SMAST University of Massachusetts Dartmouth
The School for Marine Science and Technology

Applied COASTAL

TECHNICAL MEMORANDUM

To: **Congressman Bill Keating**

From: **John Ramsey, P.E. Applied Coastal Research and Engineering, Inc**
Brian Howes, Ph.D., Director, Coastal Systems Program (SMAST-UMD)

Re: **Review of 2013 Draft Federal Emergency Management Agency Flood Insurance Study for Town of Marshfield, MA**

Date: **December 3, 2013**

This technical memorandum summarizes the brief review of the draft FEMA maps for the Town of Marshfield, MA. This review was undertaken at the request of Congressman Keating's Office to determine if issues may exist associated with the new flood maps. To this end, a coastal engineer at Applied Coastal Research and Engineering and coastal scientist at UMass Dartmouth conducted a top level review to determine if any major issues were present that might need further examination to facilitate the on-going process and to assist the Congressman's Office in assisting the citizens of his district. As part of the evaluation, we also reviewed work by the Town of Marshfield's consultant.

Two major points arose from the review that are worth considering as the Town of Marshfield moves forward:

- The modeling analysis used in the development of the 2013 FEMA maps is relatively new. Specifically, the method used in the preliminary delineation to compute wave setup at Long Beach is the Direct Integration Method (DIM) as described in the FEMA mapping guidelines and specifications for the Pacific Coast (2005). Wave setup is a phenomenon where water levels along a coastline are elevated due to breaking waves pushing water against the shore.

  This methodology was developed to address particular issues related to the Pacific Coast, including very long wave periods (much longer than the U.S. East

Coast), wave 'groupiness', and dynamic wave setup. The key advantage of the DIM is that is it a simple empirical method that can be applied as a straightforward calculation. This is in contrast to other more appropriate methods which typically require detailed physics-based modeling for the region of interest.

These more advanced and accurate methodologies have been utilized by FEMA. For example, in Region III, the U.S. Army Corps of Engineers Research and Development Center (ERDC) developed a combined hydrodynamic and wave model for the computation of storm surge levels, including setup along the open Atlantic coastline (Blanton, *et al*., 2011). This type of physics-based numerical modeling analysis typically yields substantially lower wave setup values than the DIM for the U.S. East Coast. By definition, these lower setup values would yield lower wave heights and limit the extent of FEMA mapped V-Zones.

To determine the actual magnitude of error associated with the DIM which was incorporated into the Marshfield analysis, it is necessary that FEMA apply a physics-based modeling approach to New England (or just Massachusetts, if possible). This will provide a consistent comparable approach for the East Coast of the U.S. and greatly increase the acceptability of the results.

- The Town's appeal to FEMA brought up an additional point to be evaluated. This point involves the 100-year Still Water Level used to develop the 'inundation level, calculating the average slope for wave set up, and determining water depths for overland wave transformation.' The Town's consultant analysis revealed a vertical datum issue, where they indicate corrections from NGVD29 to NAVD88 were not performed on all transects. Specifically, this correction would lower the SWL by approximately 1 foot in 8 of 11 transects (the other 3 had prior datum corrections). This lower storm surge level also would lead to inaccurate mapping of both V-Zones and A-Zones on the Preliminary FEMA maps and should be corrected.

Overall, the Preliminary FEMA Maps for the Town of Marshfield, MA provide overly conservative results, which consistently over-predict the level of flooding that would occur during a 100-year storm event. The methodologies utilized to predict coastal flood levels do not incorporate modern physics-based numerical techniques that have provided the basis for FEMA analyses in other Regions. This shortcoming in the use of modern numerical modeling techniques appears to be consistent throughout the FEMA Flood Insurance Studies for Massachusetts Counties.

References

Blanton, Brian, Lisa Stillwell, Hugh Roberts, John Atkinson, Shan Zou, Michael Forte, Jeffrey Hanson and Rick Luettich (2011). FEMA Region III Storm Surge Study Coastal Storm Surge Analysis: Computational System, Report 2: Intermediate Submission No. 1.2. U.S. Army Engineers Research and Development Center (ERDC), Kitty Hawk, NC.

FEMA, (2005). Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States. Northwest Hydraulic Consultants, West Sacramento, CA.