



# B Understanding the FEMA Benefit-Cost Process

The purpose of this appendix is to provide basic guidance on using the Federal Emergency Management Agency's (FEMA's) Benefit-Cost Analysis (BCA) Tool (Version 4.5.5 [FEMA 2009a]) to complete a BCA when considering floodproofing a non-residential building.

The FEMA BCA Tool is used to determine the cost effectiveness of proposed mitigation projects submitted for assistance under FEMA's Hazard Mitigation Assistance grant programs. The software is used to estimate the economic consequences of a natural disaster (flood, hurricane, tornado, earthquake, or wildfire) with and without the proposed mitigation.

For flood events, loss is estimated using depth-damage functions (DDFs), which are used to predict inundation impacts to the building, contents, and use of the building. DDFs relate flood depths to predicted percentages of damage to a building exposed to inundation at a given recurrence interval. The estimated avoided damage (loss) from the mitigation project is the benefit.

The flood recurrence interval is typically based on flood hazard data from a FEMA Flood Insurance Study (FIS) and/or hydrologic and hydraulic (H&H) study. When available flood hazard data are limited, the recurrence interval may be provided based on data collected after an event to determine the recurrence interval or by use of the unknown frequency calculator built into the Damage Frequency Assessment (DFA) module in the FEMA BCA Tool.

Anticipated damage to non-residential buildings varies based on the type of building, building attributes, and in some instances, location.

Determining the cost effectiveness of a floodproofing project can be done using either the Flood module or DFA module, both of which are part of the BCA Tool. The Flood module relies on flood hazard data, building characteristics, and DDFs, and the DFA module relies on historical or expected damage along with a recurrence interval associated with the damage. The DFA module is used more often for floodproofing because it generally requires less data collection and may better represent the complexity of some floodproofing projects.

The data needed for the BCA Tool Flood module and BCA Tool DFA module are listed in Table B-1.



## Special Note

Property owners considering a floodproofing retrofit may use the BCA Tool during their decision-making process. A BCA is required only when applying for FEMA mitigation grant assistance.

**Table B-1. Data Requirements of the BCA Tool Flood Module and the BCA Tool Damage DFA Module**

Item/Description	BCA Tool Flood Module	BCA Tool DFA
<b>Scope of Work:</b> Work activities, deliverables, and timelines associated with a project. For a dry floodproofing project, the scope of work typically includes the problem description, proposed solution, description of existing conditions, and work schedule.	Required	Required
<b>Project Useful Life:</b> Estimated number of years the mitigation will be effective; typically based on the type of mitigation measure.	Required	Required
<b>Project costs:</b> Cost estimate based on all anticipated project costs. Project costs typically include: <ul style="list-style-type: none"> <li>• Labor</li> <li>• Materials</li> <li>• Engineering and design</li> <li>• Project management</li> <li>• Construction engineering and inspection</li> <li>• Permitting</li> <li>• Estimated annual maintenance costs</li> </ul>	Required	Required
<b>Flood hazard data:</b> Data indicating the source and frequency of flooding at the project location. Commonly based on an FIS or H&H study indicating the source of flooding and on 10-, 50-, 100-, and 500-year flood hazard data	Required	N/A
<b>Size of building:</b> Total enclosed square footage of the building(s) being protected.	Required	N/A
<b>Building replacement value:</b> Cost per square foot to build a comparable structure(s)	Required	N/A
<b>Primary use of building</b> <sup>(a)</sup>	Required	N/A
<b>Building contents value:</b> Description of contents, their value, and how the value was assessed	Required	N/A
<b>Displacement cost:</b> Estimated cost of displacement while damage is repaired	Required	N/A
<b>Type of service(s) provided by non-residential building</b> (e.g., government, library, education, medical, shelter, administrative, warehouse/storage)	Required	N/A

**Table B-1. Data Requirements of the BCA Tool Flood Module and the BCA Tool Damage DFA Module (continued)**

Item/Description	BCA Tool Flood Module	BCA Tool DFA
<p><b>Basis for damage:</b> Explanation of how pre-mitigation damage was derived (historical or expected damages) and how post-mitigation damage was estimated (explanation of project level of effectiveness). Post-mitigation damage is expected except in acquisition projects. Damage is an approximation of damage if floodwaters exceed the height of the mitigation measure.</p> <ul style="list-style-type: none"> <li>• Damage should include:</li> <li>• Building</li> <li>• Contents</li> <li>• Displacement and/or loss of function</li> </ul> <p>Other (possible reduction in emergency temporary protective measures such as sandbags)</p> <p>Damage is often estimated by applying a DDF; see Section 2.1.4.7, Using the BCA Full Data Flood Module to Maximize Benefits in the DFA Module, in <i>Supplement to the Benefit–Cost Analysis Reference Guide</i> (FEMA 2011d).</p>	<p>N/A</p>	<p>Required</p>

(a) For example, retail, hotel, fast food, non-fast food, hospital, medical office, protective services, correctional facility, recreation, religious facilities, schools, service station, office, convenience store, grocery store, apartment, industrial, or warehouse

BCA = Benefit-Cost Analysis

FEMA = Federal Emergency Management Agency

DDF = depth-damage function

FIS = Flood Insurance Study

DFA = Damage Frequency Assessment

H&H = hydrologic and hydraulic

Loss of function is the direct economic impact that occurs when physical damage is severe enough to interrupt the function or normal use of a building. Loss of function is often overlooked in floodproofing project BCAs. Loss of function is generally the largest percentage of benefit for mitigation projects for non-residential buildings.

Typically, loss-of-function damage is calculated using the annual net income of a business or the annual operating budget for a public service (e.g., school, library) to estimate a value of service per day for the function of the building. The value of service per day is multiplied by the estimated number of days a building is expected to be closed based on the depth of flooding (the estimated number of days is typically included in a DDF and varies by building and occupancy type). It is important to consider whether displacement benefits<sup>1</sup> are already being accounted for in the BCA; if so, displacement and loss of function cannot both be included in the BCA if the function or service is being provided at a temporary facility (an exception is if partial displacement and loss of function are combined). The two components of risk, magnitude of potential loss and probability of loss, are important to consider when determining the cost effectiveness of a proposed mitigation project. Most floodproofing projects help reduce the risk of flood damage, especially in frequently occurring (high probability) floods. The greater the effectiveness of the floodproofing project to reduce or eliminate that flood risk for high probability flooding, the more likely the project will be cost effective (see Table B-2).

<sup>1</sup> The displacement benefit is the reduction of time from pre-mitigation to post-mitigation that the occupants of a building need to relocate. Moving to another location includes rental expenses for the new building and costs associated with moving building contents and setting up in a new location.

**Table B-2. Likelihood of Cost Effectiveness of Floodproofing Project**

Magnitude of Potential Loss (\$)	Probability of Loss		
	Low	Medium	High
Low	Unlikely	Unlikely	Likely
Medium	Unlikely	Likely	Highly Likely
High	Likely	Likely	Highly Likely