US. Department of Homeland Security
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Washington, DC 20472

FEMA

December 3, 2008

MEMORANDUM FOR: Regional Mitigation Division Directors
Regions I – X

FROM: Michael K. Buckley, Acting Assistant Administrator
Mitigation Directorate

SUBJECT: Procedure Memorandum No. 50 – Policy and Procedures for Identifying and Mapping Areas Subject to Wave Heights Greater than 1.5 feet as an Informational Layer on Flood Insurance Rate Maps (FIRMs)

EFFECTIVE DATE: Immediately

Background: Flood hazard identification under the National Flood Insurance Program (NFIP) divides coastal flood hazard areas into two flood zones: Zone VE and Zone AE. Present NFIP regulations make no distinction between the design and construction requirements for coastal AE Zones and riverine AE Zones. However, evidence suggests that design and construction requirements in some portions of coastal AE zones should be more like VE Zone requirements. Post-storm investigations have shown that typical AE Zone construction techniques (e.g., wood-frame, light gauge steel, or masonry walls on shallow footings or slabs, etc.) are subject to damage when exposed to waves less than 3-feet in height. One of the hazard identification criteria for VE Zone designation is where wave heights are estimated to be equal to or greater than 3 feet. Laboratory tests and field investigations confirm that wave heights as small as 1.5 feet can cause failure of the above-listed wall types. Other flood hazards associated with coastal waves (e.g., floating debris, high velocity flow, erosion, and scour) also damage AE Zone-type construction in these coastal areas.

In the past, some Flood Recovery Maps, developed in response to significant coastal flooding events, have shown the landward limit of the area subject to wave heights greater than 1.5 feet. This limit has been provided to communities and shown on the recovery maps as an informational layer to assist in safe rebuilding practices. The NFIP Community Rating System provides credits for communities that adopt and enforce more stringent floodplain management requirements in these areas. The 2006 *International Building Code* references the American Society of Civil Engineers (ASCE) 24-05 *Flood Resistant Design and Construction* standard, which has specific design requirements that apply to areas which may be affected by waves greater than 1.5 feet (which ASCE 24 refers to as Coastal A Zones). In addition, every Federal Emergency Management Agency (FEMA) coastal construction publication since the issuance of "FEMA 55 Coastal Construction Manual," dated June 2000, has recommended the use of VE

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Zone construction practices in areas subject to wave heights greater than 1.5 feet.

Issue: The AE Zone areas subject to wave heights between 1.5 and 3 feet are not differentiated from other AE Zone areas on FIRMs. Because it has been shown that typical AE Zone construction techniques are subject to damage when exposed to waves between 1.5 and 3 feet in height, this information has been provided to some communities during disaster recovery mapping to assist with mitigating these risks. FEMA Regional Offices, in coordination with State and local officials would benefit from the delineation of the landward limit of waves 1.5 feet in height as an informational layer on the FIRM.

Action Taken: For all new detailed coastal study starts in Fiscal Year 2009, the landward limit of waves 1.5 feet in height will be delineated on the FIRMs and included in the DFIRM database as an informational layer with no NFIP floodplain management requirements or special insurance ratings. Communities are encouraged but not required to adopt higher standards than the minimum NFIP requirements in these areas. The limit will be included on the preliminary FIRM; however, if a community does not want to delineate the limit on its final FIRMs, the community may provide a written request to their Regional Project Officer (RPO) with justification for such a request. All community requests to have the limit removed from the FIRM must be received prior to the issuance of the Letter of Final Determination. A community's NFIP eligibility and rates will not be affected if it opts not to include the limit on its final FIRMs. The limit will be included in the DFIRM database regardless of whether it is shown on the printed FIRM.

The attachment to this memorandum provides Mapping Partners with guidance for determining the limit of the area exposed to wave heights greater than 1.5 feet during the base (1-percent-annual-chance) flood during the development of updated flood hazard information. The attached guidance can be applied to open coast and sheltered water shorelines subject to wave propagation. This attachment provides graphic specifications for identifying the landward limit of this area on the FIRM. Also included is explanatory information to be included in the Notes To Users on the FIRM and in the Flood Insurance Study.

cc: See Distribution List

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ATTACHMENT
Delineation of the Limit of Moderate Wave Action

Introduction

In coastal areas, Zone AE, one of the Special Flood Hazard Area (SFHA) designations, may be subdivided by a limit of moderate wave action boundary at the landward extent of the propagation of waves higher than 1.5 feet. Damages to structures from wave heights between 1.5 and 3 feet are similar to, but less severe than, those in areas where wave heights are greater than 3 feet, typically designated as Zone VE on the FIRM. Damages to structures from wave heights less than 1.5 feet are more similar to those in riverine or lacustrine floodplains.

The inland limit of the area affected by waves greater than 1.5 feet is called the Limit of Moderate Wave Action (LiMWA). A simplified method for identifying the LiMWA is based on the established criteria for mapping coastal Base Flood Elevations (BFEs) described in the Federal Emergency Management Agency's *Guidelines and Specifications for Flood Hazard Mapping Partners,* Appendix D: "Guidance for Coastal Flooding Analyses and Mapping." In areas where the predominant coastal flood hazard is overland wave propagation, the BFE for both AE and VE Zones is determined by the stillwater elevation and wave setup plus a wave height component.

Mapping

The National Academy of Sciences (1977) recommended approximating the wave crest elevation for Flood Insurance Studies as 70 percent of the controlling wave height above the mean water (stillwater including wave setup) elevation; this recommendation is incorporated into FEMA's overland wave propagation model, Wave Height Analysis for Flood Insurance Studies (WHAFIS). Therefore, for a 1.5-foot controlling wave height, the wave crest elevation is approximately 1.0 foot (0.7 x 1.5 feet) above the mean water elevation. As such, the limit of the 1.5-foot wave occurs where the wave crest is approximately 1 foot above the mean water elevation. This location is indicated in the WHAFIS model output along each transect; however, the Mapping Partner will need to interpolate between transects according to coastal flood hazard mapping procedures found in Appendix D. In areas where the topography is sufficiently steep and the width of Zone AE is too narrow to be subdivided by the LiMWA, it may be necessary to locate the LiMWA immediately seaward of the limit of the base floodplain boundary.

Laboratory tests led to different conclusions for areas affected by wave runup. In areas where wave runup elevations dominate over wave heights, such as areas with steeply sloped beaches, bluffs, and/or shore-parallel flood protection structures, there is no evidence to date of significant damage to residential structures by runup depths less than 3 feet. As such, there is no need to delineate the limit of the 1.5-foot wave in areas where wave runup elevations dominate. However, it is not uncommon for coastal study reaches to alternate between wave runup-dominated and wave height-dominated flood hazard areas, and a procedure for delineating a continuous and easily understandable LiMWA in these areas has been developed.

To aid end-user understanding and application of the LiMWA, it may be advantageous for the Mapping Partner to continue the LiMWA across runup-dominated areas. In these situations, the LiMWA should be placed immediately landward of the mapped VE/AE Zone boundary.

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Similarly, if coastal study reaches alternate between wave height-dominated flood hazard areas and areas where the VE Zone designation is based on the presence of a primary frontal dune or wave overtopping, the Mapping Partner will delineate the LiMWA immediately landward of the mapped VE/AE Zone Boundary. However, if a Zone X is mapped immediately landward of the Zone VE, the LiMWA should not be extended through the Zone X.

Graphically, the LiMWA will be a boundary distinguished by a distinctive pattern of dots.

Example	Feature	Specification
	Limit of Moderate Wave Action Delineation	Dashed white line, 0.0183" in line weight, with three dashes between two-dot clusters. Dot diameter 0.0764", with spacing of 2 points between dots within each cluster.
LIMIT OF MODERATE WAVE ACTION	Limit of Moderate Wave Action Label	10 Pt. Arial, ALL CAPS

A new line layer will be added to the Digital Flood Insurance Rate Map (DFIRM) Database to accommodate the LiMWA features. This Standard DFIRM Database layer, S_LiMWA, contains the following elements.

LIMWA_ID	R	E	Primary key for table lookup. Assigned by table creator.
SOURCE_CIT	R	E	Source Citation. Abbreviation used in the metadata file when describing the source information for the S_LiMWA table.

The LiMWA will be identified in the DFIRM legend as "Limit of Moderate Wave Action" (Figure 1). A note will be added to the Notes To Users on the DFIRM panel to explain the LiMWA boundary. The note will be printed only on the panels where the feature appears. There is no specific priority order for the listing of the note. The note will be as follows:

> The AE Zone category has been divided by a **Limit of Moderate Wave Action (LiMWA)**. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between the VE Zone and the LiMWA (or between the shoreline and the LiMWA for areas where VE Zones are not identified) will be similar to, but less severe than those in the VE Zone.

The following is an example FIRM that has the LiMWA delineated. The area shown in Plot "a" shows the delineation of the LiMWA in a region where the predominant coastal flood hazard is overland wave propagation. Plot "b" shows delineation of the LiMWA in a region where the predominant coastal flood hazard is wave runup.

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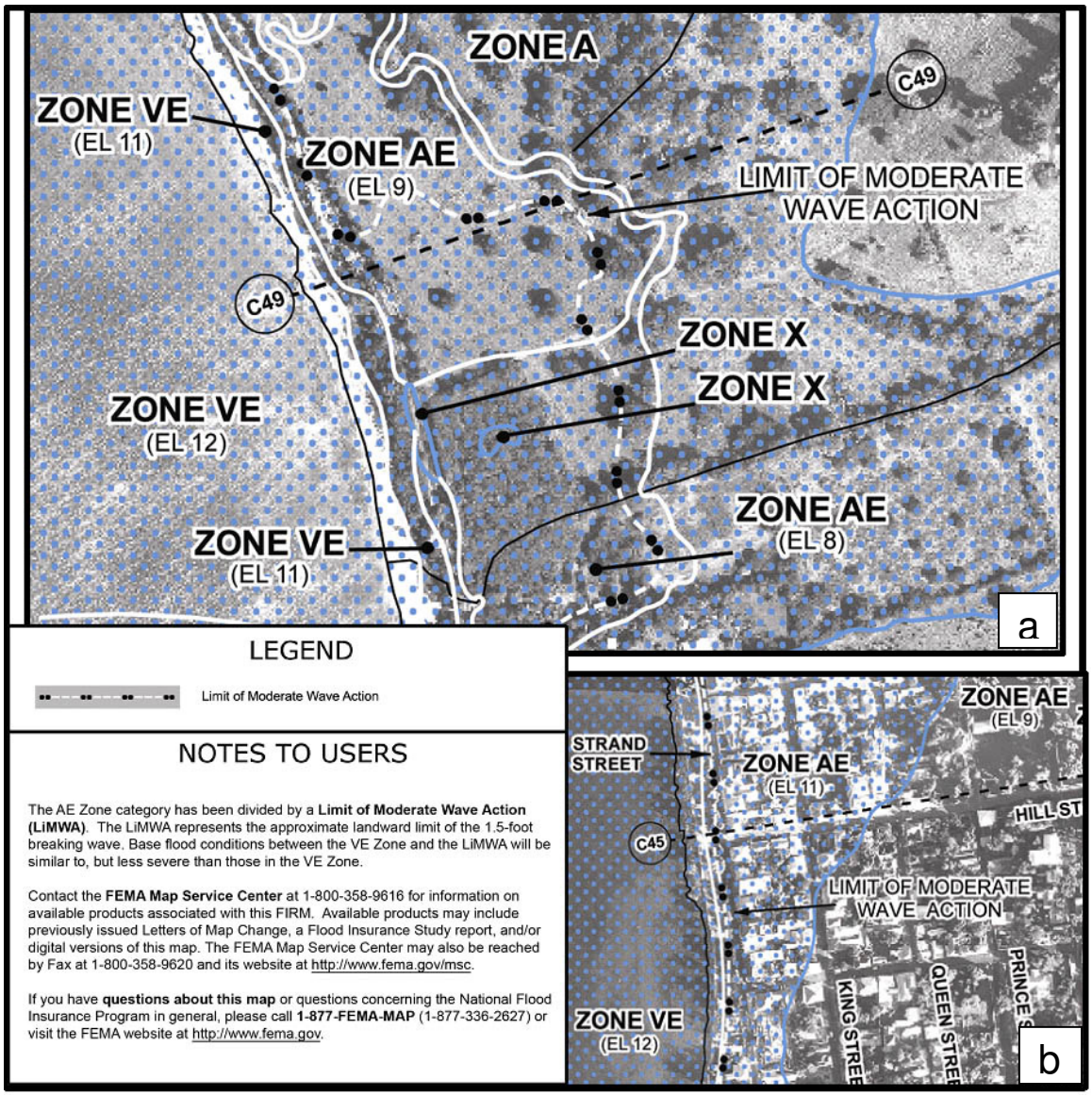

Figure 1. Sample plots of a FIRM with the Limit of Moderate Wave Action (LiMWA) delineated and the relevant entries in the Legend and Notes to Users.

FIS Standard Language

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

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

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

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