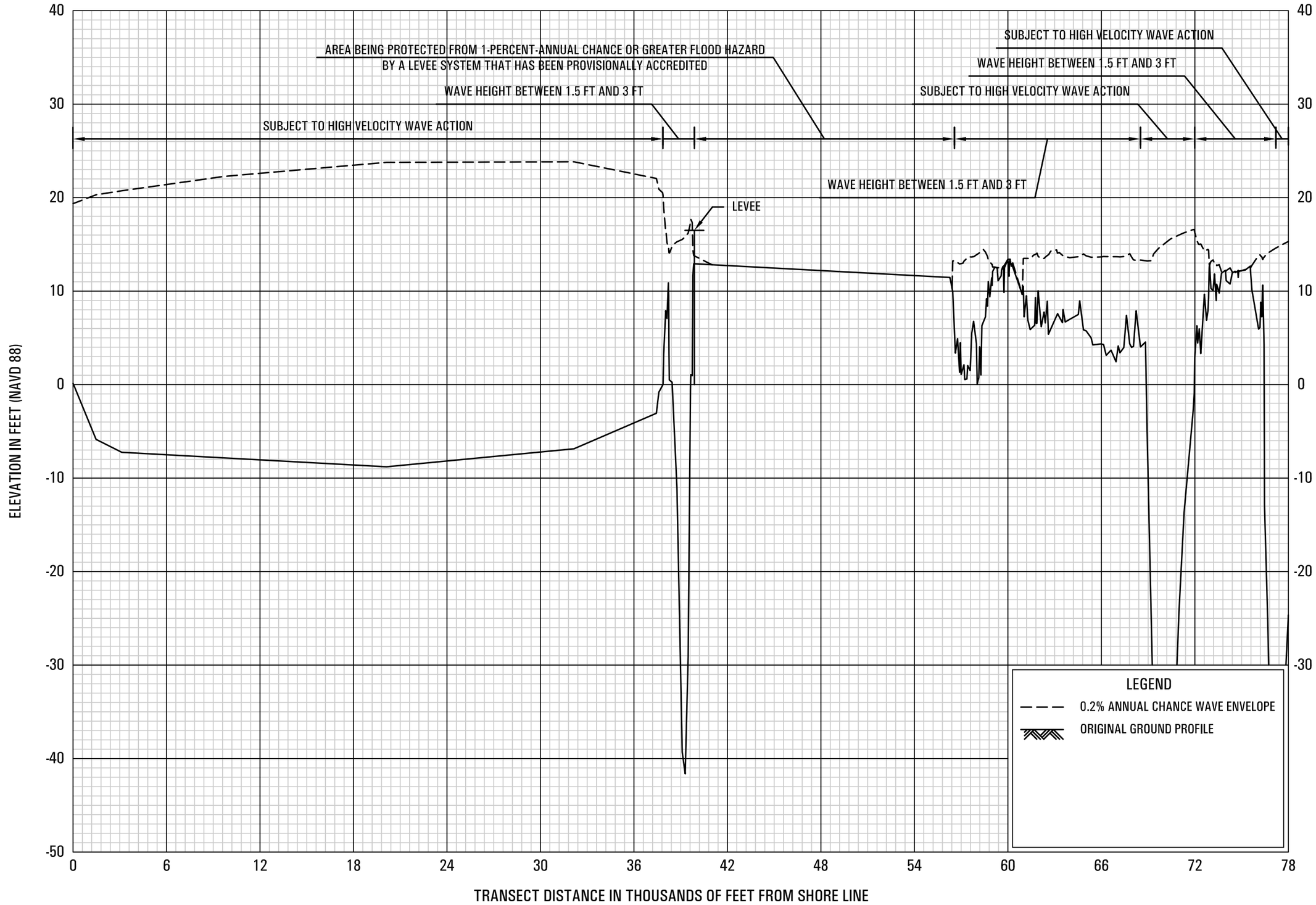
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 38

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

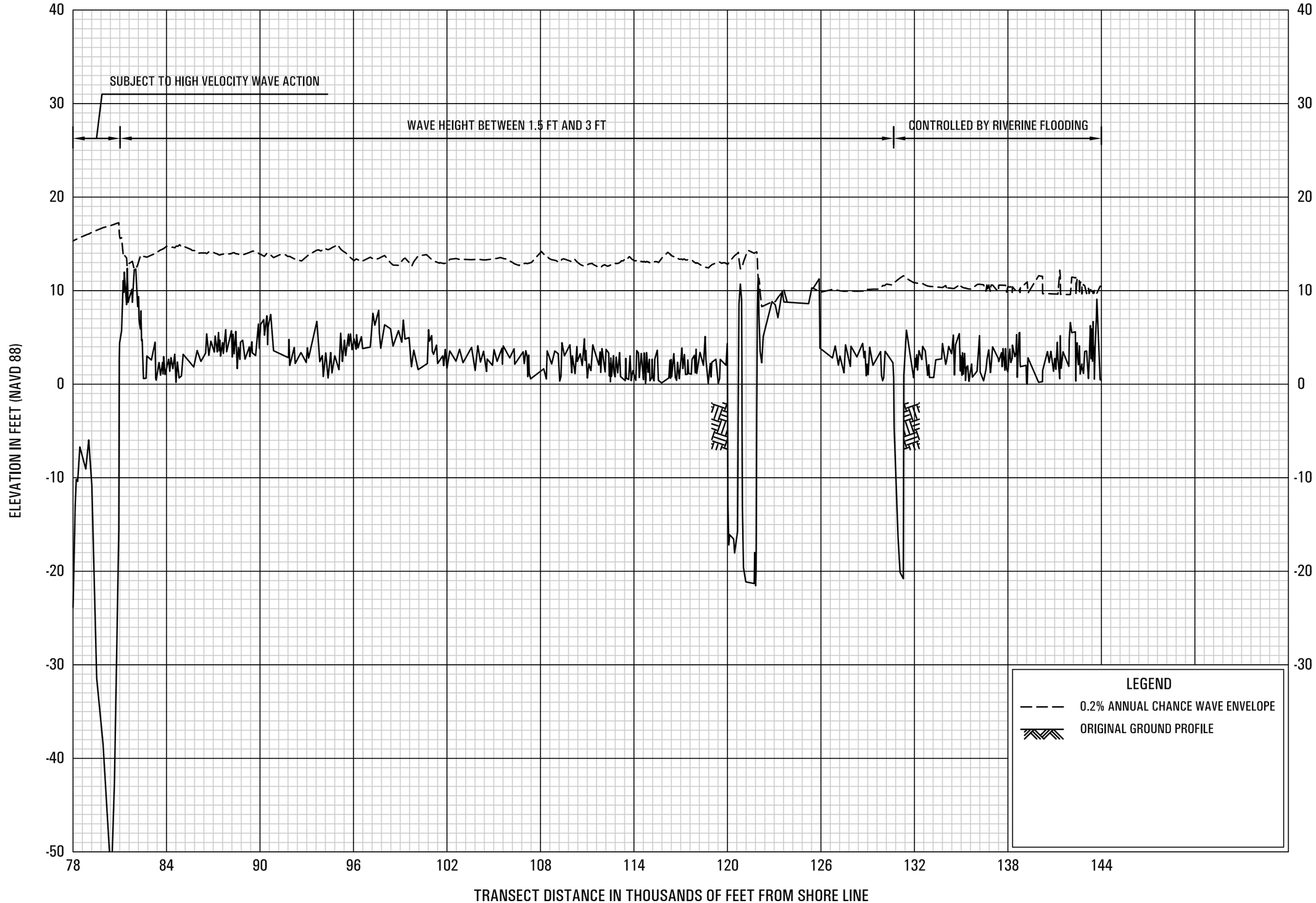


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 39

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

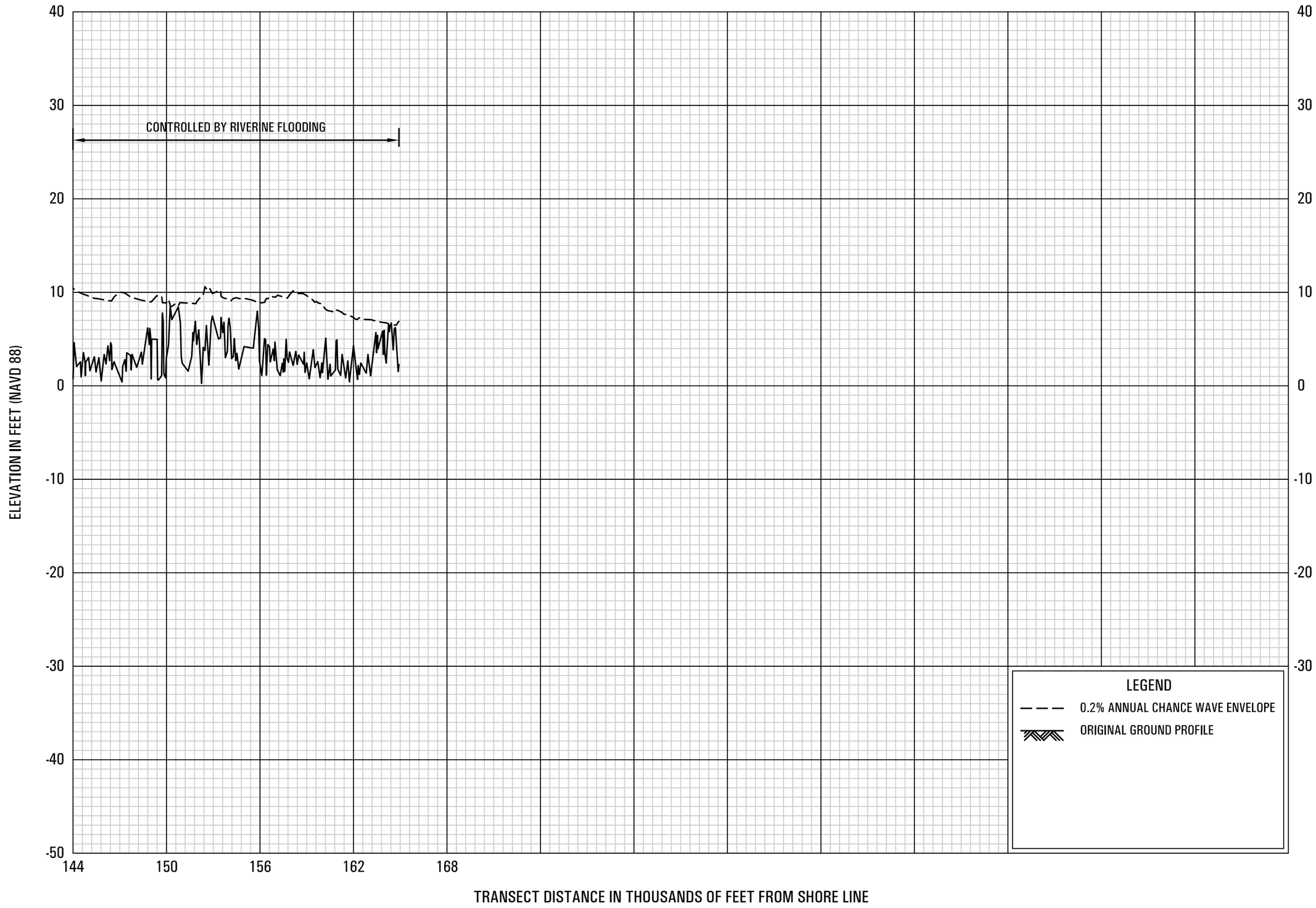
TRANSECT 39

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

55P



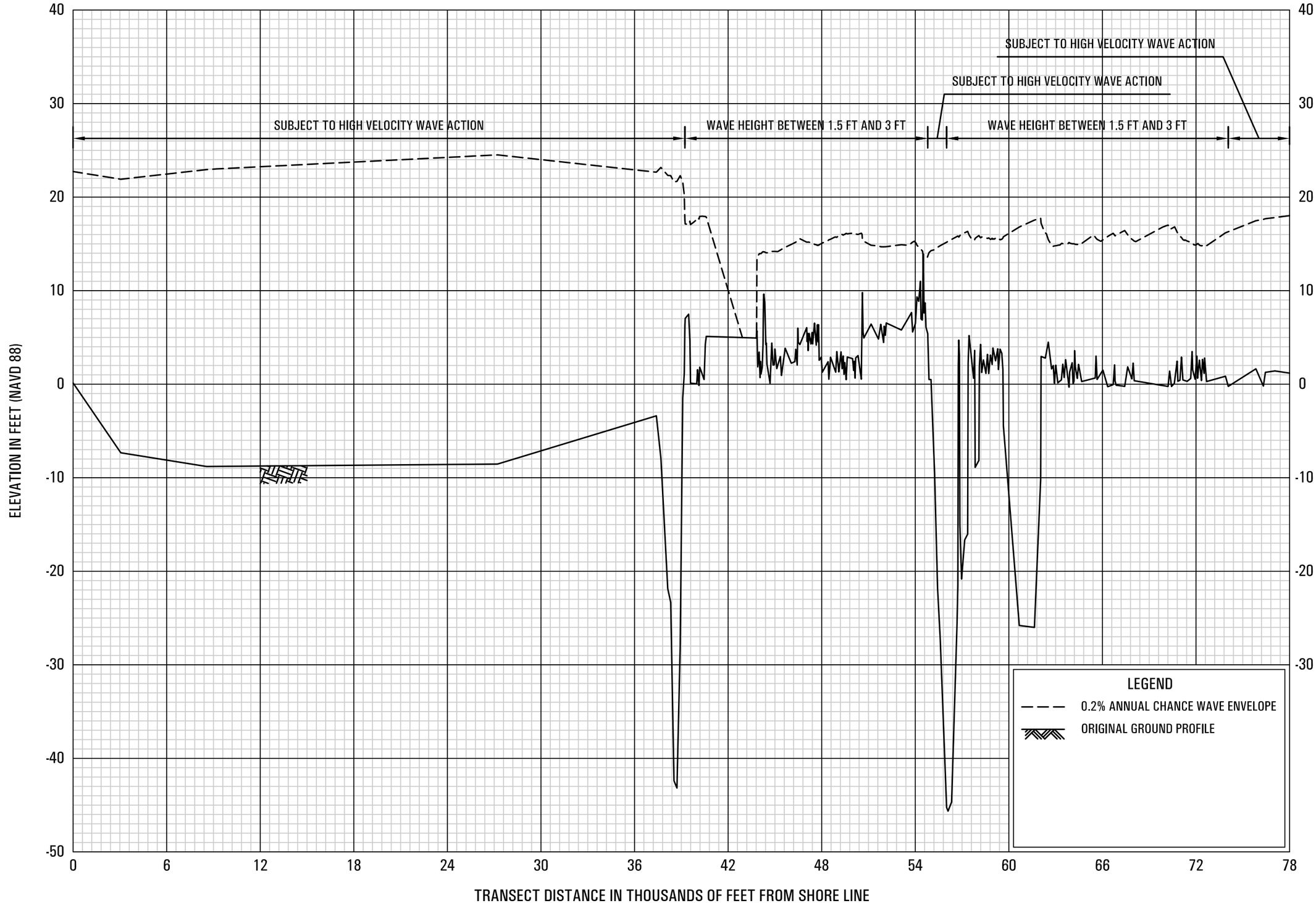
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 39

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

56P



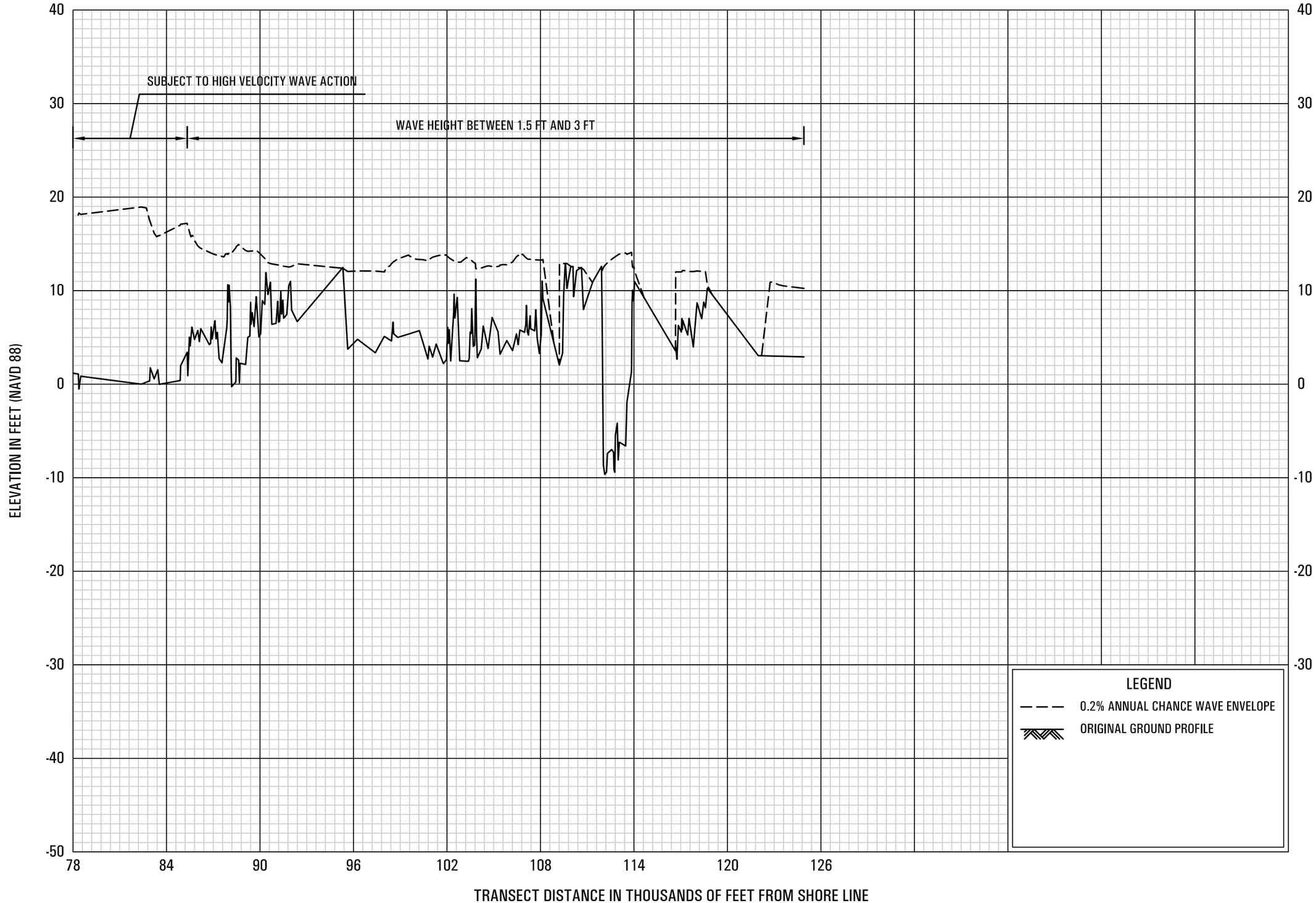
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 40

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

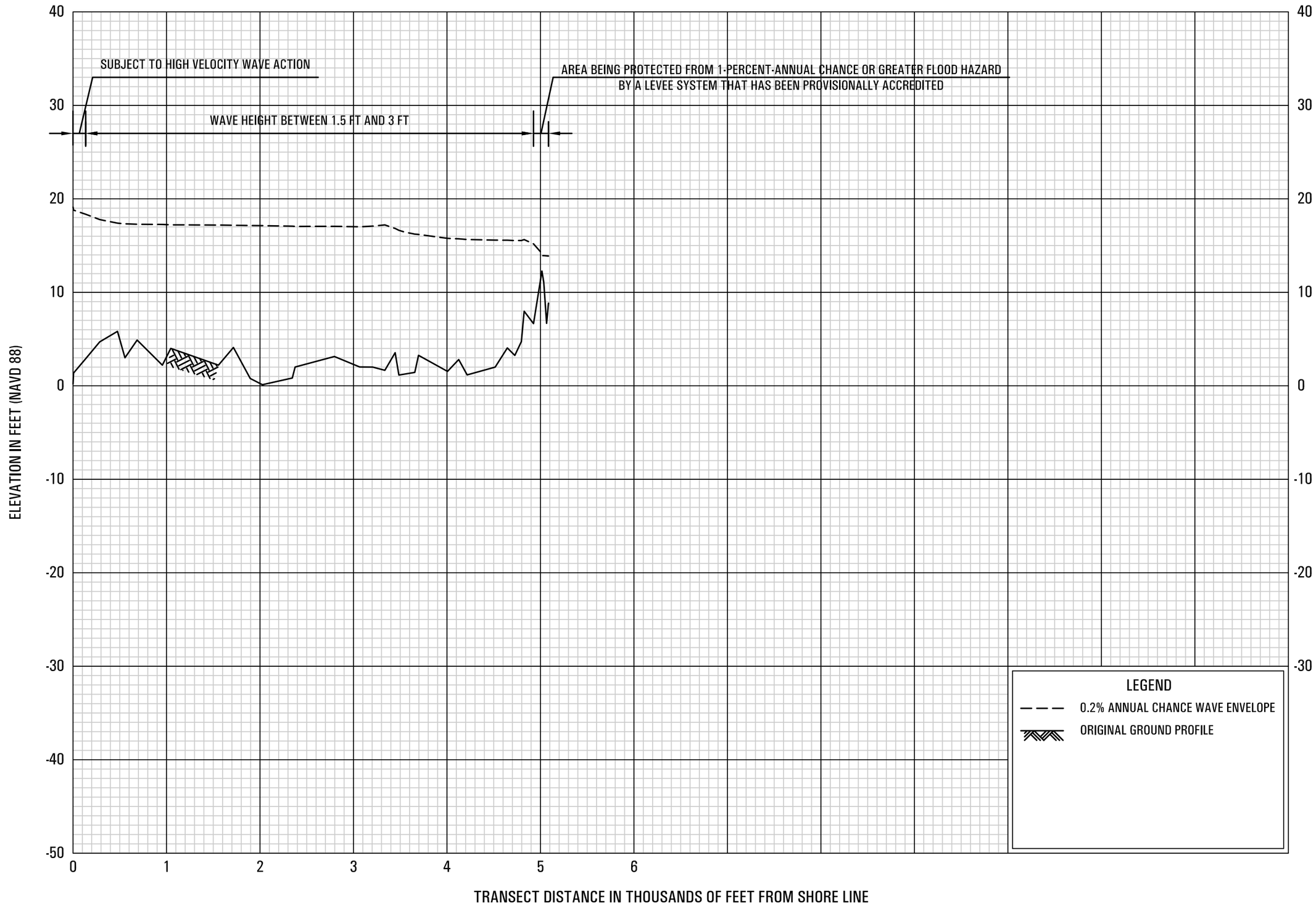


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 40

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

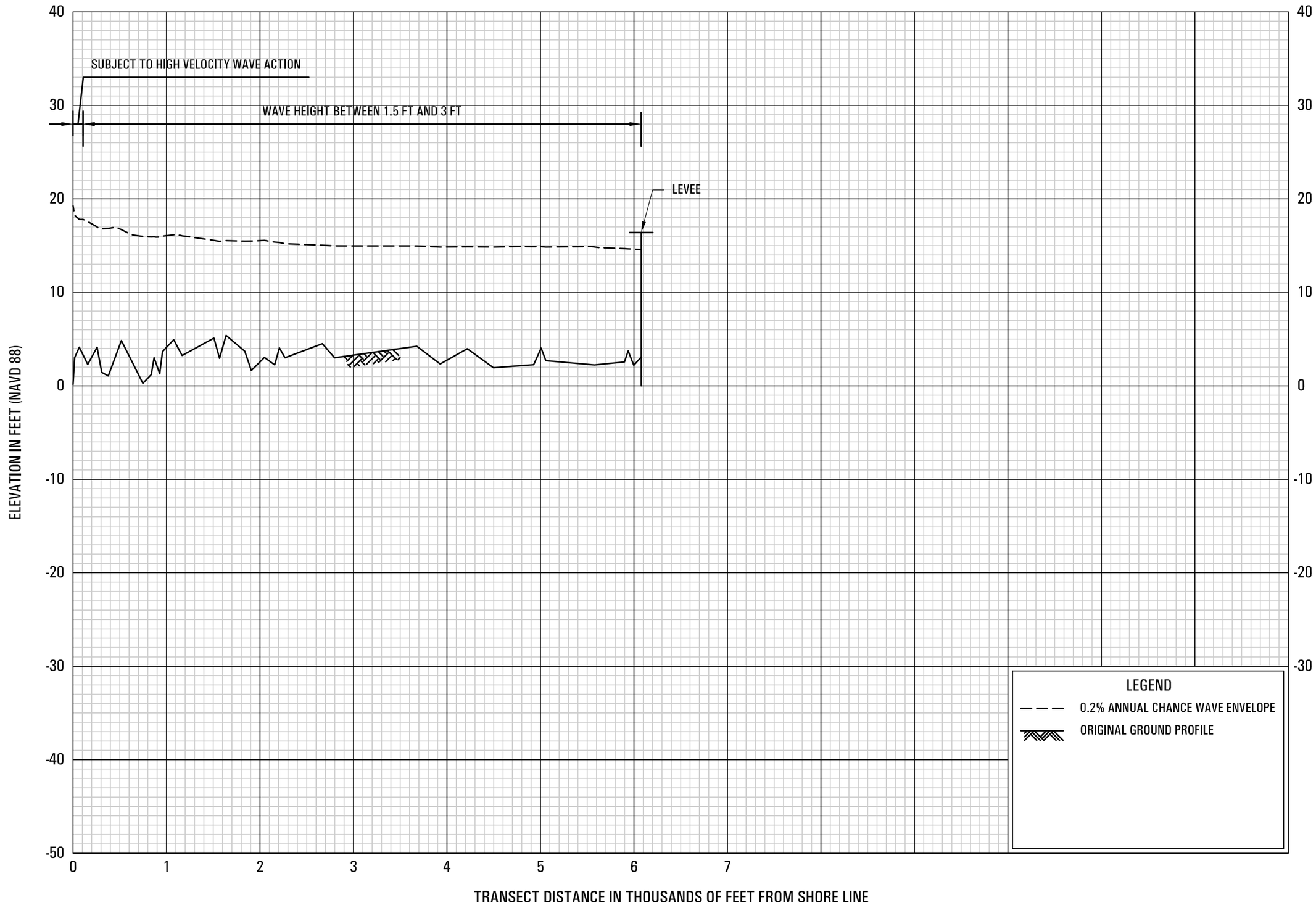


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 41

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



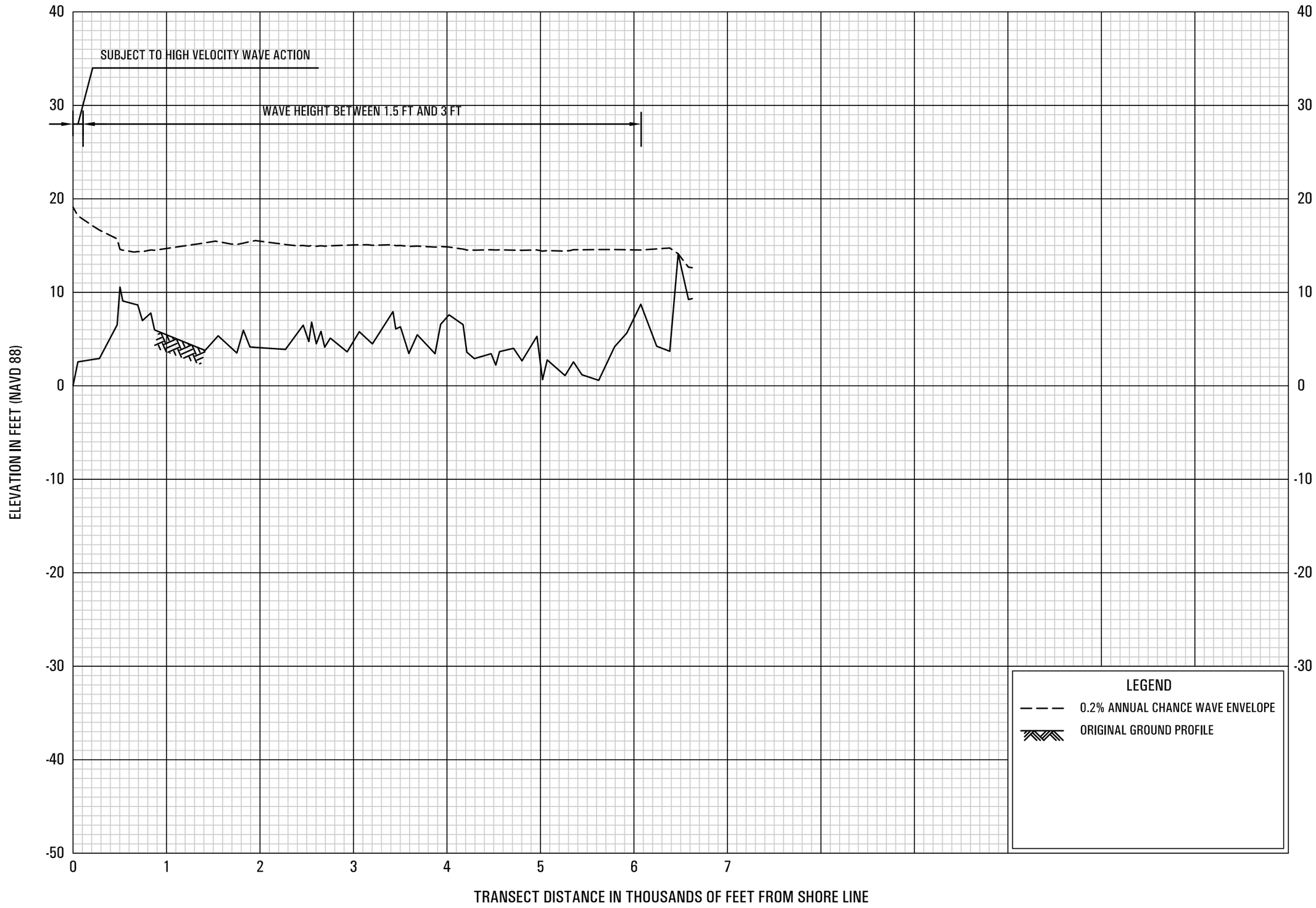
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 42

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

60P



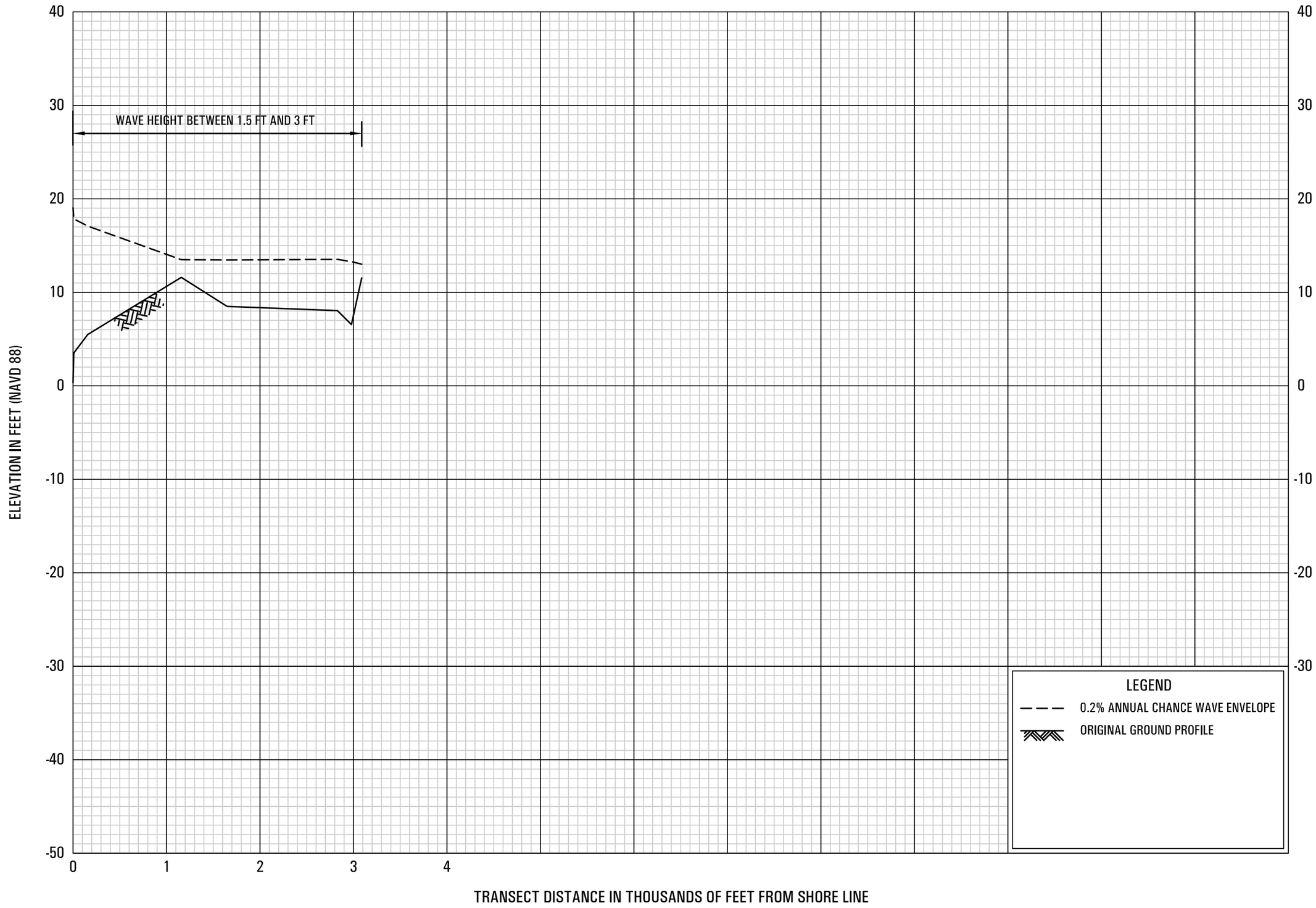
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 43

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

61P



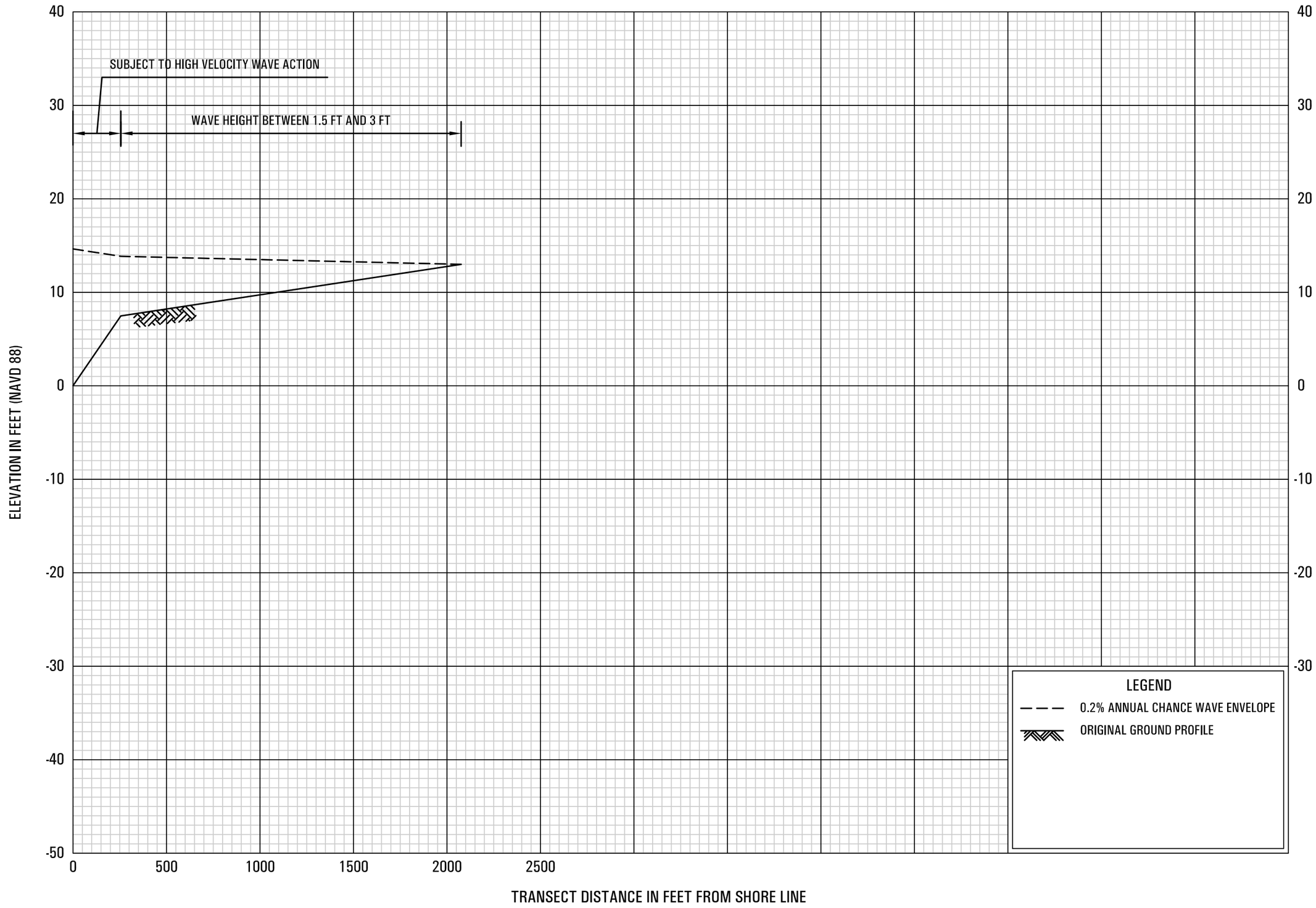
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 44

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

62P



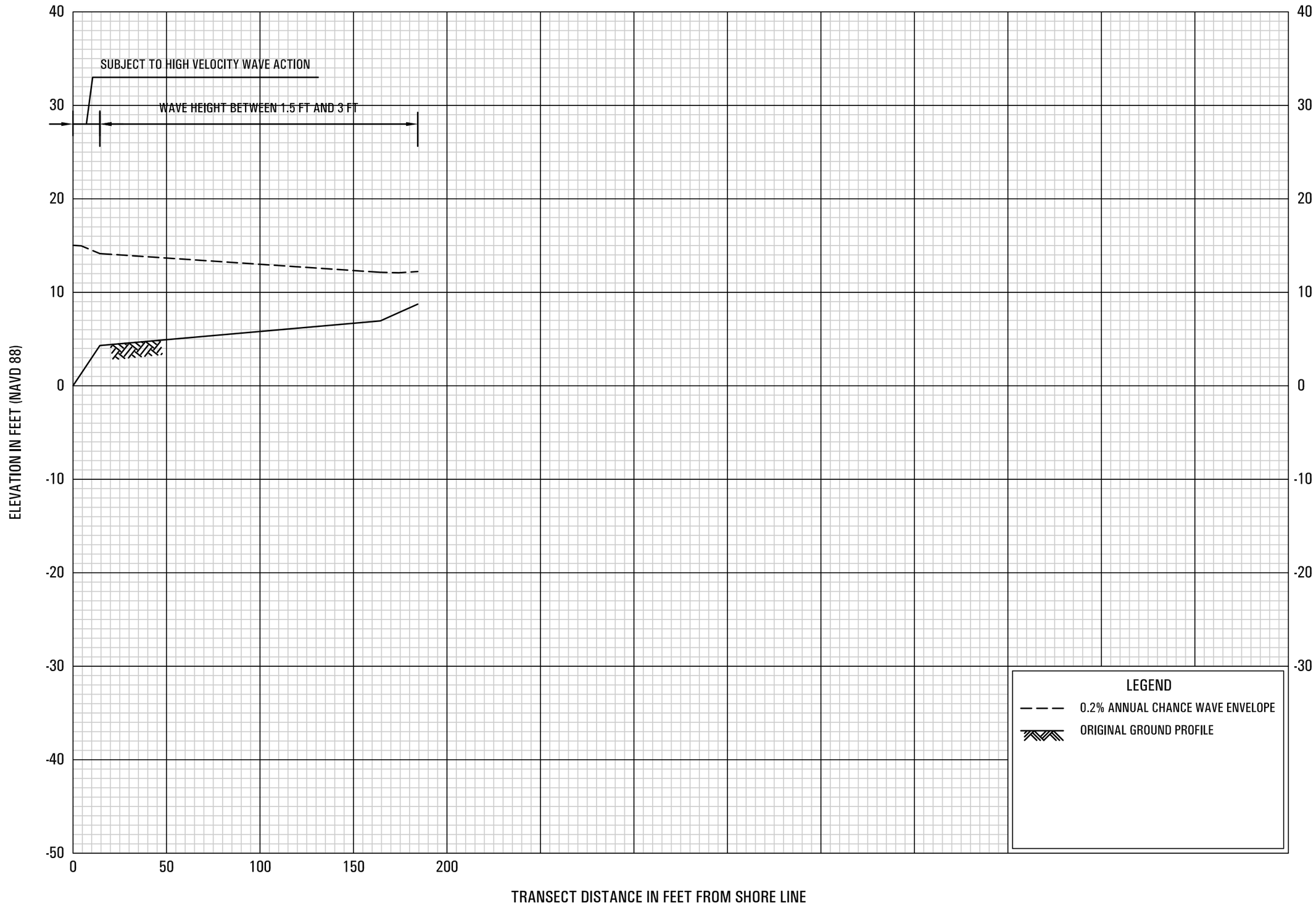
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 45

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

63P



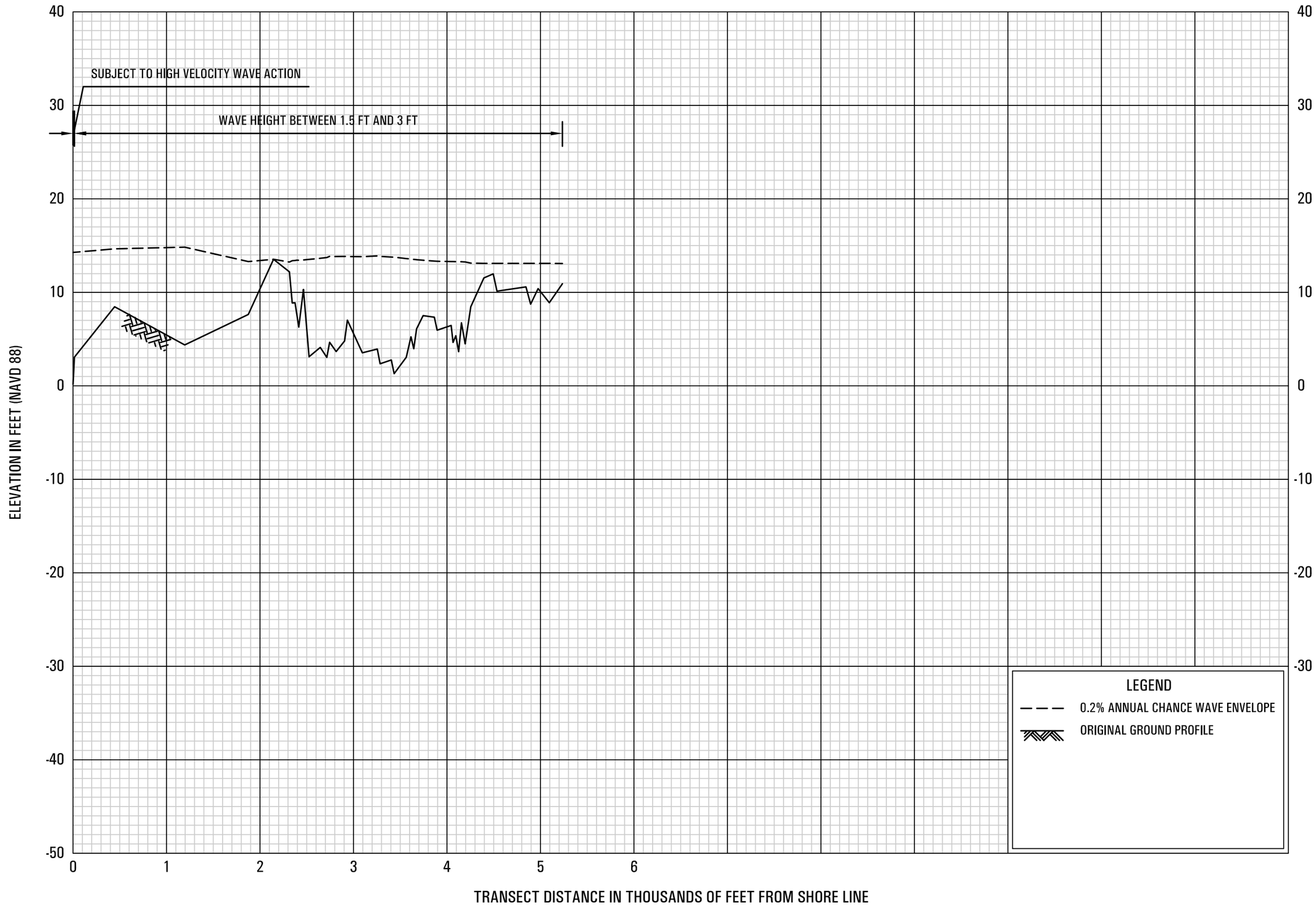
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 46

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

64P



0.2% ANNUAL CHANCE WAVE ENVELOPE

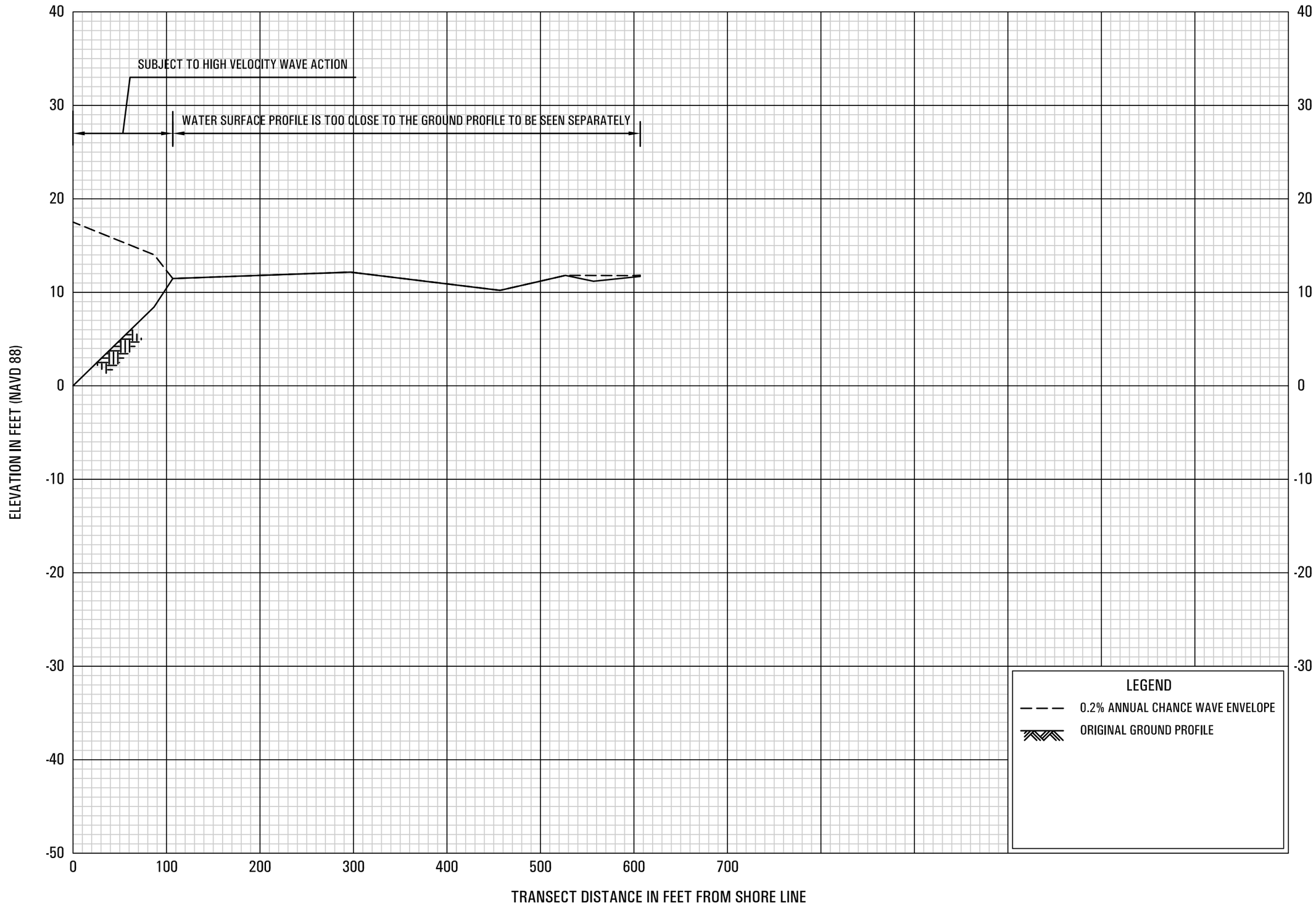
TRANSECT 47

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

65P



0.2% ANNUAL CHANCE WAVE ENVELOPE

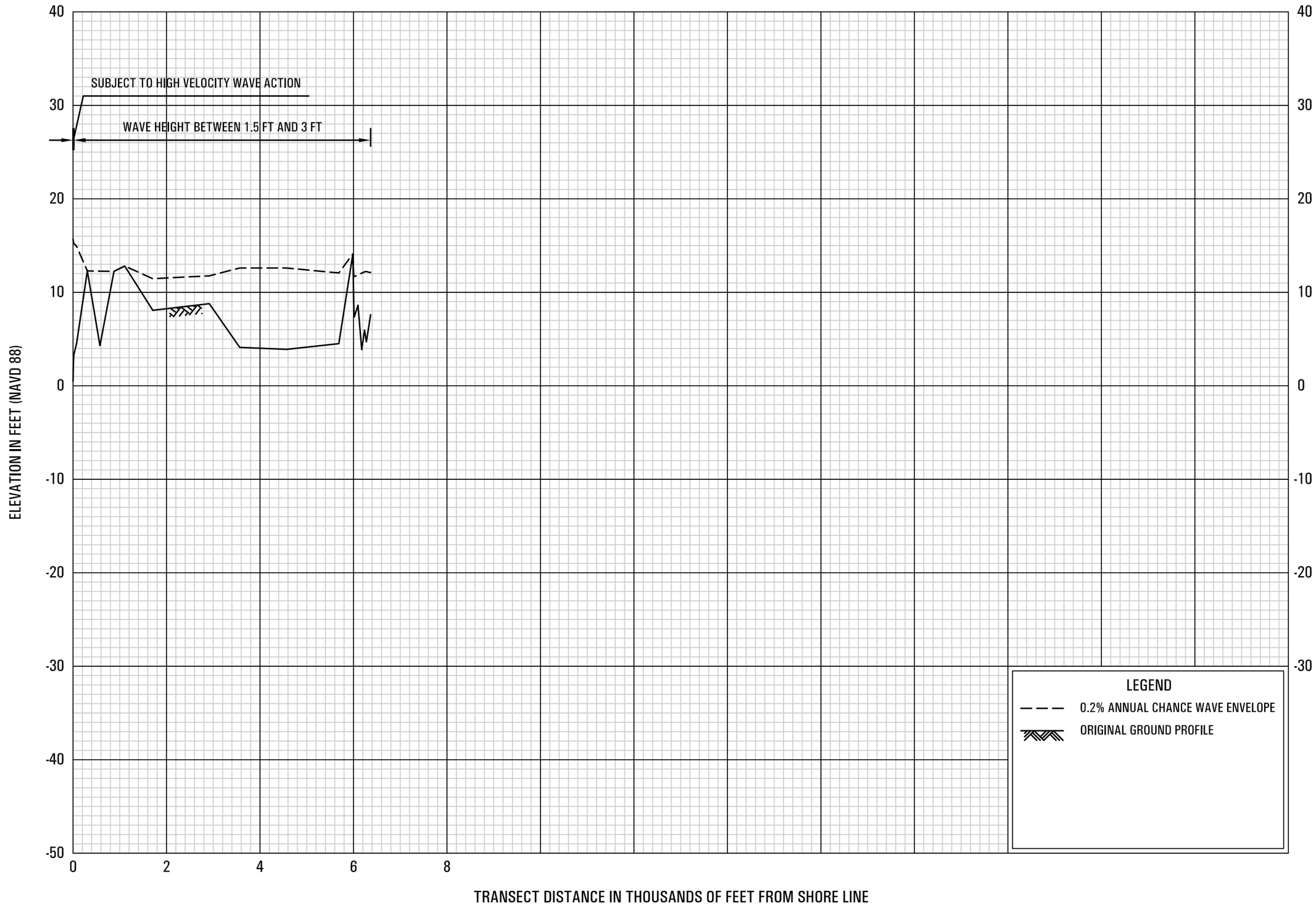
TRANSECT 48

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

66P

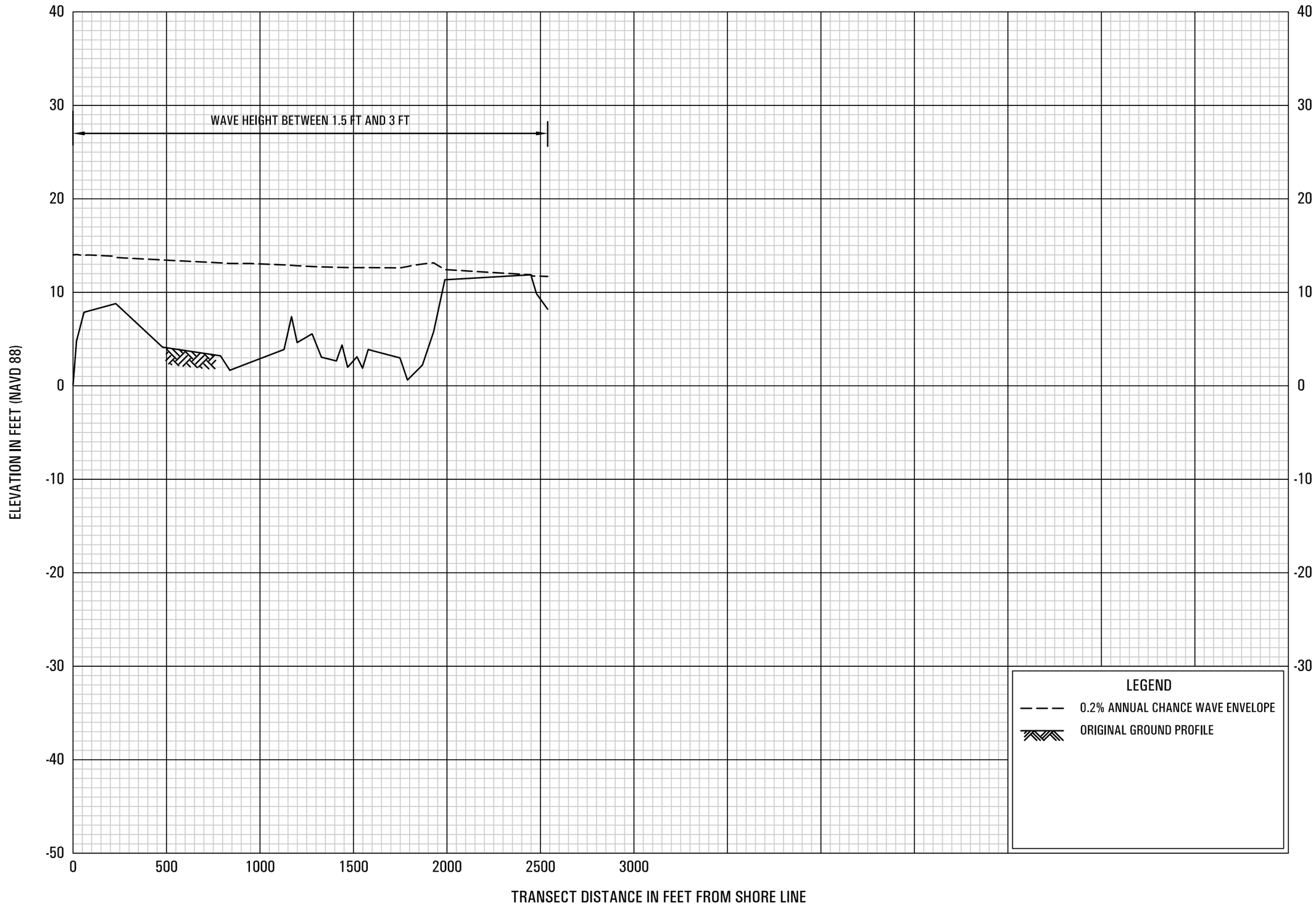


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 49

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



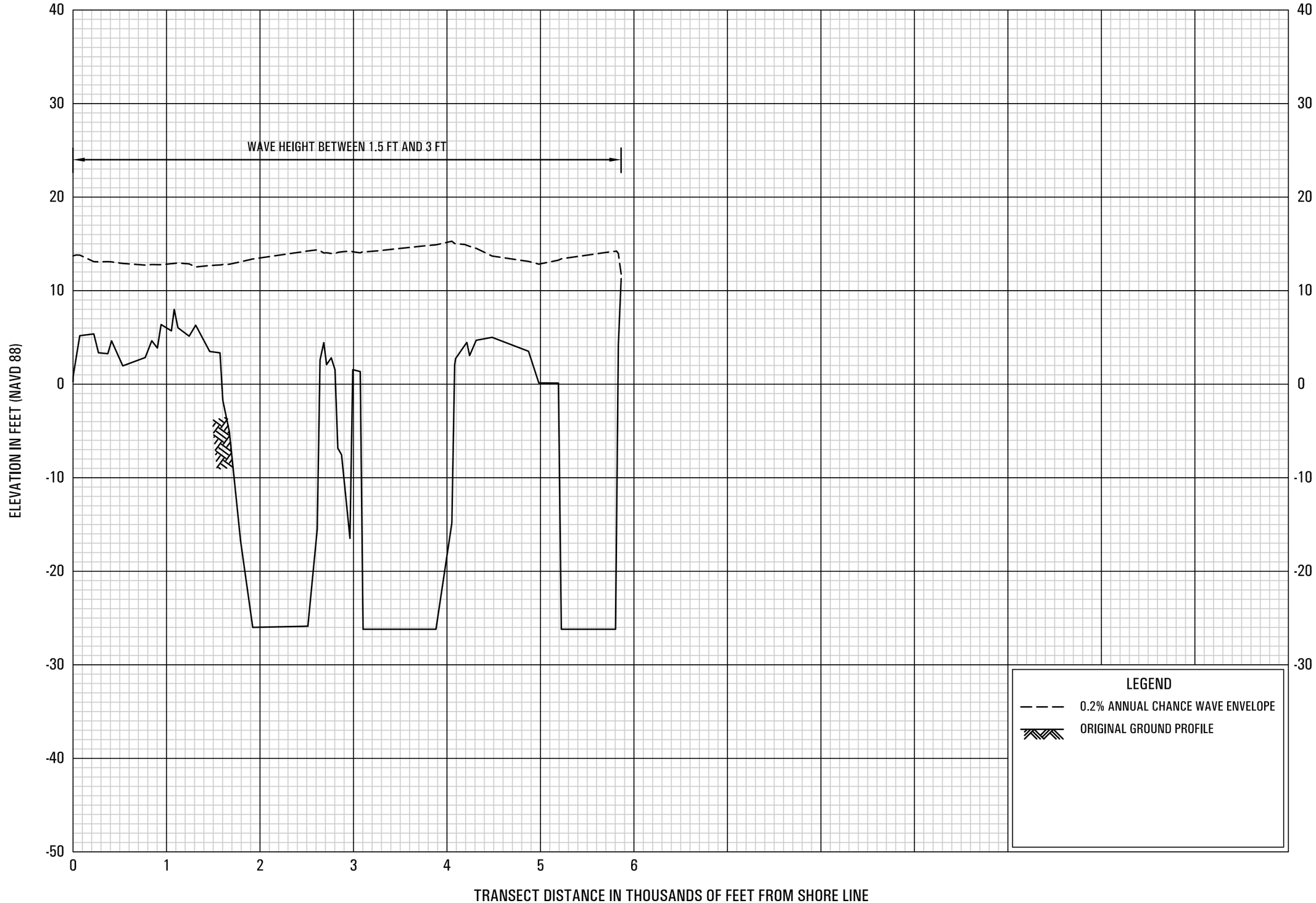
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 50

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



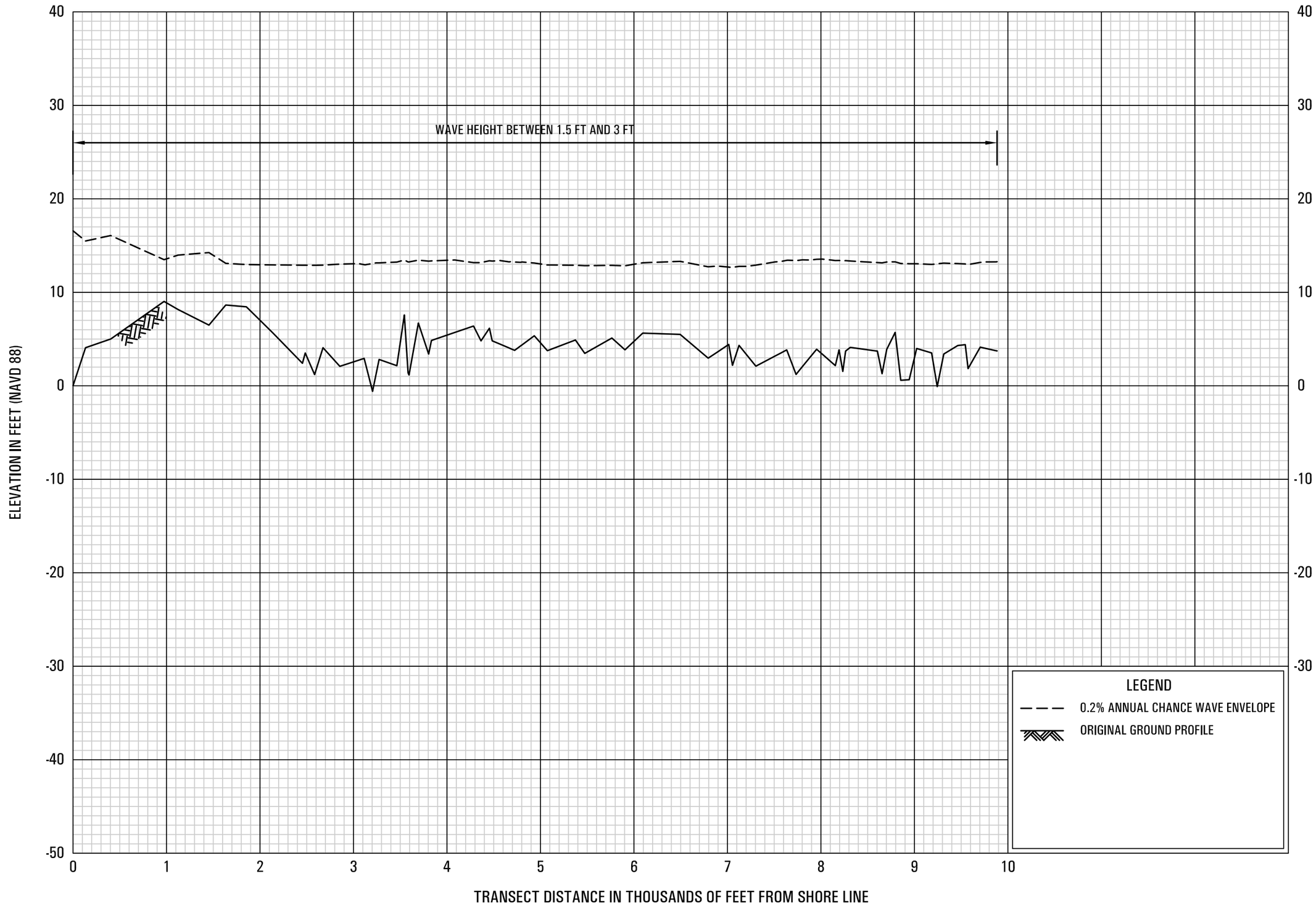
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 51

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

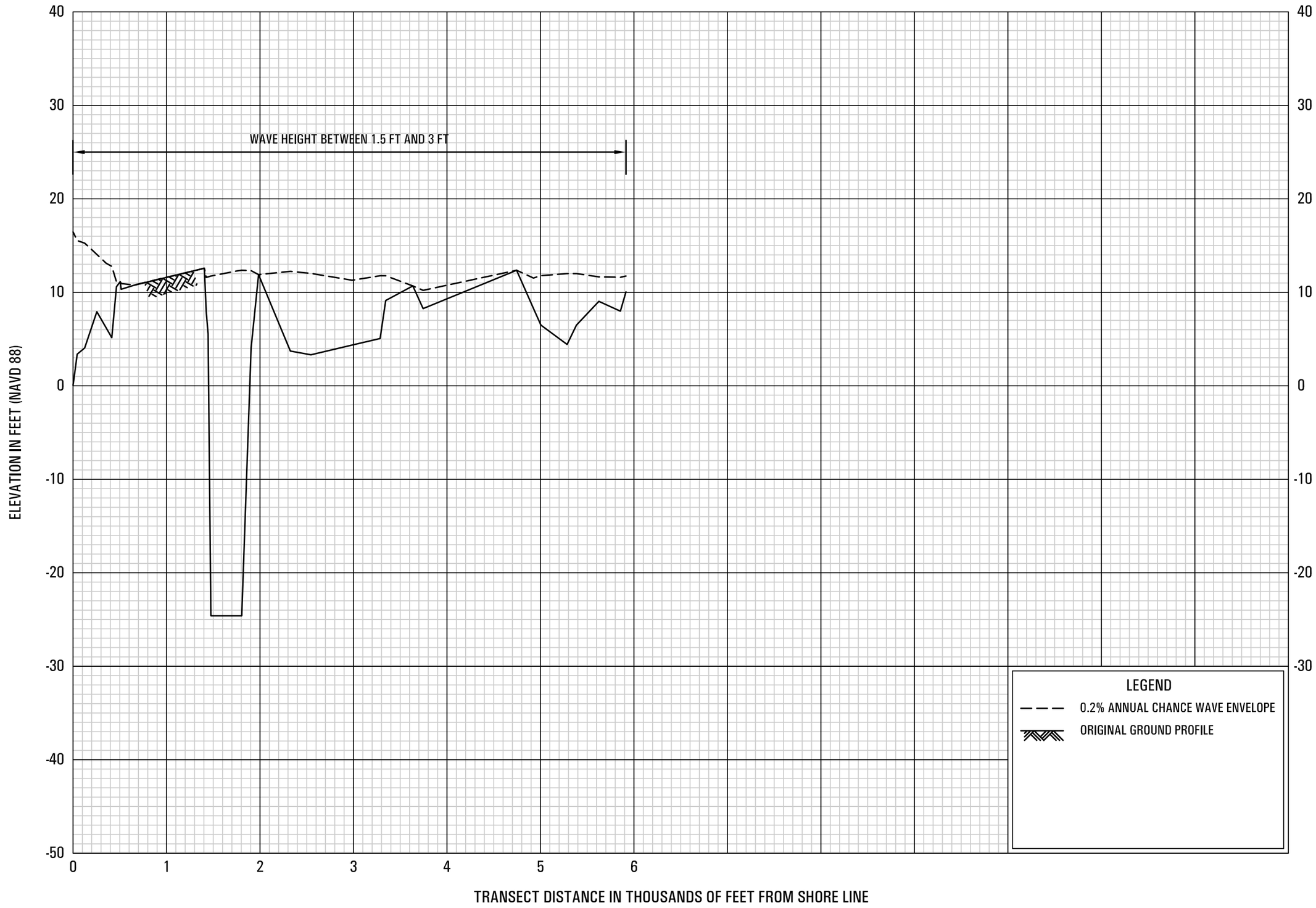
TRANSECT 52

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX

AND INCORPORATED AREAS

70P

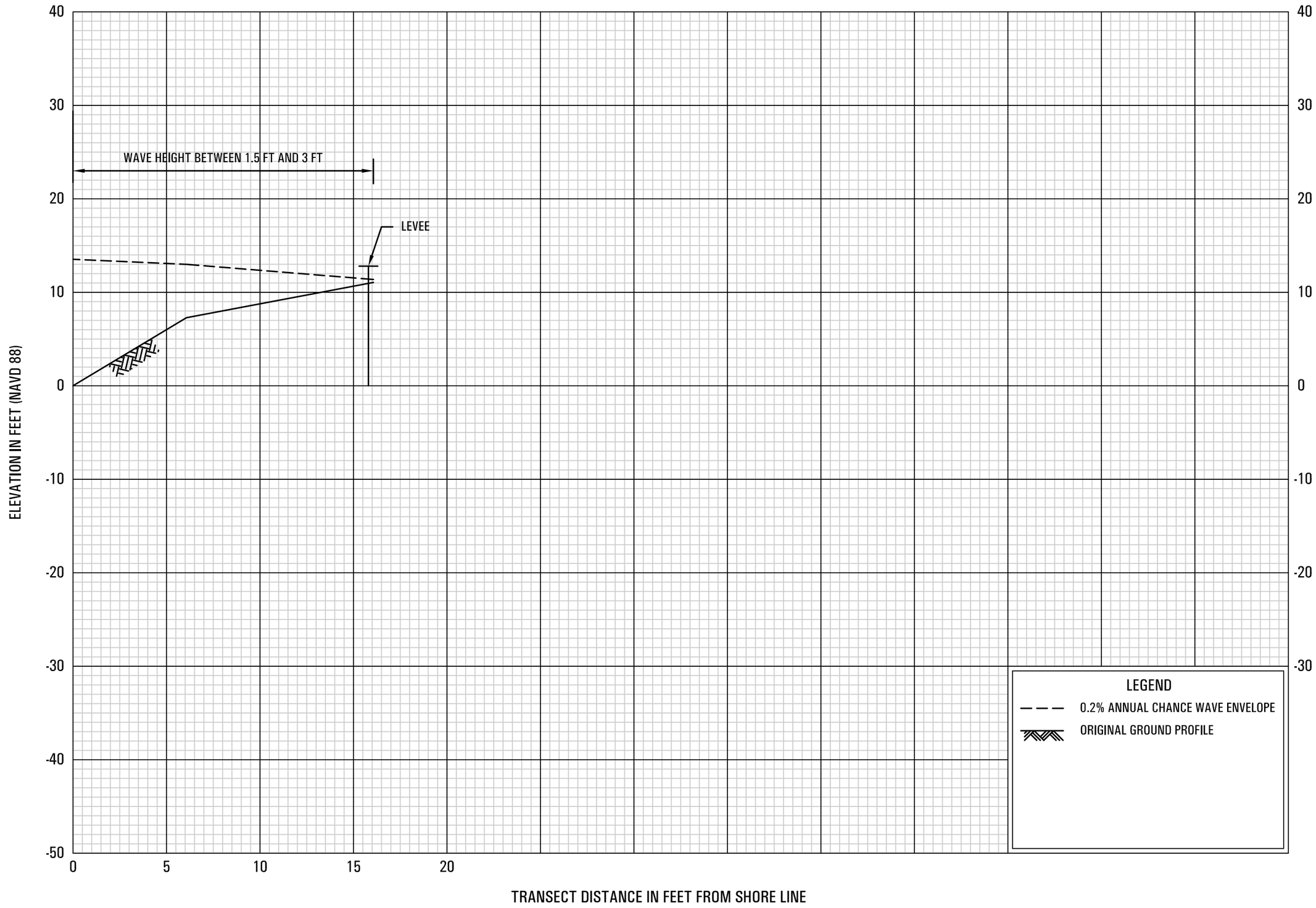


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 53

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



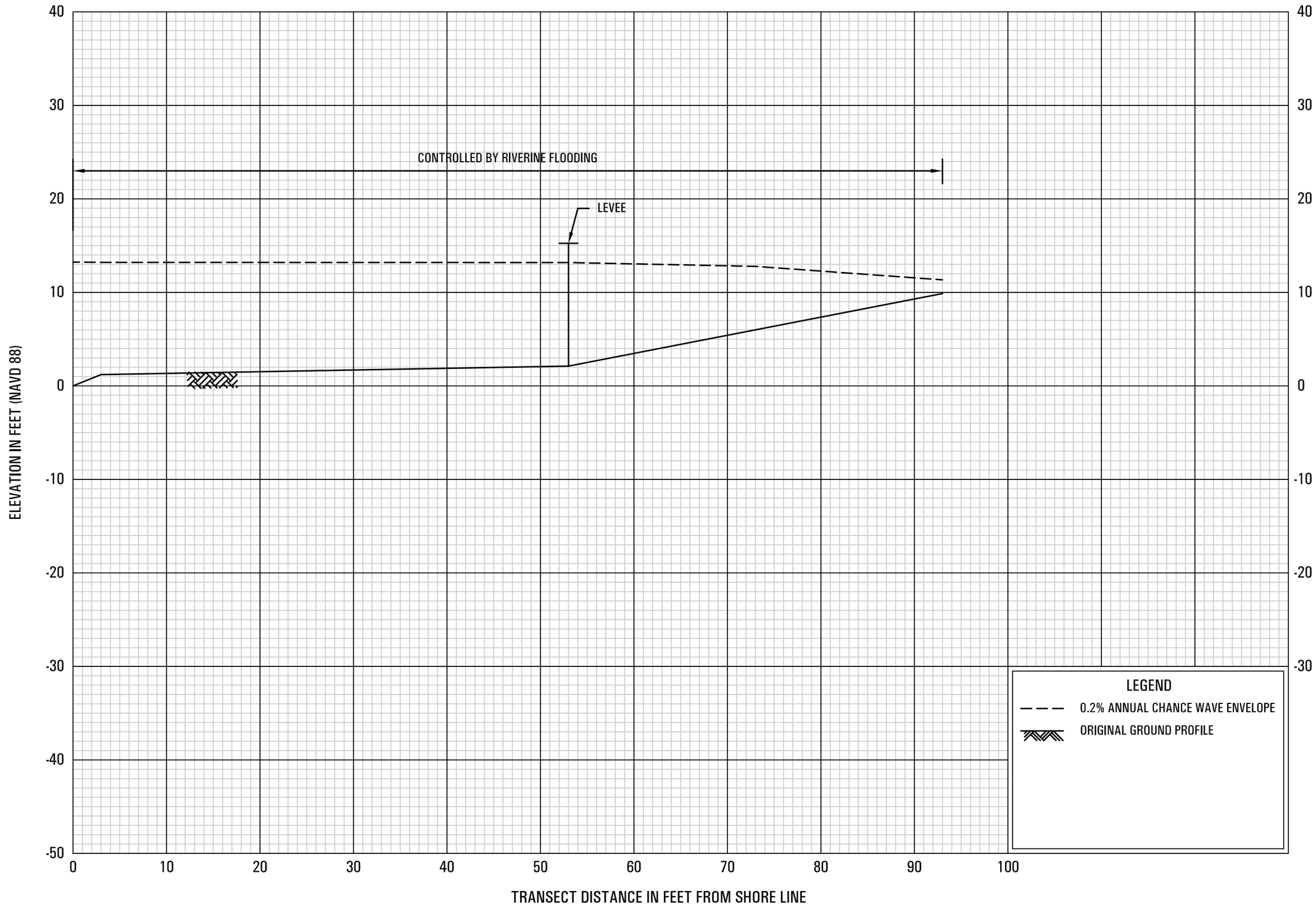
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 54

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

72P

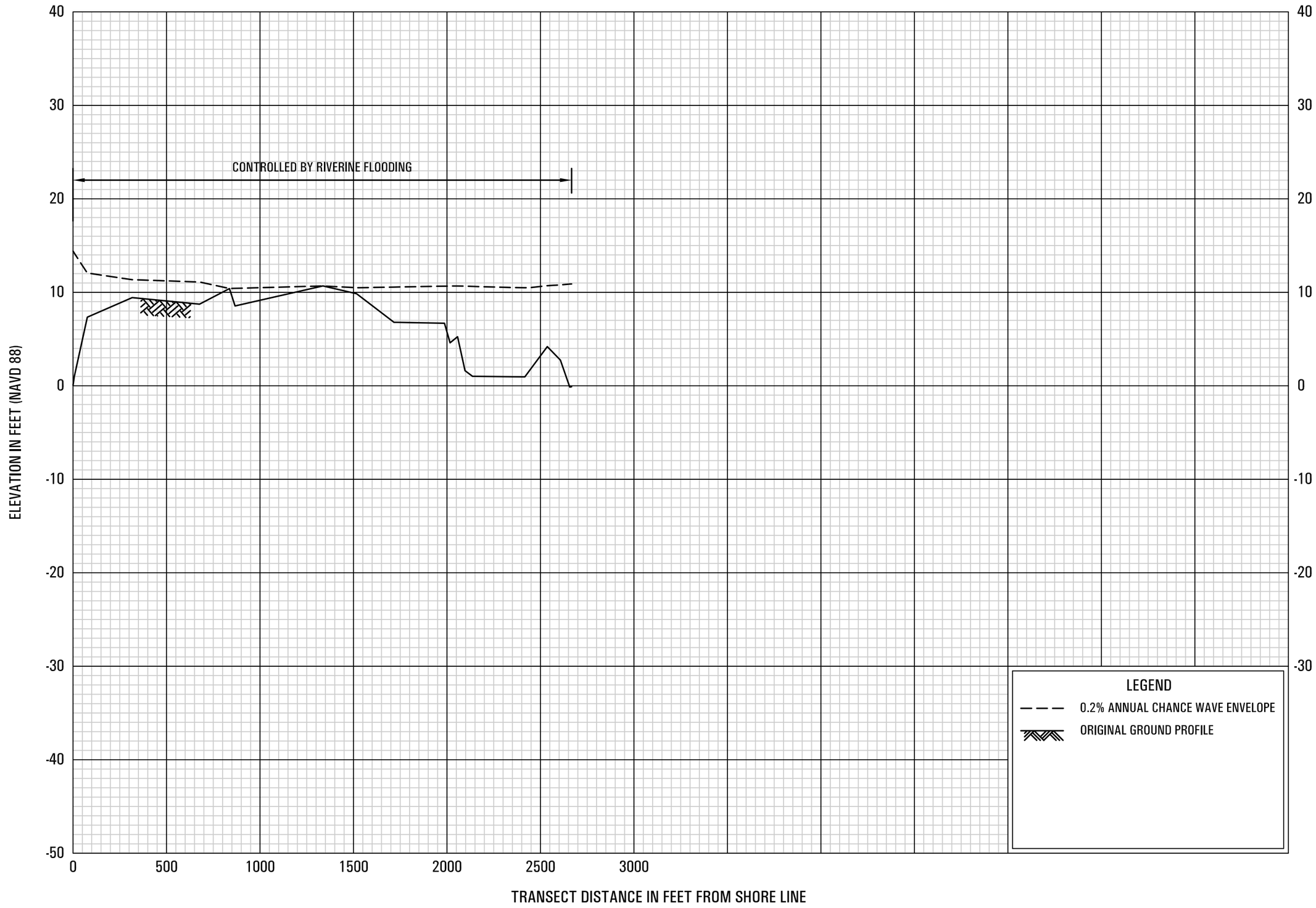


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 55

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

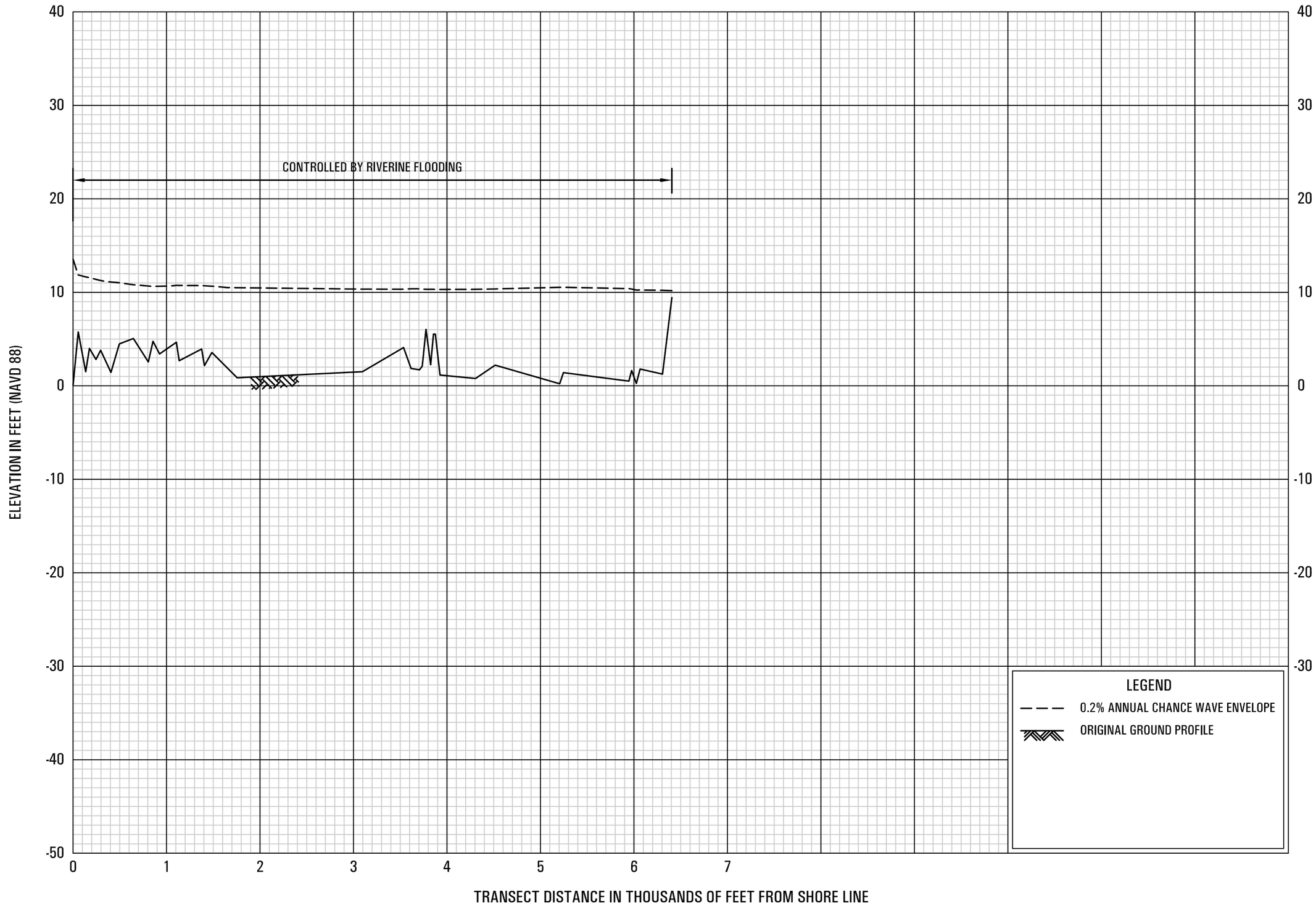


0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 56

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS



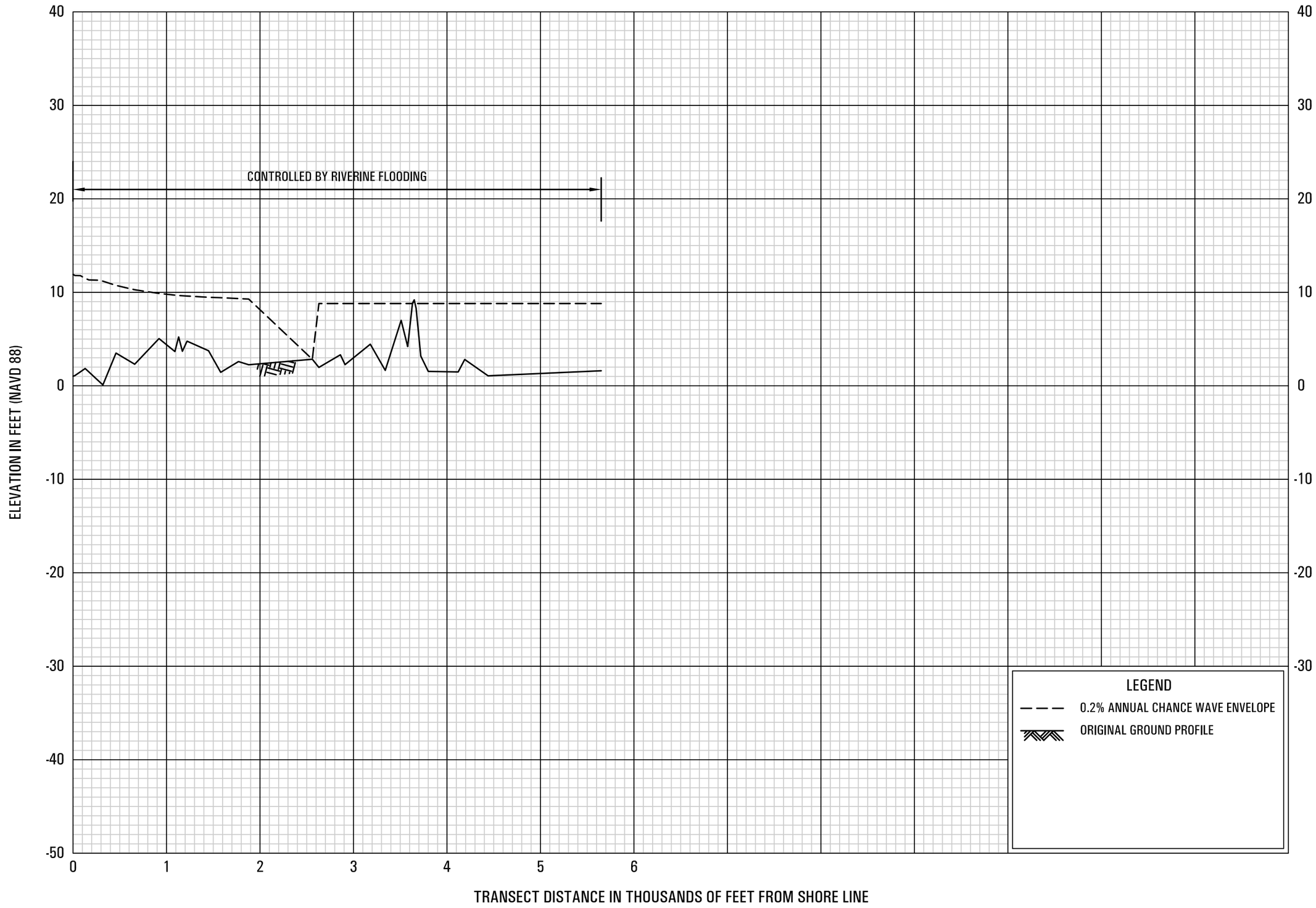
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 57

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

75P



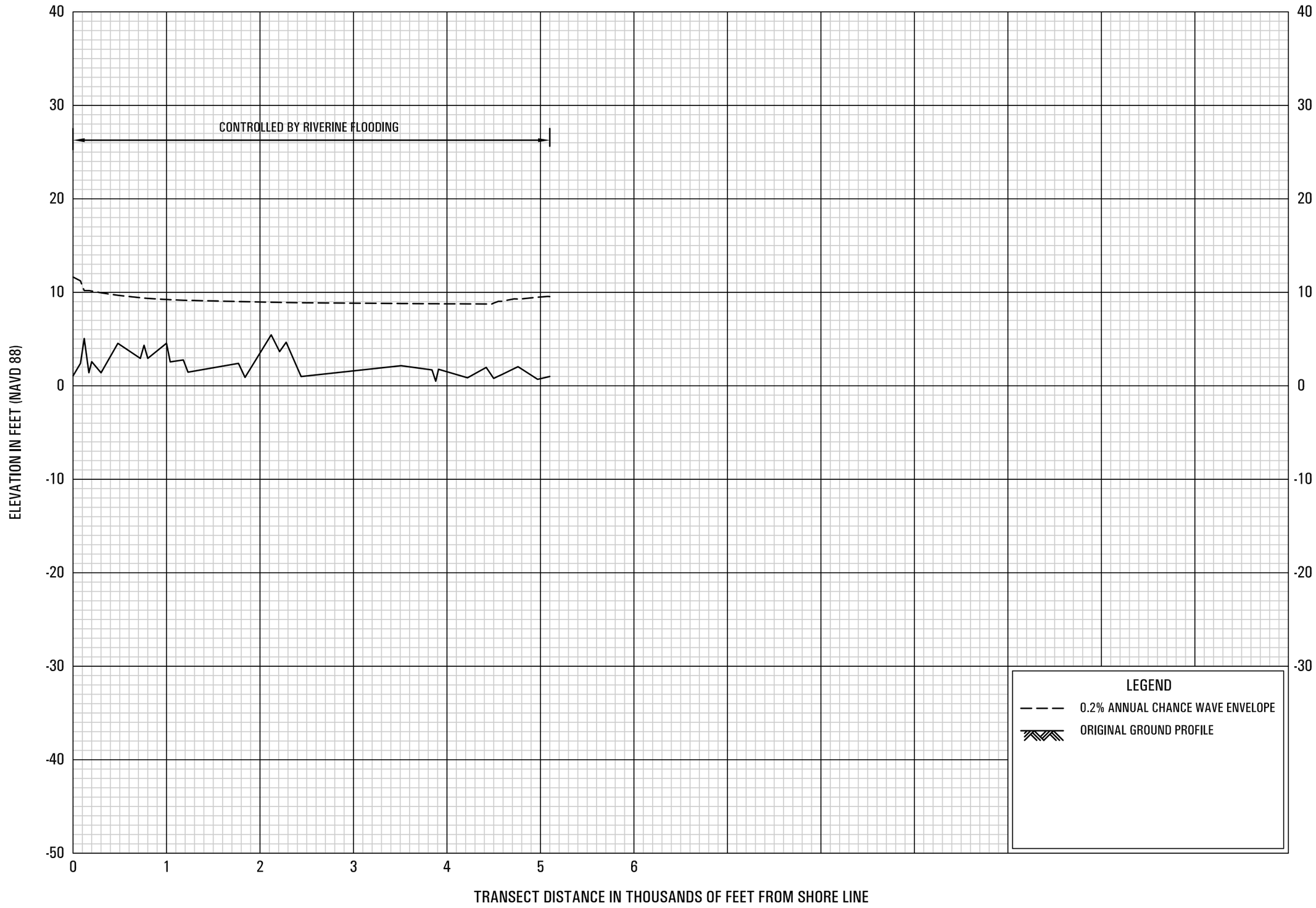
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 58

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

76P



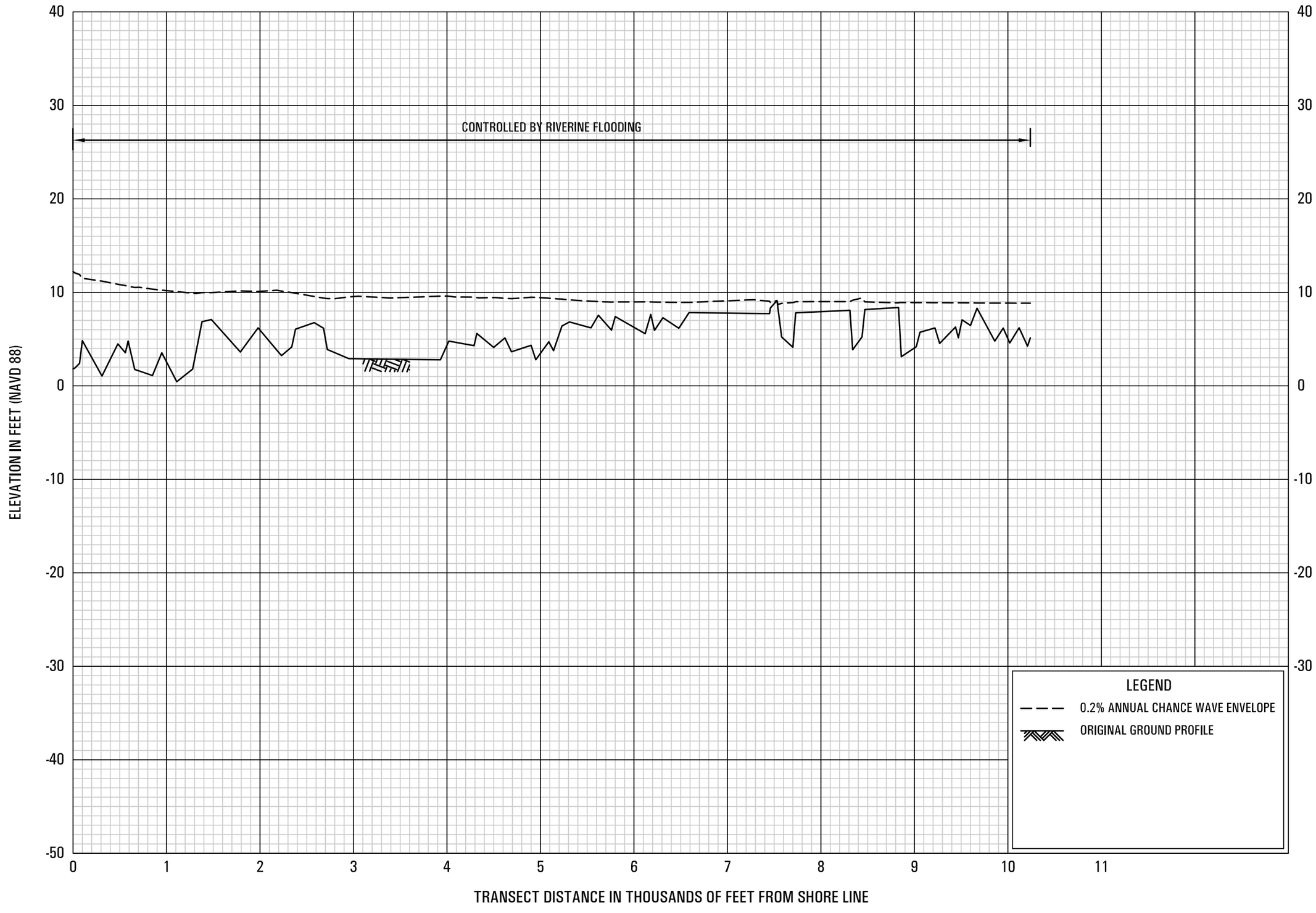
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 59

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS

77P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 60

FEDERAL EMERGENCY MANAGEMENT AGENCY

JEFFERSON COUNTY, TX
AND INCORPORATED AREAS