



Memorandum

To: FEMA Region 1

From: STARR

Date: January 29, 2016

Subject: CLIN #7 – Cumberland and York Re-evaluation.

Purpose

STARR is currently conducting coastal analysis in Cumberland and York Counties, Maine under the FY14 Task Order 15 (TO15) Contract Line Item 7 (CLIN7). The scope under CLIN7 is to re-evaluate:

- 45 transects which were analyzed using data provided by 5 Cumberland communities in 2009; and
- 50 transects which were analyzed using data provided by 3 York communities in 2009.

However, when conducting the analysis in Cumberland County, STARR identified the need to evaluate all transects within the communities that submitted data in 2009, not just those transects the communities submitted. The purpose of this memo is to provide justification for:

1. The re-evaluation of all 99 coastal transects within the 5 communities in Cumberland County that submitted data in 2009, which includes transects that have no community-submitted data.
2. Why this re-evaluation only applies to Cumberland County and not to York County.

This memo will briefly document the history of coastal flood hazard analysis for these counties beginning with the 2006 Map Modernization effort; then provide a discussion of the engineering decisions that were made during the Risk MAP FY11 Task Order 8 (TO8) work; and conclude with recommended evaluations that extend beyond the CLIN7 scope, which would result in an approach for analyzing and mapping coastal areas that is consistent for all Cumberland and York coastal communities, as well as consistent with the methodology used in other Maine counties and States within Region I.

Background

Cumberland and York Counties, Maine have gone through several iterations of coastal flood hazard analysis efforts from the FY06 Map Modernization project to the current FY14 TO15 Risk MAP CLIN7 effort. The following is a summary of these coastal flood hazard analysis efforts including the current CLIN7 effort that is being conducted in order to produce county-wide regulatory products (FIRMs and FIS reports) for Cumberland and York Counties.

2006 - Map Modernization: During the Map Modernization activities for Cumberland and York, the coastal areas in the communities of Scarborough, Cape Elizabeth, South Portland, Portland, Cumberland, Chebeague Island, and Harpswell in Cumberland County and Kittery, Ogunquit, Kennebunk, Kennebunkport, Biddeford and Old Orchard Beach in York County were restudied.

The starting wave conditions for the communities utilized offshore wave statistics. For Cumberland County, a Peaks over Threshold method was applied to the historical wave height data observations from the National Data Buoy Center (NDBC) of NOAA Buoy 44007. It was assumed that for extratropical storms (Nor'easters), the wave steepness is 0.035, and hence the deep water wavelength could be determined using the wave height and wave steepness. For York County, a Peaks over Threshold method was applied to the U.S. Army Corps of Engineers' wave hindcast called the Wave Information Studies (WIS) at Station ID 41. Wave steepness was again assumed to be 0.035 in order to determine deep water wavelength.

2009 - Preliminary FIRMs & Community-Submitted Data: In 2009, the 2006 coastal updates were released to the communities through the issuance of Preliminary FIRMs. In accordance FEMA's regulatory due process requirements, a 90-day Appeal Period was initiated for both counties. During this Appeal Period, several communities submitted additional data contesting the updated BFEs. This community-submitted data were largely based on newly established initial wave conditions developed from STWAVE, a two-dimensional wave transformation model.

Figure 1 shows the total number of transects within every community that submitted data and the number of submitted transects. The communities of Kennebunk, Kennebunkport and Biddeford of York County submitted updated analysis for all the 50 transects within these communities. The communities of Cape Elizabeth, South Portland, Portland, Falmouth and Harpswell in Cumberland County, however, submitted updated analysis for 45 out of 99 transects within these communities. Falmouth submitted revised engineering and mapping on the redelineated effective coastal flood risks.

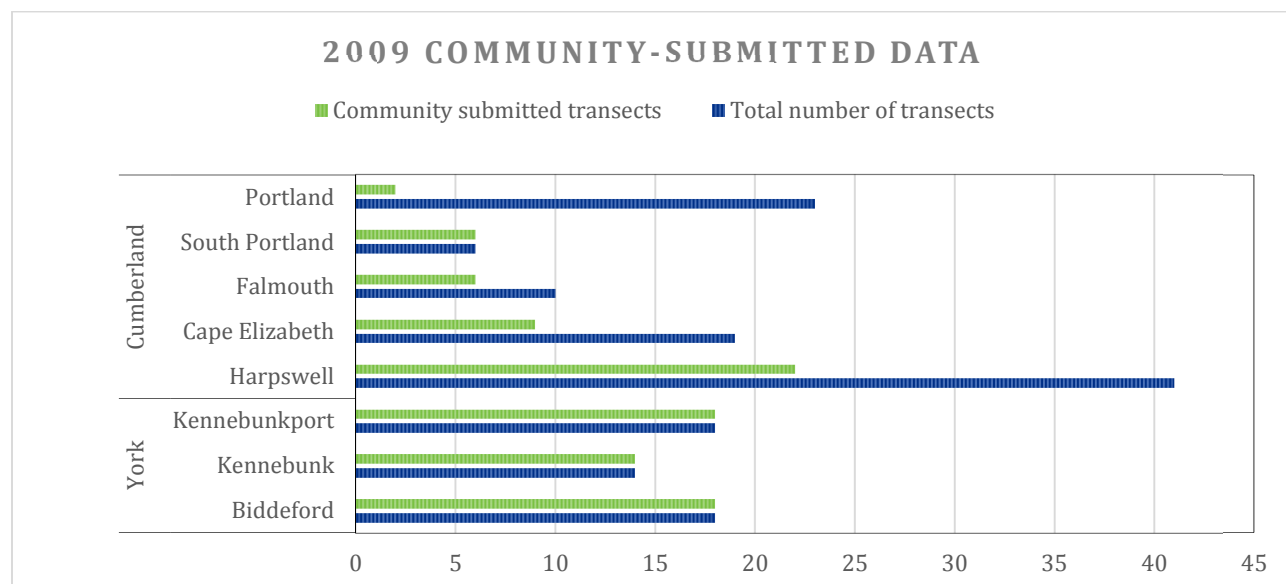


Figure 1 – Community-Submitted Transects in Cumberland and York

2012 - Risk MAP T08: Under the coastal engineering analysis scope for Risk MAP FY11 T08, STARR was tasked to complete the analysis for all transects with no community-submitted data using STWAVE. The intention of this effort was to have a consistent methodology for all transects within both counties. This involved the following:

- For communities that did not submit any data in 2009, develop an STWAVE model that could be used to conduct coastal engineering analysis. In Cumberland County, this includes the communities of Scarborough, Brunswick, Chebeague Island, Cumberland, Freeport, Long Island, and Yarmouth; and in York County, this includes the communities of Kittery, Ogunquit, Old Orchard Beach, Saco, Wells, and York.
- For communities that did submit data in 2009, STARR took the following approach:
 - Update the flood hazards maps based on the results of community-submitted data. This involves all 50 transects with community-submitted data in York County, and 45 out of 99 transects with community-submitted data in Cumberland County.
 - For the 54 transects which were not covered by community-submitted data in Cumberland County, STARR leveraged and submitted STWAVE models to update the coastal engineering analysis.

The “2012 T08 Engineering Decisions” section that follows provides details regarding the wave setup decisions that were made during T08 coastal analysis effort that need to be re-visited based on the outcome of a Scientific Resolution Panel (SRP) ruling in Plymouth County, Massachusetts. The current FY14 T015 CLIN7 scope for Cumberland and York coastal analysis is based on this SRP ruling and the need to re-evaluate wave setup.

Current – FY14 Risk MAP T015 (CLIN7): Under the current CLIN7 scope for the Cumberland and York coastal analysis, STARR is tasked to re-visit only the transects for which communities submitted data using potentially inaccurate wave setup per the SRP ruling. Also, STARR was not scoped to re-evaluate wave runoff.

In York County, the scope includes the re-evaluation of all 50 transects in the communities of Biddeford, Kennebunk and Kennebunkport.

In Cumberland, as shown in **Figure 1**, 4 of the 5 communities that submitted data, did not provide data for all the transects in their community. Data was submitted for 45 out of 99 total transects within the 5 communities (Harpwell, Cape Elizabeth, Falmouth, South Portland, and Portland) that submitted data. STARR is scoped to re-evaluate these 45 transects that have community-submitted data.

Due to engineering decisions made during the T08 coastal analysis effort (discussed below), STARR has identified the need to expand the scope to evaluate all 99 transects in Cumberland County so the mapping would be based on the appropriate, consistent approach for all transects within the county. There is no need to expand the scope in York County since the scope already covers all of the transects in the communities that submitted data. During the re-evaluation of all transects, STARR further recommends reviewing wave runoff as well. Initially, this factor was not anticipated

to change but in the process of re-evaluating transects in York County, it was observed that wave runup may need to change for some transects.

Table 1 summarizes the communities impacted by each of the three mapping efforts listed above as well the CLIN7 scope that STARR is currently working on.

County	Community	# of Transects	2006 MapMod	2009 Communities Submit Data	2012 Risk MAP TO8 Preliminary	FY14 TO15 CLIN7
York	Biddeford	18	X	x		X
	Kennebunk	14	X	x		X
	Kennebunkport	18	X	x		X
	Kittery	17	X		x	
	Ogunquit	9	X		x	
	Old Orchard Beach	8	X		x	
	Saco	8			x	
	Wells	15			x	
	York	37			x	
Cumberland	Harpswell	41	X	P	P	X
	Cape Elizabeth	19	X	P	P	x
	Falmouth	10		P	P	x
	South Portland	6	x	x		x
	Portland	23	x	P	P	x
	Brunswick	4			x	
	Chebeague Island	15	x		x	
	Cumberland	6	x		x	
	Freeport	9			x	
	Long Island	5			x	
	Yarmouth	8			x	
	Scarborough	15	x		x	

x - Complete analysis for all the community transects

P - Partially completed analysis for selective number of transects

Table 1 – Communities Receiving Coastal Analysis and Submittals for Cumberland & York Counties

2012 TO8 Engineering Decisions

As mentioned, the communities of Cape Elizabeth, South Portland, Portland, Falmouth and Harpswell in Cumberland County submitted data in response to the 2009 Preliminary FIRMs for some of the communities' transects. As part of the TO8 coastal analysis scope, STARR was tasked to complete the coastal analysis at transects for which these communities did not provide data.

STARR reviewed the initial wave conditions at the transects with community-submitted data and found that initial wave conditions were not associated with deep water wave height as defined by the depth to wavelength ratio. Since the community-submitted documentation did not explain how the initial wave conditions were obtained, STARR evaluated the submitted information in order to replicate their initial wave height. STARR found that a wave height from about 2,000 feet off the shore (not deep water) would approximately replicate the initial wave height used in the analysis submitted by the 5 communities in Cumberland County.

Figure 2 shows that the transects which have community-submitted data (red) are interspersed amongst transects which do not have community-submitted data (green) in Cumberland County. If STARR used the method of identifying the deep water wave condition based on the depth over wavelength criteria (that has been used for other Region I coastal studies) at the transects with no community-submitted data, it would have yielded substantially different flood zones and associated BFEs than neighboring transects which were analyzed using a different initial wave height condition. To avoid using inconsistent initial wave height conditions, STARR decided to apply the method that replicated the starting wave conditions used for the transects with community-submitted data.

In 2014, a Scientific Resolution Panel (SRP) met to discuss the method of identifying wave conditions in the communities of Scituate and Marshfield in Plymouth County, Massachusetts. STARR had used the water depth to wavelength criteria to identify deepwater wave conditions for use in the identification of flood hazards in Plymouth County. Specifically, the Direct Integration Method (DIM) was used to calculate wave setup. DIM requires deepwater wave statistics to be used in the equation. The appeals that were denied in Scituate and Marshfield had used the existing wave model information (STWAVE) but did not identify initial conditions using the depth to wavelength criteria, but rather a different approach that resulted in non-deepwater conditions. Since the appellant submitted coastal analysis based on a method which is not in compliance with the guidance in the *Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update* (FEMA, 2007), the SRP ruled that the approach implemented by FEMA was correct and, thus, denied the Marshfield and Scituate appeals in Plymouth County.

Since the method of identifying initial wave conditions in Scituate and Marshfield was similar to that of the community-submitted data in York and Cumberland Counties, FEMA funded (in CLIN7) the re-evaluation of the transects which have community-submitted data. Due to the engineering decision made during the TO8 coastal analysis effort, transects with no community-submitted data will also need to be reviewed in the 5 Cumberland County communities that submitted data since the initial wave conditions were not identified using the water depth to wavelength criteria.

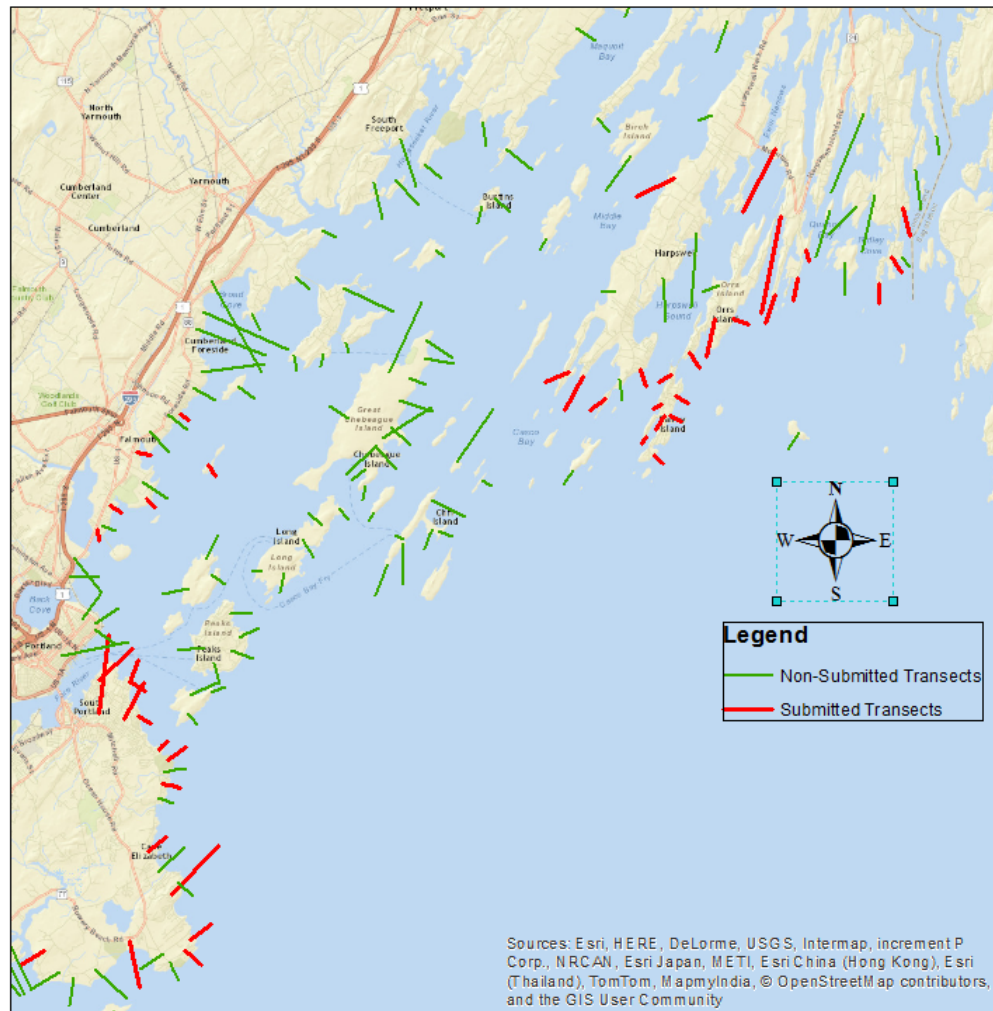


Figure 2: Submitted and Non-submitted Transects within Cumberland County.

Recommendations

STARR is tasked under CLIN7 to revisit coastal engineering and mapping for the communities which submitted data in response to the 2009 Preliminary FIRMs and update the initial wave conditions as a results of the SRP decision for Plymouth County, Massachusetts.

The scope includes obtaining deep water wave heights for all community-submitted transects (50 in York County and 45 in Cumberland County) and then utilize it to update the wave setup calculation and WHAFIS analysis. Runup analysis was not required to be updated. However, since there are additional transects that may not be using the appropriate definition of deepwater wave height for initial conditions; STARR recommends the following efforts which are not part of the current CLIN7 scope:

- Re-evaluate all 99 transects within the 5 communities that submitted data in Cumberland County communities to maintain consistency within the Community, the County and the Region.
- During the process of re-evaluating the transects in Cumberland and York Counties, review the wave run-up analysis as part of the coastal flood hazard analysis.
- Other than reviewing wave run-up, no additional tasks are anticipated for York County since the CLIN7 scope, to re-evaluate all 50 transects within Biddeford, Kennebunk and Kennebunkport, is adequate to complete coastal analysis in this county.