HOW2 Determine BFE Outside a Floodplain

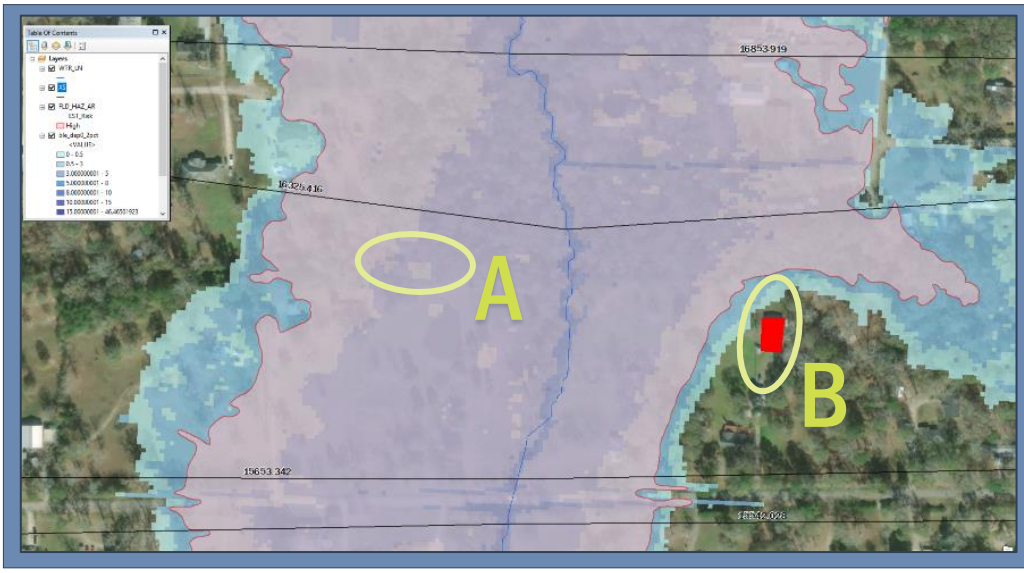
Base Flood Elevations from One-Dimensional (1D) Analysis

As a participating community in the National Flood Insurance Program, the minimum standards outlined in the Code of Federal regulation require communities to (1) permit all development, (2) review all proposed development, and (3) assure that development activities will be built in a manner that will be reasonably safe from flooding. Developments in excess of 5 lots or 50 acres are required to determine a Base Flood Elevation (BFE) - 44CFR60.3(b)(3). This document will help you to determine a BFE for sites that are outside of a designated floodplain extent using Base Level Engineering (BLE) data and the **BFE Interpolate Tool**.

Permitting should require new construction in the vicinity of flood prone areas to build at or above the Base Flood Elevation (BFE). FIRMs may be complemented by the data on the Estimated BFE viewer, providing additional flood information to support local permitting efforts. Communities may permit at or above the base flood elevation. To further reduce flood potential of new structures communities may adopt/enforce a freeboard (1 or 2 feet) that is added to the Base Flood Elevation.

1 Locate your project area on the **current effective FIRMs**. Effective, historic, preliminary and pending FIRMs may be accessed on FEMA's Map Service Center website at https://msc.fema.gov or the National Flood Hazard Layer viewer at https://msc.fema.gov/nfhl.

2 **Find Base Level Engineering data.** Once you have accessed the site, review the DISCLAIMER, click OK. You will be greeted with a screen, select View Base Level Engineering Data from the three available options. On the left of the screen, click the REPORT tab enter the location, or address of interest. Locate your project area and print the property flood report, if available.



The graphic to the left illustrates two scenarios.

A – When a structure is within the floodplain shown on the estBFE viewer, the report function can be used to estimate the BFE.

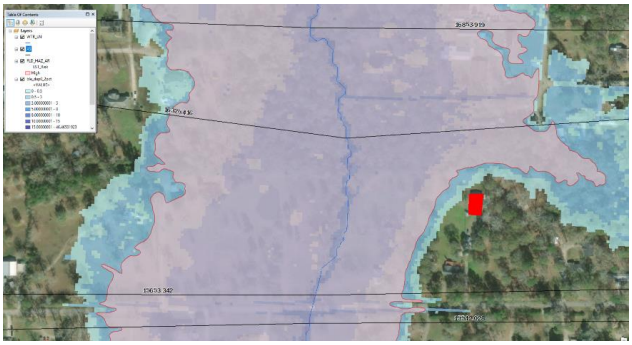
B – When the structure is in the vicinity of the floodplain, but outside of the floodplain delineated the BLE data can be used to estimate the BFE.

If your project is near a floodplain (Zone A/X on FIRMs) or mapped on viewer but not on FIRMs, you can leverage the BLE datasets to establish a Base Flood Elevation (BFE), see steps beginning on the next page. If there is no data in the S_XS file, **then skip to the 2D step-by-step instructions starting on page 4.**

3 **Download BLE Data.** Using the download layer (turn on with the Data Layers button – at top left), click on the teal watershed in the vicinity of your interest area. Download the following three items from the viewer – 1% event depths, 1% event elevations, and Vector Spatial Data. In order to access this information, you will need to utilize GIS software. Free software is available for download, allowing interaction with the BLE data, a couple include:

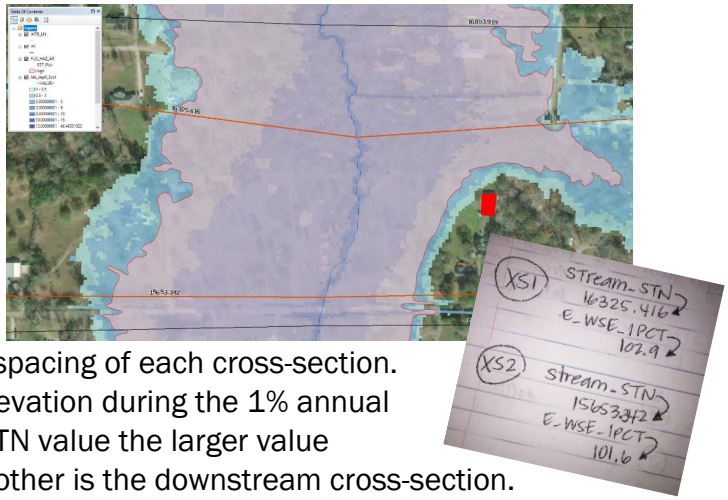
- ArcReader can be freely downloaded at: https://www.esri.com/en-us/arcgis/products/arcreader
- QGIS is freely available for download at: https://www.qgis.org/en/site/forusers/download.html

4 **Open/Add the following BLE database layers/coverage** to your GIS software – 1% event depths (BLE_DEP01PCT), 1% event elevations file (BLE_WSE01PCT), FLD_HAZ_AR (floodplains), S_WTR_LN (stream centerlines), and S_XS (modeling cross-sections). When these files are added to GIS software, the picture you will see will appear something like the one below.



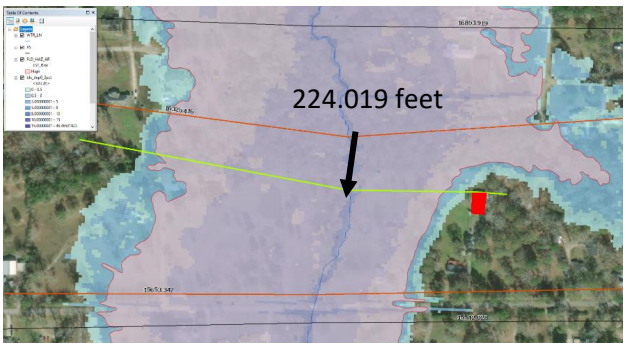
Red box in the graphic to the right indicates the structure to be analyzed. This structure will be used for our example, we will estimate a base flood elevation for this location. **Black Lines** show location of analysis cross-sections. Cross-sections are labeled with analysis Stream_STN. This field is available in the database. Blue line is the stream centerline. Pink shades the area where flood waters are expected during the 1% annual chance event, called the "floodplain". This floodplain is overlaying a blue gridded flood area depicting the flood depths for a larger extent, the 0.2% annual chance event.

5 Zoom into the structure of concern and **locate/identify the analysis cross-sections in your area of concern.** In the image to the right we have highlighted the two cross-sections (orange) available in the vicinity of the structure of interest. Find the identification tool in your GIS software and investigate the information available within the S_XS file.



Click on each cross-section and write down the numeric values in the following data fields – Stream_STN and E_WSE_1PCT. The first value is the stream station, this is an indication of the spacing of each cross-section. The second value is the estimated Base Flood Elevation during the 1% annual chance storm event. If you review the Stream_STN value the larger value denotes the upstream XS (XS1 in this case), the other is the downstream cross-section.

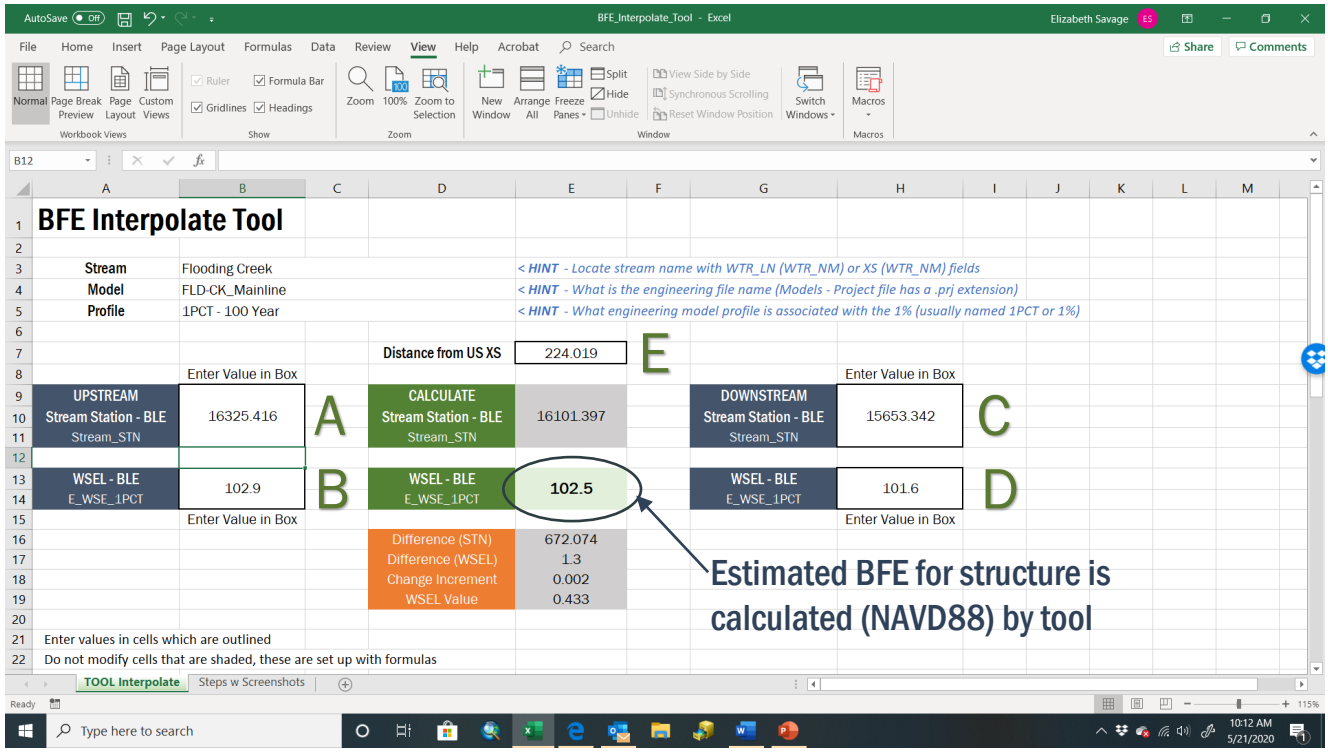
6 Draw a cross-section (green) to intersect the most upstream corner of the structure in question and extend it to stream centerline. Using the measure tool in your GIS tool measure from US cross-section to the cross-section you created. Mark down the measurement, 224.019 in this example.



7 Download the **BFE Interpolate Tool** from FEMA's website at the following web location: https://go.usa.gov/xsGGx. This excel file will assist in calculating an estimated BFE based on the values you have collected, the values for the example are included below.

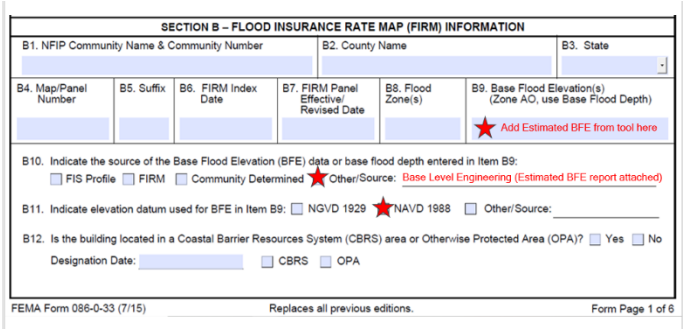
XS 1 (Upstream) **Stream_STN** = 16325.416 (A) **E_WSE_1PCT** = 102.9 (B)
XS2 (Downstream) **Stream_STN** = 15653.342 (C) **E_WSE_1PCT** = 101.6 (D)
Measure (US to Drawn XS) = 224.019 (E)

The greyed-out cells are calculation cells in the tool (column E) and should not be altered.



Once the five values are added to the interpolation tool, an estimated BFE is calculated by the tool. This value may be used for local permitting or may be used in the submittal of a Letter of Map Amendment (LOMA). If a LOMA will be submitted, include the following details in the Elevation Certificate (Section B):

- **B9** – Add BFE value determined. Print BFE Interpolate tool page and include.
- **B10** – Mark Other Source, indicate Base Level Engineering model (Stream name), download and include BLE model.
- **B11** – check box for NAVD 1988



Letter of Map Revision Based on Fill (LOMR- F). If fill will be placed, you can use the BLE modeling or request that a developer prepares analysis (existing conditions and proposed conditions) to determine the effect of fill along the water course. This will assure your community remains in alignment with the minimum NFIP requirements.

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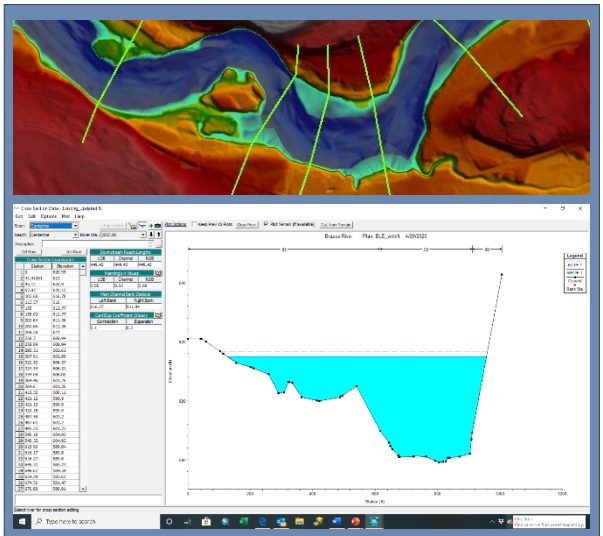
Base Flood Elevations from Two-Dimensional (2D) Analysis

Some BLE watersheds are prepared with two-dimensional (2D) modeling where a gridded representation of the ground elevations is the basis of analysis versus cross-sections which are used in 1D modeling.

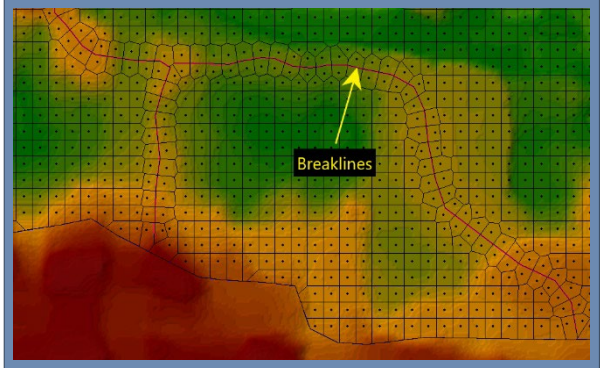
3 **Download BLE Data.** Using the download layer (turn on with the Data Layers button – at top left), click on the teal watershed in the vicinity of your interest area. Download the following three items from the viewer – 1% event depths, 1% event elevations, and Vector Spatial Data. In order to access this information, you will need to utilize GIS software. Free software is available for download, allowing interaction with the BLE data, a couple include:

ArcReader can be freely downloaded at:
https://www.esri.com/en-us/arcgis/products/arcreader

QGIS is freely available for download at:
https://www.qgis.org/en/site/forusers/download.html



1D analysis models several cross-sections along a stream reach, these cross-sections are analyzed to determine a water surface elevation.

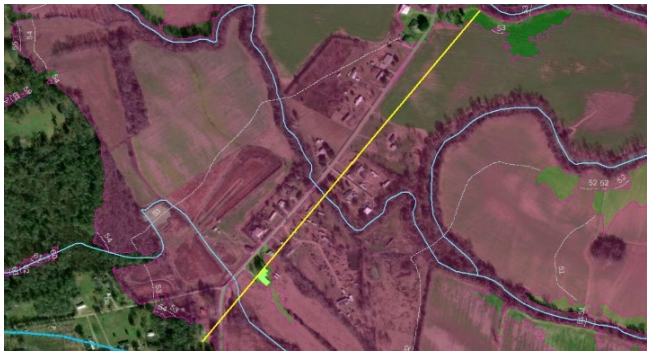


2D analysis models use a gridded surface and a series of breaklines to define the analysis areas.

4 **Open/Add the following BLE database layers/coverage** to your GIS software – 1% event depths, 1% event elevations, and FLD_HAZ_AR (floodplains), S_WTR_LN (stream centerlines) and BFE_2D (elevation contours). When these files are added to GIS software the picture you will see will appear similar to the image below.

Green polygon in the graphic above indicates the structure to be analyzed. This structure will be used for our example, we will estimate a base flood elevation for this location. **Grey dashed lines** depict the BFE_2D, showing elevations of the water surface. Blue line denotes the stream centerline. Pink shades the area where flood waters are expected during the 1% annual chance event, called the "floodplain". This floodplain is overlaying a blue gridded flood area depicting the flood depths for a larger extent, the 0.2% annual chance event.

5 Zoom to the structure of concern and **draw a reference line** (yellow in image to the right). This line should be drawn perpendicular to the floodplain and drawn to align with the upstream most point of the structure of concern. This line will provide you a reference point to query the Water Surface Elevation Grid and estimate a BFE elevation from the 1% event elevations file (BLE_WSE01PCT).



6 Select five or more locations along the line you have drawn and use a GIS identify tool to query the 1% event elevation file to find a water surface elevation. Write down the pixel value returned when you click on each of the 5 points along the line.

Calculate the average of these five points to derive an estimated Base Flood Elevation for the structure in question.

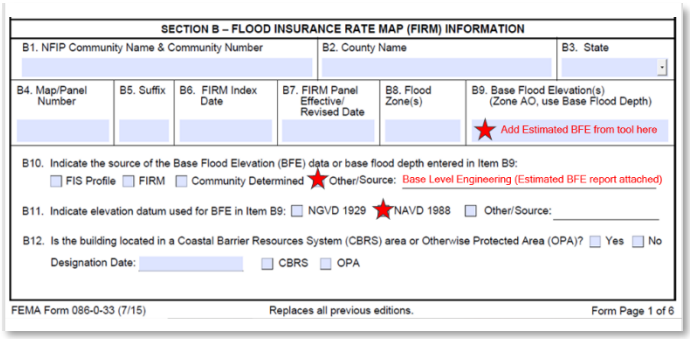
In our example this calculation is detailed below

(52.5+52.6+52.6+52.6+52.8)/5
BFE = 52.62 ft

Once the five values are added to the interpolation tool, an estimated BFE is calculated by the tool. This value may be used for local permitting or may be used in the submittal of a Letter of Map Amendment (LOMA). If a LOMA will be submitted, include the following details in the Elevation Certificate (Section B):

- B9 – Add BFE value determined. Print a screen shot and include a marked-up image like that shown above.
- B10 – Mark Other Source, indicate Base Level Engineering model. You can indicate the name of the watershed and reference the estBFE viewer for the model source.

  Estimated BFE viewer address is: https://webapps.usgs.gov/infrm/estBFE/
  2D BLE modeling available for download – Little Red (08040301) – Models
- B11 – check box for NAVD 1988



SECTION B – FLOOD INSURANCE RATE MAP (FIRM) INFORMATION

B1. NFIP Community Name & Community Number	B2. County Name	B3. State

B4. Map/Panel Number	B5. Suffix	B6. FIRM Index Date	B7. FIRM Panel Effective/ Revised Date	B8. Flood Zone(s)	B9. Base Flood Elevation(s) (Zone AO, use Base Flood Depth)
					Add Estimated BFE from tool here

B10. Indicate the source of the Base Flood Elevation (BFE) data or base flood depth entered in Item B9:
☐ FIS Profile ☐ FIRM ☐ Community Determined ★ Other/Source: Base Level Engineering (Estimated BFE report attached)

B11. Indicate elevation datum used for BFE in Item B9: ☐ NGVD 1929 ★ NAVD 1988 ☐ Other/Source:

B12. Is the building located in a Coastal Barrier Resources System (CBRS) area or Otherwise Protected Area (OPA)? ☐ Yes ☐ No
Designation Date: ☐ CBRS ☐ OPA

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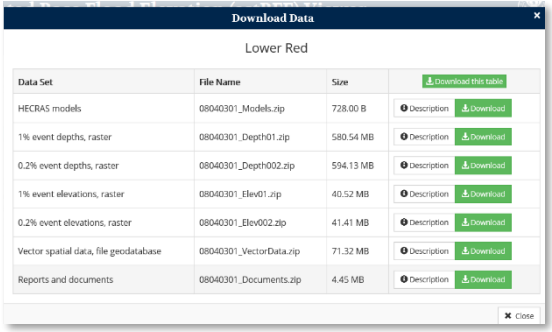

Download Data

Lower Red

Data Set	File Name	Size	
HECRAS models	08040301_Models.zip	728.00 B	Description Download
1% event depths, raster	08040301_Depth01.zip	580.54 MB	Description Download
0.2% event depths, raster	08040301_Depth002.zip	594.13 MB	Description Download
1% event elevations, raster	08040301_Elev01.zip	40.52 MB	Description Download
0.2% event elevations, raster	08040301_Elev002.zip	41.41 MB	Description Download
Vector spatial data, file geodatabase	08040301_VectorData.zip	71.32 MB	Description Download
Reports and documents	08040301_Documents.zip	4.45 MB	Description Download

Close