Unit 1
Basic Tools

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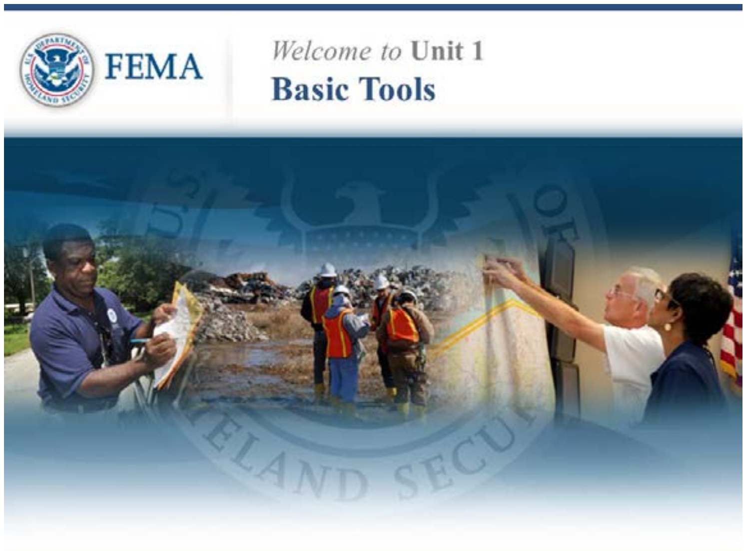
Welcome and Introductions

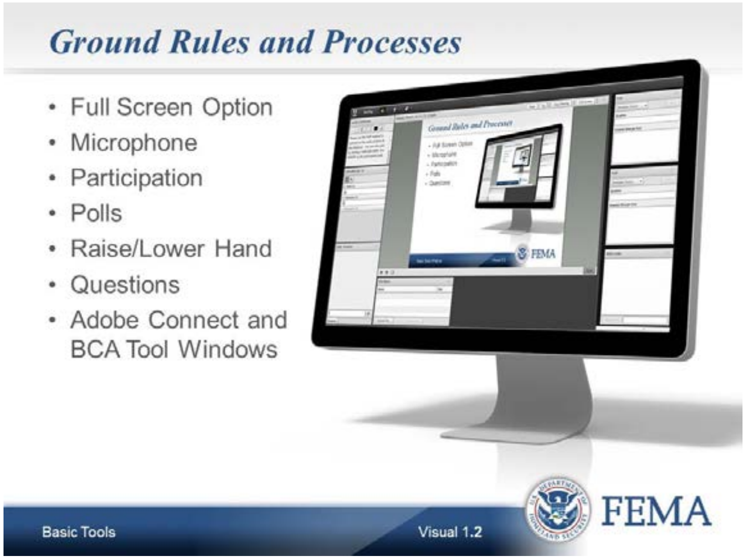


Visual 1.1: Unit 1 – Basic Tools

Welcome to Unit 1 of Benefit-Cost Analysis: Entry Level course. This unit focuses on basic tools.

The Participant Manual, Flood Module Case Study Walkthrough and Independent Case Study Assignment are needed for this unit.

Ground Rules and Processes

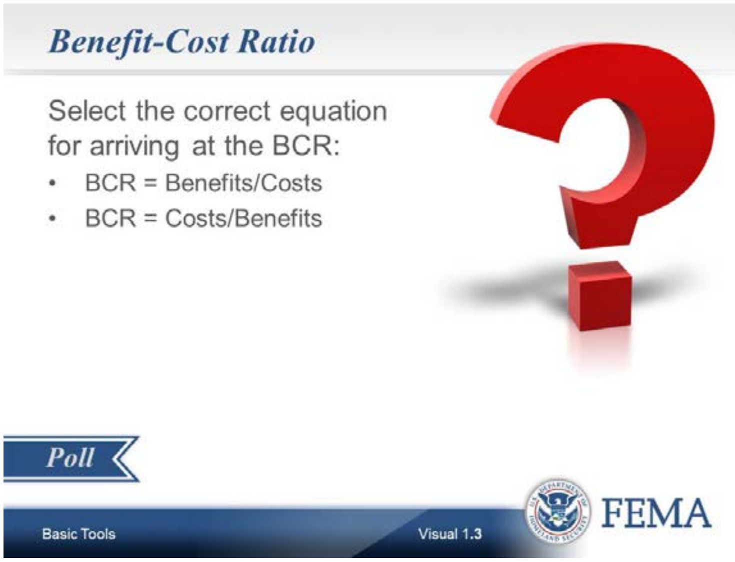


Visual 1.2: Ground Rules and Processes

Ground rules and processes:

- Full Screen option - The Full Screen view allows the instructor's screen to fill the screen, but makes other screen functions such as polls and chat inaccessible. Toggle between Full Screen and normal mode by selecting the Full Screen button.
- Microphone - Mute the microphone during the session to minimize background noise.
- Participation:
  - Remember to unmute before speaking.
  - Say name before participating.
  - Speak clearly and articulate fully.
  - Allow other participants to finish without interruption.
  - Minimize distracting background noises while unmuted.
- Polls – Polls provide a way to make the facilitated distance learning classroom interactive. Polls will be used to ask questions related to the course. To participate, select the desired option(s) or enter the response in the designated pod, depending on the polling activity.
- Raise/Lower Hand – Select the Raise Hand icon to raise or lower hand as needed.
- Questions – Submit questions using the Q & A Pod or the Private Chat Pod. Depending on the nature of the question, the instructor or host will respond in private or in public. The instructor or host will do their best to answer all questions, even if it means having to respond after Unit 1 is over.
- Adobe Connect and BCA Tool windows – Both windows will be used during the BCA module walkthroughs. Toggle between the two windows by either of these two ways:
  - Mouse: Select the window you wish to view.
  - Keyboard: Hold down the alt key and then press tab.

IS-0276 Review



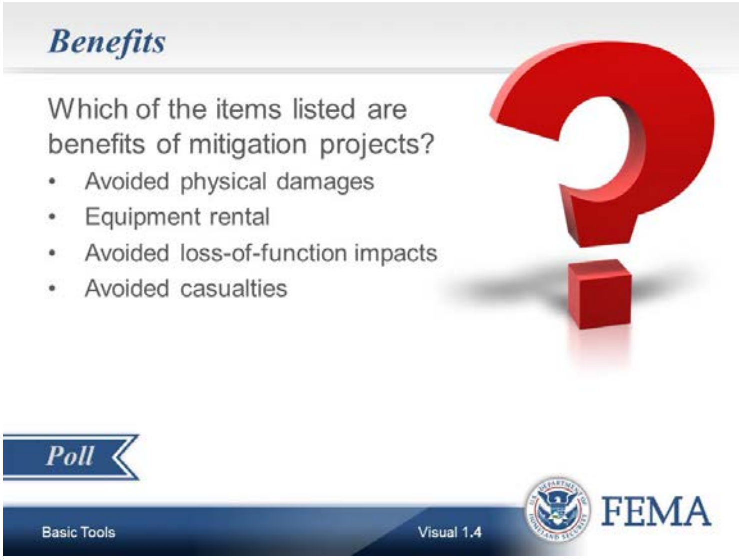
Visual 1.3: Benefit-Cost Ratio

As a review of the basic BCA theory and basic flood concepts covered in IS-0276., answer the following knowledge checks.

Select the correct equation for arriving at the BCR:

- BCR = Benefits/Costs
- BCR = Costs/Benefits

Write the correct answer below.



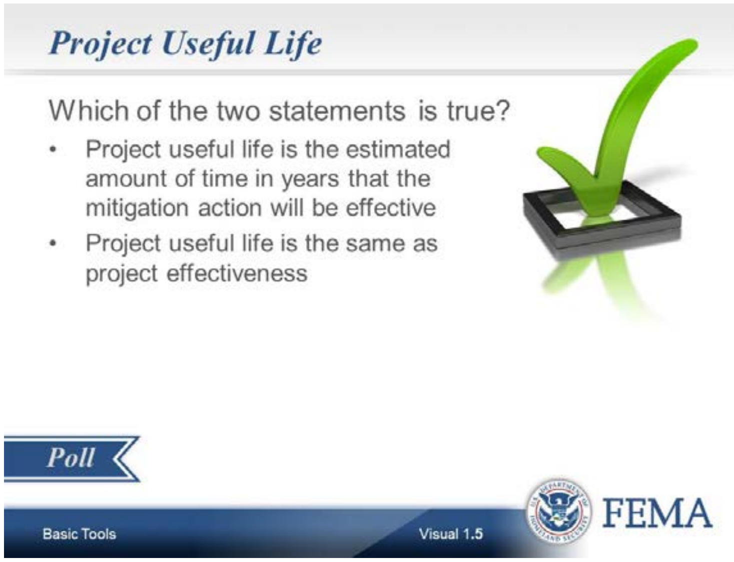
Visual 1.4: Benefits

Answer the following knowledge check:

Which of the items listed are benefits of mitigation projects? Select more than one.

- Avoided physical damages
- Equipment rental
- Avoided loss-of-function impacts
- Avoided casualties

Write the correct answer below.



Visual 1.5: Project Useful Life

Answer the following knowledge check:

Which of the two statements is true?

- Project useful life is the estimated amount of time in years that the mitigation action will be effective.
- Project useful life is the same as project effectiveness.

Write the correct answer below.

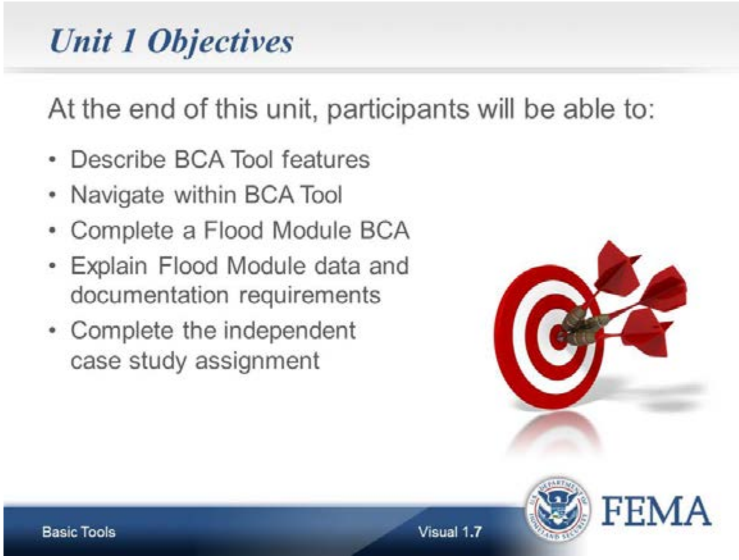
Visual 1.6: Flood Elevations

Answer the following knowledge check:

Explain why this statement is wrong: "We were not supposed to have another 100-year flood—we just had one 15 years ago."

Write the correct answer below.

Unit 1 Overview

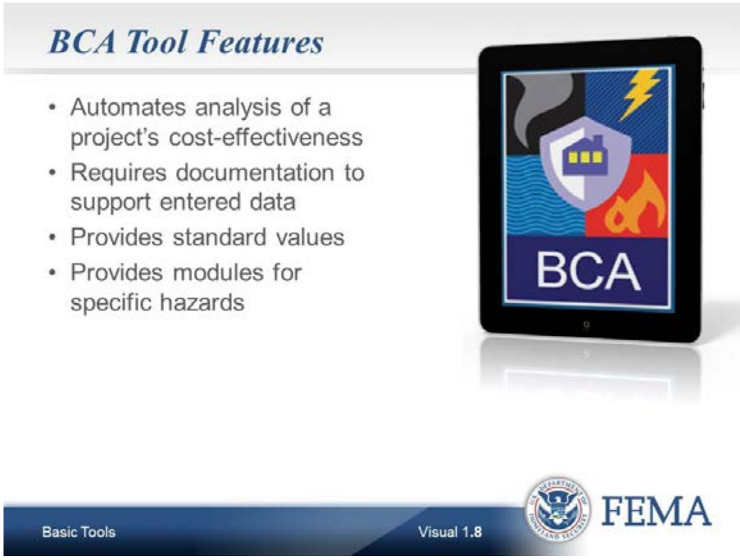


Visual 1.7: Unit 1 Objectives

The purpose of this unit is to learn how to use the BCA Tool to complete a benefit-cost analysis. The objectives are for participants to:

- Describe the features of the BCA Tool.
- Navigate within the BCA Tool.
- Complete a benefit-cost analysis using the Flood Module of the tool.
- Explain the purpose of important screens and data fields in the Flood Module.
- Complete the independent case study assignment.

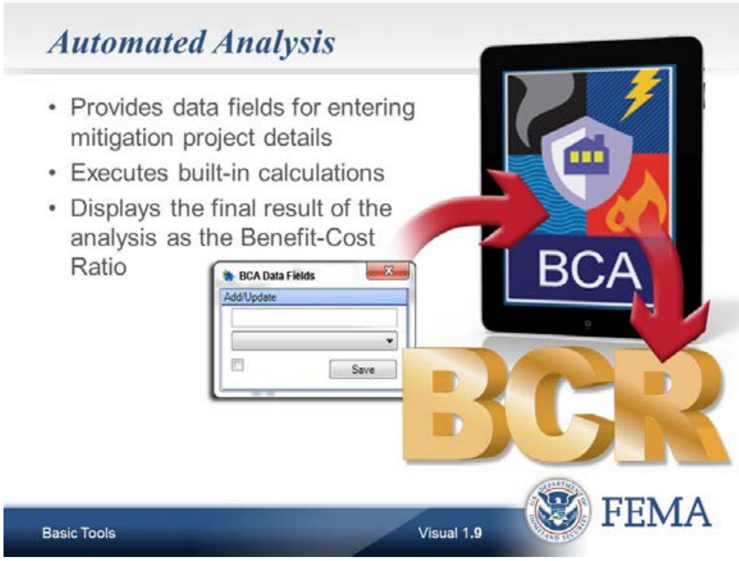
BCA Tool Features



Visual 1.8: BCA Tool Features

The BCA Tool has many features, but this introduction will focus on four of them:

- Automates the cost-effectiveness analysis required by regulation.
- Requires documentation to support the data entered in the tool.
- Provides standard values where applicable.
- Provides modules for specific hazards.

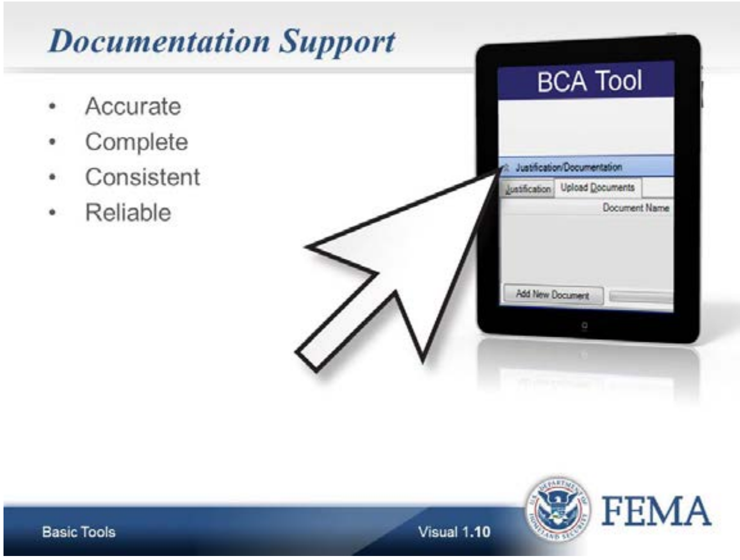


Visual 1.9: Automated Analysis

The BCA Tool automates the cost-effectiveness analysis required by regulation by:

- Providing data fields where users enter data about the mitigation project and structures.
- Using the data entered by the users to execute built-in calculations that will determine the cost-effectiveness of the project.
- Displaying the final result of the analysis in the form of a Benefit-Cost Ratio, commonly known as the BCR.

Just like any automatic processing tool, the input or the data entered is important and has a direct impact on the output. The accuracy of the output can only be as good as the accuracy and completeness of the data entered.



Visual 1.10: Documentation Support

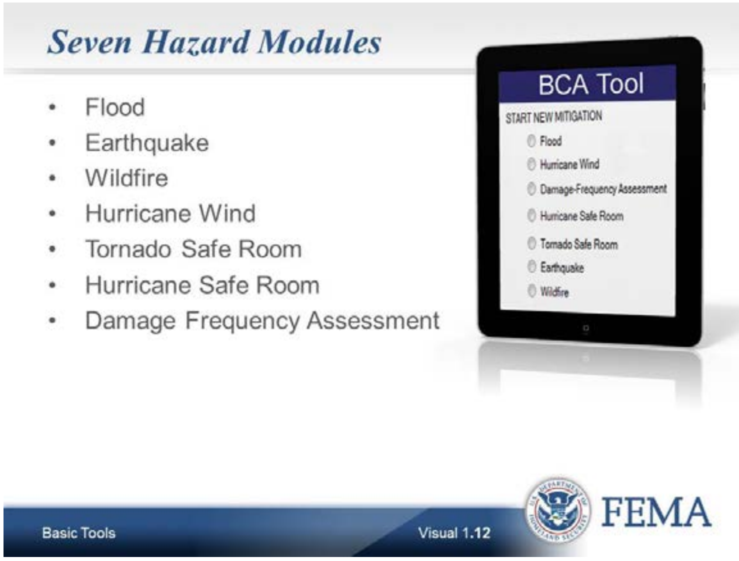
The second feature of the BCA Tool is that it requires back-up documentation.

- It is not enough to enter the project data in the data fields of the tool. Certain data fields require users to attach documentation that supports the value entered.
- These data fields that require documentation and the kind of documentation that is valid and acceptable will be explained during the Flood Module walkthrough.
- Documentation should be accurate, complete, consistent and reliable. For example, when submitting a cost estimate document from a local building contractor, the costs provided should reflect current and realistic prices, and include the eligible cost items needed to complete the project, and only those items. Any contractor used to prepare the cost estimate document should be a reliable and experienced provider of such services.

Visual 1.11: Standard Values

The third feature of the BCA Tool is that it provides standard values where applicable.

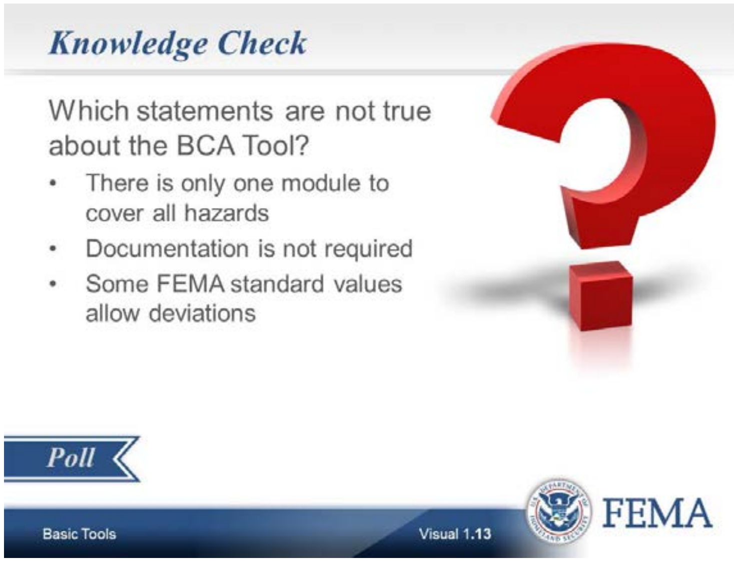
- For certain data fields in the tool, default values have been assigned. Default values are FEMA standard values and are the result of previously-conducted economic and statistical analyses.
- Some standard values apply to all hazard modules and mitigation projects, while some standard values are specific to a hazard module or to a project type. For example, the Discount Rate standard value applies to all mitigation projects. The percentage Demolition Damage Threshold standard value, however, is used specifically in the Flood Module.
- Many standard values are pre-filled in the tool. Some FEMA standard values do not allow users to override with better data, while some do. Where overrides are allowed, users must justify the new value and provide documentation to explain and support their new value. For example, users cannot override the Discount Rate standard value, but they may override the Project Useful Life standard value.
- Data fields that have standard values, overrides, and how to attach the justification and documentation that supports and explains the new values will be explained in the Flood Module walkthrough.



Visual 1.12: Seven Hazard Modules

The last feature of the tool is that specific hazards have their own modules.

- The tool is organized by module, and there are seven modules: Flood, Earthquake, Wildfire, Hurricane Wind, Tornado Safe Room, Hurricane Safe Room and Damage Frequency Assessment (DFA).
- The Hurricane Safe Room module is new to Version 5.0 and has limited scope, per the HMA Guidance.
- The seven hazard modules are covered in the following units:
  - Unit 1 – Flood Module
  - Unit 3 – DFA Module
  - Unit 4 – Tornado Safe Room Module
  - Unit 5 – Hurricane Wind Module
  - Unit 6 – Wildfire Module
  - Unit 7 – Hurricane Safe Room Module
  - Unit 8 – Earthquake Module



Visual 1.13: Knowledge Check

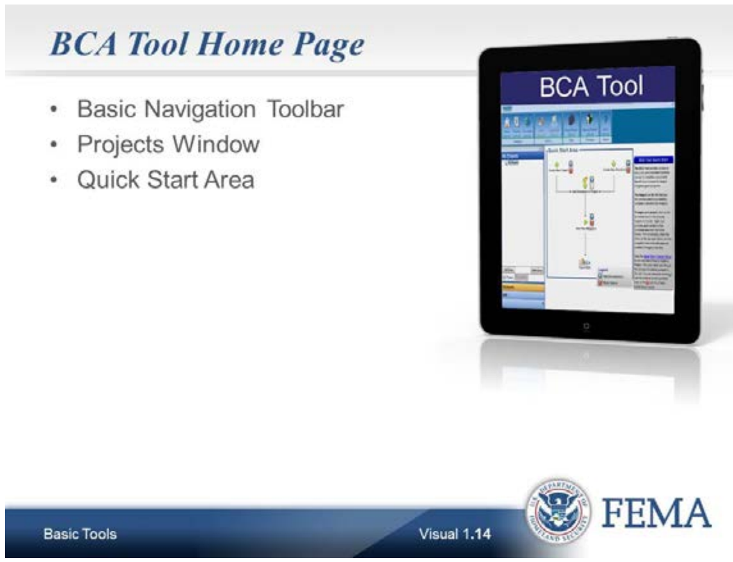
Answer the following knowledge check:

Which statements are not true about the BCA Tool? Select more than one.

- There is only one module to cover all hazards.
- Documentation is not required.
- Some FEMA standard values allow deviations.

Write the correct answer below.

Flood Module Walkthrough



Visual 1.14: BCA Tool Home Page

Launch the BCA Tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, let the host know by using the Private Chat or Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics

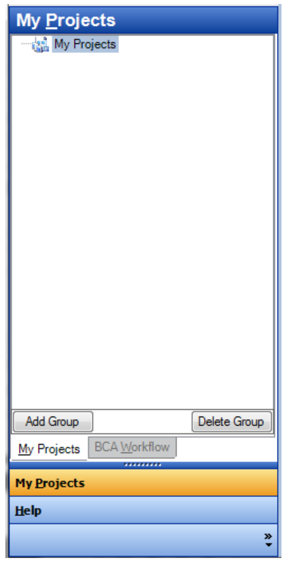
The three main parts of the BCA Tool Home page:

- Basic Navigation Toolbar at the top;
- Projects Window on the left; and
- Quick Start Area on the right.

Screenshot 1.1: Basic Navigation Toolbar

The toolbar provides links to the various functionalities of the tool:

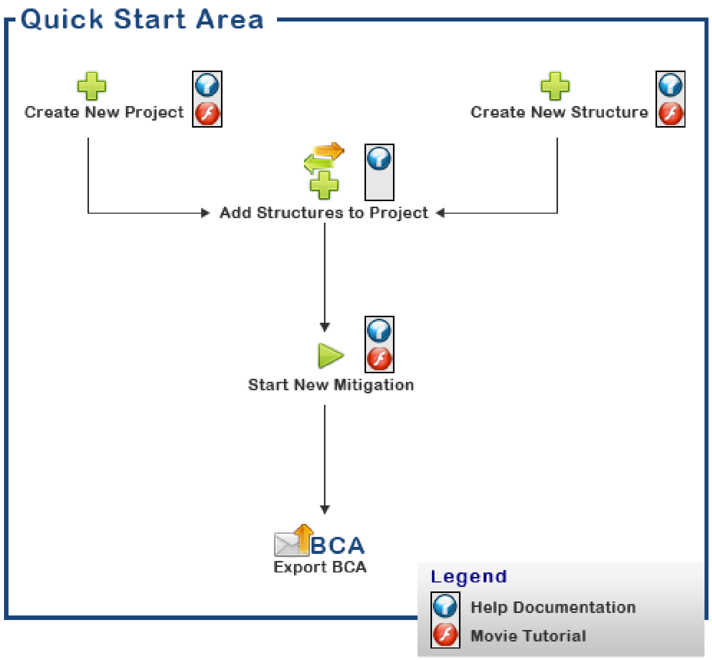
- *Home* displays and always takes users back to the Home page.
- *Projects* displays the PROJECT INVENTORY screen where users can see the list of projects they have finished or are in the process of analyzing.
- *Structures* displays the STRUCTURE INVENTORY screen where users can see the list of structures entered into the tool.
- *Print* displays a list of projects that have already been entered in the tool (if any). After selecting a project, the BCA Report dialog box is displayed. This allows users to print the report in PDF or Excel format.
- *Export BCA* displays a list of projects that have already been entered in the tool (if any). After selecting a project, a traditional Window "Save As" dialog box is displayed. Navigate to the location on the computer where the export file needs to be saved.
- *Import/Export* displays the BCA-Import Export dialog box. This function will be used later in this unit.
- *Backup/Restore* displays the BCA-Database Backup and Restore dialog box. This functionality enables users to backup and restore files.
- *About* displays software version and BCA Helpline contact information. The BCA Helpline is your resource for BCA Tool software issues and questions on completing a BCA for your mitigation project. Note that the helpline can be reached via a toll-free number or via email.



Screenshot 1.2: Projects Window

The projects window visible on the left side of the screen contains a list of the projects that have been entered in the tool. The first time the tool is used, the projects list will be empty.

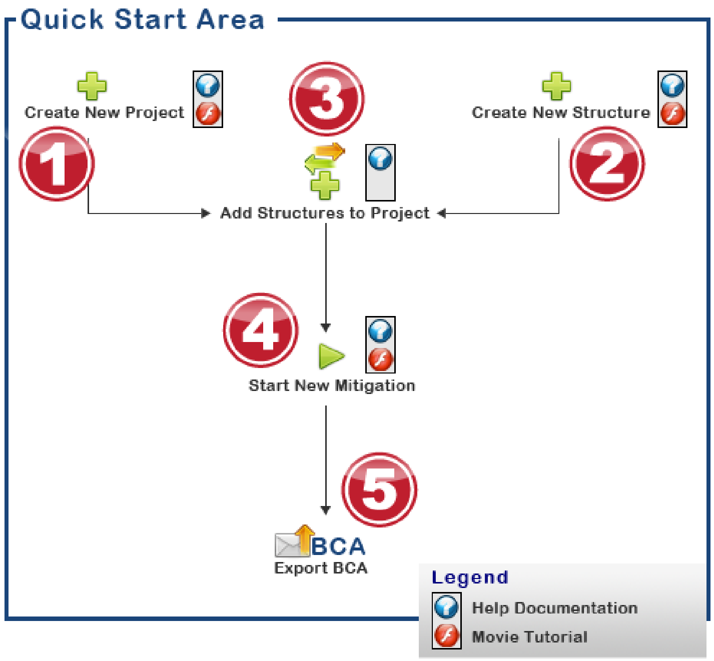
Selecting *Help* at the bottom of the projects window displays a list of Help topics related to the data fields on the current screen. Since the current screen is the Home Page, selecting *Help* displays a list of video software demonstrations. While working the analysis, this Help content is the first stop for assistance.



Screenshot 1.3: Quick Start Area

The Quick Start Area diagram visible in the center of the screen serves three purposes:

- To graphically show the steps of how to complete a BCA;
- To provide access to the Quick Start Movie Tutorial; and
- To provide quick access to the tool's functionalities using the hot links from the icons.



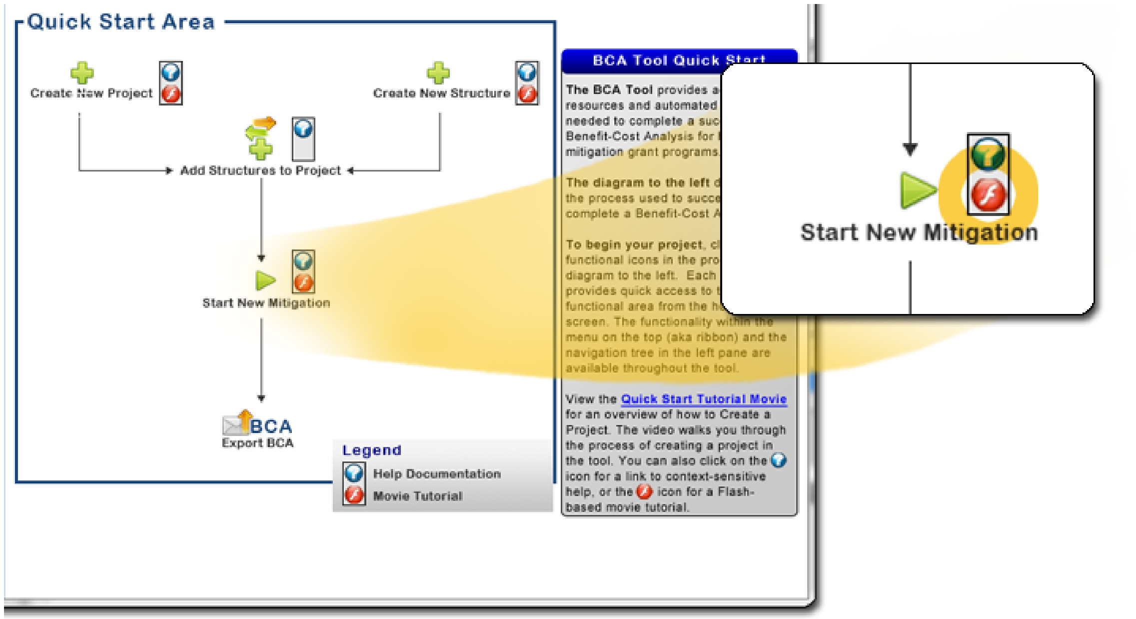
Screenshot 1.4: Steps to Complete a BCA

Completing a BCA involves the following steps:

- Step One: Create new project.
- Step Two: Create new structure(s).
- Step Three: Add structures to project.
- Step Four: Start new mitigation. This means starting the analysis of a mitigation project.
- Step Five: Export BCA.

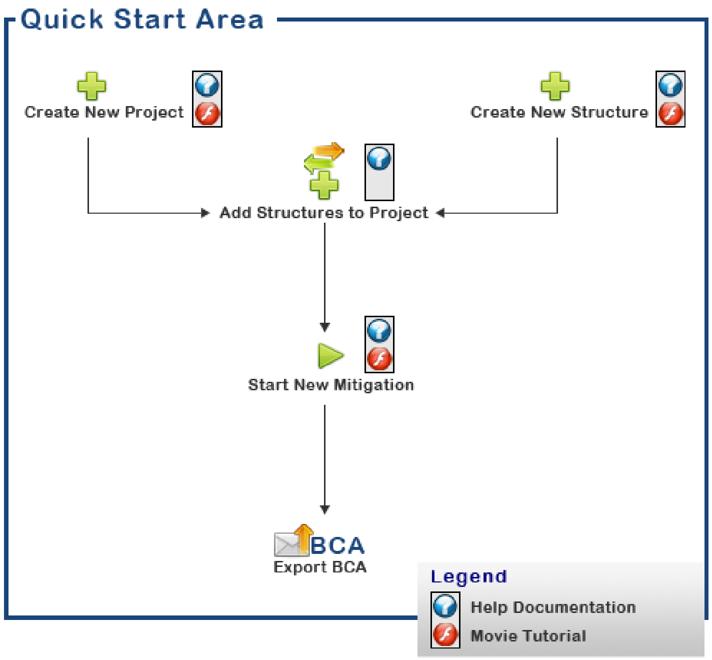
The Quick Start Area diagram displays these five steps. *S*teps one and two are interchangeable in order. Create new structures may come first before creating the new project. In older versions of the tool, users were asked to create new structures first. In this Version 5.0, users are encouraged to create the new project first, but are not prevented from creating new structures first.

The difference between a project and a structure is that a structure is generally a specific building, road, bridge or utility that is being protected from direct damages. A project generally refers to the entire mitigation activity, which could protect a single structure or multiple structures. A project and structures are both needed to run a BCA, but the analysis itself is performed on each structure.



Screenshot 1.5: Quick Start Movie Tutorial

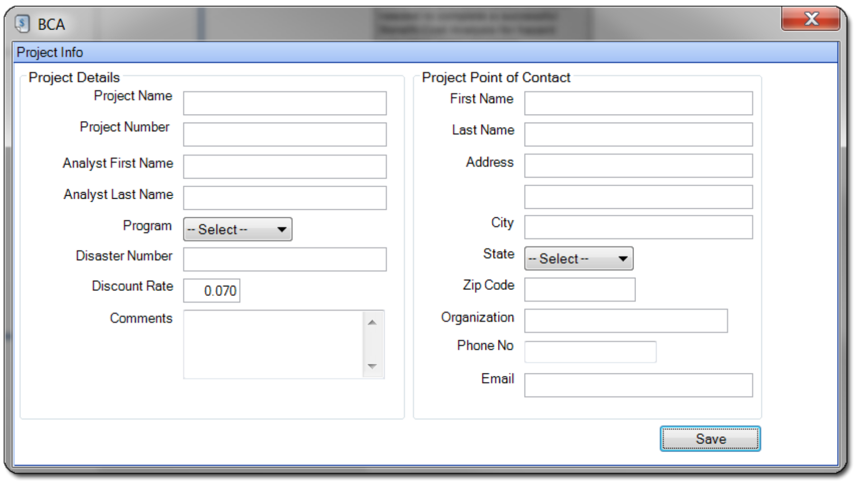
The Quick Start Movie Tutorial presents video clips that demonstrate how to complete Steps One through Five. Access the tutorial by selecting the Flash icon.



Screenshot 1.6: Access to Functionalities

The diagram also provides quick access to the tool's functionalities where users can complete each of the BCA steps:

- *Create New Project* displays the Project Info dialog box where users can create a new project and enter data about the proposed mitigation project.
- *Create New Structure* displays the Add/Update Structure dialog box where users can create a new structure and enter data about that structure.
- *Add Structures to Project* displays a list of projects that have already been entered in the tool (if any). After selecting a project, the Add/Remove Structures dialog box is displayed.
- *Start New Mitigation* displays a list of projects that have already been entered in the tool (if any). After selecting a project, the list of structures that have been added to that project (if any) is displayed. After selecting a structure, the MITIGATION INFORMATION screen is displayed.
- *Export BCA* displays a list of projects that have already been entered in the tool (if any). After selecting a project, the Save As dialog box is displayed. Navigate to the location on the computer where the export file will be saved.



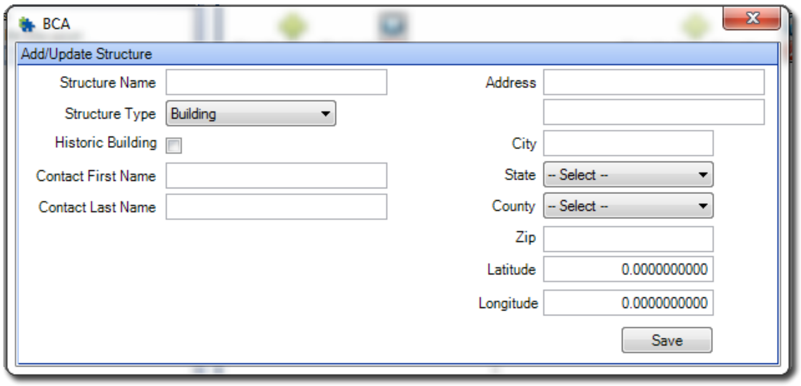
Screenshot 1.7: Project Info

The BCA Tool should be up on the screen and the Flood Module Case Study handout ready. For each screen, the purpose of that screen and important data fields will be explained, especially if the information is not included in the Help content. In this case study, the project proposes to elevate a residential structure located in the 100-year floodplain of a river.

The first step to completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start area to complete Step One. In this case study, all the data fields will be completed because the goal is to finish a complete analysis. There may be situations where users want to simply determine the general cost-effectiveness of a project, or compare the BCRs for a range of mitigation options. In those situations, it will be enough to complete the **Project Name**, **State**, and **Organization** data fields.
For this case study, complete Step One by doing the following steps:

- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter “Smithville Elevation.”
- In the **Project Number** data field, enter “908.”
- In the **Analyst First Name** data field, enter “A.R.”
- In the **Analyst Last Name** data field, enter “Gyle.”
- In the **Program** data field, select “PDM.”
- There is no need to enter a value in the **Disaster Number** data field because this is not a Hazard Mitigation Grant Program (HMGP) subapplication. Disaster numbers are assigned for disasters that are declared a Federal disaster by the President of the United States. The HMGP program is the only post-disaster mitigation program; therefore, it is the only program for which a disaster number is relevant.
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.
- In the **Contact Name** data fields, enter “John Jameson.” This information in the Project Information window is for the local point of contact for the project.
- In the **Address** data field, enter “1234 Smith Road.”
- In the **City** data field, enter “Smithville.”

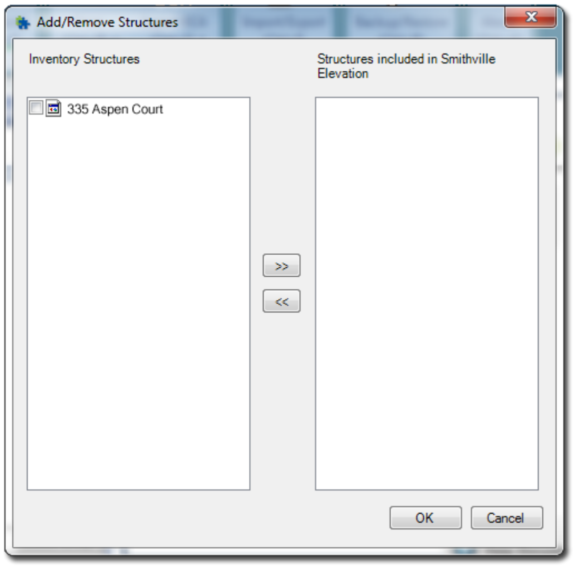
- In the **State** data field, select "Illinois."
- In the **Zip Code** data field, enter "61536."
- In the **Organization** data field, enter "City of Smithville."
- In the **Phone Number** data field, enter "555 555-5555."
- In the **Email** data field, enter "jjameson@CityofSmithville.gov." The tool will not use this data to send an email to the addressee. This data is for the reviewer to be able to contact the project point of contact in case there are any questions.
- Select *Save*. The tool displays the "Project saved successfully" message.
- Select *OK*. The Home page is displayed.



Screenshot 1.8: Add/Update Structure

The second step to completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start area to complete Step Two.

- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter "335 Aspen Court." It is wise to use a description of the structure that is specific enough so that it can be found in a list of other structure. This will become clearer in the next step of associating the structure with the project.
- In the **Structure Type** data field, select "Building." Note that there are two other structure types: Utility and Other. Select "Building" if the project seeks to reduce losses to buildings. Select "Utility" if the project seeks to mitigate the loss of function of utility services. Select "Other" if the project seeks to mitigate losses to roads, bridges or other items that do not fit with Building or Utility. Selecting a value other than "Building" will mean an analysis cannot be completed in the Flood module—only the DFA Module will be possible.
- In the **Historic Building** data field, leave the box unchecked. This box has no impact on the analysis—it only tells the reviewer that this is a historic structure.
- In the **Contact First Name** data field, enter "James." The contact information in the Structure Information window is for the property owner.
- In the **Contact Last Name** data field, enter "Parker."
- In the **Address** data field, enter "335 Aspen Court."
- In the **City** data field, enter "Smithville."
- In the **State** data field, select "Illinois."
- In the **County** data field, select "Peoria."
- In the **Zip** data field, enter "61536."
- In the **Latitude** data field, enter "40.6600."
- In the **Longitude** data field, enter "-89.8000."
  Some modules use the State, County, Zip, or Latitude/Longitude information for pulling in risk data. This is not the case for the Flood Module. The other hazard-specific units that use the above data fields to pull in risk data will cover that topic.
- Select *Save*. The tool displays the "Structure saved successfully" message.
- Select *OK*. The Home page is displayed.

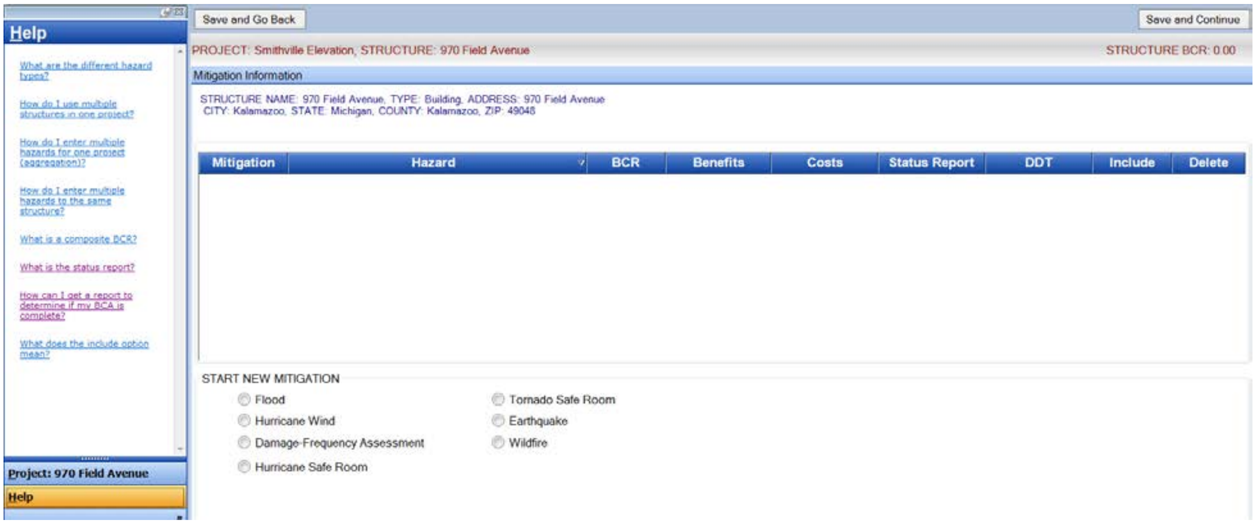


Screenshot 1.9: Add/Remove Structures

The third step to completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start area to complete Step Three.

- Select *Add Structures to Project* to display a list of existing projects.
- Select the "Smithville Elevation" project. The Add/Remove Structures dialog box is displayed.
- Select the "335 Aspen Court" structure.
  It will be useful to have a structure naming system that makes it easy to find the structure amongst many other structures in the left window. Using the street number and name to name the structure makes it easy to find the correct structure.
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the "Add/Remove Structures Succeeded" message.
- Select *OK*. The Home page is displayed.

Steps One, Two, and Three, Create New Project, Create New Structure and Add New Structures to Project are completed for <u>every analysis</u>, regardless of module.

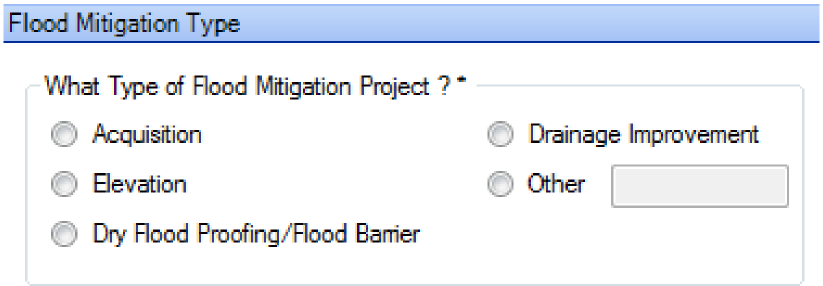


Screenshot 1.10: Mitigation Information

The fourth step to completing the BCA is to start a new mitigation. Use the *Start New Mitigation* icon in the Quick Start area to complete Step Four.

- Select *Start New Mitigation* in the Quick Start Area to display a list of existing projects.
- Select the “Smithville Elevation” project.
- Select the “335 Aspen Court” structure. The MITIGATION INFORMATION screen is displayed.
- In the projects window on the left, select *Help*. The list of available Help topics for this screen is displayed.
- In the Start New Mitigation section at the bottom of the screen, select “Flood.”
- In the upper right part of the screen, select *Save and Continue.* The FLOOD MITIGATION TYPE screen is displayed.

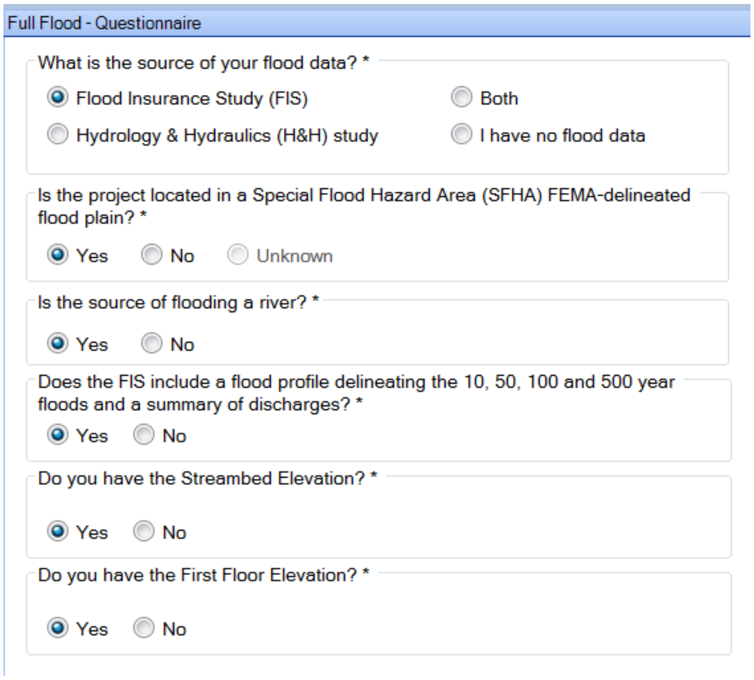
The following screens that will be discussed are all part of adding a new mitigation. After the data is entered in all the screens, the tool completes the benefit-cost analysis and generates the BCR based on the data entered. The first screen is the FLOOD MITIGATION TYPE screen.



Screenshot 1.11: Flood Mitigation Type

The case study handout identifies the flood mitigation type as an elevation project. In the workplace, the flood mitigation type can be determined from the detailed scope of work, which should be included in the subapplication.

- Hover the mouse on each flood mitigation project type. A screen tip is displayed, giving a brief description of that project type.
- Note that most drainage improvement projects use the Damage Frequency Assessment (DFA) Module. However, drainage improvement is still included as an option here in the Flood Module because if the drainage project has information on water surface elevations and discharges for four flood frequencies, the Flood Module can be used.
- Select "Elevation."
- Select *Save and Continue*. The FULL FLOOD – QUESTIONNAIRE screen is displayed.



Screenshot 1.12: Full Flood – Questionnaire

The purpose of this screen is to verify that all data are available that would be required to perform a BCA in the Flood Module. If the responses to the questionnaire on this screen fail that verification, then the tool automatically transfers the analysis to the DFA Module.

Two possible scenarios could trigger the analysis being redirected to the DFA Module:

- Absence of flood data; and
- Absence of still water elevations information in coastal flood data.

To see how the tool transfers the analysis to the DFA Module when flood data is absent, execute the following steps. Users need to be careful that they do not end up in the DFA Module when what they really wanted was to use the Flood Module for the analysis.

- In the **What is the source of your flood data?** data field, select “I have no flood data.” This response triggers the display of the Redirect to Damage-Frequency Assessment Module dialog box.
- Select *Cancel* to stay in the Flood Module because that is what this unit is about. Select *OK* to be taken to the DFA Module.

To see how the tool transfers the analysis to the DFA Module when still water elevations information is absent in coastal flood data, execute the following steps:

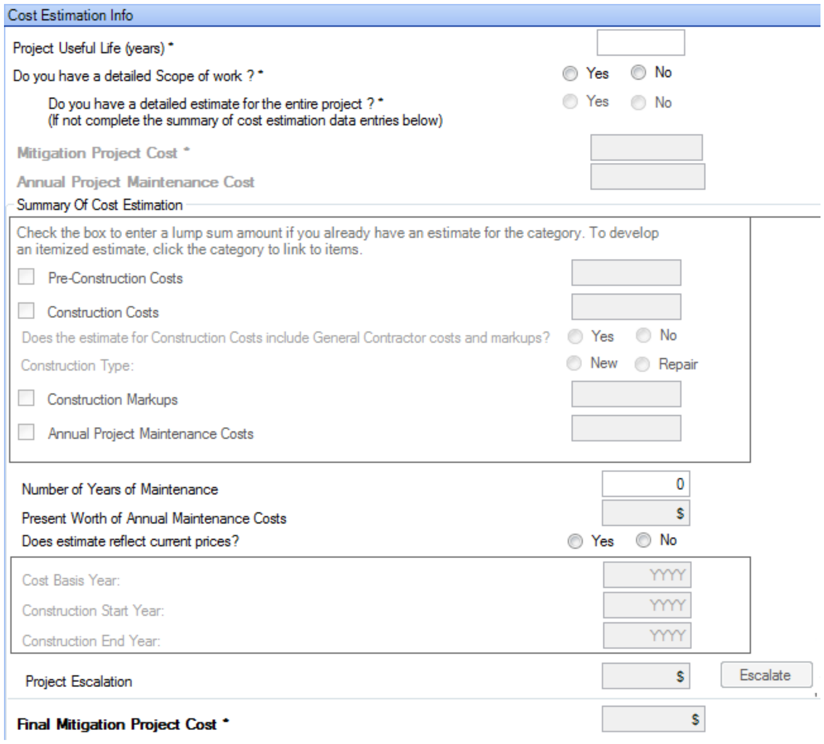
- In the **Is the source of flooding a river?** data field, select “No.” This tells the tool that the source of flooding is coastal. For flood problems related to stormwater drainage not connected to a river, chances are you will not have the flood data needed to run an analysis in the Flood Module and will have to use the DFA Module.
- In the **Does your flood data include a summary of still water elevations (SWEL)?** data field, select “No.” This response triggers the display of the Redirect to Damage-Frequency Assessment Module dialog box.

- Select *Cancel* to stay in the Flood Module.

This screen has Help topics that are organized into three sections: Flood Data Documents, Riverine, and Coastal. Flood Data Documents and Riverine are the Help sections applicable to this case study. It may be a good idea to keep the Help window open so that Help information can be easily accessed.

Enter the following data for the case study:

- In the **What is the source of your flood data?** data field, select “Flood Insurance Study (FIS).”
- In the **Is the project located in a Special Flood Hazard Area (SFHA) FEMA-delineated flood plain?** data field, select “Yes.”
- In the **Is the source of flooding a river?** data field, select “Yes.”
  Note: Although the source of flooding in this case study is a river, there may be situations where the source of flooding is not a river. Selecting “No” to this question displays the question about SWEL. Selecting “Yes” displays the **Coastal Flooding** data field with three choices to select from: “A,” “V,” and “Unknown.” The Help topic on Coastal Flood Zones provides assistance on choosing the correct response. Go back to the case study and make sure that a river is selected as the source of flooding.
- In the **Does the FIS include a flood profile delineating the 10-, 50-, 100-, and 500-year floods and a summary of discharges?** data field, select “Yes.”
- In the **Do you have a Streambed Elevation?** data field, select “Yes.”
- In the **Do you have the First Floor Elevation?** data field, select “Yes.”
- Select *Save and Continue*. The COST ESTIMATION INFO screen is displayed.



Screenshot 1.13: Cost Estimation Info

The purpose of this screen is to establish the “C” or “costs” needed to calculate the BCR. This screen is important because it runs across all the BCA Tool modules.

Enter the following basic information on this screen:

- In the **Project Useful Life** data field, enter “30.”
- In the **Do you have a detailed Scope of Work?** data field, select “Yes.”
- In the **Do you have a detailed cost estimate for the entire project?** data field, select “Yes.” Note that this dollar amount is in the case study handout.
- In the **Mitigation Project Cost** data field, enter "$118,215.00.”
- In the **Annual Project Maintenance Cost** data field, enter “0.”
- Scroll down to the **Does estimate reflect current prices?** data field and select “Yes.”
- Note that the tool filled in the **Final Mitigation Project Cost** data field.

The icon that has an exclamation mark in a red bubble next to the **Project Useful Life** and **Mitigation Project Cost** data fields indicates that the tool expects justification or supporting documentation for the data provided.

The important data fields on this screen are:

- **Project Useful Life (PUL)**
- **Mitigation Project Cost**
- **Annual Project Maintenance Cost**

IS-0276 covered the definition of PUL. Select the Help topic, How do I determine Project Useful Life? and scroll down to the PUL table on page 2.

When using the FEMA standard values in this PUL table, there is no need to provide back-up documentation. However, there is still a need to provide justification text that the value entered is from the FEMA PUL table. Providing justification/documentation within the tool is discussed in the next screenshot. When overriding the standard value with a higher PUL there is a need to provide justification and attach back-up documentation such as official vendor publications or certified engineering data need to be attached.

The **Mitigation Project Cost** data field is important because it provides the basis for the "cost" value in the benefit-cost analysis. Higher cost values lower the final BCR. Valid and reliable sources of this data include: licensed building contractors or engineers; national cost estimates guides (e.g., RS Means, Marshall & Swift); and historic costs of completed similar mitigation projects. Support the data by uploading the cost estimate document signed and certified by the source.

The **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness.

For example, even if a culvert is widened to handle more storm water, it still has to be regularly cleared of debris to maintain its effectiveness. Costs incurred for this type of maintenance include the staff time and equipment to clear the culvert, debris disposal and inspections. Another example would be the costs of maintaining a wildfire hazardous fuels reduction mitigation project. Such projects need to be actively maintained, possibly even several times a year.

Not all project types will have a maintenance cost. Structure elevation and structure acquisition/demolition projects require no maintenance costs. For project types that are expected to have a maintenance component, however, reviewers will be checking for a maintenance cost value. Higher maintenance costs lower the final BCR. In situations where maintenance costs outweigh the benefits of the mitigation activity, other alternatives to mitigate the risk would have to be found. Support the maintenance cost data values by attaching maintenance cost documentation from reliable and competent sources such as licensed building contractors or engineers. Note that maintenance costs are the responsibility of the local entity submitting the project, so therefore, they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

The screen has other features, the first of which is the tool's built-in cost estimator. This feature is used in situations where the project does not have a documented total mitigation project cost and allows users to generate their own total project cost. The built-in cost estimator allows users to enter eligible cost items, including the dollar amount per unit, and the number of units. When using the built-in cost estimator, support each cost item input with back-up documentation. Although this case study does not use the built-in cost estimator, there may be situations in the future when this feature will need to be used. To access and use this feature, execute the following steps: (*Note: It is recommended that you try these steps outside of the classroom so that you can focus on the content being covered by the Instructor.)*

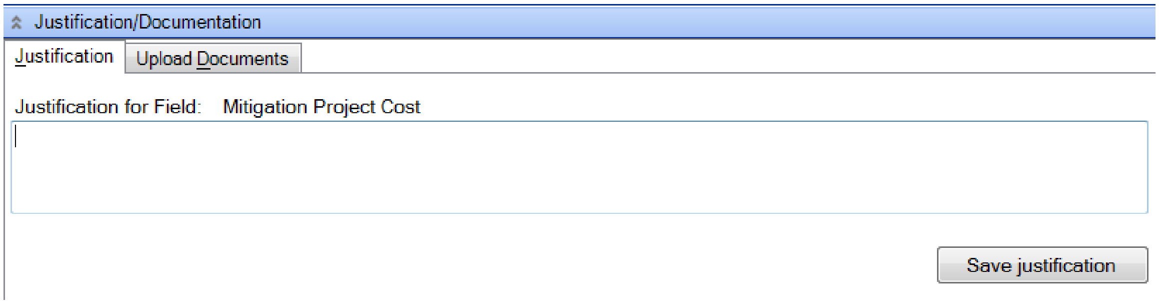
- In the **Do you have a detailed cost estimate for the entire project?** data field, select "No." The Summary of Cost Estimation section becomes active. This section is where the tool's built-in cost estimator begins.

- Select the *Construction Costs* link. The COST ESTIMATION screen is displayed with three types of costs: *Demolition*, *New Construction* and *Site Restoration*.
- Select the *New Construction* link. A cost estimation table with a list of cost items related to an elevation project is displayed.
- This elevation project has costs for new water, sewer and electric, and a new foundation of spread footings/walls. The cost estimates are historic (based on similar projects implemented by the community) so check the boxes under the “H” column. The “P” column is for published costs and the “C” column is for contractor-provided cost estimates.
- For each of the four items enter a quantity of “1.”
- For each of the four items enter a unit of “each.”
- Enter the following costs for each item (not representative of an actual project):
  - New water: $2,000.00
  - New sewer: $2,000.00
  - New electric: $2,000.00
  - New foundation: $75,000.00
- Delete the rows that will not be used. Position the cursor on the blue rectangle to the left of the item description to highlight the row. Press the Delete key on the keyboard. Repeat the process for each cost item that will not be used.
- The table also provides a way to add cost items. Position the cursor in the Description column of the bottom blank row. Type “Project Management”. Check the box under “H”, enter a quantity of “20”, enter the unit “hours”, and enter a cost of $50.00. Note that the tool calculates 20 times 50 to arrive at a total of $1,000.00
- Select *Save*. The total estimated cost is displayed.
- To go back to the COST ESTIMATION INFO screen, select *Save and Go Back*. The COST ESTIMATION INFO screen is displayed again.
- In the **Do you have a detailed cost estimate for the entire project?** data field, select “Yes” again to go back to the case study. Note that the Summary of Cost Estimation section is no longer active.

The second feature of this screen is cost escalation. This feature is used in situations where the mitigation project cost was obtained from similar projects that were completed in the past, and the costs no longer reflect current prices. Although the case study does not use the cost escalation feature, there may be situations in the future when this feature will need to be used. To access and use this feature, execute the following steps:

- In the **Does estimate reflect current prices?** data field, select “No.” The **Cost Basis Year** data field becomes active.
- In the **Cost Basis Year** data field, enter the previous year, which is when the cost estimate was developed.
- In the **Construction Start Year** data field, enter one year into the future.
- In the **Construction End Year** data field, enter two years into the future.
- Select *Escalate*. The **Project Escalation** data field displays the escalation amount.
- Note that in the **Final Mitigation Project Cost** data field, the escalation amount was added to the **Mitigation Project Cost** value.
- To get back to the case study, which has a current value, select “Yes” once again in the **Does estimate reflect current prices?** data field.

The third feature of this screen is the Justification/Documentation section. This section is available on all the screens of the tool, except in the final SUMMARY OF BENEFITS screen. The next topic covers Justification/Documentation.



Screenshot 1.14: Justification/Documentation

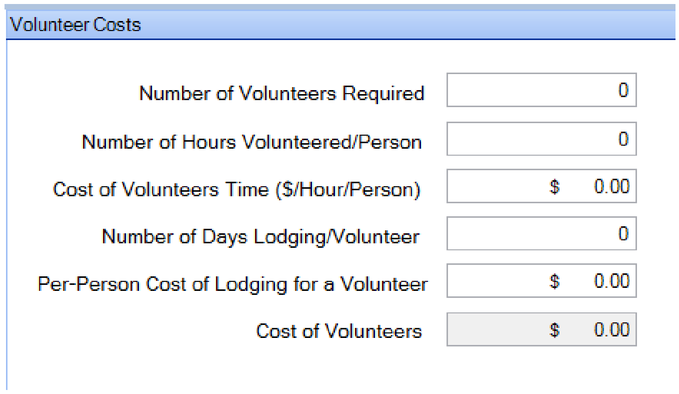
It is important to provide justification and upload documentation to support the data entered in the COST ESTIMATION INFO screen. The Justification/Documentation section at the bottom of the screen provides a way to attach the justification/documentation with the corresponding data field. To use the Justification/Documentation section, complete the following steps:

- Click the cursor inside the **Project Useful Life** data field. Note that the Justification/Documentation section at the bottom of the screen displays the text "Project Useful Life." Enter the text "See project useful life table" as a justification of the value entered in the **Project Useful Life** data field.
- For another example, click the cursor inside the **Mitigation Project Cost** data field. Note that the Justification/Documentation section at the bottom of the screen now displays the text "Mitigation Project Cost."
- Each time users click the cursor inside a data field, the tool associates the justification text and the uploaded documents with that data field.

To enter justification/documentation for the mitigation project cost of the case study, complete the following steps:

- Click the cursor inside the **Mitigation Project Cost** data field.
- In the **Justification** data field for Mitigation Project Cost, enter the text "See contractor cost estimate."
- Select *Save justification*.
- Select *Upload Documents*. The Upload Documents table is displayed.
- Select *Add New Document*. The Windows Explorer navigation dialog box is displayed.
- Navigate to the file that needs to be uploaded. Highlight the file.
- Select *Open*. The file is now displayed in the Upload Documents table. The exclamation point icon next to the **Mitigation Project Cost** data field now displays a paper clip icon.
- Select *Save and Continue*. The VOLUNTEER COSTS screen is displayed.

Note that the tool will only check to see if justification or documentation is provided for the data fields that need documentation support. The tool does not check if the attached information is accurate, complete, consistent or reliable.

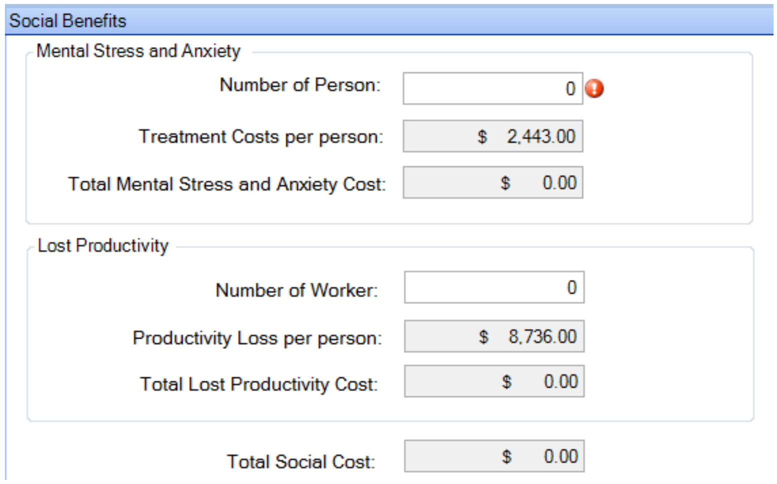


Screenshot 1.15: Volunteer Costs

The purpose of this screen is to calculate the total cost of volunteers required to provide volunteer emergency services after a disaster occurs related to the structure included in the mitigation project. Note that avoided volunteer costs are a new benefit that has been added to Version 5.0 of the BCA Tool.

Examples of volunteer costs that will be prevented or avoided by implementing the mitigation project include volunteer labor to fix a flooded residence or volunteer sandbagging to prevent the loss of function of a water treatment plant. Mitigation projects that eliminate or reduce the need for volunteer labor can claim a benefit. The higher the volunteer costs avoided, the higher the final BCR. The data can be obtained from sources like: volunteer sign-in sheets from a reliable source such as the American Red Cross or Emergency Management Agency; estimates by experts; estimates transferred from similar past disasters or documented information from the homeowner. Support the data by uploading volunteer sign-in sheets provided by a reliable source, documented estimates from experts or similar past disasters, or a signed affidavit from the homeowner stating the number of people and estimated number of hours. Per diem days for non-local charities should only count the number of days spent repairing the actual structure(s) being mitigated in the project.

For the case study, do not enter any data. Select *Save and Continue*. The SOCIAL BENEFITS screen is displayed.



Screenshot 1.16: Social Benefits

The purpose of this screen is to calculate the value of mental stress and anxiety and lost productivity. Note that this is a new benefit that has been added to Version 5.0 of the BCA Tool.

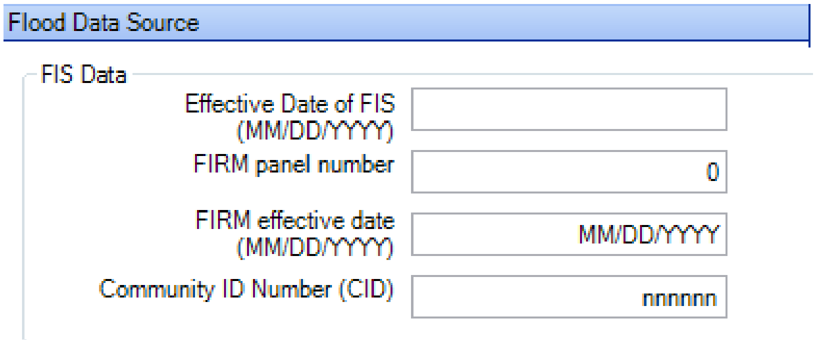
On this screen enter the following:

- In the **Number of Persons** data field, enter “2.” This is the number of people who live in the structure.
- Note that the **Treatment Costs per Person** data field is pre-filled with a FEMA standard value.
- Note that the **Total Mental Stress and Anxiety Cost** data field value is the product of **Number of Person** x **Treatment Costs per Person** (built-in calculation).
- In the **Number of Workers** data field, enter “1.” This is the number of wage earners who live in the household.
- Note that the **Productivity Loss per Person** data field is pre-filled with the FEMA standard value.
- Note that the **Total Lost Productivity Cost** data field value is the product of **Number of Worker** x **Productivity Loss per Person** (built-in calculation).
- Select *Save and Continue*. The FLOOD DATA SOURCE screen is displayed.

The **Treatment Costs per Person** and **Productivity Loss per Person** are FEMA standard values. The Help topics provide an explanation of how the standard values were determined.

In situations where the property is a rental and the renters are counted in the **Number of Persons** data field, the property owner(s) are not counted in the **Number of Persons** data field. Count only the number of people who are “living” in the structure being mitigated.

Occupants of the structure who are retired are not counted in the **Number of Workers** data field. They are not wage earners, so there is no corresponding productivity loss.

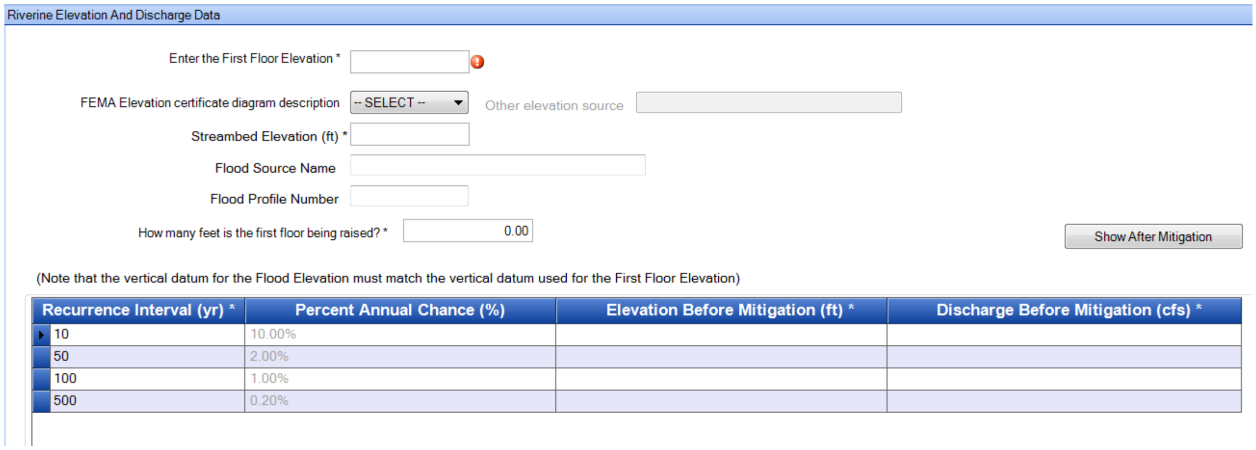


Screenshot 1.17: Flood Data Source

The purpose of this screen is to provide information about the flood data source, mostly for the grant application reviewer. The information is also available in the grant subapplication. The data fields on this screen are not required for BCR calculation.

On this screen, enter the following:

- In the **Effective Date of FIS** data field, enter “02/10/1982.”
- In the **FIRM panel number** data field, enter “45.”
- In the **FIRM effective date** data field, enter “02/10/1982.”
- In the **Community ID Number (CID)** data field, enter “123456.”
- Select *Save and Continue*. The RIVERINE ELEVATION AND DISCHARGE DATA screen is displayed.



Screenshot 1.18: Riverine Elevation and Discharge Data

The purpose of this screen is to provide the flood elevation data (depth of flooding) for the different flood event probabilities. The elevation data then provides the basis for determining damages from the Depth Damage Function (DDF). The DDF is used to correlate the flood depths to damage amounts, which are part of the avoided losses of the project.

On this screen, enter the following:

- In the **First Floor Elevation** data field, enter "440.7."
- In the **FEMA Elevation Certificate Diagram Description** data field, select "Diagram 2."
- In the **Streambed Elevation** data field, enter "430.6."
- In the **Flood Source** data field, enter "Buchannon River."
- In the **Flood Profile Number** data field, enter "01C."
- In the **How many feet is the first floor being raised?** data field, enter "6.2."

In the Elevations and Discharges table, enter the following values in the **Elevation before Mitigation** data field:

- In the **10-year Recurrence Interval** row, enter "440.7."
- In the **50-year Recurrence Interval** row, enter "441.8."
- In the **100-year Recurrence Interval** row, enter "442.3."
- In the **500-year Recurrence Interval** row, enter "443.6."

Enter the following values in the **Discharge** data field:

- In the **10-year Recurrence Interval** row, enter "7,390."
- In the **50-year Recurrence Interval** row, enter "11,880."
- In the **100-year Recurrence Interval** row, enter "14,260."
- In the **500-year Recurrence Interval** row, enter "20,780."

The important data fields on this screen are:

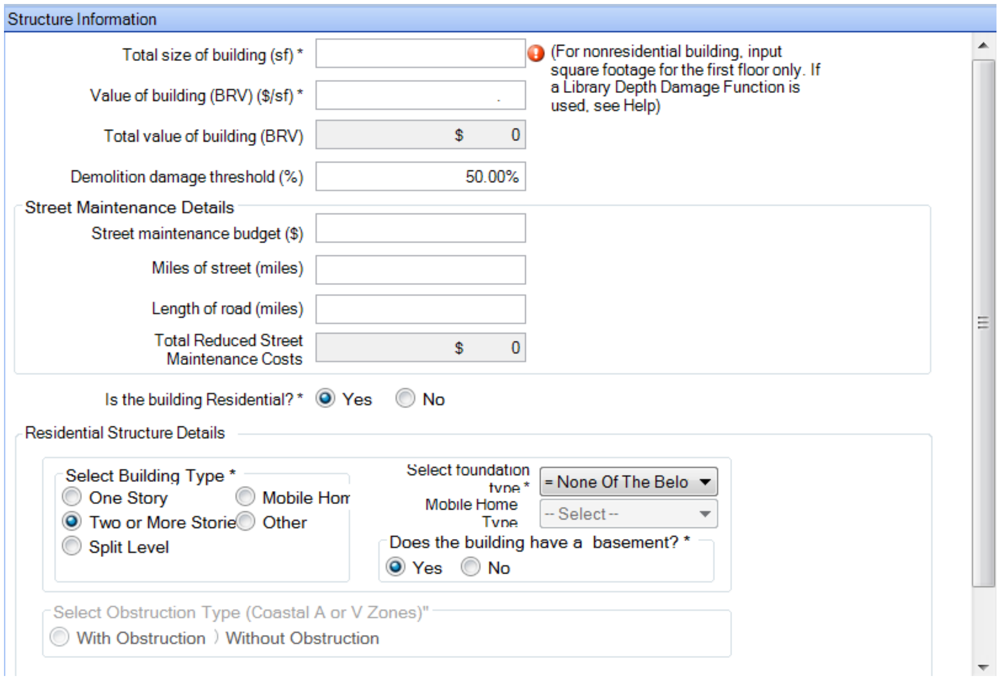
- **First Floor Elevation (FFE)**
- **Streambed Elevation**
- **Elevation Before Mitigation (ft)**
- **Discharge Before Mitigation (cfs)**

The **FFE** data field is important because, together with flood elevations, it determines how high flood water gets into the structure. This “depth” is the basis for the value used to correlate flood depth to flood damage in the DDFs. Raising or lowering the value by even tenths of a foot can have a significant impact on the final BCR. The greater the flood depth—measured as the difference between the FFE and the flood elevations—the higher the BCR. Ideally, the FFE data should be obtained from the elevation certificate, and must be entered in feet in the same vertical datum as the flood elevations. It is best to attach the elevation certificate as back-up documentation, but other documentation like a report from a surveyor is also acceptable, along with some other elevation techniques explained in the Help section.

The **Streambed Elevation**, **Elevation Before Mitigation**, and **Discharge Before Mitigation** data fields are important because, together with the FFE, the streambed and flood elevation values determine flood depth. As explained previously, this “depth” is the basis for calculating damages in the DDFs. Flood discharge values add a little more information since higher flows will cause slightly more damage. Changes in elevation values have a significant impact, while changes in flood discharge values do not have as much. As discussed in IS-0276, the flood elevation and discharge data are obtained from the community’s FIS. The elevation data are entered in feet in the same vertical datum as the FFE. Flood discharge data are entered in cubic feet per second (cfs). Attach a document that provides the FIS elevation and discharge data as back-up documentation.

The *Show After Mitigation* button on this page can be used for drainage improvement projects that have a detailed study which shows the impact of the drainage project on reduced flood elevations for each structure. Selecting this button causes the after-project flood elevation and discharge columns to become visible and available for data entry.

Select *Save and Continue*. The STRUCTURE INFORMATION screen is displayed.



Screenshot 1.19: Structure Information

The purpose of the STRUCTURE INFORMATION screen is to establish the total building replacement value for the structure and to provide information to pull in the correct DDF.

On this screen, enter the following:

- In the **Total Size of Building** data field, enter “1,800.”
- In the **Value of Building (BRV)** data field, enter “$95.00.”
- Note that the **Total Value of Building (BRV)** is the product of **Total Size of Building** x **Value of Building**, or “$171,000.00” (built-in calculation).
- Note that the **Demolition Damage Threshold** is pre-filled with the FEMA standard value of 50 percent. That is the level where most local floodplain management ordinances consider the structure substantially damaged. Historic structures may have a higher threshold value because, even if they are damaged beyond 50 percent, the community may still want to repair the structure and not demolish it.
- In the **Is the building residential?** data field, select “Yes.”
- In the **Building Type** data field, select “Two or more stories.”
- In the **Foundation Type** data field, select “None of the Below.”
- In the **Does the building have a basement?** data field, select “Yes.”

The important data fields in this screen are:

- **Total Size of Building**
- **Value of Building ($/sf)**
- **Is the building residential**
- **Building Type**
- **Does the building have a basement?**

The **Total Size of Building** is the total square feet of livable space for a residential structure, and the square feet of first floor only for a non-residential structure (if the building is more than one story). The higher the **Total Size of Building** value, the higher the final BCR. Large changes in the value will have a large impact. These data can be obtained from assessor records, tax cards, deeds or the structure owner. Documentation to support the data can be a printout of assessor records, letterhead from assessor/tax agency or a copy of the deed.

The **Value of Building ($/sf)** is the cost per square foot of building a comparable structure (residential, commercial, etc.). Multiplying this cost per square foot by the square footage entered in the **Total Size of Building** yields the total **Building Replacement Value (BRV)**. The **BRV** is how much it would cost to repair or replace the structure if it is damaged in a flood. This is similar to the replacement cost values that insurance companies use. Note that the replacement value is being used instead of market value—in most cases, the replacement cost will be higher than the market value. The higher the **Value of Building** is, the higher the final BCR. Preferably, the data should be obtained from local building officials, but national cost estimation tools like RS Means and Marshall and Swift can be used. Documentation to support the data can be a letter from a local building official, a copy of a national cost estimating manual or a copy of other estimating tools used. Cite the reference of the data source.

For residential buildings, note the Help topic How do I determine if the building is residential? The Help topic states that "The building is considered residential if the primary purpose of the building is for living space. A location is considered non-residential if it is open to the public or is a place of work." The question about running a business out of the home may also come up. The Help topic states that "If the primary purpose of the building is living space, the building should be considered residential; however, you can still account for business income losses and/or displacement costs from an in-home business, such as daycare services."

Although the case study is for a residential building, there may be situations in the future where a BCA needs to be completed for non-residential structures. For such situations, complete the following steps:

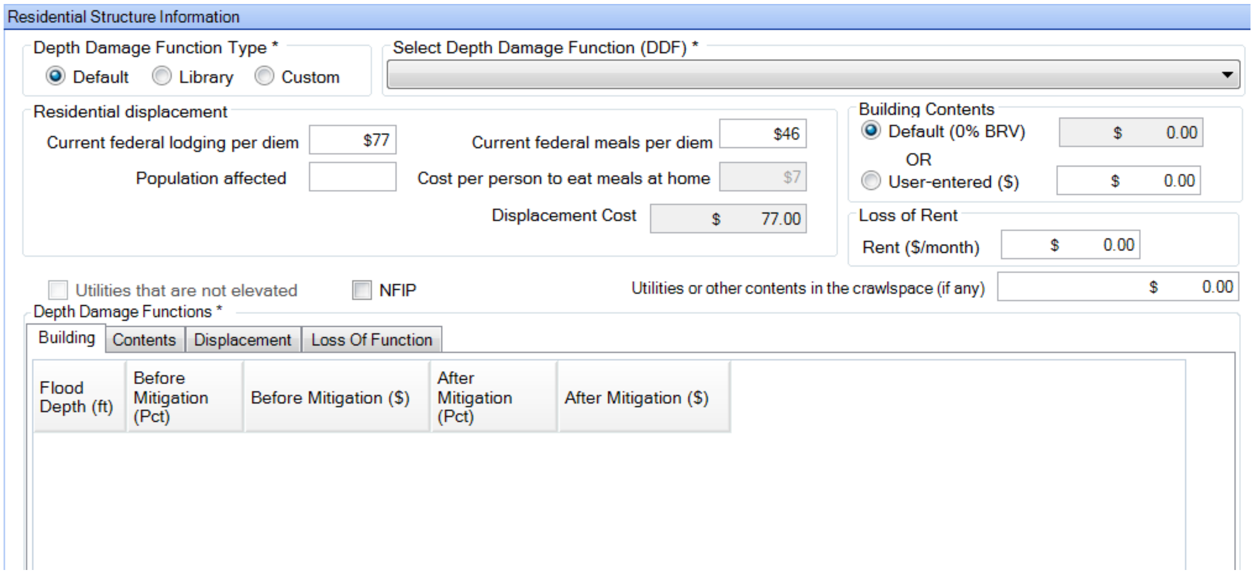
- In the **Is the building residential?** data field, select "No." Note that the following data fields are displayed:
  - **Type of Structure**
  - **Primary use of Building**
  - **Building Contents ($)**
  - **Displacement Costs ($/month)**
  - **One-Time Displacement Costs**

  The **Type of Structure** determines how well the structure was constructed. This information can be obtained from building officials and other competent sources, including engineers and architects. Selecting a value from the **Primary Use of Building** drop-down menu will calculate a **Contents Damage Value** based on a standard percentage for the primary use, multiplied by the Total BRV. The **Contents Damage Value** can be overridden if there are expensive contents, as in a manufacturing building with very expensive equipment. Unit 2- Supplemental Tools discusses calculation of displacement costs in greater detail.

Going back to the case study, select "Yes" again in the **Is the building residential?** data field.

The Street Maintenance Details section in the middle of the screen is explained by the Help topic Why are street maintenance costs treated as a benefit? The Help document explains that these data fields are applicable for “flood acquisition or relocation projects that allow a community to remove or abandon certain lengths of road and associated infrastructure.” Read the Help topic for complete details.

Select *Save and Continue*. The RESIDENTIAL STRUCTURE INFORMATION screen is displayed.



Screenshot 1.20: Residential Structure Information

The purpose of this screen is to select the appropriate DDF and determine the residential displacement costs.

On this screen, enter the following:

- In the **Depth Damage Function Type** data field, select “Default.”
- In the **Select Depth Damage Function** data field, select “USACE Generic.”
- Note that the **Current Federal Lodging Per Diem** data field is pre-filled with the FEMA standard value of $77.00 per day.
- Note that the **Current Federal Meals Per Diem** data field is pre-filled with the FEMA standard value of $46.00 per day.
- In the **Population Affected** data field, enter “2.” This is the number of people who live in the structure.
- Select the **NFIP** checkbox.

The important data fields on this screen are:

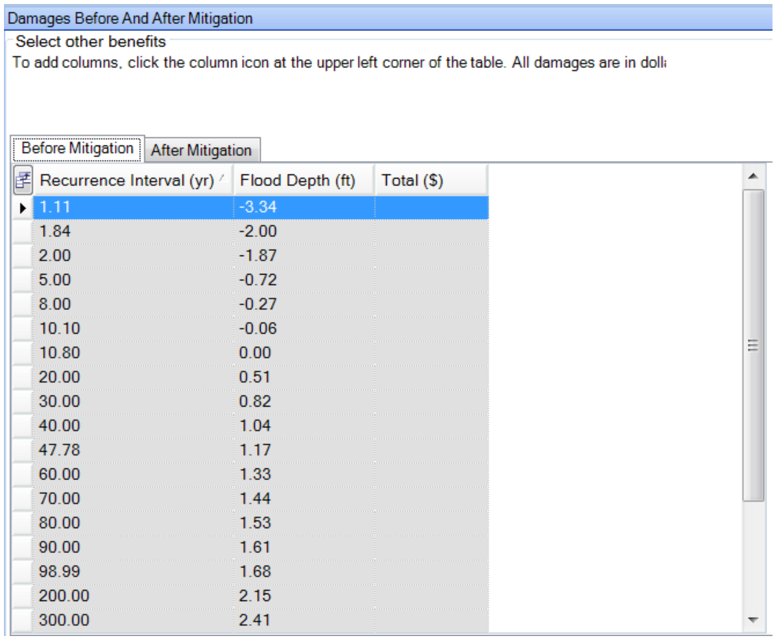
- **Depth Damage Function Type**
- **Current Federal Lodging Per Diem**
- **Current Federal Meals Per Diem**
- **NFIP**

DDFs take the flood depths that were calculated previously and bring in those percentages of BRV as damage. The vast majority of DDFs will be the U.S. Army Corps of Engineers (USACE) default.

The **Current Federal Lodging Per Diem** and the **Current Federal Meals Per Diem** data fields are used to calculate the residential displacement costs. This methodology is new in BCA Version 5.0. These data fields use the General Services Administration (GSA) rates to represent the additional out-of-pocket expenses that an individual or family will incur when displaced from their residence. The **Current Federal Meals Per Diem** is multiplied by the **Population Affected** value, which is the number of people who reside in the structure. The total food per diem is added to the lodging per diem to calculate the **Displacement Cost**. The Help topic How do I calculate residential displacement costs? provides users with links to websites for looking up the applicable GSA per diem rate for their location, and how to document any per diem calculations.

Another new benefit in BCA Version 5.0 is the **NFIP** checkbox. By checking this box, there are NFIP policy administration costs that are avoided for future claims and Increased Cost of Compliance (ICC). If the NFIP checkbox is selected, provide the NFIP policy number in the **Justification** data field as back-up documentation. The Help topic How do I calculate flood insurance administration benefits? provides more information.

Select *Save and Continue*. The DAMAGES BEFORE AND AFTER MITIGATION screen is displayed.



Recurrence Interval (yr)	Flood Depth (ft)	Total ($)
1.11	-3.34	
1.84	-2.00	
2.00	-1.87	
5.00	-0.72	
8.00	-0.27	
10.10	-0.06	
10.80	0.00	
20.00	0.51	
30.00	0.82	
40.00	1.04	
47.78	1.17	
60.00	1.33	
70.00	1.44	
80.00	1.53	
90.00	1.61	
98.99	1.68	
200.00	2.15	
300.00	2.41	

Screenshot 1.21: Damages Before and After Mitigation

The purpose of this screen is to allow users to input additional losses avoided with respect to flood depths. The values entered would be the damage class and dollar value of damage for a flood depth. Entering values on this screen allows for a more complete estimate of project benefits, and is really only done if the BCR is slightly below 1.00. The data can be obtained from the property owner and documentation to support the data must be provided—including insurance claims or repair records.

For this case study, there is no need to override the default values displayed. Select *Save and Continue*. The DAMAGE CALCULATION TABLE screen is displayed.

Damage Calculation Table

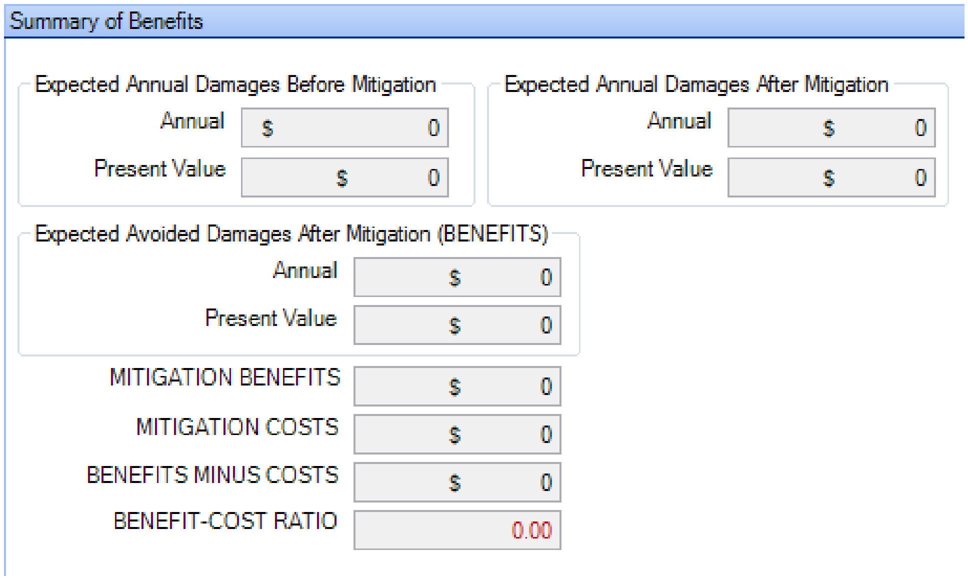
Damages Before Mitigation | Damages After Mitigation

Flood	Recurrence I	Building	Contents	Displacement	Loss Of Function	Other
-3.343	1.111	$0.00	$0.00	$0.00	$0.00	$0.00
-2.000	1.844	$758.00	$617.80	$0.00	$0.00	$0.00
-1.866	2.000	$6,498.14	$4,904.89	$0.00	$0.00	$0.00
-0.725	5.000	$2,037.65	$1,410.59	$0.00	$0.00	$0.00
-0.268	8.000	$766.16	$515.66	$0.00	$0.00	$0.00
-0.058	10.099	$194.02	$129.26	$0.00	$0.00	$0.00
0.000	10.795	$1,384.54	$902.27	$0.00	$0.00	$0.00
0.511	20.000	$593.59	$375.22	$2.48	$0.00	$0.00
0.825	30.000	$313.53	$194.79	$1.77	$0.00	$0.00
1.039	40.000	$158.64	$97.44	$1.03	$0.00	$0.00
1.169	47.781	$171.08	$104.04	$1.22	$0.00	$0.00
1.332	60.000	$98.17	$59.17	$0.76	$0.00	$0.00
1.440	70.000	$75.08	$44.96	$0.61	$0.00	$0.00
1.533	80.000	$59.37	$35.36	$0.50	$0.00	$0.00
1.615	90.000	$43.74	$25.94	$0.38	$0.00	$0.00
1.680	98.994	$231.95	$135.55	$2.22	$0.00	$0.00
2.149	200.000	$80.84	$46.33	$0.87	$0.00	$0.00
2.411	300.000	$41.98	$23.80	$0.48	$0.00	$0.00
2.593	400.000	$37.73	$21.20	$0.45	$0.00	$0.00
2.808	563.424	$303.48	$303.48	$3.30	$0.00	$0.00
	9999999.000					

Screenshot 1.22: Damage Calculation Table

The purpose of this screen is to show all calculated benefits on one screen—before and after mitigation. This is a summary screen, and there is nothing to calculate. The BCA Flood Module automatically populates the expected annual damages for a specific structure before and after mitigation based on the data users selected on the previous screens.

Select *Save and Continue*. The SUMMARY OF BENEFITS screen is displayed.



Screenshot 1.23: Summary of Benefits

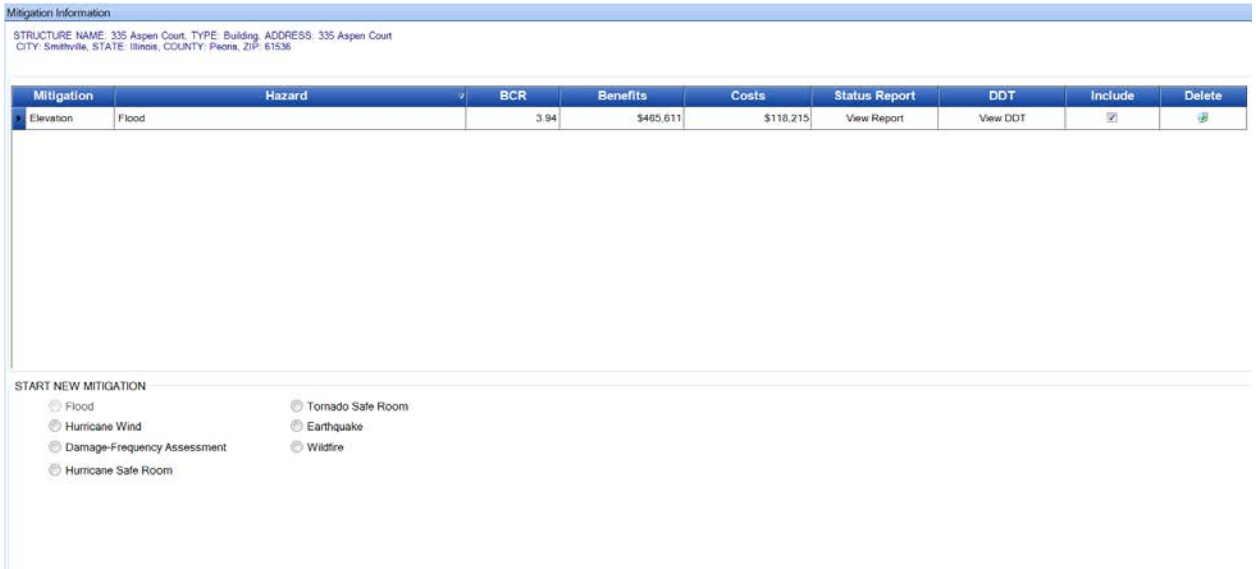
The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

The top section of the screen displays the **Expected Annual Damages Before Mitigation** and **Expected Annual Damages After Mitigation**. Remember from IS-0276 that all BCAs calculate damages twice—first looking at the current risk, or Before Mitigation, and the second looking at the impact of the project, or After Mitigation. In this section two values have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. These are the values in the **Annual** and **Present Value** data fields. The **Annual** data field shows the annualized damages—this means that, on average, there is that much expected damage before and after the project. The **Present Value** shows the impact of the net present value coefficient which, as explained in IS-0276, is automatically determined by the combination of the discount rate and the Project Useful Life of the project.

The next section of the screen—**Expected Avoided Damages After Mitigation (BENEFITS)**—shows the impact of the project. The **Annual** and **Present Value** values in this section are the difference between the two Before Mitigation and After Mitigation boxes. The Present Value is then used as the Benefits value—or the "B" in the "BCA."

In the bottom section of the screen, the **Mitigation Benefits** data field is filled in with the Present Value amount. The **Mitigation Costs** data field is filled in with the mitigation project cost previously entered in the COST ESTIMATE INFO screen. The value in the **Benefits Minus Costs** data field is the difference between the benefits and the costs. The important value—the **Benefit-Cost Ratio**—is the Benefits divided by the Costs.

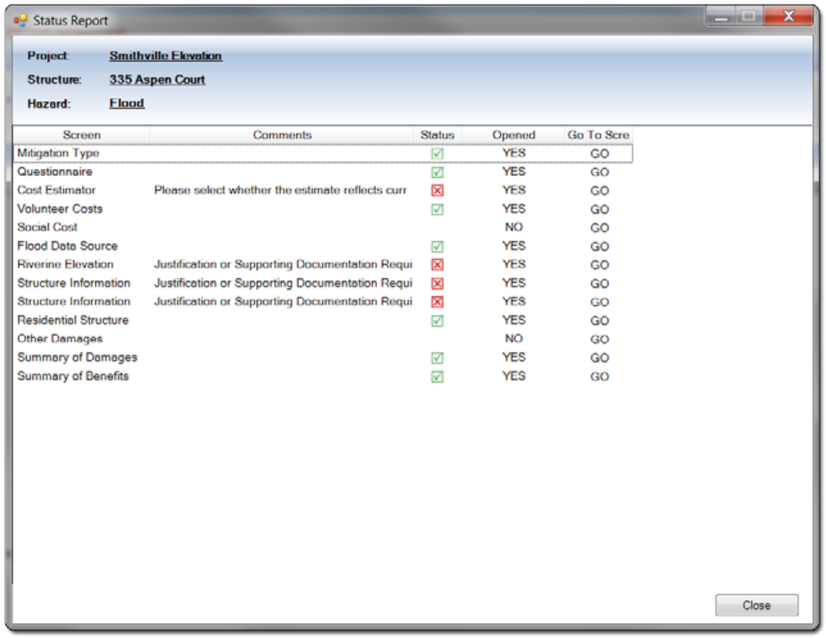
Select *Save and Continue*. The MITIGATION INFORMATION screen is displayed.



Screenshot 1.24: Mitigation Information

From this screen, users can start on another mitigation action for the same structure. An example would be completing a BCA of an acquisition/demolition project for the same structure.

The *View Report* link is also on this screen. Selecting this link displays a Status Report table.



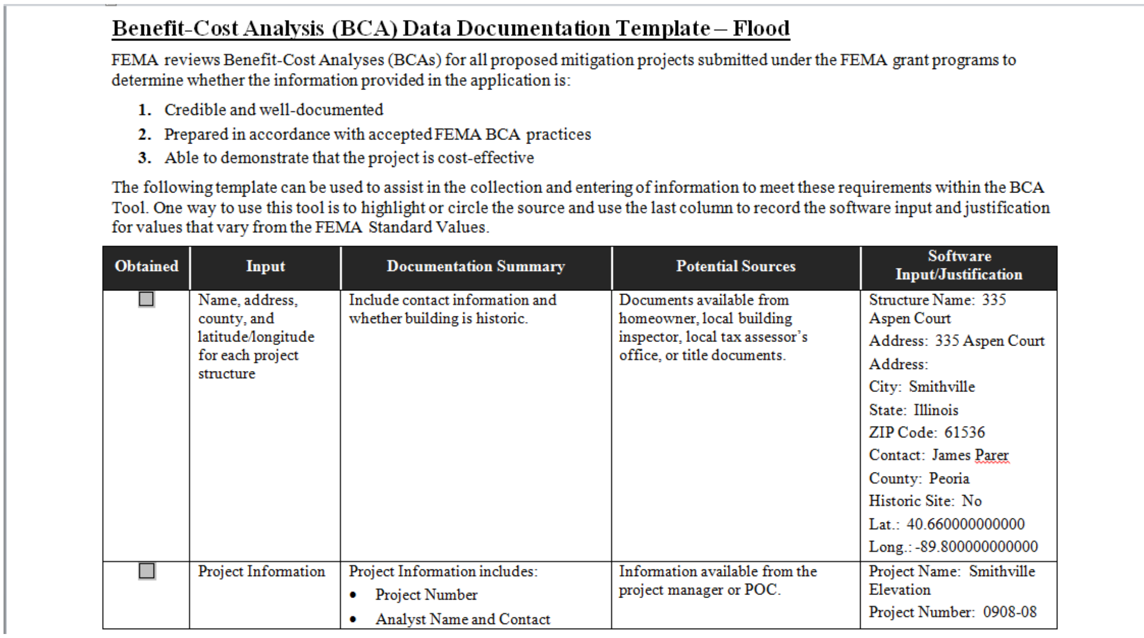
Screenshot 1.25: Status Report Table

The purpose of this table is to display the status of the documentation attached to the BCA. The first column lists the screen name, and the second column provides comments. The third column provides either a green check mark status or a red “X” status. The green check mark means that documentation has been attached. The red “X” means that documentation has not been attached. The fourth column displays “Yes” or “No,” depending on whether the screen has been opened or not. The final column displays the text “Go.” Selecting “GO” will display that screen so that documentation can be added.

Close the Status Report window. The MITIGATION INFORMATION screen is displayed again.

Screenshot 1.26: View Data Documentation Template (DDT)

On the MITIGATION INFORMATION screen, select *View DDT*. DDT stands for Data Documentation Template. The DDT is described next.



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

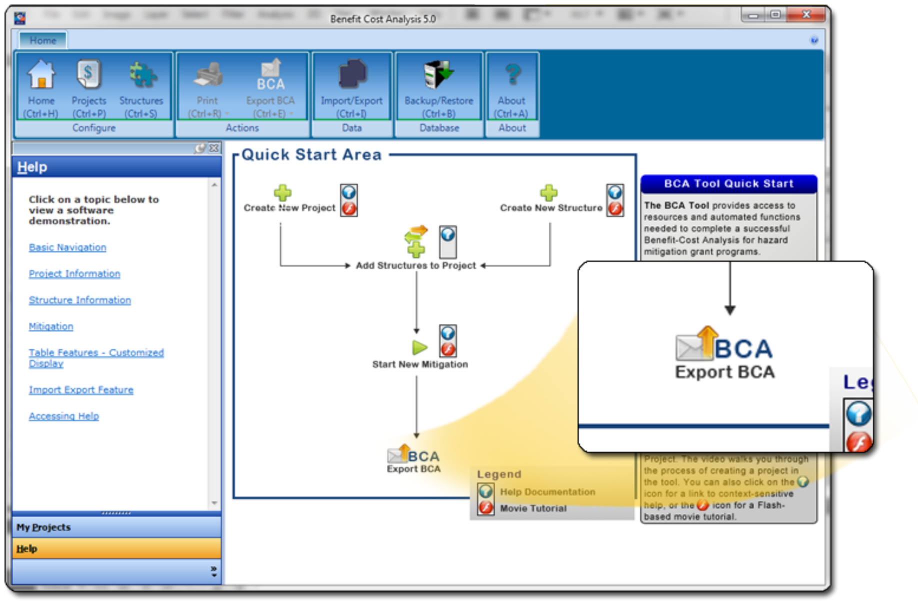
The following template can be used to assist in the collection and entering of information to meet these requirements within the BCA Tool. One way to use this tool is to highlight or circle the source and use the last column to record the software input and justification for values that vary from the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

Obtained	Input	Documentation Summary	Potential Sources	Software Input/Justification
☐	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: James Parer County: Peoria Historic Site: No Lat.: 40.660000000000 Long.: -89.800000000000
☐	Project Information	Project Information includes: • Project Number • Analyst Name and Contact	Information available from the project manager or POC.	Project Name: Smithville Elevation Project Number: 0908-08

Screenshot 1.27: Data Documentation Template

The Data Documentation template can be used as a guide in collecting information to meet the data and documentation requirements of the BCA Tool. It is important to note that these Data Documentation Templates (DDTs) are not required; however, some States are requiring these reports to be submitted along with the BCA.

It should also be noted that the “Potential Sources” of documentation is not intended to be exhaustive, and other sources are certainly possible—those listed are merely the most common documentation sources. Contact the State, Tribal and Region Office for determination of acceptable documentation.



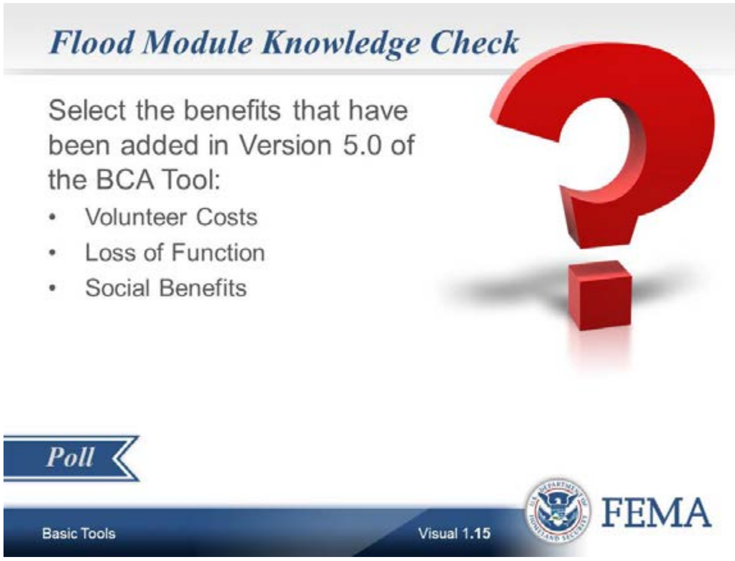
Screenshot 1.28: Export the BCA

Steps One through Four of the BCA process are now complete. To complete Step Five: Export the BCA, do the following steps:

- Select *Home* on the basic navigation toolbar. The Quick Start Area is displayed.
- Select the Export BCA icon in the diagram. A list of the projects that have been created is displayed.
- Select "Smithville Elevation" as the project to export. The Windows Explorer dialog box is displayed. Note that the file type is ".zip" by default.
- In the **File Name** field, enter "Smithville_Elevation."
- Save the zip file to the desired location in the computer.

The export file will be used by other analysts or reviewers to evaluate the data entered in the completed BCA, the justification and documentation that was included and the final BCR.

This ends the Flood Module walkthrough. Review the content covered by answering the knowledge check questions.



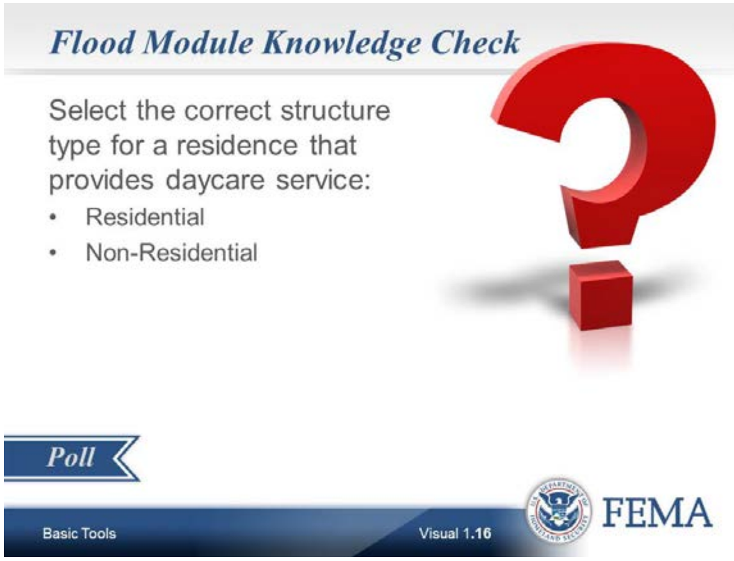
Visual 1.15: Flood Module Knowledge Check

Answer the following knowledge check:

Select the benefits that have been added in Version 5.0 of the BCA Tool. Select more than one.

- Volunteer Costs
- Loss of Function
- Social Benefits

Write the correct answer below.



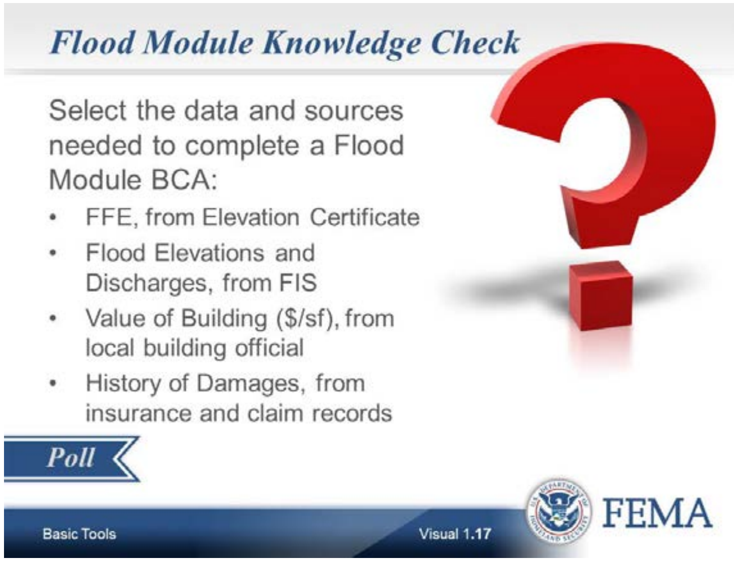
Visual 1.16: Knowledge Check

Answer the following knowledge check:

The property owner's residence is used both as a living space and a daycare. Select the correct structure type for the property.

- Residential
- Non-Residential

Write the correct answer below.



Visual 1.17: Knowledge Check

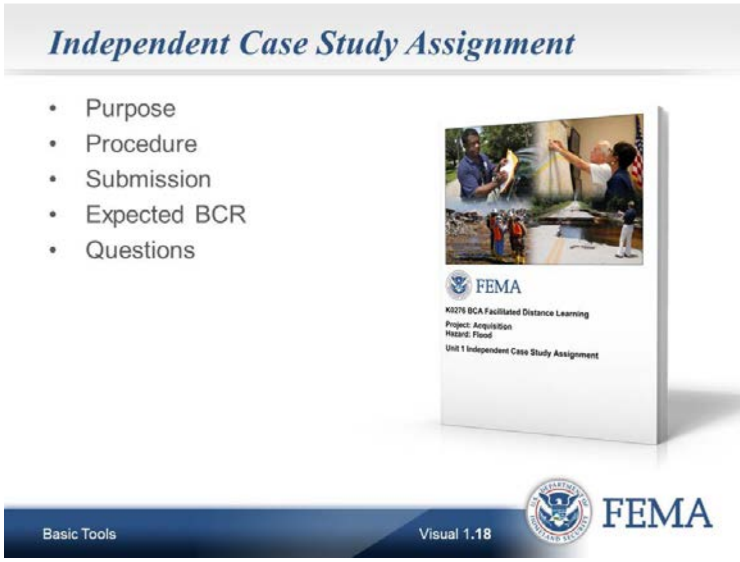
Answer the following knowledge check:

Select the data and sources needed to complete a Flood Module BCA.

- FFE, from Elevation Certificate
- Flood Elevations and Discharges, from FIS
- Value of Building ($/sf), from local building official
- History of Damages, from insurance and claim records

Write the correct answer below.

Independent Case Study Assignment



Visual 1.18: Independent Case Study Assignment

Purpose
The purpose of this activity is to provide participants the opportunity to become more familiar with the Flood Module of the BCA Tool and to put into practice the skills and knowledge learned in Unit 1 - Basic Tools.

Procedure
Working independently, participants will complete a BCA of the Independent Case Study Assignment. The case study document was downloaded together with the participant materials. The document is also available in the File Share Pod.

Procedure for Completing the Independent Case Study Assignment:

1. Using the information provided in the case study document, complete the BCA using the Flood Module.
2. At the end of the analysis, export the BCA into a zip file, with the participant's last name included in the file name.
3. Submit that zip file in the File Share Pod by midnight Pacific Time the night before Unit 2.
4. Note that the final BCR of the case study is expected to be somewhere between 0.9 and 1.1.)

Questions
Post any questions that may arise while completing the case study assignment in the Adobe Connect training room. The training room will stay open and available. Questions will be answered publicly to help all participants complete the assignment.

Summary

Visual 1.19: Summary

Unit 1 – Basic Tools covered the following topics:

- Review of basic BCA theory and flood concepts learned in IS-0276.
- Discussion of basic features of the BCA Tool.
- Identification of the different mitigation activities available in the Flood Mitigation Type screen.
- Completion of a Flood Module BCA using the case study walkthrough.
- Completion of an independent case study assignment.

Unit 2
Supplemental Tools

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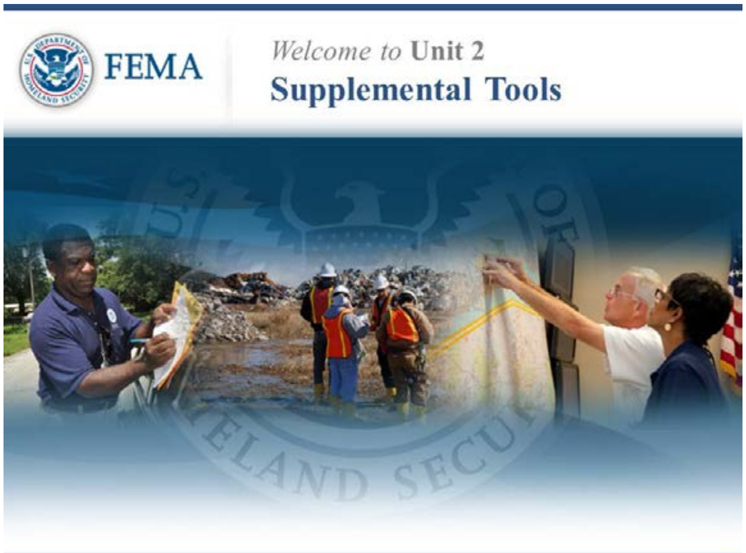
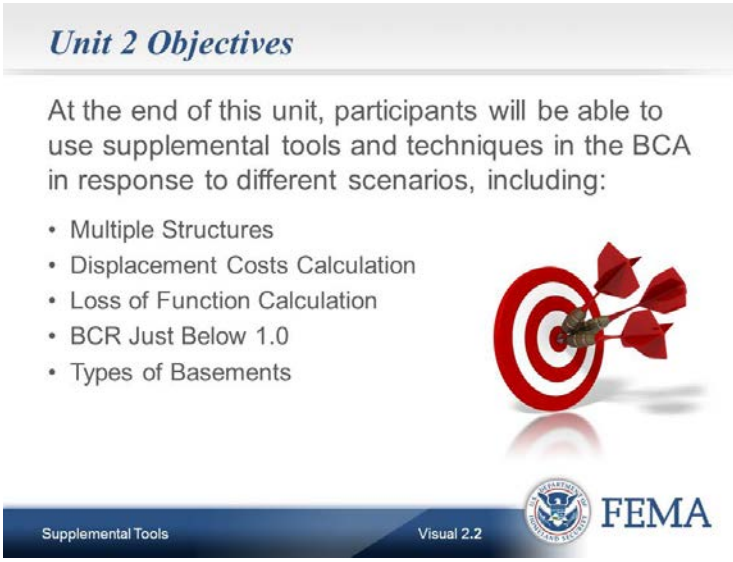
Unit 2 Overview



Visual 2.1: Unit 2 – Supplemental Tools

Welcome to Unit 2 of the Benefit-Cost Analysis: Entry Level course, which covers Supplemental Tools. This unit will take approximately 120 minutes.

The answer key for the Unit 1 Independent Case Study Assignment is needed for this unit.

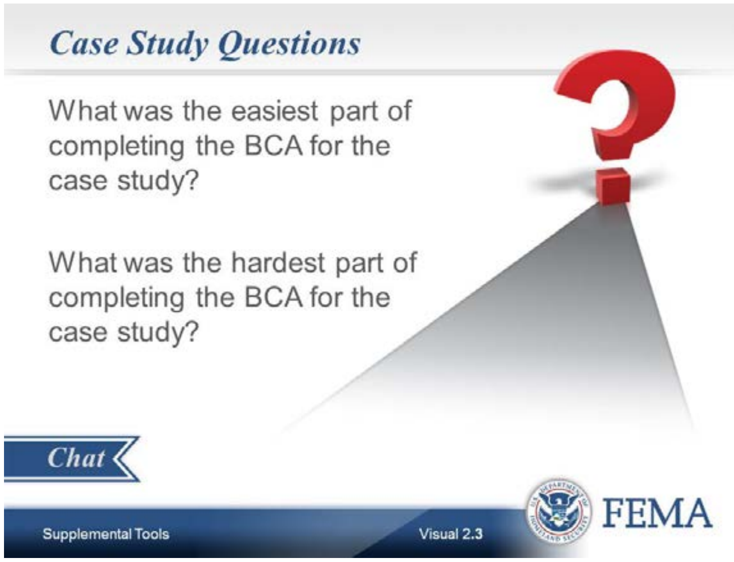


Visual 2.2: Unit 2 Objectives

Unit 1 covered completing a BCA using the Flood Module and an independent Flood Module case study assignment. The purpose of Unit 2 is to learn supplemental tools needed to complete more complicated analyses. The objectives are for participants to use supplemental tools and techniques in the BCA Tool in response to different scenarios, including:

- Multiple Structures
- Displacement Costs Calculation
- Loss of Function (LOF) Calculation
- BCR Just Below 1.0
- Types of Basements

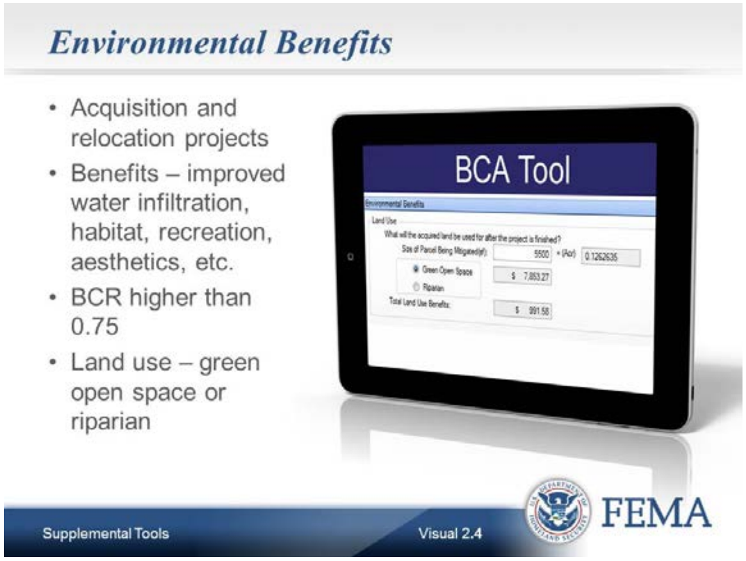
Debrief of Unit 1 Independent Case Study



Visual 2.3: Case Study Questions

The question for participants whose last name starts with the letters A to M is: What was the easiest part about completing the BCA for the case study?

The question for participants whose last name starts with the letters N to Z is: What was the most difficult part about completing the BCA for the case study?



Visual 2.4: Environmental Benefits

The Unit 1 Independent Case Study Assignment involved developing a BCA for a residential acquisition.

In the BCA for the Unit 1 Independent Case Study Assignment was a screen about environmental benefits. This is a new benefit for Version 5.0 of the BCA Tool that was not apparent in the Unit 1 Smithville case study walkthrough because that was an elevation project. Environmental benefits apply only to acquisition and relocation projects because of the improvement in the natural environment that comes from a change from developed to undeveloped land use. These benefits include improved water infiltration, habitat, recreation, aesthetics and more.

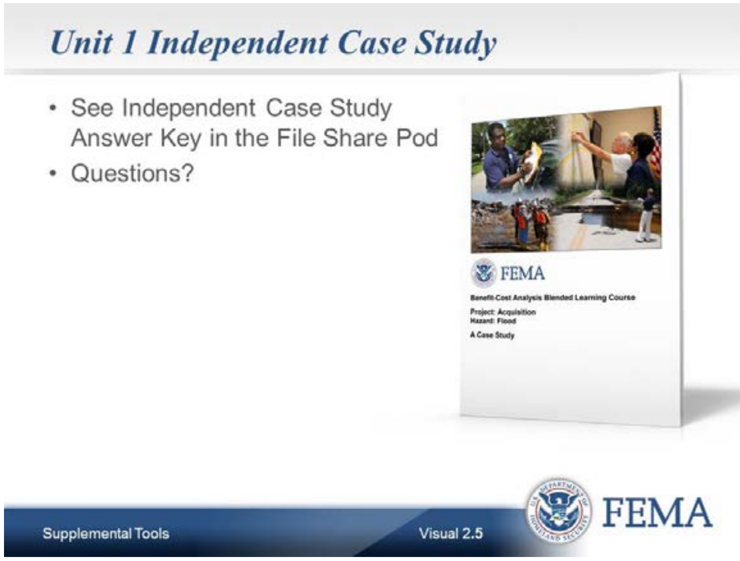
Environmental benefits can only be considered in the BCA calculation if the structure BCR is higher than 0.75; this is because FEMA's primary authorization for mitigation is to reduce damage, but reducing damage can also bring environmental improvements. In the tool, environmental benefits are calculated based on the size of the parcel to be mitigated and how it will be used.

There are two types of land use to choose from: green open space or riparian. Each has a standard benefits value associated with it. This value is then multiplied by parcel size to determine an annual estimated environmental benefit that the cleared parcel will provide.

For the Unit 1 Independent Case Study Assignment, the parcel size was 5,500 square feet, and the project sponsor was planning to keep the acquired parcel as green open space. The parcel size and post-project land use (green open space or riparian) are the critical inputs, and both require documentation.

Refer to the Help content for more detailed information about environmental benefits and their use in the BCA Tool.

Next is the review of the independent case study.



Visual 2.5: Unit 1 Independent Case Study

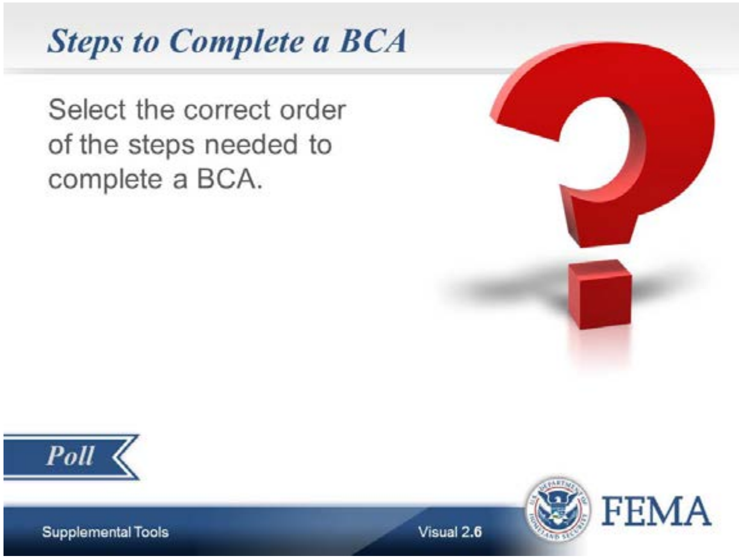
The task was to develop a BCA for a residential acquisition using the Flood Module.

The BCR was 0.97.

The answer key shows the Summary of Benefits.

This project would not be approved because the BCR is less than one. Later slides will explore the different items to check in the analysis to see if the BCR can be brought to 1.0 or greater.

Supplemental Tools



Visual 2.6: Steps to Complete a BCA

Answer the following review question:

Which of the following answers show the steps in the right order for creating a BCA?

- Import BCA, create new structure, add structures to project, create new project, start new mitigation.
- Start new mitigation, create new project, import structures to the project, export BCA, create new project.
- Create new project, create new structure, add structures to project, start new mitigation, export BCA.
- Add structures to the project, export BCA, create new project, start new mitigation, create new structure.

Write the correct answer below.

Visual 2.7: Supplemental Tools

The five techniques listed on this visual that will be covered in this unit will allow for completing more complicated analyses using the BCA Tool. These techniques will help ensure that all of the benefits when analyzing the cost effectiveness of a mitigation project have been fully captured and counted

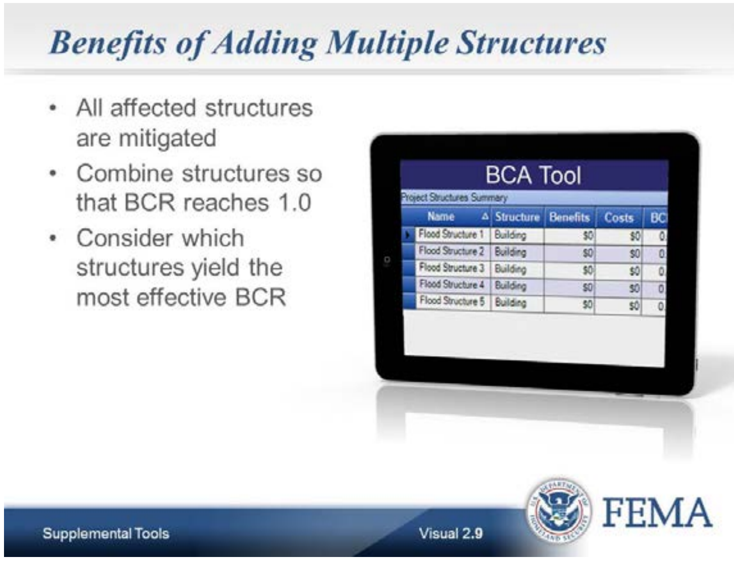
These techniques are used in response to different scenarios, including:

- Multiple Structures
- Displacement Costs Calculation
- Loss of Function (LOF) Calculation
- BCR Just Below 1.0
- Types of Basements

Visual 2.8: Multiple Structures

The first supplemental tool that will be covered is how to add multiple structures. As an example, imagine there are 10 homes that need to be acquired or elevated in a flood-prone area. All 10 homes must be associated into one project.

Associating all the structures into a single project allows for calculating the benefits and costs for all of the structures included in that project.



Visual 2.9: Benefits of Adding Multiple Structures

The benefits are:

- All the structures affected by the hazard are mitigated.
- Structures that cannot be stand-alone projects are combined with structures so that the project BCR reaches 1.0.
- Structures that yield the most effective BCR are used.

Multiple structures can easily be imported into the tool, and this technique can be used in all of the BCA modules.

The BCA from the Unit 1 Independent Case Study Assignment will be used as a reference to illustrate how to add multiple structures.

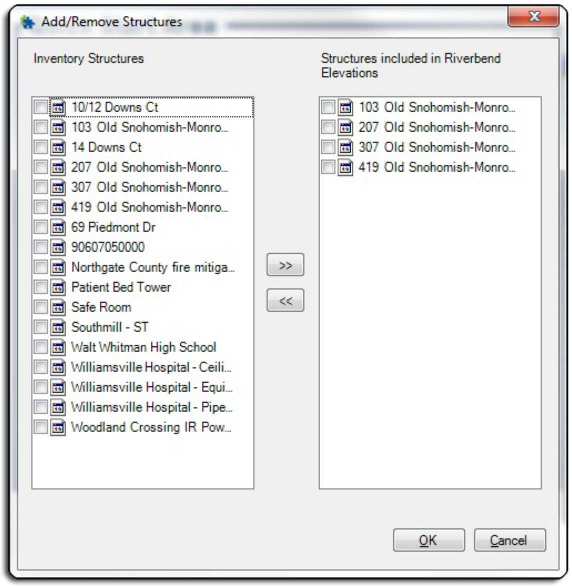
PROJECT INVENTORY

Project Name	BCR	Costs	Benefits	Is Active	Delete
Earthquake	0.00				
Harold County Hospital	0.00				
DFA	0.00	$0	$0		
Flood	0.00	$0	$0		
HWSR	0.00	$0	$0		
Smithville Elevation	0.00	$0	$0		
Wildfire	0.00	$0	$0		
Walden Mitigation	0.00	$0	$0		

Screenshot 2.1: Project Inventory

The first way to add multiple structures is to:

- Select the Projects icon on the navigation toolbar at the top of the screen.
- The PROJECT INVENTORY screen is displayed with a list of projects.
- Double click on the project on the PROJECT INVENTORY screen.



Screenshot 2.2: Add/Remove Structures

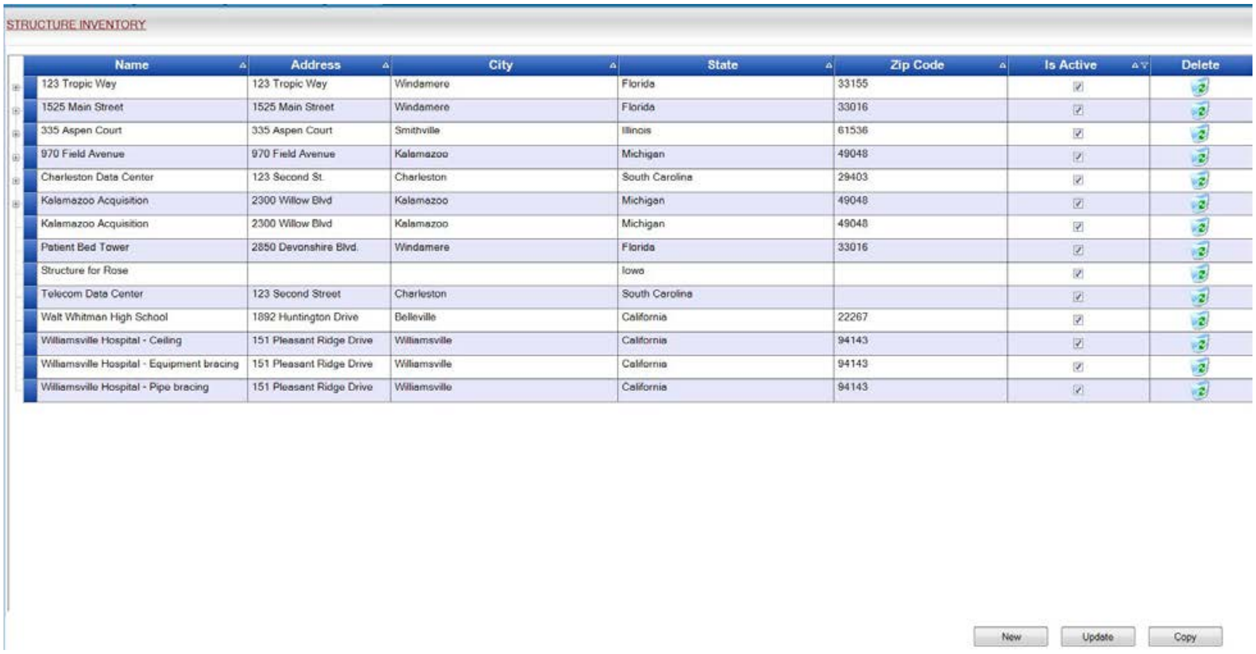
- Under the PROJECT NAME screen, select *Add/Remove Structures.*
- Select multiple structures from the Inventory Structure.
- Select the arrow, and then the structures will be associated with the project.
- Select *OK*.

Screenshot 2.3: Importing Structure Data

The second way to add multiple structures is when structures are already listed in a table.

- Select the Import/Export Tab at the top of the screen.
- Select the Structure Import Tab.
- Select *Open Excel File.*
- The next step would then be to browse the computer to find the location of the Excel file with the structures.
- Select *Column Mapping* and map the columns from the file to the BCA Tool columns.
- Select *Import*.
- Make sure that the structure file has all of the needed field headings in the first row.

Note that clicking on the Import Flood Project tab accesses an import template that has been designed to import multiple structures for a flood mitigation project. The fields in the Excel spreadsheet contain structure information and the flood data inputs for each structure. These inputs were covered in Unit 1.



STRUCTURE INVENTORY

Name	Address	City	State	Zip Code	Is Active	Delete
123 Tropic Way	123 Tropic Way	Windamere	Florida	33155	☑	
1525 Main Street	1525 Main Street	Windamere	Florida	33016	☑	
335 Aspen Court	335 Aspen Court	Smithville	Illinois	61536	☑	
970 Field Avenue	970 Field Avenue	Kalamazoo	Michigan	49048	☑	
Charleston Data Center	123 Second St.	Charleston	South Carolina	29403	☑	
Kalamazoo Acquisition	2300 Willow Blvd	Kalamazoo	Michigan	49048	☑	
Kalamazoo Acquisition	2300 Willow Blvd	Kalamazoo	Michigan	49048	☑	
Patient Bed Tower	2850 Devonshire Blvd.	Windamere	Florida	33016	☑	
Structure for Rose			Iowa		☑	
Telecom Data Center	123 Second Street	Charleston	South Carolina		☑	
Walt Whitman High School	1892 Huntington Drive	Belleville	California	22267	☑	
Williamsville Hospital - Ceiling	151 Pleasant Ridge Drive	Williamsville	California	94143	☑	
Williamsville Hospital - Equipment bracing	151 Pleasant Ridge Drive	Williamsville	California	94143	☑	
Williamsville Hospital - Pipe bracing	151 Pleasant Ridge Drive	Williamsville	California	94143	☑	

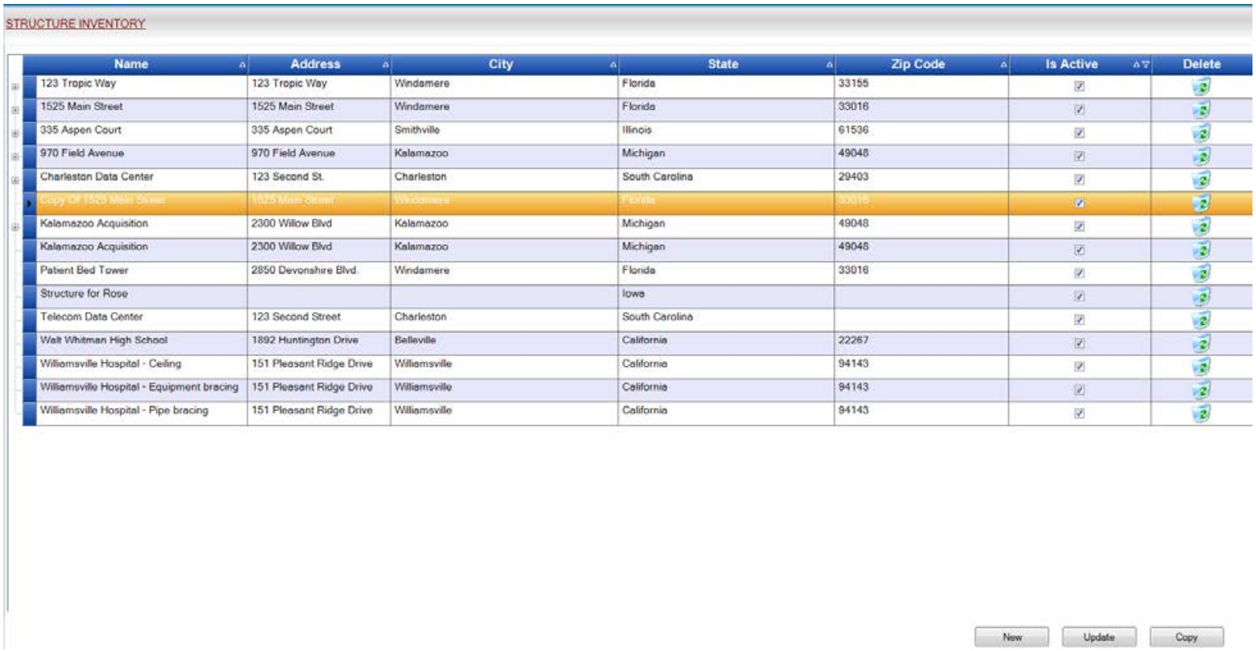
New Update Copy

Screenshot 2.4: Copy a Structure

In some situations, there is a need to add structures that have very similar data to an existing structure in the Structure Inventory. The BCA Tool allows users to make a copy of the existing structure, and then update that copy by changing only the information that needs to be changed.

To make a copy of a structure, complete the following steps:

- Select the Structures icon on the basic navigation toolbar. The STRUCTURE INVENTORY screen is displayed.
- Select the structure that needs to be copied.
- Select the *Copy* button on the bottom right of the screen. The Structure successfully copied! message is displayed.
- The copied structure is now listed in the STRUCTURE INVENTORY screen.



STRUCTURE INVENTORY

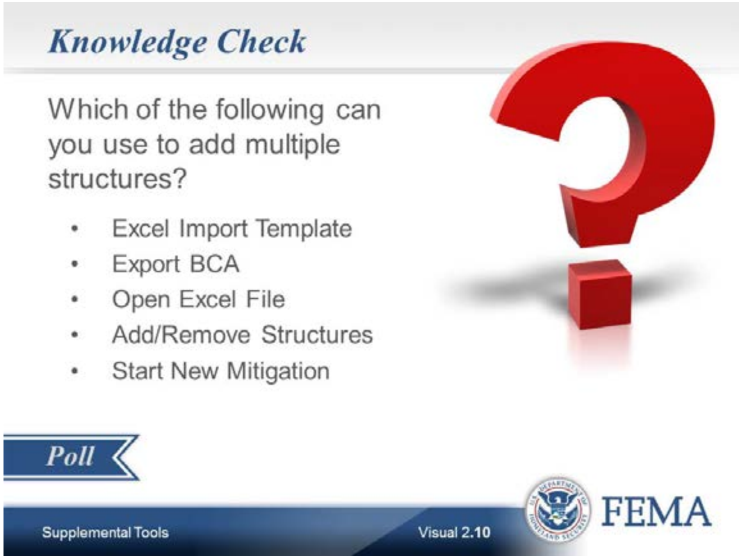
Name	Address	City	State	Zip Code	Is Active	Delete
123 Tropic Way	123 Tropic Way	Windamere	Florida	33155		
1525 Main Street	1525 Main Street	Windamere	Florida	33016		
335 Aspen Court	335 Aspen Court	Smithville	Illinois	61536		
970 Field Avenue	970 Field Avenue	Kalamazoo	Michigan	49048		
Charleston Data Center	123 Second St.	Charleston	South Carolina	29403		
Copy Of 1525 Main Street	1525 Main Street	Windamere	Florida	33016		
Kalamazoo Acquisition	2300 Willow Blvd	Kalamazoo	Michigan	49048		
Kalamazoo Acquisition	2300 Willow Blvd	Kalamazoo	Michigan	49048		
Patient Bed Tower	2850 Devonshire Blvd.	Windamere	Florida	33016		
Structure for Rose			Iowa			
Telecom Data Center	123 Second Street	Charleston	South Carolina			
Walt Whitman High School	1892 Huntington Drive	Belleville	California	22267		
Williamsville Hospital - Ceiling	151 Pleasant Ridge Drive	Williamsville	California	94143		
Williamsville Hospital - Equipment bracing	151 Pleasant Ridge Drive	Williamsville	California	94143		
Williamsville Hospital - Pipe bracing	151 Pleasant Ridge Drive	Williamsville	California	94143		

New Update Copy

Screenshot 2.5: Update a Structure

To update the copied structure, complete the following steps:

- Select the copied structure in the STRUCTURE INVENTORY screen.
- Select the *Update* button on the bottom right of the screen. The ADD/UPDATE STRUCTURE screen is displayed.
- Edit the data fields that need to be changed and then select *Save*. The Structure saved successfully! message is displayed.



Visual 2.10: Knowledge Check

Answer the following knowledge check:

Which of the following can be used to add multiple structures? (More than one answer can be correct.)

- Excel Import Template
- Export BCA
- Open Excel File
- Add/Remove Structures
- Start New Mitigation

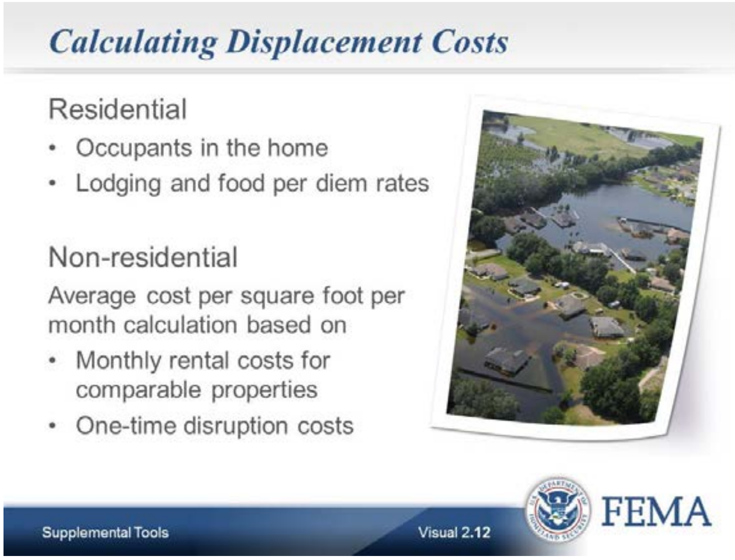
Write the correct answer below.

Visual 2.11: Displacement Costs Calculation

The second supplemental tool is calculating displacement costs.

Displacement costs are the extra costs incurred when occupants of a residence are displaced to temporary quarters due to a hazard event (e.g., hurricanes, flooding, wildfire, earthquake, tornado, etc.). Displacement occurs only when damages to a structure are sufficiently severe that the structure cannot be repaired with the occupants in place.

Displacement costs may be incurred for residential, commercial or public buildings, but the methodology is different for residential and non-residential buildings.



Visual 2.12: Calculating Displacement Costs

Residential displacement costs are determined by the number of occupants in the home and by the lodging and food per diem rates for the location.

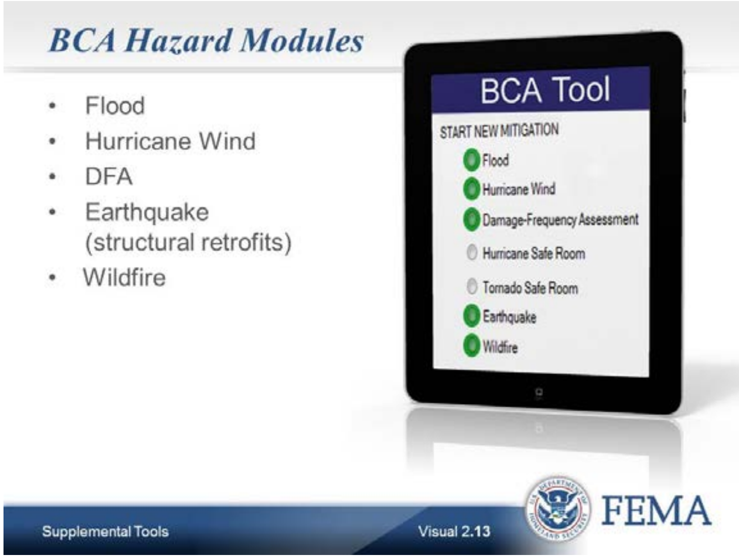
This is a new methodology in Version 5.0 of the BCA Tool. In Version 4.8, the methodology used an average cost per square foot per month calculation. That method is still used for non-residential buildings.

For non-residential buildings, displacement costs are based on:

- Monthly rental costs for comparable housing/ building space, and
- One-time disruption costs.

The goal is to account for all benefits for a project, and there is no FEMA standard value for non-residential buildings. If the displacement costs are high, then this may assist in raising the BCR to 1.0 or above.

Displacement costs are the costs incurred when building occupants are displaced to temporary quarters so that repairs can be made. Although they are referred to as costs, in this instance, the avoidance of displacement is counted as an expected benefit of the mitigation project.



Visual 2.13: BCA Hazard Modules

The new residential displacement methodology is used in the Flood, Hurricane Wind, DFA, structural retrofits in Earthquake and Wildfire Modules.

Visual 2.14: Launching the BCA Tool

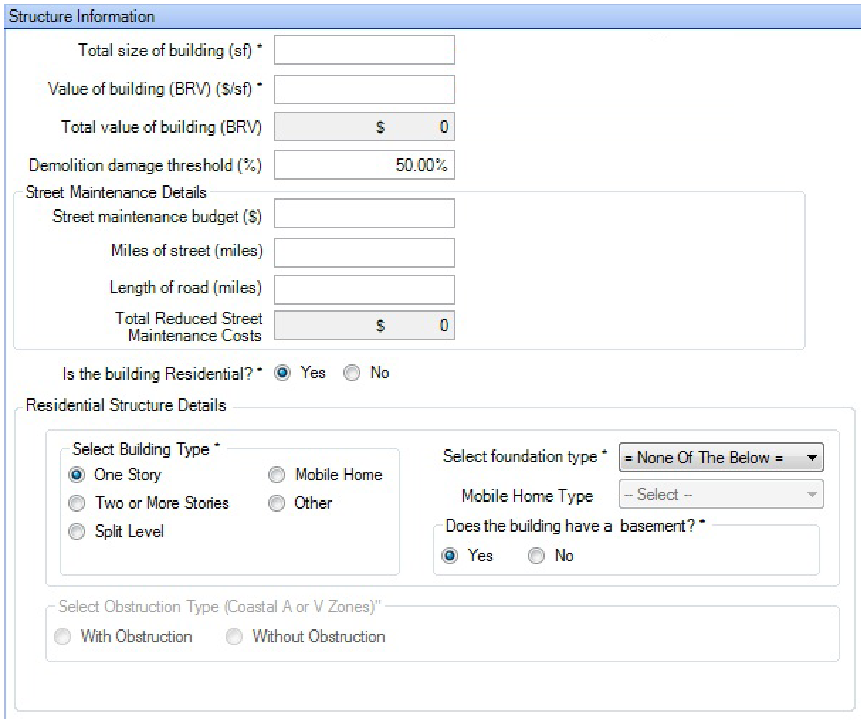
Launch the BCA tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, let the host know using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics

Open the BCA for the Unit 1 Independent Case Study Assignment.

Confirm that the values related to displacement costs already there from the independent case study assignment are correct.



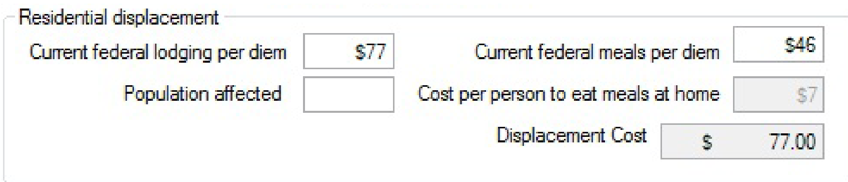
Screenshot 2.6: Structure Information

Before calculating displacement costs for residential buildings, confirm that the BCA Tool has the following Structure Information from the case study. If not, change the values during the review:

- **Total size of the building (sf)** data field**, "1,240."**
- **Value of building (BRV) ($/sf)** data field, "92."
- **Is the building Residential?** data field, "Yes."

After "Yes" is selected, the screen will generate the **Residential Structure Details** data field.

- For **Select Building Type** data field, the value should be "One Story."
- "Yes" for the question **Does the building have a basement?**
- Select Save and Continue.



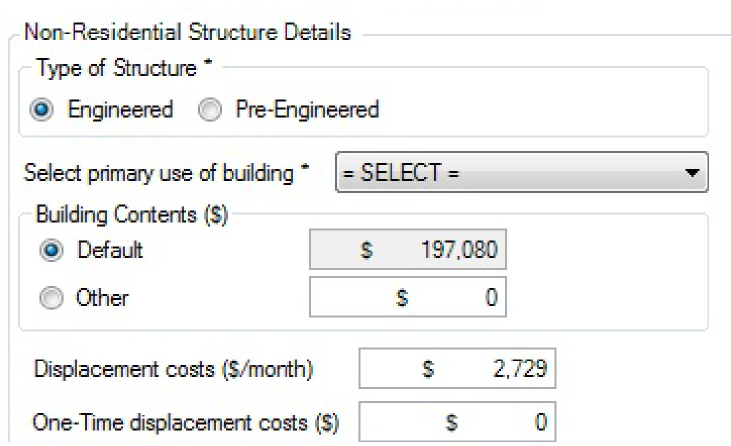
Screenshot 2.7: Residential Structure Information

Select the Help topic for the steps on how to calculate residential displacement costs. This step-by-step example contains all of the values needed for making the calculations. Confirm the following information.

- For the **Current federal lodging per diem** data field**,** “$77” is the FEMA standard value that is automatically generated.
- For the **Current federal meals per diem** data field, “$46” is the FEMA standard value that is automatically generated.
- For the **Population affected** data field, it should read “1.”

Change the value in the **Population affected** data field to “4.” Notice how that immediately changes the value in the **Displacement Cost** data field.

Change the number back to “1” in the **Population affected** data field. Select *Save and Go Back* .



Screenshot 2.8: Non-Residential Structure

When calculating displacement for a non-residential building, select “No” for the **Is the building residential?** data field on the STRUCTURE INFORMATION screen. After selecting “No,” select “Retail Furniture” for the **Select primary use of building** data field. The screen will then generate the values to enter in the Non-Residential Structure Details section of the screen that will include the **Displacement costs** data field and the **One-Time displacement costs** data field. Note that the contents value for non-residential structures is determined by selecting “Default,” which then provides a standard value for the **Primary Use of Building** data field. This value can be overridden with a dollar value of contents with supporting documentation like insurance records.

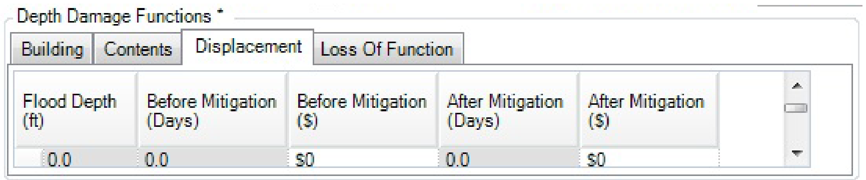
Under Help, these topics explain how to calculate non-residential displacement costs:

- How do I calculate monthly displacement (rental) costs?
- How do I calculate one-time displacement costs?

A step-by-step example has all the values needed for making the calculations.

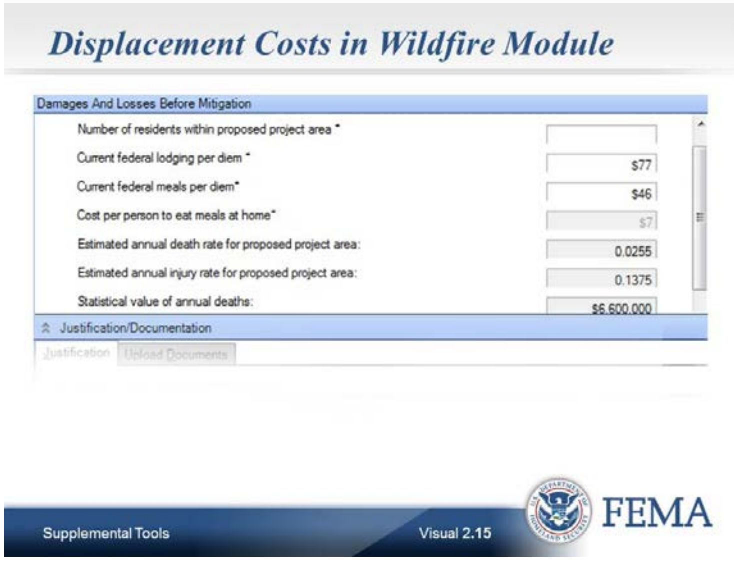
In the STRUCTURE INFORMATION screen, select *Save and Continue.*

Note that if “Default” was selected as the Depth Damage Function Type**,** then the tool will generate calculations for displacement based on the DDF.



Screenshot 2.9: Non-Residential Structure

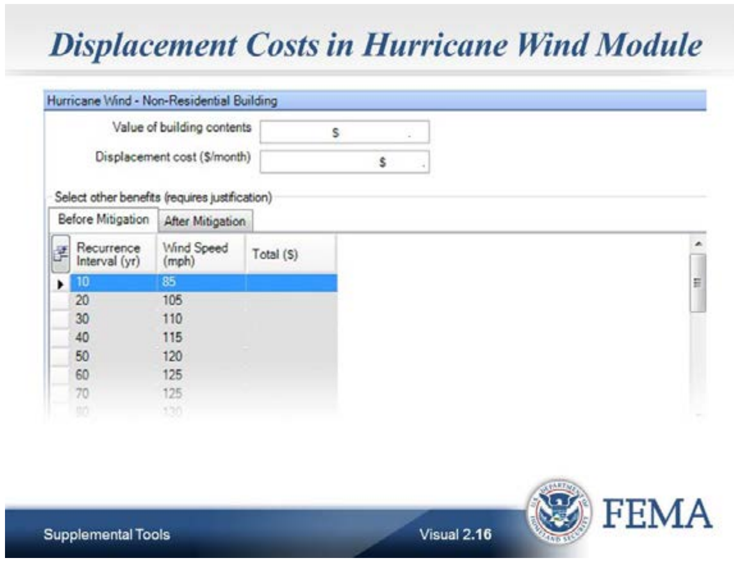
If “Custom” is selected as Depth Damage Function Type, then values can be entered for non-residential displacement on this screen. However, documentation of those values from a reliable and competent source would be needed.



Visual 2.15: Displacement Costs in Wildfire Module

In the Wildfire Module, the DAMAGES AND LOSSES BEFORE MITIGATION is used to calculate displacement costs.

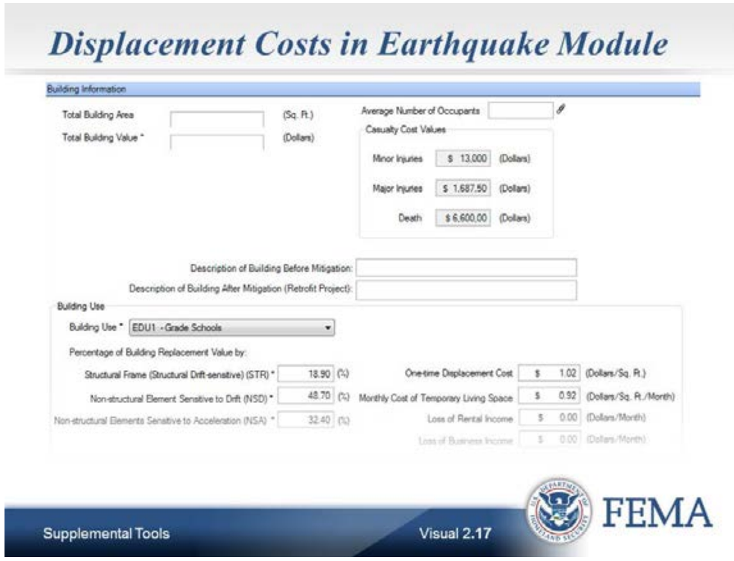
- The number of residents is added.
- The number of residents will then drive the displacement costs based on the Federal lodging and meals per diem rates.
- The Help section for this screen has more information about Federal lodging and meal rates.



Visual 2.16: Displacement Costs in Hurricane Wind Module

The Hurricane Wind Module follows a similar process to the Flood Module for calculating displacement costs. The screen is called HURRICANE WIND – NON-RESIDENTIAL BUILDING.

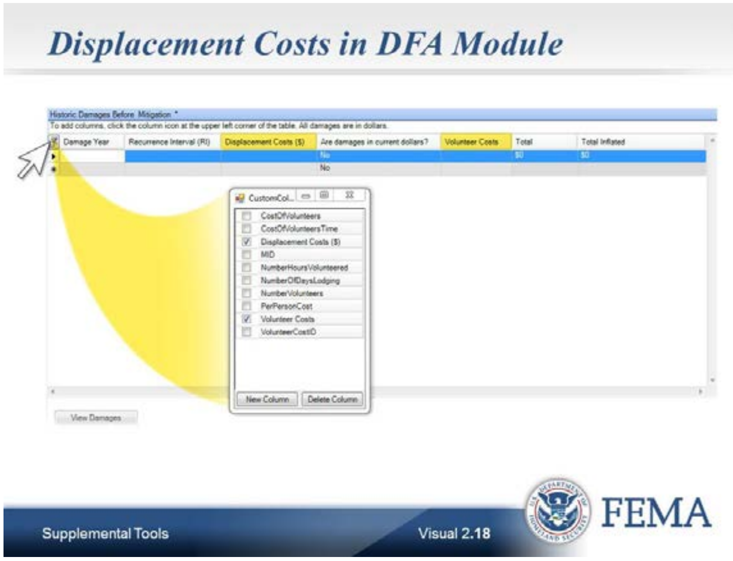
- There is no **One-Time displacement costs** data field for non-residential displacement, but this cost can be added a different way.
- For a step-by-step explanation of how to add displacement and one-time displacement costs in the BCA Tool for the Hurricane Wind Module, select the Help topic for calculating displacement costs for a non-residential building.



Visual 2.17: Displacement Costs in Earthquake Module

In the Earthquake Module, the BUILDING INFORMATION screen is used to calculate displacement costs.

Once the **Building Use** for the project is chosen, the displacement costs are automatically calculated based on the selection. These values can be overridden by directly changing the values in the boxes, with appropriate documentation.



Visual 2.18: Displacement Costs in DFA Module

In the DFA Module, displacement costs are calculated on the HISTORIC DAMAGES BEFORE MITIGATION screen. Unit 3 will cover the DFA Module and displacement costs in more detail.

For all the applicable hazards in the DFA Module, displacement costs can be added to the calculation by selecting the column icon at the upper left corner of the table.

- Select *New Column* and name it “Displacement Costs.”
- Calculate the displacement costs for each damage year listed.

Visual 2.19: Displacement Costs Help Content

For residential displacement costs in the DFA module, select the Help topic for the steps in calculating those costs. This step-by-step example contains all of the values required for making the calculations.

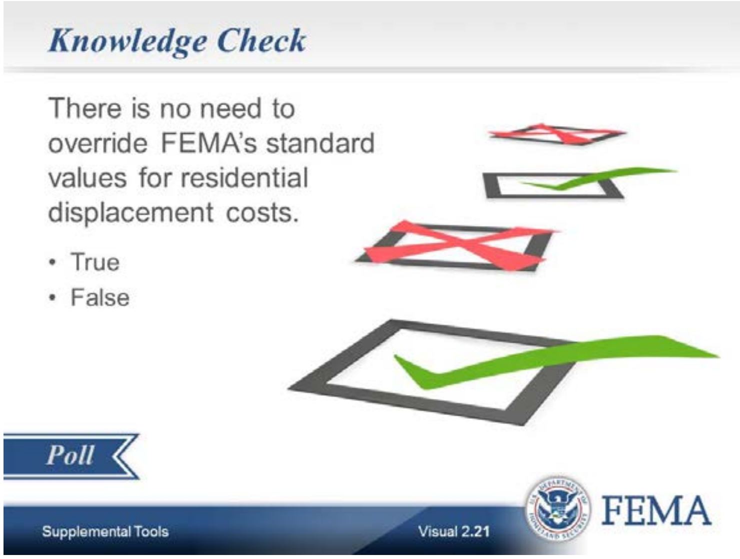
For non-residential displacement costs in DFA, the subapplicant has to find out what the facility's actual rental and relocation costs were for each listed event. Then those costs are entered in the Displacement Costs column for each damage year.

Visual 2.20: Standard Values for Displacement Costs

Generally, there is no need to override the FEMA standard values for residential displacement costs unless the local values are higher than those values. If the values are higher, then the subapplicant will need to include documentation from a reliable and competent source.

FEMA provides standard values for calculating the Non-Residential Displacement Costs that are explained in detail in the Help content.

- In lieu of those FEMA standard values, local rental rates may be used for the analysis, but they must be documented.
- Acceptable documentation includes copies of advertisements for local rentals, records of telephone contacts with rental agencies, receipts from rentals of the same usage type (residential, commercial, etc.) and similar items.

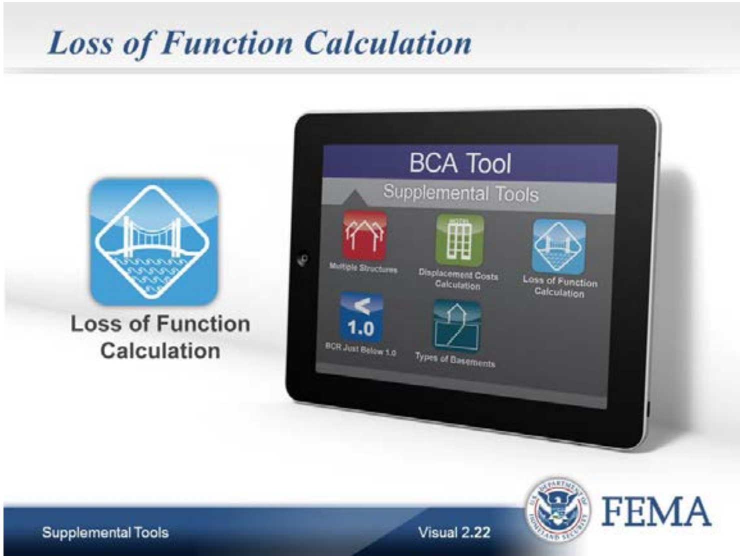


Visual 2.21: Knowledge Check

Answer the following knowledge check.

There is no need to override FEMA standard values for residential displacement costs.
True or False?

Write the correct answer below.



Visual 2.22: Loss of Function Calculation

The third supplemental tool relates to Loss of Function, or LOF, calculations. People who are new to mitigation may not have experience in addressing LOF in a BCA.

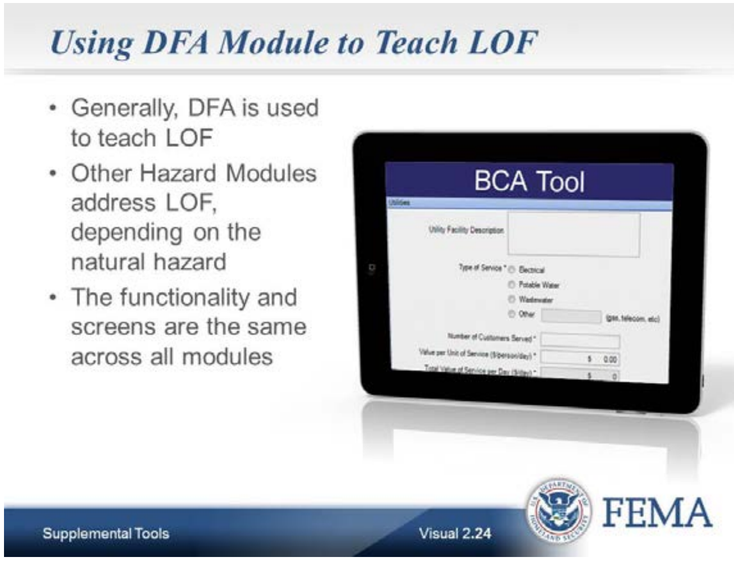
Visual 2.23: Calculating Loss of Function (LOF)

When mitigation prevents a loss of service from police, firefighters or a utility, or keeps a road open when it otherwise would have been washed out, these constitute future benefits arising from the mitigation activity. People who know that loss of function can be added to a BCA may not know how to calculate it or which BCA modules include an LOF calculation.

This supplemental tool can be used when any natural hazard causes an LOF to:

- Critical facilities (i.e., fire stations, hospitals, police stations or other);
- Roads;
- Bridges; or
- Utilities.

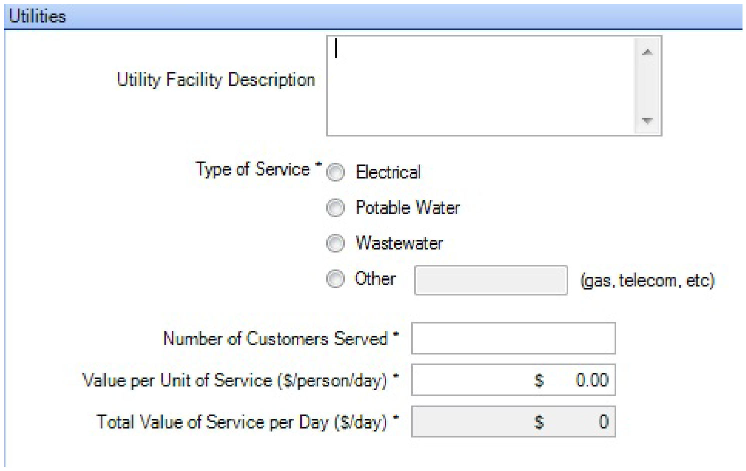
The goal is to describe a project's loss of function benefits and provide appropriate documentation.



Visual 2.24: Using DFA Module to Teach LOF

LOF is generally taught using the DFA Module; however, other modules address different types of LOF depending on the natural hazard. The functionality and screens are the same across all modules.

Ice storms, earthquakes, winter storms, hurricane wind and flood can all result in the loss of utilities.



Screenshot 2.10: Utilities

All utilities are valued as per-person, per day costs. It is essential that the values used in the BCA reflect this. Often, data received from a utility will include the number of accounts or hook-ups, and a multiplier will be needed to determine the number of people. U.S. Census data or State or local data can provide this multiplier. If a utility serves the entire population of a community, then the population value will suffice.

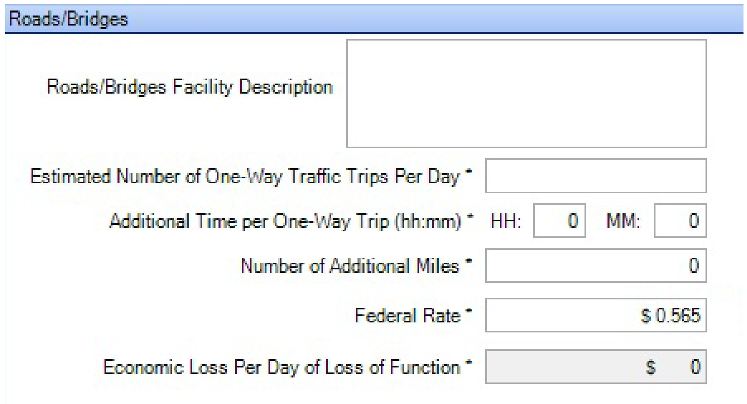
For the Electrical selection, the FEMA standard value is $131/pp/day. For the Potable Water selection, the FEMA standard value is $103/pp/day. For the Wastewater selection, the FEMA standard value is $45/pp/day.

For other utilities like telecommunications, no FEMA standard value exists, and any value used must be documented. In this example, the values have already been entered for this screen.

- For the **Type of Service** data field, “Other” has been selected.
- The **Utility Facility Description** data field requires users to type some kind of description, such as a “telephone company data center.”
- For the **Number of Customers Served** data field, “17,000” has been entered.
- For the **Total Value of Service per Day** data field, “$22.00” has been entered.

These Help topics are all useful:

- How do I document the number of customers affected by the loss of service?
- How do I locate the value per unit of service and how do I document it?
- What is the utility facility type?
- What should be included in the utility description?



Screenshot 2.11: Roads/Bridges

To calculate loss of function for roads and bridges, the ROADS/BRIDGES screen is used.

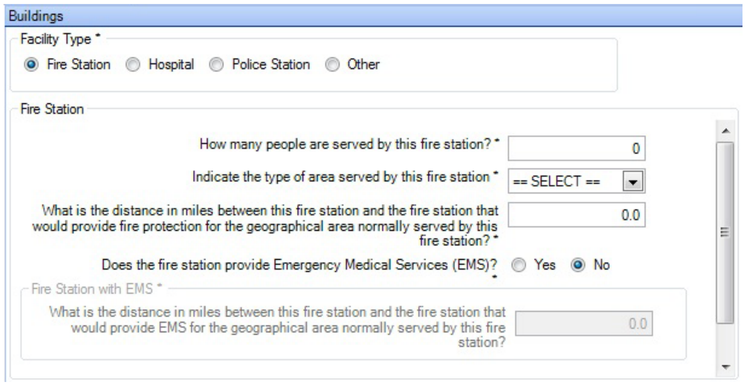
Roads and bridges are most often affected by the hazards of flood and earthquake. The saying “Time is money” applies to road loss of function because increased detour time—along with increased cost—are factored into the calculation.

For the **Estimated Number of One-Way Traffic Trips Per Day** data field, enter “5,000.” Traffic counts must be documented from a reliable source such as a State or County Department of Roads or local road or planning department.

The **Roads/Bridge Facility Description** data field requires users to enter some kind of description, like “a secondary road/bridge that provides an egress (detour) around the primarily impacted structure,” for example.

For the **Additional Time per One Way Trip** data field, enter “0” for HH, and “25” for MM. This must be documented, but fortunately this is relatively easy to do with Google Maps, Google Earth or other online mapping programs. Provide the map showing the detour time calculation and the increased distance.

For the **Number of Additional Miles** data field, enter “8.” This can be documented with the mapping programs just mentioned.



Screenshot 2.12: Buildings

To calculate LOF for critical facilities, the NON-RESIDENTIAL BUILDINGS screen in the DFA Module can be used.

Buildings can be affected more frequently by the following hazards: earthquake, hurricane wind, flood and tornado.

In the **Facility Type** data field for this example, Fire Station" is selected.

- In the **How many people are served by this fire station?** data field, the value is "15,000."
- In the **Indicate the type of area served by this fire station** data field, the selection is "Urban."
- In the **What is the distance in miles between this fire station and the fire station that would provide fire protection for the geographical area normally served by this fire station?** data field, the value is "5."
- In the **Does this fire station provide Emergency Medical Services (EMS)?** data field, "No" has been selected.

When *Show Total* is selected, the tool adds $4,771.54 per day as the loss of function cost for that fire station being out of service. This calculation assumes that the increased response time will result in greater fire losses. Similar calculations are made for hospitals and police stations, except they assume higher casualties for hospitals and higher crime rates for police stations. For the other critical facilities listed, the same steps would be followed.

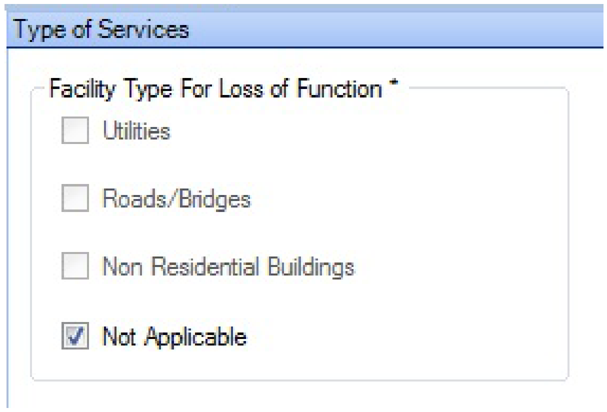
The Help topics for the "Other" option include:

- How do I determine if the building is a critical facility?
- How is the annual operating budget calculated?
- How is the daily cost of service calculated?

Screenshot 2.13: Buildings – Help Section

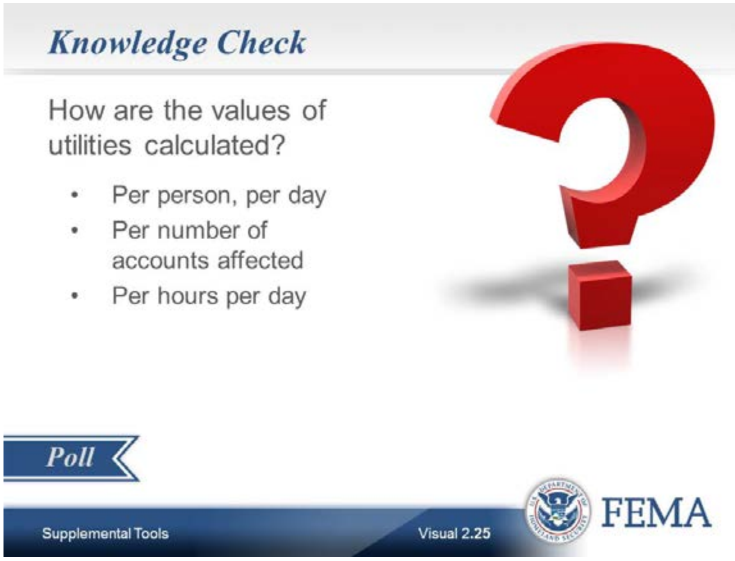
The Help section provides guidance on where to find LOF values for a utility, roads and bridges and critical facilities and how to document the required data inputs.

The only case for overriding a FEMA standard value would be if there are documented values that are higher than the FEMA standard values. The documentation must come from a utility service provider, facility owner or contact person, planning or road departments or other reliable and competent source.



Screenshot 2.14: Type of Services

The “Not Applicable” option for facility type should be used for residential buildings. In this case, it will take users straight to the DAMAGES BEFORE MITIGATION screen. Also, for acquisition demolition or relocation projects, the “Not Applicable” option for facility type will take users to the ENVIRONMENTAL BENEFITS screen if the project has a Benefit Cost Ratio equal to or greater than 0.75.



Visual 2.25: Knowledge Check

Answer the following knowledge check.

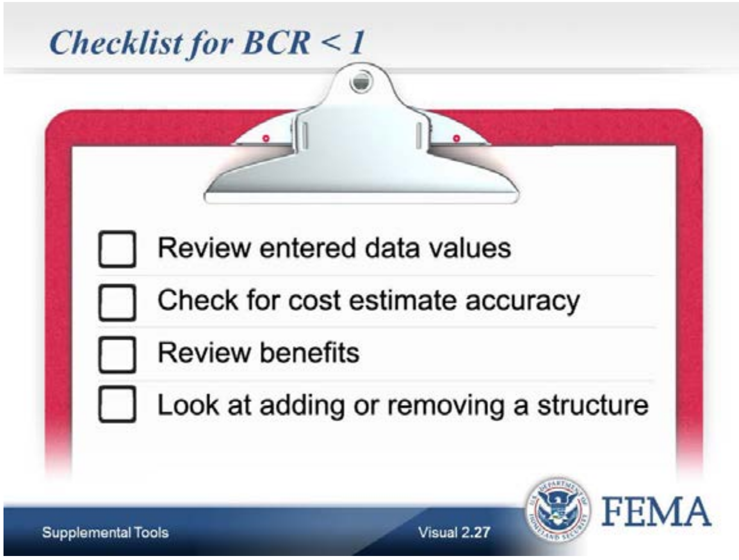
How are the values of utilities calculated?

- Per person, per day
- Per number of accounts affected
- Per hours per day

Write the correct answer below.

Visual 2.26: BCR Just Below 1.0

The fourth supplemental tool addresses what to do when BCR is just below 1.0.



Visual 2.27: Checklist for BCR < 1

Here is a checklist that may help to bring the BCR to 1.0 or more.

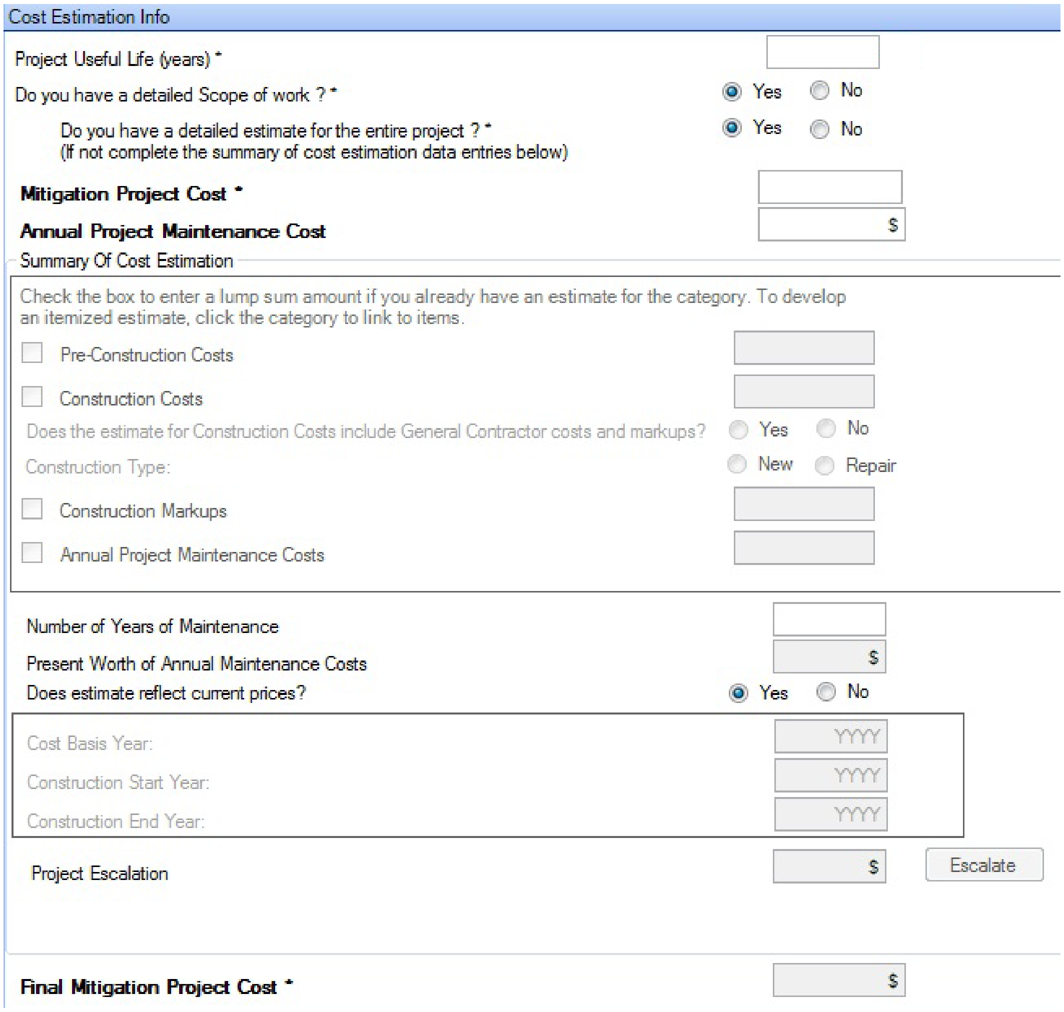
The four items on this checklist are:
- Review entered data values.
- Check for cost estimate accuracy.
- Review benefits.
- Look at adding or removing a structure.

Visual 2.28: Launching the BCA Tool

Launch the BCA Tool and open the BCA created for the Unit 1 Independent Case Study Assignment.

Download from the File Share Pod new information about this acquisition project, along with an Elevation Certificate.

Use the values found in the new case study information to revise the BCA.



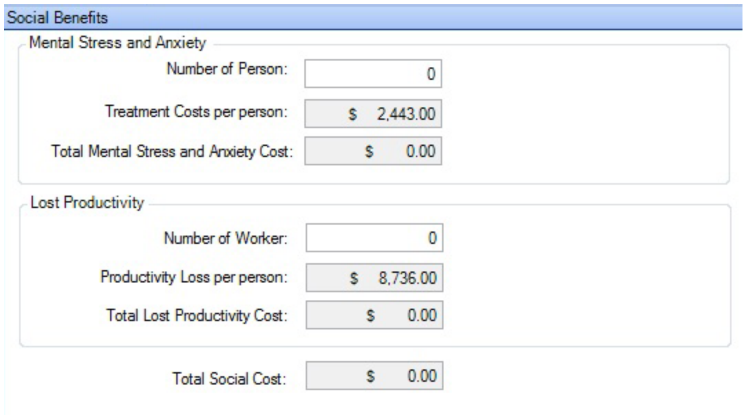
Screenshot 2.15: Cost Estimation Information

Review the data values in the COST ESTIMATION INFO screen. These values are assumed to be correct. Also check cost estimates for accuracy.

In the case study, the original cost estimate assumed a $15,000 adjustment (increase) to the market value because a State law requires that County assessed values be accurate within 15 percent of market value. To prevent the possibility of a project cost overrun, the subapplicant added 15 percent to the assessed value, in case the market value-based appraisal finds a value at the high end of the 15-percent range.

Upon talking to the county assessor, his recent analyses have found that they have been accurate within 10 percent. This means that the final mitigation project cost can be reduced from $137,950 to $132,950.

Change the final mitigation project cost to “132,950.”



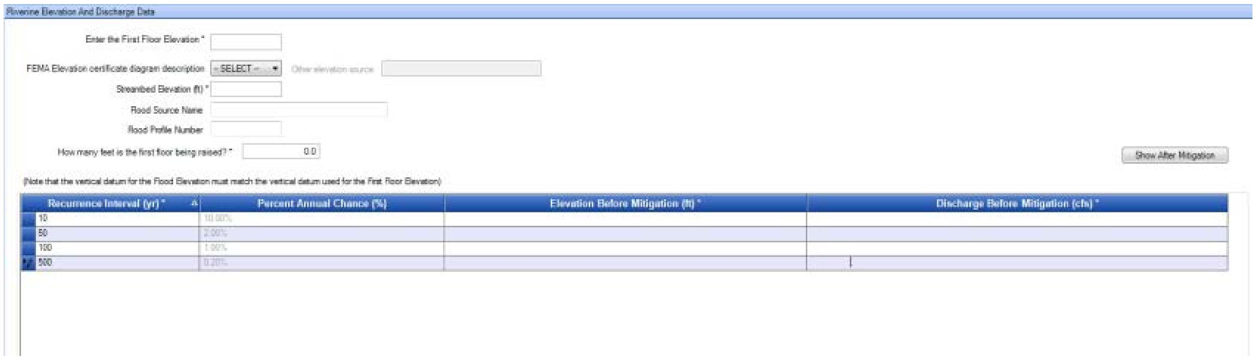
Screenshot 2.16: Social Benefits

In the SOCIAL BENEFITS screen, the next item on the checklist is to review benefits. Make sure that all of the possible benefits in the analysis have been entered. Some common benefits that are left out include the volunteer costs or the social benefits cost. These are two new benefits that are available within version 5.0 of the BCA Tool.

For the Unit 1 Independent Case Study Assignment, the original assumption was that one inhabitant lived in the house. In talking to the property owner, it has been discovered that a retired couple lives here (They are willing to be voluntarily acquired, so they have no problem providing personal information.) They have experienced mental stress and anxiety due to the flooding.

Correct those errors on the SOCIAL BENEFITS screen:

- In the **Number of Person** data field, enter “2.” This is the number of people who live in the structure.
- Note that the **Treatment Costs per Person** data field is pre-filled with a FEMA standard value.
- Note that the **Total Mental Stress and Anxiety Cost** data field value is the product of **Number of Person** x **Treatment Costs per Person** (built-in calculation).
- In the **Number of Worker** data field, it should still be “0.” This is the number of wage earners who live in the household.
- Select *Save and Continue*.



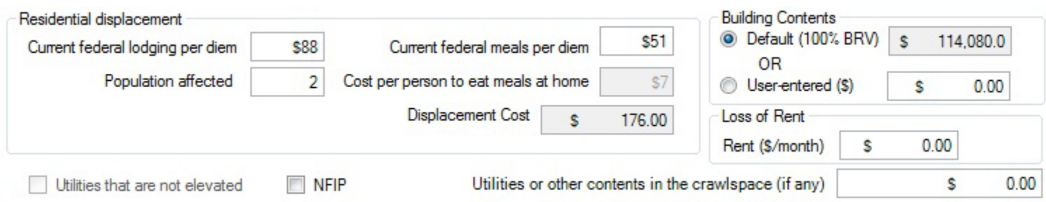
Screenshot 2.17: Riverine Elevation and Discharge Data

Please note that the first step on the checklist is to review all data entry points and documentation. The RIVERINE ELEVATION AND DISCHARGE DATA screen has many data entry points and it is very common to find a transposed number or a decimal point in the wrong place. As mentioned in Unit 1: analysis is only as good as the data entered into the BCA Tool.

In the new information for the Unit 1 Independent Case Study Assignment, it turns out that the preliminary figure for the First Floor Elevation is incorrect. The local floodplain administrator has now provided the Elevation Certificate for this property. It shows that the FFE should be “763.2,” not “763.6.” The Elevation Certificate is available in the File Share Pod.

Replace “763.6” with “763.2.”

Select *Save and Continue*.



Screenshot 2.18: Residential Structure Information

The RESIDENTIAL STRUCTURE INFORMATION screen has some other data entry errors. Kalamazoo per diem rates are higher than the federal standard values.

The GSA website at http://www.gsa.gov/portal/category/100120 has per diem rates for Kalamazoo.

The rates for Kalamazoo are $88/night lodging and $51/day meals.

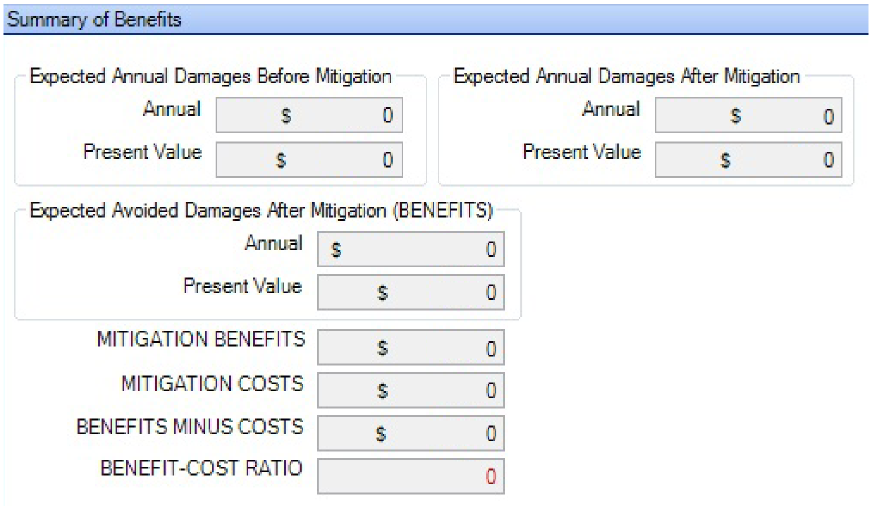
Change the standard values by entering “88” for the **Current federal lodging per diem** data field and “51” for the **Current federal meals per diem** data field.

Notice that this does not affect the BCR.

Also, there are two people living in the house. Change the **Population affected** data field to “2.”

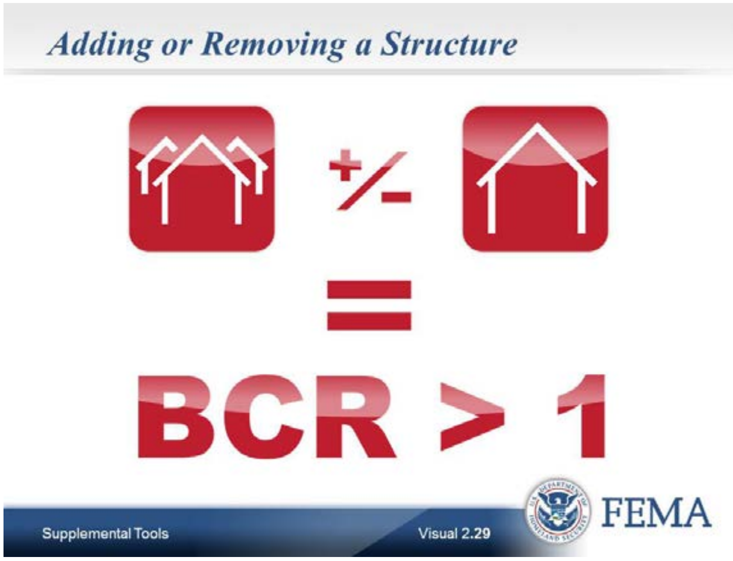
There is one more value to correct on this screen. The owner of the property has indicated that there is a NFIP policy purchased after the house was flooded for the first time. The owner has had a policy ever since.

Correct this by selecting the **NFIP** data field. When selecting the **NFIP** data field, provide the policy number in the **Justification** data field so that the NFIP policy can be verified.



Screenshot 2.19: Summary of Benefits

These changes have resulted in a new BCR. Write the new BCR below.



Visual 2.29: Adding or Removing a Structure

The last step in the checklist is to look at adding or removing a structure.

The project BCR must be more than 1.0 to show that the project is cost-effective. Individual structures can have BCRs less than 1.0 as long as they are offset by structures with BCRs of more than 1.0, so that the BCR for the total project is more than 1.0.

If multiple structures have been analyzed in the project, and the BCR is slightly below 1.0, then least cost-effective structures can be dropped from the analysis to see if the project BCR rises to more than 1.0. Another strategy is to add more structures to the analysis if the project is to mitigate more than one structure. This applies to adding new structures or adding a structure to the completed analysis.

Visual 2.30: Adding or Removing a Structure

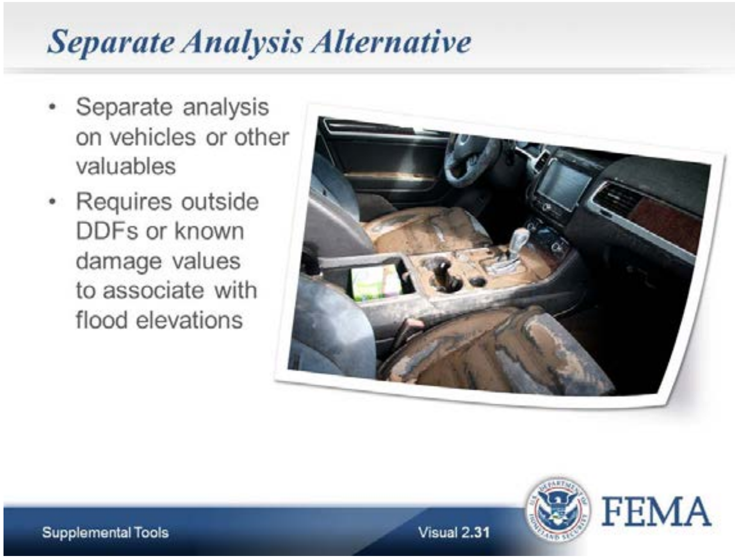
A detached garage is an example. If the structure has a detached garage, a separate Flood Module analysis could be performed for it. The cost for the garage will be included in the appraisal, and there will be a cost for its demolition; however, there are no benefits for the garage to offset these costs unless there is a separate structure analysis completed in the BCA.

In the BCA for the Unit 1 Independent Case Study Assignment, the revised BCR is more than 1.00, so there is no need to complete a separate BCA for the garage, assuming there is a detached garage for this property. However, if the BCR were still below or around 1.00, one approach is to add a new structure, associate it with the project, and after the analysis, the benefits for the home and for the garage would be combined to show the total project benefits.

Care should be taken not to double-count costs; the cost of the garage should already be included in the total project cost for the home. Double-counting costs is not only incorrect, but also unnecessarily hurts the BCR. Since a detached garage analysis would be added to an existing BCA for the home, it is okay to have $0 for the costs; it will just show as a BCR of 0.00 since anything divided by zero is zero.

However, any benefits calculated will be calculated into the project (home and garage combined) analysis. The same process should be followed as the analysis for the home, but some inputs in the Flood Module will be different. For example, there will be a different (lower) building replacement value for a detached garage.

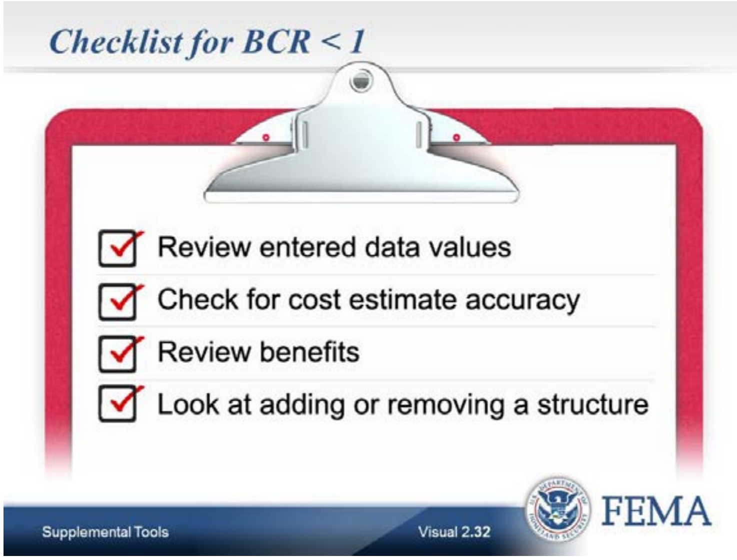
Overall, a separate analysis for a detached garage will probably not add a lot of benefits; however, in some situations, every dollar counts!



Visual 2.31: Checklist for BCR of Less than One

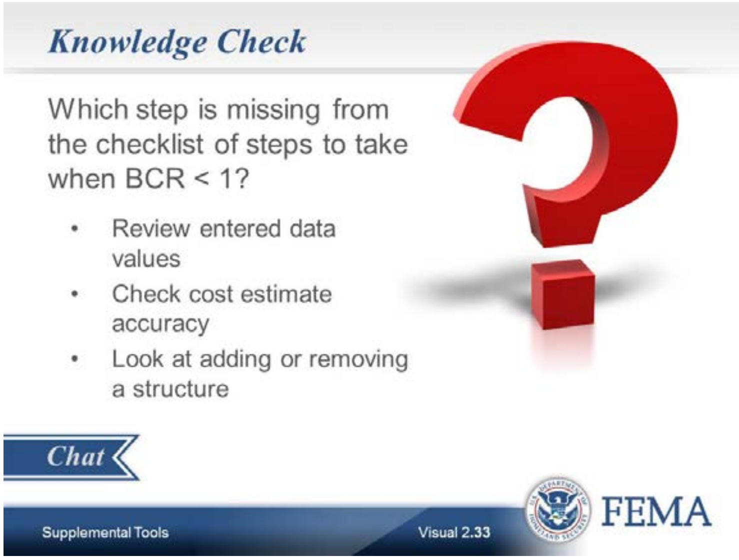
Conceivably, if the BCR was still below 1.0, a separate analysis could be done on vehicles or other valuables like a storage shed, but these would require outside DDFs or known damage values to associate with flood elevations.

These analyses would typically have little—if any—impact to the BCR and the documentation requirements may make it more hassle than it's worth.



Visual 2.32: Separate Analysis Alternative

In summary, using this checklist may result in a BCR over 1.0 and help to account for all of the benefits. However, checking these items may still not raise the BCR enough. Sometimes, it just may not be a cost-effective mitigation project.



Visual 2.33: Knowledge Check

Answer the following knowledge check.

Here are three of the steps in the checklist:

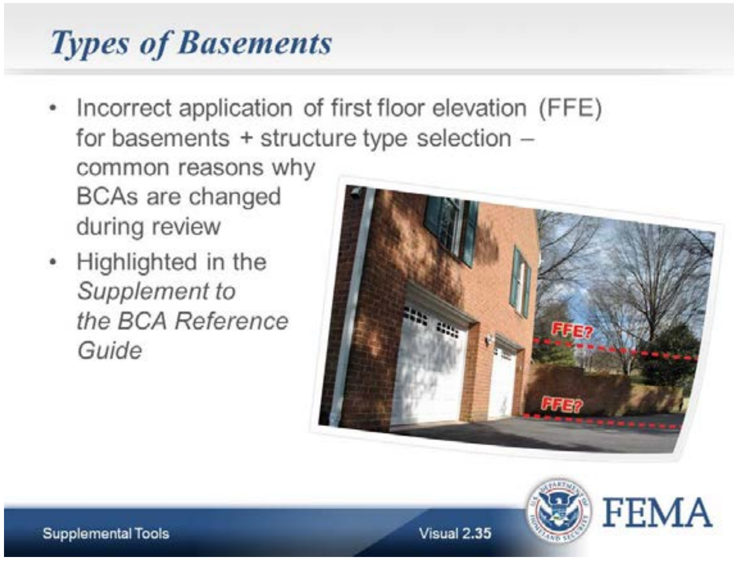
- Review entered data values
- Check cost estimate accuracy
- Look at adding or removing a structure

Which step is missing from the checklist?

Write the correct answer below.

Visual 2.34: Types of Basements

The last supplemental tool relates to different types of basements.



Visual 2.35: Types of Basements

In the Flood Module, the incorrect application of the combination of the First Floor Elevation (FFE) for basements and the structure type selection are common reasons why BCAs are changed during review (which often means project applications are found ineligible due to being not cost-effective). This error was common enough that FEMA specifically highlighted it in the *Supplement to the Benefit-Cost Analysis Reference Guide*, beginning on page 2-39. You can download that document from the BCA Tool Resources page on the FEMA website at http://www.fema.gov/library/viewRecord.do?id=4830.

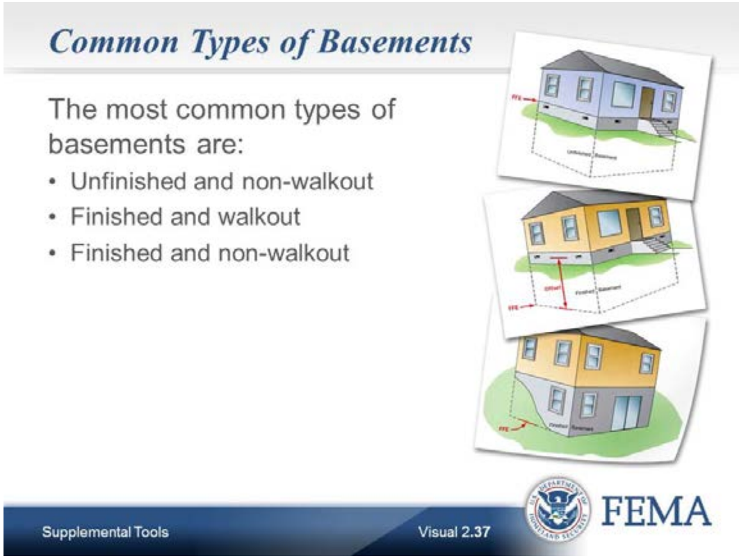
Developing a BCA in the Flood Module for a structure with a basement can be tricky, depending on whether a basement is finished, not finished, a walkout type or a combination. It's important to know how to properly select the FFE, structure information and how to adjust the Depth Damage Function, or DDF (if necessary), so that project applications are less likely to be rejected due to BCA errors.

Visual 2.36: Experience with Flood Mitigation

Answer the following poll question.

Have you worked on flood mitigation projects?

- Yes
- No

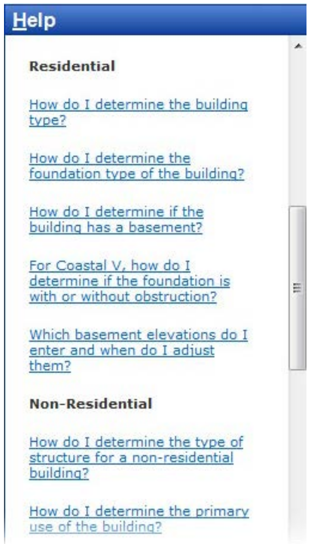


Visual 2.37: Common Types of Basements

Structures with basements usually have one of these common basement types:

- Unfinished and non-walkout;
- Finished and walkout; and
- Finished and non-walkout.

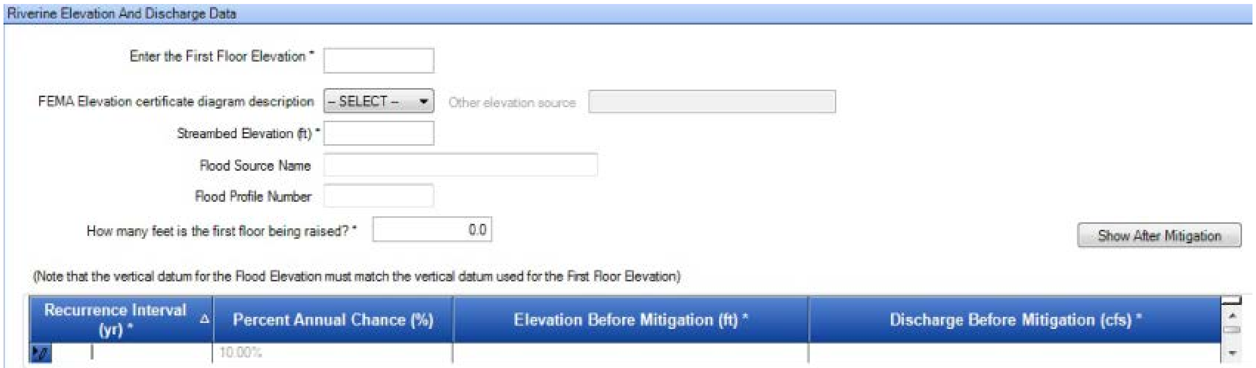
The BCA Tool has data entry criteria for each basement type and the following screenshots show how the information is entered into the tool.



Screenshot 2.20: Structure Information

Navigate to the STRUCTURE INFORMATION screen. Access the Help topics and scroll down to the Residential section. Select the topic entitled Which basement elevations do I enter and when do I adjust them? This topic will help you become familiar with the process of counting damages for finished and unfinished basements.

The first type of basement: is unfinished and non-walkout.



Screenshot 2.21: Riverine Elevation and Discharge Data

The BCA already has values entered for the RIVERINE ELEVATION AND DISCHARGE DATA screen.

Enter the First Floor Elevation. The First Floor Elevation, or FFE, is for the first habitable floor, even if there is a cellar, crawlspace or unfinished basement. It is important to understand that for a structure with an unfinished basement, the FFE is the top of the finished floor, or the floor where a person walks in. This would not be the case for a split level basement or a walk-out basement.

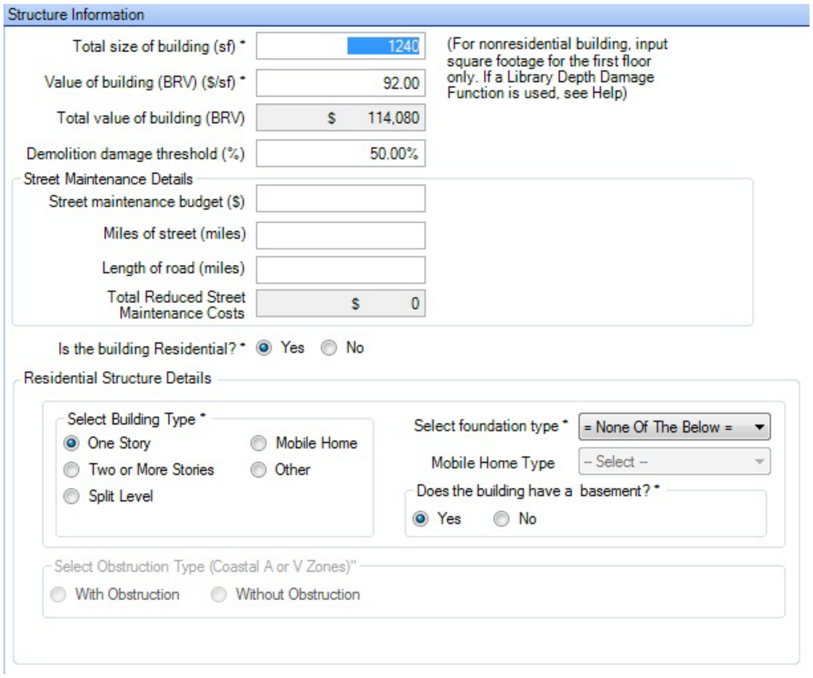
The Help content can assist in determining the First Floor Elevation.

Go to the Help topic "How do I determine the First Floor Elevation (FFE)?" Go to page 2, which shows a sample Elevation Certificate.

- The easiest way to determine the correct value is to look at the Elevation Certificate (EC). There is a sample EC in the Help content. Look for the Diagram Number on the EC, which can be found in number A7.

- Next, go to page 3 in the same Help topic to look at the FFE Guidance Table. The "A Zone FFE Location" in this table will show the correct elevation in Section C to use as the FFE. This means that, according to the A Zone FFE Location file, the elevation provided in line C.2.b. for the FFE should be used.

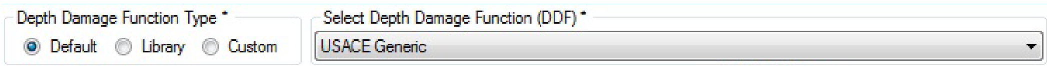
Return to the RIVERINE ELEVATION AND DISCHARGE DATA screen. The next step is to **Select the FEMA Elevation Certificate diagram description.** Pull this from the same area of the Elevation Certificate, number A7.



Screenshot 2.22: Structure Information

On the STRUCTURE INFORMATION screen:

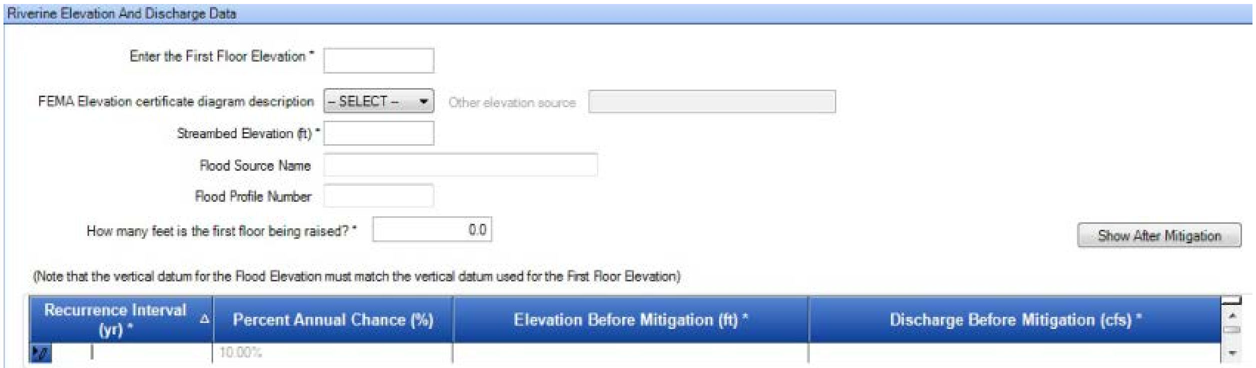
- For the **Total size of building (sf)** data field, only livable space should be included for this value. No unfinished basement square footage should be entered.
- For the **Select Building Type** data field, it will be either “One Story” or “Two or More Stories.” For the case study, it is “One Story.”
- For the question—**Does the building have a basement?**—“Yes” should be selected here.



Screenshot 2.23: Residential Structure Information

In the RESIDENTIAL STRUCTURE INFORMATION screen:

- For the **Depth Damage Function Type** data field, “Default” has been selected.
- For the **Select Depth Damage Function (DDF)** data field, “USACE Generic” has been selected.
- As soon as a DDF has been selected, the damage percentage and value calculations populate the table. If they do not, then a value is missing for the tool to be able to calculate damage values.



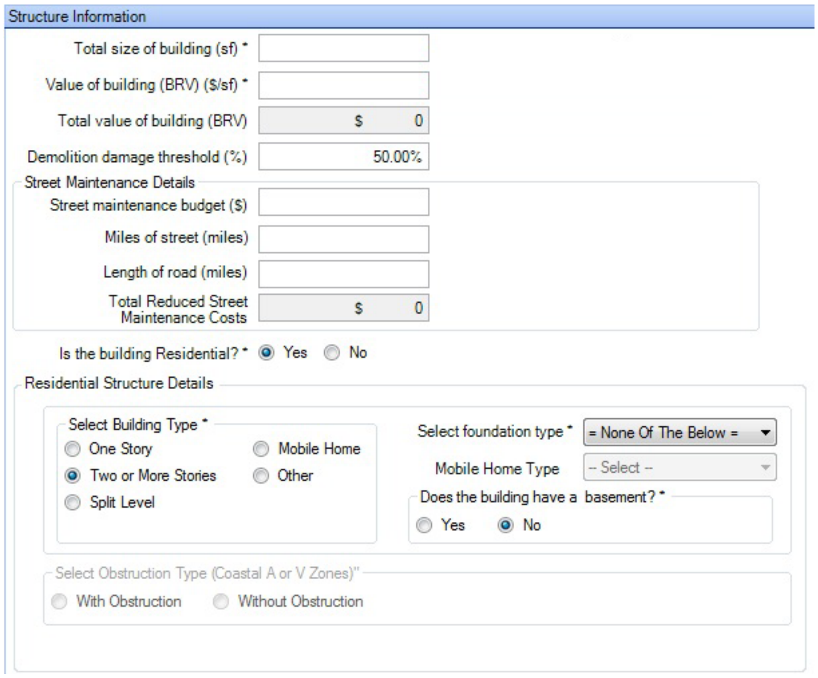
Screenshot 2.24: Riverine Elevation and Discharge Data

The second type of basement is finished and walkout.

On the RIVERINE ELEVATION AND DISCHARGE DATA screen:

For the **Enter the First Floor Elevation** data field, the FFE is for the basement floor elevation since damage will occur when water enters the lowest level.

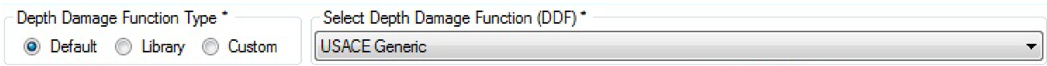
For the **FEMA Elevation Certificate diagram description** data field, read the value from line A7of the Elevation Certificate. Since it has a basement, it will most likely be 1A, 1B, or 3, in which case the Help content directs reading the FFE value from EC line C.2.a.



Screenshot 2.25: Structure Information

On the STRUCTURE INFORMATION screen:

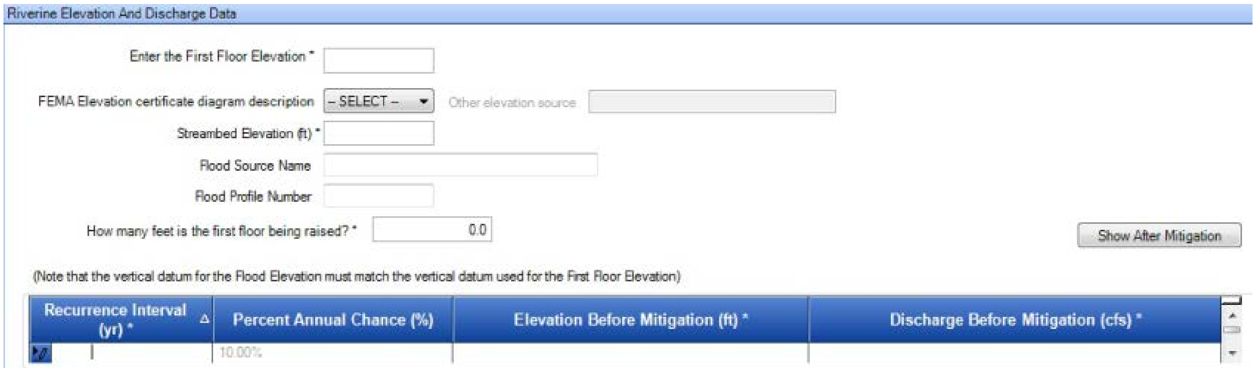
- For the **Total size of building (sf)** data field, in this case, the basement area is considered livable space and is included in the calculation.
- For the **Select Building Type** data field, it will be "Two or More Stories," since the basement is considered the first story.
- For the question—**Does the building have a basement?**—"No" should be selected. Even though there is a basement, by selecting "Yes" for this variable, it would tell the BCA Tool that there is a basement beneath the walkout basement.



Screenshot 2.26: Residential Structure Information

On the RESIDENTIAL STRUCTURE INFORMATION screen:

- For **Depth Damage Function Type**, it will be “Default.”
- For Select Depth Damage Function (DDF), it will be “USACE Generic.

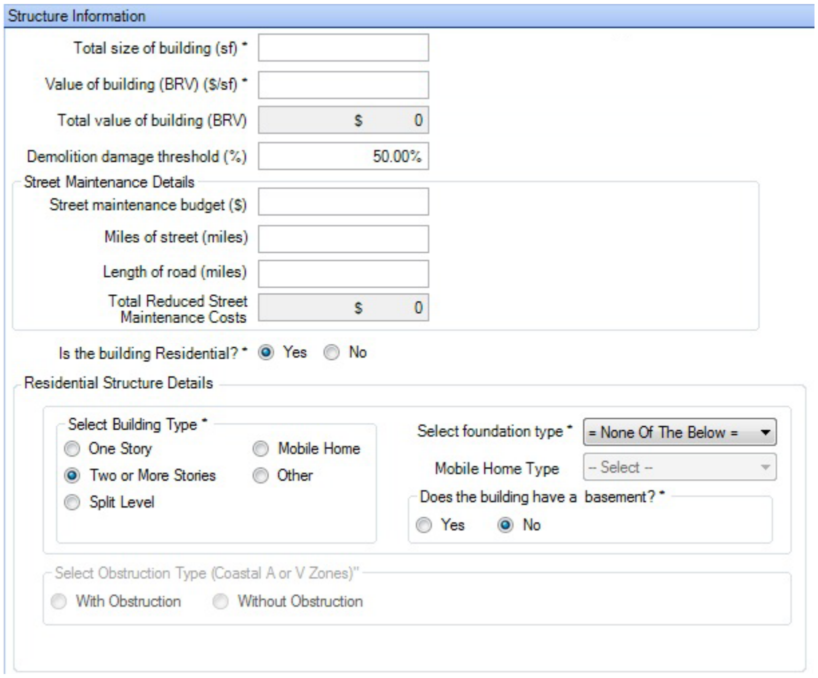


Screenshot 2.27: Riverine Elevation and Discharge Data

The third type of basement is finished and non-walkout, or sub-grade on all sides.

On the RIVERINE ELEVATION AND DISCHARGE DATA screen:

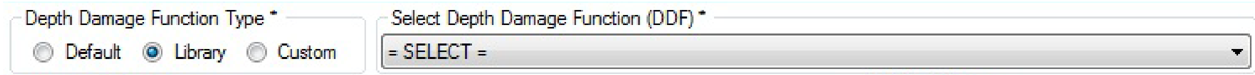
- For **Enter the First Floor Elevation**, the FFE is for the basement floor elevation, just like the last example with a finished walkout basement.
- The next step is to select the FEMA Elevation Certificate diagram description. Like the previous basement type, it will most likely be option 1A, 1B, or 3. The Help content directs reading the FFE from EC value C.2.a.



Screenshot 2.28: Structure Information

On the STRUCTURE INFORMATION screen:

- For the **Total size of building (sf)** data field**,** the basement area is still considered finished livable space and is therefore included in the calculation.
- For the **Select Building Type** data field, it will be “Two or More Stories,” since the basement is considered the first story.
- For the question—**Does the building have a basement?**—“No “should be selected. Even though there is a basement, by selecting “Yes” for this variable, it would tell the BCA Tool that there is an additional basement beneath the basement. So the reference elevation is still the basement floor, but damage will not result in this non-walkout basement until water can physically enter the structure. For this, users need to offset the elevation between the basement floor and lowest entry. That is accomplished on the next screen.



Screenshot 2.29: Residential Structure Information

On the RESIDENTIAL STRUCTURE INFORMATION screen:

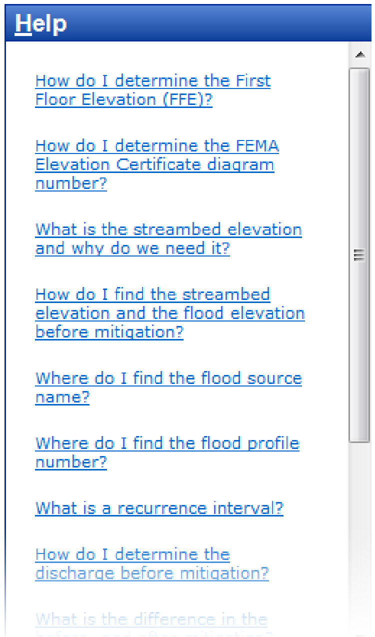
Here is the key difference between basement type #2 and basement #3:

- For the **Depth Damage Function Type** data field, it will be "Library."
- For the **Select Depth Damage Function (DDF)** data field, it will be "USACE Generic."

The same USACE Generic DDF can be selected within the Library option; however, there is also the option in the Depth Damage Function table at the bottom of the screen to adjust the **Before Mitigation User Entered (Pct)** boxes. This option is not available by selecting the USACE Generic DDF from the Default option. Under the Building tab, users <u>must</u> enter a "0" value for each foot of flood depth for the number of feet between the basement floor elevation and the lowest elevation where water can enter the basement. Zero values must be entered for the Contents and Displacement tabs as well. The Loss of Function tab applies only to non-residential structures and so is not applicable for this example.

By not adjusting the DDF, users are saying that flood damages will occur based on an elevation that is often many feet lower than where water can enter the structure.

After adjusting the DDF, the calculation of damages will begin at the elevation of either the lowest window opening (for basement windows above grade) or at ground elevation adjacent to the top of a below-grade window (i.e., top of the window well).

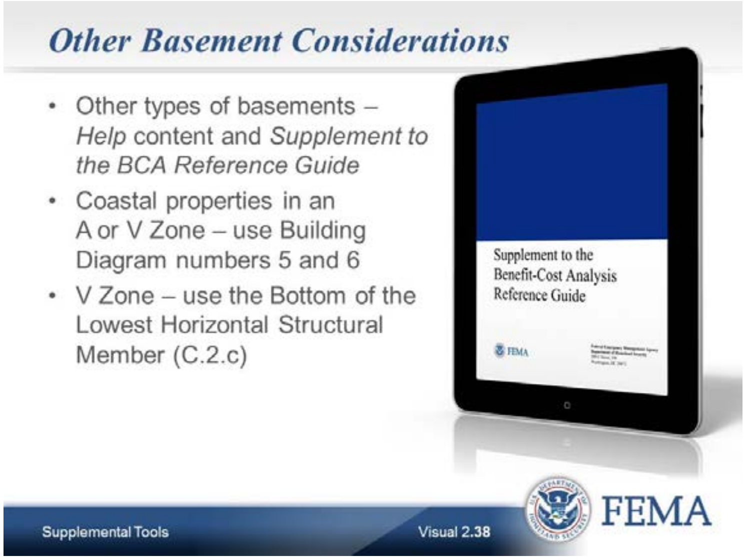


Screenshot 2.30: Riverine Elevation and Discharge Data

The Help section for the RIVERINE ELEVATION AND DISCHARGE DATA screen is very useful.

- How do I determine the FEMA Elevation Certificate diagram number? describes where to find the Building Diagram number on the Elevation Certificate.
- How do I determine the First Floor Elevation (FFE)? explains how to take a Building Diagram number and determine FFE. Also see the FFE Guidance Table on page 3 of 8.

On the STRUCTURE INFORMATION screen, see the Help topic “Which basement elevations do I enter and when do I adjust them?” It may be the most useful and important Help topic for dealing with types of basements.

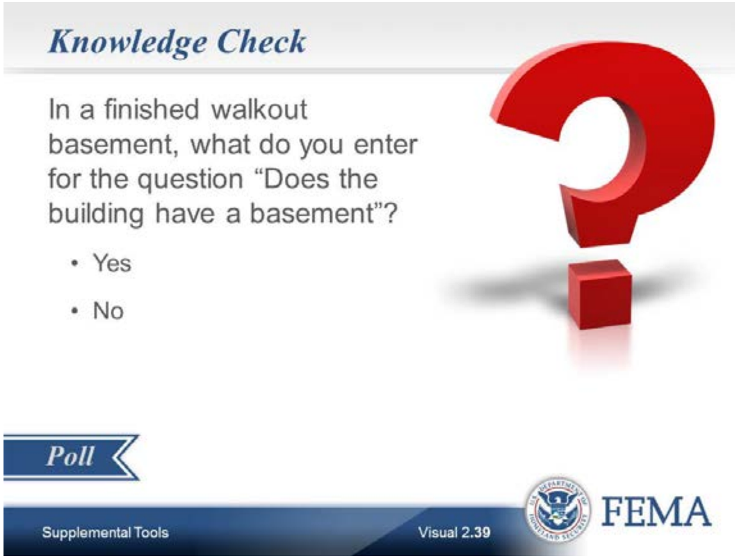


Visual 2.38: Other Basement Considerations

The USACE Generic DDF can be used for all three common basement types. However, there may be instances where an alternate DDF is applicable and usable.

There are other types of basements, like partially-finished basements. They are rare compared to the common types. The Help topic” Which basement elevations do I enter and when do I adjust them?” explains them, as does the Supplement to the *Benefit-Cost Analysis Reference Guide*.

For coastal properties in an A or V Zone, Building Diagram numbers 5 and 6 are applicable, but the same principles should be followed. For V Zone properties, the Bottom of the Lowest Horizontal Structural Member (C.2.c) should be used.



Visual 2.39: Knowledge Check

Answer the following knowledge check.

In a finished walkout basement, what is entered for the question "Does the building have a basement?"

- Yes
- No

Write the correct answer below.

Summary

Visual 2.40: Summary

Unit 2 covered supplemental tools to address the following situations:

- Multiple Structures
- Displacement Costs Calculation
- Loss of Function Calculation
- BCR Just Below 1.0
- Types of Basements

Unit 3
Damage Frequency Assessment (DFA)

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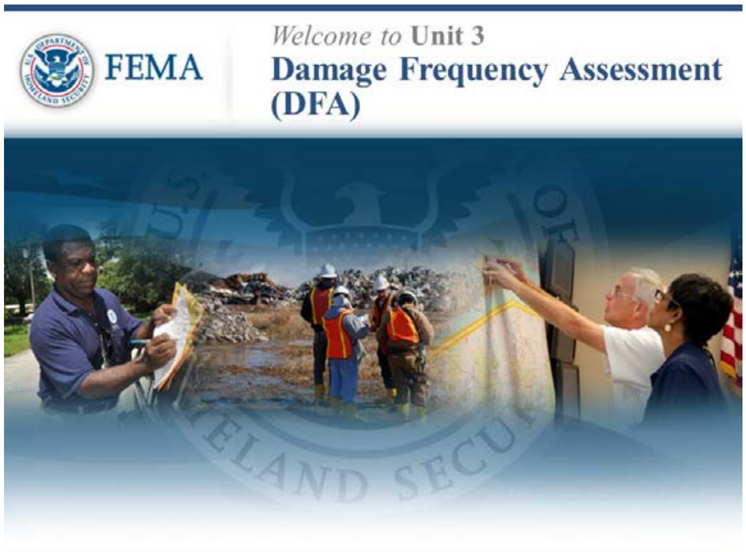
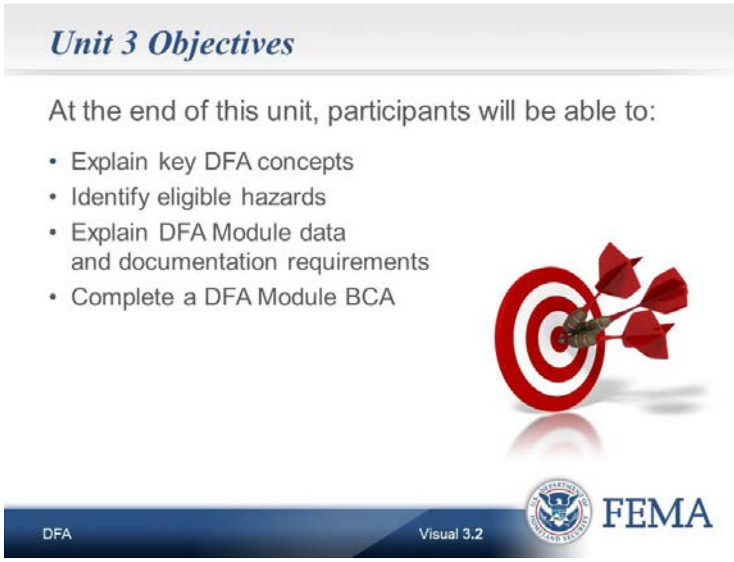
DFA Overview



Visual 3.1: Unit 3 – Damage Frequency Assessment

Welcome to Unit 3 of the Benefit-Cost Analysis: Entry Level course, which covers the DFA Module. The case study handout is needed for this unit.

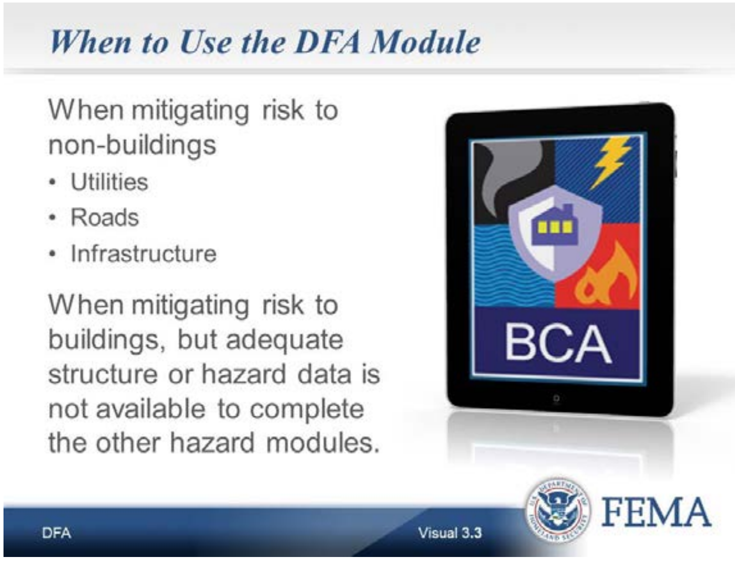


Visual 3.2: Unit 3 Objectives

Unit 1 covered completing a BCA using the Flood Module and an independent Flood Module case study. Unit 2 explained supplemental tools needed to complete more complicated analyses.

The purpose of this unit is to complete a BCA, using the DFA Module. The objectives are for participants to:

- Explain key DFA concepts.
- Identify eligible hazards.
- Explain the DFA Module data and documentation requirements.
- Complete a DFA Module BCA.



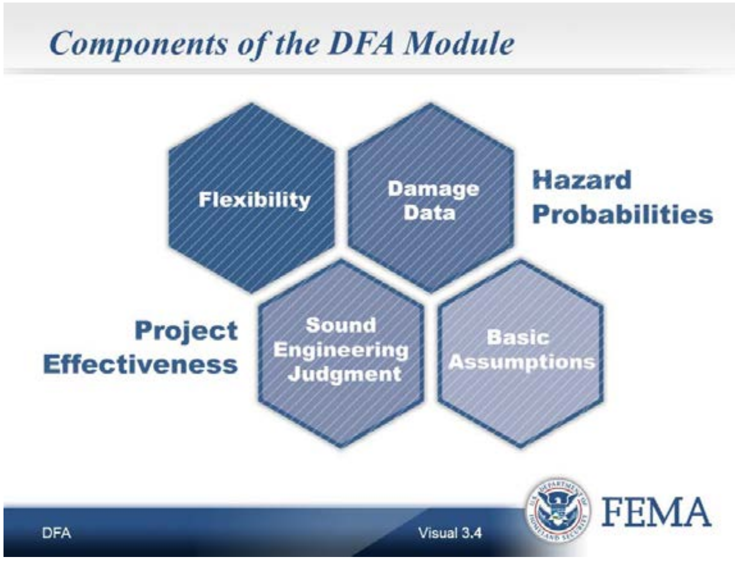
Visual 3.3: When to Use the DFA Module

The Damage-Frequency Assessment, or DFA, Module is used when there is not enough technical data available to use the "Full Data" versions of the BCA software or the project is to mitigate the loss of function for a non-building, such as a utility, road or infrastructure.

As such, the DFA Module is required for mitigation projects when one or more of the following conditions are met:

- Flood mitigation projects outside of a floodplain or where flood elevation and discharge data are not available from a Flood Insurance Study (FIS) or other source, such as another agency, engineer or hydrologist;
- Flood mitigation projects where the first floor elevation of the structure is not documented;
- Flood mitigation projects related to flash flooding or alluvial fan flooding;
- Flood mitigation projects related to debris/mudflows and landslides;
- Flood, wind or earthquake hazard mitigation projects for non-building facilities such as culverts, roads, bridges and utility systems; and
- Other project types, as long as historic damages have occurred or if future damages can be calculated, along with recurrence intervals.

The DFA can also be used as a secondary analysis method for mitigation projects that do not result in a BCR of 1.0 or more in the Full Flood Module or other hazard modules. If the BCR is less than 1.0 for a project analyzed in its respective hazard module, but is equal to or greater than 1.0 using the DFA Module, then a complete and well-documented DFA Module analysis is acceptable.



Visual 3.4: Components of the DFA Module

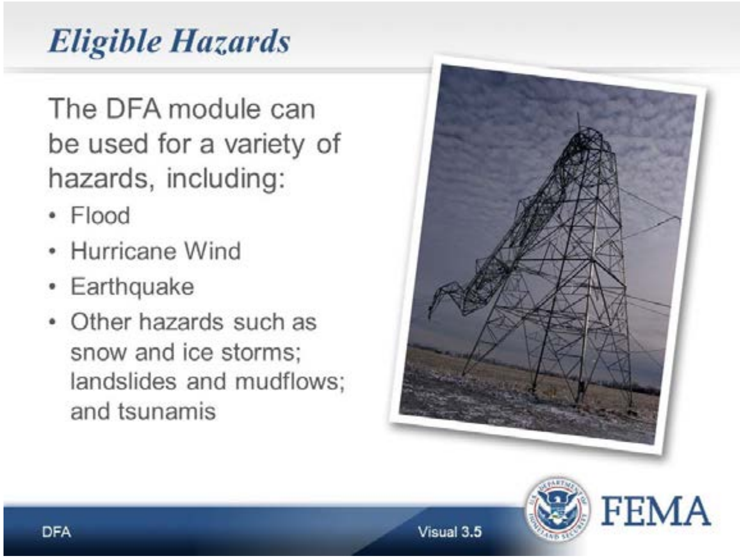
The advantage of the DFA Module is its flexibility—it can be used for a wide range of hazards.

It performs an analysis based on historical hazard frequency data, damage observations, project effectiveness, engineering judgment and some basic assumptions. The DFA Module will provide the most accurate analysis if no hazard data or specific building data are available.

It is important to remember with the DFA Module that, because of its flexibility and dependency on user-provided data, clear and acceptable documentation is a critical requirement. Documentation that does not support the analysis could result in an application not being approved. These documentation requirements will be discussed throughout the DFA Module walkthrough.

It should be said that extraordinary claims require extraordinary documentation! One error commonly seen in the DFA module is to assume that damages occur at a one-year frequency. This is telling the BCA tool that this damage is guaranteed every year, which will add a considerable number of benefits over the project useful life. Although this could be true depending on the situation, reviewers will be looking for documentation to back up this claim.

Eligible Hazards



Visual 3.5: Eligible Hazards

The DFA Module can be used for a number of natural hazards, such as mudflows and landslides, ice storms, snow, tsunami and volcanic hazards.

If FEMA has existing modules with parameters, then those modules should be used instead of DFA (i.e., the Wildfire Module should be used for wildfire projects). Some specific examples when a DFA analysis would be used include:

- Flood, wind or earthquake hazard mitigation projects for non-building facilities like culverts, roads, bridges and utility systems;
- Flood projects in areas with no or limited flood data, as discussed previously; or
- Projects to purchase and install generators for critical facilities like police and fire stations, hospitals, and water and wastewater treatment facilities.

Visual 3.6: Landslides and Mudflows

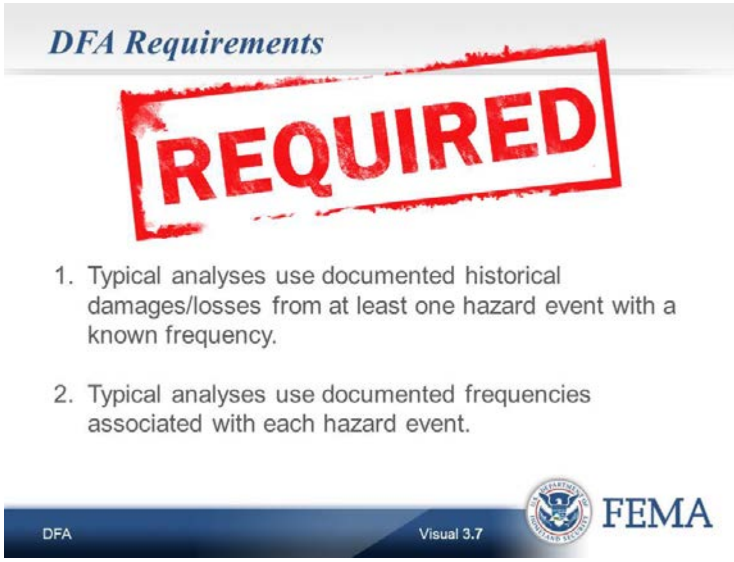
Landslides/mudflows are unique hazards because there typically is no varying degree of damage like is seen with flood depths or different magnitudes like a tornado—either the landslide happens or it doesn't.

Responses to the landslide/mudflow hazard are typically to remove vulnerable structures or to stabilize infrastructure or buildings.

There are two distinct methodologies for landslide/mudflow BCAs:

- For projects where slope failure is imminent, or
- For projects with an annual rate of erosion which, if it continues, will undermine structures.

Contact the BCA Helpline for assistance on how to analyze either situation. Access the BCA Helpline contact information by selecting the *About* icon on the BCA Tool navigation toolbar at the top of the screen.



Visual 3.7: DFA Requirements

DFA requirements are related to documented damages/losses and documented frequencies. Damages/losses must be documented from at least one hazard event with a known frequency based on:

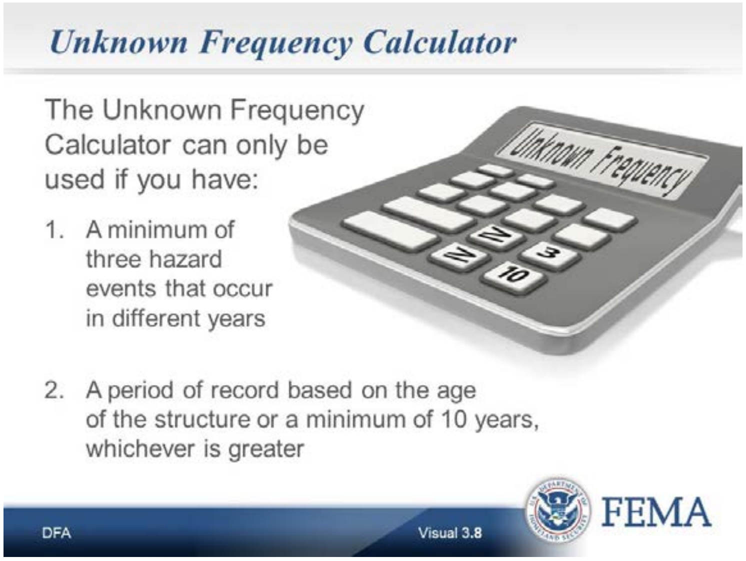
- FEMA Project Worksheets/Damage Survey Reports
- Insurance or repair records
- Newspaper articles citing other credible sources

More events with known frequencies will improve the confidence of the calculation.

Frequencies associated with each hazard event must be documented based on:

- A comparison of observed flood elevations or discharges to FIS, stream gage or tide gage data
- Documented data from a credible source to estimate frequencies
- Use of the Unknown Frequency Calculator when the requirements are met.

Hence, the name of the module: Damage-Frequency Assessment. The damage amounts are compared to how often these events are expected to occur. The tool will determine how likely and how much damage will occur over the project's useful life to calculate benefits.



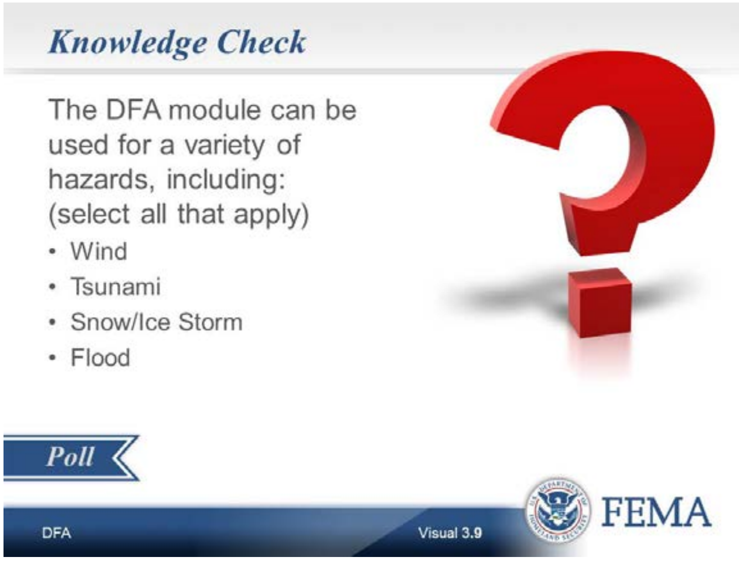
Visual 3.8: Unknown Frequency Calculator

If there is information on the damage history and amounts (an example would be a report of spreadsheet that provides the years and damage amounts from past events), but none on recurrence intervals and there are no resources to determine what they may have been, the Unknown Frequency Calculator can be used to calculate recurrence intervals.

The Unknown Frequency Calculator can be used if the following information is available:

- A minimum of three hazard events that occur in different years where either:
  - Frequencies/Recurrence Intervals (RIs) of all events are unknown, or
  - A mix of known and unknown frequencies, but the frequencies/recurrence intervals of the large events are known.
- A period of record based on the age of the structure or a minimum of 10 years, whichever is greater.

The Unknown Frequency Calculator is the last option for using the DFA Module to tie dollar amounts to damage events.



Visual 3.9: Knowledge Check

Answer the following knowledge check.

The DFA Module can be used for a variety of hazards, including: (select all that apply).

- Wind
- Tsunami
- Snow/Ice Storm
- Flood

Write the correct answer below.

DFA Module Walkthrough

Visual 3.10: DFA Module Walkthrough

Launch the BCA Tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, please let the host know using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in the Participant Manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics

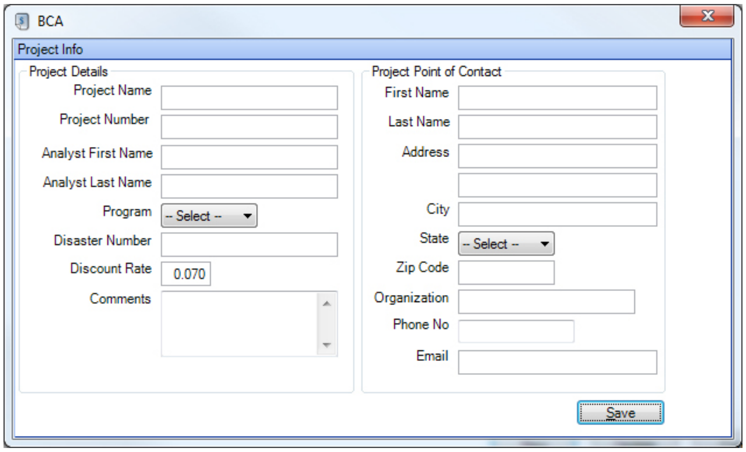
Visual 3.11: Steps to Complete a BCA

Answer the following review question.

Which is the last step in completing a BCA?

- Start new mitigation.
- Create new structure.
- Create new project.
- Add structures to the project.
- Export BCA.

Write the correct answer below.



Screenshot 3.1: Project Info

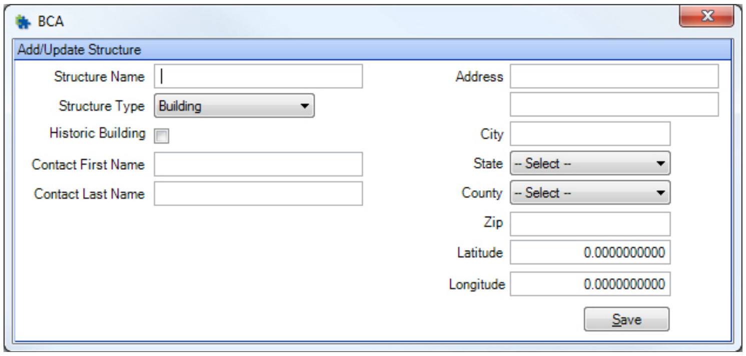
Open the DFA Case Study Handout.

In this case study, the project proposes to raise the floor of a telephone company's data center as a floodproofing measure against repeated flooding. This is different from a structure elevation project, which would elevate the entire building. Since this is a telecommunications building, perhaps there are important connections that cannot be elevated along with the building. Instead, the floor on the inside of the building is being raised in order to elevate the equipment inside to make it less prone to flood damage.

The first step to completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start Area to complete Step One.

- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter "Charleston Data Center Floodproofing."
- In the **Project Number** data field, enter "678."
- In the **Analyst First Name** data field, enter "John."
- In the **Analyst Last Name** data field, enter "Williams."
- In the **Program** data field, select "PDM."
- In the **Disaster Number** data field, leave blank.
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.
- In the **Contact First Name** data field, enter "Becky," and in the **Contact Last Name** data field, enter "Doll." This information in the Project Information window is for the local point of contact for the project.
- In the **Address** data field, enter "567 First Ave."
- In the **City** data field, enter "Charleston."
- In the **State** data field, select "South Carolina."
- In the **Zip Code** data field, enter "29403."
- In the **Organization** data field, enter "City of Charleston."
- In the **Phone Number** data field, enter "555 555-5555."
- In the **Email** data field, enter "b.doll@CityofCharleston.gov."
- Select *Save*. The Tool displays the "Project information saved successfully" message.

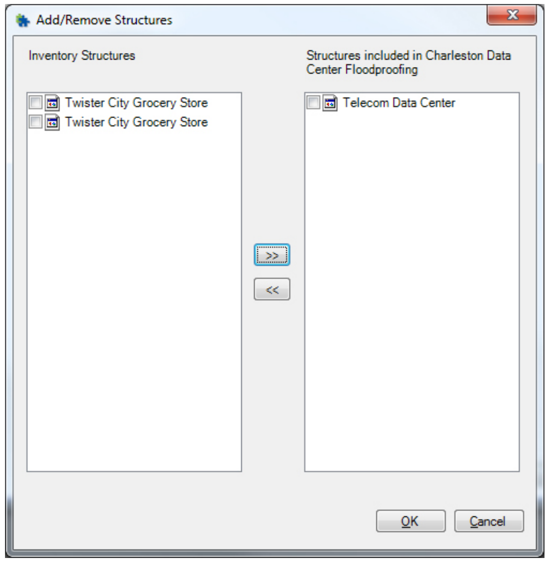
- Select *OK*. The Home page is displayed.



Screenshot 3.2: Add/Update Structure

The second step to completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start Area to complete Step Two.

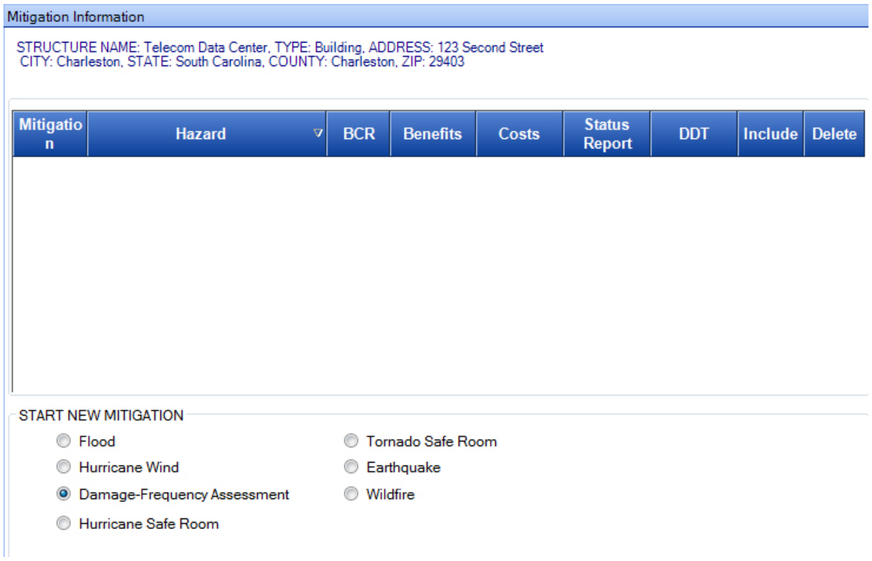
- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter "Telecom Data Center."
- In the **Structure Type** data field, select "Building."
- In the **Historic Building** data field, leave the box unchecked.
- In the **Contact First Name** data field, enter "Betty." The contact information in the Structure Information window is for the property owner.
- In the **Contact Last Name** data field, enter "Smith."
- In the **Address** data field, enter "123 Second Street."
- In the **City** data field, enter "Charleston."
- In the **State** data field, select "South Carolina."
- In the **County** data field, select "Charleston."
- In the **Zip** data field, enter "29403."
- In the **Latitude** data field, leave blank.
- In the **Longitude** data field, leave blank.
- Select *Save*. The tool displays the "Structure saved successfully" message.
- Select *OK*. The Home page is displayed.



Screenshot 3.3: Add/Remove Structures

The third step to completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start Area to complete Step Three.

- Select *Add Structures to Project* to display a list of existing projects.
- Select the "Charleston Data Center Floodproofing" project. The Add/Remove Structures dialog box is displayed.
- Select the "Telecom Data Center."
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the "Add/Remove Structures Succeeded" message.
- Select *OK*. The Home page is displayed.

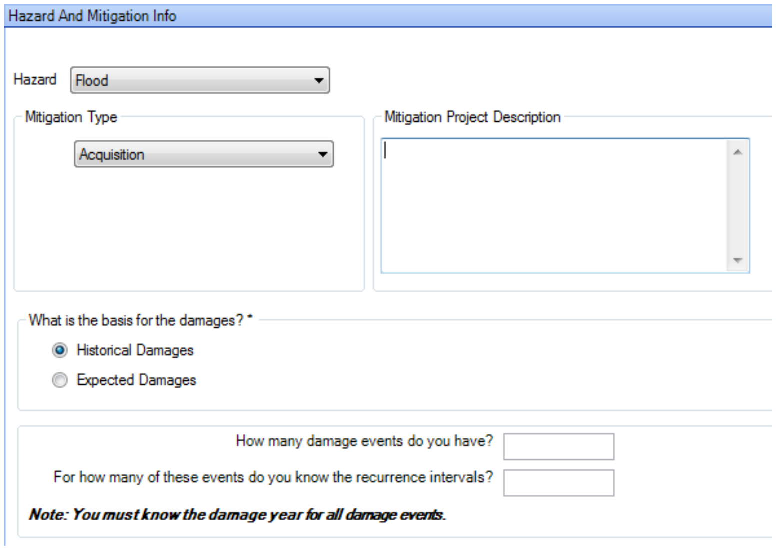


Screenshot 3.4: Mitigation Information

The fourth step to completing the BCA is to start a new mitigation. Use the *Start New Mitigation* icon in the Quick Start Area to complete Step Four.

- Select *Start New Mitigation* to display a list of existing projects.
- Select the “Charleston Data Center Floodproofing” project.
- Select the “Telecom Data Center” structure. The MITIGATION INFORMATION screen is displayed.
- In the projects window on the left, select *Help*. The list of available Help topics for this screen is displayed.
- In the Start New Mitigation section at the bottom of the screen, select “Damage Frequency Assessment.” A common source of confusion with the “Hazard” selection is that a flood mitigation assessment can still be done within the DFA Module. If the necessary flood data is lacking before starting the analysis, then select DFA from this screen.
- In the upper right part of the screen, select *Save and Continue.* The HAZARD AND MITIGATION INFO screen is displayed.

The following screens that will be discussed are all part of adding a new mitigation. After the data is entered in all the screens, the tool completes the benefit-cost analysis and generates the BCR based on the data entered.



Screenshot 3.5: Hazard and Mitigation Info

The purpose of this screen is for users to identify the Hazard and Mitigation measure they wish to analyze. Also, users will be required to describe the mitigation measure and the number of damage events and recurrence intervals they will be using in the analysis.

The case study handout identifies the damage frequency assessment mitigation type as a floodproofing measure. In the workplace, the mitigation measure can be determined from the detailed scope of work, which should be included in the subapplication.

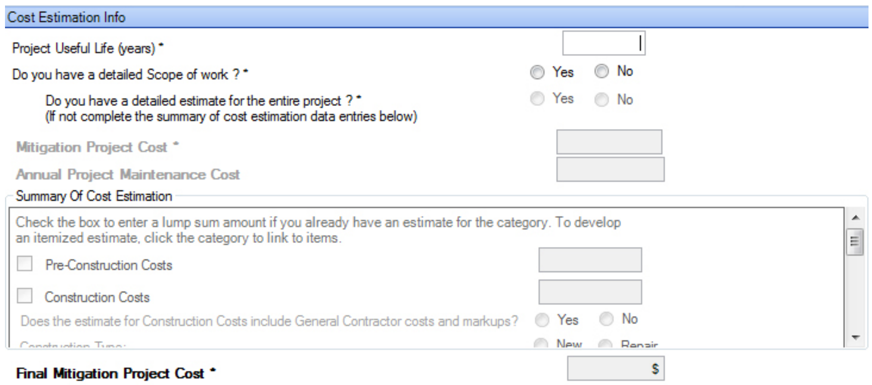
- In the **Hazard** data field, select “Flood.”
- In the **Mitigation Type** data field, select “Other floodproofing measures.”
- In the **Mitigation Project Description**, type “Raising floor.”
- In the **What is the basis for the damages?** data field, select “Historical Damages.”
- In the **Damage Events** data field, type “3.”
- In the **Recurrence Intervals** data field, type “0.”
- Select *Save and Continue*. The message “Note: Note that to complete the analysis, the year the structure was built is needed. Enter a maximum of two events with known recurrence intervals. (If there are more than two, enter the two with the largest total inflated damages.)” Select *OK*.

For the **What is the basis for the damages?** data field, the majority of DFA analyses are “Historical” because the need for mitigation has most likely arisen from actual past damage events. For historical damages, users will need a date (year) and dollar amounts for at least one loss category (e.g., physical damage, loss of function, etc.) for each event. “Expected Damages” are complicated; more advanced BCA experts can use this selection to project the amount of damage for events of known recurrence intervals. This selection often pulls damage and frequency calculations in from other BCA modules. Engineering reports are also a valid and reliable source of expected damages information.

Users will need to know how many damaging events have occurred that will be mitigated by the project minimum requirements: at least two events with known frequencies (recurrence intervals) or at least three events with unknown frequencies. It is through the number of historic events OR number of expected events (usually number of frequencies) that the total benefits will be developed. The tool will use this information to develop the BCR.

Page 2-4 of the Supplement to the BCA Reference Guide provides a section on determining recurrence intervals for a storm event near a project site. The URL for downloading the document was provided in Unit 2.

Select *Save and Continue* again. The COST ESTIMATION INFORMATION screen is displayed.



Screenshot 3.6: Cost Estimation Info

The purpose of this screen is to establish the “C” or “costs” needed to calculate the BCR. Important data fields in this screen are:

- **Project Useful Life (PUL)** data field
- **Mitigation Project Cost** data field
- **Annual Project Maintenance Cost** data field

On this screen, enter the following:

- In the **Project Useful Life** data field, enter “40.”
- In the **Do you have a detailed Scope of Work?** data field, select “Yes.”
- In the **Do you have a detailed cost estimate for the entire project?** data field, select “Yes.”
- In the **Mitigation Project Cost** data field, enter “$280,000.”
- In the **Annual Project Maintenance Cost** data field, enter “$3,500.”
- Scroll down to the **Does estimate reflect current prices?** data field and select “Yes.”
- Note that the tool filled in the value in the **Final Mitigation Project Cost** data field.

The **PUL** data field is important because it establishes the timeframe to calculate annualized benefits. Raising or lowering the **PUL** value impacts the final BCR. Higher values extend the duration over which benefits are calculated, thus making the final BCR higher. This value is required for calculating the BCR and can be obtained from the PUL table.

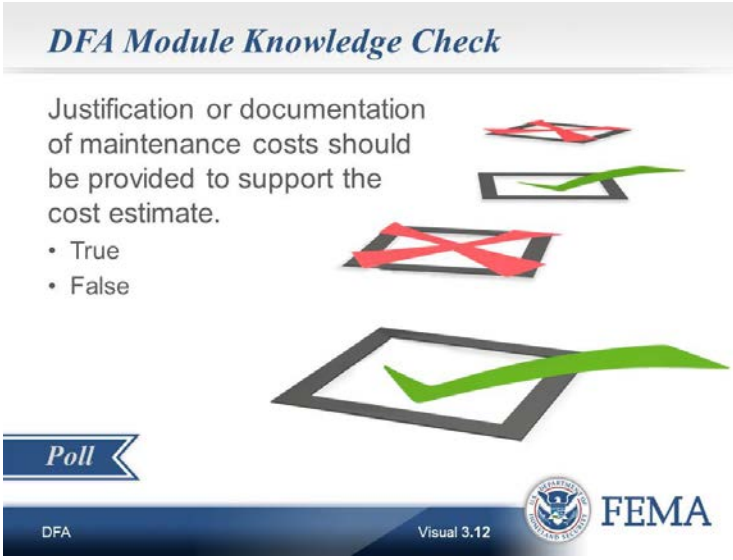
(Show the participants how to get to the PUL Table in the Help section by selecting the *Help* button and identifying the link.)

The **Mitigation Project Cost** data field is important because it provides the basis for the “cost” value in the benefit-cost analysis. Raising or lowering the **Mitigation Project Cost** value impacts the final BCR—the higher the cost, the lower the BCR. This value is required for calculating the BCR and can be obtained from a valid and reliable source, which include: licensed building contractors or engineers; national cost estimates guides (e.g., RS Means, Marshall & Swift); and historic costs of completed similar mitigation projects. Users may also use the tool’s built-in cost estimator. If entering a cost estimate provided by a valid and reliable source, support the data by uploading the cost estimate document signed and certified by the source. If using the tool’s built-in cost estimator, support each entry by uploading documentation for each of the inputs.

The **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness. Remember also that maintenance costs are the responsibility of the local entity submitting the project; therefore, they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

Like the Flood Module, in the Damage Frequency Assessment Module, the COST ESTIMATION INFO screen is the first screen where it is important to upload documentation to support the data entered. To upload documents so that they will be attached to the analysis, use the Justification/Documentation section at the bottom of the screen. This process was demonstrated in the Flood Module.

Select *Save and Continue*. The TYPE OF SERVICES screen is displayed.



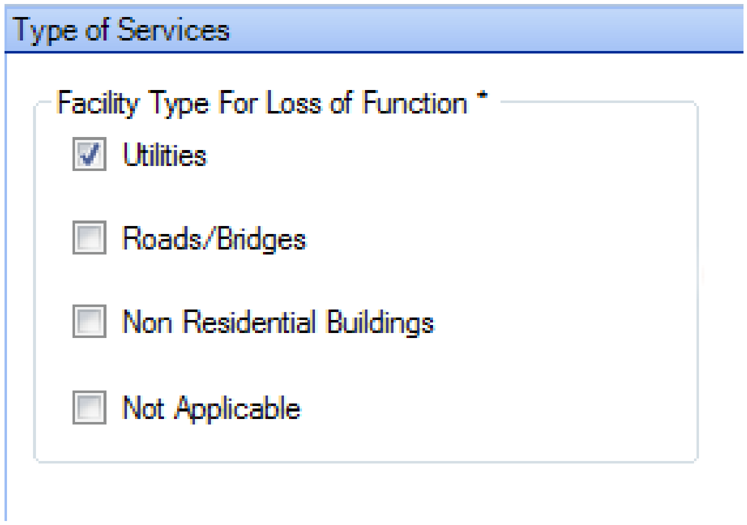
Visual 3.12: DFA Module Knowledge Check

Answer the following knowledge check.

Justification or documentation of maintenance costs should be provided to support the cost estimate.

- True
- False

Write the correct answer below.



Screenshot 3.7: Type of Services

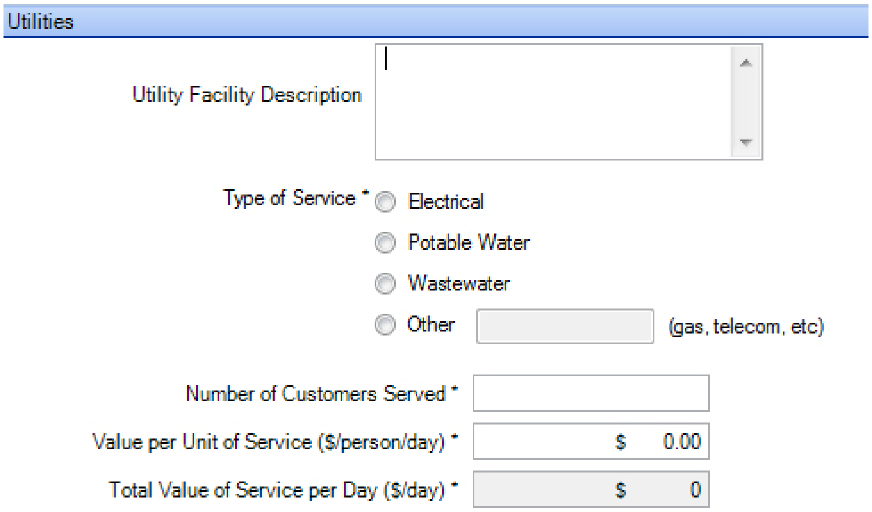
The purpose of this screen is to lead users through the process of determining the Loss of Function (LOF) values for utilities, roads/bridges and non-residential buildings (i.e., critical facilities like fire stations, hospitals, police stations and other facilities.)

For this case study, enter the following:

- In the **Facility Type for Loss of Function** data field, select "Utilities."

Loss of Function was covered in Unit 2 with supplemental tools. The **Facility Type for Loss of Function** data field is a critical input for this screen. Depending on which boxes are checked, the future screens will change, incorporating different methodologies for calculating LOF benefits.

Select *Save and Continue*. The UTILITIES screen is displayed because this was the facility type selected.



Screenshot 3.8: Utilities

The purpose of this screen is to calculate the LOF benefits for the utility being analyzed.

For this case study, enter the following:

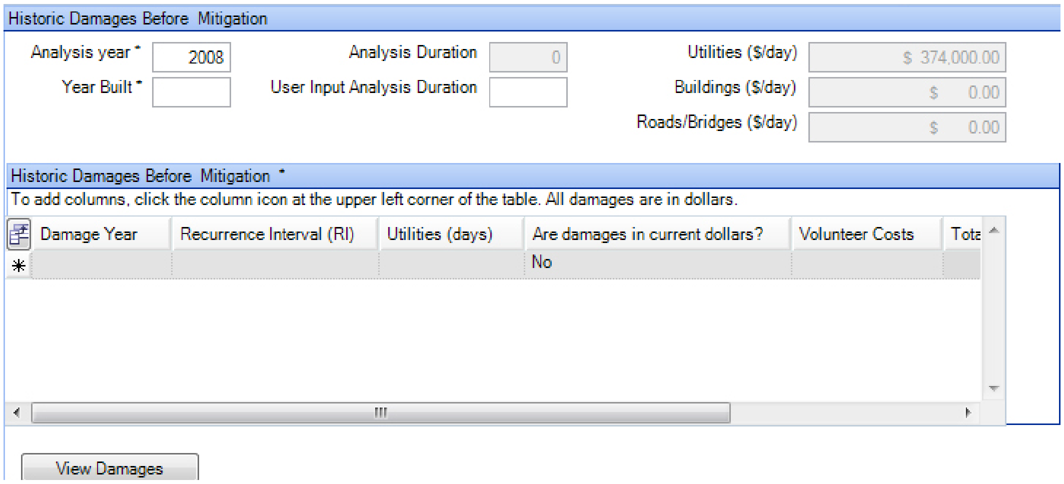
- In the **Utility Facility Description** data field, type “telephone company data center.”
- In the **Type of Service** data field, select “Other” and then type “Telecom.”
- In the **Number of Customers Served** data field, enter “17,000.”
- In the **Value per Unit of Service** data field, enter “$22.00.”

The critical inputs for this screen are the **Type of Service**, **Number of Customers Served**, and the **Value per Unit of Service**.

Type of Service is the type of utility (electric, water, wastewater, other), which determines what **Value per Unit of Service** standard value to use, if applicable. This information can be found in the Scope of Work. The three named utilities have FEMA standard values. The standard value for electrical is $131/per person/day, the standard value for potable water is $103/per person/day and the standard value for wastewater is $45/per person/day. The provided standard values are calculated based on residential and regional economic impact from national statistics. The standard values can be overridden by entering a value in the “Other” data field. As true for all cases where the FEMA standard values are overridden, accompanying documentation is needed. In this case, the source for this documentation would most likely be the utility company. For example, if the mitigation is for the LOF for a home on a well, where both electric and potable water services are lost, select “Other,” explain that it is combination of these utilities and then enter the combined economic value in the **Value per Unit of Service** box.

Number of Customers Served is the number of people served by the utility who will not have a loss of service as a result of the project. This information will come from the utility company and should be on company letterhead. However, remember from Unit 2 that care should be taken that the value is in people served, not the number of accounts or hookups that the utility services. For these instances, a multiplier for the number of people per household from Census or other population statistics is acceptable. If a utility serves all persons in a community, then the community population is acceptable as long as the project application supports it.

Select *Save and Continue*. The HISTORIC DAMAGES BEFORE MITIGATION screen is displayed.



Screenshot 3.9: Historic Damages Before Mitigation

The purpose of this screen is to enter the historical damage and/or recurrence interval data that the analysis is based upon. This is the heart of the DFA Module where the damage amounts are tied to previous damage events (years for historic damages) or future events (recurrence interval for expected damages).

For this Charleston case study, enter the following:

- In the **Analysis Year** data field, type “2008.”
- In the **Year Built** data field, type “1963.”
- In the first row:
  - In the **Damage Year** data field, enter “1998.”
  - In the **Utilities (days)** data field, enter “1.” This represents the duration in days of the loss of function of the telecom facility. The utility itself would have to provide this downtime value for users to document.
- In the second row:
  - In the **Damage Year** data field, enter “2004.”
  - In the **Utilities (days)** data field, enter “2.”
- In the third row:
  - In the **Damage Year** data field, enter “2007.”
  - In the **Utilities (days)** data field, enter “3.”
- Select *View Damages* and note that, even though the recurrence intervals are unknown, the tool is still calculating them based on the number of events and the analysis duration. Lastly, make a mental note that the Before Mitigation annual damage value is $54,546.

The critical inputs at the top of this screen are the **Analysis Year** data field and **Year Built** data field. These two dates establish the “time window” through which the damage events are seen by the Tool {[Analysis Year] – [Year Built] + 1} = Analysis Duration. The Help content also provides this information with an example. The more damaging events, the more projected events the project will mitigate over the project’s useful life. If the Unknown Frequency Calculator is being used, then the tool calculates recurrence intervals/frequencies in a rudimentary way, even if they aren’t known by users. A minimum of 10 years is required for the analysis duration.

Analysis Duration data field can be modified if users have a valid and documented reason. For example, the analysis duration can be adjusted for certain situations like a change of a river's flow or if the date of construction for rural electric or roads is unknown or very old. Appropriate documentation would be required, such as floodplain map change correspondence, engineering reports or photography showing the rapid change of land use development. Another reason for changing the analysis duration is if a building has undergone substantial structural renovations since it was originally constructed. Again, documentation such as engineering reports and tax assessor records would be required. Shortening the Analysis Duration will increase the BCR because the number of damage events will be seen through a shorter time window.

Once the Analysis Duration has been determined, the Historic Damages Before Mitigation table information should be completed. For this, the **Damage Year** data field, **Recurrence Interval** data field and damage values should be entered into the screen. There must be documented historical damages/losses from two or more hazard events of known frequencies, based on:

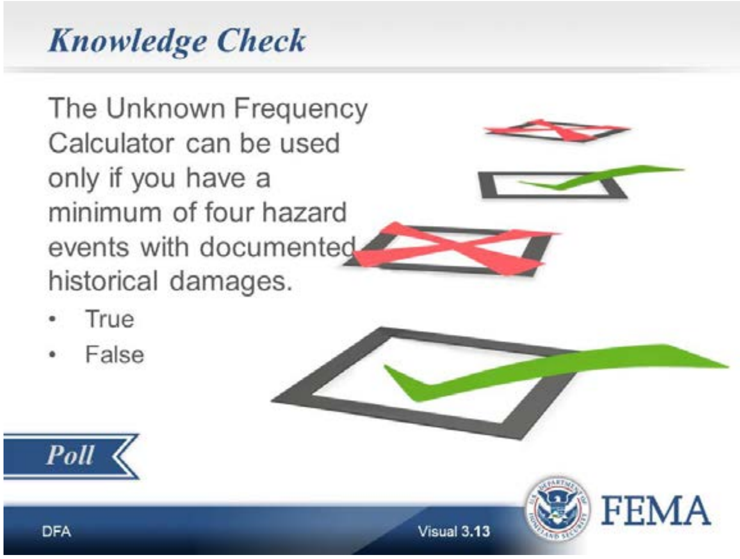
- FEMA Project Worksheets/Damage Survey Reports;
- Insurance claims or repair records; or
- Newspaper articles citing other credible sources.

There must be documented historical damages/losses from three or more hazard events of unknown frequencies, based on:

- Insurance records (if used to assess how often events occurred);
- Online information from FEMA's National Flood Insurance Program's BureauNet;
- Newspaper accounts when they cite other credible sources; or
- Other documentation not listed (e.g., engineering or technical reports or documentation from the National Weather Service, National Oceanic and Atmospheric Administration (NOAA) or National Climatic Data Center).

If there is documentation for additional damages—not just loss of function—the BCA Tool allows users to add columns to the Damages Before Mitigation Table. For example, at the Telephone Data Center, let's say that hazard events have caused damage to equipment, and this has been documented. Those values can be used in the calculations as long as the project will cause these damages to be avoided in future floods. To add this information:

- Select the column adder icon in the upper left hand corner of the table and select *New Column*.
- Enter a damage class. Let's call it "Equipment damage" (has to be something with a dollar value).
- Select *OK,* and an "Equipment damage" column added in the Damages Before Mitigation table should appear.
- Type $50,000 (or any dollar value) of equipment damage for the 1998 event.
- Dollar values in the column heading can be inflated to today's value. This is not the case for "days" values because those values are considered to be a current value. Note that the dollar values are automatically assumed to be inflated to current dollars. Turn this off by mousing over the box under the "Are damages in current dollars?" column and selecting "Yes" from the drop-down menu.
- The case study does not assume any additional damages in the case study, so to delete the added column, select the column adder icon and highlight the column just added, and then select *Delete Column*. That column should now be gone from the Damages Before Mitigation table.
- Select *Save and Continue*. The DAMAGES AFTER MITIGATION screen is displayed.



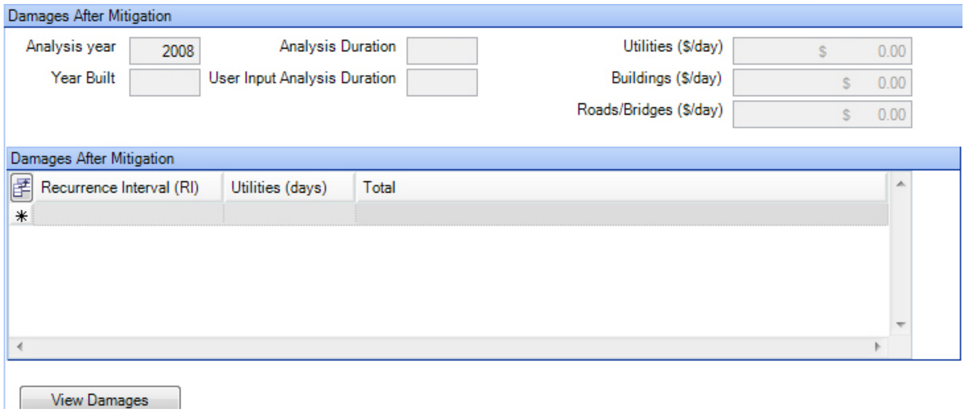
Visual 3.13: DFA Module Knowledge Check

Answer the following knowledge check.

The Unknown Frequency Calculator can be used only if you have a minimum of four hazard events with documented historical damages.

- True
- False

Write the correct answer below.



Screenshot 3.10: Damages After Mitigation

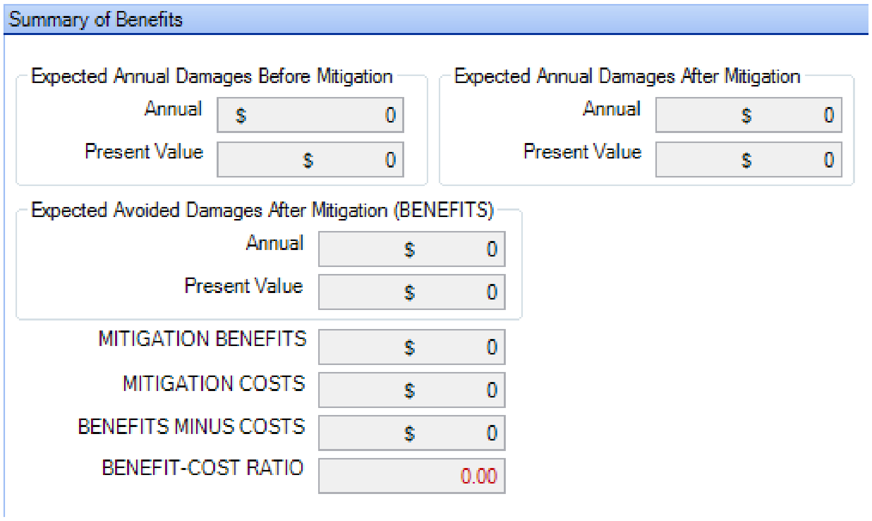
The purpose of this screen is to enter the effectiveness of the mitigation measure once it is put in place. It is important to remember that most mitigation projects do not eliminate all risk, except for acquisition and relocation projects. There should be a BCR value in the upper right of the screen; however, this assumes that the project is completely effective. In this case, for a floor elevation project, the assumption cannot be made that there are no after-mitigation damages. Other modules can calculate the project effectiveness; however, for DFA, users need to tell the tool how effective the mitigation measure will be. For example, due to space limitations, a larger culvert may only be able to pass a 25-year event, but it only passes a 5-year event now. This means that the damages after mitigation will be the same as before mitigation for anything greater than a 25-year flood. It is common for larger recurrence interval events (100-year, 500-year, etc.) to be the same before-vs.-after mitigation due to the higher design costs to mitigate for these rarer events. See the Help content to address other hazards.

For this case study, enter the following:

- In the first row:
  - In the **Recurrence Interval** data field, enter "50."
  - In the **Utilities** data field, enter "1."
- In the second row:
  - In the **Recurrence Interval** data field, enter "100."
  - In the **Utilities** data field, enter "2."
- Select *View Damages* and note that the annualized damages are calculated to be $12,769. Remember that the Before-Mitigation annualized damages were $54,546, so damages have been significantly reduced, but not eliminated.

In this screen, the **Analysis Year, Year Built** data field, **Analysis Duration** data field and any added damage classes are populated from data entered in the previous screen. Project effectiveness data will need to be input into the Damages After Mitigation table. This data can be acquired from a reliable source—usually an engineer or from product specifications—stating the level of effectiveness of the proposed project. Some theory can be used (with documentation), but it has to be based on the level of effectiveness information from a reliable, competent, documented source.

Select *Save and Continue*. The SUMMARY OF BENEFITS screen is displayed.



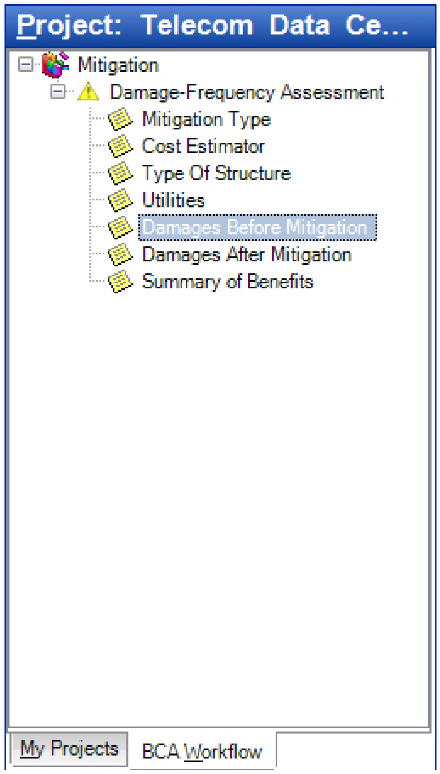
Screenshot 3.11: Summary of Benefits

The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

Remember from Unit 1that this screen has three sections. The top section of the screen displays the Before and After Mitigation values that have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. The next section of the screen shows the impact of the project or the benefits. Finally, in the bottom section of the screen, are both the benefits and the costs, the difference between the two values, and the most important value—the **Benefit-Cost Ratio** data field. This is the benefits divided by the costs.

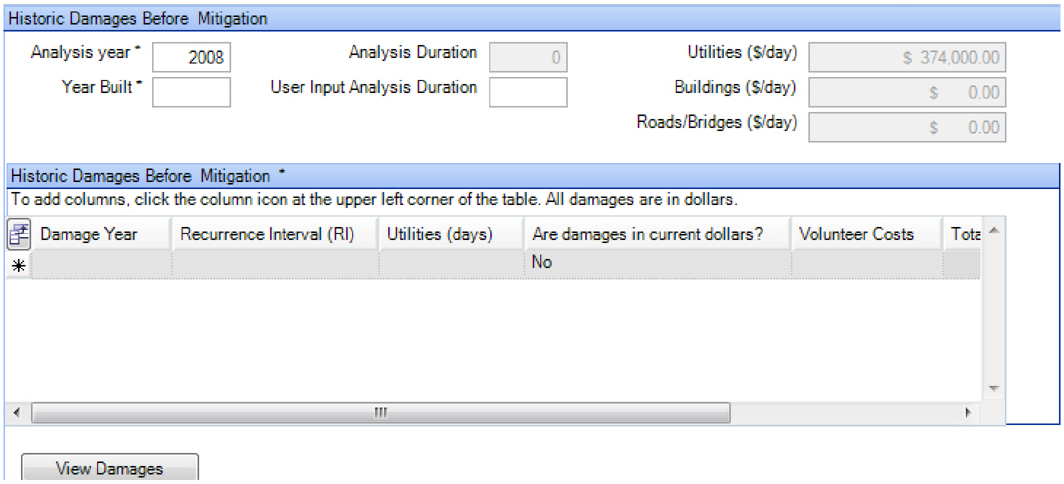
Steps One through Four of the BCA process are now complete. To complete Step Five: Export the BCA, do the following steps:

- Select *Home* on the basic navigation toolbar. The Quick Start Area is displayed.
- Select the Export BCA icon in the diagram. A list of the projects created is displayed.
- Select “Charleston Data Center Floodproofing” as the project to export. The Windows Explorer dialog box is displayed. Note that the file type is "zip” by default.
- In the **File Name** field, enter “Charleston_Data_Center.”
- Save the zip file to the desired location on the computer.



Screenshot 3.12: BCA Workflow Tab

By selecting the BCA Workflow tab beneath the Project window, the menu of available data screens can be used to navigate between screens.



Screenshot 3.13: Historic Damages Before Mitigation

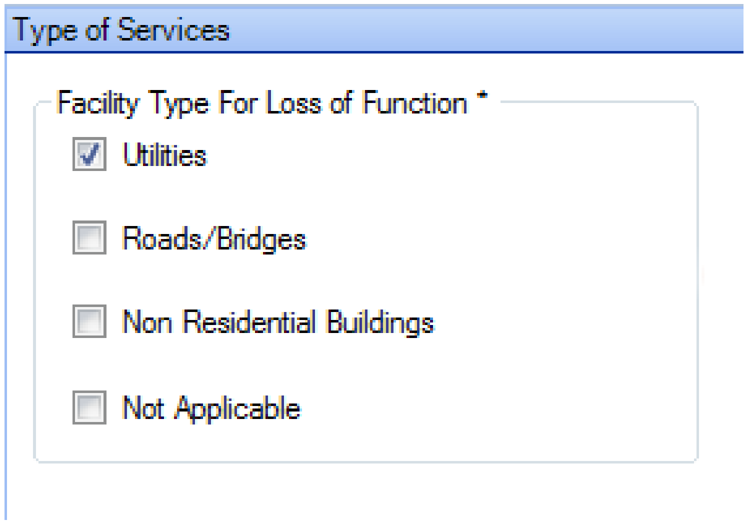
Double-click on "Damages Before Mitigation" to navigate directly to the HISTORIC DAMAGES BEFORE MITIGATION screen.

To test understanding of the Analysis Duration and its impact on the BCR, if the Analysis Year is changed to the current year, what would happen to the BCR? The expected result is the same number of damage events over a longer time period to result in a lower BCR.

For this Charleston case study, enter the following:

- In the **Analysis Year** data field, type the current year.
- Leave all the other values on this page the same as before.
- Select *Save and Continue*. The DAMAGES AFTER MITIGATION screen is displayed.

Notice that changing the **Analysis Year** to the current year increases the analysis duration and causes the BCR to decrease.



Screenshot 3.14: Type of Services

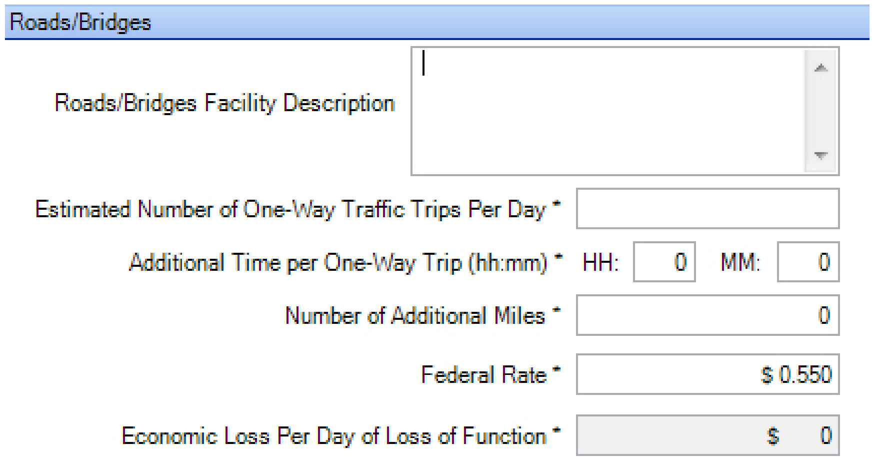
Using the BCA Workflow tab, select “Type of Structure” to navigate directly to that screen.

The Charleston example dealt with the LOF for a utility, but what if the project seeks to reduce the LOF for roads or a critical facility?

To select a different facility type, enter the following:

- In the **Facility Type for Loss of Function** data field, select “Roads/Bridges” and “Non Residential Buildings” and deselect “Utilities.”
- Select *Save and Continue*. The ROADS/BRIDGES screen is displayed.

The “Not Applicable” facility type moves directly to the HISTORIC DAMAGES BEFORE MITIGATION screen and would be for residential buildings or other buildings or facilities that are not a utility, road or bridge or non-residential building.



Screenshot 3.15: Roads/Bridges (Update screenshot upon V5.0 release)

The purpose of this screen is to calculate the LOF benefits for road and bridge mitigation projects. These types of projects can avoid detours caused by damage during a hazard event.

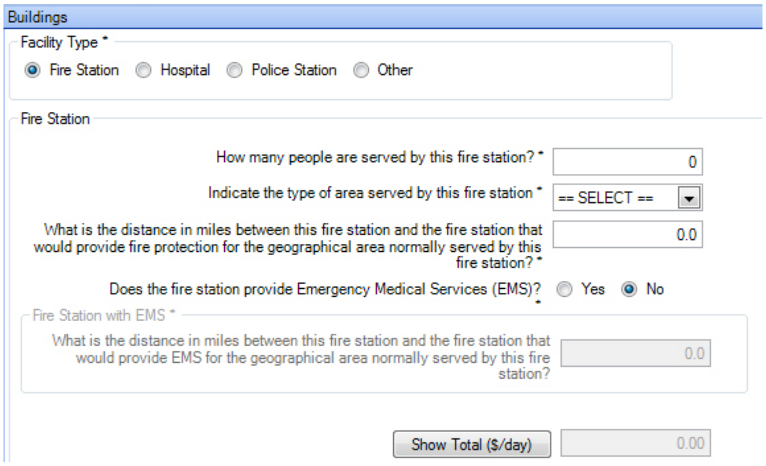
The critical inputs for this screen are the **Estimated Number of One-Way Traffic Trips Per Day** data field**, Additional Time per One-Way Trip** and **Number of Additional Miles** data field.

The **Estimated Number of One-Way Traffic Trips Per Day** data field comes from the traffic count data for the road or bridge to be mitigated. This data can be acquired from local or State road department agencies and must be documented. See the Help content for additional guidance.

The **Additional Time per One-Way Trip** data field is the duration of a detour (in hours and minutes) of an avoided detour. There is a saying that "Time is money," and the tool has a standard calculation for the value of a person's time. It can be minimal if the detour doesn't take drivers significantly out of their way. With the availability of easily accessible mapping platforms Geographic Information Systems or online mapping programs like Google Maps, Google Earth or MapQuest, a good map can be provided easily. A printout of the map showing the time calculations can be used as documentation.

The **Number of Additional Miles** data field counts the extra miles that the detour will cause. The Additional Miles value is the length of the detour, subtracted by the length of the normal route—this value can be minimal if the detour doesn't take drivers significantly out of their way. The information can be acquired by accessing the same mapping applications just discussed, with the printouts used as documentation.

Select *Save and Continue*. The BUILDINGS screen is displayed.



Screenshot 3.16: Buildings-Fire Station

The purpose of this screen is to calculate the LOF benefits for a building used as a fire station. If Fire Station A is out of service, forcing Fire Station B to serve a larger geographical area, the average response time will increase. With that increase in the response time, fire losses will increase as well.

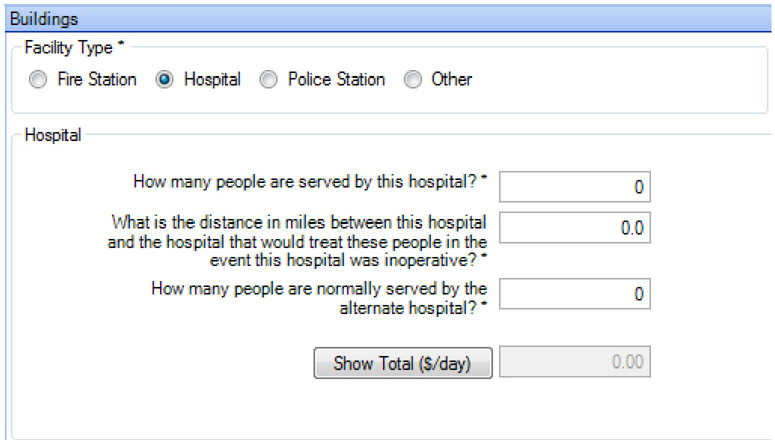
The following text explains the critical inputs for this screen. The value entered in the **How many people are served by this fire station?** data field is the number of people from the surrounding community who would be affected if the fire station being mitigated was damaged.

In the **Indicate the type of area served by this fire station** data field**,** identify the geographic area served by the fire station as urban, suburban, rural or wilderness.

The value entered in the **What is the distance in miles between this fire station and the fire station that would provide fire protection for the geographic area normally served by this fire station?** data field is the number of additional miles it would take the next closest fire station to respond to emergency calls in the community served by the fire station being mitigated.

The selected answer in the **Does fire station provide Emergency Medical Services (EMS)?** data field tells the tool if casualties avoided by the project need to be added to the calculation. If “No” is selected, then no additional information is needed. If “Yes” is selected, then a value for casualties avoided by the project will be added to the equation and the distance (in miles) it would take the next closest fire station to respond to provide EMS service in the community will have to be entered.

Potential documentation sources for the above critical inputs are the fire station itself, a community planning department, or other reliable source. Map and distance information can be obtained from a Geographic Information System (GIS) or from an online mapping source, with a printout of the map used as documentation.



Screenshot 3.17: Buildings-Hospital

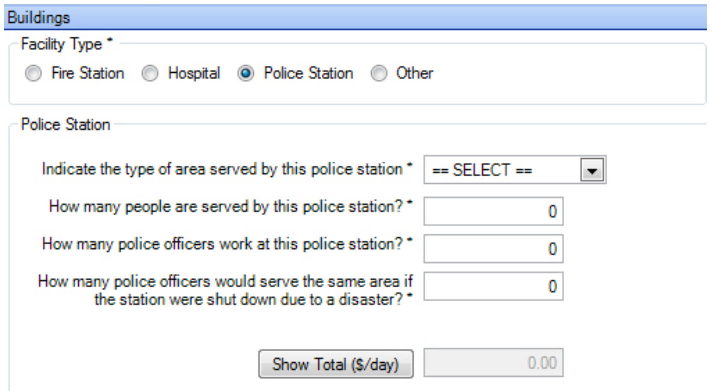
The purpose of this screen is to calculate the LOF benefits for a building used as a hospital. The calculation estimates how the temporary loss of function of a hospital affects the users of the Emergency Department (ED). This methodology assumes that if a hospital (for example, Hospital A) is temporarily shut down, then its users will choose the second nearest hospital (Hospital B) in case of an emergency. It also assumes that only patients using the ED, whether or not they are admitted to the hospital, will be affected. The increased travel time and the additional time to be seen at Hospital B are included as increased casualties avoided by the project.

The following text explains the critical inputs for this screen. The value entered in the **How many people are served by this hospital?** data field is the number of people from the surrounding community who would be affected if the hospital being mitigated was damaged.

The value entered in the **What is the distance in miles between this hospital and the hospital that would treat these people in the event this hospital was inoperative?** data field is the number of additional miles it would take to reach the next closest hospital to which emergencies could be rerouted from the community served by the hospital being mitigated.

The value entered in the **How many people are normally served by the alternate hospital?** data field shows the number of people from the surrounding community who are already served by the alternate hospital.

Potential documentation sources for the above critical inputs are the hospital itself, a community planning department, or other reliable source. Map and distance information can be obtained from a Geographic Information System (GIS) or from an online mapping source, with a printout of the map used as documentation.



Screenshot 3.18: Buildings-Police Station

The purpose of this screen is to calculate the LOF benefits for a building used as a police station. The calculation estimates the increase in crime that results from a decreased police presence. It also calculates the increased cost to society of that increased crime. If a mitigation project prevents the loss of function of a police station, these would both qualify as losses avoided, or project benefits.

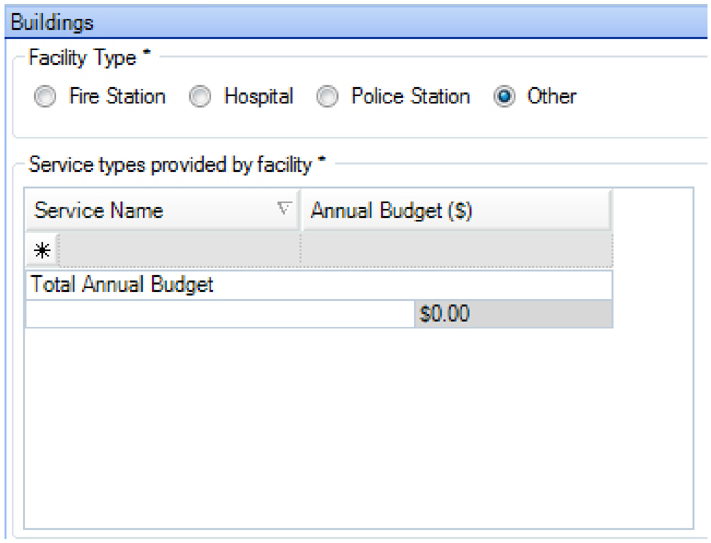
The following text explains the critical inputs for this screen. The **Indicate the type of area served by this police station** data field identifies the type of geographic area being served by the police station as urban, suburban, rural or wilderness.

The value entered in **How many people are served by this police station?** data field is the number of people from the surrounding community who would be affected if the police station being mitigated was damaged.

The value entered in the **How many police officers work at this police station?** data field is the number of police officers currently based in the police station being mitigated that serves the surrounding community.

The value entered in the **How many police officers would serve the same area if the station were shut down due to a disaster?** data field is the number of police officers that would serve the surrounding community if the police station being mitigated was damaged.

Potential documentation sources for the above critical inputs are the police station itself, multiple police stations that would provide additional officers if the police station being mitigated were down, a community planning department, or other reliable source. Map and distance information can be obtained from a Geographic Information System (GIS) or from an online mapping source, with a printout of the map used as documentation.



Screenshot 3.19: Buildings-Other

The purpose of this screen is to calculate the LOF benefits for a building housing a non-critical public service (i.e., a library, school, other government agency or a business).

The critical input for this screen is the **Annual Budget** data field**.** This value would come from either public information posted online or from the agencies/businesses housed in the building itself. If a government building houses multiple agencies with individual budgets, then the combined budgets should be used, along with documentation. If the entity involved is a school district and the mitigation project is looking at the loss of function of one school, then the school district will have to provide an annual budget for that one school.

Summary

Visual 5.14: Summary

Remember: It is always about risk, regardless of the hazard. Cost-effective mitigation projects address high-risk situations with lower costs and higher benefits.

The objectives in this unit were for participants to:

- Explain key DFA concepts.
- Identify eligible hazards.
- Explain the DFA Module data and documentation requirements.
- Completed a DFA Module BCA.

Unit 4
Tornado Safe Room

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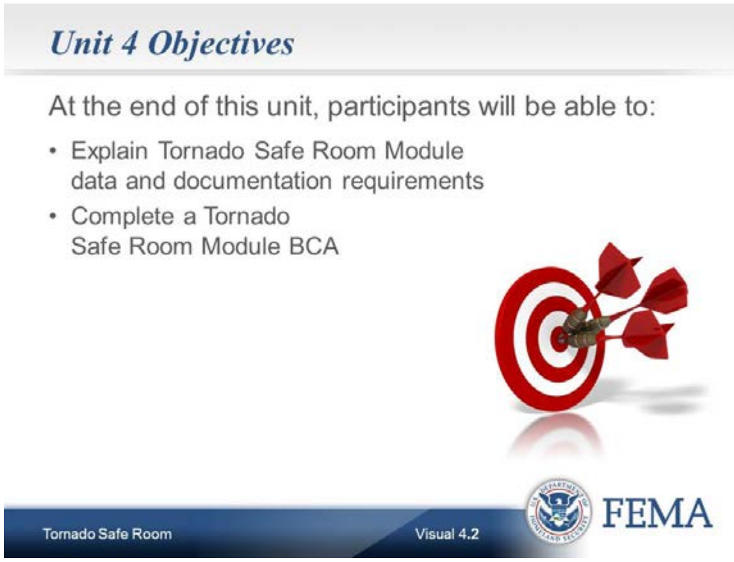
Unit 4 Tornado Safe Room Overview

Visual 4.1: Unit 4 – Tornado Safe Room

Welcome to Unit 4 of the Benefit-Cost Analysis: Entry Level course. This unit focuses on the Tornado Safe Room Module.

The case study handout is needed for this unit.

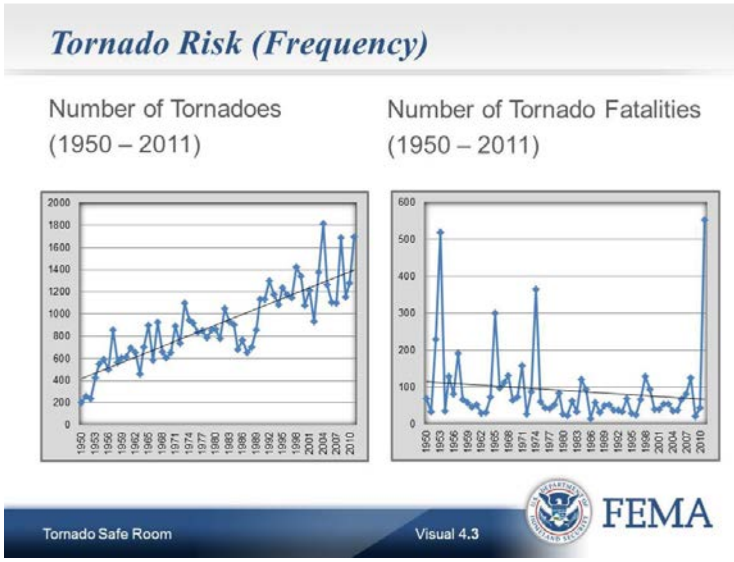


Visual 4.2: Unit 4 Objectives

Unit 1 covered the completion of a BCA using the Flood Module and an independent Flood Module case study. Unit 2 explained supplemental tools needed to complete more complicated analyses. In Unit 3, BCA Tool skills were applied by using the DFA Module. The purpose of Unit 4 is to complete a BCA, using the Tornado Safe Room Module. The objectives in this unit are for participants to:

- Explain Tornado Safe Room Module data and documentation requirements.
- Complete a Tornado Safe Room Module BCA.

Tornado Hazard Overview

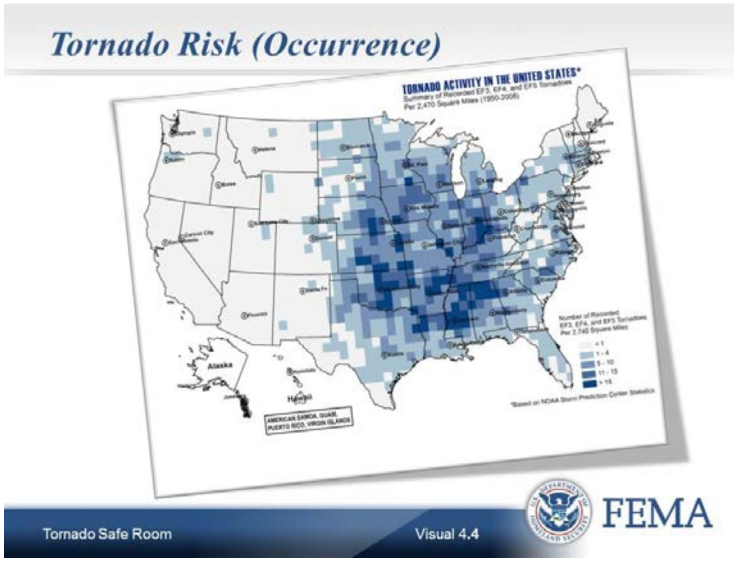


Visual 4.3: Tornado Risk (Frequency)

A tornado is defined as a violently rotating column of air, extending beneath a cumuliform cloud and can be visible as a funnel cloud. Tornadoes are among the most destructive weather events.

These graphs demonstrate that the number of detected tornadoes has increased since 1950. This is largely due to the invention and use of radar starting in 1950. More recently, storm chasing has led to more tornadoes being reported.

Along with radar and other technological advances, warnings have led to a steady decline in the number of tornado fatalities. However, as 2011 demonstrates, even good warnings do not mean that significant tornado deaths are impossible. With 2011 removed, the downtrend line since 1950 would be much steeper.



Visual 4.4: Tornado Risk (Occurrence)

The figure above shows the combined EF3, EF4, and EF5 tornado counts across the United States (the tornadoes most likely to produce injuries or deaths). Tornadoes have occurred most frequently in the Midwest. In some areas, these types of tornadoes have occurred more than 15 times in the time period from 1950 to 2008.

Enhanced Fujita (EF) Scale Classifications

Table TSR-6.5-1: Enhanced Fujita (EF) Scale Classifications

Categories	3-Second Wind Gust
EF0	65-85 mph
EF1	86-110 mph
EF2	111-135 mph
EF3	136-165 mph
EF4	166-200 mph
EF5	>200 mph

Tornado Safe Room Visual 4.5 FEMA

Visual 4.5: Enhanced Fujita (EF) Scale Classifications

The EF Scale is an improved version of the existing Fujita Scale for tornado severity and has been in effect since 2007. The tornado that devastated Greensburg, Kan. on May 4, 2007 was the first to register as an EF5 on the Enhanced Fujita Scale.

The EF Scale not only correlates wind speeds with damage, but it also takes into account the quality and type of structure that has been damaged in order to estimate wind speeds. An important criterion for the resulting EF Scale was to be able to easily associate it with the Fujita Scale so that data collected in previous years would not be lost.

The resulting scales contain the same six categories, from 0 to 5; however, the wind speeds have been adjusted in the EF scale for more accurate representation of the damages that occur within that category.

Visual 4.6: EF0 and EF1 Damages

The next several slides provide a brief description of the different tornado intensities. Photos are included to show representative damage for each EF rating.

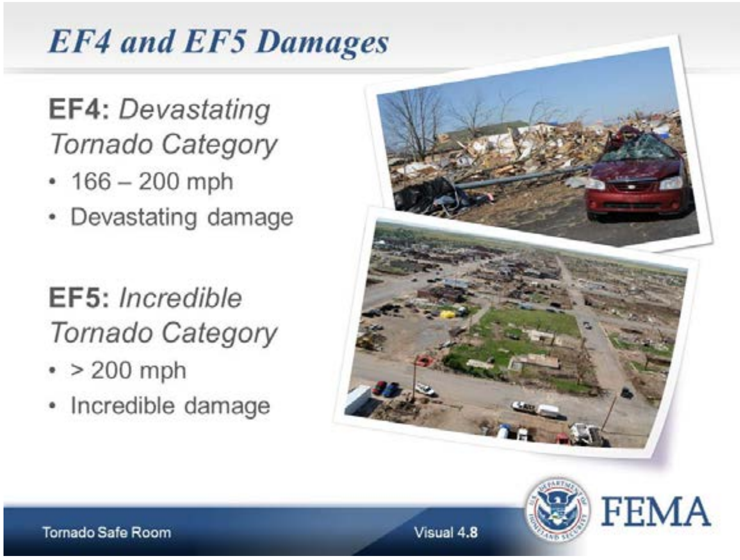
EF0–Gale Tornado 65–85 mph, Damage: Some damage to chimneys, breaks branches off trees, pushes over shallow-rooted trees and damages sign boards.

EF1–Moderate Tornado 86–110 mph, Damage: Peels surfaces of roofs, mobile homes pushed off foundations or overturned and moving autos pushed off roads.

Visual 4.7: EF2 and EF3 Damages

EF2–Significant Tornado 111–135 mph, Damage: Roofs torn off the frames of houses, mobile homes demolished, trains overturned, large trees snapped or uprooted and cars lifted off ground and thrown.

EF3–Severe Tornado 136 –165 mph, Damage: Roofs and some walls torn off well-constructed houses and most trees in forest uprooted.



Visual 4.8: EF4 and EF5 Damages

EF4–Devastating Tornado 166–200 mph, Damage: Well-constructed houses leveled, structures blown off weak foundations and cars and other large objects thrown about.

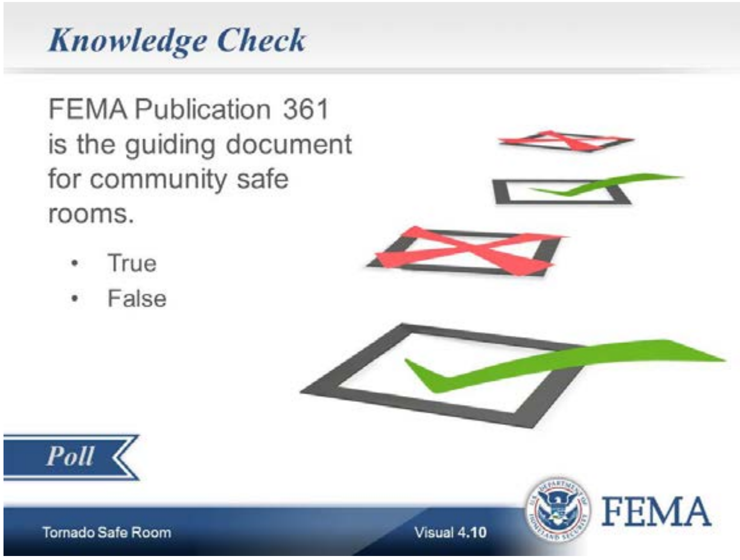
EF5–Incredible Tornado >200 mph, Damage: Strong frame houses are lifted off foundations and carried a considerable distance and disintegrated, automobile-sized missiles fly through the air in excess of 100 meters and trees debarked. Slab swept clean.

Visual 4.9: Tornado Safe Room Mitigation Types

Two types of safe room mitigation are residential safe rooms and community safe rooms.

A residential safe room is a small, specially designed ("hardened") room, such as a bathroom or closet, which is intended to provide a place of refuge for the people who live in the home. An external residential Safe Room is similar in function and design, but it is a separate structure installed outside the home, either above or below ground. According to FEMA Publication 320, a residential Safe Room or small community Safe Room can have a maximum occupancy of 16. To be considered a FEMA safe room, residential safe rooms must be designed and constructed according to the guidelines specified in FEMA Publication 320, *Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business*, found at
http://www.fema.gov/library/viewRecord.do?id=1536

Community Safe Room: A Community Safe Room is designed and constructed to protect a large number of people from a natural hazard event. The number of persons taking refuge in the Safe Room can be up to several hundred or more. To be considered a FEMA safe room, community safe rooms must be designed and constructed according to the guidelines specified in FEMA Publication 361, *Design and Construction Guidance for Community Safe Rooms,* found at
http://www.fema.gov/library/viewRecord.do?id=1657



Visual 4.10: Knowledge Check

Answer the following knowledge check.

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

- True
- False

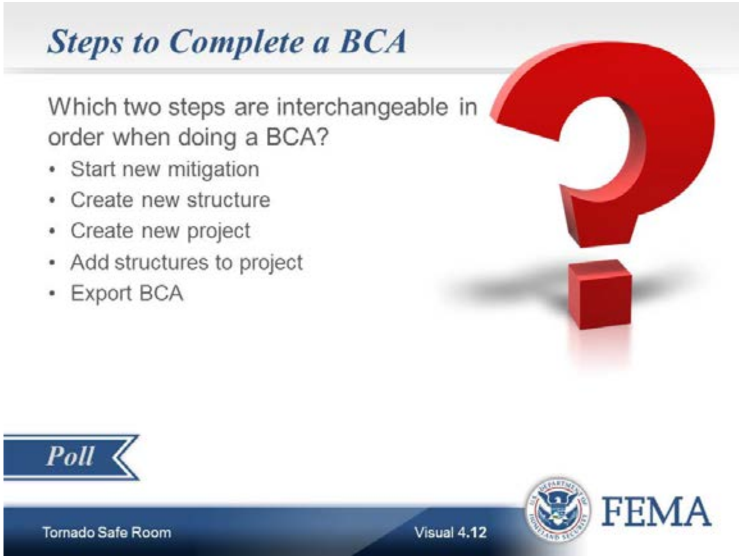
Write the correct answer below.

Tornado Safe Room Module Walkthrough

Visual 4.11: BCA Tool Walkthrough

Launch the BCA Tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, let the host know using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem. The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics



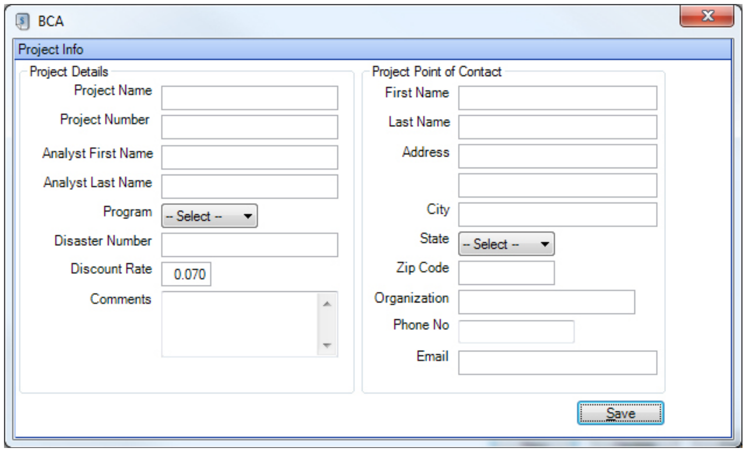
Visual 4.12: Steps to Complete a BCA

Answer the following review question.

Which two steps are interchangeable in order when doing a BCA?

- Start new mitigation.
- Create new structure.
- Create new project.
- Add structures to the project.
- Export BCA.

Write the correct answer below.



Screenshot 4.1: Project Info

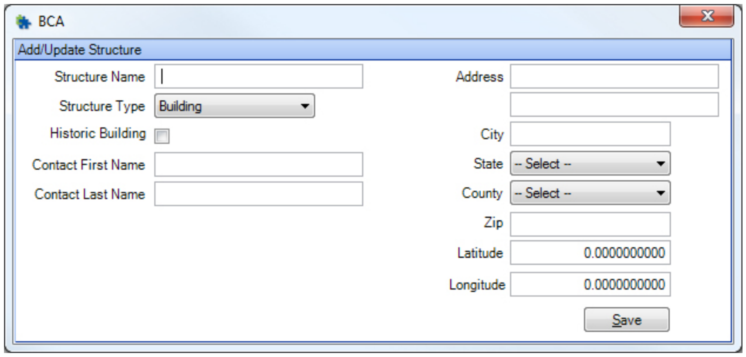
Open the Tornado Safe Room Module Case Study handout.

In this case study, the project proposes to retrofit the existing Twister City Grocery Store as a community safe room. This safe room will provide shelter to nearby residents in the event of a tornado.

The first step to completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start Area to complete Step One.

- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter “Twister City Grocery Safe Room.”
- In the **Project Number** data field, enter “987.”
- In the **Analyst First Name** data field, enter “Robert.”
- In the **Analyst Last Name** data field, enter “Smith.”
- In the **Program** data field, select “PDM.”
- There is no need to enter a value in the **Disaster Number** data field because this is not a Hazard Mitigation Grant Program (HMGP) subapplication. Disaster numbers are assigned for disasters that are declared a Federal disaster by the President of the United States. The HMGP program is the only post-disaster mitigation program; therefore, it is the only program for which a disaster number is relevant.
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.
- In the **Contact Name** data fields, enter “Barbara Jones.” This information in the Project Information window is for the local point of contact for the project.
- In the **Address** data field, enter “123 Main Street.”
- In the **City** data field, enter “Twister City.”
- In the **State** data field, select “Oklahoma.”
- In the **Zip Code** data field, enter “74103.”
- In the **Organization** data field, enter “Town of Twister City.”
- In the **Phone Number** data field, enter “555 555-5555.”
- In the **Email** data field, enter “bjones@TwisterCity.gov.”

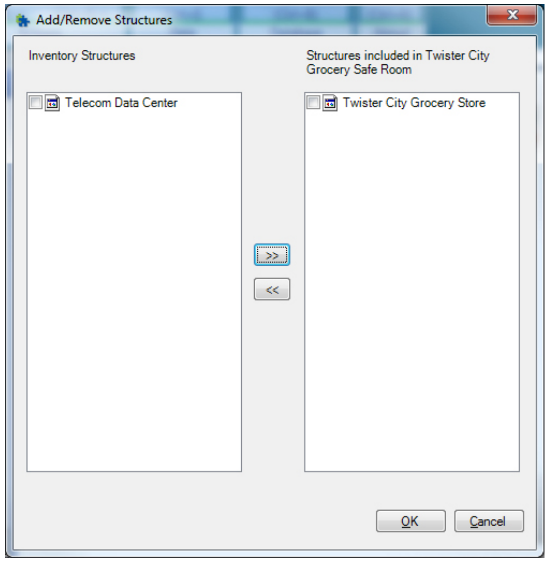
- Select *Save*. The Tool displays the “Project information saved successfully” message. Select *OK* to return to the Quick Start Area.



Screenshot 4.2: Add/Update Structure

The second step to completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start Area to complete Step Two.

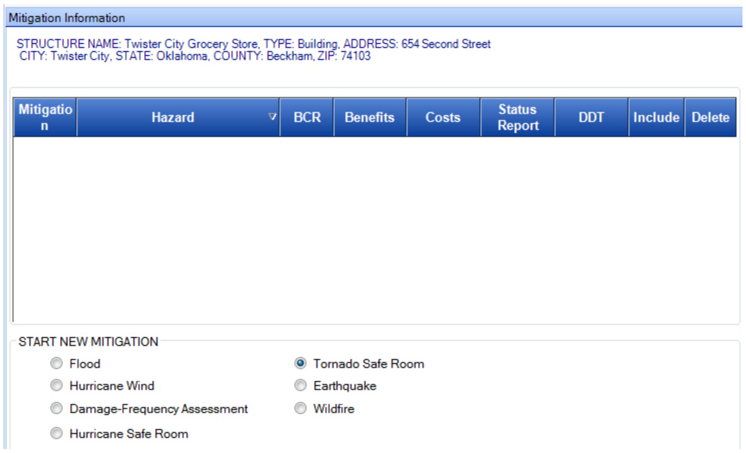
- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter "Twister City Grocery Store."
- In the **Structure Type** data field, select "Building."
- In the **Historic Building** data field, leave the box unchecked.
- In the **Contact First Name** data field, enter "William." The contact information in the Structure Information window is for the property owner.
- In the **Contact Last Name** data field, enter "Brown."
- In the **Address** data field, enter "143 Windy Avenue."
- In the **City** data field, enter "Twister City."
- In the **State** data field, select "Oklahoma."
- In the **County** data field, select "Beckham." The State and County is required for the Tornado Safe Room Module so the tool can look up and pull in the tornado risk data.
- In the **Zip** data field, enter "74103."
- In the **Latitude** data field, leave blank.
- In the **Longitude** data field, leave blank.
- Select *Save*. The tool displays the "Structure saved successfully" message. Select *OK* to return to the Quick Start Area.



Screenshot 4.3: Add/Remove Structures

The third step to completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start Area to complete Step Three.

- Select *Add Structures to Project* to display a list of existing projects.
- Select the “Twister City Grocery Safe Room” project. The Add/Remove Structures dialog box is displayed.
- Select the “Twister City Grocery Store.”
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the “Add/Remove Structures Succeeded” message. Select *OK* to return to the Quick Start Area.

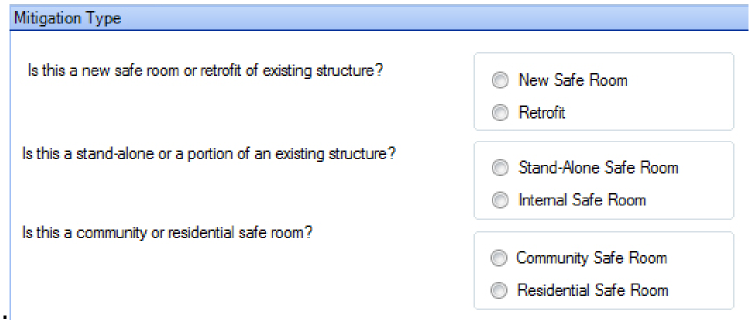


Screenshot 4.4: Mitigation Information

The fourth step to completing the BCA is to start a new mitigation. Use the *Start New Mitigation* icon in the Quick Start Area to complete Step Four.

- Select *Start New Mitigation* to display a list of existing projects.
- Select the "Twister City Grocery Safe Room" project.
- Select the "Twister City Grocery Store" structure. The MITIGATION INFORMATION screen is displayed.
- In the projects window on the left, select *Help*. The list of available Help topics for this screen is displayed.
- In the Start New Mitigation section at the bottom of the screen, select "Tornado Safe Room."
- In the upper right part of the screen, select *Save and Continue.* The TORNADO SAFE ROOM MITIGATION TYPE screen is displayed.

The following screens that will be discussed are all part of adding a new mitigation. After the data are entered in all the screens, the tool completes the BCA and generates the BCR based on the data entered.

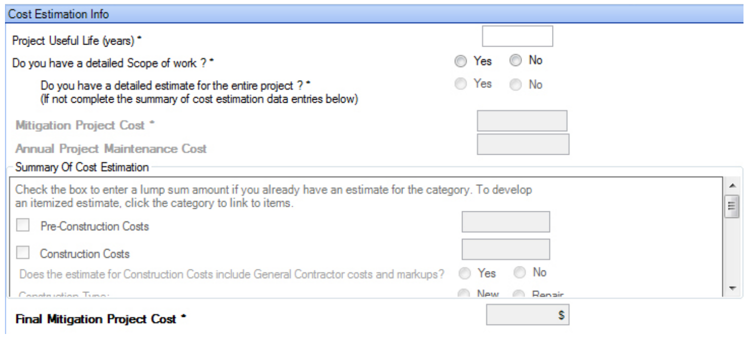


Screenshot 4.5: Mitigation Type

The case study handout identifies the tornado safe room mitigation type as a retrofit community safe room.

- Hover the mouse on each tornado safe room mitigation project type. A screen tip is displayed, giving a brief description of that project type.
- To be considered for funding under HMA, tornado safe room projects must include a descriptive statement of the operations and maintenance plan at the time of application.
- Select “Retrofit.”
- Select “Internal Safe Room.”
- Select “Community Safe Room.”
- Select *Save and Continue*. In the Tornado Safe Room Module, the COST ESTIMATION INFO screen is displayed.

In the workplace, the tornado safe room mitigation type can determined from the detailed scope of work, which is a required part of the subapplication.



Screenshot 4.6: Cost Estimation Info

The purpose of this screen is to establish the "C" or "costs" needed to calculate the BCR. Important data fields in this screen are:

- **Project Useful Life (PUL)**
- **Mitigation Project Cost**
- **Annual Project Maintenance Cost**

On this screen, enter the following:

- In the **Project Useful Life** data field, enter "30."
- In the **Do you have a detailed Scope of Work?** data field, select "Yes."
- In the **Do you have a detailed cost estimate for the entire project?** data field, select "Yes."
- In the **Mitigation Project Cost** data field, enter "$723,500.00."
  If project costs need to be escalated:
  - In the **Does estimate reflect current prices?** data field, select "Yes."
- In the **Annual Project Maintenance Cost** data field, enter "$1,000.00."
- Note that the tool filled in the **Final Mitigation Project Cost** data field.

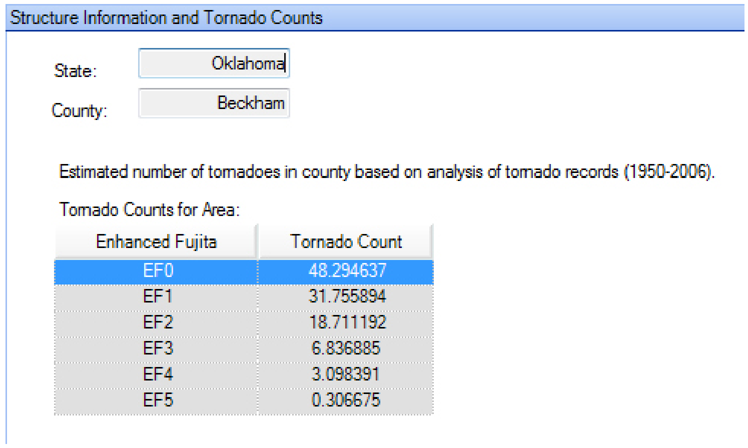
The **PUL** data field is important because it establishes the timeframe to calculate annualized benefits. Raising or lowering the **PUL** value impacts the final BCR. Higher values extend the duration over which benefits are calculated, thus making the final BCR higher. This data is required for calculating the BCR and can be obtained from the PUL table.

The **Mitigation Project Cost** data field is important because it provides the basis for the "cost" value in the benefit-cost analysis. Raising or lowering the **Mitigation Project Cost** value impacts the final BCR—the higher the cost, the lower the BCR. This data is required for calculating the BCR and can be obtained from a valid and reliable source. Valid and reliable sources include: licensed building contractors or engineers; national cost estimates guides (e.g., RS Means, Marshall & Swift); and historic costs of completed similar mitigation projects. Users may also use the tool's built-in cost estimator. If entering a cost estimate provided by a valid and reliable source, support the data by uploading the cost estimate document signed and certified by the source. If using the tool's built-in cost estimator, support each entry by uploading documentation for each of the inputs. For the Tornado Safe Room Module, chances are that a detailed budget estimate will be given by a licensed architect or professional engineer.

Remember from Unit 1 that the **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness. Remember also that maintenance costs are the responsibility of the local entity submitting the project; therefore, they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

Like the Flood Module, in the Tornado Safe Room Module, the COST ESTIMATION INFO screen is the first screen where it is important to upload documentation to support the data entered. To upload documents so that they will be attached to the analysis, use the Justification/Documentation section at the bottom of the screen. The process will be the same as was demonstrated in the Flood Module.

Select *Save and Continue*. The STRUCTURE INFORMATION AND TORNADO COUNTS screen is displayed.



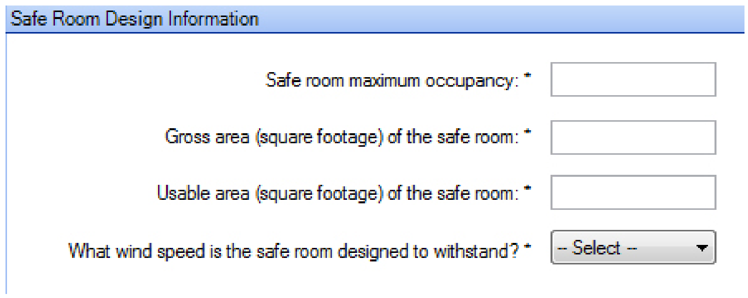
Screenshot 4.7: Structure Information and Tornado Counts

The purpose of this screen is to provide the tornado risk statistical data that is the basis for the frequency and severity calculations done behind the scenes. There are three specific Help questions on this page.

- Where do the state and county come from?
- What is the Enhanced Fujita Scale?
- How are the tornado counts calculated?

The tornado risk statistics provide the basis for determining risk from frequency/severity of tornadoes. The BCA module automatically populates these tornado statistics based on the Structure's County and State values.

Select *Save and Continue*. In the Tornado Safe Room Module, the SAFE ROOM DESIGN INFORMATION screen is displayed



Screenshot 4.8: Safe Room Design Information

The purpose of this screen is to calculate how large the safe room needs to be; this is based on the number of occupants and the uses of the space. Some type of dual use is assumed, which means that fixed objects will reduce the needed space for people inside.

For this case study, enter the following:

- In the **Maximum Occupancy** data field, enter "500."
- In the **Gross Area** data field, enter "2,959."
- In the **Usable Area** data field, enter "2,515." The math works like this:
  - 500 people at 5 square feet per person equals 2,500 square feet.
  - At an occupancy of 500, this also assumes 3 handicapped individuals, which means an additional 15 square feet, or a total of 2,515 square feet.
  - In this case, the community is planning to have open plan furnishings and no fixed seating. This means there is a reduction of 15 percent from the gross area to the usable area. So by dividing the usable square footage of 2,515 by 0.85, the gross area is 2,958.8, or rounded up to 2,959.
- In the **Designed Wind Speed** data field, select "250."

The critical inputs for this screen are the **Maximum Occupancy**, **Gross Area**, **Usable Area**, and the **Designed Wind Speed** data fields. There are five Help topics related to these data fields:

- How do I determine safe room maximum occupancy?
- What are some data sources for occupancy data?
- How do I determine the gross area of the safe room?
- How do I determine the usable area of the safe room?
- How do I determine the wind speed the safe room is designed to withstand?

Maximum occupancy is the number of people the safe room can hold. It may be only designed for the number of students and faculty of a school, or it could assume a population in a certain buffer area from the site.

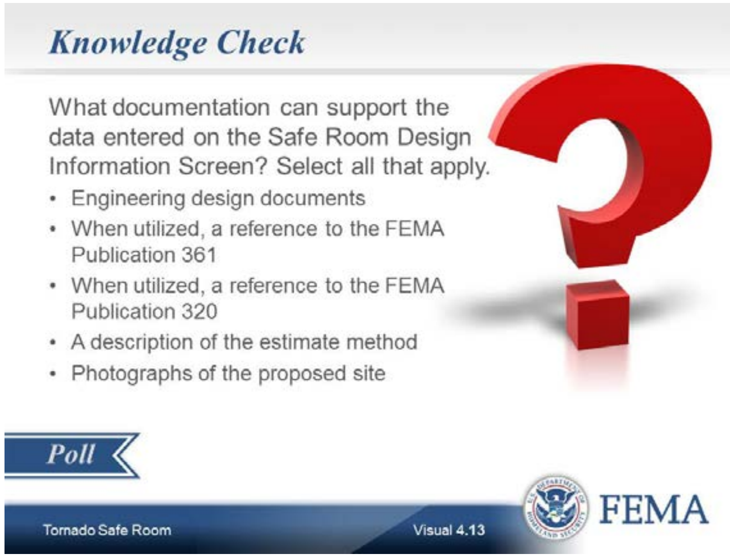
Gross Area is the total area of the safe room including any room obstructions (i.e. columns, room partitions, and walls), fixed or moveable objects, furniture or other equipment and features placed in the safe room. This information should be found on the proposed safe room's design drawings.

Usable Area is a reduction of space depending on how the safe room will be used and should accommodate the number of people input in **Maximum occupancy**. For community safe rooms, FEMA Publication 361 requires 5 square feet per person and 10 square feet for a handicapped individual and assumes there will be 1 handicapped person for every 200 occupants. The reduction in space is impacted by the planned use of the proposed safe room. A reduction is required from the **Gross Area** and will be determined by whether a safe room will be used only as a safe room or if the area will have multiple uses in addition to being a safe room—such as a school gymnasium or classroom. Please see the help content “How do I determine the usable area of the safe room?” for more information. More detailed information is provided in the *Supplement to the Benefit-Cost Analysis Reference Guide* (FEMA, 2011) which can be downloaded from FEMA’s BCA website. The URL was provided in Unit 2.

Designed wind speed is based on the tornado data. The tool can calculate how strong the safe room needs to be designed. If a building is built only to an EF1 level in Oklahoma, then the project still may come out cost-effective, but not as cost effective if it were designed to an EF5 level, as needed. FEMA will only approve if designed to the appropriate wind speed.

This wind speed map from FEMA Publication 361, *Design and Construction Guidance for Community Safe Rooms*, can be used to determine the designed wind speed for a safe room. This document can be downloaded from http://www.fema.gov/library/index.jsp.

Select *Save and Continue*. The SAFE ROOM STRUCTURE TYPE screen is displayed.



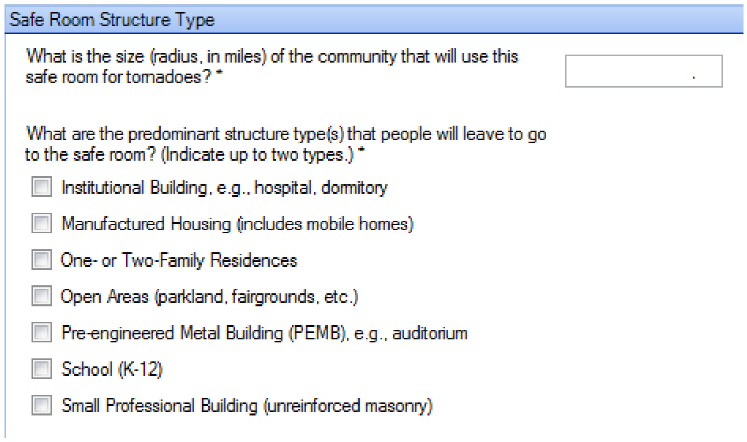
Visual 4.13: Knowledge Check

Answer the following knowledge check:

What would be applicable as supporting documentation for the data entered on the Safe Room Design Information Screen? Select all that apply.

- Engineering design documents
- When utilized, a reference to the FEMA Publication 361
- When utilized, a reference to the FEMA Publication 320
- A description of the estimate method
- Photographs of the proposed site

Write the correct answer below.



Screenshot 4.9: Safe Room Structure Type

The purpose of this screen is to input the structure types that the safe room occupants (from the occupancy value) will be evacuating from to get to the safe room. For this case study, enter the following:

- In the **Safe Room Radius** data field, input “0.5.”
- In the **Predominant Structure Types** data field, select “One or Two Family Residences” and “Small Professional Building.” The maximum number of structure types that may be selected is two.

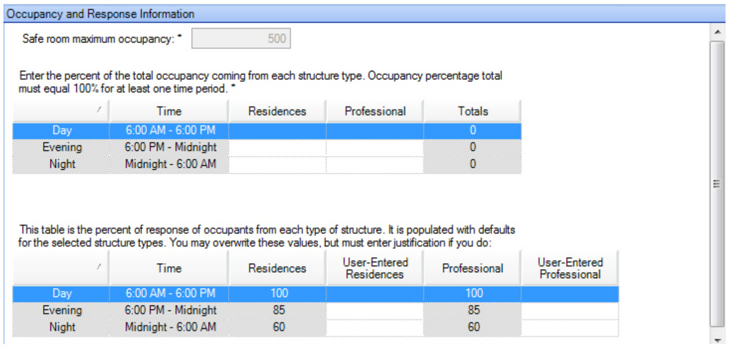
The building performance (wind resistance) of each structure type determines the likelihood for casualties to be prevented. For example, evacuating from a mobile home to a safe room will prevent more casualties (and therefore provide more benefits) than evacuating from a more sturdily-constructed institutional building. There are three Help topics related to this screen:

- How do I determine the radius of the community that will use the shelter for tornadoes?
- How do I determine the predominant structure types currently used as safe rooms?
- Why can I only select two structure types? What if I have more?

The first critical input for this screen is the **Safe Room Radius** data field. The HMA Unified Guidance states that “the distance from the safe room for the at-risk population is based on a maximum walking travel time of 5 minutes or a maximum driving travel distance of approximately 0.5 mile.”

The second critical input for this screen is the **Predominant Structure Types** data field. Sufficient documentation includes maps with locations of sample structure types and photographs of the corresponding structure types located within the safe room service area or a letter from a local official that includes both structure types.

Select Save and Continue. The OCCUPANCY AND RESPONSE INFORMATION screen is displayed.



Occupancy and Response Information

Safe room maximum occupancy: * 500

Enter the percent of the total occupancy coming from each structure type. Occupancy percentage total must equal 100% for at least one time period. *

	Time	Residences	Professional	Totals
Day	6:00 AM - 6:00 PM			0
Evening	6:00 PM - Midnight			0
Night	Midnight - 6:00 AM			0

This table is the percent of response of occupants from each type of structure. It is populated with defaults for the selected structure types. You may overwrite these values, but must enter justification if you do:

	Time	Residences	User-Entered Residences	Professional	User-Entered Professional
Day	6:00 AM - 6:00 PM	100		100	
Evening	6:00 PM - Midnight	85		85	
Night	Midnight - 6:00 AM	60		60	

Screenshot 4.10: Occupancy and Response Information

The purpose of this screen is to determine the number of people who will be at risk at different times of the day. Both are tied to the predominant structure type(s) selected on the previous screen. Because benefits are calculated based on the number of casualties prevented and because different structure types have different wind performance, knowing how many occupants will be coming from each structure type is important. Response rates are pulled from research showing the average response rates during different time periods of the day. At home in the middle of the night, response will be lower than if school students are there and take shelter during the day.

For this case study, enter the following:

- In the **Occupancy** table, enter the following:
  - Residences: Day "25," Evening "80," Night "95"
  - Professional: Day "75," Evening "20," Night "5"
- In the **Response** table, assume the default response percentages.

The critical inputs for this screen are the **Occupancy** and the **Response**. Acceptable occupancy data for this input can come from the facility/school/building owners themselves or homeowners—any reliable, competent source that is in position to provide a reliable number. If all occupants are coming from one predominant structure type, then the occupancy percentage will not have to be split. If two predominant structure types are used, then the occupancy values for each are the percentage of the total safe room occupants from each structure type. The values have to be split between the two structure types, and at least one time period must equal 100 percent occupancy. Response data are default values that can be overridden with supporting documentation. See Help content.

Select *Save and Continue*. The OCCUPANCY RESULTS screen is displayed.

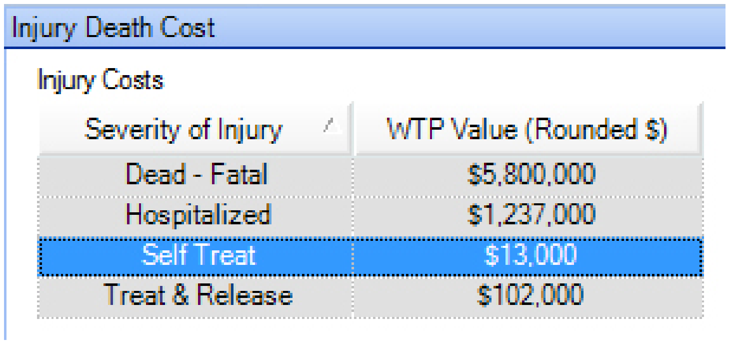
Occupancy Results

Calculated Number Of Occupants Per Structure Type Based On Occupancy Percentage And Warning Response: *

	Time	Residences	Professional
Night	Midnight - 6:00 AM	285.00	15.00
Evening	6:00 PM - Midnight	340.00	85.00
Day	6:00 AM - 6:00 PM	125.00	375.00
	Average Occupancy:	218.75	212.50

Screenshot 4.11: Occupancy Results

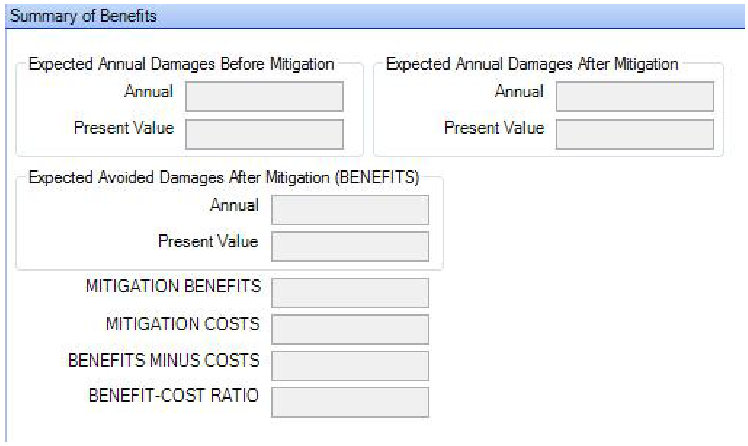
The purpose of this screen is to show the average occupancy results for each structure type from the previous screen. There is nothing to input on this page; it is for informational purposes only. However, the average occupancy value for each structure type is used in the benefits calculation. Select *Save and Continue*. The INJURY DEATH COST screen is displayed.



Screenshot 4.12: Injury Death Costs

The purpose of this screen is to display the economic value of different injury levels (including fatalities) used to calculate benefits from the casualties prevented. There is nothing to input on this screen.

Select *Save and Continue*. The SUMMARY OF BENEFITS screen is displayed.



Screenshot 4.13: Summary of Benefits

The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

As mentioned previously in Unit 1, this screen has three sections. The top section of the screen displays the Before and After Mitigation values that have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. The next section of the screen shows the impact of the project or the benefits. Finally, in the bottom section of the screen are both the benefits and the costs, the difference between the two values, and the most important value—the **Benefit-Cost Ratio**. This is the benefits divided by the costs.

Steps One through Four of the BCA process is now complete. To complete Step Five which is Exporting the BCA, do the following steps:

- Select *Home* on the basic navigation toolbar. The Quick Start Area is displayed.
- Select the Export BCA icon in the diagram. A list of the projects that have been created is displayed.
- Select “Twister City Grocery Safe Room” as the project that is to be exported. The Windows Explorer dialog box is displayed. Note that the file type is “.zip” by default.
- In the **File Name** data field, enter “Twister_City_Grocery.”
- Save the zip file on to the computer.

Summary

Visual 4.14: Summary

Remember: It is always about risk, regardless of the hazard. Cost-effective mitigation projects address high-risk situations with lower costs and higher benefits.

The objectives in this unit were for participants to:

- Explain Tornado Safe Room Module data and documentation requirements.
- Complete a Tornado Safe Room Module BCA.

Unit 5
Hurricane Wind

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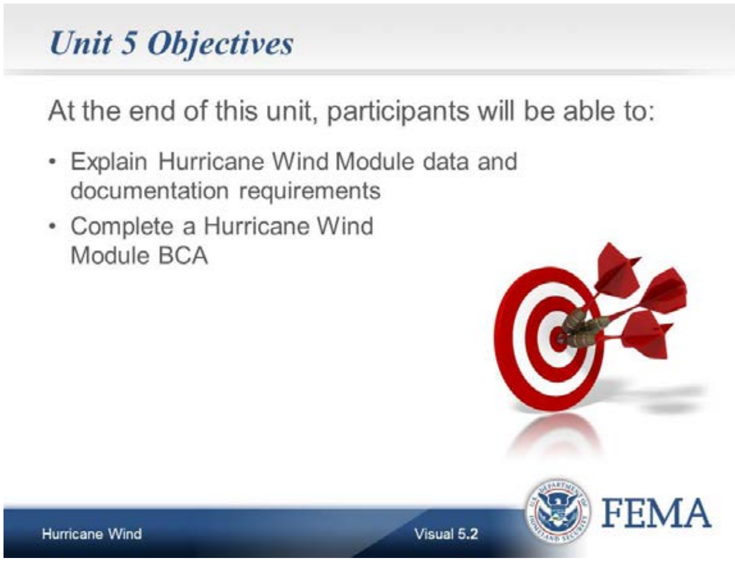
Unit 5 Hurricane Wind Overview

Visual 5.1: Unit 5 – Hurricane Wind

Welcome to Unit 5 of the Benefit-Cost Analysis: Entry Level course. The focus in this session is on Hurricane Wind.

The case study handout is needed for this unit, along with the wind speed data that should have been imported with the BCA Tool.

Hurricane Wind Overview



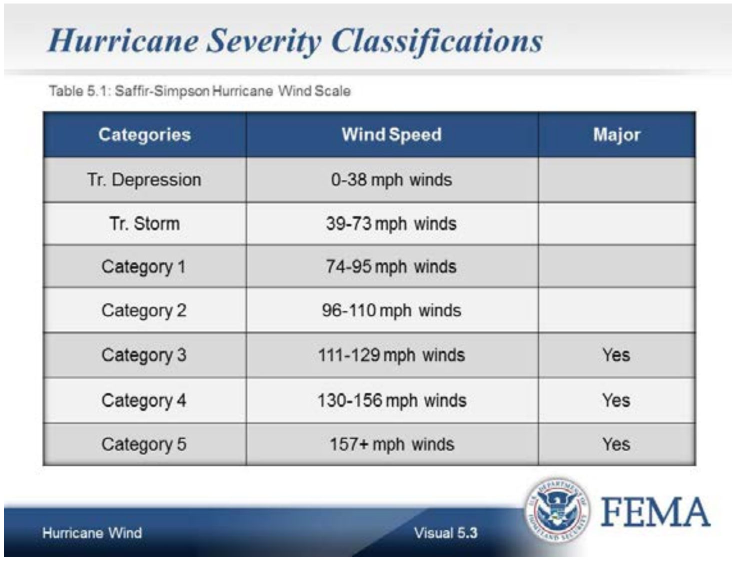
Visual 5.2: Unit 5 – Hurricane Wind Objectives

Unit 1 covered completing a BCA using the Flood Module and an independent Flood Module case study. Unit 2 explained supplemental tools needed to complete more complicated analyses. In Units 3 and 4, BCA Tool skills were applied, using the DFA and Tornado Safe Room Modules.

The purpose of this unit is to complete a BCA, using the Hurricane Wind Module. The objectives are for participants to:

- Explain Hurricane Wind Module data and documentation requirements.
- Complete a Hurricane Wind Module BCA.

Hurricane Wind Hazard Overview



Categories	Wind Speed	Major
Tr. Depression	0-38 mph winds	
Tr. Storm	39-73 mph winds	
Category 1	74-95 mph winds	
Category 2	96-110 mph winds	
Category 3	111-129 mph winds	Yes
Category 4	130-156 mph winds	Yes
Category 5	157+ mph winds	Yes

Visual 5.3: Hurricane Severity Classifications

A hurricane is an intense tropical weather system of strong thunderstorms with a well-defined surface circulation and maximum sustained winds of 74 mph or higher. Hurricane season in the Atlantic runs from June 1st to November 30th, with activity generally ramping up in August, peaking in early September.

Hurricanes are assigned a category using the Saffir-Simpson Hurricane Wind Scale. The scale separates hurricanes into five categories based on wind speed. It is used to estimate potential property damage.

- The U.S. National Hurricane Center classifies hurricanes of Category 3 and above as *major hurricanes*.
- Tropical Depressions and Tropical Storms are sub-hurricane strength storms that can still cause significant damage, especially from flooding (T.S. Allison – 2001, T.S. Debby – 2012).
- Forecasting hurricanes and predicting their movement has become much more accurate as a result of technological advances such as increased meteorological surveillance with satellites and high-speed computers.

The Saffir-Simpson Hurricane Wind Scale can be found at: http://www.nhc.noaa.gov/aboutsshws.php. Note that at the bottom of the web page is a conceptual animation of wind damage associated with increasing hurricane intensity.

Visual 5.4: Category 1 and 2 Damages

Category 1 hurricanes have wind speeds of 74-95 miles per hour and are the weakest category of hurricanes. Typical damage for a Category 1 hurricane includes:

- Damage to unanchored mobile homes and to poorly constructed signs
- Could result in damage to power lines that could result in power outages

Category 2 hurricanes have wind speeds of up to 110 miles per hour. Typical damage for a Category 2 hurricane includes:

- Some damage to building roofs, doors and windows
- Considerable damage to mobile homes
- Some trees blown down, especially if ground is already saturated

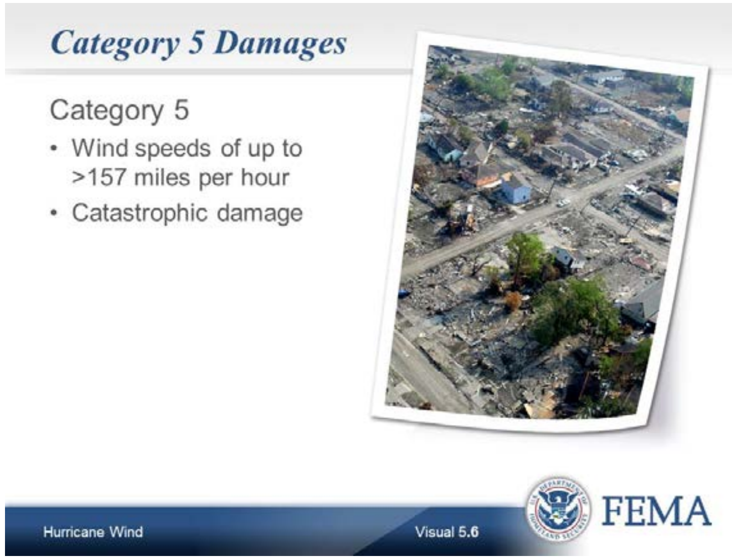
Visual 5.5: Category 3 and 4 Damages

Category 3 storm wind speeds can reach 129 miles per hour. Typical damage for a Category 3 hurricane includes:

- Some structural damage to small residences and utility buildings
- Large trees blown down; mobile homes and poorly built signs destroyed

Category 4 wind speeds can be as high as 156 miles per hour. Typical damage for a Category 4 hurricane includes:

- More extensive curtain-wall failures with some complete roof structure failures on small residences
- Shrubs, trees and all signs blown down
- Complete destruction of mobile homes
- Extensive damage to doors and windows



Visual 5.6: Category 5 Damages

Category 5 storms produce wind speeds of 157 miles per hour or greater and are considered very rare. Typical damage for a Category 5 hurricane includes:

- Complete roof failure on many residences and industrial buildings
- Some complete building failures, with small utility buildings blown over or away

Visual 5.7: Hurricane Wind Mitigation Types

Most experts agree that one of the best things that can be done to mitigate the potential for loss due to hurricanes is to “harden” the insured property and make it less susceptible to damage. Mitigation types that can be analyzed using the BCA software include:

- Building Performance Related mitigation such as:
  - Shutters and impact resistant glazing;
  - Load path activities;
  - Roof activities; and
  - Code plus activities.
- Acquisition (Non-Building Performance Related) activities

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Visual 5.8: Hurricane Wind Mitigation - Shutters

This mitigation type is geared to protect all windows and doors with shutters, laminations or other systems that meet the debris impact and wind pressure design requirements of the International Residential Code (IRC)/International Building Code (IBC). This helps keep the wind and rain out of the building, reducing structural damage and damage to contents.

Visual 5.9: Hurricane Wind Mitigation – Load Path

Load Path activities are considered to be structural retrofit projects. They aim to improve the structural system of a building to transfer loads from the roof to the foundation. Load Path activities, such as *Improved Roof-Wall Connections,* use methods such as installing metal hurricane clips or hurricane straps. This type of activity will provide a continuous load path from the roof to the foundation, helping to prevent catastrophic roof uplift failures.

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Visual 5.10: Hurricane Wind Mitigation – Roof

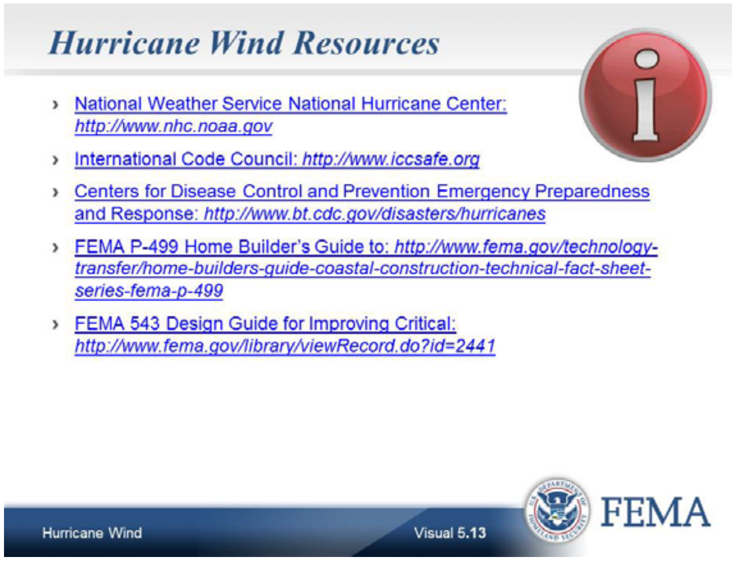
Roof activities are also considered to be structural retrofit projects. They aim to secure the building envelope and building integrity during a wind event. An example of a roof activity is an *Improved Roof Sheathing Attachment,* which is a better attachment of the plywood or oriented strand board (OSB) roof sheathing to the roof structure through appropriate fasteners. Closer fastener spacing helps to prevent sections of a roof deck from being lifted off by the wind. This reduces progressive failures and the penetration of wind and water into the building envelope.

Visual 5.11: Hurricane Wind Mitigation – Code Plus

Code Plus activities are designed to exceed the local building codes and standards to achieve a greater level of protection. For example, Code Plus typically refers to buildings that have been designed and constructed to withstand a higher wind speed than what is required in the code. As with acquisition activities, if Code Plus is selected as the mitigation type, then multiple mitigation types cannot be selected, as there are no additional benefits to capture.

Visual 5.12: Hurricane Wind Mitigation - Acquisition

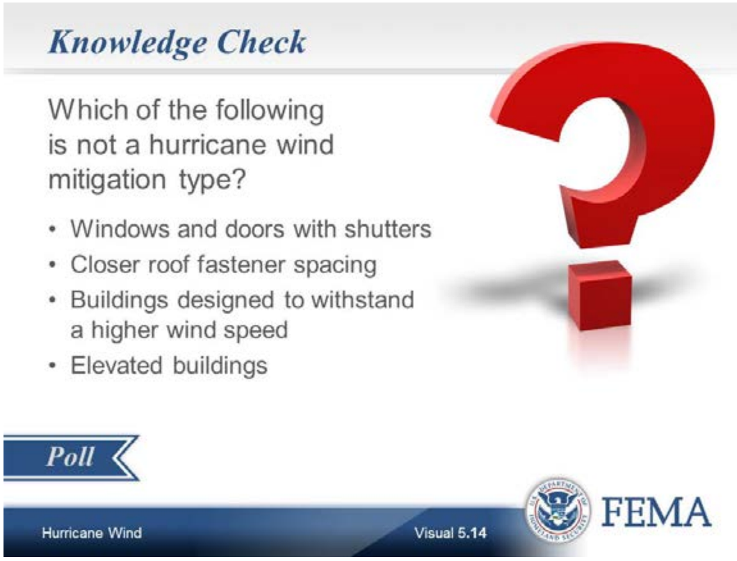
Acquisition activities include acquiring and demolishing a structure and turning the property into open space in perpetuity. For example, a community could apply for and administer an acquisition project to acquire as many properties as possible along community streets in order to avoid a “checkerboard” approach. All at-risk buildings in the project area would be uniformly removed. It is important to note that if acquisition is selected as the mitigation type, then multiple mitigation types cannot be selected, as there are no additional benefits to capture.



Visual 5.13: Hurricane Wind Resources

There are several websites available as resources. They include:

- http://www.nhc.noaa.gov (National Weather Service National Hurricane Center)
- http://www.iccsafe.org (International Code Council)
- http://www.bt.cdc.gov/disasters/hurricanes (Centers for Disease Control and Prevention Emergency Preparedness and Response)
- http://www.fema.gov/technology-transfer/home-builders-guide-coastal-construction-technical-fact-sheet-series-fema-p-499 (FEMA P-499, *Home Builder's Guide to Coastal Construction Technical Fact Sheets*)
- http://www.fema.gov/library/viewRecord.do?id=2441 (FEMA 543, *Design Guide for Improving Critical Facility Safety from Flooding and High Winds*)



Visual 5.14: Knowledge Check

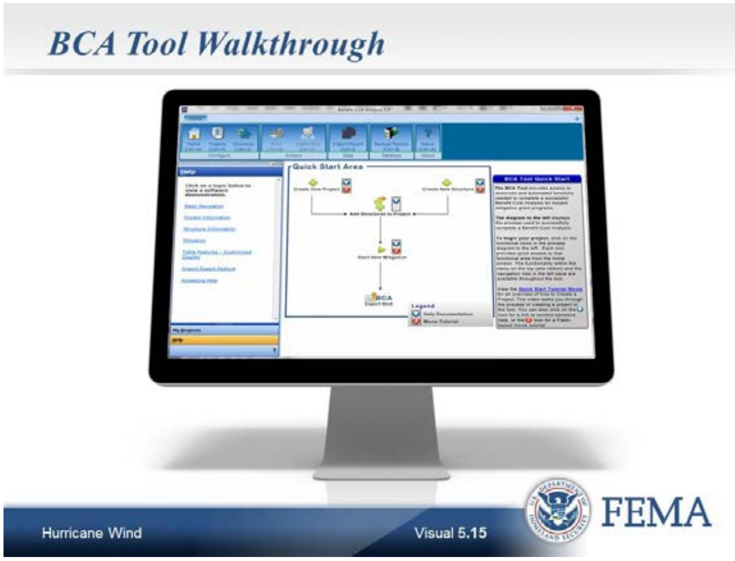
Answer the following knowledge check.

Which of the following is not a hurricane wind mitigation type?

- Windows and doors with shutters
- Closer roof fastener spacing
- Design buildings to withstand a higher wind speed
- Elevated buildings

Write the correct answer below.

Hurricane Wind Module Walkthrough

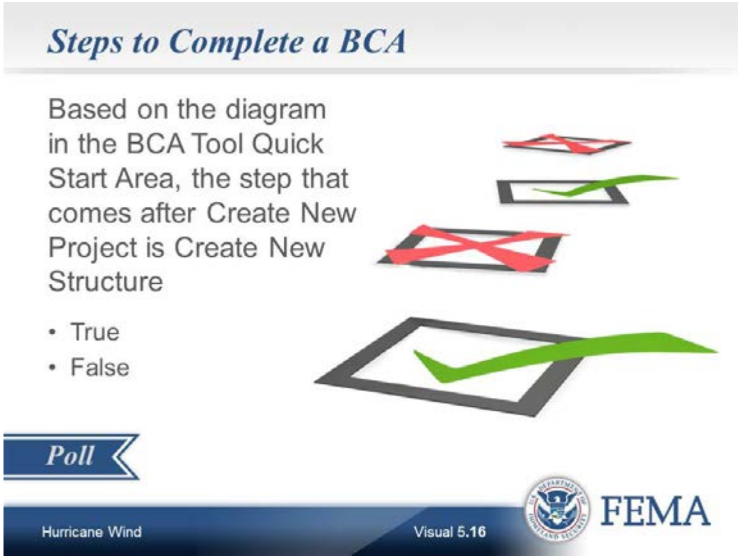


Visual 5.15: BCA Tool Walkthrough

Launch the tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, let the host know by using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics

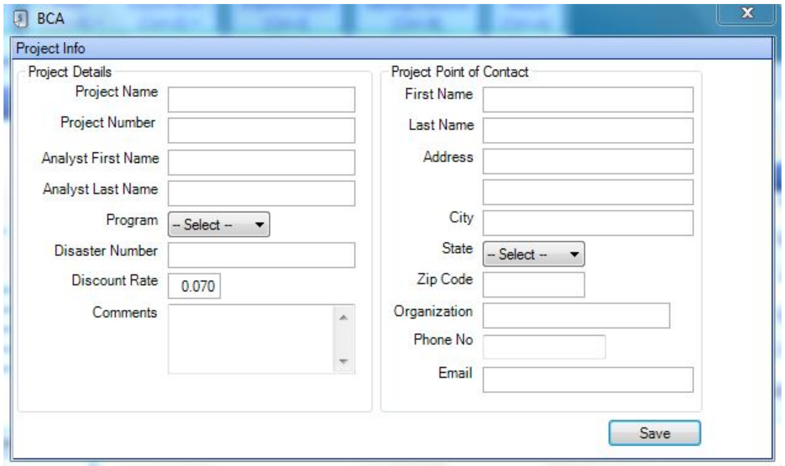


Visual 5.16: Steps to Complete a BCA

Answer the following review question.

Based on the diagram in the BCA Tool Quick Start Area, the step that comes after Create New Project is Create New Structure: True or false?

Write the correct answer below.



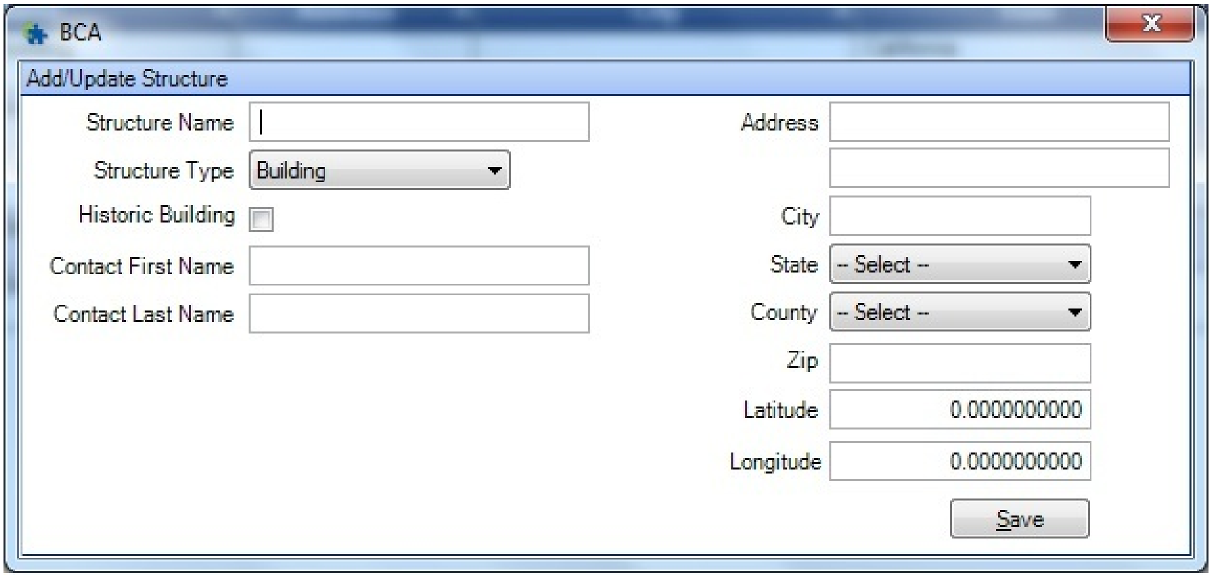
Screenshot 5.1: Project Information

Open the Hurricane Wind Module Case Study handout.

The City of Windamere in Broward County, Florida has experienced numerous hurricanes over the years, resulting in structure damage and destruction. The city proposes retrofitting one of its primary government buildings with hurricane shutters.

The first step to completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start Area to complete Step One.

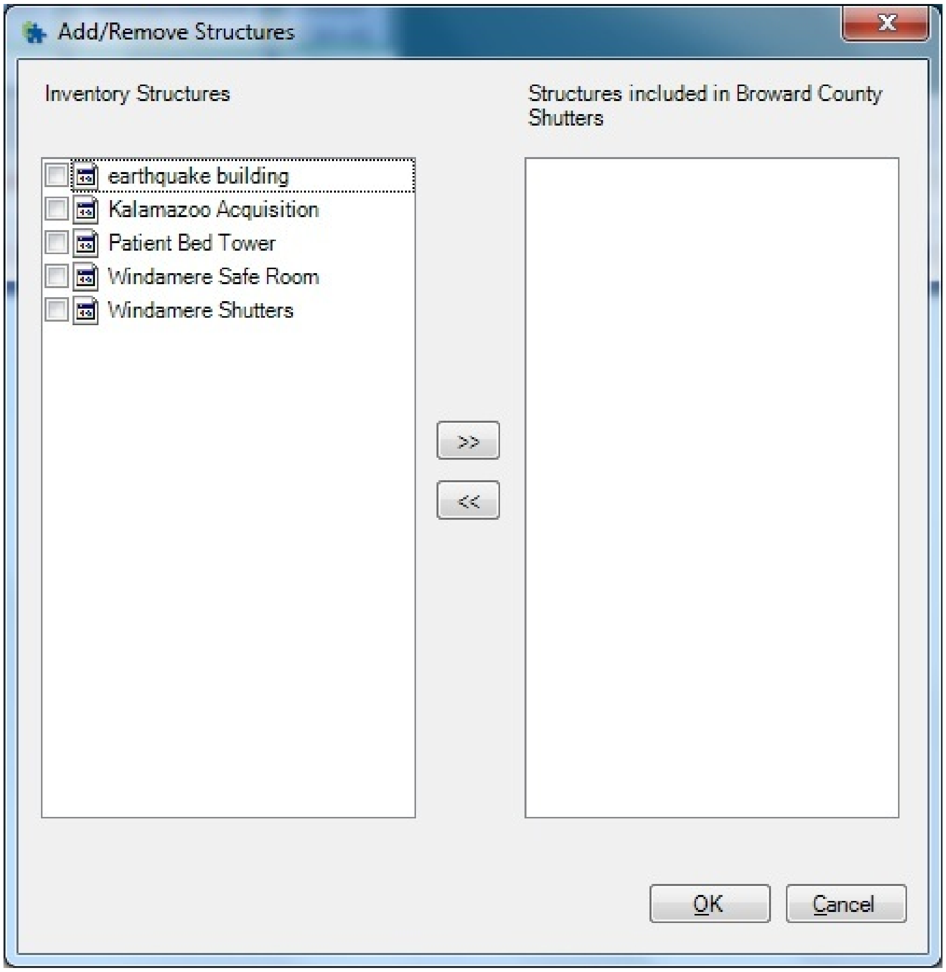
- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter "Broward County Hurricane Shutters."
- In the **Project Number** data field, enter "5."
- In the **Analyst First Name** data field, enter "William."
- In the **Analyst Last Name** data field, enter "Jones."
- In the **Program** data field, select "PDM."
- The **Disaster Number** data field is used for HMGP projects. Therefore nothing needs to be entered here.
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.
- In the **Contact Name** data fields, enter "Gillian O'Brien." This information in the Project Information window is for the local point of contact for the project.
- In the **Address** data field, enter "222 First Street."
- In the **City** data field, enter "Windamere."
- In the **State** data field, select "Florida."
- In the **Zip Code** data field, enter "33155."
- In the **Organization** data field, enter "City of Windamere."
- In the **Phone Number** data field, enter "555 555-5555."
- In the **Email** data field, enter "gobrien@windamere.gov."
- Select *Save.* The tool displays the "Project saved successfully" message.
    - Select *OK*. The Home page is displayed.



Screenshot 5.2: Add/Update Structure

The second step to completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start Area to complete Step Two.

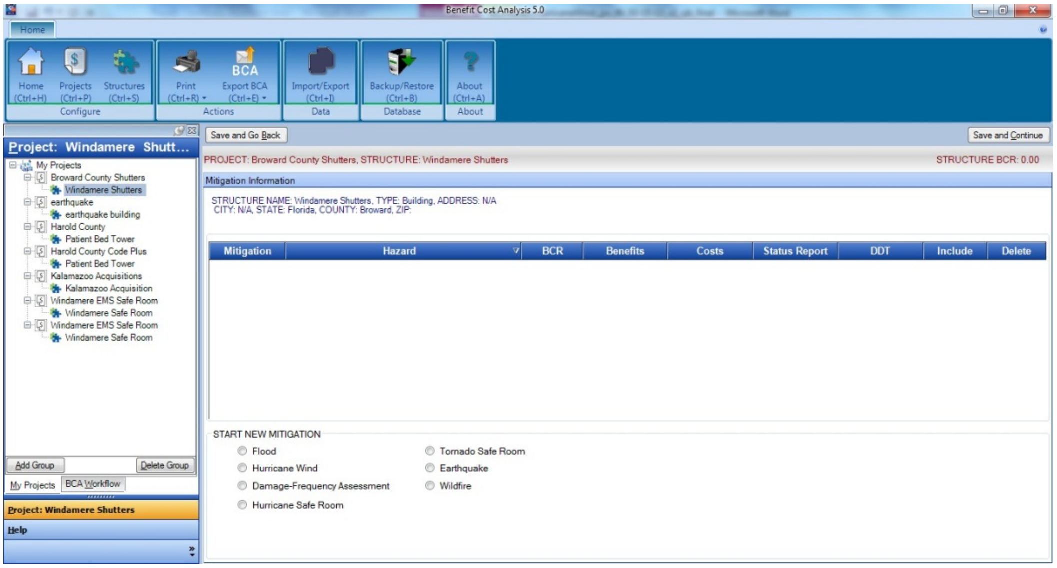
- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter “123 Tropic Way.”
- In the **Structure Type** data field, select “Building.”
- In the **Historic Building** data field, leave the box unchecked.
- In the **Contact First Name** data field, enter “John.” The contact information in the Structure Information window is for the property owner.
- In the **Contact Last Name** data field, enter “Smith.”
- In the **Address** data field, enter “123 Tropic Way.”
- In the **City** data field, enter “Windamere.”
- In the **State** data field, select “Florida.”
- In the **County** data field, select “Broward.”
- In the **Zip** data field, enter “33155.”
- In the **Latitude** data field, enter “25.7414001.”
- In the **Longitude** data field, enter “-80.294438.”
- Select *Save*. The tool displays the “Structure saved successfully” message.
- Select *OK*. The Home Page is displayed.



Screenshot 5.3: Add/Remove Structures

The third step to completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start area to complete Step Three.

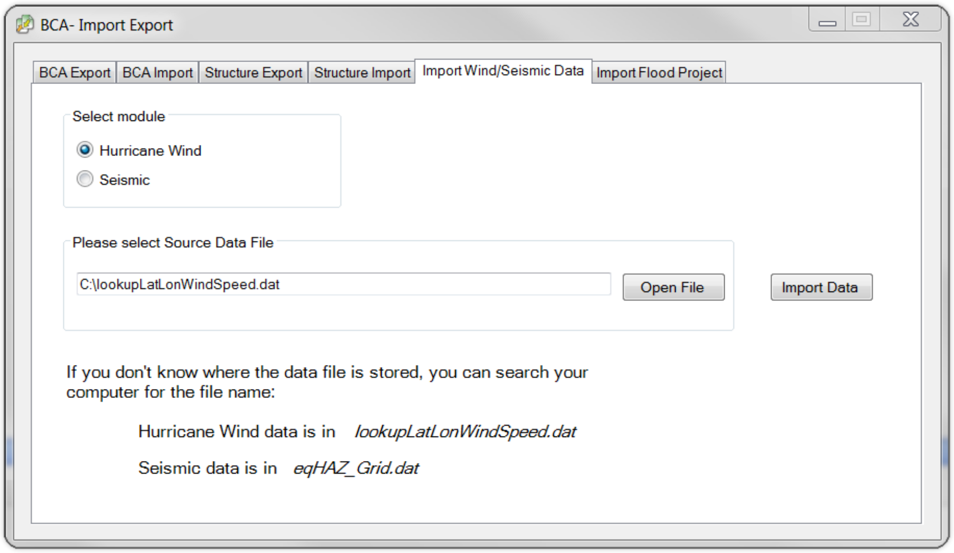
- Select *Add Structures to Project* to display a list of existing projects.
- Select the “Broward County Hurricane Shutters” project. The Add/Remove Structures dialog box is displayed.
- Select the “123 Tropic Way” structure.
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the “Add/Remove Structures Succeeded” message.
- Select *OK*. The Home page is displayed.



Screenshot 5.4: Mitigation Information

The fourth step to completing the BCA is to start a new mitigation. Use the *Start New Mitigation* icon in the Quick Start Area to complete Step Four.

- Select *Start New Mitigation* to display a list of existing projects.
- Select the “Broward County Shutters” project.
- Select the “123 Tropic Way” structure. The MITIGATION INFORMATION screen is displayed.
- In the projects window on the left, select *Help*. The list of available Help topics for this screen is displayed.
- In the Start New Mitigation section at the bottom of the screen, select “Hurricane Wind.”
- In the upper right part of the screen, select *Save and Continue.* The HURRICANE WIND MITIGATION TYPE screen is displayed.



Screenshot 5.5: BCA Import Export

Before moving on to the MITIGATION TYPE screen, make sure that the correct data file is imported.

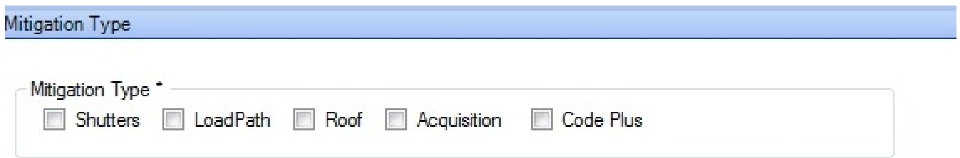
Instructions about how to download the *lookupLatLonWindSpeed.dat* file and import it into the BCA Tool were previously provided.

Although the instructor will briefly recap how to import the wind speed data file, if this file has not been downloaded and imported, then the best option from this point forward is to observe what is done in the rest of the walkthrough.

To import the Hurricane Wind data that downloaded during registration, select *Import/Export* on the basic navigation toolbar at the top. Select the Import Wind/Seismic Data tab. Select "Hurricane Wind" under **Select module.**

Select the source data file that would have downloaded along with the BCA tool. A quick search in the computer for the data file *lookupLatLonWindSpeed.dat* will reveal the location. Select *Open File* and choose this file. Then select *Import Data*. After the data file has been imported, a message that the file has been imported will appear. Select *OK*. Then close this window to return to the MITIGATION INFORMATION screen.

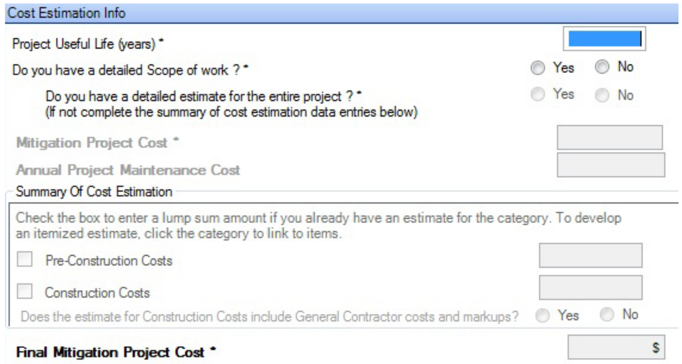
The following screens discuss adding a new mitigation. After the data is entered in all the screens, the tool completes the BCA and generates the BCR.



Screenshot 5.6: Mitigation Type

The purpose of this screen is to identify the hurricane wind mitigation activity. The Hurricane Wind Module Case Study Handout identifies the mitigation type as a Shutters project. In the workplace, the hurricane wind mitigation type can be determined from the detailed scope of work, which should be included in the subapplication.

- Hover the mouse on each hurricane wind mitigation project type. A screen tip is displayed, giving a brief description of that project type.
- To be considered for funding under HMA, hurricane wind projects must include a draft operations and maintenance plan at the time of application.
- Select “Shutters.”
- Select *Save and Continue*. The COST ESTIMATION INFORMATION screen is displayed.



Screenshot 5.7: Cost Estimation Information

Unit 1 explained that the purpose of this screen is to establish the "C" or "costs" needed to calculate the BCR. Below is the basic information needed for this screen:

- In the **Project Useful Life** data field, enter "15."
- In the **Do you have a detailed Scope of Work?** data field, select "Yes."
- In the **Do you have a detailed cost estimate for the entire project?** data field, select "Yes."
- In the **Mitigation Project Cost** data field, enter "$75,000.00."
- In the **Annual Project Maintenance Cost** data field, enter "$5,000.00."
- Note that the tool filled in the **Final Mitigation Project Cost** data field.

Scroll down the Summary of Cost Estimation to the following question:

- **Does Estimate reflect current prices?** Select "Yes."

Important data fields in this screen are:

- **Project Useful Life (PUL)**
- **Mitigation Project Cost**
- **Annual Project Maintenance Cost**

The **PUL** data field is important because it establishes the timeframe to calculate annualized benefits. Raising or lowering the **PUL** value impacts the final BCR. Higher values extend the duration over which benefits are calculated, thus making the final BCR higher. This data is required for calculating the BCR and can be obtained from the PUL table.

The **Mitigation Project Cost** is either provided by a competent source or created by using the cost estimator. The source can be a competent entity such as a licensed engineer for a construction project. If a community has completed multiple similar mitigation projects, it can use a detailed cost estimate based on its historic costs. National cost estimation guides (i.e., RS Means, Marshall & Swift) can also be used.

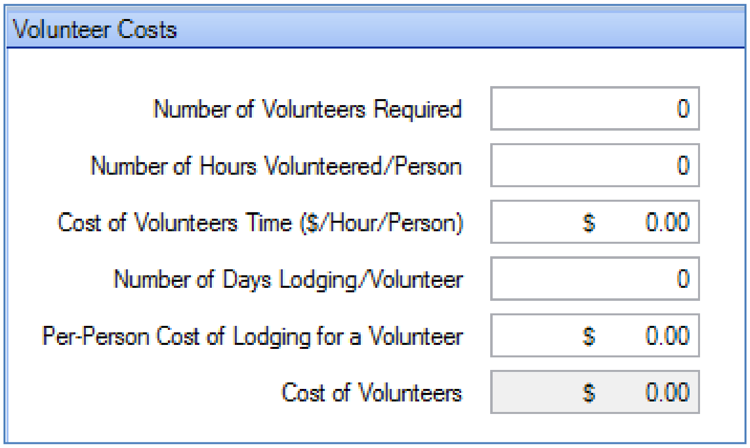
For a professional budget provided to users by a competent source, the cost estimate itself should be attached as documentation. If users are building the cost in the cost estimator, documentation should be provided for each of the inputs (e.g., for the project, documentation for the appraisal cost, structure market values, demolition and site restoration, etc.). This value forms the basis for the "cost" value in the benefit-cost analysis. The higher the cost, the lower the BCR.

Remember from Unit 1 that the **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness. Please note that adding any maintenance costs will lower the BCR. Remember also that maintenance costs are the responsibility of the local entity submitting the project; therefore, they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

For documenting maintenance costs, an estimate on letterhead or other document which highlights where it came from and whether the source is reliable to judge the future maintenance costs should be provided.

Like the Flood Module, the COST ESTIMATION INFO screen is the first screen in the Hurricane Wind Module where it is important to upload documentation to support the data entered. To upload documents so that they will be attached to the analysis, use the Justification/Documentation section at the bottom of the screen. This process was demonstrated in the Flood Module.

Select *Save and Continue*. The VOLUNTEER COSTS screen is displayed.

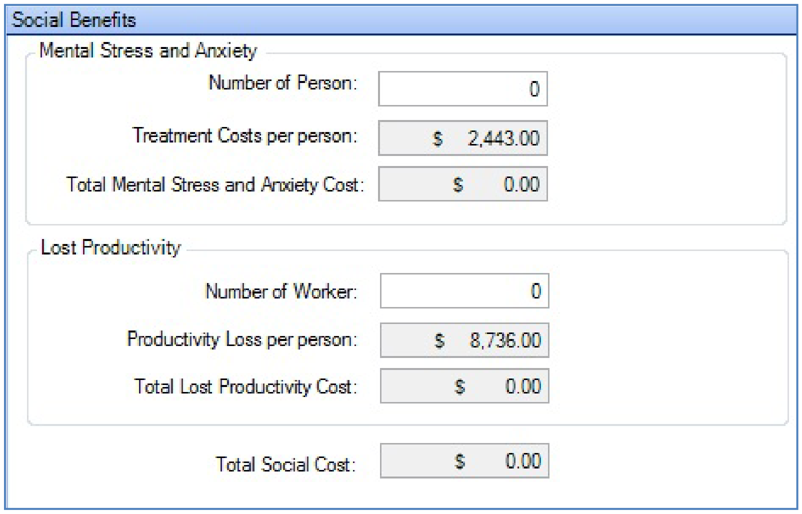


Screenshot 5.8: Volunteer Costs

The purpose of this screen is to calculate the total cost of volunteers required to provide volunteer emergency services after a disaster occurs related to the structure included in the mitigation project. Note that avoided volunteer costs are a new benefit that has been added to Version 5.0 of the BCA Tool.

Examples of volunteer costs include volunteer labor to fix a flooded residence or volunteer sandbagging to prevent the loss of function of a water treatment plant. Mitigation projects that eliminate or reduce the need for volunteer labor can claim a benefit. The higher the volunteer costs avoided, the higher the final BCR. The data can be obtained from sources like: volunteer sign-in sheets from a reliable source such as the American Red Cross or Emergency Management Agency; estimates by experts; estimates transferred from similar past disasters or documented information from the homeowner. Support the data by uploading volunteer sign-in sheets provided by a reliable source, documented estimates from experts or similar past disasters, or a signed affidavit from the homeowner stating the number of people and estimated number of hours. Per diem days for non-local charities should only count the number of days spent repairing the actual structure(s) being mitigated in the project.

For the case study, do not enter any data. Select *Save and Continue*. The SOCIAL BENEFITS screen is displayed.

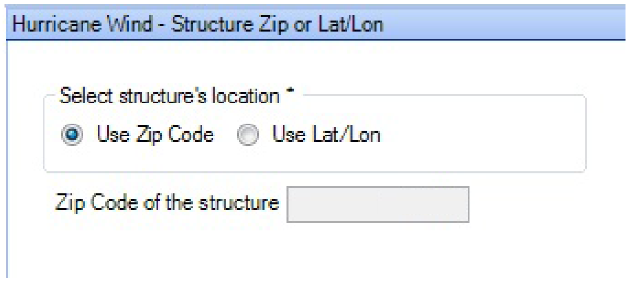


Screenshot 5.9: Social Benefits

The purpose of this screen is to calculate the value of mental stress and anxiety and lost productivity. Note that this is a new benefit that has been added to Version 5.0 of the BCA Tool.

The **Treatment Costs per person** and **Productivity Loss per person** are FEMA standard values. The Help topics provide an explanation of how the standard values were determined.

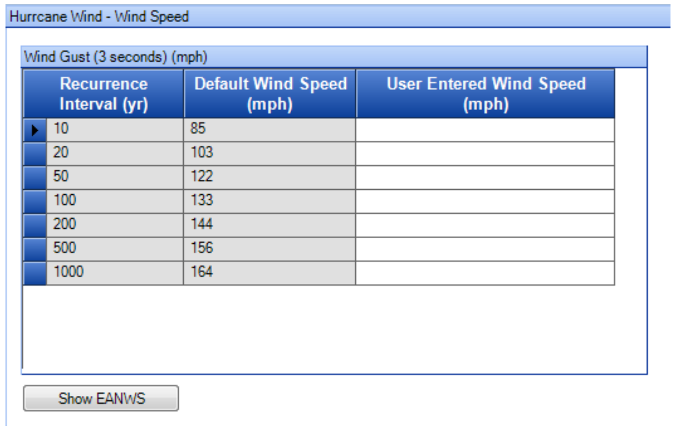
The applicant did not provide any data that applies to this screen. Select *Save and Continue*. The HURRICANE WIND – STRUCTURE ZIP OR LAT/LON screen is displayed.



Screenshot 5.10: Hurricane Wind – Structure Zip or Lat/Lon

The purpose of this screen is to provide information about the hurricane wind strength. The wind speeds will be selected based on the Zip Code or the Latitude and Longitude values entered in the Add/Update Structure dialog box. If the Zip Code or Latitude/Longitude values do not automatically populate in this screen, it may be because values were not entered in the Add/Update Structure dialog box. To correct this, select "Structures" in the basic navigation toolbar at the top, highlight the structure that needs to be updated, then select *Update* in the lower right. Once the Zip Code or Latitude/Longitude values have been entered, then return to the project and the values should populate on this screen.

- On this screen, in the **Select Structure Location** data field, select either "Use Zip Code" or "Use Lat/Long." For this case study, select "Use Zip Code*."* Note that the tool fills in the previously-entered Zip Code.
- Select *Save and Continue*. The HURRICANE WIND – WIND SPEED screen is displayed.

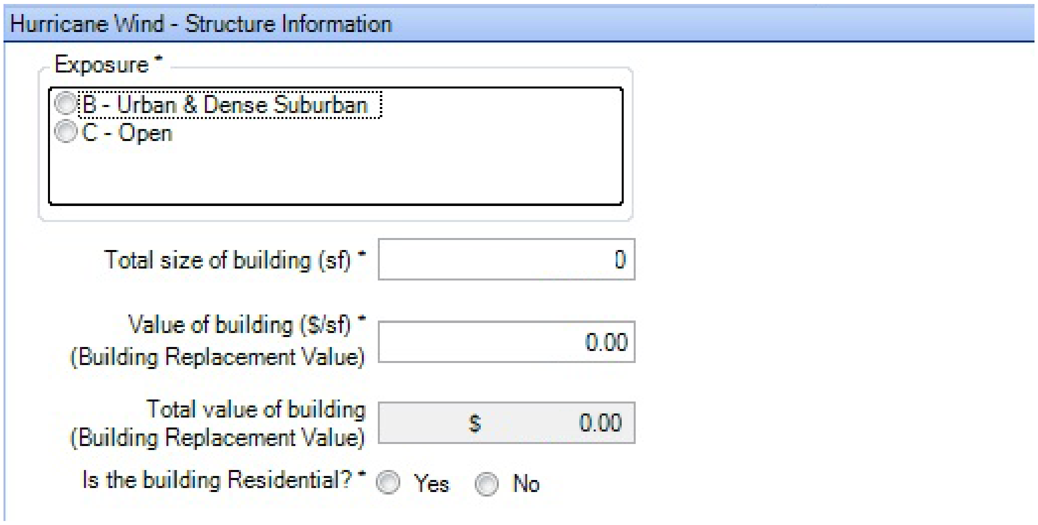


Screenshot 5.11: Hurricane Wind – Wind Speed

The purpose of this screen is to provide default wind speed data in three-second gusts for multiple return periods based on the zip code or latitude and longitude for the structure. There are three specific Help questions on this page

- How do I read the Wind Gust table?
- How do I override default Wind Speeds and how should it be documented?
- What is EANWS?

This case study uses default wind speeds, so select *Save and Continue*. The HURRICANE WIND – STRUCTURE INFORMATION screen is displayed.



Screenshot 5.12: Hurricane Wind – Structure Information

The purpose of this screen is to 1)Establish the characteristics of the ground roughness and surface irregularities in the vicinity of a building; 2) Establish the total building replacement value (BRV) for the structure; and 3) Identify whether the building is residential.

For this case study, enter the following:

- In the **Exposure** data field, select “B – Urban & Dense Suburban.”
- In the **Total size of building** data field, enter “10,000.”
- In the **Value of building** data field, enter “$96.”
- In the **Is the building residential?** data field, select “No.”
- When “No” is selected, a subsequent **Non-Residential** box appears. Either “Retrofit project” or “New construction” will be selected. For this case study, select “Retrofit project.”

The important data fields on this screen are:

- **Exposure**
- **Total size of building (sf)**
- **Value of the building (sf)**
- **Is the building residential?**
- **Retrofit project or New construction?**

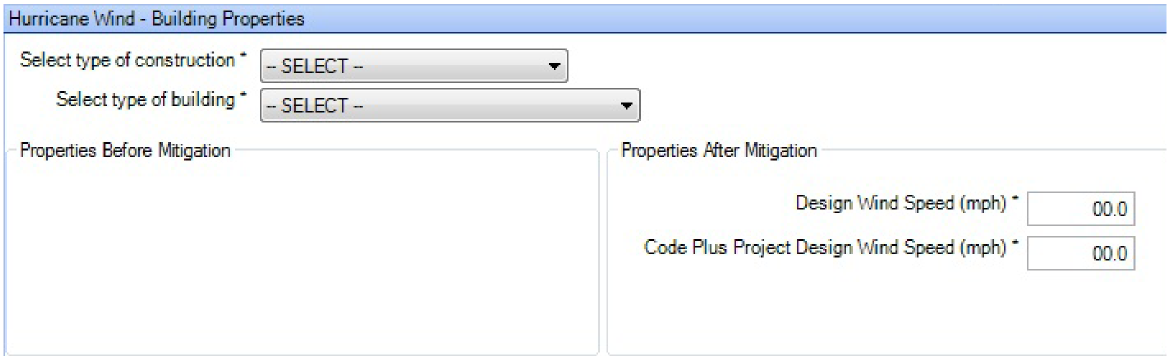
For the **Exposure** data field, the selections are “B – Urban & Dense Suburban” or “C –Open.” This data is available using maps in the subapplication or by accessing Google to find the location of the building. This data identifies the exposure of the structure based on the natural topography, vegetation and constructed facilities surrounding the project location. The open coast has fewer barriers to knock down the impact of wind, while urban/suburban areas have more barriers. Therefore, development on an open coast will experience more wind loads. This information is required to calculate the BCR.

For the **Total size of building** data field, the tool requires the total square feet of livable space for residential or the square feet of the first floor only for non-residential (if building is more than one story). This value is available from assessor records, tax cards, the deed or the facility owner and must be documented with a copy of any of these records. In combination with the cost per square foot, the **Total size of building** data field calculates the BRV, which is the basis for calculating damages based on the hurricane wind data. The data is input in square feet. Significant changes in the building size will have a large impact on the BCR.

The data needed for the **Value of building** data field is the cost per square foot for building a comparable structure (residential, commercial, etc.). This information should be obtained from a local building official, but if that is not possible, it can be obtained from national cost estimation guides like RS Means, and Marshall & Swift. This is a required value and is provided as dollars/square foot so the tool can calculate the Total Value of Building (BRV). If a structure is damaged in a hurricane, the replacement value determines the cost to repair it, so it is based on replacement value instead of market value.

The last set of important data for this screen is the **Non-Residential Building** data. In this case study, the structure is non-residential. The tool displays a follow-up question on whether the project is a retrofit or new construction. Based on the data entered, the tool will generate information on the building properties. Provide documentation for the data entered by attaching photographs for a retrofit project, or blueprints and/or design schematics for new construction.

Select *Save and Continue*. The HURRICANE WIND – BUILDING PROPERTIES screen is displayed.



Screenshot 5.13: Hurricane Wind – Building Properties

The purpose of this screen is to determine the use, style and structural components of the building. For this case study, enter the following:

- In the **Select type of construction** data field, select "Masonry."
- In the **Select type of building** data field, select "MECBM – Masonry, Engineered Commercial Building, Mid-Rise (3-5 stories)."
- In the **Properties Before Mitigation** box:
  - In the **Window Area** data field, select "Medium."
  - In the **Roof Cover Type** data field, select "BUR."
  - In the **Wind Debris** data field, select "Residential/Commercial Mix."
  - In the **Shutters** data field, select "No."
  - In the **Roof Deck Attachment III (Metal)** data field, select "Standard."
- In the **Properties After Mitigation** box:
  - In the **Window Area** data field, select "Medium."
  - In the **Roof Cover Type** data field, select "BUR."
  - In the **Wind Debris** data field, select "Residential/Commercial Mix."
  - In the **Shutters** data field, select "Yes."
  - In the **Roof Deck Attachment III (Metal)** data field, select "Standard."

The important data fields on this screen are:

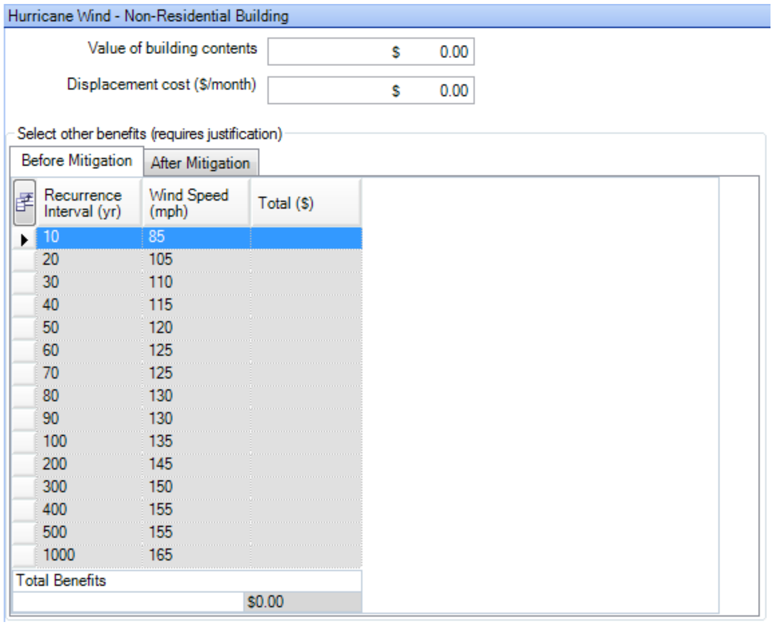
- **Select type of construction**
- **Select type of building**
- **Properties Before Mitigation**
- **Properties After Mitigation**

The **type of construction** is needed to define whether the building type is masonry, steel or concrete. Different construction types have different building performance characteristics that are used in determining the losses avoided (benefits) by the mitigation project.

The **type of building,** along with the **Properties Before Mitigation** and the **Properties After Mitigation**, are key factors in generating a BCR based on the wind damage function. The building properties drop-down selection lists are determined by the mitigation type, construction type and building type selected. The building properties questions appear in descending order of relative impact or importance to the wind damage function. Therefore, accurate responses to the first questions are the most critical. If subsequent, less critical questions are given a response of "Unsure," the depth-damage function will apply a percent probability for that item based on the location (zip code) of the structure. The wind damage function curve will be the more accurate if the “Unsure” response is not used. The data entered on this screen can be obtained from a structural engineer, contractor or building inspector. To support the construction and building data, attach documentation on official letterhead.

The BCA Tool Help content on this screen provides guidance on selecting building types; and on selecting building properties based on the type of building.

Select *Save and Continue*. The HURRICANE WIND – NON-RESIDENTIAL BUILDING screen is displayed.



Screenshot 5.14: Hurricane Wind – Non-Residential Building

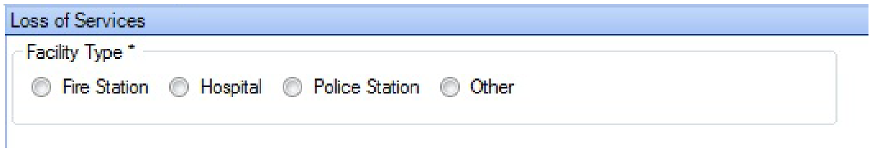
The purpose of this screen is to determine the **Value of building contents** and one-time **Displacement cost**. For this case study, enter the following:

- In the **Value of building contents** data field, enter "$150,000."
- In the **Displacement cost** data field, enter "$10,000."

Guidance for determining the **Value of building contents** is found in a table in the Help content. Justification and documentation are required if the values come from alternative sources, especially if the contents value exceeds the values in the table shown in the Help content.

The **Displacement cost** is made up of the costs incurred when building occupants are displaced to temporary quarters so that repairs can be made. Although they are referred to as costs, the avoidance of displacement costs counts as an expected benefit of the mitigation project. Displacement costs may be incurred for residential, commercial or public buildings. Displacement occurs only when damages to a structure are sufficiently severe that the structure cannot be repaired with occupants in place. **Displacement costs** consist of A) monthly rental costs for comparable housing/building space and B) one-time disruption costs. The **Displacement cost** has a low to moderate impact on raising the final BCR, depending on the total cost of the project. Smaller amounts will have little to no impact on the BCR unless the project cost is relatively low. The Help section addresses the methods for calculating the non-residential displacement costs.

Select *Save and Continue*. The LOSS OF SERVICES screen is displayed.



Screenshot 5.15: Loss of Services

The purpose of this screen is to calculate LOSS OF SERVICES (LOS) benefits for critical facilities (e.g., Fire, Police and Hospital) and other buildings. For this case study, enter the following:

- In the **Facility Type** data field, select "Other." The Service Type data fields are displayed.
- In the **Service Name** data field, enter "Government."
- In the **Annual Budget** data field, enter "$3,000,000."

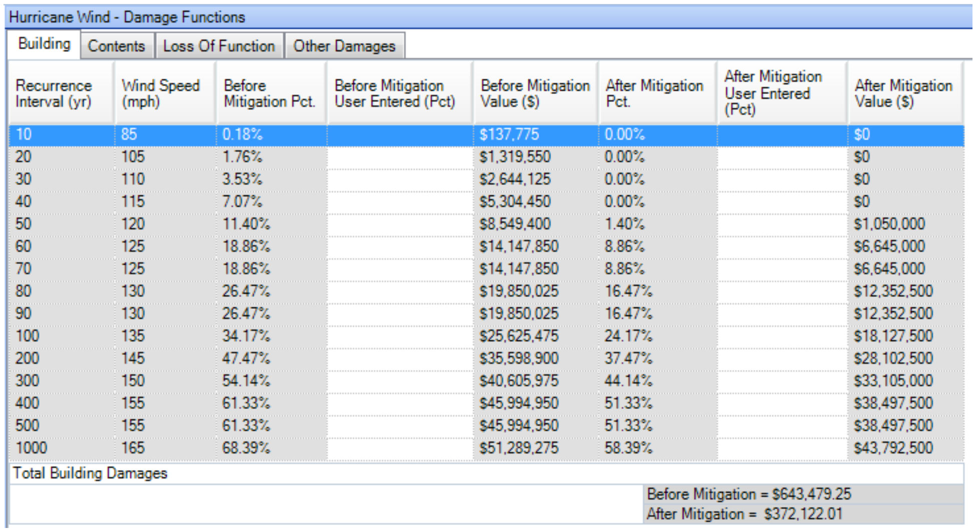
All the individual LOS inputs add up to calculate the facility LOS. In general, these inputs calculate a value, which is typically a significant economic benefit. This data is required only for calculating a BCR for a facility LOS.

The data entered on this screen varies depending on the **Facility Type** selected. If "Fire Station" is selected, the tool needs information on a) how many people are served by fire station, b) the type of area served by fire station, c) the distance in miles to closest fire station, and d) whether the fire station also provides emergency medical services (EMS). If the station does provide EMS, then the tool will request the distance in miles to the next fire station that also provides EMS, and if the station does not provide EMS, then the tool does not require additional information. This information is available from the fire station, community planning department or other reliable source including Google Maps, MapQuest and Google Earth to get the distance in miles to the next fire station.

If "Hospital" is selected, the tool will request information on the population served by the hospital being mitigated, the distance in miles to closest alternative hospital, and the population served by the alternative hospital. This information is available from the hospital, local planning agency or other reliable source, including Google Maps, MapQuest and Google Earth to get the distance in miles to the next hospital.

If "Police Station" is selected, the tool will request information on the type of area served by police station (metropolitan, city, rural), the population served by the police station, the number of police officers in the station being mitigated, and the number of officers that would serve the area if this station is shut down/lost. Much of this information is available from the police station. Google Maps, MapQuest and Google Earth can supply the distance in miles to the next police station, but the affected police station would likely need to consult other police stations for the data on the number of officers to serve the area if the station was shut down or lost. If "Other" is selected, the tool requests information on the annual budget of the facility, which would come from the facility being mitigated.

Select *Save and Continue.* The HURRICANE WIND – DAMAGE FUNCTIONS screen is displayed.



Hurricane Wind - Damage Functions

Building | Contents | Loss Of Function | Other Damages

Recurrence Interval (yr)	Wind Speed (mph)	Before Mitigation Pct.	Before Mitigation User Entered (Pct)	Before Mitigation Value ($)	After Mitigation Pct.	After Mitigation User Entered (Pct)	After Mitigation Value ($)
10	85	0.18%		$137,775	0.00%		$0
20	105	1.76%		$1,319,550	0.00%		$0
30	110	3.53%		$2,644,125	0.00%		$0
40	115	7.07%		$5,304,450	0.00%		$0
50	120	11.40%		$8,549,400	1.40%		$1,050,000
60	125	18.86%		$14,147,850	8.86%		$6,645,000
70	125	18.86%		$14,147,850	8.86%		$6,645,000
80	130	26.47%		$19,850,025	16.47%		$12,352,500
90	130	26.47%		$19,850,025	16.47%		$12,352,500
100	135	34.17%		$25,625,475	24.17%		$18,127,500
200	145	47.47%		$35,598,900	37.47%		$28,102,500
300	150	54.14%		$40,605,975	44.14%		$33,105,000
400	155	61.33%		$45,994,950	51.33%		$38,497,500
500	155	61.33%		$45,994,950	51.33%		$38,497,500
1000	165	68.39%		$51,289,275	58.39%		$43,792,500

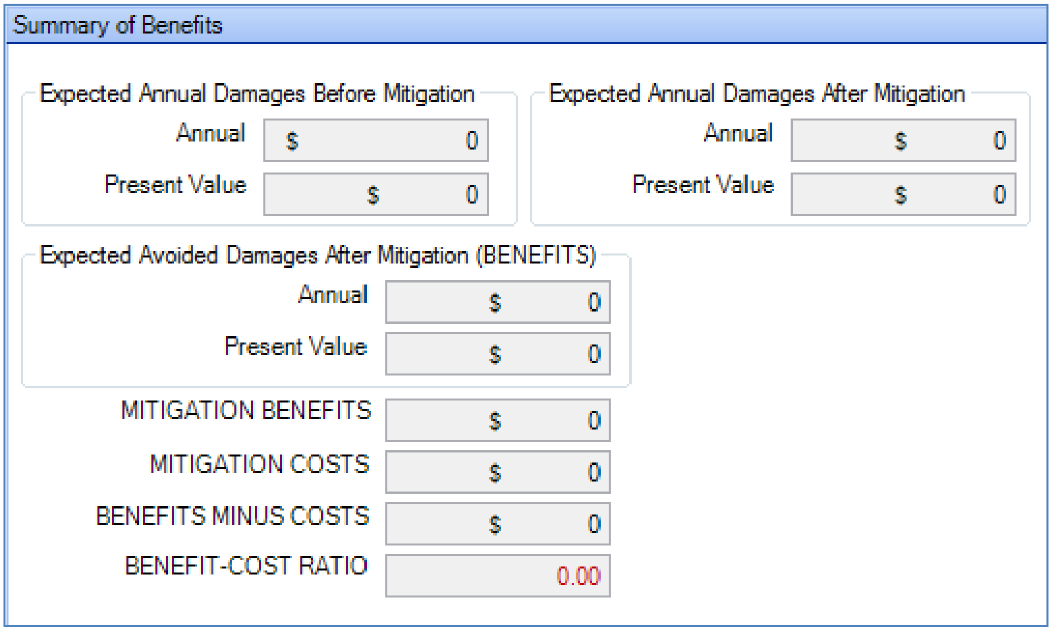
Total Building Damages

Before Mitigation = $643,479.25
After Mitigation = $372,122.01

Screenshot 5.16: Hurricane Wind – Damage Functions

The purpose of this screen is to provide before and after mitigation damages for 1) Building, 2) Contents, 3) Loss of Function, and 4) Other damages. This is an auto-populated screen based on other calculations. The Help section provides users with guidance for understanding this screen. There are no inputs on this screen.

Select *Save and Continue.* The SUMMARY OF BENEFITS screen is displayed.

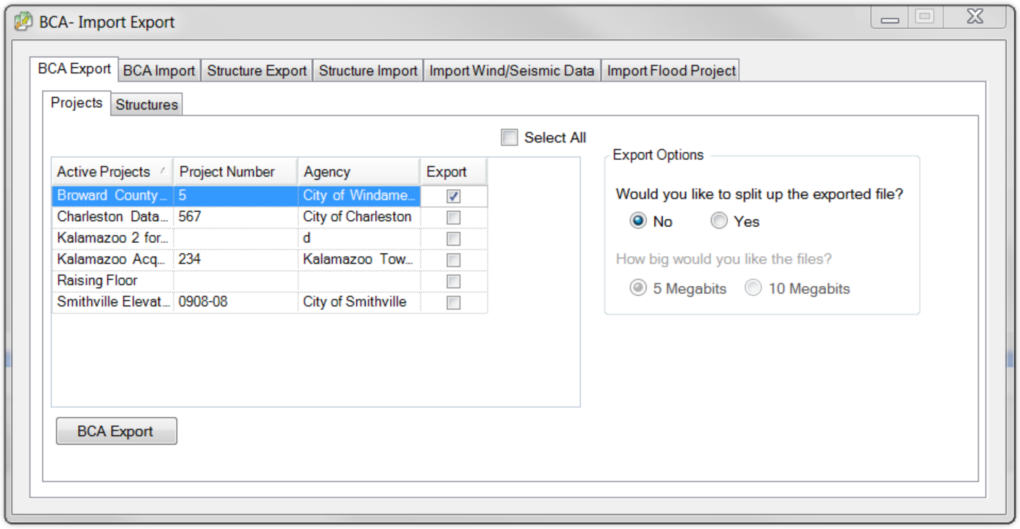


Screenshot 5.17: Summary of Benefits

The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

Remember Unit 1 that this screen has three sections. The top section of the screen displays the Before and After Mitigation values that have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. The next section of the screen shows the impact of the project or the benefits. Finally, in the bottom section of the screen are both the benefits and the costs, the difference between the two values, and the most important value—the **Benefit-Cost Ratio**. This is the benefits divided by the costs.

At this stage either select *Save and Continue,* which will lead to the MITIGATION INFORMATION screen, or stay in the same screen.

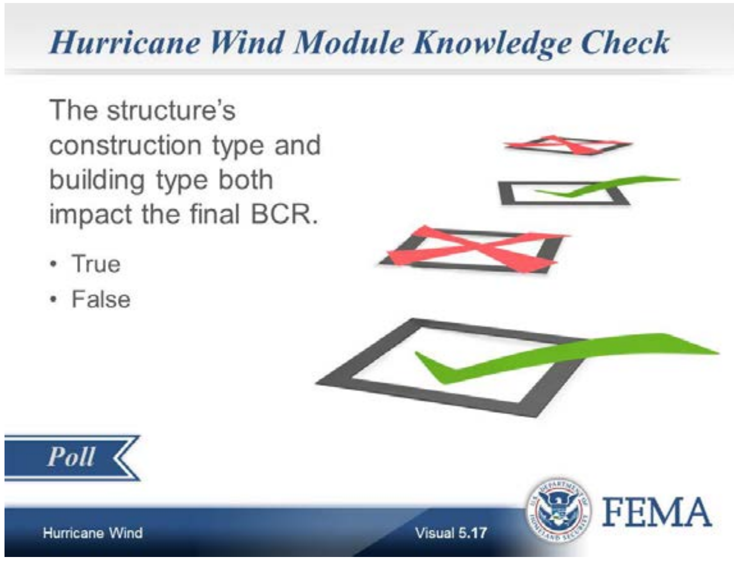


Screenshot 5.18: BCA – Import Export

Steps One through Four of the BCA process are now complete. To complete Step Five: Export the BCA, do the following steps:

- Select *Home* on the basic navigation toolbar. The Quick Start Area is displayed.
- Select the Export BCA icon in the diagram. A list of the projects created is displayed.
- Select “Broward County Shutters” as the project to export. The Windows Explorer dialog box is displayed. Note that the file type is “.zip” by default.
- In the **File Name** data field, enter “BrowardCounty_HWRetrofit.”
- Save the zip file to the desired location on the computer.

A message of success will pop up. Select *OK* and close the Import/Export window.



Visual 5.17: Hurricane Wind Module Knowledge Check

Answer the following knowledge check.

The structure's construction type and building type both impact the final BCR.

- True
- False

Write the correct answer below.

Summary

Visual 5.18: Summary

Remember: It is always about risk, regardless of the hazard. Cost-effective mitigation projects address high-risk situations with lower costs and higher benefits.

The objectives in this unit were for participants to:

- Explain Hurricane Wind Module data and documentation requirements.
- Complete a Hurricane Wind Module BCA.

Unit 6
Wildfire

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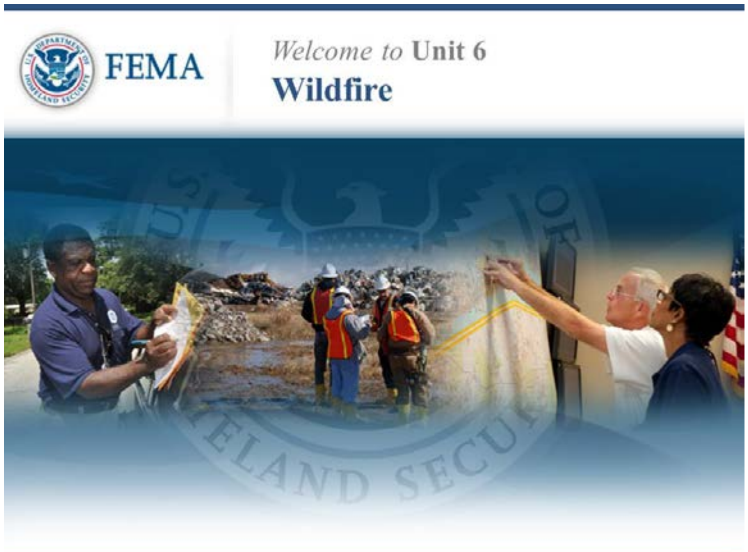
Unit 6 Wildfire Overview



Visual 6.1: Unit 6 – Wildfire

Welcome to Unit 6 of the Benefit-Cost Analysis: Entry Level course. This unit focuses on Wildfire.

The case study handout is needed for this unit.

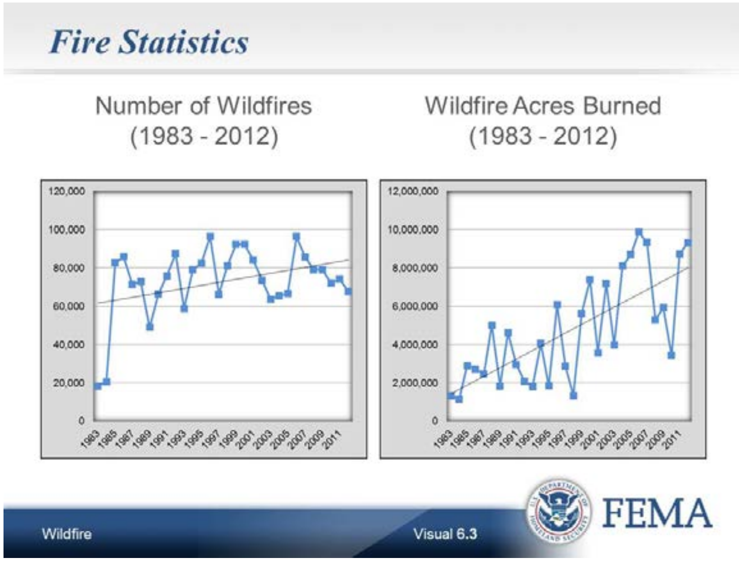
Visual 6.2: Unit 6 Objectives

Unit 1 covered completing a BCA using the Flood Module and an independent Flood Module case study. Unit 2 explained supplemental tools needed to complete more complicated analyses. In Units 3 through 5, BCA Tool skills were applied, using the DFA, Tornado Safe Room and Hurricane Wind Modules.

The purpose of Unit 6 is to complete a BCA, using the Wildfire Module. The objectives are for participants to:

- Explain Wildfire Module data and documentation requirements.
- Complete a Wildfire Module BCA.

Wildfire Hazard Overview



Visual 6.3: Fire Statistics

This overview of the wildfire hazard looks at the fire statistics as well as other aspects of wildfire.

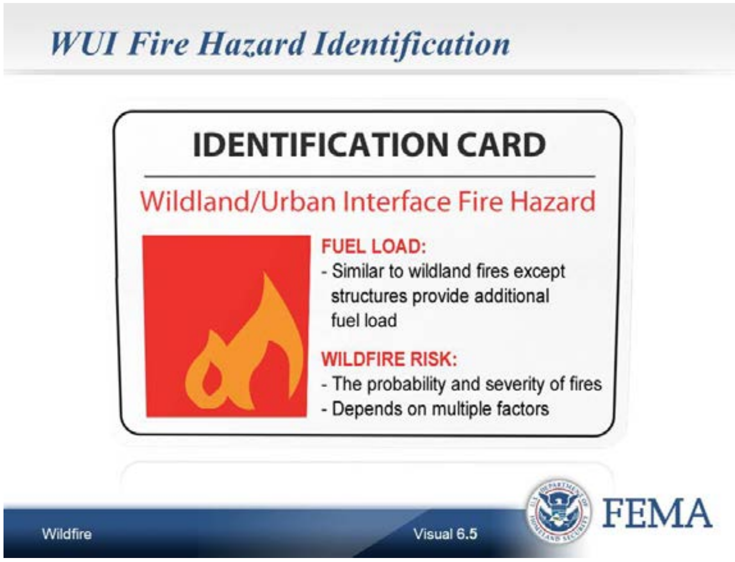
The number of wildfires and acres burned since 1983 has generally increased at a steady rate. The source of this information is the National Interagency Fire Center (NIFC). They began using a new statistical measure in 1983. As the graphs above illustrate, the top six burned acreage years have occurred since 2004 in this 30-year period.

The ground area that burned in 2012 alone was roughly the same size as Massachusetts and Connecticut put together.

Visual 6.4: Overview of Wildfires

Wildland/Urban Interface (WUI) is the transition zone from natural or wilderness areas to developed areas. This is where the fuel source for wildfires changes from vegetation to structures.

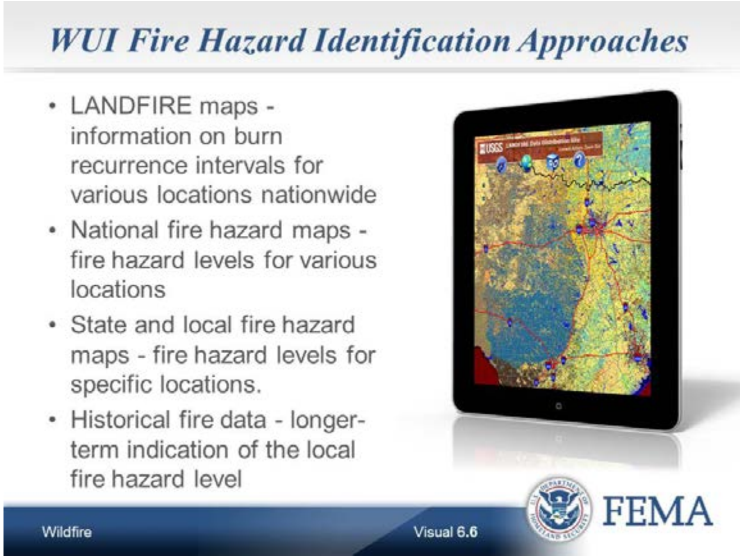
FEMA wildfire mitigation grants are awarded for certain project types and for WUI areas that are not Federally-owned.



Visual 6.5: WUI Fire Hazard Identification

Characteristics for Wildland/Urban Interface fires are identical to those for wildland, except wildland/urban interface fires have additional fuel loads from structures.

- The term “wildfire risk” refers to the probability and severity of fires.
- Wildfire risk depends on the following factors:
  - Fire suppression capabilities;
  - Fuel continuity;
  - Fuel load;
  - Moisture content;
  - Topography;
  - Weather conditions; and
  - Time of year.



Visual 6.6: WUI Fire Hazard Identification Approaches

LANDFIRE data maps provide burn recurrence intervals for various locations nationwide. This data set is used in the Wildfire Module to determine the default burn recurrence intervals.

- National fire hazard maps provide fire hazard levels for various locations as well.
- State and local fire hazard maps provide fire hazard levels for specific locations.
- Historical data provide longer term indication of local fire hazard levels.
- These maps can be used as documentation sources.

Visual 6.7: WUI Mitigation Measures

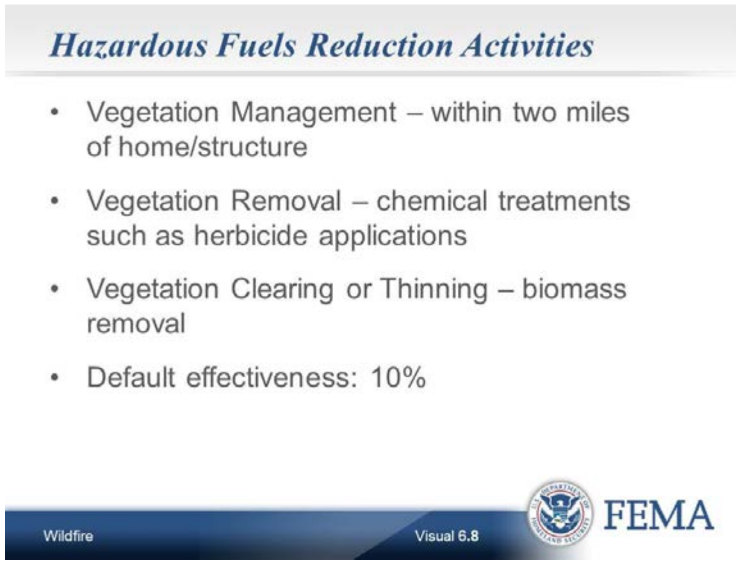
There are three mitigation measure classifications for Wildland/Urban Interface fires under FEMA's 2008 Wildfire Policy and the HMA Guidance:

- Hazardous fuels reduction
- Defensible space
- Ignition-resistant construction: only if the property owner agrees to create and maintain a defensible space around the structure. Research has shown that fire-resistant construction is effective when combined with defensible space activities.

Wildfire mitigation projects may apply to residential and non-residential structures.

The following resources provide homeowners and State/Tribal and local officials information on mitigation measures against the wildfire hazard.

- Home Builder's Guide to Construction in Wildfire Zones (P-737): http://www.fema.gov/library/viewRecord.do?id=3646
- Wildfire Hazard Mitigation Handbook for Public Facilities (P-754): http:/www.fema.gov/library/viewRecord.do?id=3723

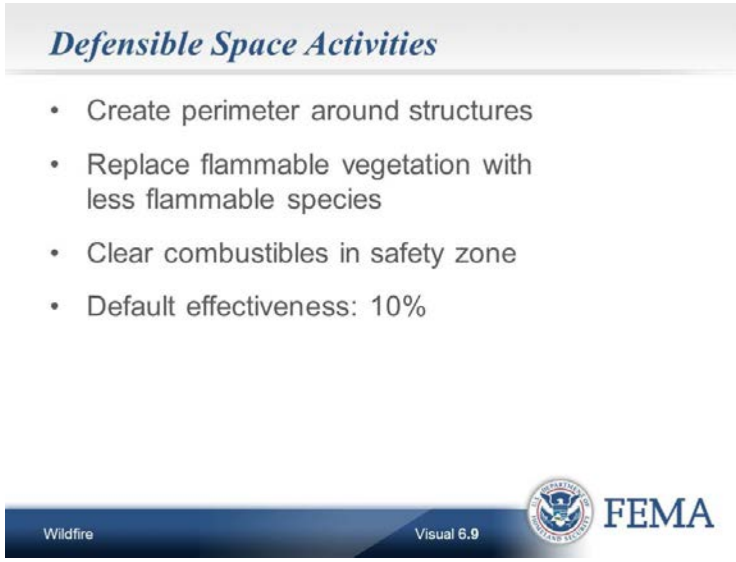


Visual 6.8: Hazardous Fuels Reduction Activities

Hazardous fuels reduction activities include:

- Vegetation management – this is vegetation control within two miles of home or structure.
- Vegetation removal – this includes chemical treatments such as herbicide applications.
- Vegetation clearing or thinning – biomass removal including clearing straw and dead or dry vegetation, thinning and removal of brush, pine straw, or blown-down timber.

The default project effectiveness of such activities is 10%.

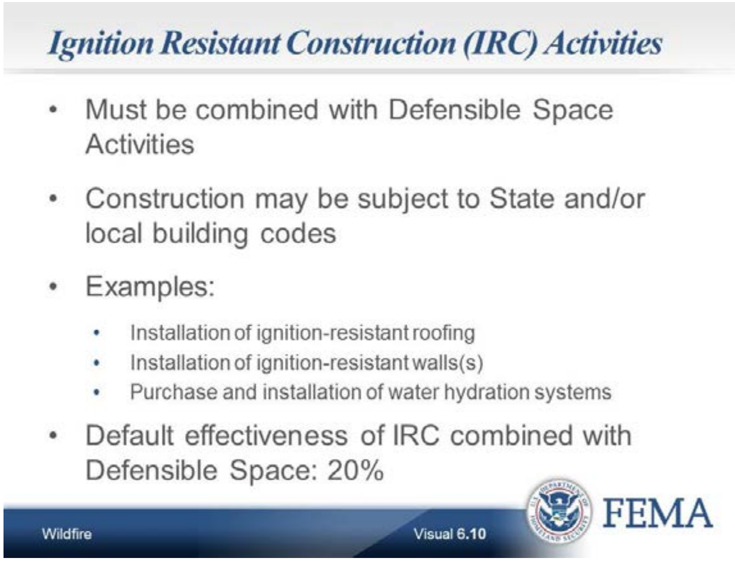


Visual 6.9: Defensible Space Activities

Instructor:
Hazardous fuels reduction activities include:

- Creating a perimeter around structures by minimizing the volume of vegetation around structures.
- Replacing flammable vegetation with less flammable species.
- Clearing all combustibles in the safety zone surrounding the structure.

The default project effectiveness of such activities is 10%.

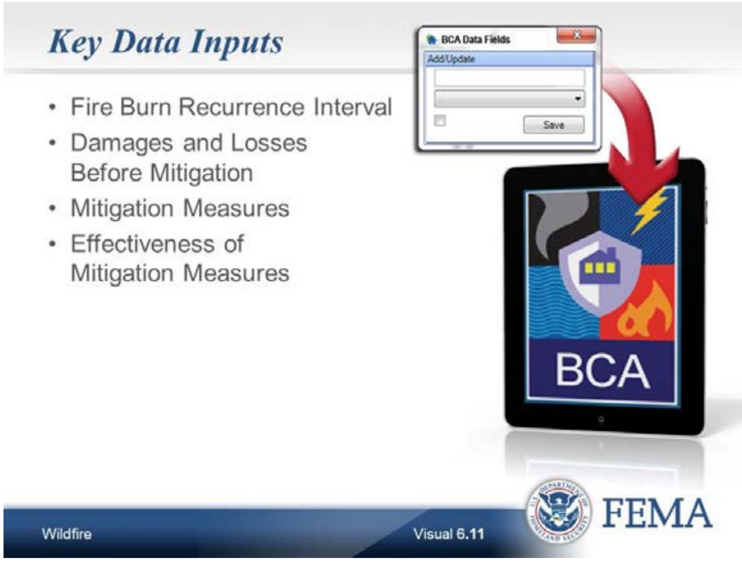


Visual 6.10: Ignition Resistant Construction (IRC) Activities

Instructor:
Ignition resistant construction activities must be combined with defensible space activities. Construction may be subject to State and/or local building codes. Examples include:

- Installing ignition-resistant roofing comprised of non-combustible materials (composite shingles or tiles).
- Installing ignition-resistant walls comprised of non-combustible material (ember-resistant vents).
- Purchasing and installing water hydration systems.

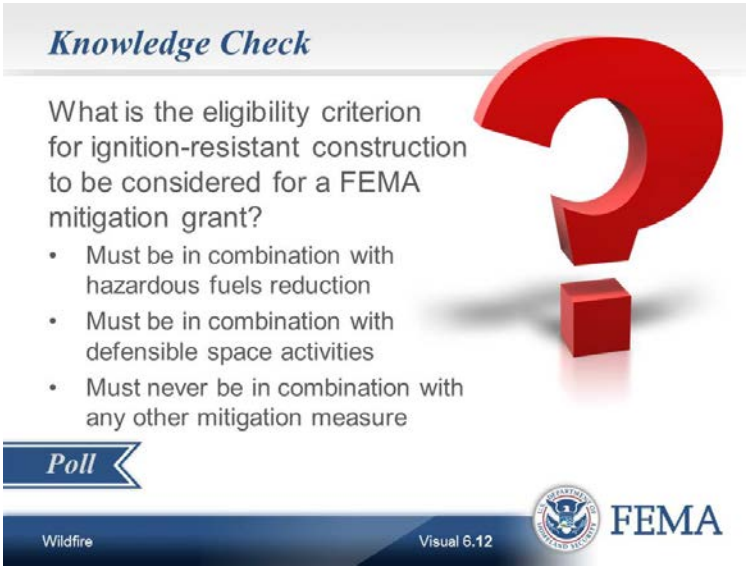
The default project effectiveness of ignition resistant construction activities combined with defensible space is 20%.



Visual 6.11: Key Data Points

Key data points for the Wildfire Module for Wildland/Urban Interface include:

- Fire Burn Recurrence Interval;
- Damages and Losses Before Mitigation;
- Mitigation Measures; and
- Effectiveness of Mitigation Measures.



Visual 6.12: Knowledge Check

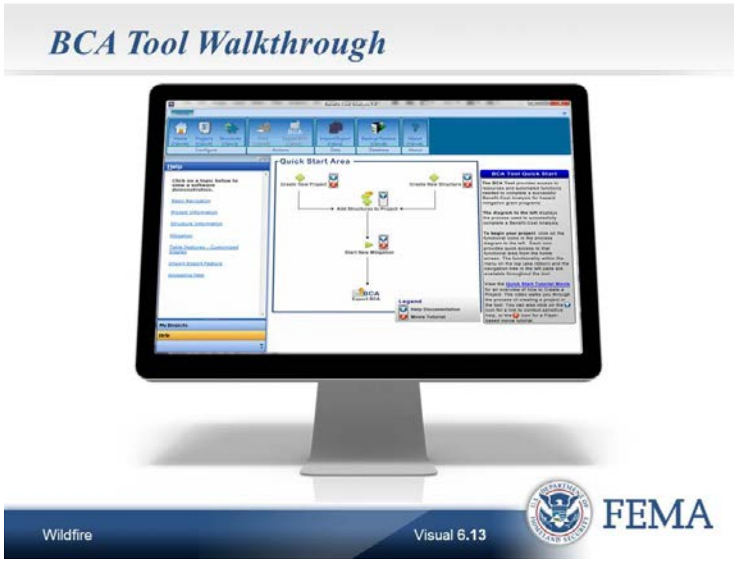
Answer the following knowledge check.

What is the eligibility criterion for ignition-resistant construction to be considered for a FEMA mitigation grant?

- Must be in combination with hazardous fuel reduction
- Must be in combination with defensible space activities
- Must never be in combination with any other mitigation measure

Write the correct answer below.

Wildfire Module Walkthrough

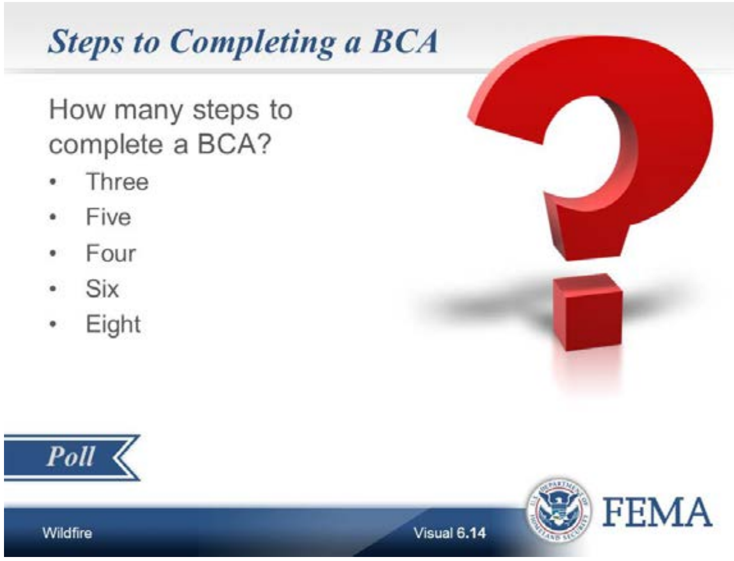


Visual 6.13: BCA Tool Walkthrough

Launch the BCA Tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, let the host know by using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics



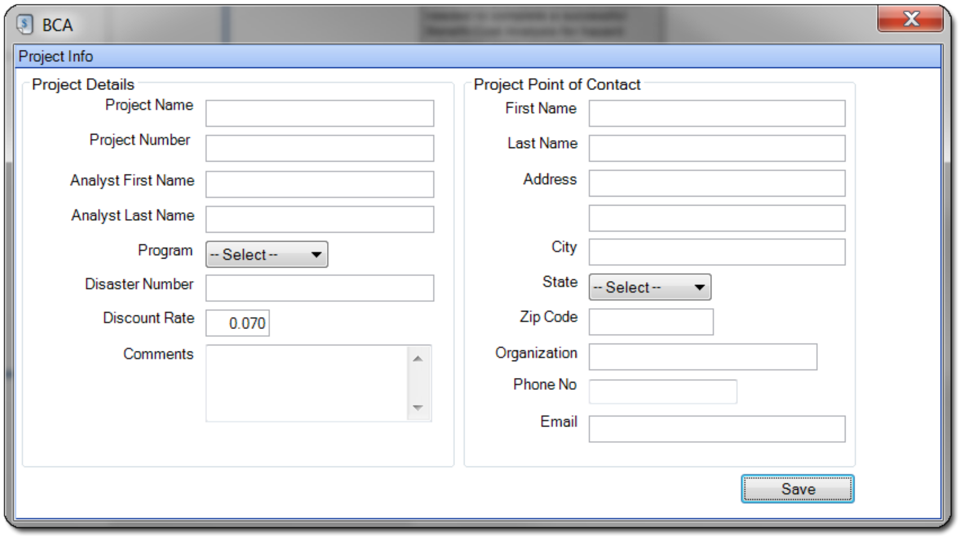
Visual 6.14: Steps to Completing a BCA

Answer the following review question.

How many steps to complete a BCA through the BCA tool?

- Three
- Five
- Four
- Six
- Eight

Write the correct answer below.



Screenshot 6.1: Project Info

Open the Wildfire Module case study handout.

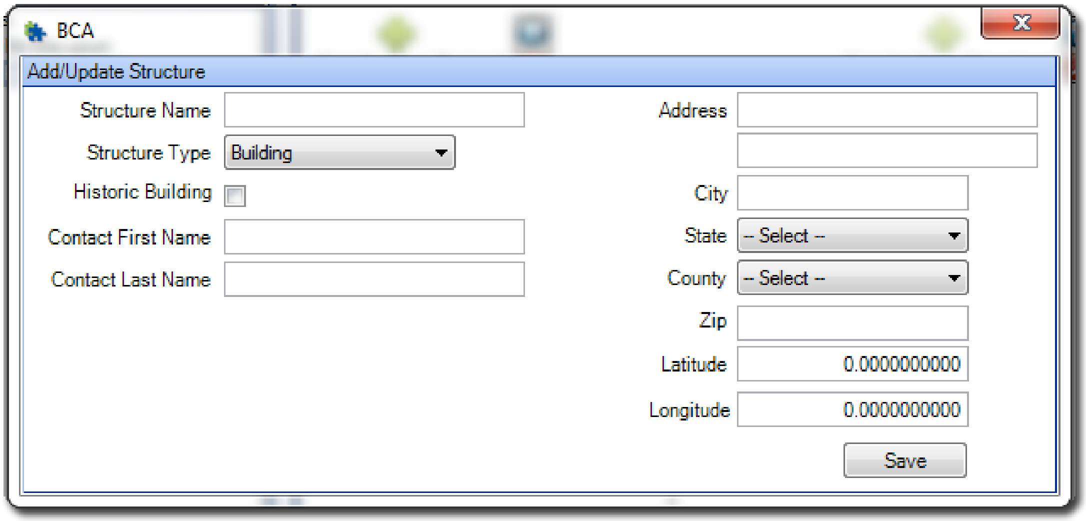
The State of California has seen numerous fires during the last decade, resulting in a number of lost structures, displaced families and even injury and death. The Community of Walden in Sacramento County, California consists of 100 homes and/or structures. The community proposes to implement some wildfire mitigation measures through vegetation control to reduce the wildfire threat for these 100 structures.

The topography consists of rolling hills, with moderately steep slopes, heavily covered in grass, brush and small trees. The mitigation project will implement vegetation controls around the Town of Sacramento to protect the town and its inhabitants from wildfires. Similar projects implemented in towns near Sacramento have resulted in a 20-percent reduction in wildfire damages. The 100 homes have a total replacement value of $15,000,000. The town has a population of 350, with infrastructure valued at $500,000 and timber valued at $250,000. The mitigation project will cost $50,000, plus an annual maintenance cost of $5,000 for the four-year useful life of the project.

The first step in completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start Area to complete Step One.

- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter “Walden Mitigation.”
- In the **Project Number** data field, enter “123.”
- In the **Analyst First Name** data field, enter “Jane.”
- In the **Analyst Last Name** data field, enter “Smith.”
- In the **Program** data field, select “HMGP.”
- In the **Disaster Number** data field, enter “555.”
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.

- In the **Contact Name** data fields, enter "John Smith." This information in the Project Information window is for the local point of contact for the project.
- In the **Address** data field, enter "123 International Drive."
- In the **City** data field, enter "Sacramento."
- In the **State** data field, select "California."
- In the **Zip Code** data field, enter "95814."
- In the **Organization** data field, enter "Town of Sacramento."
- In the **Phone Number** data field, enter "555 555-5555."
- In the **Email** data field, enter "John.Smith@TownofSM.gov."
- Select *Save*. The tool displays the "Project saved successfully" message. Select *OK* to return to the Quick Start Area.



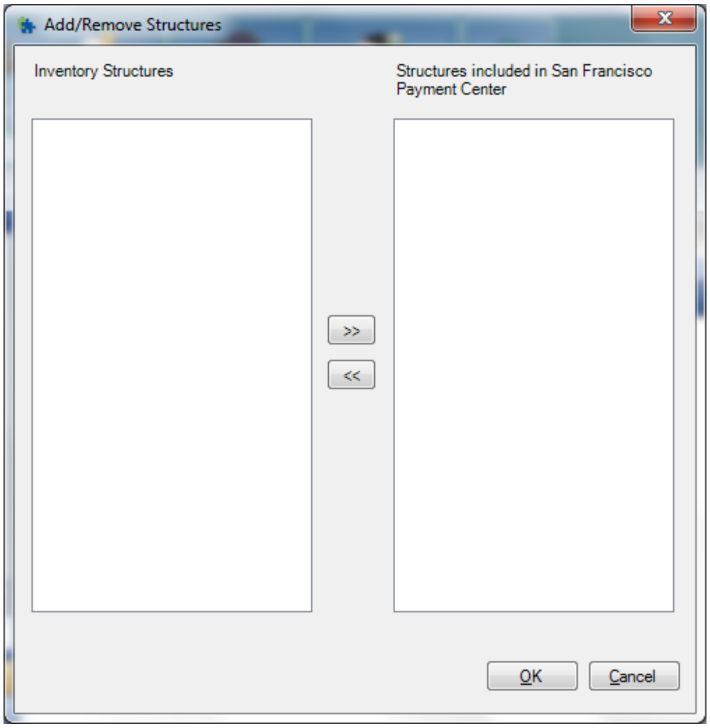
Screenshot 6.2: Add/Update Structure

The second step in completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start Area to complete Step Two.

- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter "Community of Walden." It is wise to use a description of the structure that is specific so it stands out in a list of other structures. This makes it easier to implement the next step of associating the structure with the project.
- In the **Structure Type** data field, select "Building." Note that there are two other structure types: "Utility" and "Other." Select "Building" if the project seeks to reduce losses to buildings.
- In the **Historic Building** data field, leave the box unchecked. This box has no impact on the analysis; it only tells the reviewer that this is a historic structure.
- In the **Contact First Name** data field, enter "Jane."
- In the **Contact Last Name** data field, enter "Smith."
- In the **Address** data field, enter "123 International Drive."
- In the **City** data field, enter "Sacramento."
- In the **State** data field, select "California."
- In the **County** data field, select "Sacramento."
- In the **Zip** data field, enter "95814."

It is very important to realize that the default Burn Recurrence Interval value is pulled in to the BCA calculation by the State, County and Zip Code values entered. If these values are skipped when entering the Structure Information, there will be no default BRI value.

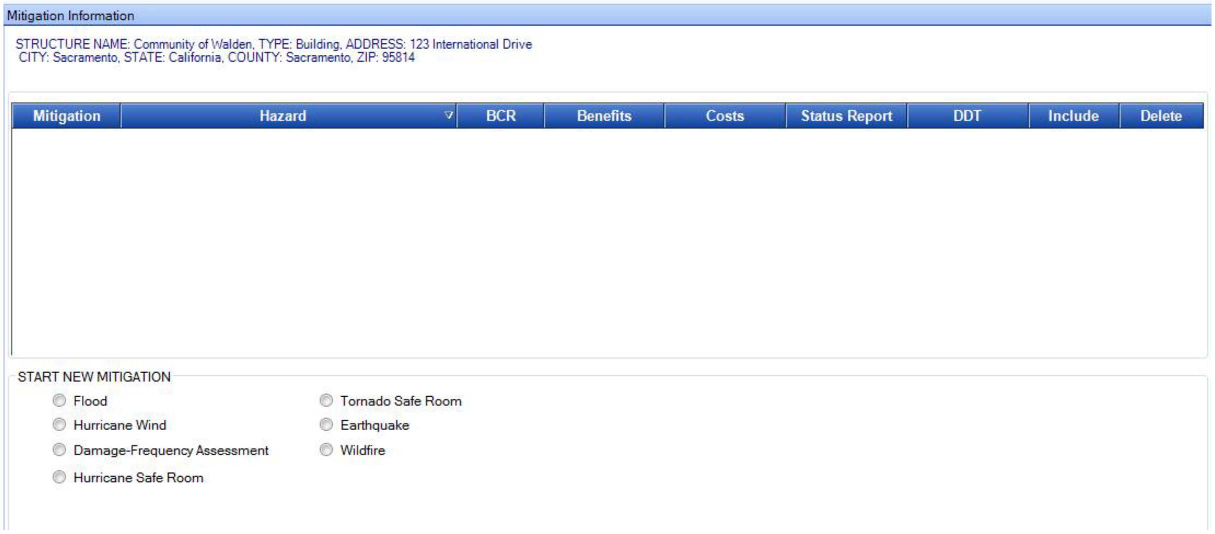
Select *Save*. The tool displays the "Structure saved successfully" message. Select *OK* to return to the Quick Start Area.



Screenshot 6.3: Add/Remove Structures

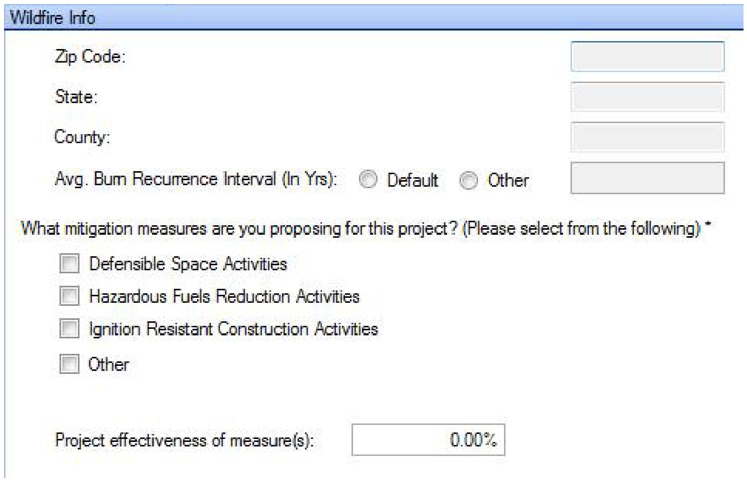
The third step in completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start Area to complete Step Three.

- Select *Add Structures to Project* to display a list of existing projects.
- Select "Walden Mitigation." The Add/Remove Structures dialog box is displayed.
- Select the "Community of Walden" structure.
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the "Add/Remove Structures Succeeded" message.
- Select *OK* to return to the Quick Start Area.



Screenshot 6.4: Mitigation Information

Click on the structure called “Community of Walden” under the project tree on the left. The MITIGATION INFORMATION screen appears. Under **START NEW MITIGATION**, select “Wildfire” as the hazard type. Select *Save and Continue* to proceed to the WILDFIRE INFO screen.



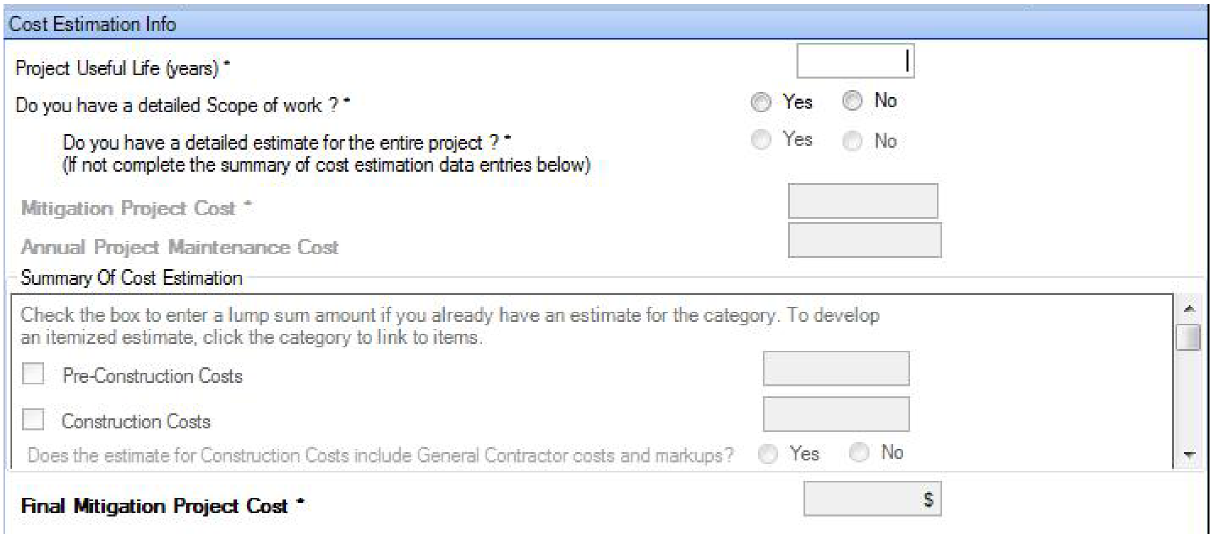
Screenshot 6.5: Wildfire Info

On the WILDFIRE INFO screen, some of the fields are already populated by the data entered previously in the PROJECT INFO screen:

- In the **Zip Code** data field, "95814" should be there.
- In the **State** data field, "California" should be there.
- In the **County** data field, "Sacramento" should be there.

Enter the following information:

- In the **Avg. Burn Recurrence Interval (In Yrs.)** data field, override the FEMA standard value by selecting "Other" and entering "75." The appropriate supporting documents must be uploaded to justify this value.
- **What mitigation measures are you proposing for this project?** Select both "Defensible Space Activities" and "Hazardous Fuel Reduction Activities."
- The **Project Effectiveness** data field should say "20.00%."
  Every box checked in the activities assumes a 10-percent effectiveness level. With appropriate documentation, this level of effectiveness value can be overridden by selecting the "Other" box and manually entering the percentage—up to a maximum of 45-percent effectiveness. Also, notice that if only "Ignition Resistant Construction" is selected, the effectiveness level is 0 percent because this technique must be combined with defensible space activities.
- Select *Save and Continue* to proceed to the COST ESTIMATION INFO screen.



Screenshot 6.6: Cost Estimate Info

On the COST ESTIMATION INFO screen, enter the following information:

- In the **Project Useful Life (years)** data field, enter “4.”
- For the question **Do you have a detailed Scope of work?** select “Yes.”
- For the question **Do you have detailed estimate for the entire project?** select “Yes.”
- In the **Mitigation Project Cost** data field, enter “$50,000.”
- In the **Annual Project Maintenance Cost** data field, enter “$5,000.”

Next, scroll down the Summary of Cost Estimation to the following question:

- **Does the estimate reflect current prices?** select “Yes.”

The **Project Useful Life** (PUL) data field is important because it establishes the timeframe to calculate annualized benefits. Raising or lowering the PUL value impacts the final BCR. Higher values extend the duration over which benefits are calculated, thus making the final BCR higher. This data is required for calculating the BCR and can be obtained from the PUL Table.

(Show the participants how to get to the PUL Table in the Help section by selecting *Help* and identifying the link.)

The **Mitigation Project Cost** is either provided by a competent source or created by users with the cost estimator. The source can be a competent entity such as a licensed engineer for a construction project or a wildfire specialist for vegetation-related activities. If a community has completed multiple similar mitigation projects, it can use a detailed cost estimate based on its historic costs. National cost estimation guides (i.e., RS Means, Marshall & Swift) can also be used.

For a professional budget provided to users by a competent source, the cost estimate itself should be attached as documentation. If users are building the cost in the cost estimator, then documentation should be provided for each of the inputs (e.g., for the project, documentation for the appraisal cost, structure market values, demolition and site restoration, etc.)
This value forms the basis for the “cost” value in the benefit-cost analysis. The higher the cost, the lower the BCR.

The **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness. Remember also that maintenance costs are the responsibility of the local entity submitting the project; therefore; they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

For documenting maintenance costs, an estimate on letterhead or other document should be provided that highlights where the estimate came from and whether the source is reliable to judge the future maintenance costs.

(Direct participants to select *Save and Continue* to reach the VOLUNTEER COSTS screen.)

Screenshot 6.7: Volunteer Costs

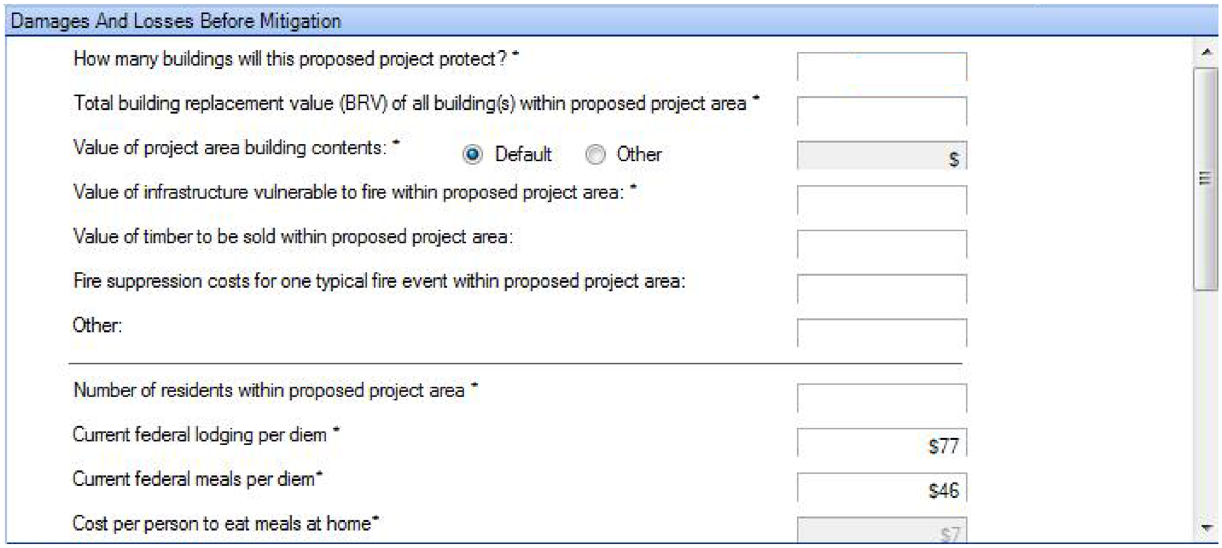
The purpose of this screen is to calculate the total cost of volunteers required to provide volunteer emergency services after a disaster related to the structure included in the mitigation project. The source of this data may be:

- Volunteer sign-in sheets from a reliable source such as the American Red Cross or Emergency Management Agency;
- Estimates by experts;
- Estimates transferred from similar past disasters; or
- A signed affidavit from the homeowner.

The documentation that would be needed includes information on the number of volunteers, their hours of service and the need for lodging and meal costs. However, this information may not be readily available directly after a disaster. If volunteer sign-in sheets are not provided by a reliable source, such as a local emergency management agency, estimates can be transferred from similar past disasters or estimated by experts. For time spent by a homeowner’s friends, family or outside charity volunteers to repair a house, a signed affidavit from the homeowner stating the number of people and estimated number of hours is required. Per diem days for nonlocal charities can only assume the number of days spent repairing the actual structure(s) being mitigated in the project.

This particular case study does not include information on volunteer costs.

To get to the DAMAGES AND LOSSES BEFORE MITIGATION screen, select *Save and Continue*.



Screenshot 6.8: Damage and Losses Before Mitigation

In the DAMAGES AND LOSSES BEFORE MITIGATION screen, enter the following information:

- **How many buildings will this proposed project protect?** Enter "100."
- In the **Total building replacement Value (BRV) of all building(s) within proposed project area** data field, enter "$15,000,000."
- In the **Value of project area building contents** data field, select "Default," which will result in a standard value of "$7,500,000."
- In the **Value of infrastructure vulnerable to fire within proposed project area** data field, enter "$500,000."
- In the **Value of timber to be sold within proposed project area** data field, enter "$250,000."
- In the **Number of Residents within the proposed project area** data field, enter "350."
- In the **Current federal lodging per diem** data field, keep the standard value of "$77."
- In the **Current federal meals per diem** data field, keep the standard value of "$46."

Supporting Documentation will be required for many of the data fields on this screen.

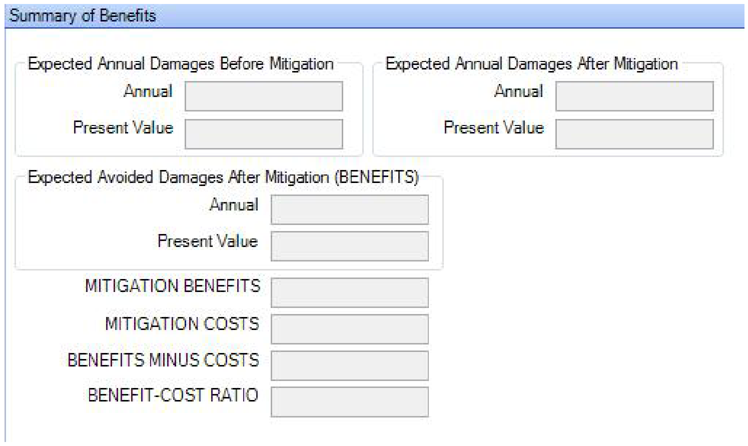
- The number of buildings protected can be obtained from the Statement of Work in the subapplication, and the same can be given as justification.
- Acceptable documentation for the BRV includes a letter from a construction or contracting firm or local building inspector; or a photocopy of pages from a standard cost reference manual. If tax records are used, the source must be an assessor.
- For the value of infrastructure information, reliable sources include municipal offices with jurisdiction over the public infrastructure (e.g., Department of Public Works, Wastewater Management, etc.)
- For the value of timber sold, some good sources include the USDA Forest Service or other qualified agency, forester, qualified timber company representative or owner of the property that has experienced a wildland fire previously (must be supported with signed estimate).
- For fire suppression costs, reliable sources include the local, State or Federal fire-fighting agency that fights wildland fires; USDA Forest Service; or the owner of the

property that has experienced a wildland fire previously (must be supported with signed estimate).

- The supporting documentation for the number of residents is in the subapplication.

Of all the values on this screen, the BRV is the main driver of the benefits. Reviewers will check to see if the total BRV is reasonable, considering the number of buildings protected. The other values associated directly with a dollar value, such as building contents, value of infrastructure, value of timber, etc. and the total number of people, will have a low to moderate impact on the BCR. The added burden of documenting timber value and suppression costs, for example, may not be worth the incremental increase in benefits, especially if the project is cost effective with the damages and casualties prevented. A higher combined dollar amount will result in a higher BCR; however, low valuations will have minimal if any impact on the overall BCR.

Select *Save and Continue* to get to the SUMMARY OF BENEFITS screen.

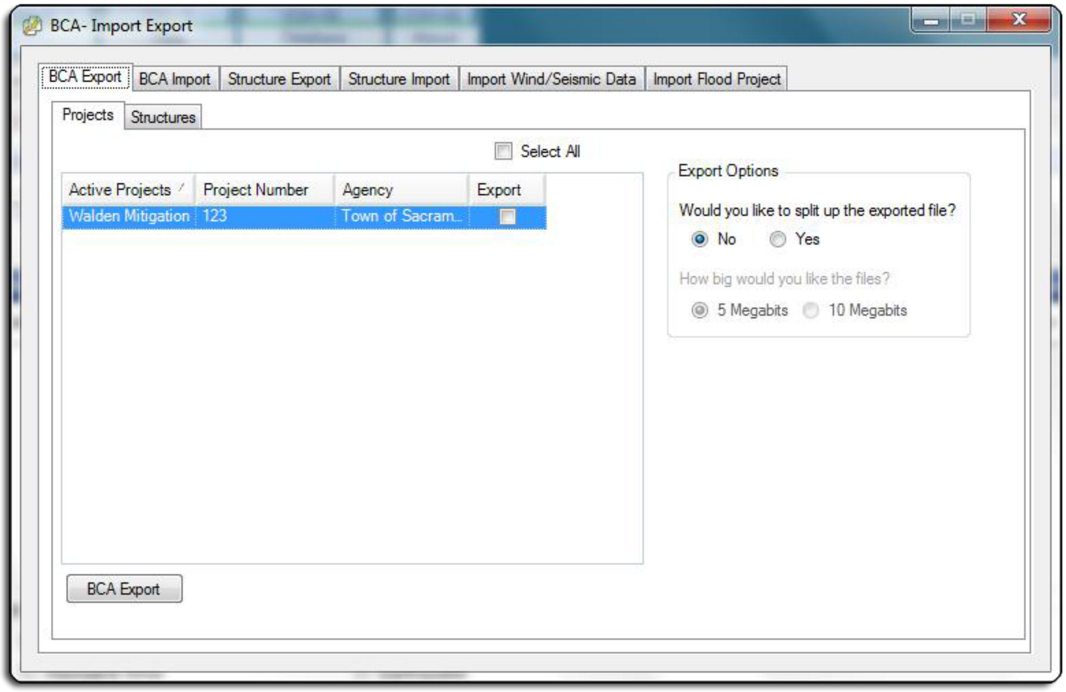


Screenshot 6.9: Summary of Benefits

The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

Remember from Unit 1 that this screen has three sections. The top section of the screen displays the Before and After Mitigation values that have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. The next section of the screen shows the impact of the project or the benefits. Finally, the bottom section of the screen displays the benefits and the costs, the difference between the two values, and the most important value—the **Benefit-Cost Ratio**. This is the benefits divided by the costs.

At this stage, either select *Save and Continue* to reach the MITIGATION INFORMATION screen, or stay in the same screen.



Screenshot 6.10: BCA Import Export

Steps One through Four of the BCA process are now complete. To complete Step Five: Export the BCA, do the following steps:

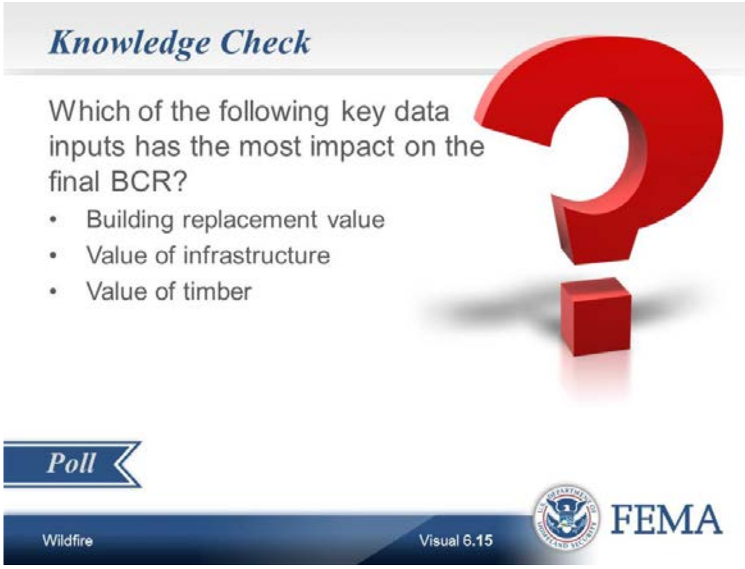
- Select *Import/Export* on the toolbar.
- Select the "BCA Export" tab.
- Select the box under the column "Export" next to "Walden Mitigation" and select *BCA Export*.
- Save the zip file to the desired location on the computer.

Another method to Export the BCA includes the following steps:

- Select *Home* on the basic navigation toolbar. The Quick Start Area is displayed.
- Select the Export BCA icon in the diagram. A list of the projects created is displayed.
- Select "Walden Mitigation" as the project to export. The Windows Explorer dialog box is displayed. Note that the file type is ".zip" by default.
- In the **File Name** data field, enter "Walden Mitigation."
- Save the zip file to the desired location on the computer.

The exported file will be used by other analysts or reviewers to evaluate the data entered in the completed BCA, the justification and documentation that was included and the final BCR.

Select *OK* and close the Import/Export window to return to the main screen of the BCA tool, which can either be the MITIGATION INFORMATION screen or the SUMMARY OF BENEFITS screen.



Visual 6.15: Knowledge Check

Answer the following knowledge check.

Which of the following key data inputs has the most impact on the final BCR?

- Building replacement value
- Value of infrastructure
- Value of timber

Write the correct answer below.

Summary

Visual 6.16: Summary

The objectives in this unit were for participants to:

- Explain Wildfire Module data and documentation requirements.
- Complete a Wildfire Module BCA.

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Unit 7
Hurricane Safe Room

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Unit 7 Hurricane Safe Room Overview

Visual 7.1: Unit 7 – Hurricane Safe Room

Welcome to Unit 7 of the Benefit-Cost Analysis: Entry Level course. This unit focuses on Hurricane Safe Room.

The case study handout is needed for this unit, along with the wind speed data that should have been imported with the BCA Tool.

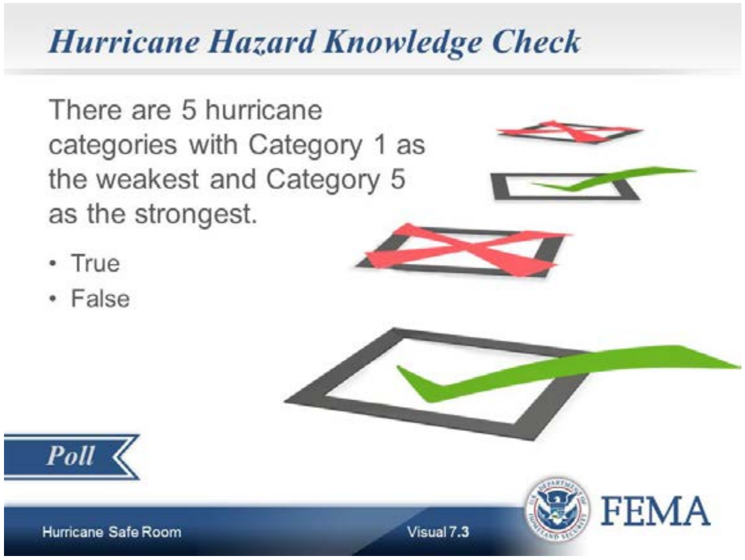
Visual 7.2: Unit 7 Objectives

Unit 1 covered the completion of a BCA using the Flood Module and an independent Flood Module case study. Unit 2 explained supplemental tools needed to complete more complicated analyses. In Units 3 through 6, BCA Tool skills were applied by using the DFA, Tornado Safe Room, Hurricane Wind and Wildfire Modules. The purpose of Unit 7 is to complete a BCA, using the Hurricane Safe Room Module. The objectives in this unit are for participants to:

- Explain Hurricane Safe Room Module data and documentation requirements.
- Complete a Hurricane Safe Room Module BCA.

As written in the Unified Hazard Mitigation Assistance Guidance, hurricane safe rooms are projects that provide safe room mitigation for high-wind events. They differ from tornado safe rooms in that hurricane safe rooms can only be used for:

- First responders;
- Critical services personnel who may be required to remain in harm's way to facilitate the continued operation of certain critical facilities who cannot be evacuated; and
- Facility occupants such as patients in hospitals, residents of long-term care facilities and prison/jail inmates.

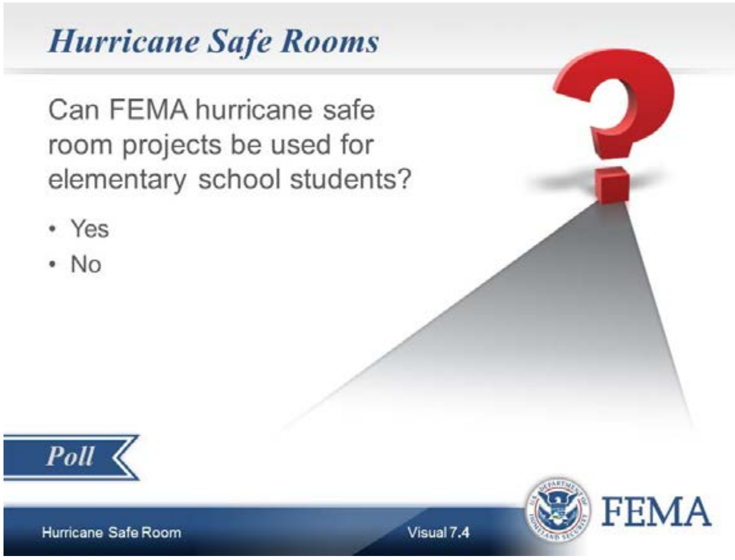


Visual 7.3: Hurricane Hazard Knowledge Check

Answer the following knowledge check to review what was covered about the hazard of hurricane wind in Unit 5.

There are five hurricane categories, with Category 1 as the weakest, and Category 5 as the Strongest. True or False?

Write the correct answer below.



Visual 7.4: Hurricane Safe Rooms

Answer the following knowledge check.

Can FEMA hurricane safe room projects be used for elementary school students?

Write the correct answer below.

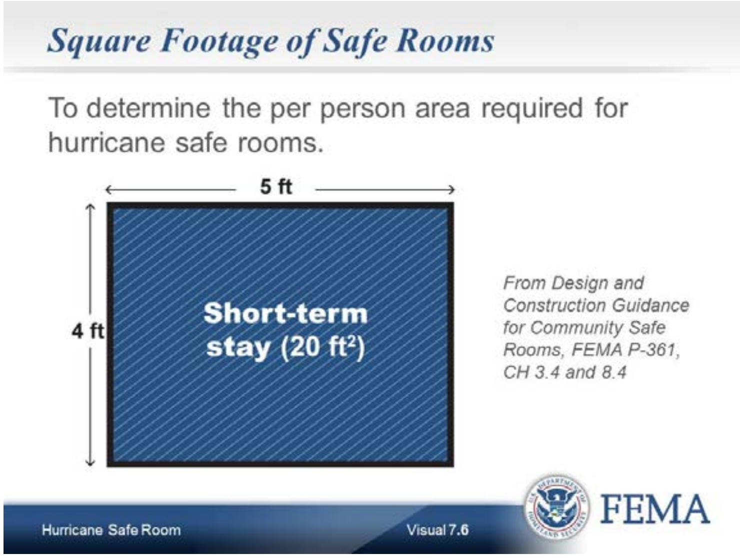
Hurricane Safe Room Mitigation Types

Visual 7.5: Hurricane Safe Room Mitigation Types

FEMA will only cover Hurricane Safe Room projects that provide safe room mitigation for high-wind events for first responders, critical facility personnel and occupants.

Hurricane safe rooms can be new safe rooms installed during initial construction or retrofitted safe rooms within buildings or added to buildings that already exist. Safe rooms must comply with FEMA publication P-361 *Design and Construction Guidance for Community Safe Rooms*. Note that any floodplain requirements, such as acceptability of safe rooms in a floodplain, must be verified and provided. If such safe rooms are indeed allowed, they will need to comply with all applicable floodplain management requirements, which also may mean insurance is required. The reviewers will need to know this information for a complete review of the application and BCA.

An internal safe room is a hardened area or room in an existing building. Stand-alone safe rooms are designed specifically as a safe room, which means they can be designed to accommodate a larger population and can be built away from other buildings that could generate debris from a strong hurricane.



Visual 7.6: Square Footage of Safe Rooms

From a design and construction standpoint, there is no limit on the maximum population that a safe room may be designed to protect. However, limitations do apply to the size of the safe room. FEMA safe room policy and BCA recommendations have evolved, and the criteria are being updated frequently. Please visit FEMA's website for the latest information.

To determine the gross area of the safe room, Section 3.4.1 of FEMA P-361 recommends a minimum of 20 square feet per person for hurricane community safe rooms. This square footage requirement is an increase over the original FEMA P-361 hurricane community safe room criteria. This change resulted from experts analyzing data from the use of shelters during hurricanes in 2004 and 2005. This increase brings the minimum requirements in-line with the recommendations of American Red Cross (ARC) Publication No. 4496, which recommends 20 ft^2 per person for a short-term stay (i.e., a few hours to a few days).

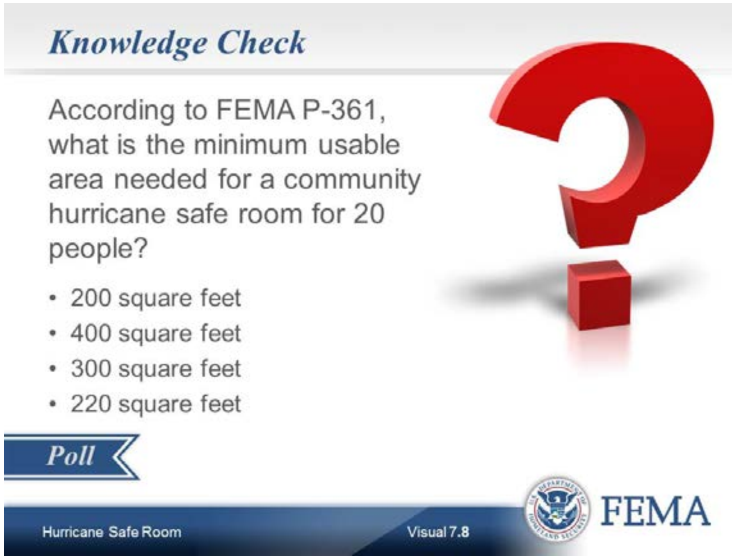
As identified in the FEMA's Safe Room Policy, Section VII, Part C, and in FEMA P-361 requirements, the time of protection for hurricane safe rooms is a minimum of 24 hours. The gross area of the safe room is the total area from wall-to-wall for the portion of the building used as a safe room. For a stand-alone safe room, the gross area is the entire area of the building. For an internal safe room, the gross area should be based on the area of the building where structural elements are proposed to be upgraded to FEMA P-361 guidelines.

Visual 7.7: Hurricane Safe Room Occupancy

Determining the hurricane safe room population depends on the assumptions used in developing and implementing evacuation or emergency response plans, as well as policies administered by local, State and Federal (if applicable) emergency management organizations. Therefore, applicants and subapplicants are encouraged to coordinate with the relevant agency in the jurisdiction developing those plans. The occupancy should depend on the number of persons who need protection in the event of a hurricane. Applicants and subapplicants must provide documentation to support the identified at-risk population for the safe room. Per the FY2011 HMA guidance, section C.2 Overview, page 109, Hurricane Safe Rooms are intended only for a specific population, as detailed below.

Category 1: First Responders
First responders are those who may be required to remain in harm's way, (i.e., the personnel for emergency response services). These groups include, but are not limited to, personnel of fire and police departments, rescue squads, emergency operations centers (EOCs), emergency medical and ambulance services, search and rescue teams and similar personnel that a community may depend on for a successful response.

Category 2: Critical and Essential Services Personnel and Facility Occupants
In many cases, other critical services personnel may be required to remain in harm's way to facilitate the continued operation of certain critical facilities, including long-term care and custodial care facilities, water supply and wastewater facilities, power supply and distribution plants, fuel and other hazardous material storage facilities, communications and data centers, and others that a local community may depend on for a successful response to a hurricane. This category may also include occupants of these facilities such as patients in hospitals, residents of long-term care facilities and prison/jail inmates.



Visual 7.8: Knowledge Check

Answer the following knowledge check.

According to FEMA P-361, what is the minimum gross area needed for a community hurricane safe room for 20 people?

- 200 square feet
- 400 square feet
- 300 square feet
- 220 square feet

Write the correct answer below.

Hurricane Safe Room Module Walkthrough

Visual 7.9: BCA Tool Walkthrough

Launch the BCA Tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If anybody is having trouble launching the tool, please let the host know by using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

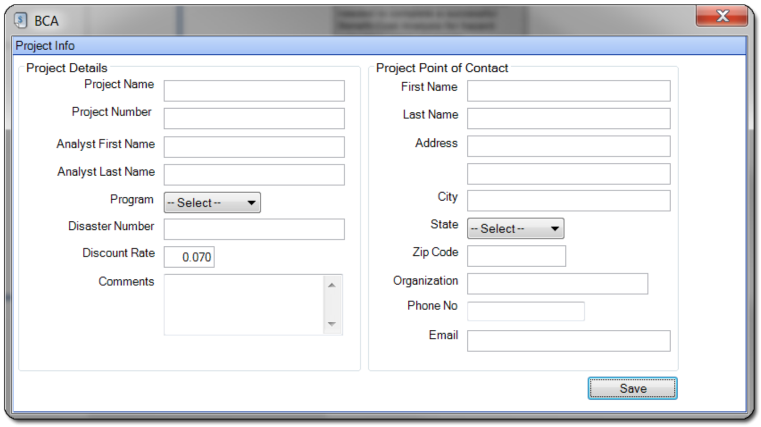
- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics

Visual 7.10: Steps to Complete a BCA

Answer the following review question.

Based on the BCA Tool Quick Start Area diagram, Create New Structure comes after Start New Mitigation: True or False?

Write the correct answer below.



Screenshot 7.1: Project Information

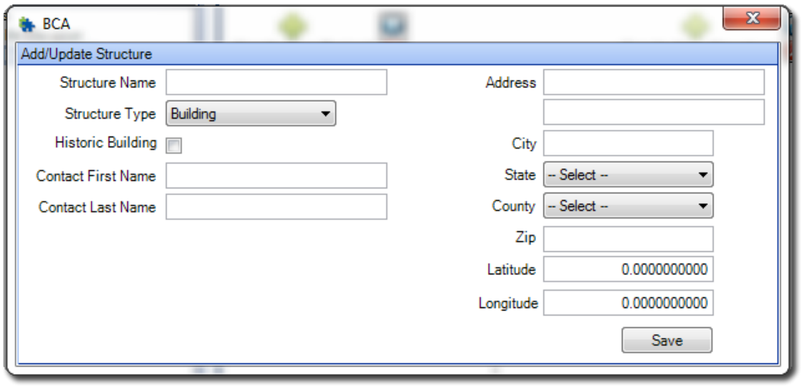
Open the Hurricane Safe Room Module handout.

In this case study, the project proposes to build a safe room for the Windamere Emergency Medical Services (EMS) staff to allow them to respond more quickly to hurricanes and other wind-related events by remaining near the emergency operations center.

The first step to completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start Area to complete Step One.

- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter “Windamere EMS Safe Room.”
- In the **Project Number** data field, enter “12.”
- In the **Analyst First Name** data field, enter “Linda.”
- In the **Analyst Last Name** data field, enter “Smith.”
- In the **Program** data field, select “HMGP.”
- In the **Disaster Number** data field, select “2751.”
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.
- In the **Contact Name** data fields, enter “Carol Taylor.”
- In the **Address** data field, enter “1525 Main Street.”
- In the **City** data field, enter “Windamere.”
- In the **State** data field, select “Florida.”
- In the **Zip Code** data field, enter “33016.”
- In the **Organization** data field, enter “Windamere EMS.”
- In the **Phone Number** data field, enter “555-555-5555.”
- In the **Email** data field, enter “carol.taylor@windamere.gov.”
- Select *Save*. The tool displays the “Project saved successfully” message.

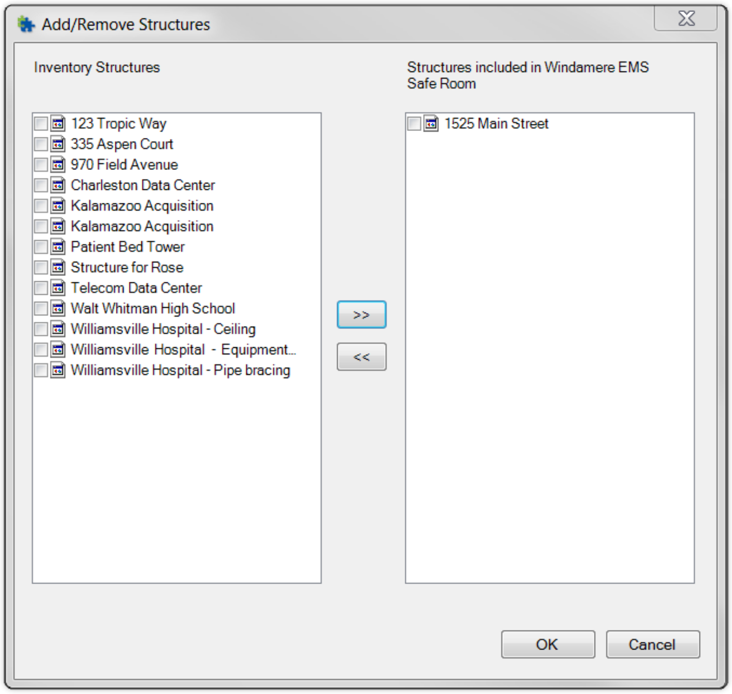
Select *OK*. The Home page is displayed.



Screenshot 7.2: Add/Update Structure

The second step to completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start Area to complete Step Two.

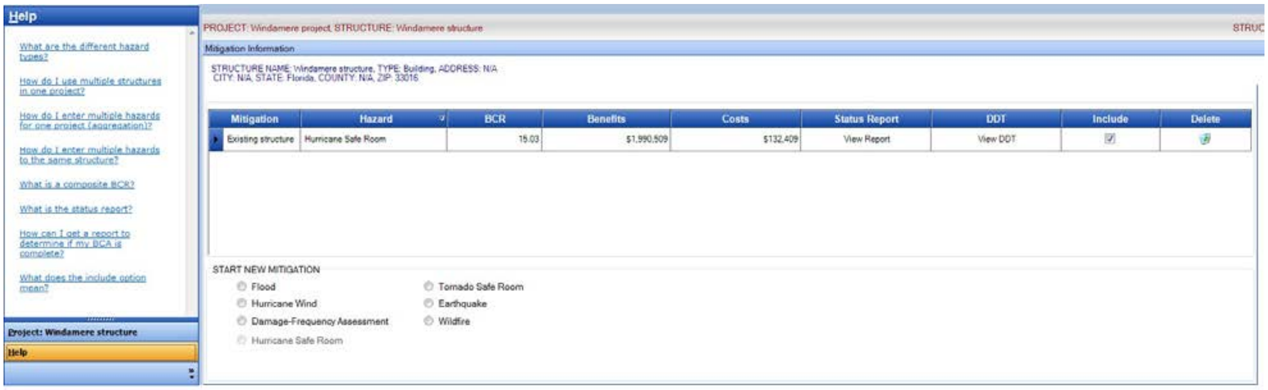
- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter “1525 Main Street.”
- In the **Structure Type** data field, select “Building.”
- In the **Historic Building** data field, leave the box unchecked.
- In the **Contact First Name** data field, enter “Carol.”
- In the **Contact Last Name** data field, enter “Taylor.”
- In the **Address** data field, enter “1525 Main Street.”
- In the **City** data field, enter “Windamere.”
- In the **State** data field, select “Florida.”
- In the **County** data field, select “Broward.”
- In the **Zip** data field, enter “33016.”
- In the **Latitude** data field, enter “25.7414001.”
- In the **Longitude** data field, enter “-80.294438.”
- Select *Save*. The tool displays the “Structure saved successfully” message.
- Select *OK*. The Home page is displayed.



Screenshot 7.3: Add/Remove Structures

The third step to completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start area to complete Step Three.

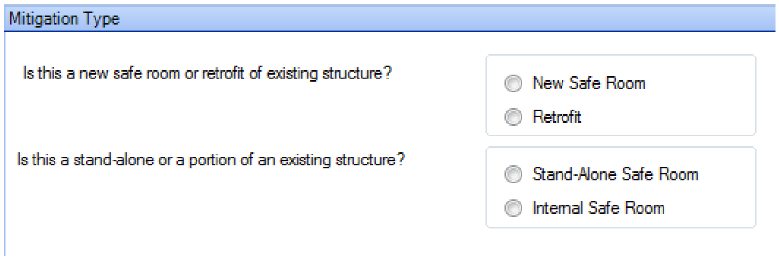
- Select *Add Structures to Project* to display a list of existing projects.
- Select the “Windamere EMS Safe Room” project. The Add/Remove Structures dialog box is displayed.
- Select the “1525 Main Street” structure.
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the “Add/Remove Structures Succeeded” message.



Screenshot 7.4: Mitigation Information

The fourth step to completing the BCA is to start a new mitigation. Use the *Start New Mitigation* icon in the Quick Start Area to complete Step Four.

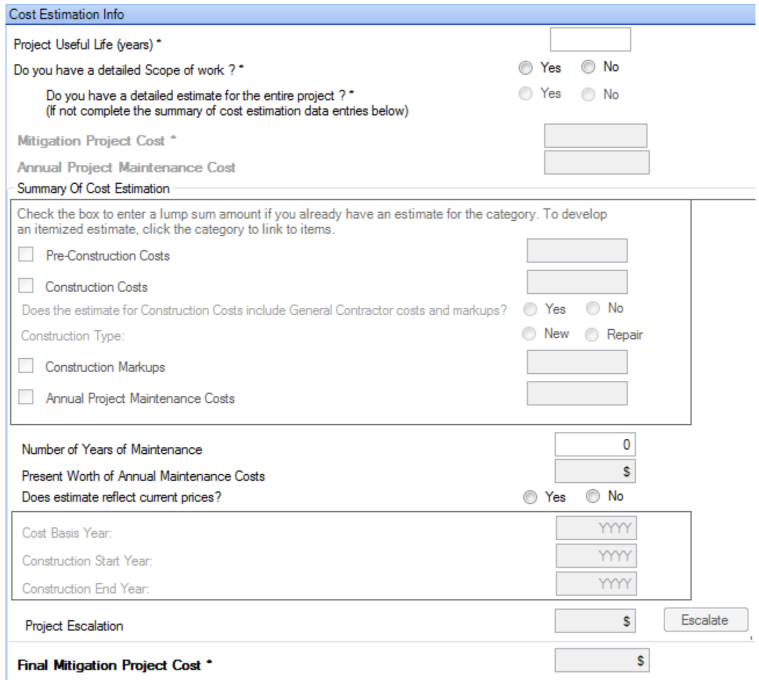
- Select *Start New Mitigation* to display a list of existing projects.
- Select the “Windamere EMS Safe Room” project.
- Select the “1525 Main Street” structure. The MITIGATION INFORMATION screen is displayed.
- In the projects window on the left, select *Help*. The list of available Help topics for this screen is displayed.
- In the Start New Mitigation section at the bottom of the screen, select “Hurricane Safe Room.”
- In the upper right part of the screen, select *Save and Continue.* The HURRICANE SAFE ROOM MITIGATION TYPE screen is displayed.



Screenshot 7.6: Mitigation Type

This screen identifies whether the hurricane safe room is a new safe room or a retrofit and whether it is a stand-alone safe room or an internal safe room. In the workplace, the hurricane safe room mitigation type can be determined from the detailed scope of work, which should be included in the subapplication.

- Hover the mouse on each hurricane safe room mitigation project type. A screen tip is displayed, giving a brief description of that project type.
- To be considered for funding under HMA, according to the UHMA Guidance, hurricane safe room projects must include a descriptive statement of Operations and Maintenance plan at the time of application.
- In the **Is this a new safe room or a retrofit of an existing structure?** data field, select “Retrofit.”
- In the **Is this a stand-alone or a portion of an existing structure?** data field, select “Internal Safe Room.”
- In the **Justification/Documentation** data field, enter “See SOW.” This screen requires users to enter justification.
- Select *Save and Continue*. In the Hurricane Safe Room Module, the COST ESTIMATION INFO screen is displayed.



Screenshot 7.7: Cost Estimation Info

The purpose of this screen is to establish the “C” or “costs” needed to calculate the BCR. Below is the information needed to be entered on this screen:

- In the **Project Useful Life** data field, enter “30.”
- In the **Justification/Documentation** data field, enter “Project Useful Life table.”
- In the **Do you have a detailed Scope of Work?** data field, select “Yes.”
- In the **Do you have a detailed cost estimate for the entire project?** data field, select “Yes.”
- In the **Justification/Documentation** data field, enter “See SOW.”
- In the **Mitigation Project Cost** data field, enter “$120,000.”
- In the **Annual Project Maintenance Cost** data field, enter “$1,000.”
- In the **Justification/Documentation** data field, enter “See maintenance cost memo.”
- Note that the tool filled in the **Final Mitigation Project Cost** data field.

Scroll down the Summary of Cost Estimates to the following question:

- **Does Estimate reflect current prices?** Select “Yes.”

Important data fields in this screen are:

- **Project Useful Life (PUL)**
- **Mitigation Project Cost**
- **Annual Project Maintenance Cost**

The **PUL** data field is important because it establishes the timeframe to calculate annualized benefits. Raising or lowering the **PUL** value impacts the final BCR. Higher values extend the duration over which benefits are calculated, thus making the final BCR higher. This data is required for calculating the BCR and can be obtained from the PUL table.

The **Mitigation Project Cost** data field is either provided by a competent source or created by using the cost estimator. The source can be a competent entity such as a licensed engineer for a construction project. If a community has completed multiple similar mitigation projects, it can use a detailed cost estimate based on its historic costs. National cost estimation guides (i.e., RS Means, Marshall & Swift) can also be used.

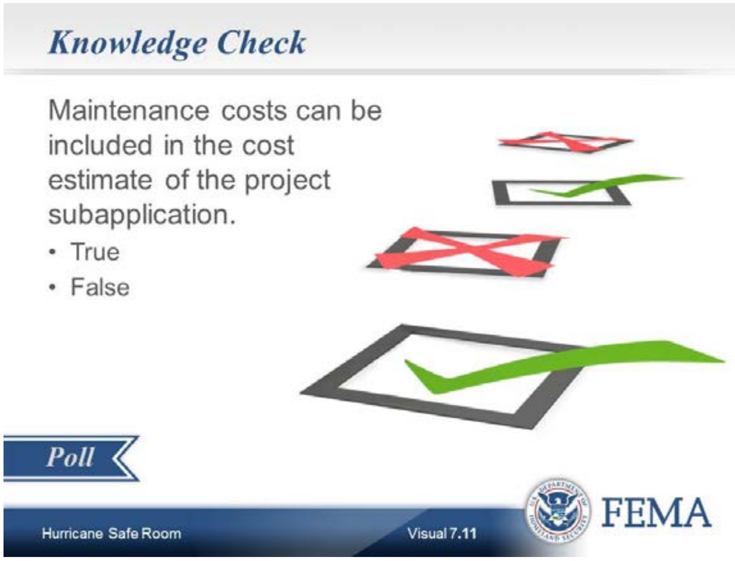
For a professional budget provided to users by a competent source, the cost estimate itself should be attached as documentation. If users are building the cost in the cost estimator, documentation should be provided for each of the inputs (e.g., for the project, documentation for the appraisal cost, structure market values, demolition and site restoration, etc.) This value forms the basis for the “cost” value in the benefit-cost analysis. The higher the cost, the lower the BCR.

The **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness. Please note that adding any maintenance costs will lower the BCR. Remember also that maintenance costs are the responsibility of the local entity submitting the project; therefore, they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

For documenting maintenance costs, an estimate on letterhead or other document which highlights where it came from and whether the source is reliable to judge the future maintenance costs should be provided.

Like the Flood Module, the COST ESTIMATION INFO screen is the first screen in the Hurricane Wind Module where it is important to upload documentation to support the data entered. To upload documents so that they will be attached to the analysis, use the Justification/Documentation section at the bottom of the screen. This process was demonstrated in the Flood Module.

Select *Save and Continue*. The STRUCTURE INFORMATION AND WIND SPEEDS screen is displayed.

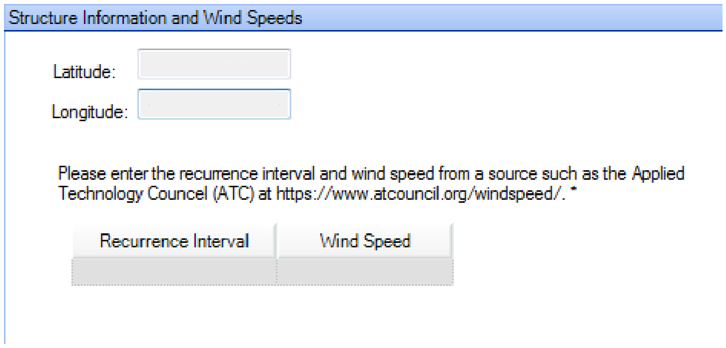


Visual 7.11: Knowledge Check

Answer the following knowledge check.

Maintenance costs can be included in the cost estimate of the project subapplication: True or False?

Write the correct answer below.



Screenshot 7.8: Structure Information and Wind Speeds

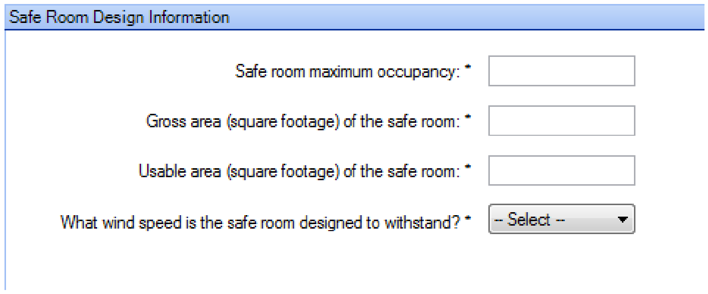
The purpose of this screen is to provide the wind speed and recurrence interval data for the project location used by the tool in the casualties prevented calculation. On this screen, in the **Recurrence Interval** and **Wind Speed** data fields, enter the following:

- For the first row, enter “10” for **Recurrence Interval** and “89” for **Wind Speed**.
- For the second row, enter “25” and “112.”
- For the third row, enter “50” and “128.”
- For the fourth row, enter “100” and “138.”
- For the fifth row, enter “300” and “155.”
- For the sixth row, enter “700” and 167.”
- For the last row, enter “1700” and “179.”

The **Latitude** and **Longitude** on this screen are automatically populated from the structure information that was entered. The **Recurrence Interval** and **Wind Speed** can be obtained from the Applied Technology Council (ATC) at: https://www.atcouncil.org/windspeed/. This data comes from the American Society of Civil Engineers (ASCE) 7-10 wind speeds, as measured in three-second peak gusts in miles per hour (mph). Enter the Mean Recurrence Intervals (MRI) 10-, 25-, 50-, and 100-year recurrence intervals and their corresponding values. Enter the Risk Category I, II, and III/IV wind speeds and denote them as recurrence intervals 300-, 700- and 1700-year respectively.

The wind speeds are entered in mph, and this is required data for calculating the BCR. The data is location specific, but along the Gulf/South Atlantic coast, wind speeds will be higher and result in higher benefits. Remember to attach a printout from the ATC website so that reviewers can easily verify the entered data.

Select *Save and Continue*. The SAFE ROOM DESIGN INFORMATION screen is displayed.



Screenshot 7.9: Safe Room Design Information

The purpose of this screen is to gather occupancy information to calculate the casualties prevented, which translates into losses avoided for this module. On this screen, enter the following:

- In the **Safe room maximum occupancy** data field, enter “12.”
- In the **Gross area of the safe room** data field, enter “240.”
- In the **Usable area of the safe room** data field, enter “204.”
- In the **What wind speed is the safe room designed to withstand?** data field, select “250.”

The **Safe room maximum occupancy** data field is the number of people who will not be evacuated and will therefore need to be protected by hurricane. In general, the higher the occupancy, the higher the casualties avoided benefits. Written documentation is required to state the number of people who will be housed in the hurricane safe room and which facility(ies) they are supposed to be manning when the all-clear is sounded.

For the **gross area of the safe room** and **usable area of the safe room** data fields**,** adequate documentation must be provided to determine whether the proposed safe room size is appropriate for the at-risk population identified. The documentation should be sufficiently detailed to be verified during the grant review process and should show how the at-risk population number was determined and how lives and injuries would be prevented. Acceptable documentation includes safe room design plans, additional design information or a letter from the safe room design engineer, or tax records and appraisals.

The value for the **usable area of the safe room** data field, as defined by FEMA P-361, should be determined by subtracting partitions and walls, columns, fixed or movable objects, furniture, equipment or other features from the gross floor area. These objects, under probable conditions, cannot be removed or stored during use as a safe room. An alternative method for determining the usable safe room floor area is to use the following percentages:

- Reduce the gross floor area of safe rooms with concentrated furnishings or fixed seating by a minimum of 50 percent.
- Reduce the gross floor area of safe rooms with unconcentrated furnishings and without fixed seating by a minimum of 35 percent.
- Reduce the gross floor area of safe rooms with open plan furnishings and without fixed seating by a minimum of 15 percent (FEMA P-361).

Acceptable documentation for usable area includes the usable area calculations and a statement describing if a default reduction percentage was used or if usable area was estimated directly from the design drawings or engineering information.

The next data field is the **wind speed the safe room is designed to withstand** data field. The safe room provides life-safety protection from wind events and therefore should be capable of resisting ultimate-wind loads without failure, although some damage may occur and serviceability of the safe room may be an issue after an event. From the drop-down list in this data field, users should select the wind speed that the safe room is designed to withstand that is equal to or is the next greater value than the wind speed value shown for that location on the figures below. For example, if the wind speed at a location is 160 mph, the 160 mph design speed should be selected. If the wind speed at a location is 175 mph, then the 200 mph design wind speed should be selected. Below are a few wind speed design maps from FEMA P-361.

Figure 3-2a shows the Hurricane Safe Room Design Wind Speed Map for the Western Gulf of Mexico area. The landward extent of the hurricane prone region (per ASCE 7-05) is the solid heavy line. The wind speeds for this region range from 160-210 mph.

Figure 3-2a. Hurricane Safe Room Design Wind Speed Map from the ICC-500 - Western Gulf of Mexico Detail

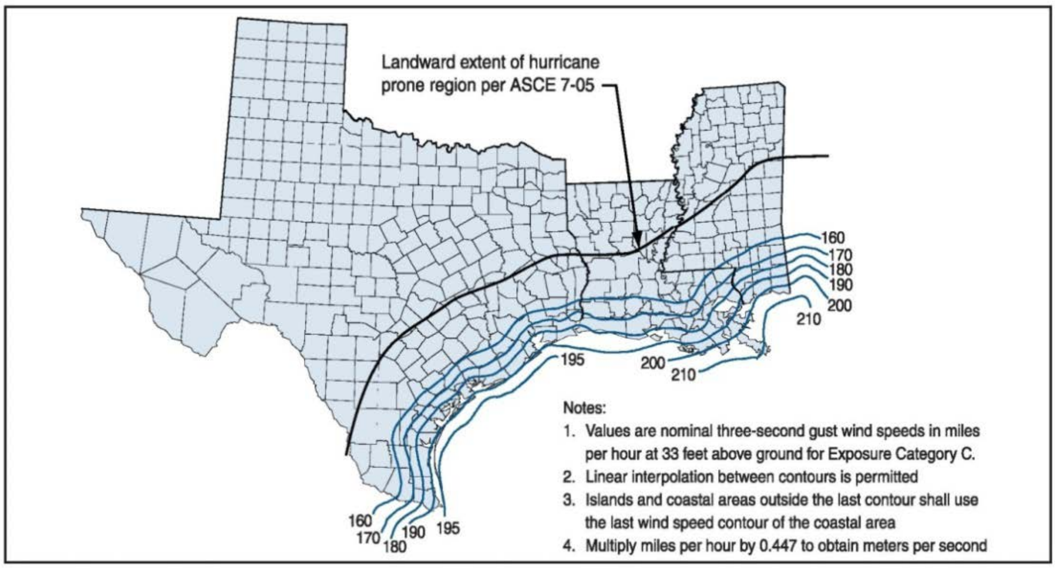


Figure 3-2b shows the Hurricane Safe Room Design Wind Speed Map for the Eastern Gulf of Mexico area. The wind speeds for this region range from 160-225 mph.

Figure 3-2b. Hurricane Safe Room Design Wind Speed Map from the ICC-500 – Eastern Gulf of Mexico Detail

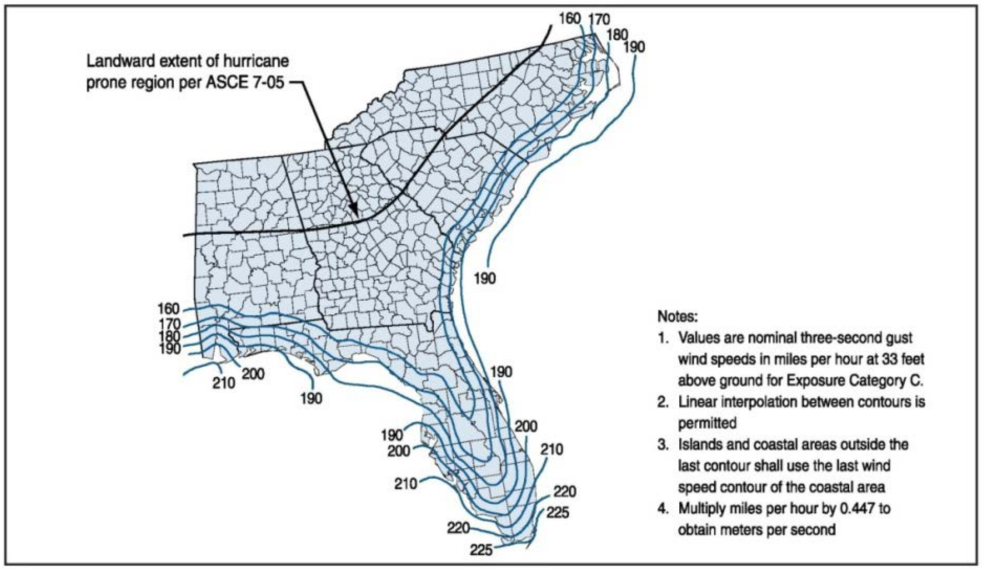
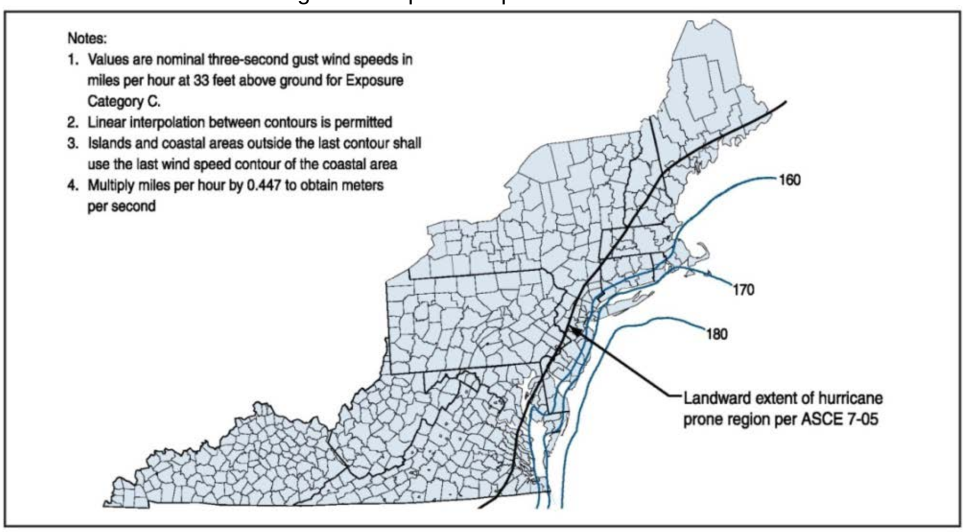


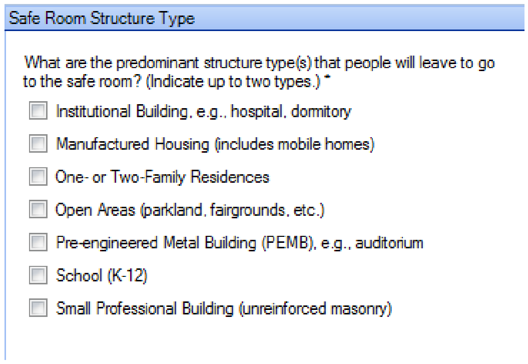
Figure 3-2c shows the Hurricane Safe Room Design Wind Speed Map for the Mid-Atlantic and Northeast area. Here the wind speeds for this region range from 160-180 mph.

Figure 3-2c. Hurricane Safe Room Design Wind Speed Map from the ICC-500 – Mid Atlantic and Northeast Detail



Always use the wind speed for the location of the safe room. If this location is between two contours, then chose the higher wind speed for the design of the safe room.
Now, let's switch back to the BCA Tool to continue the walkthrough.

Select *Save and Continue*. The SAFE ROOM STRUCTURE TYPE screen is displayed.



Screenshot 7.10: Safe Room Structure Type

The purpose of this screen is to outline the structure types that the people (occupancy value) will be evacuating from to get to the safe room. The building performance (wind resistance) of each structure type will determine the likelihood for casualties to be prevented. For example, evacuating from a small professional building to a safe room will prevent more casualties (and therefore provide more benefits) than evacuating from an institutional building.

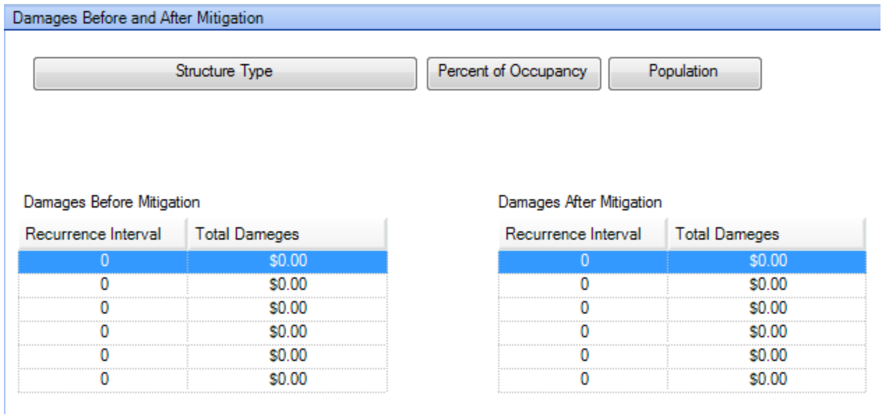
On this screen, enter the following:

- In the **What are the predominant structure type(s) that people will leave to go to the safe room** data field, select “Institutional building” and “Pre-engineered Metal Building.”

The values entered in this data field are available from the community and can be documented by providing maps with locations of sample structure types and photographs of the corresponding structure types located within the safe room service area. Another documentation source is a letter from an authorized local official that includes the predominant structure types.

The structure types represent the current location (before mitigation) of the population to be protected from the hurricane. For an internal safe room, one of the predominant structure types should correspond with the structure type of the building where the safe room will be constructed. The seven pre-defined structure types provided in the model are based on the categories used in the development of the Enhanced Fujita Scale for the Tornado Safe Room Module. Casualty rates were defined based on additional subject matter expert information that is published in the Enhanced Fujita Scale report.

Select *Save and Continue*. The DAMAGES BEFORE AND AFTER MITIGATION screen is displayed.



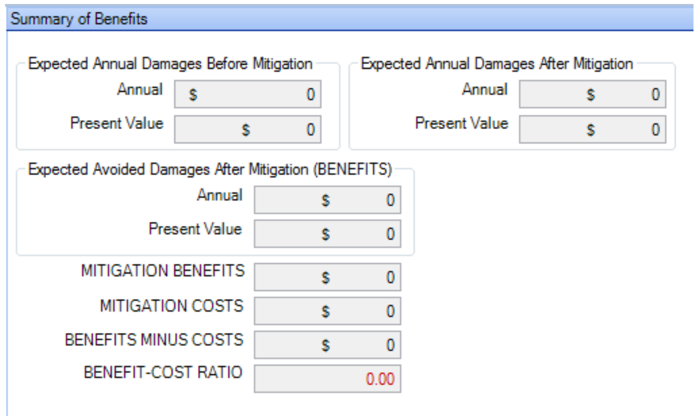
Screenshot 7.11: Damages Before and After Mitigation

The purpose of this screen is to determine the occupancy rates based on the structure type that the facility workers would have used during a hurricane, assuming no safe room existed. On this screen, enter the following:

- In the **Percent of Occupancy** data field for Institutional building, enter "75." Note the tool will automatically fill in the percent occupancy for the Pre-engineered metal building.

Benefits are calculated based on the number of casualties prevented. Different structure types have different wind performance, thus knowing how many occupants will be coming from the structure types (assuming two predominant structure types) is important. The percentage of hurricane safe room occupants must equal 100 percent and is based on the one or two different structure types from previous screen. This information is available from the facility/school/building owners and should be available from the same documentation provided for the structure type and safe room occupancy. The number of people housed in the hurricane safe room (regardless of the structure type they are evacuating from) is the big driver of benefits since this is the pool from which casualties avoided (benefits) is determined. If more than one structure type is selected, the ratio between the two will determine the benefits since different structure types have different wind performance characteristics.

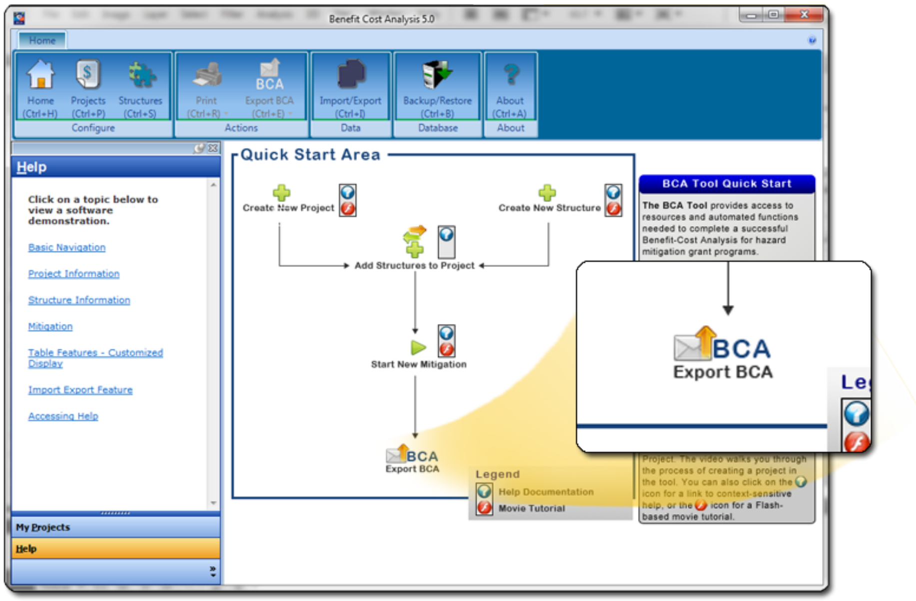
Select *Save and Continue*. The SUMMARY OF BENEFITS screen is displayed.



Screenshot 7.12: Summary of Benefits

The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

This screen has three sections. The top section of the screen displays the Before and After Mitigation values that have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. The next section of the screen shows the impact of the project or the benefits. Finally, the bottom section of the screen displays the benefits and the costs, the difference between the two values, and the most important value—the **Benefit-Cost Ratio**. This is the benefits divided by the costs.

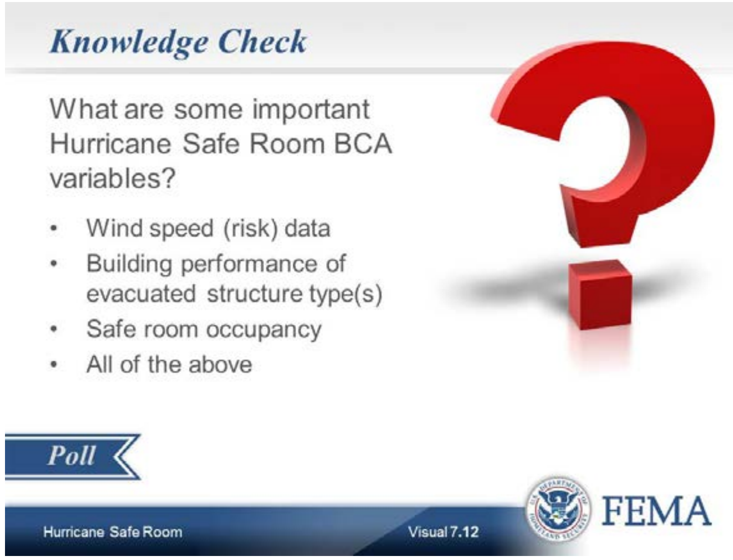


Screenshot 7.13 BCA Export

Steps One through Four of the BCA process are now complete. To complete Step Five: Export the BCA, do the following steps:

- Select *Home* on the basic navigation toolbar. The Quick Start Area is displayed.
- Select the Export BCA icon in the diagram. A list of the projects created is displayed.
- Select “Windamere EMS Safe Room” as the project to export. The Windows Explorer dialog box is displayed. Note that the file type is “.zip” by default.
- In the **File Name** data field, enter “Windamere_EMS_SafeRoom.”
- Save the zip file to the desired location.

A message of success will pop up. Select *OK* and close the Import/Export window.



Visual 7.12: Knowledge Check

Answer the following knowledge check:

What are some important Hurricane Safe Room BCA variables?

- Wind speed (risk) data
- Building performance of evacuated structure type(s)
- Safe room occupancy
- All of the above

Write the correct answer below.

Summary

Visual 7.13: Summary

Remember: It is always about risk, regardless of the hazard. Cost-effective mitigation projects address high-risk situations with lower costs and higher benefits.

The objectives in this unit were for participants to:

- Explain Hurricane Safe Room Module data and documentation requirements.
- Complete a Hurricane Safe Room Module BCA.

Unit 8
Earthquake

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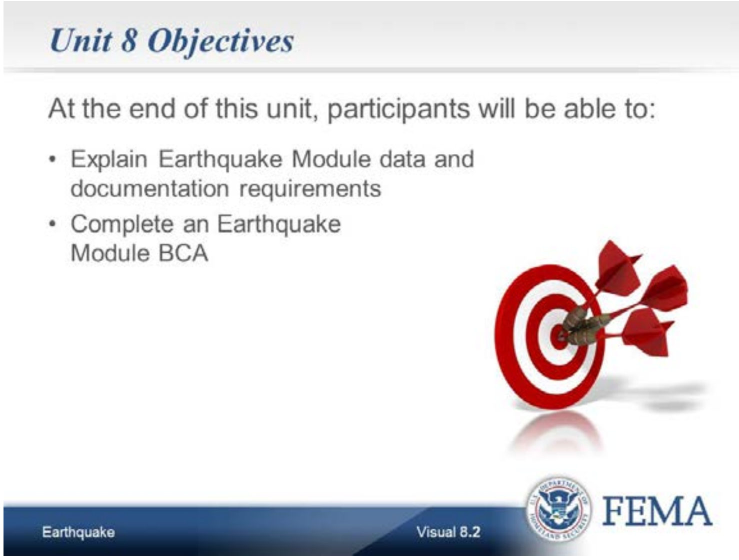
Unit 8 Earthquake Overview

Visual 8.1: Unit 8 – Earthquake

Welcome to Unit 8 of the Benefit-Cost Analysis: Entry Level course. This unit focuses on the Earthquake Module.

The case study handout is needed for this unit, along with the seismic data that should have been imported with the BCA Tool.

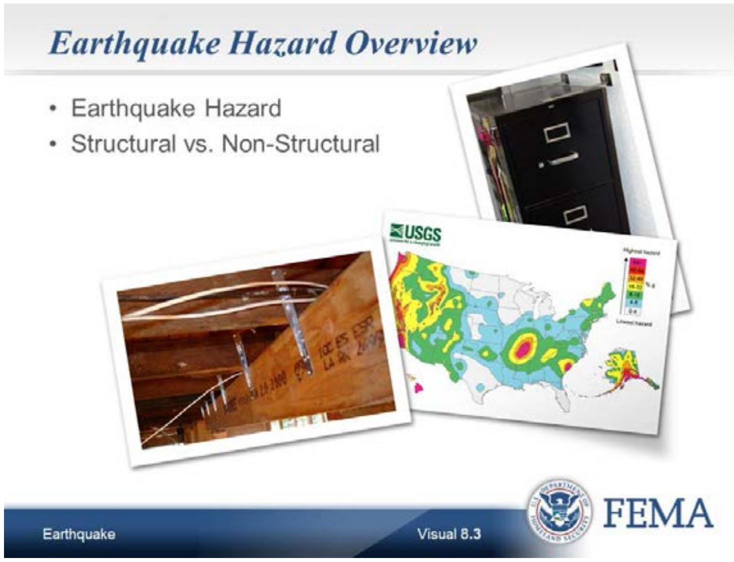


Visual 8.2: Unit 8 Objectives

Unit 1 covered completing a BCA using the Flood Module and an independent Flood Module case study. Unit 2 explained supplemental tools needed to complete more complicated analyses. In Unit 3, BCA Tool skills were applied, using the DFA Module. In Units 5 through 7, those skills were practiced, using the Tornado Safe Room, Hurricane Wind, Wildfire, and Hurricane Safe Room Modules. The purpose of Unit 8 is to complete a BCA, using the Earthquake Module. The objectives are for participants to:

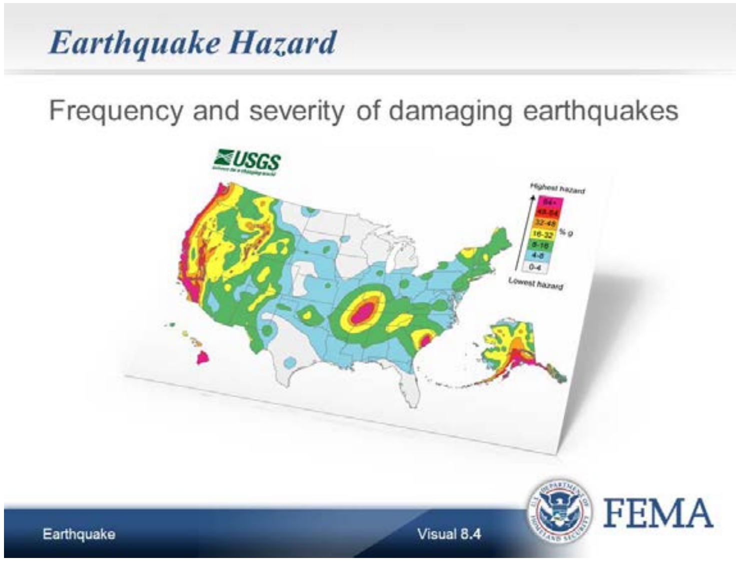
- Explain Earthquake Module data and documentation requirements.
- Complete an Earthquake Module BCA.

Earthquake Hazard Overview



Visual 8.3: Earthquake Hazard Overview

This overview of the earthquake hazard looks at hazard data and a seismic map. States on both sides of the hazard risk spectrum are examined. Structural and non-structural elements of a building are both analyzed with a more detailed look into the non-structural elements, since the case study focuses on those elements.



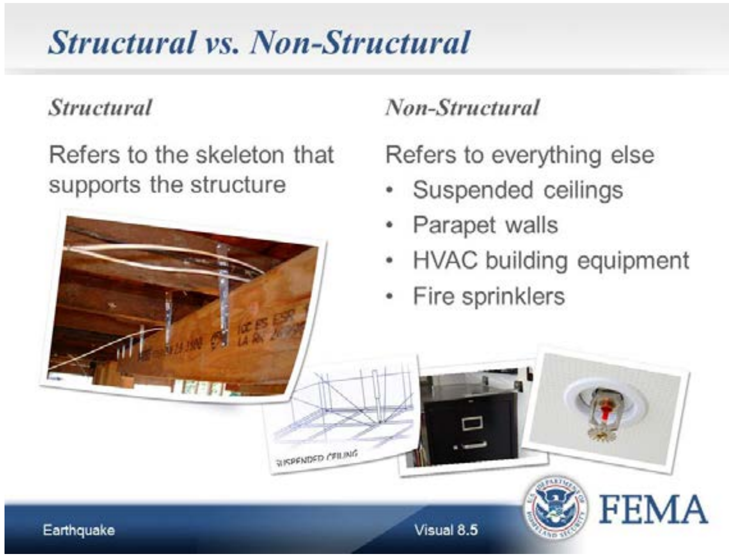
Visual 8.4: Earthquake Hazard

Earthquake hazard refers to the frequency and severity of damaging earthquakes. For a given community, the higher the level of earthquake hazard, the more likely it is that a specific earthquake mitigation project will be cost effective.

Seismologists review historical earthquake activity, locations and characteristics of mapped faults, and regional geology to estimate the earthquake hazard. This information is often depicted on a seismic hazard map as shown here.

The link to the seismic hazard map location on the FEMA website is: http://www.fema.gov/earthquake/earthquake-hazard-maps.

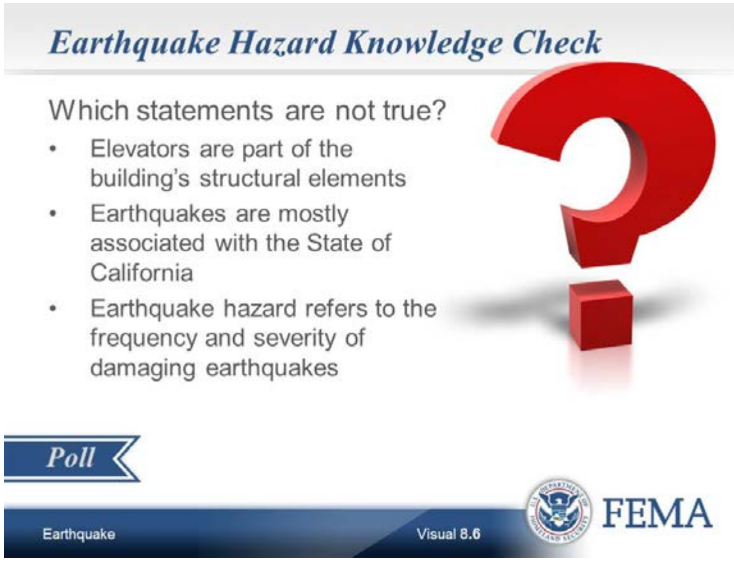
In the United States, earthquakes are most commonly associated with California because of the high earthquake hazard level in many parts of that State. However, only a handful of States have earthquake hazard levels that are essentially negligible statewide, including Florida, Iowa, Michigan, Minnesota and Wisconsin. Nearly every other State has some areas where the level of earthquake hazard may be consequential.



Visual 8.5: Structural vs. Non-Structural

Structural elements refer to the skeleton that supports the structure. Non-structural elements refer to everything else.

Non-structural elements include: generic contents and equipment, parapet walls, racks and shelves, generators, elevators, fire sprinklers, HVAC (building equipment), suspended ceilings and electrical cabinets.



Visual 8.6: Earthquake Hazard Knowledge Check

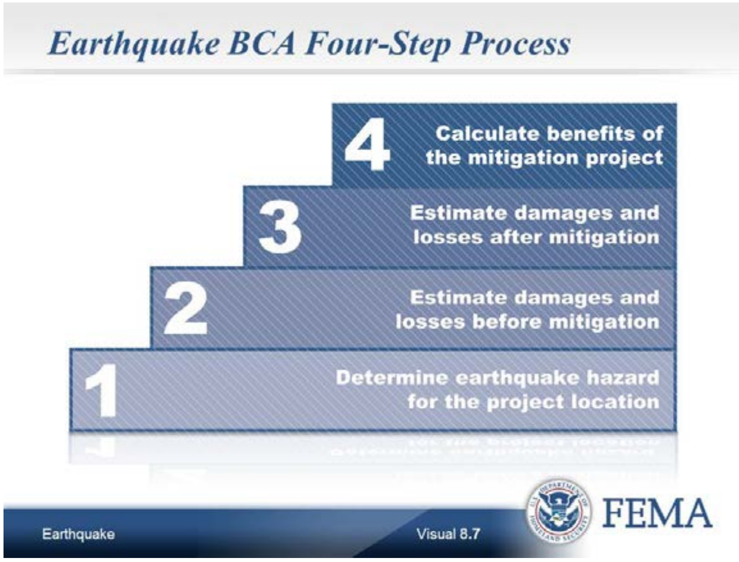
Answer the following knowledge check:

Which of the following statements are not true?

- Elevators are part of the building's structural elements.
- Earthquakes are mostly associated with the State of California.
- Earthquake hazard refers to the frequency and severity of damaging earthquakes.

Write the correct answer below.

Earthquake Module Overview

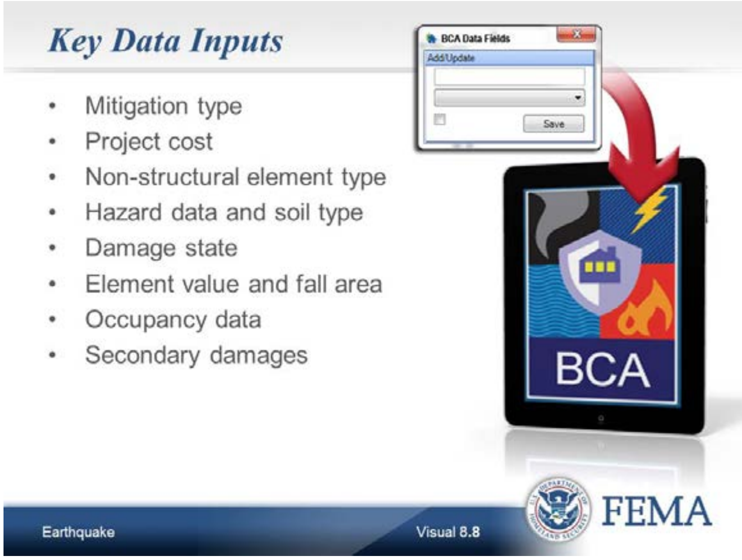


Visual 8.7: Earthquake BCA Four-Step Process

The four-step process that applies to any hazard mitigation project also applies to earthquake mitigation projects:

1. Determine the earthquake hazard for the project location.
2. Estimate damages and losses before mitigation.
3. Estimate damages and losses after mitigation.
4. Calculate benefits of the mitigation projects

Structural mitigation projects will require a competent engineer and the remainder of this unit will concentrate on BCAs for non-structural mitigation projects only.



Visual 8.8: Key Data Inputs

The eight key data inputs for a Non-structural Earthquake BCA include:

1. Mitigation type
2. Project cost information
3. Non-structural element type and support or weighting
4. Hazard data and soil type
5. Damage state information
6. Element value and fall area
7. Occupancy data
8. Secondary damages

Earthquake Module Walkthrough

Visual 8.9: BCA Tool Walkthrough

Launch the BCA Tool on the computer by double-clicking the BCA V5.0 icon on the desktop. If there are any problems launching the tool, let the host know using the Q & A Pod. Describe the problem and the exact words of any error message. The host will help resolve the problem.

The following text notations are used in this manual when referring to items on the screens of the BCA Tool:

- SCREEN TITLES – All capitalized
- **Data Fields** – Mixed case, bold
- *Buttons* – Mixed case, italics

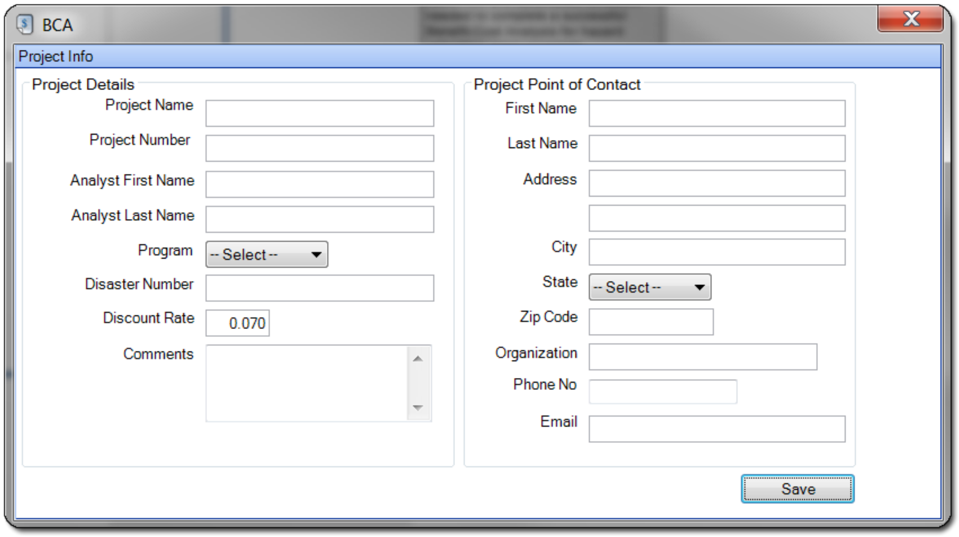
Visual 8.10: Steps to Completing a BCA

Answer the following review question.

Based on the diagram in the BCA Tool Quick Start Area, which step comes after ‘Create a New Project’?

- Start New Mitigation
- Create New Structure
- Add Structures to Project
- Export the BCA

Write the correct answer below.



Screenshot 8.1: Project Info

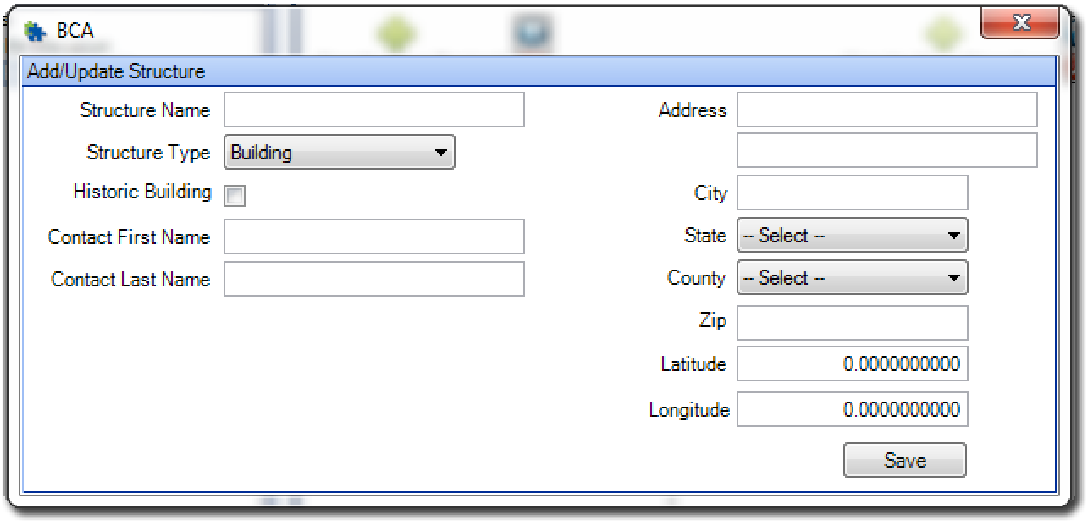
Open the Earthquake Module Case Study handout.

In this case study, the City of San Francisco in San Francisco County, California proposes a non-structural retrofit to the ceiling (installing wire diagonal and wires on fixtures) of the City's Payment Center building. The building was constructed in the 1960s and has a current square footage of 40,000. The total construction cost is $20,000. No annual maintenance costs are estimated.

Remember that the first step to completing the BCA is to create the project. Use the *Create New Project* icon in the Quick Start Area to complete Step One.

- Select *Create New Project* to display the Project Info dialog box.
- In the **Project Name** data field, enter "San Francisco Payment Center."
- In the **Project Number** data field, enter "789."
- In the **Analyst First Name** data field, enter "J."
- In the **Analyst Last Name** data field, enter "Smith."
- In the **Program** data field, select "HMGP."
- In the **Disaster Number** data field, enter "123."
- The **Discount Rate** data field is pre-filled with the FEMA standard value. Although the value is displayed as editable, the current discount rate policy established by the OMB requires a value of seven percent (or 0.070) for a BCA submitted as a part of a grant application.
- In the **Contact Name** data fields, enter "Tina Turner." This information in the Project Information window is for the local point of contact for the project.
- In the **Address** data field, enter "850 Polk Street."
- In the **City** data field, enter "San Francisco."
- In the **State** data field, select "California."
- In the **Zip Code** data field, enter "94102."
- In the **Organization** data field, enter "City of San Francisco."
- In the **Phone Number** data field, enter "555 555-5555."

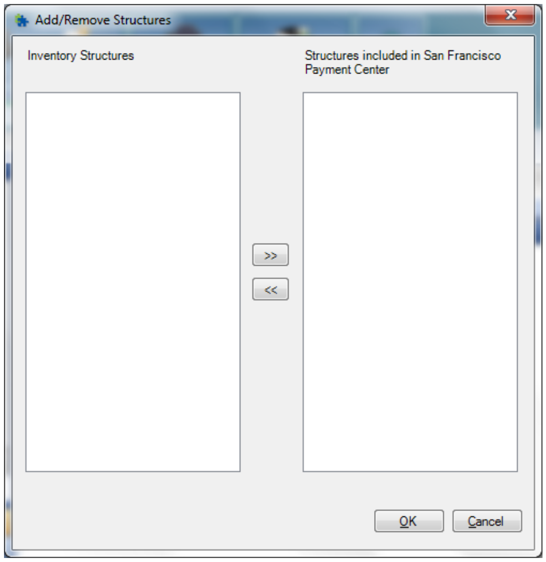
- In the **Email** data field, enter "tina.turner@CityofSF.gov."
- Select *Save*. The tool displays the "Project saved successfully" message. Select *OK* to return to the Quick Start Area.



Screenshot 8.2: Add/Update Structure

The second step to completing the BCA is to create the structure. Use the *Create New Structure* icon in the Quick Start area to complete Step Two.

- Select *Create New Structure* to display the Add/Update Structure dialog box.
- In the **Structure Name** data field, enter "San Francisco Payment Center." It is wise to use a description of the structure that is specific so that it can be found in a list of other structures. This makes it easier when to associate the structure with the project.
- In the **Structure Type** data field, select "Building." Note that there are two other structure types: "Utility" and "Other." Select "Building" if the project seeks to reduce losses to buildings.
- In the **Historic Building** data field, leave the box unchecked. This box has no impact on the analysis; it only tells the reviewer that this is a historic structure.
- In the **Contact First Name** data field, enter "J."
- In the **Contact Last Name** data field, enter "Smith."
- In the **Address** data field, enter "123 Green Drive."
- In the **City** data field, enter "San Francisco."
- In the **State** data field, select "California."
- In the **County** data field, select "San Francisco."
- In the **Zip** data field, enter "94102."
- In the **Latitude** data field, enter "37.800429."
- In the **Longitude** data field, enter "-122.401668."
- Select *Save*. The tool displays the "Structure saved successfully" message. Select *OK* to return to the Quick Start Area.



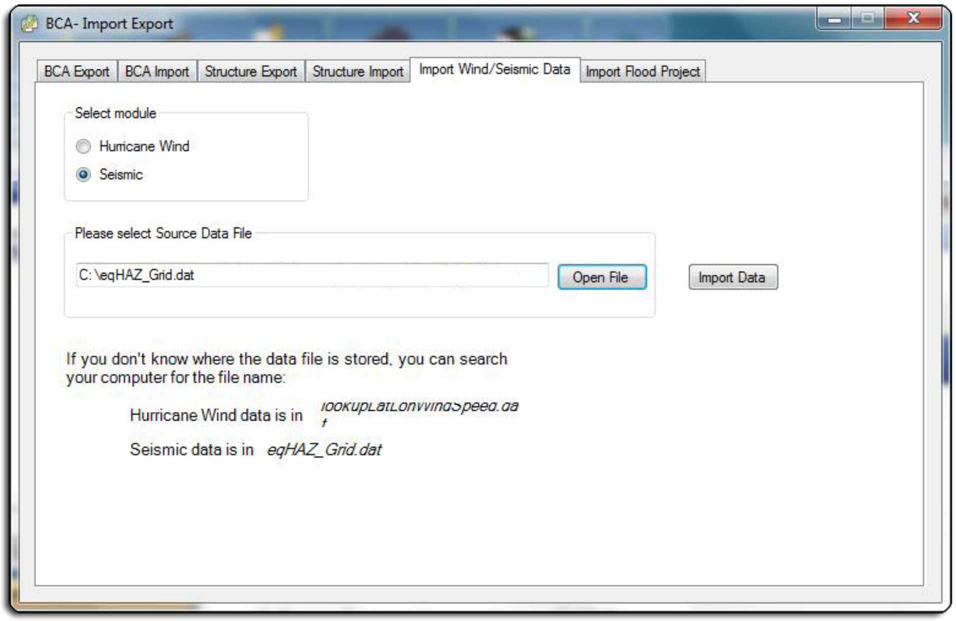
Screenshot 8.3: Add/Remove Structures

The third step to completing the BCA is to add a structure or structures to a project. Use the *Add Structures to Project* icon in the Quick Start Area to complete Step Three.

- Select *Add Structures to Project* to display a list of existing projects.
- Select the “San Francisco Payment Center.” The Add/Remove Structures dialog box is displayed.
- Select the “San Francisco Payment Center” structure.
- Select >> to add the structure to the project.
- Select *OK*. The tool displays the “Add/Remove Structures Succeeded” message. Select *OK* to return to the Quick Start Area.

Screenshot 8.4: Mitigation Information

Select the structure under the project tree on the left. On the next screen, the hazard type is chosen. Select “Earthquake.”



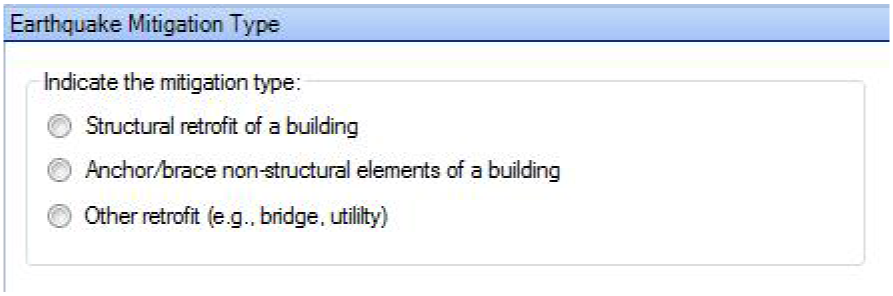
Screenshot 8.5: BCA Import Export

When registering, there were instructions about how to download the *eqHAZ_Grid.dat* file and import it into the BCA Tool.

Although the instructor will briefly recap how to import the seismic data file, if this file has not been downloaded and imported, then the best option from this point forward is to observe what is done in the rest of the walkthrough.

To import the seismic data that was downloaded during registration, select *Import/Export* on the basic navigation toolbar at the top. Select the Import Wind/Seismic Data tab. Select “Seismic” under **Select module.**

Select the source data file that would have downloaded along with the BCA tool. A quick search in the computer for the data file *eqHAZ_Grid.dat* will reveal the location. Select *Open File* and choose this file. Then select *Import Data*. After the data file has been imported, a message that the file has been imported will appear. Select *OK*. Then close this window to return to the MITIGATION INFORMATION screen.

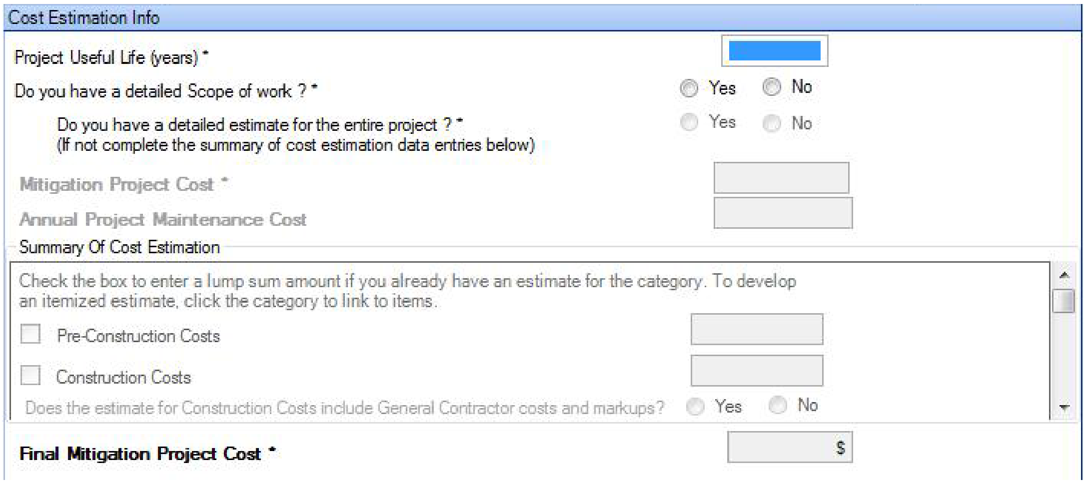


Screenshot 8.6: Earthquake Mitigation Type

Double click on the Hazard to start a mitigation project. The next screen EARTHQUAKE MITIGATION TYPE appears.

The mitigation type information can be obtained from the Statement of Work in the subapplication. This information defines the nature and type of seismic activity and forms the basis for the BCA.

Choose "Anchor/Brace non-structural elements of a building" and select *Save and Continue*. The COST ESTIMATION INFORMATION screen is displayed.



Screenshot 8.7: Cost Estimation Info

In the Cost Estimation Info enter the following information:

- In the **Project Useful Life** data field, enter "30 years."
- For the **Do you have detailed scope of work?** data field, select "Yes."
- For the **Do you have detailed estimate for the entire project?** data field, select "Yes."
- In the **Mitigation Project Cost** data field, enter "$20,000."
- In the **Annual Project Maintenance Cost** data field, enter "$0."

Scroll down the Summary of Cost Estimation section to the following question:

- In the **Does Estimate reflect current prices?** data field, Select "Yes."

The **Project Useful Life** (PUL) data field is important because it establishes the timeframe to calculate annualized benefits. Raising or lowering the PUL value impacts the final BCR. Higher values extend the duration over which benefits are calculated, thus making the final BCR higher. This data is required for calculating the BCR and can be obtained from the PUL table.

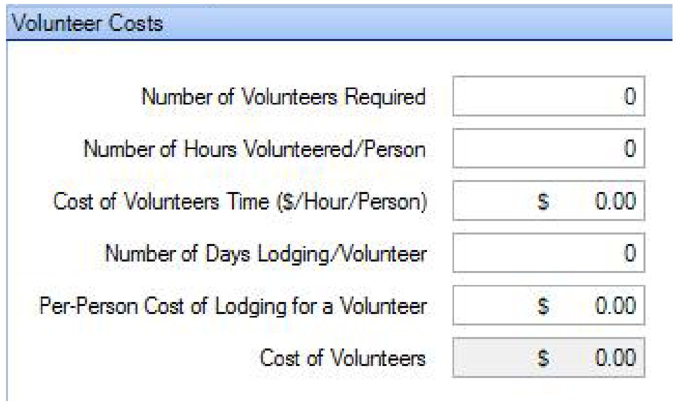
The **Mitigation Project Cost** data field is either provided by a competent source or created by using the cost estimator. The source can be a competent entity such as a licensed engineer for a construction project. If a community has completed multiple similar mitigation projects, it can use a detailed cost estimate based on its historic costs. National cost estimation guides (i.e., RS Means, Marshall & Swift) can also be used.

For a professional budget provided to users by a competent source, the cost estimate itself should be attached as documentation. If users are building the cost in the cost estimator, documentation should be provided for each of the inputs (e.g., for the project, documentation for the appraisal cost, structure market values, demolition and site restoration, etc.) This value forms the basis for the "cost" value in the benefit-cost analysis. The higher the cost, the lower the BCR.

Remember from Unit 1 that the **Annual Project Maintenance Cost** data field is important because it represents an added, future cost that should be included in the cost-effectiveness calculation. Maintenance keeps the completed project functioning to the designed level of effectiveness. Please note that adding any maintenance costs will lower the BCR. Remember also that maintenance costs are the responsibility of the local entity submitting the project; therefore, they are entered in the benefit-cost analysis but cannot be included in the cost estimate of the project subapplication.

For documenting maintenance costs, an estimate on letterhead or other document which highlights where it came from and whether the source is reliable to judge the future maintenance costs should be provided.

Select *Save and Continue* to go to the VOLUNTEER COSTS screen.



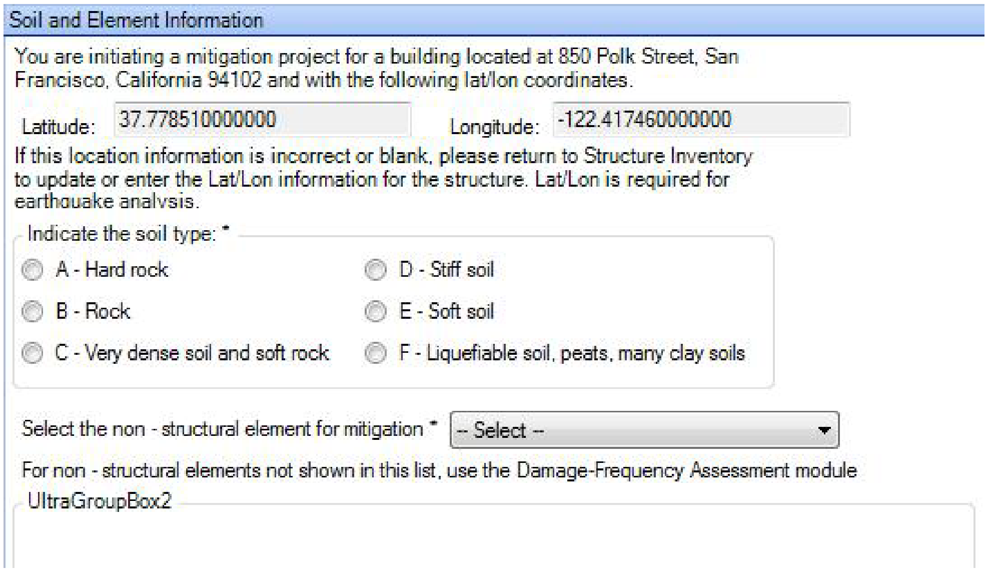
Screenshot 8.8: Volunteer Costs

Information on volunteers and the associated costs can be obtained from:

- Volunteer sign-in sheets from a reliable source such as the American Red Cross or Emergency Management Agency;
- Estimates by experts;
- Estimates transferred from similar past disasters; or
- A signed affidavit from the homeowner.

The documentation that would be needed includes information on the number of volunteers, their hours of service and the need for lodging and meal costs. However, this information may not be readily available directly after a disaster. If volunteer sign-in sheets are not provided by a reliable source, such as a local emergency management agency, estimates can be transferred from similar past disasters or estimated by experts. For time spent by a homeowner’s friends, family or outside charity volunteers to repair a house, a signed affidavit from the homeowner stating the number of people and estimated number of hours is required. Per diem days for non-local charities can only assume the number of days spent repairing the actual structure(s) being mitigated in the project.

This particular case study has no information about volunteer costs. Select *Save and Continue*.



Screenshot 8.9: Soil and Element Information

SOIL AND ELEMENT INFORMATION is the next screen. The latitude and longitude information previously entered automatically populates the latitude and longitude fields in this screen.

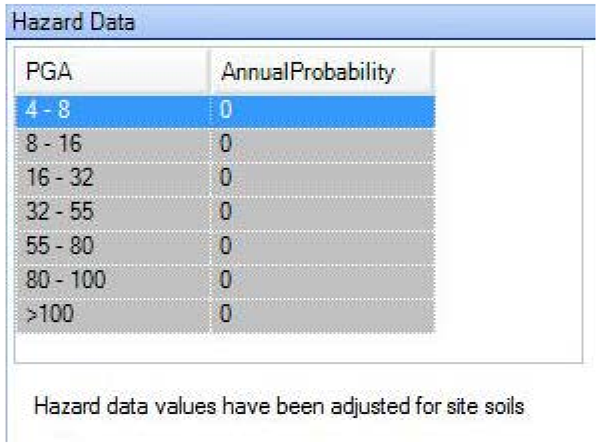
Enter the following information in the remaining fields:

- For the **Indicate the Soil Type** data field**,** select “D - Stiff Soil.”
- For **Select the Non-Structural Element for Mitigation** data field, choose “Ceiling - suspended or dropped.”
- For **Type of Suspended Ceiling Before Mitigation** data field, select “No seismic design.”
- For **Type of Suspended Ceiling After Mitigation** data field, select “Wire diagonals and wires on fixtures.”

The information on soil types can be obtained from documentation from a reliable source for the type of soil (e.g., USGS or licensed engineer) or from a map or survey identifying the building location included in the subapplication. Both the soil type and non-structural elements are key variables in calculating the risk associated with the seismic hazard and ultimately affect the BCR.

All documentation required by the tool is listed in the Help section.

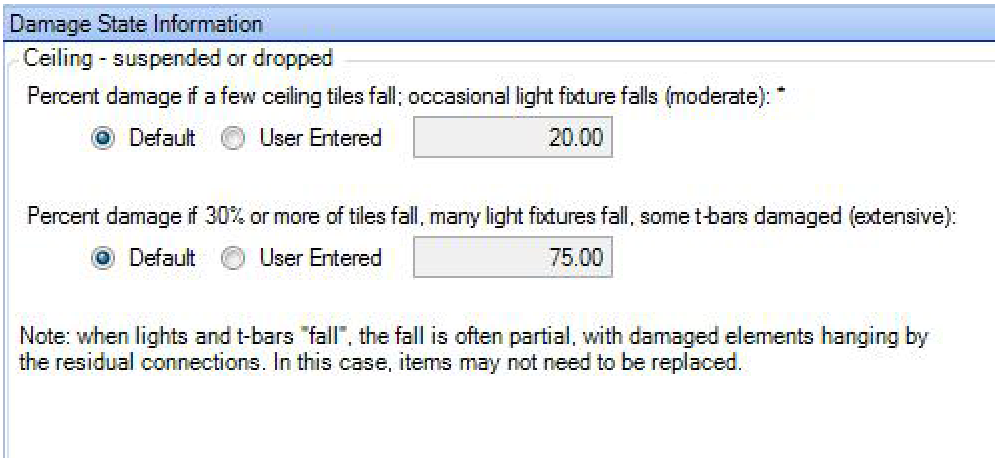
Select *Save and Continue* to reach the HAZARD DATA screen.



Screenshot 8.10: Hazard Data

On the HAZARD DATA screen, the values have been adjusted by the selected soil type. No user input is required.

The Help section provides guidance on how to read the hazard data table. Select *Save and Continue* to navigate to the DAMAGE STATE INFORMATION screen.



Screenshot 8.11: Damage State Information

The DAMAGE STATE INFORMATION screen indicates the percentage damage for the non-structural elements. The "Default" settings for both items will automatically generate the following two standard values:

- For the **Percent Damage (moderate)** data field, the FEMA standard value should be "20."
- For the **Percent Damage (extensive)** data field, the FEMA standard value should be "75."

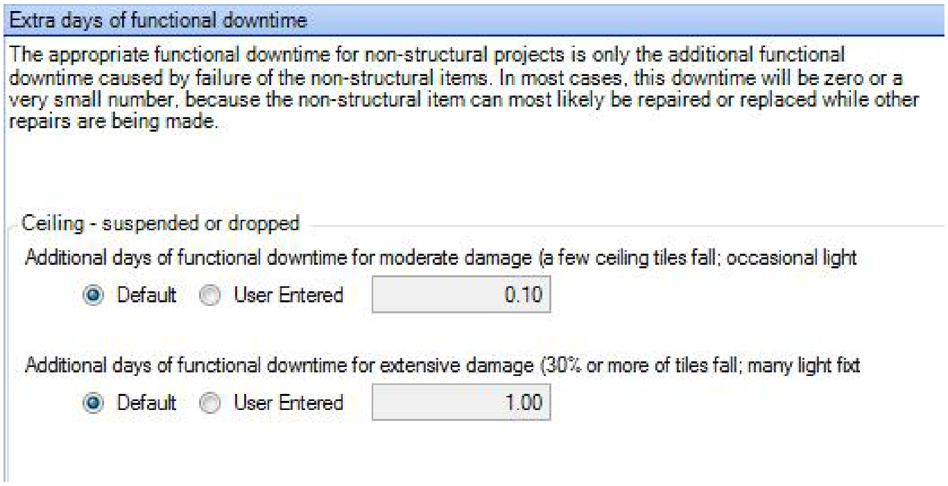
No additional user input is required here. However, if users want to override the FEMA standard values, an engineering analysis from a credible source (civil or structural engineer) must be submitted as supporting documentation.

Here is some information on determining the extent of damage to some non-structural elements.

- For ceilings, the default state for moderate damage is when a few ceiling tiles fall and/or an occasional light fixture falls. Extensive damage is when 30 percent or more of the tiles fall, many light fixtures fall and some t-bars are damaged.
- For generators, moderate damage is defined as failure of fuel lines and battery racks.
- For generic contents, the default damage state is moderate and is defined as items falling over (toppling).
- For electric cabinets, the default damage state is extensive and is defined as cabinets toppling or sliding, with damage to components inside.
- The default damage state for racks and shelves is extensive and is defined as shelves toppling over, metal shelves being bent beyond repair and irreparable wooden shelves in some cases. The average repair in such cases is likely to be 100 percent of the value of shelves or racks.
- For elevators, moderate damage: the default state is when the counterweight or cab rails are bent, with loose brackets. Extensive damage is when the counterweight or cab derails and causes significant damage to the shaft walls.

More information on other non-structural elements, such as fire sprinklers, HVAC, parapet walls or chimneys can be found in the Help section.

Select *Save and Continue* to go to the EXTRA DAYS OF FUNCTIONAL DOWNTIME screen.

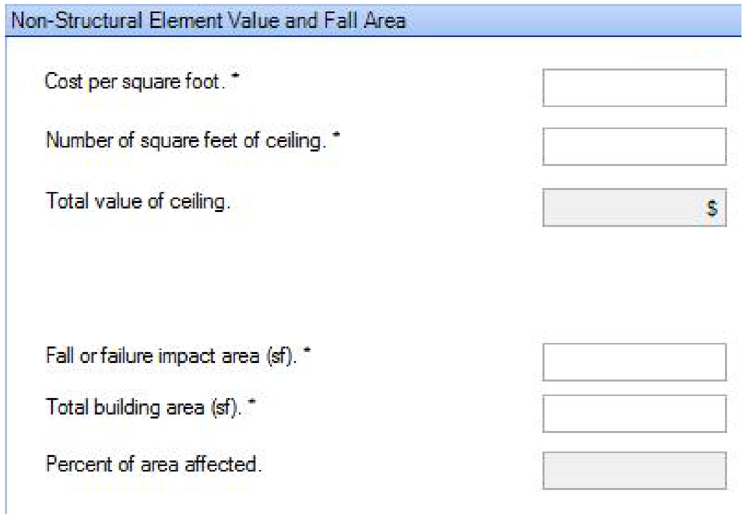


Screenshot 8.12: Extra Days of Functional Downtime

The purpose of this screen is to determine the additional time a building is out of service due to non-structural damage, beyond what is required for structural repairs.

- For the **Additional days of functional downtime for moderate damage** data field, the “Default” selection is “0.10.”
- For the **Additional days of functional downtime for extensive damage** data field, the “Default” selection is “1.0.”

No user input is required on this screen. Select *Save and Continue* to go to the next screen.



Non-Structural Element Value and Fall Area

Cost per square foot. *

Number of square feet of ceiling. *

Total value of ceiling. $

Fall or failure impact area (sf). *

Total building area (sf). *

Percent of area affected.

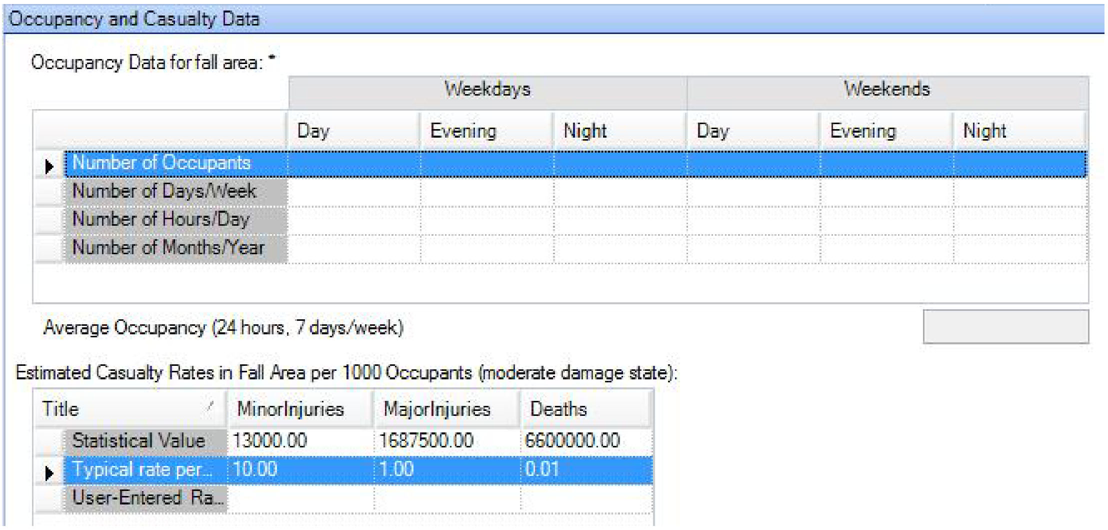
Screenshot 8.13: Non-Structural Element Value and Fall Area

In the NON-STRUCTURAL ELEMENT VALUE AND FALL AREA screen, enter the following information:

- In the **Cost per square foot** data field, enter "$3."
- In the **Number of square feet of ceiling** data field, enter "20,000."
- In the **Fall or failure impact area (sq. ft.)** data field, enter "20,000."
- In the **Total building area (sq. ft.)** data field, enter "40,000."

The cost per square foot calculates the non-structural element replacement value, which is the basis for calculating damages based on seismic activity. The fall area also contributes to calculations affecting annualized damages "before mitigation" and "after mitigation." Please see the Help section for more information. Also upload the necessary documentation as mentioned in the handout as support for the data entered.

Select *Save and Continue* to reach the OCCUPANCY AND CASUALTY DATA screen.



Screenshot 8.14: Occupancy and Casualty Data

In the OCCUPANCY AND CASUALTY DATA screen, enter the following information:

- In the Weekdays columns:
  - For **Number of Occupants**, enter 250 under day, 50 for evening and 4 for night.
  - For **Number of Days/Week**, enter 5 under day, 5 for evening and 5 for night.
  - For **Number of Hours/Day**, enter 8 under day, 8 for evening and 8 for night.
  - For **Number of Months/Year**, enter 12 under day, 12 for evening and 12 for night.
- In the Weekends columns:
  - For **Number of Occupants**, enter 20 under day, 4 for evening and 4 for night.
  - For **Number of Days/Week**, enter 2 under day, 2 for evening and 2 for night.
  - For **Number of Hours/Day**, enter 8 under day, 8 for evening and 8 for night.
  - For **Number of Months/Year**, enter 12 under day, 12 for evening and 12 for night.

The Casualty rates for “moderate” damage should be populated with the following information:

- For the **Minor Injuries** data field, the standard value should be “10.”
- For the **Major Injuries** data field, the standard value entered is “1.”
- For the **Deaths** data field, the standard value is “0.01.”

The Casualty rates for “extensive” damage should also be populated with the following information:

- For the **Minor Injuries** data field, the standard value should be “100.”
- For the **Major Injuries** data field, the standard value entered is “10.”
- For the **Deaths** data field, the standard value is “0.01.”

The average occupancy will be a key factor in calculating an estimated casualty per non-structural element break per 1,000 occupants. The time of day and type of critical facility play a role in how sensitive the data are. For example, a hospital will have a similar number of occupants regardless of time of day or year, resulting in a higher average occupancy, thus making it more sensitive than a commercial office building. It is reasonable to assume that a commercial office building, generally speaking, would have fewer occupants in the evening and night, thus reducing the value of the estimated casualty per non-structural element break per 1,000 occupants.

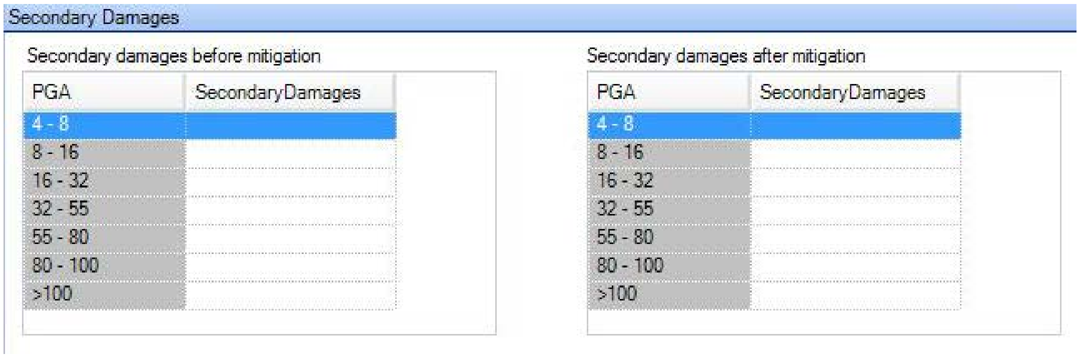
The occupancy data may be obtained from employment records, attendance records or other information from the building owner or manager. Photographs of people congregating in areas that may be affected by a falling parapet or chimney may be helpful in supporting the methodology.

If the retrofit is for ceilings, enter the occupancy data based on how the building area data was entered. If the entire area of the building was entered, use that as a basis for the occupancy figures. If the fall area was entered, base the occupancy on only the fall area.

Casualty rates are calculated by the BCA software based on the estimated number of casualties (minor injuries, major injuries and deaths) per 1,000 occupants for the described damage states. The statistical (dollar) values are based on the 2008 published Federal Aviation Administration's *Revised Department Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analysis*. Casualty rate tables for ceilings show moderate damage state and extensive damage state casualties.

The Help section has more information on this key BCA screen.

Select *Save and Continue* to go to the SECONDARY DAMAGES screen.

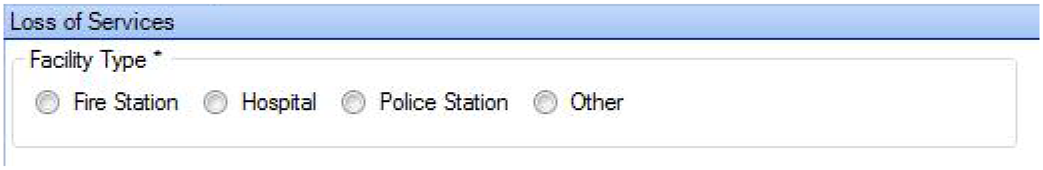


Screenshot 8.15: Secondary Damages

The purpose of the SECONDARY DAMAGES screen is to account for other benefits that have not been covered by the non-structural software, but are allowed based on FEMA guidelines. Quantified damages must be associated with a frequency or seismic intensity level (i.e., Peak Ground Acceleration (PGA)). Examples of secondary damages are a fire following an earthquake or hazardous material spills.

Documentation would include engineering analysis from a civil or structural engineer experienced with non-structural element behavior during earthquakes.

No user input is required for this screen. Select *Save and Continue* to get to the LOSS OF SERVICES screen.



Screenshot 8.16: Loss of Services

In the LOSS OF SERVICES screen, enter the following information:

- For **Facility Type**, select “Other.”
- For **Service Name**, select “Government” from the dropdown menu.
- For **Annual Budget,** enter “$4,000,000.”

As was covered in Units 2 and 3, the purpose of this screen is to calculate Loss of Function (LOF) benefits for critical facilities (e.g., fire, police and hospital) and other buildings. All the individual LOF inputs add up to calculate the facility LOF. In general, these inputs calculate a value, which is typically a significant economic benefit. This data is required only for calculating a BCR for a facility LOF.

Select *Save and Continue* to reach the SUMMARY OF DAMAGES screen.

Summary of Damages

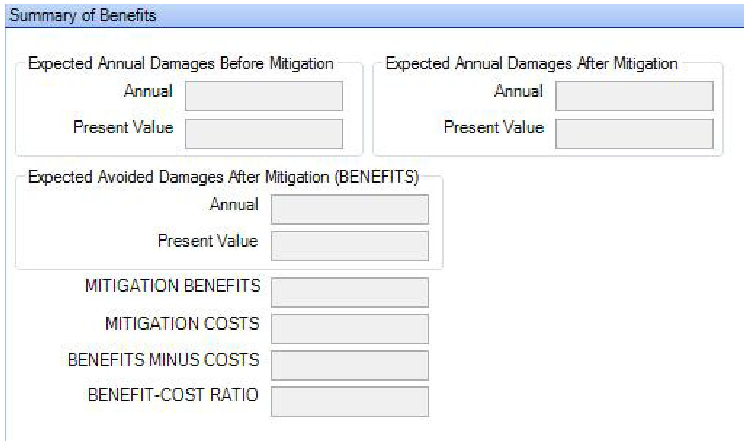
Before Mitigation | After Mitigation

PGA	Damages to Item	Secondary Damage	Casualties	Loss Of Function	Total Damages	Annualized Damages and Losses
4 - 8	$26	$	$89	$2	$117	$
8 - 16	$924	$	$3,552	$99	$4,575	$
16 - 32	$7,955	$	$43,462	$1,213	$52,630	$
32 - 55	$23,272	$	$171,913	$4,799	$199,984	$
55 - 80	$35,670	$	$294,802	$8,229	$338,701	$
80 - 100	$40,981	$	$350,041	$9,771	$400,793	$
>100	$43,670	$	$378,446	$10,564	$432,680	$

Screenshot 8.17: Summary of Damages

This screen provides the summary of the scenario damages before and after mitigation to the non-structural element, secondary damages, casualties and loss of function for each bin or range of PGA.

No user input is required for this screen. Proceed to the SUMMARY OF BENEFITS screen by selecting *Save and Continue*.

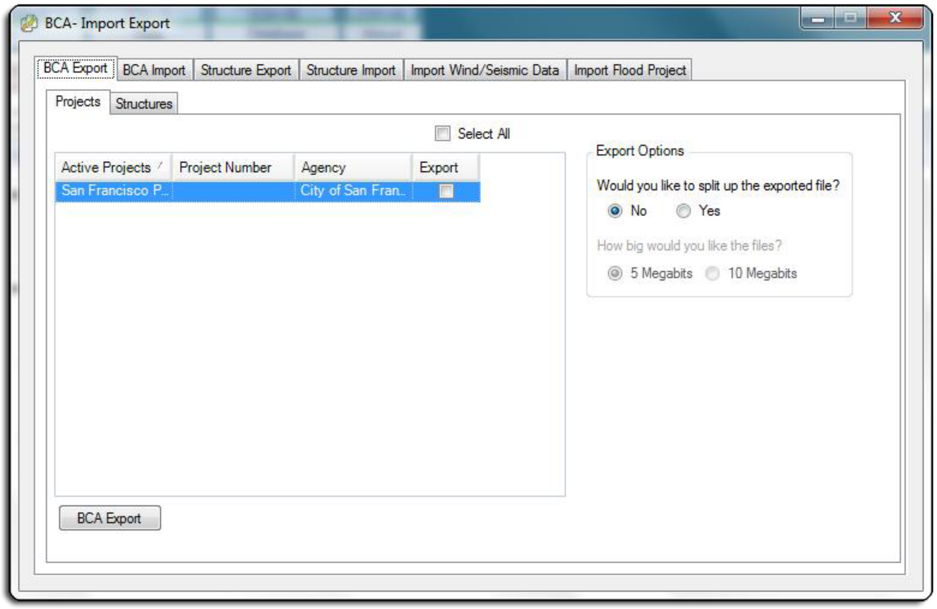


Screenshot 8.18: Summary of Benefits

The purpose of this screen is to display the summary information and to present the value of benefits divided by total costs, which provides the mitigation project BCR.

Remember from Unit 1 that this screen has three sections. The top section of the screen displays the Before and After Mitigation values that have been filled in by the tool based on the data entered in the previous screens and the calculations built into the tool. The next section of the screen shows the impact of the project or the benefits. Finally, in the bottom section of the screen are the benefits and the costs, the difference between the two values, and the most important value—the **Benefit-Cost Ratio**. This ratio is the benefits divided by the costs.

At this stage, either select *Save and Continue* to go to the MITIGATION INFORMATION screen or stay in the same screen.

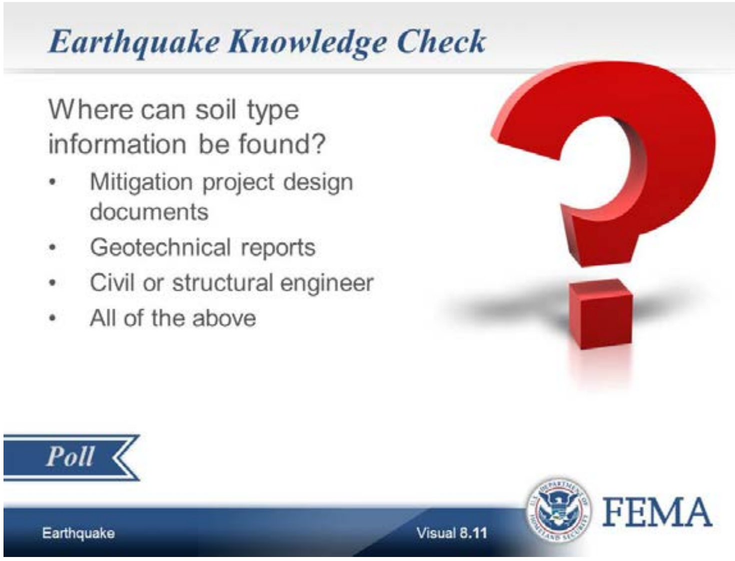


Screenshot 8.19: BCA – Import/Export

Steps One through Four of the BCA process are now complete. To complete Step Five: Export the BCA, do the following steps:

- Select *Import/Export* on the toolbar.
- Select the "BCA Export" tab.
- Select the box under the column "Export" next to "San Francisco Payment Center" and select *BCA Export*.
- Save the zip file to the desired location on the computer.

A message of success will pop up. Select *OK* and close the Import/Export window to return to the main screen of the BCA tool, which can either be the MITIGATION INFORMATION screen or the SUMMARY OF BENEFITS screen.



Visual 8.11: Earthquake Hazard Knowledge Check

Answer the following knowledge check:

Where can soil type information be found?

- Mitigation project design documents
- Geotechnical reports
- Civil or structural engineer
- All of the above

Write the correct answer below.

Summary

Visual 8.12: Summary

Remember: It is always about risk, regardless of the hazard. Cost-effective mitigation projects address high-risk situations with lower costs and higher benefits.

The objectives in this unit were for participants to:

- Explain Earthquake Module data and documentation requirements.
- Complete an Earthquake Module BCA.