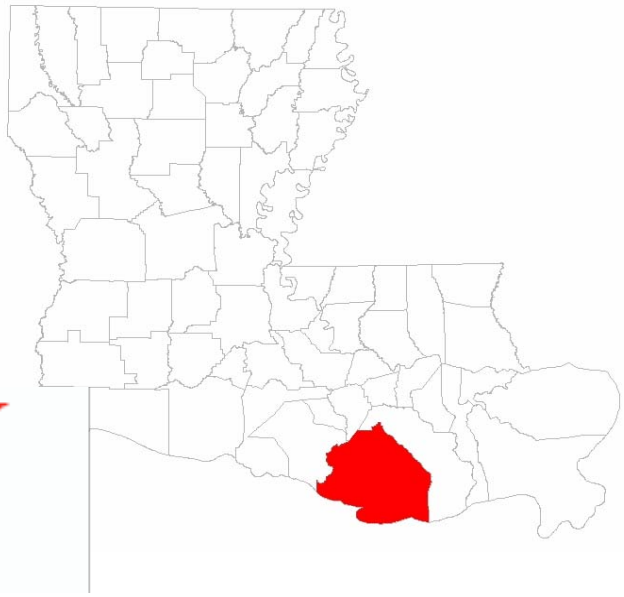
FLOOD INSURANCE STUDY

TERREBONNE PARISH, LOUISIANA
AND INCORPORATED AREAS

Community Name	Community Number
Terrebonne Parish	225206
City of Houma	220220



PRELIMINARY
JULY 30, 2008

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
22109CV00B

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 only profiles added or revised as part of the restudy. These profiles are presented in 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.

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FLOOD INSURANCE STUDY
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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 Terrebonne Parish, including the City of Houma, and is referred to collectively herein as Terrebonne Parish, 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.

Previously the Flood Insurance Rate Map (FIRM) was produced showing only the stillwater storm surge elevations due to the lack of a suitable and generally applicable methodology for estimating the wave crest elevations associated with storm surges. These stillwater elevations were subsequently stipulated in community floodplain management ordinances as the minimum elevation of the lowest floor, including basement, of new construction. Communities and individuals had to consider the additional hazards of velocity waters and wave action on an ad hoc basis. Because there has been a pronounced tendency for buildings to be constructed only to meet minimum standards, without consideration of the additional hazard due to wave height, increasing numbers of people could unknowingly be accepting a high degree of flood-related personal and property risk in coastal areas subject to wave action. Therefore Federal Emergency Management Agency (FEMA) has pursued the development of a suitable methodology for estimating the wave crest elevations associated with storm surges. The recent development of such a methodology by the National Academy of Sciences (Reference 1) has led to the adoption of wave crest elevations for use as the base flood elevation (BFE) in coastal communities.

The most recent hurricanes affecting Terrebonne Parish were Hurricanes Katrina and Rita, which occurred August 29 and September 24, 2005, respectively.

Hurricane Hilda brought flood elevations of 14.6 feet National Geodetic Vertical Datum (NGVD) at the Keystone Lock and Dam gaging station. This is the highest recorded flood stage elevation of Bayou Teche in the 48-year record. The extent of flooding in the overbanks of Bayou Teche was limited, however, in comparison to the flooding along the fringes of Dauterive Lake and Lake Fausse Pointe. The observed pressure at Franklin, Louisiana station was 959.4 mb. Storm direction was on a course of 1750 (clockwise from north) with winds of 111-130 miles per hour which caused extensive damage to the coastal community (References 2, 3, and 4). Offshore oil facilities were extensively damaged by

winds and waves. The purpose of this study is to revise the FIRM for Terrebonne Parish to include the effects of wave action from the Gulf of Mexico.

1.2 Authority and Acknowledgement

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

The hydrologic and hydraulic analyses for the previous study in the City of Houma were performed by the New Orleans District, U.S. Army Corps of Engineers (USACE-MVN), for the Federal Insurance Administration (FIA), under Inter-Agency Agreement (IAA)-H-7-76, Project Order No. 10. This study was completed in October 1978.

The hydrologic and hydraulic analyses for this parishwide study were prepared by USACE-MVN as part of the Contract No. W912P8-05-D-0013. This work was completed in 2008.

1.3 Coordination

For the City of Houma, community base map selection and streams requiring detailed study were identified at an initial Consultation Coordination Officer (CCO) meeting attended by representatives of the USACE-MVN, the FIA, and representatives of the City of Houma in May 1975. During the course of the study, the flood elevations and flood boundaries were reviewed with community officials and with officials of the State Office of Public Works.

On August 15, 1979, the results of the study were reviewed at the final meeting attended by representatives of the USACE-MVN, FIA, and community officials. The study was acceptable to the community.

For this parishwide study, the final CCO meeting was held on _____ and attended by representatives of FEMA, USACE-MVN, the contractor and the community. 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 Terrebonne Parish, Louisiana, 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 through 2007.

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 community officials.

Coastal flooding from the Gulf of Mexico affecting Terrebonne Parish was studied by detailed methods.

2.2 Community Description

Terrebonne Parish is located in the southern part of Louisiana, and is bordered on the north by Assumption Parish, to the east by Lafourche Parish, on the northwest by St. Mary's Parish and to the south by the Gulf of Mexico. The parish has a total area of 2,080 square miles, and is considered the largest parish in Louisiana with regards to land area (Reference 4). According to the U.S. Census, the 2006 parish population was 109,348. The parish seat is the City of Houma (Reference 5).

Two natural watercourses originate in the City of Houma, Bayou Grand Caillou, which flows south to the Gulf of Mexico, drains 0.8 square miles at the corporate boundary, and is 4.2 miles long at that point, and Bayou Chauvin, which flows south to Lake Boudreaux, and has a drainage area at the corporate boundary of 5.0 square miles. Its length at that point is 4.5 miles.

The Gulf Intra-Coastal Waterway passes through the center of the City of Houma, and crosses Bayous Terrebonne, Black and LaCarpe within the corporate limits, thereby effectively joining these natural watercourses with the Houma Navigation Canal, which extends southward to the Gulf of Mexico.

The City of Houma is a principal trade center for southeast Louisiana. It also has sugar cane and seafood processing plants, offshore oil production service industries, and boat repair facilities. US Highway 90 passes through the city, as does a branch of the Southern Pacific Railroad.

The climate of the area is strongly influenced by the Gulf of Mexico, giving it a semi-tropical marine character. The greatest rainfall events can arise from tropical storms moving inland, from intensive convective storms triggered by southerly gulf winds, and frontal storms resulting from interaction of warm moist air with cold dry air. The annual average temperature is 69 degrees Fahrenheit, ranging from 56 degrees Fahrenheit in the winter to 82 degrees Fahrenheit in summer. Annual average precipitation is 65 inches. Snowfall is very infrequent.

2.3 Principal Flood Problems

The low-lying unprotected areas of the City of Houma are subject to periodic flooding caused by hurricanes and tropical storms, or by rainfall runoff aggravated by high tides in the Gulf of Mexico.

Areas that are protected by natural or artificial barriers from tide induced flooding would experience occasional ponding-type flooding from local runoff that is in excess of outlet capacities. Localized flooding may also occur along the floodplains of Bayous Grand Caillou and Chauvin.

Prior to Hurricanes Katrina and Rita, the most damaging hurricane affecting Terrebonne Parish was Hurricane Hilda, which brought flood elevations of 14.6 feet (NGVD) at the Keystone Lock and Dam gaging station. Post Hurricane Hilda and pre- Hurricanes Katrina and Rita, the highest observed water levels at a recording gage on the Intra-Coastal Waterway at the City of Houma (period of record, July 1941 to date) occurred in 1973, with

a peak stage of 4.2 feet NGVD, and in 1975 with a reading of 4.1 feet. (The estimated recurrence intervals of these two events were 60 and 50 years, respectively.) Each was caused by a combination of heavy rainfall and abnormally high tides. High water levels in 1971, 1974 and 1977 were associated with hurricanes, while the peak stage in 1976 was primarily the result of high tides associated with persistent southerly winds. The recorded peak stages were 3.5, 3.8, 3.8, and 3.3, respectively. Of these, only the 1974 and 1976 events were considered to be in excess of a 10-year frequency (each at 20 years). Other hurricanes that have the impacted Terrebonne Parish were Carmen (1974), Bob (1979), Danny and Juan (both 1985), Andrew (1992), Frances and George (both 1998).

2.4 Flood Protection Measures

The Terrebonne Parish Police Jury in 1970 created a parish-wide forced drainage district. Under this authority, numerous individual drainage projects for the parish were proposed. Each of the projects provided for pumped drainage of developed or developing areas, with a low-lying portion of each protected area designated for temporary storage of excess runoff.

Most of these projects took advantage of existing barriers to protect against outside flooding sources while certain others, particularly Project 1-5, required protective levees to become fully effective. The analyses considered as complete all drainage projects affecting the City of Houma that were completed within 12 months after publication of the previous FIS report. None of the levees in the parish provide protection from the 1-percent annual chance event.

In addition to these projects, other projects were pursued which provided drainage for the City of Houma.

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-, 2-, 1-, or 0.2-percent annual chance period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at 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 flood 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.

For the previous study done for the City of Houma, hydrologic analyses were carried out to establish peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the community.

Analyses were also conducted to establish peak elevation-frequency relationships for tidal flooding, and for combinations of tidal and headwater flooding affecting the community.

Discharge-frequency determinations were made for those areas that are protected by natural or artificial barriers from tidal flooding and are served by pumping stations. Peak discharge-frequency relationships were also established for the two riverine flood sources, Bayou Grand Caillou and Bayou Chauvin, which are also affected by coastal backwater flooding.

The peak discharge-drainage area relationships for the selected recurrence intervals are presented in Table 1, "Summary of Discharges."

TABLE 1 – SUMMARY OF DISCHARGES

FLOOD 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
PONDED RAINFALL					
Area bounded by St. Louis Canal, Six Foot Ditch, New Orleans Blvd., and W. Park Ave.	0.77	610	790	890	1,080
BAYOU GRAND CAILLOU[1]					
Pumping Station near Grand Caillou Road	0.84	610 (600)[4]	790 (760)[4]	890 (860)[4]	1,070 (1,010)[4]
Grand Caillou Road (Upper Crossing)	0.64	500 (480)[4]	650 (590)[4]	730 (650)[4]	870 (760)[4]
Oaklawn Drive	0.37	370 (340)[4]	460 (380)[4]	540 (430)[4]	670 (490)[4]
Hialeah Avenue	0.21	280	350	380	460
Cleveland Street	0.05	130	160	190	220

TABLE 1 – SUMMARY OF DISCHARGES
(continued)

FLOOD 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
BAYOU GRAND CAILLOU[1] (continued)					
Jane Avenue	0.13	210	260	290	360
PONDED RAINFALL					
Area bounded by Saadi Ave., Acadian Dr., and Southern Pacific Railroad	0.70	960 (970)[4]	1,250 (1,290)[4]	1,420 (1,480)[4]	1,720 (1,800)[4]
BAYOU CHAUVIN					
Pumping Station near Corporate Limit	4.97	1,825	2,475 (2,380)[4]	2,800 (2,695)[4]	3,400 (3,270)[4]
Boundary Road	3.32	1,425	1,900 (1,785)[4]	2,150 (1,930)[4]	2,600 (2,235)[4]
Moffet Road	1.76	950	1,225 (1,040)[4]	1,400 (1,040)[4]	1,700 (1,100)[4]
Prospect Avenue	1.24	750	975	1,075	1,325
East Street	0.82	575	750	825	1,000
Tulane Street	0.47	425	550	600	750
PONDED RAINFALL[2]					
Pumping Station at Baringer Street	0.28	420	520	580	680
PONDED RAINFALL[3]					
Pumping Station at Southern Pacific Railroad	1.19	1,260	1,620	1,830	2,190

[1] Terrebonne Parish Forced Drainage Project 1-2
[2] Terrebonne Parish Forced Drainage Project 1-7
[3] Terrebonne Parish Forced Drainage Project 1-8
[4] Peak Discharge Adjusted for Interbasin Flow

Remaining areas were analyzed with respect to peak flood elevations in adjacent waterways and/or wetlands, which constitute their most important flooding source. Local rainfall would generally produce only temporary shallow water depths, generally less than one foot, in these relatively small drainage areas.

The pumped drainage projects that affected the City of Houma were analyzed by routing computed runoff hydrographs through pumps and, in some cases, gravity outlets. That analysis has been superseded by this restudy.

Generalized rainfall frequency-depth-duration data (Reference 7) were used with synthetic unit hydrographs to develop runoff hydrographs for each pumped area. Concentration times were determined on the basis of travel distances (overland and channel), slopes, and land use patterns. Relative lengths of the rising and falling limbs of the unit hydrographs were assumed to vary with size of drainage area.

Computed unit hydrograph ordinates, incremental rain amounts for each storm frequency, and appropriate infiltration loss rates were entered into the HEC-I computer program (Reference 8) together with drainage areas and imperviousness ratios. The resultant discharge hydrographs were assumed to have the same frequencies of occurrence as their associated storms. The absence of observed discharge data in the City of Houma area ruled out a statistical discharge-drainage area analyses.

The stage-recording gage located on the Intracoastal Waterway at Bayou Terrebonne in the City of Houma is considered a reliable indicator of ambient water levels in and around the community. A peak stage-frequency analysis was conducted for this gage using the Log-Pearson Type III distribution.

The average water-level relationships that were observed before Hurricanes Katrina and Rita between the gages at the City of Houma and the area of Cocodrie (on Bayou Petit Caillou about 21 miles south of the City of Houma) were taken as generally applicable to that reach during non-tropical storm periods.

Using the above-described pre-Hurricanes Katrina and Rita relationships, ambient water levels corresponding to the 10-, 2-, 1- and 0.2-percent annual chance floods (hurricane and non-hurricane) were determined at the outlets of the pumped areas. Since major rain events can be associated with either of the above flood sources, ambient (tailwater) elevations between the two limiting values were chosen for use in the storage routing computations for each of the pumped areas that also have gravity outlets. A summary of computed peak water-surface elevations at particular locations is shown in Table 2, “Summary of Elevations."

TABLE 2 – SUMMARY OF ELEVATIONS

FLOOD SOURCE AND LOCATION	ELEVATION ABOVE NAVD (feet)			
	10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
GULF OF MEXICO At Outlet of Project 1-2	3.3*	4.7	5.3	6.0
GULF OF MEXICO At Outlet of Project 1-3	3.4*	4.2	4.8	5.4
GULF OF MEXICO At Outlet of Project 1-5	3.3*	4.8	5.5	6.2
GULF OF MEXICO At Outlet of Project 1-7	3.5*	4.1*	4.5	5.1

* Primary Flood Source is Rainfall

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied are 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 table 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.

Please note that the profiles for Bayou Grand Caillou and Bayou Chauvin (Sale) have been removed due to the new coastal analysis.

3.3 Coastal Analysis

The hydraulic characteristics of flooding from possible 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 in the FIS report.

3.3.1 Storm Surge Analysis and Modeling

For areas subject to tidal inundation, the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations and delineations were taken directly from a detailed storm surge study documented in the Technical Study Data Notebook (TSDN) for this new Louisiana coastal flood hazard study.

The Advanced Circulation model for Coastal Ocean Hydrodynamics (ADCIRC) developed by the USACE-MVN was applied to predict the stillwater elevations or storm surge levels for coastal Louisiana. The ADCIRC uses an unstructured grid and is a finite-element long wave model. It has the capability to stimulate tidal circulation and storm surge propagation over large areas and is able to provide highly detailed resolution in the areas of interests along shorelines, open coasts and inland bays. It solves three dimensional equations of motion, including tidal potential, Coriolis, and nonlinear 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 to calculate wave runup and overtopping on structures, and wave momentum (radiation stress) was considered as contribution to elevated water levels (wave setup). The numerical model STWAVE was used to generate and transform waves to the shore. 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 surge field. The surge significantly alters the wave transformation and generation for the hurricane simulations in shallow areas flooded.

STWAVE was applied on several grids for the Southern Louisiana area. The input for each grid includes the bathymetry (interpolated from the ADCIRC domain), surge fields (interpolated from ADCIRC surge fields), and wind (interpolated from the ADCIRC wind fields, which apply land effects to the OWI wind fields). The wind applied in STWAVE is spatially and temporally variable for all domains. STWAVE was run at 30-minute intervals.

An existing ADCIRC grid mesh developed by the USACE-MVN was refined along the shoreline of Louisiana and surrounding areas using bathymetric and topographic data from various sources. Bathymetric data consisted of ETOPO5 and Digital Nautical chart databases in the offshore regions. In the nearshore areas, bathymetric data came from regional bathymetric surveys conducted by the USACE-MVN. The topographic portion of the ADCIRC mesh was populated with topographic light detection and ranging (LiDAR) from several sources. In addition, subgrid sized features such as roads and levees were captured in the grid and modeled as weirs. Further details about the terrain data and how it was processed can be found in the TSDN.

The completed ADCIRC grid mesh resulted in a finite element model coded with over 2,200,000 grid nodes. The National Oceanic and Atmosphere Administration's (NOAA) high definition vector shoreline was used to define the change between water and land elements. The grid includes other features, such as islands, roads, bridges, open waters, bays, and rivers. Field reconnaissance detailed the significant drainage and road features, and documentation of coastal structures in the form of seawalls, bulkheads, and harbors. The National Land Cover Dataset was used to define Manning's n values for bottom roughness coefficients input at each node to the mesh. A directional surface wind roughness value was also applied. Further details about the ADCIRC mesh creation and grid development process can be found in the TSDN.

Predicted tidal cycles were used to calibrate the ADCIRC model and refine the grid. Tidal boundary conditions were obtained from a total of 40 NOAA tide gauges. Seven tidal constituents were used (K1, O1, Q1, M2, S2, N2, and K2). The simulated water-surface elevation time series was compared to measured tides from tide gauge stations for over a 30-day period. Model validation, which tests the model's ability to reproduce historical events, was performed against Hurricanes Katrina and Rita (2005), and Andrew (1993). Simulated water levels for each event were compared to observed water levels from NOAA tidal gauges, as well as available high water marks. Further details about the model calibration and validation can be found in the TSDN.

Production runs were carried out with STWAVE and ADCIRC on a set of hypothetical storm tracks and storm parameters in order to obtain the maximum water levels for input to the statistical analysis. The hypothetical (synthetic) population of storms was divided into two groups, one for hurricanes of Saffir-Simpson scale Category 3 and 4 strength or "greater storms" and another set for hurricanes of Category 2 strength or "lesser storms." A total of 304 individual storms with different tracks and various combinations of the storm parameters were chosen for the production run set of synthetic hurricane simulations. Each storm was run for at least 3 days of simulation and did not include tidal forcing. Wind and pressure fields obtained from the PBL model and wave radiation stress from the STWAVE model were input to the ADCIRC model for each production storm. All stillwater results for this study include the effects of wave setup. Maximum

water-surface was output at every ADCIRC grid point that was wetted by a model storm. This resulted in more than 1,000,000 locations where statistical methods were applied to obtain return periods of the stillwater elevation. A Triangular Irregular Network (TIN) was created to represent the Stillwater surface based on the density of the output points from ADCIRC. Further details about the production run process can be found in the TSDN.

3.3.2 Statistical Analysis

The Joint Probability Method (JPM) was used to develop the stillwater frequency curves for the 10-, 2-, 1-, and 0.2-percent-annual-chance stillwater elevations. The JPM approach 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. The JPM approach was modified for this coastal study based on updated statistical methods developed by FEMA and the USACE-MVN for Mississippi and Louisiana.

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 developed cooperatively by FEMA and the USACE-MVN for the Mississippi and Louisiana coastal flood studies that were being performed simultaneously, 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 Louisiana coast.

3.3.3 Stillwater Elevation

The results of the ADCIRC model, as described above, provided stillwater elevations, including wave setup effects that are statistically analyzed to produce probability curves. The JPM-OS is applied to obtain the return periods associated with tropical storm events. The approach involves assigning statistical weights to each of the simulated storms and generating the flood hazard curves using these statistically weights. The statistical weights are chosen so that the effective probability distributions associated with the selected greater and lesser storm populations reproduced the modeled statistical distributions derived from all historical storms.

Stillwater elevations for each Louisiana coastal parish, obtained using the ADCIRC and JPM-OS models, are provided for JPM and ADCIRC grid node locations for the 10-, 2-, 1-, or 0.2-percent-annual-chance return period stillwater elevations in the TSDN.

3.3.4 Wave Height Analysis

Areas of coastline subject to significant wave attach are referred to a coastal high hazard zones. The USACE-MVN has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones. The 3-foot wave has been established as the minimum size wave capable of causing major damage to conventional wood frame and brick veneer structures. Wave heights were computed along transects (cross-section lines) that were located along the coastal areas.

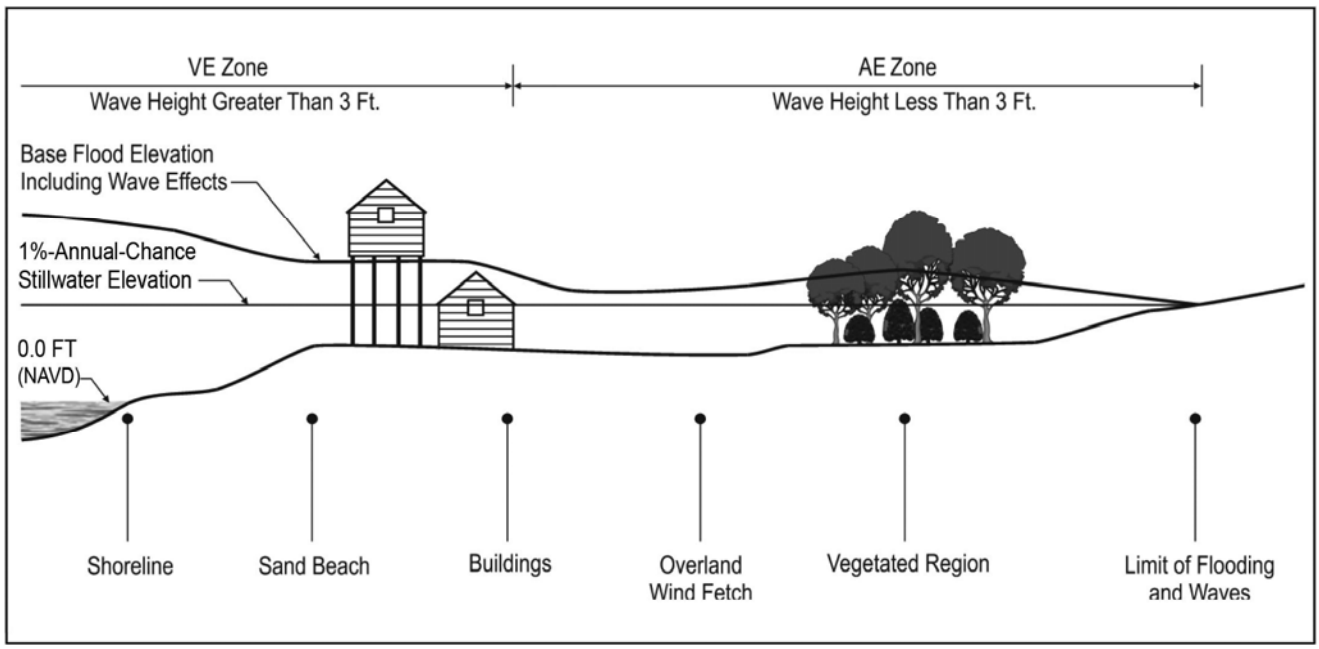

FIGURE 1 - TRANSECT SCHEMATIC

Figure 1 shows a profile for a typical transect, and illustrates the effects of energy dissipation and regeneration of a wave as it moves inland. 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 1 also illustrates the relationship between the local stillwater elevations, the ground profile, and the location of the Zone VE and Zone AE boundary. This inland limit of the coastal high hazard area is delineated to ensure that adequate insurance rates apply and appropriate construction standards are imposed.

For Terrebonne Parish, all transects are running from south (the Gulf of Mexico) to north, starting at the coastline and ending at the parish boundary. The initial wave heights representing the 1- and 0.2-percent-annual-chance flood events were determined based on depth-limited breaker heights, which is approximately 78% of the stillwater depth under the corresponding surge conditions. Wave periods were extracted from STWAVE modeling results.

The wave transects for this study were developed considering the physical and cultural characteristics of the land so that they would closely represent physical conditions in their locality. Transects were spaced dense enough to represent the hydraulic conditions and to capture hydraulic changes. In areas having more uniform characteristics, transects were spaced at relatively larger intervals. Transects were also located in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects. Transects are shown on the respective FIRM panels for the parish.

The topographic information applied to transect profiles was based on ADCIRC grid bathymetry and LiDAR data collected by the State of Louisiana and FEMA between 2003 and 2005. The vertical datum for topographic/bathymetry data is the NAVD88.

The Louisiana GAP Analysis Project developed by the USGS (Reference 9), served as the primary source for the spatial distribution of vegetative cover. Aerial imagery and field reconnaissance were performed to verify the Louisiana GAP Analysis Project data. Aerial photos and images downloaded from the Louisiana State University Atlas website (http://atlas.lsu.edu/) were applied to verify features such as buildings, levees, forested vegetation, and marsh grass for input to the wave height models.

Levees that did not meet FEMA's free board requirements were removed from the analysis. No storm-induced erosion analysis was performed. Primary frontal dune erosion was not applicable for this parish.

Wave height calculation used in this study follows the methodology described in the Appendix D of the October 2006 FEMA Guidelines and Specifications for Flood Hazard Mapping Partners. WHAFIS 4.0 was applied to calculate overland wave height propagation and establish BFEs. In addition to the 1-percent-annual chance event, the 0.2 percent-annual-chance event was also modeled with WHAFIS 4.0. The 0.2-percent-annual-chance wave height results are not included on the FIRMs but are provided as wave transect profiles in this FIS.

Stillwater elevations are applied to each ground station along a transect and input to WHAFIS. The stillwater elevations were obtained from the ADCIRC storm surge study, using the stillwater TIN generated by the USACE-MVN. Wave setup was not calculated separately because wave setup was included in the base stillwater elevations from the storm surge analysis.

Wave runup analysis was performed for levees or embankment structures meeting FEMA free board requirements. The van der Meer method described in the 2003 version of the Coastal Engineering Manual (CEM) was used in calculating wave runup over sloped levees. Wave characteristics and stillwater elevations were obtained from the WHAFIS wave height analysis and USACE-MVN's storm surge analysis (without wave setup). The FIRM panel shows a BFE along the levee that includes wave runup.

A summary of the results from the coastal analyses, which reflects the stillwater elevation determined along each transect at the 2-, 1-, and 0.2-percent-annual-chance recurrence intervals is shown in Table 3, "Coastal Data Table."

Table 3. 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	
Terrebonne	1	Located at west end of Parish, traversing south to north from Gulf Coast to northern parish line	29.2503	91.2830	6.1 Range Not Available	8.7 Range Not Available	10.6 8.6-10.6	13.3 11.2-15.3	AE 10-13 VE 11-16
Terrebonne	2	Located to the east of transect 1, traversing south to north.	29.2223	91.1986	6.7	9.4	11.3 6.7-11.3	14.4 9.6-14.5	AE 7-13 VE 9-17
Terrebonne	3	Located to the east of transect 2, traversing south to north.	29.2180	91.1405	6.7	9.3	11.34 6.6-11.4	14.7 9.4-14.9	AE 7-13 VE 10-17
Terrebonne	4	Located to the east of transect 3, traversing south to north.	29.1885	91.0736	6.6	9.4	11.3 0-11.4	14.8 2.8-15.1	AE 0-13 VE 9-17
Terrebonne	5	Located to the east of transect 4, traversing south to north.	29.1845	91.0151	6.5	9.6	11.3 2.1-11.4	15.0 2.6-15.5	AE 2-13 VE 9-17
Terrebonne	6	Located to the east of transect 5, traversing south to north.	29.1767	90.9479	6.5	9.9	11.6 2.0-11.6	14.9 2.3-16.2	AE 2-13 VE 10-18
Terrebonne	7	Located to the east of transect 6, traversing south to north.	29.1456	90.8991	6.4	9.7	11.7 2.85-11.8	14.9 2.3-16.3	AE 3-13 VE 13-18
Terrebonne	8	Located to the east of transect 7, traversing south to north.	29.1522	90.8573	6.4	10.1	12.2 2.7-12.2	15.2 0-16.2	AE 3-14 VE 10-19
Terrebonne	9	Located to the east of transect 8, traversing south to north.	29.1504	90.8077	6.8	10.3	12.4 0-12.6	15.3 0-18.0	AE 0-14 VE 11-19
Terrebonne	10	Located to the east of transect 9, traversing south to north.	29.1850	90.7471	7.1	10.6	12.5 0-12.5	15.4 0-19.7	AE 0-14 VE 14-19
Terrebonne	11	Located to the east of transect 10, traversing south to north.	29.2146	90.6758	7.2	10.4	12.3 0-12.4	15.2 0-16.8	AE 0-14 VE 14-19
Terrebonne	12	Located to the east of transect 11, traversing south to north.	29.2343	90.6422	7.2	10.2	12.2 2.1-12.4	15.2 0-17.0	AE 2-14 VE 6-19
Terrebonne	13	Located to the east of transect 12, traversing south to north.	29.2636	90.6207	6.8	9.8	12.2 0-12.4	15.2 0-21.5	AE 0-14 VE 6-19

Table 3. COASTAL DATA TABLE
(continued)

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	
Terrebonne	14	Located to the east of transect 13, traversing south to north.	29.3251	90.5733	7.1	9.9	12.1 0-13.3	15.3 0-18.9	AE 0-14 VE 6-20
Terrebonne	15	Located to the east of transect 14, traversing south to north.	29.3285	90.5272	6.6	9.6	11.8 0-12.4	15.0 0-16.9	AE 0-13 VE 9-18
Terrebonne	16	Located to the east of transect 15, traversing south to north.	29.2969	90.4710	6.2	9	10.9 2.1-12.0	14.0 2.5-16.1	AE 2-13 VE 7-17
Terrebonne	17	Located to the east of transect 16, traversing south to north.	29.3383	90.4253	6.2	9	11.1 3.7-11.6	14.2 2.2-16.5	AE 3-14 VE 7-17
Terrebonne	18	Located to the east of transect 17, traversing south to north.	29.2880	90.3796	5.6	8.3	10.2 5.2-11.3	13.2 7.7-17.4	AE 5-12 VE 8-15

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 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 Terrebonne Parish is -0.11 foot.

For additional 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:

Vertical Network Branch, N/CG13
National Geodetic Survey, NOAA
Silver Spring Metro Center 3
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

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 visit their website at www.ngs.noaa.gov.

4.0 FLOODPLAIN MANAGEMENT APPLICATION

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 delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:6000, with a contour interval of 2 feet (Reference 10).

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, 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.

Approximate 1-percent-annual-chance floodplain boundaries in some portions of the study area were taken directly from the previous FIRM.

4.2 Floodway Analyses

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 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 2, Floodway Schematic.

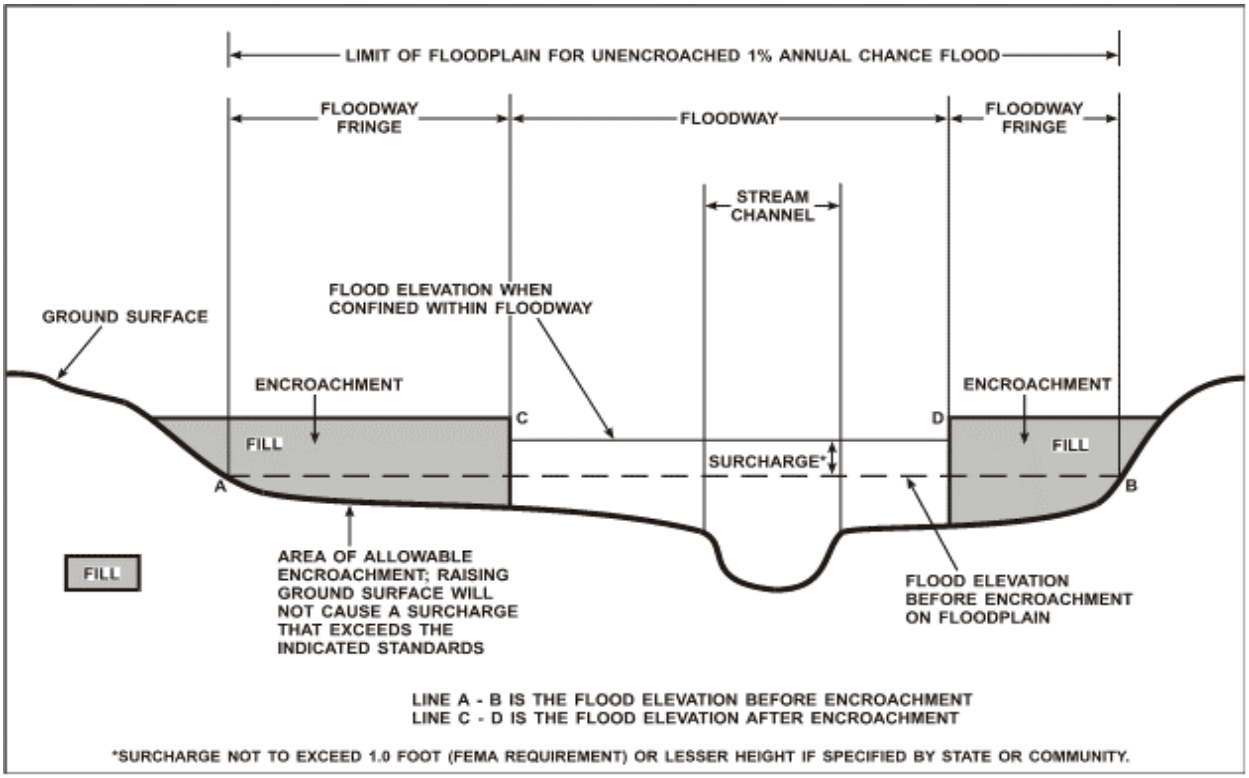

FIGURE 2 – FLOODWAY SCHEMATIC

No floodways were computed for Terrebonne Parish because no water surface profiles are provided and all the studied channels are defined by the berms between storage areas.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. 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 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 BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

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 parishwide FIRM presents flooding information for the entire geographic area of Terrebonne Parish. Previously, FIRMs were prepared for each incorporated community and the unincorporated areas of the Parish identified as flood-prone. This parishwide 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 4, “Community Map History.”

7.0 OTHER STUDIES

FIRMs for the adjacent St. Mary Parish and Lafourche Parish are being revised concurrently for parishwide studies. The revised studies will be in agreement with this information published in this FIS.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Federal Insurance and Mitigation Division, FEMA Region VI, Federal Regional Center, Room 206, 800 North Loop 288, Denton, Texas, 76201-3698

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Houma, City of	November 28, 1973	April 9, 1976 October 31, 1978	May 19, 1981	
Unincorporated Areas Terrebonne Parish	November 20, 1970	None	November 20, 1970	July 1, 1974 November 19, 1976 December 16, 1980 May 1, 1985 April 2, 1992

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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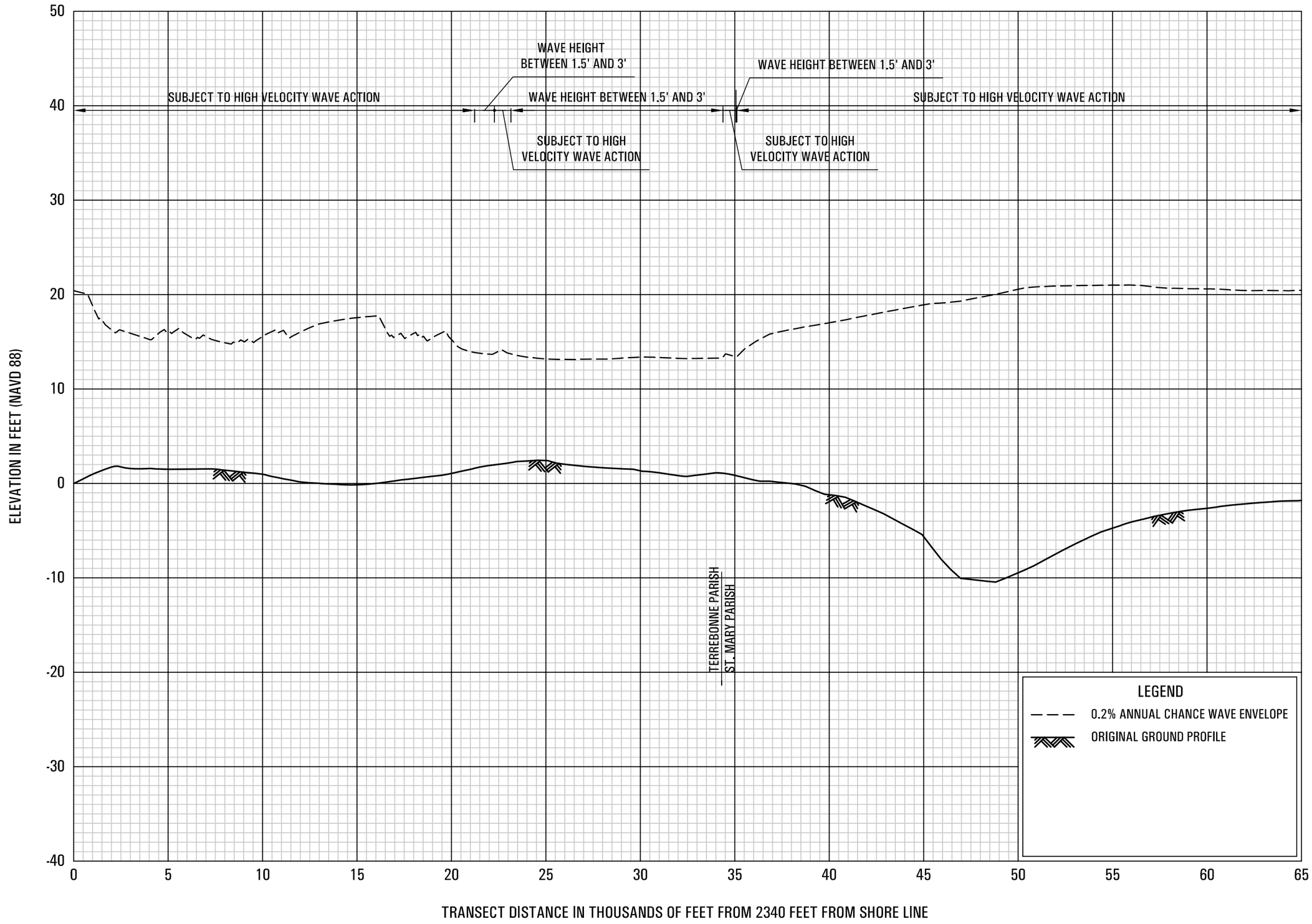


0.2% ANNUAL CHANCE WAVE ENVELOPE

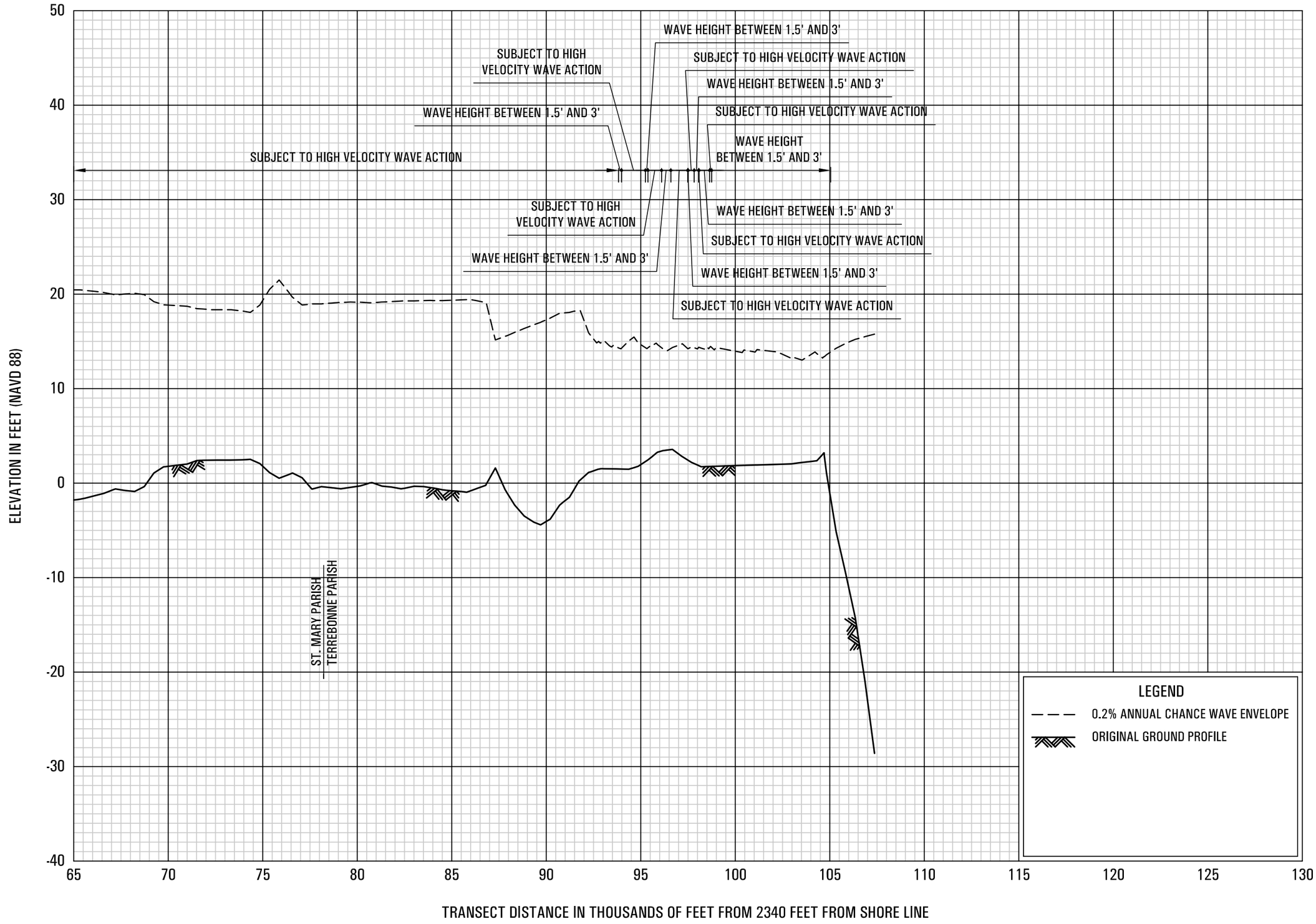
TRANSECT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

01P



0.2% ANNUAL CHANCE WAVE ENVELOPE

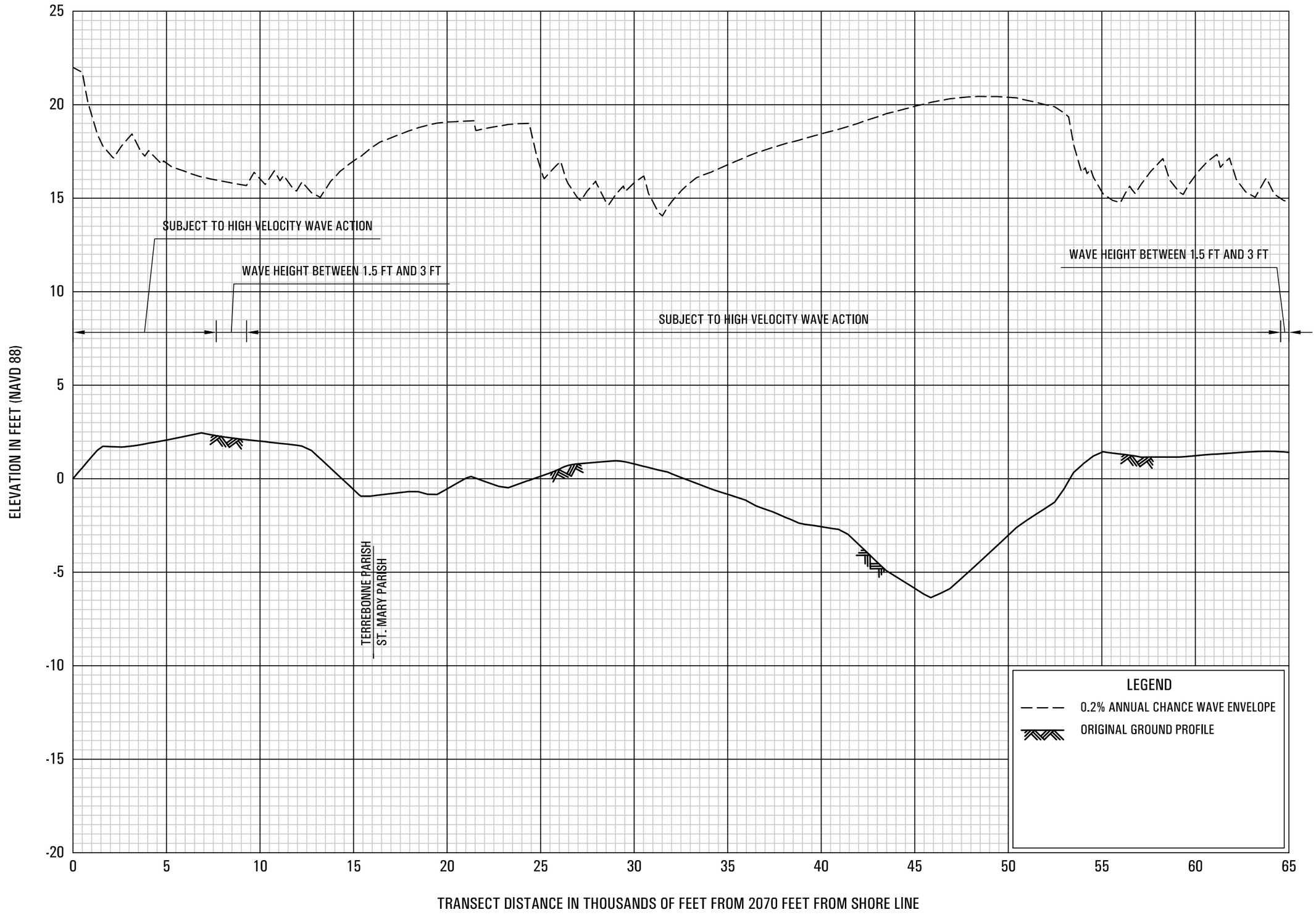
TRANSECT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

02P



0.2% ANNUAL CHANCE WAVE ENVELOPE

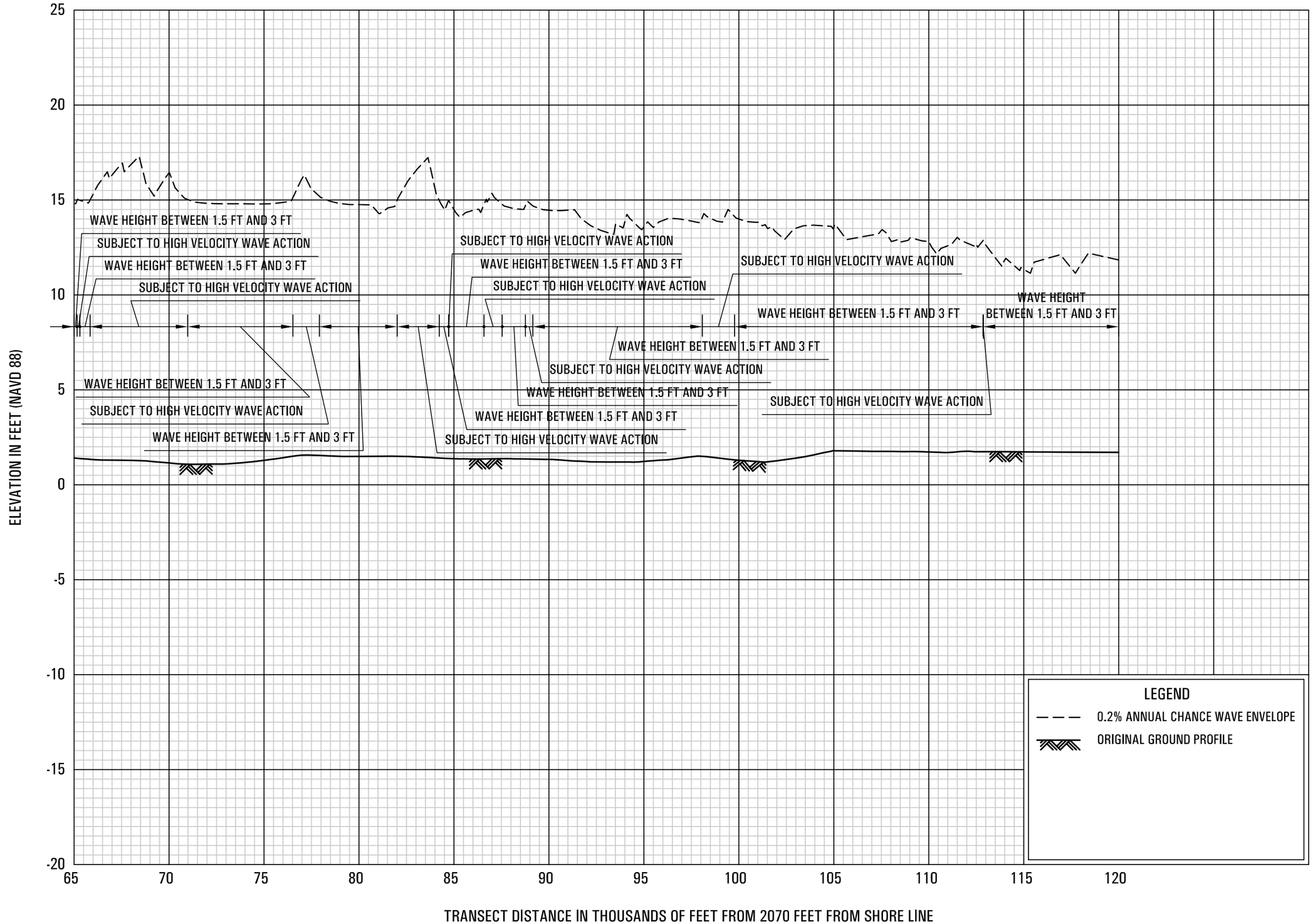
TRANSECT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

03P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

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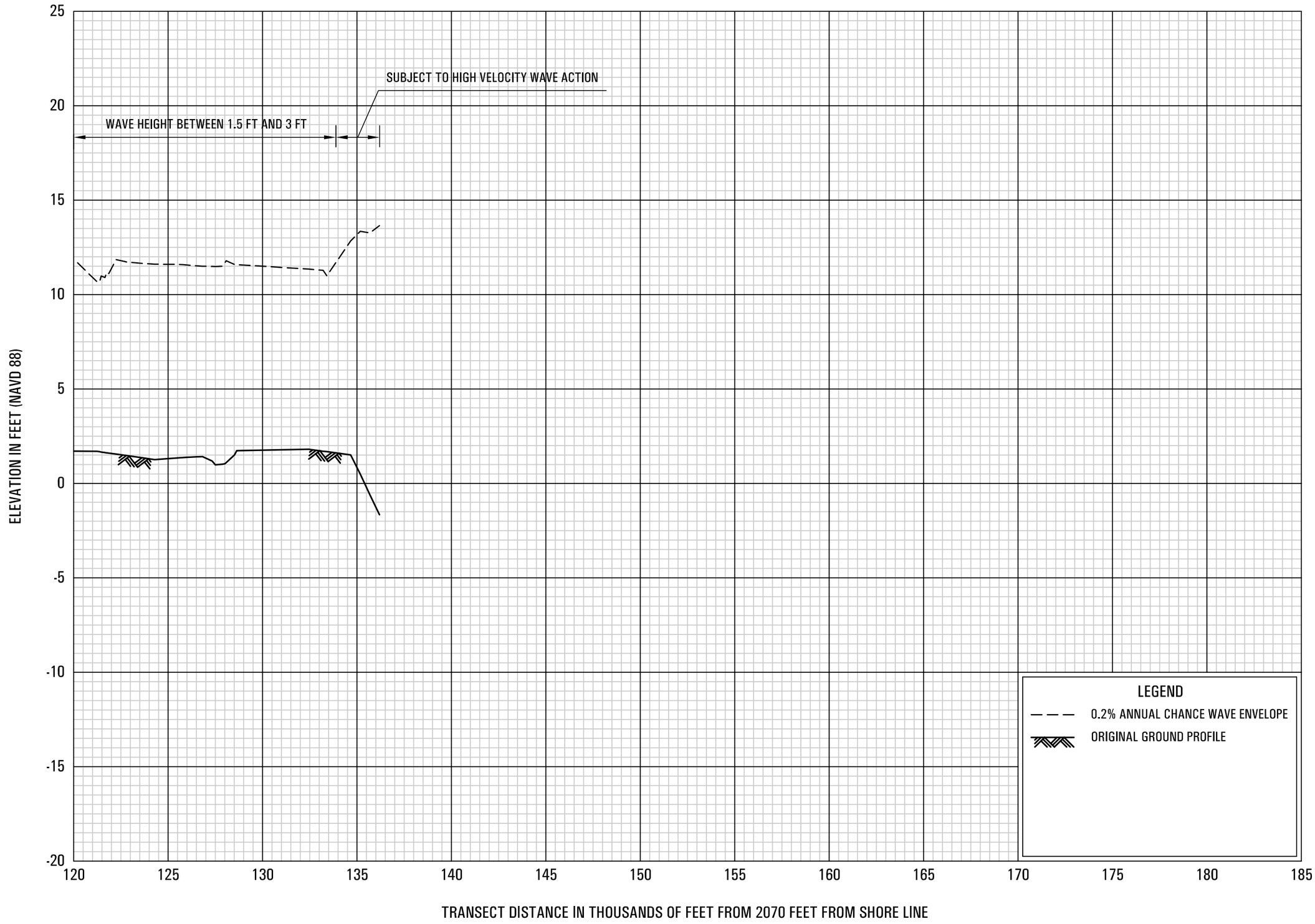


0.2% ANNUAL CHANCE WAVE ENVELOPE

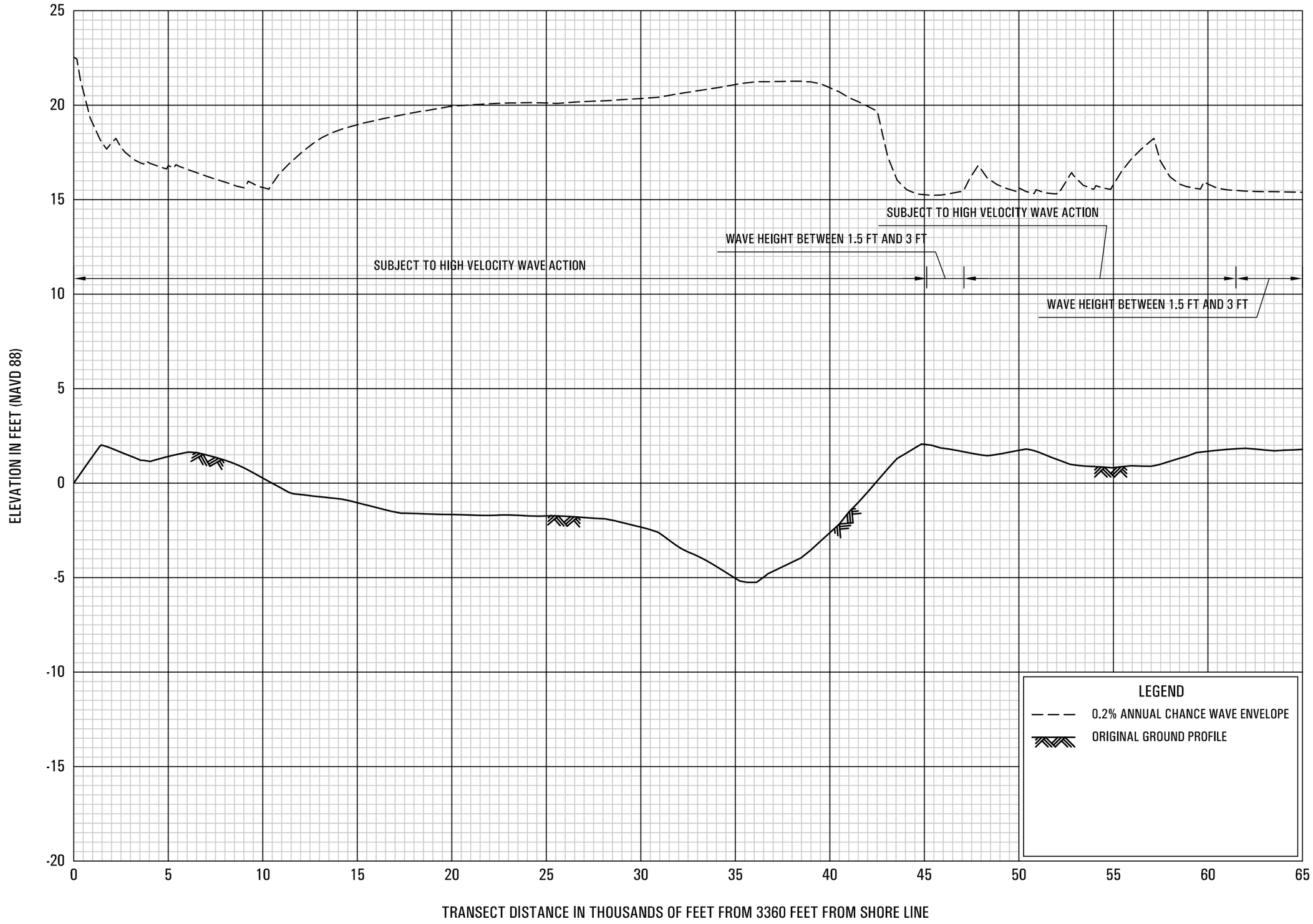
TRANSECT 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

05P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

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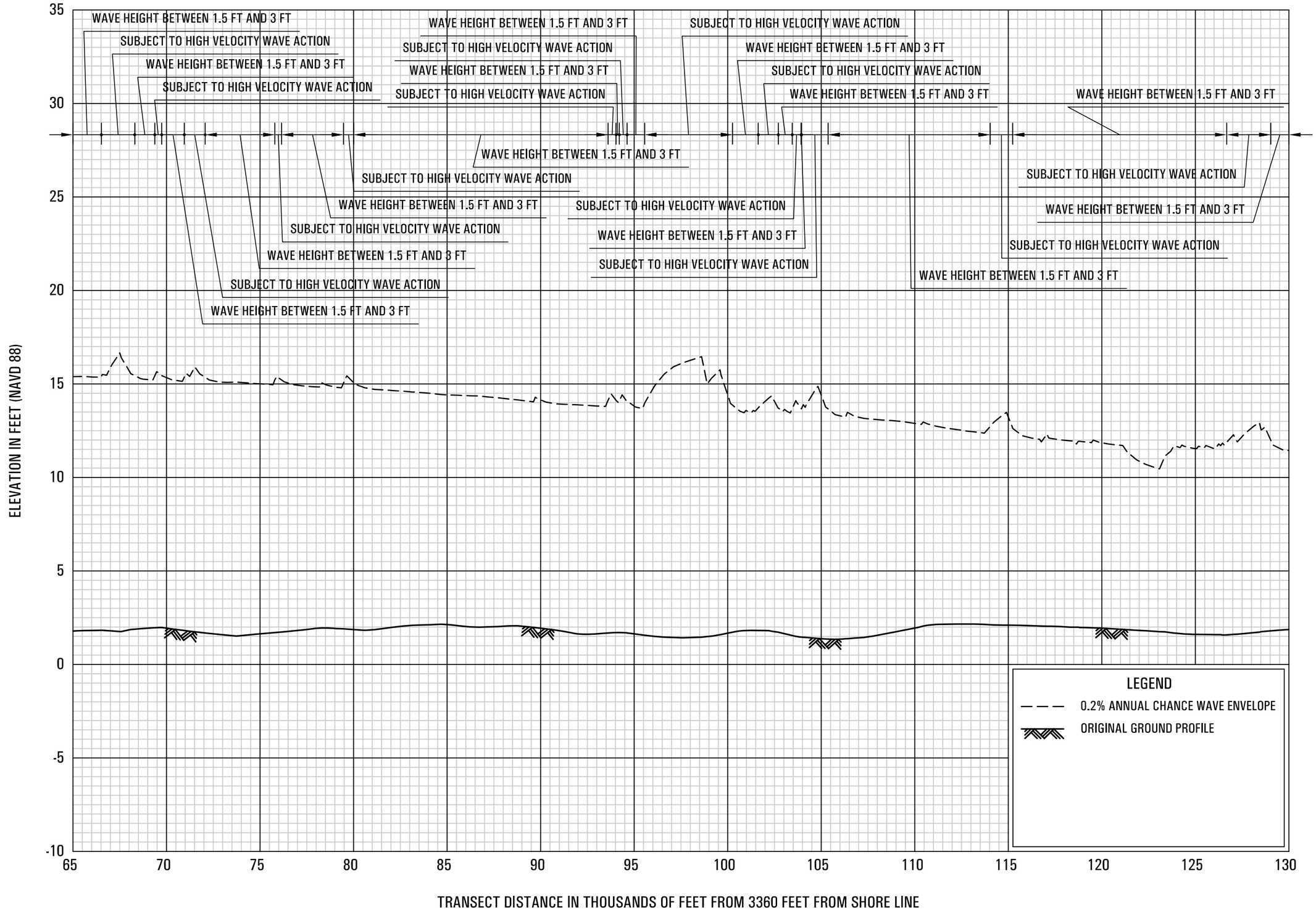

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TRANSECT 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

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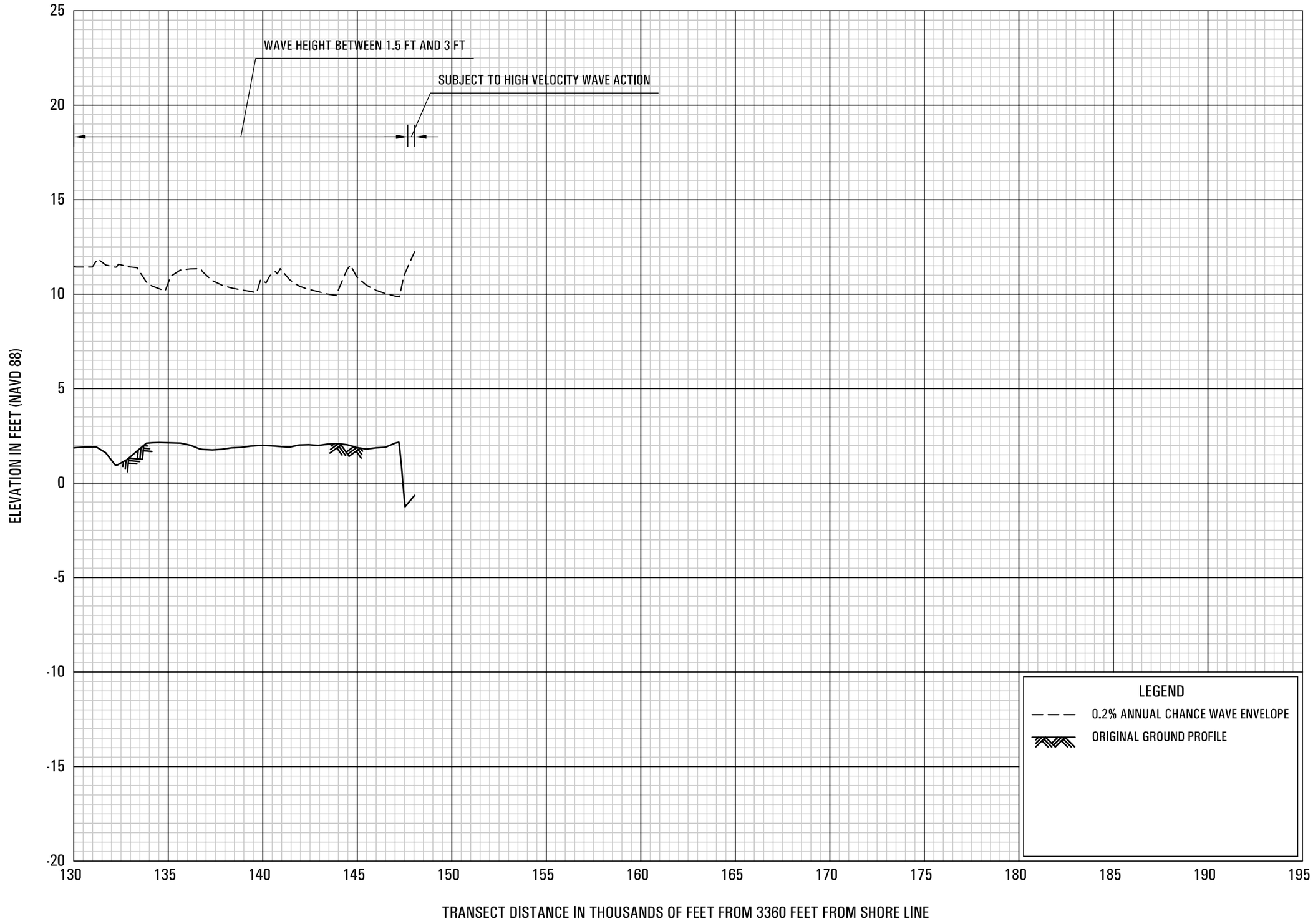


0.2% ANNUAL CHANCE WAVE ENVELOPE

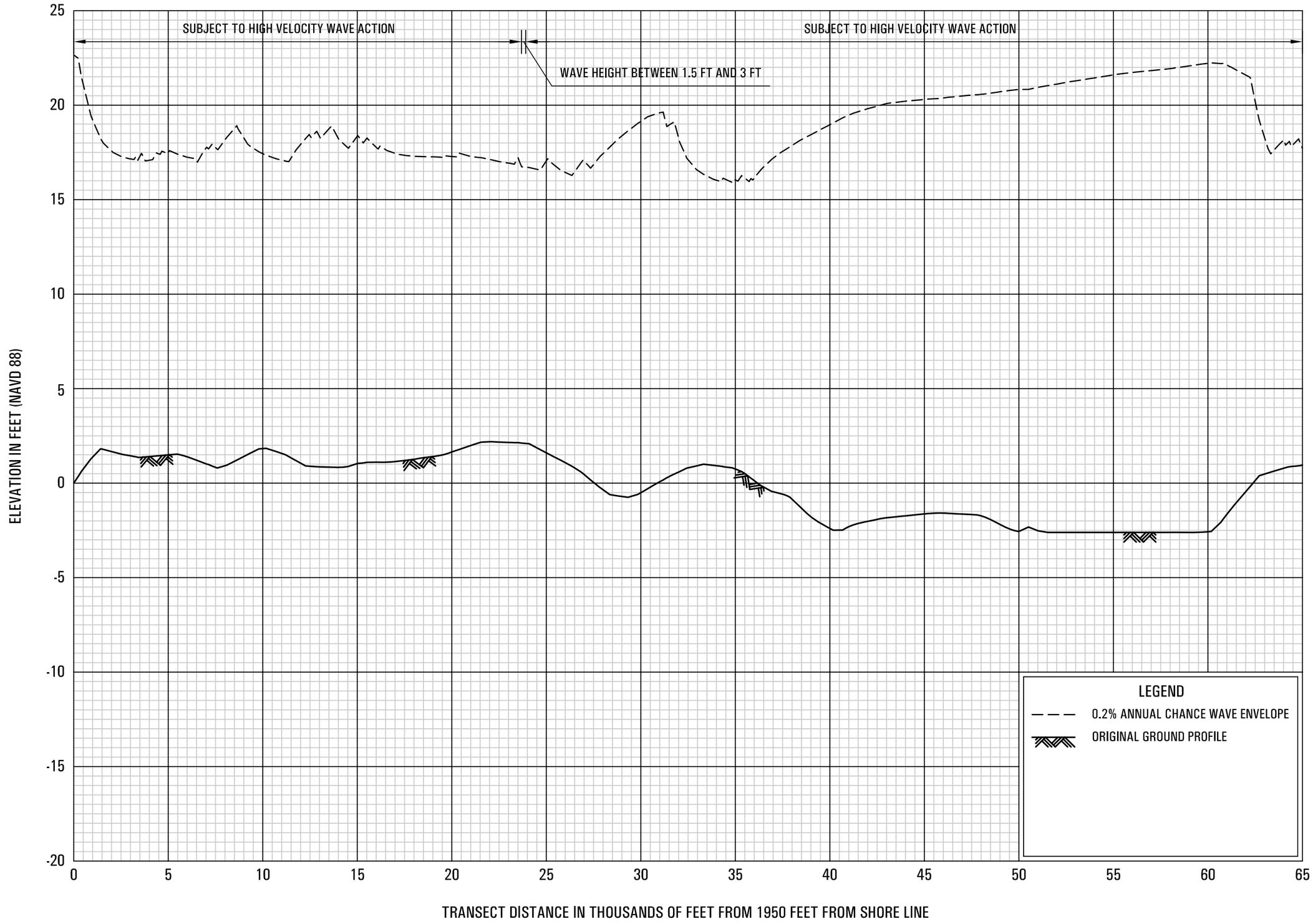
TRANSECT 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

08P



0.2% ANNUAL CHANCE WAVE ENVELOPE

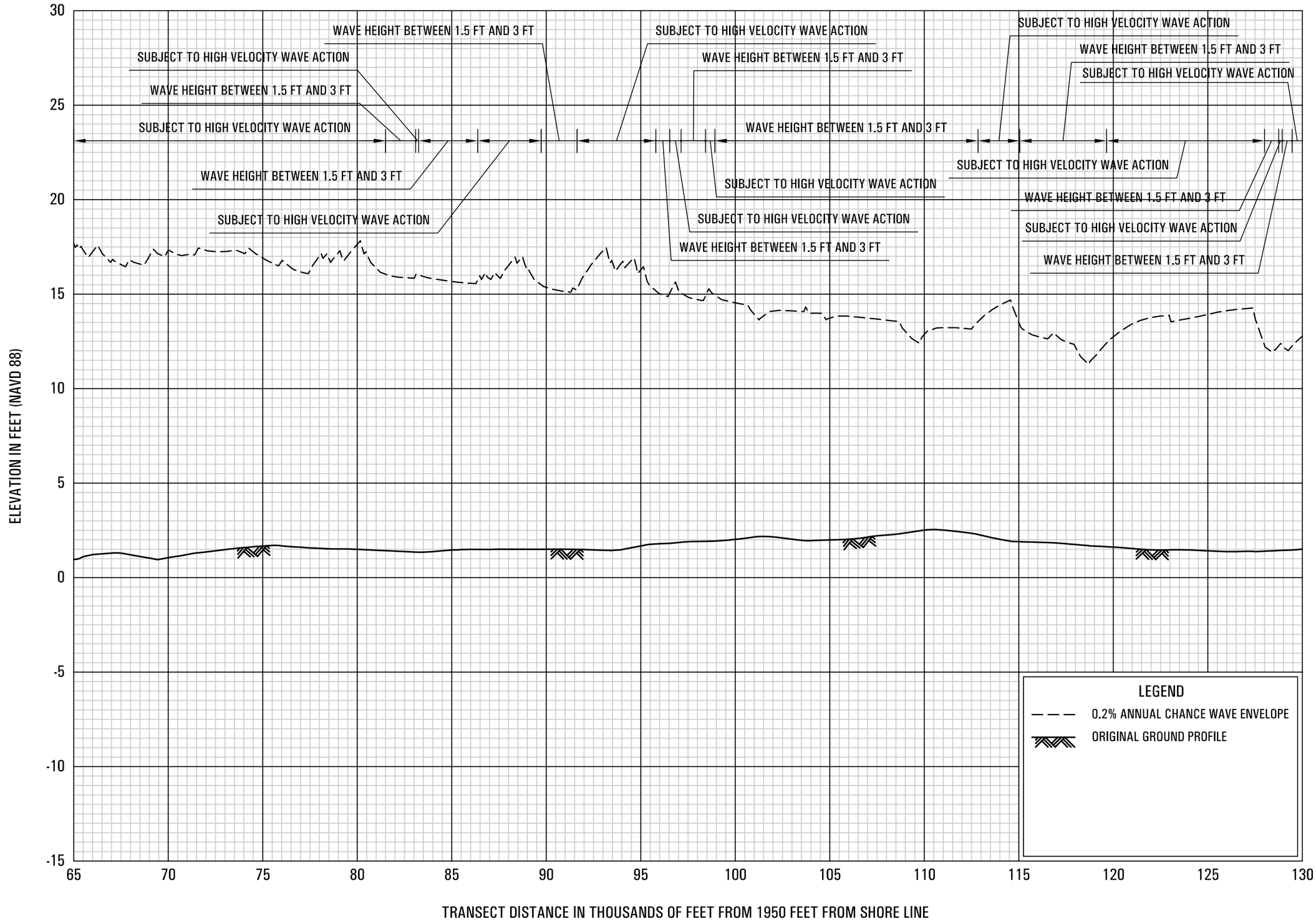
TRANSECT 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

09P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

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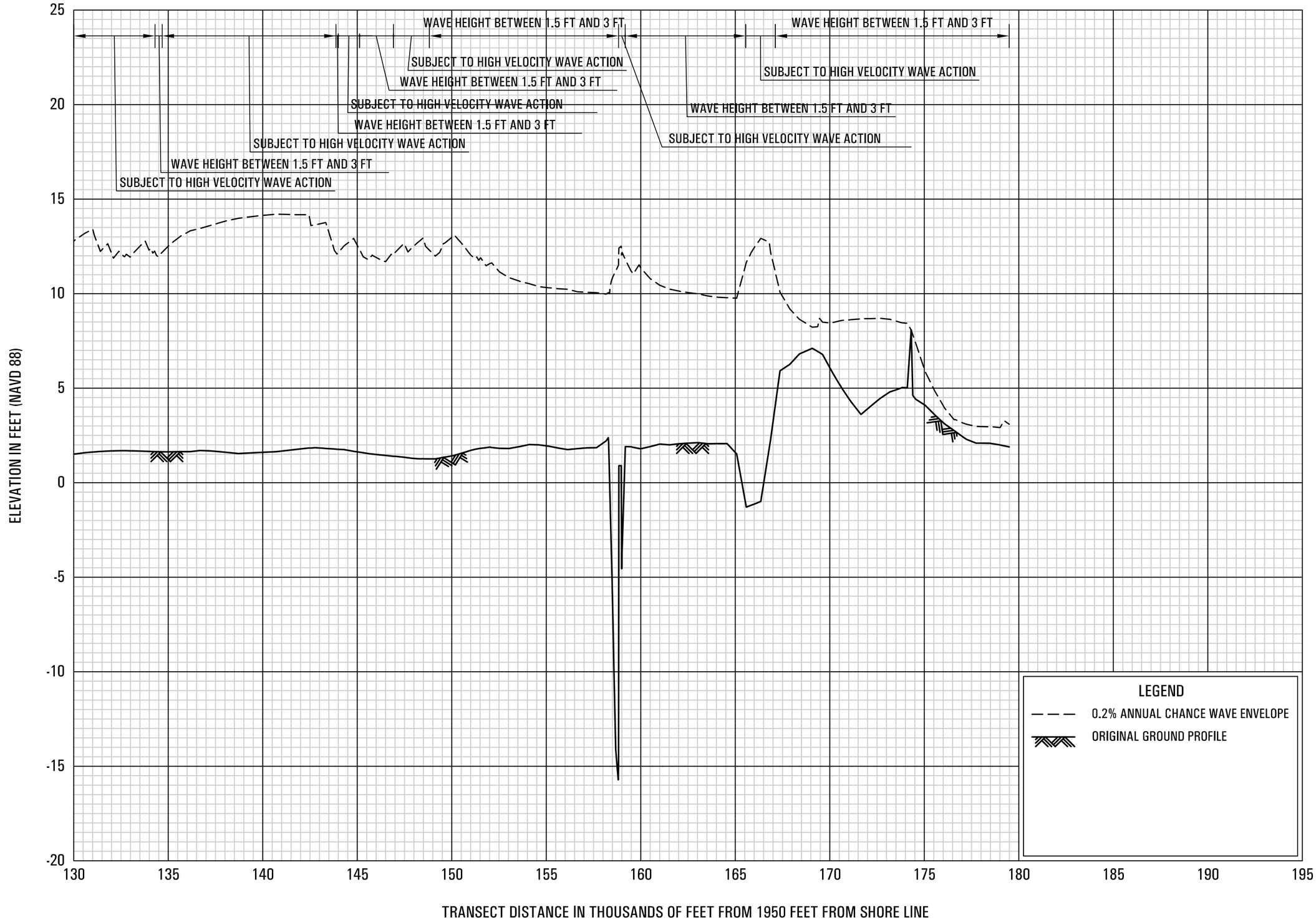

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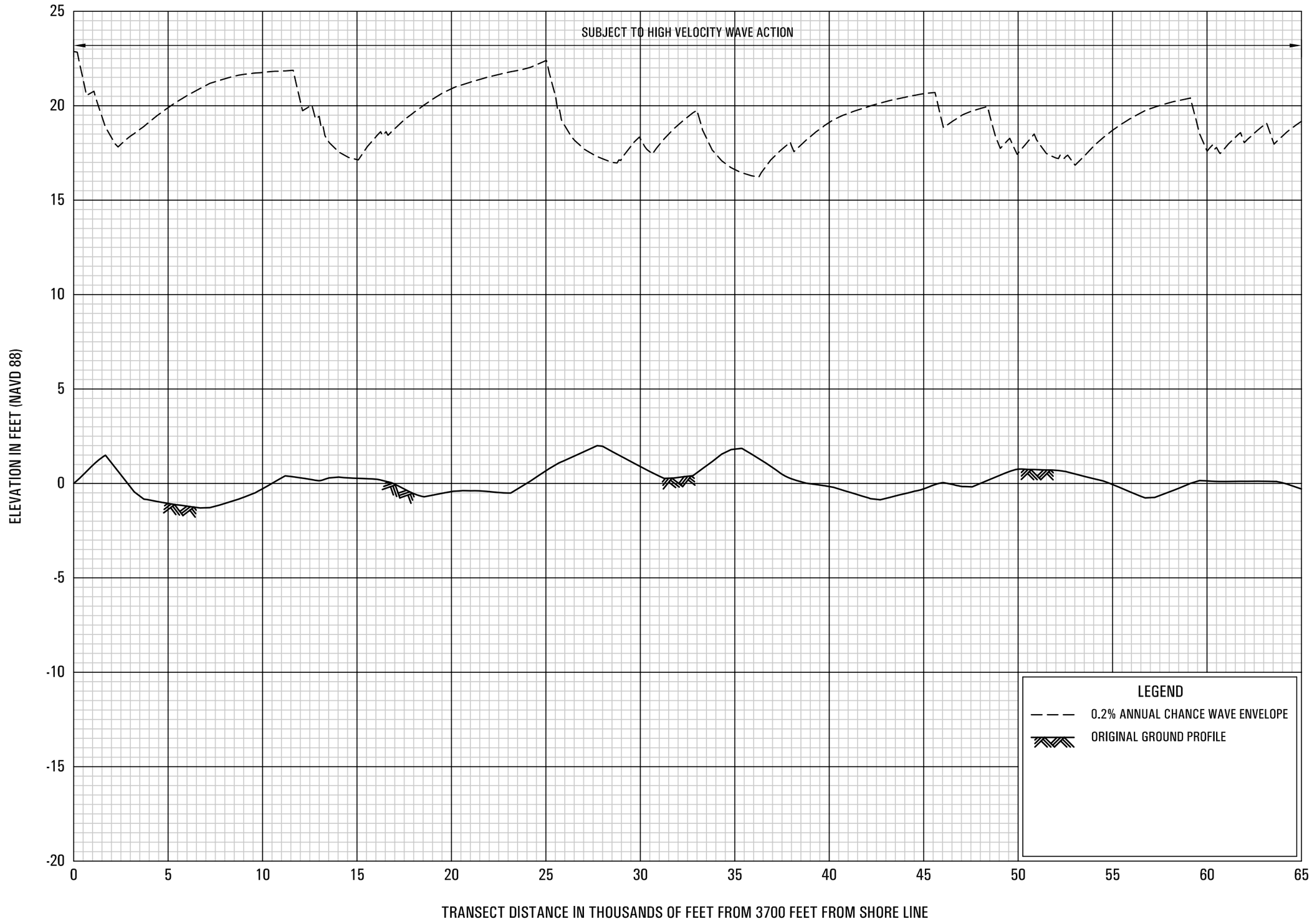
TRANSECT 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



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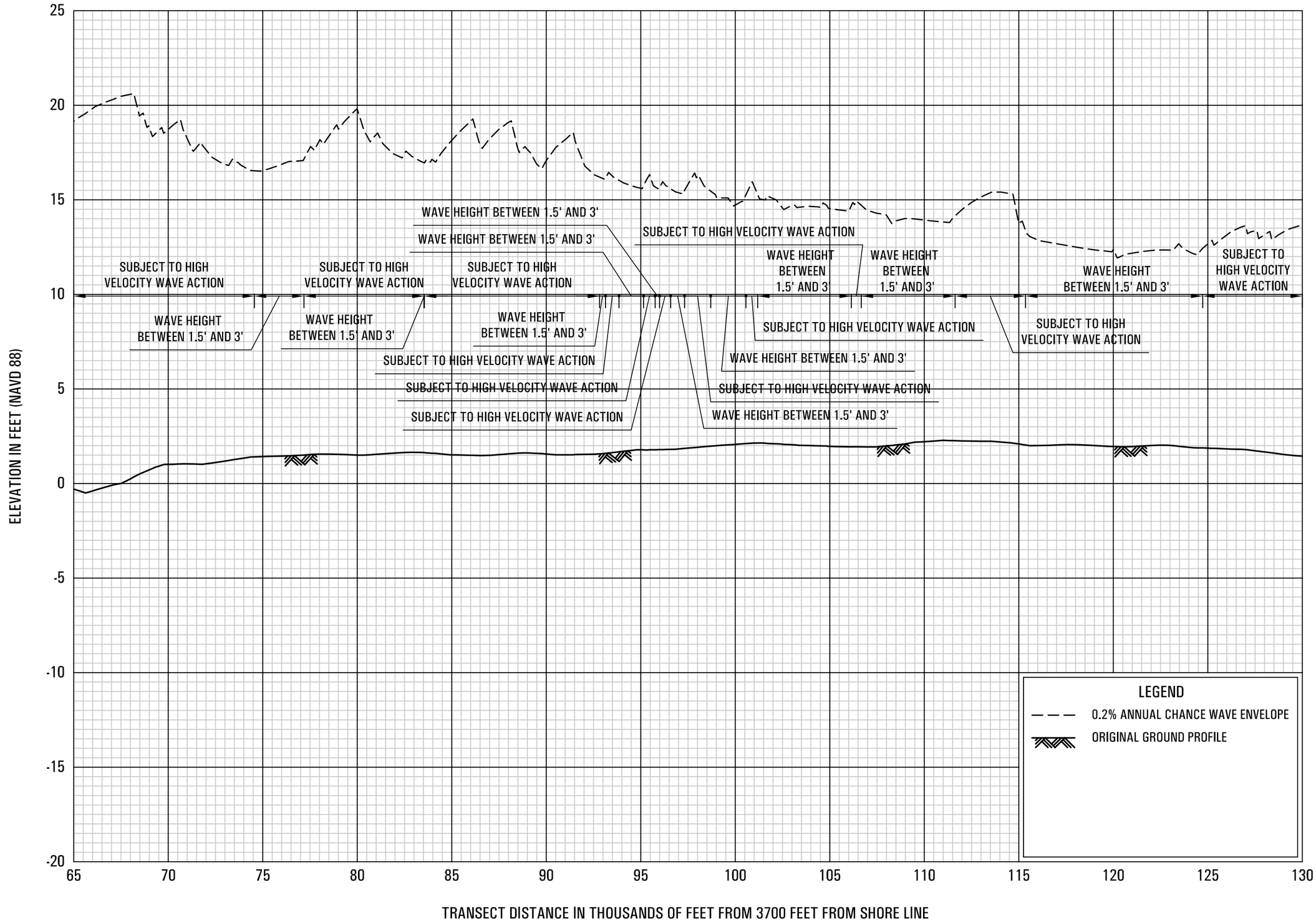
TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



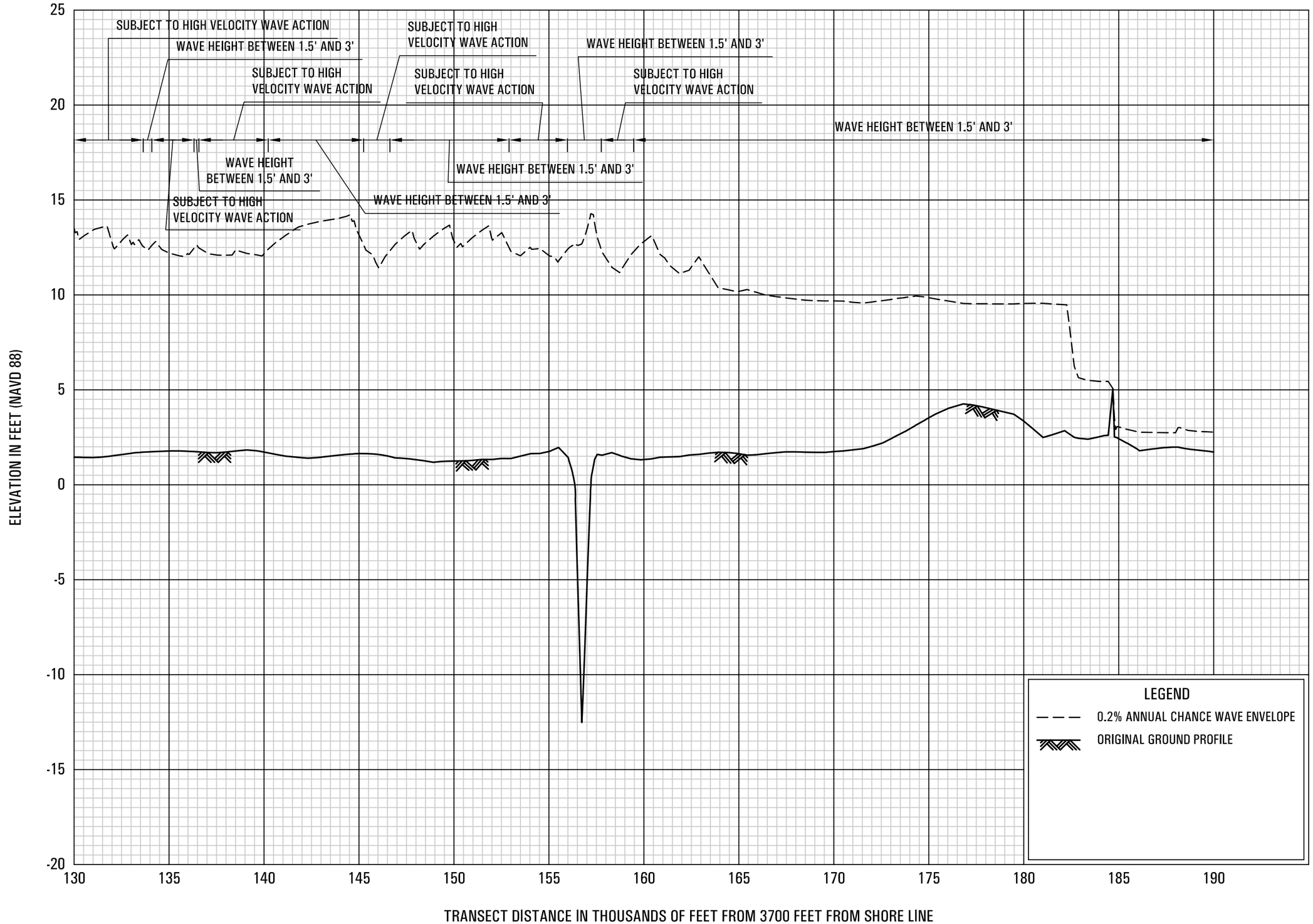
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



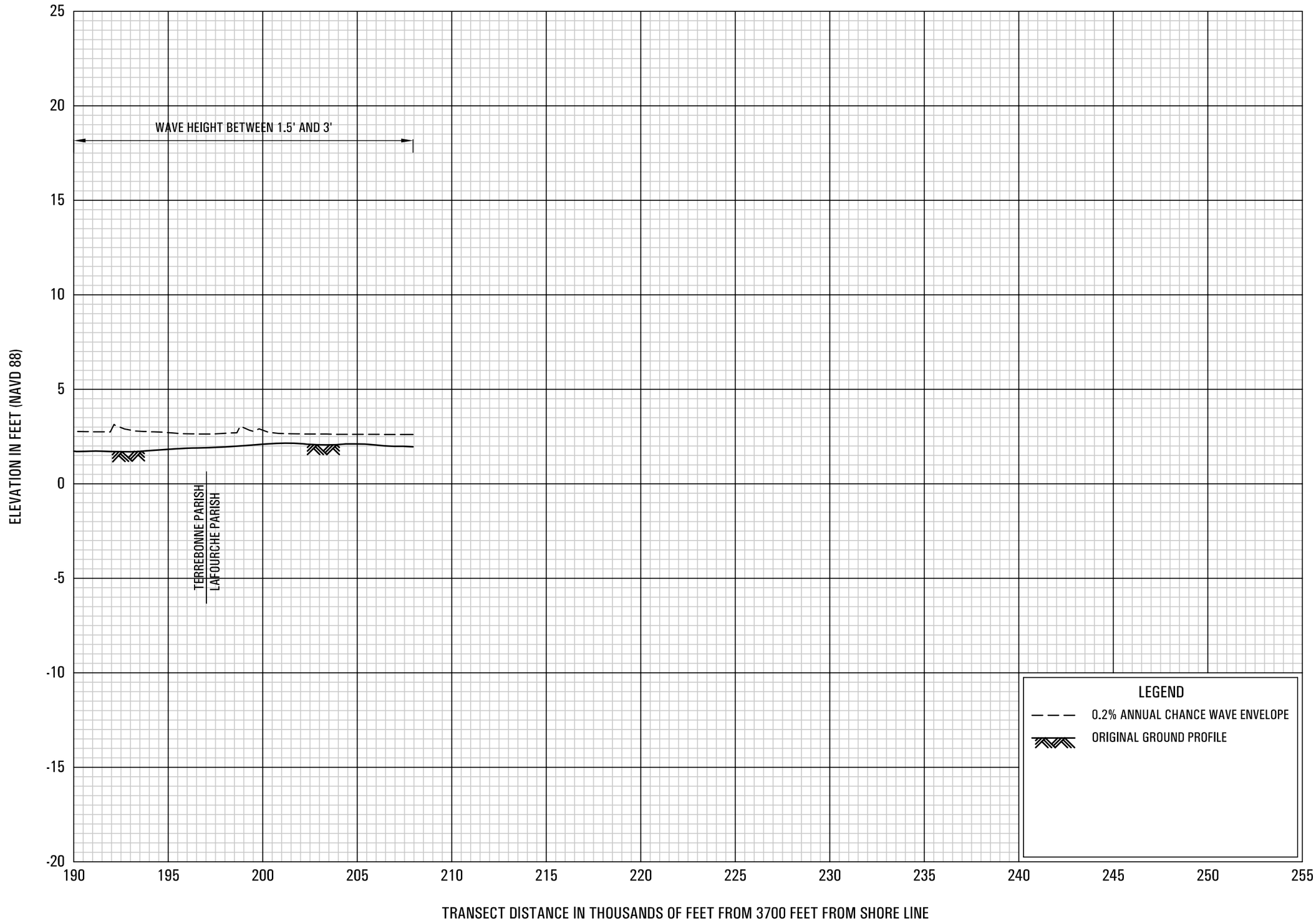
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



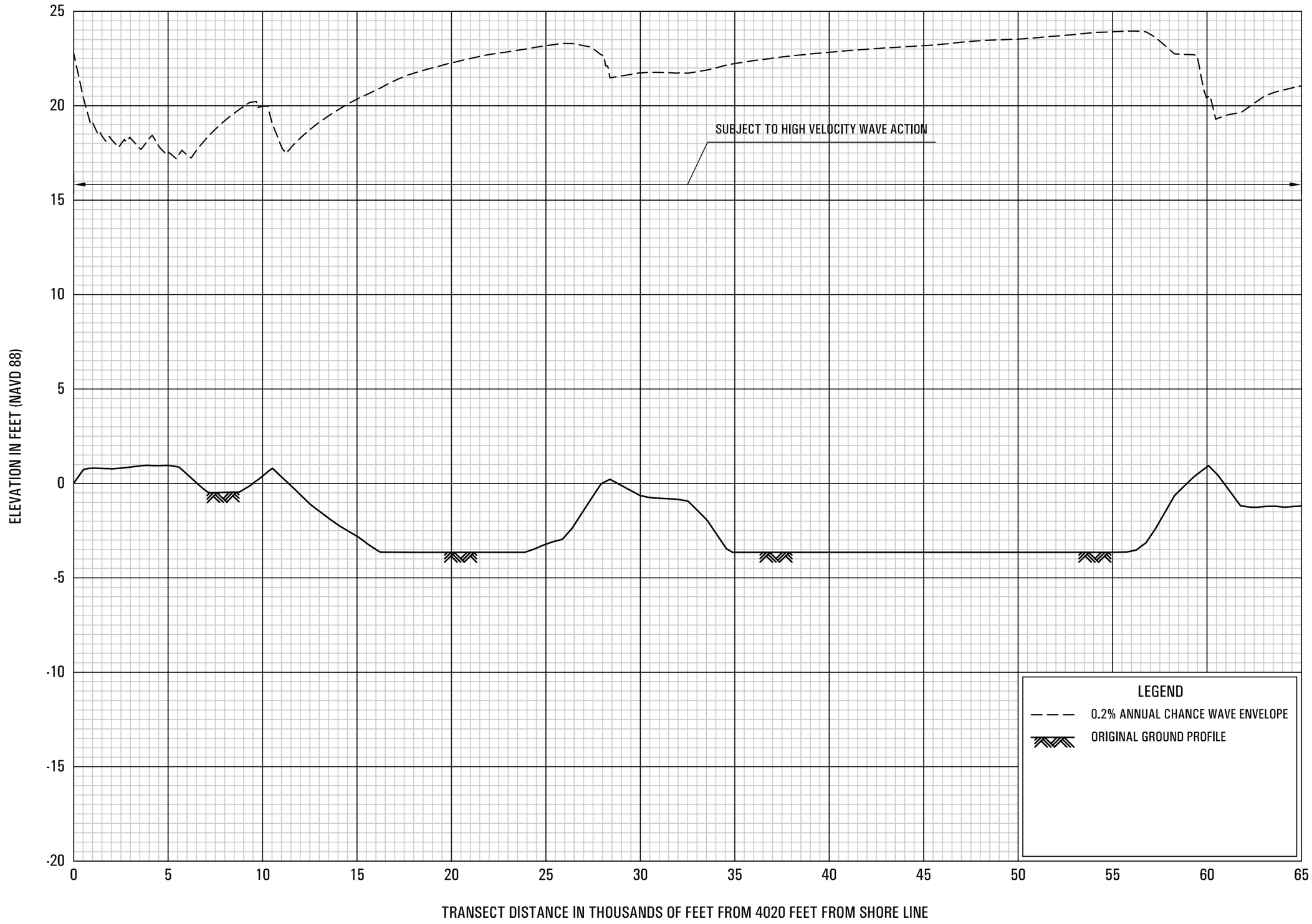
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



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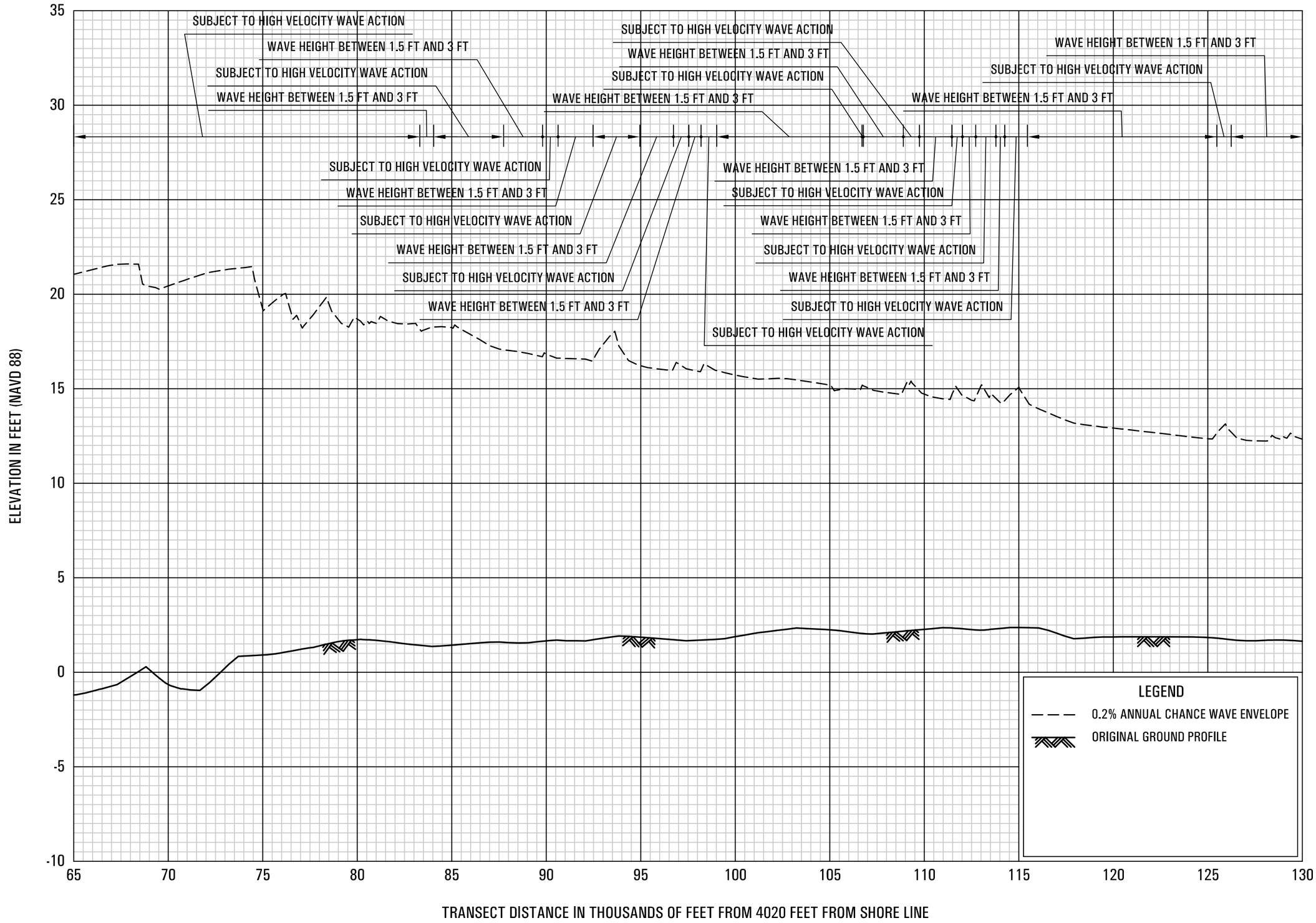
TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



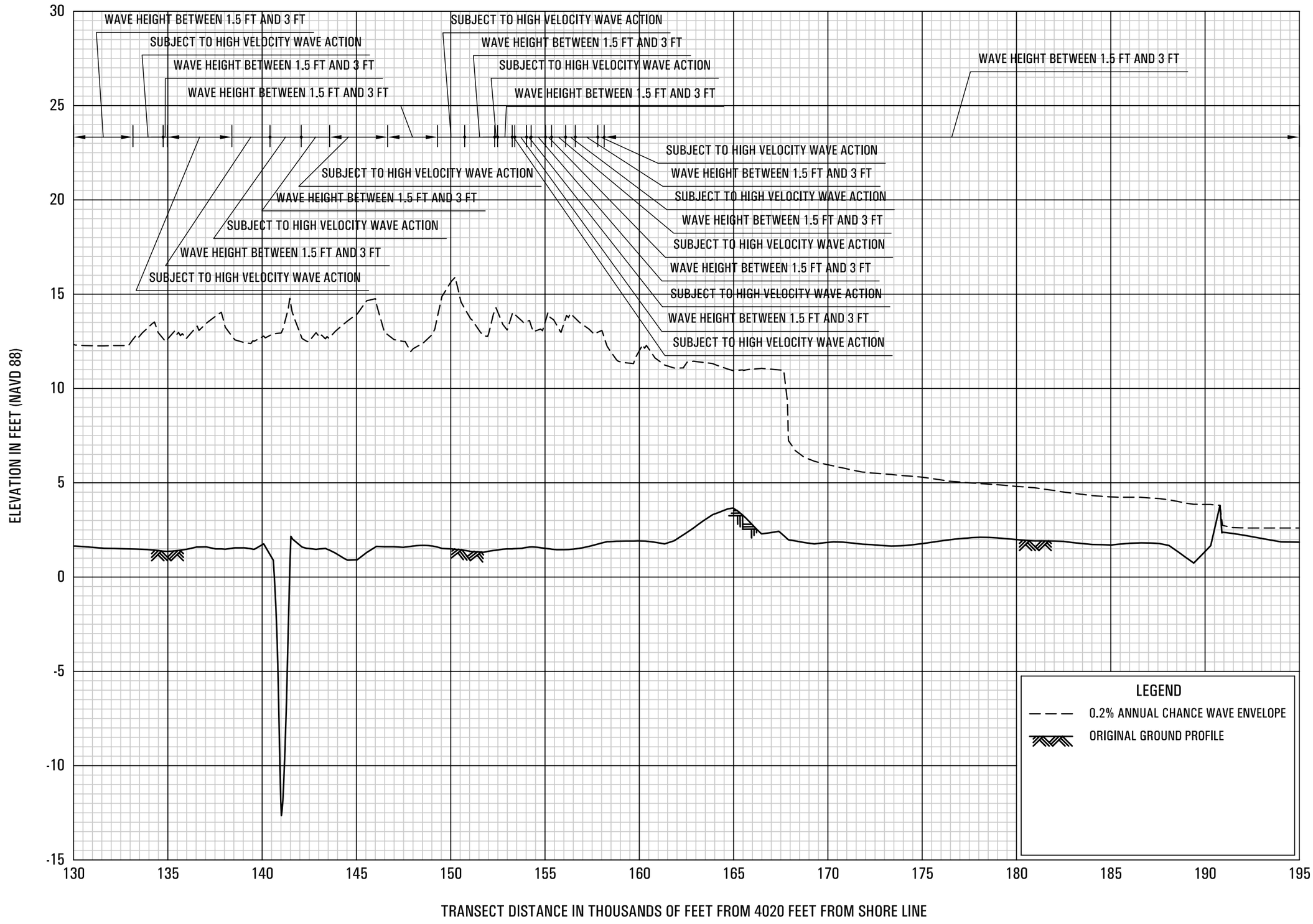
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

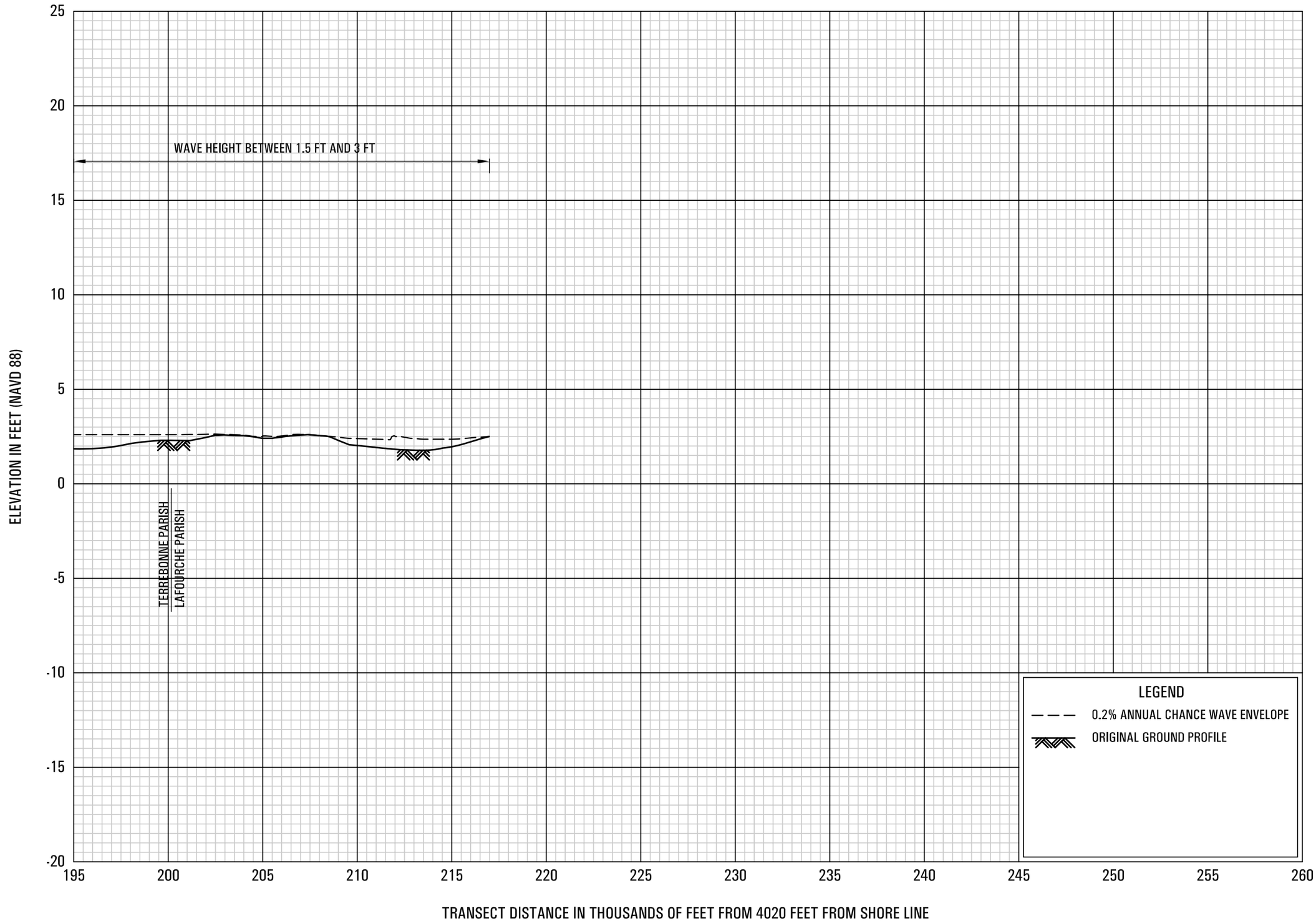
TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

18P



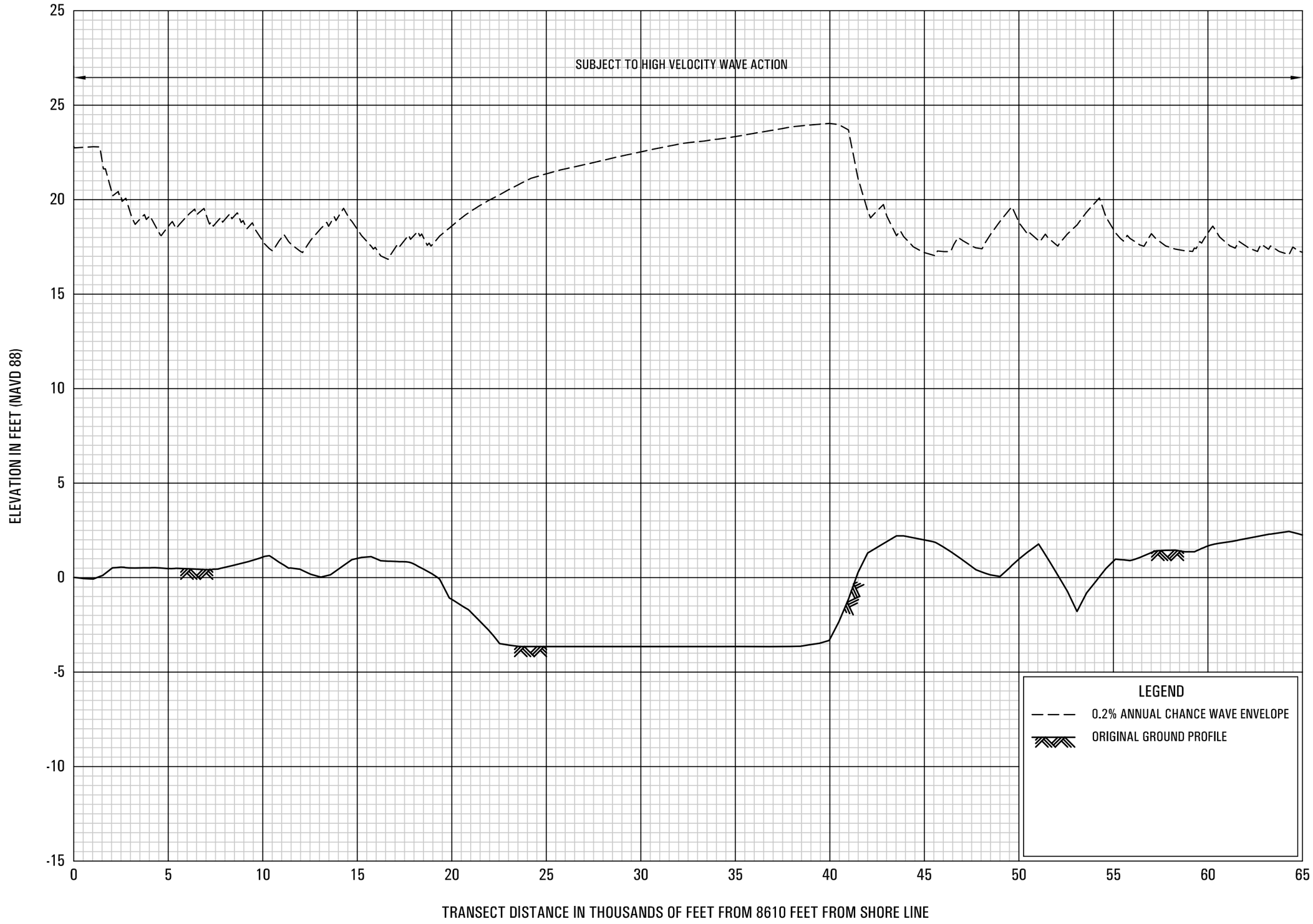
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

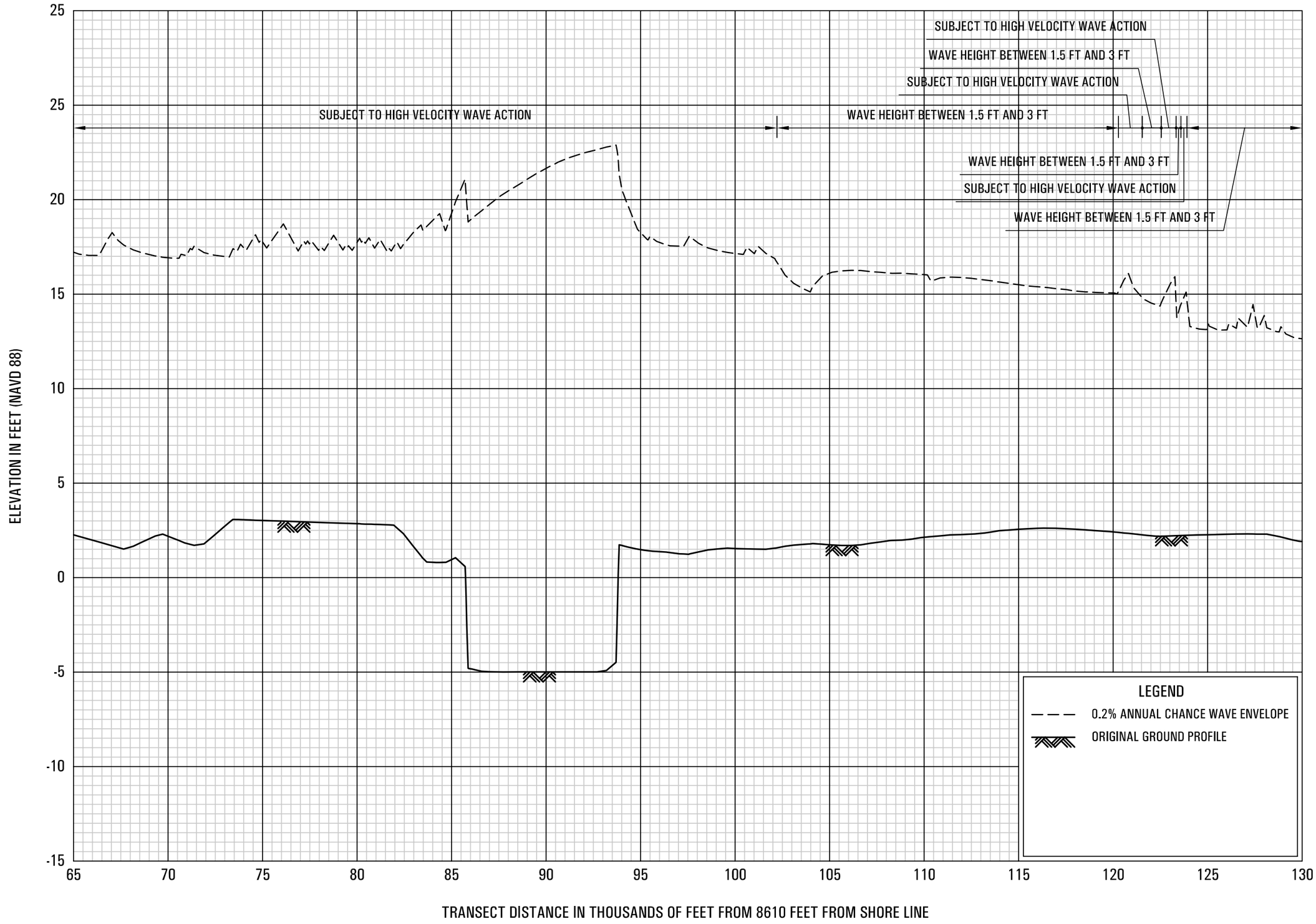
TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

20P



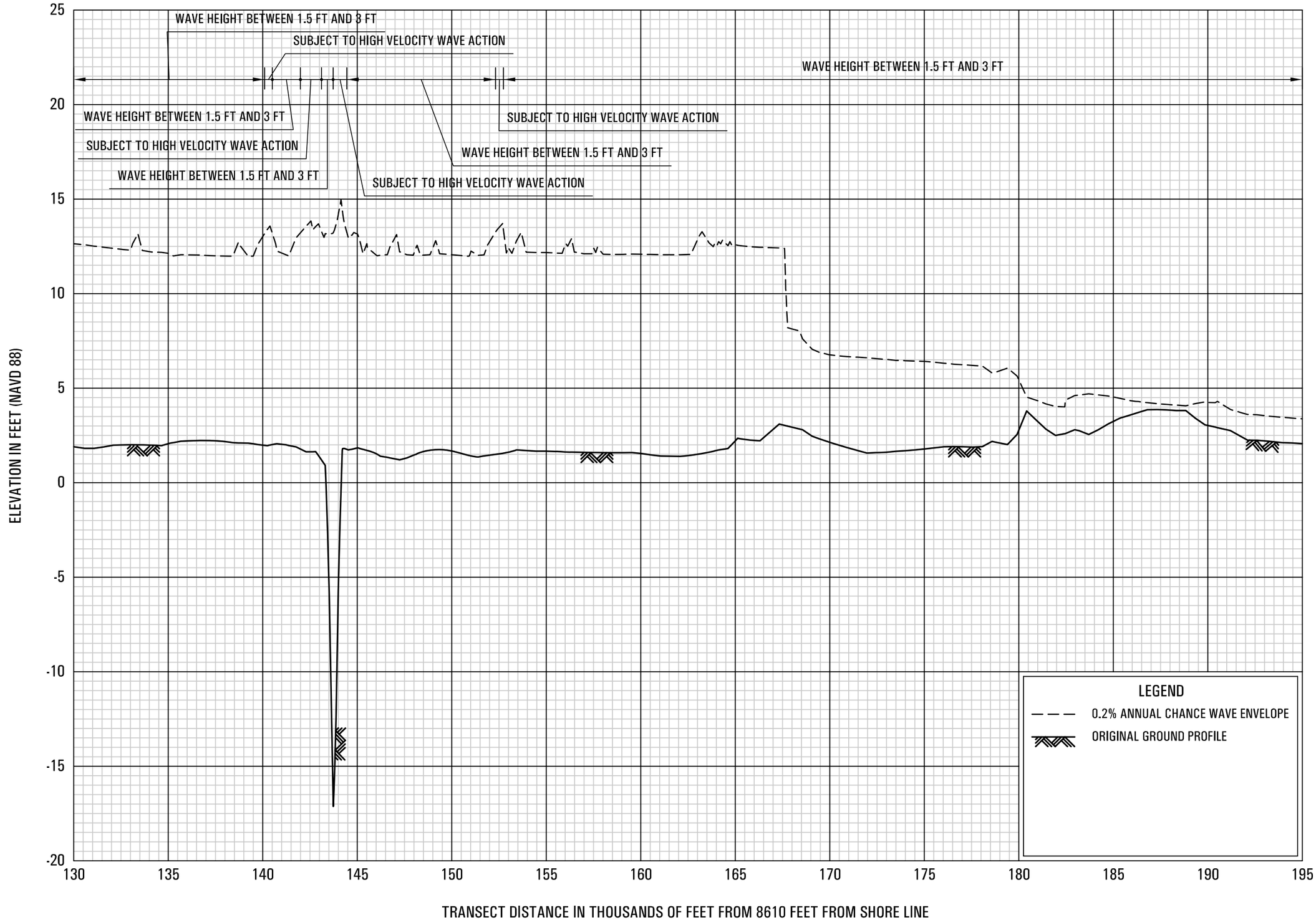
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



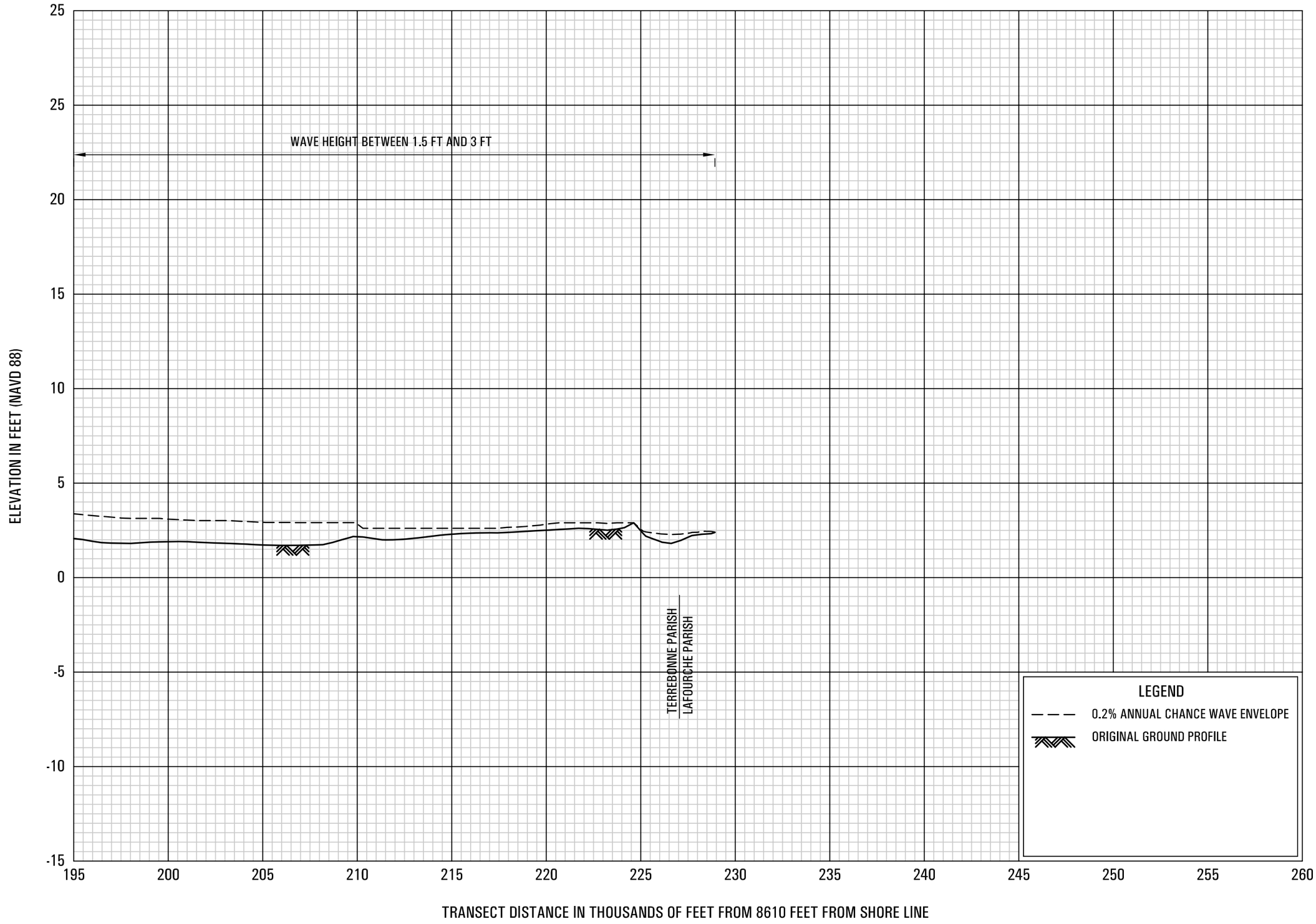
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



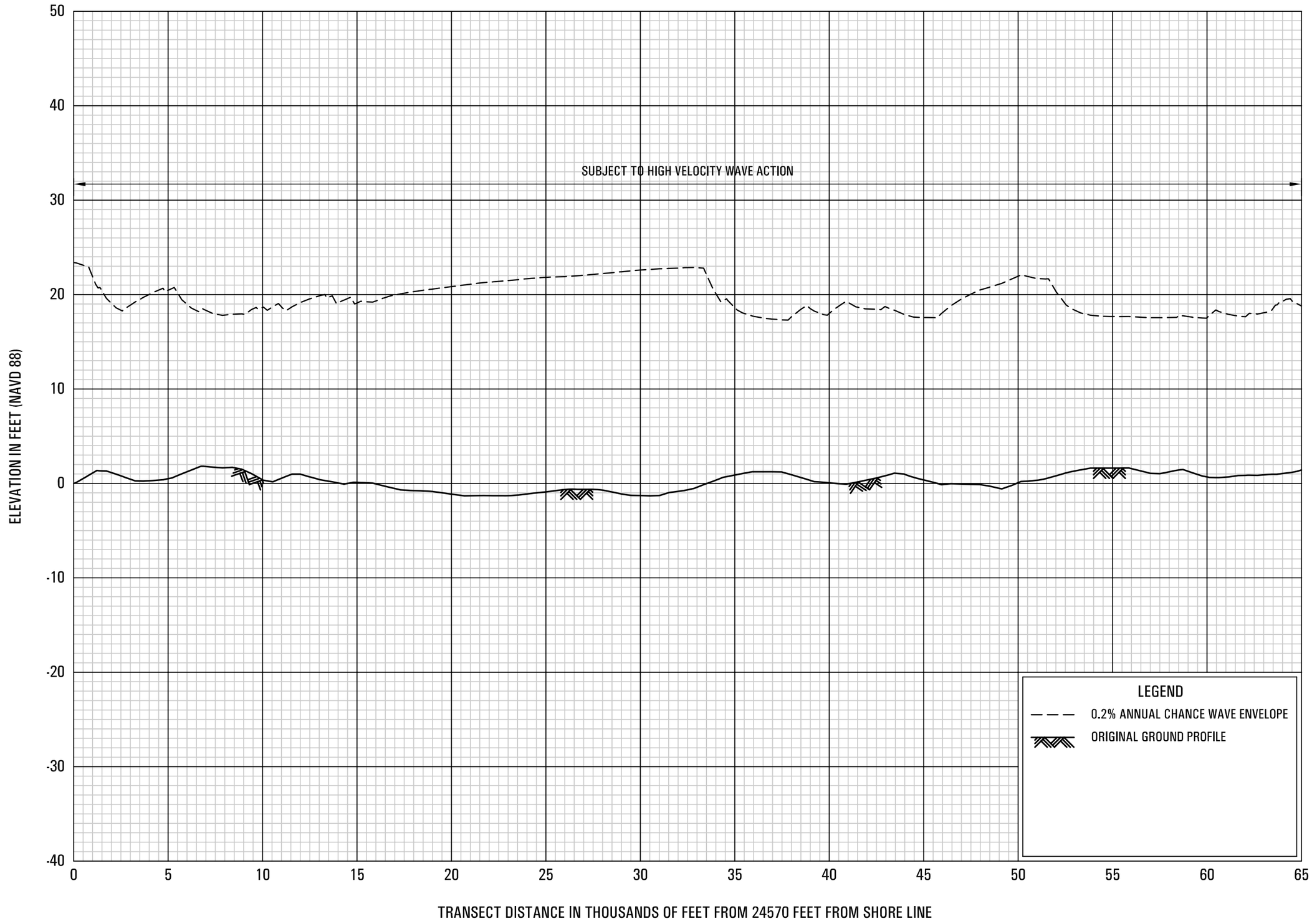
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

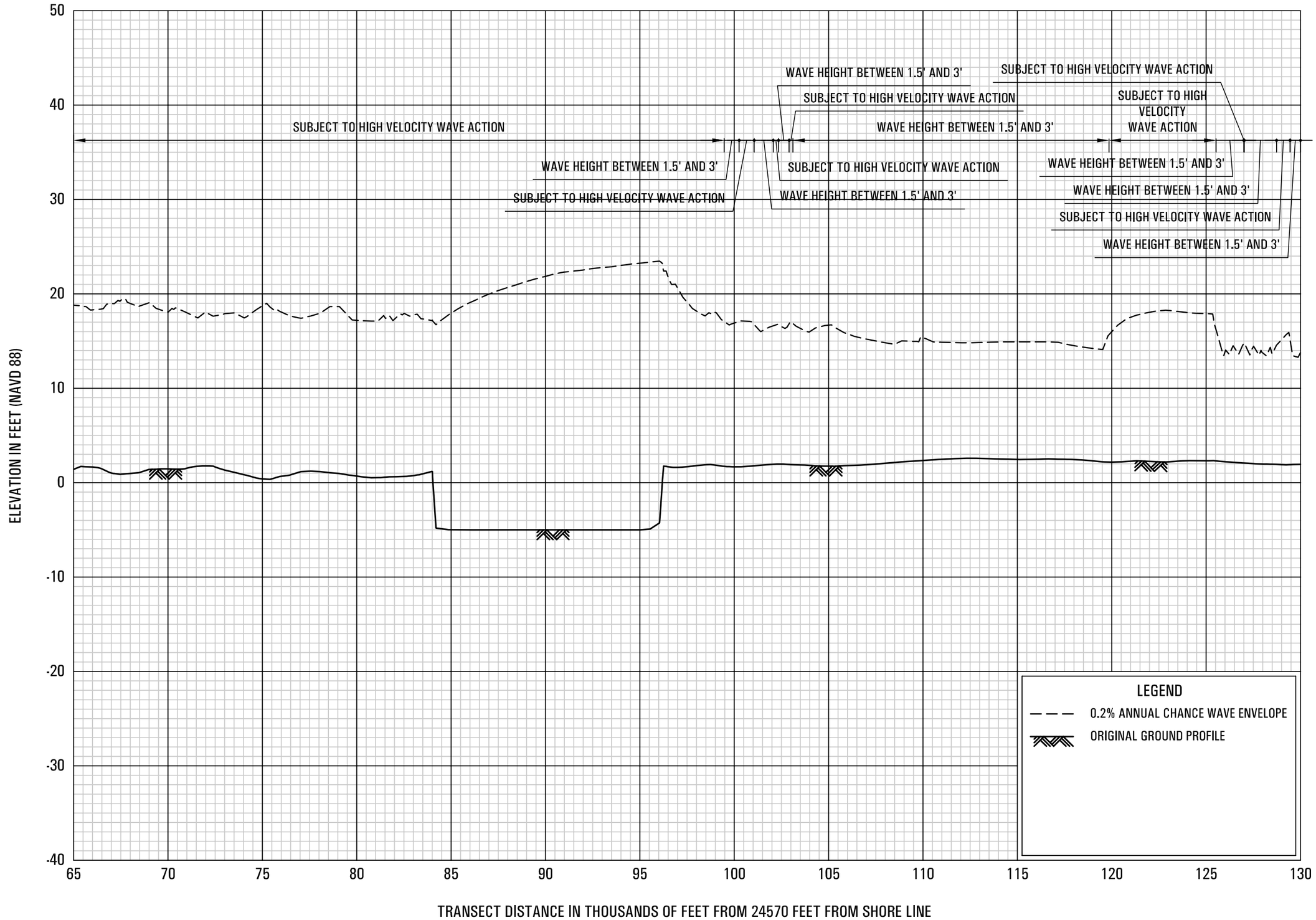
TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

24P



0.2% ANNUAL CHANCE WAVE ENVELOPE

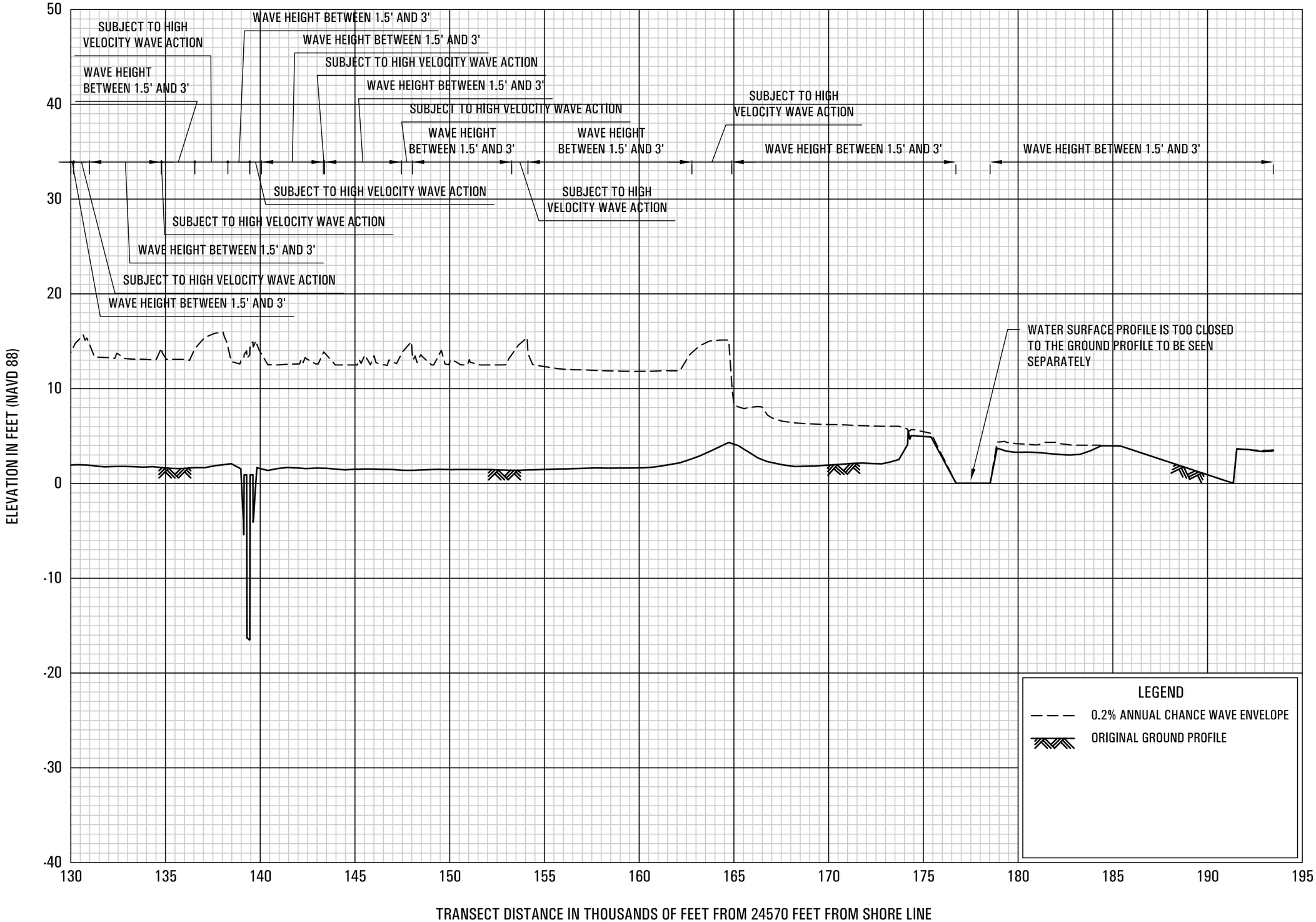
TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

25P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 8

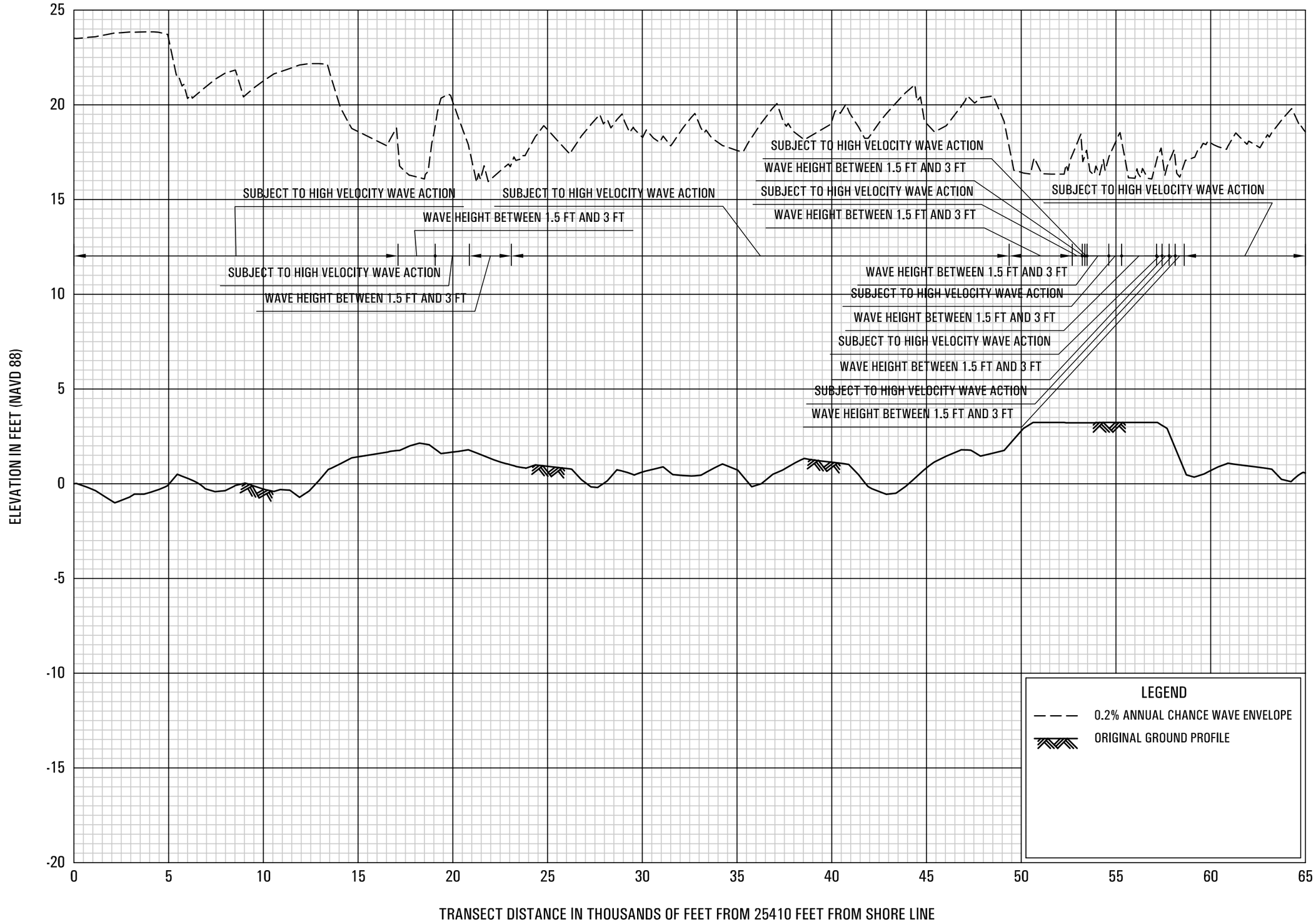
FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

0.2% ANNUAL CHANCE WAVE ENVELOPE

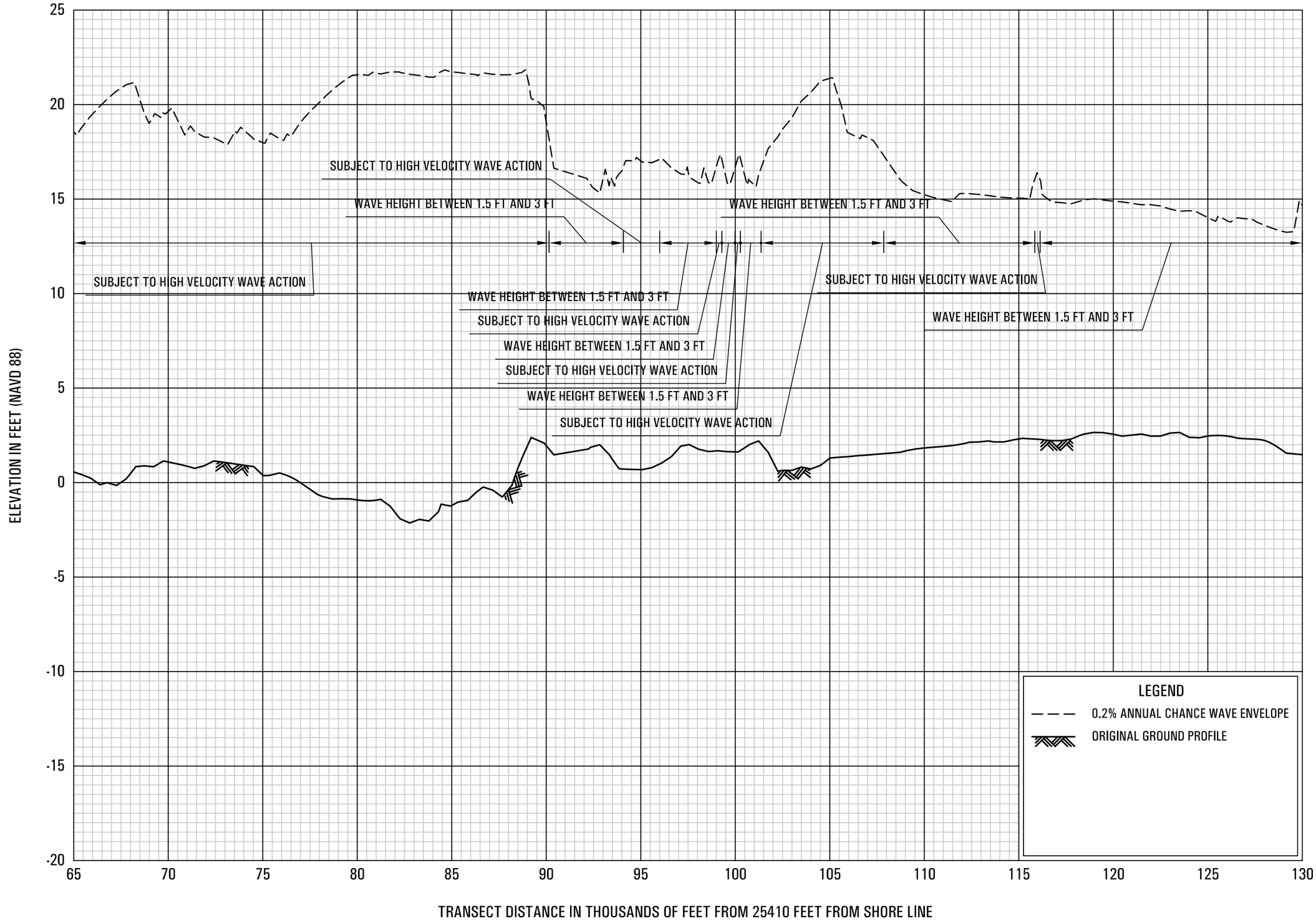
TRANSECT 9



FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



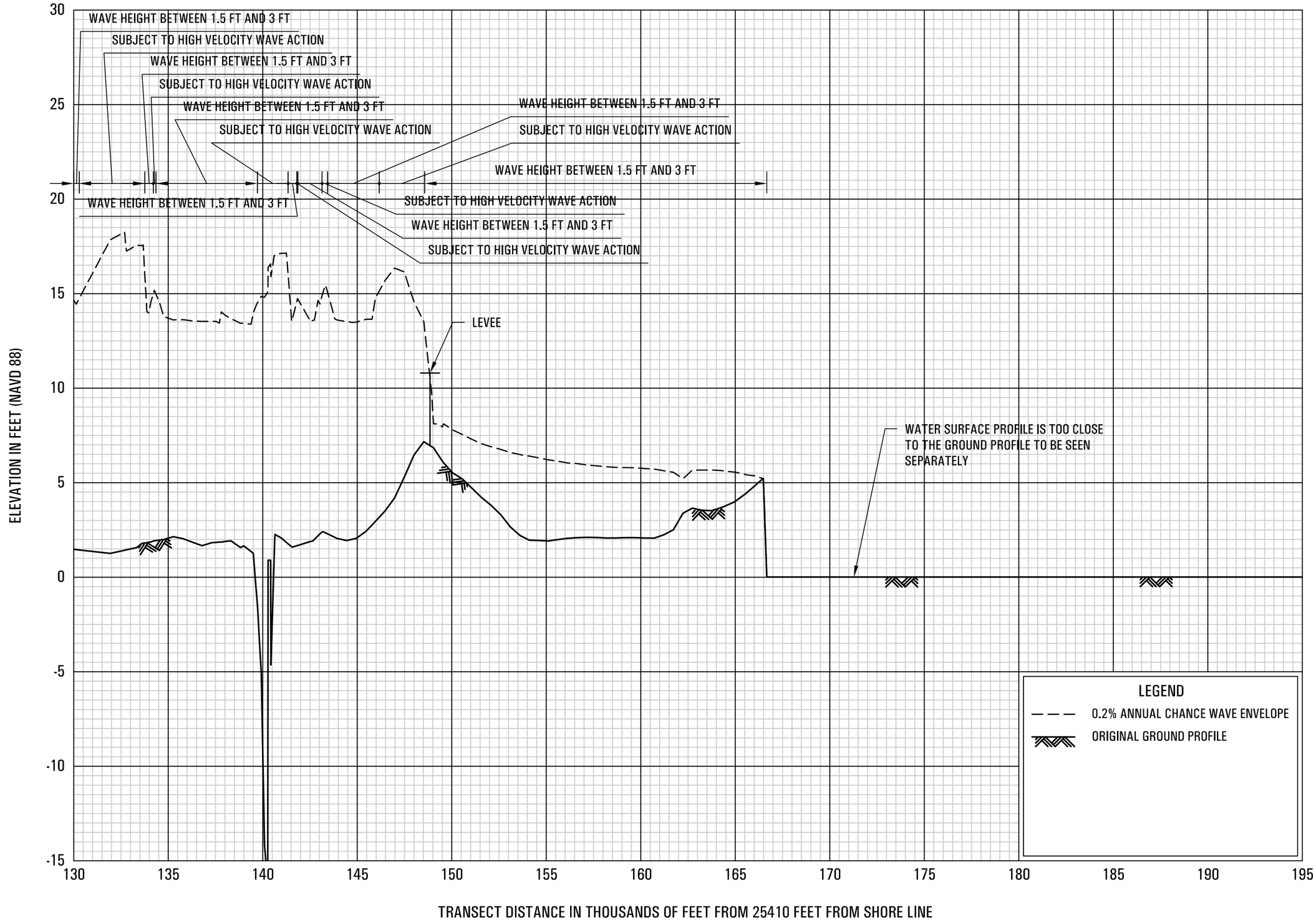
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



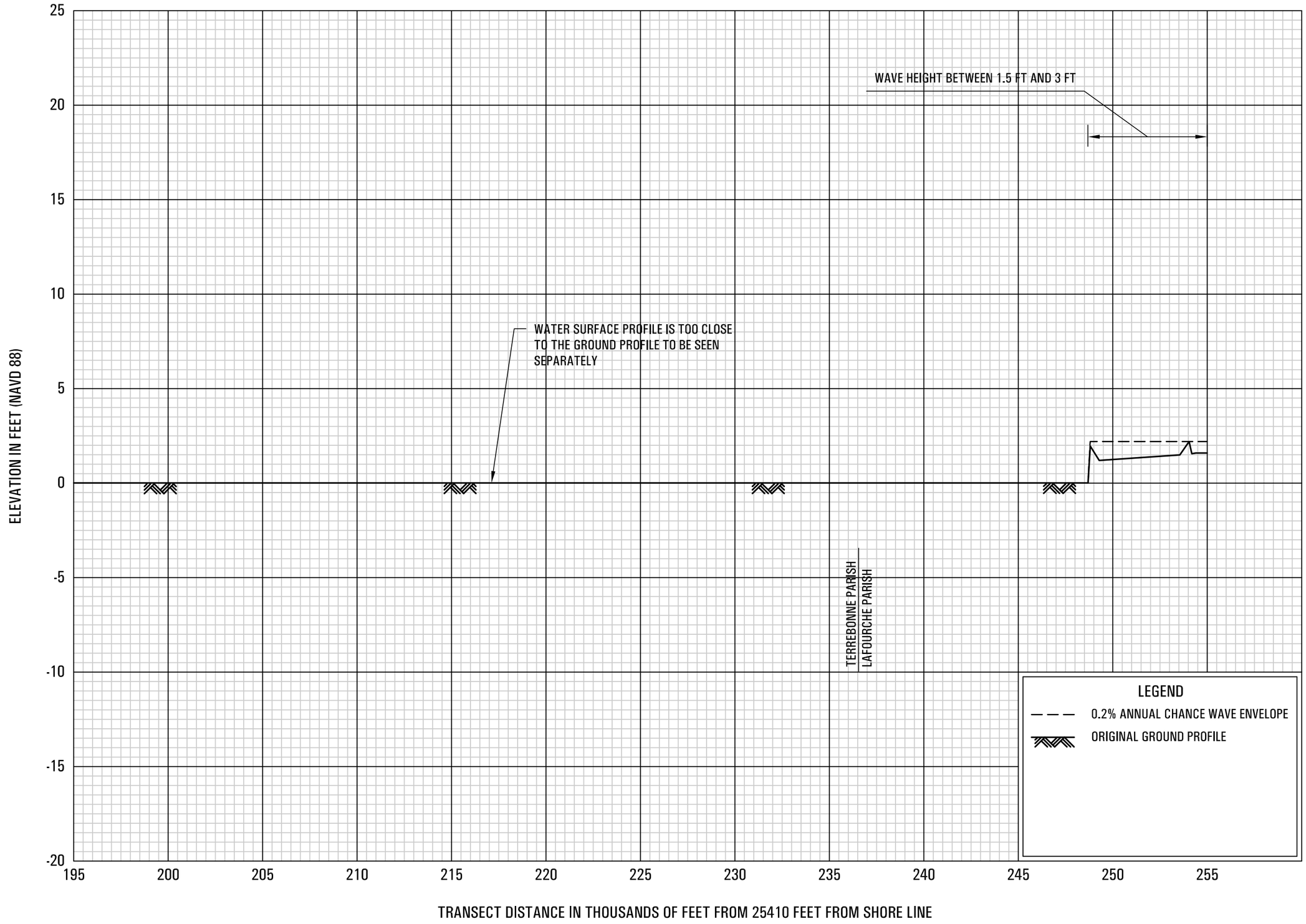
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

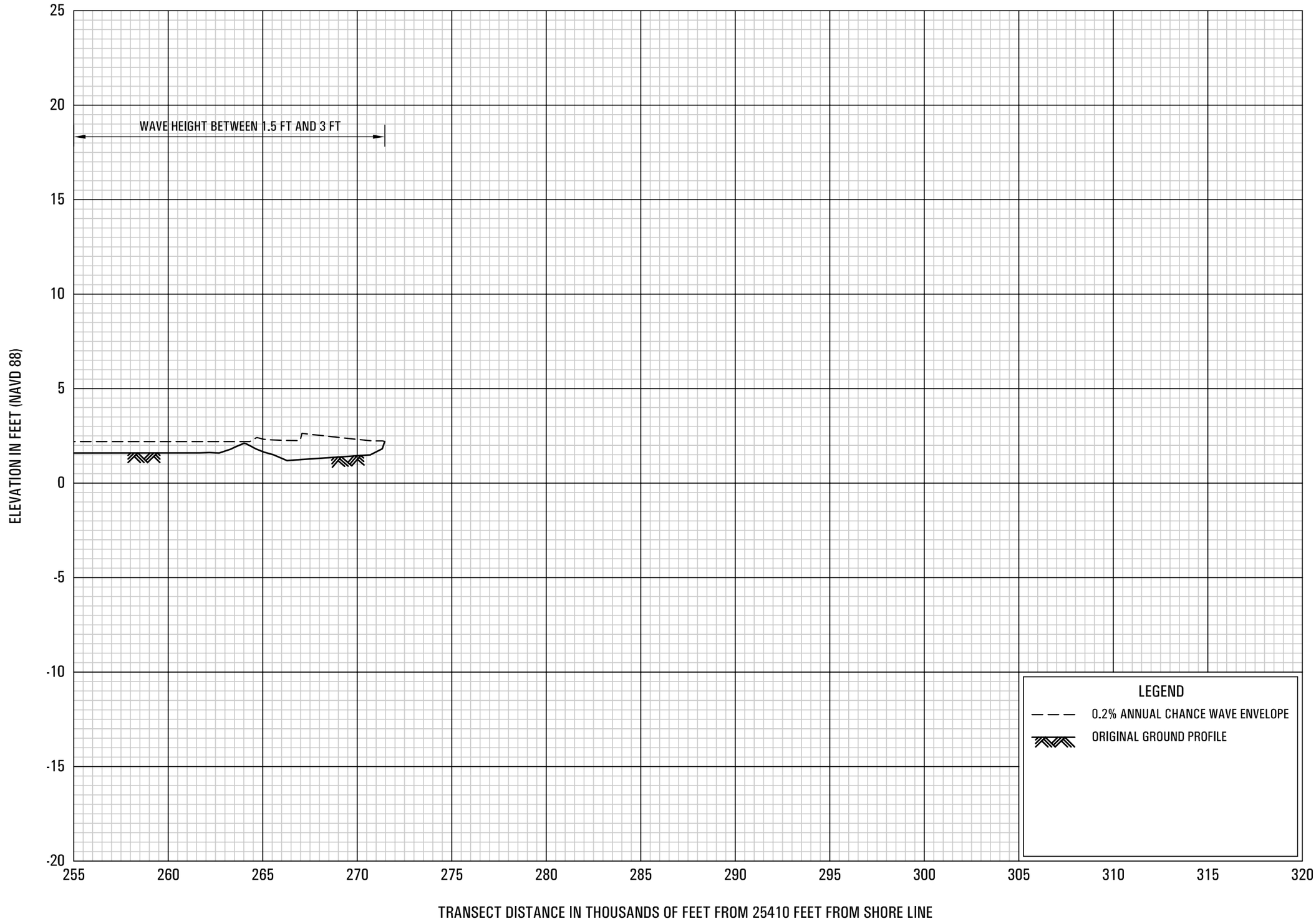
TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

30P



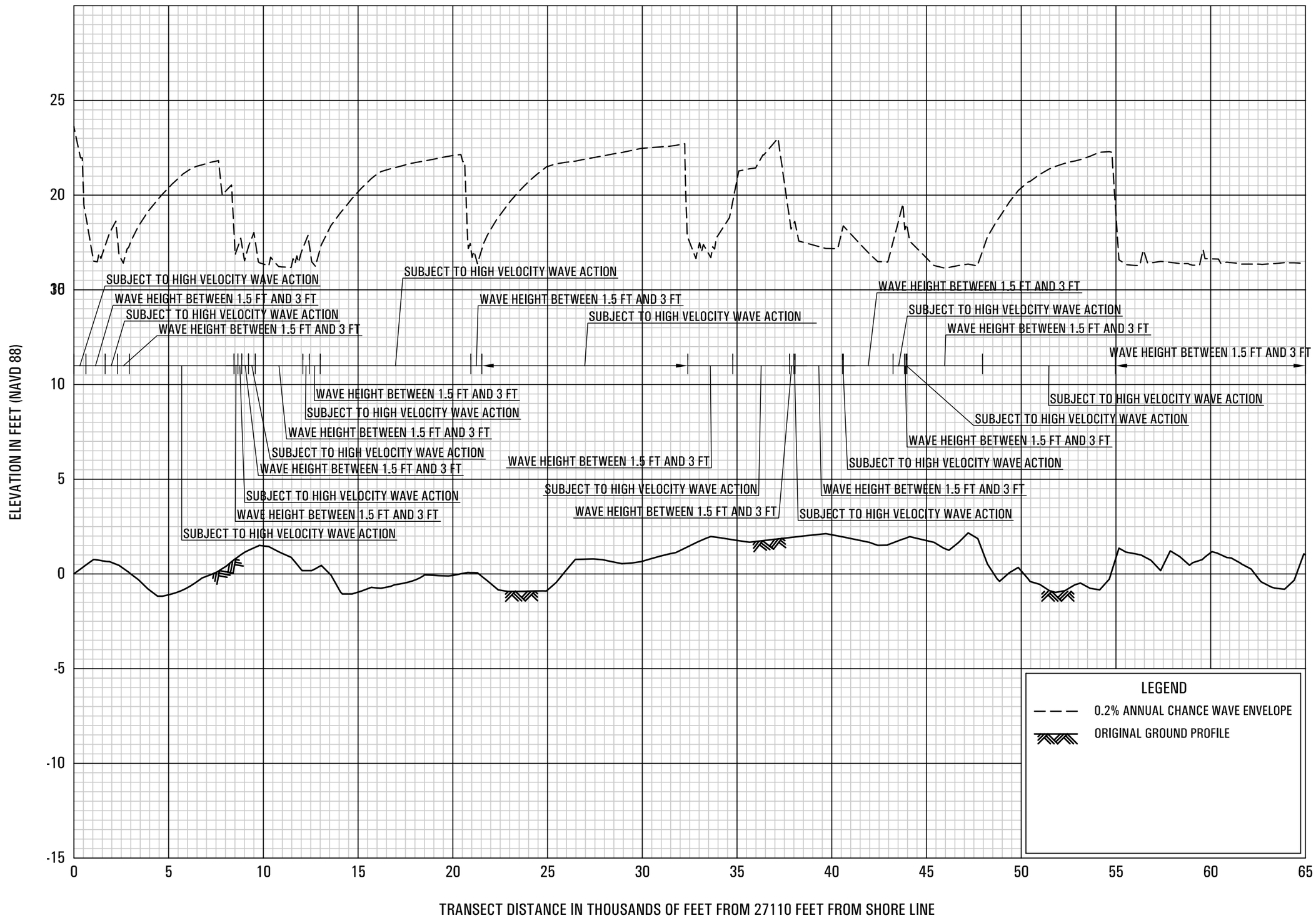
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



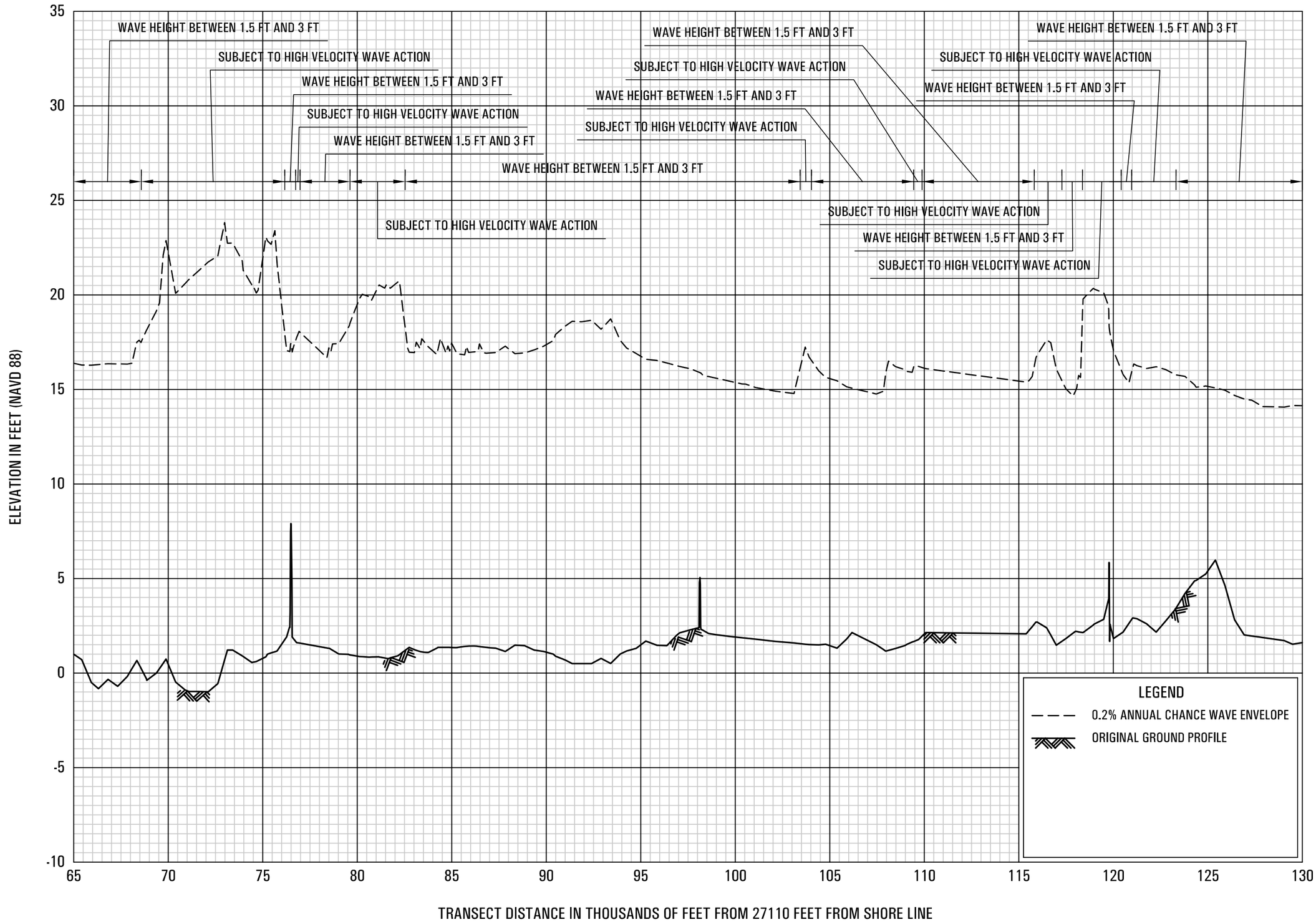
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

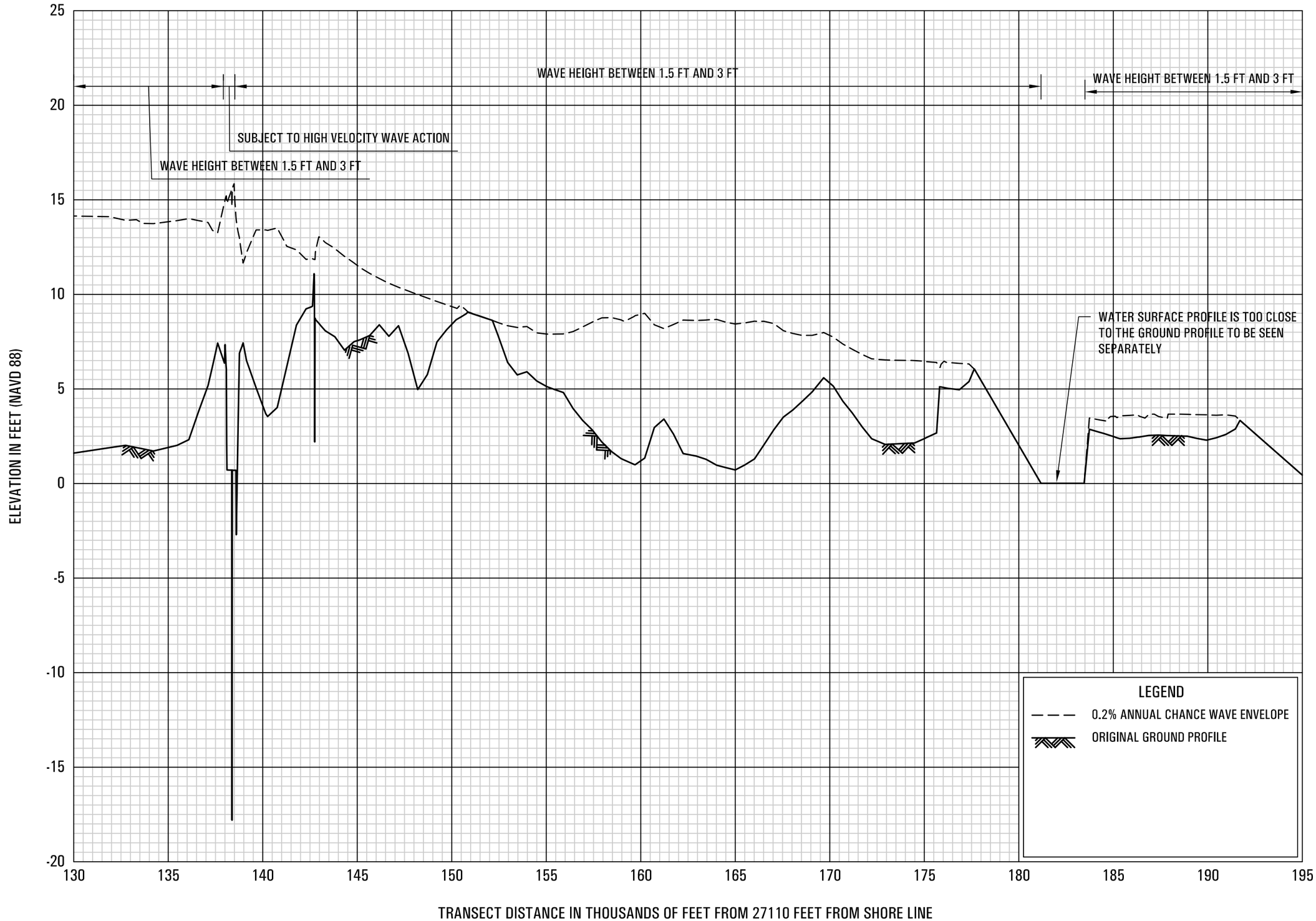
TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

33P



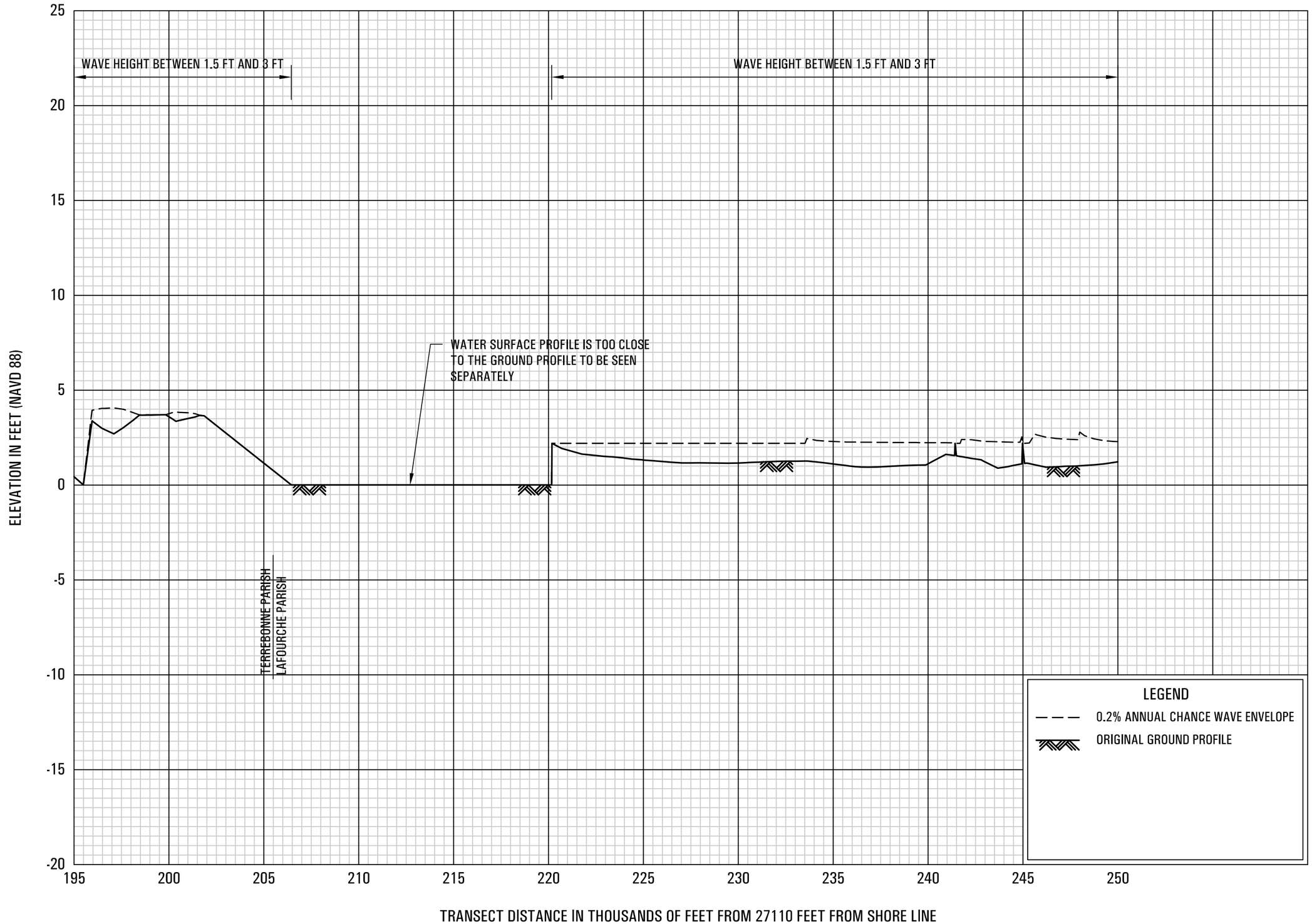
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



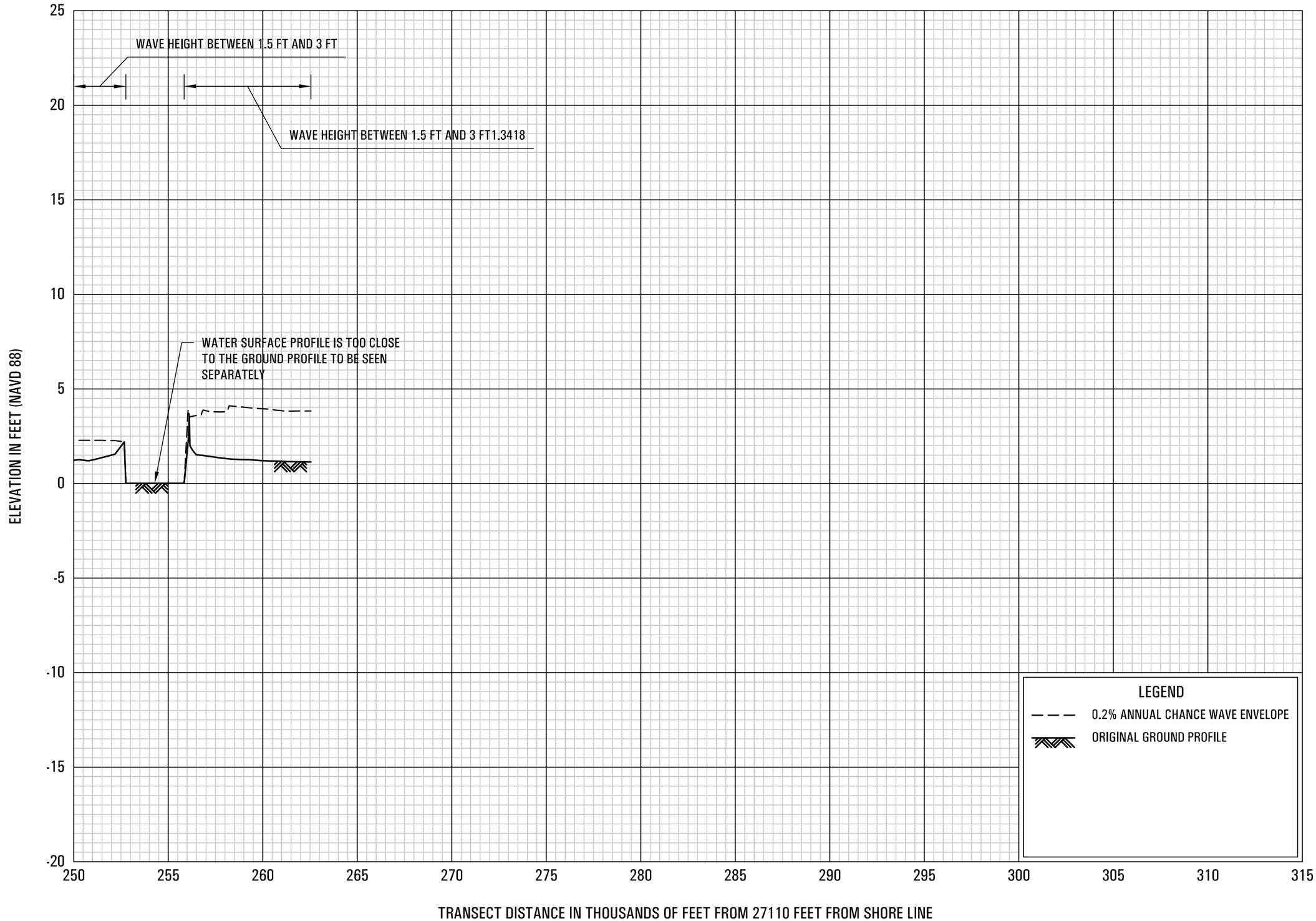
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



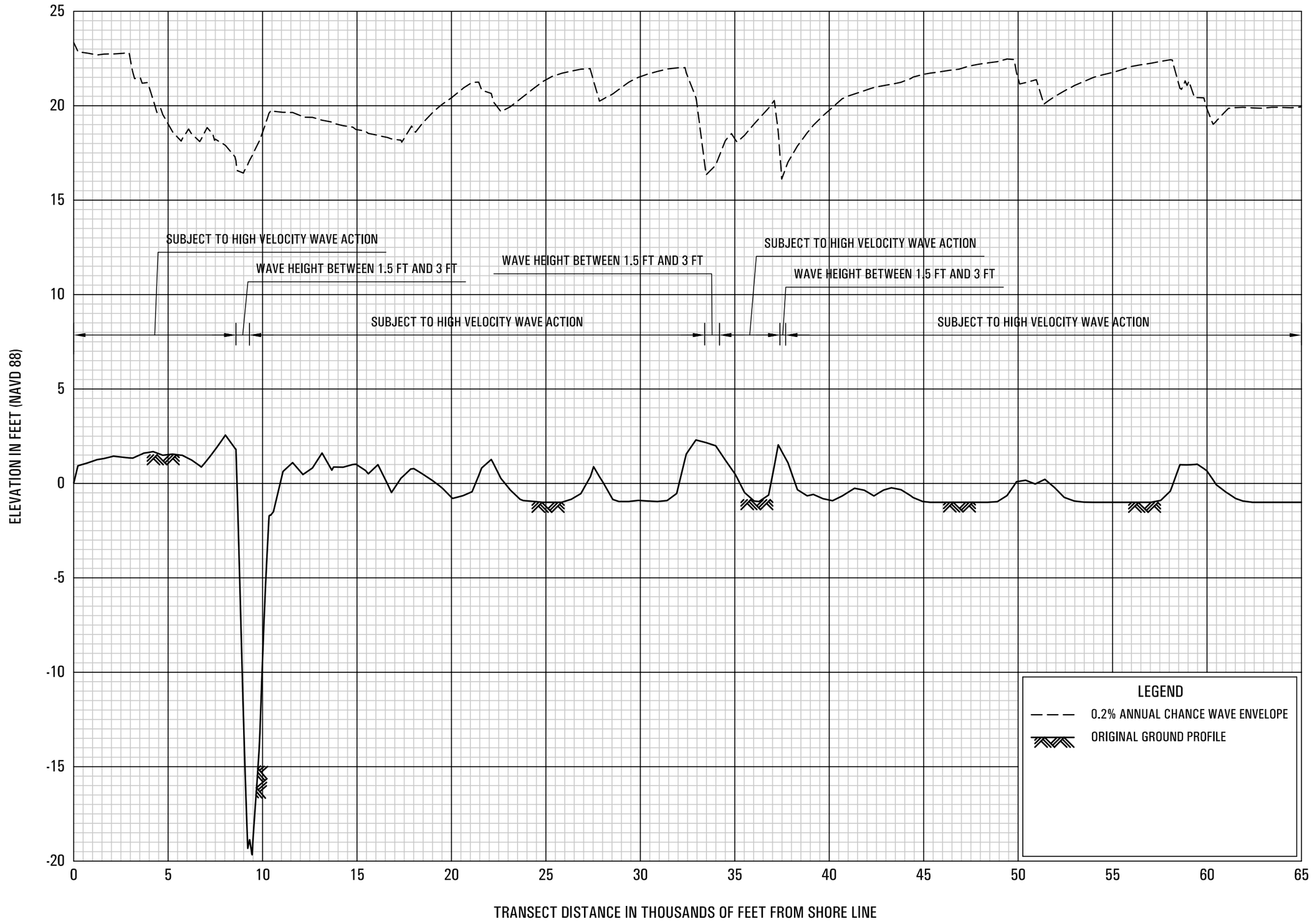
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



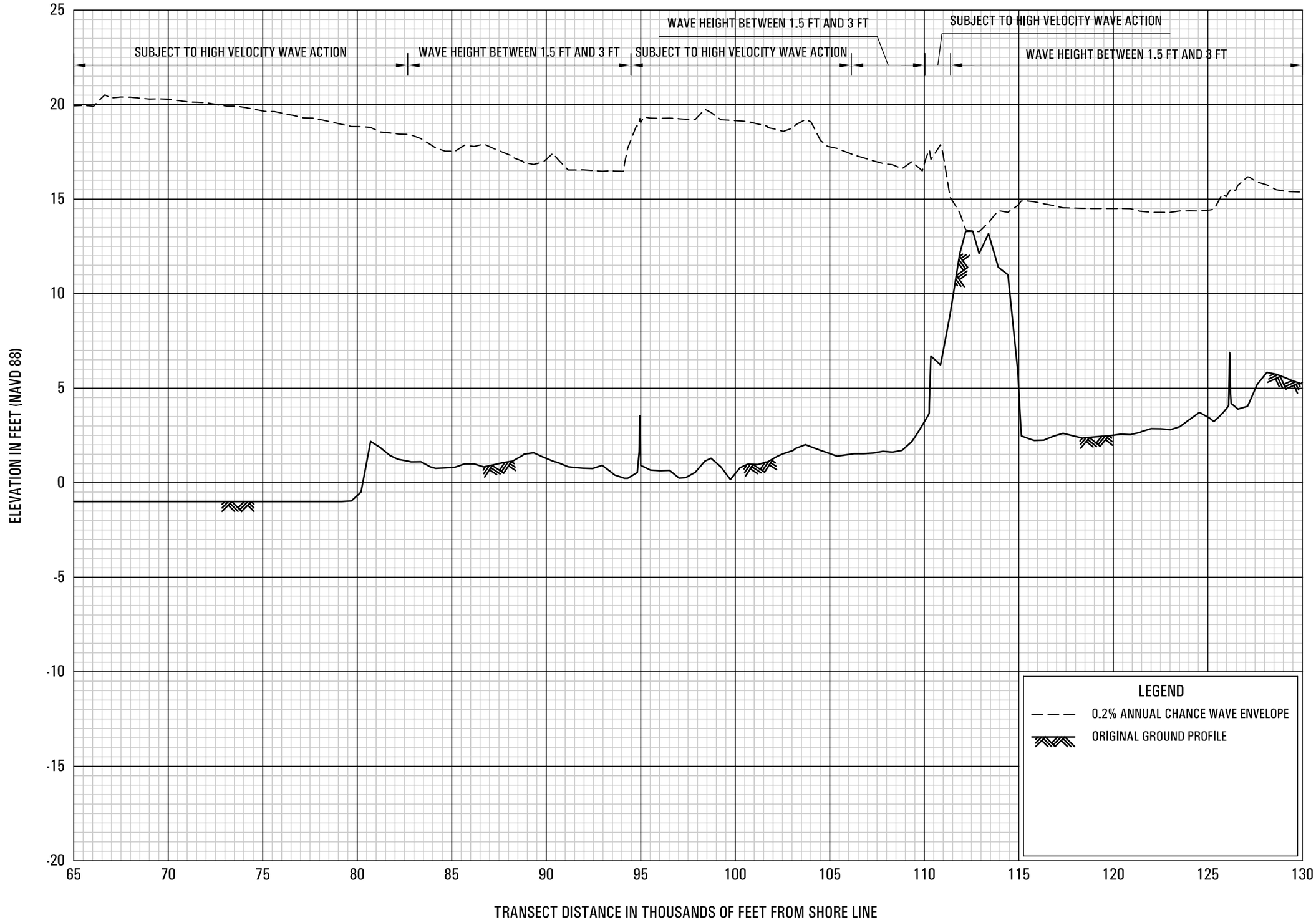
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

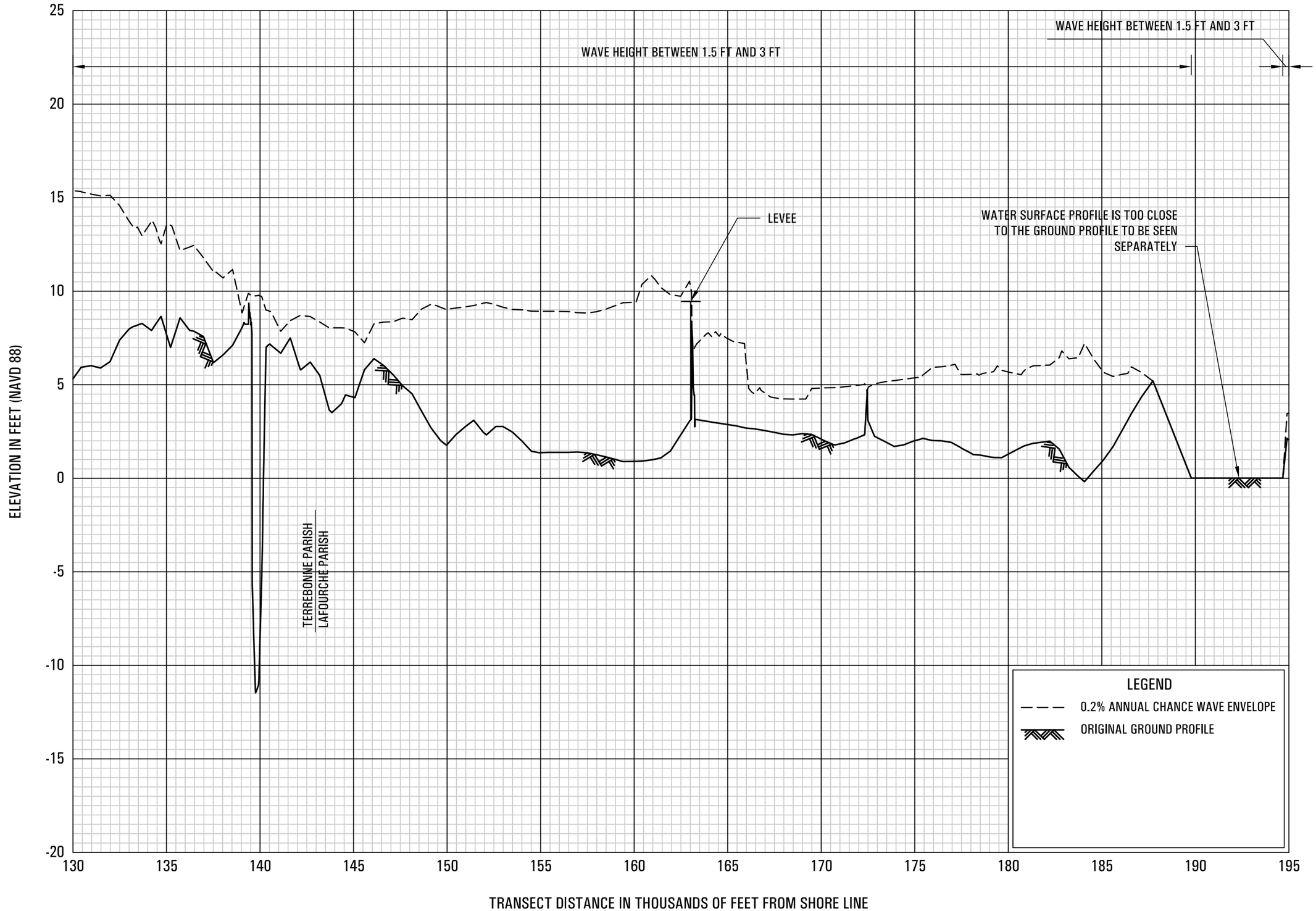
TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

38P



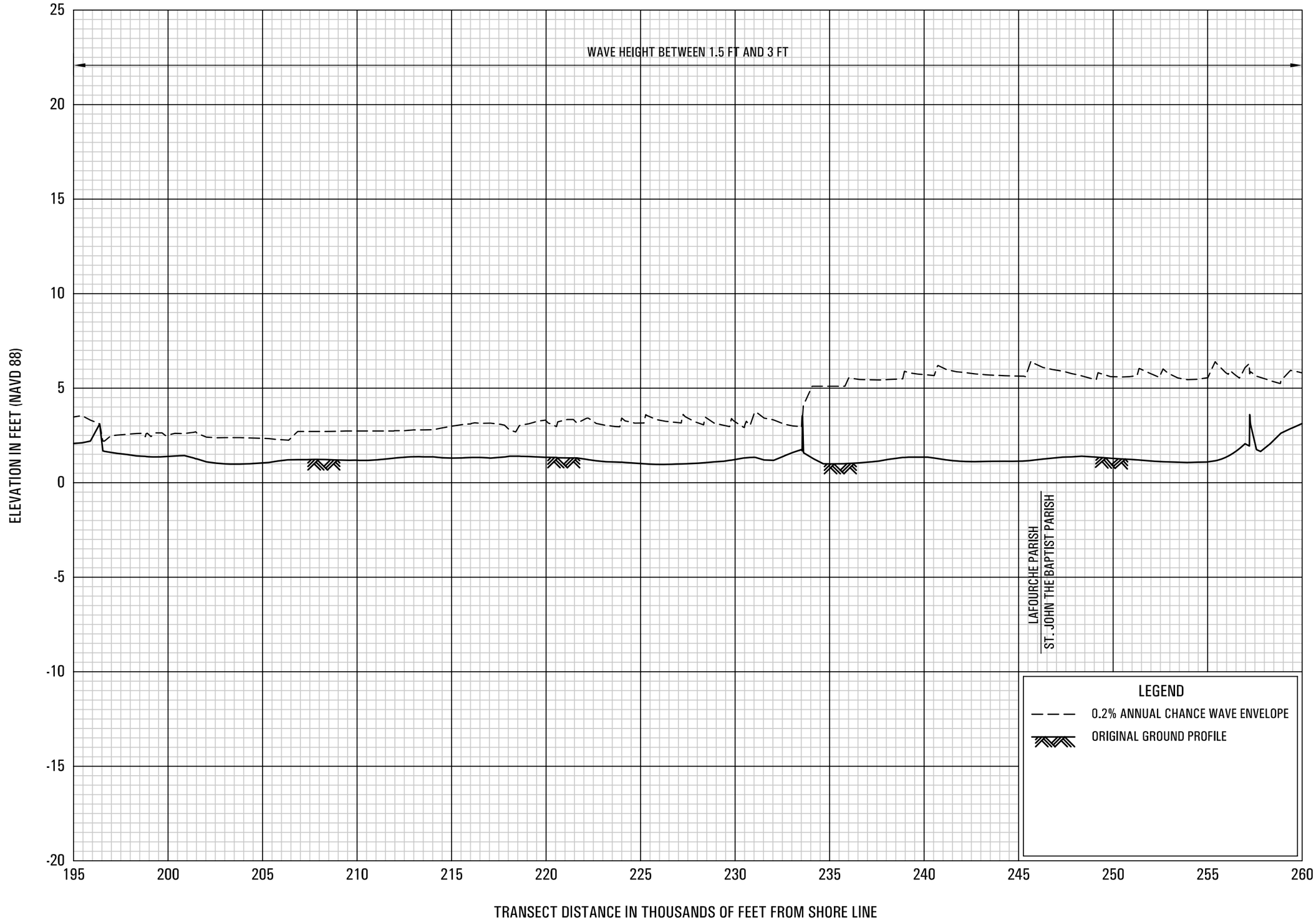
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



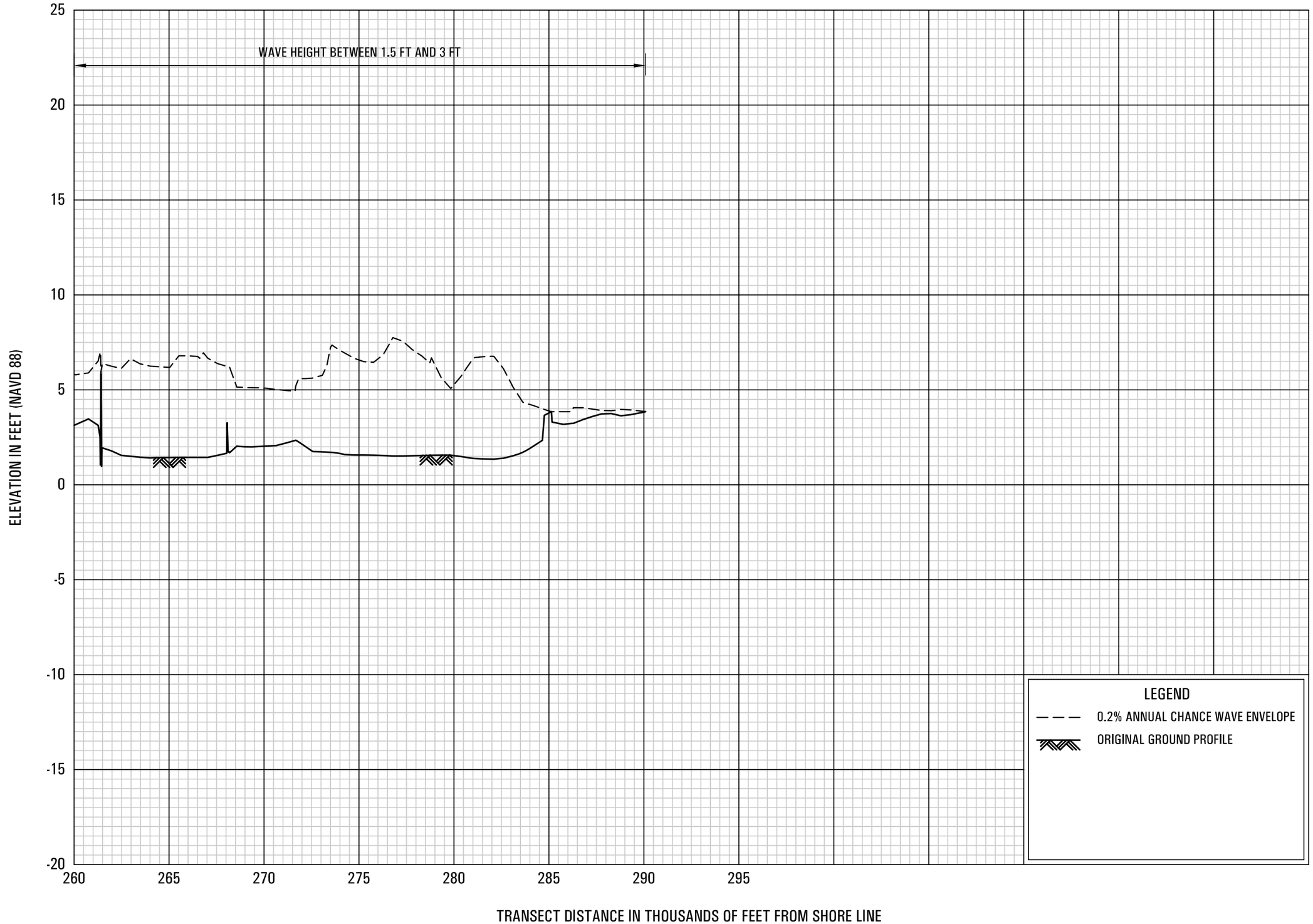
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



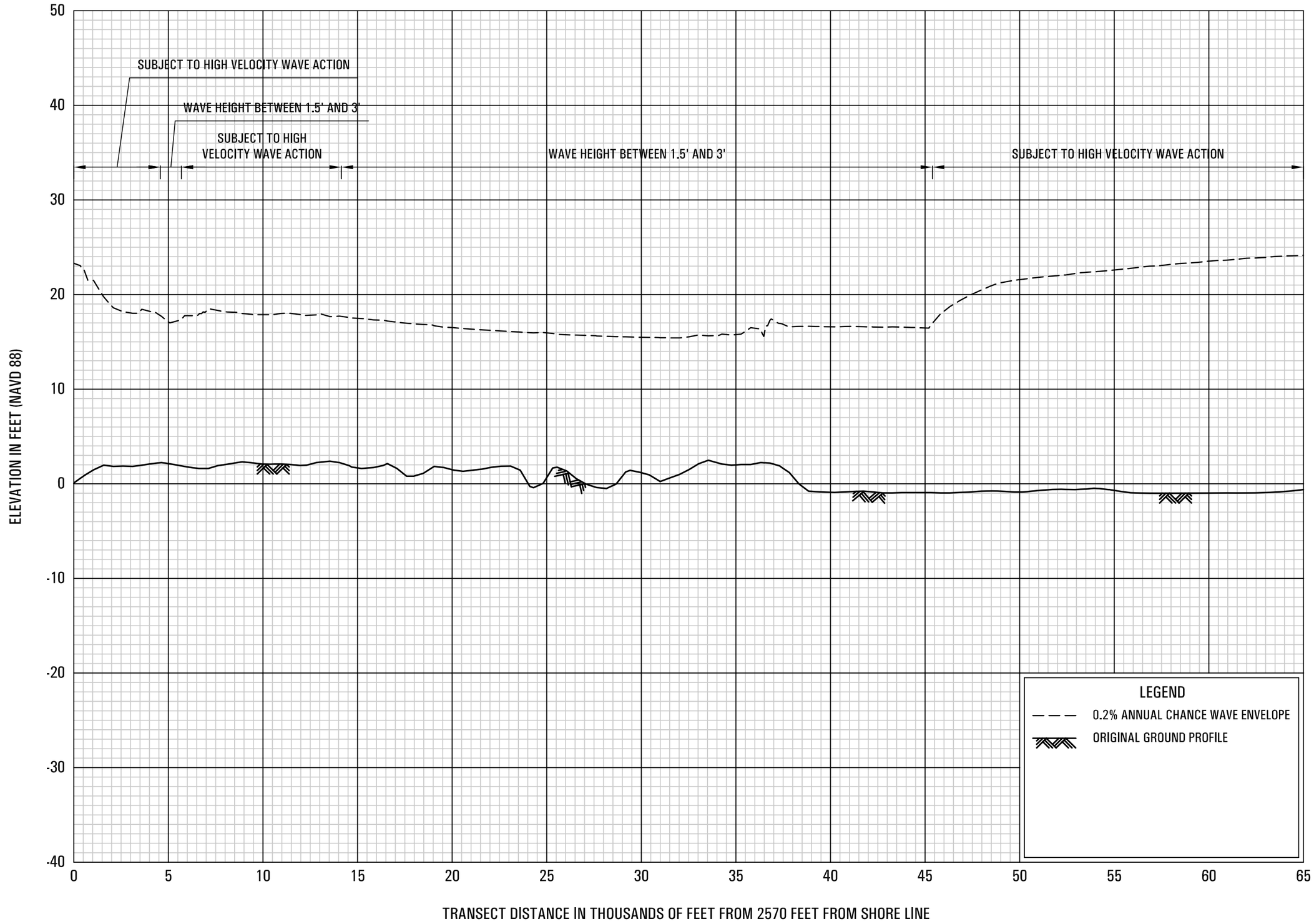
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

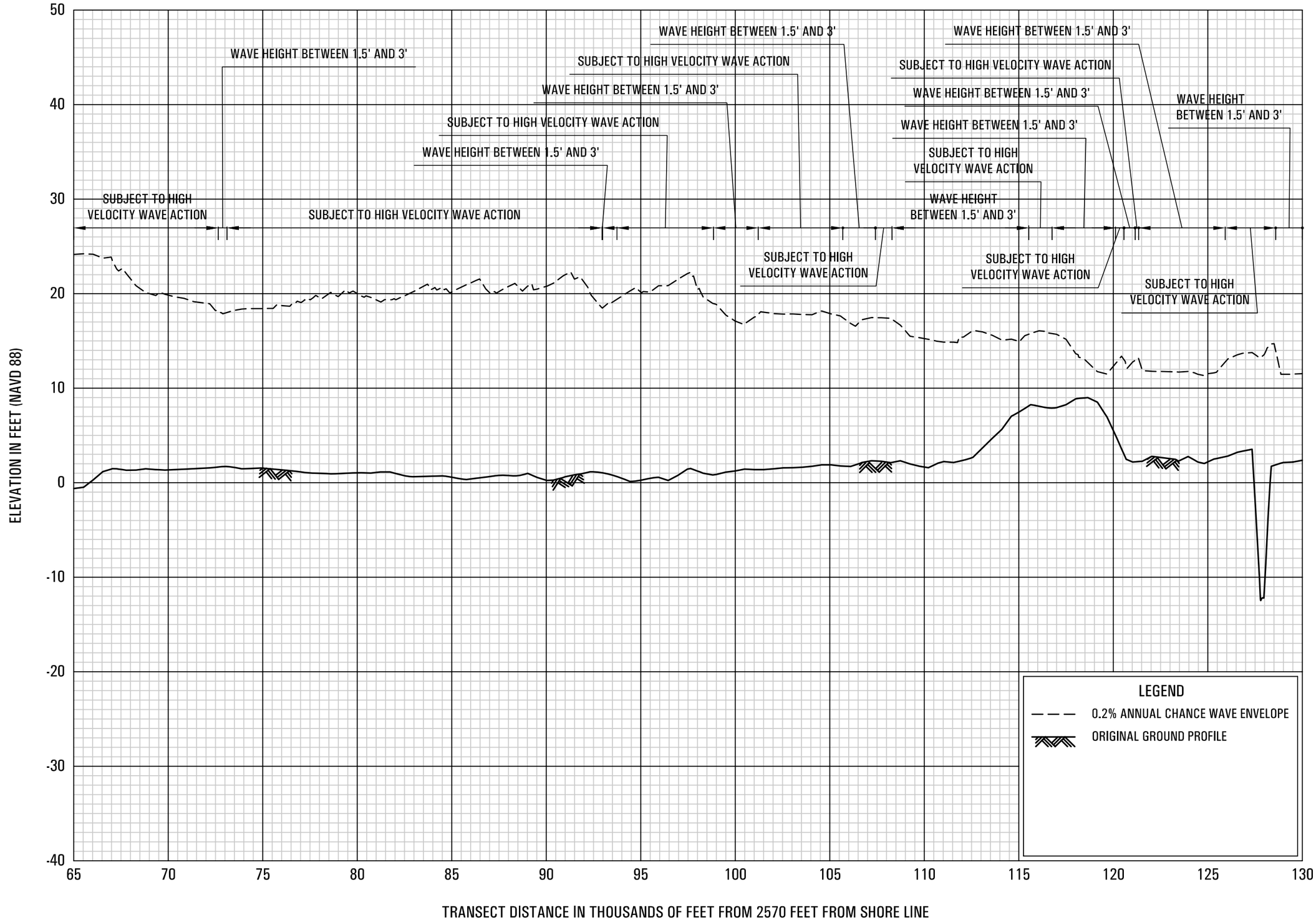
FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

0.2% ANNUAL CHANCE WAVE ENVELOPE

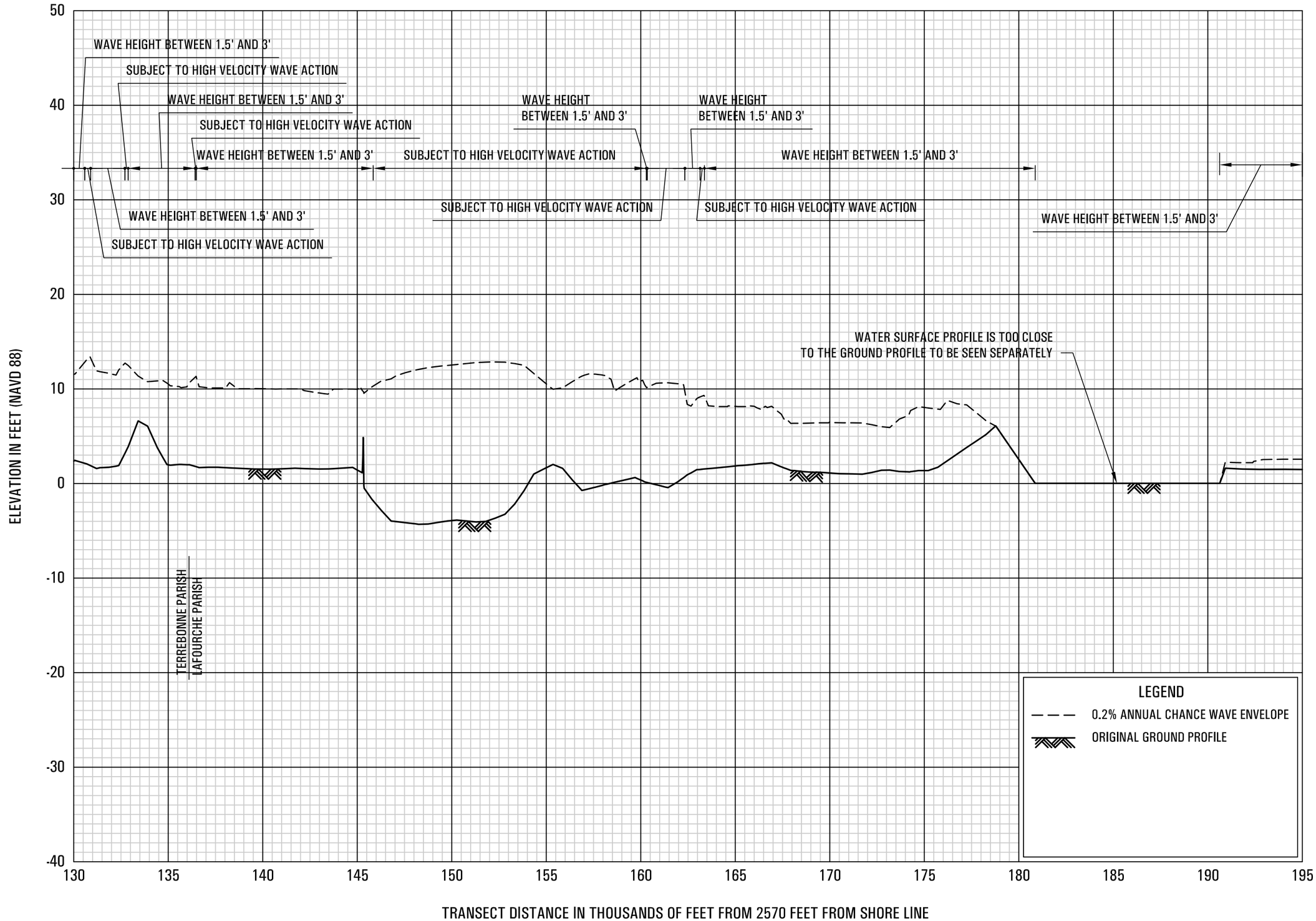
TRANSECT 12



FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



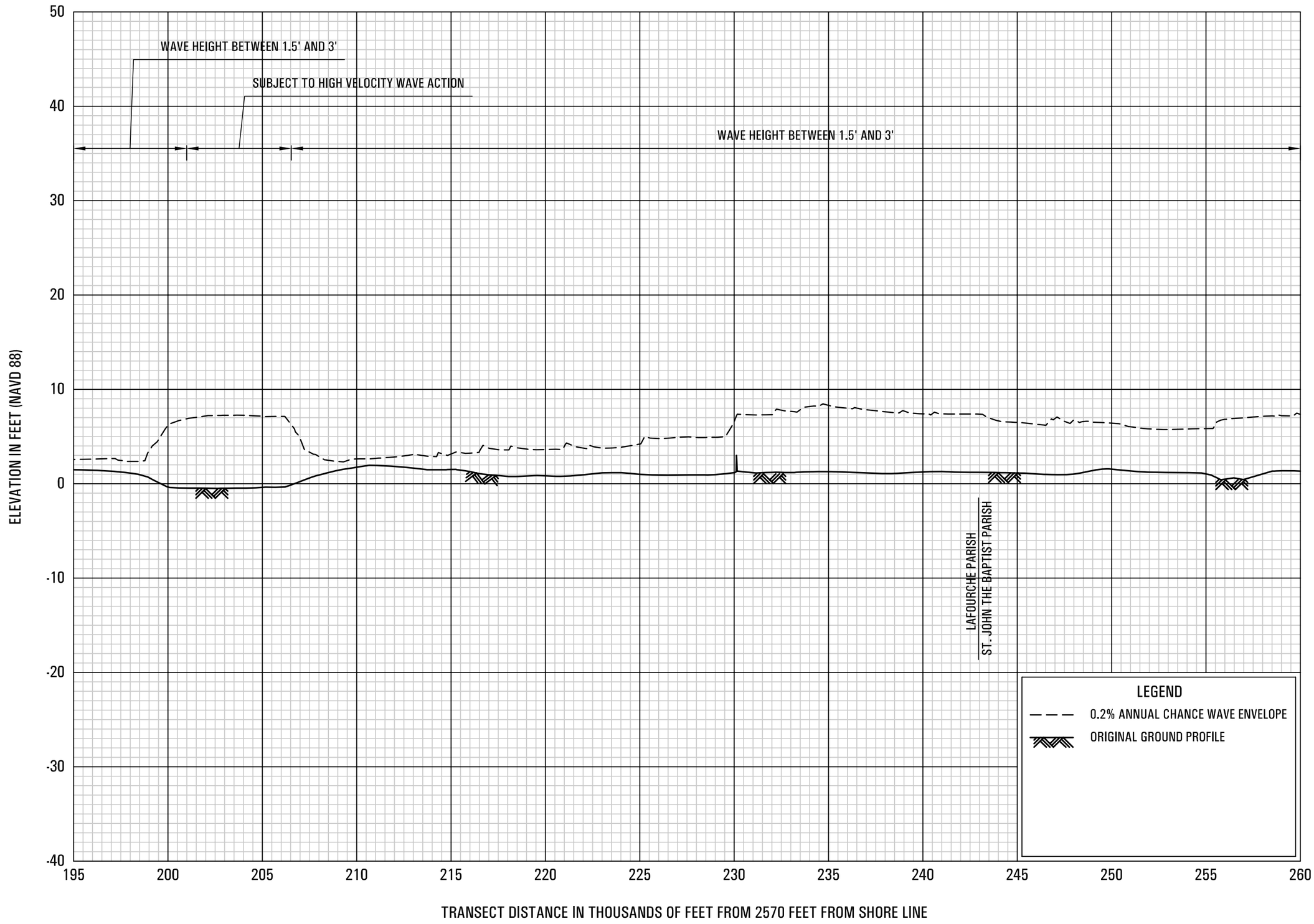
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



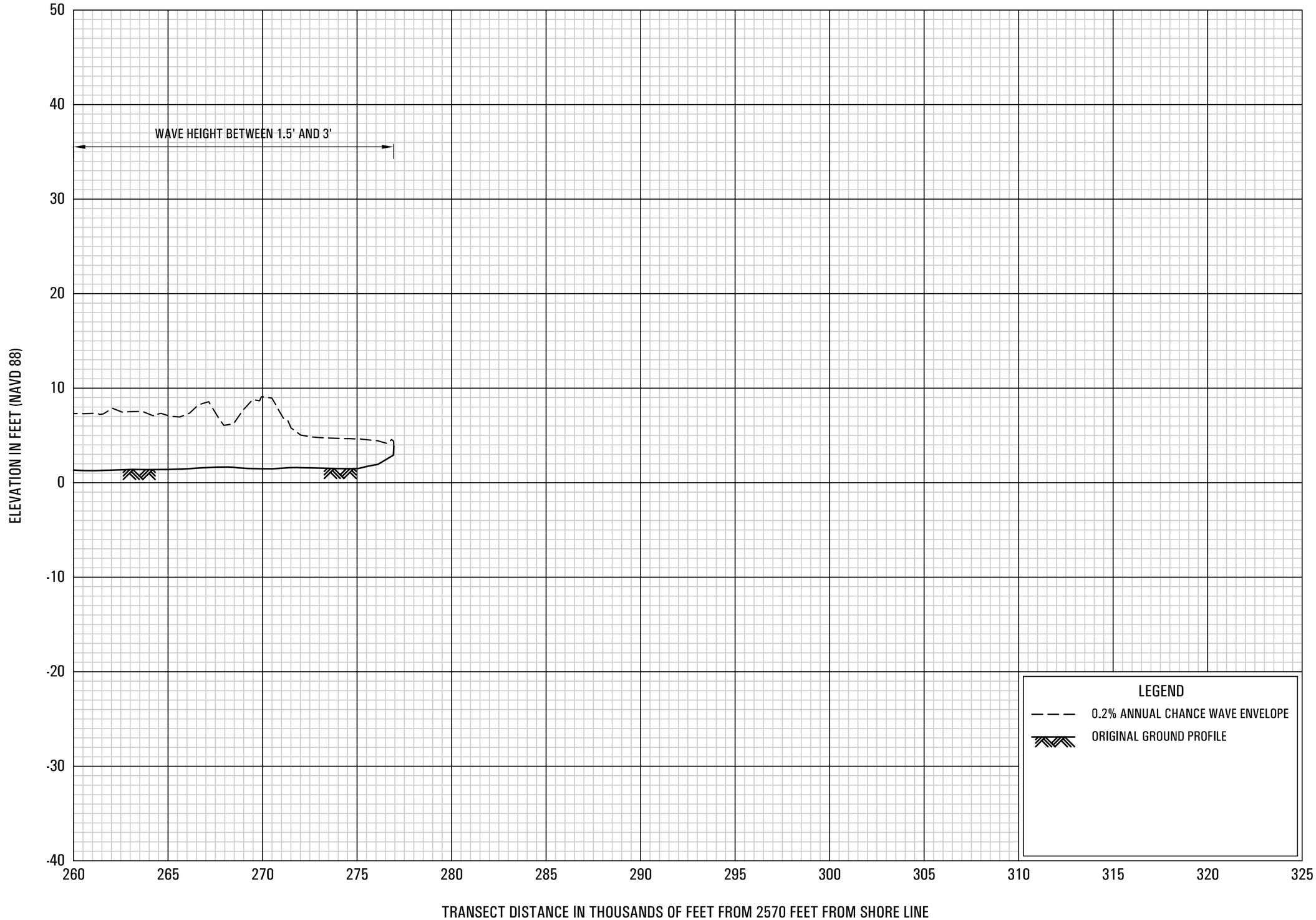
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



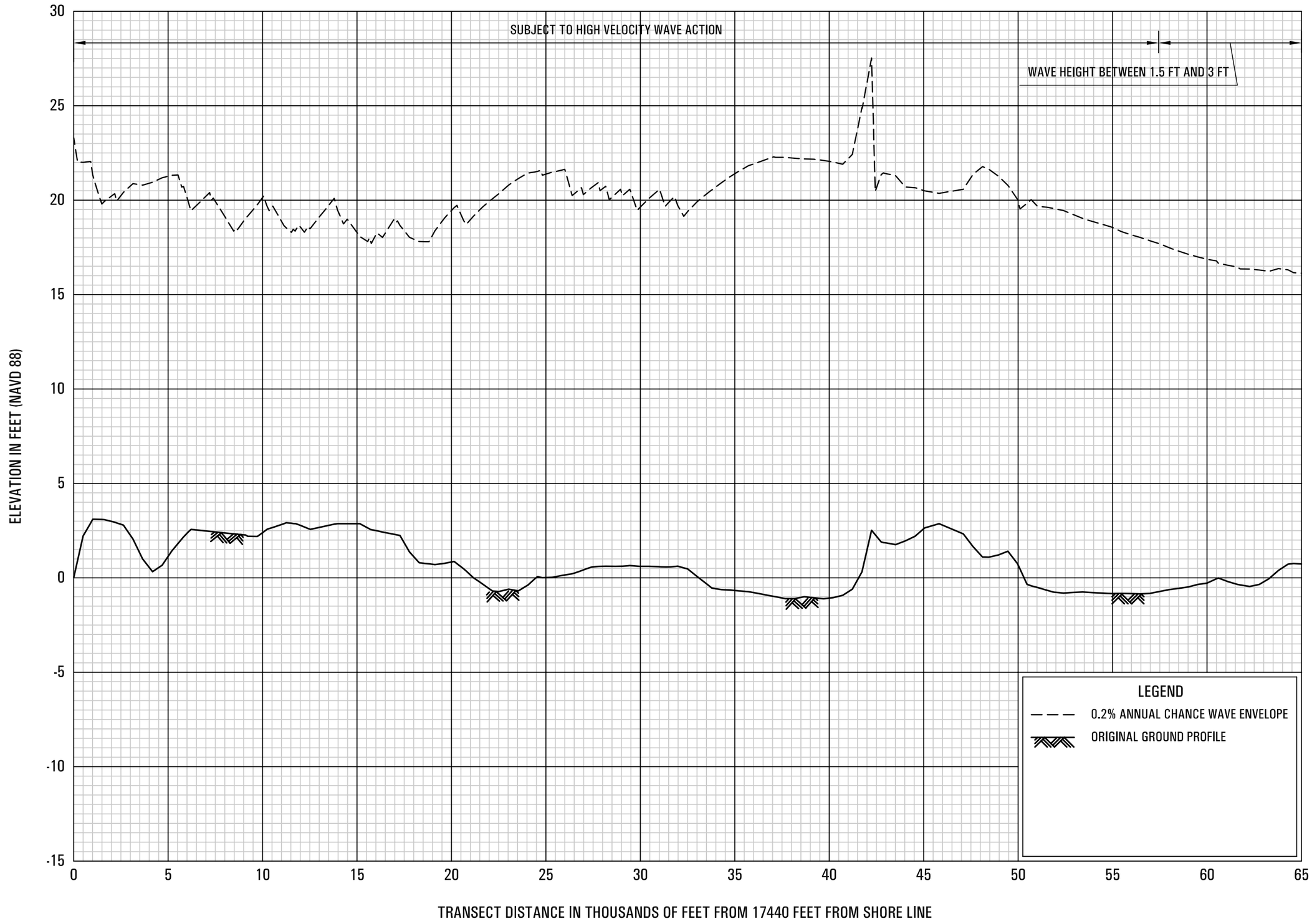
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

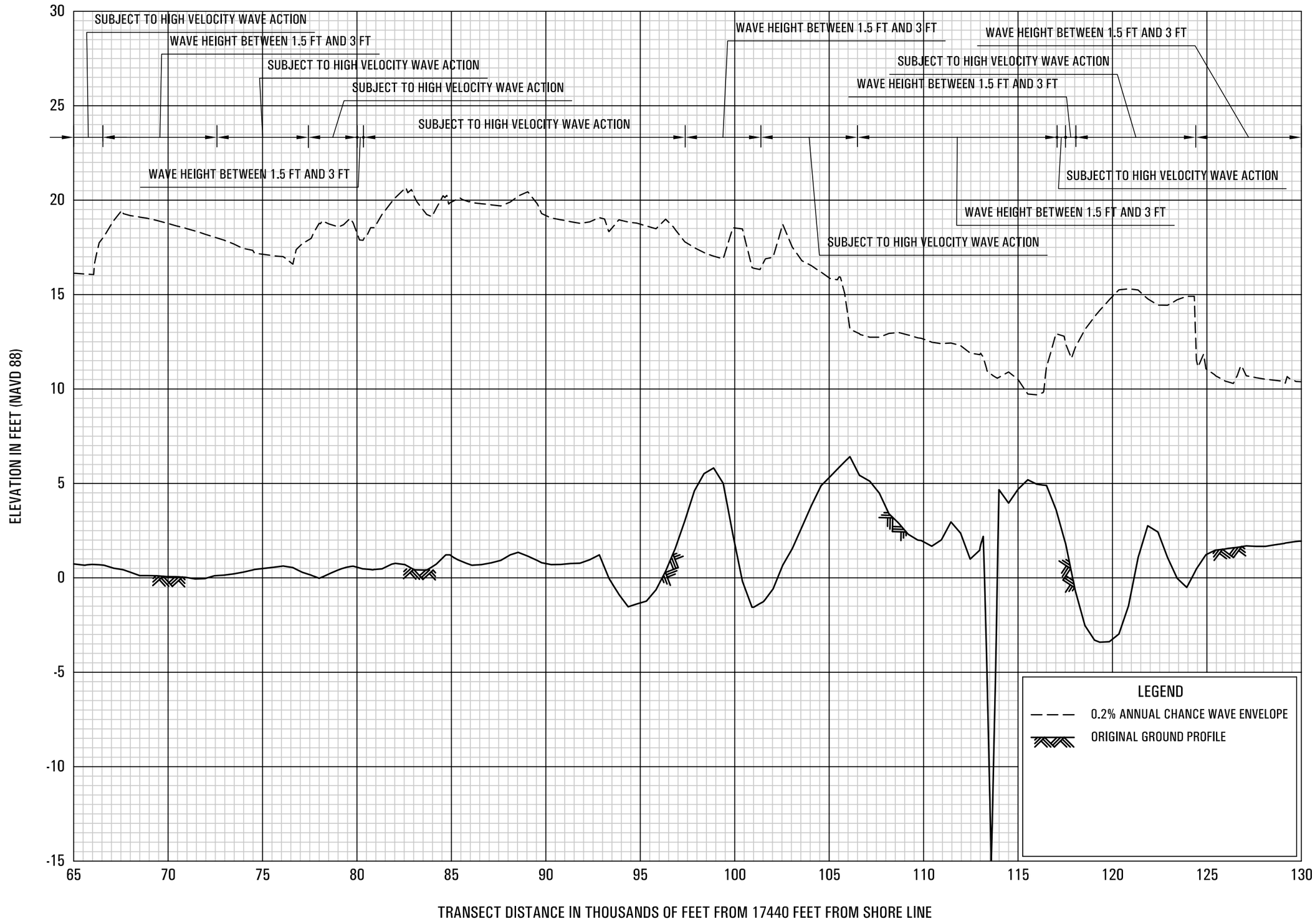
TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

47P



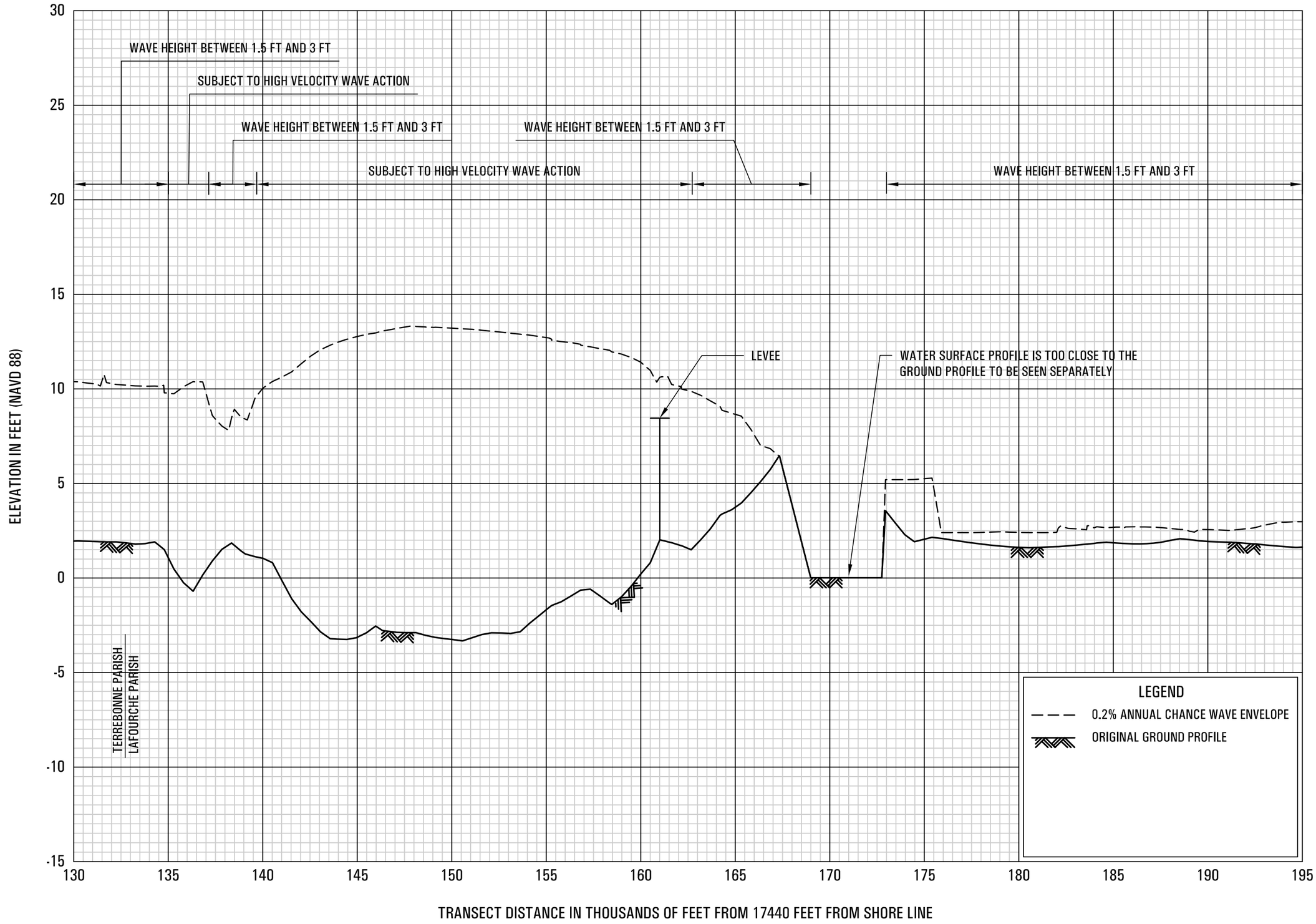
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



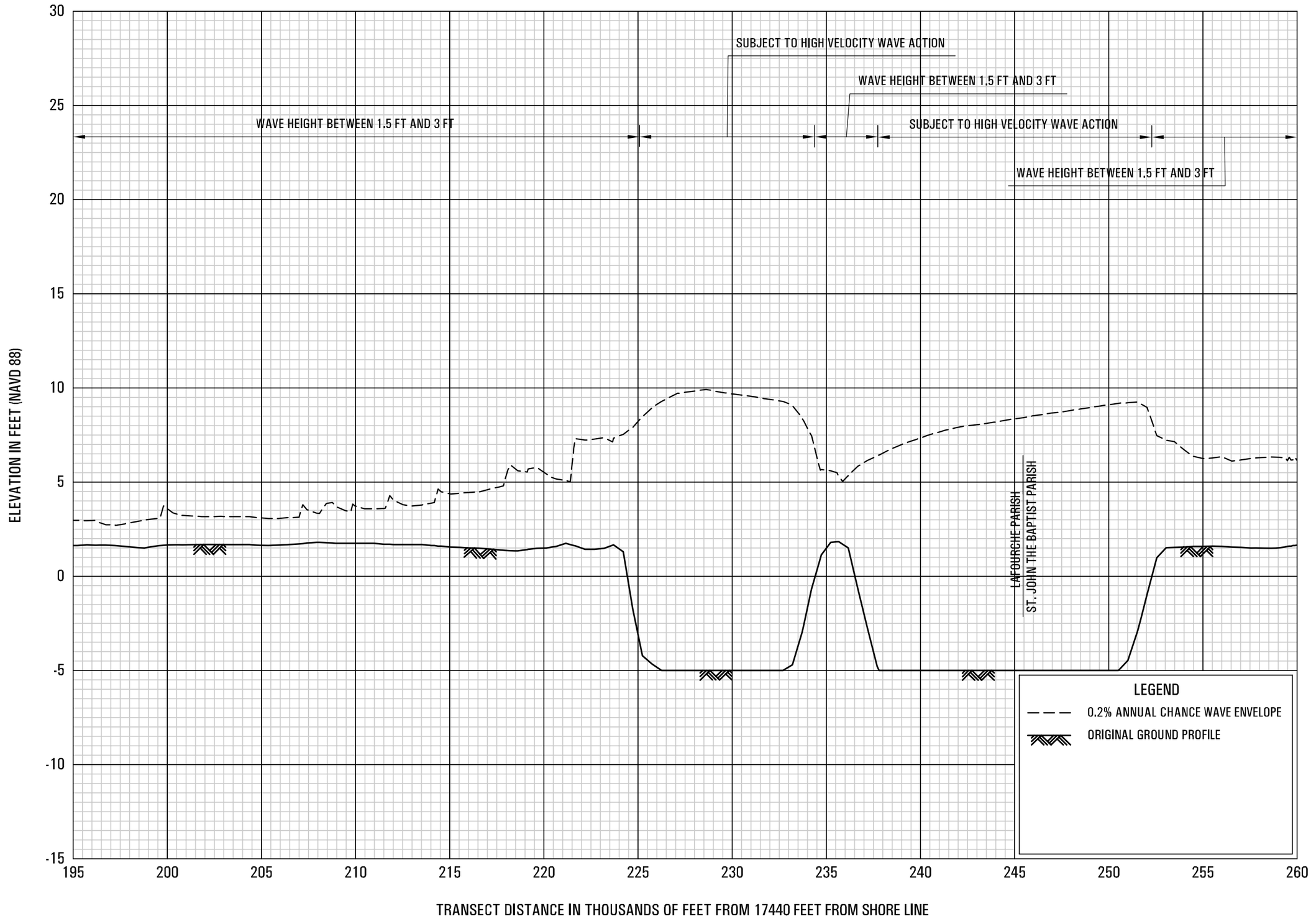
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



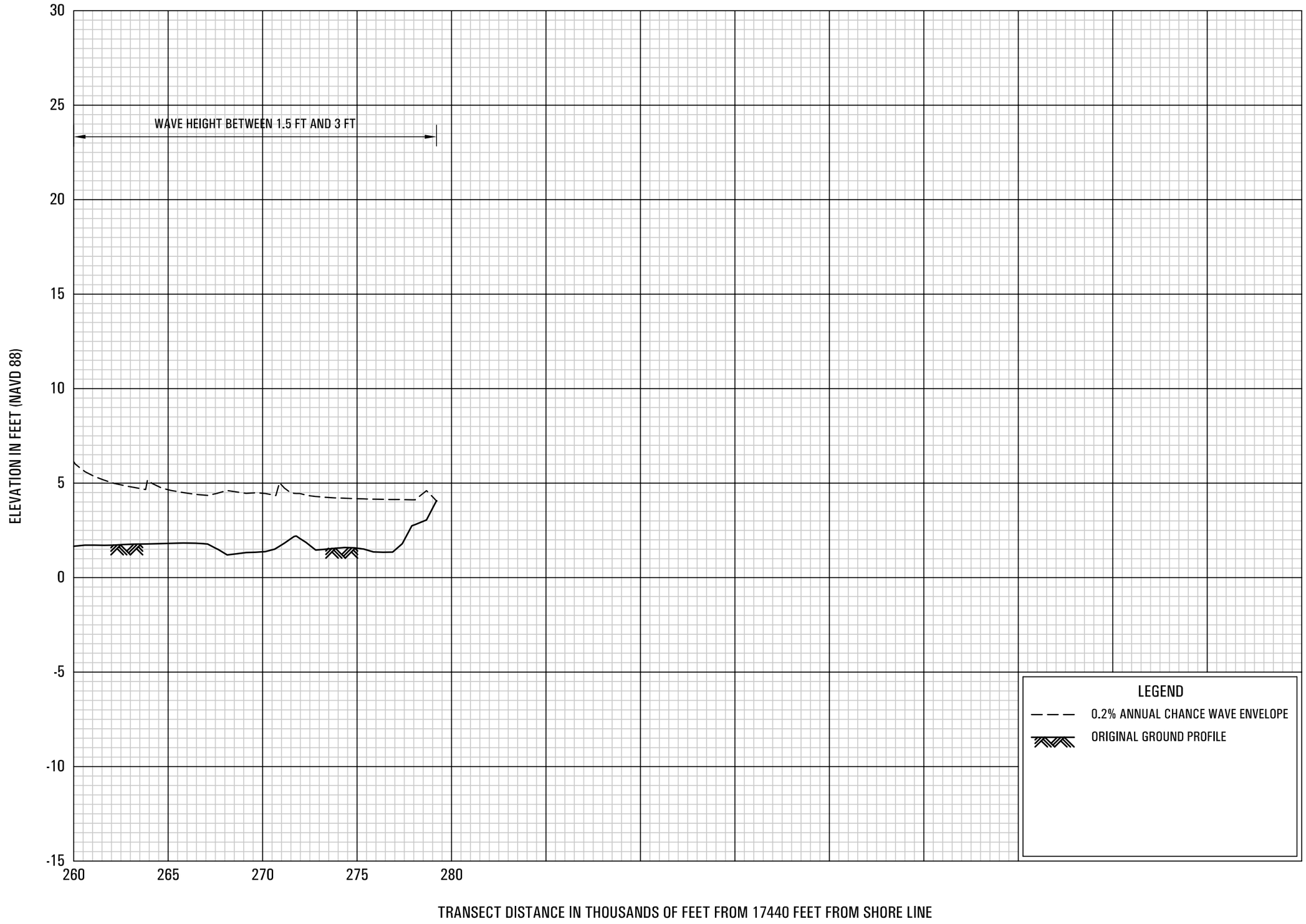
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



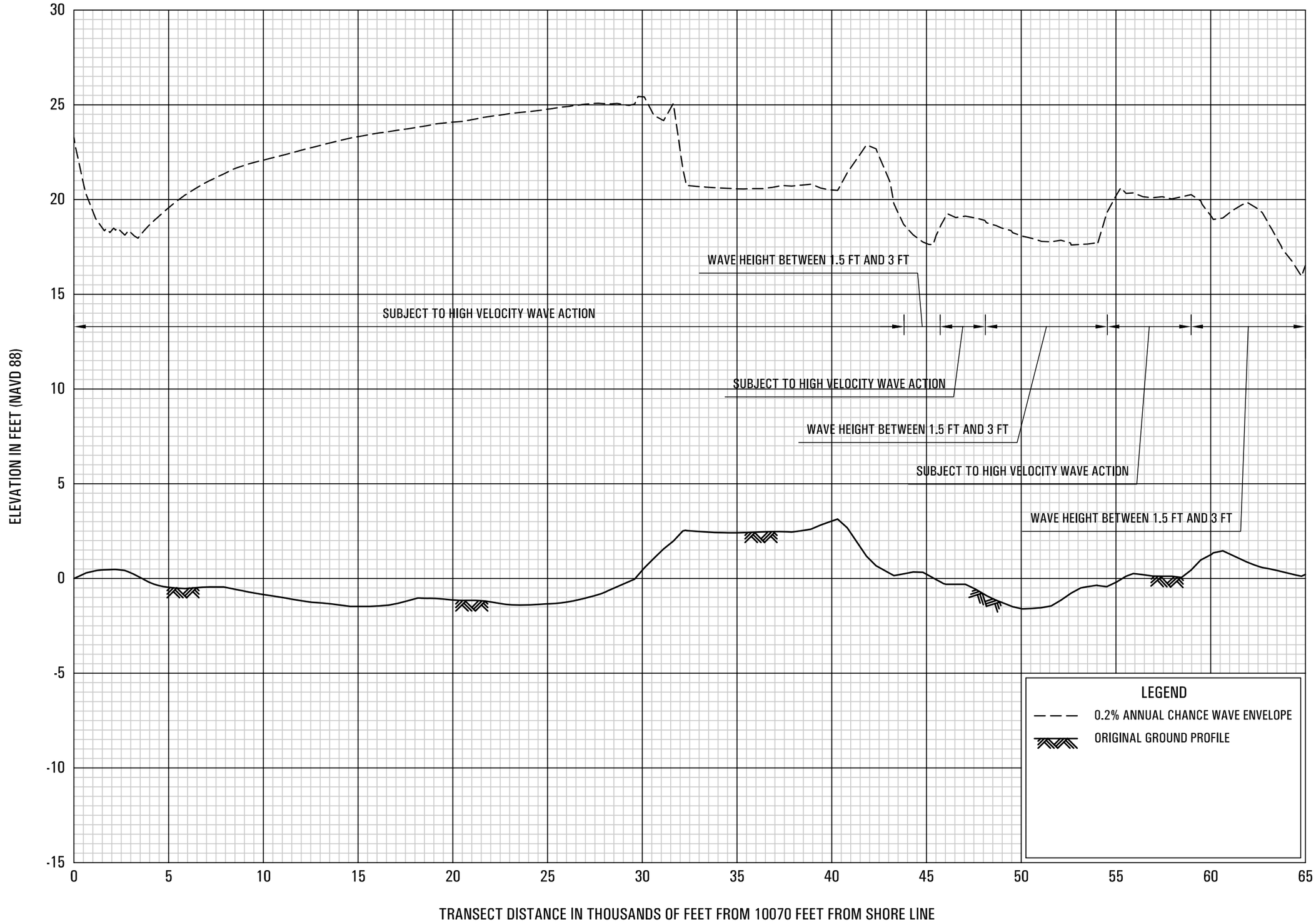
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



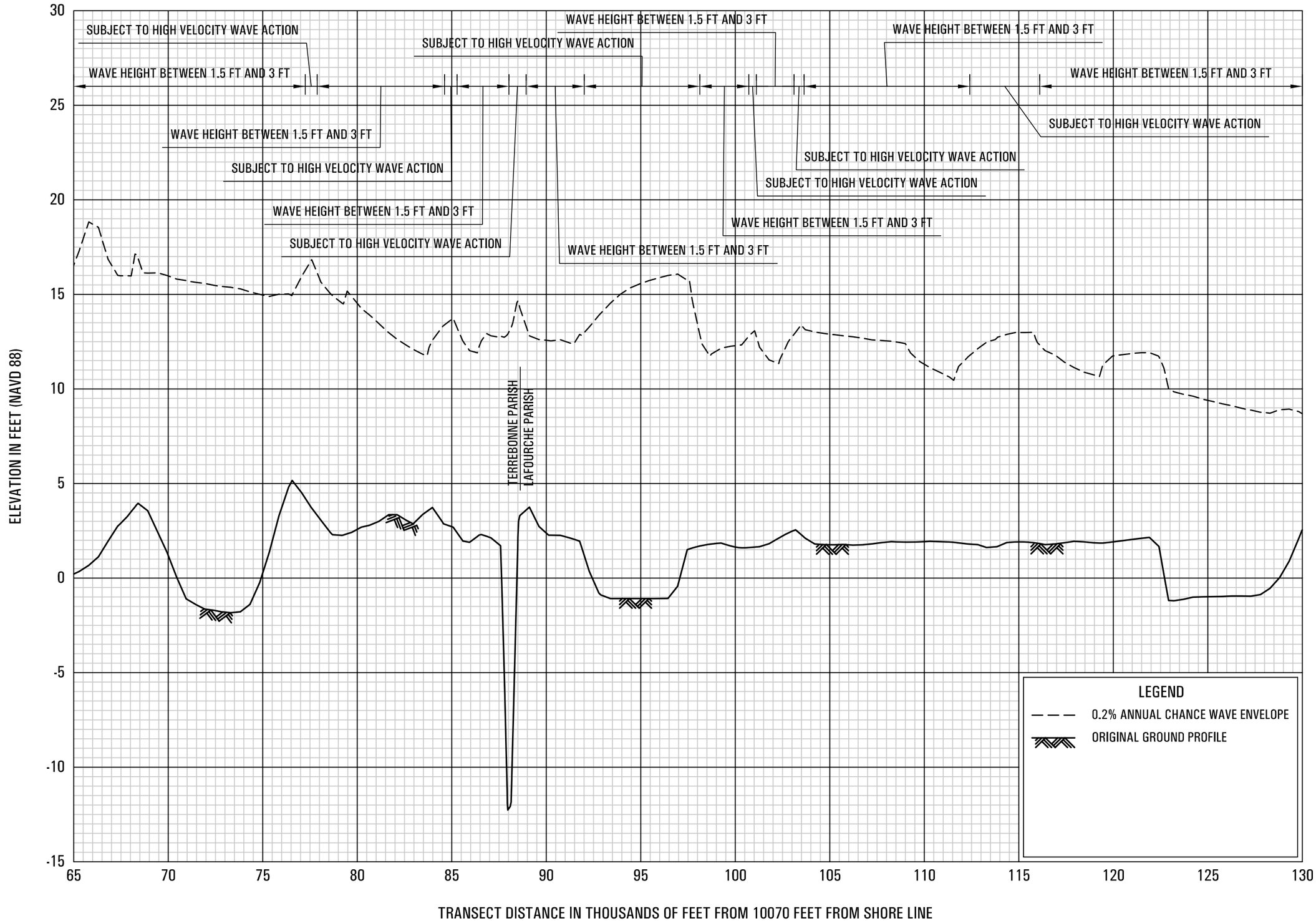
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

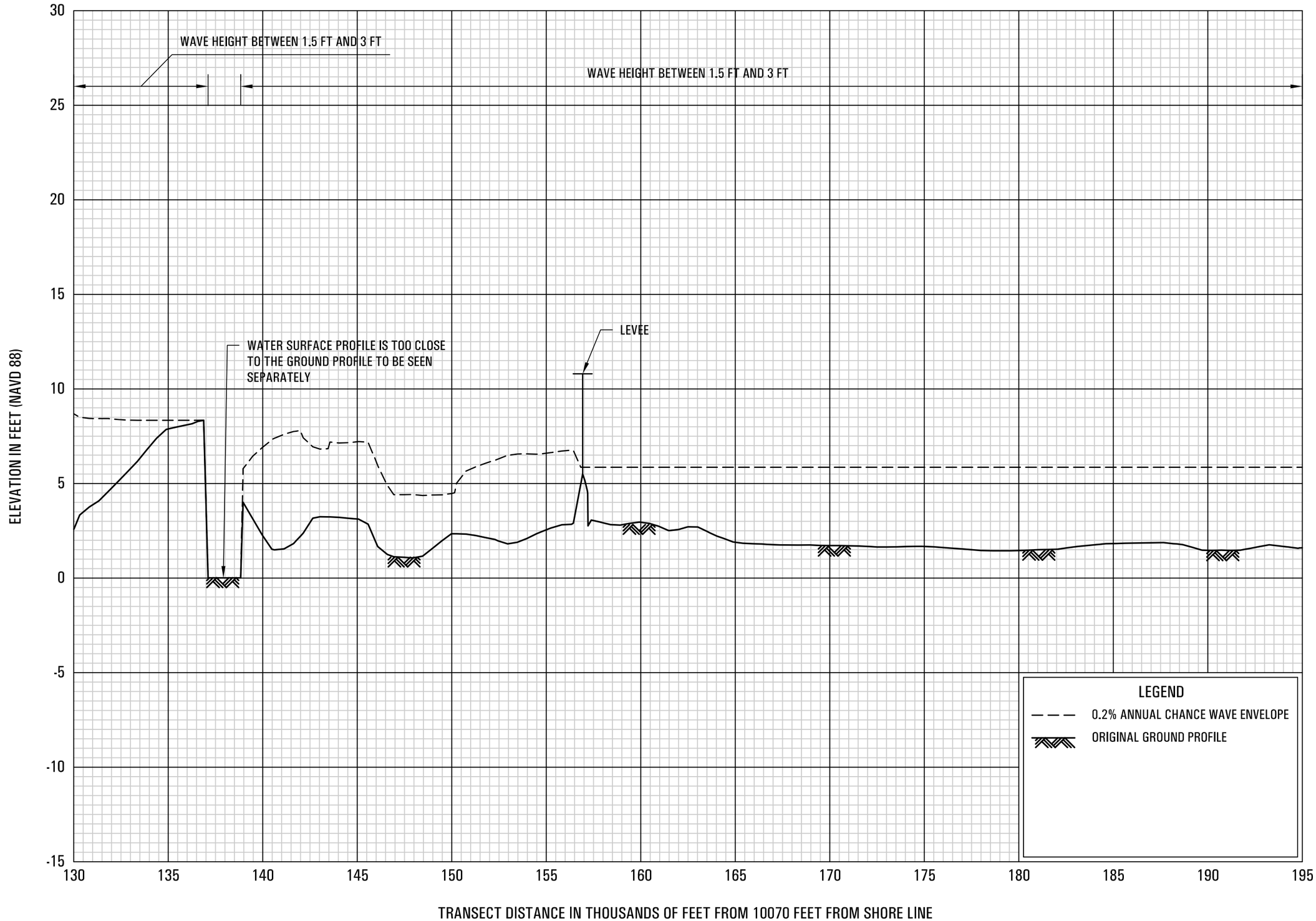
TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

53P



0.2% ANNUAL CHANCE WAVE ENVELOPE

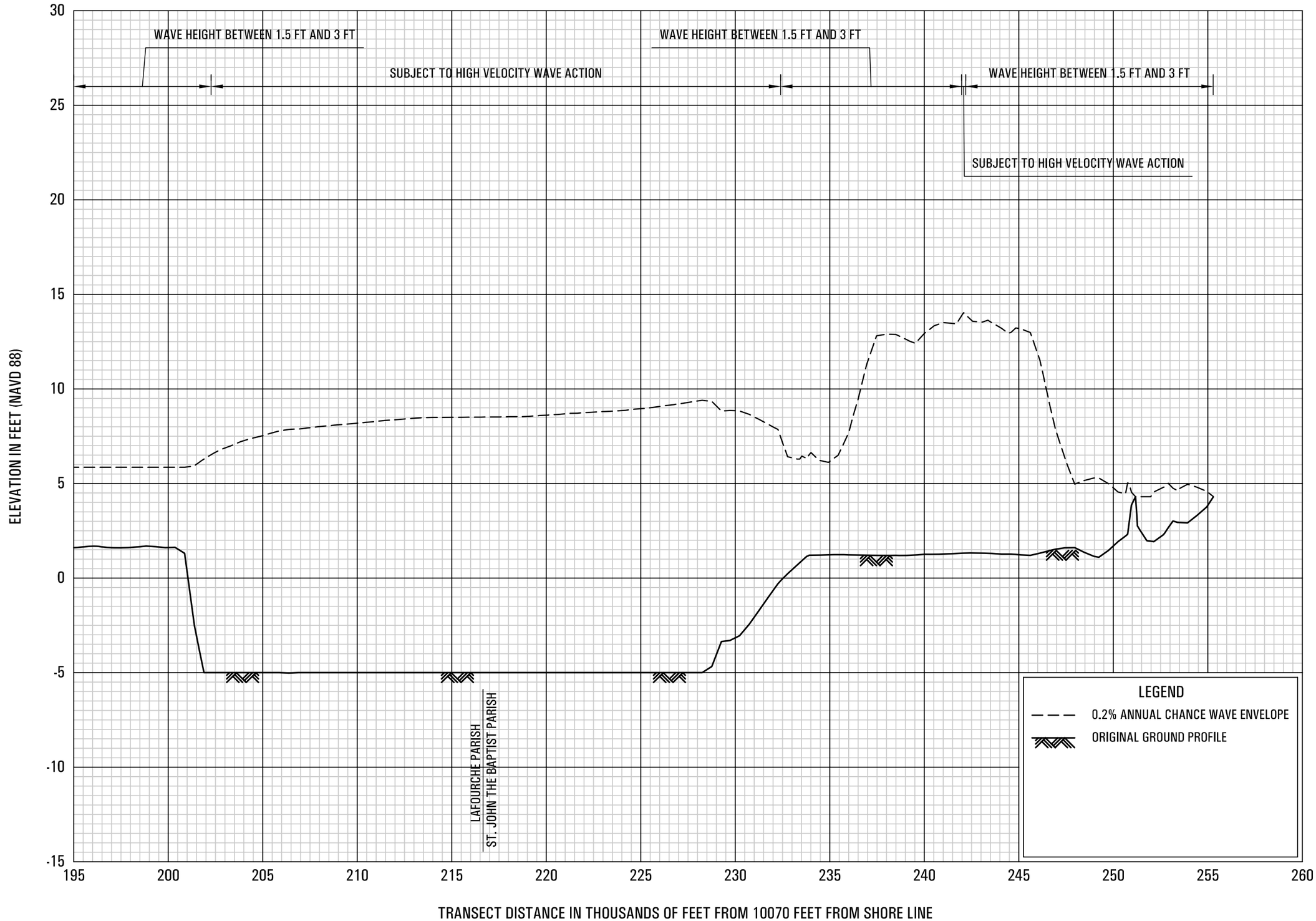
TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

54P



0.2% ANNUAL CHANCE WAVE ENVELOPE

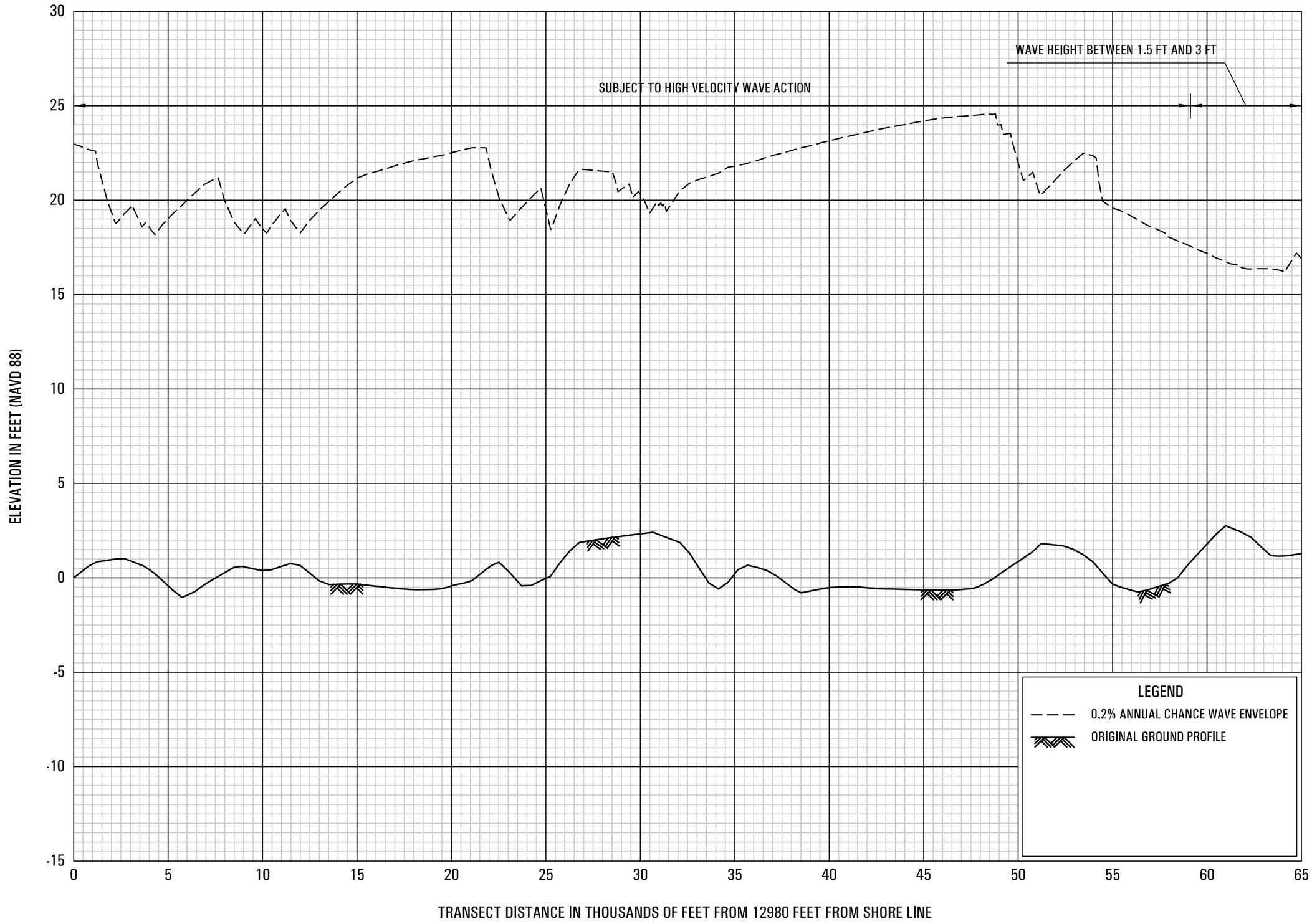
TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

55P



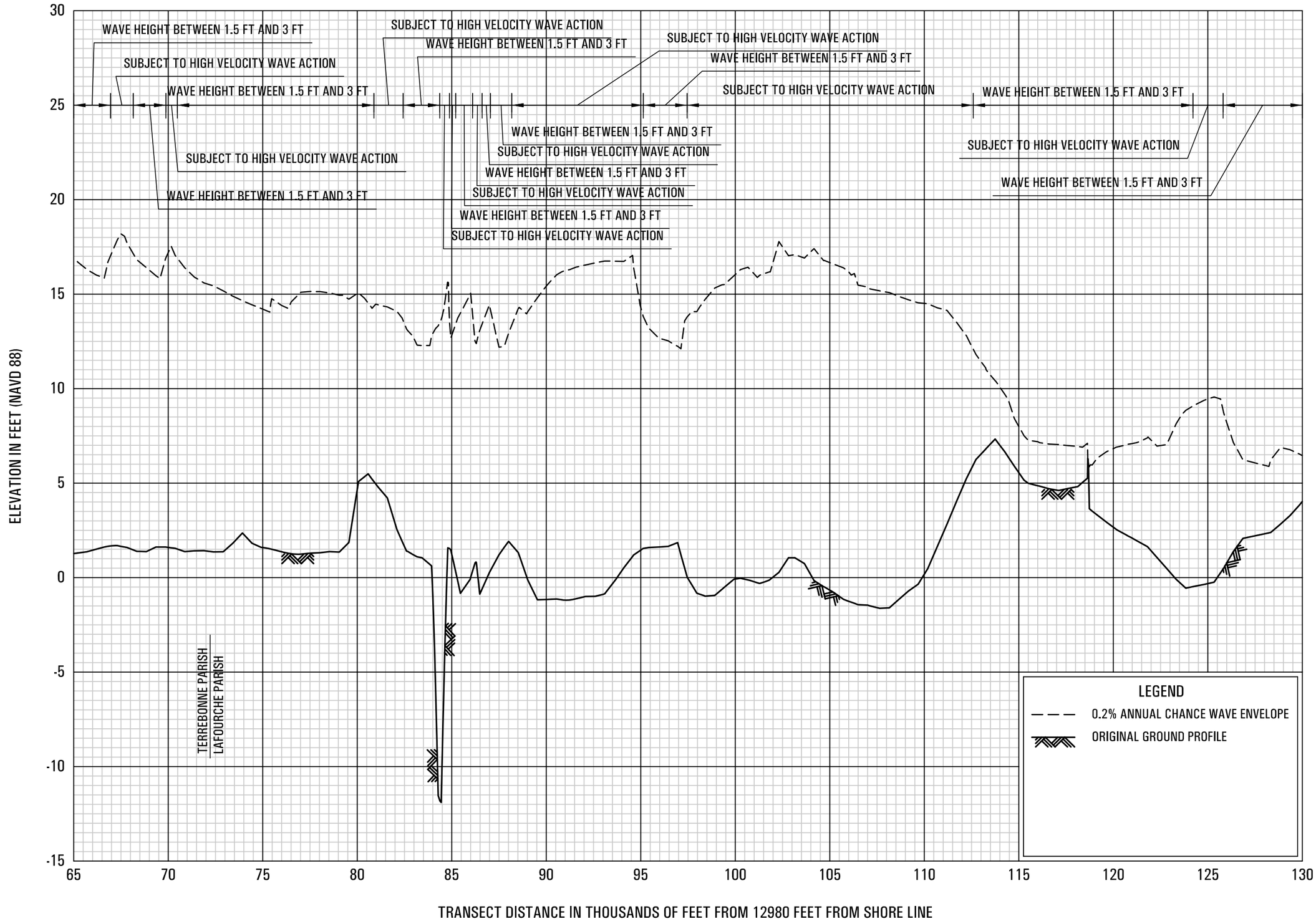
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



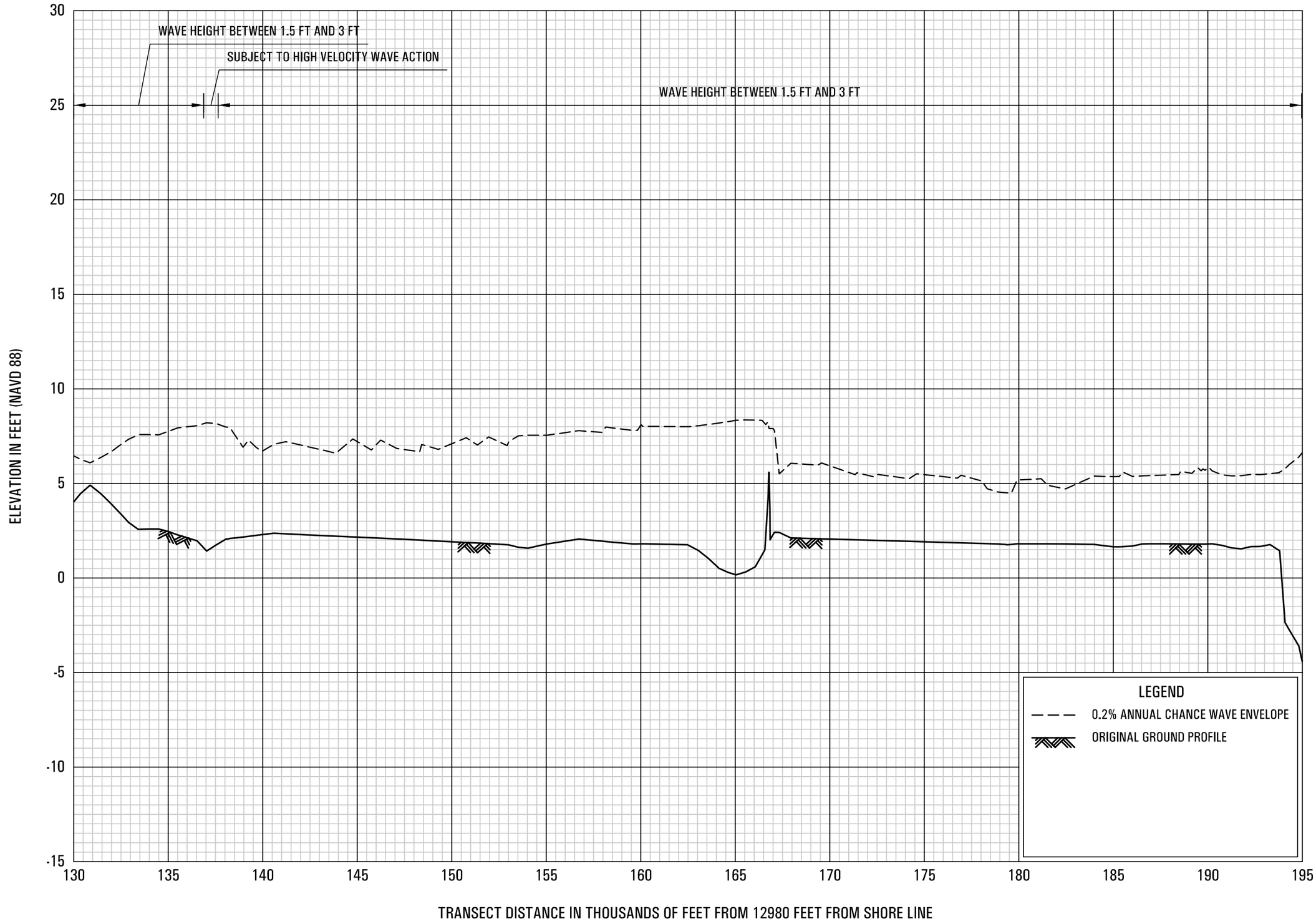
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

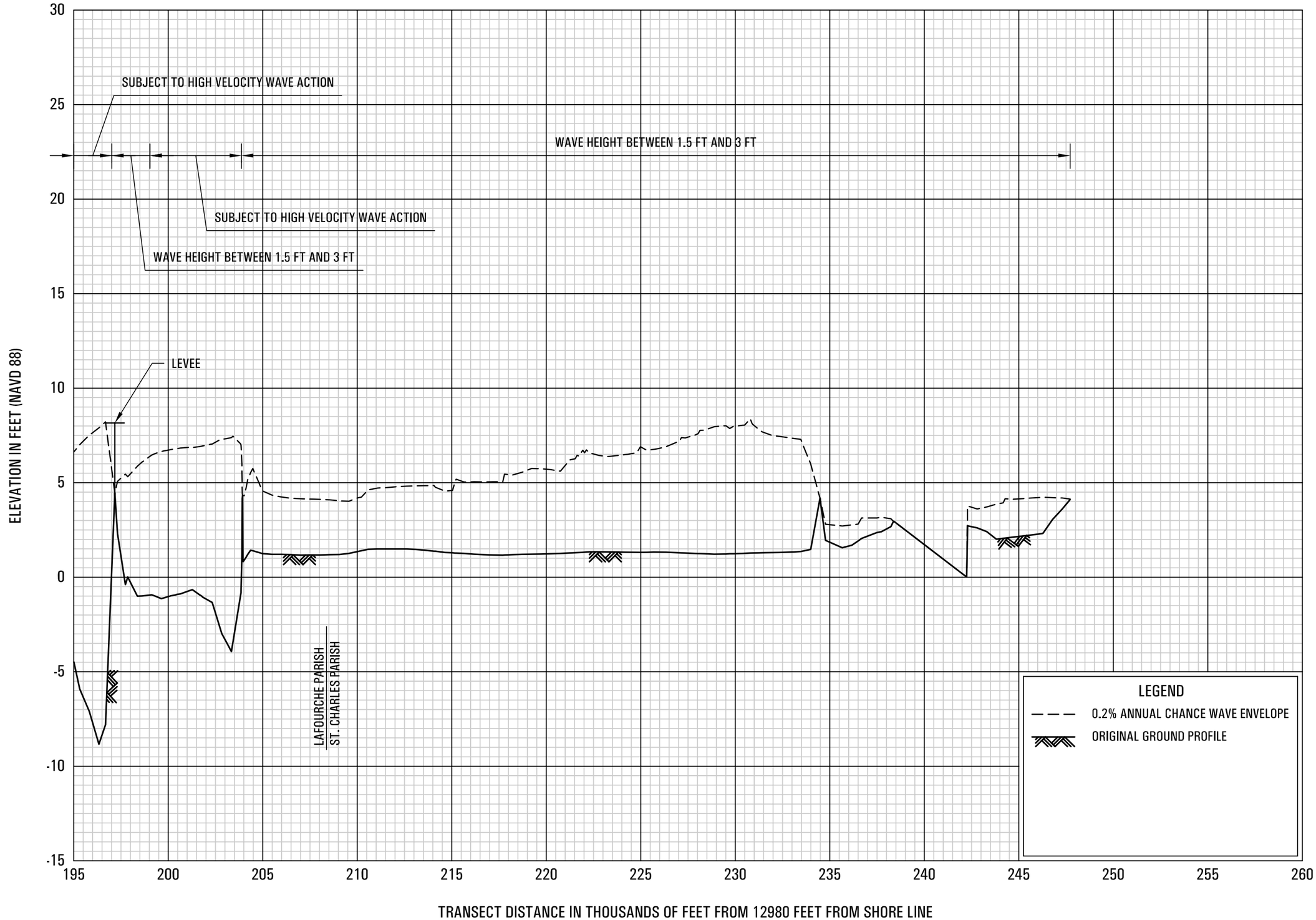
TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

58P



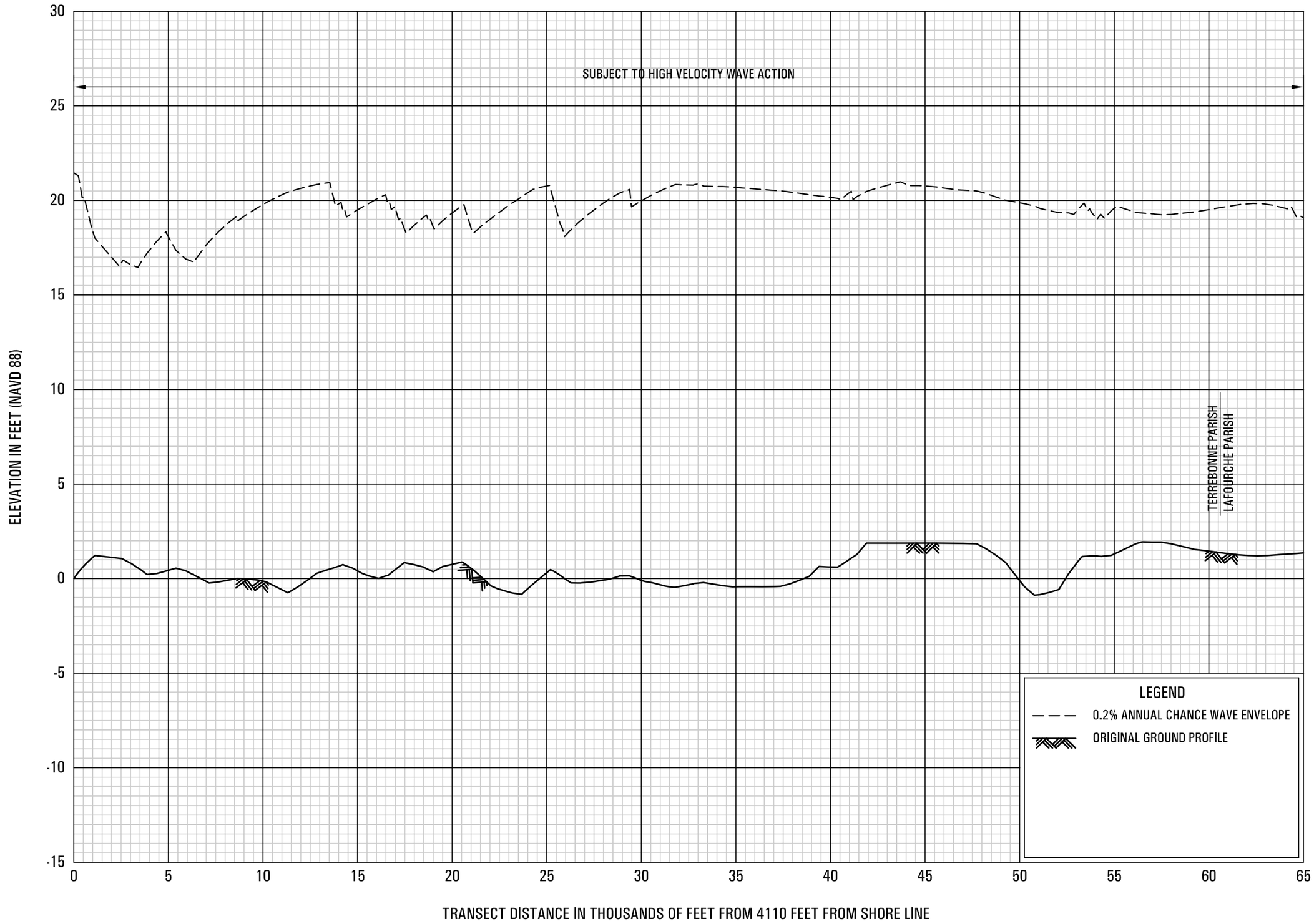
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

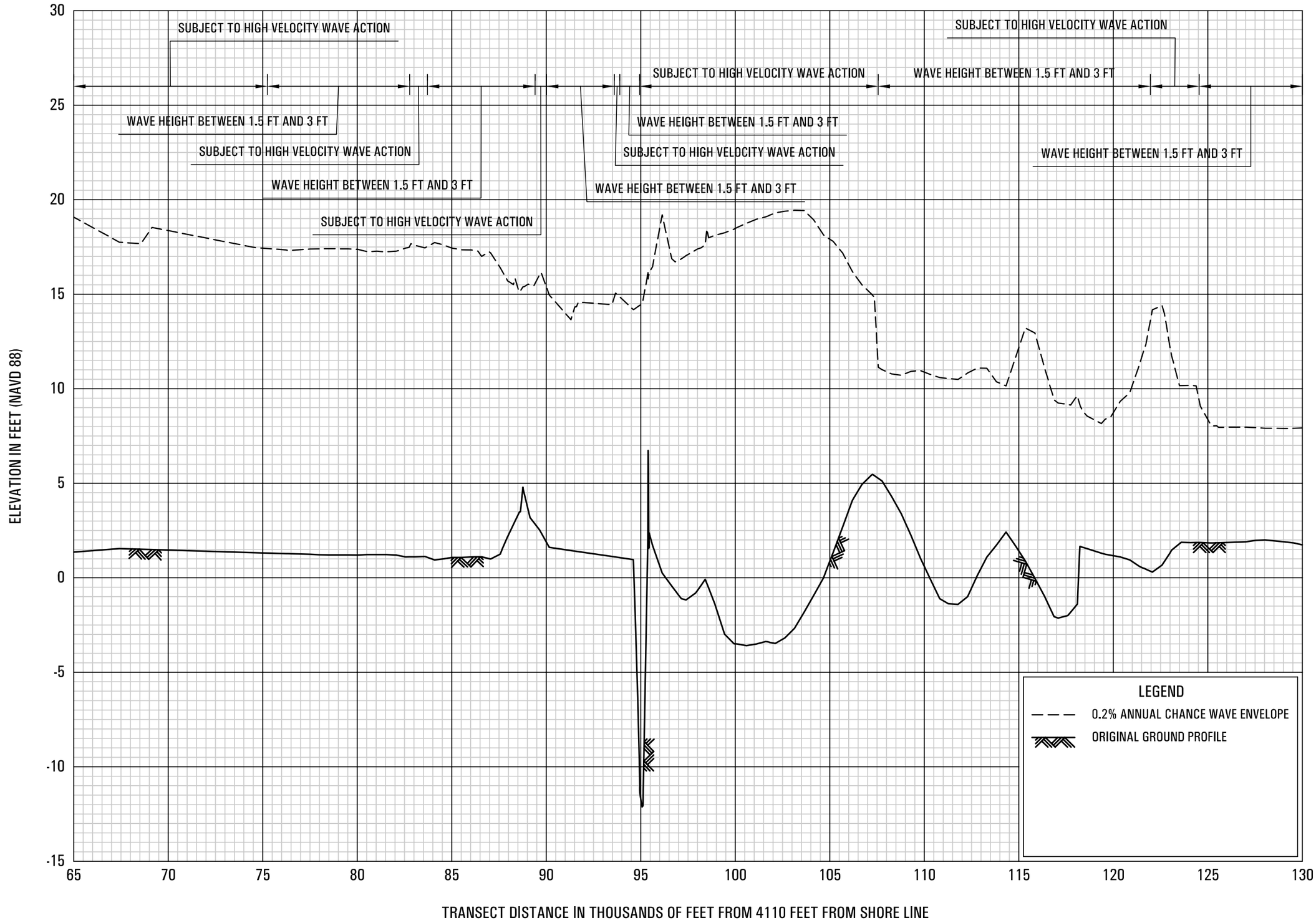
TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

60P



0.2% ANNUAL CHANCE WAVE ENVELOPE

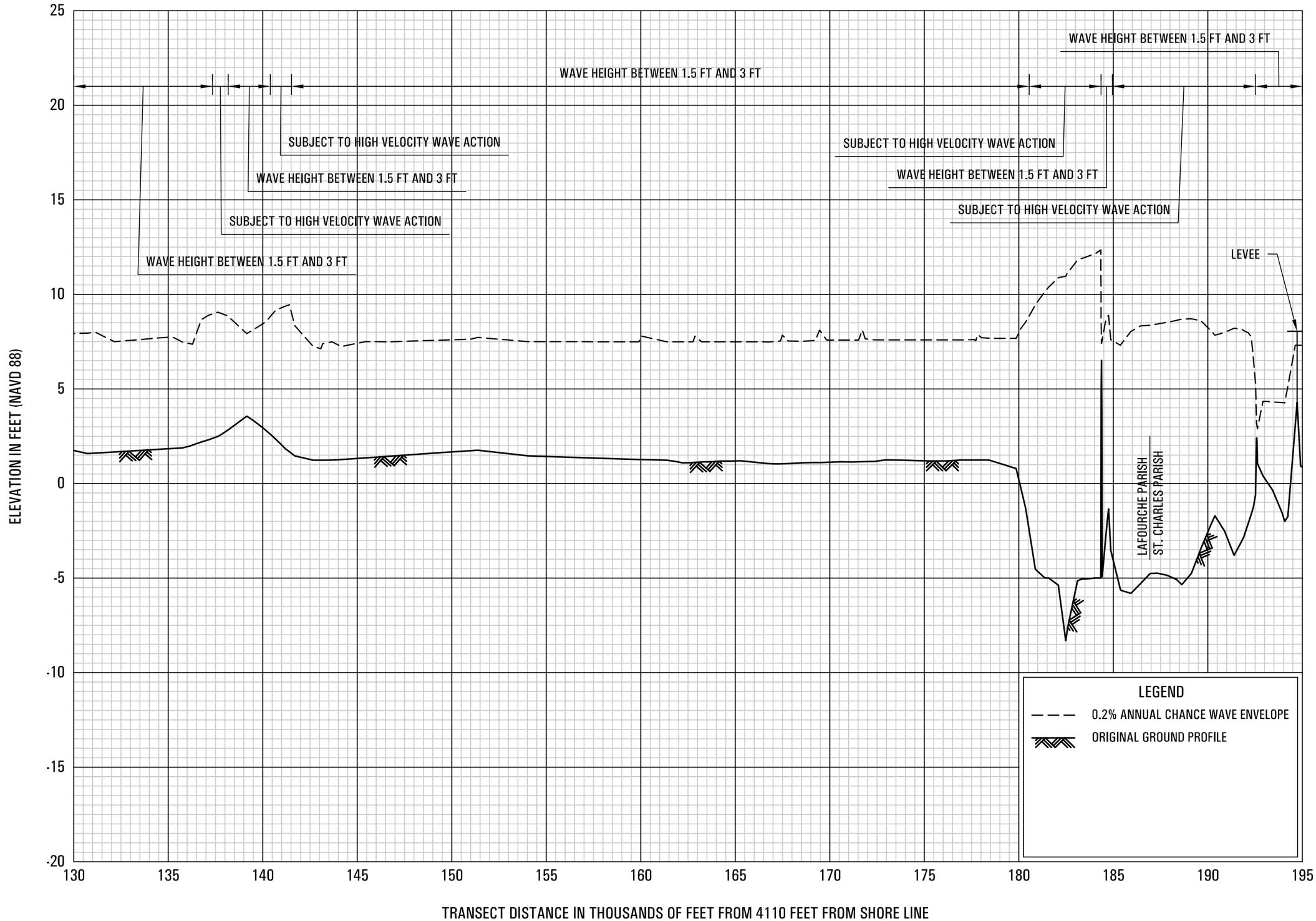
TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

61P



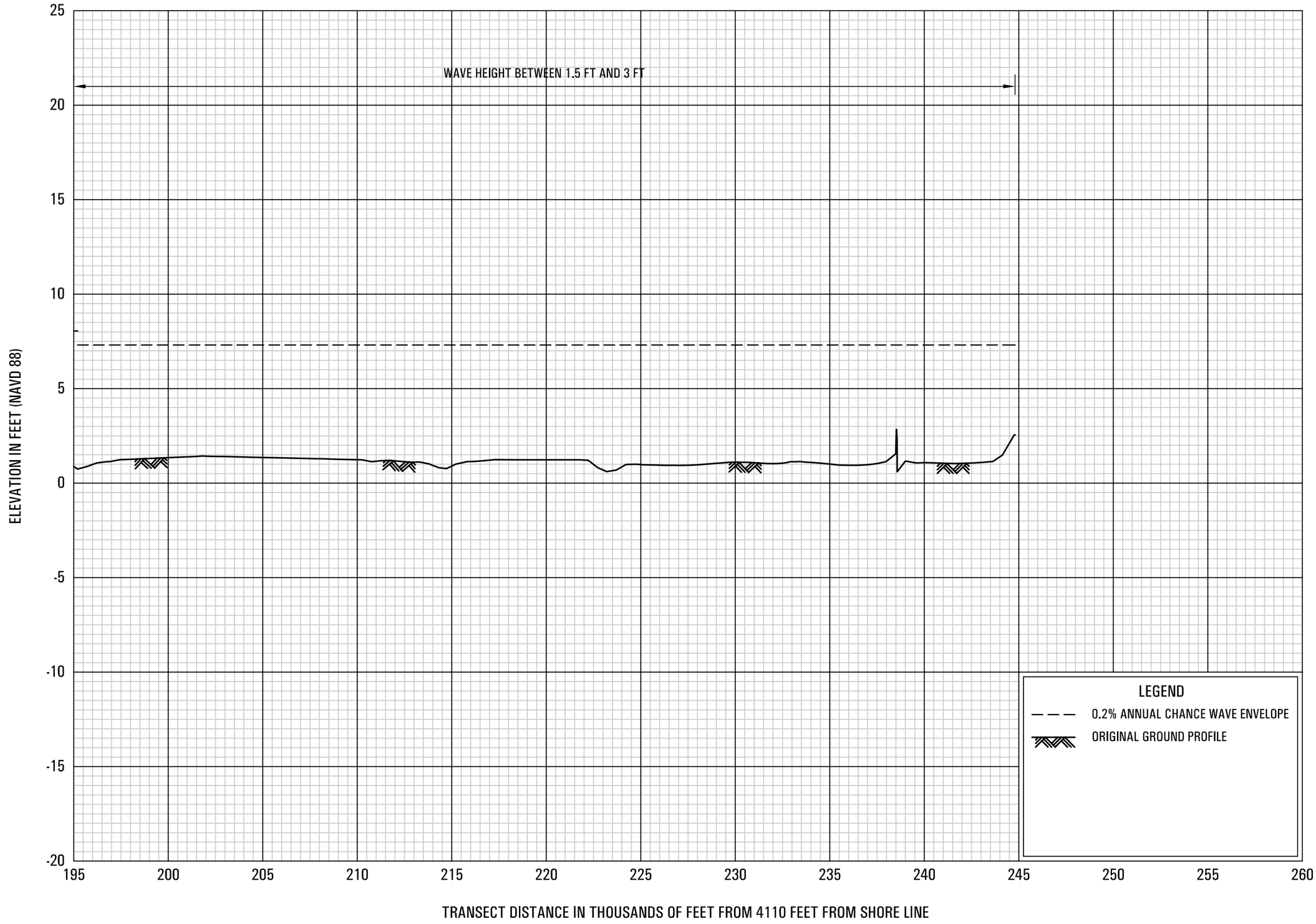
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

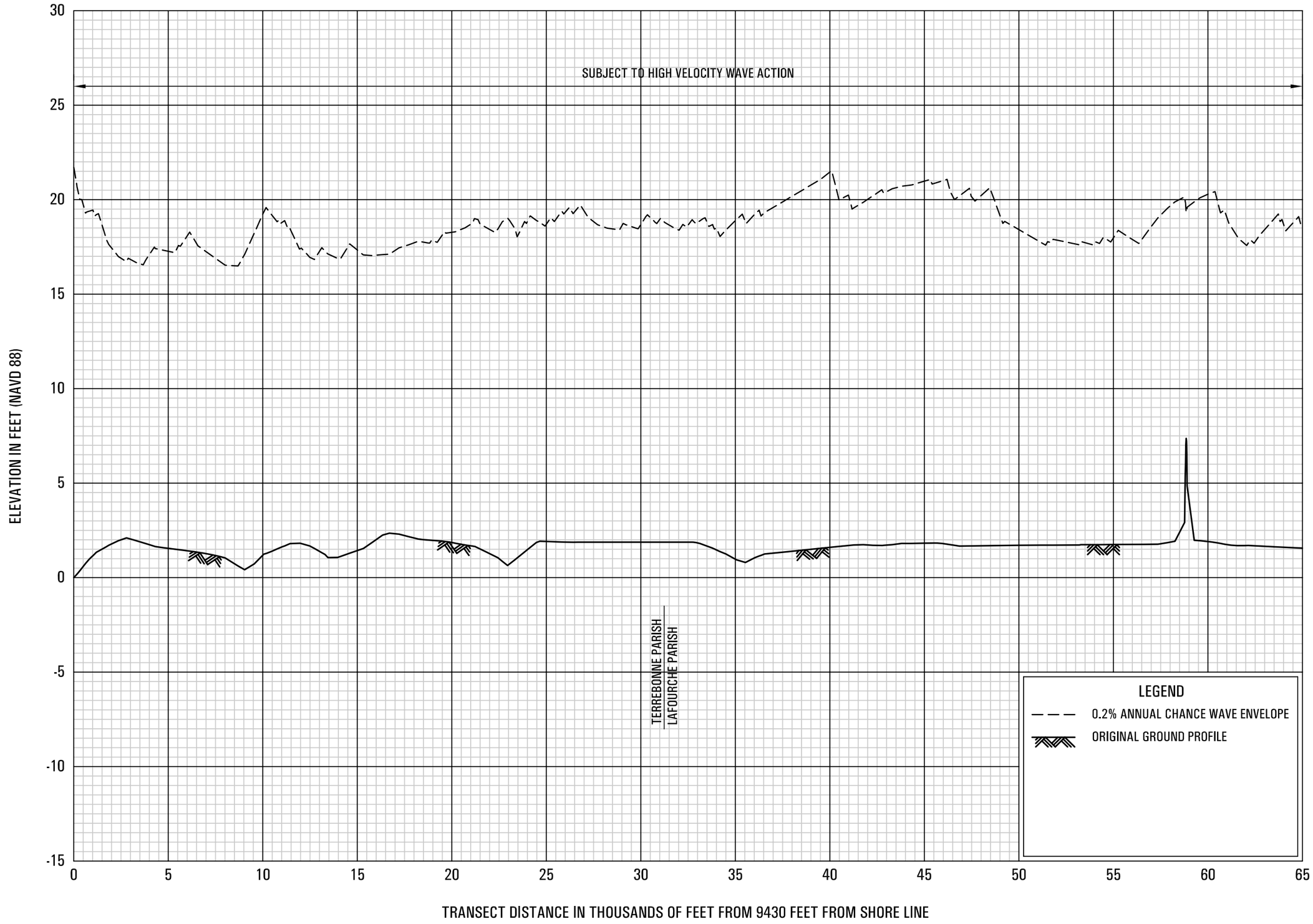
TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

63P



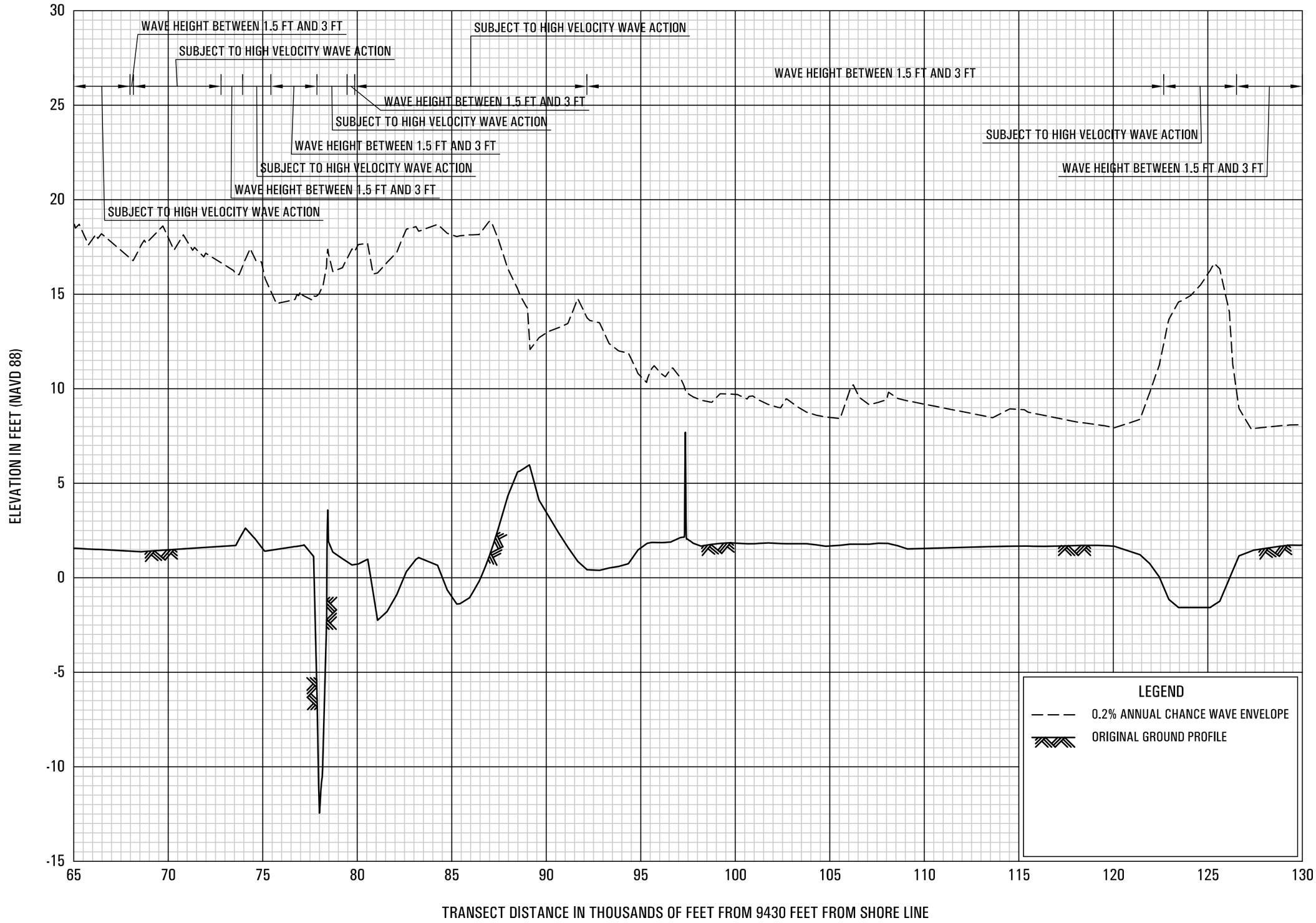
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

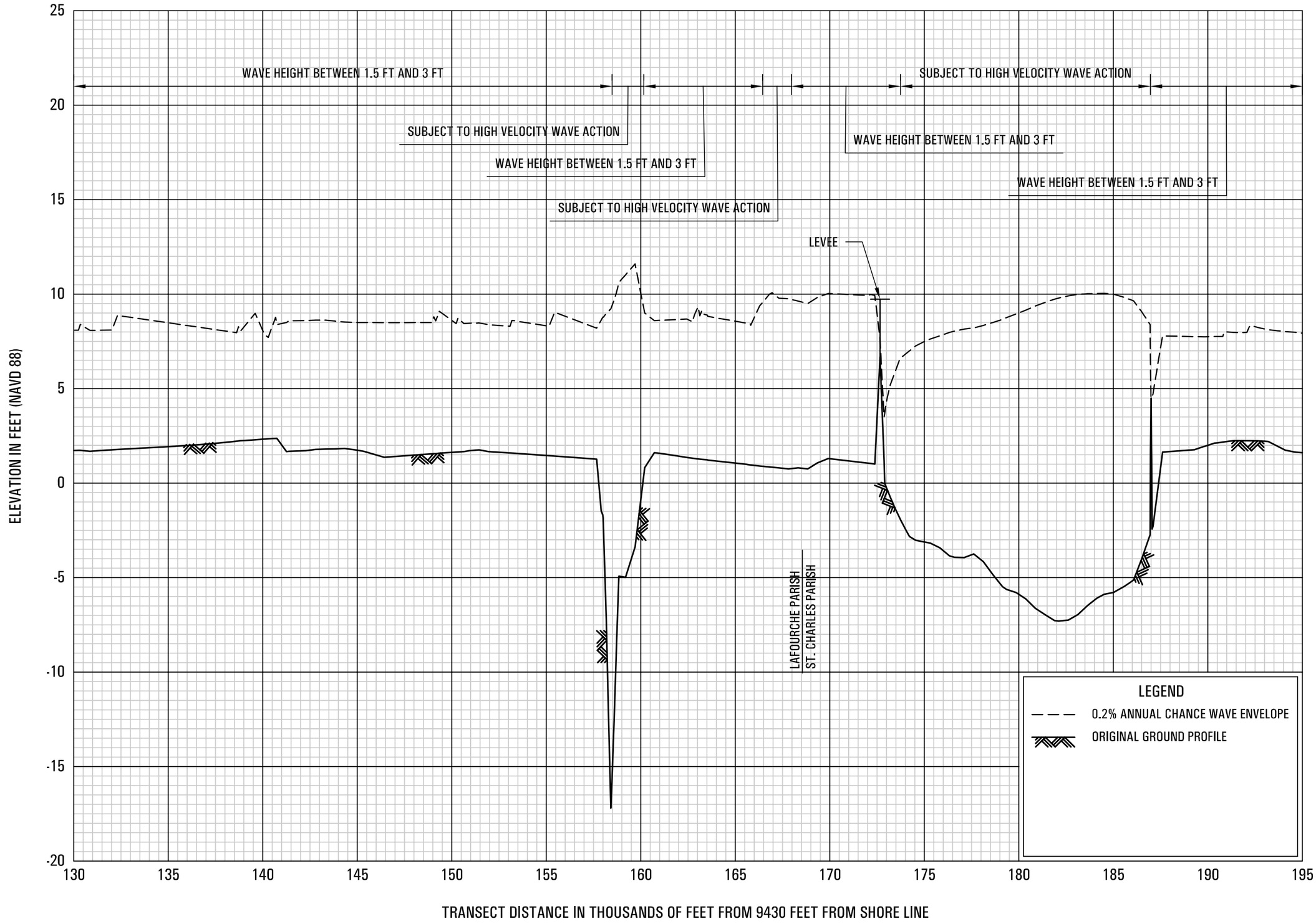
TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

65P



0.2% ANNUAL CHANCE WAVE ENVELOPE

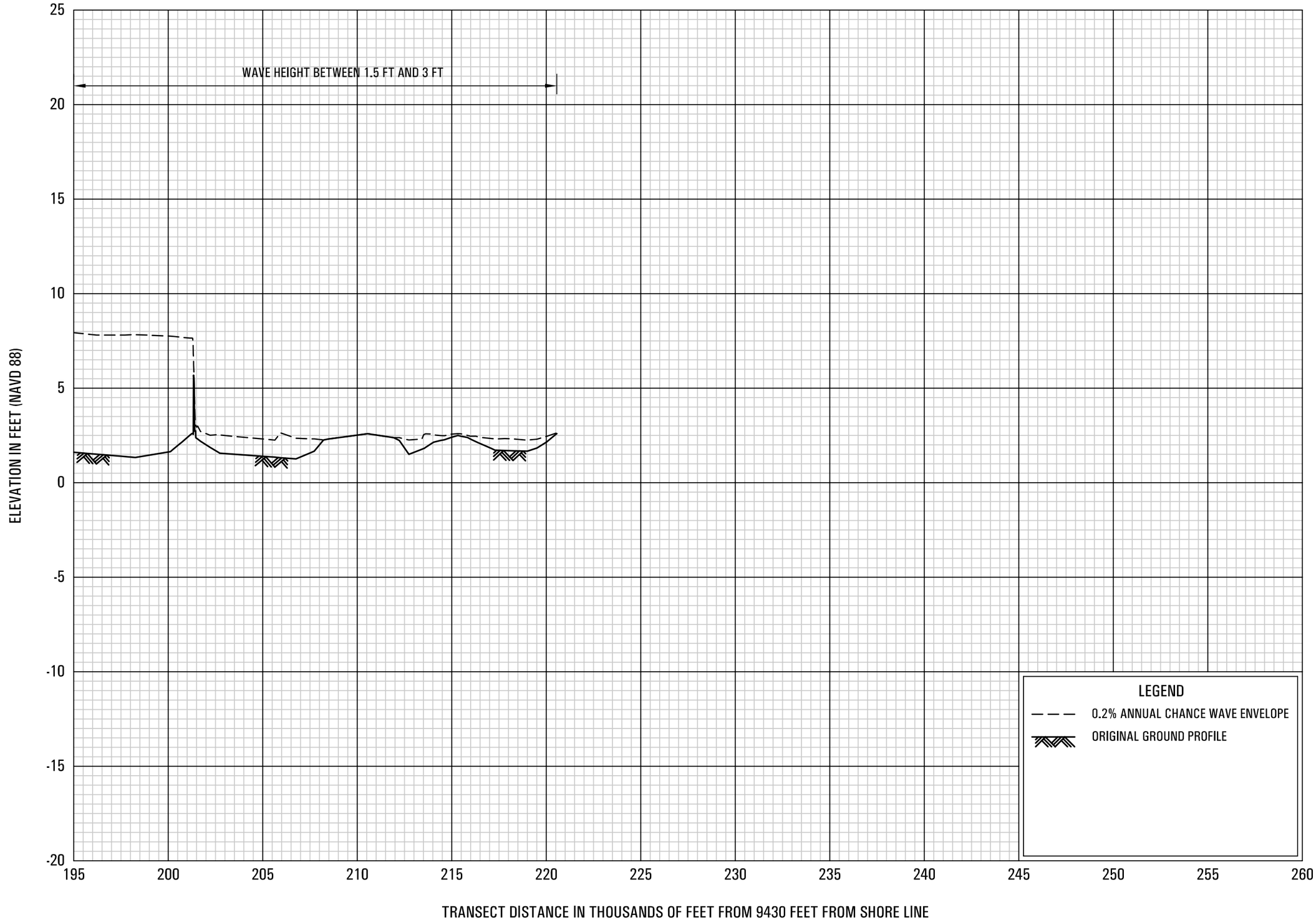
TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

66P



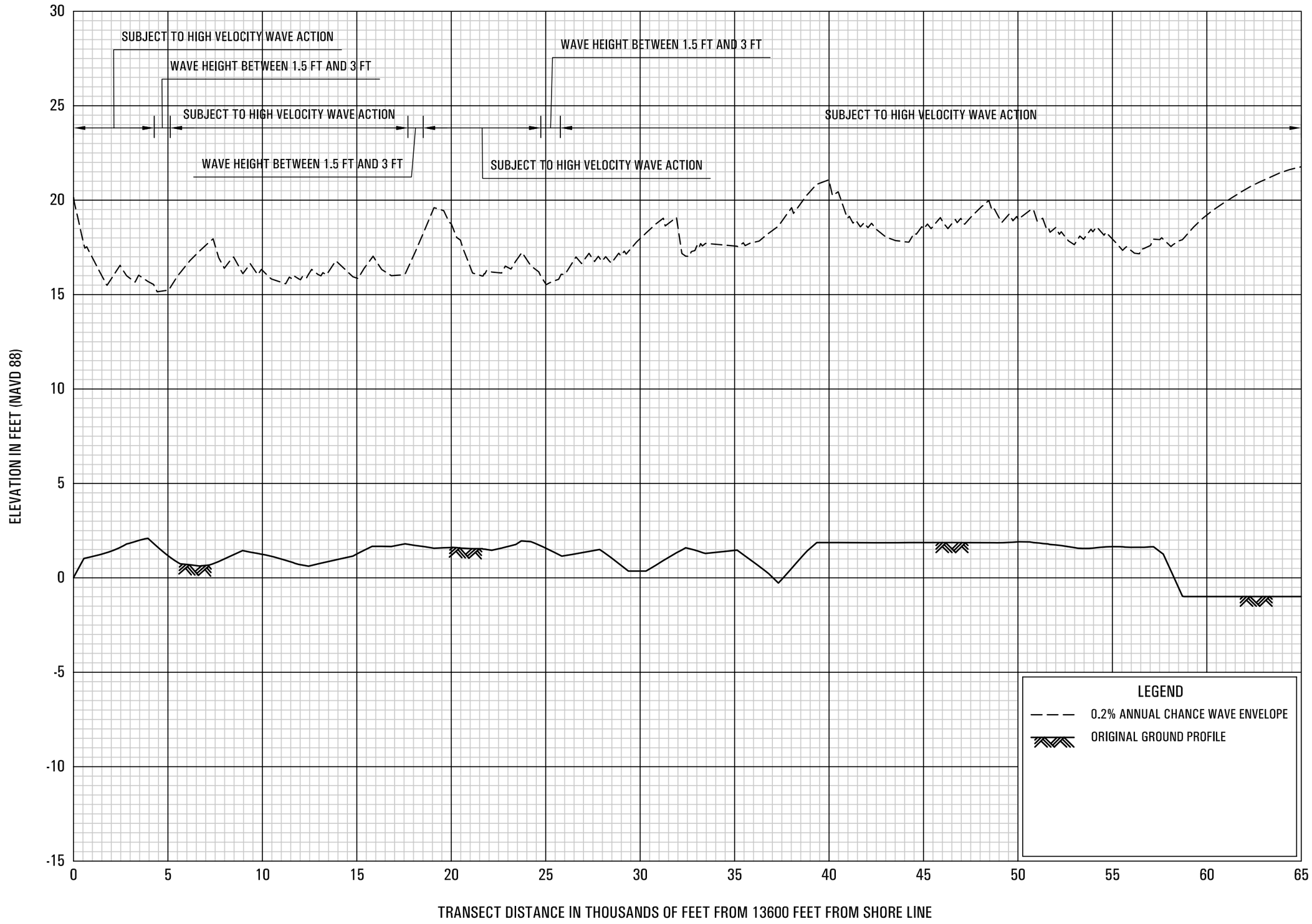
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

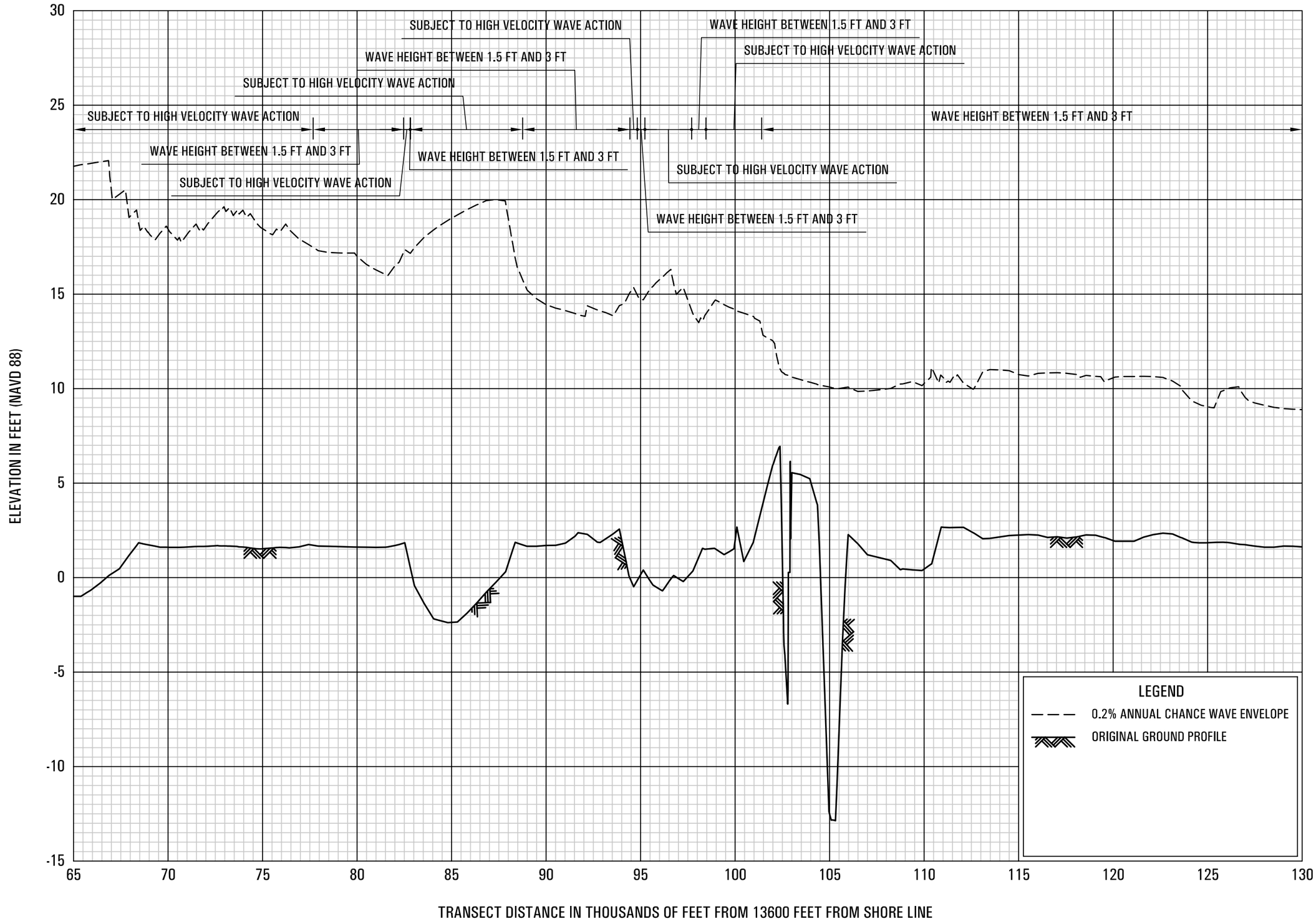
TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

68P



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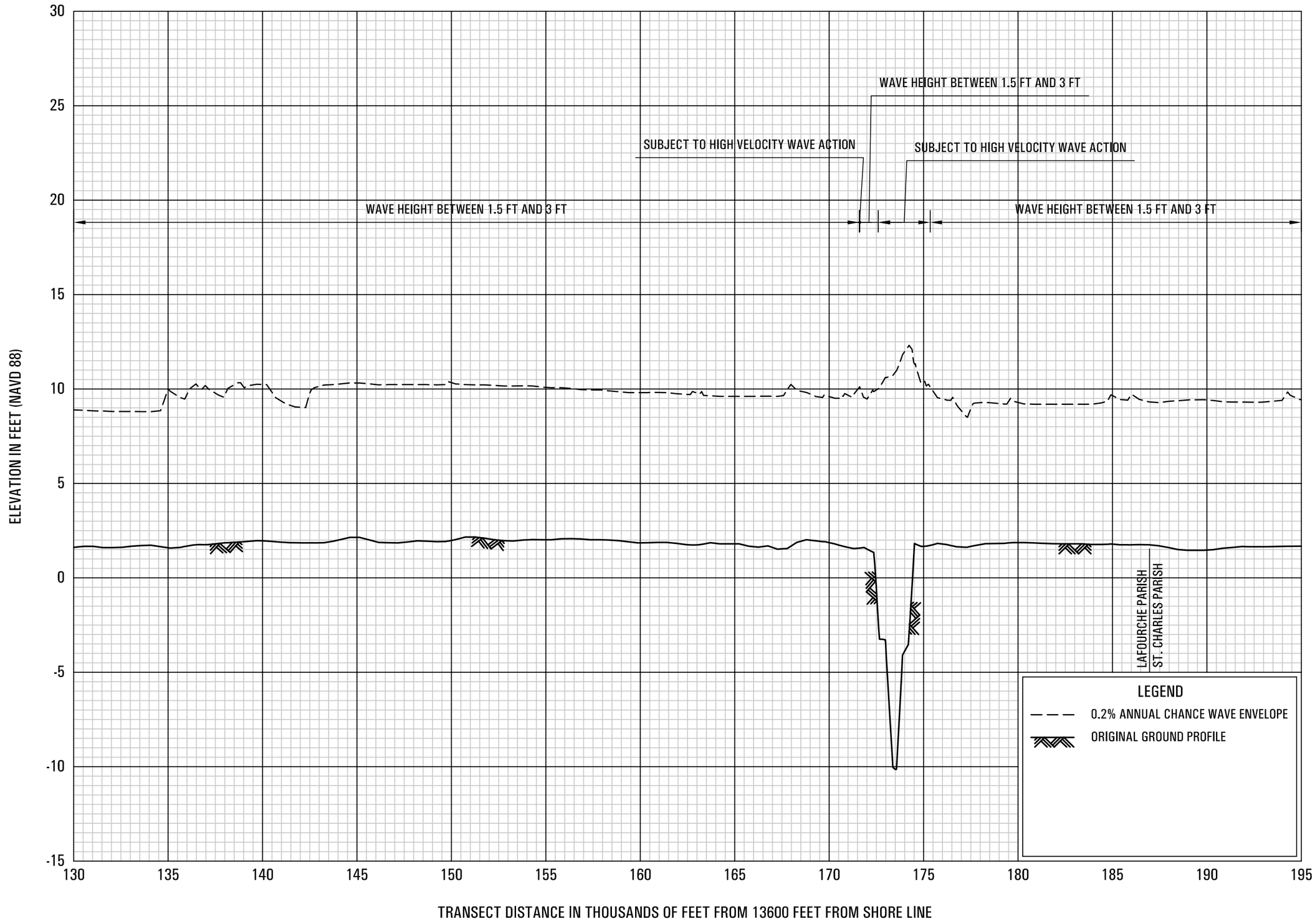
TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

69P



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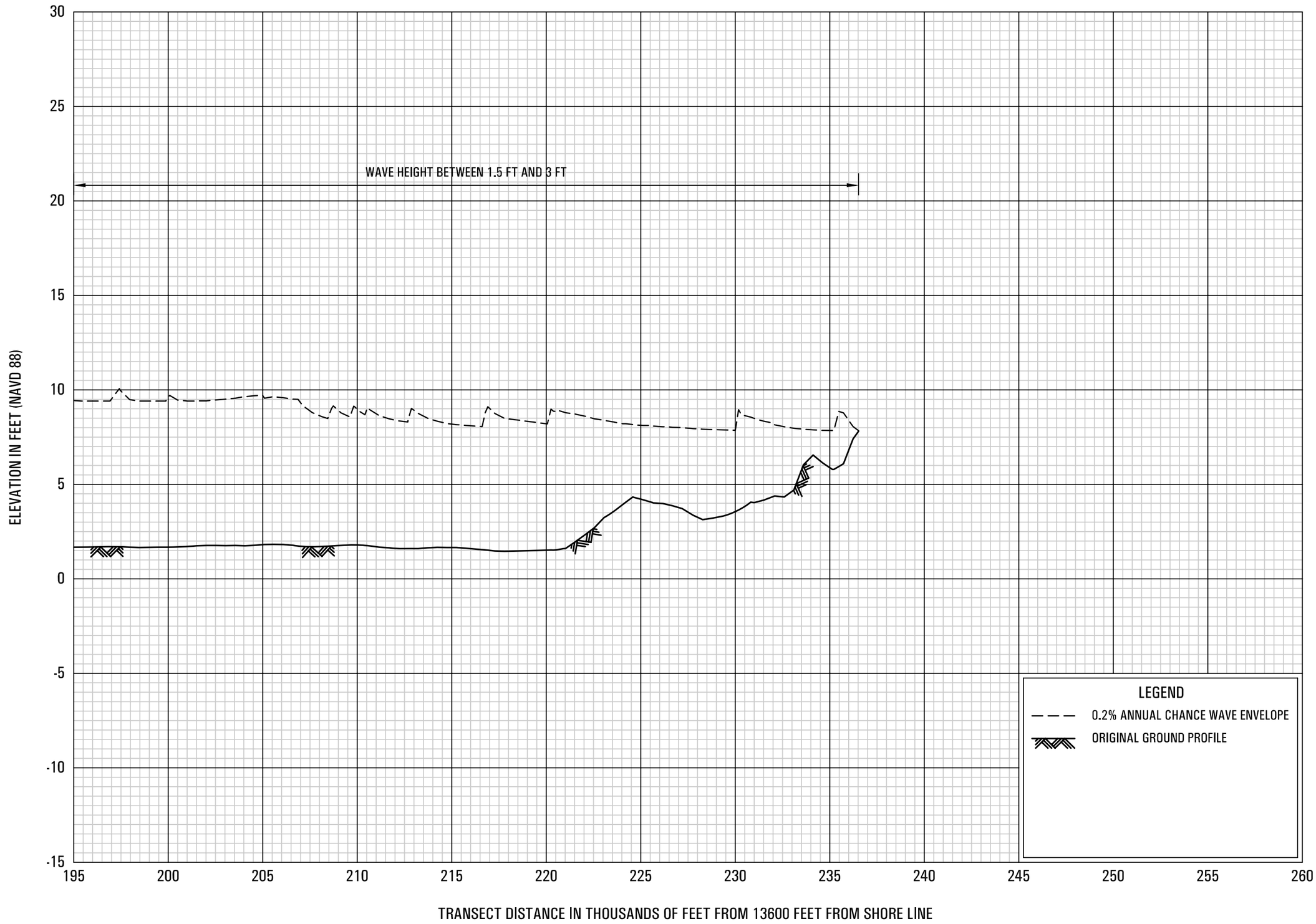
TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

70P



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TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

TERREBONNE PARISH, LA

AND INCORPORATED AREAS

71P