



# Memo

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Date: February 24, 2017  
To: Christina Therrien, Town Manager, Town of Machias  
From: Nathan Dill, P.E. and Leila Pike, E.I.T.  
Subject: Preliminary Flood Insurance Rate Maps Initial Review

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## INTRODUCTION

Ransom Consulting, Inc. (Ransom) has prepared this memorandum for the Town of Machias, Maine to describe our initial review of the preliminary Flood Insurance Rate Maps (FIRMs), recently issued to the Town by the Federal Emergency Management Agency (FEMA). This review includes a brief discussion and explanation of the methods FEMA<sup>1</sup> has applied to determine the Special Flood Hazard Area (SFHA) and Base Flood Elevations (BFE) in Machias, our opinion regarding the reasonableness of the methods and resultant mapping, and recommendations revising the maps, if necessary. We are also providing attachments to this memo to help guide our discussion.

The new coastal analysis considers the potential storm surge and damaging wave effects associated with a hypothetical 100-year storm<sup>2</sup>, while the riverine hydrologic and hydraulic analysis considers the peak water level for a 100-year flood of the Machias River. A new hydrologic and hydraulic analysis of the Machias River was not performed for these flood maps. Instead, the flood elevations determined from the original study performed in 1988 were redrawn to new topography data. Flood zone delineation for both riverine and coastal analyses were performed using 2-foot elevation contours derived from lidar data collected by the USGS in 2011 for the "Lidar for the Northeast" project. These topographic data are available from the Maine Office of Geographic Information Systems.

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<sup>1</sup> For our purposes "FEMA" refers to the Federal Emergency Management Agency and/or contractors that were hired by FEMA to perform the flood mapping work.

<sup>2</sup> The "100-year" storm is more appropriately described as the 1% annual chance storm, which means the storm (or flood elevation) that has a 1% chance of being equaled or exceeded in any given year. As such, it is possible, albeit unlikely, to have multiple 100-year events within a century, or even within the same year.

## INFORMATION REVIEWED

Our review is based on the 2016 preliminary FIRM, 2016 preliminary Flood Insurance Study (FIS), and GIS mapping data downloaded from FEMA's Mapping Service Center (MSC) website<sup>3</sup>. In addition, because riverine mapping of the Machias River was based on previous survey data and hydraulic analyses, we requested technical data, collected during previous studies, from FEMA's Engineering Library<sup>4</sup>. The following list provides brief descriptions of files that were provided from FEMA's Engineering Library for Machias. These files are also provided on the attached DVD.

- **230140-19881118\_survey.pdf** – 1985 scans of field survey notes of river cross section surveys
- **230140-hydro22.pdf** – 1979 Annual peak flow frequency analysis used to determine return interval discharge values for the Machias River.
- **230140-MachiasRiver.pdf** – Input and output from the WSPRO model of the Machias River used to determine flood elevations for areas upstream of Route 1.
- **230140V00.pdf** – 1988 FIS for the Town of Machias
- **WASHINGTON\_ME0004.pdf** – Annotated map from 1980's FEMA study showing transect locations and flood zones

## UPDATED ANALYSIS

The updated SFHA flood zones in Machias have been derived through a new coastal flood hazard analysis, a re-delineation of riverine flood zones using an older detailed analysis of the Machias River and new topographic data, and a re-delineation of previous approximate riverine flood zones that have not been studied by detailed methods. **Attachment 1** shows all the flood zones within the Town boundaries. The zones labeled "AE" are zones that are based on detailed hydraulic analyses (either the newer coastal analysis or the older riverine analysis). Zones labeled "A" are approximate zones that are not based on a detailed hydraulic analysis. The number following the zone label indicates the BFE. For coastal AE zones this number represents the BFE. The only coastal BFE shown on the FIRM in Machias is 11 feet<sup>5</sup> corresponding to the coastal zone along Yoho Creek. For riverine zones, the BFE is provided in the Flood Insurance Study (FIS), on the Floodway Data Table and also in the flood profiles, which are provide in **Attachment 2**.

The new coastal flood hazard analysis impacts the updated flood mapping in Machias in two different locations and in different ways. Near the downtown area of Machias, the new coastal

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<sup>3</sup> Please note that 2016 preliminary data are not currently available from FEMA's MSC website. FEMA took the data down at the end of November 2016, after the end of the statutory appeal period. These data will become available from the MSC as "effective data," once the FIRMS and FIS are made effective later this year. We assume the anticipated effective data will be unchanged from the preliminary data that were provided in 2016.

<sup>4</sup> Previously FEMA performed an initial FIS for Machias in the 1980's (effective 1988).

<sup>5</sup> All elevations in this memorandum are in reference to the North American Vertical Datum of 1988.



analysis has been used to update the tidal backwater elevation for the lower portion of the Machias River downstream of the falls at Route 1. The other location, with zones based on the new coastal analysis, is along the tidal shoreline of Yoho Creek.

In both locations, FEMA has based the BFE on a coastal Still Water Elevation Level (SWEL) of 10.7 feet. The SWEL is the water surface elevation that results from a combination of astronomical tides, storm surge, and fresh water inputs, but not including any increase in the water level associated with waves. The SWEL for Machias was derived from long term tide gage analysis performed by FEMA in 2012 and applied to FIRM updates throughout New England<sup>6</sup>. **Attachment 3** provides a table, taken from FEMA's report on this analysis, which shows changes in the SWEL between the older effective values and the updated values. The SWEL of 10.7 feet at Machias has been interpolated between the values of 9.71 feet and 11.02 feet that were determined for Bar Harbor and Cutler, respectively. The highlighted values in the attachment show how the SWEL for Machias has decreased nearly 1 foot from the 1988 effective SWEL. Based on our experience in reviewing FEMA analyses in other areas, and considering the reduction in SWEL from the 1988 FIS, we do not believe the SWEL could be reasonably reduced below 10.7 feet for Machias.

For coastal flood zones, the BFE is based on a combination of the SWEL, plus some additional height, due to wave effects, such as the wave setup, and wave run-up or wave crest elevation. This generally requires additional analyses of the waves. After the wave effects are determined and added to the SWEL, FEMA's guidelines and specifications require that coastal BFE's are rounded to whole foot values. Along the tidal shoreline of Yoho Creek, FEMA has essentially assumed that wave effects are negligible and rounded up the SWEL value to get a BFE of 11 feet. This is the lowest possible coastal BFE that could be determined for Machias, without an unreasonable revision to the SWEL. As such, we do not see any buildings that are impacted by the proposed flood zones along Yoho Creek.

FEMA has also apparently assumed that wave effects are negligible in the tidal portion of the Machias River. However, they decided to treat the tidal portion of the Machias River, within the Town limits, as riverine zone, instead of a coastal zone. This means that the BFE for the lower portion of the Machias River (within Machias) is not shown next to the "AE" zone designation on the FIRM, and that the BFE value is best determined from the Floodway Data Table (**Attachment 2**). This seemingly arbitrary decision to treat a coastal portion of the Machias River as a riverine zone may actually benefit the town, because FEMA's Riverine analyses guidelines allow a more precise determination of the BFE<sup>7</sup>. This may be favorable when determining flood insurance rates for properties that are impacted by the new flood zones, because an elevation of 10.7 feet from the floodway data table can be used, instead of the rounded coastal BFE of 11 feet.

**Attachment 4** shows a close-up view of an area in the Town where the flood zone has a BFE of 10.7 feet along the Machias River. This is the only area in the town where we see buildings within the new flood zones. In this figure, the proposed flood zone is shown, as well as the 10.7 foot elevation contour derived from the lidar data. From this comparison, it is apparent that the flood zone boundary follows the 10.7 foot contour fairly closely, but there are some areas within

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<sup>6</sup> Updated Tidal Profiles for the New England Coast, STARR technical report, March 2012. Washington DC, USA. <https://www.fema.gov/media-library/assets/documents/85240>

<sup>7</sup> Riverine flood hazard data presented in the Floodway Data Table in the FIS can provide BFEs which are precise to the tenth of a foot at specific river cross sections, whereas coastal BFEs are only shown on the FIRMS and are always rounded to the nearest whole foot.

the zone that may lie above the BFE. Areas above the BFE may include the roadway and some of the building footprints in the area. It is possible that the lidar data contain errors, so we cannot make any conclusive statement, whether or not, there are areas above the BFE within the flood zone, without certified topographic field survey.

For the rest of the Machias River, upstream of Route 1, FEMA has used BFE data from the previous FIS to redraw the flood zone boundaries, based on new topographic data. The BFEs in the previous FIS were determined in the 1980's, by running a hydraulic computer model called WSPRO. WSPRO computes the water surface elevation at a series of cross-sections along the river. **Attachment 5** shows the location of the river cross-sections and computed BFE values at each cross-section, which are also shown on the FIRMS. For the cross-sections below Route 1 (with a BFE of 10.7 feet), the WSPRO model computed BFE values that were lower than the new coastal SWEL, so the SWEL elevation is used instead of the WSPRO results. This is also indicated by a foot note in the Floodway Data Table in Attachment 2. Although it is technically inconsistent and potentially problematic to re-delineate the flood zones using topographic information that is potentially different from the older river cross-section profiles that were used in the hydraulic model, we do not see any buildings impacted by the re-delineated flood zones, upstream of Route 1, where the older hydraulic analysis is still used.

The updated coastal analysis has also resulted in two small detached coastal AE zones that are apparent in **Attachment 4**. We believe these zones are an artifact of automated GIS mapping procedures used by FEMA and are not correct. One of the zones appears to be impacting the Waste Water Treatment Facility on Kilton Lane. It is possible that FEMA will remove these erroneous zones prior to releasing the effective maps, since their contractors are required to perform a GIS "cleaning" process before submitting the final data.

In addition to the flood zones determined by detailed hydraulic and/or coastal analyses, the proposed FIRMS in Machias contain a few approximate A zones. These are shown on **Attachment 1**. The approximate zones (also called "unnumbered A zones") appear to have been simply carried forward onto the proposed maps from the current effective maps. We do not have any information to evaluate the accuracy or reasonableness of these zones, nor does FEMA provide BFE values for these zones. We have looked closely at these zones, overlaid on aerial photography, and we do not see any buildings within these approximate zones.

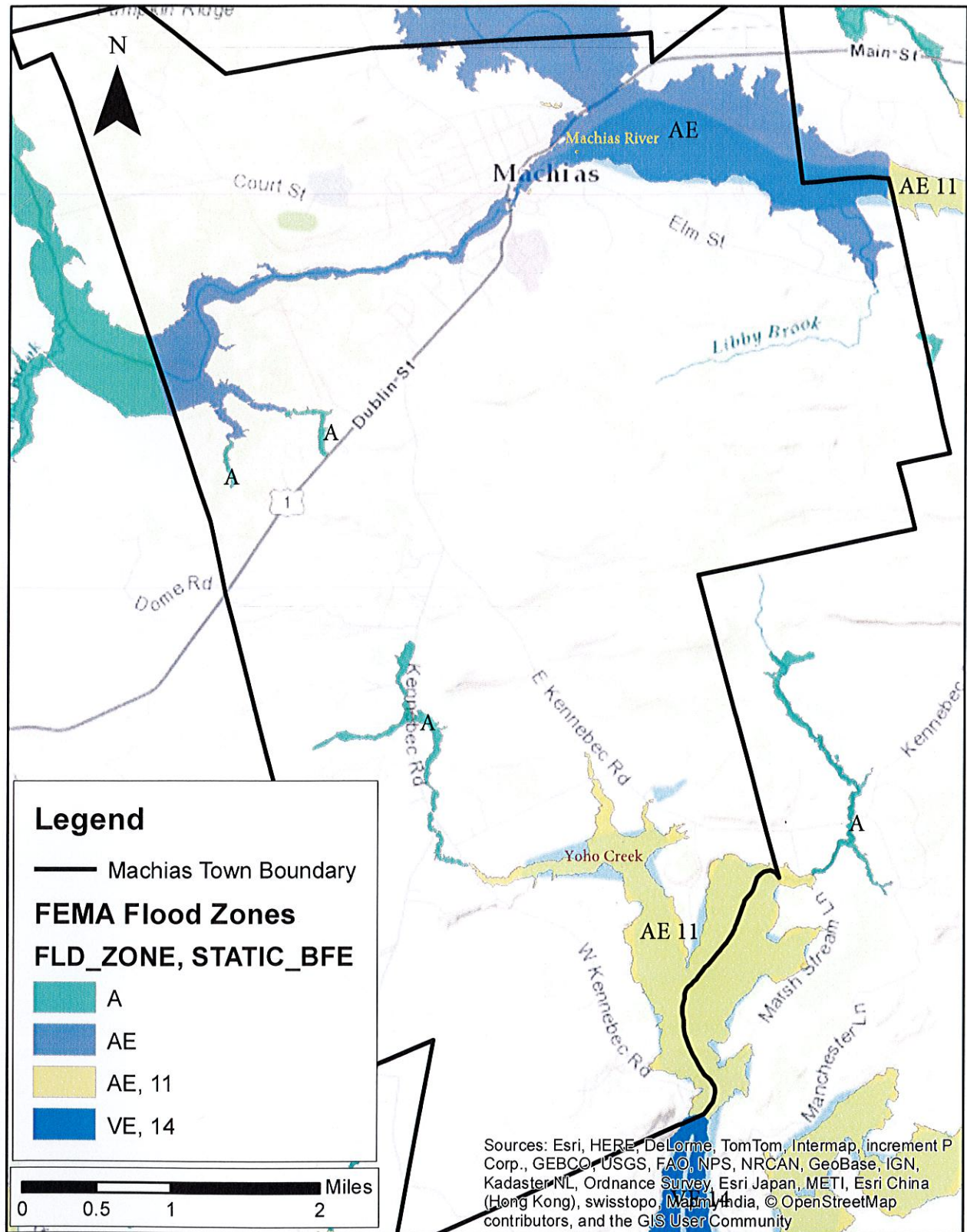
## RECOMMENDATIONS

The deadline for the statutory appeal period for Washington County was November 30, 2016. Therefore, if Machias were to pursue revised analysis and mapping of the flood zones and base flood elevations in the Town, it would need to be completed as a municipal Letter of Map Revision (LOMR), when the final maps become effective. Assuming there are no appeals in Washington County, it is likely that FEMA will issue their Letter of Final Determination for the Washington County FIRMS in early 2017, and the maps could become effective in the summer of 2017.

In general, Ransom does not recommend that the Town of Machias pursue a LOMR, since we found that the flood zones and BFEs appear reasonable. However, as an exception, we would recommend pursuing a LOMR, if the incorrect detached AE zones are not removed from the final effective maps (e.g. the zone impacting the Waste Water Treatment Facility).

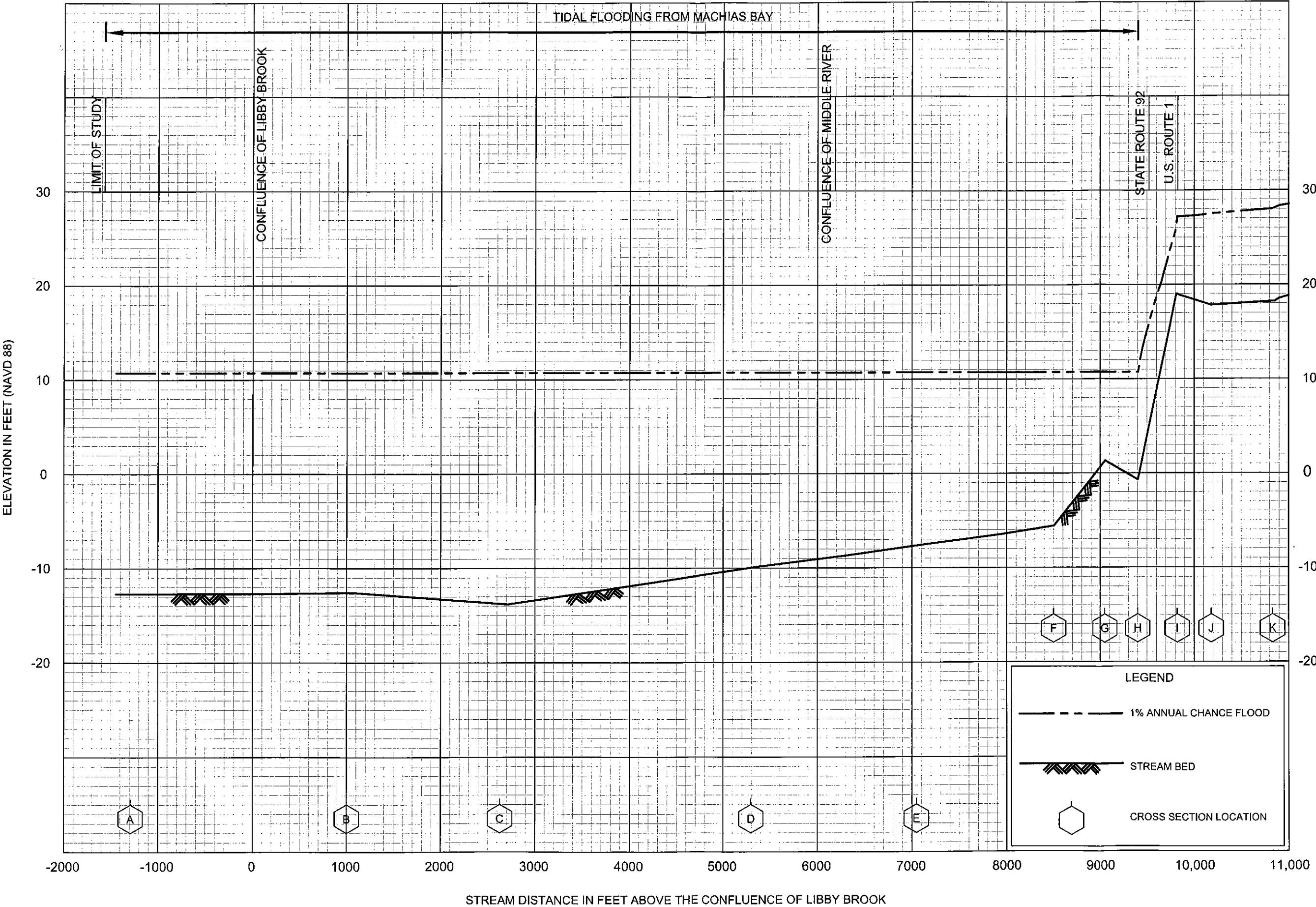
For the property owners that are impacted by the Machias River zone in the area shown in **Attachment 4**, we recommend hiring a licensed surveyor to prepare an elevation certificate. It is possible that an on-the-ground survey will show some areas in that riverine AE zone are in fact above the BFE. If a survey shows that a building is above the BFE, the property owner can apply for a Letter of Map Amendment (LOMA), which can effectively remove the property from the SFHA, otherwise having a survey can help more precisely determine relative elevation of the building and the BFE to ensure that flood insurance rates are set correctly, if the property owner is required or chooses to purchase flood insurance through the National Flood Insurance Program.





FEMA Preliminary Flood Zones  
 Town of Machias, Maine  
 LAP 2-15-17  
 161.06154

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
MACHIAS RIVER								
A	-1,280	*	*	*	10.7 <sup>2</sup>	*	*	*
B	1,000	*	*	*	10.7 <sup>2</sup>	*	*	*
C	2,620	*	*	*	10.7 <sup>2</sup>	*	*	*
D	5,300	*	*	*	10.7 <sup>2</sup>	*	*	*
E	7,050	*	*	*	10.7 <sup>2</sup>	*	*	*
F	8,500	*	*	*	10.7 <sup>2</sup>	*	*	*
G	9,050	*	*	*	10.7 <sup>2</sup>	*	*	*
H	9,400	*	*	*	10.7 <sup>2</sup>	*	*	*
I	9,820	*	*	*	27.2	*	*	*
J	10,180	*	*	*	27.5	*	*	*
K	10,830	*	*	*	28.0	*	*	*
L	11,080	*	*	*	29.1	*	*	*
M	11,280	*	*	*	30.0	*	*	*
N	11,410	*	*	*	30.3	*	*	*
O	11,610	*	*	*	30.8	*	*	*
P	11,850	*	*	*	31.4	*	*	*
Q	12,500	*	*	*	32.2	*	*	*
R	12,830	*	*	*	32.9	*	*	*
S	13,640	*	*	*	36.9	*	*	*
T	14,840	*	*	*	40.4	*	*	*
<sup>1</sup> Distance in feet above the confluence of Libby Brook					*Data Not Available			
<sup>2</sup> Elevations affected by tidal flooding								
FEDERAL EMERGENCY MANAGEMENT AGENCY					FLOODWAY DATA			
WASHINGTON COUNTY, ME (ALL JURISDICTIONS)					MACHIAS RIVER			
TABLE 24								



FLOOD PROFILES

MACHIAS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

WASHINGTON COUNTY, ME

(ALL JURISDICTIONS)

01P



[ Taken from STARR report "Updated Tidal Profiles for the New England Coastline", March 2012.  
<https://www.fema.gov/media-library/assets/documents/85240> ]

based on at-site estimates using the Pearson Type III distribution, but the method of moments was used to fit the distribution, rather than L moments as in our current study.

**Table 7. Comparison of 1-percent-annual-chance elevations based on the regional L-moment analyses (Wakeby), effective SWELs from FIS reports, 1988 USACE profiles, Pearson Type III at-site analyses, and the maximum observed elevations (in feet NAVD).**

Station	1-percent elevation, feet (NAVD)	Effective SWELs, feet (NAVD)	1988 USACE 1-percent elevation, feet (NAVD)	Pearson Type III elevation, feet (NAVD)	Maximum observed elevation, feet* (NAVD)	Record Length (years)
Eastport	14.72	13.99	14.80	14.31	14.38	78
Cutler	11.02	12.01	12.50	10.51	10.43	24
Bar Harbor	9.17	10.00	9.30	9.34	9.29	60
Rockland	9.93	9.51	8.70	---	---	---
Portland	9.51	8.88	8.70	9.02	9.88	95
Seavey Island	9.48	7.93	8.80	9.22	9.64	75
Boston	10.04	9.40	9.50	11.45	14.30	86
Buzzards Bay	13.85	12.96	13.60	---	---	---
New Bedford	11.86	11.97	11.40	12.07	14.58	85
Newport	10.52	10.72	10.70	9.55	11.84	77
Quonset Point	11.23	11.32	11.20	---	---	---
Fall River	12.09	13.85	13.00	---	---	---
Providence	13.79	15.18	14.80	14.20	16.18	69
New London	9.40	9.04	8.90	8.05	9.22	69
New Haven	8.87	9.66	9.60	---	---	---
Bridgeport	9.95	9.61	9.10	9.15	9.31	43
Stamford	10.85	10.49	10.50	10.74	11.11	69
Montauk	5.84	6.86	9.80	6.83	7.59	60
Port Jefferson	9.80	9.77	9.10	8.84	8.38	35
Willeys Point	11.41	12.71	12.30	13.61	13.23	75
New Rochelle	10.44	10.90	11.90	9.23	8.27	33
The Battery	7.36	8.59	---	7.46	7.66	87
Bergen Point	7.57	7.20	---	6.51	6.20	25

\* Reported maximum observed elevation also includes high water mark values.

The major differences (on the order of 4 feet or more) between the updated 1-percent chance elevations from the regional L-moment analyses and the 1988 USACE 1-percent chance elevations occurs at Montauk. For this station, the mean annual elevation is relatively low as compared to the 1-percent-elevations reflected in the 1988 USACE report for this site. Additionally, the difference between the mean annual elevations and the 1988 USACE 1-percent-elevations is much greater than the similar comparisons at other sites along the New England coastline. This implies that the 1988 USACE 1-percent-elevation at Montauk was driven by a singular, extremal event which far exceeded the typical high water levels for the area. With the exception of Hurricane Bob in 1991,





**RANSOM**  
Consulting  
Engineers  
and Scientists

Feet  
0 200 400 800 1,200

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