

ENHANCED PORTION:

**PART V:
Assessment of Mitigation
Actions**

REQUIREMENT §201.5 (B) (2) (IV):

To be "Enhanced," the Commonwealth of Kentucky must document the system and strategy by which it will conduct an assessment of its completed mitigation actions and include a record of the effectiveness (actual cost avoidance) of each mitigation action.

***A. Describing the System and Strategy
by Which the Commonwealth of Kentucky Will Conduct an Assessment of the
Completed Mitigation Actions***

----- **AND** -----

***B. Including a Record of Effectiveness of Each Mitigation Action (Including
How Assessments Were Completed)***

The National Research Council (NRC) in a 1999 report intended to specifically deal with loss estimation methodology for natural disasters concluded that there was no widely-accepted framework for estimating the losses resulting from natural hazards [National Research Council 1999¹].

It is assumed here that the conclusion to the NRC report remains valid; that as yet there is no one universally-accepted method to performing a Loss Avoidance study.

Acknowledging such, Kentucky's hazard mitigation plan will use FEMA's current and general guidance and past precedent in conducting its assessment of mitigation actions: Using FEMA's conception of Loss Avoidance (detailed below) as a guide, ultimately, the method used in Kentucky's assessment of mitigation actions to evaluate past mitigation projects relies upon using 1) the "presidentially-declared" disasters that affected the Commonwealth of Kentucky throughout its 2010 – 2013 planning cycle and 2) benefit-cost analysis reports for those assessed projects.

¹ National Research Council. [1999]. "The Impact of Natural Disasters: A Framework for Loss Estimation."

However, also included in this assessment of mitigation actions (as **Appendix E-5-1**) is a separate assessment study of twenty-two properties acquired and demolished in Shepherdsville (in Bullitt County), Kentucky using FEMA grant funds. The inclusion of this study represents an alternative and perhaps more ideal (and certainly more qualitative and deductive) methodology for estimating “losses avoided” from completed mitigation actions. It represents a type of study that the Commonwealth would like to pursue in the future given the environment (i.e. availability of a similar post-disaster quasi-experiment) and resources to conduct such a time-intensive and thorough study.

It is relevant to begin this assessment of completed mitigation actions by discussing *how* disasters are presidentially declared and *how* and *for what* federal assistance is implemented. This background information will assist in project selection for this assessment of mitigation actions.

A Discussion of Disaster Declaration and Federal Assistance

The federal government offers states disaster-related assistance through the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. §5121-5207, referred to informally as the “the Stafford Act.” The Stafford Act’s intent is limited to adding *supplemental* disaster assistance to states: In other words (and relevant for this Loss Avoidance methodology), federal assistance only arrives (is requested) when disasters occur of such severity as to overwhelm state-level emergency response mechanisms.

The general response to a disaster is as follows: A disaster hits and community-level emergency teams respond. If these community-level emergency teams decide that help is necessary beyond the boundaries of their communities, then requests for said help are made to the *state*. The Governor of a state, then, decides on the use of state-level emergency response forces, the National Guard, State Police, etc. If the Governor decides that the extent of the effects of the disaster are too great for state-level emergency response, then the Governor requests that the President of the United States “declare a major disaster,” which authorizes federal funds and assistance to be used within the state.

Two (2) common vehicles for federal assistance immediately following a federal “disaster declaration” involve the Public Assistance Program (PA) and the Individuals and Households Assistance Program (IA). PA and IA provide assistance to eligible applicants within counties (typically) included in the “presidential declaration.”

Eligibility for Public Assistance (PA) is dependent upon four (4) interrelated and hierarchical considerations. The first asks if the county is eligible as an “Applicant,” thusly able to apply for PA grants. Eligible “Applicants” include: State government agencies, local governments and special districts, private nonprofit organizations that own or operate facilities open to the general public and/or serve functions/provide services that would or could otherwise be performed by a government agency. Following, then, the second question asks if the facilities for which PA grants would assist are eligible. A facility is eligible if it is the responsibility of an eligible applicant, if it is located in the designated disaster area, if it is not under the authority of another federal agency, and was in active use during the time of the disaster. The third and related question asks if the work to be done to the facility or if the emergency protective measures via the PA grant are eligible. Eligible disaster recovery work to be performed on an eligible facility or the emergency measures of an eligible “Applicant” must be the result of a major disaster event, must be located within the designated disaster area, and must be the legal responsibility of said eligible “Applicant.” The final question asks if costs for the eligible work to the eligible facility of the eligible “Applicant” are, indeed, eligible. Eligible costs must be tied to the performance of eligible work. Eligible costs are: reasonable and necessary to perform the work; compliant with federal, state, and local government procurement requirements; and reduced to the amount needed *minus* applicable credits such as insurance payouts and salvage values [FEMA 2012²].

² Federal Emergency Management Agency (FEMA). 2012. “Public Assistance: Eligibility.” See: <http://www.fema.gov/public-assistance-eligibility>. [Last updated: 6/21/2012; Last Accessed: 9/29/2013].

Of most relevance to the assessment of mitigation actions, however, is that Public Assistance (PA) grants are intended for assistance in recovery operations such as: replacement or repair to publicly-owned buildings and infrastructure; replacement or repair to eligible private nonprofit organizations; debris removal; assistance with protective measures used by local communities; etc.

The Individuals and Households Assistance Program, on the other hand, surrounds the eligibility of *impacted citizens* for assistance with (most relevantly) housing needs, legal matters, crisis counseling, etc. that resulted from or were necessary due to the declared disaster event.

The Presidentially-Declared Disasters to Affect Kentucky from 2010 – 2013

During its 2010 – 2013 planning cycle, the Commonwealth of Kentucky suffered from four (4) “presidentially-declared” disasters:

FEMA-1925-DR: Severe Storms; Flooding; Mudslides (Declared July 23, 2010)

On July 21, 2010, Governor Steven L. Beshear requested a major disaster declaration due to *severe storms, flooding, and mudslides* that occurred between the dates July 17 – 30, 2010. Governor Beshear requested Hazard Mitigation assistance for the entire Commonwealth of Kentucky. He requested 100% federal funding for Public Assistance (PA) and direct federal-level assistance for the first 14 days of the disaster.

From July 20 – 21, 2010, federal, Commonwealth, and local representatives conducted Joint Preliminary Damage Assessments (JPDAs) in the impacted counties toward which a “presidential-declaration” was requested. JPDAs estimate damages immediately after a disaster event and are considered (along with other factors) in determining whether or not a disaster is of such severity and magnitude as to overwhelm state-level and local-level emergency response and to thusly warrant federal assistance.

President Obama “declared” the disaster: Direct federal assistance was authorized; Governor Beshear’s request for Hazard Mitigation Grant Program assistance was authorized for the entire Commonwealth; and Public Assistance was granted where requested.

Following is a tabular summary of the Joint Preliminary Damage Assessment (JPDA) used to determine whether President Obama would “declare” a major disaster:

Table E-5-1: Summary of JPDA Used to Determine Whether to “Declare” a Disaster

RE: Individual Assistance (IA)		
Total Number of Residences Impacted		217
	<i>Destroyed</i> ³	120
	<i>Major Damage</i> ⁴	38
	<i>Minor Damage</i> ⁵	42
	<i>Affected</i> ⁶	17
Percentage of Insured Residences		14%
Percentage of Low-Income Households		11%
Percentage of Elderly Households		N/A
Total IA Cost Estimate		\$2,221,985
RE: Public Assistance (PA)		
Primary Impact		Damage to Roads and Bridges
Total PA Cost Estimate		\$8,603,621
	<i>Statewide Per-Capita Impact</i> ⁷	\$2.13
	<i>Statewide Per-Capita Impact Indicator</i> ⁸	\$1.29
	<i>Countywide Per-Capita Impact</i> ⁹	\$125.17
	<i>Countywide Per Capita Impact Indicator</i> ¹⁰	\$3.23

³ “Destroyed” = “total loss of structure; structure is not economically feasible to repair, or complete failure to major structural components (e.g., collapse of basement walls/foundation, walls, roof, etc.)”

⁴ “Major Damage” = “substantial failure to structural elements of residence (e.g., walls, floors, foundation, etc.), or damage that will take more than 30 days to repair

⁵ “Minor Damage” = home is damaged and uninhabitable, but may be made habitable in a short period of time with repairs

⁶ “Affected” = some damage to the structure and contents; but, structure is still habitable

⁷ Based on 2000 Census data

⁸ See Statewide Per Capita Impact Indicator for FY10, *Federal Register*, October 1, 2009

⁹ The county to which this applies is Pike County.

¹⁰ See Countywide Per Capita Impact Indicator for FY10, *Federal Register*, October 1, 2009

With the above justification and understanding that all counties within the Commonwealth of Kentucky were eligible to apply for Hazard Mitigation Grant Program assistance, the following counties were deemed by the President of the United States as being directly affected by the severe storms, flooding, and mudslides that would become FEMA-1925-DR. Further, whether each county was eligible for assistance through IA, PA, or both is listed.

Table E-5-2: FEMA-1925-DR: Severe Storms; Flooding; Mudslides

County Affected	IA	PA
Carter	✓	✓
Elliott		✓
Lewis	✓	✓
Madison	✓	✓
Mason	✓	
Pike	✓	✓
Rowan	✓	
Shelby		✓

FEMA-1976-DR: Severe Storms; Tornadoes; Flooding (Declared May 4, 2011)

On April 28, 2011, Governor Steven L. Beshear requested a major disaster declaration due to *severe storms, tornadoes, and flooding* that began April 22, 2011. Governor Beshear requested Hazard Mitigation assistance for the entire Commonwealth of Kentucky. He requested Individuals and Households Assistance (IA) and Public Assistance (PA) for 48 counties.

Starting April 28, 2011, federal, Commonwealth, and local representatives conducted Joint Preliminary Damage Assessments (JPDAs) in the counties toward which “presidential-declaration” was requested. JPDAs verify the amount of damages reported by impacted counties immediately after a disaster event and are considered (along with other factors) in determining whether or not a disaster is of such severity and magnitude as to overwhelm state-level and local-level emergency response and to thusly warrant federal assistance.

President Obama “declared” the disaster: Direct federal assistance was authorized; Governor Beshear’s request for Hazard Mitigation Grant Program assistance was authorized for the entire Commonwealth; and Individuals and Households and Public Assistance was granted where requested. The declaration provided for 75% funding for Public Assistance.

Following is a tabular summary of the Joint Preliminary Damage Assessment (JPDA) used to determine whether President Obama would “declare” a major disaster:

Table E-5-3: Summary of JPDA Used to Determine Whether to “Declare” a Disaster

RE: Individual Assistance (IA)		
Total Number of Residences Impacted		N/A ¹¹
	<i>Destroyed</i> ¹²	N/A
	<i>Major Damage</i> ¹³	N/A
	<i>Minor Damage</i> ¹⁴	N/A
	<i>Affected</i> ¹⁵	N/A
Percentage of Insured Residences		N/A
Percentage of Low-Income Households		N/A
Percentage of Elderly Households		N/A
Total IA Cost Estimate		N/A
RE: Public Assistance (PA)		
Primary Impact		Damage to Roads and Bridges
Total PA Cost Estimate		\$5,767,281
	<i>Statewide Per-Capita Impact</i> ¹⁶	\$1.43
	<i>Statewide Per-Capita Impact Indicator</i> ¹⁷	\$1.30
	<i>Countywide Per-Capita Impact</i> ¹⁸	Varies: From \$3.75 - \$67.22 ¹⁹
	<i>Countywide Per Capita Impact Indicator</i> ²⁰	\$3.27

¹¹ Presumably, given the nature of the destruction this disaster caused, there was little need to justify “presidential declaration” using Individual Assistance-related determinants.

¹² “Destroyed” = “total loss of structure; structure is not economically feasible to repair, or complete failure to major structural components (e.g., collapse of basement walls/foundation, walls, roof, etc.)”

¹³ “Major Damage” = “substantial failure to structural elements of residence (e.g., walls, floors, foundation, etc.), or damage that will take more than 30 days to repair

¹⁴ “Minor Damage” = home is damaged and uninhabitable, but may be made habitable in a short period of time with repairs

¹⁵ “Affected” = some damage to the structure and contents; but, structure is still habitable

¹⁶ Based on 2000 Census data

¹⁷ See Statewide Per Capita Impact Indicator for FY11, *Federal Register*, October 1, 2010

¹⁸ The county to which this applies is Pike County.

¹⁹ For: Boone County (\$5.24); Bracken County (\$15.96); Campbell County (\$3.75); Carroll County (\$49.38); Carter County (\$22.17); Fleming County (\$21.03); Gallatin County (\$36.07); Kenton County (\$11.25); Lawrence County (\$15.30); Morgan County (\$12.99); Nicholas County (\$67.22); Oldham County (\$5.83); Owen County (\$10.53); Washington County (\$20.04)

²⁰ See Countywide Per Capita Impact Indicator for FY11, *Federal Register*, October 1, 2010

With the above justification and understanding that all counties within the Commonwealth of Kentucky were eligible to apply for Hazard Mitigation Grant Program assistance, the following counties were deemed by the President of the United States as being directly affected by the severe storms, flooding, and mudslides that would become FEMA-1976-DR. Further, whether each county was eligible for assistance through IA, PA, or both is listed.

Table E-5-4: FEMA-1976-DR: Severe Storms; Tornadoes; Flooding

County Affected	IA	PA
Anderson		✓
Ballard	✓	✓
Bath		✓
Boone		✓
Boyd	✓	✓
Bracken		✓
Breathitt		✓
Breckinridge		✓
Butler		✓
Caldwell		✓
Calloway		✓
Campbell		✓
Carlisle	✓	✓
Carroll	✓	✓
Carter		✓
Christian		✓
Clay		✓
Crittenden	✓	✓
Daviess	✓	✓
Edmonson		✓
Elliott		✓
Estill		✓
Fleming		✓
Floyd	✓	✓
Franklin		✓
Fulton	✓	✓
Gallatin		✓
Grant		✓
Graves	✓	✓
Grayson		✓
Green		✓
Greenup		✓
Hancock		✓
Hardin	✓	
Harlan		✓
Henderson	✓	✓

County Affected	IA	PA
Henry		✓
Hickman	✓	✓
Hopkins		✓
Jefferson	✓	
Johnson	✓	✓
Kenton		✓
Knott		✓
Lawrence	✓	✓
Lee		✓
Lewis		✓
Livingston	✓	✓
Logan		✓
Lyon		✓
Magoffin		✓
Marion		✓
Marshall	✓	✓
Martin		✓
Mason		✓
McCracken	✓	✓
McLean	✓	✓
Meade		✓
Menifee		✓
Mercer		✓
Monroe		✓
Morgan		✓
Nelson		✓
Nicholas		✓
Oldham		✓
Owen		✓
Owsley		✓
Pendleton		✓
Perry		✓
Pike	✓	
Robertson		✓
Rowan		✓
Spencer		✓
Todd		✓
Trigg		✓
Trimble		✓
Union	✓	✓
Washington		✓
Webster	✓	✓
Wolfe		✓

FEMA-4008-DR: Severe Storms; Tornadoes; Flooding (Declared July 25, 2011)

On July 13, 2011, Governor Steven L. Beshear requested a major disaster declaration due to *severe storms*, *tornadoes*, and *flooding* that occurred between the dates July 19 – 23, 2011. Governor Beshear requested Hazard Mitigation assistance for the entire Commonwealth of Kentucky.

From June 23 – July 10, 2011, federal, Commonwealth, and local representatives conducted Joint Preliminary Damage Assessments (JPDAs) in the counties toward with “presidential-declaration” was requested. JPDAs verify the amount of damages reported by impacted counties immediately after a disaster event and are considered (along with other factors) in determining whether or not a disaster is of such severity and magnitude as to overwhelm state-level and local-level emergency response and thusly to warrant federal assistance.

President Obama “declared” the disaster: Governor Beshear’s request for Hazard Mitigation Grant Program assistance was authorized for the entire Commonwealth and Public Assistance was granted where requested.

Following is a tabular summary of the Joint Preliminary Damage Assessment (JPDA) used to determine whether President Obama would “declare” a major disaster:

Table E-5-5: Summary of JPDA Used to Determine Whether to “Declare” a Disaster

RE: Individual Assistance (IA)		
Total Number of Residences Impacted		369
	<i>Destroyed</i> ²¹	29
	<i>Major Damage</i> ²²	86
	<i>Minor Damage</i> ²³	169
	<i>Affected</i> ²⁴	85
Percentage of Insured Residences		4%
Percentage of Low-Income Households		87%
Percentage of Elderly Households		13.5%
Total IA Cost Estimate		\$3,840,560
RE: Public Assistance (PA)		
Primary Impact		Damage to Roads and Bridges
Total PA Cost Estimate		\$5,744,719
	<i>Statewide Per-Capita Impact</i> ²⁵	\$1.32
	<i>Statewide Per-Capita Impact Indicator</i> ²⁶	\$1.30
	<i>Countywide Per-Capita Impact</i> ²⁷	Varies: From \$9.73 - \$75.75 ²⁸
	<i>Countywide Per Capita Impact Indicator</i> ²⁹	\$3.27

²¹ “Destroyed” = “total loss of structure; structure is not economically feasible to repair, or complete failure to major structural components (e.g., collapse of basement walls/foundation, walls, roof, etc.)”

²² “Major Damage” = “substantial failure to structural elements of residence (e.g., walls, floors, foundation, etc.), or damage that will take more than 30 days to repair

²³ “Minor Damage” = home is damaged and uninhabitable, but may be made habitable in a short period of time with repairs

²⁴ “Affected” = some damage to the structure and contents; but, structure is still habitable

²⁵ Based on 2000 Census data

²⁶ See Statewide Per Capita Impact Indicator for FY11, *Federal Register*, October 1, 2010

²⁷ The county to which this applies is Pike County.

²⁸ For: Bell County (\$65.90); Breathitt County (\$75.75); Knott County (\$9.73); Knox County (\$23.68); Lee County (\$69.32); Magoffin County (\$13.13); Perry County (\$40.65)

²⁹ See Countywide Per Capita Impact Indicator for FY11, *Federal Register*, October 1, 2010

With the above justification and understanding that all counties within the Commonwealth of Kentucky were eligible to apply for Hazard Mitigation Grant Program assistance, the following counties were deemed by the President of the United States as being directly affected by the severe storms, flooding, and mudslides that would become FEMA-4008-DR. Further, whether each county was eligible for assistance through IA, PA, or both is listed.

Table E-5-6: FEMA-4008-DR: Severe Storms; Tornadoes; Flooding

County Affected	IA	PA
Lee		✓
Breathitt		✓
Magoffin		✓
Knott		✓
Perry	✓	✓
Knox	✓	✓
Bell	✓	✓

FEMA-4057-DR: Severe Storms; Tornadoes; Straight-Line Winds; Flooding (Declared March 6, 2012)

On March 4, 2012, Governor Steven L. Beshear requested an (expedited) major disaster declaration due to *severe storms, tornadoes, straight-line winds, and flooding* that occurred between the dates February 29 – March 3, 2012. Governor Beshear requested Hazard Mitigation assistance for the entire Commonwealth of Kentucky.

What would become FEMA-4057-DR was so severe in effects that federal assistance was authorized *before* the federal, Commonwealth, and local Joint Preliminary Damage Assessments (JPDAs) were conducted in the counties toward which “presidential-declaration” was requested. According to federal regulation³⁰, JPDAs can be waived for those hazard events of such unusual severity and magnitude that formal field damage assessments are superfluous.

President Obama “declared” the disaster: Governor Beshear’s request for Hazard Mitigation Grant Program assistance was authorized for the entire Commonwealth and Individual Assistance was granted where requested.

³⁰ 44 C.F.R. §206.33(d) and §206.36(d)

Following is a tabular summary of the Joint Preliminary Damage Assessment (JPDA) used to determine whether President Obama would “declare” a major disaster:

Table E-5-7: Summary of PDA Used to Determine Whether to “Declare” a Disaster

RE: Individual Assistance (IA)		
Total Number of Residences Impacted		N/A ³¹
	<i>Destroyed</i> ³²	N/A
	<i>Major Damage</i> ³³	N/A
	<i>Minor Damage</i> ³⁴	N/A
	<i>Affected</i> ³⁵	N/A
Percentage of Insured Residences		N/A
Percentage of Low-Income Households		N/A
Percentage of Elderly Households		N/A
Total IA Cost Estimate		N/A
RE: Public Assistance (PA)		
Primary Impact		N/A ³⁶
Total PA Cost Estimate		N/A
	<i>Statewide Per-Capita Impact</i> ³⁷	N/A
	<i>Statewide Per-Capita Impact Indicator</i> ³⁸	\$1.35
	<i>Countywide Per-Capita Impact</i> ³⁹	N/A
	<i>Countywide Per Capita Impact Indicator</i> ⁴⁰	\$3.39

³¹ The disaster event was of such unusual severity and magnitude that no Individual Assistance justification was necessary.

³² “Destroyed” = “total loss of structure; structure is not economically feasible to repair, or complete failure to major structural components (e.g., collapse of basement walls/foundation, walls, roof, etc.)”

³³ “Major Damage” = “substantial failure to structural elements of residence (e.g., walls, floors, foundation, etc.), or damage that will take more than 30 days to repair

³⁴ “Minor Damage” = home is damaged and uninhabitable, but may be made habitable in a short period of time with repairs

³⁵ “Affected” = some damage to the structure and contents; but, structure is still habitable

³⁶ The disaster event was of such unusual severity and magnitude that no Public Assistance justification was necessary.

³⁷ Based on 2000 Census data

³⁸ See Statewide Per Capita Impact Indicator for FY11, *Federal Register*, October 1, 2010

³⁹ The county to which this applies is Pike County.

⁴⁰ See Countywide Per Capita Impact Indicator for FY11, *Federal Register*, October 1, 2010

With the above justification and understanding that all counties within the Commonwealth of Kentucky were eligible to apply for Hazard Mitigation Grant Program assistance, the following counties were deemed by the President of the United States as being directly affected by the severe storms, flooding, and mudslides that would become FEMA-4057-DR. Further, whether each county was eligible for assistance through IA, PA, or both is listed.

Table E-5-8: FEMA-4057-DR: Severe Storms; Tornadoes; Straight-Line Winds; Flooding

County Affected	IA	PA
Adair		✓
Ballard		✓
Bath	✓	✓
Campbell	✓	
Carroll	✓	
Grant	✓	✓
Grayson	✓	
Johnson	✓	✓
Kenton	✓	✓
Larue	✓	✓
Laurel	✓	✓
Lawrence	✓	✓
Magoffin	✓	✓
Martin	✓	✓
Menifee	✓	✓
Montgomery	✓	
Morgan	✓	✓
Ohio	✓	
Pendleton	✓	✓
Rowan	✓	
Russell	✓	
Trimble	✓	✓
Wolfe	✓	✓

The Loss Avoidance Methodology Used

FEMA's Articulation of Loss Avoidance (Assessment of Mitigation Actions)

The basic, fundamental component of the Loss Avoidance Study methodology is the "Loss Estimation Analysis." The Loss Estimation Analysis (and its limitations) completely drives the rest of any methodology used in the Loss Avoidance Study. FEMA frequently (if not always) includes in its Loss Avoidance Study both a written and graphical breakdown of the Loss Avoidance Study Methodology. The published methodology is generally divided into three (3) phases:

Phase 1 emphasizes the mitigation action/project selection that will comprise the focus of the Loss Avoidance Study

Phase 2 collects the data that ultimately will be input into the Loss Estimation model.

Phase 3 uses the project selection and the data corresponding to the selected projects to derive the prescribed Loss Avoidance.

In other words, because all methodology prior to the Loss Estimation Analysis is performed in order to use the Loss Estimation Analysis technique, then the inverse is assumed to be true, as well: The Loss Estimation Analysis drives the rest of a FEMA Loss Avoidance Study's methodology.

Throughout, then, FEMA Loss Avoidance Studies, the Loss Estimation model is simplified to the following conceptual equation:

$$MP_A - MP_C = LA,$$

where MP_A is "Mitigation Project Absent," MP_C is "Mitigation Project Complete," and LA is "Losses Avoided."

Further, a Return on Investment (ROI) is calculated from the Loss Estimation Analysis:

$$\frac{\$LA}{\$PI} = \%ROI,$$

where

- "LA" is "Losses Avoided,"
- "PI" is "Project Investment," and
- "ROI" is "Return on Investment."

"Project Investment" ("PI") here refers to the amount of money *FEMA actually paid* for the completed mitigation project. The Return on Investment ultimately refers to *FEMA's* return on *its* investment, which, generally (and for all of the projects selected by

Kentucky to be assessed) amounts to 75% of the amount of money *actually spent* (as opposed to budgeted) to complete the mitigation action being assessed.

Phase I: Project Selection Methodology

The assessment of mitigation actions (i.e. the Loss Avoidance Report) for this Enhanced Portion of the Commonwealth of Kentucky's hazard mitigation plan uses the abovementioned "presidentially-declared" disasters that occurred throughout Kentucky's 2010 – 2013 planning cycle to guide project selection. The idea is to attempt to imagine what might have been had presently completed mitigation projects not been completed in the areas when and where FEMA-1925-DR, FEMA-1976-DR, FEMA-4008-DR, and FEMA-4057-DR occurred.

Ultimately, relevant past completed mitigation projects' Benefit-Cost Analysis (BCA) reports will be used to establish "losses avoided" calculated according to FEMA's proscribed Loss Avoidance formula (described below).

However, the natures of the completed projects and the federal declaration statuses of the locations in which relevant mitigation projects were completed will aid in project selection. Other considerations will, of course, involve feasibility and data constraints.

Limiting Project Selection by Quarterly Report and by Obvious Exclusion

Potential project selection was limited to those completed mitigation actions that could have been affected by FEMA-1925-DR through FEMA-4057-DR and that were accounted for on Kentucky Emergency Management's (KYEM's) and FEMA's Quarterly Reports. This means that completed-project selection did not include any completed projects funded under "presidentially-declared" disasters prior to FEMA-1407-DR.

The use of the Quarterly Report as a limiting tool was justified by reasons of relevance: A (arguably) primary purpose of a Loss Avoidance Report is the Return on Investment (ROI) that results from the report. A potential mitigation project's pre-approval Benefit-Cost Analysis (BCA) predicts an ROI (i.e. the "benefits") for what would or might be a completed mitigation project. However, such benefits/ROIs rely upon a number of mainly historical and statistical-aggregate assumptions. A Loss Avoidance Report's usefulness extends to its insight as to the true nature of benefits/ROIs *within a short period of time*. A pre-approved project's BCA may predict that a would-be completed mitigation project will pay for itself in 30-plus years based upon a number of historical assumptions and assumptions about the statistically aggregated and averaged level of flooding. This is the project's *expected benefit* (or *expected value* or *expected ROI*). But, it is only after events that have occurred (i.e. events that are outliers to the average) relatively shortly after a project's completion that insight into the true nature or the true magnitude of "benefits"/Returns-on-Investment are provided or justified.

That completed mitigation projects funded under FEMA mitigation programs *that are too old to be included on FEMA's Quarterly Report* are excluded, then, is assumed justified from the time-constrained usefulness of performing Loss Avoidance: FEMA-1407-DR was presidentially declared in March of 2002. Projects funded under FEMA-1407-DR, then, have been completed for around ten years.

Here it is assumed that after ten years, the expected benefits calculated in the FEMA-approved Benefit-Cost Analysis (BCA) can be considered *nearly* equal to any result deriving from a Loss Avoidance study. Such an assumption derives from FEMA's default discount rate used in its Benefit-Cost Analysis: At a 7% discount rate, a project's expected *annual* benefit should equal its expected *total* benefits in about fourteen (14) years for a project whose useful life is 50 or 100 years, or in about twelve (12) years for a project whose useful life is 30 years⁴¹.

⁴¹ The general process from which these numbers (14 and 12 years) derive is explained in the discussion of calculating Expected Annual Benefits within "Phase III: Kentucky's Methodology for Calculating Losses Avoided." FEMA's calculation of a project's "benefits" (B) is a function of the project's "expected annual benefits" (EAB) multiplied by a formula using the project's expected useful life (T) and the default discount rate used by FEMA (r), which is 7%. Though introduced below, FEMA's formula used to calculate benefits is:

$$B = EAB \left[\frac{1 - (1 + r)^{-T}}{r} \right]$$

This formula can be converted algebraically to:

$$EAB = \frac{B}{\left[\frac{1 - (1 + r)^{-T}}{r} \right]}$$

Expected Annual Benefits (EAB), then, is an *average*: The total value of benefits divided by a *number of years*.

Using FEMA's discount rate (r) of 7%, and assuming a project's useful life (T) of 100 years (for acquisition projects), to derive "Expected Annual Benefits" means dividing the total value of benefits (B) by just over 14 years. Assuming a project's useful life (T) is 50 years means dividing the value of total benefits (B) by just shy of 14 years. Finally, assuming a project's useful life (T) is 30 years means dividing the value of total benefits (B) by approximately 12 years.

In other words, within 12 to 14 years, a project's annual benefits is expected to equal its total benefits. Consequently, worrying about selecting projects begun from presidentially-declared disasters that occurred before FEMA-DR-1407 (in 2002) is trivial. At the time of this writing, it has been eleven years (and will be close to twelve) years since the occurrence of FEMA-DR-1407 and the beginning of mitigation actions applied for and funded from FEMA's grant programs deriving from it.

Appendix E-5-2 lists *all* of the past completed mitigation actions that had been hit by FEMA-1925-DR through FEMA-4057-DR found on Quarterly Reports throughout Kentucky's 2010 – 2013 planning cycle. This full list includes (primarily for illustration) the generator and siren projects that automatically are excluded from project selection in this “loss avoidance” report. That generator, siren, etc. projects are excluded solely is a function of feasibility: While their importance to mitigation is logically obvious, the monetary benefits to generator, siren, etc. projects are indirect. Assuming that a generator or siren project's benefits are synonymous to its “losses avoided” is not justifiable. To imagine a hypothetical, i.e. *what could have occurred in a different state of nature if the generator, siren, etc. had NOT been purchased/placed* prior to FEMA-1925-DR through FEMA-4057-DR involves too many variables that are, at this time, infeasible to monetize in a “loss avoidance” setting. Further, even with a methodology that relies upon an individual project's FEMA-approved Benefit-Cost Analysis as this “loss avoidance” report does, the link between a generator or siren's expected benefits and its actual “losses avoided” is assumed here to be a far more tenuous link than the link between, for example, an acquisition's expected benefits and its actual “losses avoided.”

The one “obvious exclusion” (DR-1703-0006) is highlighted in red.

**Table E-5-9: Completed Projects “Hit” by FEMA-1925-DR through FEMA- DR-4057 I:
Excluding Siren and Generator Projects; One Obvious Exclusion**

FEMA Disaster #	Completed Action #	Action Type	County	Approved Budget	IA	PA
1925	1454-0004	Landslide Acquisition	Lewis	\$147,200	✓	✓
	1523-0006	Acquisition	Rowan	\$162,736	✓	
	PDM-2007-0002	Lift Station Relocation	Shelby	\$578,550		✓
1976	1407-0002	Acquisition	Harlan	\$928,895		✓
	1407-0009	Acquisition	Christian	\$309,405		✓
	1407-0010	Acquisition	Boyd	\$448,899	✓	✓
	1454-0004	Landslide Acquisition	Lewis	\$147,200		✓
	1454-0008	Acquisition	Fleming	\$129,027		✓
	1454-0010	Detention Basin	Calloway	\$806,812		✓
	1454-0011	Acquisition	Jefferson	\$728,731	✓	
	1454-0012	Lift Station Relocation	Ballard	\$439,687	✓	✓
	1523-0004	Acquisition	Nelson	\$154,650		✓
	1523-0005	Acquisition	Jefferson	\$178,785	✓	
	1523-0006	Acquisition	Rowan	\$162,736		✓
	1523-0010	Acquisition	Martin	\$262,800		✓
	1537-0003	Safe Room	Franklin	\$84,640		✓
	1703-0004	Drainage	Christian	\$229,870		✓
	1703-0006	Acquisition	Christian	N/A ⁴²		✓
	1746-0007	Soil Stabilization	Jefferson	\$740,279.41	✓	
	1818-0008	Acquisition	Hardin	\$215,400	✓	
	1818-0105	Acquisition	Boyd	\$976,837	✓	✓
	PDM-2006-0003	Acquisition	Christian	\$335,400		✓
	PDM-2006-0004	Safe Room	Marion	\$295,000		✓
PDM-2007-0005	Acquisition	Jefferson	\$98,125	✓		
PDM-2007-0008	Acquisition	Hardin	\$149,415	✓		
4008	1407-0005	Acquisition	Bell	\$850,185	✓	✓
4057	1523-0006	Acquisition	Rowan	\$162,736	✓	
	1523-0010	Acquisition	Martin	\$262,800	✓	✓

⁴² DR-1703-0006 was withdrawn and resubmitted under DR-1912-0016. The project only recently has been closed out. Thus, as a hypothetical, it would not have been hit by any of Kentucky declared disasters.

Further Limiting Project Selection by Date Completed

In order for the methodology that uses “presidentially-declared” disasters that affected Kentucky to guide the project selection, the project that we are hypothesizing may not have existed (“Mitigation Project Absent”) but in fact was completed (“Mitigation Project Complete”) *has to have been hit* by the “presidentially-declared” disaster. In other words, the completed mitigation action being assessed has to have been completed by the time either FEMA-1925-DR through FEMA-4057-DR struck Kentucky.

FEMA-4057-DR struck Kentucky in March of 2012. Kentucky has not suffered a “presidentially-declared” disaster since. Thus, any mitigation project completed after March 2012 is excluded from assessment using this methodology.

One final consideration: Though it records a mitigation action’s “completion date” where available, this project selection methodology excludes based upon a mitigation action’s “close-out” date⁴³. The “close-out” date refers to the date after which the project not only is structurally complete, but is administratively complete as well. That a mitigation action would be “administratively complete” refers to that action having been audited by the Commonwealth of Kentucky and confirmed by FEMA for regulatory compliance and adherence to the approved scope-of-work.

Tabulated below is a revised list of completed mitigation projects to be assessed emphasizing their “closeout dates” (and, for illustration, “project completion” dates) that displays the exclusion of those projects closed out after March of 2012. Where available, project completion dates also are included. Those projects to be excluded will be highlighted in red.

⁴³ There is one exception to this, where “project completion” is the exclusionary criterion. The reasoning is elaborated in a footnote below.

**Table E-5-10: Completed Projects “Hit” by FEMA-1925-DR through FEMA-4057-DR II:
Excluding Those Projects Completed/Closed after FEMA-1925-DR through FEMA-4057-DR**

FEMA Disaster #	Completed Action #	Action Type	County	Approved Budget	Completion Date	Close-Out Date	
1925	1454-0004	Landslide Acquisition	Lewis	\$147,200	7/22/2005	10/26/2006	
	1523-0006	Acquisition	Rowan	\$162,736	1/27/2007	1/7/2008	
	PDM-2007-0002	Lift Station Relocation	Shelby	\$578,550	Not Available	3/28/2011	
1976	1407-0002	Acquisition	Harlan	\$928,895	Not Available	10/19/2006	
	1407-0009	Acquisition	Christian	\$309,405	2/13/2005	9/18/2006	
	1407-0010	Acquisition	Boyd	\$448,899	Not Available	1/8/2007	
	1454-0004	Landslide Acquisition	Lewis	\$147,200	7/22/2005	10/26/2006	
	1454-0008	Acquisition	Fleming	\$129,027	2/28/2008	1/22/2009	
	1454-0010	Detention Basin	Calloway	\$806,812	Not Available	12/7/2011	
	1454-0011	Acquisition	Jefferson	\$728,731	10/31/2006	3/20/2007	
	1454-0012	Lift Station Relocation	Ballard	\$439,687	12/8/2008	4/29/2009	
	1523-0004	Acquisition	Nelson	\$154,650	11/28/2006	10/23/2007	
	1523-0005	Acquisition	Jefferson	\$178,785	2/5/2007	10/22/2007	
	1523-0006	Acquisition	Rowan	\$162,736	1/27/2007	1/7/2008	
	1523-0010	Acquisition	Martin	\$262,800	6/13/2008	2/25/2010	
	1537-0003	Safe Room	Franklin	\$84,640	5/24/2009	3/31/2011	
	1703-0004	Drainage	Christian	\$229,870	7/29/2011	6/12/2012	
	1746-0007	Soil Stabilization	Jefferson	\$740,279.41	11/4/2011	3/19/2013	
	1818-0008	Acquisition	Hardin	\$215,400	12/5/2011	5/14/2012	
	1818-0105	Acquisition	Boyd	\$976,837	Not Available	2/15/2013	
	PDM-2006-0003	Acquisition	Christian	\$335,400	Not Available	12/9/2011	
	PDM-2006-0004	Safe Room	Marion	\$295,000	Not Available	1/6/2012	
	PDM-2007-0005 ⁴⁴	Acquisition	Jefferson	\$98,125	5/19/2010	5/24/2011	
	PDM-2007-0008	Acquisition	Hardin	\$149,415	1/13/2009	3/5/2010	
	4008	1407-0005	Acquisition	Bell	\$850,185	Not Available	3/11/2010
	4057	1523-0006	Acquisition	Rowan	\$162,736	1/27/2007	1/7/2008
1523-0010		Acquisition	Martin	\$262,800	6/13/2008	2/25/2010	

⁴⁴ This project should be excluded based upon its “close-out” date: May 24, 2011 occurred after FEMA-1976-DR was declared on May 4, 2011. However, it will be included based upon that we know that the project was completed and audited nearly a year earlier.

Finally Limiting Project Selection by County Affected by Presidentially-Declared Disaster

Again, relating to the need to isolate completed mitigation actions that addressed structures and populations *that would have been affected by a “presidentially-declared” disaster had they been “absent,”* it is relevant to finally limit project selection to projects residing *within counties* affected by a “presidentially-declared” disaster within the year the disaster hit.

This is already displayed above in “Table: Completed Projects ‘Hit’ by FEMA-1925-DR through FEMA-4057-DR I”: Each of the counties listed in this table also is accompanied by whether the county was eligible for “Individuals and Households Assistance (IA)” or “Public Assistance (PA)” grants.

A Brief Discussion of Individual Assistance (IA) versus Public Assistance (PA) and Project Selection

Remember from the discussion above that “Individuals and Households Assistance (IA)” and “Public Assistance (PA)” funding are directed toward different sources for mitigation actions.

IA funding is intended to address *individuals*: Individuals and Household Assistance (IA) funding and the eligibility for them surrounds individual eligibility for assistance in (most relevantly) housing needs, legal matters, crisis counseling, etc.

Meanwhile, PA funding addresses *public* effects: Public Assistance (PA) grants are intended for assistance in recovery operations such as the replacement or repair to publicly-owned buildings and infrastructure, the replacement or repair to eligible private nonprofit organizations, debris removal, and the assistance with protective measures used by local communities, etc.

It may, then, have been relevant to exclude actions using Individuals and Households Assistance (IA) versus Public Assistance (PA) designation as a tool. It could be argued that if FEMA-1976-DR (declared in 2011) hit a county declared only as “PA” but affected a completed *acquisition/demolition* type of mitigation action, which is considered an *individual* mitigation action, then perhaps this particular action in this PA-declared county should be excluded: A PA designation without an accompanying IA designation might imply that individual properties were not dramatically affected by the hazard event. Only public properties primarily were affected by the hazard.

Considering the above situation was deemed *too exclusionary*, however. And the logic cannot be wholly justified: A county’s declaration as “PA” without “IA” may be as much about success in completed *acquisition/demolition* mitigation actions as implying any measure of severity of the hazard event within the county. As more acquisition/demolition mitigation actions are completed within a county (and as the county’s individual properties become less vulnerable to flooding), the less likely that

county will garner an “Individuals and Households Assistance” designation upon being hit by a “presidentially-declared” disaster event.

Below is the Commonwealth of Kentucky’s *final* list of selected mitigation actions that will be assessed according to the “losses-avoided” methodology detailed below.

Table E-5-11: Completed Projects “Hit” by FEMA-1925-DR through FEMA-4057-DR III: FINAL Table

FEMA Disaster #	Completed Action #	Action Type	County	Approved Budget	Completion Date	Close-Out Date	IA	PA
1925	1454-0004	Landslide Acquisition	Lewis	\$147,200	7/22/2005	10/26/2006	✓	✓
	1523-0006	Acquisition	Rowan	\$162,736	1/27/2007	1/7/2008	✓	
1976	1407-0002	Acquisition	Harlan	\$928,895	Not Available	10/19/2006		✓
	1407-0009	Acquisition	Christian	\$309,405	2/13/2005	9/18/2006		✓
	1407-0010	Acquisition	Boyd	\$448,899	Not Available	1/8/2007	✓	✓
	1454-0004	Landslide Acquisition	Lewis	\$147,200	7/22/2005	10/26/2006		✓
	1454-0008	Acquisition	Fleming	\$129,027	2/28/2008	1/22/2009		✓
	1454-0011	Acquisition	Jefferson	\$728,731	10/31/2006	3/20/2007	✓	
	1454-0012	Lift Station Relocation	Ballard	\$439,687	12/8/2008	4/29/2009	✓	✓
	1523-0004	Acquisition	Nelson	\$154,650	11/28/2006	10/23/2007		✓
	1523-0005	Acquisition	Jefferson	\$178,785	2/5/2007	10/22/2007	✓	
	1523-0006	Acquisition	Rowan	\$162,736	1/27/2007	1/7/2008		✓
	1523-0010	Acquisition	Martin	\$262,800	6/13/2008	2/25/2010		✓
	1537-0003	Safe Room	Franklin	\$84,640	5/24/2009	3/31/2011		✓
	PDM-2007-0005 ⁴⁵	Acquisition	Jefferson	\$98,125	5/19/2010	5/24/2011	✓	
	PDM-2007-0008	Acquisition	Hardin	\$149,415	1/13/2009	3/5/2010	✓	
4008	1407-0005	Acquisition	Bell	\$850,185	Not Available	3/11/2010	✓	✓
4057	1523-0006	Acquisition	Rowan	\$162,736	1/27/2007	1/7/2008	✓	
	1523-0010	Acquisition	Martin	\$262,800	6/13/2008	2/25/2010	✓	✓

⁴⁵ Per the rule of this methodology (i.e. to rely upon FEMA’s conception of “complete,” i.e. the action is administratively complete, accounted for, and paid for), this project should be excluded based upon its “close-out” date: May 24, 2011 occurred after FEMA-1976-DR was declared on May 4, 2011. However, it will be included based upon that we know that the project was completed and audited nearly a year earlier. Though “administratively incomplete,” Jefferson County would have seen losses avoided between 2010 and 2011.

Phase II: Data Collection

All data used in this Loss Avoidance study derives from the following sources:

- 1) Benefit-Cost Analyses Conducted During Application of a Project;
- 2) "Close-Out" Documents;
- 3) Project-Specific Correspondence Recorded and Maintained in Project Files;
- 4) Interviews from Project Managers and Area Development Districts.
- 5) The Community Hazard Assessment and Mitigation Planning System (CHAMPS)

A completed mitigation action's Benefit-Cost Analysis reveals the benefits that here are interpreted synonymously with "losses avoided" and from which this methodology will calculate Expected Annual Benefits (EAB).

"Close-out" documents provide a completed mitigation action's approved budget and the amount that was *actually spent* to complete the project. These documents provide "close-out" dates that determine by how many "times" the Expected Annual Benefit of a project is multiplied in order to more accurately convey "losses avoided." (This is explained below.) They further and many times provide project-specific narrative and context that can prove relevant to a report such as this.

The main sources of data used in the Loss Avoidance Report derived, of course, from a project's Benefit-Cost Analysis conducted during its application phase and from its "close-out" documents. However, especially regarding cases dealing with acquisitions, reading through the e-mails and correspondence between local project managers, Kentucky Emergency Management (KYEM), and FEMA that took place throughout the approval and implementation stages of a project were necessary in order to better comprehend and validate any discrepancies between what was approved and what was finally completed.

In those rare instances where the wealth of information and context provided in project files still allowed for pieces requiring comprehension and information still needing validation, personal interviews with local project managers and/or Area Development Districts (ADDs) who either were directly responsible for the management of the mitigation project or who could provide more specific context than what was provided in the projects' files were relevant and extremely helpful.

Finally, though still in its infancy regarding implementation, Kentucky's Community Hazards Assessment and Mitigation Planning System (CHAMPS) – its core function being a data warehouse – was able to provide important and illustrative information, especially concerning locations of mitigation projects being assessed and the values of surrounding infrastructure.

Phase III:

Part I, Kentucky's General Methodology for Determining Losses Avoided:

MP_A – MP_C = Expected Annual Benefits⁴⁶ = Losses Avoided

To derive a value for the “Losses Avoided,” the same basic premise as used in Kentucky’s 2010 assessment of its mitigation actions remains: Kentucky will use a mitigation project’s Benefit-Cost Analysis report (where available) to derive what would be the difference between MP_A and MP_C.

However, when compared to the 2010 mitigation action assessment, the methodology does differ significantly while representing an evolution from 2010’s methodology (as opposed to a deviation from it).

This assessment of mitigation actions will do the following in order to calculate MP_A – MP_C = Losses Avoided:

One: Calculate Expected Annual Benefits

Where FEMA benefit-cost analyses were required in application for the mitigation project that is being assessed, this loss avoidance report will calculate “Expected Annual Benefits” for the project.

FEMA established the following formula to calculate overall benefits that will be algebraically reconfigured to calculate an assessed mitigation project’s “Expected Annual Benefits”:

$$B = EAB \left[\frac{1 - (1 + r)^{-T}}{r} \right]$$

Where:

- “B” is Total Benefits,
- “r” is FEMA’s default discount rate (which is 7%),
- “T” is the useful life of the mitigation project, and
- “EAB” is Expected Annual Benefits.

⁴⁶ Expected Annual Benefits multiplied by the number of years between a project’s completion and it being hit by a presidentially-declared disaster. Obviously, this is too lengthy to serve as a subtitle. The process is explained in this section.

Of course, because this formula is being applied to *completed* mitigation projects, Total Benefits (“B”) are known. FEMA once had to approve what is now a completed mitigation project. This approval (in most cases) required a Benefit-Cost Analysis that supplied the Total Benefits (“B”) used here. In order, then, to isolate Expected Annual Benefits, the above formula is reconfigured:

$$EAB = \frac{B}{\left[\frac{1 - (1 + r)^{-T}}{r} \right]}$$

Further, “r” is known: It is 7%.

“T” is known: It is 100 (years) for acquisition projects and assumed 30 (years) for all other types of projects assessed in this section.

METHODOLOGY NOTE:

EXPECTED ANNUAL BENEFITS AND ITS RELATION TO YEARS UNTIL TOTAL BENEFITS ARE ACHIEVED

From the formula above, one notices that Expected Annual Benefits (EAB) is an *average*: The total value of benefits divided by a *number of years*.

By using FEMA’s discount rate (r) of 7%, and assuming a project’s useful life (T) of 100 years (for acquisition projects), deriving “Expected Annual Benefits” means dividing the total value of benefits (B) by just over 14 years (14.26925071 years).

Assuming a project’s useful life (T) is 50 years means dividing the value of total benefits (B) by just shy of 14 years (13.80074629 years).

Finally, assuming a project’s useful life (T) is 30 years means dividing the value of total benefits (B) by approximately 12 years (12.40904118 years).

In other words, within 12 to 14 years, a project’s annual benefits are expected to equal to its total benefits. Consequently, worrying about selecting projects begun from presidentially-declared disasters that occurred before FEMA-1407-DR (in 2002) is trivial. At the time of this writing, it has been eleven years (and will be close to twelve) years since the occurrence of FEMA-1407-DR and the beginning of mitigation actions applied for and funded from FEMA’s grant programs deriving from it.

Two: Determine the Number of Years between an Assessed Mitigation Project's Completion by FEMA (i.e., Closeout Date) and the Year that It Suffered under FEMA-1925-DR through FEMA-4057-DR (i.e. 2010-2012)

Having calculated a mitigation project's *annual* benefit that ultimately will serve as the "losses avoided," it is relevant to determine the number of years in between FEMA's conception of the completion of the mitigation project⁴⁷ being imagined as not ever having been pursued and the year in which this hypothetical project was affected by one of the "presidentially-declared" disasters covered under this 2013 enhanced portion of Kentucky's hazard mitigation plan (i.e. FEMA-1925-DR through FEMA-4057-DR).

The point of this step is to determine by how many times the Expected Annual Benefit (EAB) calculated above will be multiplied to derive the benefits presumed to have accrued from completing the project which would have been "lost" if said project indeed had never been pursued (i.e. was a "Mitigation Project Absent").

For example, we know from above that FEMA-1925-DR through FEMA-4057-DR "hit" certain counties within Kentucky in years 2010, 2011, and 2012. We know that an acquisition project whose properties *would have been affected* by FEMA-1925-DR in 2010 had the project not been pursued was, in fact, completed in 2006. It is important, then, to consider that these now-acquired properties *had they not been acquired in 2006* would have been susceptible to varying degrees of effects from hazards during the four (4) years leading up to and including the hypothetical properties being hit by FEMA-1925-DR. Thus, in this example, we have four (4) years of Expected Annual Benefits (EABs) that can be considered accrued due to the completion of this acquisition project in 2006. These are benefits that would have been "lost" had the acquisition project been "absent."

However, before we multiply the Expected Annual Benefits (EABs) of an assessed mitigation project by the number of years between its completion and its being hit by FEMA-1925-DR through FEMA-4057-DR, one more step is important:

⁴⁷ The individual mitigation action reports will record "project completion" dates where available. There can be a significant time lag in between when construction (or acquisition and demolition) of a mitigation action is completed and when that action is "closed-out" administratively by FEMA. For the sake both of providing the most conservative results and adhering to FEMA's definition of "complete" (i.e. "close-out"), loss avoidance calculations will rely upon the year in which the mitigation action was "closed out" as opposed to its recorded completion.

Three: Inflate (Deflate) Expected Annual Benefits

The Expected Annual Benefits need to be inflated before they can be summed the appropriate number of times between a mitigation project's completion and its being hit by FEMA-1925-DR through FEMA-4057-DR.

The use of the verb "summed" is relevant: If, for example, Expected Annual Benefits (EABs) to a mitigation project completed in 2006 is calculated at \$10,000 and if this project – had it been absent – would have been hit by FEMA-1925-DR in 2010, it is incorrect simply to *multiply* \$10,000 by four (4) years (i.e. \$40,000).

Rather, the "benefits" or "losses avoided" need to be displayed in constant dollar amounts. \$10,000 in 2006 is *not the same* as \$10,000 in 2010.

Given that the last "presidentially-declared" disaster to strike Kentucky before the publication of its most recent (2013) hazard mitigation plan occurred in March 2012, the "losses avoided" being reported here will be reflected in constant 2012 dollars.

Consequently, the need for summation: From the above example, \$10,000 in 2007 is inflated to 2012 dollars added to \$10,000 in 2008 that is inflated to 2012 dollars added to \$10,000 in 2009 that is inflated to 2012 dollars added to \$10,000 in 2010 that is inflated to 2012 dollars gives the "losses avoided" for a mitigation project completed in 2006 with Expected Annual Benefits of \$10,000 that was hit by FEMA-1925-DR in 2010.

One final consideration related to inflating the value of Expected Annual Benefit: There are actually two (2) rounds of inflation that occur. First, a project's Benefit-Cost Analysis is conducted *during the application stage* of that project. A mitigation project, once approved, can take two to three years to complete. This implies that there are differences between the monetary value calculated at the *beginning* of a mitigation project's life versus what would have been the monetary value if benefits had been calculated *upon completion* of the mitigation project two to three years later. This, then, counts as the "first round" of inflation: We will (for illustration) first calculate the present value of Expected Annual Benefits in the constant dollar terms of the *date in which a mitigation project is completed*.

Consider the above example: A mitigation project was completed in 2006 with Expected Annual Benefits (EABs) of \$10,000. If the 2006 completion date for this project represents the end of a three-year project, then the Expected Annual Benefit of \$10,000 actually was calculated in 2003 with the project's application. The \$10,000 will first be adjusted to 2006 dollars from 2003.

The "second round" of inflation occurs as discussed above: Adjust the adjusted Expected Annual Benefits to constant 2012 dollars per year and sum by the number of years in between project completion and its being affected by one of the "presidentially-declared" disasters to strike Kentucky between the years 2010 – 2012.

Finally, keeping in mind that only *benefits* are inflated here, costs for the mitigation actions are not adjusted for inflation. Costs are not adjusted because FEMA does not practice inflation-adjustment in reimbursement (project investment) of mitigation actions. FEMA approves a budget for a mitigation action and pays according to that nominal amount regardless the years between project approval and project completion⁴⁸. Benefits are rarely “paid” explicitly. The monetary value of benefits is symbolic. Thus, in order to accurately convey that symbol, the monetary value of benefits should be inflation-adjusted.

All inflation calculations are performed using the United States Department of Labor’s Bureau of Labor Statistics’ “CPI Inflation Calculator.” The tool can be found at the following web address: http://www.bls.gov/data/inflation_calculator.htm.

⁴⁸ This payment of a nominal amount is, of course, justified because FEMA is paying for materials, labor, and fees whose prices are *quoted* at the time of project approval. FEMA allows for inflation-adjustment to the budget after FEMA has approved a project. But, the adjustment has to be pre-approved.

Phase III:
Part II, Kentucky’s Methodology for Determining Losses Avoided:
Mitigation Action Idiosyncrasies

Above describes generally the methodology the Commonwealth of Kentucky uses to assess the final list of completed mitigation actions below.

However, there exist instances where the data available for a mitigation action will not allow strict adherence to the above general methodology. Further assumptions were necessary. The individual “losses avoided” reports below detail these assumptions and slight changes to the methodology when they arise.

Presented here is a brief overview of those mitigation action-specific changes. The changes will fall into the following three (3) categories:

Category I:

That a Mitigation Action Upon Application Had No Benefits Calculated

FEMA policy before and during 2007 did not require Benefit-Cost Analyses to be conducted during the application phase of a now-completed mitigation action if that then-proposed action involved properties located within an NFIP⁴⁹-designated (100-year) floodplain. Such then-proposed mitigation actions were deemed “cost-effective,” thus negating the need for a formal Benefit-Cost Analysis⁵⁰.

Without a formal Benefit-Cost Analysis, there are no recorded “benefits” for the mitigation actions from which this methodology would derive Expected Annual Benefits and subsequently derive a “losses-avoided” estimate.

In such cases, this methodology assumes, then, “cost-effectiveness” in the most minimal and conservative sense: The benefits from which Expected Annual Benefits will be calculated is equal to the costs recorded at the time of application for the mitigation action. In other words, this methodology assumes a Benefit-Cost Ratio (BCR) of 1.0.

⁴⁹ National Flood Insurance Program

⁵⁰ FEMA, beginning in 2013, has implemented a similar policy of assuming “cost-effectiveness” for proposed mitigation actions whose properties are located within an NFIP-designated floodway. However, now the “cost-effectiveness” assumption is based upon newly-available data about trends in calculated benefits nationwide that provide evidence for the assumption of “cost-effectiveness” within an NFIP-designated floodplain.

Category II:

That the Properties Covered Under a Mitigation Action Were “Substantially Damaged”

Related to the above category, one completed mitigation action assessed not only did not possess a formal Benefit-Cost Analysis (from which to derive Expected Annual Benefits and subsequent “losses avoided”), but the properties for which the mitigation action was completed also were all declared “substantially damaged.”

“Substantially damaged” is a specifically-defined term: From a hazard event (usually flooding), damages to a property are valued at 50% of the assessed value of that property. Thus, the property is considered “substantially damaged.”

In this case, this methodology uses the above definition of “substantially damaged” to assume the benefits from which this methodology’s “loss avoidance” estimates ultimately derive. It will assume a Benefit-Cost Ratio (BCR) of 1.5 *based upon the assessed values of the properties.*

Category III:

That Two Loss Avoidance Estimates Will Be Calculated

Further related to the above two categories, it will be relevant to calculate two estimates for “losses avoided” in order to be able to choose which one represents the most accurate estimate of “losses avoided” according to this methodology.

A mitigation action that involves multiple properties may or may not have benefits calculated for the action as a whole while the individual properties for which the mitigation action is being conducted do have benefits calculated. Alternatively, the benefits calculated for a mitigation action as a whole may have been calculated at a different time than the benefits calculated for individual properties for which that mitigation action is being implemented.

Consequently, it is relevant to look at “losses avoided” from the perspective of the mitigation action as a whole *and* using benefits calculated from individual properties in order to (subjectively) determine the most accurate “losses avoided” estimate.

FEMA-DR-1407-0002

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Harlan County</i>
Year Mitigation Action Was Applied For	<i>2002</i>
Approval Date	<i>January 1, 2003</i>
Project Completion Date	<i>Not Available</i>
"Close-Out" Date	<i>October 19, 2006</i>
Approved Amount to Spend for Mitigation Action	<i>\$1,040,960.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$928,894.72</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>5 Years</i>

Scope of Work

FEMA-DR-1407-0002 acquired and demolished twenty (20) properties that all were (a) located within a 100-year floodplain and (b) declared "substantially damaged."

Justification for the Mitigation Action

The twenty (20) properties acquired and demolished had been deemed "substantially damaged" from the effects of a previous flood event.

Note on Methodology

FEMA-DR-1407-0002 (and its individual properties) will have no Benefit-Cost Ratio (BCR) because each of the twenty (20) properties that were acquired under this mitigation action was deemed "substantially damaged." Benefit-Cost Analyses were and are not required for "substantially-damaged" structures.

The definition of "substantially damaged" is relevant for this analysis: "Substantially damaged" refers to damages that amount to 50% of the value of a property or structure.

This analysis uses this definition to infer a Benefit-Cost Ratio (BCR) from which benefits will be calculated and subsequently leading to the calculation of "Expected Annual Benefits" that will result in "losses avoided."

The logic used is as follows: This analysis assumes a Benefit-Cost Ratio (BCR) of 1.5 for the entire project. A BCR of 1.5 implies that the total benefits amount to 150% of the properties' values. This analysis assumes not only "cost-effectiveness" (i.e. a Benefit-Cost Ratio of 1.0), but also assumes avoidance from what made these properties

“substantially damaged,” i.e. that damages amounted to 50% of the properties’ assessed values.

A further point must be emphasized: That the definition of “substantially damaged” is being used to infer a Benefit-Cost Ratio means the definition must be used correctly. “Substantial damage” is damage amounting to 50% of *the assessed value* of a property. Normally, however, BCRs of acquisition-type mitigation actions are calculated using amounts that exceed *the assessed value* of a property (i.e. including the net present value of the cost of annual maintenance and the costs associated with demolishing the property once acquired).

The BCR for this analysis is the Benefit-Cost Ratio considering only the *assessed values* of the properties under this project. Keep in mind, however, that FEMA would have approved a budget and reimbursed for expenses that exceed simply the assessed values of the properties being acquired.

Tabulated below, then, is the list of twenty (20) properties acquired under FEMA-DR-1407-0002, their assessed values, and their benefits assuming a BCR of 1.5 using assessed values as the “costs” to a Benefit-“Cost” Analysis:

Table E-5-12: FEMA-DR-1407-0002 Assessed Values of Properties and Their Benefits Assuming “Substantial Damage” Benefit-Cost Ratio (BCR) of 1.5

<i>Property</i>	<i>Assessed Value (in \$ 2002)</i>	<i>Benefit-Cost Ratio</i>	<i>Benefits Calculated (in \$ 2002)</i>
1	\$24,500.00	1.5	\$36,750.00
2	\$72,000.00	1.5	\$108,000.00
3	\$67,500.00	1.5	\$101,250.00
4	\$16,500.00	1.5	\$24,750.00
5	\$16,000.00	1.5	\$24,000.00
6	\$76,500.00	1.5	\$114,750.00
7	\$59,500.00	1.5	\$89,250.00
8	\$34,000.00	1.5	\$51,000.00
9	\$32,500.00	1.5	\$48,750.00
10	\$42,000.00	1.5	\$63,000.00
11	\$34,500.00	1.5	\$51,750.00
12	\$35,000.00	1.5	\$52,500.00
13	\$67,500.00	1.5	\$101,250.00
14	\$56,500.00	1.5	\$84,750.00
15	\$61,500.00	1.5	\$92,250.00
16	\$47,500.00	1.5	\$71,250.00
17	\$18,500.00	1.5	\$27,750.00
18	\$30,000.00	1.5	\$45,000.00
19	\$35,000.00	1.5	\$52,500.00
20	\$12,500.00	1.5	\$18,750.00
Totals	\$839,500.00	1.5	\$1,259,250.00

FEMA-DR-1407-0002

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

Year Mitigation Action Was Applied For	2002
Benefit-Cost Ratio (BCR) at Time of Application	1.5 (of Assessed Value) (Substantially Damaged)
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$839,500.00
Mitigation Action Benefits Calculated at Time of Application	\$1,259,250.00
Year Mitigation Action was "Closed Out"	2006
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2002) (i.e. EAB at Time of Mitigation Action Application)	\$88,249.20
Expected Annual Benefits (EAB) (in \$ 2006) (i.e. EAB at Time of Mitigation Action "Close Out")	\$98,894.05
Expected Annual Benefits (EAB) (in \$ 2007)	\$101,710.76
Expected Annual Benefits (EAB) (in \$ 2008)	\$105,616.00
Expected Annual Benefits (EAB) (in \$ 2009)	\$105,240.24
Expected Annual Benefits (EAB) (in \$ 2010)	\$106,966.47
Expected Annual Benefits (EAB) (in \$ 2011)	\$110,342.89
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$696,671.04

Losses Avoided (LA) = EAB in 2007 + EAB in 2008 + EAB in 2009 + EAB in 2010
+ EAB in 2011

LA =

LA = \$529,876.36

Return on Investment (ROI) = \$529,876.36/\$696,671.04

ROI = 0.76 (76%)

FEMA-DR-1407-0002

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1407-0002 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) about five years after “close out” of the acquisitions in 2006. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit. This analysis is further assuming that in the four (4) years prior to FEMA-1976-DR, less severe but no less costly damages had occurred, thus justifying the addition of four additional years of inflation-adjusted Expected Annual Benefits.

Within five (5) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped just over three-quarters (76%) of its investment in FEMA-DR-1407-0002. Stated differently, for an investment of approximately \$697,000 intended to last 100 years, in five (5) years we can assume that this investment has already saved Harlan County approximately \$530,000 in damages.

FEMA-DR-1407-0005

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Bell County</i>
Year Mitigation Action Was Applied For	<i>2002</i>
Approval Date	<i>November 21, 2003</i>
Project Completion Date	<i>Not Available</i>
"Close-Out" Date	<i>March 11, 2010</i>
Approved Amount to Spend for Mitigation Action	<i>\$850,185.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$417,396.55</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-4008-DR, Declared July 25, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>1 Year</i>

Scope of Work

FEMA-DR-1407-0005 ultimately would acquire thirteen (13) properties located along the Cumberland River in Bell County, Kentucky and all located within a National Flood Insurance Program (NFIP)-designated floodway. The original scope of work involved thirty (30) properties. That seventeen (17) properties were excluded is discussed below.

Justification for the Mitigation Action

The thirty (30) properties from the original scope of work and the thirteen (13) properties eventually acquired were all justified as being within an NFIP-designated floodway. (As discussed below, some of the original thirty (30) properties later were deemed to not exist within such a floodway.)

Information About the Properties Acquired

The original scope-of-work for FEMA-DR-1407-0005 included thirty (30) properties. FEMA eventually would approve and approve budgets for only thirteen (13). Seventeen (17) properties were excluded for one or more of the following reasons:

1. Kentucky's Heritage Council (KHC) had determined that some of the properties may have needed to be included on the National Register of Historic Places.
2. The United States Army Corps of Engineers (USACE) found properties whose first-floor elevations (FFE) were above the ten-year flood elevation mark.
3. While it was presumed at the time of application that all thirty (30) original properties were located within an NFIP-designated floodway, then-new Flood Insurance Rate Maps (FIRMs) were used for this project that found that some of the properties were located just outside such designated floodways.

Note on Methodology

FEMA-DR-1407-0005 (and its individual properties) will have no Benefit-Cost Ratio (BCR) because each of the final thirteen (13) properties that were acquired under this mitigation action was located within an NFIP-designated floodway.

Prior to and throughout 2007, FEMA maintained a policy that properties located within an NFIP-designated floodway did not require a Benefit-Cost Analysis (BCA) (from which the calculations for “losses avoided” would derive).

In order to ensure the most conservative analysis, then, the benefits and “losses avoided” will reflect only “cost-effectiveness.” “Cost-effectiveness” here is defined as having a Benefit-Cost Ratio (BCR) of 1.0.

Tabulated below, then, is the list of the final thirteen (13) properties approved to be and acquired under FEMA-DR-1407-0005, their assessed values, their amount from the project’s file assumed to derive a BCR of 1.0, and their subsequent “benefits” (which will be equal to the amount assumed to derive the BCR of 1.0):

Table E-5-13: FEMA-DR-1407-0005: Final 13 Properties Acquired and Their Benefits Assuming “Cost-Effectiveness”

<i>Property</i>	<i>Assessed Value</i>	<i>Benefit-Cost Ratio (BCR)</i>	<i>Amount Used to Determine BCR</i>	<i>Benefits Deriving from BCR</i>
1	\$28,000.00	1.0	\$32,000.00	\$32,000.00
2	\$14,500.00	1.0	\$31,000.00	\$31,000.00
3	\$2,000.00	1.0	\$34,000.00	\$34,000.00
4	Not Available	1.0	\$6,500.00	\$6,500.00
5	\$1,500.00	1.0	\$6,500.00	\$6,500.00
6	\$24,400.00	1.0	\$33,000.00	\$33,000.00
7	Not Available	1.0	\$18,500.00	\$18,500.00
8	\$3,900.00	1.0	\$18,000.00	\$18,000.00
9	\$17,000.00	1.0	\$25,000.00	\$25,000.00
10	\$21,000.00	1.0	\$52,000.00	\$52,000.00
11	\$8,000.00	1.0	\$25,000.00	\$25,000.00
12	\$20,000.00	1.0	\$22,000.00	\$22,000.00
13	Not Available	1.0	\$65,000.00	\$65,000.00
Totals	N/A	1.0	\$368,500.00	\$368,500.00

FEMA-DR-1407-0005

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

Year Mitigation Action Was Applied For	2002
Benefit-Cost Ratio (BCR) at Time of Application	1.0 (Cost-Effectiveness)
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$368,500.00
Mitigation Action Benefits Calculated at Time of Application	\$368,500.00
Year Mitigation Action was "Closed Out"	2010
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2002) (i.e. EAB at Time of Mitigation Action Application)	\$25,824.76
Expected Annual Benefits (EAB) (in \$ 2010) (i.e. EAB at Time of Mitigation Action "Close Out")	\$31,302.08
Expected Annual Benefits (EAB) (in \$ 2011)	\$32,290.14
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$313,047.41

Losses Avoided (LA) = EAB in 2011

LA = \$32,290.14

LA = \$32,290.14

Return on Investment (ROI) = \$32,290.14/\$313,047.41

ROI = 0.10 (10%)

FEMA-DR-1407-0005

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1407-0005 was hit by one (1) “presidentially-declared” disaster (FEMA-4008-DR) just outside one (1) year after “close out” of the acquisitions in March of 2010. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-4008-DR hit.

For one (1) year, then, from a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 10% of its investment in FEMA-DR-1407-0005. Stated differently, for an investment of approximately \$313,000 intended to last 100 years, in one (1) year we can assume that this investment has already saved Bell County approximately \$32,000 in damages.

Further, bear in mind that this “losses avoided” estimate (and its subsequent return on investment) represents a very conservative interpretation of this mitigation action’s benefits. Assuming mere “cost-effectiveness” (i.e. a Benefit-Cost Ratio of 1.0) allowed benefits that did not equal what FEMA in the end spent on the mitigation action, much less the more than double the amount that FEMA initially approved for the action. The “losses avoided” likely is an underestimation.

FEMA-DR-1407-0009

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Christian</i>
Year Mitigation Action Was Applied For	<i>2002</i>
Approval Date	<i>November 21, 2003</i>
Project Completion Date	<i>February 3, 2005</i>
"Close-Out" Date	<i>September 18, 2006</i>
Approved Amount to Spend for Mitigation Action	<i>\$382,395</i>
Actual Amount Spent for the Mitigation Action	<i>\$309,405.25</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>5 Years</i>

Scope of Work

FEMA-DR-1407-0009 mitigated flood hazard to six residences located within a FEMA designated floodway by acquiring and demolishing six residential structures.

Justification for the Mitigation Action

The six properties were determined to be within a floodplain according to FEMA information.

Note on Methodology

FEMA-DR-1407-0009 (and its individual properties) will have no Benefit-Cost Ratio (BCR) because each of the six (6) properties that were acquired under this mitigation action was located within an NFIP-designated floodway at a time when FEMA policy did not require Benefit-Cost Analyses (BCAs) to be conducted for properties in these locations.

For the sake of providing the most conservative "loss avoidance" that can be justified without being arbitrary, this analysis assumed only "cost-effectiveness." "Cost-effectiveness" is defined here as a Benefit-Cost Ratio of 1.0.

Tabulated below, then, is the list of six (6) properties acquired under FEMA-DR-1407-0009, their assessed values, and their benefits assuming a BCR of 1.0:

Table E-5-14: FEMA-DR-1407-0002 Assessed Values of Properties and Their Benefits Assuming “Substantial Damage” Benefit-Cost Ratio (BCR) of 1.5

<i>Property</i>	<i>Assessed Value (in \$ 2002)</i>	<i>Value Used to Determine BCR</i>	<i>Benefit-Cost Ratio</i>	<i>Benefits Calculated (in \$ 2002)</i>
1	\$46,350.00	\$50,400	1.0	\$50,400
2	\$45,180.00	\$46,500	1.0	\$46,500
3	\$61,020.00	\$42,500	1.0	\$42,500
4	\$61,335.00	\$49,300	1.0	\$49,300
5	\$43,200.00	\$44,500	1.0	\$44,500
6	\$54,000.00	\$45,100	1.0	\$45,100
Totals	\$311,085	\$278,300	1.0	\$278,300

FEMA-DR-1407-0009

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

Year Mitigation Action Was Applied For	2002
Benefit-Cost Ratio (BCR) at Time of Application	1.0 (Cost-Effectiveness)
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$278,300
Mitigation Action Benefits Calculated at Time of Application	\$278,300
Year Mitigation Action was "Closed Out"	2006
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2002) (i.e. EAB at Time of Mitigation Action Application)	\$19,503.48
Expected Annual Benefits (EAB) (in \$ 2006) (i.e. EAB at Time of Mitigation Action "Close Out")	\$21,856.04
Expected Annual Benefits (EAB) (in \$ 2007)	\$22,478.55
Expected Annual Benefits (EAB) (in \$ 2008)	\$23,341.62
Expected Annual Benefits (EAB) (in \$ 2009)	\$23,258.58
Expected Annual Benefits (EAB) (in \$ 2010)	\$23,640.08
Expected Annual Benefits (EAB) (in \$ 2011)	\$24,386.29
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$232,053.94

Losses Avoided (LA) = EAB in 2007 + EAB in 2008 + EAB in 2009 + EAB in 2010
+ EAB in 2011

LA = \$22,478.55+\$23,341.62+\$23,258.58+\$23,640.08+\$24,386.29

LA = \$117,105.12

Return on Investment (ROI) = \$117,105.12/\$232,053.95

ROI = 0.51 (51%)

FEMA-DR-1407-0009

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1407-0009 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) about five (5) years after “close out” of the acquisitions in 2006. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-DR-FEMA-1976-DR hit. This analysis is further assuming that in the four (4) years prior to FEMA-1976-DR, less severe but no less costly damages had occurred, thus justifying the addition of four additional years of inflation-adjusted Expected Annual Benefits.

Within five (5) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped just over half (51%) of its investment in FEMA-DR-1407-0009. Stated differently, for an investment of approximately \$232,000 intended to last 100 years, in five (5) years we can assume that this investment has already saved Christian County approximately \$117,000 in damages.

FEMA-DR-1407-0010

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Boyd County</i>
Year Mitigation Action Was Applied For	<i>2002</i>
Approval Date	<i>May 30, 2004</i>
Project Completion Date	<i>Not Available</i>
"Close-Out" Date	<i>January 8, 2007</i>
Approved Amount to Spend for Mitigation Action	<i>\$543,000.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$448,899.43</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>4 Years</i>

Scope of Work

FEMA-DR-1407-0010 acquired, demolished, and cleared nine (9) properties in Boyd County, Kentucky that had been flooded repeatedly.

Justification for the Mitigation Action

The properties included in FEMA-DR-1407-0010 had experienced repeated and damaging instances of flooding in 1996, 1997, 2000, 2001, and 2002.

Note on Methodology

This analysis will derive two (2) separate estimates of "losses avoided" for FEMA-DR-1407-0010: It will calculate the "losses avoided" (and subsequent return on investment) for the mitigation action as a whole and it will calculate the "losses avoided" using Benefit-Cost Ratios (BCRs) and costs broken down by the individual properties involved in this project.

FEMA-DR-1407-0010

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action as a Whole

Year Mitigation Action Was Applied For	2002
Benefit-Cost Ratio (BCR) at Time of Application	3.14
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$543,000.00
Mitigation Action Benefits Calculated at Time of Application	\$1,705,020.00
Year Mitigation Action was "Closed Out"	2007
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2002) (i.e. EAB at Time of Mitigation Action Application)	\$119,489.11
Expected Annual Benefits (EAB) (in \$ 2007) (i.e. EAB at Time of Mitigation Action "Close Out")	\$137,716.01
Expected Annual Benefits (EAB) (in \$ 2008)	\$143,003.69
Expected Annual Benefits (EAB) (in \$ 2009)	\$142,494.91
Expected Annual Benefits (EAB) (in \$ 2010)	\$144,832.23
Expected Annual Benefits (EAB) (in \$ 2011)	\$149,403.90
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$336,674.57

Losses Avoided (LA) = EAB in 2008 + EAB in 2009 + EAB in 2010 + EAB in 2011

LA = \$143,003.69 + \$142,494.91 + \$144,832.23 + \$149,403.90

LA = \$579,734.73

Return on Investment (ROI) = \$579,734.73/\$336,674.57

ROI = 1.72 (172%)

Alternate Losses Avoided: Per Acquired Structure

Given that FEMA-DR-1407-0010 is an acquisition/demolition, the value of “losses avoided” and FEMA’s subsequent “return on investment (ROI)” may look differently if we evaluate the properties individually.

Table E-5-15: FEMA-DR-1407-0010 Losses Avoided Using Individual Property Data

Property	Assessed Value	Amount Expected ⁵¹ to Acquire (in 2002)	Benefit-Cost Ratio (BCR)	Total Benefits (in \$ 2002)	Expected Annual Benefits (EAB) (in \$ 2002)	EAB (in \$ 2007)	FEMA's Project Investment (PI)
1	\$97,500.00	\$107,050.00	2.05	\$219,452.50	\$15,379.40	\$17,725.38	\$80,287.50
2	\$54,600.00	\$64,150.00	0.39	\$25,018.50	\$1,753.32	\$2,020.77	\$48,112.50
3	\$125,450.00	\$135,000.00	2.05	\$276,750.00	\$19,394.85	\$22,353.35	\$101,250.00
4	\$35,750.00	\$45,300.00	6.72	\$304,416.00	\$21,333.71	\$24,587.96	\$33,975.00
5	\$40,690.00	\$50,240.00	3.83	\$192,419.20	\$13,484.88	\$15,541.87	\$37,680.00
6	\$48,880.00	\$58,430.00	1.66	\$96,993.80	\$6,797.40	\$7,834.28	\$43,822.50
7	\$70,200.00	\$79,750.00	1.00	\$79,750.00	\$5,588.94	\$6,441.48	\$59,812.50
8	\$150,800.00	\$160,350.00	1.19	\$190,816.50	\$13,372.57	\$15,412.43	\$120,262.50
9	\$32,240.00	\$41,790.00	2.54	\$106,146.60	\$7,438.83	\$8,573.55	\$31,342.50
FEMA's Project Investment Total							\$556,545.00

Table E-5-15 (Cont.): FEMA-DR-1407-0010 Losses Avoided Using Individual Property Data

Property	I: EAB (in \$ 2008)	II: EAB (in \$ 2009)	III: EAB (in \$ 2010)	IV: EAB (in \$ 2011)	V: Losses Avoided (I + II + III + IV)	ROI: VI/PI
1	\$18,405.95	\$18,340.47	\$18,641.30	\$19,229.72	\$74,618.44	0.93
2	\$2,098.36	\$2,090.90	\$2,125.19	\$2,192.27	\$8,508.72	0.18
3	\$23,211.61	\$23,129.03	\$23,508.41	\$24,250.46	\$94,102.51	0.93
4	\$25,532.03	\$25,441.19	\$25,858.50	\$26,674.73	\$103,510.45	3.05
5	\$16,138.61	\$16,081.19	\$16,344.96	\$16,860.90	\$65,430.66	1.74
6	\$8,135.08	\$8,106.14	\$8,239.10	\$8,499.17	\$32,985.49	0.75
7	\$6,688.80	\$6,665.01	\$6,774.33	\$6,988.16	\$27,123.30	0.45
8	\$16,004.19	\$15,947.25	\$16,208.83	\$16,720.47	\$64,888.74	0.54
9	\$8,902.74	\$8,871.06	\$9,016.57	\$9,301.18	\$36,100.55	1.15
Total Losses Avoided					\$507,268.86	0.91 (91%)

⁵¹ The use of the word “expected” is purposeful: These were the costs to acquire used in order to calculate the Benefit-Cost Ratio (BCR). Multiplying the BCR by these numbers gives the total benefits for the property “expected.” Further, this expected amount to be paid to acquire the nine (9) properties is what was actually paid for the acquisitions. Thus, FEMA’s project investment (PI) is 75% of these values.

FEMA-DR-1407-0010

III: Loss Avoidance Interpretation

Of the two displays of loss avoidance results, in this specific case, the method calculating the losses avoided from the project as a whole is the most accurate.

This is rare that looking at the project as a whole would provide more accurate losses avoided than looking at individual projects. The usual problem with calculating losses avoided using the methodology of this report and acquisition projects as a whole involves the sometime dramatic changes that occur in between the approval of an acquisition mitigation action and the implementation of it. Benefits for the overall acquisition project are calculated *before approval* of the project. However, if during the implementation of the project, owners of their homes decide not to sell, or a different grant funds the acquisitions of properties originally included in the FEMA-approved project, or different properties are added (while other subtracted), the *overall* project does not get a new Benefit-Cost Analysis performed. Rather, the individual properties are assessed for their benefits minus their costs.

In FEMA-DR-1407-0010's case, however, any changes to the amount or distribution of properties occurred *before* FEMA approved the project. In other words, the approved budget and the amount FEMA finally spent reflect the acquisitions that actually occurred.

Correspondence within the FEMA-DR-1407-0010 file recorded that, *prior to approval* a couple of the nine (9) properties were excluded. What is not clear from the file is whether those excluded properties were acquired or demolished using other sources of funds.

Thus, the interpretation of the loss-avoidance results:

FEMA-DR-1407-0010 was hit by one "presidentially-declared" disaster (FEMA-1976-DR) about four (4) years after "close out" of the acquisition in 2007. We know, then, that we can expect the inflated Expected Annual Benefit to apply 2011 when FEMA-1976-DR hit. This analysis is further assuming that between 2008 and 2011, less severe but no less costly damages were occurring yearly, thus justifying the addition of three (3) more years of inflation-adjusted Expected Annual Benefits.

Within four (4) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped over 100% of its investment in FEMA-DR-1407-0010. Stated differently, for an investment of approximately \$337,000 intended to last 100 years, in just four (4) years we can assume that this investment has already saved Boyd County almost double that investment at approximately \$580,000.

FEMA-DR-1454-0004

I: Summary of Mitigation Action

Mitigation Action Type	<i>(Landslide) Acquisition/Demolition</i>
County in which Completed	<i>Lewis County</i>
Year Mitigation Action Was Applied For	<i>2004</i>
Approval Date	<i>May 3, 2004</i>
Project Completion Date	<i>July 22, 2005</i>
"Close-Out" Date	<i>October 26, 2006</i>
Approved Amount to Spend for Mitigation Action	<i>\$147,200.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$145,274.54</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1925-DR, Declared July 23, 2010</i> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>5 Years</i>

Scope of Work

FEMA-DR-1454-0004 acquired, demolished, and cleared four (4) homes in Lewis County, Kentucky that had been consistently and adversely affected by landslides

Justification for the Mitigation Action

The four (4) properties had been considered by the United States Geological Survey (USGS) to be within a "moderate landslide area." Further, at the time of mitigation action application, the properties had been affected by two (2) previous "presidentially-declared" disasters that had occurred within six (6) months of each other.

FEMA-DR-1454-0004

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action as a Whole

Year Mitigation Action Was Applied For	2004
Benefit-Cost Ratio (BCR) at Time of Application	1.67
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$147,200.00
Mitigation Action Benefits Calculated at Time of Application	\$246,480.00
Year Mitigation Action was "Closed Out"	2006
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2004) (i.e. EAB at Time of Mitigation Action Application)	\$17,273.51
Expected Annual Benefits (EAB) (in \$ 2006) (i.e. EAB at Time of Mitigation Action "Close Out")	\$18,861.72
Expected Annual Benefits (EAB) (in \$ 2007)	\$19,398.95
Expected Annual Benefits (EAB) (in \$ 2008)	\$20,143.78
Expected Annual Benefits (EAB) (in \$ 2009)	\$20,072.11
Expected Annual Benefits (EAB) (in \$ 2010)	\$20,401.35
Expected Annual Benefits (EAB) (in \$ 2011)	\$21,045.32
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$108,955.91

Losses Avoided (LA) = EAB in 2007 + EAB in 2008 + EAB in 2009 + EAB in 2010
+ EAB in 2011

LA = \$19,398.95 + \$20,143.78 + \$20,072.11 + \$20,401.35 + \$21,045.32

LA = \$101,061.51

Return on Investment (ROI) = \$101,061.51/\$108,955.91

ROI = 0.93 (93%)

Alternate Losses Avoided: Per Acquired Structure

Table E-5-16: FEMA-DR-1454-0004 Losses Avoided Using Individual Property Data

Property	Assessed Value ⁵²	Amount Expected to Acquire (in 2004)	Benefit-Cost Ratio (BCR)	Total Benefits (in \$ 2004)	Expected Annual Benefits (EAB) (in \$ 2004)	FEMA's Project Investment (PI)
1	\$20,000.00	\$26,000.00	2.94	\$76,440	\$5,356.97	\$19,500.00
2	\$30,300.00	\$37,300.00	1.51	\$56,323	\$3,947.16	\$27,975.00
3	\$11,000.00	\$15,000.00	3.40	\$51,000	\$3,574.12	\$11,250.00
4	\$45,000.00	\$51,500.00	1.22	\$62,830	\$4,403.17	\$38,625.00
FEMA's Project Investment Total						\$97,350.00

Table E-5-16 (Cont.): FEMA-DR-1454-0004 Losses Avoided Using Individual Property Data

Property	EAB (in \$ 2006)	I: EAB (in \$ 2007)	II: EAB (in \$ 2008)	III: EAB (in \$ 2009)	IV: EAB (in \$ 2010)	V: EAB (in \$ 2011)	VI: Losses Avoided (I + II + III + IV + V)	ROI: VI/PI
1	\$5,717.13	\$5,879.96	\$6,105.73	\$6,084.00	\$6,183.80	\$6,378.99	\$30,632.48	1.57
2	\$4,212.53	\$4,332.51	\$4,498.86	\$4,482.86	\$4,556.39	\$4,700.21	\$22,570.83	0.81
3	\$3,814.41	\$3,923.06	\$4,073.68	\$4,059.19	\$4,125.77	\$4,256.00	\$20,437.70	1.82
4	\$4,699.20	\$4,833.04	\$5,018.61	\$5,000.76	\$5,082.78	\$5,243.22	\$25,178.41	0.65
Total Losses Avoided							\$98,819.42	0.91 (91%)

⁵² The assess values of these four (4) properties would be reassessed during the implementation of this mitigation action. The reassessed values became, respectively: \$32,000; \$18,000; \$7,500; \$66,000. The reassessed values were reflected in FEMA-DR-1454-0004's "close-out" documents

⁵³ The use of the word "expected" is purposeful: These were the costs to acquire used in order to calculate the Benefit-Cost Ratio (BCR). Multiplying the BCR by these numbers gives the total benefits for the property "expected." Further, this expected amount to be paid to acquire the four (4) properties is what was actually paid for the acquisitions. Thus, FEMA's project investment (PI) is 75% of these values.

FEMA-DR-1454-0004

III: Loss Avoidance Interpretation

Of the two displays of loss avoidance results, in this specific case, the method calculating the losses avoided from the project as a whole is the most accurate: More imputation and assumption-making was involved in calculating the losses avoided for the individual properties.

This is rare that looking at the project as a whole would provide more accurate losses avoided than looking at individual projects. The usual problem with calculating losses avoided using the methodology of this report and acquisition projects as a whole involves the sometime dramatic changes that occur in between the approval of an acquisition mitigation action and the implementation of it. Benefits for the overall acquisition project are calculated *before approval* of the project. However, if during the implementation of the project, owners of their homes decide not to sell, or a different grant funds the acquisitions of properties originally included in the FEMA-approved project, or different properties are added (while other subtracted), the *overall* project does not get a new Benefit-Cost Analysis performed. Rather, the individual properties are assessed for their benefits minus their costs.

FEMA-DR-1454-0004 acquired the same properties approved from the overall mitigation action. Granted, per the footnote, the assessed values of the properties changed; but, this did not affect overall benefits. FEMA approved \$147,200 and paid 75% of \$145,274.54. The benefits were based on the effects from four (4) properties that were indeed acquired from this FEMA-funded mitigation action. In this case, it was far less clear the situation with individual payments (and thus the distribution of benefits and costs) for the individual properties.

Thus, the interpretation of the loss-avoidance results:

FEMA-DR-1454-0004 was hit by two (2) “presidentially-declared” disasters (FEMA-1925-DR and FEMA-1976-DR) in less than four (4) years after “close out” of the acquisition in 2006. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2010 and 2011 when FEMA-1925-DR and FEMA-1976-DR hit. This analysis is further assuming that between 2007 and 2010, less severe but no less costly damages were occurring yearly, thus justifying the addition of three (3) more years of inflation-adjusted Expected Annual Benefits.

Within five (5) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 93% of its investment in FEMA-DR-1454-0004. Stated differently, for an investment of approximately \$108,000 intended to last 100 years, in just five years we can assume that this investment has already saved Lewis County approximately \$101,000 in damages.

FEMA-DR-1454-0008

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Fleming County</i>
Year Mitigation Action Was Applied For	<i>2004</i>
Approval Date	<i>June 2, 2005</i>
Project Completion Date	<i>February 28, 2008</i>
"Close-Out" Date	<i>January 22, 2009</i>
Approved Amount to Spend for Mitigation Action	<i>\$129,027.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$125,078.00</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>2 Years</i>

Scope of Work

FEMA-DR-1454-0008 acquired and demolished one (1) flood-prone critical facility, a volunteer firehouse.

Justification for the Mitigation Action

The property acquired under FEMA-DR-1454-0008 was a volunteer fire department's building that had been flooded six (6) times between 1989 and the time of application. Further, the building that was acquired represented a critical facility. This assumed that any amount of flooding or general detriment to functionality had dramatic consequences for Fleming County. Anytime it flooded, the fire department in Fleming County was unable to provide its services effectively.

Information about the Property that Was Acquired

<i>Property Acquired</i>	<i>Assessed Value</i>
Muses Mill Fire Department	\$124,283.00

FEMA-DR-1454-0008

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

This acquisition project involved only one (1) property. Thus, the losses avoided for the mitigation action “as a whole” is equivalent to looking at the mitigation action from the standpoint of its individual properties.

Year Mitigation Action Was Applied For	2004
Benefit-Cost Ratio (BCR) at Time of Application	1.06
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$129,027.00
Mitigation Action Benefits Calculated at Time of Application	\$138,210.00
Year Mitigation Action was “Closed Out”	2009
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2004) (i.e. EAB at Time of Mitigation Action Application)	\$9,731.41
Expected Annual Benefits (EAB) (in \$ 2009) (i.e. EAB at Time of Mitigation Action “Close Out”)	\$11,052.13
Expected Annual Benefits (EAB) (in \$ 2010)	\$11,233.42
Expected Annual Benefits (EAB) (in \$ 2011)	\$11,588.00
FEMA’s Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$93,808.50

$$\text{Losses Avoided (LA)} = \text{EAB in 2010} + \text{EAB in 2011}$$

$$\text{LA} = \$11,233.42 + \$11,588.00$$

$$\text{LA} = \mathbf{\$22,821.42}$$

$$\text{Return on Investment (ROI)} = \$22,821.42 / \$93,808.50$$

$$\text{ROI} = \mathbf{0.24 (24\%)}$$

FEMA-DR-1454-0008

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1454-0008 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) approximately two (2) years after “close out” of the acquisition in 2009. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-DR-FEMA-1976-DR hit. This analysis is further assuming that in the year before FEMA-1976-DR, less severe but no less costly damages were occurring yearly, thus justifying the addition of one (1) more year of inflation-adjusted Expected Annual Benefits.

Within two (2) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 24% of its investment in FEMA-DR-1454-0008. Stated differently, for an investment of approximately \$94,000 intended to last 100 years, in two years we can assume that this investment has already saved Fleming County approximately \$23,000 in damages.

FEMA-DR-1454-0011

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Jefferson County</i>
Year Mitigation Action Was Applied For	<i>2004</i>
Approval Date	<i>November 18, 2005</i>
Project Completion Date	<i>October 31, 2006</i>
"Close-Out" Date	<i>March 20, 2007</i>
Approved Amount to Spend for Mitigation Action	<i>\$728,731.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$726,827.33</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>4 Years</i>

Scope of Work

FEMA-DR-1454-0011 acquired six (6) properties located in Jefferson County, Kentucky.

Justification for the Mitigation Action

Four (4) of the six (6) properties acquired and demolished were located within the 100-year floodplain. The remaining two (2) properties were near wetlands and were characterized by extremely flat topography with no drainage system.

Information About the Properties That Were Acquired and Note on Methodology

FEMA-DR-1454-0011 as a whole will have no Benefit-Cost Ratio (BCR) because, per FEMA policy at the time, a Benefit-Cost Analysis would not have been required at the time of application for this acquisition/demolition project located within a floodway.

Consequently, this mitigation action assessment will assume only "cost-effectiveness." "Cost-effectiveness" is defined here by a BCR of 1.0.

However, FEMA-DR-1454-0011 is unique in that, while the project as a whole did not require Benefit-Cost Analyses, two (2) of the four (4) properties within the project *did* require Benefit-Cost Analyses because they were not within Jefferson County's floodway. Consequently, these two (2) properties *will have* Benefit-Cost Ratios (BCRs).

From this, the analysis of FEMA-DR-1454-0011 will be conducted in two (2) ways: The first analyzes the project as a whole; the second looks at the individual properties.

FEMA-DR-1454-0011

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action as a Whole

FEMA-DR-1454-0011 acquired six (6) properties; four (4) of which were located within a 100-year floodplain. Mitigation actions funded from Hazard Mitigation Grant Program (HMGP) grants deriving from “presidentially-declared” disasters that occurred before declaration of FEMA-DR-1703 in May of 2007 did not require Benefit-Cost Analyses to be conducted for mitigation actions protecting structures and populations within a 100-year floodplain. In other words, per FEMA policy, mitigation actions pursued in order to protect structures and populations within a 100-year floodplain did not require Benefit-Cost Analyses before 2007. This mitigation action was approved in 2004. Consequently, for the overall project, and to convey the most conservative losses-avoided calculation, only “cost-effectiveness” was assumed. “Cost-Effectiveness” is synonymous with a Benefit-Cost Ratio (BCR) of 1.0.

Year Mitigation Action Was Applied For	2004
Benefit-Cost Ratio (BCR) at Time of Application	1.0 (Cost-Effectiveness)
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$728,731.00
Mitigation Action Benefits Calculated at Time of Application	\$728,731.00
Year Mitigation Action was Completed	2007
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2004) (i.e. EAB at Time of Mitigation Action Application)	\$51,070.03
Expected Annual Benefits (EAB) (in \$ 2007) (i.e. EAB at Time of Mitigation Action “Close Out”)	\$56,055.91
Expected Annual Benefits (EAB) (in \$ 2008)	\$58,208.21
Expected Annual Benefits (EAB) (in \$ 2009)	\$58,001.12
Expected Annual Benefits (EAB) (in \$ 2010)	\$58,952.50
Expected Annual Benefits (EAB) (in \$ 2011)	\$60,813.35
FEMA’s Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$545,120.50

Losses Avoided (LA) = EAB in 2008 + EAB in 2009 + EAB in 2010 + EAB in 2011

LA = \$56,055.91 + \$58,001.12 + \$58,952.50 + \$60,813.35

LA = \$233,822.88

Return on Investment (ROI) = \$233,822.88/\$545,120.50

ROI = 0.43 (43%)

Alternate Losses Avoided: Per Acquired Structure

Table E-5-17: FEMA-DR-1454-0011 Losses Avoided Using Individual Property Data

<i>Property</i>	<i>Assessed Value</i>	<i>Amount Approved to Acquire (in 2004)</i>	<i>Benefit-Cost Ratio (BCR)</i>	<i>Total Benefits (in \$ 2004)</i>	<i>Expected Annual Benefits (EAB) (in \$ 2004)</i>	<i>FEMA's Project Investment (PI)⁵⁴</i>
1	\$153,000.00	\$166,350	1.0 (Cost-Effectiveness)	\$166,350.00	\$11,657.94	\$124,762.50
2	\$108,000.00	\$118,475	1.0 (Cost-Effectiveness)	\$118,475.00	\$8,302.82	\$88,856.25
3	\$108,000.00	\$117,163	1.0 (Cost-Effectiveness)	\$117,163.00	\$8,210.87	\$87,872.25
4	\$104,000.00	\$111,818	1.0 (Cost-Effectiveness)	\$111,818.00	\$7,836.29	\$83,863.50
5	\$105,000.00	\$114,900	1.44	\$165,456.00	\$11,595.28	\$86,175.00
6	\$81,000.00	\$100,025	1.09	\$109,027.25	\$7,640.71	\$75,018.75
FEMA's Project Investment Total						\$546,548.25

Table E-5-17 (Cont.): FEMA-DR-1454-0011 Losses Avoided Using Individual Property Data

<i>Property</i>	<i>I: EAB (in \$ 2008)</i>	<i>II: EAB (in \$ 2009)</i>	<i>III: EAB (in \$ 2010)</i>	<i>IV: EAB (in \$ 2011)</i>	<i>V: Losses Avoided (I + II + III + IV)</i>	<i>ROI: V/PI</i>
1	\$13,287.40	\$13,240.13	\$13,457.30	\$13,882.08	\$53,866.91	0.43
2	\$9,463.32	\$9,429.65	\$9,584.32	\$9,886.86	\$38,364.15	0.43
3	\$9,358.52	\$9,325.22	\$9,478.18	\$9,777.37	\$37,939.29	0.43
4	\$8,931.59	\$8,899.81	\$9,045.79	\$9,331.33	\$36,208.52	0.43
5	\$13,215.98	\$13,168.96	\$13,384.97	\$13,807.47	\$53,577.38	0.62
6	\$8,708.67	\$8,677.69	\$8,820.02	\$9,098.43	\$35,304.81	0.47
Total Losses Avoided					\$255,261.06	0.47 (47%)

⁵⁴ These amounts technically will be inaccurate: FEMA's Project Investment here ends up being 75% of the amount *approved* to acquire the properties rather than 75% of the amount that *was actually spent*. However, it is assumed here that using these values causes little harm: Overall, there was a \$1,903.67 difference between the amount approved for the mitigation action and the amount spent. Further, the difference was an "under-run." Consequently, using values based upon the higher approved amount only makes the Loss Avoidance results more conservative.

FEMA-DR-1454-0011

III: Loss Avoidance Interpretation

Of the two results in calculating “losses avoided,” the second result is the most accurate: In order to derive a value for “losses avoided” as a whole, this analysis had to assume a very conservative set of benefits from which to derive Expected Annual Benefits that would be inflated and summed to provide a conception of “losses avoided” thus far within the project’s useful life. This analysis assumed only “cost-effectiveness,” or a Benefit-Cost Ratio of 1.0.

However, that when this mitigation action is broken down into the properties that it covered, two (2) of the six (6) properties required a Benefit-Cost Analysis to be conducted. This means, that the “losses avoided” results deriving from this is more accurate: This analysis only had to assumed a Benefit-Cost Ratio of 1.0 for four (4) of the six (6) properties; we actually had data for two (2) of the six (6).

Thus, the interpretation of the loss-avoidance results:

FEMA-DR-1454-0011 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) approximately four (4) years after “close out” of the acquisition in 2007. We know, then, that we can expect the inflated Expected Annual Benefit to apply 2011 when FEMA-1976-DR hit. This analysis is further assuming that between 2008 and 2011, less severe but no less costly damages were occurring yearly, thus justifying the addition of three more years of inflation-adjusted Expected Annual Benefits.

Within four (4) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped almost 50% of its investment in FEMA-DR-1454-0011. Stated differently, for an investment of approximately \$547,000 intended to last 100 years, in just four (4) years we can assume that this investment has already saved Jefferson County about \$255,000.

FEMA-DR-1454-0012

I: Summary of Mitigation Action

Mitigation Action Type	<i>Sewer Lift Station Relocation</i>
County in which Completed	<i>Ballard County</i>
Year Mitigation Action Was Applied For	<i>2004</i>
Approval Date	<i>September 28, 2006</i>
Project Completion Date	<i>December 8, 2008</i>
"Close-Out" Date	<i>April 29, 2009</i>
Approved Amount to Spend for Mitigation Action	<i>\$439,687</i>
Actual Amount Spent for the Mitigation Action	<i>\$439,686.31</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>2 Year</i>

Scope of Work

FEMA-DR-1454-0012 acquired and demolished a sewer lift station in the City of Wickliffe that was prone to flooding. FEMA-DR-1454-0012 designed and constructed a replacement sewer lift station and replaced 1,000 linear feet of sanitary sewage line and sewage mains. The mitigation action also installed a grinder system.

Justification for the Mitigation Action

Several high-water events had occurred within the City of Wickliffe in Ballard County that had left the sewer lift station unable to operate. To illustrate the extent of high-water events to have occurred in the City of Wickliffe prior to completion of FEMA-DR-1454-0012, the City of Wickliffe historically has been hit by almost every "presidentially-declared" disaster in Kentucky since at least 2007.

FEMA-DR-1454-0012

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

Year Mitigation Action Was Applied For	2004
Benefit-Cost Ratio (BCR) at Time of Application	4.86
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$400,000.00
Mitigation Action Benefits Calculated at Time of Application	\$1,943,823.00
Year Mitigation Action was "Closed Out"	2009
Mitigation Action Years of Useful Life (T)	50 Years ⁵⁵
Expected Annual Benefits (EAB) (in \$ 2004) (i.e. EAB at Time of Mitigation Action Application)	\$140,849.12
Expected Annual Benefits (EAB) (in \$ 2009) (i.e. EAB at Time of Mitigation Action "Close Out")	\$159,964.78
Expected Annual Benefits (EAB) (in \$ 2010)	\$162,588.65
Expected Annual Benefits (EAB) (in \$ 2011)	\$167,720.81
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$329,764.73

$$\begin{aligned} \text{Losses Avoided (LA)} &= \text{EAB in 2010} + \text{EAB in 2011} \\ \text{LA} &= \$162,588.65 + \$167,720.81 \\ \mathbf{LA} &= \mathbf{\$330,309.46} \end{aligned}$$

$$\begin{aligned} \text{Return on Investment (ROI)} &= \$330,309.46 / \$329,764.73 \\ \mathbf{ROI} &= \mathbf{1.00 (100\%)} \end{aligned}$$

⁵⁵ See *Appendix E-5-3*

FEMA-DR-1454-0012

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1454-0012 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) just two (2) years after “close out” of the acquisition, demolition, and replacement of a sewer lift station. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit. This analysis is further assuming that in the year before FEMA-1976-DR, less severe but no less costly damages were occurring yearly, thus justifying the addition of one more year of inflation-adjusted Expected Annual Benefits.

Within just two (2) years, then, of a project whose useful-life is 50 years, Kentucky concludes that FEMA already has recouped its total investment (i.e. 100% of its investment) in FEMA-DR-1454-0012. Stated differently, for an investment of approximately \$329,000 intended to last 50 years, in just two (2) years we can assume that this investment has already saved the City of Wickliffe in Ballard County approximately over \$330,000 in damages.

*There is one final caveat to introduce specific to FEMA-DR-1454-0012: The “losses avoided” displayed here very probably **underestimates** the actual losses avoided by pursuing this project. While from 2010-2012, the City of Wickliffe in Ballard County and its sewer lift station were hit by only one “presidentially-declared” disaster, before 2010, the city suffered almost every disaster presidentially declared in Kentucky from at least 2007 to 2010.*

FEMA-DR-1523-0004

I: Summary of Mitigation Action

Mitigation Action Type	<i>(Landslide) Acquisition/Demolition</i>
County in which Completed	<i>Nelson County</i>
Year Mitigation Action Was Applied For	<i>2005</i>
Approval Date	<i>January 9, 2006</i>
Project Completion Date	<i>November 28, 2006</i>
"Close-Out" Date	<i>October 23, 2007</i>
Approved Amount to Spend for Mitigation Action	<i>\$154,650.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$145,369.00</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>4 Years</i>

Scope of Work

FEMA-DR-1523-0004 acquired and demolished one (1) residential structure and its surrounding lot in order to eliminate inevitable future landslide damages.

Justification for the Mitigation Action

Multiple landslides had caused repeated damage to the foundation of the residential property acquired under this mitigation action. At the time of application, the Kentucky Geological Survey (KGS) had conducted further inspections of the site and had concluded that future damage to the property was highly likely to occur as the land under and around the property had continued to erode down a nearby hill.

Information about the Property that Was Acquired

<i>Property Acquired</i>	<i>Assessed Value</i>
<i>1</i>	<i>\$145,000.00</i>

FEMA-DR-1523-0004

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

This acquisition project involved only one (1) property. Thus, the losses avoided for the mitigation action “as a whole” is equivalent to looking at the mitigation action from the standpoint of its individual properties.

Year Mitigation Action Was Applied For	2005
Benefit-Cost Ratio (BCR) at Time of Application	1.27
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$154,650.00
Mitigation Action Benefits Calculated at Time of Application	\$195,770.00
Year Mitigation Action was “Closed Out”	2007
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2005) (i.e. EAB at Time of Mitigation Action Application)	\$13,719.71
Expected Annual Benefits (EAB) (in \$ 2007) (i.e. EAB at Time of Mitigation Action “Close Out”)	\$14,565.65
Expected Annual Benefits (EAB) (in \$ 2008)	\$15,124.91
Expected Annual Benefits (EAB) (in \$ 2009)	\$15,071.10
Expected Annual Benefits (EAB) (in \$ 2010)	\$15,318.31
Expected Annual Benefits (EAB) (in \$ 2011)	\$15,801.83
FEMA’s Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$109,026.75

Losses Avoided (LA) = EAB in 2008 + EAB in 2009 + EAB in 2010 + EAB in 2011

LA = \$15,124.91 + \$15,071.10 + \$15,318.31 + \$15,801.83

LA = \$61,316.15

Return on Investment (ROI) = \$61,316.15/\$109,026.75

ROI = 0.56 (56%)

FEMA-DR-1523-0004

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1523-0004 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) about four years after “close out” of the acquisition in 2007. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit. This analysis is further assuming that in the three (3) years before FEMA-1976-DR, less severe but no less costly damages were occurring yearly, thus justifying the addition of three more years of inflation-adjusted Expected Annual Benefits.

Within four (4) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 56% of its investment in FEMA-DR-1454-0008. Stated differently, for an investment of approximately \$109,000 intended to last 100 years, in four years we can assume that this investment has already saved Nelson County approximately \$61,000 in damages.

FEMA-DR-1523-0005

I: Summary of Mitigation Action

Mitigation Action Type	<i>(Landslide) Acquisition/Demolition</i>
County in which Completed	<i>Jefferson County</i>
Year Mitigation Action Was Applied For	<i>2005</i>
Approval Date	<i>January 31, 2006</i>
Project Completion Date	<i>February 5, 2007</i>
"Close-Out" Date	<i>October 22, 2007</i>
Approved Amount to Spend for Mitigation Action	<i>\$178,785.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$138,355.49</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>4 Years</i>

Scope of Work

FEMA-DR-1523-0005 acquired and demolished one residential structure and its surrounding lot in order to eliminate inevitable future landslide damages.

Justification for the Mitigation Action

Multiple landslides had caused repeated damage to the foundation of the residential property acquired under this mitigation action. The foundation damage had resulted in leaks in the basement of the property and general dilapidation of the structural integrity of the home. There had also been several instances of nearby trees being uprooted due to erosion and consequently falling onto the property.

Information about the Property that Was Acquired

<i>Property Acquired</i>	<i>Assessed Value</i>
<i>1</i>	<i>\$134,220.00</i>

FEMA-DR-1523-0005

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action as a Whole

This acquisition project involved only one (1) property. Thus, the losses avoided for the mitigation action “as a whole” is equivalent to looking at the mitigation action from the standpoint of its individual properties.

Year Mitigation Action Was Applied For	2005
Benefit-Cost Ratio (BCR) at Time of Application	1.25
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$178,785.00
Mitigation Action Benefits Calculated at Time of Application	\$223,481.25 ⁵⁶
Year Mitigation Action was “Closed Out”	2007
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2005) (i.e. EAB at Time of Mitigation Action Application)	\$15,661.74
Expected Annual Benefits (EAB) (in \$ 2007) (i.e. EAB at Time of Mitigation Action “Close Out”)	\$16,627.43
Expected Annual Benefits (EAB) (in \$ 2008)	\$17,265.85
Expected Annual Benefits (EAB) (in \$ 2009)	\$17,204.42
Expected Annual Benefits (EAB) (in \$ 2010)	\$17,486.62
Expected Annual Benefits (EAB) (in \$ 2011)	\$18,038.59
FEMA’s Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$103,766.62

Losses Avoided (LA) = EAB in 2008 + EAB in 2009 + EAB in 2010 + EAB in 2011

LA = \$17,265.85 + \$17,204.42 + \$17,486.62 + \$18,038.59

LA = \$69,995.48

Return on Investment (ROI) = \$69,995.48/\$103,766.62

ROI = 0.67 (67%)

⁵⁶ The benefits expressed here were not recorded in the project file: We do know from the file that the project involved one acquisition and that the one property had a Benefit-Cost Ratio (BCR) of 1.25. Using the approved budget as the “cost” that would be input into FEMA-DR-1523-0005’s application Benefit-Cost Analysis (BCA), 1.25 * Approved Budget = Total Benefits.

FEMA-DR-1523-0005

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1523-0005 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) about four years after “close out” of the acquisition in 2007. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit. This analysis is further assuming that in the three years before FEMA-1976-DR, less severe but no less costly damages were occurring yearly, thus justifying the addition of three (3) more years of inflation-adjusted Expected Annual Benefits.

Within four (4) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 67% of its investment in FEMA-DR-1523-0005. Stated differently, for an investment of approximately \$103,000 intended to last 100 years, in four years we can assume that this investment has already saved Jefferson County approximately \$70,000 in damages.

FEMA-DR-1523-0006

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Rowan County</i>
Year Mitigation Action Was Applied For	<i>2005</i>
Approval Date	<i>January 31, 2006</i>
Project Completion Date	<i>January 27, 2007</i>
"Close-Out" Date	<i>January 7, 2008</i>
Approved Amount to Spend for Mitigation Action	<i>\$162,736.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$162,736.00</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1925-DR, Declared July 23, 2010</i> • <i>FEMA-1976-DR, Declared May 4, 2011</i> • <i>FEMA-4057-DR, Declared March 6, 2012</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>4 Years</i>

Scope of Work

FEMA-DR-1523-0006 acquired and demolished one residential structure in Rowan County, Kentucky.

Justification for the Mitigation Action

The residential structure acquired and demolished had been located within a 100-year floodplain in Rowan County.

Information about the Property that Was Acquired and Note on Methodology

<i>Property Acquired</i>	<i>Assessed Value</i>	<i>Cost That Would Have Been Used in BCA</i>	<i>Assumed Benefit-Cost Ratio (BCR)</i>
1	\$141,580.00	\$162,736.00	1.0 (Cost-Effectiveness)

The property (and the project as a whole) will have no Benefit-Cost Ratio (BCR) because, per FEMA policy at the time, a Benefit-Cost Analysis would not have been required at the time of application for this acquisition/demolition project located within a floodway.

Consequently, this mitigation action assessment will assume only "cost-effectiveness." "Cost-effectiveness" is defined by a BCR of 1.0.

FEMA-DR-1523-0006

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action as a Whole

This acquisition project involved only one (1) property. Thus, the losses avoided for the mitigation action “as a whole” is equivalent to looking at the mitigation action from the standpoint of its individual property.

Year Mitigation Action Was Applied For	2005
Benefit-Cost Ratio (BCR) at Time of Application	1.0 (Cost-Effectiveness)
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$162,736.00
Mitigation Action Benefits Calculated at Time of Application	\$162,736.00
Year Mitigation Action was “Closed Out”	2008
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2005) (i.e. EAB at Time of Mitigation Action Application)	\$11,404.66
Expected Annual Benefits (EAB) (in \$ 2008) (i.e. EAB at Time of Mitigation Action “Close Out”)	\$12,572.75
Expected Annual Benefits (EAB) (in \$ 2009)	\$12,528.02
Expected Annual Benefits (EAB) (in \$ 2010)	\$12,733.51
Expected Annual Benefits (EAB) (in \$ 2011)	\$13,135.45
Expected Annual Benefits (EAB) (in \$ 2012)	\$13,407.28
FEMA’s Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$122,052.00

Losses Avoided (LA) = EAB in 2009 + EAB in 2010 + EAB in 2011 + EAB in 2012

LA = \$12,528.02 + \$12,733.51 + \$13,135.45 + \$13,407.28

LA = \$51,804.26

Return on Investment (ROI) = \$51,804.26/\$122,052.00

ROI = 0.42 (42%)

FEMA-DR-1523-0006

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1523-0006 was hit by three (3) “presidentially-declared” disasters (FEMA-1925-DR, FEMA-1976-DR, and FEMA-4057-DR) about four years after “close out” of the acquisition in 2008. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2010, 2011, and 2012 when FEMA-1925-DR, FEMA-DR-FEMA-1976-DR, and FEMA-4057-DR hit, respectively. This analysis is further assuming that in the one (1) year before FEMA-1925-DR, less severe but no less costly damages were had occurred thus justifying the addition of one (1) more years of inflation-adjusted Expected Annual Benefits.

Within four (4) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 42% of its investment in FEMA-DR-1523-0006. Stated differently, for an investment of approximately \$122,000 intended to last 100 years, in four (4) years we can assume that this investment has already saved Rowan County approximately \$52,000 in damages.

*Finally, as mentioned above, because this project (and the one property that it covered) was acquired from within a floodway during a point in FEMA’s history when it did not require Benefit-Cost Analyses (BCAs) to be conducted for such scenarios, the “losses avoided” calculated relied upon a very conservative assumption that **had** the project required a BCA, the results would have shown only minimal “cost-effectiveness” (i.e. the Benefit-Cost Ratio = 1.0). That BCR is 1.0 arguably implies that any result deriving from this assumption (i.e. “benefits” or “losses avoided” calculations) will be highly under-representative.*

Especially that the property acquired under FEMA-DR-1523-0006 was hit three (3) years in a row by “presidentially-declared” disasters further implies that due to those events alone, it can be argued (and expected) that FEMA already has recouped near 100% of its “project investment.”

FEMA-DR-1523-0010

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Martin County</i>
Year Mitigation Action Was Applied For	<i>2005</i>
Approval Date	<i>July 12, 2007</i>
Project Completion Date	<i>June 13, 2008</i>
"Close-Out" Date	<i>February 25, 2010</i>
Approved Amount to Spend for Mitigation Action	<i>\$262,800.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$186,750.16</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i> • <i>FEMA-4057-DR, Declared March 6, 2012</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>2 Years</i>

Scope of Work

FEMA-DR-1523-0010 originally intended to acquire six (6) properties located in Martin County, Kentucky. FEMA-DR-1523 would end up acquiring only two (2) of those six (6) properties.

Justification for the Mitigation Action

The proposed and approved acquisition of all six (6) properties was justified through their repeated exposure to and damage from flooding. All were located within a floodway, though Benefit-Cost Analyses (BCAs) were conducted for the project as a whole and for the individual properties.

Note on Methodology

This particular "losses avoided" analysis of FEMA-DR-1523-0010 will be conducted in two ways: The first analyzes the project as a whole; the second looks at the individual properties: The project was approved (and thus initial "benefits" – later to be interpreted as "losses avoided") assuming FEMA would be (partially) reimbursing for the acquisition of six (6) structures. In the end, only two (2) properties were acquired using FEMA's funds. Thus, it is relevant to look at "losses avoided" for both the project as a whole and for the individual properties (partially) purchased by FEMA.

FEMA-DR-1523-0010

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action as a Whole

Year Mitigation Action Was Applied For	2005
Benefit-Cost Ratio (BCR) at Time of Application	4.05
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$262,800.00
Mitigation Action Benefits Calculated at Time of Application	\$1,064,340.00
Year Mitigation Action was Completed	2010
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2005) (i.e. EAB at Time of Mitigation Action Application)	\$74,589.76
Expected Annual Benefits (EAB) (in \$ 2010) (i.e. EAB at Time of Mitigation Action "Close Out")	\$83,582.28
Expected Annual Benefits (EAB) (in \$ 2011)	\$86,220.58
Expected Annual Benefits (EAB) (in \$ 2012)	\$88,004.87
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$140,062.62

$$\begin{aligned} \text{Losses Avoided (LA)} &= \text{EAB in 2011} + \text{EAB in 2012} \\ \text{LA} &= \$86,220.58 + \$88,004.87 \\ \mathbf{LA} &= \mathbf{\$174,225.45} \end{aligned}$$

$$\begin{aligned} \text{Return on Investment (ROI)} &= \$174,225.45 / \$140,062.62 \\ \mathbf{ROI} &= \mathbf{1.24 (124\%)} \end{aligned}$$

Alternate Losses Avoided: Per Acquired Structure

Table E-5-18: FEMA-DR-1523-0010 Losses Avoided Using Individual Property Data

Property	Assessed Value	Amount Spent to Acquire (in 2010)	Benefit-Cost Ratio (BCR)	Cost Amount Used to Determine BCR	Total Benefits ⁵⁷ (in \$ 2005)	Expected Annual Benefits (EAB) (in \$ 2005)	FEMA's Project Investment (PI) ⁵⁸
1	\$63,600.00	\$116,000.00	3.41	\$69,050.00	\$235,460.50	\$16,501.25	\$87,000.00
2	\$79,200.00	\$46,900.00	2.41	\$84,650.00	\$204,006.50	\$14,296.93	\$35,175.00
3	Not Available	\$0.00	1.41	Not Available	N/A ⁵⁹	N/A	\$0.00
4	Not Available	\$0.00	8.66	Not Available	N/A	N/A	\$0.00
5	Not Available	\$0.00	1.79	Not Available	N/A	N/A	\$0.00
6	Not Available	\$0.00	4.58	Not Available	N/A	N/A	\$0.00
FEMA's Project Investment Total							\$122,175.00⁶⁰

Table E-5-18 (Cont.): FEMA-DR-1523-0010 Losses Avoided Using Individual Property Data

Property	EAB (in \$ 2010)	I: EAB (in \$ 2011)	II: EAB (in \$ 2012)	III: Losses Avoided (I + II)	ROI: III/PI
1	\$18,423.95	\$19,005.50	\$19,398.81	\$38,404.31	0.44
2	\$9,463.32	\$9,429.65	\$9,584.32	\$19,013.97	0.54
3	N/A	N/A	N/A	N/A	N/A
4	N/A	N/A	N/A	N/A	N/A
5	N/A	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A	N/A
Total Losses Avoided				\$57,418.28	0.41⁶¹ (41%)

⁵⁷ Total Benefits are imputed here: BCR * Cost Amount Used to Determine the BCR = Total Benefits.

⁵⁸ FEMA's Project Investment (PI) is 75% of the "Amount Spent to Acquire"

⁵⁹ N/A = Not Applicable. "Not Available" is always spelled out in this study.

⁶⁰ The "Project Investment Total" calculated here was not used to derive the "Total Losses Avoided" from the individual properties: From "close-out" reports, we know that FEMA spent \$140,062.62.

⁶¹ This "total" ROI derives from dividing the "Total Losses Avoided" by the PI of the project as a whole (i.e. \$140,062.62)

FEMA-DR-1523-0010

III: Loss Avoidance Interpretation

Of the two methods used to calculate the “losses avoided” above, obviously, the method looking at individual properties provides the most accurate conception of “losses avoided”: All of the data that was used to calculate “losses avoided” and the subsequent “return on investment (ROI)” looking at the project as a whole derived from an initial mitigation action that intended to acquire six (6) properties but that ended up acquiring only two (2).

So, in one sense, the following interpretation of the losses avoided results:

FEMA-DR-1523-0010 was hit by two (2) “presidentially-declared” disasters (FEMA-1976-DR and FEMA-4057-DR) two (2) years after “close out” of the acquisitions in 2010. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 and 2012 when FEMA-1976-DR and FEMA-4057-DR hit, respectively.

Within two (2) years, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 41% of its investment in FEMA-DR-1523-0010. Stated differently, for an investment of approximately \$140,000 intended to last 100 years, in two (2) years we can assume that this investment has already saved Martin County approximately \$57,000 in damages.

Unique to this mitigation action, however, is one other possible interpretation: If the original project was to acquire and demolish six (6) properties and in the end six (6) properties were indeed acquired and demolished, then the benefits calculated for the project as a whole and subsequent Benefit-Cost Ratio of 4.05 remains valid. The difference between application and completion/close-out, then, involves *only* what FEMA ended up having to pay. In other words, FEMA may have gotten a deal, of sorts. FEMA was willing to pay for and demolish six (6) properties for \$262,800 because the benefits were expected to be 4.05 times that amount (\$1,064,340). Instead, FEMA may only have been required to pay for two (2) of those properties while all six (6) were actually acquired and demolished (by another party, presumably). FEMA may have experienced the bureaucratic version of “consumer surplus.”

It arguably can be interpreted that FEMA paid \$140,062.62 (75% of \$186,750.16, or the actual amount paid for the project as recorded at “close-out”) for \$1,064,340 worth of benefits. This, of course, argues for the validity of the method of “losses avoided” that looked at the project as a whole, in which case the alternate interpretation:

Within two (2) years of a project whose useful-life is 100 years, FEMA has recouped almost a quarter more than their total project investment (124% return on investment) in benefits from funding FEMA-DR-1523-0010. Stated differently, for an investment of approximately \$140,000 intended to last 100 years, in two (2) years we may be able to assume that this investment already has saved Martin County approximately \$174,000 in damages (i.e. almost as much as the value of the entire project paid by FEMA, Kentucky, and Martin County).

FEMA-DR-1537-0003

I: Summary of Mitigation Action

Mitigation Action Type	<i>Safe Rooms</i>
Jurisdiction in which Completed	<i>Kentucky State University (KSU)/Franklin County</i>
Year Mitigation Action Was Applied For	<i>2006</i>
Approval Date	<i>August 7, 2006</i>
Project Completion Date	<i>May 24, 2009</i>
"Close-Out" Date	<i>March 31, 2011</i>
Approved Amount to Spend for Mitigation Action	<i>\$84,640.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$88,844.95</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> • <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>2 Years⁶²</i>

Scope of Work

FEMA-DR-1537-0003 installed two (2) safe rooms on Kentucky State University's (KSU's) campus located in Franklin County, Kentucky. One safe room was installed at an aquaculture research center; the other safe room was installed on a research "farm." The former safe room was constructed to protect 50 people; the latter was constructed to protect fifteen (15) people.

Justification for the Mitigation Action

Employees and students working on the two research sites were considered at risk of being affected by high wind and tornadoes because the aquaculture research center and research "farm" facilities were not considered to provided adequate protection.

Note on Methodology

Two difference to this analysis to point out:

1. The individual safe room sites recorded Benefit-Cost Ratios (BCRs) and the amounts used to derive the BCRs. This analysis will use those individual BCRs.
2. This analysis is not using the "close-out" date as the point in which "losses" first are avoided. The safe rooms were completed in 2009. It took two years beyond 2009 to "close out" the project. Presumably, the two-year lag had to do with a need for a budget increase at the last minute to pay for the two rooms. But, per conversation with the project manager at the time, the safe rooms were fully functional by 2009.

⁶² This analysis will use "project completion" date instead of the "close-out" date. The explanation for this change is above. The use of "project completion" date was validated through conversation with the manager of the project at the time.

FEMA-DR-1537-0003

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

	<i>Aquaculture Research Center Site</i>	<i>Research "Farm" Site</i>
Year Mitigation Action Was Applied For	<i>2006</i>	<i>2006</i>
Benefit-Cost Ratio (BCR) at Time of Application	<i>1.10</i>	<i>1.03</i>
Mitigation Action Costs Used to Calculate BCR at Time of Application	<i>\$65,110.00</i>	<i>\$19,530.00</i>
Mitigation Action Benefits Calculated at Time of Application	<i>\$71,621</i>	<i>\$20,115.90</i>
Year Mitigation Action was Completed	<i>2009</i>	<i>2009</i>
Mitigation Action Years of Useful Life (T)	<i>30 Years</i>	<i>30 Years</i>
Expected Annual Benefits (EAB) (in \$ 2006) (i.e. EAB at Time of Mitigation Action Application)	<i>\$5,771.68</i>	<i>\$1,621.07</i>
Expected Annual Benefits (EAB) (in \$ 2009) (i.e. EAB at Time of Mitigation Action Completion)	<i>\$6,142.06</i>	<i>\$1,725.10</i>
Expected Annual Benefits (EAB) (in \$ 2010)	<i>\$6,242.80</i>	<i>\$1,753.39</i>
Expected Annual Benefits (EAB) (in \$ 2011)	<i>\$6,439.86</i>	<i>\$1,808.74</i>
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	<i>\$33,316.86⁶³</i>	<i>\$33,316.86</i>

$$\begin{aligned} \text{Losses Avoided}_1 (LA_1) &= \text{EAB}_1 \text{ in 2010} + \text{EAB}_1 \text{ in 2011} \\ LA_1 &= \$6,242.80 + \$6,439.86 \\ \mathbf{LA_1} &= \mathbf{\$12,682.66} \end{aligned}$$

$$\begin{aligned} \text{Losses Avoided}_2 (LA_2) &= \text{EAB}_2 \text{ in 2010} + \text{EAB}_2 \text{ in 2011} \\ LA_2 &= \$1,753.39 + \$1,808.74 \\ \mathbf{LA_2} &= \mathbf{\$3,562.13} \end{aligned}$$

$$\begin{aligned} \text{Total Losses Avoided (TLA)} &= LA_1 + LA_2 \\ TLA &= \$12,682.66 + \$3,562.13 \\ \mathbf{TLA} &= \mathbf{\$16,244.79} \end{aligned}$$

$$\begin{aligned} \text{Return on Investment (ROI)} &= \$16,244.79 (TLA) / \$66,633.71 \\ \mathbf{ROI} &= \mathbf{0.24 (24\%)} \end{aligned}$$

⁶³ This amount simply is 75% of the actual amount paid for *both* safe rooms *divided by two (2)*. Bear in mind that a higher amount was actually spent than was budgeted.

FEMA-DR-1537-0003

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-DR-1537-0003 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) within two years after completion of the mitigation action in 2009. We know, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit. This analysis is further assuming that in the one year before FEMA-1976-DR, less severe but no less costly damages were had occurred the previous year, thus justifying the addition of one more year of inflation-adjusted Expected Annual Benefits.

Within two (2) years, then, of a project whose useful-life is 30 years, Kentucky concludes that FEMA has recouped nearly one quarter (24%) of its investment in FEMA-DR-1537-0003. Stated differently, for an investment of approximately \$67,000 intended to last 30 years, in two (2) years we can assume that this investment has already saved Kentucky State University (KSU) and Franklin County approximately \$16,200 in damages.

FEMA-PDM-2007-0005

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Jefferson County</i>
Year Mitigation Action Was Applied For	<i>2007</i>
Approval Date	<i>February 1, 2007</i>
Project Completion Date	<i>May 19, 2010</i>
"Close-Out" Date	<i>May 24, 2011</i>
Approved Amount to Spend for Mitigation Action	<i>\$98,125.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$98,125.00</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>1 Year⁶⁴</i>

Scope of Work

FEMA-PDM-2007-0005 acquired and demolished one (1) property in Jefferson County, Kentucky. The area where the property once stood would serve as "open/green space."

Justification for the Mitigation Action

Due to its repeated flooding, the United States Army Corps of Engineers (USACE) conducted a study on the sewer system and water table surrounding the property. The study showed at the time that the area indeed was "flood-prone."

Information about the Property that Was Acquired and Note on Methodology

<i>Property Acquired</i>	<i>Assessed Value</i>	<i>Benefit-Cost Ratio (BCR)</i>	<i>Cost Used to Calculate BCR</i>
1	\$79,000.00	1.262	\$100,979.00

If using the "close-out" date, this mitigation action technically would not be included in this assessment of Kentucky's mitigation actions. However, it is included based upon the assumption that the acquisition was fully completed in 2010. Unlike FEMA-DR-1537-0003 – which assumed similarly – this assumption was not validated in any way. That "project completion" date was used entirely is subjective: The "presidentially-declared" disaster that hit FEMA-PDM-2007-0005 occurred so near the "close-out" date (within a couple of weeks), that it just seemed wrong to exclude the project.

⁶⁴ Like FEMA-DR-1537-0003, this analysis also assumes completion of the project before its "close-out" date.

FEMA-PDM-2007-0005

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

Year Mitigation Action Was Applied For	2007
Benefit-Cost Ratio (BCR) at Time of Application	1.262
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$100,979.00
Mitigation Action Benefits Calculated at Time of Application	\$127,435.50
Year Mitigation Action was Completed	2010
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2007) (i.e. EAB at Time of Mitigation Action Application)	\$8,930.78
Expected Annual Benefits (EAB) (in \$ 2010) (i.e. EAB at Time of Mitigation Action Completion)	\$9,392.26
Expected Annual Benefits (EAB) (in \$ 2011)	\$9,688.73
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$73,593.75

Losses Avoided (LA) = EAB in 2011

LA = \$9,688.73

LA = \$9,688.73

Return on Investment (ROI) = \$9,688.73/\$73,593.75

ROI = 0.13 (13%)

FEMA-PDM-2007-0005

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-PDM-2007-0005 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) within one year after the assumed completion of the acquisition in mid-May 2010. We assume, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit.

Within one (1) year, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 13% of its investment in FEMA-PDM-2007-0005. Stated differently, for an investment of approximately \$74,000 intended to last 100 years, in shy of one (1) year we can assume that this investment has saved Jefferson County approximately \$9,700 in damages.

FEMA-PDM-2007-0008

I: Summary of Mitigation Action

Mitigation Action Type	<i>Acquisition/Demolition</i>
County in which Completed	<i>Hardin County</i>
Year Mitigation Action Was Applied For	<i>2007</i>
Approval Date	<i>February 1, 2007</i>
Project Completion Date	<i>January 13, 2009</i>
"Close-Out" Date	<i>March 5, 2010</i>
Approved Amount to Spend for Mitigation Action	<i>\$149,415.00</i>
Actual Amount Spent for the Mitigation Action	<i>\$149,415.00</i>
Mitigation Action Was Hit by the Following 2010-2012 Presidentially-Declared Disaster(s) to Affect Kentucky	<ul style="list-style-type: none"> <i>FEMA-1976-DR, Declared May 4, 2011</i>
Length (Approximately) of Time Between "Close-Out" and Presidentially-Declared Disaster(s)	<i>1 Year</i>

Scope of Work

FEMA-PDM-2007-0008 acquired and demolished one (1) property in the City of Elizabethtown in Hardin County, Kentucky.

Justification for the Mitigation Action

The area surrounding the property had experienced repeated flooding generally. However, in 2006 a storm hit the area with 100-year intensity. Flooding in the area was severe enough that this property and surrounding properties experienced a water line that was eight feet (8') high. Further, the property had lain within a floodway.

Information about the Property that Was Acquired and Note on Methodology

<i>Property Acquired</i>	<i>Assessed Value</i>
1	\$79,000.00

The application of FEMA-PDM-2007-0008 was submitted in 2007. Consequently, a Benefit-Cost Analysis (BCA) would have been conducted in 2007. Until and throughout 2007, FEMA had maintained a policy that acquisition projects mitigating the effects of flooding within a floodway did not require a Benefit-Cost Analysis (BCA).

The methodology for this analysis, then, simply will assume "cost-effectiveness" in order to ensure the most conservative analysis. "Cost-effectiveness" is defined here as a Benefit-Cost Ratio (BCR) of 1.0. The inflation-adjusted Expected Annual Benefits will be calculated from a BCR of 1.0.

FEMA-PDM-2007-0008

II: Loss Avoidance of Mitigation Action

Losses Avoided for the Mitigation Action

Year Mitigation Action Was Applied For	2007
Benefit-Cost Ratio (BCR) at Time of Application	1.0 (Cost Effectiveness)
Mitigation Action Costs Used to Calculate BCR at Time of Application	\$149,415.00
Mitigation Action Benefits Calculated at Time of Application	\$149,415.00
Year Mitigation Action was "Closed Out"	2010
Mitigation Action Years of Useful Life (T)	100 Years
Expected Annual Benefits (EAB) (in \$ 2007) (i.e. EAB at Time of Mitigation Action Application)	\$10,471.10
Expected Annual Benefits (EAB) (in \$ 2010) (i.e. EAB at Time of Mitigation Action Completion)	\$11,012.17
Expected Annual Benefits (EAB) (in \$ 2011)	\$11,359.78
FEMA's Project Investment (i.e. 75% of Actual Amount Spent for Mitigation Action)	\$112,061.25

Losses Avoided (LA) = EAB in 2011

LA = \$11,359.78

LA = \$11,359.78

Return on Investment (ROI) = \$11,359.78/\$112,061.25

ROI = 0.10 (10%)

FEMA-PDM-2007-0008

III: Loss Avoidance Interpretation

The interpretation of the loss-avoidance results:

FEMA-PDM-2007-0008 was hit by one (1) “presidentially-declared” disaster (FEMA-1976-DR) a little over one year after the “close out” of the acquisition in early March of 2010. We assume, then, that we can expect the inflated Expected Annual Benefit to apply for 2011 when FEMA-1976-DR hit.

Within one (1) year, then, of a project whose useful-life is 100 years, Kentucky concludes that FEMA has recouped approximately 10% of its investment in FEMA-PDM-2007-0008. Stated differently, for an investment of approximately \$112,000 intended to last 100 years, in a little over one (1) year we can assume that this investment has saved the City of Elizabethtown and Hardin County approximately \$11,000 in damages.

Further, due to the conservative assumption that this mitigation action only would have been deemed “cost-effective” (i.e. with a Benefit-Cost Ratio of 1.0) at the time of application, the “losses avoided” calculated from this assumption are equally conservative and very likely underestimate the value of “losses avoided” resulting from this mitigation action.

Summary of Results

Loss Avoidance

Below is a tabular summary of the result of the individual assessments of mitigation actions analyzed above.

<i>FEMA Disaster #</i>	<i>Completed Action #</i>	<i>Action Type</i>	<i>County</i>	<i>Approved Budget</i>	<i>Amount Paid for Completed Action #</i>	<i>FEMA's Project Investment (PI)</i>	<i>Benefit-Cost Ratio (BCR) Used</i>	<i>Losses Avoided to Date</i>	<i>Return-on-Investment (ROI) to Date</i>
1925; 1976	1454-0004	Landslide Acquisition	Lewis	\$147,200.00	\$145,274.54	\$108,955.91	1.67	\$101,061.51	93%
1925; 1976; 4057	1523-0006	Acquisition	Rowan	\$162,736.00	\$162,736.00	\$122,052.00	1.0	\$51,804.26	42%
1976; 4057	1523-0010	Acquisition	Martin	\$262,800.00	\$186,750.16	\$140,062.62	4.05	\$57,418.28	41%
1976	1407-0002	Acquisition	Harlan	\$1,040,960.00	\$928,894.72	\$696,671.04	1.5	\$529,876.00	76%
1976	1407-0009	Acquisition	Christian	\$382,395.00	\$309,405.25	\$232,053.94	1.0	\$117,105.12	51%
1976	1407-0010	Acquisition	Boyd	\$543,000.00	\$448,899.43	\$336,674.57	3.14	\$579,734.73	172%
1976	1454-0008	Acquisition	Fleming	\$129,027.00	\$125,078.00	\$93,808.50	1.06	\$22,821.42	24%
1976	1454-0011	Acquisition	Jefferson	\$728,731.00	\$726,827.33	\$546,548.25	1.0	\$255,261.06	47%
1976	1454-0012	Lift Station Relocation	Ballard	\$439,687.00	\$439,686.31	\$329,764.73	4.86	\$330,309.46	100%
1976	1523-0004	Acquisition	Nelson	\$154,650.00	\$145,369.00	\$109,026.75	1.27	\$61,316.15	56%
1976	1523-0005	Acquisition	Jefferson	\$178,785.00	\$138,355.49	\$103,766.62	1.25	\$69,995.48	67%
1976	1537-0003	Safe Room	Franklin	\$84,640.00	\$88,844.95	\$66,633.72	1.10; 1.03 ⁶⁵	\$16,244.76	24%
1976	PDM-2007-0005	Acquisition	Jefferson	\$98,125.00	\$98,125.00	\$73,593.75	1.262	\$9,688.73	13%
1976	PDM-2007-0008	Acquisition	Hardin	\$149,415.00	\$149,415.00	\$112,061.25	1.0	\$11,359.78	10%
4008	1407-0005	Acquisition	Bell	\$850,185.00	\$417,396.55	\$313,047.41	1.0	\$32,290.14	10%
			Totals		\$4,511,057.73	\$3,384,721.06	1.744 ⁶⁶	\$2,246,286.88	55.07%⁶⁷

⁶⁵ FEMA-DR-1537-0003 involved two (2) safe rooms with separate Benefit-Cost Ratios (BCRs) that were both used in the analysis.

⁶⁶ Average Benefit-Cost Ratio of completed mitigation actions used

⁶⁷ Average Return-on-Investment (ROI) of completed mitigation actions used (as percentage)