Unit 2

Estimating Costs and Calculating Benefits
Unit 2 Objectives

- Recognize the BCA Tool screens
- Learn basic BCA Tool navigation
- Differentiate between eligible project costs and costs required in the Benefit-Cost Analysis (BCA)
- Identify benefits associated with a proposed mitigation project
Unit 2 Objectives (cont.)

- Determine net present value of mitigation benefits using the benefit computation process
- Recognize and use BCA terms
- For a hypothetical mitigation grant application, use available resources to estimate costs and benefits, and identify documentation requirements
BCA Tool Overview

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

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.

Quick Start Area

Create New Project

Add Structures to Project

Create New Structure

Start New Mitigation

Export BCA

BCA Tool Quick Start

Legend

Help Documentation

Movie Tutorial
Unit 2: Benefit-Cost Analysis Course
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Multiple Structures, Multiple Hazards

- **Project 1**
  - 23 Elm St.
  - 15 Pine St.
  - 100 Green St.
  - 27 Spruce St.
  - 52 Jade St.

- **Project 2**
  - 23 Elm St.
  - 15 Pine St.
  - 100 Green St.
  - 27 Spruce St.
  - 52 Jade St.

- **Hazards**
  - Hurricane Wind
  - Flood
  - Flood
  - Wildfire
Unit 2: Benefit-Cost Analysis Course
BCA Import
Structure Import

![Structure Import interface](image-url)

- **Import/Export** (Ctrl+I) Data
- **Excel Import**
  - Select Sheet to Import
  - Open Excel File
  - Column Mapping
- **CSV Import**
  - Open CSV File
  - Column Mapping
- **System Column**

**BCA - Import Export**

- **BCA Export**
- **BCA Import**
- **Structure Import**
- **Import Wind/Seismic Data**
- **Import Flood Project**

**Unit 2: Benefit-Cost Analysis Course**

2-18
BCA Export
Structure Export

![Structure Export](image)

The image shows a software interface for importing and exporting data related to structures. The table includes columns for Active Structure, Address, City, State, Zip code, FFE, Building Type, and Export. The interface is part of the FEMA (Federal Emergency Management Agency) tool for managing data related to structures, which is pertinent to the Benefit-Cost Analysis Course.
Backup/Restore
### Project Structures Summary

<table>
<thead>
<tr>
<th>Name</th>
<th>Structure</th>
<th>Benefits</th>
<th>Costs</th>
<th>BCR</th>
<th>Address</th>
<th>City</th>
<th>State</th>
<th>County</th>
<th>Zip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smithville Elev</td>
<td>Building</td>
<td>$298,500</td>
<td>$118,215</td>
<td>2.53</td>
<td>335 Aspen Court</td>
<td>Smithville</td>
<td>Illinois</td>
<td>Adams</td>
<td>61536</td>
</tr>
</tbody>
</table>

---

**Unit 2: Benefit-Cost Analysis Course**
### Mitigation Information

**Structure Name:** 335 Aspen Court, **Type:** Building, **Address:** 335 Aspen Court

**City:** Smithville, **State:** Illinois, **County:** Adams, **ZIP:** 61535

### Mitigation Table

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Hazard</th>
<th>BCR</th>
<th>Benefits</th>
<th>Costs</th>
<th>Status Report</th>
<th>DDI</th>
<th>Include</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>Flood</td>
<td>2.53</td>
<td>$298,508</td>
<td>$118,215</td>
<td>View Report</td>
<td>View DDT</td>
<td></td>
</tr>
</tbody>
</table>

### Start New Mitigation

- Flood
- Hurricane Wind
- Damage-Frequency Assessment
- Tornado Safe Room
- Earthquake
- Wildfire
### Benefit-Cost Analysis Course

**Unit 2:** Benefit-Cost Analysis Course

![Image of Benefit-Cost Analysis Software](image)

**Project: 335 Aspen Court**

**Mitigation Information**

- **Structure Name:** 335 Aspen Court, **Type:** Building, **Address:** 335 Aspen Court
- **City:** Smithville, **State:** Illinois, **County:** Adams, **Zip:** 61536

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Hazard</th>
<th>BCR</th>
<th>Benefits</th>
<th>Costs</th>
<th>Status Report</th>
<th>DDT</th>
<th>Include</th>
<th>Delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>Flood</td>
<td>2.53</td>
<td>$230,500</td>
<td>$118,215</td>
<td>View Report</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**START NEW MITIGATION**

- Flood
- Hurricane Wind
- Earthquake
- Damage Frequency Assessment
- Wildfire

---

**FEMA**

*Unit 2: Benefit-Cost Analysis Course*
### Unit 2: Benefit-Cost Analysis Course

#### Project Inventory

<table>
<thead>
<tr>
<th>Project Name</th>
<th>BCR</th>
<th>Costs</th>
<th>Benefits</th>
<th>Active</th>
<th>Delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalamazoo Acquisition</td>
<td>1.39</td>
<td>$37,650</td>
<td>$52,370</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smithville Elevation</td>
<td>2.53</td>
<td>$187,215</td>
<td>$288,506</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shelters in Broward County</td>
<td>3.08</td>
<td>$120,540</td>
<td>$371,840</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twister City Grocery Safe Room</td>
<td>4.11</td>
<td>$737,301</td>
<td>$3,033,904</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Image of a computer interface for Benefit Cost Analysis software]
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.

BCA Tool Quick Start

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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 menus on the top (aka ribbon) and the navigation tree in the left pane are available throughout the tool.
### Unit 2: Benefit-Cost Analysis Course

**Project: 335 Aspen Court**

**PROJECT:** Smithville Elevation, **STRUCTURE:** 335 Aspen Court

**STRUCTURE NAME:** 335 Aspen Court, **TYPE:** Building, **ADDRESS:** 335 Aspen Court

**CITY:** Smithville, **STATE:** Illinois, **COUNTY:** Adams, **ZIP:** 61535

#### Mitigation Information

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Hazard</th>
<th>BCR</th>
<th>Benefits</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>Flood</td>
<td>2.53</td>
<td>$298,508</td>
<td>$118,21</td>
</tr>
</tbody>
</table>

#### Status Report
- **View Report**
- **View DDT**

**START NEW MITIGATION**
- Flood
- Hurricane Wind
- Tornado Safe Room
- Earthquake
- Damage-Frequency Assessment
- Wildfire

---

**FEMA**

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[Image of a computer interface showing Benefit-Cost Analysis software with highlighted sections for viewing reports and DDT.]
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.

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

<table>
<thead>
<tr>
<th>Obtained</th>
<th>Input</th>
<th>Documentation Summary</th>
<th>Potential Sources</th>
<th>Software Input/Justification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Name, address, county, and latitude/longitude for each project structure</td>
<td>Include contact information and whether building is historic.</td>
<td>Documents available from homeowner, local building inspector, local tax assessor’s office, or title documents.</td>
<td>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.: -89.820000000000 Project Name: Smithville Elevation Project Number: 0908-08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Project Information</th>
<th>Project Information includes:</th>
<th>Information available from the project manager or POC.</th>
<th></th>
</tr>
</thead>
</table>
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.
Cost Estimation

Why is cost estimation important?
Cost Estimation (cont.)

- Two types of cost estimates:
  - Professional Provided
  - User Developed
Using the Cost Estimator

<table>
<thead>
<tr>
<th>COST ESTIMATION INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Useful Life (years)</td>
</tr>
<tr>
<td>Do you have a detailed Scope of work?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Do you have a detailed estimate for the entire project?</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Mitigation Project Cost:</td>
</tr>
<tr>
<td>Annual Project Maintenance Cost</td>
</tr>
</tbody>
</table>

Summary Of Cost Estimation

- Pre-Construction Costs
- Construction Costs
- Does the estimate for Construction Costs include General Contractor costs and markups? Yes | No
- Construction Type
  - New
  - Repair
- Construction Markups
- Annual Project Maintenance Costs

Number of Years of Maintenance | 30
Present Worth of Annual Maintenance Costs | $
Does estimate reflect current prices? Yes | No

Cost Basis Year: [Year]
Construction Start Year: [Year]

Final Mitigation Project Cost | $118,215

Justification/Documentation
Using the Cost Estimator

<table>
<thead>
<tr>
<th>COST ESTIMATION INFO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Useful Life (years)</td>
</tr>
<tr>
<td>Do you have a detailed Scope of work?</td>
</tr>
<tr>
<td>Do you have a detailed estimate for the entire project?</td>
</tr>
<tr>
<td>Mitigation Project Cost:</td>
</tr>
<tr>
<td>Annual Project Maintenance Cost</td>
</tr>
<tr>
<td>Summary Of Cost Estimation</td>
</tr>
<tr>
<td>Check the box to enter a lump sum amount if you already have an estimate for the category. To develop an itemized estimate, click the category to link to items:</td>
</tr>
<tr>
<td>Pre-Construction Costs</td>
</tr>
<tr>
<td>Construction Costs</td>
</tr>
<tr>
<td>Does the estimate for Construction Costs include General Contractor costs and markups?</td>
</tr>
<tr>
<td>Construction Type</td>
</tr>
<tr>
<td>Construction Markups</td>
</tr>
<tr>
<td>Annual Project Maintenance Costs</td>
</tr>
<tr>
<td>Number of Years of Maintenance</td>
</tr>
<tr>
<td>Present Worth of Annual Maintenance Costs</td>
</tr>
<tr>
<td>Does estimate reflect current prices?</td>
</tr>
<tr>
<td>Cost Basis Year:</td>
</tr>
<tr>
<td>Construction Start Year:</td>
</tr>
<tr>
<td>Final Mitigation Project Cost</td>
</tr>
</tbody>
</table>

Unit 2: Benefit-Cost Analysis Course
What are the six cost estimation steps?
Using the Cost Estimator

**Cost Estimation Info**
- Project Useful Life (years): 30
- Do you have a detailed Scope of work? (Yes/No)
- Do you have a detailed estimate for the entire project? (Yes/No)

**Mitigation Project Cost:**
- Annual Project Maintenance Cost
- Summary of Cost Estimation

**Check the box to enter a lump sum amount if you already have an estimate for the category. To develop an itemized estimate, click the category to link to items.**

- Pre-Construction Costs
- Construction Costs
- Does the estimate for Construction Costs include General Contractor costs and markups? (Yes/No)
- Construction Type: New/Repair
- Construction Markups
- Annual Project Maintenance Costs
- Number of Years of Maintenance: 30
- Present Worth of Annual Maintenance Costs
- Does estimate reflect current prices? (Yes/No)

**Cost Basis Year:**
- Construction Start Year:

**Final Mitigation Project Cost**
- Justification/Documentation
Using the Cost Estimator

```
<table>
<thead>
<tr>
<th>Description</th>
<th>P</th>
<th>H</th>
<th>C</th>
<th>Qty</th>
<th>Unit</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>New water</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>New sewer</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>New electric</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Other new utilities</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Import/export fill</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Storm water management</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>New foundation - piles/piers</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>New foundation - spread footings/walls</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>New Construction Sub Total:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$0</td>
</tr>
<tr>
<td>Phase Total:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>
```

Justification/Documentation:
- Justification
- Upload Documents
- Justification for Field:

Save justification
Estimate Annual Maintenance Costs

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

What are some examples of annual maintenance costs?
Benefit Calculation
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
- Displacement
- Rental or net business loss of income
- Loss of services
- Casualties
Avoided Damages and Losses

- Avoided physical damages
- Avoided loss-of-function impacts
- Avoided casualties
- Avoided emergency management costs
Avoided Damages and Losses (cont.)

What physical damages will be avoided by your mitigation project?
Avoided Damages and Losses (cont.)

What *loss-of-function* expenses will be avoided by your mitigation project?
Avoided Damages and Losses (cont.)

What *casualties* will be *avoided* by your mitigation project?
Avoided Damages and Losses (cont.)

- The Federal Aviation Administration (FAA) rates the value of a person’s injuries, from a minor injury to a fatality.

- The Willingness to Pay (WTP) values are based on four levels of severity.

- The 2008 FAA revised guidance is used in the BCA tool.

- FEMA will update these values periodically.

<table>
<thead>
<tr>
<th>Injury Severity Levels</th>
<th>$ WTP Value (rounded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead – Fatal</td>
<td>$5,800,000</td>
</tr>
<tr>
<td>Hospitalized</td>
<td>$1,088,000</td>
</tr>
<tr>
<td>Treat and Release</td>
<td>$90,000</td>
</tr>
<tr>
<td>Self Treat</td>
<td>$12,000</td>
</tr>
</tbody>
</table>

Federal Aviation Administration, 2008. Revised Department Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analysis
Avoided Damages and Losses (cont.)

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

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

<table>
<thead>
<tr>
<th>Project Useful Lifetime</th>
<th>Project Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length in years of how long the project will <em>physically last</em></td>
<td>Length in years of the level of protection the project provides</td>
</tr>
</tbody>
</table>
Calculating Benefits (cont.)

What do the magnitude and probability of hazard events and damages have to do with calculating benefits?
Assume one story without basement

Structural damage only

100-year flood elevation

6-foot flood depth = 58.6% damage

1-foot flood depth = 23.3% damage

Ground elevation

Assume one story without basement
Structural damage only
Calculating Benefits (cont.)

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Useful Lifetime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisitions or relocations</td>
<td>100 years</td>
</tr>
<tr>
<td>Public building or infrastructure projects</td>
<td>50 years</td>
</tr>
<tr>
<td>Residential, office, or commercial building projects</td>
<td>30 years</td>
</tr>
<tr>
<td>Equipment</td>
<td>5-30 years</td>
</tr>
</tbody>
</table>
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%
Calculating Benefits (cont.)

Present Value Coefficient

Combined effect of the discount rate and the useful lifetime of a mitigation project
Example
# BCA: Damages Before Mitigation

<table>
<thead>
<tr>
<th>Flood Depth (feet)</th>
<th>Annual Probability of Flooding</th>
<th>Scenario Damages and Losses (per flood event)</th>
<th>Annualized Damages and Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.2050</td>
<td>$6,400</td>
<td>$1,312</td>
</tr>
<tr>
<td>1</td>
<td>0.1234</td>
<td>$14,300</td>
<td>$1,765</td>
</tr>
<tr>
<td>2</td>
<td>0.0867</td>
<td>$24,500</td>
<td>$2,124</td>
</tr>
<tr>
<td>3</td>
<td>0.0233</td>
<td>$28,900</td>
<td>$673</td>
</tr>
<tr>
<td>4</td>
<td>0.0098</td>
<td>$32,100</td>
<td>$315</td>
</tr>
<tr>
<td>5</td>
<td>0.0034</td>
<td>$36,300</td>
<td>$123</td>
</tr>
<tr>
<td><strong>Total Annualized Damages and Losses (Before Mitigation)</strong></td>
<td></td>
<td><strong>$6,312</strong></td>
<td></td>
</tr>
</tbody>
</table>
# BCA: Damages After Mitigation

**Table 2.4**

Example Showing Principles of BCA Summary Calculation

<table>
<thead>
<tr>
<th>Flood Depth (feet)</th>
<th>Before Mitigation Annualized Damages (from Table 2.3)</th>
<th>After Mitigation Annualized Damages</th>
<th>Annualized Benefits (Avoided Damages) “Before Mitigation” – “After Mitigation”</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$1,312</td>
<td>$0</td>
<td>$1,312</td>
</tr>
<tr>
<td>1</td>
<td>$1,765</td>
<td>$0</td>
<td>$1,765</td>
</tr>
<tr>
<td>2</td>
<td>$2,124</td>
<td>$0</td>
<td>$2,124</td>
</tr>
<tr>
<td>3</td>
<td>$673</td>
<td>$0</td>
<td>$673</td>
</tr>
<tr>
<td>4</td>
<td>$315</td>
<td>$63</td>
<td>$252</td>
</tr>
<tr>
<td>5</td>
<td>$123</td>
<td>$49</td>
<td>$74</td>
</tr>
<tr>
<td>Totals</td>
<td>$6,312</td>
<td>$112</td>
<td>$6,200</td>
</tr>
</tbody>
</table>

Present Value Coefficient (7% discount rate, 30 year project lifetime) 12.41

Net Present Value of Future Benefits $76,942

Mitigation Project Costs $20,000

Benefit-Cost Ratio (Net Present Value of Future Benefits ÷ Project Costs) 3.85
Small Group Activity

- Refer to the Activity Worksheet in the Student Manual
- Answer the questions at the end