



FEMA

Welcome to Benefit Cost Analysis



Benefit-Cost Ratio

Which is the correct equation for arriving at the BCR:

1. $BCR = \text{Benefits/Costs}$
2. $BCR = \text{Costs/Benefits}$



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Benefits

- Which of the items listed are benefits of mitigation projects?
 - Avoided physical damages
 - Equipment rental
 - Avoided loss-of-function impacts
 - Avoided casualties



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Flood Elevations

- Explain why this statement is wrong.
- *“We were not supposed to have another 100-year flood – we just had one 15 years ago.”*



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Workshop Objectives



- Access and navigate FEMA BCA Tool
- Estimate hazard mitigation project costs
- Compute hazard mitigation project benefits
- Identify, gather, and analyze BCA documentation required



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BCA Tool Features

- Automates analysis of a project's cost-effectiveness
- Requires documentation to support entered data
- Provides standard values
- Provides modules for specific hazards



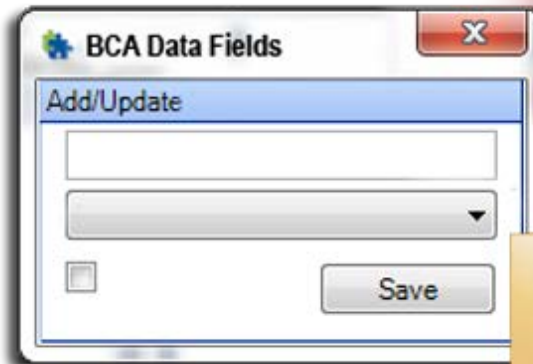
Download from www.FEMA.gov/benefit-cost-analysis



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Automated Analysis

- Provides data fields for entering mitigation project details
- Executes built-in calculations
- Displays the final result of the analysis as the Benefit-Cost Ratio



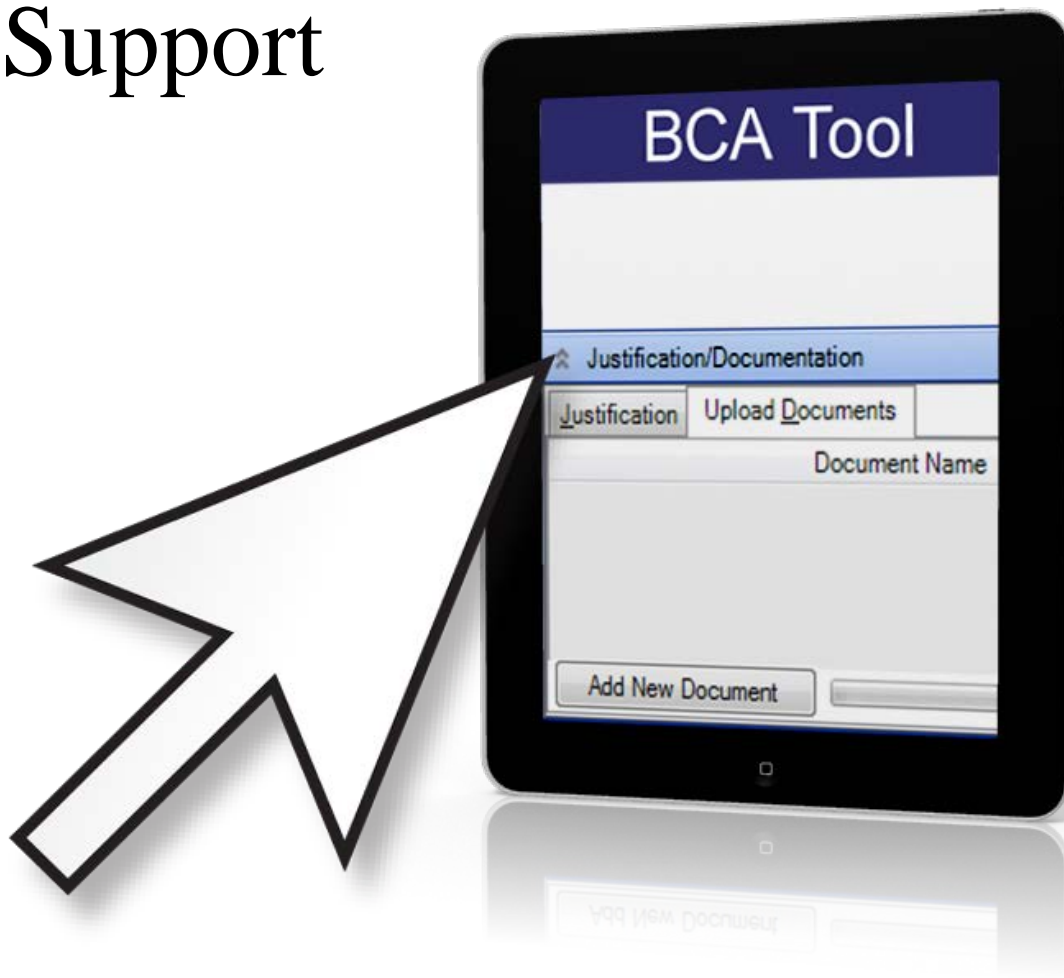
BCR



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Documentation Support

- Accurate
- Complete
- Consistent
- Reliable



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Seven Hazard Modules

- Flood
- Earthquake
- Wildfire
- Hurricane Wind
- Tornado Safe Room
- Hurricane Safe Room
- Damage Frequency Assessment



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BCA Tool Overview

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BCA Tool Quick Start

The BCA Tool provides access to resources and automated functions needed to complete a successful Benefit-Cost Analysis for hazard mitigation grant programs.

The diagram to the left displays the process used to successfully complete a Benefit-Cost Analysis.

To begin your project, click on the functional icons in the process diagram to the left. Each icon provides quick access to that functional area from the home screen. The functionality within the menu on the top (aka ribbon) and the navigation tree in the left pane are available throughout the tool.

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```

graph TD
    A[Create New Project] --> C[Add Structures to Project]
    B[Create New Structure] --> C
    C --> D[Start New Mitigation]
    D --> E[Export BCA]
  
```

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Legend

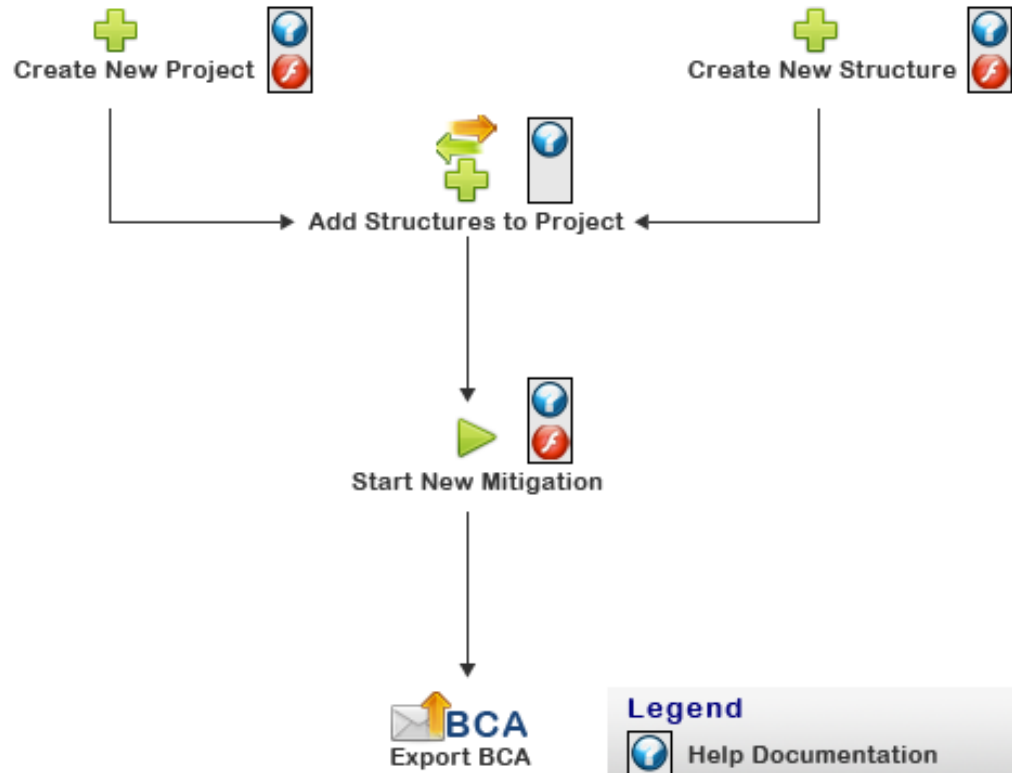
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Quick Start Area



Legend



-  Help Documentation
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My Projects

PROJECT INVENTORY

Project Name	BCR	Costs	Benefits	Is Active	Delete
Kalamazoo Acquisition	1.39	\$37,650	\$52,370	<input type="checkbox"/>	
Smithville Elevation	2.53	\$118,215	\$298,508	<input type="checkbox"/>	
Shutters in Broward County	3.08	\$120,540	\$371,840	<input type="checkbox"/>	
Twister City Grocery Safe Room	4.11	\$737,301	\$3,033,904	<input type="checkbox"/>	

New Update Copy

New Update Copy



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Twister City Grocery Safe Room	4.11	\$737,301	\$3,033,904	<input type="checkbox"/>	

BCA

Project Info

Project Details

Project Name: Smithville Elevation

Project Number: 0908-08

Analyst First Name: James

Analyst Last Name: Parker

Program: PDM

Disaster Number:

Discount Rate: 0.070

Comments:

Project Point of Contact

First Name: John

Last Name: Jameson

Address: 1234 Smith Road

City: Smithville

State: Illinois

Zip Code: 61536

Organization: City of Smithville

Phone No: 555-555-5555

Email: john.jameson@cityofsmithville.

Save

New Update Copy



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Structures (Ctrl+S)

STRUCTURE INVENTORY

Name	Address	City	State	Zip Code	Is Active	Delete
2300 Willow	2300 Willow Blvd	Kalamazoo	Michigan	49048	<input checked="" type="checkbox"/>	
Bailey Residence	133 Sweet Gum Rd	Miami	Florida	33001	<input checked="" type="checkbox"/>	
San Andreas	125 High School Road	San Andreas	California	95249	<input checked="" type="checkbox"/>	
Shutters in Broward County	123 Tropic Way	Fort Lauderdale	Florida	33155	<input checked="" type="checkbox"/>	
Smithville Home	335 Aspen Court	Smithville	Illinois	61536	<input checked="" type="checkbox"/>	
Twister City Grocery Store	315 Windy Avenue	Twister City	Oklahoma	74103	<input checked="" type="checkbox"/>	

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Twister City Grocery Store	315 Windy Avenue	Twister City	Oklahoma	74103	<input checked="" type="checkbox"/>	

BCA

Add/Update Structure

Structure Name: 335 Aspen Court | Address: 335 Aspen Court

Structure Type: Building | City: Smithville

Historic Building: | State: Illinois

Contact First Name: Betty | County: Adams

Contact Last Name: Smith | Zip: 61536

Latitude: 40.6600000000 | Longitude: -89.8000000000

Save

New | Update | Copy



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Create New Structure

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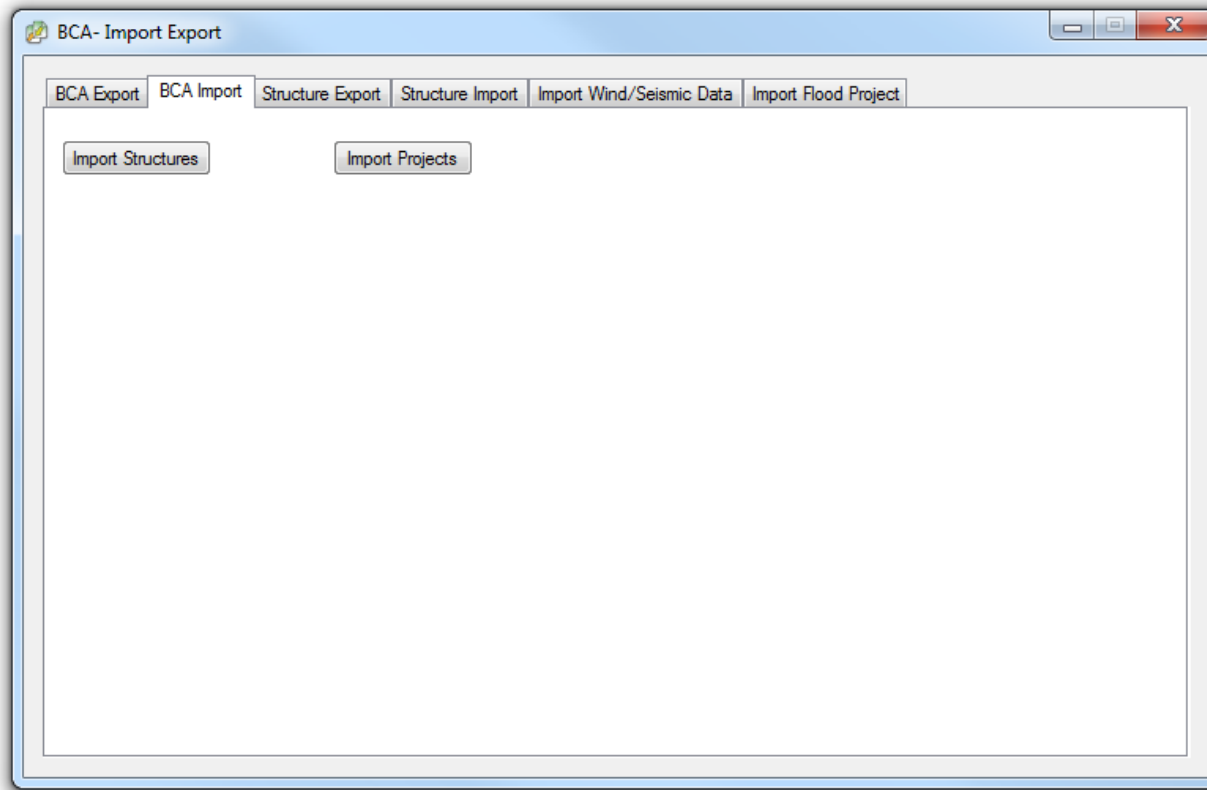
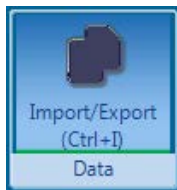
My Projects

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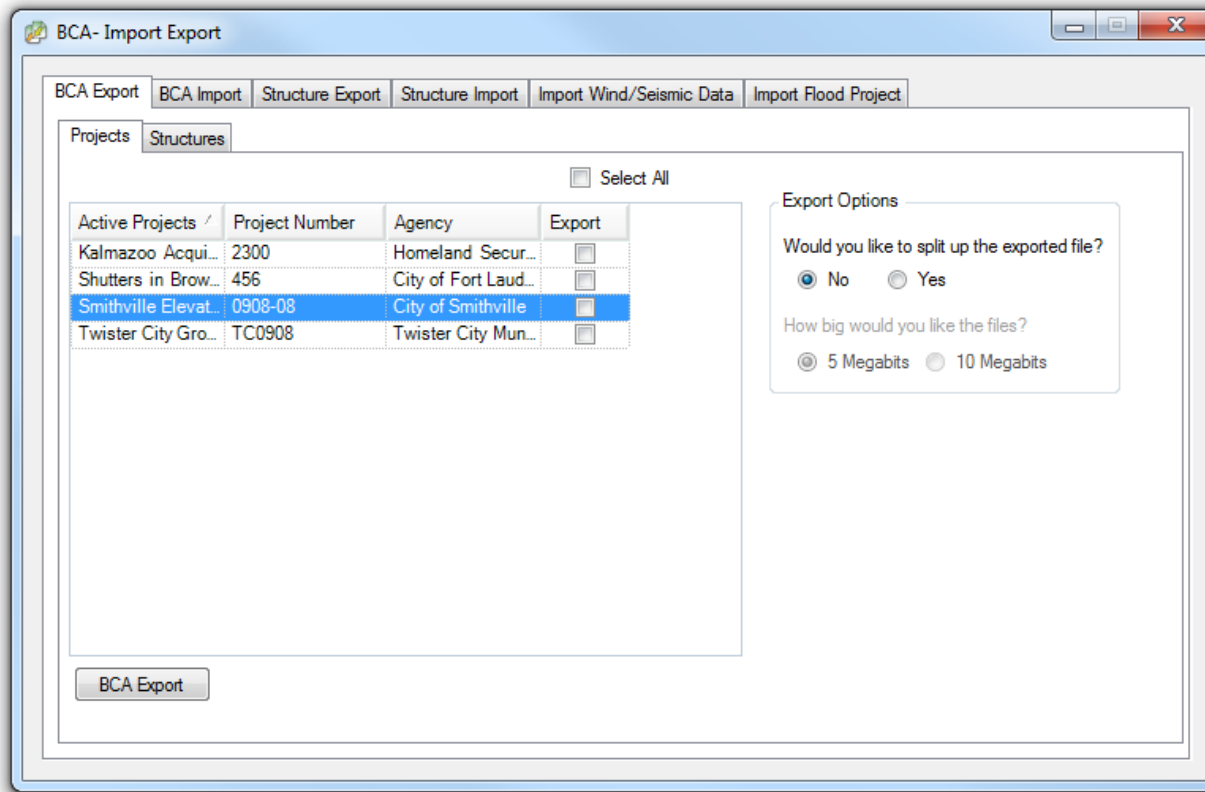
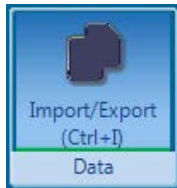
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BCA Import



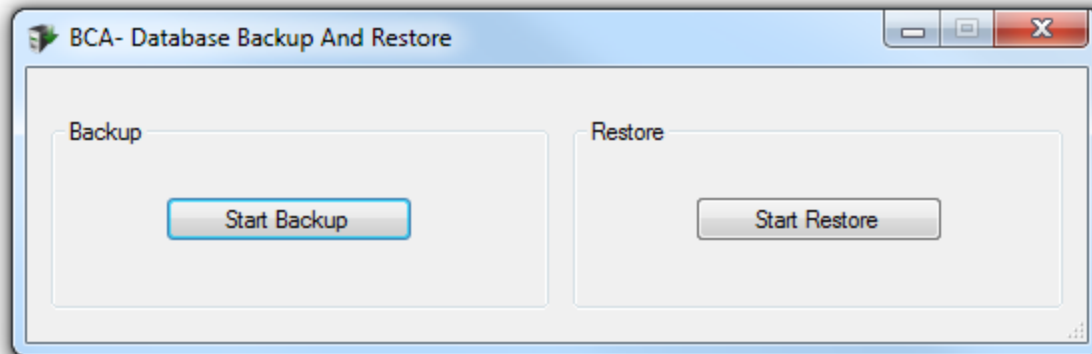
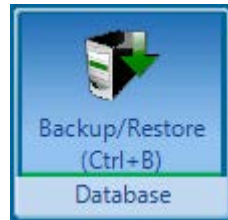
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BCA Export



FEMA

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PROJECT NAME: Smithville Elevation PROJECT BCR: 2.53

PROJECT STRUCTURES SUMMARY

Name	Structure	Benefits	Costs	BCR	Address	City	State	County	Zip
Smithville Home	Building	\$298,508	\$118,215	2.53	335 Aspen Court	Smithville	Illinois	Adams	61536

Add/Remove Structures

Inventory Structures

- 2300 Willow
- Bailey Residence
- San Andreas
- Shutters in Broward County
- Twister City Grocery Store

Structures included in Smithville Elevation

- Smithville Home

>> <<

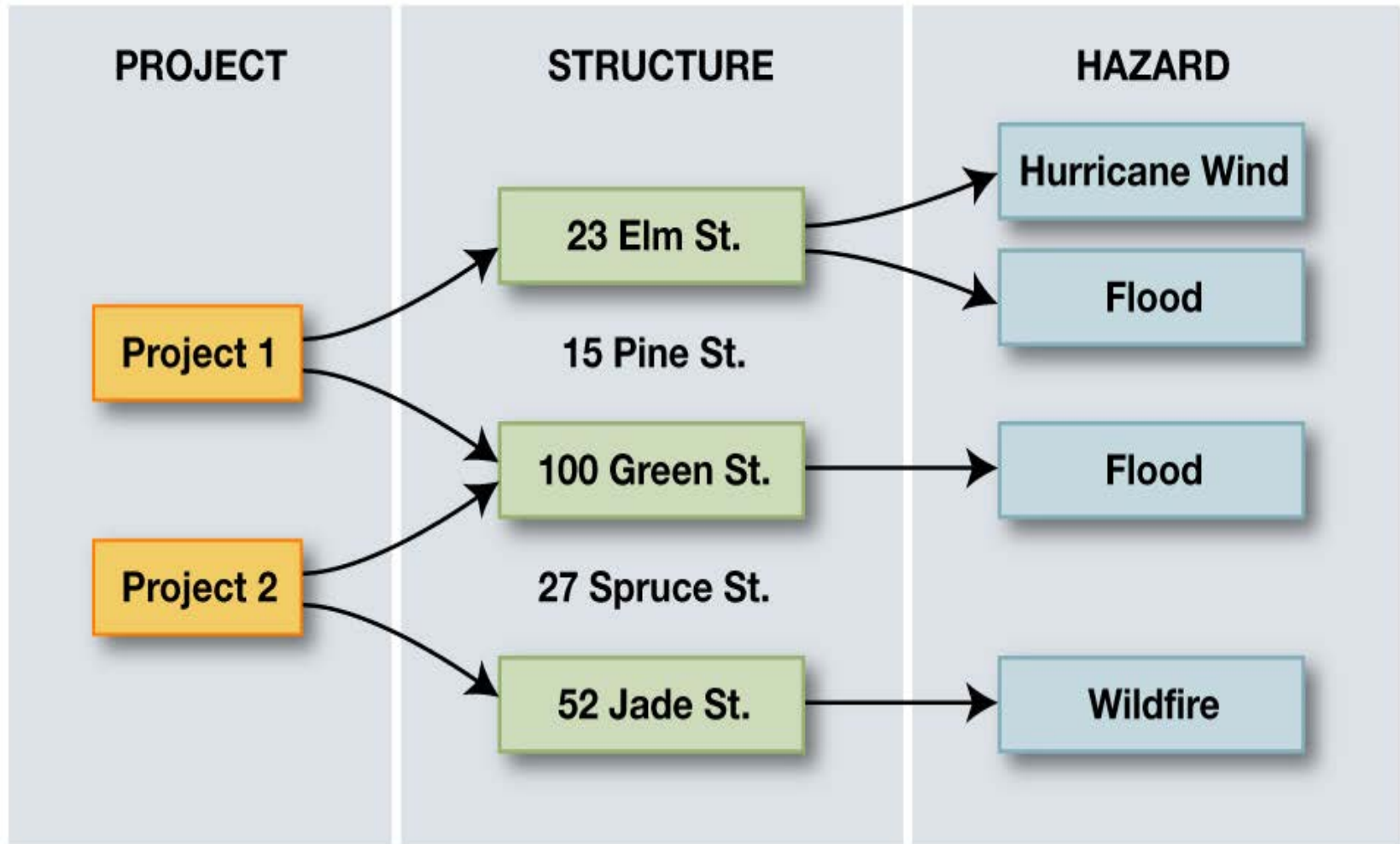
OK Cancel

Print Report Add/Remove Structures



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Multiple Structures, Multiple Hazards



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Add Structures to Project



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Name	Address	City	State	Zip Code	Is Active	Delete
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Project Name

Smithville Elevation

Name	Address	City	State	Zip Code	Is Active	Delete
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Shutters in Broward County	123 Tropic Way	Fort Lauderdale	Florida	33155	<input checked="" type="checkbox"/>	
Twister City Grocery Store	315 Windy Avenue	Twister City	Oklahoma	74103	<input checked="" type="checkbox"/>	

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Project: 335 Aspen Court

PROJECT: Smithville Elevation, STRUCTURE: 335 Aspen Court STRUCTURE BCR: 2.53

MITIGATION INFORMATION

STRUCTURE NAME: 335 Aspen Court, TYPE: Building, ADDRESS: 335 Aspen Court
CITY: Smithville, STATE: Illinois, COUNTY: Adams, ZIP: 61536

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Elevation	Flood	2.53	\$298,508	\$118,215	View Report	View DDT	<input checked="" type="checkbox"/>	

START NEW MITIGATION

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Tornado Safe Room
- Earthquake
- Wildfire

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PROJECT: Smithville Elevation, STRUCTURE: 335 Aspen Court STRUCTURE BCR: 2.53

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START NEW MITIGATION

Flood
 Tornado Safe Room
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 Wildfire

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Project: 335 Aspen Court



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    graph TD
      A[Create New Project] --> C[Add Structures to Project]
      B[Create New Structure] --> C
      C --> D[Start New Mitigation]
      D --> E[Export BCA]
      style E stroke:#f00,stroke-width:2px
  
```

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Save and Continue

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Add Structures to Project



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The BCA Tool provides access to resources and automated functions needed to complete a successful Benefit-Cost Analysis for hazard mitigation grant programs.

The diagram to the left displays the process used to successfully complete a Benefit-Cost Analysis.

To begin your project, click on the functional icons in the process diagram to the left. Each icon provides quick access to that functional area from the home screen. The functionality within the menu on the top (aka ribbon) and the navigation tree in the left pane are available throughout the tool.

View the [Quick Start Tutorial Movie](#) for an overview of how to Create a Project. The video walks you through the process of creating a project in the tool. You can also click on the  icon for a link to context-sensitive help, or the  icon for a Flash-based movie tutorial.

Add Group Delete Group

My Projects BCA Workflow

My Projects

Help



FEMA

Home

Home (Ctrl+H) Projects (Ctrl+P) Structures (Ctrl+S) Print (Ctrl+R) Export BCA (Ctrl+E) Import/Export (Ctrl+I) Backup/Restore (Ctrl+B) About (Ctrl+A)

Project: 335 Aspen Court

PROJECT: Smithville Elevation, STRUCTURE: 335 Aspen Court STRUCTURE BCR: 2.53

MITIGATION INFORMATION

STRUCTURE NAME: 335 Aspen Court, TYPE: Building, ADDRESS: 335 Aspen Court
CITY: Smithville, STATE: Illinois, COUNTY: Adams, ZIP: 61536

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Elevation	Flood	2.53	\$298,508	\$118,215	View Report	View DDT	<input checked="" type="checkbox"/>	

START NEW MITIGATION

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Tornado Safe Room
- Earthquake
- Wildfire



FEMA



Status Report

View Report

Benefit Cost Analysis 4.8

Home

Home (Ctrl+H) Projects (Ctrl+P) Structures (Ctrl+S) Print (Ctrl+R) Export BCA (Ctrl+E) Import/Export (Ctrl+I) Backup/Restore (Ctrl+B) About (Ctrl+A)

Project: 335 Aspen Court

PROJECT: Smithville Elevation, STRUCTURE: 335 Aspen Court

STRUCTURE BCR: 2.53

MITIGATION INFORMATION

Status Report

Project: **Smithville Elevation**
 Structure: **335 Aspen Court**
 Hazard: **Flood**

Screen	Comments	Status	Opened	Go To Screen
Mitigation Type		<input checked="" type="checkbox"/>	YES	GO
Cost Estimator		<input checked="" type="checkbox"/>	YES	GO
Questionnaire		<input checked="" type="checkbox"/>	YES	GO
Flood Data Source		<input checked="" type="checkbox"/>	YES	GO
Riverine Elevation		<input checked="" type="checkbox"/>	YES	GO
Structure Information		<input checked="" type="checkbox"/>	YES	GO
Residential Structure		<input checked="" type="checkbox"/>	YES	GO
Other Damages		<input type="checkbox"/>	NO	GO
Summary of Damages		<input checked="" type="checkbox"/>	YES	GO
Summary of Benefits		<input checked="" type="checkbox"/>	YES	GO

18,215

Status Report	DDT	Include	Delete
View Report	View DDT	<input checked="" type="checkbox"/>	

Close



FEMA



DDT

View DDT

Benefit Cost Analysis 4.8

Home

Home (Ctrl+H) | Projects (Ctrl+P) | Structures (Ctrl+S) | Print (Ctrl+R) | Export BCA (Ctrl+E) | Import/Export (Ctrl+I) | Backup/Restore (Ctrl+B) | About (Ctrl+A)

Save and Go Back Save and Continue

PROJECT: Smithville Elevation, STRUCTURE: 335 Aspen Court STRUCTURE BCR: 2.53

MITIGATION INFORMATION

STRUCTURE NAME: 335 Aspen Court, TYPE: Building, ADDRESS: 335 Aspen Court
 CITY: Smithville, STATE: Illinois, COUNTY: Adams, ZIP: 61536

Benefit-Cost Analysis (BCA) Data Documentation Template – Flood

FEMA reviews Benefit-Cost Analyses (BCAs) for all proposed mitigation projects submitted under the FEMA grant programs to determine whether the information provided in the application is:

1. Credible and well-documented
2. Prepared in accordance with accepted FEMA BCA practices
3. Able to demonstrate that the project is cost-effective

The following template can be used to assist in the collection and entering of information to meet these requirements within the BCA Tool. One way to use this tool is to highlight or circle the source and use the last column to record the software input and justification for values that vary from the FEMA Standard Values.

Obtained	Input	Documentation Summary	Potential Sources	Software Input/Justification
<input type="checkbox"/>	Name, address, county, and latitude/longitude for each project structure	Include contact information and whether building is historic.	Documents available from homeowner, local building inspector, local tax assessor's office, or title documents.	Structure Name: 335 Aspen Court Address: 335 Aspen Court Address: City: Smithville State: Illinois ZIP Code: 61536 Contact: Betty Smith County: Adams Historic Site: No Lat.: 40.660000000000 Long.: -89.800000000000
<input type="checkbox"/>	Project Information	Project Information includes: <ul style="list-style-type: none"> • Project Number • Analyst Name and Contact 	Information available from the project manager or POC.	Project Name: Smithville Elevation Project Number: 0908-08

DDT	Include	Delete
View DDT	<input checked="" type="checkbox"/>	

Project: 335 Aspen Court

- My Projects
 - Kalamazoo Acquisition
 - 2300 Willow
 - Shutters in Broward County
 - Shutters in Broward County
 - Smithville Elevation
 - 335 Aspen Court
 - Twister City Grocery Safe Room
 - Twister City Grocery Store

Add Group Delete Group

My Projects BCA Workflow

Project: 335 Aspen Court

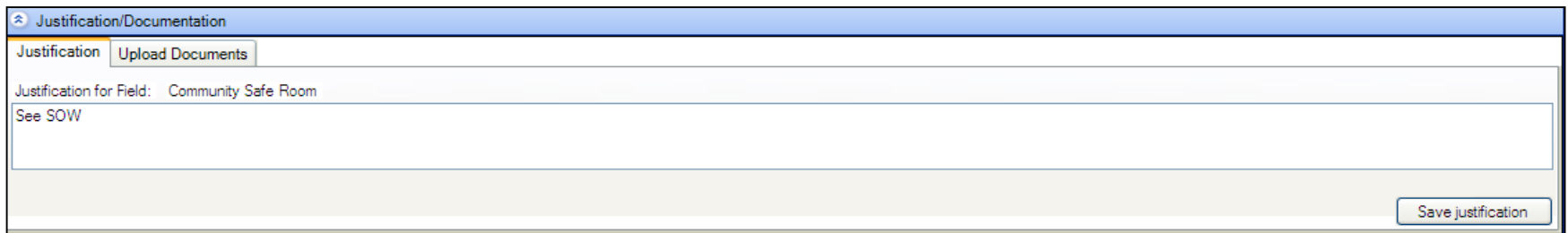
Help



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Using Integrated Calculators

- Each data element that affects the BCA must be documented
- Any deviation from the FEMA Standard Values **MUST** be justified and documented
- Once documentation is uploaded into the BCA software, and the software is then loaded into eGrants, all documentation will follow to eGrants.



The screenshot shows a web-based interface for entering justification. The window title is "Justification/Documentation". There are two tabs: "Justification" (selected) and "Upload Documents". Below the tabs, the text "Justification for Field: Community Safe Room" is displayed. A large text area contains the entry "See SOW". At the bottom right of the form is a button labeled "Save justification".



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Cost Estimation



Why is cost estimation important?



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Cost Estimation Methodology



1. Estimate Pre-construction and Non-construction Costs
2. Develop estimate of Construction Costs
3. Develop estimate of Ancillary Costs
4. Develop estimate of Annual Maintenance Cost
5. Adjust the estimate to account for project timing and time value of estimates
6. Review and confirm Cost Estimate



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Estimate Annual Maintenance Costs



Why is it important to include maintenance costs in the BCA?

What are some examples of annual maintenance costs?



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Benefit Calculation



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Avoided Hazard Impacts

Examples of the avoided hazard impacts suggested in the FEMA mitigation grant guidance include:



- *Damage to buildings and contents*
- *Building loss of function (non-residential)*
- *Displacement*
- *Loss of services from Essential Facilities*
- *Casualties*
- *Emergency Response*
- *Debris Removal*



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Avoided Damages and Losses



*What **physical damages** will be avoided by your mitigation project?*



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Avoided Damages and Losses



*What **loss-of-function** expenses will be avoided by your mitigation project?*



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Loss-of-Function Impacts

Type of Facility	Loss-of-Function Impact	Data Inputs
Building (residential, commercial, public)	Displacement costs	<ul style="list-style-type: none"> • Displacement time • Rent for temporary quarters • One-time costs
Building (residential)	Disruption costs	<ul style="list-style-type: none"> • Disruption time • Economic value per person per hour
Building (public, ordinary services)	Loss of public services	<ul style="list-style-type: none"> • Functional downtime • Operating budget
Building (public, critical services)	Economic impact of Loss of public services	<ul style="list-style-type: none"> • Functional downtime • Operating budget
Utilities	Economic Impact of Loss of public services	<ul style="list-style-type: none"> • Functional downtime • Economic impact per capita per day
Roads and Bridges	Economic impact of road and bridge closures	<ul style="list-style-type: none"> • Functional downtime • Delay or detour time • Daily traffic load • Economic value per person per hour



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Avoided Damages and Losses

*What **casualties** will be **avoided** by your mitigation project?*



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Avoided Damages and Losses (cont.)

What emergency management expenses will be avoided by your mitigation project?



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Calculating Benefits



- Before vs. after mitigation
- With vs. without mitigation
- Useful lifetime of the mitigation project
- Probabilities of natural hazard
- Time value of money



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Project Useful Lifetime vs Project Effectiveness

Project Useful Lifetime

Length in years of how long the project will physically last

Project Effectiveness

Length in years of the level of protection the project provides



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Calculating Benefits (cont.)

Commonly Used Project Lifetimes

Type of Project	Useful Lifetime
Acquisitions or relocations	100 years
Elevation of a Residential building	30 years
Tornado Safe Room- Community	30 years
Culverts (concrete, PVC, CMP, HDPE, etc.)	10 to 30 years
Major Utility (powerline, water, sewer lines, cable, gas)	50 years
Wildfire Defensible Space	4 years



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Calculating Benefits (cont.)

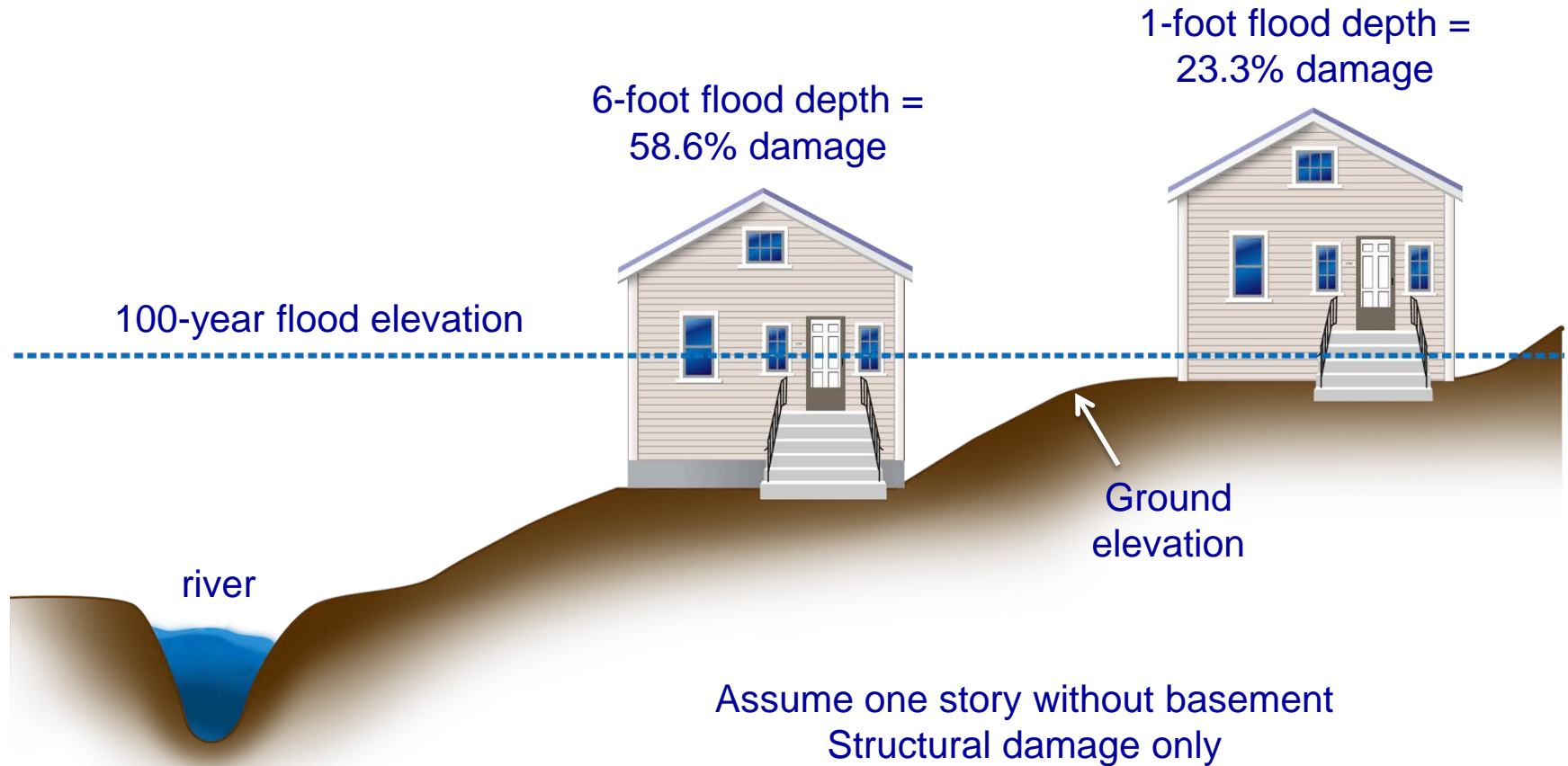


What do the magnitude and probability of hazard events and damages have to do with calculating benefits?



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Risk and Probability vs. Benefits

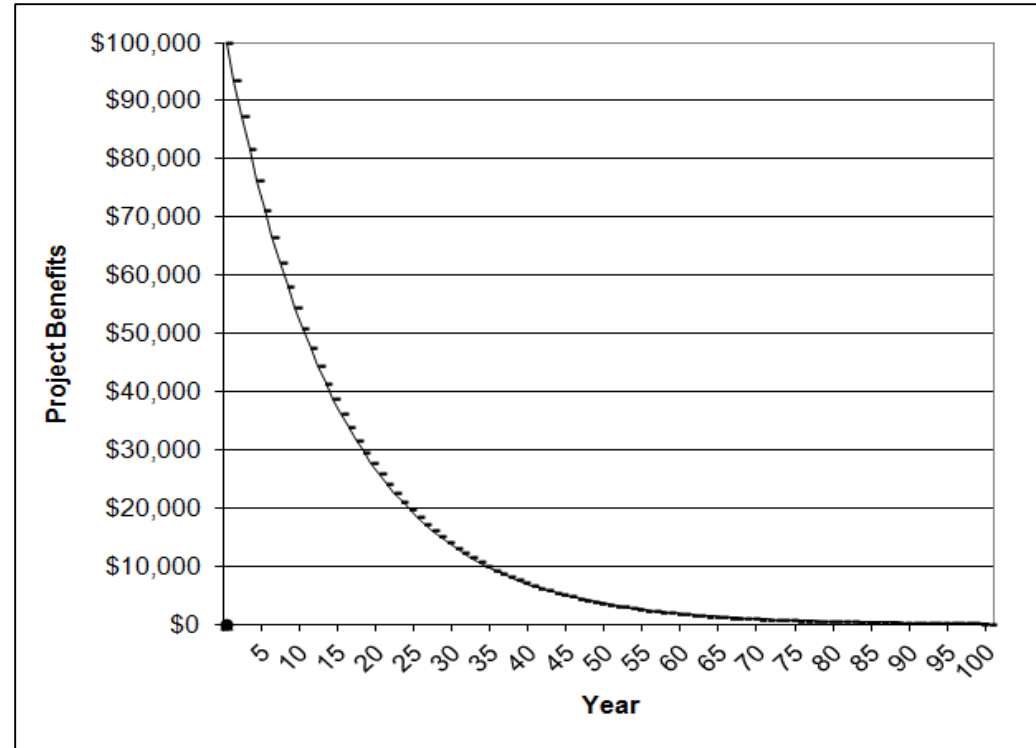


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Calculating Benefits (cont.)

Time Value of Money

The amount of goods that can be purchased with a given amount of money decreases over time



Value of \$100,000 over 100 years
Discount rate: 7%



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Calculating Benefits (cont.)

Present Value Coefficient

Combined effect of the discount rate and the useful lifetime of a mitigation project



FEMA



ACTIVITY: IDENTIFYING COSTS AND BENEFITS

Earthquake Retrofit Project

The island town of Quakeville sustained three earthquakes in a 14-day period approximately 10 years ago. Less than 30 homes are on this island, with only one road and bridge for access and one pipeline for its water source. That waterline follows along Island Road and across the bridge.

The Town of Quakeville is applying for a FEMA mitigation grant to replace approximately 200 feet of pipeline on each side of the bridge and across it, totaling 450 feet. Flexible joints have been designed to rotate, extend, retract, and twist. Connections will be high density 8-inch sleeved polyethylene water main pipes run through 10-inch steel pipes for extra protection.

In the event of an earthquake, these pipes move along with the bridge and avoid rupturing, which would cause loss of water to the island and thousands of dollars in repair. "It would cost \$4,000 for one coupling alone," states Mark Russell, Design and Construction Manager for the City of Quakeville, Public Works Department. A temporary system would cost \$15,000 to \$20,000."



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DISCUSSION

1. What costs do you anticipate in and where will you obtain the necessary data?

- *Pre-construction or non-construction costs (planning and design costs, permitting, survey, appraisals, site preparation, legal recordation)*
- *Construction costs (site acquisition, demolition, restoration, construction materials, equipment, labor)*
- *Ancillary costs (mobilization and demobilization costs, AE fees, contractor general conditions, contractors overhead and profit, project management costs, permit review fees)*
- *Annual maintenance costs (any costs needed to maintain the project)*



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DISCUSSION

2. What are the benefits of this project and what are possible data sources for quantifying the benefits?

- *Avoided physical damages (buildings, contents ,infrastructure, vehicles, equipment, site contamination)*
- *Avoided loss-of-function impacts (temporary quarters displacement costs, rental income loss, public services loss, business income loss, lost wages, disruption time for residents, economic impact of loss of utility services or road/bridge closures)*
- *Avoided casualties (Examples for other projects would include deaths, injuries, illnesses for this project there are no avoided casualties)*
- *Avoided emergency management costs (emergency center operation costs, evacuation or rescue costs, security costs, temporary protective measures, debris removal and cleanup, other management costs)*



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Flood Module Overview

Benefit Cost Analysis 5.2.1

Home Projects Structures Print Export BCA Import/Export Backup/Restore About

Home (Ctrl+H) Projects (Ctrl+P) Structures (Ctrl+S) Print (Ctrl+R) Export BCA (Ctrl+E) Import/Export (Ctrl+I) Backup/Restore (Ctrl+B) About (Ctrl+A)

Configure Actions Data Database About

Save and Go Back Save and Continue

Project: 1200 Club Dr. PROJECT: Club Drive Flood Mitigation, STRUCTURE: 1200 Club Dr. STRUCTURE BCR: 0.00

Mitigation Information

STRUCTURE NAME: 1200 Club Dr., TYPE: Building, ADDRESS: 1200 Club Dr.
CITY: Bloomfield Township, STATE: Michigan, COUNTY: Oakland, ZIP: 48302

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Dry Flood Proofin	Flood	0.00	\$18,271	\$0	View Report	View DDT	<input checked="" type="checkbox"/>	

START NEW MITIGATION

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Hurricane Safe Room
- Tornado Safe Room
- Earthquake
- Wildfire

Add Group Delete Group

My Projects BCA Workflow

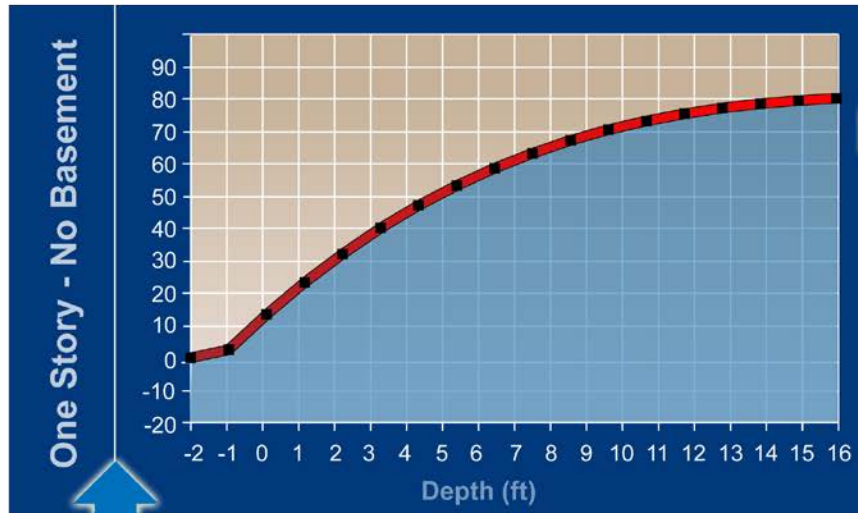
Project: 1200 Club Dr.

Help



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Flood Module Overview



Flood Damages

Flood depths = flood elevations minus FFE

Flood Elevations
(10-, 50-, 100-, 500- years)

First Floor Elevation (FFE)



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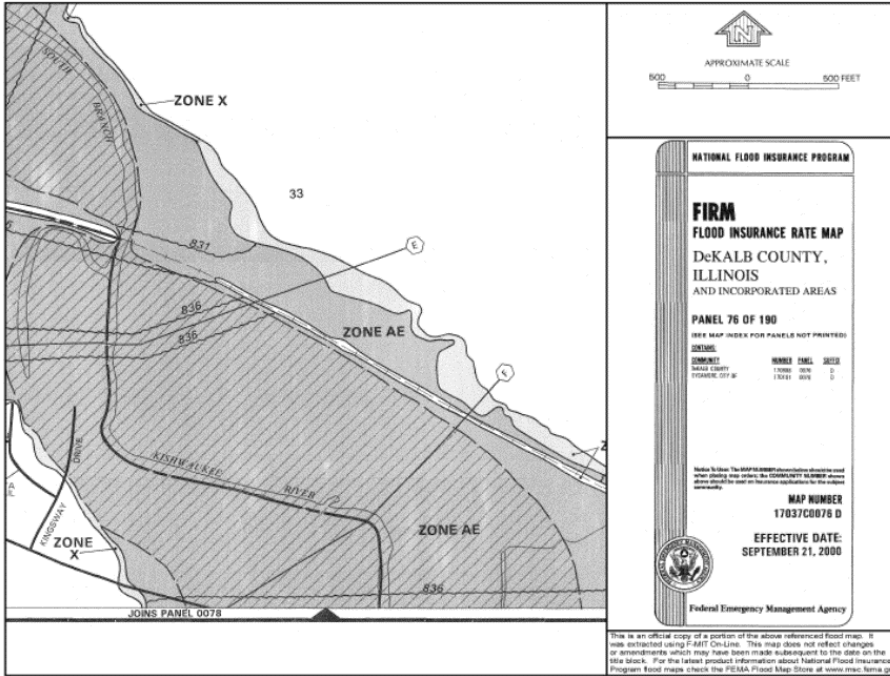
BCA Information Provided by a Flood Insurance Study and FIRM

- A FIS provides important BCA data inputs:
 - Flood elevation data from flood profiles
 - Streambed elevation
 - Flood discharges
- A FIRM provides important BCA data inputs:
 - If the property is in the Special Flood Hazard Area (SFHA)
 - Base Flood Elevation (BFE) for the property
 - Community number, map panel and effective date



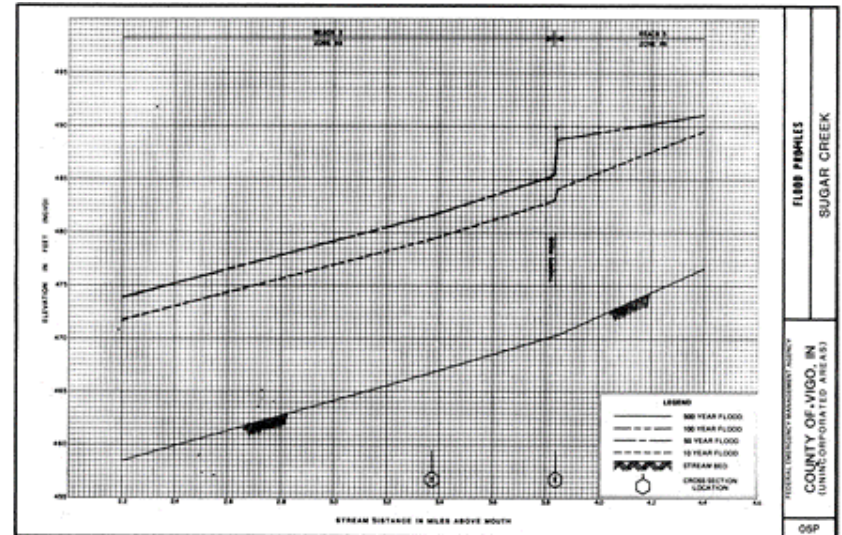
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Map and Profile



Flood Insurance Rate Map

Profile



Flood BCA Documentation: General Guidance

Data used in place of FEMA standards or default values MUST be documented

Documentation should include justification for the use of data in place of FEMA values.

- Hydrologic and hydraulic analyses
 - Building Replacement and Contents Values
 - Elevation Certificate(s)
-
- Federal, State, county, regional, and local government agencies
 - Qualified professionals such as licensed architects, engineers, and surveyors

All data must be obtained from a credible source



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Mitigation Project Types

Acquisition

- The purchase and demolition of a building. Future damage is eliminated because the project site is deed-restricted as open space.

Elevation

- The raising of a building on an extended foundation or fill to place the lowest floor at or above the designated flood elevation.

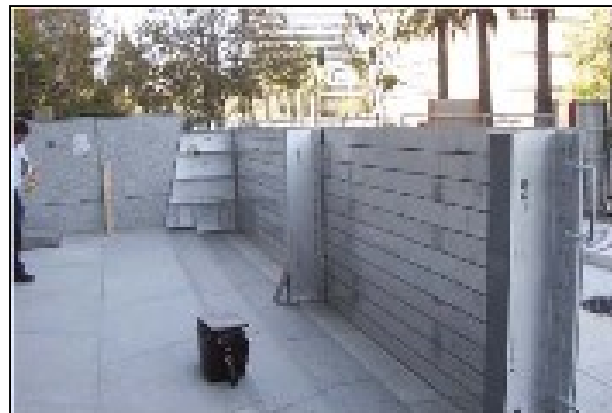


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Mitigation Project Types

Dry Flood Proofing/Flood Barrier

- Mitigation measures added or incorporated into an asset to prevent flood damage by making the exterior walls impermeable to floodwater.



Drainage Improvement

- An activity within or adjacent to a flood source intended to improve the flow capacity, drainage, erosion and sedimentation control, or stability.



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Demonstration of Flood Module

The screenshot displays the 'Benefit Cost Analysis 5.2.1' software interface. The top navigation bar includes 'Home', 'Projects', 'Structures', 'Print', 'Export BCA', 'Import/Export', 'Backup/Restore', and 'About'. The main window title is 'PROJECT: Club Drive Flood Mitigation, STRUCTURE: 1200 Club Dr. MITIGATION TYPE: Flood - Dry Flood Proofing'. The left sidebar shows a tree view of projects, with '1200 Club Dr.' selected. The main content area is titled 'Full Flood - Questionnaire' and contains several questions with radio button options:

- What is the source of your flood data? *
 - Flood Insurance Study (FIS)
 - Hydrology & Hydraulics (H&H) study
 - Both
 - I have no flood data
- Is the project located in a Special Flood Hazard Area (SFHA) FEMA-delineated flood plain? *
 - Yes
 - No
 - Unknown
- Is the source of flooding a river? *
 - Yes
 - No
- Does the FIS include a flood profile delineating the 10, 50, 100 and 500 year floods and a summary of discharges? *
 - Yes
 - No
- Do you have the Streambed Elevation? *
 - Yes
 - No
- Do you have the First Floor Elevation? *
 - Yes
 - No

At the bottom, there is a 'Justification/Documentation' section with an 'Upload Documents' button and a 'Justification for Field:' text area. A 'Save Justification' button is located at the bottom right of the interface.



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Damage Frequency Module

Benefit Cost Analysis 5.2.1

Home (Ctrl+H) Projects (Ctrl+P) Structures (Ctrl+S) Print (Ctrl+R) Export BCA (Ctrl+E) Import/Export (Ctrl+I) Backup/Restore (Ctrl+B) About (Ctrl+A)

Save and Go Back Save and Continue

Project: Charleston Telec... PROJECT: DFA Charleston Data Center, STRUCTURE: Charleston Telecom Center STRUCTURE BCR: 1.71

Mitigation Information
STRUCTURE NAME: Charleston Telecom Center, TYPE: Building, ADDRESS: 123 Second Street
CITY: Charleston, STATE: South Carolina, COUNTY: Charleston, ZIP: 29403

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Other flood proof	Damage-Frequency Assessment	1.71	\$556,958	\$326,661	View Report	View DDT	<input checked="" type="checkbox"/>	

START NEW MITIGATION

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Hurricane Safe Room
- Tornado Safe Room
- Earthquake
- Wildfire

Add Group Delete Group

My Projects BCA Workflow

Project: Charleston Telecom Center

Help



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Damage Frequency Assessment Module Overview

- The Flood Module runs on data and probabilities; for the DFA Module, users provide all of the data needed to calculate the BCA
- Like it sounds, the user-input data is attaching damage values to the frequency (recurrence intervals) of actual historic events
- Users must provide post-project effectiveness values; this is done for you in the Flood Module
- The Tool calculates before-project damages and subtracts the after-project damages



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DFA Module Overview (cont.)

- Requires some assumptions and sound engineering judgment, especially for after-project effectiveness
- DFA provides flexibility and can be used for a wide range of hazards and project types
- If recurrence intervals from historic events are unknown, the Tool can calculate recurrence intervals for you



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DFA Hazard Types

The DFA module can be used for a variety of hazards including:

- Flood Control
- Snow/ice storm
- Earthquake
- High Wind
- Landslides



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When to use the DFA Module

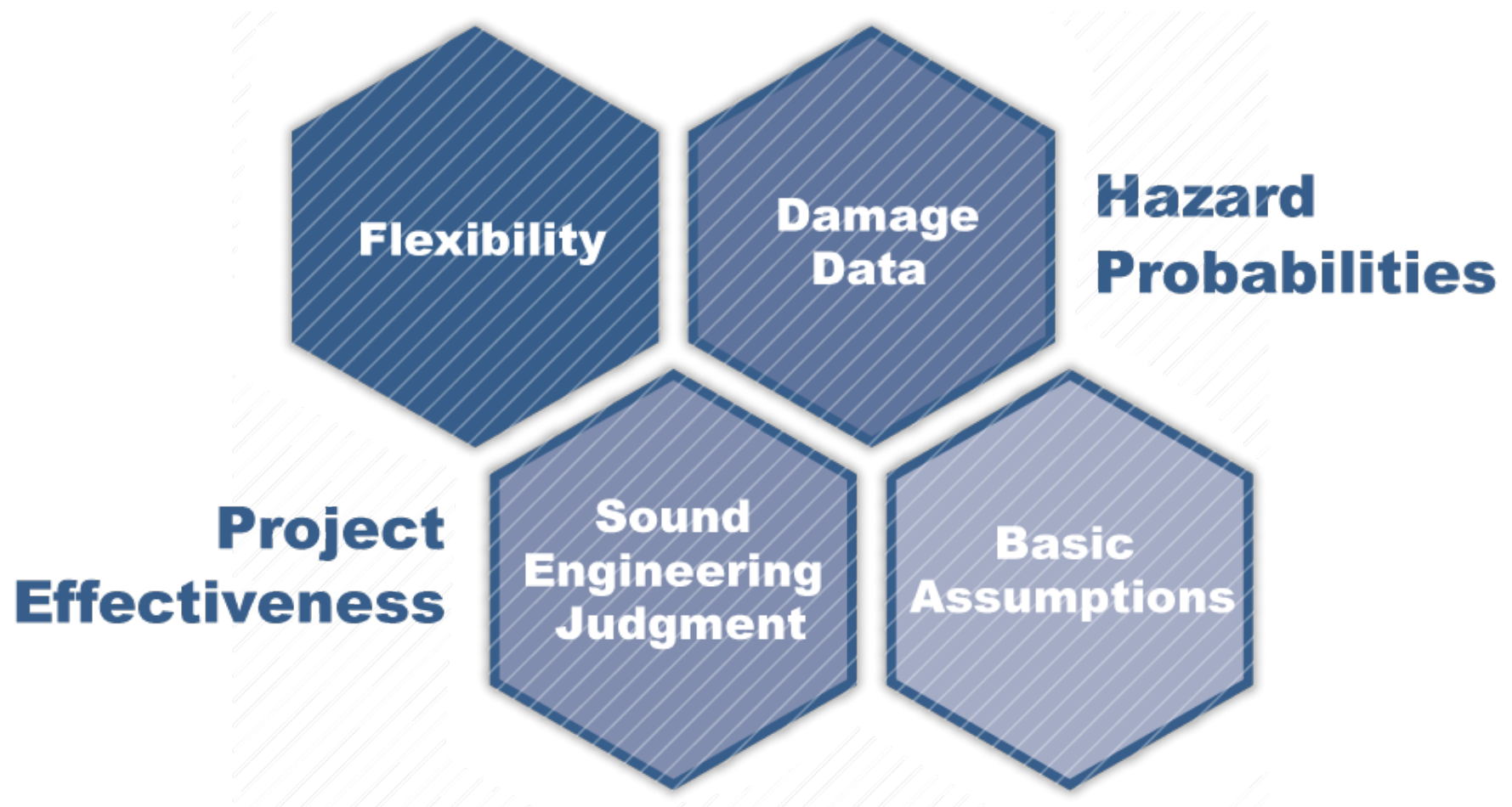
When any of the following situations apply:

- Mitigating risk to non-buildings:
 - Utilities
 - Roads
 - Infrastructure
- Mitigating risk to buildings, but structure or hazard data are unavailable



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Components of the DFA Module



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DFA Requirements

REQUIRED

Typical analyses use documented historical damages/losses from:

- FEMA Project Worksheets
- Damage Survey Reports
- Insurance or repair records
- Other credible sources



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Unknown Frequency Calculator

The Unknown Frequency Calculator can only be used if you have:

1. A minimum of three hazard events that occur in different years
2. A period of record based on the age of the structure or a minimum of 10 years, whichever is greater



Analysis Period

The “window of time” through which the frequency of damaging events are seen in DFA:

- Most often based on the date of construction
- Must be a minimum of 10 years
- Can be adjusted with appropriate documentation for reasons like altered hydrology, complete reconstruction, or a 50-year analysis duration is acceptable if the date of construction is unknown for roads and rural electric lines



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Visual 3.76

Unit 4. Damage Frequency Assessment



FEMA



Project Effectiveness

Elements to documenting project effectiveness:

- Keep in mind that nearly all mitigation projects have some residual risk/damages
- Some projects will not completely eliminate damages after mitigation, but will reduce damages by a certain percentage
- Consult with the mitigation project designer to determine the level of effectiveness
- Assume damages after mitigation occur once the level of effectiveness frequency is reached



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Demonstration of DFA Module

The screenshot displays the 'Benefit Cost Analysis 5.2.1' software interface. The top navigation bar includes buttons for Home, Projects, Structures, Print, Export BCA, Import/Export, Backup/Restore, and About. The main window is titled 'Project: Charleston Telec...' and shows a tree view of projects on the left. The selected project is 'DFA Charleston Data Center, STRUCTURE: Charleston Telecom Center'. The right pane displays 'Mitigation Information' for 'Other flood proof' with a BCR of 1.71, Benefits of \$556,958, and Costs of \$326,661. Below this, there is a 'START NEW MITIGATION' section with radio buttons for various hazard types.

PROJECT: DFA Charleston Data Center, STRUCTURE: Charleston Telecom Center STRUCTURE BCR: 1.71

Mitigation Information
 STRUCTURE NAME: Charleston Telecom Center, TYPE: Building, ADDRESS: 123 Second Street
 CITY: Charleston, STATE: South Carolina, COUNTY: Charleston, ZIP: 29403

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Other flood proof	Damage-Frequency Assessment	1.71	\$556,958	\$326,661	View Report	View DDT	<input checked="" type="checkbox"/>	

START NEW MITIGATION

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Hurricane Safe Room
- Tornado Safe Room
- Earthquake
- Wildfire



FEMA

Tornado Safe Room Module

The screenshot displays the 'Benefit Cost Analysis 4.8' software interface. The main window title is 'Benefit Cost Analysis 4.8'. The interface includes a top navigation bar with icons for Home, Projects, Structures, Print, BCA, Import/Export, Backup/Restore, and About. Below this is a 'Save and Go Back' button and a 'Save and Continue' button.

The left sidebar shows a project tree for 'Project: Twister City Groc...'. The tree includes 'My Projects' with sub-items like 'DFA Case Study #1', 'Raising Floor-DFA', 'Kalmazoo Acquisition', '2300 Willow', 'Shutters in Broward County', 'Smithville Home', '335 Aspen Court', and 'Twister City Grocery Safe Room'. The 'Twister City Grocery Safe Room' is selected.

The main content area displays 'PROJECT: Twister City Grocery Safe Room, STRUCTURE: Twister City Grocery Store' and 'STRUCTURE BCR: 4.11'. Below this is a 'MITIGATION INFORMATION' section with the following details: 'STRUCTURE NAME: Twister City Grocery Store, TYPE: Building, ADDRESS: 315 Windy Avenue, CITY: Twister City, STATE: Oklahoma, COUNTY: Beckham, ZIP: 74103'.

A table lists the mitigation options:

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Existing structur	Tornado Safe Room	4.11	\$3,033,904	\$737,301	View Report	View DDT	<input checked="" type="checkbox"/>	

Below the table is a 'START NEW MITIGATION' section with radio buttons for: Flood, Hurricane Wind, Damage-Frequency Assessment, Tornado Safe Room, Earthquake, and Wildfire.



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Tornado Statistics

- On average, more than 1,300*** tornadoes have been reported nationwide each year since 1997 (NOAA)
- From 1950 through 2011, tornadoes have caused 5,516 deaths and 93,287 injuries
- The longest path is 219 miles (Tri-State Tornado of 1925) and the widest is 2.5 miles (Hallam, Nebraska, 2004)
- The most violent tornadoes are capable of tremendous destruction, with wind speeds over 200 miles per hour near ground level.



Tornado occurrence data from the NOAA Storm Prediction Center records:

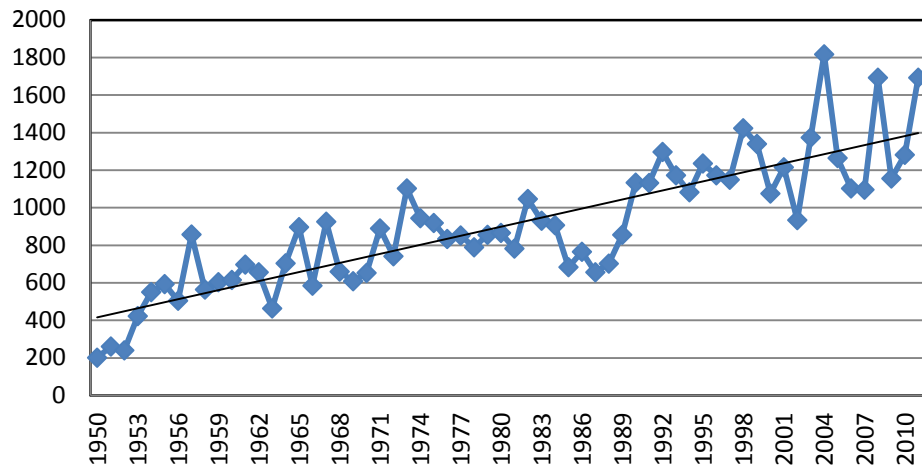
<http://www.spc.noaa.gov/climo/historical.html>



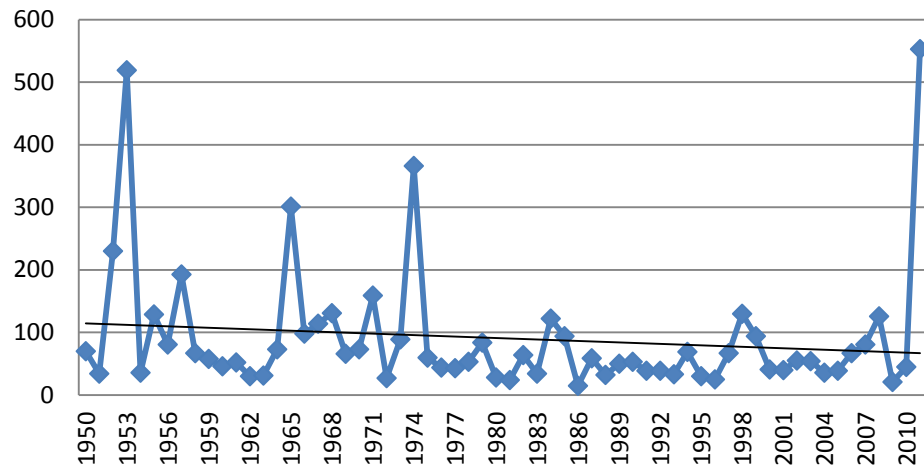
FEMA

Tornado Statistics

Tornadoes (1950-2011)



Tornado Fatalities (1950-2011)



FEMA

Damages by Classification

EF0–Gale Tornado Category 65–85 mph, Light damage



EF1–Moderate Tornado Category 86–110 mph, Moderate damage



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Damages by Classification (cont.)

***EF2—Significant Tornado
Category 111–135 mph,
Considerable damage***



***EF3—Severe Tornado Category
136–165 mph, Severe damage***



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Damages by Classification (cont.)

***EF4–Devastating Tornado Category
166–200 mph, Devastating damage***

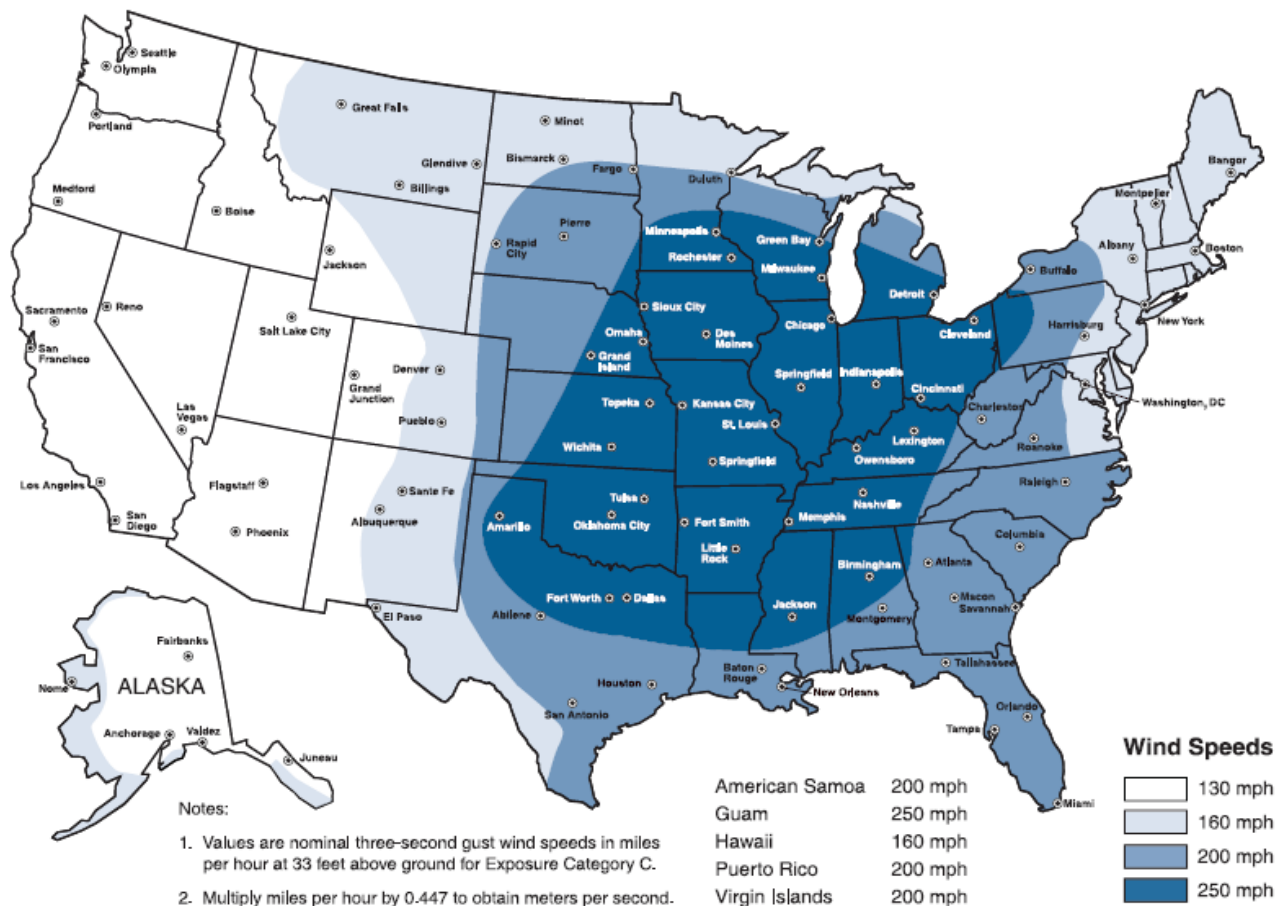


***EF5–Incredible Tornado Category
>200 mph, Incredible damage***



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Design Wind Speeds for Safe Rooms



FEMA 361 : Tornado Safe Room Design Wind Speed Map (consistent with ICC-500 Tornado Hazard Map)



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Safe Room Types

Residential Safe Room:

- A small, specially designed (“hardened”) room
- Provides a place of refuge for the people who live in the home
- Can be constructed outside the home, either above or below ground
- Maximum occupancy of 16



Community Safe Room:

- Constructed to protect a large number of people
- Most federally funded Safe Rooms



FEMA



Tornado Safe Room Module-Key Inputs

- Location (State, County)
- Type of Safe Room
- Project cost
- Safe Room maximum occupancy
- Square footage of Safe Room
- Design wind speed
- Radius of community using Safe Room
- Structure types occupants are currently using
- Occupancy and response information



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Tornado Probability

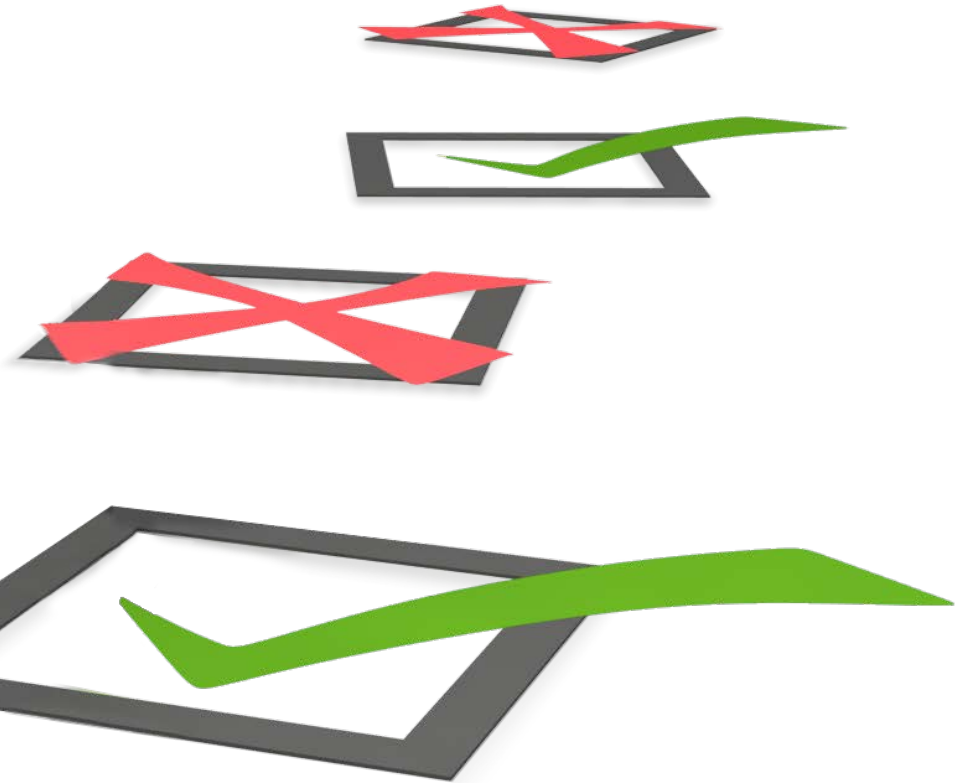
- Tornado probability is automatically calculated by the module.
- The probability is based on the Safe Room county and state location that the user enters.
- The software shows the individual tornado counts by EF class for the county selected.
- These counts are compiled from NOAA tornado data collected from 1950 through 2008.
- The data were analyzed using advanced computer mapping techniques (GIS) to create expected tornado counts for each county.



FEMA

Knowledge Check

- FEMA Publication 361 is the guiding document for community safe rooms.
- True
- False



Poll



FEMA

Demonstration Tornado Safe Room

The screenshot displays the 'Benefit Cost Analysis 4.8' software interface. The main window title is 'Benefit Cost Analysis 4.8'. The interface includes a 'Home' ribbon with buttons for Home (Ctrl+H), Projects (Ctrl+P), Structures (Ctrl+S), Print (Ctrl+R), Export BCA (Ctrl+E), Import/Export (Ctrl+I), Backup/Restore (Ctrl+B), and About (Ctrl+A). Below the ribbon is a 'Save and Go Back' button and a 'Save and Continue' button.

The left sidebar shows a project tree for 'Project: Twister City Groc...'. The tree includes 'My Projects' and several sub-projects, with 'Twister City Grocery Store' selected. Below the tree are 'Add Group' and 'Delete Group' buttons, and a 'My Projects' section with 'BCA Workflow'.

The main content area displays 'PROJECT: Twister City Grocery Safe Room, STRUCTURE: Twister City Grocery Store' and 'STRUCTURE BCR: 4.11'. Below this is the 'MITIGATION INFORMATION' section, which contains a table with the following data:

Mitigation	Hazard	BCR	Benefits	Costs	Status Report	DDT	Include	Delete
Existing structur	Tornado Safe Room	4.11	\$3,033,904	\$737,301	View Report	View DDT	<input checked="" type="checkbox"/>	

Below the table is the 'START NEW MITIGATION' section, which includes radio buttons for the following options:

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Tornado Safe Room
- Earthquake
- Wildfire



FEMA

BCA Resources

<http://www.fema.gov/benefit-cost-analysis>



The screenshot shows the FEMA website's navigation menu and a sidebar. The main navigation includes: Plan, Prepare & Mitigate; Disaster Survivor Assistance; Response & Recovery; and Topics & Audiences. The sidebar on the left lists: Safer, Stronger, Protected Homes & Communities; Protecting Homes; Protecting Our Communities; Protecting Your Businesses; National Preparedness; and Preparedness (Non-Disaster) Grants. The main content area is titled 'Benefit-Cost Analysis' and contains a list of links: About the Benefit-Cost Analysis Tool, Tool Download, Training Materials, Benefit-Cost Analysis Technical Assistance, Benefit-Cost Analysis Methodology, and Benefit-Cost Analysis Toolkit. Below this list is a link for 'About the Benefit-Cost Analysis Tool'.

- Latest version of the BCA Tool (download)
- Training Materials
- BCA Methodologies and Technical Assistance
- Program Resources



FEMA

Other BCA Resources (continued)



- FEMA BCA Guidelines
- FEMA HMA Program Guidance
- FEMA BCA Information Checklist
- FEMA Data Documentation Templates
- Hazard-specific guidance for mitigation projects

BCA Helpline

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Questions?



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