ELEVATION TECHNICAL REVIEW

PURPOSE: All Hazard Mitigation Assistance (HMA) applications must comply with the requirements outlined in the HMA Guidance. According to the guidance, in addition to a general programmatic review, an Environmental Planning and Historic Preservation (EHP) review and a technical review will be performed by the Federal Emergency Management Agency (FEMA) for each proposed project. The technical review will ensure that a project demonstrates feasibility, effectiveness, and cost-effectiveness.

This supplement will cover requirements associated with the technical reviews for HMA funded structure elevation projects. It augments the Elevation Job Aid and provides additional information, examples, and potential sources of documentation for items listed in the Job Aid to help communities applying for HMA grants comply with application requirements.

ADDITIONAL RESOURCES:

- ✓ Hazard Mitigation Assistance Guidance
- ✓ Hazard Mitigation Assistance Guidance Addendum, Part E
- ✓ Benefit-Cost Analysis Reference Guide and Supplement to the Benefit-Cost Analysis Reference Guide.

Introduction

The following provides a review of the information that should be provided with the grant application and recommended documentation and supplemental information for FEMA to conduct a technical review of the project application. Additional technical resources are identified throughout this supplement to provide supplementary information on specific components, and the final section provides a comprehensive list of resources identified throughout this supplement.

The project-specific guidance in this supplement does not provide all of the information necessary to apply for funding through an HMA program and must be read in conjunction with all other relevant guidance documents.

IMPORTANT TERMS:

Base flood elevation (BFE): The elevation shown on the Flood Insurance Rate Map (FIRM) for Zones AE, AH, A1–A30, AR, AR/A, AR/AE, AR/A1–A30, AR/AH, AR/AO, V1–V30, and VE that indicates the water surface elevation resulting from a flood that has a 1 percent chance of equaling or exceeding that level in any given year.

Elevated building: A building that has no basement and a lowest floor that is elevated to or above the BFE by foundation walls, shear walls, posts, piers, pilings, or columns.

First Floor Elevation (FFE): The elevation of the top of the lowest finished floor in a building.

Flood Insurance Rate Map (FIRM): The official map of a community on which FEMA has delineated both the special hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study (FIS): A compilation and presentation of flood risk data for specific watercourses, lakes, and coastal flood hazard areas within a community. When a flood study is completed for the National Flood Insurance Program (NFIP), the information and maps are assembled into an FIS. The FIS report contains detailed flood elevation data in flood profiles and data tables.

Special flood hazard areas (SFHA): The land in the floodplain within a community subject to a 1 percent or greater chance of flooding in any given year. Also, an area having special flood, mudflow, or flood-related erosion hazards and appearing on a Flood Hazard Boundary Map or a FIRM as Zone A, AO, A1–A30, AE, A99, AH, AR, AR/A, AR/AE, AR/AH, AR/AO, AR/A1–A30, V1–V30, VE, or V.

ELEVATION TECHNICAL REVIEW

Technical Review Components

In order to complete a successful project application, a minimum amount of technical information is required for review. The following is a step-by-step approach to addressing the major components of an elevation project. Data collected in these steps will provide reviewers with the necessary information to determine whether a project is feasible and effective.

The data requirements in the following steps should be compiled in an attachment to the project application. If the project impacts multiple structures, this information must be provided for each.

☐ STEP 1: Provide a Scope of Work (SOW)

Description: Provide a project narrative clearly identifying the proposed mitigation action and structures to be mitigated, a description of the proposed activities, and a clear explanation of how the project will mitigate risk. The scope of work should include key milestones and coincide with the design information, project schedule, and cost estimate.

References: When preparing a SOW, refer to the following:

- For guidance, see
  - **HMA Guidance Part IV, Section H: Scoping Narrative: Scope of Work, Schedule, and Cost Estimate**
  - **Addendum to the HMA Guidance, Part E: Structure Elevation**
- For an example narrative for an Elevation Project, see the **HMA Application Development - Mitigation Project Subapplication Scope of Work Examples** and **Sample Engineering Case Study for Elevation.**

Approach: The following items should be included in the SOW:

- Provide a narrative of the flood risk being mitigated, including flood event history in the project area if available.
- Mitigation project alternatives are required as part of application development. Document at least two alternatives that were considered as part of the planning or design phase. Clearly indicate which alternative is the preferred mitigation project and discuss why it is the most practical, effective, and environmentally sound alternative. One alternative is often considered the "no-action alternative" and reflects conditions expected to exist if a mitigation project is not completed. This is a key step to ensure an efficient EHP review process. For additional guidance, see the **Elevation EHP Review – Supplement No. E1.3** available at FEMA.gov.
- Clearly explain the proposed mitigation activity, specifying the deliverables, identifying the tasks required to complete the proposed activity, and defining the tasks to be accomplished in clear, concise, and meaningful terms. All cost elements must match tasks and provide sufficient detail for FEMA to determine whether the subapplication is eligible. The scoping narrative (including SOW) will become part of the conditions of the award.
- Describe the existing conditions of the structure(s) to be elevated. Specific details and documentation to support the narrative are described in Step 2.
- Define the level of protection, i.e., the number of feet the first floor elevation of the structure is being raised above the BFE. The first floor must be raised to above the BFE or to the elevation specified in local ordinances, if higher.
  - Example: If the BFE at a given property is 14 feet, the existing FFE is 10 feet, and the proposed mitigation will raise the FFE to 2 feet above the BFE (for a final FFE of 16 feet), then the number of feet the first floor elevation of the structure is being raised above the BFE would be 2.
- A description of the elevation method and the steps required to implement the mitigation activity, including the following:
  - Mechanism for elevation (e.g., continuous foundation walls; elevation on open foundations, such as piles, piers, posts,

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

or columns; and elevating on fill)

☐ STEP 1: Provide a Scope of Work (SOW) *(continued)*

- Description of activities needed to elevate utilities, if known. (This information may be further developed during the design phase.)
- Debris disposal and erosion control (if necessary)

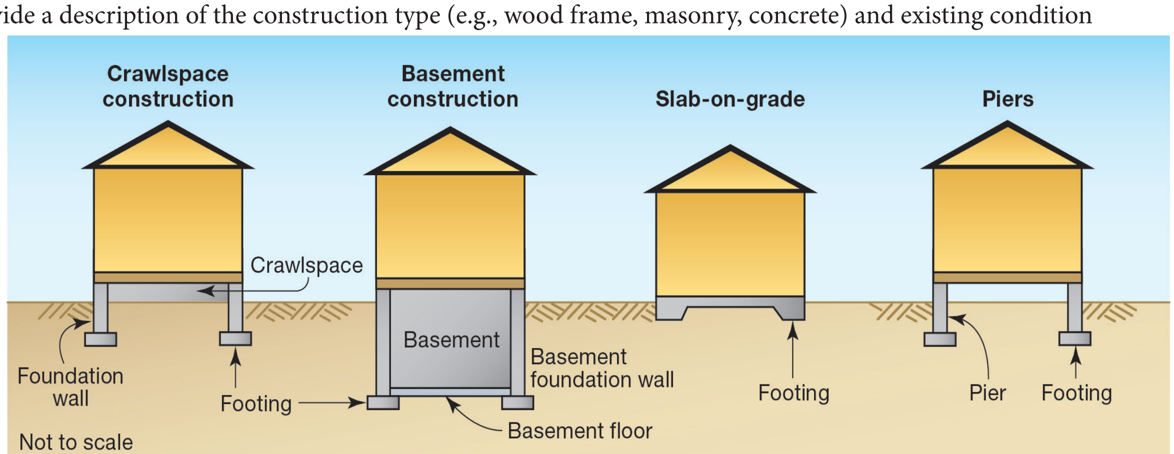
▪ Verify that the project will be constructed to the appropriate codes and standards by including all of the following:
  - A statement that the proposed project will be designed and constructed to meet the requirements of ASCE 24-14 is required. For more information, refer to **Addendum to the HMA Guidance, Part F.3: Use of ASCE 24-14 as Minimum Design Requirements for Certain Flood Risk Reduction Activities.**
  - A statement that the project will be designed in compliance with the NFIP standards in **44 Code of Federal Regulations (CFR) Part 60.**
  - A description of any additional building code standards that will be followed.

☐ STEP 2: Provide Specific Building Details

Description: Provide detailed information about each structure in the project.

Approach: Provide the following information about the building. If there are multiple buildings, this information must be provided and documented for each.

▪ Date structure was built
▪ Building type (e.g., one story residential, apartment, police station, hospital, mobile home)
▪ Structure information, including the size of the house, number of stories, existence of attached garage, and description of outbuildings, if present
▪ Provide a description of the construction type (e.g., wood frame, masonry, concrete) and existing condition



▪ Provide a description of the foundation (see below)

Potential Sources: Structure information may be verified through city or county property records or from building permit information. This information can often be found from publicly available websites such as tax assessor website. Some cities and counties have parcel databases with this information. Alternatively, online mapping programs with measuring features and high

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

quality aerial photos may be used to estimate the size of the building.

STEP 2: Provide Specific Building Details *(continued)*

Example: One story residential building, slab on grade, without a basement, no outbuildings, built in 1900; see the attached Residential Property Record Card for documentation.

Floodville, NY: Residential Property Record Card

[Back to Search Results] [Start a New Search] [Help with Printing]

Search for Properties

Parcel ID | Name | Street Name | Reset

Parcel ID	Card	Map-Block-Lot	Location	Zoning	State Class	Acres
1234-5678	1		23 River St	LA307	101 - n/1	0.106

Owner Information
23 River St
Floodville, NY 12345

Property Picture
[No Picture Available]

Deed Information
Book/Page: 9953/16
Sale Date: 2009/09/01

Dwelling Information

Living Units:	1
Style:	Conventional
Story Heights:	1.5
Exterior Wall:	Alum/Vinyl
Attic Living:	None
Basement:	Part
Year Built:	1900
Ground Floor Area:	518
Unfinished BSMT Area:	0
FIN BMST Living:	n/a
Tot Living Area:	854
Rec Room:	0 x 0
Tot Rooms:	6
Bedrooms:	2
Full Baths:	1
Half Baths:	0
Mas Fire Place:	n/a
Frame Fire Place:	n/a
Heating Type:	Basic

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 3: Provide Available Technical Data

Description: It is necessary to demonstrate that a project is feasible and will be effective at reducing risk. Engineering or design plans may be conceptual in nature at the time of project application and can be developed following award and should be accounted for in the SOW, schedule, and cost estimate, if not available during application development.

References: When preparing the technical data, refer to the following, as appropriate:

ASCE 24-14, Flood Resistant Design and Construction (or latest addition)

FEMA P-55, Coastal Construction Manual, Fourth Edition (2011)

FEMA P-259, Engineering Principles and Practices of Retrofitting Floodprone Structures (2012)

FEMA P-312, Homeowner's Guide to Retrofitting, Third Edition (2014)

FEMA P-499, Home Builders Guide to Coastal Construction Technical Fact Sheet Series (2010)

FEMA P-550, Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations, Second Edition (2009)

Approach: In addition to verifying that the project will meet the required codes and standards in the narrative (Step 1), provide any available information to support the following:

- Demonstrate that it is feasible to meet the aforementioned standards:
  - Buildings proposed for elevation must be structurally sound and capable of being elevated safely.
  - Proposed foundations must be designed to properly address all loads and be appropriately connected to the floor structure above.
  - Foundation construction shall be capable of accommodating all loads and of transmitting the resulting loads to the supporting soil. [A geotechnical engineer should be consulted when any unusual or unknown soil condition is encountered. Frequently, designs are prepared on a presumed bearing capacity; however, if there is quantifiable data created by accepted soil science methodologies indicating expansive, compressible, shifting, or other questionable soil characteristics are likely to be present, then a soil test should be conducted to derive the actual bearing capacity (measures the ability of soils to support gravity loads without soil shear failure or excessive settlement). Another critical geotechnical consideration is localized scour. In some locations, soil at or below the ground surface can be susceptible to localized scour, and the foundation must be designed to account for these estimated scour depths.]

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 4: Provide a Project Schedule

Description: Include a detailed project schedule for all tasks identified in the project cost estimate and scope of work. The schedule identifies major milestones with start and end dates for each activity. Project schedules must show completion of all activities (including construction period) within the period of performance (POP) allowed by the relevant HMA program. Sufficient detail must be provided so FEMA can determine whether the proposed activities can be accomplished within the POP.

Reference: **HMA Guidance Part VI, Section D.4: Program Period of Performance**

Approach: Ensure that the information in the schedule supports the scope of work and aligns with the project cost estimate.

STEP 5: Provide Project Cost Estimate

Description: Include a detailed line item cost estimate for all tasks identified in the project schedule and scope of work. Allowable costs are costs that are necessary and reasonable for the proper and efficient performance and administration of the federal award. All costs included in the subapplication should be reviewed to ensure they are necessary, reasonable, and allocable consistent with the provisions of 2 Code of Federal Regulations Part 200. Include sufficient detail so that FEMA can determine whether costs are reasonable based on proposed activities and level of effort. Costs incurred prior to award may be considered pre-award costs (and eligible for reimbursement) if they are incurred after the date of President Major Disaster Declaration (Hazard Mitigation Grant Program) or after the release of the Notice of Funding Opportunity for Flood Mitigation Assistance (FMA) and Pre-Disaster Mitigation (PDM).

Reference: For more detailed information on eligible and ineligible costs for elevation projects, refer to Addendum to the **HMA Guidance Parts E.4.2 and E.4.3.**

Approach: Ensure that the information in the cost estimate supports the scope of work and aligns with the schedule. Source materials used to support the cost estimate should be referenced.

Allowable costs are costs that are necessary and reasonable for the proper and efficient performance and administration of the federal award and may include but are not limited to:

- Engineering services for design, structural feasibility analysis, and cost estimate preparation
- Project administration and construction management
- Surveying
- Soil sampling
- Completion of Elevation Certificate, title search, and deed recording fees
- Permitting and/or legal fees
- Building of a foundation to the proposed BFE
- All construction activities required for elevation
- Disconnecting and reconnecting utilities, extending lines, and pipes as necessary, and elevating all utilities and service equipment
- Debris disposal and erosion control
- Costs for repair of lawns, landscaping, sidewalks, and driveways if damaged by elevation activities

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

- Construction of new stairs, landings, and railings to access the elevated living space per minimum code or local ordinance
- Construction of Americans with Disabilities Act-compliant access facilities or ramps when an owner or a member of the owner's family has a permanent disability and a physician's written certification
- Filling basements with compacted clean fill

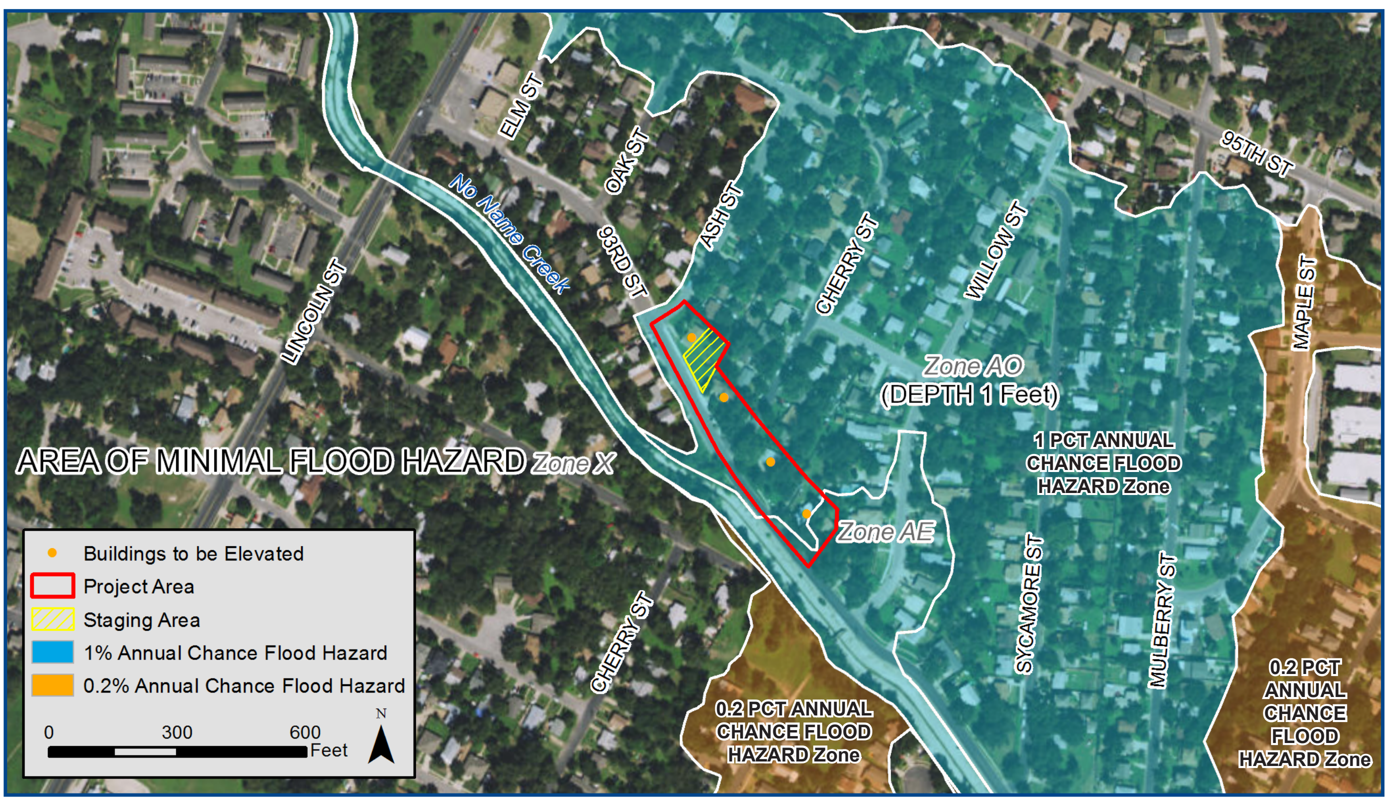
☐ STEP 6: Provide Project Site Map

Description: Provide a map showing project location, and if the project includes multiple structures, show the project boundaries, including staging area.

Approach: Provide a map showing the project location, including structures, flooding source, map scale, and location information.

Potential Sources: Official site survey, assessor maps, and topographic maps obtained from the project engineer or planner, maps created using a web-based service such as Google Maps. (Ensure that a scale bar and north arrow are shown and the map is clearly labeled to identify the project boundaries.)

Reference: Supplement to the Benefit-Cost Analysis Reference Guide Section 5: Available Technology Aids



ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

☐ STEP 7: Provide Property Location Information: Address and Latitude and Longitude

PROPERTY ADDRESS

Description: Provide both the physical address and the latitude and longitude of each structure in the project application. For projects with multiple properties, tables containing all relevant information by property can be helpful.

Approach: Provide property address(es) of the mitigation project. This includes street name and number; city, county, or parish; state; and zip code. A post office box number is not an acceptable address.

Potential Sources: Obtain the information from the property owner, local building inspector, tax assessor records, deed to the property, or engineering plans.

Example: 456 River Road, Martinsburg, Berkeley County, WV 25409

LATITUDE AND LONGITUDE

Approach: Provide latitude and longitude for the project location. The latitude and longitude should be taken at the center of the property. The latitude and longitude can be provided in either decimal degrees (e.g., 27.9807, -82.5340) or degrees, minutes, and seconds (27° 58' 50.5" N, 82° 32' 2.4" W).

If your global positioning system (GPS) or mapping application provides degrees, minutes, and seconds, you will need to convert this into decimal degrees to enter it into eGrants (Pre-Disaster Mitigation and Flood Mitigation Assistance applications only). Several free tools are available on the Internet for this conversion. Enter "coordinate converter" into a search engine to find one of these tools.

Potential Sources:

- A GPS device
- Multiple free online map tools or search engines that generate the latitude and longitude coordinates when an address is supplied

Example: 27.9807, -82.5340

☐ STEP 8: Provide First Floor Elevation

Description: The risk to the structure from flooding is based on the elevation of the building.

Approach: Based on the foundation type, determine the FFE or lowest floor member of each structure included in the project.

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

☐ STEP 9: Provide Building Photographs

Description: Provide photography documenting the existing structure and project area.

Approach: Provide photographs of all sides of the building showing the foundation and entrances.

- For each photograph, provide a descriptive caption explaining what the photo shows, the direction it was taken (e.g., "looking east" or "east side of building, looking west"), side of the structure shown (e.g., front, back), and other relevant details.
- When a structure has multiple levels, it is important to provide photographs that provide different views of the structure.
- For structures that are raised (or partially raised) due to surrounding ground level changes or other circumstances, it is important to provide photographs of different sides and angles of the building so that the correct building diagram is chosen for determining the FFE.

Potential Sources: Use a cell telephone, tablet, or camera to take clear, good quality photos for inclusion in the application.

Example:

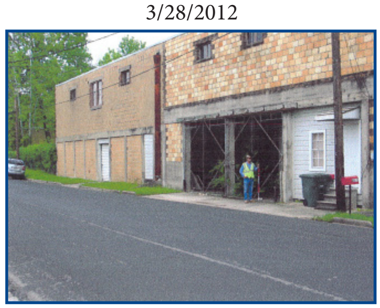
Picture 1. Front Side of Building
3/28/2012

Picture 2. Front Side of Building
Facing North
3/28/2012

Picture 3. Back Side of Building
Facing South
3/28/2012

Picture 4. Right Side of Building
3/28/2012

Picture 5. Left Side of Building
3/28/2012



Picture 6. Left Side of Building
3/28/2012

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

☐ STEP 10: Document the Flood Risk

Description: There are two ways to demonstrate the risk of flooding to a hazard-prone structure: using engineering analysis to estimate the risk or using historical information to demonstrate the risk. In many flood-prone areas, FEMA has performed an engineering analysis of the risk that can be found in an FIS and accompanying FIRM. In some areas, it may be possible that an engineering professional has performed an independent study of the flood risk and has prepared an engineering report documenting the results. If the area has not been studied in detail, flood risk can be demonstrated through documentation of a flood event history.

References: FEMA's How to Find Your FIRM and Make a FIRMette and **FEMA's Map Service Center**

Approach: The following steps should be taken to document flood risk:

1) If an FIS and FIRM are available for the project area, provide a copy of the map with the project location and building footprint outlined on the map and a copy of the associated information in the FIS. Ensure that the flood zone in which the structure is located is clear. Note whether the structure is in the SFHA (the 100-year floodplain) and if located in a regulatory floodway.

2) If an independent engineering study exists and is being used to assess the flood risk for the project, provide a copy of the professionally certified report. The report should include hydrologic and hydraulic (H&H) calculations used to determine flood elevations for four events with varying flood recurrence intervals such as the 10-year, 50-year, 100-year, or other interval. If these calculations were completed using modeling software, the engineering report should document all model inputs and outputs. Inundation maps are also recommended to support the analysis and document which structures are at risk.

> Note that if an FIS and FIRM exist for the project area, documentation should be provided whether or not an independent flood analysis or historical flood information was used to assess the project.

3) If detailed flood analysis is not available, then provide a list of historical flood events along with the following information:

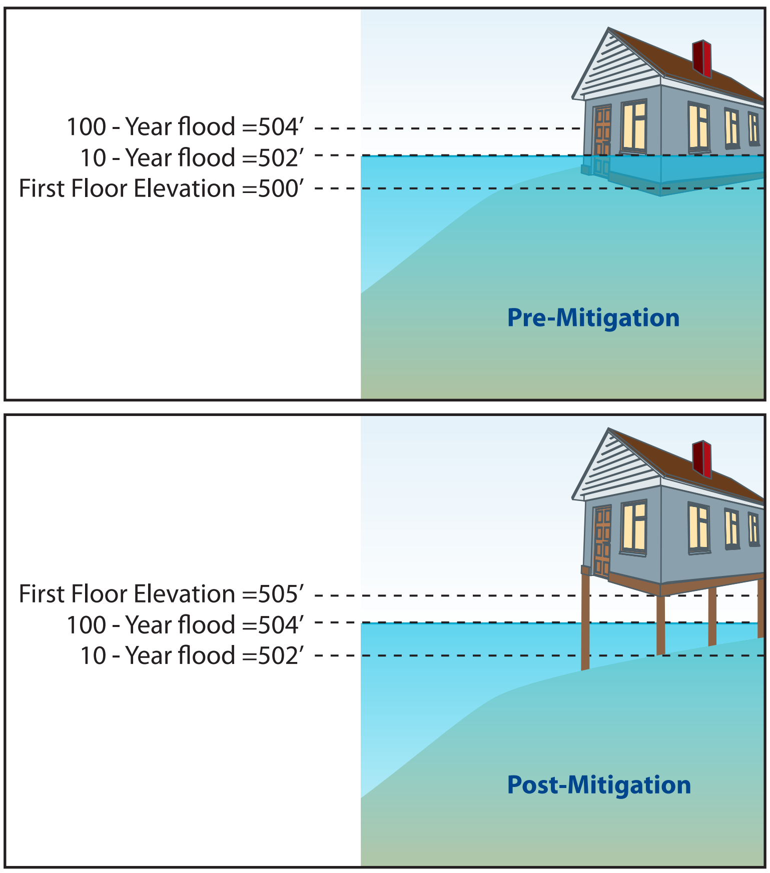
- Specific date of each flood event.
- Measured or estimated high water marks from the event in the vicinity of the project area, if available.
- Size of the event (flood recurrence interval such as the 10-year, 50-year, or other) if known. See **Supplement to the Benefit-Cost Analysis Reference Guide Section 2.1.2: Determining Recurrence Intervals.**
- A list of physical damages to the buildings included in the project application and the associated repair costs. Actual insurance claims may be available through the homeowner or BureauNet if the buildings are flood-insured. **See Supplement to the Benefit-Cost Analysis Reference Guide Section 2.1.4: Using National Flood Insurance Program BureauNet Data.**
- Number of volunteer hours spent at the project site to assist in repair/recovery activities such as damaged material removal, if any.

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

☐ STEP 11: Cost-Effectiveness Analysis

Description: Cost-effectiveness of an elevation project must be demonstrated in order to obtain FEMA funding. FEMA has provided an approach to demonstrating cost-effectiveness based on pre-calculated benefits with minimal documentation that is available to all applicants if certain requirements are met. If it is not possible to meet those requirements, a benefit-cost analysis (BCA) is required to assess the cost-effectiveness of the project. A BCA is a quantitative procedure that assesses the cost-effectiveness of a hazard mitigation measure over the useful life of the project by comparing the potential avoided damages (benefits) associated with the mitigation measure to the cost of a project in current dollars. The figure and table below help illustrate this concept.



Recurrence Interval	Expected Damages Before Mitigation	Expected Damages After Mitigation - Elevating Structure FFE 4 ft	Damages Avoided (Benefits)
10-year flood	$1,981	$ 0	$1,981
100-year flood	$17,121	$1,000	$16,121

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 11: Cost-Effectiveness Analysis *(continued)*

FEMA will only consider applications that use a FEMA-approved methodology to demonstrate cost-effectiveness. FEMA provides a BCA Tool that allows Applicants to calculate a project Benefit-Cost Ratio (BCR). The BCR is a calculation of the project benefits divided by the project costs. Projects for which benefits exceed costs (a BCR of 1.0 or greater) are generally considered cost-effective. Benefits may include avoided damage, loss of function, and displacement. In the case of elevation projects, these include:

- Avoided physical damage to the building and contents
- Avoided displacement costs – the costs required to move and stay in a temporary location while repairs are performed on the building
- Residential properties:
  - Avoided mental stress
  - Lost productivity
- Commercial properties: Avoided loss of net revenue
- Public properties: Avoided loss of public services
- Avoided volunteer labor time that typically supports cleanup and repair work

It is important to note that there are a number of benefits that could be counted for a project, and any or all of the benefits can be included in a BCA when analyzing cost-effectiveness. The approaches outlined in Step 11B and 11C of this supplement are focused primarily on avoided physical damage (building and contents). It is recommended that the applicant start a BCA using these types of benefits as they are typically the largest benefits for elevation projects. If the BCR does not exceed 1.0, or is only slightly over 1.0 after following Steps 11B or 11C, move to Step 11D find additional methods of calculating potential benefits for the project.

This supplement only provides a recommended approach to documenting cost-effectiveness. For detailed guidance on using the **FEMA BCA Tool**, please refer to **FEMA BCA Reference Guide** and **FEMA Supplement to the BCA Reference Guide**. For additional questions, contact the ***BC Helpline at bchelpline@dhs.gov or at 1-855-540-6744***. If the FEMA BCA Tool is used, please provide a .pdf of the BCA report and an export of the BCA as a .zip file.

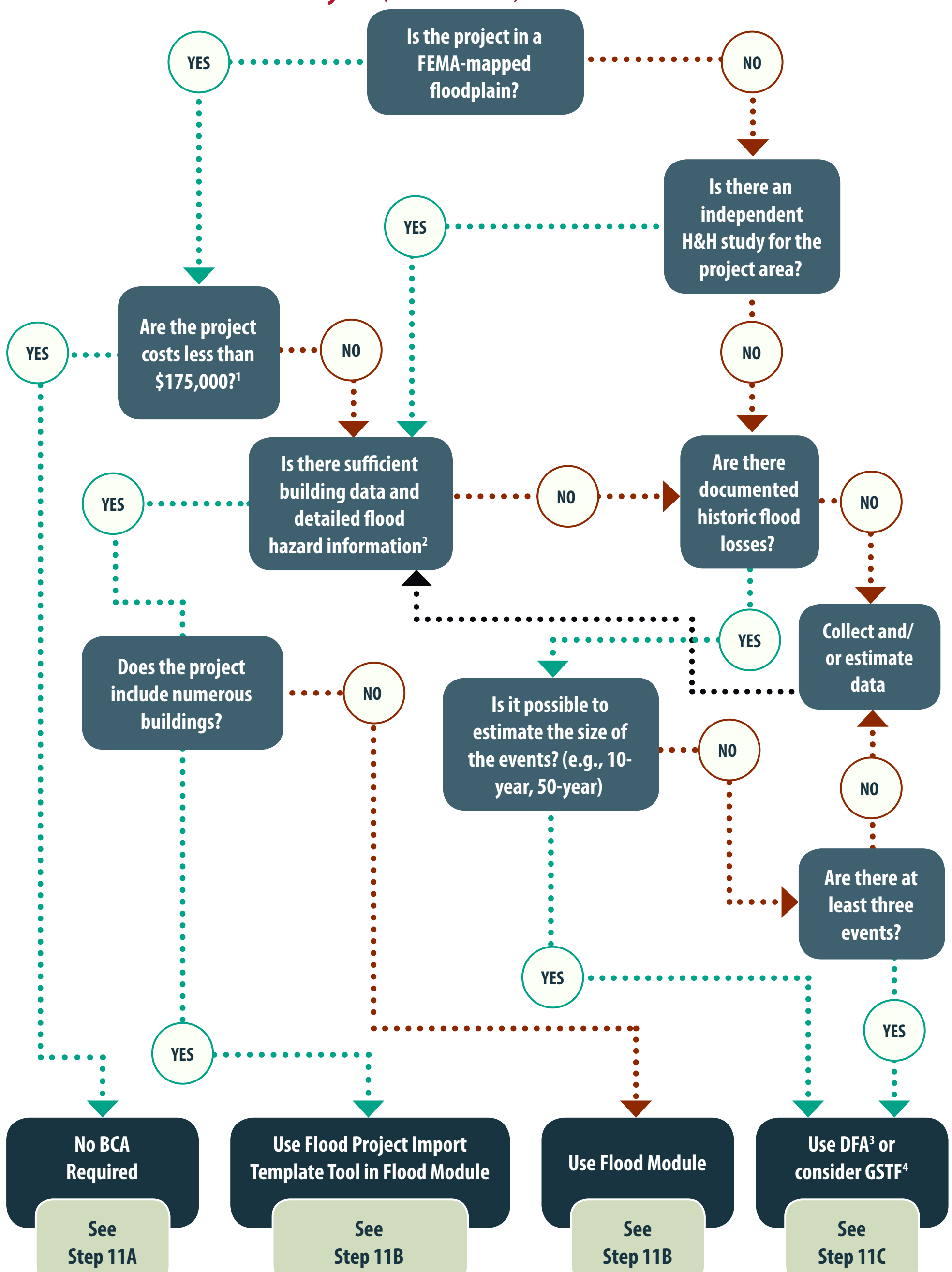
All BCA inputs must be justified and documented. When appropriate FEMA standard values are used, it should be clearly stated.

Approach: There are a number of methods to evaluate cost-effectiveness. The method used will depend on the data collected in the previous steps of this supplement. Use the flow chart below to analyze the data available for the project site and determine the recommended approach.

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 11: Cost-Effectiveness Analysis *(continued)*



NOTES

1 For projects that contain multiple structures, the average cost of all structures in the project must meet the stated criterion. Additionally, the specific geographic location of structures can greatly increase elevation costs, and the benefits identified may be adjusted using locality multipliers that are included in industry-accepted cost and pricing guides for construction. Refer to HMA Guidance Part IV, I.7.

2 Described in Step 10 (approach 1 or 2), must have information on 4 events. Building information much include FFE as described in Supplement 4.2.

3 Damage Frequency Assessment.

4 Greatest Savings to the Fund (Refer to HMA Guidance Part IV, I.5).

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 11A: Pre-calculated Benefits for Elevation Projects in SFHA

Description: For elevation projects located in the SFHA, **HMA Unified Guidance Part IV, Section I** describes the pre-calculated benefits that may be used to demonstrate cost-effectiveness for elevation projects, including the specific documentation required.

The elevation of a structure located in the 100-year floodplain for which costs are equal to or less than $175,000 is cost-effective. For projects that contain multiple structures, the average cost of all structures in the project must meet the stated criterion, e.g., if there are 10 structures, the total project cost must be less than $1,750,000 (10 x $175,000).

Additionally, the specific geographic location of structures can greatly increase elevation costs, and the benefits identified may be adjusted using locality multipliers that are included in industry-accepted cost and pricing guides for construction.

If cost-effectiveness is met through pre-calculated benefits, no further cost-effectiveness analysis is required.

Approach: : Ensure that documentation requested under Steps 1 through 10 of this supplement is provided. A BCA is not required.

STEP 11B: Flood Module

Description: The flood module analyzes proposed mitigation projects by comparing estimated flood elevations for various flood events to the FFE. The BCA Tool then uses the depth of each scenario flood event above (or below in some instances) the FFE and establishes depth-damage curves to estimate damages to the building based on a percentage of the Building Replacement Value (BRV). Additionally, it uses the same depth-damage curves to estimate damage to building contents, displacement from the building, and loss of use of the building. The flood module is recommended for BCAs when users have detailed flood hazard information and structural data (using Step 10 methods 1 or 2).

References: FEMA's Benefit-Cost Analysis Reference Guide. Supplement to the Benefit-Cost Analysis Reference Guide Section 2.2: Working with the Flood Module. FEMA BCA Tool (including Help menu within the tool)

Approach: The following describes the essential flood hazard and structural data required to estimate avoided physical damages using the flood module. If **Steps 1 through10 of this supplement** were followed and all data gathered, there should be minimal additional data collection needed to complete the flood module BCA:

1. Structural Information
   a. Building information (Step 2)
   b. FFE or lowest floor member
2. Project useful life
3. Building Replacement Value (BRV)
4. Annual maintenance cost associated with maintaining the effectiveness of the components installed as part of the elevation project
5. Flood hazard information – **Step 10** (1 or 2)

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 11B: Flood Module *(continued)*

Coastal Projects	Riverine Projects
Ground surface elevation	Base flood elevations
BFE or 100-year elevation with wave action	Flood elevations for the 10-, 50-, 100-, and 500-year recurrence intervals (RIs) (alternative recurrence intervals are acceptable when using an H&H studies)
Still water elevation (for the 10-, 50-, 100-, and 500-year RI). Alternative RIs are acceptable when using a non FEMA H&H study	Flood discharge rates for the 10-, 50-, 100,- and 500-year RIs (riverine flood hazard analysis only, alternative RIs are acceptable when using an H&H study)

Note that while the information listed above is required to calculate avoided building damages, the Flood Module will use FEMA standard values to automatically count avoided loss to contents and avoided displacement costs (the costs required to move and stay in a temporary location while repairs are performed on the structure). If additional benefits are to be calculated, go to STEP 11D.

TIP: Data are entered for each structure individually in the Flood Module. To reduce data entry time, consider first entering data in the Flood Project Import Template found under the Import/Export button and then importing into the BCA software.

STEP 11C: Damage Frequency Assessment (DFA) Module

Description: The FEMA BCA DFA module is a flexible tool for analyzing project benefits and costs for proposed mitigation projects for any hazard. The tool compares user-entered damages/losses and the frequency that they occur in the pre-project scenario versus the post-project scenario to calculate benefits. The DFA module is recommended for BCAs when using historic flood information (Step 10, method 3).

References: **FEMA's Benefit-Cost Analysis Reference Guide. Supplement to the Benefit-Cost Analysis Reference Guide, Section 2.1: Working with the Damage Frequency Assessment Module. FEMA BCA Tool** (including Help link within the tool)

Approach: The DFA module was developed to calculate project benefits for proposed hazard mitigation projects based on either documented historic damages or expected damages (based on events of known frequency or recurrence interval such as a 10-year flood) from at least two events of different recurrence intervals. If recurrence intervals are not known and there are historical damage data from at least three events, the module can estimate recurrence intervals, otherwise additional data collection or analysis will be needed. The calculation compares pre- and post-project conditions:

- **Pre-Project:** Based on existing conditions at the site. To demonstrate the current risk, actual historical damages or estimated damages for certain severity events (e.g., the 10-year flood, the 50-year flood) can be entered in the DFA to perform a BCA.

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 11C: Damage Frequency Assessment (DFA) Module *(continued)*

- **Post-Project:** The same scenario flood events should result in reduced damages due to the mitigation project. The post-project damages should be estimated based on the level of protection provided by the project. For example, for a project that elevates a home above the 100-year flood elevation, it could be assumed that there would no longer be damages to the home below the 100-year level of protection.

	Pre-Mitigation Days		Post-Mitigation Days	
RI	Building	?	Building	?
10 year	$500	$250	$0	$0
100 year	$7,500	$3,750	$0	$0
500 year	$75,000	$12,000	$5,000	$7,500

For an elevation project, the DFA module is most typically utilized when there is no detailed H&H analysis for the project area, and the risk to the project site is demonstrated through past flood damages to the structure. Information regarding each of the scenario events was described in **Step 10 of this supplement**. For each damage event, the corresponding recurrence interval information is needed. If recurrence intervals are not available, the BCA Tool will calculate a recurrence interval when historical damage data from at least three events are provided.

Potential Sources: Insurance claims, receipts, FEMA Public Assistance Worksheets, Bureau Net data. Property owner affidavit, estimated from damage functions.

Example: The attached insurance claim information shows $12,000 in damages to flooring and air conditioning on June 10, 1998 from riverine flooding. The recurrence interval was estimated from stream gage information to be a 10-year event.

FEMA also allows for the use of the GSTF data and methodology to demonstrate cost-effectiveness. The GSTF calculation measures the expected savings of a mitigation project over the project useful life. Using past NFIP claims, the total expected future insurance claims can be projected. GSTF is calculated by subtracting total expected future insurance premiums from expected future claim payments.

ELEVATION TECHNICAL REVIEW

Technical Review Components *(continued)*

STEP 11D: Additional Benefits for a BCA

Description: There are a number of benefits that could be counted for a project. Any or all of the benefits can be used to demonstrate that a project is cost-effective, with a BCR greater than 1.0. Once the initial BCA information is collected and a preliminary analysis is performed, additional benefits may be analyzed if needed.

Approach:

Answer the following questions:

1. Is the building residential? If yes, how many residents reside in the building? If not readily available, use averages from Census data related to the municipality or county.
2. Does the building include any rental property for which the owner receives rental income?
3. Is there a business run out of the building or home?
4. Are there any non-critical governmental services provided from the building such as a permit office or library?
5. Are there any critical services provided from the building such as police, fire or medical services?
6. Does the project eliminate or reduce the need for volunteer labor?

STEP 12: Environmental and Historic Preservation Considerations

Environmental and historical preservation compliance will need to be considered as part of the application process. Please refer to **Elevation EHP Review – Supplement No. E1.3.**

ELEVATION TECHNICAL REVIEW

Resources

Below is a list of resources identified throughout this supplement. Not all of these resources are necessary for every elevation project but are provided to ease in identification of source material.

PROGRAM GUIDANCE

- 44 Code of Federal Regulations
- Benefit-Cost Analysis Reference Guide and Supplement to the Benefit-Cost Analysis Reference Guide
- FEMA Hazard Mitigation Assistance Guidance and Addendum to the Hazard Mitigation Assistance Unified Guidance, Part E
- The National Flood Insurance act of 1968, As Amended, 42 U.S.C. 4001 et seq.
- The Robert T. Stafford Disaster Relief and Emergency Assistance Act, As Amended, 42 U.S.C. 4001 et seq.

TECHNICAL GUIDANCE AND STANDARDS

- American Society of Civil Engineers (ASCE) Structural Engineering Institute's ASCE/SEI 24-14, Flood-Resistant Design and Construction (or latest version)
- FEMA P-55, Coastal Construction Manual, 4th Edition, August 2011 (or latest version)
- FEMA P-259, Engineering Principles and Practices of Retrofitting Floodprone Residential Structures, 3rd Edition, January 2012 (or latest version)
- FEMA P-312, Homeowners Guide to Retrofitting, 3rd Edition, June 2014 (or latest version)
- FEMA P-499, Home Builder's Guide to Coastal Construction Technical Fact Sheet Series, December 2010 (or latest version)
- FEMA P-550, Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations (2009) (or latest version)

ADDITIONAL TOOLS AND RESOURCES

- FEMA's How to Find Your FIRM and Make a FIRMette
- FEMA's Map Service Center
- Benefit-Cost Analysis (BCA) Tool
- Cost Estimating Principles for Hazard Mitigation Assistance Applications
- FEMA's National Flood Hazard Layer