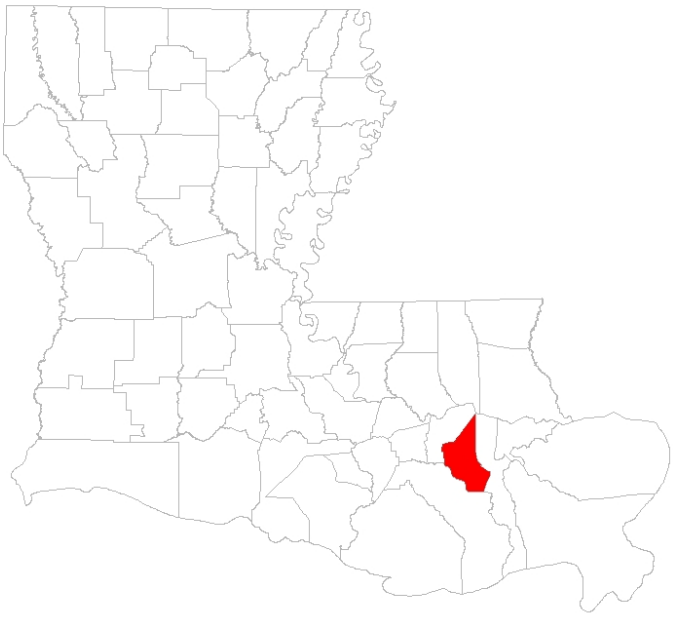
FLOOD INSURANCE STUDY

ST. CHARLES PARISH, LOUISIANA

UNINCORPORATED AREAS

Community Name	Community Number
ST. CHARLES PARISH UNINCORPORATED AREAS	220160



PRELIMINARY
Oct 30, 2008

Effective:

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
22055CV00B

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

Selected Flood Insurance Rate Map (FIRM) panels for the community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map 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

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

Initial FIS Effective Date: FIS report - November 2, 1982 /
Flood Insurance Rate Map - May 2, 1983

First Revision FIS Date: June 16, 1992

Second Revision Date: <To Be Determined>

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Transect 12	Panels	12P
Transect 13	Panels	13P
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FLOOD INSURANCE STUDY
ST. CHARLES PARISH, LOUISIANA UNINCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises previous FIS/Flood Insurance Rate Maps (FIRMs), for the geographic areas of St. Charles Parish, Louisiana unincorporated areas (hereinafter referred to collectively as St. Charles Parish). This FIS aids in the administration of the national Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates. This information will also be used by St. Charles Parish to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 DFR, 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 are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The original hydrologic and hydraulic analyses for all revised flooding sources were prepared by the New Orleans District, U.S. Army Corps of Engineers (USACE), as a part of a contract with the USACE under Task Order HSFE06-05-X0012 for St. Charles Parish, Louisiana. This work was completed in March 2008.

1.3 Coordination

The initial Consultation Coordination Officer (CCO) meeting was held on August 10, 2005, and attended by representatives of FEMA, the communities, and the study contractors to explain the nature and purpose of Flood Insurance Studies and to identify the streams to be studied by detailed methods.

The result of the study were reviewed at the final CCO meeting 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 St. Charles Parish, Louisiana.

For the portions of the parish north of the Mississippi River, the USACE has completed the detailed study which includes internal drainage ditches, Labranche wetland, and Lake Pontchartrain.

For the portions of the parish south of the Mississippi River, the USACE has completed a detailed study for portion of the Louisiana parishes of St. Charles, Jefferson, Orleans, and Plaquemines. This entire study is called the Donaldsonville To The Gulf Feasibility Study (D2G EAST, Reference 1). This specific St. Charles study area was taken from that study. The flooding sources studied by detailed methods are shown in Table 1.

Coastal flooding from the Gulf of Mexico affecting Lake Cataouatche, Lake Salvador, Lake des Allemands and the adjacent land areas was also studied by detailed methods.

The Mississippi River within St. Charles Parish was redelineated from the previous study.

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.

TABLE 1 - SCOPE OF STUDY

New Detailed Study Streams and Lakes

Almedia Canal	Labranche Wetland Ditch	Turtle Canal
Bar None Ditch	Lake Pontchartrain Ditch	Lake des Allemands
Bayou Perot	Motiva Canal	Lower Labranche
Des Plant Canal	New Sarpy Canal	Lake Pontchartrain
Destrehan East Canal	Norco Canal	Lake Cataouatche
Destrehan West Canal	Ormond Canal	Lake Salvador
Diane Place Canal	Plant Business Center Canal	Lower Labranche
IMTT Canal	St. Rose Canal	Wetland

Redelineated Study Stream Mississippi River

2.2 Community Description

St. Charles Parish is located in southeast Louisiana, approximately 10 miles west of the City of New Orleans. The parish is bounded by Lake Pontchartrain on the north, Lake Cataouatche and Jefferson Parish on the east, St. John the Baptist and Lafourche Parishes on the west, and Lake Salvador on the south.

The parish covers approximately 410.2 square miles, of which 283.6 square miles is land and 126.6 square miles is water. The parish is divided into north and south by the Mississippi River. The lakes and river, combined with the small bayous and canals flowing into them, provide good drainage for the parish. The major waterways in the southern part of the parish are Ellington, Cousin, and Boulin Canals: and Bayous Gauche and des Allemands. The major northern waterways are Bayous Traverse and Labranche.

The population in the year 2000 was reported to be 48,072 by the U.S. Bureau of the Census (Reference 2). The normal annual precipitation averages 54–58 inches (Reference 3). The climate of the area is subtropical and is strongly influenced by the Gulf of Mexico. Extremes of temperature are seldom experienced and the average temperatures range from an average high of 82.7 degrees Fahrenheit in July to an average low of 52.6 degrees in January (Reference 4).

2.3 Principal Flood Problems

The majority of St. Charles Parish consists of low elevation marsh-coastal areas of approximately 2 to 3 feet North American Vertical Datum (NAVD). The profile or ground elevation slopes gradually to higher ground, 10 to 20 feet NAVD, which was created by historical Mississippi River overflows. Flooding from high stages in the Mississippi River does not now occur due to protection by main line levees constructed by the USACE. Most of the developed areas are located along the higher elevations.

The area is subject to tidal flooding created by winter storm fronts, tropical storms, and hurricanes. The sources of flooding are Lake Pontchartrain to the north, Lake Salvador to the south, and Lake Cataouatche to the southeast. Wave action near the shoreline is significant. Significant wave action further inland near developed areas is not a factor due to the dampening effects of the vegetation, roads, and railroad tracks.

In areas protected by levee systems, pumping stations are sometimes inadequate to handle intense rainfalls and flooding when ponding occurs (Reference 5). Representative flood stages at selected recording gages are summarized in the following tabulations (Reference 6):

Gage: Lake Pontchartrain at Frenier
Period of Record: 1932 – Present
(East Bank of the Mississippi River)

Date/Event	Stage
September 1915/Unnamed Hurricane	12.50 feet NGVD
September 1965/Hurricane Betsy	12.09 feet NGVD
October 1985/Hurricane Juan	7.50 feet NGVD
September 1956/Hurricane Flossy	6.80 feet NGVD

Note: The average annual high water stage in Lake Pontchartrain is approximately 4.0 feet NGVD.

Gage: Lake Pontchartrain at West End
Period of Record: 1932 – Present
(East Bank of the Mississippi River)

Date/Event	Stage
October 1985/Hurricane Juan	6.00 feet NGVD
September 1947/Fort Lauderdale Hurricane	5.46 feet NGVD
September 1965/Hurricane Betsy	5.37 feet NGVD

Note: High water marks during Hurricane Juan in October 1985 were surveyed in March 1987. The highest recorded stage in the New Sarpy developed area between U.S. 61 and the Mississippi River levees was 6.6 feet NGVD.

Gage: des Allemands
Period of Record: 1950 – Present
(West Bank of the Mississippi River)

Date/Event	Stage
October 1985/Hurricane Juan	3.90 feet NGVD
April 1973/Spring Storm	3.74 feet NGVD
April 1980/ Spring Storm	3.45 feet NGVD
September 1977/Hurricane Babe	3.12 feet NGVD

Gage: Bayou Barataria
Period of Record: 1952 – Present
(West Bank of the Mississippi River)

Date/Event	Stage
October 1985/Hurricane Juan	4.25 feet NGVD
September 1977/Hurricane Babe	3.87 feet NGVD
April 1980/ Spring Storm	3.82 feet NGVD
October 1964/Hurricane Hilda	3.60 feet NGVD
April 1973/ Spring Storm	3.51 feet NGVD

Gage: Harvey Lock IWW
Period of Record: 1925 – Present
(West Bank of the Mississippi River)

Date/Event	Stage
October 1985/Hurricane Juan	4.51 feet NGVD
April 1973/ Spring Storm	4.21 feet NGVD
October 1964/Hurricane Hilda	3.63 feet NGVD
September 1961/Hurricane Carla	3.57 feet NGVD
September 1977/ Hurricane Babe	3.51 feet NGVD

Gage: Bayou Chevreuil Near Chegby, Louisiana
Period of Record: 1952 – Present
(West Bank of the Mississippi River)

Date/Event	Stage
April 1980/ Spring Storm	4.35 feet NGVD
April 1973/ Spring Storm	4.20 feet NGVD
February 1966/ Spring Storm	4.00 feet NGVD
October 1985/Hurricane Juan	3.86 feet NGVD
June 1975 / Tropical Storm	3.70 feet NGVD

2.4 Flood Protection Measures

The St. Charles Parish Department of Public Works and the Sunset Drainage District have installed numerous pumping stations and built many miles of levees to prevent tidal surges from flooding developed areas. Most of the levees in the area do not provide 1-percent-annual-chance flood protection, due to inadequate pumping capacity or substandard levee construction (Reference 5).

The USACE has prepared a General Design Memorandum for providing protection on the East Bank of the Mississippi River. This report is entitled "Lake Pontchartrain and Vicinity Hurricane Protection – St. Charles Parish, North of Airline Highway Alignment" (Reference 7). The improvement consists of a levee construction north and generally parallel to Airline Highway from the Bonnet Carre Spillway on the west to the Jefferson Parish boundary on the east, plus associated interior drainage. This levee prevents Standard Project Hurricane (SPH) stages from flooding the developed area south of the levee towards the Mississippi River. The crest of the levee would vary between 12.8 feet NAVD and 14.7 feet NAVD. The levee system included culverts at 6 locations. The drainage structures were designed to have sufficient capacity to dispose of inflows from high intensity storms without excessive overflow of lands and to provide for prompt evacuation of impounded runoff following periods of gate closure. A storm with a frequency of 4-percent-annual-chance and a duration of 24 hours was assumed to occur coincident with a Lake Pontchartrain stage of 1.4 feet NAVD. This lake stage is based on a 50 percent duration elevation of 1.0 feet NAVD, with a 0.4 foot tidal influence.

Federal Emergency Management Agency (FEMA) specifies that all levees must have a minimum of 3 foot freeboard against 1-percent-annual-chance flooding to be considered a safe flood protection structure.

Levees exist in the study area that provide the community with some degree of protection against flooding. However, it has been ascertained that some of these levees may not protect the community from rare events such as the 1-percent-annual-chance flood. The criteria used to evaluate protection against the 1-percent-annual-chance flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 100-year flood are not considered in the hydraulic analysis of the 1-percent-annual-chance floodplain.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail, standard hydrologic and hydraulic study methods were used to determine the flood hazard data. Flood events of a magnitude which are 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 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 the peak discharge-frequency relationships for each flooding source as well as direct runoff inflow hydrographs from the associated contributing areas for each flooding source studied by detailed methods affecting the community.

Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) version 3.1.0 (Reference 8) was utilized for the hydrologic analyses. The HEC-HMS model received, contained in the Donaldsonville To The Gulf Feasibility Study, includes open channels as well as ponding areas within several adjacent parishes including St. Charles Parish. From the study, runoff hydrographs generated by HEC-HMS were then routed through the hydraulic models including open channels and storage areas for channel/storage routing to establish the peak stages.

The discharge range at Tarbert Landing, Mississippi River Mile 306.3 above Head of Passes on the Mississippi River, was the principal source of data for defining discharge-frequency relationships for the Mississippi River. Data from this station obtained from the USACE reflected present conditions for the river below this point and had been collected since 1938. A log-Pearson Type III distribution of annual

peak flows (1938-1974) was derived using a computer program based on Leo Beard's method of frequency analysis (Reference 9). The discharge for the 10-percent-annual-chance flood was determined and a frequency of 1 in 16 years for the Mississippi River and Tributaries Project Flood of 1,500,000 cubic feet per second (cfs) was assigned by using this curve. The 53-year, 1-percent-annual chance, and Mississippi River Project Floods will not produce greater than 1,500,000 cfs in St. Charles Parish because they are limited by the controls of the Mississippi River Project. The project is designed for floods in excess of the 1-percent-annual-chance flood event. The 0.2-percent-annual-chance flood is indeterminate on the Mississippi River in the study area. The determination of maximum wave crest elevations associated with the 1-percent-annual-chance event was approached by the method recommended by the National Academy of Sciences (Reference 10).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 2, "Summary of Discharges."

It should be noted that the northern parish St. Charles model and the Donaldsonville To The Gulf Feasibility Study model were performed using unsteady-state condition. Therefore, the peak discharges listed in Table 2 resulted from hydraulic analysis including channel and floodplain routings.

TABLE 2 - SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage Area (sq.mi)	Peak Discharges (cfs) 10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Mississippi River at Parish line[1]	-	1,375,000	1,500,000	1,500,000	-
des Allemands					
At outlet of Lake des Allemands*	-	184	172	185	281
At mouth (near Lake Salvador) *	-	1,514	1,852	1,969	7,307
Bayou Perot					
At mouth (outlet of Lake Salvador) *	-	1,457	1,689	1,724	1,439

1 from the previous FIS, Reference 6
* Peak discharge rates at mouth are influenced by the stages of Lake des Allemands.
Peak discharges resulted from unsteady HEC-RAS modeling when maximum stages occur.
- : Not Available

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 in

the coastal 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.

For streams as well as storage areas included in the Donaldsonville To The Gulf Feasibility Study (D2G WEST, Reference 1), water surface elevations for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods were computed using the U.S. Army Corps of Engineers' HEC-RAS version 3.1.3 (Reference 11). It was modeled using unsteady-state condition simulation.

The northern parish study area, north of the Mississippi River, was modeled for the unsteady-state condition using the U.S. Army Corps of Engineers' HEC-RAS version 4.0 Beta 2 (Reference 12).

Due to the flat terrain characteristics, no significant water surface elevation changes exist in long distances of open channels. Also the flood stages in the channel are influenced by the stages of adjacent storage areas. Therefore, no water surface profiles are developed except the Mississippi River. In addition, since most of channels are well defined by man-made berms between storage areas, floodway analysis was not necessary.

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

TABLE 3 - SUMMARY OF STORAGE AREA ELEVATIONS

Major Lakes and Storage Areas	Initial Stage (FT. NAVD)
Lake des Allemands	0.0
Lake Cataouatche	0.0
Lake Salvador	0.0
Lake Pontchartrain	2.0
Labranche wetland	3.5

Roughness coefficients were estimated based on field inspection of stream channels and floodplain areas. The following Table 4 shows the Manning's "n" ranges for the streams studied by detailed methods in this study.

TABLE 4 - SUMMARY OF ROUGHNESS COEFFICIENTS

Stream	Channel "n"	Overbank "n"
All drainage channels in northern parish	0.032 ~ 0.045	0.040 ~ 0.045
All drainage channels in southern parish	0.030 ~ 0.042	0.035 ~ 0.070

3.3 Coastal Analyses

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, was applied to predict the stillwater elevations or storm surge levels for coastal Louisiana. 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 the areas of interest including shorelines, open coasts and inland bays. It solves the three dimensional equations of motion, including tidal potential, Coriolis acceleration, 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.

Nearshore waves are required to calculate wave runup and overtopping on structures, and the wave momentum (radiation stress) 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.

The STWAVE model 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 wind fields input to the surge model). The wind applied in the STWAVE is spatially and temporally variable for all domains. The STWAVE model was run at 30-mintue intervals.

An existing ADCIRC grid mesh developed by the USACE 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. 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 forming the finite element model has over 2,200,000 grid nodes. The National Oceanic Atmospheric Administration (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 water, 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 its ability to reproduce historical events, was performed against Hurricanes Katrina (2005), 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 runs 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 Planetary Boundary Layer model and wave radiation stress from the STWAVE model were input into the ADCIRC model for each production storm. All stillwater results for this study include the effects of wave setup. The maximum water-surface elevation was output at every wetted ADCIRC grid point in a specific 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 the 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 for Mississippi and Louisiana.

Due to the excessive number of simulations required for the traditional JPM method, the Joint Probability Method-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 for 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 statistical 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 attack are referred to as coastal high hazard zones. The USACE 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 coastal areas.

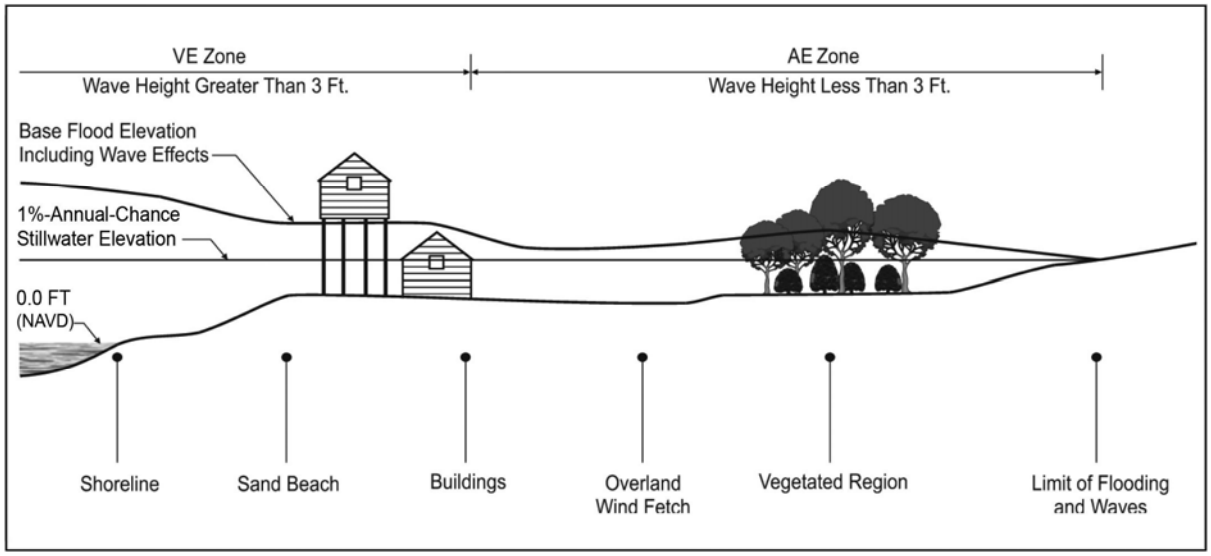

FIGURE 1 - TRANSECT SCHEMATIC

Figure 1 shows a profile for a typical transect and illustrates the effects of energy dissipation and regeneration of 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 V/A 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, should local agencies permit building in this coastal high hazard area.

For St. Charles Parish, the only flood source for the area north of the Mississippi River is Lake Pontchartrain. Therefore, all transects start at the Lake Pontchartrain shoreline and end at the Mississippi River north levee. For the area south of the Mississippi River, the flood source is the Gulf of Mexico. All transects running in the north-south directions originate from the Gulf shoreline in the Terrebonne, Lafourche and Jefferson Parishes, and end at the Mississippi River south levee. Wave Height Analysis for Flood Insurance Studies (WHAFIS) for those extended transects were performed and included in the parishes where the transects originated. The initial wave heights representing 1- and 0.2-percent-annual-chance flood events were determined based on depth-limited breaker

heights, which is 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, the transects were spaced at relatively larger intervals. Transects are 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, developed by the USGS, 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 data. Aerial photos and images downloaded from 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.

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 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 base flood elevations. 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 wave height results are not included on the FIRMs but are provided in wave transect profiles in the 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. Wave setup was not calculated separately because wave setup was included in the base stillwater elevations from the storm surge analysis.

Levees and embankment structures not meeting FEMA's free board requirements were removed in the WHAFIS wave height analysis. For the remaining levees, if there is a high ground in front of those levees and the surge did not reach those levees, then no wave runup analysis is performed. Otherwise, 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. The wave runup formula for the vertical walls described in the Shore Protection Manual (SPM 1984) was applied in calculating the wave runup over the Bonnet Carre spillway for transects

intersecting the spillway (C2, C3 and C4) under the 0.2 percent-annual-chance event. Wave characteristics and stillwater elevations were obtained from the WHAFIS wave height analysis and USACE's storm surge analysis (without wave setup). The FIRM panel shows a Base Flood Elevation (BFE) along the levee that includes wave runup.

TABLE 5 - SUMMARY OF COASTAL DATA TABLE

Community Name	Transect	Description	Latitude & Longitude at Start of Transect		Starting Stillwater Elevations (FT. NAVD) Range of Stillwater Elevations (FT. NAVD)				Zone Designation and BFE
					10% Annual	2% Annual	1% Annual	0.2% Annual	(FT. NAVD)
St. Charles	1	Located at west end of Parish, North of Mississippi River traversing northeast to southwest from Lake Pontchartrain to Mississippi River levee.	30.0779	90.4053	6.5 Range Not Available	10.1 Range Not Available	10.7 7.0-10.7	13.5 6.7 - 13.5	AE 7-11 VE 11-16
St. Charles	2	Located to the east of transect 1, traversing northeast to southwest.	30.0702	90.3965	6.4	9.9	11.6 10.1-11.6	14.1 13.4-15.6	AE 10-14 VE 14-17
St. Charles	3	Located to the east of transect 2, traversing northeast to southwest.	30.0665	90.3925	6.4	9.9	11.5 10.1-11.5	14 13.4-15.8	AE 11-14 VE 14-17
St. Charles	4	Located to the east of transect 3, traversing northeast to southwest.	30.0619	90.3831	6.3	9.7	11.4 9.9 - 11.4	13.9 13.1-14.7	AE 10-13 VE 13-17
St. Charles	5	Located to the east of transect 4, traversing northeast to southwest.	30.0552	90.3700	6.2	9.6	11.3 8.7-11.3	13.7 12.3-14.0	AE 9-13 VE 13-16
St. Charles	6	Located to the east of transect 5, traversing northeast to southwest.	30.0548	90.3608	6.1	9.4	11.1 11.1-11.3	13.5 13.5-14.0	AE 11-13 VE 13-16
St. Charles	7	Located to the east of transect 6, traversing northeast to southwest.	30.0547	90.3534	6.0	9.3	10.9 10.9-11.4	13.4 13.3 - 14.1	AE 11-13 VE 13-16

TABLE 5 - SUMMARY OF COASTAL DATA TABLE (CONT.)

Community Name	Transect	Description	Latitude & Longitude at Start of Transect		Starting Stillwater Elevations (FT. NAVD) Range of Stillwater Elevations (FT. NAVD)				Zone Designation and BFE (FT. NAVD)
					10% Annual	2% Annual	1% Annual	0.2% Annual	
St. Charles	8	Located to the east of transect 7, traversing northeast to southwest.	30.0389	90.3406	5.9	9.2	10.8 10.8- 11.5	13.3 13.3 - 14.4	AE 11-13 VE 13-16
St. Charles	9	Located to the east of transect 8, traversing northeast to southwest.	30.0520	90.3286	5.8	8.7	10.2 10.2- 11.3	12.6 12.6- 14.3	AE 12-13 VE 13-16
St. Charles	10	Located to the east of transect 9, traversing northeast to southwest.	30.0541	90.3094	5.7	8.4	9.8 9.8- 11.2	12.2 12.2- 14.8	AE 11-13 VE 12-15
St. Charles	11	Located to the east of transect 10, traversing northeast to southwest.	30.0519	90.2989	5.7	8.2	9.7 9.7 - 10.9	12.0 12.0- 13.7	AE 11-13 VE 12-15
St. Charles	12	Located to the east of transect 11, traversing northeast to southwest.	30.0492	90.2891	5.6	8.1	9.5 9.5- 10.8	11.9 11.9- 13.9	AE 11-12 VE 12-14
St. Charles	13	Located to the east of transect 12, traversing northeast to southwest.	30.0460	90.2829	5.6	8.0	9.4 9.4- 10.5	11.8 11.8- 13.3	AE 11-12 VE12-14

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 St. Charles Parish is -0.21 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 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 flood 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 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 scales of 1:6000, with a contour interval of 2 feet (Reference 13).

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 correspond to the boundaries of the areas of special flood hazard (Zones A, AE, AO, and VE), and the 0.2-percent-annual-chance floodplain boundaries correspond to the boundaries 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 areas 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.

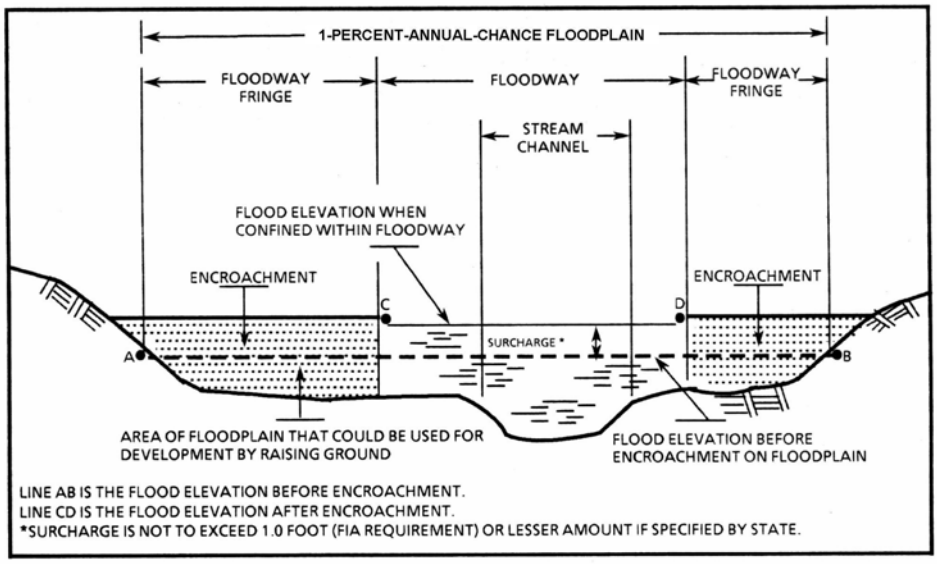

FIGURE 2 - FLOODWAY SCHEMATIC

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

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 Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations 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 Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations 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 hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the base flood by levees. No base flood elevations or depths are shown 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 FIRM presents flooding information for the entire geographic area of St. Charles Parish.

7.0 OTHER STUDIES

Flood insurance studies were prepared for the St. John the Baptist Parish, Lafourche Parish, and Jefferson Parish (References 20, 21, and 22). The results of this study are in complete agreement with these studies.

In addition, Dawson Engineers completed a St. Charles Parish Drainage Study in December 1986 (Reference 5). This report is available from the parish. The USACE has completed a report entitled Lake Pontchartrain, Louisiana, and Vicinity High Level Design Memorandum No. 18, General Design Jefferson/St. Charles Return Levee (Reference 24). The USACE also prepared a report entitled Lake Pontchartrain and Vicinity Hurricane Protection Project, St. Charles Parish, North of Airline Highway Alignment (Reference 7).

Because it is based on more up-to-date analyses, this FIS supersedes the previously printed FIS for the unincorporated areas of St. Charles Parish (Reference 6).

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.

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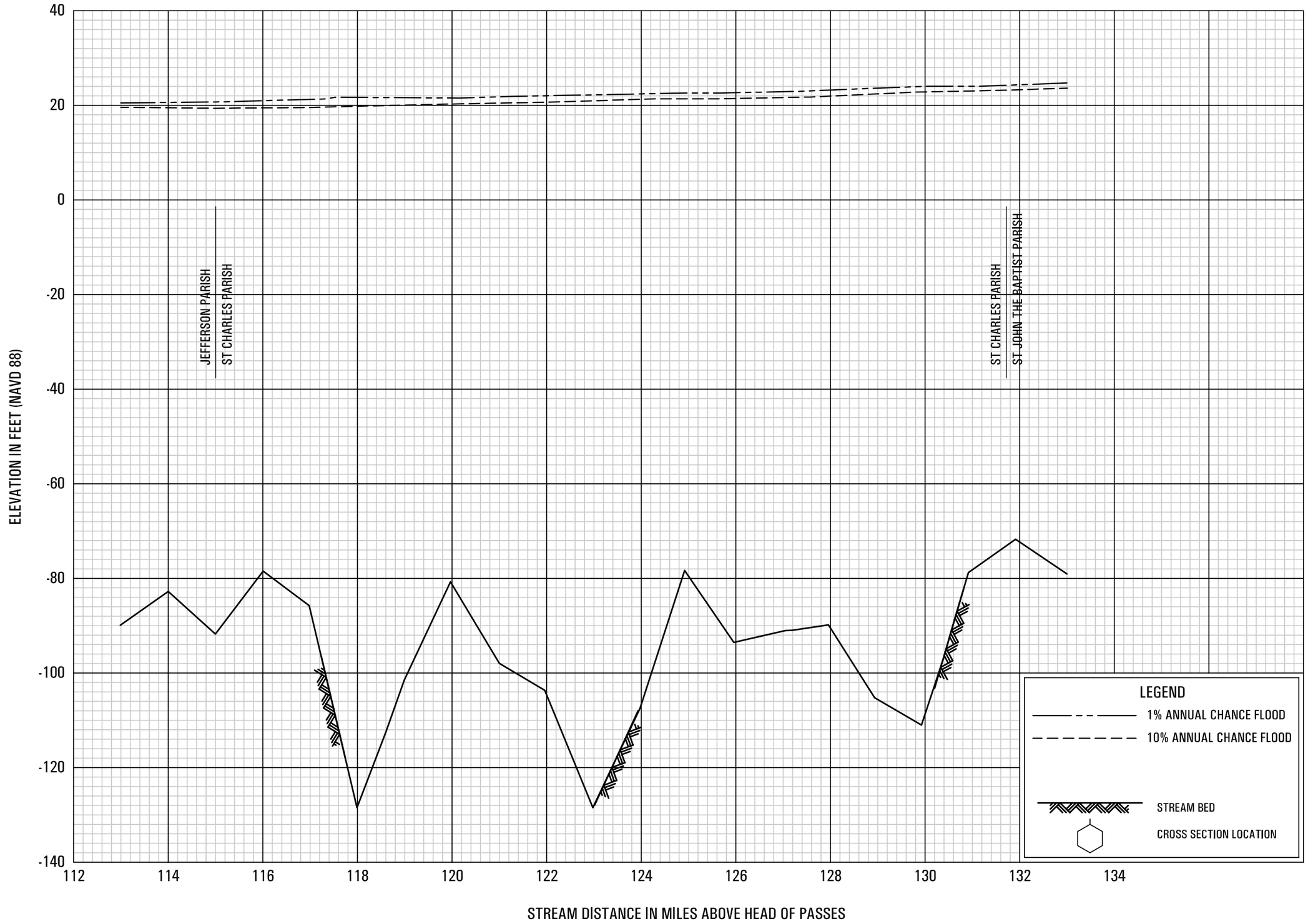


FLOOD PROFILES

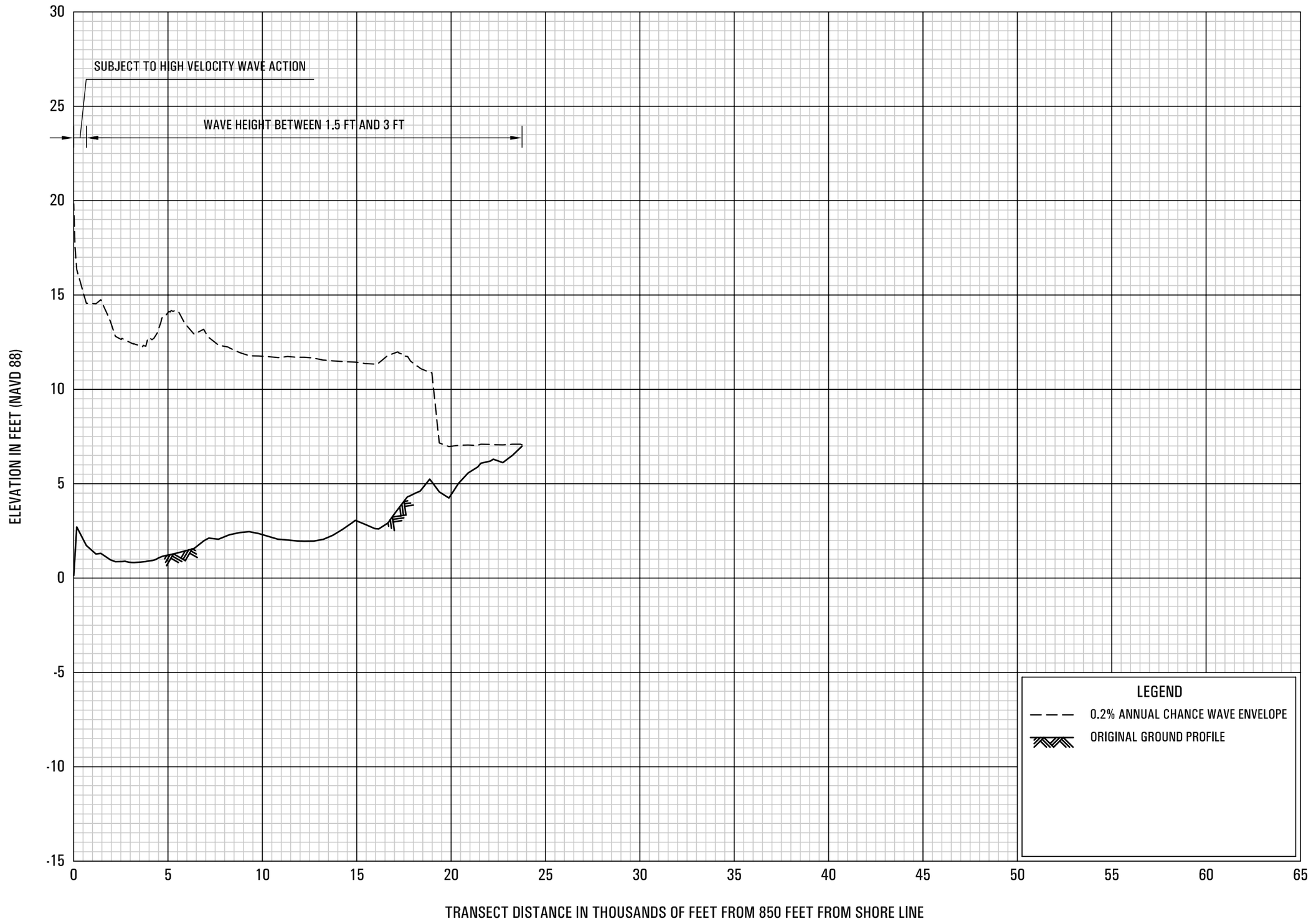
MISSISSIPPI RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

01P



0.2% ANNUAL CHANCE WAVE ENVELOPE

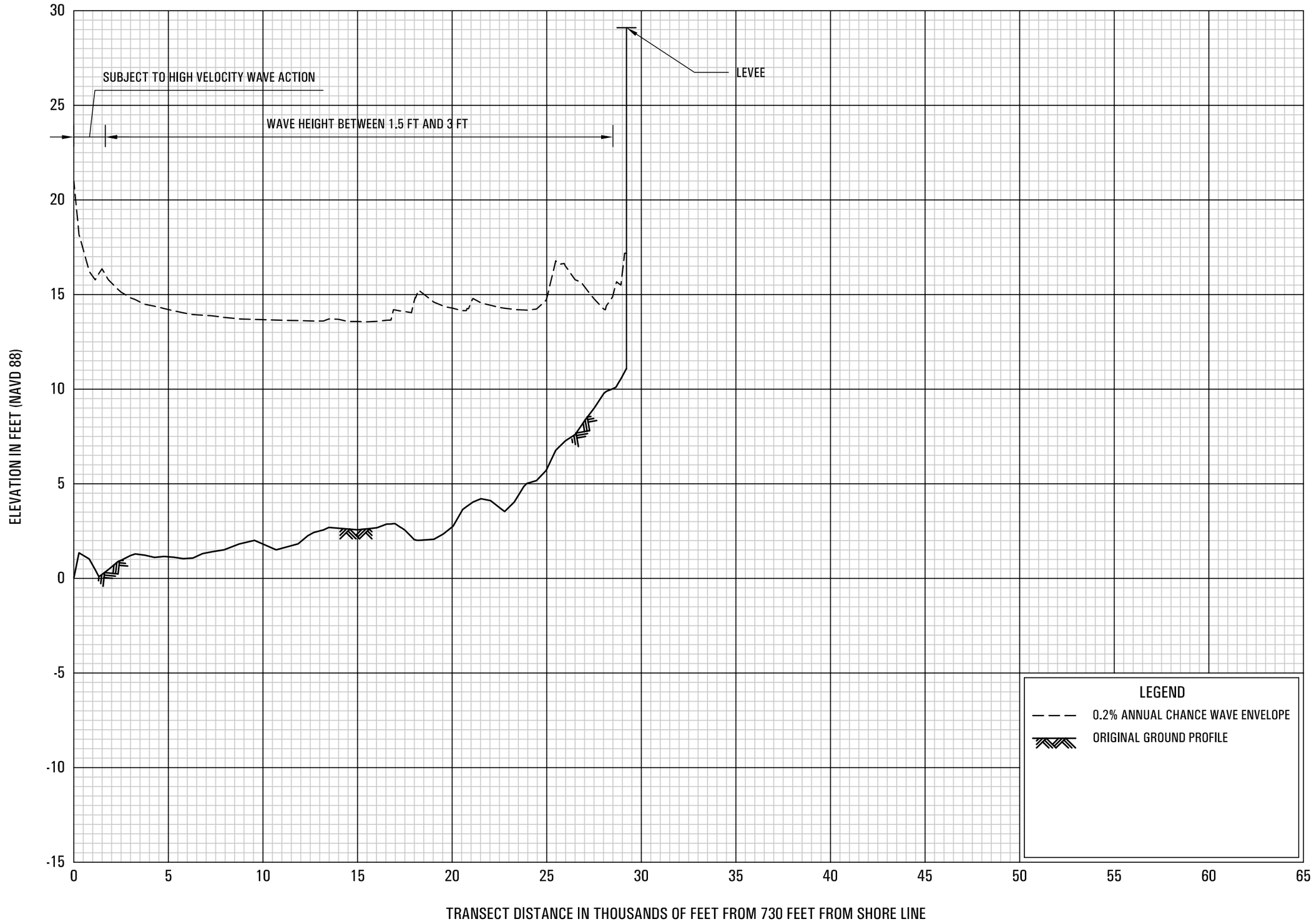
TRANSECT 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

01P



0.2% ANNUAL CHANCE WAVE ENVELOPE

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UNINCORPORATED AREAS

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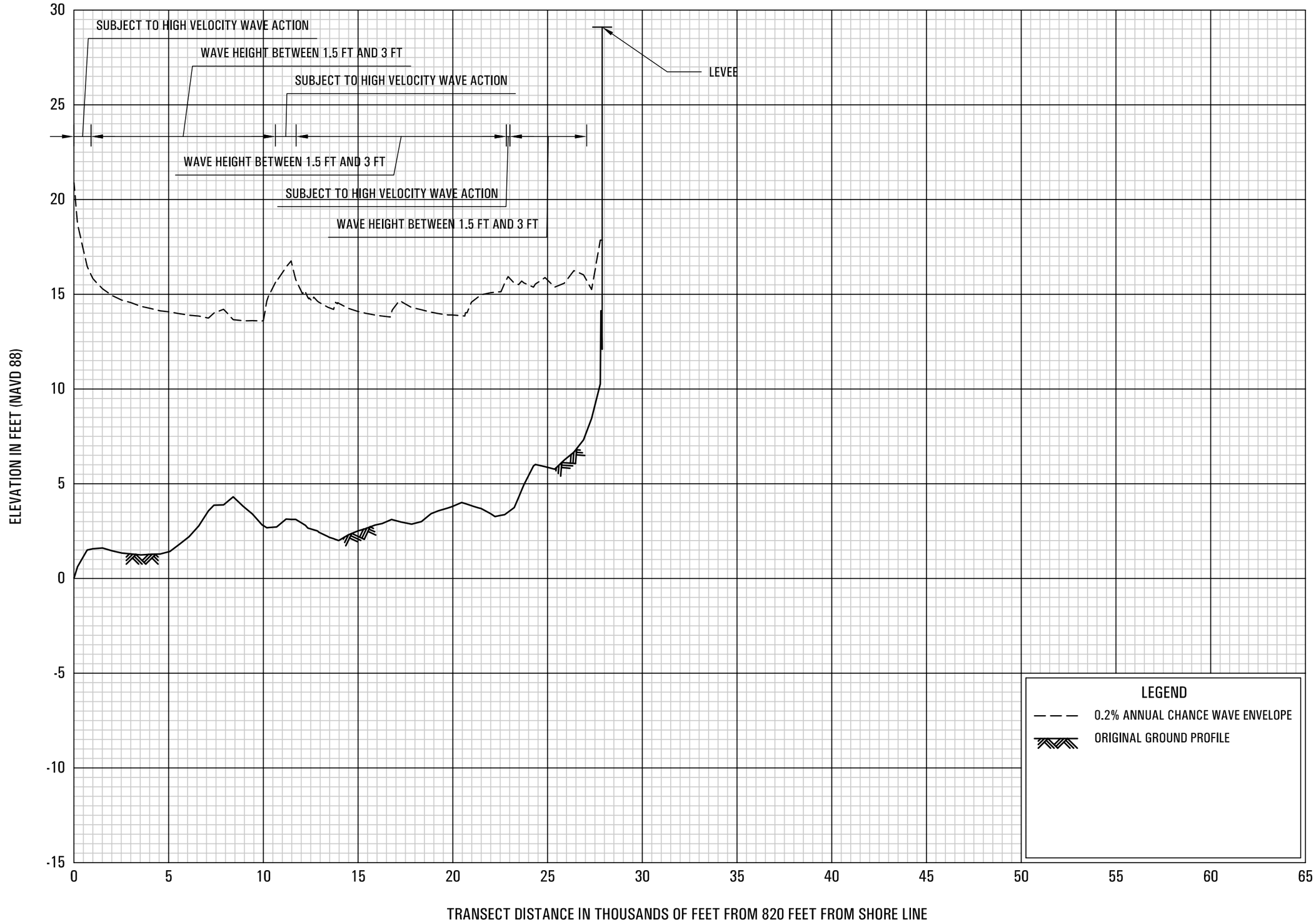

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FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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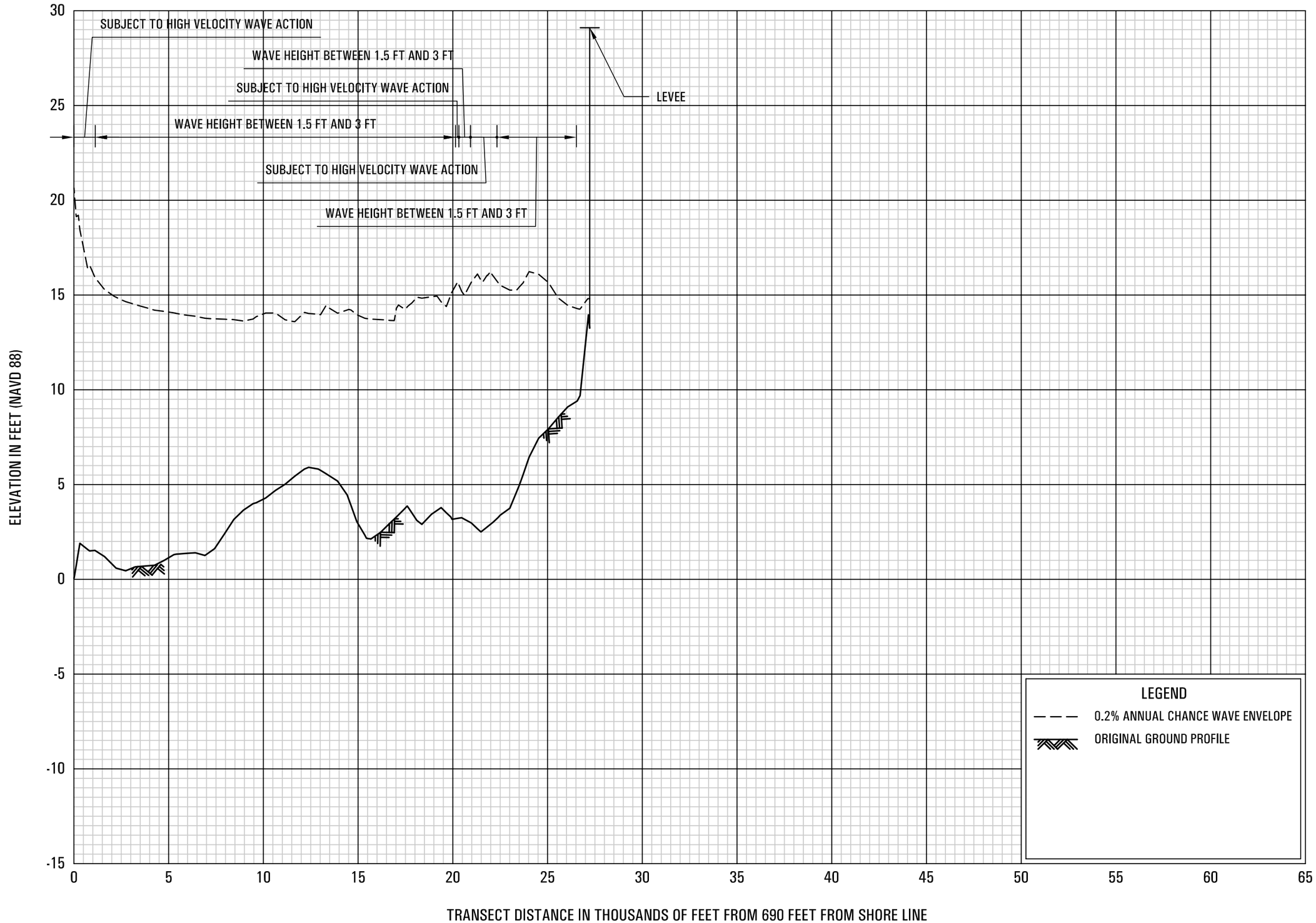

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TRANSECT 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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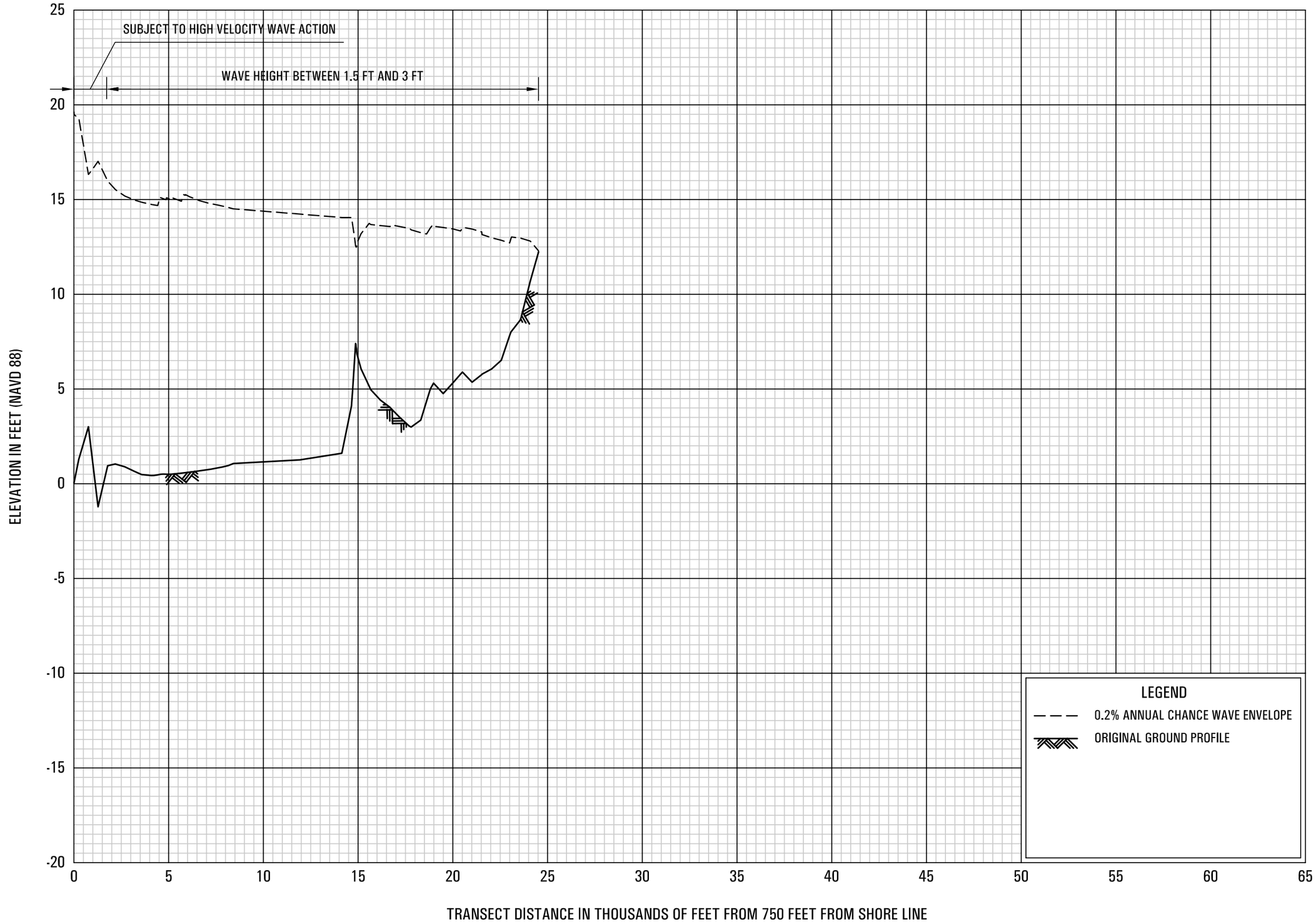

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FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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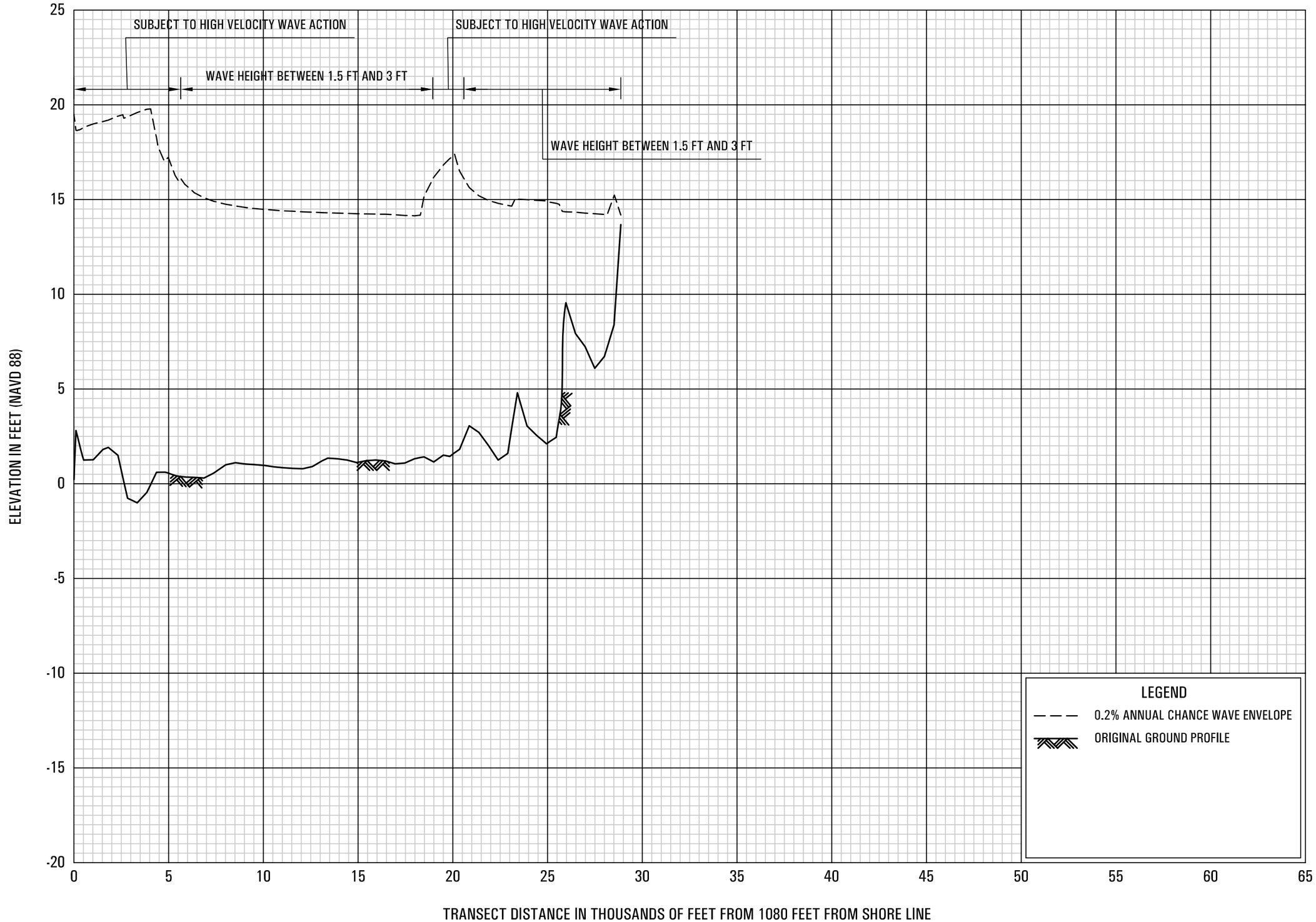

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TRANSECT 6

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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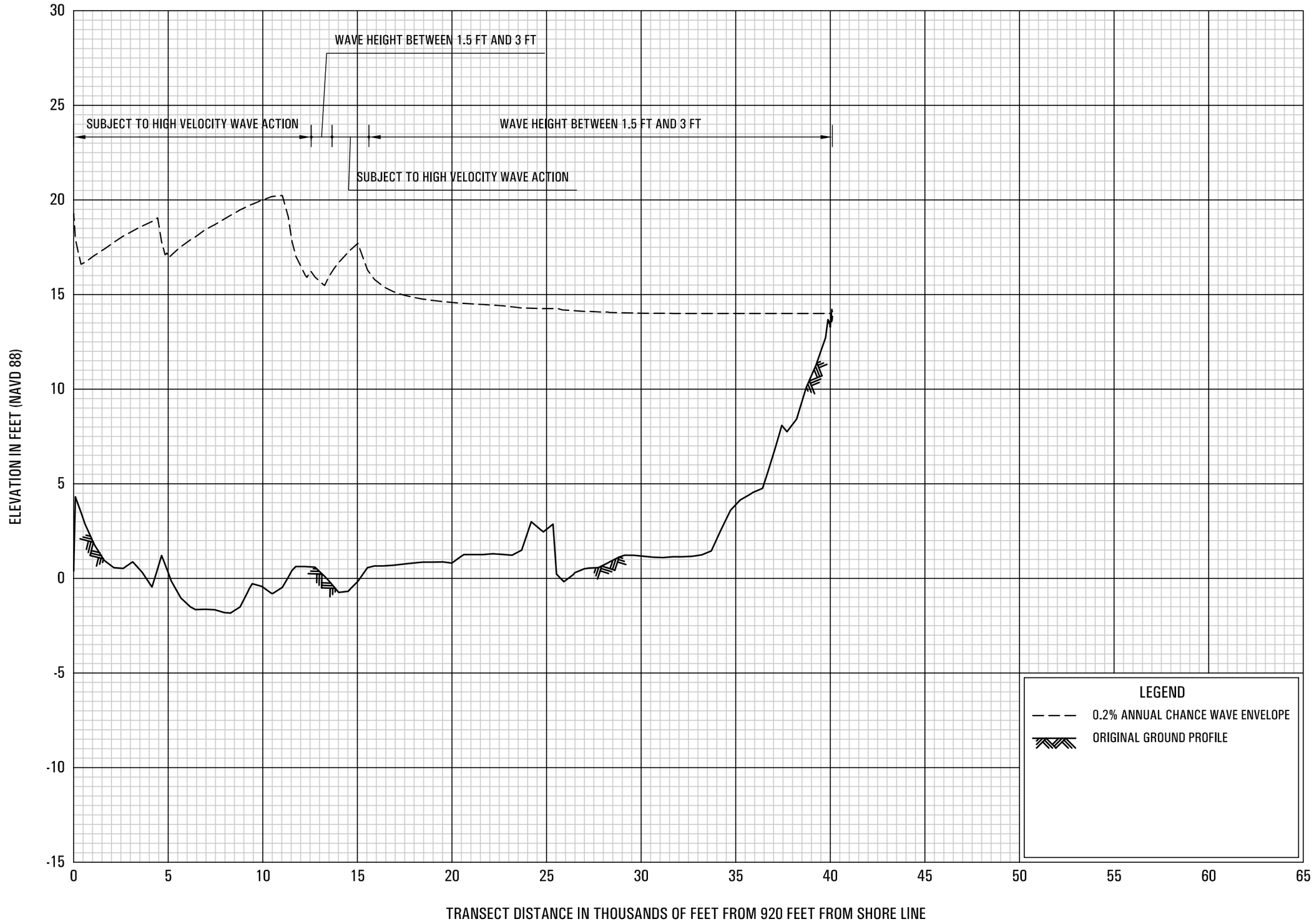

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TRANSECT 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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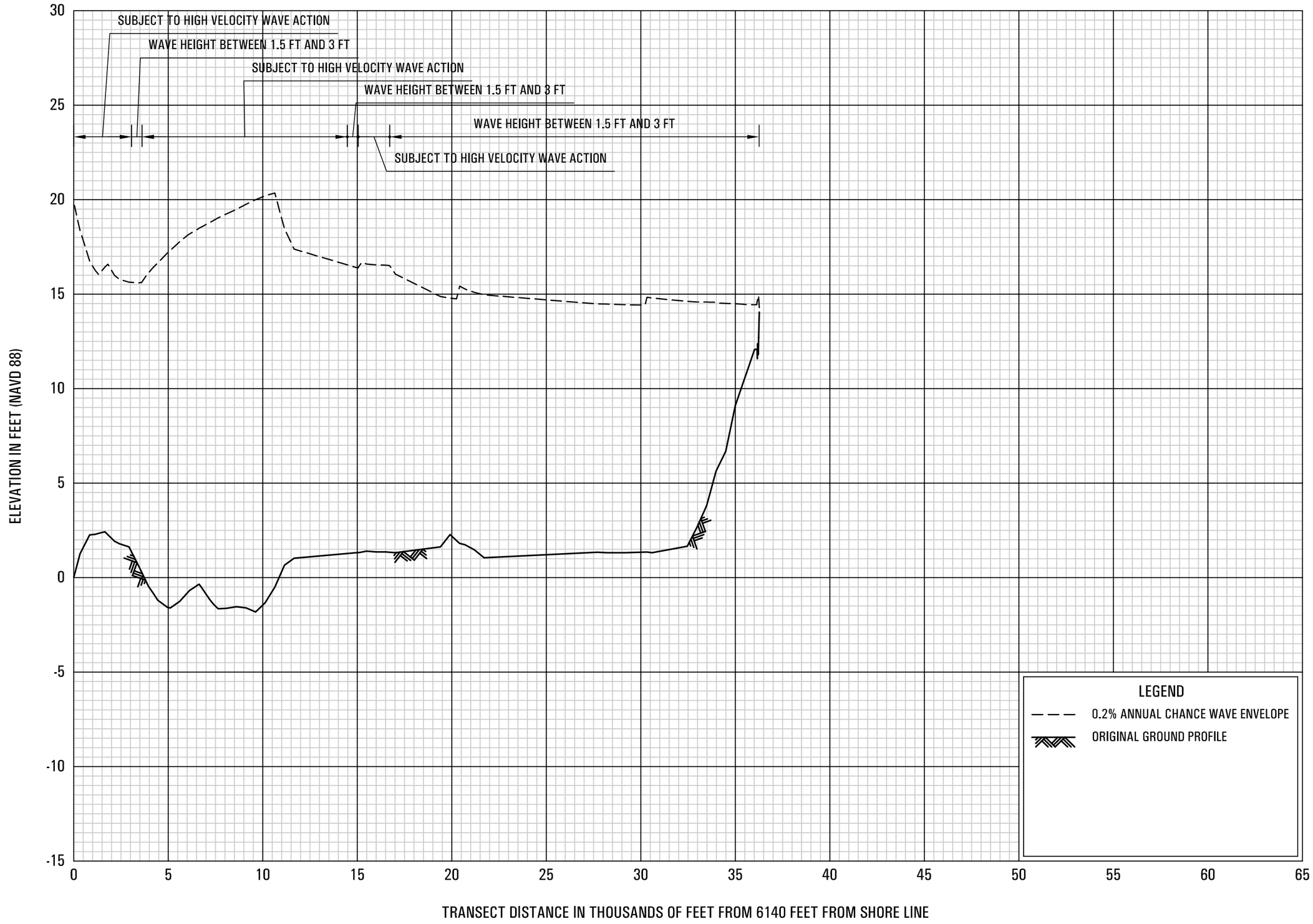

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TRANSECT 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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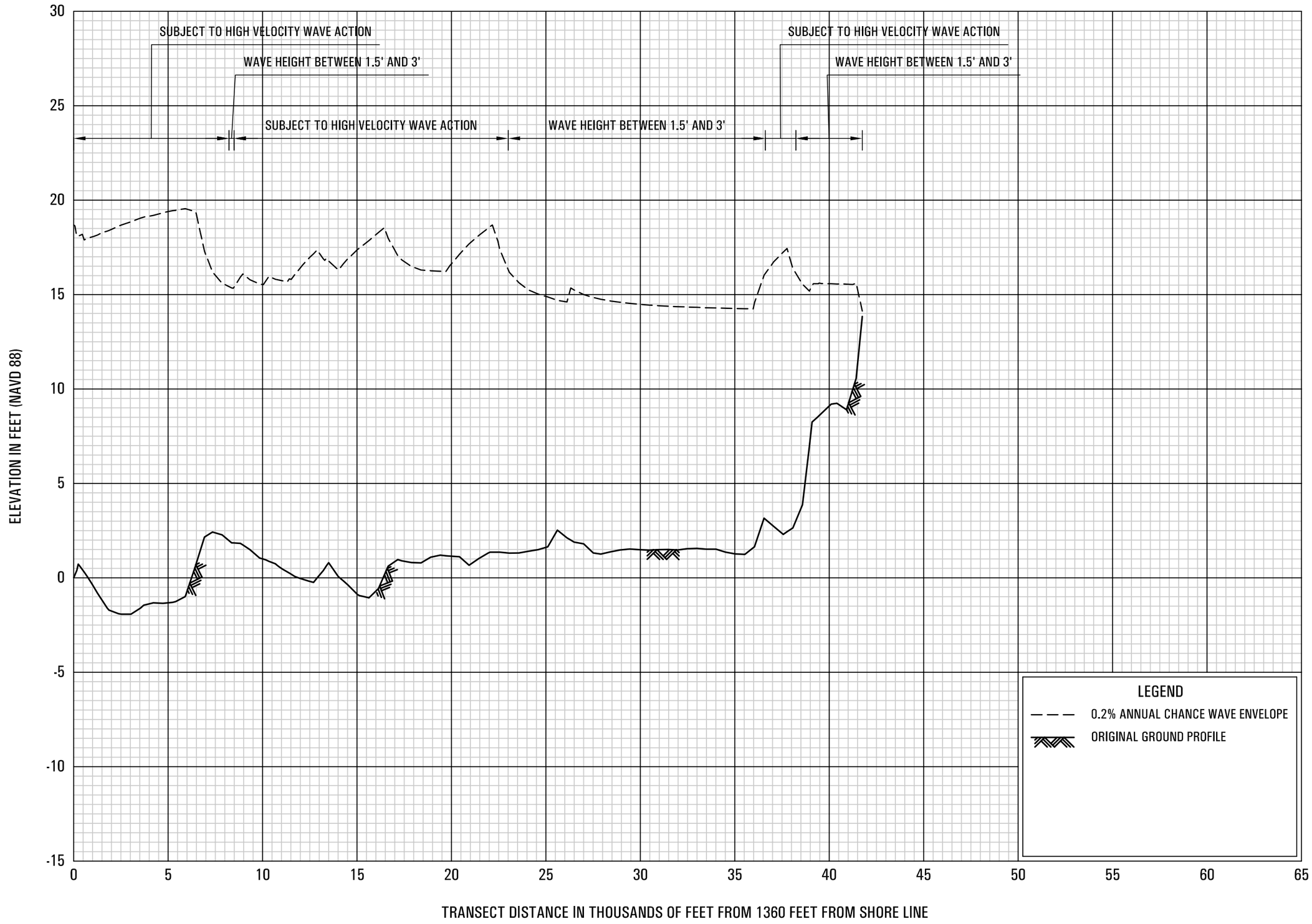

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TRANSECT 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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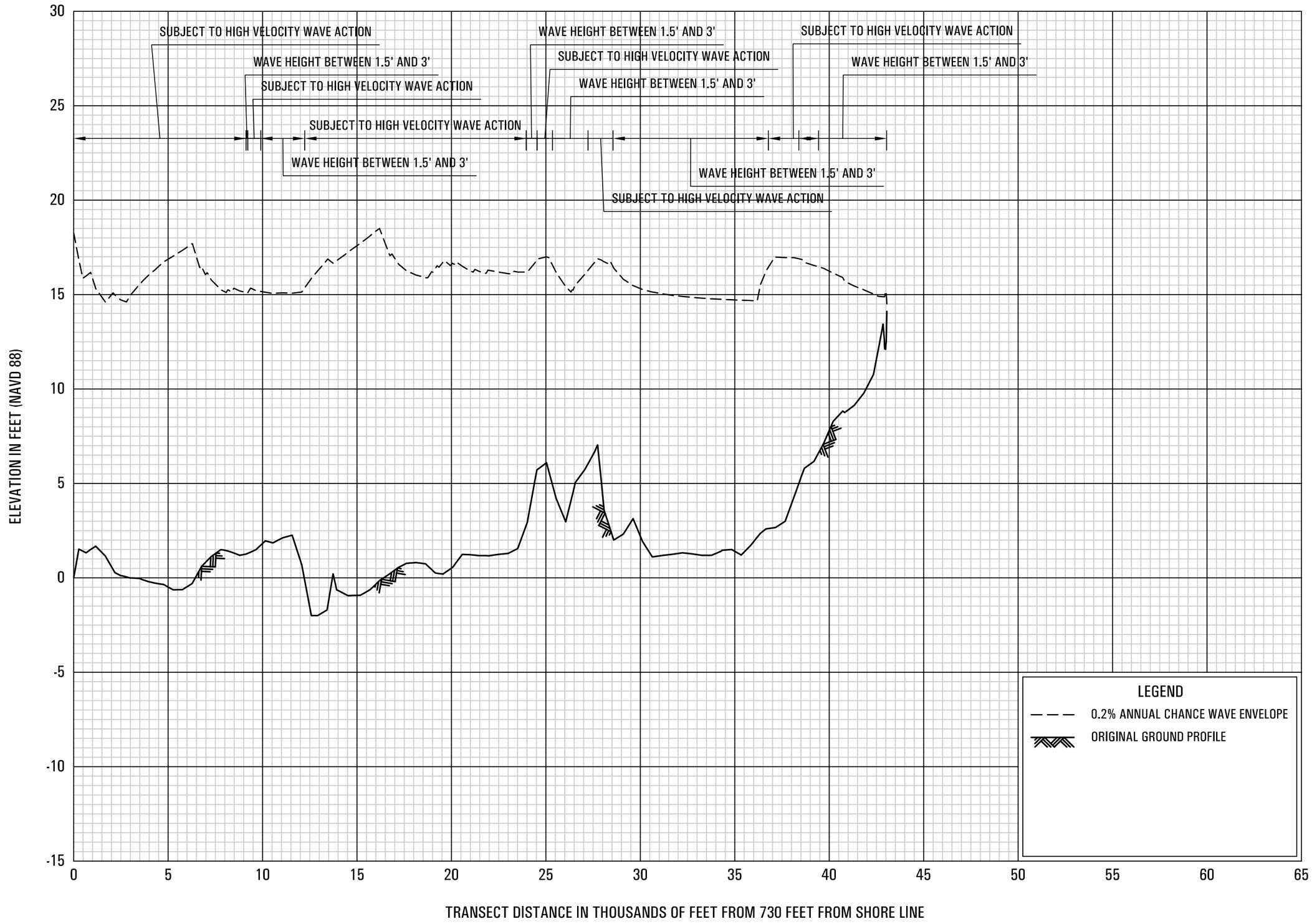

0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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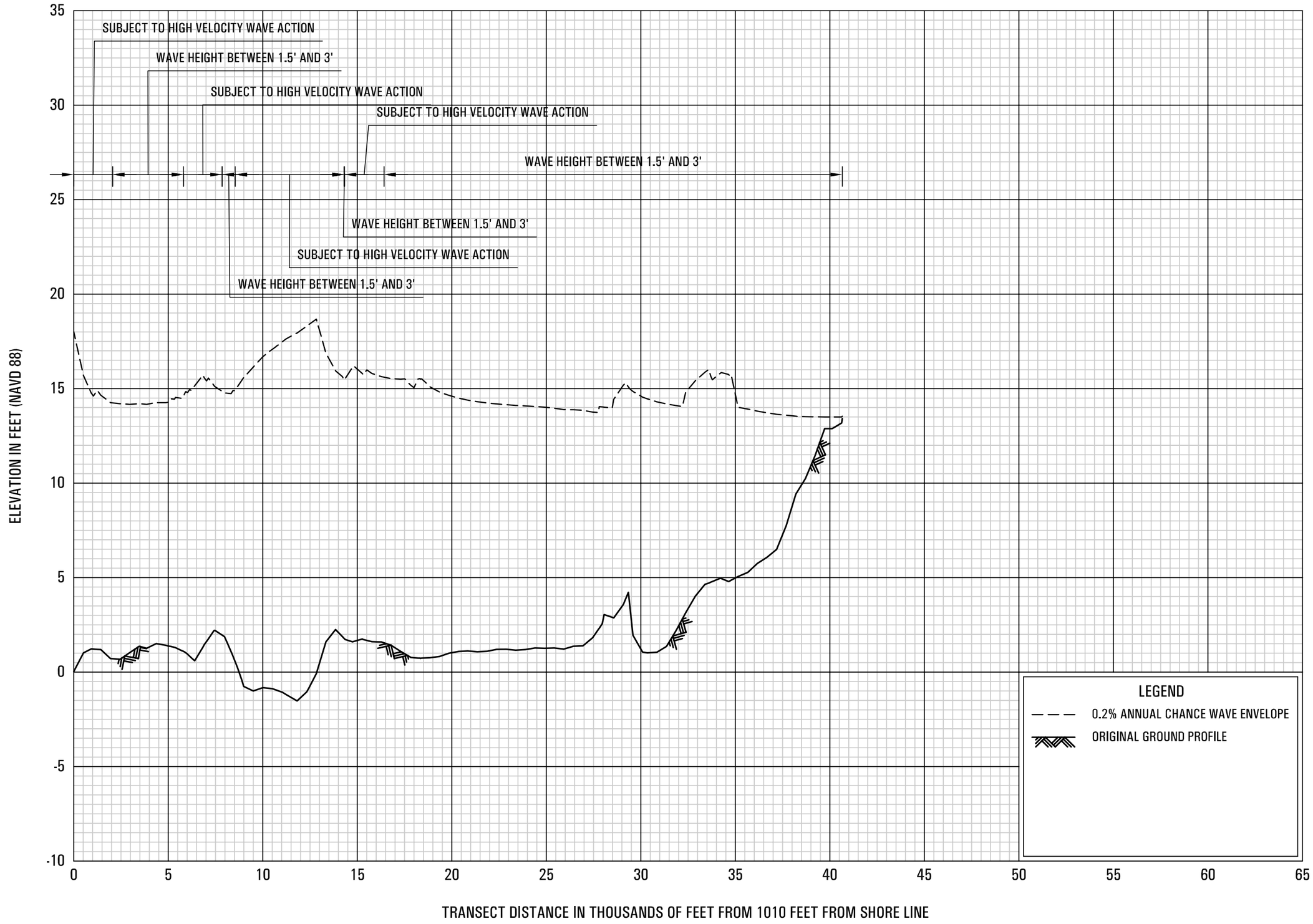

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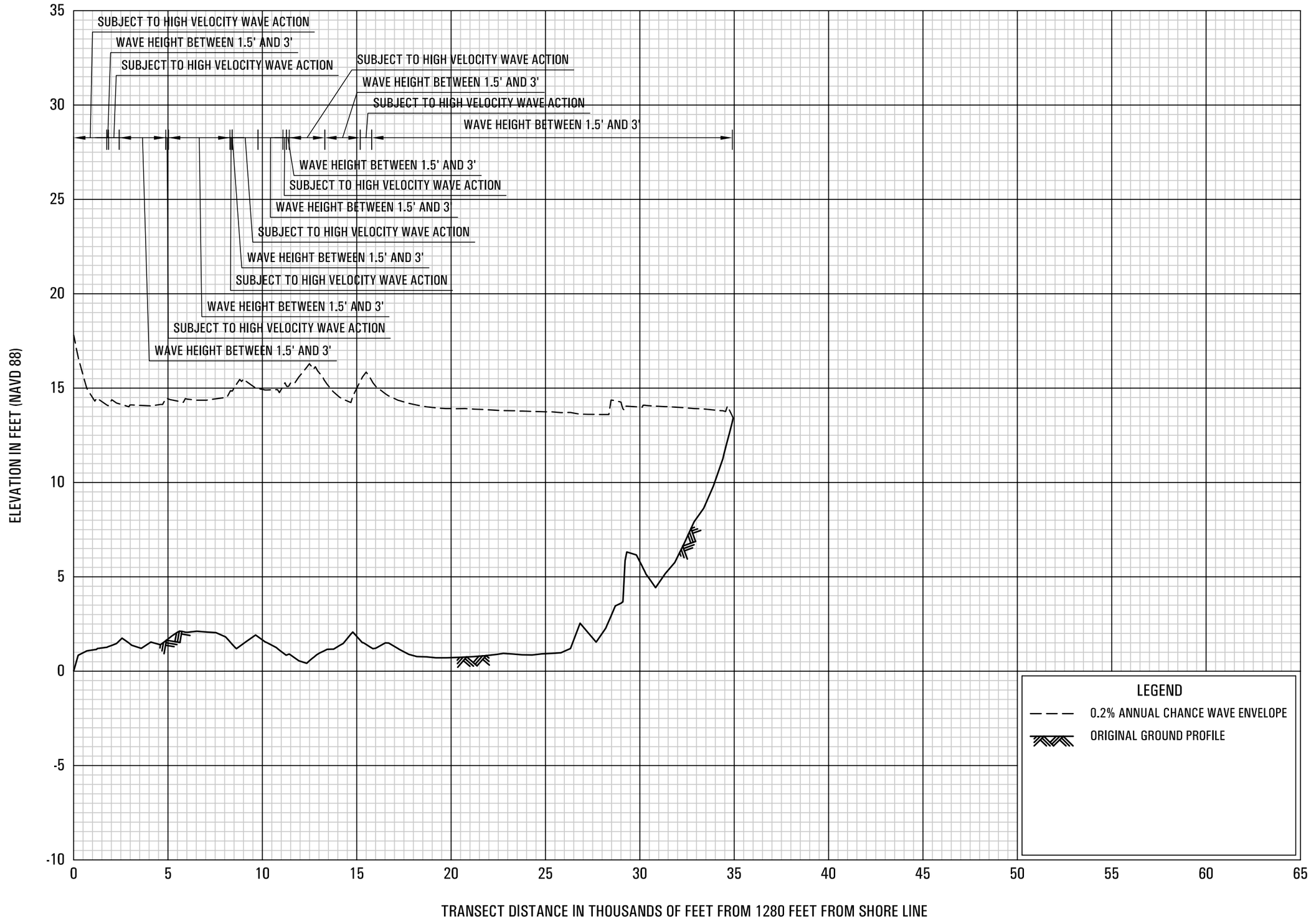
TRANSECT 11

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



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TRANSECT 12

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

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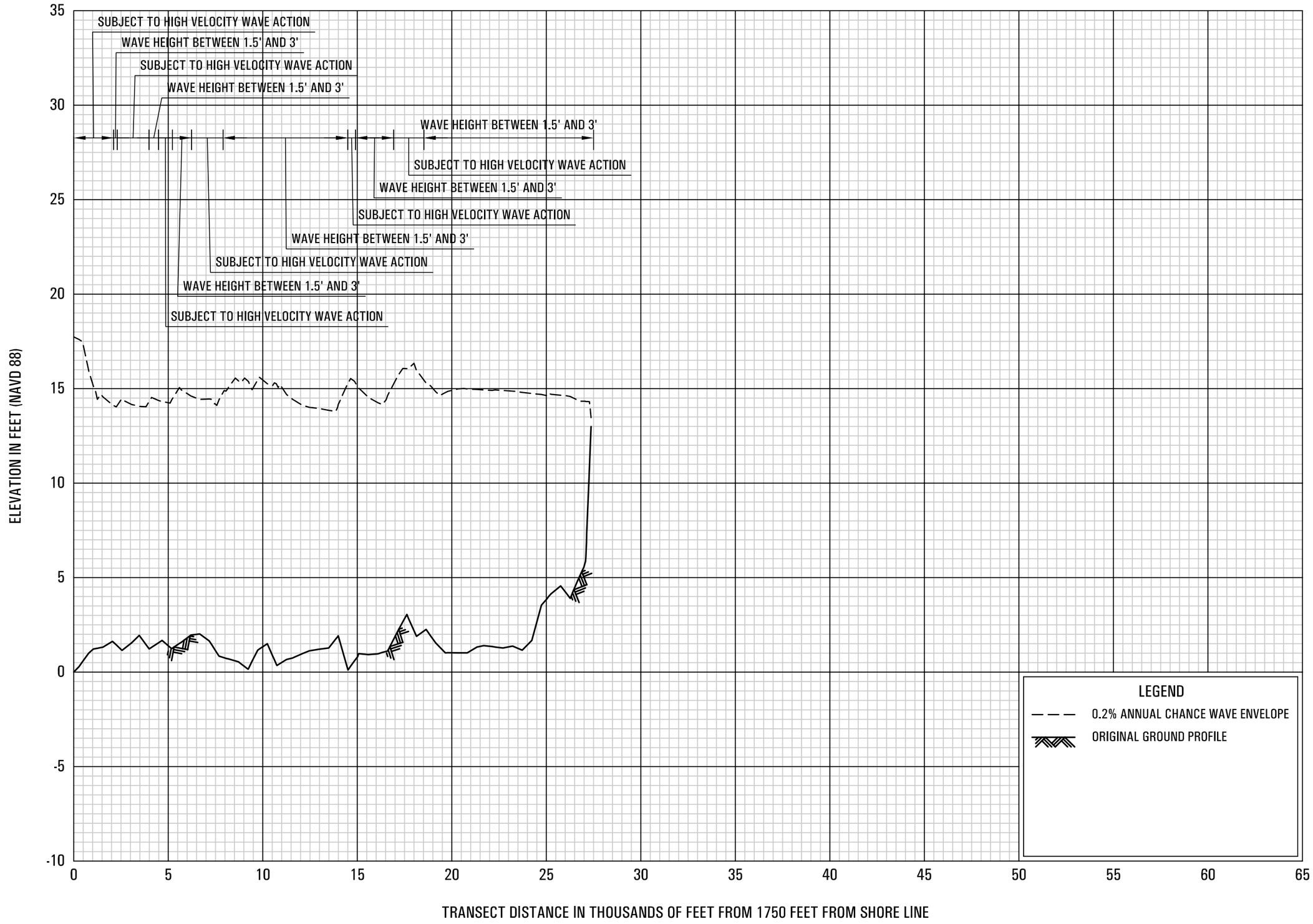


0.2% ANNUAL CHANCE WAVE ENVELOPE

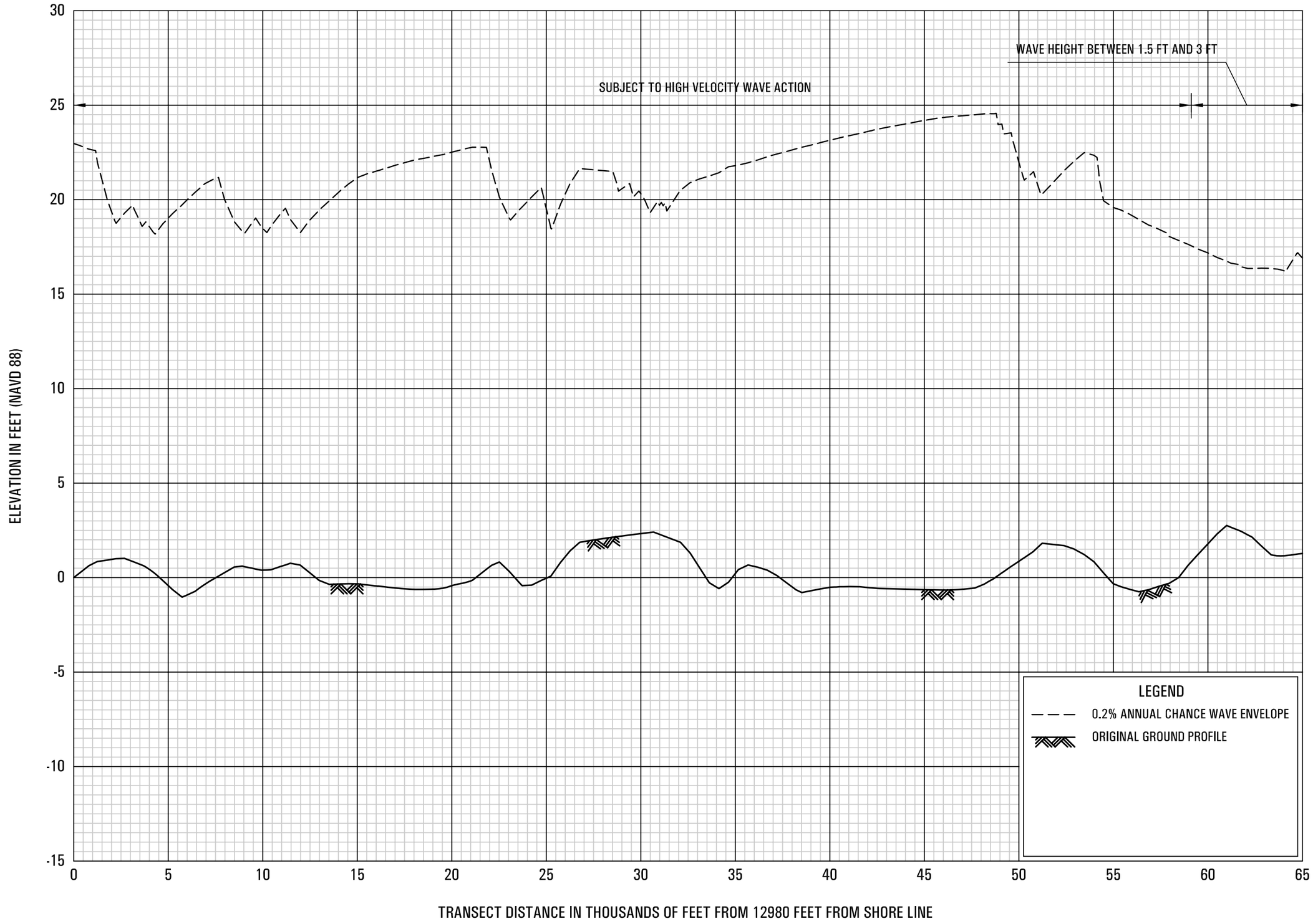
TRANSECT 13

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

13P



0.2% ANNUAL CHANCE WAVE ENVELOPE

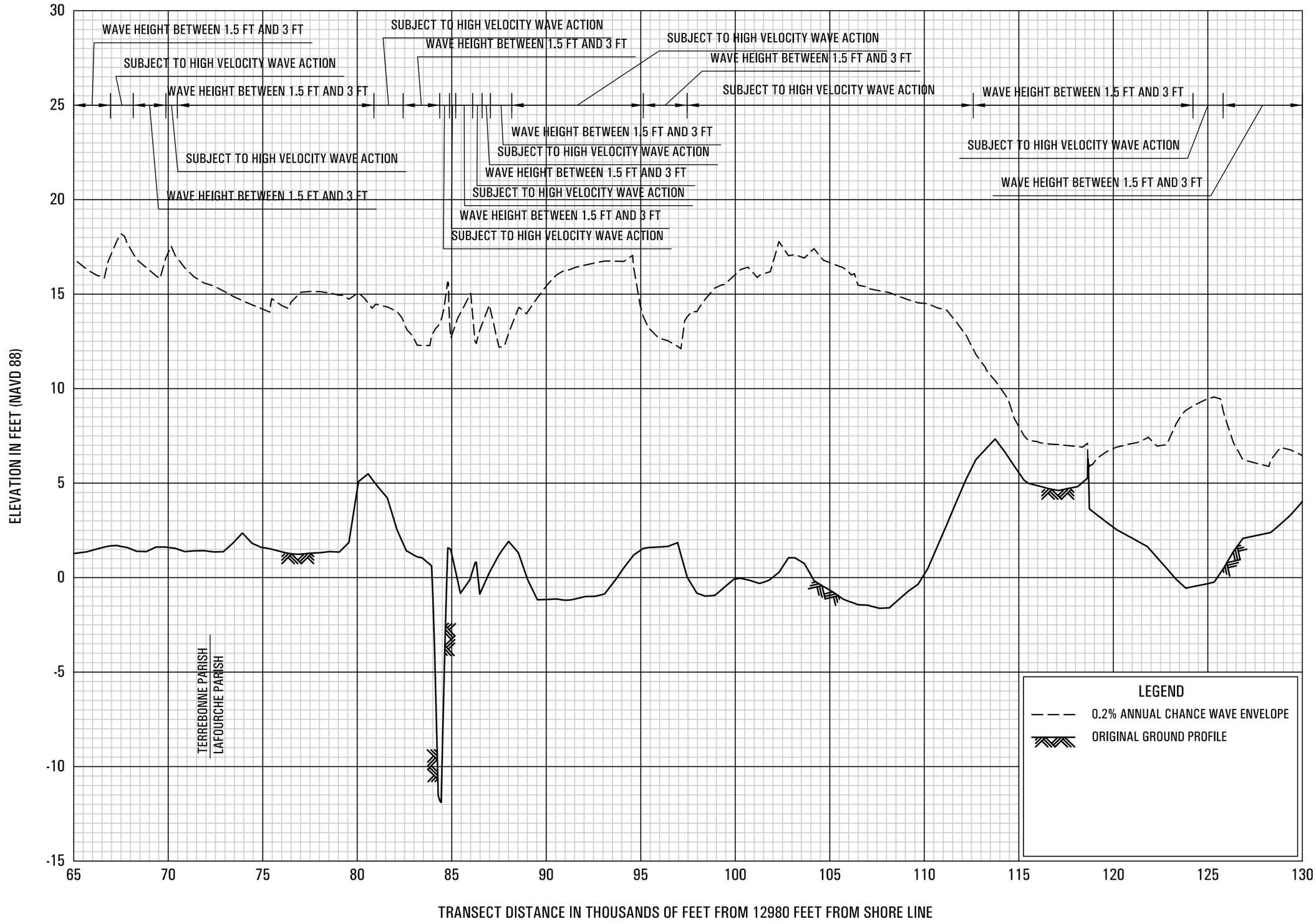
TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

14P



0.2% ANNUAL CHANCE WAVE ENVELOPE

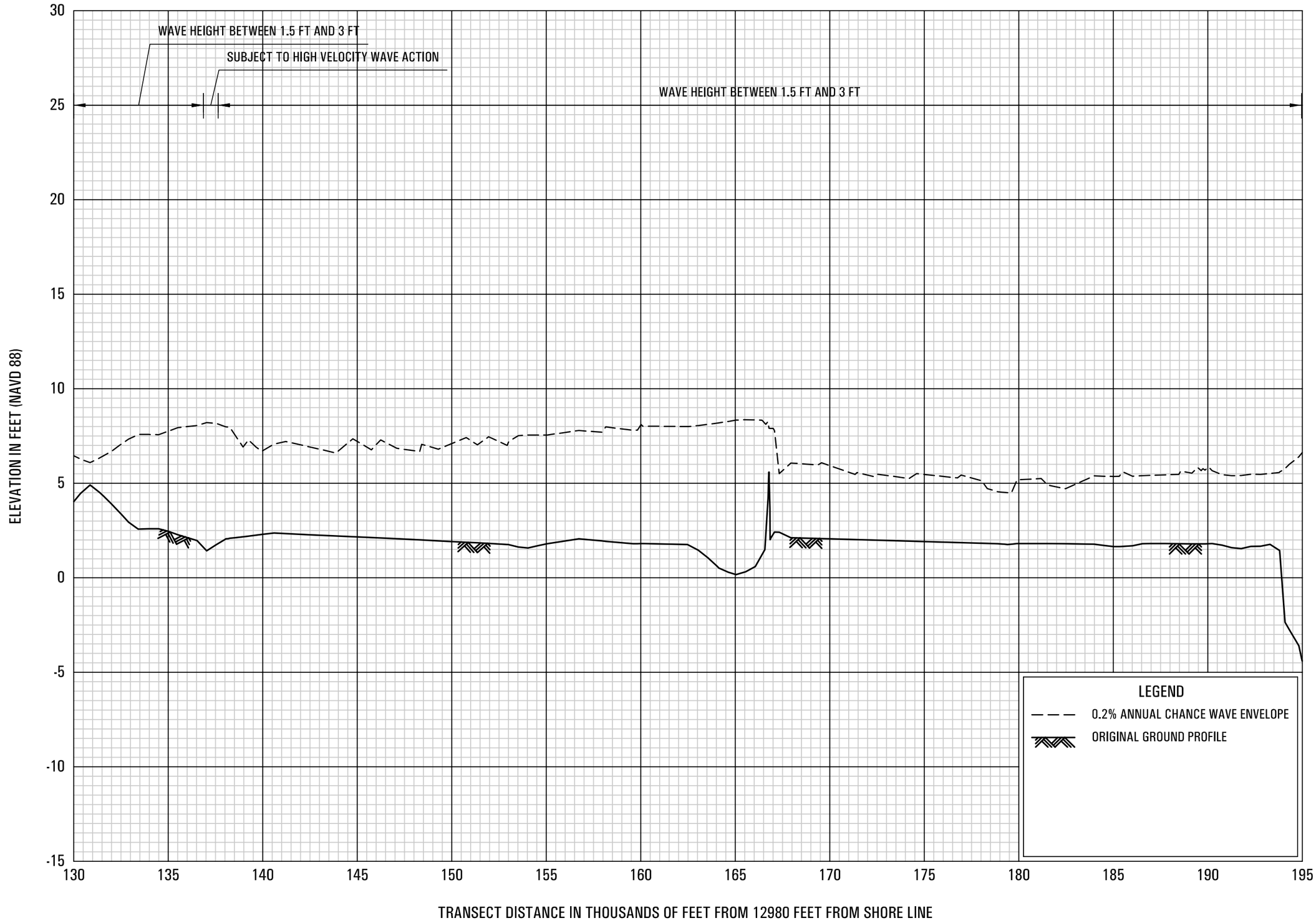
TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

15P



0.2% ANNUAL CHANCE WAVE ENVELOPE

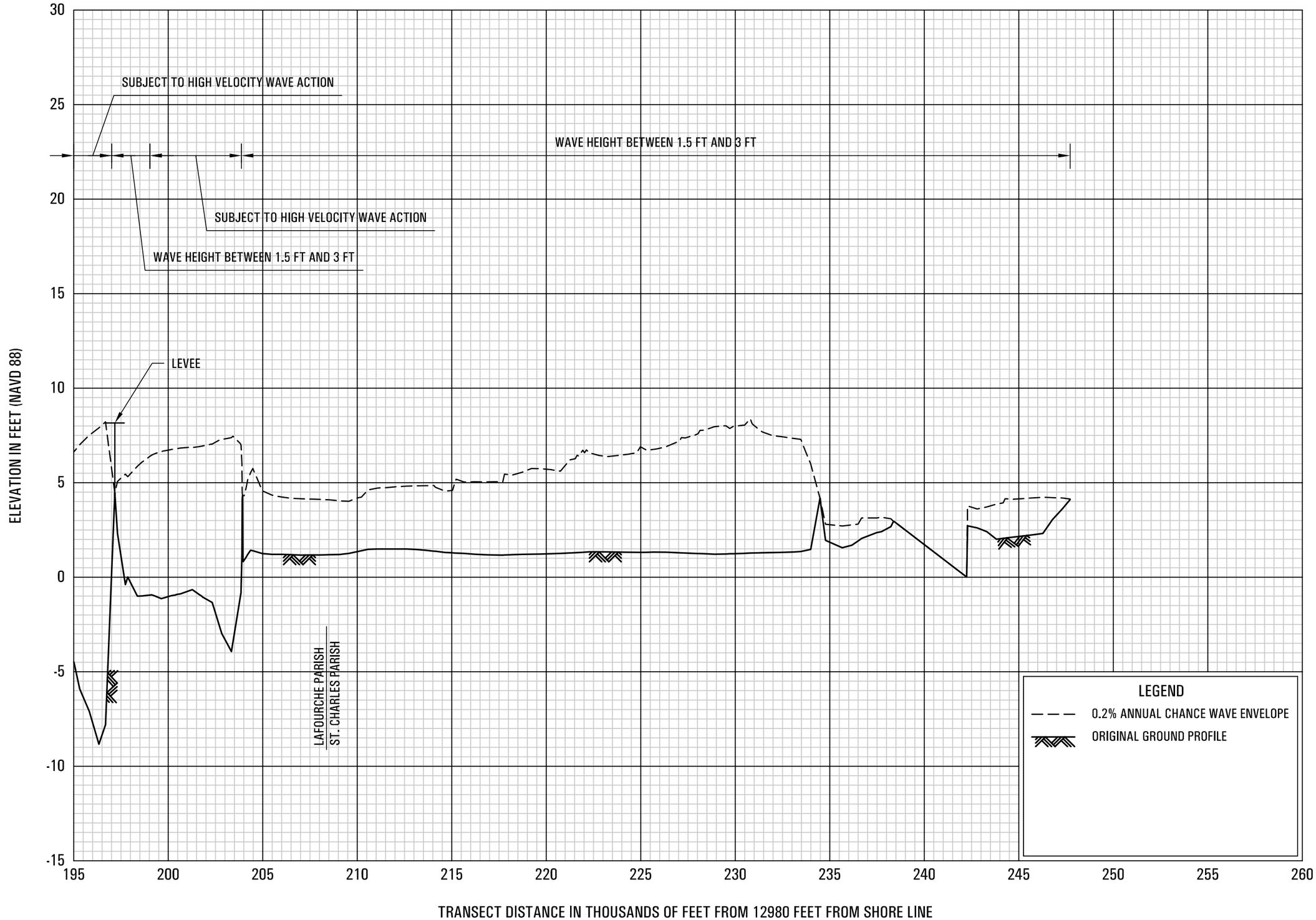
TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

16P



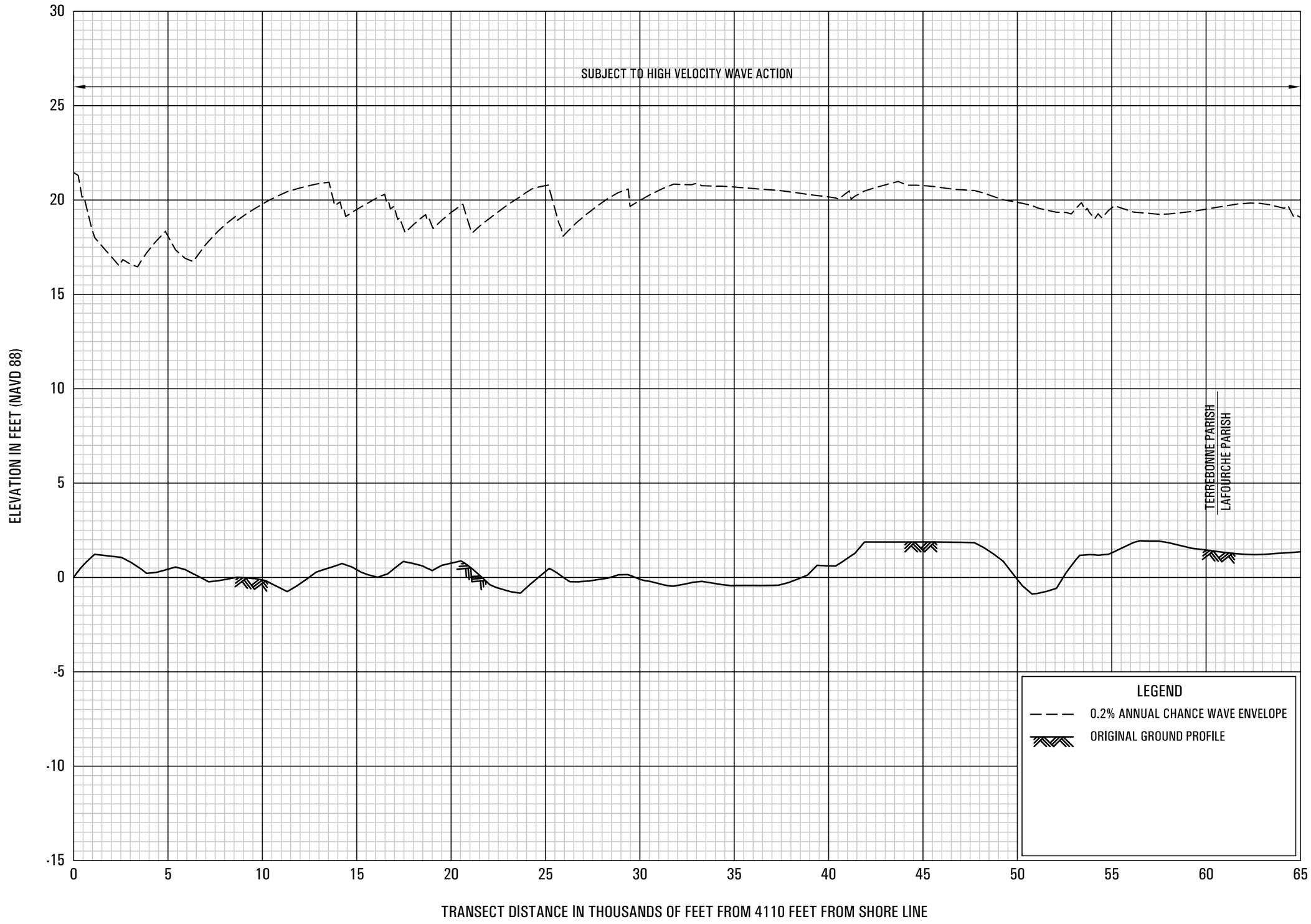
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



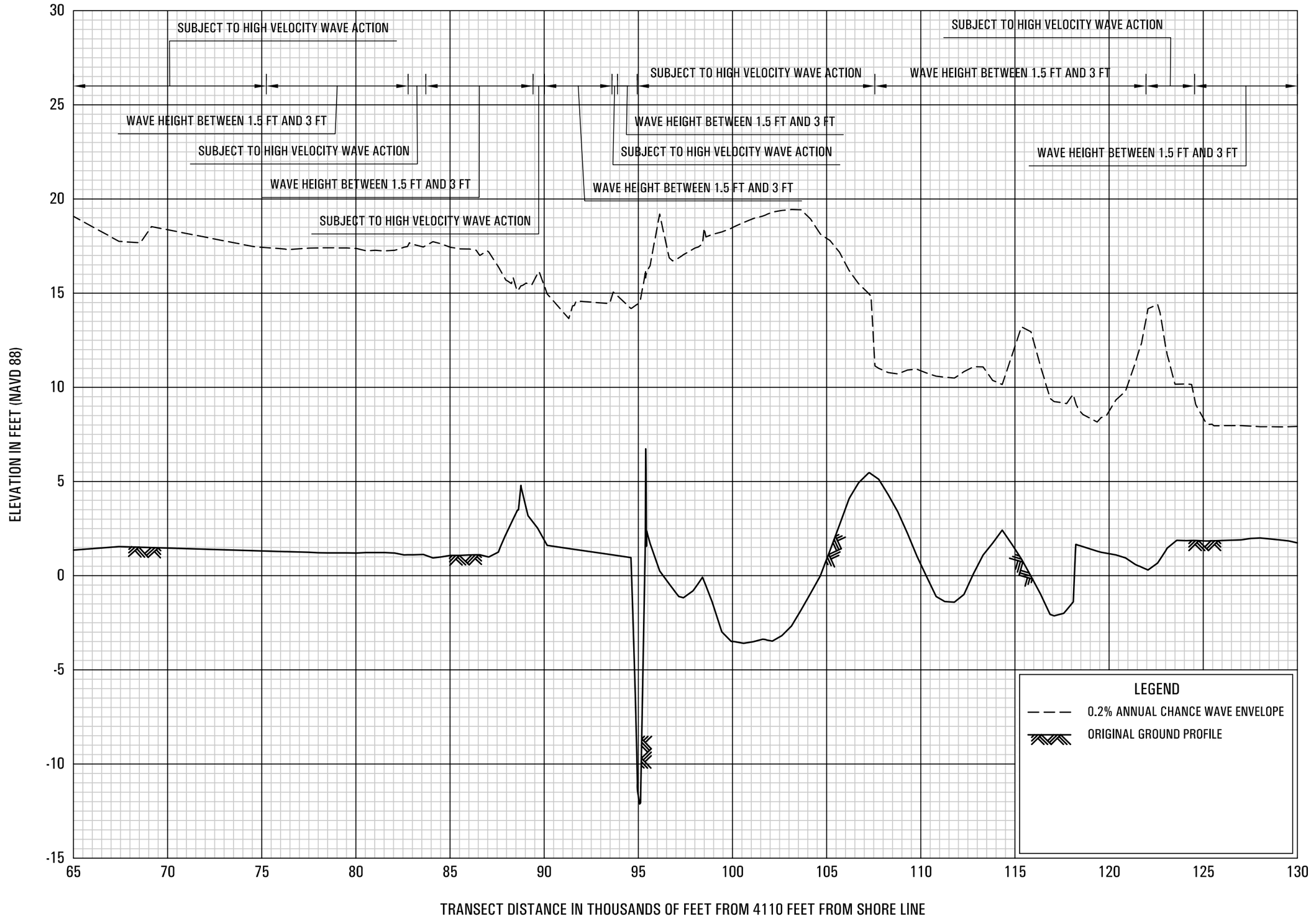
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

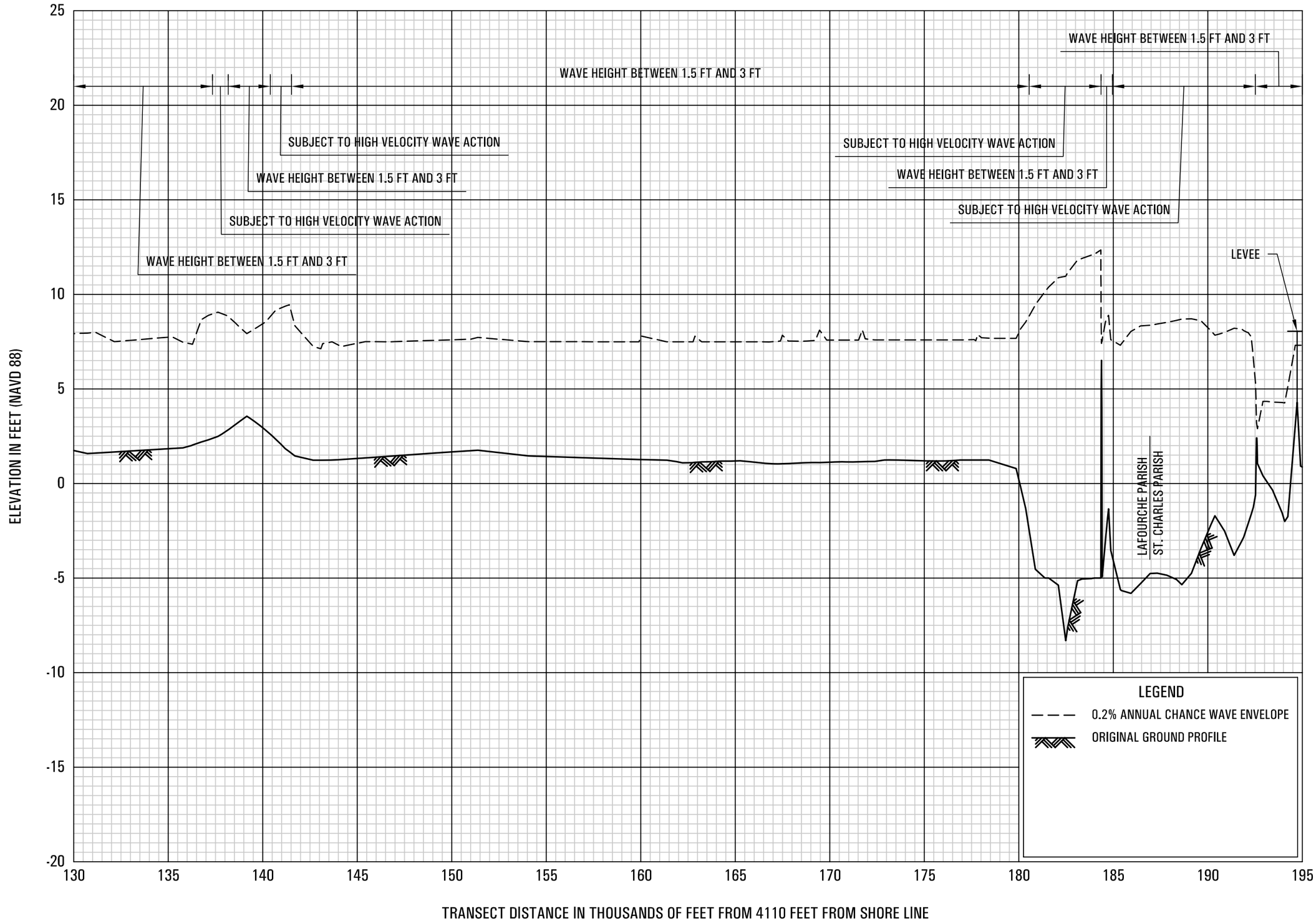
TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

19P



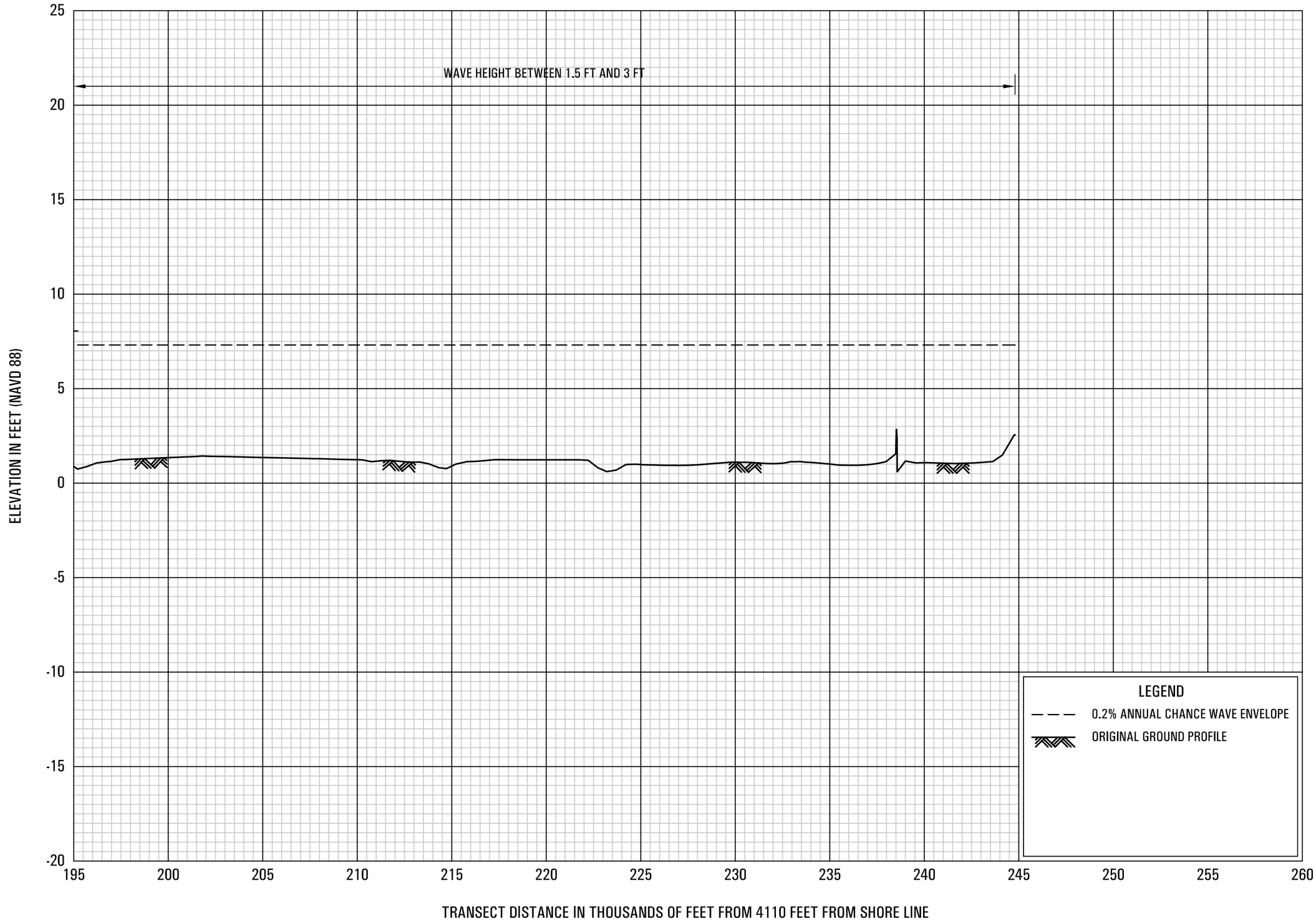
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



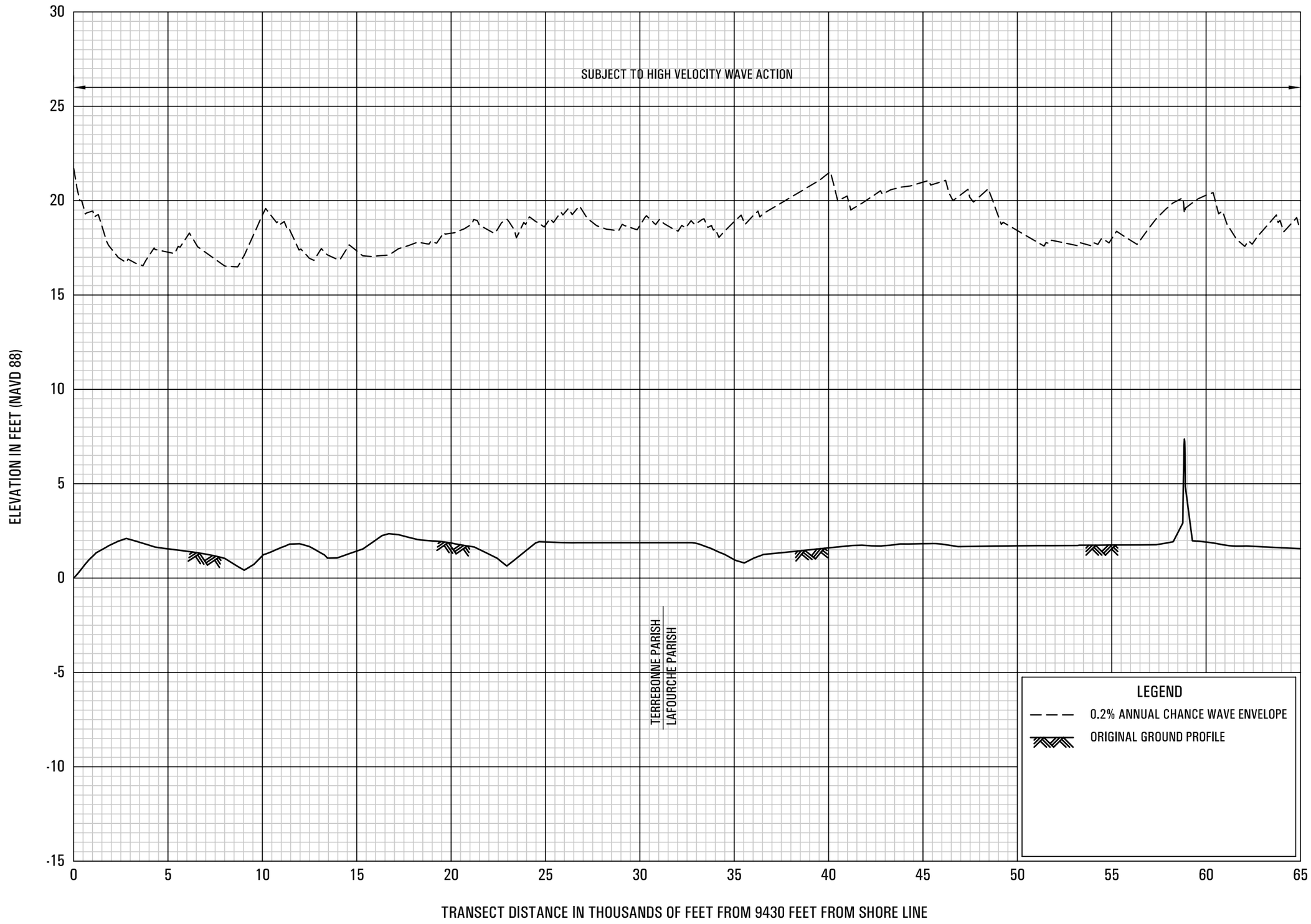
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 15

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



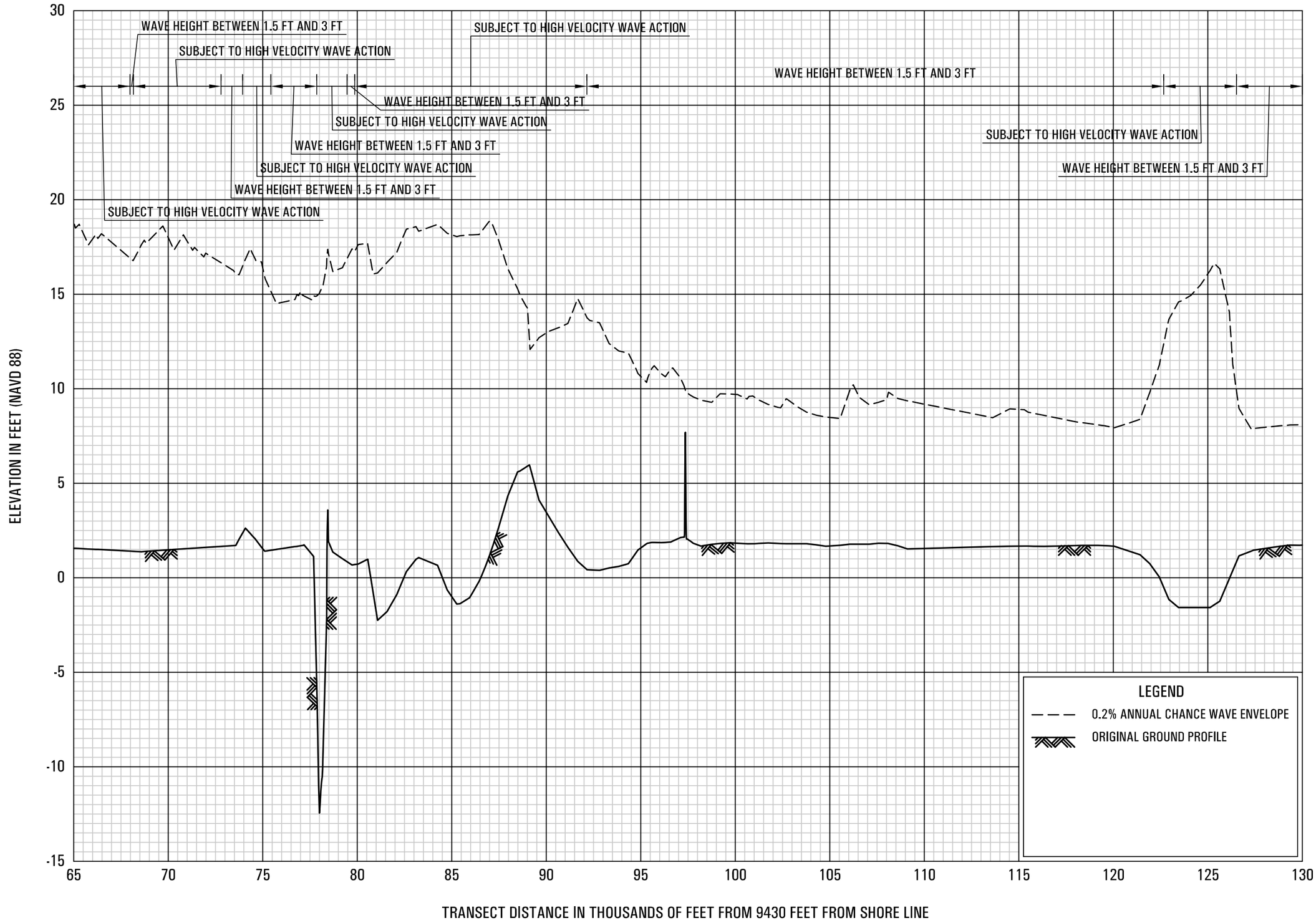
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

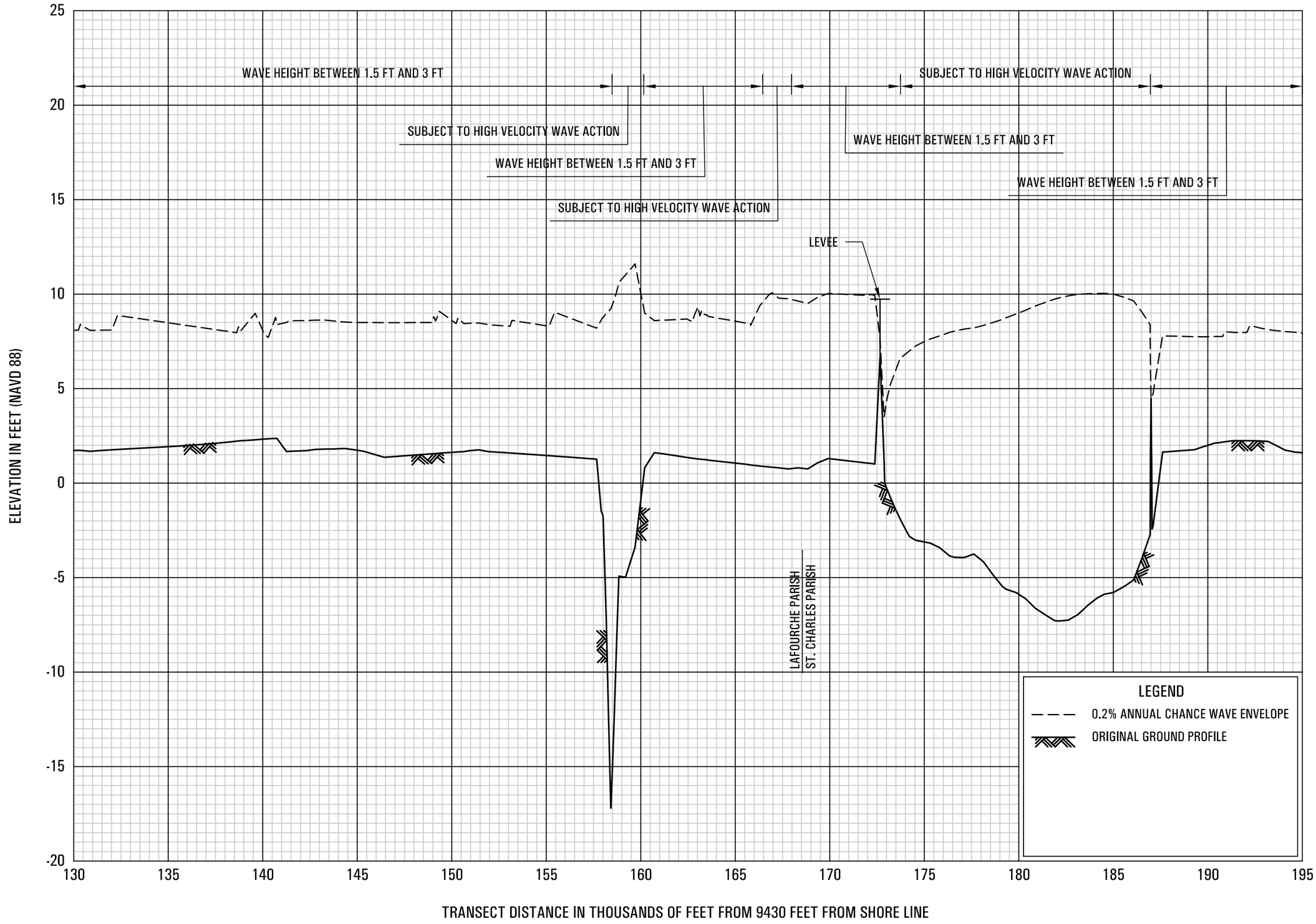
TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

23P



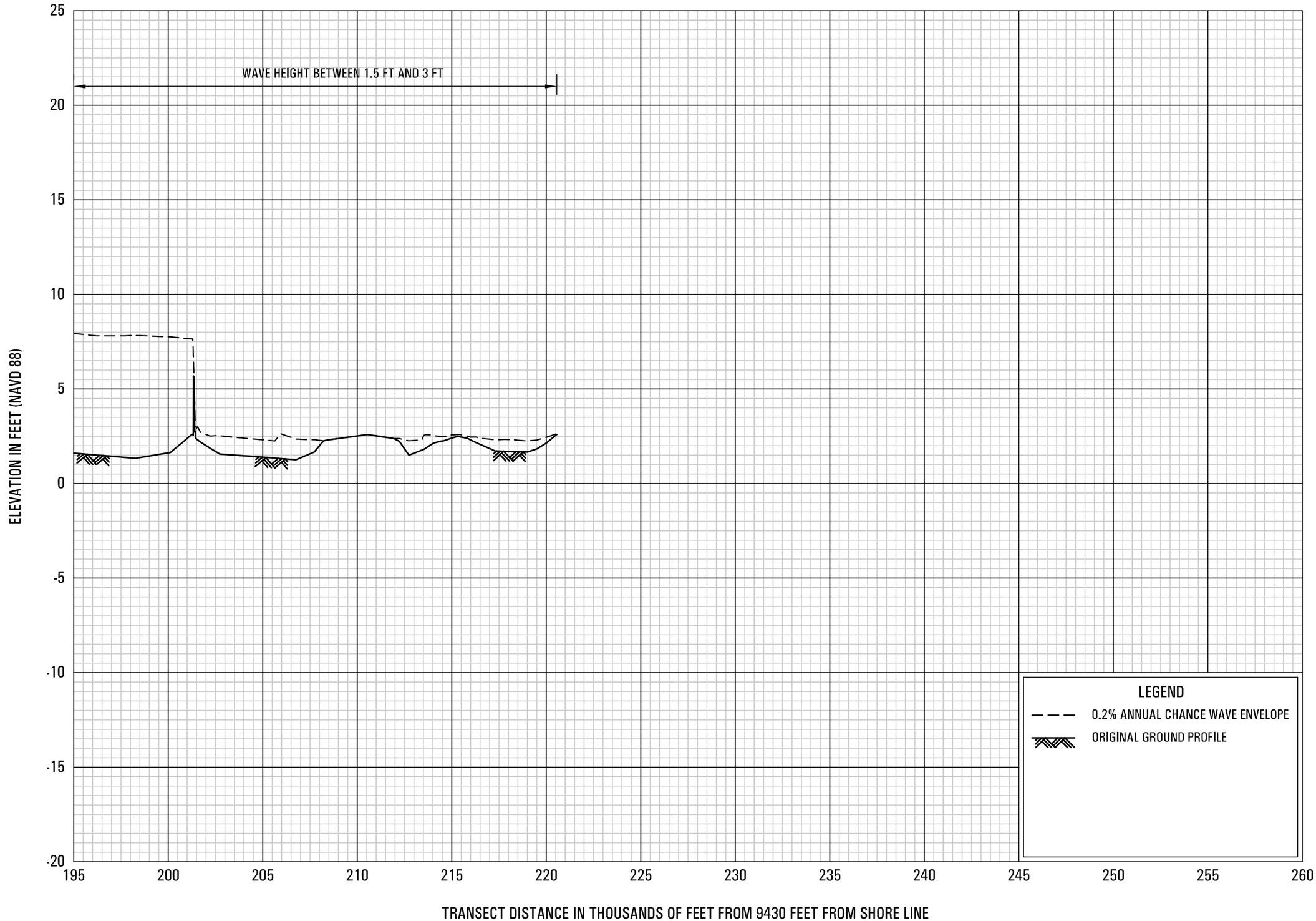
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

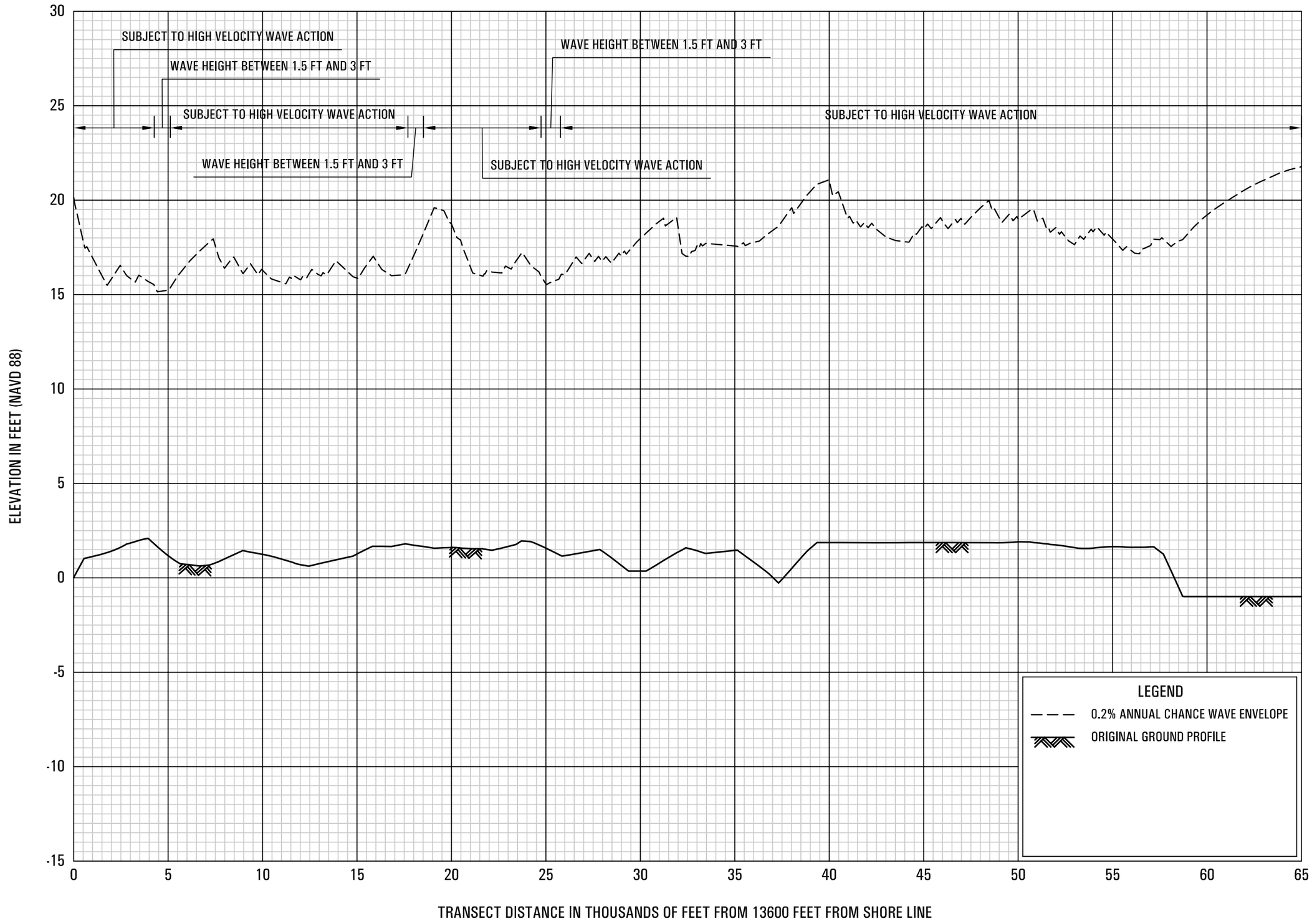
TRANSECT 16

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

25P



0.2% ANNUAL CHANCE WAVE ENVELOPE

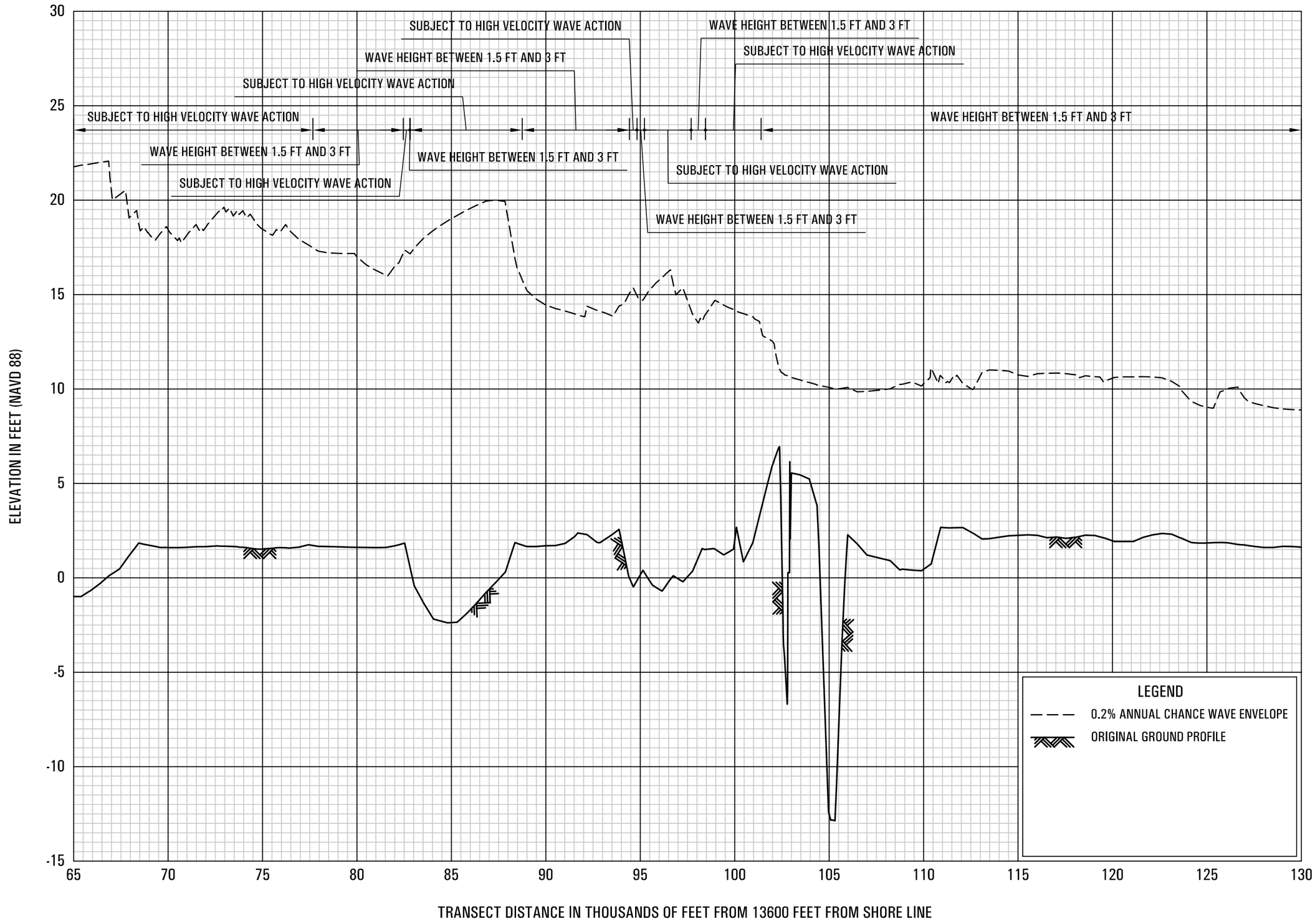
TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

26P



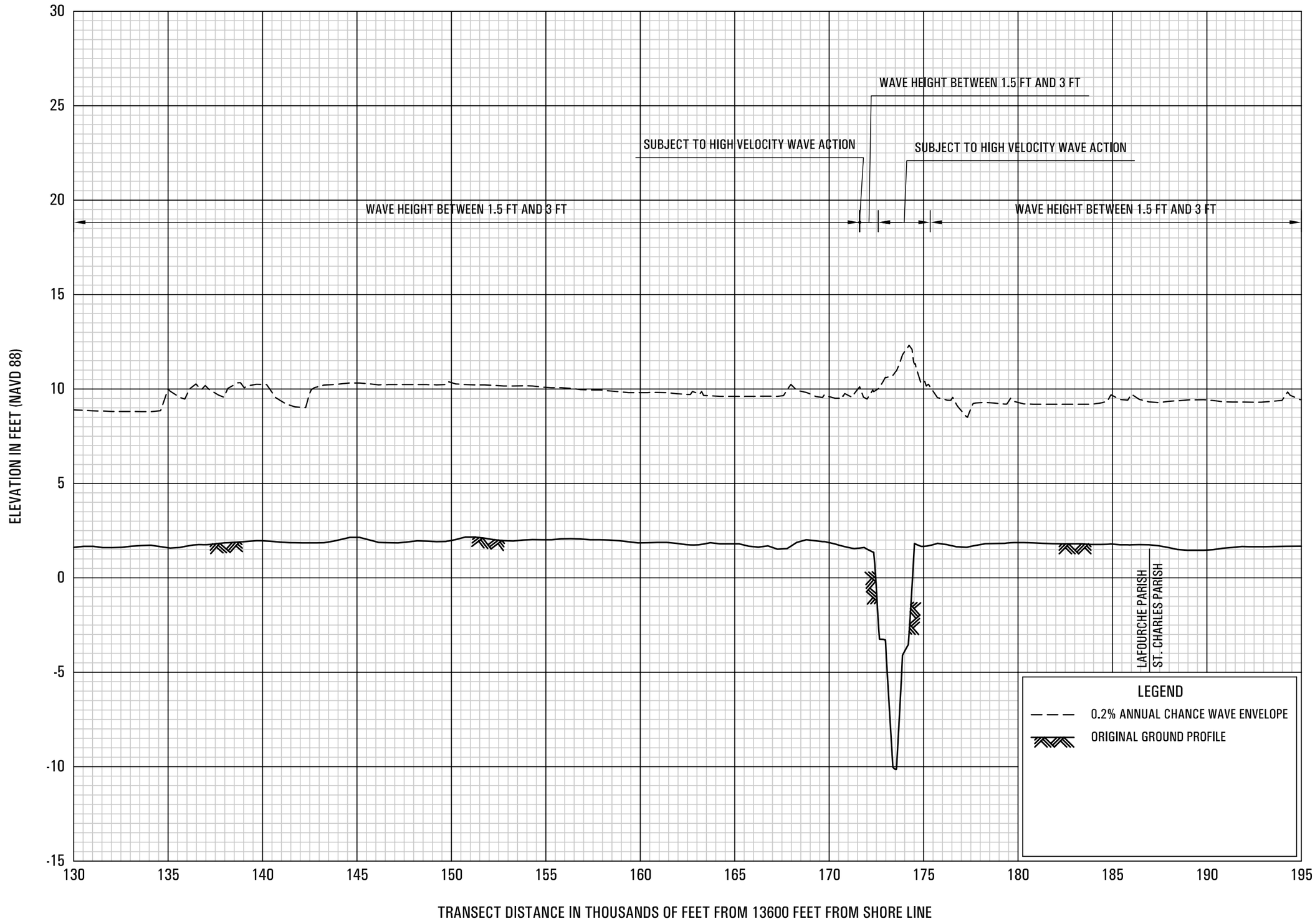
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



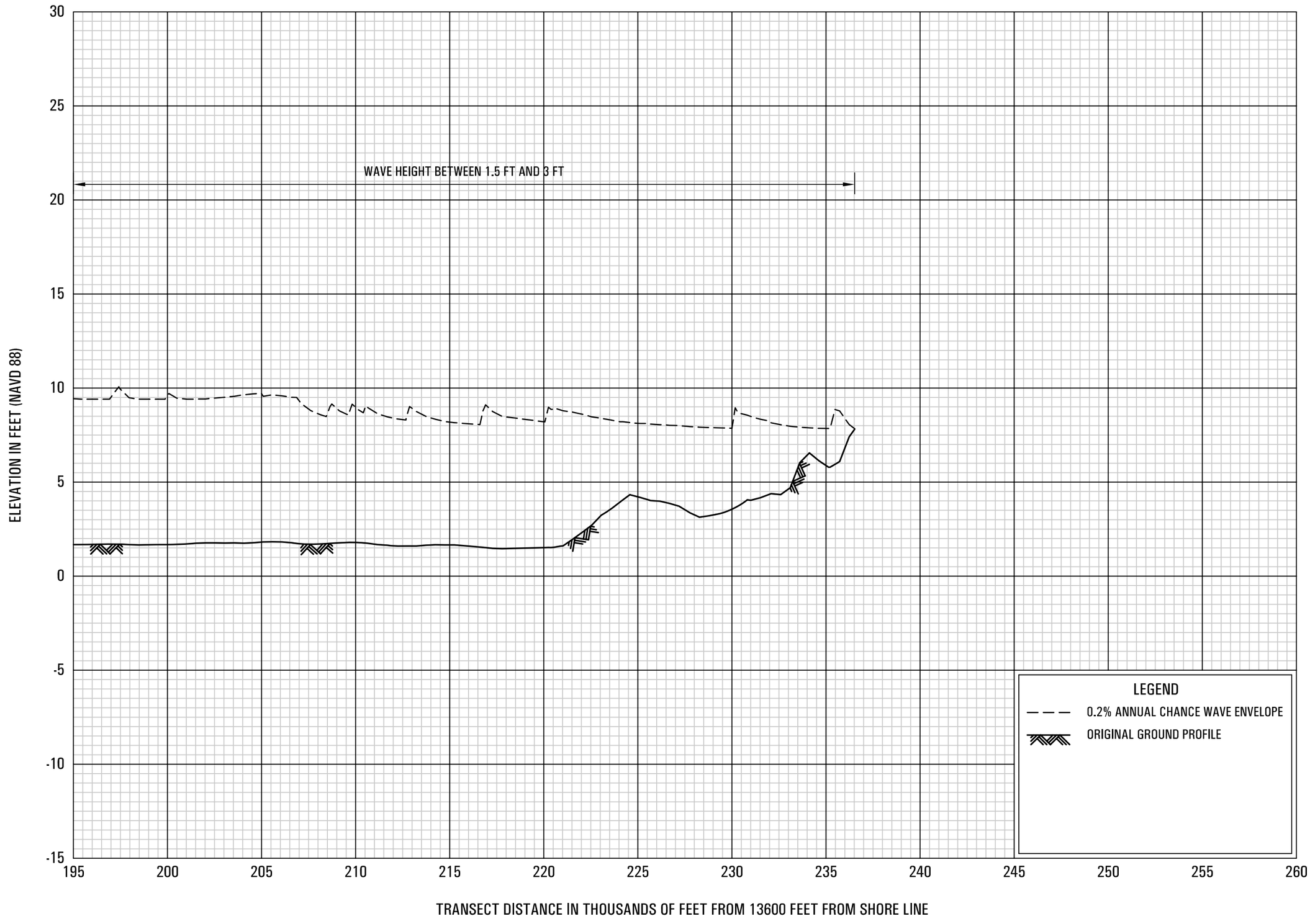
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

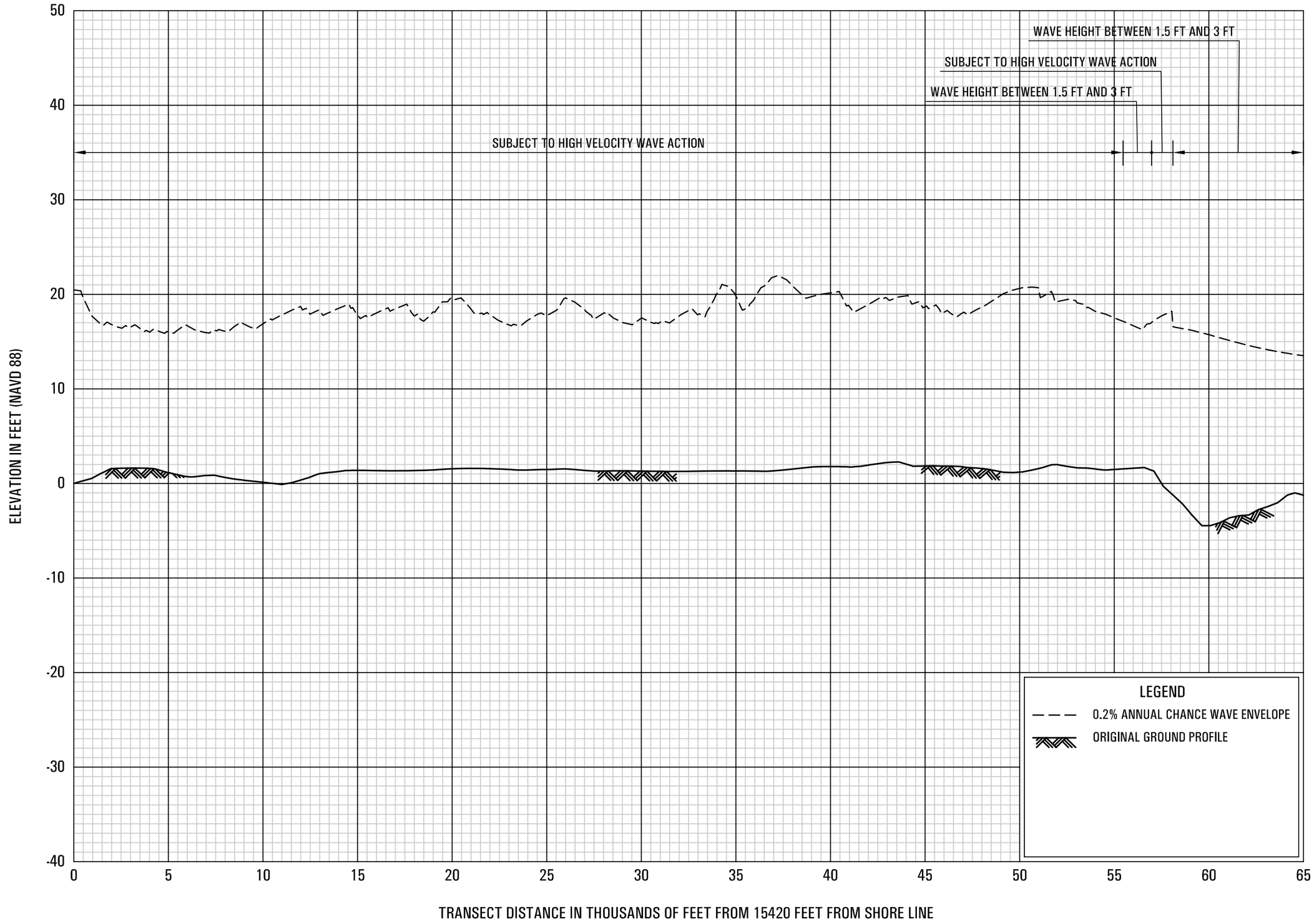
TRANSECT 17

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

29P



0.2% ANNUAL CHANCE WAVE ENVELOPE

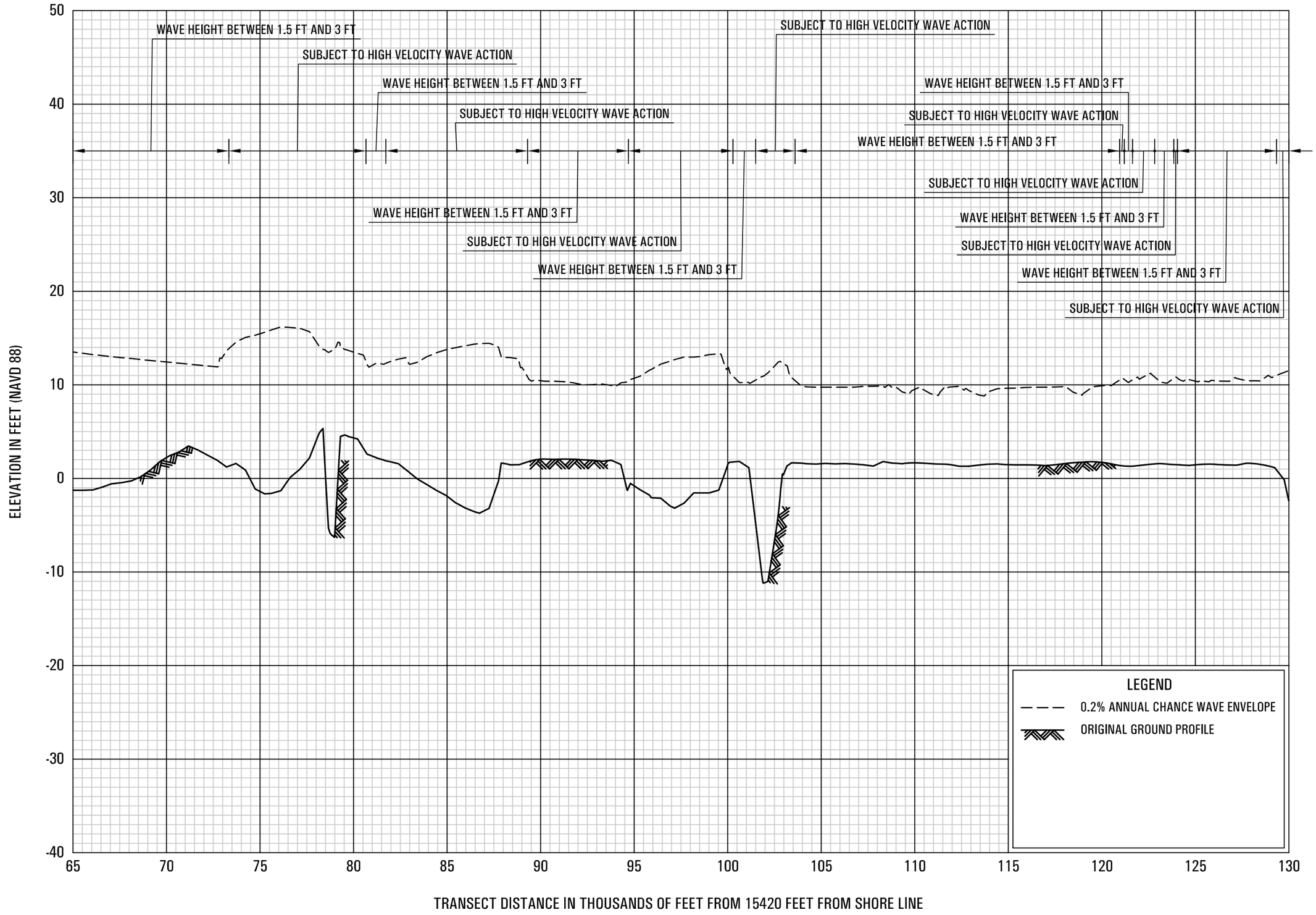
TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

30P



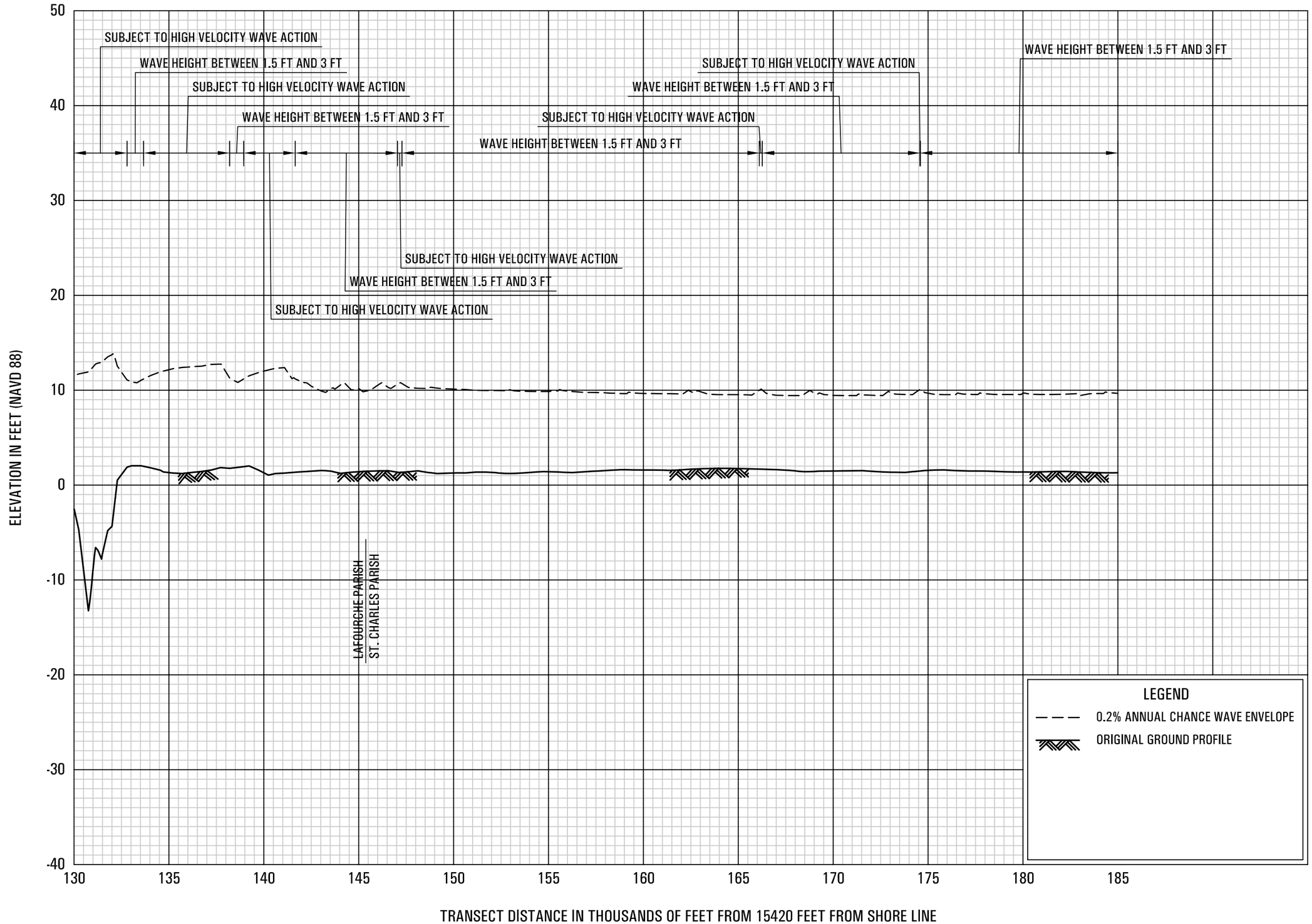
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



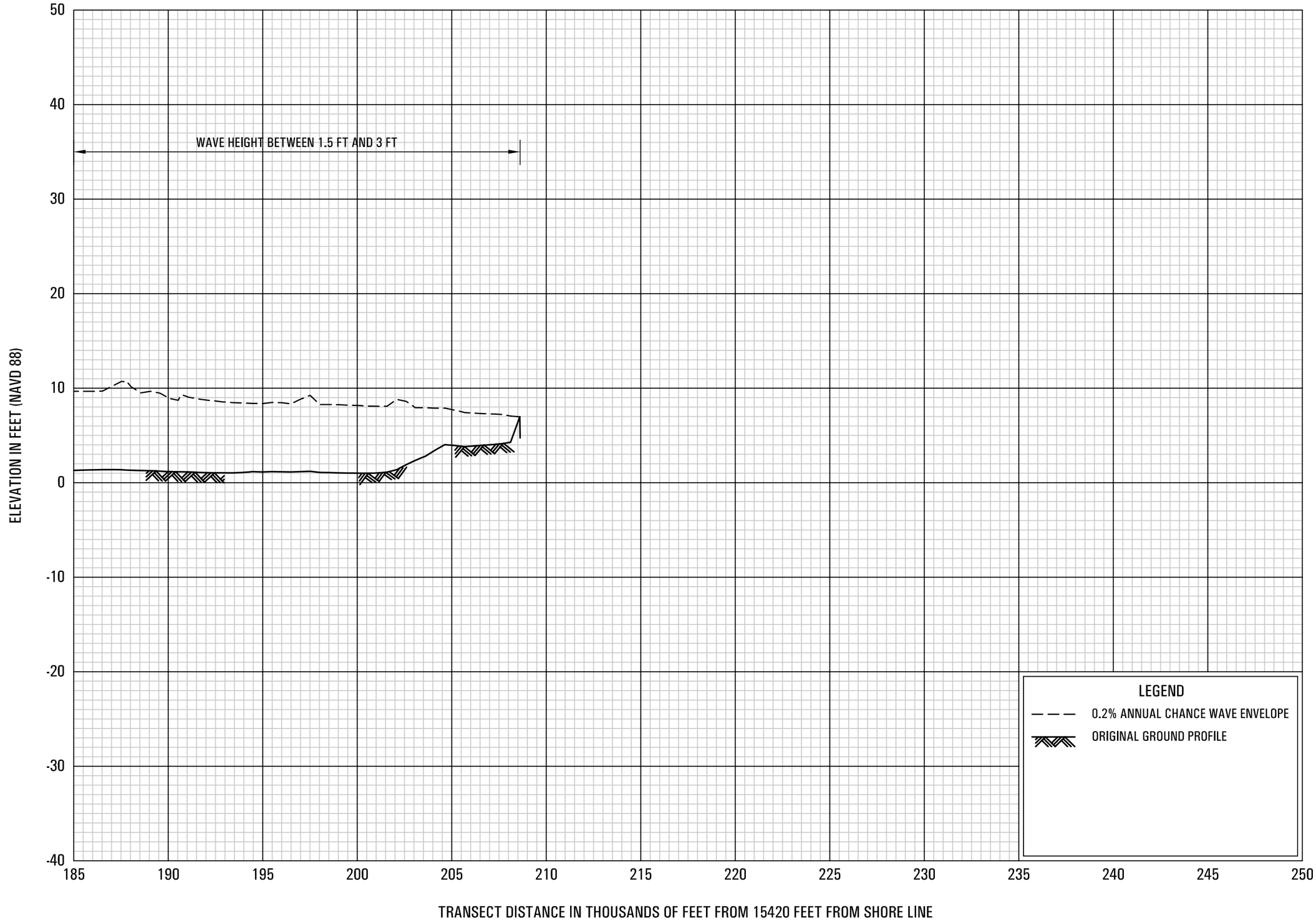
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



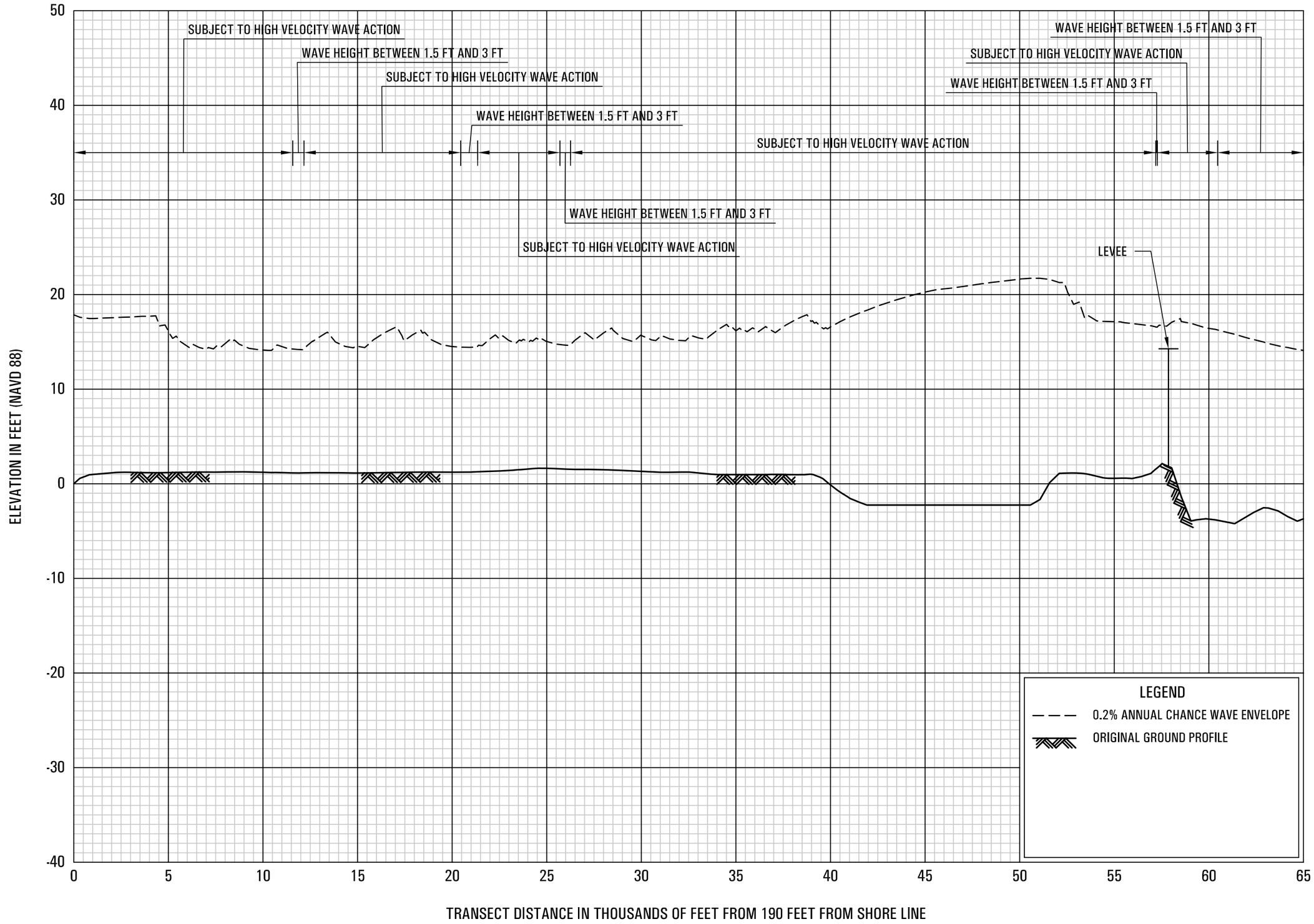
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 18

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



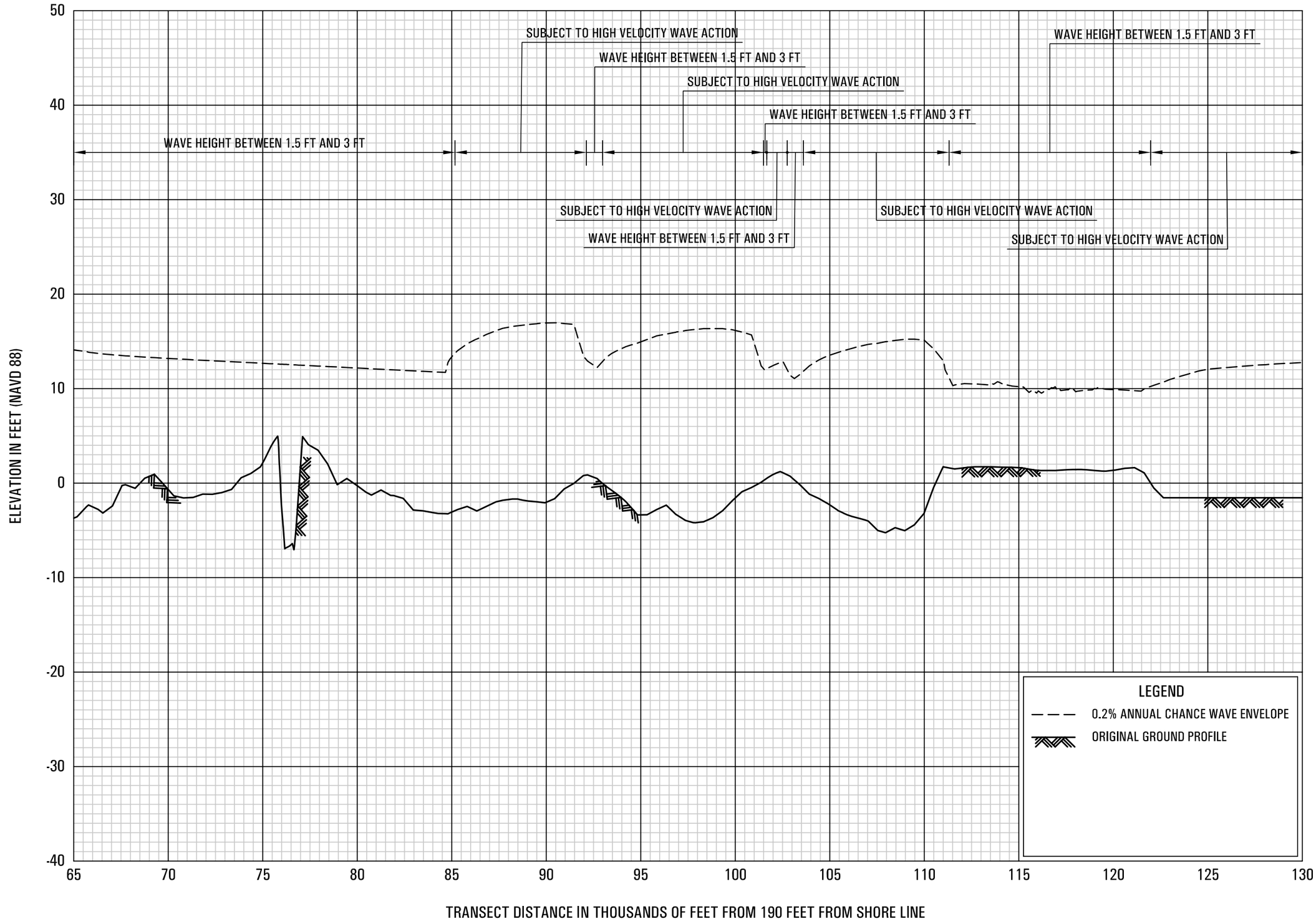
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

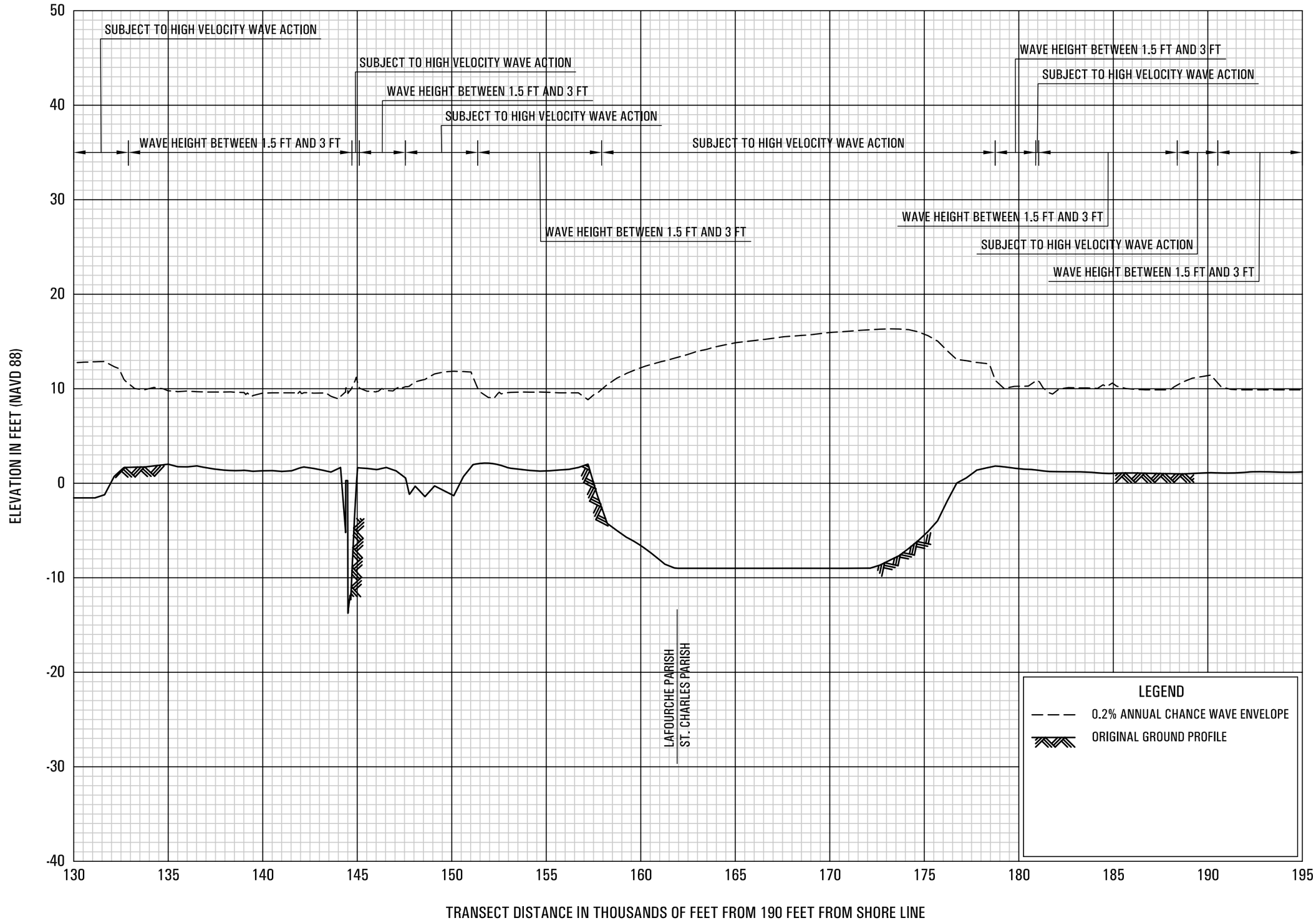
TRANSECT 19

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

35P



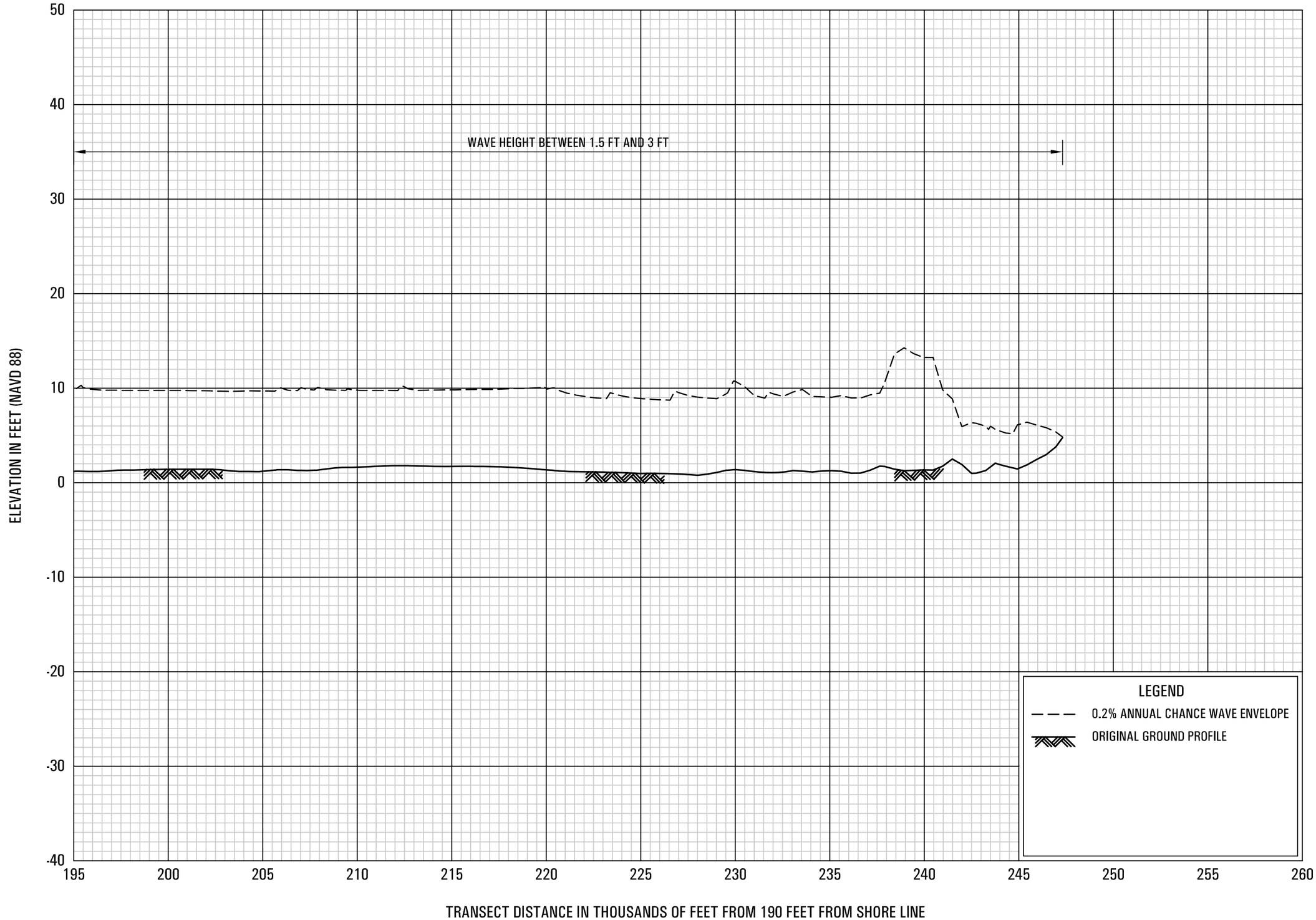
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



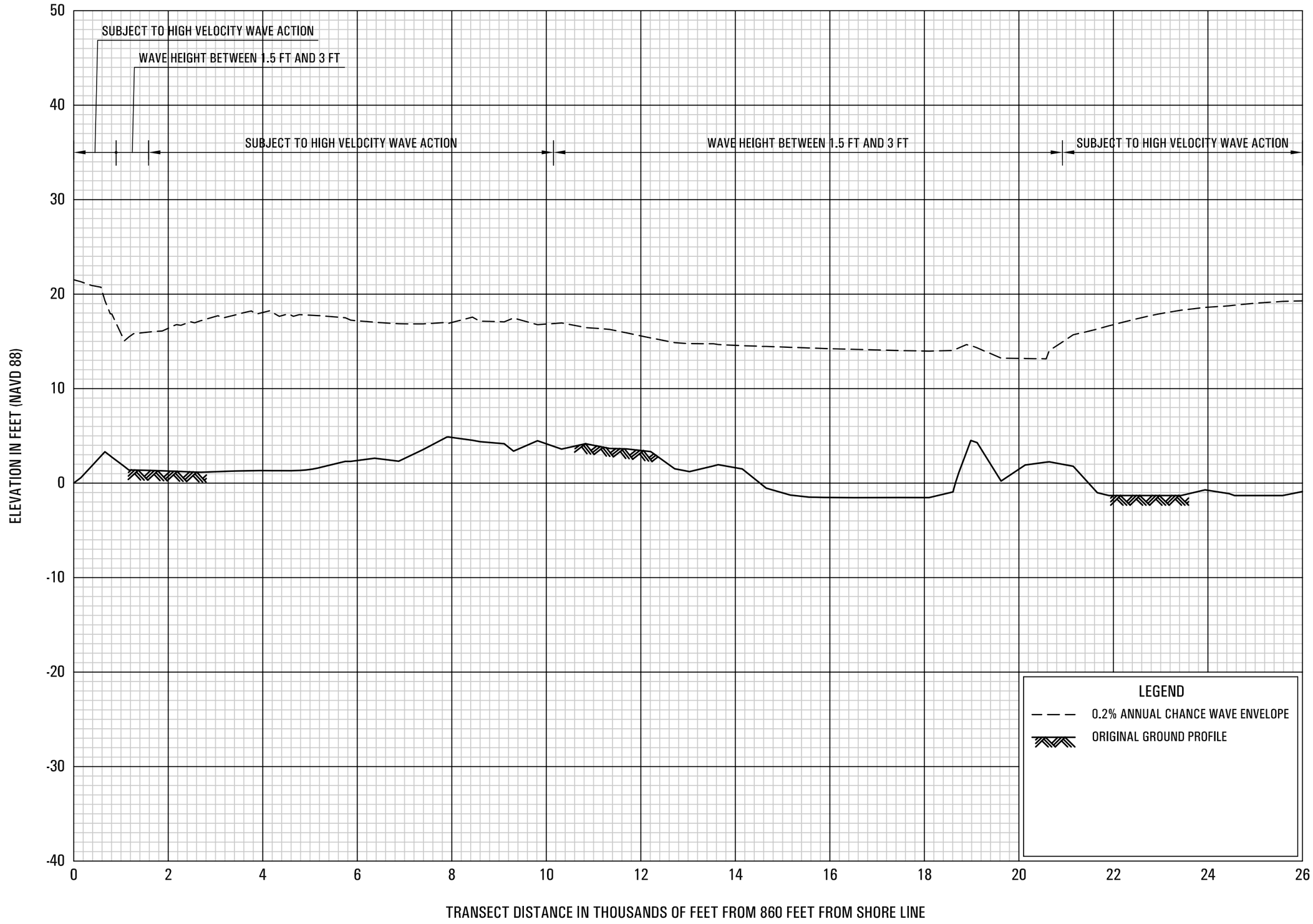
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 19

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



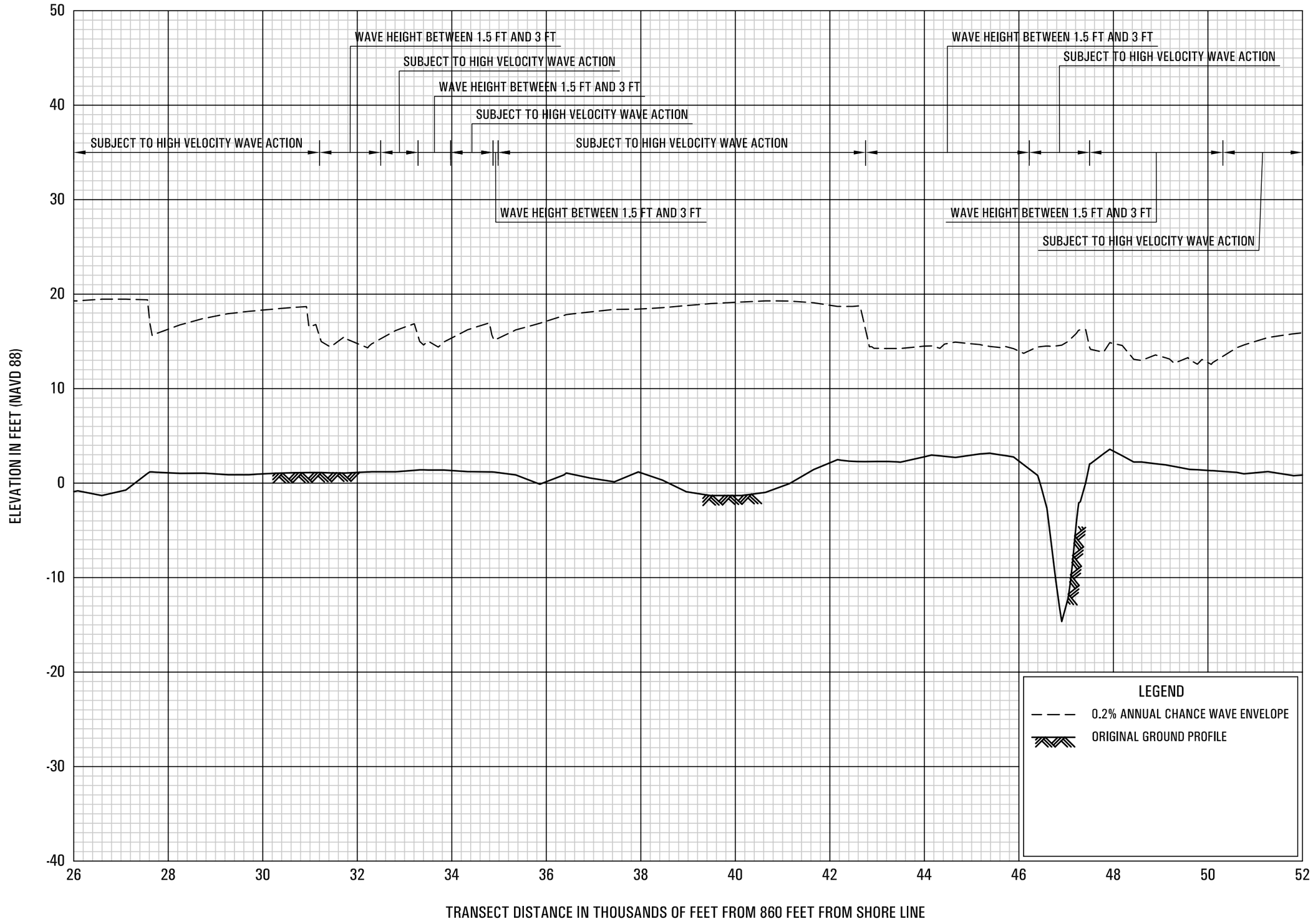
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

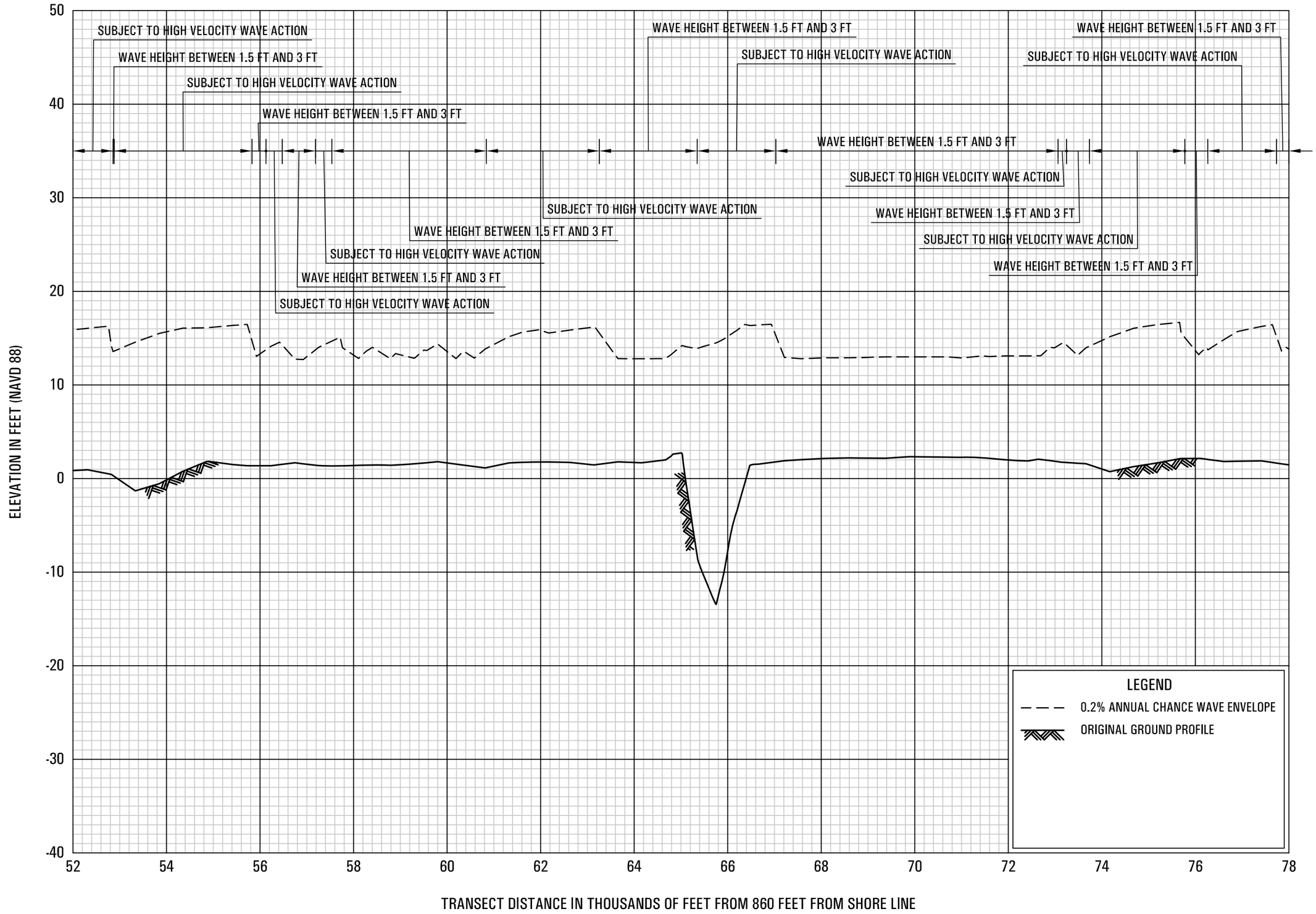
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

39P



0.2% ANNUAL CHANCE WAVE ENVELOPE

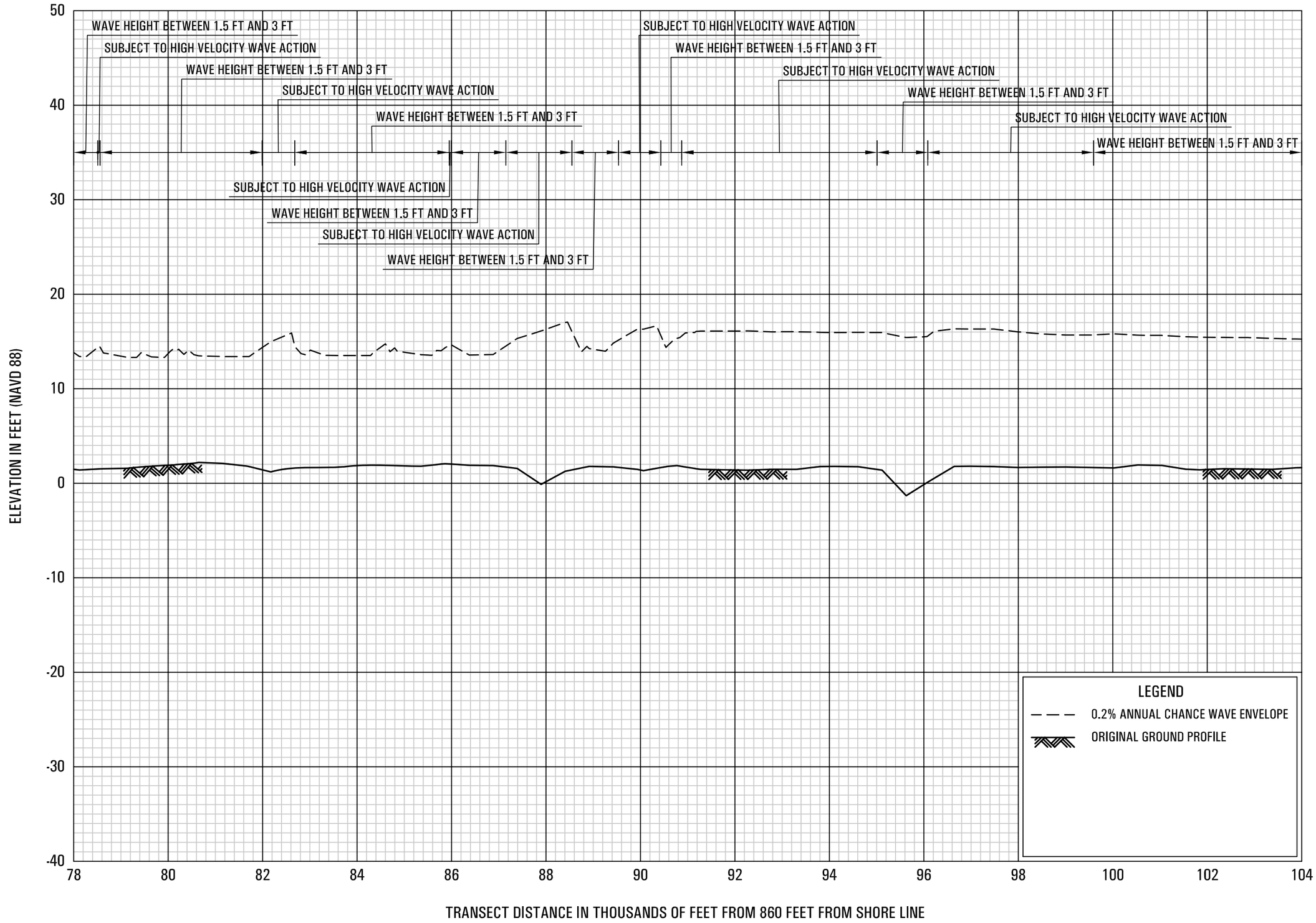
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

40P



0.2% ANNUAL CHANCE WAVE ENVELOPE

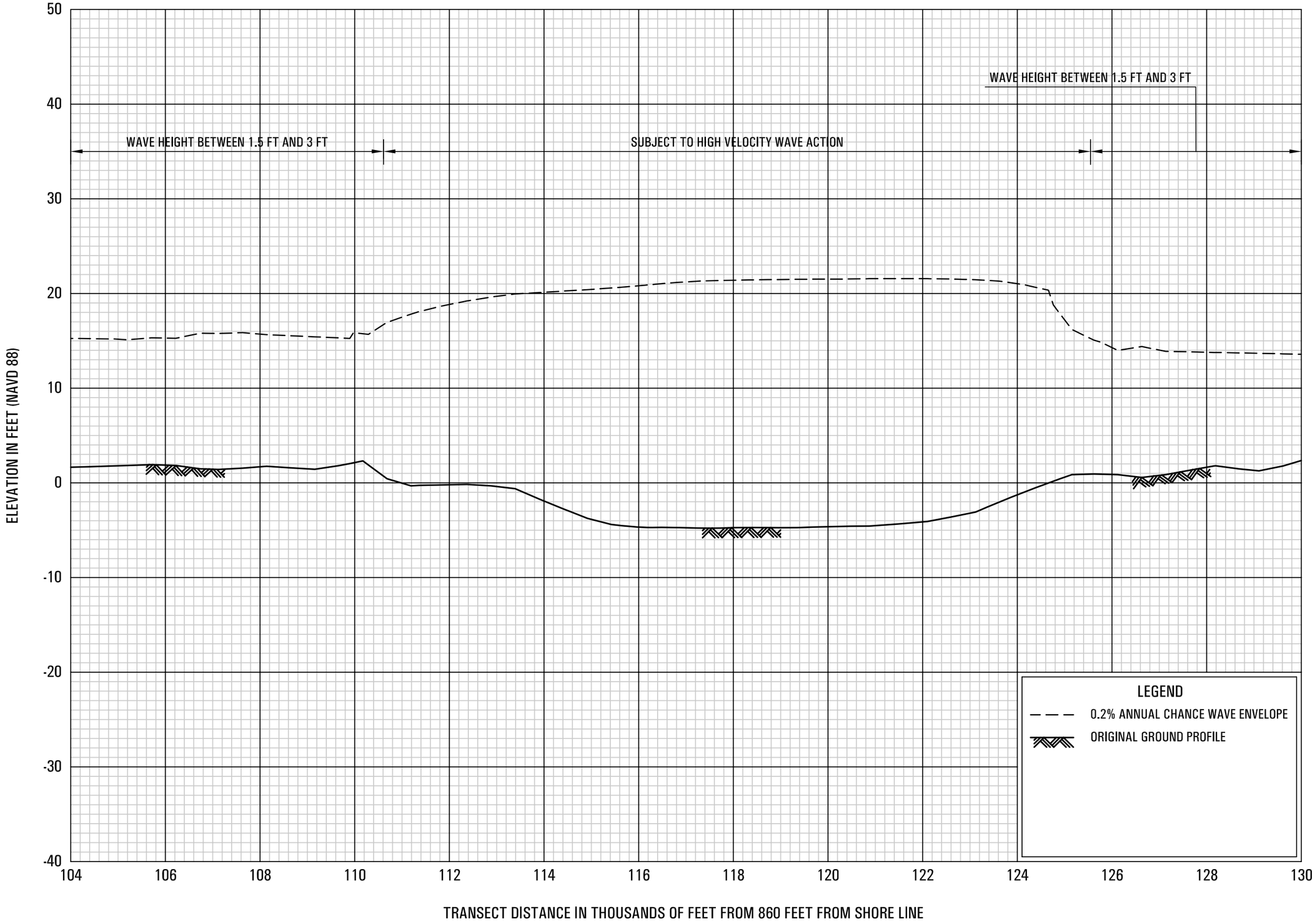
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

41P



0.2% ANNUAL CHANCE WAVE ENVELOPE

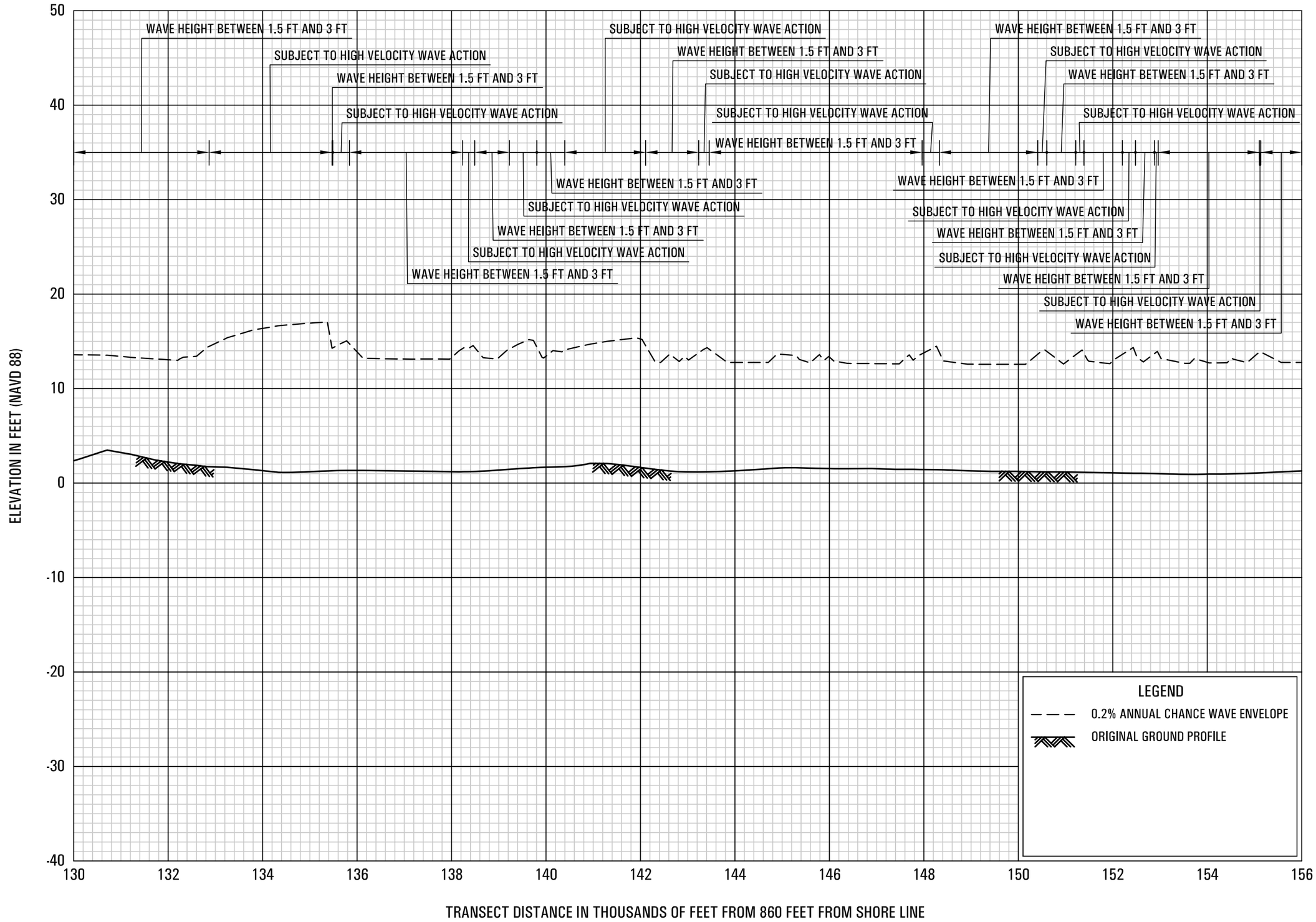
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

42P



0.2% ANNUAL CHANCE WAVE ENVELOPE

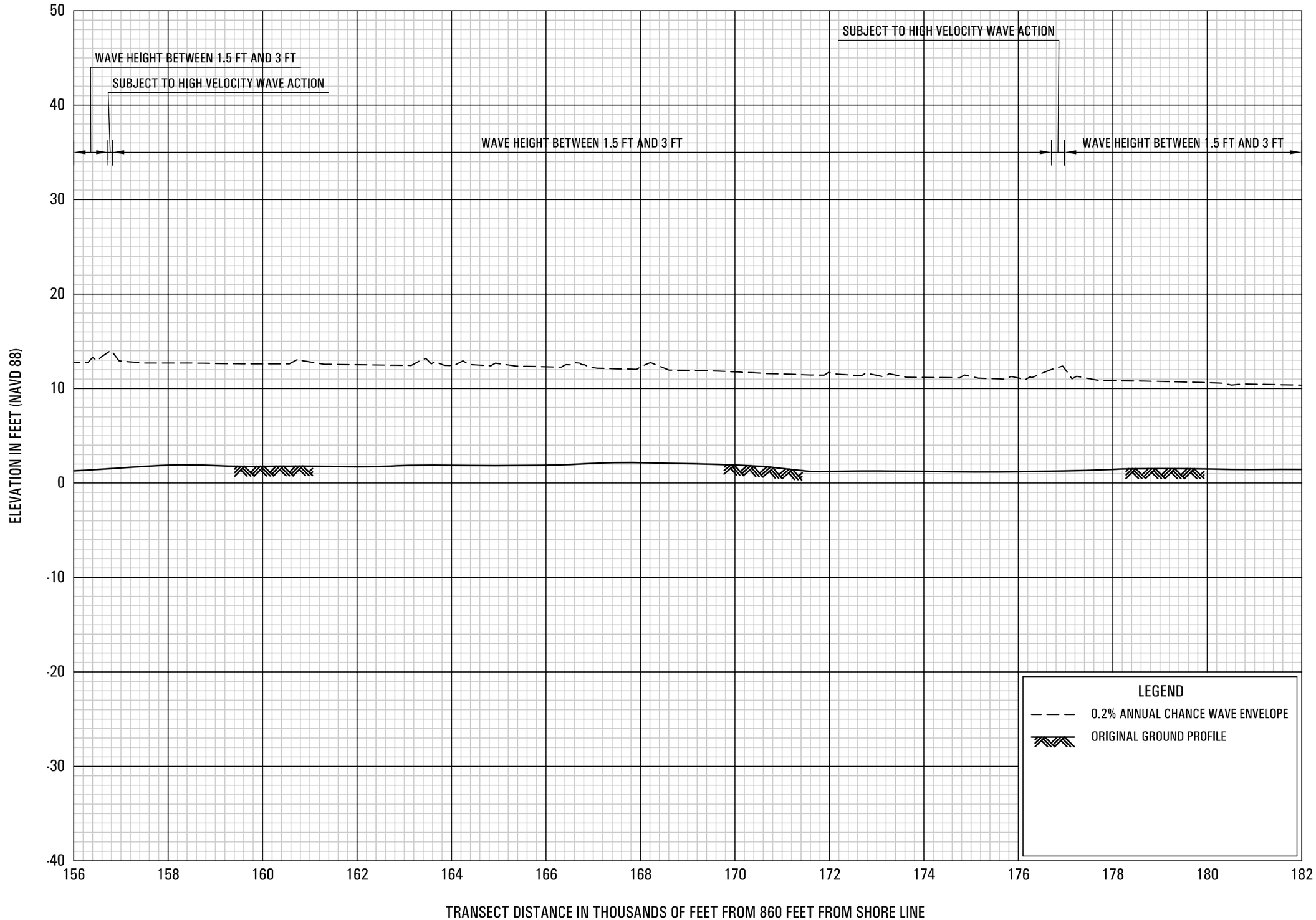
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

43P



0.2% ANNUAL CHANCE WAVE ENVELOPE

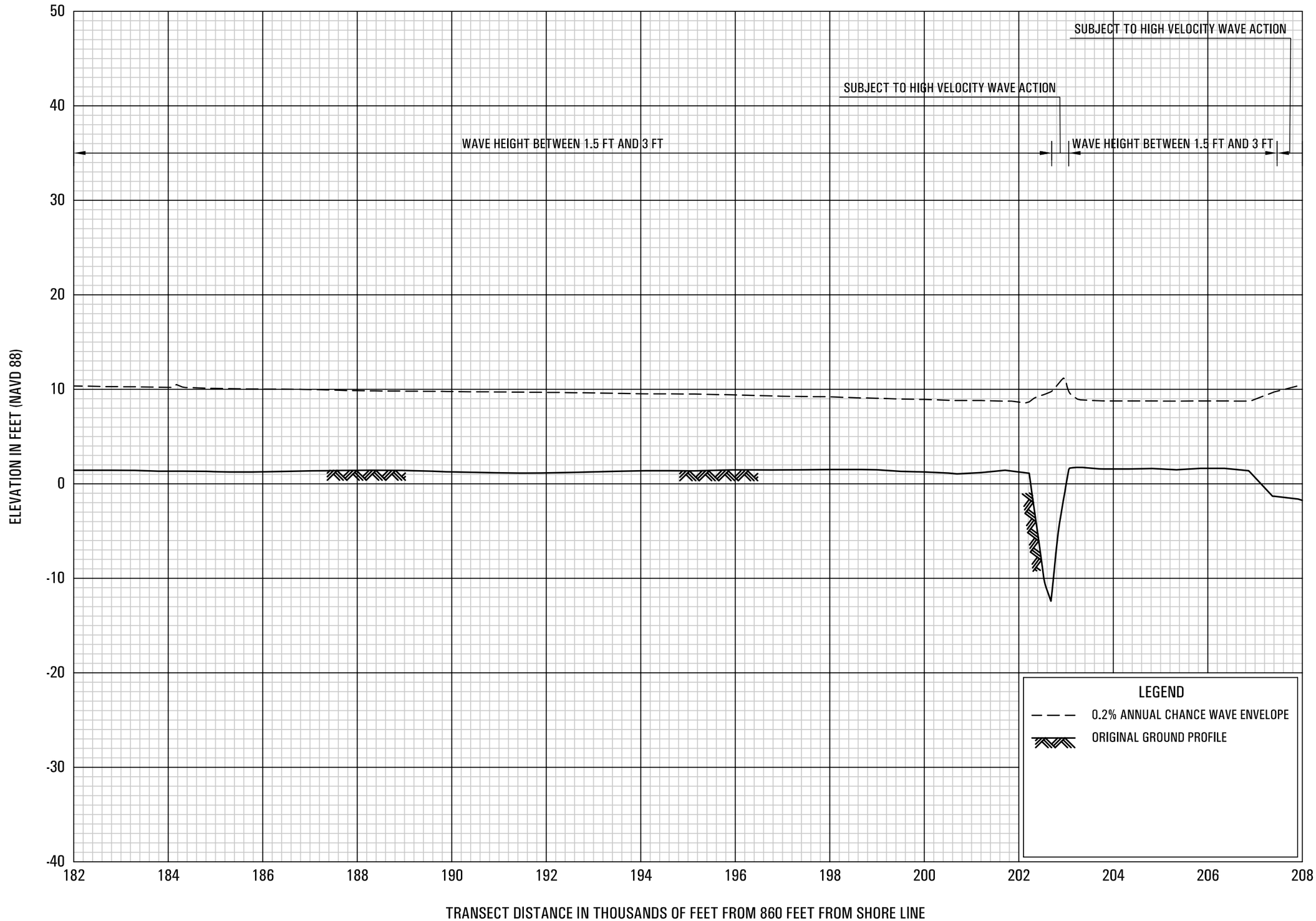
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

44P



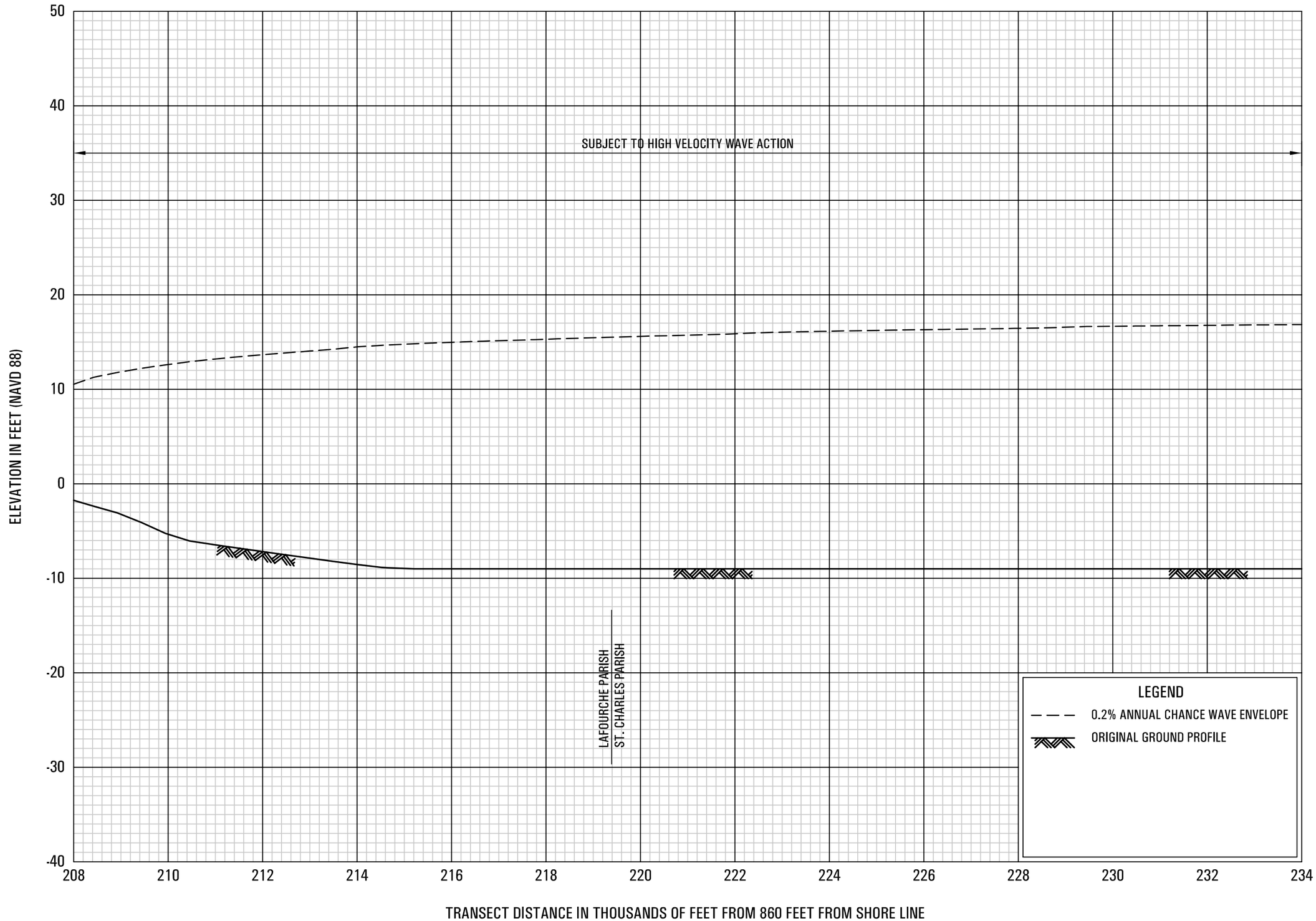
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



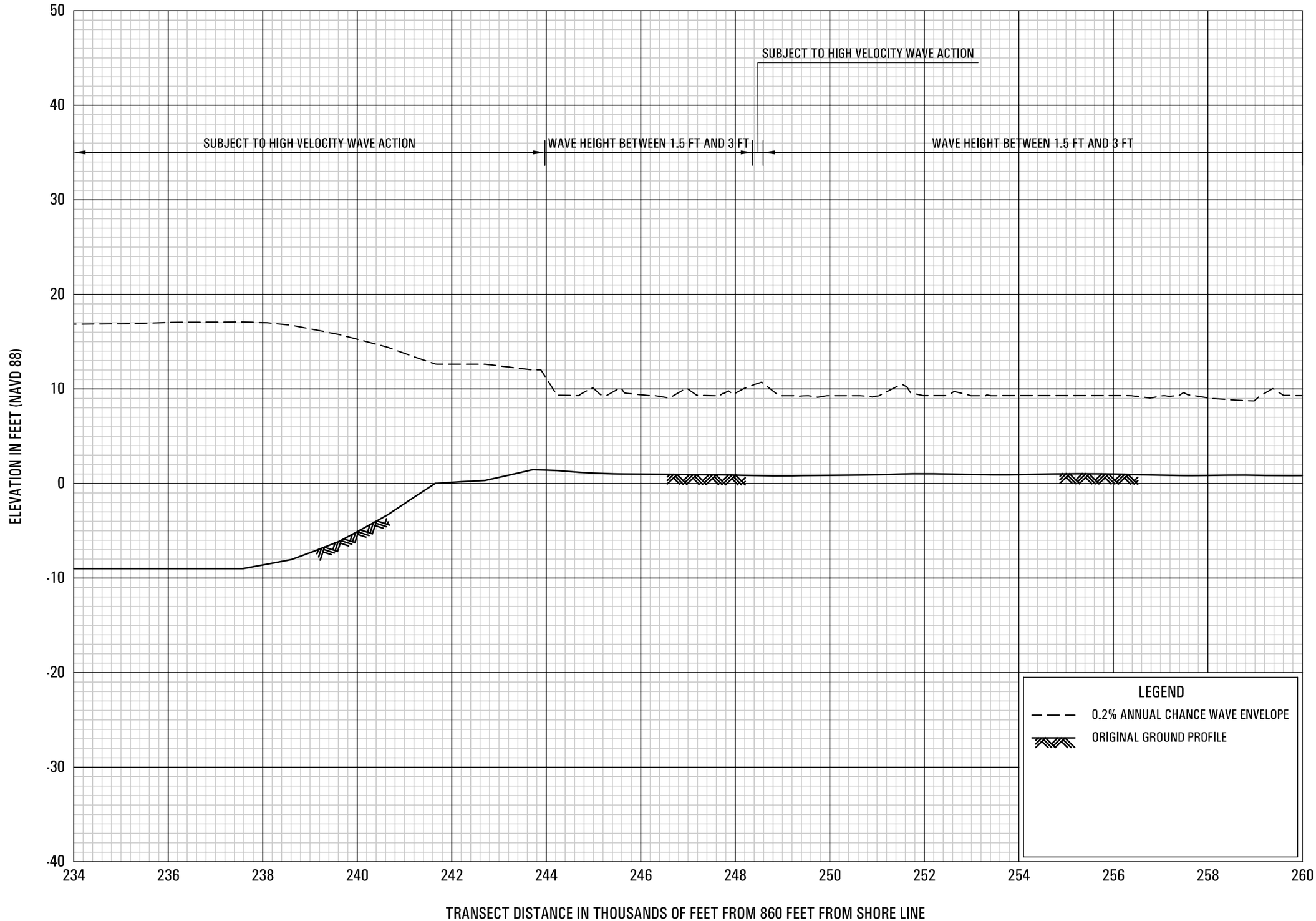
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



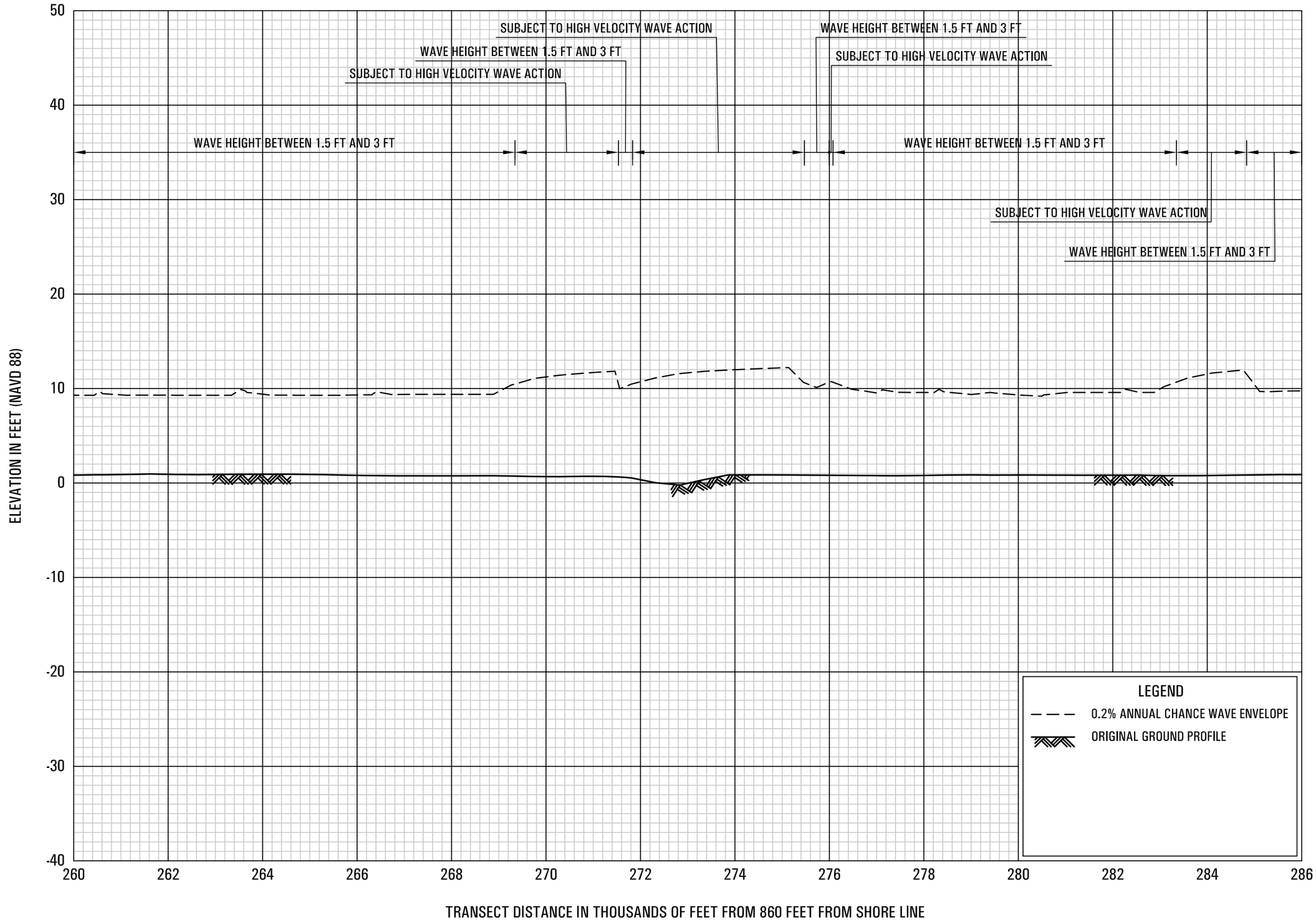
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

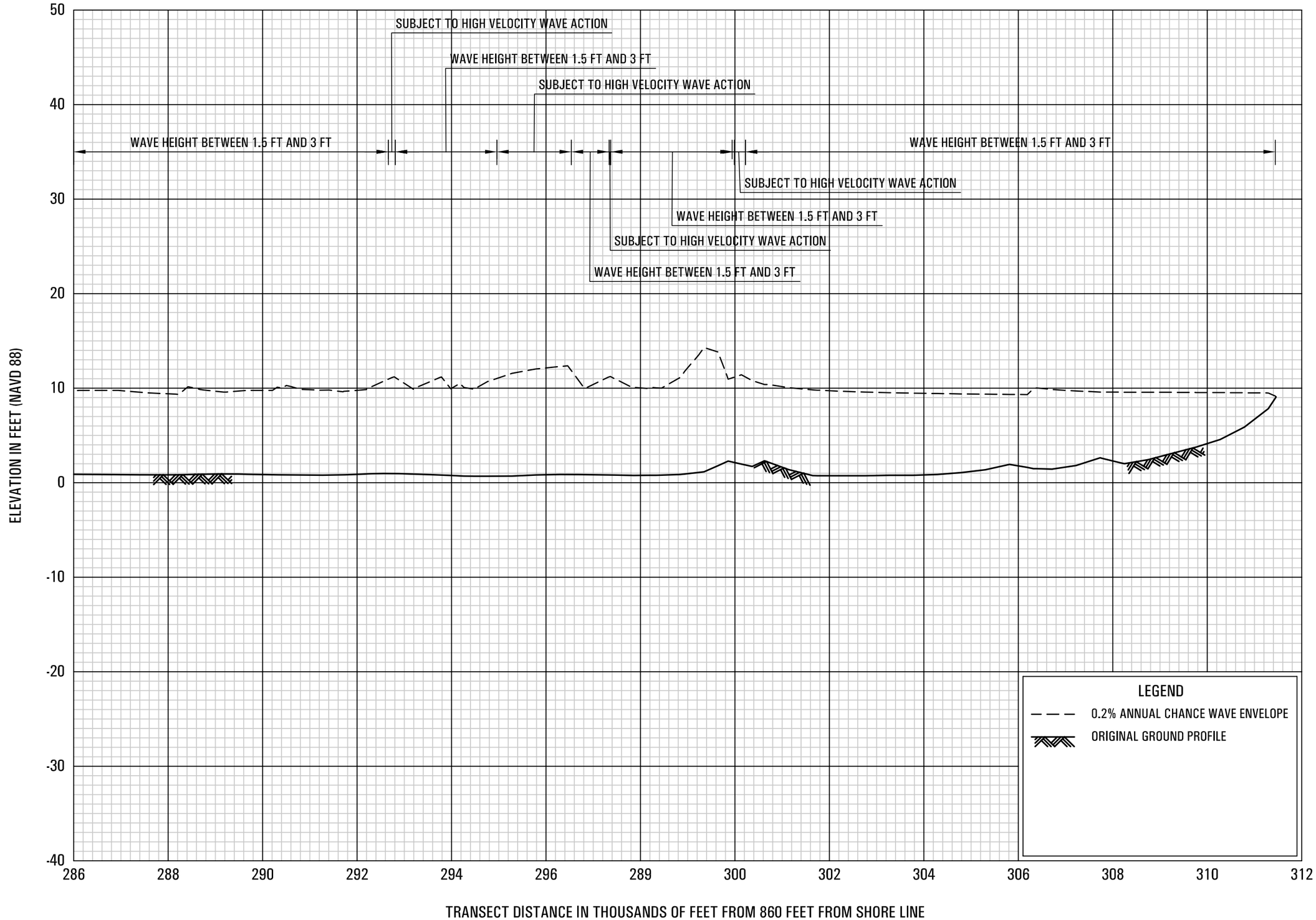
TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

48P



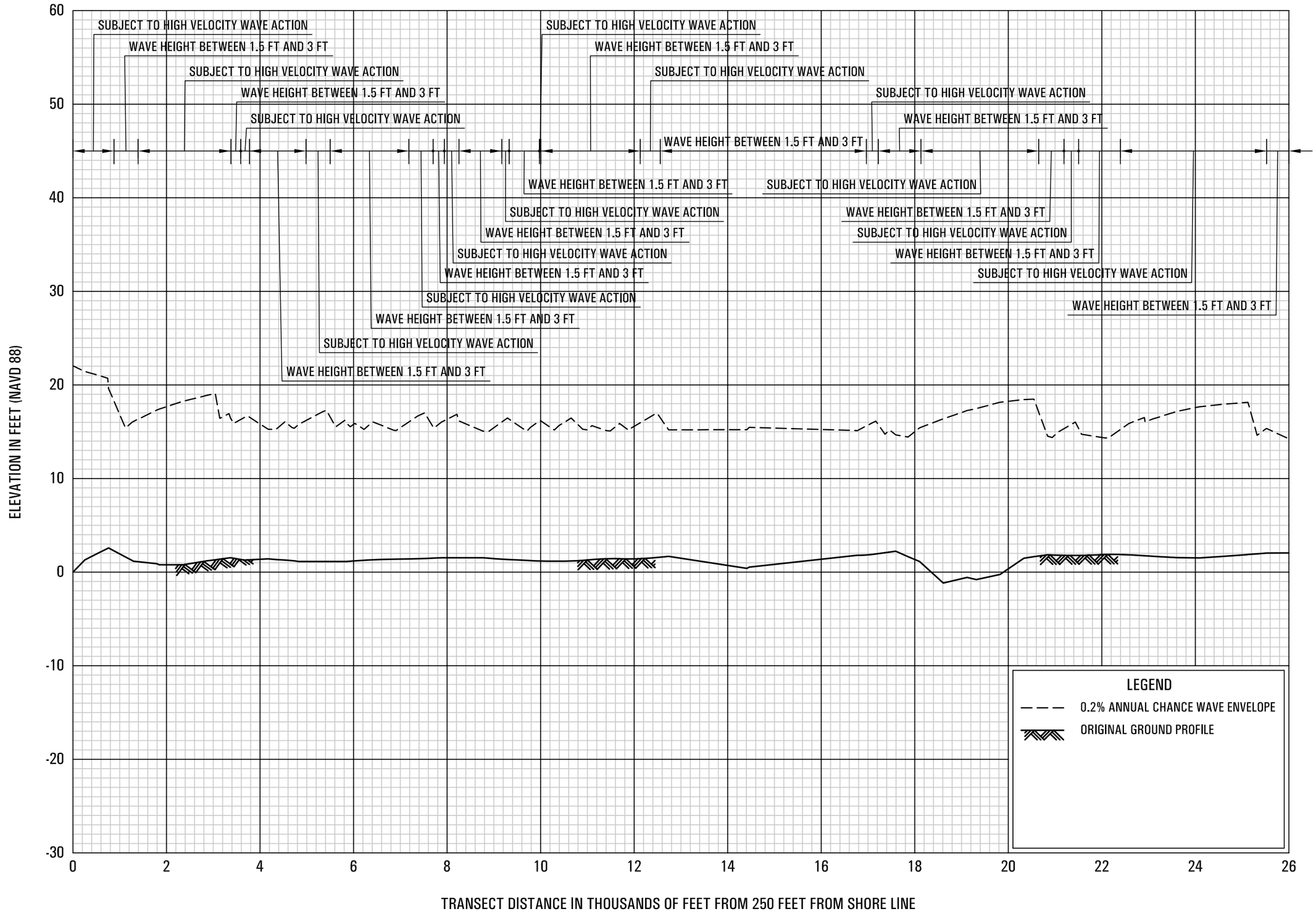
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 20

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

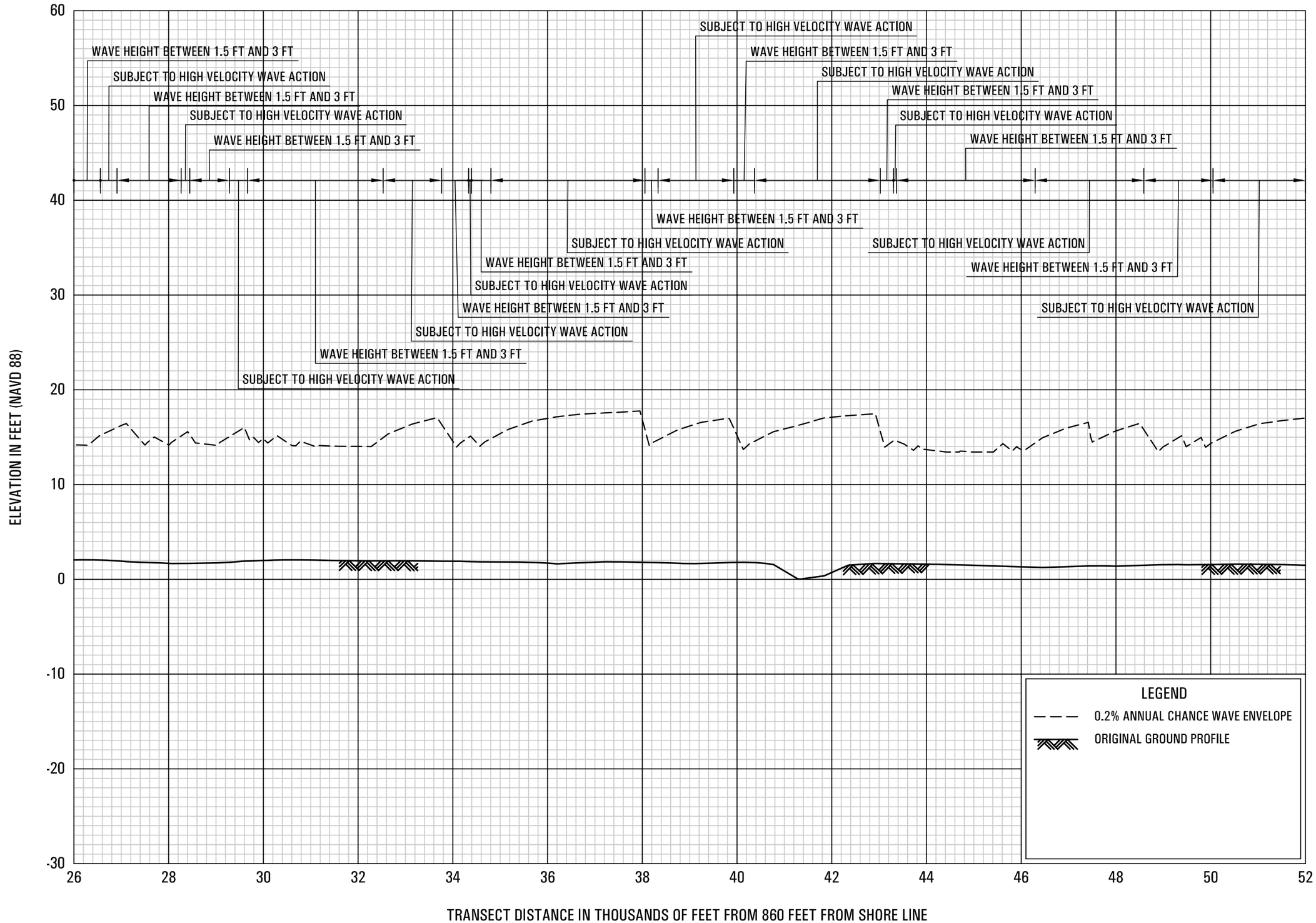
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

50P



0.2% ANNUAL CHANCE WAVE ENVELOPE

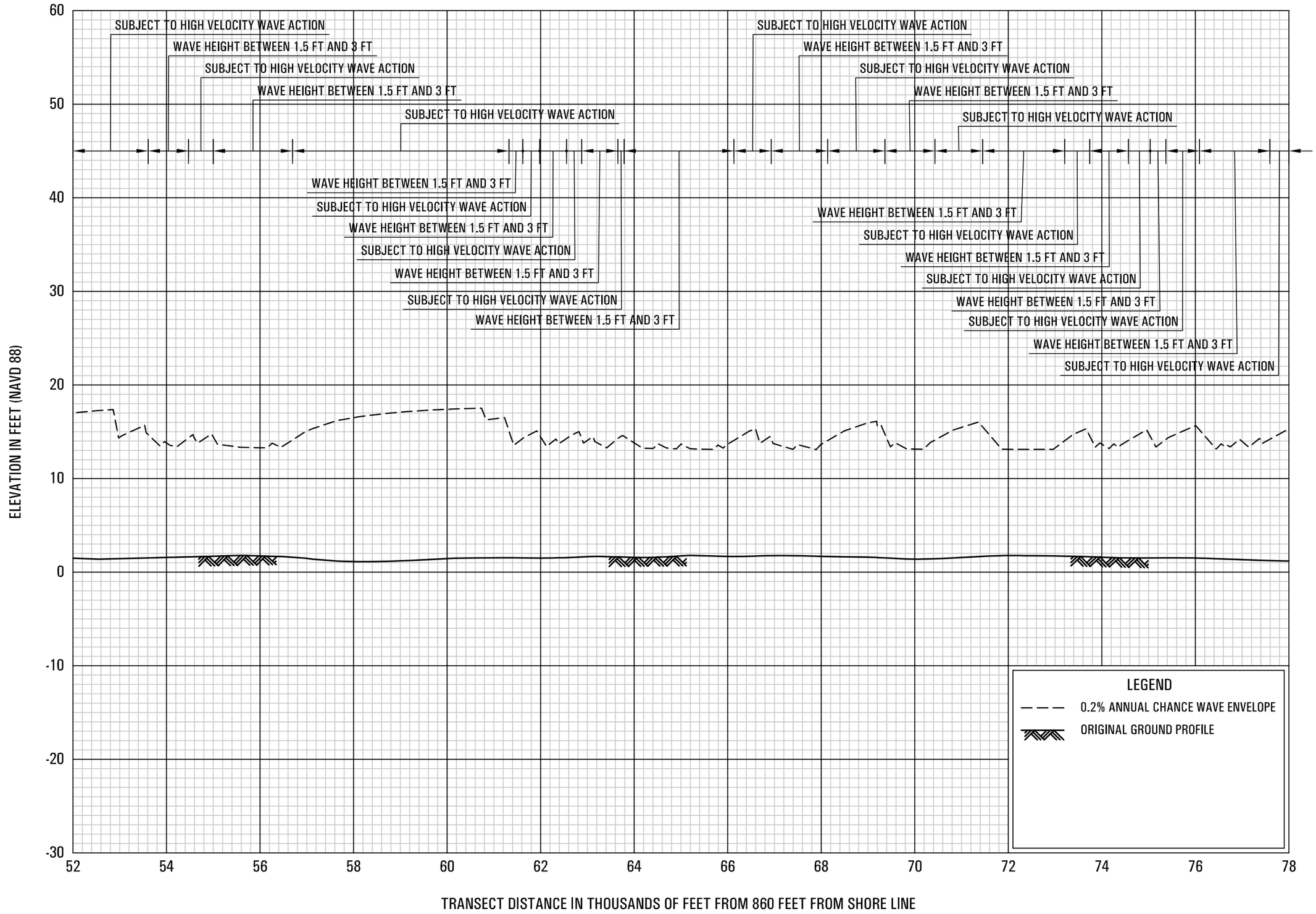
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

51P



0.2% ANNUAL CHANCE WAVE ENVELOPE

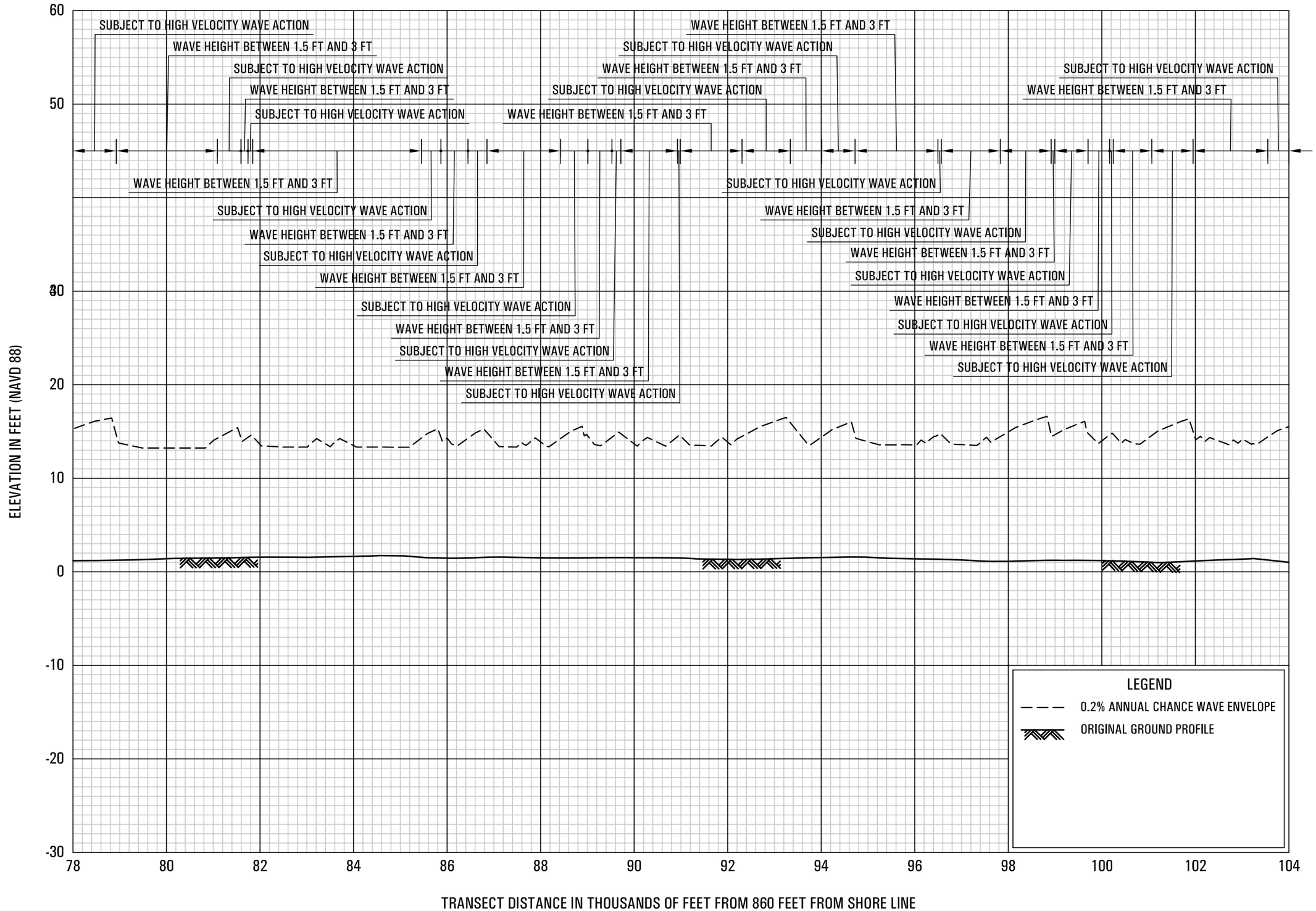
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

52P



0.2% ANNUAL CHANCE WAVE ENVELOPE

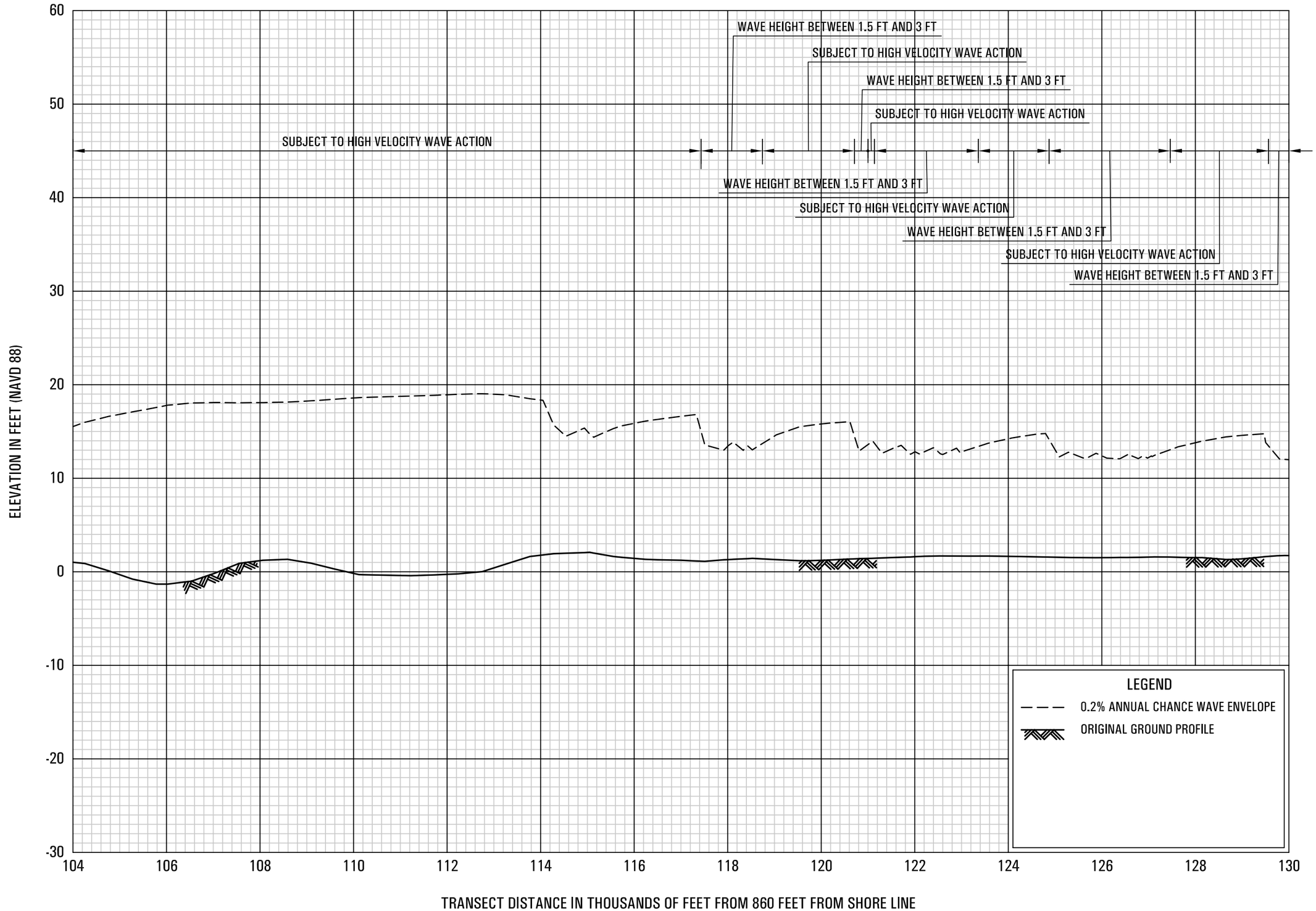
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

53P



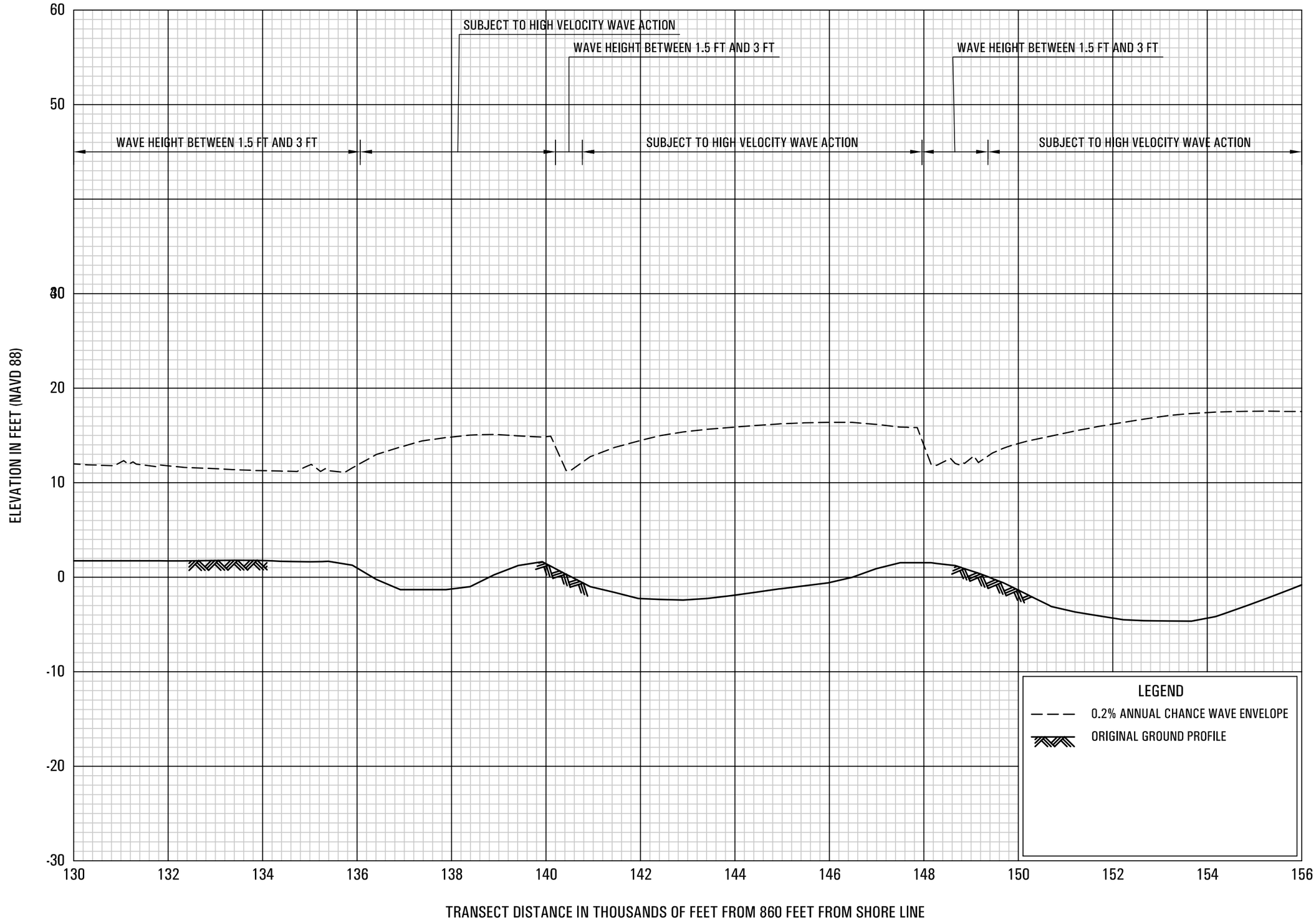
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

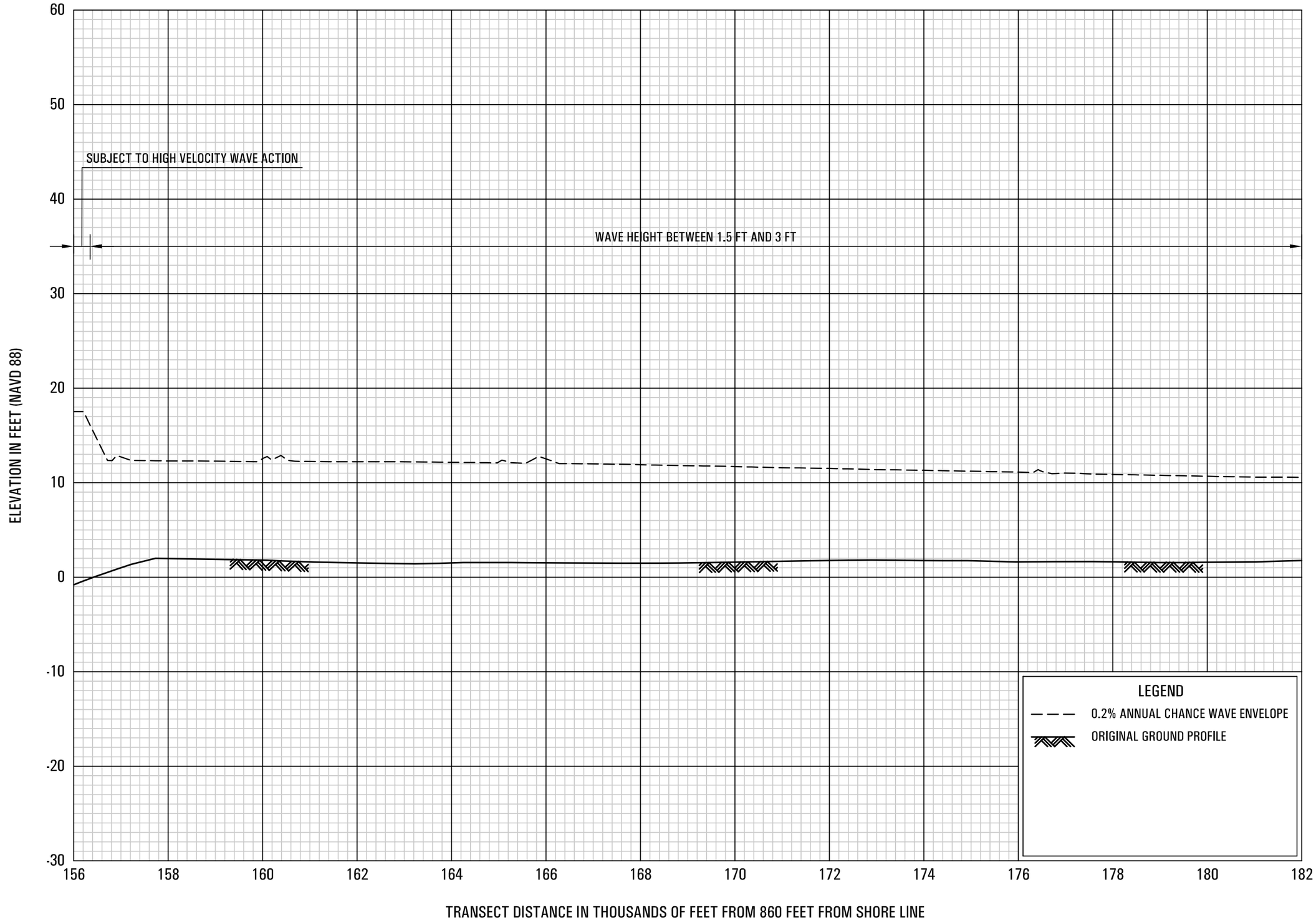
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

55P



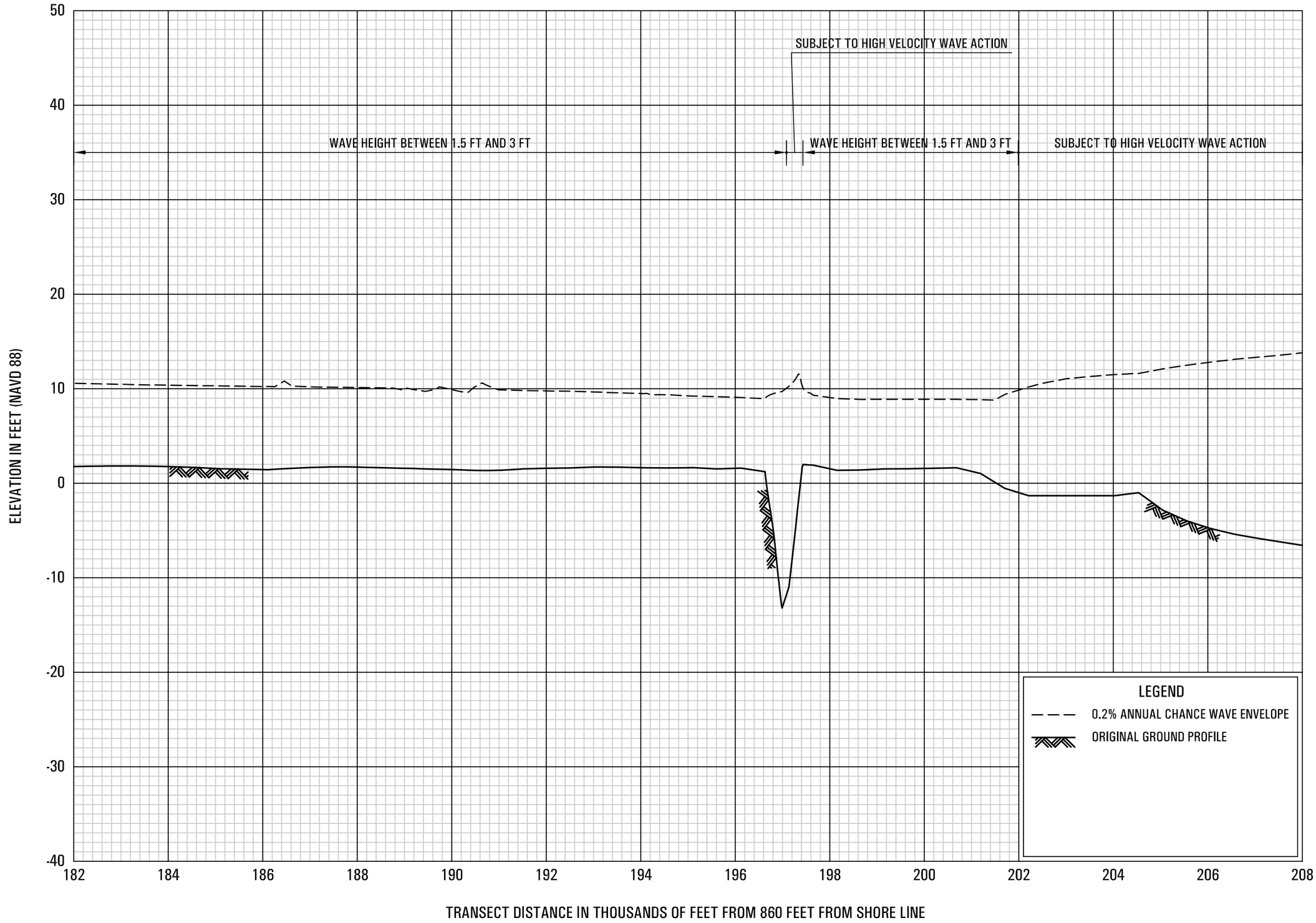
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

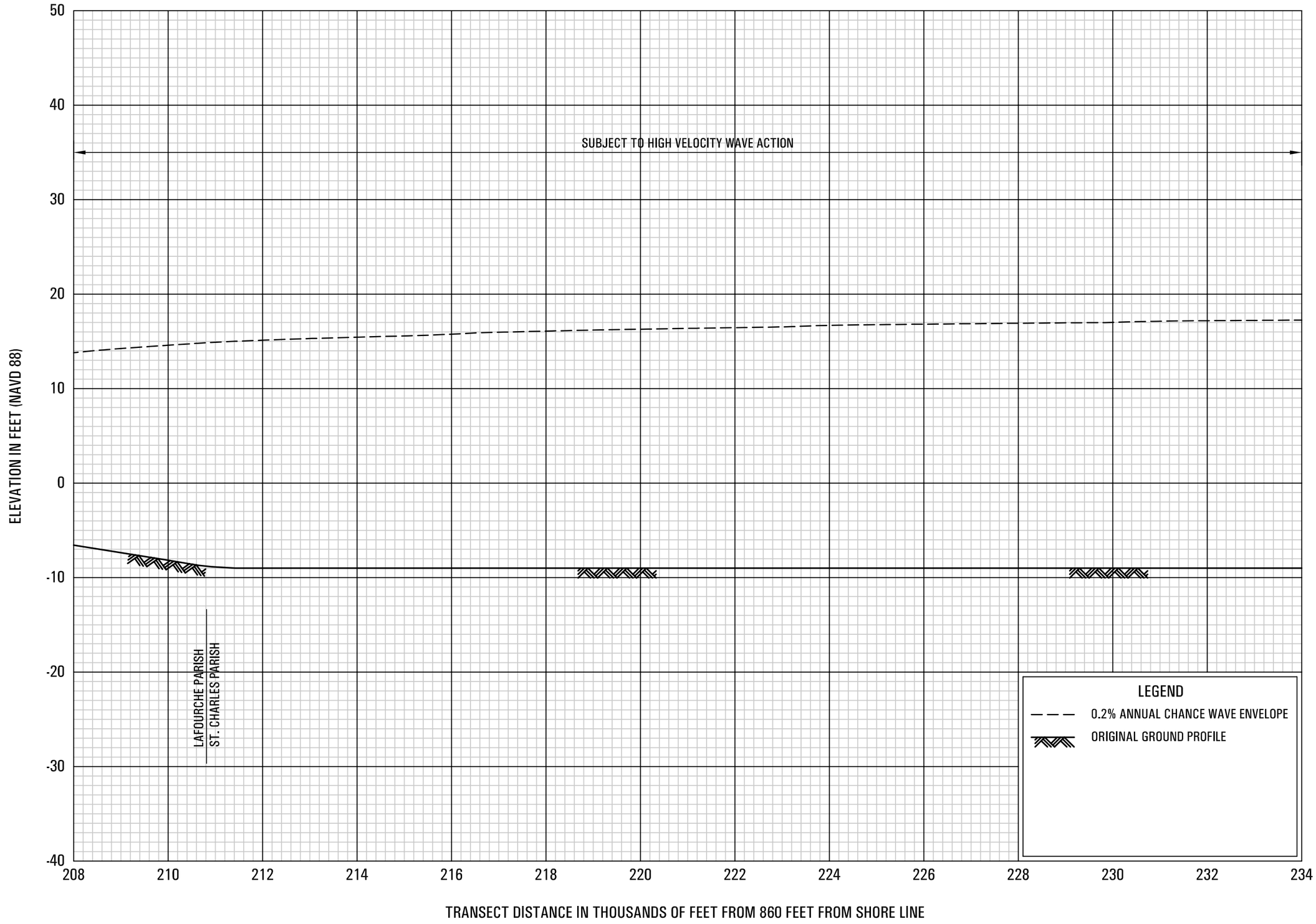
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

57P



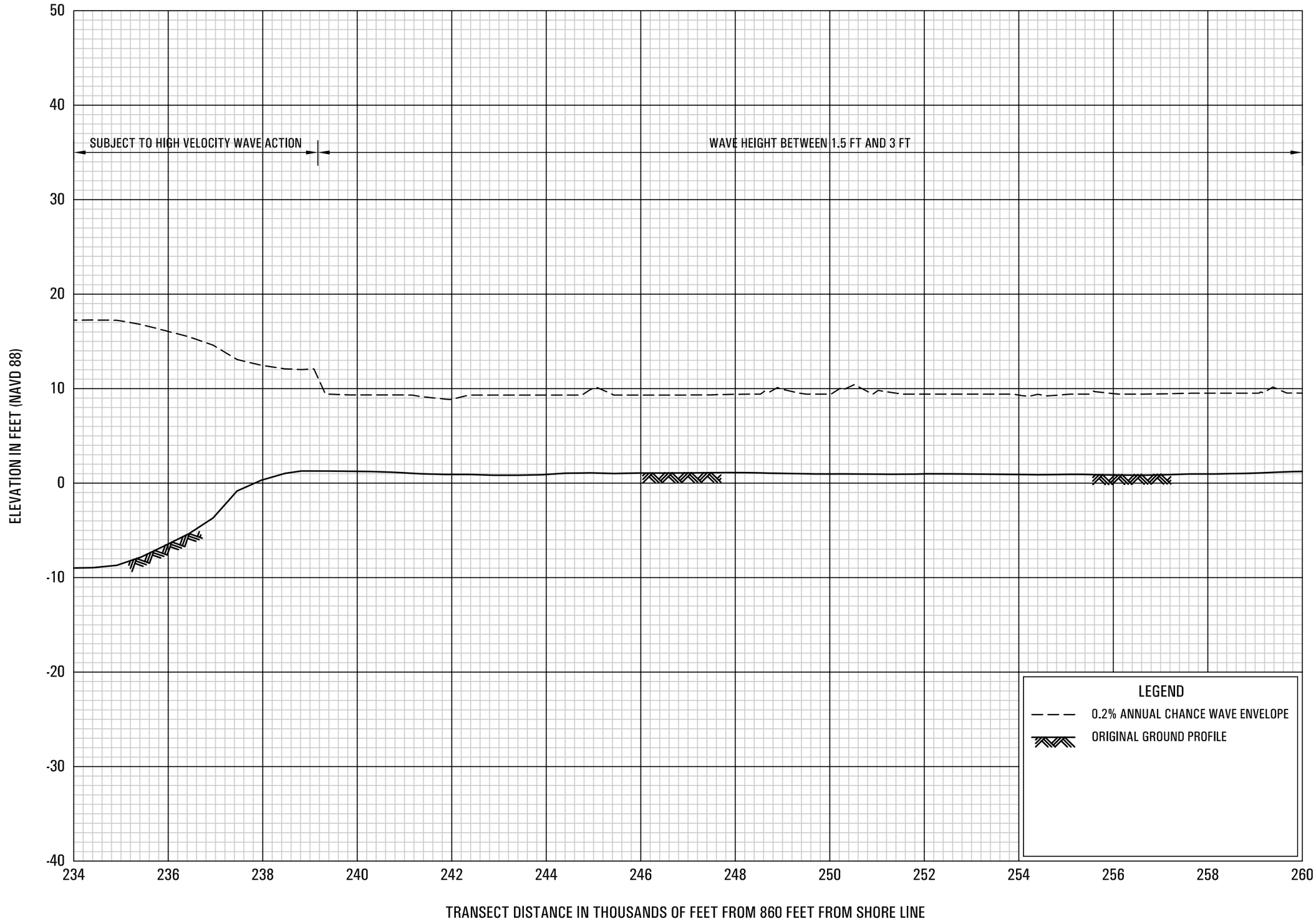
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



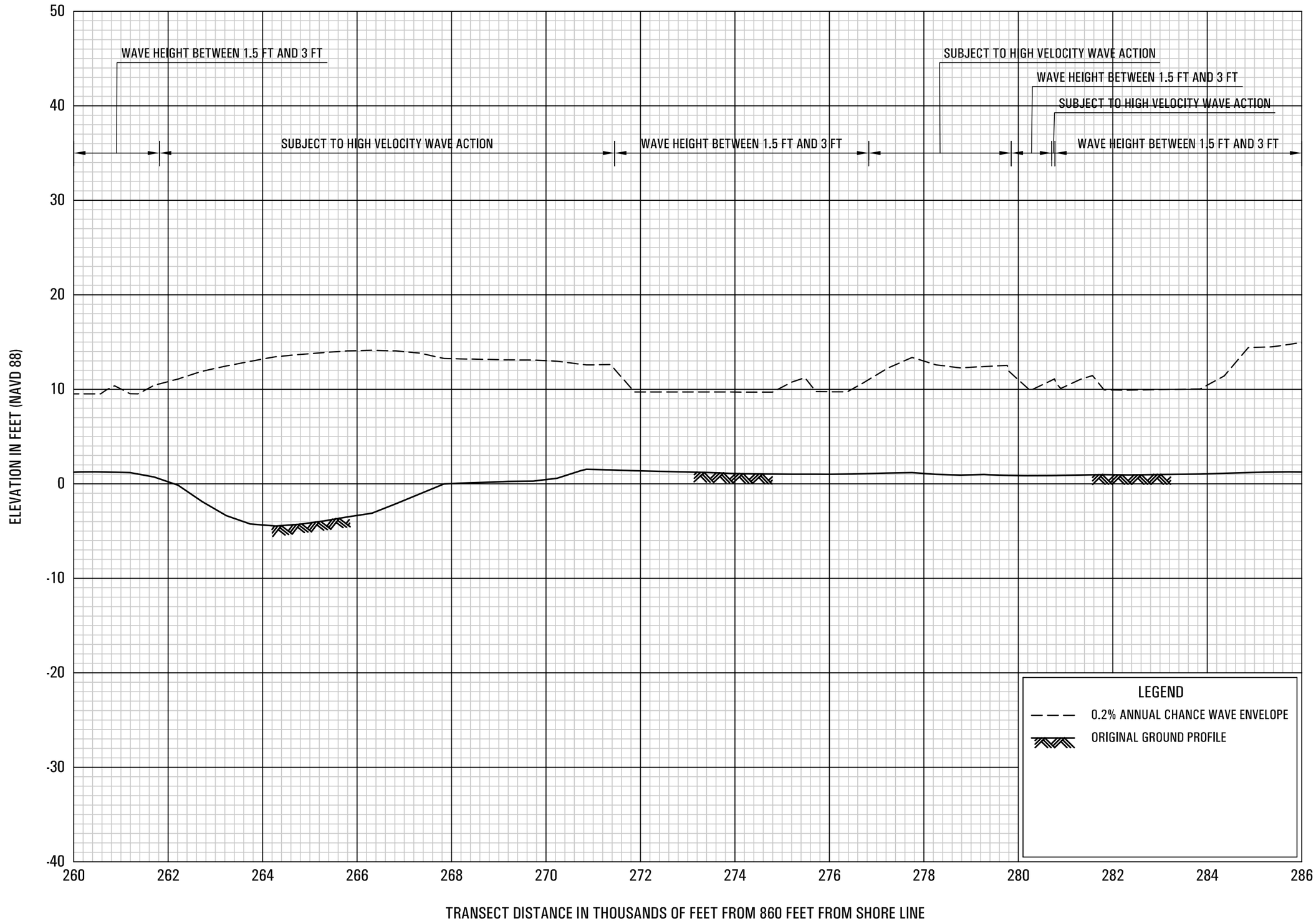
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

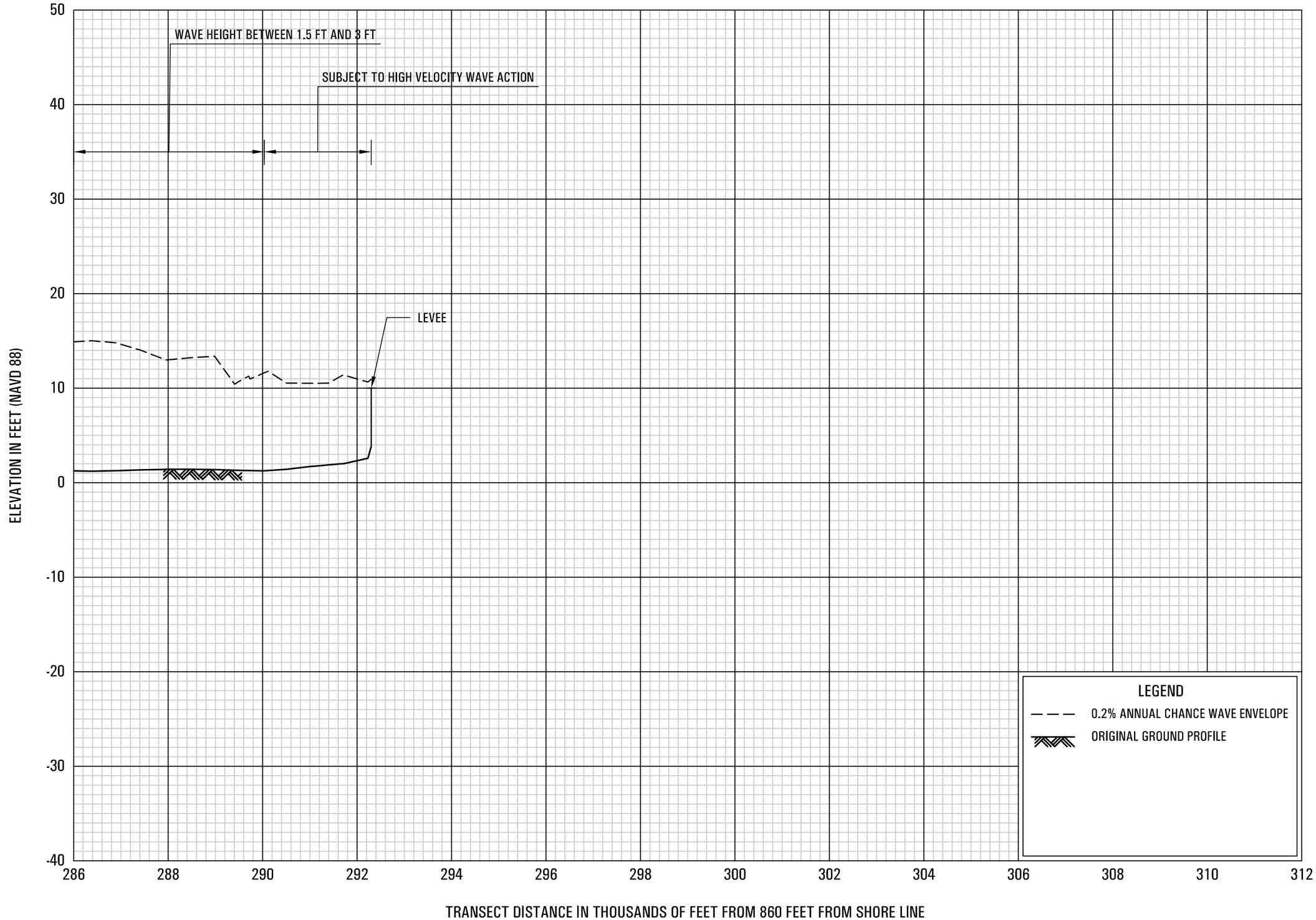
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

60P



0.2% ANNUAL CHANCE WAVE ENVELOPE

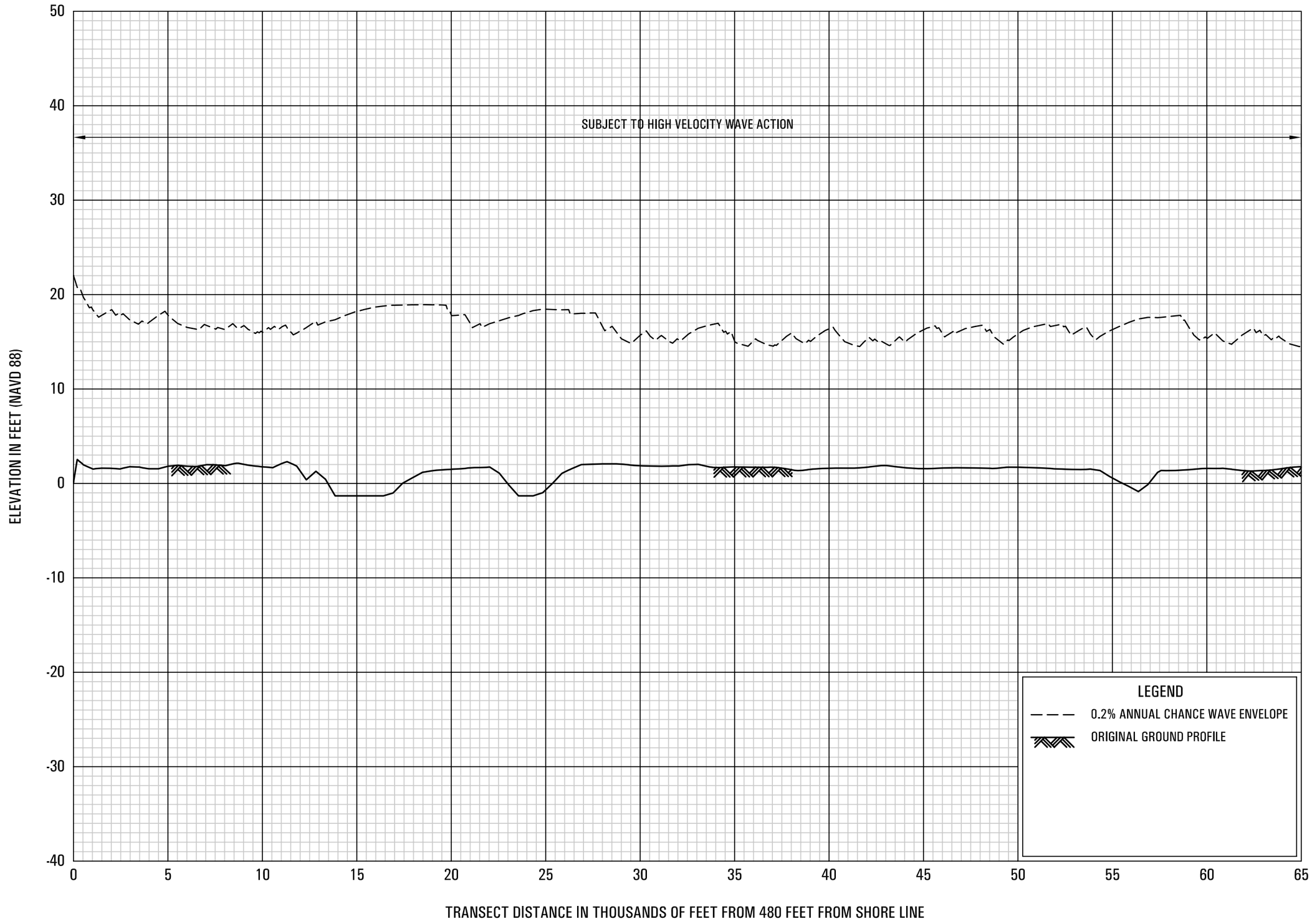
TRANSECT 21

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

61P



0.2% ANNUAL CHANCE WAVE ENVELOPE

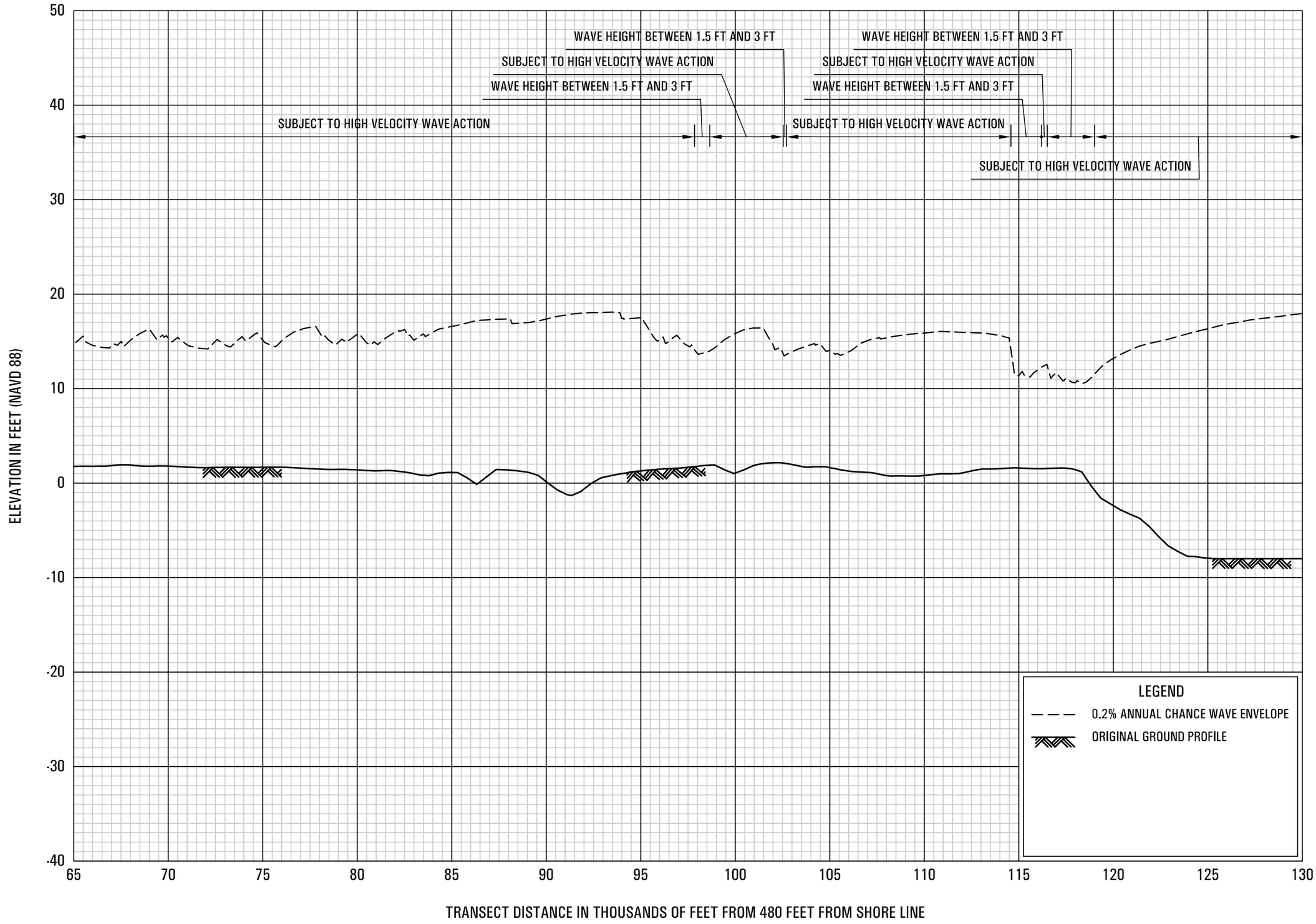
TRANSECT 22

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

62P



0.2% ANNUAL CHANCE WAVE ENVELOPE

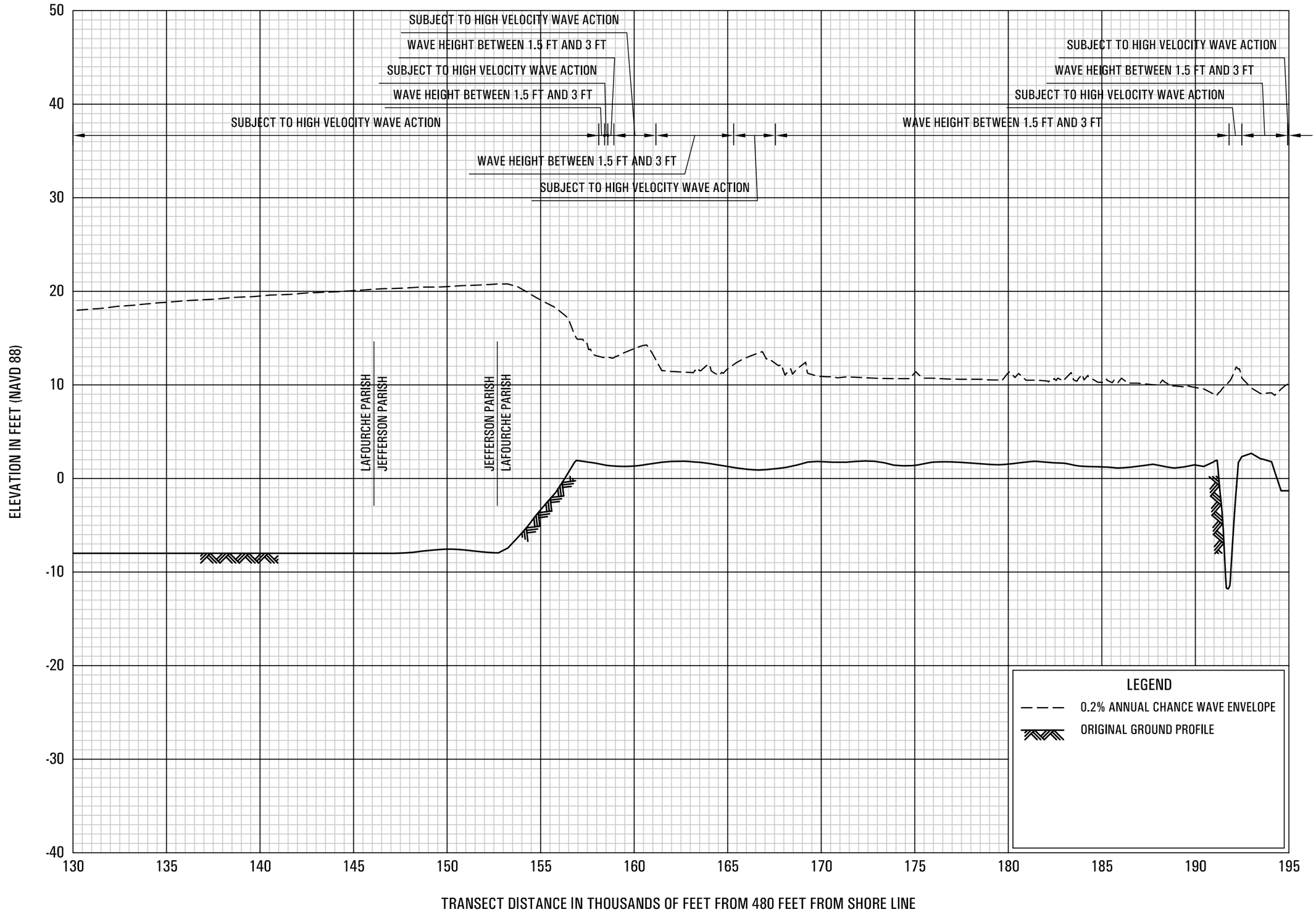
TRANSECT 22

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

63P



0.2% ANNUAL CHANCE WAVE ENVELOPE

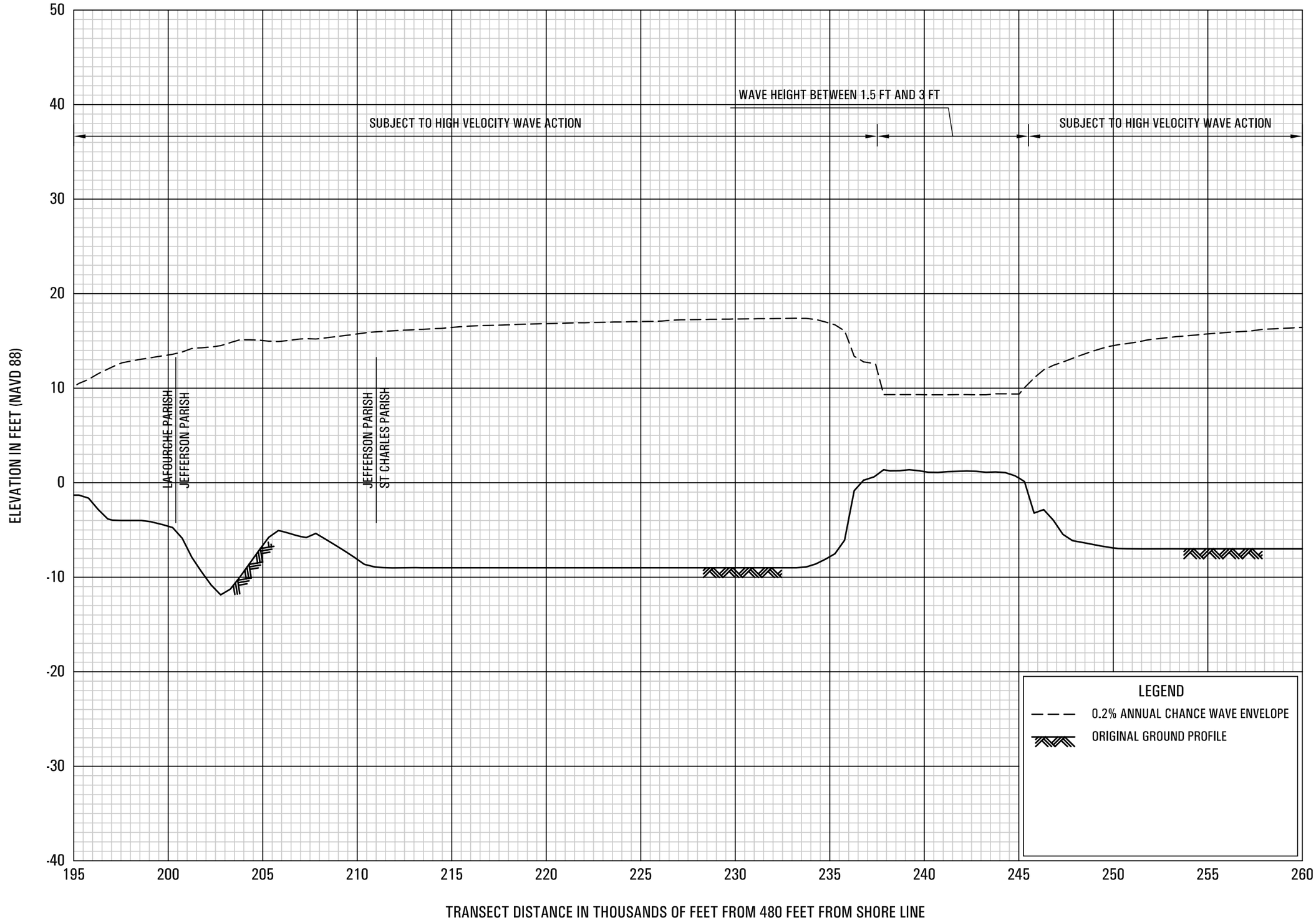
TRANSECT 22

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

64P



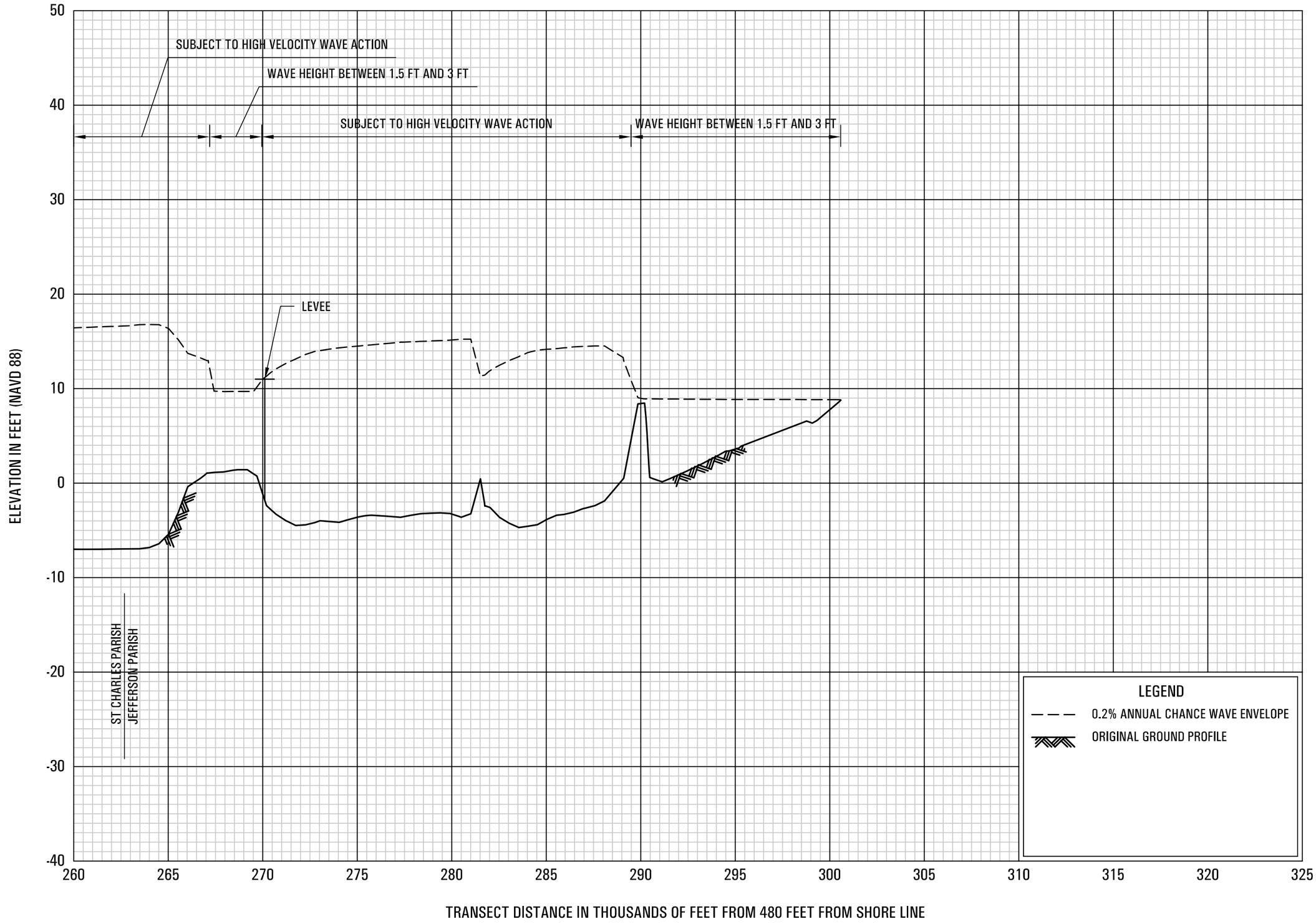
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 22

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



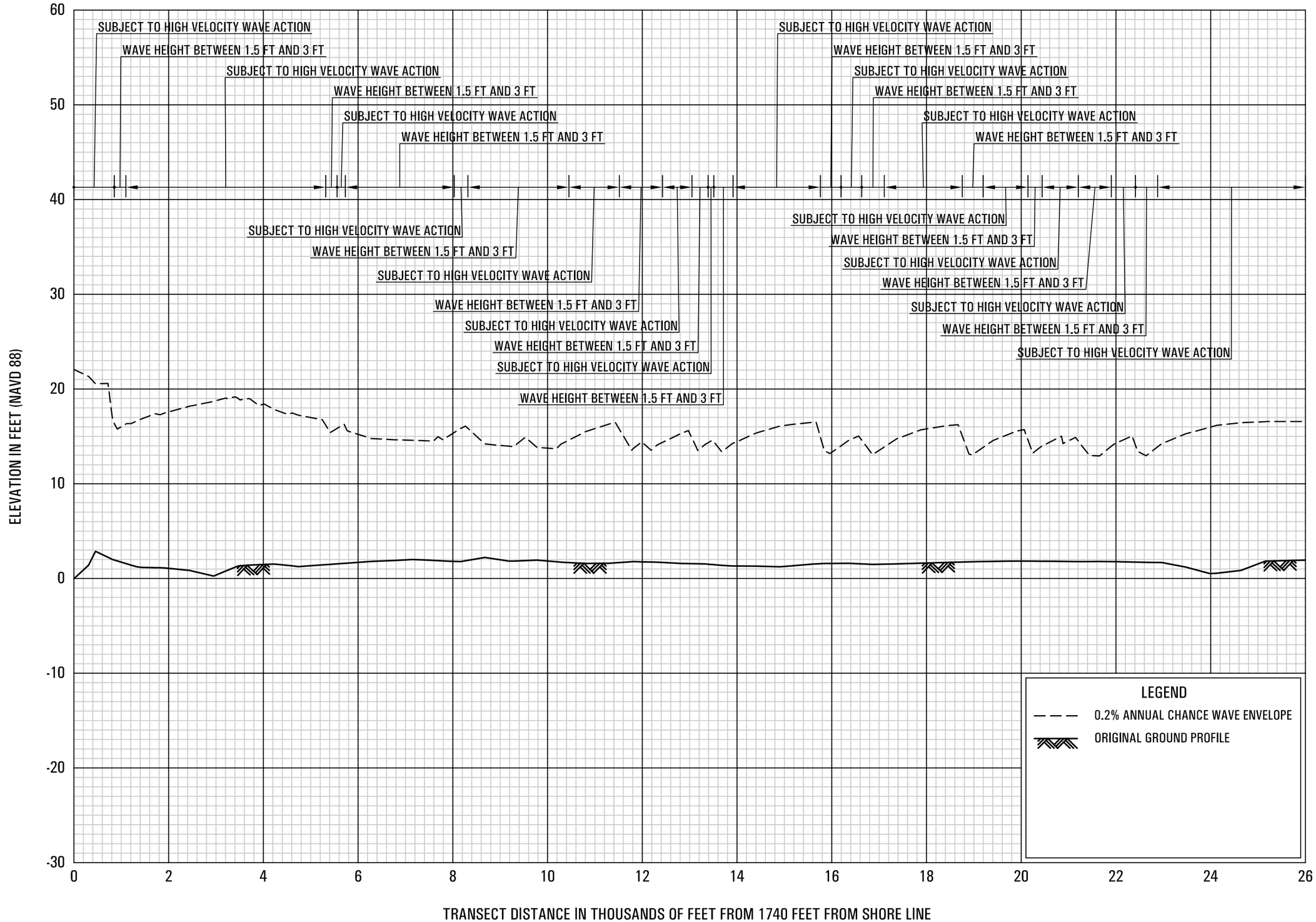
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 22

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



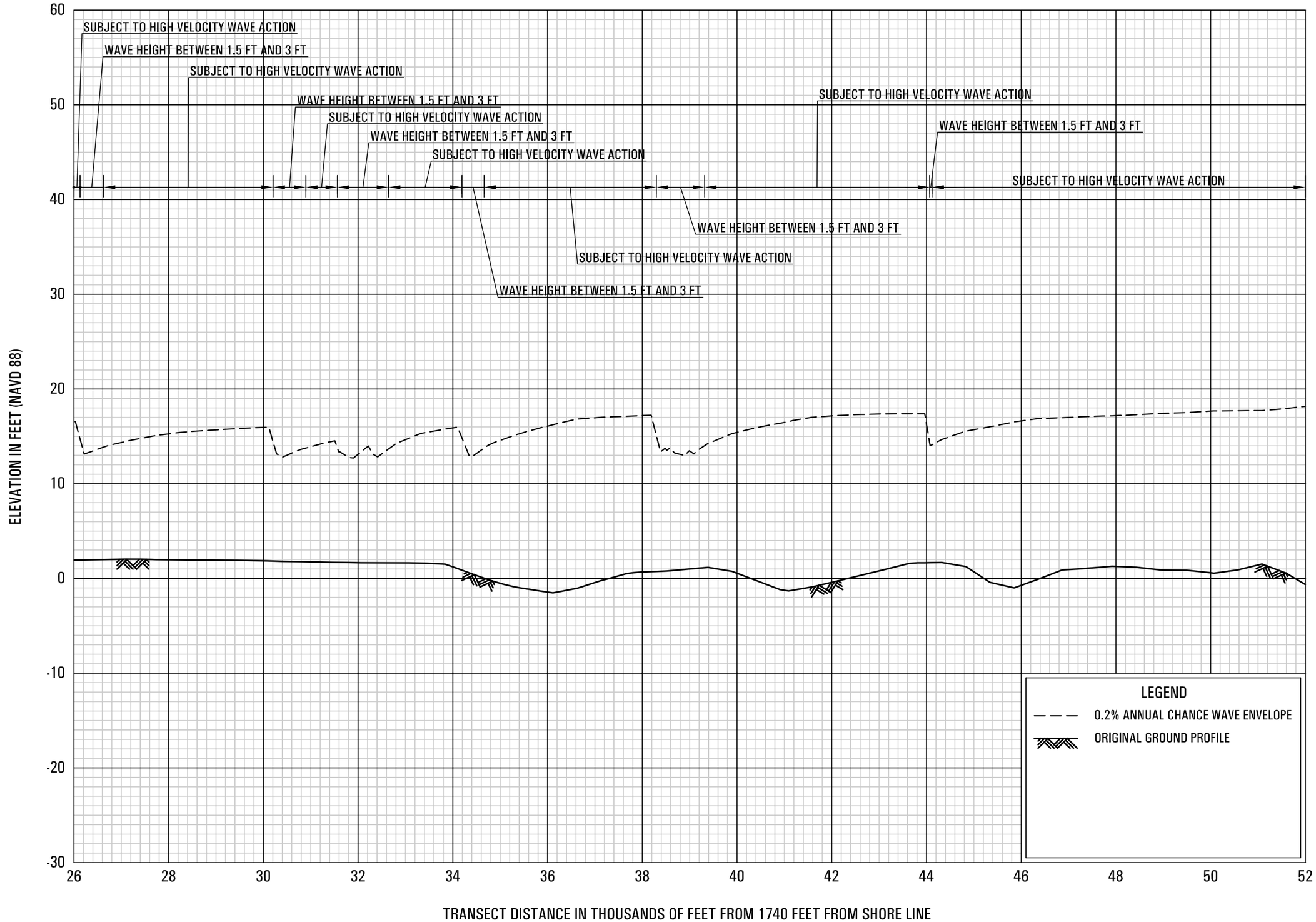
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

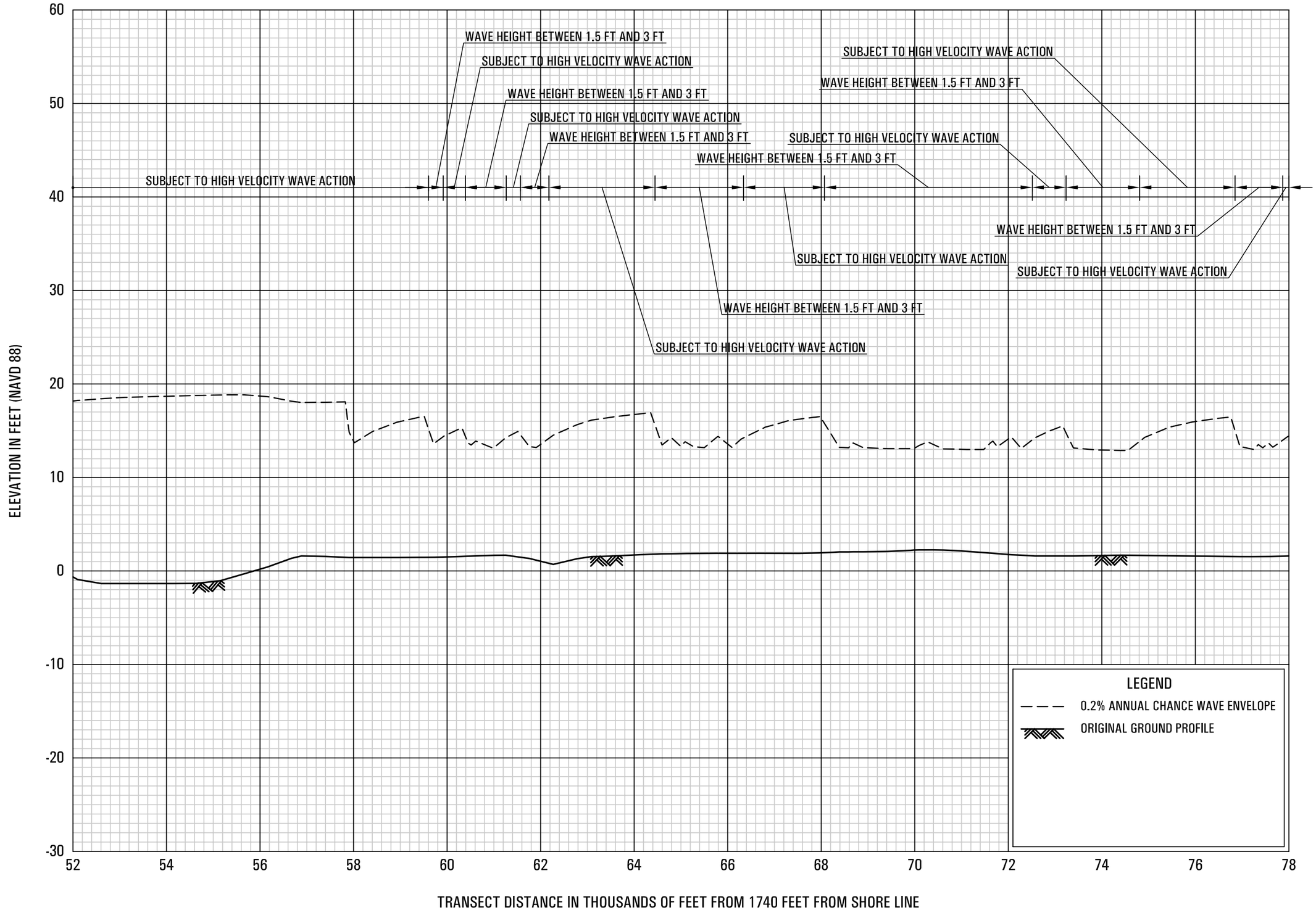
TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

68P



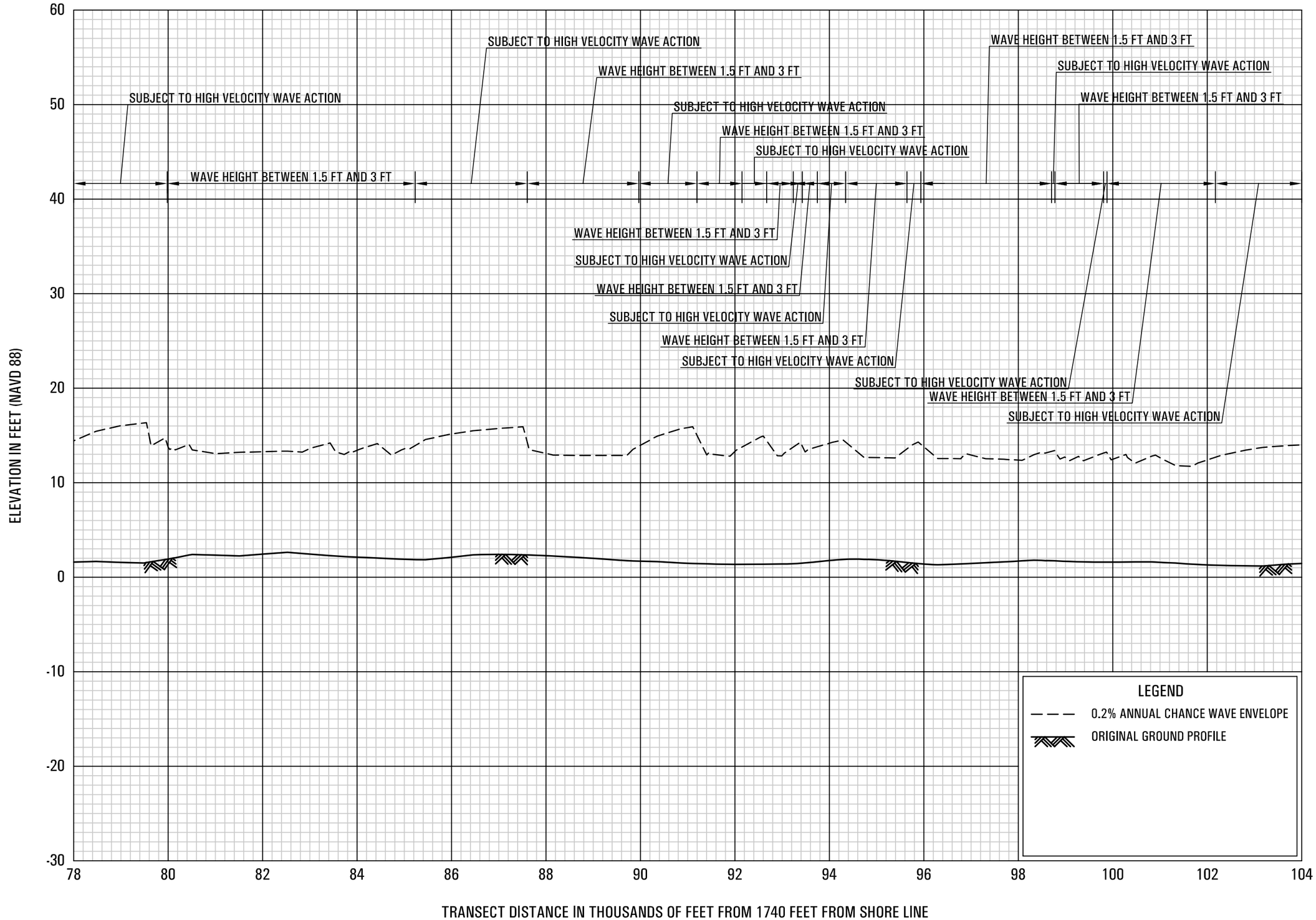
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



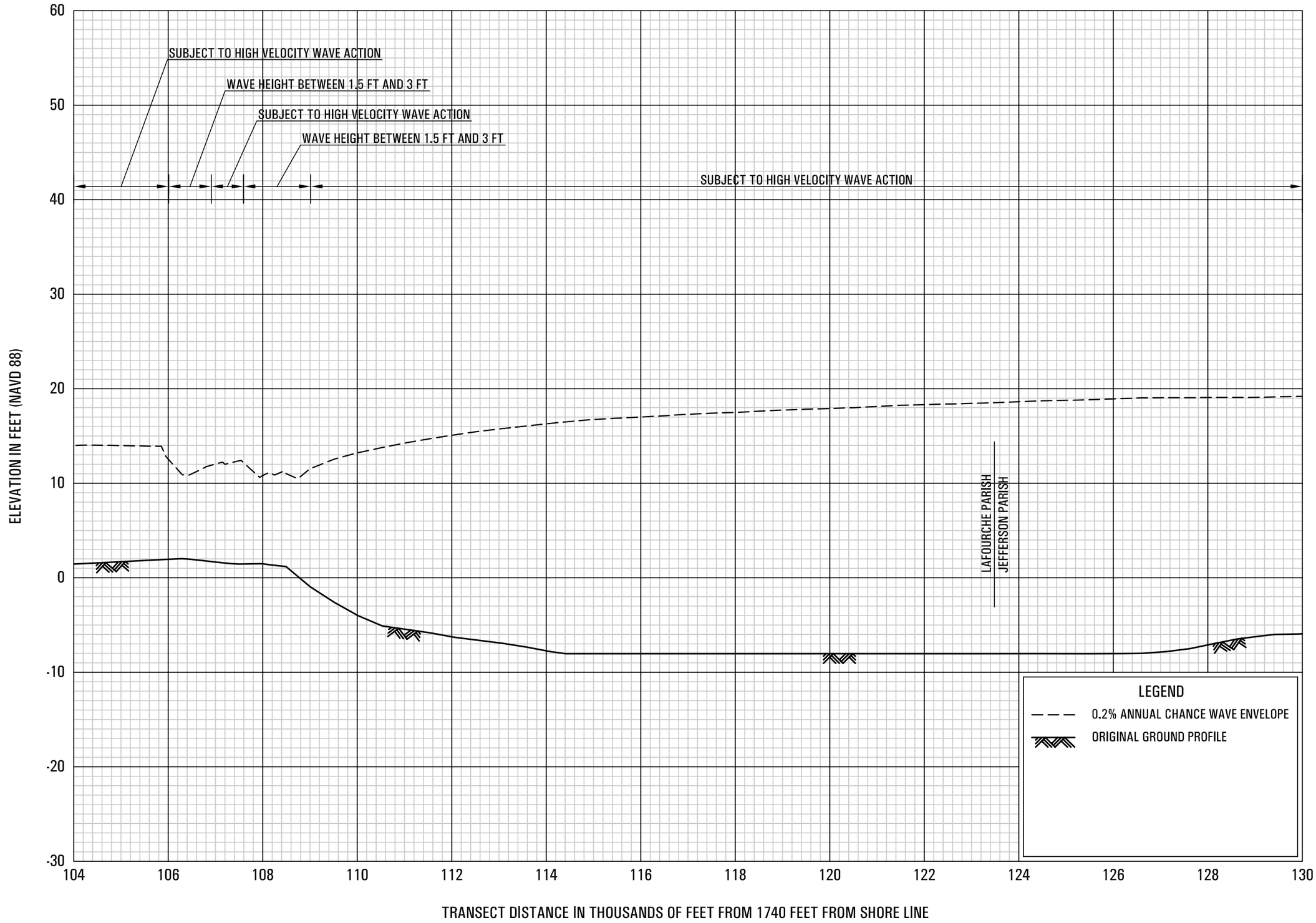
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



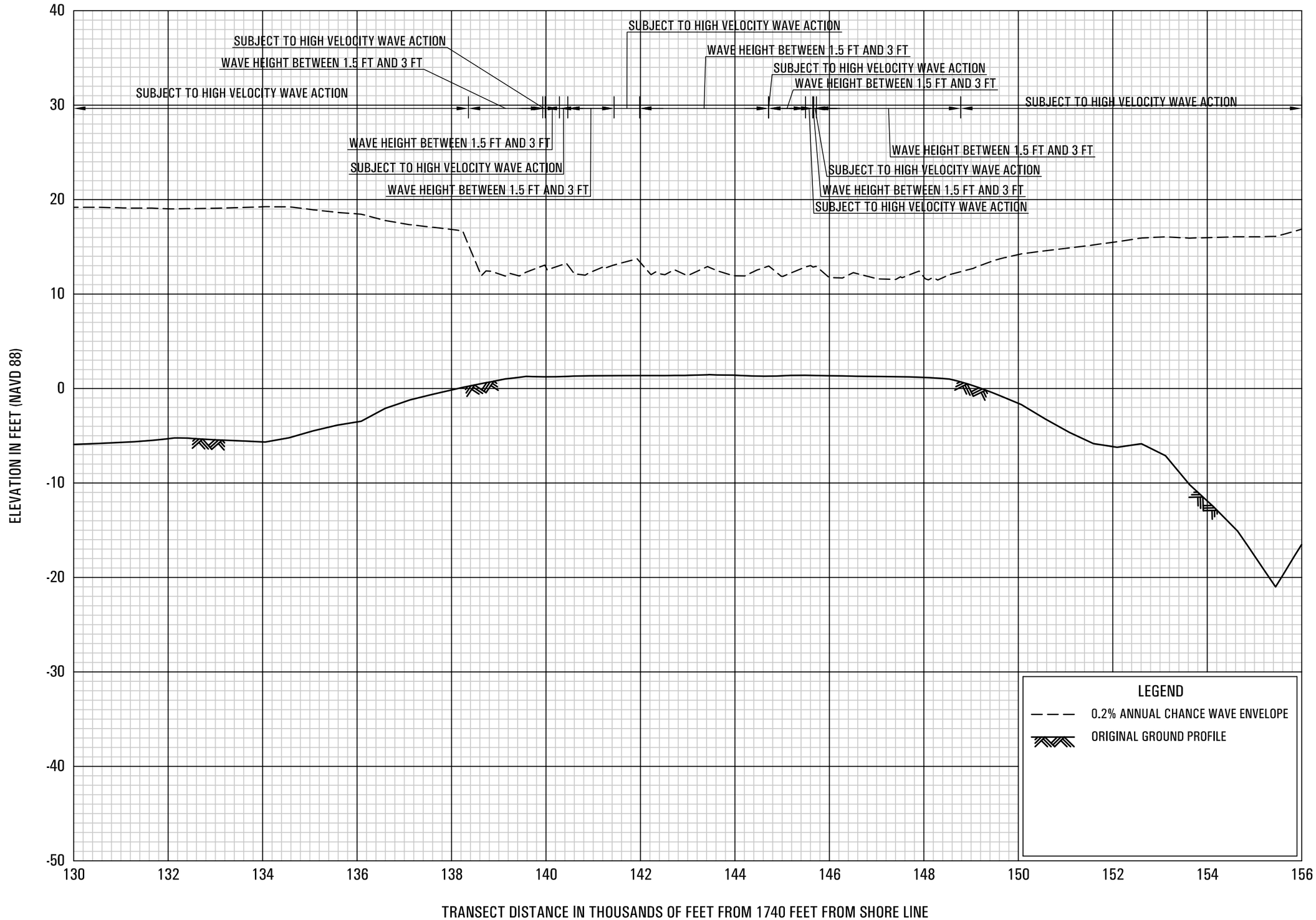
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

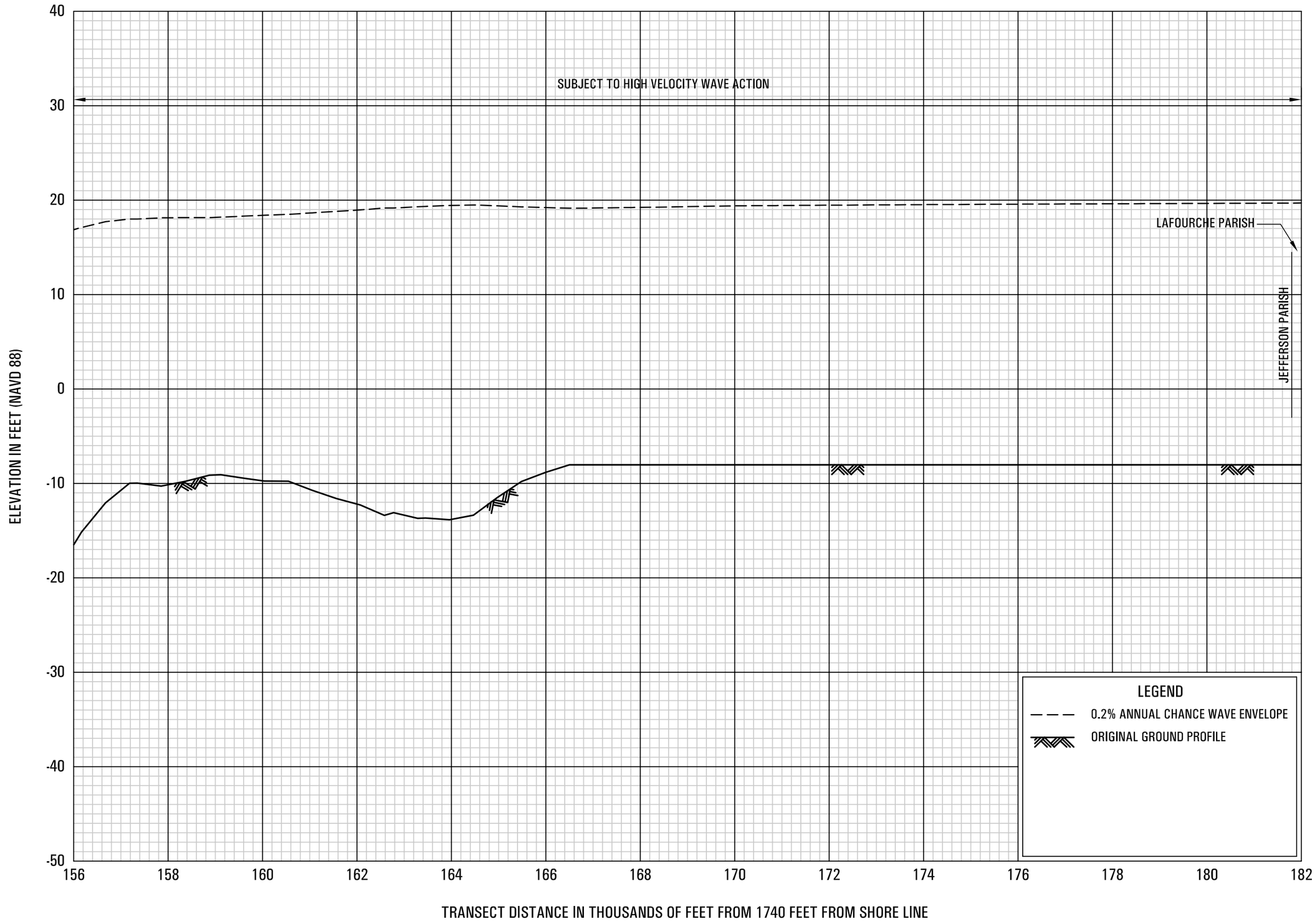
TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

72P



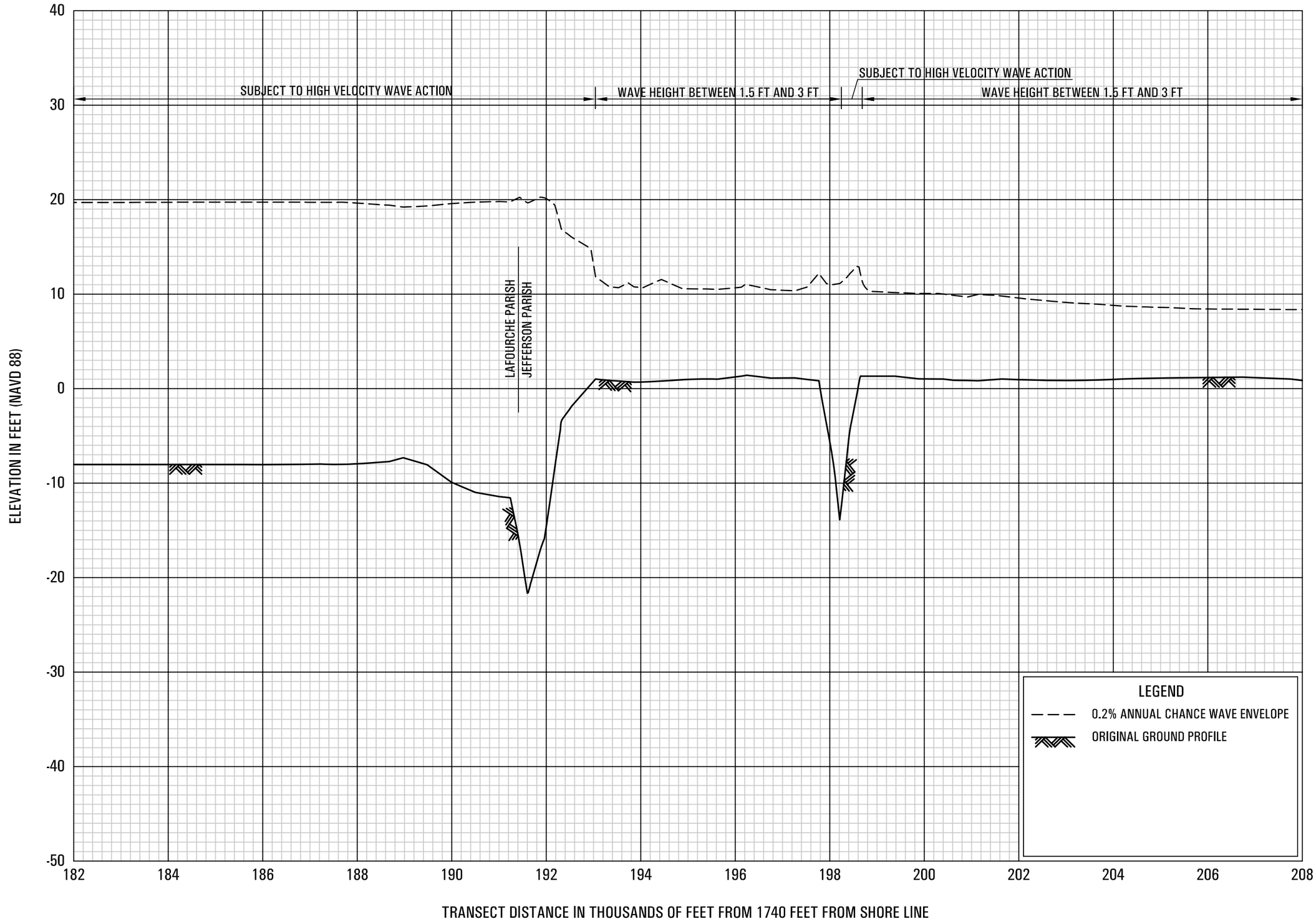
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



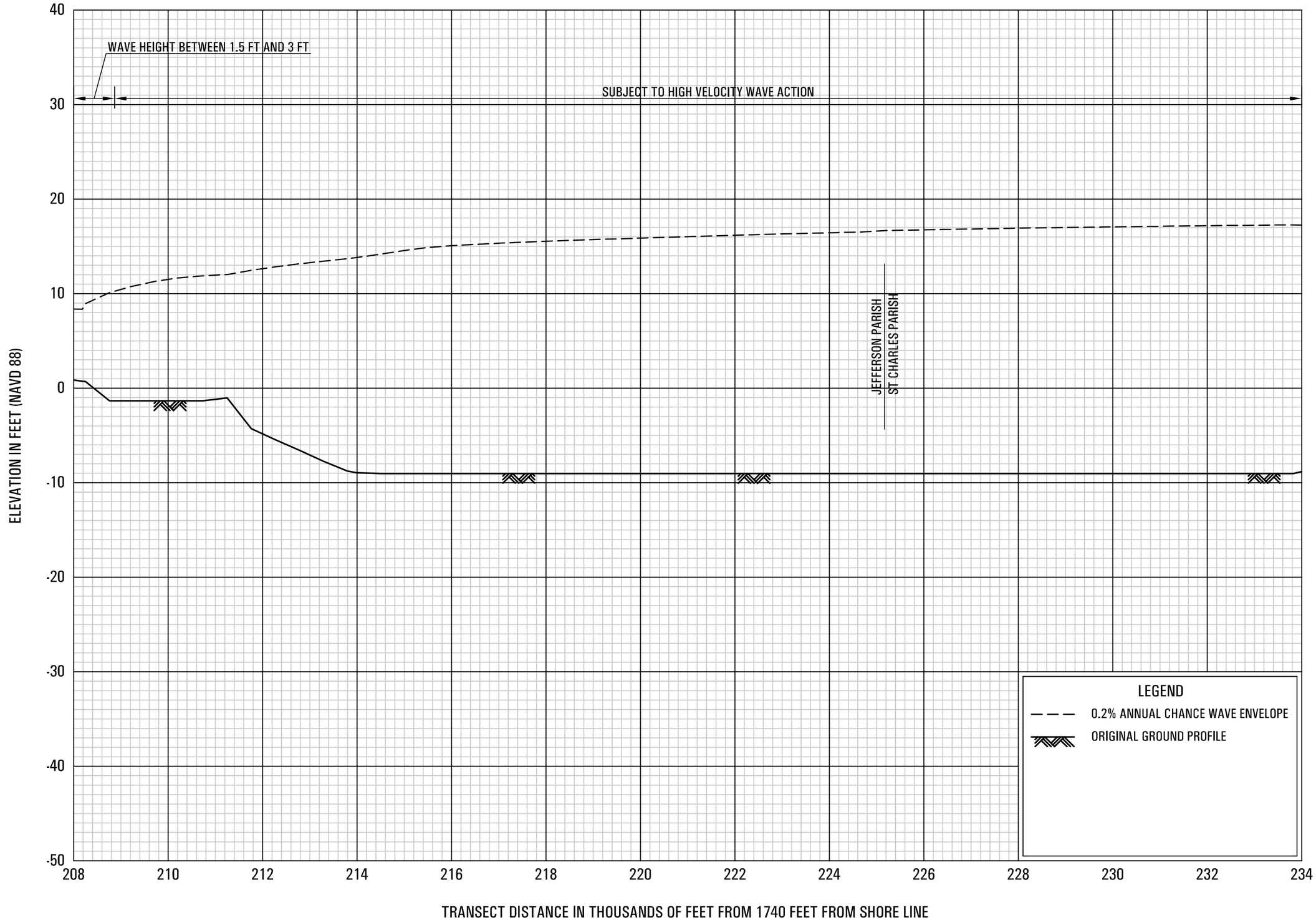
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



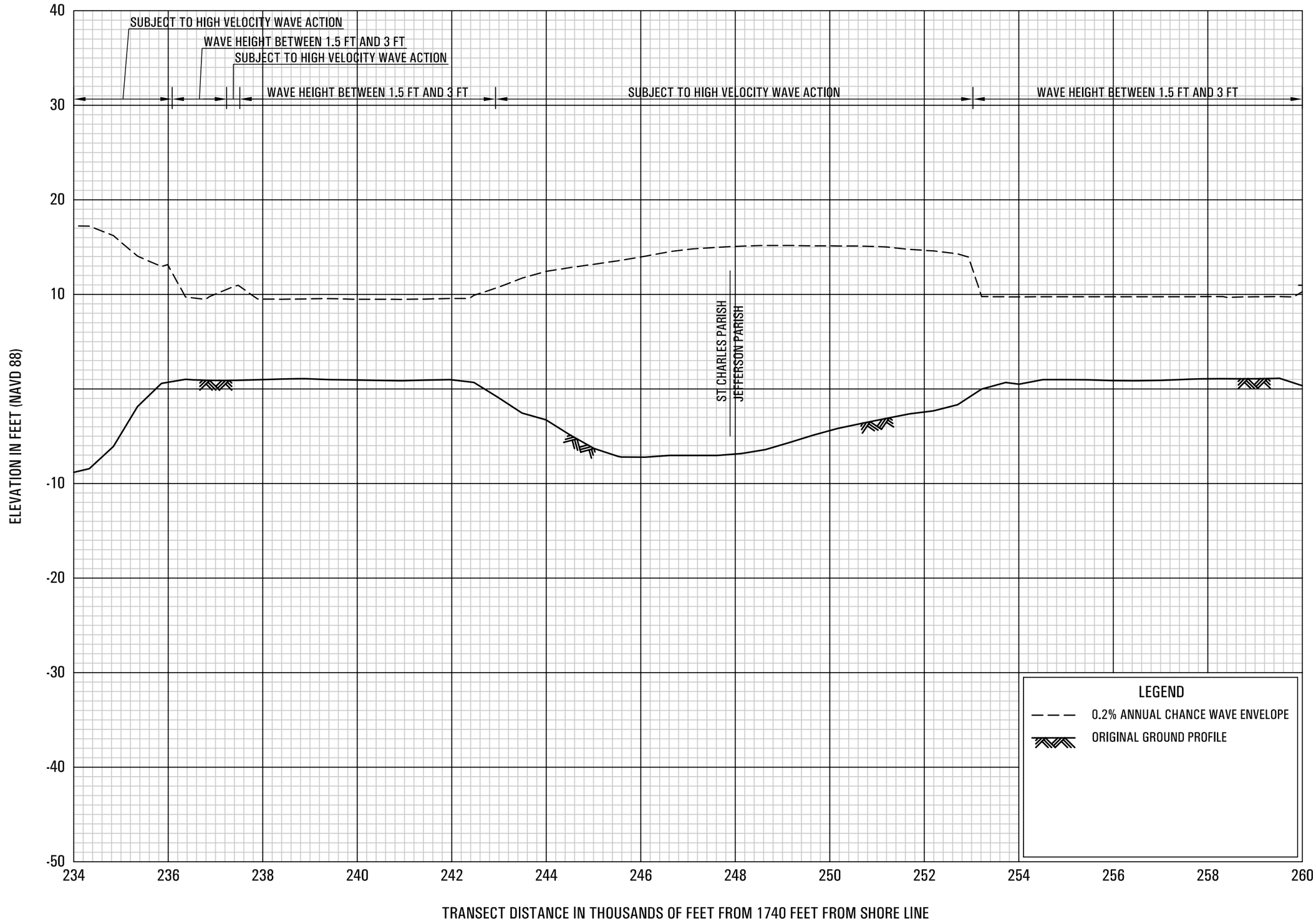
0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS



0.2% ANNUAL CHANCE WAVE ENVELOPE

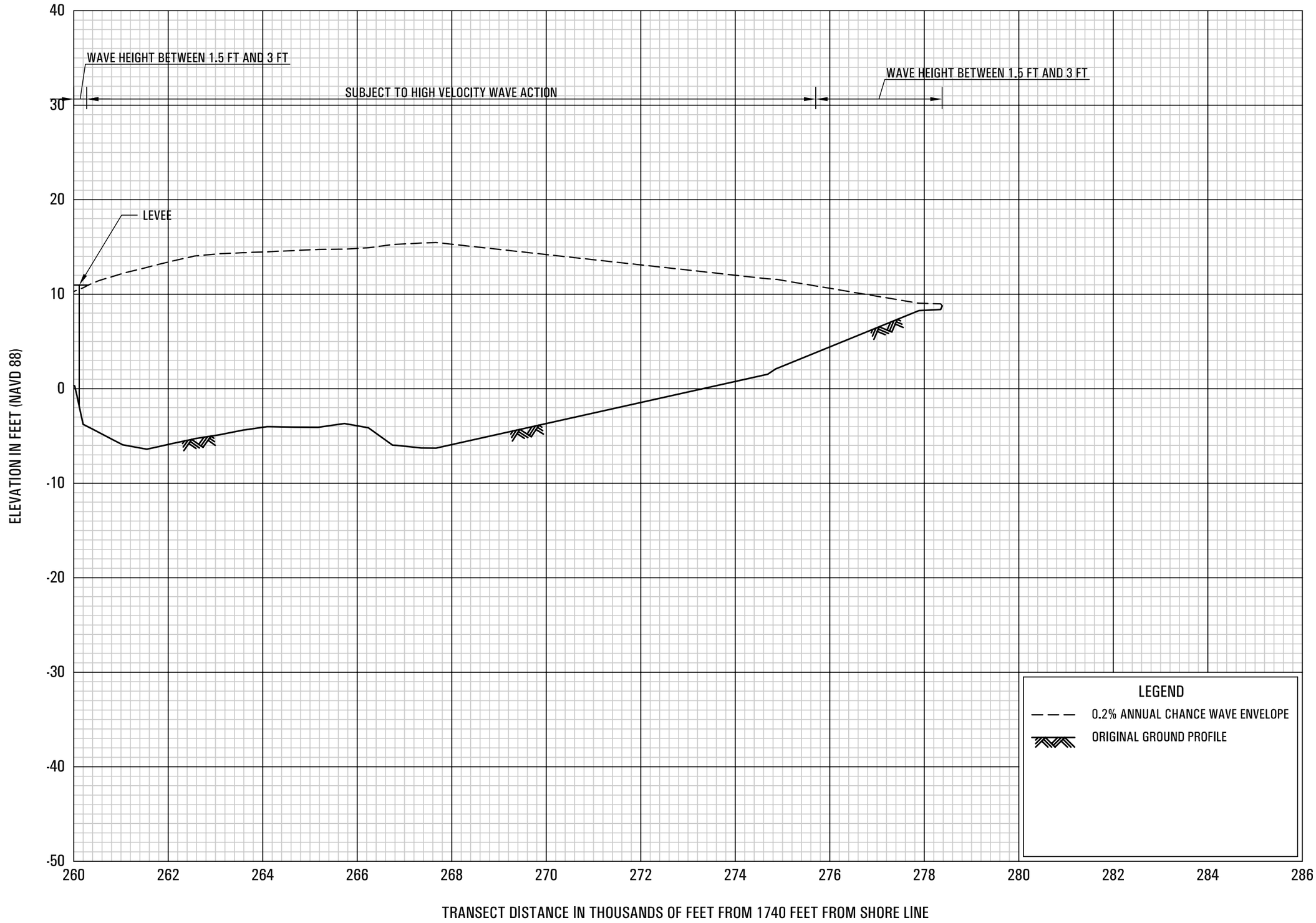
TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

76P



0.2% ANNUAL CHANCE WAVE ENVELOPE

TRANSECT 23

FEDERAL EMERGENCY MANAGEMENT AGENCY

ST. CHARLES PARISH, LA

UNINCORPORATED AREAS

77P