Berks County

Hazard Vulnerability Assessment and Mitigation Plan

March 2007

BERKS COUNTY HAZARD VULNERABILITY ASSESSMENT AND MITIGATION PLAN

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TABLE OF CONTENTS

PAGE

1.0 INTRODUCTION 1

1.1 HAZARD MITIGATION PLANNING AND THE DISASTER MITIGATION ACT OF 2000 1
1.2 MULTI-JURISDICTIONAL PLAN ADOPTION 2
1.3 MULTI-JURISDICTIONAL PLANNING PARTICIPATION 3
1.4 THE PLANNING PROCESS 10

2.0 HAZARD IDENTIFICATION AND RISK ASSESSMENT 12

2.1 HAZARD IDENTIFICATION 12
2.2 HAZARD EVENT PROFILES 16
2.3 VULNERABILITY ASSESSMENT: IDENTIFYING ASSETS 36
2.4 VULNERABILITY ASSESSMENT: ESTIMATING POTENTIAL LOSSES 43
2.5 VULNERABILITY ASSESSMENT: ANALYZING DEVELOPMENT TRENDS 55
2.6 MULTI-JURISDICTIONAL RISK ASSESSMENT 56

3.0 HAZARD MITIGATION GOALS 57

3.1 HIGH-PRIORITY HAZARD MITIGATION GOALS 57
3.2 MEDIUM-PRIORITY HAZARD MITIGATION GOALS 58
3.3 LOW-PRIORITY HAZARD MITIGATION GOALS 58

4.0 CAPABILITY ASSESSMENT 59

4.1 INTRODUCTION 59
4.2 INSTITUTIONAL CAPABILITY 59
4.3 LEGAL CAPABILITY 60
4.4 FISCAL CAPABILITY 61
4.5 POLITICAL CAPABILITY 63
4.6 TECHNICAL CAPABILITY 64

5.0 HAZARD MITIGATION STRATEGY 66

5.1 IDENTIFICATION AND ANALYSIS OF HAZARD MITIGATION MEASURES 66
5.2 IMPLEMENTATION OF HAZARD MITIGATION MEASURES 114
5.3 MULTI-JURISDICTIONAL HAZARD MITIGATION STRATEGY 130

6.0 PLAN MAINTENANCE PROCEDURES 131

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN 131
6.2 IMPLEMENTATION THROUGH EXISTING PROGRAMS 132
6.3 CONTINUED PUBLIC INVOLVEMENT 133

LIST OF APPENDICES

APPENDIX A - ADOPTION RESOLUTIONS

APPENDIX B - PUBLIC MEETING RECORDS

APPENDIX C - REPRESENTATIVE STRUCTURE ANALYSIS

APPENDIX D - HAZUS EARTHQUAKE REPORT

APPENDIX E - CAPABILITY ASSESSMENT MATRIX

APPENDIX F - GROWING SMARTER MATERIALS

APPENDIX G - REGIONAL HAZARD MAPPING

APPENDIX H - BUSINESS-INDUSTRY RESPONSE PLAN

APPENDIX I - HAZARD MITIGATION OPPORTUNITY FORMS

APPENDIX J - STRUCTURAL PROJECT FORMS

APPENDIX K - PROGRESS MONITORING REPORT

APPENDIX L - REFERENCES

LIST OF TABLES

NO.	DESCRIPTION	PAGE
1-1	MITIGATION STEERING COMMITTEE MEMBERS	3
1-2	MULTI-JURISDICTIONAL PLANNING PARTICIPATION	4
2-1	BERKS COUNTY DISASTER HISTORY	12
2-2	BERKS COUNTY HAZARD IDENTIFICATION SUMMARY	14
2-3	BERKS COUNTY NFIP PARTICIPATION STATUS BY MUNICIPALITY	22
2-4	KNOWN EARTHQUAKES IN BERKS COUNTY THROUGH DECEMBER 2006	32
2-5	BERKS COUNTY ASSET VULNERABILITY BY MUNICIPALITY	39
2-6	BERKS COUNTY NFIP POLICY CLAIMS DATA BY MUNICIPALITY	46
2-7	FLOOD DEPTH-DAMAGE FUNCTIONS FOR RESIDENTIAL REPRESENTATIVE STRUCTURES (ONE- OR TWO-STORY WITH BASEMENT/CRAWLSPACE)	50
2-8	FLOOD DEPTH-DAMAGE FUNCTIONS FOR COMMERCIAL/INDUSTRIAL REPRESENTATIVE STRUCTURES [1]	51
2-9	SUMMARY OF 100-YEAR FLOOD LOSS ESTIMATE RESULTS FOR RESIDENTIAL REPRESENTATIVE STRUCTURES	52
2-10	SUMMARY OF 100-YEAR FLOOD LOSS ESTIMATE RESULTS FOR COMMERCIAL/INDUSTRIAL REPRESENTATIVE STRUCTURES	52
5-1	SUMMARY OF BENEFIT-COST ANALYSIS RESULTS FOR RESIDENTIAL REPRESENTATIVE STRUCTURES	81
5-2	SUMMARY OF BENEFIT-COST ANALYSIS RESULTS FOR COMMERCIAL/INDUSTRIAL REPRESENTATIVE STRUCTURES	82
5-3	BERKS COUNTY PROPERTY PROTECTION GUIDE	83
5-4	RELOCATION COST GUIDE	84
5-5	ELEVATION COST GUIDE	89
5-6	DRY FLOODPROOFING COST GUIDE	91
5-7	WET FLOODPROOFING COST GUIDE	95

LIST OF TABLES
(CONTINUED)

NO.	DESCRIPTION	PAGE
5-8	MUNICIPAL HAZARD MITIGATION ACTION PLAN	115
5-9	MULTI-JURISDICTIONAL HAZARD MITIGATION STRATEGY	123

LIST OF FIGURES

NO.	DESCRIPTION	PAGE
1-1	LOCATION MAP	11
2-1	FLOODING HAZARDS	17
2-2	GEOLOGIC HAZARDS	29
2-3	WILDFIRE HAZARDS	37
5-1	STEEL I-BEAMS AND JACKS ARE INSTALLED IN PREPARATION FOR LIFTING THE HOUSE	86
5-2	THE HOUSE, SUPPORTED ON THE I-BEAMS, IS RAISED ON THE JACKS	86
5-3	NEW MASONRY PIERS ARE CONSTRUCTED TO SUPPORT THE HOUSE, AND THE BASEMENT IS FILLED WITH DIRT	87
5-4	WHEN THE HOUSE HAS BEEN RAISED TO THE DESIRED HEIGHT, THE NEW MASONRY PIERS ARE COMPLETED	87
5-5	A TYPICAL DRY FLOODPROOFED HOUSE	90
5-6	A TYPICAL WET FLOODPROOFED HOUSE	93
5-7	A TYPICAL DRY HYDRANT	105

1.0 INTRODUCTION

Incorporated in 1752 from parts of Lancaster, Chester and Philadelphia Counties, Berks County is a diamond-shaped area of 864 square miles, situated in Southeastern Pennsylvania. An urban area of 385,307 persons (2003 US Census Data estimate), the County seat, Reading, is 56 miles northwest of Philadelphia. The county, (a Third Class county), is made up of seventy-three incorporated municipalities: Forty-four townships, twenty-eight boroughs and one city. Although broad-based, the Berks County economy reflects its' historical development, with agriculture and manufacturing continuing to play important economic roles within the county.

1.1 HAZARD MITIGATION PLANNING AND THE DISASTER MITIGATION ACT OF 2000

With the passage of the Disaster Mitigation Act of 2000 (DMA 2000) (Public Law 106-390) on October 10, 2000, the Federal Emergency Management Agency (FEMA) established new criteria for the development of multi-Hazard Mitigation Plans at the state and local level on a pre-disaster basis. Specifically, Section 322, Mitigation Planning, of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (42 U.S.C. 5121-5206), enacted by Section 104 of DMA 2000, provided new and revitalized approaches to hazard mitigation planning. This section also emphasized the importance of coordinating state and local hazard mitigation planning and implementation activities and continued the requirement for a state Hazard Mitigation Plan as a condition for receiving federal disaster assistance. In addition, Section 322 allows the amount of funding available through FEMA's Hazard Mitigation Grant Program (HMGP) to be increased for states that demonstrate an increased commitment to comprehensive hazard mitigation planning and implementation through the development of an "enhanced" Hazard Mitigation Plan. Finally, Section 322 authorized the expenditure of up to 7% of the HMGP funds available to each state to be used for the completion of Hazard Mitigation Plans on a pre-disaster basis. Also important is the fact that state and local governments were not eligible for post-disaster HMGP funds after June 3, 2005, without an approved Hazard Mitigation Plan.

To implement the new hazard mitigation planning criteria developed under DMA 2000, FEMA published an Interim Final Rule in the Federal Register at 44 CFR Part 201. This Interim Final Rule clearly established the hazard mitigation planning criteria for state and local plans. According to Section 201.1(b) of FEMA's Interim Final Rule, the purpose of hazard mitigation planning is for state, local, and Indian tribal governments to identify the natural hazards that impact them, to identify actions and activities to reduce any losses from those hazards, and to establish a coordinated process to implement the plan, taking advantage of a wide range of

resources. FEMA's Interim Final Rule describes three general types of Hazard Mitigation Plans. These include Standard State Mitigation Plans, Enhanced State Mitigation Plans, and Local Mitigation Plans. Regardless of the type of plan, the hazard mitigation planning process must be open to the public and must provide an opportunity for the public to comment on the plan during the drafting stage and prior to plan approval. Involving the public in the hazard mitigation planning process allows for the development of a more comprehensive approach to reducing the effects of disasters, which is essential to the development of an effective plan.

Given the above law, regulations, and policies, the Berks County Commissioners decided to prepare this multi-jurisdictional Hazard Mitigation Plan for the County's 73 municipalities. The Hazard Mitigation Plan includes documentation of the process that was used to develop the plan, including how it was prepared, who was involved, and how the public was involved. In accordance with FEMA guidance, the risk assessment part of the plan includes a description of all natural hazards that affect the County and the County's vulnerability to those hazards. Following the risk assessment, a mitigation strategy for reducing the potential losses is also included. The mitigation strategy identifies and analyzes a comprehensive range of specific mitigation actions to reduce the effects of each identified hazard. The mitigation strategy also includes an action plan that ranks the identified projects in terms of their priority status, identifies who is responsible for administering the projects, and outlines a schedule for project implementation. Finally, the Hazard Mitigation Plan includes documentation of an established plan maintenance process and proof of plan adoption by Berks County and its municipalities.

Adoption of this plan by Berks County and its municipalities will not only allow each municipality to be eligible for disaster mitigation grant funds, but also provide each municipality with a thorough understanding of its vulnerability to various hazards and a blueprint for mitigating the damaging effects of those hazards.

1.2 MULTI-JURISDICTIONAL PLAN ADOPTION

In order for a multi-jurisdictional Hazard Mitigation Plan to be approved, each jurisdiction (municipality) that is included in the plan must have its governing body adopt the plan before submission to the State and FEMA, even when a regional agency (Berks County Emergency Management Agency [BEMA]) has the authority to prepare such a plan on behalf of the respective jurisdictions. As such, this Hazard Mitigation Plan has been formally adopted by Berks County and its municipalities. Copies of the county and municipal adoption resolutions are included in the appendices.

1.3 MULTI-JURISDICTIONAL PLANNING PARTICIPATION

Throughout the development of the Berks County Hazard Mitigation Plan, numerous avenues of public outreach were employed to ensure the maximum level of participation from all facets of individuals. Copies of public and committee meeting summaries are found in the appendices and materials were made available throughout the process on a Web site maintained by BEMA (http://www.co.berks.pa.us/ema/cwp/view.asp?a=1256&Q=478012&PM=1). The process of public outreach began in September of 2005 when the initial meeting was held to begin discussing the development of the plan. The first task of this meeting was to establish a steering committee comprised of federal, state, county and local Emergency Management Agencies (EMAs), county and municipal planners, flood plain managers, elected officials, and emergency service agency representatives. At the conclusion of this meeting communications were distributed to a select number of individuals including those identified above, requesting their participation as representatives of the steering committee. The members of the steering committee are listed in Table 1-1.

TABLE 1-1
MITIGATION STEERING COMMITTEE MEMBERS

MUNICIPALITY/ORGANIZATION	NAME
Berks EMA	Jeffrey Weidner
Berks EMA	James Major, Jr.
Earl Township	John Hetrick
Ruscombmanor Township	Thomas Rhoads
Oley Township	Ronald Klein
Kutztown Borough	Richard Diehm
Berks County Planning Commission	Matthew McGough
Berks County Conservation District	Judith Smet-Weiss
Berks County GIS	Brad Shirey
Reading Hospital and Medical Center	Kawika Feltman
Albright College	Robert Gerken
Alvernia College	Doug Smith

From September 2005 until the first Steering Committee meeting in April, dissemination of materials regarding the development of the plan was presented in several formats. A project

information sheet was developed by the contractor, Skelly and Loy and was distributed via US Mail and E-mail to all 73 municipalities in Berks County (see Table 1-2). This brochure was also posted on the Berks EMA Web site (http://www.berksema.com).

TABLE 1-2
MULTI-JURISDICTIONAL PLANNING PARTICIPATION

MUNICIPALITY	TITLE	NAME	PLANNING PARTICIPATION [2]	ADOPTION DATE
Albany Township	Chairman	Lawrence A. Schrawder	x	
Alsace Township	Chairman	Joe Williams	x	
Amity Township	Chairman	Leslie S. Sacks	x	
Bally Borough	President	Leo Mutter	x	
Bechtelsville Borough	President	Kathryn Updegrove	x	
Bern Township	Chairman	Walter Scheipe	x	
Bernville Borough	President	Danny Strunk, Sr.	x	
Bethel Township	Chairman	Randall Haag	x	
Birdsboro Borough	President	Neal McCauley	x	
Boyertown Borough	President	Barton K. Feroe, Jr.	x	
Brecknock Township	Chairman	Jeffrey M. Fiant	x	
Caernarvon Township	Chairman	M. Lewis Gable	x	
Centerport Borough	President	Lori Balthaser	x	
Centre Township	Chairman	Barry Good	x	
Colebrookdale Township	President	Todd Gamler	x	
Cumru Township	President	Tim Rowley	x	
District Township	Chairman	Ed Overberger	x	
Douglass Township	Chairman	Jeanne Trivellini	x	
Earl Township[1]	Chairman	William Moyer	x	03/12/07
Exeter Township	Chairman	Dr. Christ L. Ganas	x	
Fleetwood Borough	President	Alexander J. Szoke	x	
Greenwich Township	Chairman	Victor Berger	x	
Hamburg Borough	President	Tammy Wilkinson	x	
Heidelberg Township	Chairman	David Randler	x	
Hereford Township	Chairman	John Membrino	x	
Jefferson Township	Chairman	Leon G. Huey, Jr.	x	
Kenhorst Borough	President	Lawrence Blanski	x	
Kutztown Borough[1]	President	Malcolm Eidle	x	

TABLE 1-2
(CONTINUED)

MUNICIPALITY	TITLE	NAME	PLANNING PARTICIPATION [2]	ADOPTION DATE
Laureldale Borough	President	Chester F. Bogacki	x	
Leesport Borough	President	Dorothea Angelis	x	
Lenhartsville Borough	President	Gerald Peters	x	
Longswamp Township	Chairman	Donald C. Siegfried	x	
Lower Alsace Township	Chairman	Thomas Orth	x	
Lower Heidelberg Township	Chairman	R. David Seip	x	
Lyons Borough	President	Lynn G. DeTurk	x	
Maidencreek Township	Chairman	Roy Timpe	x	
Marion Township	Chairman	Tony L. Brubaker	x	
Maxatawny Township	Chairman	Carl E. Zettlemoyer	x	
Mohnton Borough	President	Ronald E. Kruk	x	
Mount Penn Borough	President	Thomas Staron	x	
Muhlenberg Township	President	Natale DeLuca	x	
New Morgan Borough	President	Franklin Eisenhauer	x	
North Heidelberg Township	Chairman	Jeff Schatz	x	
Oley Township[1]	Chairman	David R. Kessler	x	
Ontelaunee Township	Chairman	William Klein	x	
Penn Township	Chairman	Kyle Loder	x	
Perry Township	Chairman	Dean A. Adam	x	
Pike Township	Chairman	Jeffrey E. Gorrin	x	
Richmond Township	Chairman	Gary J. Angstadt	x	
Robeson Township	Chairman	Roger K. Feeg	x	
Robesonia Borough	President	Michael Frasch	x	
Rockland Township	Chairman	Russell Coffin	x	
Ruscombmanor Township [1]	Chairman	Don Miller, Jr.	x	
Shillington Borough	President	Conrad Vanino	x	
Shoemakersville Borough	President	Clark Zimmerman	x	
Sinking Spring Borough	President	Lawrence Schmidt	x	
South Heidelberg Township	Chairman	Richard E. Hummel	x	
Spring Township	Chairman	Jay Vaughan	x	
St. Lawrence Borough	President	Robert J. May	x	
Strausstown Borough	President	George Brown, Jr.	x	

TABLE 1-2
(CONTINUED)

MUNICIPALITY	TITLE	NAME	PLANNING PARTICIPATION [2]	ADOPTION DATE
The City of Reading	President	Vaughn D. Spencer	x	
Tilden Township	Chairman	Troy Hatt	x	
Topton Borough	President	Arthur L. Hahn	x	
Tulpehocken Township	Chairman	Ronald S. Whitmoyer	x	
Union Township	Chairman	Donald Basile	x	
Upper Bern Township	Chairman	Paul L. Mogel, Sr.	x	
Upper Tulpehocken Township	Chairman	Mark C. Wicks	x	
Washington Township	Chairman	Michael Krestynick	x	
Wernersville Borough	President	Stephen H. Price	x	
West Reading Borough	President	Stephanie J. Murray	x	
Windsor Township	Chairman	Robert L. Seidel	x	
Womelsdorf Borough	President	John F. Hays	x	
Wyomissing Borough	President	Thomas H. Heck	x	
Berks County			x	03/08/07

1 Municipality directly represented on the Mitigation Steering Committee
2 Planning participation includes meeting attendance and receipt of planning materials

In May 2006, a newsletter describing the project and the upcoming public meetings was developed and disseminated to all municipal and county elected officials, and municipal Emergency Management Coordinators (EMCs). This information was once again published to the BEMA Web site (http://www.berksema.com).

Also in May, a dedicated webpage to the development of the Hazard Mitigation Plan was developed by Berks EMA. This page provides an area which lists upcoming meetings dates and a general overview of what hazard mitigation is and how the public can participate. Links to this page were established on the following Web sites.

- http://www.co.berks.pa.us (main Berks County webpage, County Commissioner's Web site, Conservation District Web site, Planning Commission Web site).
- http://www.co.berks.pa.us/shillington (Borough of Shillington Web site)
- http://www.co.berks.pa.us/union (Union Township Web site)

- http://www.co.berks.pa.us/kenhorst (Kenhorst Borough Web site)
- http://www.co.berks.pa.us/greenwich (Greenwich Township Web site)
- http://www.co.berks.pa.us/douglass (Douglass Township Web site)
- http://www.co.berks.pa.us/longswamp (Longswamp Township Web site)
- http://www.co.berks.pa.us/mohnton (Mohnton Borough Web site)
- http://www.co.berks.pa.us/bethel (Bethel Township Web site)
- http://www.co.berks.pa.us/birdsboro (Birdsboro Borough Web site)
- http://www.kutztownboro.org (Kutztown Borough Web site)

Face to face dissemination of materials was also started in May 2006. During this month, several opportunities to meet with the public and explain the project were utilized. Presentation and delivery of the materials was performed at the "Safe Kids Day" held at the Liberty Fire Company in Sinking Spring. A static display was utilized and much conversation was held with the attendees which averaged around 300. Materials were also distributed to the attendees of the Twin Valley School District Health Fair and also the Southern Berks EMS Week Fair.

Another function of our public outreach was the development of a press release that was sent to all media outlets in Berks County. On May 11, 2006, a press release reviewing the basic concept of the plan and the dates and times of the upcoming public meetings was sent to the following:

- Radio – WRFY, WEEU
- Newspaper – Reading Eagle, Kutztown Patriot, Southern Berks News, Pottstown Mercury
- Television – Channel 69 (WFMZ), WGAL-TV

In addition to the press release, a public notice of the upcoming public meetings was published in the Monday, June 12, 2006, edition of the Reading Eagle.

June was a particularly busy month for the development of the Hazard Mitigation Plan for Berks County. A front-page story was published in the "West Side Weekly" Newspaper featuring the status of the plan and the upcoming meeting dates. In addition, a second front-

page story was published in the “Southern Berks News” featuring the same style information as the West Side Weekly story.

On June 21, 2006, our first of three public meetings was presented at the Kutztown Fire Company. With an average of twenty participants present, information and maps were presented for the audience to review and comment on. Active participation from the attendees ensued with many comments on the flooding potential in the Northeastern part of Berks County, especially Kutztown Borough. Attendees included local elected officials, EMCs, and residents of the neighboring municipalities.

Our next public meeting was held on June 22, 2006, at the Daniel Boone High School Auditorium. Although not nearly well attended as our previous meeting, attendees included EMCs and a local elected official. Participants took an active role in reviewing the maps and providing comments on the data that was displayed.

Our final public meeting for the initial plan development process took place on June 29, 2006, at the Berks County Agricultural Center. This meeting took place one day after Berks County experienced one of the most severe flooding events since Hurricane Agnes struck in 1972. The participation at this meeting was limited to a Berks County Commissioner, the Berks County Floodplain Monitor, several local elected officials and EMCs. This lack of turnout from the general public may be directly related to the significant flooding experienced, as most residents may have been recovering from the effects of the flood.

During our third steering committee meeting which was held on June 6, 2006, we were privileged to have in attendance a representative from FEMA, Mr. Michael Shuler. Mr. Shuler recommended that further outreach be done to recruit more members to the steering committee. With this advice, the steering committee decided to pursue inviting representatives from larger businesses and schools located in the Berks County in addition to members of community groups such as the Lions Club and Chamber of Commerce. With this recommendation made, invitations were sent to the following county organizations:

- Kutztown Rotary Club
- Reading Community Development Department
- Berks County Chamber of Commerce
- Berks County Community and Economic Development
- Cumru Township Lions Club
- Reading Rotary Club
- Albright College
- Alvernia College
- Kutztown University
- Reading Area Community College

- Berks Economic Partnership
- Reading Hospital & Medical Center
- East Penn Manufacturing
- Boscov's Department Stores
- Reading School District
- Carpenter Technology
- Sovereign Bancorp

Several weeks after these invitations were distributed, the steering committee received notification from Albright College, Alvernia College, and the Reading Hospital that a representative from each respective agency would be joining the committee. Mr. Robert Gerken, Director of Public Safety with Albright College, Mr. Doug Smith, VP for Finance and Administration with Alvernia College, and Mr. Kawika Feltman, EMC for the Reading Hospital, joined the committee and have been very active in the implementation of the plan.

Throughout the development of the plan, the Hazard Mitigation Plan Web site (http://www.berksema.com) was continually updated with the status of the plan and monthly updates were presented at our municipal EMC training sessions.

As the end of 2006 approached, the committee found itself with the need to provide more opportunities for the general public and the constituent municipalities to review and comment of the plan before final adoption. In January of 2007 a presentation of the plan was made to the municipal EMCs at their monthly training session. During this presentation, 44 attendees representing 27 municipalities throughout Berks County were offered the opportunity to review the maps and mitigation measures, and comments were well received from various attendees. The committee was then welcomed by the Pennsylvania State Association of Boroughs (PSAB) and the Pennsylvania State Association of Townships (PSATS) at a meeting specifically sponsored by their respective organizations to present this plan to the members at large. During this meeting, 43 attendees representing 30 municipalities were present. Our final meeting to present the plan was held on February 7, 2007 and was focused on the general public. Although attendance was not optimal, the announcement of this meeting prompted other avenues of outreach regarding the plan. Prior to the meeting, WFMZ Television performed an on-camera interview with the Project Manager, Jeff Weidner, who explained the importance of the plan and a general overview of what it is comprised.

On Sunday, January 28, 2007, the Reading Eagle published a significant article on the basic concepts surrounding the plan and highlighted the importance of the plan to the 73 constituent municipalities. The Reading Eagle continued to offer the committee assistance in publicizing the plan by publishing a follow-up story in the February 8, 2007, edition of the paper.

Our final outreach action prior to the plan adoption occurred on February 8, 2007, when Chuck Gallagher, managing editor of the Reading Eagle, performed an on-camera interview with the project manager. This interview was broadcast on the weekly television show, "The Eagles Eye" which airs on BCTV Thursdays at 7:00 P.M.

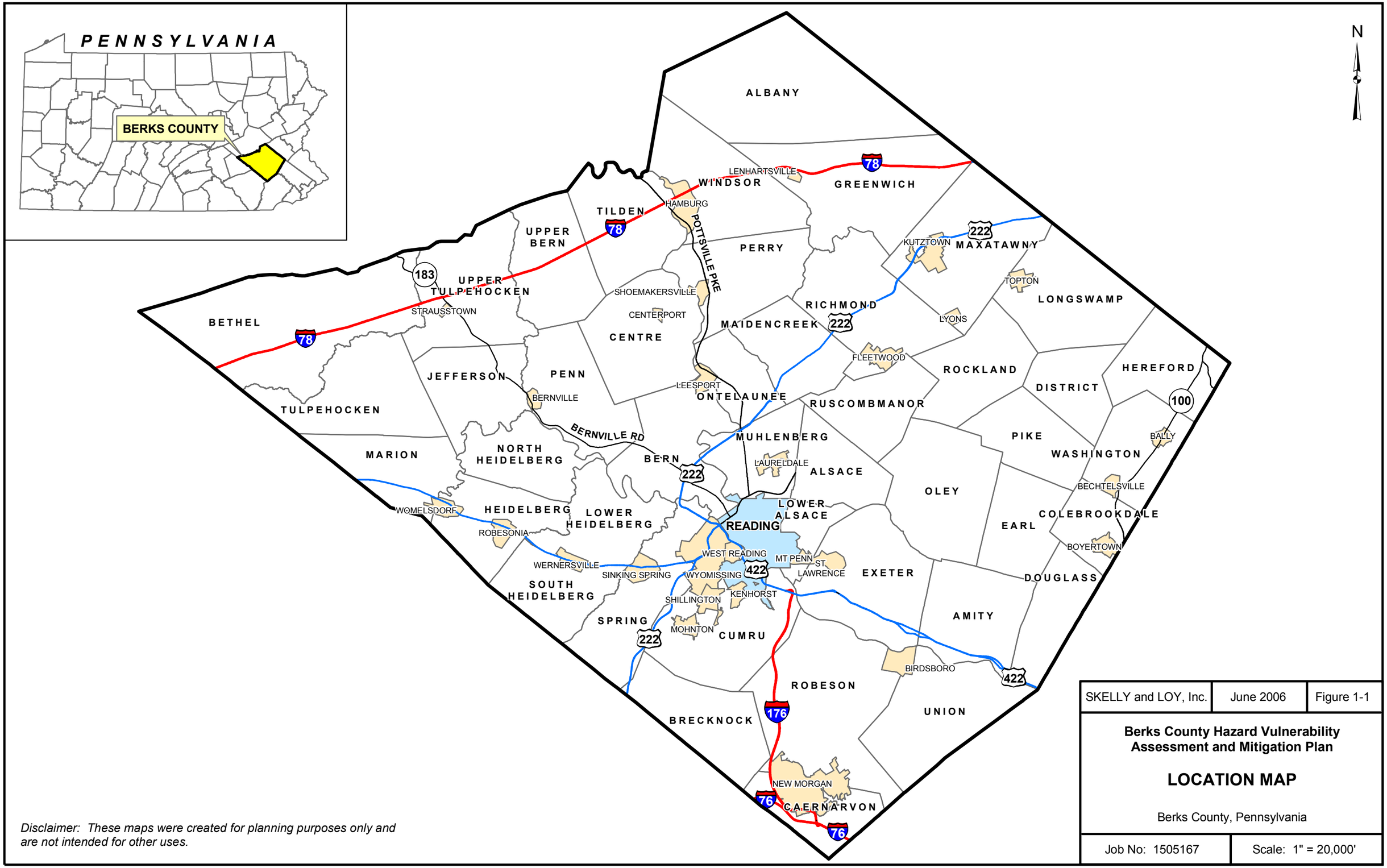
1.4 THE PLANNING PROCESS

BEMA was responsible for the development and coordination of this Hazard Mitigation Plan. To accomplish this task, BEMA formed a Mitigation Steering Committee comprised of representatives from FEMA, the Pennsylvania Emergency Management Agency (PEMA), various Berks County agencies, and several municipal emergency management and planning personnel. The Mitigation Steering Committee met on a monthly basis and the plan was developed over the course of one year.

Efforts were made to solicit both municipal and public input throughout the planning process. Two series of public meetings were held during the formation of the plan. Identical regional meetings were held to provide better accessibility for all of the County's residents. The first set of public meetings was held during the data collection phase to introduce the planning effort and solicit information from the public. The second set of public meetings was held following the development of the draft mitigation measures to solicit additional input into this important phase of the planning effort. Feedback received from the public proved valuable in the development of the plan. Documentation of these public meetings is included in the Appendices.

A number of organizations and individuals provided support through the development of the plan including the EMA, Planning Commission, and Conservation District of Berks County, PEMA, FEMA, the Pennsylvania Department of Conservation and Natural Resources (PA DCNR), the Pennsylvania Department of Community and Economic Development (PA DCED), and the National Weather Service (NWS). This support included provision of background materials, coordination with local municipalities and businesses, and administrative support with mailings and other information distribution efforts.

The Berks County Multi-Jurisdictional Hazard Mitigation Plan incorporates a number of other plans, studies and reports that have been produced about the County. These documents include the Commonwealth of Pennsylvania's Hazard Mitigation Plan, FEMA Flood Insurance Studies for the participating jurisdictions, and the Berks Vision 2020 County Comprehensive Plan. Information about these plans and studies is included throughout this plan.



Disclaimer: These maps were created for planning purposes only and are not intended for other uses.

SKELLY and LOY, Inc.	June 2006	Figure 1-1

Berks County Hazard Vulnerability Assessment and Mitigation Plan

LOCATION MAP

Berks County, Pennsylvania

Job No: 1505167	Scale: 1" = 20,000'

2.0 HAZARD IDENTIFICATION AND RISK ASSESSMENT

2.1 HAZARD IDENTIFICATION

Based on historical occurrences specific to Berks County and the surrounding area, the Mitigation Steering Committee developed a listing of known natural hazards to be addressed in this plan. These known natural hazards were identified through an extensive process that involved the following:

- input from the individual Steering Committee members, local officials, and the public;
- coordination with various federal, state, and local agencies;
- a review of past disaster declarations at the federal and state level specific to Berks County (see Table 2-1);
- analysis of hazard identification and risk assessment publications at the state and local level;
- limited field reconnaissance; and
- Internet research.

TABLE 2-1
BERKS COUNTY DISASTER HISTORY

DATE	HAZARD EVENT	ACTION
February 1958	Heavy Snow	Governor's Proclamation
September 1963	Drought	Governor's Proclamation and President's Declaration of Major Disasters
August 1965	Drought	Governor's Proclamation and President's Declaration of Major Disasters
January 1966	Heavy Snow	Governor's Proclamation and President's Declaration of Major Disasters
February 1972	Heavy Snow	Governor's Proclamation and President's Declaration of Major Disasters
June 1972	Flood (Agnes)	Governor's Proclamation and President's Declaration of Major Disasters
July 1973	Flood	President's Declaration of Major Disasters
April 1975	High Winds	None

TABLE 2-1
(CONTINUED)

DATE	HAZARD EVENT	ACTION
September 1975	Flood (Eloise)	Governor's Proclamation and President's Declaration of Major Disasters
January 1978	Heavy Snow	Governor's Proclamation
February 1978	Blizzard	Governor's Proclamation
November 1980	Drought Emergency	Governor's Proclamation
September 1987	Flood	SBA - Physical Disaster Loans and Economic Injury Disaster Loan
September 1989	Flood	SBA - Physical Disaster Loans and Economic Injury Disaster Loan
March 1993	Blizzard	Governor's Proclamation and President's Declaration of Major Disasters
January 1994	Severe Winter Storms	Governor's Proclamation and President's Declaration of Major Disasters
September 1995	Drought	Governor's Proclamation
January 1996	Flooding	Governor's Proclamation and President's Declaration of Major Disasters
January 1996	Severe Winter Storms	Governor's Proclamation and President's Declaration of Major Disasters
June 1998	Severe Storms/ Tornadoes	Governor's Proclamation; Presidential Major Disaster for Individual Assistance for Pike, Berks, Allegheny, Beaver, Somerset, Wyoming and Susquehanna counties
July 1999	Drought	Governor's Proclamation, Individual Assistance, Hazard Mitigation Grant Program - Amended to include all 67 counties for an agricultural disaster
September 1999	Hurricane Floyd	Governor's Proclamation and President's Declaration Of Major Disasters - Individual Assistance - Berks County; Individual Assistance and Public Assistance - Bucks, Chester, Adams and Philadelphia counties; Individual Assistance and Public Assistance, Categories A and B - Lancaster and York counties
March 2001	Fire	SBA
May 2001	Fire	SBA
June 2001	Flash Flood (Tropical Storm Allison)	Governor's Proclamation & President's Declaration of Major Disasters
August 2001	Flooding	SBA - Economic Injury Disaster Loan
February 2002	Drought and Water Shortage	Governor's Proclamation
February 2003	Severe Winter Storm	Governor's Proclamation of Disaster Emergency

TABLE 2-1
(CONTINUED)

DATE	HAZARD EVENT	ACTION
September 2005	Proclamation of Emergency (Hurricane Katrina)	Governor's Proclamation
June 2006	Flooding	Governor's Proclamation and President's Declaration of Major Disasters

Source: PEMA

In addition, Berks County's Geographic Information System (GIS) database was used as an important resource in identifying and mapping the County's infrastructure, critical facilities, and land uses. Data from this source and GIS data made available from other project participants (i.e., FEMA and PA DCNR) were used to determine those hazards that present the greatest risk to the County. Table 2-2 summarizes the identification of these hazards. The known natural hazards to be addressed in this plan include:

- Dam Failure,
- Drought,
- Flooding,
- Hurricanes,
- Land Subsidence,
- Landslides,
- Earthquakes,
- Severe Storms,
- Tornadoes, and
- Wildfires.

TABLE 2-2
BERKS COUNTY HAZARD IDENTIFICATION SUMMARY

HAZARD	HOW IDENTIFIED	WHY IDENTIFIED
Dam Failure	• Input from Pennsylvania Department of Environmental Protection, Division of Dam Safety • United States Geological Survey	• Presence of Blue Marsh Dam and Ontelaunee Dam near major population centers within the County • Antietam Dam near population centers and elementary school and Kernsville Dam upstream from Hamburg

TABLE 2-2
(CONTINUED)

HAZARD	HOW IDENTIFIED	WHY IDENTIFIED
Drought	• Review of past disaster declarations • Analysis of the County's Vulnerability Assessment • Input from the Department of Environmental Protection	• Severity and frequency of past events • Numerous County residents and agricultural operations dependent on constant water sources
Flooding	• Review of past disaster declarations • Review of Flood Insurance Rate Mapping • Identification of NFIP repetitive loss properties • Analysis of post-disaster/risk assessment reports	• Severity and frequency of past events • Acknowledged as a potentially devastating natural hazard event • Presence of the Schuylkill River and its many tributary streams
Hurricanes/ Tropical Storms	• Review of past disaster declarations • Analysis of the County's Vulnerability Assessment • Input from the National Oceanic and Atmospheric Administration	• Severity of the flood-related damages caused by the 1972 (Agnes), 1975 (Eloise), 1999 (Floyd) and 2001 (Allison) events
Land Subsidence	• Input from the PA Geological Survey • Analysis of geologic mapping	• Presence of carbonate rock units • Known sinkhole locations within the County
Landslides	• Input from the PA Geological Survey • Input from the Pennsylvania Department of Transportation	• Mountainous topography within the County
Earthquakes	• Input from the PA Geological Survey	• Severity and frequency of past events
Severe Storms (thunderstorms, hailstorms, and blizzards)	• Review of past disaster declarations • Input from the National Oceanic and Atmospheric Administration • Local knowledge/public input	• Severity and frequency of past events • Identified as a significant threat Countywide
Tornadoes	• Analysis of the County's Vulnerability Assessment • Review of past disaster declarations • Input from the National Oceanic and Atmospheric Administration	• Severity and frequency of past events
Wildfires	• Analysis of the County's Vulnerability Assessment • Input from the Pennsylvania Department of Conservation and Natural Resources	• Frequency of past events • Presence of forested tracts within the County

Natural hazards including avalanches, coastal storms, coastal erosion, expansive soils, tsunamis, and volcanoes are not addressed in this plan due to the nonexistence or infrequency of these events in Berks County.

2.2 HAZARD EVENT PROFILES

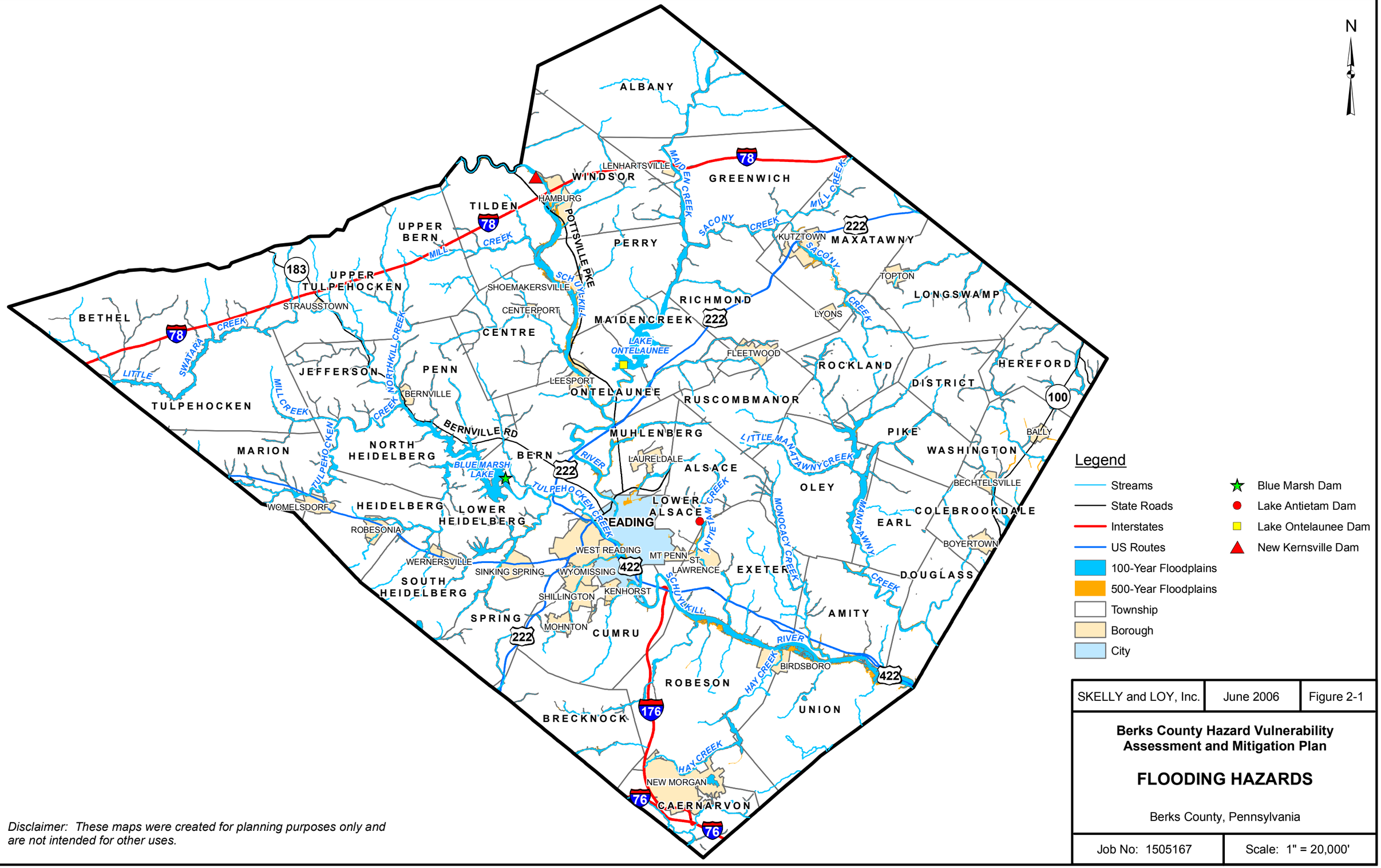
2.2.1 Dam Failure

Dam failures can produce an extremely dangerous flood situation due to the large volume of high-velocity water that is released and the minimal amount of time (if any) for conducting warning and evacuation procedures. Breaching often occurs within hours after the first visible signs of a failure. As such, three of the top four killer floods in the Country (including the 1977 Johnstown flood in Pennsylvania) were the result of dam failures. Dam failures typically occur for one of three reasons.

- The foundation fails due to seepage, settling, or earthquake.
- The design, construction, materials, or operation were deficient.
- Flooding exceeds the capacity of the dam's spillway.

Proper design, regular maintenance and routine inspection can go a long way in preventing a dam failure.

Dam failure presents a potential flooding hazard for Berks County due to the presence of a number of regulated dams. These dams are being considered "high" hazard due to the size of the impoundments and the potentially large populations downstream that could be affected by a dam breach. Four of these high hazard dams were specifically identified by the Mitigation Steering Committee as having the potentially greatest impact. These include Blue Marsh Dam on Tulpehocken Creek located northeast of the City of Reading, Ontelaunee Dam on Maiden Creek located northwest of the City of Reading, Kernsville Dam on the Schuylkill River 1 mile northwest of the Borough of Hamburg and Lake Antietam Dam on Antietam Creek in Lower Alsace Township (see Figure 2-1). There are many smaller dams throughout the County, however, these smaller scale dams/impoundments do not represent as great of a hazard due to their smaller capacities and inundation areas and therefore were not analyzed. The following paragraphs describe Berks County's four key high hazard dams in detail.



SKELLY and LOY, Inc.	June 2006	Figure 2-1

Berks County Hazard Vulnerability Assessment and Mitigation Plan

FLOODING HAZARDS

Berks County, Pennsylvania

Job No: 1505167	Scale: 1" = 20,000'

Disclaimer: These maps were created for planning purposes only and are not intended for other uses.

Blue Marsh Dam was constructed in the mid 1970's for the purpose of flood control. The dam is owned and operated by the U.S. Army Corps of Engineers (USACE), Philadelphia District. The dam's summer flood control storage is 27,109 acre-feet while winter flood control storage is 32,383 acre-feet. According to the Blue Marsh Dam Safety Plan (September 1989) dam failure at normal pool would produce a peak flow of 217,000 cubic feet per second (cfs) with worst case scenario being spillway design flood with dam failure producing peak flow of 493,000 cfs. The USACE estimates that if a Spillway Design Flood with dam failure were to occur, the flood waters would reach the Schuylkill River (approximately 6 miles from the dam) 2 hours after the event and peak 1.5 hours later at an elevation of 257 feet. Just south of Reading on the Schuylkill River, flooding would begin 2.5 hours after the event, producing peak flows only 5 hours after the event reaching an elevation of 234 feet. These elevations exceed the 500-year flood by 30 feet and would be considered a catastrophic event in the highly populated areas in and around Reading for two reasons; the significant inundation of a highly residential area and the short notification and evacuation times (under 2 hours). As such, the Mitigation Steering Committee selected the Spillway Design Flood with dam failure event as the maximum magnitude dam failure hazard to be studied in the plan for the Blue Marsh Dam.

The Ontelaunee Dam is a concrete dam and spillway owned by the City of Reading and operated and maintained by the Reading Area Water Authority. At present, the water supply for the City of Reading is obtained solely from Lake Ontelaunee. Lake Ontelaunee was constructed in 1926 and is located about eight (8) miles north of the City, the dam itself is 54 feet high and 550 feet long. Lake Ontelaunee has a water surface area of 1,350 acres and a capacity of 11,600 acre-feet with maximum flood capacity of 24,200 acre-feet. According to the Emergency Action Plan for the Ontelaunee Dam (December 1995), the Probable Maximum Flood (PMF) would produce peak water flow of 215,270 cfs with a peak water level just downstream of the dam at an elevation of 312 feet. The PMF would correspond to a flood in excess of the 500-year flood at this location. The water treatment plant and a number of residences are located downstream on Maiden Creek and would be within the inundation area. As such, the Mitigation Steering Committee selected the Probable Maximum Flood event as the maximum magnitude dam failure hazard to be studied in the plan for the Ontelaunee Dam.

The Kernsville Dam is owned by the Pennsylvania Department of Environmental Protection and operated along with the Raush Creek Treatment Plant and was constructed for the purpose of trapping sediment. The dam is a 44-foot high, 1,600-foot long concrete gravity overflow dam. According to the Kernsville Emergency Action Plan (May 2002), the normal pool is 583 acre-feet with a 1,260-acre-foot impoundment area. The inundation area resulting from a

sudden dam failure would extend 20 miles down the Schuylkill River to Muhlenberg Township, just north of Reading. The inundation area would range in width from 1,000 feet to 3,000 feet and would affect Hamburg, Shoemakersville, Dauberville and Leesport. The inundation area, if the dam were to breach, would include approximately 3,000 residences, 800 homes, and 90 businesses. No schools, hospitals, nursing homes or day care centers are located within the inundation area. As such, the Mitigation Steering Committee selected this sudden dam failure event as the maximum magnitude dam failure hazard to be studied in the plan for the Kernsville Dam.

Lake Antietam Dam is owned by Berks County and operated by the Reading Area Water Authority. According to the Lake Antietam Dam Emergency Action Plan (January 1999, revised August 2004) the dam is a 60-foot high, 230-foot long stone masonry structure. Normal pool elevation is 264 acre-feet with maximum pool elevation at 430 acre-feet. The inundation area resulting from a sudden failure includes portions of Stony Creek Mills, St. Lawrence, Lower Alsace and Exeter Townships. This inundation area includes approximately 200 homes, 6 businesses, and a school with approximately 560 persons. Population affected could total 1,200 residents. As such, the Mitigation Steering Committee selected this sudden dam failure event as the maximum magnitude dam failure hazard to be studied in the plan for the Lake Antietam Dam.

2.2.2 Drought

Much like the rest of Pennsylvania, Berks County is subject to periodic droughts that impact the County's ability to meet all of its water needs. As defined by FEMA, a drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Unlike some hazards, droughts are not specific to certain parts of the County. Rather, a drought is likely to impact the County in a relatively uniform fashion with only minor localized variations in rainfall amounts of specific storm events. As such, it is not practical to map drought occurrence at the county-level.

The effects of a drought can be far-reaching and typically include reduced productivity of aquatic resources, mandatory water use restrictions, well failures, cutbacks in industrial production, agricultural losses, and limited recreational opportunities. Numerous indices have been developed to define the severity of droughts. Some of the more commonly used indices include the Palmer Drought Severity Index, the Crop Moisture Index, departure from normal precipitation, accumulated departure from normal stream flow, low-flow frequency estimates, groundwa-

ter levels, and lake/water storage levels. Ultimately, the severity of a drought event is determined by its aerial extent when combined with its intensity and duration. Similarly, the frequency or probability of occurrence of a given drought event is calculated as a function of its intensity and duration (i.e., how bad was it and for how long). As such, the statistical analysis for determining the probability of drought events is similar to that used for calculating the return interval of flood events and results in a "percent chance" for a more severe event to occur.

Analysis of Berks County's disaster history (see Table 2-1) indicates that there have been six disaster declarations since 1958 as the result of drought. These events occurred in 1963, 1965, 1980, 1995, 1999, and 2002. In January 1999, the Delaware River Basin Commission declared a conditional drought emergency due to low reservoir levels. Later that year on July 20, Pennsylvania's Governor declared a drought emergency in 55 counties in the Commonwealth, including Berks County. The USGS operates 14 wells in the Delaware River Basin portion of Pennsylvania and in August, 12 wells were reporting below normal levels including BE-623 in Berks County which set a new record low level for August and for the period of record (January 1975 to date), regardless of month. Across the state, agricultural losses were reported between 40% and 70% that summer and on August 9 Governor Ridge requested a federal drought disaster declaration, which would open the door for farmers to recoup losses. According to the Berks County Farm Service Agency, 1999 was the worst drought for Berks County in recent past. As such, the Mitigation Steering Committee selected the 1999 drought event as the maximum magnitude of drought hazard for study in this plan.

2.2.3 Flooding

As with many communities in Pennsylvania, Berks County is susceptible to the problems and hazards associated with flooding. Within Berks County, most flooding typically occurs when a channel (i.e., a river, creek, stream, or ditch) receives too much water and the excess flows over its banks onto the adjacent floodplain. This type of flooding is known as riverine (or overbank) flooding and is generally a problem only where there has been development in the floodplain. Riverine flooding in an undisturbed floodplain is a natural process that has been occurring for millennia with little or no adverse consequences. It is only in recent history that natural floodplains have been altered by human encroachment, giving rise to flooding as a potentially devastating natural hazard. Within Berks County, there are numerous places where homes, businesses, and even industries have been constructed in a floodplain. As such, flooding is a potentially significant natural hazard that Berks County must face.

2004 Flooding on Manatawny Creek

In addition to basic riverine/overbank flooding (such as occurs on the Schuylkill River, Maiden Creek, Tulpehocken Creek, and Manatawny Creek), Berks County is also susceptible to a modified form of riverine/overbank flooding known as flash flooding. Unlike larger rivers, which may take up to two or more days to rise and crest, many of the County's streams and watercourses are subject to flash flooding. Flash floods occur in hilly and mountainous areas where surface water runoff enters a drainage channel during and/or immediately following a significant storm event or in urban areas where pavement and drainage improvements speed runoff to a stream. As such, flash flooding is characterized by a rapid rise in water levels and higher velocity flows. Flash floods tend to be particularly dangerous and destructive because there is typically little or no warning time and people are caught unaware. All flash floods strike quickly and end swiftly. Berks County experienced a severe flash flooding event in June 2001 that caused an estimated 15 million dollars in damage. The county was declared a federal disaster. Storm precipitation estimates were between 6 and 8 inches across the northern and southwestern portions of the county. In Reading, a 20 foot section of the Angelica Lake Dam collapsed, washing away Morgantown Road (S.R. 0010). Seven people were evacuated from their homes and several water rescues were necessary. Another flash flood event in July 2004 hit Berks County rather hard, leaving $2.1 million in damages with storm totals between 5 and 6

inches. Over 13 inches of precipitation fell in July at Reading International Airport, the wettest July on record and the third wettest month on record.

Figure 2-1 indicates that Berks County has a well-developed drainage network consisting of numerous first, second, and third order streams. Several larger watercourses (e.g., Tulpehocken Creek, Maiden Creek, Manatawny Creek, and the Schuylkill River) also traverse the County. As evidenced by Figure 2-1, most of these watercourses have delineated floodplains established by FEMA through the National Flood Insurance Program (NFIP). These delineated floodplains show the estimated area of inundation associated with the 100- and 500-year storm events.

For most communities that participate in the NFIP (see Table 2-3), FEMA has prepared a detailed Flood Insurance Study (FIS). The FIS presents water surface elevations for floods of various magnitudes, including the flood that has a 1-percent probability of being equaled or exceeded in any given year (also called the 100-year flood or base flood) and the flood that has a 0.2-percent probability of being equaled or exceeded in any given year (also called the 500-year flood). The water surface elevation of the 100-year flood event is called the base flood elevation (BFE). BFEs and the boundaries of the 100- and 500-year floodplains are shown on the participating community's Flood Insurance Rate Mapping (FIRM). For participation in the NFIP, FEMA has established the 100-year floodplain as the regulatory standard for local floodplain management purposes. As such, the Mitigation Steering Committee selected the 100-year floodplain (see Figure 2-1) as the maximum magnitude of flood hazard for study in this plan.

TABLE 2-3
BERKS COUNTY NFIP PARTICIPATION STATUS BY MUNICIPALITY

MUNICIPALITY	COMMUNITY ID #	DATE OF ENTRY	CURRENT EFFECTIVE MAP	POLICIES IN FORCE*	INSURANCE IN-FORCE ($)*	WRITTEN PREMIUMS IN FORCE ($)*
Albany Twp.	421046	09/30/88	12/07/97	18	665,000	6,339
Alsace Twp.	421376	04/01/81	05/21/01	13	1,034,000	6,587
Amity Twp.	420124	07/18/77	12/07/97	52	7,747,000	30,734
Bally Boro.	420125	08/01/01	12/07/97	0	0	0
Bechtelsville Boro.	420126	05/15/84	12/07/97	13	1,617,000	7,704
Bern Twp.	421050	11/19/80	05/21/01	5	874,000	2,922
Bernville Boro.	421051	12/06/83	12/07/97	1	107,000	480
Bethel Twp.	421052	07/15/88	12/07/97	3	289,000	1,782
Birdsboro Boro.	420127	12/18/79	12/07/97	21	2,435,000	11,638

TABLE 2-3
(CONTINUED)

MUNICIPALITY	COMMUNITY ID #	DATE OF ENTRY	CURRENT EFFECTIVE MAP	POLICIES IN FORCE*	INSURANCE IN-FORCE ($)*	WRITTEN PREMIUMS IN FORCE ($)*
Boyertown Boro.	420128	06/25/76	12/07/97	3	827,000	3,649
Brecknock Twp.	421053	06/15/81	12/07/97	4	597,000	1,842
Caernarvon Twp.	421055	01/16/81	12/07/97	6	1,228,000	3,396
Centerport Boro.	420129	07/16/82	12/07/97	1	102,000	238
Centre Twp.	421056	12/16/80	12/07/97	11	1,437,000	5,864
Colebrookdale Twp.	421057	05/01/84	12/07/97	8	1,250,000	5,170
Cumru Twp.	420130	10/03/79	12/07/97	7	1,615,000	9,566
District Twp.	421378	08/19/85	12/07/97	2	98,000	317
Douglass Twp.	420131	08/15/77	12/07/97	37	4,804,000	27,246
Earl Twp.	420132	07/18/77	12/07/97	11	1,859,000	7,411
Exeter Twp.	421063	03/15/82	12/07/97	41	8,252,000	41,596
Fleetwood Boro.	420133	02/02/89	12/07/97	4	759,000	2,213
Greenwich Twp.	421067	02/17/89	12/07/97	15	1,716,000	8,777
Hamburg Boro.	420134	02/15/80	12/07/97	74	7,109,000	46,606
Heidelberg Twp.	421069	05/03/90	05/21/01	7	1,221,000	5,922
Hereford Twp.	421379	05/03/90	12/07/97	11	1,609,000	6,801
Jefferson Twp.	421071	09/01/87	05/21/01	4	490,000	3,281
Kenhorst Boro.	420135	02/15/78	12/07/97	2	212,000	582
Kutztown Boro.	420136	05/02/77	12/07/97	50	7,951,000	50,638
Laureldale Boro.	422646	11/30/78	12/07/97	0	0	0
Leesport Boro.	420138	05/16/77	05/21/01	10	1,637,000	8,233
Lenhartsville Boro.	420139	02/17/89	12/07/97	2	257,000	789
Longswamp Twp.	421380	07/03/90	12/07/97	4	1,391,000	4,897
Lower Alsace Twp.	420140	07/05/77	05/21/01	18	3,021,000	12,312
Lower Heidelberg Twp.	421077	08/16/82	12/07/97	7	1,720,000	5,361
Lyons Boro.	N/A	N/A	N/A	N/A	N/A	N/A
Maidencreek Twp.	421078	03/16/81	05/21/01	19	4,257,000	7,081
Marion Twp.	421079	03/02/89	05/21/01	8	719,000	4,111
Maxatawny Twp.	421381	11/05/80	12/07/97	11	1,568,000	6,148
Mohnton Boro.	420142	07/02/80	12/07/97	6	1,175,000	7,048
Mount Penn Boro.	420143	07/31/78	12/07/997	1	210,000	294
Muhlenberg Twp.	420144	09/01/77	05/21/01	77	14,734,000	71,066

TABLE 2-3
(CONTINUED)

MUNICIPALITY	COMMUNITY ID #	DATE OF ENTRY	CURRENT EFFECTIVE MAP	POLICIES IN FORCE*	INSURANCE IN-FORCE ($)*	WRITTEN PREMIUMS IN FORCE ($)*
New Morgan Boro.	422755	04/20/98	12/07/97	0	0	0
North Heidelberg Twp.	421086	03/18/83	05/21/01	0	0	0
Oley Twp.	420965	09/14/90	12/07/97	17	3,150,000	9,844
Ontelaunee Twp.	420966	06/01/77	05/21/01	25	3,422,000	18,937
Penn Twp.	421091	07/15/88	12/07/97	2	630,000	648
Perry Twp.	421093	08/16/82	12/07/97	33	3,139,000	18,157
Pike Twp.	421382	07/18/83	12/07/97	7	789,000	5,276
Reading City	420145	09/29/78	05/21/01	90	25,159,000	142,621
Richmond Twp.	421096	09/17/82	12/07/97	16	1,241,000	9,289
Robeson Twp.	420146	09/03/80	12/07/97	36	4,544,000	25,619
Robesonia Boro.	420147	06/18/90	12/07/97	8	873,000	4,146
Rockland Twp.	421098	09/02/88	12/07/97	11	1,790,000	5,791
Ruscombmanor Twp.	421099	02/02/89	05/21/01	1	57,000	509
Shillington Boro.	420148	08/01/77	12/07/97	5	663,000	4,421
Shoemakersville Boro.	420149	06/15/79	12/07/97	17	2,121,000	13,369
Sinking Spring Boro.	420150	08/16/82	12/07/97	6	1,209,000	5,145
South Heidelberg Twp.	421107	05/17/90	12/07/97	7	727,000	2,171
Spring Twp.	421108	04/18/83	05/21/01	19	4,060,000	12,624
St. Lawrence Boro.	420151	12/16/80	12/07/97	1	140,000	263
Strausstown Boro.	420152	02/11/83	12/07/97	1	28,000	193
Tilden Twp.	421112	07/16/80	12/07/97	2	234,000	1,288
Topton Boro.	420154	07/16/90	12/07/97	1	58,000	454
Tulpehocken Twp.	421115	08/04/88	05/21/01	4	364,000	2,875
Union Twp.	420155	08/15/77	12/07/97	35	3,670,000	21,691
Upper Bern Twp.	421118	11/05/82	12/07/97	2	356,000	2,190
Upper Tulpehocken Twp.	421120	07/16/82	12/07/97	0	0	0
Washington Twp.	421383	06/01/84	12/07/97	11	2,275,000	7,931
Wernersville Boro.	421374	08/02/82	12/07/97	2	212,000	430
West Reading Boro.	420156	03/16/76	12/07/97	17	5,610,000	38,696
Windsor Twp.	421125	12/16/80	12/07/97	3	349,000	2,052
Womelsdorf Boro.	420157	10/15/85	05/21/01	4	247,000	1,886
Wyomissing Boro.	421375	04/18/83	05/21/01	19	2,705,000	7,865

TABLE 2-3
(CONTINUED)

MUNICIPALITY	COMMUNITY ID #	DATE OF ENTRY	CURRENT EFFECTIVE MAP	POLICIES IN FORCE*	INSURANCE IN-FORCE ($)*	WRITTEN PREMIUMS IN FORCE ($)*
Berks County				989	158,415,000	793,022

Source: NFIP PA Community Status Book, HUDEX Report and the DCED.
* Data current through 1/31/06

In regard to past flood events, Berks County experienced flooding as a result of tropical storms/hurricanes, severe thunderstorms and snowmelt events. Tropical storms and hurricanes typically occur between the months of June and November, with the peak season being September to October. These storms bring torrential rains and high winds and often cause flash flooding as well as overbank flooding of inland streams and rivers. Snowmelts typically occur between the months of January and April. Because the ground often remains frozen under snow, it cannot absorb the water from the melt, and large volumes of surface water runoff are produced. Extreme flooding events can occur during snowmelts when additional rainfall combines with the snowmelt runoff.

The first recorded flooding events reported in Berks County date back to the late 1700's. In 1786, an event described as the Pumpkin Freshet occurred on the Schuylkill River. Thousands of pumpkins were lifted out of the fields and taken downstream. It has been suggested that the river rose 27 feet during this flood. In the 1800's, two floods in 1850 brought the Schuylkill River up over 21 feet, the second of which, in September, sent the Penn Street covered bridge downstream. The river crested at 26.2 feet during that flood. Damages were set at $500,000 in 1850 dollars and included 500 destroyed or damaged homes (Bernhart).

In the 20th century, several substantial flooding events were recorded in Berks County starting with the winter of 1902. A combination of large amounts of snow, and an increase in temperature and over 6 inches of rain gave way to a flood that brought the Schuylkill River to 24.5 feet. The next time the Schuylkill River crested over 20 feet was on May 23, 1942, due to a series of thunderstorms, at Reading the River crested at 22.2 feet. The Schuylkill River would remain relatively quiet for the next several decades, until 1972 when, along with the rest of Pennsylvania, Berks County was overwhelmed by the flooding and the associated hazards brought on by Hurricane Agnes. Hurricane Agnes is the storm of record for the Schuylkill River in Berks County. Remnants of Agnes hit the County in June 1972 just after an earlier rainfall had saturated the ground. Agnes brought as much as 18 inches of rain to some places in

Pennsylvania, with Reading receiving a reported 8 inches in 24 hours. The Schuylkill River crested at 4:30 AM on June 23, 1972 at 31.5 feet in Reading, almost three times normal base flow of the river. Only two roads in Reading remained open, 30 city blocks were submerged causing $30 million in damages in Reading alone (Bernhart, p. 11).

2006 Flooding in Reading City along the Schuylkill River

In 1996, snowmelt combined with rainfall led to a large-scale flash flooding event across Pennsylvania. The combination of heavy snow, unseasonably warm temperatures and one to two inches of rain caused severe flooding. Ten people were evacuated along the Schuylkill River in Muhlenberg Township and several homes were damaged. The Schuylkill River crested at 14.32 feet in Berne and 15.85 at Reading, approximately two feet higher than flood stage (NOAA).

In September 1999, Hurricane Floyd entered eastern Pennsylvania bringing with it torrential rains and damaging winds. Flash floods were experienced throughout the area and storm totals averaged around six inches in Berks County. The flooding from the hurricane caused several deaths and over $2 million in damages in Southeastern Pennsylvania. Hundreds of people were rescued from trapped cars and flooded creeks. The Schuylkill River crested at 13.3 feet at Berne and 14.9 at Reading, both over flood stage.

Most recently, remnants of Hurricane Ivan in September 2004 caused flooding throughout the County. Precipitation totals ranged from 2.5 to 5 inches throughout the County, the storm total in Reading was 4.18 inches. The Schuylkill River crested at 16.1 feet at Reading, the fifth highest since Agnes. Interestingly, as illustrated when reviewing flooding events in Berks County over the last three decades, there is a marked decrease in flood elevations on the Schuylkill River. In 1955, the U.S. Congress authorized a study of the Delaware River basin. The USACE recommended building several reservoirs/dams, two of which would be in Berks County. The Flood Act of 1962 laid the foundation for the dams to be built, the purpose of which included flood control, water quality, water supply and recreation. Blue Marsh Lake was the only dam/reservoir to be built in Berks County (construction started in 1974); the other project was discontinued due to public opposition. Of the flooding events reviewed in this section, it is easy to see when flood control measures were implemented in Berks County.

2.2.4 Hurricanes/Tropical Storms

As previously mentioned, Berks County experienced some of its worst flooding as the result of hurricanes/tropical storms. While Berks County is located too far inland to be impacted by all of the common hazards associated with a hurricane/tropical storm event (i.e., severe winds and coastal storm surge), it is susceptible to the high winds, significant rainfall and associated flooding that can sometimes occur. Analysis of Berks County's disaster history (see Table 2-1) indicates that there have been five disaster declarations since 1958 due to flooding associated with hurricane/tropical storm events. These events occurred in 1972 (Agnes), 1975 (Eloise), 1999 (Floyd), 2001 (Allison), and 2005 (Katrina). More detailed information on hurricane/tropical storm-related flooding can be found in Section 2.2.3.

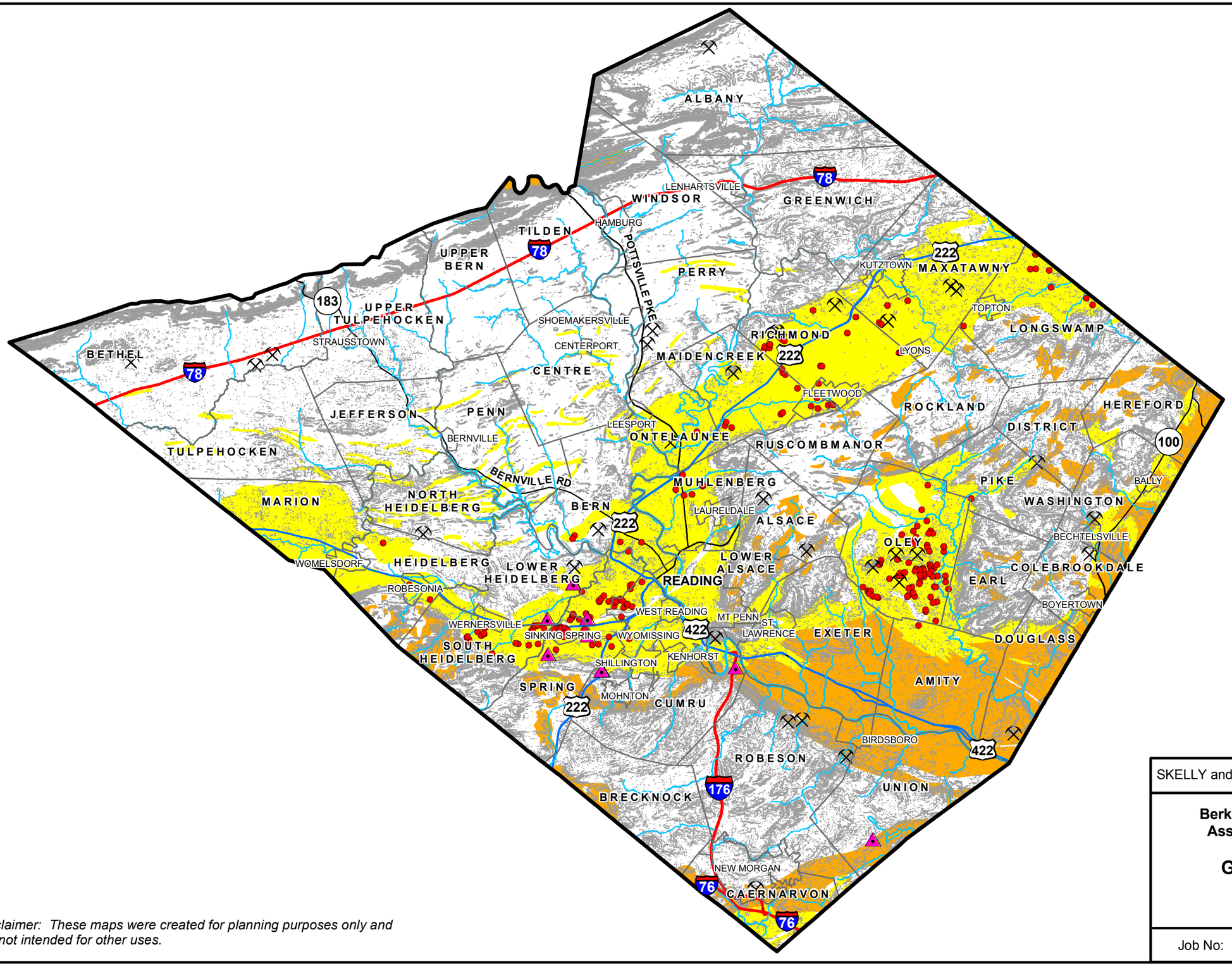
2.2.5 Land Subsidence

Subsidence is defined as the downward movement of surface material with little or no horizontal movement. Subsidence can occur naturally due to the physical and chemical weathering of certain types of bedrock or can be human-induced due to underground mining or excessive pumping of groundwater. Regardless of the reason for occurrence, the overall effect of a subsidence event is the same. That is, the development and eventual failure of a sinkhole, which can cause significant structural damage if buildings and/or infrastructure are present.

Berks County is susceptible to land subsidence in two regions. According to DCNR, there is a band of known sinkholes and surface depressions that span the central region of Berks County. This area is within the Allentown, Ontelaunee, Elper and Rickenbach Geologic Formations that are dolomite and limestone formations that span the County throughout Longswamp, Maxatawny, Rockland, Richmond, Maidencreek, Ontelaunee, Muhlenberg, Bern, Spring, Lower Heidelberg, South Heidelberg, Heidelberg, and Marion Townships. There is also another area south of that belt, mainly in Oley Township, where known sinkholes and surface depressions are located.

Sinkhole in Sinking Spring Borough

Figure 2-2 shows these sinkholes and surface depressions in Berks County. The limestone belt, as it begins in the far eastern portion of the County, is in agricultural and rural areas of the County. The same is true for the sinkhole area located in Oley Township. However, the sinkhole prone "limestone belt" area does continue through the County just north of the City of Reading and continues west of the City where development exists. As such, the Mitigation Steering Committee identified the limestone belt and carbonate bedrock area of the County as the maximum physical extent of subsidence hazard for study in this plan.



Disclaimer: These maps were created for planning purposes only and are not intended for other uses.

SKELLY and LOY, Inc.	June 2006	Figure 2-2

Berks County Hazard Vulnerability Assessment and Mitigation Plan

GEOLOGIC HAZARDS

Berks County, Pennsylvania

Job No: 1505167	Scale: 1" = 20,000'

2.2.6 Landslides

As defined by FEMA, a landslide is the downward and outward movement of earth materials reacting under the force of gravity. As such, "landslide" can be used to describe a number of different types of events displaying different movement characteristics and involving different materials. Rockslides, rock falls, mudflows, mudslides, debris flows, and debris avalanches are all types of landslide events that involve different materials moving in a different manner. Landslides typically occur when some factor (e.g., increased water content or change in load) causes the force of gravity to outweigh the forces working to hold material in place, resulting in the downslope movement of the subject material. Several natural and human factors may contribute to or influence landslides. These factors include topography, geology, precipitation, steepness of cut and fill slopes, and cut-slope stability.

According to the PA DCNR, "landslides cause damage to transportation routes, utilities, and buildings and create travel delays and other side effects. Fortunately, deaths and injuries due to landslides are rare in Pennsylvania. Almost all of the known deaths due to landslides have occurred when rock falls or other slides along highways have involved vehicles. Storm induced debris flows are the only other type of landslide likely to cause death and injuries. As residential and recreational development increases on and near steep mountain slopes, the hazard from these rapid events will also increase."

Coordination with the PA DCNR Bureau of Topographic and Geologic Survey indicated that most landslide events in Pennsylvania tend to be human-induced. Cut and fill slopes for roadways, septic fields on sloped areas, seeps from detention areas/reservoirs, and clearing of vegetation in sloped areas are all human-induced causes of landslide events. Within Berks County, the local maintenance district of the Pennsylvania Department of Transportation (PennDOT) identified one known location of previous landslide events. This area was located in a steep roadway cut along S.R. 0724, River Road between I-176 and Route 10 (just south of Reading along the Schuylkill River near Fritz Island). A concrete wall and fence has been built to mitigate this hazard and is no longer considered an issue by PennDOT. Similarly, no other known landslide event locations were reported.

Figure 2-2 also shows areas in the County that have bedrock geology with poor cut-slope stability and areas with slopes greater than 15 percent. The combination of these two factors results in the identification of potential landslide hazard areas at the County level. As is to be expected, the vast majority of these potential landslide hazard areas are located in the northern/southern mountainous part of the County. The Mitigation Steering Committee identi-

fied these potential landslide hazard areas, as the maximum physical extent of landslide hazard for study in this plan.

2.2.7 Earthquakes

Compared to other regions of the world and the United States, Pennsylvania would not be considered a high earthquake activity area. However, earthquakes do occur in Pennsylvania; and Pennsylvania is also susceptible to the effects of earthquakes that have epicenters in other states like Missouri and South Carolina. According to the PA DCNR, "earthquakes in Pennsylvania are most common in the southeastern and northwestern parts of the state. In the southeast, they are most frequent in the Lancaster and Reading areas, and to a lesser extent around Philadelphia." Therefore, it is worth considering the hazard that earthquakes present to Berks County.

FEMA defines an earthquake as a sudden motion or trembling caused by an abrupt release of accumulated strain on the tectonic plates that comprise the Earth's crust. Seismic activity, or activity related to earthquakes, is measured by two components, magnitude and intensity. Magnitude represents the energy released while intensity measures the effects to a particular location. While an earthquake can only have one magnitude, there can be varying intensities depending on the impact to people and property. Magnitude is most commonly measured by the Richter Scale where the magnitude is expressed in whole numbers and decimals. In the U.S., intensity is commonly measured by the Modified Mercalli Intensity Scale that is composed of 12 increasing levels of intensity from imperceptible to catastrophic.

Earthquakes in Berks County are clustered around the Reading area; epicenters obtained from the DCNR are depicted on Figure 2-2 and listed in Table 2-4. According to the USGS article *Earthquake History of Pennsylvania*, "the area around Sinking Spring, west of Reading, experienced minor damage from an earthquake on January 7, 1954. Plaster fell from walls (VI), dishes and bottles tumbled from shelves, and furniture was upset. Other slight damage to several brick and frame buildings was reported. The tremor was felt in western Berks County and eastern Lancaster County. During the rest of the month, many smaller shocks were felt in the vicinity of Sinking Spring." More recently, on January 15, 1994, an earthquake was recorded in Wyomissing Hills that registered 4.6 on the Richter Scale, the highest recorded in Southeastern Pennsylvania. To profile this hazard in HAZUS, FEMA's loss estimation model, an earthquake of magnitude 5.0 is the minimum magnitude that can be

analyzed. As such, the Mitigation Steering Committee has identified this earthquake as the maximum magnitude of earthquake hazard for study in this plan.

TABLE 2-4
KNOWN EARTHQUAKES IN BERKS COUNTY THROUGH DECEMBER 2006

DATE/TIME	LOCATION	MAGNITUDE	REMARKS
May 28, 1906	Geigertown	Unknown	
June 8, 1937	Reading	Unknown	
January 7, 1954	Sinking Spring	3.2 (estimate)	Aftershocks for one year
June 25, 1972	Wyomissing	Unknown	Start of a series of earthquakes that lasted a few days
August 12, 1973	Wyomissing	Unknown	
May 10, 1993	Spring Twp.	2.8	
January 15, 1994	Spring Twp.	4.0, 4.6	Two events about one hour apart. Long aftershock sequence into the late 1990s
October 28, 1996	Wyomissing	2.5	May be delayed aftershock of 1994 earthquake
April 16, 2006	Sinking Spring	2.3	
December 13, 2006	Shoemakersville	2.5	

Source: DCNR Earthquake Hazard in Pennsylvania, ES 10 and PEMA

2.2.8 Severe Storms

Severe storms include thunderstorms, hailstorms, and blizzards. Thunderstorms and hailstorms are generated when a warm, moist air mass rises rapidly into the atmosphere as a result of some lifting force (e.g., colliding weather fronts, sea breezes, or orographically due to mountains). As the warm, moist air rises, it cools, and the moisture condenses, forming towering cumulonimbus clouds, thunder, and lightning. When compared to hurricanes/tropical storms and winter storms, thunderstorms affect relatively small areas. The typical thunderstorm is only 15 miles in diameter and lasts an average of 30 minutes. However, despite their small size, every thunderstorm should be considered dangerous. Every thunderstorm produces lightning, which kills more people each year than tornadoes. Heavy rain from thunderstorms can also lead to flash flooding. Strong winds, hail, and tornadoes are also dangers associated with some thunderstorms. Of the estimated 100,000 thunderstorms that occur each year in the United States, only about 10 percent are classified as severe. A thunderstorm is considered to be severe if it produces hail at least ¾ inch in diameter, wind 58 miles per hour (mph) or higher, or

tornadoes. Hailstorms are an outgrowth of severe thunderstorms and cause nearly $1 billion in damage to property and crops on an annual basis in the United States.

According to NOAA, between 1950 and 2005, Berks County reported 244 occurrences of thunderstorm-high wind events and 42 occurrences of thunderstorm-related hail in excess of ¾ inch in diameter. The largest hail ever reported in Berks County was approximately 2.0 inches in diameter (August 12, 1956). One of the most damaging thunderstorms Berks County has ever experienced occurred in June 1998, which resulted in wind gusts of 68 mph and approximately $150,000 in damages. Amity and Oley Townships were hit hardest with about six homes damaged by falling trees. About 12,000 homes and businesses were without power. An inch of rain fell and flooded portions of Reading, submerging one car. As such, the Mitigation Steering Committee selected this thunderstorm event as the maximum magnitude severe storm hazard to be studied in this plan.

Berks County is also susceptible to blizzards and other severe winter storms (i.e., heavy snows and ice storms). Blizzards are severe winter storms that pack a combination of blowing snow and wind resulting in very low visibilities. While heavy snowfalls and severe cold often accompany blizzards, they are not required. Sometimes strong winds pick up snow that has already fallen, creating a blizzard. Officially, the NWS defines a blizzard as large amounts of falling or blowing snow with winds in excess of 35 mph and visibilities of less than ¼ mile for an extended period of time (greater than 3 hours). Blizzards and other severe winter storms can create a variety of dangerous conditions. Traveling by automobile can become difficult or even impossible due to “whiteout” conditions and drifting snow. The strong winds and cold temperatures accompanying these storms can be dangerous if people are exposed for any length of time. Threats such as hypothermia and frostbite can lead to loss of fingers and toes or cause permanent kidney, pancreas, and liver damage and even death.

Analysis of Berks County’s disaster history (see Table 2-1) indicates that there have been nine disaster declarations since 1958 due to severe winter storms (heavy snow and blizzards). According to NOAA, Berks County has experienced 113 snow and/or ice events between 1950 and 2005. Most recently, Berks County experienced a severe winter storm in February 2003 that resulted in 22 inches of accumulated snowfall and a disaster declaration by the Governor. As such, the Mitigation Steering Committee selected this winter storm event as the maximum magnitude severe winter storm hazard for study in this plan.

Unlike some hazards, severe storms are not specific to select parts of the County. Rather, a severe storm could strike in any part of the County, and at any time, and could cause

as much or as little damage as possible for the given magnitude event. As such, it is not appropriate to map severe storm occurrence as a method of profiling the hazard.

2.2.9 Tornadoes

A tornado is a rapidly rotating column of air extending from a thunderstorm to the ground that has the potential to cause significant damage to anything in its path. Although tornadoes occur in many parts of the world, these destructive forces of nature are found most frequently in the United States east of the Rocky Mountains during the spring and summer months. In an average year, 800 tornadoes are reported nationwide, resulting in 80 deaths and over 1,500 injuries. With wind speeds in excess of 250 mph, tornadoes are considered nature's most violent storms. Damage paths can be as wide as one mile and over 50 miles long.

1998 Tornado Damage in Lyons Borough

Tornadoes are related to larger vortex formations and often form in convective cells such as thunderstorms or in the right forward quadrant of a hurricane, far from the hurricane eye. Tornadoes in the winter and early spring are often associated with strong frontal systems that form in the central states and move east. Occasionally, large outbreaks of tornadoes occur with this type of weather pattern. Several states may be affected by numerous severe thunder-

storms and tornadoes. It is interesting to note that tornadoes may appear nearly transparent until dust and debris are picked up or a cloud forms in the funnel.

Analysis of Berks County's disaster history indicated that, in May 1998, the County experienced a tornado with enough force to warrant a disaster declaration. Coordination with NOAA revealed that this particular tornado event was categorized as an F3 (158-206 mph wind speeds) according to the Fujita Tornado Scale and resulted in an estimated $1.4 million in damage. Seven persons were injured (five within the Borough of Lyons). About 40 homes were either destroyed or damaged in Lyons, Maidencreek, Maxatawny and Richmond Townships. About 10,250 homes and businesses lost power. This was the first tornado of that strength to occur in Southeast Pennsylvania since the Limerick Tornado on July 27, 1994 and the first F3 tornado to occur within Berks County since November 4, 1950. According to NOAA data, there have been 20 additional documented tornadoes from 1950 through 2005 in Berks County. Of the 21 documented tornadoes that have occurred in Berks County, two have been categorized as F3, eight have been categorized as F2 (117-157 mph wind speeds), nine have been categorized as F1 (73-112 mph wind speeds), and two have been categorized as F0 (40-72 mph wind speeds).

Unlike some hazards, tornadoes are not specific to select parts of the County. Rather, a tornado could strike in any part of the County, and at any time, and could cause as much or as little damage as possible for the given magnitude event. As such, it is not appropriate to map tornado occurrence as a method of profiling the hazard. Since an F3 has been the largest tornado ever recorded in Berks County, the Mitigation Steering Committee selected this magnitude as the maximum tornado hazard to be studied in this plan. According to the Fujita Tornado Scale, a typical F3 tornado would result in severe damage including roofs and some walls torn off well-constructed houses, trains overturned, most trees in forests uprooted, heavy cars lifted off the ground and thrown and weak pavement blown off roads.

2.2.10 Wildfires

On average, Pennsylvania experiences approximately 1,000 wildfires every year. The vast majority of these wildfires (90 percent) is caused by people and could be easily prevented by applying simple common-sense safety practices when using fire. Fortunately, it is rare in Pennsylvania for a wildfire to consume structures. Rather, most Pennsylvania wildfires affect forested areas in rural settings that have a minimal number of permanent structures. This is not to say, however, that Pennsylvania is not susceptible to a wildfire event that could destroy a

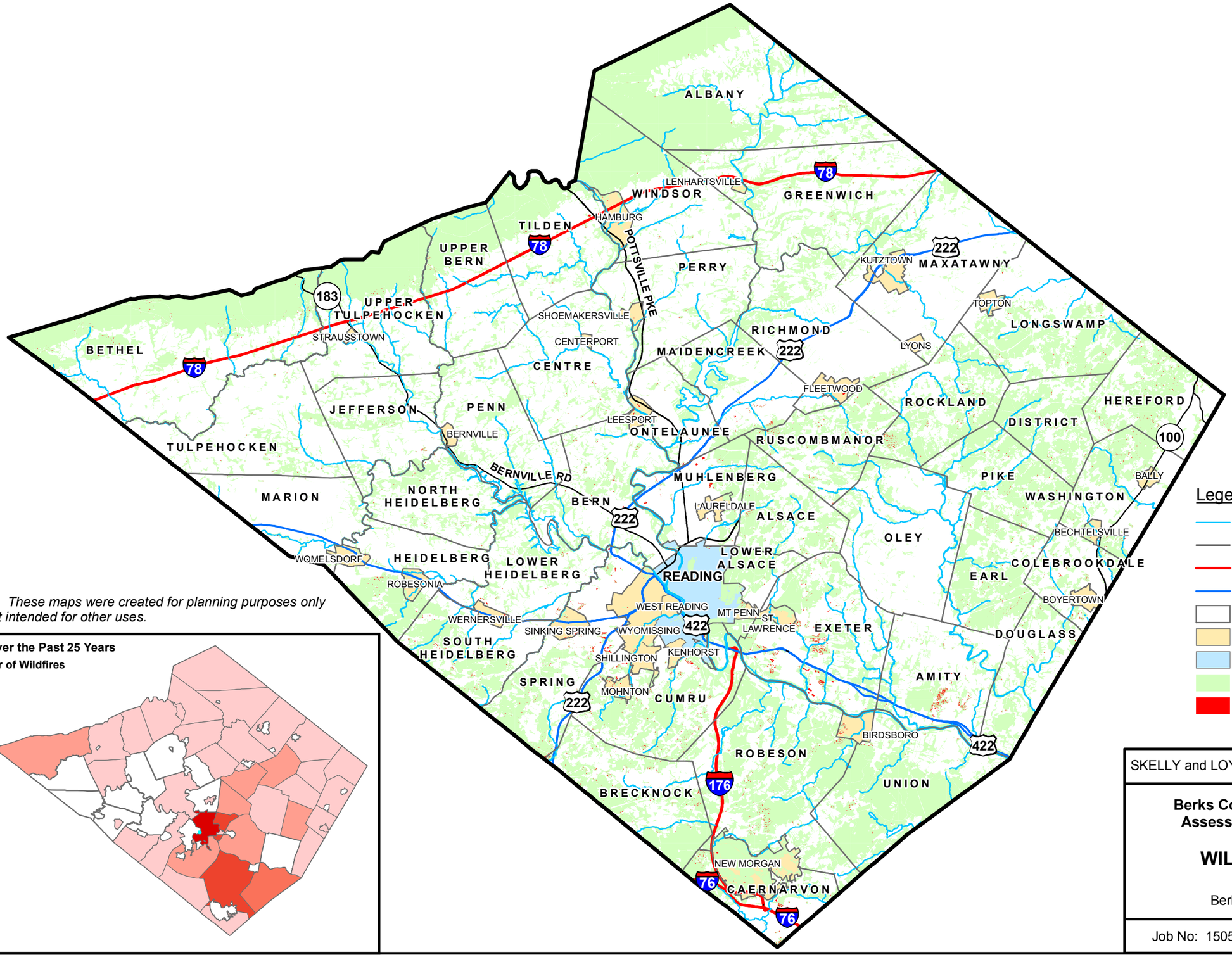
significant number of structures. This is true now more than ever, as development encroaches further into the rural countryside, often taking place in wooded mountainous settings. This concept is particularly applicable to northern and southern Berks County with its wooded, mountainous setting and its ever-increasing development potential.

Structures that are built in the wooded (and typically mountainous) settings adjacent to more urbanized areas are in the wildfire danger zone known as the Wildland/Urban Interface. As its name implies, the Wildland/Urban Interface is that general land area considered to be the fringe of suburban development where houses and other structures are typically built in or at least bordered by extensive tracts of undeveloped woodlands. Within Berks County, these extensive tracts of undeveloped woodlands (many of which are State Game Land and State Forest Land) are primarily located in the northern part of the County (see Figure 2-3) and are considered to be wildfire hazard areas due to their mountainous topography and availability of fuel. As such, structures built in the Wildland/Urban Interface are more at risk of being destroyed by wildfire due to their close proximity to wildfire hazard areas.

Coordination with the PA DCNR Bureau of Forestry indicated that Berks County has averaged approximately 13 wildfires per year over the past twenty-five years. On average, these wildfires account for approximately 39 acres of burned area per year, which equates to an estimated average burned area of 3 acres per fire. The largest wildfire in Berks County in the past 25 years resulted in approximately 95 acres of burned area. Figure 2-3 shows the likely areas of Berks County that would be most susceptible to wildfires due to their forested land cover. This figure also shows the Wildland/Urban Interface structures throughout the County that would be subject to the greatest risk of destruction by wildfire. As such, the Mitigation Steering Committee identified this wildfire hazard area as the maximum physical extent of Berks County's wildfire hazard to be studied in this plan.

2.3 VULNERABILITY ASSESSMENT: IDENTIFYING ASSETS

Asset identification is a critical step in the hazard mitigation planning process. Inventorying existing structures and identifying critical facilities provide insight into the County's vulnerability to select hazards and the magnitude of the potential damages from those hazards. As such, asset identification was conducted as a phased process that involved municipal coordination, public input, GIS data analysis, Internet research, review of local emergency management plans, and limited field reconnaissance.



Disclaimer: These maps were created for planning purposes only and are not intended for other uses.

Wildfires Over the Past 25 Years

Total Number of Wildfires

- 0-10
- 10-20
- 20-30
- 30-40
- 40+

SKELLY and LOY, Inc.	June 2006	Figure 2-3

Berks County Hazard Vulnerability Assessment and Mitigation Plan

WILDFIRE HAZARDS

Berks County, Pennsylvania

Job No: 1505167	Scale: 1" = 20,000'

The first task of the asset identification focused on the identification and mapping of critical facilities throughout the County. These facilities are often structures in which vital community operations are performed and are therefore very important to protect against the impacts of natural hazards. There is not a specific definition of "critical facility" by FEMA, but rather, communities are encouraged to evaluate their own facilities and determine which would be necessary during an emergency event. As such, critical facilities typically fall into two general categories:

- buildings or locations vital to the hazard response effort (i.e., Emergency Operations Centers, police, fire and EMS stations, hospitals/mass care centers, evacuation centers/emergency shelters, communications facilities, schools, etc.); and
- buildings or locations that, if impacted, would create secondary disasters (i.e., hazardous materials facilities, water/wastewater treatment plants, etc.).

After the critical facilities were identified and mapped, the focus of the asset identification shifted to assessing vulnerability on a per-hazard basis. Based on the hazard event profiling that was described in the previous section, GIS data analysis was used to inventory the total number of structures as well as the critical facilities that are potentially vulnerable to the identified hazards. As previously mentioned, natural hazards such as drought, hurricanes/tropical storms, tornadoes, earthquakes and severe storms are not appropriate to be mapped at the county level as they are likely to impact the entire County or undefined locations within the County. As such, the entire County must be considered vulnerable to these hazards. In regard to the other identified hazards (i.e., dam failure, flooding, land subsidence, landslides, and wildfires), Table 2-5 lists the total number of vulnerable structures and vulnerable critical facilities by municipality for the profiled hazard event. Information reported in Table 2-5 was used to estimate potential losses from the profiled hazard events (see next section).

In addition to critical facilities, Berks County contains "at risk" populations that must be factored into the vulnerability assessment. These include a relatively large population of elderly residents with limited mobility located in several dozen senior centers throughout the County; the inmate populations of the Berks County Prison and Berks County Youth Center in Bern Township; and the resident patients at the Wernersville State Hospital in South Heidelberg Township.

TABLE 2-5
BERKS COUNTY ASSET VULNERABILITY BY MUNICIPALITY

MUNICIPALITY	DAM FAILURE*		FLOODING		LAND SUBSIDENCE		LANDSLIDES		WILDFIRES	
	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES
Albany Twp			28	1	0	0	0	0	80	1
Alsace Twp			70	0	193	0	60	0	183	0
Amity Twp			120	1	728	1	580	1	660	0
Bally Boro			0	0	179	0	2	0	0	0
Bechtelsville Boro			43	0	372	3	45	0	19	0
Bern Twp			29	1	1,278	11	0	0	140	1
Bernville Boro			6	1	0	0	0	0	7	0
Bethel Twp			60	3	13	0	0	0	265	0
Birdsboro Boro			58	4	0	0	387	1	135	0
Boyertown Boro			0	0	206	1	76	1	1	0
Brecknock Twp			13	0	0	0	43	0	351	1
Caernarvon Twp			14	0	989	5	149	0	224	0
Centerport Boro			10	0	0	0	0	0	0	0
Centre Twp			45	0	185	1	0	0	87	0
Colebrookdale Twp			40	0	453	0	161	0	143	0
Cumru Twp			107	0	2,304	10	233	4	619	4
District Twp			16	0	11	0	67	0	107	0
Douglass Twp			76	0	189	0	296	1	84	0
Earl Twp			35	0	492	0	66	0	227	0
Exeter Twp			181	0	4,232	12	1,303	1	1,273	1
Fleetwood Boro			22	0	2,150	15	0	0	10	0
Greenwich Twp			82	0	0	0	0	0	116	0
Hamburg Boro			314	0	0	0	0	0	13	0

TABLE 2-5
(CONTINUED)

MUNICIPALITY	DAM FAILURE*		FLOODING		LAND SUBSIDENCE		LANDSLIDES		WILDFIRES	
	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES
Heidelberg Twp			11	1	510	2	1	0	86	0
Hereford Twp			68	0	103	1	103	0	313	0
Jefferson Twp			21	0	44	0	0	0	71	0
Kenhorst Boro			3	0	1,748	3	0	0	0	0
Kutztown Boro			119	6	2,105	12	0	0	1	0
Laureldale Boro			0	0	1,288	9	0	0	0	0
Leesport Boro			34	3	719	5	0	0	45	0
Lenhartsville Boro			7	0	0	0	0	0	2	0
Longswamp Twp			57	1	1,164	7	24	0	170	0
Lower Alsace Twp			98	1	2,032	6	70	0	45	0
Lower Heidelberg Twp			123	0	1,097	0	0	0	133	0
Lyons Boro			0	0	285	5	0	0	0	0
Maidencreek Twp			113	0	3,653	6	0	0	159	0
Marion Twp			64	0	594	4	0	0	15	0
Maxatawny Twp			73	0	1,395	12	0	0	32	0
Mohnton Boro			26	0	0	0	24	0	136	0
Mt Penn Boro			0	0	1,658	7	0	0	15	0
Muhlenberg Twp			409	0	9,216	21	17	0	273	1
New Morgan Boro			0	0	0	0	13	0	8	1
North Heidelberg Twp			1	0	110	2	0	0	46	0
Oley Twp			101	1	1,108	4	23	0	36	0
Ontelaunee Twp			33	0	570	7	0	0	22	0
Penn Twp			28	0	134	0	0	0	33	0

TABLE 2-5
(CONTINUED)

MUNICIPALITY	DAM FAILURE*		FLOODING		LAND SUBSIDENCE		LANDSLIDES		WILDFIRES	
	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES
Perry Twp			61	0	53	0	0	0	34	0
Pike Twp			53	0	209	0	33	0	152	0
Reading City			134	0	41,642	84	38	0	64	0
Richmond Twp			65	1	1,113	9	0	0	77	1
Robeson Twp			95	0	6	0	266	1	511	1
Robesonia Boro			43	1	1,082	8	0	0	13	0
Rockland Twp			64	0	86	0	36	0	375	1
Ruscombmanor Twp			19	0	99	0	21	0	314	0
Shillington Boro			3	0	2,949	10	0	0	2	0
Shoemakersville Boro			55	4	0	0	0	0	4	0
Sinking Spring Boro			15	0	1,774	4	0	0	123	0
South Heidelberg Twp			93	0	1,966	5	139	0	218	0
Spring Twp			131	1	10,340	30	81	0	707	1
St Lawrence Boro			7	0	755	4	0	0	31	0
Strausstown Boro			2	0	0	0	0	0	3	0
Tilden Twp			25	0	0	0	0	0	55	0
Topton Boro			29	0	1,053	5	0	0	4	0
Tulpehocken Twp			21	0	71	0	0	0	52	0
Union Twp			70	2	0	0	200	3	154	0
Upper Bern Twp			9	0	0	0	0	0	71	1
Upper Tulpehocken Twp			14	0	0	0	0	0	68	0
Washington Twp			57	0	530	4	114	0	275	0
Wernersville Boro			0	0	1,185	7	0	0	1	0

TABLE 2-5
(CONTINUED)

MUNICIPALITY	DAM FAILURE*		FLOODING		LAND SUBSIDENCE		LANDSLIDES		WILDFIRES	
	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES	TOTAL # VULNERABLE STRUCTURES	VULNERABLE CRITICAL FACILITIES
West Reading Boro			10	0	2,537	10	0	0	0	0
Windsor Twp			36	0	0	0	0	0	39	0
Womelsdorf Boro			9	0	1,303	6	0	0	24	0
Wyomissing Boro			22	0	4,290	17	0	0	25	0
TOTAL**			**3,900**	**33**	**116,550**	**375**	**4,671**	**13**	**9,781**	**15**

* Given the number of high hazard dams in the County and the varying severity of dam failure events, individual dam failure/emergency action plans should be consulted to determine the applicable number of vulnerable structures/facilities.

** Structures located on municipal boundaries may be counted twice.

Note: Structures used in analysis provided by Berks County GIS in 2006.

In regard to the future development of additional critical facilities, the Berks County Planning Commission indicated in the Berks County Comprehensive Plan "Berks Vision 2020" that the County is expected to experience continued growth over the next 20 years. Growth areas were developed to include a range of services and facilities as well as commercial, residential, institutional and industrial land uses that should accommodate the growth anticipated. The growth areas are focused around areas already developed with existing infrastructure services including sewer, water, highways, police, fire protection, schools, parks and other services. While any future development will be susceptible to drought, hurricanes/tropical storms, tornadoes, and severe storms, the contents of this hazard plan (once adopted) can be incorporated into the comprehensive plan to help ensure less hazard-prone development. In addition, enforcement of local codes and ordinances as recommended to be amended herein should minimize vulnerability to flooding and other hazards.

2.4 VULNERABILITY ASSESSMENT: ESTIMATING POTENTIAL LOSSES

Estimating potential losses/damages from natural hazard events at the county level can be a very difficult task to complete with limited data. As such, the Mitigation Steering Committee relied on the detailed hazard event profile mapping (and associated GIS data) and reported damage estimates from past hazard events. Damage estimates from past hazard events were used specifically for those natural hazards that are not applicable to be mapped at the county level (e.g., droughts, hurricanes/tropical storms, tornadoes, and severe storms). For those natural hazards that are specific to certain parts of the County (e.g., dam failure, flooding, land subsidence, landslides, and wildfires), the GIS data analysis that was conducted for the asset identification and reported in Table 2-5 served as the primary means for estimating potential losses from the profiled hazard events. In addition, NFIP claims data and 100-year flood loss estimates calculated for a number of representative floodplain structures identified throughout the County were used to supplement the loss estimation for regional flooding. FEMA's HAZUS loss estimation program was used to calculate approximate earthquake losses for the profiled event throughout the County. A summary of the estimated potential losses from the profiled hazard events is provided below.

2.4.1 Potential Dam Failure Losses

As indicated in the hazard event profiling, the failure of Blue Marsh Dam and Ontelaunee Dam would result in nearly instantaneous downstream flows that exceed the 500-year flood

event in varying degrees of magnitude. The mass destruction and widespread loss of life that would be experienced as a result of these events could best be characterized as devastating. In this capacity, the profiled dam failure events for these structures would be considered catastrophic to Berks County and beyond measurable calculation. As such, no dollar loss estimates were attempted for these hazard events, as to do so would not effectively capture the severity and magnitude of such an event.

Analysis of the Kernsville Emergency Action Plan indicated that 800 residences would be flooded and 90 businesses would be inundated by a "sudden dam failure". Based on assessment data for the County, an average residence value of $100,000 was used to calculate hazard losses. Similarly, an average commercial structure value of $350,000 was used. As such, the following losses can be estimated for Berks County's Kernsville Dam failure hazard.

Residential = 800 Structures X $100,000 average value per structure X 30% impact* = $24,000,000
Commercial = 90 Structures X $350,000 average value per structure X 30% impact* = $9,450,000
Total = $33,450,000 (does not include potential content losses)
*30% impact assumes some structural damage due to high velocity flood flows, with many structures in close proximity to the Schuylkill River.

Analysis of the Lake Antietam Dam Emergency Action Plan indicated that 200 residences, 6 businesses and one school would be inundated by a "sudden dam failure". Based on assessment data for the County, an average residence value of $100,000 was used to calculate hazard losses. Similarly, an average commercial structure value of $350,000 and approximately $7 million for the Antietam School was used. As such, the following losses can be estimated for Berks County's Lake Antietam Dam failure hazard.

Residential = 200 Structures X $100,000 average value per structure X30% impact* = $6,000,000
Commercial = 6 Structures X $350,000 average value per structure X 30% impact* = $630,000
Institutional = 1 Structure X $7 million average value per structure X 30% impact* = $2,100,000
Total = $8,730,000 (does not include potential content losses)
*30% impact assumes some structural damage due to high velocity flood flows, with many structures in close proximity to Antietam Creek.

2.4.2 Potential Drought Losses

The 1999 drought event resulted in low groundwater levels, low stream flow levels, and record low reservoir/lake levels. Many local farmers suffered crop losses. Through coordination with the Berks County Farm Service Agency, it was determined that 908 requests for drought crop loss assistance were filed and $3,763,010 (2005) was paid out to impacted farmers in Berks County.

2.4.3 Potential Flooding Losses

GIS data analysis indicates that there are approximately 3,885 occupied structures in the 100-year floodplain in Berks County. Based upon available GIS data and a windshield survey, assuming that 90 percent (3,497) of these structures are residences, eight percent (310) are commercial establishments, and two percent (78) are industrial buildings, the following losses can be estimated for Berks County's flooding hazard.

Residential = 3,497 Structures X $100,000 average value per structure X 10% impact* = $34,970,000
Commercial = 310 Structures X $350,000 average value per structure X 10% impact* = $10,850,000
Industrial = 78 Structures X $1.1 million average value per structure X 10% impact* = $8,580,000
Total = $54,400,000 (does not include potential content losses)
*10% impact is based on average value of flood insurance claims payments through the NFIP and assumes some structural damage due to high velocity flows and/or depth of floodwaters

In addition to estimating potential future flood losses, NFIP policy claims data were used to determine recorded flood losses from past flood events. Table 2-6 shows the total number of flood loss claims, total claims payments, and repetitive loss claims payments for each municipality in the County. A repetitive loss property is defined as any property for which two or more flood insurance claims have been paid for more than $1,000 in a 10-year period. Analysis of Table 2-6 indicates that the 31 identified repetitive loss properties within Berks County account for 25 percent of the total NFIP flood loss claims to date. Table 2-6 also indicates that the NFIP has paid nearly $4 million in flood insurance claims payments to Berks County residents for reported flood losses. Finally, Table 2-6 indicates that only 16 of Berks County's 73 municipalities have identified repetitive loss properties. These repetitive loss properties are distributed across the County; however, approximately ½ to 2/3 are located in a band beginning near Reading and extending to the east including Reading City (5), Exeter Township (2), Amity Township (5), Earl Township(4), Oley Township(1) and Colebrookdale Township (1).

TABLE 2-6
BERKS COUNTY NFIP POLICY CLAIMS DATA BY MUNICIPALITY

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY ($)
Albany Twp.	20	120,411	0	N/A	N/A	N/A	N/A
Alsace Twp.	4	8,028	0	N/A	N/A	N/A	N/A
Amity Twp.	35	102,016	5	10	2	54,531.10	10,906.22
Bally Boro.	0	0	0	N/A	N/A	N/A	N/A
Bechtelsville Boro.	3	13,900	0	N/A	N/A	N/A	N/A
Bern Twp.	11	37,461	2	4	2	12,683.15	6,341.58
Bernville Boro.	0	0	0	N/A	N/A	N/A	N/A
Bethel Twp.	0	0	0	N/A	N/A	N/A	N/A
Birdsboro Boro.	25	259,343	0	N/A	N/A	N/A	N/A
Boyertown Boro.	3	14,025	0	N/A	N/A	N/A	N/A
Brecknock Twp.	1	1,470	0	N/A	N/A	N/A	N/A
Caernarvon Twp.	1	5,957	0	N/A	N/A	N/A	N/A
Centerport Boro.	0	0	0	N/A	N/A	N/A	N/A
Centre Twp.	2	5,780	0	N/A	N/A	N/A	N/A
Colebrookdale Twp.	5	11,828	1	2	2	4,858.58	4,858.58
Cumru Twp.	7	41,180	0	N/A	N/A	N/A	N/A
District Twp.	0	0	0	N/A	N/A	N/A	N/A
Douglass Twp.	22	46,012	0	N/A	N/A	N/A	N/A
Earl Twp.	37	384,870	4	10	2.5	101,551.66	25,387.92
Exeter Twp.	47	73,590	2	5	2.5	19,087.71	9,543.86
Fleetwood Boro.	2	645	0	N/A	N/A	N/A	N/A
Greenwich Twp.	22	107,605	2	4	2	37,378.93	18,689.47
Hamburg Boro.	7	9,295	0	N/A	N/A	N/A	N/A
Heidelberg Twp.	4	14,549	1	2	2	13,470.26	13,470.26

TABLE 2-6
(CONTINUED)

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY ($)
Hereford Twp.	2	6,525	0	N/A	N/A	N/A	N/A
Jefferson Twp.	0	0	0	N/A	N/A	N/A	N/A
Kenhorst Boro.	4	2,215	0	N/A	N/A	N/A	N/A
Kutztown Boro.	49	637,056	1	5	5	222,615.44	222,615.44
Laureldale Boro.	3	3,248	0	N/A	N/A	N/A	N/A
Leesport Boro.	5	6,654	0	N/A	N/A	N/A	N/A
Lenhartsville Boro.	8	59,434	0	N/A	N/A	N/A	N/A
Longswamp Twp.	1		0	N/A	N/A	N/A	N/A
Lower Alsace Twp.	6	9,928	0	N/A	N/A	N/A	N/A
Lower Heidelberg Twp.	0	0	0	N/A	N/A	N/A	N/A
Lyons Boro.	N/A	N/A	0	N/A	N/A	N/A	N/A
Maidencreek Twp.	7	21,354	0	N/A	N/A	N/A	N/A
Marion Twp.	4	15,926	0	N/A	N/A	N/A	N/A
Maxatawny Twp.	12	126,722	1	3	3	61,842.87	61,842.87
Mohnton Boro.	12	28,191	2	6	3	25,672.42	12,836.21
Mount Penn Boro.	2	4,363	0	N/A	N/A	N/A	N/A
Muhlenberg Twp.	90	327,099	0	N/A	N/A	N/A	N/A
New Morgan Boro.	0	0	0	N/A	N/A	N/A	N/A
North Heidelberg Twp.	2	7,204	0	N/A	N/A	N/A	N/A
Oley Twp.	6	16,385	1	2	2	6,662.41	6,662.41
Ontelaunee Twp.	36	56,997	0	N/A	N/A	N/A	N/A
Penn Twp.	0	0	0	N/A	N/A	N/A	N/A
Perry Twp.	13	50,021	1	2	2	15,654.23	15,654.23
Pike Twp.	2	1,997	0	N/A	N/A	N/A	N/A

TABLE 2-6
(CONTINUED)

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY ($)
Reading City	84	554,026	5	14	2.8	332,282.25	66,456.45
Richmond Twp.	19	51,777	0	N/A	N/A	N/A	N/A
Robeson Twp.	20	80,492	0	N/A	N/A	N/A	N/A
Robesonia Boro.	1	Unavailable	0	N/A	N/A	N/A	N/A
Rockland Twp.	6	60,604	1	2	2	18,614.10	18,614.10
Ruscombmanor Twp.	0	0	0	N/A	N/A	N/A	N/A
Shillington Boro.	2	2,784	0	N/A	N/A	N/A	N/A
Shoemakersville Boro.	2	Unavailable	0	N/A	N/A	N/A	N/A
Sinking Spring Boro.	0	0	0	N/A	N/A	N/A	N/A
South Heidelberg Twp.	3	700	0	N/A	N/A	N/A	N/A
Spring Twp.	7	3,225	0	N/A	N/A	N/A	N/A
St. Lawrence Boro.	4	7,040	0	N/A	N/A	N/A	N/A
Strausstown Boro.	0	0	0	N/A	N/A	N/A	N/A
Tilden Twp.	5	13,280	0	N/A	N/A	N/A	N/A
Topton Boro.	4	28,143	0	N/A	N/A	N/A	N/A
Tulpehocken Twp.	1	1,383	0	N/A	N/A	N/A	N/A
Union Twp.	12	53,364	1	3	3	37,185.77	37,185.77
Upper Bern Twp.	2	186,137	0	N/A	N/A	N/A	N/A
Upper Tulpehocken Twp.	0	0	0	N/A	N/A	N/A	N/A
Washington Twp.	0	0	0	N/A	N/A	N/A	N/A
Wernersville Boro.	2	1,395	0	N/A	N/A	N/A	N/A
West Reading Boro.	2	658	0	N/A	N/A	N/A	N/A
Windsor Twp.	4	9,348	1	2	2	8,944.59	8,944.59
Womelsdorf Boro.	3	4,724	0	N/A	N/A	N/A	N/A

TABLE 2-6
(CONTINUED)

MUNICIPALITY	FLOOD LOSS CLAIMS	TOTAL CLAIMS PAYMENTS ($) 1978-PRESENT	REPETITIVE LOSS PROPERTIES	NUMBER OF CORRESPONDING NFIP CLAIMS	AVERAGE NUMBER OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY	AMOUNT OF CORRESPONDING NFIP CLAIMS ($)	AVERAGE AMOUNT OF NFIP CLAIMS/ REPETITIVE LOSS PROPERTY ($)
Wyomissing Boro.	22	108,819	0	N/A	N/A	N/A	N/A
BERKS COUNTY TOTAL	**727**	**3,807,183**	**31**	**76**	**2.45**	**973,035.47**	**31,388.24**

Note: Column 1 and 2 data current through 1/31/06
Source: HUDEX Report, Policy and Loss Data by Community http://bsa.nfipstat.com/reports/reports.htm and National Flood Insurance Program Repetitive Loss Correction Worksheets for the County of Berks, PA.

As previously mentioned, 13 representative floodplain structures (8 residential and 5 commercial/industrial) from throughout the County were also used to estimate 100-year flood losses via FEMA's Flood Depth-Damage Function (DDF) tables. These 100-year flood losses were used to determine the benefit-cost ratios for implementing various property protection measures (see Section 5.1.3), but can also be used to supplement the regional flood loss estimate. Flood DDF tables were developed by FEMA to estimate structural damage to buildings, building contents, displacement time, and other losses from flood events. DDF tables list typical damages to various residential building types based on the depth of flooding in relation to the structure's first floor elevation. Two of the DDF tables used to prepare 100-year flood loss estimates for the 13 Berks County representative floodplain structures shown as Tables 2-7 and 2-8. Additional DDF tables are included in the appendices. A summary of the loss estimate results from the 100-year flood event for the 13 representative floodplain structures are shown in Tables 2-9 and 2-10. The complete loss estimate results and supporting documentation for these thirteen representative floodplain structures are included in the appendices.

TABLE 2-7
FLOOD DEPTH-DAMAGE FUNCTIONS FOR RESIDENTIAL REPRESENTATIVE STRUCTURES [1]
(ONE- OR TWO-STORY WITH BASEMENT/CRAWLSPACE)

FLOOD DEPTH (FEET)	BUILDING DDF (% DAMAGE BASED ON BRV)	CONTENTS DDF (% DAMAGE BASED ON TOTAL CONTENTS VALUE)	DISPLACEMENT TIME DDF (BASED ON DAYS OF LOST SERVICE)
-2	4	6	0
-1	8	12	0
0	11	16.5	38
1	15	22.5	70
2	20	30	110
3	23	34.5	134
4	28	42	174
5	33	49.5	214
6	38	57	254
7	44	66	302
8	49	73.5	342
>8 [2]	51	76.5	365

NOTES:
1 Values based on FIA's Depth-Damage Data Tables in FEMA's Full Data Benefit-Cost Module for Riverine Flooding, Version 5.2.4 dated November 22, 2004.
2 DDFs values for depths 9 feet or greater were estimated from values listed above.

TABLE 2-8
FLOOD DEPTH-DAMAGE FUNCTIONS FOR COMMERCIAL/INDUSTRIAL REPRESENTATIVE STRUCTURES [1]

FLOOD DEPTH (FEET)	BUILDING DDF BY BUILDING TYPE (% DAMAGE BASED ON BRV)				CONTENTS DDF BY BUILDING TYPE (% DAMAGE BASED ON TOTAL CONTENTS VALUE)				FUNCTIONAL DOWNTIME DDF BY BUILDING TYPE (BASED ON DAYS OF LOST SERVICE)			
	COMMERCIAL ONE-STORY WITH BASEMENT [2] (90 WATER STREET)	COMMERCIAL ONE-STORY WITHOUT BASEMENT (TIKI BAR, POST OFFICE)	COMMERCIAL ONE-STORY WITHOUT BASEMENT (10 WATER STREET)	INDUSTRIAL BUILDING [3] (PENSKE)	COMMERCIAL ONE-STORY WITH BASEMENT [2] (90 WATER STREET)	COMMERCIAL ONE-STORY WITHOUT BASEMENT (TIKI BAR, POST OFFICE)	COMMERCIAL ONE-STORY WITHOUT BASEMENT (10 WATER STREET)	INDUSTRIAL BUILDING [3] (PENSKE)	COMMERCIAL ONE-STORY WITH BASEMENT [2] (90 WATER STREET)	COMMERCIAL ONE-STORY WITHOUT BASEMENT (TIKI BAR, POST OFFICE)	COMMERCIAL ONE-STORY WITHOUT BASEMENT (10 WATER STREET)	INDUSTRIAL BUILDING [3] (PENSKE)
-2	2	0	0	0	3	0	0	0	4	0	0	0
-1	4	0	0	0	6	0	0	0	8	0	0	0
0	5.5	9	4.5	4.5	8.25	13.5	6.75	6.75	11	9	9	9
1	7.5	14	7	7	11.25	21	10.5	10.5	15	14	14	14
2	10	22	11	11	15	33	16.5	16.5	20	22	22	22
3	11.5	27	13.5	13.5	17.25	40.5	20.25	20.25	23	27	27	27
4	14	29	14.5	14.5	21	43.5	21.75	21.75	28	29	29	29
5	16.5	30	15	15	24.75	45	22.5	22.5	30	30	30	30
6	19	40	20	20	29	60	30	30	30	30	30	30
7	22	43	21.5	21.5	33	64.5	32.25	32.25	30	30	30	30
8	24.5	44	22	22	36.75	66	33	33	30	30	30	30
>8	25.5	45	22.5	22.5	38.25	67.5	33.75	33.75	30	30	30	30

NOTES:

1 Values based on FIA's Depth-Damage Data Tables in FEMA's Full Data Benefit-Cost Module for Riverine Flooding, version 5.2.3 dated March 10, 1999.

2 DDFs for Commercial 1 Story with basement based on 1 story structure without basement; building and contents DDFs reduced by 50% to account for commercial building with masonry construction.

3 DDFs for Industrial Buildings based on 1 story structure without basement; building and contents DDFs reduced by 50% to account for commercial building with masonry construction.

TABLE 2-9
SUMMARY OF 100-YEAR FLOOD LOSS ESTIMATE RESULTS FOR RESIDENTIAL REPRESENTATIVE STRUCTURES

FLOODPLAIN REPRESENTATIVE STRUCTURE	BREAKDOWN OF TYPICAL 100-YEAR FLOOD LOSSES ($)			
	BUILDING	CONTENTS	DISPLACEMENT	TOTAL
Hay Creek - Birdsboro	$9,811	$4,415	$3,617	$17,842
Schuylkill River - Union Township	$44,425	$19,992	$18,048	$82,465
Manatawny Creek - Earl Township	$21,185	$9,533	$9,065	$39,783
Swamp Creek -Bechtelsville	$25,973	$11,688	$3,913	$41,574
Sacony Creek - Kutztown	$35,568	$16,005	$11,177	$62,750
Schuylkill River - Shoemakersville	$36,251	$16,313	$10,877	$63,441
Mill Creek - Hamburg	$24,231	$10,904	$3,787	$38,922
Antietam Creek -Stony Creek Mills	$2,959	$1,383	$0	$4,342
TOTAL	**$200,402**	**$90,233**	**$60,484**	**$351,119**

TABLE 2-10
SUMMARY OF 100-YEAR FLOOD LOSS ESTIMATE RESULTS FOR COMMERCIAL/INDUSTRIAL REPRESENTATIVE STRUCTURES

FLOODPLAIN REPRESENTATIVE STRUCTURE	BREAKDOWN OF TYPICAL 100-YEAR FLOOD LOSSES ($)			
	BUILDING	CONTENTS	LOSS OF FUNCTION	TOTAL
Manatawny Creek - Earl Township	$28,328	$42,492	$1,205	$72,024
Laurel Run - Muhlenberg	$58,025	$130,557	$11,653	$200,235
Schuylkill River - Reading	$391,498	$880,871	$95,881	$1,368,251
Laurel Run - Muhlenberg	$22,853	$34,280	$1,394	$58,527
Schuylkill River - Leesport	$67,431	$101,146	$93,299	$261,876
TOTALS	**$568,136**	**$1,189,346**	**$203,432**	**$1,960,914**

2.4.4 Potential Hurricane/Tropical Storm Losses

According to NOAA, Hurricane Floyd in 1999 caused over $1.1 million (2005) in flooding damages to Berks County. Given that such damages are not geographically specific within the County and the intensity of the storms can vary significantly, this value is used as a reasonable estimate of future damages from this hazard.

2.4.5 Potential Land Subsidence Losses

GIS data analysis conducted for the asset identification indicated that there are approximately 116,356 structures in the profiled land subsidence hazard area of Berks County. Given the prevalence of land subsidence in the past, an estimate has been made that up to five percent of these structures (of which 90 percent are residences, eight percent are commercial, and two percent are industrial [based upon GIS data and a windshield survey of the profiled land subsidence hazard area]) could be impacted by subsidence events over time. Therefore, the following losses can be estimated for Berks County's subsidence hazard.

Residential = 5,236 Structures X $100,000 average value per structure X 10% impact* = $52,360,000
Commercial = 465 Structures X $350,000 average value per structure X 5% impact* = $8,137,500
Industrial = 116 Structures X $1.1 million average value per structure X 1% impact* = $1,276,000
Total = $61,773,500 (assumes no content losses)
*% impact is based upon the average cost to structurally mitigate a subsidence feature in relation to the average value per structure

2.4.6 Potential Landslide Losses

GIS data analysis conducted for the asset identification indicated that there are approximately 4,661 structures in the profiled landslide hazard area of Berks County. Based upon windshield survey and the history of past landslide events, it is estimated that only up to five percent (233) of these structures are expected to incur losses due to a landslide event over time. As such, assuming that 95 percent (221) of these structures are residences and five percent (12) are commercial establishments, the following losses are estimated for Berks County's landslide hazard.

Residential = 221 Structures X $100,000 average value per structure X 10% impact* = $2,210,000
Commercial = 12 Structures X $350,000 average value per structure X 5% impact* = $210,000
Total = $2,420,000 (assumes no content losses)
*10% impact assumes some structural damage due to a landslide event

2.4.7 Potential Earthquake Losses

Using HAZUS-MH, a loss estimation model developed by FEMA, loss estimates were calculated for earthquakes in Berks County. Using a scenario that assumed an earthquake of magnitude 5.0 with an epicenter located in Cumru Township, just north of Mohnton (historic epicenter of the 1954 earthquake), HAZUS generated a report that indicated the economic loss

associated with this hazard totaled $48 million (2005) in structural damages. The HAZUS report can be found in the Appendices.

2.4.8 Potential Severe Storm Losses

The best available historic damage estimate associated with severe storms are for the June 1998 severe thunderstorm event, where NOAA reported losses at $174,000 (2005) for Berks County. Given that such damages are not geographically specific within the County and the intensity of the storms can vary significantly, this value is used as a reasonable estimate of future damages from this hazard.

2.4.9 Potential Tornado Losses

The best available historic damage estimate associated with tornadoes is from the May 1998 F3 tornado event where NOAA reported losses at $1.6 million (2005) for Berks County. Given that such damages are not geographically specific within the County and the intensity of tornadoes can vary significantly, this value is used as a reasonable estimate of future damages from this hazard.

2.4.10 Potential Wildfire Losses

GIS data analysis conducted for the asset identification indicated that there are approximately 9,736 vulnerable structures in the profiled wildfire hazard area of Berks County. Based upon windshield survey of the geographic area, it is reasonable to assume that the vast majority of these vulnerable structures consist of residences. As previously mentioned, the largest wildfire to occur in Berks County in the past 25 years resulted in approximately 95 acres of burned area. Using this largest recorded event, and assuming a worst-case scenario of one burned residence per acre of burned area, the following losses can be estimated for Berks County's wildfire hazard.

Residential = 95 Structures X $100,000 average value per structure X 100% impact* = $9,500,000
Total = $9,500,000 (does not include content losses)
*100% impact assumes total loss of structure due to wildfire event

2.5 VULNERABILITY ASSESSMENT: ANALYZING DEVELOPMENT TRENDS

Berks County is located in the southeastern portion of the state and consists of a diverse mixture of land uses. The prominent population center in Berks County is the City of Reading, centrally located in the County along the Schuylkill River. Many of the townships and outlying areas surrounding Reading have, and are continuing to experience, ample suburban development. Designated growth areas depicted in the Berks Vision 2020 Comprehensive Plan are mainly located north, south and west of Reading along Routes 422, 222 and 61 primarily in Spring, Bern and Ontelaunee Townships. Designated growth areas continue down Route 422 along the Schuylkill River mainly in Amity Township, and a pocket of development is focused along Route 100 in Washington Township. In addition to designated growth areas, Berks County has delineated areas outside the designated growth areas as future growth areas. Future growth areas are also dispersed across the County with no great concentration of growth in any one area. This development consists of residential subdivisions, commercial complexes, and industrial parks.

Land use and development trends in the far northern, eastern and southern areas of the County are very different than metropolitan Reading. Other than the small Boroughs and development along major thoroughfares, the County is quite rural. Several permanent open space recreation areas can be found throughout the County which includes federal, state, county, and municipal parkland, recreation facilities, and open space areas including Blue Marsh Lake and Lake Ontelaunee just north of Reading. The remaining rural area land uses include forested, agricultural and rural residential uses.

In regard to assessing the vulnerability of the County's future development to natural hazards, several generalizations can be made. Natural hazards such as drought, hurricanes/ tropical storms, severe storms, and tornadoes have the potential to impact all future development as they are not defined to specific locations of the County. As evidenced by the regional hazard event profile mapping, future development along or near streams and the Schuylkill River have the potential for flooding, or depending on their location, dam failure inundation damage. Future development near Reading and the central portion of the County may be susceptible to sinkholes and earthquakes while the southern municipalities should be aware of landslide potential and wildfires.

2.6 MULTI-JURISDICTIONAL RISK ASSESSMENT

From a natural hazard perspective, none of the County's municipalities exhibits special features or unique characteristics that make them noticeably more or less susceptible to the profiled hazards. As previously mentioned, natural hazards such as drought, hurricanes/tropical storms, severe storms, and tornadoes are not specific to certain parts of the County but rather impact the entire County or any location in the County. Conversely, natural hazards such as dam failures, flooding, land subsidence, earthquakes, landslides, and wildfires are specific to certain locations and jurisdictions within the County as shown on the regional hazard event profile mapping and described in the preceding text.

3.0 HAZARD MITIGATION GOALS

The Mitigation Steering Committee identified and prioritized project-planning goals following the completion of the hazard vulnerability assessment. The findings of the hazard vulnerability assessment were used to develop possible planning goals that would be specifically focused on the County's vulnerability to the profiled natural hazard events and the potential severity (i.e., frequency and magnitude) of those hazard events. These goals, along with an opportunity to identify separate goals, were then presented to the Committee and the general public (in the form of a survey) at the first round of public meetings. The results of the surveys were then compiled and are summarized here. These project-planning goals are consistent with and build upon the goals and policies in Berks Vision 2020, the County's current Comprehensive Plan, as identified in the section addressing Environmental Hazard Areas. As such, these goals represent the County's vision for minimizing damages caused by flooding and other natural hazards.

To prioritize the goals, individual Mitigation Steering Committee members and the public were asked to assign a rank value to each goal based on a scale of 1 to 5, with 1 representing low-priority and 5 representing high-priority. These individual rank values were then tallied for each goal and divided by the total number of responses to come up with a composite prioritization ranking for each goal. These composite prioritization rankings were used to classify the goals as high-, medium-, and low-priority. The project-planning goals identified for the County are listed below (in random order within each priority level) according to their calculated composite prioritization.

3.1 HIGH-PRIORITY HAZARD MITIGATION GOALS

- Identify measures to reduce the County's overall vulnerability to natural hazards.
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County.
- Ensure that emergency response services and critical facility functions are not interrupted by natural hazards.
- Ensure that safe and efficient evacuation routes are available throughout the County.
- Ensure that emergency communications systems are available and adequate at all levels throughout the County.
- Ensure that emergency forecasting and warning programs are adequate throughout the County.

- Ensure local adequacy of existing plans and ordinances from a hazard mitigation perspective.

3.2 MEDIUM-PRIORITY HAZARD MITIGATION GOALS

- Identify cost-beneficial measures to reduce and/or eliminate personal property losses caused by natural hazards.
- Investigate options for the permanent preservation of areas where natural hazard potential is high (i.e., steeply sloping areas, sinkhole areas, floodplains, wetlands, etc.).
- Identify opportunities and options for implementing best management practices that minimize the County's vulnerability to natural hazards.
- Identify appropriate public information/community outreach tools to better inform the County's residents about natural hazards and ways they can protect themselves.
- Consider opportunities and appropriate venues for implementing hazard-related public information programs.
- Ensure that adequate emergency shelters are available throughout the County.
- Ensure that new construction is reasonably resistant to applicable natural hazards.
- Identify additional opportunities throughout the County for implementing preventive actions aimed at minimizing or eliminating natural hazard vulnerability.

3.3 LOW-PRIORITY HAZARD MITIGATION GOALS

- Identify and make recommendations for homeowner-implemented activities to reduce vulnerability to natural hazards.
- Consider the viability of constructing additional flood control projects throughout the County.
- Identify problem areas in the County's existing drainage systems (pipes, culverts, channels) and make recommendations for short- and long-term improvements.
- Investigate the need for structural solutions to the County's wildfire, drought, subsidence, and landslide hazards.

4.0 CAPABILITY ASSESSMENT

4.1 INTRODUCTION

A capability assessment involves an evaluation of the County in regard to its governmental structure, political framework, legal jurisdiction, fiscal status, policies and programs, regulations and ordinances, and resource availability. These factors are evaluated with respect to their strengths and weaknesses in preparing for, responding to and mitigating the effects of the profiled natural hazards. By doing so, the Mitigation Steering Committee can draw reasonable conclusions as to the relative appropriateness of various hazard mitigation action items that may be identified as part of the hazard mitigation strategy. As such, the capability assessment plays an important role in the hazard mitigation planning process.

Within Pennsylvania, no county-level capability assessment would be complete without considering the constituent municipalities. Local municipalities have their own governing body, enforce their own rules and regulations, purchase their own equipment, maintain their own infrastructure, and manage their own resources. In many ways, the County is only as good as the capabilities of its constituent municipalities. As such, this capability assessment does not consider Berks County as a lone entity, but evaluates it in light of the various characteristics and differences of and between its seventy-three constituent municipalities.

4.2 INSTITUTIONAL CAPABILITY

Berks County's seventy-three constituent municipalities include one city, twenty-eight boroughs, and forty-four townships. Each of these municipalities carries out their daily operations and provides various community services according to their local needs and limitations. Some of these municipalities have formed cooperative agreements and work jointly with their neighboring municipalities to provide such services as police protection, fire and emergency response, solid waste disposal, recreational opportunities, wastewater treatment, infrastructure maintenance, and water supply management, while others choose to operate on their own. They vary in staff size, resource availability, fiscal status, service provision, constituent population, overall size, and vulnerability to the profiled hazards.

Certain municipalities in Berks County have fewer residents, less staff, and, by default, a more limited supply of available resources than other municipalities in the more urbanized part of the County. This is not to say, however, that hazard mitigation is not an important factor for the

less populated municipalities. It simply may require a more unified or coordinated approach and/or more efficient utilization of a limited supply of available resources (e.g., financial, technical, and human). For example, Lenhartsville Borough, with its resident population of 173 persons, would not be expected, nor would it be appropriate, to engage in hazard mitigation activities on a scale similar to that of Reading City, with its resident population of 81,207 persons. Rather, Lenhartsville Borough would be expected to engage in hazard mitigation activities according to its local needs and available resources, which may prove to be as valuable to its residents as that of some other municipality's hazard mitigation activities.

In addition to the institutional capability of the municipal government structure described above, the County itself is capable of engaging in hazard mitigation activities. The County has its own staff, resources, budget, equipment, and objectives, which may or may not be similar to those of its constituent municipalities. As such, the County itself has its own capabilities to mitigate the profiled hazards. When partnered with the local municipalities, the state, the federal government, local COGs, watershed groups, environmental groups, or some other entity, the results could be limitless.

4.3 LEGAL CAPABILITY

Within Pennsylvania, municipalities have the authority to govern more restrictively than state and county minimum requirements as long as they are in compliance with all criteria established in the Pennsylvania Municipalities Planning Code and their respective municipal codes. Municipalities can, and typically do, develop their own policies and programs and implement their own rules and regulations to protect and serve their local residents. Local policies and programs are typically identified in a comprehensive plan, implemented via local ordinance, and enforced through the governmental body or its appointee.

Municipalities regulate development via the adoption and enforcement of zoning, subdivision and land development, building code, building permit, floodplain management, and/or stormwater management ordinances. Within the development, adoption, and enforcement of these ordinances, there is an opportunity for hazard mitigation in the form of preventive measures. Most notably is the municipal adoption of NFIP and Pennsylvania Floodplain Management Act (Act 166 of 1978) minimum floodplain management criteria. A municipality must adopt and enforce these minimum criteria to be eligible for participation in the NFIP. As such, municipalities have the option of adopting a single-purpose ordinance or incorporating these provisions into

their zoning, subdivision and land development, or building code ordinances, thereby mitigating the potential impacts of local flooding in a preventive manner.

Berks County is committed to regional planning and intergovernmental cooperation. In 1997, the Berks County Board of Commissioners adopted an Intergovernmental Cooperation Policy which reinforced this commitment. Four programs have been implemented at the County level including the Joint Local Comprehensive Planning Program; Joint Zoning Program; Agricultural Zoning Incentive Program (AZIP); and Existing Developed Areas Program (EDAP). These programs allow municipalities with limited resources to work together while also encouraging regional cooperative efforts.

The Capability Assessment Matrix included in the Appendices has been prepared to document the County's and its constituent municipalities' existing legal capabilities to mitigate the profiled hazards in a preventive manner. This matrix identifies the municipalities' existing planning documents, thereby indicating their level of hazard mitigation planning. Preventive measure hazard mitigation recommendations are based on the information contained in this matrix.

4.4 FISCAL CAPABILITY

Finances can be an important factor in the capability of any jurisdiction to implement hazard mitigation activities. Every jurisdiction, including those in Berks County, must operate within the constraints of limited financial resources. As such, the key factor in determining fiscal capability is to analyze how tight these constraints are. This could involve a detailed auditing process to tally all revenues and expenditures, or could involve an assessment of existing financial ratings as identified and reported by the PA DCED. For the purposes of this planning program, the Mitigation Steering Committee elected to use the existing financial ratings reported by the PA DCED as a base indicator of fiscal capability at the municipal level.

The Pennsylvania Municipalities Financial Recovery Act (Act 47 of 1987) identified fiscally distressed municipalities based on established criteria, and authorized the PA DCED to assist in developing financial recovery plans in these areas. Analysis of the Act 47 fiscally distressed municipality list indicated that none of Berks County's municipalities were identified as being fiscally distressed according to the established rating criteria. However, in accordance with Section 1303 of the Pennsylvania Job Enhancement Act (73 P.S. Section 400.1303) the PA DCED designated several Berks County municipalities as distressed communities based on their ability to meet at least three of the following five criteria.

- Twenty percent or more of the population with incomes below the poverty level as reported in the latest decennial census.
- Fifteen percent or more of the labor force is unemployed as reported in the census or as reported in a survey done by the municipality.
- Five percent or more loss of population as reported in the census.
- Significant business vacancy rate within the area, either in gross footage or acreage or in the number of business or industrial buildings.
- Significant reduction in employment.

Those Berks County municipalities that are designated as distressed communities under the Job Enhancement Act include:

- Bern Township,
- Cumru Township,
- Jefferson Township,
- Kutztown Borough,
- Leesport Borough,
- Lyons Borough,
- Marion Township,
- Maxatawny Township,
- North Heidelberg Township,
- Perry Township,
- Reading City,
- Richmond Township,
- Shoemakersville Borough,
- South Heidelberg Township,
- Spring Township,
- Tulpehocken Township, and
- Wyomissing Borough.

While this distressed community designation may provide some insight into the fiscal capability of the subject municipalities, it most certainly does not preclude these municipalities from participating in hazard mitigation activities. Cooperative arrangements, coordinated efforts, and resource efficiency may serve as effective avenues for overcoming fiscal constraints and accomplishing hazard mitigation objectives at the local level.

It is important to remember that finances are not the only factor in determining fiscal capability. There are numerous partnering opportunities and grant programs available to assist in offsetting the expenses of local hazard mitigation efforts. Thanks to the Pennsylvania Department of Environmental Protection's (PA DEP) Growing Greener grant program there are numer-

ous watershed associations available for municipalities to partner with to accomplish hazard mitigation activities. Within Berks County, watershed associations have been formed for:

- Allegheny Creek,
- Cocalico Creek,
- Furnace Creek,
- Hay Creek,
- Little Swatara Creek,
- Maiden Creek,
- Mill Creek,
- Schuylkill Action Network,
- Tulpehocken Creek and Blue Marsh Lake, and
- Pine Creek.

In addition, there are partnering opportunities at the local level with the Berks County Conservation District (BCCD), Berks County Planning Commission (BCPC), Delaware River Basin Commission (DRBC), BEMA and the Western Berks Council of Governments (WBCOG). Grant programs that may be utilized to accomplish hazard mitigation objectives include the PA DCED's Land Use Planning and Technical Assistance (LUPTAP), Shared Municipal Services (SMS), Community Revitalization (CR), and Floodplain Land Use Assistance Programs; the PA DEP's Growing Greener, Act 167 Stormwater Management, Source Water Protection, and Flood Protection Programs; the PA DCNR's Community Conservation Partnership Program; PEMA's Pre-Disaster Mitigation (PDM) Grant and Flood Mitigation Assistance Programs (FMAP); the Pennsylvania Infrastructure Investment Authority's (PennVEST) low interest loan and grant program; and various other federal and state programs.

4.5 POLITICAL CAPABILITY

Political capability refers to a jurisdiction's incentive or willingness to accomplish hazard mitigation objectives. Local decision makers may not rank hazard mitigation as a high priority task if there hasn't been a disaster in recent history or if there are other more immediate political concerns. Unfortunately, there is no better way to get people thinking about hazard mitigation than to have a disaster occur. Responding to and recovering from a disaster event can exhaust local resources, thereby elevating hazard mitigation to the forefront of political agendas. This reactionary effort, while somewhat nominal in value during the aftermath of a disaster event, can go a long way in preparing for and mitigating future events.

Within Berks County, many long-term residents and business owners remember the devastation that was caused by Hurricane Agnes in June 1972. The Agnes flood event is the flood of record for the Schuylkill River in Berks County. If not the Agnes event, most Berks County residents can recall the June 1998 F3 tornado that swept through Lyons Borough, Maidencreek, Maxatawny and Richmond Townships leaving behind $1.4 million in damages. And most recently, the floods of 2006 left portions of Berks County under water in June 2006. Given these relatively significant recent event and the severity of the 1972 Agnes event, the political capability of Berks County should not be an issue when planning for and implementing local hazard mitigation activities, as long as the activities are generally accepted by the public and perceived to be relatively cost-beneficial.

4.6 TECHNICAL CAPABILITY

Technical capability refers to a jurisdiction's availability of resources (other than financial) and knowledge/skill level to accomplish hazard mitigation objectives. Necessary resources typically include personnel (paid or volunteer), equipment/machinery, and materials/supplies. Without the necessary resources, all other measurements of a jurisdiction's capability (i.e., institutional, legal, fiscal, and political) to accomplish hazard mitigation are moot. Conversely, resource availability is moot if the jurisdiction does not have the knowledge/skill level necessary to effectively accomplish the designated hazard mitigation objective. As such, technical capability (i.e., resource availability and knowledge/skill level) is an important factor when analyzing a jurisdiction's ability to accomplish hazard mitigation objectives.

Within Berks County, technical capability varies between the municipalities. Even neighboring municipalities may exhibit extreme variations in technical capability. Generally speaking, the more financial resources a municipality has, the more technically capable it will probably be from a resource availability perspective. This is not necessarily the case, however, when analyzing technical capability from a knowledge/skill level perspective. As such, technical capability must be analyzed by each individual municipality prior to implementing any hazard mitigation activities. It is important to note, however, that much like fiscal capability, shortfalls in technical capability may be overcome by cooperative arrangements, coordinated efforts, and/or resource efficiency.

In the case of Berks County, municipal staffing, while highly variable, is supported by a network of professional personnel through the BCPC, BCCD, BEMA, and other organizations and offices of the County. Many of these offices also draw upon extensive volunteer support. Such is

the case for BEMA, who has an extensive training and support program for the EMCs who are located in each municipality of the County. These EMCs have played a key role in the development of this plan and will play pivotal roles in its implementation. Therefore, given the municipal and County staffing available and the expertise of the County's many trained volunteers, technical capability does not appear to be a limiting factor for the implementation of the hazard mitigation plan.

5.0 HAZARD MITIGATION STRATEGY

5.1 IDENTIFICATION AND ANALYSIS OF HAZARD MITIGATION MEASURES

5.1.1 Preventive Measures

Preventive measures are designed to minimize the potential development of new natural hazard problems and are intended to keep such problems from becoming worse. They ensure that future land development projects do not increase local and/or regional natural hazard damage potential. Preventive measures are usually administered by local building, zoning, planning, and/or code enforcement officials and typically include the following:

- land use planning/zoning efforts;
- subdivision and land development ordinances;
- building codes;
- floodplain development regulations;
- stormwater management;
- operations and maintenance (O&M) procedures;
- subsurface investigation requirements;
- public education programs; and
- burning restrictions

Implementation of preventive measures of this nature will work towards the fulfillment of the following high and medium-priority project planning goals as identified by the Mitigation Steering Committee.

- Identify measures to reduce the County's overall vulnerability to natural hazards (High Priority).
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County (High Priority).
- Ensure local adequacy of existing plans and ordinances from a hazard mitigation perspective (High Priority).
- Ensure that new construction is reasonably resistant to applicable natural hazards (Medium Priority).
- Identify additional opportunities throughout the County for implementing preventive actions aimed at minimizing or eliminating natural hazard vulnerability (Medium Priority).

5.1.1.1 Land Use Planning/Zoning Efforts

Comprehensive plans and other similar land use plans define how and where a community, region, or area should be developed. Similarly, zoning ordinances regulate development by dividing a community or region into zones or districts and establishing specific development criteria for each zone or district. As such, comprehensive/land use plans and zoning ordinances can be developed to include provisions for the area's known natural hazards. For example, a comprehensive/land use plan can include an assessment and associated mapping of the respective area's vulnerability to location-specific hazards (e.g., dam failure, flooding, landslides, land subsidence, earthquakes, and wildfires) and make appropriate recommendations for the planned use of these known hazard areas. Similarly, a zoning ordinance can include separate zones or districts with appropriate development criteria for these known hazard areas. As such, the Mitigation Steering Committee identified the following Preventive Measure (PM) Hazard Mitigation Measures to be implemented within the County.

PM-1: As Comprehensive Plans are developed or updated, include an assessment and associated mapping of the municipality's vulnerability to location-specific hazards and incorporate appropriate recommendations for the use of these hazard areas.

PM-2: As Zoning Ordinances are developed or revised, either include separate zones or districts with appropriate development criteria for known hazard areas or incorporate such criteria within existing districts where hazards are known to exist.

PM-3: Make available for municipal use the digital natural hazard mapping files that were developed as part of this hazard vulnerability assessment and mitigation planning effort.

PM-4: Continue to maintain and update the County GIS structure layer to better define hazard-prone structures.

5.1.1.2 Subdivision and Land Development Ordinances

Subdivision and land development ordinances regulate how land can be subdivided into individual lots and establish certain standards/criteria for the location and construction of buildings and associated infrastructure (i.e., roads, sidewalks, utility lines, stormwater management facilities, etc.). As such, local subdivision and land development ordinances can be written to include municipality-specific, hazard mitigation-related development criteria for the location and construction of buildings and other infrastructure in known hazard areas in an effort to avoid future damages and minimize existing problems. Examples of some hazard mitigation-related development

criteria include watershed-specific stormwater management regulations, land use-specific erosion and sedimentation control requirements, hazard-specific building and infrastructure location limitations, and a requirement to incorporate various pre-defined, municipality-specific hazard mitigation/prevention measures into all development plans. Along these same lines, the mandatory use of conservation subdivision design principles could also be employed to minimize/ mitigate the potential impacts of natural hazards. Conservation subdivision design principles involve clustering homes/development in a proposed subdivision to avoid known hazard areas (i.e., steep slopes, floodplains, etc.) and environmentally sensitive resources (i.e., wetlands, critical wildlife habitats, etc.), thereby developing the most appropriate land while permanently establishing a network of protected open spaces (additional information on these "Growing Smarter" land use concepts is included in the appendices for reference purposes). As such, the Mitigation Steering Committee identified the following Preventive Measure Hazard Mitigation Measure to be implemented within the County.

PM-5: As Subdivision and Land Development (SLD) Ordinances are developed or revised, include municipality-specific, hazard mitigation-related development criteria and/or provisions for the mandatory use of conservation subdivision design principles in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.

PM-6: As SLD Ordinances are developed or revised, they should include municipality-specific development criteria and/or provisions that require proper access (for emergency vehicles) to hazard prone residential developments (i.e., Urban/ Wildland Interface areas). Such criteria should be developed in cooperation with the municipal EMCs and/or emergency personnel.

5.1.1.3 Building Codes

Building codes regulate the construction, renovation, and alteration of new and existing structures by establishing minimum building standards and providing for routine inspections by a certified building code inspector. As such, local building codes can include specific standards for hazard-resistant construction. Examples of some hazard mitigation-related building standards include requiring the use of fireproof/resistant building materials, specifying particular construction practices to promote wind resistance, specifying the use of waterproof/resistant building materials in known flood hazard areas, and requiring certain foundation and structure anchoring specifications in known floodwater velocity areas. In Pennsylvania, a state law was passed in 1999 establishing a statewide Uniform Construction Code (UCC). The law establishes the BOCA National Building Code (and its successor codes) as the minimum standard for the construction,

alteration, and repair of commercial and residential structures throughout the Commonwealth. While the UCC includes some general hazard mitigation-related building standards, some hazard-prone municipalities may find it appropriate to adopt more stringent building standards to ensure hazard resistant construction. As such, the Mitigation Steering Committee recognized the ongoing implementation of the UCC and the potential local adoption of more stringent standards for hazard resistant construction as a Preventive Measure Hazard Mitigation Measure for the County.

PM-7: Enforce the minimum building standards of the Pennsylvania Uniform Construction Code and/or consider the potential adoption of more stringent building standards to ensure hazard-resistant construction.

5.1.1.4 Floodplain Development Regulations

Floodplain development regulations establish regulatory criteria for the construction and/or alteration of buildings and other development located in the 100-year floodplain in an effort to minimize potential flood-related damages and ensure that new development does not exacerbate local flood hazards. Municipalities that participate in the NFIP must adopt and enforce floodplain development regulations that meet or exceed minimum NFIP standards and requirements. NFIP floodplain development regulations prohibit obstruction of the regulatory floodway and require new buildings being constructed in the 100-year floodplain to be protected from damage by the base flood (i.e., 100-year or 1% annual chance flood). NFIP floodplain development regulations are intended to prevent loss of life and property as well as economic and social hardships that result from flooding.

In addition to these minimum federal requirements, the Pennsylvania Floodplain Management Act (Act 166 of 1978) established more restrictive floodplain development regulations. Act 166 discourages the construction of hospitals, nursing homes, jails, and mobile home parks in the floodplain and prohibits development that “may endanger human life” in the regulatory floodway. Such development includes that which would require the production or storage of hazardous and radioactive materials. Floodplain development regulations can be incorporated into a municipality’s existing codes/ordinances or can be adopted as a separate, stand-alone ordinance. As such, the Mitigation Steering Committee identified the following Preventive Measure Hazard Mitigation Measures to be implemented within the County.

PM-8: Ensure municipal compliance with, and continued enforcement of, NFIP and PA Act 166 floodplain development regulations and/or encourage more restrictive requirements, as appropriate.

PM-9: Develop a municipal Memorandum of Understanding with the County Floodplain Management Coordinator that allows her/his review and concurrence on plans for proposed construction or substantial improvement of existing construction in the floodplain.

PM-10: Confirm that existing municipal Floodplain Ordinances include a provision for all new development requiring 50-foot setbacks from top of bank in areas without defined floodway boundaries and ensure the enforcement of this provision.

5.1.1.5 Stormwater Management

Effective management of stormwater runoff from developed areas can go a long way in minimizing local and regional drainage problems and associated flooding hazards. In addition, stormwater management practices that promote infiltration work towards the minimization of drought impacts by contributing to the base flow of local streams and watercourses. Stormwater management regulations, which are usually incorporated into a municipality's subdivision and land development ordinance, require developers to construct on-site stormwater management facilities that will effectively collect, convey, and store surface water runoff.

According to its Web site, much of Berks County has Act 167 Stormwater Management Plans either approved or underway. The designated watersheds without such plans are Manatawny Creek, Perkiomen Creek, Swatara Creek, French Creek, and the Little Schuylkill River (http://www.co.berks.pa.us/planning/cwp/view.asp?a=1165&Q=466063&PM=1&planningNav=|26458|).

PA DEP has recently shifted from funding most stormwater management plans on a watershed basis to county-level studies covering multiple watersheds, with seven pilot county plans currently in various stages. These watershed-specific Act 167 Stormwater Management Plans establish stormwater management criteria based on the hydrologic and hydraulic characteristics of the subject watershed. Within six months of County adoption of an Act 167 Stormwater Management Plan, the respective watershed municipalities must adopt and enforce the stormwater management ordinance included in the Plan. As such, the Mitigation Steering Committee identified the following Preventive Measure Hazard Mitigation Measure to be implemented within the County.

PM-11: Complete the Act 167 Plans that are currently underway and ensure municipal compliance with all watershed-specific Act 167 Stormwater Management Plans and Ordinances while lobbying PA DEP to provide the necessary funding and support to prepare a plan that covers all of Berks County.

5.1.1.6 Operations and Maintenance Procedures

Effective implementation of appropriate operations and maintenance (O&M) procedures at Berks County's high hazard dams are fundamental to the prevention of a potential failure. Routine inspections, regular maintenance and continual Emergency Action Plan review are the most critical measures that can be taken to prevent a dam failure. As such, the Mitigation Steering Committee recognized the existing O&M procedures at these dams and identified the continued implementation of these O&M procedures as a Preventive Measure Hazard Mitigation Measure for the County.

PM-12: Ensure continued implementation of appropriate O&M procedures (routine inspections, regular maintenance and continual updates to the EAP) at the County's high hazard dams in an effort to prevent a potential failure.

5.1.1.7 Subsurface Investigation Requirements

Subsurface investigation requirements for new subdivision and land development projects in known land subsidence hazard areas can prevent costly, and sometimes irreparable, structural damage caused by sinkholes. Subsurface investigation requirements in the form of borings, geophysical surveys, and/or studies conducted by a registered Professional Geologist can be incorporated into a municipality's existing zoning and/or subdivision and land development ordinances or can be adopted as a separate, stand-alone ordinance. While existing structures would continue to be susceptible, local implementation of this type of ordinance provision would successfully reduce the potential for new construction to be damaged by the land subsidence hazard. As such, the Mitigation Steering Committee identified the following Preventive Measure Hazard Mitigation Measure to be implemented within the County.

PM-13: Revise existing zoning and/or subdivision and land development ordinances or adopt a separate, stand-alone ordinance to require the completion of subsurface investigations (i.e., borings, geophysical surveys, and/or studies by a registered Professional Geologist) for all new subdivision and land development projects in known land subsidence hazard areas.

5.1.1.8 Public Education Programs

Public education programs can be implemented as a preventive hazard mitigation measure when dealing with hazards that have the potential to be induced by human activity. Public education can counter the viability of these hazards and diminish their frequency of occurrence. A good example of a public education program that has successfully decreased the number of occurrences of human-induced incidents is the U.S. Forest Service's use of Smokey the Bear. Since the development of Smokey the Bear, the number of wildfires caused by children playing with matches has decreased dramatically. Within Berks County, the only natural hazard that has the potential to be human-induced is wildfire. As such, the Mitigation Steering Committee identified the implementation of a public education program aimed at minimizing human-induced wildfires as a Preventive Measure Hazard Mitigation Measure to be implemented at the County level. This public education program is to be a joint effort between BEMA and the PA DCNR Bureau of Forestry and is to consist of the development and mass distribution of an informative brochure and training for local officials on Pennsylvania's Firewise Communities Program. In addition, the Mitigation Steering Committee identified municipal enrollment in the Pennsylvania Firewise Communities Program as a Preventive Measure Hazard Mitigation Measure for the County.

PM-14: Implement a wildfire-prevention public education program consisting of the development and distribution of an informative brochure and training for local officials on Pennsylvania's Firewise Communities Program.

PM-15: Municipalities with identified wildfire potential should enroll in the Pennsylvania Firewise Communities Program.

5.1.1.9 Burn Restrictions

Open burn restrictions and burning ordinances for municipalities in known wildfire hazard areas can reduce or prevent property damage and loss of valuable forested tracts located throughout the County. Wildfires in the Urban/Wildland Interface areas not only endanger the forest and residents, but also the fire department personnel who respond to those fires, often on roads that do not allow easy access to remote areas. Municipalities concerned with wildfire hazards can create and adopt a Burn Ordinance that promotes public health, safety and welfare by imposing bans on the open burning of debris, lawn clippings, leaves, etc. during set times

throughout the year, or during unseasonably dry parts of the year. The ordinance can be created as a stand-alone ordinance that focuses on the portion of the municipality most at risk. As such, the Mitigation Steering Committee identified the following Preventive Measure Hazard Mitigation Measure to be implemented within the County.

PM-16: Adopt an ordinance to ban open burning during designated times of the year in wildfire hazard areas or throughout the municipality.

5.1.2 Emergency Services

Emergency services measures protect people during and immediately following a natural hazard event. Counties and municipalities typically develop an Emergency Operations Plan (EOP) to formally document their emergency preparedness and response planning. The local EOP identifies standard operating procedures for various emergency management personnel and establishes the location and operating conditions of the emergency operations center (EOC). As such, adopting and implementing the EOP is a critical first step in providing local emergency services measures in response to a natural hazard event. Berks County, and all 73 of its constituent municipalities, recently updated their EOPs in 2003. With this critical plan in place, Berks County can investigate more specific emergency service measures which can be implemented at the local, county, state, and/or Federal level, depending on the severity of the hazard event, and typically include the following:

- hazard warning;
- hazard response;
- critical facilities protection;
- health and safety maintenance; and
- post-disaster recovery and mitigation.

Implementation of these emergency services measures will work towards the fulfillment of the following project-planning goals as identified by the Mitigation Steering Committee.

- Identify measures to reduce the County's overall vulnerability to natural hazards. (High Priority)
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County. (High Priority)
- Ensure that emergency response services and critical facility functions are not interrupted by natural hazards. (High Priority)

- Ensure that safe and efficient evacuation routes are available throughout the County. (High Priority)
- Ensure that emergency communications systems are available and adequate at all levels throughout the County. (High Priority)
- Ensure that emergency forecasting and warning programs are adequate throughout the County. (High Priority)
- Ensure that adequate emergency shelters are available throughout the County. (Medium Priority)

5.1.2.1 Hazard Warning

The first step in dealing with a natural hazard is to know that one is coming. Early warning of a pending hazard enables residents and business owners to secure their property to the greatest extent possible and move to safety before putting themselves at risk. Effective mitigation involves both accurate forecasting and broadly based warning procedures. In regard to flooding, forecasting and warning services are provided for Berks County by the NWS Mid-Atlantic River Forecast Center in State College, Pennsylvania. The flood forecast and warning system uses a network of gauges that measure streamflow and rainfall to provide data for forecasting river levels and issuing accurate early warnings. Flood forecasts useful to Berks County are issued for the U.S.G.S. stream gauges on the Schuylkill River at Berne, Blue Marsh Dam and Reading.

Hazard warning programs generally have two levels of notification:

- hazard watch – conditions are right for a suspected hazard, and
- hazard warning – a specific hazard has started or is expected to occur.

Under certain conditions, the NWS may issue a “flash flood watch”. This means the amount of rain expected may cause rapid increases in local stream flows and/or localized ponding. However, these events are so localized and so rapid that a “flash flood warning” is seldom issued. Warnings from the NWS are relayed to municipalities by County EMAs, who monitor weather radio and broadcast networks. County EMAs are alerted by PEMA.

After the Flood Forecast and Warning System alerts the local EMC that a flood is coming, the next step is to notify the other local emergency management personnel and the public that a flood is imminent. The earlier and more accurate the warning, the greater the number of people

who can implement protection measures. A flood or other natural hazard warning may be disseminated in a variety of ways, including the following:

- sirens;
- NOAA Weather Radio;
- commercial or public radio stations;
- commercial or public television stations;
- cable TV emergency news inserts on community bulletin boards;
- mobile public address systems;
- telephone trees;
- Internet weather related sites;
- municipal/county/state Internet sites; and
- door-to-door contact.

Multiple or redundant systems are most effective: if people do not hear one warning, they may still get the message from another part of the system.

Given the potentially life-saving importance of hazard warning programs, the Mitigation Steering Committee identified the following Emergency Services (ES) Hazard Mitigation Measures to be implemented within the County.

ES-1: Develop a real-time Web portal that would provide a link to Berks County information (i.e., County Web site - http://www.co.berks.pa.us/berks/site/default.asp) during non-emergencies, but act as an extension of the Emergency Alert System in times of pending disaster and during a disaster.

ES-2: Participate in the NWS's StormReady Program, a nationwide program that helps communities develop plans to handle all types of severe weather.

ES-3: Establish a partnering relationship with the NWS Mid-Atlantic River Forecast Center to enhance the existing Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program.

ES-4: Install a NOAA weather radio transmitter/repeater in Berks County to improve signal strength and quality.

ES-5: Coordinate with the U.S.G.S., local watershed organizations, and/or the BCCD to increase the number of U.S.G.S. and Integrated Flood Observing and Warning System (IFLOWS) rain and stream gauges in the County as a potential enhancement to the existing Delaware River Basin Flood Forecast and Warning System.

ES-6: Increase the number of NOAA Weather Alert radios in public places and other critical facilities across the County (i.e., municipal buildings, public libraries, police stations, fire stations, etc).

ES-7: Provide high bandwidth wireless service and/or alphanumeric pagers for local EMCs as a means of improving the County's warning dissemination program.

ES-8: Conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event.

ES-9: Ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level.

ES-10: Develop and implement a reverse 9-1-1 system; also known as Interactive Communication Notification System.

5.1.2.2 Hazard Response

After a potential hazard is recognized, the first priority is to alert others through the local warning dissemination program. The second priority is to respond with actions that can prevent or reduce damage and injuries. These actions are typically defined as standard operating procedures in an EOP. An updated EOP ensures that all bases are covered and that the response activities are coordinated and appropriate for the expected hazard. Drills and practice exercises should be conducted on a routine basis to ensure that all emergency management personnel understand their assigned duties and are capable of accomplishing them. The result is a coordinated and appropriate response that demonstrates maximum efficiency in the use of available and otherwise limited resources.

Given the potentially life-saving importance of hazard response activities, the Mitigation Steering Committee identified the following Emergency Services Hazard Mitigation Measures to be implemented within the County.

ES-11: Respond to hazards with actions that are consistent with the local EOP.

ES-12: Conduct hazard response practice drills and emergency management training exercises on an annual basis.

ES-13: Create locally coordinated snow routes in municipalities where snow removal is limited or difficult during major winter storm events.

ES-14: Implement a system similar to PennDOT's RWIS (Road and Weather Information System) that will monitor major arteries in Berks County and report this information to the County's Web site.

ES-15: Install cameras along major arteries in Berks County to monitor traffic flow. Accessibility to these cameras should be provided to the County EOC, 911 Center and also on the County's Web site.

ES-16: Provide generators for every municipal EOC and possibly those critical facilities that do not currently have one.

ES-17: Provide battery backup systems for traffic control systems throughout the County.

ES-18: Revise and update evacuation plans on a consistent basis.

ES-19: Conduct routine inspections, regular maintenance, and annual tests on all emergency response equipment.

5.1.2.3 Critical Facilities Protection

Protecting critical facilities during a hazard event is a vital part of any emergency services effort. If a critical facility is threatened and/or damaged during a hazard event, workers and resources may be drawn away from protecting and assisting other hazard-prone areas of the community. However, if the vulnerable critical facility was adequately prepared, it would be better able to support (or at least not detract from) the community's hazard response efforts. The Mitigation Steering Committee used the Critical Facilities Inventory and regional hazard event profile mapping included in the appendices and GIS data analysis to identify vulnerable critical facilities throughout the County, including those that are located in natural hazard-prone areas. As such, the Mitigation Steering Committee identified the following Emergency Services Hazard Mitigation Measure to be implemented within the County.

ES-20: Encourage the owners/operators of critical facilities in natural hazard areas to develop and implement an emergency response plan to mitigate potential impacts. --OR-- EMA should consider partnering with the owners/operators of critical facilities to provide adequate planning and protection.

5.1.2.4 Health and Safety Maintenance

Preventing and/or minimizing potential threats to public health and safety during and immediately following a natural hazard event are critical. After a disaster, many people are more interested in returning to and repairing their damaged properties than in taking personal health and safety precautions. Many flood-related drowning victims put themselves in a dangerous situation by ignoring travel warnings and driving through a flooded area, not realizing that the bridge has washed out. Cars can float in less than two feet of moving water and can be easily swept downstream into deeper waters. As such, drowning in vehicles is the number one cause of

flood-related deaths. Interestingly, the second most frequent cause of flood-related deaths is through electrocution by way of floodwaters carrying a live electrical current.

Also of concern is what can be carried by floodwaters from upstream areas. Floodwaters pick up and carry whatever was on the ground upstream. This can include trash, oil, pesticides, and industrial chemicals. During significant flooding events, wastewater treatment plants can be inundated and sewer lines can back up. This can result in untreated sewage mixing with floodwaters, further increasing the public health risk.

Given the potentially life-saving importance of health and safety maintenance activities, the Mitigation Steering Committee identified the following Emergency Services Hazard Mitigation Measures to be implemented within the County.

ES-21: Develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events.

ES-22: Encourage rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed.

5.1.2.5 Post-Disaster Recovery and Mitigation

After a natural disaster occurs, local governments should engage in activities that will better prepare people and property for the next disaster. These activities are implemented during the post-disaster recovery period to prevent people from immediately going “back to normal” (i.e., the way they were before the disaster) in their potentially hazard-prone location and condition. These post-disaster activities typically include such things as requiring permits, conducting inspections, and enforcing the NFIP substantial improvement/substantial damage regulations. Unfortunately, these activities can be very difficult on a post-disaster basis, especially for smaller and/or understaffed municipalities. However, if these activities are not carried out properly, not only does the municipality miss an opportunity to redevelop or clear out its known hazard areas, but it may also be violating its obligations under the NFIP. As such, the Mitigation Steering Committee identified the following Emergency Services Hazard Mitigation Measures to be implemented within the County.

ES-23: Develop a technical proficiency at the municipal level for conducting post-disaster damage assessments and regulating reconstruction activities to ensure compliance with NFIP substantial damage/substantial improvement requirements.

ES-24: Develop a technical proficiency at the municipal level for assisting local residents and business owners in applying for hazard mitigation and assistance funds and identifying cost-beneficial hazard mitigation measures to be incorporated into reconstruction activities.

ES-25: Continue to maintain/update the Berks EMA Web site that contains information related to the hazard plan and educational materials for hazard mitigation measures (www.co.berks.pa.us/ema/cwp/view.asp?a=1256&q=465412&emaNav=|27168|). Also provide a link to FEMA's "DisasterHelp" Web site on the Berks EMA Web site (https://www.disasterhelp.gov/portal/jhtml/index.jhtml).

5.1.3 Property Protection

Property protection measures are used to minimize an existing structure's vulnerability to a known hazard rather than trying to modify or control the hazard itself. Property protection measures involve improvements to privately owned property and must therefore be coordinated (and potentially even cost-shared) with the respective property owners. Many of these measures do not affect the appearance or use of the structure, making them particularly appropriate for historical sites or landmarks. Implementation of a property protection measure typically requires acquisition of a local building permit and associated coordination with the local building, zoning, planning, and/or code enforcement office. Property protection measures include the following:

- relocation/acquisition;
- elevation;
- floodproofing;
- insurance;
- brush/shrub removal; and
- emergency response planning.

Implementation of property protection measures of this nature will work towards the fulfillment of the following project-planning goals as identified by the Mitigation Steering Committee.

- Identify measures to reduce the County's overall vulnerability to natural hazards (High Priority).
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County (High Priority).
- Identify cost-beneficial measures to reduce and/or eliminate personal property losses caused by natural hazards (Medium Priority).
- Identify and make recommendations for homeowner-implemented activities to reduce vulnerability to natural hazards (Low Priority).

As previously mentioned, 13 representative floodplain structures were identified from throughout the County (see Section 2.4.3) and analyzed to determine approximate loss estimates for the 100-year flood event. These 100-year flood loss estimates, along with additional structure-specific information collected in the field, were input into FEMA's Benefit-Cost Analysis (BCA) Limited Data Module to determine the cost-effectiveness of implementing various property protection measures for these 13 representative floodplain structures. In FEMA terms, cost-effectiveness is measured by means of a benefit-cost ratio, which is a ratio of project benefits to project costs. If the project benefits exceed the project costs, the benefit-cost ratio is greater than 1.0 and the project is considered to be cost-effective; if the project benefits do not exceed the project costs, the benefit-cost ratio is less than 1.0 and the project is not considered to be cost-effective.

While project costs are relatively simple to estimate, calculating project benefits can be much more difficult because they involve the damages avoided as a result of a property protection project from flood events of varying frequency and intensity that can occur over the life of the project. For this reason, FEMA developed the BCA Modules to aid users in estimating project benefits and computing benefit-cost ratios.

The benefit-cost analyses conducted for the 13 representative floodplain structures considered alternative property protection measures as listed below.

- Relocation – Moving the existing structure outside of the floodplain
- Acquisition – Buying and demolishing the existing structure
- Elevation – Raising the existing structure on a foundation constructed above the flood elevation
- Dry Floodproofing – Making the structure watertight by strengthening the structural elements and using sealants and shields to resist low-level flood events
- Wet Floodproofing – Using flood-resistant materials and protecting utilities and other equipment to resist flood damage when waters enter the structure

A summary of the benefit-cost analysis results for the 13 representative floodplain structures is shown in Tables 5-1 and 5-2. The complete results (including supporting documentation) of the benefit-cost analyses are included in the Appendices. These benefit-cost ratios were used to assist in the identification of an appropriate property protection measure for each of the 13

representative floodplain structures. Ideally, a benefit-cost ratio should be higher than 1.0 to be considered reasonably grant-eligible. Lower ratios still provide a relative degree of project feasibility, but are also indicative of projects that may require private funding or funds from sources other than FEMA grants. The representative floodplain structures and their identified property protection measure were then used to develop a guide to identifying and selecting an appropriate property protection measure. This guide (see Table 5-3) takes into consideration the type/use of the structure, the foundation of the structure, and the associated 100-year flood impact to make a general recommendation on the most appropriate property protection measure for any given structure in Berks County. As such, this guide can be used throughout the County to assist in the identification and selection of appropriate property protection measures. Additional information on property protection measures and how they apply to the 13 representative floodplain structures is provided below. In accordance with PEMA directives, Hazard Mitigation Opportunity Forms for the 13 representative floodplain structures are in the Appendices.

TABLE 5-1
SUMMARY OF BENEFIT-COST ANALYSIS RESULTS FOR RESIDENTIAL REPRESENTATIVE STRUCTURES

FLOODPLAIN REPRESENTATIVE STRUCTURE	BENEFIT-COST RATIO BY FLOOD MITIGATION METHOD				
	ELEVATION	RELOCATION	WET FLOODPROOFING	DRY FLOODPROOFING	ACQUISITION
Hay Creek – Birdsboro	0.03	0.05	N/A	0.04	0.06
Schuylkill River – Union Township	1.18	1.02	0.30	N/A	0.57
Manatawny Creek – Earl Township	0.55	0.47	N/A	N/A	0.73
Swamp Creek – Bechtelsville	N/A	0.48	0.47	N/A	0.38
Sacony Creek – Kutztown	1.30	0.98	0.45	N/A	0.54
Schuylkill River – Shoemakersville	0.64	0.50	N/A	N/A	0.45
Mill Creek – Hamburg	N/A	0.14	0.13	N/A	0.08
Antietam Creek – Stony Creek Mills	N/A	0.02	0.05	N/A	0.01

N/A – Not Applicable

TABLE 5-1
(CONTINUED)

TABLE 5-2
SUMMARY OF BENEFIT-COST ANALYSIS RESULTS
FOR COMMERCIAL/INDUSTRIAL REPRESENTATIVE STRUCTURES

FLOODPLAIN REPRESENTATIVE STRUCTURE	BENEFIT-COST RATIO BY FLOOD MITIGATION METHOD			
	ELEVATION	RELOCATION	DRY FLOODPROOFING	ACQUISITION
Manatawny Creek – Earl Township	0.21	0.20	0.72	0.23
Laurel Run – Muhlenberg	N/A	N/A	N/A	0.81
Schuylkill River – Reading	N/A	N/A	0.65	0.12
Laurel Run – Muhlenberg	0.33	0.34	0.80	0.34
Schuylkill River – Leesport	0.09	0.21	1.12	0.36

N/A – Not Applicable

5.1.3.1 Relocation/Acquisition

Moving a building to higher ground (i.e., relocation) and/or purchasing and demolishing a flood-prone building (i.e., acquisition) are the surest ways to minimize potential flooding impacts. Municipalities with areas subject to ice jams, flash flooding, high velocity flows, deep water, or where the only safe approach is to remove the building, should consider relocation and/or acquisition. Removing buildings from the floodplain is not only the most effective flood protection measure available, it is also a way to convert a problem area into a community asset and obtain environmental benefits.

TABLE 5-3
BERKS COUNTY PROPERTY PROTECTION GUIDE

100-YEAR FLOOD IMPACT	TYPE OF STRUCTURE							
	RESIDENTIAL						COMMERCIAL [1]	INDUSTRIAL [1]
	1-2 STORY WOOD FRAME			1-2 STORY MASONRY				
	WITH BASEMENT	SLAB-ON-GRADE	CRAWLSPACE	WITH BASEMENT	SLAB-ON-GRADE	CRAWLSPACE		
High Velocity and/or Floodway	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]	Relocation/ Acquisition [2]
0-2' In Basement	Sump Pump [3] and/or Wet Floodproofing [4]	N/A	N/A	Sump Pump [3] and/or Wet Floodproofing [4]	N/A	N/A	N/A	N/A
2'-8' In Basement	Wet Floodproofing [4]	N/A	N/A	Wet Floodproofing [4]	N/A	N/A	N/A	N/A
< 1' First Floor	Wet Floodproofing [4] or Elevation [5]	Dry Floodproofing [3]	Wet Floodproofing [4] or Elevation [5]	Wet Floodproofing [4]	Dry Floodproofing [3]	Wet Floodproofing [4]	Dry Floodproofing [3]	Dry [3] or Wet [4] Floodproofing
1'-3' First Floor	Elevation [5]	Dry Floodproofing [3]	Elevation [5]	Elevation [5]	Dry Floodproofing [3]	Elevation [5]	Dry Floodproofing [3]	Dry [3] or Wet [4] Floodproofing
3'-8' First Floor	Elevation [5] or Relocation/ Acquisition [6]	Elevation [5] or Relocation/ Acquisition [6]	Elevation [5] or Relocation/ Acquisition [6]	Elevation [5] or Relocation/ Acquisition [6]	Elevation [5] or Relocation/ Acquisition [6]	Elevation [5] or Relocation/ Acquisition [6]	Elevation [5] or Relocation/ Acquisition [6]	Wet Floodproofing [4] or Relocation/ Acquisition [6]
>8'	Elevation [7] or Relocation/ Acquisition [6]	Elevation [7] or Relocation/ Acquisition [6]	Elevation [7] or Relocation/ Acquisition [6]	Elevation [7] or Relocation/ Acquisition [6]	Elevation [7] or Relocation/ Acquisition [6]	Elevation [7] or Relocation/ Acquisition [6]	Relocation/ Acquisition [6]	Relocation/ Acquisition [6]

Notes: These recommendations are for planning purposes only. Professional expertise should be sought before taking any flood mitigation action. Some projects may not meet FEMA cost-benefit requirements, thereby requiring property owner or other funding sources.

1 Assuming slab-on-grade foundation.
2 Floodway location/vulnerability to high velocity flows warrant relocation and/or acquisition.
3 See dry floodproofing text later in this chapter.
4 See wet floodproofing text later in this chapter.
5 See elevation text later in this chapter.
6 See relocation/acquisition text later in this chapter.
7 Only appropriate for seasonal structures.

Relocation is preferred for large lots that include buildable area outside the floodplain or where the owner already has a new flood-free lot available. Relocation can be expensive, however. While almost any building can be moved, the cost goes up for heavier structures, such as those with exterior brick and stone walls, and for large or irregularly shaped buildings. As shown in Table 5-4, the cost of moving a 1,000-square-foot building can range from $31 to $71 per square foot, depending on the construction type (e.g., frame or masonry) and the type of existing foundation (e.g., basement, crawlspace, or slab-on-grade). There are also a number of factors that affect the feasibility of relocation such as road width and grade, density of overhead utilities, and other related factors.

TABLE 5-4
RELOCATION COST GUIDE

CONSTRUCTION TYPE	EXISTING FOUNDATION	RELOCATION COST [a]
Frame [b]	Basement Crawlspace Slab-on-Grade	$34 $29 $54
Masonry	Basement Crawlspace Slab-on-Grade	$52 $34 $65

Source: FEMA 259 2nd Edition/June 2001
a per square foot of building footprint
b for frame building with masonry veneer, add 10 percent

It should be noted that the costs shown in Table 5-4 do not represent the entire cost of a relocation project. Additional costs may be necessary for acquiring a new lot on which to place the relocated building and for restoring the old site. Also, relocation costs do not increase proportionally with the size of a building. The cost per square foot for relocating a building larger than 1,000 square feet may be less, but some larger buildings may have to be cut and the parts moved separately.

Like relocation, acquisition of buildings in a flood-prone area ensures that they will no longer be subject to damage. The major difference is that acquisition is undertaken by a government agency, so the cost is not borne by the property owner, and the land is converted to a public use, such as a park. Acquisition, followed by demolition, is most appropriate for buildings that are difficult to move, such as larger, slab-on-grade foundation or masonry structures, and dilapidated structures that are not worth protecting. An acquisition budget should be based on the median price of similar properties in the community plus $10,000 to $20,000 for appraisals, abstracts, title

opinions, relocation benefits, and demolition. Costs may be lower after a flood. For example, the municipality may have to pay only the difference between the full price of a property and the amount of the flood insurance claim received by the owner. Municipalities should be cautious, however, to avoid creating a "checkerboard" acquisition pattern in which non-adjacent properties are acquired. This can occur when some owners, especially those who have and prefer a waterfront location, prove reluctant to leave. Creating such an acquisition pattern in a community simply adds to the maintenance costs that taxpayers must support.

Occasionally, acquisition and relocation projects are undertaken jointly. The purchasing agency typically sells the building for salvage. Sometimes, the original owner of the acquired building can make arrangements to buy it back at the salvage value. The advantage of this approach is that a new owner relocates the building rather than demolishes it. This way, the owner gets to keep the building and may have enough money from the sale to pay for a new lot and moving expenses.

Within Berks County, the representative floodplain structure located along Manatawny Creek in Earl Township (see Appendices) serves as an excellent sample structure for potential relocation/acquisition. At this location, the representative floodplain structure is located immediately adjacent to Manatawny Creek and is susceptible to high velocity floodway flows. In addition, the 100-year flood event results in approximately two to three feet of water on the first floor of this structure. Even the 50-year flood event results in first floor flooding for this structure. As such, given this structure's location within the regulatory floodway and its vulnerability to high velocity first floor flooding, relocation and/or acquisition appear to be the most appropriate and effective flood hazard mitigation options. Based on a number of similar occurrences throughout the County, the Mitigation Steering Committee identified the following Property Protection (PP) Hazard Mitigation Measure for potential implementation.

PP-1: Relocate and/or acquire known flood-prone structures in accordance with the general guidelines of Table 5-3.

5.1.3.2 Elevation

Raising a building above the flood level (i.e., elevation) is the best on-site property protection method (see Figures 5-1 through 5-4). Water flows under or around the building, causing little or no damage to the structure or its contents. Buildings can be elevated on an open foundation (i.e., posts, piles or columns), continuous foundation walls, or compacted earthen fill.

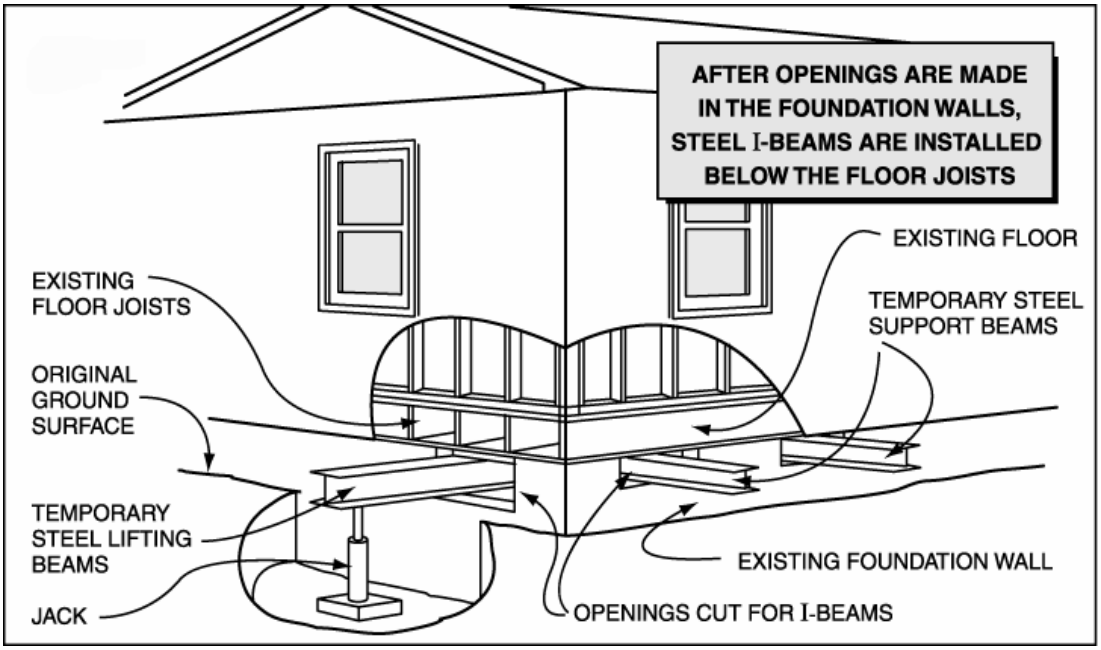


FIGURE 5-1
STEEL I-BEAMS AND JACKS ARE INSTALLED IN PREPARATION FOR LIFTING THE HOUSE

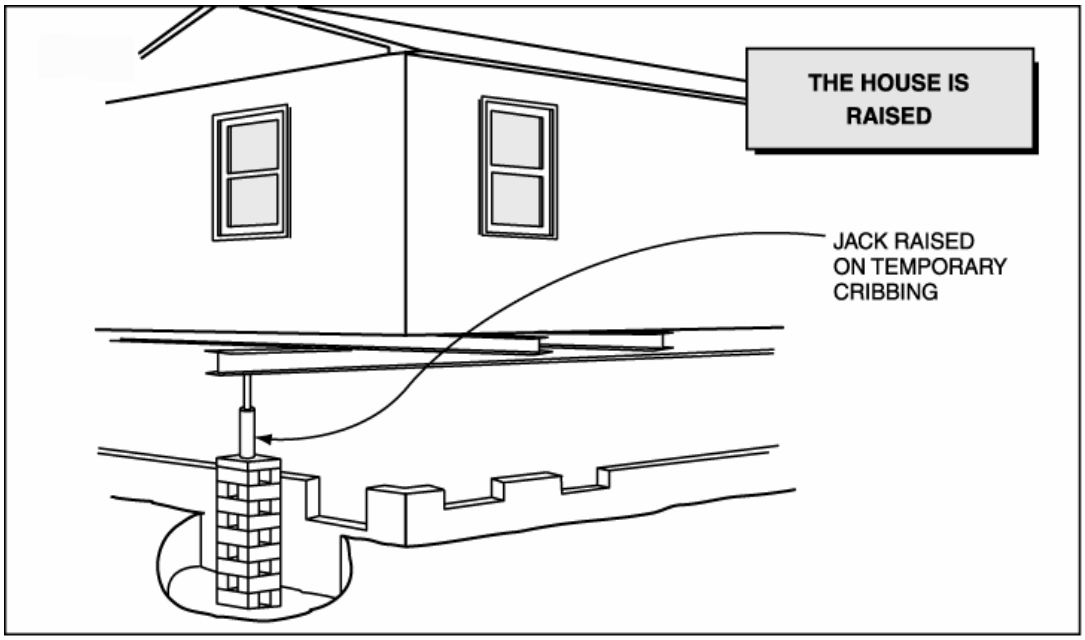


FIGURE 5-2
THE HOUSE, SUPPORTED ON THE I-BEAMS, IS RAISED ON THE JACKS

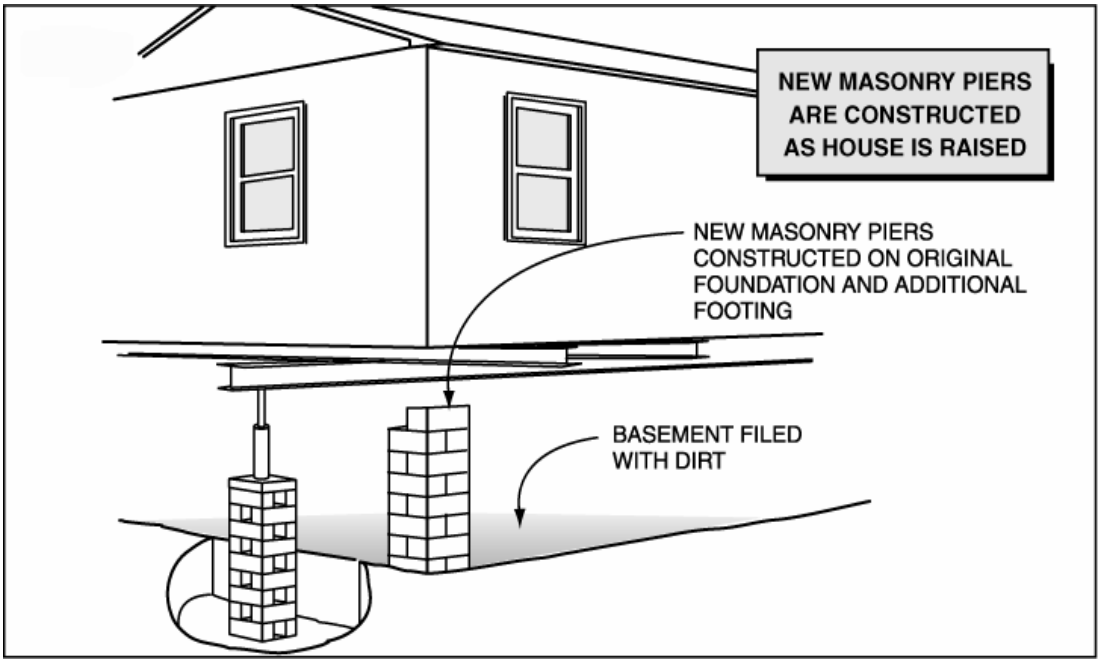


FIGURE 5-3
NEW MASONRY PIERS ARE CONSTRUCTED TO SUPPORT THE HOUSE, AND THE BASEMENT IS FILLED WITH DIRT

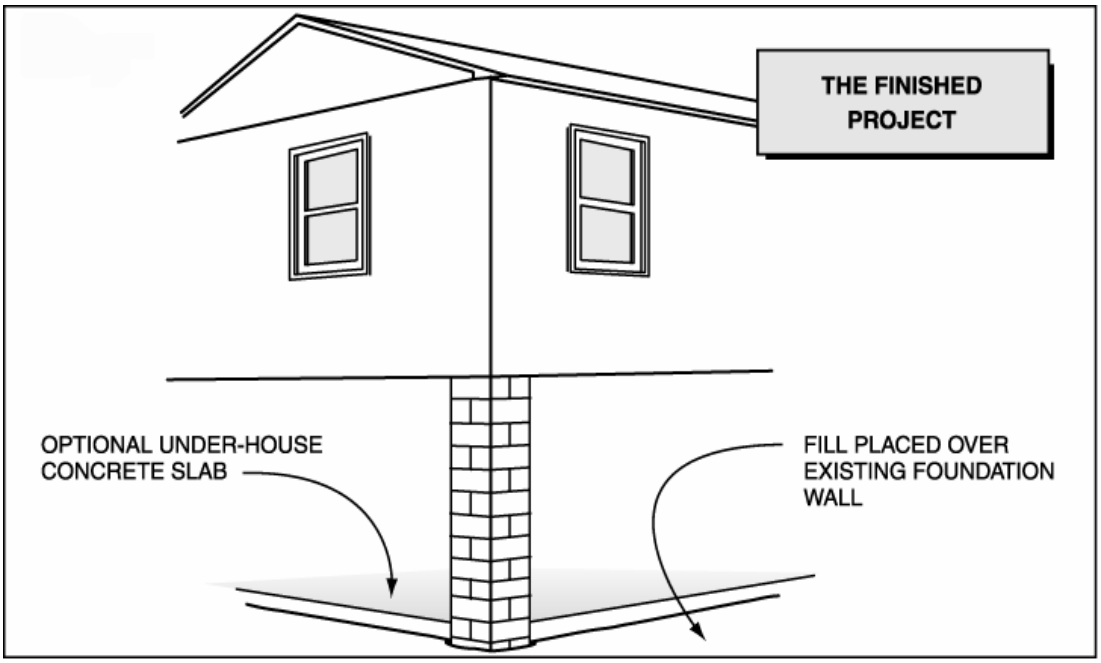


FIGURE 5-4
WHEN THE HOUSE HAS BEEN RAISED TO THE DESIRED HEIGHT, THE NEW MASONRY PIERS ARE COMPLETED

While elevating on compacted fill is sometimes the most desirable elevation solution, it is a complicated alternative. The building has to be temporarily moved so that the fill can be placed and properly compacted. As such, elevating on fill may prove to be more costly than elevating on an open foundation or continuous foundation walls. In addition, it must be remembered that the streets, utilities, and other infrastructure that serve an elevated building will still be vulnerable to damage during a flood. Therefore, the elevated building may be isolated and without utilities during a flood. There will also be a risk to the occupants who may try to enter or leave the building during a flood.

Elevating a building will also change its appearance. If the required amount of elevation is low, the result is similar to putting a building on a two- or three-foot crawlspace. If the building is raised two feet, the front door would be three steps higher than before. If the building is raised eight or more feet, the lower area can be wet floodproofed (see next section) and used for parking and/or storage of items that will not be damaged by floodwaters.

Elevating a building above the flood level is cheaper than relocating it and can be less disruptive to a neighborhood. In addition, elevation has proven to be an acceptable means of complying with NFIP regulations that require substantially damaged (and new) buildings to be elevated above the 100-year flood elevation when repaired (or constructed) in a floodplain. Table 5-5 shows the costs of elevating various types of buildings a total of two feet on either an open foundation or continuous foundation walls. As shown in Table 5-5, the cost can vary depending on the construction type (e.g., frame or masonry) and the type of existing foundation (e.g., basement, crawlspace, or slab-on-grade). The costs for extending utility lines and adding or extending staircases are included. The costs for elevating buildings with slab-on-grade foundations are based on the assumption that the building is raised with the existing slab attached. To estimate the cost of elevating more than two feet, add $0.80 per square foot of building footprint for each additional foot of elevation up to eight feet. For elevations greater than eight feet, add $1.05 per square foot for each additional foot of elevation.

TABLE 5-5
ELEVATION COST GUIDE

CONSTRUCTION TYPE	EXISTING FOUNDATION	ELEVATION COST [a]
Frame [b]	Basement or Crawlspace Slab-on-Grade	$18 $50 [c]
Masonry	Basement or Crawlspace Slab-on-Grade	$37 $50 [c]

Source: FEMA 259 2nd Edition/June 2001
a per square foot of building footprint
b for frame building with masonry veneer, add 10 percent
c price shown for raising the building with the slab attached

Within Berks County, the representative floodplain structure along the Schuylkill River in Union Township (see Appendices) serves as an ideal sample structure for potential elevation. This representative floodplain structure is a typical two-story residence of wood frame construction with a basement foundation. The structure is located within the 100-year floodplain of the Schuylkill River, but not within the regulatory floodway. The 100-year flood event results in full basement flooding and approximately five feet of water on the first floor of this structure. Even the 10-year flood event results in full basement flooding, but little to no first floor flooding. Given this structure's location outside the regulatory floodway or other high velocity-flooding situation, its wood frame construction and basement foundation (less expensive to elevate than masonry and slab-on-grade structures), and its vulnerability to significant first floor flooding during a 100-year event, elevation appears to be the most appropriate flood hazard mitigation option. Based on a number of similar occurrences throughout the County, the Mitigation Steering Committee identified the following Property Protection Hazard Mitigation Measure for potential implementation.

PP-2: Encourage the elevation of known flood-prone structures in accordance with the general guidelines of Table 5-3.

5.1.3.3 Floodproofing

In areas of relatively low flood threat (e.g., where flooding is infrequent or characterized by low velocity flows or shallow depths), dry or wet floodproofing can be efficient approaches to minimizing potential damages. These approaches can also be less disruptive to a neighborhood than relocation, acquisition, and elevation. However, it must be remembered that the streets, utilities, and other infrastructure that serve a floodproofed building will still be vulnerable to

damage during a flood. Therefore, the floodproofed building may be isolated and without utilities during a flood. There will also be a risk to the occupants who may try to enter or leave the building during a flood. A brief description of these two floodproofing approaches is provided below.

5.1.3.3.1 Dry Floodproofing

Dry floodproofing involves sealing a building against floodwaters. All areas below the flood protection level are made watertight and impermeable to flood waters (see Figure 5-5).

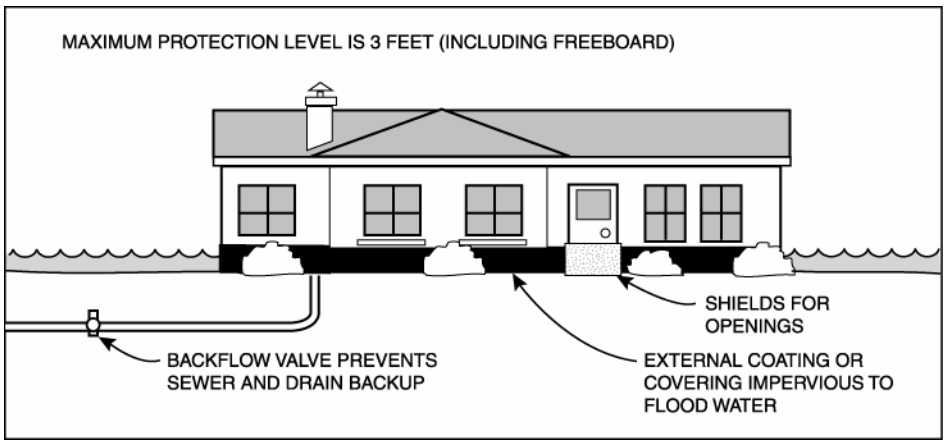


FIGURE 5-5
A TYPICAL DRY FLOODPROOFED HOUSE

Examples of dry floodproofing modifications include the following:

- installing watertight shields over doors and windows;
- reinforcing walls to withstand floodwater pressures and impact forces generated by floating debris;
- using membranes and other sealants to reduce seepage of floodwater through walls and wall penetrations;
- installing drainage collection systems and sump pumps to control interior water levels, collect seepage, and reduce hydrostatic water pressures on the floor slab and walls;
- installing backflow valves to prevent the entrance of floodwater or sewage flows through utilities; and
- anchoring the building to resist flotation, collapse, and lateral movement.

Dry floodproofing is only recommended in areas where floodwaters are less than three feet (two feet plus one foot of freeboard) in depth and relatively slow-moving. It may also be appropriate for buildings that are too expensive to elevate (e.g., slab-on-grade buildings). The flood protection level for dry floodproofing should be no more than three feet above the top of the foundation because building walls and floors cannot typically withstand the pressure of deeper water. As such, dry floodproofing should not be used in areas where floodwaters are expected to remain high for long periods. In addition, dry floodproofing is not appropriate for any structure that has a basement. The disadvantages of dry floodproofing include the deterioration of waterproofing compounds over time and the dependence on human action for the installation of closures on windows and doorways. Each of these disadvantages may lead to failure of the dry floodproofing. Table 5-6 provides cost information for some typical dry floodproofing activities.

TABLE 5-6
DRY FLOODPROOFING COST GUIDE

TYPE	COST	UNIT
Sprayed-on Cement (above grade)	$3.50	Square foot
Waterproof Membrane (above grade)	$1.17	Square foot
Asphalt (two coats below grade)	$1.17	Square foot
Perimeter Drainage	$33	Linear foot
Plumbing Check Valve	$660	Lump sum
Sump Pump (with backup battery)	$1,060	Lump sum
Metal Flood Shield	$77	Square foot
Wood Flood Shield	$24	Square foot

Source: FEMA 259 2nd Edition/June 2001

Dry floodproofing of new and existing nonresidential buildings in the 100-year floodplain is permitted under the NFIP. Dry floodproofing of existing residential buildings in the 100-year floodplain is also permitted as long as the building is not substantially damaged or being substantially improved (exceeding 50% of the structure's market value). Owners of buildings located outside the 100-year floodplain can always use dry floodproofing techniques. The design and planning considerations that must be taken into account include the following.

- Warning Time – Sufficient lead time is necessary before a flood to evacuate a flood-prone building and implement dry floodproofing measures that require human intervention (e.g., installing a flood shield).

- Safety and Access – There must remain a safe escape route for all persons responsible for implementing dry floodproofing techniques that require human intervention. Roads to be used as evacuation routes must remain passable as floodwaters rise.

- Flood Velocity – Where flood velocities exceed five feet per second, hydrodynamic forces are too great to implement floodproofing techniques.

- Flood Depth – Generally, the cost of dry floodproofing is too high in areas where flood depths are greater than three feet. As flood depths exceed three feet, hydrostatic flood forces mandate a more expensive solution.

- Flood Frequency – Dry floodproofing is generally not appropriate for buildings that flood frequently. The cost of the wear and tear on the building combined with the frequent business interruption warrants a different approach such as relocation.

- Duration – Dry floodproofing should not be used in areas where floodwaters are expected to remain for over four to eight hours. Hydrostatic pressures will eventually overcome components of the floodproofing system, allowing water to enter the structure. It is very expensive to successfully floodproof a structure, especially a historic structure, which will be exposed to floodwaters for more than four to eight hours.

Within Berks County, the commercial representative floodplain structure located along the Schuylkill River in Leesport (i.e., the Leesport Post Office) serves as an ideal sample structure for potential implementation of dry floodproofing measures. This representative floodplain structure is a one-story building of masonry construction with a concrete slab foundation. The structure is located within the 100-year floodplain of the Schuylkill River, but not within the regulatory floodway. The 100-year flood event results in approximately 1.5 feet of water on the main floor of this structure. The structure does not appear to be impacted by the 10-year or 50-year flood events. Given this structure's location outside the regulatory floodway or other high velocity flooding situation, its slab-on-grade foundation, and its vulnerability to only shallow (i.e., less than three feet) first floor flooding during the 100-year flood event, dry floodproofing appears to be the most appropriate flood hazard mitigation option for this structure. Based on a number of similar occurrences throughout the County, the Mitigation Steering Committee identified the following Property Protection Hazard Mitigation Measure for potential implementation.

PP-3: Encourage dry floodproofing of known flood-prone structures in accordance with the general guidelines of Table 5-3.

5.1.3.3.2 Wet Floodproofing

Wet floodproofing, unlike dry floodproofing, allows floodwater to enter a structure in order to counterbalance the hydrostatic pressure on the walls, surfaces, and supports of the structure. This technique is often used when other techniques are not technically feasible or too costly for the level of flood impact. Wet floodproofing is appropriate for structures with uninhabited areas below the flood elevation, such as unfinished basements, garages, and crawlspaces (see Figure 5-6). However, because wet floodproofing allows floodwater to enter a structure, modifications must be made to minimize damage to the portion of the structure below the flood elevation and its contents. Typically, the structure is designed so that walls and floors below the flood elevation are resistant to damage from floodwaters, and utilities and other valuable equipment are located above the flood elevation.

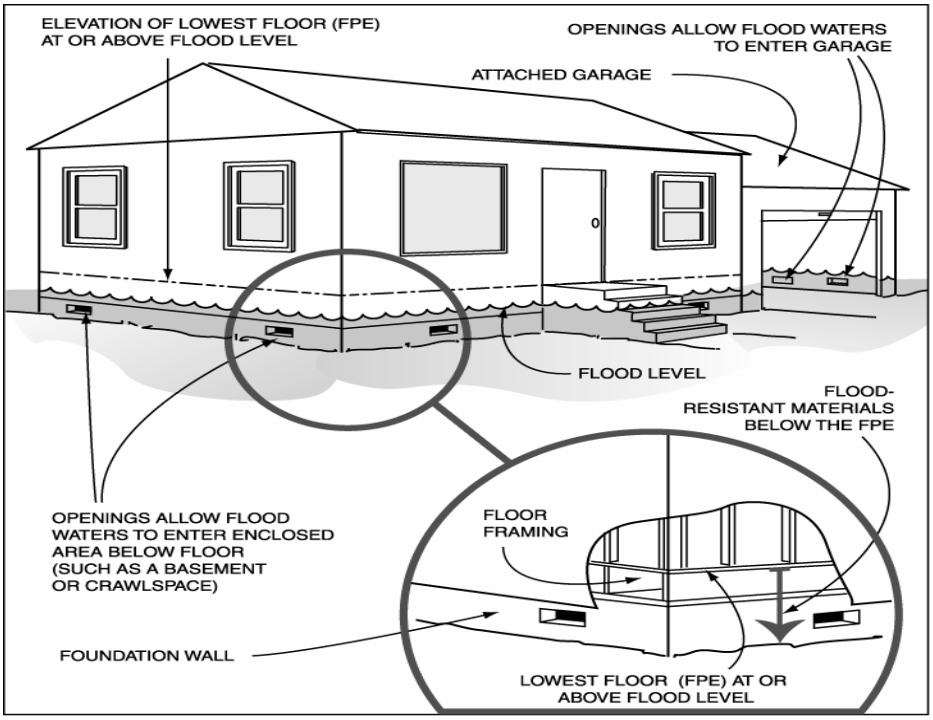


FIGURE 5-6
A TYPICAL WET FLOODPROOFED HOUSE

It is important to note that, although wet floodproofing can be an effective and economical means of reducing flood damage, it does not satisfy NFIP regulatory requirements for substantially damaged and substantially improved structures in the 100-year floodplain. Communities

that want to wet floodproof such structures may do so only through the issuance of a variance from the NFIP requirements. The NFIP allows variances for wet floodproofing for the following categories of structures.

- Historic Buildings – repair and rehabilitation of historic structures is contingent on a determination by the community that the proposed work will not preclude the structure's continued designation as a historic structure and that the variance is the minimum effort necessary to preserve the historic character and design.
- Accessory Structures – usually limited to buildings used for parking or limited storage.
- Structures Functionally Dependent on Close Proximity to Water – these structures include certain types of docking, port facilities, etc.
- Certain Agricultural Structures – the NFIP recognizes that wet floodproofing may be appropriate for certain types of agricultural structures located in wide, expansive floodplains.

When wet floodproofing is used, the occupants of the wet floodproofed structure will need adequate warning of an impending flood so that they will have time to leave safely. If the wet floodproofing design requires human intervention (e.g., moving vulnerable materials to a location above the flood level), there must remain a safe escape route for all people responsible for human intervention activities. Roads to be used as evacuation routes must remain passable as floodwaters rise.

All structural and non-structural components in the wet floodproofed area of a structure must be constructed of materials that are durable, resistant to flood forces, and resistant to deterioration caused by repeated exposure to floodwaters (e.g., masonry and concrete). Wall elements, insulation, and flooring should all be constructed of materials that will not be damaged by water or retain water once floodwaters have receded. For example, when water enters a building and inundates a standard cavity wall system, the cavity wall will retain water, silt, and other flood contaminants, which can result in structural damage and economic losses.

In addition, the structural foundation must be designed and constructed to withstand frequent inundation without failure. It is very important that the structure is properly anchored to the foundation to prevent uplift and separation. Electrical and mechanical systems installed within the wet floodproofed area should be located above the expected flood level (see Figure 5-6). For example, in a basement storage area or garage that may be flooded with two feet of water (above the floor) during a flood, locating outlets, heaters, and other utility elements three

feet or more above the floor can help to prevent damage to electrical and mechanical systems. Such relocations should be coordinated with the respective utility provider.

It is also important to remember that any fuel tanks (inside or outside) should be properly anchored to avoid flotation. Unanchored fuel tanks pose serious threats to residences, public safety and the environment. An unanchored tank can be driven into and can be swept downstream where it can damage other structures. When an unanchored tank is moved by floodwaters, the supply line can break, which can cause serious safety and environmental problems.

Table 5-7 provides cost information for wet floodproofing to various heights.

TABLE 5-7
WET FLOODPROOFING COST GUIDE

CONSTRUCTION TYPE	HEIGHT OF WET FLOODPROOFING	EXISTING FOUNDATION	COST	UNIT
Wood Frame or Masonry	Two Feet	Basement	$1.80	Square foot
		Crawlspace	$1.40	
	Four Feet	Basement	$3.70	Square foot
		Crawlspace	$3.45	
	Eight Feet	Basement	$10.60	Square foot
		Crawlspace	N/A	

Source: FEMA 259 2nd Edition/June 2001

Within Berks County, the representative floodplain structure along Swamp Creek in Bechtelsville (see Appendices) serves as an ideal sample structure for potential implementation of wet floodproofing measures. This representative floodplain structure is a 2 ½-story residence of wood frame construction with a concrete block basement foundation. The structure is located within the 100-year floodplain of Swamp Creek, but not within the regulatory floodway. The 100-year flood event results in full basement flooding, but no water on the first floor of this structure. Even the 10-year flood event results in several feet of water in the basement area of this structure. Given this structure's location outside the regulatory floodway or other high velocity flooding situation, its concrete block basement foundation, and its lack of first floor flooding, wet floodproofing the basement area appears to be the most appropriate flood hazard mitigation option for this structure. Based on a number of similar occurrences throughout the County, the Mitigation Steering Committee identified the following Property Protection Hazard Mitigation Measures for potential implementation.

PP-4: Encourage wet floodproofing of known flood-prone structures in accordance with the general guidelines of Table 5-3.

PP-5: Encourage the anchoring of fuel tanks located in floodprone areas to concrete slabs that are heavy enough to resist the force of floodwaters and be sure all filling and ventilation tubes are above the 100-year flood level so that floodwaters cannot enter the tank.

PP-6: Inventory historic assets within the county and verify whether wet floodproofing may be the most effective measures to protect those that are floodprone.

5.1.3.4 Insurance

Insurance has the advantage that, as long as the policy is in force, the property is covered and no human intervention is needed for the measure to work. The advantage of insurance can apply to several hazards including flooding, drought and sinkholes. Although most homeowners' insurance policies do not cover a property for flood damage, an owner can insure a building through the NFIP. A municipality must participate in the NFIP in order to make flood insurance available to its residents. As evidenced by Table 2-3, only one of Berks County's seventy-three municipalities (Lyons Borough) does not participate in the NFIP. As of January 2006, there were a total of 989 flood insurance policies in force in Berks County covering in excess of $158 million in personal property. Table 2-6 indicates that, as of January 2006, Berks County residents have submitted a total of 727 flood insurance claims and have received nearly $4 million in claims payments since joining the flood insurance program.

It is important to note, however, that not every flood-prone building in the County is covered under a flood insurance policy. Table 2-5 indicates that there are over 3,900 structures in the County that are vulnerable to potential flooding impacts during a 100-year event. While some of these structures may not warrant insurance coverage (i.e., sheds, pavilions, garages, and other miscellaneous accessory structures), it is clear that, with only 989 policies in force, there are a number of insurable structures in the County that are not covered under a flood insurance policy.

Since farmers are subject to unpredictable weather, crop insurance is one way that they can help safeguard themselves against disasters, including drought. According to the Pennsylvania Department of Agriculture, 63% of the $ 217 million crop insurance loss payments from 1981 to 2005 were for drought loss claims across Pennsylvania. Obviously, farmers have chosen to transfer some of the risk of farming to crop insurance; keeping the premium manageable and

including it as part of typical operation costs. The national crop insurance program is undergoing significant changes and improvements as a result of the new Agricultural Risk Protection Act of 2000. It is a work in progress that may have new benefits for farmers on a year-to-year basis.

Portions of Berks County sit on carbonate bedrock. This does not mean that a sinkhole will open up on any one homeowner's property, but the possibility does exist. Some homeowners have encountered this very problem only to learn that sinkhole damage is not covered under their homeowner's policy. For those instances when sinkhole damage is not covered in a homeowner's policy, generally it can be purchased as additional coverage.

As such, the Mitigation Steering Committee identified the following Property Protection Hazard Mitigation Measures for implementation within the County.

PP-7: Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.

PP-8: Encourage farmers to visit their local FSA office to discuss the benefits of obtaining crop insurance.

PP-9: Encourage uninsured property owners in known subsidence hazard areas to purchase sinkhole insurance as a supplement to their existing homeowner's policy.

5.1.3.5 Brush/Shrub Removal

Removing excess brush and shrubby plants from the immediate vicinity of buildings in potential wildfire hazard areas can help prevent the buildings themselves from catching on fire. Brush and shrubby plants can serve as fuel for wildfires and cause them to spread more quickly. Having this available fuel in close proximity of buildings only increases the likelihood of those buildings to catch on fire during a wildfire event. By removing excess brush and shrubby plants from the immediate vicinity of a building (i.e., 50 to 100 feet), thereby decreasing and/or eliminating the available fuel load, the likelihood of that building to succumb to fire during a wildfire event decreases dramatically. Given Berks County's vulnerability to wildfire hazards, and the number of residential structures that are located in potential wildfire hazard areas (See Figure 2-3), the Mitigation Steering Committee identified the following Property Protection Hazard Mitigation Measure to be implemented within the County.

PP-10: Encourage property owners in potential wildfire hazard areas to remove all excess brush and shrubby plants from the immediate vicinity (i.e., 50 to 100 feet) of all buildings.

5.1.3.6 Emergency Response Planning

In certain situations, implementation of physical property protection measures (i.e., relocation, elevation, or floodproofing) may not be technically or fiscally appropriate. This is most often the case for larger flood-prone business and industry buildings, where relocation is undesirable and retrofitting techniques may be too costly or not technically feasible. As such, alternatives to physical property protection measures must be explored. One alternative to implementing physical property protection measures is to develop an emergency response plan specific to the particular business or industry. An emergency response plan is a guidance document that identifies and describes specific emergency preparation and response procedures to be implemented on a pre- and post-disaster basis in order to minimize potential flooding impacts. As such, emergency response planning can serve to minimize potential impacts to both the structure and its contents/inventory. In this manner, emergency response planning for a particular business or industry would constitute a property protection measure. FEMA guidance on developing and implementing a business/industry specific emergency response plan is included in the appendices. Given the wide-scale applicability and the potential reduction in flooding impacts, the Mitigation Steering Committee identified the following Property Protection Hazard Mitigation Measure to be implemented within the County.

PP-11: Encourage local business and industry owners in known flood hazard areas to develop an emergency response plan as a potential alternative to implementing a physical property protection measure, where otherwise not technically or fiscally appropriate.

PP-12: Provide protection of critical Berks County records through emergency response planning or other appropriate measures.

5.1.4 Structural Projects

Structural projects are typically constructed in compliance with applicable regulations to keep floodwaters and other natural hazards away from select areas. They are usually designed by engineers and managed or maintained by public works staff. From a flood hazard mitigation standpoint, structural projects can be used to control flows and water surface elevations for both flood minimization and recreational purposes. However, due to their limiting costs and potential environmental implications, structural projects are not normally constructed to protect individual

properties, but are usually large-scale undertakings designed to protect numerous people and properties. As such, structural hazard mitigation projects typically include the following:

- dams/levees/floodwalls;
- bridge/culvert modifications;
- storm water drainage improvements;
- channel modifications/maintenance;
- firebreaks;
- sinkhole abatement; and
- emergency water source development.

Implementation of structural projects of this nature will work towards the fulfillment of the following project-planning goals as identified by the Mitigation Steering Committee.

- Identify measures to reduce the County's overall vulnerability to natural hazards (High Priority).
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County (High Priority).
- Consider the viability of constructing additional flood control projects throughout the County (Low Priority).
- Identify problem areas in the County's existing drainage systems (pipes, culverts, channels) and make recommendations for short- and long-term improvements (Low Priority).
- Investigate the need for structural solutions to the County's wildfire, drought, subsidence, and landslide hazards (Low Priority).

To identify structural hazard mitigation projects throughout the County, BEMA developed and circulated a Structural Project Identification Form to every municipality with directions to complete one form for every applicable project. These forms were then returned to BEMA, where they were analyzed for incorporation into the Plan. These Structural Project Identification Forms document a number of different types of structural hazard mitigation projects to be implemented throughout the County. Incorporation of these Structural Project Identification Forms into the Plan is hereby accomplished through their inclusion in the Technical Appendices. Reference is made to these Structural Project Identification Forms throughout this section of the Plan.

5.1.4.1 Dams/Levees/Floodwalls

Dams, levees and floodwalls are similar in that they control flooding by restricting floodwaters from reaching/inundating protected areas. Dams, levees and floodwalls are probably the best-known forms of structural flood control projects that have been implemented in the United States. It is important to note, however, that just like any other engineering feature, if the design capacity of a dam, levee and/or floodwall is exceeded, its functional utility becomes compromised. As such, dams, levees and floodwalls can give a false sense of security to the property owners that they protect.

Several structural flood control projects have been constructed in Berks County. The most notable of these structural flood control projects is the Blue Marsh Dam, which was constructed by the USACE in the mid 1970's. The primary function of the Blue Marsh Dam is to control flood flows along the Tulpehocken Creek and Schuylkill River. The impoundment created by the dam has an approximate floodwater storage capacity of 30,000 acre-feet. It is also important to point out that Blue Marsh Dam serves a significant secondary function by providing opportunities for recreational activities on a regional basis.

Analysis of the Structural Project Identification Forms included in the Technical Appendices reveals two additional locations for the potential construction of a structural flood control project. These locations include the William Delong Park area of Maxatawny Township and the Cambridge Commons Apartment area of Wyomissing Borough. The construction of a berm/levee has been identified as a potential structural solution to localized flooding problems at these locations. Implementation of either of these projects would first need to be evaluated for its long-term viability and economic feasibility (i.e., cost-benefit ratio). As such, the following structural project hazard mitigation measure has been identified.

SP-1: Investigate the feasibility of constructing a berm/levee system to minimize local flooding impacts in accordance with the Structural Project Identification Forms found in the Technical Appendices.

5.1.4.2 Bridge/Culvert Modifications

In the wake of a significant storm event, undersized bridge and culvert crossings of local streams and watercourses can result in water overtopping stream banks upstream of the structure, causing significant flooding problems. Therefore, from a flood hazard mitigation standpoint, bridge/culvert modifications typically involve the replacement, enlargement, and/or removal of

existing roadway and railway bridges and culverts that are known to cause flooding problems. Regulations set forth in PennDOT Design Manual Part 4, and the PA DEP's Title 25, Chapter 105 state that all new bridges and culverts shall be designed and constructed to pass a 25-year frequency flood flow in rural areas, a 50-year frequency flood flow in suburban areas, and a 100-year frequency flood flow in urban areas.

In addition, the regulations state that the structure must pass the 100-year frequency flood flow with less than a 1.0-foot increase in the natural unobstructed 100-year water surface elevation, except where the structure would be located in a regulatory floodway delineated on a FEMA Flood Boundary and Floodway Map, in which case, no increase in the 100-year water surface elevation will be permitted. While these regulations now exist for the design and construction of new bridge and culvert projects, many existing bridges and culverts throughout the County were constructed prior to these regulations being in place. Additionally, while many of these existing bridges and culverts may have been capable of passing design flows when they were built, upstream development could result in increased peak flows to a point that the existing structure is no longer hydraulically adequate.

Analysis of the Structural Project Identification Forms included in the Technical Appendices reveals a number of potential bridge/culvert modification projects throughout the County. Replacing, enlarging, or removing these known problematic structures can go a long way in minimizing the County's flooding problems. As such, the following structural project hazard mitigation measure has been identified.

SP-2: Design and construct the bridge/culvert modification projects in accordance with the Structural Project Identification Forms found in the Technical Appendices to minimize local flooding impacts.

5.1.4.3 Storm Water Drainage Improvements

Effective collection and conveyance of storm water runoff is key to avoiding potential flooding problems. Undersized or clogged inlet boxes and substandard piping can result in system back-ups and surface ponding. When these back-ups and surface ponding overtop roadways and impact buildings, flood-related damages can occur. In certain municipalities, storm water drainage is combined with sanitary sewer lines, which can lead to overloaded treatment plants and system back-ups that affect individual homeowners. In many instances, existing drainage systems were adequate at the time of construction, but as development occurred and more surface water runoff was generated the systems became inadequate to handle current

flows. Enforcement of subdivision and land development regulations and the subsequent construction of storm water retention/detention facilities help to control surface water flows from new developments, but existing problems still occur. As such, improving/upgrading existing storm water drainage systems can significantly aid in minimized localized flooding problems.

Analysis of the Structural Project Identification Forms included in the Technical Appendices reveals a number of potential storm water drainage improvement projects throughout the County. Implementation of these drainage improvement projects could significantly reduce the County's overall vulnerability to localized flooding impacts. As such, the following structural project hazard mitigation measure has been identified.

SP-3: Investigate the feasibility of implementing a storm water drainage improvement project to minimize local flooding impacts in accordance with the Structural Project Identification Forms found in the Technical Appendices.

5.1.4.4 Channel Modifications/Maintenance

Channel modifications involve the physical alteration of a channel to modify its hydrologic and hydraulic characteristics to accomplish a given purpose. From a flood hazard mitigation standpoint, the typical purpose of a channel modification project is to minimize overbank flooding by increasing the capacity of the channel, regulating flow within the channel, relocating the channel, or diverting flow from the channel. With today's modern fluvial geomorphological channel stabilization practices, there are now a number of different types of channel modifications that can be implemented to accomplish hazard mitigation objectives while improving the overall health and ecology of the stream. However, much like bridge and culvert modifications, precautions must be taken to ensure that downstream flooding problems are not exacerbated by an upstream channel modification. In addition, long-term channel maintenance can be just as important as the one-time channel modification project.

Analysis of the Structural Project Identification Forms included in the Technical Appendices reveals a number of potential channel modification/maintenance projects throughout the County. As such, the following structural project hazard mitigation measures have been identified.

SP-4: Design, permit and construct channel modification projects in accordance with the Structural Project Identification Forms found in the Technical Appendices.

SP-5: Develop and implement a community-specific channel maintenance program consisting of routine inspections and subsequent debris removal to ensure maximum hydraulic capacity of all local streams and watercourses.

5.1.4.5 Firebreaks

Firebreaks can be constructed at key locations to minimize an area's vulnerability to potential wildfire damages. Construction of a firebreak involves removing all woody and otherwise flammable vegetation in a linear strip to significantly diminish the available fuel load, thereby stopping or containing a potential wildfire. The PA DCNR and the Pennsylvania Game Commission have used firebreaks across the State to limit the mobility of potential wildfires in State Forests and State Game Lands, respectively. From a hazard mitigation perspective, firebreaks should be considered in large wooded areas where a density of permanent structures exists or is planned to be built. If properly placed and constructed, firebreaks can significantly reduce a developed area's wildfire susceptibility. As such, the Mitigation Steering Committee identified the following Structural Project Hazard Mitigation Measure for potential implementation within the County.

SP-6: Consider the feasibility of constructing firebreaks in areas that have extensive forestland combined with a density of Wildland/Urban Interface structures or in conjunction with future residential development in forested areas.

5.1.4.6 Sinkhole Abatement

As previously mentioned, a large portion of the County (see Figure 2-2) is underlain by carbonate geology and is susceptible to the formation of sinkholes. Sinkholes form when carbonate bedrock is dissolved by naturally-occurring atmospheric carbonic acid. Sinkholes have the potential to result in significant structural damage and are a major concern for many property owners. In an ideal situation, sinkholes would occur in undeveloped rural areas where they would result in little to no surface damage. Unfortunately, this is not always the case in Berks County and structural abatement must sometimes be employed. Therefore, structural sinkhole abatement has been included in this Hazard Mitigation Plan because it is the primary method of dealing with a sinkhole after it has been exposed at the ground surface.

Sinkhole abatement is the physical treatment of new and existing sinkholes to minimize potential damage to buildings, infrastructure and other surface features. Sinkhole abatement involves filling the surface feature with a mixture of materials including concrete, soil, grout,

synthetic filter fabrics, and various sizes of crushed stone. Since no two sinkholes are alike, abatement can vary significantly in the type and volume of materials that are used. Regardless of the size and nature of the sinkhole, however, certain precautions should be taken when dealing with structural sinkhole abatement. These precautions, which are designed to reduce safety concerns and mitigate potential environmental impacts, include barricading the site to prevent personal injury, excavating the overlying soil to determine the appropriate abatement method and to expose a competent limestone ledge, and directing surface drainage away from the site to prevent a reoccurrence. Given these relatively inexpensive and potentially life-saving precautionary steps, the Mitigation Steering Committee identified the following Structural Project Hazard Mitigation Measures to be implemented within the County.

SP-7: Implement the suggested precautionary steps when using structural abatement techniques (recommended to be identified by a registered Professional Geologist or other acceptable expert) to remedy surface-exposed sinkhole features.

SP-8: Require expert technical assistance and establish mandatory timeframes for structurally abating surface-exposed sinkhole features that pose an identifiable threat to the general public.

5.1.4.7 Emergency Water Source Development

Within Berks County, there are numerous municipalities that lack a public water supply system and the associated curbside hydrants for local fire fighting needs. Therefore, many local fire companies must use tanker trucks and remote water supply sites to fight fires. As such, quick and easy access to reliable water sources and the ability to efficiently pump water from those sources is a critical issue for a number of Berks County's fire companies. Generally, this concept is more important in the more rural part of the County, as opposed to the more urbanized central part of the County. This need could be most easily fulfilled through the installation of dry hydrants at various bridge and culvert crossings of local streams and watercourses. A dry hydrant (see Figure 5-7) is a non-pressurized pipe system permanently installed in existing lakes, ponds and streams that provides a suction supply of water to a fire department tank truck. Dry hydrants provide an easily accessible and reliable source of water for pumping in times of emergency need.

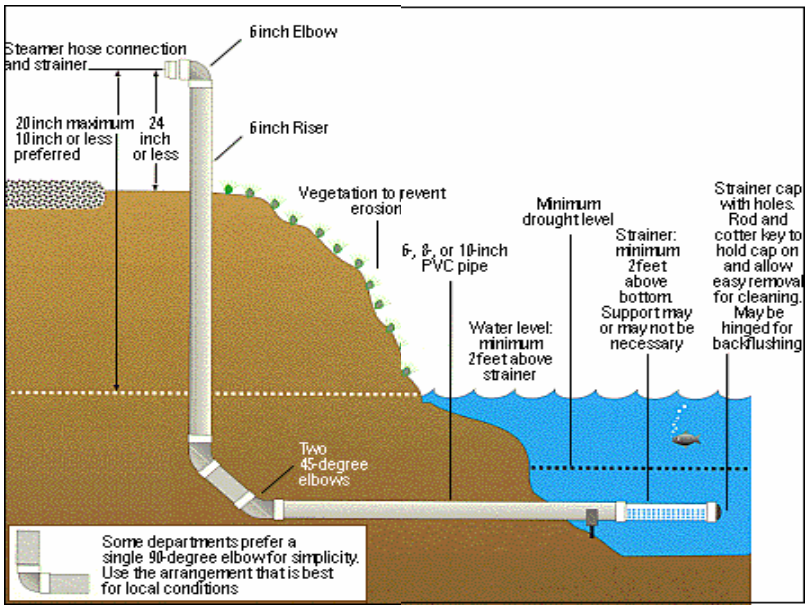


FIGURE 5-7
A TYPICAL DRY HYDRANT

In addition to providing quick and easy access to water sources for firefighting needs, the development of emergency water supply sources could also be considered to offset potential shortages caused by extreme drought events. Such emergency water supply sites should be developed to allow for the storage and transmission of potable water. If conducted properly, emergency potable water supply sources could also be used for firefighting needs, thus serving a dual hazard mitigation purpose. As such, the Mitigation Steering Committee identified the following Structural Project Hazard Mitigation Measures for implementation within the County.

SP-9: Install easily accessible and reliable water supply dry hydrants at various bridge and culvert crossings of local streams and watercourses for emergency fire fighting uses through coordination with local fire companies.

SP-10: Consider the feasibility of establishing an emergency potable water supply source to offset potential shortages caused by extreme drought events.

5.1.5 Natural Resource Protection

Natural resource protection activities that are implemented as hazard mitigation measures can be multiple in scope, purpose, and outcome. They are generally aimed at preserving (or in some cases restoring) local natural areas, environmentally sensitive resources, or the overall quality of some locally significant feature but can also play a significant role in reducing local and regional damages caused by natural hazard events. Natural resource protection activities are

typically implemented by park, recreation, or conservation agencies and organizations (i.e., Berks County Conservancy, Berks County Conservation District, etc.) but are not limited to these types of entities. Any responsible entity, such as a local government, can develop and implement a natural resource protection program that will minimize the impacts of natural hazards while enhancing the local and regional environment. Natural resource protection activities that can minimize the potential impacts of natural hazards include the following:

- open space preservation;
- wetland protection;
- identification and implementation of Best Management Practices (BMPs); and
- water resources management planning.

Implementation of natural resource protection activities of this nature will work towards the fulfillment of the following project-planning goals as identified by the Mitigation Steering Committee.

- Identify measures to reduce the County's overall vulnerability to natural hazards. (High Priority)
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County. (High Priority)
- Investigate options for the permanent preservation of areas where natural hazard potential is high (i.e., steeply sloping areas, sinkhole areas, floodplains, wetlands, etc.). (Medium Priority)
- Identify opportunities and options for implementing best management practices that minimize the County's vulnerability to natural hazards. (Medium Priority)
- Identify additional opportunities throughout the County for implementing preventive actions aimed at minimizing or eliminating natural hazard vulnerability. (Medium Priority)

5.1.5.1 Open Space Preservation

Keeping known hazard areas free of development and in a natural condition can be the best approach to minimizing or preventing potential damages. In regard to Berks County, this concept is applicable to natural hazards like flooding, land subsidence, and wildfires where floodplain, sinkhole prone-geology, and forested area preservation (respectively) can effectively

minimize the County's susceptibility to potential damage. Preserving open space in an undeveloped floodplain not only prevents potential flood damage, but also allows for the full realization of the floodplain's natural and beneficial functions. These natural and beneficial floodplain functions include floodwater storage/floodflow attenuation, surface water infiltration/groundwater recharge, removal/filtering of pollutants and sediments from floodwater, habitat for flora and fauna, and recreational opportunities. Similarly, keeping development away from sinkhole prone areas and extensive forested areas not only prevents potential damage but also provides valuable habitat for many plant and animal species and the potential for increased recreational opportunities. As previously mentioned, open space preservation can be accomplished locally through the adoption and enforcement of various ordinance provisions (see Preventive Measures) but can also be accomplished through property acquisition and easement. As such, the Mitigation Steering Committee identified the following Natural Resource (NR) Protection Hazard Mitigation Measures to be implemented within the County.

NR-1: As comprehensive plans or similar documents are developed or updated, conduct a detailed inventory and prioritization of local environmental resources. Much of this task can be accomplished by sharing the GIS databases completed through this effort and other work done by the Berks County Planning Commission, Berks County Conservancy, and others.

NR-2: Preserve the highest priority undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize/prevent potential flooding damages and enhance the regional environment. Less critical floodplain areas may be preserved/protected via local ordinance.

NR-3: Preserve critical undeveloped forested areas and sinkhole prone areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize/prevent potential wildfire and subsidence damages and enhance the regional environment. Implementation of conservation subdivision design principles, as identified in PM-5, could be used to preserve other less critical hazard prone areas as deemed appropriate by the municipality.

5.1.5.2 Wetland Protection

Wetlands as defined by the PA DEP and the USACE are often found in floodplains and depressional areas of a watershed. Many wetlands receive and store floodwaters, thus slowing and reducing downstream flows. They also serve as a natural filter, which helps to improve water quality and provide habitat for many species of fish, wildlife, and plants. Wetlands are regulated

by the USACE under Section 404 of the Clean Water Act and by PA DEP under Chapter 105 of Pennsylvania's Dams Safety and Encroachment Act. Federal and state permits are required for projects that will impact wetlands. Before a permit is issued, the plans are reviewed by several agencies, including the USACE, PA DEP, U.S. Fish and Wildlife Service, and U.S. Environmental Protection Agency. If a permit is issued, the wetland impact is typically required to be mitigated. Wetland mitigation can include creation, restoration, enhancement, or preservation of wetlands. The appropriate type of mitigation is addressed in each independent permit action. Even with this federal and state protection, many wetlands (particularly smaller ones) continue to be impacted due to gaps (i.e., unregulated activities) in the federal and state regulations. As such, local wetland protection programs can be developed to address these gaps in the federal and state regulations. Given the local and regional importance of wetlands, the Mitigation Steering Committee identified the following Natural Resource Protection Hazard Mitigation Measures to be implemented within the County.

NR-4: Preserve high priority wetland areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize potential flooding damages and enhance the regional environment.

NR-5: Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that require the identification of wetlands in accordance with federal and state standards and minimize/eliminate their disturbance in accordance with federal and state laws.

5.1.5.3 Identification and Implementation of Best Management Practices

Best Management Practices (BMPs) are measures that reduce the volume of surface water runoff and associated non-point source pollutants from entering waterways. Non-point source pollutants are transported by surface water runoff and include lawn fertilizers, pesticides, farm chemicals, sediments, and oils from both pervious and impervious urban and rural areas. Non-point source pollutants not only affect the quality of our local water resources but also their ability to carry and store floodwaters. Eroded soil from farmlands and construction sites is typically deposited where streams and rivers slow down and lose energy, such as when they enter a lake or confluence with another stream. As such, sedimentation will gradually fill in channels and lakes, reducing their ability to carry or store floodwaters. In addition, uncontrolled surface water runoff contributes to local and regional flooding problems.

From a hazard mitigation perspective, the identification and implementation of BMPs is focused on structural and non-structural erosion and sedimentation control and stormwater management facilities. Many BMP measures (structural and/or non-structural) can be implemented on a site to address specific site needs. Both erosion and sedimentation control and stormwater management BMPs can be incorporated into retention and detention basins, drainageways, and many other parts of new developments. Depending on local ordinances, specific BMPs and structural measures may already be required on industrial sites, mined lands, construction sites, farms, forested areas, and high-use public lands.

As previously mentioned, much of Berks County already has plans completed or underway in accordance with Pennsylvania's Stormwater Management Act (Act 167 of 1968). These stormwater management plans and associated stormwater management ordinances typically include provisions for local implementation of stormwater management BMPs. As such, effective completion of PM-11 would, by default, result in the identification and implementation of stormwater management BMPs at the local level.

Fortunate for Berks County is the fact that the Conservation District has several erosion and sedimentation control technicians who monitor construction sites to ensure contractor compliance with the approved Erosion and Sedimentation Pollution Control Plan and work with local farmers to implement erosion and sedimentation control BMPs. As such, the Mitigation Steering Committee recognizes the BCCD's existing efforts to control erosion and sedimentation and identified continued implementation of these efforts as a Natural Resource Protection Hazard Mitigation Measure for the County.

NR-6: Working through the Conservation District, the County should ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and should continue to work with local farmers to implement erosion and sedimentation control BMPs.

5.1.5.4 Water Resources Management Planning

Comprehensive water resources management planning is a topic that has gained increased attention over the past several years due to the alarming frequency and severity of recent drought events. The importance of water as a critical life-sustaining natural resource is never more realized than during a water supply shortage caused by a severe drought event. Within Pennsylvania, the Water Resources Planning Act (Act 220 of 2002) was passed to help mitigate the potentially devastating effects of Pennsylvania's drought hazard. The Act requires

the State Water Plan (a document that analyzes existing and future water resources supply and demand) to be updated within five years and every five years thereafter. Public water suppliers and other water use sectors are working with the Pennsylvania Department of Environmental Protection to determine current water withdrawal and use on an annual basis to help analyze water use and future needs. Similarly, the Delaware River Basin Commission (DRBC) is active in analyzing water availability and identifying ways to manage water supply to ensure clean, fresh water is always available. In Southeastern Pennsylvania, the Commission has designated Ground Water Protected Areas (GWPAs) in Bucks, Montgomery, Chester, Lehigh and Berks Counties. The GWPA program allows DRBC to assess potential impacts of ground water withdrawals on a watershed basis and to limit withdrawals when they reach levels that could adversely affect streamflows. As development pressures continue, programs like this one could help alleviate the need for, or reduce the length of, future water restrictions. DRBC also has a program that encourages municipalities within a watershed to work together developing a multi-municipal Integrated Resource Plan. According to DRBC, this planning process facilitates an analysis of water resources and land use patterns. It can help to answer critical questions such as: How much growth can be supported within the watershed? Where are the best locations for certain land uses? How can impacts to water resources be reduced or eliminated?

The Berks County Comprehensive Plan, completed in 2003, recognizes the ramifications of negatively impacting surface and groundwater resources. The County recommends several measures to carefully manage water resources to ensure safe water supplies can be maintained and flood hazards minimized. Some of these measures include the preparation of a Comprehensive Water Study at the County level and the adoption of zoning ordinances to protect wellhead protection areas. Implementation of a comprehensive water resources management plan would be an appropriate activity for the County to also help mitigate the potentially devastating effects of severe drought events. As such, the Mitigation Steering Committee identified the following Natural Resource Protection Hazard Mitigation Measure to be implemented within the County.

NR-7: Develop and implement a comprehensive water resources management plan that analyzes the County's existing water resources supply and evaluates the County's anticipated water use demand in an effort to identify suspected water supply shortages and potential new water supply sources.

5.1.6 Public Information

Providing the public with accurate and relevant information is a key component of a successful hazard mitigation program. Public information activities advise residents, business owners, and local officials about natural hazards and ways they can protect themselves, their property, and their constituents from these hazards. Public information activities can be aimed at the entire County or at select residents and business owners in known hazard areas. These programs are intended to motivate people to take precautionary steps on a pre-disaster basis.

Within Berks County, information dissemination is handled through a number of different avenues. As such, all hazard mitigation related public information activities should be coordinated and implemented as indicated herein. These public information activities include the following:

- map information;
- library resources;
- outreach projects; and
- environmental education.

Implementation of public information measures of this nature will work towards the fulfillment of the following project-planning goals as identified by the Mitigation Steering Committee.

- Identify measures to reduce the County's overall vulnerability to natural hazards (high priority).
- Identify mitigation recommendations aimed at minimizing the impacts of natural hazards throughout the County (high priority).
- Identify appropriate public information/community outreach tools to better inform the County's residents about natural hazards and ways they can protect themselves (medium priority).
- Consider opportunities and appropriate venues for implementing hazard-related public information programs (medium priority).

5.1.6.1 Map Information

Many benefits stem from providing flood hazard map information to inquirers. Residents and business owners who are aware of potential flood hazards can take steps to avoid problems and/or reduce their exposure to flooding. Real estate agents and potential homebuyers can

determine if a particular property is located in a known flood hazard area and whether flood insurance may be required. Even with the passage of Pennsylvania Act 84 of 1996 (which requires the seller of any residential real estate to complete a mandatory property disclosure statement) it is still important for potential buyers to review the community's flood insurance rate mapping to ensure that their prospective property is not located in a floodplain. It is important to remember, however, that flood maps are not perfect; they display only the larger flood-prone areas that have been studied. Some maps are based on data that are more than 20 years old. In some areas, watershed developments make even recent maps outdated. As such, the Mitigation Steering Committee identified the following Public Information (PI) Hazard Mitigation Measures to be implemented within the County.

PI-1: Coordinate with FEMA and the PA DCED regarding updating Berks County's Flood Insurance Rate Mapping via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional Base Flood Elevations (BFEs).

PI-2: Municipalities should store in an easily accessible location and make available for public inspection, their community's Flood Insurance Rate Mapping and associated Flood Insurance Study. Berks County could provide copies of these maps at the courthouse and/or conservation district offices and/or scan and post current maps on their Web site for all communities or those unable to provide information on their own Web site.

5.1.6.2 Library Resources

Local libraries (i.e., the Berks County Public Libraries) are an obvious place for residents to seek information on natural hazards and natural hazard mitigation. The community library is one of the first places people may turn when researching a topic. Interested property owners can read or check out handbooks or other publications that cover their particular situation. Additionally, libraries typically offer Internet access, which can be used to find a wealth of information on just about any topic, including hazard mitigation. For example, FEMA's Web site at http://www.fema.gov/ is not only user friendly, but also contains great information for homeowners, engineers, lenders, and other interested citizens. Libraries also have public information campaigns with displays, lectures and other projects, which could augment the County's natural hazard mitigation activities. In addition, municipalities can keep their own library of hazard-related resources as a public service for their constituents. As part of this hazard mitigation planning program, various FEMA guidance documents were provided to a number of the county's municipalities for public information purposes. As such, the Mitigation Steering Committee

identified the following Public Information Hazard Mitigation Measures to be implemented within the County.

PI-3: Maintain natural hazard risk assessment and mitigation publications/materials found on BEMA's Web site at public libraries throughout the County for those who do not have access to the internet.

PI-4: Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and available FEMA guidance documents.

5.1.6.3 Outreach Projects

Map information and library resources are not of much use if no one knows they exist. An outreach program can remedy this. Sending notices to hazard-prone property owners can introduce the idea of property protection and identify sources of assistance. Outreach programs are the first step in the process of orienting property owners to property protection measures and assisting them in designing and implementing a project. These programs are designed to encourage people to seek out more information and take steps to protect themselves and their properties. An outreach project can be a notice that is mailed or otherwise distributed to hazard-prone property owners and/or an article in a newsletter or local newspaper that will reach local residents. Other approaches can include the following:

- displays in public buildings or shopping malls;
- radio and TV news releases and interview shows;
- presentations at meetings or relevant local organizations;
- floodproofing open houses; and
- Web site notices with hyperlinks to other sources of information.

Research has proven that outreach projects work. However, awareness of the hazard is not enough; people need to know what they can do in preparation for, during and after a hazard event. Public outreach programs should include information on property protection measures, safety procedures, and post disaster clean-up tips. Outreach projects should also be locally designed and run so the public recognizes the relevance to their specific needs and local conditions. As such, the Mitigation Steering Committee identified the following Public Information (PI) Hazard Mitigation Measures to be implemented within the County.

PI-5: Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard specific "do's" and "don'ts", hazard-prone areas, and emergency contact information.

PI-6: Develop and implement a post-disaster recovery and mitigation training program for local officials.

PI- 7: Develop a business continuity plan display to raise awareness of importance (display would be used at Chamber of Commerce, civic group events, etc.).

PI-8: Develop a partnership with the Visitors Bureau to alert tourists to potential natural hazards and what actions to take should the hazard occur.

PI-9: Develop and distribute materials for residents who live in the floodplain explaining the hazards and risks that are inherent to living in the floodplain.

PI-10: Develop floodplain management training at the local level for elected officials, EMC's, etc.

5.1.6.4 Environmental Education

Environmental education programs can teach people about natural hazards, the factors that cause them, and the significance of avoiding known hazard areas. These programs can be undertaken by municipalities, schools, park and recreation departments, conservation associations, and youth organizations such as the Boy Scouts/Girl Scouts, Campfire Girls, and summer camps. An activity can be as involved as course curriculum development or as simple as an explanatory sign near a river. The more educated people are about natural hazards, the less likely they will be to reside in known hazard areas. As such, the Mitigation Steering Committee identified the following Public Information Hazard Mitigation Measure to be implemented within the County.

PI-11: Coordinate with FEMA, PEMA, PA DCED, NWS, the BCCD and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools

5.2 IMPLEMENTATION OF HAZARD MITIGATION MEASURES

Table 5-8 has been developed to summarize and prioritize the identified hazard mitigation measures from both an overall Berks County perspective and an individual municipal perspective (to be completed by each adopting municipality). From an overall county perspective, the Mitigation Steering Committee prioritized the projects as being high-, medium-, or low-priority hazard

mitigation measures based on their perceived technical feasibility, their ability to fulfill the identified project-planning goals (see Chapter 3) and their relative hazard mitigation/protection afforded. To assist in this county-level prioritization, the Mitigation Steering Committee established criteria for evaluating and comparing the projects. These project prioritization evaluation criteria were then used to rank each project as being high-, medium-, or low-priority. The composite score tallied from all committee members was used to assign the overall Berks County prioritization for each measure. The project prioritization evaluation criteria established by the committee included the following.

- Perceived and/or calculated benefit-cost ratio
- Number of hazards addressed (i.e., single- or multi-hazard)
- Number of people the project would benefit
- Frequency of impact (i.e., repetitive losses)
- Severity of impact
- Longevity/permanence of the project

TABLE 5-8
MUNICIPAL HAZARD MITIGATION ACTION PLAN

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PM-1	As Comprehensive Plans are developed or updated, include an assessment and associated mapping of the municipality's vulnerability to location-specific hazards and incorporate appropriate recommendations for the use of these hazard areas.	H			
PM-2	As Zoning Ordinances are developed or revised, either include separate zones or districts with appropriate development criteria for known hazard areas or incorporate such criteria within existing districts where hazards are known to exist.	H			
PM-3	Make available for municipal use the digital natural hazard mapping files that were developed as part of this hazard vulnerability assessment and mitigation planning effort.	H			
PM-4	Continue to maintain and update the County GIS structure layer to better define hazard-prone structures.	H			
PM-5	As Subdivision and Land Development (SLD) Ordinances are developed or revised, include municipality-specific, hazard mitigation-related development criteria and/or provisions for the mandatory use of conservation subdivision design principles in order to regulate the location and construction of buildings and other infrastructure in known hazard areas.	H			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PM-6	As SLD Ordinances are developed or revised, they should include municipality-specific development criteria and/or provisions that require proper access (for emergency vehicles) to hazard prone residential developments (i.e., Urban/Wildland Interface areas). Such criteria should be developed in cooperation with the municipal EMCs and/or emergency personnel.	H			
PM-7	Enforce the minimum building standards of the Pennsylvania Uniform Construction Code and/or consider the potential adoption of more stringent building standards to ensure hazard-resistant construction.	H			
PM-8	Ensure municipal compliance with, and continued enforcement of, NFIP and PA Act 166 floodplain development regulations and/or encourage more restrictive requirements, as appropriate.	H			
PM-9	Develop a municipal Memorandum of Understanding with the County Floodplain Management Coordinator that allows her/his review and concurrence on plans for proposed construction or substantial improvement of existing construction in the floodplain.	H			
PM-10	Confirm that existing municipal Floodplain Ordinances include a provision for all new development requiring 50-foot setbacks from top of bank in areas without defined floodway boundaries and ensure the enforcement of this provision.	H			
PM-11	Complete the Act 167 Plans that are currently underway and ensure municipal compliance with all watershed-specific Act 167 Stormwater Management Plans and Ordinances while lobbying PA DEP to provide the necessary funding and support to prepare a plan that covers all of Berks County.	H			
PM-12	Ensure continued implementation of appropriate O&M procedures (routine inspections, regular maintenance and continual updates to the EAP) at the County's high hazard dams in an effort to prevent a potential failure.	H			
PM-13	Revise existing zoning and/or subdivision and land development ordinances or adopt a separate, stand-alone ordinance to require the completion of subsurface investigations (i.e., borings, geophysical surveys, and/or studies by a registered Professional Geologist) for all new subdivision and land development projects in known land subsidence hazard areas.	H			
PM-14	Implement a wildfire-prevention public education program consisting of the development and distribution of an informative brochure and training for local officials on Pennsylvania's Firewise Communities Program.	L			
PM-15	Municipalities with identified wildfire potential should enroll in the Pennsylvania Firewise Communities Program.	L			
PM-16	Adopt an ordinance to ban open burning during designated times of the year in wildfire hazard areas or throughout the municipality.	M			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
ES-1	Develop a real-time Web portal that would provide a link to Berks County information (i.e., County Web site - http://www.co.berks.pa.us/berks/site/default.asp) during non-emergencies, but act as an extension of the Emergency Alert System in times of pending disaster and during a disaster.	H			
ES-2	Participate in the NWS's StormReady Program, a nationwide program that helps communities develop plans to handle all types of severe weather.	M			
ES-3	Establish a partnering relationship with the NWS Mid-Atlantic River Forecast Center to enhance the existing Flood Forecast and Warning System via the Advanced Hydrologic Prediction Services Program.	M			
ES-4	Install a NOAA weather radio transmitter/repeater in Berks County to improve signal strength and quality.	H			
ES-5	Coordinate with the U.S.G.S., local watershed organizations, and/or the BCCD to increase the number of U.S.G.S. and Integrated Flood Observing and Warning System (IFLOWS) rain and stream gauges in the County as a potential enhancement to the existing Delaware River Basin Flood Forecast and Warning System.	M			
ES-6	Increase the number of NOAA Weather Alert radios in public places and other critical facilities across the County (i.e., municipal buildings, public libraries, police stations, fire stations, etc).	H			
ES-7	Provide high bandwidth wireless service and/or alphanumeric pagers for local EMCs as a means of improving the County's warning dissemination program.	H			
ES-8	Conduct routine inspections, regular maintenance, and annual tests on all emergency communications equipment, public address systems, and hazard alert sirens to ensure unhindered operation during an emergency event.	H			
ES-9	Ensure that a planned, coordinated, and effective public warning dissemination program exists at the local level.	H			
ES-10	Develop and implement a reverse 9-1-1 system; also known as Interactive Communication Notification System.	H			
ES-11	Respond to hazards with actions that are consistent with the local EOP.	H			
ES-12	Conduct hazard response practice drills and emergency management training exercises on an annual basis.	H			
ES-13	Create locally coordinated snow routes in municipalities where snow removal is limited or difficult during major winter storm events.	L			
ES-14	Implement a system similar to PennDOT's RWIS (Road and Weather Information System) that will monitor major arteries in Berks County and report this information to the County's Web site.	H			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
ES-15	Install cameras along major arteries in Berks County to monitor traffic flow. Accessibility to these cameras should be provided to the County EOC, 911 Center and also on the County's Web site.	M			
ES-16	Provide generators for every municipal EOC and possibly those critical facilities that do not currently have one.	H			
ES-17	Provide battery backup systems for traffic control systems throughout the County.	M			
ES-18	Revise and update evacuation plans on a consistent basis.	H			
ES-19	Conduct routine inspections, regular maintenance, and annual tests on all emergency response equipment.	H			
ES-20	Encourage the owners/operators of critical facilities in natural hazard areas to develop and implement an emergency response plan to mitigate potential impacts. --OR-- EMA should consider partnering with the owners/operators of critical facilities to provide adequate planning and protection.	M			
ES-21	Develop and distribute a public informational pamphlet related to the potential health and safety implications of various natural hazard events.	L			
ES-22	Encourage rigorous sampling and analysis of public and private drinking water supply sources immediately after an inundating flood event and issue boil water advisories as needed.	M			
ES-23	Develop a technical proficiency at the municipal level for conducting post-disaster damage assessments and regulating reconstruction activities to ensure compliance with NFIP substantial damage/substantial improvement requirements.	L			
ES-24	Develop a technical proficiency at the municipal level for assisting local residents and business owners in applying for hazard mitigation and assistance funds and identifying cost-beneficial hazard mitigation measures to be incorporated into reconstruction activities.	M			
ES-25	Continue to maintain/update the Berks EMA Web site that contains information related to the hazard plan and educational materials for hazard mitigation measures (www.co.berks.pa.us/ema/cwp/view.asp?a=1256&q=465412&emaNav=|27168|). Also provide a link to FEMA's "DisasterHelp" Web site on the Berks EMA Web site (https://www.disasterhelp.gov/portal/jhtml/index.jhtml).	H			
PP-1	Relocate and/or acquire known flood-prone structures in accordance with the general guidelines of Table 5-3.	M			
PP-2	Encourage the elevation of known flood-prone structures in accordance with the general guidelines of Table 5-3.	M			
PP-3	Encourage dry floodproofing of known flood-prone structures in accordance with the general guidelines of Table 5-3.	M			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PP-4	Encourage wet floodproofing of known flood-prone structures in accordance with the general guidelines of Table 5-3.	L			
PP-5	Encourage the anchoring of fuel tanks located in floodprone areas to concrete slabs that are heavy enough to resist the force of floodwaters and be sure all filling and ventilation tubes are above the 100-year flood level so that floodwaters cannot enter the tank.	H			
PP-6	Inventory historic assets within the county and verify whether wet floodproofing may be the most effective measures to protect those that are floodprone.	M			
PP-7	Encourage uninsured property owners in known flood hazard areas to purchase flood insurance through the NFIP.	L			
PP-8	Encourage farmers to visit their local FSA office to discuss the benefits of obtaining crop insurance.	L			
PP-9	Encourage uninsured property owners in known subsidence hazard areas to purchase sinkhole insurance as a supplement to their existing home-owner's policy.	L			
PP-10	Encourage property owners in potential wildfire hazard areas to remove all excess brush and shrubby plants from the immediate vicinity (i.e., 50 to 100 feet) of all buildings.	L			
PP-11	Encourage local business and industry owners in known flood hazard areas to develop an emergency response plan as a potential alternative to implementing a physical property protection measure, where otherwise not technically or fiscally appropriate.	M			
PP-12	Provide protection of critical Berks County records through emergency response planning or other appropriate measures.	M			
SP-1	Investigate the feasibility of constructing a berm/levee system to minimize local flooding impacts in accordance with the Structural Project Identification Forms found in the Technical Appendices.	M			
SP-2	Design and construct the bridge/culvert modification projects in accordance with the Structural Project Identification Forms found in the Technical Appendices to minimize local flooding impacts.	M			
SP-3	Investigate the feasibility of implementing a storm water drainage improvement project to minimize local flooding impacts in accordance with the Structural Project Identification Forms found in the Technical Appendices.	M			
SP-4	Design, permit and construct channel modification projects in accordance with the Structural Project Identification Forms found in the Technical Appendices.	M			
SP-5	Develop and implement a community-specific channel maintenance program consisting of routine inspections and subsequent debris removal to ensure maximum hydraulic capacity of all local streams and water-courses.	M			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
SP-6	Consider the feasibility of constructing firebreaks in areas that have extensive forestland combined with a density of Wildland/Urban Interface structures or in conjunction with future residential development in forested areas.	L			
SP-7	Implement the suggested precautionary steps when using structural abatement techniques (recommended to be identified by a registered Professional Geologist or other acceptable expert) to remedy surface-exposed sinkhole features.	L			
SP-8	Require expert technical assistance and establish mandatory timeframes for structurally abating surface-exposed sinkhole features that pose an identifiable threat to the general public.	M			
SP-9	Install easily accessible and reliable water supply dry hydrants at various bridge and culvert crossings of local streams and watercourses for emergency fire fighting uses through coordination with local fire companies.	M			
SP-10	Consider the feasibility of establishing an emergency potable water supply source to offset potential shortages caused by extreme drought events.	M			
NR-1	As comprehensive plans or similar documents are developed or updated, conduct a detailed inventory and prioritization of local environmental resources. Much of this task can be accomplished by sharing the GIS databases completed through this effort and other work done by the Berks County Planning Commission, Berks County Conservancy, and others.	M			
NR-2	Preserve the highest priority undeveloped floodplain areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize/prevent potential flooding damages and enhance the regional environment. Less critical floodplain areas may be preserved/protected via local ordinance.	M			
NR-3	Preserve critical undeveloped forested areas and sinkhole prone areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize/ prevent potential wildfire and subsidence damages and enhance the regional environment. Implementation of conservation subdivision design principles, as identified in PM-5, could be used to preserve other less critical hazard prone areas as deemed appropriate by the municipality.	L			
NR-4	Preserve high priority wetland areas via fee simple acquisition and/or permanent easement and retain as public open space for passive recreational uses in an effort to minimize potential flooding damages and enhance the regional environment.	H			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
NR-5	Develop and implement a wetland protection program consisting of public education materials that highlight the functions and values of wetlands and local ordinance provisions that require the identification of wetlands in accordance with federal and state standards and minimize/eliminate their disturbance in accordance with federal and state laws.	M			
NR-6	Working through the Conservation District, the County should ensure continued contractor compliance with approved Erosion and Sedimentation Pollution Control Plans and should continue to work with local farmers to implement erosion and sedimentation control BMPs.	M			
NR-7	Develop and implement a comprehensive water resources management plan that analyzes the County's existing water resources supply and evaluates the County's anticipated water use demand in an effort to identify suspected water supply shortages and potential new water supply sources.	M			
PI-1	Coordinate with FEMA and the PA DCED regarding updating Berks County's Flood Insurance Rate Mapping via FEMA's Flood Map Modernization Program to include the expansion of previously unmapped areas and additional Base Flood Elevations (BFEs).	M			
PI-2	Municipalities should store in an easily accessible location and make available for public inspection their community's Flood Insurance Rate Mapping and associated Flood Insurance Study. Berks County could provide copies of these maps at the courthouse and/or conservation district offices and/or scan and post current maps on their Web site for all communities or those unable to provide information on their own Web site.	M			
PI-3	Maintain natural hazard risk assessment and mitigation publications/materials found on BEMA's Web site at public libraries throughout the County for those who do not have access to the internet.	M			
PI-4	Store in an easily accessible location and make available for public inspection, this hazard mitigation plan and available FEMA guidance documents.	H			
PI-5	Develop and distribute a public summary of this hazard mitigation plan including relevant information on hazard specific "do's" and "don'ts", hazard-prone areas, and emergency contact information.	M			
PI-6	Develop and implement a post-disaster recovery and mitigation training program for local officials.	H			
PI-7	Develop a business continuity plan display to raise awareness of importance (display would be used at Chamber of Commerce, civic group events, etc.).	L			
PI-8	Develop a partnership with the Visitors Bureau to alert tourists to potential natural hazards and what actions to take should the hazard occur.	L			
PI-9	Develop and distribute materials for residents who live in the floodplain explaining the hazards and risks that are inherent to living in the floodplain.	M			

TABLE 5-8
(CONTINUED)

MITIGATION MEASURE	DESCRIPTION	COUNTY PRIORITY (H, M, OR L)	MUNICIPAL APPLICABILITY (CHECK AS APPROPRIATE)	MUNICIPAL PRIORITY (H, M, OR L)	COMPLETION DATE
PI-10	Develop floodplain management training at the local level for elected officials, EMC's, etc.	L			
PI-11	Coordinate with FEMA, PEMA, PA DCED, NWS, the BCCD and any other appropriate entities on developing and implementing a natural hazard awareness curriculum in local schools.	L			

NOTE: Primary responsibility for items with the shading has been assigned to entities other than municipal governments.

- Human impacts vs. property impacts (i.e., potential for loss of life)
- Potential for economic losses
- Preventive value
- Implications of the impact

In establishing the overall Berks County prioritization, the Mitigation Steering Committee recognized that the municipalities will likely have differing implementation priorities. Municipalities are likely to find that their individual and unique needs/circumstances warrant a re-prioritization of the recommended action items to more appropriately address local conditions. This concept is perfectly acceptable and is expected to occur following local adoption of the plan. As such, Table 5-8 is structured to allow each municipality to 1) check off or indicate those projects that have been identified as being applicable to its particular jurisdiction (see Table 5-9 Multi-Jurisdictional Hazard Mitigation Strategy) and 2) establish its own prioritization scheme for those projects. This table also allows the municipality to track its implementation progress by simply recording the completion date of each measure.

In general, projects identified as being a high-priority are to be implemented within the first five years following plan adoption, pending availability of project funding. Medium-priority projects are to be implemented within five to seven years following plan adoption, pending availability of project funding, or upon completion of the high-priority projects. Similarly, low-priority projects are to be implemented within seven to ten years following plan adoption, pending availability of project funding, or upon completion of the high-and medium-priority projects.

TABLE 5-9
MULTI-JURISDICTIONAL HAZARD MITIGATION STRATEGY

(SEE SEPARATE EXCEL FILE)

5.2.2 Potential Funding Sources

FEMA's Pre-Disaster Mitigation and Hazard Mitigation Grant Programs (PDM and HMGP) assist states and local communities in implementing long-term hazard mitigation measures before and following a major disaster declaration, respectively. PDM and HMGP monies can be used to fund projects that provide protection to either public or private property. Some projects include structural hazard control, such as debris basins or floodwalls, and retrofitting measures including floodproofing, acquisition and relocation of structures. FEMA can fund up to 75 percent of the eligible costs of each project. The state or local match does not have to be cash; in-kind services or materials may be used. Federal funding under the HMGP is based on 15 percent of the federal funds spent on the Public and Individual Assistance programs (minus administrative expenses) for each disaster. Eligible applicants must apply for the PDM and HMGP through PEMA. More information is available through the FEMA Web site (http://www.fema.gov/about/divisions/mitigation/mitigation.shtm).

FEMA's Flood Mitigation Assistance Program (FMAP) provides grants to states and communities for planning assistance and mitigation projects that reduce the risk of flood damage to structures covered by flood insurance. There are three types of grants: planning, project and technical assistance. Technical assistance grants are given to state agencies that provide assistance to communities, so communities apply for planning and project grants. FMAP monies are available to eligible applicants when a Flood Mitigation Plan has been developed and it has been approved by FEMA. FEMA may contribute up to 75 percent of the total eligible costs. At least 25 percent of the total eligible costs must be provided by a non-federal source. Of this 25 percent, no more than half can be provided as in-kind contributions from third parties. There are limits on the frequency of grants and the amount of funding that can be allocated to a state or community in any five-year period. PEMA serves as the administrator of the planning and projects portions of the grant program. More information is available through the FEMA Web site (http://www.fema.gov/about/divisions/mitigation/mitigation.shtm).

FEMA's Public Assistance Grant Program (PA) is one way federal assistance gets to the state and local governments and to certain private nonprofit organizations. These grants allow them to respond to disasters, to recover from their impact and to mitigate impact from future disasters. While these grants are aimed at governments and organizations -- their final goal is to help a community and all its citizens recover from devastating natural disasters.

The PA Program provides the basis for consistent training and credentialing of staff who administer the program; more accessible and understandable guidance and policy for participat-

ing in the grant program; improved customer service through a more efficient grant delivery process, applicant-centered management, and better information exchange; and continuing performance evaluations and program improvements. More information is available through the FEMA Web site (http://www.fema.gov/government/grant/pa/index.shtm).

FEMA's National Dam Safety Program (NDSP) is another way that FEMA protects communities by ensuring the availability of grant funds to individuals and communities. Funding is available for improvement for the state dam safety program that oversees and regulates over 79,500 dams in the United States. NDSP funding provides grants funds not only for improvement, but also for dam safety research and dam safety training. Funding is provided in part due to the Dam Safety and Security Act of 2002, which was reauthorized for four years on December 2, 2002, to safeguard dams against terrorist attacks (http://www.fema.gov/plan/prevent/damfailure/ndsp.shtm).

The **FEMA Fire Management Assistance Grant Program** (FMAGP) provides funds to States, local and tribal governments, for the mitigation, management, and fire control located on both public and private forests and grasslands. Funding is available for those properties which the threat of a fire would cause a major disaster. FMAGP provides 75% funding and state funding would cover the remaining 25% of actual costs. In order to apply a state must demonstrate that the total eligible cost of the declared fire be equal to or greater than the individual cost threshold. Eligible costs include total expenses for equipment use; field camps, tools, material and supplies, and mobilization and demobilization activities. (http://www.fema.gov/government/grant/fmagp/index.shtm).

If the **USACE** determines that a flood control project falls within the **Continuing Authorities Program** (CAP), they initiate a short reconnaissance effort to determine federal interest in proceeding. If there is interest, a feasibility study is performed, and the project continues through a plans and specifications phase, and finally a construction phase. A local sponsor must identify the flood-related problem and request USACE assistance. Small flood-control projects are also eligible. The cost share for the CAP is 65 percent USACE and 35 percent local. The federal project limit is $7,000,000. The USACE's Baltimore District office would review the local sponsor's request for assistance and would request funds from the USACE's annual appropriations. More information is available through the USACE Web site (http://www.nap.usace.army.mil/).

The **USACE's Floodplain Management Services Program** aims to support comprehensive floodplain management planning to encourage and guide sponsors to prudent use of the nation's floodplains for the benefit of the national economy and welfare. Some examples of the types of projects that would be funded include the following:

- flood warning and flood emergency preparedness measures;
- flood-proofing measures;
- studies to improve methods and procedures for mitigating flood damages; and
- preparation of guides and brochures on flood-related topics.

A local sponsor must identify a problem and request USACE assistance under the Floodplain Management Services Program. The USACE may provide up to 100 percent of the funding at the request of the sponsor. The USACE's Baltimore District office would review the local sponsor's request for assistance and determine if it fits within the program. More information is available through the USACE Web site (http://www.nap.usace.army.mil/).

The **USACE's Water Resources Development Act, Section 22** provides authority for the USACE to assist states, local governments, and other non-federal entities in the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources. Congress funds the Planning Assistance to state programs annually. Federal allotments for each state from the nationwide appropriation are limited to $500,000 annually but typically are much less. Individual studies, of which there may be more than one per state per year, generally cost $25,000 to $75,000. The program can encompass many types of studies dealing with water resources issues. Types of studies conducted in recent years under the program include the following:

- Water Supply and Demand Studies;
- Water Quality Studies;
- Environmental Conservation/Restoration Studies;
- Wetlands Evaluation Studies;
- Dam Safety/Failure Studies;
- Flood Damage Reduction Studies;
- Flood Plain Management Studies;
- Coastal Zone Management/Protection Studies; and
- Harbor/Port Studies.

State or local governments that are interested in obtaining planning assistance under this program can contact the appropriate USACE office for further details. Alternatively, interested parties can contact the appropriate state coordinator to request assistance. In either case, the USACE will coordinate all requests for assistance with the state coordinator to ensure that studies

are initiated on state prioritized needs. More information is available through the USACE Web site (http://www.usace.army.mil/cw/cecw-cp/library/pas.pdf).

The **U.S. Department of Housing and Urban Development's (HUD) Community Development Block Grant - Disaster Recovery Initiative** (DRI) program provides flexible grants to help municipalities, counties, and states recover from Presidentially declared disasters, especially in low-income areas. Since it can fund a broader range of recovery activities than most other programs, the DRI helps communities and neighborhoods that otherwise might not recover due to limited resources. When disasters occur, Congress may appropriate additional funding for the Community Development Block Grant Program as DRI grants to rebuild the affected areas and bring crucial seed money to start the recovery process. Grantees may use DRI funds for recovery efforts involving housing, economic development, infrastructure and prevention of further damage, if such use does not duplicate funding available from FEMA, the Small Business Administration, and the USACE. Examples of these activities include the following:

- buying damaged properties in a floodplain and relocating them to safer areas;
- relocation payments for people and businesses displaced by the disaster;
- debris removal;
- rehabilitation of homes and buildings damaged by the disaster;
- buying, constructing, or rehabilitating public facilities such as water and sewer systems, streets, neighborhood centers, and government buildings;
- code enforcement; and
- planning and administration costs (limited to no more than 20 percent of the grant).

HUD notifies eligible governments, which must then develop and submit an Action Plan for Disaster Recovery before receiving DRI grants. The Action Plan must describe the needs, strategies, and projected uses of the Disaster Recovery funds. More information is available through the HUD Web site (http://www.hud.gov/grants/index.cfm).

The PA DCED Governor's Center for Local Government Services sponsors the **Floodplain Land Use Assistance Program**. This Floodplain Management Program focuses on providing technical and financial assistance to local governments to help them adopt and administer land use regulations and controls to reduce and avoid future flood damages. Municipalities seeking assistance must be NFIP communities. Funds are available to assist in the preparation,

administration, and enforcement of floodplain management regulations. More information is available through the DCED Web site (http://www.newpa.com/programDetail.aspx?id=99).

The Land Use Planning and Technical Assistance Program (LUPTAP) is also sponsored by PA DCED through the Governor's Center for Local Government Services. This program provides financial assistance for municipalities and counties of the Commonwealth for developing and strengthening community planning and management. The program encourages intergovernmental cooperation in planning, including cooperation with contiguous municipalities, counties, and school districts. The LUPTAP program provides financial assistance to fund activities such as preparing environmental protection or physical development strategies or special studies that will support comprehensive planning and developing or updating ordinances and other tools for the implementation of comprehensive community development plans and policies or environmental protection or physical development strategies. PA DCED generally funds 50 percent of the total cost of an approved application. More information is available through the DCED Web site (http://www.newpa.com/programDetail.aspx?id=100).

The **PA DCNR** is leading state efforts, under the **Pennsylvania Greenways Initiative**, to implement the Greenways Action Plan. The PA Interagency Coordination Team, a team of state agencies, will be pooling the agencies' talents and resources to assist in the implementation of the Plan. Each of Pennsylvania's 67 counties is encouraged to consider greenways as part of their land use strategy and to map their existing and proposed county greenway network in a *County Greenway and Open Space Conservation Plan*. The outcome of the Plan is county identification of priorities for conservation of open space and greenway corridors, which together comprise a county "greenway network." The "greenway network" includes linear greenway corridors, related open space, and natural or manmade features or destinations like parks, schools, or scenic natural areas that are linked by these corridors. An overall goal is the linkage of the County Greenway and Open Space Conservation Plan to the County Comprehensive Plan and other community planning and revitalization initiatives. When aggregated, county greenway plans will lay the framework for Pennsylvania's statewide greenway network as well as provide a foundation for local greenways development. In some areas of the state where other regional, multi-county planning efforts are already underway, counties can choose to work together with neighboring counties to promote larger-scale regional planning and development of a greenways network. Since greenways are often associated with stream corridors or other important natural features, this program could easily supplement the initiatives contained herein regarding preservation of floodplains and other natural hazard-prone areas. Several funding sources and pro-

grams are available to help communities meet the goals of the greenway initiative. More information is available through DCNR's greenways Web site (http://www.pagreenways.org/).

Community Conservation Partnership Programs are sponsored by **PA DCNR – Bureau of Recreation and Conservation**. Grants are provided for planning, acquisition, development, and rehabilitation of park, recreation, conservation, greenways, and heritage areas and facilities and, in some components, maintenance of trails. Some components of the program offer funding for technical assistance, education, and training projects. Heritage Parks grants can also fund promotion and marketing, special purpose studies and other heritage conservation, tourism, and development projects. Generally, all grant components require a match, usually 50 percent of cash or in-kind contributions. Eligible applicants are county and local governments; municipal authorities; and nonprofit recreation, conservation, greenway, and watershed groups. More information is available through the DCNR Web site (http://www.dcnr.state.pa.us/brc/grants/preface.aspx).

The **Growing Greener Grant Program** is sponsored by the **PA DEP** Growing Greener Grant Center. The purpose of this grant is to address water-quality-impaired watersheds in Pennsylvania that are polluted by non-point sources of pollution such as abandoned mine drainage, urban and agricultural runoff, atmospheric deposition, on-lot sewage systems, and earth-moving. The grant addresses these and similar concerns through local, watershed-based planning, restoration, and protection efforts. More information is available through the PA DEP Web site (http://www.dep.state.pa.us/grantscenter/ProgramSummary.asp?ID=65).

PA DEP, Bureau of Watershed Management sponsors the state's **Stormwater Management Program**. This program provides grants to counties to develop stormwater management plans for designated watersheds and to municipalities to implement the plans. The Pennsylvania Stormwater Management Act (Act 167) requires that counties develop and adopt stormwater management plans for the watersheds within their boundaries and also to update those plans every five years. The municipalities located in the county-adopted watershed plan areas are required to enact, implement, and administer stormwater control ordinances. The grant assistance to counties and municipalities is limited to 75 percent of the costs for the eligible expenses. PA DEP makes $1.2 million available for this program each fiscal year to counties and municipalities. See the PA DEP Web site for more information on this program (http://www.dep.state.pa.us/dep/deputate/watermgt/wc/default.htm).

PA DEP offers low-interest loans through the **Pennsylvania Infrastructure Investment Authority (PennVEST)** for design, engineering, and construction of publicly and privately owned drinking water distribution and treatment facilities, stormwater conveyance, and wastewater

treatment (WT) systems. These loans and grants are available to communities or private firms needing clean drinking water distribution and treatment facilities and/or safe sewage and storm-water conveyance and treatment facilities. Communities may apply to PennVEST for loans up to $11 million per project for one municipality, up to $20 million for more than one municipality, up to $350,000 for design and engineering, and up to 100 percent of the total project cost. In regards to flood planning, communities may apply for loans or grants through PennVEST to help flood-proof sewage treatment or water treatment plant facilities. Communities may also seek out PennVEST funds to upgrade stormwater control systems to help minimize surface water flooding problems within developed areas. Through one form, communities can apply for financial assistance through PennVEST or other PA DCED funding sources. More information can be found on the following Web site (http://www.newpa.com/programDetail.aspx?id=42).

5.3 MULTI-JURISDICTIONAL HAZARD MITIGATION STRATEGY

To fulfill FEMA requirements for multi-jurisdictional (i.e., multi-municipal) planning, each municipality must have identifiable action items for implementation. As evidenced by Table 5-8, over seventy hazard mitigation measures have been identified for implementation within Berks County. While some of these recommended mitigation measures are to be implemented by County personnel, many are to be implemented at the local level by the appropriate municipal official(s). Additionally, given the myriad of regional differences between various municipalities, certain hazard mitigation measures are only to be implemented within select municipalities. As such, Table 5-9 has been developed to identify the multi-jurisdictional approach to implementing the identified hazard mitigation measures. Table 5-9 enables Berks County's municipalities to easily identify those hazard mitigation measures that are applicable to their particular jurisdiction and mark them on their own version of Table 5-8 for implementation tracking. Development of this municipality-specific/multi-jurisdictional hazard mitigation strategy fulfills FEMA's requirements for multi-jurisdictional plan implementation.

6.0 PLAN MAINTENANCE PROCEDURES

6.1 MONITORING, EVALUATING, AND UPDATING THE PLAN

Berks County has established a procedure for monitoring, evaluating, and updating this hazard mitigation plan. Monitoring and evaluating this hazard mitigation plan shall be an ongoing process conducted by BEMA and coordinated with the representative members of the Mitigation Steering Committee on an annual basis via a Progress Monitoring Report (included in the technical appendices) to be submitted by December 31 of each year. BEMA will track overall plan progress not only at the county-level but also at the municipal level via coordination with local EMCs at their training sessions. The County will use Tables 5-8 and 5-9 to record the date of completion of the various hazard mitigation recommendations and to track plan implementation progress at the municipal level. The end-of-year Progress Monitoring Report will summarize that year's progress towards meeting the identified hazard mitigation planning goals.

Every five years, the Mitigation Steering Committee will convene to review the County's annual monitoring activities, evaluate the current effectiveness of the hazard mitigation plan, and make any needed updates/changes to the hazard mitigation plan. The five-year review will evaluate the hazard mitigation plan in regard to its current accuracy, relevance, and applicability. In particular, the Mitigation Steering Committee will review the hazard mitigation plan in light of the following.

- The ability of the identified hazard mitigation planning goals to address current and anticipated future conditions.
- Any known or perceived changes in the County's vulnerability to the identified hazards.
- The current capabilities (i.e., institutional, legal, fiscal, political, and technical) of the County and its constituent municipalities.
- The successes, failures, and/or lessons learned from implementing the identified hazard mitigation recommendations during the three-year period.
- The need to address additional hazards in the plan and/or the need for other modifications to the plan.
- Advances in the County's GIS structure database that would allow for more detailed analysis of asset vulnerability and loss estimation.

If the Mitigation Steering Committee determines that updates and/or changes are needed to the hazard mitigation plan, assignments will be made to the representative members and the Committee will meet as deemed necessary until all updates and/or changes have been completed and incorporated into the hazard mitigation plan. It will be the responsibility of BEMA to oversee the plan review/update process and to coordinate all plan revisions with the appropriate municipalities.

As was witnessed during the development of this plan, the continual enhancement of the County's GIS database will pay dividends in the ongoing hazard mitigation planning efforts. A continuing dialogue between the Berks County GIS staff and BEMA that will be facilitated through the continuation of the Mitigation Steering Committee will help identify those features that will contribute most to the hazard planning effort if added to the GIS database. These improvements will then be reflected in future updates to the Hazard Mitigation Plan. The sources for the GIS data and other elements of this plan are provided in the appendices to help facilitate the future updates of the plan.

6.2 IMPLEMENTATION THROUGH EXISTING PROGRAMS

Implementation of the hazard mitigation recommendations outlined in this plan will be initiated upon plan adoption. Analysis of PM-1 indicates that the municipalities are encouraged to develop a new or amend their existing Comprehensive Plan to include hazard related provisions. As such, it is anticipated that those municipalities with an existing Comprehensive Plan will be adopting this hazard mitigation plan as an amendment to their Comprehensive Plan, thus fulfilling PM-1. By so doing, those municipalities will be initiating their local hazard mitigation program simply by adopting this hazard mitigation plan. Similarly, those municipalities can then proceed to revise other existing local planning documents (i.e., capital improvement plan, zoning ordinance, subdivision and land development ordinance, building code, floodplain ordinance, etc.) as appropriate to implement the various hazard mitigation recommendations that apply to their jurisdiction. Ultimately, it will be left to the discretion of the individual municipalities to revise their existing policies, plans, and programs to be consistent with and to help implement the hazard mitigation planning recommendations.

For those municipalities that do not have an existing Comprehensive Plan, the critical first step will be to adopt this hazard mitigation plan as a stand-alone document. Once this occurs, those municipalities will then be free to implement the various hazard mitigation recommendations that are applicable to their respective jurisdiction. It is understood, however, that in certain

instances, select municipalities may not have any existing programs through which to implement the hazard mitigation recommendations. This concept was clearly defined in the Capability Assessment (see Chapter 4) and is not to be interpreted as an inability to implement the hazard mitigation recommendations. Rather, implementation of the hazard mitigation recommendations in these select municipalities may be accomplished through cooperative arrangements, more coordinated efforts, and/or resource efficiency.

Projects that require large investments, such as acquisitions or structural projects, are candidates for inclusion in capital improvements plans. The members of the Mitigation Steering Committee will ensure that the department responsible for developing their jurisdiction's capital improvements plan is familiar with this hazard mitigation plan and that any large-scale projects recommended by the plan are considered for inclusion in the capital improvements plan.

6.3 CONTINUED PUBLIC INVOLVEMENT

Berks County is committed to involving the public in the continual reshaping and updating of this hazard mitigation plan. BEMA is responsible for monitoring the plan and for the three-year review/update of the plan. In this capacity, it will also be the responsibility of BEMA (working in concert with other County agencies) to implement long-term public participation activities.

In accordance with PI-3 and PI-4, copies of this hazard mitigation plan will be catalogued and kept on file at public libraries and municipal buildings throughout the County. In addition, copies of the plan and any proposed changes will be posted on the County's Web site. This site will also contain an e-mail address and phone number to which people can direct their comments or concerns. Finally, a public meeting is to be held after each five-year review/update of the plan. This meeting will provide the public an opportunity to express concerns, opinions, or ideas about the plan. BEMA will be responsible for organizing and advertising this public meeting.